UNIVERSIDADE DE LISBOA

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Em colaboração com a Escola Superior de Teatro e Cinema,
da Escola Superior de Dança e da Escola Superior de Música do
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LISTENING TO ARCHITECTURE:
Creating Aural Architectures through Aesthetic Experience

María Sofía Balbontín Gallo

Orientador(es): Prof. Doutor António Sousa Dias de Macedo
Prof. Doutor Pascal Amphoux

Tese especialmente elaborada para a obtenção do grau de Doutor em Artes

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2025

DECLARAÇÃO DE AUTORIA

Eu Sofía Balbontín Gallo, declaro que a tese de doutoramento intitulada “Listening to Architecture: Creating Aural Architectures through Aesthetic Experience”, é o resultado da minha investigação pessoal e independente. O conteúdo é original e todas as fontes consultadas estão devidamente mencionadas na bibliografia ou outras listagens de fontes documentais, tal como todas as citações diretas ou indiretas têm devida indicação ao longo do trabalho segundo as normas académicas.

O Candidato

Lisboa, 25-03-2025

Resumo.

A prática de "escutar a arquitetura" transforma a realidade construída numa experiência incorporada (*embodied experience*). Este ato de escuta ocorre dentro de um enquadramento temporal onde sensibilidades e corporeidades convergem. Quando a arquitetura é afetada pelo som, emerge uma dimensão sonora, acústica e auditiva do espaço. A interação desta presença sonoro-espacial dentro de acústicas específicas forma um mapa cognitivo acessível através da escuta incorporada. Este processo interativo unifica som, espaço e corpo no que eu apresento como *arquitetura auditiva*. A arquitetura auditiva é uma prática estética que nos convida a explorar espaços invisíveis através da escuta. Através de experiências auditivas e interpretações sensoriais, torna-se possível construir arquiteturas auditivas resultantes da ação artística do artista, da acústica do espaço e da percepção criativa do ouvinte.

Esta pesquisa artística explora a prática da arquitetura auditiva através do projeto *Espacios Resonantes*, que investiga o som do espaço através de expedições ao redor do mundo em busca de arquiteturas industriais onde este fenómeno se manifesta como uma presença tangível. A tese compila e organiza todo o trabalho realizado pelo projeto até à data; assim, o resultado deste processo é a história do projeto *Espacios Resonantes*, apresentado como uma narrativa temporal de processos teóricos e práticos onde as questões evoluíram ao longo do tempo, as direções mudaram várias vezes, e os pontos de partida levaram a destinos inesperados.

Como arquiteta, sinto o dever de reinventar a arquitetura reinterpretando a sua condição física e movendo-me em direção à criação de arquiteturas imateriais. Utilizando o som como material de construção invisível e a escuta como força criativa de design, *Espacios Resonantes* abraça a ideia de desmaterializar a arquitetura para criar estruturas especulativas de som em movimento. O projeto concentra-se na recuperação e valorização de espaços industriais abandonados, estudando e reinterpretando-os através da ação artística. Este processo é uma prática espacial crítica que apropria e reinterpreta locais industriais como símbolos do declínio da nossa sociedade orientada para o progresso. Estes espaços representam um processo sistemático de entropia urbana que caracteriza a era do Antropoceno, revelada pela ação artística do som no espaço, reconvertendo os espaços residuais do extrativismo em locais culturais temporais.

A estrutura desta tese divide-se em três partes: a primeira parte apresenta o projeto *Espacios Resonantes*, a segunda parte estabelece os fundamentos conceptuais para o desenvolvimento prático apresentado na terceira parte, que destaca as práticas artísticas e os métodos de pesquisa práticos centrados na escuta da arquitetura como uma prática criativa que constrói arquiteturas auditivas através da experiência estética. Assim, esta tese apresenta a prática criativa da arquitetura auditiva como um empreendimento artístico que distribui e localiza sons no espaço. Estes sons interagem com a arquitetura, gerando discursos em torno do som espacial para analisar a experiência subjetiva através da qual a imagem espacial desse som e o seu significado simbólico são social e culturalmente construídos, tanto individualmente como coletivamente.

A primeira parte desta tese apresenta a pesquisa artística *Espacios Resonantes*, um projeto coletivo composto por mim e o meu colega Mathias Klenner. A metodologia de pesquisa consiste em métodos práticos, conceptuais e fenomenológicos. Os métodos práticos, baseados na pesquisa artística, formam o núcleo da tese e são apoiados pelos métodos conceptuais e fenomenológicos, proporcionando consistência e uma estrutura sólida à prática estética. Nesta primeira parte, é apresentado um arquivo sob a forma de um diário de viagem, documentando todos os espaços estudados ao longo dos anos; num total de 24 espaços ressonantes. O termo espanhol *bitácora de viaje* é utilizado como título deste capítulo, pois refere-se mais precisamente a um diário que documenta todas as aventuras da viagem, incluindo experiências relevantes, observações e reflexões pessoais. Emprega um vocabulário poético e informal para capturar as impressões subjetivas experimentadas *in-situ*. A *bitácora de viaje* inclui uma ficha de cada espaço, apresentando uma revisão histórica, levantamento arquitetónico, informações técnicas, localização, fotos do local e um registo em áudio de como o espaço soa.

O que é espaço sonoro? Foi o ponto de partida da pesquisa conceitual, desencadeando uma discussão em torno de um universo de termos, conceitos, práticas e definições de várias disciplinas que tentaram abordar o espaço sonoro a partir de ângulos diferentes, criando um amálgama caótico de terminologias intersecionais e sobrepostas. Portanto, a segunda parte desta tese envolve a coleta de todas estas experiências teórico-práticas e a organização delas num mapa rizomático sem uma ordem categorial, mas sim num diagrama dinâmico que superpõe diferentes disciplinas, autores, práticas e teorias baseadas numa revisão da literatura e

entrevistas com especialistas. Consequentemente, foi desenhado um mapa conceitual sem hierarquias ou pontos centrais, mas com múltiplas entradas, conexões e movimentos laterais, permitindo uma rede de relações não-linear e não hierárquica.

Com base neste trabalho conceitual, o foco da pesquisa deslocou-se do espaço sonoro para a arquitetura auditiva, em trânsito do sonoro para o acústico e do acústico para o auditivo. O que começou como uma prática de "escutar o espaço" evoluiu para uma prática mais precisa de "escutar a arquitetura". Neste processo estrutural de organização da informação, o termo arquitetura auditiva emergiu como uma prática e conceito capaz de abarcar o espaço sonoro, juntamente com muitos outros conceitos e práticas identificados nesta pesquisa. Os termos sonoro, acústico e auditivo, frequentemente utilizados como sinónimos, foram diferenciados como conceitos únicos e distintos, melhorando a legibilidade deste mapa conceitual. Através desta diferenciação, emergiram as fases ou partes constitutivas distintas que compõem a arquitetura auditiva, que denominei como espaço sonoro, espaço acústico e espaço auditivo. O espaço sonoro, um conceito já desenvolvido e estabelecido, foi incorporado neste diagrama. Quanto aos termos espaço acústico e espaço auditivo, estes foram alvo de um aprofundamento específico para os fins desta tese. Utilizando esta base teórico-prática, é introduzido um modelo conceitual de arquitetura auditiva.

A terceira parte desta tese considera os termos espaço sonoro, espaço acústico e espaço auditivo—dimensões integrais da arquitetura auditiva—como o quadro principal para apresentar o desenvolvimento prático. A seção inicial de cada capítulo apresenta referências relevantes e suas práticas artísticas associadas a estes conceitos, juntamente com a progressão prática da pesquisa artística. No primeiro capítulo, focado no espaço sonoro, são apresentados os resultados artísticos do projeto *Espacios Resonantes* como métodos práticos empregados na pesquisa em três grupos de obras de arte: intervenções *site-specific*, traduções sonoras e arquiteturas virtuais. A passar para o segundo capítulo, espaço acústico, são detalhadas as características acústicas dos espaços estudados através de um levantamento urbano e arquitetónico, e da implementação de experimentos acústicos. Estas características acústicas servem tanto como espaço de propagação para as intervenções *site-specific* quanto como material artístico para o desenvolvimento as obras de traduções sonoras e de arquiteturas virtuais. O terceiro capítulo, espaço auditivo, introduz métodos fenomenológicos que permitem a exploração do

reino subjetivo da experiência estética através de uma escuta incorporada às obras de arte sonoras previamente apresentadas.

Juntos, estes três capítulos explicam as dimensões constitutivas da arquitetura auditiva: o espaço sonoro, que constrói instalações e performances multicanal reais e virtuais; o espaço acústico, onde as informações sonoras são refletidas e filtradas; e o espaço auditivo, que traduz o som num mapa mental, transformando fenômenos auditivos numa experiência criativa. Assim, a prática da arquitetura auditiva refere-se à forma como percebemos as obras de arte sonoras a interagir com elementos espaciais e interpretamo-las subjetivamente em significados visuais atribuídos pelo ouvinte. Isto traduz-se num contributo para a produção sensorial do mundo contemporâneo, desafiando a noção de arquitetura como algo puramente material. Neste sentido, a experiência estética da escuta da arquitetura contribuirá para a construção de novos paradigmas sobre os ambientes humanos, incorporando a interação sensorial no processo de conceção. A prática da arquitetura auditiva valorizará o património industrial moderno, demonstrando as potencialidades destas arquitecturas através da ação artística e da pré-reservação do seu património acústico, conservando assim o seu valor arquitetónico para uma futura reconversão em possíveis espaços culturais temporários ou permanentes.

Palavras-Chave.

Arquitetura Auditiva, Espaço Sonoro, Espaço Acústico, Espaço Aural, Experiência Estética.

Abstract.

The practice of "listening to architecture" transforms the built reality into an embodied experience. This act of listening occurs within a temporal framework where sensitivities and corporeality converge. When architecture is affected by sound, a sonorous, acoustic, and auditory dimension of space emerges. The interaction between sound and space within site-specific acoustics, forms a cognitive map accessible through embodied listening. This interactive process unifies sound, space, and body into what I present as *aural architecture*. Aural architecture is an aesthetic practice that invites us to explore invisible spaces through listening. By auditory experiences and sensory interpretations, it becomes possible to construct aural architectures arising from the artistic action of the artist, the acoustics of the space, and the creative perception of the listener.

This artistic research explores the practice of aural architecture through the *Espacios Resonantes* project, which investigates the spatial-sound presence within industrial architectures. As part of its practical methodology, sound material is collected from case studies featuring spaces with unique and pronounced acoustic characteristics. Using this material, a series of artworks is produced to create aural architectures. This creative process is viewed as a subversive act aimed at dematerializing architecture into subjective interpretations.

For the theoretical development of this research, the notion of aural architecture is examined as a practice and concept emerging at the intersection of music, architecture, and sound arts. This transdisciplinary approach defines a vocabulary that breaks down aural architecture into three dimensions: sound space, acoustic space, and aural space. Each of these dimensions possesses distinct characteristics and plays a role in conceptualizing the various aspects and phases of the practice of aural architecture. The practical theoretical development of this conceptualization process is supported by a series of aesthetic experiences translated into experimental outcomes, generating alternative and subjective narratives of space through various media such as music, video, performance, multichannel installation, and virtual reality.

Keywords

Aural Architecture, Sound Space, Acoustic Space, Aural Space, Aesthetic Experience.

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First, I would like to thank Mathias Klenner for being my partner in sound experimentation and urban exploration throughout most of the adventures described in this thesis. Besides engaging in insightful theoretical discussions, he has contributed creatively to the development of the spatial imaginary of this work. Our conversations and joint projects have profoundly shaped both the theoretical framework and practical aspects of this dissertation, as well as my professional career.

I would also like to thank my supervisor, Antonio Sousa Dias, for guiding my ideas to solid ground and expanding my theoretical and experiential field along the way. I am thankful for all the shared knowledge and for the eternal hours spent in our lengthy conversations and gatherings during these four years.

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INTRODUCTION

This thesis is a retrospective of a project that has filled my days with adventures, artistic sonic experiments, and theoretical reflections on aural architecture. This thesis compiles and organizes—up to the date—all the work undertaken by *Espacios Resonantes*, a project that explores the sound of space through expeditions around the world in search of industrial architectures where this phenomenon manifests itself as a tangible presence. I present this creative, exploratory, and interpretative practice as *aural architecture*. In this regard, the result of this thesis is the story of the *Espacios Resonantes* project, presented as a temporal narrative of theoretical and practical processes where questions have evolved over time, directions have shifted multiple times, and starting points have led to unexpected destinations.

As an architect, I feel a duty to reinvent architecture by re-interpreting its physical condition and moving toward creating immaterial architectures. Using sound as an invisible construction material and listening as a creative force of design, *Espacios Resonantes* embraces the idea of dematerializing architecture to create speculative structures of sound in motion. The project focuses on recovering and enhancing abandoned industrial spaces, studying and re-interpreting them through artistic action. This process is a critical spatial practice that appropriates and reinterprets industrial sites as symbols of the decline of our progress-oriented society. These spaces represent a systematical process of urban entropy that characterizes the Anthropocene era, which is revealed by the artistic action of sound in space, reconverting the residual spaces of extractivism into temporal cultural sites.

The structure of this thesis is divided into three parts: the first part presents the *Espacios Resonantes* project, the second part establishes the conceptual foundation for the practical development presented in the third part, which showcases the artistic practices and practical research methods centered around listening to architecture as a creative practice that constructs aural architectures through aesthetic experience. Thus, this thesis presents the practice of aural architecture as an artistic endeavor that distributes and locates sounds in space. These sounds interact with the architecture, generating discourses around spatial sound to analyze

the subjective experience through which the spatial image of that sound and its symbolic significance are socially and culturally constructed, both individually and collectively.

The first part of this thesis presents *Espacios Resonantes*, a collective project comprising myself and my colleague Mathias Klenner. The research methodology consists of practical, conceptual, and phenomenological methods. The practical methods, based on practice-based research, form the core of the thesis and are supported by the conceptual and phenomenological methods, providing consistency and a solid structure to the artistic practice. In this first part, an archive is presented in the form of a travel log, documenting all the spaces studied over the years; in total 24 resonant spaces. The Spanish term *bitácora de viaje* is used as the title of this chapter, as it more precisely refers to a diary that documents all the adventures of the journey, including relevant experiences, observations, and personal reflections, unlike the term *travel log*, which is more factual. It employs a poetic and informal vocabulary to capture the subjective impressions experienced in situ. *Bitácora de viaje* includes a record of each space, featuring a historical review, architectural survey, technical information, location, photos of the place, and an audio recording of how the space sounds.

What is sound space? This question was the starting point of this research, which triggered a discussion around a conceptual universe of terms, concepts, practices, and definitions from various disciplines that attempted to approach the sound space from different angles, creating a chaotic amalgam of intersecting and overlapping terminologies. Therefore, the second part of this thesis involves collecting all these theoretical-practical experiences and arranging them in a rhizomatic map without a categorical order, but rather in a dynamic diagram that superimposes different disciplines, authors, practices, and theories based on a literature review and expert interviews. Consequently, a conceptual map was drawn without hierarchies or central points, but with multiple entries, connections, and lateral movements, allowing for a non-linear and non-hierarchical network of relations.

Based on this conceptual work, the focus of the research shifted from *sound space* to *aural architecture*, through a journey that transitioned from the sonorous to the acoustic and from the acoustic to the aural. What began as a practice of "listening to space" evolved into a more precise practice of "listening to architecture". In this structural process of organizing the information, the term *aural architecture* emerged as a practice and concept capable of

encompassing sound space, alongside many other concepts and practices identified in this research. The term *aural architecture* is introduced by Blesser and Salter (2009)[1] referring to how we listen to the multiple sound sources interacting with the spatial elements of their context and the symbolic meaning attributed to them by the listener. In this thesis I take this concept and definition as a starting point to develop an *artistic practice* of listening to architecture. The decision to situate aural architecture as the focal point of this work is based in a disciplinary position that operates from architecture and towards the intersection and interrelation with other disciplines. Likewise, choosing the term *aural* over sonic or acoustic, emphasizes the artistic nature of this thesis, valuing the subjective and experiential over the objective and rational. In other words, architecture is approached from the auditory experience, in contrast with the purely sonorous, which can exist as matter beyond our perception.

Therefore, the terms sonorous, acoustic, and aural, often used as synonyms, are differentiated as unique and distinct concepts. Through this differentiation, the distinct constitutive dimensions that make up aural architecture are presented; I termed them as sound space, acoustic space, and aural space. Sound space, an already developed and established concept, was incorporated into this diagram. However, the terms acoustic space and aural space, which were not previously well-defined, have been analyzed in more detail for the purposes of this thesis. Using this practical-theoretical foundation, a conceptual model of aural architecture is introduced.

The third part considers the terms *sound space*, *acoustic space*, and *aural space*—integral dimensions of aural architecture—as the primary framework for presenting the practical development. The initial section of each chapter introduces relevant references and their artistic practices associated with these concepts, alongside the practical progression of the artistic research. In the first chapter, focused on *Sound Space*, the artistic outcomes of the *Espacios Resonantes* project are presented as practical methods employed in the research across three groups of artworks: site-specific interventions, sonic translations, and virtual architectures. Moving to the second chapter, *Acoustic Space*, it details the acoustic characteristics of the studied spaces through an urban and architectural survey, and the implementation of acoustic

[1] This thesis adopts the Harvard citation style for referencing.

experiments. These acoustic characteristics serve both as the propagation space for site-specific interventions and as the artistic material for the development of sonic translations and virtual architectures artworks. The third chapter on *Aural Space* introduces phenomenological methods that enable exploration of the subjective realm of aesthetic experience through an embodied listening to the previously presented sound artworks.

Together, these three chapters explain the constitutive dimensions of aural architecture: the *Sound Space*, a creative dimension, which constructs real and virtual multichannel installations and performances; the *Acoustic Space*, an exploratory dimension, where sound information is reflected and filtered; and the *Aural Space*, an interpretative dimension, which translates the spatial-sound into a mental map, transforming auditory phenomena into a creative experience. Thus, the practice of aural architecture refers to how we perceive the sound artworks interacting with spatial elements and subjectively interpret them into visual meanings attributed by the listener. This undoubtedly translates into the sensorial production of the contemporary world, challenging the notion of architecture as something purely material. In this sense, the aesthetic experience of listening to architecture will contribute to the construction of new paradigms about human environments, incorporating sensory interaction in the design process of the built reality. Likewise, the practice of aural architecture within the *Espacios Resonantes* project, will enhance modern industrial heritage by demonstrating the potential of these architectures through artistic action and by preserving their acoustic heritage, thus conserving their architectural value for future reconversion into possible temporary or permanent cultural spaces.

THE SONIC PRESENCE

EXPLORATIONS

ESPACIOS RESONANTES

Presentation

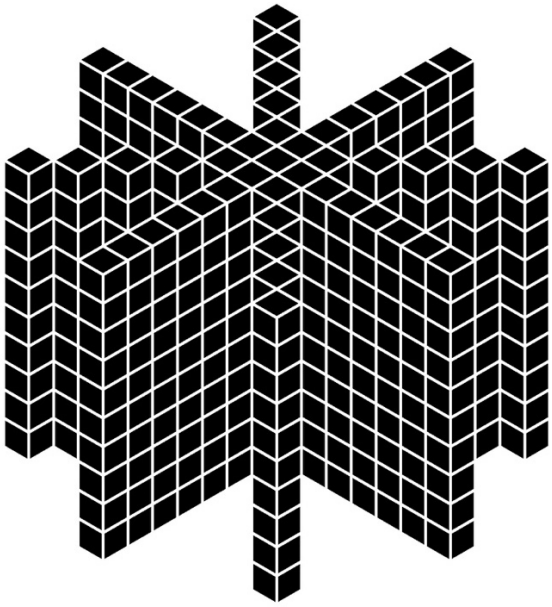


Figure 1. Visual image of Espacios Resonantes. (T. Olivos 2022).

Architecture is a multidisciplinary field of practices that share one common element: the built reality.

Built reality
in the form of buildings,
in the form of cities,
in the form of territories,
in the form of landscapes,

in the form of sound.

Espacios Resonantes is an artistic research project that involves an expedition around the world to explore, collect and create aural architectures. Since 2016, it has delved into the interaction between architecture, sound, and listening, capturing the echoes of industrial heritage through the distinctive acoustics that define its structures. These industrial architectures of production are designed to store liquids, substances, gases, and various forms of matter. Therefore, their design crystallizes into pure geometric forms of large dimensions. They are inhabitable spaces with exacerbated and distinctive acoustics that offer a unique listening experience. These spaces retain within their voices the auditory memory of industrialization. Employing a methodical process of collecting sonic materials from industrial sites, the project produces artworks that explore the aesthetic, political, social, and sensory dimensions of architecture, aiming to construct alternative and subjective narratives. The gathered aesthetic information conforms an archive (fig. 2) and is then translated into experimental outcomes spanning music, video, performance, multichannel installation, and virtual reality.

Figure 2. QR Code: *Espacios Resonantes'* archive: http://espaciosresonantes.com/

The project involves investigating sound as a spatial phenomenon; seeks out niches where sound presents itself in a way that can be captured and contained. The focus is on the unexplored acoustics of spaces designed for the production and storage of industrial elements, intended for non-human habitation. With their large dimensions and pure geometric shapes, these spaces allow us to perceive how vibrations traverse the air, presenting sound as a plastic, malleable, and tangible entity. Sound interacts with the architecture, responding to its morphology—its lines and curves—which shape and filter the voice of space. Often abandoned, these industrial spaces become modern ruins, symbolic of societal decay and the anthropic impact on the planet, characteristic of a process of urban entropy;

> I should now like to prove the irreversibility of eternity by using a jejune experiment for proving entropy. Picture in your mind's eye the sand box divided in half with black sand on one side and white sand on the other. We take a child and have him run hundreds of times clockwise in the box until the sand gets mixed and begins to turn grey; after that we have him run anti-clockwise, but the result will not be a restoration of the original division but a greater degree of greyness and an increase of entropy (Smithson 1967: 6).

Espacios Resonantes seeks to uncover a hidden acoustic heritage within these spaces, revealing an undiscovered sonority emanating from their uninhabitable geometric forms. The act of exploring these forgotten urban vestiges is both an artistic and performative action, while immersing bodies in an experience heightened by its exacerbated acoustics. These locations offer more than just auditory stimulation; they also present captivating visual panoramas of futuristic landscapes and sci-fi scenarios. The initial step is observation, followed by documentation of visual and sonic information, ultimately intervening artistically inside the space or by relocating the experience elsewhere. Within this process, *Espacios Resonantes* creates an aesthetic event that transitions from passive contemplation, to the space's activation through artistic action. Although there is no aesthetic aspiration for acoustic sublimation behind these spaces' original design, these artistic processes serve as exploratory and interpretative tools, allowing to transform the space from decay into an animated and performative entity. Sound brings these forgotten spaces back to life.

These modern ruins allow to explore the intersections between time and space, which are revealed by human intervention on the planet and accumulate as urban cemeteries. This reflects a process of entropy and degradation that is manifested in the project through the acoustic characteristics of the remnants of the industrial era. Through sonic intervention, the project reveals what was once seen as a symbol of progress, now is transformed into symbols of decadence and indicators of the degradation process characterizing the Anthropocene. What seems monumental one day may become a residual layer of history, revealing the fragility of our constructed reality and how the passage of time subjects us to the ephemeral nature of human existence.

Collective.

Sofía Balbontin and Mathias Klenner

Figure 3. Members of *Espacios Resonantes* project (M. Klenner 2023).

Espacios Resonantes project is developed by a collective composed of Sofía Balbontín, based in Lisbon, and Mathias Klenner, based in Barcelona (fig. 3). Both are Chilean architects and sound artists. Since 2019, they have conducted five different expeditions around the world searching for *resonant spaces* and collecting sonic material: Expedition #1 Scotland's highlands, Charleroi, and Barcelona; Expedition #2 Valparaiso; Expedition #3 Santiago de Chile; Expedition #4 Berlin; Expedition #5 Lisbon, Viseu and Barcelona. An upcoming Expedition #6, is planned in Lota, Chile, on September 2024.

In 2023, *Espacios Resonantes* was actively engaged in numerous projects, performances, and exhibitions. They participated in the SANFIC Film Festival in Chile, the SONAR

Festival in Barcelona, and the Museu Terres Ebre exhibition in Spain, showcasing their Virtual Reality Project titled *Wastelands*. In November, they performed at the CREA 2023 Festival, presenting a multi-channel sound performance at the historic La Veloç factory in Barcelona, based on the installation *De la Tierra* by Lolo & Sosaku. They also contributed to the Subbar project at Teatro Bocage in Lisbon, performing compositions focused solely on sub frequencies. They conducted a multichannel installation 100m long inside the Galerias do Loreto, 2 km of the underground tunnels of the Museu da Agua (water museum), together with a performance inside the Patriarchal Water Reservoir, both in Lisbon. In June and July, they participated in the Binaural Nodar residency, employing a 10.1 multichannel system for sound spatialization at the Queiriga Mines in Viseu, Portugal. Additionally, they performed at the Quantum Sound Symposium in July, presenting a performance inside the anechoic and reverberant chambers. In June, they were awarded by ARSgames for the best virtual reality artistic project of the Vortex program. That year, *Espacios Resonantes* received funding from the Goethe Institute for an expedition to Berlin.

In 2022, *Espacios Resonantes* undertook on its most challenging project: the production of the first version of the Architecture and Listening Festival, in Santiago de Chile. This event provided a platform for a multidisciplinary community of national and international artists, researchers, architects, and musicians to converge and explore experimental practices, such as installations, performances, and concerts, using the acoustics of two industrial water infrastructures as artistic material.

Previously, *Espacios Resonantes* participated in two installations at the Biennale of Media Arts of Santiago and at the Soundtiago Festival Chile in 2022. In 2021, they took part in the Spatial Sound Institute Residency in Budapest, where they used the spatialized room with 60 speakers, employing 4DSound technology for the creation of a multichannel performance. They also performed at the 4th International Ambiances Congress and the VII Music Biennale at Yale University in 2020. In 2019, they conducted an expedition in Valparaiso as part of a residency at TSONAMI Sound Art Base, developing a project about the reverbs of the city. In the same year, they exhibited at the Cultural Center GAM Chile with a project that captured migration voices within the *Translinguistic Device*. This same year marked a significant step with the first expedition of *Espacios Resonantes*. They visited industrial spaces

around Europe such as Inchindown Oil Tank, Lyness Oil Tank, and Tugnet Ice House in Scotland, the Rain Water Reservoir and Refugi 307 in Barcelona, and the Cooling Tower and Gasometer in Belgium. This expedition was part of a two-year artistic research project funded by Universidad de las Américas, Chile, where they explored the interaction between sound and space within industrial spaces, employing the "act of listening to architecture" as the main methodology.

In 2018, *Espacios Resonantes* collaborated with Universidad Austral de Chile to develop the project *Sound Translations*, organizing an urban intervention in the central square of Valdivia, Chile. This intervention featured acoustic capsules connecting each structure's architectural sonority with live soundscapes transmitted through recording devices. In 2016, Klenner and Balbontín founded *Espacios Resonantes* and initiated their collective work with a feedback concert at the Museum of Contemporary Art of Santiago, Chile. This concert showcased a spatialized sound installation using ambient sounds from the museum as the basis for composition.

Until the end of August 2024, they are exhibiting at CentroCentro Madrid, while preparing for an exhibition at the 1st Biennal-VR in Barcelona. Recently, they conducted an expedition in Barcelona and are planning another to an abandoned Charcoal Mine in Lota, Chile, scheduled for September 2024. Additionally, they are preparing for the 2nd version of the Architecture and Listening Festival on March-April 2025 and working on a new architecture project to design and build a resonant space at GAM Cultural Center in Santiago, Chile.

Espacios Resonantes has been funded by the Ministerio de las Culturas, las Artes y el Patrimonio Chile, the Research Unit of Universidad de las Américas, Goethe Institute, and ANID Chilean National Agency for Research and Development, along with the support of the Núcleo de Lenguaje y Creación, the Facultad de Arquitectura, Animación, Diseño y Construcción UDLA, and the Faculty of Fine Arts of the University of Lisbon.

TIMELINE

EXPEDITION #1
Charleroi, Belgium
Cooling Tower
Gasometer

Barcelona, Spain
Refugi 307
Water Reservoir Joan Miró
Water Tank Cal Grau

Highlands, Scotland
Inchindown Oil Tank
Lyness Oil Tank
Tugnet Ice House

EXPEDITION #2
Valparaíso, Chile
Muelle Barón
La Pólvora Tunnel
Caleta Portales Sewer
Water Reservoir Valparaíso

EXPEDITION #3
Santiago, Chile
Water Tower Quinta Bella
Water Reservoir Quinta Bella

EXPEDITION #4
Berlin, Germany
Teufelsberg Spy Station
Gasometers Mariendorf
Rüdersdorf Lime Plant

EXPEDITION #5
Lisbon, Portugal
Patriarcal Reservoir
Galerias do Loreto
Silos da Nutasa

Barcelona, Spain
Water Reservoir Trinitat Nova
Cement Dome Sanson

EXPEDITION #6
Lota, Chile
Charcoal Mine

ARTWORKS

2016
Foundation of Espacios Resonantes
Endogamia, Contemporary Art Museum, SCL
Constructos Sonoros, Desfase Festival, SCL

2018
Sound Translation, Péndulo Square, ZAL
The sensitive experience of soundscape within a natural disaster, Cresson, GNB

2019
Resuenarradarresonante, Tsonami, VS
Babel, GAM Cultural Center, SCL

2020
Resonant Spaces, VII Music Biennal Yale University, NY
Resonant Spaces Videogame, IV International Congress on Ambiances, online

2021
Resonant Spaces, Festival Tsonami, VS
Resonant Spaces, La Casa del Sonido, RTVE
Space Dystopia, Spatial Sound Institute, BUD
Resonant Spaces, XV Biennal of Media Art, Contemporary Art Museum, SCL
Resonant Spaces: Wastelands, Control Alt Play, Etopía Art Center, ZAZ

2022
Architecture and Listening Festival: Espacios Resonantes, Quinta Bella, SCL
Polyphono, Festival Espacios Resonantes, SCL
Resonant Spaces: Wastelands, Congress of Landscape and Sustainability, UAM, MAD
Resonant Spaces: Wastelands, Sónar Festival Barcelona, Spain

2023
Resonant Spaces: Wastelands, Sónar Festival Barcelona, BCN
Resonant Spaces: Wastelands, Museu Terres Ebre, EBR
Resonant Spaces: Wastelands, Cinema Festival SANFIC, SCL
Som sob o solo, Museu da Agua, LIS
Polyphono, Subbar, Teatro Bocage, LIS
Tungsteno, Binaural Nodar, VIS
Lost and found territories office, CREA Festival, La Veloç factory, BCN
Resonant Spaces, Quantum Sound Symposium, BCN

2024
II Architecture and Listening Festival : Espacios Resonantes, Quinta Bella, SCL
Seminario Sonido, Cuerpo y Espacio, Galpon Victor Manuel, UDLA, SCL
La Esfera, GAM Cultural Center, SCL

Figure 4. Timeline of *Espacios Resonantes* (S. Balbontín 2024).

Methodology.

The methodology process of observing and acquiring knowledge about aural architecture involves first, the logical reflection on *a priori* knowledge; second, the creation and production of artworks; and third, the subjective information derived from experience. Therefore, this artistic research primarily employs practice-based methods, blending it with conceptual and phenomenological methods (fig. 5). The aim is to stimulate situated knowledge through artistic experiences, based on a conceptual model of aural architecture.

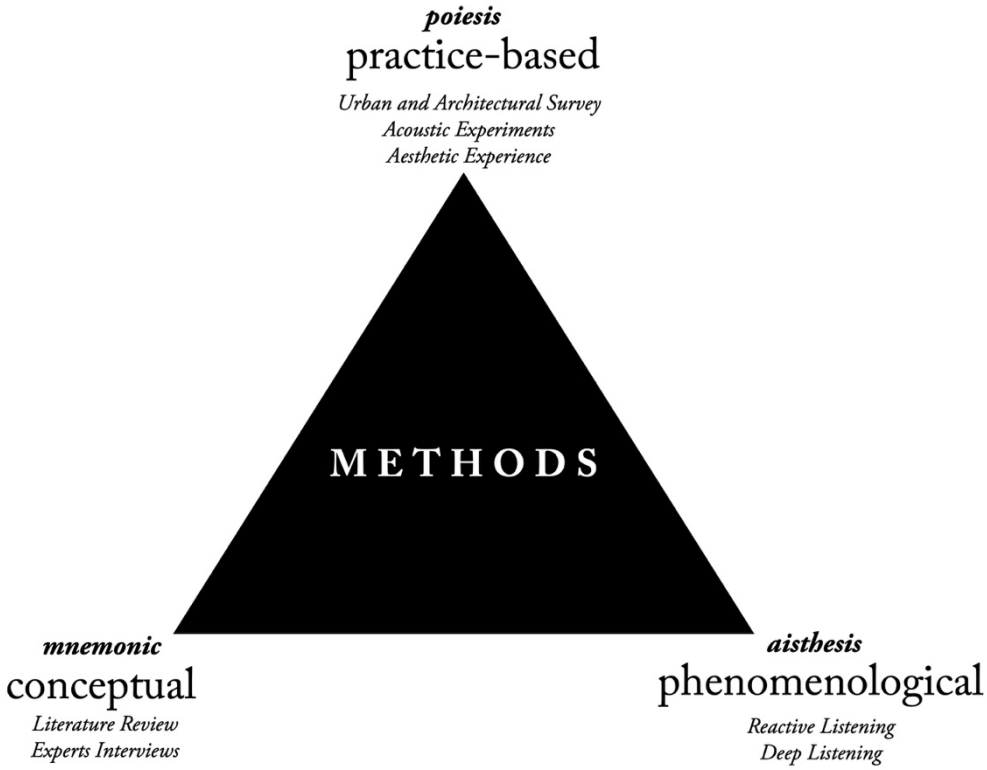


Figure 5. Methodological diagram (S. Balbontín 2024).

Mnemonic.

Conceptual methods, such as Literature Review and Experts Interviews, provide the foundation for developing a rhizomatic tool to manipulate the notion of sound space and facilitate

further conceptualizations. This serves as the starting point for developing a conceptual model around the practice of aural architecture, organizing the research into different phases focusing later on practical and phenomenological applications.

(1) *Literature Review.* Elaborating a conceptual framework that explores various interactions between sound and space, drawing from theoretical and practical references in music, media arts, and architecture. The aim is to address the research problem concerning sound space, aural architecture, and the interdisciplinary intersections of architecture, sound, and listening.
(2) *Interviews with Experts.* Nine interviews were conducted with specialists in the subject of study, including Pascal Amphoux, Francesc Daumal, Anna Bofill, Brandon LaBelle, Daniel Neumann, Ricardo Atienza, Bernhard Leitner, Mark Bain, and Pablo Elinbaum.

Poiesis.

Practice-based methods appear in three distinct forms: 1) urban and architectural survey, 2) acoustic experiments, and 3) aesthetic experiences, including artistic events, installations, performances, virtual reality, and compositions. These methods enable experimentation with various media to establish a practical framework derived from diverse artworks, fostering a sensitive understanding of aural architecture through the act of listening.

(1) ***Urban and Architectural Survey.*** Examination of the architectural and territorial aspects of the space through plans and 3D models.
(2) ***Acoustic Experiments.*** These methods involve collecting sound material within spaces, utilizing techniques from both acoustical engineering and artistic practice.
(3) ***Aesthetic Experience.*** The creation of aesthetic experiences through various mediums such as performances, installations, multi-channel concerts, compositions, virtual reality, and simulated acoustic environments.

Urban and Architectural Survey.

(1) *Expeditions.* The first practical method of this research involves an urban exploration of industrial spaces, often abandoned remnants of contemporary society. This process includes identifying, and locating these spaces, followed by conducting visits, which may entail obtaining permits or entering clandestinely.
(2) *Plans and 3D Models.* Within the space, the whole architectural form is measured, and then this information is used to create plans and 3D models.

Acoustic Experiments.

Sonic activations by acoustic means (field recordings):

(1) *Ambient Sound.* Capturing ambient sounds through audio recordings to identify the sound sources in the environment. These recordings are used to analyze the background noise and contextualize the space by listening to its soundscape.
(2) *Impulse Response.* We create a broad spectrum of frequencies using the explosion of a balloon. Each location exhibits its unique acoustic response, influenced by its morphological characteristics, construction materials, and specific dimensions. The impulse response (IR) allows us to analyze this acoustic reaction by measuring the reverberation time (T60) of the space, which indicates how long it takes for the reverberant tail to decay by 60dB. This parameter is analyzed using REW software, which also give us data regarding the predominant frequencies in the space; those that are sustained for longer periods and with greater intensity. Moreover, the impulse response serves as artistic material and is used to generate convolution reverberations.
(3) *Voices and Instruments.* This artistic and performative methodology involves capturing acoustic reactions resulting from the flexible use of voices and instruments brought to the site, such as bells, bowls, flutes, trumpets, and drums.
(4) *Found Objects.* The recording of acoustic responses produced by objects discovered on-site using percussive and/or vibratory elements.

Sonic activations by electronic means (field recordings):

(5) *Sweep of Frequencies.* Using a loudspeaker and a patch in MaxMSP, we reproduce a sweep of frequencies across the entire spectrum to measure the space's response in each case study. This parameter helps identify resonant frequencies – those frequencies reinforced and heard for a longer period with greater intensity – as well as specific harmonics and partials that are unique to each space.
(6) *Resonant Frequencies.* Resonant frequencies within a space are often associated with modes of vibration or standing waves. Using the information from the sweep of frequencies, resonant frequencies and stationary waves can be stimulated to evaluate their acoustic response.
(7) *Slow Feedback.* This method, inspired by Alvin Lucier's *I am sitting in a room* (1969), involves recording a voice and playing it back in the space repeatedly, gradually emphasizing predominant frequencies until only a specific range remains. The process is repeated five to ten times, depending on the space's acoustic response.

Aesthetic Experience.

(1) *Site-Specific Interventions.* Performance and/or installation pieces serve as site-specific devices for sound-spatial experimentation. These situated experiences are artworks that create aural architectures within an existing space that has been intervened by the piece. The artwork acts as a medium between the listener and the space, redefining spatial dimensions through sound spatialization and the acoustic properties of the architectural form.
(2) *Sonic Translations.* The translation of a space through the simulation of its acoustics in a different space. For this simulation, we use the convolution reverb technique, commonly used in audio production to replicate the reverberation of a physical space. This method involves convolving an audio signal with an impulse response (IR) recorded from the real acoustic environment. The creative process behind such artworks involves recreating the ambiance or atmosphere of one space in another through a multichannel installation of spatialized sound.

(3) *Virtual Architectures.* These artworks use the architectural information, from plans and three-dimensional models, to recreate the spatiality and morphology of the spaces within a virtual environment. The acoustic is simulated through convolution reverberation, and the sound sources of the original place are located and triggered by the player/performer. These sounds are then filtered by the acoustics of the space, transforming the virtual reality into a meta-instrument capable of creating sound compositions as the space is virtually traversed. Outcomes of these artworks are mainly audiovisual projects, augmented and virtual reality experiences, and hybrid performances, but also virtual spaces using only sonic and acoustic information.

Aesthesis.

Phenomenological methods appear in the form of interviews, workshops, and listening sessions, embodied by both a sample of individuals and my own experience, to gather information concerning the perception, cognition, and interpretation of aural architecture. These methods aim to facilitate a discussion surrounding the subjective aspects of the subject of study.

(1) *Reactive listening.* Developed since 1981 at the CRESSON laboratories, involves observing reactions to specific environments through sound recordings (Augoyard 1978, 2001). This method works by recording sounds from a particular environment and then replaying them out of context using headphones or loudspeakers. It can be conducted individually with headphones or through a multichannel performance and/or installation. After the session, individual or collective interviews are carried out.
(2) *Deep listening.* Coined by Pauline Oliveros (2005), refers to an attentive and focused form of listening. It involves not only hearing the sound but also paying attention to its details, textures, and the space in which it occurs. This method it is based on an aesthetic experience aimed at stimulating the auditory perception of the audience through a performance, concert, or multichannel installation. Following the experience, individual or group interviews are conducted to explore participants' interpretations of the sonic experience in terms of sensory perception and spatial imagination.

BITÁCORA DE VIAJE

Espacios Resonantes' Archive

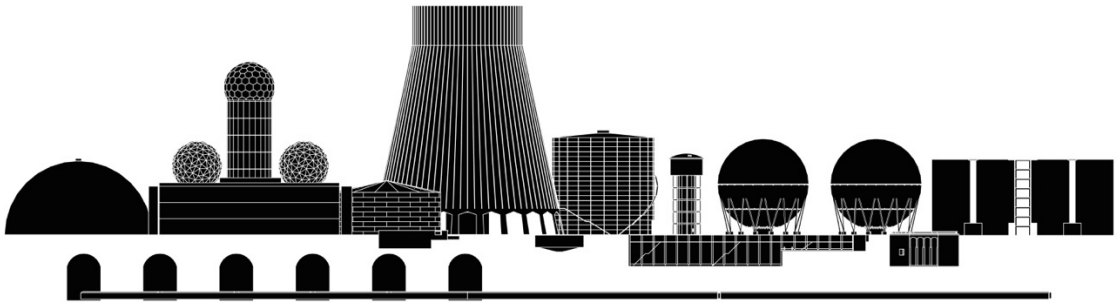


Figure 6. Espacios Resonantes' case studies (M. Klenner 2024).

This research focuses on obsolete infrastructures built since the industrial revolution, leaving behind huge abandoned industrial sites and decaying urban landscapes. These sites, once vibrant symbols of human activity and progress, became haunting reminders of impermanence and decline. Some were used for extractive purposes, while others served wartime objectives. The case studies for experimentation include abandoned infrastructures on the margins of memory and the urban; sublime architectures for production. These sites are uninhabitable spaces with exacerbated and unique acoustics, serving as monuments of a future that never existed.

Expedition #1: Charleroi | Highlands | Barcelona

(1) Refugi 307 (air raid shelter), Barcelona, Spain.
(2) Joan Miró Rainwater Reservoir, Barcelona, Spain.
(3) Cal Grau Water Reservoir, Sabadell, Spain.
(4) Cooling Tower of the IM Thermoelectric Plant in Charleroi, Belgium.
(5) Gasometer of the IM Thermoelectric Plant in Charleroi, Belgium.
(6) Lyness Oil tank, Lyness, Scotland.
(7) Tugnet Ice House, Spey Bay, Scotland.
(8) Inchindown Oil Tank, Invergordon, Scotland.

Expedition #2: Valparaíso

(9) Las Ánimas Tunnel, Camino La Pólvora, Valparaíso, Chile.
(10) Caleta Portales Sewer, Valparaíso, Chile.
(11) Muelle Barón (main dock), Port of Valparaíso, Chile.
(12) Firefighter Water Reservoir, Valparaíso, Chile.
(13) Wheelhouse, Valparaíso, Chile.

Expedition #3: Santiago

(14) Quinta Bella Water Tower, Recoleta, Santiago de Chile.
(15) Quinta Bella Water Reservoir, Recoleta, Santiago de Chile.

Expedition #4: Berlin

(16) Rüdersdorf Lime Plant, Berlin, Germany.
(17) Mariendorf Gasometers, Berlin, Germany.
(18) Teufelsberg Spy Station, Berlin, Germany.

Expedition #5: Lisboa | Barcelona | Viseu

(19) Galerias do Loreto Tunnels, Aqueduto das Águas Livres, Lisbon, Portugal.
(20) Water Reservoir, Reservatório da Patriarcal, Aqueduto das Águas Livres, Lisbon, Portugal.
(21) Minas de Queiriga, Viseu, Portugal.
(22) Silos da Nutasa, Barreiro, Lisbon, Portugal.
(23) Water Reservoir, Casa de l'Aigua Trinitat Nova, Barcelona, Spain.
(24) Cement Dome Sanson Plant, Barcelona, Spain.

Location Map.

Figure 7. Location map of case studies (S. Balbontín 2024).

Expedition #1

Charleroi | Highlands | Barcelona

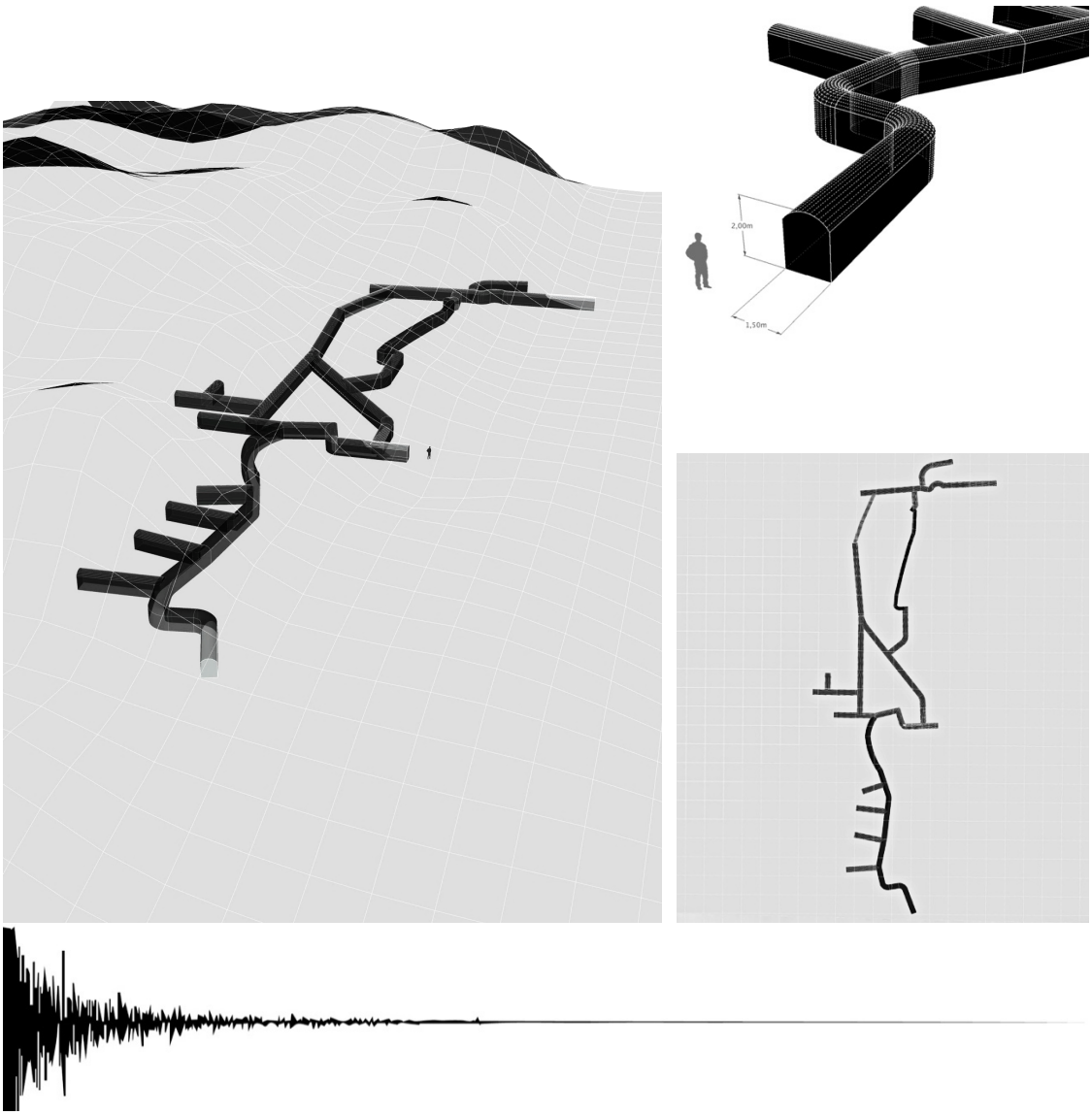
2019

In collaboration with my colleague Mathias Klenner and with funding from Universidad de las Américas, Chile, we organized our first expedition to explore sites associated with the legacy of war and the industrial revolution. Our destinations included Catalonia, Scotland, and Belgium in Europe. During our journey, we sought out spatial voices that led us away from human-inhabited spaces towards areas dedicated to non-human activities. These included sites of war and industrial infrastructure, where usually liquids, gases and substances used to inhabit. These spaces, characterized by oversized forms and precise geometries, seemed to transcend human reality by their de-escalated size, resembling living organisms with voices of their own. Sometimes, they even seemed to speak, encapsulating in their speech a process of historical dehumanization.

Figure 8. Previous page. Exterior of Cooling Tower (Recovered from rumhipstern.de). **Figure 9.** Charleroi, Belgium (M. Klenner 2019).

Refugi 307 (Air Raid Shelter), Barcelona, Catalonia, Spain.

Coordinates: 41°22'17.96"N 2°10'0.74"E
Status: Reconditioned for Cultural Purposes



T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
4-8	926	2	300	1.50

Figure 10. Left: 3D view (S. Balbontín 2024). Top-Right: Zoom-in Tunnel (M. Klenner 2019). Bottom-Right: Ground level (S. Balbontín 2024). Bottom: Wave form IR T60 - 2" (S. Balbontín 2019). QR code: Audio of Impulse Response.

The first stop of this first expedition was Refugi 307, an air raid shelter located in the city of Barcelona, built in 1936 to protect citizens from bombing during the Spanish Civil War. The shelter consists of a complex network of tunnels forming a labyrinthine map of different voices that echo the pain of the civilian population at the time, creating an identity associated with terror and death. The spatial voices engage in several simultaneous dialogues throughout the shelter, traversing the labyrinthine corridors, encountering varying tones and speeds, thus constructing a brief spatial symphony of its aural architecture.

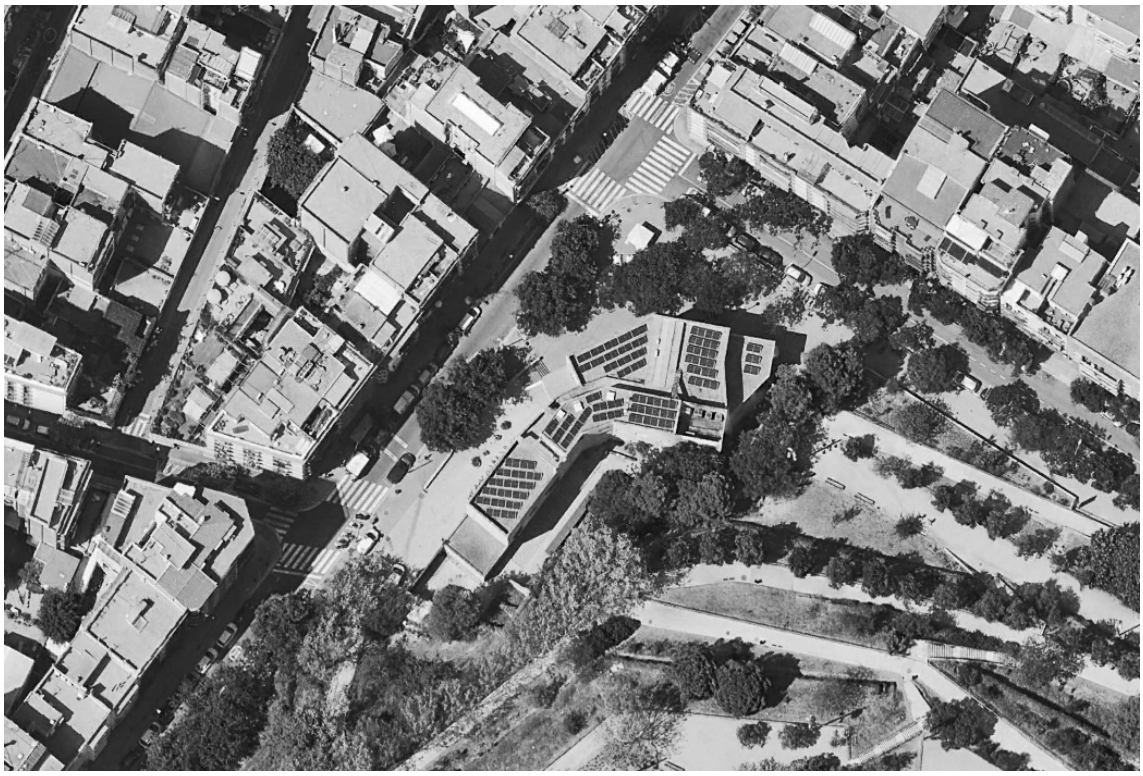


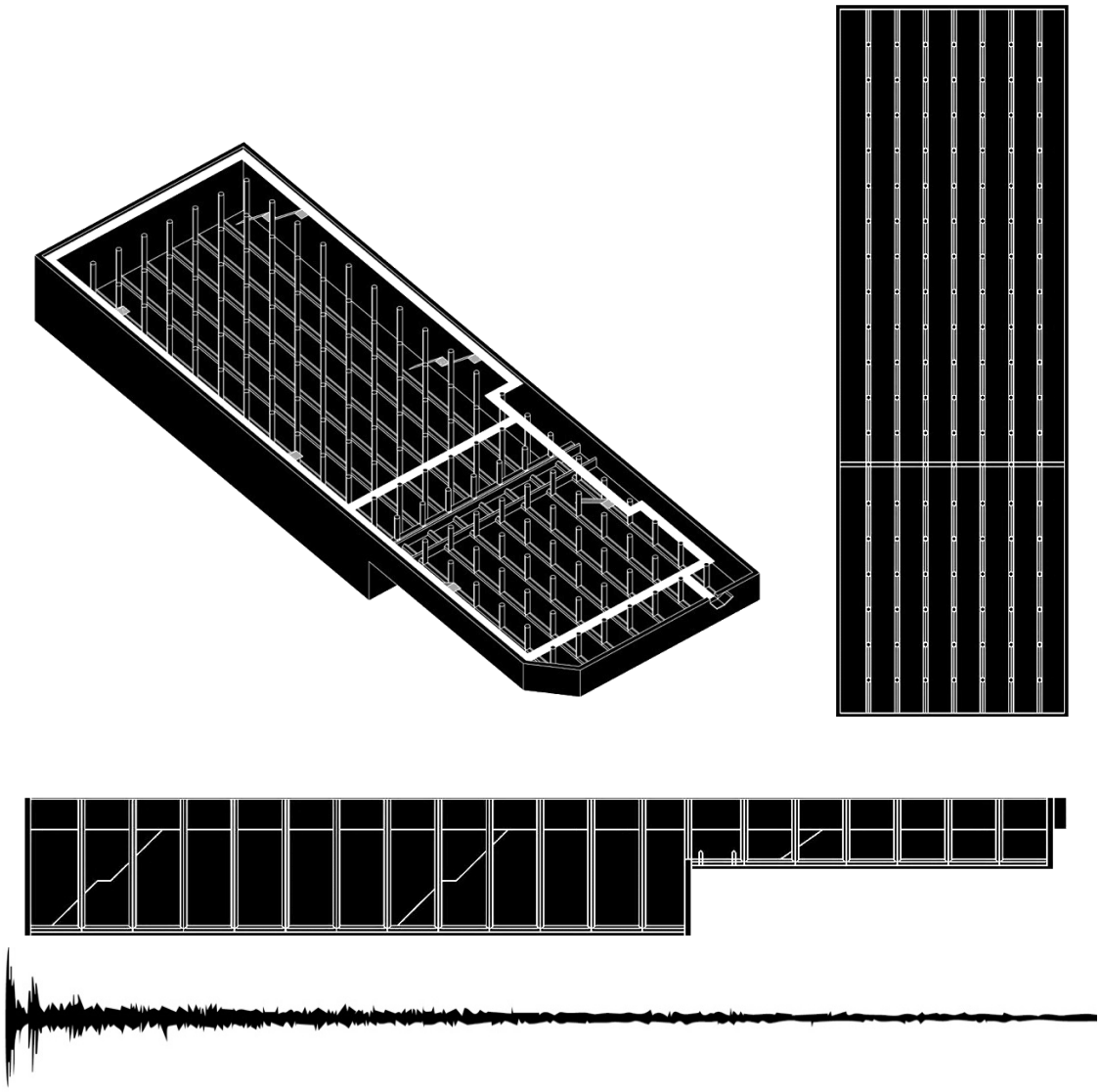
Figure 11. Localization. Aerial view of Refugi 307. Recovered from Google Earth.

Situated beneath Montjuic hill, the shelter comprises narrow spaces that evoke a sense of distress, portraying the transformation of areas intended for life into those designed for death. The voice of the shelter not only echoes the wartime experiences of history but also represents spaces of dehumanization, in opposition to life.

Figure 12. Interiors of Refugi 307 (S. Balbontín 2019).

Joan Miró Rainwater Reservoir, Barcelona, Catalonia, Spain.

Coordinates: 41°22'38.43"N 2° 8'55.80"E
Status: In use



T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
30	55,000	10	76.75	24.4

Figure 13. Top-Right: Ground level (S. Balbontín 2024). Top-Left: 3D view (M. Klenner 2024). Middle: Front view (M. Klenner 2024). Bottom: Wave form IR T60 - 2" (S. Balbontín 2019). QR code: Audio of Impulse Response.

The Joan Miró Rainwater Reservoir, located in Barcelona, is a large empty box structure designed to collect rainwater. The interior resembles a forest, with tall rustic pillars arranged in an orthogonal and equidistant grid pattern. This expansive environment exhibits a rich acoustic response, characterized by a diverse range of sounds and harmonics.

Figure 14. Interiors of Joan Miró Reservoir (S. Balbontín 2019).

The Joan Miró Rainwater Tank is located on one side of the *Plaça Espanya*, under the Joan Miró Park. It occupies a total area of approximately 6,500m2, with two bodies having a combined retention volume of 55,000m3.

We had the opportunity to enter the rainwater tank for an hour, however with many restrictions due to safety concerns. The space resembles a large hypostyle room, featuring a total of 175 pillars measuring 50 centimeters in diameter and ranging from 5 to 10 meters in height. Inside, the constant murmur of water from the city's subway canals was constantly present, accompanied by urban noises filtered through the air connections. Various measurements were taken inside the space, including impulsive responses, slow feedback, frequency sweeps, and recordings of the soundscape. Notably, the rectangular proportions of the space and the presence of pillars resulted in a wide range of harmonics.

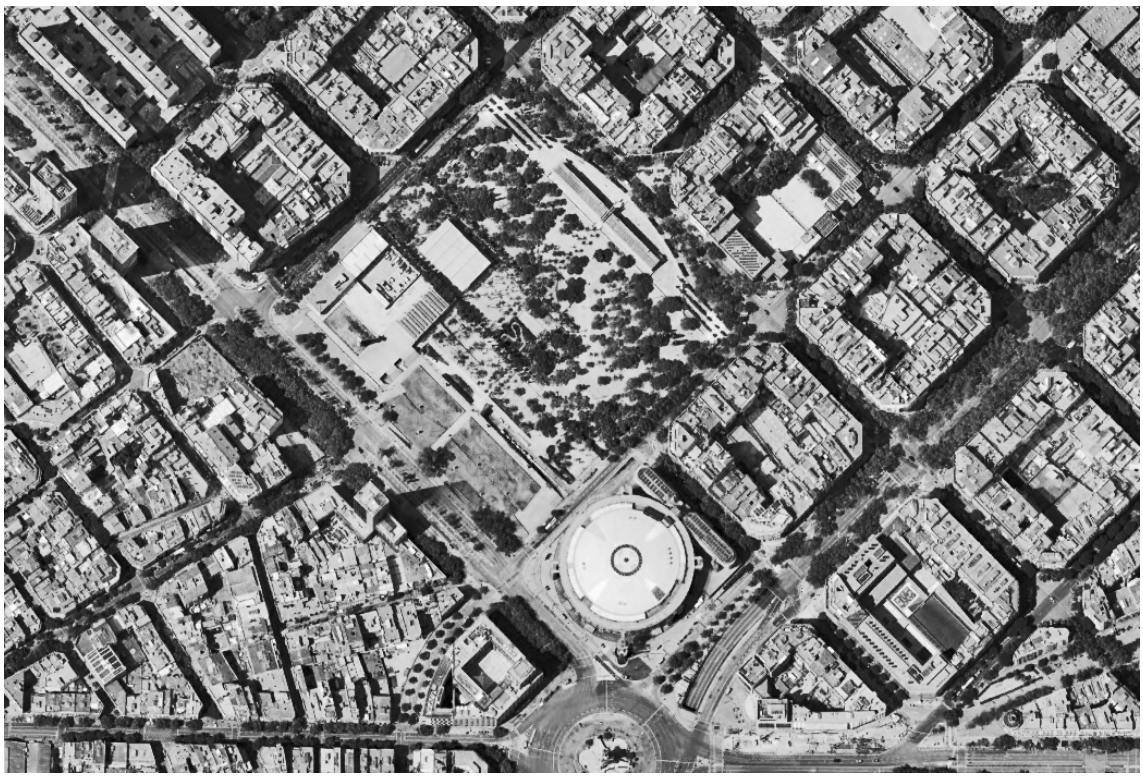
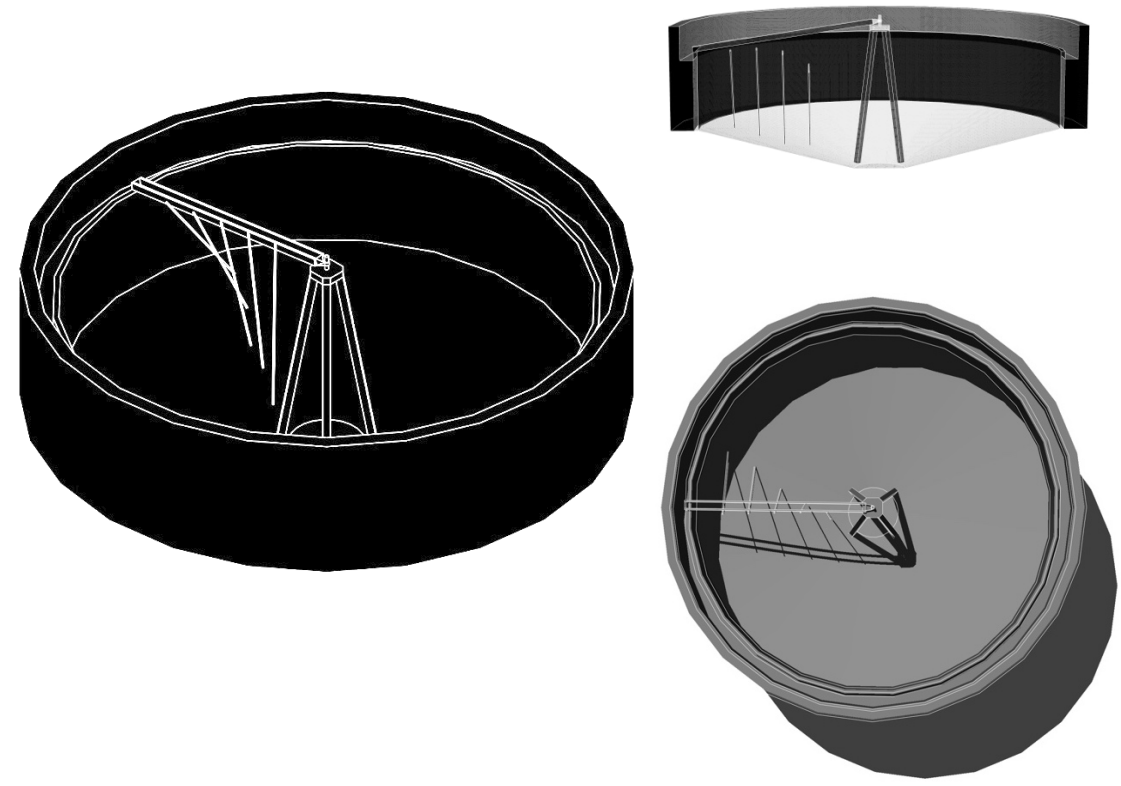
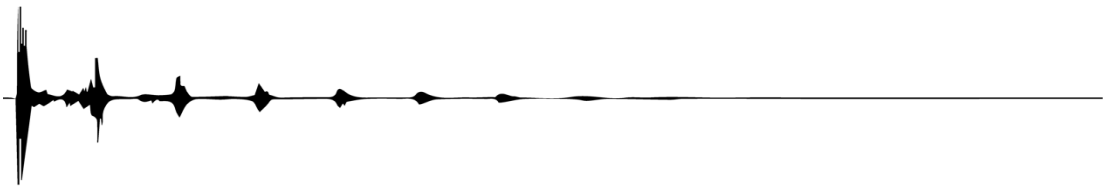


Figure 15. Location. Aerial view of Joan Miró Rainwater Reservoir. Recovered from Google Earth.

Cal Grau Water Reservoir, Textile Plant Sabadell, Catalonia, Spain.

Coordinates: 41°32'37.96"N 2° 7'33.22"E
Status: Abandoned





T60 (S)	VOL (M3)	H (M)	R (M)	D (M)
8	615.8	4	7	14

Figure 16. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level (M. Klenner 2024). Bottom: Wave form IR T60 - 2'' (S. Balbontín 2019). QR code: Audio of IR.

On the banks of the Ripoll River in Sabadell, Catalonia, lies the abandoned textile factory Cal Grau. Cal Grau is among a series of textile factories abandoned during the 19th and 20th centuries. These factories were significantly impacted by the flood of 1962 and began a process of abandonment in the 1970s, reflecting the ongoing shifts in the global economy.

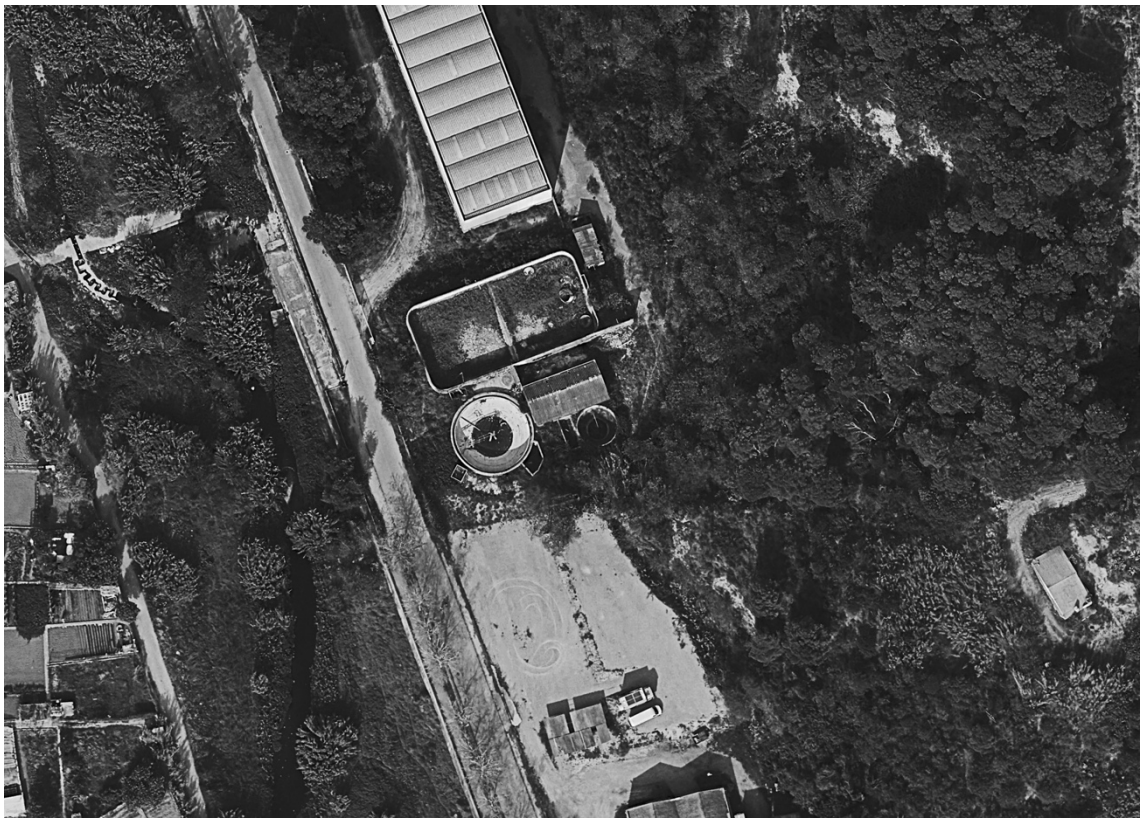


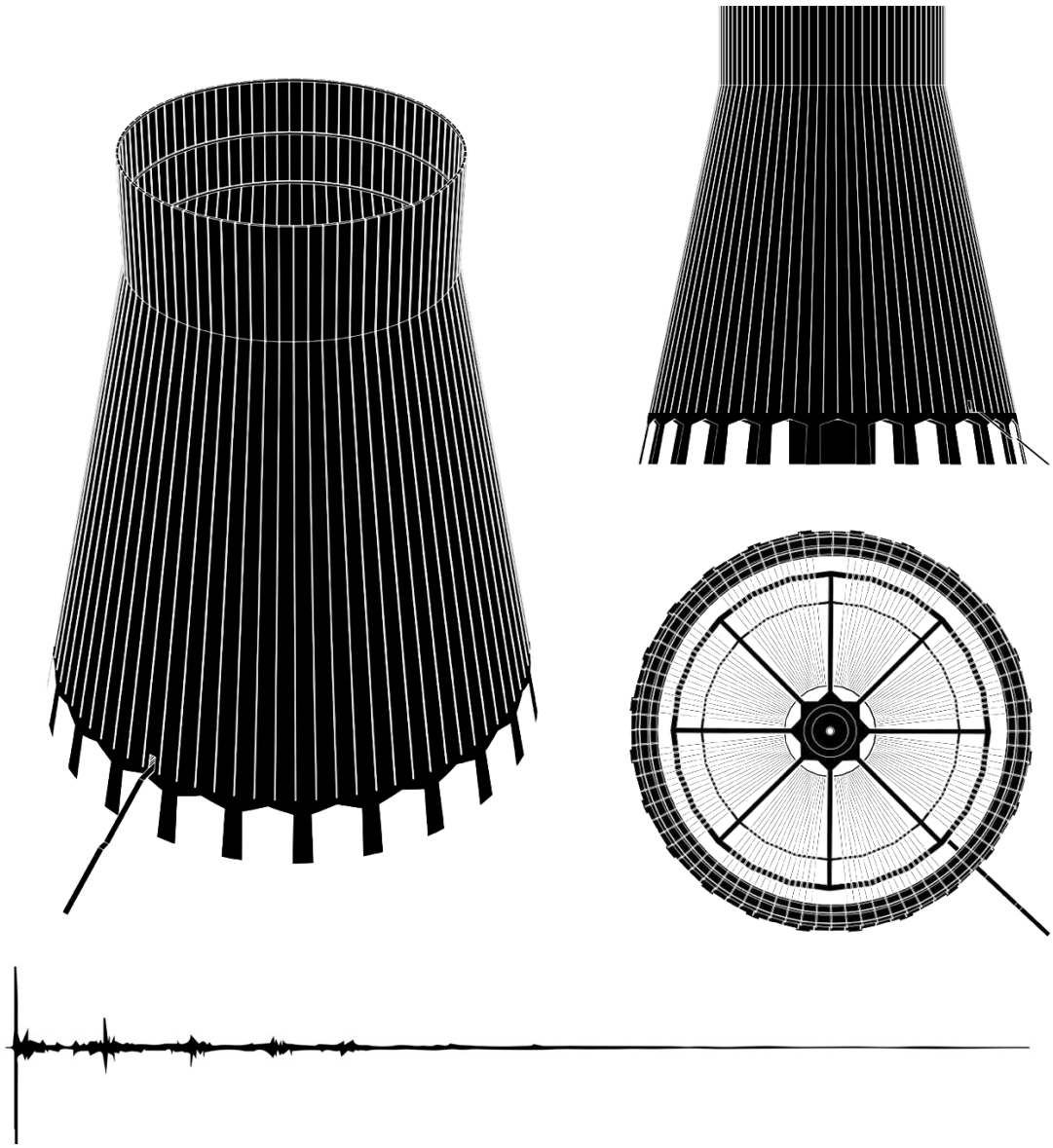
Figure 17. Location. Aerial view of Cal Grau Water Reservoir. Recovered from Google Earth.

The factory houses a cylindrical water reservoir measuring 14 meters in diameter and approximately 4 meters deep. As part of a residency at the Fábrica de Creación l'Estruch, led by Mathias Klenner, a study of the acoustics of this space was conducted.

Figure 18. Left and Right-Bottom: Interior of Cal Grau Reservoir. Right-Top: Exterior of Cal Grau Reservoir (M. Klenner, 2019).

Cooling Tower of the IM Thermoelectric Plant in Charleroi, Belgium.

Coordinates: 50°23'41.16"N 4°22'55.42"E
Status: Abandoned



T60 (S)	VOL (M3)	H (M)	R (M)	D (M)
15	212,057.5	75	30	60

Figure 19. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level (M. Klenner 2024). Bottom: Wave form IR T60 - 2'' (S. Balbontín). QR code: Audio of IR.

The Cooling Tower was part of a completely abandoned industrial complex on the outskirts of Charleroi, Belgium, known for its distinctive brutalist aesthetic. We traveled to the plant by train, observing how the landscape of houses and factories suddenly transformed into one of obsolescence. A strange sensation suddenly enveloped us, as if we had entered the "zone" of Stalker (Tarkovsky 1979). In the distance, the Cooling Tower came into view, gradually growing larger as the train approached.

Figure 20. Aerial View of the Thermoelectric Plant. Recovered from Google Earth.

Walking through this industrial graveyard, we couldn't help but appreciate the inorganic matter scattered across the land, constantly reminding us of the reason for its abandonment. Originally built in 1921 as a Thermoelectric Plant, the complex grew to become one of Belgium's largest plants. By 1977, the plant had become the primary source of energy in the region, but also a significant contributor to pollution, responsible for 10% of the country's CO2 emissions. Due to constant environmental protests, the plant closed in 2007.

The Cooling Tower is a concrete structure in the shape of a truncated cone. It measures 60 meters in diameter at the base, 45 meters at the top, and stands 75 meters tall. Its primary function was to cool water during the coal combustion process, with a capacity to cool 480,000 gallons of water per minute, extracted directly from the adjacent river.

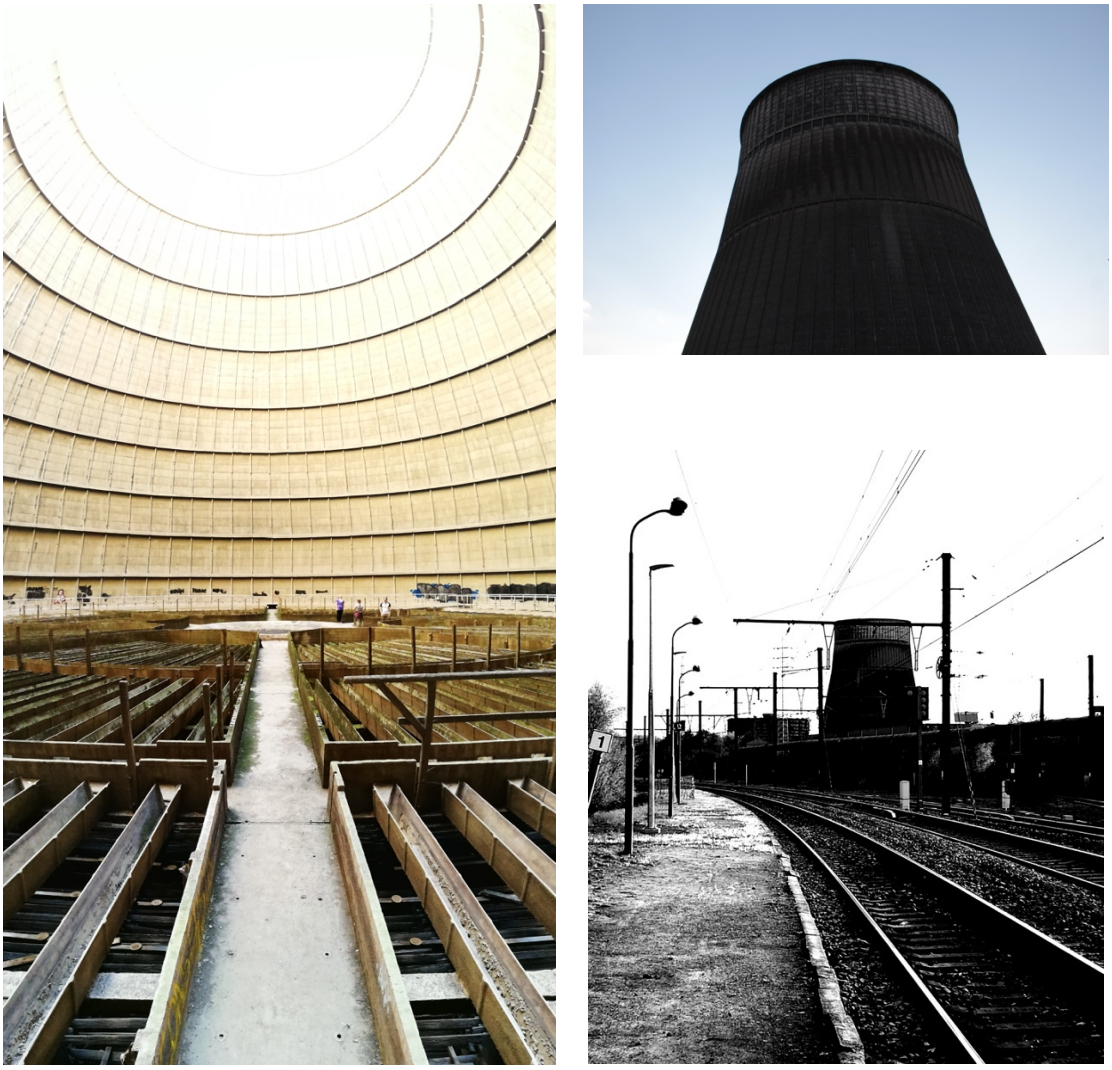
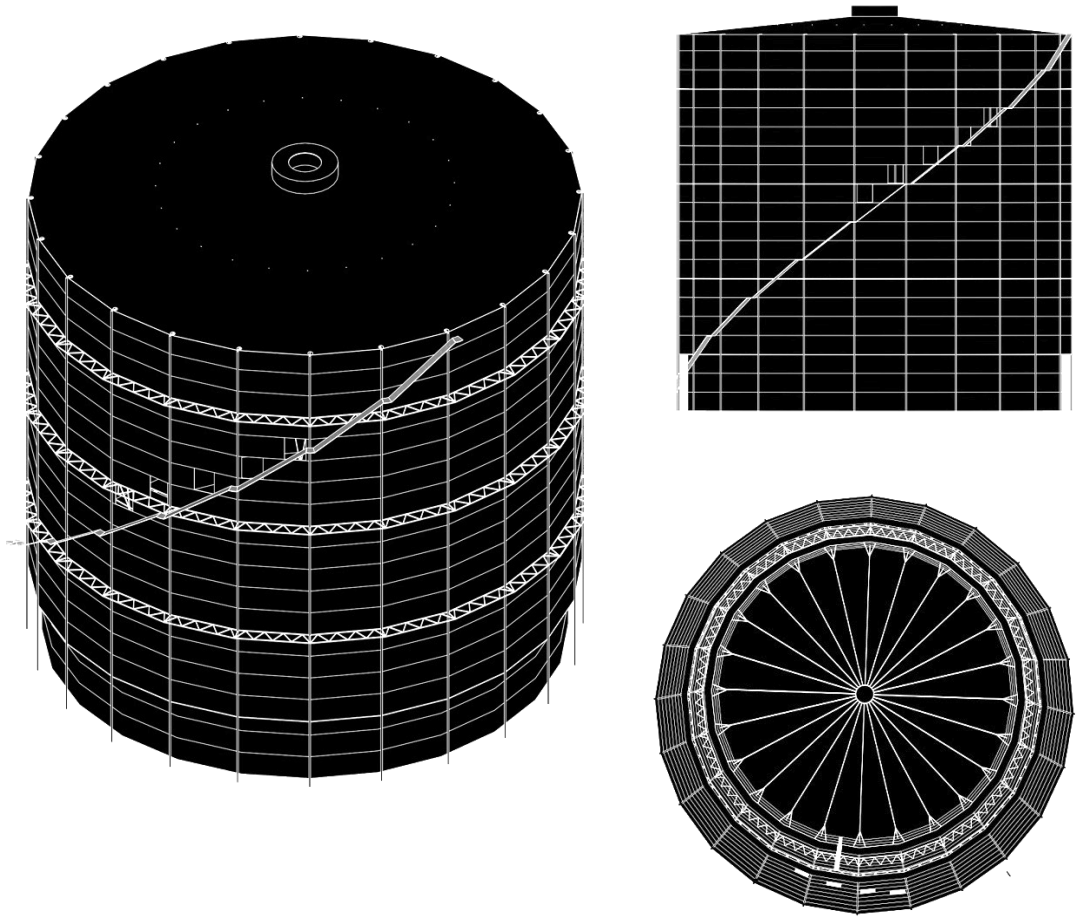


Figure 21. Left: Interior of Cooling Tower (S. Balbontín 2019). Right-Top: Exterior of Cooling Tower (M. Klenner 2019). Right-Bottom: Context (S. Balbontín 2019).

Gasometer of the IM Thermoelectric Plant in Charleroi, Belgium.

Coordinates: 50°23'40.44"N 4°22'56.46"E
Status: Abandoned



T60 (S)	VOL (M3)	H (M)	R (M)	D (M)
20	27,369.5	33	16	32

Figure 22. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level (M. Klenner 2024). Bottom: Wave form IR T60 - 2'' (S. Balbontín 2024). QR code: Audio of IR.

The gasometer is a steel cylinder, 33 meters in diameter and 32 meters high. To access the tank, we used a side staircase and then descended 20 meters into the interior of the tank using a ladder. The presence of particles in the air made it difficult to breath. The space is presented as a large reverberant cylinder, where every movement generated long reverberations. The floor of the gasometer functioned as a large steel membrane of an inhabitable drum, and the sounds of the exterior soundscape seeped in along with the light through lateral openings.

Figure 23. Aerial View of the Thermoelectric Plant. Recovered from Google Earth.

There are two ways of conceiving architecture: the first as a physical construction of space and the second as a symbolic perception of space (Careri 2002). The voice of space, the acoustic response of its architectural forms, and the reception of sensory information by the body, culminate in the transmission of sensory data. This process begins with an action from my body, triggering a spatial reaction, and returns to me as sensory data. Perception and listening play an important role in tracing the relationship between one's own body and the

body of the space, as well as the possible relationships that exist between the other elements arranged in it.

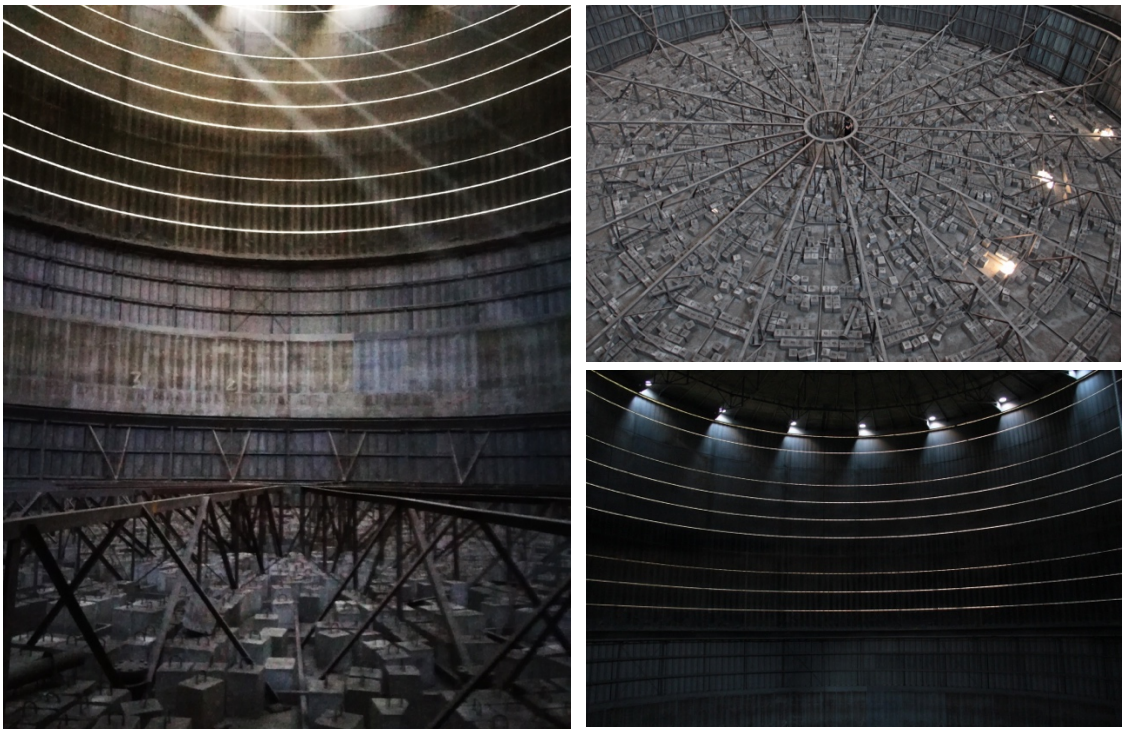
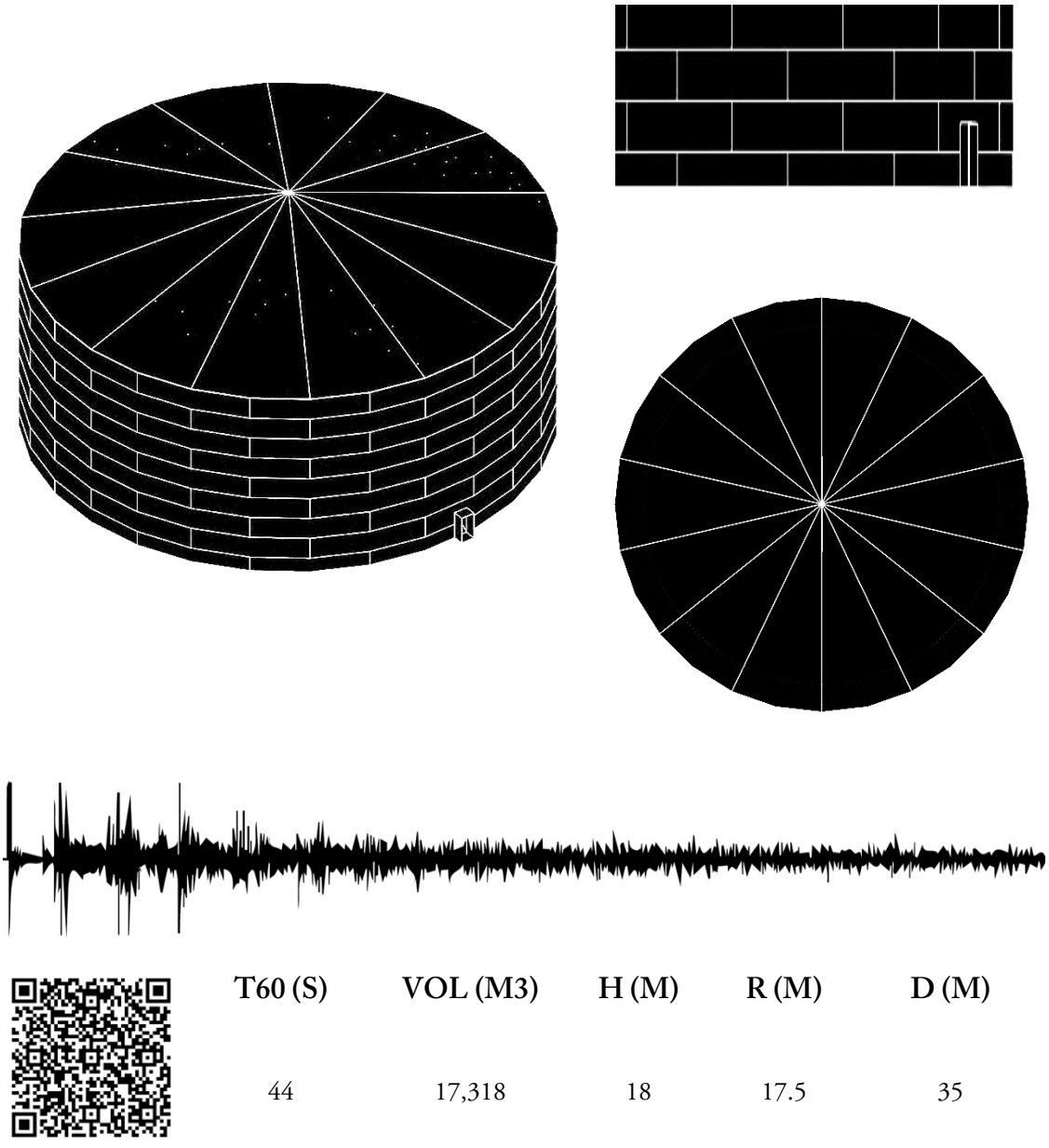


Figure 24. Left: Interior of Gasometer (S. Balbontín 2019). Right: Interiors of Gasometer (M. Klenner 2019).

On the gasometer floor, we discovered various industrial elements: concrete cubes and steel structures recognizable by their acoustic response. The floor material was made of tinplate and resonated with each step, creating a delightful reverberation, especially at the center. In this performative dynamic, the body's presence is fundamental, breaking into space through action and then perceiving it. Following the body's involvement, subjective interpretations emerge. My colleague and I, as living organisms, act as sensitive machines, intimately engaging with our environment. This engagement is subjective and personal, shaping the world through our sensory capacity. Perception, therefore, is not merely receptive but also creative. We continually engage in a process of perception-action, actively constructing our subjective reality. This creative perception, according to Thompson (2011), reflects an autopoietic process, referring to a system organized as the self-production of an interconnected network of vital processes.

Lyness Oil Tank, Lyness, Scotland.

Coordinates: 58°50'1.05"N 3°11'54.65"W
Status: Reconditioned for Cultural Purposes



T60 (S)	VOL (M3)	H (M)	R (M)	D (M)
44	17,318	18	17.5	35

Figure 25. Left: 3D view. Top-Right: Front view (M. Klenner 2024). Bottom-Right: Roof plan (S. Balbontín 2024). Bottom: Wave form IR T60 - 2'' (S. Balbontín 2019). QR code: Audio of IR.

The expedition continued by ferry to the Orkney Islands, Scotland. On the island of Hoy, there lay an abandoned military base that once housed the British Army during WWI and WWII. Among the remnants of the military grounds were 16 oil storage tanks, with only one remaining intact. The setting surrounding the tank was desolate, characterized by relentless winds, biting cold, and a hint of mystery.

Figure 26. Aerial View of the Lyness Oil Tank. Recovered from Google Earth.

Inside the tank, darkness prevailed; there were no windows, only bullet holes piercing the walls. These apertures acted as camera obscura introducing the outside world, allowing clouds to drift into the enclosure and projecting a semblance of the sky within. The vastness of this interior space, with its illusion of an expansive sky, was further amplified by the sound, which seemed to transcend the confines of the architecture and human scale into a territorial one. It was as if the entire island of Hoy was encapsulated within the walls of that solitary tank.

Here, we witness a convergence of processes involving different organisms: the perceptual and creative faculties of human bodies, juxtaposed with the entropic evolution of our surroundings. Instead of succumbing to decay, these residual processes give rise to a new false

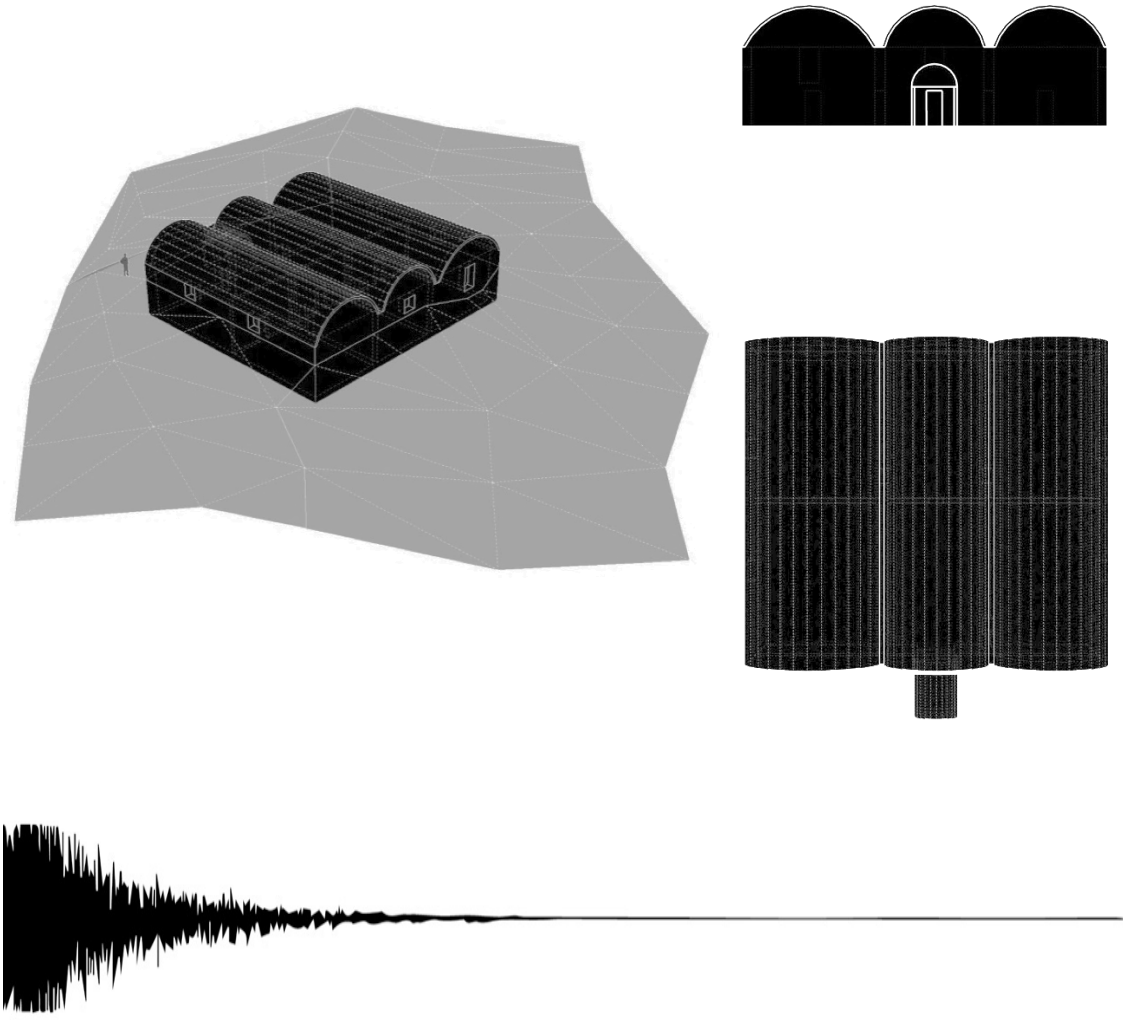
nature – a landscape of the future marked by the decay of matter. This notion finds its roots in Guy Debord's concept of the *banal city*, where representations of a spectacular life degrade into mere remnants of the spectacle. As Debord aptly puts it, "The spectacle is a concrete inversion of life, an autonomous movement of the nonliving" (Debord 1967: 11).

Figure 27. Left: Exterior of Lyness Oil Tank (M. Klenner 2019). Right-Top: Interior of Lyness Oil Tank (S. Balbontín 2019). Right-Bottom: Balbontín and Klenner doing acoustic experiments inside Lyness Oil Tank.

From this point onward, our expedition transforms into an ongoing archaeological discovery of voices of a frozen time. It becomes an aesthetic practice aimed at capturing the sound material hidden in the stagnant air of architectural cemeteries. This invisible information resides not only on the periphery of cities but also on the periphery of society.

Tugnet Ice House, Spey Bay, Scotland.

Coordinates: 57°40'24.89"N 3° 5'36.74"W
Status: Reconditioned for Cultural Purposes



T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
8	27,729	13	237	9

Figure 28. Left: 3D view (M. Klenner 2019). Top-Right: Front view. Bottom-Right: Roof plan (S. Balbontín 2024). Bottom: Wave form IR T60 - 2'' (S. Balbontín 2019). QR code: Audio of IR.

Toward the North Sea coast of Scotland, we encounter the Tugnet Ice House, an ancient structure originally designed as an industrial facility for storing ice. Constructed in the 19th century, it stands as one of the most significant ice houses preserved in the United Kingdom. Originally, the ice house served as part of the Tugnet salmon fishing station, playing a vital role in preserving the catch.

Figure 29. Aerial View of the Tugnet Ice House. Recovered from Google Earth.

The Tugnet Ice House is located near the mouth of the River Spey in Spey Bay, Scotland. It originally served for packing salmon from the Spey fishery before shipment to market. Today, the building has been repurposed as part of the Scottish Dolphin Centre, which is dedicated to dolphin watching and marine conservation efforts.

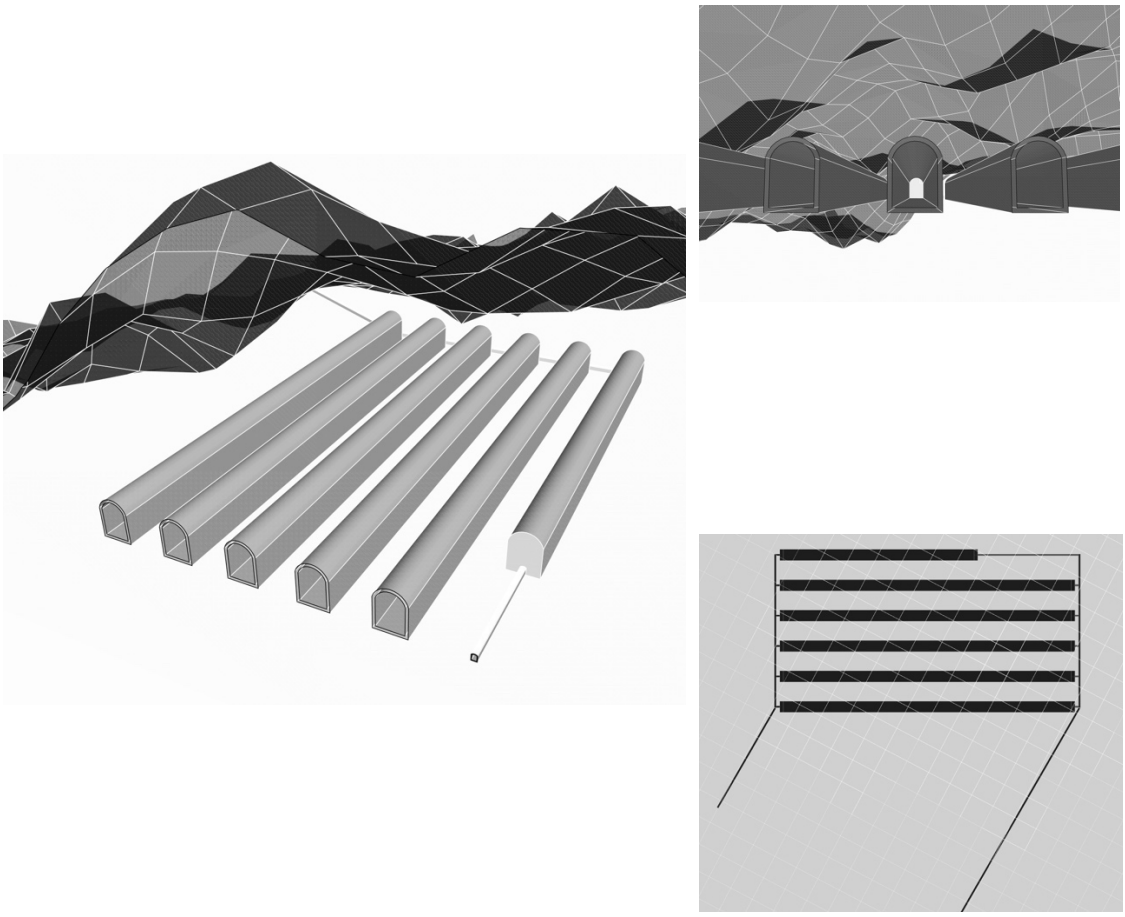
Figure 30. Left and Right-Top: Exterior of Tugnet Ice House. Right-Bottom: Interior of Tugnet Ice House (M. Klenner 2019).

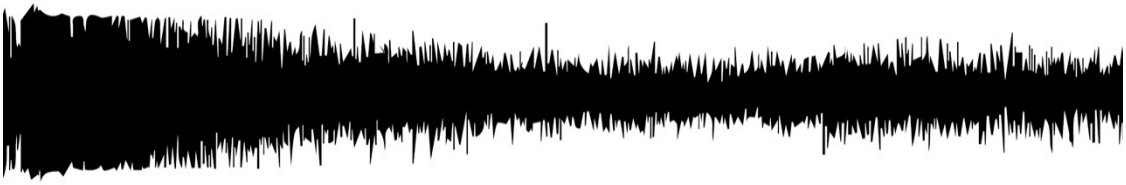
The space is semi-buried to conserve cold, with vaulted ceilings maximizing storage possibilities. Originally constructed of stone, some parts have been restored with bricks. There are three chambers, each 5 meters wide and 7.5 meters long, with a vault height of 6 meters at the highest point. The acoustic reaction is notable due to its shape; however, the porosity of the brick and stone absorbs sound, resulting in a reverberating yet muffled voice, akin to a silenced and softened echo with a shift towards lower frequencies.

The space, serving as an ice storage cellar dating back to 1830, stands as a relic of pre-modern machinery, offering an old-school method for food preservation without electricity. The architectural features that shaped its aural architecture were designed to preserve the Scottish winter inside a space.

Inchindown Oil Tank, Invergordon, Scotland.

Coordinates: 57°44'25.21"N 4°12'16.96"W
Status: Abandoned





T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
80	27.729	13	237	9

Figure 31. Left: 3D view. Top-Right: Front view (M. Klenner 2024). Bottom-Right: Roof plan (S. Balbontín 2024). Bottom: Wave form IR T60 - 2'' (S. Balbontín 2019). QR: Audio of IR.

Inchindown is a complex of six oil tanks nestled beneath a hill in Invergordon, Scotland, overlooking Loch Ness, where machinery tirelessly extracts oil. Equipped with protective clothing, helmets, and flashlights, we ventured into the oil tanks tunnels, knowing they would be smeared with oil. Passing through a narrow, mine-like tunnel stretching 1.5km, we finally reached the tanks' pipes. Each tank boasted four pipes, each less than 45 cm in diameter. To enter, we rode a wagon through one of these pipes. Emerging on the other side, we encountered absolute darkness, enveloped in a wet, viscous layer of oil. Despite the absolute silence, myriad voices seemed to echo every subtlest sound was emitted.

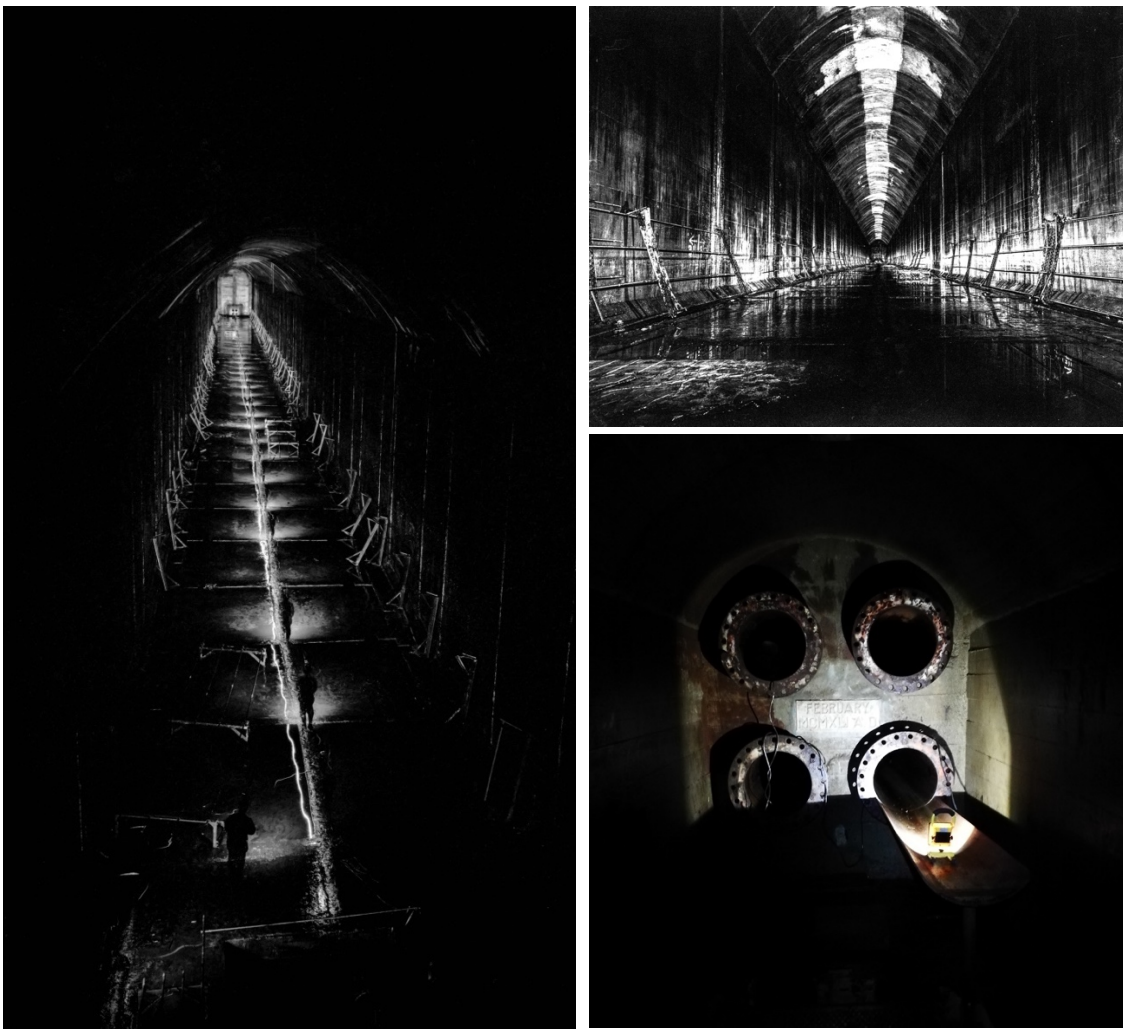


Figure 32. Left and Right-Top: Interior of Inchindown Oil Tank (S. Riddell 2019). Right-Bottom: Pipes to enter the tanks (S. Balbontín 2019).

Each of these architectures of sublime dimensions is not a sacred cenotaph but a large construction for war or industrial purposes, symbols of global extractivism. The voices of space emerge as a result of this expedition, akin to "archaeological" objects collected audibly. The echoes of space reveal information inherent to the spatial and residual condition of infrastructures, acting as portals to other dimensions and temporalities, blurring the boundaries between past and future in an ambiguous present. This border between the habitable and the uninhabitable is an artistic niche that transforms the apparent residual reality into a realm of possibilities. Aural architecture finds in this border one of those possibilities to exist and reformulate the aesthetic character of space through personal and poetic experiences with sound. As Duchamp (1957) expressed, "The creative act takes another aspect when the spectator experiences the phenomenon of transmutation; through the change from inner matter into a work of art, an actual transubstantiation has taken place..." (139-140).

Figure 33. Aerial View of the Inchindown Oil Tanks. Recovered from Google Earth.

Expedition #2

Valparaíso

2019

I conducted the second expedition of Espacios Resonantes as part of a residency at the Experimental Sound Arts Base TSONAMI, exclusively utilizing the Impulse Response Method, which involved employing a balloon burst. TSONAMI is located in Valparaíso, Chile, a coastal city characterized by its hilly geography and constant interplay of peaks and ravines. This creates an urban landscape that gives a sense of chaos, encompassing numerous anomalous spaces that you can encounter during daily walks through the city. These spaces include forgotten areas, hidden alleys, and ruins from past (and future).

Figure 34. Previous page. City of Valparaíso (D. Vives 2024). **Figure 35.** Below the dock Muelle Baron (S. Balbontín 2019).

