M U S I C   F O R   S P A C E S

Politecnico di Milano
Master of Science in Interior and Spatial Design
Research Thesis

Music for spaces

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/ ABSTRACT

This thesis is founded on the investigation of how sound can be conceived and utilized as a primary construction material to enhance the spatial experience. The research explores the dynamics and properties of digital sound, specifically understood as music: sound to which a deliberate artistic and architectural intention is applied.
The work develops through a theoretical framework examining how music captures spatial and atmospheric values, reflecting its acoustic and emotional characteristics within the physical realm. Following this theoretical discourse, the thesis presents a design proposal that merges musical elements with spatial perception through two twin acoustic-spatial installations.
The spatial development of the project is paired with a sonic evolution, involving the composition of audio tracks intended as the “foundational material” of the two spaces. Alongside these tracks, the study introduces a system of graphic notation designed to visually represent the characteristics of the various sounds analyzed and developed.
The final result is a project that bridges the worlds of music and architectural design, allowing both disciplines to express values and qualities that would otherwise remain unexpressed if treated independently.

KEYWORDS:
Soundscape, Music, Sound, Space, Atmosphere, Resonance, Perception, Multimedia, Audio-spatial synthesis

La tesi si fonda sull’intenzione di studiare e comprendere come il suono possa essere concepito ed utilizzato come materiale di costruzione ed esaltazione dell’esperienza spaziale. Il tema esplora le dinamiche e le proprietà del suono digitale, inteso in modo più specifico come musica: un suono a cui è applicata un’intenzione artistica e progettuale.
Il lavoro si sviluppa attraverso una ricerca ed elaborazione teorica legata a come la musica sia in grado di cogliere valori spaziali ed atmosferici, riflettendo le proprie caratteristiche acustiche ed emozionali all’interno dello spazio fisico. A seguito del discorso teorico viene presentata una proposta progettuale che ricerca l’unione dell’elemento musicale e sonoro con il progetto e una riflessione sulla percezione degli spazi. Il progetto è costituito da due installazioni acustico-spaziali gemelle, in cui lo sviluppo spaziale si accosta a quello sonoro attraverso la composizione di tracce audio destinate a diventare materiale costruttivo degli spazi stessi.
A queste tracce si affianca l’elaborazione di un sistema di notazione grafico-musicale capace di rendere, attraverso espedienti visivi, le caratteristiche dei diversi suoni analizzati e sviluppati. Il risultato determina un progetto che intende unire due mondi spesso lontani, quello musicale e quello architettonico-spaziale, dando la possibilità a entrambi di esprimere valori e caratteri che, indipendentemente, andrebbero perduti.

PAROLE CHIAVE:
Soundscape, Musica, Suono, Spazio, Atmosfera, Risonanza, Percezione, Multimediale, Sintesi audio-spaziale

CONTENTS

/ INTRODUCTION

The predominant conception within the discourse of the design of spaces is based on strictly material, formal, and functional aspects. What is most often considered during a design process is determined by the necessities of space usage and, very strongly, by visual qualities. The theme of ocularcentrism, explored by Pallasmaa (2005) in *The eyes of the skin: Architecture and the senses*, reflects precisely on how attention to what is seen (the color and the form of the architectural material) is often privileged as a founding aspect for the outcome of a design work. In addition to these characterizing elements, other factors are present, such as light, which is generally less considered than forms but is nonetheless often included and elaborated within a project. But the atmospheric, emotional, and perceptive qualities of a space are also defined by other factors that contribute to the total sensory connotation of a place.

The point I intend to focus on through the work that follows concerns one of these aspects: the acoustic one. Beyond the understanding of the acoustic physics of spaces and materials, which intrinsically participates in the material characteristics of architecture, I intend to go a step further; that is, to understand how the integration of sound as an additional element can contribute to the creation of a more intense perceptive space. The goal is therefore to overcome the ocularcentric culture, shifting the attention toward the invisible, which will be analyzed not only as vibration but also as a true material of spatial composition.

The research work is based on a process that starts from the understanding of the value of environmental sounds, essential elements of the space we inhabit, which characterize and at the same time represent it. What follows becomes a study that includes themes related to the history, philosophy, and aesthetics of music, always seeking a spatial connotation, highlighting the historical links that the art concerning sound has sought with the discipline concerning space. The sought result is therefore a demonstration of how these two worlds, extremely broad and complex, characterized by two important historical timelines, have been brought into contact and have sought a collaboration over time, especially during the last century and a half. What derives from this is an experimentation carried out by numerous key authors in the history of music, whose works and visions are analyzed to understand the methods and reasons that led these figures to search for a meeting point between music and physical space.

Following the theoretical framework, which lays the conceptual foundations, the intent is to develop a design demonstration and experimentation capable of showing how spatial design can benefit from the encounter with music and sound, elevating spatial properties and defining new experiences of life within places.

PART I

LISTENING TO SPACE

/ THE SOUNDSCAPE

/ NOISE

/ SILENCE

The act of listening to the surrounding space constitutes a fundamental entry point for the experience of understanding context. Places are animated by distinct sonic components that are in constant flux; these participate in the construction of environmental perception in its totality. Every sound carries meanings, evocations, and memories, rendering one's presence in a place a moment of reflection on the dynamic relationship between the external world and the listening subject. The transience, stability, intensity, rhythm, and frequencies of sounds introduce dynamism to spatial characteristics, acting as indicators of elements, understood as sound sources, that influence places and express their specificities.

/ THE SOUNDSCAPE

SEMANTIC VALUE OF AMBIENT SOUNDS

Environmental sounds largely define the acoustic experience of human life. They are often ignored or not analyzed with particular attention in everyday life, as most of us are used to living in environments where a wide variety of sounds coexist. Because of this constant exposure, our minds automatically associate specific semantic values with these sounds and contextualize them according to the situations in which they most often occur.

COLLECTIVE MEMORY

The perception of environmental sounds is therefore a universal human experience, yet it varies depending on the place in which one lives. Each community coexists with its own range of auditory stimuli, which become part of the collective memory of that group and are imbued with shared meanings.

WORLD SOUNDSCAPE PROJECT

THE ACOUSTIC ENVIRONMENT

The study of the meaning and phenomenology of such sounds was explored by the Canadian researcher R. Murray Schafer. In the 1960s, Schafer launched the World Soundscape Project, an international research initiative, in Vancouver. The term “soundscape” refers to the landscape of environmental sounds of all kinds that together compose the acoustic environment, in which every element contributes to the overall auditory field. The research continued for several years, examining the topic from multiple perspectives (scientific, social, artistic, and psychological) to create as comprehensive a picture as possible.

ACOUSTIC ECOLOGY

Thanks to the multidisciplinary approach applied to this project, it was possible to develop what is now defined as acoustic ecology, a field of study that, through listening to the soundscape, analyzes its characteristics to foster social and environmental awareness. One of Schafer’s followers who contributed most to the development of this discipline was Hildegard Westerkamp (2002), who, in *Linking soundscape composition and acoustic ecology*, examines the importance of studying the acoustic environment and its presentation to the public by composers through their works.
She thus highlights the connection between scientific analysis of sound and its artistic transposition, conceived as a method of communication between the composer and the audience.

THE SOUNDSCAPE AS A REPRESENTATION

More broadly, acoustic ecology reveals how the soundscape functions as a mirror of the social and environmental conditions of a given place, and how attentive listening can help identify the underlying issues that characterize it. Acoustic ecology, therefore, reinforces Schafer’s theories, demonstrating that the soundscape is not merely the background of our environments but a clear representation of them.

EVOLUTION OF THE SOUNDSCAPE

Beyond the ecological aspects, Schafer examines also the morphological and temporal evolutions of the soundscape. The immense variety of soundscapes makes this study even more compelling, and, much like physical landscapes, sonic environments also undergo significant transformations over time. The relationship between the soundscape and time is one of the most fascinating themes discussed in Schafer’s (1977) *The soundscape*, where he highlights how the temporary presence of certain elements, even those invisible to the eye, can influence acoustic change.

VISUAL AND ACOUSTIC LANDSCAPE

THE SOUNDSCAPE LEAVES NO TRACE

Schafer distinguishes between the visual and the acoustic landscape: the visual one is easier to frame and define through measurable parameters such as the field of vision or the coherent presence of specific typological elements (plant species, land morphology, distinctive features such as bodies of water or buildings). Changes in the visual landscape are also relatively simple to trace, since physical elements that no longer exist often leave visible traces, which can be studied to reconstruct their evolution. The soundscape, on the other hand, leaves no tangible evidence. It is impossible to determine what a specific environment sounded like in the past by studying its physical remnants, due to the intangible and ephemeral nature of acoustic events. The only way to reconstruct a past sound environment is through memory, by gathering testimonies from those who experienced it, or by identifying the elements that once characterized that place and extrapolating the likely combinations of sounds they produced.

TEMPORAL MODIFICATIONS

Soundscapes evolve across different temporal phases. By examining them through historical periods, one can trace alterations brought about by technological progress, the emergence of new occupations and lifestyles, and the resulting environmental transformations. However, significant shifts can also be observed within a single day. In *The soundscape*, Schafer presents several examples of acoustic monitoring over time. One particularly interesting case concerns the recording of a natural environment, where the sounds produced by different animal species alternated throughout the day, revealing striking acoustic variations between night, morning, and evening. Urban soundscapes also change according to the time of day: during commuting hours, traffic noise becomes much more intense than during the quiet of the night, when the streets are nearly empty.

DAILY CHANGES

RURAL AND URBAN SOUNDSCAPES

Schafer also identifies key differences between rural and urban soundscapes, defining the former as hi-fi and the latter as lo-fi. Rural environments have historically contained fewer ambient sounds than cities. For this reason, they are considered hi-fi (high fidelity) because of the relative sparsity of acoustic events, allowing each to be heard distinctly. Urban environments, by contrast, are saturated with overlapping sounds, creating what Schafer describes as a lo-fi soundscape (low fidelity) where the simultaneous presence of numerous sonic stimuli makes it difficult to distinguish individual sources. The urban soundscape, however, in relation to the temporal changes discussed earlier, often reaches a condition of high fidelity during the night, when ambient sounds decrease and it becomes easier to distinguish each sonic element. The silence of the city at night acts almost as an amplifier for environmental sounds, making us perceive them more intensely than when we hear them immersed in the daytime turmoil.

RURAL: HI-FI CONDITION

URBAN: LO-FI CONDITION

CURRENT SONIC HYBRIDIZATION

Today, the condition of both types of soundscapes, particularly the rural one, is changing rapidly. Urban areas continue to be dominated by artificial and chaotic noises, yet there is an increasing tendency to seek tranquility within green spaces and areas distant from traffic. Countryside environments, while still retaining their hi-fi characteristics, are gradually being infiltrated by sounds associated with technology and urban life.

THE RADIO AND THE PHONOGRAPH

The most radical changes in the soundscape are also due to two inventions dating back to the late nineteenth century: the phonograph and the radio. These technologies made it possible for the first time to reproduce sounds without the presence of their actual emitting source. The phonograph and the

radio enabled what had previously been unthinkable: introducing foreign sounds into soundscapes to which they did not belong and allowing their continuous reproduction.

The soundscapes that emerged after these inventions were thus invaded by a new and unprecedented variety of sounds, adding further complexity to acoustic environments that were already highly intricate. From that moment on, real and reproduced sounds began to coexist, exponentially expanding the boundaries of the soundscape and radically transforming perceptual possibilities, which had previously been constrained by distance and proximity to real sound sources.

SONIC EXPANSION

Moreover, these two inventions paved the way, in the following century, for the development of new technologies that have become deeply rooted in our daily lives and form an integral part of the contemporary soundscape. This has contributed to saturating the acoustic environment with constant stimuli coming from multiple sources at once, allowing us to know sounds we could never have heard within our immediate surroundings: today, even those who have never been to the sea recognize the sound of the waves.

ACOUSTIC OVERSTIMULATION

All this demonstrates that the soundscape is in constant transformation, shaped by historical, social, technological, and environmental developments. It is composed of events that are not entirely under human control, yet humans are simultaneously the authors of what it contains. Over time, the communities inhabiting certain places both undergo and contribute to their acoustic changes, shaping the evolution of the soundscape and of the values that each of us, and society, assign to sounds.

CONTINUOUS TRANSFORMATION

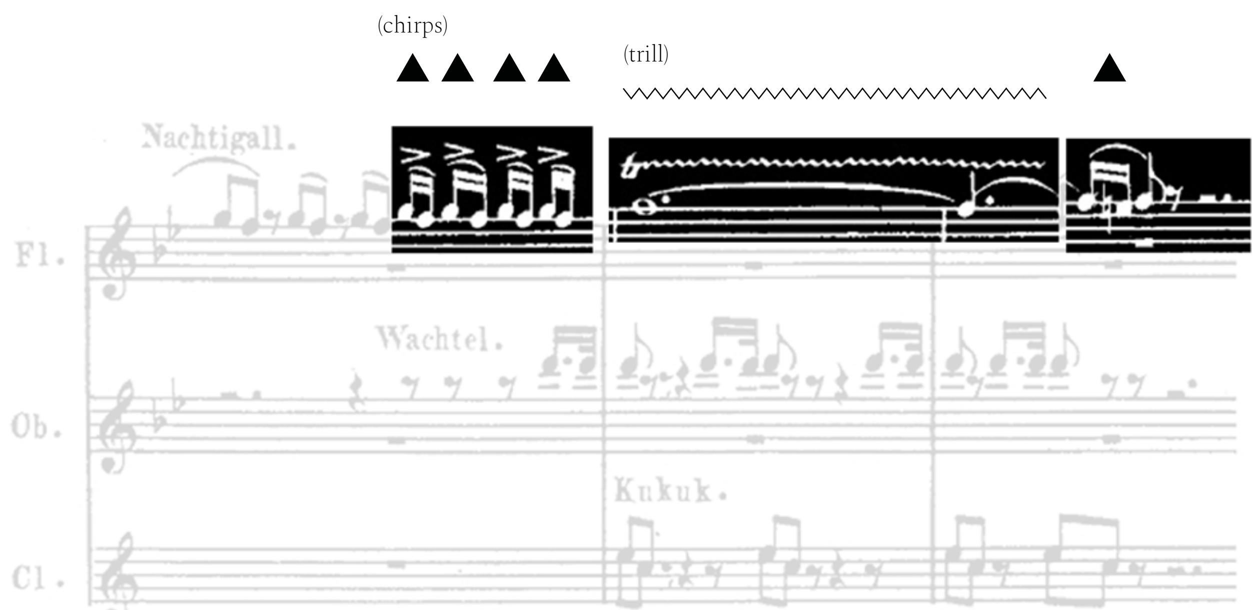
The value that environmental sounds hold in shaping the perception of a space or situation is also evident in the fact that they have been widely reproduced or referenced by many musicians. For example, one might think of pastoral music, in which natural sounds such as birdsong or the blowing of the wind are imitated. There also exist certain musical genres whose rhythmic foundations are based on environmental sounds, such as the rhythm of a running train, often used in jazz and blues styles, or the galloping of horses, found in various types of folk music.

COMMUNAL VALUE OF SOUNDS

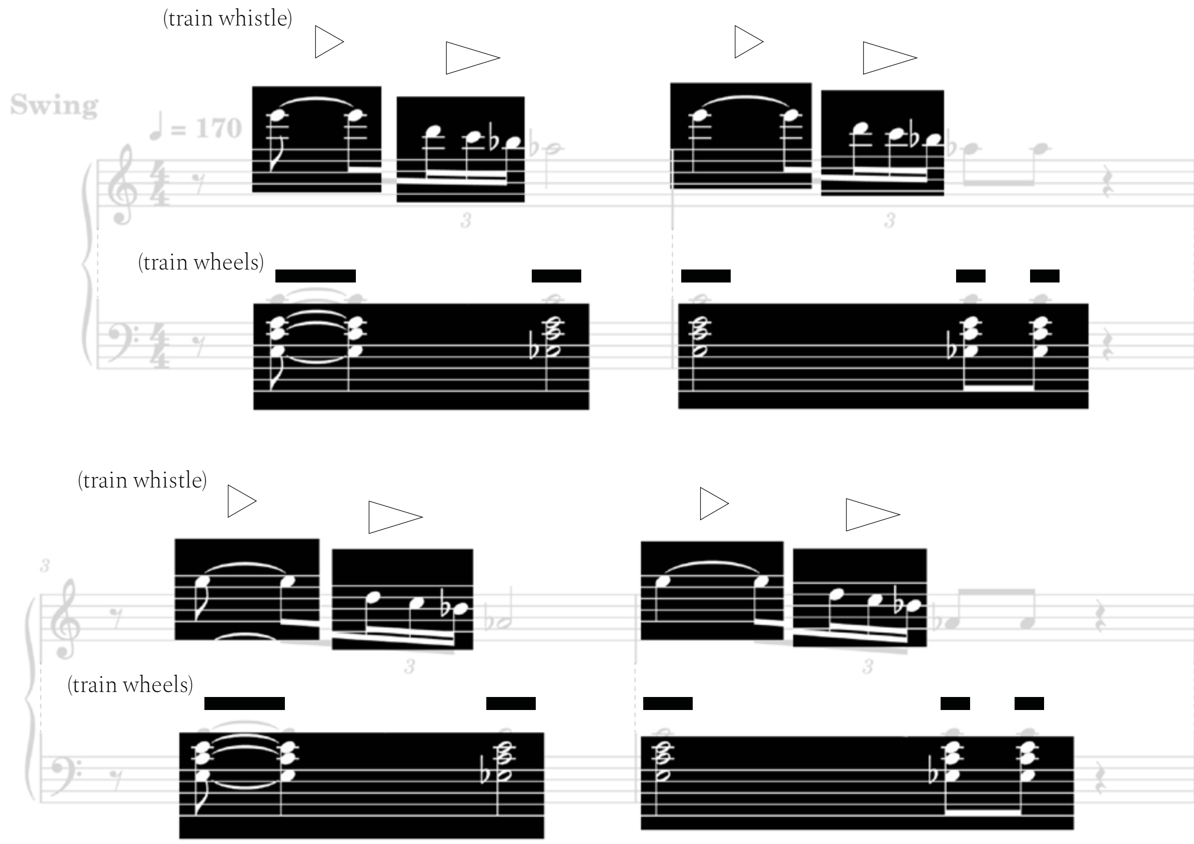
These sonic elements appear within musical contexts tied to specific living environments, in which a given sound has acquired an important collective meaning and value.

ENVIRONMENTAL SOUNDS IN THE ARTS

More generally, environmental sounds have thus served as a source of inspiration for artistic practices, initially in music, but more recently also in practices such as sound art and multimedia art. These movements, as Salomé Voegelin (2010) argues in *Listening to noise and silence: Towards a philosophy of sound art*, have brought general attention back to the act of listening, which a predominantly visually oriented sensory culture had long overshadowed.
Artistic reasoning, therefore, originates from sound itself, giving rise to one of the key themes that revolutionized twentieth-century musical philosophy and aesthetics: the questioning of the conceptual distinction between sound and music.



Morphological comparison between birdsong and its musical imitation
[extract from Ludwig van Beethoven, Symphony No. 6 in F major, *Op. 68 "Pastoral"* (1808)].
Original score analysis by the author.



Representation of railway-derived rhythmic structures in the train shuffle
[extract from Duke Ellington / Billy Strayhorn, *Take the 'A' train* (1941)].
Original score analysis by the author.

/ NOISE

Sound is noisy when it deafens my ears to anything but itself.

(Voegelin, 2010, p. 44)

UNWANTED SOUNDS

Schafer (1977), in *The soundscape*, dedicates a chapter to that part of environmental sounds considered "noise". This concept has undergone various definitions throughout history, influenced by the changing soundscape and the evolution of sound sources themselves. Schafer reports several official definitions of the term from different historical periods, but he regards the one from the Oxford English Dictionary as the most satisfying. The OED contains citations and definitions of "noise" dating as far back as 1225, describing it as "unwanted sound".

ACOUSTIC POWER

If we think about how "noise" is commonly understood today, most people would associate it with something negative compared to "sound." Schafer (1977) also explains how noise has been the subject of numerous laws aimed at controlling and limiting it. Over time, many cities began to ban certain noises during specific hours, imposing control over local sound environments. Noise tends to overpower other sounds, holding a kind of acoustic power: whoever or whatever produces noise at a given moment is, in some sense, dominating the surrounding environment. By restricting what were defined as noisy sounds, the ruling classes sought to reclaim this sonic power through silence, which, as Schafer notes, became "the ultimate power."

EXCLUSIVITY

The totalizing acoustic dimension of noise is highlighted by Salomé Voegelin (2010) in *Listening to noise and silence: Towards a philosophy of sound art*. She identifies noise as "exclusive," in the sense that it can exclude all other sounds from our perception: "Sound is noisy when it deafens my ears to anything but itself." (Voegelin, 2010, p. 44). This statement clearly expresses the exclusive nature of noise described by the author, a noise that does not necessarily have to be loud, but that inevitably and involuntarily captures our attention.

ACTIVE LISTENING

Once again, we see here the power of noise: its ability to channel attention toward itself and distract us from everything else. Voegelin interprets this exclusivity as an instance of active listening by the subject who perceives the noise. The defining feature of noise is precisely its ability to penetrate the listener, demanding their attention. In this way, the listener is compelled to act, that is, to listen attentively. This process takes us beyond mere hearing, toward a deeper form of sensing. It creates a kind of closeness, almost a union, between the object producing the noise, the noise itself, and the listener. At that moment, the listener is profoundly connected to the phenomenological events inhabiting their space. Thus, experiencing noise, though often described as unpleasant, connects us more deeply to our surroundings than many other forms of listening.

RUPTURE

Douglas Kahn (1999), in *Noise, water, meat: A history of sound in the arts*, writes, "We know they are noises in the first place because they exist where they shouldn't or they don't make sense when they should" (Kahn, 1999, p. 21). Here, the unpredictable nature of noise is emphasized: it represents rupture, surprise, and emancipation from the predictability of sound. In general, noise is an interference with the ordinary. Yet such interference is also a turning point, a change, an act of generating something new. This underscores the vast creative and conceptual value that noise, even more than "beautiful sound", possesses.

Both Kahn and Voegelin thus recognize in noise an immense creative potential, stemming from the power it exerts over its surroundings. Noise has both mental effects (emotion, surprise, attention) and physical ones, as the vibrations it produces penetrate the body and shake it, often causing tangible physical sensations. These physical and emotional properties are also accompanied by intrinsic meanings tied to social aspects such as technology, politics, or religion. The characteristics of noise described above made it a topic that, at a certain point in history, could no longer be ignored. Its generative power led to the incorporation of noise into art.

FUTURISM

In this regard, the most significant, and indeed the first, artistic phenomenon was Futurism. This movement arose during a specific historical moment when technology was advancing rapidly, and the sounds and noises linked to it were increasingly becoming part of the soundscape. At the end of the 19th century, Italy was not as technologically developed as other European countries, so progress in this area arrived later. Once industrial and technological growth began to take hold, a cultural movement emerged that embraced the theme of the machine and technology, a reaction to how slowly these ideas had materialized in Italy. The futurist movement was officially born in 1909 with the publication of *The Manifesto of Futurism* by Filippo Tommaso Marinetti in *Le Figaro*.

PROGRESS

The central idea of this movement was an embrace of modernity, technology, and progress, alongside a contempt for tradition and history, two notions still deeply rooted in Italian culture at the time. This break with the past is evident in literature, visual arts, and music.

THE ART OF NOISES

In 1913, Luigi Russolo wrote what can be considered the manifesto of Futurist music: *L'arte dei rumori* [*The art of noises*]. This was the first explicit artistic and musical stance on noise. In this text, Russolo distinguishes between sound and noise. Sound is defined as something artificial and perfect, belonging to the musical sphere, an element detached from everyday life. Throughout the history of music, composers have sought to produce sounds pleasing to the ear, increasing their complexity through harmonies and chords that blended well together.
Russolo observes that in the music of his time, sounds were becoming increasingly complex, orchestras larger, and compositions began to combine tones that created not only pleasant harmonies but also slight dissonances,

SOUND-NOISE

producing what he called "sound-noise". He attributed this to an evolution in the soundscape of daily life: the growing presence of machines was accustoming the human ear to more intense, varied, and chaotic sounds. There was a growing need for stronger auditory stimulation in music, paralleling the rise of technology.

However, according to Russolo, this sonic development could no longer rely on traditional music, as its instruments and sounds had become too limited. It was time to bring noise into the musical domain. Russolo defined noise as an imperfect sound, with irregular and unpredictable tones and vibrations. This very unpredictability gave noise a particular charm, making it a symbol of progress, a key Futurist ideal. Noise was the sound of novelty, while traditional music had become obsolete, dull, and predictable, in line with Futurism's disdain for historicism in all the arts.

WAR NOISES

Russolo was fascinated by noises such as internal combustion engines, the movement of trams on metal rails, or the sharp sounds of pipes. Perhaps even more captivating to him and to Futurists in general were the noises of war, described as the supreme sounds of modernity, similar in character to urban noises (mechanical and metallic) but louder and more powerful. For Russolo, the sounds of war represented the ultimate form of the noise so highly praised by Futurism. He recounts his experiences in battle, noting how the auditory dimension overwhelmingly dominated the visual; noise reigned over the modern battlefield.

INTONARUMORI

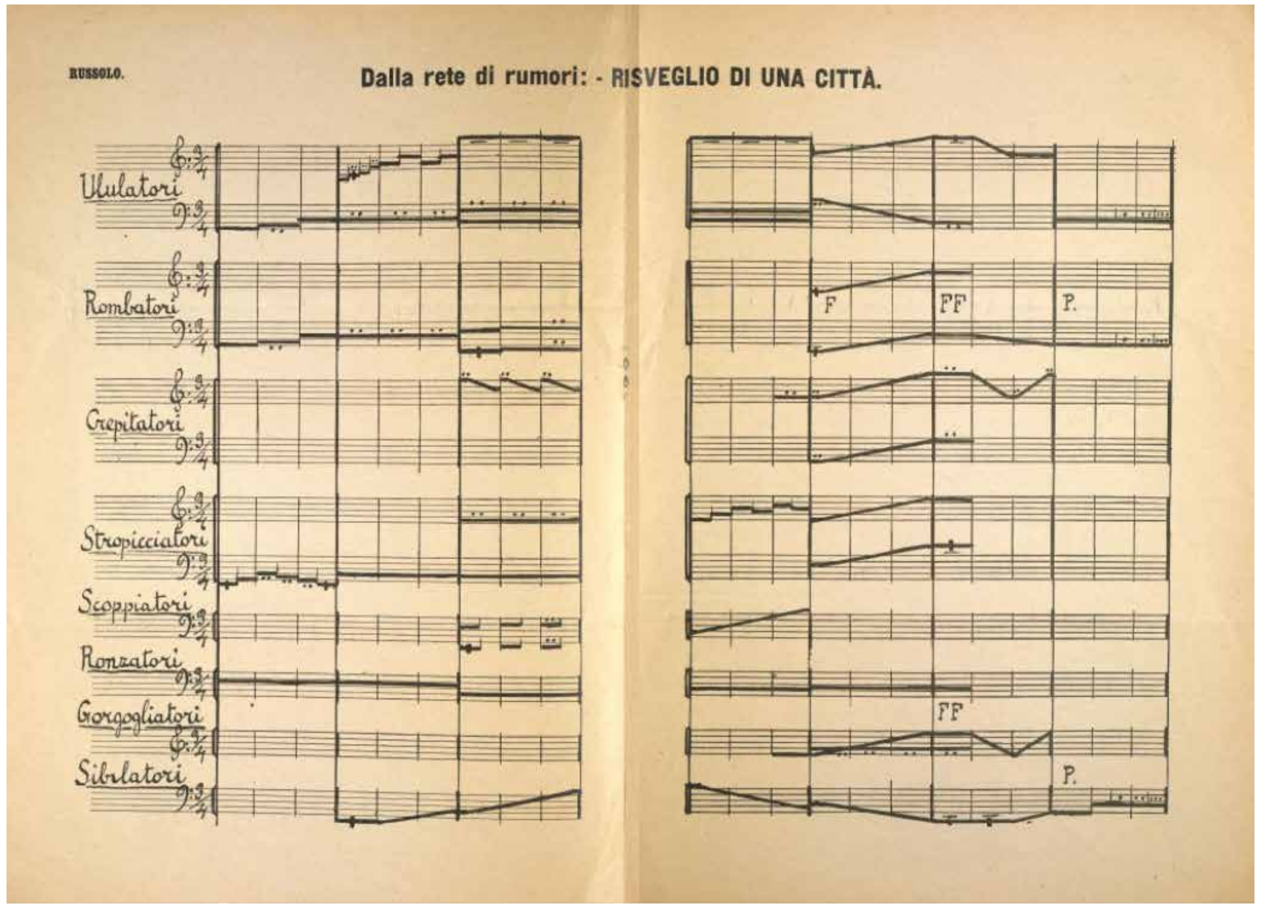
Russolo meticulously analyzed these sounds, observing changes in pitch over time, their timbre, and the physical reasons behind their acoustic properties. These studies led to the creation of what revolutionized the music of his era: the "orchestra of noises," or *intonarumori*. These were box-like instruments of various sizes, each equipped with a horn-like opening to amplify the noise produced inside, a crank to modify the emitted sound, and a dial to adjust its pitch. Each intonarumori generated a specific type of noise, classified by Russolo based on real-world sounds, such as "howlers," "roarers," or "cracklers." The sounds they produced were inspired by real sources but mechanically reproduced, creating a separation between object and emitted sound. The intonarumori were later used as a true orchestra, combining and modifying noises to create effects that, according to Russolo, far surpassed the now outdated traditional orchestras in creativity and expression.

MUSICAL EXPERIMENTATION

At the time, Futurism's position on noise was deeply divisive, provoking strong dissent. Yet it also sparked philosophical discussions that opened the way for further experimentation, ultimately shaping contemporary music. From that moment, the environment itself became an integral part of the musical discourse, solidifying the relationship between the spaces we inhabit and the music we create.

FIELD RECORDING

With technological advancement came field recording, the capturing of real-world sounds and their later reproduction, expanding the possibilities for using these noises and allowing them to be regarded as true music.



Luigi Russolo, *Risveglio di una città* (1914). Reprinted in *The scores project*, Getty Research Institute (2025).

/ SILENCE

DIGITAL OVEREXPOSURE

The spatial context we live in today carries with it an enormous amount of stimuli. We often speak of visual saturation, a constant presence of images that is difficult to escape. Due to technological development, images follow us wherever we go, indoors, outdoors, in public and private spaces. Think, for example, of the screens that display news and advertisements at public transport stops, the digital billboards in many large cities, and, of course, the devices that accompany us daily, such as televisions and smartphones.

POLLUTED SOUNDSCAPE

However, the sonic saturation that comes with the visual one is less frequently discussed. In fact, images are almost always accompanied by sound, which adds to the multitude of ambient noises inhabiting our spaces. Schafer (1977) analyzed this condition, identifying it as a "polluted soundscape." In this kind of environment, the density of sounds eliminates the possibility of deep listening, leading instead to an increasingly superficial and habituated mode of hearing.

NOISE INTENSIFICATION

The increasing complexity of the soundscape, especially in urban areas, had already been evolving over a century ago. The noises of machines, so admired by the Futurists, were already invading cities. From that moment on, noise also invaded music, which became increasingly charged with environmental sounds.

SILENCE AS A REACTION

Kahn (1999) argues that between the early and mid-twentieth century, Western culture had become obsessed with sound and noise. In 1952, one of the most famous works of radical music was produced as a reaction to this obsession: *4'33''* by John Cage. The piece features a musician who takes the stage but does not play; its central theme, therefore, is silence.
In general, it can be said that silence had already been the subject of reflection before Cage, but he was the first to transform it into music.

SILENCE IN TRADITIONAL MUSIC

In traditional music, silence existed but was understood as a pause in the music itself, as a moment of waiting and tension. As Gisèle Brelet (as cited in Bindeman, 2017) argues, music is born precisely from the silence that precedes it; silence is its fundamental precondition and the moment when the listener prepares for hearing. Musical silence thus becomes both a moment of remembrance of what has been heard and of anticipation of what is to come, a meeting point between memory and expectation.

SILENCE FOR JOHN CAGE

Cage, however, expanded its meaning in 1952.
Two experiences in Cage's life led him to reflect deeply on the theme of silence. The first, recounted by Kahn (1999) in *Noise, water, meat: A history of sound in the arts*, refers to a time when Cage worked as an entertainer in a psychiatric hospital. There, he was instructed not to produce any sounds so as not to disturb the patients. In that moment, Cage began to listen to silence itself, which led him to a form of inner listening, to perceiving what was happening within his own body. The second event, mentioned by Cage (1961) in *Silence: Lectures and writings*, was his visit to an anechoic chamber, an acoustically isolated space designed to eliminate all echoes and reverberations. In this environment, one can experience something close to total silence; yet, as Cage noted, it is not absolute, because under such conditions it is possible to hear the sounds produced by one's own body. Silence, understood as the total absence of sound, is therefore unattainable, and this is precisely what Cage sought to highlight with *4'33''*.

UNATTAINABILITY OF TOTAL SILENCE

4' 33''

During the performance, the musician produces no intentional sounds, allowing the audience to listen to what happens within the environment itself. The ambient sounds of that moment thus become the conceptual elements composing the piece. For Cage, silence is a kind of window that allows us to hear what lies beyond a given primary sound, in this case, music. Ultimately, this represents another way of bringing noise into music and art in general, though an approach opposite to that of the Futurists. While the Futurists rejected silence, overloading their works with sound, Cage embraced silence in a neutral and impersonal way, using it as a moment of openness and suspension.

SILENCE AS A WINDOW

LOSS OF CONTROL OVER MUSIC

Cage was profoundly influenced by Eastern philosophies, which shaped his view that art should imitate nature, understood as spontaneous, ruleless, and without intentional order. This idea is reflected in his works, including *4'33''*, where, during the four minutes and thirty-three seconds of performance, the ambient sounds would vary depending on the time and place, making it impossible to control what would occur within that temporal window. The outcome of the work was therefore beyond the composer's control, highlighting one of the central themes of Cage's philosophy.

SILENCE AND SILENCING

Cage's concept of silence was criticized by Kahn (1999) in certain respects, who pointed out that silence inevitably implies silencing. To create silence, something must be silenced, in this case, music itself. This, according to Kahn, represents an exclusion, an act of power performed by Cage, who in some way imposes on the audience what to hear and what not to hear.

BOUNDARIES OF CAGE'S CONTROL

Furthermore, both Kahn (1999) and Voegelin (2010), in *Listening to noise and silence: Towards a philosophy of sound art*, argue that Cage's work produces silence and thus induces the listening of that silence within a particular context: the concert hall.
In such a context, social conventions and behaviors allow the experience of silence because it is possible, to a certain extent, to control what happens and to highlight this silence, something impossible to achieve in a less controllable setting. Cage's silence is therefore a musical silence, confined to a musical context and heard in a manner conditioned by musical listening.

MUSICAL SILENCE

This represents another conceptual limitation of *4'33''*. According to Voegelin, what one hears in this instance is a new form of music, not the world itself.
Cagean silence is thus a kind of window that grants access to what lies outside traditional music, but, like any window, it offers a view (in this case, an auditory one) limited by its own frame.

SONIC SILENCE

In the text as mentioned above, Voegelin devotes an entire chapter to the theme of silence, which she considers, similarly to Cage, a moment of deep and inward listening. Comparing Voegelin's theory of noise and silence, we see that she describes them as sonic elements leading to two opposite forms of listening: the first directed outward, toward noise, which, as discussed in the previous chapter, captures all our external attention; the second directed inward, toward our heartbeat, breath, and thoughts.

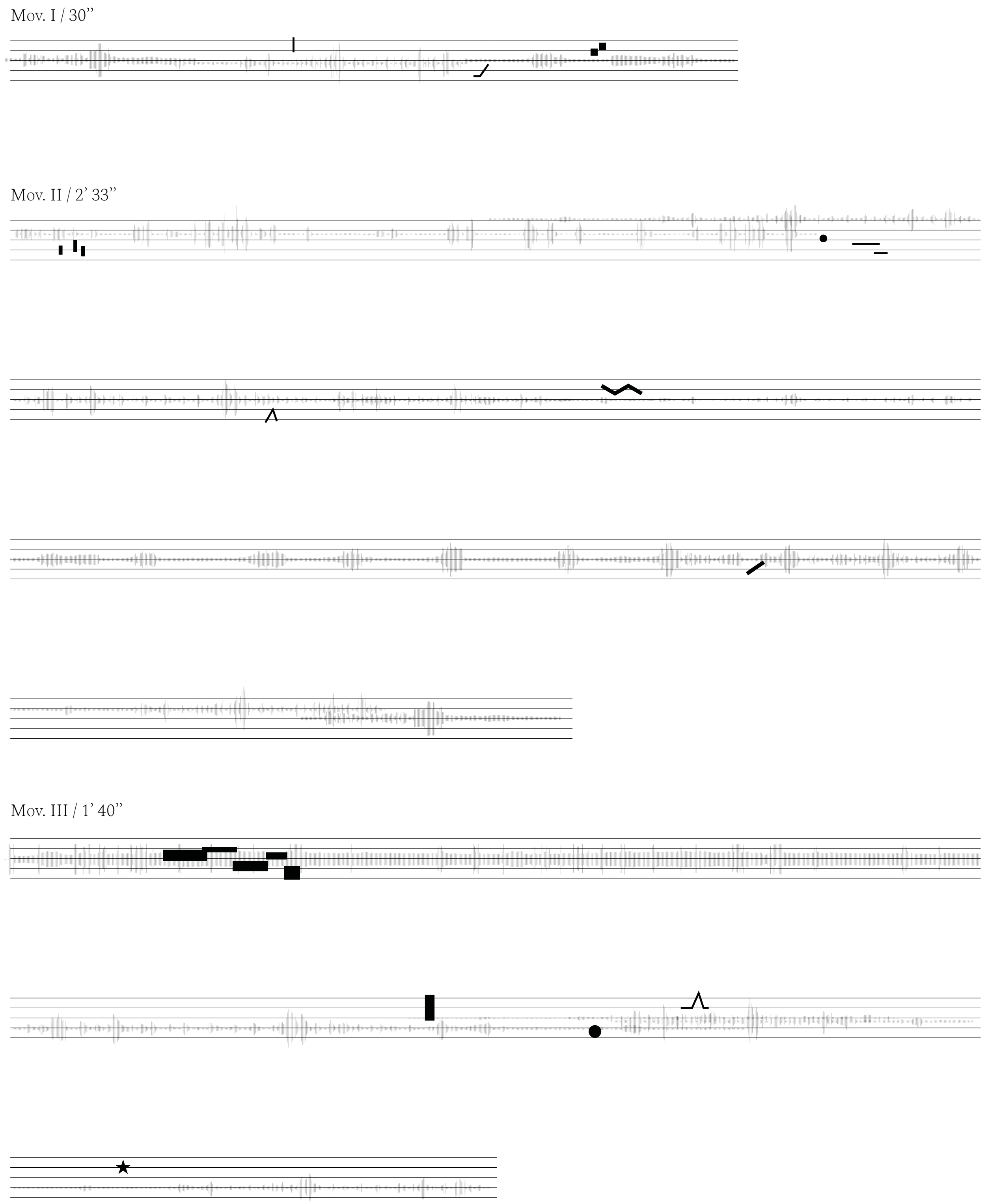
LISTENING AS A SENSORY EXPERIENCE

The sonic silence, distinct from the musical silence mentioned earlier, is what allows, according to Voegelin, listening as a sensory experience, one not

bound to any specific form or context. Sonic silence compels us to listen to ourselves, laying us bare. The revelatory nature of silence thus becomes evident: depending on the context and the depth of our listening, it can bring to light various factors, from environmental sounds to our emotions and memories.

SILENCE AS AN AWARENESS GENERATOR

Silence is therefore a generator of awareness, becoming an element within the aesthetics of listening that enables perception, understanding, and sharing. It can also be considered a moment of openness, allowing something different to emerge, a kind of contrast between the subtraction that produces silence and the addition of what we discover through it.



Diagrammatic interpretation of John Cage's *4'33"* (1952), illustrating how environmental sound becomes the compositional material in the absence of intentional musical gesture. Original graphic elaboration by the author.

/ CHAPTER CONCLUSIONS

Sound, in all its manifestations, proves essential to defining spatial experience. The soundscape, composed, as we have seen, of noise and silence, is not something that exists parallel to physical and tangible space, but rather its ephemeral representation. These two aspects are deeply intertwined and interdependent, making it impossible to separate them. Changes in physical space are immediately reflected in their sonic counterparts, bringing the sonic dimension to the center of both design and the understanding of spaces. We can think of the soundscape as the collective resonance of a place, inhabited by noises and silences. Noise generates ruptures, moments of transformation and outward attention from the listener. At the same time, silence represents a moment of suspension that, through reflection, enables greater awareness of what we hear around us. Listening is therefore, in itself, a spatial act: hearing connects us to external space, making us part of that same space. Among all sensory modes of perception, listening is the one that most fully merges us with space; what we hear and receive from the outside penetrates us, and each of us then processes it internally.

Jean-Luc Nancy (2002/2004), in *All'ascolto* [Listening], emphasizes the concept of "resonance" as a central point of his thought. Listeners themselves are considered as places of resonance for sound, in the sense that sound literally resonates within our bodies during the processes of perception and comprehension. Thus, according to Nancy (2002/2004), during listening one is simultaneously in contact with both the internal and external dimensions of the self. For this reason, sound can be defined as the most powerful spatial instrument, capable of generating the deepest connection between the subjects inhabiting space, what occurs within it, and the space itself. In this way, thresholds are created that bind human beings and the vibrations present in space, establishing an inseparable link between interiority and exteriority.

ALTERATIONS

/ ELECTRONICS

/ HYPER-REALITY

/ DREAMS

From a deep listening to the sounds of the real world, the focus shifts to synthetic soundscapes. This transition formed the core of the new music of the last century, establishing it as the most revolutionary period in musical history. The sonic and compositional spheres were pushed toward new, previously unimaginable horizons, vastly expanding the creative possibilities tied to sound. This musical avant-garde also brought about a substantial revolution in the spatial domain, redefining the relationship between sound and space. These two elements engaged in a close dialogue during this era, offering new perceptual possibilities that simultaneously elevated both composition and the design of music in space.

/ ELECTRONICS

THE XX CENTURY: THE NEW MUSIC

The twentieth century brought about profound changes in the soundscape compared to previous times, due to significant technological developments and to a social context that profoundly influenced the way music was conceived and experienced.
By the late nineteenth century, traditional musical theories based on harmonic and melodic foundations had already begun to waver.

THE CRISIS OF TRADITIONAL MUSIC

The long musical tradition, originating in the Middle Ages and evolving over the following centuries, retained many characteristics of earlier modal music. From modal music developed tonal music, closely linked to the concept of harmony, a form of music deeply tied to mathematical harmonic rules and a rigorously controlled theory. As Rognoni (2002) observes in *La musicologia filosofica di Adorno*, during the Romantic era, the first signs of a crisis in this musical theory appeared: works that were still bound to objective harmonic rules began to include more subjective and emotional elements, starting with Beethoven and finding their fullest expression in Wagner's *Tristan und Isolde* (1859).

THE ATONAL SYSTEM

From that moment on, a philosophical and theoretical revolution in musical composition took place, moving from the tonal to the atonal system. The composer who defined this departure from the traditional rules was Arnold Schoenberg, who, between 1908 and 1923, developed the twelve-tone technique (Zwölftontechnik).

THE TWELVE-TONE COMPOSITION

Twelve-tone composition is based on the use of all twelve notes of the chromatic scale in a non-hierarchical way, eliminating the centrality of the tonic note that, in traditional music, would determine the harmonic relationships among the others. The twelve notes must all be used before any can be repeated; this initial series of notes defines a matrix that, through its variations, constitutes the foundation for the composition of the entire work.

MUSIC AS A MACHINE

The twelve-tone system, therefore, stands as a serial compositional method, one that almost anticipates the relationship between music and machine that would become a defining element of twentieth-century music.

ALIENATION AND FRAGMENTATION

This moment marks the threshold of modern music, which, as Adorno (1949/2002) states in *Filosofia della musica moderna* [Philosophy of modern music] was determined by the political and social situation of the first half of the twentieth century. Atonal music thus represents an intentional reflection of the reality of that time.

MUSIC AS A REFLECTION OF THE CRISIS

Music could no longer represent the world through the rigorous, objective, and harmonic methods typical of traditional works driven by the pursuit of beauty; instead, the atonal method reflected the fragmentation and alienation of the society contemporary to Schoenberg, making explicit the crisis of both modern culture and music itself.

NEW INSTRUMENTS

Parallel to these philosophical and musical changes were technological advances that would enable the evolution of modern music. Phonographic and radio reproduction, already discussed in the previous chapter, became the foundation for new musical experiments. With the invention of magnetic tape in the 1950s, it became possible to work with sound in an entirely new way.

NEW SONIC TECHNIQUES

These experiments transformed the ontological and phenomenological dimensions of music. Sound was no longer an event tied to a specific place or gesture; at this point, any sound could potentially become music: recorded, reproduced, cut, accelerated, or altered. The composer's power over sound expanded exponentially, as did the interest in treating sound as tangible matter. Sound was no longer an ephemeral event but something entirely controllable.

SYNTHETIC SOUNDS

A crucial element of the twentieth-century soundscape was therefore mechanical sound, already explored by the Futurists, who reproduced the noises of technological development. Yet at that stage, sound remained linked to the dimension of reality. Noises were analysed and reproduced, elevated to a higher perceptual dimension, but not yet modified. Over the course of the century, the relationship between humans, music, and technology tightened, leading to the creation of instruments capable of generating sound electronically. As Schoenberg freed music from tonal constraints, technology freed music from the traditional instrument. From this moment on, the perception of the origin of sound and the composer's relationship with it changed profoundly.
Adorno viewed the use of technology in musical composition with ambivalence, attributing to it both emancipatory and alienating potential. In any case, it was precisely through technology that electroacoustic and electronic music emerged.

MAIN INVENTIONS

The main inventions that enabled the development of this new musical current appeared in the early twentieth century and continued to evolve through the postwar years. The first playable electronic instrument was the Theremin, invented in 1920 by the Russian physicist Lev Sergeevič Termen, which allowed the performer to control frequency and tone. In 1928, Maurice Martenot invented the Ondes Martenot, the first true expression of the electronic synthesizer. From this innovation, increasingly sophisticated instruments were developed, which in the 1950s were combined with other devices such as microphones, loudspeakers, and oscillators, enabling more effective and versatile reproduction and manipulation of sound.

BEYOND THE SOUNDS OF REALITY

SOUND AS A MATERIAL ENTITY

ELECTROACOUSTIC MUSIC

After exploring the natural soundscape, humankind began to shape new, artificial soundscapes, defining a new level of sound that went beyond reality, beyond the physical processes of matter, such as the channeling of air in wind instruments, a percussive strike, or a vibrating string. Sound itself became a material entity, entirely malleable through electronic means. This new mode of sound production reflected the broader relationship between humans and machines emerging at the time: the machine was no longer merely an aid to human activity but a tool for altering reality and, eventually, generating new realities. Real sounds were now analyzed more deeply than ever before, deconstructed, recomposed, and transformed, a process of analysis intimately connected to reality to transcend it. Electroacoustic music was thus founded on the principle of combining or transforming acoustic or authentic sounds through electronic manipulation and the creation of artificial timbres.

PIONEERS

STUDIO DI FONOLOGIA MUSICALE RAI

By the mid-twentieth century, three major centers for the study and development of electronic music had been established: Pierre Schaeffer founded the Groupe de Recherches de Musique Concrète in Paris in 1948; the Studio für Elektronische Musik was created in Cologne in 1953; and in 1955 the Studio di Fonologia Musicale of RAI was founded in Milan. The latter proved to be one of the most productive and innovative, developing new sound experiments and pioneering tools such as oscillators, filters, and noise generators. The leading figures of the Milan studio were Luciano Berio and Bruno Maderna, who created two seminal works that helped shape the understanding of electroacoustic production processes. In 1959, Berio produced *Thema (Omaggio a Joyce)*, working with a recording of a reading from James Joyce's texts and focusing on the manipulation of the spoken word through cutting, segmentation, and superimposition. Maderna, in 1958, composed *Musica su due dimensioni* (Music in Two Dimensions), for flute and magnetic tape, an example of dialogue and union between acoustic instrument and electronics, representing an alternative approach to the electroacoustic performance model proposed by Berio.

JOHN CAGE AND ELECTRONICS

The Milan studio also hosted prominent international figures such as John Cage and Henri Pousseur, whose work contributed to its prestige and avant-garde status. Cage was a key experimenter in many electroacoustic themes, using magnetic tape and radio extensively. His use of these elements is central in the *Imaginary landscape* series (1939–1952), five musical works characterized by the essential presence of electronic components. In addition to exploring the new possibilities granted by technology, Cage also delved into the theme of chance, clearly evident in *Imaginary landscape no. 4* and *no. 5*.

IMAGINARY LANDSCAPES

Imaginary landscape no. 4 (1951) is written for twelve radios and twenty-four performers, who, following Cage's score, switch the radios on and off according to precise timings and tune them to different frequencies. The element of chance arises from the fact that what is transmitted on the radio is constantly changing, so each performance produces a different result. *Imaginary landscape no. 5* (1952), on the other hand, involves recording excerpts from existing musical works onto tape, selected through numerical parameters and subsequently mixed and overlapped.

THE AUTHORSHIP ISSUE

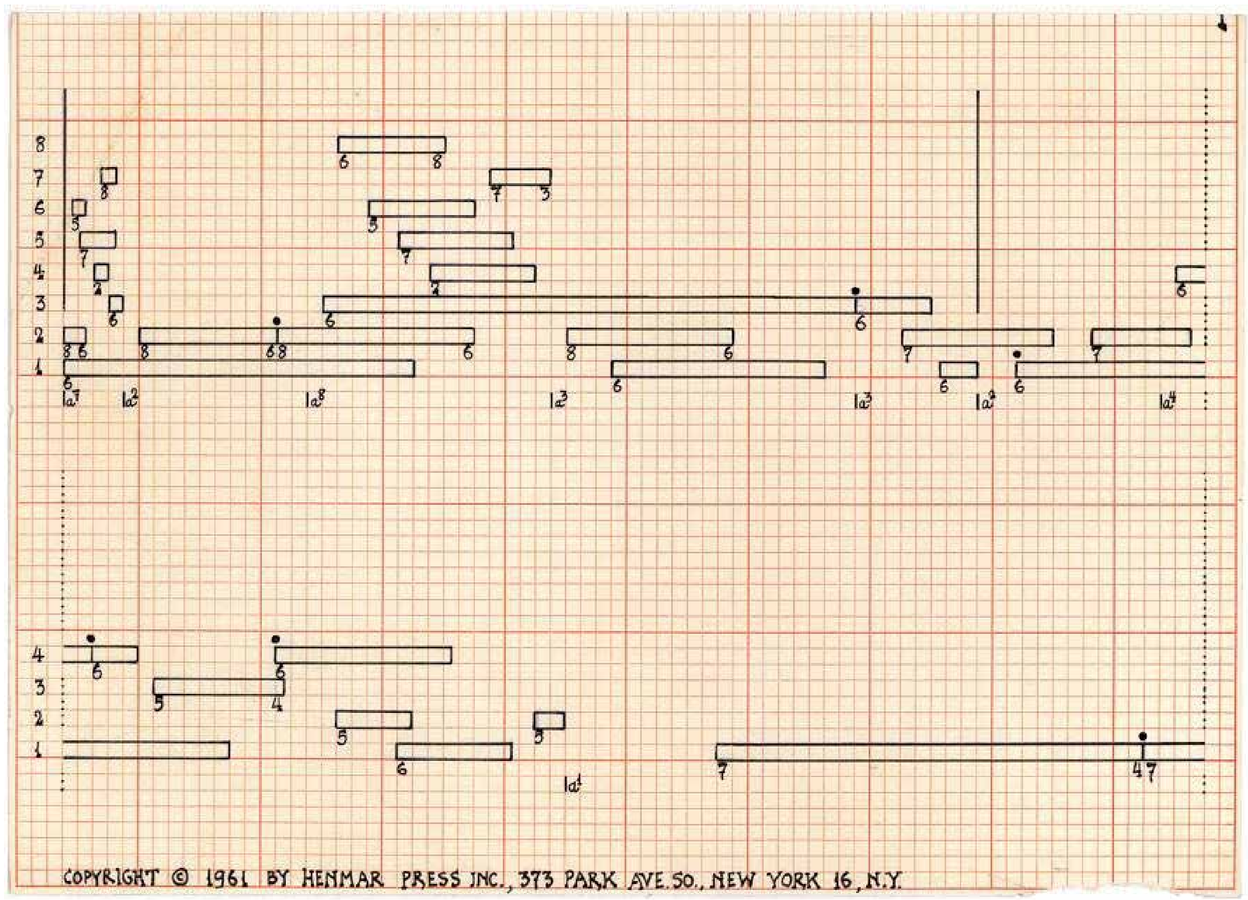
In both compositions, Cage's intention to distance himself from authorship is evident. He introduces a profound philosophical theme within the avant-garde musical panorama, the separation between author and work, reducing the composer's control and entrusting it to factors beyond their will.

CHANGES IN THE LISTENING SPACE

As the titles of these Cagean works suggest, electronic music began to create imaginary soundscapes, inaugurating a new relationship between listener and listening space. The listener was no longer positioned in front of the music but immersed in it: loudspeakers enabled a spatial definition of sound, allowing the composer to become an architect of sonic space. This condition enabled a new mode of listening, analytical yet unpredictable, composed of abstract sounds often unrecognizable as real-world elements.

MUSIC: A MIRROR OF THE TIMES

This, in turn, recalls what Schafer and Voegelin emphasized in their theories: the importance of deep listening. It can be argued that the compositional methods of this period were refining themselves once again toward the analysis of sound, as an attempt to bring order to the chaos of the soundscape, further exacerbated by the wars that marked the first half of the century. Thus, according to Adorno's theory, musical methods return to being a reflection and restitution of the surrounding world, placing us in a position to conceive of music as part of the emotional, social, and geographic space we inhabit.



John Cage, *Imaginary landscape no. 5* (1952), music score. Copyright © 1961 Henmar Press Inc.

/ HYPER-REALITY

PIERRE SCHAEFFER

Within this new technologically expanded soundscape, the question of how to work directly with recorded sound becomes central. Building on the Futurists' attention to everyday noise stands Pierre Schaeffer, a French sound technician who, beginning in 1948, developed compositional techniques that, like those of Russolo, were grounded in the attentive listening of sounds belonging to the real world. It becomes evident, therefore, that the interest in environmental sounds remained a central aspect of acoustic and musical theory, though elevated to a new level compared to the Futurists' intonarumori. Russolo had created an orchestra of mechanical devices capable of reproducing existing noises; although he introduced certain modifications, the sounds remained largely faithful to their source. Schaeffer, on the other hand, initiated new processes made possible by the technological means that had emerged in the first decades of the twentieth century. Environmental sounds were no longer merely reproduced: through recording, they could be isolated, reshaped and transformed, opening the way for entirely new sonic configurations. It is in this context that Schaeffer formulates and defines la *musique concrète*, the transposition of concrete, real-world sounds into the electronic domain.

COMPOSITIONAL INQUIRY

LA MUSIQUE CONCRÈTE

In *musique concrète*, the very conception of sound departs from the traditions of Western music. Each sonic element is no longer understood as a note, but as an entity endowed with morphological and timbral properties: a material substance to be worked on directly, without relying on a conventional system of notation and composition. The magnetic tape becomes the actual material of composition, marking a methodological rupture with previous practices based on written scores and their subsequent performance. Here, the act of performance no longer depends on interpreters: it is intrinsically tied to mechanical reproduction.

THE MAGNETIC TAPE

LANDMARK WORKS

A paradigmatic work of this new approach is *Étude aux chemins de fer* (1948), one of the earliest pieces of Schaeffer's musique concrète. This sonic experiment is built entirely from sounds associated with the railway environment, recorded from moving trains. Once removed from their original context, these acoustic fragments are reassembled, altered and manipulated, creating a representation that does not describe the real environment from which they originate, but instead constructs an abstract reconfiguration of it. Each sound ceases to belong to a specific setting and becomes an autonomous musical entity.

HUMAN SOUNDS TURNED INTO MUSIC

Schaeffer later began collaborating with Pierre Henry, another pioneer in the field, whose contributions to the compositional experiments led to works such as *Symphonie pour un homme seul* (1949). This composition explores the musical potential of sounds linked to everyday gestures, such as footsteps or breaths, paired with instrumental material. Human sonic elements are reorganized into sequences that produce rhythmic patterns absent in everyday reality, giving rise to a new musical sensibility.

SONIC ALTERATIONS

In 1951, Schaeffer founded the Groupe de Recherches Musicales, which allowed the experiments he had initiated to be further developed. The use of tape recorders made it possible to apply alterations such as loops, cuts, reversals, pitch changes and reverberation, treating sound as a tangible and manipulable material. In this way, complex soundscapes could be crafted from sounds extracted from the continuous flow of everyday life.

SOUND AS A PLASTIC OBJECT

These original elements play a crucial role in the compositional practice of musique concrète. Schaeffer (1966/2017), in *Treatise on musical objects: An essay across disciplines*, identifies the central role of the *objet sonore*, the real sound abstracted from its context, stripped of its causal properties and relocated into a purely perceptual sphere. In the *Traité*, he also introduces a typology and morphology of sound objects, classifying them according to parameters such as duration, dynamics, texture, timbre and form. This classification is not merely descriptive; it constitutes a true compositional method. To know a sound object means to understand its transformative potential, how it can be combined with other materials, or employed as a structural element within the composition.

MICROSCOPIC SOUND ANALYSIS

MODES OF LISTENING

These analytical processes rely on the different modes of listening identified by Schaeffer: *ouïr*, passive hearing; *écouter*, attentive listening; *entendre*, grasping the structure of the sound; and *comprendre*, interpreting what is perceived. *Musique concrète* is therefore not simply an archive of recorded sounds, but a system of relations among objects, a kind of language articulated through the physical and phenomenological behavior of sonic materials. Each sound may be broken down into minimal fragments, morphological nuclei that become recomposable acoustic matter. In many aspects, this approach anticipates the microscopic analysis of sound characteristic of the digital audio era.

SONIC ABSTRACTION

Through the process of sonic abstraction, listening becomes an experience that originates from a real causal condition but is progressively detached from it, transforming sound from a physical event into a perceptual phenomenon. Removing sound from its original spatial and temporal context allows the shift from causal listening to acousmatic listening, centered on the phenomenology of sound itself. Acousmatic music is thus theorized by Schaeffer as a consequence of this ontological and phenomenological inquiry into sound. The term recalls the *akusmatikoi* of the Pythagorean school, where the master spoke to his disciples from behind a veil: the voice was severed from the body that produced it; an analogy to acousmatic listening, in which the physical source becomes concealed.

THE ACOUSMATIC LISTENING

PERCEPTUAL DELOCALIZATION

With technological innovation, loudspeakers make it possible to reproduce sound without the presence or recognizability of its source. Acousmatic listening is therefore a condition in which the cause-sound relationship is obscured, and sound assumes an ephemeral, elusive perceptual nature. This condition has profound consequences for spatial perception: sound becomes abstracted from physical and visual elements, emerging as a fundamental and independent component of the spatial experience. Acousmatic practice thus becomes not only a musical methodology but one that can be extended to physical space itself, where the behavior of sound enables the listener to construct space through perception. Schaeffer implicitly anticipates the spatial power of sound, which, thanks to the placement of loudspeakers and diffusion devices, can be shaped as an invisible material capable of immersing the listener in an exclusively acoustic environment.

ACOUSTIC SPACE-BUILDING

LISTENING AS A MEDIATION

David Toop (2010), in *Sinister resonance: The mediumship of the listener*, explores themes that parallel those of acousmatic theory, positioning sound as a mediator between sensory experience and imagination rather

than a purely physical phenomenon. According to Toop, listening does not necessarily rely on a causal connection to its source: when the origin of a sound is concealed, the auditory experience activates autonomous perceptual processes rooted in memory, imagination, and cultural or emotional associations.

In this sense, Toop describes sound as something “unmoored” from its material origin: “The sound came from nowhere, belonged nowhere [...]” (Toop, 2010, p. 8). This perceptual displacement produces a mode of listening that reconstructs the world phenomenologically within the subject, making sound a vehicle for presences, absences, memories, and apparitions.

PHENOMENOLOGICAL RECONSTRUCTION

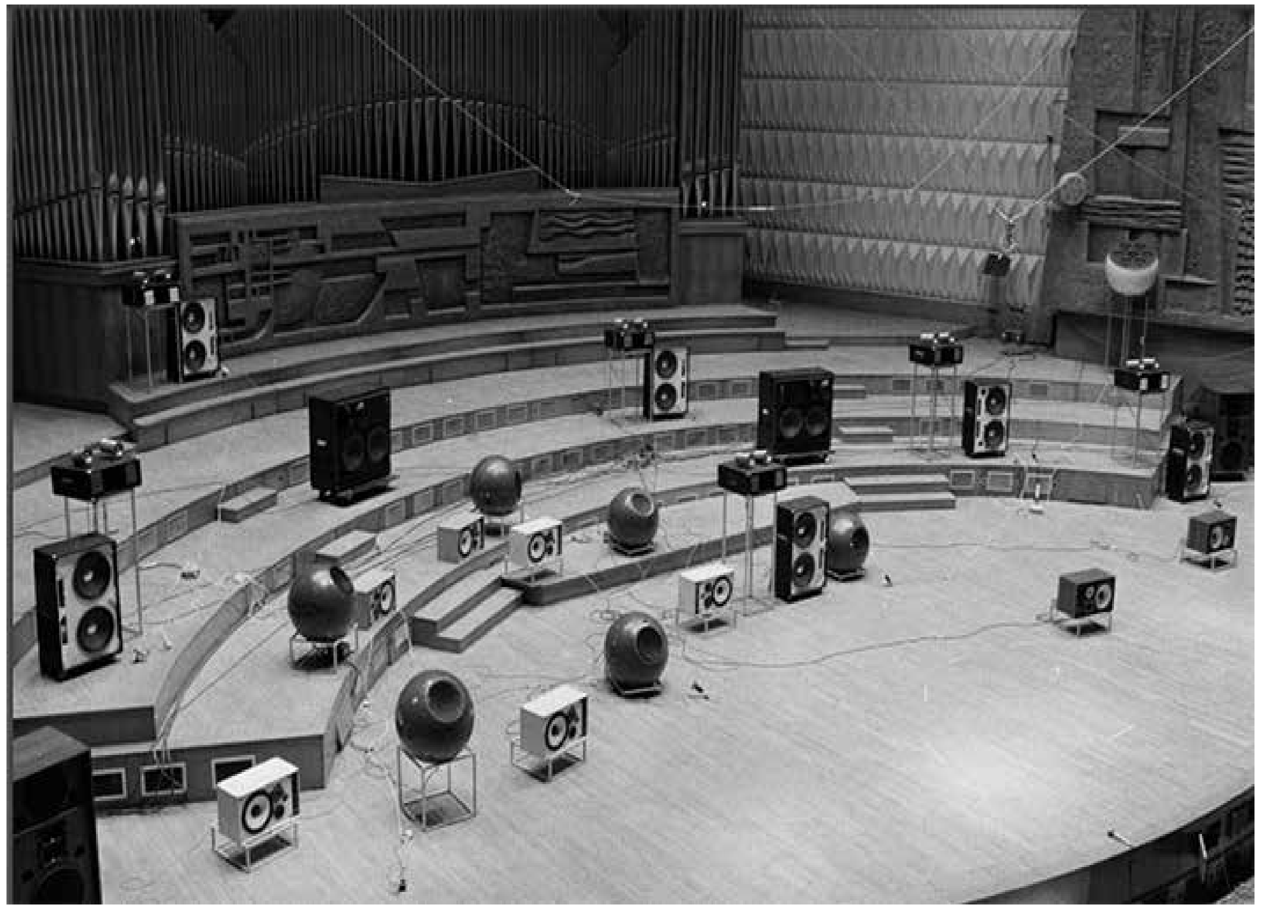
ACTIVE MANIFESTATION

Whereas Schaeffer’s concept of acousmatics arises from a technical condition, the separation between sound and source through electronic diffusion, Toop reframes this separation as an interior, almost mediumistic experience in which the listener becomes the site where sound manifests, rather than its passive recipient.
Both *musique concrète* and acousmatic music offer insights and avenues for reflection on how human beings inhabit and interpret space. They begin from an observation of reality, capturing its objects and phenomena, which, once reworked, create a new reality that transcends physical appearance and shifts into the realm of perception. What one hears is no longer immediately recognizable, due to the manipulations typical of *musique concrète* and the causal opacity characteristic of acousmatic listening. These processes can generate disorientation, inviting the listener to question what is perceived, to reconsider distances, depths and movements of sound that had never before been problematized. In doing so, they reveal themes such as the mutable nature of acoustic space and the immaterial dimension of sonic phenomena, topics that would be widely explored by theorists of sound in the decades that followed.

MUTABLE ACOUSTIC SPACE

ACOUSMONIUM: THE SPATIAL ORCHESTRA

Acousmatics thus becomes a technique for the spatial design of sound, as demonstrated by the example of the Acousmonium. This system is configured as an orchestra of loudspeakers, developed in 1974 by François Bayle, a member of the GRM. Drawing on Schaeffer’s theories, the sound propagation devices were organized in space according to an orchestral arrangement. The eighty loudspeakers, of varying types and sizes, distribute sound as a dynamic mass. The arrangement of these devices makes it possible to diversify depth and the various planes of acoustic perception.



Acousmonium (1980). Loudspeaker orchestra used by Groupe de Recherches Musicales (GRM) at Maison de la Radio, Paris. Photograph by Laszlo Ruszka © Institut National de l'Audiovisuel (INA), from Hereafter (Sonic Acts Press, 2019).

/ DREAMS

ACOUSTIC CONTINGENCY

Roughly in parallel with the development of Schaeffer's *musique concrète*, the electronic and electroacoustic artistic landscape was outlining different experimental directions. The referential nature of *musique concrète*'s sounds maintained a tie to the phenomenal world, producing not an escape from reality but its transfiguration. Schaeffer's acoustic object was almost physical matter: an element harvested from the world and examined with meticulous care, in all its smallest aspects, then often radically reshaped, yet always with full awareness of the sonic potentials and facets that could be drawn from it.

ONEIRIC VISIONS

Other artists pushed electronic experimentation toward a higher degree of abstraction, searching for sounds entirely foreign to the dimension of the real and reaching toward other planes. These new worlds were able to shape oneiric visions, carrying the theme of perception into a complete ascent from the contingent toward a waking dream.
Edgar Varèse and Karlheinz Stockhausen were the major electronic experimenters who brought electroacoustic music to greater levels of abstraction in the mid-twentieth century.

EDGAR VARÈSE

Varèse was an artist who positioned himself very clearly within the musical scene of his time. He knew Russolo and his music personally, yet Varèse's theoretical stance was openly different from the Futurist one. David Toop (1995), in *Ocean of sound: Aether talk, ambient sound and imaginary worlds*, recounts this conceptual positioning, noting how, compared to Varèse, the Futurists were essentially literalists. Varèse rejects any imitative function of sound: he does not aim to reproduce nature or industry, but to construct an autonomous sonic universe, made of dynamic acoustic masses that occupy and shape space like almost physical presences.

AUTONOMOUS SONIC UNIVERSES

RESIDUAL REALITY

Toop (1995) nevertheless points out how this intention in Varèse's work was unconsciously not fully upheld. After the first performance of his small-orchestra piece *Hyperprism* in 1923, Varèse realized that a particular pitch in the score resonated exactly like a siren that often sounded near the river, one he had been hearing throughout the entire period of composing the work.

PURELY PERCEPTUAL MUSIC

Varèse's early pieces were orchestral experiments, not yet tied to electronics, but already grounded in an experimental process oriented toward the sonic possibilities of instruments. For this reason, he did not compose by relying on conventional metric, harmonic, or mathematical references; he did not present his works through treatises, notations, or explanatory texts, but conceived his music in order to stimulate the listener's perception in a significant way.

Toop writes of Varèse's aims: "Varèse struggled to deliver music that could incorporate the whole world, that obliterated the equal tempered scale, the written rules of harmony, the predominance of pitch over timbre and rhythm. The ear - not numerical systems of rhythm or pitch - was the final judge of music." (Toop, 1995, p. 83).

INSTRUMENTAL TRANSITION

A close look at his output shows how Varèse gradually experimented with new sounds made available by the technical possibilities emerging in those years, adopting new instruments in step with technological developments. *Hyperprism* (1923) employed winds and percussion; *Ecuatorial* (1934) included brass, organ, baritone, percussion, and a Theremin; *Déserts* (1950–54) was conceived for winds, percussion, and magnetic tape; and with *Poème électronique* (1958) he arrived at a fully electronic work.

POÈME ÉLECTRONIQUE

This last piece is the most emblematic in terms of experimentation and sonic abstraction, made possible, of course, by the availability of electronic tools capable of supporting such composition. *Poème électronique* was composed for the 1958 Brussels World's Fair. For the event, the Philips Electronics Corporation wanted to build a pavilion in which its new technological proposals would be showcased. Philips's artistic director turned to Le Corbusier, who designed the pavilion together with the then young Greek architect and composer Iannis Xenakis, who was working in Le Corbusier's studio.

THE PHILIPS PAVILION

The pavilion was conceived from a generative vision of the interior space as a stomach, defining a pathway with an entrance, a larger central area, and an exit opposite the entrance, all shaped by curved, organic lines. This interior was intended to host multimedia projections alongside Varèse's composition. Le Corbusier himself produced the projected images; multimedia art

MULTIMEDIA INTEGRATION

had fascinated him for some time, since, as Joseph Clarke (2012) notes in *Iannis Xenakis and the Philips Pavilion*, Le Corbusier's youthful stay in Vienna brought him into contact with Wagner's work, which impressed him for its fusion of music, drama, movement, and set design into a single pluralistic artwork.

THE ARCHITECTURAL CONCEPTION

Le Corbusier established the overall framework, but Xenakis developed much of the effective design and final form of the pavilion, working out a curved structure based on the stomach concept as a fundamental planimetric reference. From this initial suggestion, the rest of the architecture took shape: a solution more evocative than functional, using hyperbolic paraboloids that, in a sense, anticipate parametric design approaches. Xenakis's intention was thus, in some way, already declared by the architecture itself: to evoke a sensation, shaping the exterior in relation to the experience to be lived inside.

SEEKING A SENSORY EXPERIENCE

The search for a spatialization of experience, an increased perceptual complexity, was likely of particular interest to Xenakis also because of his artistic versatility. As a composer, he understood the importance of the sonic and perceptual factors within a work of this kind. For that reason, he studied meticulously how to integrate Varèse's piece into the pavilion's space. According to the technical reconstruction by Izzo (2023), 325 loudspeakers and 25 low-frequency propagators were installed. As Joel Chadabe (1997) reports in *Electric sound: the past and promise of electronic music*, these devices were organized into groups called "sound routes" (paths of sonic trajectory), so that the sound could be distributed and moved through the space, tracing continuously shifting sonic paths. Varèse himself stated: "For the first time, I heard my music literally projected into space" (Chadabe, 1997, p. 61).

THE INTEGRATION OF VARÈSE'S WORK

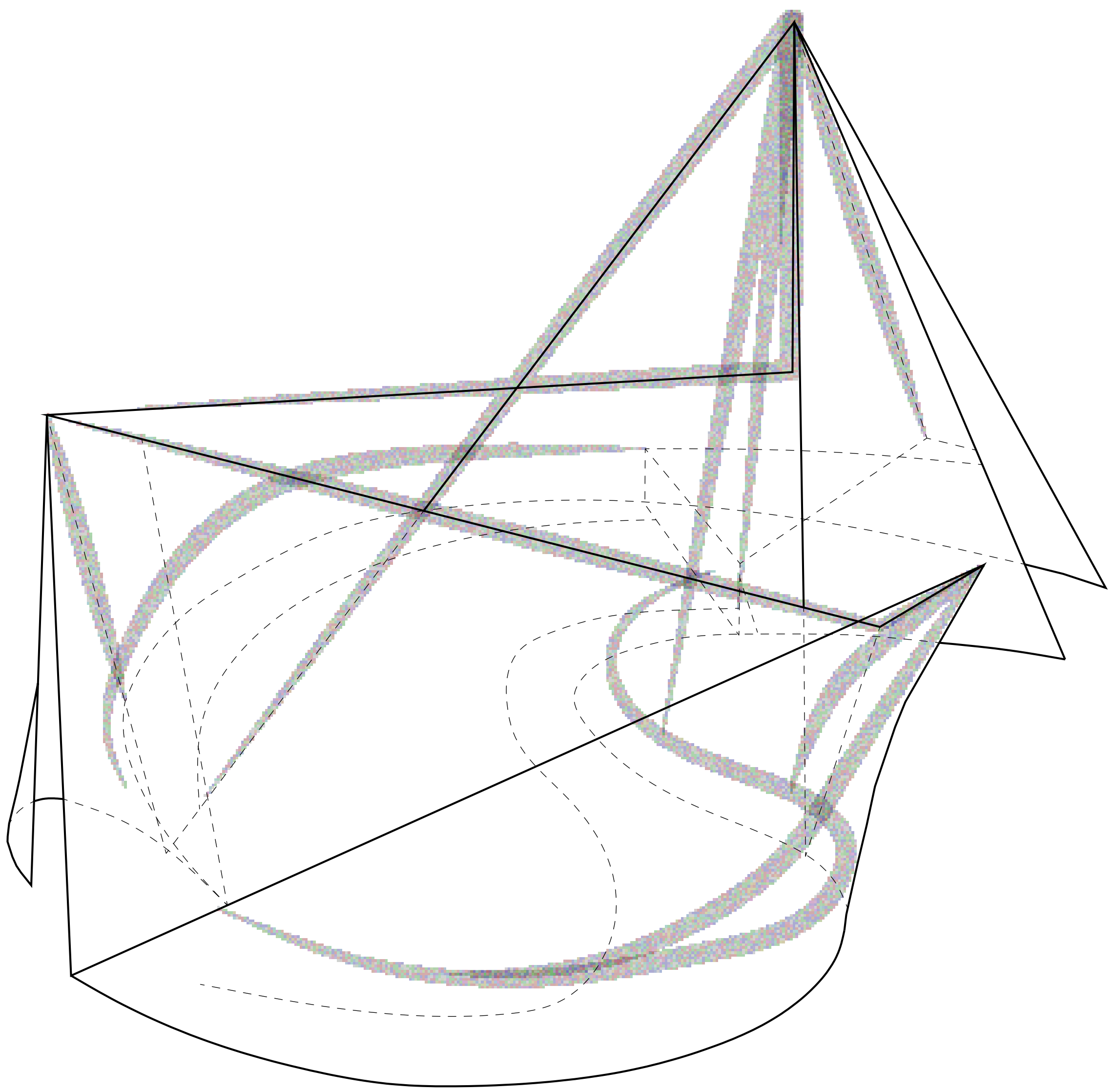
SONIC SPATIALIZATION

TOTALIZING EXPERIENCE

In this work, sound and space merge inseparably, requiring the acoustic devices to be arranged so that sound would fully envelop the audience. The pavilion interior was meant to be completely dark in order to highlight the projected images, so the form of the structure was not perceptible from within. Sound thus became what enabled space to be perceived, and through the synchronization of audio and images, the experience inside the pavilion was rendered total.

SPATIAL TRANSCENDENCE

This example of the relationship between space and sound is emblematic because it belongs to the first major successful fusions of the two elements, made possible in these terms only through electronics, and in particular through loudspeakers. One can see here how Schaeffer's acousmatic condition finds an extreme realization, creating sound-spaces that envelop the listener in fully abstract sonorities, and momentarily transport the mind into an otherworldly dimension.



Author's graphic adaptation of the original *Les routes du son* diagram (*Petit*, 1958), attributed to Iannis Xenakis for the Philips Pavilion.
The diagram illustrates the different sound trajectories conceived for the pavilion, showing the paths along which the sound was spatially projected.

KARLHEINZ STOCKHAUSEN

The second great experimenter of that period, both in musical terms and in terms of spatializing sound, was the German Karlheinz Stockhausen. Varèse's conception of sound as a living, dynamic mass that inhabits and shapes space is radicalized by Stockhausen, who studies means and environments capable of enabling the spatial perception of new electronic music.

REFUSAL OF IMITATION

The German artist's musical philosophy states clearly his position with respect to imitation and to the past. This theoretical line is reported by Stockhausen (1959/2024) in *Testi sulla musica elettronica e strumentale* [Texts on electronic and instrumental music]:

> It is clear that a composer of Electronic Music should not attempt to imitate the timbres of traditional instrumental ensembles, nor familiar sounds and noises. [...] As a general rule, however, a primary criterion of quality for an electronic composition is its independence from instrumental or other types of sonic associations. Associations such as those evoked by the sounds of bells, organs, birds, or flowing water distract the listener from the autonomy of the sound world presented before them. (Stockhausen, 1959/2024, p. 134, translation by the author).

UNFAMILIAR SONIC WORLDS

It is therefore evident, similarly to Varèse, that Stockhausen intends to compose music and produce sonorities that step outside the reality we know, opening onto fantastic and unfamiliar worlds. The power of this kind of sound lies precisely in its capacity to allow an open interpretation, evoking emotions and memories and immersing the listener in an invisible perceptual substance. Electronic sounds originate in an immaterial condition, unlike instrumental or environmental sounds, which have physical causes.

SURREALISM

SUBJECTIVE RESONANCE

This already places electronic sound in a state of evanescence and heightened surrealism, so that it becomes more natural and direct to use it to define alien, dreamlike acoustic landscapes. Stockhausen (1989) radicalizes this view further in *Towards a cosmic music*, where sound is conceived as pure vibration capable of resonating with each individual. In this text, music becomes a means of personal spiritual elevation: listening is framed as a kind of divine experience, able to raise our physical bodies toward a higher energetic and vibrational dimension. Each of us can connect with the vibration most closely aligned to us, making our relationship with music profoundly subjective and differently accessible according to personal perceptual

ACCESSING INNER WORLDS

dispositions and imagination. Through pure sonic vibrations, it becomes possible to travel into new inner worlds, exploring realities that are not only sonic but also psychological and introspective.

> When I listen to music, an entire individual universe opens up. I have the most incredible images, dreams and visions. I can develop the angel within myself, the angel that has fortunately never felt the necessity of agreeing with everything even my best friend has to say. (Stockhausen, 1989, p. 51).

REFLECTIONS ON SPACE

Stockhausen recognizes the importance of how sound is perceived in order to reach the clearest possible sonic awareness. For this reason, he integrates into his thinking an intense reflection on space and on the spatial distribution of music. Again, in *Testi sulla musica elettronica e strumentale*, he analyzes how much electronic music tends to appear "pointillistic" in its structure, presenting simultaneous changes of pitch, duration, intensity, and amplitude in each sound, thereby simplifying, in a sense, the sonic spectrum that lies between one acoustic element and the next. The solution is found precisely in space. Sonic complexity can be distributed spatially so that it becomes clearer and more intelligible. Perception must, in some way, envelop the listener, drawing them inside the sound itself, where every detail and sonic particle is separated spatially while remaining part of a single composition. In this way, musical situations that are too dense to be fully grasped through a single unidirectional source are spatialized, so that their elements are unfolded and made perceivable through multiple points and directions.

SPATIAL DISTRIBUTION OF MUSIC

DIRECTIONAL SOUND PROJECTIONS

One of Stockhausen's first electronic compositions was *Gesang der Jünglinge* (1955-56), whose reproduction was distributed across five groups of loudspeakers placed around the audience. Sound is projected from different points and in different directions, making it possible to create directional effects that are dynamic or static. This allows for a more articulated rendering of the work and highlights a strong spatiotemporal relationship. *Gruppen* (1955-57) follows a similar logic: three orchestras, three conductors, and the audience. The orchestral groups are positioned to the right, in front, and to the left of the public, surrounding and immersing it in the musical performance. The composition takes the spatial factor into account, letting the sounds produced by the three orchestras dialogue and chase one another, creating a sonic flow that circulates the listeners. Here, the acoustic

ENVELOPING PERFORMANCE

experience is circular and enveloping: the audience is immersed in a totalizing world of sound, strengthening the union between music, body, and space.

REIMAGINING LISTENING SPACES

These experiments on the relationship between sound and space develop into a broader reflection on what new listening places should be. For Stockhausen (1959/2024), traditional concert halls are obsolete: the exclusively frontal arrangement between audience and sound source no longer works for new spatial music. What is needed are environments with new forms, able to host diffused musical performances. Hence, the idea of circular halls, in which sound could come from loudspeakers placed along the entire perimeter, turning interiors into fully sonic spaces through sounds arriving from every direction. The conventional auditorium thus becomes a sonic gallery, a permanent acoustic event, shifting from a space that merely hosts musical activity to a true sound-space, in which space and sound become a single material.

THE SONIC GALLERY

SONIC DREAMSCAPES

In this way, the idea of a oneiric experience is further enhanced. The ability of these authors to explore new sonorities and to translate them into spatial form means that anyone immersed in this sea of sounds is carried, both mentally and physically, into a dimension of "images, dreams and visions."

/ CHAPTER CONCLUSIONS

The trajectory of this chapter has traced the major twentieth-century developments and innovations in the technological, philosophical, and aesthetic domains of sound. Never before these decades did Western music undergo transformations so radical, pushing musical theory into territories that had previously remained unexplored. The initial emancipation of compositional techniques from traditional tonal and harmonic models unfolded in parallel with the experimentation of new sonic materials and the emergence of new theories of listening. The tools available to composers made it possible to treat sound as matter, eventually turning it into a constitutive element of architectural and perceptual space.
What began, in the early avant-gardes, as the electronic reproduction of sounds became, in the space of only a few decades, the capacity to analyse, fragment, and recombine the real, opening onto the construction of transfigured realities. Electroacoustic research then carried this logic beyond hyper-reality toward fully autonomous sonic territories, where the phenomenal referent dissolves and gives way to an imaginative, oneiric dimension. The origin of sound thus shifts from the reworking of real acoustic objects to the generation of elements independent of the physical world.

This material turn in sound appears in Schaeffer through the possibility of shaping the objet sonore as a plastic substance; in Varèse and Stockhausen, by contrast, sound itself becomes a vibrational mass capable of invading and carving space. Such acoustic physicality redefines the relationship between listener and environment, casting new light on the interactions between the human body and perceptual space. The human being is immersed in sound and drawn into a total experience in which the mind can move through fantasies and waking dreams. Sounds are no longer used to represent worlds, but to generate new ones. Musical works that inhabit space produce sensations, emotions, and atmospheres, becoming a decisive device for the sensory characterisation of the environment.

A T M O S P H E R E S

/ PAINTINGS

/ MACHINES

/ AETHER

The physical qualities of an environment and the perception of them by the inhabiting subject can be said to define its atmosphere. Through three crucial stages in the history of music, the investigation shifts from technique to the most impalpable and subjective dimension of space. Music is thus considered an invisible building material, capable of coloring, solidifying, or rarefying the air, altering the perception of time and drastically changing the experience of dwelling in spaces.

/ PAINTINGS

[...] only musicians are able to capture all the poetry of night and day, of heaven and earth, and to re-create their atmosphere and give rhythmic form to their intense vibrations.

(Debussy, as cited in Jarocinski, 1966/1976, p. 96)

THE EMOTIONAL COMPONENT

MUSIC PAINTS A SPATIAL PRESENCE

While the electronic revolution discussed in the previous chapter rendered sound a tangible, physically malleable material, instrumental music had already set out on a divergent path from the classical tradition in the preceding decades. Between the late nineteenth and early twentieth centuries, certain composers began to move away from linear and narrative structures, seeking to construct works capable of immersing the listener in a suspended emotional state. This new sensibility did not aim to tell a story through temporal development, but rather to evoke a mood, a presence in space that communicated through pure suggestion. The objective was not yet to generate new synthetic worlds, but to transpose the essence of real places and moments into sound, "painting" atmospheric situations. Sound thus becomes a spatial presence rather than a rhetorical discourse.

TUNING THE ENVIRONMENT

THE ATMOSPHERIC QUALITIES OF A SPACE

Music begins to create atmospheres which, diffused within listening spaces, tune the environment to the frequencies of a precise moment. This perspective resonates with the theories of Gernot Böhme (1995/2017) in *Atmosphere: Essays on the new aesthetic*, according to whom sound, like light, is a decisive element in the construction of a place's atmosphere, acting as a mediator between the physical qualities of the space and the bodily vibrations of the subject. Atmospheric qualities make a direct connection possible between the environment and personal interiority, binding emotions to the lived space and leading to a complex and totalizing spatial perception.

CLAUDE DEBUSSY

The two authors who contributed most significantly to this shift from Romantic narration to modern spatiality were Claude Debussy and Erik Satie. As Stefan Jarocinski (1966/1976) illustrates in *Debussy: Impressionism and symbolism*, Debussy was often labeled by his contemporaries as an Impressionist. The term, borrowed from painting, alluded to his ability to paint scenarios through timbre; however, the author himself rejected this classification, deeming it reductive. Debussy did not intend to objectively reproduce an external object, but to translate into music the sensations and memories it evoked. To achieve this, the French composer dismantled traditional harmonic rules, using the chord no longer as a syntactic function but as color, prioritizing timbral value over the melodic line. The use of whole-tone scales and bitonality created effects of musical blurring, moving away from the rigor of classical tonality. His pieces thus appear composed of instants of evocation, imprinting moments of suspension and dreamlike allusions onto time. For this reason, the artistic movement most analogous to his poetics is not so much Impressionism as Symbolism: the painted scenes are not descriptions, but correspondences. Musical figures are not sharp but made of lights and nuances that leave the listener in an imaginative spatial condition, extending mental space onto physical space.

TRANSLATING SENSATIONS INTO MUSIC

MUSICAL SYMBOLISM

EVANESCENT EVOCATIONS

ATMOSPHERIC ABSTRACTIONS

Vladimir Jankélévitch (1961/1985) in *La musica e l'ineffabile* [Music and the ineffable] analyzes how Debussy suggests in broad strokes rather than describing punctually, leaving the imagination free. The music is structured as a dense texture that binds together symbols and evanescent evocations. A fundamental work in this poetics is *Nocturnes* (1897-1899). In the three movements (*Nuages*, *Fêtes*, *Sirènes*), there is no intention to represent realistic night landscapes, but to render luminous impressions and perceptions of dilated spaces. The female voice in *Sirènes*, used as pure timbre without text, is a significant example of sound as a means of atmospheric abstraction. Similarly, *La Mer* (1903-1905) stands as one of Debussy's most important orchestral frescoes: marine images (the movement of waves, the dialogue between wind and water) are suggested in a distant and symbolic manner. Even more radical is the operation in *Préludes* (1909-1913): Debussy places the titles of the pieces only at the end of the score, to impose upon the performer and listener a pure experience of the sound, arriving at the evoked image only subsequently. As Jankélévitch writes:

THE SUGGESTION OF AN IMAGE

> Music does not express word by word, nor does it signify point by point, but rather suggests in broad strokes. It is not made for interlinear translations, nor for the confidences of indiscreet intimacies, but for atmospheric and pneumatic evocations. (Jankélévitch, 1961/1985, p. 74, translation by the author).

ERIK SATIE

MUSIQUE D'AMEUBLEMENT

MUSIC AS A PART OF THE ROOM

The atmospheric component is articulated in a conceptually different manner by Erik Satie. Through various avant-garde phases, Satie arrived around 1917 at the concept of *musique d'ameublement* (furniture music or upholstery music), introducing a revolutionary thought regarding the relationship between music and environment. This music was conceived to be an integral part of the room, an atmospheric background that reacted against the intellectual academicism of the era. Satie provocatively stated that his music should not be listened to: he urged the audience to speak and walk during the performance, treating sound as a background element on the same level as light or furniture.

SOUND TREATED AS DECORATION

Compositions such as the *Gymnopédies* or *Gnossiennes* reflect this intent: devoid of dramatic linear development, they rely on a hypnotic and repetitive circularity that requires no active attention. This theory configures a drastic ontological shift, where sound becomes an object in space, an "acoustic upholstery." Rooms are thus painted by music, which ceases to be an event to become a permanent environmental feature. The static and spatial value of these works constitutes the theoretical and aesthetic foundation of the Ambient Music that would be codified decades later.

James Abbott McNeill Whistler
Nocturne in blue and silver: The lagoon, Venice, 1879-1880.
Museum of Fine Arts, Boston.
This series of works provided direct inspiration for Debussy's *Nocturnes*, offering a visual translation of the hazy atmospheres and timbral evanescence sought by the composer. Here, form dissolves into a chromatic mist, and the boundaries between elements are made entirely imperceptible.

/ MACHINES

The music feels like it is inside you, or that you are inside it; you are not just listening to it, you are inhabiting it.

(Reynolds, 1998, p. 9)

PHYSICAL ATMOSPHERES

THE BIRTH OF TECHNO MUSIC

If the atmospheres composed by "musical paintings" aimed to convey impressions and symbols of landscapes and moments, in the second half of the century the concept of atmosphere, following the development of electronic music, became drastically more physical and tangible. The floating and aerial melodies of Impressionism, Symbolism, or *musique d'ameublement* shifted toward a strongly earthly and vibrational dimension, seeking the most visceral power that music could express. This phenomenon reached its fruition in the early 1980s with the birth of techno music in Detroit.

MUSICAL INFLUENCES

THE SOCIAL CLIMATE OF DETROIT

MUSIC AS SOCIAL REDEMPTION

This new genre was founded on diverse influences, such as African polyrhythm, Italo disco, soul, funk, and German and Japanese electronic music. Kraftwerk played a fundamental role in the subsequent development of the genre through works like *Autobahn* (1974), in which pop elements merged with repetitive electronic sounds. These varied influences were collected and re-elaborated in Detroit as a reaction to the American mainstream music that dominated major cities like New York and Los Angeles at the time, leaving the Midwest with greater freedom to cultivate an alternative genre. The city's numerous social issues contributed to the need to find in music a tool for community construction and consolidation, especially for Black and Queer minorities. These groups, often marginalized within society, used this process as a mode of affirmation, creating their own artistic scene. Through the appropriation of a technological aesthetic, the African American community opened up the perspective of a future to which they could feel they belonged, moving toward what would later be called Afrofuturism. The machine thus became an instrument of social redemption, a means to transcend the segregationist limits that were still deeply rooted at the time.

THE ECONOMIC CRISIS

Furthermore, Detroit's economic scenario was in steep decline compared to the past: the automotive industry, which had consolidated between the late nineteenth and early twentieth centuries, faced a major crisis in the 1970s, leading the city into a phase of economic and cultural stagnation.

FILLING A CULTURAL VOID

URBAN DECAY AND SONIC REBIRTH

This decay provided the backdrop for the birth of techno, increasing the urgency to find spaces for union and artistic development for young people within a context of civic identity crisis. Dan Sicko (1999) in *Techno Rebels: The renegades of electronic funk*, describes this situation of decline, recounting how young artists found space to develop their music precisely within this cultural void. The abandonment was not only social and economic but, consequently, architectural. The numerous decommissioned or downsized industries left behind unused offices, workshops, and workspaces, voids that became the new nuclei of musical experimentation.

The legendary stretch of Gratiot Avenue, known as "Techno Boulevard." Once housing Metroplex and KMS Records and still home to Transmat, these buildings served as the primary creative nuclei for the Detroit scene. Source: Sicko, D. (1999). *Techno rebels: The renegades of electronic funk* (p. 86). Billboard Books.

FOREFATHERS OF THE SCENE

In this context, the genre began to take shape thanks to figures like Juan Atkins and Richard Davis, who formed a duo named Cybotron, which was influenced by Kraftwerk and Chicago House and initially experimented with works of electronic funk. An emblematic example is *Clear* (1983) by Cybotron, where the warmth of funk is cooled by electronic synthesis, creating that hybrid between human and machine typical of the early Detroit sound. Subsequently, Kevin Saunderson and Derrick May entered the scene, contributing to the musical evolution. In parallel, hip hop was gaining ground as an alternative to pop and rock, bringing a contamination that Jeff Mills fully grasped. Mills inserted himself into this current, utilizing his ability to amalgamate hip hop, house, new wave, and electro elements into dance music, operating with a broad vision within the contemporary panorama.

THE EVOLUTION OF THE GENRE

GEOGRAPHICAL EXPANSION

Building on these foundations, the genre continued to develop, branching into various subgenres such as minimal techno, industrial techno, and hardstyle across different European countries. The influence expanded beyond US borders, reaching the entire world and making Berlin the new global capital of techno after Detroit. This transition was due to social and political factors that echoed the reasons for the genre's development in Detroit. After the fall of the Wall in 1989, Berlin was a fragmented city, both physically and socially. These voids became the ideal context for the cultural settlement of techno music, which acted, in this case as well, as a movement of unification and rebirth.

MUSIC AND THE MACHINE

Kodwo Eshun (1998), in *More brilliant than the sun: Adventures in sonic fiction*, delves into the relationship between this musical genre and the machine. This relationship is not based merely on the technical use of synthesizers or mixers but, almost ironically, on the link between the automobile industry and the birth of techno. The rhythm and sonorities reflect an industrial context of repetition, characterized by hard, angular, and metallic sounds. The Detroit artists completely embraced this imagery, coming to consider themselves one with the machines of musical production and reproduction, generating synthetic rhythms capable of moving physically through space. The rigidity of the sounds, loops, and repetitions represents a poetics of automation indissolubly linked to the machine, industry, and technology. This vision is fully manifested in works such as *The Bells* (1997)

RHYTHM AND REPETITION

by Jeff Mills, in which the absence of melody and the insistence on an obsessive percussive loop lock time into a continuous industrial cycle. Thus, an effect of alienation and depersonification is generated upon listening to the pressing, cadenced beats, which transport the listener into a loop of vibrations and movement. The linear timeline typical of traditional and melodic music is completely abolished, leading to a circular musical temporality that places listeners in an eternal present.

RIGID LOOPS

A CYCLICAL MUSICAL PRESENT

The experiential dimension of techno music finds its elected place, from the genre's genesis, within the club, later expanding into the broader phenomenon of the rave. The originally communitarian nature of this music is reflected, specularly, in its spatial dimension. The places destined for listening to techno are frequently ex-industrial or post-industrial spaces. Witness to this, even today, are some of the most iconic clubs in the world, such as Berghain, Revier Südost, or Tresor in Berlin, De School in Amsterdam, or the Knockdown Center in New York. There is, therefore, a strong tendency toward the recovery and re-semanticization of disused buildings, architectural skeletons brought back to life thanks to music-based projects.

INDUSTRIAL VOIDS TURN TO CLUBS

ARCHITECTURAL RE-SEMANTICIZATION

These spaces are characterized by a brutalist aesthetic, made of bare concrete, iron and imposing volumes, that enters into resonance with the mechanical and repetitive rigidity of the techno sound.
The materials present in these structures, such as concrete, glass, or metal, contribute enormously to the final acoustic output. While concert halls use linings of porous materials capable of absorbing sound waves to make the listening experience as clean and precise as possible, the opposite occurs in the presence of reflective surfaces like those mentioned above. In this case, the sound bounces off the walls and is violently repelled back into the space, generating extremely long reverberation times. This effect dilates the so-called decay, causing sounds reflected from rigid surfaces to remain suspended in the air longer and overlap with those reproduced subsequently.

EXTREME REFLECTIVITY

The box-like forms typical of these architectures favor the formation of standing waves, causing frequencies to bounce and concentrate in specific areas of the space. In this way, points of greater sonic intensity are defined, where the physical presence of sound becomes more perceptible. Beyond the interaction between

PHYSICAL SOUND PERCEPTION

sound waves and architecture, there is the additional component of human bodies within the musical space. The crowd acts as soft matter, absorbing high and medium frequencies, effectively becoming an acoustic material itself. The bass frequencies, characterized by a longer wavelength, traverse organic masses more easily, amplifying the rhythmic component of the music while minimizing the melodic one. Thanks to this phenomenon, the listening experience shifts from a standard auricular reception to a predominantly bodily one.

VISCERAL RESONANCE

SONIC-SPATIAL SYMBIOSIS

In these contexts, music is played for hours in a continuous flow, defining a totalizing union between architecture and sound, and constructing through this combination the specific atmosphere of the place. Simon Reynolds (1998) in *Energy flash* describes this phenomenology with precision: the powerful vibrations of regular bass kicks physically move the air of the dancefloor, engulfing everything within it and making the movements of the music perceptible directly in the bodies. Sound acts here as a tactile matter: as the author notes, in this genre, "the pleasure of the text (melody, lyrics, structure) is replaced by the pleasure of the texture (timbre, grain, the physical impact of sound)" (Reynolds, 1998, p. 396). This dense substance serves as a glue for the crowd: it surrounds everyone equally, yet paradoxically isolates each individual in a personal and introspective experience.

SOUND BECOMES A TACTILE MATTER

ATMOSPHERIC COHESION

THE SENSORY MICROCLIMATE

The club environment is characterized not only by the sonic component but also by a specific internal climatic situation. The crowd moving within these enclosed spaces produces heat, which in turn generates condensation and humidity. Thus, an internal condition is created, characterized by a sonic, physical, and climatic power that makes the sensory experience even more engulfing. The power of sound manifests, therefore, as a fluid in which one is immersed to be enveloped and then fused with it. This acoustic pressure moves individual bodies in unison; submerged in the same sonic matter, they see their individual boundaries dissolve, transforming the crowd into a single pulsating organism.

TOTAL PERCEPTUAL FUSION

THE ROLE OF ARTIFICIAL LIGHTING

An essential element of this sensory architecture is the management of light. Since the dawn of club culture, lighting has been designed in symbiosis with acoustics. Darkness dominates the environment, erasing surrounding architectural and social details.

This visual blackout eliminates distractions, making sound the only true element of orientation and focus. This diminishing of visual dominance resonates with Juhani Pallasmaa's (2005) critique of ocularcentrism in *The eyes of the skin*. The architect argues that while vision tends to isolate and distance the observer from the world, sound incorporates the subject, creating a sense of interiority. The visual void of the club thus validates this concept, forcing the listener to abandon the detachment of the gaze in favor of a fully embodied, acoustic immersion. The frequent use of stroboscopic lights amplifies the sense of alienation provided by techno sounds, rapidly alternating moments of high brightness with moments of intense darkness. Thus, vision is fragmented into very brief instants, leaving the sequential progression of the music as the only continuous element. In this way, darkness and vibration collaborate to disconnect the listener from ordinary time and space, completely immersing them in the atmosphere of the machine.

COMPLETE ACOUSTIC IMMERSION

THE SUSPENSION OF TIME

/ AETHER

SONIC DEMATERIALIZATION

Moving beyond the materiality and hardness of the machine atmosphere's "wall of sound," the atmospheric investigation dissolves toward an aerial musicality and spatiality. Compression becomes dilation, matter dematerializes, and rhythmic rigidity is nullified. Air and space become media for the propagation of slow, continuous sounds that color environments with light hues, without violently filling the voids. Music thus begins to act on the light and emotional temperature of a place. The transition is therefore from earth to sky, from the contingent to the transcendental, from a sound that vibrates in the body to one that gently envelops the mind.

BRIAN ENO AND AMBIENT MUSIC

Ambient music began to emerge towards the late 1970s, driven by the intuition of the musician considered the genre's greatest experimenter: Brian Eno. In *Ocean of sound*, David Toop (1995) recounts the biographical episode in which the musician arrived at the insight that allowed for the development of this new aesthetic:

THE SEMINAL INTUITION

> Then Brian was knocked down and seriously injured by a taxi whilst crossing the Harrow Road. While he was recovering, I visited him in his Maida Vale flat. Judy Nylon had visited him, he told me, and left a record of eighteenth-century harp music. He had put the album on the deck, dropped the stylus and fallen back into bed. Once there, he discovered that the volume was almost too low for him to be able to hear the music. One stereo channel was missing also, but since he was barely able to move, he left it as it was and listened. As he did so, an alternative mode of hearing unfolded. Rather than standing out from its environment, like a ship on an ocean, the music became part of that ocean, alongside all the other transient effects of light, shade, colour, scent, taste and sound. So ambient was born, in its present definition at least: music that we hear but don't hear; sounds which exist to enable us better to hear silence; sound which rests us from our intense compulsion to focus, to analyse, to frame, to categorise, to isolate. (Toop, 1995, pp. 139-140).

MUSIC AS A SPATIAL COMPONENT

This episode was the epiphany that led Eno to conceive of music as a spatial component equal to any other. One can observe in this reasoning a continuity with the theoretical line that had founded musique d'ameublement (furniture music) at the beginning of the century. In 1978, Eno published his first true ambient work: *Ambient 1: Music for airports*. In the liner notes, he acknowledges the temporal precedence of Muzak, developed in the 1950s as "environmental music," again along the lines of furniture music. Muzak was often viewed negatively, considered a sonic tool tied to labor and consumption. In that context, music was almost engineered to fill workspaces and commercial areas, covering environmental sounds with reassuring melodies to boost productivity. Sound was thus used in a manipulative manner, imposing atmospheres upon places that deliberately masked their true nature.

THE MUZAK PHENOMENON

AMBIENT AS AN OPPOSITION

Eno, through ambient, opposed this situation by elaborating a genre that dialogues with the environment and its real sounds, without imposing itself on those inhabiting the space, but leaving open freer and more personal levels of perception. Sound becomes a light atmospheric element, like light, color, and scent. Attention is not completely focused on the music, allowing the mind to welcome it with varying degrees of intensity. Again in the liner notes of *Ambient 1: Music for airports*, the author declares: "Ambient Music must be able to accommodate many levels of listening attention without enforcing one in particular; it must be as ignorable as it is interesting" (Eno, 1978). This was the theme that pushed Brian Eno to pursue musical experimentation in this direction, proposing a light and enveloping sound that would evaporate into space like gaseous matter.

A LIGHT ATMOSPHERIC ELEMENT

ADDRESSING THE NON-PLACES

The artistic choice to indicate a spatial direction for Eno's first ambient album communicates much about the atmospheric intentions sought in this genre. The airport belongs to those spaces that anthropologist Marc Augé (1992) calls "Non-Places" (*Non-Lieux*): places of connection and exchange of goods and people, devoid of history, identity, and relationality. In a sense, non-places symbolize the nature of much contemporary architecture and building: shopping malls, airports, connecting tunnels, and subway stations constitute a series of totally utilitarian structures and infrastructures, similar to one another, cold and impersonal. The lighting of non-places contributes to the definition of a standardized atmosphere, often eliminating the difference between day and night, excluding these spaces from the natural cycle of temporal change, hibernating them

IGNORED SPACES

in a condition of perpetual staticity. The minds of people transiting through airports, stations, or other structures of this type are often elsewhere; they do not consider the space they are in, precisely due to its connotation as a transitory and depersonalized space. The mind is thus disconnected, or occupied with other thoughts.

EMOTIONAL RECONNECTION

Here lies Eno’s intention, who decides to inhabit these spaces by contrasting their cold and rigid atmosphere, “coloring the air” to reconnect it to the emotional state of those passing through. The final result ends up being shared, in a certain sense, with techno music: arriving at a state of temporal suspension. This is achieved, however, through a diametrically opposite compositional methodology: the rigid rhythmic grid typical of techno is completely dissolved.

