Bartlett Design Research Folios

Paul Bavister

Audialsense

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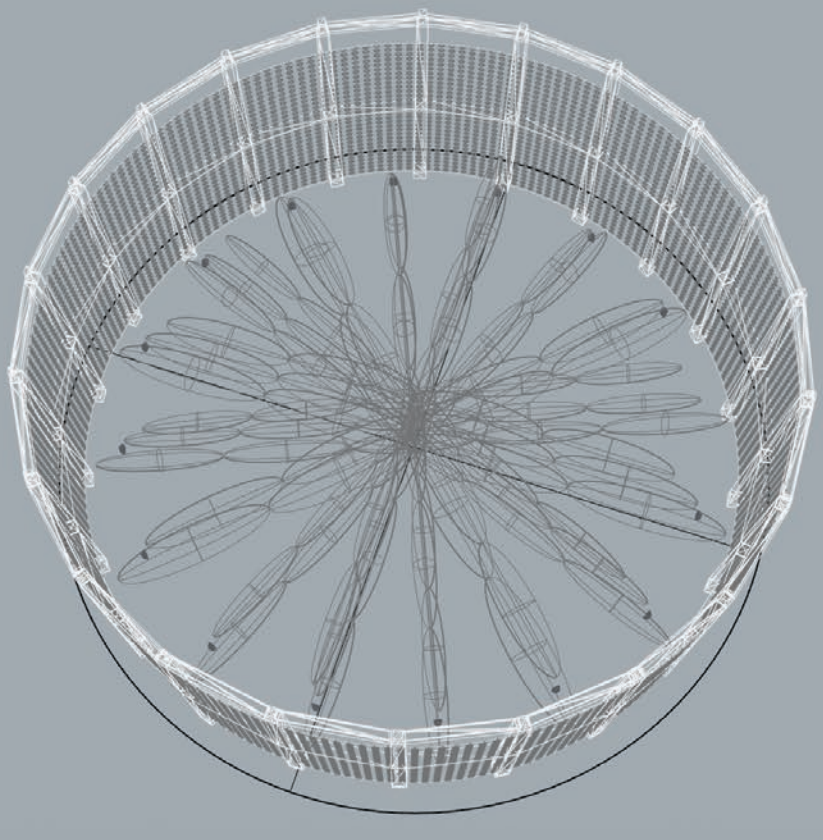
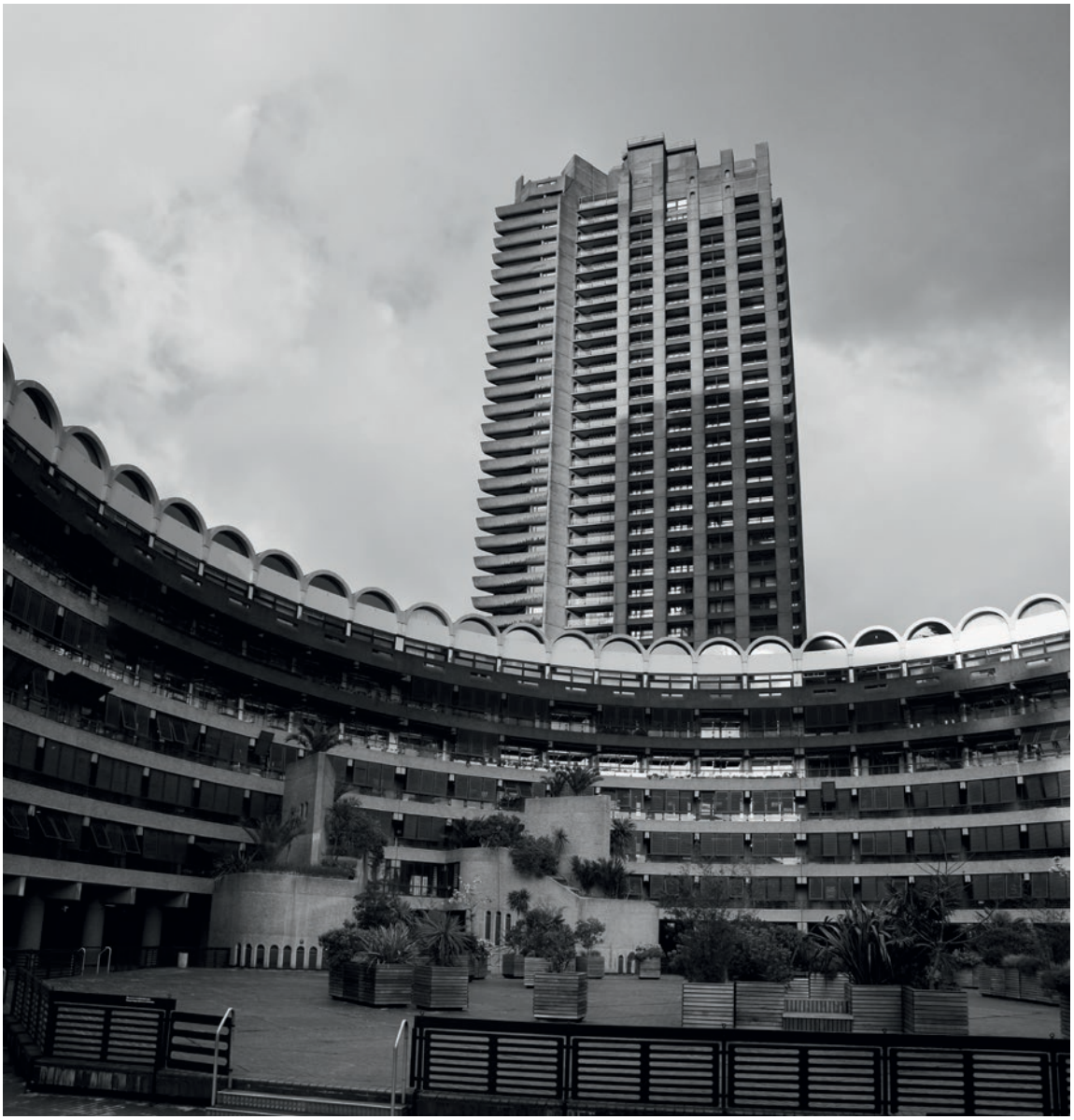