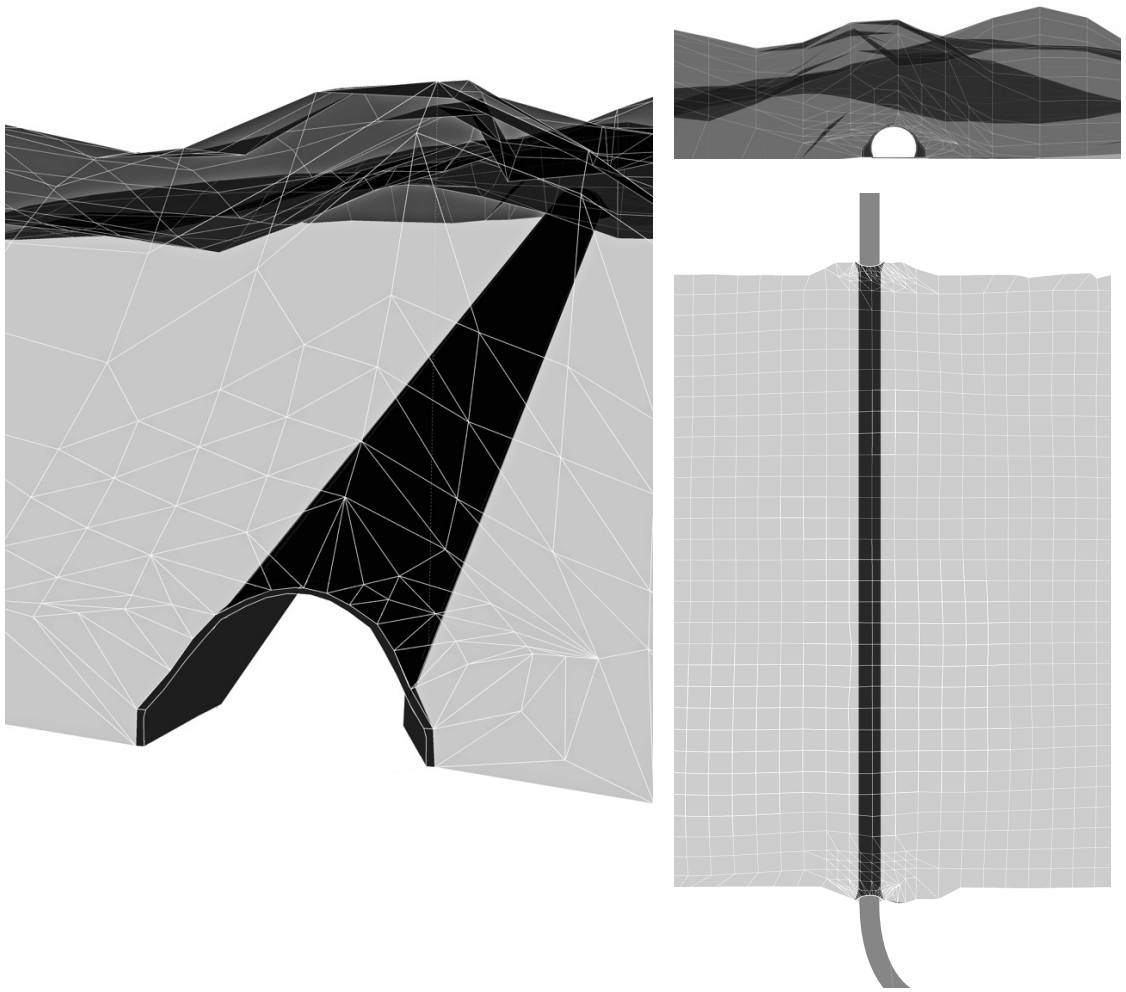
The chaotic city of Valparaíso mirrors its heterogeneous social composition, with strong identity patterns shaped by its unique geography. Known for its vibrant and spontaneous artistic culture, it embodies a sense of freedom in constant struggle to maintain its identity. My daily routine entailed a continual meandering through the labyrinthine streets and hills of Valparaíso. Initially, my destinations were precise points, but they gradually evolved into interconnected routes and eventually expansive zones calculating a starting point and an end point. I viewed the space within that distance as a complex and unpredictable labyrinth, where I had the freedom to wander aimlessly. Sound became my guide, with impulse response as a tool to animate the space. My body acted as a conduit for sensory information, fostering a symbiotic relationship that highlighted the sonic expression of the space.

The act of wandering was accompanied by the act of listening, forming an inseparable bond of "listening walk" that served as a method to explore aural architectures. Aural architecture is closely tied to creating a dialogue with space through sound, simultaneously inducing a psychosocial effect when humans inhabit the context, altering the conventional use of urban space. The IR method serves not only as an information-gathering tool but also as a manifesto seeking to uncover new urban behaviors and alternative forms of city living. The brief explosion of a balloon momentarily alters the sensory condition of the space, disrupting the urban environment and temporarily transforming it.

Within this expedition, 11 spaces were studied, but only 5 of them were considered for the *Espacios Resonantes'* Archive. The reason for this is that several of the spaces explored during this expedition were random spaces form the city, such as alleys, ravines, streets, stairways, underpass bridges, and other places that are part of the essence of Valparaíso but fall outside the scope of the *Espacios Resonantes* project. In this section, I will only present those 5 selected spaces which qualify as resonant space; an industrial space with exacerbated and/or unique acoustics.

Las Ánimas Tunnel, Camino La Pólvora, Valparaíso, Chile.

Coordinates: 33° 2'20.56"S 71°39'11.01"W
Status: In use



T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
6.5	13,500	6	300	7.5

Figure 36. Left: 3D view. Top-Right: Front view. Right-Bottom: Ground level. Bottom: Wave form IR T60 - 2'' (S. Balbontín 2024). QR code: Audio of IR.

Streets and highways can be understood in two ways: as connectors of distant places or as spaces themselves. Highways, in particular, are known for their role as transit spaces, fostering a constant flow of movement and fleeting connections, with automobiles serving as extensions of human mobility and speed. However, if we perceive vehicles as non-humans—entities separate from humans inhabiting spaces—then highways become their habitat, where machines coexist in a realm of speed and constant motion.

Figure 37. Left-Top: Interior of Las Ánimas Tunnel (P. Saavedra 2019). Right-Top: View from Las Ánimas Tunnel (P. Saavedra 2019). Bottom: Exterior of Las Ánimas Tunnel (S. Balbontín 2019).

Las Ánimas Tunnel is part of a highway that runs through the depths of the hill, piercing an extended and linear cavern-like transverse hole. The tunnel is 800m long, divided into two sections: one of 315m and the other of 433m. Measurements are taken from the first section. The tunnel serves not only as a passageway connecting one side of the hill to the other, but also as a longitudinal architectural structure designed to accommodate a fast-moving ecosystem of transit elements; a transhumance of artificial cattle. This linear cavern maintains a narrative structure that communicates a story in its own language, reflecting its function, architectural form, and subway-like character designed for speed.

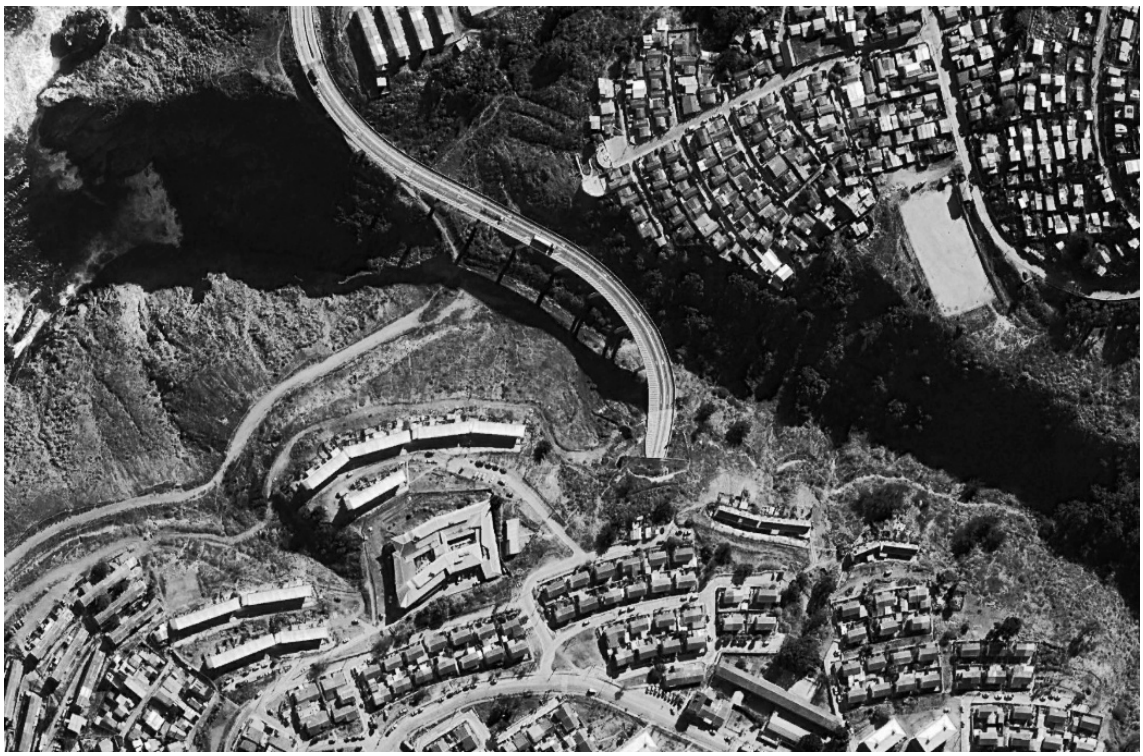


Figure 38. Aerial View of Las Ánimas Tunnel. Recovered from Google Earth.

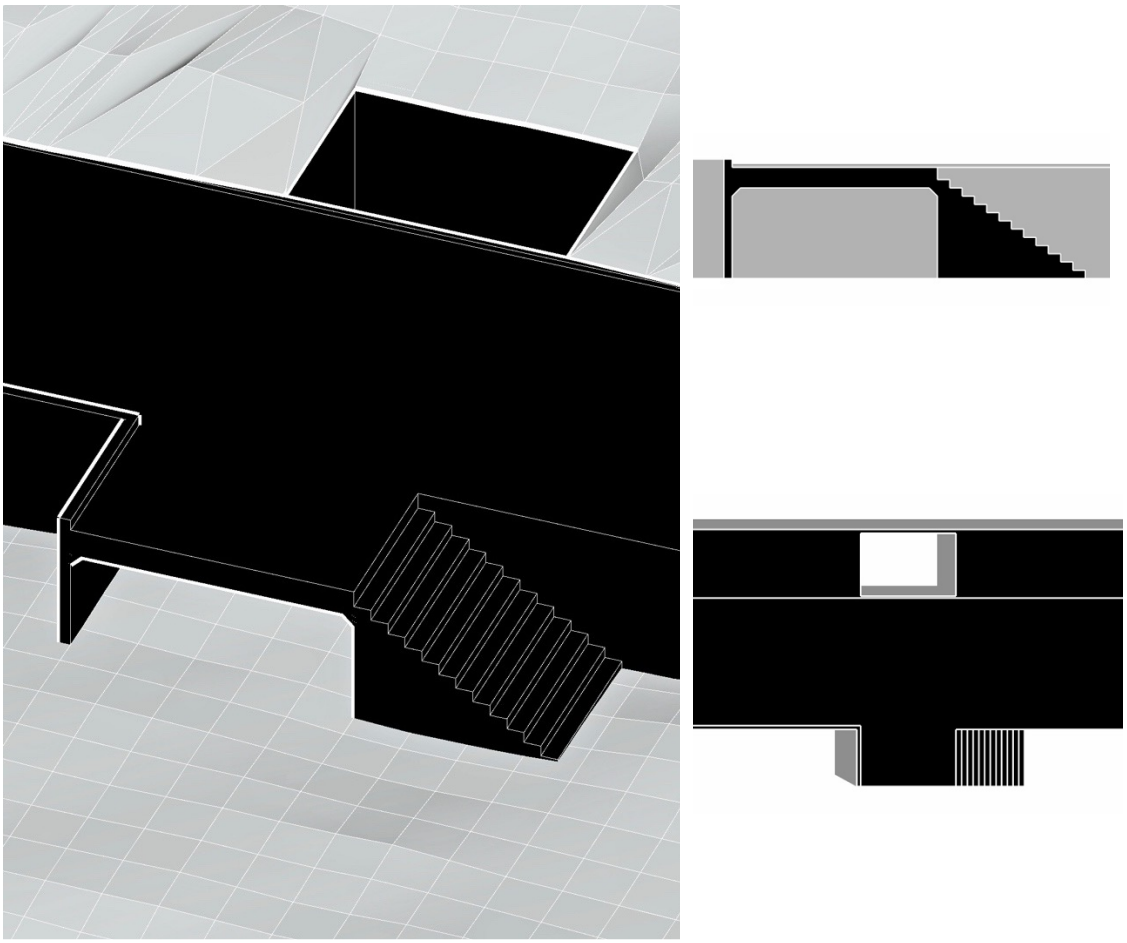
Las Ánimas Tunnel's aural architecture is unveiled through the transformation of urban infrastructures designed for humans into territorial infrastructures for non-humans—in this case, automobiles—where the concept of *circulation* as a utilitarian action intersects with that of aesthetic action or artistic methodology of sound exploration. This methodology, derived from the *deriva* theory practiced by Situationists and previously by Surrealists and Dadaists, juxtaposes the rationality of the explored place (the tunnel as a highway) with the irrationality

of the exploratory exercise (the tunnel as a sound *deriva*), fostering a certain connection between the conscious space of the city and the unconscious realm of potential alternative practices (Careri 2002). It entails a journey through sound spaces originating in the heart of the city and naturally extending into the urban peripheries, as well as into the peripheries of the human and the habitable.

The tunnel's aural architecture resonates with a voice that fills its linear space, resembling an invisible tube of sound that persists. This sound wave wanders along the cavern, traversing its curved walls like a helix, cutting through longitudinal space with remarkable speed.

Caleta Portales Sewer, Valparaíso, Chile.

Coordinates: 33°2'7.87"S 71°35'56.85"W
Status: In use



T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
2.5	110	2.20	10	5

Figure 39. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level. Wave form IR T60 - 2" (S. Balbontín 2024). QR code: Audio of IR.

The recognition of space through its voices juxtaposes the physicality of space with its sonic representation. Space is shaped by the sounds emitted by its architectures, environments, and ecosystems. This process creates a map that traces a trajectory from the human scale of the city to the non-human scale of the automobile, ultimately expanding to a new scale: the scale of water.

Figure 40. Interior of Caleta Portales Sewer (S. Balbontín 2019).

Walking beneath the Wheelwright promenade, which connects Caleta Portales and Muelle Barón via small beaches, I encounter a concrete sewer that frames the landscape from within, reminiscent of a movie theater. The proposed performative action is a form of celebration of the landscape, serving as an acoustic initiation ritual aimed at evoking the voices emitted by the water through the sewer.

Here, various layers converge, resulting in a unique combination that characterizes the place. Within the sewer, there are several elements: sea, beach, natural water drainage from the hill, and a specific architectural design to channel water flow. The distinct boxed shape sewer, culminate in the creation of a perfectly geometric form with smooth surfaces and

expansive reflections. This configuration gives rise to the sewer's voice, emerging from the interplay between natural, urban, architectural, and sonic elements.

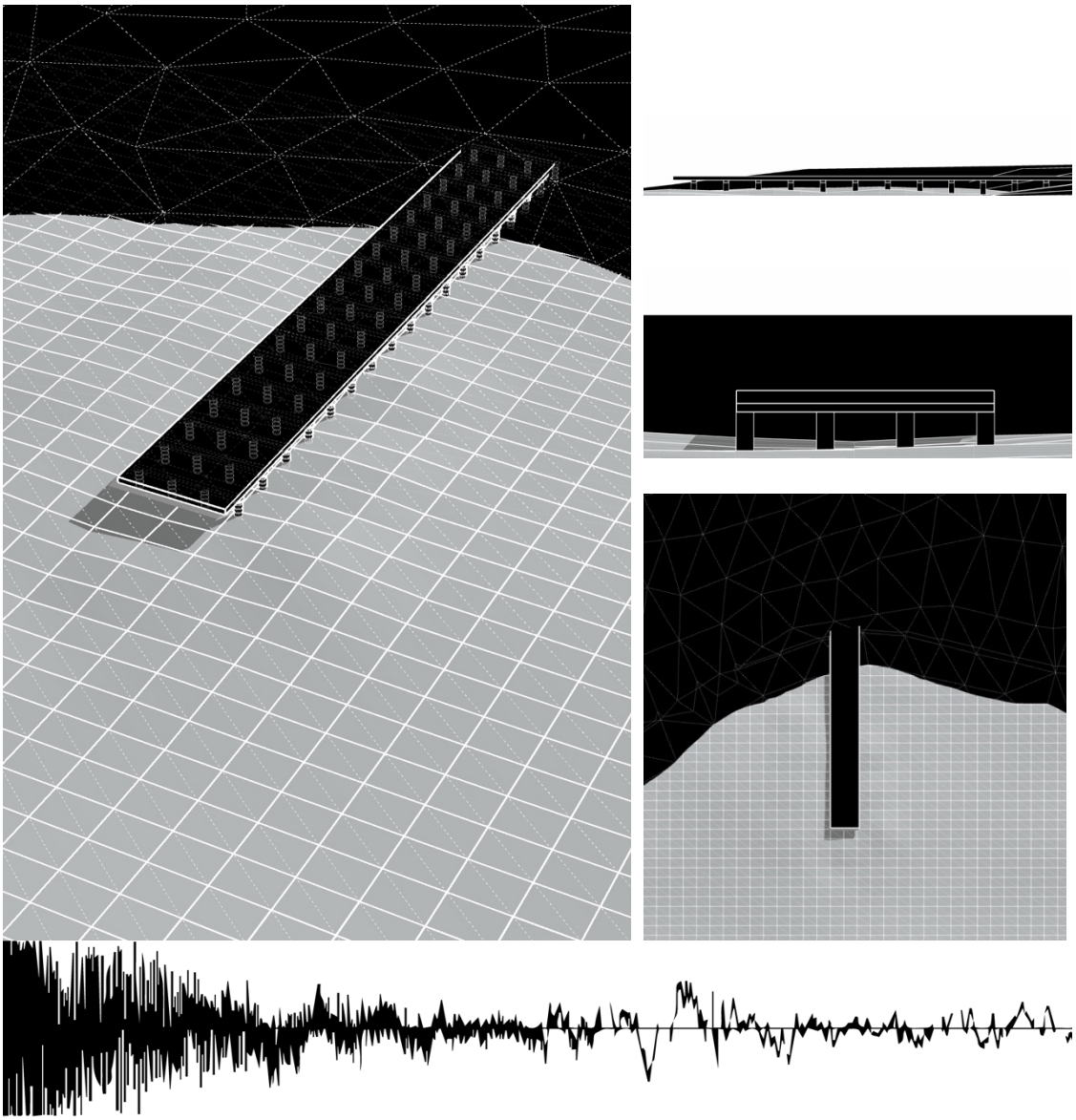
Figure 41. Aerial View of Desagüe Caleta Portales. Recovered from Google Earth.

The sewer's aural architecture resembles a contained and channeled song. It bursts with force, only to be swiftly extinguished, much like a cry silenced by the geometry of the space. The sound contained and silenced, the water contained and channeled, here nature is contained and disciplined to human will. The voices of the drain reveal the extent of an anthropic intervention.

Sound serves as a measuring device to capture space. Space-time undergoes a transformation, translating sound-spatial information into an aesthetic experience. The body, as a perceptive element, becomes a creative entity, designing its own acoustic reception. Therefore, the acoustics of the sewer is presented not only as an aesthetic experience but also as an immaterial art object.

Muelle Barón (main dock), Port of Valparaíso, Chile.

Coordinates: 33° 2'27.35"S 71°36'29.68"W
Status: In use



T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
1.5	27,735	4.30	215	30

Figure 42. Left: 3D view. Top-Right: Lateral view. Middle-Right: Front view. Bottom-Right: Ground level. Bottom: Wave form IR T60 - 2" (S. Balbontín 2024). QR code: Audio of IR.

Muelle Barón is the main dock of Valparaíso, located within the port. Beneath the dock, there is a space with a concrete roof and a seafloor, divided along its entire length by large pillars and open to the seascape of Valparaíso. To explore this area, I rented a kayak from the small water sports school on the dock. Unlike previous spaces, where the vocal dialogue mainly echoed between parallel and twin walls, here the conversation was a direct confrontation between the concrete ceiling and the water seafloor. Sound travels and reverberates between solid and watery mediums in a dance that expands and recedes, penetrating through the pillars and delineating the time-distance of this covered sea. The voice of the space acts as a measure of space-time, where temporality becomes flexible, providing a tangible chronology to the extent that one can sense the sound in transit.

Figure 43. Aerial View of Muelle Barón. Recovered from Google Earth.

Under the dock, my relationship with space undergoes a transformation. The movement feels like a dance, where the sea becomes an extension of my body, and we both must coordinate to maintain direction. There is a certain insight that this place offers regarding its inhabitability, suggesting a notion of non-existence or invisibility to society; beyond social

limits. The view of pillars adorned with crustaceans holds a unique aesthetic charm and offers a contrasting perspective to the scene above the dock as an urban public space. This contrast symbolizes a significant distance, greater than the physical separation between the upper and lower faces of the dock, illustrating the proximity of residual spaces to society.

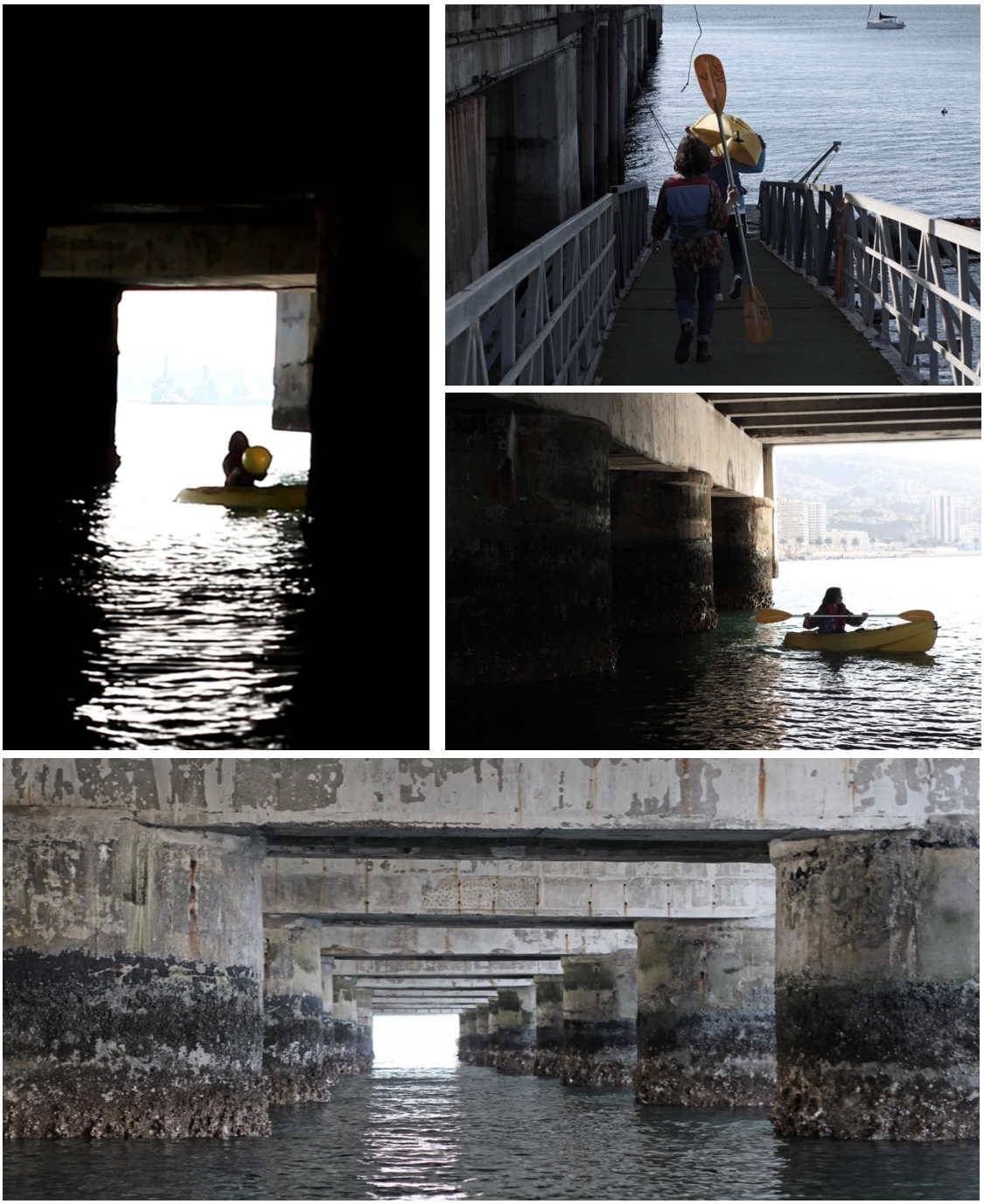
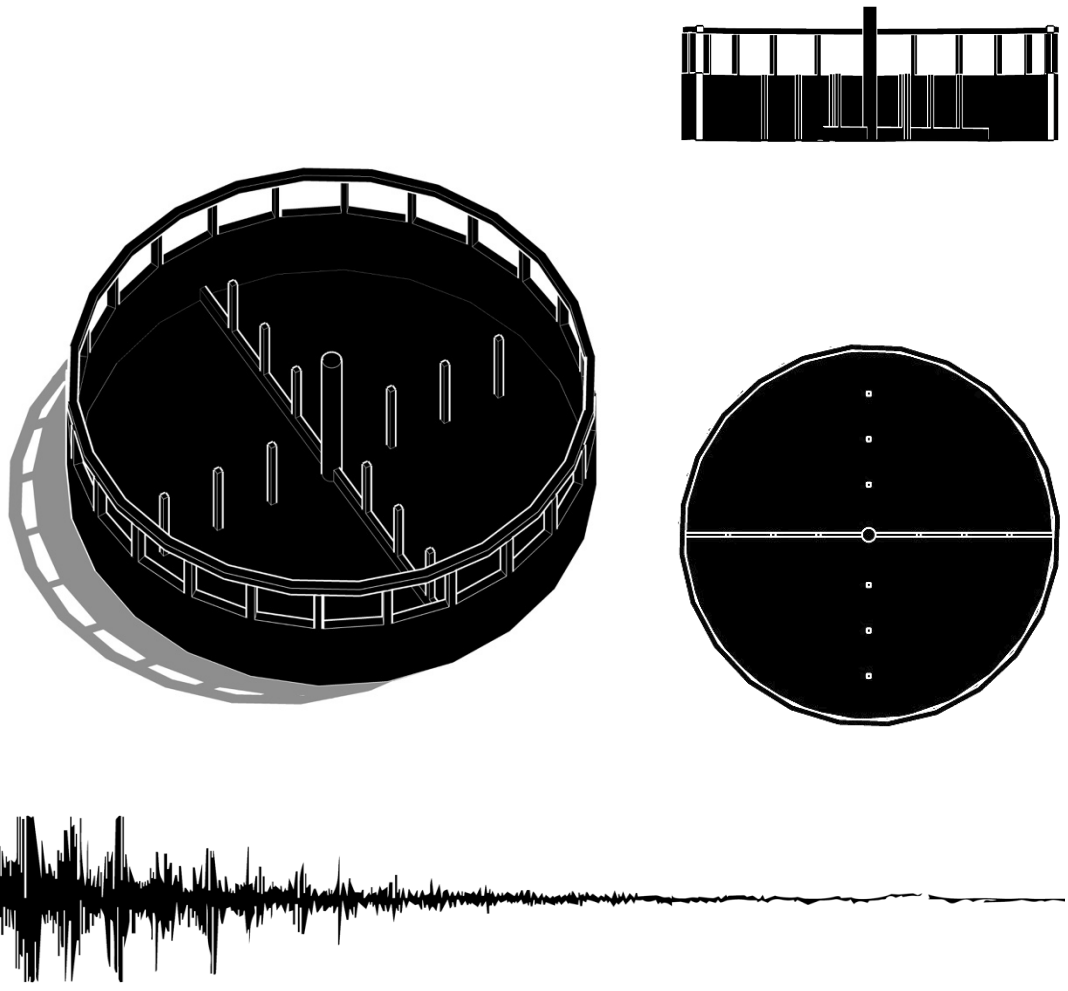


Figure 44. Left, Middle and Bottom: Interior of Muelle Barón (P. Saavedra 2019). Right-Top: Taking the kayak under the dock (P. Saavedra 2019).

Firefighter Water Reservoir, Valparaíso, Chile.

Coordinates: 33° 2'43.60"S 71°37'37.80"W
Status: Abandoned



T60 (S)	VOL (M3)	H (M)	R (M)	D (M)
3	2,863	5	13,5	27

Figure 45. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level. Wave form IR T60 - 2" (S. Balbontín 2024). QR code: Audio of IR.

The reservoir, situated at the foot of the old prison of Valparaíso, was a basin ten meters deep under the ground level, built to reserve water for extinguishing potential fires in the city. Geometrically, the reservoir forms a perfect cylinder of 27m diameter which produced a slowly fading tremolo. The architecture serves as a box of resonance where neither the architecture nor the sound takes precedence; rather, the aesthetic experience of their dialogue surpasses the significance itself.

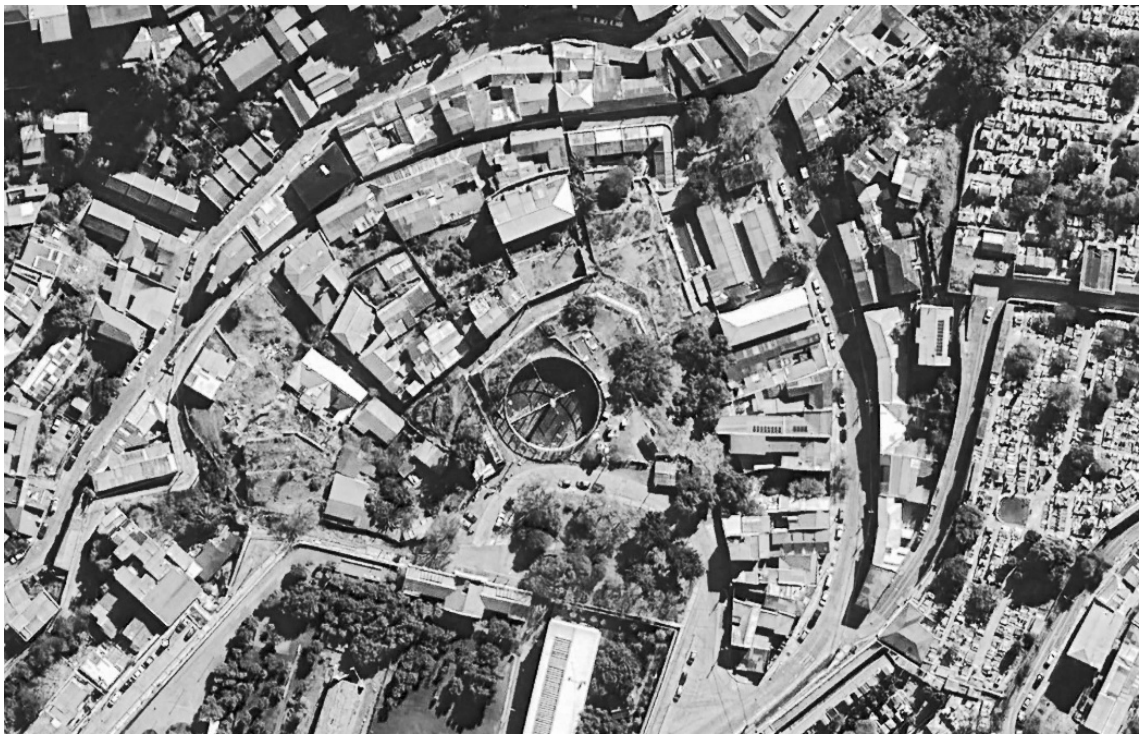


Figure 46. Aerial View of Muelle Barón. Recovered from Google Earth.

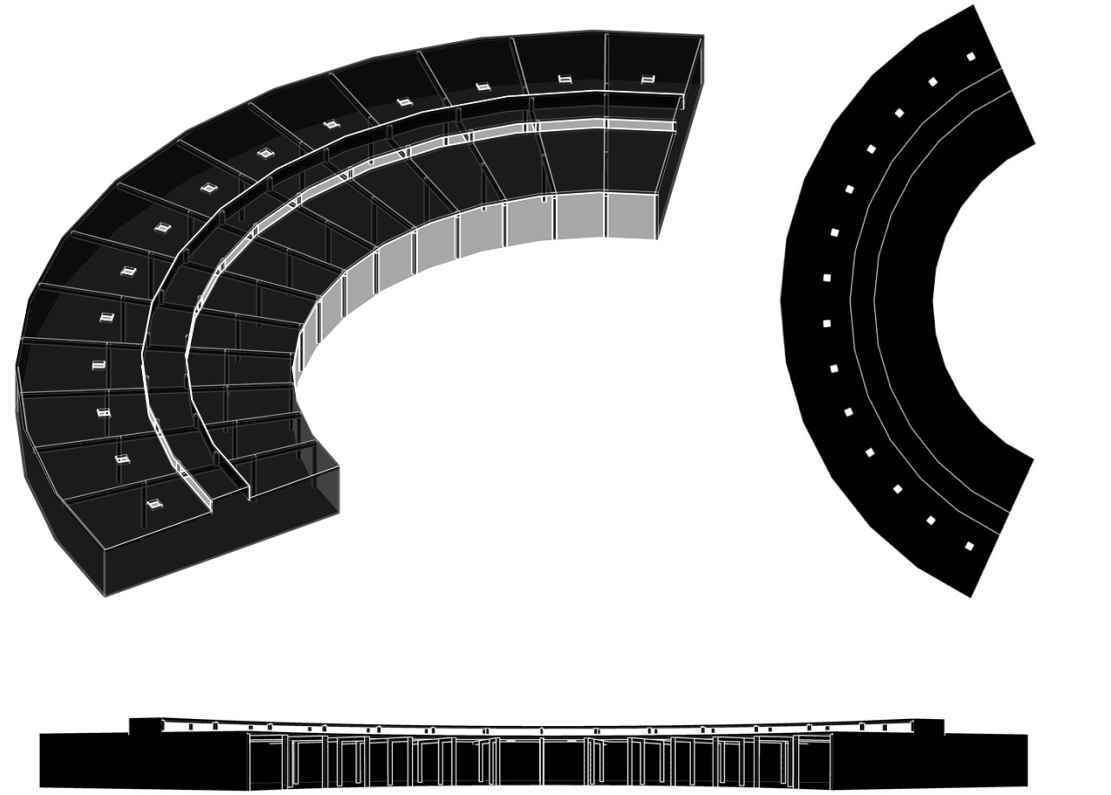
It requires performative action for the aural architecture to manifest, creating an intricate relationship between architecture, sound, and performance. Within its disciplinary sphere, architecture gives shape to space, however, this is disfigured through the sound reflections that are filtered by its geometry. The behavior of sound within geometric spaces adheres to a physical logic known as acoustics, which is measurable and dimensional. While the principles of acoustics can be applied to any space, urban or geographical, they often remain confined to a quantitative field focused on measurements and data. The study of aural architecture, while using the tools of acoustics, approaches them from a sensory perspective, translating

technical knowledge into artistic interpretation. Sound art has used the physical manifestations of acoustics for building spaces, drawing inspiration from sound phenomena across various scales—architectural, urban, and territorial—integrating them within artistic practice.

Figure 47. Left, Middle and Bottom: Interior of Water Reservoir (P. Saavedra 2019). Right-Top: Aerial View.

Wheelhouse, Valparaíso, Chile.

Coordinates: 33° 2'15.13"S 71°36'8.21"W
Status: Abandoned



T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
2	11,145	5	95	25

Figure 48. Left: 3D view. Top-Right: Ground level. Middle: Front view. Wave form IR T60 - 2" (S. Balbontín 2024). QR code: Audio of IR.

Valparaíso's Wheelhouse is located on Paseo Wheelwright between Muelle Barón Dock and Caleta Portales. The train and railroad connecting Valparaíso with Santiago were built in the 19th century due to the commercial boom in Valparaíso at the time. The Barón Station, located next to the port, was complemented by the Maestranza of the State Train Company, which built and repaired the railroad for its proper operation.

After the Chilean dictatorship, the railroads were replaced by trucks and buses, leaving Chile's railroad infrastructure in a state of abandonment. In 1990, the Barón Station and the Maestranza were permanently closed. Currently, the site is abandoned, with the old wheelhouse and the sheds of the Maestranza preserved. Both were declared Historic Monuments in 1986 for their heritage value and their close relationship with the history of the city.

Figure 49. Aerial View of Muelle Barón. Recovered from Google Earth.

The currently abandoned space has been partially renovated by a climbing center that has used one of the sheds, improving the site's landscape and facilitating the habilitation of various parts of the Maestranza, including the wheelhouse. Multiple informal cultural activities,

such as theater, concerts, and artistic interventions, take place inside, although the space is not officially designated as a cultural venue.

The wheelhouse building is empty and open, in good condition. The sound of the space is characterized by its curved wall, which retains sound inside. However, the reverberation time is short due to the completely open side facing the railroad. A fluttering effect is perceived with a significant delay because of the large dimensions, which also generate an echo. Therefore, the voice of the space is a combination of two simultaneous effects: late fluttering and echo.

Figure 50. Interiors of Water Reservoir (Left: S. Balbontín 2019) (Right: Unknown author).

Expedition #3

Santiago

2019-2022

The preamble to this expedition began in 2019, following the last expeditions in Europe and Valparaíso. Upon returning to my residence city at the time, Santiago de Chile, and having explored foreign territories, I felt compelled to focus the research on my hometown inspiring the idea of exploring its acoustic heritage. All around Santiago, there are water towers known as *Copas de Agua* to the citizens. These towers are recognized as modern industrial heritage and as an integral part of the urban landscape of the city, serving as important landmarks that define its cultural identity.

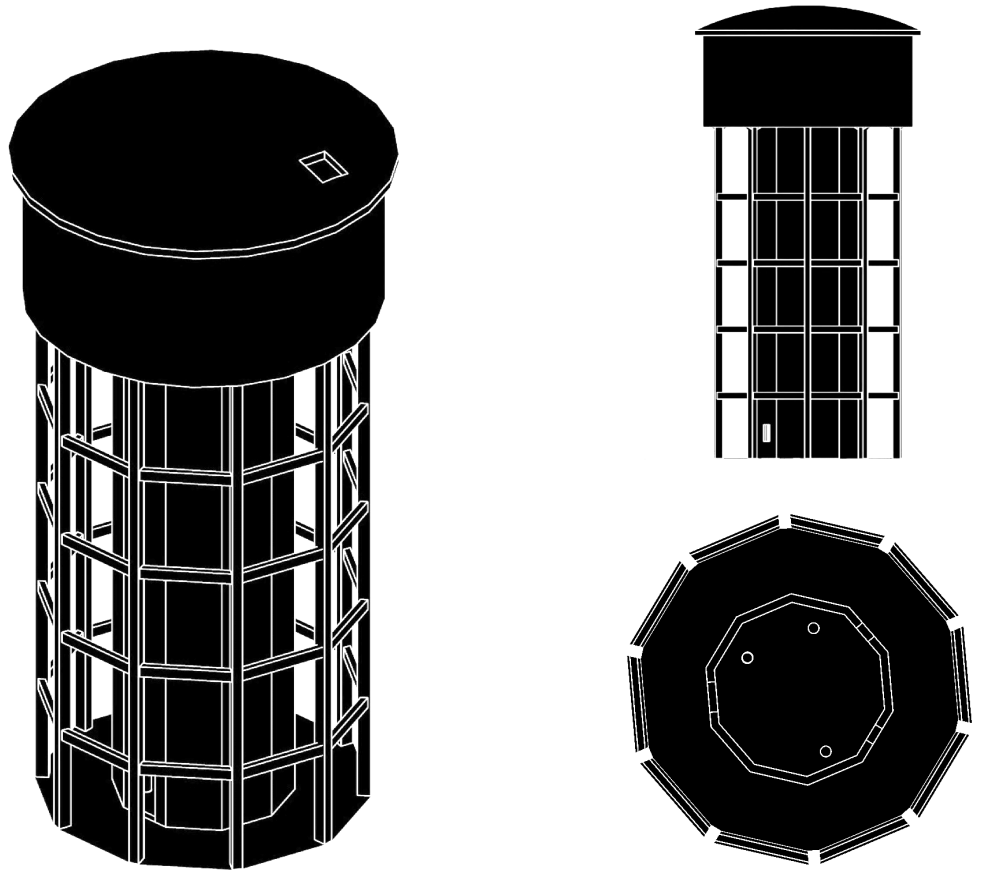
I embarked on a search for these infrastructures throughout the Metropolitan Region of Chile, discovering a total of 56 water towers, each with its own unique typology. Most of them belong to the water company Aguas Andinas, and part of the research process involved meetings with them to secure permission for our study. However, I did not receive a favorable response.

Figure 51. Previous page. View of the Northern área of Santiago de Chile (S. Balbontín 2022). **Figure 52.** Water Tower Quinta Bella (F. Mardones 2022).

The valuable outcome of these meetings was a document indicating the status of each water tower: whether in use, abandoned, or transferred to other owners. Over the course of two years, I visited all the abandoned water towers and those owned by others. I discovered various new uses for them; most of them had become places of informal occupation, supports for advertising, or warehouses. Eventually, I found a water tower and a water reservoir in Quinta Bella, which had been transferred to the Municipality of Recoleta. This institution supported our project and granted permission not only for investigation but also for hosting the first Architecture and Listening Festival: *Espacios Resonantes*. With funding from the Ministerio de las Culturas, las Artes y el Patrimonio of Chile, I joined Mathias, and together we conducted a rigorous study at the site, thoroughly examining its acoustic and spatial characteristics.

Water Tower Quinta Bella, Recoleta, Santiago de Chile.

Coordinates: 33°24'12.98"S 70°38'29.16"W
Status: Abandoned



T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
10-13	348,520	20	4.87	4.63

Figure 53. Left: 3D view. Top-Right: Front view (M. Klenner 2024). Bottom-Right: Ground level. Wave form IR T60 - 2'' (S. Balbontín 2024). QR: Audio of IR. Data taken from the base of the tower.

The Water Tower at Quinta Bella, approximately 100 years old, is situated north of Santiago, adjacent to the Cultural Center of Recoleta. Originally constructed for water distribution in the commune, it is now in disuse. The property is currently the second stage of the social housing project of the *Inmobiliaria Popular* of the communist Local Government of Recoleta, which is in its design process. The water tower includes a base with a vertical void that supports an elevated reservoir on top. Both spaces have acoustic qualities of interest for the research.

Figure 54. Aerial View of Quinta Bella Water Tower. Recovered from Google Earth.

The water tower is a concrete structure with a decagonal base 1.5 meters edge, measuring 5 meters wide, surrounded by 10 pillars that rise together to a height of 20 meters, supporting the elevated reservoir. The elevated reservoir, with a circular base and dimensions of 5 meters in height and 10 meters in diameter, is crowned with a flattened dome. At the tower's base, the sound reverberates with metallic echoes. Climbing a 25-meter-high staircase, we reach the tower's top with a panoramic view of the whole northern part of the city of Santiago (fig.

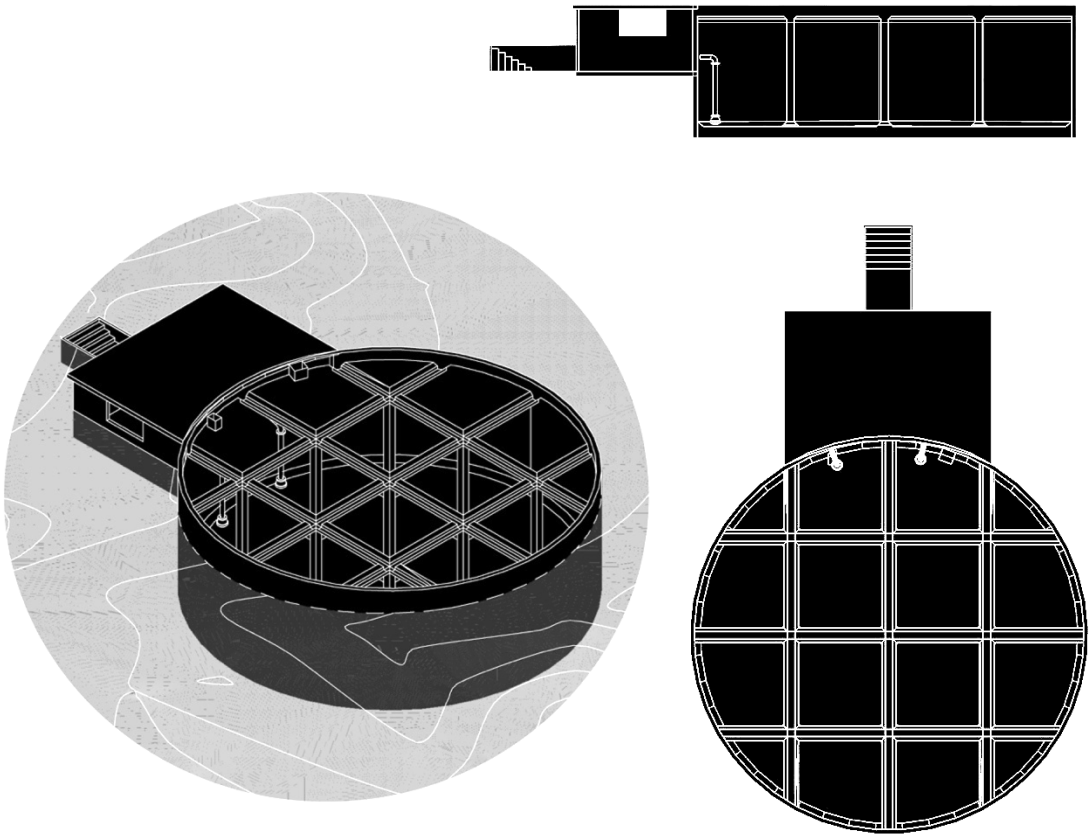
55). Descending through a hatch to the interior of the elevated reservoir, the curved surfaces amplified sound, resulting in a subtle fluttering sensation in the ears. At the elevated center, atop a hemisphere, the sound becomes so concentrated that it seems to be emanated from within.

Figure 55. Left: Exterior of Water Tower. Right-Top: Ground lever of Water Tower. Right-Bottom: Interior of Water Tower. (F. Mardones 2022)

The Quinta Bella water tower has a transparent structure that surrounds its perimeter, offering both a plastic and aesthetic value as a monument visible throughout much of the commune. Its presence serves not only as an orientation point, but also contributes to the neighborhood's identity. These *Copas de Agua* serve as tangible reminders of Chile's industrial history, connecting them to a pivotal period of the country's modernization. As many of these water towers fall into obsolescence, they symbolize the gradual decomposition of infrastructures becoming abandoned monuments. Therefore, recognizing the value of these industrial infrastructures as modern architectural heritage is a crucial aspect of our objectives.

Water Reservoir Quinta Bella, Recoleta, Santiago de Chile.

Coordinates: 33°24'13.19"S 70°38'30.17"W
Status: Abandoned



T60	VOL (M3)	H (M)	R (M)	D (M)
22-35	1,121.6	5	8.45	16.9

Figure 56. Left: 3D view. Top-Right: Front view (M. Klenner 2024). Bottom-Right: Ground level. Wave form IR T60 - 2" (S. Balbontín 2024). QR code: Audio of IR.

The water reservoir is located in Quinta Bella, Recoleta, at the same site as the water tower. They function together as an industrial system, with the reservoir storing water that is then pumped through pipes to the elevated reservoir of the water tower. From there, the water is distributed to the rest of the neighborhood.

Figure 57. Aerial View of Quinta Bella water infrastructures. Recovered from Google Earth.

The reservoir is a concrete cylinder, completely enclosed, with only two small openings. It has a surface area of 220m2, a diameter of 16.8m, and a height of 5m. Inside, there is a structure of 9 pillars supporting the concrete slab, arranged in a 3 x 3 row pattern with a distance of 3.9m between pillars. Currently, it is an empty space that housed water for decades. The walls bear a layer of black dry mold, indicating the previous water level inside the reservoir. Two pipes, covered with orange rust, connect the engine room, located next to the reservoir, to pump water from the underground reservoir to the elevated one. This rust serves as a tangible reminder of the passage of time, bearing witness to both periods of operation and abandonment, and revealing the years of these forgotten spaces hidden beneath the ground.

Figure 58. Left, Middle-Right and Bottom-Right: Interior of Water Reservoir (F. Mardones 2022). Right-Top: Interior of Water Reservoir (S. Balbontín 2022)

During our first visit to the water tower, we were still unaware of the existence of the underground reservoir. Upon arrival, we discovered that the base of the water tower was being used as a warehouse by the construction company building the *Justicia Social 1* housing project, adjacent to the tower. The architect in charge of the construction site, informed us that the work facilities had been built over the ceiling of a water reservoir, which no one had explored yet, but suggested we might be interested in it. Naturally, we were intrigued and requested permission to descend. They were unsure of the entrance's location and improvised a wooden ladder through one of the two exterior openings. Accompanied by a worker, we

descended into the unknown darkness, unable to anticipate its contents. Illuminated by flashlights, we discovered a majestic water reservoir with towering pillars. It was completely empty and pristine, except for a layer of earth covering the floor, cracked by the passage of time.

During the process of preparing the space for the festival, we cleared away layers of earth using shovels, brooms, and buckets. As we dug deeper, we encountered a solidified crust that reacted dramatically when water was poured onto it, hissing and gurgling as if thirstily drinking after years waiting for this moment. Inside the cylinder, sound reverberated for several seconds, with the bass resonating throughout the space like a powerful force piercing the body.

Panasonic

Expedition #4

Berlin

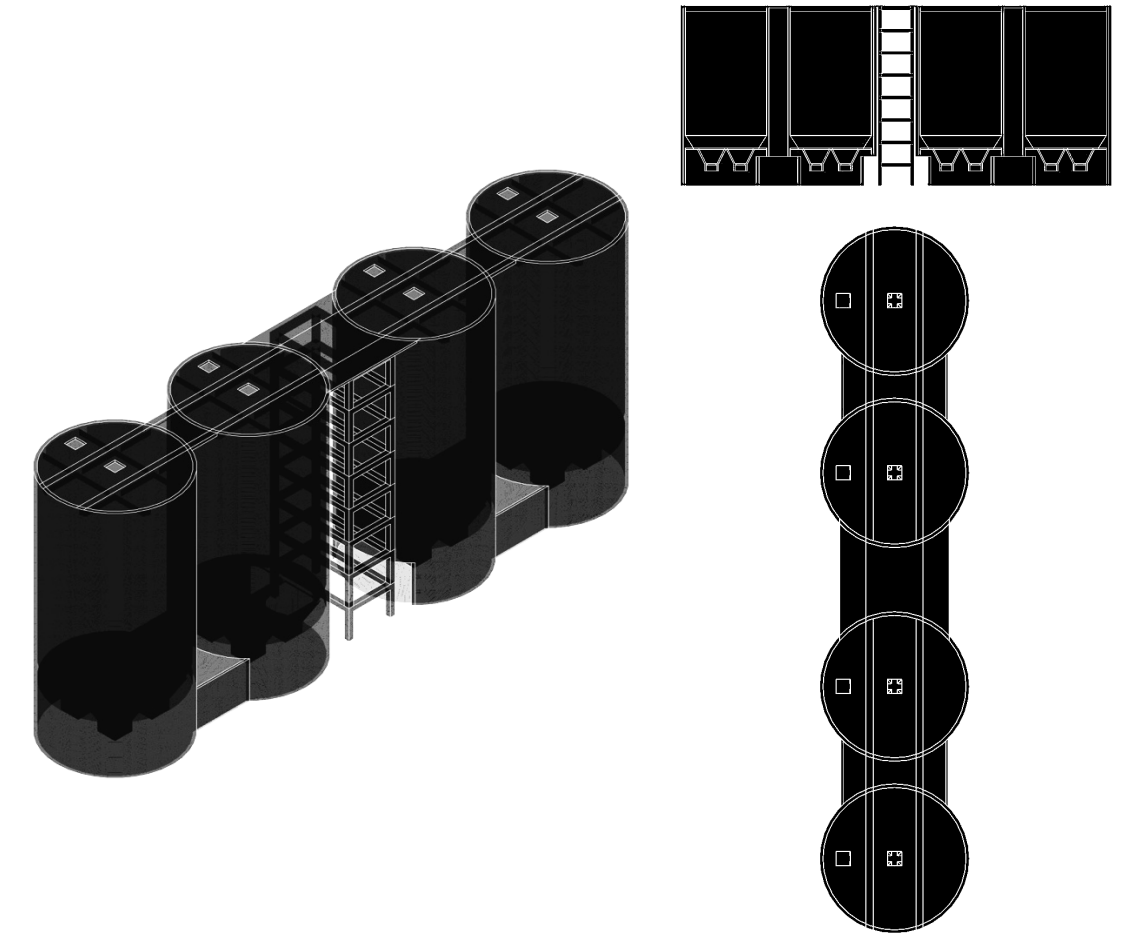
2021-2023

This expedition was developed over the course of two years and involved separate journeys. Firstly, I conducted an expedition alone in 2021 to the Rüdersdorf Lime Plant in Berlin, Germany. Then, in 2023, Mathias conducted an expedition as part of a mobility project with the Goethe Institute. He visited and studied Rüdersdorf, the Teufelsberg Spy Station, and the Gasometers of Mariendorf. Berlin and the eastern part of Europe have always been of great interest to the project due to their numerous industrial sites, many of which were once part of the Soviet Union. These spaces contain a political history, marked by the industrial production force, wars and power struggles, reflected in their spatial morphologies born from a need for economic power, control and domination, which directly shape the voices of these abandoned ruins.

Figure 59. Previous page. Berlin view from Teufelsberg (M. Klenner 2023). **Figure 60.** Rüdersdorf Lime Plant (S. Balbontín 2019).

Rüdersdorf Lime Plant Silos, Berlin, Germany.

Coordinates: 52°29'2.85"N 13°47'25.44"E
Status: Abandoned



T60 (S)	VOL (M3)	H (M)	R (M)	D (M)
8	2,205.4	19.5	6	12

Figure 61. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level (M. Klenner 2024). Wave form IR T60 - 2'' (S. Balbontín 2024). QR code: Audio of IR.

The abandoned Rüdersdorf lime plant is situated on the outskirts of Berlin, in the Municipality of Rüdersdorf. Its construction began in the 17th century for lime extraction and processing. Throughout its history, the lime was mined for various purposes. For instance, during the World War years, the plant shifted its focus to the production of synthetic bauxite for aluminum manufacturing. Following the Soviet Union's invasion of Berlin, the plant was dismantled, but it was later reinstated for fertilizer and chemical production. However, with the fall of the Berlin Wall, production and workforce were significantly reduced, leading to the plant's bankruptcy in 1999. Since its closure, the plant has been abandoned, serving as a scenario for movies, concerts, and Sunday walks.

Figure 62. Aerial View of Rüdersdorf Lime Plant. Recovered from Google Earth.

To reach the Rüdersdorf plant, I cycled from Berlin with all the equipment needed to document and collect acoustic data. Accessing the plant involves crossing a bridge over a river, reminiscent of entering a castle, passing over a drawbridge across a moat. Upon crossing the bridge, you are greeted by two tall chimneys resembling turrets. There's something about

this place that evokes an intermediate dimension between medieval and Soviet times. Despite the wide-open doors, the place was deserted. In the distance, electronic music could be heard, adding to the surreal sci-fi atmosphere of this post-industrial setting. Following the music led me to the end of the site, where I found the plant's ovens, and behind them, I stumbled upon a Berlin-style electronic party. I continued to explore the plant, finding dismantled buildings open for exploration. Climbing to the top provided a panoramic view of the entire site, revealing silos and chimneys dotting the factory landscape, surrounded by vegetation, rivers, and lagoons.

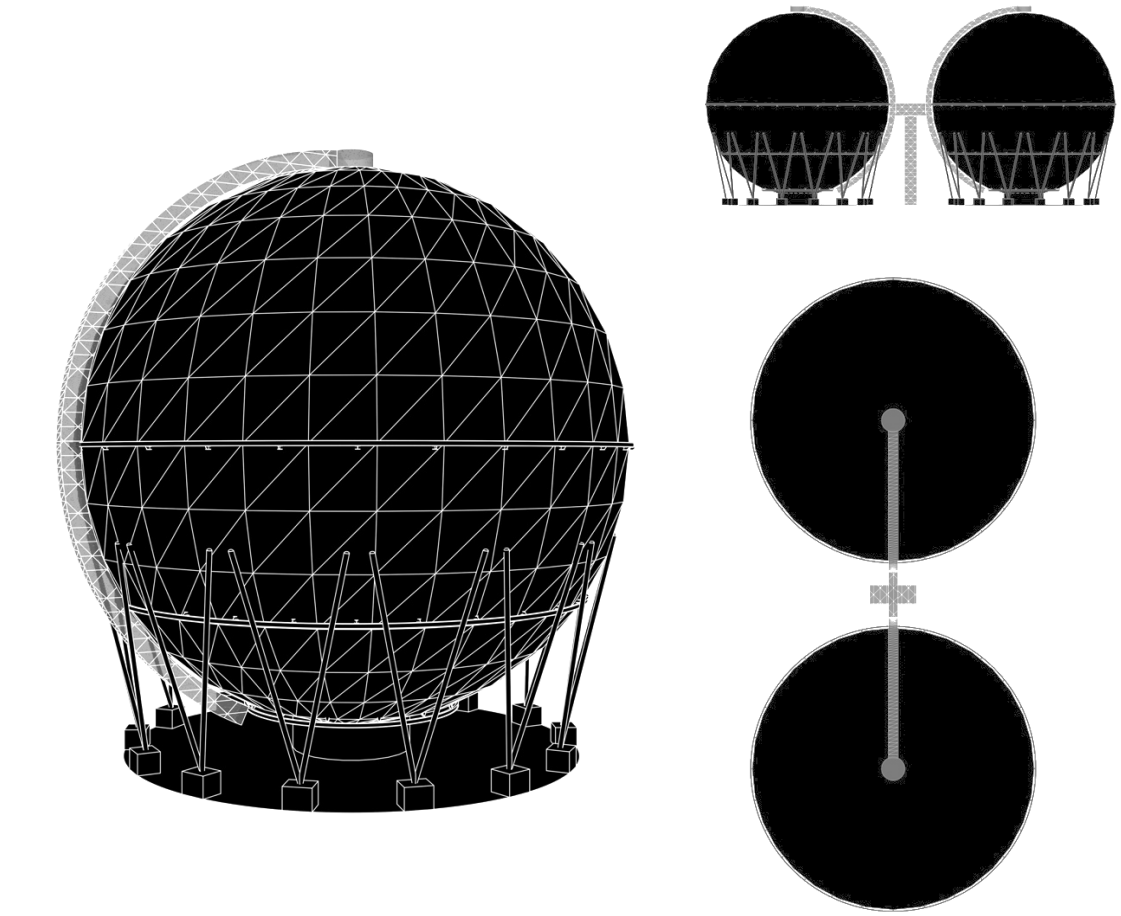
Figure 63. Left: Interior of silos inside Rüdersdorf Lime Plant. Right-Top: Exterior of silos. Right-Bottom: Room below the silos (S. Balbontin 2021).

To conduct the experiments, I opted for one of the silos with an open entrance, as all the others were blocked. Beneath the silo was a low-ceilinged room with several closed openings connecting to the silo (fig. 63: right-bottom); however, one of them was open. With the help

of a structure that acted as a ladder, I climbed up and entered the silo. The interior was covered in graffiti and littered with beer cans, indicating its use as a clandestine social space. Inside, the sound was enveloping. At the center was a sort of pyramid that appeared to provide the optimal listening point for experiencing the space. The distant electronic music reverberated within the silo, its sound filtered by the acoustics, resulting in a drone-like hum of low frequencies punctuated by percussion and beats.

Mariendorf Gasometers, Berlin, Germany

Coordinates: 52°26'14.4"N 13°22'17.4"E
Status: Abandoned



T60 (S)	VOL (M3)	H (M)	R (M)	D (M)
24-31	14,137.2	30	15	30

Figure 64. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level (M. Klenner 2024). Wave form IR T60 - 2'' (S. Balbontín 2024). QR code: Audio of IR. IR taken with a geofon from the exterior of the Gasometer.

The expedition to the Mariendorf Gasometers was conducted by Mathias Klenner. The gasometers are situated in the Mariendorf area in the southern part of Berlin. They are part of an abandoned industrial site, which once housed several factories and industrial buildings serving various purposes over different periods. Dating back to the early 20th century, the gasometers were built as a gas reserve for illuminating the southern part of Berlin before the widespread use of electricity. Today, the industrial site has been repurposed as a park and is currently up for sale. Some of its structures have been converted into commercial sheds or recreational establishments like the case of a brewery. Mathias visit the gasometers on a Sunday to avoid encountering guards or personnel that could impede the study. Upon arrival at the park, several families and people walking their dogs were around in their Sunday tour.

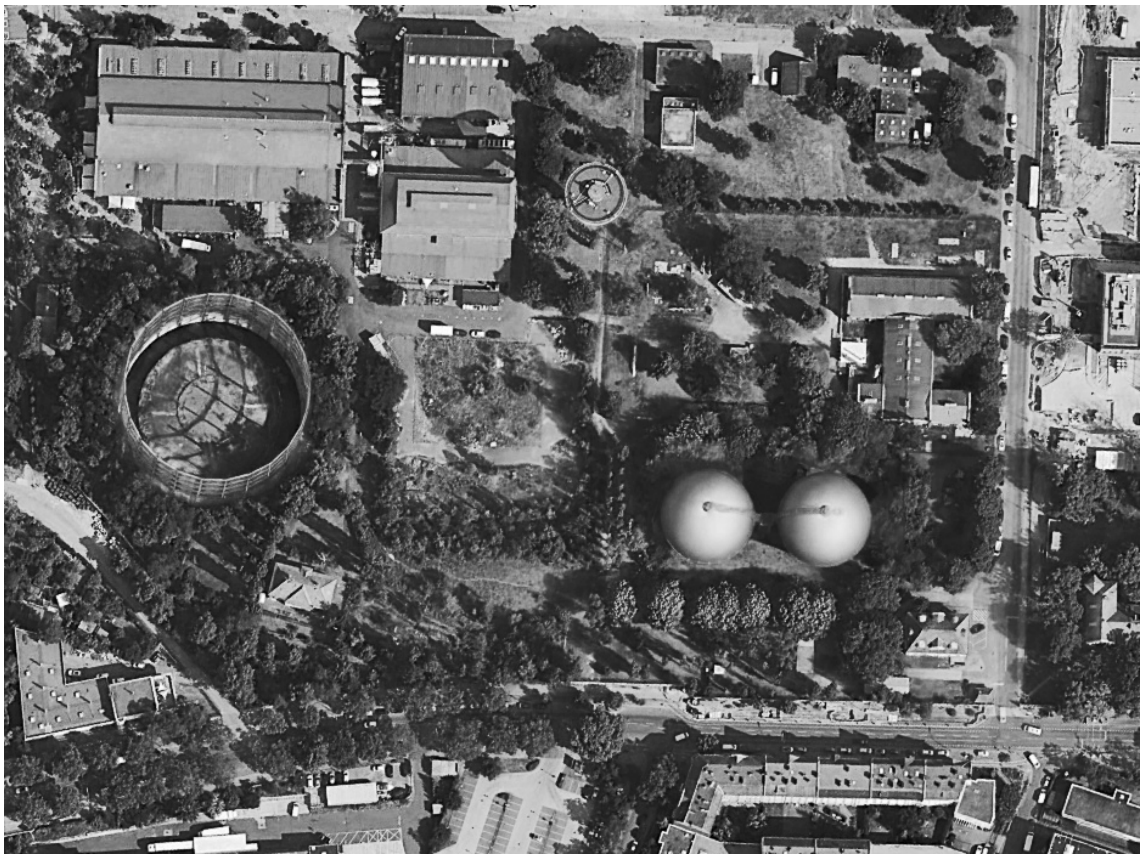


Figure 65. Aerial View of Mariendorf Gasometers. Recovered from Google Earth.

There were two identical gasometers facing each other, each with a ladder descending from its highest point. Both culminated in the same staircase box that served as a meeting point between the two infrastructures. Spherical in shape, the gasometers were 30 meters high and 30 meters in diameter, supported by pillars that functioned as structural legs guiding the weight to the ground. The landscape depicted by the gasometers, in conjunction with the other industrial infrastructures, was that of a spatial landscape, with two large silver spheres nestled amidst Berlin's lush vegetation.

Figure 66. Exteriors of Mariendorf Gasometers (M. Klenner 2023).

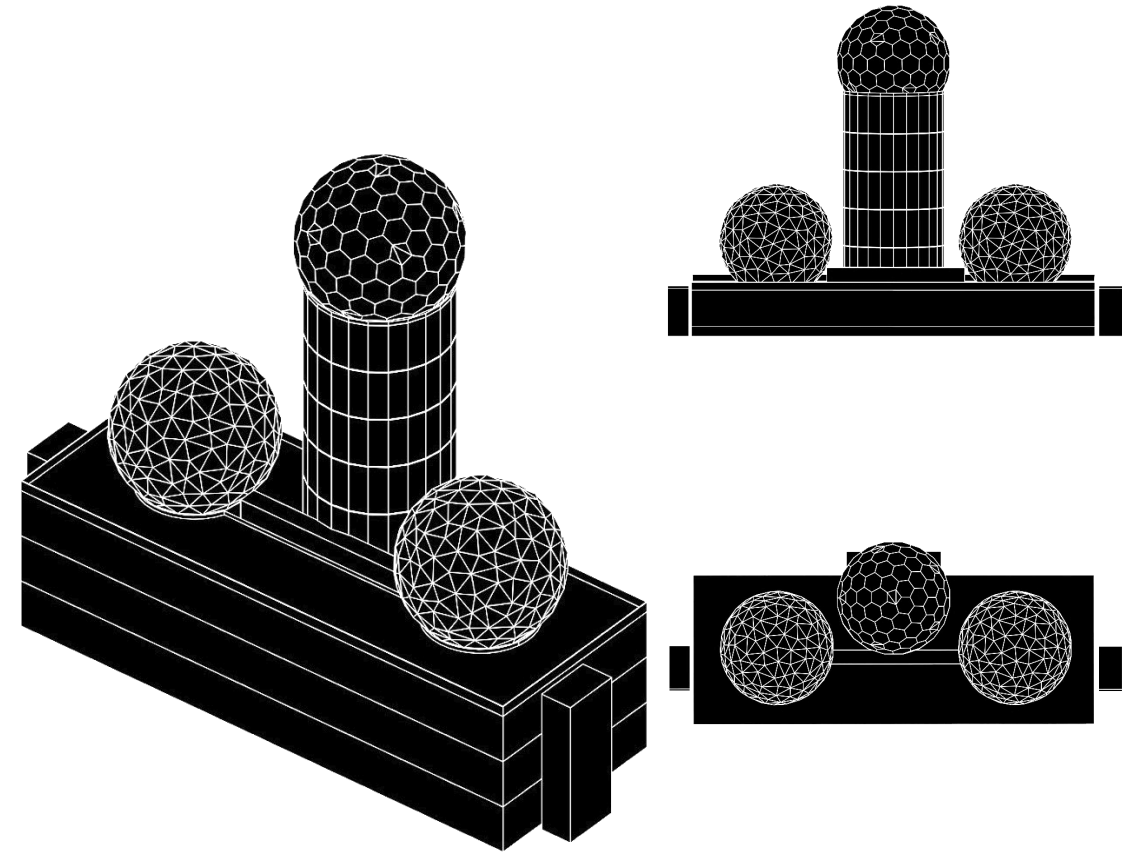
Around the gasometers, there was a perimeter of blackberry bushes mixed with tall plants, all vegetation with spines that fenced the passage to the base. Mathias had to trespass this perimeter to approach the gasometers and conduct the studies. Access to the staircase was blocked with bars, preventing him from entering the interior of the structure. Instead, he

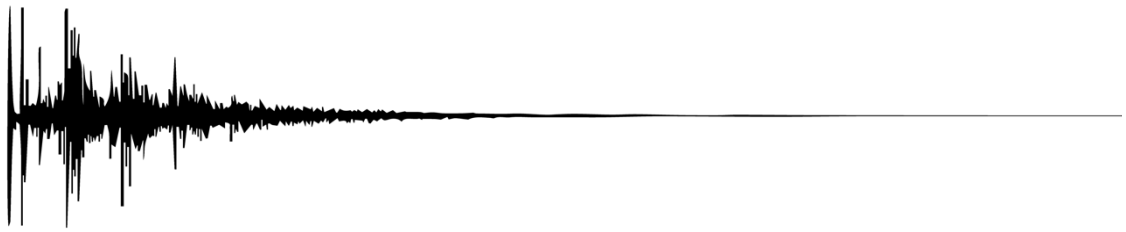
completed the study using a geofon[2] that recorded the sounds from the large outer spherical membrane. With the geofon, the gasometer functioned as a giant microphone, picking up and amplifying the sounds of the city. Some of the experiments involved exciting the space with percussions on its metallic membrane, resembling a gigantic drum.

[2] Seismic contact microphone that captures sound through solid.

Teufelsberg Spy Station, Berlin, Germany.

Coordinates: 52°29'51.0"N 13°14'28.0"E
Status: Reconditioned for cultural purposes





T60 (S)	VOL (M3)	H (M)	R (M)	D (M)
2	2,144.7	15	8	16

Figure 67. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level (M. Klenner 2024). Wave form IR T60 - 2'' (S. Balbontín 2024). QR code: Audio of IR. Data from the secondary spheres.

The expedition to Teufelsberg was also conducted by Mathias Klenner. Teufelsberg is an old Spy Station from the Cold War, located in Grunewald on the west side of Berlin. It is built on a non-natural hill called Teufelsberg, meaning Devil's Hill in German, made up of debris and rubble that covers an old Nazi Military Technical Faculty of the Berlin Institute of Technology. Founded by Adolf Hitler, the building was started in 1937 for engineering research in armament and warfare, however, it was never completed. With the end of the war and Berlin in ruins, the Military Faculty was used as a rubble dump for 22 years, resulting in an 80-meter hill. In 1952, it was planted with trees and bushes and during the Cold War, the US forces gained control of the mountain, building the Spy Station complex in 1971, which was in use for over 20 years. With the end of the Cold War in 1990, the facility was decommissioned and finally closed in 1992. Over the next 30 years, the site was used as an informal and temporary occupation by graffiti artists and cultural projects, becoming a meeting point of the Berlin artist scene. Recently, the site has been formalized as an open museum of graffiti art and a viewpoint of the city.

Figure 68. Aerial View of Teuflesberg. Recovered from Google Earth.

Our interest in this site was focused on the radar stations, where protective spherical envelopes covered the radars atop the building. There are a total of four spheres, but only the three ones located in the central building were examined. Two of them are 17 meters above ground level, each with a height of 15 meters and a diameter of 16 meters, while the main sphere is situated 47 meters above ground level, with a height of 13 meters and a diameter of 16 meters. Mathias reached the site by climbing from the base of the hill along a forest trail up to the facilities. A scaffolding staircase was installed to access the lower spheres, as the original ones had completely collapsed. These lower spheres were semi-destroyed, with damaged fabric resulting in a less powerful acoustic effect. To ascend to the upper sphere, he used the original staircase, which spiraled around a disused elevator box. The envelope covering the staircase was made of the same fabric as the spheres, indicating a similar state of abandonment. However, the upper sphere, constructed of fiberglass, was in good condition, and the studies yielded more favorable results.

The spheres were originally used to intercept radio waves transmitted between planes and the Soviet airport in Berlin. Unfortunately, the lower spheres' wave concentration effect was diminished due to their deteriorated state, particularly because the enveloping fabric was torn at head level and reverberation quickly dissipated, causing also a mixing of ambient sound with the desired acoustic effect. In contrast, the upper sphere exhibited a more powerful acoustic manifestation, with waves seeming to originate from within the listener's head. However, being an absorbing surface rather than a reflective one, the reverberation was not as prolonged as expected for a sphere.

Teufelsberg stands as a modern monument to Berlin's history, serving as a tangible reminder of the Cold War era and the division of Berlin by the Berlin Wall, separating the west Federal Republic of Germany from the east German Democratic Republic. These places are living ruins from the past, where art brings life into the space, creating a new paradigm of flexible realities.

Figure 69. Left: Exterior of Teufelsberg's main radar. Right-Top: Exterior of Teufelsberg. Middle-Top: Interior of radar domes. Bottom: Exterior of Teufelsberg (M. Klenner 2023).

Expedition #5

Lisbon | Viseu | Barcelona

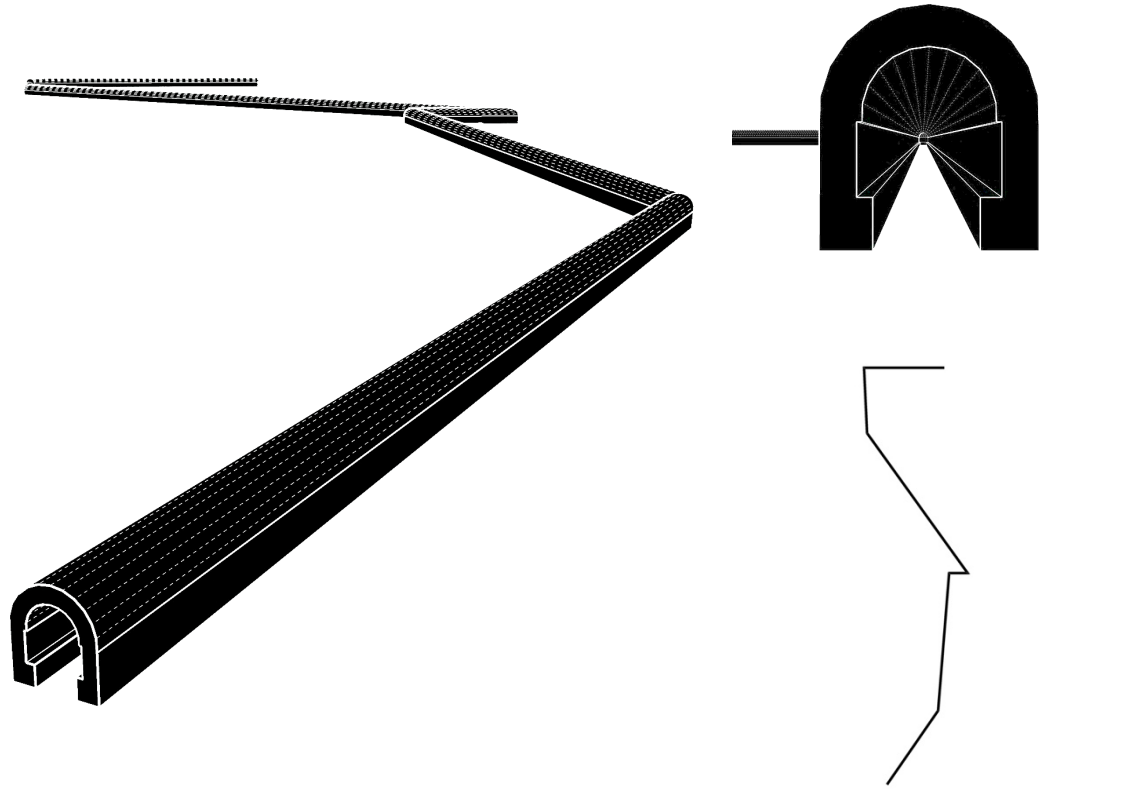
2021-2024

This expedition was carried out in parts. It began in 2021 with the Aqueduto das Águas *Livres* in Lisbon, the city's old water infrastructure. With the support of the Museu da Agua, a research process and subsequent creation period were conducted over two years (2021-2023). In 2023, an expedition was undertaken at Minas de Queiriga in Viseu as part of a two-week residency at Binaural Nodar, an art center dedicated to promoting artistic activation in rural areas in the region of Viseu Dão Lafões. Additionally, in 2023, an expedition was conducted inside the Silos da Nutasa in Barreiro, Lisbon. In 2024, the latest expedition to date took place in Barcelona, inside Casa de l'Aigua and Cementera Sanson. This final expedition was part of an internship at the Sound Art Lab at University of Barcelona for three months, funded by the Erasmus program. This expedition brings together the local knowledge of our respective home countries, where the authors of *Espacios Resonantes* reside.

Figure 70. Previous page. Barreiro view from Nutasa Factory (M. Klenner 2023). **Figure 71.** Sanson Plant (P. Descazeaux 2024).

Galerias do Loreto Tunnels, Aqueduto das Águas Livres, Lisbon, Portugal.

38°43'15.29"N 9°09'21.37"W
Status: Reconditioned for cultural purposes



T60(S)	VOL (M3)	H (M)	L (M)	W (M)
3	2,611	1.9	1,018	1.35

Figure 72. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level (S. Balbontín 2024). Wave form IR T60 - 2'' (S. Balbontín 2024). QR code: Audio of IR.

The Galerias do Loreto is part of the historic underground tunnels through which water once flowed, forming Lisbon's historic water infrastructure system, known as Aqueducto das Aguas Libres de Lisboa. The first time I visited Galerias do Loreto was part of a guided tour offered by the Museu da Agua, which restored and repurposed these structures for cultural and historical use. We entered through Casa do Registo, adjacent to Reservatório da Mae das Amoreiras. The tour covered about 1.2 kilometers through the underground tunnels, linking Reservatório da Mae das Amoreiras to Reservatório da Patriarcal and culminating at Miradouro de São Pedro de Alcântara in the Principe Real zone.

Figure 73. Aerial View of Galerias do Loreto. Recovered from Google Earth.

The Aqueduto das Águas Livres' system dates back to the 18th century as the first water network in Lisbon and was constructed along the path of the old Roman aqueduct. Galerias do Loreto is one of the five galleries comprising the Aqueduto das Águas Livres' system, declared a national monument in 1910 and later designated as a UNESCO World Heritage Site. Its entire underground extension measured 2,835 meters including all its branches. This

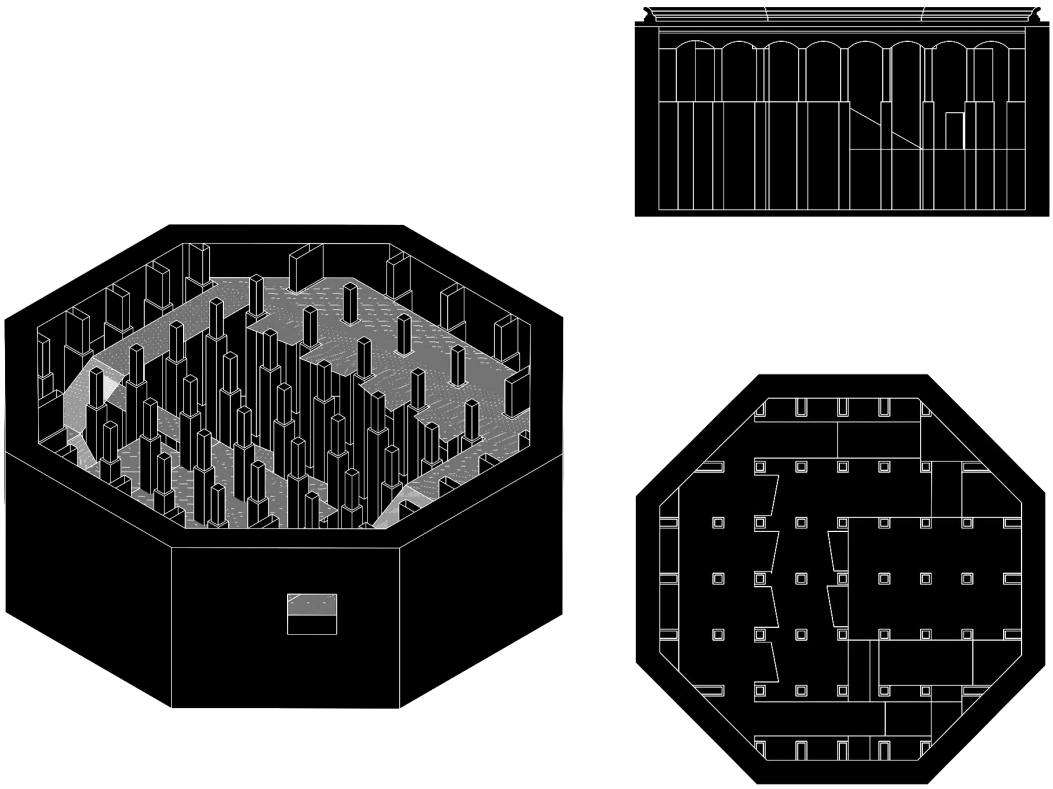
gallery supplied drinking water to public establishments and citizens through urban wells until the entire system was deactivated in 1977. Today, it has been restored and is maintained by the Museu da Água for cultural purposes.

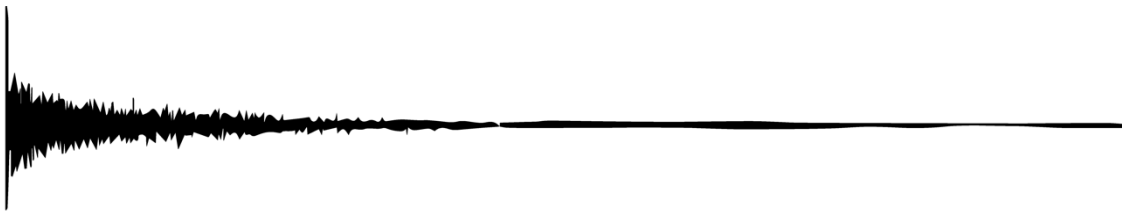
Figure 74. Interior of Galerias do Loreto (S. Balbontin, 2021).

Subsequent visits were coordinated with the Museu da Água, which supported the research from the beginning, granting access and assistance in the methodological processes. For a year and a half, I conducted acoustic measurements and field recordings, both alone and with Mathias Klenner. An interesting aspect of this location was that despite being underground, we could hear all the sounds of the city, particularly the tram. The sounds of the city traveled through the solid medium, transforming the urban soundscape into telluric sounds. Inside the galleries, we could hear the movement of the city as vibrations traveling through earth, stone, and cement, being amplified within the galleries. This acoustic characteristic gave the tunnels a deep, throbbing voice reminiscent of a tremor which constitute a background noise of low frequencies, creating a constant roar.

Water Reservoir, Reservatório da Patriarcal, Aqueduto das Águas Livres, Lisbon, Portugal.

38°42'58.26"N 9°08'55.37"W
Status: Reconditioned for cultural purposes





T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
3	3,090	10	20	20

Figure 75. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level (M. Klenner 2024). Wave form IR T60 - 2'' (S. Balbontín 2024). QR code: Audio of IR.

The Reservatório da Patriarcal was initially supplied by the Águas Livres Aqueduct and from 1833 by the Alviela system. It is located underground in the Príncipe Real Garden on the west side of the city. Built with stone masonry, it consists of two compartments with a total capacity of 884m3 of water.

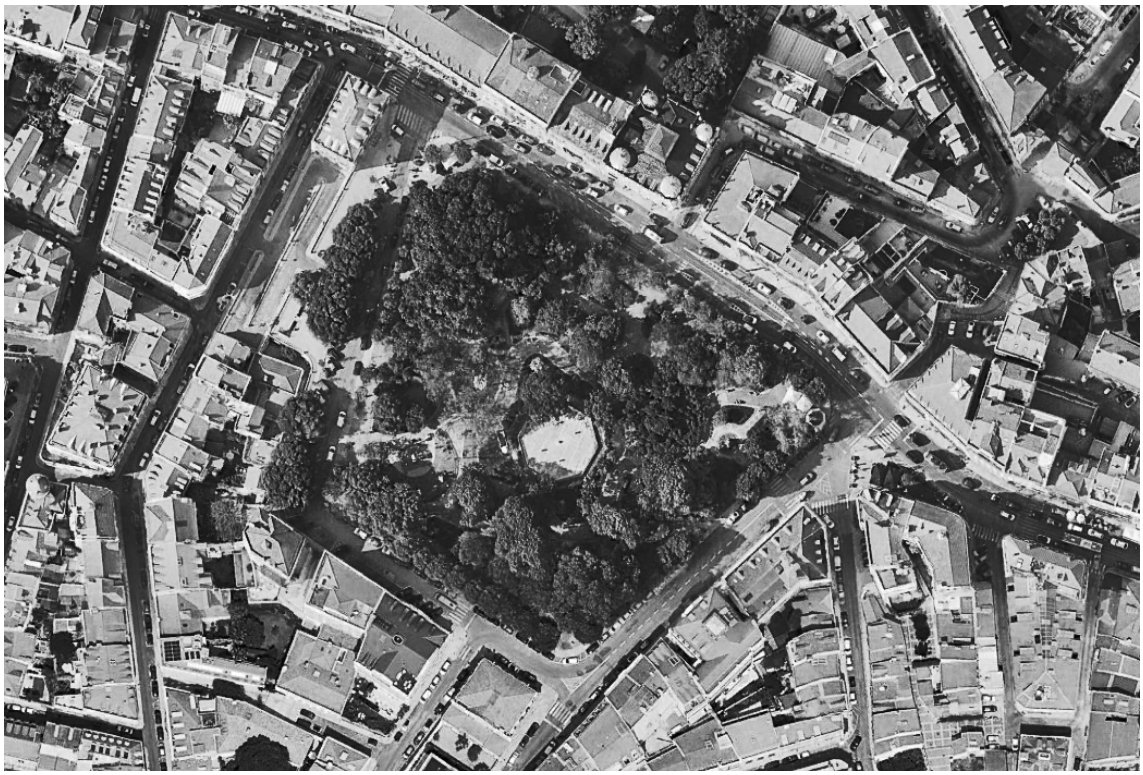


Figure 76. Aerial View of Reservatório da Patriarcal. Recovered from Google Earth.

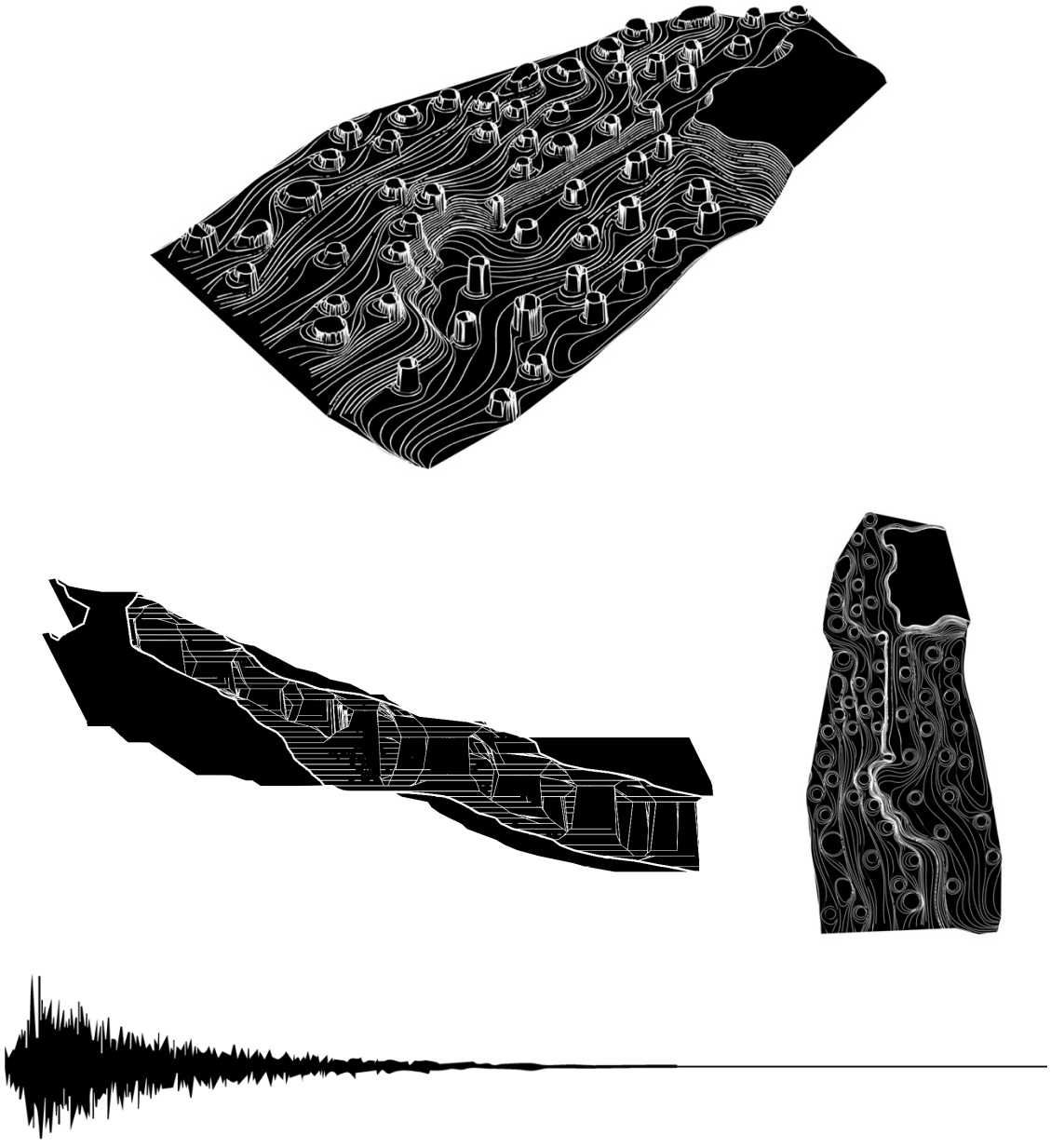
The reservoir was constructed between 1860 and 1864 with the original purpose of supplying water to the lower part of Lisbon. Its octagonal shape mirrors that of the lake situated above the tank, located at the center of the Príncipe Real Garden. The reservoir comprises segments each 8 meters wide, with a maximum width of 20 meters and a height of 10 meters. Supported by thirty-one pillars, varying in width and standing at a height of 9.25 meters each, the stonework arches bear the weight of the vaults.

Figure 77. Left: Interior of Reservatório da Patriarcal (S. Balbontin 2023).

The reservoir is open to the public from May to October and has been reconditioned and adapted for cultural activities, although the renovation did not consider the reservoir's original morphology. A platform installed halfway up the structure obstructs the complete understanding of the space and restricts the free dispersion of reflections during the acoustic experiments. Despite the high reverberation, the acoustics enhance sounds without causing muddiness, denoting its architecture with a clear and strong voice.

Minas de Queiriga, Viseu, Portugal

40°47'11.26"N 7°44'17.56"W
Status: Abandoned



T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
3	82,880	2-10	160	74

Figure 78. Top: 3D view. Middle-Right: Ground level. Middle-Left: Front view. Bottom: Wave form IR T60 - 2'' (S. Balbontín 2024). QR code: Audio of IR.

The Minas de Queiriga, located in the district of Viseu, is an abandoned mine formerly exploited for extracting wolfram, also known as tungsten—a highly resistant metal used extensively during the world wars. The mine was abandoned in the mid-20th century due to the economic uncompetitiveness of tungsten mining in Portugal.

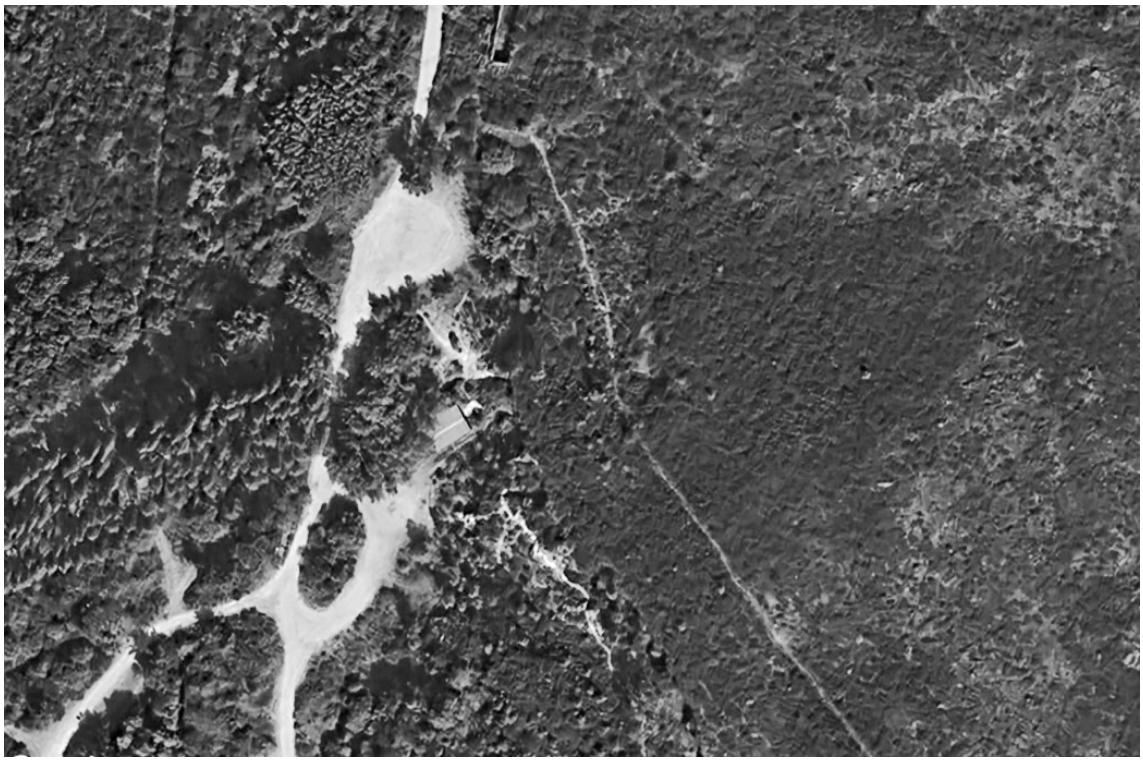


Figure 79. Aerial View of Minas de Queiriga. Recovered from Google Earth.

The Minas de Queiriga features a cavernous appearance, with organic forms sculpted by the mining process, resembling columns reminiscent of Gaudi's organic architectural style. These natural-looking columns rise from the ground at intervals of 3 to 20 meters and are residual structures strategically left behind by miners for supporting the ceiling rock and the hill above during extraction. The mine is 160 meters in its maximum length and 74 meters in its maximum width, descending at a slope of approximately 14-23º into a water lagoon formed by rain accumulation and humidity, located 20 meters below the surface.

Figure 80. Left: Interior of Minas de Queiriga (S. Balbontin 2023). Left-Bottom: S. Balbontín recording sounds (L. Costa 2023).

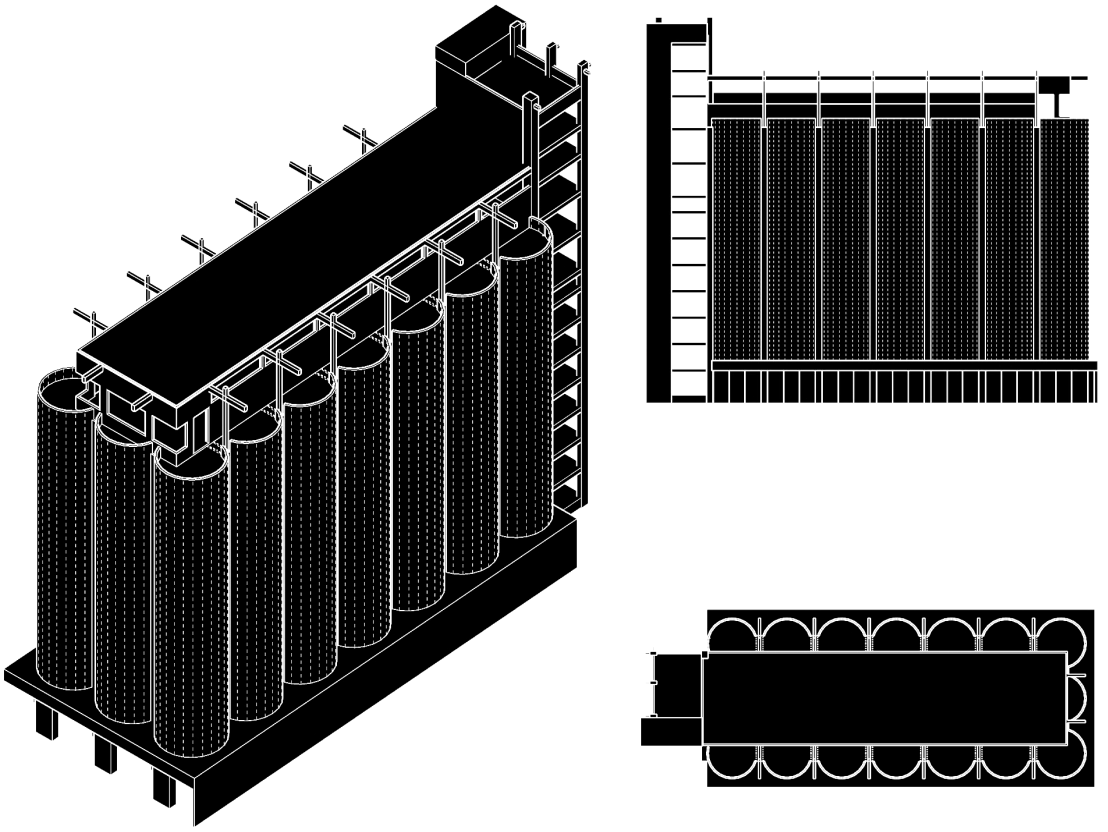
This expedition was conducted by me during a two-week residency at Binaural Nodar. Successive visits were made to the site, which is currently abandoned and at risk of collapse. The first visit was at the end of June on a very hot day. From the outside, the mine resembles any other hill in the area, making it hard to believe it keeps such a unique place. To enter, I descended the edge of a rock through a narrow passage. Inside, the space opens up, revealing a mix of natural and man-made scenario. A 1.5-meter path leads from the entrance to the middle point of the mine through an intermediate level, with the hill descending towards the lagoon and ascending towards the exterior. Upon entering, the temperature drops drastically from the 35ºC hot day outside to a cooler 15ºC, caused by excess of moisture and shadows within.

Water droplets continuously drip from the walls and ceiling. In the deepest part of the grotto, the lagoon emits a bright blue glow when sunlight is direct. The path is blocked by fallen rocks, indicating the risk of landslides within the mine. Evidence of an abandoned attempt to develop the cave as a tourist attraction is seen in a derelict light installation along the trail. Plans to make the space suitable for visits were abandoned due to safety concerns. Beyond the blockage, a descending path leads to the lagoon, granting access to tunnels leading deeper into the mine.

The space's sound is irregular, influenced by its vast dimensions and the ambient sounds, resembling an organic cave rather than a geometric space. Its size contributes to a bass-heavy background noise, interrupted by the rhythmic droplets falling into the water and the constant chirping of birds nesting among its columns.

Silos da Nutasa, Barreiro, Lisbon, Portugal.

38°39'59.42"N 9°4'28.12"W
Status: Abandoned



T60 (S)	VOL (M3)	H (M)	R (M)	D (M)
10	1,161.4	35	3.25	6.5

Figure 81. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level (S. Balbontín 2024). Wave form IR T60 - 2'' (S. Balbontín 2024). QR code: Audio of IR. All measures are based on one silo.

The Silos da Nutasa, situated on the banks of the Tejo River in the northern part of Barreiro, were integral to the Nutasa Factory, an industrial complex specialized in the production of animal nutrition and livestock products. These silos were primarily used for storing agricultural goods. Since 2020, the site has remained abandoned and permanently closed. While it is speculated that changes in the economic context led to the closure, the exact reasons remain unknown.

Figure 82. Aerial View of Silos da Nutasa. Recovered from Google Earth.

The expedition to the Silos da Nutasa took place on a Sunday to avoid encountering guards or personnel who could impede our study, as the only way to enter was clandestinely. Accessing the site required scaling the wall. Once inside, we observed evidence of informal use, including graffiti on many walls and recent garbage in certain areas. The complex appeared completely dismantled, facilitating entry into the various venues. Exploring the base of the silos, we found a large open space divided by structural walls supporting the concrete

cylinders. While it was impossible to enter the silos directly due to their height, openings at the bottom and top allowed us to conduct experiments from both locations.

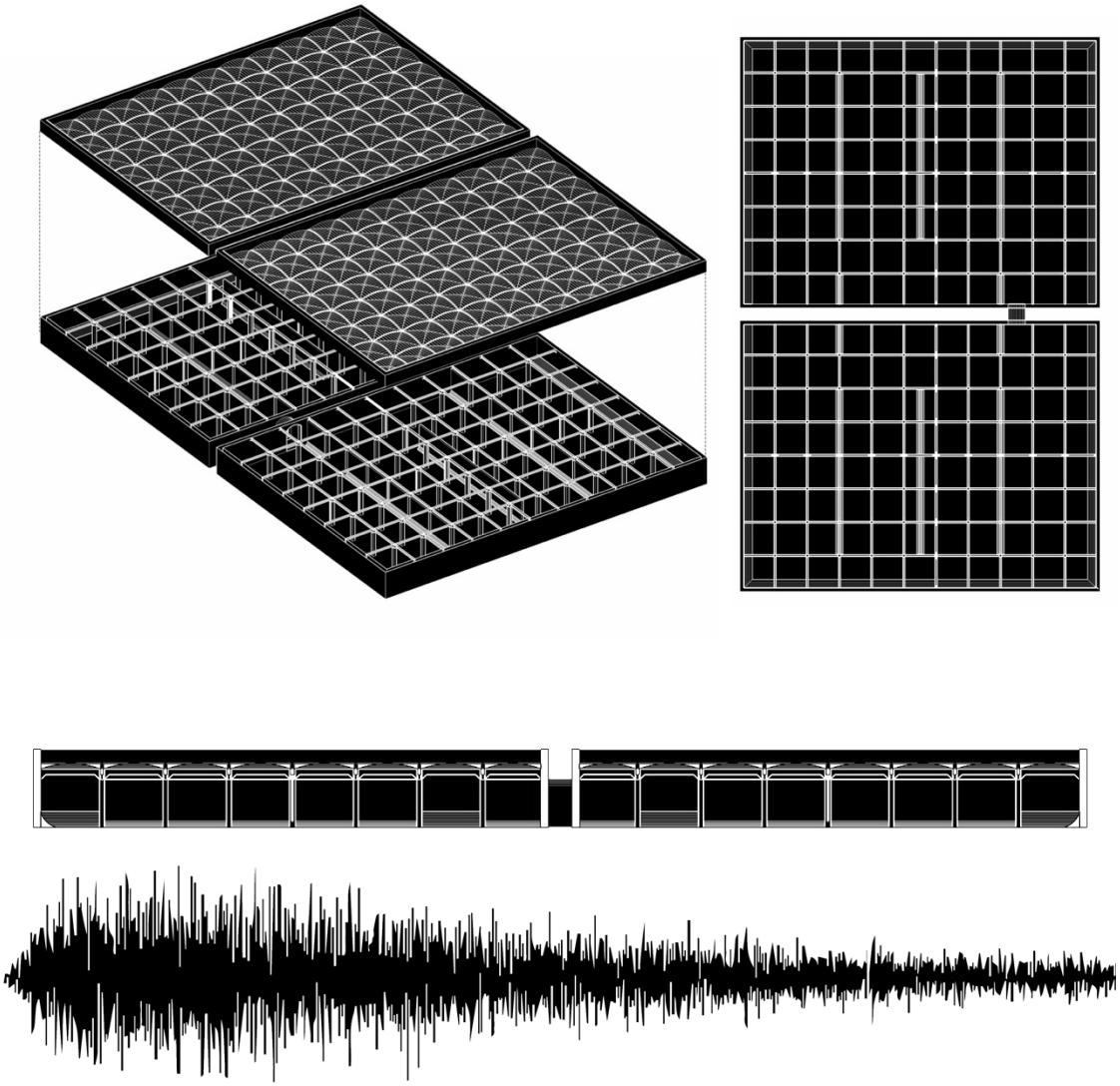
Figure 83. Top: Exterior of Silos da Nutasa (M. Klenner 2023). Bottom: Exterior and interior of Silos da Nutasa (S. Balbontín 2023).

To collect sonic material, we conducted experiments in five different silos that we considered representative and distinctive based on their position and acoustic quality. After gathering material from the ground level, we went up to the top floor via a partially deteriorated

staircase. Upstairs, we discovered a spacious room with openings in the floor connecting to the silos. Despite we run the experiments again, the sound downstairs proved to be more immersive. For better results, we tied an audio recorder to a rope and lowered it inside the silo to capture a proper acoustic effect of the impulse response. The echoes from the silos evoked a whirlpool effect, gradually receding into the distance. On the ground level, shattered glass covered the floor, amplifying the sound of each step as it reverberated through the space. The voice of space was a blend of cylindrical acoustics, fragmented glass, and the soundscape of the Tejo River banks.

Water Reservoir, Casa de l'Aigua Trinitat Nova, Barcelona, Spain.

41°27'12.99"N 2°11'15.06"E
Status: Reconditioned for cultural purposes



T60 (S)	VOL (M3)	H (M)	L (M)	W (M)
8	11,327.8	4	66.4	42.65

Figure 84. Top-Left: 3D view. Top-Right: Ground level. Middle: Front view. Bottom: Wave form IR T60 - 2'' (S. Balbontín 2024). QR code: Audio of IR.

Casa de l'Agua Trinitat Nova is located in the northern part of the city of Barcelona and is linked to the Casa de l'Aigua Trinitat Vella. Together, they used to serve as a pumping station and plant for the storage, treatment, and channeling of water. The Casa de l'Aigua was built by the municipal public company Aigües de Moncada between 1915 and 1919. Water from Trinitat Vella was pumped to the reservoir located in Trinitat Nova, where it was chlorinated before being piped to the old part of the city, including Barceloneta. In 1989, it ceased to be used and remained closed until 2007, when the Barcelona City Council initiated the consolidation and improvement of the heritage complex. Nowadays, it is preserved as a heritage site of modern history by MUHBA, the Museum of the History of Barcelona, which is responsible for preserving, studying, documenting, and exhibiting the historical heritage and history of Barcelona.

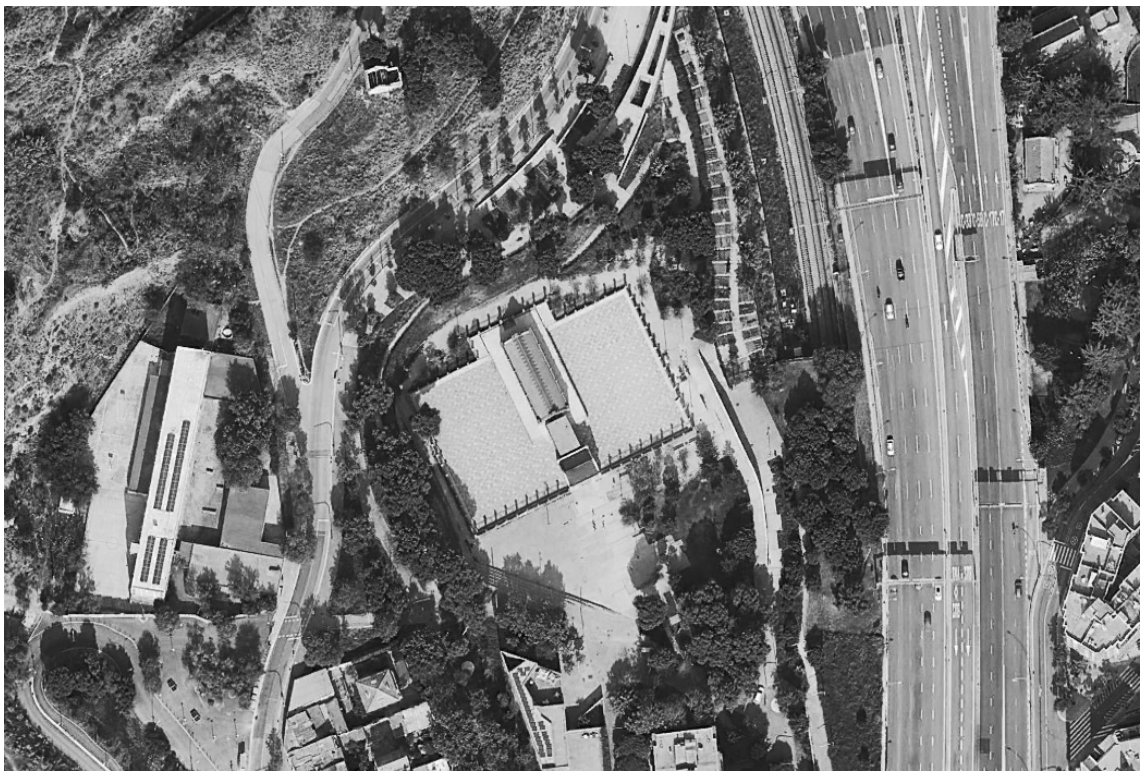


Figure 85. Aerial View of Casa de l'Aigua Trinitat Nova. Recovered from Google Earth.

This expedition was part of an internship I undertook at the Sound Art Lab of the Faculty of Fine Arts at the University of Barcelona. It was organized in collaboration with MUHBA

and the staff responsible for the Casa de l'Aigua Trinitat Nova, who granted us access to conduct our research methodologies. The reservoir, currently undergoing conversion into a gallery, is situated below ground level. The original space was divided into four chambers regarding the different stages of the water purification chain. Since two chambers had been converted into exhibition rooms, we focused our experiments on the remaining two rooms to ensure unobstructed spaces. Following our research in the reservoir, we also conducted experiments in the tunnel connecting the water facilities of Trinitat Nova and Trinitat Vella.