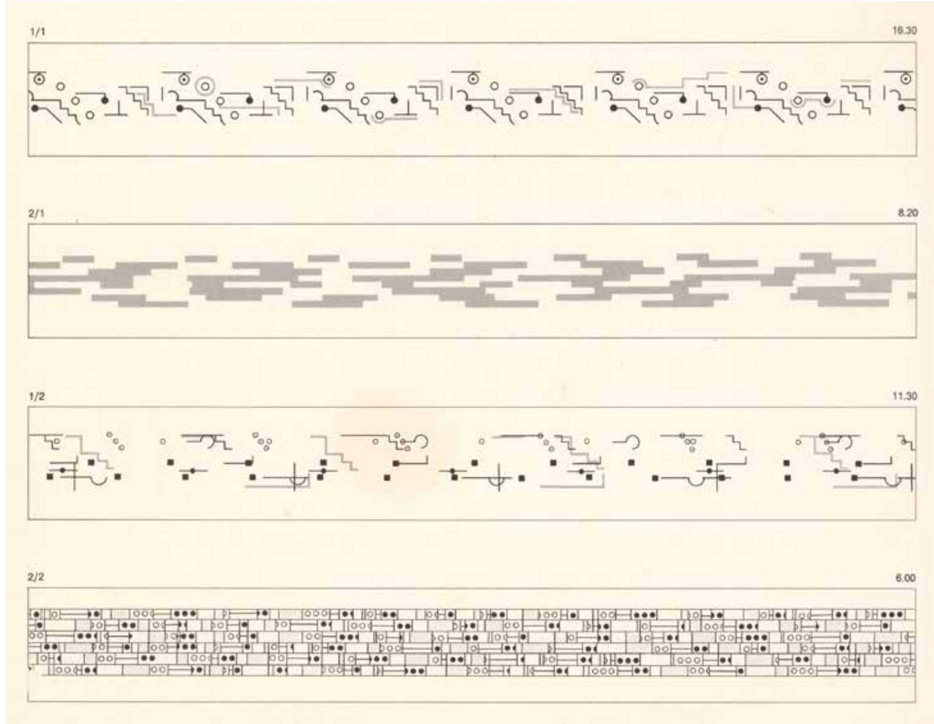
AN AERIAL MUSICAL CONSTRUCTION

Ambient’s atmospheric fluidity arises precisely from a composition made of irregular loops, creating sounds that float in spaces, mutating cyclically and extremely slowly. The technique used is asynchronous; loops are constructed with different durations, reproducing them one after another through slight overlaps, both between different loops and with other sounds. This leads to the concept of generative music theorized by Eno, where the asynchronous repetition of loops leads to a slow and never-repetitive progression, allowing the music to evolve over long periods starting from limited generating elements.

COMPOSITIONAL CONNOTATIONS

DILATED TEMPORAL PERCEPTION

An example of this technique is the track *1/1* from *Music for airports*, in which a piano phrase is constantly repeated, superimposed over other synthetic sounds. This creates a constant but imperceptible evolution of the track, defining an extremely dilated temporal perception. While techno defines a mathematically scanned time, founded on solid and recognizable rhythmic pillars, ambient frees itself from these structural connotations, presenting music that slowly spreads into the architectural space of non-places. For these reasons, techno time results in being extremely concentrated and recognizable, cyclically progressive, continuously running toward the next beat. Conversely, ambient time becomes almost imperceptible, expanding physical and temporal space into a situation of stability that lies outside a typically chronological scan.



Graphic score included in the liner notes for Brian Eno’s *Ambient 1: Music for airports* (1978). The notation illustrates the visual structure of the album’s four tracks, showing how diverse musical elements overlap and intertwine to define the fluid and non-linear nature of ambient music. Source: Eno, B. (1978). *Ambient 1: Music for airports* [Liner notes]. Polydor.

SOFTENING THE ARCHITECTURE

SPATIAL-MENTAL CONTINUUM

Temporal dilation acts to blur the architectural space as well. Sound operates as a perceptual filter for non-places, often defined by cold materials and bare, rigid lines, whose spatial limits are softened and expanded. Distances are altered by a lack of precise rhythmic frequencies and by the use of ample reverbs, conferring a spatial softness and fluidity. The sonic substance that forms cancels the real geometry of the architecture, transporting the listener into an ethereal mental state that becomes a continuum between sound and space, eliminating the ontological distinction between the two elements. Architecture is not covered by the music but is modeled and modified through a relationship of dialogue and complementarity.

DISSOLUTION OF THE MIND

THE OCEANIC FEELING

OCEAN OF SOUND

This spatial condition brings with it a new concept in the psychological perception of inhabiting spaces. If the sound of the machine engulfed listeners by defining a fusion of the collective, creating a single resonant body, the aerial sound of ambient produces a dissolution of the mind through space and music. In this condition, one can see the Freudian theory of the "oceanic feeling." Reynolds (1998) himself compares the experience of immersion in electronic music to the state of dissolution of the ego that occurs at birth, in which, according to Freud, the awareness of the difference between subjectivity and the surrounding world does not yet exist. Toop (1995) picks up this concept of the ocean, declining it into his "ocean of sound," reasoning on the ambient theme of personal dissolution into sonic matter and perceptual space. This mental state proves central to the musical design of ambient artists like Eno and Toop himself, who consider transit or stasis in non-places a moment in which, through passive listening, psychological boundaries fade until they coincide with the space itself.

/ CHAPTER CONCLUSIONS

The journey through Paintings, Machines, and Aether has traced a conceptual thread highlighting the atmospheric properties of music, whose potential enables a new perception of physical space. Debussy's symbolism refers to a liquid conception, portraying and capturing the emotional essence of a place, while the musical structures of techno and ambient interact with the spaces of reproduction, becoming spatial elements in their own right.

Spatial perception, emotions, and visceral sensations are determined by sound, a generator of atmospheres and psychological states within the individual inhabiting such environments. In each of the described cases, atmosphere is configured not as an accessory condition, but as the very essence of space. Sound, together with physical volumes and light, defines a situation that makes the spatial experience totalizing, determining its emotional temperature.

R E S O N A N C E

/ MATTER

/ BODY

To understand how atmospheres can manifest in space, it is necessary to delve into the physical modalities with which sound waves interact with it. Physical mechanisms lie at the foundation of spatial perception, which shifts in relation to various contextual factors that make the listening experience variable. Everything surrounding us acts as a reactive element to sound propagation. Vibrations, matter, and perception intertwine in a process of actions and reactions that lead to substantial alterations in acoustic physics.

/ MATTER

“*Baukunst ist eine erstarrte Musik*”
(Architecture is frozen music)

FROZEN ARCHITECTURE

Goethe stated in a conversation from 1829 recorded by Eckermann (1836/1850), revisiting a concept expressed by Schelling years prior. This citation proposes a precise vision of traditional architecture, deeply tied to the ideals of precision and stasis typical of the Neoclassical style of the time. Architecture was conceived as a series of numbers stationary in space, whereas music was seen as a numerical series moving through time. As observed in the previous chapter, the interaction between music and architecture allows for the melting and fusion of the Neoclassical visions regarding these two realms. Techno and ambient music have demonstrated that it is possible to “thaw” architecture, merging it with sound, modifying its atmosphere, and physically interacting with its constituent materials, causing structural stasis to vibrate and move in sync with sound waves.

MELTING ARCHITECTONIC RIGIDITY

PHYSICAL INTERACTIONS

Architectural materiality thus becomes an integral part of the auditory experience of a place, acting as a tool for the manipulation and modeling of the internal soundscape. This behavior of architecture as a musical instrument, or as a resonance chamber defined by its intrinsic properties, is investigated by Barry Blesser and Linda-Ruth Salter (2007), who employ the term “Aural Architecture.” According to their theory, the architectural properties of a space can be communicated to and perceived by the human ear without the use of sight. Optical space and acoustic space behave, in fact, in the same manner: we can see forms thanks to the interaction between light waves and matter captured by the eye; similarly, the contact between matter and sound waves allows our auditory system to decode the acoustic characteristics of a location. Acoustic space is, therefore, the fruit of the material reaction to sonic solicitations, proving capable of indicating the qualities and characteristics of an environment, amplifying the sensory perception of architecture.

ARCHITECTURE AS AN INSTRUMENT

AURAL ARCHITECTURE

REVEALING THE INVISIBLE

ACOUSTIC IMPEDANCE

This dialogue between sound and matter relies on the physical characteristics of surfaces and their consequent acoustic impedance. This material aspect indicates the resistance that each material opposes to the penetration of sound waves. Materials defined as high impedance, specifically those that are very dense, rigid, and non-porous, cause an almost total reflection of the waves striking them, propagating the sound back into the space. These materials include concrete, metal, stone, and smooth plaster. Glass, in particular, presents a sensory dichotomy: while visually permeable, implying openness, it acts acoustically as a rigid barrier. It generates sharp reflections that accentuate high frequencies, contributing to a cold sonic atmosphere that contrasts with its visual lightness. The phenomenon generated in most of these cases is a specular reflection that acoustically saturates the space, increasing the perceived volume. In psychoacoustics, environments characterized by these reflective surfaces are defined as “wet”: here, sound bounces and fills the volumes, making them perceived as wider and more monumental. However, these phenomena often result in a more confused and less defined sound, caused by the superimposition of waves coming from the primary acoustic source with those reflected by high-impedance materials. Steen Eiler Rasmussen (1959), in *Experiencing architecture*, addresses this theme, noting how highly reflective spaces can generate a sense of disorientation in those who inhabit them; the user often feels overwhelmed by acoustic persistence, as the loss of clarity renders speech or music less intelligible, amplifying the power of sound into an often chaotic reverberant effect.

REFLECTIVE MATERIALS

MONUMENTAL PERCEPTION OF SPACES

DISORIENTING EFFECTS

Conversely, the opposite behavior occurs with low-impedance surfaces, namely those materials that allow for greater penetration by the wave. These are characterized by high porosity and softness, such as fabrics, untreated wood, or fibrous panels; human bodies also act as low-impedance material, absorbing a large part of the frequencies. The physical mechanism acting in these cases is not a reflection, but a welcoming of the wave within the porosity of the matter. The captured sound is consequently transformed into heat due to the friction generated through penetration into the material. This process renders the environment acoustically “drier,” drastically reducing sound tails and, therefore, the reverberation time. If in the previous case the perception of the environment resulted in saturation and dispersion, in this second instance the atmosphere created is extremely more collected and intimate, communicating a sense of proximity. This happens

ABSORBENT MATERIALS

INTIMATE SPATIAL PERCEPTION

SENSE OF PROXIMITY

because, in high-absorption spaces, the perceived distance between the listening subject and the sound source is shortened. This situation is often found in domestic environments, and even more evidently in recording studios, where, due to a necessity for extreme precision and acoustic clarity, every type of reverberation that would interfere with a clean listening experience is eliminated as much as possible.

ARCHITECTURAL MORPHOLOGIES

THE PARALLELEPIPED VOLUME

The behavior of various materials in reaction to sound is not the only element defining the acoustic properties of a space. Architectural morphology plays a fundamental role in the final result of this physical process, determining the vectorial behavior of sound waves, their trajectory, and their distribution in space. The simplest and most common architectural structure, that of the parallelepiped, is acoustically one of the situations causing the most complex and often problematic phenomena. Parallel walls, if smooth, prove to be extremely reflective: when the sound's wavelength mathematically coincides with the room's dimensions, waves travel along the same trajectory, bouncing back and forth. This creates an in-phase superimposition of sound waves, generating what are defined as standing waves. In this case, certain frequencies, generally the low ones, rumble in the space in an unnatural way, while others tend to cancel each other out. These types of spaces also generate flutter echo, a phenomenon manifesting as a rapid, metallic, and repetitive sound bounce.

GENERATION OF STANDING WAVES

DOMES AND VAULTS

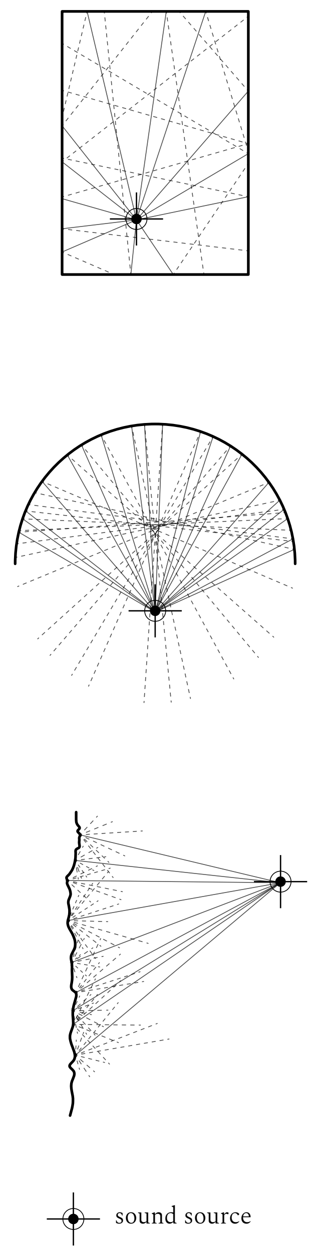
DELOCALIZING REFLECTIVITY

Extremely different behavior is noted in structures with curved and concave forms, such as domes or vaults. These specific morphologies act as acoustic collectors, similar to an optical lens. Sound waves are reflected by concave surfaces and consequently directed toward a specific area. For this reason, in particular conditions, some sounds coming from a distant source can be heard with great clarity in a different point, causing a perceptual scission between the sight indicating where the source is located and the auditory perception placing itself close to the listener, generating a disorienting effect.

IRREGULAR SURFACES

HOMOGENEOUS DIFFUSION

Finally, more complex forms, such as coffers, columns, or three-dimensional textures, are characterized by an irregularity that prevents sound waves from behaving as direct and defined rays. When a wave comes into contact with a faceted surface, the sound is broken up and redirected in multiple directions, in a phenomenon defined as scattering. This allows for a less directional and more diffused perception of sound, filling the air of an environment homogeneously and transforming the physical space into a diffused sound field.



Diagrams of acoustic propagation.
Graphic elaboration by the author.
From top to bottom: specular reflection within a parallelepiped volume, waves create a saturated network of reflections;
reflection on a vaulted or domed surface acting as an acoustic collector toward a focal area;
scattering on an irregular surface, the complex morphology induces a multi-directional diffusion.

/ BODY

THE BODY AS AN ACOUSTIC MEDIUM

CORPOREAL PERCEPTION

BIOLOGICAL RESONANT CHAMBER

Subsequent to the type of spatial propagation of sound waves, determined by the physical and morphological characteristics of a space, the final recipient of sound, from an anthropocentric perspective, is the human body. Sound, having become space, strikes the listener, defining a sensory perception that is both psychological and corporeal. The body functions, as seen previously, as a material with low acoustic impedance, becoming a medium for wave absorption. Deepening this theme, we move from a conception of sound perception as exclusively acoustic to a corporeal one, in which the body itself transforms into a resonance chamber, a physical definition that aligns with the psychological and philosophical concept previously exposed by Nancy (2002/2004).

DIVERSE CORPOREAL DENSITIES

DENSITY-BASED PROPAGATIONS

BONE CONDUCTION

The body behaves as a propagation medium due to its composition, consisting of 60-70% water, in addition to the presence of bones as rigid, high-density material. This dichotomy between liquid or soft matter and rigid matter allows sound waves to be received and internalised in physically different ways. Acoustic physics indicates that the speed of sound propagation in water is almost 5 times higher than in air (1500 m/s in water versus 343 m/s in air), and even higher through solids. These represent fundamental data for understanding how and with what speed sound waves propagate within a human body. For this reason, low-frequency sound waves (20-100 Hz), upon contact with the body, penetrate beyond the skin, traveling through fluids and bones, traversing the somatic mass with almost no attenuation. This phenomenon activates bone conduction, a mechanism that makes sound perceptible beyond the auditory canal, pushing sound waves through the skull and skeleton. Sound perception expands within the entire body, and in environments with high acoustic pressure, sound ceases to exist as an exclusively external element, pushing itself inside the subject, amplifying the inner acoustic dimension.

ORGANS AND SOFT TISSUES

SYMPATHETIC RESONANCE

VIBRATIONAL SYNCHRONIZATION

Beyond water and bones, the body is also composed of soft tissues and internal organs, each of which possesses a natural resonant frequency. This theme is part of bioacoustic studies, which define the phenomenon of "sympathetic resonance of organs." Steve Goodman (2010) documents in his studies on vibrational ecology how specific frequencies stimulate different parts of the body, triggering involuntary reactions within them. An example of this is seen in the resonance of the ribcage, which reacts to low frequencies (50-100 Hz); this part of the body vibrates in the context of the club, where these frequencies are widely present and powerful. This resonance generates a sympathetic synchronization between body and sound, causing the mass to vibrate at the same frequency as the waves striking it. In this case, for low frequencies, there is a physical sensation of compression, making a tangible element out of something ephemeral and invisible like sound.

THE EFFECTS OF INFRASOUNDS

PSYCHOSOMATIC DISCOMFORT

OCULAR RESONANCE PHENOMENA

Similarly, infrasonic frequencies (below 20 Hz) have a vibrational effect on the human body. Infrasound cannot be heard, as it is below the human auditory threshold, but it is perceived at a physical level, generating a bodily response of alertness and fear, being unconsciously associated with terrestrial frequencies linked to phenomena such as earthquakes. In the film *Irréversible* (2002) by Gaspar Noé, Thomas Bangalter curated the soundtrack and sound design. In the initial sequences of the film, a 28 Hz frequency, at the limit of audibility, is played in the background. This choice was made precisely to exploit the properties of the frequency, causing a sense of restlessness and unease in the viewers. The violent images that are projected later are anticipated by a sonic strategy that induces a precise sensation in the audience even before experiencing it explicitly through the image. A similar phenomenon, linked to architectural space, was documented by Vic Tandy (1998) in the article *The ghost in the machine*. The engineer worked in a laboratory where those inside perceived sensations of cold, discomfort, and depression. Tandy discovered that a defective ventilation fan was emitting a standing sound wave at 18.98 Hz. This infrasonic frequency was not heard but was physically perceived by the staff, causing unpleasant symptoms. Furthermore, the frequency corresponds to the resonant frequency of human eyes, causing the vibration of the eyeballs and leading to visions and illusions of non-existent shadows or movements.

THE EFFECTS OF ULTRASOUNDS

VESTIBULAR SYSTEM INTERFERENCE

High frequencies, on the other hand, hold a different physical power. High-frequency waves (above 2000–4000 Hz) are not perceived as diffuse vibration but penetrate more deeply into the central nervous system. Ultrasound (above 20,000 Hz) eludes the audible spectrum, but if the body is exposed to it for a long time, it can cause physical responses impacting the vestibular system, which governs balance. For this reason, some effects can include migraines, nausea, or vertigo.
The pitch of frequencies can thus act on the body in different ways, bringing visceral sensations for lower frequencies, and a heightened nervous response for higher ones.

NEURAL ENTRAINMENT

RHYTHMICAL BRAIN STATES

CHRONOBIOLOGICAL ALIGNMENT

A further level of connection between somatic responses to sound and spatial acoustics is the phenomenon of Neural Entrainment. Michael H. Thaut (2005), in his text *Rhythm, music, and the brain*, highlights how the human auditory system and the motor system are profoundly connected. Musical periodicity is detected by the brain, and the firing frequencies of neurons, the frequency at which neural impulses are released, are synchronized to it. Musical rhythm, therefore, plays a fundamental role in the perception of sound from a physical and cognitive point of view. A fast and repetitive rhythm, like that of techno music (120-140 bpm), pushes the brain toward Beta waves, associated with motor activation and wakefulness, but cyclic and highly repetitive rhythms can eventually induce dissociative states. Conversely, slow and arrhythmic musicalities can lead brain activity toward Alpha or Theta waves, linked to sleep and relaxation. In this state of entrainment, the body comes to surrender its normal chronobiological control, aligning itself with the external sonic stimulus, where automatic activities such as heartbeat or respiration synchronize with the sonic characteristics of the space.

SKIN AS A BOUNDARY

DISSOLUTION OF THE SELF

The capacity of sound to pervade the somatic mass demonstrates its power to connect perceptual exteriority and interiority. In *The book of skin*, Steven Connor (2004) identifies the skin as a bodily boundary that sight maintains by distancing subject and object, whereas sound dissolves it. Through sound, the Self and the world are no longer separate entities but interpenetrating ones. The vibrations of space, invading the body and generating resonance, facilitate a dissolution of bodily boundaries, leading to a deep connection with the lived space.

/ CHAPTER CONCLUSIONS

The analysis conducted in this chapter closes the circle between music, space, and perception. Goethe's frozen architecture has thawed through the process of union between three principal actors: sound, matter, and the body. Architectural solidity is challenged by the presence of the sonic element, which interacts with material and formal qualities, defining behaviors capable of enhancing spatial characteristics. The recipient of this process becomes fully integrated into it, reaffirming the concept of resonance and leading to an inseparable fusion between inhabiting space and experiencing one's own interiority. Physical space thus positions itself as an intermediate medium, acting as a mediator between sound and its corporeal perception. Architecture acts as an instrument that, thanks to its specific characteristics, sculpts the invisible quality of sound. The receiving body subsequently tunes into frequencies and rhythms, indicating how somatic sound perception is an extremely invasive act that recalibrates internal biological rhythms based on external events and penetrates the bodily boundary of the skin. Space can therefore be considered a complex system of vibrations capable of touching the physiological sphere of those who's in it. Architecture is thus transformed from an object of contemplation into an extension of the body.

CASE STUDIES

The theoretical framework finds a clearer concretization within the world of sound art which, having developed throughout the twentieth century, has brought the conception of music and sound to a level even more deeply linked to space. The authors analyzed in the preceding chapters have uprooted music from a purely narrative and concert-oriented dimension, leading this form of art to engage more closely with environments and architectures. This approach has allowed musical boundaries to expand toward a coexistence and collaboration with other disciplines, generating artistic manifestations that touch upon unprecedented points of the perception of both phenomenal and emotional reality. Through the description of the physical interactions between sound and matter, and sound and human bodies, the power of this invisible material to shape our surroundings has been highlighted, generating reactions as powerful as those of a tangible object. Through the analysis of the following case studies, the intent is to highlight these material-spatial reactions and characteristics of the acoustic element, demonstrating how its value as an architectural component can be equated to that of pillars, walls, or solid structures.

/ MATERIALITY

The evolution of contemporary spatial design has increasingly integrated immaterial components that reveal and challenge the latent properties of built environments. Within this framework, sound emerges as a primary substance rather than a secondary environmental layer. This section examines how acoustic energy can be treated as a plastic material, possessing a density and structural weight capable of redefining the site's identity.
The following case studies trace a trajectory through the physical nature of sound: from its role as a perceptual probe that unveils the hidden frequencies of architecture, to its manifestation as a sculptural mass that occupies the void. Through the works of Alvin Lucier, Jacob Kirkegaard, and Bruce Nauman, the inquiry moves beyond traditional aesthetics toward a deeper engagement with the environment. Here, sound is designed to render the invisible audible and the ephemeral tactile, demonstrating that the transition from listening to a work to traversing a sonic space constitutes a fundamental shift in the experience of architectural materiality.

/ ALVIN LUCIER
I am sitting in a room (1969)

ITERATIVE METHODOLOGY

Alvin Lucier's *I am sitting in a room* operates as a profound exploration of acoustic physics and the materiality of sound. The work is built upon a generative methodology of recursive re-recording, where a recorded spoken text is repeatedly broadcast and re-captured within a specific architectural environment. This iterative process allows the physical characteristics of the space to gradually dominate the audio signal. Through the continuous reinforcement of the room's resonant frequencies, its "modes", the environment actively shapes the sonic output, transforming the initial vocal input into a series of sustained harmonic drones.

SPATIAL GEOMETRY

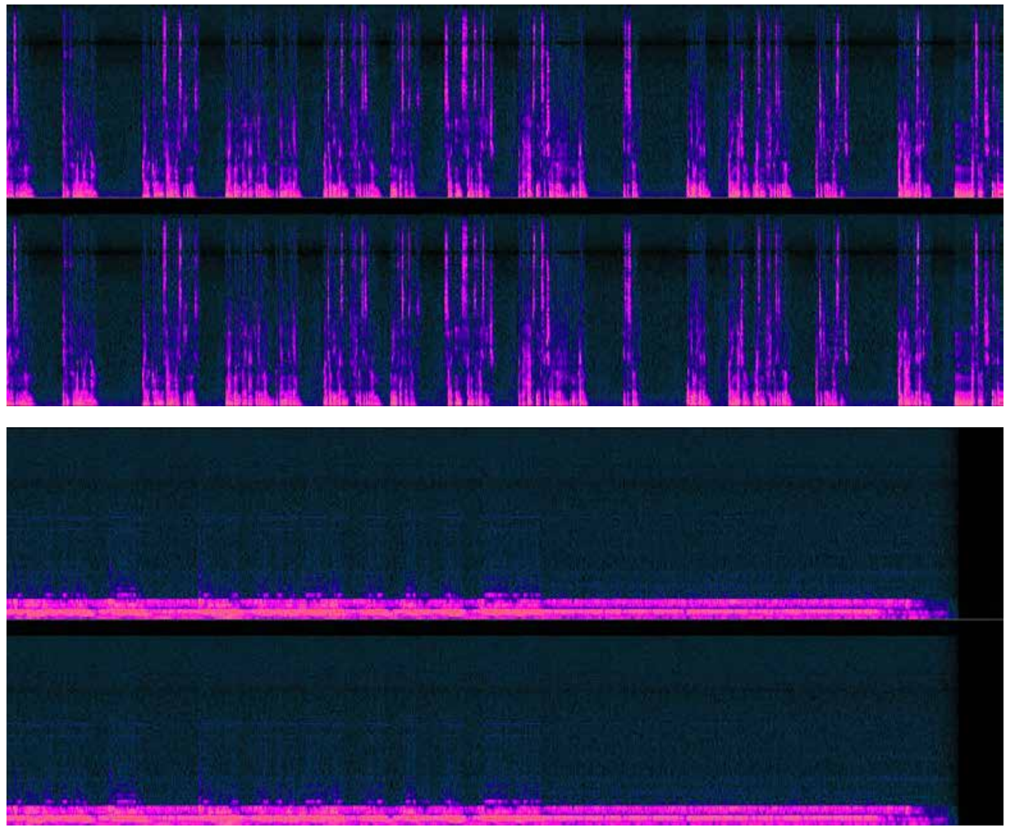
The core of this transformation lies in the phenomenon of constructive interference. As the recording cycles accumulate, the room acts as a natural filtering system, amplifying frequencies that correspond precisely to its dimensions while attenuating those that do not. Consequently, the work serves as an audible manifestation of invisible spatial geometry. The specific material composition of the walls and the cubic volume of the air become the primary determinants of the piece's pitch and timbre, creating a soundscape that is inherently unique to the location of its execution.

LINGUISTIC DISSOLUTION

As the piece progresses, there is a clear transition from semantic clarity to abstract resonance. The initial focus on the linguistic meaning of the words dissolves as high-frequency consonants disappear and vowel formants merge into rhythmic tonal clusters. This shift highlights the physical properties of the voice over its communicative function, effectively reducing speech to a rhythmic trigger for spatial excitation. The human element becomes a source of energy for the architectural instrument, leading to a state where the boundaries between the performer's vocal identity and the physical environment become increasingly blurred.

OBJECTIVE SUBLIMATION

The inclusion of Lucier's own speech dysfluency adds a significant layer of biological data to the process. The rhythmic irregularities of his natural speech pattern provide the specific impulses that set the room in motion. By subjecting these idiosyncratic vocal traits to the laws of acoustics, the work achieves a form of objective sublimation. The resulting textures are the product of an interaction between human imperfection and environmental physics, offering a compelling demonstration of how sound functions as a bridge between the biological subject and the material world.



Spectral evolution of Lucier's *I am sitting in a room*. Top: initial minute showing the complex harmonic profile of human speech. Bottom: final minute illustrating the complete dissolution of language into the room's resonant modes. Original data visualization by the author.

/ JACOB KIRKEGAARD
4 rooms (2006)

ACOUSTIC ARCHEOLOGY

Jacob Kirkegaard's *4 rooms* (2006) marks a significant evolution in the study of environmental resonance, shifting the inquiry from vocal interaction to a form of acoustic archeology. Captured in October 2005 within the Chernobyl Exclusion Zone, the work focuses on four symbolic sites of human activity: a church, an auditorium, a gymnasium, and a swimming pool. While the methodology shares a formal lineage with the recursive techniques of Alvin Lucier, Kirkegaard introduces a critical distinction by removing all external sonic input. Rather than using the human voice as a catalyst, the artist recorded twelve minutes of the existing ambient sound, the silence of the abandoned spaces, and allowed the architecture to excite its own latent frequencies through ten generations of re-recording.

MATERIAL MEMORY

This process transforms the architectural void into an active acoustic archive. By absenting himself from the rooms during the recording process, Kirkegaard highlights the autonomous agency of the environment. The initial signal, composed of microscopic vibrations and atmospheric stillness, is gradually amplified by the rooms' dimensions until it merges into dense and harmonic drones. In this context, resonance functions as a temporal bridge, manifesting the enduring physical presence of a site severed from human history. Released on the 20th anniversary of the Chernobyl disaster, the work serves as a sonic monument, rendering audible the invisible "half-life" of spaces where human time has effectively stopped.

TEMPORAL PERSISTENCE

The resulting compositions, also presented in the audio-visual project Aion, interrogate the boundaries between decay and persistence. Through the systematic layering of resonance, Kirkegaard reveals that these rooms are not truly silent but can be conceptualized as time capsules holding a spectral identity. The shift from near-silence to overwhelming sonic density suggests that the material world retains a memory of its own proportions, independent of human observation. Ultimately, *4 rooms* demonstrates that even in the most desolate environments, the laws of physics continue to generate a "voice," offering a transcendental perspective on the relationship between materiality, trauma, and eternity.

The four rooms of the Chernobyl Exclusion Zone. Clockwise from top left: the Gymnasium, the Swimming Pool, and the Auditorium in Pripyat; the Village Church in Krasno. These sites served as the primary architectural resonators for the *4 rooms* project. © Jacob Kirkegaard, 2005. Courtesy of the artist (fonik.dk).

/ BRUCE NAUMAN
Raw materials (2004)

VOLUMETRIC TOPOGRAPHY

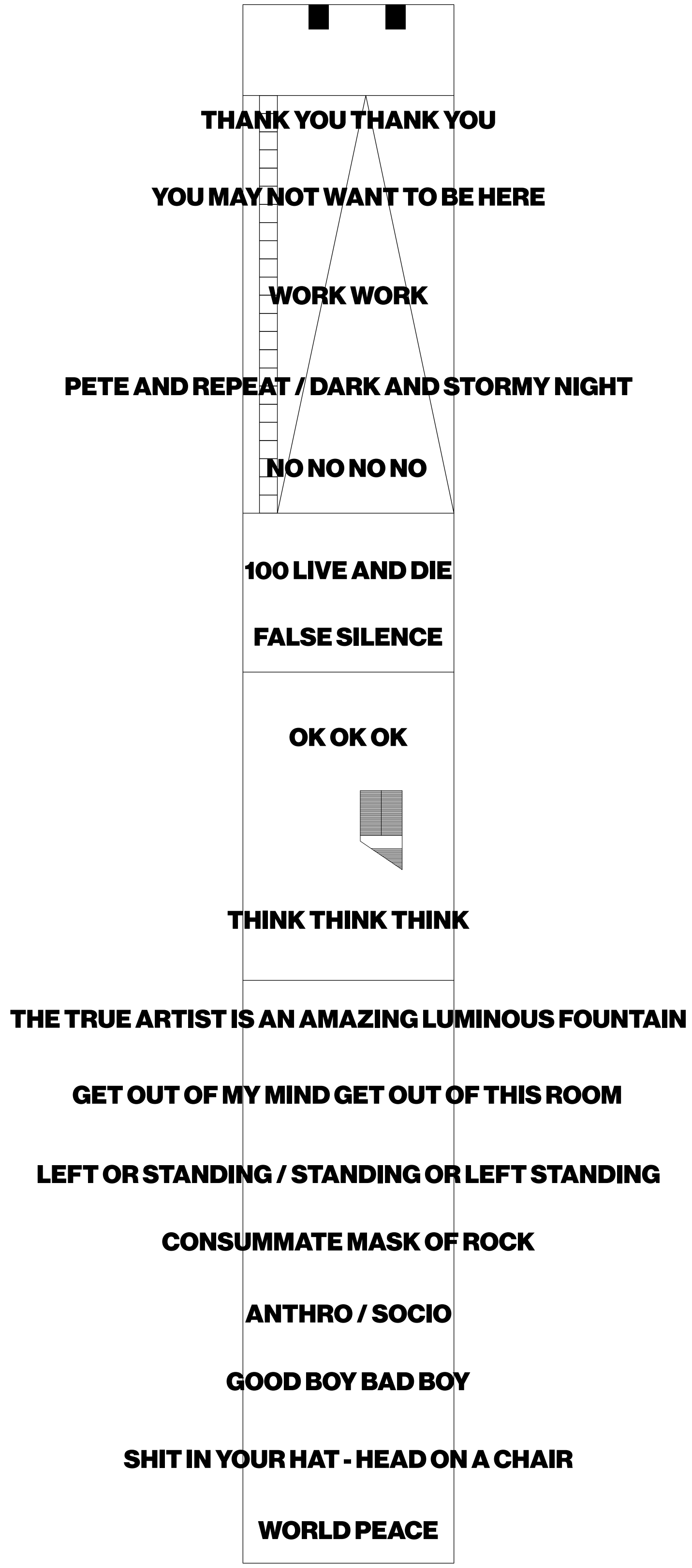
In *Raw materials* (2004), Bruce Nauman reconfigures the vast industrial void of the Tate Modern's Turbine Hall, treating audio not as a temporal event, but as a tangible, volumetric substance. The installation functions as an invisible topography, utilizing twenty-two archival recordings strategically positioned to map out a series of auditory zones. Within this framework, the traditional relationship between architecture and sound is inverted: the building does not merely house the sound; instead, the sound becomes the primary architectural agent, constructing a sequence of invisible barriers and corridors that the visitor must navigate with their entire body.

SCULPTURAL MATERIALITY

Nauman approaches sound as a literal "raw material", stripping the voice of its narrative priority to emphasize its spatial presence. Through the use of highly directional speakers, verbal fragments are projected with such precision that they create distinct boundaries within the air. As the visitor moves through the gallery, they do not encounter a diffuse environmental echo, but rather collide with localized pockets of sonic pressure. This manipulation transforms the architectural vacuum into a solid medium. The obsessive repetition of the texts grants the sound a tactile, almost obstructive quality, effectively treating a frequency in the air with the same sculptural authority as a physical object placed in a passageway.

STRUCTURAL LOGIC

The dialogue between the site and the sound manifests as a tension between the monumental stability of the industrial hall and the invasive, fragmented nature of the human voice. As the concrete architecture of the Tate Modern suggests permanence, Nauman's sonic material introduces a dynamic of psychological and spatial disruption. These recordings do not seek to harmonize with the room's natural resonance; rather, they impose a new, invisible structural logic that challenges the site's monumentalism. In *Raw materials*, sound operates as a plastic force that models the experience of the void, demonstrating that acoustic energy possesses the capacity to fill, divide, and redefine an environment with the same permanence and structural weight as a solid wall.



Sound Mapping of the Turbine Hall. Topographic layout of the vocal fragments for Bruce Nauman's *Raw materials* (2004). The diagram illustrates the linear distribution of the sound stations, transforming the architectural void into a sequence of invisible thresholds. Original diagram by the author.

/ TOPOGRAPHIES

This group of case studies explores the transition from the material dimension of sound to its capacity to function as an infrastructure connecting bodies and territories. Space transforms into a dynamic network of frequencies and signals, where sound reveals urban layers typically precluded from human perception, enabling the inhabitation of invisible thresholds that link individual experience to the monumental scale of the city.
Through the next works, the inhabitant evolves into an active sensor, capable of navigating acoustic topographies that superimpose distinct locations into a single temporal synchronicity. These interventions highlight the double nature of contemporary architecture, consisting of both solid mass and a vibrational aura that defines its core identity. Spatial design thus shifts toward the engineering of these resonances, elevating transposition and energetic sensing to new materials for constructing spatial experience.

/ MARYANNE AMACHER
City links (1967 - 1981)

TELEMATIC INFRASTRUCTURE

Maryanne Amacher's *City links* series established a pioneering design methodology based on "long-distance music," treating architecture as a terminal for environmental information flows. The material process relied on activating cutting-edge telemetric infrastructures: Amacher installed permanent microphones at high-energy urban nodes, such as Boston Harbor, Buffalo's steel mills, or international airports, connecting them via high-fidelity, dedicated telephone lines directly to her workspaces or galleries. This system did not produce a simple audio transmission; it functioned as a technological umbilical cord, injecting the acoustic pressure and vibratory dynamics of an entire urban ecosystem into a controlled architectural volume. The live signal, active uninterrupted for months, transformed environmental noise into raw physical data, a material that the artist shaped through multi-channel diffusion systems to reconfigure the acoustic response of the hosting room.

SYNCHRONOUS INHABITATION

Regarding spatial transposition, *City links* achieves one of the earliest forms of synchronous inhabitation of distant locations. Through sound, the physical boundary of the walls is made permeable, allowing the listener to reside simultaneously in the immediate room and the remote signal site. This phenomenological superposition dismantles the hierarchy of proximity: a place's identity is no longer bound to its visual presence or material solidity. Still, it manifests as an aural persistence that occupies and deforms the present space.

VIRTUAL STRUCTURALISM

Amacher demonstrates that spatial design can operate on geographical scales, turning latency and transmission into tools for volumetric construction. Architecture thus becomes an interface between different temporal and spatial coordinates, where the absence of the source site is offset by a virtual presence so dense that it acts as an invisible load-bearing structure, capable of radically altering the perception of the space.

Maryanne Amacher places a protective box for the microphone mixer at Pier 6, Boston. This site, along with other high-energy urban nodes, functioned as a primary signal source for the *City links* project. © Anne Bray, 1973. Courtesy of the Maryanne Amacher Archive.

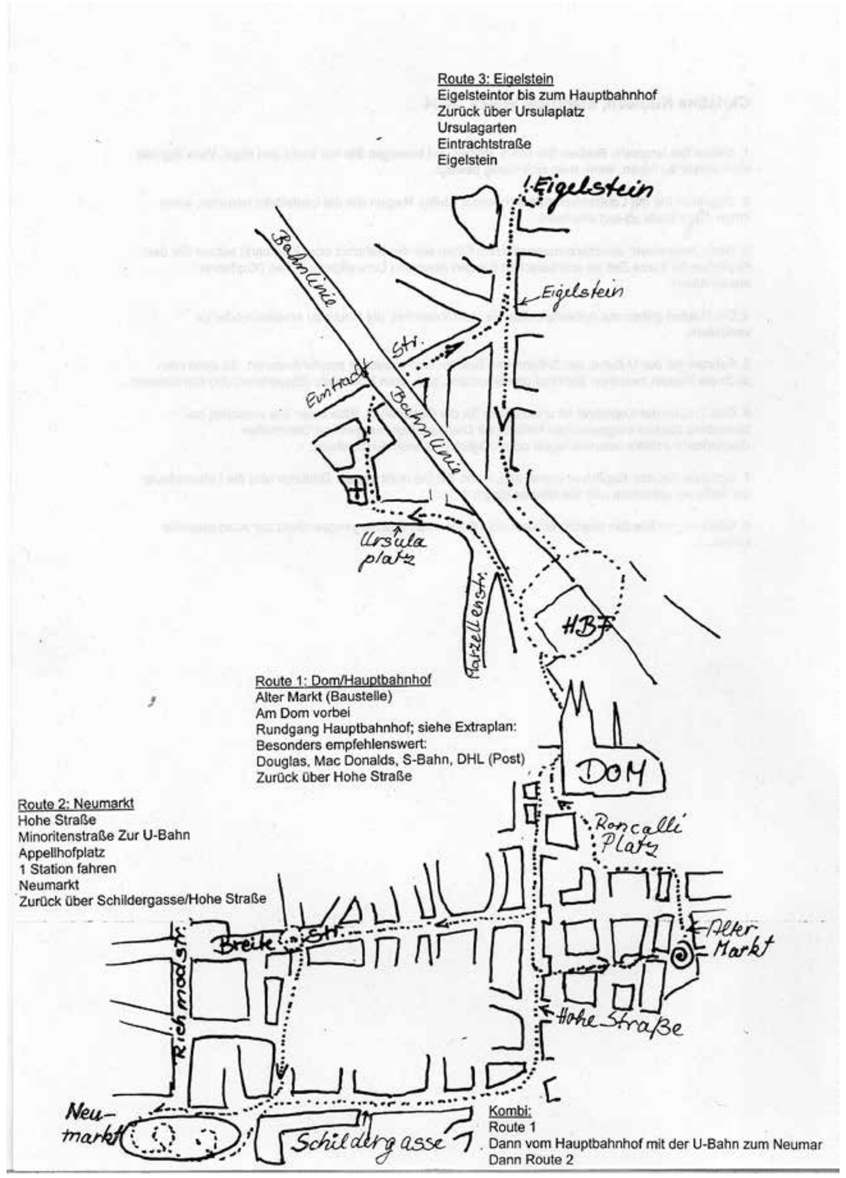
/ CHRISTINA KUBISCH
Electrical walks (2003 - present)

ELECTROMAGNETIC TOPOGRAPHY

Christina Kubisch's *Electrical walks* shifts the investigation from the transposition of distant locations to the revelation of an invisible and omnipresent spatial layering: the urban electromagnetic field. The material operation relies on the use of induction headphones designed by the artist, which convert electromagnetic flows, generated by antennas, ATMs, Wi-Fi networks, neon signs, and transit infrastructures into audible acoustic signals in real-time. The visitor's body becomes a mobile antenna, a sensing probe traversing the city as a dense web of energetic frequencies rather than a mere volume of air and concrete.

INVISIBLE URBAN LAYERING

From a theoretical and design perspective, Kubisch's practice reconfigures public space through an electromagnetic topography that overrides the visual hierarchy of architecture. The inhabitant experiences a perceptual duality: a turbulent, invisible, yet structural electrical geography is superimposed onto the stability of physical space. This walk constitutes a form of critical inhabitation of an occult infrastructure. Sound reveals the technological density of the urban landscape, transforming human presence into a chemical reagent that activates the space. The identity of a place is defined by its radiant activity; Kubisch demonstrates that contemporary architecture is intrinsically double, consisting of solid matter and an electronic aura that the body, mediated by technology, navigates as a new habitable territory.



A navigational map for the first *Electrical walks* in Cologne. The graphic notations mark the electromagnetic topography of the city center, identifying specific nodes of interference within the urban infrastructure. © Christina Kubisch, 2004. Courtesy of the artist (electricalwalks.org).

/ BILL FONTANA
Harmonic bridge (2006)

STRUCTURAL SONIFICATION

Bill Fontana's material operation targeted London's Millennium Bridge by installing accelerometers (precision seismic sensors) to detect the infinitesimal vibrations produced by wind, traffic, and pedestrian movement across the steel spans. These frequencies, otherwise inaudible to the human ear, were transmitted in real-time and broadcast within the Tate Modern's Turbine Hall. The bridge functioned as an immense stringed instrument, its structural voice decontextualized to occupy a pre-existing monumental volume.

TRANS-ARCHITECTURAL CONTINUITY

With this work, Fontana performs a trans-architectural resonance that merges two urban icons into a single sensory organism. Through sound, the Millennium Bridge is virtually extended into the Tate Modern, transforming the Turbine Hall into a resonance chamber for external mechanical stresses. The listener's experience is one of augmented inhabitation: the body remains physically indoors while perceiving the material and dynamic tension of an external infrastructure. This transposition redefines the building's identity through its acoustic vulnerability. Fontana demonstrates the vibrating nature of architecture; inhabiting space involves deep listening to structural energies, where the distinction between interior and exterior converges into a total acoustic synchronicity.

An accelerometer sensor part of a network installed by Bill Fontana on the Millennium Bridge. © Rex Features/Shutterstock, 2006. Courtesy of the artist.

/ PLASTICITY

This final section marks the transition from the revelation of existing infrastructures to the deliberate construction of autonomous and inhabitable sonic volumes. While previous inquiries focused on sound as a tool for environmental sensing, the focus now shifts toward its application as a primary building material for modeling plastic geometries. Unlike the inherent rigidity of traditional architecture, sound acts as a dynamic medium, allowing for the rapid mutation of forms, volumes, and spatial densities within the same environment. Through the engineering of vibrational architectures, acoustic energy generates new spatial coordinates independent of the preexisting site. The following case studies demonstrate how sound can define thresholds and sculptural masses with the same precision as solid partitions, yet with a unique fluid versatility. Artistic design thus evolves into the production of ephemeral environments where the designer manipulates the perception of gravity and depth, creating a state where the distinction between physical structure and vibrational field completely dissolves.

/ MARYANNE AMACHER
Music for sound-joined rooms (1980)

ARCHITECTURE AS INSTRUMENT

The *Sound-joined rooms* cycle, initiated by Maryanne Amacher in the late 1970s, represents a radical paradigm shift in the relationship between musical composition and physical space. In this body of work, architecture ceases to be a passive container for sound and transforms into an active, resonant limb of the composition itself. Amacher approaches the concept of "structure" as a plastic material: walls, floors, and ceilings become extensions of the playback system, mediating the propagation of waves through solid matter.

MATERIAL PLASTICITY

STRUCTURE-BORNE TRANSMISSION

The technical core of *Sound-joined rooms* lies in the deliberate manipulation of structure-borne transmission. By placing transducers in adjacent rooms or concealing them behind structural elements, Amacher generates a layered sensory experience characterized by "shadow sounds." The listener perceives frequencies that have already undergone a natural timbral coloring through the filtration of wood, concrete, or glass. This creates a tactile presence where low-frequency waves are felt through the skeletal system before they are consciously identified by the auditory nerve, triggering a profound proprioceptive response.

LIQUID ARCHITECTURE

Amacher's methodology, which she often described as "liquid architecture," involves a meticulous study of the site's natural resonant frequencies. Every crevice, ventilation duct, and building material is treated as a component of a colossal musical instrument. By "injecting" sound into the load-bearing structures, the rooms communicate through sympathetic vibrations, creating a topological map where the visitor becomes a spatial explorer. In this context, the traditional musical score is replaced by a geographical arrangement of acoustic events, where silence and distance serve as crucial compositional tools.

BIOLOGICAL SOUND PROCESSING

Beyond the external environment, *Sound-joined rooms* ventures into the physiological space of the listener through the use of Distortion Product Otoacoustic Emissions (DPOAEs). By calibrating specific frequency intervals and intensities, Amacher stimulates the listener's inner ear to generate its own sounds.
This creates a short circuit phenomenon: while the building's walls vibrate with external tones, the listener's head resonates with "phantom" frequencies produced internally.

BIO-ACOUSTIC CO-COMPOSER

This interaction effectively dissolves the boundary between the macroscopic architectural space and the microscopic biological space. The listener becomes a bio-acoustic co-composer. The resulting sound is a hybrid, partly structural and partly neurobiological, realizing Amacher's vision of an art form that inhabits the world on a synaptic level. Through *Sound-joined rooms*, the act of listening is redefined as a total immersion where the building, the sound, and the body merge into a single entity.

/ BERNHARD LEITNER
***Sound-Space systems* (1968 - 1971)**

SOUND-SPACES

Bernhard Leitner's research occupies a unique position at the intersection of architecture, sculpture, and psychoacoustics. His work treats sound as a tangible building material, capable of defining volumes and spatial boundaries without the need for physical mass. By meticulously arranging loudspeakers in precise configurations, Leitner creates "sound-spaces" where the listener's perception of geometry is shaped by the movement and pressure of acoustic waves.

VOLUMETRIC DELINEATION

The *Sound cube* stands as the most rigorous example of Leitner's investigation into three-dimensional acoustic boundaries. The structure is composed of a steel frame equipped with a systematic grid of surfaces. The listener, positioned at the center, experiences a sense of spatial loudspeakers. Through a complex process of signal distribution, Leitner generates "sound lines" that travel along the edges of the enclosure defined by the movement of the frequencies. The sound acts as an invisible skin, creating a volumetric presence that oscillates between expansion and contraction.

LONGITUDINAL DYNAMICS

In the *Sound tube*, the focus shifts toward the experience of linear motion and directional acceleration. This installation utilizes a series of speakers aligned along a horizontal or vertical axis to create a "tunnel" of sound. As the acoustic signal shifts rapidly from one transducer to the next, the listener perceives a physical flow, similar to a stream of air or a projectile passing through space. This system challenges the static nature of architectural environments, introducing a dynamic temporal dimension that forces the body to orient itself according to the speed and direction of the sound.

PHYSICS OF PERCEPTION

The core of Leitner's methodology lies in the translation of architectural concepts, such as tension, weight, and balance, into the medium of sound. His compositions are often devoid of traditional melodic or harmonic content, focusing instead on the physics of perception. Each installation is a calibrated environment where the auditory system is used as a tool to map invisible geometries. By manipulating the phase, intensity, and timing of signals, Leitner transforms the act of listening into a kinesthetic experience, proving that space can be built, felt, and inhabited through the medium of vibration alone.

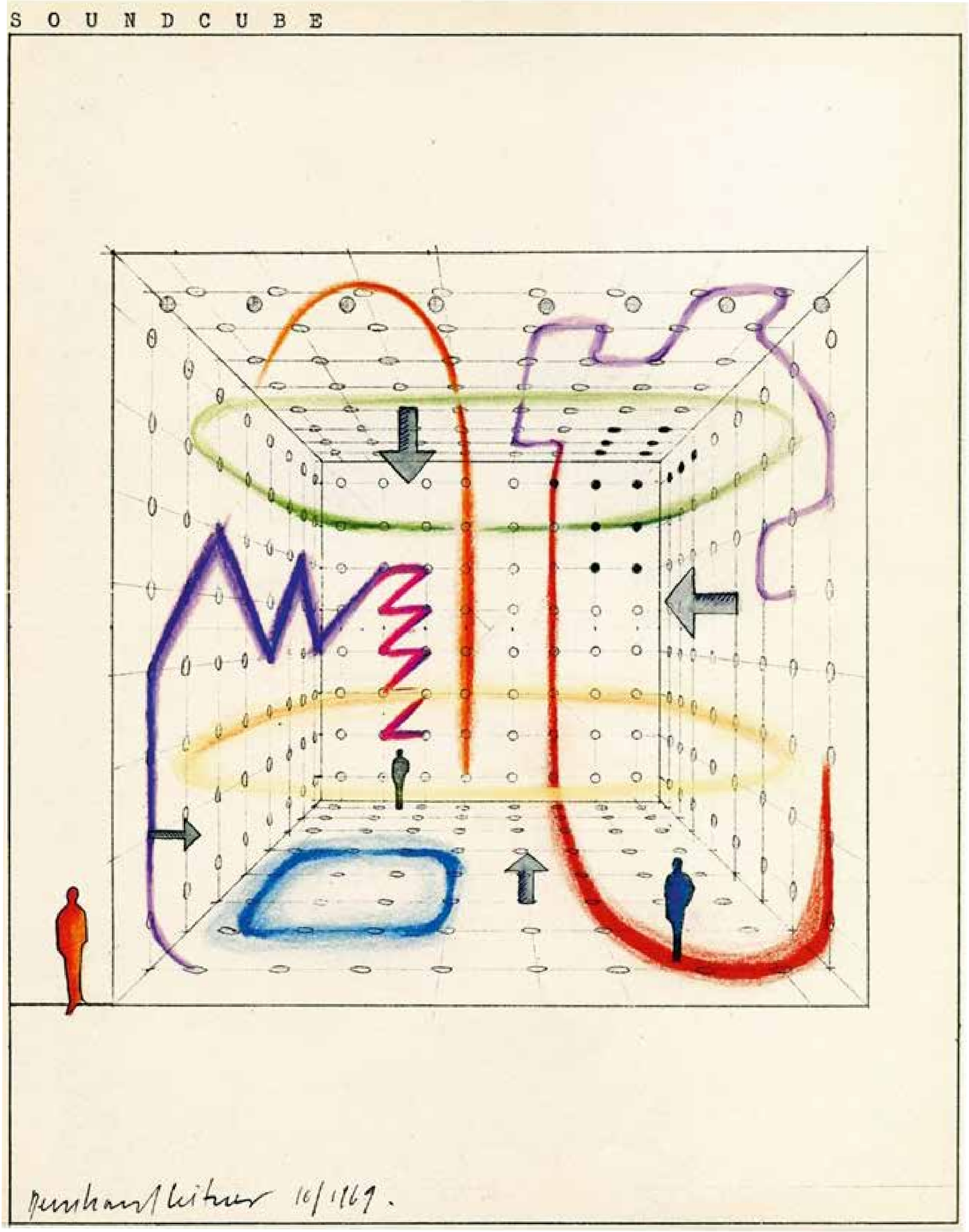


Diagram for the *Sound cube* (1969), from the *Designs for sound spaces series*, showing the geometric distribution of acoustic trajectories within the frame. © Bernhard Leitner. From: N. Kratzer (Ed.), *Bernhard Leitner: Sound space sculpture. Catalogue raisonné*, Verlag für moderne Kunst, 2023, p. 37.

/ JANET CARDIFF
***The forty part motet* (2001)**

SPATIAL POLYPHONY

Janet Cardiff's *The forty part motet* represents a seminal exploration of the spatial and sculptural properties of the human voice. The installation is a reimagining of the 16th-century motet *Spem in alium nunquam habui* by Thomas Tallis, scored for forty individual voices. Cardiff's technical intervention consists of deconstructing the choir by assigning each singer a dedicated microphone and, subsequently, an individual loudspeaker. The forty speakers are arranged in a large oval configuration within the exhibition space, transforming a temporal musical event into an inhabitable sound sculpture.

VOCAL ISOLATION

The technical core of the work lies in isolating the sound source. Unlike a traditional stereophonic or surround-sound recording, which aims to blend voices into a unified field, Cardiff's system preserves the idiosyncratic timbre and spatial position of every performer. This granular approach allows the listener to move freely within the oval, experiencing the composition as a shifting landscape of breath, vocal texture, and localized resonance. The architecture of the room is thus redefined by the intersecting trajectories of forty distinct biological sound sources.

ACOUSTIC INTIMACY

This installation activates a profound sense of intimacy and voyeurism. Between the musical movements, Cardiff includes the ambient sounds of the recording session: singers coughing, whispering, or clearing their throats. These "non-musical" elements ground the work in a physical, human reality, bridging the gap between the sublime nature of the Renaissance polyphony and the visceral presence of the performers. The listener is granted access to a level of proximity that would be physically impossible in a live concert setting, effectively placing the body within the very structure of the choir.

VIRTUAL ARCHITECTURE

From a psychoacoustic perspective, *The forty part motet* functions through the principles of spatial localization and immersion. As the counterpoint moves from one group of speakers to another, the listener perceives the physical weight and movement of the music through space. The oval arrangement creates a virtual architecture where the boundaries of the sound field are defined by the voices themselves. The act of listening becomes a choreographic process, where the movement of the audience determines the harmonic and timbral balance of the piece, turning the visitor into an active participant in the spatial reconstruction of the motet.

BIOLOGICAL PRESENCE

Ultimately, Cardiff's work dissolves the distance between the historical composition and the contemporary observer. By externalizing the internal mechanics of the choir, she creates a hybrid space where memory, breath, and architec-ture converge. The installation proves that sound can function as a sculptural medium capable of evoking presence and absence simultaneously, redefining the gallery space as a site of collective, yet deeply personal, biological resonance.

Installation view of *The forty part motet* (2001) at BALTIC Centre for Contemporary Art (2012), showing the 40-speaker oval configuration. The work is a spatial reworking of Thomas Tallis's *Spem in alium*. © Janet Cardiff. Photo: Colin Davison. Courtesy of the artist and BALTIC.

/ MAX NEUHAUS
Times Square (1977; restored 2002)

SOUND IN THE PUBLIC SPACE

Max Neuhaus's *Times Square*, located in the heart of New York City, represents a milestone in public sound art. In this project, Neuhaus abandons the logic of the traditional concert to explore the concept of a permanent and invisible sound installation. The work consists of a continuous sound emission emerging from a ventilation grate situated on a pedestrian island between 45th and 46th Streets, integrating itself entirely into the metropolitan soundscape.

FORMAL INVISIBILITY

The most radical aspect of the work lies in its total absence of visual cues. Neuhaus designed the intervention to be discovered accidentally by passersby, removing the barrier between the artistic object and the surrounding environment. The sound emerges from the subterranean space as an architectural presence. This choice transforms the perception of the site: the listener does not stand before a work of art but rather within an alteration of daily acoustic reality.

SUBTERRANEAN PHYSICALITY

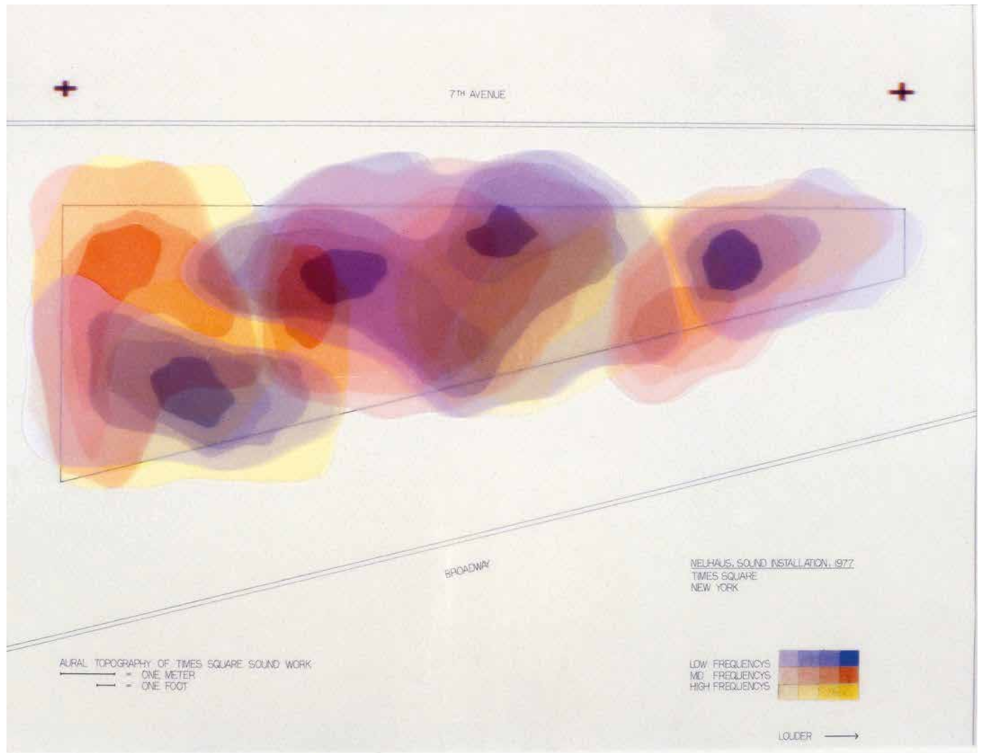
From a technical standpoint, the sound of *Times Square* is a dense texture of mid-to-low frequencies, reminiscent of the resonance of a large bell or the harmonics produced by a metallic conduit. Neuhaus utilizes electronic sound generators to create a resonance that seems to originate from the depths of the subway system. This cavity resonance interacts with the physical space of the grate and the tunnel below, acquiring a timbral quality that mirrors the natural acoustic phenomena of enclosed spaces.

SPATIAL ANCHORING

The installation operates through a subtle balance between masking urban noise, such as traffic, voices, and sirens, and inserting a stationary frequency that provides an auditory anchor point. Neuhaus aims to stimulate what he defines as "focused listening" within a context of mass distraction. Since the work has no temporal beginning or end, it exists in a continuous present. This interaction transforms the grate into a solid volume of vibration, where sound defines a zone of calm and introspection in contrast to the visual chaos of the area.

SPATIAL DENSITY

Times Square functions as a topographical sculpture that redefines the identity of the site through air pressure and frequency modulation alone. The act of crossing the emission area allows the pedestrian to perceive a change in the density of the air and the depth of the space. Neuhaus thus proves that a public space can be reconfigured without physical construction, using sound as a structural tool to inhabit and reshape the urban experience on a synaptic level.



Graphic rendering of the *Aural topography of Times Square* (1977). The illustration maps the invisible acoustic boundaries and frequency density generated by the subterranean installation. © Estate of Max Neuhaus. Courtesy of the Dia Art Foundation.

/ CHAPTER CONCLUSIONS

The case studies presented do not only constitute a catalog of works, but define a series of design methodologies and strategies that enable the manifestation of sound's material qualities. Through the analysis of the aforementioned artists, it has been possible to understand the ways in which a medium generally considered ephemeral and intangible can be made tangible. The revelation of architectural properties through the analysis of the sounds that inhabit them, the investigation of invisible urban layers that form fundamental elements of our cities' structure, and the treatment of sound as a physical construction are the primary points emerging from this selection. These, therefore, become fundamental pillars for understanding sound within space, leading toward an experimental design proposal committed to further exploring and comprehending these themes.

PART II

/ DESIGN INTENTIONS

SOUND AS BUILDING MATTER

The research trajectory developed in the preceding chapters has brought to light the spatial properties of sound, identifying it as a genuine invisible element that participates in the constitution of a context's totality, rather than a mere accessory phenomenon. From this perspective, sonic material, and more specifically, musical material, assumes the role of a building matter.

MUSIC AS A DESIGN GESTURE

It is fundamental here to specify the "musical" dimension as opposed to the strictly "sonic" one: music is distinguished by the fact that it is constituted by an intention. Music is, therefore, the result of a design process. It follows precise compositional imperatives that define its final essence, exactly as architecture follows structural and formal imperatives. From this assumption, a profound affinity clearly emerges between musical composition and the disciplines of spatial design.

HISTORICAL PRECEDENTS

The utilization of music as a tool for spatial definition finds historical precedents already analyzed in the theoretical section. We observed this in the work of Xenakis and Le Corbusier for the Philips Pavilion, where architecture united with the sonic experience; inversely, the use of space as an active parameter of musical experience has been theorized and practiced by authors such as Stockhausen.

SONIC SUBVERSION OF SPACE

From these historical and theoretical premises arises the intent that guides the present design proposal: to use sound as an active constructive element, capable of interacting with existing architectural space, not to decorate it, but to emphasize it, reveal its invisible characteristics, or subvert its perception. The spatial power of sound lies precisely in its ephemeral and vibrational essence, which enables a continuous mutation of the environment and, consequently, a dynamic redefinition of the perception the inhabitant has of the place.

FOUR OPERATIONAL STRATEGIES

The project is therefore articulated through four fundamental operational strategies, four methodologies that transform sound into an agent of spatial modification.

REVELATION

Sound acts as an "acoustic light," bringing to the listener's attention the intrinsic and often ignored characteristics of the architectural space. Through specific frequencies and resonances, material and volumetric qualities invisible to the naked eye are rendered evident or heightened.

ALTERATION

The physical perception of the place is actively modified through the management of acoustic material. The sonic design may collide with the geometric nature of the space, contrasting its rigidity or taking its perceived dimensions to the extreme, thereby redefining the environment's sensory boundaries.

MEMORY

Acting as a powerful sensory stimulus, music possesses the capacity to evoke sensations and thoughts, whether personal or collective. Here, sound functions as an element of reminiscence and displacement, mentally transporting the listener to a temporal or geographic "elsewhere," even while they remain physically present in the space.

NARRATION

Through the dramaturgical management of sound, a voice is conferred upon places, allowing them to recount their own identity or other stories. Vibrational, melodic, rhythmic, and spatial characteristics define an invisible plot that the listener is called upon to interpret while traversing the space.

S I T E S

/ SITE SELECTION

To operationalize the theoretical premises outlined in the preceding pages, a targeted search was conducted to identify physical locations suitable for hosting the project. The foundational intent was to locate a derelict space that could be revitalized exclusively through a sonic intervention.

RURAL / URBAN

This initial objective was further refined by integrating Schafer's (1977) *The Soundscape*, specifically the traditional antagonism between the rural hi-fi soundscape and the urban lo-fi environment; this dichotomy served as the catalyst for selecting two distinct locations, one urban, one rural, allowing for a dialectical exploration of their divergent characteristics.

DEFINING ABANDONMENT

Consequently, the search for "abandoned spaces" evolved into a deeper ontological questioning of what abandonment actually signifies, oscillating between the concepts of physical obsolescence and conceptual negligence. This dual identity draws directly from the analysis presented in Chapter 4 regarding *Atmospheres*, where the relationships between techno and ambient music and, respectively, abandoned sites and Non-Places were established. These theoretical coordinates defined the precise parameters for the site selection, grounding the choice in Gilles Clément's (2005) *Manifesto of the Third Landscape* and Marc Augé's (1992/93) anthropological definition of *Non-Places*.

URBAN SITE: THE NON-PLACE

The space selected to represent the Non-Place is situated in the heart of the Milanese urban fabric, directly beneath Piazza Duca d'Aosta, facing the Central Station. This hypogeal environment consists of a series of pedestrian tunnels connecting the Metro station to the opposite side of the square. These corridors proved to be the perfect archetype of the Non-Place: a space that is heavily utilized, and therefore not physically abandoned, yet remains conceptually abandoned. As Augé (1992/93) posits, those who transit through such spaces rarely grant them perceptual attention; it is a forgotten, disregarded locus, subject to a figurative abandonment precisely because it is transited but never lived. Furthermore, its physical interconnection with the subway and railway infrastructure establishes it as the ultimate symbol of the lo-fi urban environment theorized by Schafer (1977).

RURAL SITE: THE THIRD LANDSCAPE

Conversely, the location selected to reflect the rural context mirrors the Third Landscape: an anthropogenic artifact in a state of decay where the natural dimension has reclaimed its dominion. The choice fell upon the Serre Pasino, a small complex of abandoned glasshouses located in the small nucleus of Varedo, north of Milan. Operational until the early 2000s, the site stands today as an evocative example of industrial archaeology composed of two adjacent structures exhibiting distinct structural morphologies. The first is defined by a classic double-pitched, fully glazed gable structure, while the second features a mono-pitch roof with a vertical glazed side and a lateral concrete wall. Situated within a green context punctuated by small grassy clearings and trees, the structures are subject to the prevaricating force of vegetation, which has entirely engulfed one of the flanks, visually occluding the architecture.

SPATIAL DIALECTICS

The two selected spaces thus generate an antithetical clash that highlights their respective characteristics. The compressed, cold, and hypogeal dimension of the tunnels stands in stark contrast to the luminous, lightweight, and luxuriant nature of the greenhouses. This spatial antagonism provides the ideal premise for a project that interrogates the current state of these locations, opening the possibility for a symmetrical yet divergent sonic intervention.

But one must above all admit that every day individuals borrow, so to speak, itineraries they have no choice but to follow, constrained by memories that are born of habit and that sometimes subvert it, brushing by, unaware of, but sometimes having an inkling of, the history of others, taking paths plotted with collective memories turned trivial, whose efficacy is perceived only occasionally and at a distance.

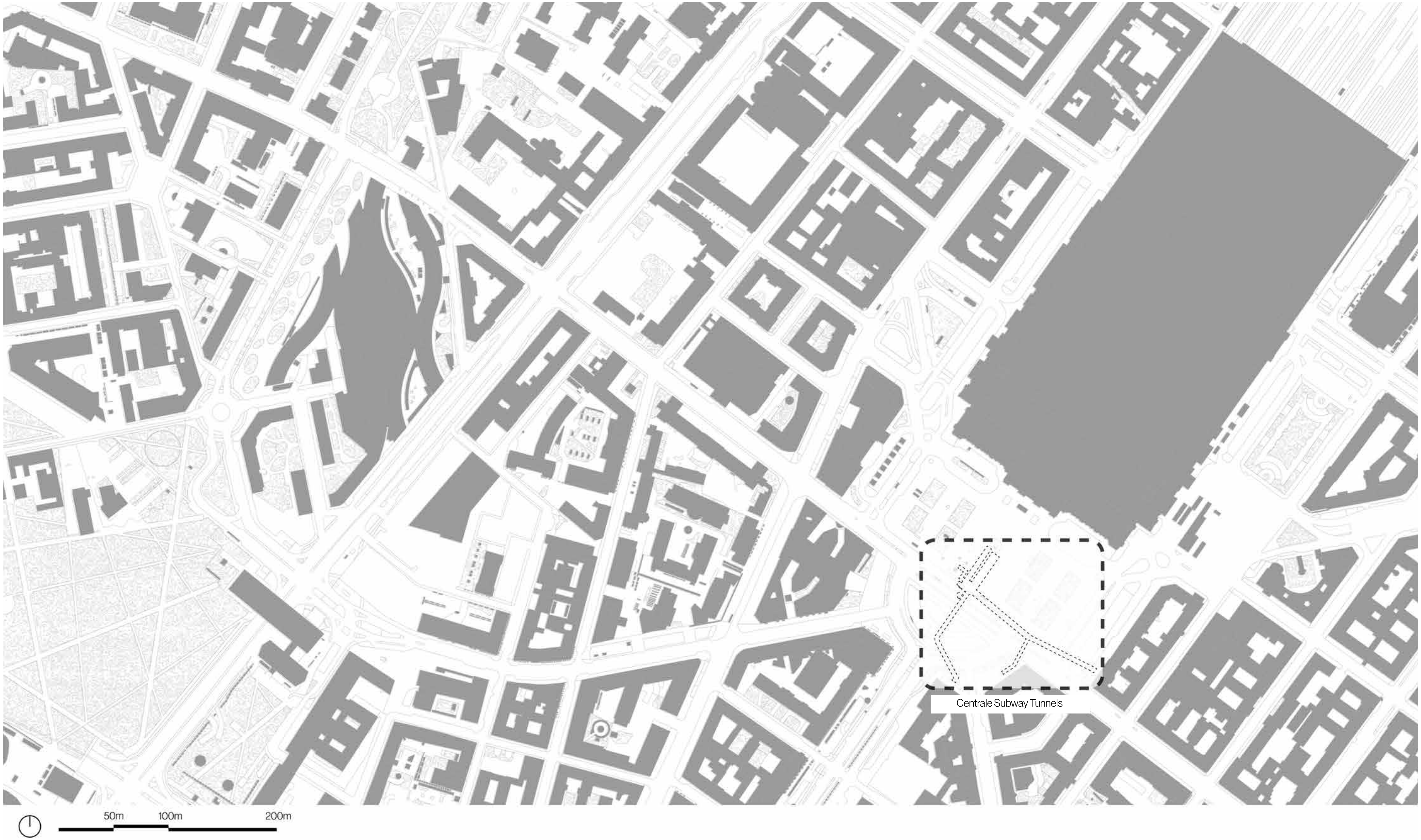
(Augé, 1986/2002, p. 25)

An undecided fragment of the planetary garden, the Third Landscape is made up of all the places neglected by human beings. These margins bring together a biological diversity that has not yet been classified as richness.

(Clément, 2004/2015, p. 23)

/ TERRITORIAL FRAMEWORK

/ TUNNELS - CONTEXT



/ SITE SPECIFICATIONS

LOCATION: Piazza Duca d'Aosta / Central Station Hypogeum.

COORDINATES: 45°29'N 9°12'E (Milano, MI).

TYPOLOGY: underground pedestrian infrastructure.

CLASSIFICATION: non-place / urban lo-fi environment.

MATERIALITY: ceramic tiling (flooring), exposed reinforced concrete (walls/ceiling), metallic technical fixtures.

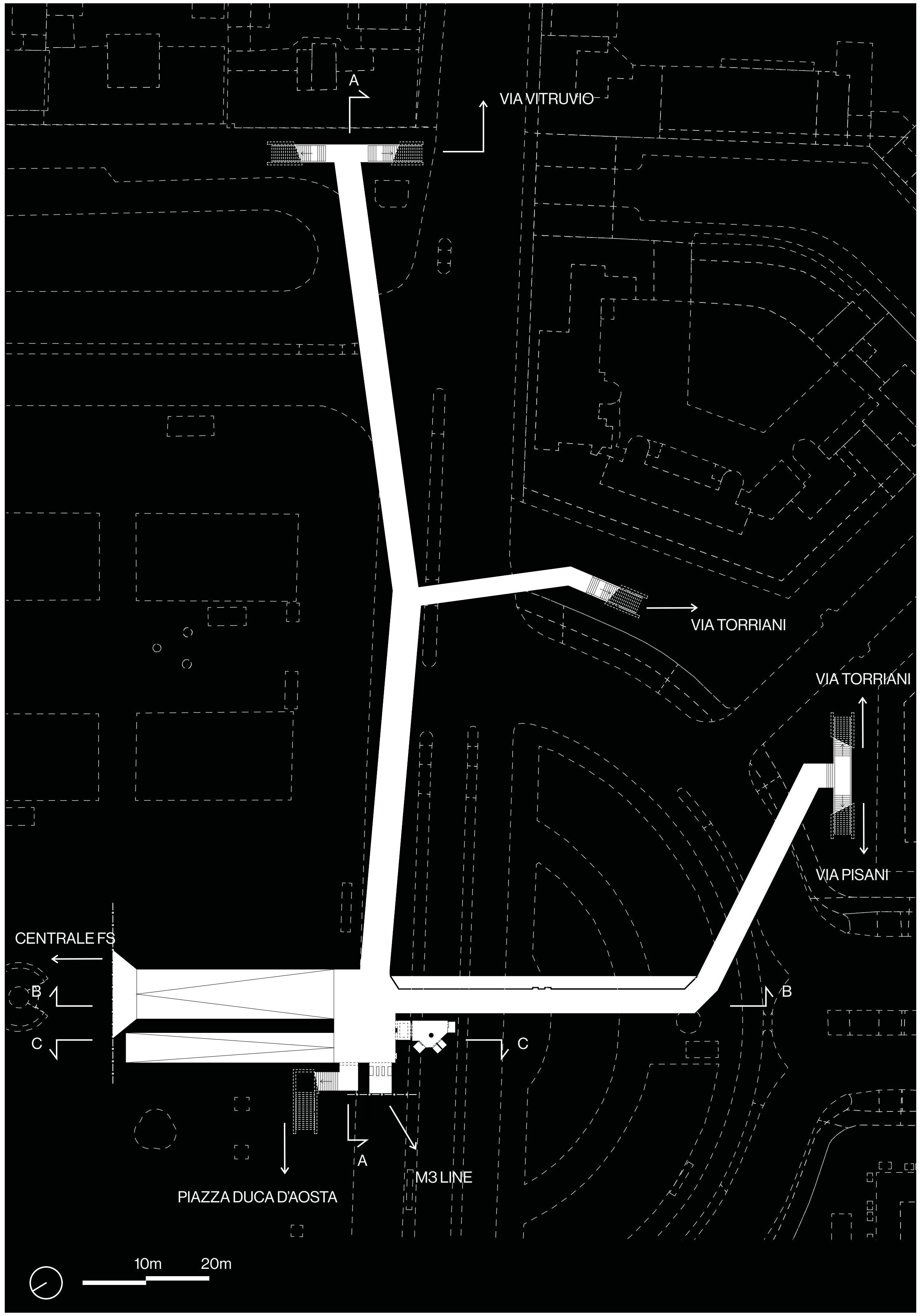
ATMOSPHERIC CONDITIONS: light exposure:
100% artificial (constant neon/fluorescent spectrum).
ventilation: mechanical / tunnel draft effect.
thermal inertia: stable hypogeal temperature (seasonal delay).

USAGE STATUS: functional state: active transit / conceptual abandonment.
human interaction: high density flow / low dwell time (transient space.)
maintenance: standard utilitarian preservation.

DIMENSIONAL DATA (SURVEY):

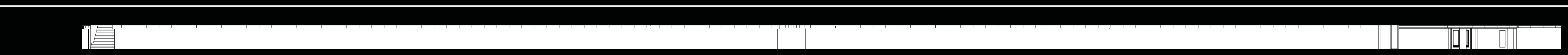
CENTRAL HUB (core & services) Central Node: ~147 mq Service Area (toilets): ~27 mq
TRANSIT ARTERIES (linear development) Tunnel 01 (metro/rail link): ~32 m. Tunnel 02 (metro/rail link): ~34 m. Tunnel 03 System (to v. Vitruvio/Torriani): ~61 m (main) + ~69 m (branch A) + ~25 m (branch B). Tunnel 04 (to v. Pisani/Torriani): ~90 m.
TOTAL FOOTPRINT: ~1642 mq.
VERTICAL PROFILE: walking level: -3.90 m (avg. from street level).
clear height: 2.50 m.
overburden: ~1.40 m (soil stratigraphy to surface).

Note: direct on-site survey data. values rounded for tolerance.



/ TUNNELS - SECTIONS

GROUND LEVEL

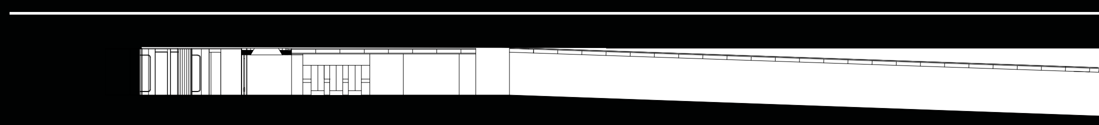


SECTION A-A

GROUND LEVEL

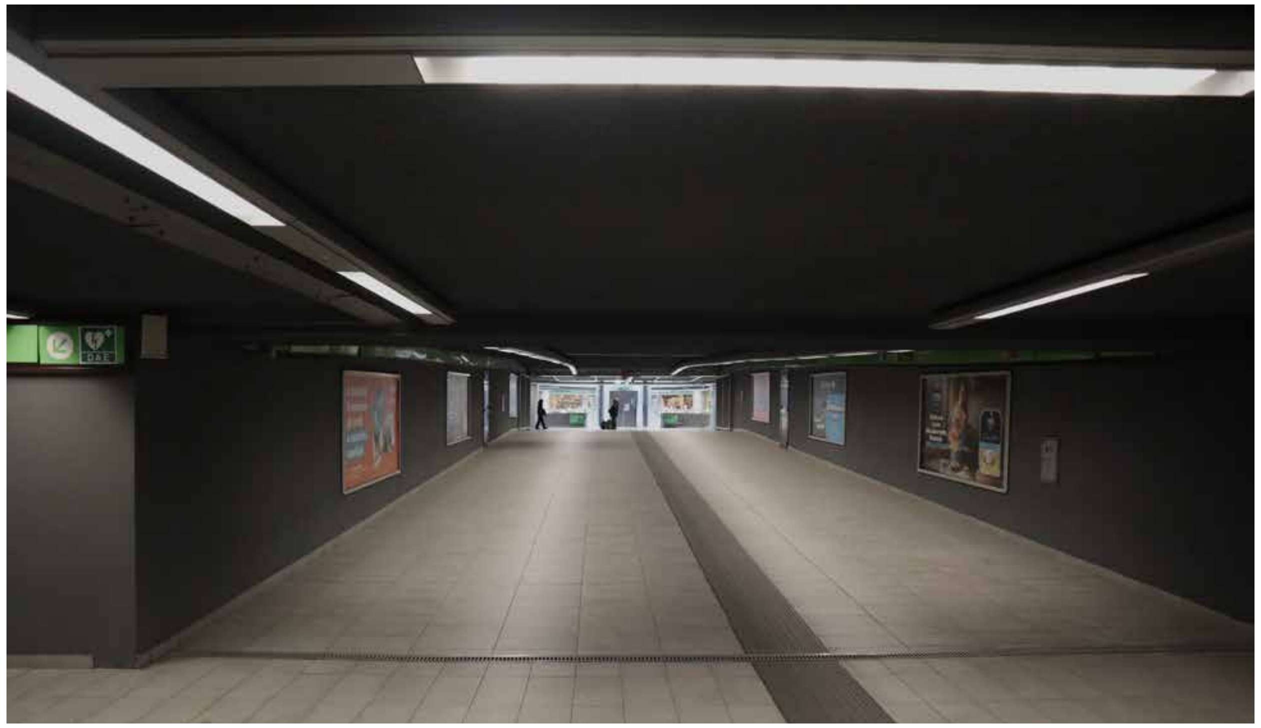
SECTION B-B

GROUND LEVEL



SECTION C-C

10m 20m



TUNNEL 01

CORE

INTERSECTION TUNNELS 03, 03A, 03B

TOILETS

/ GLASSHOUSES - CONTEXT

/ SITE SPECIFICATIONS

LOCATION: Ex Serre Pasino.

COORDINATES: 45°35'N 9°9'E (Varedo, MB).

TYPOLOGY: disused agricultural complex.

CLASSIFICATION: third landscape / industrial archaeology.

MATERIALITY: oxidized steel framing, single-pane glass (high fragmentation), reinforced concrete, spontaneous biomass.

ATMOSPHERIC CONDITIONS: light exposure: direct natural cycle (transparent envelope) ventilation: uncontrolled cross-ventilation due to glass breakage thermal seal: null (direct external equilibrium).

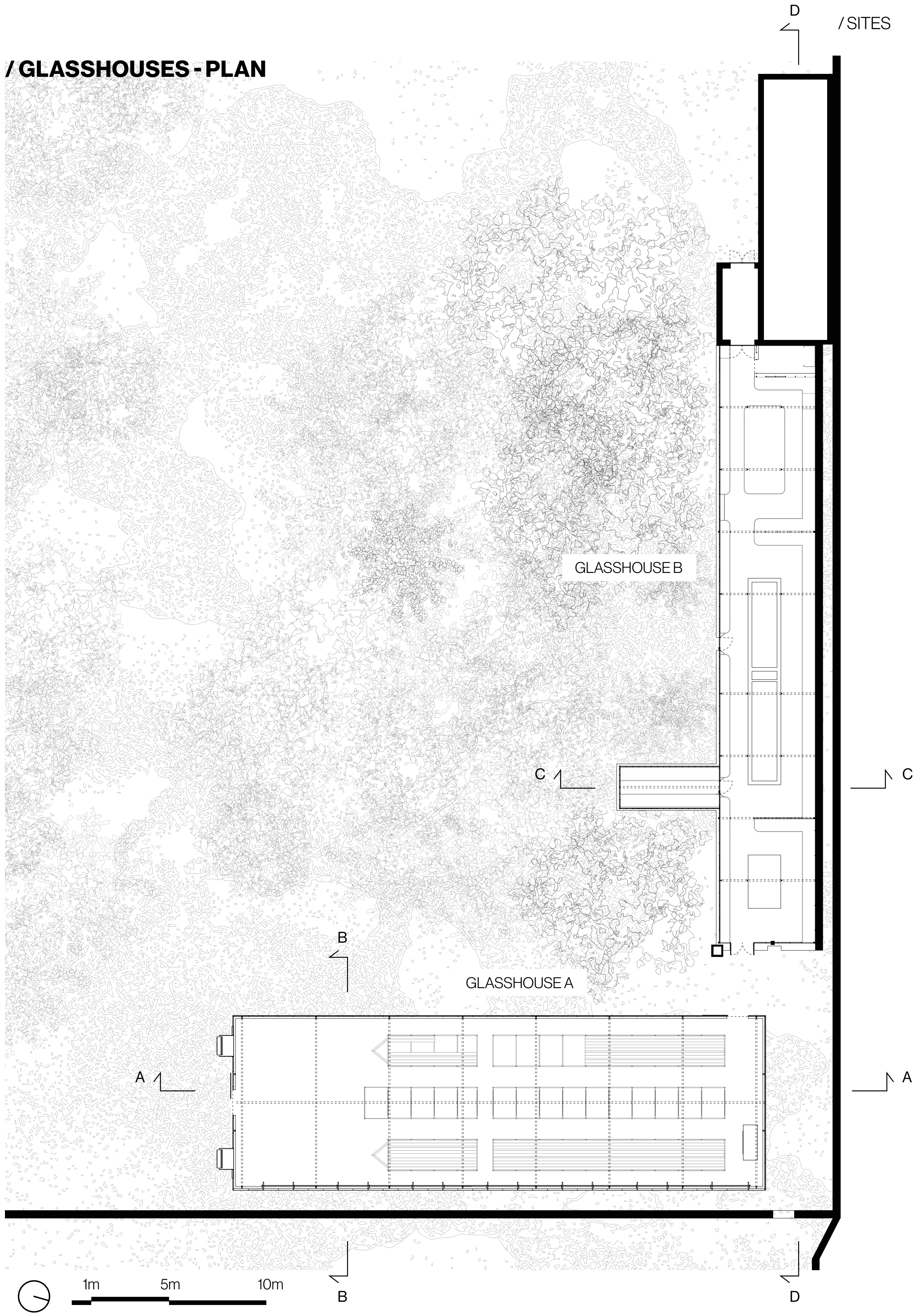
BIOLOGICAL STATUS:
colonization level: partial internal overgrowth.
vegetation: ruderal species / shrubs/ climbing plants / high-trunk trees.

DIMENSIONAL DATA (SURVEY):

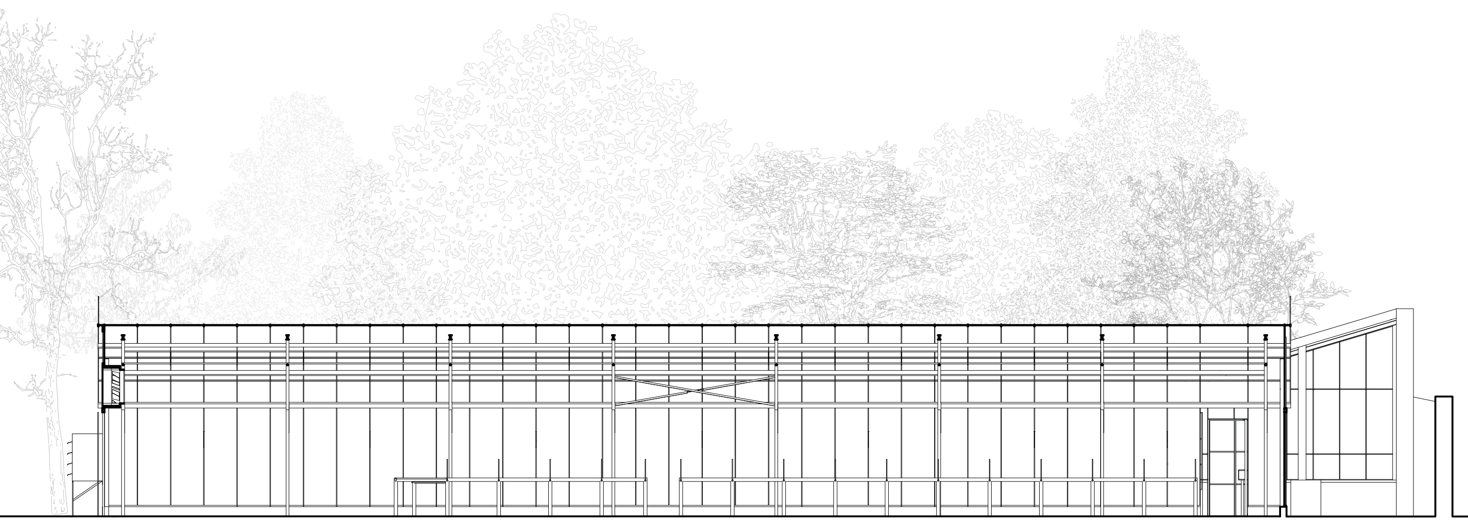
MODULE A (south volume) Morphology: gable roof / full glass structure. Net Surface: ~245 mq.
MODULE B (west volume) Morphology: mono-pitch / mixed structure (concrete & glass). Net Surface: ~163 mq.
TOTAL FOOTPRINT: ~408 mq.

Note: direct on-site survey data. values rounded for tolerance.