1 (previous) Interior of Silo 468, Helsinki, 2016.

2 Silo 468, modelling of apparent nodes and antinodes, 2020.

Project Details

Author	Paul Bavister
Title	Audialsense
Output Type	Installation and composition
Projects	Musicity x Culture Mile, Barbican, London (2019) Musicity x MEMU, Hokkaido (2019) Musicity Southwark, various locations, London (2017, 2018) RIBA, London (2017) Silo 468, Helsinki (2016) Gjallarhorn, Science Museum, London (2014)
Commissioning Bodies/Clients	Barbican, Culture Mile, Kengo Kuma and Associates, Lighting Design Collective, MEMU Earth Hotel, RIBA, Science Museum, Southwark Council, The University of Tokyo
Co-Designers	Jason Flanagan and Ian Knowles (Gallery One, Gjallarhorn, Silo 468); Nick Luscombe (Musicity)
Acoustic Consultants	Arup Acoustics
Musicity Southwark Musicians/Sites	Langham Research Centre, Tate Switch House; Hatis Noit, White Cube; Shamus Dark, Hopton's Almshouses; Sooski, Siobhan Davies Dance; The Memory Band, Flat Iron Square; Chisara Agor, Michael Faraday Memorial; William Doyle, The Shard; Throwing Shade, Borough Market; Sean O'Hagan, Peckham Library; Moses Boyd, Canada Water Bus Station; Patten, Elephant and Castle Shopping Centre; Hejira, Time & Talents Settlement Building; Stick in the Wheel, Finnish Church
Musicity x Culture Mile, Barbican Musicians and Sites	Howlround, Beech Street Tunnel; Alex Ho, Lakeside Terrace; Rahere, Great St Bartholomew; EMS Collective, Smithfield Rotunda Garden; Craig Richards, Fabric; Emma Kate Matthews, Barbican Lower Ground Foyer; Fari B, The Charterhouse; Mandhira de Saram, Barbican Sculpture Court; Tania Nwachukwu and Bump Kin, Citypoint; Tom Richards, Museum of London
Funding	£30,000 Musicity x Culture Mile, Barbican; £10,000 Musicity x MEMU; £15,000 each Musicity Southwark



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3 Musicity x Culture Mile, London, 2019. Sculpture Court, Barbican, site of Mandhira de Saram's 'Anchor & Tangents'.