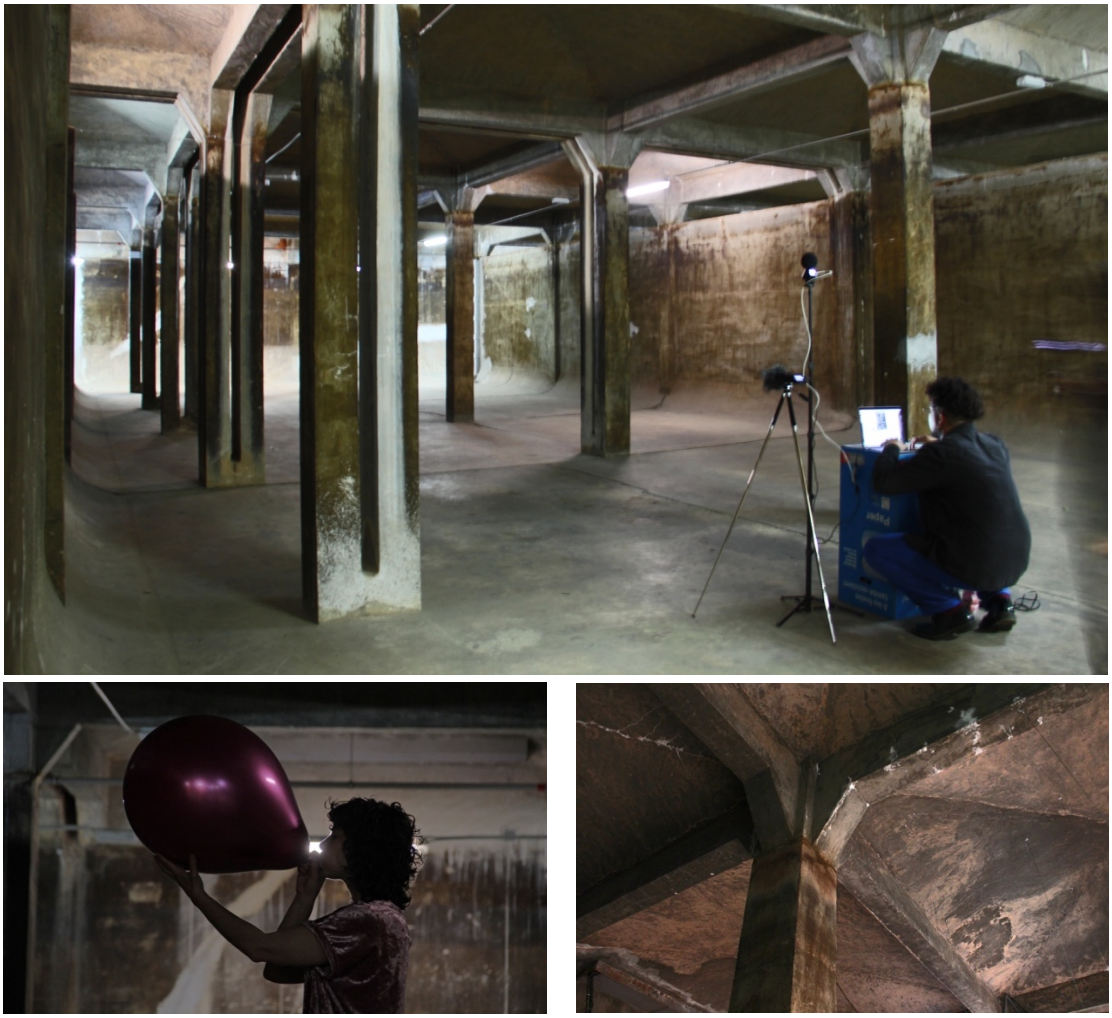
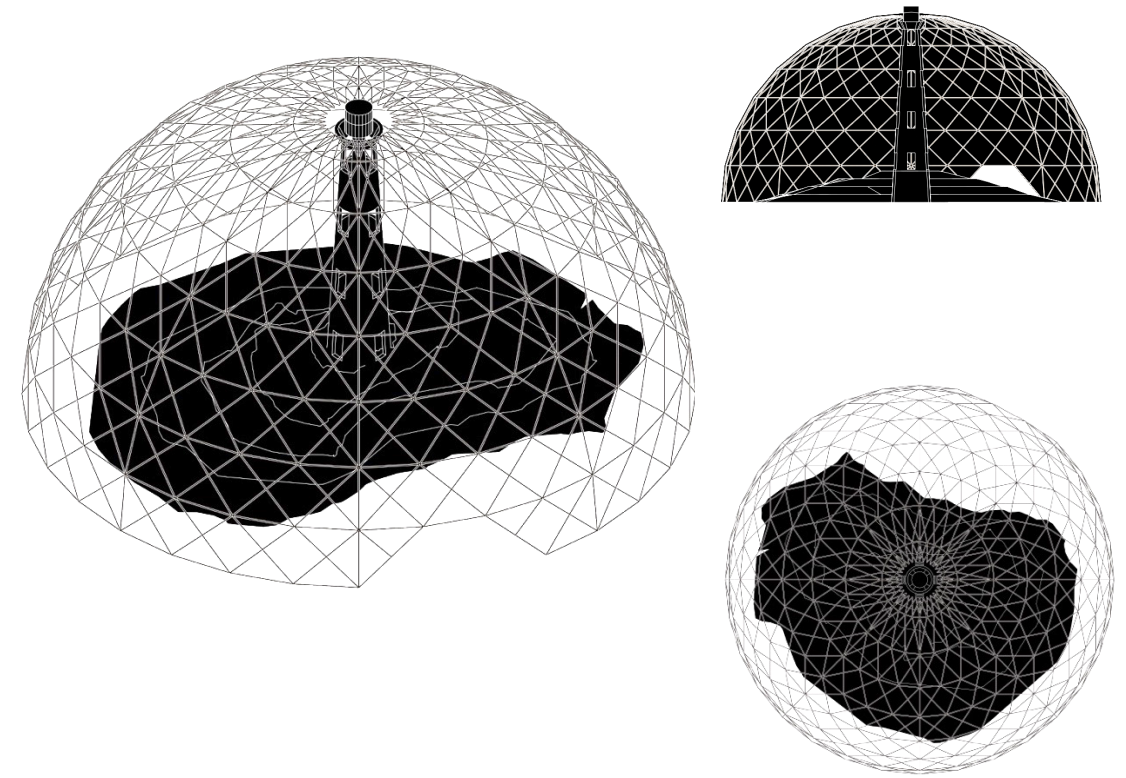


Figure 86. Conducting acoustic experiments inside the Water Reservoir Casa de l'Aigua Trinitat Nova (P. Descazeaux 2024).

We conducted an exercise by placing a recorder in the room where the experiment took place and another in a room farther away to assess the different sound qualities influenced by distance and space presence. Despite its concrete structure, the voice in the reservoir sounded piercing, sharp, and metallic. The space generated a constant murmur, reflecting even the slightest micro-sounds in its reverberation, creating a drone-like background noise whose intensity varied with external sounds, such as those from the nearby highway. During the impulse response test, the sound resembled waves crashing against the shore, with its reverberation akin to the sea foam spreading across a vast beachfront.

Cement Dome, Sanson Plant, Barcelona, Spain.

41°24'6.95"N 2° 3'18.53"E
Status: Abandoned



T60	VOL (M3)	H (M)	R (M)	D (M)
6	28,953	24	24	48

Figure 87. Left: 3D view. Top-Right: Front view. Bottom-Right: Ground level (M. Klenner 2024). Wave form IR T60 - 2'' (S. Balbontín 2024). QR code: Audio of IR.

Cementera Sanson is located in Sant Feliu de Llobregat, northwest of the city of Barcelona. Initially, the raw material for cement production was extracted from the Sant Feliu de Llobregat quarry and transported by conveyor belt to the processing facilities in Sant Just Desvern, where the stone was transformed into cement. However, in 1968, protests from Sant Just residents prompted the relocation of the processing factory to Sant Feliu, adjacent to the quarry. The factory operated at its current site until 2006 when it was closed and is now abandoned.

Figure 88. Aerial View of Silos da Nutasa. Recovered from Google Earth.

To get to the site, we took a train to Sant Feliu de Llobregat on a Sunday to avoid encountering guards or staff at the factory. The factory is normally completely open, and many people come here to walk or run. We walked from the train station to the factory, passing through all its industrial facilities until we reached the industrial storage dome. This dome was used to store the stone extracted from the quarry before it was processed into cement.

The structure is semi-spherical, measuring 48 meters in diameter and 24 meters in height. Its entrance, facing the road from the main street, features a wide opening for trucks to enter.

Figure 89. Left: Exterior of Cement Dome Sanson (S. Balbontin 2024). Right: Conducting acoustic experiments inside the Cement Dome Sanson (P. Descazeaux 2024).

The acoustic effect of this space, owing to its spherical character, captured our interest. We conducted experiments in various positions within the dome, observing different outcomes when positioning ourselves closer to the center or to the perimeter. The acoustic effect, resulting from wave concentration, altered the sound depending on the radius, creating a particular reverberation at the r/2 position and a different one at r/4, a phenomenon we had not previously studied. In r/4, near the perimeter, the sound in the space resembled a laser beam from a science fiction movie, traveling in a straight line and reflecting off surfaces, akin to a gunshot with a high-frequency initial sound that reverberated at lower frequencies. In

r/2 position, the sound produced a bubbling reverberation resembling fluttering, transitioning again from higher to lower frequencies. The industrial dome, with its earthen floor and metal membrane, possesses a shape that reflects its industrial storage capacity, efficient due to its aerodynamic curves. It is these very curves that give the space a distinct personality, akin to a bird that sings and flutters into the air with the explosion of the impulse response.

LISTENING TO ARCHITECTURE

CONCEPTUALIZATIONS

FROM SOUND TO SPACE

An introduction to the sound space

The term *sound space* has evolved from the word *sound* in relation to its context, referring to the spatial or environmental surroundings. The sound phenomenon incorporates multiple significations, including physical vibration and auditory sensation. Likewise, the space itself embraces a duality between the physical conception of geometric space and the situational manifestation of phenomenal space. This chapter aims is to introduce the notion of sound space through the examination of the raw concepts of *sound* and *space*, taking their objective and subjective nature as starting point.

On Sound. From Vibration to Perception

Throughout life, we all encounter auditory experiences and sounds. The world is full of sounds, each offering different experiences. These encounters will differ based on whether we understand them from a physical, philosophical, phenomenological, or aesthetic point of view. Furthermore, the perspectives coming from the arts, music, philosophy, or psychology may either closely align with or diverge from these viewpoints. It's interesting how these diverse conceptions can coexist or conflict in attempting to address the question of "what is sound?", recognizing that there are no inherently wrong perspectives.

Sound is presence, history, memory, flux, space, connection. Sound travels, carrying information and the soul of things, animating the static—it is life. Dynamic and temporal, sound communicates about the state of things while being communication itself, fostering connections or pushing us apart. Sound is the provocation of matter, a vibration flowing through all the particles composing the world. Is physics, is feeling, is inside and outside us, is everywhere in our planet.

The philosophical conception of Jean Luc Nancy regarding sound, combines both physical and transcendental elements. Sound propagates in space as it does within our bodies, resonating in outer and inner spaces and being re-emitted through sounding, which is already resonating. To sound is to vibrate within oneself or with itself: it is not only about the sonorous body extending itself but also about conducting and completely resolving itself in vibrations that simultaneously relate to itself and project outside itself (Nancy 2007). Sound traces

a relationship between the sounding entity and the material context that is vibrating and sounding as well, engaging the receiver in vibrations and establishing a connection with the sonorous body and its surroundings. Vibration suddenly becomes ubiquitous, present in the source, the medium, and our body, all unified by sound.

Solomos (2020) explores the haptic dimension of sound, a literal aspect in terms of vibration that imparts to sound the specific characteristic of "feeling plenitude", originating from the listening body. The body perceives sound as phenomenological impressions, as "objects of audition" (Casati and Dokic 1994). According to Gershon (2013), sound constitutes a "form of resonance and can therefore be understood as a kind of vibrational affect" (2). When something affects us, it transforms into a sensation, a sensorial experience. Technically, sound is that which can be perceived by the human ear, manifesting as sensations produced in the observer when sound waves strike the ear (Maclachlan 1989: 26). The mechanical phenomenon occurs when these waves reach the auditory nerve, and the sensation of sound emerges. However, the sounding sensation is not the only thing considered as sound.

The vibration that generates the sound in my ears is as much a part of *sound* as the sensation itself. The entire mechanical and physical aspect of sound involves the production of a sounding sensation that feeds into my ears. When a sound source vibrates and creates movements in the air, a difference in pressure levels occurs, generating a wave effect that expands through the air particles. The difference in pressure carried by the wave makes our ears vibrate until these vibrations are coded in our brain as sounds. Sound is an organized movement of molecules (forming the medium) caused by a vibrating body. According to Chion, "on the physical level, what we call sound is a wave which, after the shuddering of one or more sources called *sound bodies*, propagates according to very particular laws and, incidentally, affects what we call the ear, providing matter for auditory sensations" (1999: 41). This wave requires a medium to propagate; the particles composing it cause the existence of sound. Sound is the medium itself in motion.

Medial theories of sound support its identification with vibration. Each particle of the medium is in motion at a given frequency and with a given amplitude, and the motion propagates to neighboring particles at the same frequency, so the medium transmits the vibration, which transfers information to a listener (Casati et al. 2005). Proximal theories, on the other

hand, claim that sound is the sensation of what is heard. Therefore, sound is subdivided into two related issues: where a sound happens (is caused), and where the same sound is heard to be sounding (is perceived) (Gritten 2009). In the *Vocabulaire de l'espace en musiques electroacoustiques*, Merlier (2006) describes sound as:

> 1. Variation of pressure or constraint in the displacement or speed of particles propagating in an elastic medium. Synonym of acoustic wave.
> 2. Sensation produced in the auditory system by these variations (170).

We face a duality of the word sound, referring to both an objective nature and a subjective one simultaneously. In its objective aspect, sound can be understood as the cause, the entity that produces sound. In its subjective aspect, sound is closely bound to the individual who is sensing it. Chion (1999) identifies the nominal problem, "When, indeed, we find ourselves, as in the case of 'sound', with a perceptual phenomenon that is given the same name as the physical cause that brings it into being (the word 'sound' designates, in effect, both the physical vibration and the object heard), an extraordinary synonymy that becomes the source of the confusions that are guessed at" (60). This dilemma of sound is not new and can be traced back to Schaeffer's studies (1966) and the materialization of sound in an *object*, where sound was threatened with a certain distance from its cause. The evolution of the sound object was based on a constant analogy with light and the visual, bringing the terminology problem to the forefront, raising the necessary nominal distinction between the entity conveying sound information and the energy that makes it perceptible; "Without going back to the origins, we can observe that, in optics, there is no question at all of confusing such distinct areas as the study of light, the study of light sources, the study of illuminated bodies, the study of vision, the study of perspective, etc. Who makes such distinctions in acoustics?" (Schaeffer 1966: 160).

Authors as Schaeffer (1966) or Solomos (2020) agree in recognizing the confusion surrounding the terminology of *sound* and its two distinct meanings and nature: sensation and vibration. Through an abusive extension of the term sound, we use it to designate both the objective phenomenon that gives rise to the sensation and the sensation itself. To better understand this crossroads, I will take a step back into linguistic theory to explore the signifier-signified relationship established around sound. Drawing from Deleuze's ideas (1969) in his

book *The Logic of Sense*, we can comprehend the existence of a *Thing* with physical qualities, relations, and ideational logical attributes constituting the *state of affairs*, which in this case, is the event-effect of; 1) physical vibration of a medium, and 2) the perceptual sensation of that vibration in our body, especially in our ear, which both serves as the signified. The word *sound* functions as the signifier denoting this Thing. The terminology of sound consistently communicates through the words and significations of others, imposed by the "abstract machine of language" (Deleluze & Guattari 2005: 85-91). This statement is something which we do not necessarily need to believe, but it is a principle we must obey to engage in the scientific discussion of our society. Therefore, *sound* as a binomial concept is a foundational step necessary for delving into further conceptualizations on the subject. Nevertheless, there is in fact a lack of definition in the word *sound* as it denotes two different things. The reason for this may be diverse, but based on Schaeffer's reflections mentioned earlier, the deficiencies in a sonic vocabulary are probably based on our ocularcentrist society and the power of vision inside the sphere of language (1966). "While sight is the only sense that requires the object in question to distance itself in order to function and reveal its essence, hearing immediately raises the issue of 'non-separation"' (Barbanti 2011: 13).

While accepting the term sound as a coexistence between the objective and subjective manifestations, we can understand this duality from a relational point of view. Sound is attached to both physical and phenomenological effects, which cannot be duplicated, and it has a unique manifestation tightly linked to the time-space of its creation and to the environment in which it is produced. According to Solomos (2018), sound is described as a network of relationships that connect the vibration of the medium with the ambient space and the subject who listens;

> …is made up of a pressure wave created by a vibrating object. The vibration is transmitted by the molecules of the milieu in which the sound spreads. It is customary to add that sound is also the auditory sensation brought forth by this vibration. An object in vibration moves in a milieu and transforms into a sensation of hearing: sound does indeed manifest itself through a network of relationships (95-96).

Sound can be understood in terms of a new dimension and its possible relationships between the constructed and the perceived, between quantity and quality (Dufourt 1991). LaBelle (2015) understands sound as a relational phenomenon, where it constantly forges

connections beyond the realms of physics and perception, but also socially bonding our human encounters, bodies, and political differences. Sound is "intrinsically and unignorably relational: it emanates, propagates, communicates, vibrates, and agitates; it leaves a body and enters others; it binds and unhinges, harmonizes and traumatizes; it sends the body moving, the mind dreaming, the air oscillating" (LaBelle 2015: xi).

The etymological root of sound comes from the Latin *sonus*, introducing a dual signification to all Latin languages and Anglo-Norman French. When we look at other languages, we can notice differences of specificity regarding the phenomenon of sound. For example, in some African languages like *Wolof*, the word for sound doesn't exist, and they import the French word *bruit* to name it (even though it does not specifically mean sound, but noise). An opposite example, is the extensive repertoire of signifiers in *deutsch*, distinguishing the vibrational effect of sound as *Klang* and the sensorial effect as *Schall*. Language can condition the depth with which we can understand the totality of the sound phenomenon. Thus, the availability of a rich sonic vocabulary opens roads for an acoustic knowledge of our world.

On Space. From Absolute Space to Lived Space.

> Un espacio es un vacío, un hueco, una laguna, una duda, una pregunta: así, la "escena del crimen" con todos sus detalles es un enigma, una interrogación, la exposición de una facticidad insoportable, irresistible, cuya descarada brutalidad ha de ser inmediatamente reducida en aras de una historia que la vuelva inteligible, es un hecho mudo que se abre a la especulación del observador en una multiplicidad inabarcable de direcciones incompatibles (Pardo 1991: 10).

The concept of space has been in constant mutation throughout history, from the metaphysical ontology that designates *space* as pure abstraction to the relational space constructed by phenomena. This evolutionary process likely emerged together with human evolution and has been documented since around 300 B.C., starting with the rationalist ideas of Plato (1872). Plato designated space as an empty and infinite entity that contains everything that exists. However, this proposition was immediately refuted by Aristotle (1995), who described space as a delimited container. The evolution continued with the geometric space of Euclid (Callahan and Casey 2015), which, according to Foucault (1984), framed the concept as

localization, which was replaced by the extensive and dimensional space of Galileo, who introduced the tridimensional space.

By the 18th century, the controversy of space reaches its peak when Newton (1968), with his idea of the absolute space, displayed as a big void, infinite, and immutable, is confronted by Leibniz's concept of relative space (Arthur 2023). Newton's statement is later affirmed by Kant, who brings back the abstraction of absolute space with its "transcendental intuition" (2005). Kant links space with time, considering it as an objective (space) and subjective (time) form of external and internal phenomena, representing an *a priori* form of knowledge. Even though, the abstract nature of space is undeniable, Leibniz's relative space has prevailed throughout history and has evolved in various ways. Relative space is not absolute; it's not an empty container that must be fulfilled by something. It is not an entity different from its content but is the content itself. This independent relationship between container and content from absolute space becomes interdependent in relative space. For Leibniz, space is a set of relationships between things, objects, matter, and bodies.

Relative space opens the mathematical and philosophical discussion of abstract space into humanities. For the first time, the idea of space is introduced as something that addresses the subjective nature of knowledge through experience. According to Heidegger (2009), space is a constitutive element of the world and exists in the measure that is produced by the located relationship between objects. For Heidegger, space is not physical but existential. His ideas introduced the phenomenological perception to the conception of space, emphasized in Bachelard's *The Poetics of Space* (1994), with the transcendence of geometrical space through its signification. The intimate space of the house explores how imagination fills the inhabited space with meaning and identity, evoking an image of the lived space, a memory. The *lived space* from Merleau-Ponty considers the perception of space as the knowledge of the "spatial relations between objects and of their geometrical characteristics" (2012: 293). The question of space is no longer confined to the object *space* but to the subject who "lives the space". From now on, geometrical constraints won't absolutely define the possibilities of space; this will be the task of the constituting consciousness that embraces it; "We have refused to locate geometrical space as immanent within mythical space and, in general, to subordinate all of experience to an absolute consciousness of that experience that would situate it within the

totality of truth, because the unity of consciousness, conceived in this way, makes its variety incomprehensible" (2012: 305).

Lefebvre states that each body is a space and has a space. The body is produced in space and, at the same time, is producing that space. In *The Production of Space*, Lefebvre (1974) defines space as a social production and differentiates three types of them: 1) spatial practice (physical production through practice – *perceived space*), 2) representations of space (mental production through signs and signification – *conceived space*), and 3) spaces of representations (sensory production through lived experience – *lived space*). This produced space is intrinsically related to time and unfolds through the rhythms of everyday life. In Lefebvre's *Rhythmanalysis* (2004), space is the place of interactions that proceed in a time-based dynamic, shaping a relational collaboration between elements and events. Lefebvre's ideas have inspired a multitude of works around the produced-perceived space, such as Lynch's book *The Image of the City* (1960) with the production of the urban through memories and situations, Foucault's heterotopia (1984) addressing space as a multiplicity of relations that gives existence to a diversity of other spaces that exist simultaneously, and Certeau's "space as a practiced place" (1988) denoting space as produced by its operations, its location, its temporalities, "situated as the act of a present (or of a time..." (117).

Norberg-Schulz, in *Existence, Space and Architecture* (1972), presents the concept of *existential space* as a stable system of perceptible images and schemes of the environment. Within this concept, space is the product of the interaction between the organism and the environment, and it is impossible to dissociate perceived reality from action. Later, in *The Phenomenon of Place* (1976), Norberg-Schulz updates the concept of space to encompass a "three-dimensional totality of everyday experience", referring to the conjunction of *concrete space* (three-dimensional geometry) with *lived space* (perceptual field), rooting its results in concrete situations, finally summarizing it as a system of relations. This relational perspective of space conceives the object and the subject as a unity that is physical and phenomenological, static and dynamical, as situations in constant transformation, implying space as an entity that evolves through permanent metamorphosis. It is as active in its physical configurations as in its metaphysical determinations. In Auge's work, the relational quality of space is essential for connecting physical expressions with identity and history. Spaces that do not hold enough

significance, which "cannot be defined as relational, or historical, or concerned with identity, will be a non-place" (Augé 1995: 77-78).

The paradigm shift from abstract to phenomenological space brings together a cultural conception. This enables the dynamization of space through new social production processes, which are based on the deconstruction of traditional ideologies and the emergence of novel forms of experiences. Guy Debord's *La Dérive* (1999) proposes a different phenomenological approach to space, an endless psychogeographic variable filled with emotional entities, atmospheres, and performance. Space becomes affective and is composed through a multiplicity of situations that overlap one over the other. The production of space focuses itself on the lived space of representation and is produced not only by occupation but also by appropriation. Actions within it constantly signify it, and the sense of space is modified by crossing it; walking becomes an aesthetic act with the transformative power of the world's territories, constructing, by this act, an order on which to develop the architecture of situated objects (Careri 2009). The concept of space suddenly jumps from heterotopia to utopia, making way for new worlds to emerge—ideal worlds with new rules, as a way to escape or criticize the dominant hegemonic powers. An example of this shift is Constant's *New Babylon* (2015) and the emergence of the *happening*, the *environment*, and the *performance* as elements that produce a sensorial and situational space, defining itself as a creative ambiance. This conception of space defines itself as ephemeral and shaped by specific situations and bodies.

The performative space entails—through the process of its own production—a critical spatial practice that blurs the boundaries between rationalization and the social, and between the phenomenological and the arts. This involves the aesthetic actions of appropriation, as for example with Smithson's land art (1996) and the appropriation of the entropic spaces of the residual-built reality, or as Matta Clark's artistic action of deconstructing architecture (2006). The *in-between* role of art and architecture as critical and spatial, contributes to the expansion—or destruction—of the concept of space. These aesthetic practices hold a special potential for transforming places into spaces of social critique (Rendell 2006). They play a significant role in adding a broader critical, cultural, and spatial dimension to the interdisciplinary relationship between art and architecture. This contribution nourishes the

metaphysical, mathematical, phenomenological, and anthropological concept of space, ultimately embracing a transdisciplinary totality.

This completeness idea of space, addressing from the antiques conceptions to the contemporary ones, are actually conceived in the Deleuze and Guattari's logic of striated and smooth space; "Smooth space and striated space—nomad space and sedentary space—the space in which the war machine develops and the space instituted by the State apparatus—are not of the same nature" (2005: 474). Throughout Deleuze's propositions, I consider the absolute space of metaphysical classic philosophy as a dimensional, extensive, and mathematical-geometric body. It is measured in quantitative values and conforms to arborescent hierarchical structures. Essentially, it is a striated space. The space's conceptual evolution reported in this paper is the story of how space, initially striated with Newton's absolute space, has dissolved into a smooth space of phenomena. In contrast to striated space, the phenomenological space is intensive, rhizomatic, and defined by the qualitative values of social and aesthetic practices. It is an affective, sensorial, and emotional space.

Deleuze's smooth space becomes the paradigm for redefining the term space and guiding this research forward into sound space. Sound space, with its flexibility, not only adapts invisibly to a context but also uniquely adjusts to each experiential encounter. In this sense, sound space lacks of a defined form; it is amorphous, since the form is shaped by individual experiences. Each body imparts its own form to each space, which is modifiable based on position, movement, and perceptual approach. Sound space is essentially a smooth space, directional, where walls are sonic vectors forming relationships between body, space and traveling sound. The shape of space is in constant transformation, defined by the continuous variation of sound and its perception.

The Emergence of Sound Space

From the interaction of sound and space the dimension of sound space emerges (Balbontin and Klenner 2021). The sound space is a concept that integrates the sonic and the auditory from the sounding to the listener, bridging the objective and the subjective, and

connecting the physical with the phenomenal. The binomial definition of the word *sound* posits a duality, referencing both its objective and subjective natures simultaneously. In its objective aspect, sound is understood as the cause—the entity that produces sound. In its subjective aspect, sound is intricately tied to the emergence of sense. The term *sound* embraces a coexistence between the objective and subjective manifestations of the phenomenon of sounding; the sound space can be comprehended within this duality.

With regard to its spatial condition, sound space implies not only a physical manifestation but mainly an existential one. While geometrical space plays a crucial role in the factual manifestation, sound space transcends space through significations. These significations are dynamic creations of the body and mind exposed to the phenomenon of sound in space. It is intricately related to the sonic signal and its temporal unfolding, progressing from emission to propagation and ending with reception. *Emission* relates to sound sources, *propagation* to the objective physical phenomenon of matter vibrating to "carry" the sound wave, and *reception* to the subjective perceptual phenomenon of sound perception. These three simultaneous phases, forming a sequence from objective to subjective manifestations, lay the foundations for understanding the sound space's nature. Therefore, *sound* and *space* are no longer considered as objects but as a network of relationships that link the materiality of their physical manifestation with the phenomenality of their appreciation.

During the 20th century, the emergence of new technologies marked a significant shift in the history of music. With electroacoustic music and acousmatic concerts, the term *sound space* emerges for the first time. The sound space pushed music to integrate the context as integral part of it, while also transforming the listener from a passive to an active participant in the piece. The concert hall is replaced by alternative exhibition spaces, where it is possible to construct an aural environment. This paradigm shift radically modifies our conception of what music is, altering its narrative and discursive form towards a representational appreciation of the work. Space transforms music into an abstract and volumetric entity, creating an embodied experience where the listener is no longer an intermediary between matter and phenomenon but becomes the medium where both elements converge.

The emergence of space in music allows *sound* to rise and manifest as an independent, creative, and autonomous force capable of musicalizing itself and constructing more complex

configurations. This paradigm shift expands the notion of musical notation into a more abstract and flexible form of sound organization. Music begins to exist within a niche defined by sound, and sound, in turn, is influenced by new spatial forces that extend musical methods into other disciplines. The introduction of sound and space in music has generated a disciplinary expansion until its transformation into a transdisciplinary domain. Therefore, the emergence of sound art and other expressive forms that use sound is a consequence of the journey initiated in contemporary music and diverted by the inclusion of spatial elements, triggering a transformation of music into a transdisciplinary art form of sonic expressions.

SOUND SPACE RHIZOME

A Retrospective on Sound Space and its Rhizomatic Genealogy

The notion of *sound space* emerges as a multifaceted exploration within the music, artistic, and architectural realms, delving into its evolution from a musical object to a transdisciplinary aesthetic event. Rooted in the interplay of sound and space, the term defies strict definition, reflecting a dynamic amalgamation of interpretations throughout its historical practices and conceptualizations. This chapter engages with different perspectives on the subject of sound space, bringing together a group of architects, sound engineers, artists, and researchers—all of them dedicated to sound—to discuss the sensitive experience of listening to space, within material, and/or dematerialized realities. The methodology was based on a series of interviews, confronting their different points of view, therefore building a compelling retrospective around the subject of study. In this exploration, sound space emerges as a complex entity that transcends traditional boundaries, offering a unique lens through which practitioners redefine architecture, challenge perceptions, and engage in a dynamic interplay between sound, space, and the listener's experience. The resulting territory is depicted as a rhizomatic system with diverse temporalities coexisting and influencing the understanding of sound space within phenomenal and material perspectives. It portrays a dynamic and evolving system, celebrating diversity and interaction in a transdisciplinary field.

Introduction

When time is introduced into space, sound infiltrates, thus provoking an alternative understanding of spatiality. This conception engages the dynamism of their relationships, which are agitated through movement and vibration, destabilizing matter as a static object. Space is conditioned by movement, a relational dynamic among the matter that defines, contains, and frequents the space to which it intervenes and receives. When matter is affected by sound, a new perspective of space emerges: the sound space (Balbontín 2024). The sound space is the sonic dimension of space where both elements are intertwined and coexist, defining each other in a joint process of self-creation.

The sound space is not confined to a singular definition, rather it serves as a conceptual territory encompassing theoretical discourses and sonic practices, bringing into conversation these two essential elements: the sound and the space. The notion of sound space uses sound as a medium to express a spatial situation, whether it is a real, composed, designed, or imagined space. Explored through either theoretical analysis or artistic expression, sound space

embodies a transdisciplinary approach, drawing upon the realms of music, sound arts, and architecture. These disciplines come together to examine the sound space through various lenses, encompassing sonorous, acoustic, and auditory perspectives. This multidimensional exploration broadens the scope of inquiry, ranging from materialistic considerations to phenomenological manifestations, enabling the construction of a relational network centered around the concept of sound space.

The present chapter attempts to discuss the conceptual and sensory confrontation between sound and space, its relations and interactions, understanding both elements as a whole, as a new symbiotic element, and also as separate entities, yet still interconnected. The objective is to recognize how the sound space is produced by the social force of cultural arrangements, regarding the historical and contemporary appreciations. In this process, I have engaged with different perspectives on the subject of study, bringing together a group of architects, sound engineers, artists, and researchers—all of them dedicated to sound—to discuss the sensitive experience of listening to architecture, within material or dematerialized realities. In order to reach their auditory practices, I conducted a series of interviews. These interviews aim to create a rhizomatic map of experiences, artworks, and conceptualizations, thus presenting a territory of ideas around the notion of sound space. For organizing the information, I use the concept of the *rhizome* proposed by Deleuze and Guattari (2005), structuring a multiplicity of ideas without central points but with multiple entries, connections, and lateral movements, allowing for a non-linear and non-hierarchical network of relations.

The choice of the interviewees was made based on the proximity of their practices and research with the subject of study, considering in turn, to gather a varied and heterogeneous group of people in respect to their specific approach to sound space, which can be embraced from a more theoretical or artistic conception, from a material or phenomenological aspect, from a physical or sensory approximation. The interviewees are Ricardo Atienza[3], Brandon

[3] Ricardo Atienza is an architect, sound artist, and researcher currently living in Stockholm and originally from Spain. He is a lecturer and researcher at Aalto University in Helsinki and an associate researcher at Laboratoire Cresson (Centre for Sound Space and Urban Environment Research, Grenoble).

Labelle[4], Bernhard Leitner[5], Daniel Neumann[6], Francesc Daumal[7], Anna Bofill[8], and Pablo Elinbaum[9].

These interviews took place during a time-lapse of four years since 2019. All interviews were based in a semi-structured script that could trigger a more flexible conversation around the subject of sound and space grounded in each specific personal practice. To develop this chapter, I selected only one common question and the transcriptions have been edited for a fluid reading. They are structured in the text, one after the other, for a quick comparison of approaches, practices and thoughts. Following up, a condensation of the concept relating the interviewees perspectives with other authors on the subject, therefore putting together a conceptual puzzle for building a compelling retrospective around the rhizomatic genealogy of the notion of sound space.

[4] Brandon Labelle is an artist, writer, and theorist based in Berlin and originally from the US. He is the founding editor of Errant Bodies Press and is currently directing the artistic research project Communities in Movement at the Department of Contemporary Art, University of Bergen.

[5] Bernhard Leitner is an architect and sound artist based in Vienna, originally from the same city. He is currently a member of the Akademie der Künste Berlin. Leitner's work explores the relationship between sound, space and body, often creating architectures through sound in motion as a building material.

[6] Daniel Neumann is a sound artist and audio engineer currently residing in New York and originally from Germany. He organizes an event series called [CT::SWaM] (Contemporary Temporary:: Sound Works and Music), which focuses on spatial sound works and focused listening. He holds a master's degree in media arts from the Academy of Visual Arts in Leipzig, Germany, and has completed Electronic Music & Composition Studies at Instituto Musicale Bellini in Catania, Italy.

[7] Francesc Daumal is an acoustic architect based in Barcelona and originally from the same city. He is a lecturer at Escuela Técnica Superior de Arquitectura (ETSAB) of the Universidad Politécnica de Barcelona and at the Faculty of Fine Arts, in the Master's Program of Sound Art at the University of Barcelona. He works as an acoustic consultant for architectural projects and is currently an associate member of the Sociedad Española de Acústica.

[8] Ana Bofill is an architect, pianist, composer, and gender researcher based in Barcelona and originally from the same city. She holds a Ph.D. in architecture from the Escuela Técnica Superior de Arquitectura (ETSAB) of the Universidad Politécnica de Barcelona and has received training in Music Theory. In 1985, she worked at the Centre d'Études de Mathémathique et Automates Musicales (CEMAMU) in Paris, directed by Iannis Xenakis.

[9] Pablo Elinbaum is an architect, urbanist and researcher based in Buenos Aires and originally from the same city. He is a CONICET researcher, a lecturer at the Universidad Torcuato Di Tella, and at the Specialisation in Sound Art at UNTREF, in Buenos Aires. His work focuses on the production of urban space and urbanization processes, exploring the aurality of places.

I recognize the interaction of sound and space in your work, where these two elements collaboratively construct the binomial concept of sound space. This concept is not strictly defined as only one thing, and may have various interpretations. I would like to understand what this concept means to you and how your work incorporates it.

Ricardo Atienza: Actually, this concept is something that has occupied me for many years intermittently. It started with the reading of a classic book by Francis Bayer, about the *espaçe sonore*. In this book he raises the question of what is sound space (in music). He explores whether sound space, for example, refers to the musical work itself, or if sound space would be the score? The score as a space in itself, with codes, or is it the mental space of the composer? Or is it the space of the representation, or is the space perceived during the performance? The sound space is many things; it is a concept that encompasses a whole series of different layers.

There is no sound without space. For me, to say sound space is like saying sound. Even the sound of the anechoic chamber has a space, and the imagined sound is located in a space, in a context, even if it is mental. Sound is space; therefore, space is sound by default. It is a binomial that cannot be broken. When I talk about sound space, I'm talking about a situated experience. Sound places the listener within a specific context. From this context, and with the scale that your body is giving and the position that your body adopts, you are also giving a scale to the listening, you are situating that listening. Sound space will always be situated listening. This has a lot to do with some shortcomings of architecture, which is very graphic, very visual, it is an external conception of space, so you observe it from the outside. However, when you think of a sound space, you have to experience it from the inside; sound space is always a situated and temporal phenomenon.

Brandon Labelle: I am very much interested to develop this answer based on the idea of sound art as a field of practices. My work is very much focused on developing a historical and theoretical understanding of sound art and I approach that topic through the lens of space, architecture, urban experience, and environment. I propose that sound art is a field of

practices that understand sound as a spatial phenomenon, as a spatial possibility. In my writings I have developed the idea of space through sound, through these different spatial volumes, from the object, the sculptural voice, and finally to the environment as a soundscape. It is a larger perspective, so, it's hard to capture a single idea about what sound space is, but of course it is many things, and takes different forms, different expressions, different articulations. I can say generally speaking, that what I ended up finding out through sound and space are these relational intensities and these kinds of dynamic relational possibilities of understanding space through sound. That relationality opens up a sort of space imagination of what architecture is from a sonic perspective. What happens to architectural space if you approach it through sound? For me, it is much about sociality. Sound and space are two things that are influencing and facilitating social life and the relationships we have and/or get involved in. Sound art as a social practice and how space is part of that practice; I understand sound space as a *sociality*.

Practitioners are very aware of sound space as an entity, as a phenomenal medium, and they work with it to end up constructing different kinds of experiences of sound space; in other words, tuning sound space to create experiences, and invite us into those experiences. What interests me about sound art in relation to architecture, is that artists are very interested in upsetting architecture. Sound as a medium that can intervene within the architectural environment, and upset the stability and the geometry of architecture. Sound is a medium that can trouble the architectural form and can also work with it, leading us to ideas of atmospheres or ideas of phenomenological vitality. Often, we can say in a basic way as a conflict, presume the dichotomy of something that is static and non-static.

Sound space is this tension between time and space; a relational tension. A strange entity of those two things coming together. Sound brings architecture back to life as it agitates it molecularly. Through the voice of space, the space comes to life, and it's a moment where you understand that everything has a voice and it is very dynamic; voice is always a social question.

Bernhard Leitner: When I left Europe for New York, I had the idea of building spaces - sculptural spaces with sound. I wanted to define sound as a material, as a building material.

It was a very abstract idea, so for two years I did theoretical research, and then from 1971 to 1975 I did practical research. I rented a space in New York where I tried different configurations and different constellations to understand what it means for sound to travel. This was a very fascinating period because I discovered things that I didn't know before. I understand that you don't hear only with your ears, but also with the entire body as an acoustic sensor. In addition, I understood that the concept of space is quite different from an architectural conception which is static. Space in time has totally different concepts. The boundaries of sound spaces are not only going around, above, and under you, but are going through you.

The concept of sound space is still not really defined; there is no language for sound spaces. There is a vocabulary for sound, for architecture, for sculpture, but there is no vocabulary for sound space. This was a real challenge. People didn't understand this, so I had to use photographs, texts, and describe things. Today is much easier because sound is available to everybody. At the very beginning, I worked with movements of sound, but the line was not a visual line, it was an acoustic line of moving sound. Lines of sound can define space aurally, so, I just replaced the points for speakers.

Daniel Neumann: I'll start framing the concept of sound space as an instrument. I see the loudspeaker in connection with the space. My sound space instrument is going to create a sonic work—a composition. That instrument, between the architectural space and the loudspeaker, will create a sound space while triggering a relationship within the existing space. It creates something artificial, creates new tonalities, expands the existing space, morphs it. That's the beauty of what sound can do with space, you can actually morph a three-dimensional space into something artificial or expansive that has the listener in it. That it's not a separate thing like a painting on a wall. The beautiful thing about sound space is also that it includes the listener within it. Sound space to me is a temporary formation with all these different elements that make it happen in a certain moment. One of the fundamental elements is the listener who is inside of it and participating in its production. The space becomes a listening space and the listening space it *is* the sound space.

Francesc Daumal: Sound space for me would be the concept that combines sound with the design of space. It is the will of the architect who wants a space to sound in a certain way. It

is a poetic act that transforms architecture in a representative space. When you enter a space and you feel emotionally impressed, you are in a representative space. It has to be large, bright, reverberant in one sector and intimate in another. All spaces should have a certain reverberation. Reverberation is an aspect of the sound space. A sound space will have a tone, certain timbres, it is designed with certain dimensions so that there are stationary frequencies that match with certain musical chords, because as a designer, I can tune the space.

The sound space has certain adjectives that allow the designer of the space to define it sonorously. The concept of sound space is not the acoustics, it is not the sounds emitted by the space, but the aesthetic value given to the sound context. The parameters with which the sound space is defined are given by the musical language; reverb, sound strength, tone, timbre, crescendo, or decrescendo. All musical concepts can be transferred to space. When we have the language, we can express ourselves and we can design the sound space.

Anna Bofill: The sound space is a space that surrounds us, which is full of sounds. These sounds reach the auditory organ. The sound space is a magnetic field, a field of forces. Gravity governs not only earth, but the cosmos, all of those relationships between the elements of the universe. The relation between one mass and another is the gravitational force and they create a gravitational field that would be equivalent to the sound space. A spatial sound field is similar to a gravitational field, with forces that affect sense.

Pablo Elinbaum: The concept of sound space is quite ambiguous, open, and polysemic. For me the sound space is the space that we can perceive through listening, but it is not an acoustic space properly speaking, it is not a space designed to be built, but a space connected to experience, to the experiential, to the perceptive. I call it *aural space* rather than sound space; I think it is a more precise term. In any case, for me, aural space is a tool of knowledge, an interpretative tool of the environment, and therefore of quite broad and subjective utility. Architectural space is a Euclidean space, a geometric space, is modulated, perfectly delimited, while aural space—or sound space—is a non-Euclidean space; it's discontinuous, heterogeneous, intermittent, and disruptive. Architecture fractures space, and sound brings it back together. Aural space is a performative space, and it is the space that is produced by the

people's activities. Aural space questions the methodological notions of urbanism, geography, architecture, as also those ideas of place, territory and scale. In aural space, these notions do not exist. It has a non-factual dimension. When we listen, some things can be verified, but there are other things that cannot, and then you do not know if you are imagining them, if it is a thing of suggestion, or of memory.

Sonic-Spatial Practices

The concept of sound space first appears in music with the inclusion of the spatial variable, which quickly expands through the discipline towards its borders and into other disciplines. In this process it switches from a musical *object* to a transdisciplinary aesthetic *event*. Within the music field, Bayer (1981) describes four parameters of sound: duration, which is related to time, intensity to quantity, timbre to quality, and pitch, which is related to *space*. Thus, from a rather abstract conception arises a spatial approach to musical composition. The notion of space begins to engage an ambiguous scope of possibilities. Firstly, a sound space is evident in musical notation, employing a spatial vocabulary that designates an imaginary space where sounds are arranged at different heights, intervals, and depths, which together make the musical piece as a graphic expression of a certain sonic volumetry. Secondly, in terms of performance, we can notice the sound space displaying itself in the musical virtuosity of the interpreter, who has to build this sonic volumetry from the score with his instrument, for it to be perceived by a listener.

> Through the phenomenon of listening, space is thus perceived aurally by the subject; and it is within this aural perception that this sound space, first inscribed by the composer in the score, then physically concretized by the gestures of the performers, finally exists musically in a complete and effective way (Bayer 1981: 11).

As Bayer states, the sound space is the spatial configuration that sound can delineate between its own tonal relationships and characteristics, but also the spatialization of sound sources, which provides spatial relationships between the sound that is emitted and the reaction of the space that contains it. These ideas will organize the sound space as a transversal network of meanings that cross diverse dimensions and that will be named and classified by

a range of terms, by authors such as Michel Chion with *internal and external space* (1999), Denis Smalley with *composed and superimposed space* (2008), Karlheinz Stockhausen (1958) with *musik im raum*, Murray Schafer (1991) and Barry Truax (2006) with *acoustic space*, François Bayle (1991) with *acousmatic space*, among others.

Within the field of music, the spatial arrangement of speakers will define the sound space, enabling the manipulation of physical space through the emission of sounds from different sonic points. These sounds may vary in rhythm, speed, and movement, creating figures that traverse the space. Here, the concept of sound space is defined by the interplay between the sound produced and its spatial disposition. Sound spatialization emerges as an instrument that can modulate a dialogue between the room morphologies and the speaker. The composition incorporates a spatial proposal aimed at reimagining the surrounding architecture, while projecting sound in space within a "diffused space" (Smalley 2008: 123). As Neumann suggests, it is the composer's creativity that determines how tonalities can expand and modify the existing space.

The development of sound spatiality was widely explored by Bayle's *Acousmonium.* This instrument experiments with a heterogeneous arrangement of speakers and their relationship with space. Bayle (2008) considers space as something that is not purely objectual, but something traversed by time and speed. "Space is to be understood as a practice, a phenomenon and a representation" (Bayle 2008: 133). Sound space is presented here as a dynamic entity with creative agents, enabling us to hear it; sound has the ability of sounding space. In a perceptual process, this relation between space and sound is shaped as "energetic beings" (Bayle 2008), which enables us to hear figures, diagrams, maps, or images. For Bayle, the sounds in space are entities that take the form of sonic images that are only perceptible within the realm of listening. The sound space, as a temporary and ephemeral phenomenon arising from a creative act, can be apprehended by the listener as a plastic and autonomous element, shaped by the act of listening.

The listener, as Neumann declares, is a constituent element of the sound space; "the beautiful thing about sound space is also that it includes the listener within it". Without the listener, the sound space does not exist. It is they, the one who will produce the sound space through their listening experience. Within *spectromorphology*, a concept developed by Denis

Smalley, we can analyze the listening experience, focusing on the interaction between the sound spectra and the way it is shaped through time and space (Smalley 1997). "Spectromorphology is not a compositional theory or method, but a descriptive tool based on aural perception" (Smalley 1997: 107). This sonic motion can suggest real or imagined sonic shapes involving the body within them.

Spectromorphology becomes a sonic dynamization of the three-dimensional qualities within a listening space, shaped by both the sonic elements and the listener's presence. This interaction highlights the importance of auditory perception, challenging the conventional understanding of sound space as aural rather than sonorous. Pablo Elinbaum addresses this dichotomy by introducing the term *aural space* in place of *sound space*, as he declares "a more precise term" that refers to the space that appears while listening. In his artistic practice and research project *Monuments of Aurality* (2022), Elinbaum explores the auditory dimensions of spaces where social and spatial elements intersect, examining the social implications of sound on the physical environment. Aural figures resembling the sonic images proposed by Bayle and Smalley emerge within the context of contemporary urban space production. As Neumann suggests, "the space becomes a listening space and the listening space it *is* the sound space", indicating that the sound space produces itself through aurality.

At the same time that sound *builds* space, sound is *filtered* by the space, while generating new sonic features with spatial attributes. In the piece *Soundfield for the Cistern*, performed at the Architecture and Listening Festival *Espacios Resonantes* (2022) in Santiago de Chile, Neumann used the *Room Tone Generator*[10] to attune sound to the space's resonance, not necessarily aiming for mathematically precise resonance, but for tones that evoke a spatial sensation in the listener regarding the space's response. The sound space is capable of mapping intensities via the sound pressure of spectral differences. As the listener participates in the conception of the sound space, one can transform their listening body into a constituent element of the space. From a perceptual approach, sound space is a dynamic morphing entity shaped by the body and triggered by the corporeal presence and actions. Its temporal and

[10] The Room Tone Generator, developed by Daniel Neumann, is a software synthesiser designed to subtly manipulate existing background noise. This tool was originally created for Axel Töpfer's installations to enhance the original ambient sounds by adding subtle layers of texture.

oscillating nature distinguishes it as an event or propagating force rather than a static object. An action of *going.* Going through a certain space-time that has a beginning and an end.

The relationship of the speaker with space and the body follows a unique triad that defines sound space as a phenomenal element, as notably exemplified in Bernhard Leitner's series of sound installations—*Sound Gate, Sound Slope, Corridor Variations, Wall of Sound, Sound Waves, Oscillating Boundaries,* among others—developed and exhibited at his gallery in New York. These installations consisted of structures made of wooden elements, each 4m long, supporting up to 48 loudspeakers. These structures were designed to test various motions of sound in space, including; "a vertical descending line of sound, sound crossing below and above a moving person, the guiding characteristics of a horizontal motion, various degrees of inclination of straight lines of sound, sound moving towards a person, sound moving away from a person, loopliness in horizontal and vertical grids of loudspeakers" (Leitner 1978: 14).

Leitner's sound installations, which he designates as *sound spaces*, use sound as a material for building invisible spaces through sound spatialization. In Leitner's conception, the space in motion becomes an invisible element, with the body serving as a listening system capable of translating the abstraction of sound space into spatial sensations. After his time in New York, Leitner re-evaluated the conception of space as something static and inanimate. The sound space has a life of its own, fed by our own body as an acoustic sensorium, thus actively participating in its conformation. Leitner suggests the notion of space as a sequence of spatial sensations triggered by sound—a temporal event where "space unfolds in time; it is developed, repeated, and transformed in time" (Leitner 1978: 13). Sonic embodiment establishes a relationship between the sound installations that comprises a space and the body that experiences it. Leitner's artworks are different types of "musical" instruments for producing space through listening, where each one of them has a particular way of defining space; "a listener has to continually resituate him or herself not only to find the sculpture but, more important, to realize it" (Labelle 2015: 169).

Leitner's sound spaces can generate a large number of spatio-temporal experiences. They propose new forms of sonic embodiment, in which the action of creating sound space is in itself *the* sonic experience. The physical presence of sound moves around the body and trespasses the body; as he argues, "the boundaries of sound spaces are not only going around,

above, and under you, but are going through you". Leitner's installations were intended to be perceived by the body in different ways, through body movement by traversing the sound space, or by letting the sound space inhabit the body, wrapping it as an envelope. The effect of his sound spaces generates an expanded appreciation of the spatial sensation: a dynamic and morphing space, ephemeral, modified second by second. This sensorial activation of the body is an expanded way of listening, which triggers a space with multiple interpretations that, through the auditory imagination, produces a sounding infrastructure.

Architecture becomes performative as it responds to sonic movements experienced by the body within a physical surrounding. As sound flows through space, different acoustic phenomena emerge in this process, such as absorption, diffraction, and acoustic reflection. The space is a sonic filter which transforms sound by multiplying or diminishing its volumetric presence through acoustics. The spectral response of space to certain frequencies is part of the possible forms of interaction between sound and space; each part of the spectrum behaves differently. For example, the high frequencies are directional and as the frequency decreases, the sound loses directionality, until it reaches the low and sub-low frequencies becoming omnidirectional, generating a ubiquity effect of sounds that seems to come from *everywhere*.

Although the entire sound phenomenon—emission, propagation, reception—participates in the sound space conformation, it is undoubtedly that propagation is presented as a generative force directly related with space. In his work, Alvin Lucier explores the shaping of sound spaces through the manipulation of sound as an artistic material, delving into its natural properties and its impact within the acoustic characteristics of architectural spaces. Within this framework, works such as *I Am Sitting in a Room* and *Vespers* (Lucier 1980) reveal the tonality of space through its acoustic reflections. In *I Am Sitting in a Room*, the repetition of the same recording is exposed to the space, gradually deforming the audio as the acoustics interact, eventually isolating and reinforcing the resonant frequencies of the room. In *Vespers*, Lucier employs the principle of echolocation, sending a sound impulse into space to study its acoustic response.

The question of space as subject matter, can be modified through architectural design to create a filtering effect; sound space can be crafted through architectural interventions. Modifying the physical space will alter the filter that shapes the sound space. Daumal's

architectural interventions treat space as an instrument, as a great box of resonances. In his architectural practice, he has the ability to qualify the space sonorously, transferring the language of music to the language of architecture. This perspective shifts our understanding of sound space from the phenomenal to the material realm, framing it as a physical issue stemming from the interaction between sound and architectural space. Lucier's exploration of echolocation, delves into our sensory capacity to perceive the material impact on acoustic responses and how matter and architectural forms influence our interpretation of sonic reflections in space. When we listen, we instantaneously perceive space, as every sound we hear is indicative of a particular spatial context, as even music denotes the conditioned space of recording.

All human beings have the ability to sense space and interpret it; this ability is a survival mechanism. Through sound reflection, architecture becomes audible, allowing us to perceive the physical presence of space through auditory means. The materiality of space becomes phenomenal when we actively listen to architecture, enabling us to experience its tangible essence in a profound and sensory manner. Blesser and Salter (2009) propose the term *aural architecture* referring to how we listen to the multiple sound sources interacting with the spatial elements of their context and the symbolic meaning attributed to them by the listener. This suggests a shift from the broader concept of "listening to space" to the more precise action of "listening to architecture". Transitioning from Leitner's sound installations to Lucier's performances, there is a progression from the purely sonic to the acoustic matter of the sound space. It encompasses not only the physical presence of sound, but also its acoustic impact on the listener. Daumal's notion of representative space refers to a space that can acoustically convey its essence, whether it is intimate or public, reflecting its social and cultural significance. This process endows the space with meaning, transforming it into a specific and qualified place, with a spirit in coherence with its sociality.

> To evaluate aural architecture in its cultural context, we must ascertain how acoustic attributes are perceived: by whom, under what conditions, for what purposes, and with what meanings. Understanding aural architecture requires an acceptance of the cultural relativism for all sensory experiences (Blesser and Salter 2009: 3).

Lucier's echolocation performance *Vespers* serves as a practical example of how *Navigation Spatiality* operates, as described by Blesser and Salter (2009). They define this term as "those aural cues that allow us to successfully move through a space without using vision" (58), presenting aural architecture as an interpretative tool for recognizing architectural morphology through sound. In contrast, Elinbaum and Daumal's approach to aural architecture takes a different perspective, viewing it as an object especially designed for sounding in a particular manner. Instead, Elinbaum presents the concept of *aural space* as a tool for exploratory research of environmental sound, which serves to discover the *aurality* of existing spaces. The aural space is something pre-existent and implicit, which through certain operations or attitudes of listening we can discover it, like an archaeological act of revealing something that is there, but hidden. It is a space that is known only through listening, linked to experience and perception, and therefore essentially subjective. It is performative and produces itself through the social. Unlike traditional architectural space, aural space is a non-Euclidean space, heterogeneous, and intermittent. It integrates a series of contextual and associative elements between the spatial, the sounding, and the bodies. Its performative aspect has a phenomenological basis that allows us to understand spatiality through the sounds that are generated within a social interaction that is, at the same time, part of that physical context. Listening is a receptor of all that sociality reflected from space, where voices converge with resonances of architecture and cultural production. The architectural space is redesigned through a sonic experience, modifying the meaning of what it is to inhabit a space, while through sound, space is able to inhabit the body.

Aural architecture and aural space, intertwined concepts, enrich the conceptual territory of sound space, providing new insights and deeper understanding. The sound space takes various forms and expressions; ranging from the sculptural effect of the voice in the architectural space, the environmental expression in the soundscape, to the volumetric sculptures of sound installations within the auditory realm. It delineates a network of dynamic and intensive relationships, and is within this conjunction of relationships from where the sound space emerges. These relations involve bodies and voices in interaction. Sound space exists within a *sociality,* where "sound and space are two things that are influencing and facilitating social life and the relationships we have and/or get involved in" (LaBelle). This sociality will make

the environment and the architecture to vibrate, therefore creating an acoustic event that triggers a dynamic situation between the cultural production and the space that receives and reacts, generating diverse effects of expansion and contraction. The modulation of sound will not only be the task of the space, but also of the bodies that inhabit it, that intervene and constitute it. The sound space is in the voices, between the bodies and through the bodies, in the air, in propagation, in time, in architecture; it is everywhere.

> Sound thus *performs* with and through space: it navigates geographically, reverberates acoustically, and structures socially, for sound amplifies and silences, contorts, distorts, and pushes against architecture; it escapes rooms, vibrates walls, disrupts conversation; it expands and contracts space by accumulating reverberation, relocating place beyond itself, carrying it in its wave, and inhabiting always more than one place; it misplaces and displaces; like a car speaker blasting too much music, sound overflows borders. It is boundless on the one hand, and site-specific on the other (LaBelle 2015: xiii).

LaBelle's perspective on sound space is closely related to sound art, which he describes as a "field of practices that understand sound as a spatial phenomenon". Sonic practices have a direct impact on the notions of spatiality; they serve as the unifying element for understanding sound space through the convergence of its sonorous, acoustic, and auditory aspects. It is a relational production within a dynamic concept that constantly evolves and acquires new meanings through its material and phenomenological expressions. Sound has evolved as an artistic medium, particularly in its interaction with spatiality; at the same time that matter is affected by the movement of sound, matter is also affecting and modifying sound, filtering it. The space is defined by its acoustic presence that is agitated by social and environmental sounds, amplifying life within. As LaBelle states, "sound brings architecture back to life, it agitates it molecularly". The spatial experience involves participating in the dialogue between sound sources and surrounding space, where the acoustic response reflects its morphology and dimension through its voice.

The Listening Biennial, directed by LaBelle, serves as an experimental laboratory, bringing together different voices from artists, researchers, institutions, and collectives. It focuses on listening as a relational capacity, a philosophical and political proposition, a creative practice, and a research framework. The project provides a context for the discussion and presentation of listening practices in relation to *site-specificity*. These listening practices are social, temporal, and geographical, positioning the subject within a specific site, thus establishing the

foundation from which the relational character of sound space emerges. The contextual aspect of space transforms sound into a localized presence, thereby defining sound space as a site-specific practice. This practice promotes the dematerialization of art by constructing ephemeral situations and actions unique to specific spaces. According to Atienza, "sound space is always a situated and temporary phenomenon". Donna Haraway's concept of *situated knowledge* (1988) refers to information derived directly from our situated experience, which we can understand through our senses or alternative forms of knowledge, different from the dominating ones such as science, language, and *a priori* knowledge.

Gaining understanding of sound through space and space through sound is a form of knowledge that can only be accessed through our direct experience of listening *in situ*. In Atienza's series of artistic interventions recorded in the album *Playing the Space*, he uses instruments and voices in urban environments to gain alternative insights into the city. These practical tools act as sonic interruptions, which promote a variation of the normal urban situations by composing and recomposing the existing rhythms and resonances. Sound in these interventions is contextualized within spatial and social situations. As in LaBelle's social conception of sound space, Atienza traces a flux from the object to the subject, and to their intersections, thus illustrating the role of sound as an active agent within social and political contexts.

The idea of a flux involving sound as a continuous material flow is denoted as *sonic flux* by Christophe Cox (2018), sustained by the exploration of sound substrate and the establishment of new relationships between sound and the production of reality. One of Cox's key concepts for exploring the sonic flux is the *room tone*, which refers to the background noise of a room, the base tonality of the space, usually manifested as a low-level sonic hum. The term is often used in films to create a sonic baseline for the soundtrack. Neumann uses the room tone to create spatial tonalities by exploring the resonances between the sonic flux and the space. The background noise clears the path for a sound space *flux* to emerge, transitioning from its architectural origins to become spaces for artistic action (Balbontín and Klenner 2021). In the piece *I Am Sitting in a Room*, Lucier uses the room tone to delve into the substance of the sound space, exploring its materiality and resonances with the architectural space. For Cox, the room tone is a certain sample of the sonic flux, described as "...the

immemorial background noise out of which human sounds emerge and into which they recede…" (Cox 2018: 130).

This materialistic perspective implies the continuous presence of sound over time, with room tone serving as an atemporal base throughout history. An example of this historical room tone is McLuhan's description of the Eskimos' conception of white surroundings in the Arctic as an *acoustic space*—a dark place of the mind without horizon, direction, or limits, but full of sounds (1960). While Bofill's concept of sound space as a place "full of sounds", proposes an immersive and powerful space resembling a magnetic field. Here, sound is relational, active, and a vibrating intensive force. Bofill compares sound space to a gravitational force, where orbiting sounds follow a certain logic, shaping the space. This materialistic interpretation of sound space allows us to perceive it as something plastic, as an object that has a life of its own—that grows, mutates, fades, and grows again. Therefore, sound space can occasionally exist independently of the listener, while at other times, it becomes the listener itself. It is a relational entity that integrates various terms, appreciations, visions, perspectives, and practices, spanning from theoretical to practical and from physical to sensory.

Sound Space Rhizome

Sound is a transdisciplinary entity that wanders around the field of arts, music, and architecture in its expanded diversity. The sound space is a concept that has a long story, breaking out in the second half of the 20th century until our recent times. In those years sound has migrated from music to sound art with the inclusion of space and architecture. This migration process has expanded those practices and theories for building a conceptual territory around the notion of sound space. The resultant territory takes the form of an interconnected map or network of practices with a non-hierarchical structure. Each practice constituting a niche inside this interconnected system is independent and autonomous. It is an assemblage of heterogeneity where each piece has its own logic and cooperates for an ongoing growth and spreading of the network as a dynamic phenomenon. Sound space is not a binary

dichotomy, self-conforming between music and sound art, but a rhizomatic system where different practices use sound as a spatial phenomenon and space as a sounding entity.

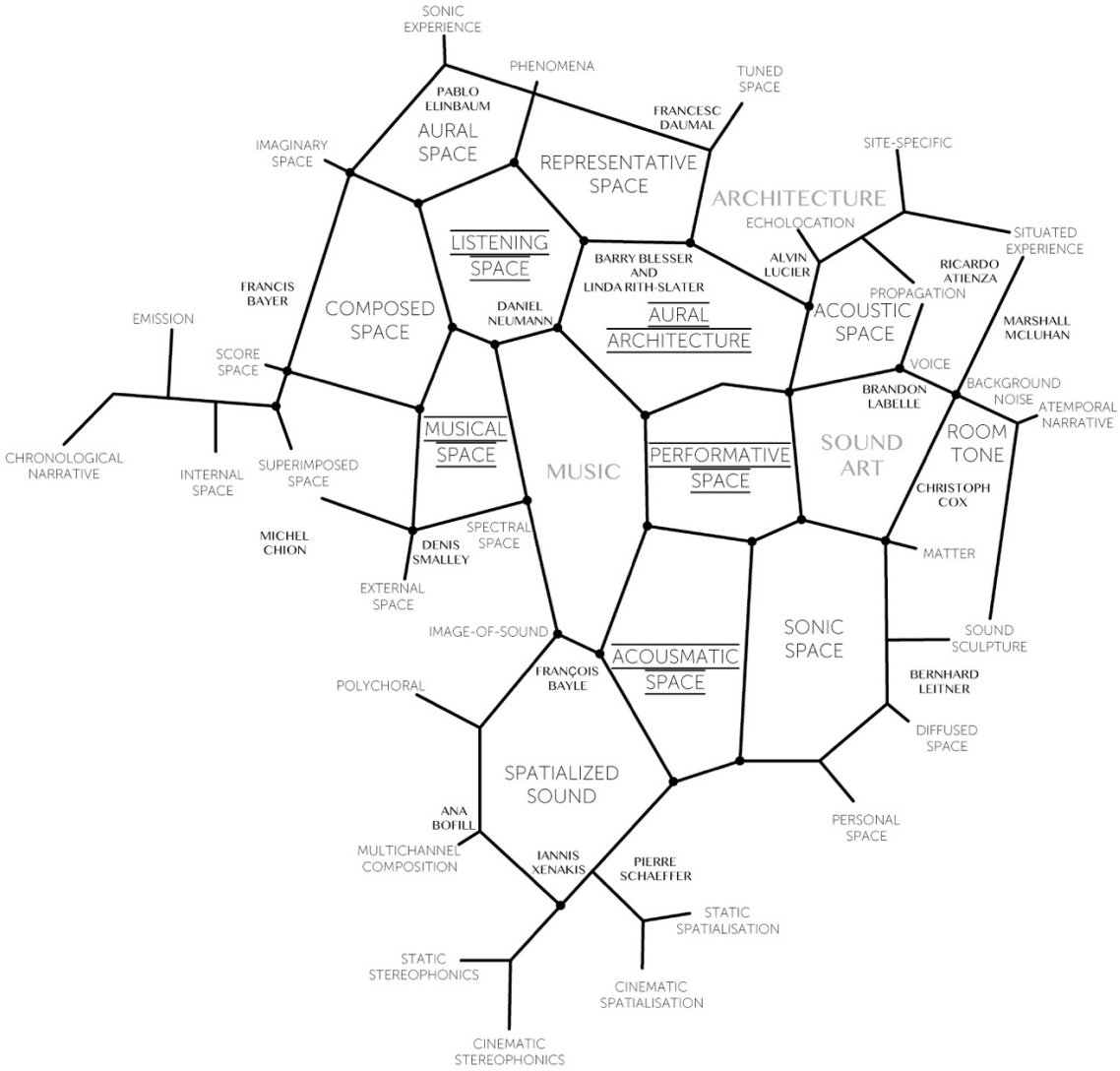


Figure 90. Sound Space Rhizome (S. Balbontin 2024).

The *Sound Space Rhizome* (fig. 90) is built from a multiplicity of perspectives and points of views, different authors, and researchers have taken the subject of study as a starting point for explaining a conceptual force that spread in multiple directions. In a similar way, artists, musicians, and practitioners in general have introduced practices, methods, and aesthetic

actions for pushing a dialogue between sound and space. Some of the terms mentioned in this chapter; the room tone, acoustic space, aural space, aural architecture, performative space, listening space, among others, are a group of terms that refer to those practices that become nodes of a bigger system. They relate with each other in a horizontal structure forming a vibrating organism that is made up of autonomous microsystems that work in conjunction as an alliance. These autonomous units have substantial differences that situate them as unique pieces of a puzzle.

Time is a constitutive component of the sound space that will be relative to each type of practice. In music, the temporal form is usually a linear narrative that has a beginning and an end, and a specific structure that leads sounds to a sequence of moments that build up a story. In Bayer's conception, the sound space is built through an expanded discourse of articulated units in a linear temporal development from the score to the *mise-en-scene*. The discursive form of sound space in music is fragmented in other temporality while transitioning to the field of arts. As in Leitner's work, linearity is replaced by looping fragments, shaping some sort of staticity that represents, through repetition, the idea of an atemporal space. The rhizomatic territory will include different temporalities that coexist inside one same entry as also in the conjunction of them; some being chronologically established while others are asynchronous. The relation with the listener will vary depending on that. Those non-chronological practices closer to the field of sound art, will conduct time in a representational form, where perception and social constructions could express an augmented notion of temporality through cultural and symbolic appreciation.

The phenomenal approach to sound space opens an extended path to the interpretative world of imagination. Smalley's tool in *spectromorphology* provides a doorway between the world of the sound spectra in terms of substratum and the world of sensation and experience. The complexity of the sound spectrum will be perceived morphologically in terms of tonality as well as in terms of temporality. Blesser and Salter reflect on how sound interacts with spatial morphology to send a filtered message to the body who will perceive and interpret, mixing it with symbolic associations, to identify the personality of space. In opposition to this phenomenological perspective, Cox's sonic flux, as a background noise that is permanently present, is not a phenomenological element, but rather matter that exists beyond our

perception; a "sonic murmur generated by the minute movements of air particles in enclosed spaces" (Cox 2009: 24). Alvin Lucier artworks use this sonic matter to transduce brain signals to sound, speech to spatial frequencies, sound impulses to sonic spatial response. All these different perspectives situate the notion of sound space in a diversity range that goes from phenomenal to material, from conceptual to literal.

This territory of ideas and practices could be understood as an extended binarism, which through polarities opens a complete spectrum of a gradient repertoire between poles. LaBelle's idea of "sound as a spatial phenomenon", activated and received by a social force, brings site-specificity to an essential aspect of the sound space. Even though acousmatic music was the first one to appropriate musical space through sound spatialization, there is a big gap from the created sound space to a contextual one. In a site-specific context, the concern on the object shifts from the sound space as a *creative tool* to the sound space as an *exploratory tool*. Here the practice introduced is not for *making* but for *knowing.* This difference is the result of a diversity of processes and methodologies to get to something "similar" but essentially different. Site-specific is to "...move away from the fabrication of objects to the dematerialized potential of events…" (LaBelle 2015: xiv). Sound as a social force that provides a means to activate perception, including personal and collective interpretations, also presents the sound space as a tool of interpretation.

Within the Sound Space Rhizome (fig. 90), the listening body, acting as a conduit for accessing auditory knowledge, gives the sound space a phenomenal quality, linking the representative space and the aural space within a listening space. However, the listening body is situated within a specific context, where spatial morphologies contribute to shaping its own sonic substratum as background noise and/or room tone. Thus, the perceived sound space undergoes a transformation from a phenomenal entity to a material manifestation, taking on the form of a tangible sonic being. Using conceptual tools such as *spectromorphology* analysis, these manifestations can be understood as energetic entities within a performative space or images-of-sound in an acousmatic space. These sonic images may take the form of invisible sound sculptures, created through atemporal narratives within the field of sound art, or by chronological narratives of spatialized sound within the music domain. In architecture, sonic images appear as invisible spaces of sound, discovered through echolocation as an exploratory

tool of aural architecture. The social body and its voices relate to one another through sonic relationships and with the surrounding context. Sound space emerges as a relational and localized presence, shaping not only physical forms but also affective characteristics. Through a process of signification, the social body begins to shape both sound and space with symbolic meaning, united by a common goal: that of giving cultural form to the sound space.

Sound space organizes itself as a natural ecosystem, with dynamic relationships between sound, space, and bodies, connecting different ontological and metaphysical dimensions, articulating a multiplicity of ideas and practices that celebrate diversity by converging a complex heterogeneity of methods and processes. Each part of this system interacts in a networked and interdependent manner, affecting and nourishing each other dynamically. Different disciplines are involved outlining a transdisciplinary field where a broad range of conceptual and material elements relate and evolve through phenomenal and physical forces. These sonic agents constitute an interconnected network of roles that contribute to specific parts of the system. While constantly changing and modifying practices, the units of the ecosystem are in a constant evolutionary process, which makes the whole system alive and morphing. Therefore, the sound space is a *transconcept* (Granger 1994), a conceptual dynamization and a restless flow of ideas, constantly integrating and organizing a multiplicity of theoretical elements into an evolving abstract macro-structure.

AURAL ARCHITECTURE

The Sonorous, The Acoustic, and The Auditory

Aural architecture emerges as a practice within artistic research based on the auditory experience, where both the artist and the listener are creative agents. It is a coexistence between the artistic action of the artist and the creative perception of the listener—a symbiotic and situated experience between both parts. This dynamic process unfolds in a sequence of episodes, beginning with a sound emitted by the artist, filtered through the architectural dimensions of the acoustic space, and being interpreted by the listener. The culmination of this process is the creation of imaginary spaces based on the auditory experience of the listener. This chapter aims to introduce the practice of aural architecture through the examination of three terms that emerge from a sonorous, acoustic, and auditory dimension of space: the sound space, the acoustic space, and the aural space. These terms will help to understand the relational and transdisciplinary nature of aural architecture and, in addition, serve as the structure for this research.

Introduction

> This is a continual production that involves the listener as intersubjectively constituted in perception, while producing the very thing he perceives, and both, the subject and the work, thus generated concomitantly, are as transitory as each other (Voegelin 2010: xii).

This chapter is an exploratory essay that situates the artist as the sonorous, the space as the acoustic, and the listener as the auditory—forming the core elements of an aesthetic practice I present as *aural architecture*. The term aural architecture, introduced by Blesser and Salter (2009), refers to how we listen to the multiple sound sources interacting with the spatial elements of their context and the symbolic meaning attributed to them by the listener. In this chapter, Blesser and Salter's concept of aural architecture is utilized as a starting point to develop the artistic practice of listening to architecture. Through this process, I will present a network of ideas and terms to explore an experiential universe of practices, which articulate together to delineate a conceptual territory that embraces the aesthetic practice of aural architecture. Therefore, readers are invited to contemplate the use of experience as a methodological approach to artistic research, fostering conceptualizations that facilitate the imagination of such experiences.

The chapter is structured into four sections. The initial three sections—*transdisciplinary practice*, *situated experience*, and *listening ecology*—lay the groundwork, leading to the final

section on *aural architecture* that presents the conceptual model of this thesis. This culmination arises from the interconnected discussions presented in the preceding sections.

The chapter addresses the listening experience as a methodology for developing a debate around music, architecture, and art—three disciplines converging to speculate on the potential outcomes arising from their intersections with sound. The initial section of this chapter introduces the subject of study from a varied disciplinary perspective, culminating in a *transdisciplinary practice*. Aural architecture could be a practice that can result in a musical composition, a dematerialized architectural design, or an artwork using sound as a creative medium. These outcomes may manifest independently or concurrently. Conceptually, this triad of disciplines is conceived as a series of negations that delineate the practice of aural architecture by what it is not. This disciplinary expansion can generate a niche formed by the sonic intersection "in-between" disciplines, not by architecture, but by acoustic architecture; not by music, but by experimental music; and not by art, but by sound art.

In the second section, *situated experience* is presented as an access channel to aural architecture. Drawing on Haraway's concept of *situated knowledge*, I argue that aural knowledge is experiential, embodied, and can only be understood through practice. Therefore, aural architecture is inherently situated, involving multidimensional and multisensory experiences, fragmented by its transdisciplinary nature into a: *situated-sonic experience*, *situated-spatial experience*, and *situated-aesthetic experience*. In this process, listening is a fundamental tool for understanding both the objective and subjective aspects of aural architecture. It connects sound emission with physical vibrations and the creative interpretation of sonic reception, bridging the gap between the sound experience and potential virtual dimensions.

The third section introduces the concept of *listening ecology*, which categorizes listening into three modalities that distinguish between the dimension of the sonorous, the acoustic and the auditory. The sonorous aspect refers to surrounding sound sources and encompasses the emission phase of sound phenomena which approaches the body through hearing within *sonic embodiment*. The acoustic aspect focuses on how sound waves propagate in a vibrating medium, influenced by the perceived physical parameters of space morphology within *sound perception*. Finally, the auditory dimension is subjective and involves the aesthetic appreciation of the sound phenomena and sense-making through *creative cognition*. These modalities

of listening form part of a process that relates sound sources to the propagation medium and the aesthetic appreciation of sound, culminating in a holistic understanding of *aural architecture* which is addressed in the last section of the chapter.

Aural architecture explores the intersection of sound, space, and body, involving interactions between the senses, environment, and imaginary interpretation. It establishes a meeting point between real and imagined spaces, facilitating heightened awareness and expanded consciousness. It involves an embodied listening, using the entire body as resonator, as sites where spatial imagination is triggered through a listening ecology. It is an experimental exploration initiated by an artistic input of sound emission, exciting matter and vibrating space, expanding to the subjective body whom perceives and interprets the sensible information, stimulating imagination and the creation of illusory spaces. This chapter concludes by introducing three constitutive terms that enrich the discourse on aural architecture: sound space, acoustic space, and aural space. Each term offers unique insights into the relationship between sound and space, contributing to a deeper understanding of aural architecture.

Transdisciplinary Practice

Aural architecture redefines geometric space by incorporating the aesthetic dimension of sound, focusing on how spatial perception is shaped exclusively by auditory experience. This idea introduces a dichotomy between acoustic architecture and aural architecture. The former refers to a discipline generally executed by architects and engineers who struggle against reverberation, echo and excessive resonance to achieve sound fidelity within spaces dedicated to music or speech. Acoustic architecture focuses on developing design techniques to mitigate or eliminate these phenomena. In contrast, aural architecture studies the acoustics of space with curiosity, as a phenomenon to promote and enhance, to exalt those qualities that reverberation, echo and resonance have, and to understand them from attentive listening and the effects it has on the listener's body. Unlike acoustic architecture, aural architecture strives to find spaces where these acoustic "conflicts" are intensified and their presence is so powerful that we can almost touch it.

Aural architecture is characterized by a nature that cannot be explained in purely spatial terms, but in a dynamic that unfolds as a direct expression of time—a temporal structure characterized by relational intensities, converging sensibilities, affects, corporeality, and topological manifestations. It shares similarities with Deleuze and Guattari's concept of the Body without Organs (Deleuze and Guattari 2005), representing a non-stratified entity devoid of defined form and inherently subjective. In their critique and rejection of the capitalist model, Deleuze and Guattari (1972, 2005), developed a theory that challenges the dominant structures of thought and social organization. Aural architecture participates in a process of *deterritorialization* (Deleuze and Guattari 2005) of architecture, freeing it from the "organs" and liberating it from physical, programmatic, and functional constraints. This dissociation from fixed structures fosters a realm of subjectivities, creative flows, intensities, and desires, preceding their channeling into specific forms of meaning. Thus, initiates a process of deconstruction of the traditionally established patterns within the discipline of architecture, challenging hierarchies of the physical over the sensorial, the objective over the subjective, and the useful over the useless, proposing new forms of existence and creative approaches to space construction from sensory experiences.

Freed from all hierarchical and dominant structures, both morphological and philosophical, aural architecture operates within a transdisciplinary and rhizomatic structure. Here, disciplinary boundaries blur, giving rise to a new niche emerging from the intersections of architecture, music, and art. Rosalind Krauss (1979) describes the convergence of disciplines as a "negation" of their original places, leading to what she terms "no-man's-land"—a space devoid of predefined meanings, akin to the Body without Organs, free from predefined roles and organizations. This no-man's-land becomes fertile ground for the creation of new paradigms and ways of understanding the world. Krauss further elucidates the emergence of Land Art through a "combination of exclusions" (1979: 66) between architecture, landscape, non-architecture, and non-landscape. Drawing from Krauss's ideas, we can discuss the emergence of aural architecture as a system of negations that delineates a territory comprising music, architecture, art, non-music, non-architecture, and non-art.

Non-Music.

In the course of history, music underwent a significant transformation, challenging the traditional canons that defined it as "musical". With the emergence of atonality in the beginning of the 20th century, music entered a period of disciplinary chaos, characterized by controversy and a lack of understanding, rendering it as unacceptable to audiences of that time. This marked a break point from the hegemonic models of the early 20th century, where atonal music no longer catered to the entertainment desires of the elite but prioritized experimentation and musical innovation.

> L'arte musicale ricercò ed ottenne dapprima la purezza e la dolcezza del suono, índi amalgamò suoni diversi, preocupandosi però di accarezzare l'orecchio con soave armonie. Oggi l'arte musicale complicandosi sempre più, ricercar gli amalgami di suoni più dissonanti, più strain e più aspri per l'orecchio. Ci avviciniamo cosi sempre più al *suono-rumore* (Russolo 1916: 10).

Therefore, music has evolved from the negation of its traditional boundaries. Technological advancements have opened new paths and interdisciplinary intersections. The advent of acousmatic music introduced the possibility of manipulating the listening space through speaker arrangement, giving rise to the concept of a *space of diffusion* (Lejeune 1991). This set off a chain of events that began with the development of sound spatialization and the introduction of the concept of *sound space* in the musical field, ultimately leading to an affective transformation in the musical experience. The evolution in musical language has redefined the relationship between "the meaning proposed by the composer and the meaning perceived by the listener" (Schumacher and Fuentes 2017: 109).

Xenakis (1958) used acousmatic listening to conceptualize a space bridging architecture and electroacoustic music. He employed principles of sound spatialization, envisioning the speaker as a point source whose repetition across space formed a line, expanding within an orthogonal network to define acoustic planes, immersing listeners in a three-dimensional auditory experience. The notion of immersion is based on the idea that sound possesses an "inner" life from which space emerges (Solomos 2020). This implies that the "inner" life of sound appears through the relational interactions among vibration, space, sonic events, sensory experience, memory, and cultural constructions of reality.

The role of music in these sonic explorations has evolved from traditional harmonic arrangements to *experimental music* configurations that uses sound as a conceptual material. When referring to experimental music, I am describing music as an experiment. This perspective on music broadens the spectrum of possibilities for spatial configurations and redefines the relationship between the composer and the listener. John Cage, in discussing experimental music, asserts, "New music: New listening. Not an attempt to understand something that is being said, for, if something were being said, the sounds, would be given the shapes of words. Just an attention to the activity of sounds" (Cage 2022: 10).

Non-Architecture.

According to Le Corbusier the word architecture means "The art of building houses, palaces or temples, ships, automobiles, wagons or airplanes" (1953: 9). However, taking this statement as a fact would be unfair regarding that, with the modern movement, the exploration of new ways of thinking and conceiving architecture has been the concern of many authors (Holl 1997, Pallasma 2012, Norberg-Schulz 1972; 1976, Ito 2000). We can recognize a will to refresh the spirit of the discipline, although without neglecting its "attributes and obligations", limited to design and construction, form and order, which materializes in the built object, and finally in what architects usually call *architecture*.

Aural architecture aims to redefine this notion by introducing alternative criteria, tools, and attitudes towards creation. It challenges staticity by dematerializing the utilitarian structures of traditional architecture, emphasizing relational and flexible environments over physical forms. It operates through the sensory stimuli, triggering creative imagination and constructing mental images based on auditory perception. These mental images are a perceptual appreciation of space through sound, constructing invisible and ephemeral architectures with walls of noise and silence.

To understand aural architecture, we must first explore the acoustic properties of space. Acoustic architecture allows us to perceive the built environment through sound propagation, providing a sensory perspective. While acoustic architecture is primarily an objective science, we can transcend its solid materiality by embracing a more sensitive approach focused

on the temporal dynamics of space through sound. The methodologies used to study the sonic characteristics of acoustic architecture will be borrowed methods to explore aural architecture. This involves enhancing listening skills and shifting the focus from acoustic high fidelity to conducting experimental acoustic investigations.

Non-art.

From the rejection of traditional art, various forms of artistic expression have emerged. One particularly intriguing form is sound art. Initially, sound art arose from tensions within the realms of art and music, often being expelled from one and the other for lack of disciplinary consistency. During the second half of the twentieth century, there was a shift from *music* to *sound*. *Music* lost its monopoly with respect to experimental arts, thus becoming a subcategory of *sound* (Cox 2018). In this context, sound art emerged as a distinct creative expression within the broader fields of media arts and music. Musicians seeking to push the boundaries of classical studies usually fell into *experimental music*. Frequently, they found themselves marginalized from traditional concert venues, instead finding acceptance in galleries and museums, where their performances—sometimes referred to as *experimental music concerts* or *sound art performances*—influenced the emergence of *sound* as an object of study, attracted by noise and silence.

Sound art uses sound as a creative and productive material for immaterial or semi-immaterial artworks. It possesses a relational nature, fostering dialogue across various disciplines and fields, and is fundamentally transdisciplinary. According to LaBelle (2015), "Sound art as a practice harnesses, describes, analyzes, performs, and interrogates the condition of sound and the processes by which it operates" (xi). The origins of sound art can be traced back to the disjunction between sound and image, facilitated by inventions such as the telephone and audio recorders, as well as the concept of acoustic space (Licht 2009). The auditory operations central to sound art are closely linked to both the listening body and the surrounding space. The impact of sound on perception contributes to a distinct spatial quality that serves as an aesthetic stimulus in creative processes.

> To register sound in the effects on perception and the hearing subject, to mark it as spatial and architectural, and therefore integral to the built environment, to speak it so as to shatter the acoustical mirror in which the self and sound bring each other into relief. And to listen intently to all that comes back (LaBelle 2015: xi).

Festival No. 25, *New Sound, New York* (2004), showcased performances and installations by sound artists exploring the connections between music, architecture, and art (Cox, 2018). Aural architecture is intricately linked to sound art from its transdisciplinary origins. The sensory construction of invisible architectures through listening, and the spatialization of sound in music to achieve architectural effects, represent artistic expressions of both sound art and aural architecture. Active participation from the listening audience is essential, enhancing a sense of expanded awareness in the listening process. This can lead to a greater appreciation of sonic qualities, fostering resonance between the human body, the sonic body, and the spatial body. Space is not merely a static object but a living instrument activated through awareness and attentive listening.

From this transdisciplinary arrangement emerges a territory encompassing music, architecture, art, non-music, non-architecture, and non-art, with peripheral niches arising from the expanded field of their oppositions into experimental music, acoustic architecture, and sound art. In the continuation of this chapter and throughout the dissertation—for better readability and flow of ideas—I will use the simplified triad of music (instead of experimental music), architecture (instead of acoustic architecture), and sound art to refer to the transdisciplinary field of aural architecture.

Situated Experience

The process of de-territorialization that occurs while conceiving aural architecture responds to a disciplinary migration within the conceptual terrain of architecture, music, and art. In the map that encloses the field of the arts, new niches have emerged that are essentially nomadic, liquid concepts that wander like islands between disciplines, like residual spaces that have been left by those traditionally established. The tangential areas of these disciplines cross over each other to bring forth the notion of aural architecture as an entity essentially

built from an intersection of relationships, falling under the category of site-specific contextual practice, and giving rise to perceptual phenomena. Considering this as a starting point for research, how can we access aural architecture?

In her rejection of scientific knowledge, Donna Haraway (1988) criticizes the social constructions that sustain and privilege the objective method to access knowledge over the experiential one. The word *objectivity* is criticized by Haraway as an iconic term of scientific domination over other areas and forms of knowledge. In opposition, Haraway proposes an embodied objectivity that supports a feminist view under the idea of *situated knowledge*. The ocularcentrist supremacy presented in the history of science and western culture, has transformed sight into a dominant and colonialist sense, by privileging an *a priori* rational knowledge that distances the object of study from those who want to know it *effectively*, referring with this, to the experience of lived knowledge.

> Science has been about a search for translation, convertibility, mobility of meanings, and universality which I call reductionism only when one language (guess whose?) must be enforced as the standard for all the translations and conversions. What money does in the exchange orders of capitalism, reductionism does in the powerful mental orders of global sciences (Haraway 1988: 580).

Contrary to scientific knowledge, aural architecture is a situated knowledge, multidimensional and essentially subjective, which arises from the aesthetic practice. It is a dynamic process, involving both the artist and the listener in a symbiotic creation between artistic action and creative perception, where the listener not only perceives but also actively contributes to the creation of the subject and the work (Voegelin 2010). Therefore, *situated experience* aims to critically engage with lived experiences derived from listening and sonic embodiment, bridging the perception of sound with imagination, to construct possible virtual realities that transcend the visual realm.

To explore sonic embodiment, I delve into the background of human experience rooted in phenomenology. Phenomenology involves understanding human experience as directly lived and perceived. According to Merleau-Ponty (2014), lived experience is closely connected to cognitive science, emphasizing the intertwining of our perception and understanding of the world with our bodily existence and sensory abilities. Our perception is not simply

passive reception but an active engagement with our surroundings involving our entire sensory system.

According to Husserl (1931), phenomenological reflection focuses on the experience of consciousness, which he refers to as the *lived-world*—the world as directly experienced and encountered in everyday life. The lived world is deeply intertwined with our subjective experiences and perspectives. It represents the world as it is actually lived and felt by individuals, rather than as an abstract concept or theoretical construct. Philosophers opposed scientific investigation, arguing that viewing the world as independent of our perception reduces the richness of experience to mere discourse.

In their book *The Embodied Mind* (1993), Varela et al. introduce the concept of *embodied reflection*, wherein the body and mind become unified. They propose that reflection "is not just *on* experience, but reflection *is* a form of experience itself" (27). They argue against disembodied theoretical traditions that separate the body and mind into two independent entities. Instead, they suggest that knowledge is dependent on our existence in a world inseparable from our embodiment. They introduce the notion of *creative cognition* as an embodiment of understanding, contrasting it with pure objectivity.

Meaning encompasses embodied experience patterns and preconceptual sensibility structures. Cognitive science has shifted away from viewing the mind as an input-output device that processes information, towards conceiving the mind as an emergent, creative, and autonomous network. Emphasizing the active role of organisms in creating their own experiences and cognition through interactions with the environment, Varela et al. (1993) articulate the notion of an *enactive* approach, which proposes that perception consists of perceptually guided action and cognitive structures emerge from the recurrent sensorimotor patterns that, in turn, enable again action to be perceptually guided. In other words, the enactive approach emphasizes that cognition is deeply attached to the body, highlighting the importance of bodily experiences, movements, and sensations in shaping cognitive processes. Cognitive processes are not pre-programmed or predetermined but emerge from the complex dynamics of the organism-environment system.

Drawing from the enactive approach, Varela et al. propose three stages of human experience: appearance, perceived attributes, and experiential category (1993). Our experience is

shaped by all three simultaneously. I will elucidate each stage using the example of aural architecture. The first stage pertains to the sonorous and how sounds manifest themselves and their sonic appearance structure, which relates to the external information of the surroundings. The second stage involves internal information concerning the perceived attributes of sound reflected from space. The third stage conceptualizes aural architecture as an experiential category.

The first stage is grounded in the notion that sound possesses predetermined properties, while the second stage involves the projection of an internal image derived from the reflection of external information triggered by sound perception. The third stage represents the dynamic interplay between the first two, where audition is not merely a passive response to external stimuli, but rather a creative process of enactment based on sonic embodiment. In this dynamic relationship, bodily interaction with external inputs, stimulates our innate capacity to imaginatively project internal information, forming a dynamically creative cognitive process that intertwines body and mind.

For the purposes of this chapter, I will state that a situated experience is rooted in these three stages of human experience. The first stage of appearance, delineates the sonic environmental information concerning the sound itself and its spatial positioning, triggering a *situated-sonic experience*. The second stage of perceived attributes, involves how the surrounding space modify the sonic signal, and how we perceive this signal filtered through space, engaging with a *situated-spatial experience*. The third stage involves a process of conceptualization through cognition, that integrates the external information through an internal process of creative-perception. This means that we cognize the external sonic information, through internal perceptual processes, and we organize mentally this information in a creative personal manner as spatial images of what we are listening. I will relate this final stage to the idea of a *situated-aesthetic experience*. While these stages are presented separately, our experience of aural architecture is shaped simultaneously by all three; sonic, spatial, and aesthetic.

Situated-sonic experience.

Situated-sonic experience refers to the encounter with sound within a specific space or environment. It encompasses an immersive experience where sound is an integral part of the overall contextual situation, giving rise to an embodied form of listening. The conceptual notion of sound being situated suggests the interplay between the body and other entities within the social and sonic dynamics of the environment. While sounding together, they reveal how space and embodiment constitute one another through sound. In this situated and embodied experience, sounds contribute to the perception of the body in relation to itself and other entities—be they social, physical, or imagined—thus forming intricate and unpredictable spatial networks (Ouzounian 2006).

A situated-sonic experience is grounded in the initial stage of appearance as described by Varela et al., wherein phenomena are directly and immediately experienced without cognitive processing or interpretation of sensory data. This stage presents raw experiences as they manifest themselves to us. Three crucial features of sound appearance significantly influence our sonic encounters: intensity, frequency, and timbre. Intensity signifies the magnitude or strength of a sound wave. Frequency refers to the rate at which a sound wave vibrates, resulting in variations in pitch across higher and lower frequencies. Timbre encompasses the distinctive quality or character of a sound, setting it apart from others, even when sharing the same pitch and intensity.

The listener's bodily presence and movements also play a crucial role in shaping a situated-sonic experience. The physical orientation, posture, and mobility of the listener influence how sounds will appear to us, involving dynamic interactions among sound sources, listeners, and the surrounding environment. It is essentially an immersive experience, as listening becomes possible only when the auditory object surrounds us, referring not to the source, but to sound itself;

> This knowing is the experience of sound as temporal relationship. This "relationship" is not between things but is the thing, is sound itself. Listening cannot contemplate the object/phenomenon heard separate from its audition because the object does not precede listening. Rather, the auditory is generated in the listening practice: in listening I am in sound, there can be no gap between the heard and hearing, I either hear it or I don't, and what I perceive is what I hear (Voegelin 2010: 5).

Situated-spatial experience.

Situated-spatial experience primarily emerges from sound as a perceived attribute. Once sounds are emitted, they become spatially located. The way we perceive sound is correlated with how it is reflected in the spatial surroundings. Thus, sound informs us about our surrounding space. As sound filters through space, what we perceive is a different sound from the original one. This compels us to conclude that we cannot solely attribute our experience of sound to the sound itself; instead, we understand sound as a perceived phenomenon through spatial morphologies. This knowledge offers a range of elements to describe the spatial experience of sound, including the space's size, shape, rigidity, and the spatial positioning of the sound source and listener in terms of distance, orientation, and trajectory.

Although a situated-spatial experience is a physical manifestation, it is primarily an existential one, built through transcendence and personal/collective significations launched by perception. These significations are dynamically created by the body and the mind exposed to the spatial experience. As Lefebvre (2013) states, each body has a space and is a space. The body is produced in space and simultaneously produces that space. Norberg-Schulz's (1976) conception of space as a "three-dimensional totality of everyday experience" contributes to understanding spatial experience as a dual signifier. The conjunction of *concrete space* (three-dimensional geometry) with *lived space* (perceptual field) engages in a dialogue between the physical aspect of space and the perceptual one, forming a system of relations. This relational perspective of space considers the objective and subjective as a unified entity that is both physical and phenomenological simultaneously. Therefore, a situated-spatial experience occurs in a situational space that must be activated by the body. It possesses a performative condition and creative energy that shape themselves through aesthetic action, holding the potential to comprehend space as the production of spatial knowledge.

The term *site-specific*, used within the field of the arts, denotes that a work is created from and for a specific space and is experienced in relation to that space. The situated-spatial experience involves not only space but also the conjunction that emerges from temporal, social, and spatial conditions. The relationships that unfold between the bodies that acoustically activate the space and the space itself transform the purely spatial into a relational and

dynamic entity. Thus, the spatial experience essentially arises from site-specific artistic practices, stemming from an interest that extends beyond the site itself but involves how that site is sculpted and activated to become a work of art.

Situated-aesthetic experience.

Situated-aesthetic experience refers to the affective interaction we have with a space or situation, evoking emotional qualities. It transforms a specific context or environment into an atmosphere, a coexistence of subjective outcomes triggered by an objective presence. Sensations become perceptual objects shaped by interpretation as part of a creative-cognition process. A situated-aesthetic experience brings forth a creative internal world of affections, giving birth to alternative realities inhabited by the phenomenological entities of perception.

A situated-aesthetic experience is related to the third stage of experiential category proposed by Varela et al. This stage involves the formation of broader, more abstract categories or concepts based on our perceived attributes and experiences, leading to a higher level of cognitive constructs that enable us to understand and interact with the world in more complex ways. Experiential categories are not fixed or absolute; they are dynamic and constantly evolving based on our ongoing experiences and interactions with the world. Drawing from enaction theory, Varela et al. emphasize the idea that cognition and perception are inherently linked to action and experience, arising through the ongoing interaction between an organism and its environment. Thus, an experiential category is formed not just through cognitive processes but also through our embodied interactions. Our perception is influenced by our actions, and our actions are guided by our perceptions; our understanding of the world is shaped not only by how we perceive it but also by how we interact with it.

In a situated-aesthetic experience, cognition is a creative process, first received by sensory knowledge and then shaped by perception to create a spatial image of what we are hearing. In aural architecture, we sense sounds within a sonic experience, perceive space within a spatial experience, and create an internal image of space within an aesthetic experience. Therefore, a situated-aesthetic experience is not a receptive-passive mode but rather a method of

dynamic exploration—a generative discovery of imagination, a sensorial engagement that shapes the symbiotic constitution between body, mind, and ambiance.

According to John Dewey (2011), no experience of any sort can achieve unity without an aesthetic quality. Even if an experience is primarily intellectual and practical, it can only be rounded into completeness by emotion. Emotions require a situational plot and space to unfold, triggering internal responses that translate sensation into the creation of aesthetic value. Thus, the artistic outcome that integrates the emotional essence of the experience is the artwork itself. Emotion serves as the driving force behind the aesthetic experience, providing qualitative unity to all the relational elements that converge and interact within the temporal action. Within this narrative of occurrences, there is a continuous interchange and blending, from the external site-specific source, to the internal filter of emotions, finally resulting in a creative interpretation. The situated-aesthetic experience establishes a modal system where sound, space, sense, perception and cognition merge to create new realities—a universe of phenomenological possibilities and exploratory potential, drawing the development of new representations and experiences.

Listening Ecology

The concept of *listening ecology* is introduced for addressing three listening modes that coexist among the sonorous, the acoustic, and the auditory. Although these terms are often used interchangeably, they are distinct, and their equivalence is often misunderstood in terms of the interaction between sound sources, the medium of propagation, and the aesthetic appreciation of the audible. The sonorous dimension refers to aspects related to the sound source, the emission of sound waves, and the initiation of sound events. It encompasses all sound sources arranged within a specific environment. The acoustic dimension refers to how sound waves propagate in space and how they are perceived. It involves measurable and quantifiable aspects of sound based on physical parameters of the phenomenon, considering the vibration of the medium as a crucial aspect. The auditory dimension is associated with the

reception and interpretation of the sound phenomenon. It excludes physical analysis and focuses on the subjectivities of cognition and phenomenal dimensions.

Listening ecology addresses the interactivity between these sounding entities—sonorous, acoustic, and auditory—the relationships they generate, and the different forms of listening that arise from each one of them. It has a transdisciplinary nature that integrates the disciplines of music, architecture, and sound art, with each contributing to a distinct type of listening that collectively shapes a new conception of reality. It is inherently linked to time; thus, all listening modes depend on a temporal condition. This confirms the coexistence between the different sounding entities, establishing their interaction within a common temporal sonic flux. Each phase of the sound phenomenon harmonizes with one another, just as each listening mode is in concordance, drawing out a relational and temporal dynamic of the complete system.

Listening modes encompass various dimensions of sound, ranging from the physiological aspects of hearing (receiving sound waves) to the cognitive aspects of processing and interpreting sound. These modes can be summarized within the sonic cognition process—from sonic embodiment to sense-making. One well-known reference that provides orientation on these sequential types of listening is Pierre Schaeffer (1966) which introduces four types of listening modes: *ouïr*, *écoute*, *entendre*, and *comprendre*. *Ouïr* primarily involves *hearing*, feeling sound with the ear, where what is heard is given by the auditory sense. *Écoute*, translated as *listening*, is hearing with some form of interest, representing an active listening where attention is focused on a specific something. Finally, *entendre* and *comprendre* are linked to a higher level of listening, involving an intention and previous knowledge for specific understanding of sound information through *sense-making*.

When it comes to listening, the information is mainly subjective regarding the way different listeners engage with sound. It is the process of receiving and interpreting auditory stimuli in order to extract meaning. There may be different modes depending on personal attitude towards sound, intention, context, and level of attentiveness. Each mode involves distinct mental and perceptual approaches to the act of listening and the interpretation of sound. It has survival attributes but also communicational ones; thus, involving not only perceiving sounds but also making sense of the information. Listening encompasses complex forms of

experiencing sound, from physical information to aesthetic appreciation, which involves further recognition of sonic aspects, with an emphasis on sensorial, creative, and emotional features of the auditory experience.

Within aural architecture, the way of approaching listening ecology is through a fragmented process of engaging architecture through aurality. Sonic embodiment shapes the dynamic interaction between the subject and the aural information coming from the space and the environment, leading to cognitive emergence. Aural architecture is not something that I can see with my eyes, nor are just the sounds that I listen from the space, but rather a cognitive process of creative knowledge that is subjective and objective simultaneously. It involves sensation, perception, and sense-making in a constant process of learning and reacting to the environment. The interaction of the body with the context will modify the way I sense, perceive, and make sense of that sensorial information. In this process, perception is not a passive receptor of sensory information but actively creative, where the perceiver constructs its own experience by giving sense to it. Using the concept of listening ecology, I will approach an interactive process between three listening modes: first, regarding the senses through *sonic embodiment*; second, from the physiological interaction with auditory stimuli by examining the relation with vibration through *sound perception*; and third, from the interpretation of sound regarding the emotional, qualitative, and aesthetic aspects that give sense to what we are perceiving aurally through *creative cognition*.

Sonic embodiment.

Listening as sonic embodiment refers to the sensory phase of the listening practice, emphasizing the sensorial aspects triggered by a sound source. It is related to what we hear and the process through which sound interacts with the body. Listening focuses on the immersive experience of audition, in which the listener engages with the sensory qualities of sound. This sensory embodiment can encompass the physical vibrations of sound, approaching it from a haptic perspective and recognizing the entire body as a listening system. Sound can evoke feelings and sensations that are integral to the sonic experience. The way we engage with

sound—our sonic embodiment—as the body's posture, movement, and physical presence, will influence how sound is sensed.

Sound perception.

Listening as sound perception mainly involves the objective aspects of how vibrations are received by auditory perception. When we perceive a sound, we discern characteristics such as space size, volume, or distance. Truax suggests that sound creates an auditory space, which, in the case of total immersion, becomes the space itself.

> …the complex pattern of simultaneous vibrations or frequencies within a sound that creates its sense of perceived volume or internal acoustic space, whereas it is the brain's ability to detect the small-time differences caused by a sound reaching our ears by different paths, such as those caused by reflections, that creates sense of an external acoustic space (Truax 2006: 2).

This mode of listening embraces the physiological aspects of sound perception, studying the relationship between physical sound properties and the auditory experience within a situated-spatial experience. It is closely related to psychoacoustics, examining how sound waves propagate through space to reach our ears. This involves analyzing fluctuations in measurable aspects of sound such as frequency, amplitude, and duration, and how these aspects influence the perception of tonal qualities, loudness, and temporality. Observing these physical cues enables humans to localize sounds within a space, providing orientation and equilibrium for vital processes. As Voegelin (2010) suggests, "Every sensory interaction relates back to us not the object/phenomenon perceived, but that object/phenomenon filtered, shaped and produced by the sense employed in its perception" (3).

Creative cognition.

Listening as creative cognition involves sound perception as an active engagement with the context, where perception and the action of the body are co-creating meaning through *sense-making* (Maturana and Varela 1972, Thompson 2011). This listening mode is intertwined with sonic cognition, representing a deeper level of listening skills that arises from an aesthetic-situated experience. Creative cognition involves executing a creative action upon

perception, stimulating imagination, which is fueled by attention and intention. It aligns with the concept of *perception-action* (Gibson 1986), where perception triggers specific actions that will shape further ways of perceiving in an ongoing loop. The interaction of the body with the context shapes how we sense and perceive, thereby modifying the entire cognitive process in a creative feedback loop. Cognition is not merely a passive receiver of perceptual information but an active process through which individuals construct their own experiences.

Aural Architecture

Aural architecture is an entity in constant flux, created moment by moment through an interactive listening ecology. This experimental journey begins with an artistic input of sonic emission, exciting matter and vibrating space, extending to the subjective body, which perceives and interprets sensory information, triggering imagination and the creation of illusory spaces. The sonic features perceived by the listener are shaped by their own interpretation, transforming sensory input into a cognitive mental map.

> The spectre of sound unsettles the idea of visual stability and involves us as listeners in the production of an invisible world. This sonic life-world might be silent but forceful, grasping us as we hear it, pulling us into an auditory imagination even if we mistake if for the thing seen (Voegelin 2010: 12).

Blesser and Salter (2009) introduce the concept of *auditory spatial awareness*, describing it as the active detection and response to sound sources and spatial acoustics. This heightened awareness entails active listener participation, elevating the act of listening to a multidimensional experience that encompasses from the sonorous, through the acoustic, and to the auditory. According to Blesser and Salter, auditory spatial awareness is an ability we can develop to explore aural architecture. It involves expanding one's perception beyond immediate auditory experience and embracing a holistic awareness that includes physical, environmental, and phenomenological aspects of the aural experience. The process of sensing, perceiving and giving meaning to sound has a scientific approach through psychoacoustics, which collaborates with aesthetic values to form a holistic appreciation of the phenomenon.

Aural architecture is not an object that stands in front of us, but rather a dynamic entity—a process that appears while being immersed by sound and immersing oneself in sound. It delves into the intersections of sound, space, and body, exploring the interplay between environment and imaginative interpretation. It is a nexus between real and imagined spaces, catalyzing an augmented state of awareness and even an expanded state of consciousness. Through an embodied listening, the entire body is used as an ear—a resonator and a conduit for spatial imagination—giving rise to the creation of aural-spatial configurations of mind-designed architectures.

Pascal Amphoux (1991) developed a taxonomy for defining the soundscape, distinguishing three subtly different considerations which he terms as the "three listening modes of the sounding world": the sound environment, the sound medium, and the soundscape. The sound environment encompasses all the audible sound sources within our context. The sound medium refers to the space through which the sonic environment propagates. The soundscape is that which we engage perceptually through aesthetic experience (Amphoux 1991). Building upon Amphoux's framework, I propose three terms that constitute the core of aural architecture: the sound space, the acoustic space and the aural space. These terms aim to establish a common language for discussing aural architecture as a creative practice, and to comprehend the extensive range of sonic information involved in the artistic process. They are not fixed concepts but rather dynamic and expansive tools, the same as the object of study in itself. While I present these concepts in a certain progression and each possesses its own logic, they collectively represent the same temporal situation perceived by a listener as simultaneous and multidimensional.

Sound space.

Sound space is built through acousmatic or acoustic configurations of one or more sound sources. It focuses on sound emission and the sources from which sound originates. Sound space is associated with sound immersion and, in the case of multiple sound sources, can include immersive configurations of traveling sound and multi-speaker arrangements

through sound spatialization. It represents an invisible space created by sound, whether static or in motion, experienced by listeners who may also be static or in motion.

Iannis Xenakis engages with sound space while modeling geometric space through sound and listening. He developed several pieces using acousmatic configurations called *polytopes* (1967-1984), where the audience could freely move within these sonic architectures. Xenakis broke down architectural space into sonic sculptures through the spatialization of sound sources. In his piece *Terretektorh* (1965-1966), he composed music involving the spatialization of an 88-musician orchestra within a performance space (1992). The audience was positioned amidst the orchestra, altering the traditional frontal disposition of the listening space.

Artworks involving sound space, such as Xenakis' *Polytopes* and *Terretektorh*, often use acoustic or acousmatic sound sources to create a space that is malleable, shape-shifting, and adaptable. These spaces are characterized by diverse morphologies and dynamic architectural structures. The arrangement of sound sources in an architectural design can determine aspects such as sound movement, velocity, pitch, volume, and silence. Each of these musical components are representing architectural decisions for providing an immersive listening experience.

Acoustic space.

Acoustic space deals with sound filtered by space, addressing the physical perspective of aural architecture. It concerns itself with acoustics and the propagation of sound waves through space, involving both objective and quantitative information of vibration, as well as subjective and qualitative information from perception. Acoustic space is closely related to acoustic architecture and the morphological design of space, which encompasses vibrations and the dynamics between sound sources and physical space. It is shaped by materiality, dimension, and morphology, which modify the way sound propagates, reflects, absorbs, and diffuses, thereby determining how sound is perceived within a given space.

Using quantitative information for artistic purposes, acoustic space can be subjectively modeled through performances or installations, enhancing the acoustic features of a space. Alvin Lucier, in his piece *Vespers* (1969), studies the morphological features of space through

performance, using sonars that affect the acoustic reaction of space through echolocation. Here, echolocation refers to the ability to understand the environment through the difference of sonic emission and acoustic response of spatial morphologies. Acoustic space brings together the acoustic characteristics of a specific built environment to create spatial experiences.

Aural space.

Aural space articulates the act of listening with cognition and sense-making through the aesthetic experience of sound in space. The sensory stimuli of aurality release a "domino effect" of cognitive responses, providing a holistic overview of the embodiment process, which triggers a creative imagination. Sound perception and individual interpretation become creative interfaces for translating the sounding space. Listening provides a way to explore our aural connection within natural or built spaces, as well as to explore our creative ability to build imaginary spaces. Therefore, the mind and body are brought to a dimension of one within the other.

In *Headscape* (2003), Bernhard Leitner experiments with new modes of sonic perception through the intersection of sound, the body, and spatial imagination. He presents a three-dimensional sculptural work exhibited as an album on audio CD. Leitner explores the creation of imaginary architectures through aurality, conceptualizing how sound, space, and embodiment can be experienced to produce and constitute another space. In this artwork, sound not only triggers a perceptual process but also an expanded state of mind. In this augmented state, the cognitive process shifts into a different dimension, where sonic immersion can alter perception, resulting in an intensified sensory experience. This can manifest as synesthesia, evoking patterns and textures from sonic atmospheres, which is part of the creative process of building imaginary spaces through sonic interpretation.

Aural space can enhance awareness of both auditory and spatial attributes, fostering a sense of unity with the surrounding sonic environment, which resonates with the body as a whole. It prompts the creation of a mental map that either recreates an existing space or invents a new one through aurality—a mental representation arising from the combined processes of

sensing, perceiving, and sense-making. Space, far from being static, becomes a dynamic instrument played through the listener's awareness.