/ GLASSHOUSES - PLAN

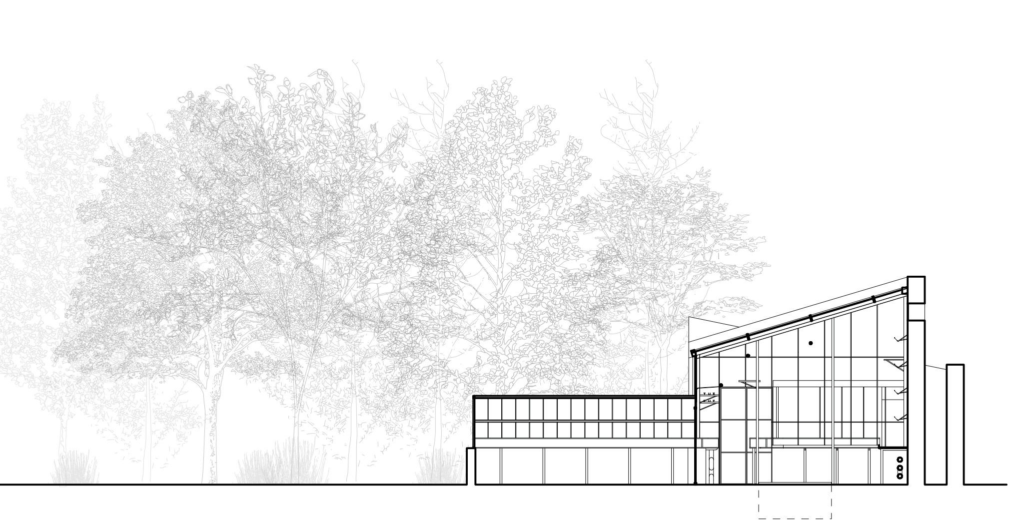


/ GLASSHOUSES - SECTIONS

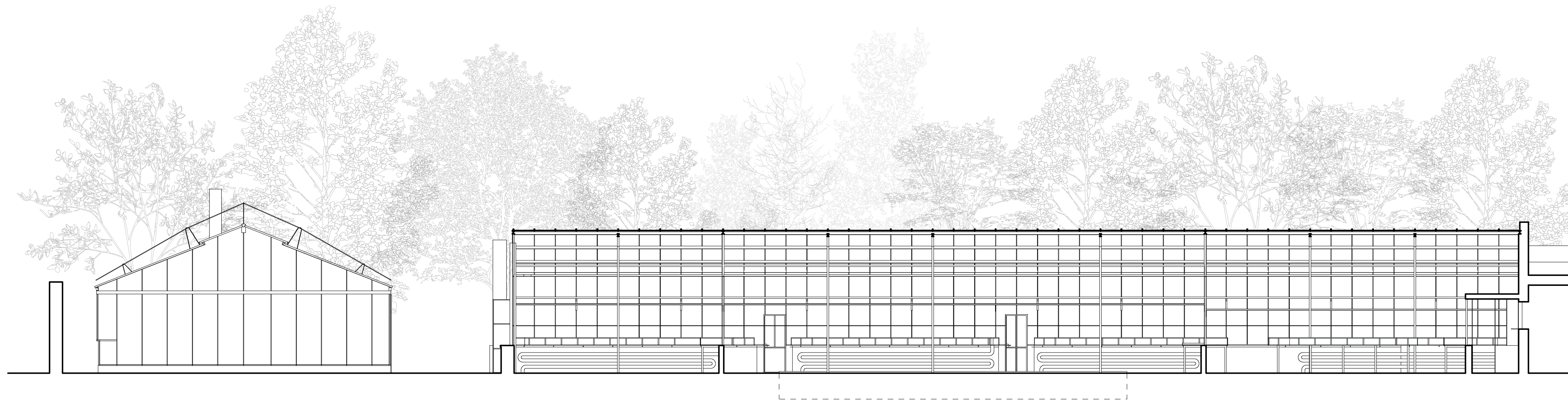


SECTION A-A

SECTION B-B



SECTION C-C

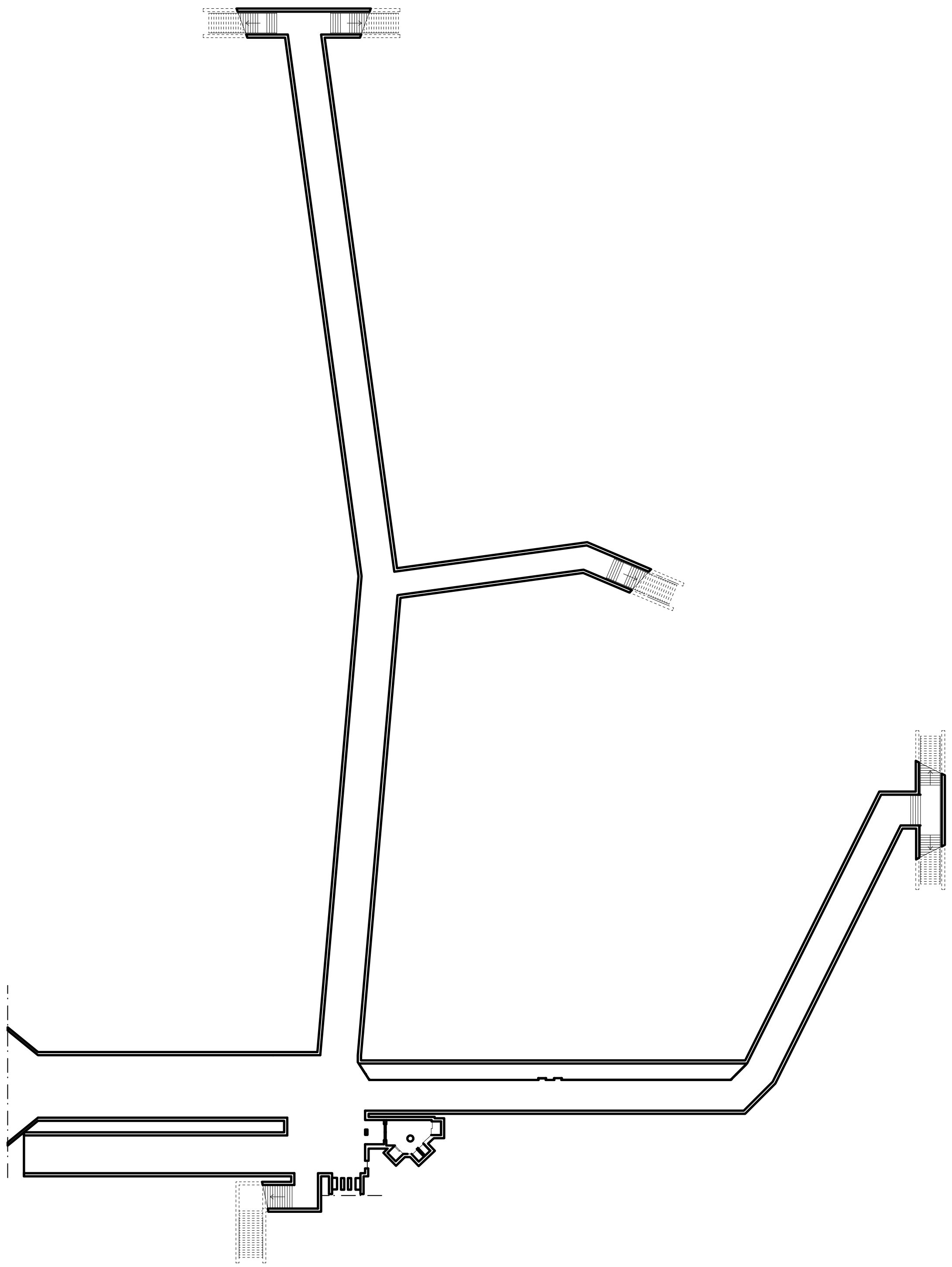


SECTION D-D

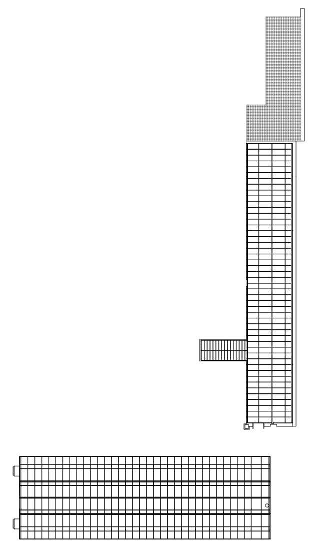
GLASSOUSE A

GLASSHOUSE B

/ SITES SCALE COMPARISON



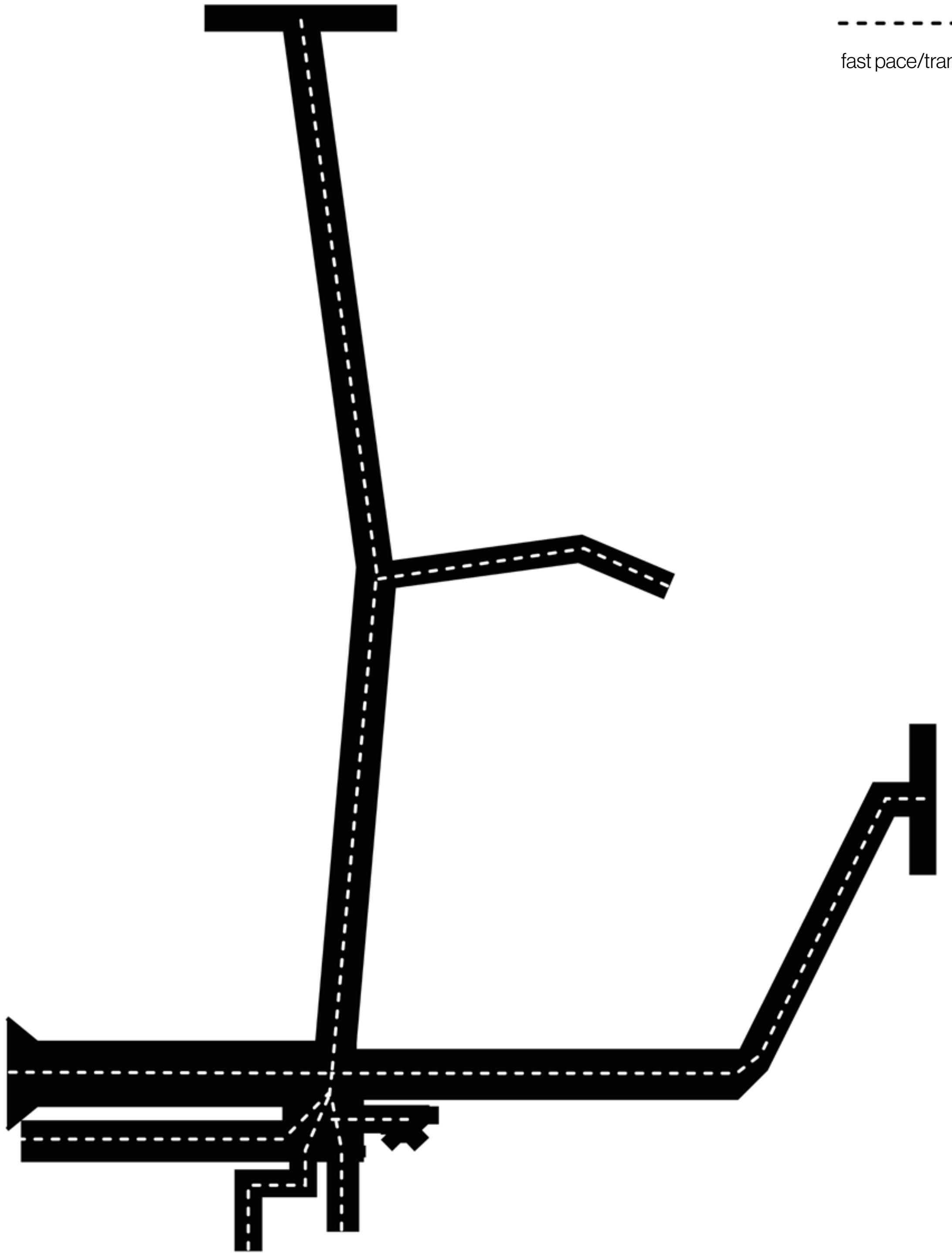
10m 20m



10m 20m

A N A L Y S I S

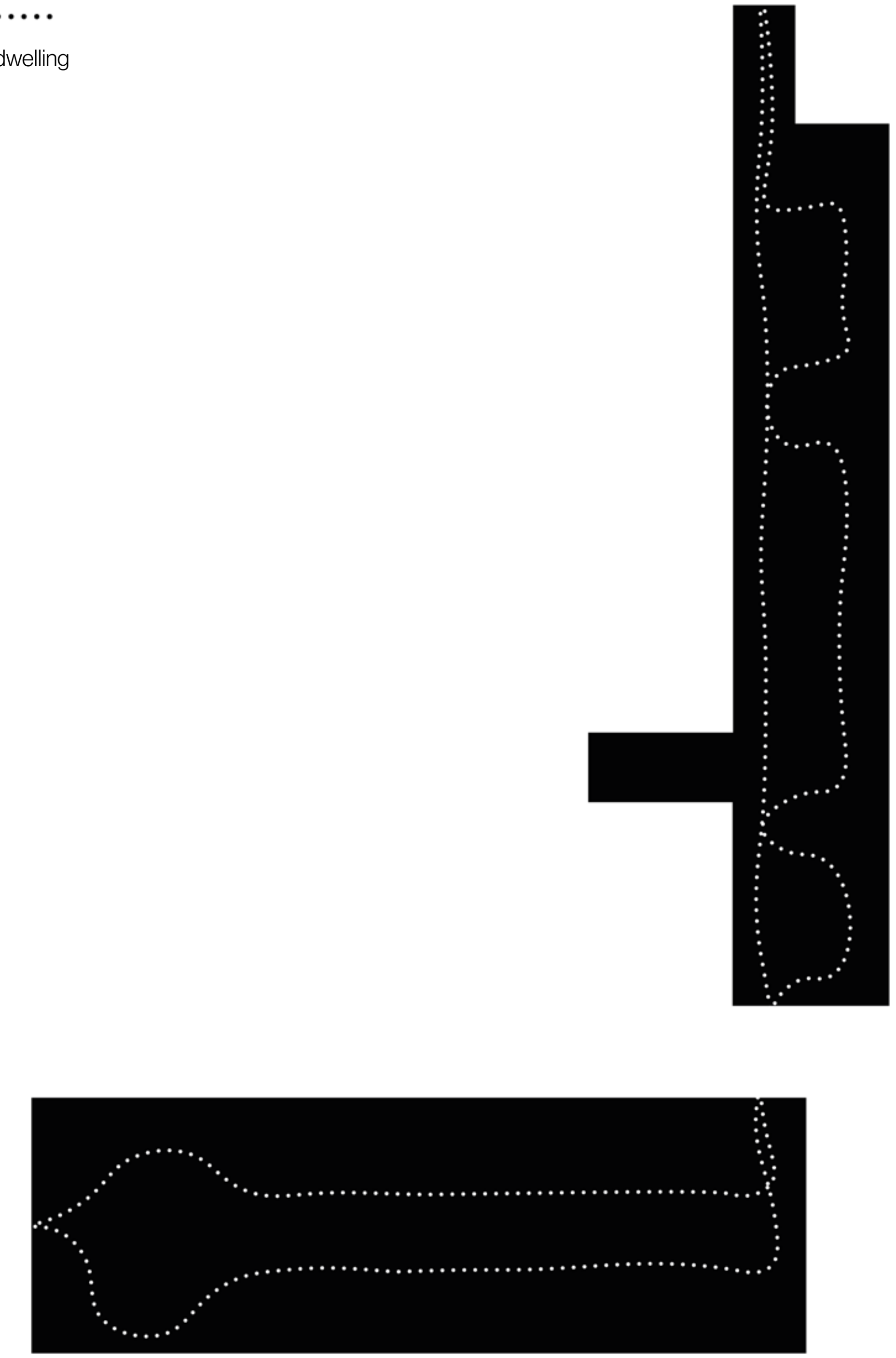
/ FLOW ANALYSIS DIAGRAM UNDERGROUND GALLERIES



fast pace/transit

/ FLOW ANALYSIS DIAGRAM GLASSHOUSES

slow pace/dwelling

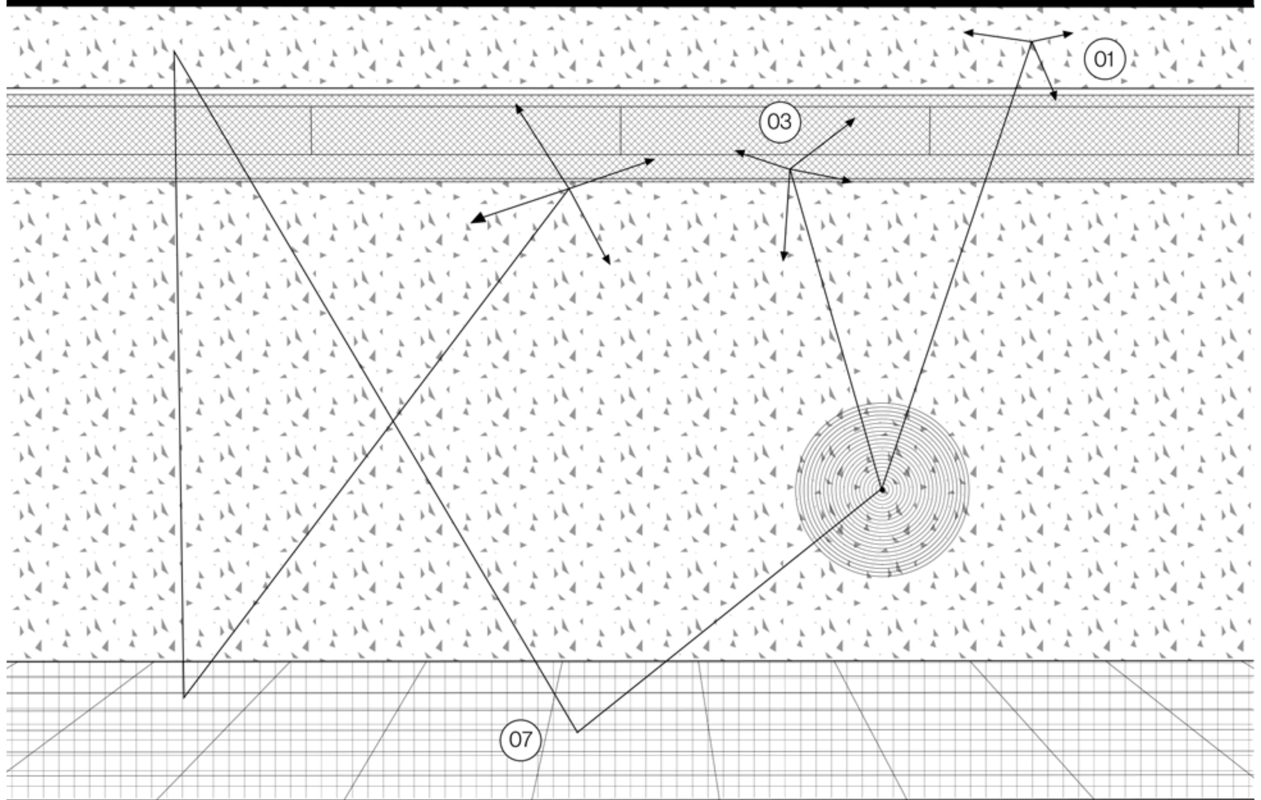


/ MATERIAL ANALYSIS - UNDERGROUND GALLERIES

01 / concrete / diffuse reflection

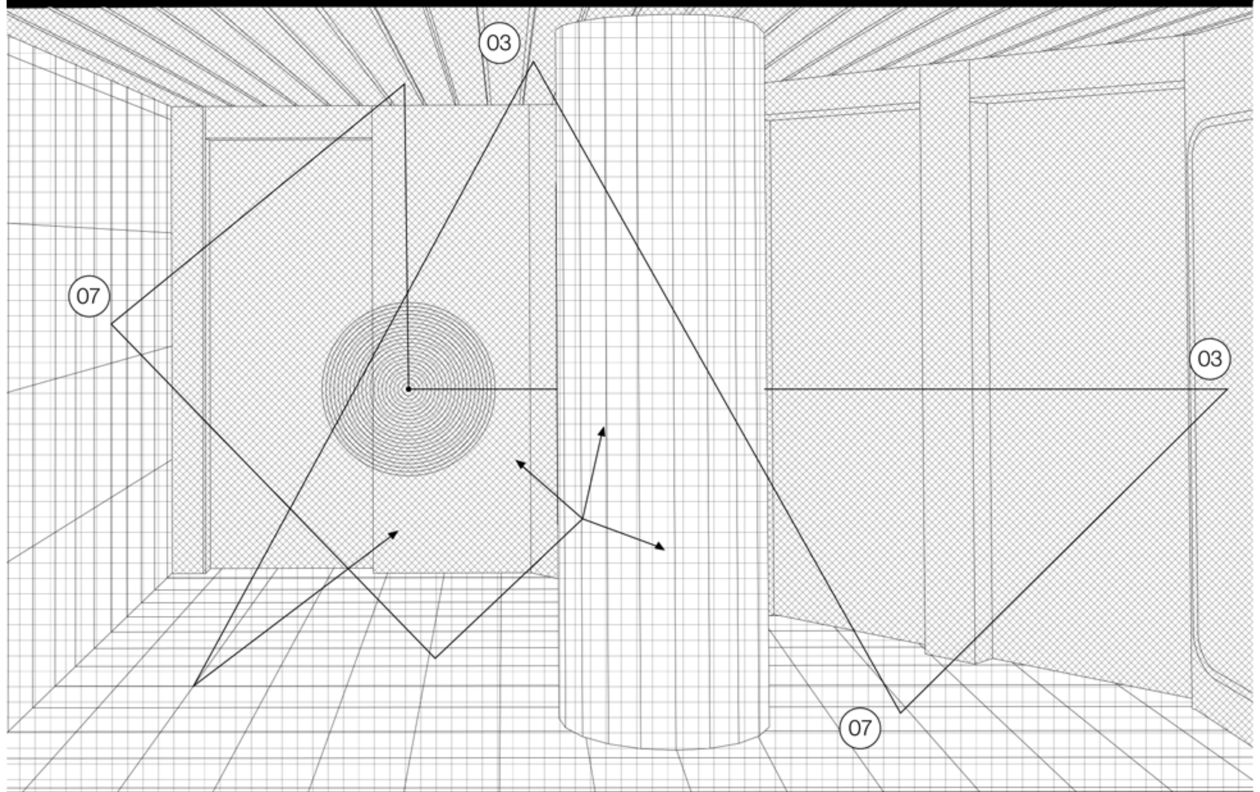
03 / metal / scattering - reflection

07 / ceramic tiles / specular reflection



1m

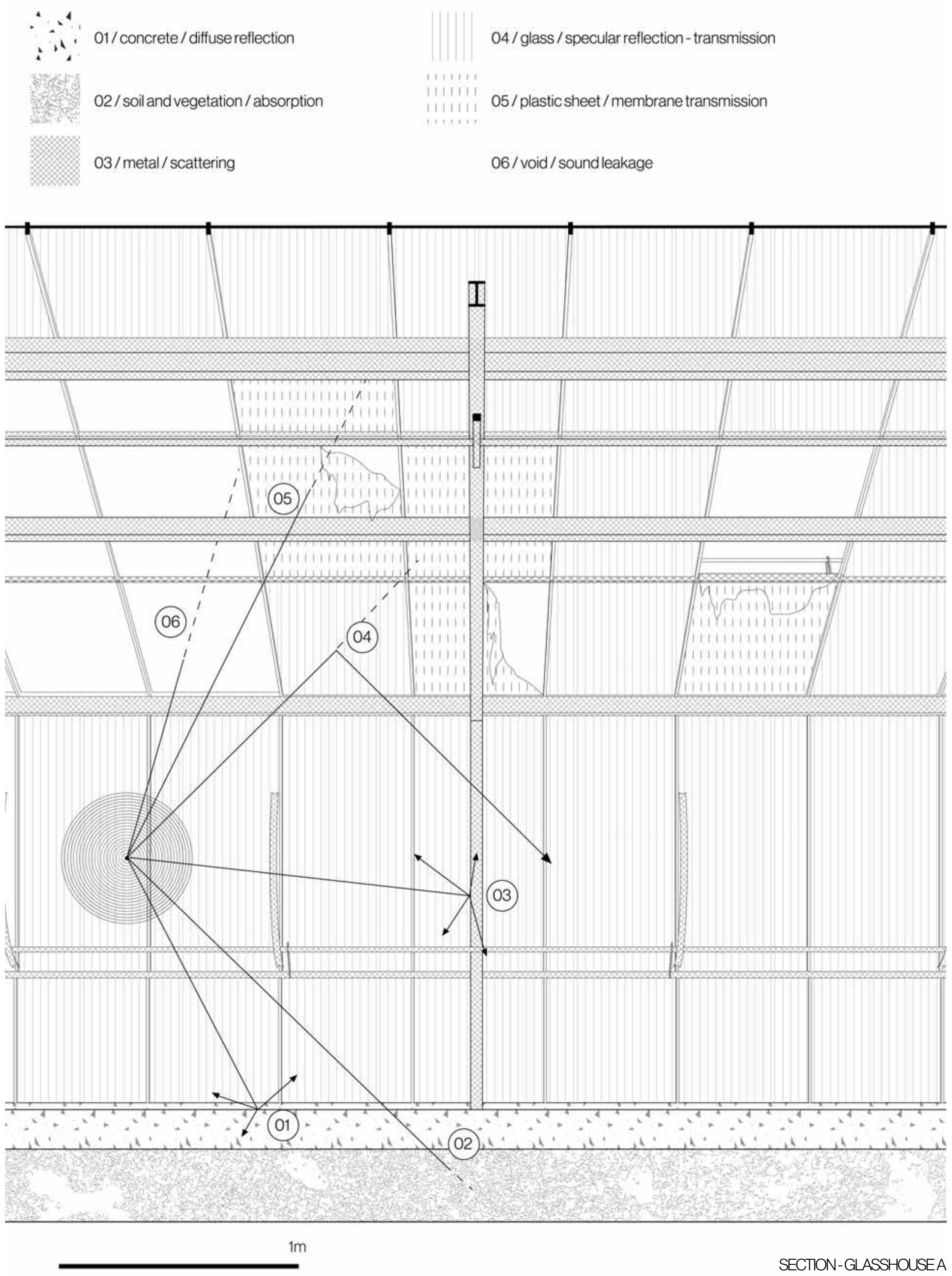
SECTION - GENERIC TUNNEL

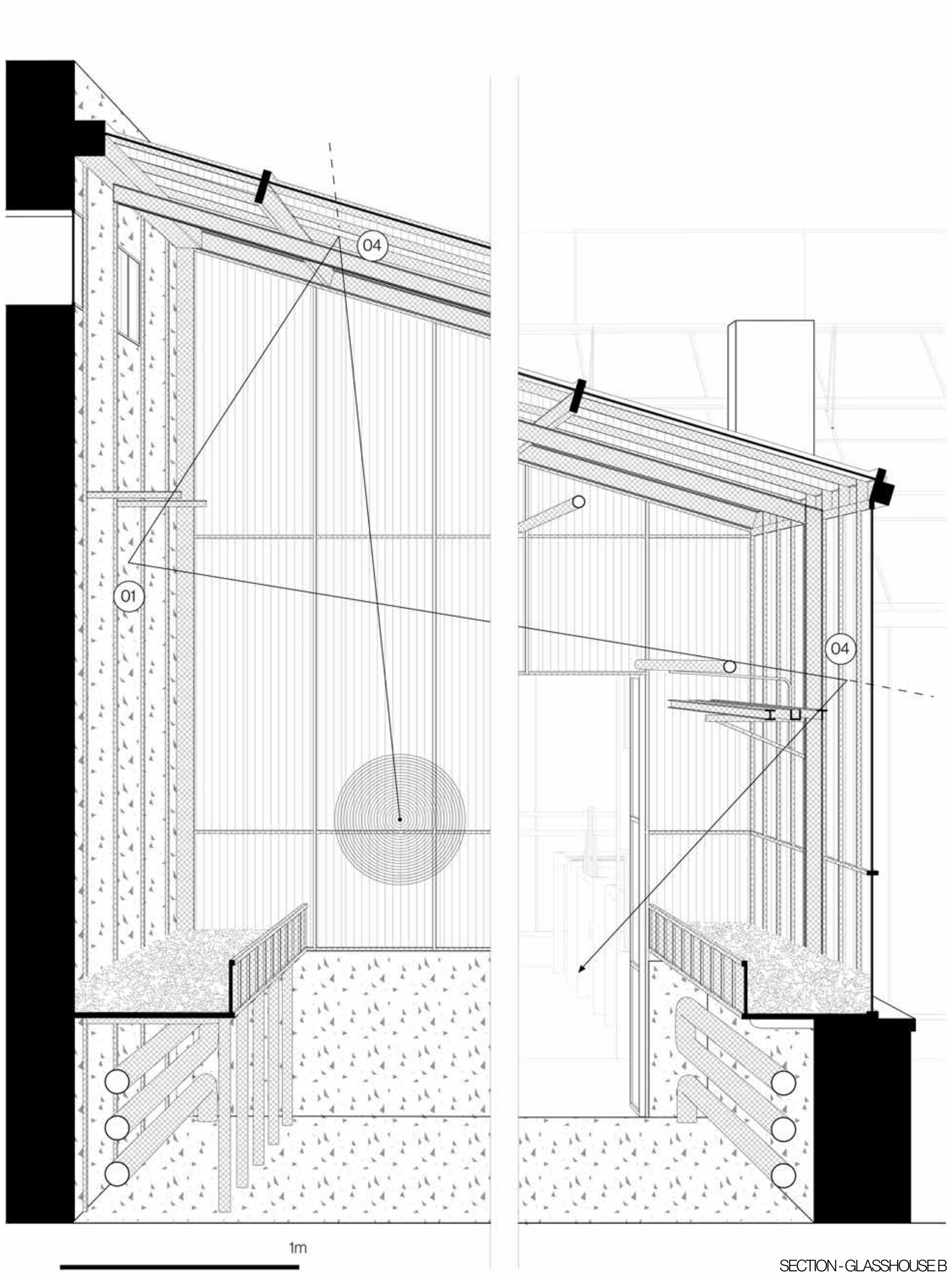


1m

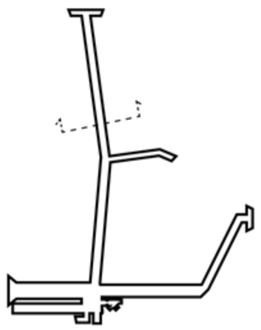
SECTION - TOILETS

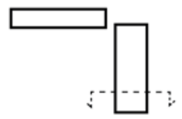
/ MATERIAL ANALYSIS - GLASSHOUSES

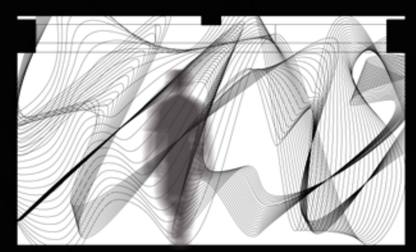




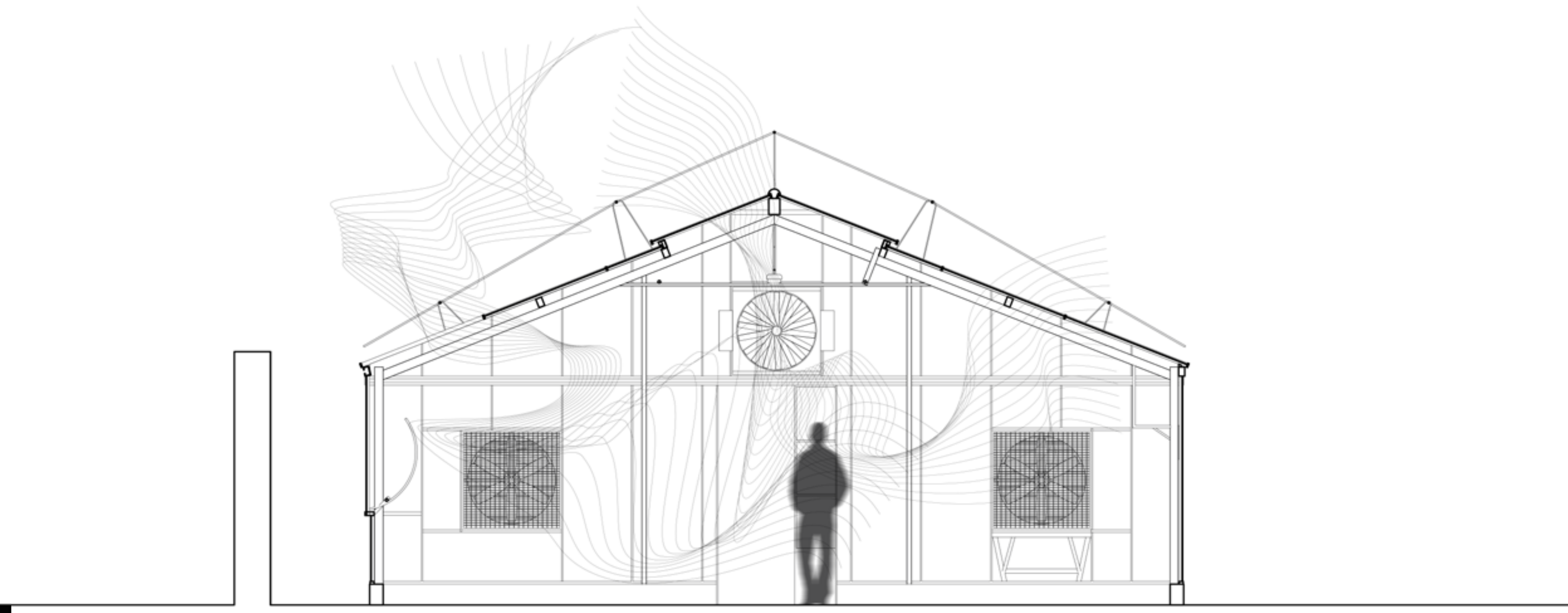
/ ACOUSTIC ATMOSPHERE







1m 2m



1m 2m

The investigation of the Tunnels and Glasshouses reveals a profound dichotomy between transit and dwelling, defined by a direct relationship between architectural form and sonic behavior. The Tunnels are characterized by a fast pace, functioning as linear infrastructures where movement is primary. In contrast, the Glasshouses encourage a slow pace, shifting the spatial experience toward a state of contemplation and stasis.

The acoustic identity of these sites emerges from their material composition. The Tunnels, built with concrete, metallic elements, and tiled floors, act as highly reflective environments. Their enclosed geometry amplifies sound waves, which generate a dense and persistent reverberation. The Glasshouses present a more complex materiality: the combination of glass, metal, and mixed earth-concrete floors creates a balance between reflection and absorption. This porous acoustic state is further influenced by structural irregularities, such as broken panes that allow for acoustic dispersion and plastic sheets that introduce localized dampening.

S Y S T E M

/ SOUND STRATIGRAPHY

The acoustic architecture of the installation is articulated through a vertical stratigraphy operating simultaneously across three planes of depth. This structural configuration effectively transmutes the work from a static scenography into a complex, living system wherein three distinct time-scales coexist and interact.

SURFACE

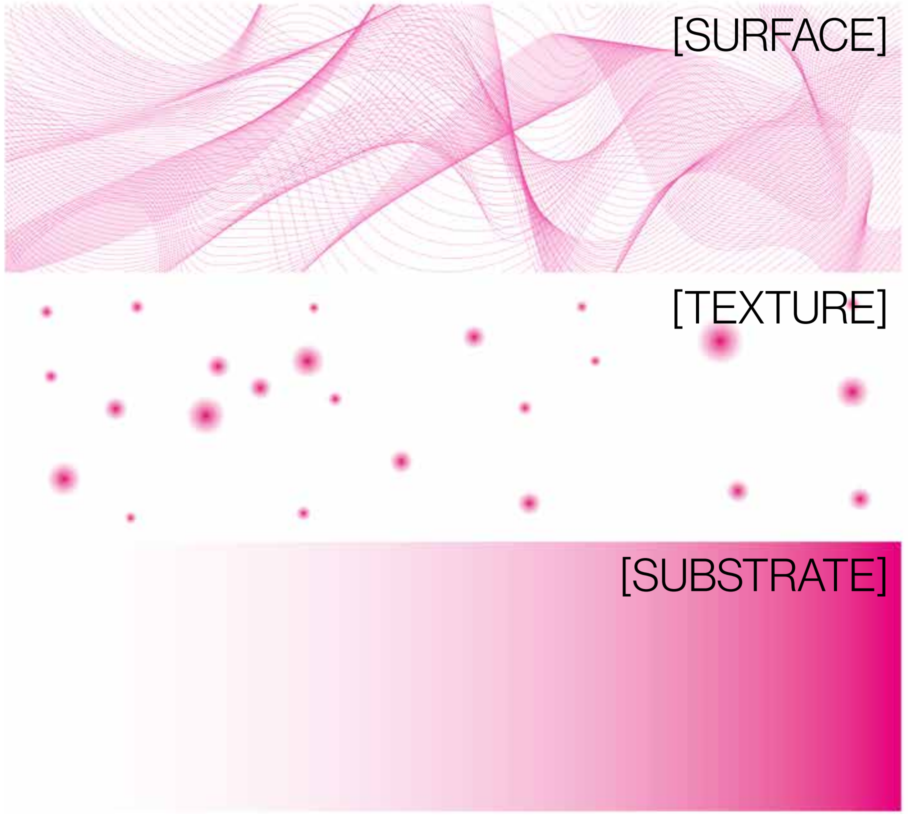
01 SURFACE (atmospheric layer)
This represents the primary perceptible horizon of the work. It constitutes the continuous sonic environment that interacts with the architectural volume, actively modulating the general perception of the space through a stochastic daily loop.

TEXTURE

02 TEXTURE (event layer)
Functioning as a stochastic engine, this layer generates punctiform anomalies designed to rupture atmospheric continuity. It introduces narrative friction, micro-events, and sudden irregularities that emerge unpredictably from the background, forcing a shift in the listener's attention from the general to the specific.

SUBSTRATE

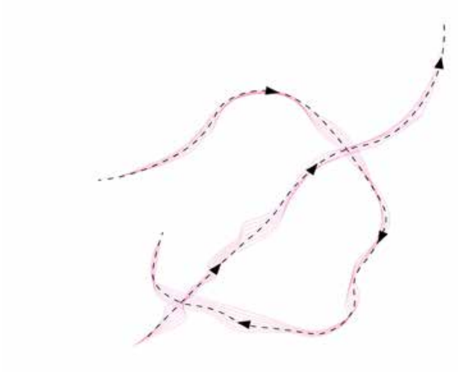
03 SUBSTRATE (foundational layer)
This forms the invisible load-bearing axis of the system. It acts as a deep-frequency undercurrent operating on a slow and continuous time scale, evolving imperceptibly day by day to steer the installation toward its final, inevitable convergence.



/ SURFACE

The project rejects the linearity of traditional musical composition in favor of a metabolic structure. Operating as the hegemonic acoustic stratum, this level bears the primary responsibility for sculpting the phenomenological experience of spatial perception, engaging the physical structure in its most rigorous dialectical exchange. The installation is thus governed by a cyclic algorithm that modulates the density, spatialization, and acoustic pressure of the environment through five distinct behavioral states, each of which radically redefines the relationship between the listener and the architecture.

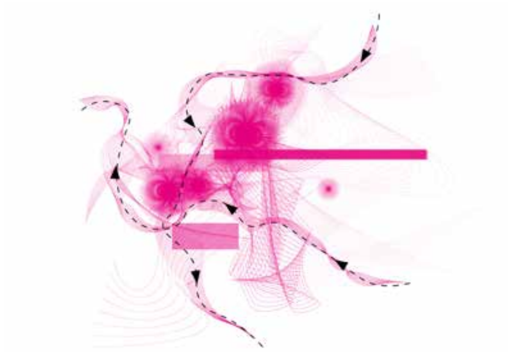
01 DIFFUSE STATE
Atmospheric Calibration / Omnidirectional
This is the system's baseline condition, a phase of calibration wherein sound operates in "background" mode, devoid of peaks or perceptible directionality. Constant and stratified frequencies homogeneously saturate the air, eliminating empty silence without imposing an active narrative; this omnidirectional output generates a perception of temporal dilation and suspension. Here, the user assimilates sound as an intrinsic property of the air (acoustic color), lowering the alertness threshold to favor a state of contemplative immersion.



02 DYNAMIC STATE
Kinematic Activation / Vectorial
The system triggers a kinematic activation of the space through advanced spatialization, where sound acquires mass or velocity, physically shifting along different trajectories. The architecture ceases to be a static container, transforming into a volume traversed by invisible movements; the ear is compelled to track the vector movement of the source, inducing a condition of tension and orientation that urges the user to move through the space or perceive the presence of virtual entities transiting the auditory field.

03 FOCUS STATE
Punctual Hierarchization / Point Source
This state represents the rupture of the atmospheric equilibrium through a punctual hierarchization of acoustic events. Isolated, dry signals are generated and positioned with precision, contrasting sharply with the environmental reverb; these high-frequency transients act as auditory anchor points, instantaneously recalling the user's alertness to specific details of the path and resetting the overall perception in favor of an immediate, analytical focus.

04 SATURATION STATE
Volumetric Compression / Full Spectrum
This is the climax of the metabolic cycle, a phase of volumetric compression in which the preceding states are activated simultaneously, pushing the environment's acoustic load capacity to its limit. Frequencies summate in a constructive superposition that exploits wall reflections to generate an impenetrable wall of sound; the resulting effect is a sensation of physical oppression and spatial collapse, where the distinction between individual sounds vanishes in favor of a purely tactile and vibratory experience.



05 SILENCE STATE
Reset / Active Silence
This constitutes the system's settling phase, characterized by the total interruption of all artificial input. It is not a passive void, but an active silence, necessary to metabolize the intensity of the saturation; in this condition, the user's ear becomes hypersensitive by contrast, allowing the real micro-noises of the place to re-emerge with force, restoring the architecture to its natural dimension before the operational cycle reboots.

[NO SIGNAL INPUT]

/ SURFACE - TEMPORAL CYCLE

SPLIT STATES

The logical architecture of the Surface layer manipulates both the temporal dimension and the sonic geography of the space, distinguishing between split-zone configurations and global states. During low-intensity phases (States 01 and 02), the system physically bisects the location, maintaining Diffused and Dynamic environments in a state of spatial inversion, a constant pendulum between stasis and movement. Conversely, high-intensity modes (Focus, Saturation) and the reset phase (Silence) rupture this duality, synchronizing the entire volume into a singular monophonic condition.

TEMPORAL WINDOWS: 10 TO 40 MINUTES

Temporal management relies on a 10-minute time quantum applied with variable multipliers (1x–4x), generating operative windows of 10 to 40 minutes. This rigid grid asserts the hegemony of time over content: the algorithm enforces premature transitions, truncating the musical evolution to strictly adhere to the system's syntax.

TRANSITION LOGIC: PROBABILISTIC

Transition logic is governed by a weighted probability matrix. While the Split States and Focus allow for fluid interchangeability, Saturation functions as a definitive point of no return, forcing a deterministic drop (100%) into Silence. This constraint ensures that maximum systemic stress is invariably resolved by total zeroing, preventing sensory exhaustion and enhancing the perception of Silence.

TECHNICAL SPECIFICATIONS

SPATIAL LOGIC: Alternating spatial dichotomy (States 01-02) vs. global synchronization (States 03-04-05).

ALGORITHM BASE: Stochastic state machine with weighted probability.

TIME QUANTUM: 10 minutes (duration multiplier 1x - 4x).

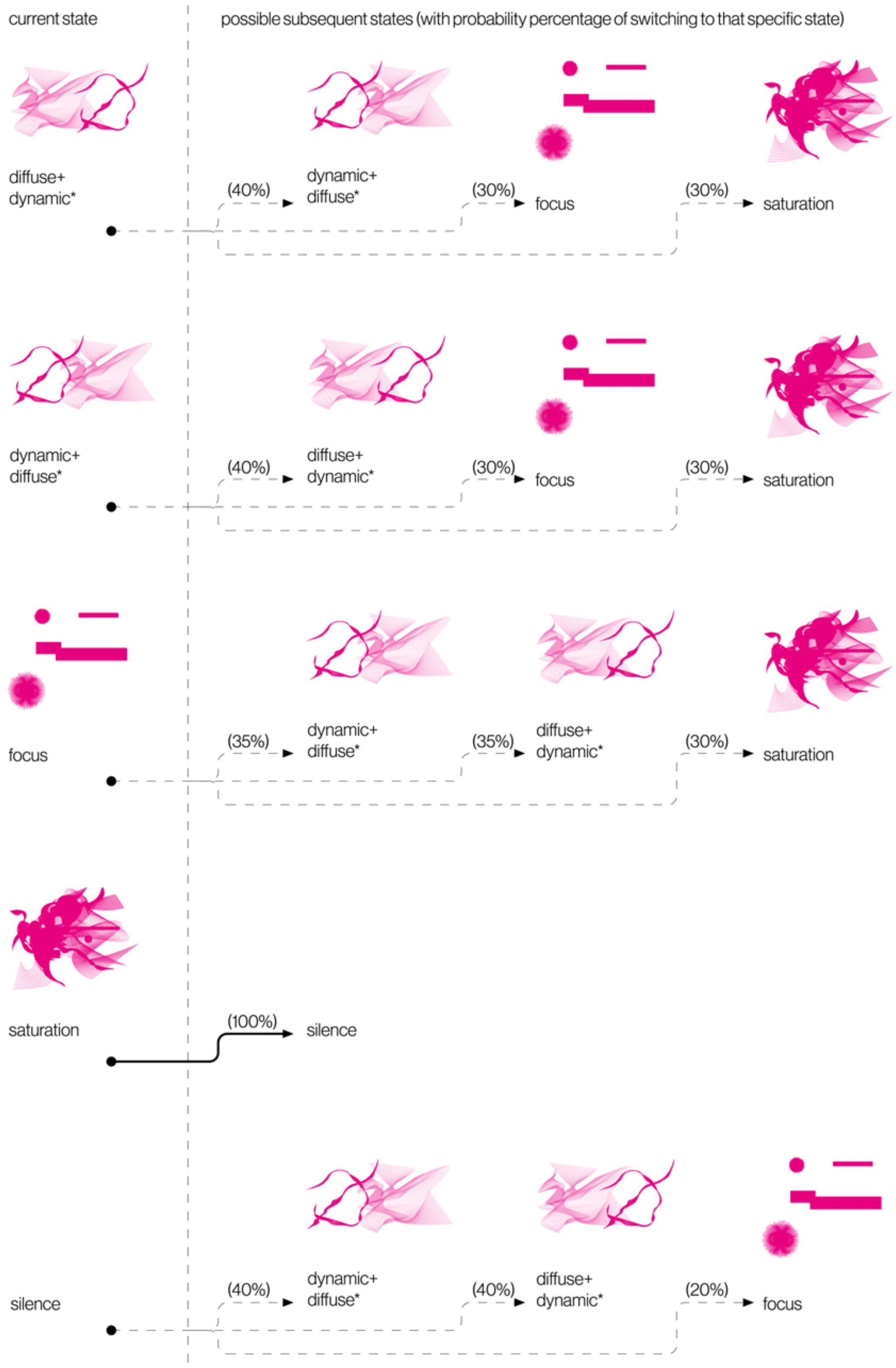
PRIORITY: Time > Content (truncation enabled).

STATE 1 (Split): Zone A (Diffused) + Zone B (Dynamic).

STATE 2 (Split): Zone A (Dynamic) + Zone B (Diffused).

TRANSITION RULES: Detailed probability distribution provided in the adjacent diagram.

/ SURFACE - TEMPORAL CYCLE DIAGRAM



*SPLIT-ZONE CONFIGURATION: spatial inversion of State 01 and State 02 across the location's sub-areas

/ SURFACE - SONIC TAXONOMY

SONIC ARCHETYPES SELECTION

The operational phase commences with the identification and cataloging of six sonic archetypes, divided into two categories of opposing origins yet placed in dialogue through comparative morphological analysis. The natural samples comprise bird calls, the croaking of frogs, and the flow of a stream, while their artificial counterparts were located in the acoustic signals of the Milan subway turnstiles, the unstable hum of a neon lamp, and the mechanical white noise of a street sweeper.

COMPOSITIONAL LOGIC

Each sample was expanded into a forty-minute sonic composition. The production transcends the simple temporal dilation of the original sound, operating instead through a complex stratification that orchestrates the coexistence of four distinct layers: the base sample, its digital alteration, musical fragments selected for timbral affinity, and their subsequent manipulations. This compositional methodology aims to generate a perceptual ambiguity wherein the ear loses the capacity to sharply distinguish between environmental noise and musical note, intentionally blurring the boundary between documented reality and artificial composition. To ensure structural variation, each composition is internally segmented into four autonomous ten-minute sub-modules: at every system activation, the algorithm selects a random entry point within this grid, ensuring that the sonic evolution remains unpredictable and never identical to the previous cycle.

/ GRAPHIC NOTATION SYSTEM

THE GRAPHIC SCORE

For each source, a significant sixty-second fragment was isolated, a time span selected to allow not only an overall understanding of the sound's behavior but also the perception of its inner variations and micro-transformations. The audio stream was thus decomposed into its constituent micro-elements to generate a graphic transcription conceived as a form of acoustic score. This diagrammatic representation conveys acoustic information that a simple waveform recording cannot capture, organizing the data on a Cartesian plane defined by perception: the horizontal axis tracks the chronological succession of events, while the vertical axis maps frequency pitch, placing lower sounds at the bottom and higher frequencies toward the top to define the intrinsic melody of the noise.

VISUAL SYMBOLOGY

Crucially, this visualization attempts to translate the act of listening into visual form. Each sonic component is represented by a specific symbol designed according to its nature, and these graphic elements are scaled based on perceived intensity: the larger the form, the stronger the sensation of loudness. This process revealed that every environmental sound is, in fact, the aggregate result of numerous smaller sonic events produced by the same source.

MORPHOLOGICAL ANALOGIES

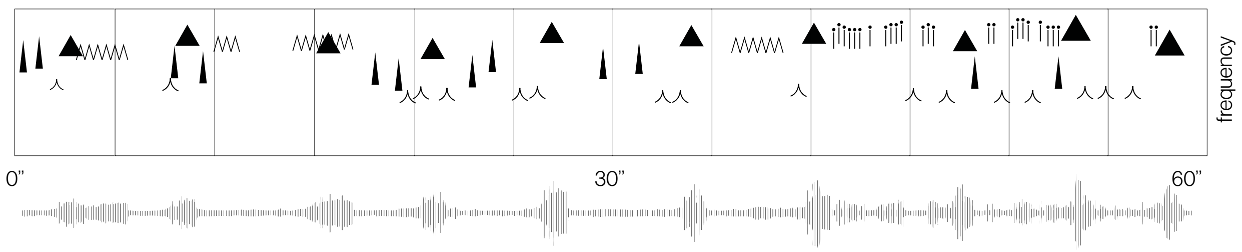
The resulting graphic tracings highlighted structural similarities between sounds of opposing natures, guiding a pairing process based on behavioral and timbral analogy. The punctual and high frequencies of bird calls found their synthetic correspondent in the beep sequence of the turnstiles; the intermittent and granular texture of the frogs was associated with the electrical instability of the neon light, while the continuous fluidity of the stream found a correspondence in the constant spectrum of the street sweeper.

/ GRAPHIC NOTATION - SPECTRUM ANALYSIS

ORGANIC SOURCES

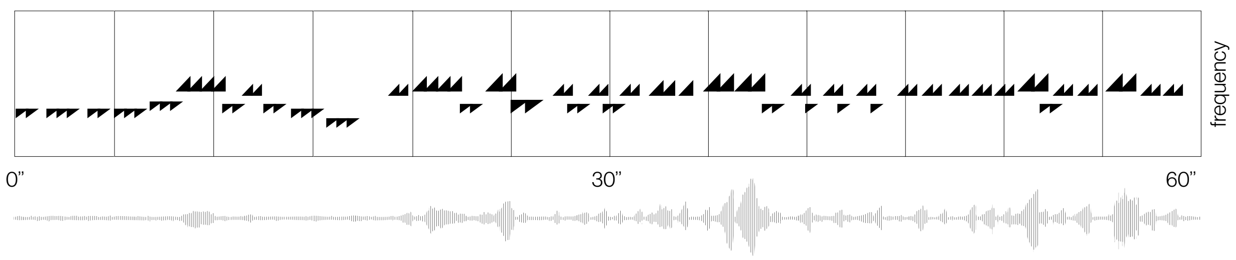
/ BIRD CALL - T1

- isolated chirp
- chirping sequence
- trill
- guttural sound
- peep



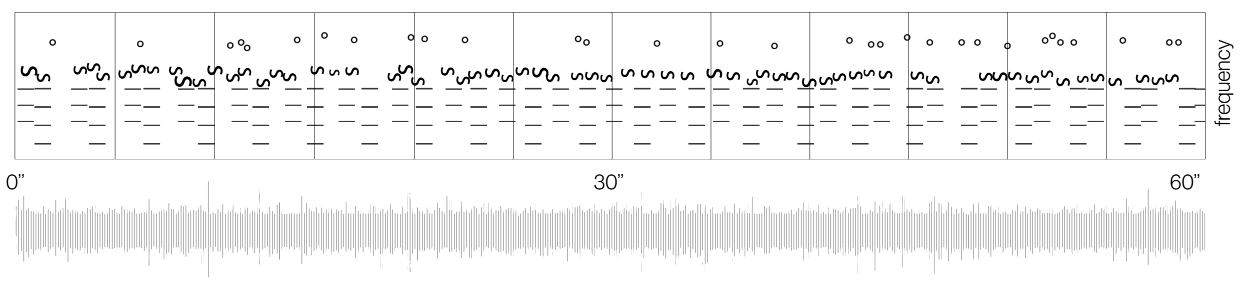
/ FROGS CROAKING - T2

- ascending croak
- descending croak



/ WATER STREAM - T3

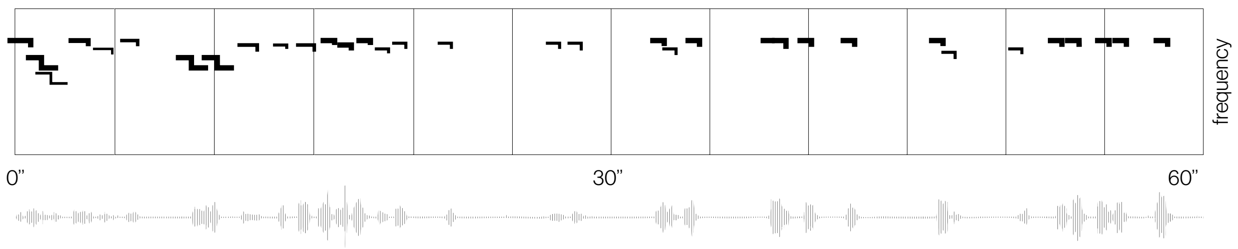
- steady water resonance
- main bubbling currents
- minor splashes



SYNTHETIC SOURCES

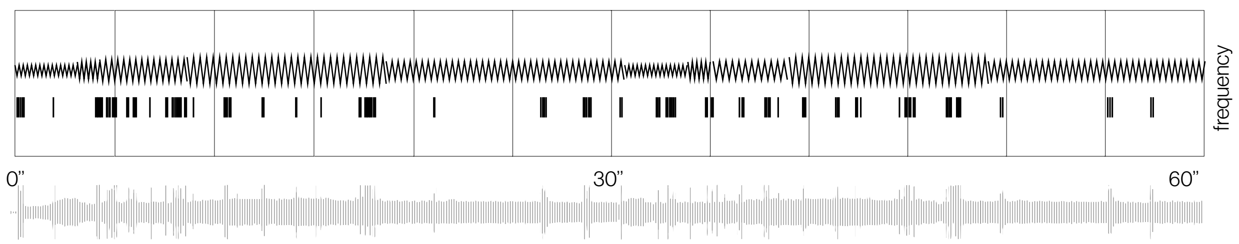
/ METRO TURNSTILES - T4

- beep (type 1)
- beep (type 2)



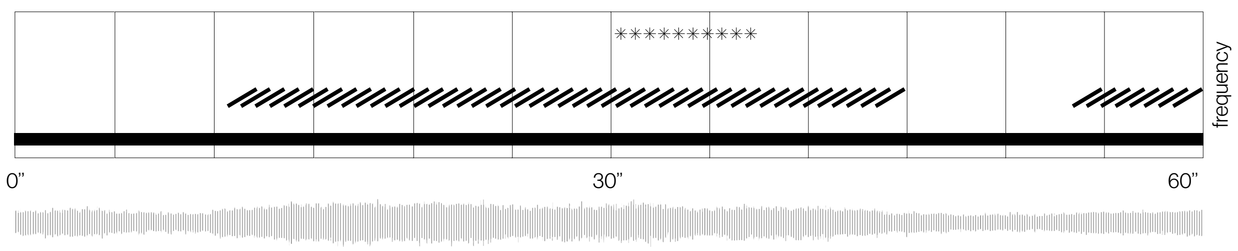
/ NEON LAMP - T5

- steady luminous hum
- flicker pulse



/ STREET SWEEPER - T6

- vehicle engine
- brushes
- beeps



/ SURFACE - SONIC ALLOCATION

SONIC COUNTERPOINT

The allocation of sonic compositions to the architectural volumes deliberately avoid mimetic coherence, adopting instead a strict strategy of semantic counterpoint. The design intentionally rejects perceptual tautology, in favor of a necessary cognitive dissonance aimed at unveiling the latent nature of the space. This logic of dialectical inversion is applied to the two poles of the intervention: the tunnels and the glasshouses.

TUNNELS: ORGANIC SOUNDSCAPE

The tunnels, archetypal "non-places", visually sterile, concrete, and artificial infrastructures, are colonized by the organic sound library. The injection of natural frequencies into an industrial conduit triggers a re-semanticization of the space, which ceases to be perceived merely as a functional artifact, transfiguring instead into a living ecosystem. Here, the Diffusion State is entrusted to the granular texture of frogs to saturate the atmosphere; the Dynamic State employs the continuous flow of the stream to suggest liquid movement along the path; and the Focus State utilizes the punctual song of birds to introduce signals of biological life into the inert volume.

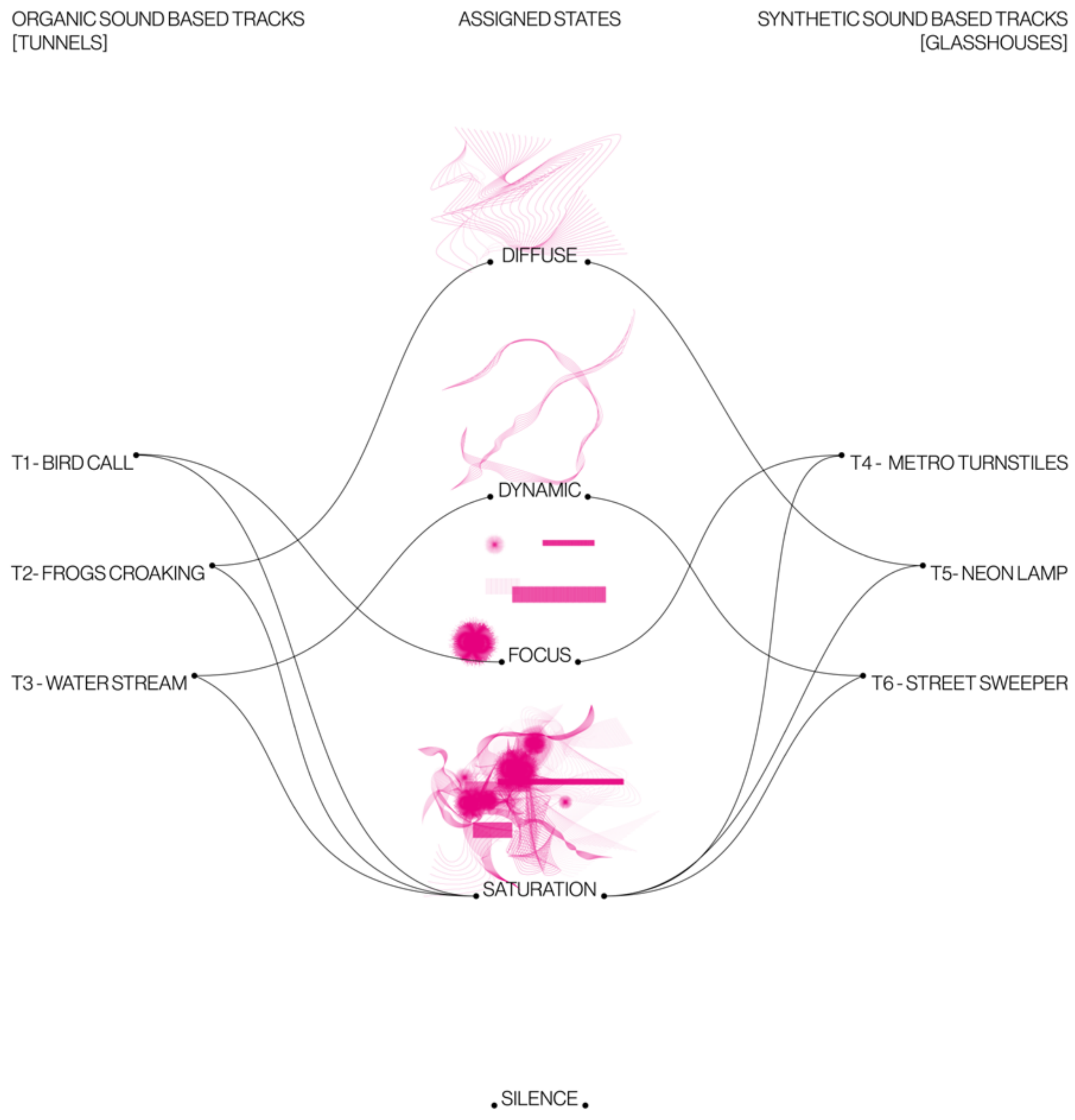
GLASSHOUSES: SYNTHETIC SOUNDSCAPE

Specularly, the glasshouses, representing the "third landscape", are stripped of their bucolic interpretation and saturated by the synthetic sound library. The environment, visually dominated by vegetation, is thus exposed in its technological truth as a machine for living. The deployment of the neon lamp's hum for Diffusion, the white noise of the street sweeper for the Dynamic flow, and the digital signals of the turnstiles for Focus shatters the naturalistic illusion. This establishes a critical atmosphere that emphasizes the vegetable ecosystem's artificial dependence on anthropic support systems: sound does not decorate the space, but contradicts its appearance to reveal its deep structure.

ANTICIPATION AND MEMORY

This inversion of acoustic worlds also alludes to R. Murray Schafer's theories (1977) regarding the contemporary evolution of the soundscape. Situated in a liminal zone between the suburban and the rural, the glasshouses represent the persistence of the natural component within a context of encroaching urban noise, an invasion that is relentlessly advancing even into the countryside. By taking this totally synthetic sonic component to the extreme, the project alludes to a future that is already unfolding. Conversely, the tunnels, immersed in the Milanese urban center, are invaded by sounds that recall the memory of a non-urbanized condition of that locus, a state that is by now historically remote.

/ SURFACE - SONIC ALLOCATION DIAGRAM



/ TEXTURE

DISCRETE ACOUSTIC EVENTS

If the Surface stratum acts as a continuous spatial volume, the Texture layer operates as its antagonist: a system of controlled discontinuity. The intent here is to rupture the linear atmosphere of the primary states through discrete acoustic events. To achieve this, the system employs two diametrically opposed logical engines, effectively splitting the installation's behavior between the tunnels and the glasshouses.

TUNNELS: ORGANIC EVENTS

In the tunnels, the logic is one of pure randomness. Drawing from a library of 21 natural samples (ranging from avian calls to raw elemental noise), the algorithm ensures constant timbral variety without ever settling into a pattern. There is no grid here; the activation of these files relies entirely on probabilistic triggers, creating ephemeral, non-repeatable sequences.

GLASSHOUSES: SYNTHETIC EVENTS

The glasshouses, by contrast, discard this unpredictability in favor of a mechanical scan. Here, the system inserts sonic events with strict precision every ten minutes. The source material (a distorted vocal announcement from the Milan Metro) acts as an aggressive temporal marker, imposing an artificial and repetitive rhythm.

/ EVENTUAL SOUNDS - ORGANIC

In the tunnels, to transcend the status of mere ambient decoration and elevate sound events into genuine psychic anomalies, the system enforces a logic of deep sparsity. The atmospheric layer comprises 95% of the total temporal experience. Consequently, the emergence of a trigger from the stochastic library is not guaranteed for every visitor; rather, it manifests as a rare, probabilistic event.

// TIMING PARAMETERS

TRIGGER MODE: asynchronous / wide random interval.

SILENCE RANGE: variable between 900s (15 min) and 1800s (30 min).

HOURLY DENSITY: approx. 2-3 events per hour.

EXPERIENCE GOAL: sonic hallucination. The extreme scarcity of these events is calculated to induce perceptual uncertainty within the user, rendering each sound an isolated epiphany.

// CATALOGUE

FAUNA (mammals)

01 DISTANT DOG BARK
Morphology: reverberated mid-low impulse.

02 HORSE SNORT
Morphology: low-frequency breath release

03 BAT ECHOLOCATION
Morphology: rapid ultrasonic clicks.

04 MOUSE SQUEAK
Morphology: short, high-pitched tone.

05 GRAZING COWBELLS
Morphology: irregular metallic clatter.

AVIAN SIGNALS (Birds)

06 RAVEN CAW
Morphology: harsh croak.

07 OWL HOOT
Morphology: soft sine wave.

08 WOODPECKER DRILLING
Morphology: fast, percussive rhythm on wood.

09 WING FLAP
Morphology: physical air displacement without vocalization.

MICRO-TEXTURES (Insects)

10 INSECT SWARM
Morphology: moving sonic cloud.

11 FLY BUZZ
Morphology: low, drone-like hum; doppler effect.

12 BEE BUZZ
Morphology: low, drone-like hum; doppler effect.

13 CRICKET CHIRP
Morphology: continuous rhythmic texture.

VEGETATION

14 DRY LEAVES CRUNCH
Morphology: friable crackling.

15 DRY WOOD SNAP
Morphology: sharp dry transient (Click).

16 WIND IN GRASS
Morphology: modulated white noise.

17 REEDS RUSTLING
Morphology: hollow, dry friction.

ELEMENTAL & GROUND

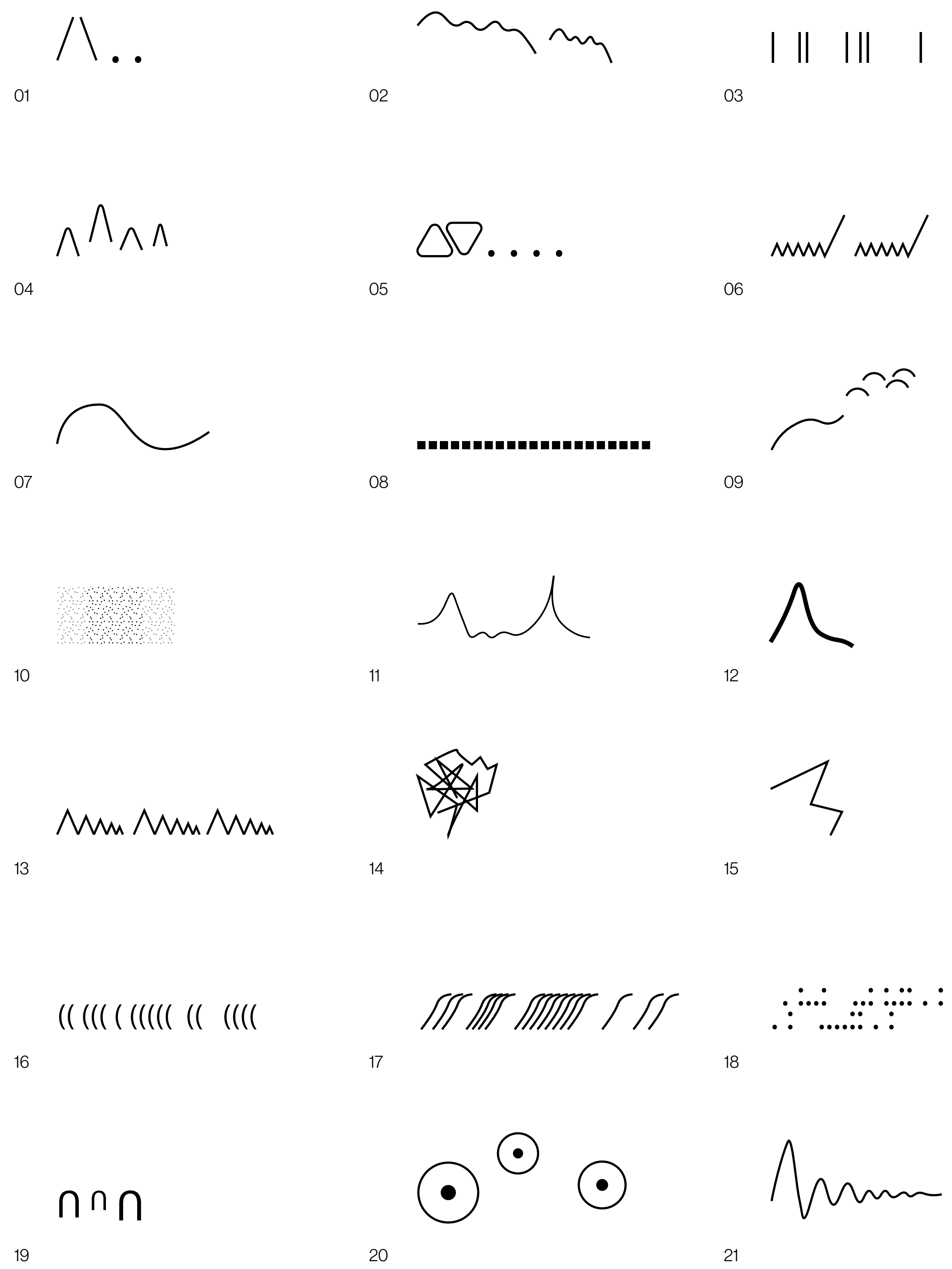
18 GRAVEL FOOTSTEPS
Morphology: mineral friction.

19 SNOW CRUNCH
Morphology: muffled compression.

20 WATER DROP
Morphology: Single liquid impulse with long decay.

21 DISTANT THUNDER RUMBLE
Morphology: deep sub-bass roll.

/ ORGANIC EVENTS - GRAPHIC NOTATION - MORPHOLOGICAL INDEX



/ EVENTUAL SOUNDS - SYNTHETIC

Standing in sharp contrast to the stochastic logic governing the tunnels, the environment within the glasshouses adheres to a strict deterministic temporal regime. The system operates under the command of a fixed-interval trigger mechanism (T = 600s): precisely every ten minutes, the installation broadcasts a sonic event culled from a closed matrix. Crucially, the audio material is not generated in real-time; rather, it is the product of an offline pre-rendering process. The singular source, a site-specific announcement, was subjected to twenty distinct processes of digital destruction (DSP) and subsequently archived into a static library. Consequently, the playback algorithm functions merely as a random selector: upon the activation of the temporal trigger, it extracts one of the twenty-one pre-calculated variants. This operation simulates an instantaneous system anomaly without imposing a heavy computational load on the real-time CPU (central processing unit).

//TIMING PARAMETERS

TRIGGER MODE: synchronous / fixed interval.

INTERVAL: 10 minutes (6 events/hour).

SOURCE MATERIAL: single audio sample ("siamo a, this is, Centrale FS").

PROCESS: 1 clean state + 20 DSP variations

//CATALOGUE

01 SOURCE REFERENCE
Unaltered original signal used as a baseline control.

02 TIME-STRETCH EXPANSION
Temporal expansion (200%) of the audio signal preserving the original pitch, resulting in prolonged articulation.

03 TIME COMPRESSION
Temporal compression (50%) of the audio signal preserving the original pitch, resulting in accelerated phrasing.

04 REVERSE PLAYBACK
Inversion of the signal's temporal direction, reversing the amplitude envelope.

05. MANUAL STUTTER
Repetitive editing of the initial transient syllables to simulate mechanical jamming.

06 CHOPPED SCATTERING
Non-linear fragmentation and randomized reassembly of audio segments.

07 BIT DEPTH REDUCTION
Reduction of the digital resolution to 8-bit, introducing quantization noise and Lo-Fi artifacts.

08 GRANULAR SYNTHESIS
Deconstruction of the source signal into microsound grains.

09 PITCH SHIFTING (LOWERING)
Downward frequency shift of the signal to alter tonal character without affecting duration.

10 LONG FEEDBACK DELAY
Application of a delay effect with high feedback settings.

11 WET REVERBERATION
Full spatial diffusion with the direct signal suppressed (100% Wet mix), simulating distance and loss of definition.

12 TONAL INTERFERENCE LAYER
Superimposition of a continuous high-frequency sine wave.

13 MANUAL SIGNAL GATING
Rhythmic silencing of the waveform via manual editing.

14 MULTI-VOICE CHORUS
Duplication and slight detuning of the signal to simulate multiple overlapping synthetic sources.

15 DOPPLER EFFECT SIMULATION
Modulation of pitch and amplitude to simulate a moving sound source passing the listener.

16 SATURATION ECHO
Long-tail delay with excessive feedback, leading to progressive signal saturation and chaotic overlap.

17 FLANGER MODULATION
Phase shifting creating a moving comb-filtering effect and metallic timbre.

18 SATURATION OVERLOAD
Extreme gain amplification resulting in dynamic flattening and a dense, muffled tonal character with loss of high-frequency definition.

19 DRASTIC GAIN REDUCTION
Extreme attenuation of the signal amplitude (-50dB).

20 UNSTABLE PHASING
Dynamic phase cancellation with irregular modulation, simulating signal instability or malfunction.

21 TOTAL SIGNAL DEGRADATION (GLITCH)
Extreme distortion combined with sample rate reduction, resulting in the complete destruction of signal integrity.

/ SYNTHETIC EVENTS - GRAPHIC NOTATION - ALTERATIONS INDEX

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02 [SIAMO A THIS IS CENTRALE FS]

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/ SUBSTRATE

SITE SPECIFIC FREQUENCIES

The foundational level, the Substrate, constitutes the invisible load-bearing axis of the work. In distinct opposition to the other layers, this stratum emerges as a direct extension of the site's intrinsic spirit, composed of two pure sine waves: the 50 Hz Mains Hum (the electricity frequency), for the tunnels, and the 432 Hz Natural Harmonic (Golden Tuning aligned with the vegetation's biological cycles) for the glasshouses.

STOCHASTIC DRIFT TOWARD A MEAN

These identities, however, are not static. From the cycle's inception, alongside a linear gain growth (+1.1 dB/day), the system imposes a directional frequency drift: the 50 Hz wave progressively ascends while the 432 Hz wave descends, both oscillating inexorably toward a common arithmetic mean.

FIBONACCI BASED LIFE CYCLE

To orchestrate the tension between organic evolution and algorithmic determination, the lifecycle is constrained within a Fibonacci sequence range (21-55 days) through a fluid, three-stage probability model.

LATENCY PHASE

INSTABILITY PHASE

COLLAPSE

The process begins with a latency phase (days 01-20), where the probability of intersection is forced to zero, guaranteeing the system a minimum period of incubation. Subsequently, the architecture enters a volatile instability phase, where the collision probability rises exponentially from 5% to 95%; within this window, the exact moment of termination is surrendered to stochastic chance, allowing the algorithm to collapse the organic cycle at any unpredictable instant. Should the system survive this volatility, the collapse phase at day 55 imposes a hard limit, forcing immediate termination.

FINAL OSCILLATION

Crucially, the final intersection is not instantaneous but heralded by a brief Low-Frequency Oscillation (LFO), a structural tremor signaling imminent collapse. Immediately following this alert, the system locks onto the 241 Hz Singularity at maximum gain (0 dB), unifying the two locations into a single monolithic drone and definitively concluding the installation's lifecycle.

//CONVERGENCE DATA SHEET

ALGORITHM SPECIFICATIONS

SYSTEM DURATION: Fibonacci Sequence constraint (min 21 days - max 55 days).

TRIGGER LOGIC: exponential probability variable

(P).

PHASES: latency (days 01-20, P=0%) > instability

(days 21-54, P= 5% to 95%) > forced collapse (day 55, P=100%).

INTENSITY DYNAMICS

START POINT (day 01): -60 dB (subliminal threshold).

GROWTH FUNCTION: linear gain ramp (+1.1 dB / day).

TARGET: 0 dB (maximum SPL) at day 55.

OVERRIDE: immediate jump to 0 dB upon Singularity trigger.

FREQUENCY TRAJECTORY

SOURCE A (Tunnels): 50 Hz / ascending pitch shift.

SOURCE B (Glasshouses): 432 Hz / descending pitch shift.

INTERSECTION (Singularity): 241 Hz (arithmetic mean).

COLLAPSE SEQUENCE

LFO WARNING: 120s pitch oscillation (+/- 5Hz).

LOCK: frequency freeze at 241 Hz.

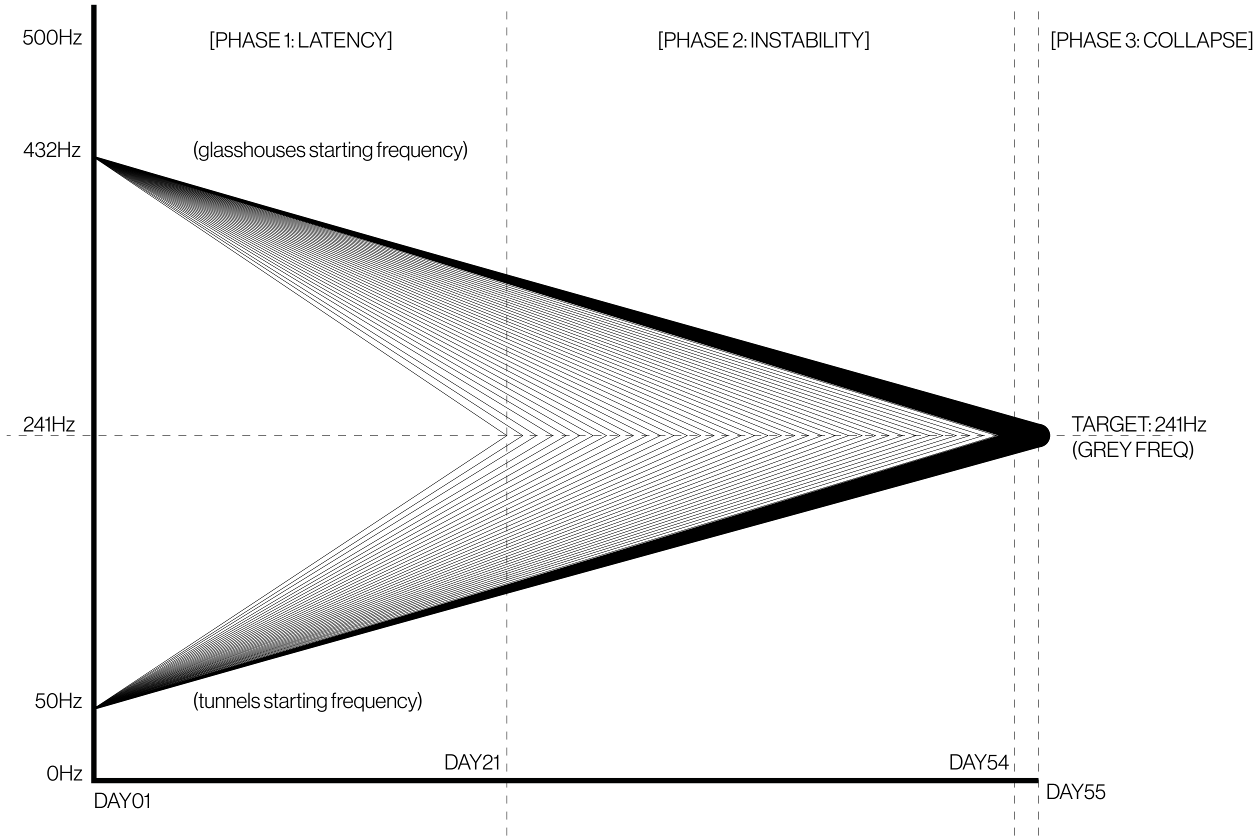
MASKING: instant gain increase to Max SPL.

STATUS: Schafer's homogenization (end of cycle).

POST-COLLAPSE PROTOCOL: the Singularity state (241 Hz) is sustained for a fixed 24-hour, followed by a global hard shutdown (permanent silence).

/ SUBSTRATE - EVOLUTION DIAGRAM

This diagram illustrates the dynamic behavior of the Substrate, mapping the frequency drift of the two sonic identities toward a shared intersection. The visualization tracks the 50 Hz industrial sine wave and the 432 Hz biological harmonic as they converge toward the 241 Hz arithmetic mean. The graph renders the system's temporal evolution through the three thresholds of latency, instability, and collapse, defining the geometric tension that precedes the final singularity and the unification of both locations into a single monolithic drone.



INFRASTRUCTURE

/ TECHNICAL IMPLEMENTATION

INTEGRATION PRINCIPLES

This chapter articulates the concrete realization of the system through the actual spatial and sound design. To successfully transform the two selected sites into immersive acoustic landscapes, it is necessary to define the sound propagation devices and their strategic positioning. These design decisions were predicated on the distinct parameters characterizing each space. The project, therefore, strictly adheres to the morphological and material specificities of the sites, while also considering the dynamics of traversal and inhabitation within the tunnels and glasshouses. Consequently, the selection and arrangement of the hardware were calibrated to technically generate the spatial and acoustic effects that underpin the entire research.

TUNNELS: SEAMLESS INTEGRATION

In both scenarios, the devices were selected to integrate seamlessly with the existing architecture. The objective is to prevent any visual friction, ensuring the listener's attention is not drawn to the apparatus itself, but remains focused on the sonic experience. Inside the tunnels, the priority was absolute discretion: the chosen devices are diminutive in size or easily assimilated into the site's industrial aesthetic. Thus, installations here are exclusively ceiling- or wall-mounted, embedded within the existing network of exposed utilities. The equipment used within the tunnels is strictly black, allowing it to dissolve visually against the dark background of the ceilings and walls. Wherever possible, devices were positioned in the shadow of other elements to conceal or minimize their presence. A clear example can be found in tunnels 03 and 04, where the protruding metal signage bands on the upper walls serve as a visual shield for the devices installed immediately beneath them.

GLASSHOUSES: SYNTHETIC EXPOSURE

At the glasshouse site, the approach shifts slightly. Here, some devices remain partially visible, utilizing suspension fixtures that anchor directly to the architectural frame, echoing its chromatic palette to become an integral part of the structure. Other devices, conversely, are concealed beneath the long planting benches in one of the glasshouses to reduce visual impact. In this context, the finish of the equipment was carefully curated to dialogue with the architecture; polished steel models were selected wherever possible to bond aesthetically with the steel skeleton of the glasshouses. Finally, as the glasshouse area encompasses a rather uncultivated green space, acoustic devices were also introduced outdoors. This allows the synthetic soundscape to expand beyond the architectural enclosure, permeating the vegetation itself.

SOFTWARE: MAX/MSP

The operational heart of the acoustic ecosystem is governed by a centralized digital infrastructure built upon a custom Max/MSP environment. This generative engine is tasked with orchestrating the complex interplay between the three sonic layers defined in the conceptual phase: Surface, Texture, and Substrate. The software manages the timeline stochastically, ensuring that transitions, density, and the emergence of specific sounds are driven by the probability percentages and variation parameters previously analyzed. This approach guarantees that the soundscape behaves as a living, non-repetitive organism, constantly shifting between background ambience and foreground events according to the specific rules established for each location.

HARDWARE

Physically, this generative logic materializes into a dedicated hardware architecture housed within the System Rack. The signal chain originates from a rack-mounted media server running the real-time algorithm, which routes discrete audio channels through a multichannel interface. From this central node, the distribution strategy bifurcates into two distinct topologies designed to accommodate the specific technical requirements of the installed devices.
The first strategy involves high-power distribution for the passive system: a bank of dedicated power amplifiers (K-Array Kommander series) is installed directly within the rack, providing the necessary wattage to drive the extensive array of passive loudspeakers, including Lyzard, Anakonda, and Gallo models, along with the subwoofers via long-distance cabling. Conversely, the directional Panphonics panels require a decentralized, line-level approach. Rather than drawing power from the main rack, they are fed by independent analog signals routed to local active drivers concealed, when possible, within the architecture. A decentralized configuration minimizes signal degradation while allowing for precise local control.

/ DEVICES

//GALLO ACOUSTICS HABITAT (A'DIVA)

DIMENSIONS: 127mm (spherical)

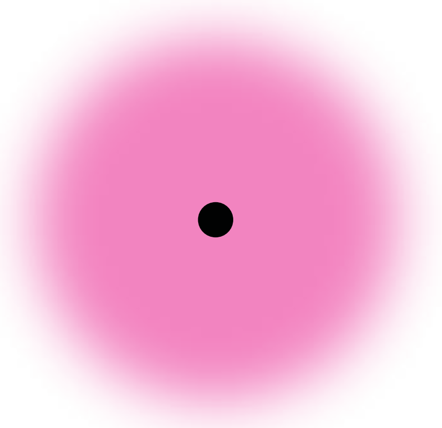
ACOUSTIC BEHAVIOR: omnidirectional radial dispersion. Spherical enclosure design generating a diffused sound field. Ensures uniform coverage and ambient saturation throughout large volumetric spaces without directional bias.

MATERIAL & RESISTANCE:
Body: stainless steel.
Rating: IP66 (dust tight & water jet resistant).

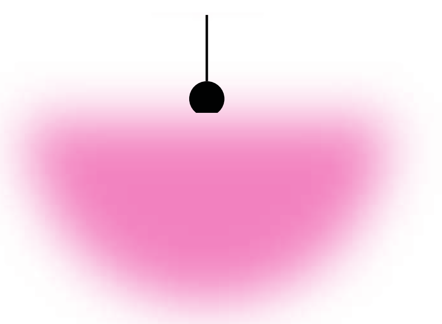
FINISH LOCATION:
Greenhouses: polished stainless steel.

FREQ. RESPONSE: 80Hz – 22kHz.

TOP VIEW



SIDE VIEW



//K-ARRAY ANAKONDA-KAN200+

DIMENSIONS: 2000 x 56 x 35mm

ACOUSTIC BEHAVIOR: continuous linear emission. distributed sound source acting as a flexible line array.

MATERIAL & RESISTANCE:
Body: flexible chassis with integrated synthetic fabric sock.
Rating: IP64 (weather resistant).

FINISH LOCATION:
Glasshouses: matte black.

FREQ. RESPONSE: 150Hz – 18kHz.

TOP VIEW

SIDE VIEW

//K-ARRAY LYZARD-KZ14

DIMENSIONS: 22 x 100 x 11mm

ACOUSTIC BEHAVIOR: point source / narrow vertical dispersion. Produces a highly controlled vertical beam with wide horizontal coverage.

MATERIAL & RESISTANCE:
Body: milled aluminum (monolithic construction).
Rating: IP64 (Dust-tight, Splash-resistant).

FINISH LOCATION:
Tunnels: matte black (RAL 9005).
Glasshouses: polished aluminum.

FREQ. RESPONSE: 500Hz – 18kHz.

TOP VIEW

SIDE VIEW

//K-ARRAY RUMBLE-KU26

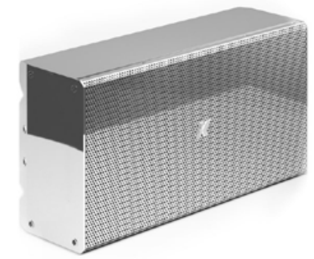
DIMENSIONS: 350 x 180 x 118mm

ACOUSTIC BEHAVIOR: omnidirectional low-frequency extension. Non-localizable low-frequency propagation due to long wavelengths.

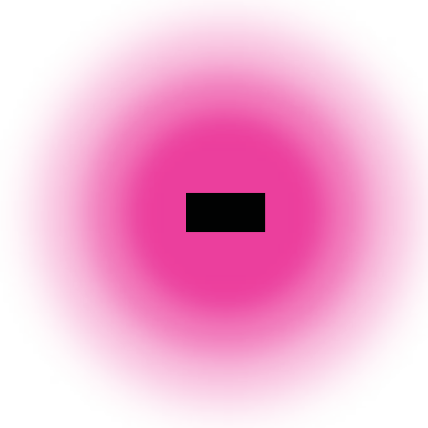
MATERIAL & RESISTANCE:
Body: stainless steel (corrosion proof).
Rating: IP64 (high humidity/outdoor suitable).

FINISH LOCATION:
Tunnels: matte black.
Greenhouses: polished steel.

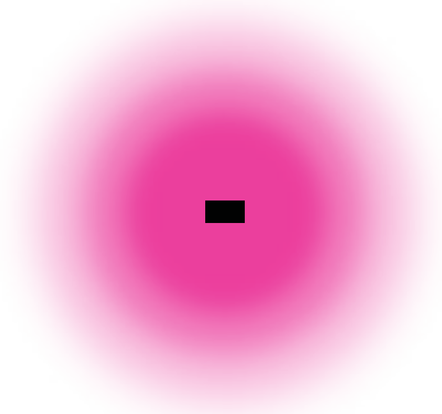
FREQ. RESPONSE: 45Hz – 150Hz.



TOP VIEW



SIDE VIEW



//PANPHONICS SOUND SHOWER

DIMENSIONS: (square) 600 x 600mm;
(strip) 1200 x 200mm.

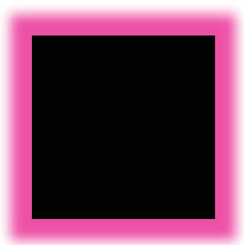
ACOUSTIC BEHAVIOR: vertical beam. Electrostatic technology generating a coherent, non-expanding sound column. High directivity ensures audio is contained strictly within the physical footprint of the panel.

MATERIAL & RESISTANCE:
Body: anodized aluminum frame + synthetic membrane.
Rating: IP20 (protected install within structural/ceiling voids).

FINISH LOCATION:
Tunnels and glasshouses: matte black.

FREQ. RESPONSE: 250Hz – 16kHz.

TOP VIEW



SIDE VIEW

//K-ARRAY KOMMANDER-KA84
Main System Power Amplifier

DIMENSIONS: 430 x 89 x 305mm (2U rack standard).

TECHNICAL ROLE: centralized amplification unit. Primary amplifier installed in the main technical rack. It supplies power to the main speaker arrays (Lyzard, Rumble, Habitat and Anakonda) and manages signal equalization to ensure correct audio balance across the primary zones.

SPECIFICATIONS:

Power: 4 channels x 2000 W @ 4Ω.
Inputs: 4 analog / 2 AES-EBU.
Finish: stainless steel chassis (black).

LOCATION: main server room.

//K-ARRAY KOMMANDER-KA02I
Distributed Zone Amplifier

DIMENSIONS: 219 x 45.5 x 170mm (compact).

TECHNICAL ROLE: compact amplification unit installed directly in remote tunnel sections. It powers local speaWker groups independently, eliminating the need for excessive cabling runs from the central server room.

SPECIFICATIONS:

Power: 4 channels x 50 W @ 4Ω.
Connectivity: Wi-Fi / bluetooth / ethernet.
Finish: aluminum (black).

LOCATION: remote tunnel sections (hidden in voids).

//PANPHONICS AA160 BASIC
Electrostatic Driver Interface

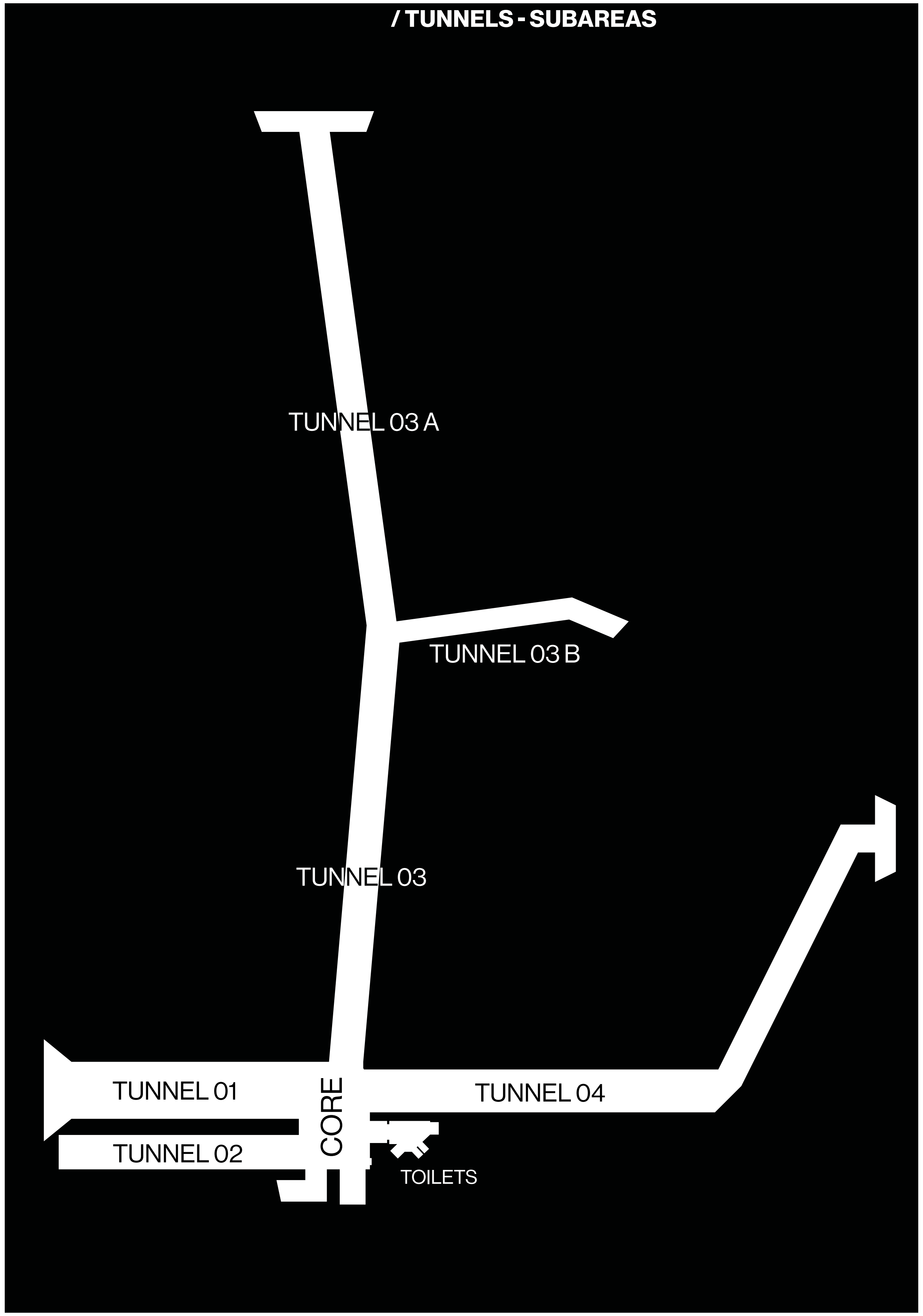
DIMENSIONS: 160 x 160 x 48mm (compact).

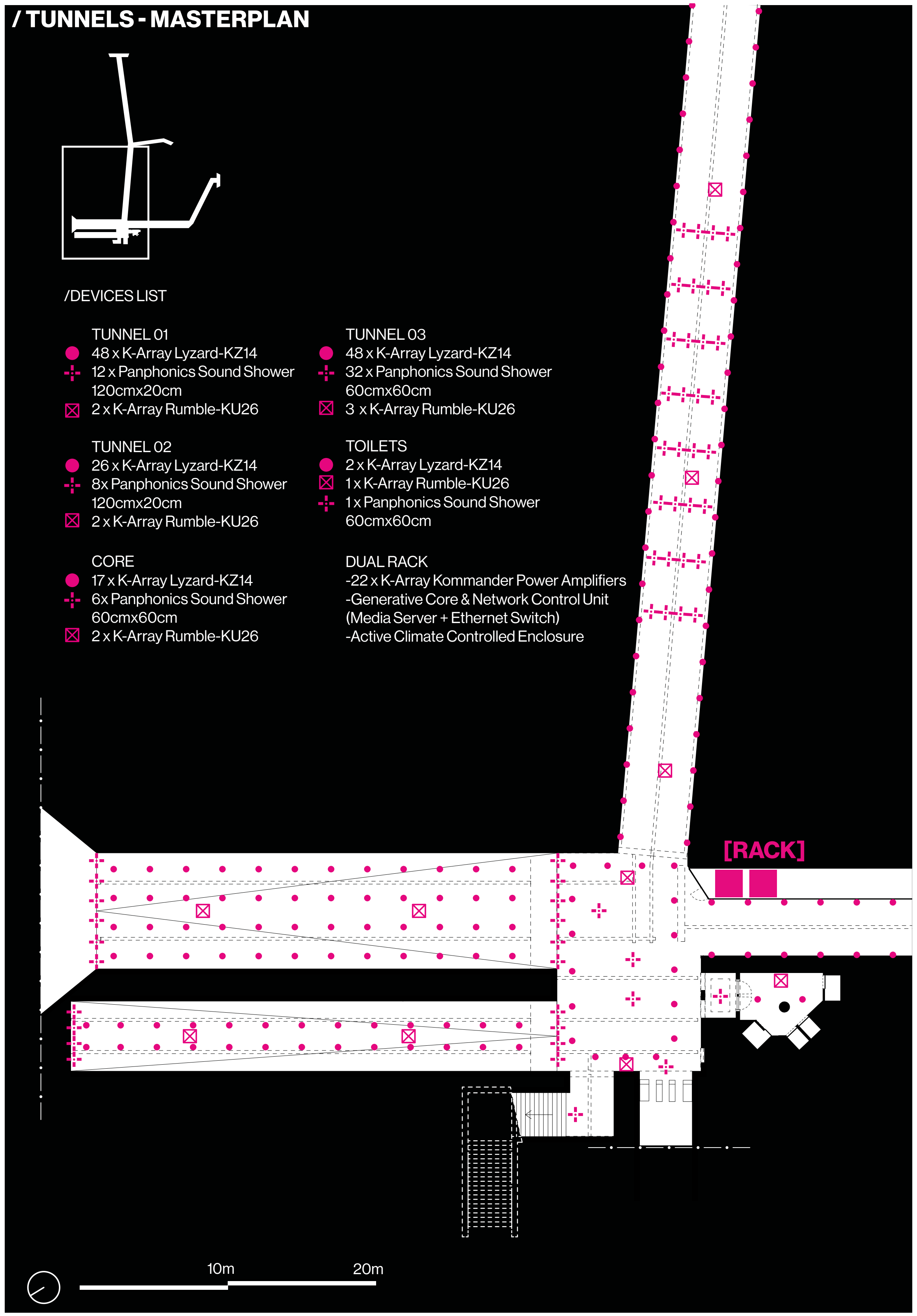
TECHNICAL ROLE: required signal interface. Essential control unit connecting the standard audio system to the Panphonics panels. It converts the audio signal to operate the specific technology of the Sound Shower directional speakers.

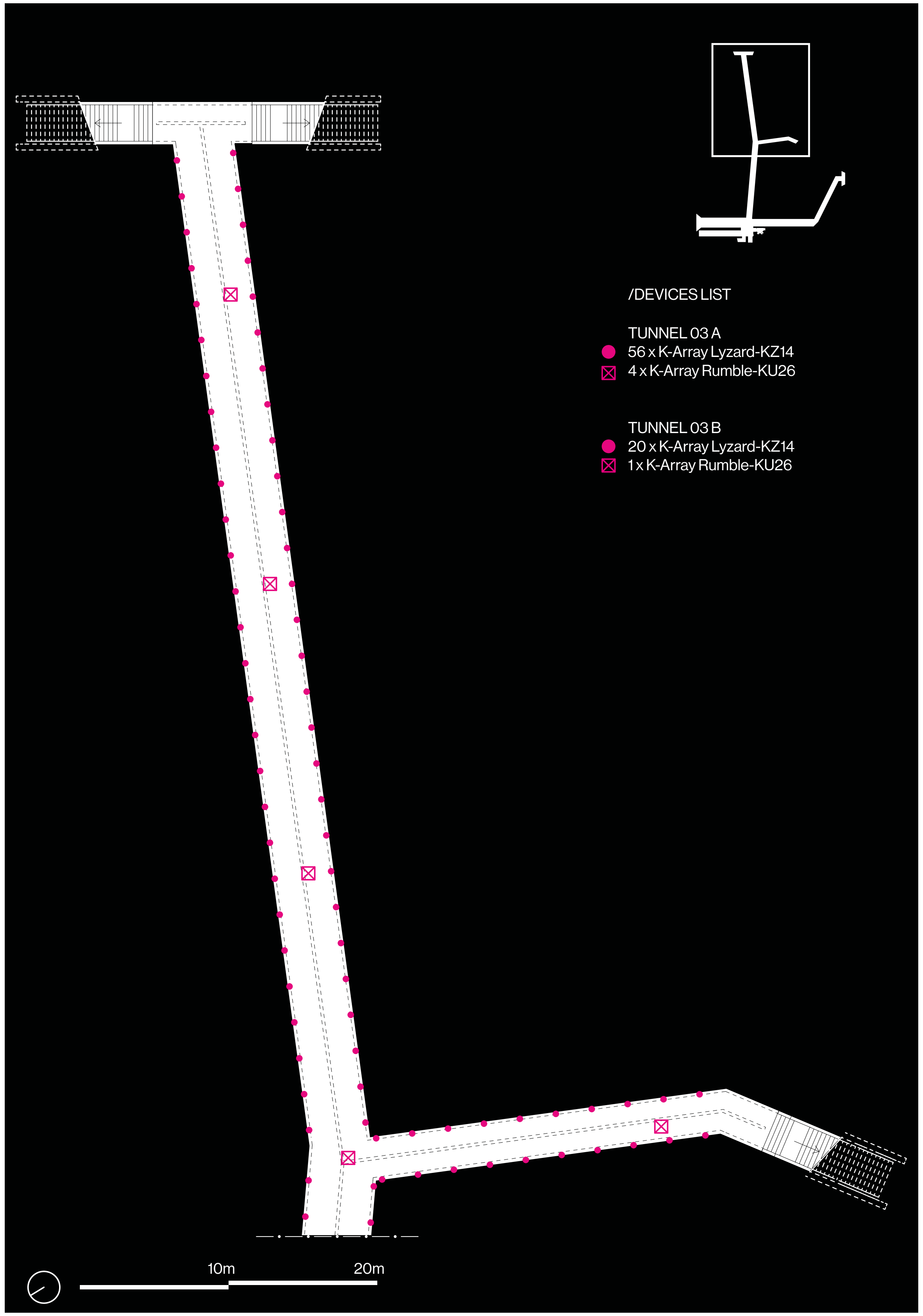
SPECIFICATIONS:

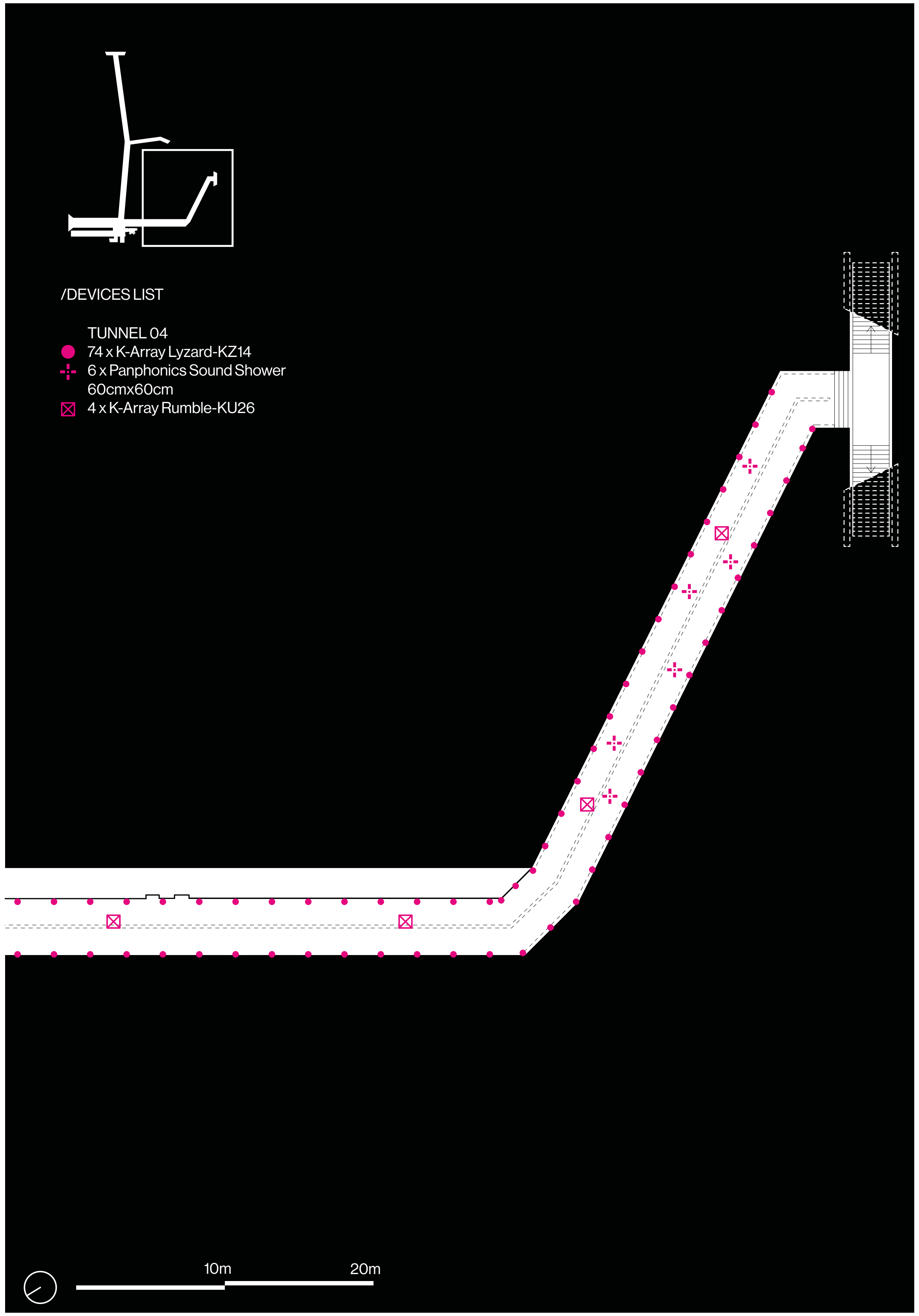
Input: analog line level.
Output: dedicated panel connection.
Power supply: 24V DC external.

LOCATION: adjacent to panels.

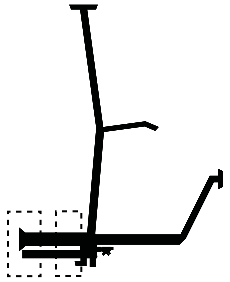

/ TUNNELS - SUBAREAS
TUNNEL 03 A
TUNNEL 03 B
TUNNEL 03
TUNNEL 01
TUNNEL 02
CORE
TUNNEL 04
TOILETS

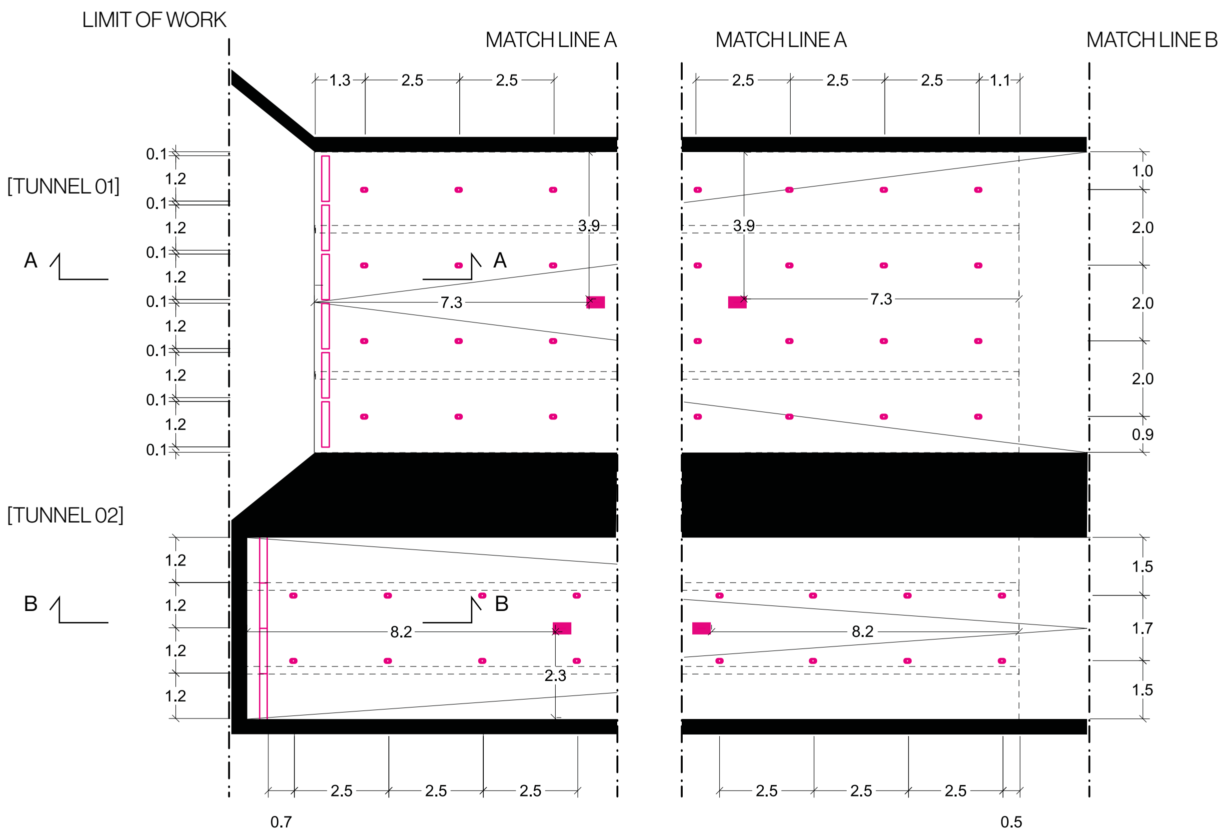

/ TUNNELS - MASTERPLAN
/DEVICES LIST
TUNNEL 01
48 x K-Array Lyzard-KZ14
12 x Panphonics Sound Shower 120cmx20cm
2 x K-Array Rumble-KU26
TUNNEL 02
26 x K-Array Lyzard-KZ14
8x Panphonics Sound Shower 120cmx20cm
2 x K-Array Rumble-KU26
CORE
17 x K-Array Lyzard-KZ14
6x Panphonics Sound Shower 60cmx60cm
2 x K-Array Rumble-KU26
TUNNEL 03
48 x K-Array Lyzard-KZ14
32 x Panphonics Sound Shower 60cmx60cm
3 x K-Array Rumble-KU26
TOILETS
2 x K-Array Lyzard-KZ14
1 x K-Array Rumble-KU26
1 x Panphonics Sound Shower 60cmx60cm
DUAL RACK
-22 x K-Array Kommander Power Amplifiers
-Generative Core & Network Control Unit (Media Server + Ethernet Switch)
-Active Climate Controlled Enclosure
[RACK]
10m
20m


/DEVICES LIST
TUNNEL 03 A
56 x K-Array Lyzard-KZ14
4 x K-Array Rumble-KU26
TUNNEL 03 B
20 x K-Array Lyzard-KZ14
1 x K-Array Rumble-KU26
10m
20m


/DEVICES LIST
TUNNEL 04
74 x K-Array Lyzard-KZ14
6 x Panphonics Sound Shower
60cmx60cm
4 x K-Array Rumble-KU26
10m
20m

/ TUNNELS 01 & 02 - PLAN



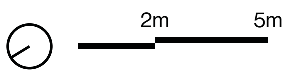


INCUBATOR - TUNNEL 01 AND TUNNEL 02

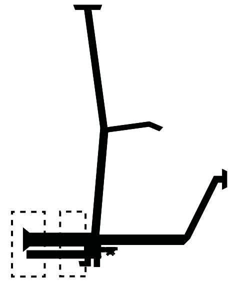
- K-Array Lyzard-KZ14
ceiling mounted (surface mount) : (Tunnel 01, @ 2.5m FFL); (Tunnel 02, height varies: follows ceiling/inclined floor)

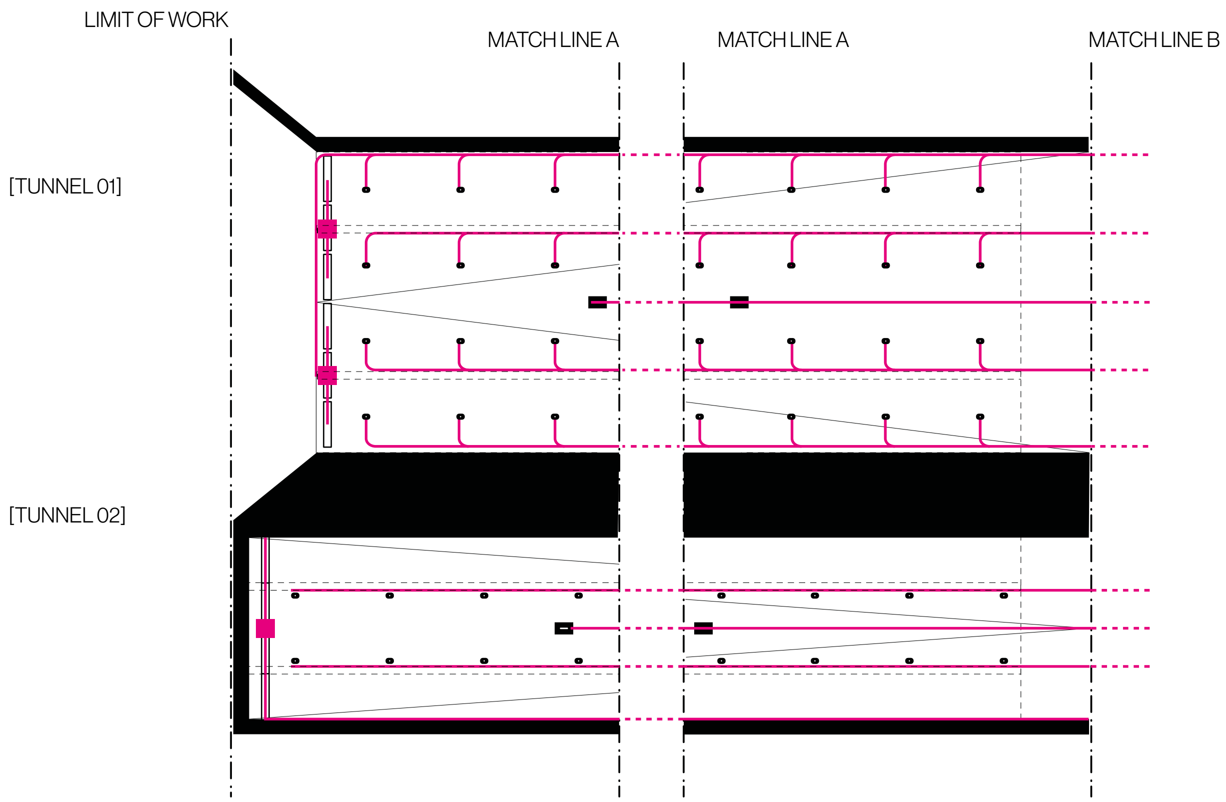
Panphonics Sound Shower 120cmx20cm
ceiling mounted (suspended): (Tunnel 01, @ 2.35m); (Tunnel 02, @ 2.5m)

K-Array Rumble-KU26
ceiling mounted (surface mount) : (Tunnel 01, @ 2.5m FFL); (Tunnel 02, height varies: follows ceiling/inclined floor)



/ TUNNELS 01 & 02 - CABLE ROUTING PLAN

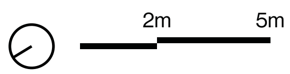




INCUBATOR - TUNNEL 01 AND TUNNEL 02

Lines represent cable conduits/
trunks containing multiple circuits
100V distribution line

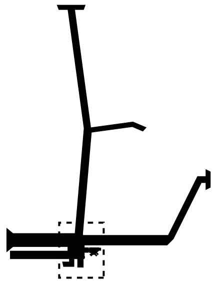
AA160 Basic Audio Element- 160 x 160 x 48 mm
(8 units)

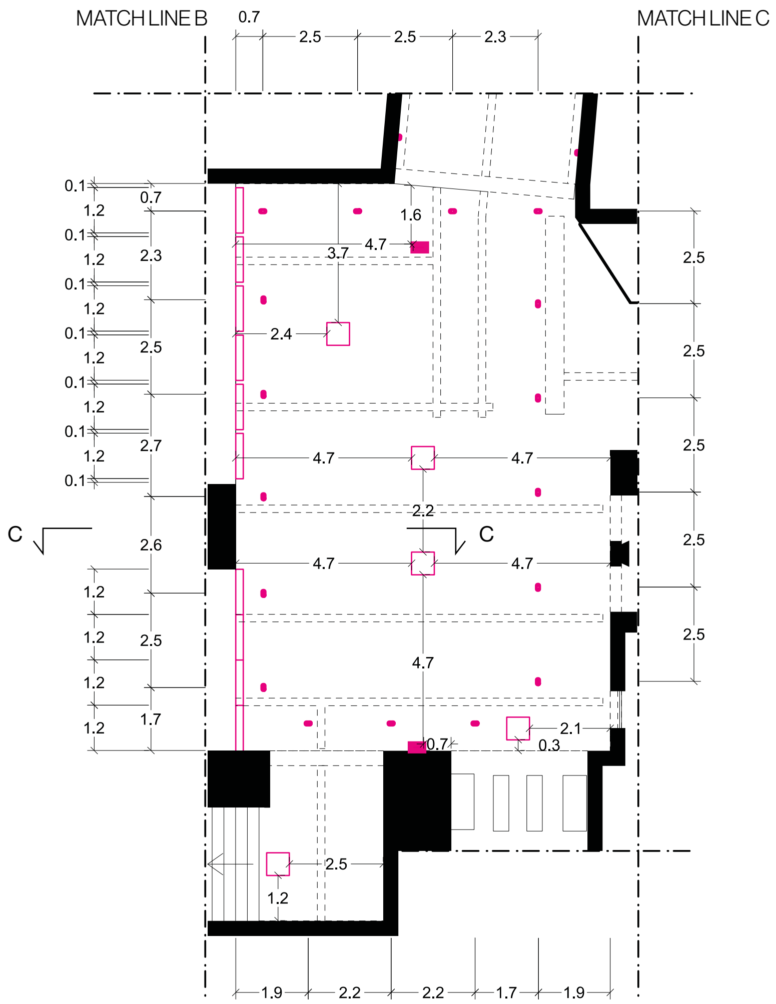


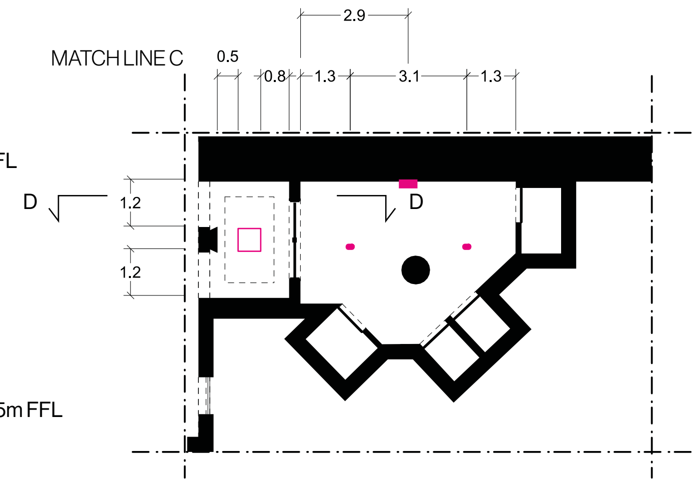
ROUTING SPECS (TUNNELS 01 -02 - CORE)

- K-ARRAY LYZARD-KZ14 (NODAL DISTRIBUTION)
Signal logistics: Signal travels via Ethernet backbones (Dante protocol) from the central rack to local relay nodes.
Relay nodes: No relay nodes.
Terminal cabling: Micro-bipolar cables branch out from each node to the speakers (bundle section: 6 - 8 cm^2).
Mounting position: Installed adjacent to ceiling lighting tracks or integrated into the ceiling-wall corners.
- PANPHONICS SOUND SHOWER (CORE CLUSTER)
Cabling: 1 x Cat6 cable (Dante) from rack to driver unit + power link to panel.
Mounting position: "Sandwich" installation hidden directly above the suspended acoustic panel in the central core.
- K-ARRAY RUMBLE (LOW FREQUENCY)
Cabling: Direct run from central rack using high-gauge bipolar audio cable (2.5mm^2 per unit).
Routing: Cables follow the linear ceiling lighting tracks to minimize visual impact.