Statement about the Research Content and Process

Description

This work consolidates a series of situated research projects that are a direct response to rigid conventions of acoustics and architecture in commercial practice. There are two types of practice documented: acoustic installation, where a sound's response to a site defines an architectural representation, and situated composition, where a site defines a musical response.

Questions

1. How can site influence acoustic understanding and musical composition?

2. How can acoustic phenomena be used to generate an understanding of space?

3. Can digital processes simulate site conditions to generate a site-specific composition?

4. Can an understanding of sound, space and music influence how architects and designers develop spatial and material proposals?

Methodology

1. Novel methods to generate acoustic phenomena and engage audiences;

2. Acoustic research with acousticians testing, surveying and developing performance parameters of sites that are not traditional acoustic spaces;

3. Deploying technology to simulate specific spaces for musicians to respond to acoustically;

4. Workshops and collaborative engagement with site owners, managers and musicians, investigating suitable sites for acoustic and musical interaction(s) and how volume and materiality can influence compositions that can be listened to on headphones or multi-channel auditory systems.

Dissemination

The project was presented at the World Architecture Festival 2017 in Berlin. It has been discussed in *Architects' Journal, The RIBA Journal* and *Architecture Today*. The project has featured on national television (BBC News and London Tonight) and on BBC Radio 4. The work featured in the London Festival of Architecture in 2017, 2018 and 2019. The author was part of a live conversation around the project hosted by the Barbican in May 2019.

Project Highlights

Collectively, the importance of this set of projects lies in how they have advanced our understanding of the ways in which architecture affects musical composition and the occupants' acoustic experience of space. Its role in this regard has been recognised through international workshops in Japan, Finland, Austria and the UK, and in public outputs such as the source recordings from the installation, Gjallarhorn, at the Science Museum, London. These recordings were subsequently released on Touch Radio – the UK's national collection of radio recordings – and are part of the British Library's sound archive.

Introduction

This work brings together a series of situated research projects that are a direct response to rigid conventions of acoustics and architecture in commercial practice. There are two types of practice covered: acoustic installation, where a sound's response to a site defines a *soft* and *plastic* architectural representation, and situated composition, where a site defines a more consolidated musical response.

For the first type, a site is studied and surveyed for its acoustic properties and sonic signature, and then sounds are played back into the space that allow occupants to interact with it on a sonic level. For the second type, a series of sites are chosen and aligned with musicians and composers. The composers are then asked to develop a piece of music that responds to the space on both an emotional and acoustic level. By responding to the volume and materiality of a space, a situated composition is created that holistically relates to site and composer.

These practices have been undertaken at many different sites over the years. This document features six case studies of importance, undertaken by the author and team since 2014. The projects featured include installations undertaken in the UK and abroad, as well as funded opportunities in the UK (London) and Japan (Hokkaido).

1. Acoustic Installation: Creating Architecture with Sound

Silo 468

As part of Helsinki Design Week 2016, Audialsense were invited to undertake a sound installation in Silo 468, a disused gas cylinder on an island outside the city. The tank is a large highly reverberant space, perforated with illuminated holes creating an animated façade. Audialsense turned the tank into a musical instrument, using local weather data and acoustic phenomena to create a complex and spatially specific set of modulating timbres in the room.

Gjallarhorn

An installation developed for Aleks Kolkowski's reconstruction of the Denman Horn, the world's largest speaker cone at 27 feet. The work used recordings from the big engines on display at the Science Museum in London to generate a site-specific installation based on the resonant frequencies of the gallery space.