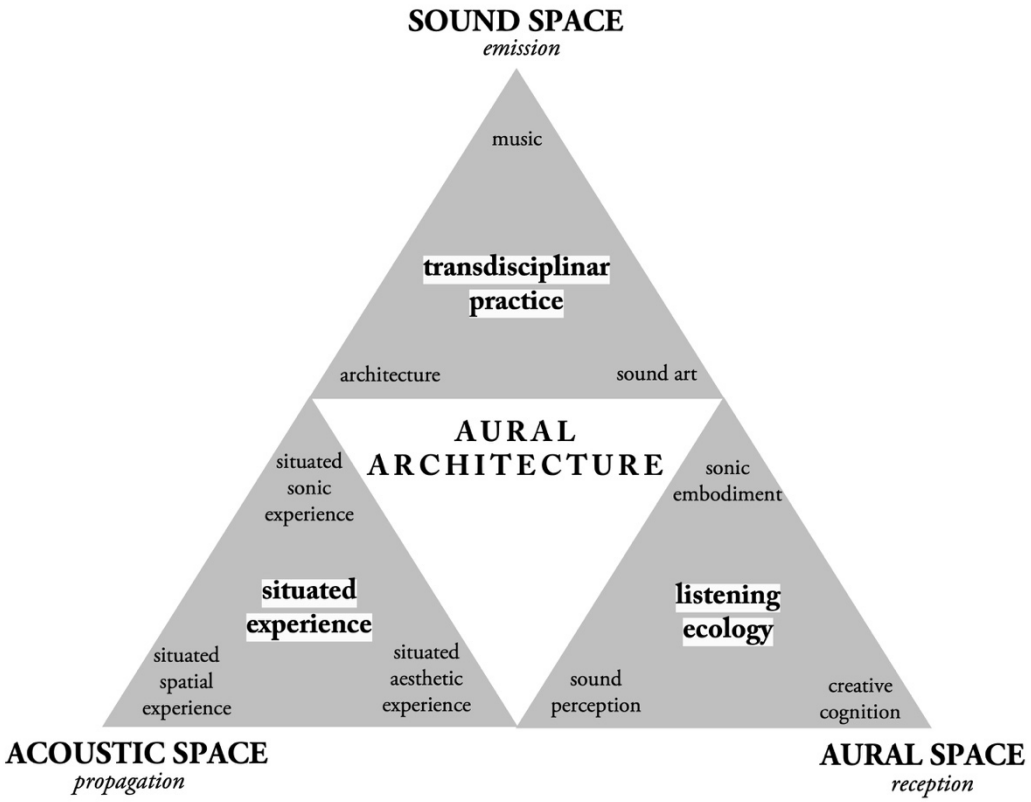


Figure 91. Conceptual model of aural architecture (S. Balbontin 2024).

The sonic encounter with music, architecture and sound art, redefines the peripheral niches of aural architecture, arising from the expanded field of their oppositions into experimental music, acoustic architecture, and sound art. Experimental music employs sound in a dynamic and malleable manner, building spaces through the arrangement of sound sources that "illuminates" architecture. In acoustic architecture, spatial elements converge to shape the sonic “voice” of space, including the modulation of sound, the flow of sonic energy and the form of propagation. In sound art, the performative artifact serves as a conduit that bridges the gap between the artist and the listener, fostering an interactive engagement with sound. For better readability and flow of ideas, I will use the simplified triad of music,

architecture, and sound art to refer to the transdisciplinary practice of aural architecture in the chapters that follow.

From these disciplinary intersections emerges a rhizomatic map of conceptualization around aural architecture based on sound phenomena. Sound emission intertwines with elements such as the sonorous, the artist, the sound source, music, sonic embodiment—the sound space. Sound propagation is linked with acoustic properties, spatial dynamics, architecture, vibration, sound perception—the acoustic space. Sound reception involves the auditory, the listener, artistic expression, aesthetic interpretation, sense-making, creative cognition, spatial imagination—the aural space. The relational nature of sound encompasses these intermodal interactions, where sound influences our perception of the "spatial-architectural", thereby enriching the cognitive process of creative imagination inherent to the practice of aural architecture.

The creative practice of aural architecture is flexible, simultaneously emerging through various listening modes. At times, it may lean towards the sound space, or the acoustic space, or both, and it can also lean towards the aural space or encompass all three equally. In this regard, the forms that aural architecture may take are diverse and unpredictable. If originating in the sound space, it will be characterized by sound spatialization. If originating in the acoustic space, the focus will be on echolocation, whereas if emerging from the aural space, the emphasis will be on the creation of imaginary spaces. Although they may be explained for clarification as separate entities, it is important to emphasize that all three will invariably work together as a whole, forming a cohesive entity presented as aural architecture.

AURAL ARCHITECTURE

PRACTICES

SOUND SPACE

Invisible spaces built by spatialized sound

This chapter delves into the concept of sound space as an integral dimension of aural architecture, examining its origins in the evolution of music and its expansion into other disciplines such as sound art and architecture through sensory experiences, thereby triggering a discussion on its scope through both conceptual and practical approaches. To address the practical phase, I focus on the invisible space built by spatialized sound as a subject of study, developing through a practice-based methodology, a creative process involving different aesthetic experiences from the *Espacios Resonantes* project. These experiences take the form of multichannel sound performances, installations and virtual reality, encompassing site-specific interventions, sonic translations and virtual architectures. The central argument proposes that within these performative experiences, sound spaces can be created through the sonic embodiment of multichannel installations featuring virtual or acousmatic spatialized sound.

Introduction

With the emergence of electroacoustic music, space gained significant compositional importance. Explorations of spatial orchestral configurations beyond traditional frontal arrangements, along with the development of acousmatic music employing spatially arranged speakers, pushed space into a prominent role within 20th-century music. This expansion of spatial considerations allowed music to open up to new fields of action, expanding its frontiers towards the artistic practices of sound installation and performance. As part of a broader musical experimentation—which often falls under the umbrella of *experimental music*—the boundaries between music and art began to blur, paving the way for the emergence of sound art.

This chapter explores the concept of sound space, first, as a breaking point in the evolution of music and as a cause of its expansion into other disciplines, second, as the result of new encounters with space through the sensory experience of sound. The aim is to initiate a discussion on the concept of sound space, delineating its scope from both conceptual and practical approaches. The conceptual methodology delves into the historical roots of sound space in music and its integration into other disciplinary realms, specifically sound art and architecture. Meanwhile, the practical methodology proposes multichannel sound performances,

installation and virtual reality as a means of both creating and investigating sound space, supported by several artistic experiences as case studies.

I suggest that the decomposition of music into "organized sound" led to the inclusion of space as a compositional element, thereby altering the historical trajectory of musical development towards transdisciplinary exploration. This leads to a central argument concerning a disciplinary shift from music to sound art, exploring how within performative experiences, the sound space can be created through the sonic embodiment of multichannel installations of real or virtual spatialized sound. To support this claim, this chapter traces the evolution of sound space through various historical experiences, beginning with composers such as Bayer, Bayle, Vande Gorne, Chion, Brant, and Smalley, who initially explored space within music. This exploration extended into disciplinary crossings with architecture, exemplified by composers as Xenakis, Varese, and Stockhausen. Finally, the narrative culminates in the realm of experimental music, which served as a bridge to sound art, involving artists such as Leitner, Minard, and La Monte Young. This progression facilitated a shift from traditional orchestral configurations towards the creation of aesthetic experiences through sound installation and multichannel music performance, within acousmatic spatialization.

The intention of this initial historical phase is to establish the conceptual framework necessary for developing practical methodologies aimed at creating immersive sound spaces. Specifically, the focus is on using multichannel and acousmatic configurations of spatialized sound to achieve this goal. The practical methodology employed in this investigation involves the evaluation of a selection of artworks from the *Espacios Resonantes* project. Within this project, the collected aesthetic information from industrial spaces is translated into experimental outcomes for generating alternative and subjective narratives across various mediums, including music, video, performance, multichannel installation, and virtual reality.

The practice of *aural architecture* is introduced as an aesthetic experience, engaging three dimensions of spatial awareness: the sonorous, the acoustic, and the aural. Within the sonorous aspect, I refer to the sounding entities as the *sound space*, engaging its evolution from musical genesis into artistic expressions within sound artworks. From this starting point, several questions arise that will guide the development of this chapter; How can real or virtual multichannel installations or performances create a sound space? How does sensory

engagement with spatialized sound construct an invisible space different from the physical one in which it is situated? How can aural architecture emerge from the creative act of composing sound spaces?

Eleven artworks will serve as case studies to observe and explore the creation process of sound space through sonic embodiment. These case studies employed acousmatic or virtual configurations for sound spatialization employing experimental music compositions. The first three performances emerged from the iteration of the *Polyhono* project conducted between 2021 and 2023:

(1) A vertical sound spatialization setup inside a water tower for the *Espacios Resonantes Festival* in Santiago.
(2) Large-scale spatialization setup within the Queiriga Mines in Viseu, as part of a residency at Binaural Nodar.
(3) Linear spatialization within the underground tunnels of Galerias do Loreto, integrated as an intervention for the Museu da Agua in Lisbon.

Subsequent artworks include:

(4) A performance with spatialized sound resulting from a residency at the Spatial Sound Institute (SSI) in Budapest, 2021.
(5) A multichannel installation that transported the Inchindown Oil Tank to the XV Biennial of Media Arts of Santiago in 2021-2022.
(6) A multichannel performance for the VII Music Biennial at Yale University in 2020.
(7) An installation of the reverbs of Valparaíso at B.A.S.E gallery in the same city in 2019.
(8) An album of spatial compositions from Expedition #1, available on vinyl and released in 2020.
(9) An augmented reality performance for the IV International Congress on Ambiances held online in 2020.
(10) A virtual reality installation for the Sonar Festival in Barcelona, 2023.
(11) A hybrid performance that mixes virtual reality and a site-specific performance in Lisbon, 2023.

Spatialized Music.

Since the 20th century, the sonic realm has expanded beyond the traditional two-dimensional axis of pitch and time. Advances in sound system technology and the advent of acousmatic approaches have introduced a new dimension in music: the space. In the field of electroacoustic music, the concept of sound space initially emerged to define the spatial arrangements of sound sources. This occurred primarily with speakers but also in post-tonal contemporary spatialized orchestras, where musicians were strategically positioned in non-frontal configurations.

Music introduced space as a new dimension with novel relational features between the composed and the perceived. Approaches to sound space encompass a diverse range of terminologies, including acoustic space (Poulard, Redolfi, Farabet, Guerin, Schafer 1991, Truax 2006), spatial-music (Henry Brant in Harley 1997), spatialized music (Harley 1993), *musik im raum* (Stockhausen 1958), spectral space (Smalley 1997), *l'espace de timbres* (Vaggione 1991), *la musique environnementale* (Minard 1991), *l'espace radiophonique* (Portevin 1991), la *polyphonie spatiale* (Ascione 1991), acousmatic space (Souffriau, Duchenne, Bayle 1991), *l'espace musical* (Bayer 1981), among others. Composers have expanded their exploration of spatial aspects, introducing new composing elements such as morphology, spectra, phases, movement, context, transients, intensity, brilliance, fusion, and separation (Risset 2005), exploring the intricate relations between them. Harley (1993) describes this transformative process as a shift "from point to sphere", wherein the understanding of music evolves from the purely temporal to the spatio-temporal, transitioning from a one-dimensional point to a three-dimensional sphere.

Within the history of music, attempts at defining and classifying sound space have led to confusion and complexity, as this concept encompasses simultaneously diverse situations such as acousmatic spatial disposition, spatialized orchestral distribution in space, and the composed space in the score and the sound source's disposition in the *mise-en-scène*. Francis Bayer (1981) identifies this confusion and explains how the problem resonates in other

artistic domains, such as art and architecture, unveiling an interdisciplinary issue surrounding the concept of sound space.

The first spatial approach to music, was that of pitch. The study of pitches in music has prompted reflection on the notion of space through a perceptual approach and interpretation. Spatiality is constitutive of any musical work, with its presence evident in musical notation, regarding drawings which define intervals of spatial figures and pitch differences. "One will speak of line or melodic curve, of joint or disjoint harmonic interval, of parallel, ascending or descending movement, etc., all terms borrowed from the spatial vocabulary… the mere spatial vision of the signs can become an inner hearing of the work…" (Bayer 1981: 10).

For Bayer, the musical space is a whole that encompasses the sound space and the acoustic space as distinct entities. On one hand, sound space constitutes an intrinsic spatiality, defined by sounds in relation to each other—pitch, intensity, and duration distributed and organized in the musical score. On the other hand, acoustic space represents extrinsic spatiality, referring to the physical spatialization of the musical work in the place of execution, where space is audibly perceived by the listener (1981). As Bayer, several composers and researchers distinguish sound space as the binomial conjunction between the space composed in the score and the listening space in the *mise-en-scene*. This concept is reflected in a range of terms, such as the internal and external space developed by Michel Chion (1999), the virtual and realized space proposed by Christian Calon (1988), and the composed and superimposed space established by Denis Smalley (1991).

Orchestral Spatial Composition.

The listening space is directly influenced by the configuration of sound sources, whether acousmatic or acoustic in a spatialized orchestra. According to Harley (1993), sound spaces can be categorized into three types: 1) real sound sources (acoustic instruments and voices), 2) acousmatic, and 3) a mixture of both. Henry Brant's orchestral spatial compositions serve as excellent examples of spatialized orchestral sound spaces. By spatially separating layers of

sound in distant locations within the performance space, Brant (in Harley 1997) enhances the perception of timber and textures, providing clarity and intelligibility through distance.

Brant's orchestral spatial compositions often involved the use of unconventional performance venues, such as parks, cathedrals, or large halls, to explore the spatial dimensions of his music. By using the architectural features and acoustics of these spaces alongside the spatial arrangement of musicians, Brant created dynamic sonic environments that enveloped the audience in immersive soundscapes. His innovative approach challenged traditional orchestration and performance norms, pushing the boundaries of spatial music and offering audiences fresh insights into the relationship between sound and space.

As Brant's orchestral pieces used the venue in an experimental manner to explore music through spatiality, Xenakis' orchestral spatial compositions also employed experimental arrangements, often integrating the orchestra within the audience. As in the case of Xenakis' piece *Terrelektorh*;

> Terrelektorh is thus a "sonotron": an accelerator of sonorous particles, a disintegrator of sonorous masses, a synthesizer. It puts the sound and the music all around the listener and close up to him. It tears down the psychological and auditive curtain that separates him from the players when positioned far off on a pedestal, itself frequently enough placed inside a box. The orchestral musician rediscovers his responsibility as an artist, as an individual (1992: 237).

Xenakis, proposes a radical reimagining of orchestral performance by dispersing musicians among the audience, thus creating a dynamic interaction between performers and listeners. This quasi-stochastic arrangement challenges traditional concert hall settings, advocating for a new architectural approach to accommodate modern music. By seating musicians individually, the audience is encouraged to move freely within the space. This spatial arrangement allows for a kinetic conception of music, enhancing the auditory experience with spatial dimension and movement for creating immersive musical experiences. These spatialized orchestral configurations can be even extended to larger scales, as in Llorenç Barber's city concerts, where spatial compositional strategies under the concept of *plurifocality* (Lopez Cano 1997: 14) involve multiple sound focal points in the city, including bell towers, local soundmarks, and instrumental groups, all dispersed around the city.

Acousmatics.

In acousmatic arrangements, the sound space involves three-dimensional sound movement, which gains volume through sound spatialization using electronic sound sources. In acousmatics, sound is perceived indirectly, without visibility or recognition of its originating causes. According to Schaeffer (1966), this auditory perception process is referred to as *acousmatic*, deriving from the Greek term *akusmatikoi*, which originated from Pythagoras's pedagogical practices. Pythagoras instructed his disciples to listen to his lessons behind a curtain, solely relying on his voice without seeing him directly. In modern times, the use of loudspeakers replicates a similar experience, where the sound source producing the sound remains unseen. Pierre Schaeffer employed acousmatics in his sound research to separate sight from hearing and isolate contextual information from the sound source. This approach aimed to stimulate listening to sonic forms as a means of content analysis of our perceptions. Acousmatics fosters conditions for *reduced listening*, a concept developed by Schaeffer to focus attention on the aesthetic complexity of the sound itself, rather than its relation to the source (Schaeffer 1966: 159-170).

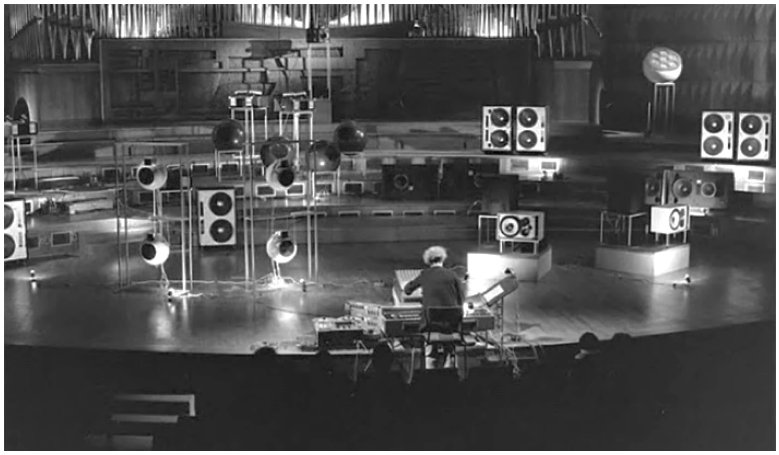


Figure 92. François Bayle performing the *Acousmonium* (INA GRM - Groupe de Recherches Musicales).

The approach to three-dimensional music by acousmatic means converge in Bayle's *Acousmonium*, an instrument built with a considerable number of diverse loudspeakers that have a broaden versatility for constructing various acousmatic configurations (fig. 92).

Designed in 1974, Bayle's *Acousmonium* can assume various spatial forms, shaping the art of acousmatics. Bayle presents space not merely as a singular entity of moving sound but as a multitude of subjective interpretations. He further develops the concept of i-son (image-of-sound) to represent the form of spatialized sound and its perceptual interpretation through a sound image described by metaphor or archetype. The i-son is delineated into three terms that deepen the definition of a sound object: im-son, di-son, and me-son (Bayle 1989: 165-170). The first term points to hearing and presentification, the second to listening and identification, and the third to understanding and interpretation, similar to the proposed conceptual model of aural architecture.

Annette Vande Gorne (2002) later uses the *Acousmonium* as a research lab for spatialization experiments, outlining an acoustic relationship between music and architecture. In this framework, space is recognized as a fundamental musical element influencing composition and performance. Vande Gorne delineates three primary spatial categories: *moving space*, *geometric space*, and *illusory space* (2002: 1-21). *Moving space* contrasts with the notion of static or fixed space, emphasizing the sonic displacement and movement of sound through time. It comprises two subtypes: *ambisonic space*, characterized by a sense of ubiquity where sound sources are not identifiable, and *source space*, composed of defined and identifiable sound sources. *Geometric space* involves the creation of an invisible structure of multitrack sound, defined by intersecting lines, planes, and volumes in three dimensions. Musical composition within geometric space is conceptualized based on the number of speakers employed, ranging from mono to octophonic setups. *Illusory space* is a phenomenological concept arising from the virtual simulation of a spatial environment through spatialization techniques, creating the illusion of perception within the listener's experience.

Music and Architecture.

Drawing a comparison between music and architecture through the idea of the planned and executed object, we find parallels in their approach to space. Just as an architectural plan is drawn to project volumes for future construction, both music and architecture denote a conceptualization of space. Examples of this binomial conformation of sound space can be

seen in the graphic scores used by Xenakis, architect and composer, for the spatialization of *Interlude Sonore*, and Varese's freehand sketches for the spatial dimension of *Poème Électronique* (Kiourtsoglou 2022). These representations by composers foresee the acoustic atmosphere of the performance execution.

Influenced by this architectural scope, Varese (1936) describes *spatial music* as the emergence of a fourth dimension in music—the sound projection into space. He envisions music as the spatial movement and collision of sound-masses, of shifting planes and beams of sound through acousmatic configurations. Varese criticizes traditional musical notation as inadequate for spatial music, proposing, "the new notation will be seismographic" (Varese 1936: 18). In *The Liberation of Sound* (1962), Varese decides to call his music *organized sound*, instead of music, freeing it from overstructured conceptualization in traditional music.

The sound space conception as an n-dimensional issue is introduced in Schaeffer's concept of *spatial music* (2012: 194) as a "static and cinematics spatialization"—static referring to the static diffusion of music, while cinematic constitutes moving sound projections. Xenakis later adopts and reshapes this binary definition, transposing Euclidean space into an acoustic space;

> We can consider a loudspeaker as a punctual source within 3-dimensional space, provided the room is acoustically inert. These sound points define space in the same manner as geometric points in stereometrics… Let us imagine an acoustic straight line defined by points of sound transmission. The sound can be emitted simultaneously from every point on this line. We may further imagine an orthogonal network of such acoustic lines that would define an acoustic plane (Xenakis 1958: 133).

This is Xenakis's definition for static stereophonics, while the movement of sound through the loudspeaker's lines and planes is announced as cinematic stereophonics. Minard applies the idea of static and cinematic spatialization/stereophonics (from Schaeffer's and Xenakis's) not exclusively in a musical context but for sound installation art, using the terms to describe the conditioning of space (static diffusion) and articulation of space (sound in movement) (1991).

The *Philips Pavilion* (fig. 93) is arguably the most emblematic project of Iannis Xenakis. Was commissioned by the Philips Company to Le Corbusier for the Brussels International Exposition in 1958, and delegated to Xenakis for the development of the architectural-multimedial design of the pavilion. The work consisted of designing an architectural layout for spatialized sound, using 425

speakers, and presenting an audiovisual show. Xenakis' proposal envisioned a static architecture housing a dynamic architecture of temporal spatialities continuously modified by sound.

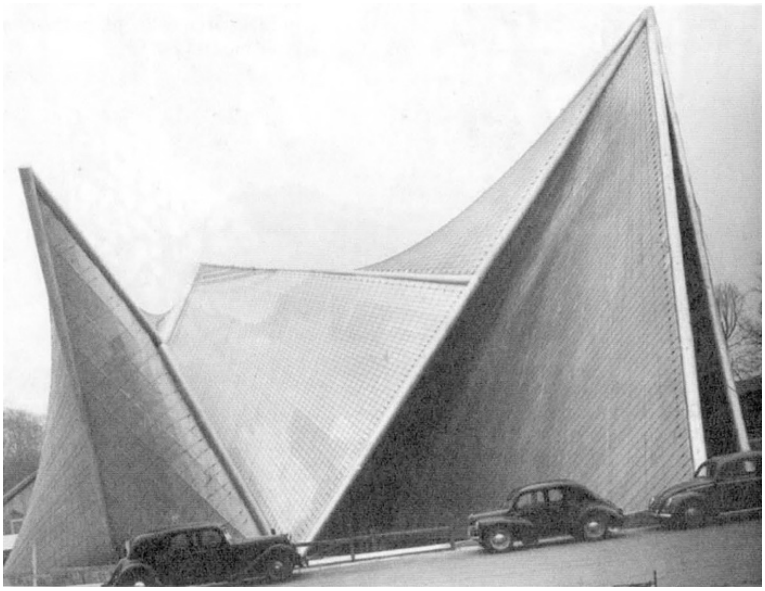


Figure 93. *Philips Pavilion*, 1958. Brussels International Exposition (Archives Xenakis).

While working on the architectural design of the Philips Pavilion, Xenakis delved into his musical composition and orchestral piece, *Metastaseis* (fig. 94). Employing the *modulor* (Le Corbusier 1953), Xenakis projected sound over time, mirroring his approach in architectural work.

The preliminary sketch for *Metastaseis* was in graphic notation and resembled the architectural plan of the Philips Pavilion more than a musical score. It showed motion graphics of masses and *glissandis* as structural beams of the piece, with pitch on one axis and time on the other. In his musical-architectural projects he was interested in exploring the possibilities of how to join one point to another without breaking continuity. In *Metastaseis* this exploration led him to *glissandis*, while in the Philips Pavilion it led him to the design of hyperbolic paraboloids. The employment of *glissandis* gave a temporal sound continuum to the composition, which later translated into a formal continuum between the floor, wall, and ceiling of the Philips Pavilion.

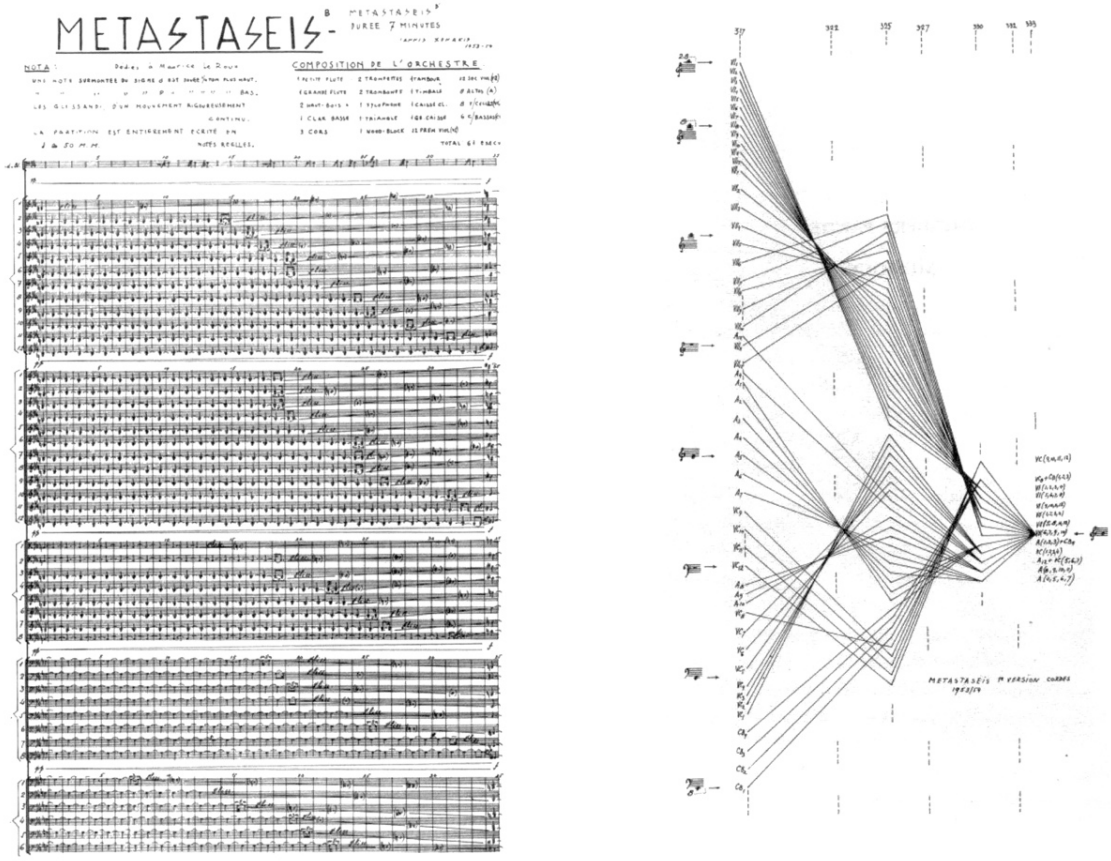


Figure 94. Iannis Xenakis, *Metastaseis,* 1953-55 (Boosey & Hawkes).

Driven by this initial experience, Xenakis went on to develop a series of works titled *Polytopes* (2008: 198-272). These pieces, in their various iterations, were compositions of light and spatialized sound that shaped multiple spaces from ruled surfaces. Often considered sound/light architectures, sculptures, installations, and technological performances, they were typically located in emblematic sites of great historical and cultural significance. One of Xenakis' earliest polytope was created for the French pavilion at the Montreal World's Fair (fig. 95). This installation featured a transparent architectural design consisting of 200 steel cables adorned with a total of 1200 flashes—800 white and 400 colored. The sound composition for the polytope proposed continuous music, while the visual composition was discontinuous, creating a contrast between sound and light. Xenakis aimed to create an interactive environment that transformed static spaces into dynamic ones, inviting participants not only to observe but also to actively engage and be part of the space.

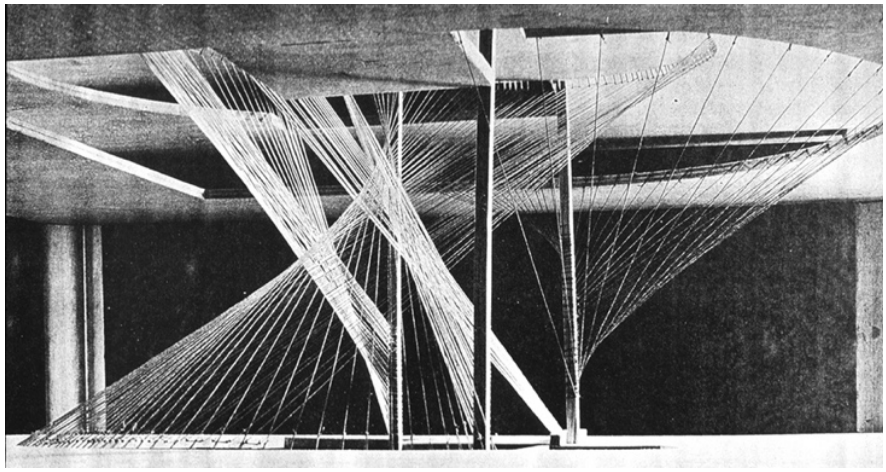


Figure 95. Scale model for *Montreal Polytope*, 1967. Montreal World's Fair (Coll).

To create the polytopes, Xenakis explored architectural designs that could enhance the human auditory experience, where sound shapes the geometric space. Similarly, Stockhausen, a serialist composer of electronic music, was among the first to experiment with spatialized sound, breaking the tradition of frontal staging. In 1958, Stockhausen delivered a lecture titled *Music in Space*, inspired by the *Philips Pavilion,* he proposed the design of a spherical concert hall for spatialized sound.

> New halls for listening must be built to meet with demands of spatial music. My idea would be to have a spherical chamber, fitted all around with loudspeakers. In the middle of this spherical chamber, a platform, transparent to both light and sound, would be hung for listeners. They could hear music… coming from above, from below and from all directions. (Stockhausen 1959: 69)

In 1970, Stockhausen was invited by the German government to the World Fair in Osaka to develop a multimedia project. There, he collaborated with architect Fritz Bornemann to create a spherical concert hall with a raised platform in the center for the audience (fig. 96). The space featured fifty speakers surrounding the platform. Stockhausen designed a 10-channel system for broadcast live or programming a show. In this multifocal setting, spectators received sound information differently based on their location, affecting each person uniquely. Thus, the role of the audience is to connect the sensory events and build a complete coherence, depending on each individual interpretation. Both Xenakis' *polytopes* and Stockhausen's *Music in Space* use spatialized sound to bridge architecture and music, creating invisible sound structures within larger spaces.

Figure 96. *Spherical Concert Hall*, 1970. World Fair in Osaka (Karlheinz Stockhausen).

Bernhard Leitner, presents a similar idea to Stockhausen's *Music in Space* and Xenakis' cinematic stereophonics, emphasizing that the three-dimensionality of sound space is achieved through sound in movement (traveling sound). He incorporates the temporal variable and underscores the irreplaceable importance of the body as a listening system. Leitner suggests an exploration of the invisible space constructed solely from traveling sound, forming spaces in constant transformation defined by their evolution over time. Sound space offers insights into time and the interaction of sound with the environment, influencing the type and quality of the sonic experience.

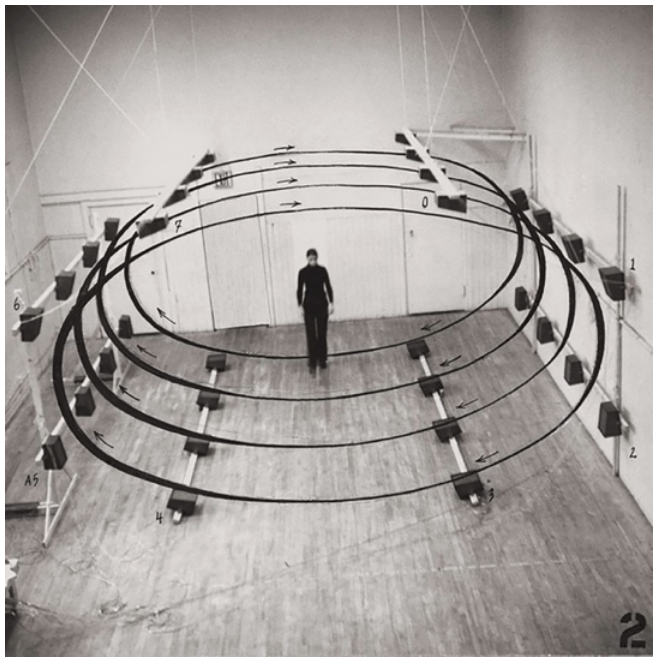


Figure 97. *Circling*, 1973. Leitner's Studio, New York (Bernhard Leitner).

In his artistic research project, initiated in 1971, Leitner (1978) constructed a series of structures to test the movement of sound in space (fig. 97). Two significant aspects emerge from his findings. One aspect relates to the physical arrangement of sound space, based on the three-dimensional placement of speakers in a space to reproduce sounds in movement. The dynamic nature of sound serves as the foundation for constructing the boundaries of this artificial space, using sound properties such as intensity, frequency, timbre, and movement characteristics (direction, speed, acceleration) as building materials for these sounding architectures. The second aspect address the perception of space in relation to temporality. Leitner defines space as spatial sensations induced by sound. Depending on static or moving positions, the body may undergo two distinct experiences: a passive reception of spatial information in a static position and an active perception-action engagement through movement and interaction with space.[11]

In a different utilization of acousmatics, composers, artists, and performers La Monte Young and Jung Hee Choi, in collaboration with visual artist Marian Zazeela, created together the *Dream House*. Situated within an apartment on the 3rd floor at 275 Church Street, New York, the *Dream House* creates an environment of light and sound that diverges from presenting sound to a stationary listener; instead, it is enlivened by the visitors' movements, shaping spatial articulations through personal compositions influenced by individual bodily flow. The sound installation comprises continuous sine-wave drones consisting of 35 different sine tones across 10 octaves emanating from large speakers positioned in each corner of the room. This arrangement creates pulsating sound patterns that offer a truly unique auditory experience through the effect of standing waves.

The *Dream House* operates by activating sonic narratives through spatial and sensory engagement. As LaBelle explains, "...the *Dream House* is formed at the moment an individual enters the sonic field—immersed as in a fluid, sounds oscillate across a range of frequencies through movements of the body, enfolding the self in a sonic architecture..." (2015: 73). Here, the sound space constitutes a temporal narrative of spatial manifestations shaped by the situated experience of the moving body.

[11] Some of the morphological categories experienced and defined by Leitner are: sound cube, spatial grid, oscillating corridor, sound portal, sound ramps, sound corridor, sound waves, among others.

Spatial Terminology.

In an attempt to clarify the conceptual territory of sound space, this notion becomes extremely diverse and complex. As we have seen, the sound space can be created using a variety of sound sources, shaped through acousmatic or acoustic spatial arrangements, and perceived on various scales. Since the ramifications of the concept of sound space are diverse, it's necessary to have a proper language to discuss the spatial experience of music. Specific words to define sonic phenomena in space are often borrowed from other disciplines (psychology, biology, linguistics) or other senses (visual), as the auditory sense still lacks sufficient language to describe itself.

Face to this problem, Smalley (1997), through his spectromorphological approach, organized a series of models and processes of sound-shapes to provide a "framework for understanding structural relations and behaviors as experienced in the temporal flux of the music" (107). According to Smalley, the spectral-space represents the relationship between the *composed space* (the imagined space as composed) and the *listening space* (the space in which the composed is heard), analogous to Francis Bayer's *sound space* and *acoustic space* (1981) and Michel Chion's *internal space* and *external space* (1988: 31–33). The composed space has two variations of; 1) the internal space (the score), 2) the external space (the *mise-en-scene*), and the listening space has also two variations; 1) the diffused space (the acousmatic space shared with others), 2) the personal space (the individual listening space). The nesting between the composed space within a listening space is defined by Smalley as a superimposed space (1991). For listeners, the superimposed space is inseparable from their experience of music. *Spectromorphology* acknowledges changes in space from a perceptual standpoint, emphasizing the spatial texture that redirects perceptual appreciation toward a spatio-spectral relationship, rather than merely identifying spatio-morphological development.

The lack of spatial terminology in music has led to an increasing challenge for researchers in sound. Merlier (2006) has compiled a vocabulary for use in the field of electroacoustic music spatialization, gathering terms from various authors working in interdisciplinary fields related to sound. These disciplines include music, sound installation, multichannel composition, architecture, and sound design. Examples of this repertoire are; visible space

(Castellani 2005 in Merlier 2006), virtual space, real space, projected space, mental space, listening space (Duchenne 2005 in Merlier 2006), source space, illusion space, geometry space, ambisonic space (Van De Gorne 2002), projection space (Fatus 1994 in Merlier 2006), landscape space, architectural or polyphonic space (Justel 2005 in Merlier 2006), internal space / external space (Chion 1988), composed space (Smalley 1991), acoustic space (Truax 1978), among others. In Merlier's repertoire, the sound space is described as a "place of representation of the acoustic vibrations, the sound space allows the expression of the energies resulting from the real or virtual sources, described by perception" (Fatus 1994 in Merlier 2006, 85). This term has a dual definition concerning the *embodied sound space*, which is synonymous with *immersive environment*, integrating the acoustic vibration with perception. Likewise, Solomos' concept of sound space encompasses various disciplines, including music and architecture, audible ecosystems within art installations, the study of environmental sound, soundscapes, and spatial music, termed by him as "composed sound spaces" (2020: 217).

In this overview, I have presented different types of sound spaces, all created by static or traveling sound through the distribution and spatial disposition of sound sources. Solomos states that sound space is in constant flux, transitioning from the "real to virtual" and from the "existent to imaginary", encompassing different disciplines and perspectives in a multidisciplinary approach, characterized by a duality that encompasses both objective and subjective dimensions.

Composing Sound Spaces

The music of the 20th century is deeply rooted in the relational nature of sound, navigating the dynamic interplay between the objective and the subjective, the sonic, the spatial, and the listener. This dynamic relationship forms the core of creativity for composers and artists, revealing the sound space as a multiplicity of perspectives. This has promoted a shift from music to sound as new modes of organization, manifestations, and practices.

Within the musical field, sound has departed from tonal organization to the creation of strategies and procedures to establish "a self-referential grammar" (Campesato 2009: 27). This transition brings sound to the forefront of musical discourse. As musical concerts modify their frontal *mise-en-scène* towards new spatial proposals and with the introduction of multichannel acousmatic systems, space begins to be a composable element, but still in an abstract dimension. Moving from music towards sound art, within sound installation and performance, a concrete conception of space emerges, aligning with an aesthetically active listening that breaks the linear narrative of musical structures.

To further explore the concrete dimension of sound space, I will discuss how sound installation and performative arts can serve as research methods to create a situated-sonic experience and contribute to our understanding of sound space. The idea of using artworks as method comes from a cognitive process known as "aesthetic conduct" (Arteaga 24). According to Arteaga's paper on *Embodied and Situated Aesthetics*, aesthetic conduct is primarily facilitated by our sensorimotor and emotional skills, fostering an exchange between our individuality and surroundings. It is receptive in nature, allowing for the spontaneous emergence of new responses to sensory stimuli. However, Arteaga argues that aesthetic conduct does not directly produce knowledge or develop skills for specific tasks. Arteaga's ideas come from the reflections of Maturana and Varela (1980) on how living systems cognize objective reality, shifting the focus from external reality to the internal structure that enables organisms to operate effectively within their environment.

The artistic practice aims to mobilize cognitive power for the emergence of aesthetic knowledge through artworks by using sound spatialization. These artistic outcomes stimulate the sensory body to address invisible spatialities. Grounded in Varese's notion of spatial music, where sound is projected into space, these artworks seek to develop strategies for enhancing sensory experience through precise sound source localization. I will illustrate this with eleven case studies: multichannel sound installations, performances and virtual reality. These artworks created aesthetic experiences acknowledged by the audience, each forming an acousmatic space that transcends its physical location, but conceptually corresponding through site-specific interventions, sonic translation and virtual architectures.

Site-Specific Interventions.

The voices of space: Polyphono

Polyphono is an instrument that dialogues with space through sound. The term is derived from two Greek words; *poly* meaning *many* and *phono* meaning *sound*, evoking a system with multiple audible extremities. The project harnesses principles of echolocation and acousmatics to establish a system of communication with space. The aim is to foster a sound-spatial dialogue through the sonic reaction of space, allowing for an auditory exploration of the principles that shape spatial environments through listening experiences, showcased in a site-specific sound performance. The system becomes an instrument that is played by the space, creating compositions that are modulated through the spatial morphologies. *Polyphono* comprises a system of 10 loudspeakers, each one of them speaking with a specific part of the space. It is a site-specific installation, so the exact disposition of the speakers depends on the site where the system will be placed. The speakers may be static or in motion. In the case of motion, the speakers will be suspended by pulleys, allowing both vertical and horizontal movement. To visualize the communication with space, the system usually controls a laser shaft, created by media artist Mauricio Lacrampette, that reacts to the spectral interactions within the sound space (fig. 98).

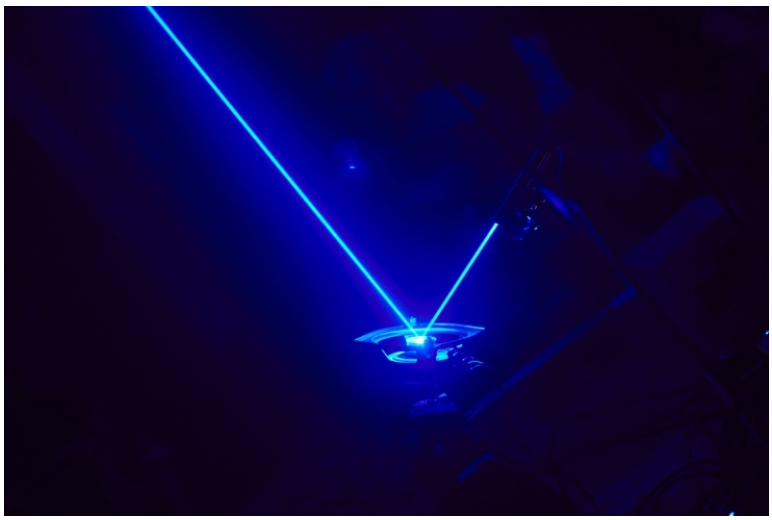


Figure 98. Laser shaft (F. Mardones 2022).

In 2022-24, *Polyphono* had four different versions, each modified for specific locations: 1) Quinta Bella Water Tower, presented at the *Espacios Resonantes Festival* in Santiago de Chile; 2) Minas de Queiriga, used during the Binaural Nodar Residency in Viseu, Portugal; 3) Galerias do Loreto, showcased at the Museu da Agua in Lisbon, Portugal; 4) Teatro Replika, presented at the In-Sonora Festival in Madrid. I will only examine in this chapter the first three versions of *Polyphono*.

Vertical Sound: Quinta Bella Water Tower, Espacios Resonantes Festival, Santiago.

Figure 99. QR code: Teaser of *Polyphono* at *Espacios Resonantes Festival*.

In its first version, *Polyphono* was installed in the Water Tower of Quinta Bella, Recoleta, as part of the *Espacios Resonantes Festival* (fig. 99-100). This festival serves as a collective platform for discussions and creations centered on "architecture and listening", bringing together architects, researchers, sound artists, and musicians who explore the intersections between music, art, and architecture.

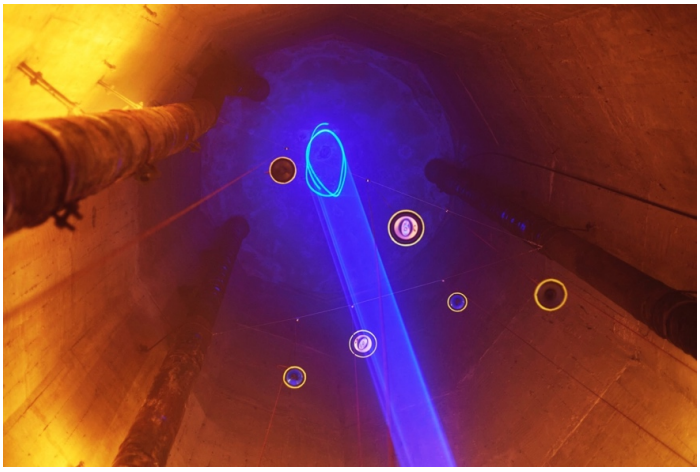


Figure 100. Speakers hanging from pulleys (F. Mardones 2022).

Polyphono was installed at the base of the Water Tower Quinta Bella, on ground level. The installation comprised 10 loudspeakers arranged vertically within the structure. The speakers formed a spiral pattern, starting at floor level with a BOSE L1 Pro8 loudspeaker and subwoofer, and ascending upwards with cone-like speakers ranging from 5 to 8 inches. Three speakers were installed hanging from the water pipes at 2 and 3 meters high, while the remaining six were suspended at a height of 11 meters from pulleys, each at a specific height, constructing the verticality with an ascending spiral (fig. 101).

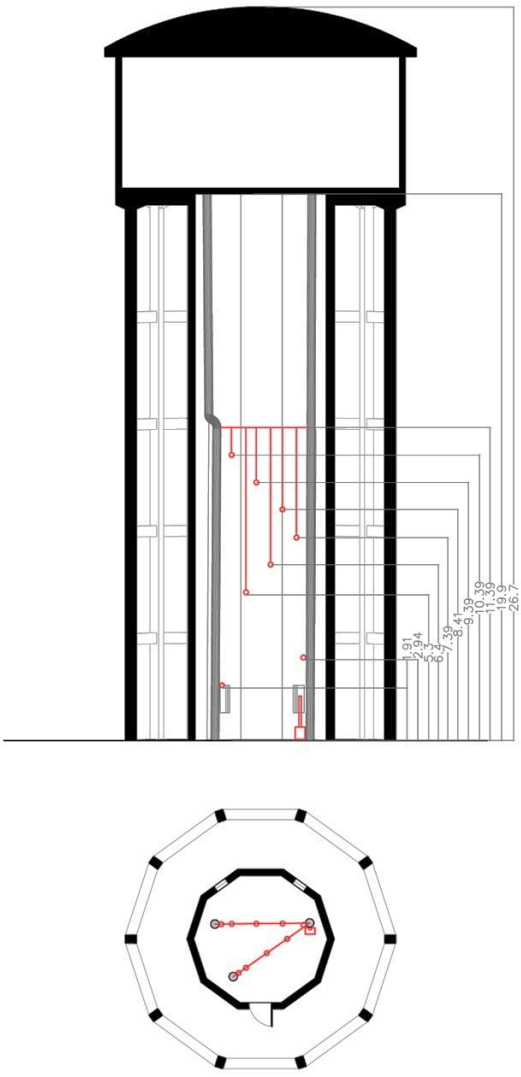


Figure 101. Plans of Polyphono's installation (S. Balbontín 2022).

The sound composition was created using sounds of a Korg MS-20 synthesizer and pure frequencies oscillators. These sounds were recorded beforehand and served as raw material for creating a multichannel composition in Ableton Live 10, which was then played in its entirety through the installed system (fig. 102).

Figure 102. QR code: Audio of complete performance.

Due to the limited space, the audience was seated along the internal perimeter of the tower on yoga mats, leaving the center free for the performer. No prior information was provided to the audience to allow them approach the work without expectations. The sound composition comprised three parts. In the first part, spatialization was emphasized, with the speakers remaining static while the sound moved through acousmatic means in a spatialized manner. The vertical space was kept in complete darkness, focusing solely on the auditory sense. During this phase, the sensation of sound was heightened by the deprivation of other senses, creating an enveloping spatial experience triggered by the moving sound. Despite the audience being situated at the periphery, the spatialization of the sound sources combined with the vertical reverberation of the space created the illusion of being surrounded by sound. In this first part, the composition consisted solely of one dry sound, resembling that of a snare. When spatialized and interacting with the tower reverberation, produced varying tonalities, modulating sound through space. The sound gradually accelerated, with its *bpm* increasing, intensifying the movement and generating new temporal spatialities based on the sound's physical position.

The second part focused on the vertical interaction of sound with space. During this phase, the speakers are lowered using a system of pulleys, while the laser is activated, providing a visual cue that directs attention to the downward movement of the speakers (fig. 103). Six different types of white noise are used, each containing a full spectrum of frequencies.

This type of sound facilitates changes in frequency as the speakers descend, gradually increasing towards higher frequencies. The proximity of the speakers to the ground serves as a high-pass filter, influencing the reflected frequencies. The continuous noise is modulated based on its vertical positioning relative to the ground, resulting in undulating patterns created by the speakers' upward and downward movements.

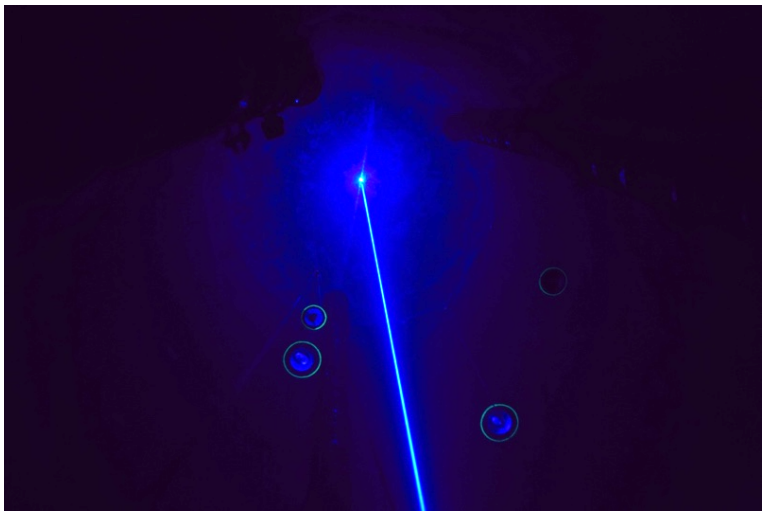


Figure 103. Laser shaft is on for the vertical movement of the speakers (F. Mardones 2022).

The third part explores the horizontal relationship between sound and space. As a "speaker dance", I moved the sound sources around the place, altering the auditory experience through the movement of the speakers. In this phase, the laser light starts to react to what is sounding, drawing a mix of frequencies over the ceiling at 20 mts high, visualizing the sound space (fig. 104). In this part of the composition, pure frequencies are employed, with each speaker emitting a distinct frequency gradually activated. As these frequencies overlap, they begin to interact, creating rhythmic patterns through beat effects, resulting in varied undulations depending on the spectral proximity of the frequencies. The horizontal movement filter the frequencies while they are modifying their position, producing subtle gradations in sound and enriching the auditory experience. Listeners not only see but also hear the movements, as the oscillating speakers traverse from the periphery to the center, modulating the sound in response to the architectural space's proximity or distance. This composition unveils a

rhythmic duality, arising from both the interplay of frequencies and the horizontal movement of the sound sources.

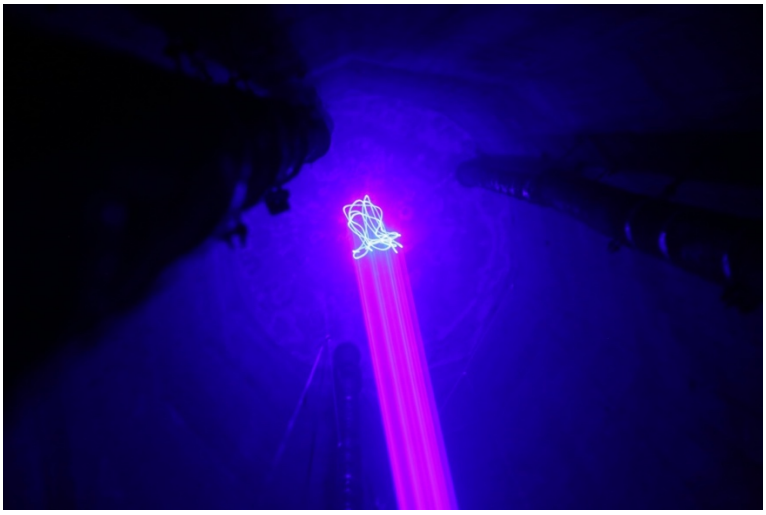


Figure 104. Visual sound (F. Mardones 2022).

The traditional listening experience typically involves fixed sound sources. However, when sound is in motion, it evokes a different sensation, creating the illusion of a dynamic surrounding space. This movement can evoke various spatial images in listeners, depending on their position relative to the sound source. The human ability to locate sound sources in space depends on factors such as the distance between the source and the listener, the listener's body position, and the acoustic properties of the architectural space. In the case of the Quinta Bella water tower, the polyphonic installation reinterpreted its acoustic space by arranging the speakers in an ascending spiral. This modification altered the natural interpretation of the space's acoustics by human perception. The sensory experience of spatialized sound sources can thus construct a unique spatial environment determined by the distribution of speakers, thereby altering the "room information" as described by Chowning (1971: 3).

The movement of sound sources significantly contributes to the sensory experience of the sound space. Hussler's concept of the *lived-world* is applied here as the spatial representation through the arrangement of sound sources in an ascending spiral and their vertical and horizontal movements. By constantly changing position, the sound source conveys information

about the relative and continuously shifting distance, transforming space from a static to a temporal experience, where it is dynamically constructed and deconstructed. As Chowning (1971) notes, "In the presence of a moving sound source, a listener receives velocity information from the rate of the angular shift in energy (angular velocity), the rate of the radial shift in energy, and frequency shift due to the Doppler effect (radial velocity)" (3). When sound sources maintain horizontal movement, the emitted sound is altered based on the relationship between the listener and the moving sound source. This perceptual effect, usually described as Doppler Effect, involves changes in frequency: if a sound source moves toward a listener, the sound waves compress, resulting in a higher frequency (higher pitch); conversely, if the source moves away from the listener, the sound waves stretch, leading to a lower frequency (lower pitch).

The appearance of sonic information is structured by the position of sound sources in space, altering the intrinsic characteristics of sound: intensity, frequency, and timbre. Three distinct dimensions intersect in the perception of sound space: sonic features, spatial sound, and spatial movement. The appearance of sound reacts to the interplay among these dimensions, filtering sonic information and dynamically modifying the sonic experience.

Macro Sounding Geologies: Minas de Queiriga, Binaural Nodar, Viseu

Figure 105. QR code: Video of *Tungsteno* 24'27''.

In June and July 2023, I participated in a residency at Binaural Nodar, located in Nogueira de Côta, Viseu. Binaural Nodar, a cultural initiative established in 2004, operates in the Portuguese region of Viseu Dão Lafões. It is dedicated to soundscapes, sound and media arts, and audiovisual ethnographic documentation, fostering a continuous social mediation laboratory with rural communities and spaces. My residency at Binaural Nodar aimed to valorize the empty spaces in the Viseu area, product of emigration. It focused on examining

the spaces and infrastructures of defunct productive systems, which have led to shifts in the local economy and subsequent emigration of residents in search of new opportunities. These empty spaces hold memories of the region's past vitality, representing the activities that once thrived in the villages but now stand abandoned, contributing to population decline through emigration.

Figure 106. Polyphono's speakers within Queiriga Mine (S. Balbontín 2023).

During my residency, I developed the performance *Tungsteno* (fig. 105). This performance involved a temporary occupation of the Queiriga Mine. The project involved exploring the sounds of the mine to create a composition that accentuates the acoustic characteristics of the location. During this process, I used *Polyphono* with its 10 sound extremities dispersed throughout the mine (fig. 106). This created a multichannel system of sound

spatialization that interacted with the various nooks and crannies of the space, amplifying the acoustic variations present within the mine to encompass its entirety. The space itself modulated the sound, working with the unique acoustic properties of the cave. The final result is a live performance held inside the mine, incorporating synthesizers, electromagnetic waves, and field recordings from the mine's soundscape. These elements are projected into space and modulated by itself, establishing a dialogue with the mine's acoustics.

Tungsteno involved exploring sound spatialization on a macro scale, covering considerable distances and creating a large-scale installation. Additionally, the challenge lay in working within a cavernous space composed of sloping rocks. While the space was not natural, as its spatial configuration resulted from the mine's exploitation, it possessed an organic and irregular character, presenting both new challenges and opportunities for *Polyphono*. The process entailed studying the site to identify positions within the space with acoustic interest in relation to the entire mine, engaging sounds from a distance. The speakers were positioned statically, with 10 sound sources: two M Audio BX6 100-Watt Carbon Compact monitors, one M Audio SBX10 240-Watt subwoofer, and seven 5-8 inches speaker cones.

Figure 107. Location of the performer within the mine (L. Costa 2023).

Me, the performer, was located at the end of the mine (fig. 107), so the arrangement of sound sources covers the entire length of the site, approximately 160 meters. Also, the sound system was arranged in space, covering both its upper and lower sections, descending roughly 23 meters below ground level. Monitors were placed beside the performer, 20 meters below ground level, while the subwoofer was positioned 15 meters below ground level. The speaker

cones were dispersed throughout the area, situated both at the top near the entrance and at the bottom near the water accumulation in the deepest part of the mine (fig. 108).

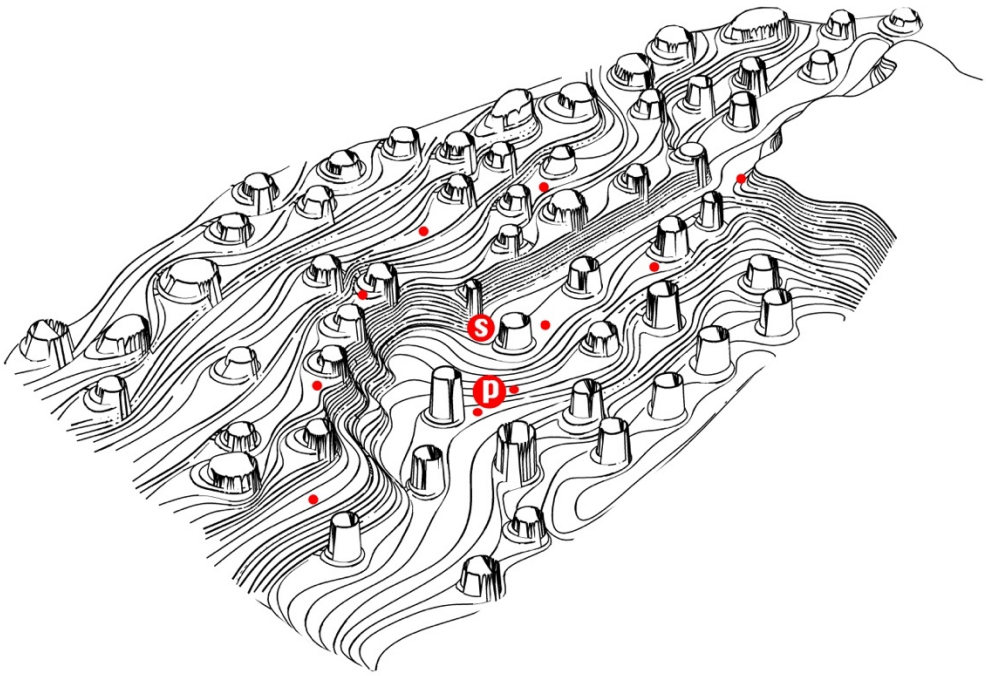


Figure 108. Location of the speakers, subwoofer and performer (S. Balbontín 2024).

The composition shared a common foundation with the initial *Polyphono* exhibition; however, in this iteration, live instruments were incorporated, including a Korg MS-20 synthesizer, an electromagnetic microphone, and contact microphones installed in metallic trays to capture the dripping water from the mine due to humidity. Additionally, a mixer was intervened and used as a synthesizer. The composition (fig. 109) comprised a first part of spatialized sound through beats engaging in dialogues with the acoustics based on specific location. This initial part highlighted the spatial dimensions and acoustic intricacies of the surroundings. The positioning of the speakers excited the acoustics from considerable distances, reflecting the vastness of the space. Despite the absence of an audience (for security reasons), the production team was present and experienced the sensation of a larger sound space than reality. The composition gradually accelerated, with the sound expanding from one end to the other. However, in contrast to the dynamic experience in the water tower, the

mine environment introduced a more static element due to multiple reverberations, creating a sense of sonic ubiquity.

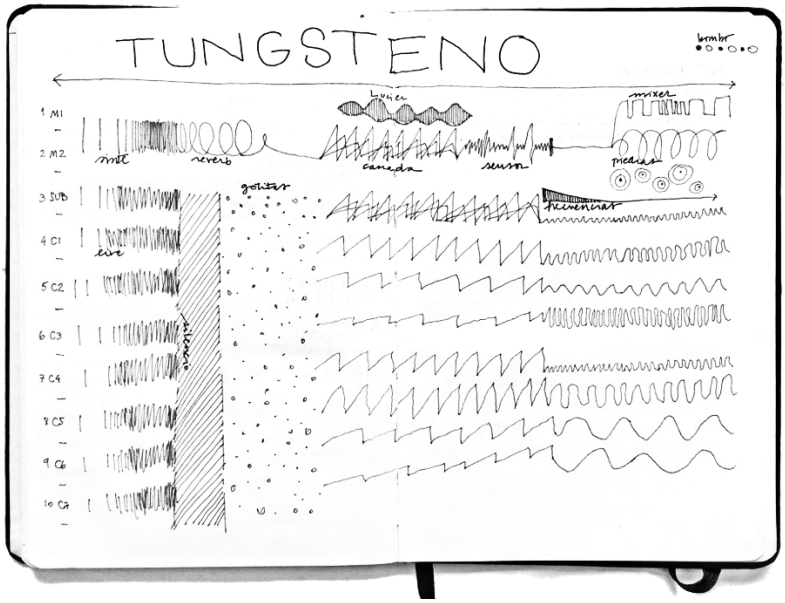


Figure 109. Composition of *Tungsteno* (S. Balbontín 2023).

The second part entailed a composition that began with the amplification of the same drops that descended from the cave into the water, as well as the drops amplified by the metal trays. This process amplified the existing sounds within the mine, resulting in a complex sonic environment where natural and acousmatic sound sources intertwined. This part is an exaltation of the natural beauty of the mine's sounds, evoking a sense of sublimation for the surroundings.

The third and final part comprised a drone music composition created with the synthesizer, a contact microphone, and samples. In this segment, the sound space was fashioned through a layering of drones. An initial drone from the synthesizer that multiplied upon encountering the space, emanating sound from various locations. It induced an immersive sensation, where sound trespassed the body. The mixer emitted sound signals that emerged and dissipated throughout the scene, interrupting the calm of the drone music with piercing interventions. These high-frequency interventions made the sound travel much faster and directed, almost visualizing the sound beam traversing from one side of the mine to the other.

Additionally, the mixer executed rhythmic interventions, introducing constant beats into the space sensed as bubbling elements within the body. At this point the sound space is perceived as something dynamic, as a living and expansive organism. The utilization of live instruments facilitated improvised interaction with the space, guiding the creation of sound spaces in real-time. This interaction with the arrangement of sound sources and their spatial relationship within the mine guided the sonic experience towards an immersive sublimation (fig. 110).

Figure 110. Performance "stage" (L. Costa 2023).

In this artwork, the idea of space is translated into the idea of site, incorporating geological, historical, and climatic features. Here, the site-specific approach emphasizes the embrace

of both the historical and natural value of the Queiriga Mines, which are constitutive elements of the piece. This musical presentation within the mine serves as an alternative "stage" while criticizing traditional modes of musical diffusion, shifting the focus from the musical object to an artistic context and the creation of an aesthetic environment.

Linear Spatialization: Galerias do Loreto, Museu da Agua, Lisboa

Figure 111. QR code: Teaser of *Polyphono* installation in Galerias do Loreto.

In November 2023, *Espacios Resonantes* organized the project *Som Sob o Solo: A Caverna de Plutão*, a two-day event for the Museu da Água. This project involved the intervention of the Reservatório da Patriarcal and the Galerias do Loreto. On this occasion, Polyphono (fig. 111) becomes an instrument played within a linear space, creating compositions modulated by the spatial characteristics of a 2 km-long tunnel. Its 10 loudspeakers were arranged along the underground tunnels, creating linear sound spatialization. The piece has a duration of 20 minutes, during which sound is modulated along the length of the tunnel. At the end, the laser shaft acts as an oscilloscope to project visual representations of the sound-space interactions, unveiling the sonic movements through visualization (fig. 112).

The sound spatialization strategy involved arranging the speakers linearly along a 100-meter tunnel. The distances between the speakers were organized based on the Fibonacci sequence and the golden section, with intervals at 1, 2, 4, 6, 9, 15, 24, 38, 62, and 100 meters apart[12]. This distribution aimed to position the audience in the first third of the tunnel, where the speakers were closer together, allowing the audience to identify the movement of sound, without falling directly into ubiquity of distance. Simultaneously, some speakers were placed at greater distances to enhance the acoustic qualities of distant sound motion.

[12] Sections were approximated to whole numbers.

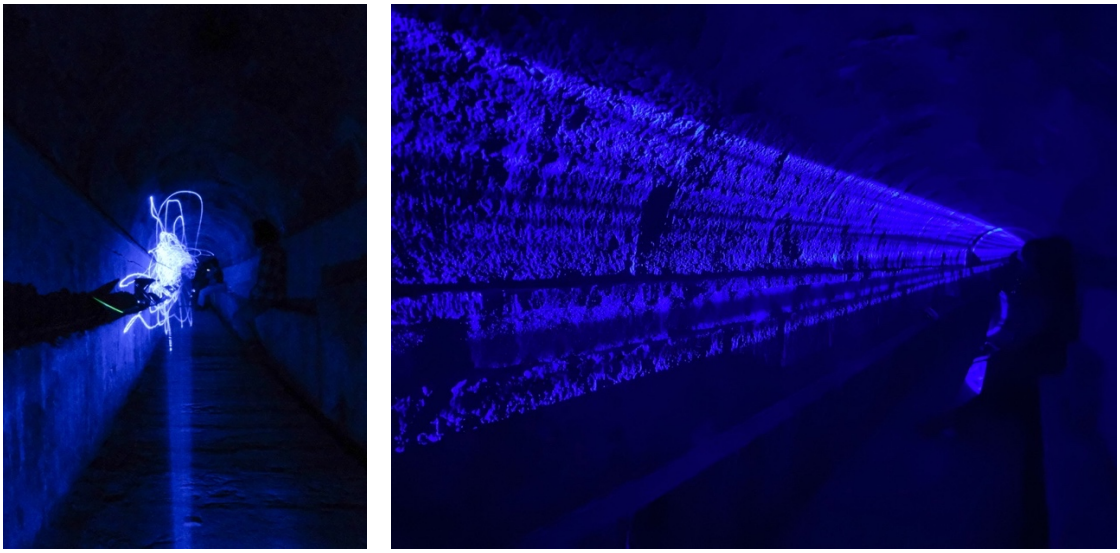


Figure 112. *Polyphono* installation in Galerias do Loreto (Left: J. Espinosa 2023. Right: M. Klenner 2023).

In this performance the speakers were in fixed positions, without movement. I composed the piece with a first segment featuring *beats* and a second segment with pure frequencies, separated by a brief transition of white noise. The Galerias do Loreto, being a very long tunnel with strong resonant properties in the bass spectrum, produced contrasting reactions between high and low frequencies, resulting in a spatialization effect where low sounds dominated, providing a base over which soft and delicate high frequencies were layered. The initial segment of *beats* created a sensation close to a passing train, either accelerating the sound wave coming from the distance or decelerating if it moved towards—a result of the Fibonacci arrangement. Thus, the sound space created by *Polyphono* followed a linear trajectory, evolving with the acceleration of sound motion, pronounced in the first segment. In the second part of the composition, the emphasis shifted from the traveling sounds to the immersive effect of low frequencies, which allowed the high frequencies to traverse linearly, resembling a mass-like movement of sound.

A situated-sonic experience, as the one developed by *Polyphono* in the Galerias do Loreto, involves a dynamic interplay of distance and longitudinality, engaging with other sensory modalities and spatial modulation. Within the tunnel, sonic tones undergo modification relative to the listener's position, resulting in shifts in timbre and inviting personal sensory

connections with the space. *Polyphono's* experiential approach challenges auditory modalities to engage with the sensory information of the sound space. The spatialization installation and multichannel composition, once resembling an acousmatic music orchestra, now serve as material for creating a musical environment within a sound art practice.

Sonic Translations.

Forest of Sounds: Spatial Sound Institute, Budapest.

Figure 113. QR code: Audio of *Space Dystopia*, complete performance.

In October 2021, I participated in a residency at the Spatial Sound Institute SSI where I had the opportunity to work with the 4DSOUND System for composing a piece (fig. 113). The SSI, located in Budapest, Hungary, is a research center dedicated to spatial sound technologies (fig. 114). The institute has a large-scale 4DSOUND studio equipped with 36 omnidirectional satelite speakers (OmniDrive Pro), 8 4D Subwoofers, and 24 Bass Shaker Tactile Transducer Aura AST-2B-4 Pro. The 4DSOUND system (fig. 115) is an immersive technology that allows for three-dimensional positioning of sound within both the system's space and the physical room, providing listeners with an experience of spatial depth and dimensionality. This system enables users to design virtual worlds through interactive engagement, allowing for direct control over the experiential reality of sound in space. Additionally, it enhances the interactivity of spatial sound composition and performance by offering various configurations of sound trajectories that respond to the behavior of listeners, thereby stimulating different sensory approaches.

During my residency, I developed the performance *Space Dystopia*, which used sound as an artistic medium to sculpt imaginary spaces through travelling sound (fig. 113). Space Dystopia explores the sound features of non-existing architectures, presenting imaginary

spaces that push the limits of our perceived reality. Dystopia arises as a fictional reality that augments space, blending with the real-time scene. Sound shapes a parallel dimension through the manipulation of space, disrupting the normal cognitive process of space recognition. By dislocating spatiality, the performance invites the audience to engage their active listening abilities, which are essential for evoking the spirit of dystopian spaces and forming a personal interpretation of this expanded reality.

Figure 114. Spatial Sound Institute (Unknown author).

For the performance preparation, I explored a narrative process of unfolding spaces inside spaces, pushing the limits of the 4DSOUND system in terms of spatialization of sound through movement and the use of reverbs. The base materials consisted of impulse responses collected from Expedition#1. These recordings were mixed with digitally created impulse responses, blending one into the other using convolution reverbs and 4DSOUND SpatialVerb[13] in Ableton Live 10. The resulting performance is a journey through different mutations that dissolve the boundaries of physical spaces into fluid, dystopian scenarios. The listening practice invites the bodies into a sonic experience, fostering a deeper awareness of how

13 SpatialVerb is a specialized spatial audio processing tool, as part of the 4DSOUND system, designed to create immersive sound environments. It uses advanced algorithms to manipulate sound in three-dimensional space, allowing for precise control over the spatial characteristics of audio.

space is sensed, directing attention not only to sounds, but also to the inner action of each one perception for reaching spaces that exceed the limits of physical possibilities.

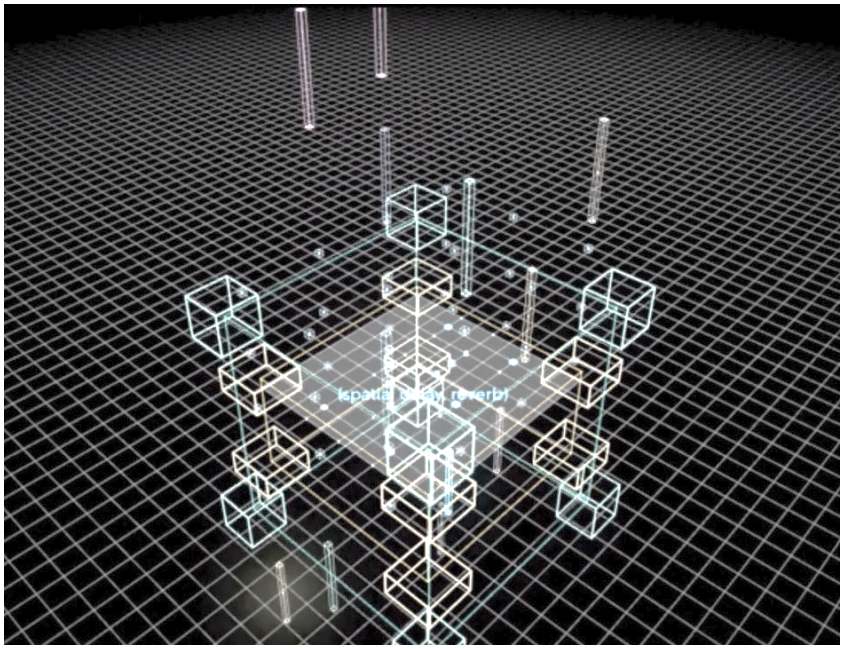


Figure 115. 4DSOUND Software visualization. Sound spatialization composition of *Space Dystopia* (S. Balbontín 2021).

The performance as method provides an input to activate the spatial perception. Before the performance, participants are instructed to enhance their active listening abilities in two modes; a static mode and a walking mode. These instructions created a listening score that guided the experience throughout the performance, offering two different ways to engage with the sound events. Based on Maturana and Varela (1980) we can modify our perception by the embodiment of diverse interactions between our internal and external reality;

> We can say that every internal interaction changes us because it modifies our internal state, changing our posture or perspective (as a functional state) from which we enter into a new interaction. As a result, new relations are necessarily created in each interaction and, embodied in new states of activity, we interact with them in a process that repeats itself as a historical and unlimited transformation (Maturana and Varela: 39).

According to Maturana and Varela, whether static or moving, individuals will experience different types of interactions, leading to completely new experiences. After the performance,

each person had a unique experience shaped by their personal interactions with the sound space.

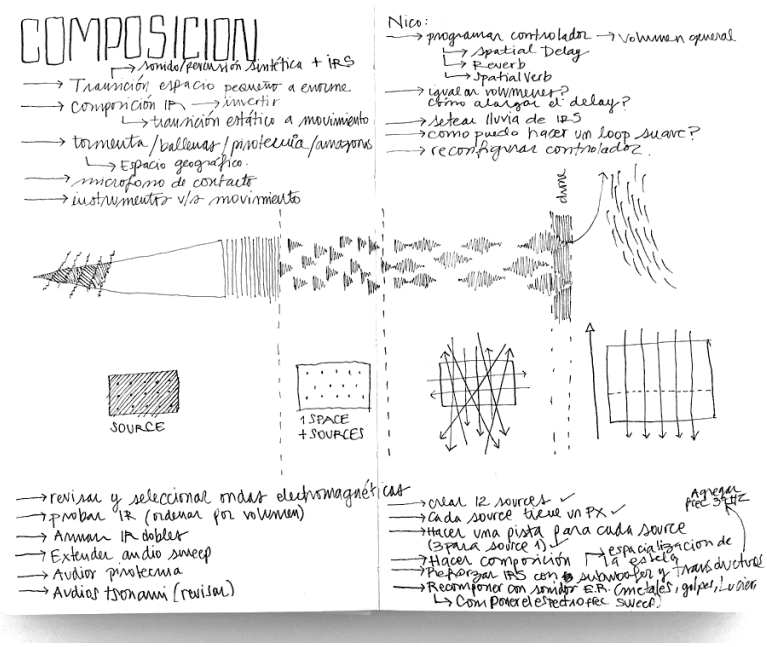


Figure 116. Composition of *Space Dystopia* (S. Balbontín 2021).

The creative process of composing *Space Dystopia* (fig. 116) involved personal and internal creative listening. Through the exploration of spatial forms using sound, the compositional operations employed musical techniques to enhance the understanding of space. Approaching the 4DSOUND and the spatialized room to stimulate the emergence of sense brought several challenges to the composition, in terms of both musical disclosures as in the invisible architectonic design. Scale was the first compositional element that expressed an eternal growing room, from an intimate and dry sensation to an abysmal magnitude which exceeded the physical understandings of closure into a void. The second part of the performance was dedicated to the time produced by space, while denoting the reflections of different overlapping spatial configurations. The layering process reaches a peak which brings chaos into the scene and a third part of climax; a chaotic mass of different architectures converging and merging at the same time that finally dissolve themselves in an infinite space.

These compositional strategies use spatialization to produce musical structures, employing various sound locations and harmonic variations influenced by cinematic trajectories. In the first part, static sound sources created a forest of sounds gradually expanding the room into an immersive environment, and this environment into an instrument capable of shaping different aesthetic experiences. The evolving performance space influences the audience's senses, revealing an inner collective reality and fostering an attentive and advanced listening attitude towards the spatial properties of sound.

In this first part, sound spatialization evoked a space constantly changing and expanding in an over dimensional dynamic, initially characterized by dry sound sources and transitioning to a "wet" spatial environment. The sense of a continuously expanding space was perceived through the increasing of reverb effect. This section concluded with an immersive reverb that merged all individual sounds from the dry static sources, promoting a sense of ubiquity and omnipresence solely through the extenuation of space reverberation.

The second part used linear movements to emphasize the sonic reflection's time of space. Time in architecture denotes the rhythm of its elements and the dimension of space. The time lapse that structures the piece becomes the space itself and is described by the Japanese concept *ma* as the in-between objects, in-between surfaces, in-between boundaries that built a space: in-between space. This section, composed of impulse responses distributed one after the other with considerable pauses in between, produced fragments of sound that dissolved into silence. These silences—the ma—shape the temporality that defines space, forming a dialogue between materiality and void, from which sound space emerges. In contrast to the antigravity states evoked in the first part, space's sensations were more closely associated with real spaces, dragging the listener back to reality. The composition of overlapping spaces was constantly denoting one space after the other, bringing a whole repertory of different types of space into scene. Time is translated into the physiognomy of space. While the first dimensional composition was increasing the dimensions of space from dry to wet, this second part was also devoted to mutation of space, but through time modeling of overlapping spaces.

In the third part, the composition of impulse responses begins to densify more and more, and within the sound densification process, the spaces begin to dry up, transforming the impulse responses into simple beats and rhythms. Suddenly the scene goes from a spatial

sensation composition to a rhythmic activation, inducing a musical element into scene. Disorientation of the public arises—who was invited to leave behind their usual musical preconceptions. In a moment, they are transported back to a recognizable techno music scene. The layering process of dried impulse responses leads chaos to a climax that was finally released by increasing the *bpm* and the reverb to form a dense mass in an accumulation process that finally dissolves in an infinite space, brining calm back to the scene for the final end.

The listener's sonic experience becomes an integral part of the performance. The artistic action is not only by domain of the performer; rather, it emerges from the sensory engagement of the audience who becomes a medium, developing awareness and cognitive capacities that foster deeper interaction within the sound space. This range of interactions, spanning various levels of spatial awareness, is facilitated by the interplay between the performer's composition and the receptive disposition of the audience.

The composition, uses sonic and spatial elements to unfold, creating a musical environment built from sound projection in space. A new way of music presentation that is no longer in a stage, but as an immersive enclosure of sonic narratives, building an artistic context for sensory discovery. The sound space created within the SSI encourages listeners to craft their own sonic experiences, allowing them to explore individual spatial relationships within the artwork.

Inside Inchindown Oil Tank: XV Biennial of Media Arts, Santiago.

From December 2021 to January 2022, we exhibited the piece *Espacios Resonantes #10: Inchindown* at the XV Biennial of Media Arts at the Contemporary Art Museum of Santiago, Chile. The project featured a 6-channel audio piece and visual projection that simulated the aural architecture of Inchindown's Oil Tank No. 1 through a virtual reconstruction. Algorithms measured the position of sounds within the virtual space, corresponding to recordings of acoustic activations performed in the actual space. The projection, created using Unreal Engine and TouchDesigner, represented a virtual tour through the oil tank. The installation included six speakers to emulate the tank's sonic atmosphere, and the wall projection simulated the surrounding oil, creating a sensory experience of the tank's interior (fig. 117).

Figure 117. *Resonant Spaces #10: Inchindown* installation.

Under the mountains of Invergordon, Scotland, there is a 200-meter-long underground tunnel. At the end of this tunnel lies the No. 1 oil tank, a completely enclosed, vaulted concrete space. Inside the tank, there is darkness and absolute silence, with the oil-covered walls absorbing all light. Any sound emitted within the tank is amplified as if it were a thousand voices. This structure, part of a set of underground tanks that supplied the British Navy during World War II, currently holds the Guinness World Record for the longest reverberation in the world with 80 seconds.

Resonant Spaces #10: Inchindown moves this World War II oil tank to Room 11 of the Museum of Contemporary Art in Santiago. This audiovisual installation replicates the acoustic environment of the original tank using algorithms that measure the positions of sounds through spatialized binaural acoustics. The installation creates an acoustic journey, making this virtual environment an instrument to modulate compositions from sounds generated in situ: percussions with found objects, voices, and ambient sound. By superimposing the original space of Inchindown with the real space of Room 11, a third space is generated. The dialogue between the Inchindown Oil Tank and the museum space creates a new acoustic environment that becomes part of the artwork. This collective process of sensations generated by translating sound produces multiple simultaneous spaces based on the listener's subjective

reinterpretation, whose presence and unique perspective reveal the architecture and its memory.

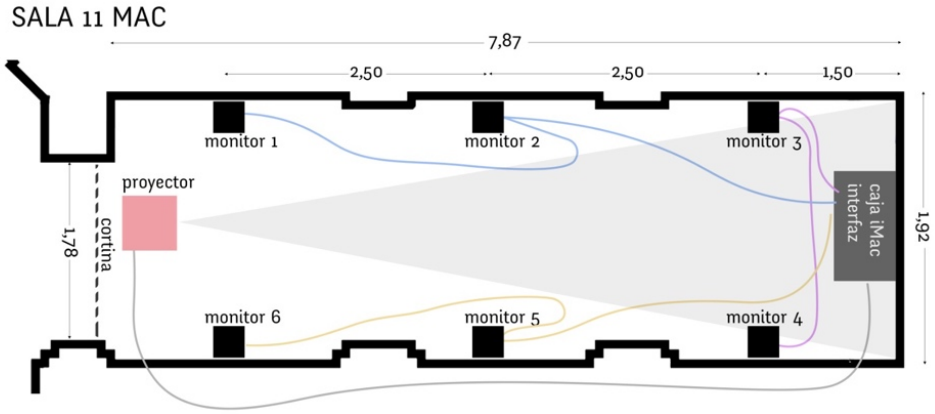


Figure 118. Room 11 scheme with speakers' location (M. Klenner 2021).

Room 11, a long and narrow space, was specifically selected by the curators for this project. Six speakers were arranged in rows of three along each side of the room (fig. 118). This configuration aimed to recreate the longitudinal tunnel experience through sound, enabling the production of a multi-channel composition that simulated the sensation of walking inside the tank from one end to the other. A video game was created as a platform to simulate the acoustic journey inside the tank, with sounds appearing in a 180º configuration. This composition was recorded directly from Unreal in six different channels. To enhance the acoustic sensation of the tank, the recorded sounds were re-simulated with the tank's acoustics using convolution reverb. This approach amplified the acoustics of the relocated space, enhancing the sensation of being transposed inside the tank.

This experience of being inside the Inchindown Oil Tank, temporarily situated within the Contemporary Art Museum, is framed as a specific moment in time, transporting the spectator to the tank's interior. Through this artistic installation, the project offers a way to travel through time and space to another period in history. The embodiment of sound sources creates an enveloping atmosphere, fostering a sense of immersion. In this piece, listeners engage in a form of embodied listening that involves not only hearing the tank's sounds but also feeling and experiencing them through the whole body.

Traveling through Resonant Spaces: VII Music Biennale, Yale University, New Haven.

Figure 119. QR code: Teaser of the performance at Yale University (S. Balbontín 2020)

In February 2020, we traveled to the USA to present the *Espacios Resonantes* project in the *Sounding Spaces* event part of the VII Music Biennale at Yale University. Our presentation combined a performance and a talk, taking the audience on a journey through all the spaces visited during Expedition #1 (fig. 119). The performance took place in a spatialized room equipped with an 8.1 sound system, creating a surround sound effect that triggered a sense of sound immersion. As part of our performance, we made an installation (fig. 120) projecting visual documentation of the expedition onto the walls, enhancing the sensory experience. For sound spatialization, we used second-order ambisonic technology. Mathias Klenner was responsible for sound spatialization and live manipulation of the convolution reverb, while I handled the narration, vocals, and the instrumental display.

The first part of the performance was a spoken narration that introduced the project and described the expedition, detailing the journey and how we entered each space. This included explanations of the morphological and acoustic particularities of each location. For this part, we reproduced the sounds collected inside the spaces and used convolution reverb to simulate the narration voice within each location. Next, we presented the research methodology. This involved playing audio recordings of the impulse responses from each location, along with frequency sweeps and slow feedback demonstrations. This way, we provided a brief demonstration of the practical methods used in the research. Finally, we transitioned from the talk to the performance, presenting a live concert that mixed field recordings with instruments and voices, using the convolution reverb effects from the different spaces.

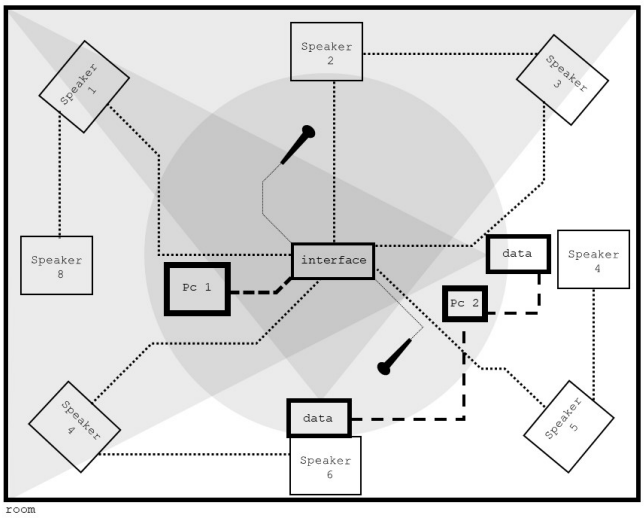


Figure 120. Performance set scheme (S. Balbontín 2020).

With this aesthetic experience, we transferred the sounds from the different spaces explored in Expedition #1 and simulated their presence inside the spatialized room at Yale University. These spaces are scattered around the world, often in difficult-to-access, abandoned, or closed locations. Through acoustic simulation and visual documentation, we constructed a sensory recreation of these spaces for an audience that would otherwise have difficulty accessing them. Given the challenges of taking people to visit these spaces, we bring these spaces to exhibition venues where spectators can experience them through listening.

During the performance, listeners were encouraged to pay attention to the physical sensations of the transported spaces. Attentive listening transforms a passive action into an active sonic experience, where bodies and listening skills become part of the artwork. This performance challenged conventional notions of musical composition and invited listeners to engage with sound in a more attentive, open-minded, and contextually aware manner.

Valparaiso Reverb Pedal: Tsonami Sound Art Base, Valparaíso.

In September 2019, I participated in a residency at Tsonami Sound and Experimental Art Base (B.A.S.E - *Base para Artes Sonoras y Experimentales*) in Valparaíso, Chile. During my residency, I conducted research focused on exploring the resonance of the territory and the

acoustic properties of spaces in Valparaíso. I used the impulse response method, which allows for capturing the sonic expression of spatial morphologies (fig. 121). The residency culminated in an exhibition at the B.A.S.E. gallery titled *Resuenarradarresonante*, aiming to contrast the voices of different spaces in Valparaíso and recreate its acoustics.

Figure 121. QR Code: Video of the acoustic study 5'58''.

In this exhibition, a round-trip process is presented, showcasing the results of an acoustic study conducted in the urban and architectural space of Valparaíso, considering its ruins, alleys, forgotten and restored spaces, as well as its geographical features characterized by peaks and streams. Using the impulse response, acoustic information is gathered from the space and then simulated within the B.A.S.E gallery, aiming to recreate the acoustic experience of Valparaíso solely based on its sounds.

The exhibition consisted of an installation that integrates an audio module with a built-in reverb pedalboard, bringing together all the reverbs of Valparaíso. Each of these reverbs represents the acoustic spaces collected during the residency. The reverbs are displayed in a loop of 11 different spaces that transition automatically, highlighting the differences between their acoustic peculiarities. The module also included a tic-tac clock and a fish tank with three different ornaments that trigger bubbling and water sounds, creating within its intermittent oscillation an aquatic composition that is enhanced by Valparaíso's reverbs. Additionally, the module had a microphone that allowed vocal interventions from the spectators (Fig. 122).

To create the pedalboard of Valparaíso's reverbs, the convolution reverb plugin was used. This way, each reverb effect simulates a specific space from the city. To complement the sound installation and clarify the work, a map was displayed showing the location of each acoustic space, along with a video featuring the impulse responses *in situ*. The gallery itself

was lined with bubble wrap plastic on all its interior walls to create a sonic isolation effect and reduce the natural reverberation of the space. In a temporary action, the B.A.S.E. gallery is transformed into a space inhabited by multiple acoustic environments of Valparaíso. All those spaces collected during the residency were translated, bringing the representative acoustics of the city within the gallery.

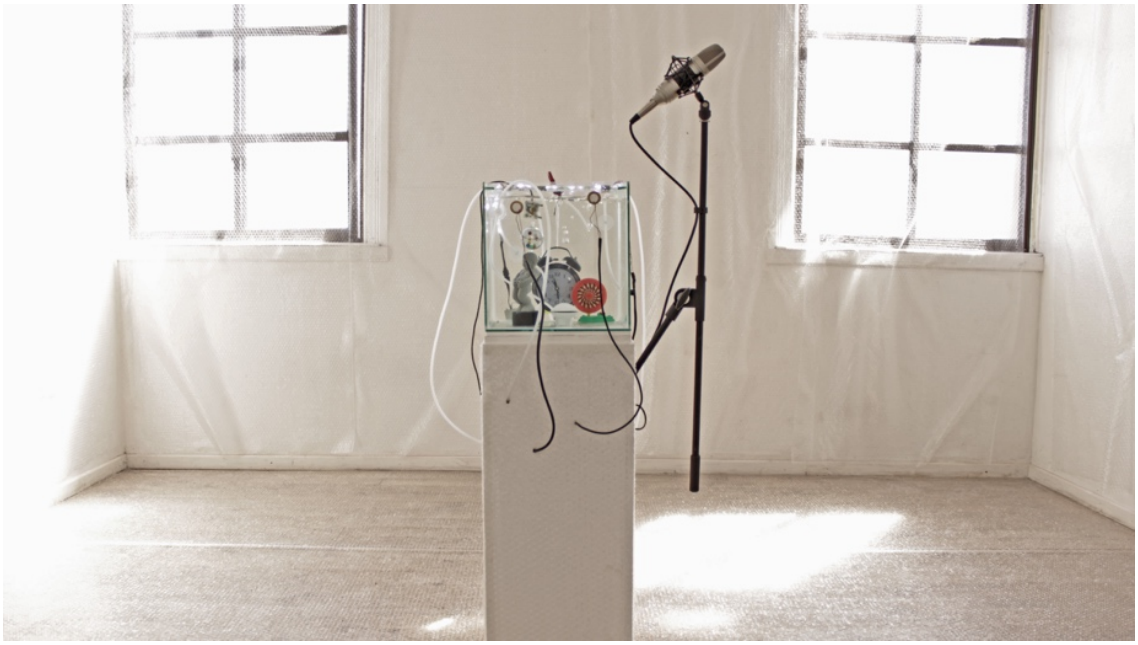


Figure 122. *Resuenarradarresonante* installation in B.A.S.E Gallery (S. Balbontín 2019).

Our forms of sonic embodiment, body posture, movement, and physical presence all influence how sound is sensed. The installation invited people to explore the artwork in their various dimensions by engaging with the created atmosphere through their bodies, seeing the video and map, hearing the acoustics of Valparaíso, and interacting with the microphone to create a complete sensation of being inside the collected spaces. Within the installation, we can understand the sound space only through sensory embodiment, which is conveyed to us in the form of spatial sound from the city. This is a form of knowledge that engages with the lived experience of listening, imagining the real space solely through its sounds.

Virtual Architectures.

Spatial Audio: Espacios Resonantes Album.

Figure 123. *Espacios Resonantes Album.* Art by S. Balbontín. Sound, Voices and Edition by S. Balbontín and M. Klenner. Image by M. Klenner 2020.

On April 24th, 2020, we released the *Espacios Resonantes Album* (fig. 123), an album in vinyl released by Soundspace Records. It consists entirely of spatial compositions from sounds collected on Expedition #1. Each track corresponds to one of the studied spaces, using the sound universe of each place to build aural architectures from an embodied listening experience. The work is presented as a virtual space to be accessed and traversed through sound, without any visual input.

Each specific environment has been carefully designed through layers of ambient sounds, specific audio cues, and dynamic changes over time to evoke each of the resonant spaces. The objective is to create an immersive experience that transports listeners to dystopian settings, from industrial decadence to acoustic sublimation. Sounds have been edited to design spaces where the acoustics themselves create a sense of structure and form, allowing listeners to perceive morphology, materiality, and other spatial features through sound alone.

All the sounds recorded in the album were made within the studied spaces using ZOOM H2n, TASCAM DR-05, and ZOOM H4n handheld recorders. No external sounds were added. The voices are those of the authors, the percussions were played using found objects, the impulsive responses were created with balloons, and the electroacoustic activations (feedbacks and frequency sweeps) were generated using a portable 200W RMS loudspeaker with a frequency spectrum of 60-20,000 Hz.

Figure 124. QR Code: Audio of *Album Espacios Resonantes.*

Each sound composition is a musical narrative that tells the story of the space's voices. Tracks on the album are from the seven spaces collected during Expedition #1. There is one bonus track, *Voces de Inchindown*, performed inside Inchindown Oil Tank (fig. 124):

(1) Inchindown Oil Tank
(2) Lyness Oil Tank
(3) Gasometer Charleroi
(4) Depósito Pluviales Joan Miró
(5) Cooling Tower Charleroi
(6) Voces de Inchindown
(7) Fábrica Textil Cal Grau

This sound artwork makes audible the spatial characteristics of space through an embodied listening experience. More than just audio, it can be conceived as a body-based sound installation: a sound work designed to be installed inside the human body (Ouzounian 2008). This type of sound work creates an encounter with sound that connects the real space with the imagined space of the mind. It involves experiencing a virtual reality exclusively through audition, for creating an intimate sound space.

Augmented Reality Performance: IV International Congress on Ambiances; Ambiances, Alloæsthesia: Senses, Inventions, Worlds. Online.

Figure 125. QR code: Video of the complete Virtual Performance at the IV International Congress on Ambiances 33'30''.

In December 2020, we presented an augmented reality performance (fig. 125) at the IV International Congress on Ambiances, held online due to the COVID pandemic. The project, originally meant to be on-site, was adapted to an online format. This adaptation gave birth to the first version of a virtual project, in collaboration with the sound artist Emilio Marx and the media artist Natalia Cabrera, and with funding of the Ministerio de las Culturas, las Artes y el Patrimonio, Chile. Using video game technology, the project recreated the three-dimensional spaces studied in expedition #1, proposing an acoustic and virtual journey through reverberant spaces within a virtual reality. These spaces simulate the acoustics and geometries of utilitarian structures designed for storing oil, gas, and water.

The sound sources were specifically adapted to the resonance frequencies of each space using electroacoustic media. The simulated virtual space was created using a video game developed on the Unity platform, which sent the listener's position and coordinates in relation to the sound sources arranged in the 3D space through Syphon to Max/Msp software. We developed a patch to transform the triggered sounds into binaural audio.

The journey in the virtual environment uses algorithms to measure the positions of sounds through spatialized binaural acoustics. Sounds within the virtual reality were field recordings from real spaces, spatialized inside the virtual space and triggered by proximity. At the same time, live sounds from the performance were processed through convolution reverberations of each space, simulating the reverberation of these architectures with voices and instruments. The virtual tour through all spaces and their sound sources was previously prepared and automatized in Unity. The tour takes advantage of flying mode to highlight the industrial

geometries of the spaces, which are impossible to fully appreciate while walking. The performance used the video game as an instrument to spatialize and modulate the compositions.

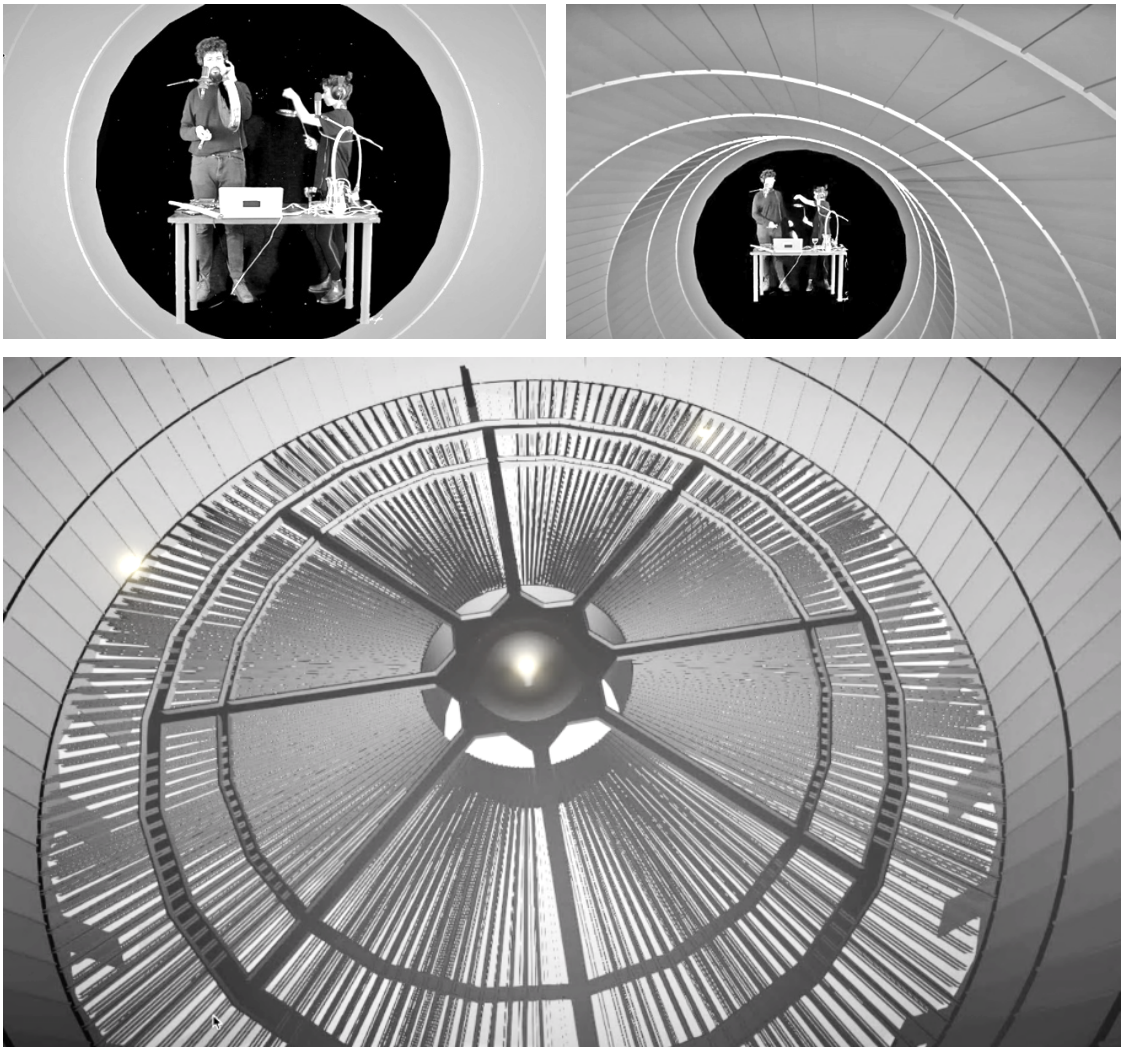


Figure 126. Performing "inside" the Cooling Tower. Extracts from the video.

We performed inside a cinema studio over the virtual reality as a sonic base. Using a chroma key (fig. 126), we overlapped the image of the performance with the virtual spaces conforming an augmented reality, as if we were playing inside the industrial sites, using a 90s aesthetic. The live voices and electroacoustic instruments were filtered through MaxMSP, using convolution reverb as the listener entered each space.

The project explores the relationship between sound, body, and space through real-time simulation of acoustic environments via the video game. This approach generates sensitive

and subjective connections with the memory of architecture and its acoustics, promoting awareness of spatial navigation through sound. This sonic experience involves an individual form of embodiment of virtual sound sources and simulated contextual factors, recreating the entirety of expedition #1 through a virtual journey guided by the performance. The compositions are specifically created to highlight the sonic peculiarities of these spaces and to trigger the body's acoustic sensations within industrial environments.

Virtual Reality: Sonar Festival, Barcelona.

Figure 127. QR code: Teaser of *Resonant Spaces Wastelands*.

In June 2023, we presented the virtual reality project *Resonant Spaces: Wastelands* (fig. 127) at the Sonar Festival, Sonar +D Project Area, in Barcelona. This project explores the creation of aural architectures through the intervention, recording, and acoustic simulation of expeditions #1 and #3. The project was developed in collaboration with the media artist Joan Lavandeira and was funded by the Arsgames Vortex Program.

Through a video game, the viewer-player embarks on a virtual and sonic journey through reverberant spaces designed to store oil, water, and gas. The virtual space becomes a meta-instrument, allowing the viewer-player to compose sound atmospheres through its movement and interaction with the virtual environment. Using algorithms to measure sound positions through binaural acoustics and convolution reverberations, five spaces from expeditions #1 and #3 were reconstructed through simulation as a process of acoustic archaeology: the Cooling Tower in Charleroi, the Joan Miró Water Reservoir in Barcelona, the Inchindown Oil Tank in Invergordon, and the Water Tower and Reservoir Quinta Bella in Santiago (fig. 128).

In this second version of the video game, the project used the Unreal Engine creation platform (instead of Unity) to create the virtual environments. Algorithms simulate binaural

listening, allowing the simulation of sound positions not only left and right through sound wave dephasing but also relative height. Additionally, sounds are attenuated based on distance and by "sound shadows" produced by architectural elements. The platform also allows the direct integration of external sounds using convolution reverberation to simulate the original acoustics.

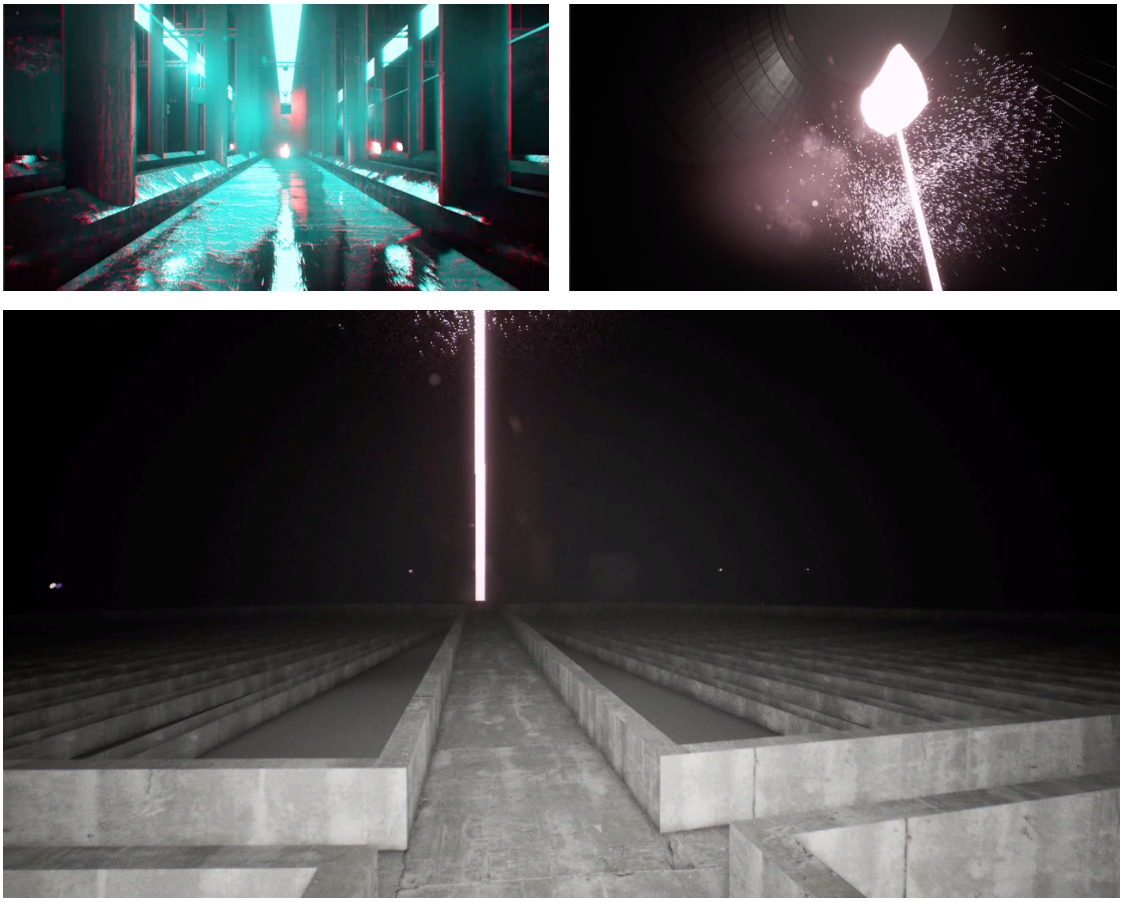


Figure 128. Extracts from *Resonant Spaces Wastelands* video game.

The video game locates sound in space using light elements and objects. When touched by the player, these objects activate the sounds they contain. As the player explores the spaces, they activate sounds and create their own composition through movement. Some sounds, such as impulse responses, generate impacts on the player, while others move within the space. Additionally, each space has a continuous background sound that builds a general

atmosphere. Through sound spatialization and distance-based attenuation, immersive soundscape compositions are created.

At the beginning of each location, there is descriptive text outlining its history, coordinates, and current infrastructure status. Subsequently, a route has been established between these spaces, facilitated by portals for transition. Sound sources are scattered along the route, accessible by the player. This version of the game has been developed for virtual reality, specifically for the Oculus Quest platform.

For the presentation at SONAR+D, a game space was designed to allow the player to explore freely, using control pads for navigation between virtual locations (fig. 129). This design choice was necessary due to the expansive dimensions of some spaces, making real-life replication in their original scale impossible. Within the virtual reality, players embark on a journey through immersive and sonorous environments. The virtual space serves as a meta-instrument, enabling players to compose unique soundscapes through interaction with the virtual surroundings.

Figure 129. Sonar +D Project Area.

Sensations triggered by *Resonant Spaces: Wastelands* constitute a sonic experience that presents an auditory encounter with the virtual spaces, deeply influenced by the atmosphere recreated from the real space. The virtual sound space can evolve over time in response to changing conditions during the journey, fostering a sense of immersion that unfolds through the narrative of the sonic and musical compositions created by the player.

Hybrid Performance: Museu da Agua, Lisboa.

Figure 130. QR code: Video of the Hybrid Performance at Reservatório da Patriarcal 3'54''.

On November 9th and 11th, *Espacios Resonantes* organized the project *Som Sob o Solo: A Caverna de Plutão*, a two-day event for the Museu da Água[14]. We presented a hybrid performance that merged virtual reality with the physical space of the Reservatório da Patriarcal (fig. 130). The performance integrated the acoustics of various virtual spaces from expeditions #1 and #3 with the site-specific acoustics of the Reservatório da Patriarcal from expedition #5, which was stimulated by the performers.

The hybrid performance was part of a sonic journey under the streets of Lisbon. This journey began within the underground tunnels of the Galerias do Loreto with the listening session *Polyphono* and culminated at the Reservatório da Patriarcal with the hybrid performance *Wastelands.* The entire journey constitutes the whole event titled *Som Sob o Solo*. Wastelands blends virtual reality with site-specific live music, immersing the audience in reverberating spaces and liquid architectures. The virtual space acts as a meta-instrument, enabling the performer to craft hybrid sonic atmospheres through interaction between the real space and the virtual environment.

[14] This project received support from the Museu da Agua and the Faculty of Fine Arts of the University of Lisbon.

Figure 132. Hybrid Performance at Reservatório da Patriarcal (J. Espinosa 2023).

This project was developed as part of expedition #5, involving investigations within the Galerias do Loreto and the Reservatório da Partiarcal. After collecting acoustic material from these locations, a performance was created, using the VR Project as a meta-instrument that traverses the spaces explored in expeditions #1 and #3, providing a foundational sound base for the performance. Using this base, a composition was crafted incorporating trumpet, saxophone, didgeridoo, synthesizers, voices, electromagnetic microphones, hydrophones, and geophones to amplify the architectural structure. The VR meta-instrument was manipulated by Mathias Klenner, while the live instrumental composition was performed by myself, Sofía Balbontín, and guest artist Jose Bica (fig. 132).

The composition took into account an acoustic study of the site, using its resonant frequencies and reverberation times. To achieve this, we primarily employed low frequencies that harmonized with the architectural features of the space. The setup involved a multichannel configuration comprising six speakers positioned around the perimeter of the area. Both the stage and the audience were situated on platforms arranged at a height of h/2 and h/4 (fig. 131). The six channels were used as follows: one stereo configuration for the VR, another for Jose Bica featuring trumpet, saxophone, didgeridoo, and digital granular synthesizer, and a third for myself, encompassing two channels connected to dynamic microphones, a hydrophone submerged within a water fountain, two geophones, a Korg MS-20 synthesizer, a mixer modified to function as a synthesizer, and an electromagnetic microphone.