/ CORE - PLAN





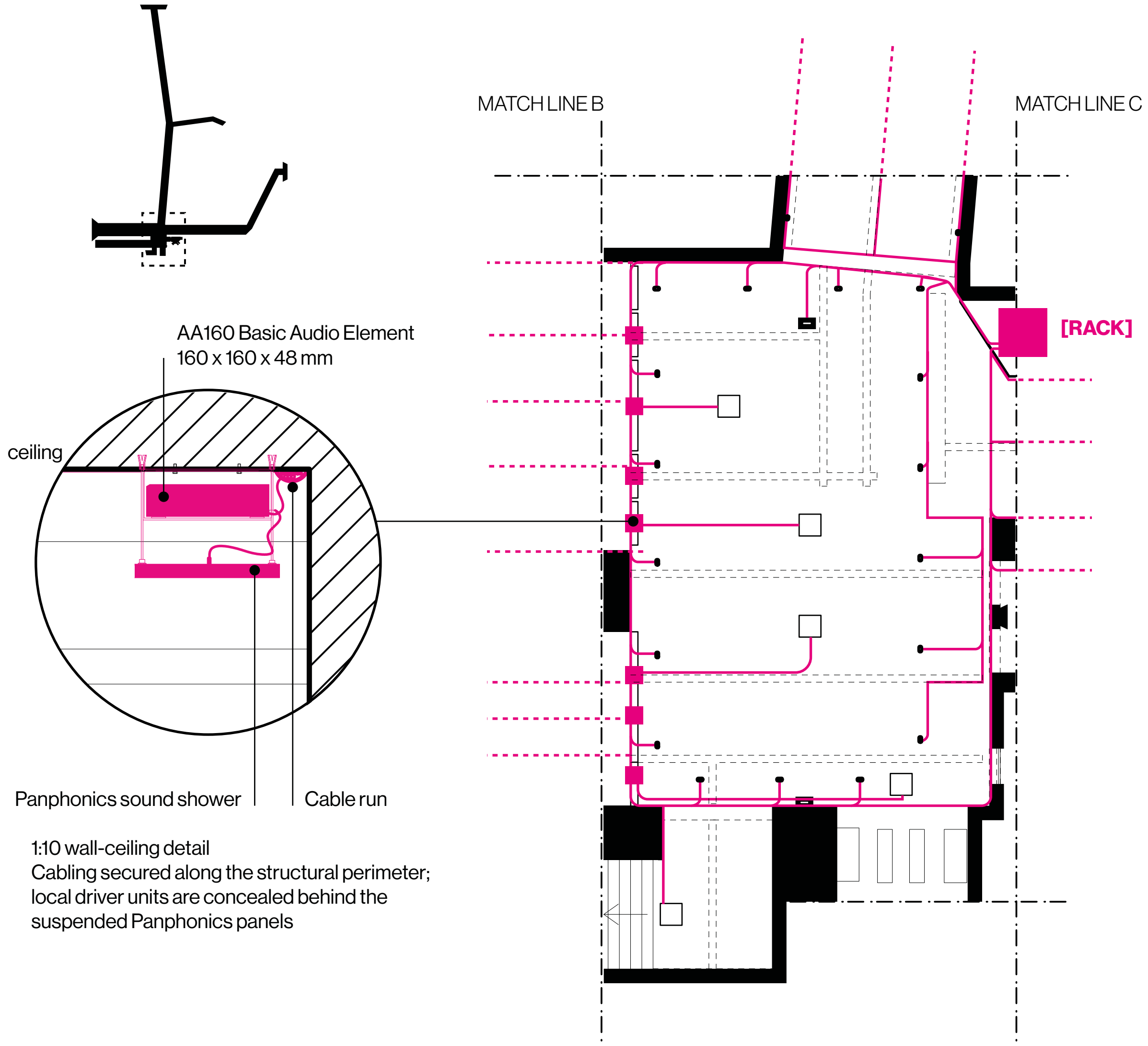


CORE AND TOILETS

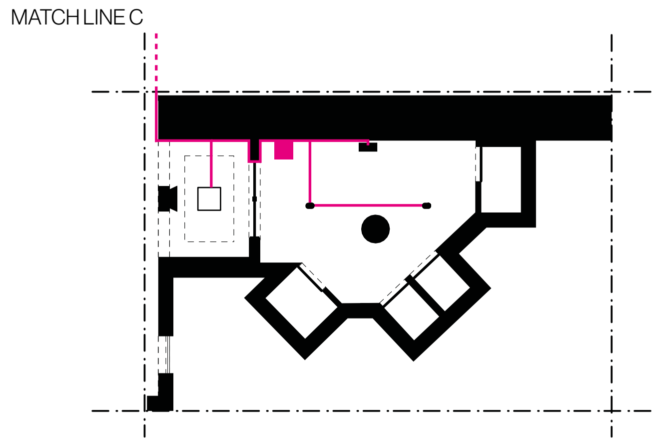
- K-Array Lyzard-KZ14 ceiling mounted (surface mount) : @ 2.5m FFL
- Panphonics Sound Shower 120cmx20cm ceiling mounted (suspended): @ 2.35m
- Panphonics Sound Shower 60cmx60cm ceiling mounted (surface mount): @ 2.5m
- K-Array Rumble-KU26 Core: ceiling mounted (surface mount) @ 2.5m FFL Toilets: wall mounted @ 2.5m (top edge)

2m 5m

/ CORE - CABLE ROUTING PLAN



1:10 wall-ceiling detail
Cabling secured along the structural perimeter; local driver units are concealed behind the suspended Panphonics panels

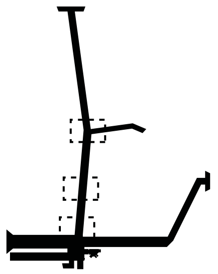


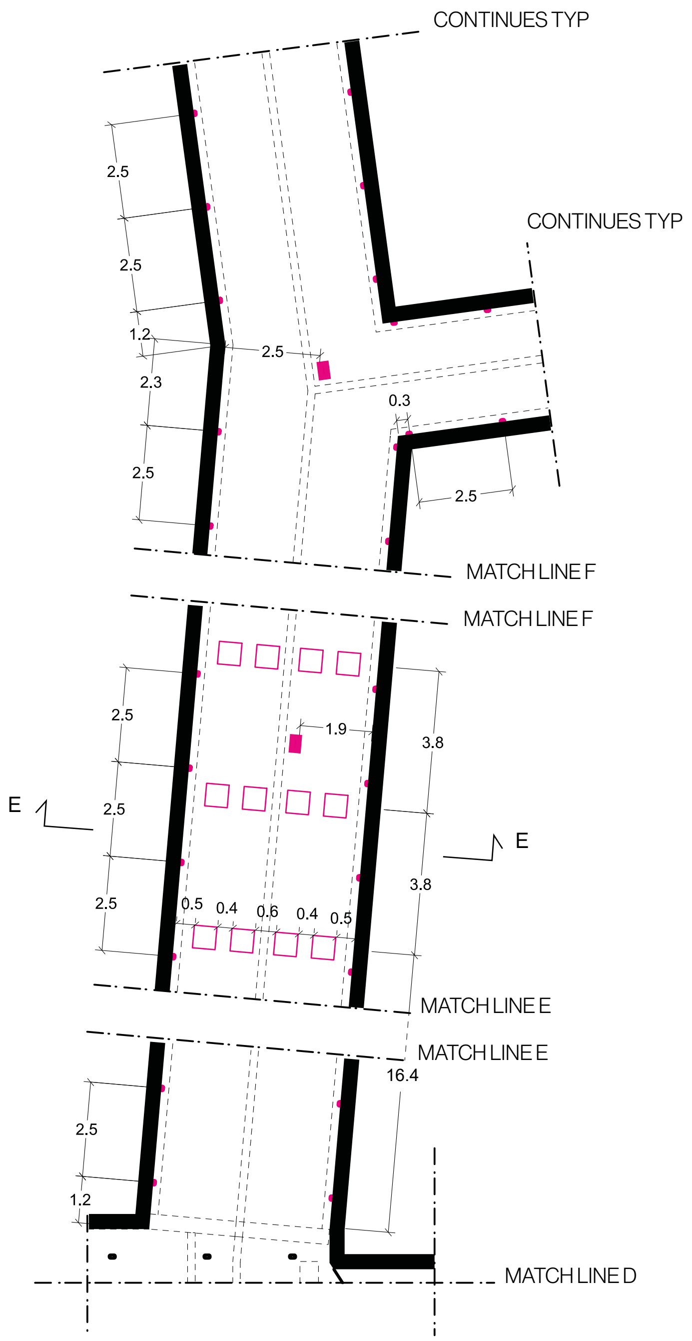
CORE AND TOILETS

- Lines represent cable conduits/ trunks containing multiple circuits 100V distribution line
- AA160 Basic Audio Element- 160 x 160 x 48 mm (8 units)

2m 5m

/ TUNNEL 03 - PLAN



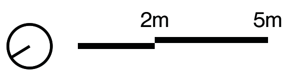


TUNNEL 03 -
INTERSECTION WITH T03A AND T03B

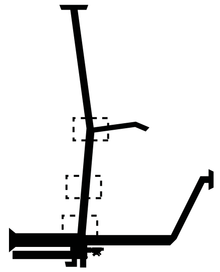
K-Array Lyzard-KZ14
wall mounted: @ 2m FFL

Panphonics Sound Shower 60cmx60cm
ceiling mounted (surface mount): @ 2.5m
(Partial representation shown.
Total installation comprises 8 identical
rows with constant spacing).

K-Array Rumble-KU26
ceiling mounted (surface mount) @ 2.5m FFL (constant spacing: 20m)

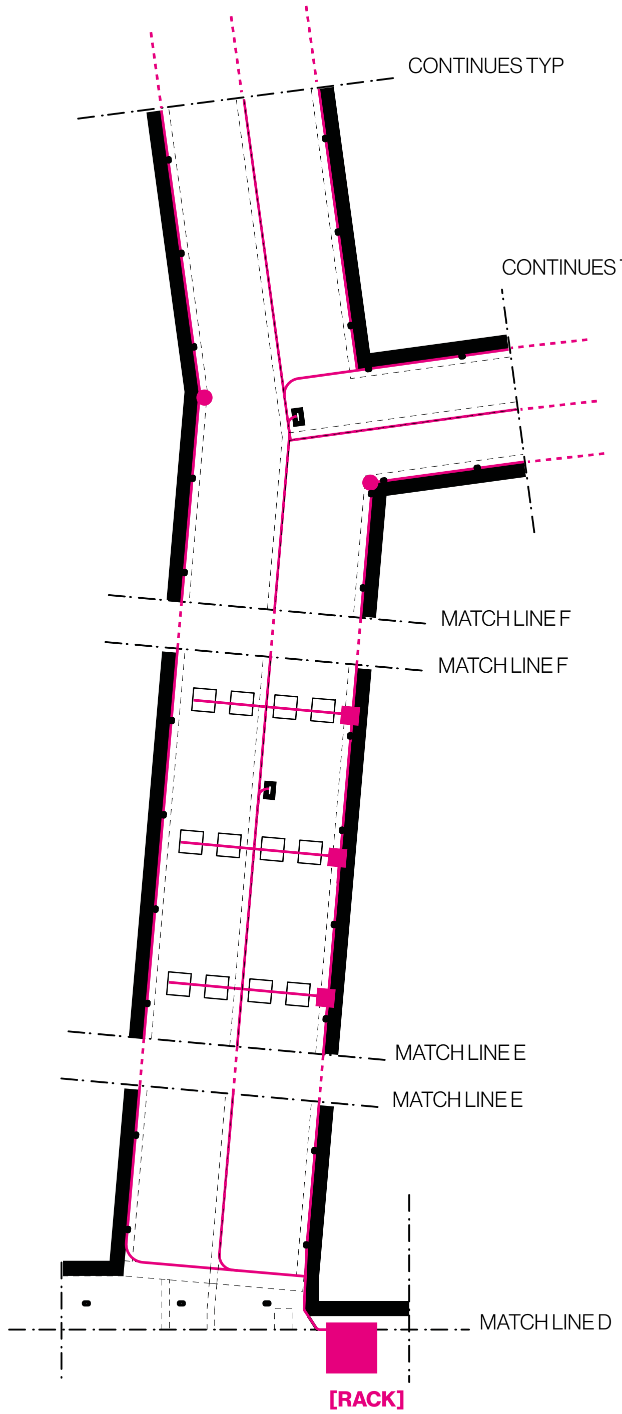


/ TUNNELS 03 - CABLE ROUTING PLAN



ROUTING SPECS (TUNNELS 03 - 04)

- K-ARRAY LYZARD-KZ14 (WALL INTEGRATION)
Signal logistics: Distributed via Ethernet backbones (Dante) extending from the main loops.
Relay nodes: Local KA02 amplifiers positioned every 50m (approx. 40-50 speakers per node).
Terminal cabling: Micro-bipolar cables routed through the wall channels.
Mounting position: Recessed and concealed directly beneath the horizontal wall signage strips.
- PANPHONICS SOUND SHOWER
Cabling: 1 x Cat6 cable (Dante) routed through the architectural wall voids, above the signage strip.
Driver unit positioning: Concealed within the structural hollow space immediately above the signage strip.
Mounting position: Concealed within the structural hollow space immediately above the signage strip (behind driver unit).
- K-ARRAY RUMBLE (LOW FREQUENCY)
Cabling: Direct run from central rack using high-gauge bipolar audio cable (2.5mm² per unit).
Routing: Cables follow the linear ceiling lighting tracks to minimize visual impact.

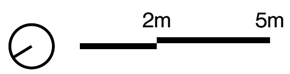


TUNNEL 03 -
INTERSECTION WITH T03A AND T03B

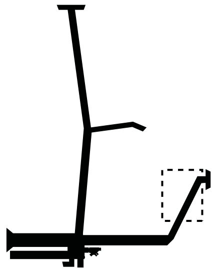
Lines represent cable conduits/
trunks containing multiple circuits
100V distribution line

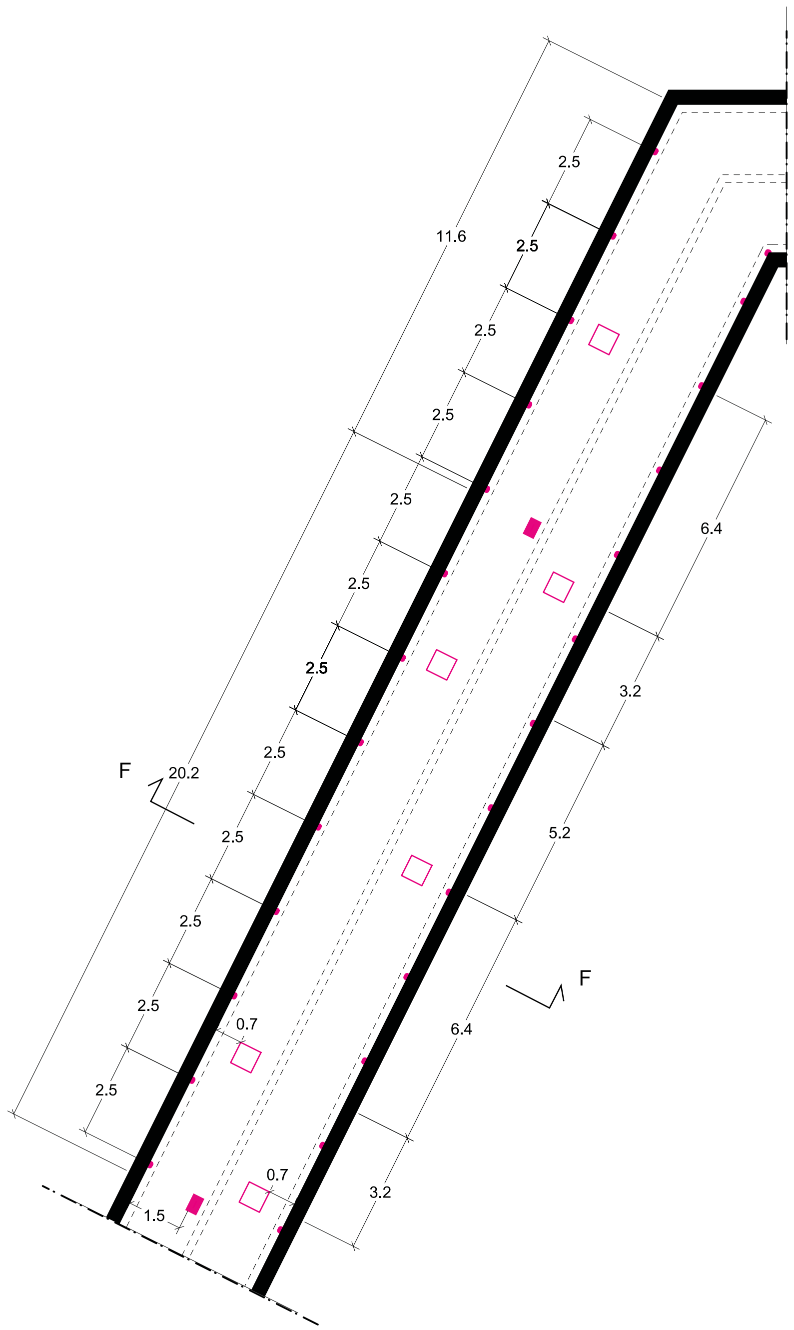
AA160 Basic Audio Element - 160 x 160 x 48 mm
(8 units)

K-Array Kommander-KA02 I - 219 x 45,5 x 170 mm
(1 every 40 devices, Lyzard - KZ14)



/ TUNNELS 04 - PLAN





TUNNEL 04

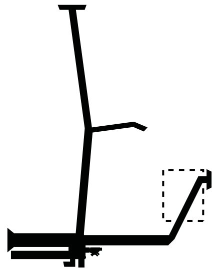
K-Array Lyzard-KZ14
wall mounted: @ 2m FFL

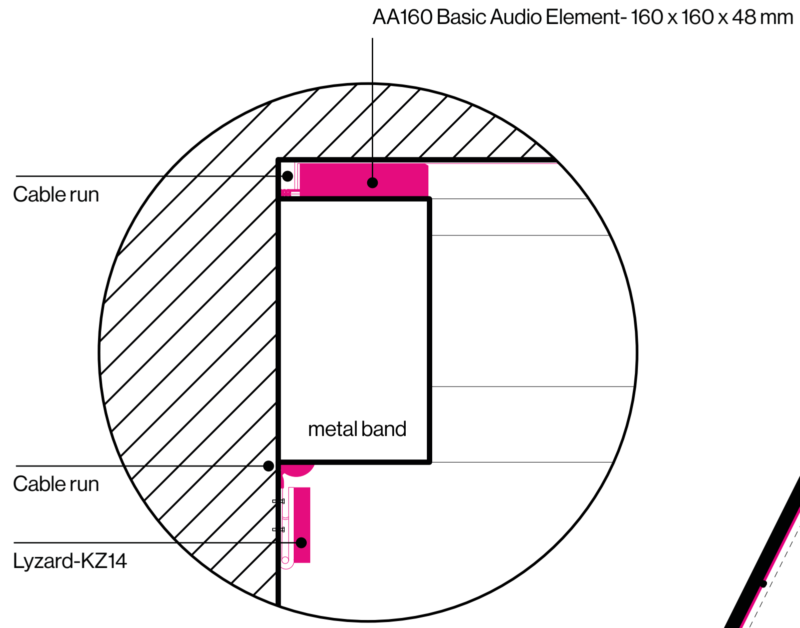
Panphonics Sound Shower 60cmx60cm
ceiling mounted (surface mount): @ 2.5m

K-Array Rumble-KU26
ceiling mounted (surface mount) @ 2.5m FFL (constant spacing: 20m)

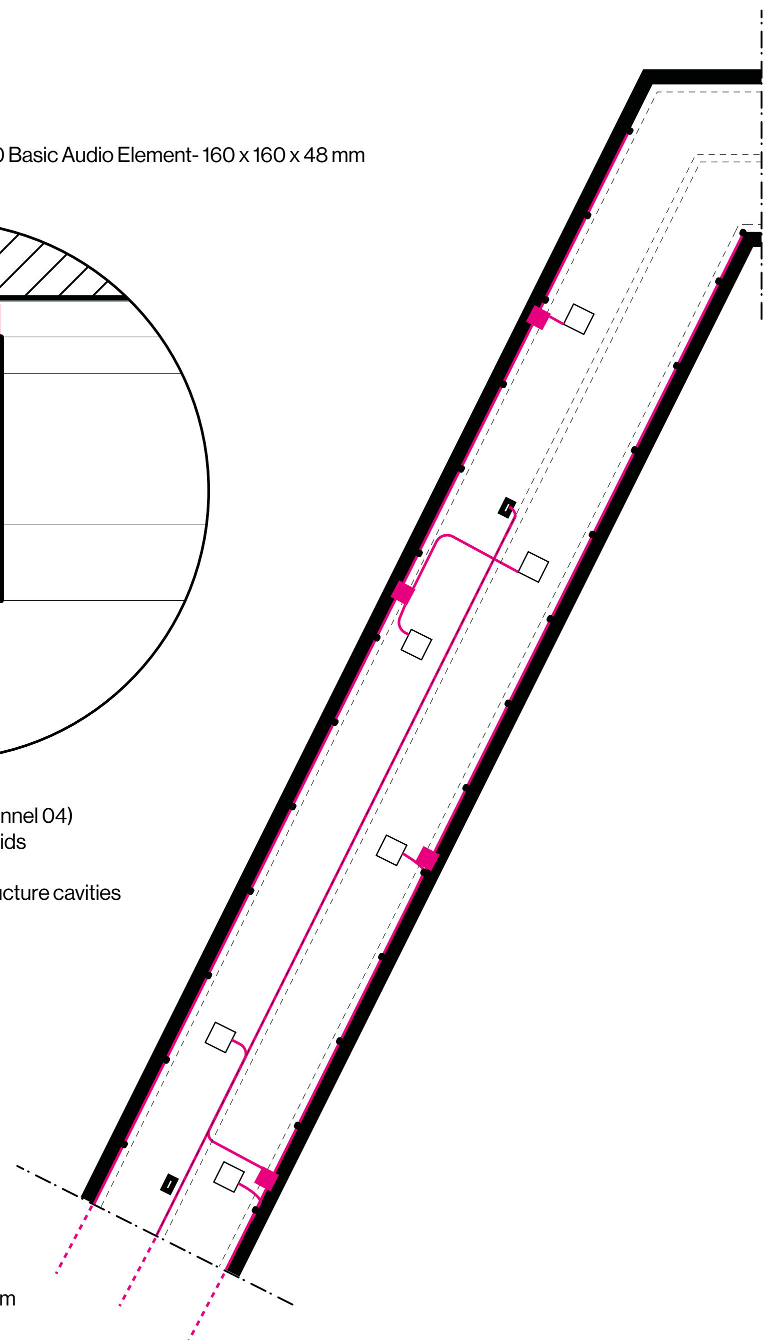
2m 5m

/ TUNNELS 04 - CABLE ROUTING PLAN





1:10 wall-ceiling detail (TYP Tunnel 03 and Tunnel 04)
Cabling routed through existing structural voids
and masked by architectural elements;
local drivers are recessed within the infrastructure cavities



TUNNEL 04

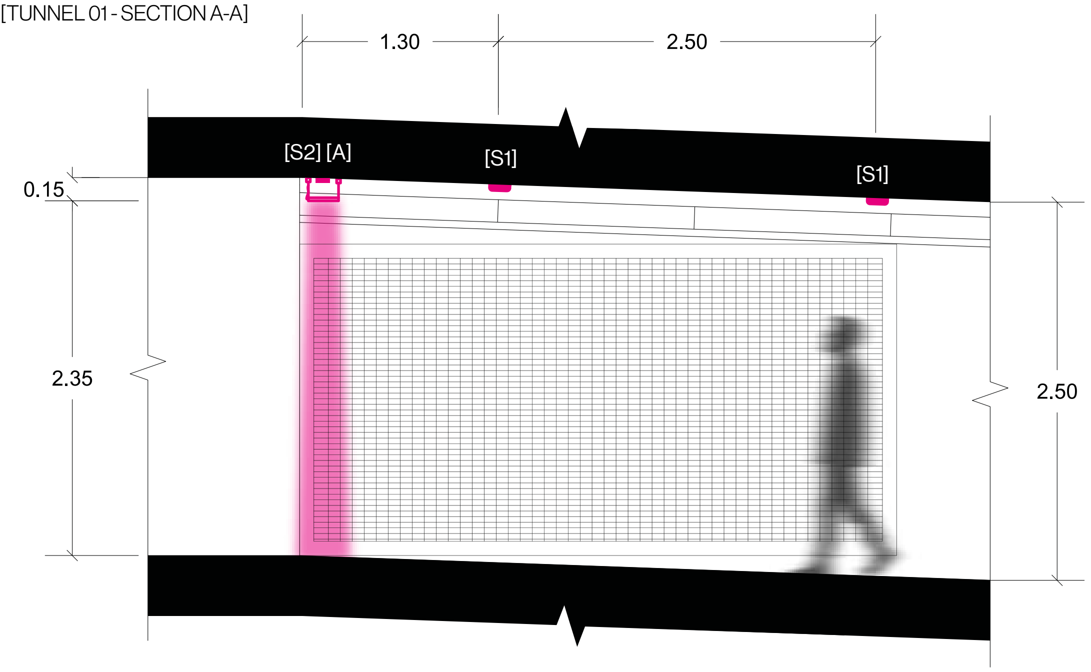
Lines represent cable conduits/
trunks containing multiple circuits
100V distribution line

AA160 Basic Audio Element- 160 x 160 x 48 mm
(4 units)

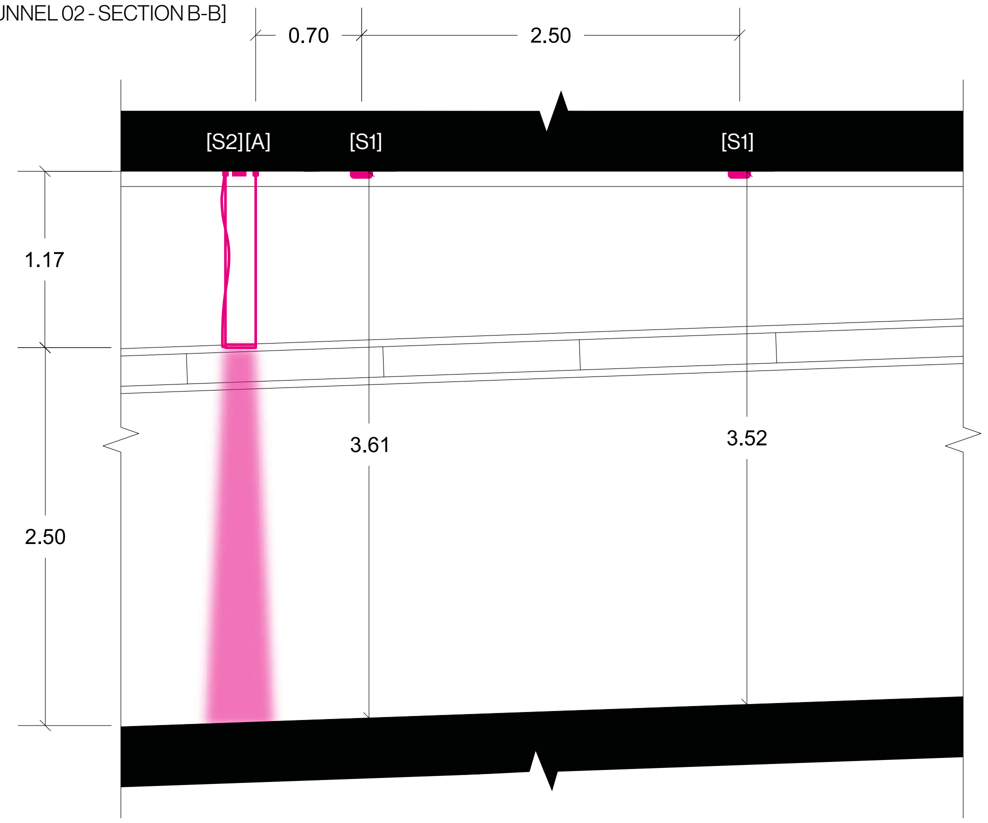
2m 5m

/ TUNNELS 01 & 02 -SECTIONS

[TUNNEL 01 - SECTION A-A]



[TUNNEL 02 - SECTION B-B]

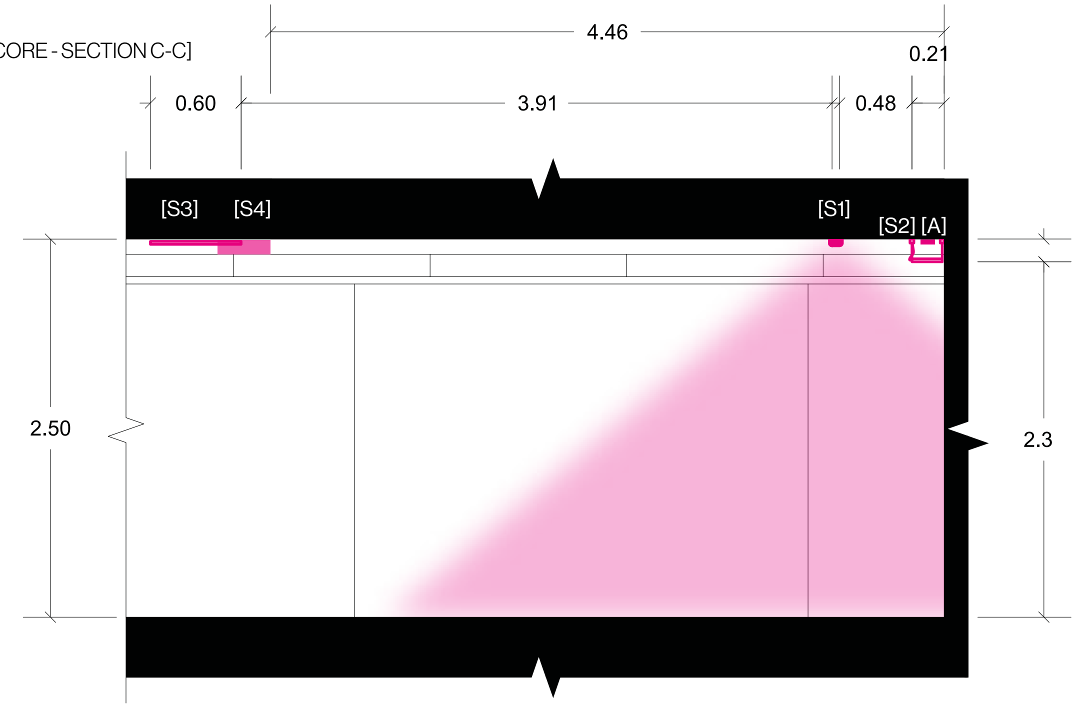


1m 2m

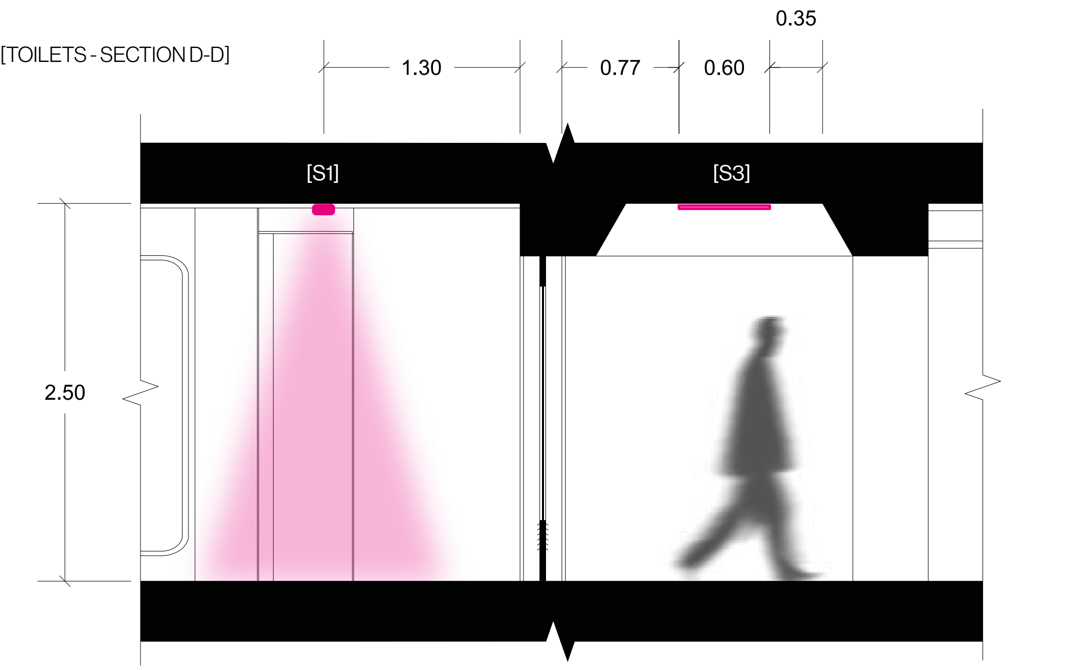
[S1] K-Array Lyzard-KZ14
[S2] Panphonics Sound Shower 120cmx20cm
[A] AA160 Basic Audio Element - 160 x 160 x 48 mm

/ CORE & TOILETS -SECTIONS

[CORE - SECTION C-C]



[TOILETS - SECTION D-D]

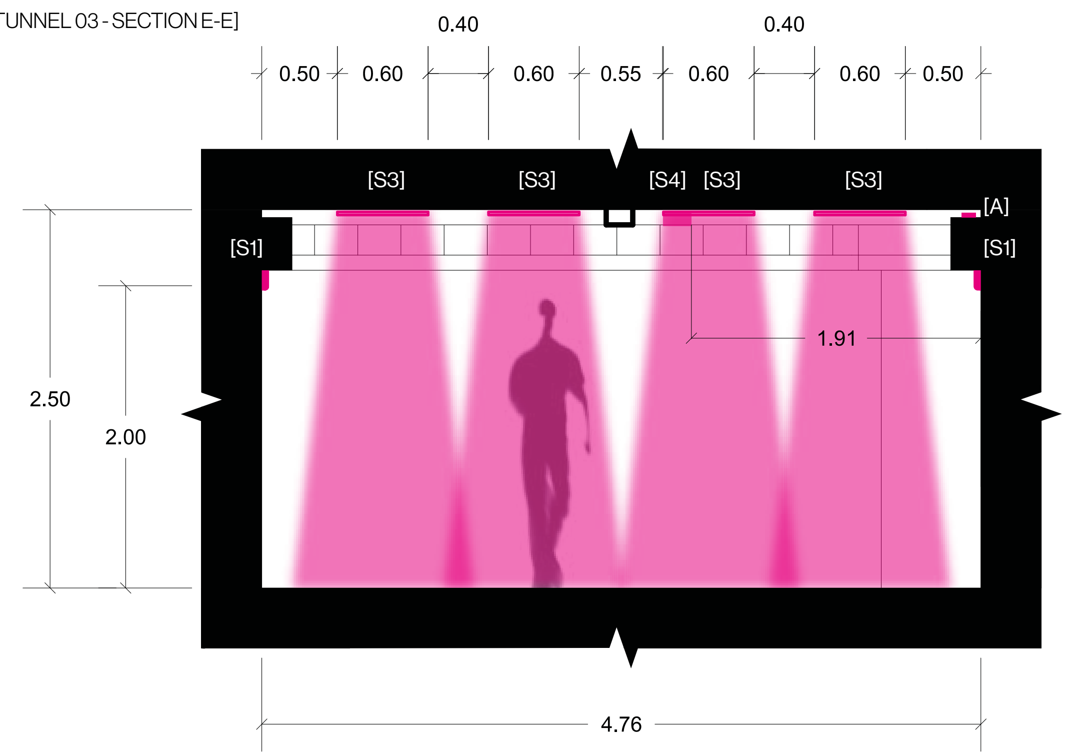


1m 2m

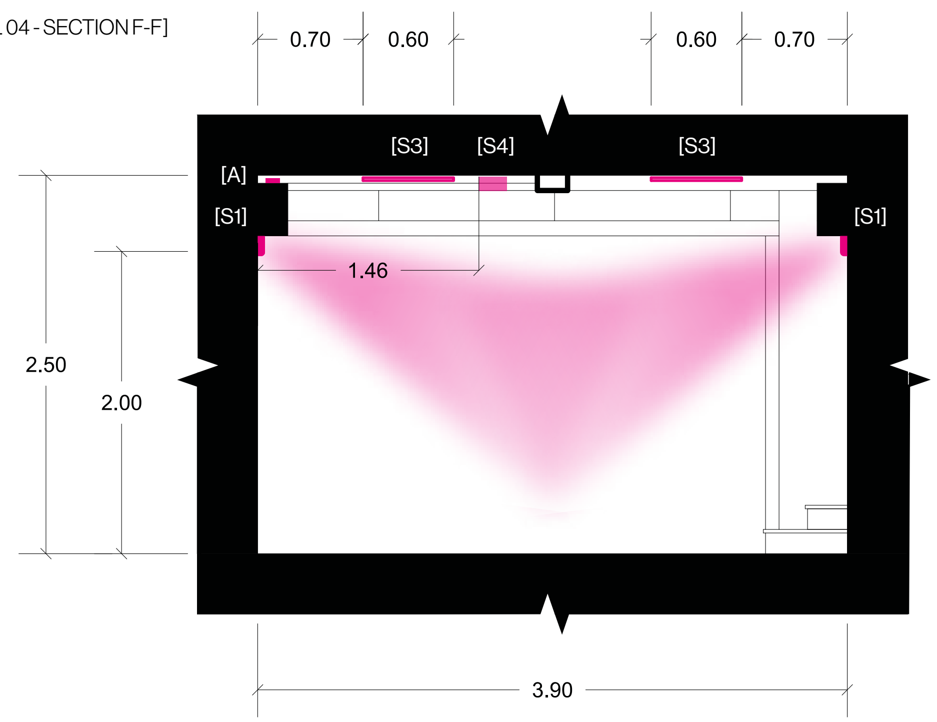
[S1] K-Array Lyzard-KZ14
[S2] Panphonics Sound Shower 120cmx20cm
[S3] Panphonics Sound Shower 60cmx60cm
[S4] K-Array Rumble-KU26
[A] AA160 Basic Audio Element - 160 x 160 x 48 mm

/ TUNNELS 03 & 04 - SECTIONS

[TUNNEL 03 - SECTION E-E]



[TUNNEL 04 - SECTION F-F]



[S1] K-Array Lyzard-KZ14

[S3] Panphonics Sound Shower 60cmx60cm

[S4] K-Array Rumble-KU26

[A] AA160 Basic Audio Element - 160 x 160 x 48 mm

1m 2m

/ GLASSHOUSES - MASTERPLAN

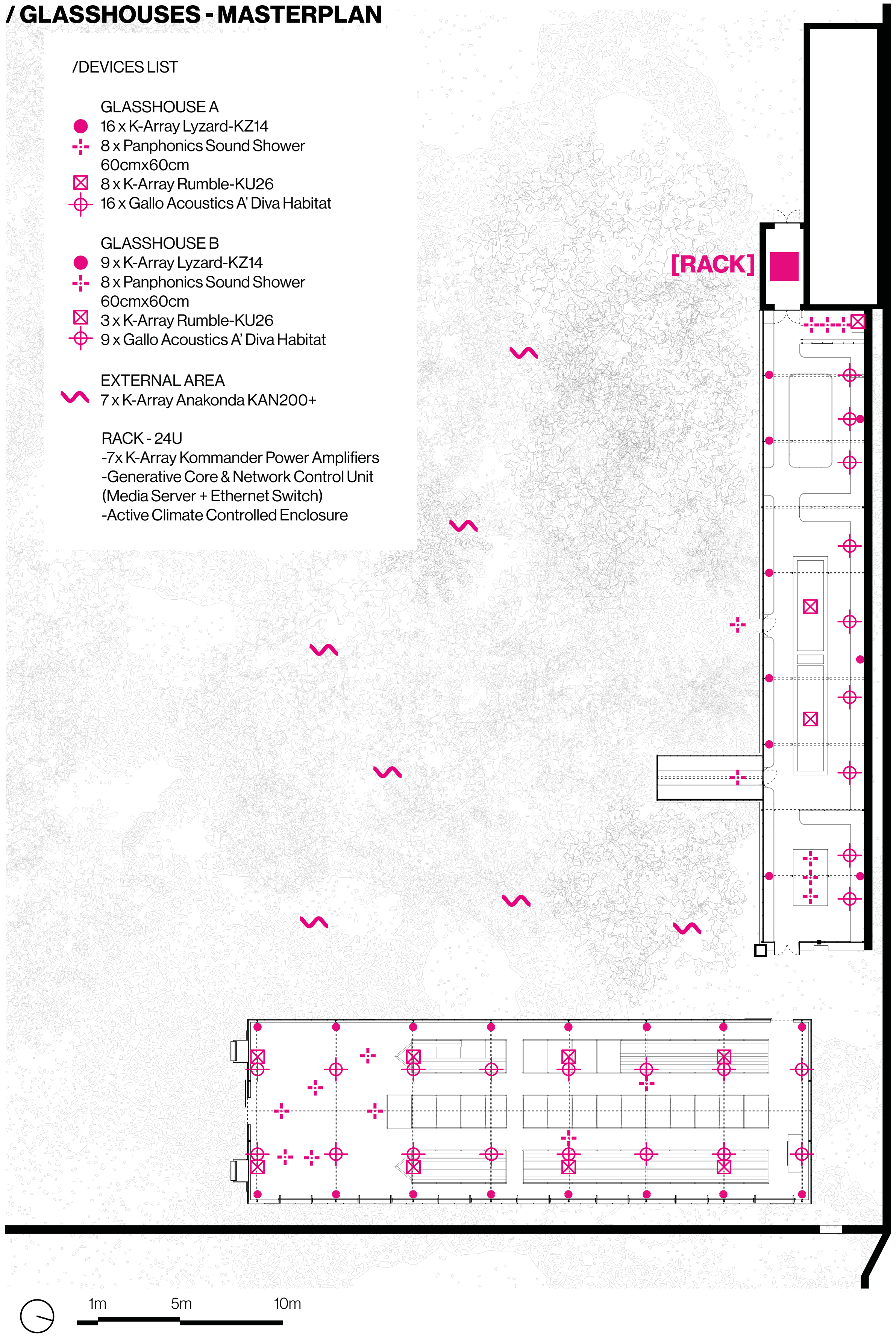
/DEVICES LIST

GLASSHOUSE A
16 x K-Array Lyzard-KZ14
8 x Panphonics Sound Shower 60cmx60cm
8 x K-Array Rumble-KU26
16 x Gallo Acoustics A' Diva Habitat

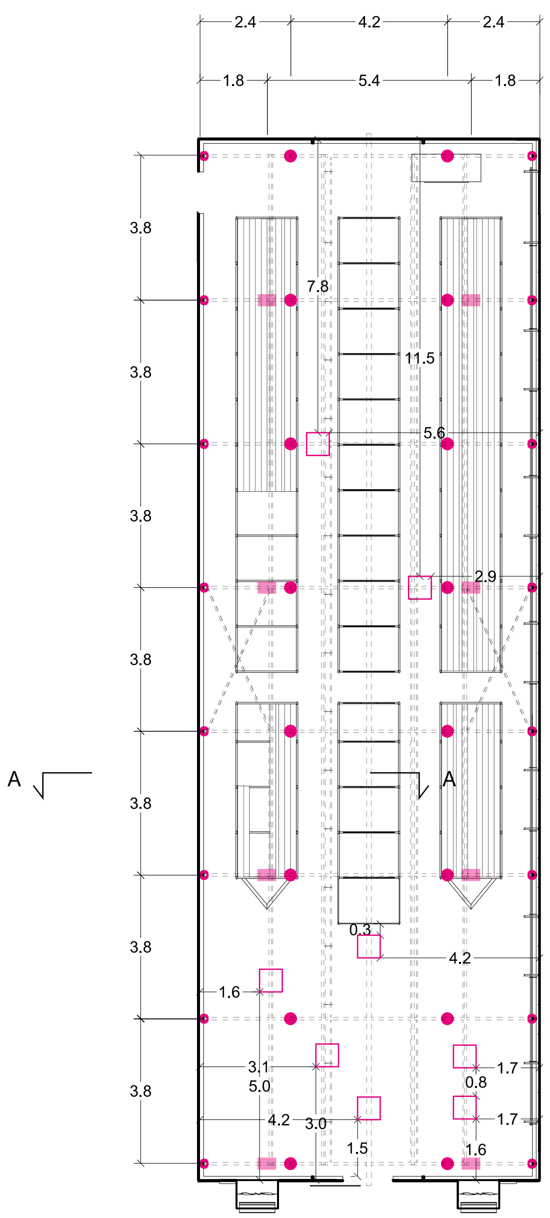
GLASSHOUSE B
9 x K-Array Lyzard-KZ14
8 x Panphonics Sound Shower 60cmx60cm
3 x K-Array Rumble-KU26
9 x Gallo Acoustics A' Diva Habitat

EXTERNAL AREA
7 x K-Array Anakonda KAN200+

RACK - 24U
-7x K-Array Kommander Power Amplifiers
-Generative Core & Network Control Unit (Media Server + Ethernet Switch)
-Active Climate Controlled Enclosure



/ GLASSHOUSE A - PLAN



GLASSHOUSE A

- K-Array Lyzard-KZ14
  column mounted: @ 1.4m FFL
- Gallo Acoustics A' Diva Habitat
  ceiling mounted (suspended): @ 3m
- K-Array Rumble-KU26
  floor mounted
- Panphonics Sound Shower 60cmx60cm
  ceiling mounted (suspended): @ 2.5m

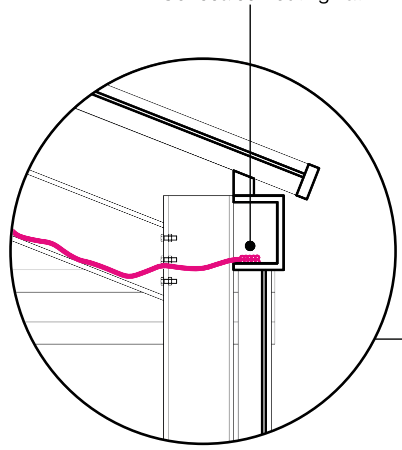
2m 5m

/ GLASSHOUSE A - CABLE ROUTING PLAN

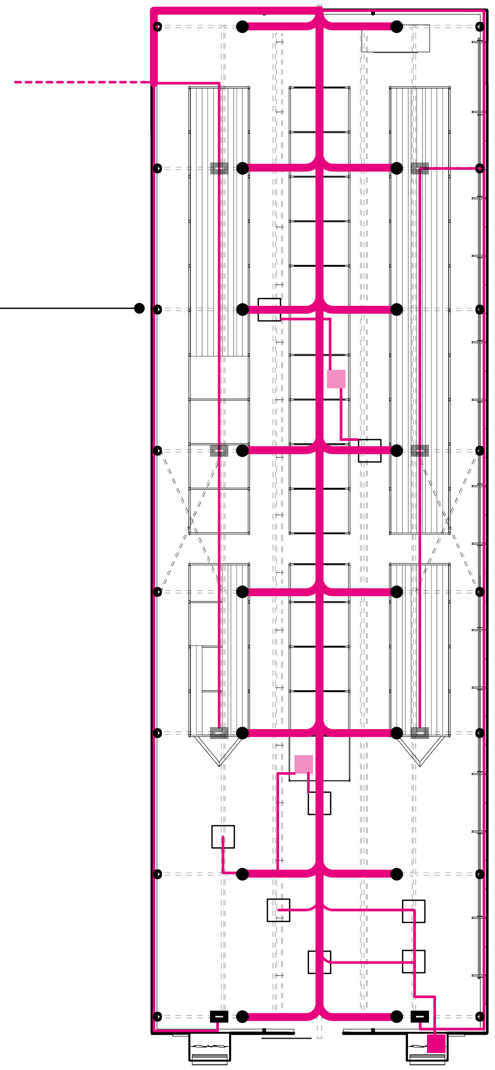
ROUTING SPECS (GLASSHOUSES A - B)

- K-ARRAY LYZARD-KZ14
Signal logistics: Point-to-point connection via direct cabling from the main central rack. No local relay nodes required.
Routing (glasshouse A): Cables are threaded through the hollow cavities of the main structural beams, utilizing the architectural voids.
Routing (glasshouse B): Cabling runs visibly along secondary metal profiles, following the industrial skeleton of the frame.
Mounting position: Integrated strictly onto the structural elements to blend with the mechanical layer of the greenhouse.
- GALLO ACOUSTICS A'DIVA
Signal logistics: High-impedance direct connection from the central rack.Terminal cabling: High-gauge bipolar audio cables (2x 4mm^2) serve simultaneously as signal transmission and visible structural suspension.
Mounting position: Suspended from the trusses with a vertical drop.
- PANPHONICS SOUND SHOWER
Amplification: Dedicated driver units housed in IP66-rated weather-resistant junction boxes.
Mounting position (glasshouse A): Junction boxes positioned beneath cultivation benches or inside the existring technical elements (fans) .
Mounting position (glasshouse B): Junction boxes concealed within the planters, covered by the vegetation layer.
Cable aesthetic: Cabling remains exposed along the framework, emphasizing the visible technological intervention.
- K-ARRAY RUMBLE (LOW FREQUENCY)
Cabling: High-gauge bipolar audio cable (2.5mm^2) for low-frequency transmission.
Routing (glasshouse A): Wired horizontally beneath the cultivation benches to maintain clear walkways.
Routing (glasshouse B): Vertical drop cabling from the overhead structure, descending directly into the basins.

Concealed Routing Path



1:10 joint detail
Pass-through cabling within structural voids

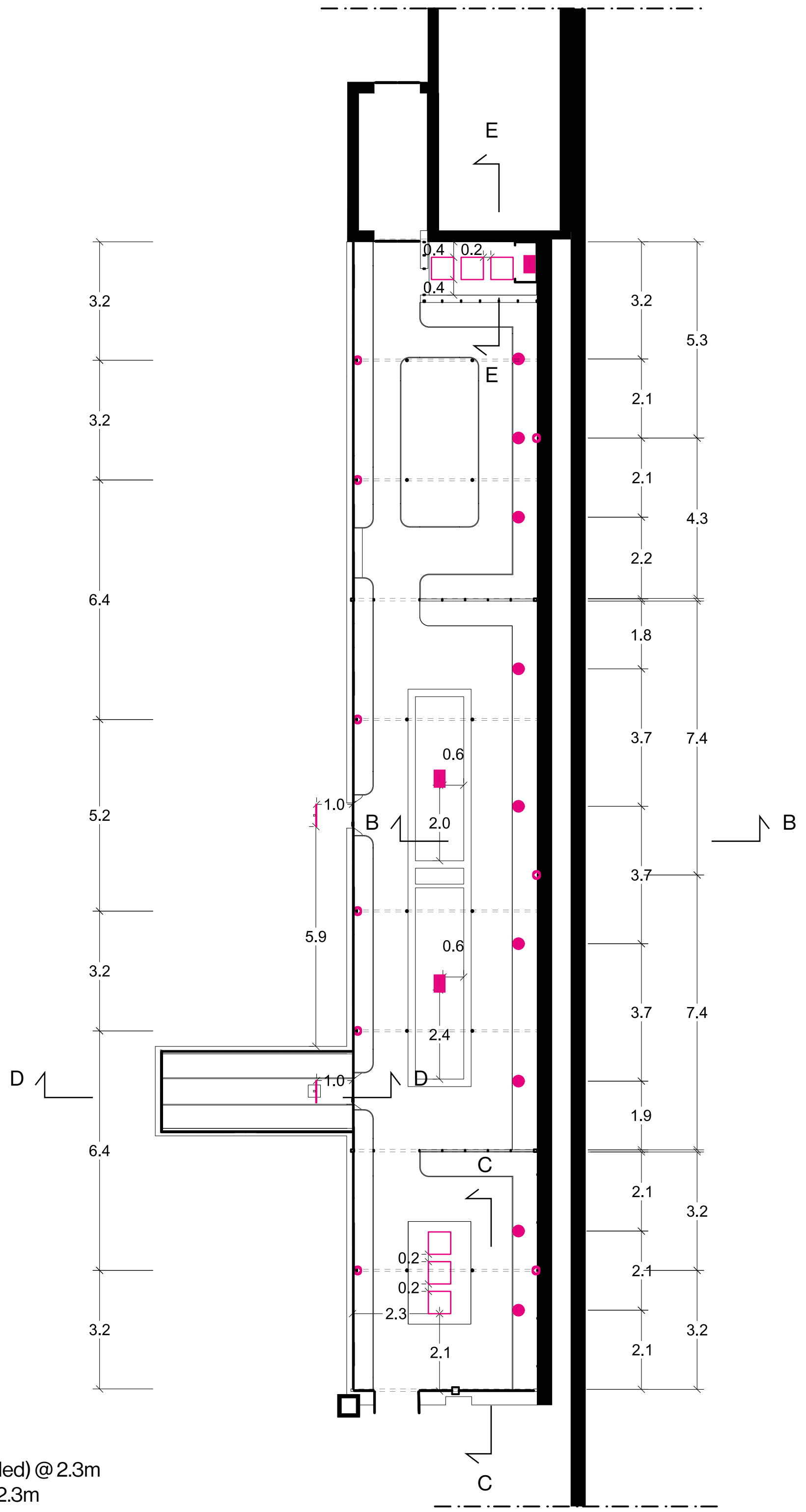


GLASSHOUSE A

- Lines represent cable conduits/
  trunks containing multiple circuits
  100V distribution line
- Lines represent cable conduits/
  trunks containing multiple circuits- 2x4mm² low-loss cables
  required for runs > 30m (only for Gallo Habitat)
- AA160 Basic Audio Element- 160 x 160 x 48 mm (3 units)
  (with IP66 weatherproof eclosure polycarbonate
  junction box with sealed cable glands to
  protect AA160 driver from humidity and condensation)

2m 5m

/ GLASSHOUSE B - PLAN

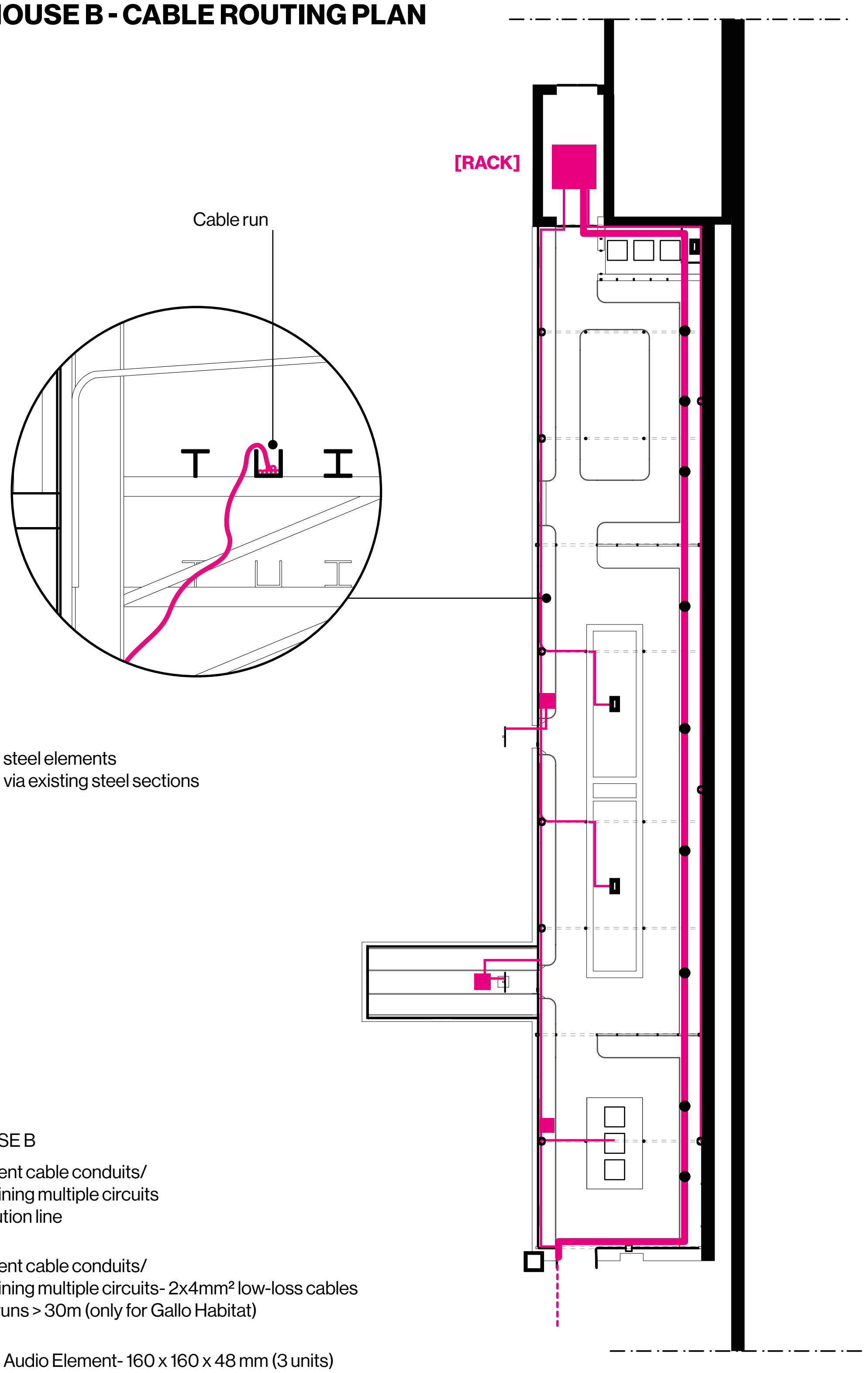


GLASSHOUSE A

- K-Array Lyzard-KZ14
  column mounted: @ 1.4m FFL (glazed wall)
  wall mounted: @ 1.7m FFL (concrete wall)
- Gallo Acoustics A' Diva Habitat
  ceiling mounted (suspended): @ 3.4m
- K-Array Rumble-KU26
  floor mounted
- Panphonics Sound Shower 60cmx60cm
  entrance space: ceiling mounted (suspended) @ 2.3m
  cabin: ceiling mounted (surface mount) @ 2.3m
- Panphonics Sound Shower 60cmx60cm
  floor stand mounted: bottom edge @ 1.1 m

2m 5m

/ GLASSHOUSE B - CABLE ROUTING PLAN



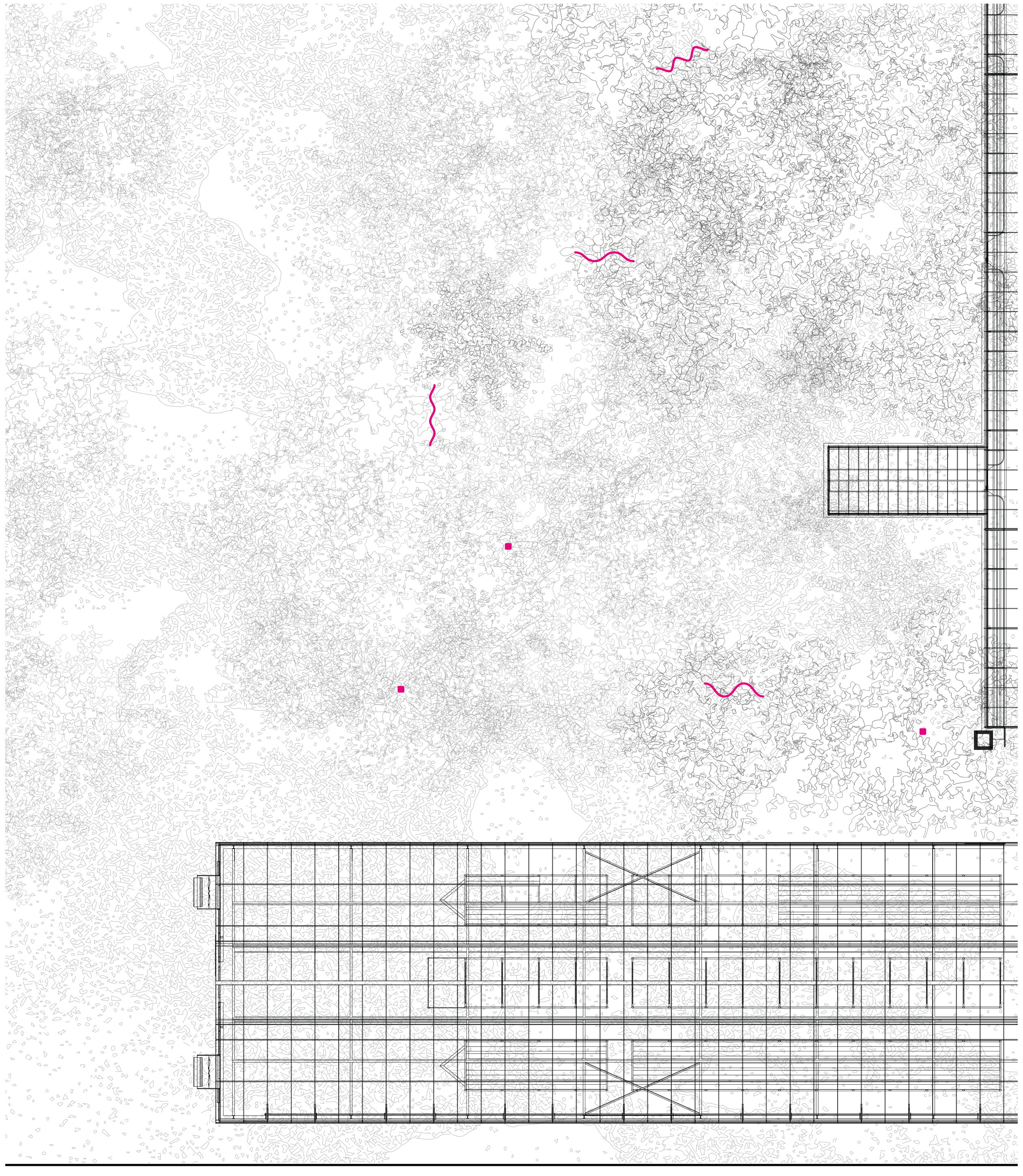
1:10 secondary steel elements
Cabling routed via existing steel sections

GLASSHOUSE B

- Lines represent cable conduits/
  trunks containing multiple circuits
  100V distribution line
- Lines represent cable conduits/
  trunks containing multiple circuits- 2x4mm² low-loss cables
  required for runs > 30m (only for Gallo Habitat)
- AA160 Basic Audio Element- 160 x 160 x 48 mm (3 units)
  (with IP66 weatherproof eclosure polycarbonate
  junction box with sealed cable glands to
  protect AA160 driver from humidity and condensation)

2m 5m

/ GLASSHOUSES (EXTERNAL AREA) - PLAN

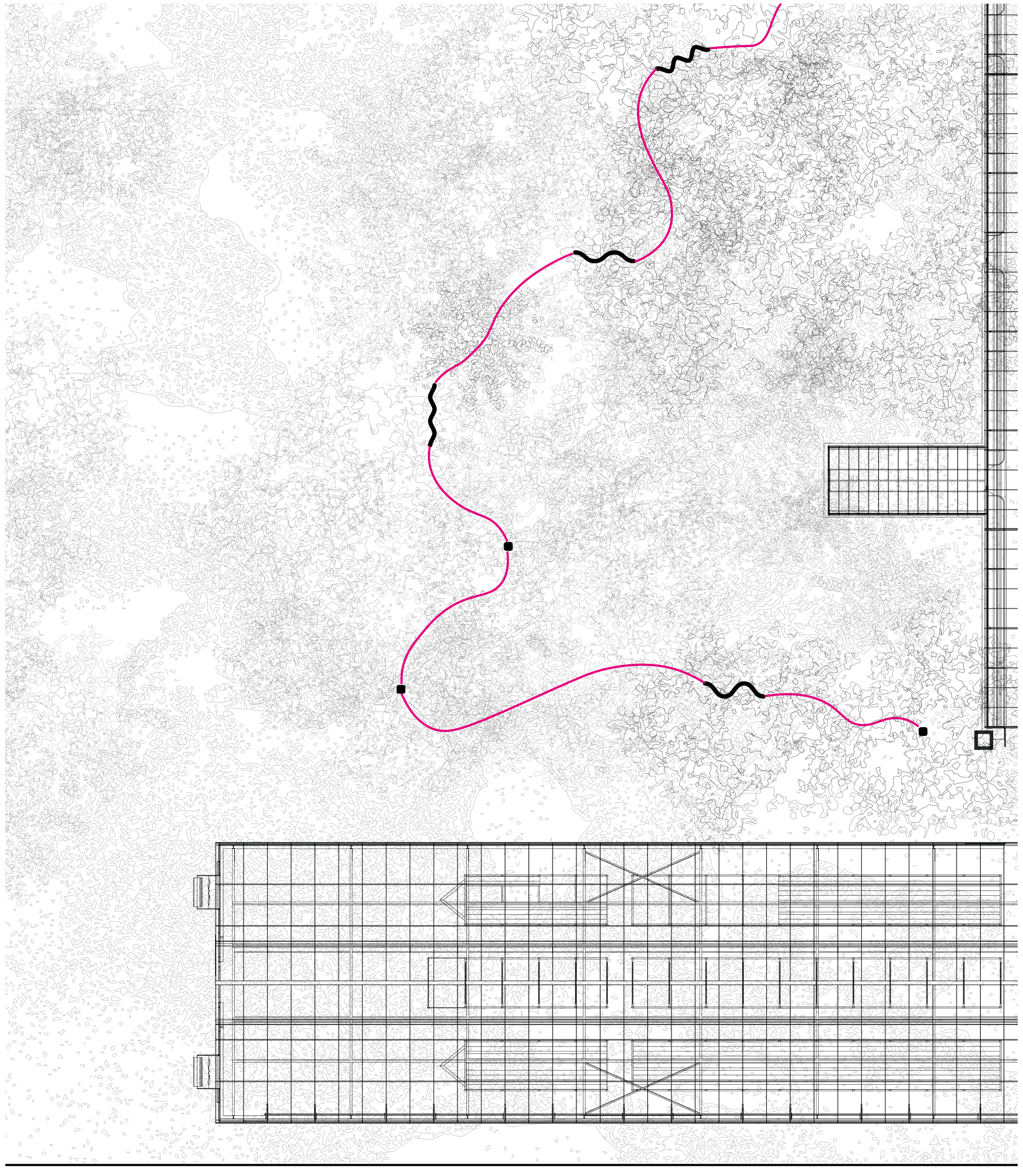


EXTERNAL AREA

K-Array Anakonda KAN200+
wrapped around or suspended on existing trees/structures
layout shown is indicative; final positioning to be verified on-site

2m 5m

/ GLASSHOUSES (EXTERNAL AREA) - CABLE ROUTING PLAN



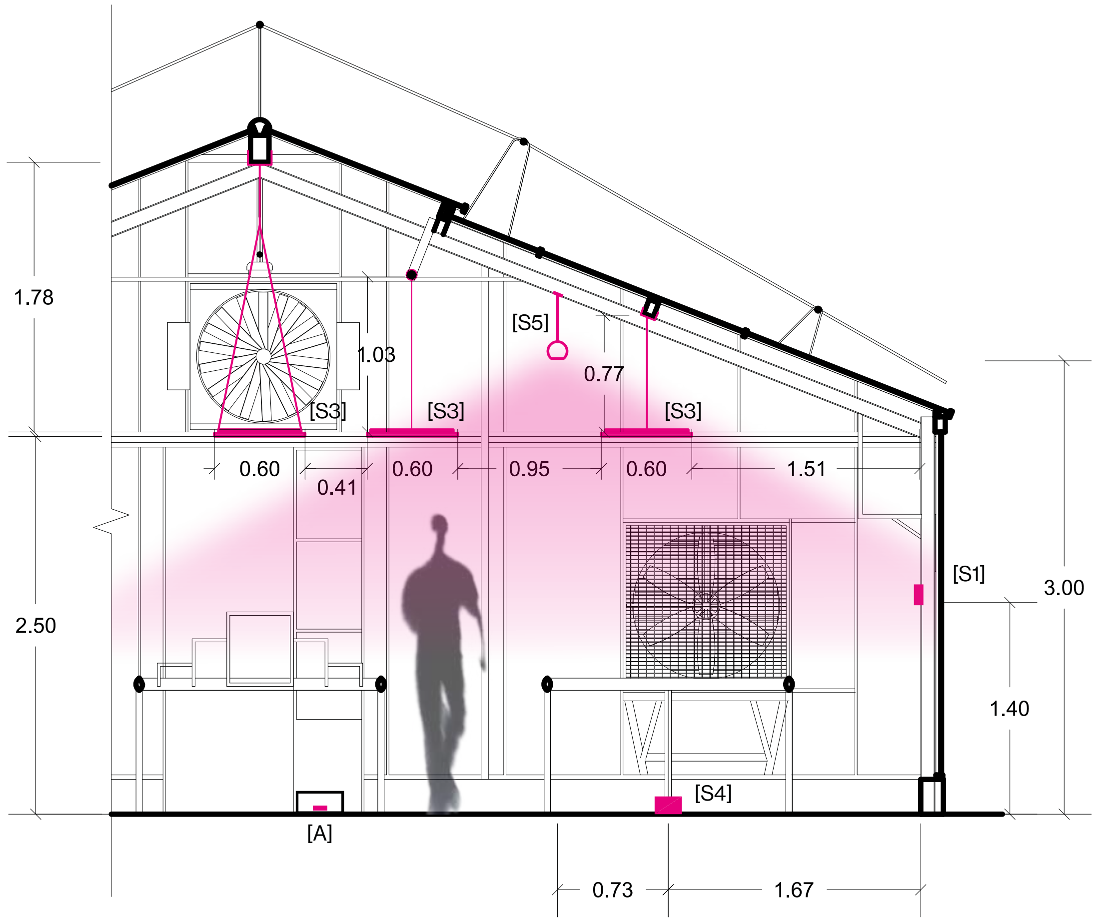
EXTERNAL AREA

continuous array line modules
interlinked directly to form a single, flexible sound strip
100V distribution line

2m 5m

/ GLASSHOUSE A -SECTION

[GLASSHOUSE A - SECTION A-A]

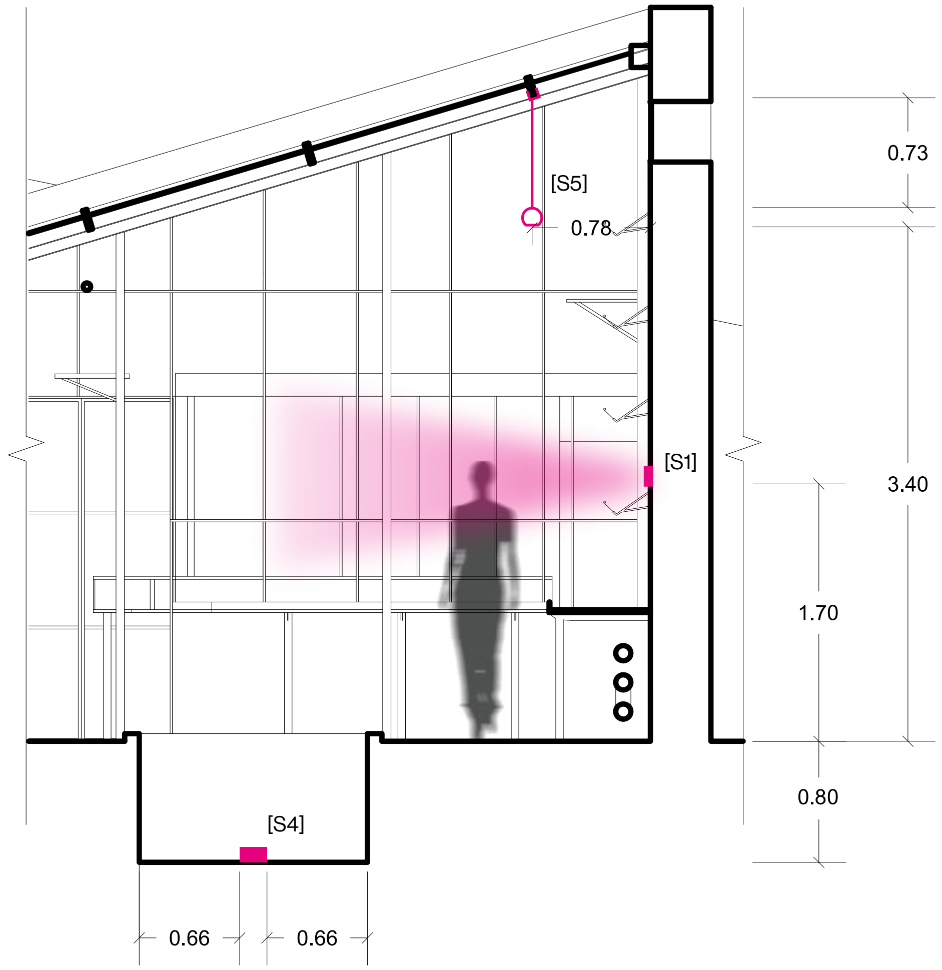


[S1] K-Array Lyzard-KZ14
[S3] Panphonics Sound Shower 60cmx60cm
[S4] K-Array Rumble-KU26
[S5] Gallo Acoustics A' Diva Habitat
[A] AA160 Basic Audio Element- 160 x 160 x 48 mm (with IP66 weatherproof eclosure)

1m 2m

/ GLASSHOUSE B -SECTION

[GLASSHOUSE B - SECTION B-B]

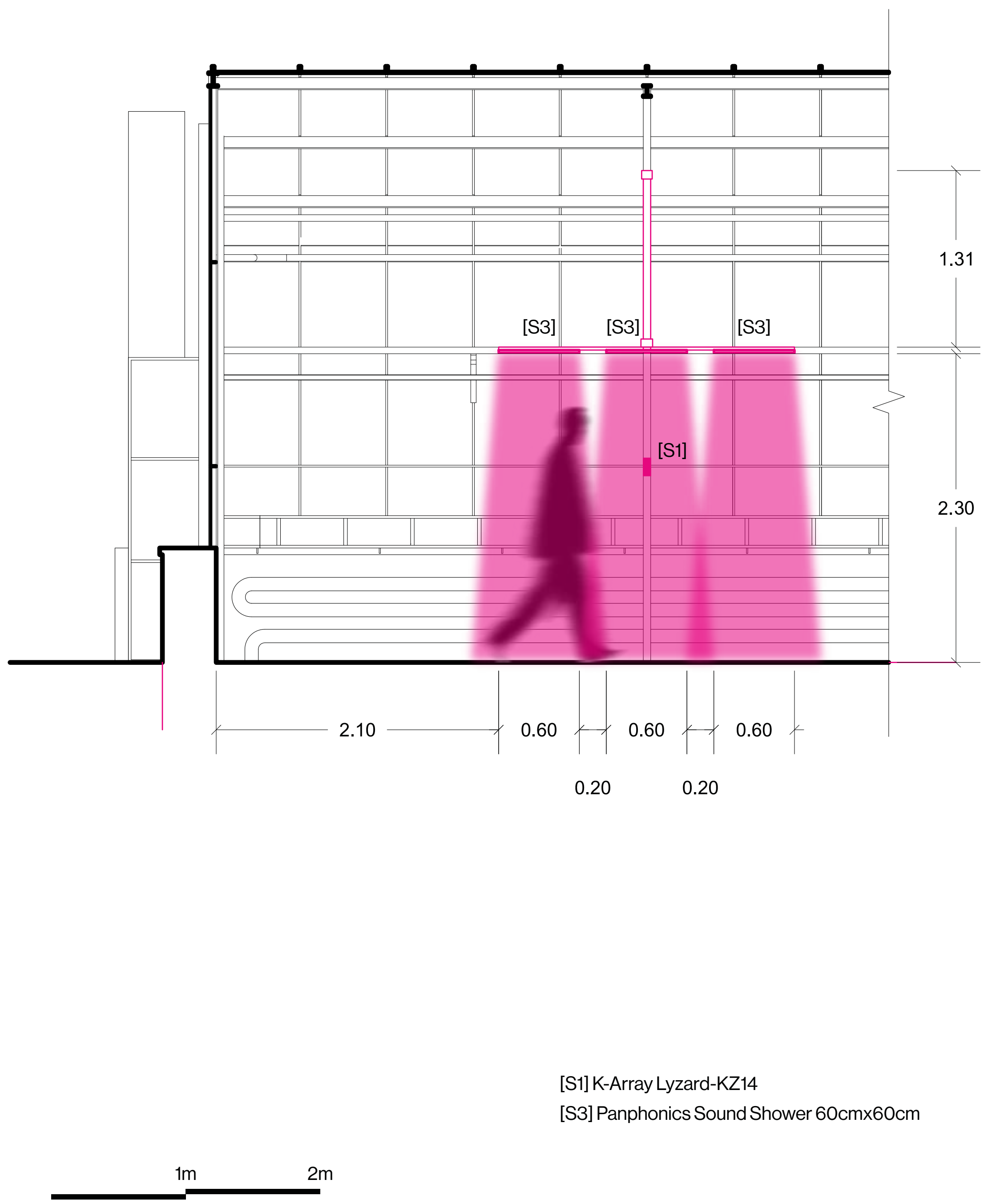


[S1] K-Array Lyzard-KZ14
[S4] K-Array Rumble-KU26
[S5] Gallo Acoustics A' Diva Habitat

1m 2m

/ GLASSHOUSE B -SECTION

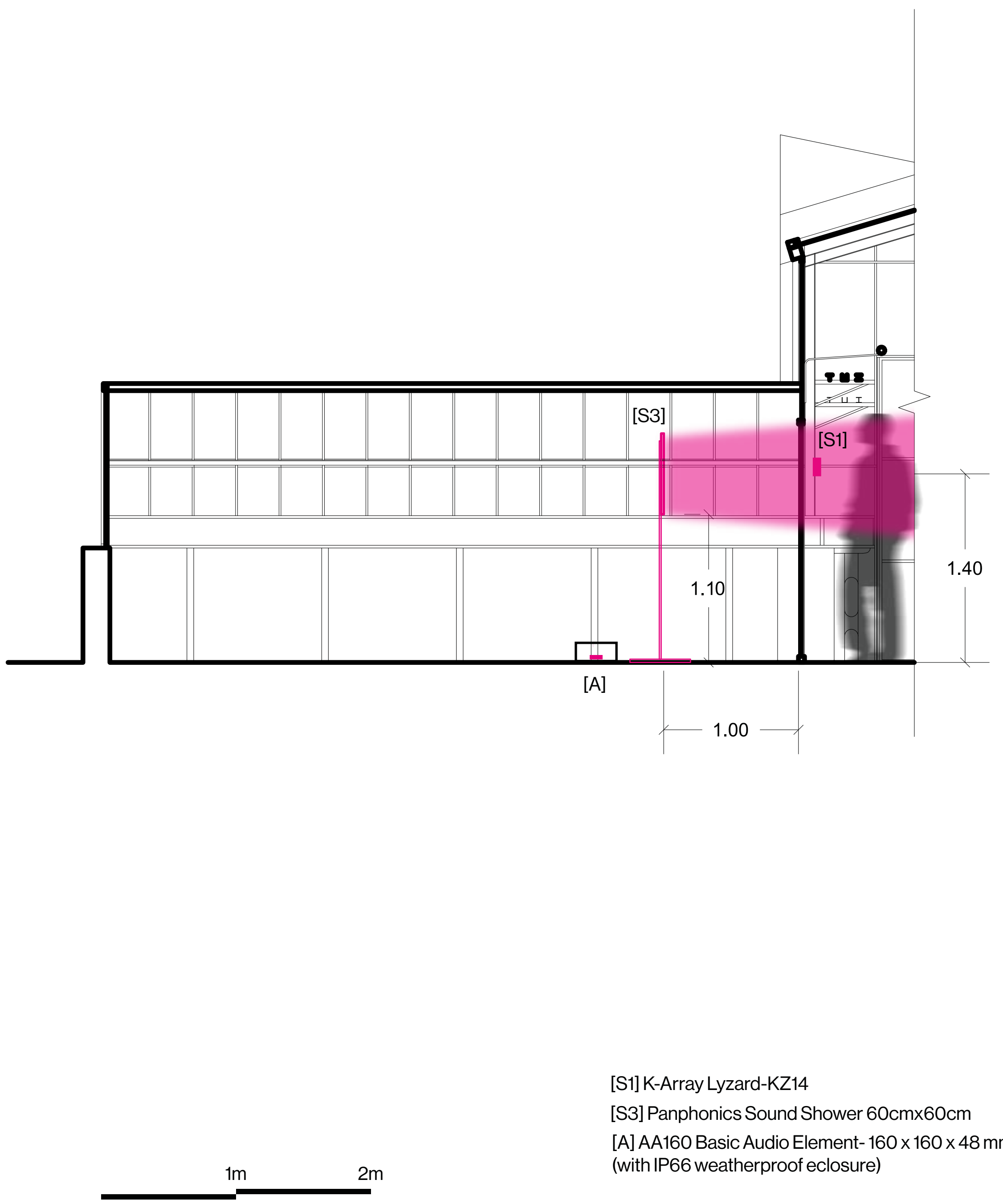
[GLASSHOUSE B - SECTION C-C]



[S1] K-Array Lyzard-KZ14
[S3] Panphonics Sound Shower 60cmx60cm

/ GLASSHOUSE B -SECTION

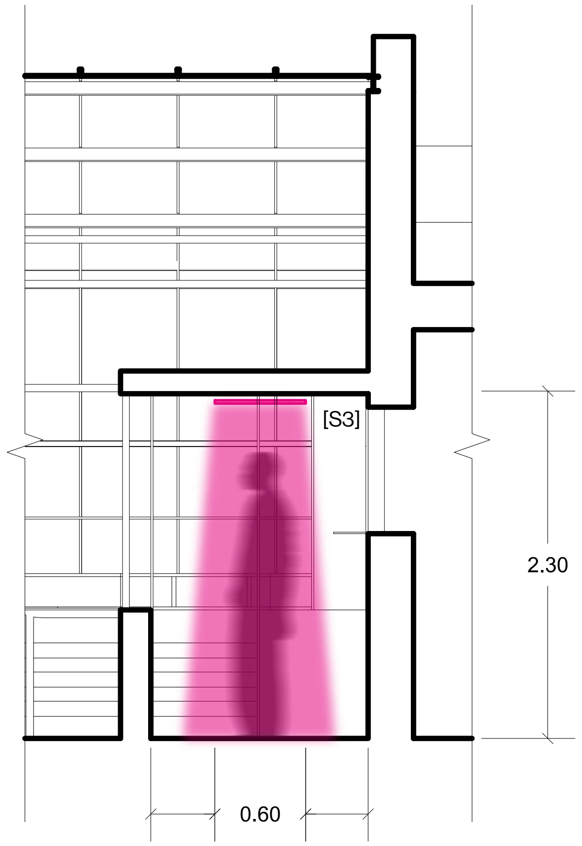
[GLASSHOUSE B - SECTION D-D]



[S1] K-Array Lyzard-KZ14
[S3] Panphonics Sound Shower 60cmx60cm
[A] AA160 Basic Audio Element- 160 x 160 x 48 mm
(with IP66 weatherproof eclosure)

/ GLASSHOUSE B -SECTION

[GLASSHOUSE B - SECTION E-E]

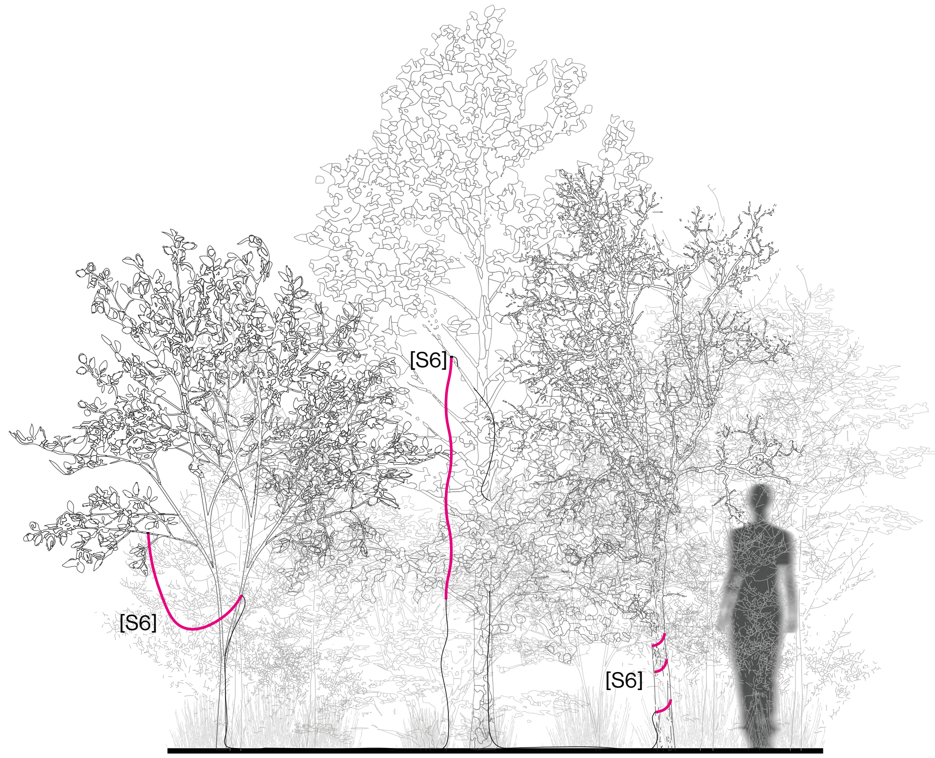


[S3] Panphonics Sound Shower 60cmx60cm

1m 2m

/ GLASSHOUSES (EXTERNAL AREA) -SECTION

[EXTERNAL AREA - CONFIGURATION SCENARIOS]



[S6] K-Array Anakonda KAN200+

1m 2m

S U R F A C E

/ NARRATIVE IDENTITIES

SONIC CHIASMUS

Before detailing the technical articulation of the individual acoustic states, it is necessary to define the conceptual framework governing sound behavior across the two sites. The design strategy relies on a deliberate sonic chiasmus: a structural inversion between the origin of the sound source and its spatial behavior.

SYNTHETIC BIO-MIMESIS

GLASSHOUSE A: THE GLADE

GLASSHOUSE B: THE UNDERGROWTH

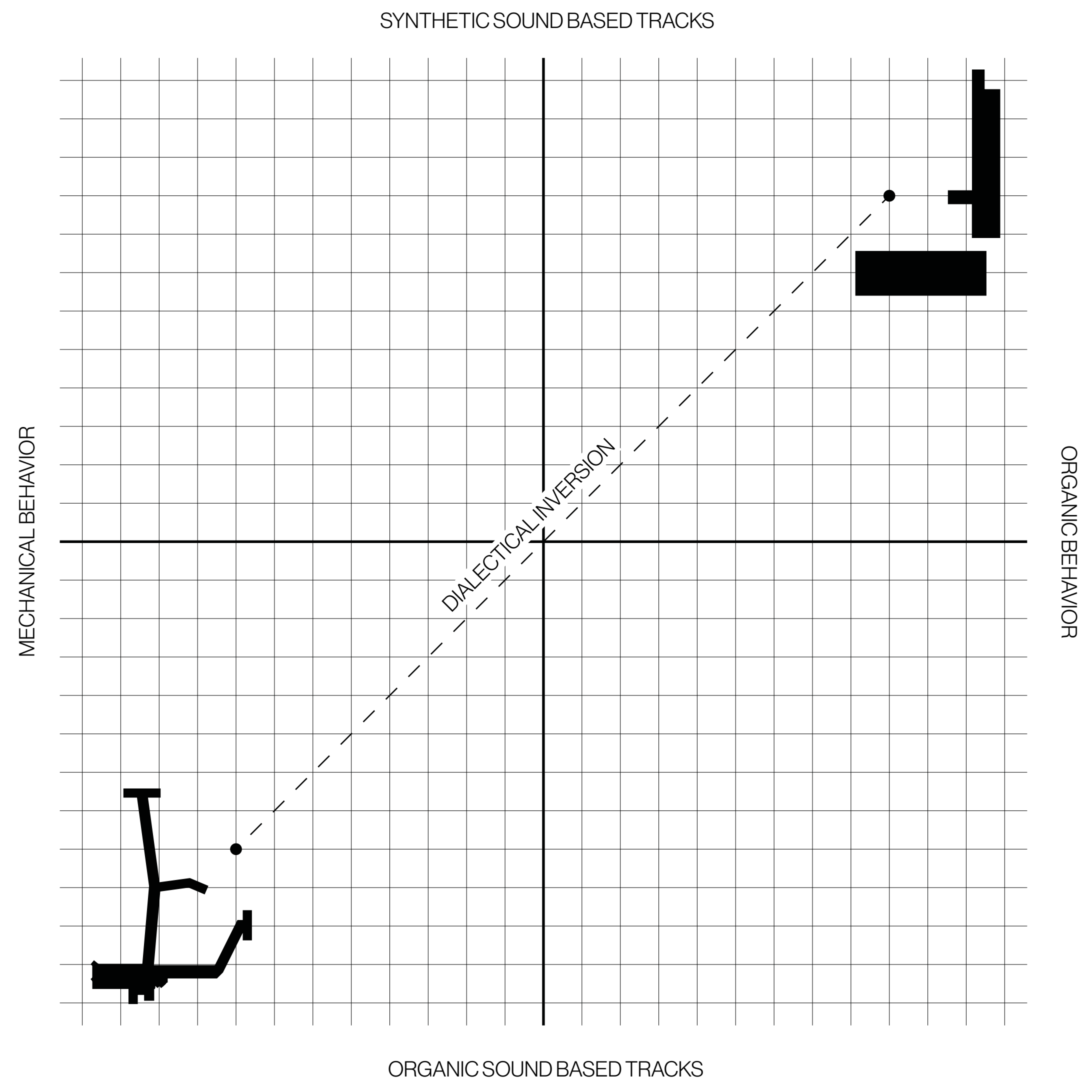
For the Glasshouses, the approach is one of synthetic bio-mimesis. Here, the source material is entirely artificial, derived from synthetic samples and digital processing. Yet, these inorganic sounds are programmed to behave as a living ecosystem. In Greenhouse A "The Glade", the synthetic texture mimics the openness and verticality of the site, defined by its fully glazed envelope and wide span, generating an atmosphere of acoustic transparency. Conversely, Greenhouse B embodies "The Undergrowth": its elongated form, bounded by a high concrete retaining wall and pressed upon by encroaching vegetation, generates a condition of spatial compression. Here, the artificial soundscape becomes dense and granular, simulating the complex friction of a biological environment.

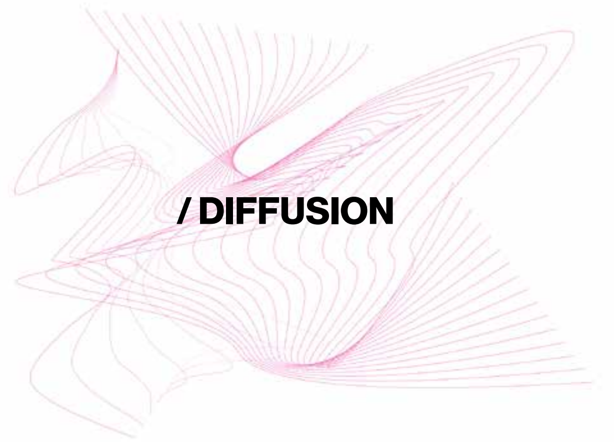
TUNNELS: ORGANIC MECHANIZATION

In contrast, the Tunnels employ a strategy of organic mechanization. The source material here is fundamentally natural, composed of organic audio traces and field recordings, but its behavior is strictly infrastructural. These biological sounds are stripped of their original freedom and forced to follow a mechanical, linear logic. Within the acoustic conduits, the organic traces do not fluctuate randomly; they traverse the space with rigid directionality, obeying the geometry of the tube. This forces the natural element into a state of performative delocalization, creating a synthetic reality where organic life is constrained by the rules of the machine.

This cross-pollination (artificial matter acting naturally, and natural matter acting mechanically) generates a pervasive cognitive dissonance, challenging the listener's perception of the boundary between the constructed and the real.

/ SONIC BEHAVIOR DIAGRAM

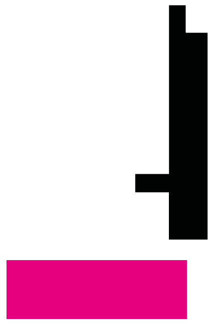




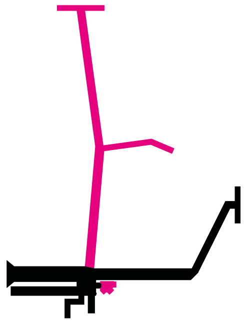
As outlined in the System chapter, the primary sonic layer (Surface) comprises distinct audio-spatial states that evolve over time through a stochastic algorithmic sequence. The Diffusion State belongs to the category of “split states,” a condition where dynamic movement and static diffusion coexist simultaneously across different sub-areas of the site. This spatial dualism was specifically designed to render the perceptual contrast between these two acoustic modalities immediately palpable.
Technically, Diffusion is implemented through a homogeneous propagation of sound throughout the architectural space, effectively defining its atmosphere by saturating the entire volume. It can be considered the most purely “atmospheric” among the five states constituting the Surface layer. Its primary objective is to fill the internal voids, inducing a static perception of the environment that links sound directly to spatial volume, thereby unveiling, or subtly altering, the site’s natural acoustic and volumetric properties.

/ DIFFUSE STATE - POSSIBLE ACTIVATION AREAS

DIFFUSE STATE - ASSIGNED SUB-AREAS (MAGENTA SYMBOLYZES THE DIFFUSE ACTIVE AREA)

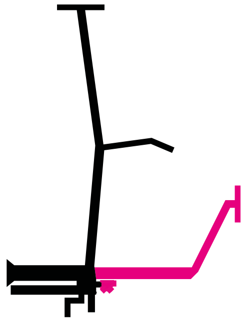


GLASSHOUSES DURING STATE DIFFUSE - DYNAMIC



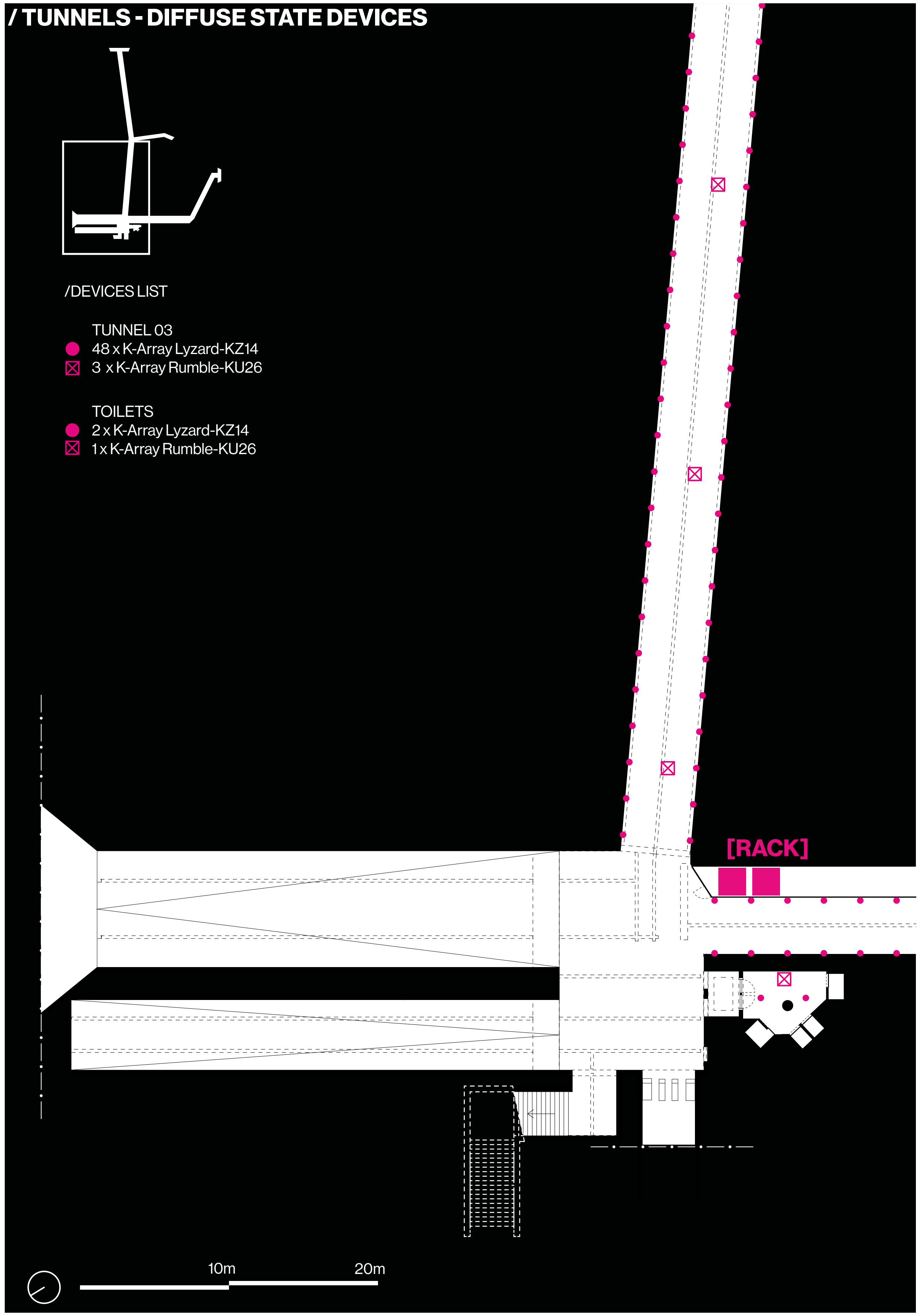
TUNNELS DURING STATE DIFFUSE - DYNAMIC

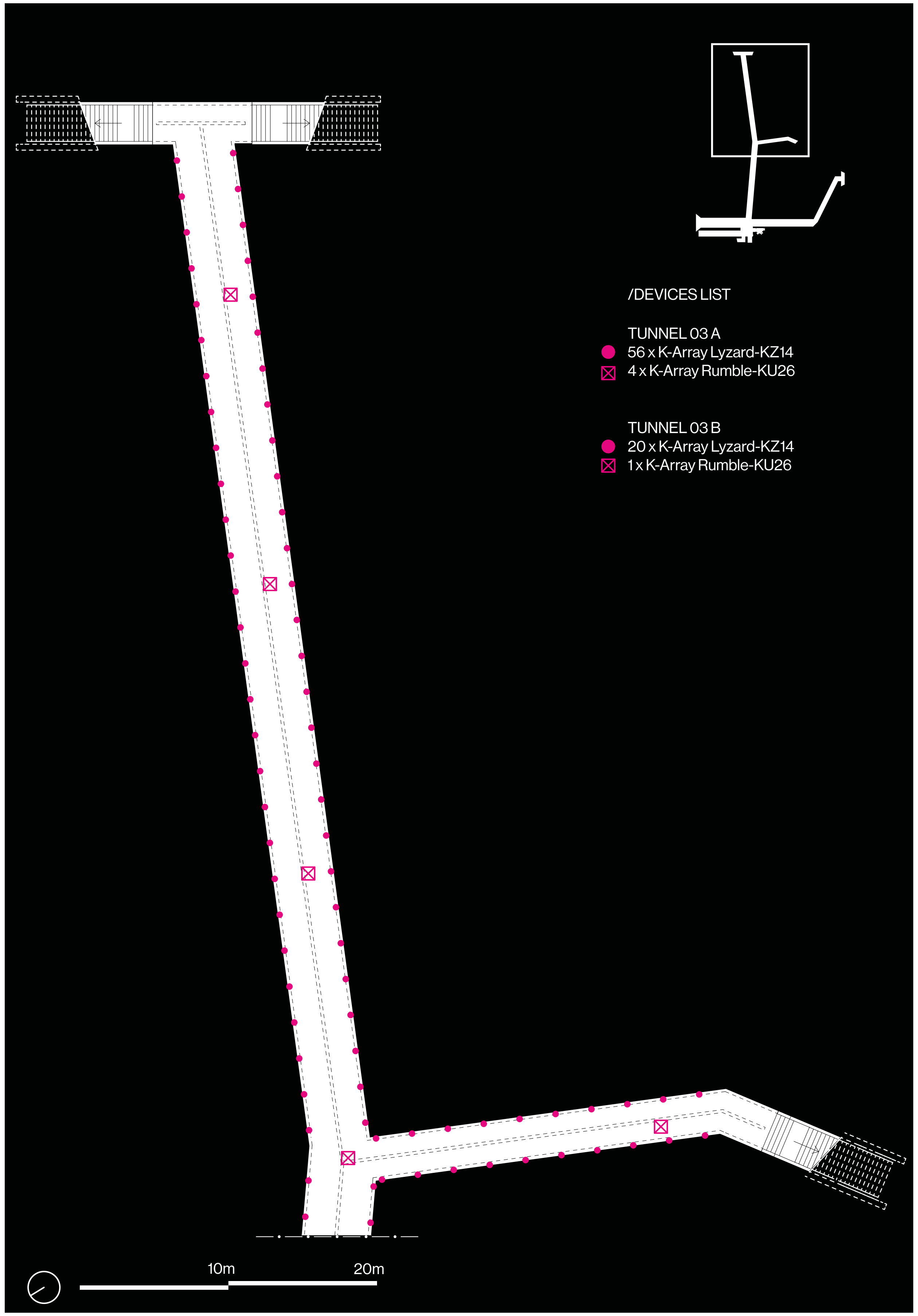
GLASSHOUSES DURING STATE DYNAMIC - DIFFUSE

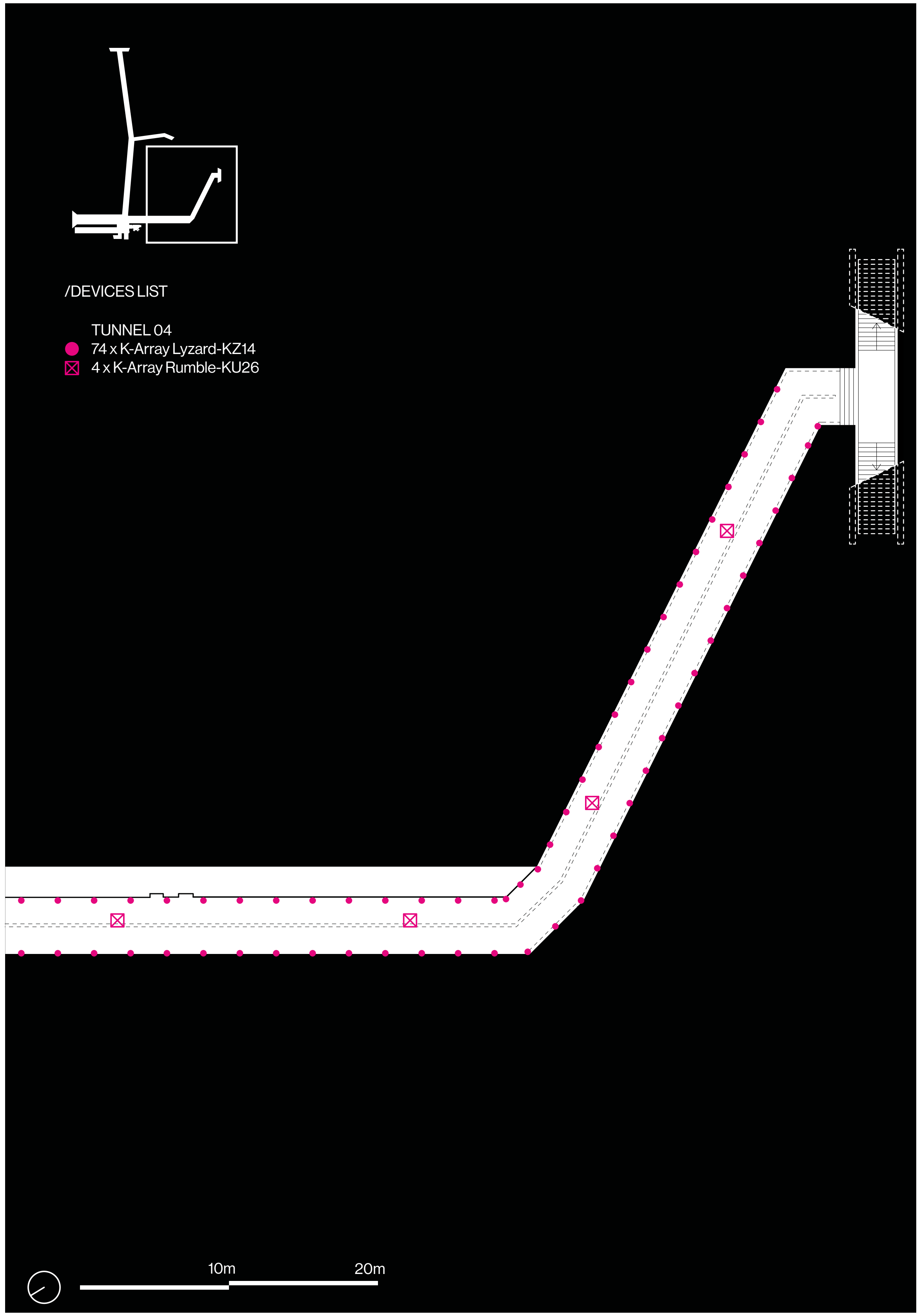


TUNNELS DURING STATE DYNAMIC - DIFFUSE

The Split States are characterized by the simultaneous presence of diffusion and dynamism within the same site, divided into designated sub-areas. Within the Tunnels, the areas potentially active during the diffuse phase are Tunnel 03, 03 A and B, Tunnel 04, and the Toilets. The Toilets are de-signed to be exclusively diffuse during split states, whereas Tunnel 03 (including 03 A and B) and Tunnel 04 will be active in the diffuse phase alternately, specifically, when one is in the dynamic phase, the other remains diffuse.
In the Glasshouses, the split states are divided more simply between the two structures (A and B), always defining one in a Diffuse State and the other in a Dynamic State.