Gallery One

As part of the Musicity Southwark launch, and the London Festival of Architecture, Audialsense were invited to undertake an installation in Gallery One of the RIBA building at 66 Portland Place. The installation ran for the duration of the launch, which involved lectures and staged discussions in the main hall of the building.

2. Situated Composition: Creating Music from Architecture

Musicity

Founded in 2010 by Nick Luscombe, Musicity is a site-specific sound/arts practice that invites musicians and recording artists to compose tracks in response to buildings and locations in cities around the world. Since 2017, the project has expanded into novel architecture and acoustic research territories that are documented in the following projects: Musicity Southwark (2017 and 2018); Musicity x Culture Mile, Barbican (2019) and Musicity x MEMU (2019).

Musicity x MEMU

In 2019, the author was invited by Tokyo University and Kengo Kuma Associates to take part in and deliver a series of workshops looking at sound, space and occupancy at the MEMU Earth Hotel site in northern Japan. The workshops opened up the methods of Musicity, so that anyone with access to music-writing software can create a situated composition.

Aims and Objectives

1. Develop site-specific *plastic architecture* using sound and perception;

2. Develop new ways of reintegrating architecture into compositional processes;

3. Experiment with different methodologies of disseminating music and sound;

4. Develop new ways of understanding a site's materiality and aspect via sound;

5. Research how conventions formed in commercial practice may be challenged and reformed.

Questions

1. How can a site's physical constraints – volume, materiality and specific acoustic idiosyncrasies – influence acoustic understanding and musical composition?

2. How can acoustic phenomena, such as standing waves, structure-borne sound and natural resonance, be used to generate an understanding of space and occupation?

3. Can digital processes simulate site conditions to generate a site-specific composition?

4. Can an understanding of sound, space and music influence how architects and designers develop spatial and material proposals?

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4 Using balloons to map room response, Silo 468, Helsinki, 2016.

Context

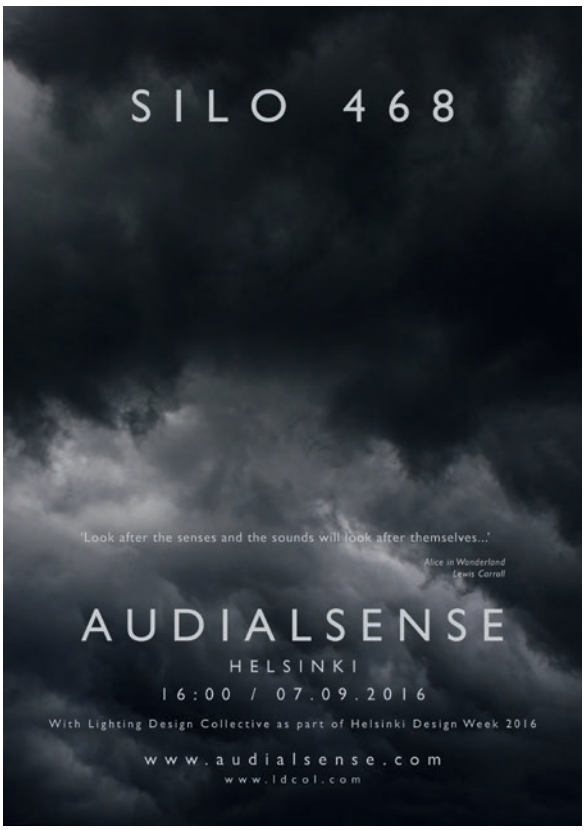
Music and Architecture

Historically, music and space have shared a creative symbiosis, whereby music is written to fit a space and spaces are designed to support music. In this sense, we might say that the history of music complements the history of architecture. This reciprocal relationship continued unabated until the early twentieth century when acoustic rules were consolidated, in part due to the work of physicist/proto-acoustician Wallace Clement Sabine and the accurate calculation of the relationship between volume, absorption and reverberation. Since the development of chant in caves and cathedrals, the creative ebb and flow of ideas over time has developed and ossified into architectural and musical precedent, so that symphony music is played in symphony halls, chamber music in chamber halls, etc. More recently, however, technology has developed synthetic reverberation algorithms, allowing music to move out of physical spaces to inhabit a more flexible synthesis of the digital and analogue. Artists are no longer writing for physical space but are looking towards the digital and the synthetic. Between the containment of music performance in purpose-built spaces on the one hand and the digitalisation and dematerialisation of musical performance on the other, the creative reciprocal link between architecture and music has been effectively severed.