The composition was designed to go along the video game as it traversed each of the spaces, comprising a first segment featuring the Inchindown Oil Tank, a second segment with the Water Reservoir Joan Miro, a third segment featuring the Cooling Tower, and a fourth segment with the Water Tower and Reservoir Quinta Bella. Each segment was characterized by a distinct instrumental approach that engaged both the virtual spaces explored in the VR journey and the physical space of the Reservoir. For the final segment, an improvisation was performed by percussively interacting with the real space, marking the conclusion of the performance. The setup included two stages: one for the live musical performance and another for the live VR projection onto the reservoir wall. Audience members were encouraged to move through the space during the performance, offering them the opportunity to experience different positions and a variety of acoustic locations.

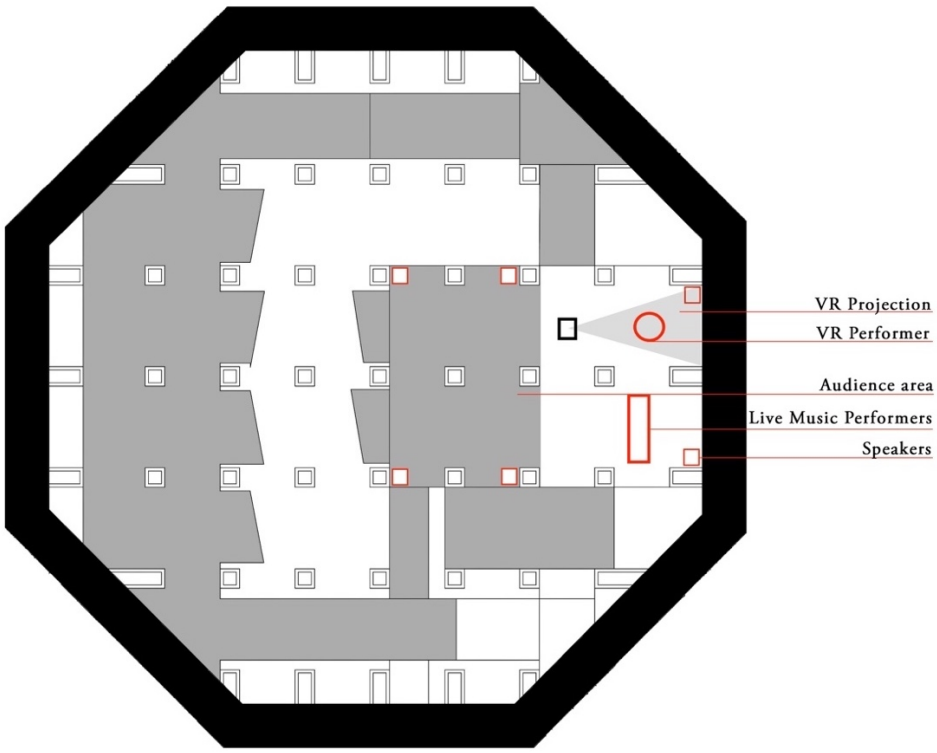


Figure 131. Installation diagram inside Reservatório da Patriarcal with speakers' location, VR projection, audience area, and performers (S. Balbontín).

The hybrid performance invited listeners to engage with sound in a contextually aware manner. The sonorous dimension refers to aspects related to the sound atmosphere created by the convergence of the virtual spaces and the real space in a 6-channel spatialized sound configuration. The sound sources were arranged to create a specific environment that was modified by the audience's embodiment, including body posture, movement, and physical presence.

Sound Space as a Creative Tool (of Multichannel Performances and Installations)

Through the act of listening, we dissolve into space; sound is a medium which develops a sense of connection and emotional resonance with space through embodiment. The artwork

is a method of exploration while creating new spatial experiences through sound, and experimenting new ways of listening spatially. This approach leads to a process of discovery that enhances our ability to perceive space through auditory stimuli, allowing us to understand invisible surroundings through spatial sound. As we engage with sound, we become increasingly attuned to our senses, facilitating an exchange of information where sound informs us about space, while our listening experience informs us about our internal state within the sound space, fostering self-awareness.

Through acousmatics, the sound space connects us to a phenomenon of transduced information about sound evolving in space. There is a temporal narrative of space messages that are communicating through sound. During the live performance at the SSI, the audience was encouraged to enter the room illuminated with a faint blue light, intentionally creating a dark ambiance to diminish the visual sense and enhance the auditory one. The desired effect on the audience was to bodily engage with the sound space through active listening. In *Polyphono's* performances, the spatialization of sound evolves throughout the composition, producing a sonic stimulus that situates the experience within site-specific acoustics. The Inchindown Oil Tank was transferred into the Contemporary Art Museum, using a multichannel installation to simulate the tank's atmosphere through convolution reverb. Using the same simulation process, a reverb pedal from Valparaíso's acoustics was used to create a multispace experience within B.A.S.E gallery. Virtualized spaces from Expedition #1 and #3 were recreated to offer a virtual experience, leading to interaction with a real space during the hybrid performance at the Reservatório da Patriarcal. This fusion of real and/or virtual acoustics constituted a third space, providing a mixed sensory experience. The spatiality evoked by each of these sonic experiences translates into multiple sonic morphologies shaped by spatial modulations in real or virtual scenarios.

Situated-sonic experiences within the artworks promote sensory perception, allowing for a holistic understanding of the environment through bodily engagement. The synesthetic activation of space through auditory features promotes new forms of embodiment of spatial narratives. The aural architectures here created by the artworks, enhance the hearing sense, fostering a unique interaction between invisible architecture and sensation, triggered by sound. Within this phenomenon, listeners attend to sound's inherent tactility, drawing from

bodily sensations to build new invisible spaces. The sound space as a creative tool can establish cross-modal correlations between sound and space, connecting them through our bodies to create aural architectures. The sensory experimentation of artistic action in performative practices brings aural architecture to a metaphysical level, while exploring transcendental intensities that can construct parallel realities.

The listener oscillates between the various sensory levels evoked by sound, transcending physical understandings to phenomenal creative outcomes. The architecture's boundaries are not defined by physical walls, but rather by the invisible spaces created by sound. As the body senses sound, it creates a sound space, while in turn, the sound space inhabits the body. This symbiotic relationship between subject and object becomes the ontological basis for the emergence of the sound space, and thus for aural architecture. The phenomenology of space and its production through situated-sonic experiences introduces the sound space as the sensory recognition of the sonic environment. Artistic expressions as installation art and performance, create a dimension of reality by blending multiple sounding elements and sensory engagement, within a situated experience of sonic embodiment. The creative spatial outcomes here produced as sound spaces, are artistic expressions itself, involving both the performer and the listener in an ongoing phenomenological, and creative process.

ACOUSTIC SPACE

Sound Filtered by Physical Space

Acoustic space is an integral dimension of aural architecture. This chapter develops the notion of acoustic space, examining its applications in the historical evolution of music and the arts, which use architecture to generate acoustic effects. In the first part, various aesthetic practices are here presented, triggering a discussion complemented by different authors and theories on the subject. In the second part, a practical study of acoustic experiments and architectural surveys is conducted through a series of case studies from the *Espacios Resonantes* project. The practical phase focuses on the acoustic space of sound propagation, studied through situated practice to understand the acoustic response of spaces and collect their "voices" for artistic purposes. Each the expeditions presented has one or more subsequent artistic outcomes that use this study as a foundation for creation. Therefore, the central argument of this chapter proposes that through a methodological process of acoustic experiments and architectural knowledge, the sonic reaction of space can be captured and used to create aesthetic experiences. This involves creating a dialogue with spaces through sound and using acoustic data and sonic matter as input for artistic creation.

Introduction

The acoustic space uses acoustics and its empirical knowledge for the perceptual and aesthetic understanding of sound spatiality. The objective is to investigate the physical field of sound and the phenomenon of propagation within a selection of industrial spaces from the *Espacios Resonantes* project. This information will be used as input for artistic creation and exploring potential sound propagation of site-specific interventions. This methodological process is an essential part of the *Espacios Resonantes* project and consists of fieldwork, applying *Urban and Architectural Survey*, and *Acoustic Experimentation* methods.

Despite addressing issues related to acoustics, it is important to state that this research is not about architectural acoustics, but about aural architecture. Aural architecture redirects the technical knowledge of acoustics towards the perception of sound phenomena in space. The methodology presented in this chapter involves strategies for sound material collection and methods borrowed from sound engineering, thereby discovering sound activations of space and enhancing their acoustic manifestation.

It is important to highlight the distinction between architectural acoustics (or acoustic architecture) and aural architecture. Architectural acoustics is a study conducted by architects and acoustic engineers focused on sound fidelity. Its main challenges include acoustic reflections within spaces dedicated to music or speech, thus focusing on developing design strategies to dampen or eliminate these acoustic phenomena. In contrast, aural architecture aims to promote and enhance them, looking forward to understand these qualities through listening and the effects they have on the listener's body. Unlike architectural acoustics, this research strives to find spaces where these acoustic "problems" are exacerbated, where their presence is so powerful that it feels almost tangible—the moment when sound becomes plastic. Aural architecture uses human experience as its language, while acoustic architecture responds only to the physical properties of sound in space.

The sound behavior within a geometric space follows a physical logic known as acoustics. For the purposes of this thesis, I propose the term *acoustic space* as an integral dimension of aural architecture. This concept establishes a dialogue between space and sound sources, delivering information about the space's morphological composition by filtering sound through its reflections. How can we use the acoustic exploration of space as artistic input for creative processes such as composition or site-specific interventions? How can we access the acoustic information of space and discover its hidden voices? How can aural architecture emerge from the spatial reflections of sound?

This chapter explores the notion of acoustic space first from a conceptual approach and then through a practical methodology. The first part presents a historical overview of various practical and theoretical experiences on the use of space as an artistic input, directly engaging with the fields of architecture, sound art, and music. The second part presents in detail the practical methodology of Urban and Architectural Survey and Acoustic Experiments, using Expedition #1, #2, #3, and #5 as case studies. The objective is to explore the proposed notion of acoustic space through a discussion articulated by both theoretical and practical information.

While the previous chapter focused mainly on music as the primary precedent for the historical development of the concept of sound space, this chapter will concentrate on architecture and how other disciplines, such as music and sound art, use architecture and acoustics

for research and artistic creation. This chapter suggests that an acoustic survey, using artistic methodologies and acoustic measurements, can form the foundational premise of an artistic work. Studying the propagation space inspires the creative process of artistic production. This includes compositions that will be exhibited as site-specific artworks and those that transpose acoustic information into other spaces, whether real or virtual.

To support this claim, the text presents the acoustic insights of composers such as Murray Schafer and Jacques Lejeune, who investigate acoustics as the interaction between architectural morphology and resulting sound quality. This exploration extends to the theories of Henry Torgue, Jean François Augoyard, Barry Blesser, and Linda Ruth Salter, who classify the acoustic effects of sound in space and the diverse spatialities they produce. Moving forward, it discusses the practical experiences of architects and artists in the realm of acoustics, showcasing works by Alvin Lucier, Michael Asher, Bernhard Leitner, Maryanne Amacher, Akio Suzuki, and Raviv Ganchrow. These practical experiences are complemented by the theoretical concepts of Christophe Cox and Brandon Labelle. Finally, the narrative transitions from artistic experiences to the sacred experiences of ancient cultures through the study of archaeoacoustics, examining case studies such as the Neolithic constructions in the United Kingdom and the Maya pyramids in Mexico.

The purpose of this historical phase is to establish a conceptual framework that underpins the practical methodologies utilizing acoustics as a means of creating and transmitting a series of aesthetic experiences, as observed in the previous chapter. The acoustic space serves as both the performance space and the artistic medium through which artworks are fashioned. The acoustic analysis, presented in the second part of this chapter, draws upon the following case studies:

(1) Expedition #1, featuring artistic outcomes as: *Space Dystopia* at the Spatial Sound Institute in Budapest; *Espacios Resonantes #10: Inchindown* at the Bienal de Artes Mediales in Santiago; a performance at VII Music Biennale, Yale University in New Haven; *Espacios Resonantes Album*, an augmented reality performance at the IV International Congress on Ambiances; and a *Resonant Spaces: Wastelands* VR Project at the Sonar Festival in Barcelona.
(2) Expedition #2, showcasing the installation *Resuenarradarresonante* exhibited at B.A.S.E Gallery in Valparaiso.
(3) Expedition #3, highlighting the *Espacios Resonantes Festival* and the performance *Polyphono* in Santiago.

(4) Expedition #5, featuring the performance *Tungsteno* at Minas de Queiriga and the event *Som Sob o Solo* with the installation *Polyphono* and the hybrid performance *Wastelands* at Museu da Agua.

Expedition #4 is not included in this list because no artistic projects have yet been developed from its acoustic study.

Sounds of Space

> As the sound wave propagates to the listener, it undergoes changes produced by the acoustics of the environment. Spatial acoustics produces reflections, resonances, reverberation, dead zones, focused intensity, sonic channels, dispersion, and so on, all of which have an audible manifestation. (Blesser y Salter 2009: 7)

Murray Schafer employs the term *acoustic space* (1991: 17-22) to describe the phenomenon where sounds articulate and define space, thereby emphasizing a perceptual shift towards an auditory mode. Acoustics, derived from the Greek word *ακουστικός* (akoustikós), pertains to the study of sound, particularly its transmission through a medium and the consequent effects it produces. It encompasses a wide range of phenomena related to sound waves and vibrations, including how they propagate through various mediums such as air, water, or solids, how they interact with objects, surfaces, and materials, and how they are perceived by humans.

Approaching from a musical perspective, Jacques Lejeune (1991) proposes three categories of acoustic space to introduce this chapter:

1. Closed spaces with a tendency towards fidelity (e.g., concert halls, theaters).
2. Cataphonic spaces or reverberant closed spaces (e.g., churches, cellars, tunnels).
3. Open-air or open urban spaces (e.g., courtyards, squares, cloisters) (81).

Sound effect.

To analyze the acoustic environment, Augoyard and Torgue (2006) developed a repertoire of sound effects that allow for a deeper and more detailed understanding of the phenomenon of sound reflections in space. Many of these sound effects depend on the morphology of the space, some rely on the combination of the space with certain actions or sound events, and

others are completely independent of the context, such as those related to memory, the semantic information of a community, and perception in general.

The sound effect cannot be treated solely from an objective or subjective perspective, as it involves the interaction between the physical and cultural characteristics of the acoustic environment. Additionally, it cannot be understood merely as a concept but rather as a paradigm. This paradigm does not aim to generate strict definitions but rather provides information about the nature of sound, opening interdisciplinary discussions towards this new type of phenomenon (Augoyard and Torgue 2006).

Augoyard and Torgue's repertoire of sound effects is a classification system divided into six categories, defined by the types of interactions that acoustic space experiences with sociality. The repertoire considers some of the categories which address each integral phase of the triad that constitutes the sound phenomenon: emission, propagation, and perception. Emission is classified under elementary effects, propagation under compositional effects, and perception under mnemo-perceptive effects. The effects directly related to acoustic space are the compositional effects, which involve the assembly of different sounds depending on the spatio-temporal conditions in which they are placed (Augoyard and Torgue 2006).

Sound makes the geometry of space audible while spatial acoustics is modifying the sound message, shaping our auditory experience. Naturally, we have an innate ability to recognize space through what we hear. According to Blesser and Salter (2009), there are perceptual cues that are physical attributes of space expressed sonically, allowing us to “visualize” space with our ears. These sound cues influence our behavior, emotional responses, and sense of intimacy, thereby reconfiguring the character of space.

Both sound and space communicate messages in their own unique languages. Blesser and Salter (2009) describe aural architecture as the properties of space perceived by a listener, encompassing how we hear multiple sound sources interacting with spatial elements and the symbolic meanings attributed to them by the listener. They argue that every space has an aural architecture, which can be manipulated by modifying spatial attributes to create new aural experiences. In this context, the sensory aspects induced by acoustics determine the cultural value and social function of architecture.

Architecture as artistic material.

Spatial attributes that have an audible manifestation, even if they do not emit sound themselves, can be detected through perception. This auditory process is called echolocation, derived from the Latin words *echo* (sound) and *locatio* (position). Echolocation is the ability to understand the environment by emitting sounds and interpreting the echoes or acoustic responses reflected by spatial dimensions. The most common example is bats, which can distinguish between emitted and reflected sounds that contain environmental information. This allows individuals to "visualize" the geometries of space and the elements within it. The acoustic response of different elements varies according to their shape, dimension, and materiality, producing high or low-frequency responses depending on each element.

In the work *Vespers* (performed for the first time in 1969), Alvin Lucier (1980: 15-17) explores the sound perception of space through its acoustic response using a sonar. The performance involves a small group of blindfolded participants who attempt to navigate an enclosure using echolocation (fig. 133). The sonar emits an acoustic signal that returns with geometric information about the space, including distances and materiality. *Vespers* exemplifies Lucier's interest in the physical properties of sound and how it interacts with architectural space. It invites listeners to engage with sound not only as a means of communication or expression but also as a material presence that shapes our perception of the environment.

Figure 133. Vespers, Alvin Lucier. New Music Festival. May 20, 2010. Venue: Het Hemels Gewerlf. (Image recovered from Youtube channel Dag in de Branding).

The biological skill of echolocating spatial morphologies can be activated based on the form, dimensions, and materials of a space. These physical properties filter frequencies, coloring and texturing the atmosphere, and also amplifying or reducing sound. Spatial strategies to generate various sonic effects are extensively used in the work of Michael Asher, a conceptual artist known for his site-specific installations and spatial interventions. Asher often removed or added walls and materials in galleries to provoke sensory alterations in acoustic perception.

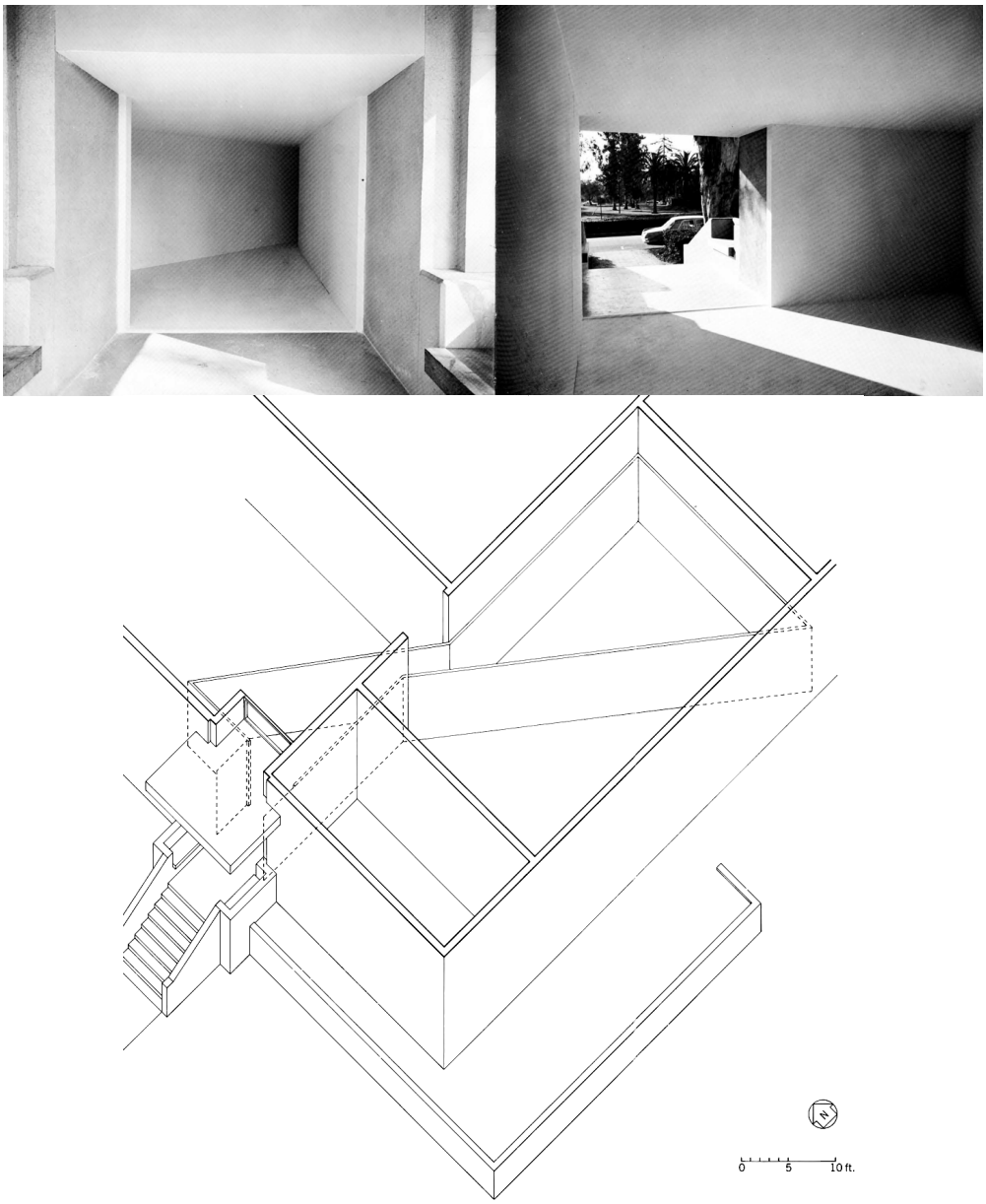


Figure 134. Intervention at the Pomona College Art Gallery, Michael Asher, 1970 (Asher 1983).

In his intervention at the Pomona College Art Gallery in 1970, Asher modified the existing gallery and lobby by using the existing walls and adding three new ones to create two triangular spaces connected by an acute angle (fig. 134). He removed the two glass doors at the entrance to the lobby, leaving the new triangular spaces open for a 24-hour gallery. The angles of the first space were open to the street, while the angles of the second space opened towards the back. This design amplified the exterior street sounds into the smaller triangular space, transmitted them through the corridor, and further amplified them in the larger triangular space, reaching their highest level at the end of the gallery.

Architecture can be treated as an artistic element that shapes sound as well as the perceptions embodied in its acoustic reflections. Bernhard Leitner's *Cylindre Sonore* is located in the middle of a garden in Parc de la Villette in Paris, and stands like a pause in the vegetation (fig. 135). The cylindrical space has on its perimeter a water system consisting of a channel fed by eight waterfalls. Above each of the slots is a speaker that plays a composition specially created for the site. The work creates an immersive atmosphere that mixes the synthetic sounds of the composition with the sound of flowing water. The cylindrical geometry of the space amplifies these sounds, as well as the ambient sounds of the surroundings.

Figure 135. *Cylindre Sonore*, Bernhard Leitner, 1987, Parc de la Villette, Paris.

Similarly, Akio Suzuki's *Space in the Sun* (fig. 136) is a construction configured as a listening space in the midst of nature. Built nearly 30 years ago on a hilltop in the town of Kyotango, in the Tango region outside Kyoto, the work consists of a floor and two brick walls, creating a space to listen to the environment. The confronting walls generate a stationary sound effect, similar to the visual infinity of two facing mirrors. The sounds of the place are reflected by the two walls, creating echoes that bounce, evoking a sonic infinity.

Figure 136. *Space in the Sun,* Akio Suzuki, 1988, Kyotango.

In acoustics, architecture can serve as both poetic material and a scientific experiment, merging art and science. The Klankkaatster (sound bouncer) is a habitable ellipsoidal sculpture designed by sound artist Hans van Koolwijk. Standing 10 meters high and 5 meters in diameter, it has two focal points (fig. 137). A sound source is positioned at the upper focal point, while the listener's head is located at the lower focal point within a specially designed listening area. Due to the ellipsoidal shape and focusing effect within this type of curved spaces, sounds from the source reach the listener's ears as if they were produced inside their head.

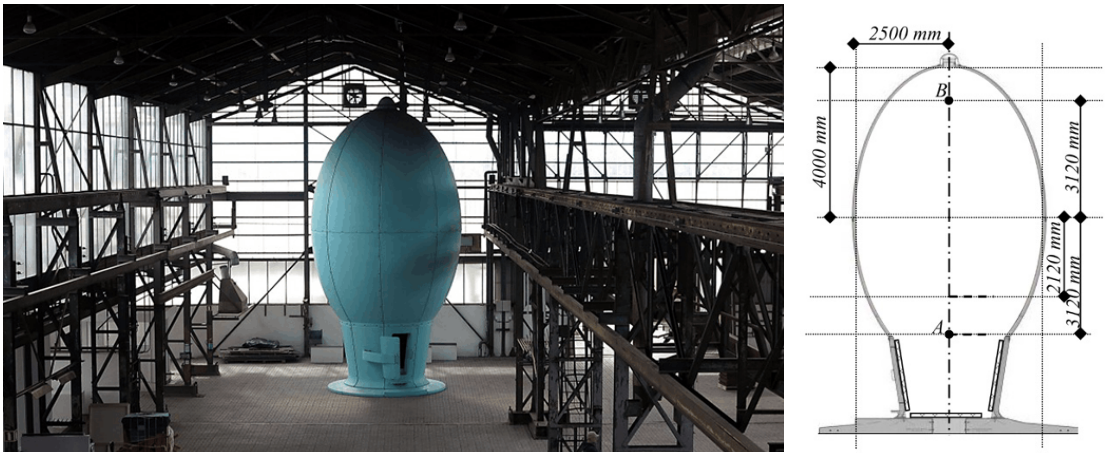


Figure 137. *Klankkaatster,* Hans van Koolwijk, 2010, Rotterdam.

Unlike the last three cases presented, which involve the design and construction of new spaces, Edwin van der Heide's artwork *The Speed of Sound* uses the architectural complexities of an existing space for a site-specific installation in the Wasserspeicher, a water reservoir in Prenzlauer Berg, Berlin (fig. 138). The artist identifies a series of acoustic characteristics typical of a circular space shaped by concentric rings, which he uses as a premise for his work. Van der Heide explains, "The sound travels from one side of the wall, all the way along the corridor, and arrives at the other side of the wall... therefore experience the speed of sound" (283).

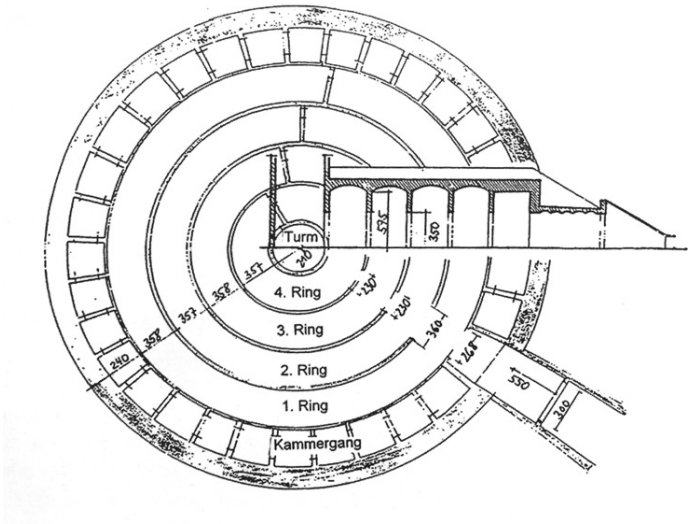


Figure 138. Wasserspeicher in Prenzlauer Berg, Berlin (Heide 2011).

Using the delay of the returning sound from the produced sound, he developed an installation where he picked up the sound and played it back, manipulating it in two ways: by delaying the sound and by modifying the pitch. With this intervention, he transformed the acoustic properties of the space in real time, creating "a dynamic form of sonic architecture" (288). The installation creates a composition that the acoustic space constantly reflects and filters. This reflection shapes the space by the resonant frequencies resulting from those reflections, which determines the behavior of the space. With his installation, Edwin van der Heide situates the audience within an inhabitable instrument.

Background noise.

Architecture has the ability to create various sound effects by manipulating sound reflection. It can modify, amplify, or diminish sound. In his piece for the exhibition *Spaces* (1983: 24-30), Asher experimented with noise reduction. Exhibited in 1969-70 at the Museum of Modern Art MoMA in New York, the work explored echolocation processes by altering the material conditions of the space and modifying its acoustic response. Whereas in previous instances Asher amplified the auditory experience of the gallery by altering its morphology, in this piece he reduces the room's acoustics by manipulating sound reflections within the enclosure, covering the entire space with insulating material (fig. 139). Asher succeeds in delivering a spatial experience with acoustic cues muffled by silence, allowing otherwise inaudible sounds to emerge, sometimes corporeal, initiating a dialogue with the space from an individual's intimate listening experience. Upon entering the installation, the sounds of the museum are restructured and dissolved by the space. Asher (1983) states that he aimed to establish a continuity without objectifying the work, achieved through the careful control of the viewer's perception, which becomes subordinate to the art object itself—the acoustic space.

Figure 139. Intervention for the exhibition *Spaces* (1969-70), Museum of Modern Art MoMA, New York (Asher 1983).

In *Spaces*, the room was treated to minimize sound reflections by using highly absorbent materials, transforming the museum's space into an anechoic chamber. The term *anechoic* originates from the Greek words *an* (meaning "without") and *echo*, indicating that the chamber is designed to reduce echoes or reflections. John Cage entered an anechoic chamber at Harvard University (fig. 140), where all six faces were covered with insulating material. He described it as "a room without echoes" (Cage 1968: 8). In this environment, completely isolated from external sounds and seemingly devoid of space, Cage attempted to discover silence. However, instead of silence, he heard two sounds: one high and one low. The former was his own nervous system, and the latter was his blood circulation. As humans, we will never experience complete silence. When background noise is minimized, biological activities within our bodies become audible. There will always be background noise, even if it is produced by our bodies. In natural settings, this background noise may be produced by animals, moving air, and vegetation. In urban environments, it may be generated by traffic, people, and machinery. Inside a room, there will always be a low hum produced by air conditioning or electrical equipment, amplified and colored by the room's reverberation. Cox (2018) refers to this background noise as an eternal material flow, which he calls *sonic flux*.

Figure 140. John Cage inside the anechoic chamber at Harvard University.

The sonic flux is a sound that remains in the background for us, which we unconsciously register but do not consciously perceive. According to Cox, background noise constitutes an auditory unconscious and forms what we understand as silence. In contrast to Cage's search for silence inside the anechoic chamber, Cox's concept of silence is what Cage would consider music; "Cage's most famous composition 4'33" (1952) calls for the performer(s) to make no intentional sound, thus shifting the audience's attention to ambient sounds and to the background noise we call 'silence'" (Cox 2017: 27). *4'33"* is an orchestral composition of background noises, composed by the audience itself, exterior noise, and the spatial reflections of the room. This background noise imparts a specific tone to the room, described by Cox as *Room Tone*: "the low-level sonic murmur generated by the minute movements of air particles in enclosed spaces" (2018: 128). In Lucier's piece *I am sitting in a room* (1969-70), he utilizes background noise and the spatial characteristics of a space to modify speech. He records his voice in a room, repeatedly plays it back to reinforce the room's resonant frequencies, and ultimately hears the room's natural resonances articulated by speech. The result is a distorted speech transformed into a drone sound composed of the resonant frequencies of the space.

Aural spatiality.

To phenomenologically define the different interactions between space, sound, and bodies, Blesser and Salter (2009) outline five types of spatialities to describe the auditory capacity of human spatial experience. *Navigational spatiality* utilizes echolocation to visualize the geometry of space (e.g., *Vespers* by Lucier). *Social spatiality* responds to the relational links between people influenced by the auditory properties of space (e.g., dining table). *Symbolic spatiality* refers to acoustic attributes acquiring additional meaning associated with activities occurring in specific spaces (e.g., cathedral). *Aesthetic spatiality* involves the experience of acoustics providing an auditory texture, often manipulated to amplify or diminish acoustics for sound-spatial experimentation (e.g., *Spaces* by Asher). *Musical spatiality* corresponds to acoustic aspects of space conditioning or influencing musical expressions occurring within it (e.g., concert hall) (Blesser and Salter 2009: 50-63).

From a perceptual standpoint, various physical, social, and psychological layers are superimposed, enabling us to understand sound within architecture. Labelle (2010) explores sound and architecture as an aesthetic project directly intertwined with spatial experience and imagination. Sound contributes performative notions to architecture, shaping space through practice and participation, providing a temporal sense of lived experience. Labelle posits that the relationship between sound and architecture creates an ambiguity, delineating the audible limits through spatial-physical rigor. Within this ambiguous gap, sound and architecture open the way for sound art, introducing a cultural practice that broadens the possibilities of spatial production. According to Blesser and Salter, this spatial production emerges from the sensory experience of spatial reflections.

According to Raviv Ganchrow (2009), the listening space reveals itself as an uninterrupted interior with dynamic and temporal boundaries. It represents a cognitive space of sounds apprehended through vibrational interactions. Ganchrow suggests that categorizing these typologies of space isn't about defining types, but rather about discerning the various modalities within which sound materiality exist in space. He considers this sonic materiality not as a vibrational stratum, but as bodily attitudes toward the experience of sound.

In his piece *Crescents* for the Tuned City Festival in Tallinn, Ganchrow developed a sound intervention inside the Tallinn Hydroplane Hangar, utilizing one of the three 60-meter in diameter domes that compose the ceiling of the hangar. The unique sonic characteristics of this architecture were utilized to circulate sound, initiating with recordings of the ambient sound of the place, which were spread across an array of loudspeakers, reflecting and focusing them into the curvature of the dome (fig. 141). Ganchrow describes, "the slow, recursive process sets off an accumulation of time-delayed reflections that manifest a series of arced resonances between properties of sound, the structure of the hangar, and arranged remnants of the location" (2011: 294).

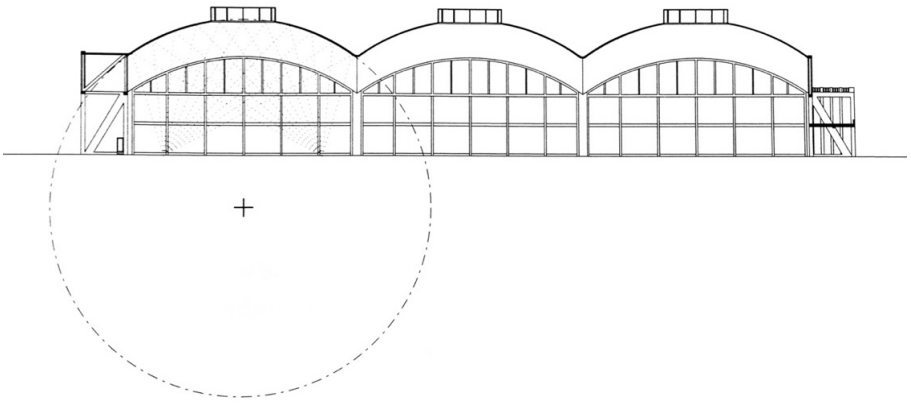


Figure 141. *Crescents,* Raviv Ganchrow, 2010, Tuned City Festival, Tallin (Ganchrow 2011).

The vibrational conception of acoustic space is also the object of study in Maryanne Amacher's spatial experiments for *Sound Joined Rooms* (1980). In this project, she proposes to inhabit a house through sound. The intervention consists of several loudspeakers distributed around an abandoned Victorian house in St. Paul, Minnesota. Her idea was to create an acoustic environment of energy flux circulating throughout the house. Within this project, she experimented with architecture and sound not only through airspace but also through the structure. She presents two vibrational phenomena of different natures: airborne sound, which refers to the experience of sound traveling through the air, and structure-borne sound, which refers to the sound wave that travels through the architectural structure, vibrating the matter of which the walls, floor, and parts of the enclosure are composed (Licht 2009: 7). The vibration here can prompt a reconsideration of what is intrinsic to architecture and

generate a specific space of bodies and objects located in that particular time, providing a unique experience.

The acoustic space encompasses the experience of sounds emitted by sound sources as they are modified by the surrounding space. Space, in turn, is activated by sound, with spatiality understood as a container of perceptual phenomena; "illuminated" by sound waves and modified by geometric space. Acoustic space is dynamic, created by sounds and filtered by objects, geometries, spatialities, and the variability of bodies.

Archeoacoustics.

In 2019, as part of Expedition #1, we visited the Ring of Brodgar located on the Mainland of the Orkney Islands, Scotland. Although the site was not included in our archive, we were deeply intrigued by it. This site is a Neolithic stone circle originally consisting of 60 standing stones, though only 21 stones remain standing today (fig. 142). The stones vary in height and width, with some reaching up to 4.7 meters tall and 2 meters wide. In its original construction, the 60 standing stones were evenly spaced from each other and from the center, forming a perfect circle with a diameter of 100 meters. Remarkably, even with only 21 stones remaining, the acoustic effects of echo and reverberation, especially from the center of the circle, are still incredibly impressive, even though this is unusual for outdoor sites.

Figure 142. *Ring of Brodgar*, Orkney Islands, Scotland (S. Balbontín 2019).

One of the applied disciplines of acoustics is archaeoacoustics, which merges archaeology and acoustics. Archaeoacoustics gained popularity when archaeologists began to notice a significant number of acoustic effects in archaeological sites. These effects were directly related to the activities carried out inside these sites in ancient times, providing valuable anthropological information. Activities such as shamanic rituals, sacred ceremonies, and political and social practices have gained importance for researchers as they uncover evidence from prehistory. By using acoustic collection techniques, archaeologists can obtain results regarding reverberation times, standing waves, echoes, and other acoustic properties.

> Archaeoacoustics research of sound behavior in ancient places of different eras and cultures has revealed that our ancestors used spaces with very particular resonant qualities, most likely to enhance ritual-based experiences (Martinho 2017: 128).

Archaeoacoustic studies typically gather information from prehistoric sites such as stone circles with peculiar outdoor echoes or from caves and underground structures like passage-grave chambers with distinct resonant frequencies. The Paleolithic art discovered in caves may have been influenced by their acoustic properties. For instance, drawings of bulls have been found in chambers with strong echoes, potentially emulating the percussive sound of stampeding. Devereux, Jahn, and Ibison (1995) examined six Neolithic and Iron Age ritual burial sites and tombs. Their research revealed that all chambers exhibited strong resonance at frequencies between 95 and 20 Hz. They suggested that rock art found in these sites resembled the acoustic patterns of standing waves, with resonant frequencies matching the male voice range. They speculated that forms of human chanting may have been enhanced by the chamber resonance.

Numerous investigations have been conducted in these types of spaces using architectural acoustics and sound engineering techniques to discover various acoustic effects. In the famous site of Stonehenge, Watson and Keating (1999) discovered modal resonances, filtering of low frequencies, and reverberation, suggesting that these effects may have been intentionally designed and shaped by polishing the stones. At Easter Aquorthies, another stone circle near Aberdeen, a curious echo was documented. With 11 standing stones, the site was constructed within a basin, intensifying the acoustic effects produced by the stones in a circular configuration (fig. 143).

> …Easter Aquorthies could direct sound in rather unexpected ways. The recumbent block and its flanking stones seemed to project speech and other sounds across specific areas of the site, so that they could be heard easily in some areas, but were faint in others. Even with fairly quiet sounds this echo noticeably fluctuated in intensity relative to the position of the listener. In addition, subtler reverberations appeared to originate from different places around the circle, and these could not easily be explained (Watson and Keating 1999: 326).

Studies on ancient sites within complete rooms, buildings, or even citadels have yielded interesting information. For instance, at Chichen Itza of the Maya Culture in Mexico (675), multiple acoustic effects were observed. One of the most well-known is the acoustic chirp produced by clapping in front of the main staircase of the pyramid El Castillo, resembling the chirp of the Quetzal (Garza et al. 2008), or the sound of raindrops heard at the bottom of the stairs while people climb. Pre-colonial cultures associated sound with mystical qualities, as the voices of gods and spirits were believed to be heard in the acoustics of sacred spaces. "When the aural experience of an acoustic space is sufficiently strong, its voice contributes, however slightly, to creating an altered state of consciousness in listeners…" (Blesser and Salter 2009: 73).

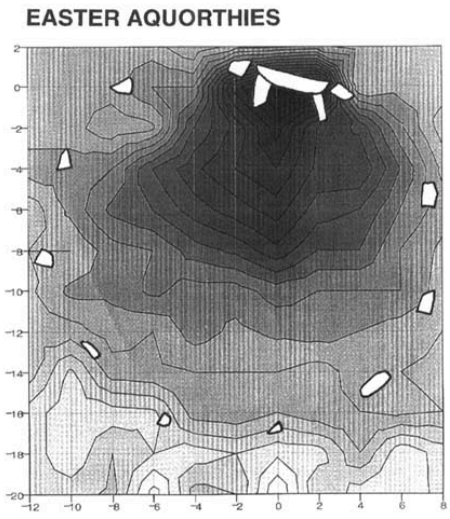


Figure 143. The distribution of sound pressure across open ground and from within Easter Aquorthies. The darker greys represent louder volumes. (Thom et al. 1980: 162).

Ancient sites like open-air Greek theaters were enormous conical-style infrastructures designed for large audiences, treating acoustics in a manner that ensured oral clarity was

distributed widely throughout the audience. Various architectural techniques were employed to enhance acoustics, such as using the wall behind the stage for sonic reflection or increasing the angle of ascent in the seating area.

With a primary focus on prehistoric and ancient sites, the study of acoustics in historical spaces extends to other locations such as temples, churches, cathedrals, theaters, and concert venues from the Classical and Medieval periods. For example, studies have examined the reverberation times in the Basilica of Saint-Denis in Paris (1144), or the whispering gallery effect in the Dome of St. Paul's Cathedral in London (1697). This effect occurs when a person whispers or speaks softly near the curved wall of the dome. The sound waves emitted travel along the curved surface and are reflected off the walls. As these sound waves converge at the focal point on the opposite side of the dome, they create a focused sound point that can be heard clearly by someone standing at that location, even if they are far away from the original speaker.

My interest in archaeoacoustics lies in collecting historical experiences of researchers who use sound engineering methodologies to investigate sound manifestations in spaces, particularly those related to ritual spaces, cenotaphs, or sacred spaces. Could archaeoacoustics be extended to include the acoustic study of Architectural Modern Heritage within industrial ruins?

The voices of the Industrial Architecture

A voice refers to the sound emitted by both humans and non-humans. The simplest examples include the human voice and the timbre of musical instruments. When referring to physical space, the voice represents the ephemeral component unique to each space, utilizing the material field to convey sonic information. Through a wave that excites every particle of matter, the voice is shaped through acoustic space and manifests itself as sound. The ontology of sound is rooted in a molecular premise common to all states of matter, where sound waves vibrate and resonate the material components of space (Gershon 2013).

Acoustic space displays sonic information, tracing a vibratory path of propagation. The acoustic response defines the character of an environment and shapes the personality of the space. This personality is translated in the personification of built reality and the animation of the static through sound. The transduction of architecture into sound serves as a mirror, reflecting the visual image in an audible format, creating a synesthetic effect that interprets spatial experience as acoustic sensations. Acoustic space is a sequence of sonic manifestations that occur in a linear chronology, converging to deliver a sensory response to physical reality; a construction of sensibilities that shape the atmosphere that surrounds us (Balbontin 2020).

The second part of this chapter explores acoustic space as the spatial conformation of sound within the artistic experience of the *Espacios Resonantes* project. It involves several expeditions that travel around the world in search of the modern ruins of society, collecting sonic material from their spatial voices. This journey reveals a natural tendency to focus the research on the entropic spaces of humanity, throughout acoustic sublimation of degrading spatialities within industrial architectures.

Expedition #1: Charleroi | Highlands | Barcelona.

Acoustic Experiments.

Case studies: Cooling Tower and Gasometer in Charleroi, Belgium; Tugnet Ice House, Lyness and Inchindown Oil Tank in Scotland; Joan Miró Reservoir and Refugi 307 in Barcelona, Spain (fig. 144). The specific methodology of acoustic analysis involved obtaining impulse response, frequency sweep, and slow feedback from the spaces. These were recorded with ZOOM H2n, TASCAM DR-05 and ZOOM H4n. For electroacoustic activations we used a 200W RMS loudspeaker with a frequency spectrum of 60-20,000 Hz.

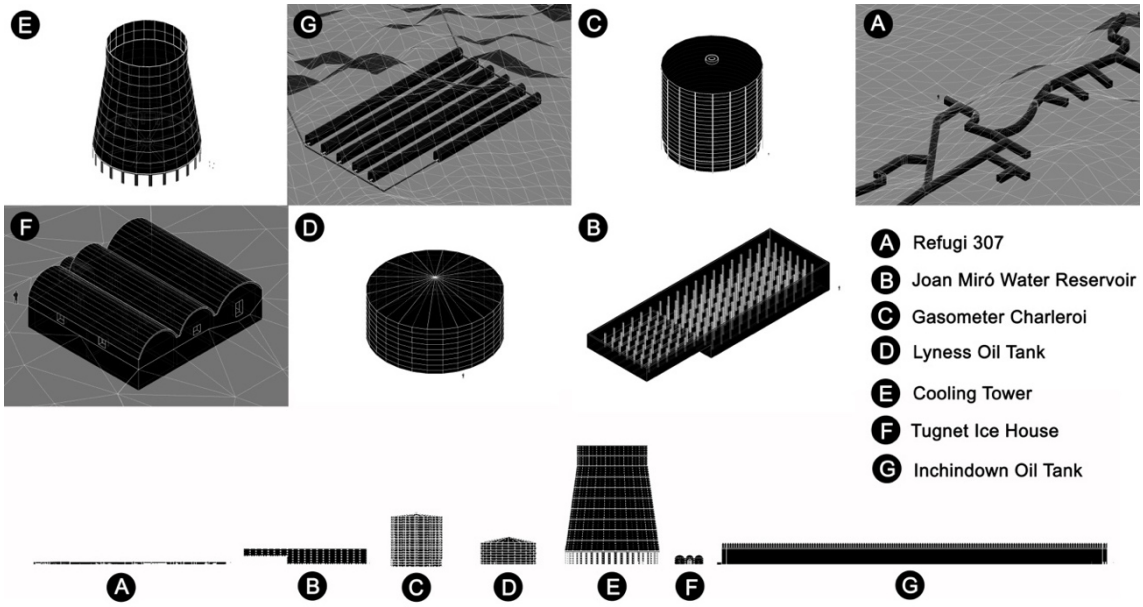


Figure 144. Case Studies from Expedition #1 (S. Balbontín 2019).

During Expedition #1, we explored industrial spaces where we encountered various sonic reflection effects. Sonic reflections within these spaces generate a series of acoustic phenomena, including reverberation, echo, resonance, standing waves, among others. These acoustic phenomena contribute to the unique acoustic character of these spaces, forming their "voice". One of the most notable acoustic phenomena we encountered was reverberation. Reverberation refers to the persistence of sound in a space after the original sound is produced. It occurs when sound waves reflect off surfaces within the room multiple times before eventually fading away. These reflected sound waves blend with the original sound, creating a complex auditory environment characterized by multiple repetitions of the original sound at varying intensities and time delays. Several factors influence reverberation, including the size and shape of the room, the materials of the surfaces, and the presence of objects within the space. As Sabine explains in his paper *Reverberation* (1923);

> Sound, being energy, once produced in a confined space, will continue until it is either transmitted by the boundary walls, or is transformed into some other kind of energy, generally heat. This process of decay is called absorption. This, in the lecture-room of Harvard University, in which, and in behalf of which, this investigation was begun, the rate of absorption was so small that a word spoken in an ordinary tone of voice was audible for five and a half seconds afterwards… This phenomenon will be called reverberation, including as a special case the echo… The term echo will be reserved for that particular case in which a short, sharp sound is distinctly repeated by reflection, either once from a single surface,

or several times from two or more surfaces. In the general case of reverberation we are only concerned with the rate of decay of the sound. In the special case of the echo we are concerned not merely with its intensity, but with the interval of time elapsing between the initial sound and the moment it reaches the observer. (9)

The significant reverberation within each of these spaces allows us to perceive the movement and expansion of sound. Depending on whether the space is curved or orthogonal, we could describe this movement as spiraling or bouncing upwards. The sonic impulse is followed by a trailing sound that decreases at different speeds and pitches, depending on the space's characteristics. Reverberation is measured using the impulse response, which considers the reverberant tail until it drops by 60dB (T60). This measurement identifies the reverberation time in relation to the morphology and dimensions of the space (table 1).

SPACES	TIME (s)	VOL (m3)	H (m)	L (m)	W (m)
Cooling Tower	15	212,057.5	75	-	60
Gasometer Charleroi	20	27,369.5	32	-	33
Lyness Oil Tank	44	17,318	18	-	35
Joan Miró Water Reservoir	30	55,000	10	76.75	24.4
Refugi 307	4-8	926	2	300	1.50
Tugnet Ice House	8	220	6	7.5	5
Inchindown Oil Tank	80	27,729	13	237	9

Table 1. Reverberation time (T60).

Each reverberation is unique, not only in terms of duration but also in relation to its morphology, texture, and timbre (fig. 145). The dimensions of a space are the primary parameters influencing reverberation time, as seen in intimate spaces such as the Tugnet Ice House and Refugi 307, compared to larger spaces like the Cooling Tower, Gasometer Charleroi, or Inchindown Oil Tank. Although dimension is important, the shape of the space is the most decisive aspect affecting this temporal characteristic. For example, comparing the Cooling Tower and the Inchindown Oil Tank shows that the relationship between volume and reverberation can be inversely proportional. The tubular morphology of the completely enclosed Inchindown Oil Tank generates thousands of reflections trapped within the space, resulting in increased reverberation compared to the open Cooling Tower.

Figure 145. QR Code: Audio of Impulse Responses.

The manner in which sound waves travel and reflect within a space is contingent upon the architectural morphology, dimension and materiality, which establish specific conditions for the vibration modes of the space to resonate, thereby stimulating air particles and increasing the sound pressure level. In a quadrilateral space, reflections typically disperse evenly, whereas in curved spaces, waves tend to focus toward certain points, intensifying sound pressure. A notable example is a circular plan space with a central sound source, where waves converge upon themselves. A more extreme scenario would involve a spherical space with a central source, further concentrating sound waves in a double curvature space. The concentration of sound waves will also vary based on the emitted sound's frequency and wavelength.

The aesthetic characteristics of sound and its acoustic structure are influenced by the spatial geometry of space. In Tugnet and Refugi 307, pyramidal waveforms are discernible (fig. 146), with the intensity of the initial sound impulse decreasing linearly, indicative of short reverberation times. Conversely, in the Cooling Tower, Gasometer, and Lyness Oil Tank, the initial impulse rapidly diminishes, accentuating a periodic bounce of sound that decreases in intensity, associated with their curved shapes. As the Gasometer Charleroi and Lyness Oil Tank are cylindrical shape, and the Cooling Tower is conical shape, all tend to concentrate wave reflections, leading to multiple self-reflections, and resulting in a fluttering sound effect.

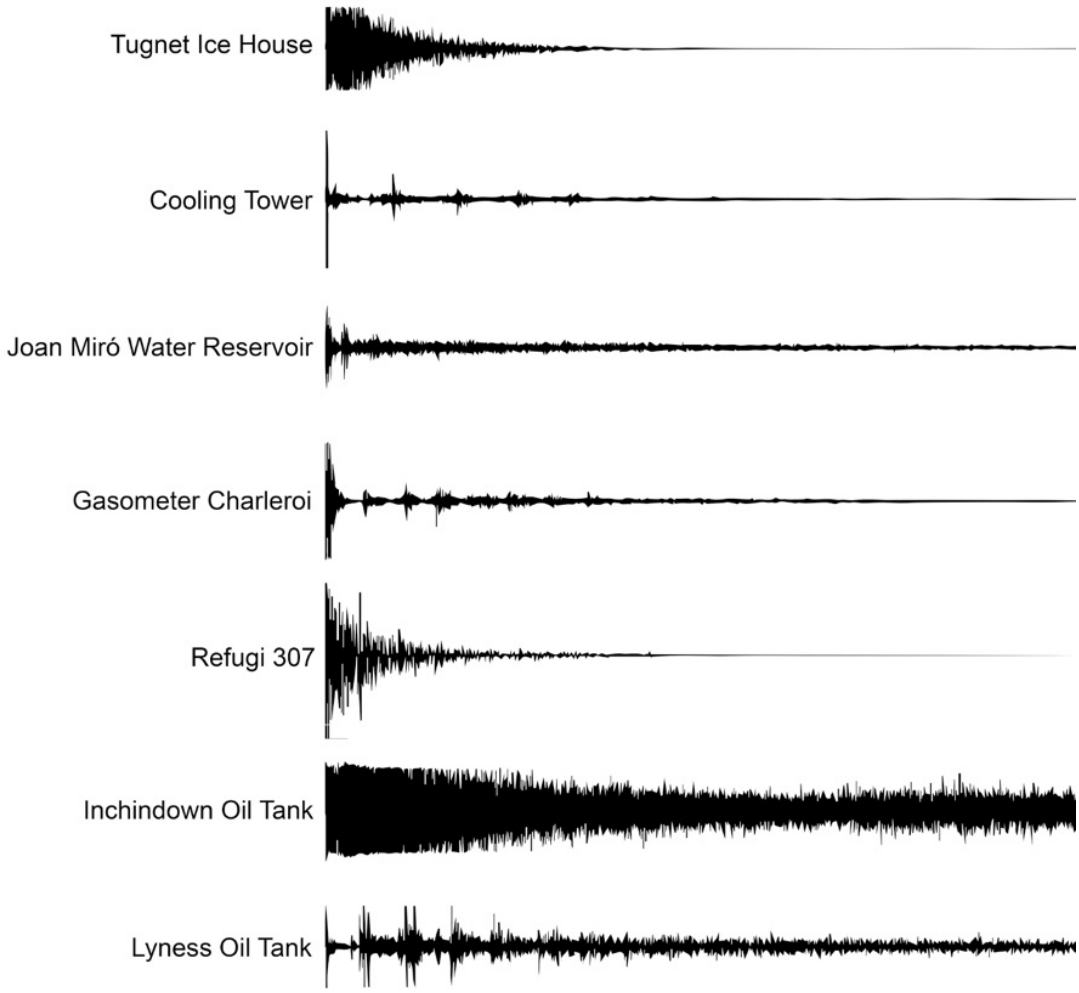


Figure 146. Waveform of the Impulse Responses in 2" (S. Balbontín 2019).

In the Joan Miró Water Reservoir, we can notice the presence of echoes, manifested as a distinct "replica" in the sound wave. Echoes represent a particular type of reverberation where the direct sound is repeated with a noticeable delay. This delay indicates a considerable distance between the sound source and the reflecting surface, typically no less than 17 meters. In the sound wave of Joan Miró Water Reservoir, echoes appear as a secondary impulse response with reduced energy.

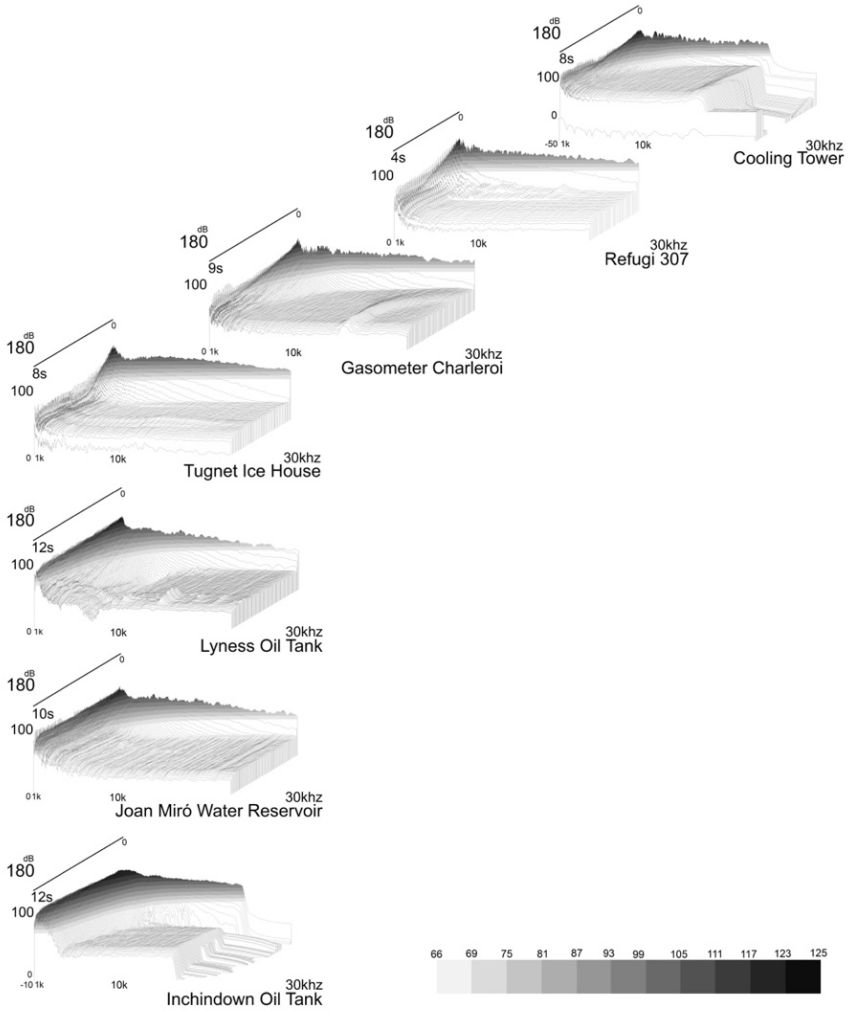


Figure 147. Three-dimensional spectrogram of the impulse response (S. Balbontín 2019).

The Impulse Response can also be visualized in a three-dimensional display, providing a volumetric representation with time, frequency, and intensity along the x, y, and z axes. Figure 147 presents a clear depiction of spectral behavior within the frequency range of 1-22 kHz at low intensity. This enables analysis of acoustic situations imperceptible to the human ear yet significantly impacting on sound aesthetics. Such situations may manifest as alterations in intensity levels of specific frequencies, altering the shape of the "waterfall", as observed in the Lyness Oil Tank and Charleroi Gasometer. Alternatively, they may appear as low-frequency roughness associated with background noise, such as the fan noise in Refugi 307 or the continuous water flow in the Joan Miró Water Reservoir.

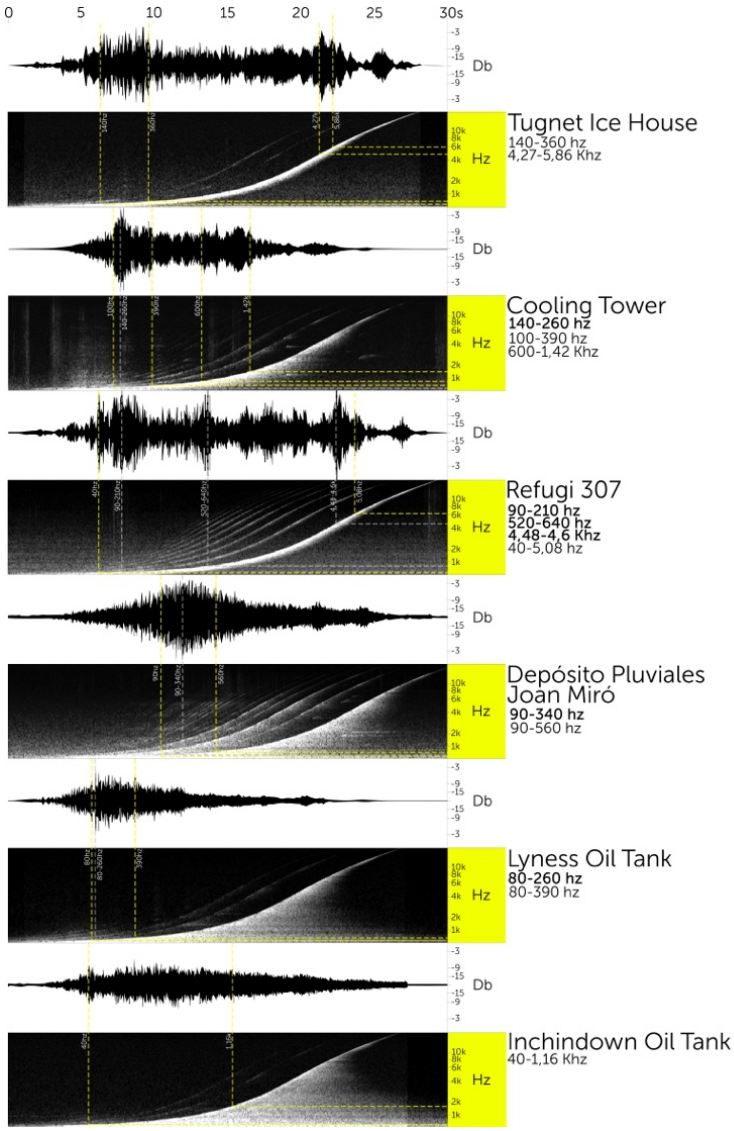


Figure 148. Frequency Sweep (S. Balbontín 2019).

Similar to the resonant chamber of a musical instrument, each space possesses a unique timbre derived from its harmonic composition of the acoustic response which can be captured by the method of frequency sweep (fig. 148). The space's timbre is defined by its harmonics and partials, distinguishing one space from another, akin to musical instruments. The frequency sweep (fig. 149) offers an initial assessment of the space's predominant frequencies by overlaying the sweep spectrogram of time-frequency (Hz) and the sweep sound waveform of time-intensity (dB), identifying high-intensity peaks in the frequency sweep. It also reveals the presence of harmonics and partials, which influence the space's "musical harmony".

Figure 149. QR Code: Audio of Frequency Sweeps.

Refugi 307 exhibits a rich and well-defined harmonic composition, while the Joan Miró Water Reservoir displays a harmonic composition accompanied by partials, creating a perceptually fragmented yet recognizable spectrum. In both cases, the presence of considerable background noise enriches the harmonic spectrum of the acoustic response. In contrast, the Inchindown Oil Tank demonstrates extreme silence, resulting in the absolute absence of harmonics. Furthermore, the morphology, size, and material construction of a space affect its vibration and thus its harmonic content. Specific dimensions (length-width-height) determine resonant frequencies. Harmonics and partials, on the other hand, are related to those resonant frequencies, but are not the same. Harmonics are integer multiples of the fundamental frequency, which is the lowest resonant frequency of the space. Partials are individual sine waves that make up the complex waveform of a sound. They include the fundamental frequency and its harmonics. The resonant frequencies of a space determine which harmonics and partials are amplified or attenuated within that space. When a sound wave interacts with the resonant frequencies of a space, certain harmonics and partials may be reinforced or emphasized, while others may be dampened. This interaction shapes the timbre or tonal quality of the acoustic space.

The imperceptible sound information analyzed in the three-dimensional spectrogram diagrams of the impulse response suggests that this "ghost" information may be a reflection of background noise present at the site. This background noise is also associated with the presence of harmonics and partials provided by the frequency sweep, which is perceived aesthetically as a musical or melodic space with the constant presence of a harmonic drone sonic base.

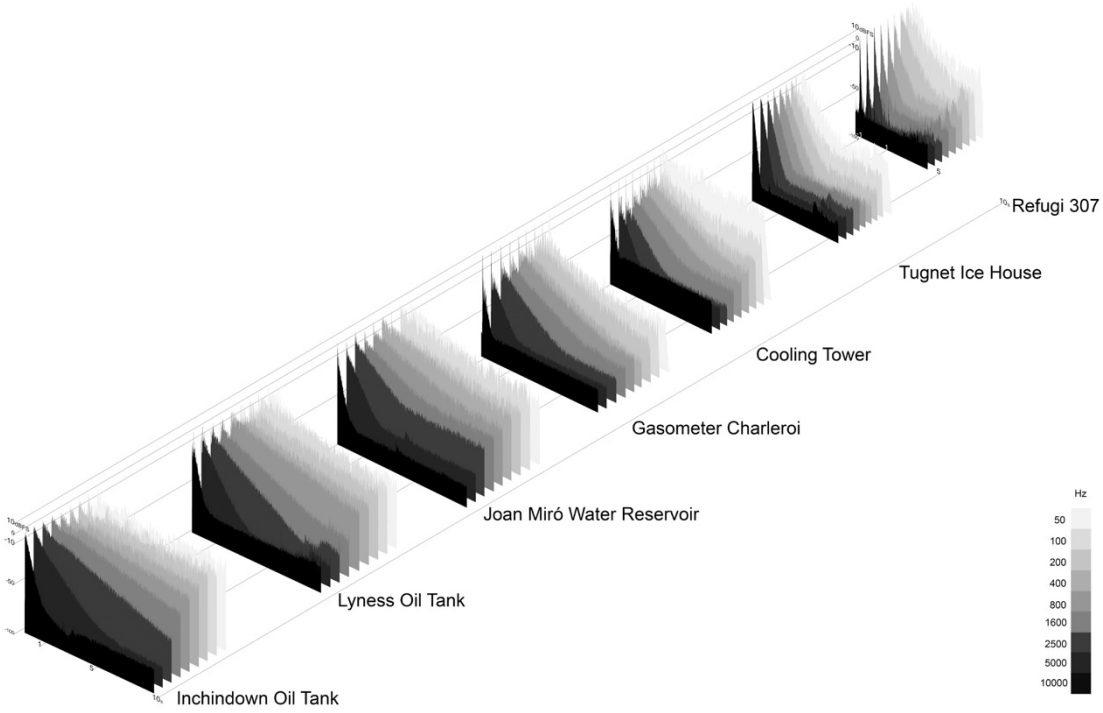


Figure 150. Filtered Impulse Responses by frequency range (S. Balbontín 2019).

We can assess the natural vibration of all spaces based on the information provided by their different responses to the same impulse. In Figure 150, we can observe a differential analysis of the spectrum using representative frequencies, enabling us to identify the range of resonant frequencies with a quick decay from those that are sustained. Resonance occurs when an object or system vibrates at its natural frequency in response to an external force. If the frequency of the external force matches the natural frequency of the system or one of its harmonics, resonance occurs, leading to a significant increase in the amplitude of vibrations, intensity, and reverberation time.

In figure 150, we can observe that resonant frequencies are generally concentrated in the low frequencies, which means that are reflected more times and for a longer duration. Conversely, high frequencies dissipate more quickly. This effect is perceived *in-situ* as the decay slightly shifting the pitch of the reverb tail towards the low frequencies. Reverberation is a combination of reflections across different frequency spectrums, and depending on the shape of the space, how these reflections will contribute to its acoustic character. In certain cases, such as the Lyness Oil Tank, Joan Miró Reservoir, and Inchindown Oil Tank, resonant

frequencies near 2500Hz are present, indicating the prevalence of high tones. This results in a reverb tail with a spectrum richer in high tones, with a sustained pitch decay driven by high frequencies, shaping the acoustic character of the space towards these tones.

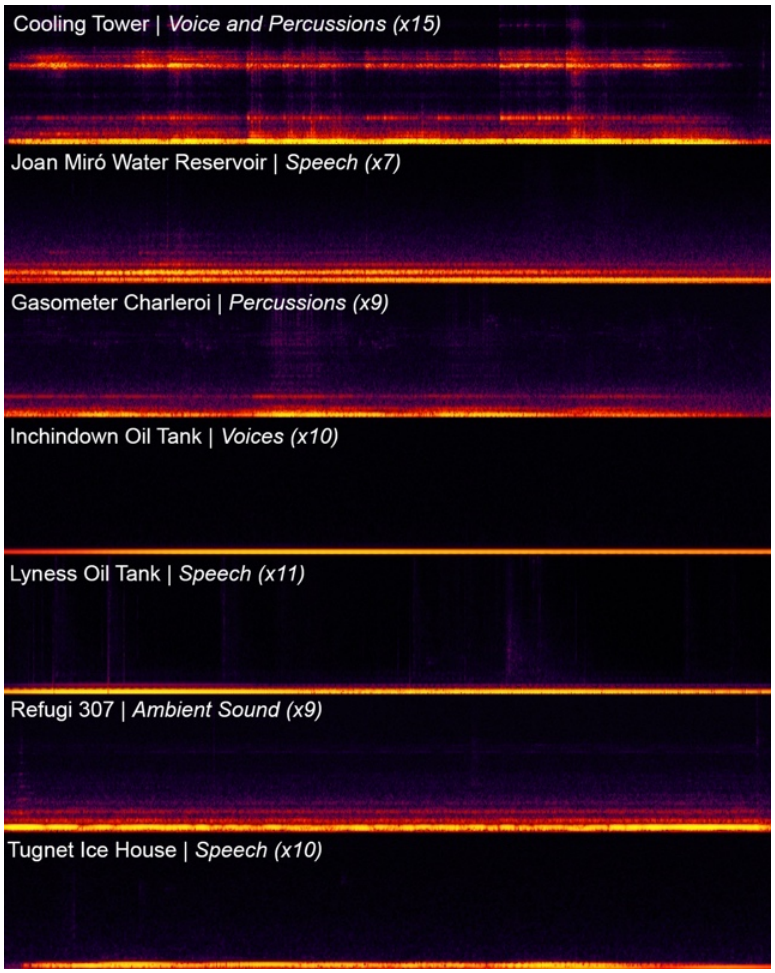


Figure 151. Slow Feedback spectrograms (S. Balbontín 2024).

The Slow Feedback method, shown in Figure 151, is inspired in Alvin Lucier's piece *I am sitting in a room*. It involves a series of steps, starting with Lucier recording himself speaking a passage. This recording is then played back into the room while simultaneously being re-recorded. This playback and re-recording process is repeated multiple times. With each iteration, the acoustics of the room begin to amplify certain frequencies of the sound while diminishing others. As this process continues, the spoken words gradually lose intelligibility, replaced by the room's resonant frequencies dominating the sound. Eventually, the spoken

words are transformed into a series of sustained tones that reflect the room's acoustic characteristics. The final result is a sound piece where the original speech is replaced by harmonic tones and resonant frequencies, creating an ethereal auditory experience.

Figure 152. QR Code: Audio of Slow Feedback.

We repeated this exercise inside different spaces using five different options as base sounds interchangeably: the ambient sound of the space, percussions against the space's structure, chanting voices, the frequency sweep of the same space, and a speech voice reciting in Spanish: "re-re ver-reverb-reverbera-reverberación". We reproduced the recordings inside each space using the slow feedback method, from 6 to 15 repetitions (fig. 152). In spaces with long reverberation times, the presence of space accelerates the process of sound deformation towards its resonant frequencies. Example of this are the speech samples (fig. 151); in large reverberation spaces, the speech quickly transforms into a melody of frequencies, becoming unintelligible after the fourth repetition. From the fourth repetition onwards, the sound simply polishes itself into the resonant frequencies. We can observe the presence of more than one resonant frequency in cases such as the Cooling Tower, Joan Miró Water Reservoir, Gasometer Charleroi, and Refugi 307, while only one resonant frequency is evident in cases such as the Inchindown Oil Tank, Lyness Oil Tank, and Tugnet Ice House.

From acoustic material to artistic production.

The acoustic information gathered from the case studies is used as input for artistic creation. In site-specific interventions, we primarily focus on the reverberation times of the space and its resonant frequencies, developing outcomes that engage in a dialogue with the space through acoustics. Thus, the propagation space becomes the artwork itself. In sound translations and virtual architectures, the collected material is used to recreate the space within other

spaces. The impulse response is primarily employed for its simulation through convolution reverb, and the original timbre of the space is also taken into account in an attempt to faithfully reconstruct it.

The collected sound material is also used as artistic matter for creating sonic environments. Specific sounds from field recordings, impulse responses, frequency sweeps, and slow feedback are selected to be used as compositional material, or for raw sounds emitted from sound sources within the real or virtual spaces. The sound material from expedition #1 has been used for the development of artworks such as *Space Dystopia* at the Spatial Sound Institute, *Resonant Spaces #10: Inchindown* at the Contemporary Art Museum of Santiago, *Resonant Spaces Wastelands* at Sonar Festival, a performance at Yale University, a augmented reality performance at the IV International Ambiances Congress, *Espacios Resonantes Album* and a hybrid performance mixing virtual and in-situ reality at Museu da Água.

In *Space Dystopia*, the frequency sweep recordings and impulse responses were used as musical elements for the composition and for the sonic simulation using the convolution reverb. In *Resonant Spaces #10: Inchindown*, all the available sound material of Inchindown Oil Tank was used to simulate it, employing both quantitative and artistic methods, including voices and percussions with found objects over the structure. In the performance at Yale University, impulse responses were used to simulate each of the spaces through convolution reverb, in addition to a referential example of each method and a selection of the best sounds recorded in each of the spaces, including voices, percussions, and field recordings of the soundscape. In the *Espacios Resonantes Album* all the available sound material from all spaces was used for the spatial compositions. In the augmented reality performance, in VR Wastelands, and in the hybrid performance, the sound recordings of the spaces were used, including the frequency sweep and slow feedback, as well as the impulse response for the simulation of each of the selected spaces in the virtual environment.

Expedition #2: Valparaíso (extended).

Acoustic Experiments.

Expedition #2 explored 11 case studies, of which only 5 were considered integral to the *Espacios Resonantes'* archive. The 11 case studies were: an underpass bridge in the port area, Almirante Goñi Street in the Echaurren zone, a ravine on Camino Cintura Street, an alley in the city center next to the famous JCruz Restaurant, the local Gym Fortín, a stairway inside the Cultural Park of Valparaíso (PCV - Parque Cultural Valparaíso), Las Ánimas Tunnel, a water reservoir for fires, Caleta Portales Sewer, Muelle Barón Dock, and the abandoned Wheelhouse. The locations of these spaces are shown in Figure 153.

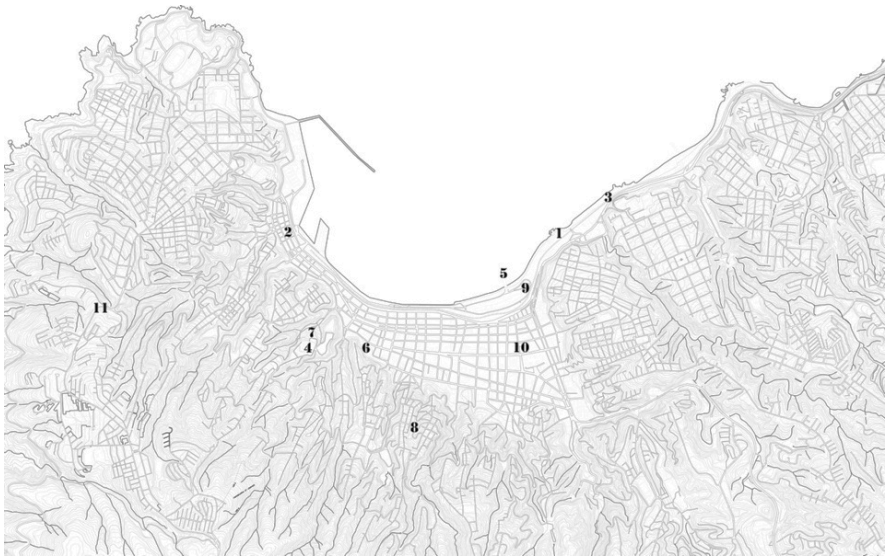


Figure 153. Location map of the spaces studied; 1) Wheelhouse, 2) Almirante Goñi St., 3) Caleta Portales Sewer, 4) Stairway PCV, 5) Muelle Barón Dock, 6) JCruz Alley, 7) Water Reservoir, 8) Ravine, 9) Underpass Bridge, 10) Fortín Gym, 11) Las Ánimas Tunnel.

The five spaces that are part of the *Espacios Resonantes'* archive are Las Ánimas Tunnel, a Water Reservoir for firefighting, Caleta Portales Sewer, Muelle Barón Dock, and the abandoned Wheelhouse (fig. 154). In this expedition, only the impulse response method was applied using a TASCAM DR-05. The objective was to find the representative voices of the spaces of Valparaíso and contrast them with each other. Valparaíso is a very special city, where its unique geography generates echoes and sound effects. Its labyrinthine streets that climb

the hills were also studied for their contribution to the city's reverberations. However, only the industrial spaces studied qualify as part of the *Espacios Resonantes'* archive.

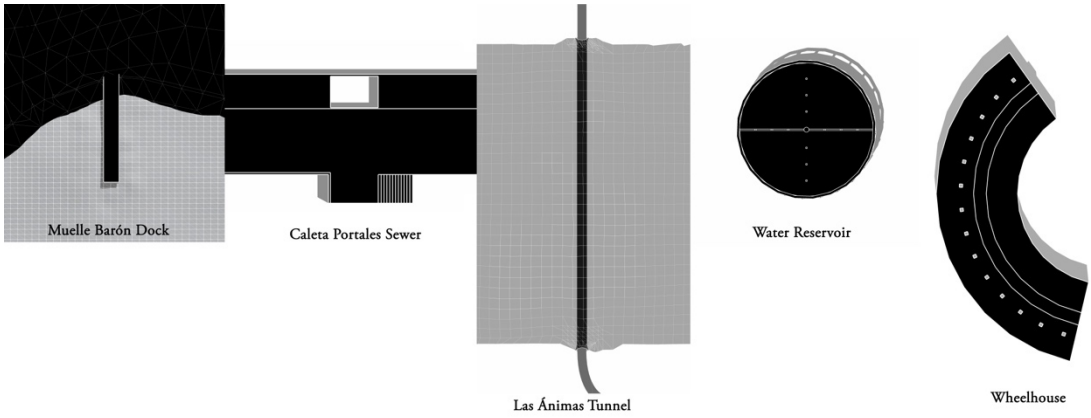


Figure 154. Case studies (S. Balbontín 2024).

The result of the study is a collection of impulse responses that reflects the acoustic character of each space. The temporal structure of a space's impulse response can trigger a sensation of space that is contrasted through their sonorities (fig. 155). This sensation of space, or spaciousness, is a subjective acoustical effect that arises from sound (both direct and reflected) reaching listeners from various directions. This is perceived as an overall feeling of space because our auditory processing is unable to locate these directions separately.

Figure 155. QR Code: Audio of Impulse Responses.

The listener's subjective impression of a physical sound field is influenced by the morphological characteristics of a space. We can analyze these morphological characteristics by examining the shape of the space (Fig. 154) and its dimensions (table 2). The cross-referenced information reiterates the inversely proportional relationship between the dimensions of a

space and its reverberation time. This is exemplified in the case of Muelle Baron Dock, which, being the space with the largest dimensions, also has the lowest reverberation time. This is due to the fact that it is a completely open space, losing reflections that are generated only by two surfaces: the water surface and the dock. The shape of the space is the main factor for increasing the number of reflections, while the dimensions of the space determine the length of these reflections. Longer-delay reflections can be perceived as echoes, whereas shorter-delay reflections are perceived as reverberation.

Another interesting effect discovered in this expedition is *coloration*. The combination of a powerful isolated reflection with the direct sound can lead to coloration, altering the timbre of the original sound. Coloration affects the perceived quality of sound and refers to a change in the spectral characteristics, where certain frequencies are emphasized or attenuated compared to the original sound, giving the space a specific and unique acoustic character.

SPACES	TIME (s)	VOL (m3)	H (m)	L (m)	W (m)
Las Ánimas Tunnel	6.5	13,500	6	300	7.5
Caleta Portales Sewer	2.5	110	2.20	10	5
Muelle Barón Dock	1.5	27,735	4.30	215	30
Valparaíso Water Reservoir	3	2,863	5	13,5	27
Wheelhouse	2	11,145	5	95	25

Table 2. Reverberation time (T60).

Since impulse response sound is always the same, the coloration effect within the acoustic space defines its voice. In expedition #2, we can observe that the time delay between emitted and reflected sounds alters this character, influencing the acoustic profile of the space: shorter delays create higher pitches, while longer delays result in lower pitches. Lower frequencies, sustained over longer periods, typically characterize larger spaces. For instance, in Las Ánimas Tunnel, the extended delay and bass-heavy characteristics reflect its substantial dimensions, akin to the acoustics of Inchindown Oil Tank from expedition #1. Conversely, Muelle Barón Dock, despite its greater size, exhibits a short delay, contributing to a higher-pitched acoustic quality. These frequency variations provide insights into spatial interpretation.

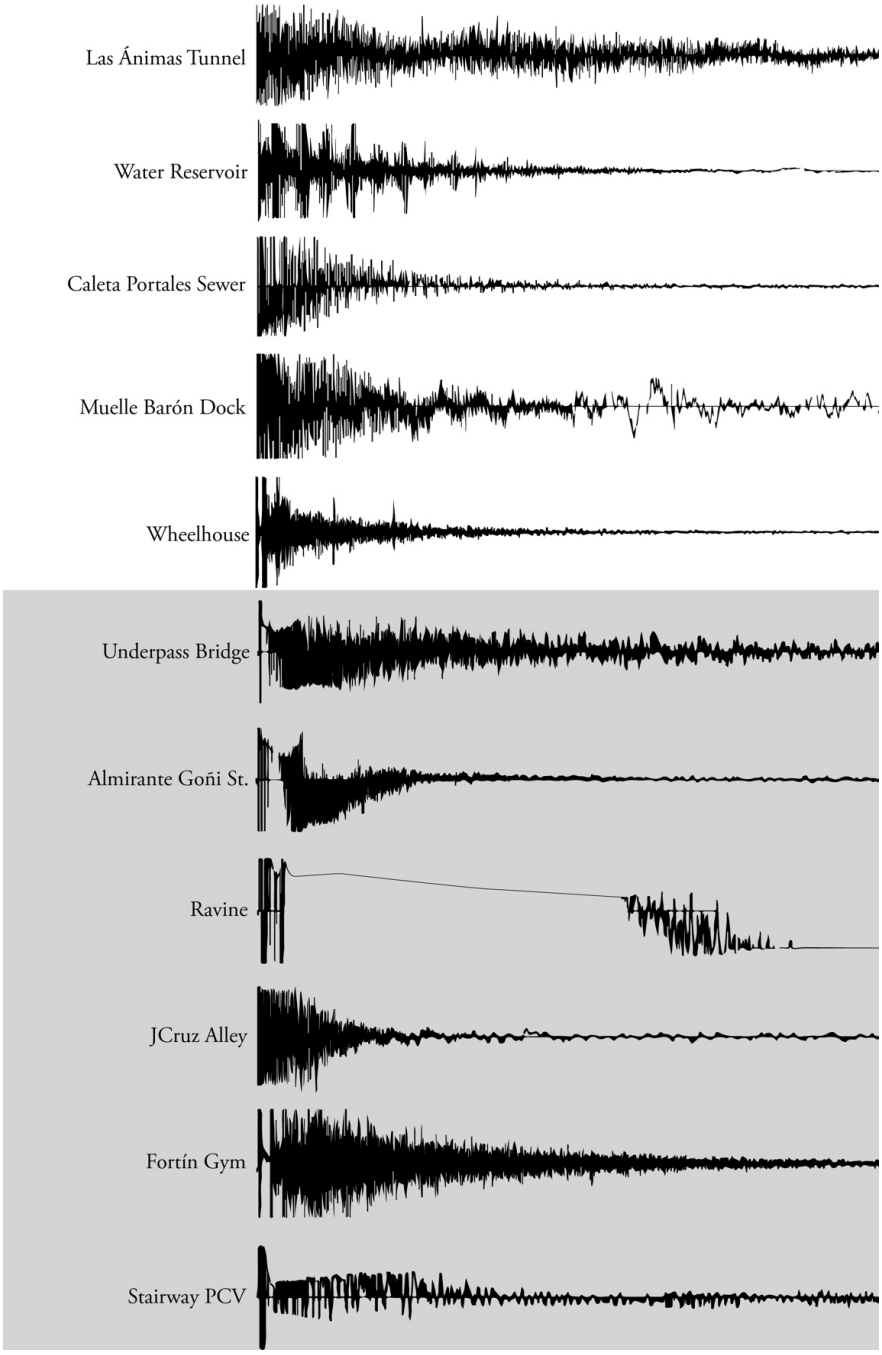


Figure 156. Waveform of the Impulse Responses in 2" (S. Balbontín 2019).

Differences in the reverberation patterns among the 11 case studies can be observed in figure 156. Spaces included in the *Espacios Resonantes'* archive are shown in white, while those excluded from the archive are in gray. In this image, we observe the fluttering effect prominently in curved spaces like the Firefighter Water Reservoir, but we may also notice a

reduced version of this effect in the Wheelhouse due to its curved wall, and in the Fortín Gym because of its curved ceiling. Stronger reverberations are observed in Las Ánimas Tunnel, the Underpass Bridge, and the Fortín Gym. Unique waveforms are identified in Almirante Goñi St. and the Stairway PCV, where reflections between closely facing parallel walls generate standing waves. Standing waves occur when sound waves reflect back and forth between such walls, causing constructive and destructive interference. This phenomenon results in uneven sound pressure levels across the space, with amplified or attenuated frequencies at nodes and antinodes. Conversely, certain areas may experience significant volume drops at specific frequencies, creating peculiar sound effects and unpredictable waveforms. Particularly intriguing is the waveform of the Ravine, recorded in an open city space with reflections on a geographical scale.

From acoustic material to artistic production.

The impulse responses collected from various spaces served as the foundation for a unique artistic outcome concluding my residency at Tsonami, Valparaíso. This resulted in the creation of a Valparaíso reverb pedalboard, which functioned as an interactive installation inside B.A.S.E Gallery (see the previous chapter on the section *Sonic Translations*). The installation replicates the acoustic characteristics of each space using convolution reverb based on the 11 impulse responses. The project aims to juxtapose the acoustic identities of these spaces, fostering a dialogue among Valparaíso's diverse acoustic spaces.

Expedition #3: Santiago.

Acoustic Experiments.

Between the 1950s and 1980s, a network of water towers was constructed in Santiago de Chile for the storage and distribution of water. Today, most of these towers are disused and abandoned (Vielma-Cabruja et al. 2023). In the Recoleta neighborhood of Quinta Bella, there is an abandoned site with a Water Tower and an underground Water Reservoir that we used as case studies during this expedition (fig. 157).

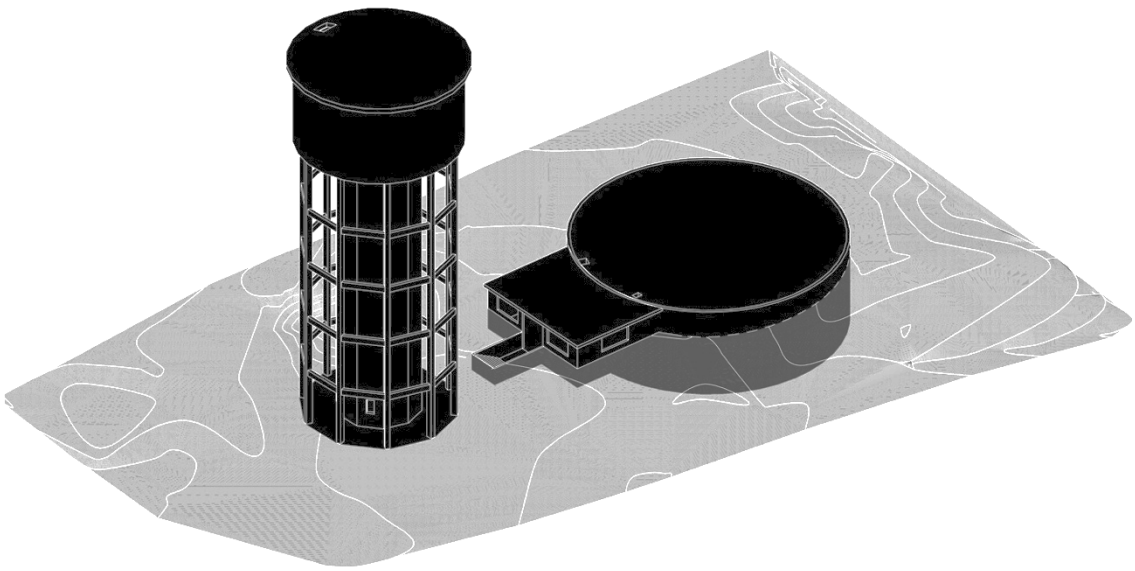


Figure 157. Case studies (M. Klenner 2024).

As architects and acoustic explorers, we have recovered these abandoned spaces and reconditioned them for cultural purposes. Our objective was to transform and inhabit them through sound activation and attentive listening. To achieve this, we organized the first edition of the *Espacios Resonantes Festival* within the Water Tower and Water Reservoir from Quinta Bella, inviting artists, musicians, architects, and researchers to explore and engage with their acoustics through listening practices. This initiative took the form of a temporary academy dedicated to aural architecture, fostering collaboration and shared learning between artists and participants.

In preparation for the festival, we studied the acoustic properties of each space to inspire the artists' creative processes and provide material for their artistic production, as well as for theoretical and practical discussions. These artistic interventions aimed to establish a dialogue with the spaces, enhancing both the artists' and the audience's experience.

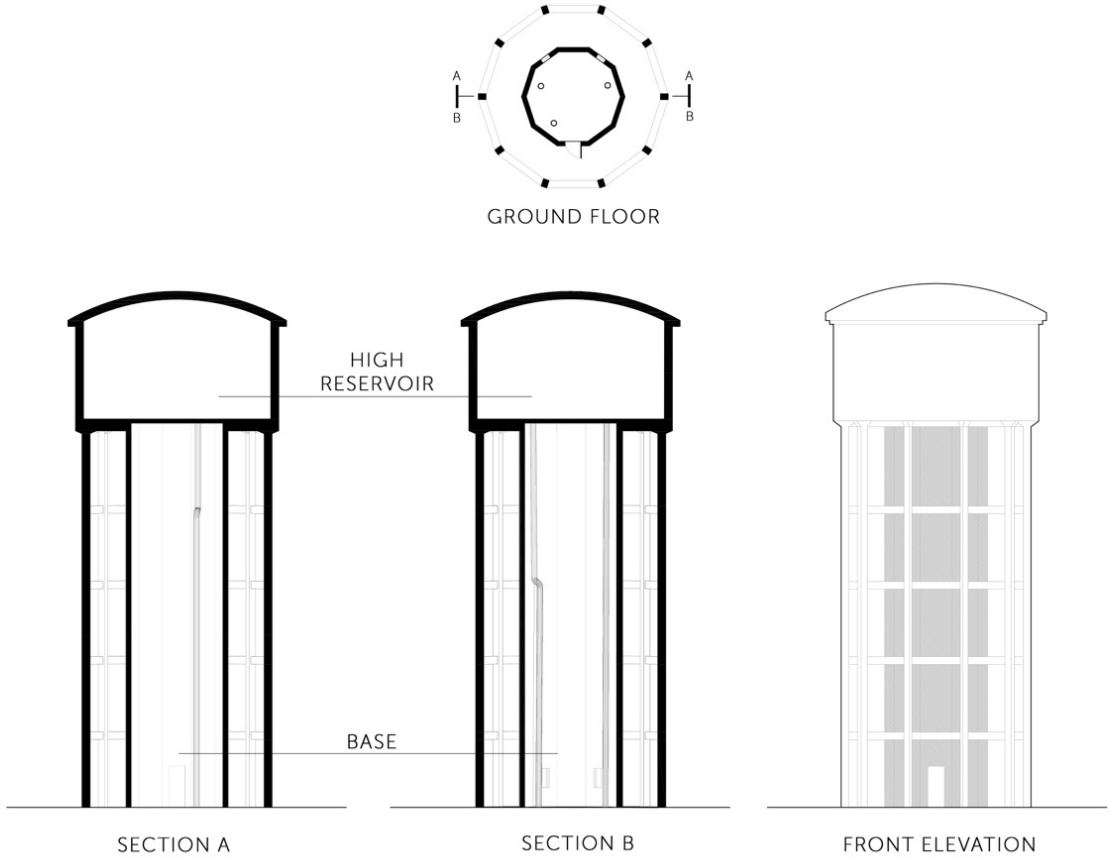


Figure 158. Water Tower architectural plans (S. Balbontín 2022).

The acoustic study utilized acoustic engineering strategies to collect sound material, aiming to enhance the development of artistic-auditory practices and create aural architectures based on the acoustic conditions of the spaces. The study investigated the physical field of sound and the phenomenon of propagation within these spaces. This information served as input for the artistic creation of the site-specific performances that comprised the festival, including the artwork *Polyphono*.

The study involved fieldwork where sound information was collected using various acoustic research methodologies at the Water Tower (fig. 158) and the Water Reservoir (fig. 159). Three specific spaces were studied: 1) the high reservoir, 2) the base of the Water Tower, and 3) the underground Water Reservoir. Of these three spaces, only the last two were artistically intervened due to safety reasons.

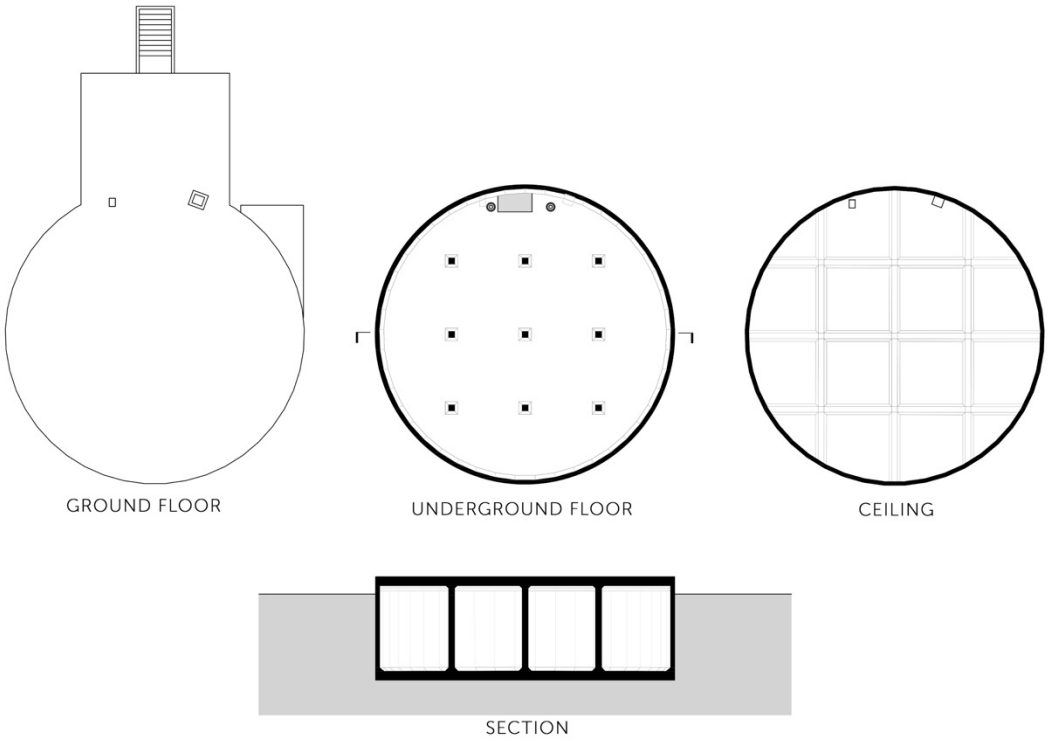


Figure 159. Water Reservoir architectural plans (S. Balbontín 2022).

The specific methodology of acoustic analysis involved obtaining impulse response, frequency sweep, and slow feedback from the spaces. These were recorded with a RODE hypercardioid microphone, a LOM geophone, an H2D Aquarian Audio contact microphone, and an X/Y Zoom H6 stereo microphone inside each space. For electroacoustic activations we used a Subwoofer 10" Wharfedale WH-S10E and a Esi Studio Active Monitor 5".

Additionally, a group of specialists from the Sound Department of the Faculty of Arts at the University of Chile, including Gonzalo Gaete Di Egidio, Michael Useche, Nicolas Jara, and Carla Badani, conducted a study of the natural frequencies in the underground Water Reservoir using a Sonometer Larson Davis LXT sound level meter (Type 1). The studies were carried out using Odeon and Adobe Audition software.

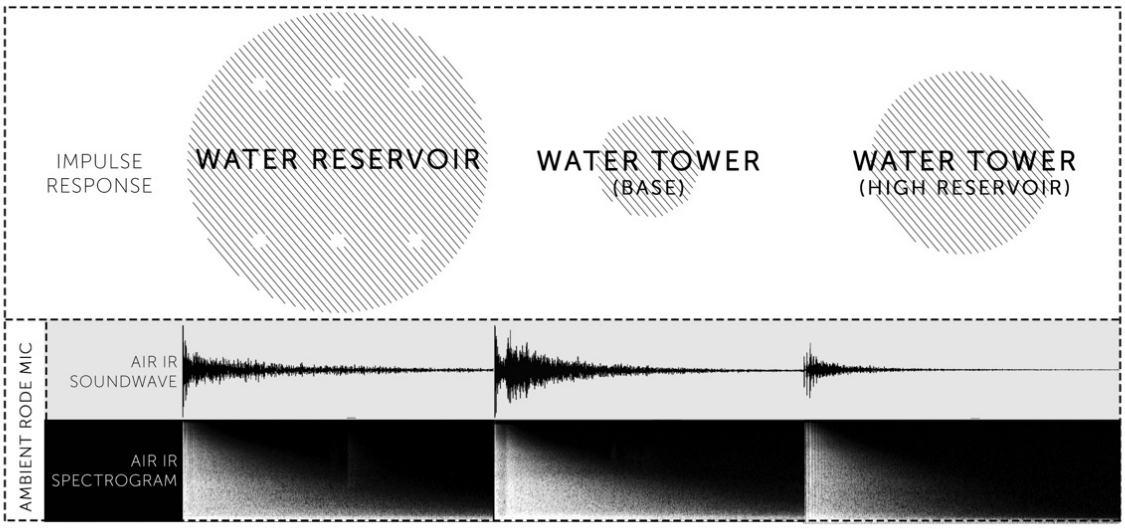


Figure 160. Impulse Response (S. Balbontín 2023).

This acoustic study of Impulse Response, enabled the visualization of sound flow caused by the molecular vibration of air in the form of reverberation. The movement of this fluid, which has direction, rhythm, speed, and density, allowed us to observe the propagation of the space's voice, revealing its acoustic character. Figure 160 illustrates the differences in the industrial spaces through the waveform and spectrogram of the impulse response.

In the case of the Water Reservoir, the reverberation time was approximately 26 seconds, with a decreasing fluttering effect that repeated three times before decaying. The High Reservoir exhibited a reverberation time of 15 seconds and a more pronounced fluttering effect with five repetitions, initially increasing and then decreasing. Cylindrical spaces concentrate sound reflections, generating fluttering effects. The dimensions of the space determine the quantity of these effects: smaller spaces allow sound waves to reflect more times due to the shorter distance they need to travel. The comparison between the High Reservoir and the underground Water Reservoir exhibits this condition.

At the base of the Water Tower, the reverberation time was 10 seconds. Unlike the previous two spaces, it did not exhibit a fluttering effect but showed an echo. This is observable in the waveform's indentation at the beginning, generating a perfect repetition of the impulse due to the height from floor to ceiling of the Water Tower base (20 meters), exceeding the 17-meter minimum distance required for an echo.

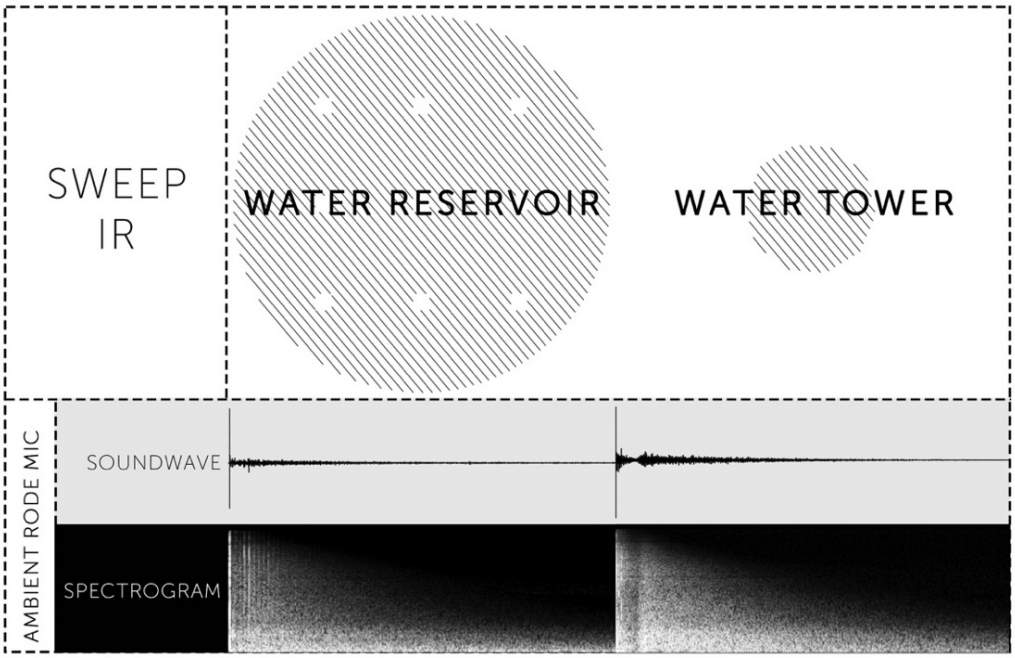


Figure 161. Sweep Impulse Response (S. Balbontín 2023).

SPACES	TIME (s)	VOL (m3)	H (m)	L (m)	W (m)
Water Tower	10-13	348,520	20	4.87	4.63
Water Reservoir	22-35	1,121.6	5	8.45	16.9

Table 3. Reverberation time (T60).

When comparing the waveforms at the base of the Water Tower and the Water Reservoir using a Sweep IR (impulse response based on frequency sweep) (fig. 161), we observe a noticeable reduced wave concentration due to the Water Tower's decagonal shape. Despite its larger volume, the Water Tower exhibits a shorter reverberation time (table 3). This is because sound waves travel a greater distance before being reflected, losing energy that dissipates through openings in the structure (one door and two windows). Thus, we can conclude that the acoustic character of the Water Reservoir is primarily defined by its long reverberation time with pronounced bass tones, whereas the Water Tower's acoustic profile is characterized by the presence of echoes and higher tones.

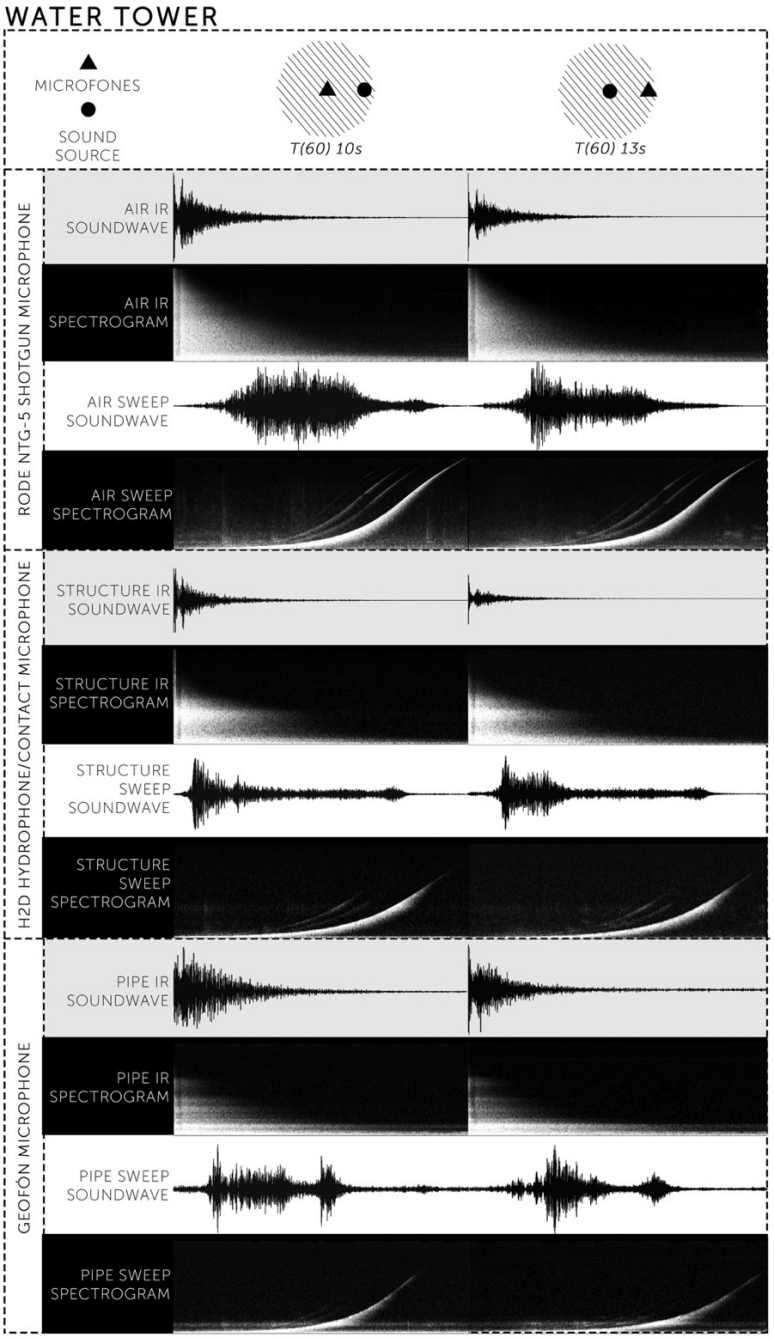


Figure 162. Water Tower Impulse Response and Frequency Sweep (S. Balbontín 2023).

The methodology for sound collection involved contrasting airborne sound with structure-borne sound to evaluate the acoustic performance of the space (Licht 2009). A direct contact microphone placed on the floor and a geophone attached to the water pipes in both spaces were utilized for this purpose. At the base of the Water Tower (Fig. 162), we observed

a subtle presence of harmonics within the structure. Additionally, echoes were recorded both through the air and the structure, reenforcing the space's strong reflective character. Samples were taken at two positions relative to the microphone and sound source: at the center and perimeter, and vice versa. The results indicate that the microphone placed at the center captured richer sound information with a more pronounced echo effect, suggesting it as the optimal listening point within the space.

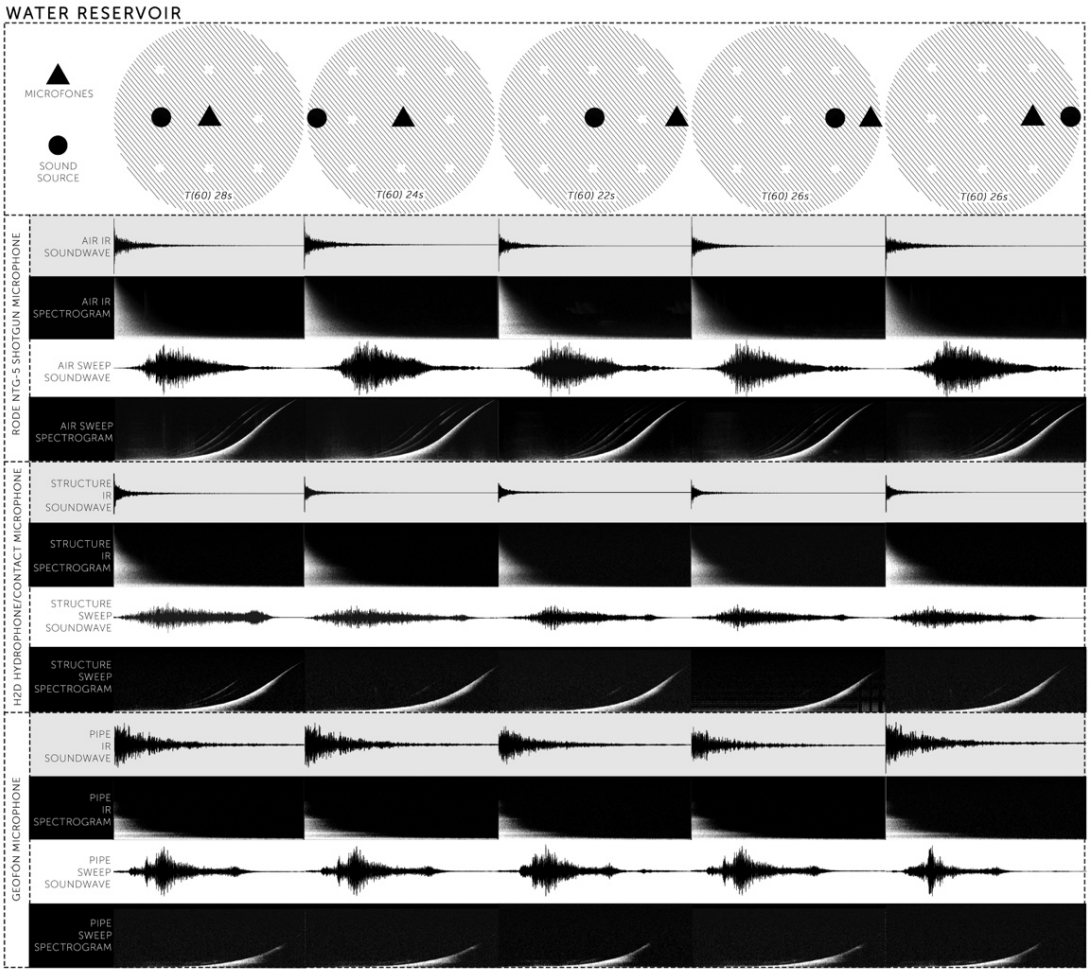


Figure 163. Water Reservoir Impulse Response and Frequency Sweep part I (S. Balbontín 2023).