/ TUNNELS - DIFFUSE STATE DEVICES
/DEVICES LIST
TUNNEL 03
48 x K-Array Lyzard-KZ14
3 x K-Array Rumble-KU26
TOILETS
2 x K-Array Lyzard-KZ14
1 x K-Array Rumble-KU26
[RACK]
10m
20m


/DEVICES LIST
TUNNEL 03 A
56 x K-Array Lyzard-KZ14
4 x K-Array Rumble-KU26
TUNNEL 03 B
20 x K-Array Lyzard-KZ14
1 x K-Array Rumble-KU26
10m
20m



/ AUDIO-SPATIAL ARTICULATION - TUNNELS

SOUNDSCAPE: FROGS CROAKING BASED
SPL: 55 dB - 60 dB

SPATIAL CONTINUITY

In the subterranean domain of the Centrale Metro Station, the narrative is rigorously defined by the architecture: a linear, concrete volume. Here, the objective is spatial continuity. Sound is not treated as a floating element; rather, it occupies the tunnel as a latent presence, transforming the infrastructure into a resonating chamber.

DIFFUSION SUB-AREAS

The designated zones are Tunnels 03, 04, and the restrooms, though behaviors differ. Tunnels 03 and 04 operate on a principle of binary alternation: when one enters the Diffusion state, the other shifts to the Dynamic state. The restrooms, however, act as reverberation capsules. They remain constantly in the Diffusion mode, during the split states, trapping sound to generate acoustic compression that mirrors the site's physical compression and reveals its material qualities.

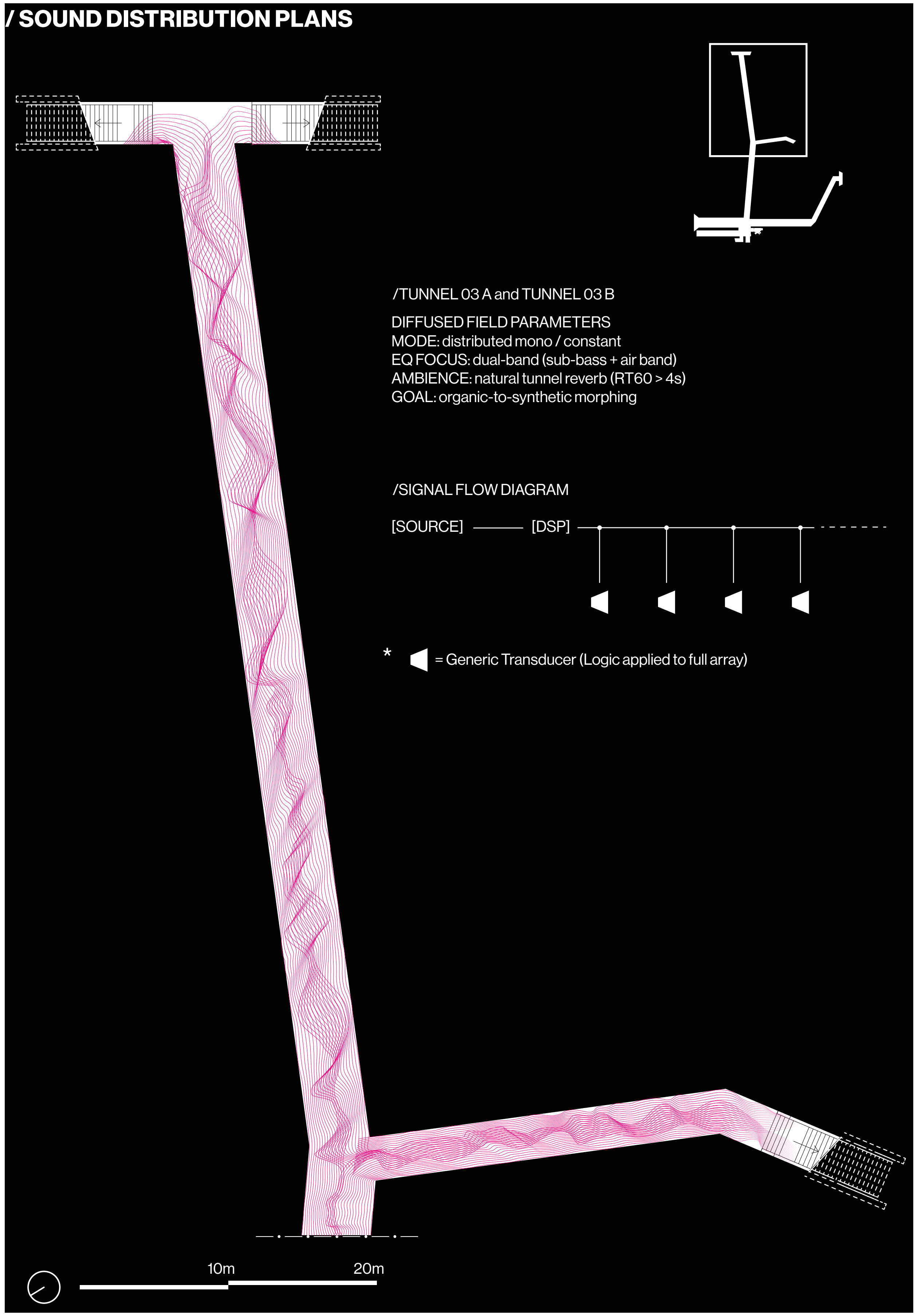
SIGNAL ARTICULATION: DUAL-BAND

The sonic content orchestrates a deliberate bio-acoustic invasion. Derived from granular amphibian bio-signals, the source undergoes organic-to-synthetic morphing via a dual-band EQ strategy. High frequencies in the "air band" (>12kHz) cut through the space, routed to Lyzard KZ14 emitters to contrast with the concrete. Simultaneously, time-stretched sub-bass drones (<60Hz) excite the structural mass via Rumble KU26 subwoofers, ensuring complete coverage. To distribute this signal, the configuration is set to distributed mono.

SPATIAL PROPAGATION - NATURAL REVERB

Every transducer reproduces the exact same signal without offsets. This generates a tunnel of sound, a constant acoustic thread accompanying the commuter, reinforcing the perception of infinite depth.
Crucially, the system utilizes zero artificial reverberation. Given the site's massive decay time (RT60 > 4s), the strategy is purely subtractive. The audio system acts solely as an exciter, relying on geometry to generate the spatial envelope. The result is a seamless fusion where digital source and physical reflection become impossible to distinguish.

/ SOUND DISTRIBUTION PLANS



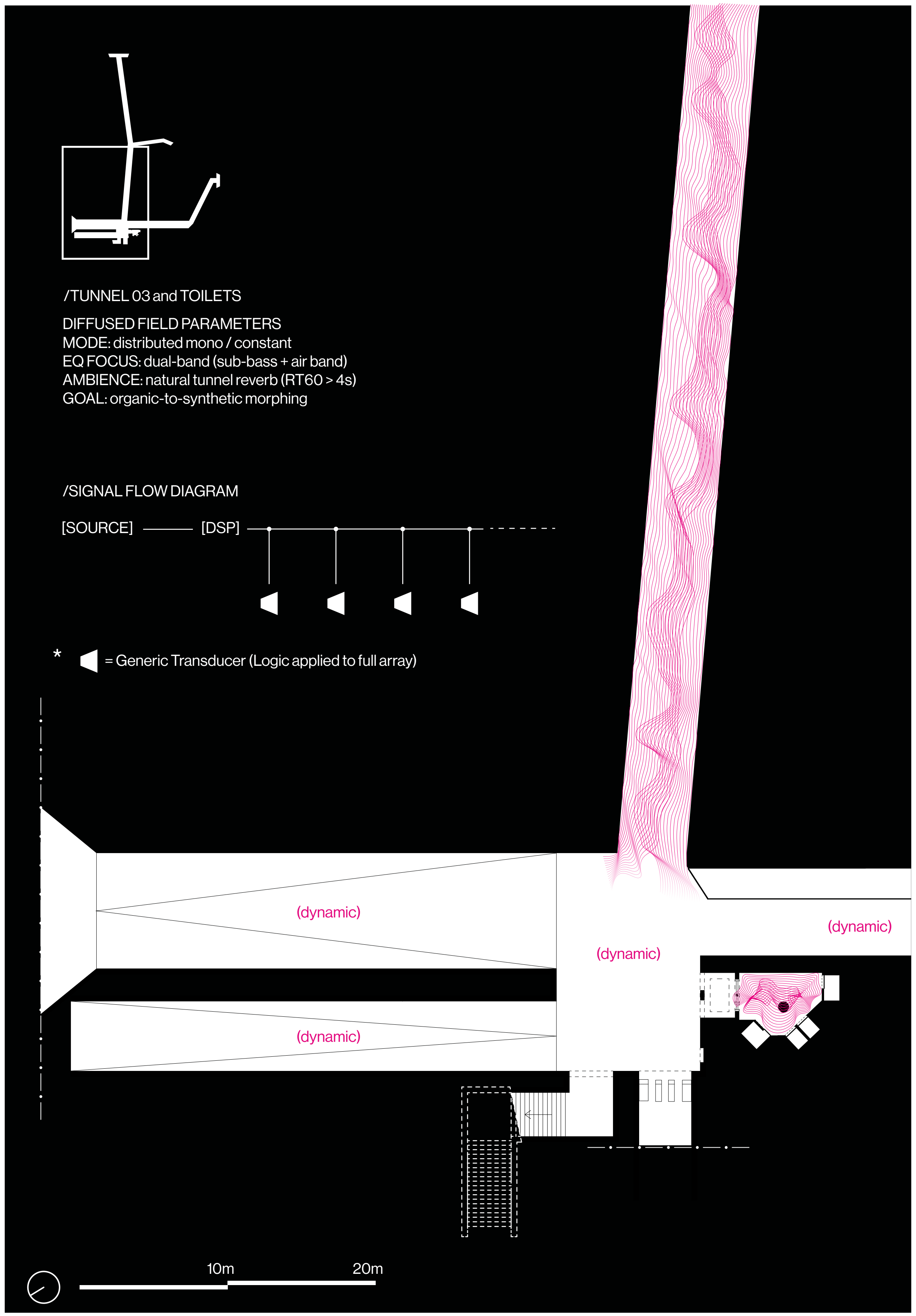
/TUNNEL 03 A and TUNNEL 03 B

DIFFUSED FIELD PARAMETERS
MODE: distributed mono / constant
EQ FOCUS: dual-band (sub-bass + air band)
AMBIENCE: natural tunnel reverb (RT60 > 4s)
GOAL: organic-to-synthetic morphing

/SIGNAL FLOW DIAGRAM

[SOURCE] —— [DSP]

* = Generic Transducer (Logic applied to full array)



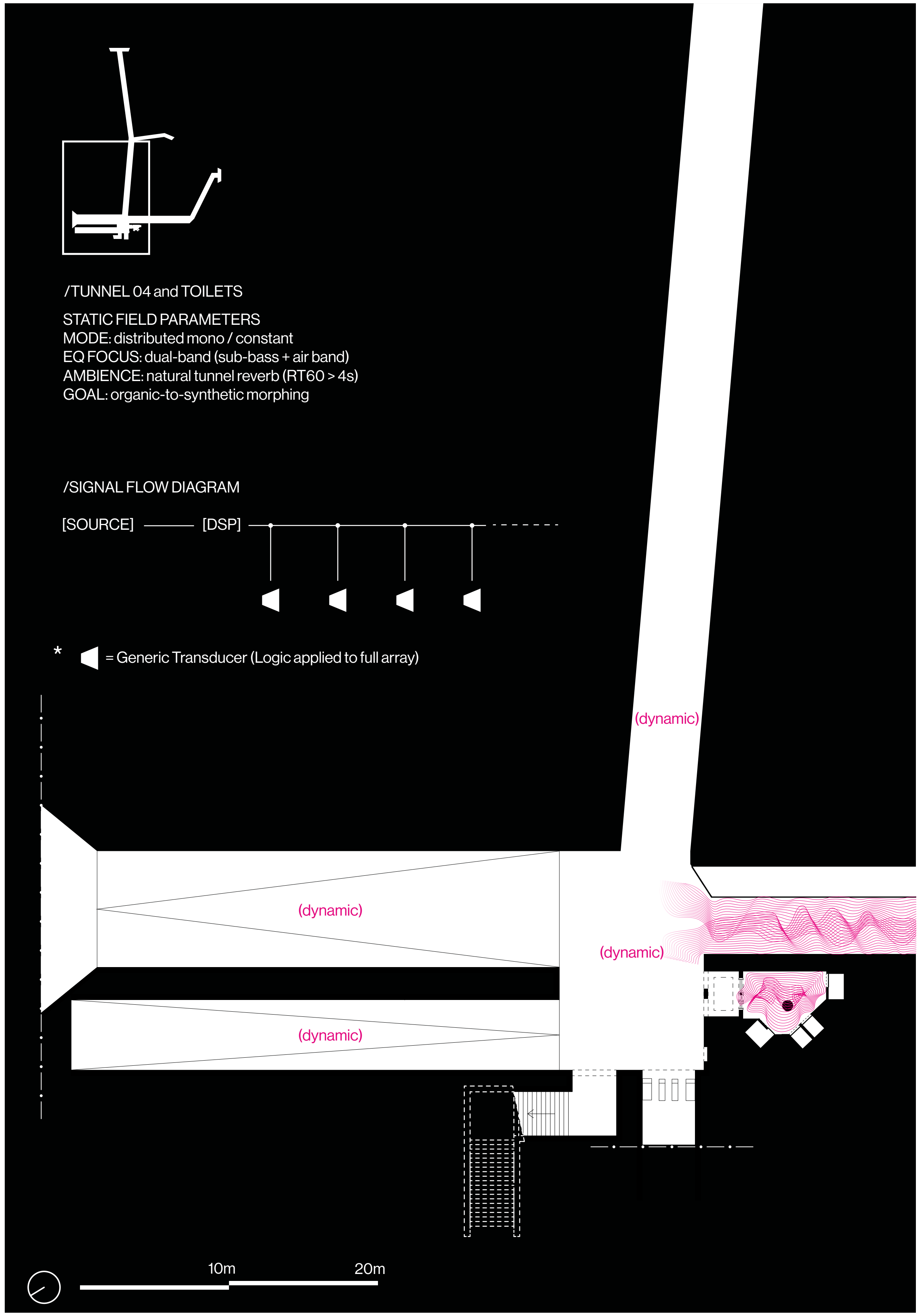
/TUNNEL 03 and TOILETS

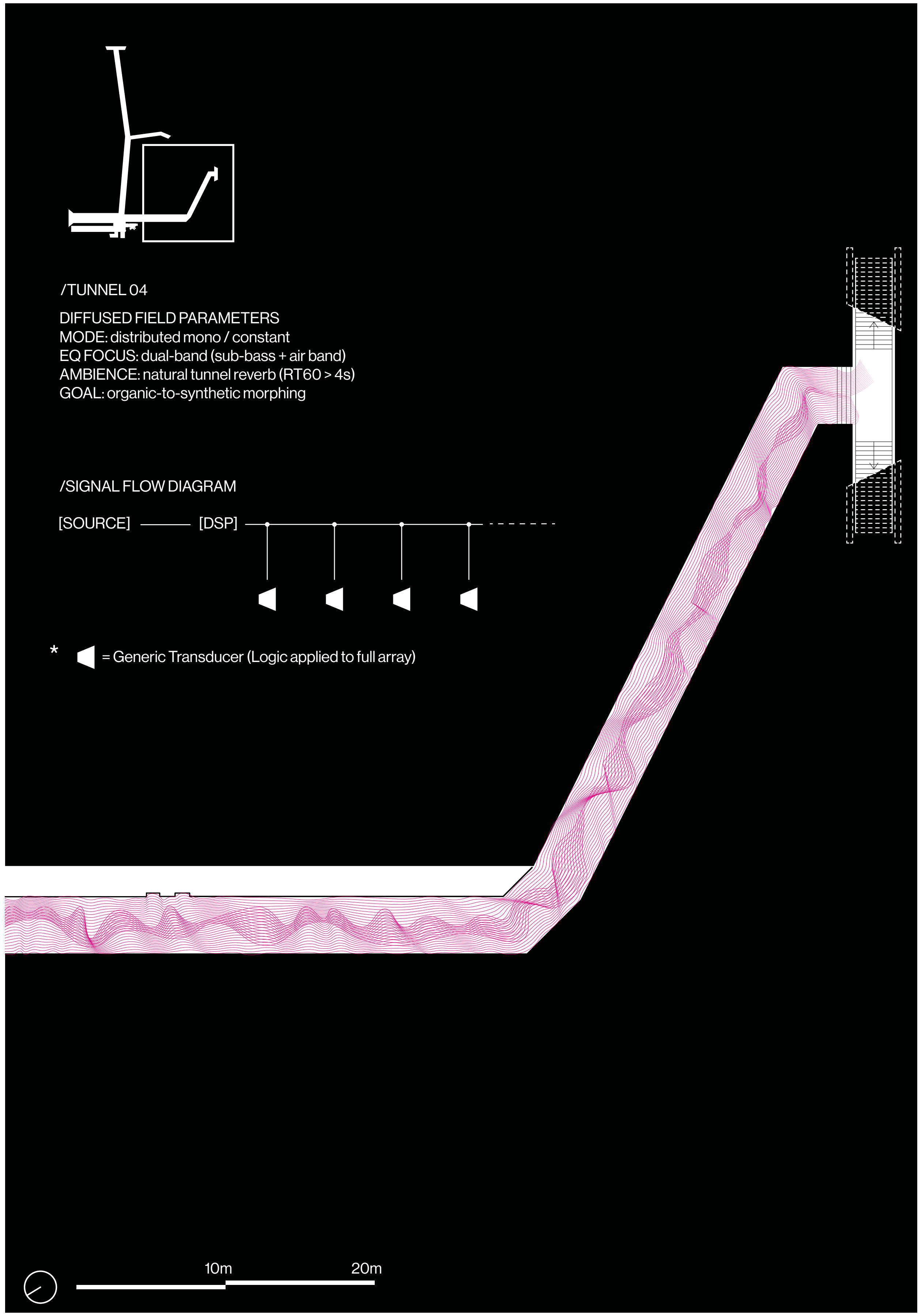
DIFFUSED FIELD PARAMETERS
MODE: distributed mono / constant
EQ FOCUS: dual-band (sub-bass + air band)
AMBIENCE: natural tunnel reverb (RT60 > 4s)
GOAL: organic-to-synthetic morphing

/SIGNAL FLOW DIAGRAM

[SOURCE] —— [DSP]

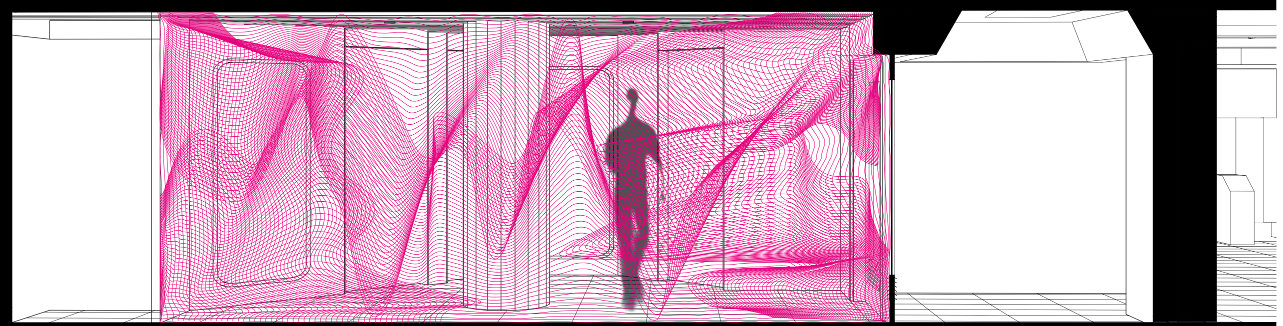
* = Generic Transducer (Logic applied to full array)


/TUNNEL 04 and TOILETS
STATIC FIELD PARAMETERS
MODE: distributed mono / constant
EQ FOCUS: dual-band (sub-bass + air band)
AMBIENCE: natural tunnel reverb (RT60 > 4s)
GOAL: organic-to-synthetic morphing
/SIGNAL FLOW DIAGRAM
[SOURCE]
[DSP]
* = Generic Transducer (Logic applied to full array)
(dynamic)
(dynamic)
(dynamic)
(dynamic)
10m
20m


/TUNNEL 04
DIFFUSED FIELD PARAMETERS
MODE: distributed mono / constant
EQ FOCUS: dual-band (sub-bass + air band)
AMBIENCE: natural tunnel reverb (RT60 > 4s)
GOAL: organic-to-synthetic morphing
/SIGNAL FLOW DIAGRAM
[SOURCE]
[DSP]
* = Generic Transducer (Logic applied to full array)
10m
20m

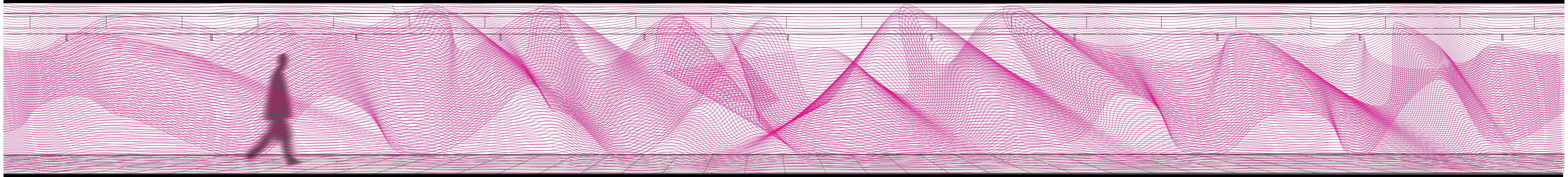
The underground architecture operates as a passive sound processor. Through the structural mediation of the Tunnels and the compact volumes of the Toilet units, the sound is trapped and reflected within high-reflectivity boundaries. This process saturates the architectural void, transforming the original signal into a homogeneous mass where the distinction between source and space collapses into a single presence.

/ TUNNELS - ATMOSPHERIC SECTION



TOLIETS - DIFFUSE STATE
HIGH REVERBERATION ENVIRONMENT

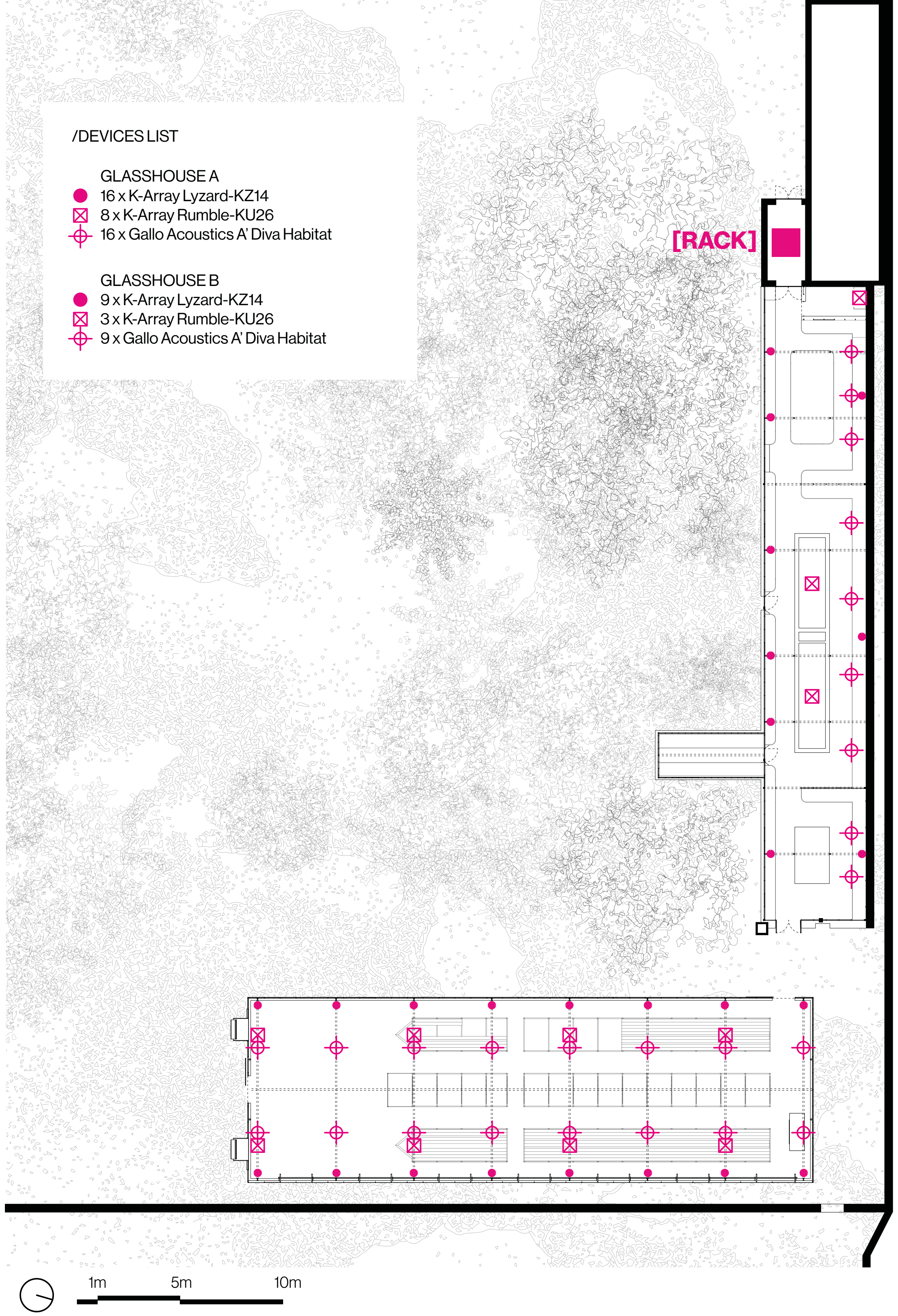
/ TUNNELS - ATMOSPHERIC SECTION



TYP SECTION (TUNNEL 03-04)
LINEAR RESONANT VOLUME

1m 2m

/ GLASSHOUSES - DIFFUSE STATE DEVICES



/ AUDIO-SPATIAL ARTICULATION - GLASSHOUSE A

SOUNDSCAPE: NEON BUZZ BASED
SPL: 60 dB - 64 dB

SUSPENSION EFFECT

In its Diffuse configuration, Glasshouse A establishes the foundational acoustic environment conceptually designated as "The Glade". Within this baseline condition, the sonic narrative retreats into a state of total suspension: a "breathing" atmosphere wherein the air itself appears to be pervaded without a discernible point of origin. To engender this level of immersion, the system mobilizes a dual technical strategy predicated on signal decorrelation and site-specific resonance.

TIME DELAY OFFSET

ARTIFICIAL REVERB

Although all transducers reproduce an identical source track (based on the neon lamp buzz), they operate asynchronously through the DSP matrix. The algorithm stochastically applies a distinct time delay offset, ranging from 5ms to 35ms, to each output channel. Crucially, the signal undergoes processing via a long-decay artificial reverberation. This choice functions as a deliberate narrative device: it mimics the high natural reverberation time (RT60) intrinsic to the concrete infrastructure of the parallel underground site. By acoustically transplanting the heavy, resonant signature of the underground tunnels into the ethereal volume of the glasshouse, the system establishes a sensory bridge connecting these two distant locations.

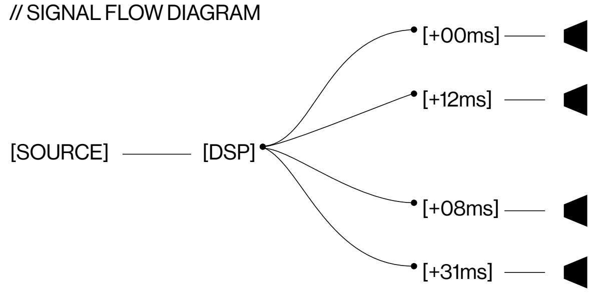
HAAS EFFECT: LOSS OF DIRECTIONALITY

This configuration relies heavily on the psychoacoustic Haas effect (or precedence effect). By randomizing signal arrival times within the integration window, the system prevents the brain from localizing the source hardware. The resulting incoherent sound field inhibits the formation of standing waves; instead, the sound behaves like an expanding gas, uniformly saturating the volume and immersing the visitor in a space that is perceived as physically larger and deeper than its glass perimeter would suggest.

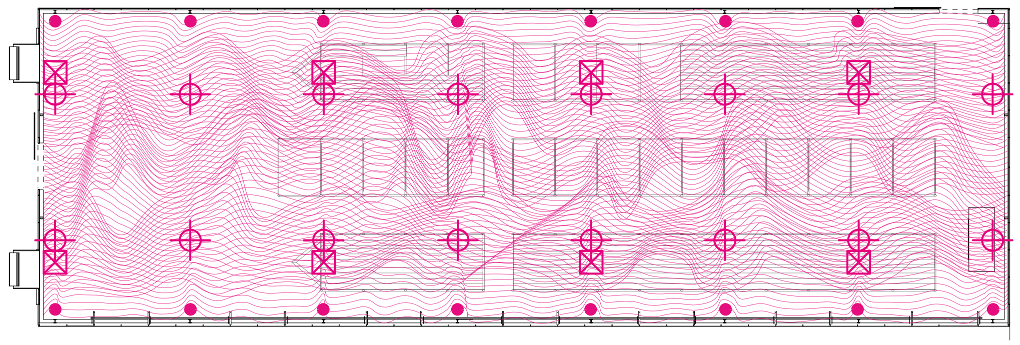
/ SOUND DISTRIBUTION PLAN

// STATIC FIELD PARAMETERS
MODE: full-range / asynchronous
ALGORITHM: haas effect (decorrelation)
DELAY RANGE: random [5ms - 35ms]
REVERB: long decay (metro tunnel acoustics)
RT60 goal: > 2.5s

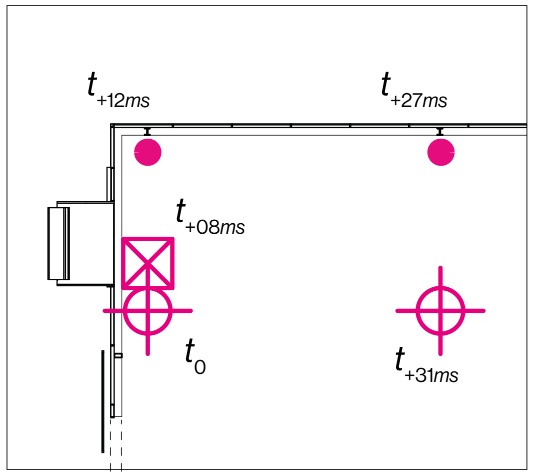
// SIGNAL FLOW DIAGRAM



* = Generic Transducer (Logic applied to full array)

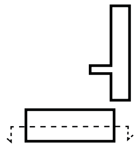


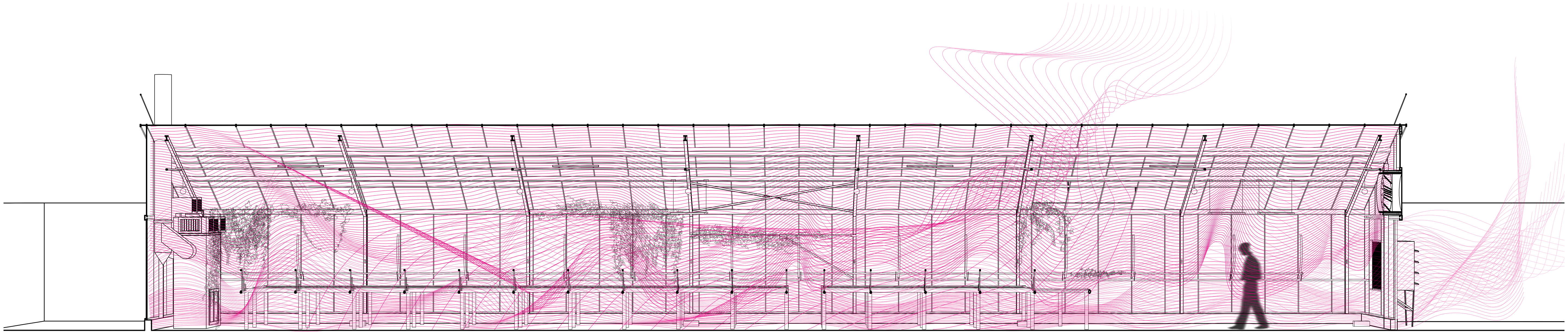
//HAAS EFFECT IMPLEMENTATION
Typical corner detail showing signal time-alignment offsets. Delay values are indicative; actual parameters are assigned stochastically (5–35ms window) to ensure uniform spatial immersion.



In the Glade, architecture is stripped of its physical constraints, opening toward a perceptual space that extends beyond material boundaries. Through the Haas effect the sound loses its directionality. Additionally, an artificial reverberation is applied to the track, conceptually bridging the glasshouse with the acoustic nature of the tunnels. The final result is a monumental expansion of the space, generating a perceptual effect of total dispersion and omnidirectionality.

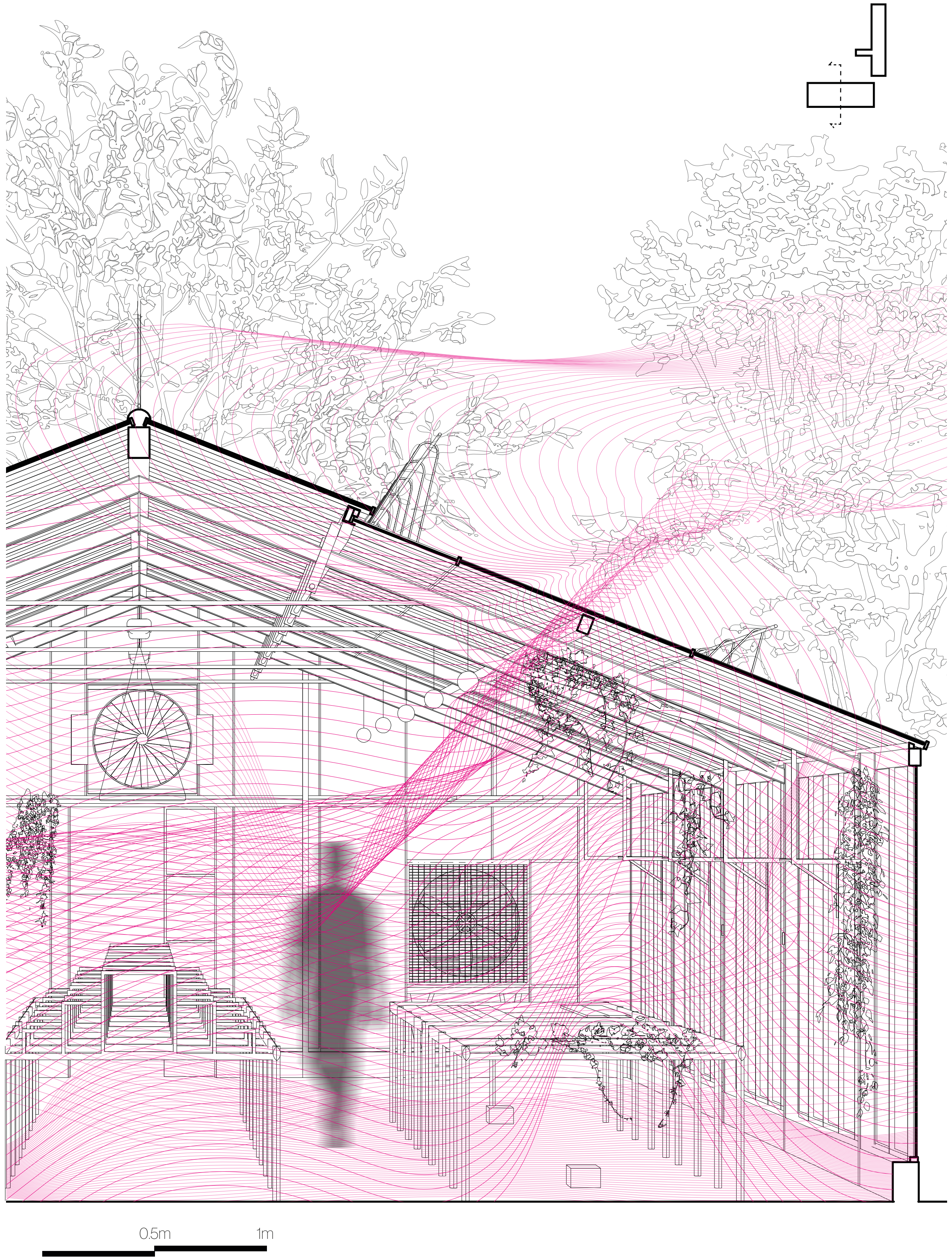
/ GLASSHOUSE A - ATMOSPHERIC SECTION





1m 2m

/ GLASSHOUSE A - ATMOSPHERIC SECTION



/ AUDIO-SPATIAL ARTICULATION - GLASSHOUSE B

SOUNDSCAPE: NEON BUZZ BASED
SPL: 70 dB - 74 dB

ATMOSPHERIC PRESSURE

In its static configuration, Glasshouse B operates in response to the conceptual framework designated as “The Undergrowth”. Here, the sonic narrative shifts to a condition of high-tension stillness, a pressurized atmosphere where the air itself seems to possess physical weight and density. To achieve this compression, the system employs a technical strategy diametrically opposed to that of Glasshouse A, utilizing phase locking and constructive interference.

PHASE LOCKING

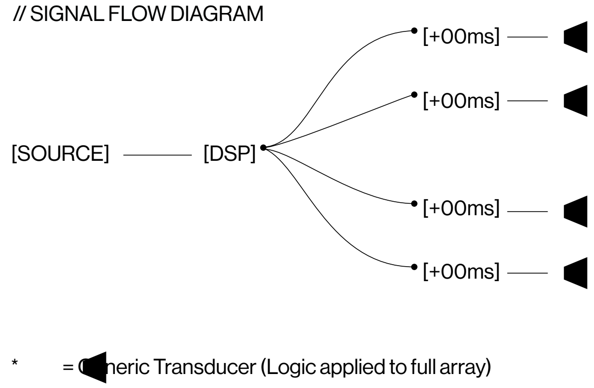
While all transducers reproduce the same source track, they operate synchronously through the DSP matrix: a strict time alignment (Δt ≈ 0ms) is applied to every output channel, effectively eliminating temporal variance. Crucially, the signal is processed to remain completely dry. This constitutes a deliberate narrative inversion: whereas Glasshouse A simulates the reverberant emptiness of the metro tunnels, Glasshouse B mimics the suffocating proximity of mechanical infrastructure. By stripping away reverberation, the system exposes the raw, naked electricity of the sound source.

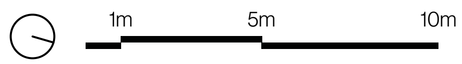
SPATIAL CONTRACTION

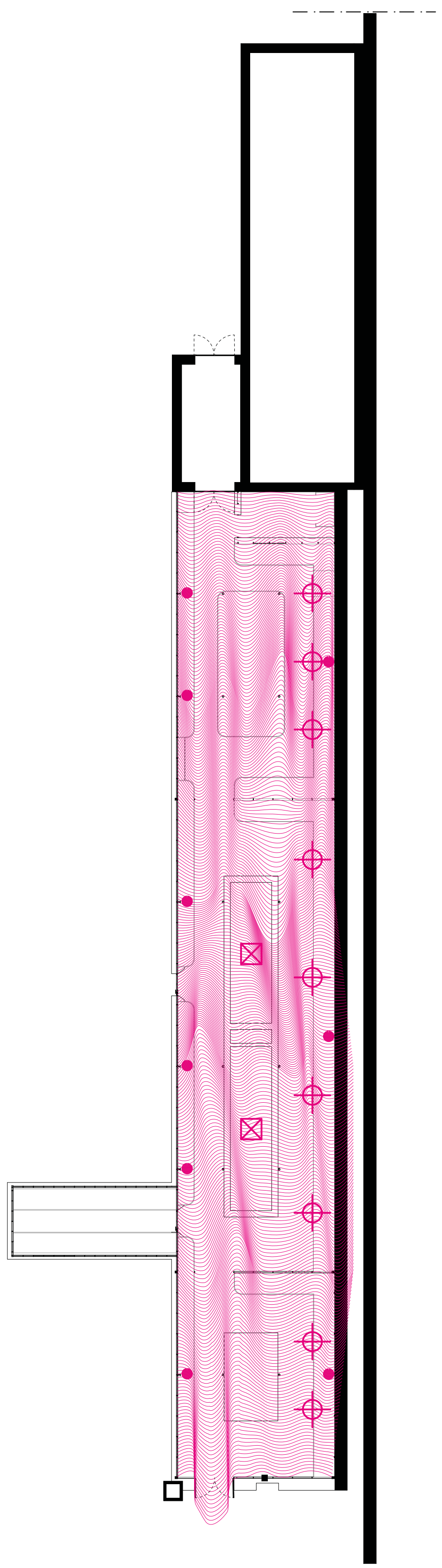
This configuration is grounded in the physics of wavefront summation. By aligning signal arrival times across the parallel array, the system maximizes sound pressure through constructive interference. The resulting coherent sound field rejects spatial ambiguity; instead, the sound acts as a solid barrier, uniformly compressing the volume and confronting the visitor with a space that feels physically denser and narrower than its actual dimensions.

/ SOUND DISTRIBUTION PLAN

// STATIC FIELD PARAMETERS
MODE: coherent mono / phase-locked
ALGORITHM: constructive interference (summation)
DELAY RANGE: fixed [0ms variance]
REVERB: dry signal / direct pressure
RT60 goal: < 0.8s

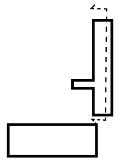


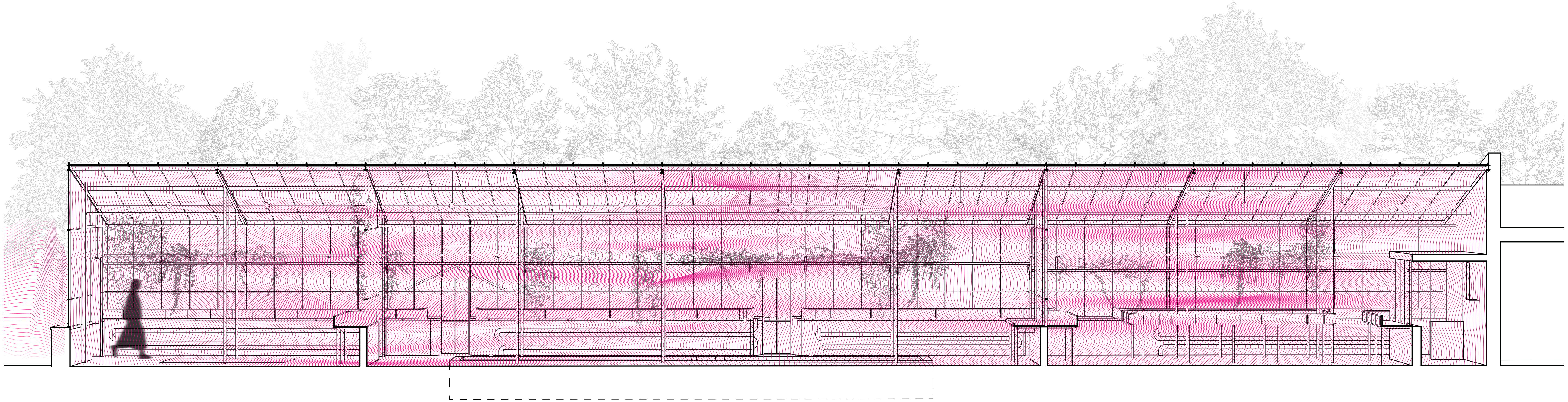




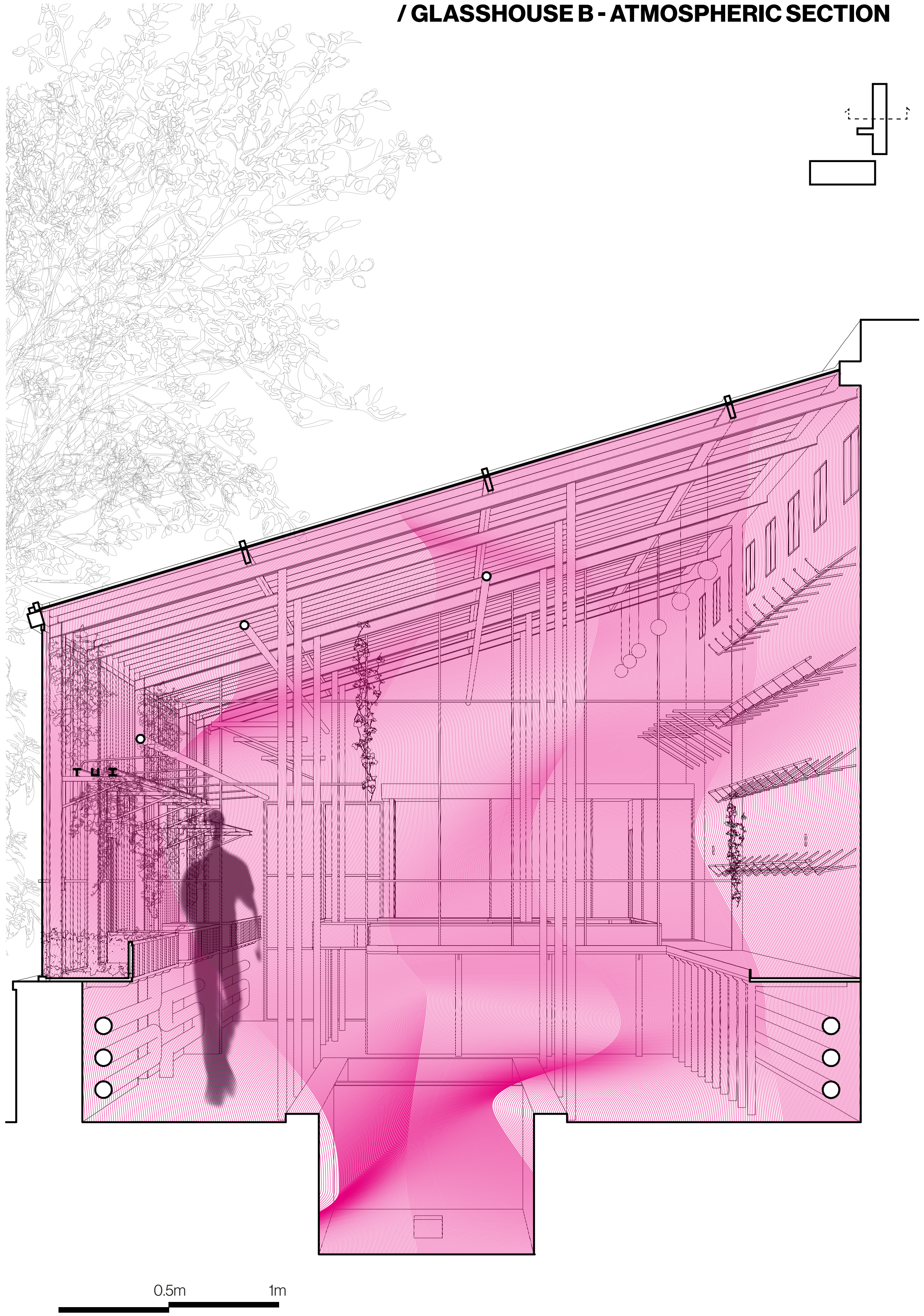
In the Undergrowth, sound recovers its material dimension through phase coherence and constructive interference. The devices operate as a single, coordinated organism that saturates the volume in an almost sculptural way. The absence of artificial reverberation prevents the sound from floating, instead compacting it into a dense acoustic mass that reveals the true scale and physicality of the space.

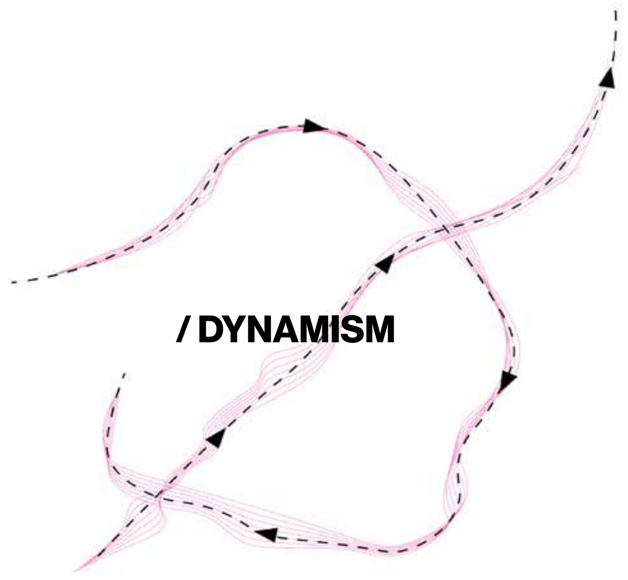
/ GLASSHOUSE B - ATMOSPHERIC SECTION





/ GLASSHOUSE B - ATMOSPHERIC SECTION



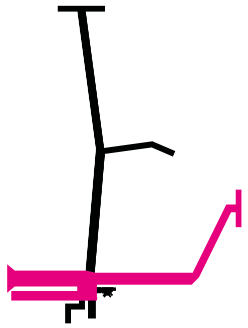


The Dynamic state emerges as the kinetic counterpoint to the system's static balance. Where the previous condition established a suspended atmosphere, this phase introduces the temporal variable, effectively activating the dormant potential of the acoustic field. It is no longer a matter of inhabiting a space, but of moving through it.
In this configuration, sound ceases to be a background presence and becomes a vector. The system investigates the physics of displacement, transforming the auditory signal into a narrative guide that physically leads or disorients the visitor. This is not merely a dialogue with the architecture, but a radical reinterpretation of its boundaries: static walls are dissolved by moving frequencies, and the perception of the physical volume is continuously reshaped by the passage of sound.
By engaging with the specific geometries of the project, the Dynamic state forces the architecture to perform. It acts as a catalyst, exalting spatial characteristics through movement and turning the passive act of listening into an active experience of navigation.

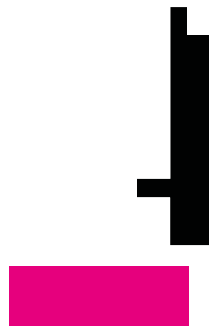
/ DYNAMIC STATE - POSSIBLE ACTIVATION AREAS

DYNAMIC STATE - ASSIGNED SUB-AREAS (MAGENTA SYMBOLYZES THE DYNAMIC ACTIVE AREA)

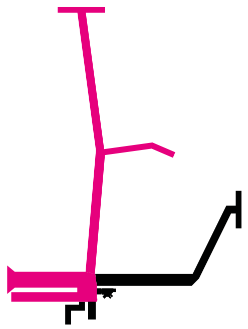
GLASSHOUSES DURING STATE DIFFUSED-DYNAMIC



TUNNELS DURING STATE DIFFUSED-DYNAMIC



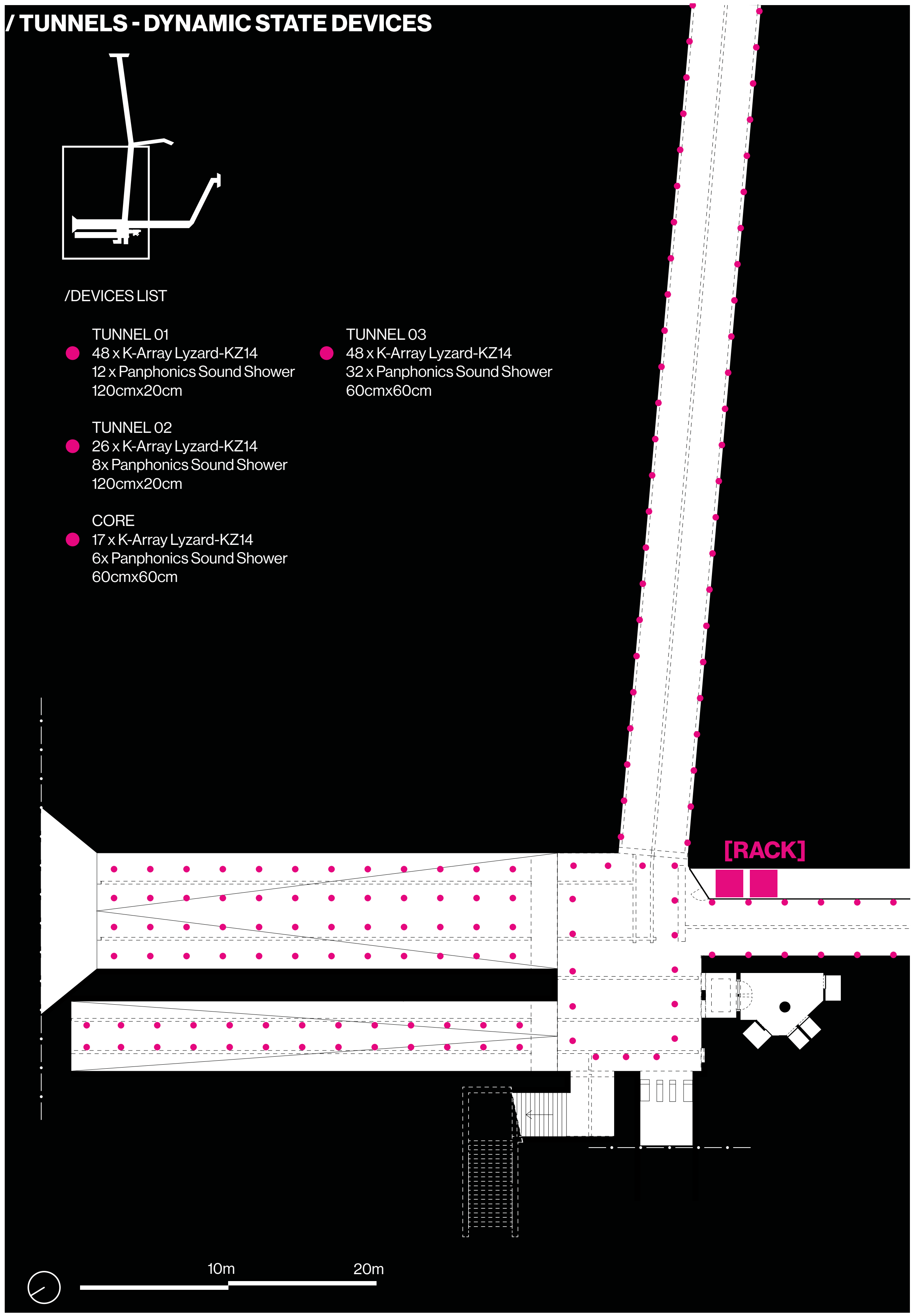
GLASSHOUSES DURING STATE DYNAMIC-DIFFUSED

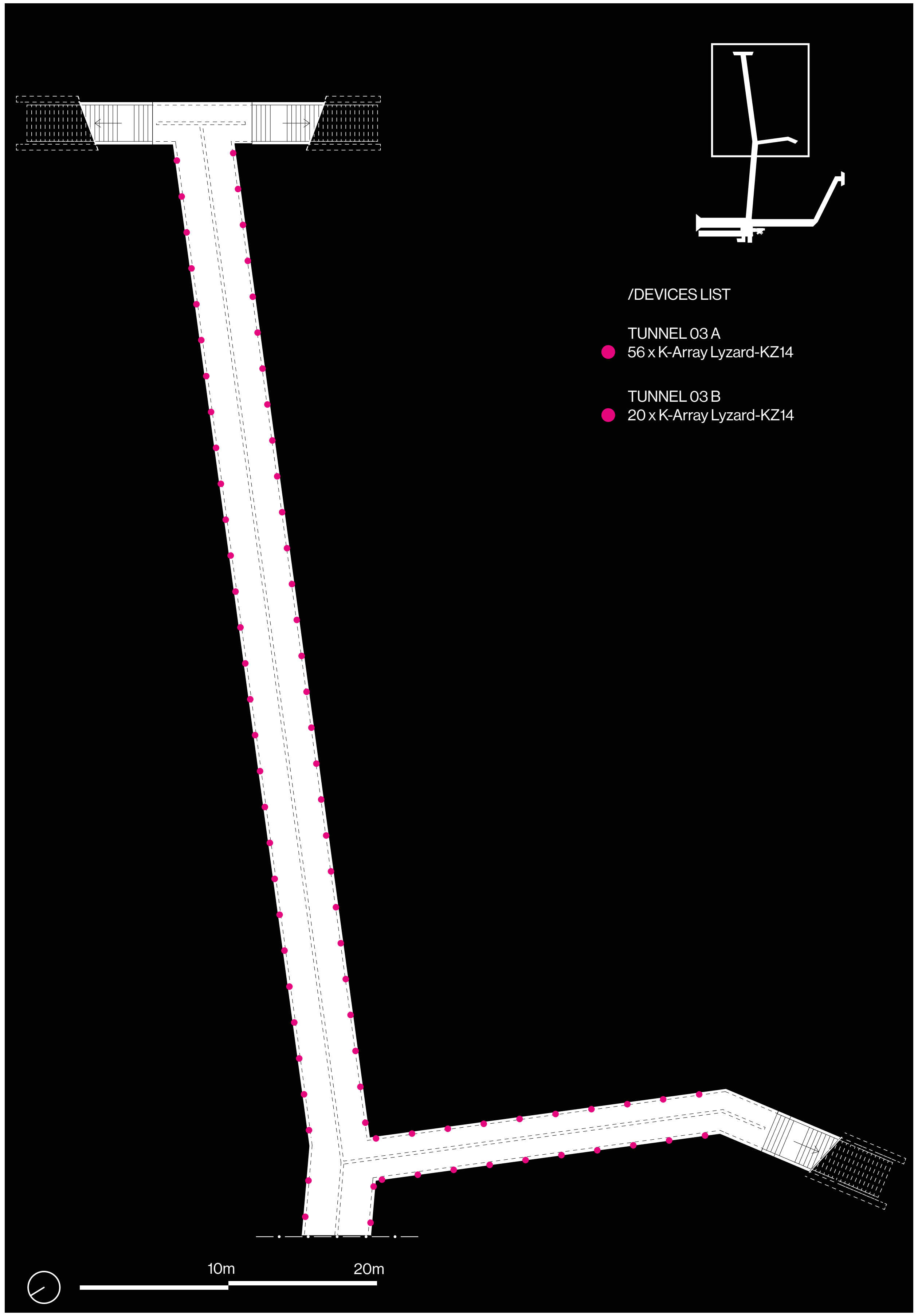


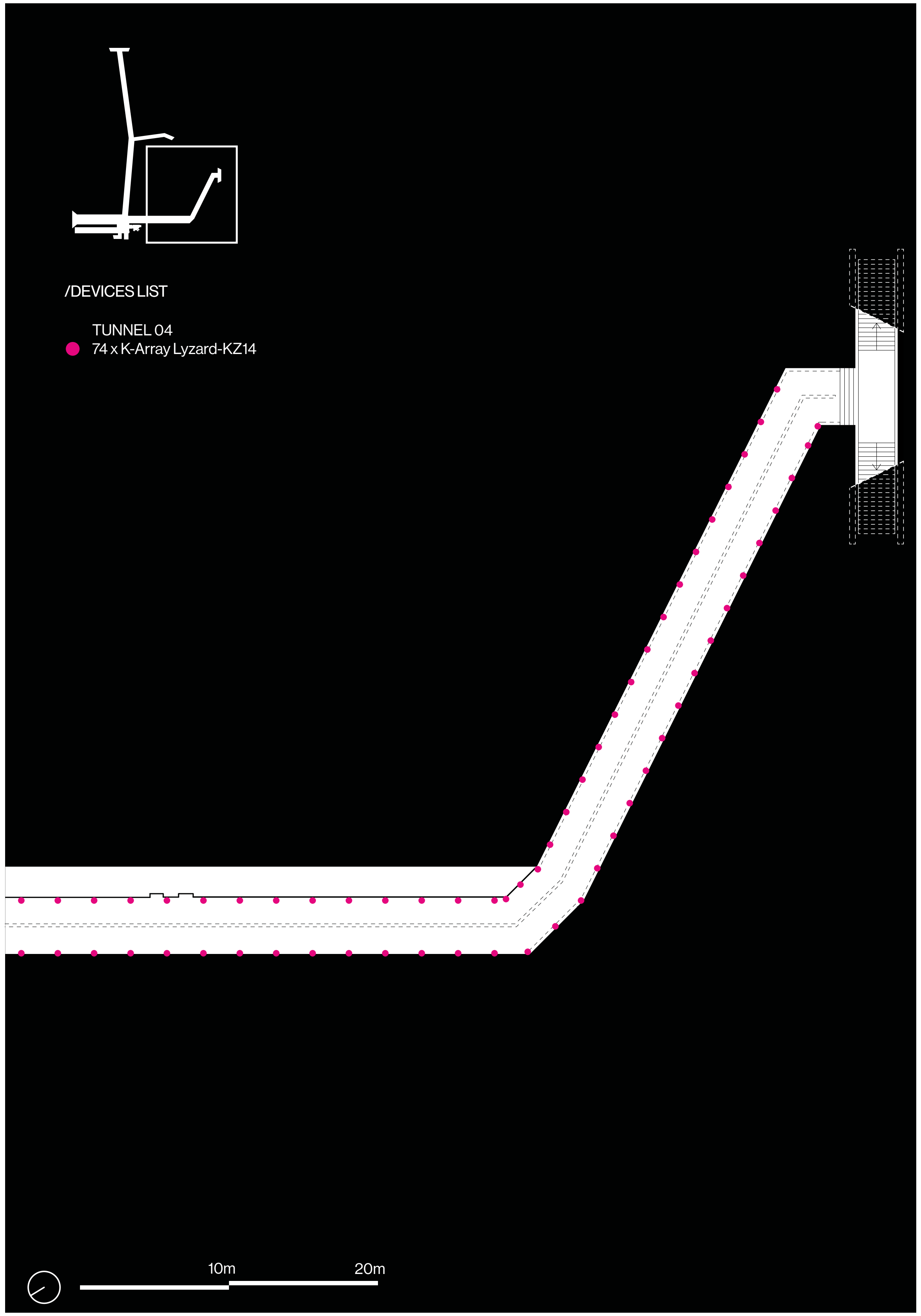
TUNNELS DURING STATE DYNAMIC-DIFFUSED

During the Split States, the Dynamic phase is active alternately within the Glasshouses. In the Tunnels, the areas designated for dynamic sound are Tunnel 01, Tunnel 02, Core, Tunnel 03 (including 03 A and B), and Tunnel 04. Tunnel 01, Tunnel 02, and the Core are active exclusively in the Dynamic State during Split States, whereas Tunnel 03 and Tunnel 04 will be active in the Dynamic State alternately.

/ TUNNELS - DYNAMIC STATE DEVICES







/ AUDIO-SPATIAL ARTICULATION - TUNNELS

SOUNDSCAPE: WATER STREAM BASED
SPL: 80 dB - 82 dB

TRANSITORY SPACE

The Tunnels infrastructure is conceptually framed as an archetype of pure movement, directly deriving its acoustic logic from its primary function as a transient space. Recognizing the varied morphology of the galleries, the sound design adopts a diversified spatial reasoning, intending to amplify this transitory nature by constructing a narrative of displacement where sound actively traverses the architecture.

INBOUND FLOW: INCUBATORS

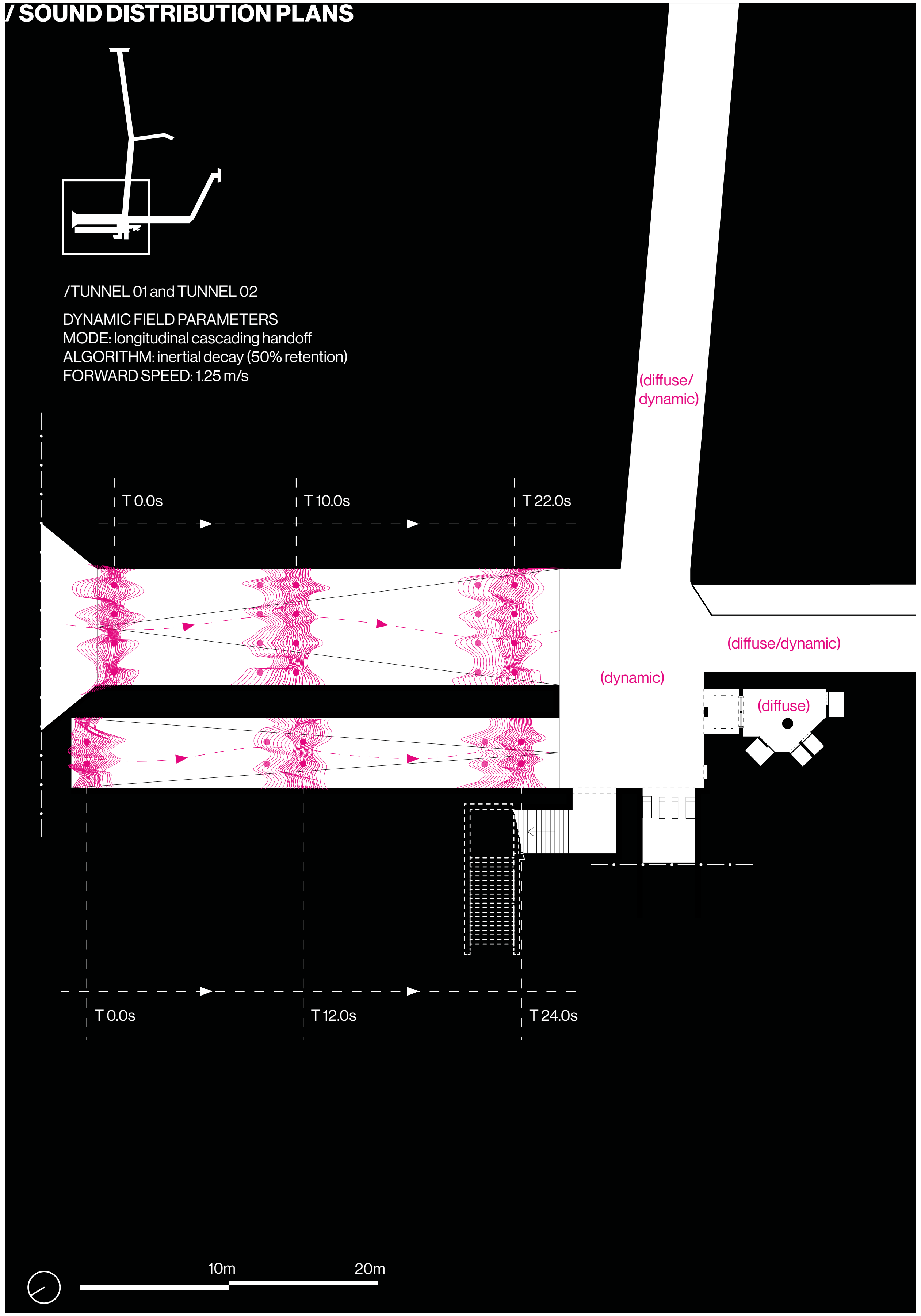
Consistent with the zoning strategy, Tunnels 01, 02, and the central Core are designated exclusively for the Dynamic State (during the activation of the Split States). The connection paths from the Metro and Train stations function as incubation areas, designed to gradually introduce the visitor to the installation's epicenter; consequently, these spaces host a unidirectional, centripetal movement towards the Core. The propagation speed is deliberately slow, with a transition time (Δt) between device rows set at 2.0s, acting as a viscous guide that accompanies the flow of people.

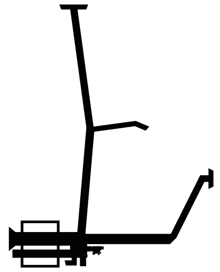
OUTBOUND FLOW: TUNNEL 03

Upon reaching the Core, the kinetic behavior bifurcates into two distinct configurations, dependent on the active outbound tunnel. If Tunnel 03 is active, the Core features an Orbital Movement (rapid device-to-device transition at 0.4s), while Tunnel 03 itself exhibits a Linear Flux, accelerating from 1.0s to 0.5s in the branches, interrupted every 5 minutes by a slower Reverse Flux.

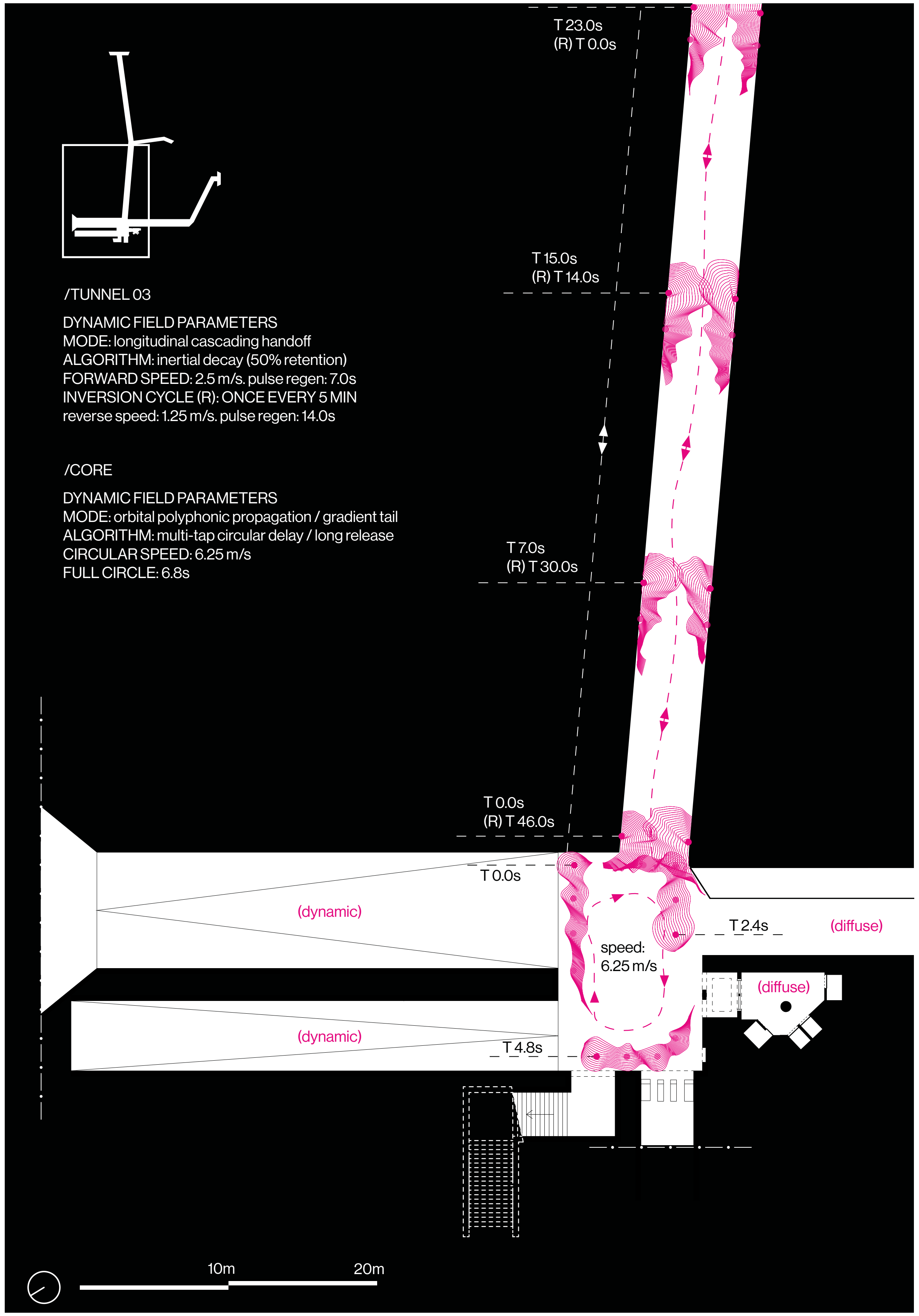
OUTBOUND FLOW: TUNNEL 04

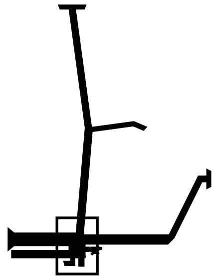
Conversely, if Tunnel 04 is active, the Core shifts to a Stochastic Bounce (Δt variable 0.3–0.8s), and the propagation within Tunnel 04 follows a "Ricochet Pattern": maintaining the same velocity logic as Tunnel 03, the trajectory becomes non-linear, physically bouncing from one side of the tunnel to the other as it advances.





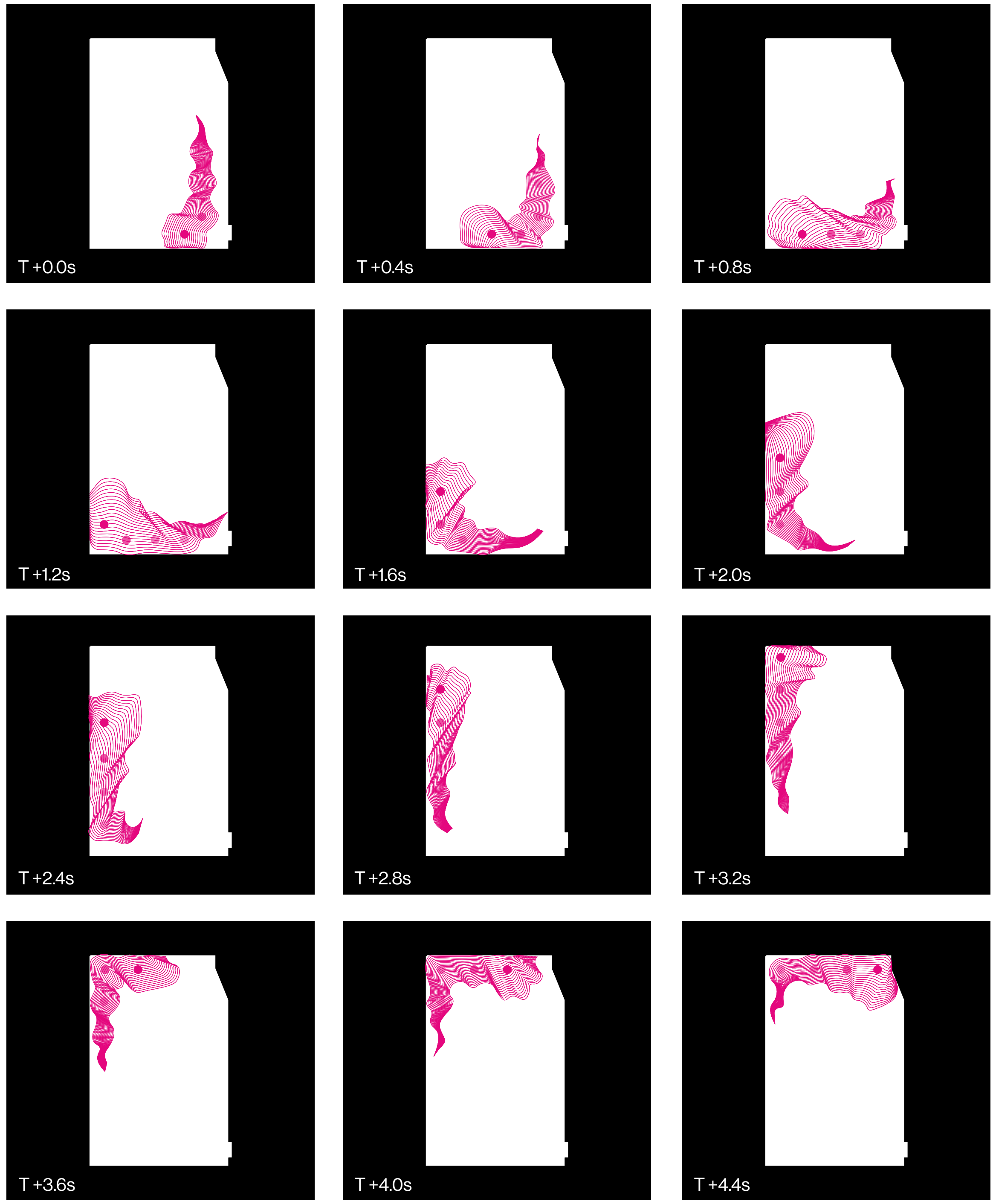
// TYPICAL PROPAGATION SEQUENCE
Tunnel 01 and Tunnel 02
linear mode - Δt: 2.0s

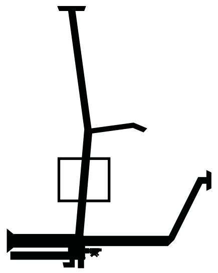




// TYPICAL PROPAGATION SEQUENCE
Core
orbital mode - Δt: 0.4s

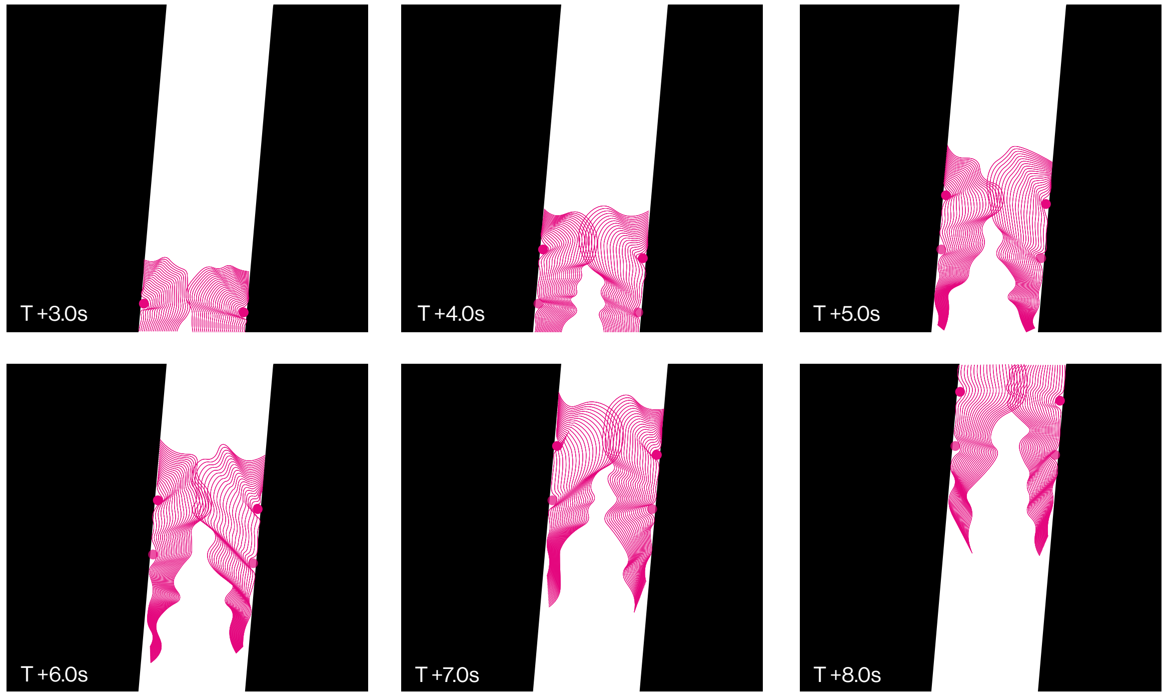
Continuous loop/full circle: 6.8s



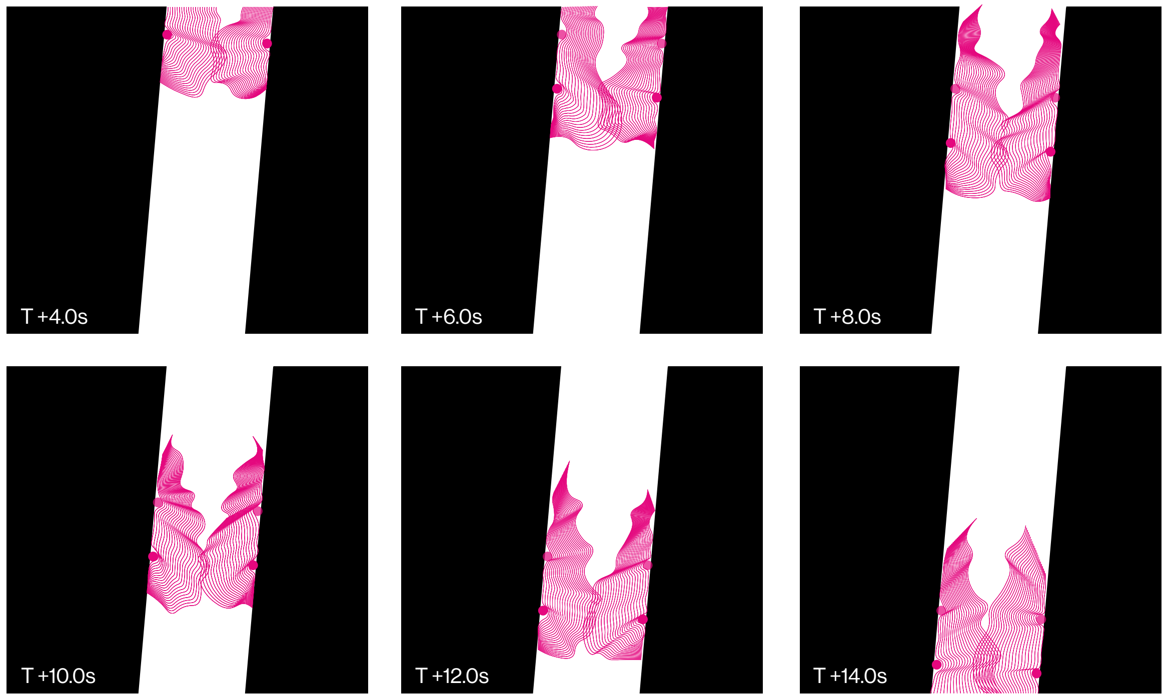


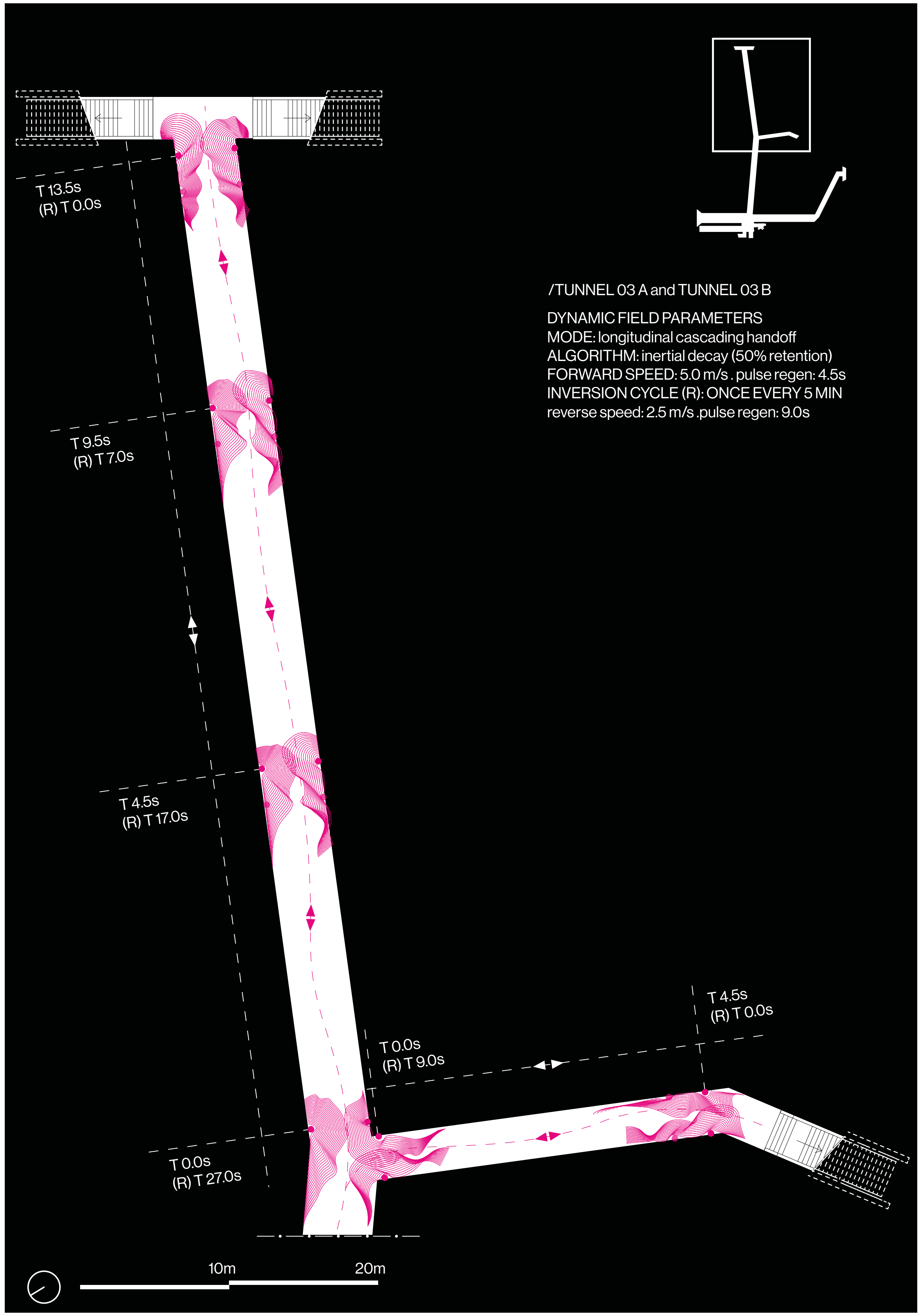
// TYPICAL PROPAGATION SEQUENCE
Tunnel 03
linear mode - Δt: 1.0s/(Reverse) 2.0s

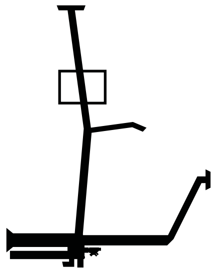
Outward flow (Δt: 1.0s)/full flow: 23.0s



(R) Inward flow (Δt: 2.0s)/full flow: 46.0s

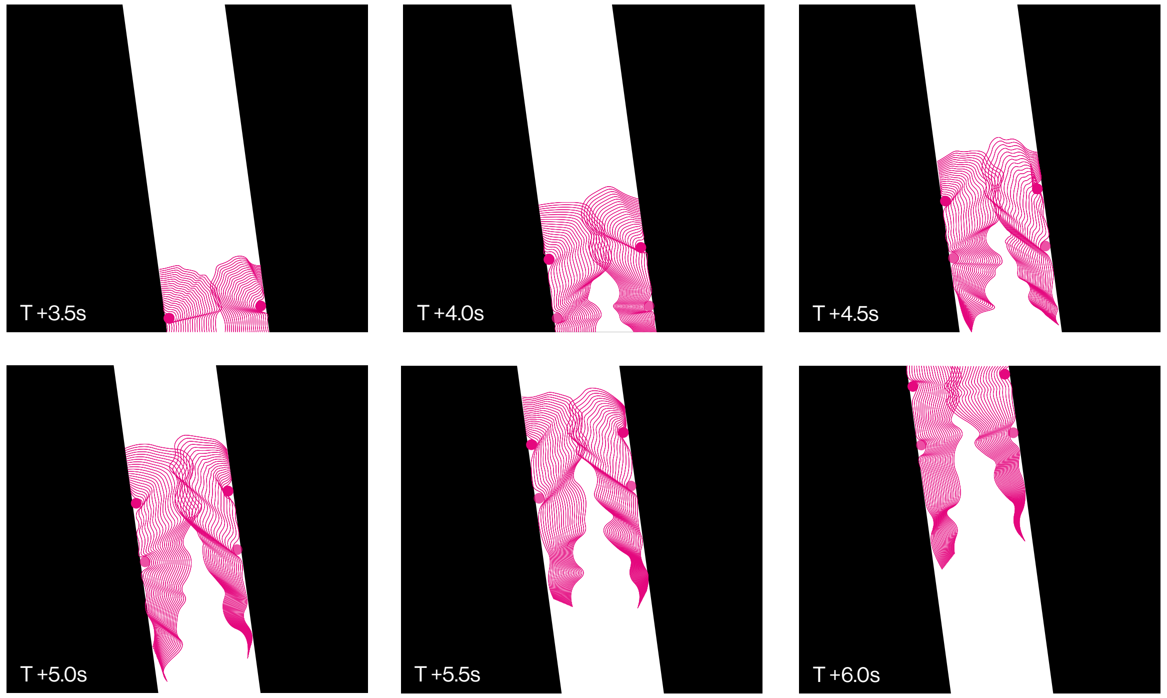




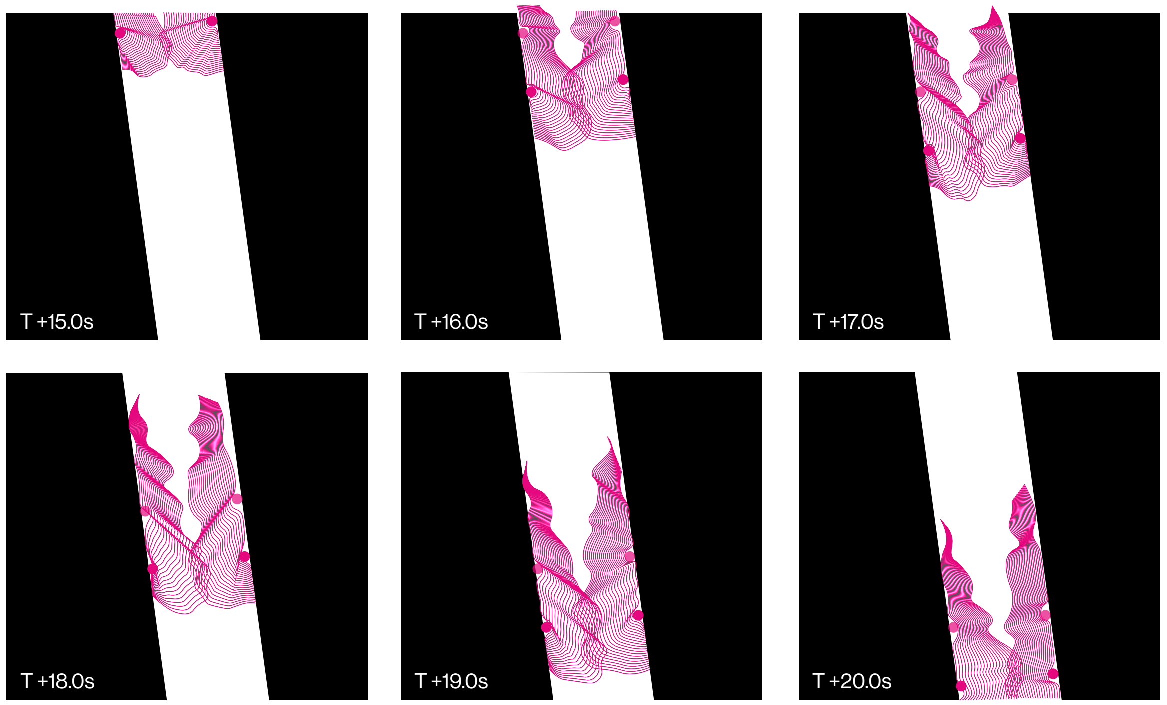


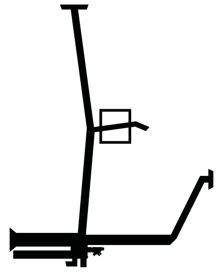
// TYPICAL PROPAGATION SEQUENCE
Tunnel 03 A
linear mode - Δt: 0.5s/(Reverse) 1.0s

Outward flow (Δt: 0.5s)/full flow: 13.5s



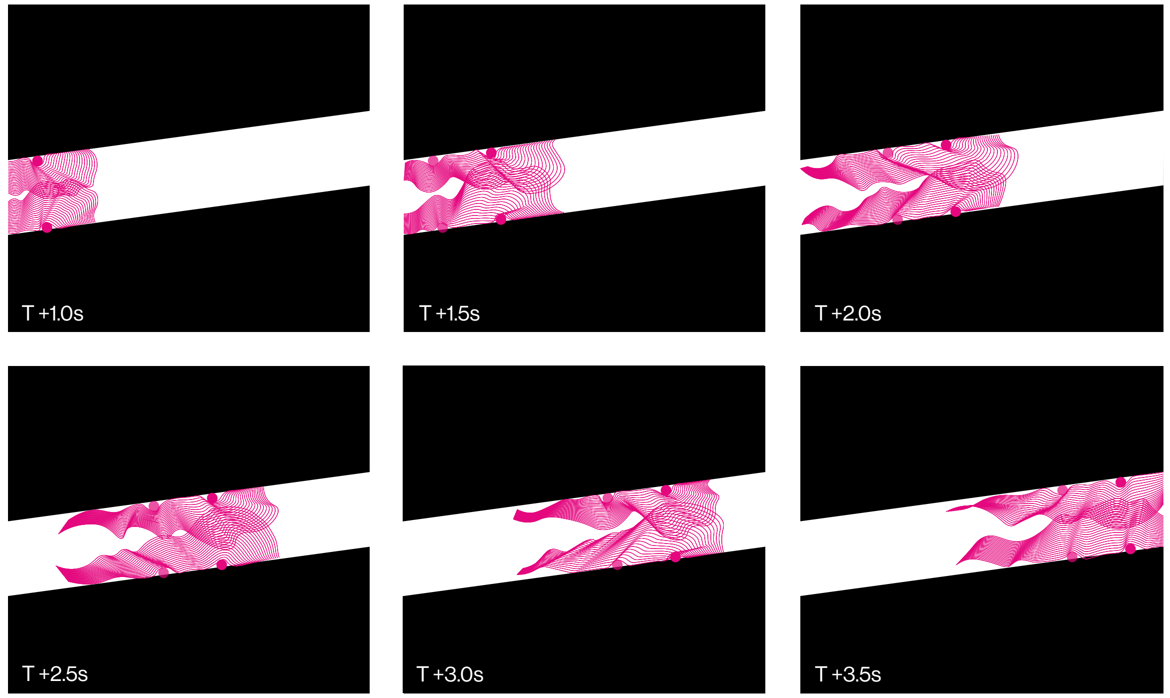
(R) Inward flow (Δt: 1.0s)/full flow: 27.0s



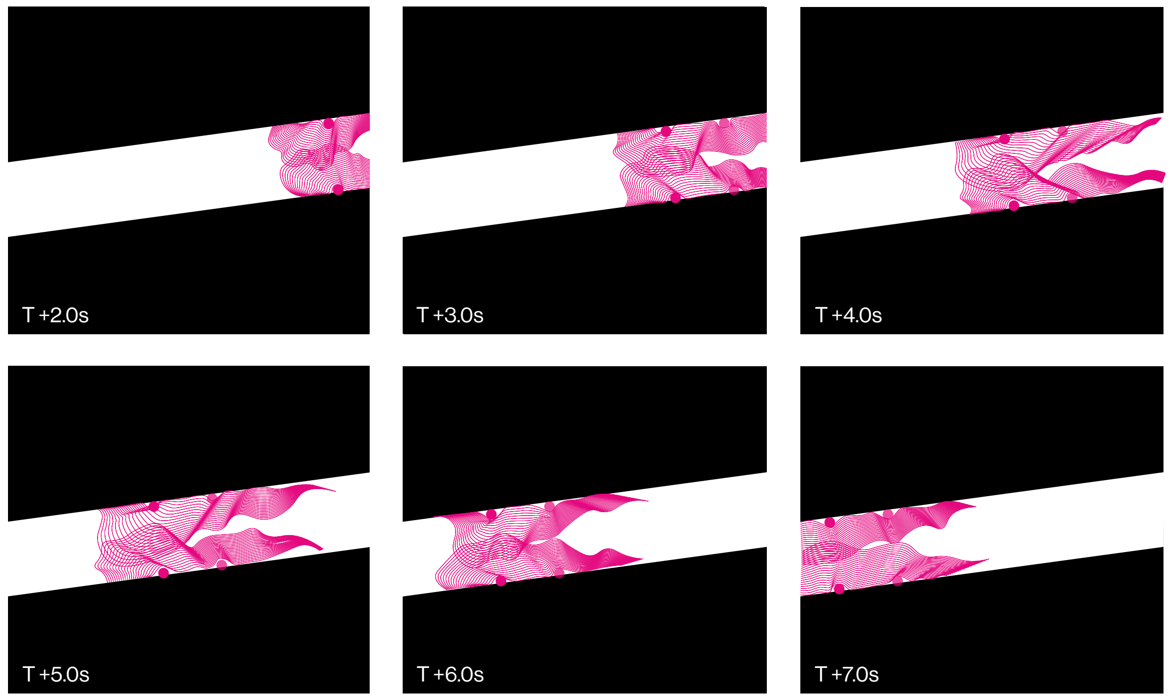


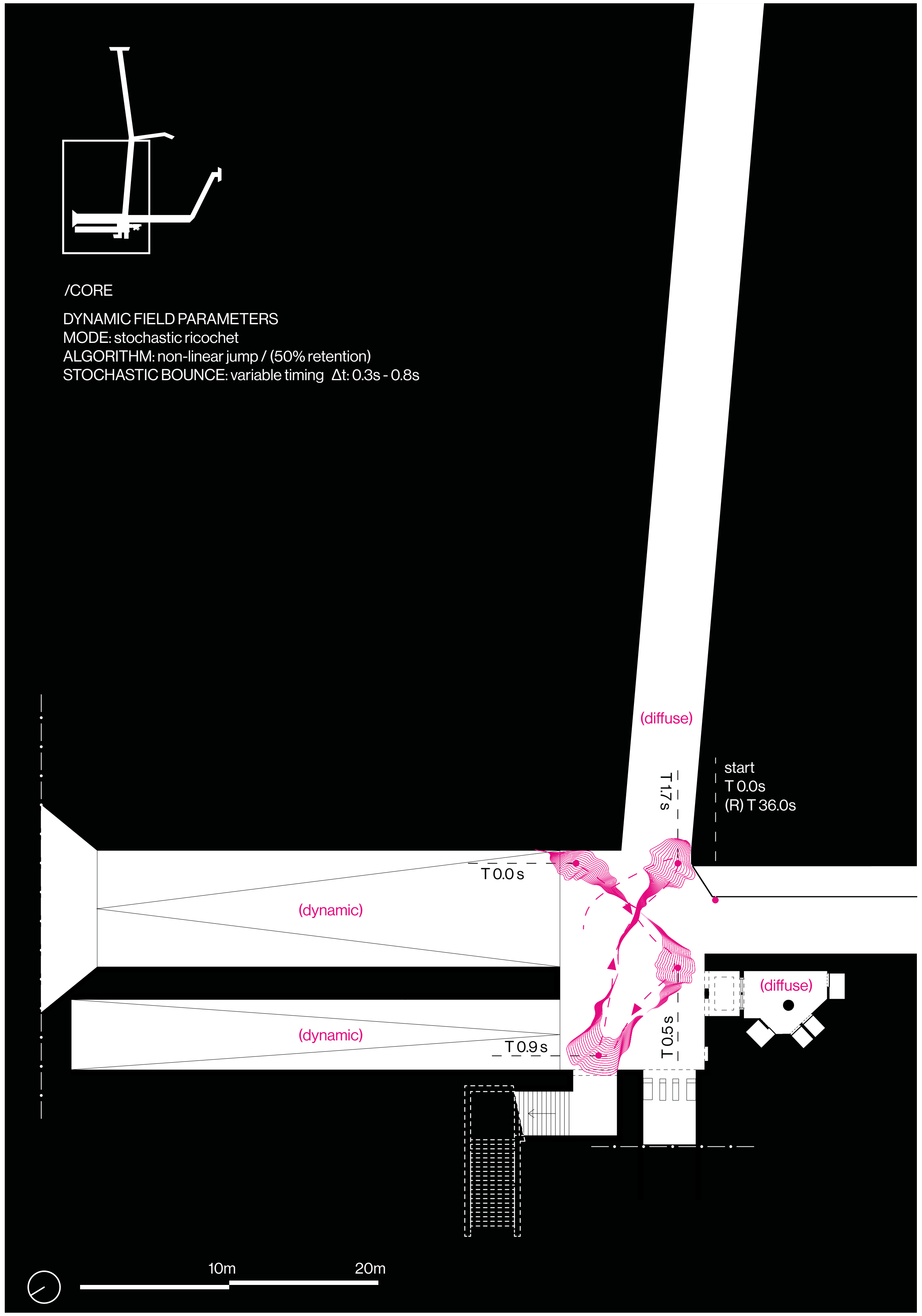
// TYPICAL PROPAGATION SEQUENCE
Tunnel 03 B
linear mode - Δt: 0.5s/(Reverse) 1.0s

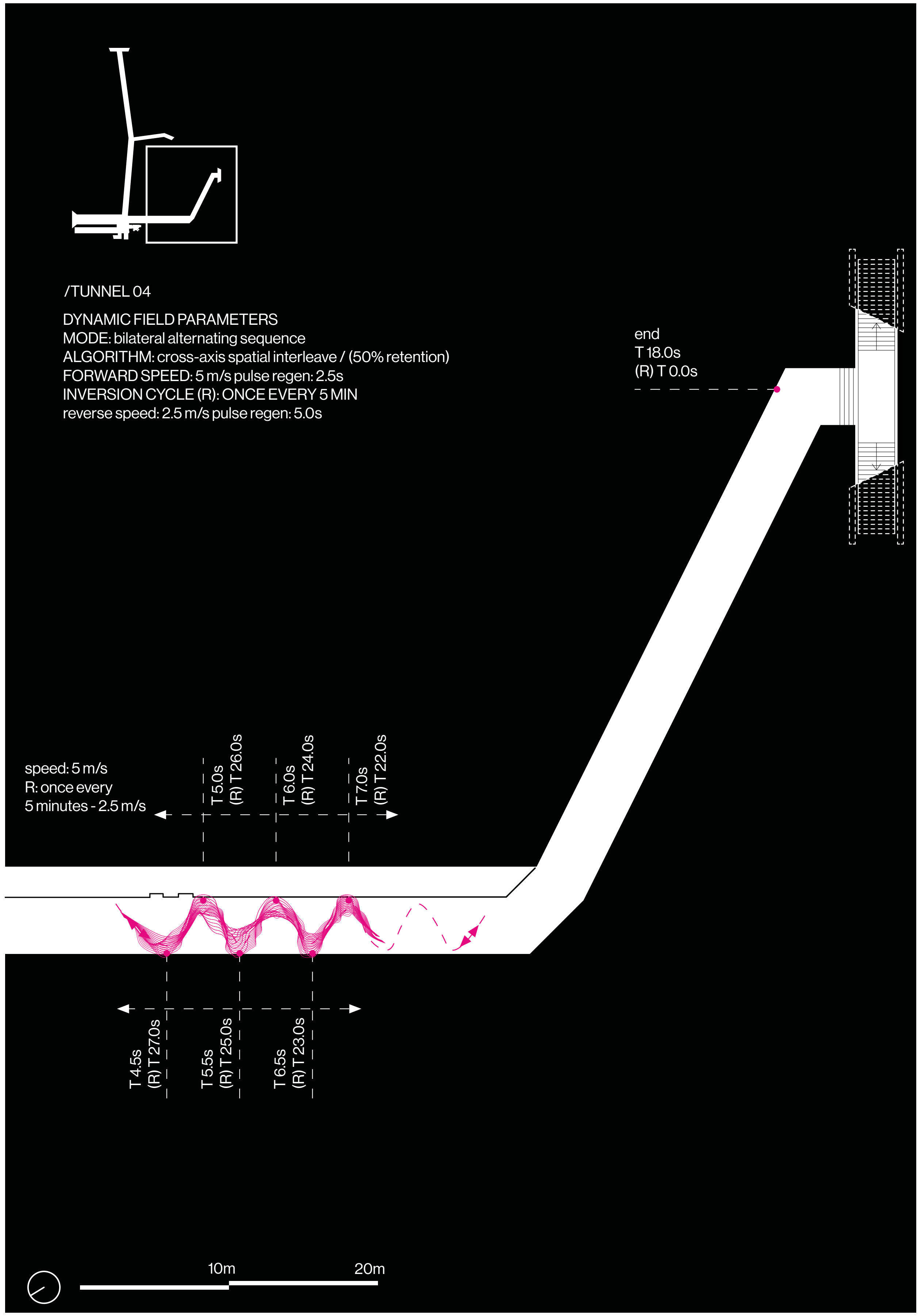
Outward flow (Δt: 0.5s)/full flow: 4.5s

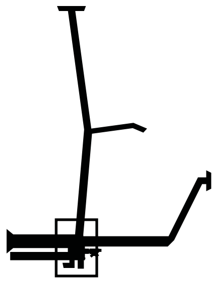


(R) Inward flow (Δt: 1.0s)/full flow: 9.0s



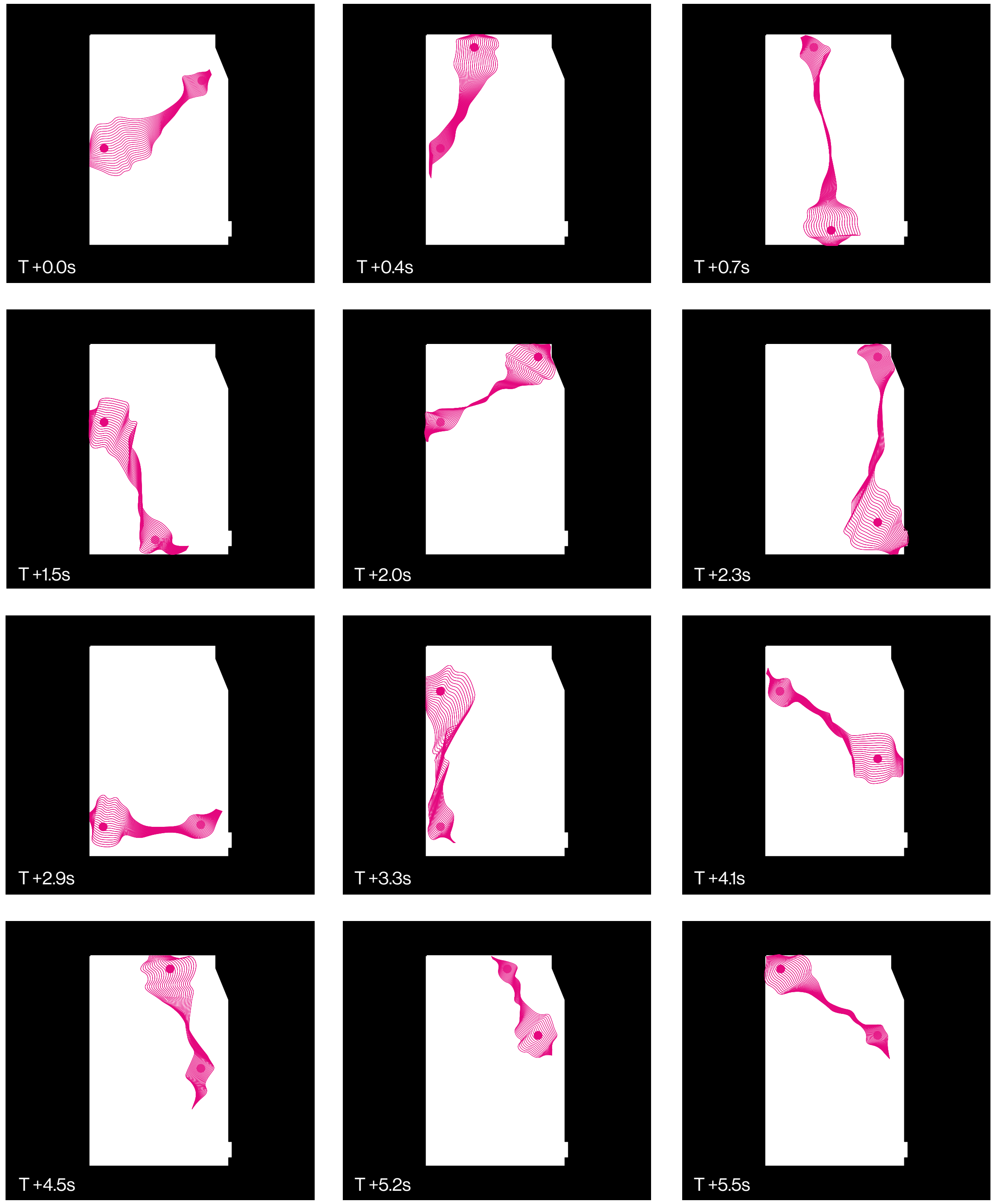

/CORE
DYNAMIC FIELD PARAMETERS
MODE: stochastic ricochet
ALGORITHM: non-linear jump / (50% retention)
STOCHASTIC BOUNCE: variable timing Δt: 0.3s - 0.8s
(diffuse)
start
T 0.0s
(R) T 36.0s
T 1.7s
T 0.0 s
(dynamic)
(dynamic)
T 0.9 s
T 0.5 s
(diffuse)
10m
20m

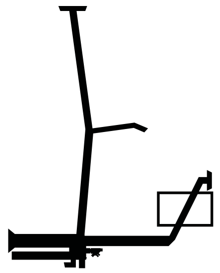

/TUNNEL 04
DYNAMIC FIELD PARAMETERS
MODE: bilateral alternating sequence
ALGORITHM: cross-axis spatial interleave / (50% retention)
FORWARD SPEED: 5 m/s pulse regen: 2.5s
INVERSION CYCLE (R): ONCE EVERY 5 MIN
reverse speed: 2.5 m/s pulse regen: 5.0s
end
T 18.0s
(R) T 0.0s
speed: 5 m/s
R: once every
5 minutes - 2.5 m/s
T 5.0s
(R) T 26.0s
T 6.0s
(R) T 24.0s
T 7.0s
(R) T 22.0s
T 4.5s
(R) T 27.0s
T 5.5s
(R) T 25.0s
T 6.5s
(R) T 23.0s
10m
20m



// TYPICAL PROPAGATION SEQUENCE
Core
stochastic bounce - Δt: 0.3s to 0.8s

Random seed

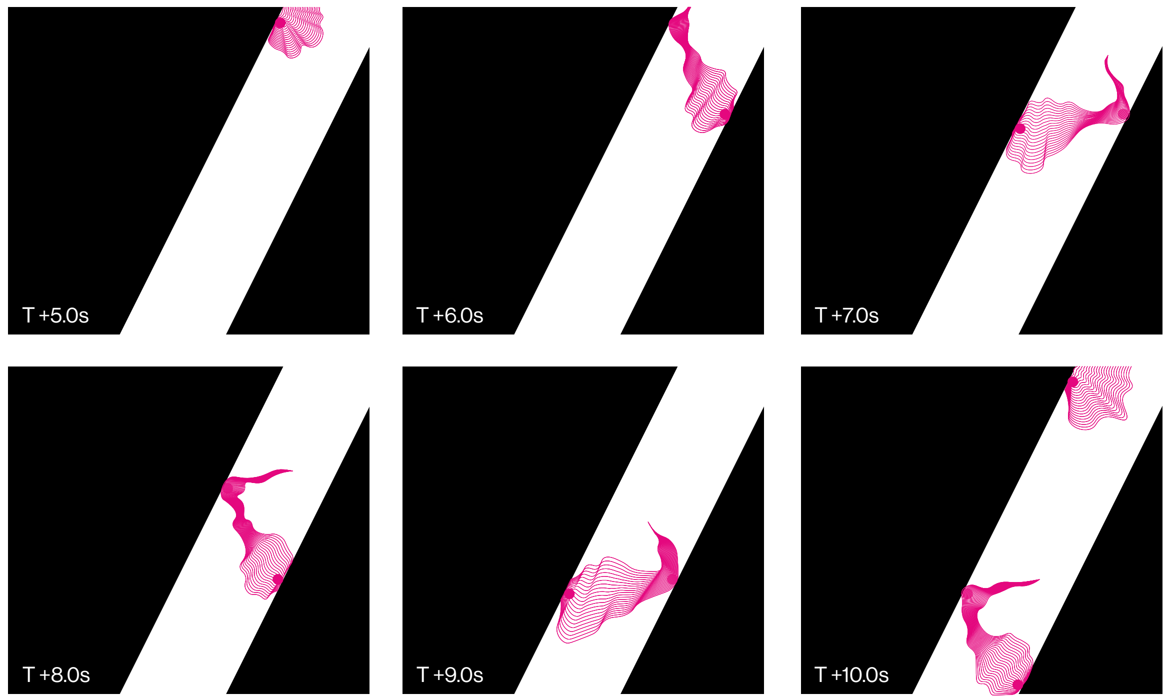




// TYPICAL PROPAGATION SEQUENCE
Tunnel 04
alternating linear mode - Δt: 0.5s
(Reverse) 1.0s

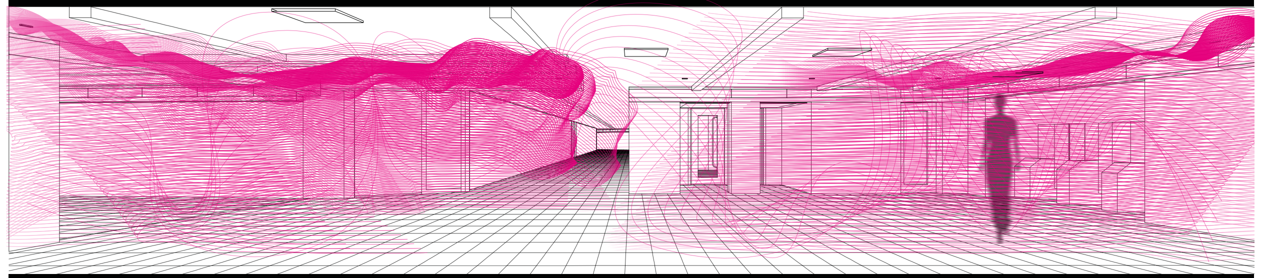
Outward flow (Δt: 0.5s)/full flow: 18.0s

(R) Inward flow (Δt: 1.0s)/full flow: 36.0s

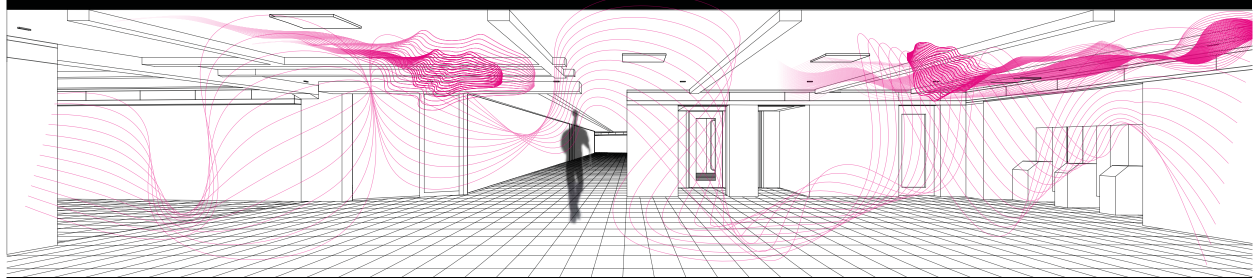


The Tunnel infrastructure is redefined as an enhanced transit machine. The sound act as a propulsion element, integrated into the very structures of movement. Through sonic acceleration, the perception of directionality and transit is pushed to its extreme, defining the transient character of the galleries. Sound flows slowly through the incubation paths toward the Core, where it is violently centrifuged outward through the long tunnels at high sonic velocity.