In commercial practice, architecture for music is usually developed with economy-driven briefs that stem specifically from repertoire and commercial viability. Audiences are more likely to pay to listen to well-known repertoires in spaces that are optimised accordingly, rather than choose venues and performances of a more experimental nature. This is understandable: the financial outlay required for a performance space is considerable, and as buildings for music are usually publicly funded, there is little scope for designing anything that is not accepted practice. In contrast, the work documented here establishes a critical position on the methodologies undertaken by conventional practice. It offers a complementary practice in which a creative reciprocal link between music and architecture can once again be established. Specifically, it does so in two ways: by producing acoustic installations and situated compositions.

The first type of project, acoustic installation, makes use of naturally occurring acoustic phenomena that, supposedly, negatively affects room acoustics and is usually designed out by the design team before construction. In a gallery situation, however, such phenomena are free to be interacted with and occupied as site-specific physical conditions.

The second type of project undertaken, situated compositions, responds to the fact that musicians have an intuitive sense of space. By listening to the space around them as they make sound, they respond to returning acoustic signals by subtly modulating a performance. This generates a unique work that is entirely suited to the space. Historically, musicians have adapted performances to suit architectural spaces, gently changing the way that a piece of music is received and how spaces are designed. It is, however, less common today to see a musician or composer writing music in and for a space that will hold it. In removing the relationship between music and architecture, the historically intimate relationship between composer, musician, instrument, space and the emotional experience of listeners is also diminished. It is these more intimate relations that various projects in Audialsense aim to reactivate.



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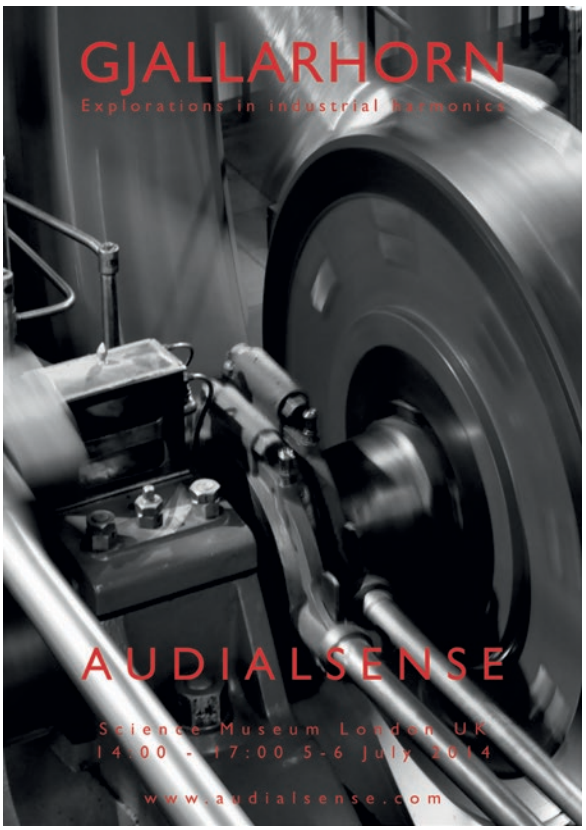