To conduct the acoustic study inside the Water Reservoir, sound samples were collected at 10 different positions between the sound source and microphone. This approach aimed to

comprehensively map the space, considering configurations such as the center, tangent, and halfway radius (r/2). Detailed impulse response studies for these positions are illustrated in Figures 163 and 164. Analysis revealed that sound waves consistently projected perpendicularly onto the wall surfaces, reflecting at varying angles depending on the source position. Generally, reverberation times showed moderate variability across positions, except when both the source and microphone were located at r/2, resulting in a prolonged reverberation time of 35 seconds. This phenomenon occurs because in circular rooms, sound waves emitted from a source at r/2 concentrate simultaneously at the mirrored r/2 position, thereby increasing reverberation time.

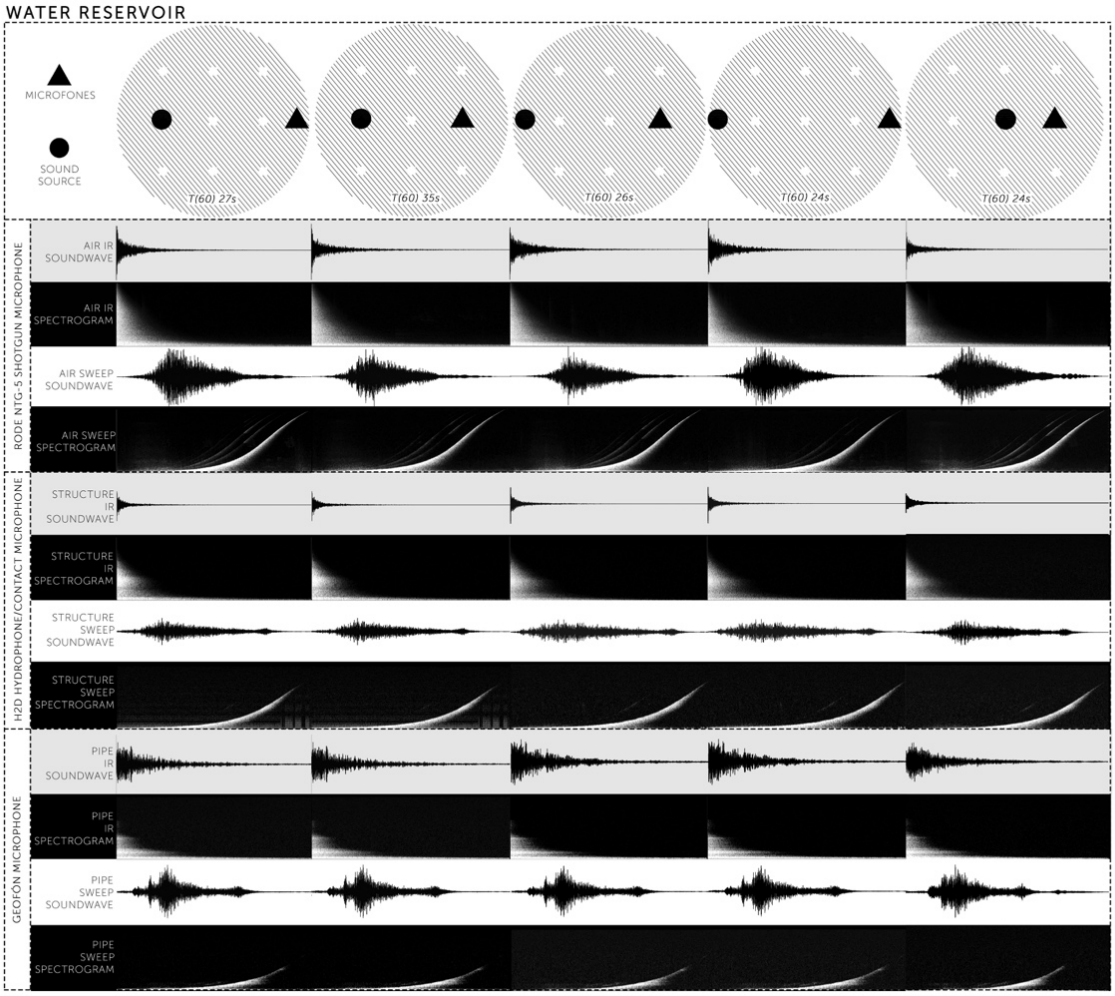


Figure 164. Water Reservoir Impulse Response and Frequency Sweep part II (S. Balbontín 2023).

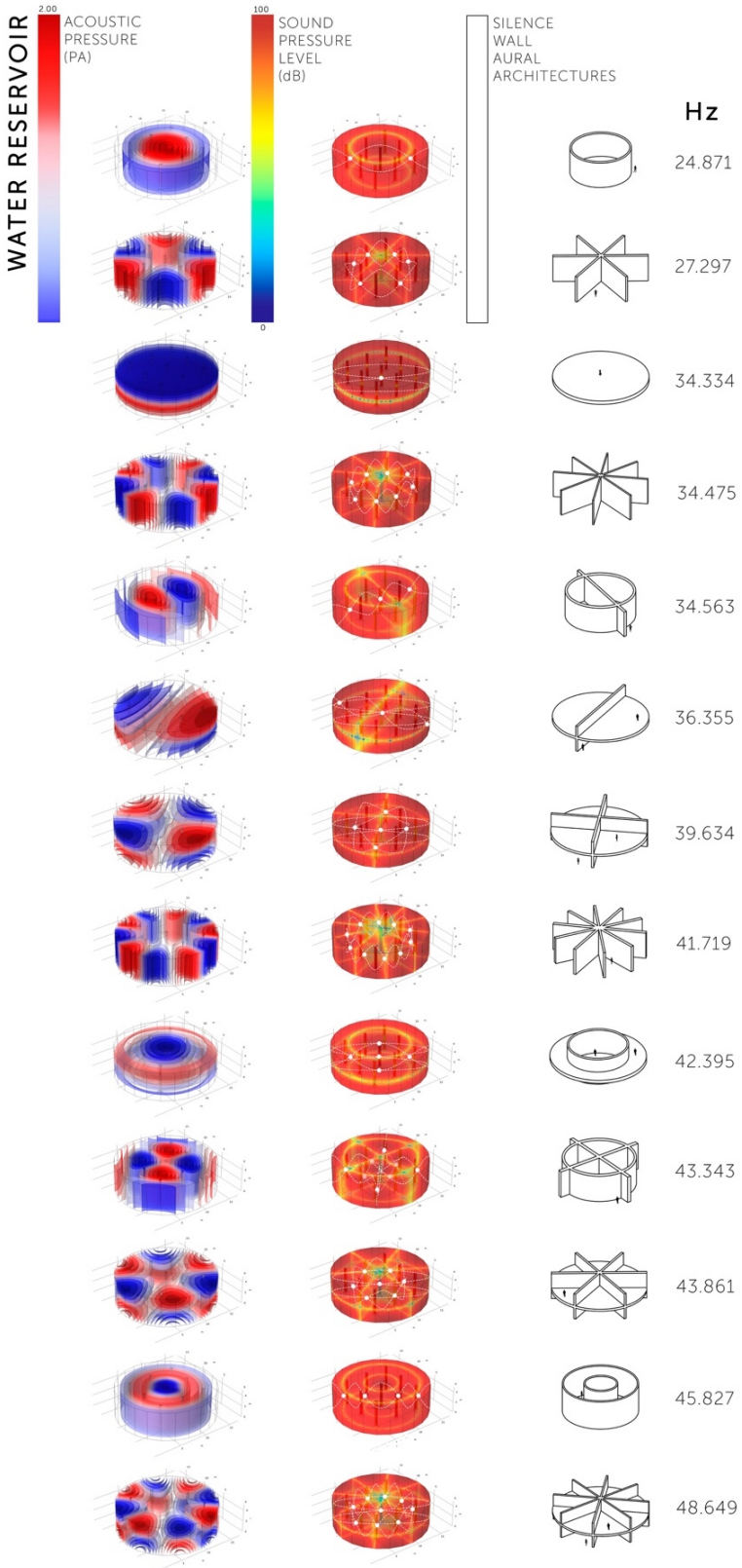


Figure 165. Resonant frequencies study and aural architectures representation (S. Balbontín 2023).

In collaboration with the Sound Department of the Faculty of Arts at the University of Chile, an acoustic study was conducted to investigate natural frequencies of the Water Reservoir. The study identified resonant frequencies ranging from 24Hz to 49Hz. The experiment utilized the frequency sweep method and pure frequencies, which were emitted and reflected within the space, and captured using a Sonometer type 1 LXT Larson Davis (Sound Level Meter). The results illustrate sound as a mass that uniquely occupies the space at each frequency, visualizing the standing waves produced by the resonant frequencies, thus demonstrating its physical presence. Figure 165 illustrates how the space responds to 13 resonant frequencies using three different types of visualization arranged in three columns: the first illustrates acoustic pressure zones where antinodes (points of maximum displacement) are situated, with red indicating crests and blue indicating valleys. The second column identifies silent zones between areas of higher acoustic pressure, where the nodes (points of no displacement) are situated. The third column represents the architectural layout that shapes these nodes and antinodes, representing the invisible yet perceptible spatial arrangement they produce through "architectures of silence".

The acoustic study reveals distinct "architectural forms" corresponding to the patterns that standing waves creates across the space when exposed to the resonant frequencies of the space. As the frequency increases, these resonances create overlapping "sonic structures". At 24.871Hz, the silent zone takes the shape of a cylinder; at 27.291Hz, an asterisk; and at 34.475Hz, a circular plane. These shapes intersect at 42.395Hz and 43.861Hz: the former combining a plane with a cylinder, and the latter a plane with an asterisk. The plane recurs in several instances, often overlapping with other shapes. In addition to the circle, plane, and asterisk, a simple wall was also observed spanning from side to side. The asterisk expands in vertices as the frequency increases. These aural architectures are perceptible within the space through the acoustic delineation of its walls of silence, evoking a fluctuating sense of volume and spatial perception across different resonant frequencies.

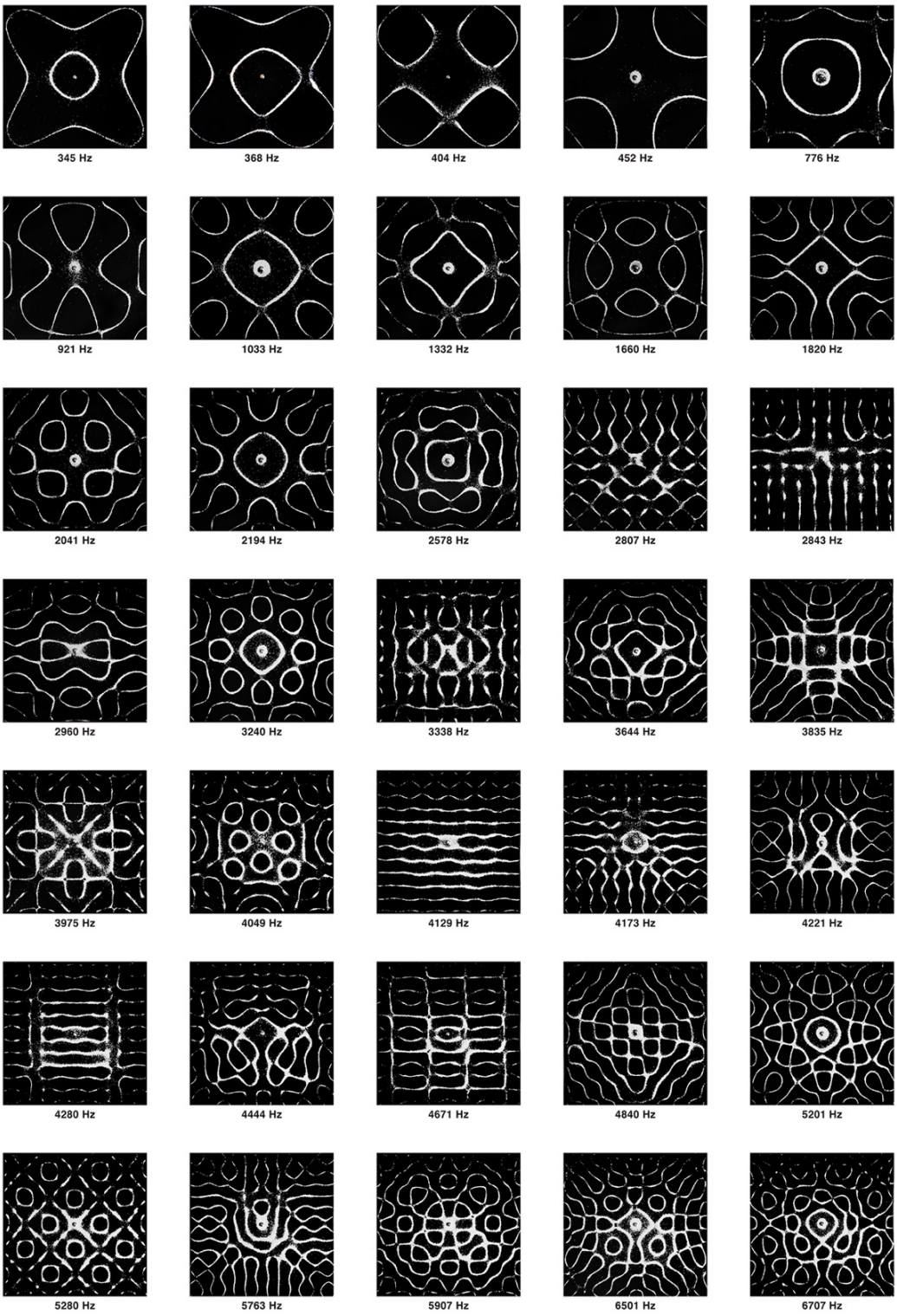


Figure 166. Chaldni figures (Jenny, 2001).

An interesting comparison can be drawn with Chladni figures, suggesting that the plates used in the experiment are analogous to space, transforming the two-dimensional behavior of resonant frequencies into a three-dimensional one. Chladni plates, named after Ernst Chladni, are used to visualize the modes of vibration on a flat surface (Ashton 2015). The resulting patterns, known as Chladni figures, visually represent how a plate vibrates at its resonant frequencies. When a plate with sand on its surface vibrates, it forms distinct standing wave patterns where the sand accumulates at nodes and nodal lines, creating diverse figures that illustrate the forms of vibration (fig. 166).

Similarly, the Water Reservoir exhibits its own vibrational patterns, depicted in Figure 165 as a three-dimensional Chladni plate. Each resonant frequency corresponds to a distinct mode of vibration that creates a specific aural architecture, analogous to how different patterns on a Chladni plate express resonance and harmony.

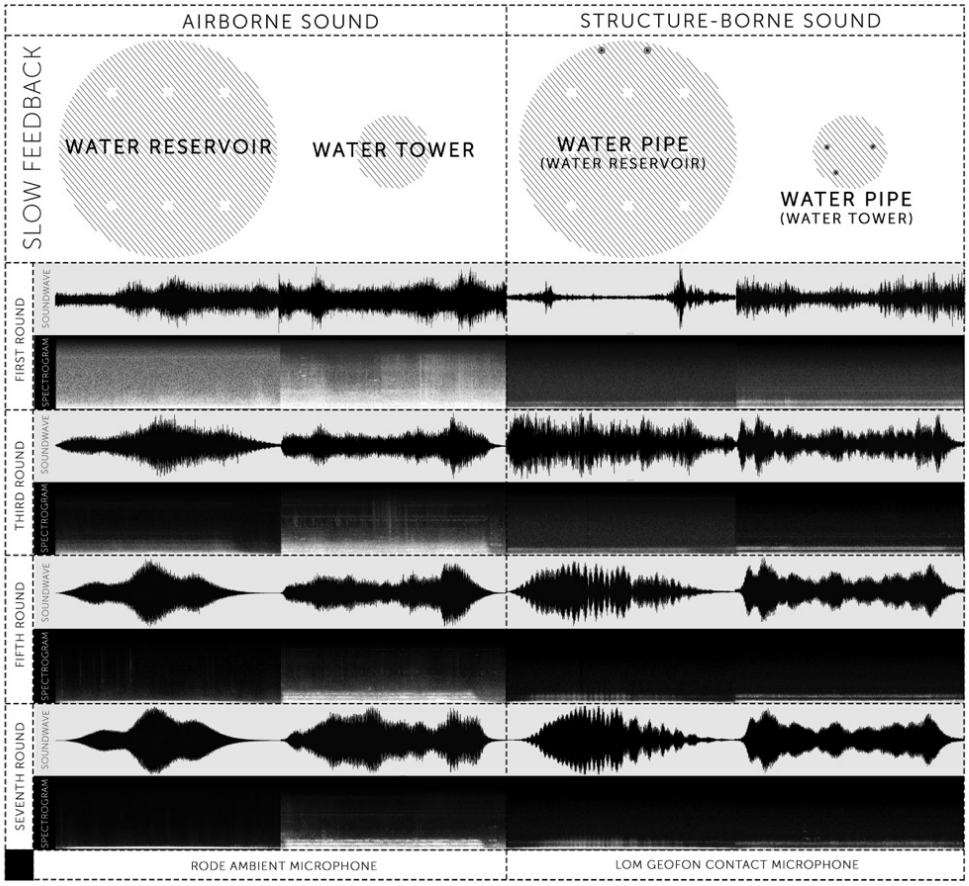


Figure 167. Slow Feedback (S. Balbontín 2023).

Figure 167 illustrates the results obtained from the slow feedback method applied to both the Water Reservoir and Water Tower. The method utilized the background noise of each space as the base sound for the experiment in both locations. The procedure was repeated seven times in the Water Tower and nine times in the Water Reservoir, however only the first seven repetitions were illustrated (fig. 167). The experiment employed the Rode Ambient Microphone and the Lom Geofon Contact Microphone. Upon contrasting the data, the results reveal a concentrated and well-defined frequency spectrum in the Water Reservoir, whereas the Water Tower exhibits three distinct predominant resonant frequency ranges. This distinction is particularly highlighted when using structure-borne sound microphones. The faster appearance of predominant frequencies in the Water Reservoir, compared to the Water Tower, is attributed to the longer reverberation time in the former. Consequently, reverberation appears to have a more direct influence on the emergence of resonant frequencies via the slow feedback method, compared to the impact of echo in the Water Tower.

Figure 168. QR Code: Audio of Slow Feedback.

Figure 169 illustrates a Zoom-in on this data, which reveals how resonant frequencies shape the behavior of sound waves. The original sound spectrum exhibits complexity, resulting in an irregular waveform. With each repetition of the experiment, the waveform progressively smoothens and homogenizes towards regularity. This refinement process polishes the sonic information towards pure frequencies, reducing the spectral irregularities of specific sounds and aiming for frequency "purification". This phenomenon underscores how quickly the waveform achieves uniformity in the Water Reservoir, evident in the smooth waves observed in the 2-second zoom and highlighted in the 0.2-second zoom by the presence of a perfectly sinusoidal wave, demonstrating precise and uniform periodicity.

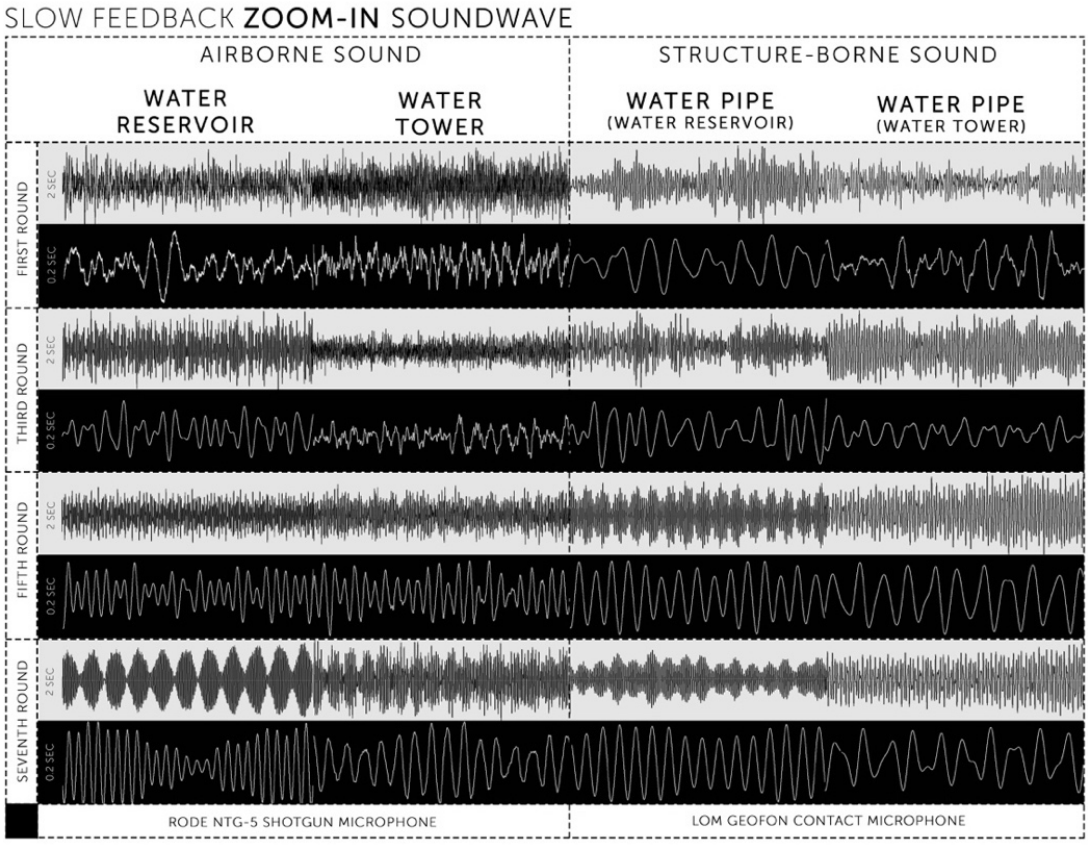


Figure 169. Slow Feedback Zoom-in (S. Balbontín 2023).

From acoustic material to artistic production.

Following these experiments, the results were shared with the artists invited to the festival. The acoustic characteristics of the space were collected to inform artistic actions aimed at fostering a dialogue with the spatial environment. The long reverberation times of the Water Reservoir and the presence of echo in the Water Tower, along with their resonant frequencies, were considered in shaping the sound compositions exhibited within these spaces. Impulse response analysis was employed to explore sound amplitude effects relative to speaker placement and to examine the interplay between sound intensity and silence through the study of resonant frequencies.

Figure 170. Festival Espacios Resonantes (F. Mardones 2022).

The *Espacios Resonantes Festival* (fig. 170) was conceived as a platform for auditory exploration, employing acoustic analysis to amplify the acoustic responses of these industrial architectures for aesthetic-spatial experimentation (fig. 171). This analysis heavily influenced the majority of the exhibited works, showcasing innovative auditory practices that redefine the integration of sound material with architecture. Artists utilized the collected data to develop diverse strategies and practices, enhancing the interaction between space and sound through site-specific installations and performances.

Figure 171. QR Code: Video of *Espacios Resonantes Festival* 9'29''.

The festival featured twenty-five performances, including *Polyphono* by Sofía Balbontín, *Monumentos de Futuros Fallidos* by Mathias Klenner, *Solo Performances* by Seth Clueth, *Soundfield for the Cistern* by Daniel Neumann, *The Archisonic* by Mark Bain, *Modulated Resonances* by Thomas Gorbach, *Extraños (extranjeros (extraños(…)))* by Misaa, and *Texturen* by ATOM$_{tm}$, among others (fig. 172).

Figure 172. QR Code: Album of the *Espacios Resonantes Festival*.

The artwork *Polyphono* used the echo of the Water Tower as a crucial element to explore the verticality of the architecture through music and sound experimentation. It employed beats and continuous drone-like sounds created from pure frequencies and white noise. The beats established a question-answer dialogue with the space, integrating the delay of reflections into the composition. The positioning of speakers within the vertical space introduced slight pitch variations that characterized each sound source relative to its spatial placement, thus modulating the composition. The selection of pure frequencies based on resonant frequency studies culminated in harmonizing the space during the final part of the performance, according to its own natural vibration.

Expedition #5: Lisbon | Viseu | Barcelona.

Acoustic Experiments.

Case studies: Galerias do Loreto, Reservatório da Patriarcal and Silos da Nutasa in Lisbon, Minas de Queiriga in Viseu, and Casa de l'Aigua and Cement Dome Sanson in Barcelona (fig. 173).

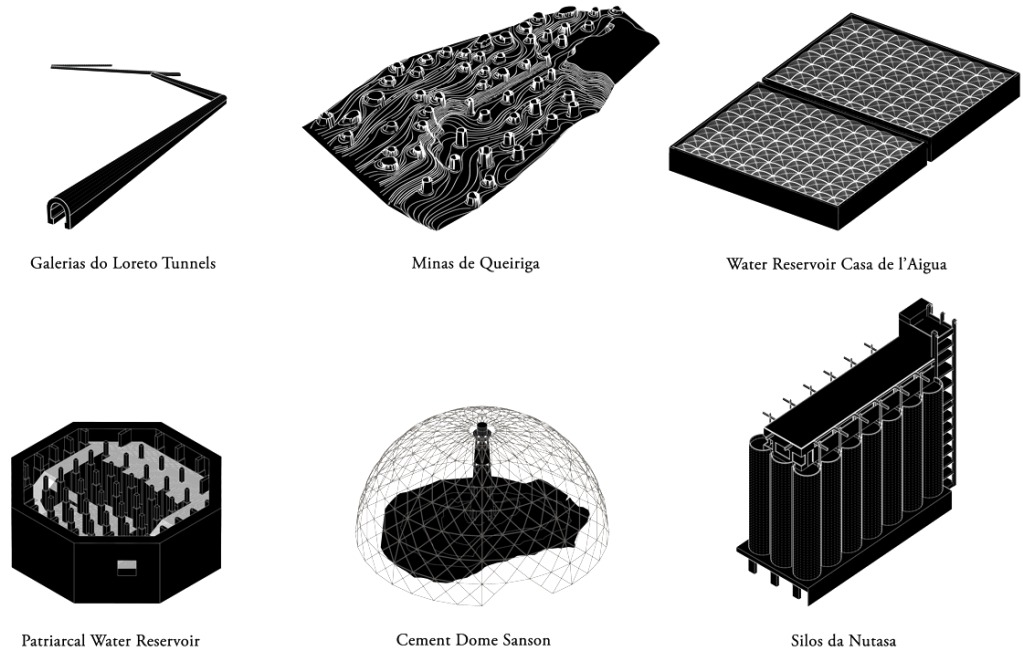


Figure 173. Case Studies (S. Balbontín 2024).

Within the industrial spaces visited in Expedition #5, we found interesting possibilities for spatial expression through acoustics. The diverse forms and dimensions of these spaces gave the expedition an eclectic character, highlighting acoustic differences. In Table 4, we observe constant reverberation times in some cases, but a rich diversity of acoustic timbres from various morphologies is shown in Figure 173. The concave spatialities of Silos da Nutasa and Cement Dome Sanson generate focusing effects, leading to high sound pressure levels and strong coloration. In the case of the silos, their cylindrical architecture triggers a strong focusing effect, but it is even stronger in the hemispherical form with double curvature, as seen in the Cement Dome.

SPACES	TIME (s)	VOL (m3)	H (m)	L (m)	W (m)
Galerias do Loreto Tunnels	3	2,611	1.9	1,018	1.35
Reservatório da Patriarcal	3	3,090	10	20	20
Minas de Queiriga	3	82,880	2-10	160	74
Silos da Nutasa	10	1,161.4	35	3.25	6.5
Water Reservoir Casa de l'Aigua	8	11,327.8	4	66.4	42.65
Cement Dome Sanson	6	28,953	24	24	48

Table 4. Reverberation time (T60).

Inside the Cement Dome Sanson, interesting effects were noticed depending on the position of the microphone and sound source within the space. With the microphone and sound source at the same distance from the center, we tested the acoustics by moving from the center to the perimeter. From the center to r/2, a very strong flutter effect was sensed. In this position, but at a lower volume level, a whispering gallery effect appeared, which served as a communication channel, mitigating the distortion of speech observed in other positions or at higher volume levels. Towards the perimeter, the fluttering was reduced, and instead, a high-frequency sound with a sharp tone appeared, resembling a laser gun shot with a strong delay effect.

The hemisphere is a parabolic shape; therefore, the sound is doubled, creating artificial echoes. The perception of these effects changed depending on whether the source and receiver were or not at the focal point, which corresponds to the center. According to Vercammen (2012), high frequencies provide very strong amplification at the focal point. Amplification is reduced with lower frequencies; however, the focusing area is increased. This amplification in a hemisphere can exceed 40dB, and in cylinders, it can exceed 30dB.

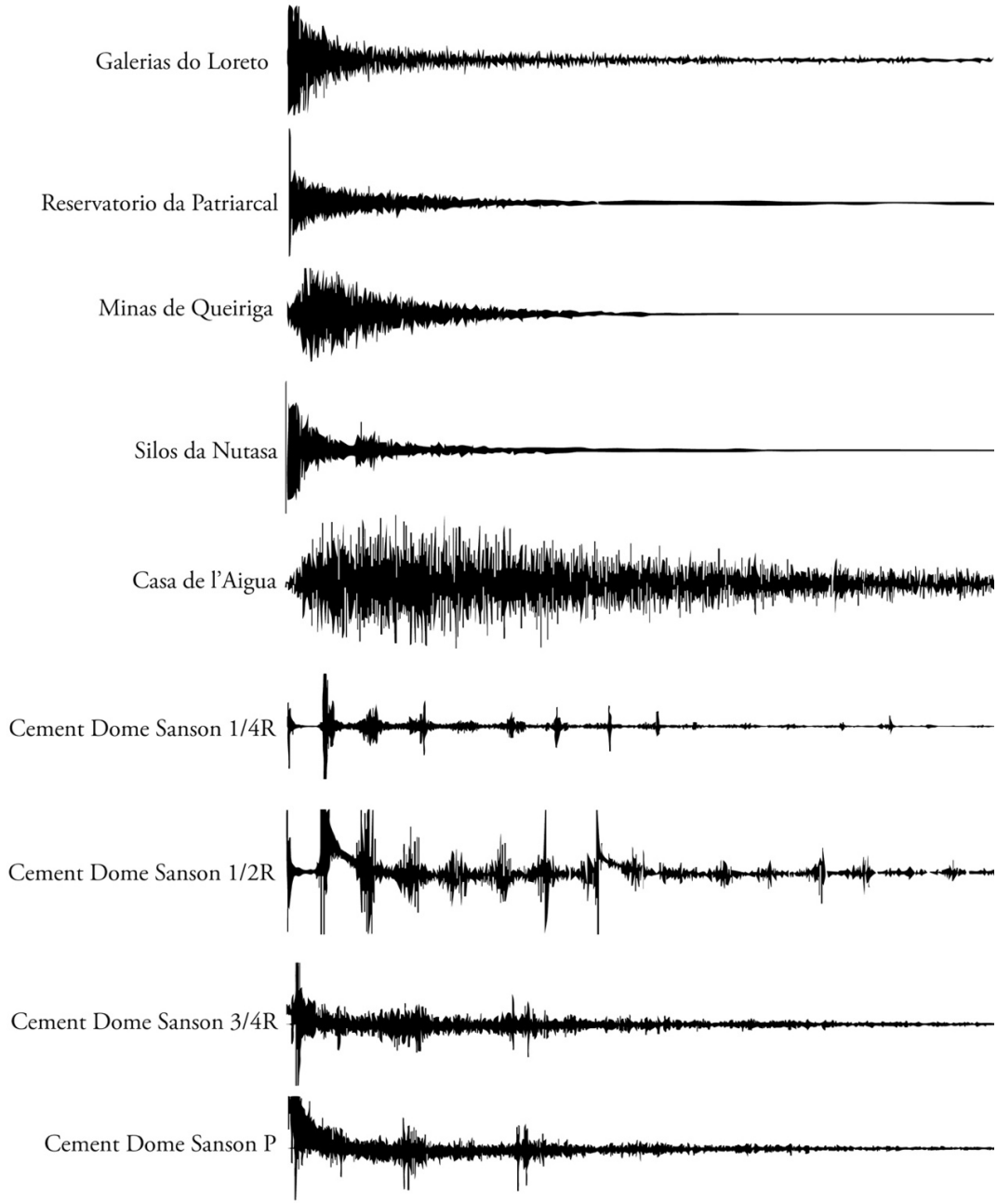


Figure 174. Waveform of the Impulse Responses in 2" (S. Balbontín 2019).

We observe a longer reverberation time in Casa de l'Aigua (table 4) due to its larger size compared to the Lisbon's water infrastructures. The tunnels of Galerias do Loreto exhibit a unique bass condition and a strong presence of underground sounds, similar to telluric noises coming from the city's surface activities, providing a unique urban experience through sensory input. The long distances within the tunnels are manifested through distant sounds,

which differ from the atmospheric sensation experienced within the Reservatório da Patriarcal, where its platform at mid-height generates an immersive effect. These underground spaces, with their echoes, resemble a reverberating cave, creating a similar echoic dynamic to the one experienced in Minas de Queiriga (fig. 174-175).

Figure 175. QR Code: Audio of Impulse Responses.

From acoustic material to artistic production.

Som sob o solo was the only artistic outcome from this last expedition. It featured the multichannel installation *Polyphono* inside Galerias do Loreto and the hybrid performance *Wastelands* in Reservatório da Patriarcal. Both projects used the acoustic study to work on the propagation space and to compose an acoustic narrative. Within Galerias do Loreto, the artwork took into account the reverberation time and the distant sounds within the space, proposing a piece that could blend with the natural composition of telluric sounds coming from the city. In Reservatório da Patriarcal, the reverberation and timbre of the space were used as a base for composition and for overlapping the acoustics of the water reservoir with the virtual acoustics from Expedition #1. The results can be heard at the following site (Fig. 176).

Figure 176. QR Code: Album of Som Sob o Solo. Includes field recording from Galerias do Loreto.

Acoustic Space as an Exploratory Tool (of Modern Ruins)

> Sound, as the result of a series of material frictions or vibrations, arises from a given object or body to propagate and leave behind the original source—it brings the original source from there to here. This movement grants the feeling of a progression; the temporality of sound, in vectorizing the image, does so by always leaving behind its origin to enliven sense of place with continual animation (LaBelle 2010: 6).

Propagation effects such as echo, reverberation, or coloration are temporal dynamics that occur within sound displacement. As LaBelle states, "the echo exaggerates the passing sound, staging it as a performance" (2010: 7). LaBelle argues that acoustics are the performative condition of space, rendering sound as a dimensional spatial object with a reverberating presence. In this regard, the staticity of architecture becomes animated, and industrial spaces abandoned by "progress" are brought back to life through their own acoustic expressions. This sonic transformation of space displaces the linear relationship between past and future, turning the chronology of sound into a spatial dimension. The modern ruins of the future are the abandoned monumental acoustics of the present—spaces evoking cenotaphs of the industrial peak and their subsequent decline. The acoustic space witnesses the decomposition processes of the capital machine and their transformation into residual urban matter.

Some of these industrial spaces are in use, others are abandoned, and some have been recovered and reconditioned for cultural purposes. The temporal facticity of these architectures, driven by their life cycles (independent of human ones), is represented in the chronology of sound and their acoustic response. Echo and reverberation perform these transformation processes from "in use" to "abandoned," where the industrial sounds of their once-filled spaces with non-human habitation are now empty. The acoustical force of their spatial dimension is reinforced, bringing these spaces back to life from a state of death. In this regard, the potential of industrial architecture offers acoustic opportunities beyond the realm of production.

The acoustic space serves as an exploratory tool that captures the reverberant dynamics of modern ruins. These spaces become an enlarged instrument envelope, an inhabitable resonating chamber of performative force. The echoic potential for artistic action stands still, waiting for the opportunity to mutate into an aesthetic experience. This animating dimension

of reverberation suggests a voice that returns the sonorous energy through acoustics as a filtered answer, an auditory mirror that speaks back with a voice of its own. The acoustic space has an acousmatic effect, distorting the original sound to such a level that it brings confusion to identifying the original sound, breaking the direct relation with the sound source that is "no longer there". If the sound is emitted by the performer, the acoustic space will augment it beyond human proportions. In this regard, human expression mixes with a non-human voice to produce something new in an aesthetic collaboration between performer and space.

The listening experience of space emerges from sound as it becomes spatially located and informs our understanding of the surrounding environment through spatial reflections. As sound interacts with space, it undergoes transformations, leading to a perceived phenomenon shaped by spatial morphologies. Here, a situated-spatial experience takes place, transcending physicality to existentiality, influenced by the interaction of the body and mind with the spatial environment. This involves the projection of an internal image derived from the reflection of external information triggered by sonic perception. Experience unfolds over time, with the individual's perception and interpretation of the space evolving within the chronology of acoustics. It is a contextual manifestation; thus, the filtered sonic signal underscores the significance of spatial context and the dynamic relationships between bodies, space, and time in shaping the spatial experience. Acoustic space is a combination of spatial attributes and auditory perception, influencing our social behavior, orienting us through echolocation, and enhancing our experience of space.

> Physical sound is a pressure wave that transports both sonic events and the attributes of an acoustic space to the listener, thereby connecting the external world to the listener's ears. Because the physics of sound is complex, transmission includes such processes as reflection, dispersion, refraction, absorption, and so on, all of which depend on the acoustic properties of space. When arriving at the inner ear, sound waves are converted to neurological signals that are processed by the brain; the external world is connected to inner consciousness (Blesser and Salter 2009: 12).

The acoustic space constantly modifies our experience of sonic events. Listeners immerse themselves in the acoustic response of the space, noticing how the space changes the sound spectrum, its intensity, and its temporal sequence. Therefore, acoustics can let us "visualize" spatial geometry. We can "visualize" the dimensions of a large space by its long reverberation time or the dimensions of a small space by its dry sound.

Acoustic space is a tool grounded in listening, subject to our exploratory aural skills. Modern ruins are remnants of industrial objects, left behind as residual structures from cycles of capital. The production systems inherent in industrialization or extractivist models are ephemeral processes with limited futures due to ecological devastation, social degradation, or shifts in the global economy. These industrial monuments, once erected by humans, transcend human existence and projections, becoming obsolete and entering a process of decomposition. While listening to acoustic space we can propose innovative ways to interpret those decomposition processes; these material entities possess a temporal nature of their own that surpasses human capacity to perceive and comprehend upcoming cycles and effects in biological processes and ecological movements. Therefore, acoustic space serves not only as a tool for exploring the aural properties of forgotten industrial architectures but also for partially diagnosing the symptoms of an entropic process linked to these modern ruins, which is independent of the human paradigm in terms of both thought and experience, object and subject. In this regard, acoustic space employs aesthetic experience to detect symptoms of phenomena that exceed our experiential limits, similar to Timothy Morton's (2016) concept of *phasing loops*, which speaks about fourth dimension entities (as global warming) that are smeared in such a way that they come in and out of phase with human temporality.

AURAL SPACE

Spatial Images Produced by Embodied Listening

Aural space addresses the embodied dimension of aural architecture. It explores how aural architecture is formed through the subjective experience of listeners. This chapter examines the concept of aural space through a theoretical-practical discussion of body-based sound artworks, making audible the creative productions of the body and making "visible" the imaginary spaces of the mind. Aural space is not only perceived by the auditory system but also produced through the intersections of space, sound, and the body. Four body-based sound artworks are presented here to support the theoretical discussion and to build a conceptual terrain around the subject of study. Based on this conceptual framework, the phenomenological methods will be presented within the aesthetic experiences of the *Espacios Resonantes's* artworks. Through this methodological process, I will explore the subjective experience of the aural space. The central argument of this chapter proposes that the immersive experience of body-based sound artworks through embodied listening triggers a creative response, forming cognitive spatial maps that constitute the aural space.

Introduction

> But what can be the common space between sense and sound? Sense consists in a remission… Sound is no less made of remissions: it propagates itself in the space where everything reverberates by reverberating "in me", as it is said (we shall return to this "inside" of the subject, we shall return only to that). It resounds in the exterior or interior space, that is to say that it is properly re-emitted by "sounding" … (Nancy 2007: 8).

Aural space is an imaginary space created in the mind through an embodied listening. It connects listening to cognition and sense-making through the aesthetic experience of sound in space, initiating a sequence of cognitive responses which triggers creative imagination. This allows sound perception and individual interpretation to act as creative interfaces for interpreting the sounding space, enabling exploration of our aural connection within physical and invisible environments. It enhances awareness of auditory and spatial attributes, fostering unity with the surrounding sonic environment and prompting the creation of a mental map that can recreate existing spaces or imagine new ones through aurality. The listener processes all this sonic information, transforming it into aural space.

Aurality refers to the sensory experience and the cognitive processing involved in listening to sound, focusing on how individuals perceive, interpret, and make-sense of auditory

stimuli. Aurality encompasses not only the physical act of listening but also the cultural, psychological, and contextual aspects that shape how sound is experienced and understood. In this thesis, I propose the term *aural space* as an integral dimension of aural architecture. It pertains to the reception of sound information from space and its interpretation into spatial images through a process of creative cognition. This includes sensitivities and emotions that signify the space with affective associations, connecting with the acoustic memories of other lived spaces. How can an external sound space become an internal aural space through aesthetic experience? How does a situated and embodied listening enhance awareness of the spatial attributes and the acoustic information, contributing to the formation of mental spatial representations? How can aural architecture emerge through embodied spaces of sound?

This chapter explores the notion of aural space first from a conceptual and practical approach, and then through a phenomenological methodology. The first part presents a historical overview of some practical and theoretical experiences, exploring references that blur the line between music and sound art, with a specific focus on listening to architecture. The second part details phenomenological methods utilizing the artistic outcomes of the *Espacios Resonantes* project to evoke aesthetic experiences. The objective is to explore the concept of aural space through a discussion that integrates information from theoretical, practical, and phenomenological approaches.

Through this methodological process, the chapter suggests that immersing oneself in the auditory world of the body and mind during a sound installation or performance elicits a creative response of spatial imagery that becomes part of the artwork. To support this claim, the text first explores the imagined spaces in compositions by artists like Anette Vande Gorne, Jean Christophe Thomas, and François Guerin, who support the idea that music composition aims to evoke spatial imagination within a mental space. These compositions, akin to Varese's and Xenakis' works, craft aural spaces that trigger a whole-body experience. This exploration extends to practical experiences in sound art with Brandon LaBelle, complemented by theoretical insights from authors such as Edmund Carpenter, Marshall McLuhan, Barry Blesser, Linda Ruth-Salter, and Gascia Ouzonian.

This first part is divided into two sections. After the introductory overview, the text explores sound works that I classify as "body-based sound installations" (Ouzounian 2008),

which may also be considered experimental music by others. These sound works are more than just music to me because they evoke an imaginary spatial universe created through the intersection of sound, body, and mind, involving a performative listening. According to Ouzounian (2008), these kinds of artworks conceive "the human body as a resonant space—one in which aural architectures can develop" (180). This second section focuses on four body-based sound installations: Poème Électronique by Edgard Varese, Deep Listening by Pauline Oliveros, Sound Characters by Maryanne Amacher, and Headscapes by Bernhard Leitner. Each piece is analyzed aurally, drawing from my own vivid experience to explore their sonic dimension of space.

The purpose of this theoretical and empirical phase is to establish a conceptual framework that contributes to the subsequent phenomenological methodologies. These methodologies utilize aesthetic experiences, presented in the previous chapters, to conduct experiential analyses through aural perception. The second part of this chapter employs embodied listening and creative cognition to explore aural space. Specifically, using *reactive listening* and *deep listening* methods in conjunction for each case study. Reactive listening involves playing field recordings from specific environments and replaying them out of context using headphones or loudspeakers. Deep listening entails attentive, focused, and meditative listening. Using these methods, I conducted interviews, workshops, and collected anecdotes to analyze three aesthetic experiences as case studies:

(1) Expedition #1
    (a) Espacios Resonantes Album
    (b) *Space Dystopia* Listening Session

(2) Expedition #3
    (a) Espacios Resonantes Festival

Spatial Imagination

When discussing sound waves, Linke (2023) explains:

> They enter the organism through an opening for them into the stirrup of the middle ear, creep through the cochlea of the inner ear and are then—having long since been transformed—«fired» into the hearing track by the hair cells. In the form of nerve impulses, they report in the brain stem and cerebrum of

> events in the world outside. This tonotopic organization in which the cortex regions of the brain open in accordance with the pitch can produce an <image> of the noise in the outside world even when no real sound ever reaches them. To the contrary, were the brain cells themselves begin to vibrate at such a high frequency they would only be diverted from their task of being present while the auditory images are being produced (230).

Composers Anette Vande Gorne and Jean Christophe Thomas (1991) explored sound space in music through an imaginary realm—the aural space—emphasizing the internal space of composition over external space. While contrasting the denoted space (composed) with the connoted space (experienced), music composition aims to evoke spatial imagination, by-passing objective space and going directly into the creation of subjective and imaginary spaces. The way we listen to music is through mental structures and recognition schemes; "The imagination uses the whole spectrum of sound as its material and constructs individual parts as well as musical space …spatial hearing is not only an act of localization; it is also in fact a process of imagination" (Kursell and Schäfer 2009: 102). Perception of space in music can take various directions, all coexisting within the same musical flow but with individual differences, leading to multiple aural spaces. Based on this, François Guerin argues that listening to music is a process that takes place inside a mental space; "The mental space is also the territory within which these architectures take shape for each listener, a territory delimited as much by the sonorous structures of the musical unfolding as by the listener's ability to interpret these structures and to organize them in a meaningful way" (1991: 131).

Varese's and Xenakis' *Poeme Electronique* and *Interlude Sonore* are compositions that craft aural spaces, triggering a whole-body experience. Both pieces aspire to be collaborative spatial creations involving composers and audience. As Elisavet Kiourtsoglou states in her paper *Tools for Immersion*, referring to the *Philips Pavilion*; "the audience was meant to experience a series of embodied sensations, like loss of orientation, a sense of immobility or an urge to make sudden movements, a feeling of expansiveness or tightness… these composers wished to create with their music an 'acoustic space', that is a mental space where sound is perceived…" (Kiourtsoglou 2022: 163). The spatial design of music, beginning with the graphic score as the spatialization plan, guides the staging of dynamic sonic atmospheres. This process is not complete without the interpretation of the embodied experience of sound in space, blending the objective and subjective aspects of the spatial-sound phenomena in a

simultaneous act. Both composers, Varese and Xenakis, intricately design the experiences and bodily sensations of the audience within their written scores, culminating in the creation of an imaginary architecture of their sound pieces.

Conversely, imaginary architecture can be derived directly from field recordings without a sound composition. Instead, the creative act lies in interpreting spatiality. This is exemplified in LaBelle's artwork *Room Tone*, which explores sound as a spatial feature—equally immaterial and ultimately generative for a spatial imaginary (LaBelle 2011). The project involved three audio recordings from LaBelle's apartment in Berlin, documenting the ambient, material, and dimensional conditions of the space. These recordings were sent to 15 architects worldwide, who created physical models of the apartment using only the recorded sound as their source of information. A process of translation and interpretation occurs through sound. LaBelle expressed, "what I hope to set in motion is the complex and complicated meeting of sonority with the languages used to construct space, to leave open the spatial imagination to the durational flux that sound comes to deliver" (2011: 245). In this process, the external space of LaBelle's apartment becomes the architect's internal space—a personal outcome of the creative process manifesting in the model elaborations (fig. 177). As observed, the internal images do not replicate the external ones.

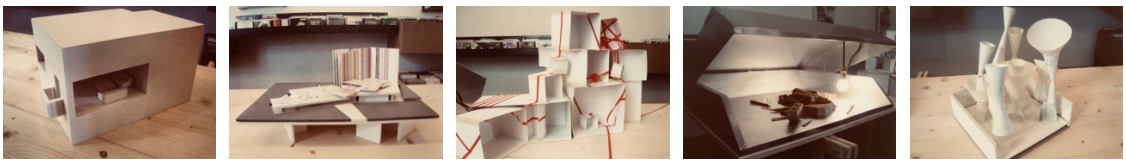


Figure 177. *Room Tone* Models (B. LaBelle 2011).

The brain constructs an internal representation by synthesizing fragmentary insights, which through a rudimentary process, can reveal a coherent picture of the external world. According to Blesser and Salter (2009), "an internal spatial image is a cognitive map of space—a private construction that includes a mental response to sensory stimuli modified by personal experience" (46). This process is grounded in the knowledge we have of the physical world, where reverberation is associated with enclosed spaces, echoes with distant surfaces, and dryness with absorbent materials. Cognitive maps of space are subjective, distorted, and personalized—in Blesser and Salter's words, "an active and synthetic creation, rather than a

passive reaction to stimuli" (46). Aural spatial imagining is thus directly linked to our spatial awareness and is specific to individual perception and cultural context.

In regards of the cultural ways of listening, the colloquial concept of *space* —as that one which separates visible objects within an empty space—is opposed to that of oral traditions, where sound plays a central role in evoking imagery and emotion. According to McLuhan and Carpenter, in their book *Explorations in Communication* (1960) Eskimo's cosmology transcends mere observation and measurement of the physical world, encompassing a sonic surrounding and intuition as vital components of cognition. The universe, is also a potential map of aural space, where our ears, enable us to instantly perceive sounds from any direction and at varying distances. This auditory perception is deeply intertwined with human emotions, originating from a primal need for survival. In oral traditions, music is highlighted as a form of auditory expression, producing itself moment by moment, perceived in 360º.

Instead, for Western culture, aural sensibilities are viewed as a retribalization, associated with primitive rituals and practices (Carpenter and McLuhan 1960). They argue that, by atomizing speech, Greek phonetic literacy had organized the Western "visual bias" based on the axioms of Euclidean geometry, where objects are fixed in a definite, linear order. In that sense, they associate visual space with modern, literate, Western societies. By transforming aural space into "visual" space, the perception of sounds shifted from the sensual and emotional realm to the structured, logical, and enlightened realm of the Western visual imagination (Ouzounian 2007).

According to Ouzounian (2008), the proliferation of electroacoustic music since the mid-20th century represented a retribalization of Western culture. *Poème Électronique*, performed in the Philips Pavilion and composed by Varese, was described by her as "a calculated negotiation of acoustic and visual space" (2008, 51). Ouzounian argues that the piece was not an abstract composition but allegorical; "This story depicted the evolution of humankind from 'primitive' societies to the Nuclear Age, through a series of juxtapositions that contrasted the intuitive with the rational, the emotional with the logical, and the primitive with the advanced" (2008, 65). The composition blended Western sounds like bells, instruments, voices, and synthetic manipulations with tribal sounds such as percussion, indigenous instruments,

voices, and rhythms. Varese's *Poème Électronique* aimed to create a complex musical experience, merging the listener with spatial music as a whole.

Poème Électronique.

Poème Électronique is an eight-minute-long piece of *musique concrète* composed for a sound spatialization system of 425 loudspeakers. The composition aimed to engage people's senses by evoking emotional and sonic associations with events or objects in the collective memory of its audience. One attendee described the experience as featuring intense reverberations from all directions simultaneously, with high-pitched shrieks, whistles, and eerie echoes (Gernsback 1958). Other attendees noted the immersive qualities of the piece, reporting a sense of not just hearing the sound but being transformed into it (J.O. 1958). The piece was designed to create the illusion that the various sound sources were in motion, moving up and down the pavilion. The script of *Poème Électronique* is as follows: 0 – 60" Genesis, 61 – 120" Spirit and Matter, 121 – 204" From Darkness to Dawn, 205 – 240" Man-Made Gods, 241 – 300" How Time Molds Civilization, 301 – 360" Harmony, 361 – 480" To All Mankind. The sequence of sounds in Varèse's composition is described by Sebastian Ars Acoustica (2017) as:

(1) 0" Low bell tolls. "Wood blocks". Sirens. Fast taps lead to high, piercing sounds. 2-second pause.
(2) 43" "Bongo" tones and higher grating noises. Sirens. Short "squawks". Three-tone group stated three times.
(3) 1'11" Low sustained tones with grating noises. Sirens. Short "squawks". Three-tone group. 2-second pause.
(4) 1'40" Short "squawks". High "chirps". Variety of "shots", "honks", "machine noises". Sirens. Taps.
(5) 2'36" Low bell tolls. Sustained electronic tones. Repeated "bongo" tones. High and sustained electronic tones. Low tone, crescendo. Rhythmic noises lead to
(6) 3'41" Voice, "Oh-gah". 4-second pause. Voice continues softly.
(7) 4'17" Suddenly loud. Rhythmic percussive sounds joined by voice. Low "animal noises", scraping, shuffling, hollow vocal sounds. Decrescendo into 7-second pause.
(8) 5'47" Sustained electronic tones, crescendo and decrescendo. Rhythmic percussive sounds. Higher sustained electronic tones, crescendo. "Airplane rumble", "chimes", jangling.
(9) 6'47" Female voice. Male chorus. Electronic noises, organ. High taps. Swooping organ sound. Three-note group stated twice. Rumble, sirens, crescendo (8 minutes and 5 seconds).

I listened to the binaural version of *Poème Électronique*[15] with headphones. Through attentive listening, I could recognize a tendency to build different dialogues within the piece, articulating abstract sounds and recognizable concrete sounds, which evoke a confrontation between the past and the future. These dialogues also occur between soft sounds and piercing sounds, drones and beats, and high and low sounds. There are dialogues between machines and "futuristic" or "outer space" sounds that confront tribal sounds, as well as dry and reverberant sounds. The rhythmic work includes constant percussions with others that are accelerated, along with static and sustained sounds. Games of attack and decay simultaneously modify the pitch in their sonorous movement. All these dialogues and conformations are placed in different positions within a virtual 360º aural space, coordinating movement with rhythms, accelerations, and decay.

The aural space of *Poème Électronique* configures a three-dimensional spherical map, where sounds create multiple spaces that change throughout the piece. In some cases, the space evokes an exterior environment, other times an intimate setting, sometimes an enormous expanse, and occasionally a nearly interior space, as if the space was confined to the head. Here, perception acts as interpretation; according to Voegelin (2010), listening is inventing a reality, rather than recognizing in it a contemporary or historical context. Listening is not merely a receptive mode of information but a method of exploration that allows me to discover rather than receive a certain spatiality. Contrary to Ouzounian's statement, I believe that *Poème Électronique* is both allegorical and abstract, and it is in this confrontation that the aural space is constructed within the audience's imagination.

Deep Listening.

In 1988, Pauline Oliveros discovered an underground cistern in Port Townsend, Washington. Together with Stuart Dempster and Panaiotis, they recorded an album inside the cistern, using the acoustic qualities of the space as a fourth instrument. Inspired by this experience, she developed the philosophy and practice of *Deep Listening*, which involves listening to sounds with heightened awareness, both in the external environment and within one's

[15] Available in YouTube: https://www.youtube.com/watch?v=JLDbBqHCslw

own feelings. It is more than just listening; it involves being fully present and engaged with the aural experience. Oliveros developed Deep Listening in response to her interest in the relationship between sound, listening, and consciousness. She believed that, through Deep Listening, individuals could expand their awareness and enhance their understanding of the world around them:

> Would you like to zoom into a waterfall to hear individual sounds of the falling drops? Would you like to hear the sound of a cell dividing in your own body? The sound of blood coursing through your veins as you monitor your own health? (Oliveros 1999: 12).

This practice is influenced by various disciplines, including meditation, music improvisation, and sound art, providing creative sound experiences through listening. Deep Listening involves being conscious of all the sounds around us, from the most prominent to the most subtle, and appreciating their qualities. It encourages an awareness of the context in which sounds occur, including the physical space and the dynamics of its acoustics. It also involves paying attention to internal sounds, such as thoughts, imagination, fantasies, memories, and bodily sensations, recognizing how they interact with external sounds: "Deep Listening is exploring the relationships among any and all sounds whether natural or technological, intended or unintended, real, remembered or imaginary. Thought is included" (Oliveros 1999: 5).

As Deep Listening is a voluntary process of attention, Oliveros developed specific exercises, such as group improvisations, sound meditations, and focused listening sessions. These activities enhance sensitivity to sound and foster a deeper connection with the auditory world. She developed three key concepts: focal listening, involving details about sounds; global listening, involving the expanded field of sound; and *quantum listening*, involving both simultaneously. Quantum listening is listening to our listening, enabling special abilities like voice recognition, echo detection, and spatial location, used for creating sonic images from the aural information. Through quantum listening, we create what we hear and we can change what we perceive. Thus, the perceiver and the perceived are co-creating together through listening; "The field of sound can be felt as potential force. There is active participation by the listener and co-creation of this form between the listener and sounds" (Oliveros 1999:

15). If listening is not expanded in such a way, and attention is diminished, then aural space disappears.

Deep listening involves expanding the field of attention to sound awareness. It is a mindful practice that drives practitioners to gain further insights into the nature of the listening experience. As Varela et. al (1993) argues, "as mindfulness grows, appreciation for the components of experience grows… it is to enable the mind to be fully present in the world" (122). Deep listening emphasizes active engagement with the sonic environment and its impact on cognition. In this regard, cognition is understood as an embodied action, meaning that depends directly on the body as a sensory receptor of experiences. Furthermore, these sensorimotor capacities are embedded in psychological and cultural contexts. The cognitive system projects its own world based on apparent reality and internal conceptions that act as a filter (Varela et al. 1993). Therefore, cognition is a dynamic process that emerges from the ongoing interaction between the inner field of the organism and the external field. This interaction is reciprocal, meaning the organism affects the environment and the environment affects the organism in turn.

Embodied action intertwines sensory and motor processes, articulating perception with action inseparably in lived cognition, evolving together within an *enactive* approach. Enaction establishes that "perception consists in perceptually guided actions and that cognitive structures emerge from sensorimotor patterns that enable action to be perceptually guided" (173). Enactivism involves autonomy and creative cognition, viewing organisms as self-organizing systems that generate new ideas and concepts through various cognitive processes such as memory retrieval, analogical thinking, and mental imagery. These processes combine existing knowledge and contextual perception to produce creative outcomes. Therefore, in deep listening, the listener and the sounds co-create interpretations of sonic information through mindful embodiment and creative cognition.

The piece recorded within the cistern was entitled *Deep Listening,* since exemplifies Oliveros's principles of the practice of deep listening through its immersive approach to sound and acoustics. The piece was performed and recorded in 1989 inside a large underground cistern with a 45-second reverberation time. This unique acoustic environment plays a crucial role in shaping the sound of the piece, creating long, lush echoes that blend and transform

the sounds produced by the musicians. The piece is dedicated to exploring reverberation, considering the spatial and temporal dimensions of the cistern, enhancing the immersive and enveloping effects provided by the space.

I decided to engage in a deep listening practice to listen to the album *Deep Listening*[16], and to elaborate reflections on its sonic and spatial nature. Using headphones, I listened to its four tracks: *Lear*, *Suiren*, *Ione*, and *Nike*. The piece is predominantly improvisational, with musicians responding to each other and to the acoustic properties of the cistern, creating an expansive, meditative soundscape.

Lear begins with a deeply grounding atmosphere, featuring resonant drone sounds from Dempster's didgeridoo, which complement the accordion's drones, resonating distinctly within the space. The reverberation creates a sense of vastness, reminiscent of a large expanse intersected by smaller spaces defined by Oliveros' high-pitched accordion sounds, constantly evolving. The didgeridoo intermittently provides a low baseline, anchoring the other sounds. Panaiotis' vocalizations introduce an ethereal quality to the piece, offering an improvised interaction with the acoustic properties of the space. They create a sonic ceiling akin to an atmospheric cloud, swelling and receding in intensity through sound. The slow pace and extended durations continuously push the boundaries of the virtual space. High-pitched tones seem to contract the space, whereas bass tones expand it, each phrase widening the auditory horizon.

Suiren continues the exploration of space and resonance with a slightly different focus. The piece is shorter and more concentrated, yet it maintains the meditative quality of the album. The tone is darker and more dramatic. Panaiotis' vocals come to the forefront, producing a variety of sounds, from harmonic overtones to throat singing.

Ione has a more personal and intimate feeling, delicately exploring the nuances of sound and space. The didgeridoo, accordion, and trombone collaborate to create a cohesive atmosphere. This triadic harmony gradually unfolds and fragments into distinct instrumental sounds, constructing a sonic infrastructure of layered textures. The accordion and trombone introduce high-pitched sounds from the background, softly rising and falling intermittently.

[16] Available in YouTube: https://www.youtube.com/watch?v=U__lpPDTUS4

A vibrating pulse emanates from the didgeridoo, encircling my head with an enveloping sound that envelops all others. The trombone establishes a distant back wall, while the accordion, positioned closer to me, creates a playful front wall of sounds.

Nike is different from the other, presenting an exploration of casual sound, space, and perception. In this final composition, no instruments are played; instead, various intermittent sounds are percussed randomly—sudden cries and shouts create a punctuated sonic environment. The overlapping sudden noises interact with the reverberation of the space, causing the cistern to resonate uniquely with each sound produced. Traditional voices and instrumental improvisation enter the scene in the latter part. A trance-like ritual unfolds with tribal sounds emerging within the space. I sense a conflict between human and non-human sounds, culminating in an intensity pick and fading off into reverberations.

The immersive quality of the various instruments creates a wide range of sounds that resonate within the reverberation, enhancing the contemplative and meditative aspects of the music and its potential spatial imagery. *Deep Listening* embodies Oliveros' philosophy of listening with heightened awareness and intention. The piece is not merely about producing sound but about engaging deeply with the act of listening itself.

Sound Characters.

While undertaking a fellowship at the Center for Advanced Visual Studies at the Massachusetts Institute of Technology, Maryanne Amacher spent three years developing a continuous real-time transmission of the Boston Harbor soundscape into her studio at MIT. Throughout this project, Amacher explored cross-sensory connections between stereo vision and auditory dimensions, mental images of immersion in space, and the physiological experience of acoustic environments, distinct from the perception of such environments audibly as images (Amacher n.d.). During this period, Amacher started her sound installation series *Music for Sound-Joined Room* (which is detailed in the previous chapter on *Acoustic Space*), large-scale, site-specific installations which utilized the architectural features of rooms inside buildings with a multi-channel sound system. Through this work, immersive aural

architectures are constructed, connecting the audience with interconnected rooms through music specifically composed for the artwork.

The music composed for this series of installations, was developed in various locations with unique acoustical characteristics from 1980 to 1995, and compiled in the albums Sound *Characters (Making the Third Ear)* and *Sound Characters 2: Making Sonic Spaces*. These two sound works are body-based sound installations that construct multi-dimensional, environment-oriented experiences. Amacher's sound works are not just for the ears, but are produced for the body and mind, serving as an intersection between space, sound, body, and cognition.

Both versions of *Sound Characters* showcased Amacher's exploration of auditory perception and spatial sound. In *Sound Characters (Making the Third Ear)*, Amacher delves deeply into psychoacoustic phenomena, creating sounds that induce unique auditory experiences, including the perception of sounds originating from within the listener's own ears — known as Otoacoustic Emissions. These are sounds generated by the inner ear itself when stimulated by certain frequencies. Amacher discovered that by crafting specific sounds, she could induce the ear to produce its own sounds, leading to what she termed *perceptual geography*.

Her second album *Sound Characters 2: Making Sonic Spaces*, explores psychoacoustics, focusing on how sound can influence and manipulate the listener's auditory perception by creating virtual spaces through sonic embodiment. It explores the concept of *sonic spaces*, where sound interacts with the physical space of the installation, to generate immersive auditory environments. The album of four tracks, features a wide range of dynamics, from subtle, barely audible sounds to powerful, room-filling vibrations. This dynamic contrast is crucial for creating the immersive and enveloping nature of the different spaces presented in the album.

In this analysis I will focus only in Amacher's second album *Sound Characters 2: Making Sonic Spaces*[17]. Inside my studio, equipped with a stereo sound system featuring a pair of Genelec Monitors, I listened to the entire album. Knowing that this music was originally intended for a specific location, I undertook a spatial transposition into my studio, aware of the potential changes the piece might undergo. I began by playing the first track at a

[17] Available in Spotify: https://open.spotify.com/intl-es/album/3SiBs8AF1dObgipYqmmtuj

considerable volume. In this first part, Amacher employs a combination of low-frequency drones, subtle high-pitched tones, and disruptive mid-range textures to envelop the listener across different spatial axes. The low frequencies evoke the feeling of a space's floor, while the high-pitched tones create an atmospheric sensation near to a cloud. The mid-frequency sounds intermittently disrupt the spatial perception. These elements are arranged to enhance a sense of spaciousness through sonic movement, with various components seeming to move around the listener, augmenting the spatial illusion.

In the second part, Amacher delves deeper into the spatialization of sound, manipulating sound intensity and silence. While some sounds fade away by reducing their volume, others enter the scene with a disruptive, high-pitched, rhythmic flutter. This creates pronounced shifts in spatial positioning, with sounds appearing to move vertically and horizontally around me.

The third part begins with a piercing high-pitched sound, similar to a scream, followed by a static drone that expands throughout the space, enveloping me. Sudden changes in pitch interrupt the scene. My own movements introduce interesting changes in the sound, encouraging continued motion rather than remaining still. This reminds me of Young's *Dream House* effect; the composition can be influenced by body position, creating varied acoustic spaces through standing waves that transform the room into a dynamic organism with overlapping sonic nodes and antinodes. This movement allows me to craft my own melodies and textures, shaping a morphing spatial experience. A tribal rhythmic aspect emerges, juxtaposed with a digital soundscape. Sounds continually vary in intensity, location, and texture.

The final part of the album synthesizes the various elements explored in the previous tracks, culminating in a dense and immersive sound environment. This track likely features a wide range of frequencies and spatial effects. A dense mass of textures is arranged to envelop the listener, creating a sensation of being inside one of Amacher's *sonic space* rather than merely listening to it. This formula of creating auditory spatiality is repeated several times during this album. In this regard, aural space emerges through immersion and is constructed through a sonic tornado that envelops me with drones and flutters. Multiple layers of sound interact in ways that challenge my perception, with sounds seeming to emanate from all

directions and at times appearing to originate from within my own head due to otoacoustic emissions.

During this final track, I experimented with moving to other rooms of the house to hear the composition as if in a sound-joined room installation. The sonic presence produces varied effects based on distance and the presence of walls, resulting in an evolving composition that changes depending on which room it is heard from. It appears as though the sound is emanating from the studio room into the rest of the house. While sounds within the studio room may seem disruptive, heard from other rooms in the house are perceived as calm and peaceful, emphasizing frequencies that might be less distinct when heard directly from the source.

This album was composed by Amacher as she explored the imagination of space and how spatiality could be perceived by the whole body. In an interview with Frank J. Oteri (2004), she describes how, through music composition, she aims to create a type of music where listeners have vivid experiences of the spatial dimension of sound. Amacher primarily uses abstract sounds that defy recognition of their real sources. Consequently, interpretations of Amacher's music can vary widely, and the perspective I offer here remains highly personal.

According to Merer et al. (2010), since the 1950s, electroacoustic music composers have addressed the problem of meaning of abstract sounds and provided interesting scope with no *a priori* differentiation on the type of sound. The utilization of abstract sounds in music compositions for body-based sound installations encourages a wide range of creative responses. This approach allows for multiple interpretations depending on the context, that trigger individual auditory differences.

Headscapes.

Sama, the Sufi term for audition or listening, was introduced by Schafer in his text *Music of the Environment* (1973) to contrast the modern human tendency to prioritize vision over hearing, unlike precolonial humans who valued audition as the primary sense. Sama denotes the practice of listening to spiritual music aimed at achieving spiritual ecstasy and connecting with the divine. In Sufism, it serves as both a form of worship and a means to deepen one's understanding of god and enhance awareness. Schafer also introduces the term *headspace*,

referring to the mental space that can be accessed through music and heightened states of consciousness: “In the headspace of earphone listening, the sounds not only circulate around the listener, they literally seem to emanate from points in the cranium itself” (1973: 17).

Schafer's concept of headspace is put into practice in Bernhard Leitner's body-based sound installation *Headscapes*, where aural spaces are directly created by the body;

> Sound spaces are interior spaces and as such always related to the body. The first empirical phase of work on sound space took years and investigated the delimitation of space through sound movements around, through, under and above the body, as well as the new spatial experiences and concepts that resulted… The sound space reverberates in the body (Leitner 2023: 142).

In previous chapters, I presented Bernhard Leitner’s series of sound spaces, which encompass a wide range of applications, from multi-channel sound installations to the actual construction of acoustic spaces. In his artistic research, this narrative unfolded to explore the body's intrinsic ability to construct spaces solely through the sensations of sound and vibration.

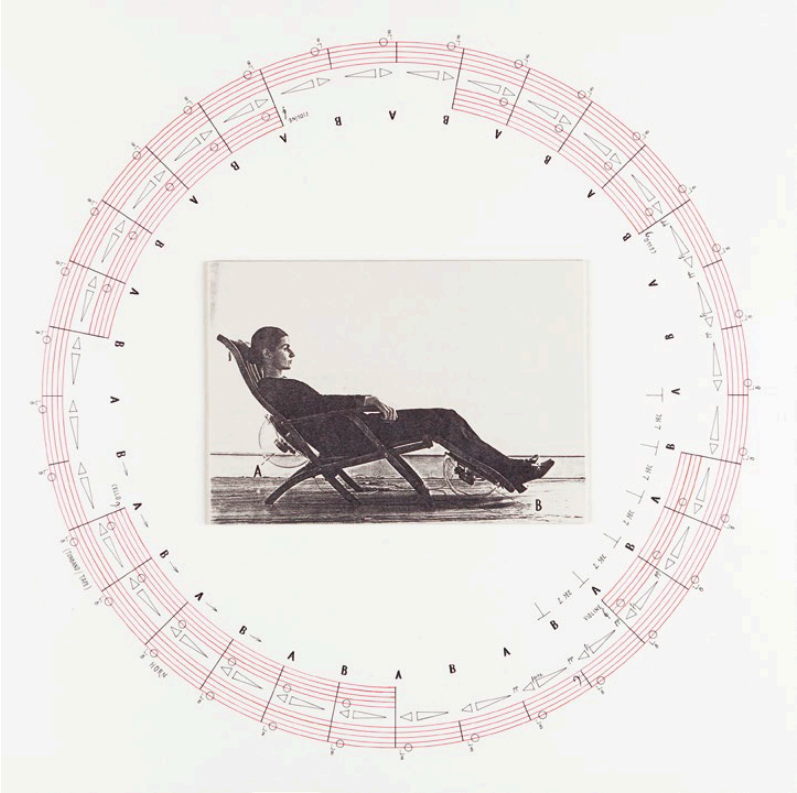


Figure 178. *Sound Chair 1* (B. Leitner 2023).

Leitner progressed from large-scale installations, exploring furniture-sound installations, portable object-sound installations, and ultimately to head-sound installations. Initially addressed as *Sound Architecture*, Leitner aimed to create spatial experiences through sound, imposing temporal constraints on architectural structures. This approach suggests that spatial boundaries were shaped not only by sound but also by time.

The research on Body Listening led Leitner to develop the Sound Space series *Lying Within Sound* (liege-objekte). Leitner designed various body-platforms/furniture incorporating speakers to experiment with different spatial configurations perceived through the body; speakers surrounding the body or moving sound along its longitudinal axis. Body position and sound spatial movements are interconnected, enabling the scanning of sound across the body. His artwork *Sound Chair 1*, comprises a chair equipped with two loudspeakers—one at the back and another in the lower legs. Sound travels between these points, traversing the body. One of the pieces reproduced in this installation is shown in Figure 178, presented in circular notation so the piece can be repeated and experienced over an indefinite period of time (Leitner 1978).

Figure 179. *Shoulder Sound-Object* or *Portable Space* (B. Leitner 2023).

In his *Portable Sound-Objects* series, Leitner integrated loudspeakers directly into wearable devices. Through this approach, individuals can effectively "wear" a *Sound Space*. These installations offer psycho-physiological experiences crafted through dynamic movements of sound. Leitner developed three versions: the *Sound Suit*, a net suit allowing for flexible placement of loudspeakers; the *Hand Sound-Object*, with a speaker held in each hand and positioned on the body according to a score; and the *Shoulder Sound-Object*, resembling a life vest with a loudspeaker facing the chest and another facing the back (fig. 179).

Leitner's sound works served as empirical research into his own auditory perception, constructing spaces that can be "seen" through sonic embodiment. In 1987, he developed the album (audio CD) *Headscapes* (fig. 180), featuring sound works specifically crafted for internalized headspaces meant to be exclusively experienced with headphones; "The head is here conceived as hollow volume, as a globe-like receptacle for time-based acoustic-geometric spaces. The eye, the listening gaze turned 180 degrees towards the inside. Acoustic thought. Acoustic eye" (Leitner 2023: 330).

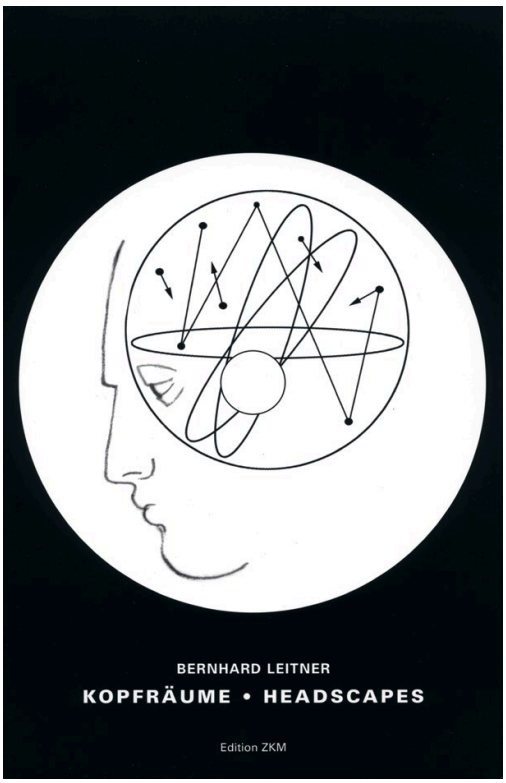


Figure 180. *Headscapes* Album (B. Leitner 2023).

While listening to *Headscapes* through headphones, space seems to flow and emanate from my head. The CD album has 16 tracks, and each one was designed by Leitner as a three-dimensional sculptural work. The first and fifth tracks feature rolling beat percussion sounds dynamically floating around my head, getting closer and farther away. The distant and closer sounds create spaces in between. These tracks remind me of Alvin Lucier's album *Vespers and Other Early Works*, which also explores headspace and sonic environments. Its first track, *Vespers*, is a percussive sound environment. The difference with *Headscapes,* is that *Vespers* explores the acoustic reaction of a specific space through the percussive sound of a sonar. Tracks 4, 5, 6, and 7 of Leitner's CD feature contact sounds that explore the creation of micro spaces expanding inside the head—sounds I would never perceive in any other way. The first two tracks (4 and 5) seem to be clothing friction sounds, resembling the micro space of a pants pocket. The next two tracks (6 and 7) feature paper friction sounds, creating spaces as if crumpling paper.

Tracks 8 and 9 create mental spaces through synthesized drone bass sounds that move continuously from side to side. While, track 10 is part of this exploration but integrates a percussive element, mixing drone-like sounds with percussion. Somehow, drone-like sounds create an interior ambiance, while percussive sounds trace space like a scanner, allowing me to locate sound much more precisely. From track 11 onward, reverb is included, as if the compositions were recorded in a much larger space or a reverb effect was added.

The following four tracks explore wind instruments that wander throughout this larger space, stretching the sounds around my head. An interesting experiment contrasts bass wind sounds with mid and high-frequency ones, indicating a space composed of a forefront of high sounds, a mid-frequency content, and a background of bass sounds, each having a different reaction to the reverb, with bass sounds being much wider and longer. The last track is a denser and more complex exploration of all the resources utilized in the previous tracks. Percussion is mixed with bass drone-like sounds that create a background ambiance, using high percussions floating restlessly around the space in a circular form, including an interesting effect of a trembling sound that moves directly from one side of my head to the other in a straight line. All these compositions experienced through headphones give me the impression

of being transported to Leitner's *in-situ* sound spaces multichannel installations, almost as if the compositions were actually recordings of the real artworks.

In *Headscapes*, Leitner developed a body-focused *Sound Space*, using exclusively aural perception for head-localization of an inner space. In this album, architecture is built through sound within the space of the head. Using very simple sounds, he defines head spaces: rolling beats of percussion instruments; fast, low, short beats produced with a synthesizer; and recorded instrumental sounds such as a constant frequency cello tone or horn tone (Leitner 1978: 14). He uses impulses moving in a "line" to make it easier to identify location and direction, which are essential for "visualizing" space. Other crucial elements integrated into the piece are speed, volume, and apparent distance. Leitner considers sound movements and variations as events in time. In this regard, aural perception becomes a temporal appreciation of space, transforming the album into a four-dimensional aural space.

> It is necessary to rethink and redefine the term "space". The boundaries of these spaces cannot be experienced at once, and they are not "dynamic, fluid" spaces in the conventional interpretation. It is space which has a beginning and an end. Space is here a sequence of spatial sensations – in its very essence an event of time (Letiner 1978: 13).

In *Headscapes*, the listener's head becomes part of the artwork, providing a sensation of the head becoming the architectural space of the piece, like an inner auditorium. In that regard, the listener is neither inside nor outside the head-based sound installation; instead, they become the installation itself. The aural space created by each of these pieces has no boundaries and unfolds as a succession of spatial events that develop over time. Leitner has described these spaces as breathing, swaying, bouncing, convulsing, slow, kneaded, arched, flickering, or prickling (de la Motte-Haber 2023), including both visual and haptic qualities in this list. In this regard, de la Motte-Haber argues that spatial perception results from a process of integration between visual, acoustic, and haptic-kinaesthetic impressions, where visual input provides the ability for spatial imagery. This album is an attempt to enhance perception towards hearing, "seeing", and feeling, while traversing in time towards the creation of an interior space.

Embodied Spaces

An embodied space is one that is understood and experienced through the body. It emphasizes the relationship between physical surroundings and human sensation, perception, and cognition. In this case, the spatial experience is understood through aural perception. Sound waves interact with the physical environment and our bodies, creating vibrations and resonances that we feel, perceive, and cognize. For instance, immersive sound within a multichannel sound system or with headphones can provide spatial impressions, fostering the creation of a mental map of space. Different sounds can evoke various emotional and psychological responses, influencing how the aural space is experienced and imagined. Furthermore, sounds carry cultural and social meanings that will also participate in the way the aural space is perceived and cognized.

Aural space articulates the act of listening with sense-making through creative cognition. While interacting with spatial sound, we can develop a performative listening for building imaginary spaces. Within a multichannel performance or a body-based sound installation, we can receive sonic information from the artwork that is filtered by the acoustic morphologies of the space, which is ultimately embraced by the body and translated through the mind into aural space.

This final chapter aims to access the aural space, which is not an objective entity, but a phenomenal one. The only way to approach the aural space is to go inside the mind of listeners and observe its cognitive processes of spatial imagination. To achieve this task, this chapter offers three case studies from the *Espacios Resonantes* project, which were exposed to a sample of people, who in return, shared their aesthetic experiences with me. In an analytical process, I collected the responses and organized them to access their individual and collective aural spaces.

The Space of the Head.

The aural spaces of Expedition #1 were gathered through the aesthetic experience of listening to the *Espacios Resonantes Album* (fig. 181). The spatial compositions that make up

the album are: *Inchindown Oil Tank*, *Lyness Oil Tank*, *Gasometer Charleroi*, *Joan Miró Water Reservoir*, *Cooling Tower Charleroi*, *Voces de Inchindown*, *Fábrica Textil Cal Grau*.

Figure 181. QR Code: Audio of *Album Espacios Resonantes.*

The phenomenological methods applied in this phase of the research involved a heterogeneous sample of 14 people who listen to the album through headphones. Both the reactive listening method and the deep listening method were employed. Reactive listening involves recording sound to later reproduce it out of its original context, whereas deep listening entails preparing the body through a meditative state to attentively perceive auditory events within a state of mindfulness. Based on these methods, individual interviews and subsequent aesthetic analysis were conducted to gather sensory information about space through aural perception (table 5).

Through this process, my objective was to access the spatial imagination of the interviewees, which would constitute the aural space. Each interviewee listened to the entire album, and after each composition, a series of questions was asked.

The interview addressed four aspects directly related to the aesthetic and sensory definition of aural space: 1) the subjective experience, a free description of perceptions; 2) spatial interpretation, how the interviewee imagines the physical space; 3) acoustic morphology, which refers to the form and materiality of the aural space; 4) the behavior of sound in space, how the aural space unfolds over time. Synesthetic tools were considered to translate sensory information from audible senses into visual or haptic forms, facilitating the description of auditory matter. Visual language is employed to describe sound, thus eliciting interpretations that evoke memories and sensations, as well as conceptual and artistic associations, resulting in a tangible visualization of the sound presence. The concept of synesthesia used in this

research corresponds to that of synesthetic metaphor, primarily employed in artistic experiences (Basbaum 2003).

	LISTENING EXPERIENCE	PHYSICAL SPACE	MORPH OLOGY	SONIC BEHAVIOR
INCHINDOWN	A storm, a thunder, a sense that an entire geography functions as a resonant box. You feel the distance through the reverberation. There is a cold, dark and damp tone, suspense, horror or science fiction. A feeling of fear, loneliness and smallness associated with something mystical and divine. A feeling of darkness and emptiness, like a black hole. A feeling of confinement, claustrophobia and the need for shelter. The sound reflections occur at a great distance, revealing the dimension of space through sound, forging a depth, like the movement of a tide at the bottom of the sea. Sound reflection is so intense that everything becomes unintelligible. The sound flow is like the wind, a chorus in the air or a gong.	An underground space, huge and closed, like the interior of a great glazed cavern with great abysses and cliffs near the sea. A great drum, tall, wide and cupular. An empty metal factory.	Metal, glass, cement, water, smooth and reflective. A sound mass of long forms and a repetitive texture that expand and fade on a liquid ground.	Major tonality, lively and strong. The sound travel in spiral forms and decays in a wide field of frequencies that evokes a spectrum of colors. Upward and slow movements, where low frequencies are heard even slower. The sound expands radially with infinite bounces in irregular zones. It is maintained in time leaving a trail that is confused with its origin. The movement of the sound is both contained and expansive, like the movement of a wave.
LYNESS	Great masses of earth in movement, telluric sounds, like collisions of great masses of sounds. Different registers, timbres and tonalities, as if there were 20 different instruments or as if one were inside a piano. Sensation of darkness, of smallness, of death, of something ancient. Presence of synthetic and musical sounds, dissonant and harmonic, reflections, stationary waves in a fight, beating. Presence of giant vibrating objects, bells, a choir, Tibetan monks, machinery, an engine, a helix. A flow is generated like a wind or an internal sea current that forms a sound mass that moves and travels long distances. The space is contained and has a lot of pressure, like an underwater pressure, triggering vibration and density. The sound is filtered in one same tone.	Deep space. A giant plastic tube, wide, long and curved. A large, metallic, rectangular cathedral. A concert hall or museum hall, with smooth and neat walls. An industrial space, large and spherical. An underground space, wide, low but extended, and closed.	Metal, rubber, stone, earth. The sound has a viscous texture. Presence of water.	The expansion of sound occurs in all directions, leaving a trail that becomes virtual. The sound is modified by space as a filter that distorts the sound and reflects it in a musical way. It is a dark tone with an ascending movement and a constant decay.
GASO	An indoor pool, mist, moving water, a choir of voices, a xylophone, bells, multiple and simultaneous vibrations, a radio tuned to several stations at the same time, wind, flow, the jungle, vegetation.	An outdoor space, a beach, a forest. It is a spherical, suspended space. A round, high,	Metallic sound that expands radially, spherically, like	The sound is static and punctual, drawing a continuous and linear trajectory. It has a circular, constant and cyclical

METER	A space outside, a dam that opens and the water comes over it. A flat and urban territory with sea, like a beach in the city. The sound is like the song of an amplified forest, with large rivers, fauna and large cliffs, which make up a soundscape that, in turn, passes through a filter transforming into a large mass of sound, a frozen sound. The sound is the product of echoes and stationary waves, of white noise and high frequencies, a mass of air that travels, like a flow that becomes melodic and rhythmic. Presence of sounds like field tools, wheat harvesting machinery, an engine. The sound becomes a drone, as if someone were pushing a stone throughout the whole space, a helicopter over the jungle or the engine of a submarine.	ceilingless space. A vaulted tunnel full of birds that passes through a cubic station, like the subway. Presence of two spaces, generating an opening. It is an open space, natural, humid and foggy. A sewer.	metal in water. The sound has a heterogeneous texture, a collage of textures; vegetal, wood, glass, stony, earthy, rusty metals, minerals, white materiality, watery, viscous and very humid.	movement, like an ascending spiral. There are short and long sounds and vibrations, which are perceived in a constant decrescendo.
JOAN MIRÓ	The sound under a bridge, inside a subway, underground, an underground cave with water running down the walls, a sewer with many directions, an underground river. An aquatic and open environment, like a viewpoint over the sea that generates an enveloping sensation of immense water and height. There is a song like a roar from the depths of the earth or like a wave of the sea on a rough and flat background that evokes the movement of sound, like water in motion. There is a lot of air and a lot of space with the presence of vibrations in low tones, resonance of elements, layered sounds at different distances, like a galaxy of sounds where each one moves in its own orbit. The distance of space is felt through sound.	The space is like a giant parking lot, an infinite free floor plan, with ceiling and floor, but without walls, like a horizon without limits. A wide and tubular space in a horizontal position. An underground space, under the sea.	Stony texture, metallic, rough, rocky, irregular, presence of rust, water, mud and earth. A hard texture and solid and defined materiality, like concrete.	Sound travels, moves, repeats, approaches and moves away. Sound has an extensive, linear displacement and has a movement of changing distances. Sound evokes the continuous movement of a water mass, which triggers, travels, transforms, resonates and fades away. A very long response of space, slow and prolonged.
COOLING TOW	A marble temple in a lush jungle with a fountain in the center. The sound is heard from inside the fountain, from under the water, through an aquatic filter, like a uterine space. A marble palace like New York's Grand Central, evoking a not-so-large, rather intimate urban environment. An open or semi-open public space, wide, a street or a square surrounded by buildings, with a sound that fills, coming from the top of the buildings. The sound travels through and generates a dreamlike sensation, of sound in movement, of travel, of a	It is a designed space, geometric, regular, symmetrical and tall. A marble and orthogonal temple. A metallic, cylindrical and horizontal gas cistern. A mixture of a tubular space with an urban space.	Solid texture like concrete. The reverberation of sound gives the space a background noise, a drone with a rough and dirty texture.	The sound has a bounce, a fluttering effect. Presence of echo and standing waves. The sound moves briefly, with controlled frequencies, local travel, like a slow falling drop that increases its radius as it falls. Sound spirals inside a tube and then broadens, reverberates more slowly, with greater wave amplitude.

ER	reality that comes and goes. It evokes the internal sound of a spaceship or an insect, the presence of an engine, of energy.			
REFUGI	A bunch of horizontally undulating and soft bed sheets, or a desert with small hills, an irregular exterior that at times is a more interior space than others, a product of the presence of reverberation and absorption at the same time. It is a tonal space, like a tuned instrument, with the presence of chords, harmonics, superimposition of subtle frequencies and Tibetan bowls within a flow of air, which forms a sum of overlapping planes, some of them smooth and others rough. The space evokes a mechanical drone like a motorcycle, a chaotic space of work or experimentation with machinery that have a life of their own.	A small, porous, wooden and closed interior. A flat, neutral, rectangular space of concrete and metal. A mine, a cavern, a catacomb. A hole in the mountain, like a mine or an underground train. An open plan metal and smooth room, with objects as furniture.	Texture of tin and foam. On one side, the interior is irregular, porous earth, like a fabric texture, and on the other side, it is metallic.	The presence of harmonics, with changes of tone that ascend and descend slowly. The sound movement is like a textile moving freely with the wind, irregular with an oscillatory linearity, horizontal, free and diverse, but static, constant and dry. The sound moves along the tunnel like a bracket within a pattern.
TUGNET	An abandoned public restroom with high vaulted ceilings. A tubular space that moves at the ends, like an inner ring that goes from one end to the other in a back-and-forth motion. A high-pitched underground theater with a static, dry and homogeneous sound, evoking the presence of different materials. The space is inflated and the air is dense, and is perceived as a small, rectangular, concrete piece, moving on a train with steel rails. The sound is tonal, but not so harmonic, with the constant presence of a sonorous shadow, a diluted repetition of each sound, like distant and distorted voices. The sound begins to corrugate, to spiral on a porous inner surface that reflects it in an irregular way, giving it a disorderly movement. The sound bounces inside and the response of the space is metallic. Sensation of being in the shade in a cold and humid place.	A vault. Human scale space, small to medium size, tubular or cupular, like an underground tunnel with a stage or an acoustic shell like a capsule. A classroom, not completely cubic (with a slope), with a soft surface, but with metallic flutter such as copper.	The sound has a metallic texture, specifically copper, smooth, with clean bouncing. Presence of cement, stone and earth, smooth and flat.	The sound is static, dry and homogeneous, which is filtered and distorted by the space. The movement is reverberant but controlled, circular and flat. There is a sound bounce. The space vibrates from low to high frequencies. Presence of echo and reverberation.

Table 5. Reactive listening interview results based on polyglot language (Thibaud 2001). All interviews were translated from Spanish.

Sound as plastic matter.

A first affective approximation to the sounds generated by space, as revealed by the interviews, arises from associations with movements of large masses of matter: the shifting masses of earth, the movements of water beneath the sea, the masses of air and atmospheric pressure, and so forth. The aural space is perceived as a mass of sound, either in motion or static, characterized by significant pressure and friction. Here, it is possible to conceptualize sound from a molecular perspective common to the states of matter, where sound waves vibrate and resonate with the material components of space (Gershon 2013). Molecular vibrations enable the materialization of the sound flow, resembling the flow of air (such as wind, clouds, or air within a ventilation duct), as well as the flow of water or other liquids. The movement of a sound fluid is tangible, possessing direction, rhythm, speed, and viscosity, contributing to a formal articulation through a morphological treatment that intimately links space with sound (Solomos 2013).

The presence of echoes and standing waves can be recognized in the album, which, depending on the geometry of the specific space, will generate a fluttering effect, giving a different character to each one. The great reverberation of these spaces triggers a perception of sound moving and expanding, often described as circular or in ascending spirals, followed by a trailing decay that varies in speed depending on the space. Generally, there is an association with past experiences that occurred in reverberant architectural spaces such as cathedrals, palaces, sacred temples, concert halls, parking lots, gymnasiums, swimming pools, public spaces like train or subway stations, tunnels, industrial spaces, urban spaces such as enclosed streets, natural spaces such as caves, and geographical spaces such as those formed between mountains. There is a tendency to draw on previous experiences to guide the aesthetic experience (Andersen and Balbontín 2019). However, there is reiterative pattern that connect the spaces from Expedition #1 to an underground and enclosed context, evoking feelings of claustrophobia, darkness, coldness, and a compressed sense of space, associated with negative emotions such as fear or film genres like suspense or terror.

The affective knowledge that emerges from the main sound effects present in space— echo, resonance, and reverberation— informs the spatial character, location, distances, forms,

and matter. This spatial character creates a sound filter that reveals the space through listening. Subjective interpretations engaged with this spatial filter distinguishing between different frequencies from the auditory spectrum, much like space diffracting spectrum differentials, as a prism diffracts white light into colors. Interviewees expressed this wide range of frequencies as "different timbres or harmonics", "a choir of different voices, different instruments, a radio with different stations", or "layered sounds at different distances, like a galaxy of sounds where each one moves in its own orbit". Following this observation, there is a common sensation of "being inside an instrument, a resonant box, a piano", often recognizing certain frequencies more prominently than others and the vibration generated by each. Listening to the spectrum of frequencies enables the identification of spaces that are more harmonious and musical than others, as observed in locations like the Lyness Oil Tank, the Joan Miró Water Reservoir, and Refugi 307.

Among the most recurrent reiterations, water appears as a descriptive element in various forms: as a flow of water, water in motion (waves, tide, river), and the sensation of being underwater to describe the spatial filter, also associated with the pressure and density of sound. Humidity manifests as the sensation of wet sound, contrasting with the sensation of dry sound, which match with the reverberation of each place. More reverberation makes the sound be sensed as "wet", while less reverberation results in "dry" sound. The presence of water is also a result of how this "sound mass" travels over greater distances, creating a sensation of slower speed.

From auditory experience to visual imagination.

The aesthetic experience of listening to the album generates significant insights, gathered from various perspectives, that construct a potential language for translating spatial-sound information into visual interpretations. Aesthetic perception and cognition play a fundamental role in transferring sensory information through synesthetic analysis, and associations and comparisons between sound and visuals, enabling me to translate acoustic experiences into aural space.

The results of the reactive listening interviews constitute a process of translating sonic information from a space that depends entirely on the relationship between a recreated environment (album) and the listener ability to interpret this environment when reproduced outside its original context. This interpretation is filtered extensively by the listener mental construction of the world, personal categorizations, memories, and past experiences, and, most importantly, by aesthetic sensitivity, which facilitates the transfer of information from a sonic state to a visual state (Balbontín 2020). Previous experiences and associations with past sensations were frequently employed as resources in interpreting the compositions, significantly contributing to approaching the aural space. The deliberate use of language, employing figures of speech such as abstract metaphors, spatial hyperboles, and personification of sound through epithets of movement, among others, promotes the construction of spatial imagery.

Listening to spatial compositions as a methodology enables the arrangement of impressions in a narrative, enhancing the aesthetic aspect of perception by removing layers of information to reveal others. The experience provided by reactive listening is stimulated by the performative character of each space, appealing to its expressive and emotive qualities. Through the activations performed, the space was able to "speak", revealing both its physical and aesthetic qualities. The musical composition of each space triggered an affective connection among the sample of people, gathering "data" that successfully formed consistent information for this artistic research. This approach helped in understanding the different studied spaces as if they were resonance boxes of musical instruments.

The aesthetic comparison of the various interviews allowed me to explore the aural space through connections between sensations and acoustic phenomena. For example, reflections alter the spectral composition as sound travels, metaphorically resembling a chorus of voices or a piano. In reality, it forms a mental image that identifies the different stages of sound propagation and the elements reflecting those sound waves. Here, an echolocation process is triggered, recognizing specific spatial morphology from the acoustic reactions and spectral compositions, even when using headphones. Reverberant spaces directly influence sensations of loneliness, darkness, claustrophobia, and humidity. These sensations are intensified with prolonged reverberations, accentuated by the absence of harmonics (as seen in the case of Inchindown), and the sensation of colossal spatial dimensions.

Sound possesses a phenomenological force that operates within space as a performative medium, evoking spatial experiences. These experiences delineate the aural space in its various forms, where architecture emerges from sound as a constructive material of sensations, fostering a process of spatial production through embodied listening. In this regard, aural space is defined by the interplay of sound behaviors with our subjectivities, encompassing memories, dreams, fantasies, norms, and values expressed through a diversity of personalized spatial images.

The Listening Session.

A second collection of aural spaces from Expedition #1 was gathered at the Spatial Sound Institute through the multichannel performance *Space Dystopia*. This aesthetic experience was developed as a listening session, where participants received instructions, and later a group workshop promoted a collective discussion. Before performing, I asked listeners to reinforce their active listening abilities in two different modes. The first one is the static mode, which involves fixing a certain position inside the space and receiving the sound movements from one specific place. The person can lay down, sit, or stand. The second one is the walking mode, which encourages the person to move around the place, discovering the different sound sources distributed all around and moving themselves as the sound moves. After the performance, everybody had a unique experience that included personal interpretations from those individual interactions in these two different listening modes. Each one of the participants was asked to answer the following question:

> Which space or spaces are evoking the sounds you hear spatialized in this room? Please describe the aural space in terms of memories, associations, shapes, textures, materiality, colors, sensations, feelings, emotions, architectures, elements, dynamics, and time.

At the end, a discussion group is formed to share experiences and sensations. The openness of the question aims to stimulate creativity when internally searching for the sensations experienced, without limiting the possibilities of imagination.

Creating aural spaces.

Thirteen people participated in the post-performance workshop. Most of the answers expressed the idea of a dynamic space that was not static but constantly changing, giving rise to the concept of temporal and morphing spaces from the fourth dimension. Participants described their experiences as follows:

> Sand spaces that were constantly being built and demolished. Over dimensional spaces. Overlapping spaces. Push and pull, close and far, personal and omnipresent. Different rooms with different sizes, stories, and sensations. The walls come close. A spacious space as the big bang. The space where the universe was born. An antigravity sensation, in between time and space. A transition from organic spaces toward mechanic environments, back and forth. Big empty spaces in a constant extension and contraction of space. The space was growing and shrinking. Atoms connecting to each other and changing in vibration. A futuristic city environment of space matter movement.[18]

Sound forms evolved around the concept of spatiality in relation to the listening experience of the performance. Questions about the presence of space through sound, perceived by the body, emerged through active listening. The answers indicated a dematerialization of space and a deconstruction of the static. This process produced various outcomes where space unfolded into abstract, morphing forms and evoked feelings brought together through the experience. Several participants connected the performance to a spiritual ritual with emotional implications, where the space became personal:

> A meditative space. A process where bad energies were swept away. A spiritual journey through different territories. Different relationships evolving between me and the space. All my inner chaos was projected outside, while being quiet inside in a calm space. Thoughts out loud. A dark place.

Sound stages the self to materialize spatiality through a spiritual subjective container. The body locates itself inside the mind-space of emotions, bringing the inner spaces of the most personal feelings to an auditory dialogue across the inside to the outside. However, the listener's framework of aural space experiences connected the emotional being with the singular object and material aspect of space. Participants associated previous sound and space experiences and imaginaries, often describing images such as:

[18] Listening session's results based on polyglot language (Thibaud 2001).

> A cave, a place made of rocks, a factory building, metal walls, the presence of water, fire, earth, and wind, waterfalls, underwater space, an old train, a highway, an airplane, a spaceship, interstellar space, a water cistern, a tunnel, shooting stars, rain, big drops.

The artistic experience of the sonic environment brought sound as a physical presence, which directly led to the creation of narrative elements that could compose stories for those aural spaces:

> I felt submerging in the ocean and constantly morphing. At first, the space was just sand, very dry, and over time, I went down until reaching a rock ground and crushing. Suddenly, I felt winded back to the surface, and the ocean was gone…

> In the beginning, I was in the ocean, the coast was close and rocky, the scenario evolved to a space where sound existed…

Illusory spaces.

In the phenomenological approach of the performance at the SSI, the process of acquiring knowledge from the space through sound spatialization was a transition from the sensations that the body received initially to the mental structures that shape the images perceived. This process involved mixing imagination with emotions, motivations, and previous beliefs about space and its sounds through memory. The materiality and formality of the aural space can only be defined phenomenologically in terms of representation and signification. Our sensible intuition reveals phenomena, which are not merely appearances but objects created and organized by ourselves through experience.

Space Dystopia performance was a perceptual experiment of illusory spaces created by sound, which in a profoundly sensory manner elicited inner elements from the self—not just sensations, but also emotions, impressions, feelings, and memories. The approach to the aural space always maintains a veil of mystery and indeterminacy, as the process of accessing this knowledge is through the deduction of what our senses offer. The elements evoked by listeners in their experience are part of the states of consciousness each of them possesses.

During the event, visual stimuli were minimized, deactivating the background or context, thus forging spatial and temporal experiences through aural perceptions. This phenomenon addresses the presence of the object in an invisible background, and since the object itself is invisible, the relationship between these elements exists only through personal images that

we create individually and collectively, forming an aural space. This aural space presents itself as an extraordinary, non-daily life experience, situating itself at the origin point of a "first time" experience, devoid of significations, preconceptions, or familiarity, akin to Deleuze's Body Without Organs (Deleuze and Guattari 2005); open to all possibilities of significations, free of the organs that could reduce it to a "particular something".

The aural space is never a defined concept but rather a creative process of perception—an experience that teaches us to observe our experiences, a phenomenon that causes us to doubt everything we thought we knew, a shot of reality constructed by ourselves, a reflection of who we are. The performance constructs a dimension of reality that put together unique sounds through multiple sensory interpretations, listening states, and spatial outcomes—an artistic action that engages both performer and listener in an infinite phenomenological process of revealing the aural space as a mystery that will never be fully unveiled.

Collective Listening.

Within the framework of the *Espacios Resonantes Festival*, which involved the artistic intervention of two industrial spaces, studied in Expedition #3: Quinta Bella Water Reservoir and Water Tower, a series of unstructured interviews was conducted individually with the audience. A total of 88 people participated by sharing their experience. The interviews were conducted right after each performance, which addressed the following question:

> Could you describe your listening experience in relation to how the interaction of sound and architecture affected you?

This methodology was applied exclusively to a selection of works using the deep listening method in live multichannel performances: *Presencias Intangibles*, *Soundfield for the Cistern*, *Acústicas Maquínicas, El Sueño del Conde, Partituras de Escucha* (Listening Scores), *Polyphono, Extraños (extranjeros (extraños(…))), Monumentos de Futuros Fallidos, Kraken, The Archisonic* (fig. 182).

Figure 182. QR Code: Album of the *Espacios Resonantes Festival*.

The question aims to explore the individual experiences of people regarding site-specific performances that engage with the acoustic space of the Water Reservoir and Tower, stimulating the space through diverse artistic practices. Through these individual aesthetic experiences, we can access the personal imagination of each person, thus recreating an aural space—the imaginary space of the mind triggered by traveling sound.

Figure 183. Word cloud from the 88 interviews (S. Balbontín 2024).

To analyze the interview responses, I used the technique of grouping the most repeated words into a word cloud (fig. 183), where some key words are observed for helping to interpret the subjective experiences of the audience. Some of these key words are directly related to accessing the inner universe: sensation, feel, experience, evoke, listen, body, imagination,

memory, remember, sense, mind, perceive. Other words detail how the experience was: enveloping, physical, auditory, different, shivering. Additionally, some words describe the characteristics of the aural space: create, resonate, vibration, visual, image, underground, sea, wave, water, underwater, texture, humidity, time, place, environment, intensity, resonance, transport, architectural, movement, moment, atmosphere, deep, soundscape, etc.

An aesthetic analysis was conducted to gather sensory information about space through aural perception and access the spatial imagination of assistants. In Table 6, the interview responses were organized according to a selection of five artworks: *Presencias Intangibles*, *Soundfield for the Cistern*, *Partituras de Escucha* (Listening Scores), *Polyphono*, and *Extraños (extranjeros (extraños(…)))*.

	SPATIAL IMAGE	TEMPORAL SPACE	SUBJECTIVE EXPERIENCE
PRESENCIAS INTANGIBLES	It evoked me something ambient, enveloping, immersive, movement, strength, agility, elements of nature such as the sea, water, an earthquake, tectonic movements, rocks colliding, catacombs, an old space in disuse, history and the years that have passed. A trance, of what I had already lived, memories, that made me return to other sectors of my mind. Mental spaces that I had in disuse and that were reactivated by the sound of the space. I experienced many visual images of my own imagination, an inner journey with colors and textures. The sound becomes a human body, aligned with the architectural body that coexist in synchrony becoming a single unit. I felt that things were being built inside the place, I imagined more organic structures or forms. At some point I thought the reservoir was going to fill with water. I felt like I was being wallow by a wave of the sea. A big speaker.	Sound waves crashing on the walls. Natural soundscapes shaped by the enclosure. Spatial differences according to the movement of sound. The pressure of the architecture, as an envelope, which conditions listening. Space is a relationship between sound, frequencies and the physical container. The sounds were coupled, while the shape of the space made the sounds resonate. Ubiquity.	Unique and interior experience. Immersive and enveloping effect. The fusion of sound and space generated different sensations. I felt surrounded by something warm. I went into a trance, I felt on drugs, I lost myself, I lost track of time and then I came back to the present. Some sounds rested on my body, while others penetrated my interior and that of the space. Strong, aggressive and violent sensation of uncertainty. At some point I felt myself drowning or sometimes just feeling the water. The reverberation, the frequency, the sound intensity were modifying these sensations.
SO	The specific vibration of the place builds reality, mixing form, height, location, where it is possible to recognize the physicality of	Humidity. Intensity. A dissociated journey. Spatial vibration. White	It was intense, I had never experienced such sensations. I was there,

UNDFIELD	the sound. When the vibration ceased, it left me floating in the air, to then return from the acoustic. The sound transported me to certain thoughts, memories of familiar stories, special effects from movies, a gong, a Tibetan drum, the idea of being inside an instrument. It was impressive the experience of a person's simple whistle on the other side of the place could be heard as if it was just next to you.	noise and echo, changing the perspective of space. Some frequencies generated a sensation of body and mind resounding. The sound and space was felt like if they were coming from behind, but then the sound circulated around. A rocking chair between vibrations and humidity. While entering into the silence and the intensity of sound, it felt like the water reservoir resonated deep inside the body at different intensities.	but at the same time I wasn't there, I was lost. It brought me to a climax then to relaxation. There were sounds that made me feel calm, but at the same time there were sounds that disturbed me.
PARTITURAS ESCUCHA	Architecture and sound complement each other. There is an expansion of the architectural and human body. Synesthesia; I tend to feel as if the sound events were going to impact me physically, as something corporeal and visual, a presence of something that has no body. For me it was immersing myself in the sea floor, in relation to the architecture that contained water at some point, that memory is still alive. A constructive experience, of light and darkness, that opens the way to the unconscious to build its own images. It allowed my mind to construct images that go beyond the visual; a world different from the one we live in. It evoked alien images, the sound of the universe, the sound of atoms. I began to create stories in relation to what I was hearing, horror movies, of sinking ships, or what would happen if the reservoir was filled up with water.	There were two experiences that I could highlight: the first one moving around and the second one lying down. In the latter, the sound felt like a phenomenon, like a spirit moving inside the place. The architecture made it resonate as something very strong. Similar to what I had heard in headphones with binaural sound, but taken to a spatial, multidimensional condition, the sound came from everywhere. Vibrant architecture. Humidity.	I felt physically vulnerable and threatened, in tension. At first it generated a lot of anxiety, but then when I was able to better understand the space, move, feel the sounds and relax, I was able to connect with the experience. The spatial sound allowed me to let go of my mind to surrender to the experience. My listening experience was expectant, very stimulating, at first over-stimulating. Sensations, not of drowning, but of intrigue of what was around and how people were interacting with the space.
POLYPHONO	It transported me to a place without any kind of substance, completely immaterial. It evoked an underground site, movement of structures, marine movements, birds. It recreated in me an environment of height, with different levels producing different sounds. The space was somehow completed through this sounds, denoting the space. At first I thought the height of the building was going to be lost in the darkness, but you could still visualize the verticality and height through the sound. There is an isolation	Different temporalities highlighting the space in vibrations.	Sensory, intimate, direct experience. A sonorous and visual experience that thrilled all the senses. Fascinating, a unique experience. A physical meditative state that was very pleasant, but then I went into a state of confusion, of being lost. A strange trip, but calm

	with the exterior, but still intervenes the interior. There was an interaction of textures and languages of the exterior with the sound and textures of the interior.		and welcoming at the same time.
EXTRAÑOS EXTRANJEROS	Union of both dimensions: space and sound. The space is an interface, which invites to inhabit the practice of sound. Industrial or mechanical spaces rules the scene. Superposition of layers of machinery. Metalic work spaces. The sound of space evokes situations that I have never lived, such as war, and I imagined how was to live that experience inside a bunker, with bombs exploding outside, while listening to everything what happens on the outside, but filtered by this underground space. Spaces of richness and depth, textures and soundscapes. At some point I felt that my head was constructing visual images from sound. For me it is very abstract, sounds inhabit a soul space that does not require a concrete and rational image, because there they can't exist. There was a tension of being on a threshold of being simultaneously in one place and in another. It evokes the stone, the church, the loneliness, a post-war feeling, a drained river, scenes from a movie. A domestic space, like the courtyard of my house, while I hear how the objects come to life.	I was very impressed by the architecture, especially by the atmosphere it generated through sound. Its temporality made me move from one place to another. The space plays with the sound as it expands throughout the place, building an environment that surrounds you. It is enveloping and associated with the sense of smell, the humidity of the place is present. I felt in front of something that I didn't know where I was but that was constantly moving.	It was an incredible experience, unique without comparison. An experience of reflection, stillness and expectation. The sound made me relax, it was very pleasant, like being on drugs, but without drugs. I felt in a kind of in-between sleep and wakefulness, as if I was about to fall asleep, but never falling asleep. The experience of being in confinement, but without fear, led me to the imagination, in a positive way.

Table 6. Deep listening interview results based on polyglot language (Thibaud 2001). All interviews were translated from Spanish.

Each spectator participated in the performances that took place within the water tower or reservoir. At the end of the session, they were interviewed. The interviews were analyzed in relation to three aspects: 1) the subjective experience, which refers to how people experienced the event; 2) the spatial image, which refers to the visual evocations that the experience triggered; 3) the temporal space, which refers to the dynamic nature of the aural space that is subject to time and has an ephemeral quality.

In this process, memory, bodily states, and emotions act together with imagination and sensations, translating the experience of spatial sound into a cognitive-creative map of a new space that is exclusively mental. The scope of these interviews and their analysis provides insights into the mental processes involved in the creative perception of aural space. However,

visual details of these mental spaces are difficult to access or recreate reliably. Rather than an exact spatial image, I appeal to the sensation of space that appears in the imagination, the cognitive processes generated by this creative act—whether voluntary or involuntary—and the associations that arise, while drawing mental maps.