/ TUNNELS - ATMOSPHERIC SECTIONS

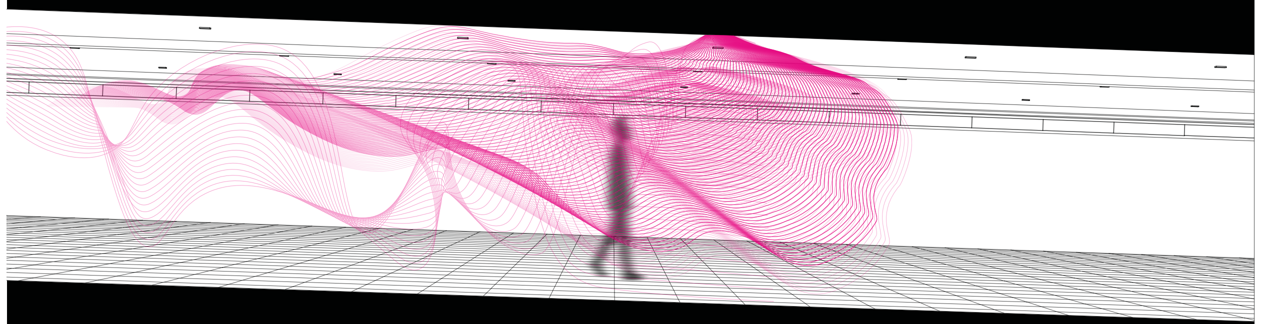


SECTION (TUNNEL 01 - INCUBATOR)
SLOW LINEAR MOTION

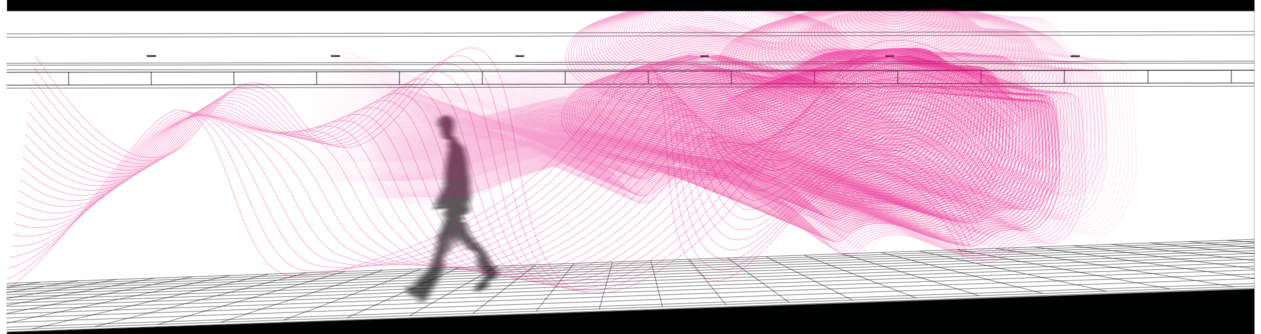


SECTION (TUNNEL 02 - INCUBATOR)
SLOW LINEAR MOTION

1m 2m



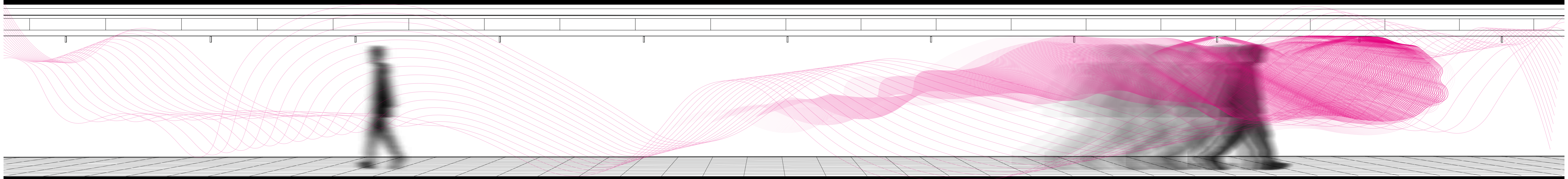
SECTION (CORE)
ORBITAL MOTION



SECTION (CORE)
RANDOM BOUNCE MOTION

1m 2m

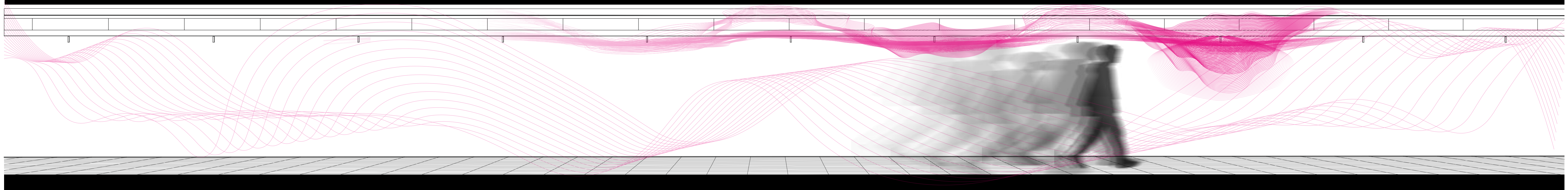
/ TUNNELS - ATMOSPHERIC SECTION



TYP SECTION (TUNNEL 03 - A -B)
FAST LINEAR MOTION

1m 2m

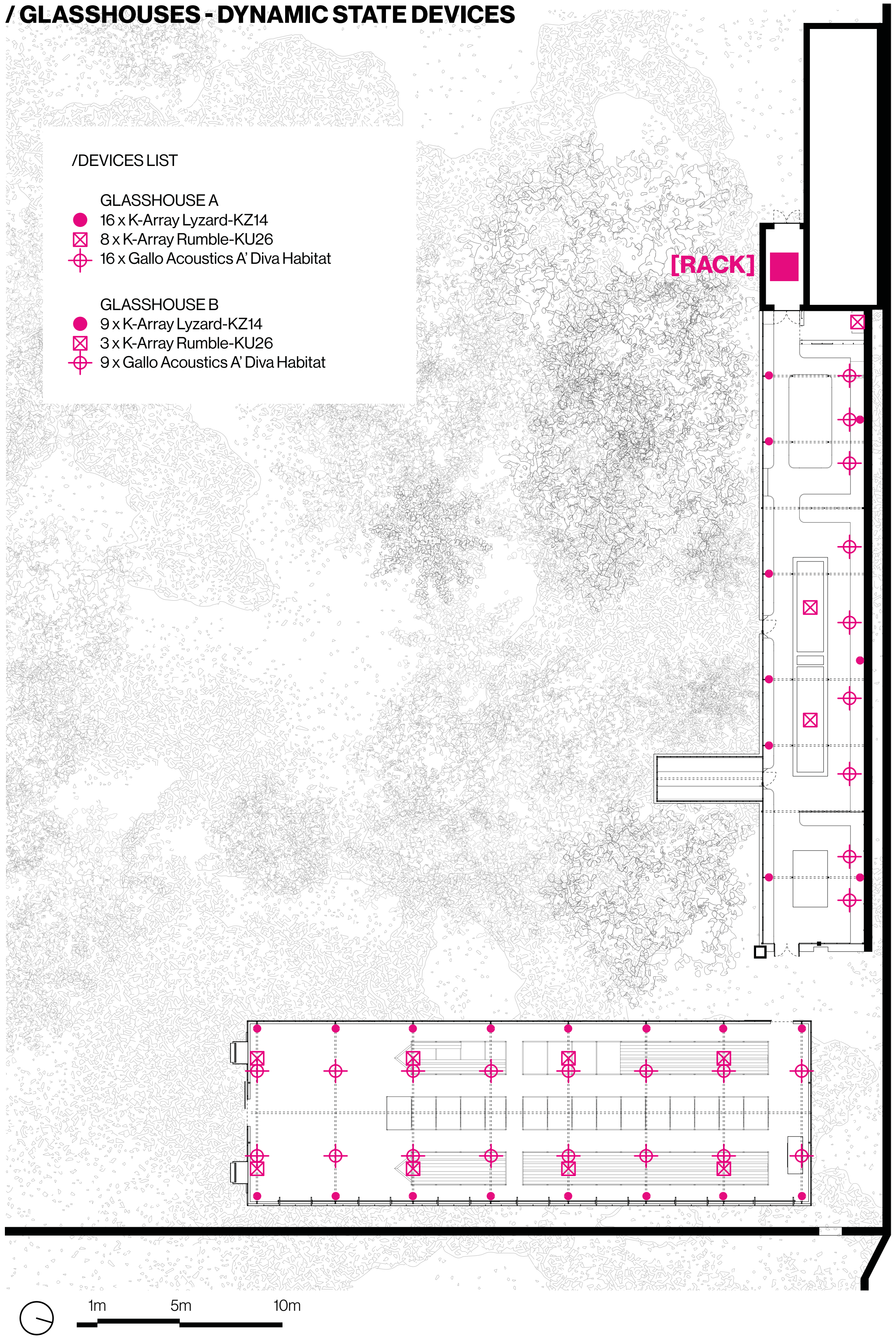
/ TUNNELS - ATMOSPHERIC SECTION



TYP SECTION (TUNNEL 04)
FAST RICOCHET MOTION

1m 2m

/ GLASSHOUSES - DYNAMIC STATE DEVICES



/ AUDIO-SPATIAL ARTICULATION - GLASSHOUSE A

SOUNDSCAPE: STREET SWEEPER BASED
SPL: 58 dB - 68 dB

THREE STRATA DYNAMIC NARRATION

The Dynamic state within Greenhouse A establishes a temporal narrative that traverses space across three primary strata (low, medium, and high) thereby shifting the auditory focal point and the locus of perception within the structural volume. The complete sonic cycle unfolds over a twenty-minute duration, occupying the greenhouse's varying levels in a mutable manner, gradually elevating attention from the ground toward the ceiling. To achieve the desired effect of kinesis and aleatoric movement, the system adopts a technical strategy of stochastic recruitment and field granulation; this defines a randomized order of sound propagation throughout the various phases, spatially decomposing the track to generate a pointillistic effect within the acoustic space.

STOCHASTIC RECRUITMENT

PHASE 01: AWAKENING; SUB-BASS RANGE

The cycle adheres to a precise tripartite structure, defined by three main phases bound to fixed rules and timings. The first phase, "Awakening," occupies the initial nine minutes and thirty seconds. Sound is propagated via an array of eight floor-mounted subwoofers utilizing an algorithm with add/drop logic, facilitating a gradual and stochastic activation of the devices. These initiate singly or in pairs, with time intervals ranging from 30 to 60 seconds. Following this initial moment of gradual onset ("proliferation"), the cycle reaches the second moment of the first phase ("overgrowth"), wherein all subwoofers are active, causing a uniform propagation of sound at the space's lowest level. Subsequent to "overgrowth," the devices begin to deactivate gradually and randomly, constituting the final moment of "Awakening" (defined as "withering"). During this interval, the emission consists of low frequencies (50Hz – 80Hz), managed by a high-pass filter set at 50Hz; this imparts a vibrational, earthly component to the sound, enacting a baric propagation, a physical increase in pressure across the greenhouse floor.

SLOW GRADUAL ACTIVATION

BARIC PROPAGATION

PHASE 02: POLLINATION; MID RANGE

From the ninth to the sixteenth minute, the second phase activates: "Pollination." Here, sound is propagated by an array of sixteen devices positioned at a height of 1.40m, fixed to the structural steel pillars in a perimeter distribution. The logic operative during this timeframe bifurcates into two moments: "swarming" and "sociotomy." During the former, the DSP triggers a vector field triangulation, where sound abandons

CLUSTER MOVEMENTS

SINGULAR ACTIVATIONS

singular movement to activate clusters of three devices simultaneously. These clusters define right-angled triangles generated by the concurrent activation of two frontal speakers and one lateral unit, selected stochastically by the system. The second moment, conversely, is defined by the singular and random activation of devices in space. The intent is to generate "sonic bubbles" that populate the mid-volume of the greenhouse at varying spatiotemporal coordinates, compelling the listener to navigate the area in search of points of total sonic envelopment, only to witness the sudden rupture of these bubbles into more punctual signals. The temporal difference between activations in this phase varies between 10 and 20 seconds, with propagated frequencies residing in the mid-range (500Hz – 2kHz).

PHASE 03: GLIMMER; HIGH RANGE

SIGNAL ATOMIZATION

Between minutes 16 and 20, the cycle transitions to the third and final phase: "Glimmer," comprising three moments ("flickering," "shimmer," and "afterglow"). The array designated for this phase consists of sixteen devices suspended 3 meters above the ground. The system atomizes the audio signal, executing a spatial dispersion that defines a dematerialization of the acoustic space. The first moment is characterized by the random activation and deactivation of various devices while maintaining low sound intensity. The second moment defines the peak of simultaneous random ignitions and maximum intensity, before passing to the third and final moment, where the system begins to diminish in both intensity and the number of active devices, descending toward silence, and, should the algorithm permit, the recommencement of the cycle. This final phase reproduces high frequencies (5kHz – 20kHz), with temporal intervals between activations ranging from 1 to 7 seconds.

/ THE GLADE - DYNAMIC NARRATIVE

PHASE 01: AWAKENING
PROLIFERATION - OVERGROWTH - WITHERING

DYNAMIC FIELD PARAMETERS
MODE: distributed baric accumulation
ALGORITHM: stochastic recruitment ramp (add/drop logic)
FREQUENCY RANGE: 50Hz - 80Hz (sub-bass physicality)
DSP PROCESSING: HPF @ 50Hz
ACTIVATION LOGIC: asynchronous . density: incremental
CYCLE WINDOW: 00:00 - 09:30
INTENSITY PEAK: array saturation . fade: random decoupling

PHASE 02: POLLINATION
SWARMING - SOCIOTOMY

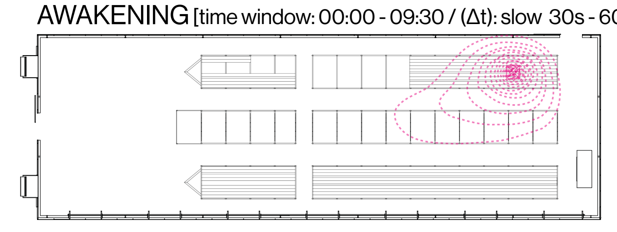
DYNAMIC FIELD PARAMETERS MODE: vector field triangulation
ALGORITHM: dynamic cluster logic (3-point topology)
FREQUENCY RANGE: 500Hz - 2kHz (mid-range presence)
HANDOFF RATE: medium . cluster hold: 10s - 20s
GEOMETRY: right-angle triad (2 Front + 1 Side)
CYCLE WINDOW: 09:00 - 16:00
FINAL SEQUENCE: single-point isolation . Δt: 10s

PHASE 03: GLIMMER
FLICKERING - SHIMMER - AFTERGLOW

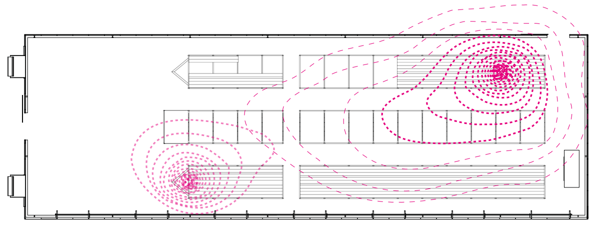
DYNAMIC FIELD PARAMETERS
MODE: spatial granulation (canopy layer)
ALGORITHM: stochastic probabilistic triggering
FREQUENCY RANGE: 5kHz - 20kHz (air band)
BURST DENSITY: variable crescendo . grain interval: 1s - 7s
DISTRIBUTION: randomized X-Y coordinates
CYCLE WINDOW: 16:00 - 20:00
FADE OUT: density rarefaction . end state: null

/ SONIC FLUX SEQUENCE

AWAKENING [time window: 00:00 - 09:30 / (Δt): slow 30s - 60s]



01. PROLIFERATION



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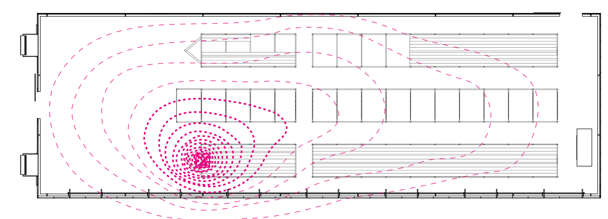

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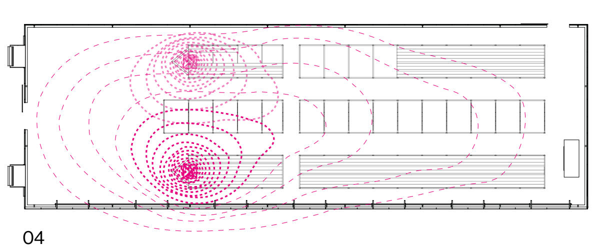

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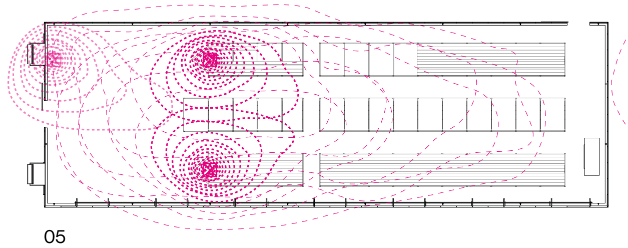

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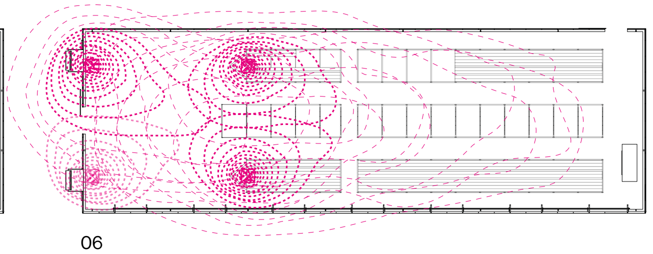

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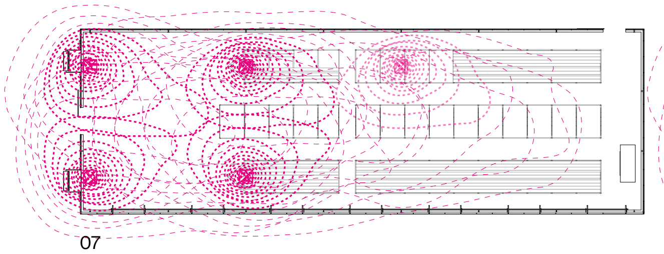

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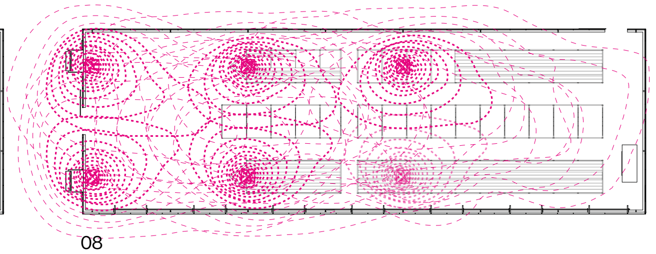

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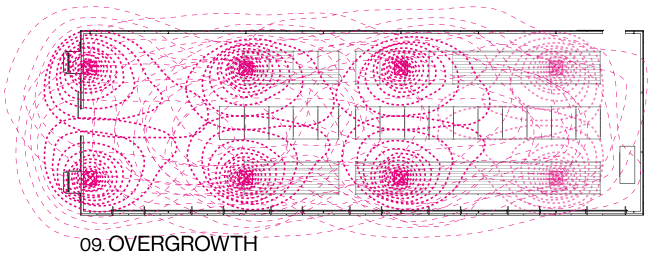
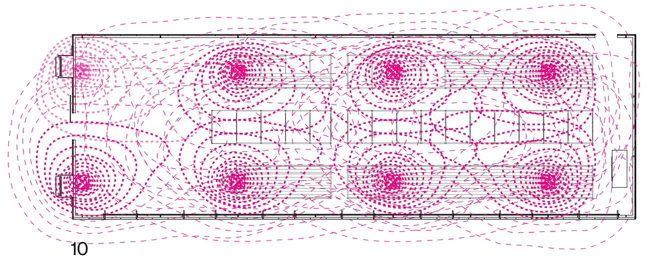


09. OVERGROWTH



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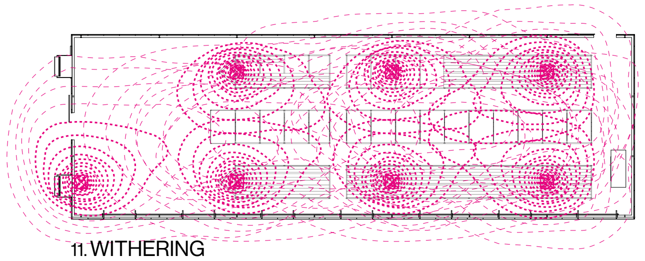
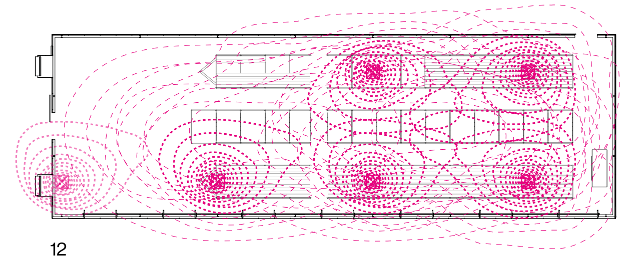


11. WITHERING



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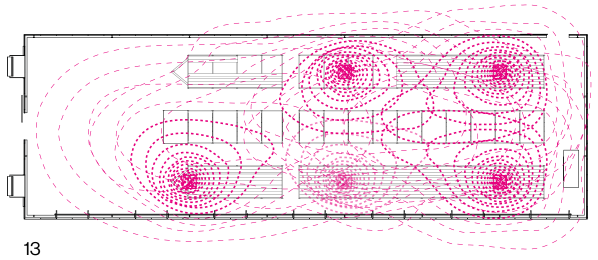

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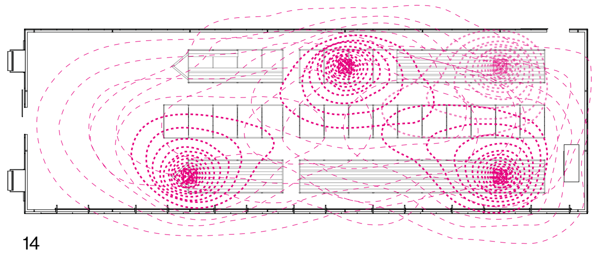

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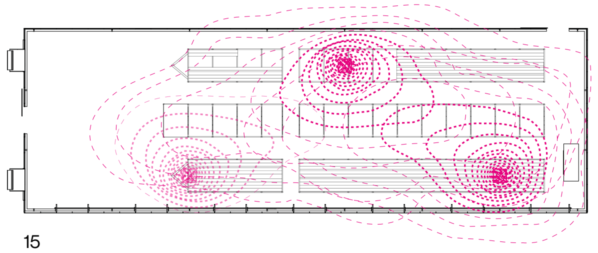

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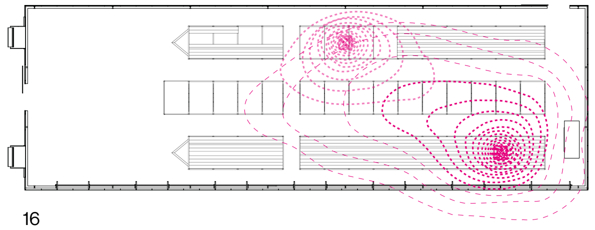

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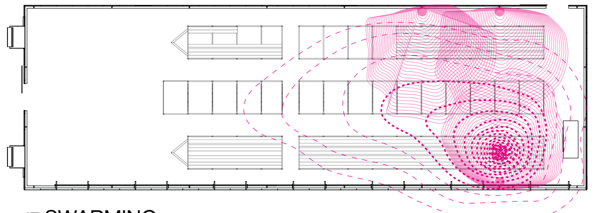
POLLINATION [time window: 09:00 - 16:00 / (Δt): medium 10s - 20s]



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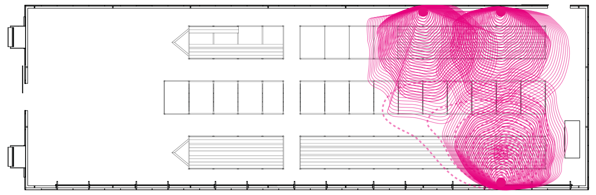

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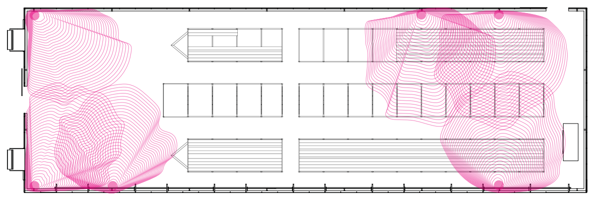

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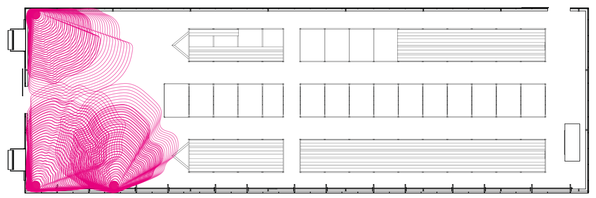

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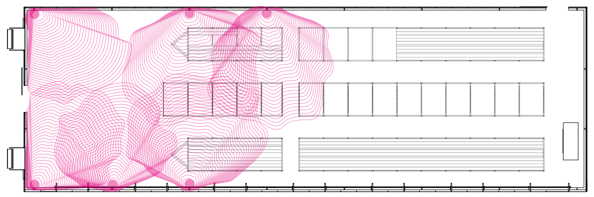

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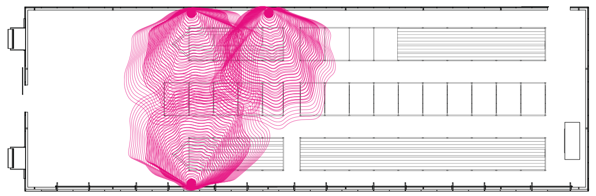

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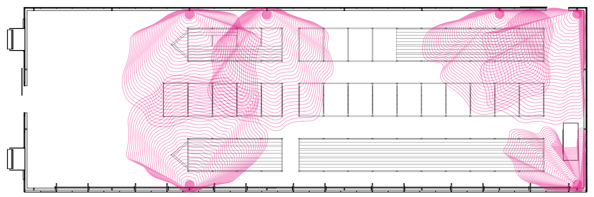

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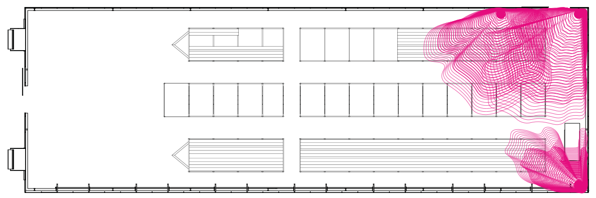

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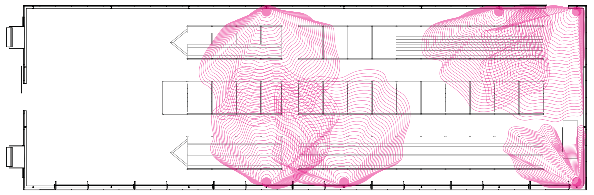
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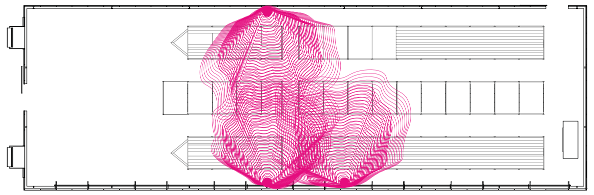
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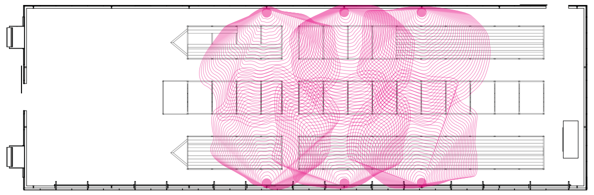
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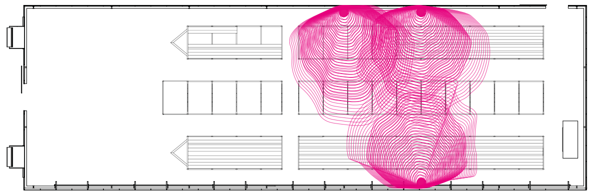
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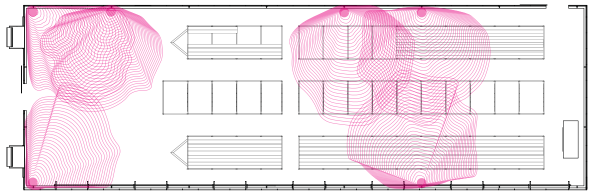
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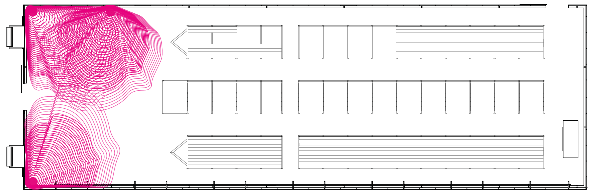
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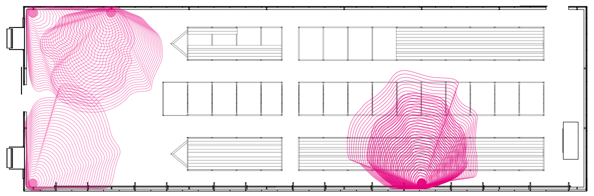
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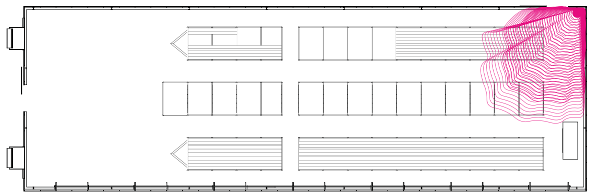
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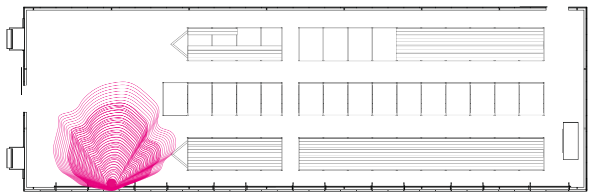
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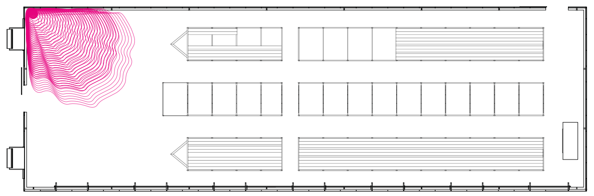
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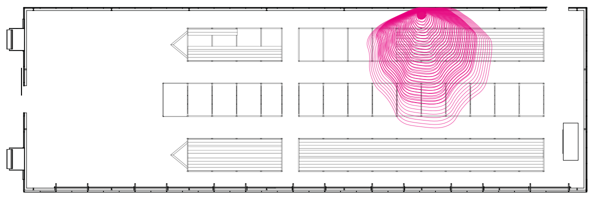
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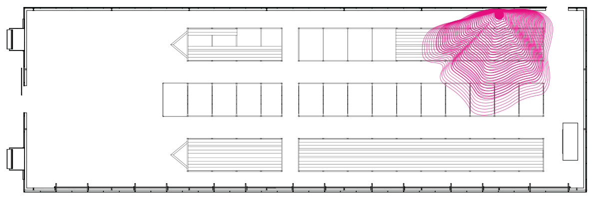
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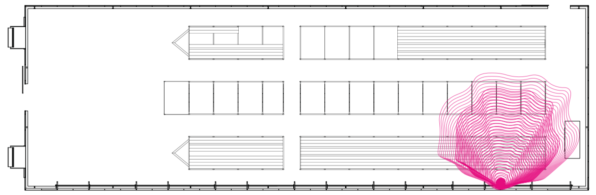
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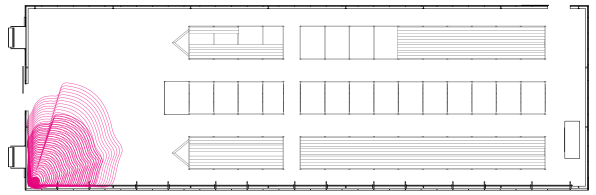
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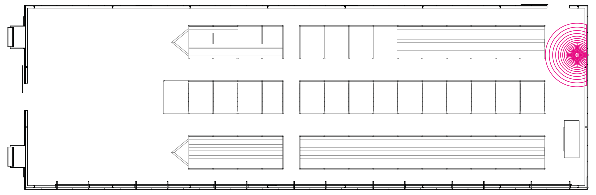
GLIMMER [time window: 16:00 - 20:00 / (Δt): fast 1.0s - 7.0s]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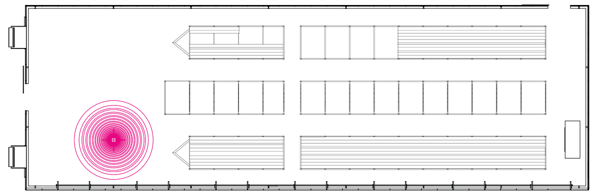
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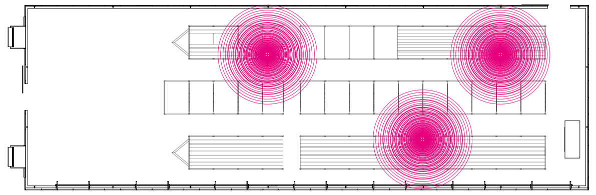
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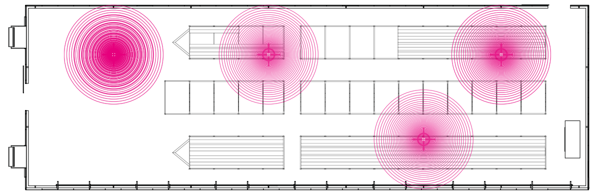
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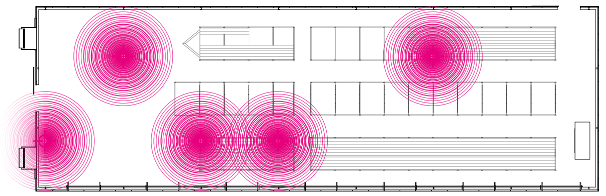
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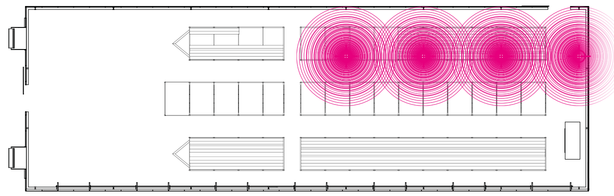
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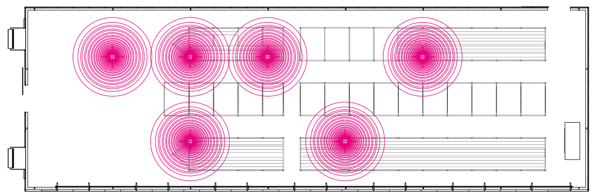
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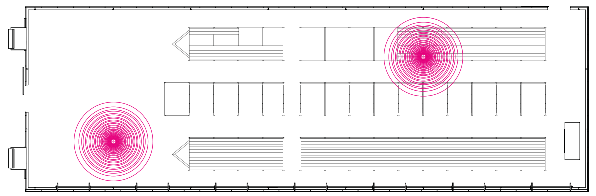
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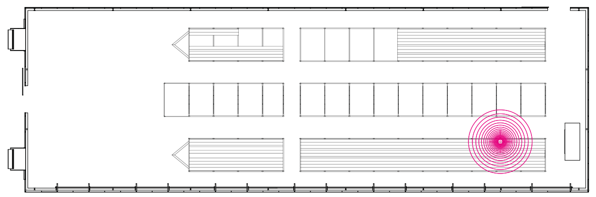
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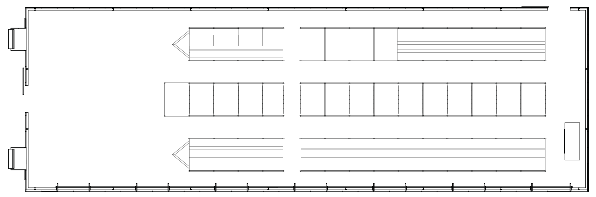
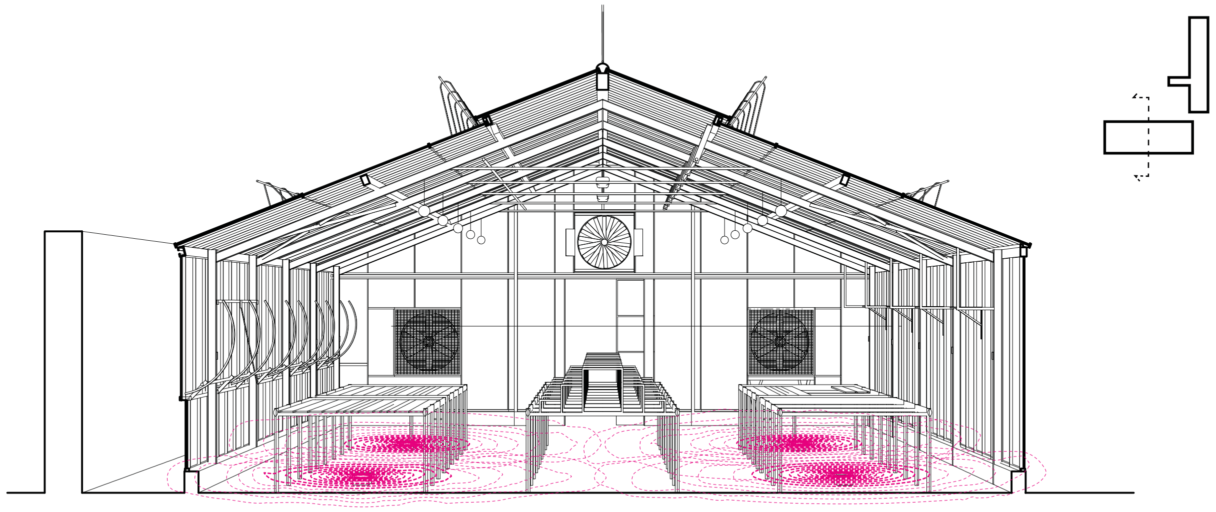
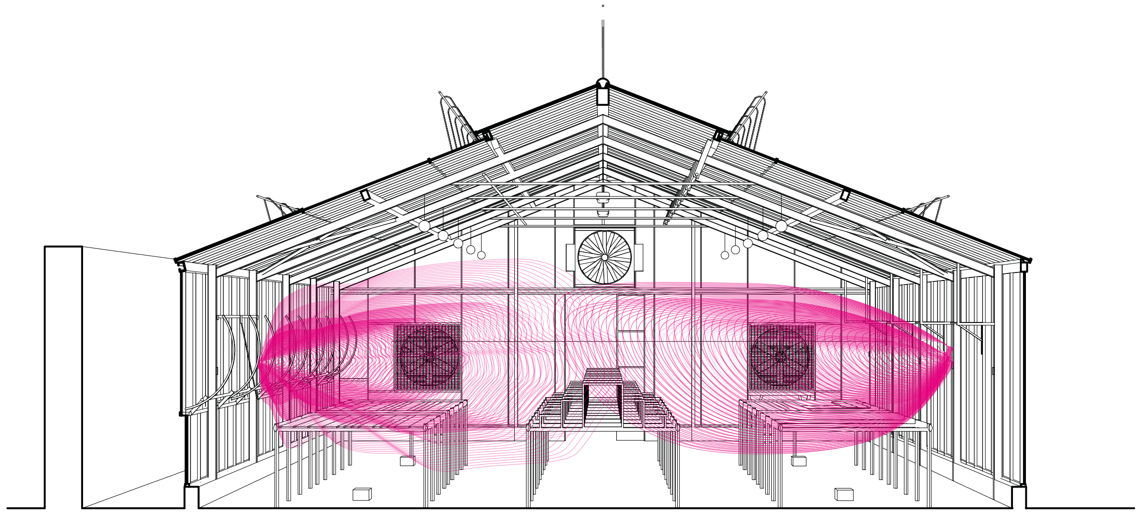

48

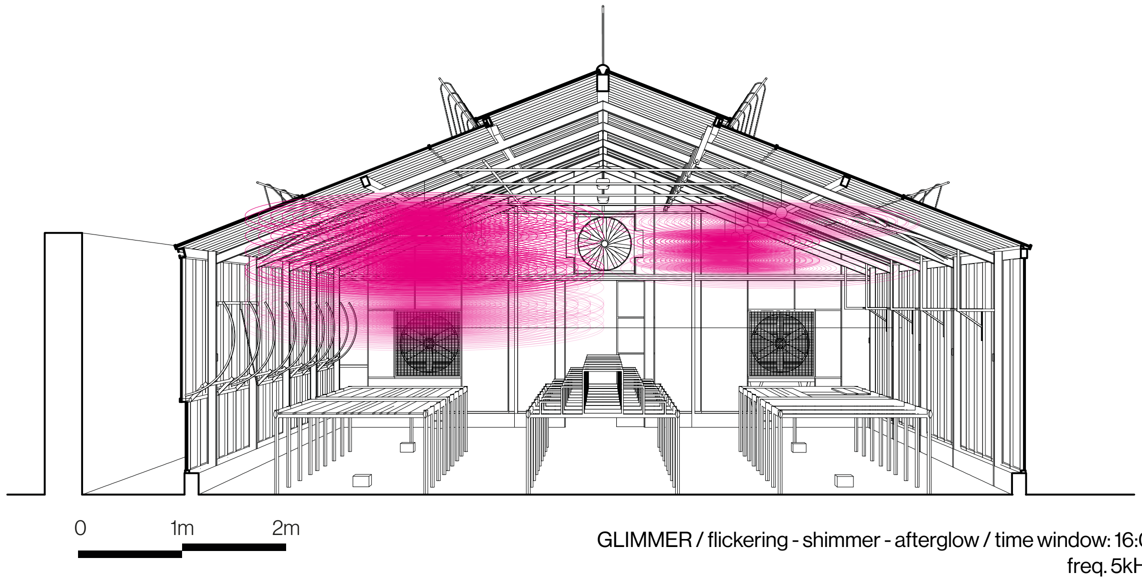
The dynamic cycle of the Glade dissects the space into three physical strata, shifting the center of gravity from the ground toward the ceiling. Through stochastic recruitment and field granulation, the sound undergoes a pointillistic decomposition that erases the stillness of the architecture. The process unfolds as a climatic ascent: “Awakening” saturates the floor into a baric mass; “Pollination” populates the mid-volume with swarms of signals and acoustic bubbles; “Glimmer” finally atomizes the signal at three meters high. Here, high frequencies dematerialize the architecture, reducing the space to a sonic dust that fades into silence.



AWAKENING / proliferation - overgrowth - withering / time window: 00:00 - 09:30 /
freq. 50Hz — 80Hz / DSP: HPF @ 50Hz



POLLINATION / swarming - sociotomy / time window: 09:00 - 16:00 /
freq. 500Hz — 2kHz



GLIMMER / flickering - shimmer - afterglow / time window: 16:00 - 20:00 /
freq. 5kHz — 20kHz

/ AUDIO-SPATIAL ARTICULATION - GLASSHOUSE B

SOUNDSCAPE: STREET SWEEPER BASED
SPL: 70 dB - 78 dB

In Greenhouse B, the Dynamic state is defined by the movement of sound conceived primarily as a sonic mass: a body that emerges from the basins present in the central zone and ascends slowly, invading the walls and saturating the air. The cycle develops over an arc of twenty minutes, and to achieve the sensation of heaviness, accumulation, and slow ascent, two principal technical strategies are employed: coherent summation and spectral morphing.

VISCOUS SONIC ASCENT

The sequence is constituted, from minute 0 to minute 9.30, by the "Exudation" phase, which in turn includes the moments of "seepage" and "pooling." Emitted frequencies range from 45Hz to 60Hz, adopting a low-shelf boost at 45Hz to amplify the lowest register, rendering the acoustic effect more intense and physical. The sound is propagated by two subwoofers positioned within the basins inside the greenhouse, at a level inferior to the walking surface. The first moment ("seepage") defines a series of alternating activations of the two devices, gradually increasing in intensity. During the second moment ("pooling"), both subwoofers are active, moving synchronously with slow pulsations via phase-locked coupling. Through this technique, the waves emitted by the two devices remain constantly in phase, generating a dense substrate that expands throughout the entire lower level of the greenhouse. These sonic movements occur with intervals between 30 and 60 seconds. The subwoofers begin to deactivate gradually once the subsequent phase commences.

PHASE 01: EXUDATION; SUB-BASS RANGE

PHASE LOCKED COUPLING

From minute 9 to minute 16.30, phase two activates: "Encroachment," comprised of the moments "capillarity" and "occlusion." Sound is propagated by a perimeter array of nine devices positioned at 1.4m on the glazed side, and at 1.70m along the concrete wall. The frequencies reproduced in this phase are medium (500Hz – 2kHz), and the time difference between various activations ranges between 10 and 20 seconds. During the "capillarity" moment, sound travels randomly between one device and another within the designated array, defining a gradual sonic invasion of the walls. Crucially, during this moment, a pitch shift is activated, raising the track's pitch to trigger a psychoacoustic process wherein the sound appears to physically ascend within the space. Following

PHASE 02: ENCROACHMENT; MID RANGE

PITCH SHIFT: VERTICAL MOVEMENT

HIGH PASS FILTER

sporadic activations, the cycle reaches the moment of “occlusion,” where sound occupies all wall devices simultaneously. Here, a high-pass filter with cut-off modulation is applied to the track, dynamically shearing the lower frequencies to enhance the perception of sonic ascent.

PHASE 03: HAZE; HIGH RANGE

From minute 16 to 20, the cycle enters the final phase: “Haze,” constituted by the moments “suspension,” “opacity,” and “rarefaction.” The designated array is composed of nine devices suspended 3.40m from the ground, positioned close to the concrete wall to exploit the material’s reflective characteristics for propagating sound throughout the space. Emitted frequencies belong to the high range (5kHz – 20kHz), and sonic movements occur within a temporal arc of 1 to 7 seconds. The phase begins with “suspension,” where a few devices begin to activate and deactivate randomly at weak intensity, actuating fast sonic pulsations that gradually saturate the upper portion of the space with a sonic mist. The second moment, “opacity,” defines a total activation of the array characterized by slight asynchronous pulsations. With “rarefaction,” the system slowly returns to silence, moving toward a new beginning of the cycle, provided the algorithm does not enact a change of state.

ASYNCRONOUS SATURATION

/ THE UNDERGROWTH - DYNAMIC NARRATIVE

PHASE 01: EXUDATION
SEEPAGE - POOLING

DYNAMIC FIELD PARAMETERS
MODE: coherent low-frequency summation
ALGORITHM: asynchronous-to-synchronous coupling
FREQUENCY RANGE: 45Hz - 60Hz (sub-harmonic band)
DSP PROCESSING: L-shelf boost @ 45Hz (gain +6db)
ACTIVATION LOGIC: sequential pairing / unitary phase lock / gradual decoupling
CYCLE WINDOW: 00:00 - 09:30

PHASE 02: ENCROACHMENT
CAPILLARITY - OCCLUSION

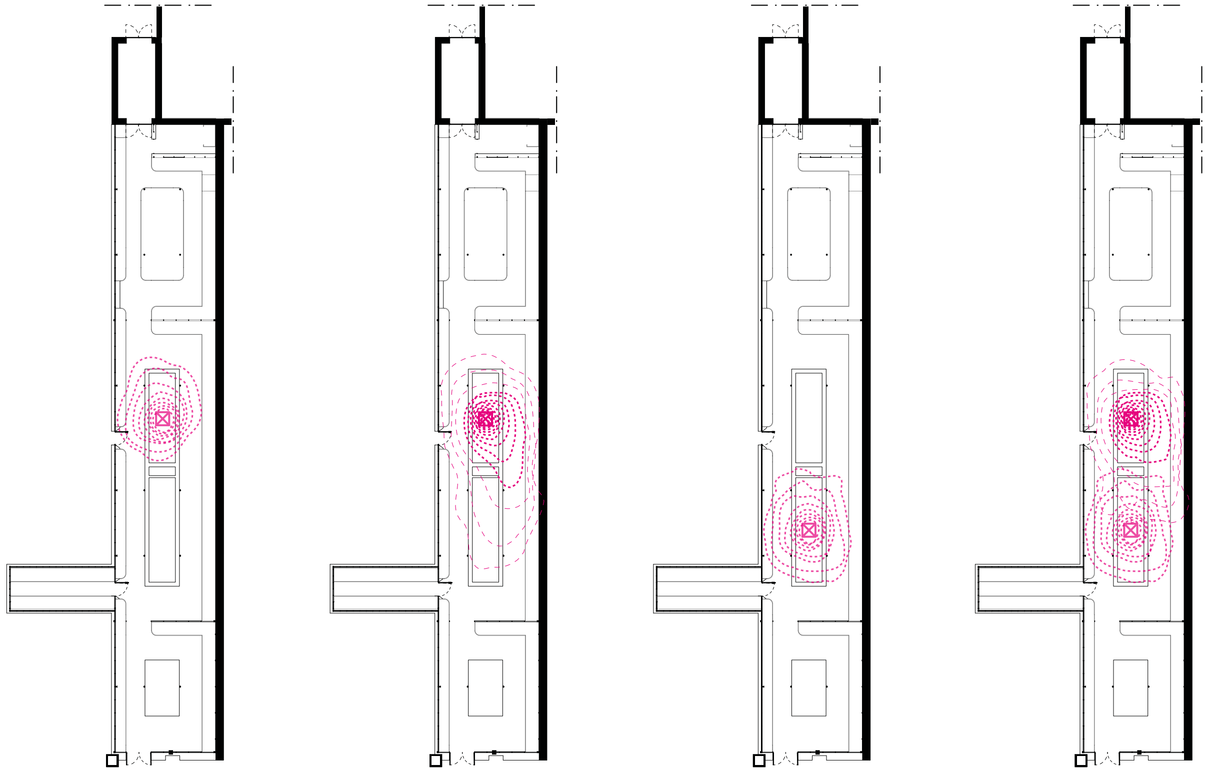
DYNAMIC FIELD PARAMETERS
MODE: spectral upward migration
ALGORITHM: stochastic density ramp (pitch scaling)
FREQUENCY RANGE: 200Hz - 2kHz (mid-band sweep)
FX PROCESSING: pitch shift (+) / dynamic HPF (cut-off modulation)
SATURATION LOGIC: random gating / linear accumulation / stable hold
CYCLE WINDOW: 09:00 - 16:30

PHASE 03: HAZE
SUSPENSION - OPACITY - RAREFACTION

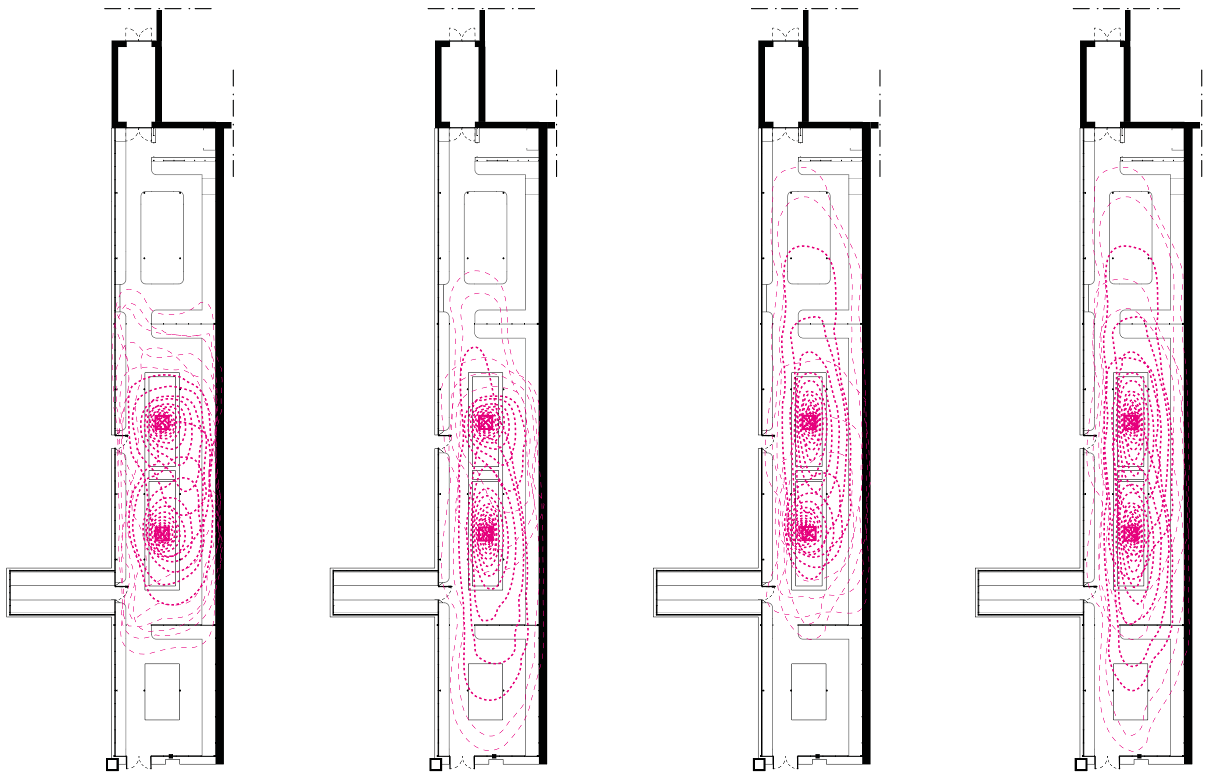
DYNAMIC FIELD PARAMETERS
MODE: distributed high-frequency saturation
ALGORITHM: pulse-to-continuous wave transition
FREQUENCY RANGE: 5kHz - 20kHz
BEHAVIOR: transient bursting / steady state signal / signal decay
Δt (TRANSITION): fast 1s - 7s
CYCLE WINDOW: 16:00 - 20:00

/ SONIC FLUX SEQUENCE

EXUDATION [time window: 00:00 - 09:30 / (Δt): slow pulse 30s - 60s]

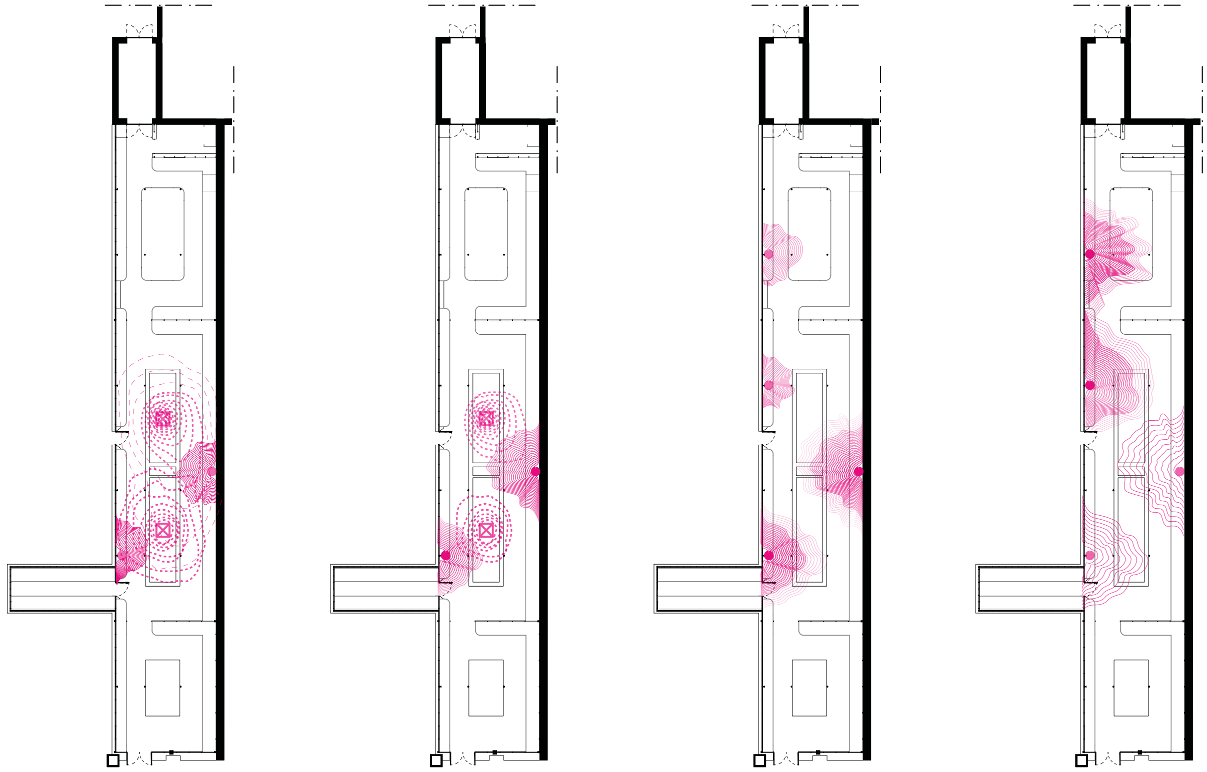


01. SEEPAGE 02 03 04

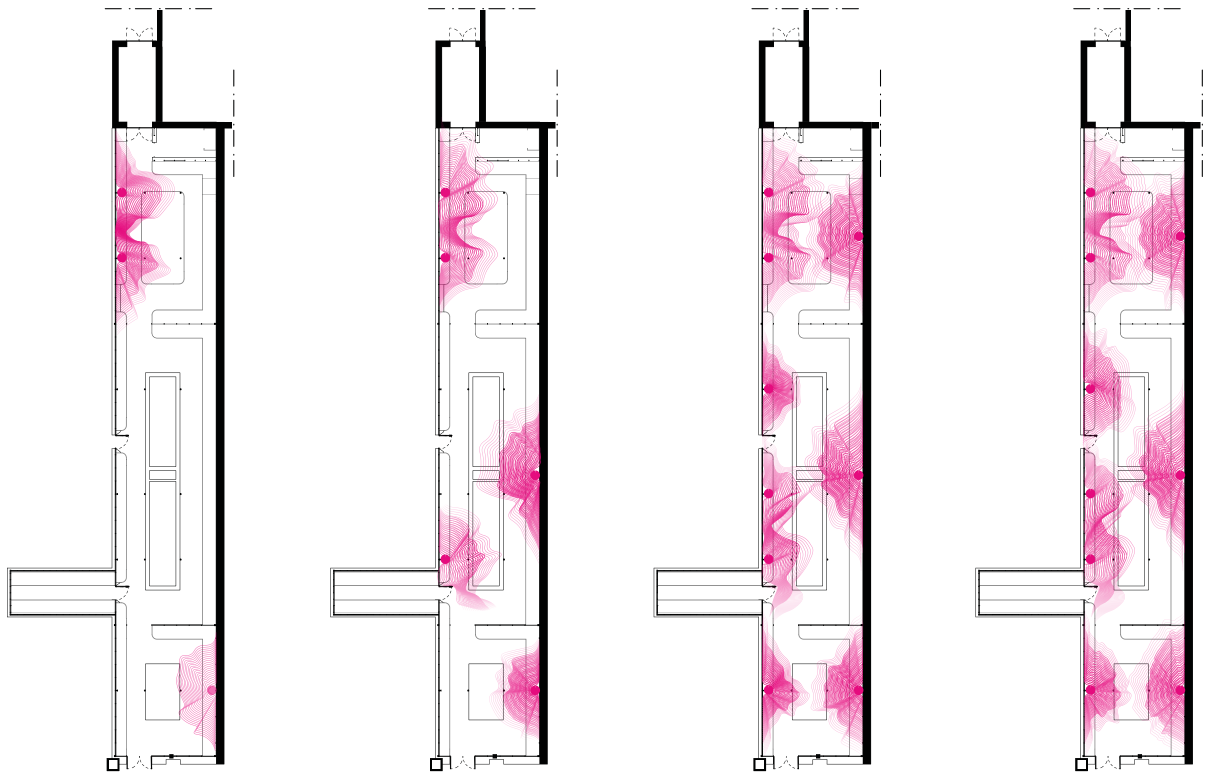


05 06. POOLING 07 08

ENCROACHMENT [time window: 09:00 - 16:30 / (Δt): ascent 10s - 20s]

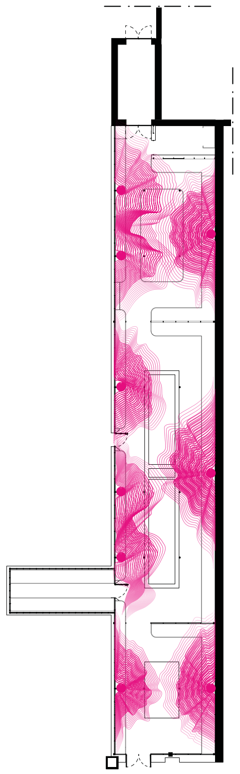


09. CAPILLARITY 10 11 12. [fx: pitch shift (+)]



13 14 15. OCCLUSION 16. [fx: high-pass filter]

HAZE [time window: 16:00 - 20:00 / (Δt): light pulse 1.0s - 7.0s]



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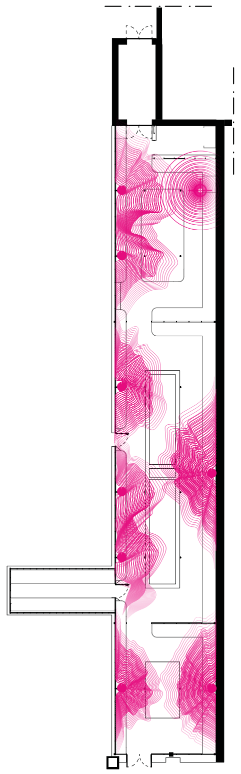
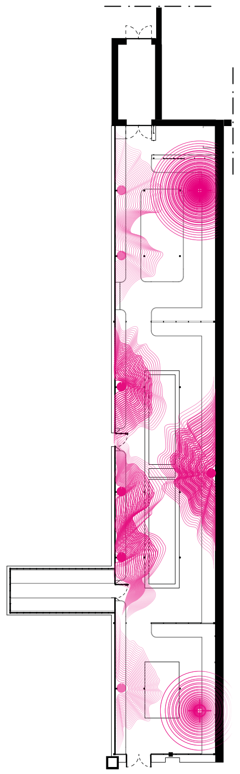


18. SUSPENSION



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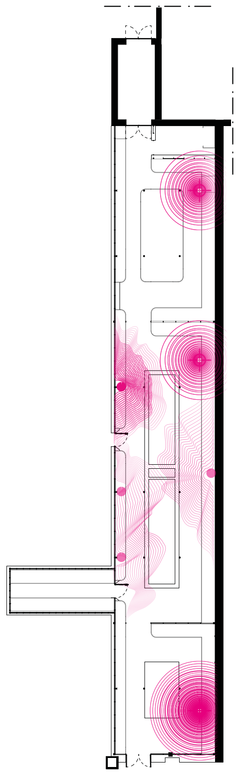

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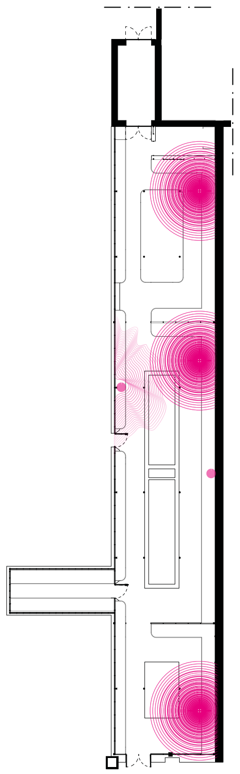

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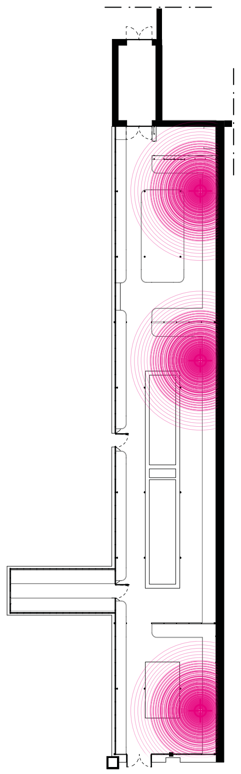

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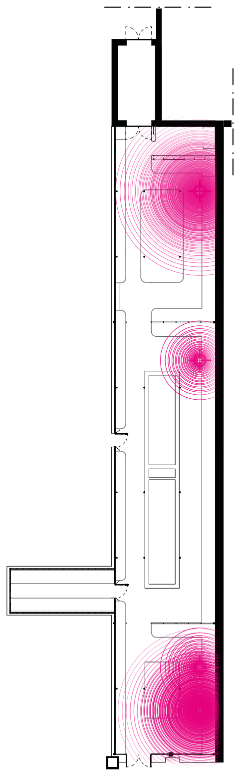

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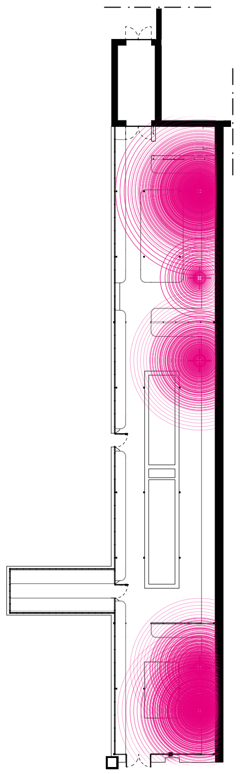

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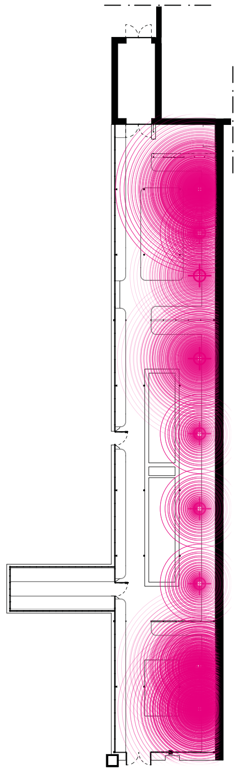

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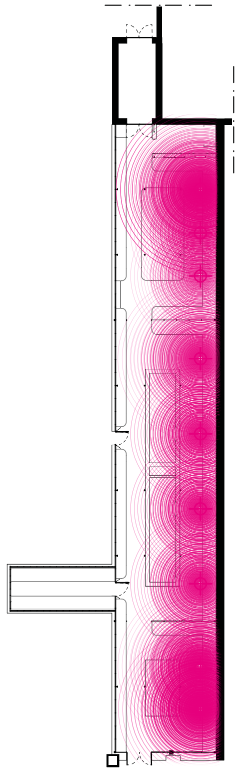

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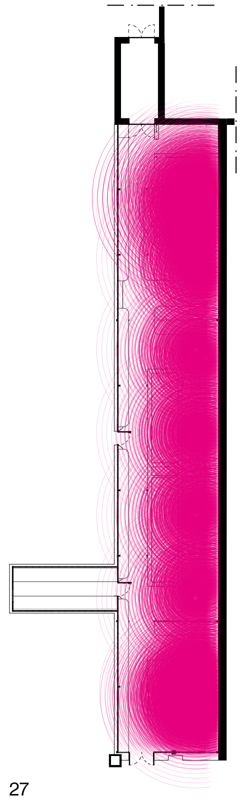

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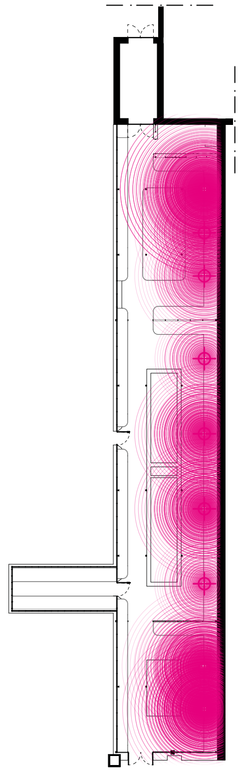

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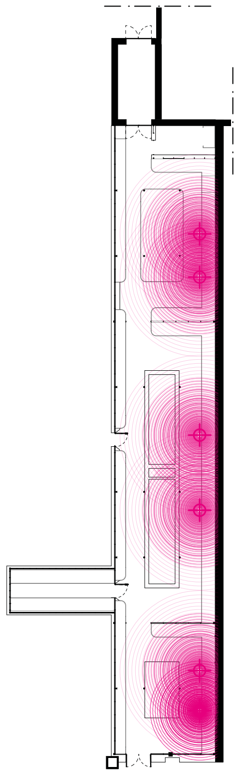

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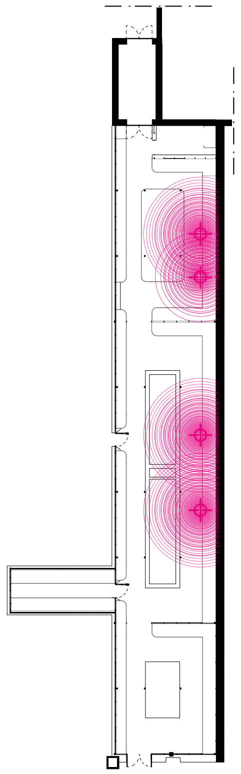

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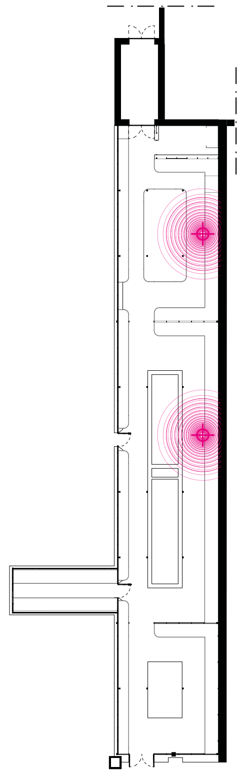

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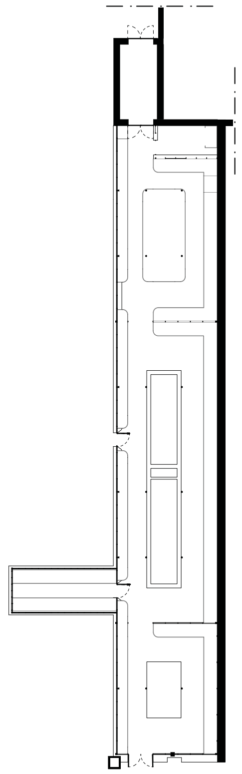
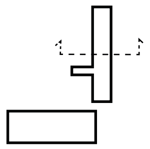


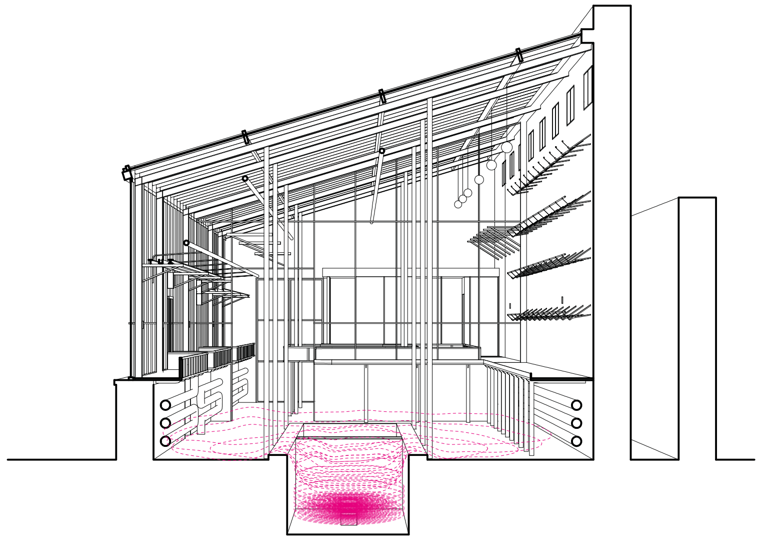
32

Within the Undergrowth, sound invades the architecture as a physical mass, exuding from the subsoil to saturate the space. Through coherent summation and spectral morphing, the signal emerges from the central basins and climbs the walls, transforming the air into a dense, opaque body.

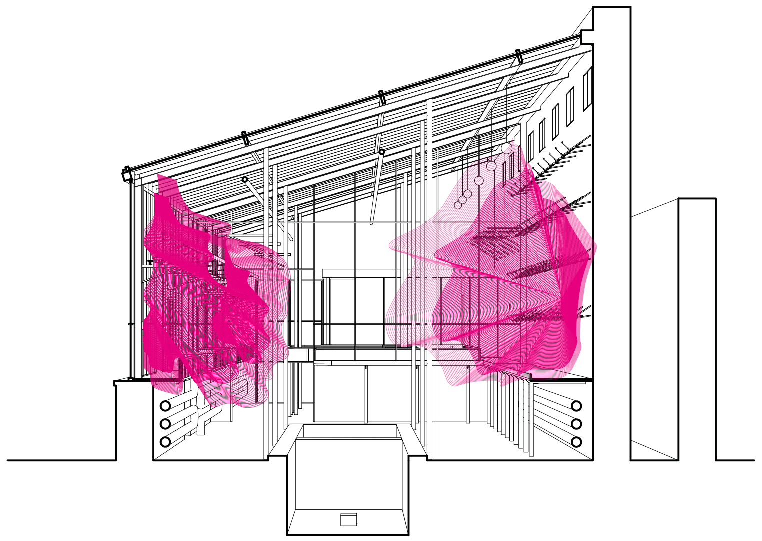
The process unfolds as a volumetric infestation: “Exudation” accumulates a vibrating substrate within the ground; “Encroachment” pushes the acoustic mass along the perimeter to occlude the space; finally, “Haze” fills the higher spatial level. Here, the sound becomes a thick mist that occupies the top of the structure before vanishing into silence.



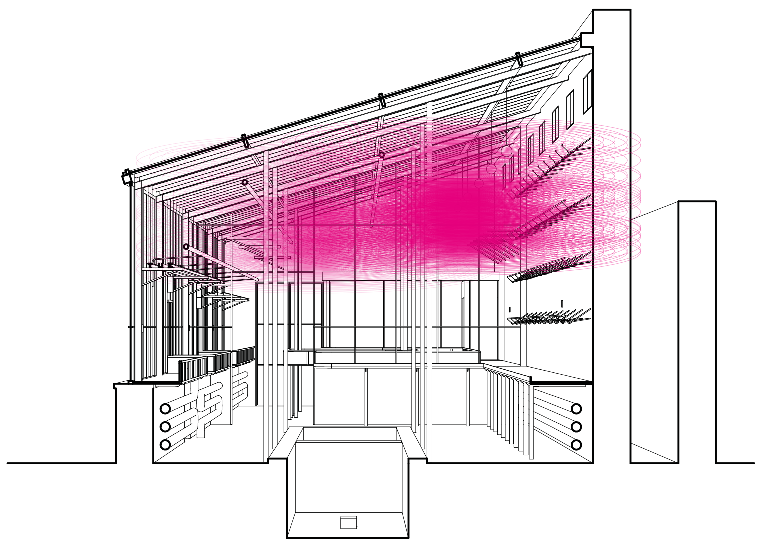
EXUDATION / seepage - pooling /
time window: 00:00 - 09:30 /
freq. 45Hz — 60Hz /
DSP: L-shelf boost @45Hz



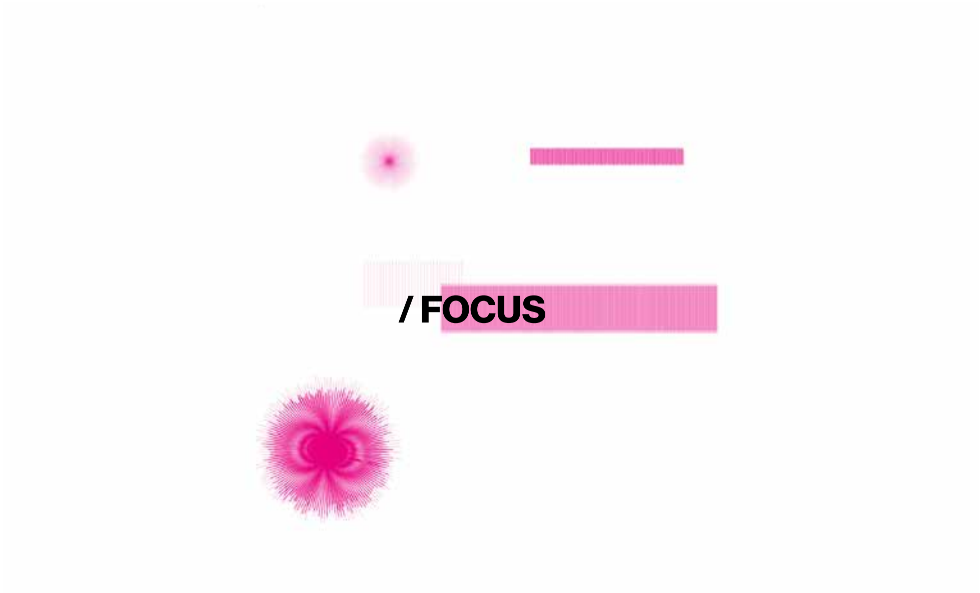
ENCROACHMENT / capillarity - occlusion /
time window: 09:00 - 16:30 /
freq. 500Hz — 2kHz /
fx: pitch shift (+) - HPF



HAZE / suspension - opacity - rarefaction /
time window: 16:00 - 20:00 /
freq. 5kHz — 20kHz

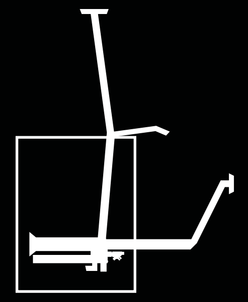


0 1m 2m



Marking a radical departure from the combinatorial logic of the preceding phases, the Focus State signals a definitive exit from the realm of Split States, previously characterized by the simultaneous confrontation of opposing atmospheres, to establish itself as a totalizing sonic condition. In this configuration, space is not merely traversed but actively constructed through the deployment of hyper-directional parametric devices, which can overcome omnidirectional propagation to sculpt sharp and confined sonic volumes. This technology generates a binary spatial syntax, defined by a radical alternation between compression (points of high intensity) and decompression (acoustic voids), effectively endowing sound with an almost tectonic property. Through this material modulation, the acoustic wave ceases to be ephemeral, evolving into a construction material that superimposes an invisible architecture over the physical one; this process guides the visitor's attention by establishing intangible thresholds, densities, and structural rigidities that profoundly alter the phenomenology of the site.

/ TUNNELS - FOCUS STATE DEVICES



/DEVICES LIST

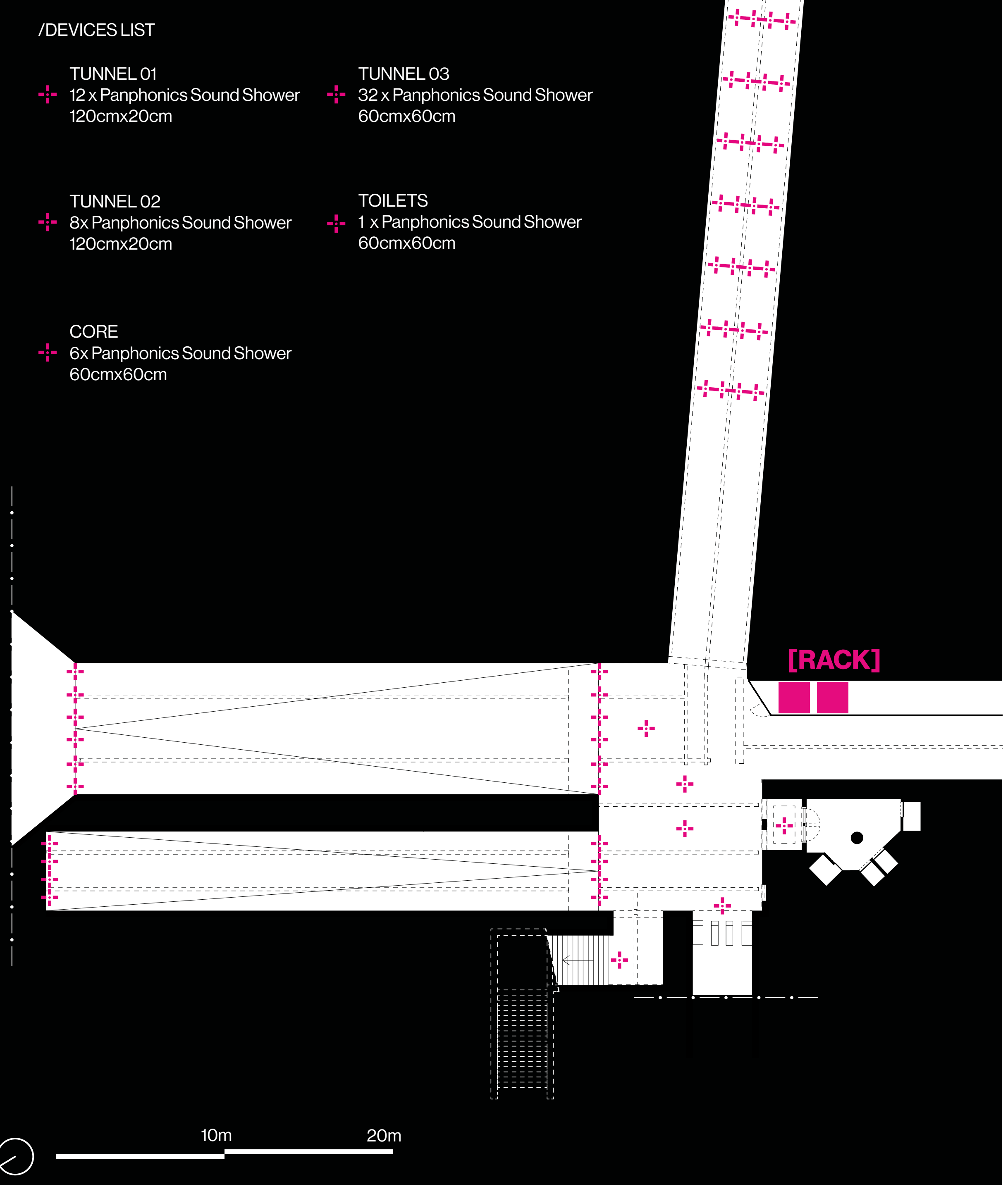
TUNNEL 01
12 x Panphonics Sound Shower
120cmx20cm

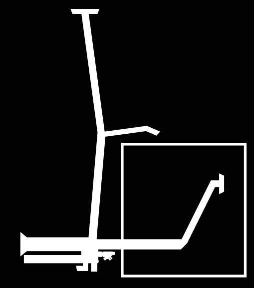
TUNNEL 03
32 x Panphonics Sound Shower
60cmx60cm

TUNNEL 02
8x Panphonics Sound Shower
120cmx20cm

TOILETS
1 x Panphonics Sound Shower
60cmx60cm

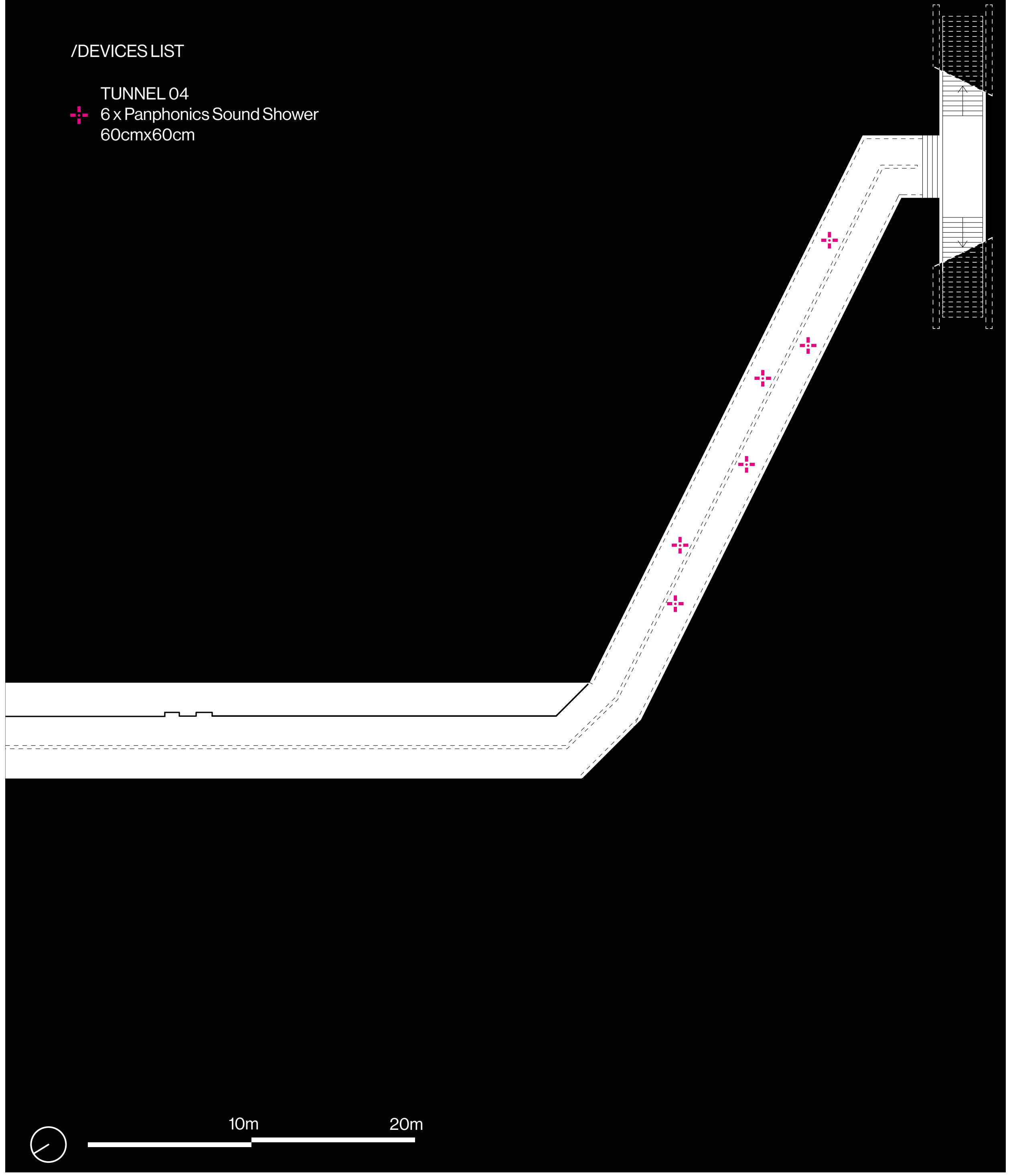
CORE
6x Panphonics Sound Shower
60cmx60cm





/DEVICES LIST

TUNNEL 04
6 x Panphonics Sound Shower
60cmx60cm



/ AUDIO-SPATIAL ARTICULATION - TUNNELS

SOUNDSCAPE: BIRD CALLS BASED
SPL: 62 dB - 66 dB

ARCHITECTURAL RE-SCRIPTING

In the infrastructure domain, the Focus State operates as a tool for architectural re-scripting, using sound to emphasize or contradict the spatial nature of the site. The source material (processed bird calls) leverages high-pitch frequencies and irregular cadences to generate sharp acoustic incisions.

SONIC THRESHOLDS

The Incubation Areas (Tunnels 01 and 02) are defined at their extremities by Sonic Portals: two transverse walls of sound that intersect the corridor's width, creating invisible thresholds that ritualize the entrance into the project area.

HIGH COMPRESSION POINTS

Conversely, within the Central Core, the sound fragments into a constellation of high-compression points scattered spatially. This includes the Anteroom (a small space between the core and the Toilets), where sound intensifies the existing architectural compression, and the base of the main entrance staircase, designed to acoustically intercept visitors upon entry to the underground area.

STRUCTURAL GLITCH

Tunnels 03 and 04 introduce a conceptual anomaly, a "structural glitch", where the architectural layout of the distant Glasshouses is transposed into the underground galleries.

SOUND WALLS/SILENT ROOMS

Tunnel 03 (Segmentation): This space replicates the structural span of Greenhouse A. The system generates 8 transverse sonic walls that cut the longitudinal axis, effectively segmenting the continuous tunnel into a sequence of virtual chambers, bounded by physical concrete walls on the sides and invisible acoustic barriers on the ends.