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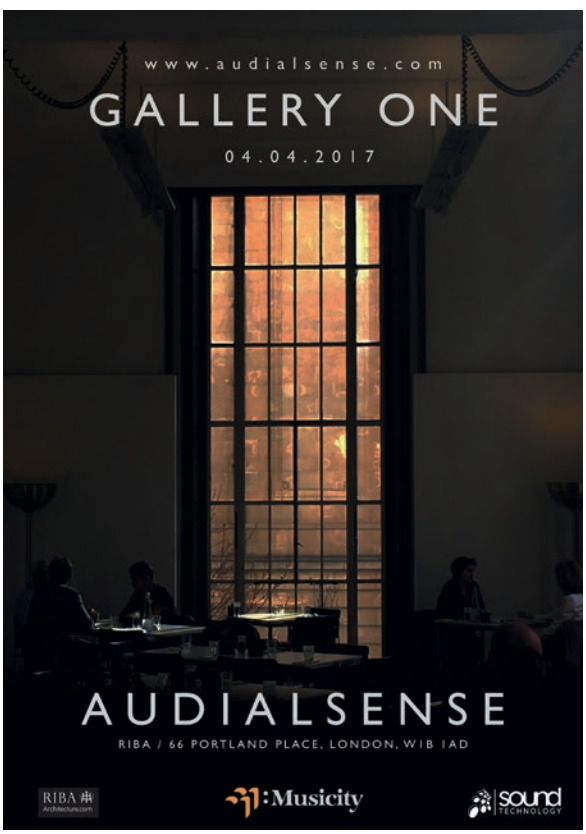

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5 Poster for Silo 468, Helsinki, 2016.

6 Poster for Gjallarhorn at the Science Museum, London, 2014.

7 Poster for Gallery One at RIBA, an installation to launch Musicity Southwark, 2017.

Wave Phenomena and Architecture

One of the central themes explored in Audialsense is standing-wave phenomena: a common problem that negatively affects room acoustics, usually designed out by the architectural team before construction. It occurs when a (sound) wave oscillates in time but the peak amplitude profile does not move in space. The locations at which the absolute value of the amplitude is minimum is called a node, and the location where the value of the amplitude is maximum is called an antinode.

Where this matters for architects is that the nodes are virtually silent, and the antinodes are often double the volume of the source sound. This can create a very uneven soundfield that is not suitable for focused listening. It does, however, generate deeply interesting spatial conditions that can be interacted with on a physical level; sounds change as you walk through a space, getting louder or softer throughout.

Composers have been using wave phenomena in their practice for some years: La Monte Young and Marian Zazeela's 'Dream House' (1962) uses pure sine waves to augment a physical experience; Alvin Lucier's 'Still and Moving Lines Of Silence In Families of Hyperbolas' (1972) uses sine waves to modulate and choreograph a dance performance; and Max Neuhaus' 'Times Square' (1977) uses wave phenomena to further engage an occupant with the work's local environment.

As these works begin to suggest, by actively generating wave phenomena in an existing space, a soft and occupiable landscape can be produced that creates a temporal 'plastic architecture' that is entirely site-specific and unique to its environment.

8 Max Neuhaus, 'Times Square', 1977.

9 Rehearsals for Lucier's 'Still and Moving Lines Of Silence In Families of Hyperbolas', 1972.

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Methodology

1. Using novel methods both to generate acoustic phenomenon and engage audiences

Silo 468

Key to Audialsense's work is an understanding of site-specific acoustic phenomena, gathered from measured data and digital production tools. By measuring a site's spatial properties and recording acoustic phenomena in a building's materiality using contact microphones and digital recording equipment, processing the results and playing them back in the space, it is possible to create new environments in sound.

The acoustic phenomena generated in Silo 468 has its roots in simple synthesizer design. Subtractive synthesis is commonly found in synthesizers developed in the 1960s and 70s, where the partials of a rich harmonic audio signal are modulated by a filter to alter the timbre of a sound. An analogue model of this process is the human mouth, with the vocal chords acting as an oscillator and the mouth and throat as a filter. By changing the shape of the mouth, some harmonic partials are retained and others removed, forming the complex timbres of the words we speak.

An example of using subtractive synthesis as an architectural tool is turning Helsinki's Silo 468 into a musical instrument and using acoustic phenomena to generate drawings with sound in the space.