Presencias Intangibles, Water Reservoir, 8.1.

A multichannel 8.1 concert featuring six compositions selected by open call was performed within the Quinta Bella Water Reservoir (fig. 184). Each composition lasted a maximum of 10 minutes and had a specific sound spatialization proposal. The call focused on creating auditory environments using multichannel sound composition. The objective of these pieces was to destabilize the material condition of architecture through aurality, creating sensorial architectures and simulated sound spaces.

Figure 184. *Presencias Intangibles* (F. Mardones 2022).

The compositions submitted by the artists offered critical reflections on architecture from its aural dimension, understanding sound as a material for constructing invisible architectures. In this concert, the audience was free to choose their position within the space. Each spectator was provided with a chair to place wherever they wished. The collective concert consisted of the following compositions:

(1) Alejando Albornoz – The Light
(2) Christoph Brunggel – Albigna
(3) Ilaria Degradi – Paisaje Marino
(4) Elen-Ira Panourgia – Birdnoise
(5) Julio César Palacio – Circular II
(6) R.H.A.S.P. – QJW3+GH Sintra

A first approach to the visual image of the aural space was its immersive and enveloping character, where the sound was not static but moved through the place with strength and agility, evoking movements of natural elements such as earth or water according to the timings and histories of the planet. Some of the interviews described these elements as earthquakes or telluric movements in the case of earth, and sea or waves in the case of water. In both cases, there appears a dynamic and temporal nature of earth movements that in turn builds soundscapes that envelop the body in sound pressure and resonance.

The spaces evoked by the performance and the constructed acoustic space draw a parallel between physical and mental spaces, often blurring the distinction between them. It's unclear whether these created spaces correspond to imagination or serve as a scanner of the mental space itself: “A trance of what I had already lived, memories that made me return to other sectors of my mind. Mental spaces that I had in disuse and that were reactivated by the sound of the space”. In this regard, the aural space is not a space distinct from the body, but is the body itself, converging with physical space through spatial sound: “The sound becomes a human body, aligned with the architectural body, coexisting in synchrony and becoming a single unit”.

The mental map that constructs the aural space often emerges from a trance state that isn't necessarily confined to consciousness, instead wanders between this one, the subconscious, and the unconscious. Many anecdotes describe the sensation of losing the notion of time or inhabiting an intermediate space between dream and wakefulness, where temporal and spatial rules unfold through other senses, different from the purely corporal ones.

Soundfield for the Cistern, Water Reservoir, 8.1.

Daniel Neumann developed a sound field composition tailored for the unique architectural and acoustic space of the Quinta Bella Water Reservoir, incorporating artificial tones.

All tones were generated on-site through improvisation with the space. He utilized a built-in software synthesizer, *Room Tone Generator*, to conduct experimental recording and feedback processes. For Neumann, *Soundfield* refers to the multidimensional listening space composed and discovered. In crafting the soundfield composition, sounds were projected into the three-dimensional architectural space using an 8.1 multichannel loudspeaker configuration. Through resonance and reverberation, various characteristics of the physical space were highlighted, articulated, transformed, fluidized, and fictionalized, providing a unique experience for listeners immersed within it. The physicality and materiality of the sound itself were emphasized and evolved over time (fig. 185).

Figure 185. *Soundfield for the Cistern,* Daniel Neumann (F. Mardones 2022).

The aural space that Neumann's performance created is primarily shaped by the vibration of space and bodies. Through vibration, reality is constructed, transforming sound from an immaterial entity into a tangible and physical presence that emerges during the performance and dissipates afterward. Here, interviewees often expressed the sensation of being inside an instrument, as vibrations activate the resonance chamber of the water reservoir, endowing them with tonalities and a musical character. Some interviews highlighted experiences akin to whispering galleries: “It was impressive how a simple whistle from someone on the other side of the space could be heard as if they were right next to you”. This phenomenon

dissociates real space into a different, intangible space that challenges form, matter, and physicality.

During Neumann's performance, the spatial sensation of the body and mind are intertwined in the space as a unified entity, a singular vibratory element. It feels as though the aural space emanates from the deepest core of the body itself, interpreted spatially by the mind through bodily sensations. The loss of the notion of reality is also recurrent, allowing for the exploration of alternative notions of space, which are not necessarily tied to dimensions and materiality, but rather to symbols that construct a dynamic and transient mental map shaped by the emotions of the moment. As one participant described, "I was there, yet at the same time, I wasn't there; I was lost. It brought me to a climax and then to relaxation. There were sounds that made me feel calm, but at the same time there were sounds that disturbed me".

Listening Scores, Water Reservoir, 8.1.

The spatialized concert *Listening Scores* is a collective performance featuring five sound pieces specially composed to be performed inside the Water Reservoir by artists invited and selected by the curatorial team. The listening score entails deep engagement with sound in a session where the audience becomes integral to the artwork, transforming their perception into a creative process of constructing aural spaces. The listening score comprises a series of instructions guiding participants through a narrative of the different pieces, detailing body positions and levels of attentiveness, inviting them to experience the concert from diverse sensory perspectives (fig. 186). The collective performance included the following compositions:

(1) Ce Pams – h2v02
(2) Thomas Gorbach – Modulated Resonances
(3) Nicolás Melmann – Fuera de campo
(4) Jaime Reis – Fluxus, pas trop haut dans le ciel
(5) Mark Vernon – Permea

The concert was conducted by me to guide the listening experience. It began with a deep listening meditation that immersed the audience in a state of mindfulness and sonic

awareness while seated in chairs. The first two compositions were experienced in this meditative listening mode. During the third piece, the audience was encouraged to stand up and explore the space, discovering how sounds were situated within it and the various effects the space produced through sound in an unpredictable dialogue. Before the fourth piece, attendees were instructed to select a fixed position within the space and listen exclusively from there. For the final piece, the audience was invited to pick up a yoga mat provided at the beginning of the concert and experience the performance while lying down. These different listening modes facilitated diverse listening experiences, enhancing interpretations and bodily sensations to experiment the aural space.

Figure 186. *Listening Scores* conducted by Sofía Balbontín (F. Mardones 2022).

As with the Event Scores introduced by Fluxus artist George Brecht, the Listening Scores represent a perceptual process that frames bodily actions in connection with the performance; "Thus conceiving of the Event as a liminal production between action and object, Brecht was perhaps attempting a kind of alchemy: turning time into space, or energy into matter, and vice-versa" (Ouzounian 2008: 144). While Brecht's Event Scores, involved participants receiving instructions on how to perform specific actions aimed at transforming space, the Listening Scores focused on the act of perception. While perceiving, the audience engages with a creative process alongside the performer, but instead, in a different aesthetic concept of art: a mental art.

Aural space is an expanded body that uses sound and space to enhance corporal presence and the impact of sound on the body. Thus, the human body dematerializes into sound and space; "a presence of something that has no body". Several interviews suggest that aural space is like a liquid or aquatic environment, like a fluid that envelops and touches you; "For me, it was immersing myself in the sea floor". The boundary between consciousness and unconsciousness blurs, allowing new entries of mental spaces; "A constructive experience of light and darkness that allows the unconscious to create its own imagery. It enabled my mind to construct images that go beyond the visual; a world different from the one we live in".

Figure 187. *Listening Scores* conducted by Sofía Balbontín (F. Mardones 2022).

The horizontal resting modality (fig. 187) from the Listening Scores brought greater diversification of interpretations to the spatialized sound, delving deeper into new mental states and potential visions; "There were two experiences that I could highlight: the first one moving around and the second one lying down. In the latter, the sound felt like a phenomenon, like a spirit moving inside the place. The architecture made it resonate as something very strong". These mental states often represent new levels of consciousness that we are not used to experiencing, bringing the subconscious or unconscious into consciousness. This can sometimes lead to resistance against the experience, which may even become unpleasant; "I felt physically vulnerable and threatened, tense. Initially, it caused a lot of anxiety, but as I began to understand the space better, move around, feel the sounds, and relax, I was able to

connect with the experience". Aural space becomes a mental space existing in an expanded consciousness that emerges through mindfulness and can reach peak experiences (Maslow 1964).

Polyphono, Water Tower, 10.1.

Polyphono is an instrument that dialogues with space through sound. The project starts from the premise of echolocation and acousmatics to build a system of communication with space. The objective is to create a spatial-sound dialogue from an auditory-luminescent experience that allows us to observe the modulation of sound through space. Through this sound-visual performance, the work of art is positioned as an executing entity and the space as a reactive entity, while the spectator's body serves as a receiver and creator of spatial sensations (fig. 188).

Figure 188. *Polyphono* by Sofía Balbontín (F. Mardones 2022).

Polyphono's aural space is an immaterial place, described as an underground site even though it is not. On the contrary, it rises 20 meters above the ground and the sound of its acoustics is governed by its height. The spatialized sound becomes a liquid mass, a moving flow, which, as an intangible presence evokes images of the earth in movement, structures in movement, sea in movement. The space at the beginning of the performance was completely dark; however, the sound spatialization system distributed through vertical levels, indicated

the verticality of the space through vibrations that ran up the space, expressing diverse temporalities: “At first I thought the height of the building was going to be lost in the darkness, but you could still visualize the verticality and height through the sound”. Some interviewees commented on feeling a state of confusion, which refers to an expanded state of consciousness similar to a meditative state. This state allows the person to get lost inside their mind, finding new mental spaces, from where the aural space emerges. The sound textures of the interior provided by the performance interact with the textures of the exterior soundscape, integrating and merging this one into an abstract mental map.

Extraños (extranjeros (extraños(…))), Water Reservoir, 8.1.

A performance developed by Misaa, and based on Tim Morton's *Dark Ecology*, proposed co-existentialist dialogue that seeks to evidence the infinite cycles that exist between the elements that constitute reality. In the process, the performer explored at different scales the implications of a sound generated on the top layer of the water reservoir and how its vibrations are capable of transmitting and altering other entities within it. These sympathetic relationships between objects are the cause of the resonances that will generate constant flows of sound, mechanical and electrical feedback within the space, where no distinctions will be recognized between object, instrument, and sound, but everything will be part of the same ecological system (fig. 189).

Figure 189. *Extraños (extranjeros (extraños(…)))* by Misaa (F. Mardones 2022).

In this performance, the physical space acts as an interface that connects sound with the body. As rhythms and percussive sounds were launched with automatic arms over the structure, the sonic imagination was ruled by mechanical spaces, bringing textured soundscapes into scene. The aural space could trigger stories with longer narratives than the performed sound piece; “The sound of space evokes situations that I have never lived, such as war, and I imagined how it was to live that experience inside a bunker, with bombs exploding outside, while listening to everything that happens on the outside, but filtered by this underground space”. The sonic environment triggers visually abstract images that spring from the spiritual space of the soul and transcend the rational stage of consciousness, delving into lost spaces of the mind. The acoustics, present in the space, awaken memory and imagination, inhabiting new spaces of the self that merge with the imaginary spaces of aurality as a single entity: “At some point I felt that my head was constructing visual images from sound. For me it is very abstract, sounds inhabit a soul space that does not require a concrete and rational image, because there they can't exist”.

This aesthetic experience is capable of triggering experiences close to teleportation or astral projections, where we can be in more than one place at the same time: “There was a tension of being on a threshold, of being simultaneously in one place and in another”, “Its temporality made me move from one place to another”. An altered mental state that some compare to the consumption of psychedelic drugs: “The sound made me relax, it was very pleasant, like being on drugs, but without drugs”. A journey to a place of the mind that transcends consciousness, to a parallel world of heightened perceptions capable of perceiving energies, waves, and particles that in normal states we are not able to perceive. That place beyond consciousness, that we associate with being asleep, it seems, as a necessary state of mind for creating the cognitive map of aural space; “I felt in a kind of in-between sleep and wakefulness, as if I was about to fall asleep, but never falling asleep”. This is how we are able to perceive the presence of an abstract living organism, which lives in space physically, but also lives within us: “I felt in front of something that I didn't know where it was, but was constantly moving”.

Aural Space as an Interpretative Tool (of Dematerialized Architectures)

The subjective interpretation of multichannel installations or performances, within site-specific acoustics, presents sound as embodied in multiple, diverse, and expansive aural spaces. The phenomenology of the acoustic experience arises from a mix of lived situations, personal behaviors, social schemes, and memories. The aural space becomes a dynamic entity with numerous relationships between material and spiritual sensations, past experiences, and future imaginations. It is a phenomenon that blends philosophical, metaphysical, cultural, and phenomenological expressions, merging symbolic and concrete realities. Aural space is a haptic and synesthetic tool of spatial interpretation, that creates a new reality, offering the self a unique set of sensory codes for interpreting meaning. Here, the artwork is a process of signification that seeks the audience as an interlocutor, a creative entity shaping an invisible world of sound. The phenomenological input in bodily performativity defines the art object as a temporal experience, creating simultaneous scenarios. As Labelle states, "…performances are organized around 'post-cognitive' understanding, creating work to be completed in the mind of the viewer/listener" (2015: xv).

In body-based installations and performances, such as the ones presented in this chapter, the sound stimuli become an active process of engagement with the self, with our perception, and imagination. It is an embodied act of bodily existence through aural perception, which is inherently subjective. In this embodied listening, body and mind become intimately connected, or as Merleau-Ponty states in his essay *Eye and Mind* (1964), body and mind become inseparable within the act of perception. According to Merleau-Ponty, art makes visible the invisible dimensions of experience. Considering his postulates, I argue that the audition and creation of aural spaces are not merely a psychoacoustic response but are embedded in memory, emotion, and imagination. It is the body that connects sonic spaces with the mind through aurality. This becomes a multi-sensory engagement through an immersive experience of space. According to Pallasma (2018), architecture is not just about building physical spaces but also about constructing experiences. In this regard, architecture should serve for haptic experiences and stimulating the senses, evoking the imaginative and poetic dimensions of space.

The temporal framework of the artworks presented in this chapter is usually relative, allowing listeners to interpret them on their own chronological terms. The performance, and consequently its aural space, proposes an aesthetic relationship between time and space through dynamic morphing spaces—a succession of different spatial sensations caused by sound. Here, space is no longer a physical entity but a temporal one; the aural space is a spatial perception of time. Space has its own metrical frames given by its physical morphology and by the concept of *ma*, turning the time of space into the space of sound. The artworks previously displayed usually avoid musical structures; instead, they are presented as a process, as the production of temporal objects which contrast spatial composition with musical form. The spatial succession of sound leads to the dematerialization and deconstruction of static space. The aesthetic experience of time is the experience of duration, with events unfolding over a certain continuity. This places the performer and the listener in a wave that flows and changes, losing the chronological notion of time. The spaces built by sound evolve through a qualitative process, as an achronycal continuum from their unstructured existence.

Aural space is shaped through creative cognition as an outcome of active and embodied listening to temporalities. The apperception—the consciousness of what we are perceiving—is a creative process of signification exercised by the mindful practice of deep listening. This practice opens a door to expanded states of consciousness, revealing new mental spaces where cognitive maps unfold. The exploration of these mental spaces merge with the production of abstract imaginary, releasing a creative outcome: the aural space, which unifies the body and mind with the sound space of the performance and the acoustic space of the site.

CONCLUSION

Reflections and Perspectives

Explorations.

This dissertation is the culmination of a process that formalizes my personal effort to organize all the artistic material, experiences, and reflections of the *Espacios Resonantes* project into a self-reinforcing rhizomatic history. It has been a wandering through the world, drifting in search of the physical presence of spatial-sound, as well as a conceptual journey through a fluid territory of ideas, concepts, and theories that have not necessarily provided concrete answers, but have positioned themselves as islands from which guidelines and courses of action are traced. Aural architecture is presented here as a lighthouse, illuminating this conceptual territory, and as a practice that has guided this exploratory, creative, and interpretative process.

The aesthetic experiences of aural architecture presented in this thesis embody an artistic form that rejects the *object* in favor of dynamic relationships among its components: space, sound, and experience. Exploring aural architecture is not only about extracting sound as a laboratory sample; it encompasses the expedition as a voyage of knowledge and personal interaction with various contexts, architectures, and atmospheres, each posing questions and revealing social, political, and ecological issues. Through the artistic practice of exploring sound in space, I have unveiled processes of decline that question the residual effects of "progress", contributing to a global decomposition of urban entropy.

When the production process no longer aims to create a specific product, but rather to sustain the system itself, consumption becomes focused on perpetuating production rather than its outcomes. This results in a system without an ultimate goal or life cycle; it perpetually grows without end. Furthermore, both nature and human essence are equated with production and industry, governed by an artificial system that contradicts natural order. Suddenly, we find ourselves in a territory of accumulated production waste, a useless, petrified landscape that resists conversion. This entropic process of residual territories is inhabited by industrial architectures like the ones presented in the *Espacios Resonantes'* archive, engaging in an

ongoing dialogue that blurs the boundaries between humanity and dehumanization, natural and artificial, to the point where they become indistinguishable. Thus, the project manifests itself as a creative catalog of the "new-ancient" situational acoustics of a dehumanized humanity. The modern ruins of Western society scream this capitalist failure through their acoustic voices; these empty spaces, once filled with extracted resources from past times, now resonate with echoes and reverberations.

The proliferation of decomposed material, a byproduct of capitalism, compresses time into mere seconds, erasing centuries and merging the past and future into an eternal present (Smithson 1966). To some extent, the relentless cycle of production materializes through the conversion of landscapes into productive zones, only to decay into desolate wastelands or monstrous industrial graveyards. These entropic wastelands are cities of the future in the present that emerge as condensed synopses of an unfolding extended reality. In the continuum of time, where the future converges with the present, entropy and evolution blend into a singular reaction. Despite their association with decay and human history, industrial relics stand as monumental testaments to uniquely colossal architectures. The more wicked the industrial objectives, the more pronounced their reverberant charm becomes.

This project rescues the voices of society's industrial waste found in these monumental resonant spaces, using them as artistic material for denunciation. Acoustics is presented here as a performative presence, essentially situated to configure semantic sense through its resonances, echoes, and reverberations. This semantic resonance acts by underscoring how embodied listening can articulate industrial voices as an acoustic agency. The acoustic power of these voices reflects human and non-human struggles represented in the dispute between ecological and posthuman perspectives, creating a place for spatial critique through the performative action of aural architecture.

Conceptualizations.

In the exercise of building the conceptual territory of aural architecture, I have encountered various practices and theories articulated around sound and space. These practices range from the spatial conception of the score and the volumetry of performance to the creation of

invisible spaces through sound spatialization or binaural listening; the creative practice of acoustic manipulation through architectural spatial design to acoustic manipulation through sound projection in space; the use of acoustics as an artistic material for the creation of spatialities to their transposition into virtual realities; and the arrangement of speakers for the construction of sound sculptures to the programming of moving sound for the creation of immersive experiences, among others.

This thesis presents a diverse repertoire of aural architectures. Each of the exposed practices represents a particular and unique type, which can emerge from the field of music, architecture, sound art, or from the most diverse crossings and possibilities of combinations between disciplines: architects who design spaces with sound, musicians who compose sound pieces with space, and artists who create installations with acoustics, to name just a few. Within this history of intersections, diverse formats, scales, and temporalities of aural architecture have been exposed; from technological installations to orchestral arrangements, from urban interventions to mental sculptures, from chronological pieces to timeless spaces.

Practices presented here have expressed different strategies to reformulate architecture from sound, such as Xenakis' piece *Metastaseis* (1954), whose graphic score is projected in the architecture of the *Philips Pavilion* (1958), while Varese's *Poeme Electronique* (1958), as the main inhabitant of the Philips Pavilion, projects its musical evolution towards the fourth dimension of space. Auditory experiences such as Leitner's *Headscapes* (1987) have dematerialized architecture into a mental construction through listening, while Amacher's sound interventions have reinterpreted architecture through her sound installation work *Sound-Joined Room* (1980). Similarly, Young's *Dream House* (1993) creates an environment made up of standing waves, where the body's movements engage in the listening action to articulate spatialities.

Therefore, the various practices become interrelated and mutually nourish each other. Lucier explores echolocation, which forms the theoretical basis of the formulations pronounced by Blesser and Salter (2009) to define aural architecture, while the acoustic response of space is also taken as artistic material in Neumann's work via the *Room Tone Generator* and the construction of spatialities through listening. Unlike Neumann, who seeks to build an auditory effect through sound and acoustic reaction, Daumal seeks to create this same

effect through architectural design and the reverberant effect of its morphologies. Conversely, listening, as an integral element of these practices, is exercised through meditation by means of *Deep Listening* proposed by Pauline Oliveros (2005). This listening mode generates diverse auditory effects, capable of being analyzed spectrally by tools for analysis of the aural experience, such as Smalley's *spectromorphology* (1997) or Augoyard and Torgue's (2006) repertoire of sound effects. These tools provide a more detailed understanding of the phenomenon of sound in space, mixing space, sound, context, memory, and gathering the semantic information that emerges from perception.

Diverse scales appear and juxtapose in a fractal process, ranging from the urban scale with the city orchestras of Llorenç Barber (1997) to the architectural scale with the sound spatialization system of Stockhausen in the *Spherical Concert Hall* (1970). Through interventions at the historical sites scale with Xenakis' *polytopes* (1967-1978) or Heide's installation *The Speed of Sound* (2007) in the Wasserspeicher, further reducing to the theater scale with the use of the *Acousmonium* (1974) by Bayle and Anette Vande Gorne's research lab for spatialization experiments. The design of reverberant tiny architectures like Hans van Koolwijk's *The Klankkaatster* (2010), or the creation of invisible architectures like Leitner's *sound spaces* (1971-1975). Finally, the scale of the head is explored through body-based installations, such as the CD album of Letiner's *Headscapes* (1987).

The different temporalities that confront the linear discourse of the musical experience, such as the orchestral composition of Xenakis' *Terrelektorh* (1966) oppose to atemporal experiences, such as Ganchrow's piece *Crescents* (2010) which intervened the Tallinn Hydroplane Hangar through the circulation of sound as a continuous and atemporal circuit. These different temporalities enrich the sonic diversity of the territory of sonic-spatial practices, transforming the discursive form of the musical narrative into a static sonic presence through the use of looped sound. Moreover, both types of temporalities integrate into the immutable continuum and infinite *sonic flux* described by Christophe Cox (2018), creating a sonic substrate of an eternal global background noise, a tonal basis for a history where temporalities transcend.

All these experiences, practices, theories, and ideas have been organized into a triad, where each one is associated with the sonorous, the acoustic, or the auditory dimension. However,

this attempt is not an absolute resolution but an exercise to situate these practices on a map. The proposed concepts of sound space, acoustic space, and aural space are not categories; they are zones of action where these practices can migrate, interchange, or relocate. The triadic scheme proposed here is not rigid but a flexible model, where concepts are not fixed in a category but are part of dynamic and malleable zones or regions. These zones can approach to each other, not only touching but also overlapping. Thus, each of these practices could be in more than one zone simultaneously.

This zonal triad—sonorous, acoustic, auditory—of which aural architecture is composed, blurs to draw a rhizomatic map (fig. 190) of an interconnected practical and conceptual territory. It is a network of practices and experiences that evolved from the Sound Space Rhizome into the Aural Architecture Rhizomatic Map; a non-hierarchical structure of independent and autonomous nodes that together form a system. This system is horizontal and expansive, with multiple entries, where new ramifications are constantly appearing and interconnecting. In this system, aural architecture and its constituent elements are presented as practices, phenomena, theories, representations, objects, methods, and experiences. Each entry is not necessarily one or the other but can be multiple elements with diverse meanings or address diverse natures simultaneously. Aural architecture does not have an exact definition but is delineated from a territory with a multiplicity of perspectives. Therefore, this concept and practice can be the starting point, the journey, or the final destination. The extensive terminology presented participates in this expansive system by integrating the parts of this puzzle. It does not pretend to reach a defined shape or size but to exist in an eternal process of construction, overlapping, and expansion.

Within this aural architecture rhizomatic map, all references presented converge to create a conceptual structure. Architecture, music, and sound art are part of the same territory, sharing methods and outcomes. This map is presented as a sonic-spatial ecosystem where different expressions, concepts, practices, and artworks come together to build a dynamic structure of relationships between artists, architects, musicians, researchers, theorists, etc. The lines in the diagram trace paths of communication between nodes. These nodes represent artworks, linking artists, and coupling concepts, representing the diverse species that

constitute the ecosystem. The diversity of artworks forms a fractal of varying scales and temporalities, provides biodiversity to the social and artistic complexity the map contains.

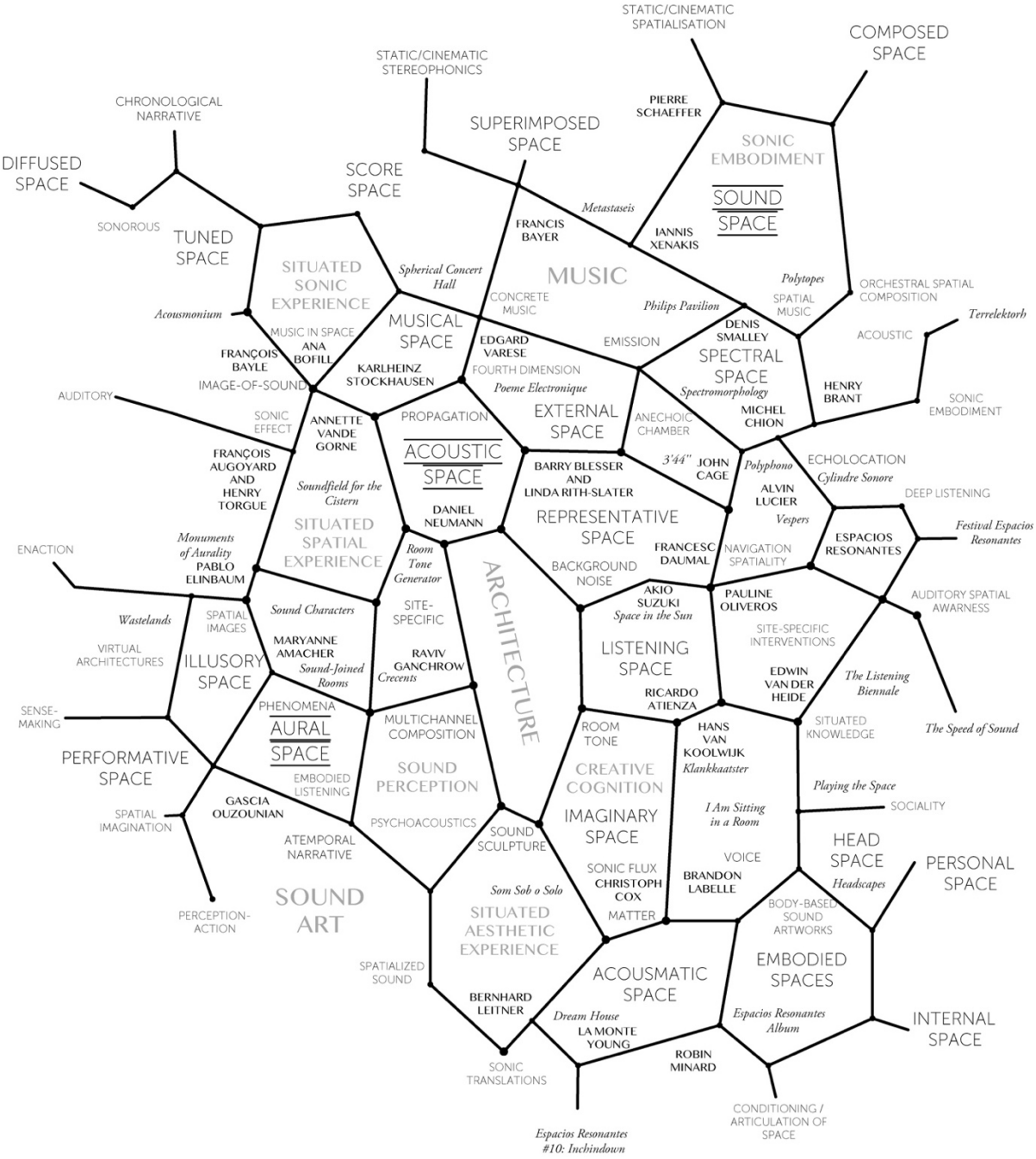


Figure 190. Aural architecture rhizomatic map (S. Balbontín 2024).

The ecosystem includes a process of internal recycling where disciplines take the residual elements of the others, to recover the value of certain forgotten or overlooked elements, forming a circular system that reinvents the artistic material, signifying it. This is how *Espacios Resonantes* rescues the residual sounds left aside by acoustic architecture—those sounds of space that acoustic architecture seeks to discard—and highlights them through artistic methodologies and aesthetic appreciation, placing these discoveries in a contemporary context of sound art. Each part of this system collaborates with the others, whether in practice or theory, phenomenon or material, abstract or figurative, playing an essential role in maintaining a horizontal balance within the system. This collaborative rhythm contributes to an expansive and continually evolving process, consistently incorporating new practices, theories, and artists in an ongoing evolution.

Practices.

My interest in aural architecture involves delving deeply into lived spaces, aiming to transform the auditory phenomenon of spatiality into a creative experience. In this process, situated experience serves as an artistic tool to develop aural architectures within a transdisciplinar practical methodology. These methodologies are presented in this thesis through phases of the sound phenomenon: emission, propagation, and reception. Therefore, aural architecture encompasses the invisible space shaped by sound emission, the sound filtered by the propagation space, and the spatial images produced through embodied listening within spatial-sound reception. Each of these phases constitute the dimensions of aural architecture—sound space, acoustic space, and aural space—playing distinct roles: sound space acts as a creative tool for developing artworks, acoustic space explores the propagation of sound within space, and aural space interprets sound to create mental architectures. Together and individually, these dimensions create the aesthetic experience of aural architecture.

The poetic and sensory explorations of aural architecture within *Espacios Resonantes'* expeditions offer a perspective that transcends the material confines of constructed reality. Through active engagement with industrial spaces and bodily experience, I uncover an acoustic world of reverberations and resonances, studying them to extract sonic material and

acoustic impressions. Using this material, I create artworks that engage with these acoustics, shaping aesthetic experiences for myself and others, inspiring the creation of imaginary spaces. This process involves moving beyond mere thought to explore different mental realms through deep listening, experiencing an expanded state of consciousness. By creating spatial sensations through sonic experiences, we can gain insights into the cognitive principles underlying how we construct our imaginary world. Drawing on autopoiesis and enactivism (Maturana and Varela 1980), this approach views aesthetics as a form of cognition manifested through action. These theories suggest that knowledge emerges from active engagement with the artwork and with space, prompting an exploration of how artistic expression structures perceptual-cognitive information from our surroundings.

When architecture is affected by sound, an auditory dimension of space emerges. The artistic practices presented in this thesis establish new interactions with spatial-sound and specific acoustics, creating a cognitive map accessible through embodied listening that unifies sound, space, and body. Through a creative practice of constructing *sound spaces* within the aesthetic realm of *acoustic space*, it triggers cognitive interpretations of *aural spaces*, shaping in this process, morphing and dynamic aural architectures by the artist's actions, sound propagation, and the listener's creative interpretation.

Espacios Resonantes utilizes the acoustic characteristics of industrial spaces to transform them into new aural architectures, where sonic exploration becomes an aesthetic practice in itself, refined as outcomes and interpreted as immaterial realities. This process acts as an agency that suggests the enhancement of modern industrial heritage. Through artistic action and the preservation of acoustic heritage, *Espacios Resonantes* reveals the spatial potential of these architectures, advocating for the conservation of their architectural value and their conversion into possible temporary or permanent cultural spaces.

Aural architecture is also presented as a tool of denunciation, revealing the entropic processes of our progress-oriented society through the collection of the modern ruins' voices. This unveils a parallel reality of decadence and decomposition that transcends human and social cycles. In this context, aural architecture detects symptoms inherent to the phenomenon of global extractivism that exceed the limits of human temporality, raising awareness about the entropic danger our planet faces.

The practice of aural architecture introduces new paradigms for the sensory acknowledgment and production of the contemporary world, challenging the disciplinary foundation of architecture as something purely material. In this context, the aesthetic experience of listening to architecture underscores the possibility of dematerializing architecture in a world where matter often seems superfluous. This contributes to the construction of new theories about human environments, incorporating sensory and auditory interactions as immaterial elements in the design process.

REFERENCES

Amacher, M. (n.d.)

Amacher, M. 2008. Psychoacoustic phenomena in musical composition: some features of a "perceptual geography". *Arcana III: Musicians on Music*. Zorn, J. (ed.) New York, NY: Hips Road. https://www.sonami.net/Articles/Amacher-OAE.pdf (Accessed July 10, 2024).

Amphoux, P. 1991. *Aux écoutes de la ville*. Lausanne : Institut de recherche sur l'Environnement Construit Ecole Polytechnique Fédérale de Lausanne.

Andersen, K. and Balbontín, S. 2019. Una experiencia de participación ciudadana en movimiento: La metodología de recorridos comentados por el campus de la Universidad de Magallanes, Punta Arenas. *Revista AUS*, 25: 32-40. doi:10.4206/aus.2019.n25-06.

Aristotle. 1995. Metaphysics. *Complete Works of Aristotle* 2. J. Barnes (ed.). Princeton, NJ: Princeton University Press.

Ars Acoustica, S. 2017. Edgard Varèse – Poème électronique (1958) [video]. YouTube. https://www.youtube.com/watch?v=JLDbBqHCslw

Arteaga, A. 2017. Embodied and Situated Aesthetics: An enactive approach to a cognitive notion of aesthetics. *Art and Research. Artnodes* 20: 20-27. http://dx.doi.org/10.7238/a.v0i20.3156

Arthur, R. 2014. Space and Relativity in Newton and Leibniz. *The British Journal for the Philosophy of Science* 45(1): 219-240. http://www.jstor.org/stable/687969 (Accessed August 3, 2023).

Ascione, P. 1991. La polyphonie spatiale. *L'Espace du son* 2: 68-74. https://www.musiques-recherches.be/fr/edition/la-revue-lien (Accessed August 3, 2023).

Asher, M. 1983. *Writings 1973-1983 on Works 1969-1979*. Halifax: The Press of the Nova Scotia College of Art and Design and The Museum of Contemporary Art Los Angeles.

Ashton, A. 2015. Armonografo. *Quadrivium*. J. Martineau (ed). Kerkedriel: Librero

Auge, M. 1995. *Non-Places. Introduction to an Anthropology of Supermodernity*. Trans. J. Howe. London: Verso.

Augoyard, J-F and Torgue, H. 2006. *Sonic Experience, A guide to everyday sounds*. Montreal: McGill-Queen's University Press.

Augoyard, J-F. 1978. *Les pratiques d'habiter à travers les phénomènes sonores*. Grenoble: Unité de recherche appliquée – Ecole spéciale d'architecture.

Augoyard, J-F. 2001. *L'entretien sur écoute réactivée*. M. Grosjean and J-P. Thibaud (Eds.) *L'espace urbain en méthodes* Marsella: Éditions Parenthèses. 140-141.

Bachelard, G. 1994. *The Poetics of Space.* Trans. M. Jolas. Boston: Beacon Press.

Balbontín, S. 2020. La experiencia sensible del paisaje sonoro frente a la catástrofe natural: el caso del tsunami del 27f en Caleta Tumbes, Talcahuano, Chile. *ACE: Architecture, City and Environment*, 14(42):1-23. doi: http://dx.doi.org/10.5821/ace.14.42.7007.

Balbontín, S. 2023. Arquitecturas invisibles: un escenario distópico de hibridación cyborg. *Revista de Comunicação e Linguagens* 59: 74-92. doi: https://doi.org/10.34619/e6oz-gacx.

Balbontín, S. 2023. La experiencia estética del sonido en el espacio. Un contraste filosófico entre espacio arquitectónico y espacio sonoro. *Revista Quintana: Revista Do Departamento De Historia Da Arte* 22. doi: https://doi.org/10.15304/quintana.22.8209.

Balbontín, S. 2024. Sound-space: a listener's creative outcome through an acousmatic performance at the Spatial Sound Institute, *Text and Performance Quarterly* 44(1): 32-48. doi: 10.1080/10462937.2022.2153910

Balbontín, S. and Klenner, M. 2022. El sonido emitido por el espacio físico y el espacio invisible construido por el sonido. *Revista 180* (49): 29-42. doi: http://dx.doi.org/10.32995/rev180.Num-49.(2022).art-854.

Balbontín, S. and M. Klenner. 2021. Espacios resonantes. Escuchar el espacio y habitar el sonido. *Revista Nodo*, 31(15): 51-66.

Barbanti, R. 2011. Ecologie sonore et technologies du son. *Sonorités, N° 6. Écologie sonore Technologies Musiques*. R. Barbanti and P. Mariétan (Eds.). Nîmes: Champ Social Éditions 191.

Basbaum, S. 2003. Sinestesia e percepção digital. Toronto: Subtle Technologies.

Bayer, F. 1981. *De Schonberg a Cage. Essai sur la notion d'espace sonore dans la musique contemporaine*. Paris: Editions Klincksieck.
Bayle, F. 1989. Image-of-sound, or i-sound: Metaphor/metaform. *Contemporary Music Review* 2(4): 165-170.
Bayle, F. 2008. Mi-lieu. *L'espace du son* 2: 133–37. www.musiques-recherches.be (Accessed 3 January 2024).
Blesser, B. and Salter, L. 2007. *Spaces Speak, are you listening? Experiencing aural architecture.* Massachusetts: The MIT Press.
Blesser, B. and Salter, L. 2009. Aural Architecture: The Invisible Experience of Space. *OASE* 78: 50-63.
Burchill, L. 2007. The Topology of Delueze's Spatium. *Philosophy Today* 51: 154–60.
Cage, John. 1968. *Silence: Lectures and writings*. London: Marion Boyars.
Callahan, D. and J. Casey. 2015. *Euclid's 'Elements' Redux*. Morrisville: Lulu Enterprises Incorporated.
Calon, C. 1988. Occuper le temps. *L'espace du son* 1: 49.
Campesato, L. 2009. A Metamorphosis of the Muses: Referential and contextual aspects in sound art. *Organised Sound* 14(1): 27–37. Cambridge: Cambridge University Press
Careri, F. 2002. *Walkscapes. El andar como práctica estética.* Barcelona, España: Editorial Gustavo Gili.
Casati, R. and J. Dokic. 1994. *La Philophie du Son*. Nimes: Chambon.
Casati, R., J. Dokic, and E. Di Bona. 2005. Sounds | Sons. *The Stanford Encyclopedia of Philosophy*. E. N. Zalta (ed.). Trans. A. Sousa Dias. https://plato.stanford.edu/archives/win2020/entries/sounds/ (Accessed August 3, 2023).
Chion, M. 1988. Les deux espaces de la musique concrète. *L'espace du son* 1: 31–33.
Chion, M. 1999. *Le Son*. Paris: Éditions NATHAN.
Chowning, John M. 1971. The Simulation of Moving Sound Sources. Journal of the Audio Engineering Society 19: 2-6.
Constant, N. 2016. *New Babylon. To Us, Liberty.* Rem Koolhas (ed.). Berlin: Hatje Cantz.
Cox, C. 2009. Sound Art and the Sonic Unconscious. *Organised Sound* 14(1): 27–37. Cambridge: Cambridge University Press. doi:10.1017/S1355771809000041
Cox, C. 2018. *Sonic Flux*. Chicago: The University of Chicago Press.
Cox, C. and D. Warner. 2017. Audio Culture: Readings in Modern Music. London: Bloomsbury Publishing Inc.
De Certeau, M. 1988. *The Practice of Everyday Life*. Berkeley: University of California Press.
De la Motte-Haber, H. 2023. Sound – Spaces – Fields – Objects. *Bernhard Leitner: Sound Space Sculpture. Catalogue raisonné.* N. Kratzer (ed.). Austria: Landessammlungen Niederösterreich. 447-450.
de Rennes.
Debord, G. 1967. *The Society of the Spectacle.* Trans. K. Knabb. Berkeley: Bureau au Public Secrets. 2014.
Debord, G. 1999. *Teoría de la deriva. Internacional Situacionista. Textos completos en castellano de la revista Internationale situactionniste (1958-1969) 1: La realización del arte. Internationale Situationniste* 1-6. Madrid: Literatura Gris.
Deleuze, G. 1968. *Différence et Répétition*. Paris: Presses Universitaires de France.
Deleuze, G. 1969. *The Logic of Sense*. London: The Athlone Press.
Deleuze, G. and F. Guattari. 1972. *L'Anti-Oedipe. Capitalisme et schizophrenie.* Trans. F. Monge. París: Les Editions de Minuit.
Deleuze, G. and F. Guattari. 1991. *Qu'est-ce que la philosophie?* Paris: Editions de Minuit.
Deleuze, G. and F. Guattari. 2005. *A Thousand Plateaus. Capitalism and Schizophrenia*. Trans. B. Massumi. Minneapolis: University of Minnesota Press.
Devereux, P., Jahn, R.G., and Ibison, M. 1995. Acoustical Resonances of Assorted Ancient Structures. *Journal of the Acoustical Society of America*, 99(2): 649-658.
Dewey, J. 2011. Art as experience. *Aesthetics: A Reader in Philosophy of the Arts*. D. Goldblatt and L. B. Brown (Eds.). Boston: Prentice Hall.
Duchamp, M. 1957. The Creative Act. *The Essential Writings of Marcel Duchamp.* M. Sanouillet and E. Peterson (eds.). London: Thames and Hudson, 1975. 138-40.
Duchenne, J. 1991. Habiter l'espace acousmatique. *L'Espace du son* 2: 84-86. https://www.musiques-recherches.be/fr/edition/la-revue-lien (Accessed August 3, 2023).
Dufourt, H. 1991. Timbre et espace!. *Le timbre, métaphore pour la composition*. Paris: Ed. Bourgois.

Farabet, R. 1991. Au commencement était l'oreille. *L'espace du son* 2: 61-67. Accessed August 3, 2023. https://www.musiques-recherches.be/fr/edition/la-revue-lien
Feld, S. 2013. Una Acustemología de la Selva Tropical. *Revista Colombiana de Antropología* 49(1): 217-239
Foucault, M. 1984. De los espacios otros. Trans. P. Blitstein and T. Lima. *Architecture, Mouvement, Continuité* 5. https://edisciplinas.usp.br/mod/resource/view.php?id=67995 (Accessed August 3, 2023).
Ganchrow, R. 2009. Hear and There: Notes on the Materiality of Sound. *OASE* 78: 70-81.
Ganchrow, R. 2011. Crescents. B. *Site of Sound: Of Architecture and the Ear.* LaBelle and C. Martinho (eds.). Berlin: Errant Bodies Press. 289-298.
Garza, M., et al. 2008. Arqueoacústica Maya: La necesidad del estudio sistemático de efectos acústicos en sitios arqueológicos. *Arqueología Mexicana*, 92: 24-29.
Gernsback, H. 1958. 400 Loudspeakers. *Radio Electronics*.
Gershon, W. 2013. Vibrational Affect: Sound Theory and Practice in Qualitative Research. *Cultural Studies <=> Critical Methodologies* 13(4): 1-6. https://doi.org/10.1177/1532708613488067 (Accessed August 3, 2023).
Gibson, J. 1986. *The ecological approach to visual perception*. New Jersey: Lawrence Erlbaum Associates.
Granger, G-G. 1992. *Formes, opérations, objets*. Paris: Vrin.
Gritten, A. 2009. *Sounds and Perception: New Philosophical Essays*. M. Nudds, C. O'callaghan (Eds.). Oxford: Oxford University Press. https://doi.org/10.1093/aesthj/AYS018 (Accessed August 3, 2023).
Guerin, F. 1991. Un espace mental à favoriser. *L'espace du son* 2: 129-132. https://www.musiques-recherches.be/fr/edition/la-revue-lien (Accessed August 3, 2023).
Haraway, D. 1988. Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective. *Feminist Studies* 14 (3): 575-599. doi: 10.2307/3178066. https://www.jstor.org/stable/3178066?origin=JSTOR-pdf (accessed 3 January 2024).
Harley, M. 1993. From Point to Sphere: Spatial Organization of Sound in Contemporary Music (after 1950) *Canadian University Music Review / Revue de musique des universités canadiennes* 13: 123–144. https://doi.org/10.7202/1014300ar (Accessed August 3, 2023).
Harley, M. 1997. An American in Space: Henry Brant's "Spatial Music". *American Music* 15(1): 70-92. Illinois: University of Illinois Press. https://www.jstor.org/stable/3052698 (Accessed August 3, 2023).
Heidegger, M. 2009. *El arte y el espacio.* Trans. J. Escudero. Barcelona: Herder.
Holl, S. 1997. *Entrelazamientos*. Trans. Gloria Bohigas. Barcelona: Editorial Gustavo Gili.
Husserl, E. 1931. Ideas: General Introduction to a Pure Phenomenology. Trans. W. R. Boyce Gibson. London: Allen and Unwin.
Ito, T. 2000. *Escritos*. J. M. Torres Nadal (Ed.). Murcia: CajaMurcia.
J.O. 1958. Le Poème électronique. *Radio et T.V.* 349-355.
Jenny, H. A. 2024. Cymatics: A Study of Wave Phenomena and Vibration. United States: MACROmedia Publishing.
Kant, I. 2005. *Crítica de la razón pura*. Trans. P. Ribas. Madrid: Editorial Taurus.
Kaye, N. 2000. Site-Specific Art: Performance, Place and Documentation. London: Routledge.
Kiourtsoglou, E. 2022. Tools of Immersion: Drawing the Acoustic Atmosphere of the Philips Pavilion, in *The Sound of Architecture*. A. Sioli and E. Kiourtsoglou (Ed.). Leuven: Leuven University Press. 161-175.
Krauss, R. 1979. La escultura en el campo expandido. *La posmodernidad*. H. Foster (ed.). Barcelona: Kairos. 59-74.
Kursell, J. and A. Schäfer. 2009. Spaces Beyond Tonality II: John Cage, Imaginary Landscape I. *OASE* 78: 96-101.
LaBelle, B. 2010. *Acoustic Territories: Sound Culture and Everyday Life*. New York: Continuum.
LaBelle, B. 2011. Room Tone. B. *Site of Sound: Of Architecture and the Ear.* LaBelle and C. Martinho (eds.). Berlin: Errant Bodies Press. 283-288.
Labelle, B. 2015. *Background Noise: Perspectives on Sound Art*. New York: Bloomsbury.
LaBelle, B. and Martinho, S. (eds). 1999. *Site of Sound: Of Architecture and the Ear*. Los Angeles: Errant Bodies Press.
Le Corbusier. 1953. *Le Modulor*. Trans. R. Vera. Buenos Aires: Editorial Poseidón.
Lefebvre, Henri. 1974. *La producción del espacio*. Trans. E. Martínez. Madrid: Capitán Swing.

Lefebvre, Henri. 2004. *Rhythmanalysis: Space, Time and Everyday Life*. Trans. S. Elden and G. Moore. London: Continuum.
Leitner, B. 1971. Sound, Architecture: Space Created Through Travelling Sound. *Artforum* 9: 44-49. New York: Artforum.
Leitner, B. 1978. *Sound: Space*. Stuttgart: Hatje Cantz Verlag.
Leitner, B. 2003. KOPFRÄUME. Karlsruhe: Edition ZKM/Ostfildern: Hatje Cantz.
Leitner, B. 2008. *P.U.L.S.E.* Ostfildern: Hatje Cantz Verlag.
Leitner, B. 2023. Deck Chair with four Speakers. *Bernhard Leitner: Sound Space Sculpture. Catalogue raisonné.* N. Kratzer (ed.). Austria: Landessammlungen Niederösterreich. 142-142.
Leitner, B. 2023. Headscapes. *Bernhard Leitner: Sound Space Sculpture. Catalogue raisonné.* N. Kratzer (ed.). Austria: Landessammlungen Niederösterreich. 330-333.
Lejeune, J. 1991. La forme dans le paysage (II). *L'espace du son* 2: 79-83. https://hal.science/hal-00096673 (Accessed August 3, 2023).
Licht, A. 2009. Sound Art: Origins, development and ambiguities. *Organised Sound* 14(1): 3–10 Cambridge: Cambridge University Press. doi:10.1017/S1355771809000028.
Lopez Cano, R.. 1997. *Música Plurifocal: Conciertos de ciudades de Llorenç Barber*. Mexico D.F.: JGH Editores.
Lucier, A. and Simon, D. 1980. *Chambers*. Connecticut: Wesleyan University Press.
Lynch, K. 1960. *The Image of the City*. Massachusetts: MIT Press.
Maclachlan, D.L.C. 1989. *Philosophy of Perception*. Englewood Cliffs, NJ: Prentice Hall.
Martinho, C. 2017. Exploring Aural Architecture: Experience, Resonance, Attunement. *Archaeoacoustics III.* 126-136.
Maslow, A.H. 1964. *Religions, Values, and Peak Experiences*. New York: Viking Press.
Matta-Clark, G. 2006. Gordon Matta Clark: Splitting the Humphrey Street Building. *An interview by Lisa Bear, May 1974. Gordon Matta-Clark Works and Collected Writings.* G. Moure (Ed.). Barcelona: Ediciones Polígrafa. 165-177.
Maturana, H. and F. Varela. 1972. *De maquinas y seres vivos*. Santiago: Editorial Universitaria S.A.
Maturana, H. and F. Varela. 1980. *Autopoiesis and Cognition: The Realization of the Living.* Dordrecht: D. Reidel Publishing Company.
McLuhan, M. 1960. Five sovereign fingers taxed the breath. M. McLuhan and E. Carpenter (eds.). *Explorations in Communication*. Boston: Beacon Press. 207-208.
McLuhan, M. and Carpenter, E. 1960. Acoustic Space. M. McLuhan and E. Carpenter (eds.) *Explorations in Communication*. Boston: Beacon Press. 65–70.
Merer, A. et. al. 2010. On the potentiality of abstract sounds in perception research. *Computer Music Modeling and Retrieval (CMMR).* 207-219.
Merleau-Ponty, M. 1964. *Eye and Mind*. In J.M. Edie (Ed.), *The Primacy of Perception*. Evanston, IL: Northwestern University Press.
Merleau-Ponty, M. 2012. *Phenomenology of Perception*. New York: Routledge.
Merlier, B. 2006. Vocabulaire de l'espace en musiques electroacoustiques. *DELATOUR France*: 230. https://shs.hal.science/halshs-00511746 (Accessed August 3, 2023).
Minard, R. 1991. La musique environnementale. In *L'espace du son* 2: 25-29. www.musiques-recherches.be. Accessed August 3, 2023.
Minard, R. 1996. *Sound Installation Art*. Graz, Austria. Robert Höldrich Institute for Electronic Music (IEM) the University of Music and performing arts in Graz.
Morton, T. 2016. *Dark Ecology*. New York: Columbia University Press.
Nancy, J. L. 2007. *A la escucha*. Buenos Aires: Amorrortu.
Newton, I. 1968. *The Mathematical Principles of Natural Philosophy. Newton's Principles of Natural Philosophy*. London: Dawsons of Pall Mall.
Norberg Schulz, C. 1972. *Existence, Space and Architecture.* London: Studio Vista.
Norberg Schulz, C. 1976. The Phenomenon of Place. *Architectural Association Quarterly* 8(4): 3-10.
Oliveros, P. 1999. *Quantum Listening*. London: Ignota. 2022.
Oliveros, Pauline. 2005. *Deep Listening. A Composer's Sound Practice*. New York, NY: iUniverse.

Oteri, F. J. 2004. Extremities: Maryanne Amacher in conversation with Frank J. Oteri. https://newmusicusa.org/nmbx/extremities-maryanne-amacher-in-conversation-with-frank-j-oteri/(Accessed August 3, 2023).
Ouzounian, G. 2006. Embodied Sound: Aural Architectures and the Body. *Contemporary Music Review* 25 (1/2): 69 – 79. London: Routledge.
Ouzounian, G. 2007. Visualizing Acoustic Space. *Circuit : musiques contemporaines* 17(3): 45-56. http://id.erudit.org/iderudit/017589ar (Accessed August 3, 2023).
Ouzounian, G. 2008. Sound Art and Spatial Practices: Situating Sound Installation Art Since 1958. PhD Thesis. University of California.
Pallasma, J. 2012. *Los ojos de la piel. La arquitectura y los sentidos.* Trans. M. Puentes y C. Muro. Barcelona: Editorial Gustavo Gili.
Pardo, J. L. 1991. *Sobre los espacios pintar, escribir, pensar*. Barcelona: Ediciones del Serbal.
Plato. 1872. *The Dialogues of Plato.* Trans. B. Jowett. New York: Charles Scribner.
Portevin, C. 1991. L'espace radiophonique : le son en plus. *L'Espace du son* 2: 55-57https://www.musiques-recherches.be/fr/edition/la-revue-lien (Accessed August 3, 2023).
Poulard, Gabriel. 1991. Sortir de la salle de concert. *L'espace du son* 2: 30-32. https://www.musiques-recherches.be/fr/edition/la-revue-lien (Accessed August 3, 2023).
Redolfi, M. 1991. Ecouter sous l'eau. *L'espace du son* 2: 41-44. https://www.musiques-recherches.be/fr/edition/la-revue-lien (Accessed August 3, 2023).
Rendell, J. 2006. *Art and Architecture: A place between*. London: I.B. Tauris Publishers.
Risset, J-C. 2005. Horacio Vaggione: Towards a Syntax of Sound. *Contemporary Music Review* 24: 4-5. https://hal.science/hal-00096673 (Accessed August 3, 2023).
Russolo, L. 1916. *El arte de los ruidos*. Trans. G. De Mola. Buenos Aires: Dobra Robota.
Sabine, W.C. 1923. Reverberation. *Collected Papers On Acoustics*. Cambridge: Harvard University Press. 3-68.
Schaeffer, P. 1952. *In Search of a Concrete Music.* Trans. C. North and J. Dack. Los Angeles: University of California Press.
Schaeffer, Pierre. 1966. *Traité des objets musicaux*. Paris: Editions du seuil.
Schafer, R. M. 1973. The Music of the Environment. *Occasional Journal devoted to Soundscape Studies* 1. Austria: Universal Edition.
Schafer, R. M. 1977. *The Soundscape: Our Sonic Environment and the Tuning of the World.* New York: Knopf.
Schafer, R. M. 1991. Acoustic Space. *L'espace du son* 2: 17-22. https://www.musiques-recherches.be/fr/edition/la-revue-lien (Accessed August 3, 2023).
Schumacher, F. and C. Fuentes. 2017. La experiencia de escucha acusmática: una propuesta de análisis integrado. *Revista Musical Chilena* 227: 108-121.
Smalley, D. 1997. Spectromorphology: Explaining Sound-Shapes. *Organised Sound* (2)2: 107–26. doi:10.1017/S1355771897009059.
Smalley, D. 2008. Spatial Experience in Electro-Acoustic Music. *L'espace du son* (2) 123-126. www.musiques-recherches.be (Accessed 3 January 2024).
Smithson, R. 1966. Entropy and the New Monuments. *Robert Smithson: The Collected Writings*. J. Flam (Ed.). Los Angeles, CA: University of California Press. 10-23.
Smithson, R. 1967. A Tour of the Monuments of Passaic, New Jersey. *Robert Smithson: The Collected Writings.* J. Flam (ed.). Los Angeles: University of California Press. 68-74.
Solomos, M. 2013. De la musique au son. Rennes: Presses Universitaires
Solomos, M. 2018. From Sound, to Sound Space, Sound Environment, Soundscape, Sound Milieu or Ambiance. *Paragraph*: 41(1): 95-109. https://hal.science/hal-01537609v2 (Accessed August 3, 2023).
Solomos, M. 2020. *From Music to Sound. The emergence of sound in 20th-and 21st-century music.* New York: Routledge.
Souffriau, A. 1991. Espace-support/Espace-Acousmatique. *L'Espace du son* 2: 76-78. https://www.musiques-recherches.be/fr/edition/la-revue-lien (Accessed August 3, 2023).
Stockhausen, K. 1958. Musik im Raum. Melos 25(47): 152-175.
Thibaud, J-P. 2001. La méthode des parcours commentés. *L'espace urbain en méthodes*. M. Grosjean and J-P. Thibaud (eds.). Marseille: Éditions Parenthèses. 79-99.

Thibaud, J-P. 2011.A sonic paradigm of urban ambiances. *Journal of Sonic Studies* 1(1): 1-4. https://hal.science/hal-00980746 (Accessed August 3, 2023).
Thom, A. et al. 1980. Megalithic rings: Plans and data for 229 monuments in Britain. Oxford: British Archaeological Reports. British series 81.
Thomas, J. 1991. Quelques propositions pour étudier l'espace imaginaire dans les musiques acousmatiques. *L'espace du son* 2: 142-146. https://hal.science/hal-00096673 (Accessed August 3, 2023).
Thompson, E. 2011. Living ways of sense making. In *Philosophy Today* 114-123. Toronto: Depaul University
Toop, D. 2021. *Resonancia Siniestra: El oyente como médium*. Buenos Aires: Caja Negra.
Torgue, H. 2006. *Le Sonore, L'imaginaire et la Ville.* Paris: L'Harmattan.
Truax, B. 1974. Soundscape Studies: An Introduction to the World Soundscape Project. *Numus West* 5: 36-39.
Truax, B. 1978. *Handbook for Acoustic Ecology.* Vancouver: A.R.C. Publications.
Truax, B. 2006. *Acoustic Space, Architecture and Acoustic Ecology.* International Cross-Disciplinary Conference Ryerson University, Toronto, Canada June 8-10.
Vaggione, H. 1991. Jeux d'espaces : Conjonctions et Disjonctions. *L'espace du son* 2: 119-122. https://www.musiques-recherches.be/fr/edition/la-revue-lien (Accessed August 3, 2023).
Van der Heide, E. 2011. The Audience Inside the Instrument. B. LaBelle and C. Martinho (eds.). Berlin: Errant Bodies Press. 283-288.
Van Leeuwen, T., W. Singer and D. Nikolić. 2015. The Merit of Synesthesia for Consciousness Research. *Front. Psychol.* 6(1850) doi: 10.3389/fpsyg.2015.01850
Vande Gordon, A. 1991. Espace et structure. *L'espace du son* 2: 127-128. https://hal.science/hal-00096673. (Accessed August 3, 2023).
Vande Gordon, A. 2002. L'interprétation spatiale. Essai de formalisation méthodologique. *Revue DEMéter,* 1-21. Lille: Université de Lille-3. www.univ-lille3.fr/revues/demeter/interpretation/vandegorne.pdf. (Accessed August 3, 2023).
Varela, F., Thompson, E., Rosch, E. 1993. The Embodied Mind. Cognitive Science and Human Experience. Massachusetts: MIT Press.
Varese, E. 1936. New Instruments and New Music. The liberation of Sound. In *Audio Culture. Readings in Modern Music.* Ed. Christoph Cox and Daniel Warner. New York: Continuum. 17-21.
Vielma-Cabruja, J.I., González-Viso, I. and Corvalán-Tapia, F. 2023. Arquitecturas inusuales: experiencias «otras» en la arquitectura y urbanismo, Santiago de Chile (1950-2020). *AS*, 41(64): 68-91.
Voegelin, S. 2010. Listening to Noise and Silence: Towards a philosophy of sound art. New York: Continuum.
Voegelin, S. 2013. Sonic Possible Worlds. In *Leonardo Music Journal* 23: 1-10, Cambridge: MIT Press Journals. http://mitpressjournals.org/lmj (Accessed August 3, 2023).
Watson, A. and Keating, D. 1999. Architecture and sound: An acoustic analysis of megalithic monuments in prehistoric Britain. *Antiquity*, 73(281): 325-336.
Westerkamp, H. 1988. *Listening and Soundmaking: A study of music-as-environment, master's thesis*. Vancouver: Simon Fraser University.
Westerkamp, H. 2002. Linking Soundscape Composition and Acoustic Ecology. *Organised Sound* 7(1): 51-56. Cambridge: Cambridge University Press.
Xenakis, I. 1958. Towards an "Electronic Gesture". Le Corbusier (ed.) *Le poème électronique*. Paris: Editions de Minuit. 226–31.
Xenakis, I. 1992. *Formalized Music*. New York: Pendragon Press.
Xenakis, I. 2008. *Music and Architecture. Architectural projects, text, and realizations*. Trans. S. Kanach. New York: Pendragon Press.

List of Artworks

Amacher, M. 1980. *Sound Joined Rooms.* [Installation] Abandoned house, St. Paul Minnesota.

Amacher, M. 1999. *Sound Characters (Making the Third Ear). [*Audio recording] Available at: https://open.spotify.com/intl-es/album/0dLjUdXurTKdje31efDbHr (Accessed July 10, 2024)

Amacher, M. 2008. *Sound Characters 2: Making Sonic Spaces.* [Audio recording] Available at: https://open.spotify.com/intl-es/album/3SiBs8AF1dObgipYqmmtuj (Accessed July 10, 2024)

Asher, M. 1970. [Installation] Pomona College Art Gallery, Claremont.

Atienza, R. and Sand, M. 2016. *Playing the Space.* [Audio recording].

Bayle, F. 1974 *Acousmonium.* [Acousmatic Installation]

Cage, J. 1953. *4'33".* [Orchestral piece] Maverick Concert Hall in Woodstock, New York.

Elinbaum, P. 2020. *Monuments of Aurality.* Available at: https://monumentoaural.cargo.site/ (Accessed July 10, 2024)

Ganchrow, R. 2010. *Crescents.* [Installation] Tuned City Festival, Tallin.

La Monte Young. 1993. *Dream House.* [Installation] New York.

Leitner, B. 1975. *Sound Chair.* [Installation]

Leitner, B. 1971-1975. *Sound Spaces.* [Installations] New York.

Leitner, B. 1987. *Cylindre Sonore.* [Architecture] Parc de la Villete, Paris.

Leitner, B. 1987. *Headscapes.* [Audio recording]

Lucier, A. 1969 *Vespers.* [Performance art].

Lucier, A. 2002. *Vespers and Other Early Works.* [Audio recording] Available at: https://new-worldrecords.bandcamp.com/album/vespers-and-other-early-works (Accessed July 10, 2024)

Lucier, A., 1969. *I Am Sitting in a Room.* [Audio recording].

Neumann, D. 2022. *Soundfield for the Cistern.* [Performance]

Oliveros, P., Dempster, S., and Panaiotis. 1989. *Deep Listening.* [Audio recording]

Stockhausen, K. 1970. *Spherical Concert Hall.* [Architecture] World Fair, Osaka.

Suzuki, A. 1988. *Space in the Sun.* [Architecture] Kyotango.

Tarkovsky, A. 1979. *Stalker.* [Film]

Van der Heide, E. 2007. *The speed of Sound.* [Installation] Wasserspeicher, Prenzlauer Berg, Berlin.

Van Koolwijk, H. 2010. *Klankkaatster* [Architecture] Muziekgebouw.

Varese, E. 1958. *Poème Électronique.* [Acousmatic Piece] Brussels International Exposition, Brussels. Available at: https://www.youtube.com/watch?v=JLDbBqHCslw (Accessed July 10, 2024)

Xenakis, I. 1958. *Interlude Sonore.* [Acousmatic Piece] Brussels International Exposition, Brussels.

Xenakis, I. 1958. *Metastaseis.* [Orchestral piece]

Xenakis, I. 1966. *Terrelektorh.* [Orquestral piece] Royan Festival, Royan.

Xenakis, I. 1967. *Polytope of Montreal.* [Installation] World's Fair, Montreal.

Xenakis, I. 1967-1978. *Polytopes.* [Installations]

Xenakis, I. and Le Corbusier. 1958. *Philips Pavilion* [Architecture] Brussels International Exposition, Brussels.

APPENDIX

Interviews with Experts

In the framework of the *Espacios Resonantes* project, nine interviews with experts in the subject of sound space and aural architecture were conducted, bringing together a group of architects, composers, sound engineers, artists, and researchers: Francesc Daumal, Anna Bofill, Bernhard Leitner, Brandon LaBelle, Pascal Amphoux, Mark Bain, Ricardo Atienza, Daniel Neumann, and Pablo Elinbaum. Interviews were conducted in Spanish and English.

Interview with Francesc Daumal, April 8, 2019

Sofía Balbontín: ¿Qué es para ti el espacio sonoro?

Francesc Daumal: En arquitectura se debe pensar el espacio sonoro de forma que sirva al arquitecto como un elemento de diseño. Espacio sonoro para mi sería el concepto que aúna el sonido y el diseño del espacio. Cuando un diseñador quiere que un espacio suene de cierta manera. Tiene que ver con la poética. Es un espacio representativo. Un espacio representativo es aquel que al entrar te sientes impresionado. Ha de ser grande, luminoso, reverberante en un sector e íntimo en otro. Que tenga resonancia, que no sea un espacio muerto. Todos los espacios deben tener una cierta reverberancia. Un hall de un ayuntamiento debiese tener una viveza a través de su reverberación. Para que el control sea mas representativo, la reverberación no puede ser medio segundo, debe ser más elevada. Pero si entras a un hall y quieres hablar con la secretaria, este espacio debe ser controlado, puede ser por ejemplo una doble altura, pero el gran espacio te recibe con una acústica especial. Cuando están acoplados los espacios se le llama "acústicas acopladas", es decir aquí se oye como resuena el gran espacio, pero me encuentro en un espacio íntimo. El arquitecto esta diseñando el espacio para que la gente cuando entre y se encuentre con esta importancia que tu le das, con un espacio reverberante, pero luego en la recepción, se encuentre en un espacio íntimo. No hay biombo ni nada, sino que la diferencia es acústica. Al ingeniero acústico le piden que haga el acondicionamiento del espacio. La reverberación es un aspecto del espacio sonoro. Un espacio sonoro puede sonar con un tono, es decir que tiene timbres determinados, lo diseño con ciertas dimensiones para que existan frecuencias estacionarias que coincidan con ciertos acordes musicales, porque yo puedo afinar el espacio con ciertos acordes. Entonces será una sala acordada. El espacio sonoro es el que esta diseñado para que suene con ciertos adjetivos sonoros. El espacio sonoro es aquel en el que existen ciertos adjetivos que permiten al diseñador del espacio definirlo sonoramente. ¿Como suena el espacio? El espacio sonoro siempre es parte de un contexto. El concepto de espacio sonoro, no es la acústica, no son los sonidos que emite el espacio, es el valor que se le da al contexto sonoro. Es un concepto interdisciplinar y está ligado al concepto de paisaje sonoro. Los parámetros con que se configura el espacio sonoro los da el lenguaje musical; reverberación, fuerza del sonido, el tono, el timbre, un crescendo o un decrescendo. Todos los conceptos musicales pueden ser traspasados al espacio. Cuando tenemos el lenguaje nos podemos expresar y podemos diseñar el espacio sonoro.

Mathias Klenner: ¿Se podría decir que la arquitectura tiene sonidos propios?

FD: Estos sonidos se basan en la forma y las proporciones del espacio, en los materiales utilizados en sus acabados y, fundamentalmente, en los medios de producción de los sonidos, o sea, las fuentes sonoras. El espacio tiene sonidos, sea interior o exterior.

SB: ¿Podrías explicar qué es la poética acústica?

FD: La poética acústica serían las intenciones que yo quiero para que el espacio sonoro exista. Y si no existe se puede rehabilitar para que vuelva a sonar acorde a lo que yo quiero que suene. La poética es cómo quieres tu vivir ese espacio o expresarlo artísticamente para que ese espacio sea de una determinada forma sonora. La poética es como yo quiero que suene y luego pienso en las herramientas que necesito para construir esa poética. La poética acústica tiene que ver con la arquitectura acústica, que tiene que ver con el diseño de como yo quiero que suene todo el edificio, cada sala, cada espacio. La poética son las intenciones y el diseño da herramientas para que estas intenciones se concreten.

MK: ¿Cómo se manifiesta el lenguaje de la arquitectura acústica?

FD: El espacio tiene un carácter y una personalidad. Ese lenguaje puede ser un espacio que te impone, que tiene una barrera, un espacio que tiene un filtro. En una carretera donde pasan vehículos yo puedo colocar una pantalla continua como una barrera o una barrera discontinua que actúa como filtro y que puede tener una intención musical rítmica. Yo puedo jugar con el carácter de los espacios. Un espacio simétrico sonoramente, donde yo me encuentre con dos masas sonoras equidistantes y de igual valor. Si me voy a los jardines de Versalles, veo el palacio al fondo, hacia un lado escucho la carretera y al otro escucho la naturaleza, esto es un espacio asimétrico sonoramente. El lenguaje se encuentra entre la personalidad y los adjetivos del espacio sonoro. Más con la adjetivación del espacio.

SB: ¿Cuál es tu experiencia en el diseño acústico que toma como base el itinerario acústico?

FD: El itinerario acústico se basa en convocar un grupo de personas, les colocamos una venda y las paseamos por la ciudad. Cuando hay un lugar ruidoso las personas piensan que pasa a escasos centímetros de distancia. Esta gente se comienza a dar cuenta de que cuando pasan frente a una puerta se oye el espacio del interior, distinto a si la puerta esta cerrada. Cuando hay portales, escuchas el sonido de la calle que entra en el portal y vuelve a salir, y sale matizado con las resonancias internas. Es como una flauta, según donde yo pongo dedos el sonido sale distinto, pues en la calle al peatón le pasa esto. Es posible determinar que tipo de espacios o edificios existen en la calle por como resuenan. Un itinerario quiere decir que voy diseñando todo lo que va ocurriendo en un recorrido. Voy tomando decisiones que afectan a la resonancia de los espacios que van conformando el recorrido. Si queremos diseñar un itinerario, es para que el peatón tenga una serie de experiencias. Consiste en una metodología que consiste en un equipo conformado por tres personas; una ejecuta el itinerario a ojos vendados, el otro es el lazarillo y el tercero es el que toma apuntes.

MK: ¿Cómo entiendes el cruce entre sonido y arquitectura desde el campo del arte?

FD: Desde John Cage con sus silencios, hacer una obra de piano sin tocar nada. El artista puede utilizar la arquitectura o no. El artista sonoro debe tener muy clara cual es su obra sonora. Si él entiende lo que es la acústica del espacio y las leyes que vinculan el sonido cuando hablamos de espacio, entonces él puede aprovechar ese espacio. Transformar el espacio para que suene a gusto para la obra que va a colocar ahí, y esta difícil, porque la obra comienza a competir con el sonido del espacio.

SB: ¿Cómo entiendes el cruce entre música y arquitectura?

FD: Se diseñan espacios para obras musicales determinadas, barrocas, modernas, sinfónicas, opera, etc. Incluso en la calle, donde los músicos encuentran espacios que suenan muy bien. En las estaciones de metro también a veces se encuentran buenos espacios y en las calles incluso la gente interviene con el sonido de los músicos. La música y la arquitectura siempre han tenido mucha relación. Hay una cierta rama de la ingeniería acústica especialmente dedicada a la música. Para ello existen diversos parámetros objetivos y subjetivos. El parámetro de la reverberación pareciera ser subjetivo, pero es totalmente medible y está categorizado para lograr una la reverberación optima, sea para la música de cámara o la música barroca.

Interview with Anna Bofill, May 21, 2019

Sofía Balbontín: Entiendo que su trayectoria creativa que explora la interacción entre arquitectura y música, se funda en un estudio del trabajo de Iannis Xenakis y en la generación de formas a partir de métodos matemáticos. Desde esa perspectiva; ¿cuál es el legado de Xenakis que podemos rescatar hoy en día para aplicarlo en el estudio de la música y la arquitectura?

Anna Bofill: Los sonidos como objetos es un pensamiento muy actual. Ahora con la electrónica se piensan los sonidos de una manera plástica. Se piensa en la música, como masa, como volumen y lo puedes trabajar como un escultor. Xenakis producía en su laboratorio música y arquitectura a través de un método arquitectónico musical. La materia es distinta, hay una especificidad, no es lo mismo que trabajar con algo solido o liquido o con la luz, no es lo mismo que trabajar con el espacio. La materia arquitectónica o urbana, es diferente de la materia del sonido, una percusión en el órgano auditivo, eso es lo que diferencia un campo del otro. Pero en cuanto a estructuras organizativas mentales están las matemáticas, la geometría y la lógica. La arquitectura es música petrificada, lo decían los griegos. Pitágoras era músico, arquitecto y todo. Para Pitágoras todo era números. Xenakis cree en esto y todo es construcciones lógicas, mentales, algebraicas, geométricas, o probabilísticas. Entramos en la teoría de la probabilidad que es la matematización del azar. En la materia esta la diferencia entre música y arquitectura.

SB: ¿Qué es para usted el espacio sonoro?

AB: El espacio sonoro es un espacio que nos rodea, pero que esta lleno de sonidos. Son estos sonidos que llegan al órgano auditivo. Es un campo magnético, de fuerzas. La física habla mucho de campo. La fuerza de la gravedad es la que rige no solo la tierra sino el cosmos. La relación entre los elementos del universo. La relación entre una masa y otra es la fuerza gravitatoria y que crean un campo gravitatorio que sería equivalente a un espacio sonoro. El sonido es un diferencial de presión en el oído que llega en forma de partícula. Que un campo sonoro espacial es semejante a un campo gravitatorio. Este concepto de espacio sonoro sería diferente a la convergencia entre música y arquitectura.

SB: ¿Cómo se manifiesta el lenguaje de la música en la arquitectura y viceversa?

AB: Hay un lenguaje común sobretodo cuando intentas describir la obra de un compositor, utilizas adjetivos que son también fundamentales en la arquitectura. Términos musicales que también son términos de la arquitectura: equilibrio, armonía, etc. Me cuesta diferenciar las cosas, soy muy holística. Es como si el sonido fuese una cualidad del espacio. Todo es espacio. Todo se reduce al espacio. Como

mamíferos, percibimos el espacio a través del sonido. Los artistas sonoros hoy son muy arquitectos. Están trabajando con sonidos que se mueven por el espacio, como fuerzas gravitatorias, están creando un entorno. El objetivo es estar en entornos, poder conseguir entornos habitacionales para poder estar. Queremos estar más que en un espacio, en un entorno que sea sumamente agradable, placentero, que nos diga algo, que nos hable. Los renacentista sabían crear estos espacios urbanos en el clima mediterráneo. Esos entornos bien adaptados al cuerpo humano, acompañados de sonidos especiales, no habría necesidad de ir a un teatro para conseguir sensaciones que construyen un entorno interesante.

SB: ¿Puede describir el método de diseño en arquitectura a partir de la música?

AB: Cuando hacía arquitectura tenía una matrix donde ponía todos los factores que tenían que intervenir: usos, necesidades, etc… cosas muy pragmáticas. La arquitectura tiene una utilidad, la música no sirve para nada, esa es la gran diferencia. La música no se habita, la arquitectura sí. Durante 10 años estuve estudiando un método de como crear arquitectura modular. Estuve investigando durante 10 años. La arquitectura modular es muy útil para hacer viviendas. Sobre todo la vivienda social o la vivienda a gran escala. Este concepto de arquitectura modular fue lo que me llevo a investigar sobre como producir grandes cantidades de viviendas unidas entre si, conjuntos habitacionales, a través de una metodología determinada. Esta metodología es esta generación geométrica de formas en el espacio a través de layers de composición que están basadas en la simetría. La simetría es parte de la geometría de los cuerpos indeformables, la simetría que conserva las distancias; las isometrías. Aplicando las 6 simetrías fundamentales (clasificadas por H. Weiss) a un elemento, en el caso del Walden este elemento era el cubo, puede generar cantidad de formas diferentes. Es un método generativo. Tienes un elemento y le aplicas una traslación (que es un tipo de simetría) y creas un cuerpo, entonces a partir de aquí le aplicas otra simetría (una simetría horizontal) y creas otro cuerpo. Por aplicaciones sucesivas por movimientos de simetría vas creando ciudades en el espacio. Se puede experimentar a través del software Mathematica. Es un software que a un cuerpo le aplicas la matriz para hacer traslaciones, para hacer giros, para hacer simetrías alrededor de un eje, de un punto. Es un proceso de generación automático que te da millones de formas diferentes. Esto mismo lo aplico a la música. Tengo autómatas musicales. Automatismo para generar música. El Walden, el módulo es el cubo. Este cubo yo lo lleno de sonidos. Estos procesos geométricos se producen igual con estos sonidos. Estoy haciendo una fuga. La fuga es un motivo que es como si fueran los sonidos dentro del cubo, un motivo al cual le aplicas unas traslaciones, en música una trasposición tonal, entonces la se traslada la misma relación interválica. Esta matriz es algebra vectorial. Con esta matriz se puede aplicar al sonido o a la forma. Se traduce de una disciplina a la otra. Este es un método geométrico, porque también esta el método de la probabilidad. Luego esto se pule a través del método sensorial. La creación artística es crear estructuras matemáticas, pero luego romperlas a través de la sensualidad, para crear sensaciones en el individuo.

SB: ¿Cuál es la relación entre la música y la arquitectura? ¿Cómo entiende el cruce entre sonido y arquitectura desde el campo del arte?

AB: Eso es inexplicable. Es solo talento. Lo que se puede explicar son metodologías, pero como romper esas metodologías tiene que ver con el talento. Entiendo el arte como la creación de emociones y pensamientos. La diferencia entre la música pop y la música culta como un tango, en la música pop la emoción llega a través de la memoria. Esa es la función popular de la música. La función de la música culta es a través del pensamiento. Una obra bien construida que repercute en mi inteligencia. Como decía Xenakis “la música es la más alta expresión de la inteligencia”.

SB: ¿Usted estuvo en el Pabellón Philips? ¿Puede hablar de la obra?

AB: Es algo muy personal. Cada uno recibe esta obra de una manera distinta. Incluso cada uno dependiendo del día le llega de manera distinta. La música tiene un aspecto que no se puede explicar que es el misterio. Cuando entre ahí tenía 14 años y yo no sabia nada de música contemporánea. Solo oía a Bach a Beethoven. Entramos y la gente se sentaba y se echaba en cojines por el suelo. Entraba un número de gente limitado. De pronto se comenzaba a escuchar esta música de Varese y comenzaban a iluminarse las luces lasers. Según los sonidos se accionaban unas luces u otras. Creo que había una relación entre el tejido que construían los lasers y el tejido neuronal que se construye en el cerebro. Quizás ese tejido eran inputs para que en el cerebro se formara una relación biológico. La música era multifonica que salía de muchos altavoces. Las luces salían de muchos puntos lumínicos. En algún momento mi cerebro conecta con esta trama sonora lumínica y mi cerebro conectó y se puso a vibrar.

SB: Usted aborda el tema del género en la composición musical; ¿existe una línea feminista en relación a la música y la arquitectura?

AB: Hay una corriente feminista sumamente importante en las dos disciplinas por separado. Yo escribí varios libros y elaboré además una guía de arquitectura y urbanismo con criterios de género. La teoría feminista aplicada al urbanismo es como hacer ciudades más habitables para todo el mundo. Esto es el urbanismo de género. En relación a la arquitectura es diseñar espacios no jerarquizados según el género. En la música hay una disciplina que se llama musicología de género y hay una teoría feminista aplicada a la musicología. Se han tipificado los movimientos musicales según si son débiles o fuertes, menores o mayores asociándolos a lo femenino o masculino. Se aplica femenino a lo menor y melancólico, y lo masculino a lo fuerte y brillante. Se ha calificado las melodías y cadencias siguiendo los tópicos de lo que es "masculino" y "femenino". El lenguaje musical esta lleno de alusiones a lo patriarcal descalificando lo femenino o de segundo grado para lo que es femenino. La tónica, la dominante siempre es masculina. El lenguaje es revelador. Por ahí va la teoría feminista.

SB: ¿Qué rol cumple la percepción dentro del estudio del sonido en el espacio?

AB: En acústica entra la percepción y la psicoacústica, pues en la arquitectura entran a participar todos los sentidos. La acústica es solo lo que percibimos a través del oído. La arquitectura se percibe con más sentidos; con la vista, con el tacto, con el oído. No existe una relación entre la acústica y la música/arquitectura. Hay una relación entre el foco sonoro y el auditor, que te va a hacer llegar el aspecto sensual del sonido. La sensualidad se expresa a través del tacto. Esta sensación del tacto se puede percibir en el espacio, se puede percibir a través del aire, a través de la humedad, y esto tributa al espacio circundante. La arquitectura interviene esa sensualidad.

Interview with Bernhard Leitner, May 27, 2019

Sofía Balbontín: Explain your work related to concepts of sound and space.

Bernhard Leitner: I studied architecture in Vienna and I was interested in avant-garde musicians because they experimented with space. One day I had an idea, when I left Europe for New York. I had the idea of building spaces, sculptural spaces with sound. I wanted to define sound as a material, as a building material. It was a very abstract idea. So, for two years I made theoretical research, and then from 1971 to 1975 I did practical research. I rented a space in New York where I tried different configurations, different constellations to understand what does it means that sound travels. This was

a very fascinating period because I discovered things that I didn't knew before. I understand that you don't hear only by your ears but also with the entire body as an acoustic sensor. In addition, I understand that the concept of space is quite different from an architecture conception which is static. Space in time has totally different concepts. The boundaries of these spaces, are not only going around, above and under you, but are going through you. In my work, these spaces are composed from smaller spaces. A cylindrical space consists of spaces that appear and disappear. After the whole composition, the space exists.

Mathias Klenner: Usually space is a dimension related to location, and sound is related to time. Your work seems to question those ideas. What does sound space means for you?

BL: That was the challenge. This concept is still not really defined. There is no language for sound spaces. There is a vocabulary for sound, for architecture, for sculpture, but there is no vocabulary for sound space. This was a real challenge. People didn't understand, so I had to use photographs, text, describe things. Today is much easier because sound is everybody, is available. 40 years ago, sound was not available. Today is available. Today you can do something with sound, you can form it, you have software, and you can work on sound as you work with wood. The technic development gives more possibilities. There are many artists doing things with sound. I always emphasize that I don't think as a musician. Our western culture has defined sound as music. I use sound, but sound is more than music for me.

SB: Did you extract information from acoustic architecture to develop your work on sound spaces? Do you think there is a relationship between acoustic architecture and sound spaces?

BL: I did inform myself from books about physics of sound and acoustics. Is a fascinating field, but is not my field. In my work I usually use acoustics depending the kind of space my sound object was placed, this space had acoustics. If I worked in a huge space, in a space with a long reverberating time, usually I had to change the concept.

MK: We can say that there is the sound that creates space and the space that creates sound. Can you explain how is the design process of the spaces built through travelling sound? And in the other way, what kind of architectures create sounds?

BL: At the very beginning I worked with movements of sound, but then the line was not a visual line, it was an acoustic line, a moving sound. It was about the motion of sound. Now this idea has changed. Different notions of acoustics have been integrated to my work. My sculpture called "Pulsating Silence" consists in two huge industrial metal sheets with a speaker under the sheet and with very low frequencies. These frequencies cannot be heard outside the sculpture, only inside, with your body. The two huge sheets project the vibration against each other, reflecting sound. For the first time, in this piece I am using sound not as a line, but as a plane. Material is used as a projector.

SB: You explain that at the beginning you worked with lines that draw space, so lines of sound can create a sensory space. Can you explain which of your reflections brought you to this conceptualization of sound space?

BL: A line is a series of points. Lines defines space visually. Lines of sound can define space. So, I just replace the points for speakers. I can call the primary space as the sound space and the secondary space is the concrete space. Architecture statements will call it the other way. The huge metal sheets of "pulsating silence" are very heavy, but the sound effect is completely different to the visual effect.

MK: The relation between music and architecture has mostly been about mathematical structures. Your work seems to create another connection. Which is for you the articulation point between music and architecture?

BL: Is very interesting the interrelationship through mathematics. But this is not my original idea. Is a material, is a sculpture, is an architecture tool. "Music and architecture" is something else. Xenakis is a very interesting composer. The Phillips Pavilion, had 340 speakers distributed on space, the sound moves around, but doesn't look for a geometry of sound. The space in renaissance times was a very important part of the musical composition. Now a days this is lost, unfortunately, because we lose the capability if listening. In renaissance, compositions were created for a specific place. If you hear the same composition in another place, it doesn't have sense.

SB: Which is the role of perception in sound space? How does the embodiment of sound create space through the sensory body?

BL: At the beginning I worked with very simple sound, because I didn't want to confuse the perception of sound. I wanted the brain to think first the space. No melody, no rhythm. The perception is a critical point of my work. There is a montage that I did in New York, an investigation with speakers and one person. Perception depends on how much you bring it with you to this dialogue of what you have to say as an artist. If you bring curiosity and some kind of knowledge with your body, there can be a very interesting dialogue. A dancer for instance could feel the sound moving around and through the body. It was very clear the consciousness of its body, and this was a very important aspect to understand if you are ready to listen something you have never heard, to start relating with sound, to start this dialogue. We hear with our skin. The physical wave transports a message. I investigated this movements of sound inside the body. Even talking to you I project my sound into your body. This sound waves are everywhere and go through us. I was very interested in this motion of sound within the body. If you have a speaker on below and a speaker above this cause different sensations. This are new concepts of directional space within the body.

MK: Can you explain in which way the visual material that complement your work is important for its understanding?

BL: What is shown here for the first time are these large graphics. Are related to the sculptural work, here the person and the body starts to dance. Dancing as sound space, by moving around. The models you see have the function to visualize what I have in mind acoustically. Visualize something which is not visual. Through the graphics you understand the language of sound space. What happens if you combine the language of architecture with the language of sound. It is a process, time-based art, this is the language of sound space.

SB: Besides perception, can we understand the sound space concept through a political or social dimension?

BL: I never said my work is political, but in a certain way, the challenge I take is political expression. The concept of sound space is a real challenge and for me is enough. Sound is so complex that is enough to focus only on that. Sound as a material is a new concept. In my early investigations you didn't have the tools to make the sound move. I did it manually, creating an instrument from space. Now a days, the whole development of technology makes sound available, but before it wasn't. Taking this challenge is a political posture.

I am not a composer, and people couldn't understand that I wasn't a musician. The importance of sound for us in this visual culture that is bombing us every day, is taking care of our acoustic sense as a very delicate thing. Sound spaces are interesting because listening is focus.

Interview with Brandon LaBelle, June 29, 2019

Sofiía Balbontín: On your book *Background Noise, Perspectives on Sound art*, in part 2: "Box with the sound of its own making: Form Gags to Sculptural Form" and in part 3: "I am sitting in a Room: Vocal Intensities" and part 4: "Public Supply: Buildings, Constructions, and Locational Listening" you write in different terms about the question of space and sound. Could you explain your work related to these concepts? What does sound space means for you?

Brandon LaBelle: Going back to background noise I was very much interested to develop this understanding of sound art as a field of practices so of course the work is very much focus on developing a historical and theoretical understanding on sound art and I think I approach that topic through the lens of space, architecture, urban experience, environment. So, I kind of propose in a way that sound art is a field of practices that understand sound as a spatial phenomenon, as a spatial possibility. So, the work that I developed is the idea of sound art and also the idea of space through sound. I guess at the end there is many different perspectives on that topic so as I already highlight from ideas of sculptural form, to ideas of voice, environment, ecology. So, the book does travels through these different spatial volumes from the object, sculptural voice and finally to environment, soundscape. Is a larger perspective. So is hard to capture a single idea about what sound space is, but of course is many things, and takes different forms, different expressions, different articulations. I can say generally speaking what I end up finding out through sound and space is this relational intensities, kind of dynamic relational possibilities of understanding space through sound. That relationality opens up a sort of space imagination of what architecture is from a sonic perspective. What happens to architectural space if you approach it through sound. At the end, for me is much about sociality and I understand sound space as a sociality. Finally, I am interested in social life. Sound and space are two things that are influencing and facilitating social life and the relationships we have and/or get involved. The work really moves in to an idea of sound art as a social practice and how space is part of that practice. Practioners are very aware of sound space as an entity as a phenomenal medium, and work with that to end up constructing sound spaces, kind of experiences of sound space. Tunning sound space to create experiences and inviting us to those experiences.

If we stay within the area sound art as a field of practices. What interest to me about sound art in relationship to architecture is that artists are very interested to upset architecture. Sound as a medium that can intervene within architectural environment and upset the stability and the geometry of architecture. Sound is a medium that can trouble architectural form and can also work with it, lead us to ideas of atmospheres or ideas of phenomenological vitality. Often, we can say in a basic way as a conflict, presume the dichotomy of something that is static and non-static. Sound is this very unfixed temporal moving thing that is in conversation with the form.

Sound is this temporal moving thing that is in conversation with the form. Sound space is this tension between time and space. Sound brings architecture back to life. Animated. Agitate it molecularly. Sound space is a strange entity of those two things coming together. A relational tension. So, concerning the question of scales, in the field of sound art, I have a practice that relates with the object that if I scratch its materiality, I am producing some kind of sound, in the way this object changes, the object is not anymore what is supposed to be, is materiality with certain properties that I start to understand sonically. This is very primary in sound practices to understand materiality as an

instrument. You can understand as the voice of the object, the object comes to life, is a moment where you understand that everything has a voice, the question of voice as something that is a very dynamic sound, that also starts to move away from materiality into the question of the social. Voice always is a social question. In terms of scales, is relationality in terms of social levels. So, from sociality you are in the topic of territory of politics, of urban life, of urban decisions.

SB: Do you think that the crossing line between music and architecture with sound and space are related? Which is the relationship? Which are their differences?

BL: Is right to make this two couples. A way to think about it is around the notion of composition. Compose sound in a way supposing sound is a raw matter that music cultivates into a cultural form, the same way architecture composes or organize space into a language. Space is the raw matter. Architecture is a specific capture of that. Sound and space agitating form, is another kind of dimension that brings us to another kind of experience, which is much more flexible and decomposed, as a decomposition. Brings us to another kind of space or dimension.

There is a desire to construct another kind of experience. Artists are really interested in derelict spaces, dysfunctional spaces, forgotten spaces. This open up what they are trying to construct which is a different kind of architecture and environment, that is related to the experience. Usually, artists are very interested in phenomenology from the sound perspective and the sensuality and the corporality and the being in the moment of that experience, that I think they have a feeling that architecture is too programmatic, too functional and the derelict space is already in the way to something else, this is much more alive in the textured, alive, in the moment, undefined.

SB: In your work from *Acoustic Territories,* you speak about acoustic spatiality, giving shape to a possible language that describe the relation of cultures of sound and listening. In this line, could you establish a possible language to describe or even define the possible relation between acoustic and spatiality? Please describe it.

BL: It is a language. I try to bring language into it. Through materiality and practices, social practices and everyday practices. In the book I move around different territories, from home, to street to the sidewalk. And each of those territories is defined by sonic material aspects, like echo vibration rhythm. Is a sort of sound space where I try to bring the question of sound onto very specific spaces and try to understand them together so how this acoustic territory really define as a sound space. The acoustic territory as an environment as a condition that is very much shape by sound. So, the language that I bring to that is to stablish acoustic spatiality as a sort of language through we might understand the world. So, each chapter develop a discourse so rhythm talking very much about of being in the sidewalk and the experience of walking. Acoustic becomes a way of speaking about questions of orientation. Is not even about sound, is the way we orient ourselves. So, rhythm is a way of orient ourselves. Acoustic is very much about location, how we become bats, where we can echolocate ourselves. Acoustic is about place, finding place and figuring oneself in places. So rhythm is a territorial practice. Echoing is vibration language for understanding ways of orienting ourselves.

Expand the idea of social practice to acoustic practices. We relate through the sound, maybe I don't necessarily have a relationship with someone but I can have an acoustic relation. So is about understanding sociality in this acoustic sense. That I may socialize with this object, so the materiality that surround as becomes part of sociality. Sound space as an expanded idea of sociality. That I relate to this wall when it becomes alive with sound and really touches me. So sound is a form of pressure. Then I have to deal with it.

SB: In your writings you have refer to some expressions of sound, such as echo, vibration, feedback, rhythm, silence, noise and others, terms used to reveal particular social narratives. In some way this can be a sort of a sound vocabulary to define some social actions or space actions. Can you make a reflection about this idea? Which do you think is the importance of developing a specific language or vocabulary to describe and define the concept of sound space and the acoustic situation of the social space?

BL: When I talk about vibration, is an acoustic language, acoustic relationship of how different communities or groups use vibration, or create kinds of vibrational forms through different musical expressions. Using the automobile as a particular spatial object, so the automobile is an extension of the vibrational base. How different communities, Mexican-American, Afro-American, youth groups, through the lens of hip-hop and rap music understand the automobile as a vibrational tool, even a vibrational weapon. So, fitting the car with a mega bass sound system to exacerbate this vibrational aspect, this becomes in a vibrational form. How that language carries a community system of values, the creation of identities by the vibrational form.

Transmission becomes how radio becomes a carrier of meaning, imagination, and articulates in different material forms. artists use frequencies, generators, to develop ideas of transmission and what transmission does, travelling through space, alien life, all this what transmission enables.

SB: In the same book you work out questions concerning sound and the built environment, the first as the fluid that give shape to the architectonic and urban space, which in turn make up the context for the social production of life. Could you explain how is materialized this connection and explain the role of sound in the production of space and social reality.

BL: Going back to these ideas of orientation, if we understand acoustic impacting our sense of orientation, how we figure ourselves acoustically, we can see that acoustic is a political question. So, what kind of acoustic decisions have come into this room we are now, and how these decisions impact on my capacity to feel myself here, to feel that I belong here, that can seat here, that we can feel safe or not. So those acoustic decisions are kind of political overtone, that I think they need to be thought about, reflected upon, so you can understand acoustics. Also, in the sense of belonging, or support, do we find support from the acoustic that surround us? Or does it threaten us? Or makes up feel we don't belong here? So acoustic enables the making and sharing of community, so these are political topics. How we intervene in our acoustic environments to enables voices to be heard, to enables community to be made? We have to think about acoustic support, acoustic struggle, acoustic economies. In acoustic territories I was leading to this idea of acoustic practice as a way of intervene and modulate our acoustic environments. To also recreate those acoustics or shift those acoustic decisions to give support to another kind of expression another kind of desire.

SB: In your writings you refer to sound as an important component for experience the place. This has to do with perception. Which is for you the role of perception for the concept of sound space? How do you think that the embodiment of sound create space through the sensory body?

BL: I don't know if its right to say that we start with perception, because perception is shaped by culture and language. I feel the field of sound there is often this relation to the body, this feeling of sensuality, corporality, being the ground. Sound enables us to bring the body to play, to activate the body, our perception of where we are. The experiences we have us a body. Perception it seems very central and I relate it very much, but I much moving towards the cultural and the social. I use perception but I bring it into the collective.

The subjective experience of the world, from our bodies, and needs to be remember and appreciate it from the differences that we have and share. Sharing our perception of things with each other. Often authors from the soundfield would start to speak in order to describe sound. This is how I am experiencing the sound; this is the only way I can describe it. Sound requires the subjective. You can't tell me about that wall until I experience it. Maybe this is also the difference between music/architecture and the sound/space, the objective and subjective.

SB: Besides perception, can we understand the sound space concept through a political or social dimension?

BL: For me is a very strong aspect. Going back to the scale, sound for me always carries this political dimension, even If I focus on the sensuality: How I hear that sound, how my subjective experiences are informed and shaped by my cultural background, in a way these things shape our capacity to hear some things and not hear others. We have an acoustic training, an acoustic education that influence how I hear things. What I am able to hear and what I am not able to hear. How I use my listening, where do I put my listening, how do I use listening to bring myself closer to certain things, or to encounter and negotiate differences in life. To what I am open to disturb my listening. The sound that is annoying, can I use that as an opportunity to relate it to something that I don't want. This is very important possibility within sound to develop a sort of agency and capacities to foster kind of relationships that can impact about ideas of social and political struggles. How can we use sounds to develop particular kinds of relationships? Or to challenge kind of relationships? Or to disagree, to demand, to be heard.

Sound is always situated, acoustically located. Is a relationality. People come together in space. We have to create these spaces to ourselves.

Interview with Pascal Amphoux, June 1, 2022

Sofía Balbontín: En tu investigación, abordas de manera más directa el concepto de mundo sonoro. Entonces, la primera pregunta sería saber a qué refieren estos dos conceptos de espacio sonoro y de mundo sonoro. Cómo se diferencian y cómo se vinculan.

Pascal Amphoux: La diferencia entre espacio sonoro y mundo sonoro radica en la noción del espacio en el sentido físico, de la materialidad, de la delimitación y de las características físicas del espacio. El mundo sonoro, por otro lado, es más metafísico. Se refiere a la diferenciación entre espacio, tiempo, uso, etc. Para mí, el mundo sonoro es una manera de dar nombre a una presencia que aún no existe, totalmente virtual. Es el mundo de la potencialidad de actualización. Se utiliza este término para diseñar algo que es metafísico, pero no en el sentido tradicional de la metafísica. Es antes de la actualización de una acción, percepción o conocimiento. Es muy interesante partir de la hipótesis de que existe una diversidad de espacios sonoros en la Tierra, diferenciados geográfica y culturalmente para un mismo individuo. Me parece interesante, desde un enfoque más especulativo y teórico, partir de la hipótesis inversa: que existe una unidad del mundo sonoro frente a un sujeto que es totalmente plural y diverso.

Hay dos posibles caminos para explorar la misma hipótesis. El primero consiste en asumir que el mundo es diverso, y que las características sonoras del espacio cultural en Lisboa, Lausanne o Shanghái son totalmente diferentes, mientras que el sujeto es único. Esta es la tradición cartesiana. El camino inverso sugiere que existe un mundo sonoro único y que la persona, el sujeto, es diverso. Una persona puede tener 10 personalidades diferentes en un día. Por ejemplo, ahora estoy contigo en Zoom, pero

hace media hora estaba en un bar discutiendo con otra persona, siendo otra persona. Esa persona no sabe que soy especialista en el espacio sonoro. Para mí, ambos caminos, ambos modos de teorización, son interesantes.

Entonces, la diferencia entre el mundo sonoro y el espacio sonoro es una diferencia de sentido y de camino epistemológico. Entre la hipótesis del mundo único y el sujeto diverso, o la hipótesis del sujeto único y el mundo diverso. No es el mundo el que es único, sino que el mundo se compone de muchos espacios.

SB: Entonces, Pascal, ¿podrías decir que el mundo sonoro engloba los diferentes espacios sonoros como también engloba las diferentes percepciones de los diferentes sujetos?

PA: Sí, en las diferentes culturas y geografías, me parece muy interesante decir que, en diferentes partes del mundo, ya sea en un contexto urbano o natural, son perceptibles los mismos efectos sonoros o las mismas características sonoras, independientemente de mi cultura sonora. Por eso la palabra "mundo" es interesante: no se trata de la diferenciación espacial entre las distintas geografías o culturas de escucha, que varían en la ciudad, en la naturaleza, en el campo, en América del Sur, en Europa del Norte, etc. El "mundo" sonoro se refiere al conjunto de efectos sonoros que se pueden escuchar en todo el mundo. Un "espacio sonoro", en cambio, está geográficamente y culturalmente situado. Sí, exactamente, situado.

Para mí, las tres maneras de escuchar son análogas a la diferenciación entre entorno, medio y paisaje. Estas son tres formas de actualizar una relación, un vínculo, entre yo y el mundo sonoro. Las tres maneras son, como decía, la forma de historizar con el entorno, y las diferenciaciones entre escuchar, oír y entender.

"Escuchar" significa que presto atención, que lo hago activamente, y es una manera muy analítica de escuchar. Identifico que es el sonido de una cosa u otra, de manera objetiva, buscando objetivar lo que escucho. "Oír" es exactamente lo contrario, una forma pasiva de escucha. Si aprendo el sonido de una cosa, lo reconozco al oírlo. Cuando digo que no entendemos, tú escuchas activamente y dices: "Ah, sí, sí, esa es la presencia del ambiente urbano". Aquí hago un movimiento de cambio entre la escucha media y la escucha ambiental, pasando de una relación medial a una relación ambiental, porque la manera de escuchar se convierte en activa. En cuanto al paisaje sonoro, en francés funciona muy bien, y en español también, porque "entender" tiene dos connotaciones: la fónica y la de comprensión. La confusión entre estas dos connotaciones es muy interesante, porque siempre que el paisaje suena a algo, tiene un significado. El sujeto es tanto interno como externo. Estoy dentro del paisaje y también fuera de él.

¿Por qué decimos que un paisaje es sublime o magnífico? ¿Es la naturaleza del paisaje la que produce este efecto en mí, o es mi proyección cultural y mi manera de escuchar lo que lo hace sublime? Son ambas cosas. El vínculo paisajístico es precisamente ese momento paradójico de identificación, conocimiento y percepción más pura. Posiciona el cuerpo en una postura que puede ser de meditación, contemplación o incluso de terror. La manera de escuchar se vuelve más paisajística.

SB: Cuando tú me hablas de estos conceptos de mundo sonoro, de espacio sonoro, son conceptos que defines a través de estas tres categorías de entorno, medio y paisaje sonoro. Todos estos conceptos se definen a través de la escucha, pero, ¿Por qué estos conceptos no tienen un término directamente asociado a la escucha? Es decir, el espacio de la escucha, o el entorno de la escucha, o el medio de la escucha, o el paisaje de la escucha ¿Por qué asociar el término al sonido, a lo sonoro, cuando el sonido tiene que ver con emisión, en vez de asociarlo directamente con la escucha, que tiene que ver con la recepción? Porque al final, cuando tú describes las tres categorías, las tres tienen que ver con la escucha y no con la emisión sonora.

PA: Exacto, exacto. Para mí, es muy importante porque creo que una gran dificultad surge cuando nuestros modelos son binarios, dispositivos de oposición. El punto de vista de la recepción frente al punto de vista de la emisión. Esta oposición es perjudicial, ya que genera una confrontación directa. Las tres maneras de escuchar, o modalidades de escucha, representan tres tipos de relación entre la emisión y la recepción.

El entorno es una forma de escuchar muy analítica, externa y objetiva, con la perspectiva de la objetivación de la acústica tradicional. Aquí se manejan criterios de calidad acústica. Suelo decir entorno, medio y paisaje, y la gente cree que son tres tipos de espacios sonoros. No es así; son tres maneras de escuchar la misma situación sonora. Puedo escuchar la situación en la que estoy como un ambiente sonoro, analizándola con instrumentos acústicos, identificando que es un automóvil e incluso determinando la marca, como un analista del entorno sonoro. Pero también puedo hacer algo completamente diferente y sumergirme en mi medio sonoro, dejando de prestar atención al automóvil porque estoy trabajando o conversando. En este caso, solo lo escucho pasivamente. O podría percibir que el automóvil que pasa ha creado un decrescendo justo cuando había un silencio en mi trabajo, lo cual me sorprende o maravilla, generando una percepción estética del sonido. Esta es una tercera manera de escuchar. En la primera forma de escuchar, realizo una reducción estrictamente acústica. En la segunda, adopto el punto de vista del receptor sin analizar el sonido del coche. La tercera es una combinación de ambas: un intercambio entre la emisión y la recepción.

En algunas teorías, digo que si la emisión está bien, el objeto que emite está bien, y el sujeto que recibe está bien. Pero también es crucial considerar el trayecto: objeto, sujeto y trayecto. Las tres escuchas representan tres formas de hacer y representar ese trayecto. Estas son representaciones teóricas del mundo sonoro, útiles no solo como herramientas de análisis e investigación, sino también para la concepción del espacio sonoro.

SB: Continuando con esta idea de categorización en base a la escucha, me gustaría pasar a la siguiente pregunta, que apunta a esta relación del espacio y del sonido desde una perspectiva más bien urbana. Cuando tu nombras las categorías de dimensión acústica, dimensión sociológica y dimensión estética, estás hablando conceptualmente también de diferentes escalas urbanas, una cierta diferenciación en magnitud de escalas territoriales que hablan de una urbanidad; ¿cómo se vincula la categorización del mundo sonoro con las diferentes escalas urbanas en términos de dimensión acústica, dimensión sociológica y dimensión estética? Y para complementar ¿Cómo vendría a ser la relación del espacio y el sonido a nivel urbano? y ¿cómo se reflejan en estas diferentes escalas?

PA: Para mí, hay que hacer algo que pueda ser universal, independientemente de la escala, del espacio de referencia, del espacio que hace el contexto de escucha. Por ejemplo, se pueden encontrar criterios de calidad acústica, sonora o fónica. Para mí, las tres calificaciones acústica, sonora y fónica son los tres tipos de calidad que corresponden al entorno, al medio, al paisaje. Las tres características, el tipo de características se puede escuchar, oír o entender. Eso es independiente de la escala y del tipo de contexto de emisión fónica. Al contrario, existe naturalmente en la ciudad tipos de espacios sonoros, de contexto de emisión sonora, que son contrastados y muy específicos a la situación de la ciudad. Por ejemplo, pienso en la característica sonora de la publicidad, de la comunicación, de la manera en que el sonido, la composición sonora de un contexto urbano genera un sentido de publicidad más fuerte o menos fuerte. Para oposición al criterio de privacidad, porque es un sonido que significa una apropiación más privada, etc. Son tipos de espacios urbanos que son naturalmente características que nosotros no hemos encontrado en otras partes del mundo, en otras situaciones.

SB: Aquí hay una diferenciación del objetivo. La acústica en relación a algo más científico, lo sociológico en relación a algo más simbólico y lo estético en relación a una percepción más personal y quizá relacionado con las emociones y lo artístico

PA: Sí, sí, exacto, exacto. Para mí, los tres son siempre un conjunto. Las tres formas de escucha son parte de la percepción general de todos. Es decir, mi relación con el mundo, mi postura corporal, no diferencia lo que es de orden acústico-físico, lo que es de orden sociológico, interacción social, espacio público, dimensión sociológica, de lo que es de orden de la percepción estética, que depende de mi cultura, de mi competencia de escucha, etc. Hay siempre estas tres dimensiones que son siempre conjuntas.

Pero a menudo, cuando hablamos de medio ambiente sonoro, decimos que son los acústicos los que se ocupan de eso. Y por lo tanto, hacemos muros de anti-sonido en las autobuses, doblamos las ventanas en el espacio doméstico, aislamos las cosas. Pero se pierde completamente la idea de que la ventana es un medio de comunicación entre dentro y fuera, es también una interacción social. Cuando puedo abrir o cerrar la ventana, la abro un poco menos porque hay demasiado ruido afuera y me perturba en el interior. Pero me modulo a mí mismo para tener un equilibrio. Y lo hago sin reflexionar, pero empiezo a abrir o cerrar la ventana para componer mi propio paisaje sonoro.

Al mismo tiempo me protejo acústicamente y al mismo tiempo mantengo un mínimo de relación social. Son siempre estas tres cosas en conjunto. Y según las situaciones, una dimensión puede tener más importancia que la otra. Si hay demasiado ruido, la dimensión acústica se va a primar. Pero siempre existirá la cuestión de poder comunicarse con alguien afuera o tener un mínimo de interacción social. O siempre habrá el hecho de tener un paisaje sonoro que sea, en el plano perceptivo. Porque si no, estoy en un oficio completamente aislado y la atmósfera es terrible. Cuando el acústico, el sociológico, se convierten en el estético, es una catástrofe. Y por eso me interesa este modelo de tres dimensiones. Porque prohíbe separar las cosas. Obliga a pensar las cosas juntos.

SB: ¿Cómo defines un posible lenguaje para el mundo sonoro desde la apreciación, la percepción y la escucha?

PA: Para mí es muy importante la investigación sobre la manera de inventar nombres para definir las características acústicas o sonoras, o sónicas. La distinción que hace Murray Schafer sobre soundscapes, que son hi-fi o lo-fi, para mí no es pertinente desde un punto de vista antropológico. En mi caso, es totalmente independiente de la manera en que la persona juzga la calidad de la situación sonora. Cuando digo calidad acústica o calidad sonora, no es calidad en el sentido positivo o negativo. Es una característica. Es una manera de dar vocabulario para describir el mundo sonoro. En el mundo visual, si digo que es simétrico, que es rojo, o que es grande, no digo que sea bien o malo. Una arquitectura simétrica no es mejor que una arquitectura disimétrica, o que el rojo no es mejor que el negro, etc. Por lo contrario, digo simétrico y son características espaciales, visuales, que son herramientas de concepción.

Son elementos de concepción que son neutros, que no tienen valor en sí. Esa es la idea que nos ha llevado a desarrollar repertorios de conceptos, criterios o caracteres cualitativos para definir las cosas independientemente de la manera en que las personas juzgan la situación. Es muy importante porque en el mundo visual existe un vocabulario muy rico. En el mundo sonoro no hay vocabulario. Nosotros diseñamos el sonido con el nombre de la emisión, del objeto emisor. Es imposible hacer una composición, hacer una concepción de un espacio sonoro con esto.

SB: Cuando yo te pregunto a ti sobre el espacio sonoro, tú me respondes que es la relación física del sonido y el espacio. Sin embargo, cuando pensamos en arquitectura aural, pensamos en la escucha del espacio arquitectónico. Según tu teoría del mundo sonoro y de las diferentes escuchas, ¿has considerado criterios con respecto a la arquitectura aural?