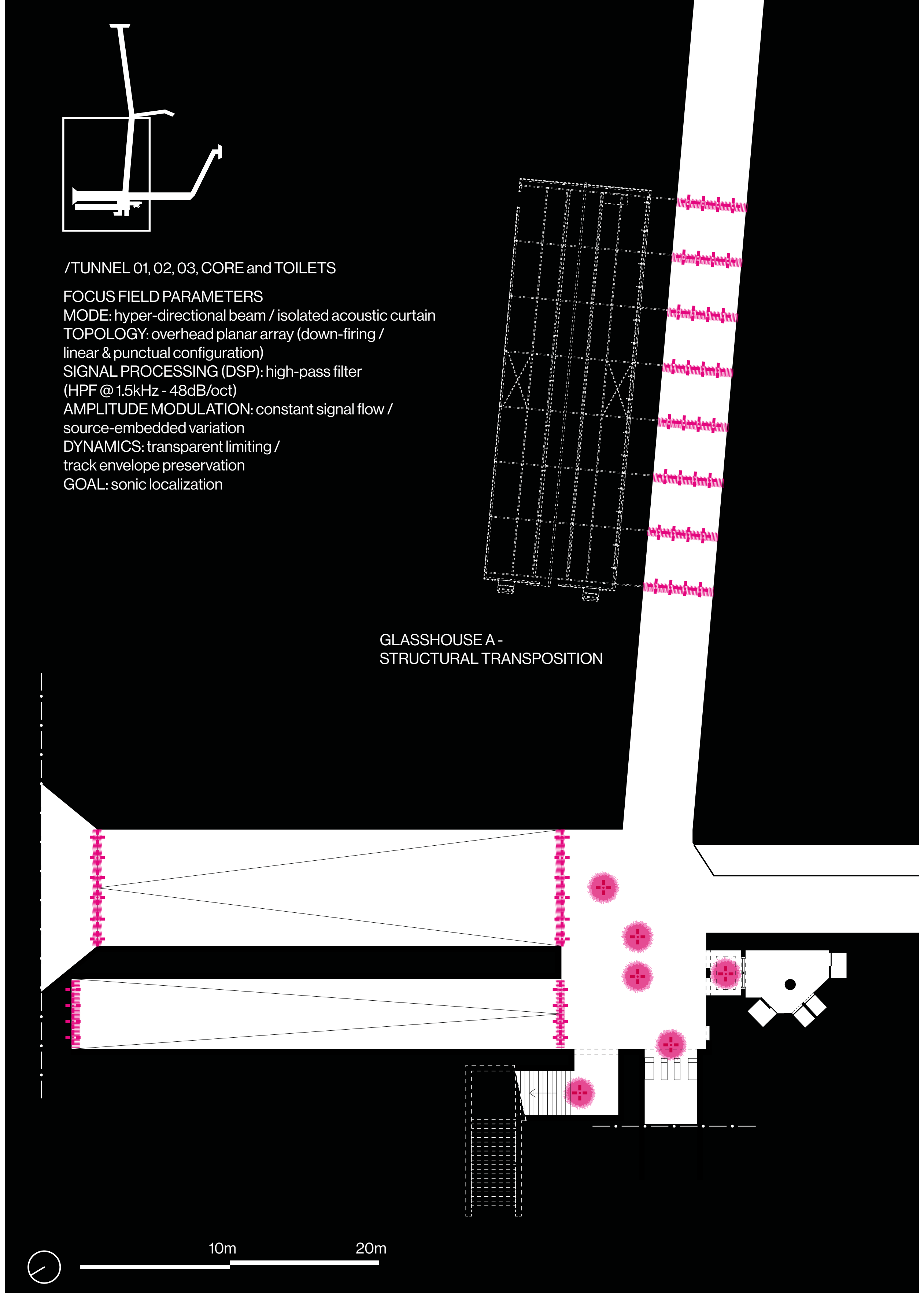
SONIC PILLARS

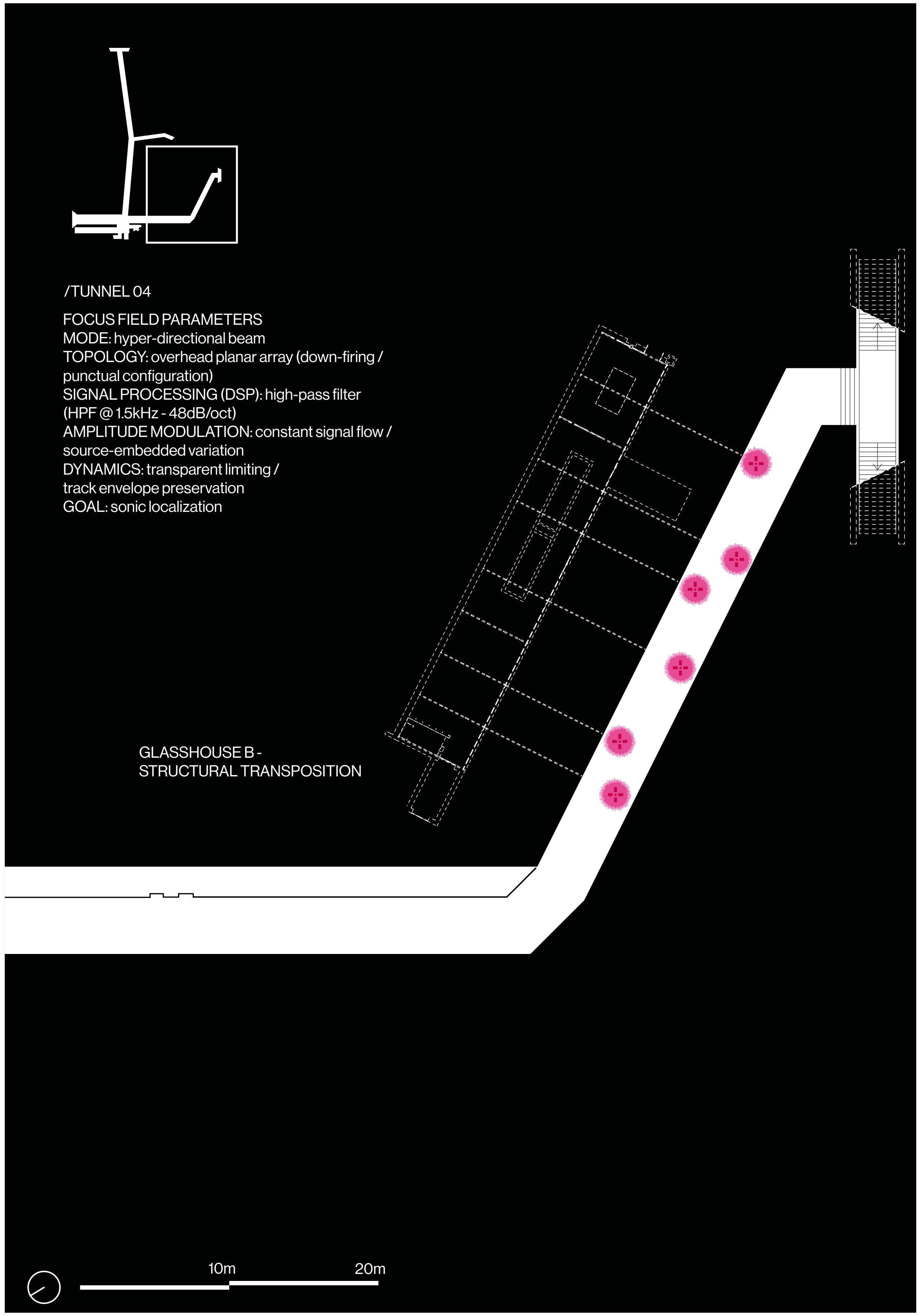
Tunnel 04 (Punctual Grid): This gallery translates the tectonic logic of Greenhouse B. Instead of walls, the focus manifests as punctual high-compression nodes, distributed to match the rhythm of the greenhouse's slender pillars. These points are not linear but alternate left and right relative to the central lighting line. This alternating pattern acts as a static echo of the ricochet movement characterizing the tunnel's Dynamic State.

CALIBRATED SOUND INTENSITY

For all focal points within the tunnels, the Sound Pressure Level (SPL) is strictly calibrated between 62 dB and 66 dB (at ear height). This moderate intensity is dictated by the material properties of the site: the tiled flooring acts as a highly reflective surface. To maintain the effect of absolute compression and decompression, the volume must be capped to prevent floor-bounce dispersion, which would otherwise scatter the signal and compromise the surgical precision of the localized beams.

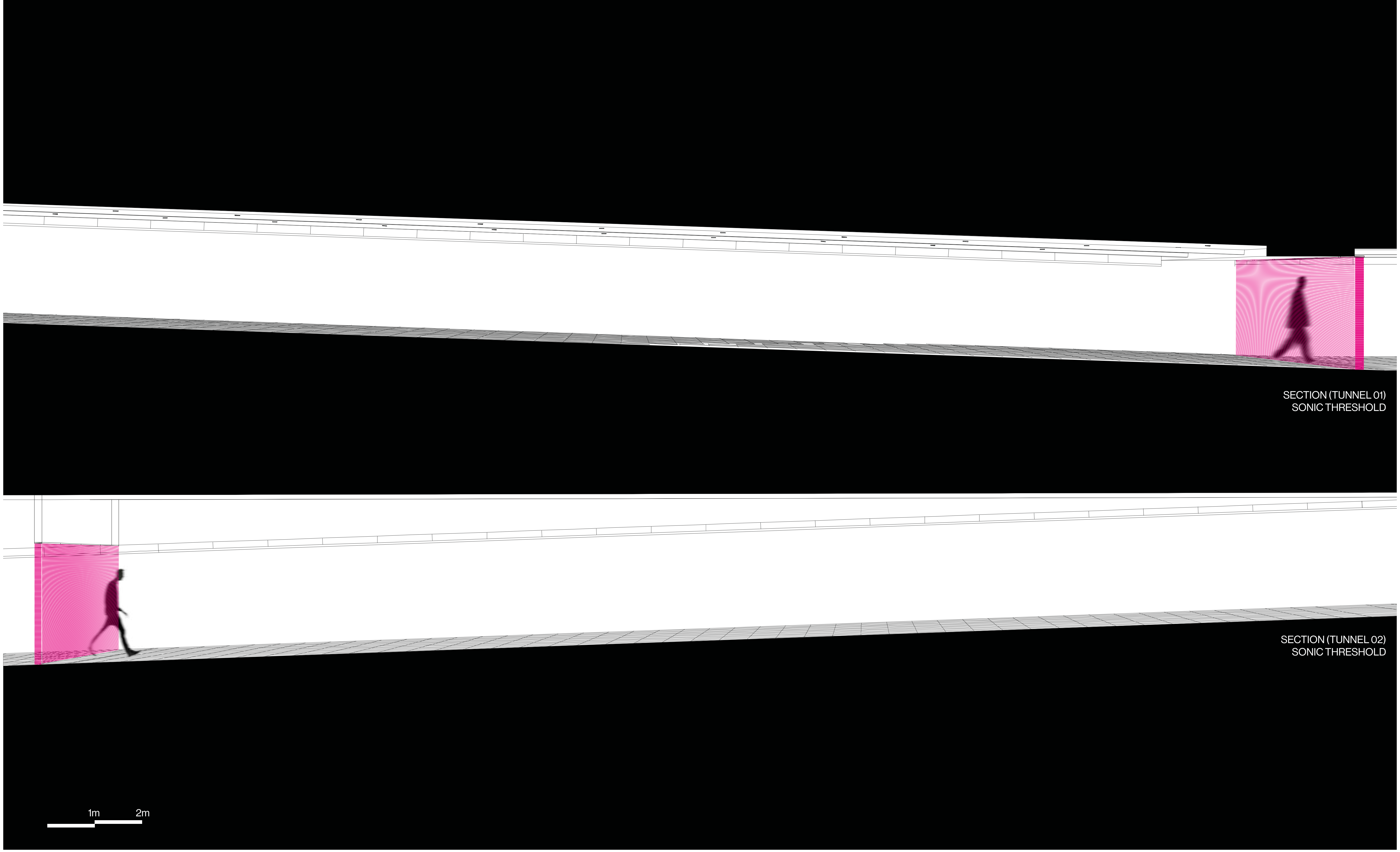
/ SOUND DISTRIBUTION PLANS



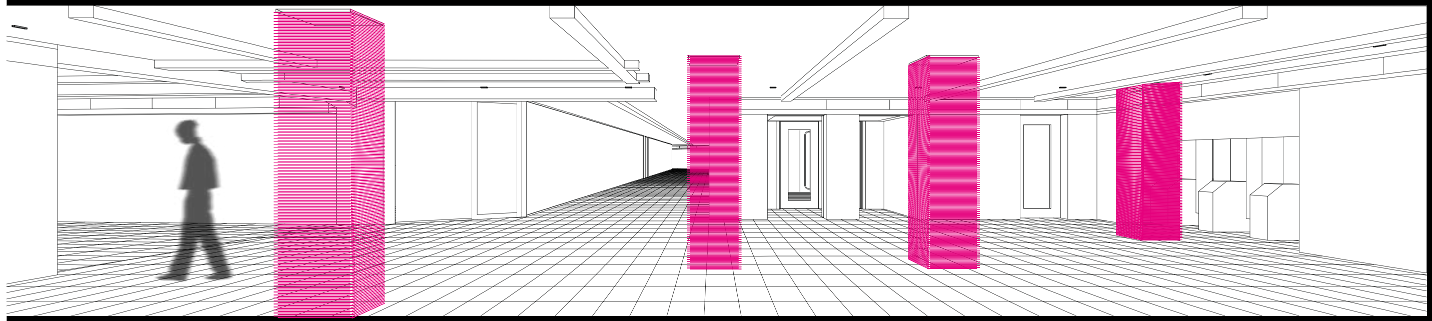


The underground infrastructure is re-scripted through sharp acoustic incisions that alter its spatial nature. Sonic portals ritualize the entrance into incubation areas, while the central Core fragments sound into a constellation of high-compression points.
The transit is interrupted by a "structural glitch": the logic of the greenhouses invades the galleries, segmenting the void into virtual chambers and punctual grids.
Sound acts as an invisible boundary, dissecting the longitudinal axis. The corridors are transformed into a sequence of physical thresholds and localized pressure shifts.

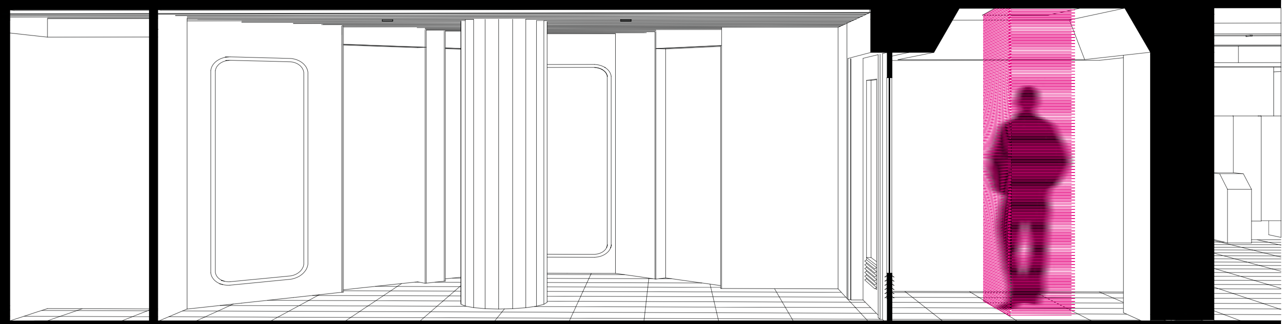
/ TUNNELS - ATMOSPHERIC SECTIONS



/ TUNNELS - ATMOSPHERIC SECTIONS



SECTION (CORE)
DISCRETE FOCAL NODES



SECTION (TOILETS)
SINGLE FOCAL NODE

/ TUNNELS - ATMOSPHERIC SECTION

SECTION (TUNNEL 03)
SONIC WALLS

/ TUNNELS - ATMOSPHERIC SECTION

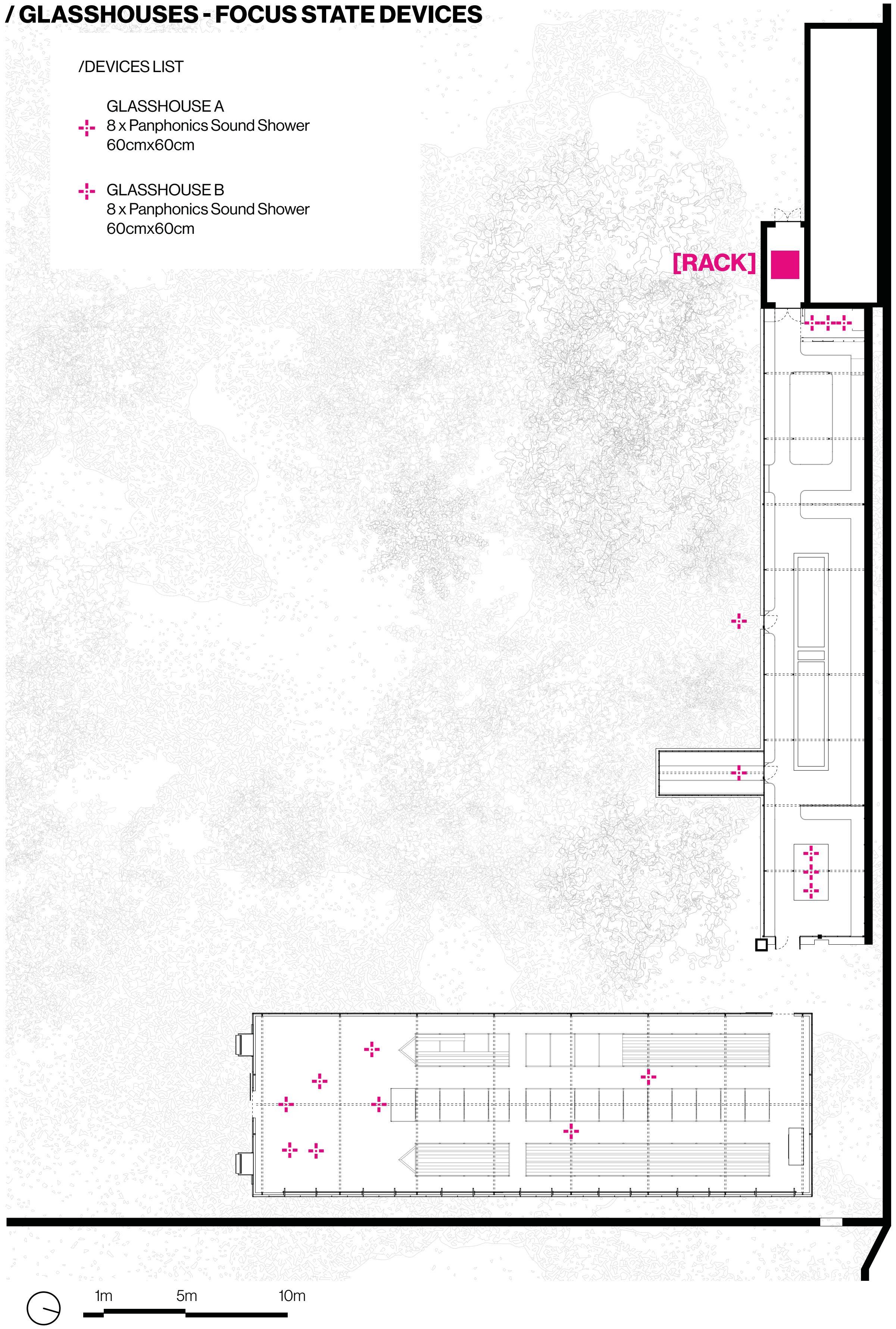
SECTION (TUNNEL 04)
ALTERNATING SONIC PILLARS

/ GLASSHOUSES - FOCUS STATE DEVICES

/DEVICES LIST

GLASSHOUSE A
8 x Panphonics Sound Shower
60cmx60cm

GLASSHOUSE B
8 x Panphonics Sound Shower
60cmx60cm



/ AUDIO-SPATIAL ARTICULATION - GLASSHOUSES

SOUNDSCAPE: TURNSTILES BEEPS BASED

SYNTHETIC INCISIONS

In the Glasshouses, the Focus State again enacts a radical semantic inversion. The source material is derived from the metro turnstile beep, a signal originally designed as a symbol of urban control and rhythmic passage. Decontextualized and harmonically re-pitched, this synthetic signal loses its functional urgency to transform into a digital seed. It generates a constant rhythmic pulse that mimics the distinct biological behaviors of the two environments, translating a synthetic alert into an organic phenomenon that permeates the glass structures.

GLASSHOUSE A - SPECTRAL AERATION
SPL: 58 dB - 62 dB

SONIC SUNLIGHT

AIRY FREQUENCIES

In The Glade, sound acts as a substitute for sunlight, manifesting through vertical plane waves that rain down from the overhead structure. To achieve a sensation of spectral aeration, the signal is stripped of all terrestrial gravity, removing the lower frequencies to leave only the airy, weightless component of the timbre. The amplitude oscillates smoothly, creating a rain of "sonic photons" that descend with a delicate and transparent presence. Here, the acoustic architecture is designed to be permeable and light, avoiding saturation to merge seamlessly with the natural reverberation of the glass volume.

GLASSHOUSE B - PHYSICAL COMPRESSION
SPL: 64 dB - 68 dB (72 dB PEAKS)

LOCALIZED HIGH COMPRESSION

SUDDEN INTENSITY SHIFTS

Shifting to The Undergrowth, the logic mutates from the ethereal to physical compression. The topology evolves into a web, combining vertical and horizontal flows to intercept the visitor from multiple axes. Unlike the Glade, the signal here is reproduced with its full physical weight, augmented by a sub-bass pressurization that couples directly with the floor structure. The modulation abandons smoothness to adopt erratic patterns, generating stochastic spikes and sudden silences that mimic the unpredictability of a dense thicket. This creates a state of dynamic Instability, where the sound invades the space with a tangible specific weight, blurring the boundary between the external wild vegetation and the internal artificial environment.

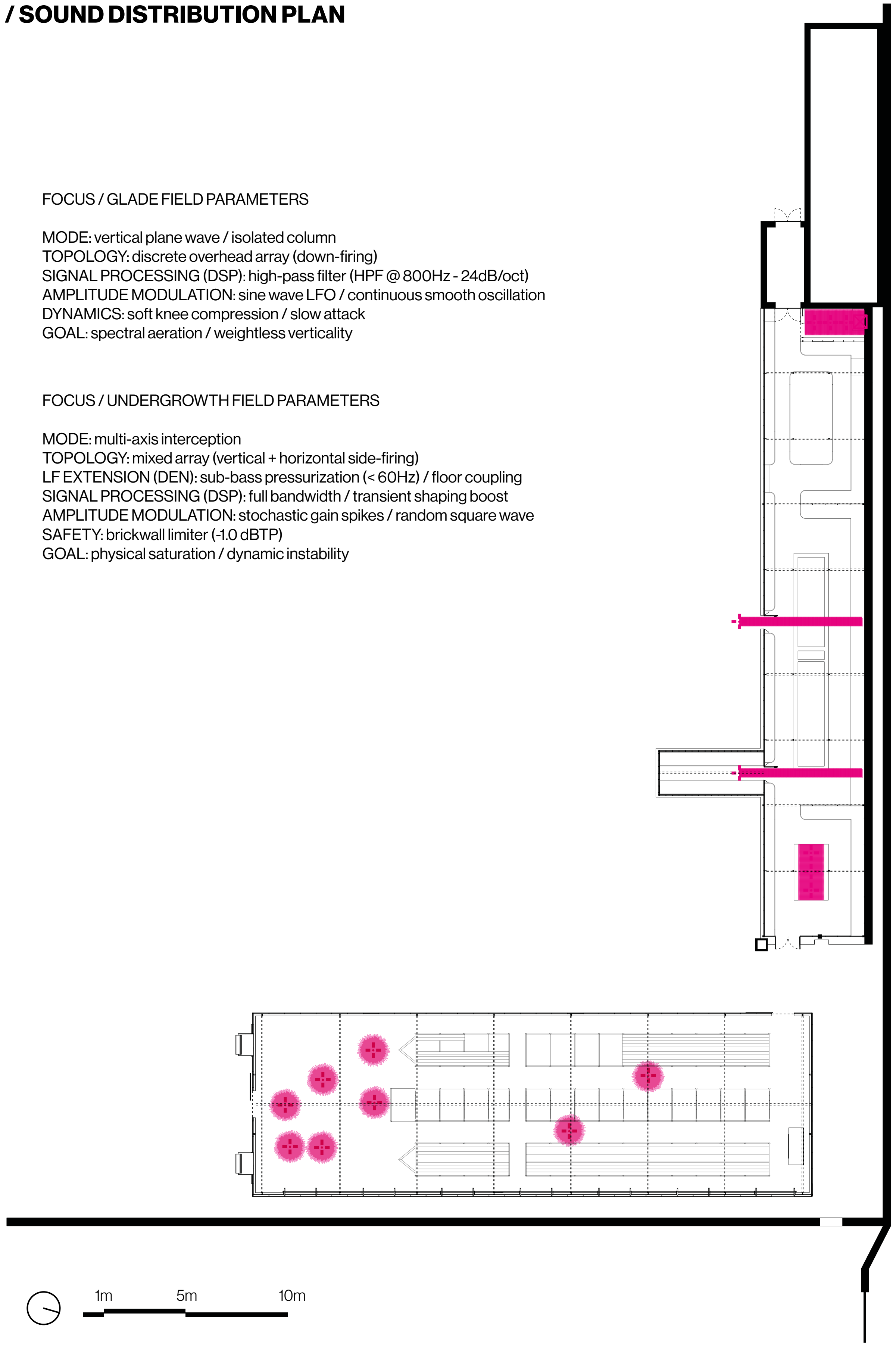
/ SOUND DISTRIBUTION PLAN

FOCUS / GLADE FIELD PARAMETERS

MODE: vertical plane wave / isolated column
TOPOLOGY: discrete overhead array (down-firing)
SIGNAL PROCESSING (DSP): high-pass filter (HPF @ 800Hz - 24dB/oct)
AMPLITUDE MODULATION: sine wave LFO / continuous smooth oscillation
DYNAMICS: soft knee compression / slow attack
GOAL: spectral aeration / weightless verticality

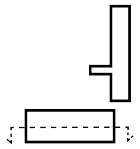
FOCUS / UNDERGROWTH FIELD PARAMETERS

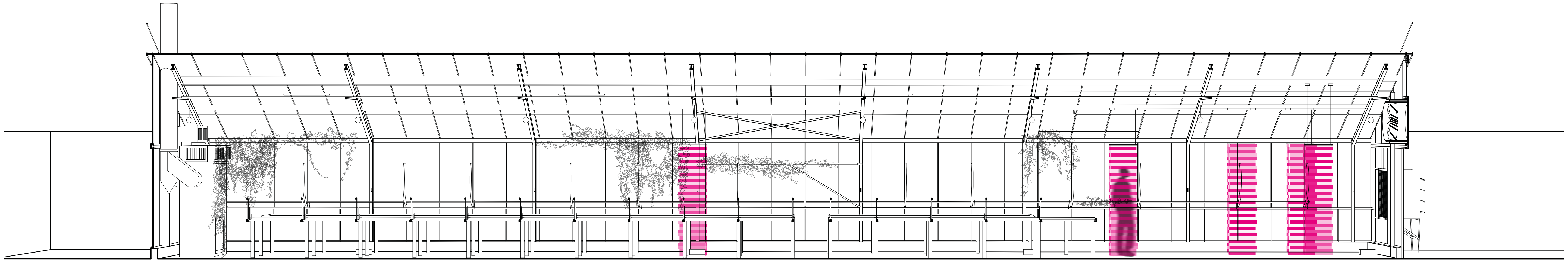
MODE: multi-axis interception
TOPOLOGY: mixed array (vertical + horizontal side-firing)
LF EXTENSION (DEN): sub-bass pressurization (< 60Hz) / floor coupling
SIGNAL PROCESSING (DSP): full bandwidth / transient shaping boost
AMPLITUDE MODULATION: stochastic gain spikes / random square wave
SAFETY: brickwall limiter (-1.0 dBTP)
GOAL: physical saturation / dynamic instability



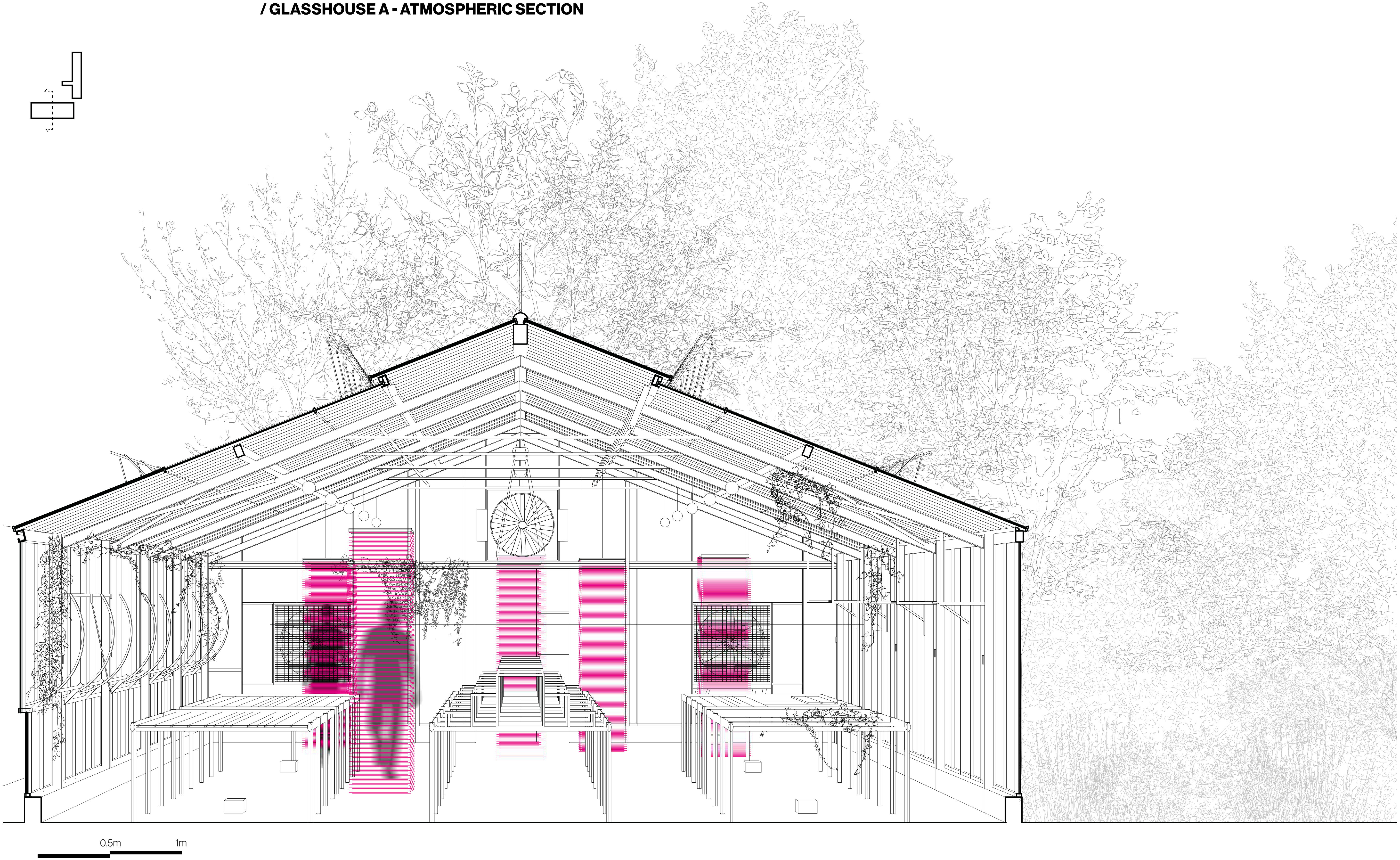
In the Glade, the synthetic signal is stripped of all terrestrial gravity to act as an acoustic substitute for sunlight. Vertical plane waves rain down from the overhead structure, constellating the volume with an airy, weightless presence. Through smooth oscillations and transparent timbres, sound transforms into a dust of sonic photons descending with zenithal delicacy. The acoustic architecture becomes permeable, merging with the glass reflections to generate a space of pure spectral rarefaction.

/ GLASSHOUSE A - ATMOSPHERIC SECTION



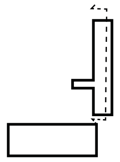


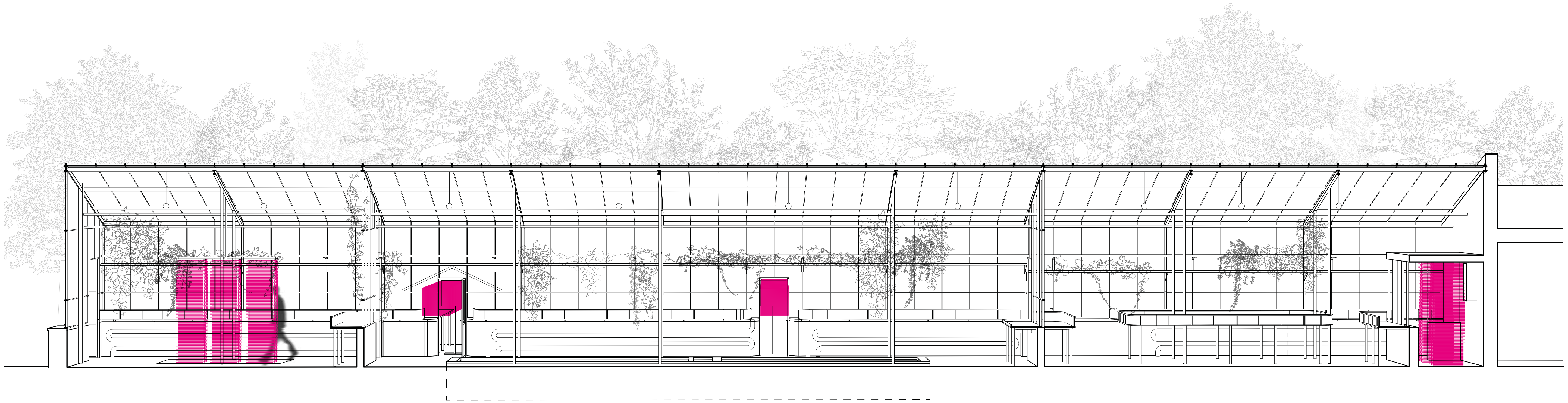
/ GLASSHOUSE A - ATMOSPHERIC SECTION



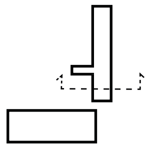
The Undergrowth transforms the signal into a web of tensions that intercept the body along multiple axes. The sonic topology abandons all lightness for a brutal specific weight, where horizontal and vertical flows operate at varying depths to generate localized physical compression. Sudden intensity shifts fuel a state of instability within static focal points, while sub-bass pressure intensifies the focal compression. The space is occupied by an unpredictable acoustic mass that exacerbates the density of the vegetation, pushing the dense condition of the environment to its artificial extreme.

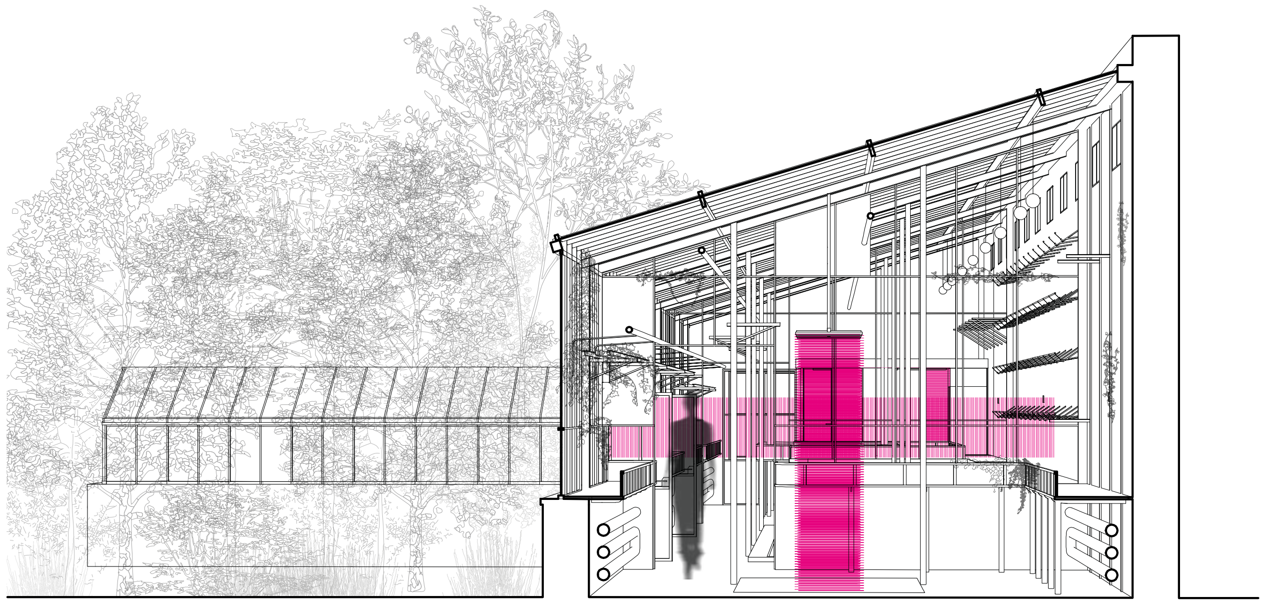
/ GLASSHOUSE B - ATMOSPHERIC SECTION





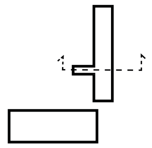
/ GLASSHOUSE B - ATMOSPHERIC SECTION

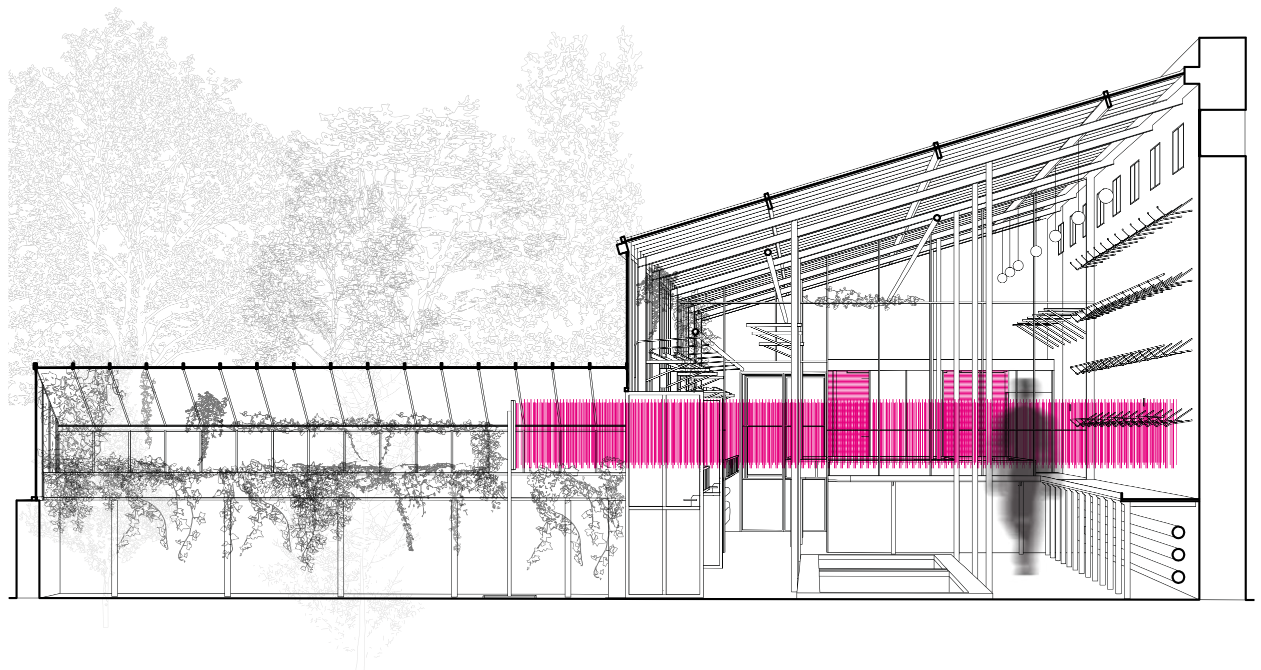




1m 2m

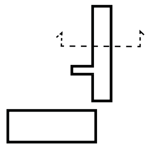
/ GLASSHOUSE B - ATMOSPHERIC SECTION

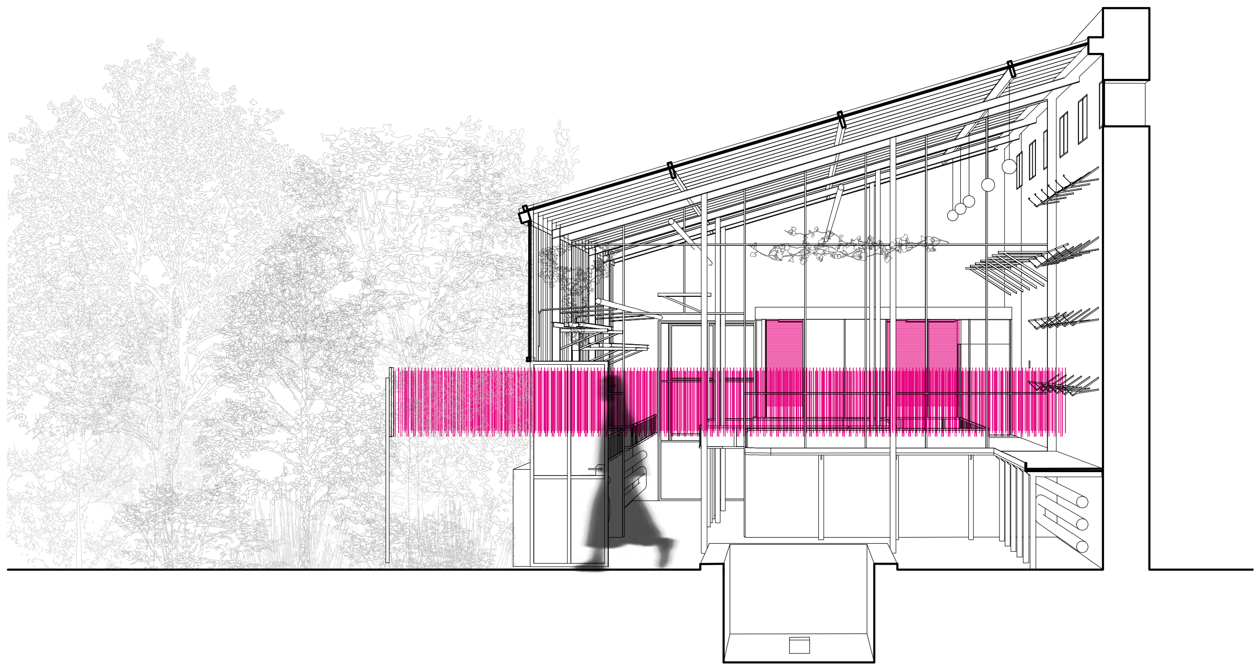




1m 2m

/ GLASSHOUSE B - ATMOSPHERIC SECTION





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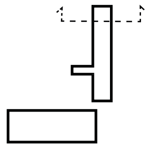
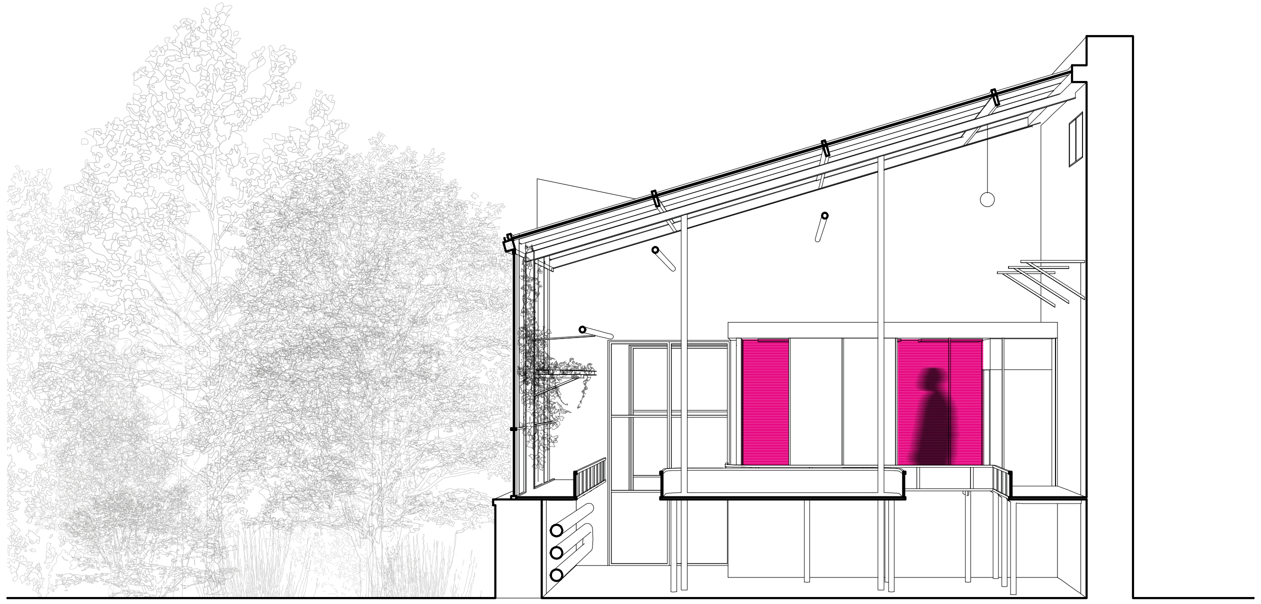
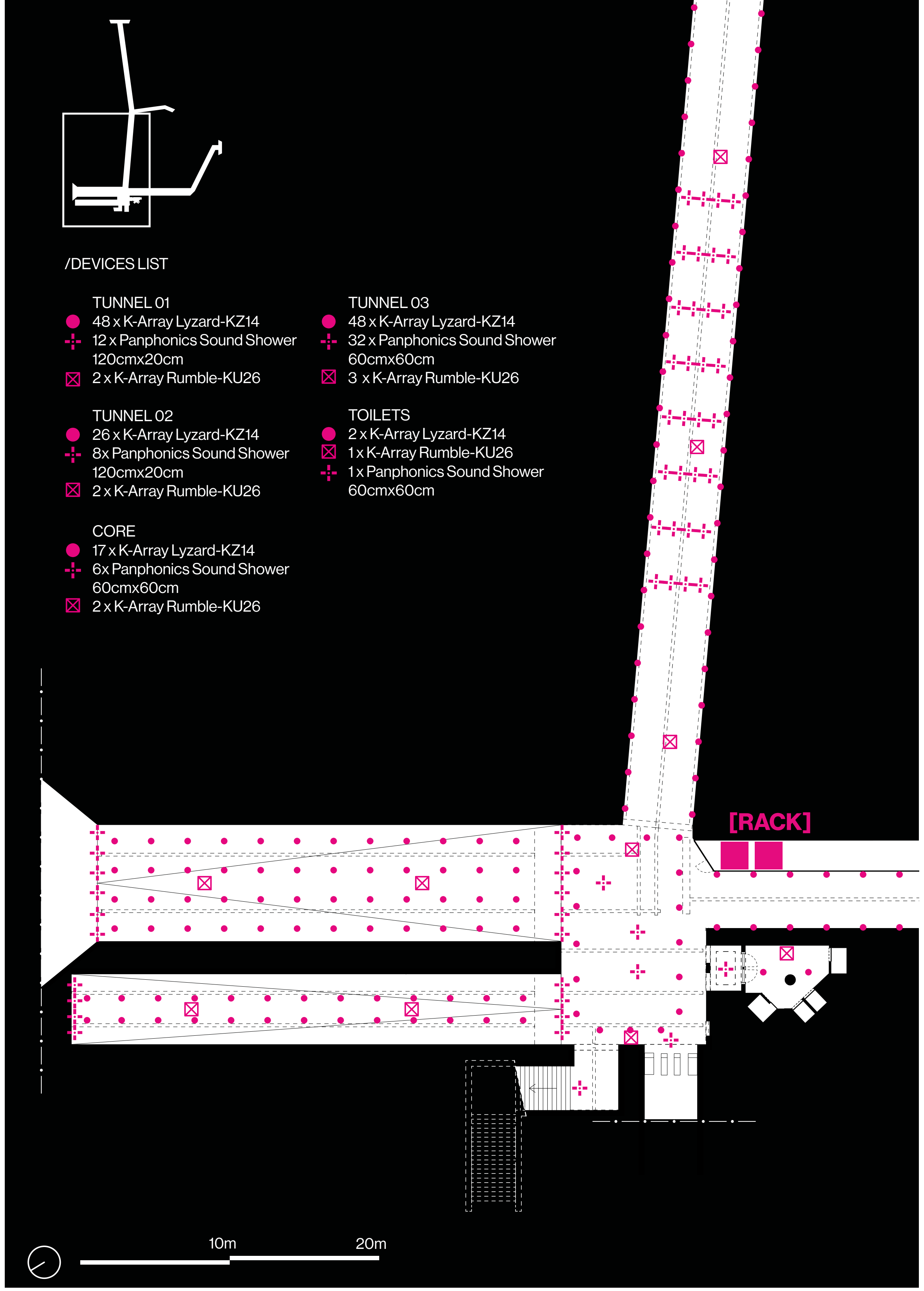
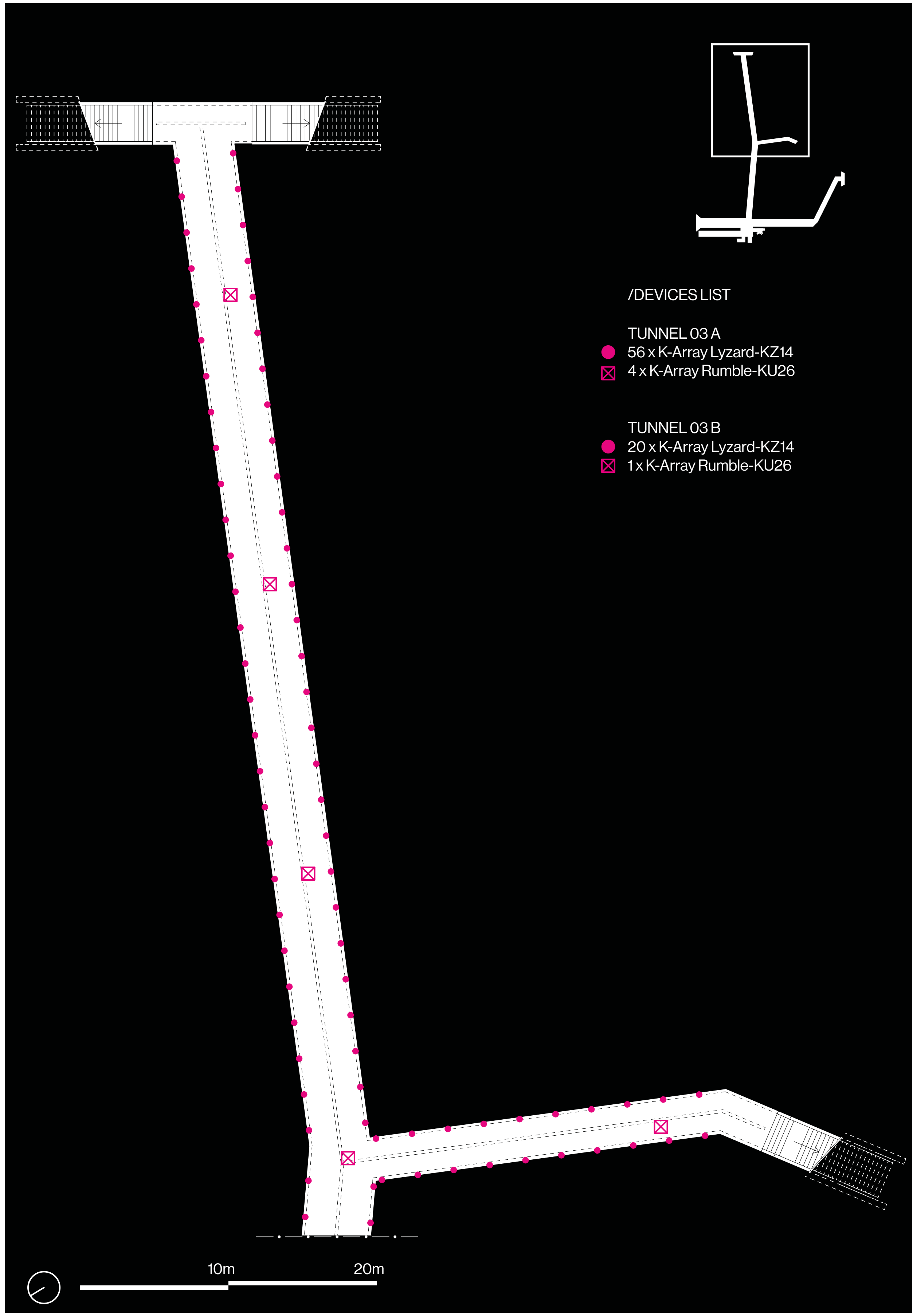


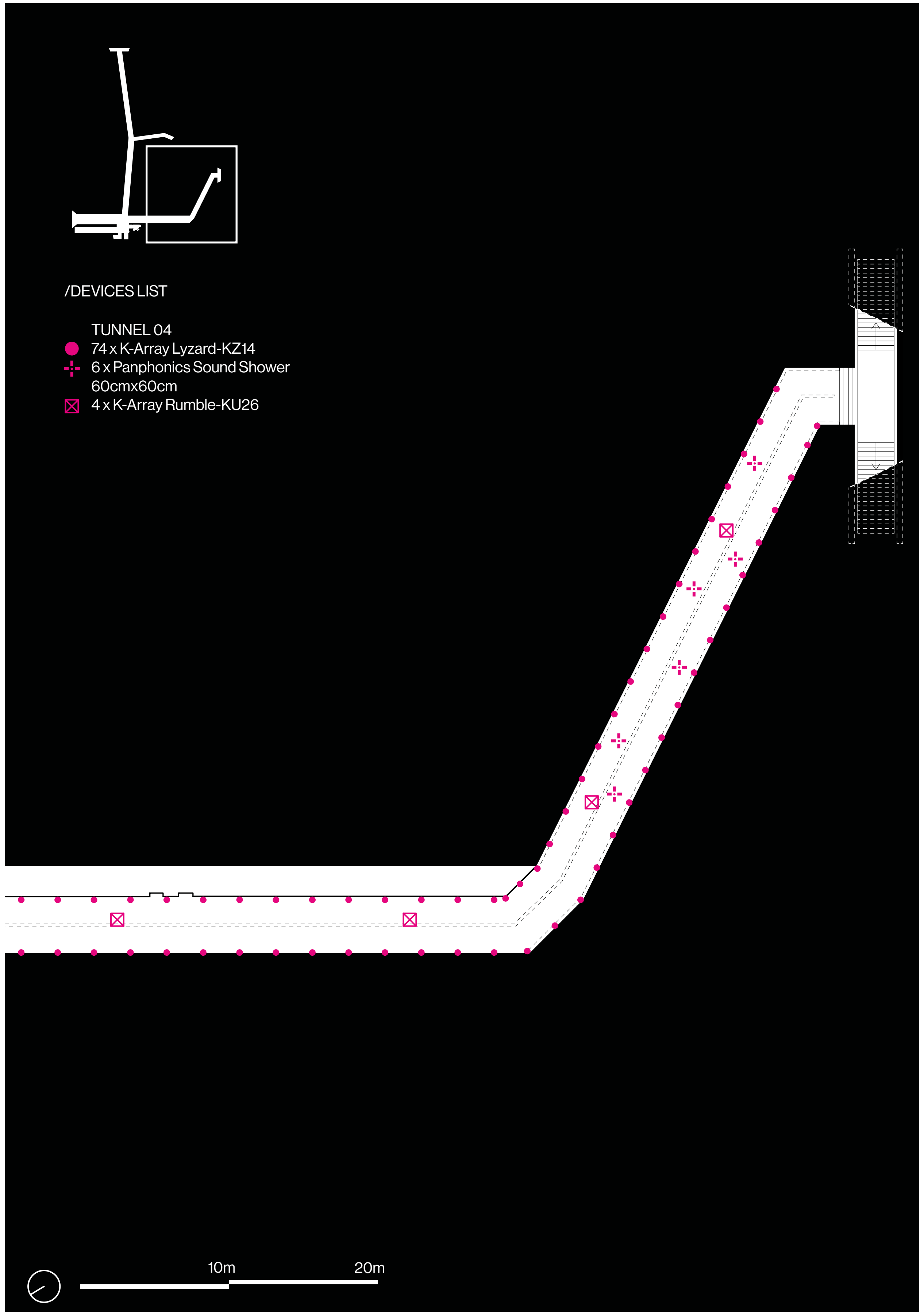


The concept of Saturation within the project framework represents a condition of maximum acoustic density. Unlike the previous phases, which relied on distinct spatial characterizations to guide or situate the visitor, this configuration functions as a moment of critical accumulation where the hierarchy between background atmosphere and foreground movement collapses. The simultaneous activation of the Diffuse, Dynamic, and Focus layers results in the complete occupation of the available frequency spectrum. Consequently, the acoustic architecture exerts a physical compression on the space, where the spatial boundaries are perceived through the weight of a critical mass that saturates the air. The sound acts as a dense, impenetrable volume that fills the architectural void, forcing a sensory experience defined by total pressure rather than homogeneous or directional clarity.

/ TUNNELS - SATURATION STATE DEVICES







/ AUDIO-SPATIAL ARTICULATION - TUNNELS

SOUNDSCAPE: MIXED (ORGANIC)
SPL: 68 dB - 72 dB

SPATIAL HYBRIDIZATION

Within the subterranean context, the Saturation configuration enacts a radical hybridization of the spatial zoning logic. By overriding the segregation between transit and static areas, the galleries of Tunnels 01, 02, and the Core are invaded by the omnipresent texture of the Diffuse layer.

DYNAMIC SIDECHAIN

To engender this complex ecosystem without generating auditory masking, the system utilizes a mixing strategy predicated on dynamic sidechain compression. Although the transducers reproduce the static granular texture of the frogs (Diffuse) and the linear flow of the stream (Dynamic) simultaneously, they interact through a prioritized signal path: the arrival of the water vector triggers a momentary gain reduction in the amphibian bed, creating a “breathing” effect where the liquid current acoustically displaces the static matter.

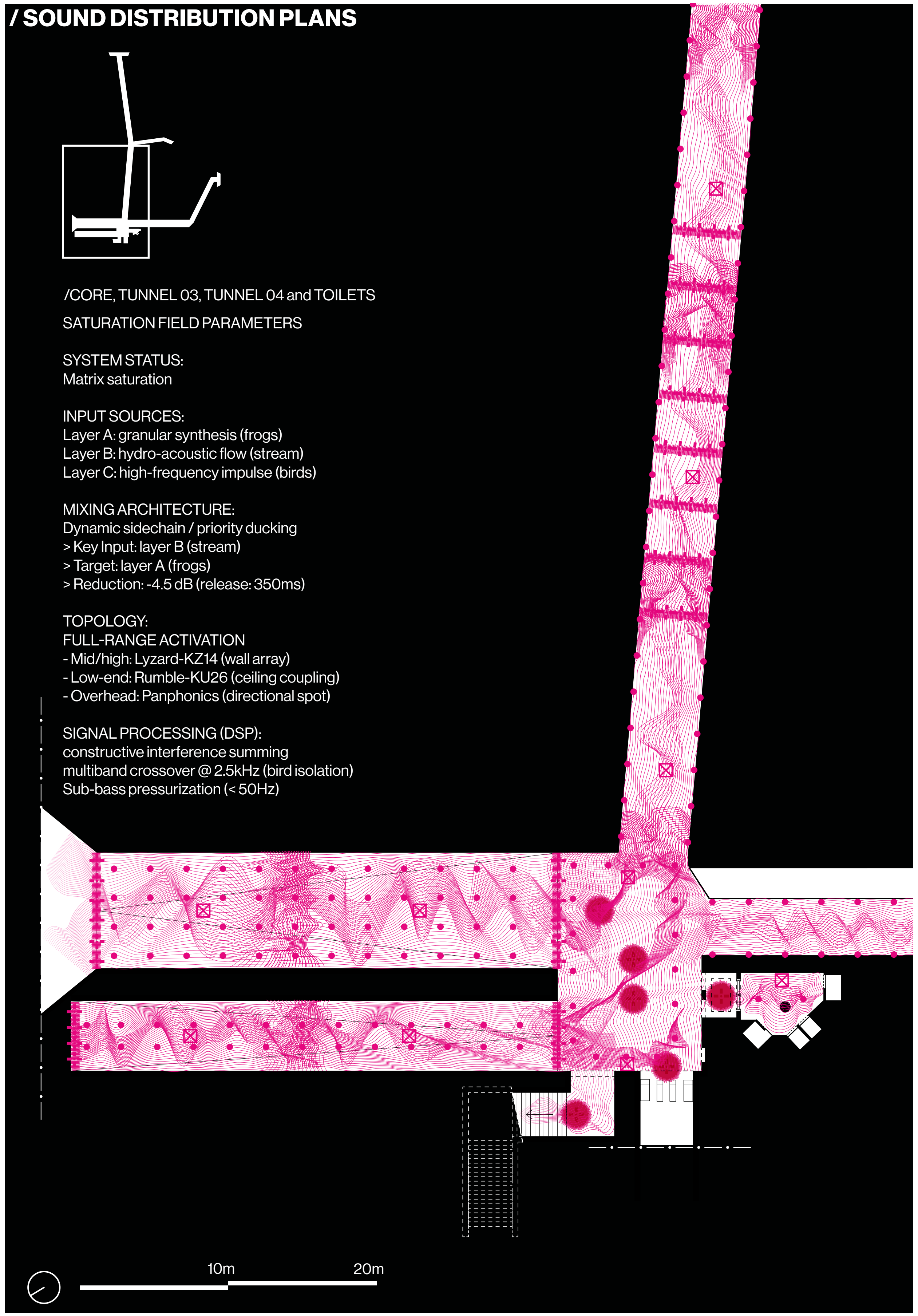
FREQUENCY STRATIFICATION

At the same time, multiband processing isolates the high-frequency avian calls (Focus), allowing them to pierce the dense mid-range ceiling. This stratification transforms the linear infrastructure into a hyper-organic swamp, where the heaviness of the ground and the directional velocity of the water coexist.

THE STATIC EXCEPTION

The sole exception to this saturation is the Toilets area: due to its limited volumetric capacity, this zone remains anchored to the static Diffuse state, preserving an isolated nucleus of stillness.

/ SOUND DISTRIBUTION PLANS



/CORE, TUNNEL 03, TUNNEL 04 and TOILETS

SATURATION FIELD PARAMETERS

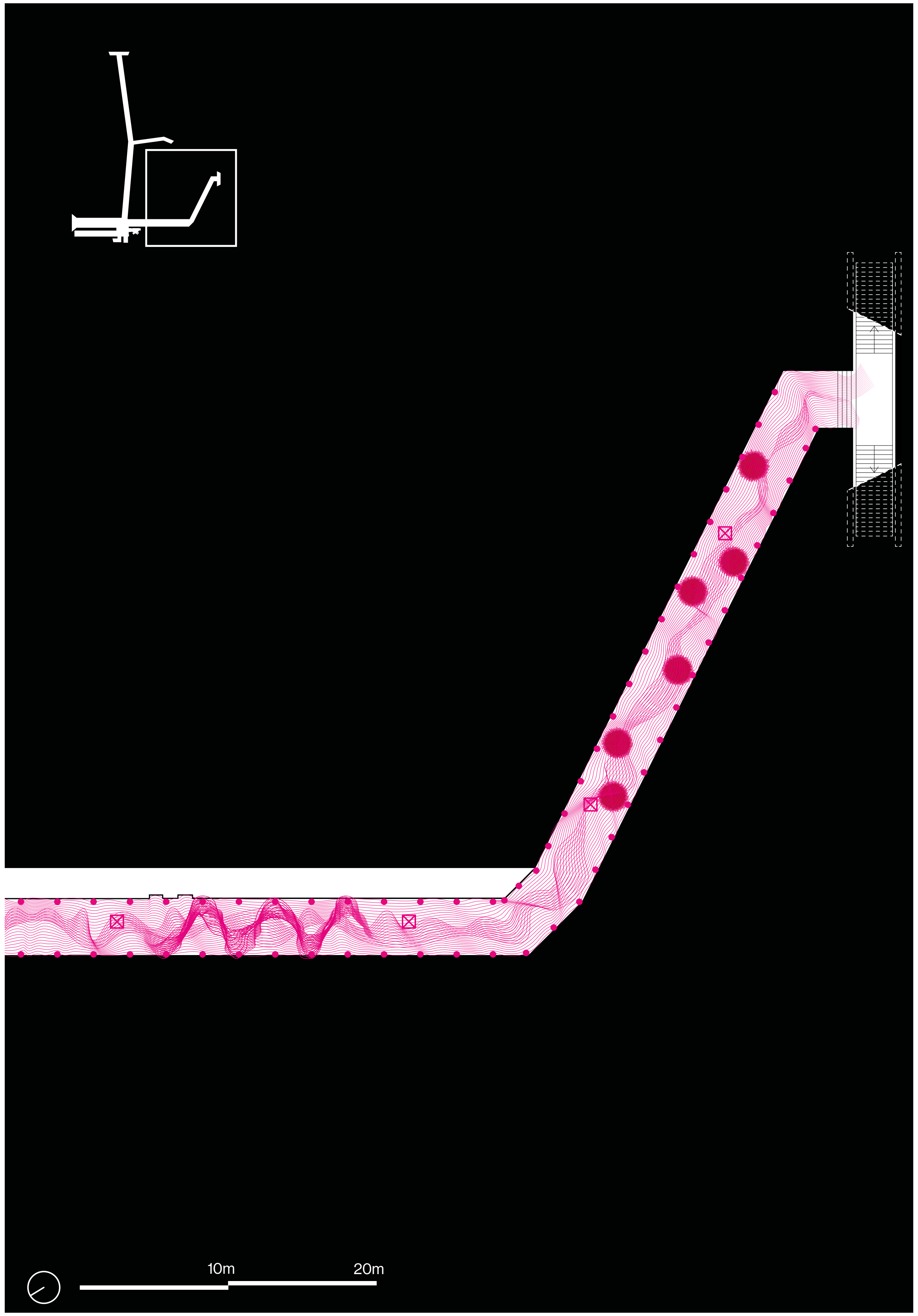
SYSTEM STATUS:
Matrix saturation

INPUT SOURCES:
Layer A: granular synthesis (frogs)
Layer B: hydro-acoustic flow (stream)
Layer C: high-frequency impulse (birds)

MIXING ARCHITECTURE:
Dynamic sidechain / priority ducking
> Key Input: layer B (stream)
> Target: layer A (frogs)
> Reduction: -4.5 dB (release: 350ms)

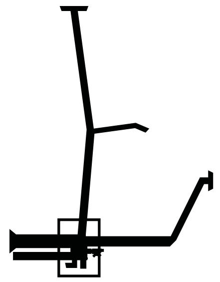
TOPOLOGY:
FULL-RANGE ACTIVATION
- Mid/high: Lyzard-KZ14 (wall array)
- Low-end: Rumble-KU26 (ceiling coupling)
- Overhead: Panphonics (directional spot)

SIGNAL PROCESSING (DSP):
constructive interference summing
multiband crossover @ 2.5kHz (bird isolation)
Sub-bass pressurization (< 50Hz)



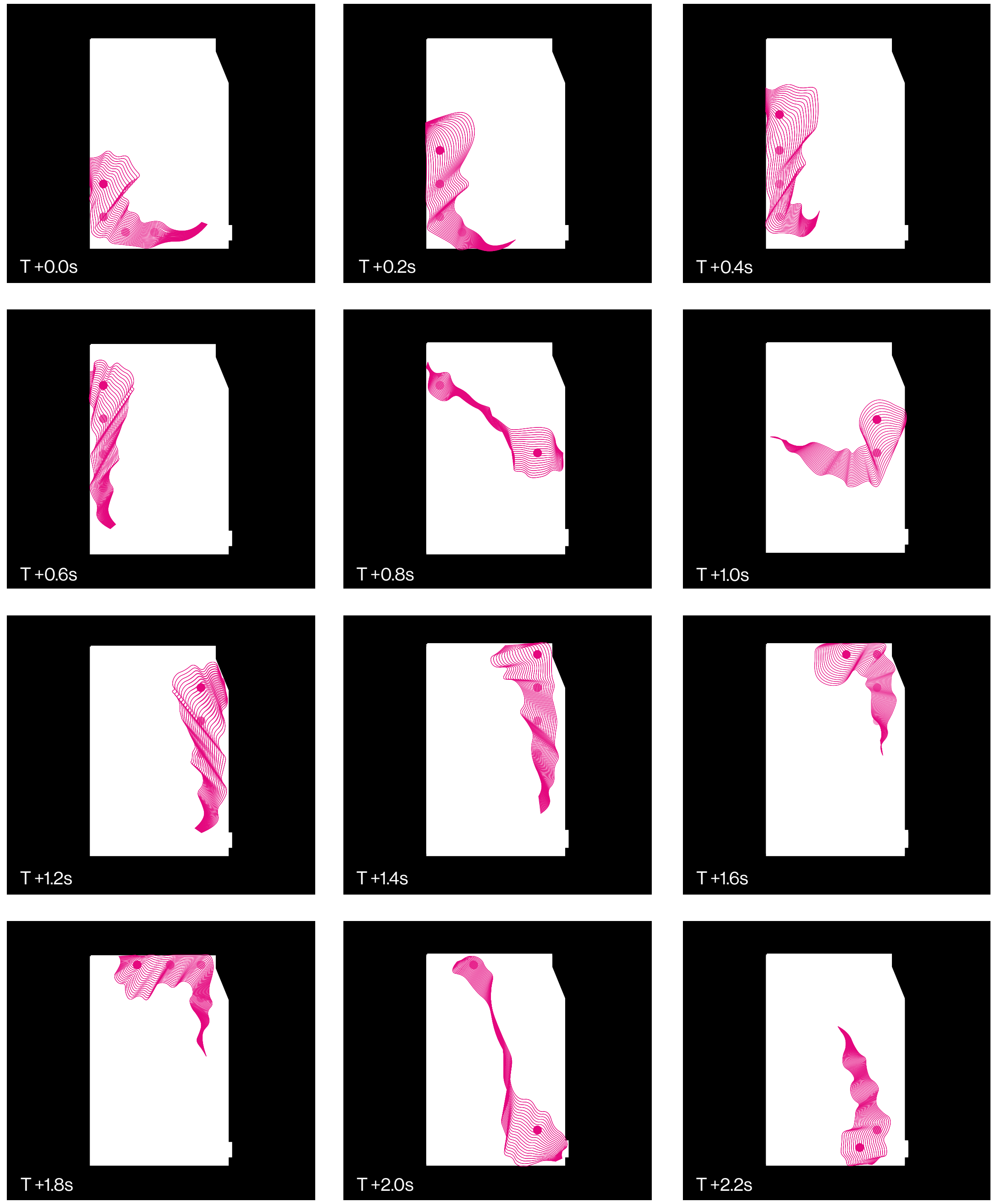
//CORE - DYNAMIC BEHAVIOR

During the Saturation State, the dynamic component of the Core undergoes a mutation in its kinetic behavior. In the previous Dynamic State, the Core was characterized by the alternation between two distinct movements: the orbital path and the stochastic bounce, defined respectively by the activation of Tunnel 03 or Tunnel 04. In the case of Saturation, however, the simultaneous activation of both tunnels generates a new behavioral synthesis. The result is an accelerated orbital movement (with doubled velocity), in which the trajectory is stochastically interrupted and forced to restart from a different point. This rupture of circularity arises from the vector contrast between the pure orbit and the random bounce; rather than canceling each other out upon superimposition, they enter into conflict. Their coexistence therefore defines a frenetic and apparently disordered kinetics, symbolizing the crisis generated by the collision of these two forces. Such instability amplifies the sensation of acoustic pressure and chaos, reinforcing the oppressive and totalizing perception typical of the Saturation State.



// TYPICAL PROPAGATION SEQUENCE
Core
fractured orbit - Δt: 0.2s

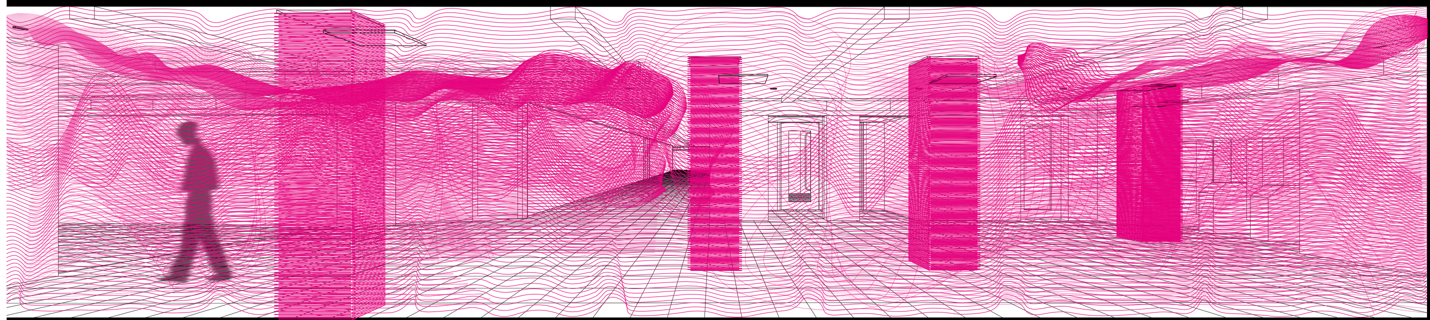
Fractured orbit



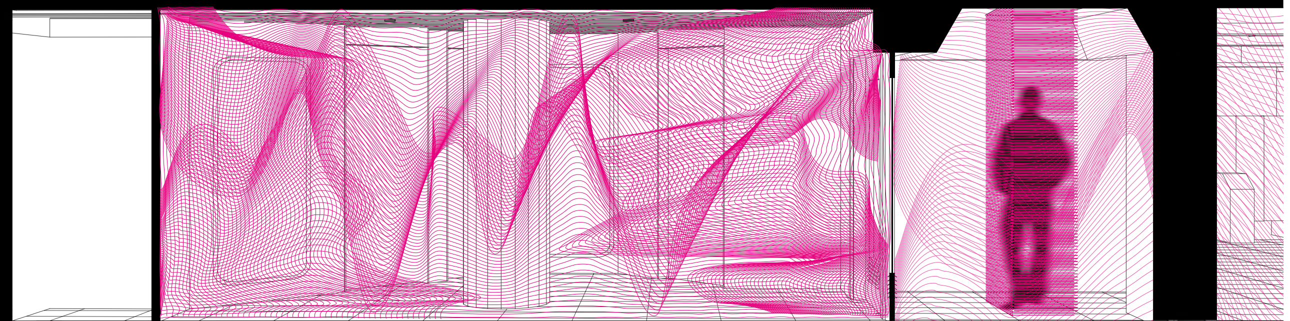
Within the tunnels, saturation manifests as the co-presence of the three biological signals, totally invading the space and erasing all previous spatial divisions. The sonic mass fills the void, fusing the velocity of movement with the stasis of diffusion to generate a denser, more oppressive sonic substance. This matter is then pierced by the high frequencies of directional sounds, merging into the final output of a single moment of utmost acoustic compression.

/ TUNNELS - ATMOSPHERIC SECTIONS

/ TUNNELS - ATMOSPHERIC SECTIONS



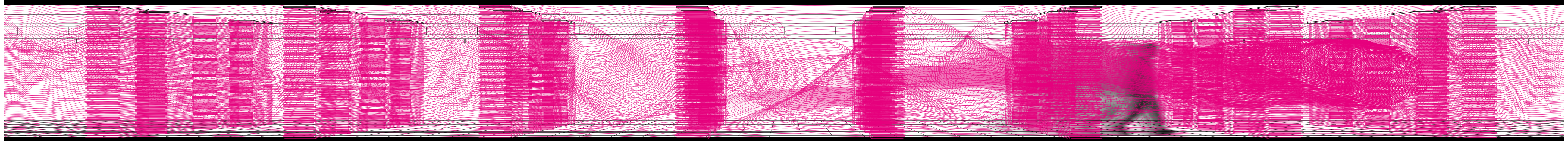
SECTION (CORE)



SECTION (TOILETS)

1m 2m

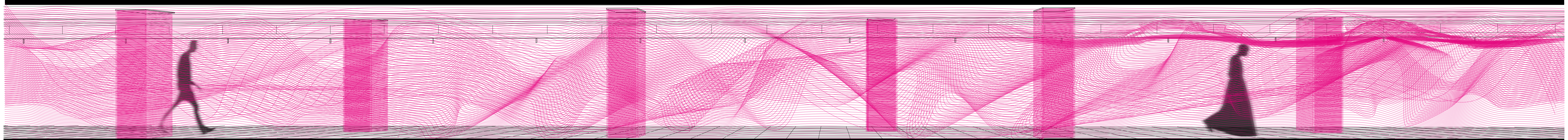
/ TUNNELS - ATMOSPHERIC SECTION



SECTION (TUNNEL 03)

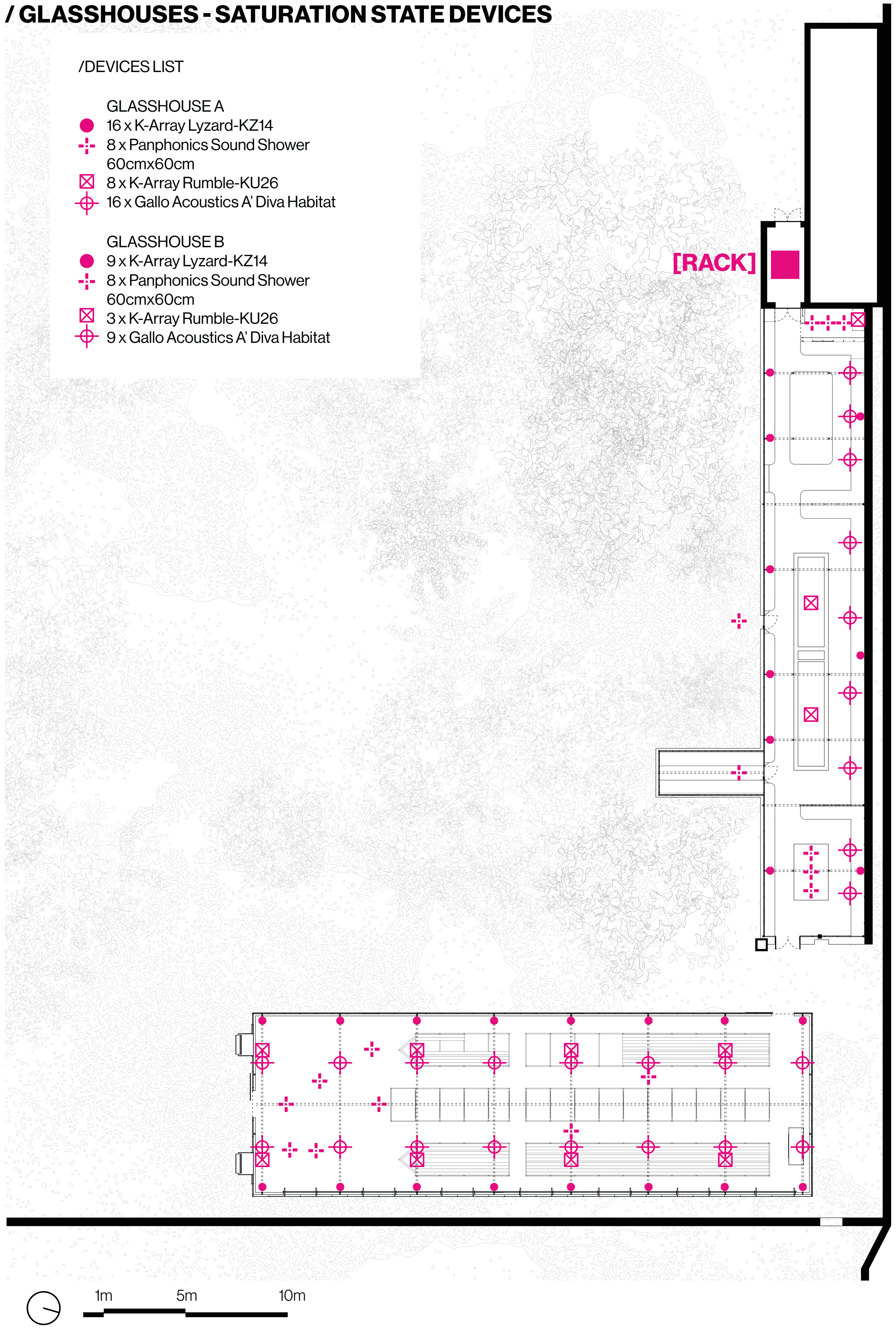
1m 2m

/ TUNNELS - ATMOSPHERIC SECTION



SECTION (TUNNEL 04)

/ GLASSHOUSES - SATURATION STATE DEVICES



/ AUDIO-SPATIAL ARTICULATION - GLASSHOUSES

SOUNDSCAPE: MIXED (SYNTHETIC)
SPL: 70 dB - 74 dB

PHYSICAL PRESSURE

DUAL PROCESSING

In the Glasshouses, within this state, the acoustic narrative contradicts the visual context of the vegetation, overriding the natural aesthetic with a dense layer of urban and mechanical frequencies. To achieve this level of physical pressure while maintaining rhythmic intelligibility, the system mobilizes a dual processing strategy predicated on dynamic contrast. The diffuse and dynamic layers, comprising the neon hum and mechanical sweeper, is assigned to the perimeter and pendant system (Lyzard, Rumble, and Gallo Habitat) and processed via parallel compression (technically known as “New York Style”). This signal path is heavily saturated and deprived of its natural dynamic range to generate a thick, suffocating sonic mass.

FOCAL ISOLATION

MECHANICAL OPPRESSION

Conversely, the focal layer (metro turnstile beeps) operates on a discrete, dry signal path routed exclusively to the overhead Panphonics array. This separation prevents the transient precision of the digital grid from being smeared by the industrial saturation.
The resulting psychoacoustic conflict reveals the glasshouse as a productive machine, where the imposition of mechanical frequencies dominates the biological silence.

/ SOUND DISTRIBUTION PLAN SATURATION INITIAL PHASE

SATURATION FIELD PARAMETERS

SYSTEM STATUS:
Omni-axial pressure / mechanical grid

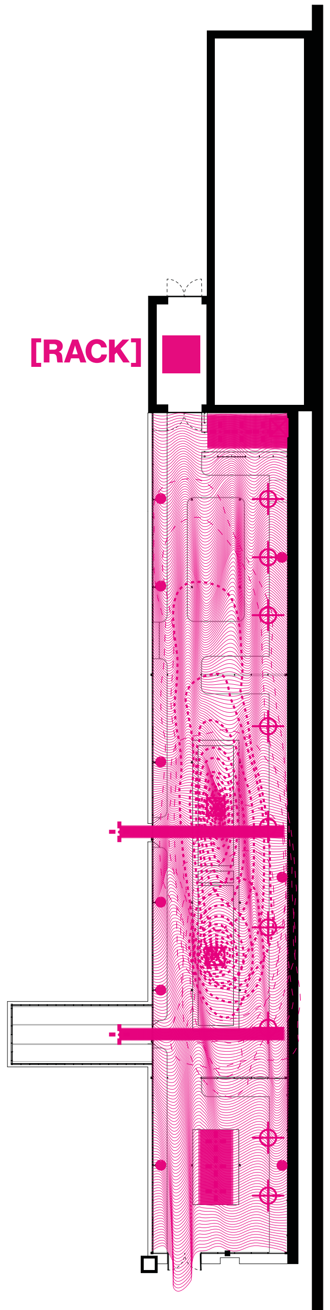
ROUTING ARCHITECTURE:
Dual-path signal flow (split-mode)

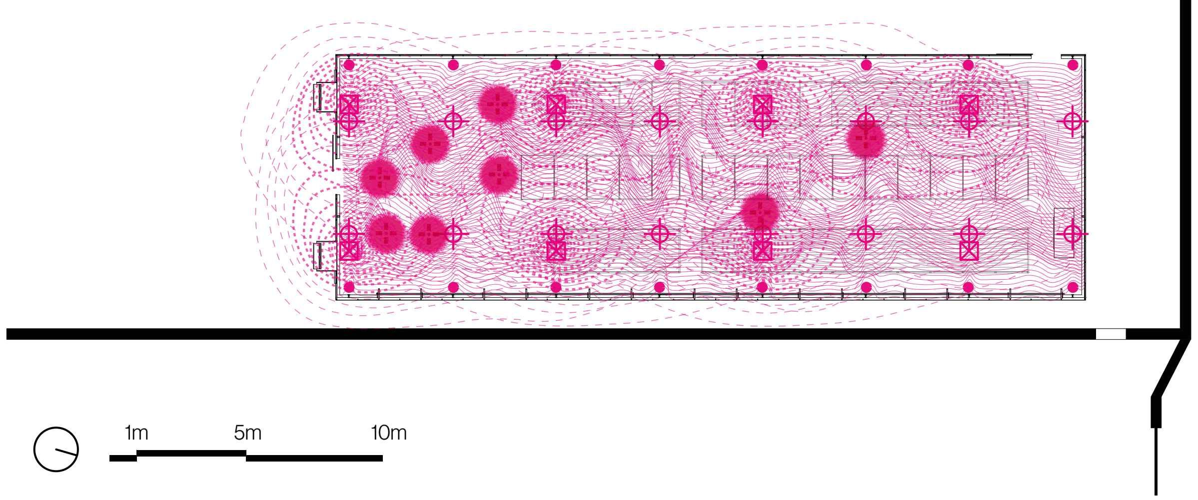
PATH A: FOCUS (dry signal)
> Source: digital beeps (turnstiles)
> Output: Panphonics (overhead)
> DSP: transient shaping / high-pass filter @ 1.2kHz
> Goal: surgical precision / temporal grid

PATH B: ATMOSPHERE (wet/saturated signal)
> Source: neon hum + street sweeper
> Output: Lyzard (wall) + Gallo Habitat (pendant) + Rumble (sub)
> DSP: parallel compression (New York Style)
> Goal: physical density / wall of sound

DYNAMICS CONTROL:
Brickwall limiter (-0.5 dBTP) preventing digital clipping

DYNAMIC PHASE:
A - AWAKENING; B - EXUDATION





/ SOUND DISTRIBUTION PLAN SATURATION MIDDLE PHASE

SATURATION FIELD PARAMETERS

SYSTEM STATUS:
Omni-axial pressure / mechanical grid

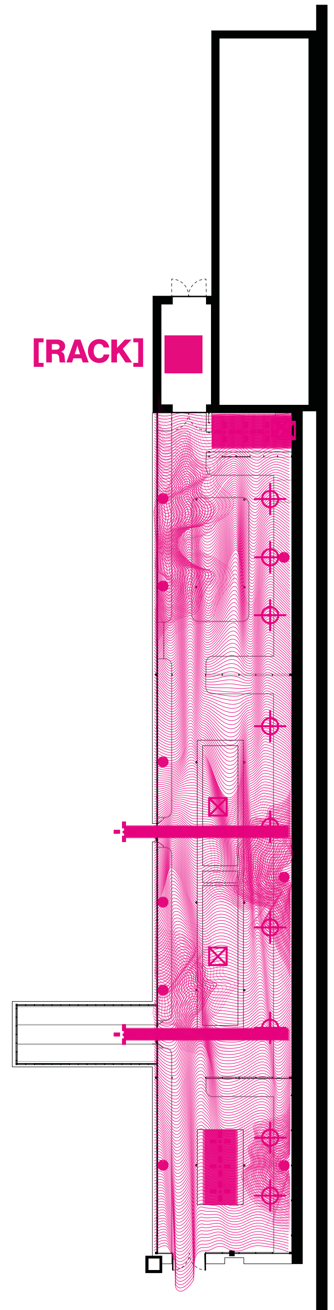
ROUTING ARCHITECTURE:
Dual-path signal flow (split-mode)

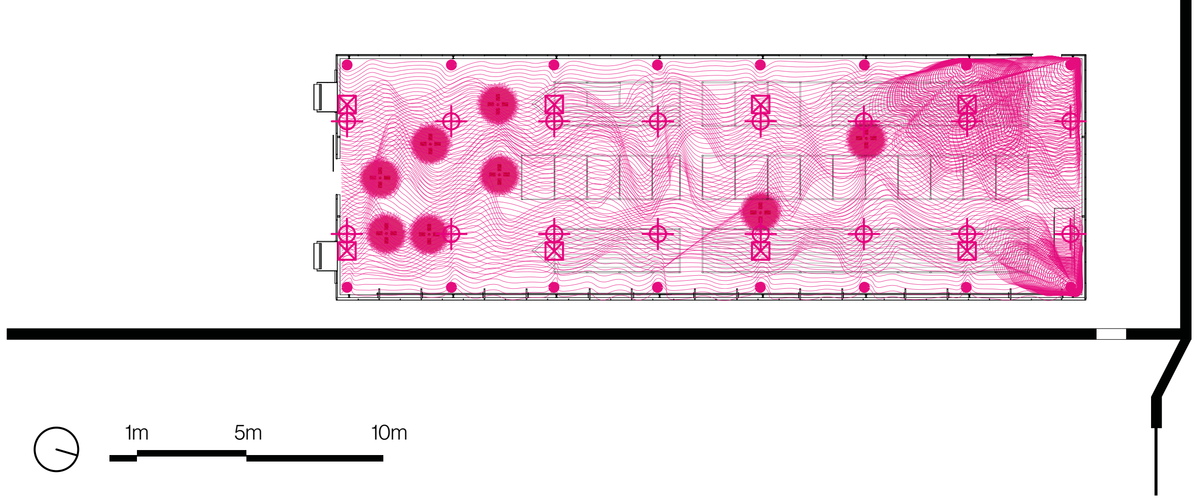
PATH A: FOCUS (dry signal)
> Source: digital beeps (turnstiles)
> Output: Panphonics (overhead)
> DSP: transient shaping / high-pass filter @ 1.2kHz
> Goal: surgical precision / temporal grid

PATH B: ATMOSPHERE (wet/saturated signal)
> Source: neon hum + street sweeper
> Output: Lyzard (wall) + Gallo Habitat (pendant) + Rumble (sub)
> DSP: parallel compression (New York Style)
> Goal: physical density / wall of sound

DYNAMICS CONTROL:
Brickwall limiter (-0.5 dBTP) preventing digital clipping

DYNAMIC PHASE:
A - POLLINATION; B - ENCROACHMENT





/ SOUND DISTRIBUTION PLAN
SATURATION FINAL PHASE

SATURATION FIELD PARAMETERS

SYSTEM STATUS:
Omni-axial pressure / mechanical grid

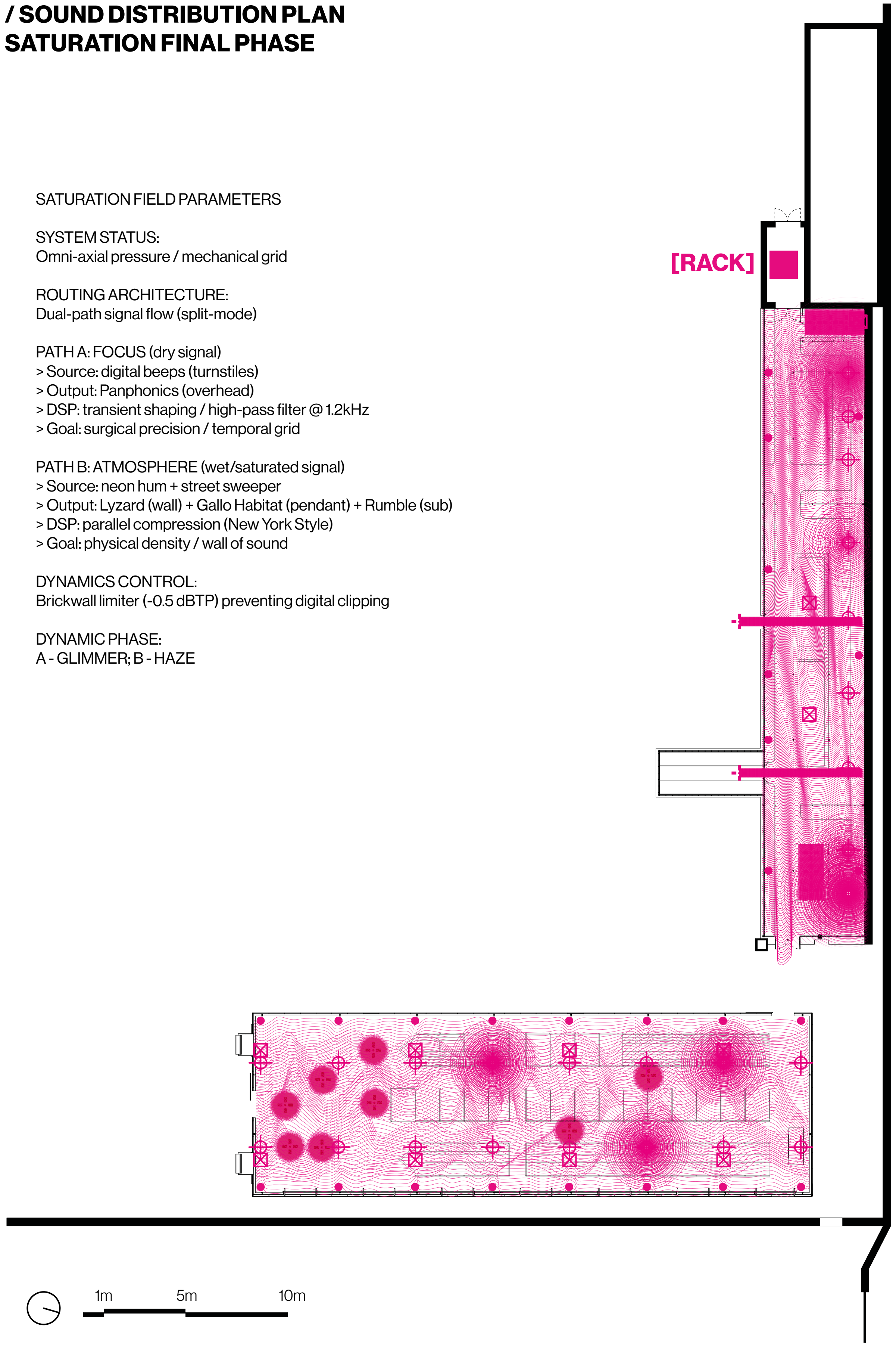
ROUTING ARCHITECTURE:
Dual-path signal flow (split-mode)

PATH A: FOCUS (dry signal)
> Source: digital beeps (turnstiles)
> Output: Panphonics (overhead)
> DSP: transient shaping / high-pass filter @ 1.2kHz
> Goal: surgical precision / temporal grid

PATH B: ATMOSPHERE (wet/saturated signal)
> Source: neon hum + street sweeper
> Output: Lyzard (wall) + Gallo Habitat (pendant) + Rumble (sub)
> DSP: parallel compression (New York Style)
> Goal: physical density / wall of sound

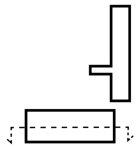
DYNAMICS CONTROL:
Brickwall limiter (-0.5 dBTP) preventing digital clipping

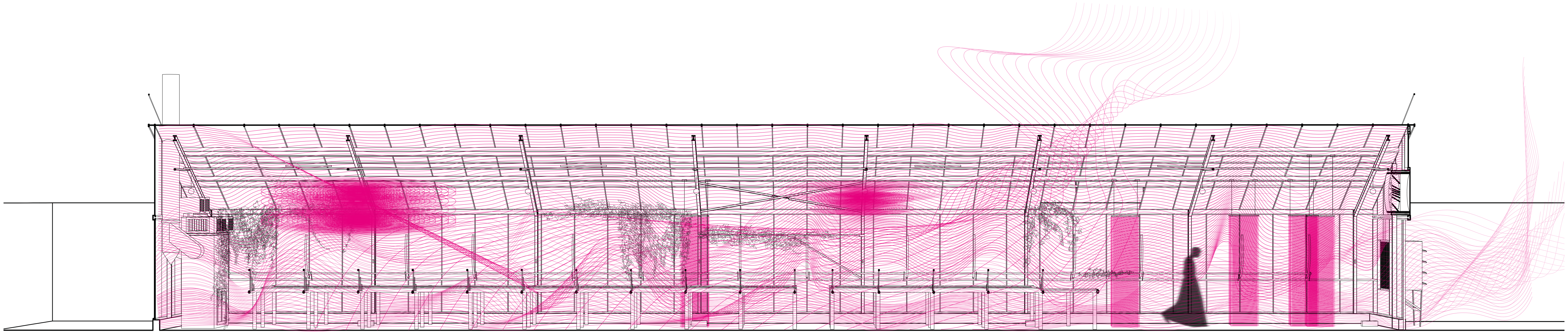
DYNAMIC PHASE:
A - GLIMMER; B - HAZE



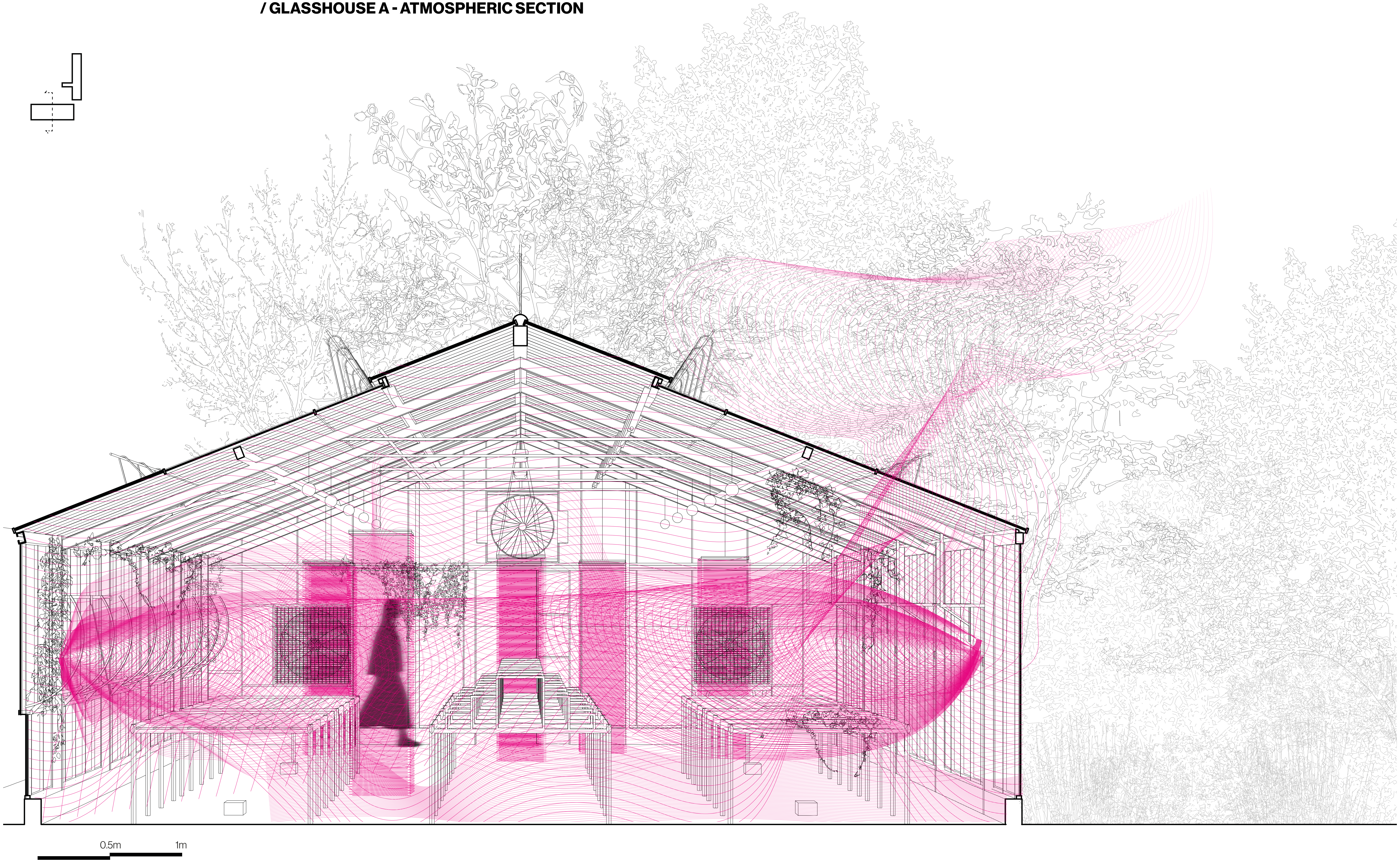
In this phase, the narrative of the Glade as an open and luminous space is subverted by the coexistence of the three acoustic states. Although the individual layers maintain an ethereal nature, their forced overlapping generates a pressure that transforms transparency into a compressed mass. The synthetic signals retain their organic behaviors, yet their saturation renders them unrecognizable, suffocating the environment's biological memory beneath a single sonic density. The Glasshouse is thus revealed as a machine in its most extreme form, where the accumulation of light frequencies collapses into a synthetic body that completely denies the vegetal context.

/ GLASSHOUSE A - ATMOSPHERIC SECTION



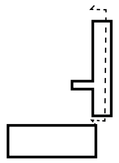


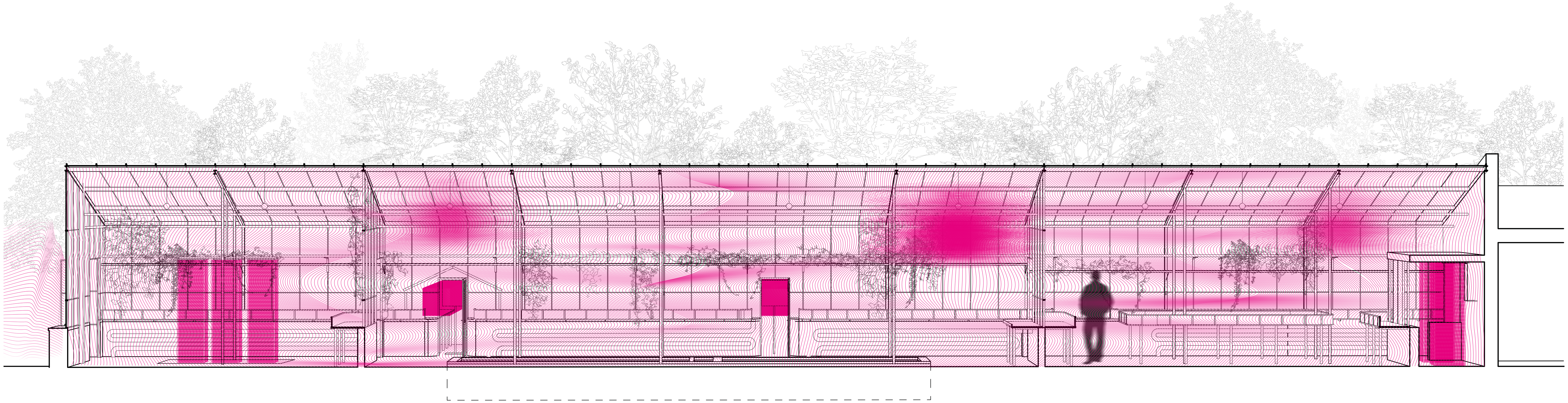
/ GLASSHOUSE A - ATMOSPHERIC SECTION



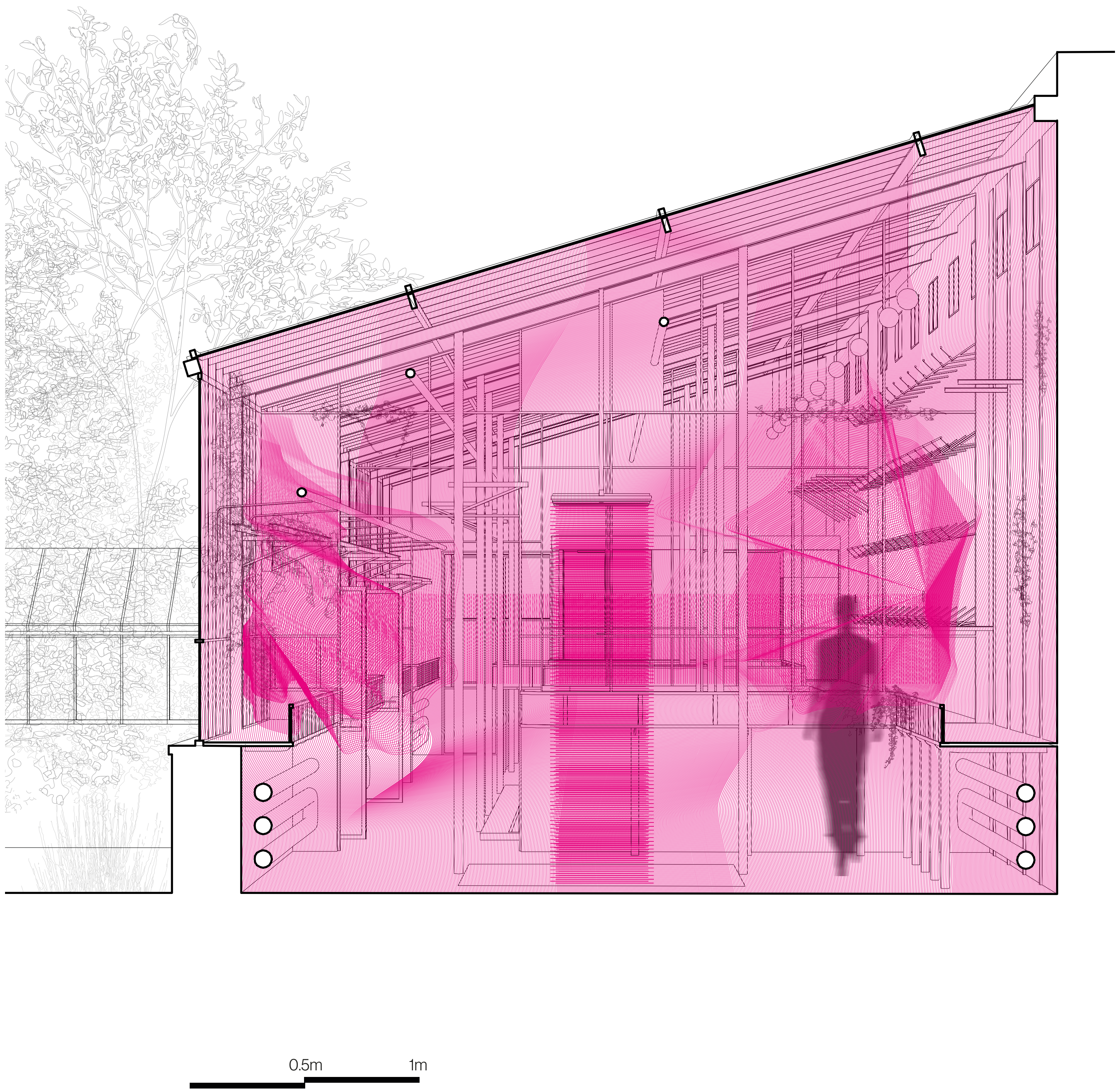
The logic of the Undergrowth reaches its climax through saturation, which pushes the characteristic of high acoustic-spatial density to the extreme. The forced overlapping of signals makes the spatial experience even denser, bringing the narrative nature built around this architecture to its maximum. The space progressively tightens, transforming the glasshouse into a synthetic volume that almost shrinks around the inhabitant.