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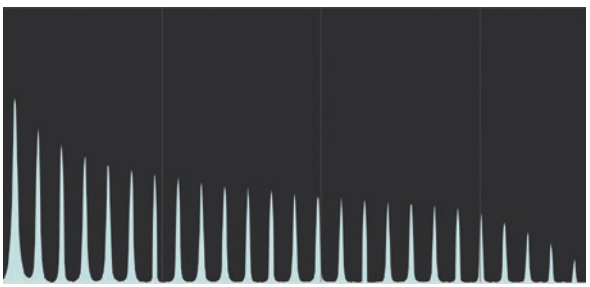

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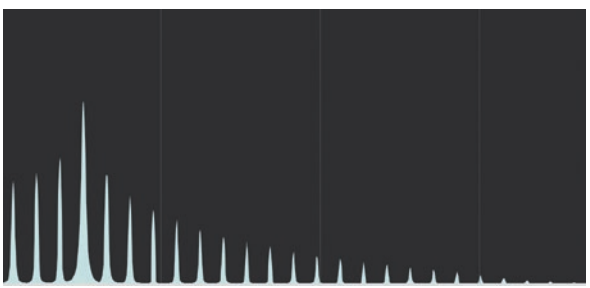

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10 Spectrogram analysis of a Sine Wave at 440 Hz (frequency vs. amplitude).

11 Spectrogram analysis of a Square Wave at 440 Hz showing upper partials.

12 Spectrogram analysis of a filtered Square Wave at 440 Hz with a centre frequency of 3 kHz.

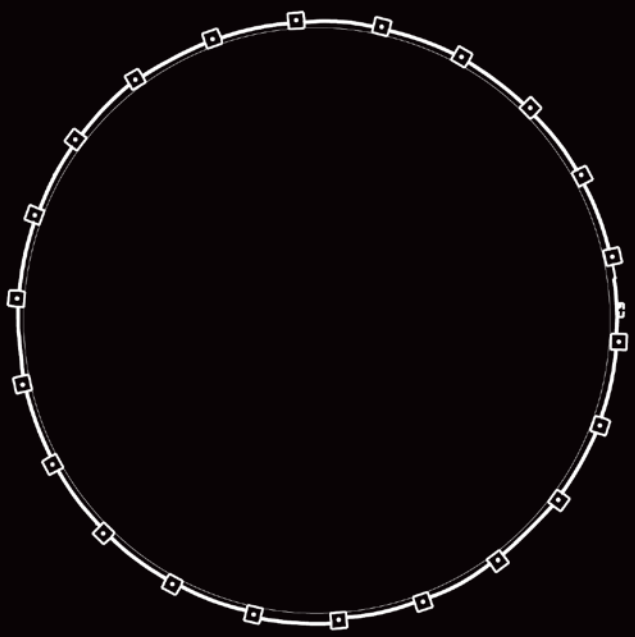
The process for generating the work was to firstly survey the space, understanding its volume and core dimensions. The room was 15,500 m^3, 35 m in diameter and 16.15 m high. The interior was fully circular with parabolic soffit. The resonant frequency of the space was the equivalent wavelength of its diameter, 35 m equalling approximately 8.5 Hz. This is well below the threshold of hearing, so the wavelength was scaled in units of ten, generating a base tone of 80 Hz, which is a very low but musically satisfying bass hum.

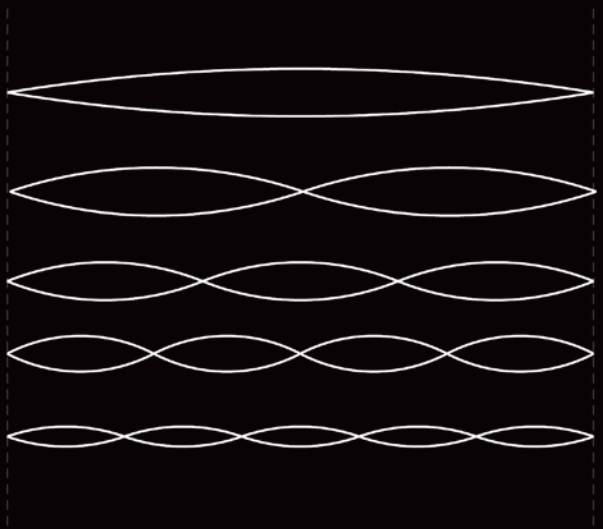
In order to generate a more elastic soundscape that is both sited in the building's volume and size, as well as being fluid and engaging, we wanted to let the soundscape be a complementary part of the existing light installation that ebbs and flows with the illumination of the tank.