PA: Creo que es una cuestión de grados, de problemáticas de gradación. Por ejemplo, si yo pienso en una arquitectura aural, específicamente en una sala filarmónica, por ejemplo, es un estudio muy escrupuloso de las distancias, de la problemática del eco, de la performance acústica del espacio arquitectural, que es perfecto. Pero si la dimensión acústica es muy importante, también lo será la capacidad de esta sala de absorber los ruidos parásitos para hacer la posibilidad de una postura medial, una postura de oír, y no interrumpir los pequeños ruidos en la sala para que no sea interrumpido por algo que es del orden del medio sonoro.

Tiene que haber un mínimo de reverberación que neutralice las cosas. Creo que incluso en estas situaciones, los tres escuchas siempre son co-presentes. Y las propiedades acústicas de la sala deben desaparecer para que pueda entrar una escucha pasajera, una escucha estética. No tiene que tener la impresión de que estoy en un lugar de performance acústica para poder entrar realmente en la música. Tal vez tomaría el ejemplo de un estudio de registro, un estudio para registrar a la radio, etc. Es totalmente absorbente.

En un iglesia, la arquitectura aural es, intencionalmente, una expresión del poder, del poder divino. O en la aula de la universidad del XIX siglo, esa es una gran aula, con el auditorio, con el parquet, las mineralidades, y también tendrá una gran reverberación. Esa es una expresión del poder de la universidad, del saber, etc. También es una manera de implicar el cuerpo de la gente que viene de esta arquitectura en una situación, en una postura muy específica. Porque luego, esa es la iglesia, la matriz del dios, y luego hay que escuchar la música, y luego hay que hacer una conversación tranquila en un restaurante, etc.

Entonces, creo que la preocupación de la fabricación acústica del espacio arquitectural es siempre intencional. Que sea voluntario o no voluntario. Pero es siempre la expresión de un relato antropológico al lugar, de una cierta forma de sociabilidad, de un cierto tipo de interacción social que va a ser favorecido o desfavorecido en ese lugar por la atmósfera acústica y también que va a permitir o no tener una postura pasajera que es más del orden de la percepción.

SB: Considerando que siempre hay una intención de parte del arquitecto, para crear estas atmosferas; Hay posibles maneras de cómo interactuar con esta arquitectura aural. La primera tiene que ver con la acústica, y con la ingeniería acústica, donde yo evalúo el espacio de acuerdo a su reacción, pero desde variables acústicas. La segunda, sería estudiar las prácticas sociales que se dan naturalmente, y cómo reacciona la acústica a esas diversas prácticas sociales. La tercera, sería a través de la práctica artística, y cómo yo puedo apelar a un estudio de la arquitectura aural, pero desde una perspectiva estética. La parte acústica se conoce bastante, la parte social yo sé que es tu fuerte, sin embargo la parte artística es algo más ambiguo; ¿cómo crees tú que la práctica artística podría rescatar información valiosa con respecto a la arquitectura aural desde una perspectiva estética?

PA: Creo que es siempre una cuestión de grado. El artista busca producir efectos sensibles. El objetivo del artista es poner a la gente, al cuerpo, al colectivo, a la persona en una situación de meditación, de contemplación, de activación de una auto-reflexión sobre la percepción. Naturalmente el artista puede intervenir con todas los herramientas acústicas y técnicas que son posibles, pero va a tener que tener una perspectiva estética. Las herramientas conceptuales son los mismos para mí y son los mismos que para un arquitecto o un diseñador, alguien que diseña el espacio. Él artista tiene las herramientas acústicas, tiene las herramientas antropológicas, porque si yo decido mover una entrada, por ejemplo, la entrada en una sala, el movimiento de la gente será diferente y el movimiento del grupo puede interactuar con la situación. Esa es una manera de influir en las interacciones sociales entre las personas.

Después, naturalmente, la composición fónica y musical toma protagonismo, pero también como una instalación en el espacio público, etc. Por ejemplo, recientemente, un artista hizo una exposición en Suiza con un mural integral compuesto por 800 piezos, cada uno con un sonido único a una

frecuencia diferente. Se creó un ambiente fónico muy interesante debido a la gran superficie de emisión diversa, pero el sonido era muy suave, creando un ambiente extraordinario. Además, había una gran sala donde se instaló un mural con una foto que absorbía el sonido, y la imagen más importante del espacio público se proyectaba en el suelo, generando una reflexión muy significativa. Era muy interesante porque se trabajaba con tres planos de emisión, reflexión y absorción. La gente llegaba de diferentes partes del espacio y percibía de manera distinta la misma integración.

Esto es una reflexión sobre la arquitectura aural, como una superficie de reflexión o absorción. También es una meditación sobre la composición cuasi-musical con emisión diferencial de frecuencias aisladas. Esta reflexión también aborda la interacción social, ya que el espacio fónico en una sala física influye en el comportamiento de las personas. Creo que el artista tiene una mayor conciencia de estas tres formas de escucha que el ingeniero acústico o el arquitecto ordinario. Ellos suelen ver el problema del espacio fónico como un tema técnico, pero no creo que la interacción social sea indiferente si el ambiente acústico varía. No pienso que se pueda ignorar la escucha artística, etc. Para el artista, normalmente hay una mayor sensibilidad hacia esta comunicación entre las diferentes formas de escucha.

SB: Para poder definir este concepto de mundo sonoro, tú desarrollas un sistema de categorización tipo taxonomía. Las formas de investigación comúnmente tienden a la categorización, y a través de la categorización se logra definir un nuevo concepto, que en este caso sería el de mundo sonoro; ¿crees que existe otra forma de definir un cierto concepto sin entrar en un sistema de categorización estructurado?

PA: Entonces, es cierto que creé un dispositivo de una taxonomía fractal. Significa que la diferenciación entre las tres formas de escucha surge de una aproximación empírica, basada en entrevistas a muchas personas que escucharon pequeñas secuencias grabadas de diferentes situaciones urbanas. Esta es la metodología de la escucha reactiva; le preguntas a la gente sobre su ambiente sonoro, a menudo te dicen que hay demasiado ruido o que es como música, ya sea buena o mala. Entonces, nosotros recurrimos a grabaciones sonoras. Hacemos pequeños fragmentos sonoros y se los damos a escuchar a diferentes personas.

Entonces, ellos reconocen e identifican cosas y tratan de entender el ambiente sonoro. Ya no hablan de ruido o de música. Identifican muchas cosas. Cuando un psicoanalista, un historiador, un acústico, un músico, una persona común y un habitante del lugar registrado dicen lo mismo sobre un fragmento sonoro, identifican el mismo momento en el fragmento sonoro, entonces se puede decir que hay algo, una característica en ese momento que se puede objetivar. Aunque son personas muy diferentes (psicoanalista, persona común, acústico, etc.), encuentran un punto común. Entonces analizan lo que dicen y nombran un criterio. Así es como inventé los criterios del Mundo Sonoro.

Luego, al identificar los tres tipos de escucha con ese material empírico, me di cuenta de que personas muy diferentes pasaban de una postura a otra. A veces decían algo de un orden estético y luego algo muy funcional. Así surgieron tres maneras de escuchar los registros sonoros que habíamos creado. Estas tres maneras se convirtieron en el modelo. Luego pensé que si tomo, por ejemplo, la escucha ambiental, en realidad tengo tres principales aspectos: cosas que hablan del espacio y del tiempo, cosas que hablan de la materia sonora y cosas que hablan de los efectos semánticos y culturales. En esta escucha ambiental, el espacio-tiempo está más relacionado con el análisis y la escucha activa.

El sentido, los criterios semánticos y culturales están más vinculados a la interacción social. La materia sonora está más relacionada con la estética y la percepción. Entonces, las posiciono en el contexto ambiental, medioambiental y paisajístico. Luego, cuando aplico ese criterio, hago lo mismo para encontrar otros aspectos. Así, hay una especie de regla donde los tres tipos de escucha atraviesan todas las escenas del dispositivo de criterios. Entonces, el modelo de tripartición, los tres modos de escuchar, se convierte en un regulador transversal para construir un dispositivo taxonómico que de alguna manera es anti-taxonómico.

Porque en cada escala de representación del sistema de criterios, se juega con la diferenciación entre los tres. Por lo tanto, una taxonomía no tiene que ser piramidal, como la tradición del siglo XIX. Es una taxonomía fractal. Esto significa que un concepto solo se puede definir si hay una representación con la posición de los tres conceptos en un nivel más fino de representación. Así se puede crear una perspectiva algo rizomática. Es una manera de evitar una definición monovalente de cada concepto. Cada criterio, concepto o nombre se define por su posición con respecto a los tres tipos de escucha. Así, hay tres características más finas y tres características más generales. Las más generales son: ambiente, medio y paisaje.

Y siempre es esta estructura la que regula la definición de los nombres. Por eso no solo es un instrumento de análisis, sino también de concepción. Porque la concepción, ya sea una invención o creación artística o de cualquier otra naturaleza, es una manera de articular las tres relaciones con el mundo.

SB: Pascal, última pregunta. Considerando el modelo del mundo sonoro basado en este sistema de clasificación fractal, y también considerando esta idea de posible definición o categorización del espacio a través de la práctica artística; ¿Crees que la experiencia estética, podría transformarse en herramienta de la práctica artística y de investigación, capaz de construir un sistema de clasificación no tradicional, en este caso más enfocado al espacio sonoro o a la arquitectura aural?

PA: Para mí, la postura artística es naturalmente una forma de privilegiar la dimensión sensible, la dimensión de la experiencia sensorial. Si eres artista y te preocupas por el espacio sonoro, para crear el espacio sonoro, no puedes ignorar los criterios acústicos. Debes utilizar las habilidades acústicas. Y también debes tener en cuenta al público, la sociedad, las personas a las que te diriges. A menudo, lo hacemos de manera implícita en la concepción. Pero si analizamos el proceso de concepción, es una forma de relacionar estas tres orientaciones. La entrada principal es la estética, pero es una estética que moviliza lo acústico o la interacción social. Esa es su entrada principal. Pero para el acústico, reflexiona sobre problemas acústicos, etc. Tiene que ser una entrada dominante respecto a los efectos que tendrá sobre la interacción social o sobre la estética fónica.

Para el sociólogo o el antropólogo, sí, analiza las interacciones sociales y la relación de cómo el sonido modifica, interactúa, aumenta o disminuye el nivel de publicidad del espacio. Pero también tiene que pensar en relación con las propiedades acústicas físicas que generan resonancia sonora, repetición y todas esas cosas. Y también en las percepciones estéticas, porque aunque las personas sean seres sociales, también tienen una percepción sensible que varía según la cultura, ya sea nacional o internacional, y la cultura profesional también.

Porque, bueno, en el caso de personas con discapacidad auditiva, si no tienen esa barrera, entienden mucho mejor. Este modelo permite a cada especialidad reconocer que la entrada principal es estética para el artista, pero debe activar aspectos acústicos, porque escucha activamente, y también los efectos que va a inducir o producir en términos de interacción social, efectos colectivos, etc. Por ejemplo, conocer la gran diferencia entre una obra para un museo, una galería o una situación específica de arte contemporáneo, y una obra para un espacio público. El problema es muy, muy diferente. En un espacio público, las personas son totalmente independientes de una obra de arte.

SB: Recuerdo que cuando estuve en Cressón tú una vez me dijiste que la muestra de personas preferentemente tenían que ser personas que pudieran tener una concepción del objeto de estudio en términos un poco más elevados, es decir, que pudiese existir una conexión profesional de esas personas hacia el objeto de estudio.

PA: Es muy importante entender que cada persona tiene una percepción individual, personal. No es seguro que tu percepción sea la misma que la mía. Si estamos en la misma situación de escucha,

podemos compartir o sentir una emoción común. No sabemos si la percepción es la misma, pero la situación de percepción es totalmente compartida. La problemática del artista es cómo generar situaciones en las que la experiencia común sea posible. En las que lo compartido de la experiencia sea inevitable. Es maravilloso porque no sabemos si la percepción es la misma, pero el momento es compartido. Esa es la estética. La estética no es una percepción subjetiva. Es completamente una condición de experiencia intersubjetiva. La emoción no es físicamente la misma, pero situacionalmente es la misma.

Interview with Mark Bain, Novemeber 28, 2022

Mathias Klenner: How do you relate with the concept of sound space in your work? In our research we have found that sound space is a concept related much more to musicians. And then aural architecture is a concept much more related, of course, with the architecture field. I know that you come from a family of architects, and that's why you relate to that.

Mark Bain: In a way it was sort of becoming like... my grandfather was an architect, then my father was coerced to be part of my grandfather's firm. So, I think back in the late 50s he started working there. And then he became one of the leaders of the company, and so between that and my other grandfather being an engineer for Boeing airplanes, and then other relatives being architects also. I had a lot of this around me all the time. I remember going on vacation with my father and my mom. It would always be vacations related to architecture. And then my father would only really take pictures of buildings rather than the family. And he taking pictures of buildings. Maybe somebody might be in the corner of the picture, in the building behind them or something. I was always sort of studying it, but then, I think because I had a twin brother who was studying architecture full on, I wanted to do something different. I didn't want to also be an architect. So, I was always kind of working around, on the periphery of that expertise, I guess. I was also at the same time playing bass guitar in bands and things. Those related to music and also low frequency music. So, in a way I sort of made a merging of these things. When I was in undergraduate school, I was doing a sort of kinetic spatial machines. Like machine constructions that were kind of sculptural, but then they kind of engaged space. So, it was a kind of motion architecture you might say. After, when I went on to graduate school at MIT I was dealing mostly with sounds of structures, and putting energy into buildings with oscillating mechanics and things like this. In a way people would refer to me as an anti-architect. But at the same time my father was my number one supporter.

Sofía Balbontín: What do you think about architecture in terms of structures? Because you somehow deconstruct these structures with sounds. How can you explain this connection with architecture through the reconfiguration of the structure? In a vibration for example.

MB: All materials have a certain resonant frequency and a certain quality to it. In a way is like sounding the building, just like ringing a bell. Only the building is your bell. When you ring a bell, you hear the molecular structure of the bronze and the metal that forms that bell, and also the shape of the bell, and how it reflects sound. I think with these machines that I design or the sensors systems I use. It's about defining that structure in another term. It's not necessarily just a pictorial or a linear concept, but more like an emotional concept, or a feeling of space. Dealing with the materiality of it somehow. And also, the spatial qualities of how things reflect in space. So that's one thing a lot of people don't understand when they go into buildings.

SB: Is it a way of representation of the space? Or is it a way to understand space? Or is it a way to design space?

MB: No, I think I'm letting the space design the sound.

MK: You play with the space, and the space is like another instrument. But you're having a dialogue with the acoustic vibration of the air, when architecture is a container of that. But in some of your pieces the instrument is the actual vibration of the whole structure. Not only the air.

MB: It's locating a sort of a tension that's within the material itself. It's the materiality of the location, and the objects you might say that references the sound. It's a characteristic of all the elements together: the space, the acoustical space, the material space, the way the molecular structure impacts each other, the impedance of material. So that's also one element, and then of course the instruments that I'm working with: sensors and things that inject frequencies, and of course the artists and the audience. In a way, it's like trying to create an acoustic glue. To connect the audience to the material of the building itself. That's why it's nice to not have like sit-down shows. Some areas can be really strong and some areas can be not so strong. That's why I think it's much better when the audience can have freedom of movement, to sort of locate the space on their own terms.

SB: I think there is a fact that things are built in a way. Let's say this house is mixed in this way, it's a building with concrete and everything, and you are somehow extracting these states of the architecture, and bringing another conception of the structure of the architecture. For example, in Chile there is a lot of earthquakes. When we have one, we can experience architecture in another way, in motion. Every space moves different. Every building has its own movement. Also in your work, architecture starts to be alive, and you start to give motion to the architecture, and suddenly this architectures changes. It's not anymore, a building as we know it. Like decomposing the original meaning of each architecture to other possible meanings.

MB: When I was living in Los Angeles, I experienced pretty heavy earthquakes. The one in 94 actually. With earthquakes you kind of know when it's going to happen. The big one will happen because a lot of times you'll have pre-shocks, like little earthquakes leading up to the main event. I remember the main event. I was in a wooden house with a friend of mine. Unfortunately, I was in a wooden house because there was some damage. You have the idea that architecture is like an object that's not going to move, and then when it's suddenly moving, the idea of stability goes away. It creates a bit of chaos in your mind of what safety is, and everything becomes like a liquid. With earthquakes you get what's called liquefaction. Where solid earth turns to liquid just through vibration and motion. I like this idea that the aspect of solidity goes away. And also, the fact that when people experience this in a group context, they have intense experiences and they get closer together, because they're trying to navigate this strange situation. I was in an aftershock in a store in LA, suddenly things start moving and people starts freaking out, they get this fear coming on their faces. But when it stops everyone is in a sigh of relief, and then we're all like we just joined a club together, there is this experiential aspect of creating a social bond, which can be interesting.

The other aspect, is also part of the *Archisonic* pieces I do. I'm interested in this idea of using space as a way to generate frequencies, that become a physical object, or sound that is a physical object. The *Archisonic* pieces all work with this idea. I look at it, as creating invisible sculptures, stuff that you can almost hug or go into. It's also what I was talking about earlier with being able to move through the space, finding these nodes and anti-nodes. To me that's another way of defining space through the body, just like how you're feeling something there, and then back off it's less.

MK: Then we're talking about haptic art, haptic sound. It's vibration. But it's not only the ear. It's in the whole body. Actually, you can grab sound as something that is permanent.
That is what I like about reverberant spaces. Because sounds become something that stops. Sound is always passing by. It's in a permanent state of present. It's difficult to grab it. But with reverb, you can actually grab it... Sound as a vast entity that stays a little bit longer, and it becomes a ghost.

SB: This is perceptual architecture. In a moment you spoke about the sensory aspects of your performance installation and I don't know if you could maybe talk a bit about this aspect of perceptual interpretation of your pieces. What are you looking at from them? or what have you concluded from these experiences?

MB: I suppose it's part of the phenomenological aspect of experiencing space and a bit like the earthquake situation. It's kind of creating an alternate universe for how to experience architecture, of which, some people can get really terrified by this kind of aspect of working with sound. I remember one time, I had a show in Glasgow and it was in a nightclub underneath a train station, in these kind of tunnel halls. It was a pretty hard space, really big system and a great project, it sounded great. I was working with my brother and my brother also is making electronic instruments, so we collaborate together. He has a project called the Mutant Data Orchestra, so he kind of messes with electronics. He takes chips and rewires them in kind of improper ways, like circuit bending.

Anyway, so we had a show there and I remember the following day I was looking up some reviews from that show. I mean, when you do these shows with large sound systems and these frequencies, you get a kind of sonic wind happening. Like your hair can be blowing, your pant legs can be shaking in the wind. I was reading a review of somebody who was at the show, and they basically had a freak out. They were like, okay, I saw the show for a bit and then I had to walk out of the room and go home. And they were like, as I was going up the stairs, the whole stairs were shaking, as a big complaint. He said like, finally I got home and I could put on some experimental music album, and relax. For him it was a complete annoyance.

MK: The *Archisonic* project, when did you start it?

MB: I had some precursors from before. I think even before when I was at MIT. It was like 98, 97, 96 or something like this. The actual name for *Archisonic* came later, about 2014 or something. I had a system that I could shake buildings. The buildings themselves kind of became the sound system. I'd like screw in or use magnetic attachments of like these rotary oscillators. And then put sine waves into buildings and that would put multiple energy transducers into buildings.

SB: When you're developing these performances and you're somehow doing a narrative, a script of what is happening. What is leading the sound you're doing? Is it the architecture? Or is it the acoustics? Or is it the sound reaction? Perceptual interpretation? Or is it something else?

MB: The analogy I take to this project is like driving a bus or a truck, like a heavy vehicle. It's not like I know where I'm going. I don't have GPS, but I'm just driving along and trying to feel my way through. Because I set up these frequencies of the structural context. But the nature of it, is like a self-referencing feedback loop, basically.

I have a system where I can just tweak the frequencies, pull out or put in frequencies. It drives that dominant frequency in other areas. And then you can find other elements of the structure just by teasing those frequencies. You have the dominant frequency, and then you have these other harmonics you can work with. Kind of try to pull that out of the space. So that's why it's changing also in a musical way.

MK: It was at MIT where you started doing this?

MB: Mostly, yes. Vibrational, because I was talking about making these machines that shake things. One of my earliest projects was called the Live Room. And it was like a defunct or no longer operating laboratory. Originally, it was part of General Radio, which was a big scientific equipment company in Cambridge, and then that space became part of General Dynamics. They were designing the control modules for the Atlas rocket systems, and for nuclear warheads. Also, for the Apollo and stuff like this, for all the moon landings. They were designing gyroscopes and the command control modules in this one space. It was a very particular laboratory; all just empty now. But they still had the original pads, these concrete pads that are floating on sand. And they're really isolated from the surrounding roadway and streets and stuff. It's like concrete pads where they put these stands on when they have the gyroscopes on those. They're really protected from vibration. Surrounding these little islands were aluminum plates floating over the sandbox. I thought: these aluminum plates are quite interesting because of their sound!

I took up all these plates and started mounting oscillating motors underneath of the structure. I had seven or eight channel system of just speed controls, which I could control the frequency of these sine waves into this structure. It was using really basic mechanics. It was like DC motors with weighted offsets, basically like giant vibrators. Also, I had really old school rheostat potentiometers, that I could control the speed pretty precisely of these motors. If you have a six-channel system, then you can control beat frequencies. So that's the way. You can have dominant frequencies of 40 Hz, and you can do another engine nearby at like 43 Hz. So, you have the harmonic of 3 Hz coming out. That way you can get these interesting infrasonic harmonics coming through. This whole plate of aluminum becomes a diaphragm, like a loudspeaker diaphragm. But it's just a physical object. You have little islands within this matrix of aluminum plate, and the audience could go there and hang out on the vibrating plates, and then go hang out on the places that aren't vibrating. I was also working with some experimental musicians there. A cellist would be playing on these vibrating plates, and it would make oscillate his cello. We had a theremin player and some horn players. It was quite interesting.

My studio was nearby, and I kept on going by this space. I was trying to figure out what it was such a weird place. I was just trying to figure out the history of this location, and then I just sort of naturally come up with some ideas on how to engage the space in that kind of active way. Actually, I based my whole thesis at MIT on this project. I wrote a whole text about it, and then everything came out of that. I was designing these machines that would shake buildings, and at the same time I was like, okay, so how do I record this? I want to make a documentation. So, I started working with these geological sensors to record the projects, which worked really well. That eventually evolved to where I was, doing projects that involved both systems. Like now with the Archisonic, that system became just the recording system. I did a project a while back in Belgium dealing with a house that they gave me that I could destroy with sound. It was near Hasselt, on a major roadway, so they had to close the road down. Across the street was this old biker bar that they were going to tear down also. The organization was based there.

We got a huge sound system on both sides of the house. In front of that was the mixing system that I was operating, and I had bought six or seven of these industrial shaking engines. They were like 380 volts, so pretty high energy. They use them for industrial conveyance, like shaking materials down a belt or something like this. Farm machinery uses it also, really intense motors. So, then we bolted these onto this house. I had a whole set up of frequency modulating systems. I could tune each motor to put cracks in the building. At the same time, I had sensors placed into it, like what I have for the Archisonic. Those sensors were going into the sound system. We could do this performance where I'm just shaking this building, and the sound of that shaking and cracking goes into the sound

system. I think that was the most sublime sound I ever did in my whole life. This heavy bass that collapsed all frequencies into one band tone, and when it was there you could hardly communicate. Your normal full frequency of your voice would be clamped down, sounding like you were Mickey Mouse or something like that. Everyone was talking in this weird mid-range frequency, because everything else was being sucked up by the other stuff. There were a lot of people there, like thousands of people. It became a big media event in Belgium. They had these TV trucks on cranes and stuff like this. They were kind of upset because I didn't actually tear down the building with sound, because they really wanted that. They went like, our Belgium buildings are tough. It became this kind of competition in the newspaper. After the whole show happened, we had this guy in a tractor crane thing. He spent like an hour just demolishing the rest of the building. He was totally drunk off his ass. As everyone is in the street at the biker bar watching it happen. It was like a total weird spectacle of architecture; it was totally rock and roll.

SB: So, you couldn't demolish the whole house by sound?

MB: Well, I've done some damages before. I was one time invited to a nightclub in the Haag, in Holland. They were renovating the building, and they wanted to get rid of the old part. Before that, they gave it to me and some other artists. So, I also put some of these machines in the building, and I did definitely put some major cracks in the architecture. I took out a whole floor of one section also; it does work. Then I mounted some other engines that were just on the floor with the public.

SB: Have you ever designed something? Yes, or no? And what? If you have the chance to explore that... What would it be?

MB: I mean, I studied design, and I've been very interested in that. My undergraduate studies were at the Art Institute. They had a design program also attached to the fine arts department. I always thought I could do design also. Maybe like furniture design, industrial design, or interior design or something like that. But then after a while working with these kinds of people, I thought they weren't that interesting. So, I just said, like, fuck it. I'll just do art. It's more interesting.

At least you can do whatever you want to do, and you can call it whatever you want to call it, you know? I was more into freedom, so that way. But at the same time, I think it's really good for you to just do design. Because then you have arguments for why certain things look a certain way. Because some artists can be just really flaky. You'd be like, oh, so why did you do it this way? Oh, I don't know, I just felt that way. It really isn't a much reason. Whereas if you go through a critique that's an architectural critique, you'll really have some focused questions on why you did things certain ways. So, I would design objects, furniture, machines, that kind of things. At MIT I designed this really great thing. I collected a lot of materials on the campus that people get rid of. I had this strange chair that you could sit on, and it had one of these vibration motors in it. It had these ingots of a cylinder of raw steel, quite heavy, like two of them. Also, I had an aluminum bar across that, and I had this motor attached in the middle., the oscillator. I had a rheostat that you could control the speed of the motor, and underneath these metal pods, there was a bit of rubber so you wouldn't scratch the surface. It was plugged into the wall. You just turn this machine up and you're just vibrating on top of the floor, you know? It was vibrating you, the body, but also vibrating the building. It was like this chair that connected the person and the building. It moved on its own because with vibration, things will start moving in it. That in a way is a design object.

Also, I did this acoustic space gun, I called it. This also deals with the urban reality of things, the space and sound. It was a very long vintage directional microphone from Sony, a long tube. It got a portable amplifier and some electronics stuff. On the backside, a parabolic dish that was projecting sound from that microphone, and a delay circuit on that. So, you could point this microphone across

the street, pick up whatever sound's coming from that location, and then it projects the sound in the opposite direction, and you could control the timing of it. I was showing this, one time in Prague, and I was going around the city, just projecting sound from that direction to that direction, and then messing with the timing of it. It creates this really weird acoustic spaces, and it really looks like a weapon. You hold it like a gun that goes over your shoulder, and this dish is in the back. That's a design object. So, you're picking up sounds of people. In Prague, it was a lot of tourists talking. It was like a teleportation tool; in a way. So, you pick up somebody's personal conversations, and suddenly they're hearing themselves talk reflected off a wall that way.

MK: For me you are an aural architect. You are designing all the time.

MB: Yeah, I suppose. Of course, in the *Archisonic*, designing sound sculptures, that for me is design. I mean, it's something that doesn't long... And it's something that happened to me, as you were saying, the buildings and the liquifying of the terrain. It's like, we understand buildings as something so permanent, but it's not like that. You understand sound waves as something so ephemeral, but also sound waves could be not that ephemeral as the same way. It's the same. Architecture and sound, acoustic space, is something that seems quite opposite. But if you see it from another perspective, architecture is something that could be that ephemeral, and could liquify itself. And sound waves could become something much more physical; material.

MK: I think it's interesting that in these works, you are always mixing up that perception.

MB: True. I mean, I do a lot of other work that's not just this kind of *Archisonic*. I used to do a lot of stuff dealing with mobile phones, like designing machines that would be in a gallery space that had focused microphones, and coupled to a loudspeaker that was also focused.

SB: What do you mean with focused microphones?

MB: I would make two of these machines, and then I would hook them up to mobile phones, and then I would advertise in newspapers two numbers. Be like, hey, call this number for free, and you can talk to somebody. Then it was in the gallery space, from maybe 50 meters away from each other, and they were focused to each other. People could call this thing, and then talk to other people, have a conversation through a big physical space. Then the people in the gallery would witness that conversation or engage in it also. It was this weird way of extrapolation of a telephonic space, you know? I had this other project where it was like collecting, in Istanbul. It was a while back.

At the time they were doing a lot of this, like Wall Street protests and things like that. I wanted to do this piece; it was based on this idea of the electronic disturbance from William Burroughs. His idea was like, you could play the recording of a car crash and then you could go somewhere with that recording, and play it back and you would have another car crash, like this idea of the virus of sound. He had this idea of an army of guys wearing overcoats and reel-to-reel decks around their neck, recording sounds here, and then projecting them out there and creating chaos of space using the psychoacoustics phenomenon. You know, it's all kind of fictional, speculative. I thought: oh, maybe that's interesting and maybe I do something like that in Istanbul. So, I spent a couple of months just downloading sounds of protests. Then I made like a 60-minute CD of recordings of just protests. No information, just the sound of rage. Mostly on the internet. But from all over the world, just different protests. Also not having any kind of specific information about what it's about.

Anyway, so I had this sound and I thought, okay, now I'm gonna make a portable sound system in Istanbul. I brought this small battery-operated amplifier that was pretty loud and went to the shops in Istanbul and bought some of these mosque horns. These horns where they project the prayer in

the temple or mosque, and I had that on a kind of a pole that it could expand up. It was this ridiculous system with just two mosque horns, sound system down here and a CD player. I would just wheel it around to certain places and play, and then people would start showing up and get really aggressive. So, the sound of the protest made the protest. I played it outside the gallery, and literally after like six minutes I had all these undercover police spies, you know, showing up and pushing me around, getting all aggressive and people would start screaming at each other. Finally, the police came and they forced me to shut it down, only after six minutes. It basically proved my theory.

MK: Can you tell us about this project *Geosite*?

MB: Yeah. I had one piece in Tilburg actually that was south of Holland. That was a steel plate of six meters with these industrial vibrating machines. I had three of them connected to this long plate. We dug out the ground, put the plate in, and then put dirt on top of it. I had these tuned to certain frequencies, and a motion detector on this terrain. So, when you walk into this area, suddenly the whole earth starts shaking. But, of course, those vibrations would travel through the ground, and people would come up to me, from blocks away saying: Hey, when this machine goes up, all my glasses in my kitchen start shaking. It's a bit crazy. That was in 2001. I was actually driving down to go tune the machine before it opened on 9-11. My girlfriend at the time called me while I was in the car. She was like, hey, you know what just happened? Some airplanes just flew into the World Trade Center. And I was like, oh, shit. I was already almost in Tilburg. I came in and all these residential streets, with Dutch building design. Everyone has their windows open, right? And then, all I could see is non-stop towers collapsing on their television screens. So, I thought if I was like running a machine that was shaking everything, it was probably not a great idea for the neighbors, you know.

A lot of my work changed after 9-11. Suddenly people weren't interested in having their buildings get destroyed or get shacked, you know. So, with the Start-end time piece, I sort of thought: oh, let's take it back to myself somehow. That was about making the modification of all the seismological record from that time period. That's why it was called Start-end time, because I would download all these wave files... Or not wave files, but the seismological files from 9-11. Data files. When you specify what you want, you have to give them the start time and the end time, and the coordinate locations. This was all the records from New Jersey, New York, and New England, all around that area. Some quite far away, but you still could get the sound of that. Then the process of interpolation was a bit more complicated... Because all these files, first of all, they're not audio files. They're just waveforms. And they're very low frequency, so you can't even hear them. You have to jack up the frequency a lot, like make a transduction. It was before a lot of this plug-in stuff was around also. I had to figure out a way to do it on my own. Even writing some code and stuff like that. Learning how to write code in order to do it. So, jacking it up to about 40 octaves or something like this, then having some software to stretch it apart so it becomes real time.

At the impact points, I was tuning it up quite high, and then when you hear the airplanes hit the towers, the seismic waveforms would actually sound like a tuning fork. If you imagine the two towers being a tuning fork attached to the ground, that's what they acted like. It was really weird; you could hear it. But because I was using a lot of seismological equipment, I knew what kind of sounds I wanted to register it as. So, I would bring that frequency down a little bit so that you'd get more of a feeling for... That piece, I have it on the archive.org website. People can download it if they want: Archive.org, I think if you look up my name you should be able to find it.

One time I did a piece on what's called the Nordsee Canal. It's like the waterway leading from Amsterdam to the Nordsee. And I was working with the Rijkswaterstaat, which is a big organization in Holland. Everything is about water. So, the head of this is, actually the queen at the time, it's really part of the government. And one of their headquarters is near what's called the A9 Tunnel. It's like a highway that went under the canal. There's maybe a kilometer and a half of a tunnel under a

waterway. Anyway, the idea was to take two modes of transportation and develop sound for both. So above ground, I had four Bose Acoustic Wave Cannon speakers on stands. These are like big plastic tubes of about 3 meters long on stands pointing towards the canal. Like really bassy speakers. I use these because they're also waterproof. You can just leave them out in the rain. They're subsystems for theaters and things like that. They made them back in the 80s, quite interesting looking. So anyway, then I got the project. I bought four of these earthwork microphones. There's a walkway in this tunnel, a kilometer and a half tunnel, cars racing through. A walkway adjacent to it that's protected by a wall. And in this wall, in certain parts, there's holes in the wall that you have access to the tunnel space where the cars are. So, I had four equal distance points. I put these microphones in, picking up the sound of cars traveling in one direction, I had a lot of wires I had to deal with. So, I took the live signal from each microphone and put it into one of these Bose acoustic wave cannons, and these were also spaced at a certain distance. So, if you're on the canal on a boat, you hear the sound of cars going by in a spatial way, because the speakers are spaced pretty far apart. It's like, meow, meow. So, I kind of translated the interior space to an exterior space. And they're crossed this way, right?

Interview with Ricardo Atienza, January 24, 2023

Sofía Balbontín: Entiendo que el proyecto de *Espèces d'Espaces* aborda la experiencia acústica del espacio, la relación con el cuerpo, el espacio circundante y su expresión sonora. ¿Cual es tu problemática frente a este proyecto? ¿Podrías explicar el proceso de investigación artística que desarrollas, incluyendo sus objetivos y metodologías?

Ricardo Atienza: Bueno, yo diría que es un proyecto un tanto "accidental". Con esto quiero decir que no está estructurado desde el principio a modo de un proyecto de investigación tradicional, sino que viene como consecuencia de una serie de casualidades. En realidad este proyecto empieza en colaboración con José Luis Carles y Cristina Palmese. Estaban interesados en hacer una serie de mediciones acústicas de una serie de espacios en Madrid, alrededor del eje del Prado, que es la avenida principal que pasa delante del Museo del Prado. En colaboración además con algunos estudiantes que querían hacer el trabajo de fin de máster y que estaban interesados en temas de arquitectura sonora. José Luis me solicitó ayuda para hacer ahí unas mediciones con los estudiantes y trabajar el tema de las modelizaciones acústicas.

Yo al inicio no participo más que como colaborador para orientar a los estudiantes en cómo se hace una campaña de medición acústica en dos o tres espacios que habían elegido. Luego surge este tema de cómo funcionan las modelizaciones acústicas. O sea, cómo se puede, a partir de un modelo gráfico 3D, extraer una serie de respuestas a impulso para poder utilizarlo por una grabación de estudio o simplemente para entender cómo está funcionando el espacio en términos de respuesta acústica. Entonces, comienzo a implicarme de forma tangencial en lo que es el diseño 3D del espacio, a través del trabajo con los estudiantes por diferentes preguntas que iba recibiendo e intereses personales de ellos. Los estudiantes querían comparar los resultados obtenidos de una campaña de medición y analizar las diferencias. Fui ayudando a los estudiantes con esto, y entonces ahí se cierra el trabajo de fin de máster de estos estudiantes.

Luego de ese proceso, me planteé que era una pena dejar este proyecto ahí, en ese punto. Yo siempre tenía una serie de preguntas, de cómo se podrían trasladar estas herramientas al campo más creativo, más artístico. Con una connotación más arquitectónica, más de instalación o de performance. Pero estas posibilidades que estas herramientas ofrecen en términos de inmersión, de simulación y experiencia inmersiva del espacio, me parecía que eran muy potentes, eran muy necesarias. Como sabéis, el sonido cada vez está más y más presente en Bellas Artes a través de diferentes vías,

porque cada vez hay más gente que trabaja con vídeo, que trabaja con instalación, con performance. Son herramientas que la necesidad las hace cada vez más acuciantes. Sin embargo, no son herramientas accesibles todavía. Entonces bueno, pues parte un poco por ahí y en la posibilidad de hacer un proyecto de investigación, de pedir fondos para poder iniciar un ese proyecto.

Yo propongo un proyecto, armo un proyecto alrededor de estos materiales y alrededor de estas ideas. Y entonces planteo un proyecto que es relativamente abierto, es decir que parte de un espacio concreto, parte de esas mediciones y de esos modelos, y planteo una serie de experimentos para entender qué tipo de aplicaciones tiene, cómo es normalmente usada esta herramienta en edición musical, en arquitectura sonora, por los ingenieros acústicos, etc. Y cómo poco a poco estas herramientas, una vez que entiendo el funcionamiento y las posibilidades, cómo puedo ir adentrándome cada vez más en el terreno de lo creativo y de lo artístico. Del diseño sonoro y de las bellas artes. Y entonces de ahí ya empiezo a plantear una serie de experimentos que tienen más que ver con, por ejemplo, cómo se puede utilizar este espacio virtual como un contexto que puede ser explorado en una obra electroacústica o a modo de herramienta de improvisación para músicos, o como herramienta que te está reflejando tu propia imagen sonora y entrando en un diálogo contigo mismo. Finalmente se transforma en una herramienta también para el músico para entender qué es lo que él está haciendo, entablar un diálogo con el espacio, con qué es lo que está proyectando y qué es lo que recibe el oyente, que estaría en el otro lado.

Él se transforma en productor y oyente. Pero bueno, va un poco en esa línea. Digamos que el proyecto cada vez se separa más de la parte técnica o de la parte tecnológica y arquitectónica y va más y más hacia aplicaciones en el terreno de lo artístico. Es un proyecto que no tiene una estructura muy precisa en términos de investigación, sino que es más explorativa, son idea sobre la marcha, en conversación con los músicos que colaboran conmigo. Les hago preguntas como; ¿Qué te parece que podría ser útil a partir de esta idea de utilizar este espacio como herramienta? O ¿Qué tipo de interacción te parecería que podría ser de inspiración o podría ayudarte a mejorar tu práctica instrumental? Y a partir de ahí surgen una serie de ideas con las que se pueden trabajar.

SB: En términos metodológicos, estas conversaciones con músicos, ¿eran parte de la metodología? ¿O cómo se traducían estas conversaciones en lo metodológico?

RA: En realidad, inicialmente no lo eran. Inicialmente no había esta componente colectiva, sino que era un trabajo más en solitario de explorar las herramientas y de buscar una serie de aplicaciones de manera práctica. Entender cómo funciona y qué se puede hacer con ello. Y muy rápidamente en el proceso, bueno ya sabéis cómo son los procesos de investigación, uno empieza con unas ideas, sobre la marcha te das cuenta de cuáles son tus carencias, a qué te gustaría abrirte, y de repente surgen ahí unas posibilidades que no habías entendido al principio. Muchas veces también surge la posibilidad de colaborar con esta persona. Y entonces rápidamente entiendo que sería muy interesante, no solamente que yo ponga en práctica estas herramientas, sino que las ponga en práctica en colaboración con... Y en colaboración con… puede ser otro arquitecto interesado por alguna cuestión más de orden histórica, como sonaba este claustro hace 300 años, o en colaboración con… pueden ser, unos músicos interesados en temas de improvisación y espacio.

Entonces digamos que este diálogo tuvo lugar de forma muy espontánea, es decir, directamente en forma de prácticas improvisatorias compartidas en las que vamos variando estos parámetros y las posibilidades que ofrece este juego de espacios. A través de esas conversaciones se van implementando nuevas ideas y nuevas posibilidades técnicas también de la herramienta. Pero me gustaría formalizarlo. Ahora en realidad estoy escribiendo un proyecto. Vamos a ver si hay suerte, conseguir financiación para él, en el que ya estaría más formalizado. Esta colaboración, no sería solamente una conversación en abierto, sino que tendría que ocurrir a través de un proceso de práctica. Es decir, la producción. Por ejemplo, este es un ejemplo de explorar cómo esta herramienta espacial funciona en términos de

improvisación. Eso tiene que ocurrir al improvisar. Y eso surge de la propia práctica, donde también surgen una serie de preguntas y de posibilidades.

SB: Yo entiendo que tú tienes otros proyectos donde la improvisación también es una metodología importante. O sea, es algo que tú ya vienes trabajando de antes.

RA: Sí, aunque en realidad la improvisación la he trabajado mucho, o más bien, diría en plural, la hemos trabajado mucho con mi compañera Mónica Sanz. Principalmente en proyectos urbanos, de cara a intervenciones colectivas en el espacio público, en el que, por ejemplo, se toma un espacio, se plantean una serie de preguntas para entender cómo funciona ese espacio y se imagina una serie de acciones de improvisación que esperamos nos den una respuesta sobre cómo opera ese espacio. O sea, que es una improvisación que está menos vinculada a lo musical. Y en realidad no me interesa tanto lo musical en este caso como más el fenómeno sonoro espacial en sí, un poco más a lo Luigi Nono; esta cosa de que finalmente es el espacio como herramienta sonora, digamos que es el binomio espacio-sonido el que centra sobre todo mi atención. Es decir, que esto genere unos resultados que pueden ser considerados más o menos musicales, no es un problema que de momento me parezca central. Ese sería mas bien el problema del performer, del músico o del improvisador que quisiera utilizar luego esta herramienta.

SB: ¿Qué relación tiene el título *Espèces d'Espaces* con el proyecto de investigación? ¿Por qué lleva ese nombre?

RA: Es más un juego de palabras. Especie de espacios en español. Esta palabra "especie" tiene un doble significado. Especie en cuanto a algo casi taxonómico, tipos, tipologías. Esto es una especie de algo, esto parece algo pero no lo es, no se sabe muy bien lo que es. Entonces esta cosa que ocurre cuando empiezas a manipular el espacio y a jugar con él, empiezas a deformarlo y a transformarlo, te vas alejando de lo que en un origen fue, porque estás explorando un terreno más imaginario.

SB: Reconocemos la interacción del sonido y el espacio en tu trabajo, donde estos dos elementos construyen en colaboración el concepto binomial de espacio sonoro. Este concepto no se define estrictamente como una sola cosa, y puede tener varias interpretaciones. Me gustaría entender qué significa para ti este concepto y cómo lo incorporas en tu trabajo.

RA: En realidad este concepto es un tema que me ha ocupado muchos años de forma irregular, entrando y saliendo. Creo que empezó con la lectura de un libro clásico de Francis Bayer, *espaçe sonore*. En este libro se pregunta, qué es esto del espacio sonoro. El espacio sonoro, es por ejemplo, ¿una obra musical? o si el espacio sonoro sería, ¿el espacio sonoro de la partitura? La partitura en cuanto a espacio en sí, con códigos. O si, ¿es el espacio mental del compositor?, o si ¿es el espacio de la representación? ¿el espacio percibido durante la performance? o ¿qué es?. Son muchas cosas. Es un concepto que en realidad engloba toda una serie de diferentes estratos. Yo vengo de la arquitectura y de la música, una especie de doble afiliación. Pero finalmente la componente física es la que más me interesa en este caso. Y entendiendo que finalmente no hay sonido sin espacio. Para mí decir espacio sonoro es decir sonido. El sonido en abstracto no existe. Incluso el sonido de la cámara anecoica tiene un espacio. Incluso el sonido imaginado es un sonido que está situado en un espacio, en un contexto, aunque sea mental. Entonces es una forma simplemente de enfatizar el hecho de que el sonido es espacio, que el espacio también es sonoro por defecto. Y que finalmente, es un binomio que no puede romperse.

SB: El espacio puede ser sumamente abstracto. De hecho el concepto de espacio viene más bien del área de la geometría y, entonces, la idea de "espacio" aparece como un objeto abstracto donde no necesariamente habría sonido.

RA: Cuando hablo de espacio sonoro, como decía Augoyard, hablo de la experiencia situada. El sonido implica que tú como oyente estás automáticamente poniéndote dentro de un contexto específico. Y desde este contexto, con la escala de tu cuerpo y la posición que tu cuerpo adopta, estás dándole una escala a la escucha y estás situando esa escucha. Siempre sería una escucha situada, no tanto en el sonido imaginado, pero sí en el sonido percibido. Yo creo que esto tiene mucho que ver con quizás algunas de las carencias de la arquitectura. Finalmente la arquitectura, tal como por lo menos a mí me la enseñaron, e imagino que en parte a vosotros también, es una arquitectura gráfica, visual. Es una concepción del espacio que puede ser externa, tú la observas desde fuera. Es algo de lo que puedes generar fácilmente una abstracción de ello. Sin embargo, cuando piensas en un espacio sonoro, esa operación es más difícil. Generalmente tú tienes que estar adentro. O sea, tú escuchas una grabación, escuchas un material e inmediatamente intentas imaginar desde dónde estarías escuchando. Incluso aunque tú no estés en ese espacio, aunque sea una grabación, se está planteando una serie de parámetros de distancia, de ubicación, de contexto, de envolvente física. Muy difícil abstraerse de eso. Sin embargo, puedes hacer un dibujo en planta o un alzado en el que tú eres totalmente externo a esa proyección. Es una herramienta muy útil, yo creo, para el arquitecto en cuanto que, de alguna forma, te fuerza a estar presente en ese espacio que tú estás intentando pensar. Te introduce en el... El espacio sonoro siempre es un fenómeno situado y temporal.

SB: ¿El espacio sonoro estaría más vinculado con la arquitectura o con la música? ¿Es un concepto vinculado al arte o es algo que está más bien vinculado con una experiencia psicoacústica? ¿dónde lo sientes más cercano?

RA: Yo creo que está a caballo de todos esos territorios y eso es lo más interesante. Es un concepto que claramente le resulta extraño a la arquitectura, es decir, no ha trabajado con él habitualmente y no sabe muy bien qué hacer con él. La arquitectura no sabe muy bien qué hacer con las cosas que tienen que ver con lo temporal. Intenta fijar, hacer una fotografía. Si se habla de recorrido o si se habla de una serie de conceptos en los que el tiempo finalmente se supone que tiene un rol importante, no deja de ser un tanto accidental. Es pensar en un espacio variable, porque finalmente cuando hablamos de espacios sonoros es una cosa que está cambiando continuamente. No tiene forma, es imposible fijarla. Entonces es algo con lo que la arquitectura no sabe muy bien como operar. Al mismo tiempo la música o lo sonoro tiene una gran dificultad para trabajar también con lo espacial. Hay un ejercicio muy divertido que seguro que habéis hecho, que es este de la representación del espacio sonoro. Tú reúnes a un grupo de estudiantes y le pides que te dibuje lo que está escuchando, sin especificarle nada más. Generalmente el resultado es muy variado; los que tienen una formación más arquitectónica te van a hacer una fotografía espacial, una abstracción espacial en la que ubican una serie de sonidos en el espacio. Y si se mueven pues se hacen puntitos o algo así. El que es de formación musical, en general te hace una partitura. Te marca una línea temporal que empieza, se acaba en un determinado punto y te está marcando una serie de eventos y ahí el espacio no está. Es muy interesante.

Finalmente son dos formas de entender el espacio sonoro. Están hablando de lo mismo pero que en realidad no le prestan una atención más global, que permita entender ambos parámetros. Xenakis siempre lo dijo, que los arquitectos son incapaces de trabajar con el tiempo y que eso es un oficio de músico. El músico trabaja con el tiempo.

Yo tampoco creo que el arquitecto no tenga que ocuparse específicamente por el sonido. El sonido es una herramienta muy potente para que la arquitectura se abra a la globalidad de los sentidos. Es una especie de herramienta de sensibilización para entender que el espacio que te rodea es mucho más

complejo de lo que habitualmente uno quiere analizar o entender. Yo creo que va un poco por ahí la capacidad o la potencia de estas herramientas para el que trabaja con proyectos espaciales.

Mathias Klenner: Muchos autores coinciden en que son músicos o artistas los que introdujeron la variable espacial en el sonido, como un punto de quiebre para la creación de esta nueva categoría. Sin embargo, en la arquitectura no sé si ha habido algún punto de quiebre al momento de introducir la variable temporal. No está tan claro, ni definido. Sí existen arquitectos que han trabajado con proyectos más performáticos, donde está presente el tiempo, pero no han tenido la relevancia que tuvo la música con la introducción del espacio.

RA: Sí, yo creo que es todo el peso de la escuela Ross y compañía. Es una forma de entender la arquitectura muy escenográfica, como una puesta en escena. Eso implica de alguna forma una imagen congelada en la que el tiempo tiene poco que aportar. Es la construcción de una escenografía realmente. Estamos hablando, de los años 50-60. Creo que todavía somos herederos de esto. Le Corbusier que habla de la promenade, del recorrido arquitectónico, y de repente parece un concepto vanguardista simplemente porque está introduciendo esto de que finalmente quien habita un espacio se mueve en él. De repente parece una cosa revolucionaria. Si simplemente pensar que el habitante recorre un espacio es un concepto relativamente vanguardístico y revolucionario, pues te da una idea del nivel de esclerosis espacial. Y efectivamente, luego se ha visto que en los 70, en los 80, aquellos arquitectos que se han interesado por estos temas, porque por supuesto los ha habido, siempre han sido excepciones. Hay gente que ha quedado al margen, o que trabajaba formas arquitectónicas temporales, efímeras, como Xenakis, que no hacen parte de los elementos que el arquitecto tradicional trabaja de forma natural. El tiempo es un elemento un tanto "alienígena".

SB: Me gustaría pasar a la siguiente pregunta que tiene que ver con cómo tú utilizas la auralización en tu trabajo. Y en relación a ello ¿Qué significaría para ti el concepto de arquitectura aural? ¿Cuál sería para ti la diferencia de ese concepto con el concepto de espacio sonoro que acabamos de conversar?

RA: Este interés por estas herramientas de auralización o por el concepto de auralización, en mi caso, está muy vinculado al interés por entender, ¿por qué la experiencia del espacio es tan potente? Es decir, ¿cómo opera esta experiencia espacial que todos tenemos? Porque lo interesante es que finalmente todos somos expertos en términos de escucha de espacios cotidianos. Cualquier persona que, aunque no tenga una formación musical, tú le pones una grabación y le puedes pedir que te describa ese espacio en el que está ocurriendo una determinada acción y será capaz de dar mucha información sobre cómo es ese espacio. Por supuesto, si además es alguien que trabaja con sonido, pues puede que te dé más detalles, pero todo el mundo tiene esta experiencia cotidiana de escuchar los espacios que le rodean y en consecuencia de ser capaz de extraer toda una serie de características del espacio en términos dimensionales, proporcionales, de materiales, recorridos, movimientos, etcétera. Porque es una información que utilizamos a diario. Y además es una información que, como sabéis, a un nivel antropológico es tremendamente pregnante, es muy potente. Esta vinculación a las acústicas que son inhabituales, de grandes tiempos de reverberación, cavernas, catedrales, pues se remontan realmente a las primera experiencias humanas del espacio refugio. Bueno, nos podríamos perder ahí en derivadas de antropología espacial o social: arqueoacústica. Ese tema no lo trabajo pero me fascina desde el punto de vista de la escucha espacial y todos somos expertos en la escucha espacial. El sonido muchas veces en términos pedagógicos se ha planteado como una educación en la que se empieza por una serie de fenómenos de vanguardia, de escuchas arduas de materiales no siempre muy accesibles, que presuponen que el estudiante o quien quiere avanzar en este terreno tiene que hacerse con un lenguaje. Ha de comprender una serie de elementos de complejidad que no son obvios en absoluto. Y sin

embargo yo creo, y esto es una cosa que yo llevo a la práctica pedagógica diaria, que es muchísimo más útil a partir de la experiencia cotidiana del espacio. De este hecho de que todos somos expertos de la escucha y de que les vas a poner una grabación de las que vosotros habéis hecho en cualquiera de estos espacios, en Shallow World o donde sea, y va a entender que está en un espacio totalmente fuera de lo común, que tiene unas dimensiones descomunales y que seguramente el material puede ser hormigón o piedra por lo reflectante. Partiendo de esa experiencia del espacio, un poco a lo Pauline Oliveros, puedes explorar luego muchos otros temas. Entonces ya le puedes hablar de Luigi Nono y de Prometeo y va a entender mucho más de lo que está ocurriendo en términos de exploración espacial.

¿Cómo utilizo yo la auralización? A mí me interesa esta herramienta como una forma de poder acceder a esta experiencia espacial y de poder jugar con ella, o de poder trabajarla de diferentes maneras. La auralización te permite, ser capaz de transportar al oyente, de proveerle una experiencia inmersiva, y llevarle a otro espacio. Y en el momento en el que eso es posible, también hay una serie de posibles juegos de transformación espacial, material, etcétera que pueden ponerse en práctica. Y entonces todo el mundo puede entender que ahí se están operando una serie de juegos de manipulaciones espaciales, porque se anclan directamente con su experiencia cotidiana.

SB: Me interesaría saber que sería para ti la arquitectura aural, y en relación o en diferenciación al concepto de espacio sonoro, de acuerdo a tu propia experiencia con la auralización.

RA: Este este tema que planteabas de la arquitectura aural es interesante porque es un concepto que yo en realidad no utilizo mucho, pero me parece muy interesante en cuanto que plantea un cambio de orientación, porque a quien pones en primer término es a quien escucha. Dices que es aural, ya no es sonoro, ya no es algo que está por defecto, sino que implica el punto de vista de quien recibe. Y esto yo creo que es un tema importante. Transforma...

MK: Tiene que ver con escuchar la arquitectura versus la arquitectura que suena. Hablar de audición o escucha es una experiencia situada, versus sonido que puede considerarse como una entidad que existe más allá de nuestra percepción.

Sí, yo diría que este es un terreno muy escurridizo, porque de nuevo entramos en referentes culturales. Hay términos que quizás en una zona geográfica van a utilizarse más que otros, aunque en realidad estés hablando de cosas muy similares. Este término de aural, es un término controvertido, hay una cierta resistencia a utilizarlo y en ciertos lugares se evita. Pero obviamente me parece que hay una diferencia entre "sonoro y aural" que es muy interesante, y que es importante de señalar.

Es interesante que hayan tomado precisamente la escucha como punto de partida, porque realmente es lo que está ocurriendo ahí. Tú quieres saber cómo, en cuanto oyente, cómo aprecias un espacio. Ese es el punto de vista que te interesa. Yo creo que el concepto de espacios sonoros es aun ambiguo. Entonces casi todos tenemos una idea relativamente precisa de lo que queremos decir y sin embargo seguramente estamos hablando de cosas bastante diferentes o incluso de diferentes conceptos simultáneamente. Entonces el concepto de aural puede tener la virtud de precisar, de intentar ser algo más concreto. Precisar qué es lo que te interesa como punto perceptivo.

MK: Es algo que también ha pasado en las artes sonoras, que se han centrado más en la escucha que en el sonido mismo.

RA: Seguramente frente a lo musical, que se centraba en la producción musical en sí, e incluso relativamente abstraída de cualquier contexto espacial, en la medida de lo posible. Eso es herencia de Pierre Schäffer con sus objetos sonoros. El arte sonoro, se encuentra ahí con un territorio ya totalmente colonizado y entonces, por necesidad, plantea un enfoque totalmente diferente hacia la

escucha. Bueno, además, la tradición de Pauline Oliveros y del Soundscape también opera de forma muy presente. Y en términos de pedagogía es obvio que es un acercamiento fantástico en términos de simplemente poder abrir el territorio de lo sonoro a cualquiera.

SB: En cuanto a la práctica de la arquitectura, si entramos en un proceso de abstracción de lo que vendría a ser el diseño arquitectónico, en cuanto a dibujar un plano y construir con ladrillos, expandiendo esa idea de lo que es el diseño arquitectónico tradicional, y entendiendo más bien éste como el crear un nuevo espacio que no existía antes ¿podría ser la auralización ser una posible práctica de diseño arquitectónico?

RA: Es una pregunta muy interesante. Yo creo que la auralización, tal como se entiende hoy en día, como herramienta de precisión casi quirúrgica, tiene por su propia naturaleza una capacidad espectacular para trabajar con arquitecturas ya semi definidas. Tienes esta cosa de la perfección, de intentar pulir una idea que ya está geométricamente bastante bien definida y que quieres de alguna forma ser más preciso en ella. Este es un tema que me ha ocupado también en investigación. Nunca le he llegado a entrar en ello, pero me interesaría explorar si hay otra forma de entender la auralización, que permitiera trabajar a nivel de boceto espacial. En el momento en el que tú tienes un modelo geométrico 3D, gráfico, en el que vas a calcular una serie de reflejos en el espacio, implica que el espacio en sí está ya definido. Eso sería en mi caso, como yo normalmente me acerco a este tema. Sin embargo, sería muy interesante imaginar una forma de auralización espacial que te permitiera un gran nivel de flexibilidad. Seguramente que fuera más general, que fuera más sensorial y menos técnico. No sé exactamente cómo podría pensarse esta herramienta, pero que te permitiera realmente pensar el espacio de forma más dinámica, más a nivel de boceto y menos a nivel de plano de detalle.

SB: Por ejemplo, en *Especies de Espacios*, tú haces un experimento de intervenir un espacio existente cambiándole los materiales. Y eso, en la plataforma, está dispuesto de manera tal que vas pasando de una intervención a la otra. Para mí, esa intervención creo que ya es una propuesta de diseño arquitectónico, porque aparece un nuevo espacio con cada una. Este claustro cubierto de pasto es un nuevo espacio y es, además, un espacio de ficción, que yo nunca he visto en la vida real. La mutación de un espacio en el otro habla de algo que no es constante, sino que también es variable. Es un espacio-repertorio de diferentes espacios, pero al mismo tiempo es un solo espacio. En la plataforma uno va viendo cómo va modificándose la espacialidad a través del sonido que emite, en cuanto a sus reflexiones. Entonces creo que ahí aparece una práctica de diseño arquitectónico bastante potente.

RA: Sí, tienes ya un modelo preexistente, tienes un espacio que está bien definido y empiezas a jugar con él, empiezas a transformarlo. Yo de lo que estaba hablando es más bien de esta posibilidad de diseñar a través del sonido, un espacio que todavía no existe. O sea, esta idea de partir de cero. La auralización es una herramienta que nunca que va a aparecer desde el principio porque no se ajusta a esa idea. Necesitas un espacio de antemano. Depende de lo que llamemos diseño espacial. Si ya estamos a esa idea, a ese nivel que tiene más que ver también con la corrección acústica. Con esta idea de que tenemos un espacio que presenta una serie de problemas o de carencias, y le queremos dar esta función, entonces cómo podemos corregirlo acústicamente para que responda bien, lo mejor posible, a esas necesidades. Efectivamente también es una operación de diseño arquitectónico, indudablemente. Si defines algo, por ejemplo un cubo, pero ese cubo ya tiene unas características sonoras muy predefinidas. Cómo se trabaja eso es lo que todavía no sé. Es un tema que realmente me interesaría trabajar. La auralización es una herramienta tremendamente potente para poder imaginar a partir de un espacio dado o de un volumen dado, poder diseñar un espacio aural, vamos a utilizar ahora este término, con unas características precisas que te interesan, o incluso diversas realidades aurales a partir

de un mismo espacio. Tienes un espacio y empiezas a generar una serie de variaciones, e imaginaos que todas esas pudieran ser posibles en paralelo.

SB: ¿Crees que entonces es posible habitar arquitecturas a través de la auralización?

RA: Yo creo que la potencia inmersiva de esta herramienta, es realmente operativa. Realmente es capaz de generar esta sensación de inmersión espacial, de trasladarte. Obviamente nunca va a ser lo mismo que estar en el espacio físico con todos tus sentidos, porque precisamente todos tus otros sentidos no están ahí. Quizás puede generar una especie de realidad virtual gráfica, pero bueno, no la estás tocando, no la estás oliendo. O sea, no deja de ser una abstracción bastante fuerte de una realidad sensorial. Pero realmente sí que genera, una sensación de inmersión espacial. Los músicos me manifestaban que desde luego se sentían transportados a ese espacio y que eran capaces de entender, de entrar en un diálogo con esa espacialidad, que obviamente no va a ser exactamente lo mismo que ocurriría si se trasladaran físicamente a ese contexto, pero de alguna forma sí queda una imagen relativamente cercana, o por lo menos coherente en cuanto a lo sensorial para ellos. Y luego esa coherencia te puede llevar a un espacio ligeramente diferente o con otras características, pero sí que generan unas formas de inmersión, aun con todas sus limitaciones.

SB: Esta idea de inmersión y considerando el rol del oyente en el proceso de auralización, me gustaría pasar a la siguiente pregunta; ¿Cuál es la importancia de la percepción en la conformación de estos conceptos de espacio sonoro y arquitectura aural? ¿Existen tipos de percepción que podrían definir algunos conceptos y no otros?

RA: Para mí percepción es más el fenómeno sensorial receptivo, no? Recepción. Y esto es más tradición del Cresson. A partir de todo lo que es en términos de interpretación lo llamaría más bien como representación o efectos sonoros. Yo indudablemente creo que finalmente al nivel al que intentamos operar es al nivel precedente de lo que ocurre después de la percepción. No solamente la percepción física y la reconstrucción física del espacio, que es un nivel fundamental, sino toda la cadena de efectos sonoros a nivel de memoria, a nivel de experiencias personales, a nivel de cómo se conecta esto con la vivencia de cada persona. Sabemos que el sonido tiene esta capacidad espectacular de conectarte con una serie de eventos vividos anteriores en medio segundo de algo es capaz de traerte, de llevarte atrás 30 años y de atravesar simplemente de una situación recordada que he vivido con particular intensidad. Yo creo que por ahí va un poco también esta potencia, la capacidad del sonido para trasladarte, para "hacerte viajar", para abstraerte de donde estás y llevarte a un territorio de memorias, estás permanentemente reconectando tu experiencia anterior vivida, sonora y sensorial en general. Este es un tema que yo creo que está particularmente bien retratado en este libro del Cresson, de Augoyard y de Torgue, cuando hablan de los efectos sonoros. En inglés, *The Sonic Experience*, de intentar ponerle un nombre a todas estas operaciones, a todos estos saltos o efectos. Ellos hablan de efectos sonoros, que es lo que pasa no en el momento de la percepción, sino después, en el momento de la interpretación de estos sonidos, que por supuesto está totalmente vinculado a la experiencia personal, a lo vivido anteriormente.

SB: *The Sonic Experience* tiene este repertorio de efectos perceptuales que, claro, son bastante específicos y que están desglosados en diferentes tipos y que a partir de ellos podría ser muy interesante contestar esta pregunta.

RA: Sí, te dan una serie de efectos también clasificados en función de a qué campo. Si estamos hablando de efectos más bien en el campo de la memoria, pueden ser desde temas más físicos. Se añade a esto la complejidad de que la experiencia espacial del sonido nunca es realmente pasiva, porque

también acontece temporalmente en el recorrido del espacio, en esa transición. Entonces es algo que está dinámicamente cambiando todo el tiempo. Lo que acabas retratando no es una foto, no es una imagen instantánea, sino que es una secuencia. Es algo muy complejo, que está cambiando continuamente en el tiempo.

SB: En *Especies de Espacios*, tú partes desde la acústica y la auralización, que es un área más bien científica, sin embargo la experiencia propiamente tal es a través del trabajo con músicos, donde el foco se redirige hacia la percepción de la escucha.

RA: Sí, exactamente. A mí me interesa este ejercicio de cruzar disciplinas. Quieres entender cómo funciona un fenómeno, entonces te pones en un momento dado la gorra de ingeniero acústico, de arquitecto acústico, y operas como uno. Haces el ejercicio de tomar este espacio, lo mides, lo modelizas, intentas extraer toda una serie de puntos, etc. Meterse en la práctica profesional de lo que representa también para entender qué posibilidades tiene la herramienta y qué puedes hacer con ello. Yo creo que es importante entrar en eso, no simplemente decir que es una herramienta técnica que alguien más puede resolver. A través de esa práctica puedes entenderse realmente hasta dónde puedes llegar. El proyecto tiene eso de tomar herramientas del campo de la ingeniería acústica, e intentar llevarlas al terreno de lo creativo. Pero para ello tienes que hacer ese recorrido. Tienes que operarlo tú mismo. Y además es un proceso que no me cuesta, que realmente lo disfruto y entiendo que es muy fructífero. También he operado en ocasiones a nivel de consultor de arquitectura acústica. Es algo que me resulta relativamente familiar y de gran interés. Es más un tema de cómo trasladar unas herramientas, que de por sí son tremendamente operativas. Son herramientas súper potentes porque te permiten evitar toda una serie de errores gruesos a la hora de diseñar un espacio, bien sea un auditorio, bien sea un edificio mucho más de uso diario, de vivienda o lo que sea. Pero a partir de esa herramienta, ¿qué otras posibilidades se derivan cuando la llevas a otros terrenos creativos?

SB: En relación a la herramienta de la auralización y también en relación con el repertorio de efectos sonoros ¿Cómo crees tú que se puede elaborar un lenguaje para definir un entorno sonoro? Con "entorno sonoro" me refiero a todo, sea tanto paisaje, espacio más amplio o algo más específico como la arquitectura. ¿Qué rol jugaría la escucha y la estética en este proceso?

RA: Bueno, yo creo que has tocado ahí en un tema fundamental, que es la dificultad de llamar a los fenómenos sonoros por un nombre, porque al final es un territorio muy híbrido, con gente que viene de diferentes especialidades, que viene de la arquitectura, que viene de la música, que viene de la antropología, que viene de la sociología, que está intentando acercarse a un fenómeno que están observando y no hay un lenguaje común, o no lo había hasta hace poco. Y precisamente este libro del Cresson, *The Sonic Experience*, tiene el objetivo fundamental de proponer una serie de términos que puedan ayudar a hablar de ello, porque realmente la disparidad es total. Y eso es un tema de pedagogía también muy interesante. Una de las cosas que más hacemos aquí es intentar ponernos de acuerdo, sobre todo en una serie de conceptos, para poder hablar de ello, para poder describirlo. Porque al final, preguntas tan sencillas como cuál es la diferencia entre un eco, una reverberación o resonancia, para gente que no esté dedicada, que no sea especialista en sonido, es todo un desafío. Supone una pregunta que puede dar lugar a una hora de debate fácilmente en una clase con los estudiantes aquí y que es muy interesante también, un poco por entender cuáles son los significados que ponemos detrás de esas palabras. También porque vienen de diferentes campos, que tienen diferentes connotaciones en función de qué campo las utilice y en boca de quién estén. Hay términos que se van buscando, se van excavando, van siendo más operativos, otros se abandonan porque claramente no sirven y son menos precisos. Este esfuerzo por definir, por ejemplo, qué es la escucha. Diversas formas de la

escucha. También es un ejercicio como intentar ponerle nombres a diferentes fenómenos que se parecen pero que no son iguales.

SB: A diferencia de lo visual, que uno lo puede entender desde términos más conceptuales, lo sonoro, siento que carece de lenguaje, o tiene un lenguaje muy limitado, y para realmente entenderlo, tenemos que experimentarlo. Cuando lo tratamos de conceptualizar, recurrimos a la experiencia visual para poder definirlo.

RA: Esto es el ejemplo del diseñador sonoro, cuando trabajas con uno y te dicen a mí me gustaría que este sonido fuera más rosa o más brillante o más... son todo metáforas. Lo peor es que ni siquiera son metáforas compartidas. Para alguien brillante puede querer decir que estás incrementando las frecuencias superiores y para otro puede querer decir que le falta un punto de intensidad sonora global. Entonces, bueno, pues es un juego de negociación, ¿no? Casi como de ponerse de acuerdo entre manos qué significa qué. Como conceptos que utilizamos todos los días trabajando con reverberación, "húmedo y seco" es una metáfora fantástica

Alguien que viene de artes gráficas, cuando empieza a hablar de colores, va a tener también unas ideas muy precisas sobre qué significa qué. Entonces también va a tener una cierta dificultad. Al final es un convenio disciplinar el ponerse de acuerdo. Pero entiendo que todavía hay mucho trabajo por hacer ahí. Claramente no hay un lenguaje...

SB: Cuando hablamos de "rosa" para referirnos a algo sonoro, estamos también apelando a una cierta apreciación estética o entendimiento estético de lo que es el color rosa. Desde ese lugar nosotros vamos definiendo elementos más específicos de lo que vendría a ser algo, por ejemplo, relativo a la supervivencia. En ese sentido; ¿Qué rol cumpliría la estética en la conformación de este lenguaje?

RA: Este tema de la estética me resulta fascinante porque entiendes que vuelve a ser algo disciplinar, influenciado por diferentes territorios disciplinares. Algo que a priori que podría pensarse, es por ejemplo un músico va a estar mucho más abierto a sonidos complejos, difíciles de escuchar en cuanto a que son más exigentes, y resulta que más bien es al contrario. Hay ciertas culturas disciplinares que imponen ya unos determinados marcos estéticos, que te imponen una apreciación determinada sobre las cualidades sonoras. Entonces, la estética vuelve a ser algo disciplinar, vuelve a ser cultural. Todavía estamos en un territorio relativamente joven, en el que se encuentra gente que viene de orígenes muy diversos y que, en consecuencia, tiene intereses, sensibilidades, gustos, curiosidades muy, muy diferentes. Y esto se ve en cuanto empiezas a hablar de sonido y especialmente del sonido cotidiano, de cómo analizar un paisaje sonoro o un espacio sonoro. Te encuentras con estas apreciaciones que van muchas veces en contra de lo que uno pensaría de forma intuitiva.

Interview with Daniel Neumann, March 3, 2023

Daniel Neumann will be developing a new soundfield composition for the peculiar architectural and acoustic space of the cistern, infusing it with artificial tonalities.The tones will all be made on site as an improvisation with the space. He will be using his Room Tone Generator (RTG) software synthesizer as well as running experimental recording and feedback processes.

For Neumann Soundfield is the name for the multi-dimensional (depth, width, height, time) composed plus found listening space. In soundfield composition sounds are projected into the architectural three-dimensional space through idiosyncratic multichannel loudspeaker setups. Through resonance and reverberation various characteristics of the physical space are being emphasized,

articulated, transformed, fluidified, fictionalized and then experienced from within by the listeners. The physicality and materiality of sound itself is foregrounded and varied over time. Sound becomes the sculptural gestalt.

Besides the work in the cistern Neumann will present his concept of Non-representational Spatial Sound Composition. The concept of Non-representational Spatial Sound Composition is meant to provide a distinct framework for analyzing and discussing site-specific or site-sensitive spatial sound works. These works have a different focus than surround sound studio composition, which usually attempts to represent a certain studio-made spatiality and aims for spatial transferability into other media or spaces, like the concert hall. So, as De La Motte-Haber frames it, there are two different artistic intentions: on the one hand, sound is represented in space, and on the other, space is presented in sound.

Mathias Klenner: Can you explain the creative process of the composition: Soundfield for the cistern? And which elements of the space are you collecting for the creative process? And how are you collecting them? And which characteristic of the space are changing within the performance?

Daniel Neumann: So, the creative process, first of all, also involves giving the piece a title after it happened. So, the title I gave the piece while I was working on it, in Santiago, now is Das Schwellenstück, which is a German word. It means, literally, the work about thresholds. But because I didn't like that as a translation, the English title is Thresholds of Decentering. Those are the two titles for the work.

I feel like the reason for titling the work afterwards, to me, is also part of the creative process, because I'm making these pieces specifically for the site. So, it's always hard to know what the work will be beforehand, because I want to stay open to what the site gives me. I also kind of see it as a process of listening, where you stay open to what a specific architectural site tells you. And to me, that also includes the name of it. Because I feel like, if I give it a title from the beginning, like a fixed title from the beginning, that's already a constraint. It makes it a little hard with how usually artworks are communicated to the world.

Otherwise, my creative process was that you invited me to create this performance / installation piece for the underground cistern. We talked about a multi-channel sound system and decided for an eight-channel sound system. That gave me the frame for the work. Also, for the past few years, I've been developing this software synthesizer that I call “Room Tone Generator”, and I thought it was a good opportunity, and challenged myself to limit my sonic output to only using this synthesizer.

The synthesizer is made so that you can really fine-tune it to specific resonances or to specific frequencies, and I usually try to tune it to resonances of a space. But not necessarily the mathematical precise resonance of a space, but some tones that create an interesting spatial response in the space. The software instrument has multiple voices, but all the other voices will relate back to one fundamental frequency. So, the different tones will be all related to the resonant frequencies that I'm choosing or tuning to. Also, I'm fascinated by triangular formations in space as the smallest unit that goes beyond the two-channel line that can go across the space. So, I programmed my synthesizer to create triangular chords. The simplest form would be: I have three pitches, and each of those pitches goes to a different speaker in the space. So, then you have a chord that is inherently spatial. That was my working unit to create the piece. I looked up how many triangles would fit into an octagon, because there were eight speakers. I was curious about how many different triangles can I get into this eight-point system, and it was 56 triangles. That became the basic structure of the piece. So, I decided that I will make 56 triangular chords or triphonic sounds, three-channel sounds.

The problem or the difficulty is that I don't live in Santiago, so I didn't have access to the space immediately. I think in an ideal world, I would have worked only in the space and created all of the chords while also sitting in the space. Since that wasn't possible, I was working with the impulse

response recordings that you sent me. That was really cool that you took them two months before. I took them and I created a simulation with my eight-channel system that basically simulated the space. So, I was sitting in the simulated space and I was creating tones for that space and sitting in it.

My original thought was that I will probably, once I get there, throw away those chords and I try to create 56 new ones while I'm there. Because I'd never really done this approach where I hadn't been to the space before creating the work. It was an interesting experiment that also talked about the relationship between this simulated space that I was able to work in at home and the real space, where we had seven days to work when I was there. What I found out pretty immediately was that the tones I created in the simulated space actually translated really well in the actual physical space. So, I decided to keep most of the ones that I created and also integrate them into the performance and used my time there, which was also fairly limited because of other activities and dust and all this stuff. So, I created about 20 or so additional chords when I was in Santiago on the ground and then mixed both of them.

The performance consisted in me sitting in the middle of the audience with an iPad mixer with 56 tracks. Each track was a triangle and a chord and I mixed the performance live between those 56 triphonic chords. It would have been interesting for me to repeat the performance a number of times because every single performance would have been different. To me, making a work usually is to put myself in the position of a listener. Where in a sense, I'm more of a node through which sound can travel. And, I want to put myself in this open position of also listening to encourage an overall situation where the audience can also really focus on that, and where it becomes a real time process that we're all going through.

Sofía Balbontín: In a moment you travel to Chile and you meet the space. So, I was wondering if there was some creative process previous to directly work on the 56 triangular configurations that you brought. Like did you make some impulse responses, for example, or some sweeps? Did you make some process of understanding the space in first instance? Or did you just start working directly in what you had already?

DN: Hmm. I think, is such an impactful space that just by going down the ladder and hearing any sound in the space, you immediately learn a lot about it. I'm sure I did the normal sound engineer thing where you play your human made impulse response, the clap. And that's what I basically do when I go into any space, any concert hall, anywhere. I clap because it's such a great and easily accomplishable test tone, that I definitely did that. And then we spent a lot of time in the space also doing these other workshops. I remember I took a video of Mathias sweeping and just the sound of sweeping in that space, I felt was amazing. So, there was just this like being in the space, spending time making some sounds. It's kind of like you said, a meeting and then getting to know each other. Then setting up some speakers and playing, playing, playing tones into it. I don't think I started immediately with the tones I created. I probably played a set of test tones or did sign sweeps. And then started playing the tones I had created.

SB: But for example, testing the tones, did you realize about something that you grabbed for the performance? Did you find out any resonant frequency that you didn't find out before? And then you start using it for the performance, for example?

DN: Yes. What was less clear or less pronounced in the simulation is how intensive the low end stayed in the space. That to me was a surprise in the actual physical space is how intense the low end remained as a resonance. I remember this one moment when I first tried out the subwoofer.

I also just played some sine waves to see which frequencies would resonate in the very low frequencies, like around 35 hertz or something, very low. I brought up the oscillator and then left it at

a certain level. Then the volume still increased a little bit to a certain point. So, it really felt like, OK, the room is accumulating this frequency, this sound, and then after a little bit, I hit mute on my oscillator. Nothing changed, it was the weirdest thing. I have never experienced that in that intensity. I hit mute and there was no change, the sound just remained in the space.

I remember the first moment that happened, and I was like, my computer is not working. I think I also went over to the subwoofer and checked if I did something wrong, if there was still something playing. Then it took, maybe 10 seconds or so, until the level slowly decreased. That experience is definitely much stronger and much more physical. In the simulation, I couldn't have predicted that. Because it's just about this physically feeling it and being in the space and being fully surrounded by it. In the simulation, you're surrounded by a horizontal plane of speakers, that was the biggest difference. The 20 chords that I made in the space, a lot of them, were concerning these very low frequencies.

SB: We sent you a study made by the Sound Engineering School. Did you use this information?

DN: You sent it to me when I was already in Santiago. Yes. I looked up what they found as resonant frequencies and tried them out in the space, as well as just trusting my own subjective perception. Actually, I love that combination of some scientific information in combination with a very subjective perception of what's happening. So, yes, I used them. And they said there was something about that you shouldn't go below 40 hertz because then the resonances just go crazy.

SB: That's why I ask you, because actually the study says that the 35 hertz is the fundamental frequency of the space. So, actually, it's the frequency that will last more than all of the others.

DN: Yes. But I think, when I did that low end sensation, when I did the first experiments, I don't think I had read the documents yet. I think I was a few hertz off that, of the actual scientific resonant frequencies. I don't fully remember, but maybe I played 36 hertz. The document it said 34 point something hertz, but it still activated the space.

MK: I wanted to know about these three tones, they are like actual chords when you speak in music. Like they are correlated to each other in a geometrical way or not necessarily?

DN: They are three channel sounds with different information, a different sound comes out of each speaker and mixes in the space. Often, they are musical chords, but not necessarily just one sine wave in one speaker and another sine wave in another speaker. I built up the chords in more complex way to create a more complex tonality for it. Sometimes I also mixed in filtered noise. But each chord has an internal relationship as like a musical chord would have, and then the tonalities were different and not necessarily based on singular frequencies, which in music is also the case, because if you play a note on a clarinet, there's also more frequencies, than just the fundamental in it.

MK: I remember some that were like quicker shattering sounds. It was not like a recorded sound.

DN: I decided to limit myself to just generate the sounds with this instrument to have some kind of coherency, and as a challenge. I think it's nice to have a limitation for work instead of mixing everything together all the time. Because I wasn't able to understand it very well when you, when you say it at the beginning.

SB: Can you explain the name of the performance? *Thresholds of Decentering*.

DN: Yes, *Decentering*, I think it's a term from the German psychology, where you put yourself into a perspective of somebody else, that is a gesture of decentering. To me, listening does that where you put yourself in onto the surface of the space or into different positions of the space, these different stages in the process of listening and sitting inside of a space, and where does your mind go? Where does your mind wander? So that's why I picked the title.

SB: Daniel, going back to the question, regarding the elements of the space that you're collecting for the creative process and how you are collecting them. They are resonant frequencies mainly, right?

DN: Yes, or maybe sometimes it's listening and testing again and listening again, and then very conscious of this process, right? Like the subjective interaction with the space more than the scientific method of discovering this. So, then sometimes I think it's also finding tones, that have an interesting character in the space. It can also be an anti-resonance, like something that gets swallowed up by the space, but it creates a weird sensation. To me, that's fascinating too. And also, detuning, especially with the low frequencies again. What was interesting is to detune an oscillator because it started beating with itself in the space between the reverberation and the new tone that's being fed in. Those kinds of phenomena, I think also super fascinating. But yeah, it was definitely a fun project for me to also go through the process of only using this instrument and making a full set of tones, and then executing the performance. This year, my project is actually to make a second version of this instrument with a professional programmer. It's all in Max MSP, but I'm starting from scratch. I'm completely reprogramming everything.

MK: I guess during the workshop, was nice that the students were able to play with it, with the software

DN: Yes. That's definitely a part of what I want to do with this instrument. Is to also offer it out to other people, to make it more accessible in that sense. But first I want to develop a version that I feel like works for my performance practice, and then see what comes after through some workshops and collaborative developments. That was also definitely inspired by the workshop I gave in the cistern and with the students, because they seemed to really enjoy playing with it. Also, because the instrument, the performance instrument itself, is super simple because you just have 56 faders. Then the routing into these different triangles all happens in the background, so you don't have to worry about it. All you can do is bring certain tones up and listen, and you don't even have to necessarily know what those tones are in order to have fun with it.

MK: Can you explain what does it mean for you, the concept of room tone?

DN: That's a good question. It actually leads to the history of this instrument because I first programmed it for an artist friend of mine, Axel Töpfer. He makes installations, and he likes to put a background sound into his installations that alters the existing room tone a little bit, but without being too obvious. It was an instrument to actually alter the room tone. Room tone usually comes from working in films where you record the tone of a room, which often is just a background hum, or just like the base tonality of a space.

This instrument was made to alter that base tone of a room. I also like working from the tone that is already present in a room. In that sense, the name for me is interesting because it refers to the room tone of the space that I am active in. I first pay attention to that, and then I put more sounds into it, and I change the existing tonality, but always listening to the background sound, the sound that is there. For me, that is also an important method of performing, is to listen to the background sound, to listen to what's there, to focus on the environment that you're sitting in.

I remember one performance that I did, it was not with this instrument, it was with other sounds. I think it was at the end of the piece. I very, very, very gradually went into silence, but there was some room tone left, and the audience didn't know if it was finished or not. We were just listening to the room for at least two or three minutes, before I gestured something that indicates that I was done. To me, that's beautiful, and that's the kind of sensibility I love to create in performance. This instrument comes from that type of thinking.

MK: It's interesting that this idea of room tone comes from the filming industry, from the field of vision. The idea of recording the background noise. But I guess probably in sound engineering and in music also, it's a common practice to just stay in the place and hear the sounds.

DN: But it's so important in terms of setting a scene and giving the people that watch the film a three dimensionality. That's what foregrounds, the sort of effect of a room tone is when in a film there's no atmosphere, the image is totally unbelievable and flat and weird. But as soon as you put a background room tone in it, all of a sudden becomes relatable. To me, it's fascinating that a lot of our spatial orientation, and how we place ourselves into an environment, how we perceive ourselves in an environment, a lot of those cues are actually sonic cues.

They usually work in a very subconscious way. But to me, it is interesting to bring those sensibilities a bit more into the consciousness, because I think there's also something grounding to it from a human existential perspective. On that note, I'm also more interested in fostering these kinds of sensibilities rather than drowning out the existing environment with something that I made. I feel as a sound engineer, you often drown out what's there to foreground the music. To also foreground the music in the sense that you have to get rid of the special characteristics of the unique space. For me, it's fascinating to use the same tools, but with an inverse goal, which is to foreground the special characteristics of the spaces and to focus on them and to see what they can tell us or to just listen to them, just be open and enjoy listening to them.

MK: That is a really beautiful approach, coming from the sound engineer perspective to do exactly the opposite that everybody has told you to do all the time.

DN: But also using the same tools, with test tones, EQs, filters.

SB: How does this software work? Like how do you find the tones? Or is it an automatized system?

DN: At the moment, it's very manual. So, I basically have different oscillator voices with different characters. Some of them are sine waves, some of them are phase modulated, some of them are very steep filtered noise. I always start with one sine wave. I tune that sine wave to a frequency and that's only coming out of one speaker. That's the starting point. Then the other voices and the other oscillators, they have mathematical ratios like one fourth, four fifth, 12th, 11th, 7th, 8th. I have multiple tuning systems that I can recall.

So, I have a just intonation, I have just weird random relation ratios. So, then I choose a ratio and bring up a second tone in the second speaker and then a third. Then I add other sounds to those until they become an interesting chord. Then I record that chord, and that's one triphonic sound that is in one triangle. I put that to the side and I start with the next one. Then I make 56, and because everything is manual, it took me two months. But it also allows this very weird, unique tunings.

Now in the second version, I want to have some more automatic analysis and different presets for overtones. So, my goal is to make this process faster, but to still be a site-specific instrument. I'm not sure what I will end up with, in terms of what the shortest amount of time in a space. But my hope is that at some point I will be able to just be in a space for one day and create a set of 56 tones and

then play the concert in the evening. From today, where I am, that's a very ambitious goal, but that would be cool. Because that would allow me to do this piece, like site-specific pieces in a variety of places and would make it easier.

MK: You don't analyze graphically the sound pressure level of the frequencies of the impulse response. You just played with the sounds directly.

DN: I looked at the input. I looked at the impulse response too, when you send it to me. So, I take some information of that, but my main approach is to rely on my subjective perspective of the room and try to create something that feels unique for the space.

MK: This is much more the way that Maryanne Amacher used to do her pieces.

DN: She was always like hearing and just scripting, putting like the tones directly on paper. I definitely feel my work is inspired by hers. I take a lot of inspiration from her spatial work for sure. Also, her ideas about composition, that a composition is never finished, that is always a temporary formation.

In the past, I have worked more similarly to her approach, because she had a collection of recordings, tapes in her case, that she always worked with. So, she had this suitcase of sound characters, tapes that she would play back in different spaces and put the speakers in strange relationships, to the existing architecture. In past pieces, I think I had more that sort of approach where I had a vocabulary of recordings that I would apply to the new spaces, which is a much faster way of working because you already have a vocabulary in your bag. Then each performance is different, and also in each performance you can expand your vocabulary, rerecord and use that for the space. With this instrument I want to reduce and focus in the very space I am in.

MK: Regarding composition, you use this concept that is directly from your work that is the non-representational spatial sound composition. Can you explain us about this concept? And how does it operate in your work?

DN: This concept of non-representational spatial sound composition is about developing a way of doing spatial sound composition that is different from the surround sound approach. The difference is that it foregrounds the existing physical space, it presents the space in sound and it does not represent a pre-existing spatiality with sound. Is a little formula that I drew from a statement by Helga De La Motte-Haber. It basically frames those works like Maryanne Amacher's or certain pieces by Alvin Lucier or the piece *4.33* by John Cage. Pieces that foreground special characteristics of spaces. Those are not pieces that are composed in a studio and then presented in a concert hall.

I used the term non-representational on that level where the spatiality that is composed is not trying to represent something when it's played back in a concert hall, but it's basically a unified method where the composed space and the listening space is folded in together, there's no separation. I feel like a lot of sound installations operate on that level, at least site-specific ones, where they are made for a specific site with the specific spatial and architectural characteristics of that space. Not only influencing, but determining how the installation is. So, with that term, I'm just trying to frame this compositional approach that I'm seeing, but I haven't found a term for it.

MK: In this case, in all these works, we may say that space is the main character, is what is put it up on front? Even though that you're working with sound directly.

DN: Yes, space becomes the material of the work as well. But the sound is implemented to foreground certain features of the space. So, it's more of a dialogue with the space, and it's less putting a certain content into a space.

MK: What happens in a simulation? I was thinking when you were in your studio working with the impulse response.

DN: To be working in the simulation is just a practical tool in instances where the performance venue is thousands of miles away. A simulation like that can provide a tool to prepare, but I still then had seven days in the actual space to make sure that what I did in the simulation actually works. But in the purest approach of this method, you would only work in the space. You would do every single step in sitting inside of the space. The simulation in a sense is like an imagined version of the space.

MK: Daniel, going forward, or maybe deeper, when you talk about the spatial sound composition, which for us is something that we are talking about at this moment, the idea of sound space, of these two words working together. We always ask this question. How does your work use this concept? And what does it mean for you?

DN: The concept of sound space. Maybe I'll start with trying to frame my instrument. I see the loudspeaker in connection with the space, as my instrument to create a sonic work, a composition. Then that instrument between the architectural space and the loudspeaker, it goes into a relationship, heightens that or mediates it, creates something artificial, creates new tonalities, expands the existing space, morphs it. Then with the tonalities that are being put in, you work creatively to morph this existing space. To me, that's the beauty of what sound can do. You can actually morph a three-dimensional space into something like artificial or expansive that has the listener in it.

To me, the beautiful thing about sound space is also that it includes the listener within it. That it's not a separate thing like a painting on a wall. It's always only happening in this very moment where this formation happens with all these elements. It's this temporary formation. Sound space to me is a temporary formation with all these different elements that make it happen in a certain moment. And one of the elements is also the listener who is inside of it and then also participating in the production of it.

MK: The other question we are always doing in these interviews is about another concept related to this one, but not exactly the same, which is the concept of aural architecture. What does it mean for you, aural architecture? And do you think there is the difference with sound space?

DN: Interesting question. It seems to have a slightly different weight. Aural architecture, to me, is maybe more focused on the material barriers and how they influence the sound. And sound space is this more wholesome thing that also includes perception, even though aural also includes perception. For me, it's hard to try to frame a difference there. It sounds it's almost the same, but maybe with aural architecture being a bit more focused on material conditions and sound space maybe more slightly weighted toward also including the perceptual, perceptional apparatuses.

Interview with Pablo Elinbaum, December 4, 2023

Mathias Klenner: La primera pregunta es sobre el concepto de espacio sonoro, nos gustaría saber qué significa para ti este concepto de espacio sonoro, y luego saber si lo utilizas en tu trabajo e investigaciones.

Pablo Elinbaum: La idea del espacio sonoro es bastante ambigua, abierta, polisémica, para mí sería como el espacio que podemos percibir a través de la escucha. Pero no es un espacio acústico propiamente, no es un espacio pensado para el cálculo, o para la construcción, o para construir un efecto de reverberación específico, sino que es un espacio más vinculado a la experiencia, a lo vivencial, a lo perceptivo. De hecho en una conversación que tuvimos hace poco, tú me preguntabas si es auralidad, espacio sonoro o espacio aural, tratando de precisar el concepto. Para mí, es más bien espacio aural que espacio sonoro. Lo pienso en primer lugar, como una herramienta de conocimiento, analítica, una herramienta interpretativa del entorno, y por lo tanto de utilidad bastante amplia y subjetiva. Es un concepto que es como un chicle, y que yo también lo fui moldeando, sobre todo en relación a mis investigaciones dentro del campo de estudios urbanos, para poder entender otras dimensiones del espacio urbano, otras dimensiones del espacio arquitectónico.

El espacio arquitectónico es un espacio euclidiano, un espacio cerrado, extremadamente geométrico, y el espacio aural o el espacio sonoro es un espacio no euclidiano. La arquitectura fragmenta el espacio, y el sonido lo vuelve a unir. Para mí eso fue muy útil, porque necesitaba ese espacio más fluido, más performático. El espacio que produce la actividad de las personas, o el sonido, entre otros. Lo que me ayudó también a complementar otro objeto de estudio que es el espacio estatal, la territorialidad que produce el Estado. Que siempre es un espacio, euclidiano, modulado, perfectamente delimitado en jurisdicciones, sonificaciones. En cambio el espacio sonoro siempre es más discontinuo, heterogéneo, intermitente, disruptivo, y además te obliga a pensar no solo en cuestiones conceptuales, sino también en cuestiones metodológicas. Nociones típicas del urbanismo, de la geografía, incluso de la arquitectura, como la idea de lugar, de territorio, de escala, en el espacio sonoro, en el espacio que podemos escuchar, pero también en el espacio de las grabaciones de campo, todo parece diluido, no es que no existe, pero tiene otra forma. Está como más imbricado, la idea de escala, de territorio, de centro no existe, y además tiene una cosa poco fáctica. Es decir, cuando escuchamos, algunas cosas se pueden verificar, y puedes decir, bueno, que estás escuchando un motor en la otra habitación, y te vas a la otra habitación y lo ves, ves que está ahí, pero hay otras cosas que no, y entonces no sabes si te las estás imaginando, si es una cosa de sugestión, de la memoria. Entonces esa dimensión no fáctica, casi misteriosa o mágica, también me ayudó mucho, me interesó mucho.

MK: Tú ya nombraste el espacio aural, a nosotros nos interesa hablar de la arquitectura aural, o arquitectura auditiva, ¿qué significa para ti ese concepto de arquitectura aural?

PE: Creo que esto alguna vez lo charlamos en Barcelona, para mí arquitectura aural es una escultura, es como lo que hace Leitner o Lucas Kühne. Son arquitecturas ad hoc, pensadas para espacios que reverberen de una forma específica, o para escuchar el entorno de una forma específica, muy didáctica, o más científica, o más artística, o más poética. Pero son esculturas, siempre es un objeto específico, una especie de artificio, algo pensado para eso específicamente. Son objetos pensados como una obra de arte objetual, algo que puede estar en un museo o incluso como algo pensado para explorar cualidades acústicas o reverberantes específicas de manera científica, que tiene un fin específico. Para mí, desde esa definición, no me interesa tanto la arquitectura aural, sino descubrir la auralidad de la arquitectura, que es como un trabajo más inductivo, interpretativo y subjetivo.

MK: ¿Existe alguna diferencia entre espacio sonoro y arquitectura aural?

PE: Para mí, la principal diferencia es esa. Arquitectura Aural es un espacio construido ad hoc para eso, para que sea interesante, entre comillas, en términos acústicos o reverberantes. Pienso en la obra de Lucas Khüne, que son estas habitaciones, cada una tiene un volumen distinto, para reverberar de manera distinta. Es una cosa siempre didáctica y pensada pura y exclusivamente para eso. A mí lo que me interesa es descubrir la auralidad de la arquitectura, o de los lugares, o del espacio público, que no fue pensado para eso. Que obviamente tiene su propia reverberación, su propio funcionamiento acústico, pero lo defino yo mismo, con mi propia experiencia, estando ahí y escuchando.

MK: Blesser & Salter definen Arquitectura Aural como una disciplina también, con un diseño de experiencias de escucha. De hecho lo llevan a distintos niveles, no sólo una sala para escuchar, un salón de clases, o una sala de música, sino que pueden ser también otro tipo de experiencias, como las que dices tú, más artísticas o virtuales.

PE: Puede ser, ahí empiezan a aparecer unas cosas que sí me interesan un poco más. Por ejemplo, lo que es el diseño de auditorios, que es un problema de acústica, es un problema científico, o sea, que ciertas fuentes se escuchen bien, con claridad, que no haya eco. Todo eso, me parece una disciplina muy específica, técnica, que puede ser la de la acústica, o ingeniería acústica, arquitectura acústica, que me parece que está bien, pero a mí no es lo que me interesa. Sí me interesa pensar espacios, pero más bien descubrir espacios. Hay un artículo de Blesser y Salter, que hay una foto, creo que es un concierto de Stockhausen, en una especie de caverna, no sé si lo vieron, es una revista holandesa: OASE. Eso sí me interesa, llevar los músicos a una caverna para ver qué pasa. La cuestión más exploratoria, pero me parece algo bien distinto a diseñar un auditorio para que suene de manera correcta, y quizás la clave está en eso, en lo normativo, en lo codificado. Me parece que la idea de espacio aural va por otro lado, va justamente por lo disruptivo, por la sorpresa, por lo discontinuo, por lo no normativo, por lo que no se puede codificar, no sé si está claro.

MK: En uno de los artículos que publicaste, mencionas otro concepto, que es el concepto de auralidad urbana. Nos gustaría que nos explicaras ese concepto, y cómo este se relaciona con el proyecto de Monumentos de la Auralidad.

PE: En relación a lo primero, a auralidad urbana, sería un poco esta actitud, ¿no?, de escucha, y de experiencia de la escucha, pero particularmente en el espacio urbano, que es un espacio de complejidad arquitectónica, por llamarlo de algún modo. Pero además el espacio urbano es una especie de caldo de cultivo del capitalismo. Entonces, está atado a otras condiciones, otros motores, otras dinámicas. En particular, para definir esa idea de espacio aural, o de auralidad urbana, trabajé con dos o tres teorías o marcos que me interesan.

Uno es el de universalismo débil de Boris Groys, y el otro es la estética relacional de Nicolás Bourriaud. Son teorías que están bastante cercanas, muy articuladas, que tienen que ver con formas transitivas, y esto tiene que ver con lo que charlábamos antes. Para mí, la idea de la obra de arte como objeto ya pasó, ya fue, me parece que es del siglo pasado. El arte tiene más que ver con experiencias, y con procesos, y con objetos que no son exclusivamente pensados como obra de arte. También tiene que ver con la transparencia de los procesos de producción, es decir, que en cada cosa que se investiga, o que se hace, tiene que mostrar cómo fue producido, y mostrar las implicancias de esa producción.

Todas esas teorías me ayudan, o me ayudaron de algún modo, a problematizar lo que les comentaba antes: aproximaciones más codificadas sobre el espacio. Por ejemplo, los mapas, o los planos codificados que hace el Estado o las disciplinas más institucionalizadas. Pensar el espacio aural a partir de tres o cuatro elementos. Primero, como una especie de interticio. Esto es casi un programa

analítico, pero también un programa de producción, de producción artística. Un interticio local, en un conjunto de dinámicas que pueden ser globales. Entonces, es delimitar una unidad de estudio, o de campo de estudio, que también tiene su propia lógica, incluso su propia autonomía. Pienso en esta idea del rizoma, que uno extrae del mundo un objeto que tiene su propia lógica, su propia entrada, pero lo extrae para poder explicarlo en sí mismo.

En segundo lugar, la idea de espacio aural tiene que ver con una materialidad compleja, híbrida, natural, artificial, cultural y natural. Una especie de materialismo sereno, como decía Guattari. Bajo la idea de poder desmontar, desterritorializar, o deconstruir esta cosa muy opaca del espacio urbano, que es la superficie que se ve. Lo que hablábamos antes, ¿no?, Sanhattan y todas estas torres, que es un paisaje genérico, que si estás ahí abajo puede parecer el 22 Arroba, o algún rinconcito de Manhattan, o cualquier distrito de oficinas. Pero se trata justamente de entender cómo se produce, cuál es la diferencia, cuál es la especificidad, qué intereses hay detrás. Es una lógica también muy investigativa en ciencias sociales. Un materialismo también aleatorio, que permite la oportunidad de inventarse nuevos materialismos a partir de cosas que generalmente están separadas. El río y la pampa, o la ciudad y el campo, cosas como muy estereotipadas, que uno puede pensar como un materialismo único. Eso también vinculado a este campo de lo sonoro, de la exploración sonora, que se opone mucho a la lógica de la ecología acústica, de Murray Schafer, que tiene un voluntarismo y un moralismo. Que tiene que ver con eso, que los sonidos de la ciudad son malos, y los sonidos del campo y de la naturaleza son buenos. Desde esta lógica, desde lo que yo propongo, eso no existe, no existe campo y ciudad, es todo una misma cosa, todo el mismo metabolismo, todo una continuidad, mucho más compleja.

En tercer lugar, este espacio aural no solo tiene una materialidad imbricada, o una espacialidad imbricada, sino también una temporalidad enmarañada, que permite cuestionar la historia, la historia con mayúscula. Eso es algo que también me ayudó mucho. Yo venía de un formato de ciencias sociales, de entender los procesos y las periodizaciones de manera muy estereotipada. La típica historiografía, que es la historia que está en los libros. La grabación de campo y toda la lógica de la escucha, me ayudó a inventarme mi propia historia, que se cruza con aproximaciones subjetivas y autobiográficas, cosas que tienen que ver con la memoria, cruzadas con el presente, y son diferentes entradas que matizan la temporalidad o las temporalidades. Ni hablar, lo que implica grabar, mezclar audio puede superponer temporalidades, eso con medios de representación visual es muy difícil.

Lo de monumentos de la auralidad, en realidad surge un poco de eso. Esta idea de espacio aural que tiene una temporalidad autobiográfica, nos hacía pensar en los trabajos de Robert Smithson, de estas recorridas o derivas que hacía por su ciudad natal, por New Jersey. Donde encontraba cloacas y cosas abandonadas, ruinas modernas, y la cloaca era como la fuente, hacía una interpretación. Entonces, a partir de una mirada interpretativa y autobiográfica, desafiar lo establecido, donde cada uno pueda definir cuál es el estatuto, qué es lo importante y qué no, cuáles son los hitos y cuáles no, cuáles son nuestros propios monumentos. También la idea del re-remake, que de pronto un desagüe de cloaca puede ser una fuente, y lo delimito como eso y lo invento desde ese punto, desde esa interpretación, más ad hoc, más personal, casi como borrando cualquier sentido anterior. Entonces, es una licencia para hacer eso, para reinventar el entorno, reconceptualizarlo, renombrarlo, refundarlo, recolonizarlo.

MK: Pero desde la escucha.

PE: Claro, se puede hacer con otros mecanismos, con otras aproximaciones, con otros medios, pero en este caso a mí me interesó hacerlo desde la escucha, me permitió hacer eso. La escucha, los paseos sonoros, y sobre todo la grabación de campo. La grabación de campo para eso es increíble.

MK: La auralidad urbana, que si lo leemos de forma literal, diríamos que es la dimensión de la escucha del espacio urbano. ¿Se puede entender como una serie de operaciones o herramientas?, ¿Se podría

entender como una parte del diseño urbano, por ejemplo, o es netamente una cosa más experiencial e investigativa?

PE: Para mí es lo segundo. Porque pensar en términos de diseño, no es espacio aural, sino de espacio acústico. Quizás es una distinción muy rudimentaria, pero lo acústico, científico, y técnico, lo separo de lo aural, de lo más perceptivo, subjetivo y autobiográfico. Las dos son formas de entender y de describir el mundo, pero con fines muy distintos. Para mí el espacio aural está más cerca del espacio vivido, y espacio acústico está más cerca del espacio concebido, como lo planteaba Henri Lefebvre. El espacio pensado desde la disciplina técnica, desde la arquitectura, desde el urbanismo, desde gente especialista que piensa el espacio. En cambio lo otro es una experiencia cotidiana. Por eso es disruptiva, porque no toma en cuenta códigos, ni indicadores, ni medidas. No hay nada preestablecido. Cuál es el umbral de ruido desde la lógica del espacio aural, no existe. En cambio desde el otro sí.

MK: Blesser & Salter, cuando hablan de arquitectura aural, y si pudiéramos hablar de urbanismo aural, postulan la idea de diseñar esas experiencias, que no tendría que ver tanto con la acústica, sino más bien cuáles son los sonidos que integrarían el espacio urbano. Porque evidentemente diseñamos el espacio urbano con una serie de estrategias que muchas veces responden a temas de funcionalidad, o de economía, o ciertas temáticas que tienen que ver con cosas estéticas, pero que quedan en un ámbito más visual en general. Pero parece lejano que los diseñadores urbanos, piensen, por ejemplo, cuáles son los sonidos que componen un espacio urbano o la ciudad misma. En realidad se entiende que esos sonidos son una resultante. Blesser & Salter postulan que es posible diseñar esa experiencia.

PE: Sí, coincido con lo que dices, me interesa eso, el diseño de la experiencia, pero sobre todo en el sentido que lo hacían los situacionistas, como una cosa autobiográfica y colectiva, pero siempre disruptiva, tratar de salir de las formas impuestas, estereotipadas, convencionales y codificadas. Pensar, tergiversar el uso de las cosas, o la forma de las cosas, en ese sentido sí me interesa. Pero después, todo el tema de la conciencia sobre la especificidad de los sonidos de un lugar en términos de identidad, por ejemplo, para mí es un arma de doble filo y es algo que tampoco me interesa mucho. No sé si leyeron algo a Antonella Radici, ella hizo una guía para los paseos sonoros, que está más afiliada a la vertiente de la ecología acústica. Hizo una especie de clasificación de los sonidos de los lugares, pero con una perspectiva patrimonialista, que es como museificar esos sonidos y congelarlos. De hecho, se convirtió en una norma ISO, de los paisajes sonoros de determinados lugares, cómo hay que registrarlos. Todo eso no sólo no me interesa, sino que estoy en contra. Milito en contra del congelamiento y la museificación de cualquier tipo de signo, ya sea sonoro, visual, etc.

MK: Me parece interesante lo que decías tú respecto a los situacionistas, bajo la idea de caminata sonora, por ejemplo, o la idea de atravesar una ciudad o un espacio, desde lo aural. Para mí, no es solamente una exploración o una investigación, sino también un acto creativo, y por lo tanto sí pasa a ser un acto de diseño, al momento de recorrer ese espacio. Me gusta la idea de que se puede romper el binomio de investigación y diseño, o investigación y creación, y que quizás es una cosa un poco más difusa, que la investigación también es una manera de crear realidad.

PE: Sí, coincido. De hecho, nosotros damos un taller, seminario que se llama Auralidad, Grabación de Campo y Cartografía Reflexiva. Esa cartografía reflexiva es esto, es una herramienta para que las personas puedan registrar y comunicar su propio espacio. Es un tipo de diseño, porque estamos hablando del mismo espacio, pero cada uno lo cuenta y lo vive de manera distinta. Poder tener herramientas para registrar eso, para describirlo, es una forma de diseño. También está la idea del proyecto implícito, de Giuseppe Dematteis, que se vincula a lo de Guattari también, que el proyecto ya está

ahí, lo único que hay que hacer es descubrirlo, como una especie de arqueología, no es hacer algo nuevo, sino descubrir relaciones que están ocultas. Esa es una forma de proyectar y de diseñar también.

MK: Paso a la siguiente pregunta ¿cuál es para ti el punto de articulación entre música y arquitectura? Y, ¿crees que el cruce entre la música y la arquitectura, con el sonido y el espacio, están relacionados?

PE: Sí, por un lado esto se vincula a lo que charlamos antes de la arquitectura aural, o por lo menos como yo la interpreto, como una escultura. Pienso en el pabellón Phillips. Son dos aproximaciones a la arquitectura y a la música que no me interesan. Me parecen que fueron productivas en un momento, pero que creo que son como discusiones o exploraciones artísticas del siglo pasado. La música en sí, la composición musical, bueno, hubo también mucha discusión sobre composición, improvisación y todo eso.

A mí, a esta altura me parece que son discusiones que ya caducaron, ni siquiera me parece muy relevante. La música como producción artística tampoco. O sea, no quiere decir que no escuche música. Sí escucho música, pero me parece que, por lo menos la música codificada, la música académica y todos sus derivados, dentro de lo que puede ser el mundo de los estudios sonoros o del arte sonoro, es una partecita mínima y muy poco interesante.

Sí me interesa, por ejemplo, para hablar del espacio aural, la improvisación libre y las prácticas de improvisación libre. En el sentido que, por lo menos como yo la interpreto, también es una práctica disruptiva y que involucra no solo desarmar los instrumentos, desarmar los códigos musicales o cualquier codificación sonora, sino que también implica desarmar el espacio de performance, desarmar el escenario público, músico, etc. Eso me parece súper interesante. En la improvisación libre no existe eso, de hecho no existe público, si nos ponemos muy finos, se rompe hasta la figura del público. Entonces, improvisar implica, por un lado, un espacio que desborda claramente el escenario y por otro lado también un tiempo que desborda el tiempo de la performance.

Hay una figura de un libro de Nachmanovtich, y que dice que en una situación de improvisación, la música empezó antes de que los músicos comiencen a improvisar, porque son los sonidos del mundo y del medioambiente, y cuando la gente termina de tocar, esos sonidos siguen. Entonces lo único que uno hace es intervenir en algo que ya empezó. Eso también lo ato con la idea de flujo sonoro de Cox, Sonic Flux, que también me parece muy productiva, y me parece uno de los libros que sobre todo sintetiza un montón de discusiones de los últimos 20 años, y pone el foco en el materialismo, en la materialidad del sonido. Él habla que existe este flujo primordial de donde vienen todos los sonidos y al cual después vuelven.

MK: La última pregunta ¿se podría entender el concepto de espacio sonoro y arquitectura aural, o espacio aural, a través de una dimensión política y social?

PE: Sí, eso siempre está, la dimensión política y social. Es el punto de partida de mi investigación en estudios urbanos, como mi práctica dentro del mundo del arte sonoro, del field recording, de los paseos sonoros. Me apoyo mucho en todos los escritos de Brandon Labelle, el carácter social del sonido y esta idea de que atrás del ruido siempre hay una persona, y que el ruido siempre es relacional, el sonido es relacional, y desde esa perspectiva, siempre es un espacio de conflicto y de negociación forzosa, de acuerdo, de transacción continua, querramoslo o no. Además es una evidencia cabal del entorno y del ambiente que habitamos, del tipo de ciudades que habitamos, ciudades modernas, de entornos capitalistas, totalmente alienantes, de proximidad forzosa. El sonido no es lo único, pero el sonido exacerba esas relaciones, y esa especificidad, esa alienación del tipo de entorno que estudiamos, y eso sale de la dimensión política y social del sonido. Nicolás Bourriaud dice que el arte moderno es un arte urbano, que tiene que ver con la proximidad, y que surge a partir de la proximidad, de estar juntos, de la masividad.

Paulino Oliveros también hablaba del ruido, pero en el otro sentido. Una vez le preguntaron en relación al deep listening, cómo era posible desarrollar esa práctica en un entorno tan alienante como el de las ciudades modernas, y ella decía que la forma de enfrentarse al ruido era hacer más ruido. Me gustó mucho eso también, me sirvió, porque todos producimos ruido. Atrás de un ruido hay una persona, y nosotros también producimos ruido, entonces esa dimensión relacional para mí es clave, para entender, para analizar y también para producir.