/ GLASSHOUSE B - ATMOSPHERIC SECTION





/ GLASSHOUSE B - ATMOSPHERIC SECTION



/ SILENCE

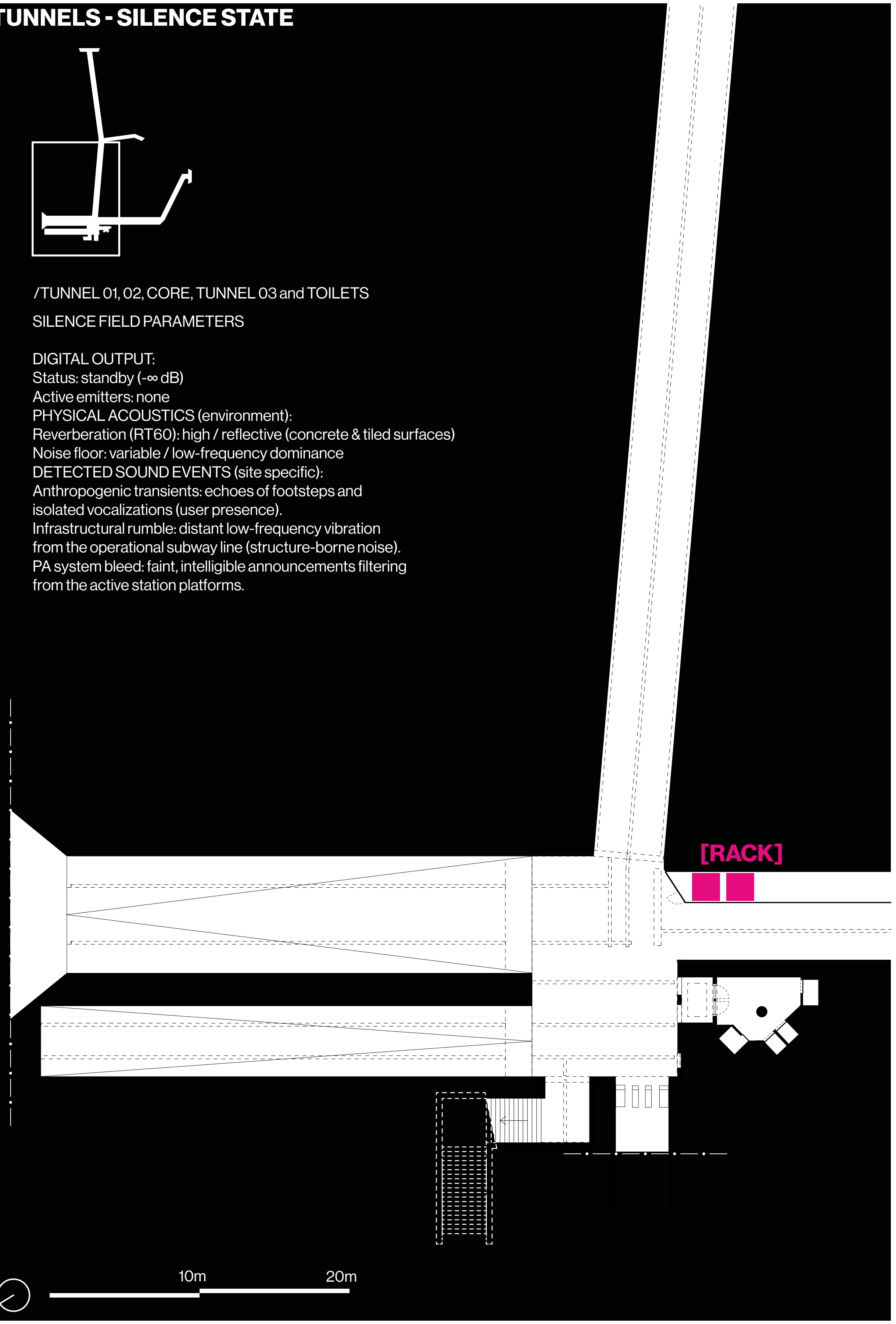
The Silence state acts as a direct and necessary counterpoint to the Saturation state. Algorithmic rules dictate that this phase occurs exclusively after the moment of maximum sonic intensity, in order to amplify the effect of spatial emptying and total decompression. Silence is not identified here merely as the deactivation of digital devices, but as an active moment of memory and anticipation: a pause designed to decompress both the architectural and perceptual space, restoring sensitivity towards the real.
This phase assumes an almost Cagean quality, where the absence of the digital sound layer, previously preponderant and invasive, gives way to the native sounds of the two sites. It therefore becomes an opportunity to deeply perceive the original soundscape: thanks to the auditory threshold heightened by the preceding saturation, the micro-vibrations and noises of the sites emerge, becoming the dominant acoustic component. Sonic reality is thus revealed in its most disruptive rawness, just before the system restarts the generative cycle from the dynamic, diffuse, or focus phases.

/ TUNNELS - SILENCE STATE

/TUNNEL 01, 02, CORE, TUNNEL 03 and TOILETS

SILENCE FIELD PARAMETERS

DIGITAL OUTPUT:
Status: standby (-∞ dB)
Active emitters: none
PHYSICAL ACOUSTICS (environment):
Reverberation (RT60): high / reflective (concrete & tiled surfaces)
Noise floor: variable / low-frequency dominance
DETECTED SOUND EVENTS (site specific):
Anthropogenic transients: echoes of footsteps and
isolated vocalizations (user presence).
Infrastructural rumble: distant low-frequency vibration
from the operational subway line (structure-borne noise).
PA system bleed: faint, intelligible announcements filtering
from the active station platforms.



/TUNNEL 03 A and TUNNEL 03 B

SILENCE FIELD PARAMETERS

DIGITAL OUTPUT:
Status: standby (-∞ dB)
Active emitters: none
PHYSICAL ACOUSTICS (environment):
Reverberation (RT60): high / reflective (concrete & tiled surfaces)
Noise floor: variable / low-frequency dominance
DETECTED SOUND EVENTS (site specific):
Anthropogenic transients: echoes of footsteps and
isolated vocalizations (user presence).
Infrastructural rumble: distant low-frequency vibration
from the operational subway line (structure-borne noise).
PA system bleed: faint, intelligible announcements filtering
from the active station platforms.

/ AUDIO-SPATIAL ARTICULATION - TUNNELS

SOUNDSCAPE: REAL/INFRASTRUCTURAL
SPL: 35 dB - 45 dB (variable)

SONIC SUBTRACTION

In the subterranean galleries, the Silence state functions as a subtractive architectural choice, stripping away the digital acoustic layer to expose the raw physical properties of the container. With the complete cessation of signal output from the Lyzard and Rumble arrays, the space shifts from an active emitter to a passive resonant chamber. The acoustic narrative is no longer imposed by the algorithm but defined exclusively by the site's reverberation time (RT60) and the structural density of the concrete and tiled surfaces.

ARCHITECTURAL REVELATION

SITE SPECIFIC SOUNDS

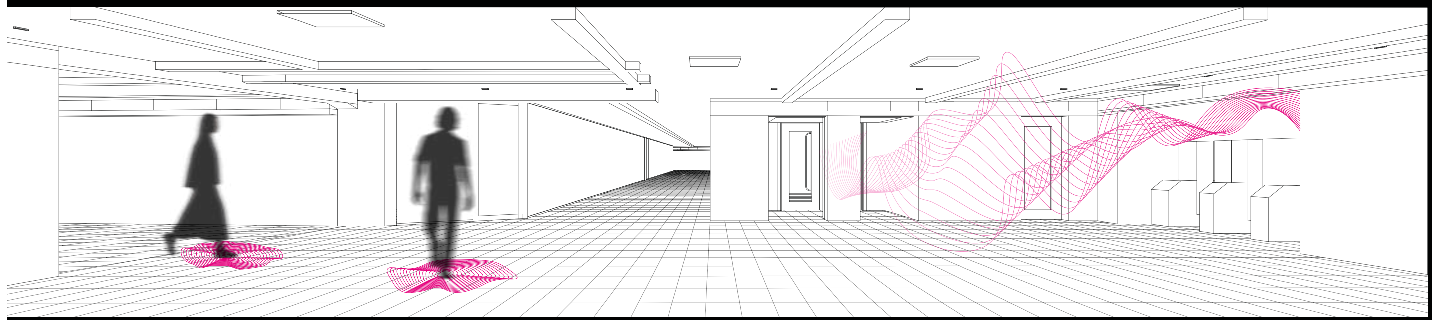
Without the masking effect of the synthetic layers, the auditory threshold resets, allowing low-frequency vibrations (structure-borne noise from the adjacent operational subway) and high-frequency transients (echoes of footsteps and distant vocalizations) to emerge from the background.

HYPER-REALISM

This operational mode transforms the tunnel into a hyper-realistic listening device: the suppression of the designed sound forces the user to confront the heavy reality of the underground infrastructure, turning the void into presence.

Underground, silence acts through subtraction, stripping the galleries of their digital veil to expose the raw matter of the void. As all digital emissions cease, the truth of the space is abruptly perceived once more through an ear hyper-sensitized by the contrast between the sonic density of saturation and the rarefied spatiality of silence. Voices, footsteps, distant platform announcements, and the rhythmic hum of the subway reclaim their place within the infrastructure, welcomed and naturally processed by the characteristic reverberation of the Tunnels.

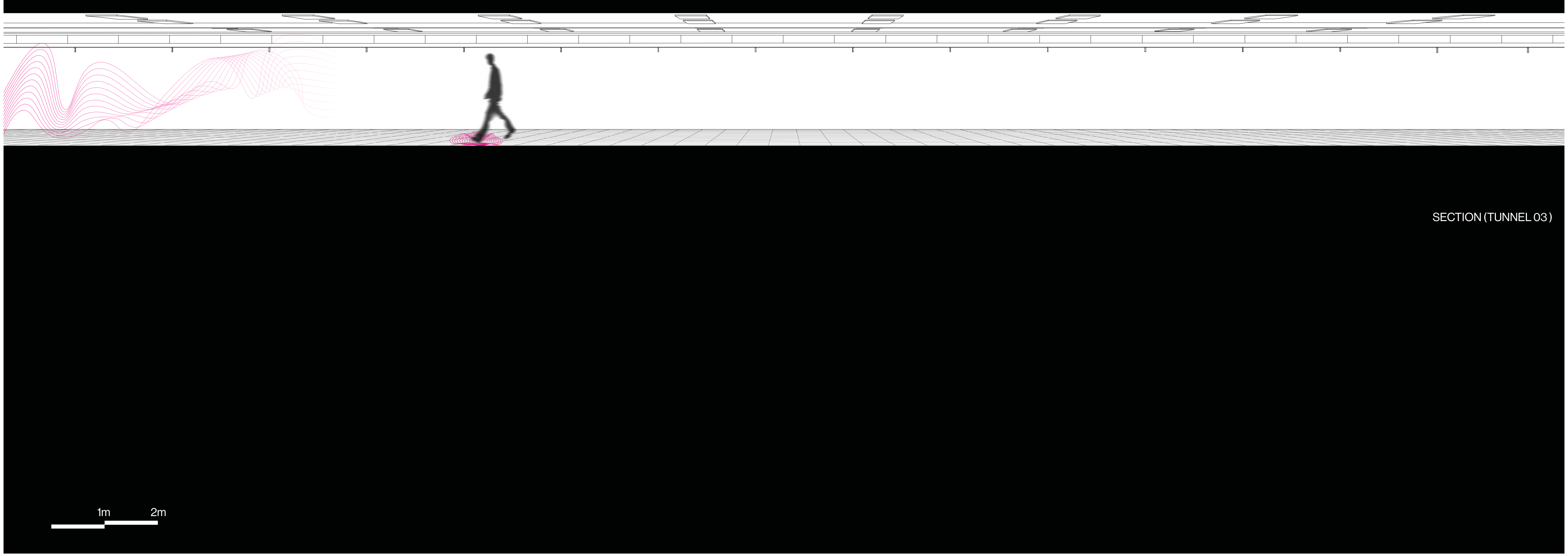
/ TUNNELS - ATMOSPHERIC SECTION



SECTION (CORE)

1m 2m

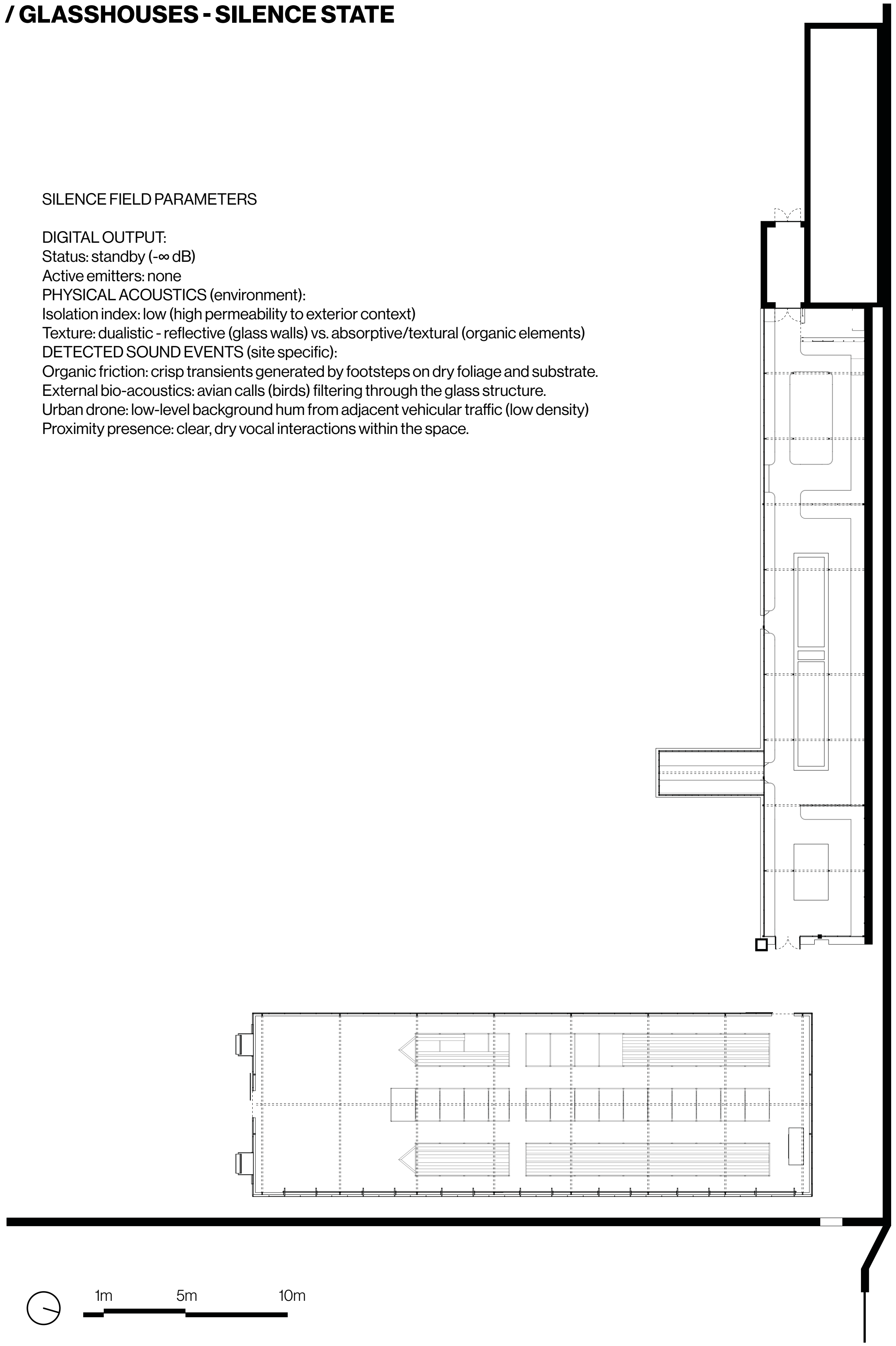
/ TUNNELS - ATMOSPHERIC SECTION



/ GLASSHOUSES - SILENCE STATE

SILENCE FIELD PARAMETERS

DIGITAL OUTPUT:
Status: standby (-∞ dB)
Active emitters: none
PHYSICAL ACOUSTICS (environment):
Isolation index: low (high permeability to exterior context)
Texture: dualistic - reflective (glass walls) vs. absorptive/textural (organic elements)
DETECTED SOUND EVENTS (site specific):
Organic friction: crisp transients generated by footsteps on dry foliage and substrate.
External bio-acoustics: avian calls (birds) filtering through the glass structure.
Urban drone: low-level background hum from adjacent vehicular traffic (low density)
Proximity presence: clear, dry vocal interactions within the space.



/ AUDIO-SPATIAL ARTICULATION - GLASSHOUSES

SOUNDSCAPE: REAL/RURAL-SUBURBAN
SPL: 32 dB - 40 dB (variable)

ARCHITECTURAL PERMEABILITY

In the Glasshouses, the transition to Silence deactivates the machine's narrative, restoring the transparency of the architectural envelope. Unlike the sealed acoustic environment of the tunnels, this state highlights the glass structure as a permeable membrane rather than a barrier.

HI-FI SOUNDSCAPE

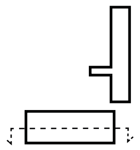
The sudden removal of the dense mechanical drone and pressurized focal beats reveals a high-fidelity, organic soundscape characterized by high dynamic range and granular detail. The auditory focus shifts to micro-events: the crisp friction of footsteps on dry foliage, the rustling of vegetation, and the leakage of external suburban noise (traffic hum and avian calls) filtering through the glazing.

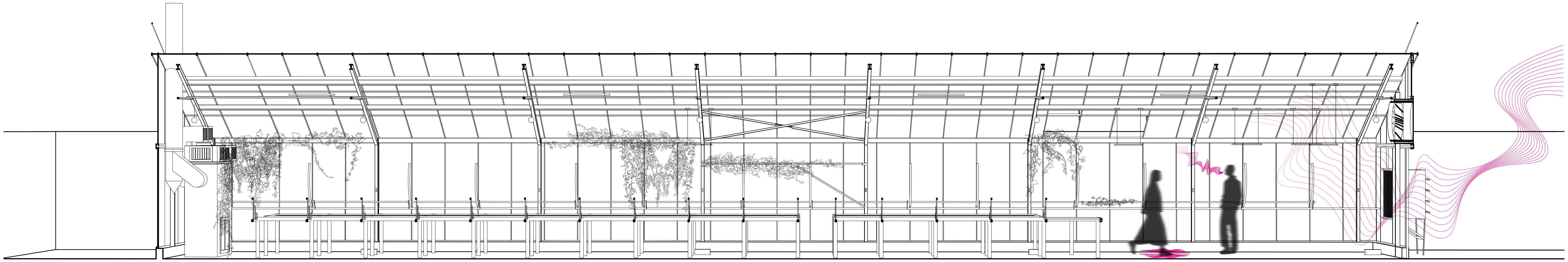
TOTAL TRANSPARENCY

This state represents the system's transparency moment, in which the absence of digital processing allows the natural acoustic impedance of the biological matter to act as the sole damping agent. The result is a reinstatement of the visual-acoustic coherence, where the delicate fragility of the ecosystem momentarily reclaims dominance over the technological grid.

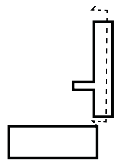
Within the Glasshouses, silence deactivates the narrative of the organic machine, restoring the acoustic landscape to its natural stillness. Synthetic pressure is removed to reveal the fragile and static nature of this environment. The glazed membranes of the architecture reclaim their function as filters, allowing external sounds to lightly permeate and rebalance the interior space with the context. Natural micro-events and suburban noises return as protagonists within a silence that acts as the transparent enclosure of the Glasshouses.

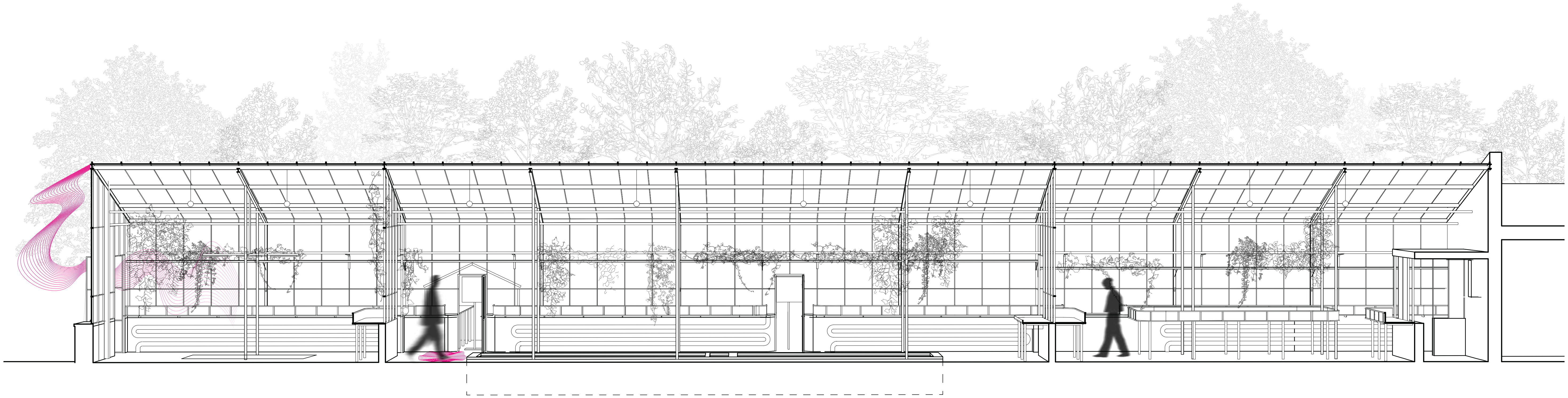
/ GLASSHOUSE A - ATMOSPHERIC SECTION





/ GLASSHOUSE B - ATMOSPHERIC SECTION





TEXTURE

While the Surface layer establishes the immersive volume of the installation, the Texture layer operates as a system of controlled discontinuity. Its primary function is to rupture the linear atmosphere through discrete events, acting as acoustic punctuation that prevents auditory habituation and re-calibrates the visitor's perception of the space. The operational logic differentiates the two environments through time rather than just timbre. In the Tunnels, the system simulates the chaotic behavior of a living ecosystem, generating events through unpredictability, to keep the listener in a state of suspended anticipation. In the Glasshouses, the logic shifts to a deterministic grid, imposing a mechanical cadence that structures the biological environment. This layer transforms the installation from a static loop into a dynamic entity, introducing specific spatial coordinates that force the visitor to constantly re-orient their attention within the space.

/ AUDIO-SPATIAL ARTICULATION - TUNNELS

EVENTS: ORGANIC SOUNDS
SPL: 76 dB - 78 dB

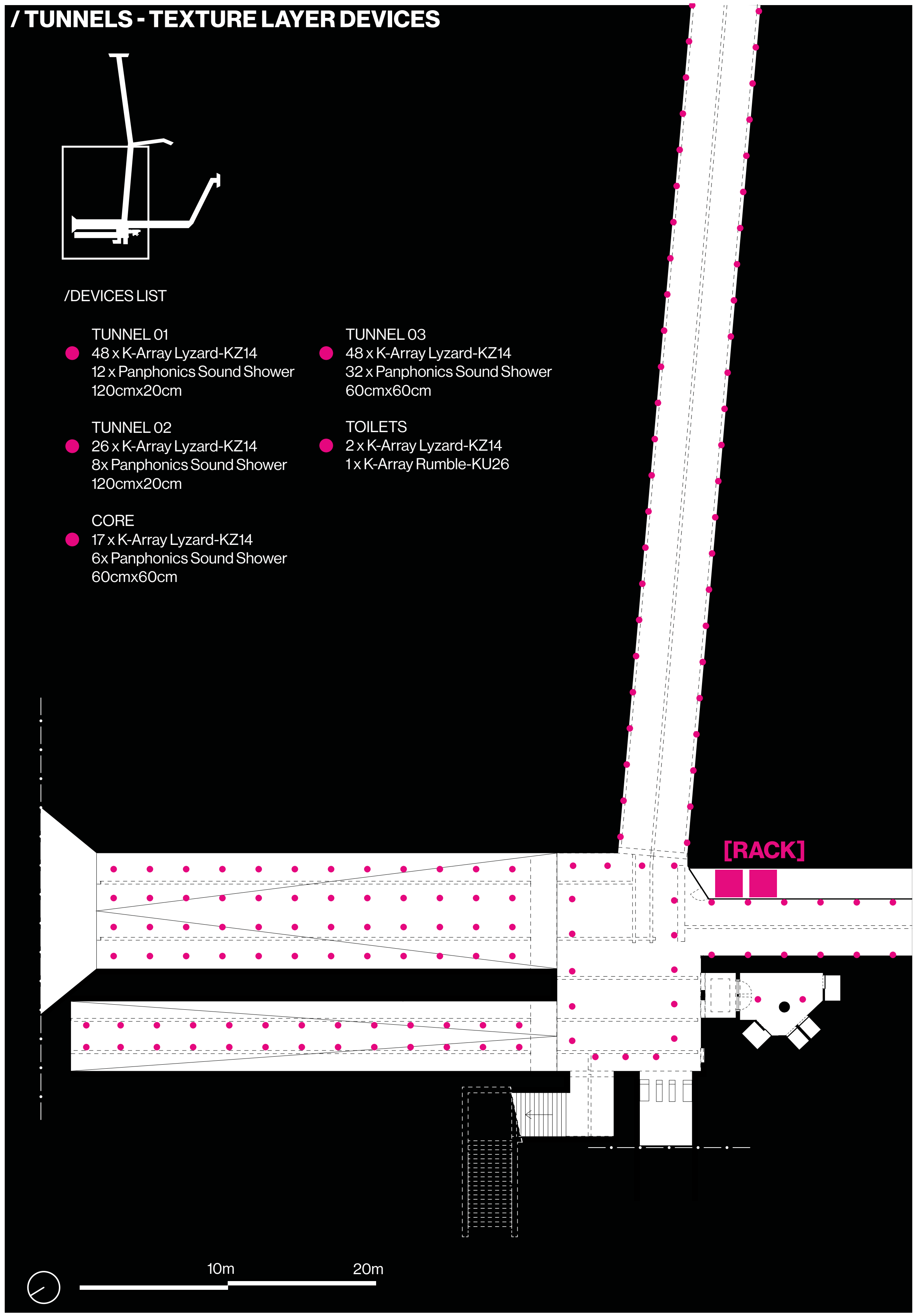
SONIC LAYERING

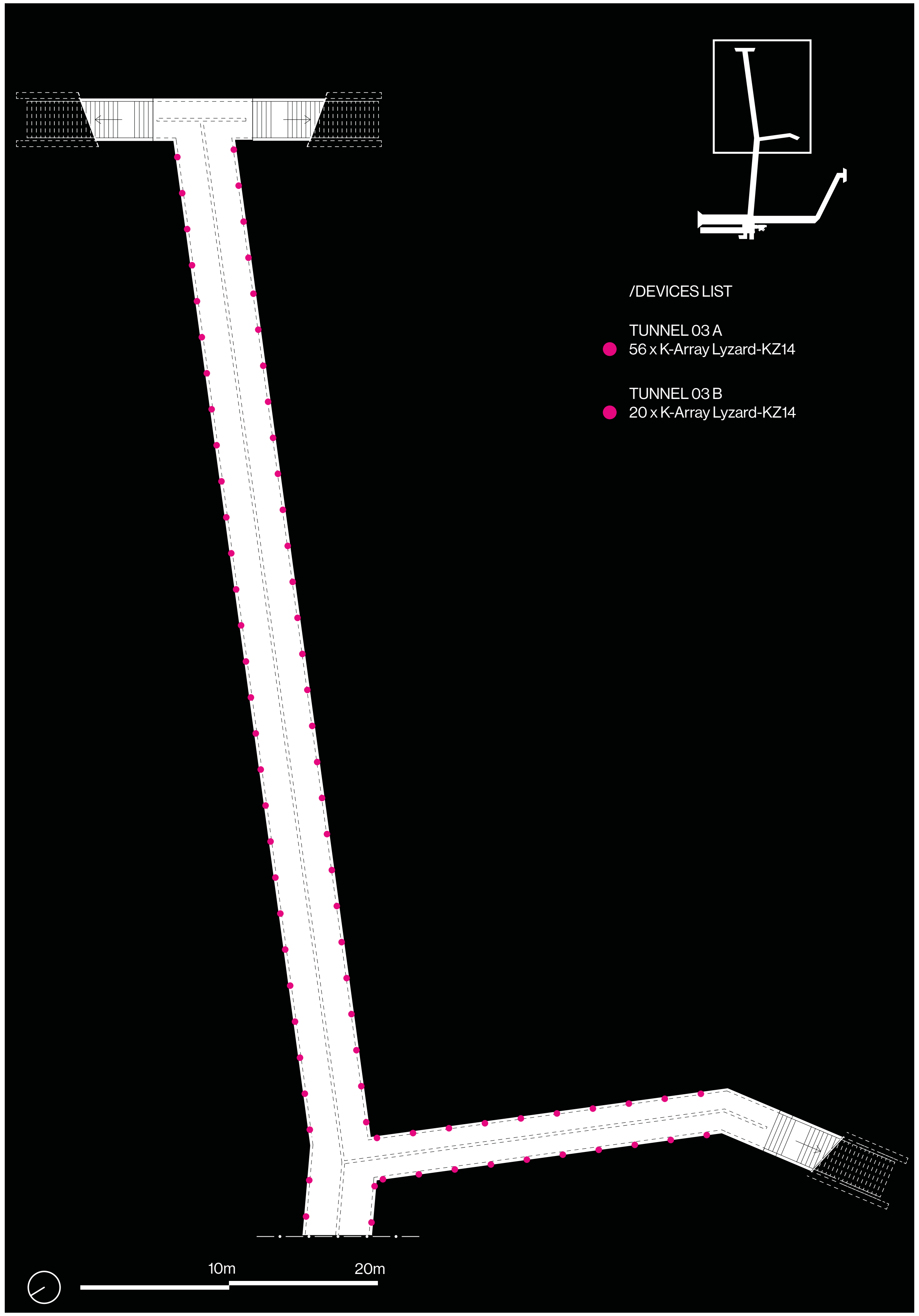
IRREGULAR ACTIVATION

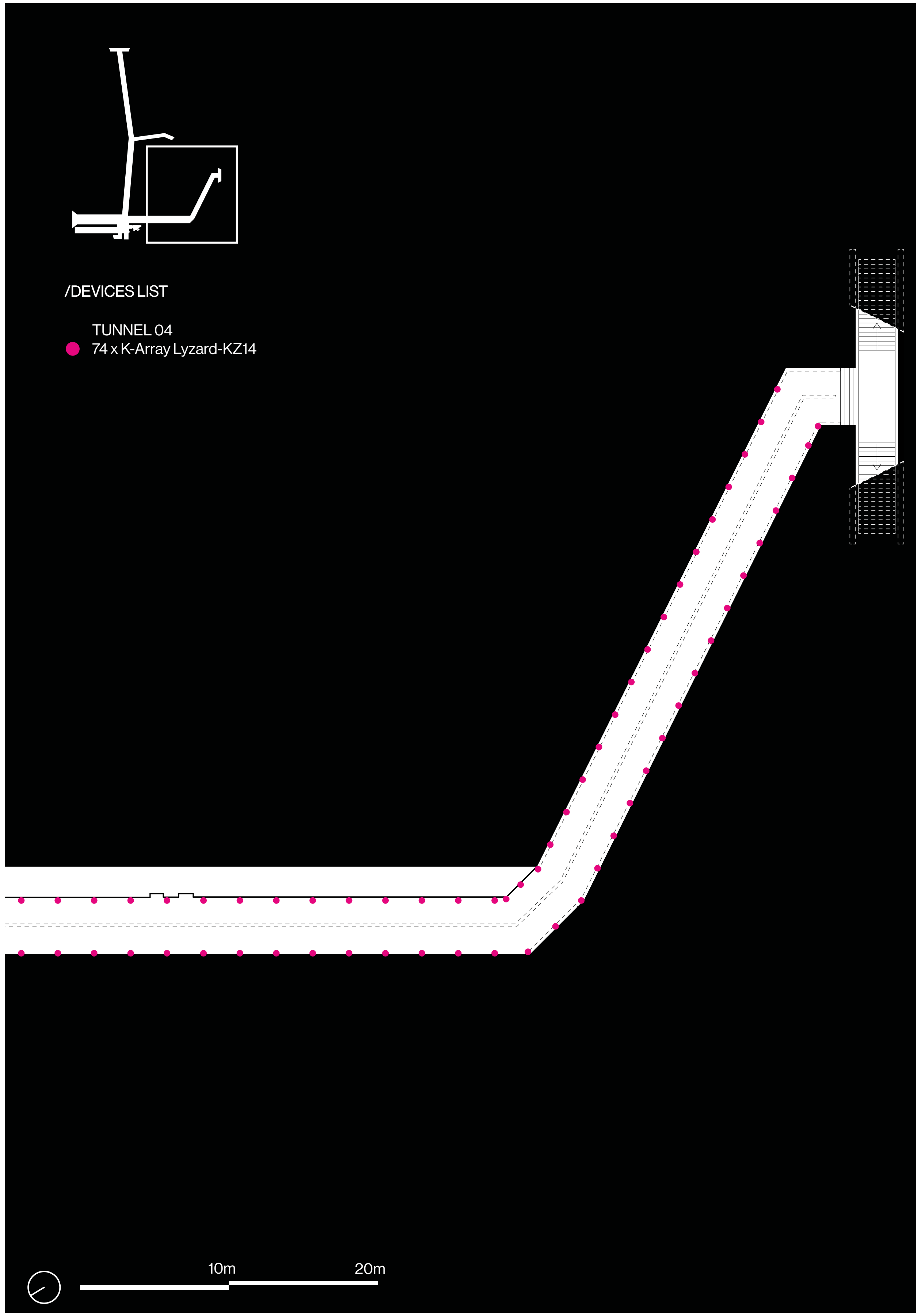
The Texture layer operates as a discontinuous stratum superimposed onto the primary acoustic states (Diffuse, Dynamic, Focus, Saturation and Silence). While the foundational layers manage the continuous atmospheric volume, this secondary system introduces discrete high-frequency events to generate spatial anomalies and maintain auditory alertness. The activation logic follows a probabilistic algorithm within a floating temporal window of 15 to 30 minutes, ensuring that the emergence of these transients remains unscheduled and distinct from the background loop.

ALGORITHMIC ALLOCATION

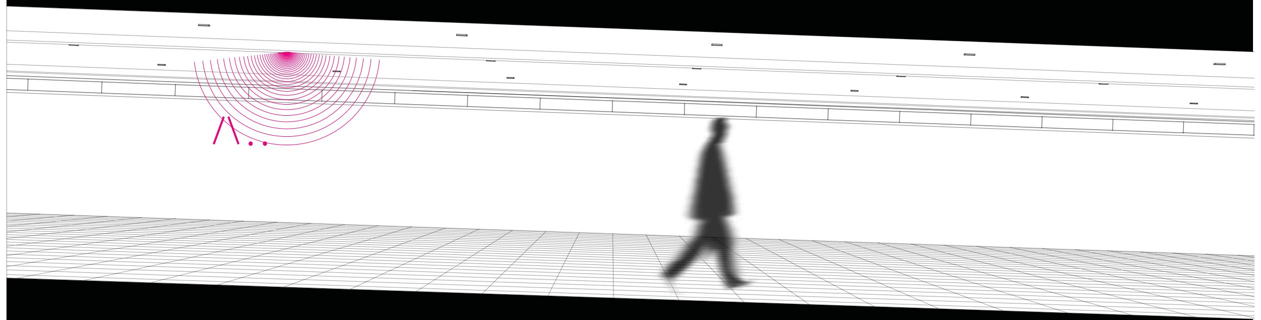
For each event, the generative engine selects a single Lyzard-KZ14 unit from the perimeter array to act as the sole emitter. This precise spatial allocation creates a localized phantom source effect: the sound appears at a specific coordinate in the tunnel, momentarily detaching from the main sonic experience. The result is a sharp, directional signal that pierces the atmosphere, recalibrating the visitor's perception of the physical space through sudden and isolated acoustic points.



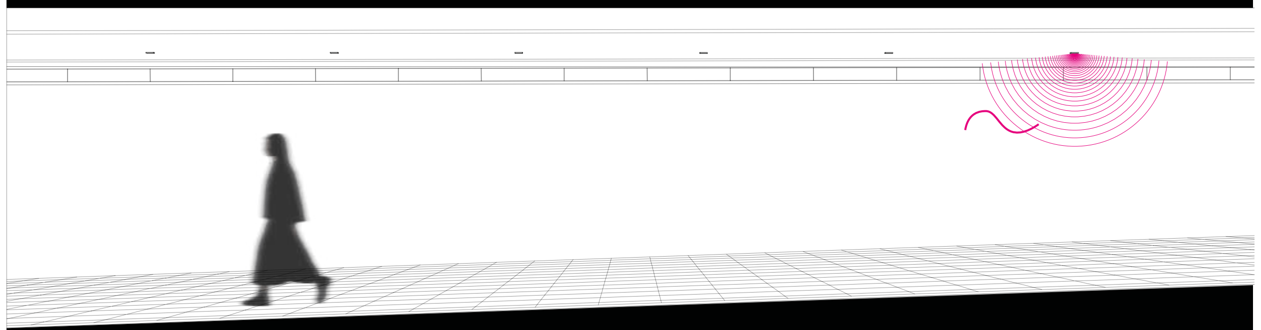

/DEVICES LIST
TUNNEL 03 A
56 x K-Array Lyzard-KZ14
TUNNEL 03 B
20 x K-Array Lyzard-KZ14
10m
20m


/DEVICES LIST
TUNNEL 04
74 x K-Array Lyzard-KZ14
10m
20m

/ TUNNELS - SECTIONS

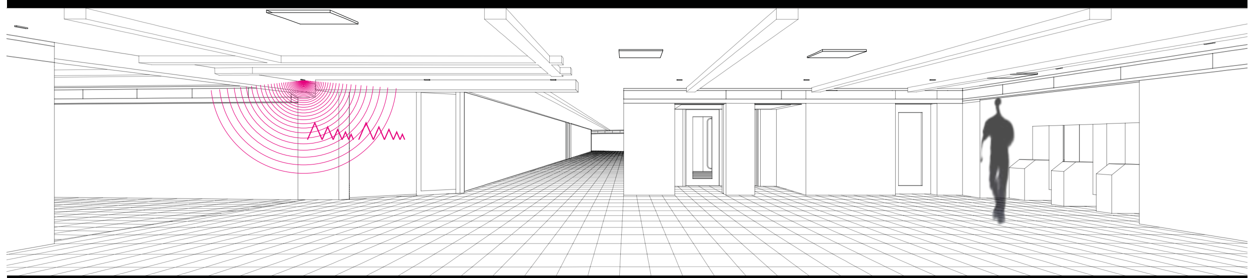


SECTION (TUNNEL 01 - INCUBATOR)
HYPOTHETICAL EVENT [T+04 MIN]

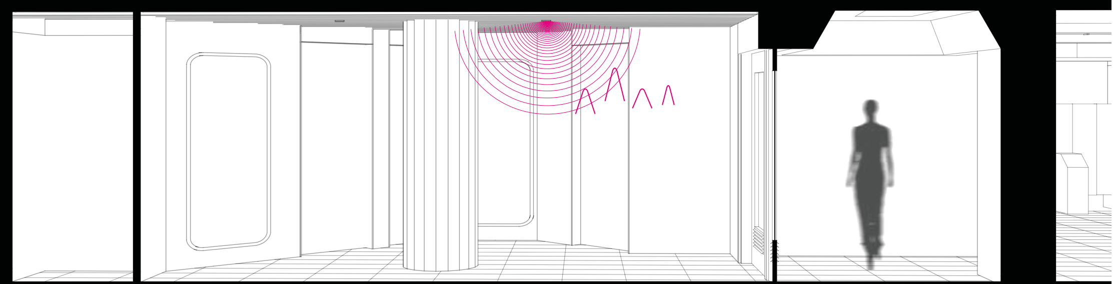


SECTION (TUNNEL 02 - INCUBATOR)
HYPOTHETICAL EVENT [T+19 MIN]

1m 2m



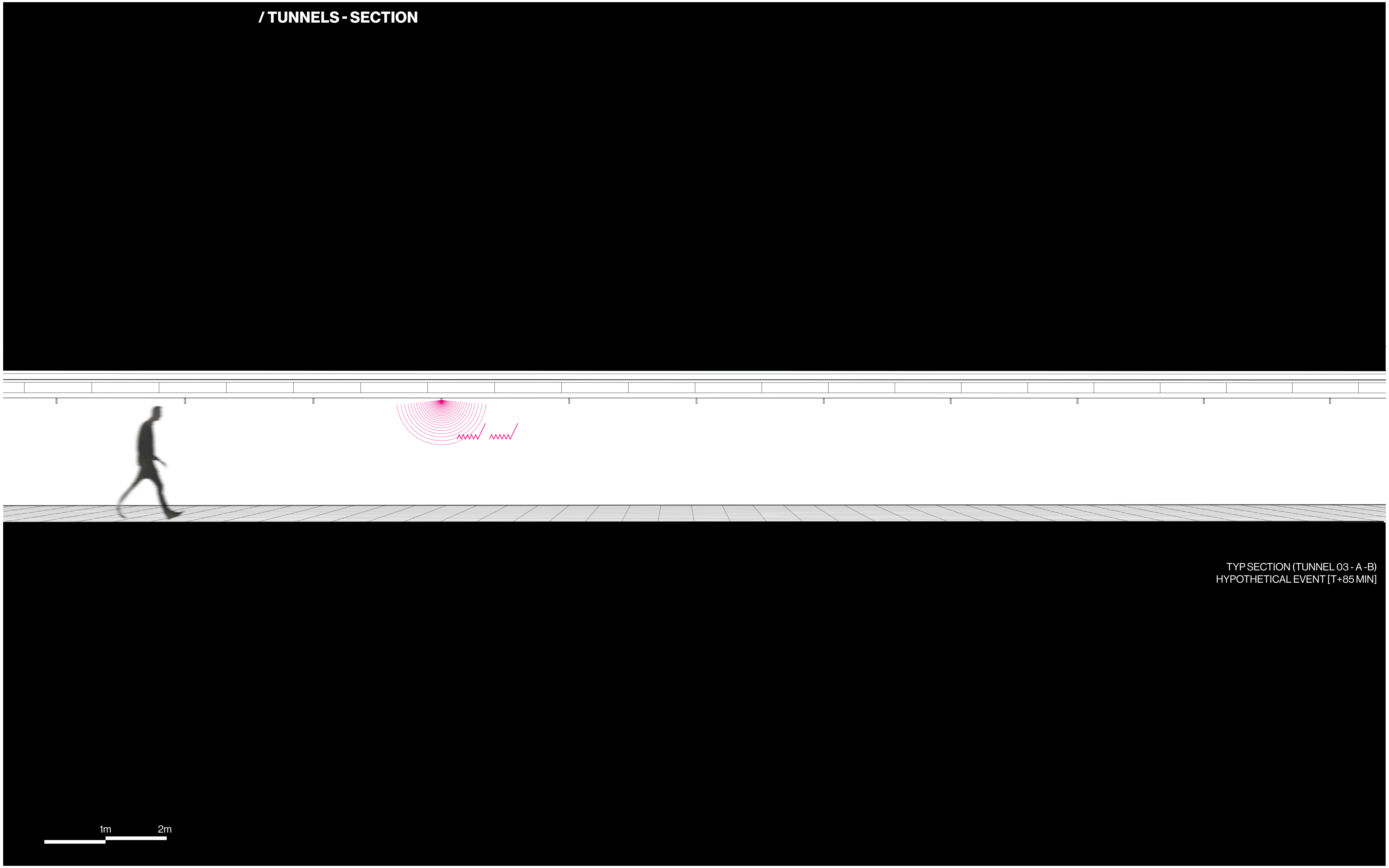
SECTION (CORE)
HYPOTHETICAL EVENT [T+42 MIN]



SECTION (CORE)
HYPOTHETICAL EVENT [T+59 MIN]

1m 2m

/ TUNNELS - SECTION



/ AUDIO-SPATIAL ARTICULATION - GLASSHOUSES

EVENTS: SUBWAY ANNOUNCEMENTS
SPL: 72 dB - 75 dB

TEMPORAL GRID

The Glasshouses utilize the Texture layer to establish a rigid temporal grid. Functioning as a mechanical clock within the biological environment, the system triggers a specific sonic marker every 10 minutes to punctuate the active soundscape. This regular interval provides a structural rhythm that overlays the fluid dynamics of the primary states, creating an additional contrast between the organic surroundings and the artificial precision of the algorithm.

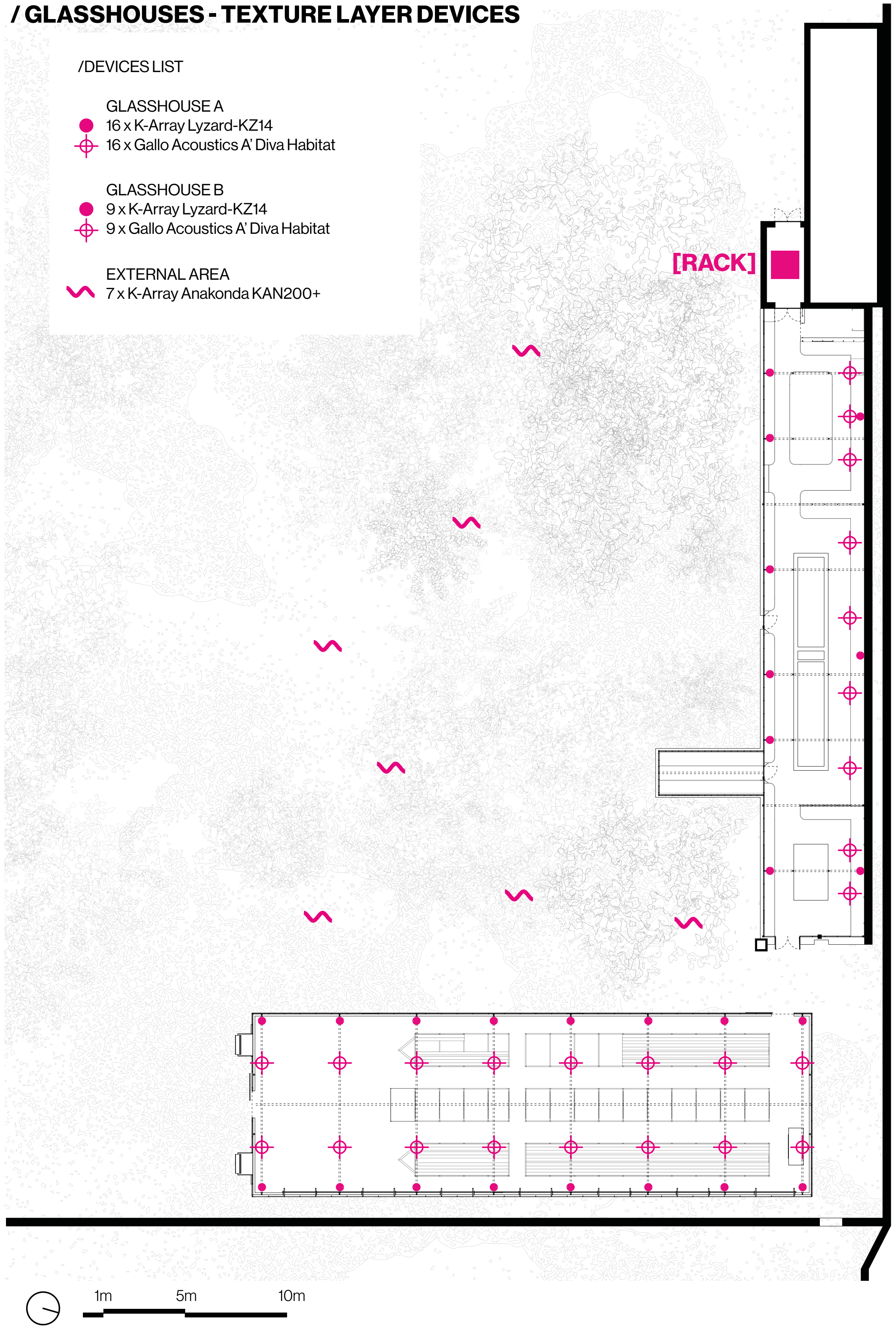
HYBRID HARDWARE

The signal routing for this layer engages a hybrid hardware configuration. The audio event is distributed across the internal Lyzard and Gallo systems, while simultaneously activating the K-array Anakonda flexible speakers concealed within the external vegetation.

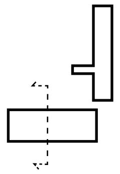
OUTDOOR EXTENSION

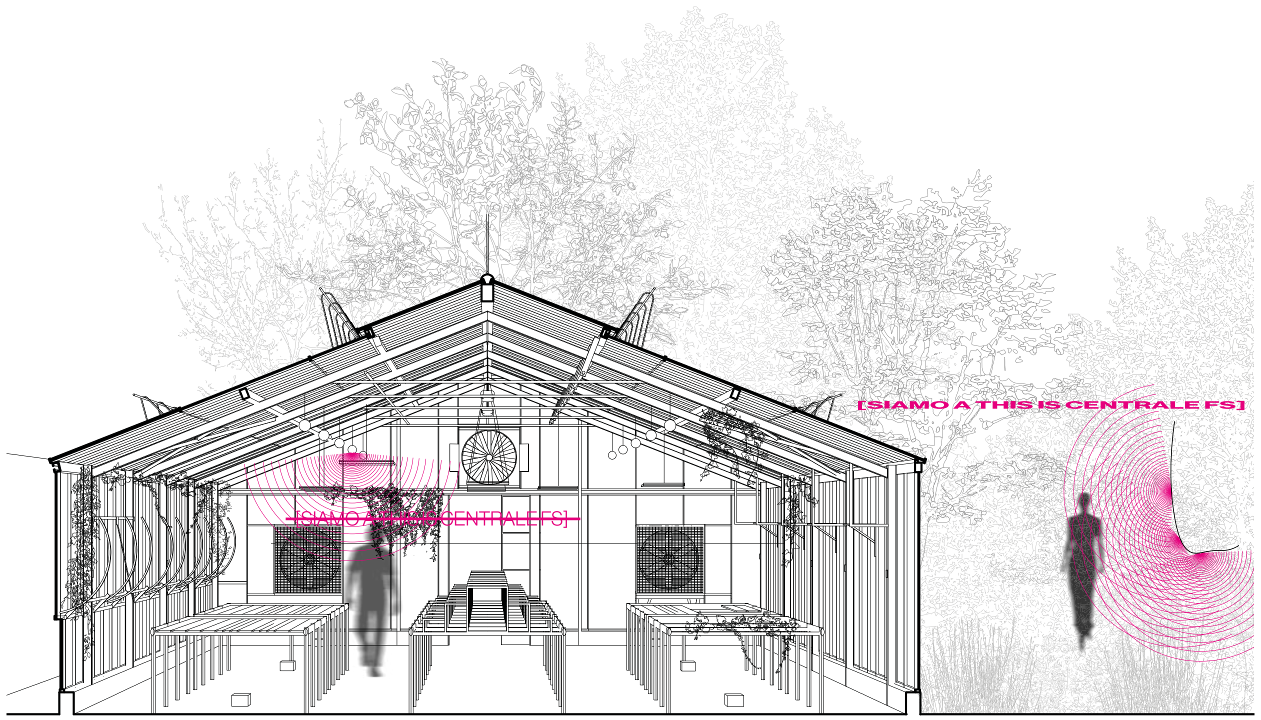
This configuration extends the installation's acoustic footprint beyond the architectural envelope. By projecting the sound through the glass and into the surrounding greenery, the system blurs the threshold between the conditioned interior and the natural context, allowing the installation to momentarily colonize the external landscape.

/ GLASSHOUSES - TEXTURE LAYER DEVICES



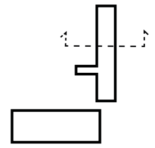
/ GLASSHOUSES - SECTIONS

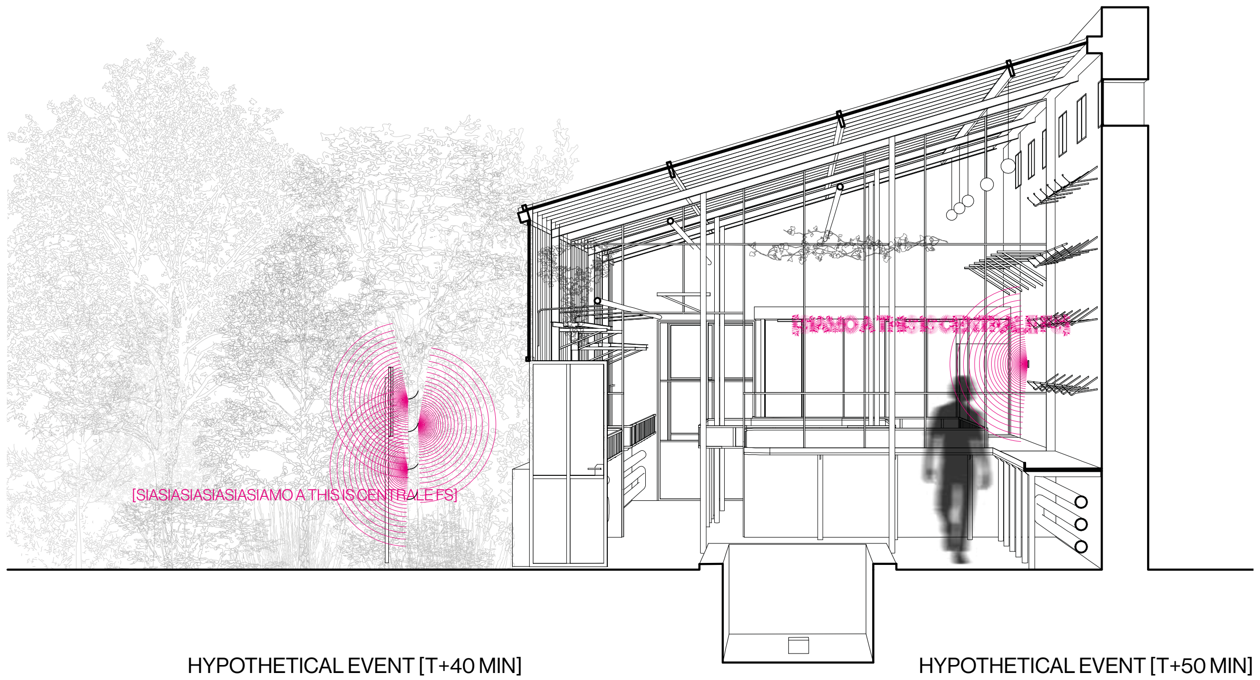




HYPOTHETICAL EVENT [T+10 MIN]

HYPOTHETICAL EVENT [T+20 MIN]





HYPOTHETICAL EVENT [T+40 MIN]

HYPOTHETICAL EVENT [T+50 MIN]

SUBSTRATE

The Substrate constitutes the invisible load-bearing axis of the work. Unlike the other layers, this stratum emerges as a direct extension of the site's intrinsic spirit: the 50 Hz Mains Hum (Electricity) for the tunnels and the 432 Hz Natural Harmonic for the glasshouses. These sonic identities are not static. From the cycle's inception, starting at near-zero intensity and following a linear gain growth, the system imposes an unstoppable directional drift.

Narratively, this frequency represents the vital soul of the two spaces. The distinct identities are inexorably attracted toward a point of convergence, progressively abandoning their unique characteristics. The inevitable culmination is the 241 Hz Singularity: a union that annihilates all spatial and sonic distinctions. At the process's peak, the volume of this layer completely saturates the environment, erasing every other sound and driving the installation toward a univocal and total conclusion.

/ AUDIO-SPATIAL ARTICULATION - TUNNELS

FREQUENCY: from 50 Hz to 241 Hz
SPL: from 35 dB to 90 dB

INITIAL STATE

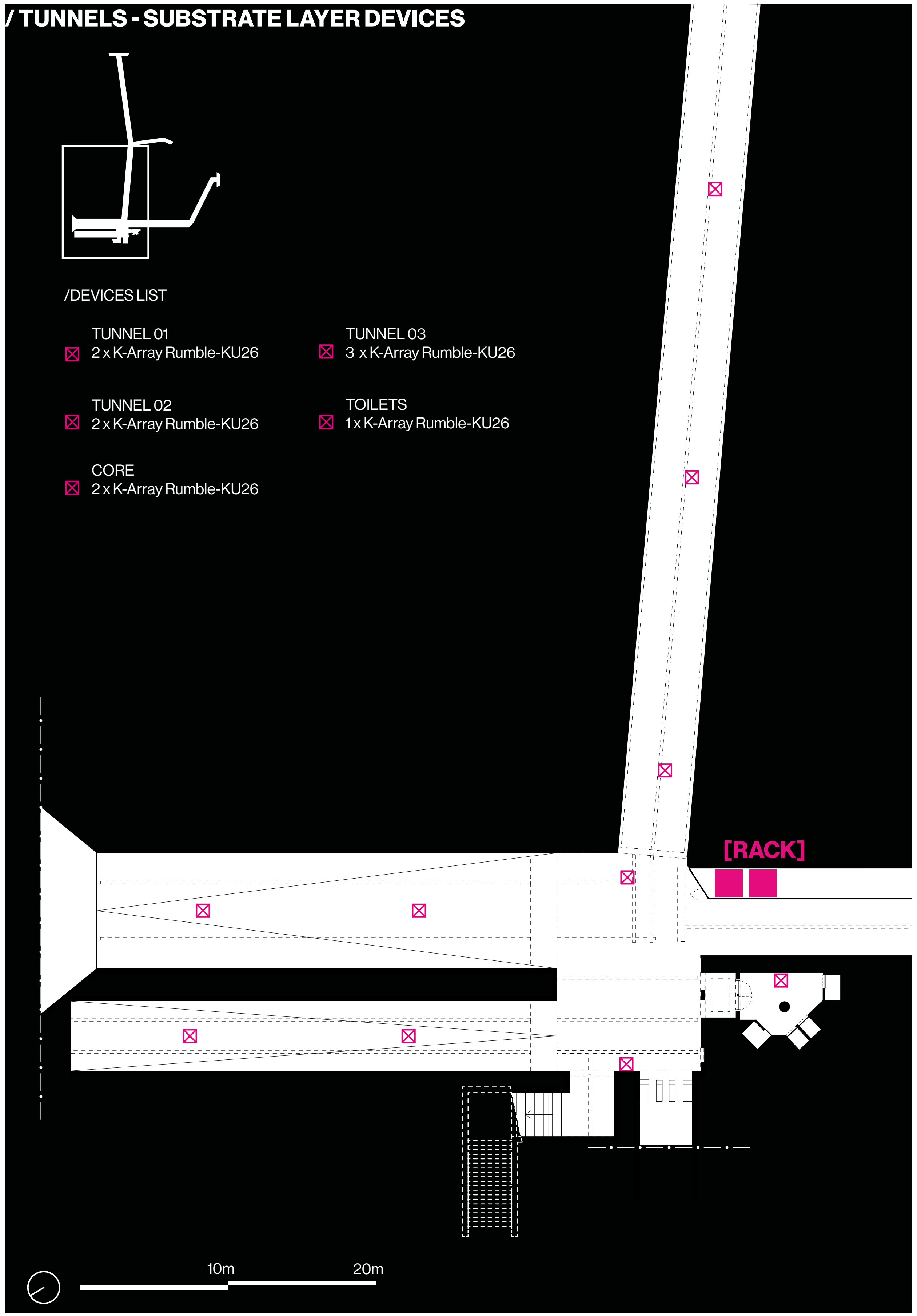
In the galleries, the delivery of the 50 Hz Mains Hum relies on the array of K-array Rumble-KU26 subwoofers. These units are engineered for optimal response in the low-frequency spectrum (45Hz - 150Hz), perfectly articulating the initial heavy, structure-borne vibration of the electrical grid.

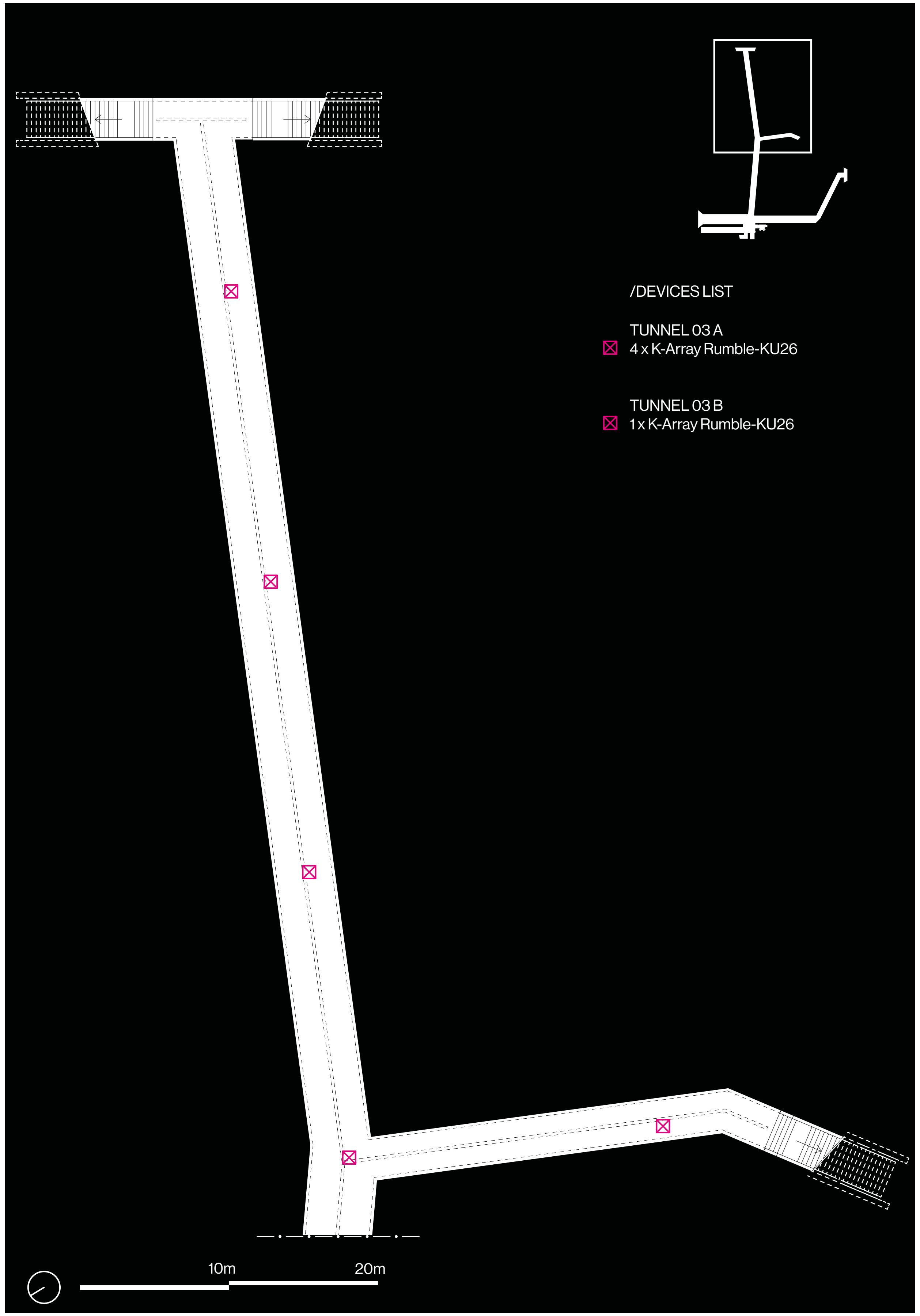
CRITICAL THRESHOLD

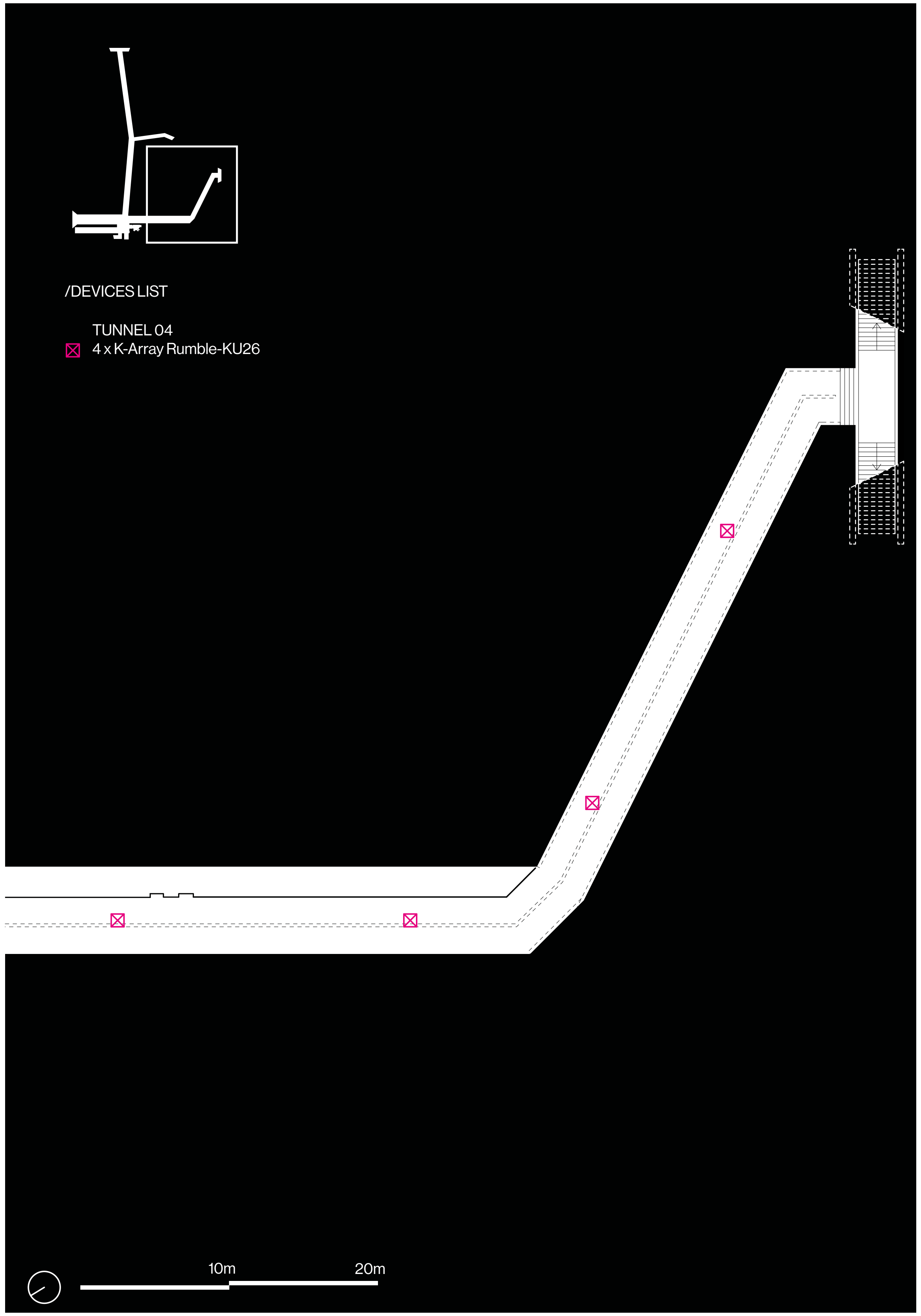
As the algorithmic cycle advances and the frequency approaches the 241 Hz Singularity, the hardware is deliberately driven out of its optimal operating range. The system drives the transducers to the absolute edge of their mechanical tolerance. To prevent permanent damage, a DSP soft-clip limiter engages at the critical threshold, protecting the voice coils while allowing audible harmonic distortion to pass through.

SIGNAL DEGRADATION

This technical balance serves a precise narrative function: as the tone rises, the subwoofers visibly and audibly struggle, introducing mechanical artifacts and physical strain into the signal without catastrophic failure. The audio quality degrades intentionally. The listener hears the hardware physically suffering under the weight of the algorithm, rendering the concept of system collapse as a tangible reality.




/DEVICES LIST
TUNNEL 03 A
4 x K-Array Rumble-KU26
TUNNEL 03 B
1 x K-Array Rumble-KU26
10m
20m


/DEVICES LIST
TUNNEL 04
4 x K-Array Rumble-KU26
10m
20m

/ AUDIO-SPATIAL ARTICULATION - GLASSHOUSES

FREQUENCY: from 432 Hz to 241 Hz
SPL: from 35 dB to 90 dB

PERMEABLE CONFIGURATION

The Glasshouses host the 432 Hz Natural Harmonic, requiring a diffusion strategy that privileges airiness and ubiquity over physical weight. The system employs a dual-layer hardware configuration: internally, Gallo Habitat pendant speakers provide a clear, omnidirectional wash; externally, a network of K-array Anakonda flexible speakers is woven directly into the vegetation, allowing the sound to colonize the biological context.

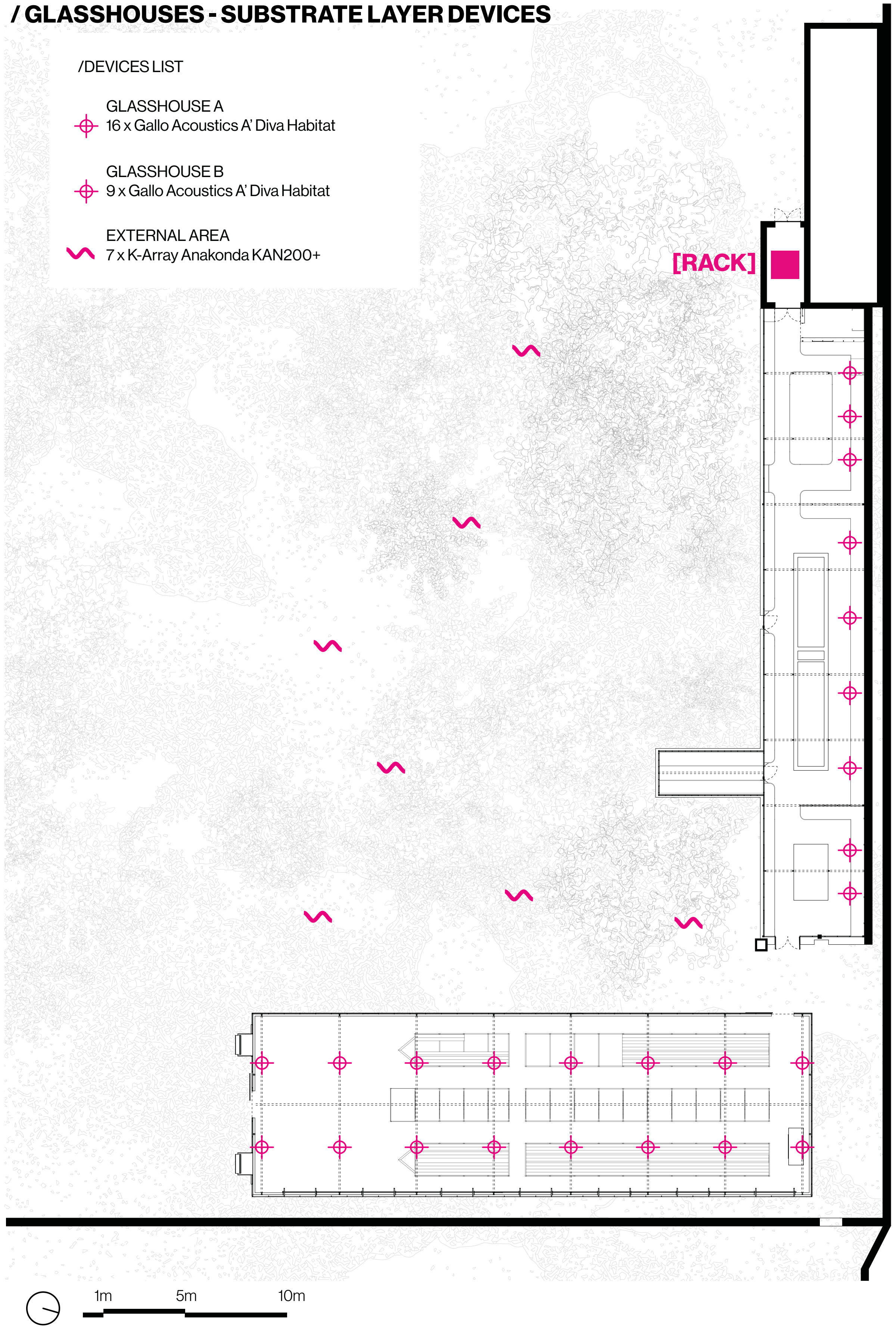
PHYSICAL OVERLOAD

However, the convergence toward the 241 Hz Singularity imposes a severe physical test on this delicate hardware. As the frequency descends from 432 Hz and the gain rises to maximum saturation (0 dB), the system forces these small-diaphragm drivers to move an excessive mass of air. The demand for acoustic pressure at this lower frequency pushes the components to their physical excursion limits, resulting in mechanical overload.

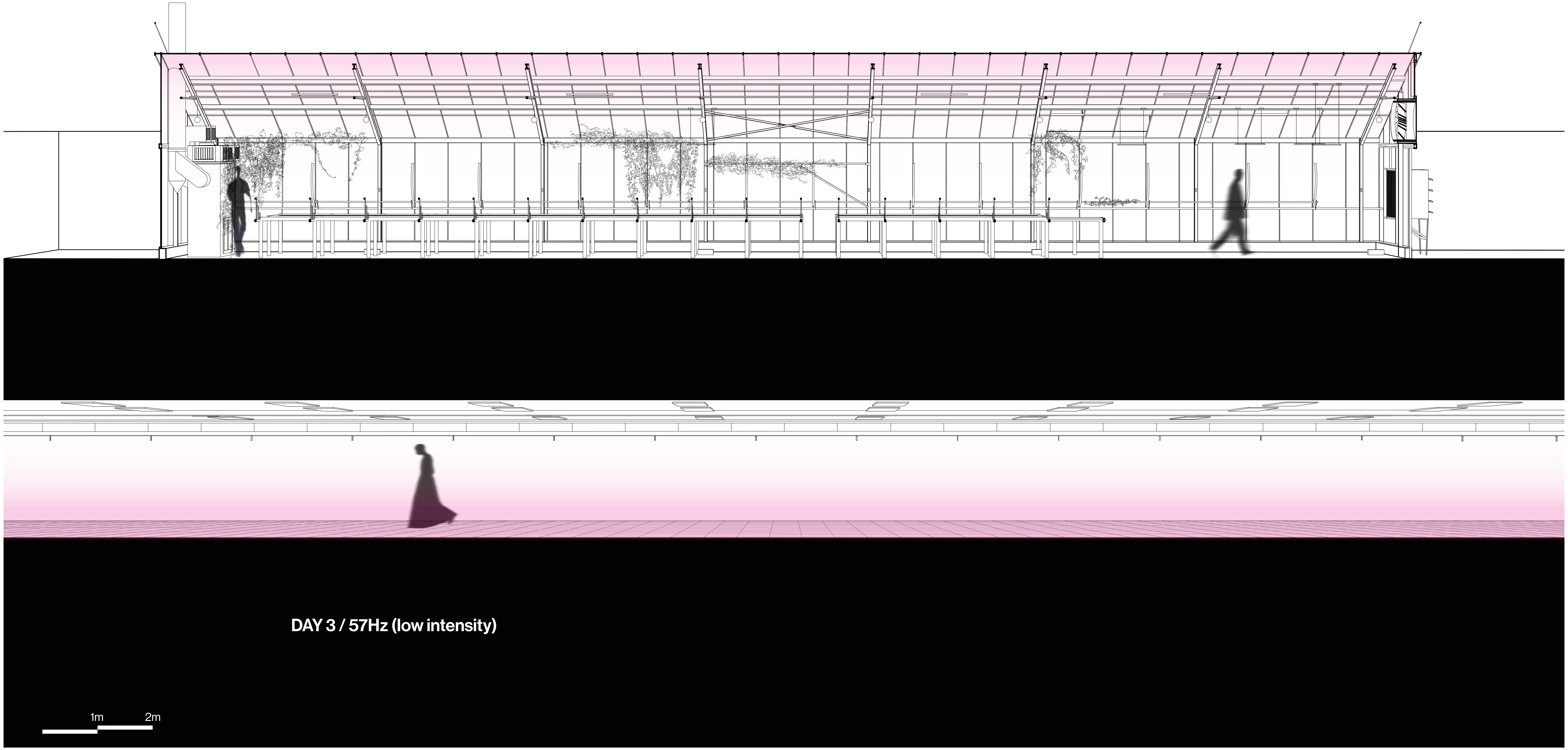
SUFFOCATED TONE

This stress manifests as a specific sonic texture: membrane saturation. Unlike the heavy struggle of the Tunnels, here the Anakonda and Gallo units begin to "choke" under the sheer energy of the monolithic drone. The sound loses its pristine definition, acquiring a trembling, breathless quality. The technology physically vibrates on the verge of breakdown, mirroring the biological vulnerability of the greenhouse environment facing the final collapse.

/ GLASSHOUSES - SUBSTRATE LAYER DEVICES

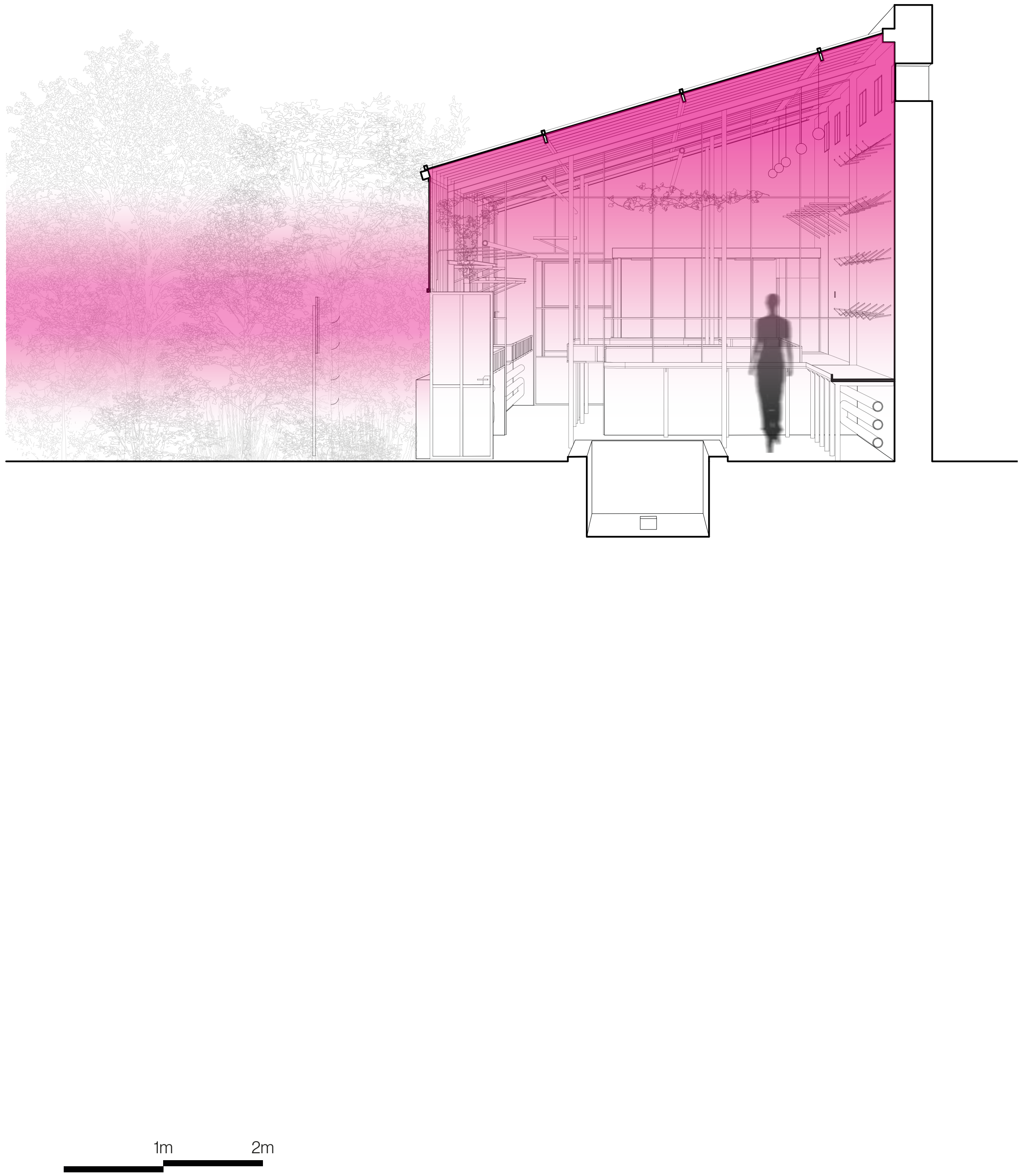


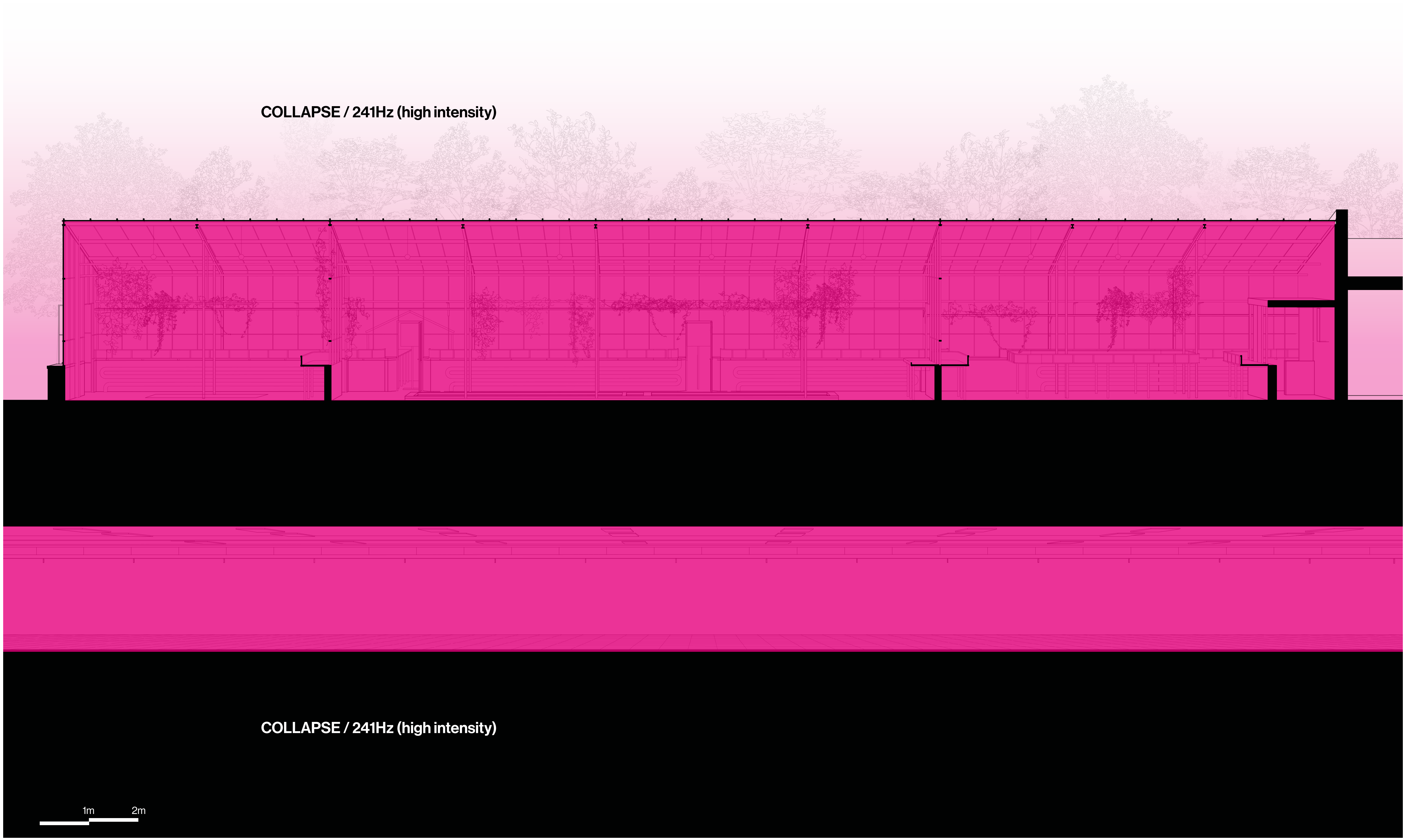
DAY 3 / 421Hz (low intensity)



DAY 21 / 143Hz (medium intensity)

DAY 21 / 358Hz (medium intensity)




COLLAPSE / 241Hz (high intensity)
COLLAPSE / 241Hz (high intensity)
1m
2m

CONCLUSIONS

Through the design development, it has been possible to demonstrate how architecture and sound can become a symbiotic and complementary organism, enabling the enhancement of the intrinsic characteristics of both musical and design worlds through a synergistic collaboration. The hope placed in this work is to bring together techniques and disciplines that are often not associated with one another, but when combined can yield a third result that transcends both material spatial design and musical composition. This result allows for the emergence of audio-spatial situations that amplify and further characterize the experience of inhabiting a place, suggesting new perspectives on the spaces themselves.

With advances in technology and the possibilities offered by new media, I believe it is natural to reflect more deeply on the integration of these tools into more traditional and established design fields. The use of multimedia enables what has been emphasized several times throughout this thesis: the provision of "immaterial materials" that can characterize spaces while simultaneously allowing for modifications and transformations impossible for material space. The necessity of architectural design remains an essential point of the design practice, but it can be decisively accompanied by a gaze open to other fields, through which new solutions can be found, both in physical terms and in terms of theoretical development.
The theoretical framework that guided this research is rooted in the first part of the work, presenting the thought of fundamental authors who promoted and deepened their vision on the link between the arts and the possibilities deriving from it. Without the contribution of these, and certainly many other theorists, this work would not have been possible in the way it was conceived and realized today. The design development was carried out following studied theoretical lines, subsequently elaborated according to specific reasonings and objectives for this project, with the hope of bringing, as far as possible, new elements and reflections regarding the historical attempts to apply sound to space.

From a technical standpoint, an effort was made to consider real constraints and limits, reasoning to overcome them and find solutions. The technical components and parameters were treated in a way that makes the drafting of the project as realistic as possible, keeping in mind that it remains a project on paper, without a real-world implementation. Certainly, this transition, as in any project, would contribute to the definition of certain parameters and different design choices, bringing an improvement to the feasibility of the installation. This suggestion offers future perspectives for a potential translation of theory into practice, putting into action the techniques presented within this thesis and providing a tangible demonstration of the acoustic and spatial conditions presented, thus opening the way for new and necessary experimentation.

REFERENCES

/ BIBLIOGRAPHY

Adorno, T. W. (2002). *Filosofia della musica moderna* [Philosophy of modern music] (G. Manzoni, Trans.). Einaudi. (Original work published 1949).

Amacher, M. (2008). City links. In A. Franke (Ed.), *Boundaries: Envisioning American territory* (pp. 162-171). University of Chicago Press.

Amacher, M. (2020). *Selected writings and interviews* (B. Dietz & A. Schatz, Eds.). Blank Forms Editions.

Augé, M. (1992). *Un etnologo nel metrò* [In the metro] (F. Lomax, Trans.). Elèuthera. (Original work published 1986).

Augé, M. (1993). *Nonluoghi. Introduzione a un'antropologia della surmodernità* [Non-places: Introduction to an anthropology of supermodernity] (D. Rolland, Trans.). Elèuthera. (Original work published 1992).

Augé, M. (2002). *In the Metro* (T. Conley, Trans.). University of Minnesota Press. (Original work published 1986).

Bindeman, S. (2017). *Silence in philosophy, literature, and art*. Brill-Rodopi. https://doi.org/10.1163/9789004352582

Blesser, B., & Salter, L.-R. (2007). *Spaces speak: Are you listening? Experiencing aural architecture*. MIT Press.

Böhme, G. (2017). *Atmospheric architectures: The aesthetics of felt spaces* (A.-C. Engels-Schwarzpaul, Ed. & Trans.). Bloomsbury Academic. (Original work published 1995).

Cage, J. (1961). *Imaginary Landscape No. 5* [Graphic musical score]. Henmar Press. (Original work published 1952).

Cage, J. (1961). *Silence: Lectures and writings*. Wesleyan University Press.

Cardiff, J., & Miller, G. B. (n.d.). *The forty part motet.* Cardiff & Miller. https://cardiffmiller.com/installations/the-forty-part-motet/

Carr, D. (2019, July 11). *How Brian Eno created 'Ambient 1: Music for Airports'*. Reverb Machine. https://reverbmachine.com/blog/deconstructing-brian-eno-music-for-airports/

Casella, A., & Valle, A. (2016). *Imaginary landscape no. 4: Study and annotation of the score*. In Proceedings of the XXI CIM – Colloquio di Informatica Musicale.

Chadabe, J. (1997). *Electric sound: The past and promise of electronic music*. Prentice Hall.

Cimini, A. (2020). *Telematic tape: Notes on Maryanne Amacher's City links (1967–1980)*. Twentieth-Century Music, 17(2), 125–151. https://doi.org/10.1017/S147857222000003X

Citera, P. (n.d.). *Lezione I – Introduzione e storia della musica elettroacustica* [Lesson I – Introduction and history of electroacoustic music] [Lecture notes]. Conservatorio di Musica "Santa Cecilia", Roma.

Clarke, J. (2012). *Iannis Xenakis and the Philips Pavilion: The reconstruction of a multimedia spectacle*. The Musical Quarterly, 95(3), 378–413.

Clément, G. (2005). *Manifesto del Terzo paesaggio* [Manifesto of the Third Landscape] (F. De Pieri, Trans.). Quodlibet. (Original work published 2004).

Clément, G. (2015). Manifesto of the Third Landscape. In S. Morris (Trans.), *The planetary garden and other writings* (pp. 35-64). University of Pennsylvania Press. (Original work published 2004).

Collaboration for NDT Education. (n.d.). *Acoustic impedance*. NDE-ED.org.

Connor, S. (2004). *The book of skin*. Cornell University Press.

Dia Art Foundation. (n.d.). *Max Neuhaus, Times Square*. https://diaart.org/visit/visit-our-locations-sites/max-neuhaus-times-square

Eckermann, J. P. (1850). *Conversations with Goethe in the last years of his life* (S. M. Fuller, Trans.). James Munroe and Company. (Original work published 1836).

Emmerson, S., & Smalley, D. (2001). Electro-acoustic music. In *Grove Music Online*. Oxford University Press.

Eno, B. (1978). *Ambient 1: Music for airports* [Album]. Polydor.

Eshun, K. (1998). *More brilliant than the sun: Adventures in sonic fiction*. Quartet Books.

Everest, F. A., & Pohlmann, K. C. (2014). *Master handbook of acoustics* (6th ed.). McGraw-Hill Education.

Fujak, J. (2025). Sonic (and other) environments as the mirror of society (and as the challenge for artistic testimony). *Linguistic frontiers*, 8(1), 1–8. https://doi.org/10.2478/lf-2025-0007

Gallo Acoustics. (n.d.). *A'Diva Habitat: 5" stainless steel spherical speaker*. https://galloacoustics.com/product/adiva-habitat/

Gillmor, A. M. (1988). *Erik Satie*. Twayne Publishers.

Goodman, S. (2010). *Sonic warfare: Sound, affect, and the ecology of fear.* MIT Press.

Izzo, L. (2023). *Poème électronique by Edgard Varèse, the Philips Pavilion, and the reconstruction of a utopian vision*. Computer Music Journal, 47(4), 5–28.

Jankélévitch, V. (1985). *La musica e l'ineffabile* [Music and the ineffable] (E. Lisciani-Petrini, Trans.). Einaudi. (Original work published 1961).

Jarocinski, S. (1976). *Debussy: Impressionism and symbolism* (R. Myers, Trans.). Eulenburg Books. (Original work published 1966).

Kahn, D. (1999). *Noise, water, meat: A history of sound in the arts*. MIT Press.

K-Array. (n.d.). *Anakonda-KAN200+: Flexible array element*. https://www.k-array.com/en/product/anakonda-kan200-plus

K-Array. (n.d.). *Kommander: Cloud-manageable amplifiers with on-board DSP*. https://www.k-array.com/en/products/line/kommander

K-Array. (n.d.). *Lyzard-KZ14: Ultra-miniature line array element*. https://www.k-array.com/en/product/lyzard-kz14

K-Array. (n.d.). *Rumble-KU26: Stainless steel passive subwoofer*. https://www.k-array.com/en/product/rumble-ku26

Kirkegaard, J. (2006). *4 rooms*. Touch.

Kirkegaard, J. (n.d.). *4 rooms*. Fonik. https://fonik.dk/works/FourRooms.html

Kratzer, N. (Ed.). (2023). *Bernhard Leitner: Sound space sculpture. Catalogue raisonné*. Verlag für moderne Kunst.

Kubisch, C. (2006). Electrical walks. In B. LaBelle (Ed.), *Site of sound: Of Architecture and the ear* (Vol. 2). Errant Bodies Press.

Kubisch, C. (n.d.). *Electrical walks*. Christina Kubisch. https://christinakubisch.de/electrical-walks

LaBelle, B. (2006). Architecture of noise. In *Background noise: Perspectives on sound art* (pp. 149–196). Continuum.

Loock, U. (2005, November 1). *Times Square: Max Neuhaus's sound work in New York City*. Open! Platform for Art, Culture & the Public Domain.

Lucier, A. (1995). *Reflections: Interviews, scores, writings*. MusikTexte.

Marinetti, F. T. (1909, February 20). Manifesto del futurismo [Manifesto of Futurism]. *Le Figaro*.

Morgan, J. (Ed.). (2004). *Bruce Nauman: Raw materials*. Tate Publishing.

The Museum of Modern Art. (n.d.). *The forty part motet (a reworking of Thomas Tallis's Spem in alium, 1573)*. https://www.moma.org/collection/works/87291

Nancy, J.-L. (2004). *All'ascolto* [Listening] (E. Lisciani-Petrini, Trans.). Raffaello Cortina. (Original work published 2002).

Pallasmaa, J. (2005). *The eyes of the skin: Architecture and the senses*. John Wiley & Sons.

Panphonics. (n.d.). *Directional audio solutions and plane wave technology*. https://panphonics.com/

Rasmussen, S. E. (1959). *Experiencing architecture* (E. M. Wendt, Trans.). MIT Press.

Rex Features. (2006). *Bill Fontana has placed a network of accelerometers (vibration sensors) on the Millennium Bridge, London* [Photograph]. Shutterstock. https://www.shutterstock.com/it/editorial/image-editorial/bill-fontana-has-placed-network-accelerometers-vibration-596368g

Reynolds, S. (1998). *Energy flash: A journey through rave music and dance culture*. Picador.

Rognoni, L. (2002). La musicologia filosofica di Adorno [Adorno's philosophical musicology]. In T. W. Adorno, *Filosofia della musica moderna* [Philosophy of modern music] (pp. VII–XXV). Einaudi.

Russolo, L. (1913). *L'arte dei rumori* [The art of noises]. Edizioni Futuriste di "Poesia".

Russolo, L. (2025). *Risveglio di una città* [Awakening of a City] [Score]. In M. Gallope, N. Harren, & J. Hicks (Eds.), *The scores project: Experimental notation in music, art, poetry, and dance*, 1950 - 1975. Getty Research Institute. (Original work published 1914).

Ruszka, L. (Photographer). (1980). Acousmonium at Maison de la Radio, Paris [Photograph]. In *Hereafter* (2019). Sonic Acts Press. Retrieved from https://kulturpunkt.hr/tema/acousmonium/

Schaeffer, P. (2017). *Treatise on musical objects: An essay across disciplines* (C. North & J. Dack, Trans.). University of California Press. (Original work published 1966).

Schafer, R. M. (1977). *The soundscape: Our sonic environment and the tuning of the world*. Inner Traditions Bear and Company.

Sica, B. (2009). Molto rumore per nulla? Il futurismo contro la musicalità [Much noise about nothing? Futurism against musicality]. *Lettere Italiane*, 61(3), 382–399. [link sospetto rimosso]

Sicko, D. (1999). *Techno rebels: The renegades of electronic funk*. Billboard Books.

Stansbie, A. J. (2013). *The acousmatic musical performance: An ontological investigation* [Doctoral dissertation, City University London].

Sterken, S. (2001). Towards a space-time art: Iannis Xenakis' Polytopes. *Perspectives of New Music*, 39(2), 262–273. https://doi.org/10.2307/833570

Stockhausen, K. (1989). *Towards a cosmic music: Texts by Karlheinz Stockhausen* (T. Nevill, Ed. & Trans.). Element Books.

Stockhausen, K. (2024). *Testi sulla musica elettronica e strumentale* [Texts on electronic and instrumental music] (A. Di Scipio, Ed.). ShaKe Edizioni. (Original work published 1959).

Tandy, V., & Lawrence, T. R. (1998). The ghost in the machine. *Journal of the Society for psychical research*, 62(851), 360–364.

Tate. (n.d.). *Bill Fontana: Harmonic bridge*. https://www.tate.org.uk/whats-on/tate-modern/bill-fontana-harmonic-bridge

Tate. (n.d.). *Raw materials, Bruce Nauman*. https://www.tate.org.uk/art/artists/bruce-nauman-1691/raw-material

Thaut, M. H. (2005). *Rhythm, music, and the brain: Scientific foundations and clinical applications*. Routledge.

Toop, D. (1995). *Ocean of sound: Aether talk, ambient sound and imaginary worlds*. Serpent's Tail.

Toop, D. (2010). *Sinister resonance: The mediumship of the listener*. Continuum.

Vande Gorne, A. (n.d.). *Space, sound and acousmatic music* (J. Guillamat, Trans.) [Manuscript].

Voegelin, S. (2010). *Listening to noise and silence: Towards a philosophy of sound art*. Continuum.

Westerkamp, H. (2002). Linking soundscape composition and acoustic ecology. *Organised Sound*, 7(1), 51–56.

Wittek, H. (2007). *The Haas effect: Lateral extent and perceptual weighting of localization cues* [Doctoral dissertation, University of Surrey]. ResearchGate.

Wrightson, K. (1999). An introduction to acoustic ecology. *Soundscape: The journal of acoustic ecology*, 1(1), 10–13.

/ DISCOGRAPHY

Atkins, J., & Davis, R. (Cybotron). (1983). *Clear* [Song]. On Enter. Fantasy Records.

Bangalter, T. (2002). *Irréversible* [Original motion picture soundtrack]. Roulé.

Berio, L. (1959). *Thema (Omaggio a Joyce)* [Electroacoustic work]. Turnabout.

Cage, J. (1951). *Imaginary landscape no. 4* [Composition for 12 radios].

Cage, J. (1952). *4'33''* [Composition].

Cage, J. (1952). *Imaginary landscape no. 5* [Composition for magnetic tape].

Debussy, C. (1899). *Nocturnes* [Orchestral work].

Debussy, C. (1905). *La mer* [Orchestral work].

Debussy, C. (1910–1913). *Préludes* [Piano collection].

Ellington, D. (1941). *Take the "A" train* [Song]. Victor.

Eno, B. (1978). *Ambient 1: Music for airports* [Album]. EG Records.

Kirkegaard, J. (2006). *4 rooms* [Album]. Touch.

Kraftwerk. (1974). *Autobahn* [Album]. Philips.

Lucier, A. (1981). *I am sitting in a room* [Album]. Lovely Music.

Maderna, B. (1958). *Musica su due dimensioni* [Work for flute and magnetic tape].

Mills, J. (1997). *The bells* [Song]. On The purpose maker. Purpose Maker.

Russolo, L. (1913). *Risveglio di una città* [Composition for intonarumori].

Satie, E. (1888). *Gymnopédies* [Piano collection].

Satie, E. (1890). *Gnossiennes* [Piano collection].

Satie, E. (1917). *Musique d'ameublement* [Composition series].

Schaeffer, P. (1948). *Étude aux chemins de fer* [Musique concrète work].

Schaeffer, P., & Henry, P. (1949). *Symphonie pour un homme seul* [Musique concrète work].

Stockhausen, K. (1955–1956). *Gesang der Jünglinge* [Electronic work]. Deutsche Grammophon.

Stockhausen, K. (1955–1957). *Gruppen* [Work for three orchestras]. Deutsche Grammophon.

Varèse, E. (1923). *Hyperprism* [Work for small ensemble].

Varèse, E. (1934). *Ecuatorial* [Work for ensemble and theremin].

Varèse, E. (1950–1954). *Déserts* [Work for ensemble and magnetic tape].

Varèse, E. (1958). *Poème électronique* [Electronic work].

Wagner, R. (1859). *Tristan und Isolde* [Opera].