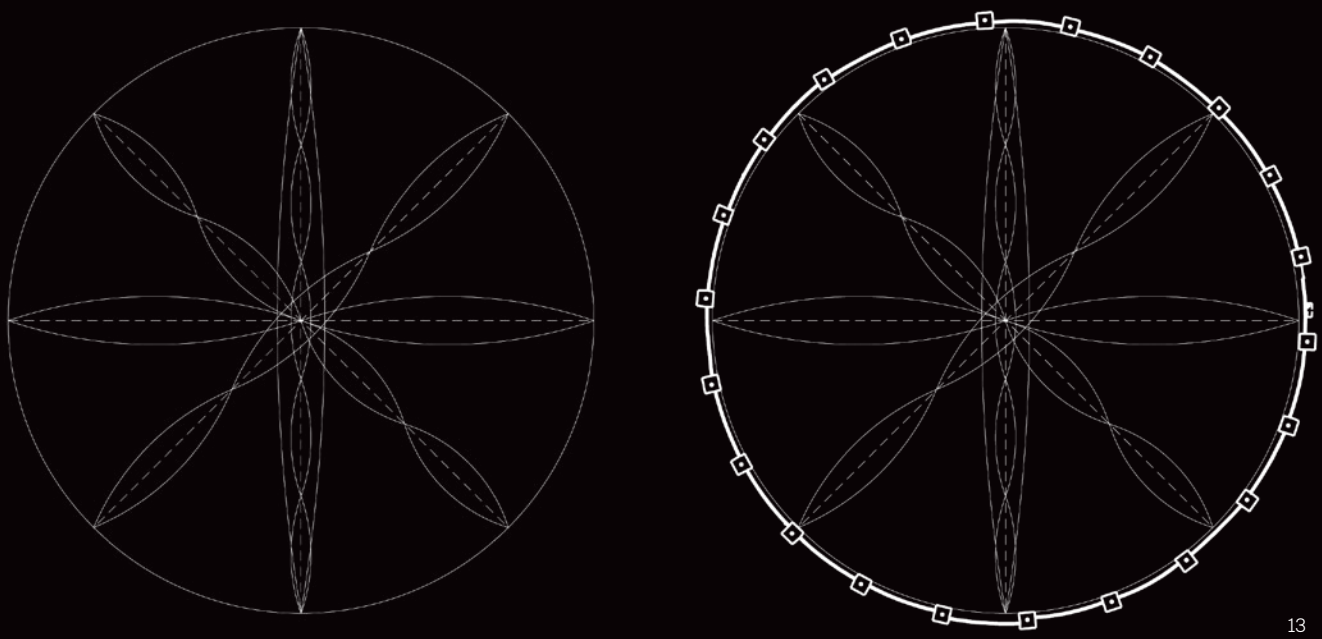
Building on a base of amplified sine waves, we added additional square and sawtooth waves with a more complex harmonic overtone sequence, so that we had a bed of scaled tones to generate a base drone. These waves were output from speakers in a circular arrangement around the room, constantly on and droning. We took data from the environmental sensors located around the building and used it to modulate a filter of a series of complex waveforms. As the wind eddied around the silo, generating high- and low-pressure points, the sound was modulated by changing the cut-off frequency and resonance of the waves' upper partials to reflect this environmental change. This created a complex spatially specific timbre in the room, generating a sonification of the local environmental changes.

The effect was surprisingly powerful and the resultant soundscape was deeply resonant and in constant flux. The antinodes generated by the non-fluctuating sine waves created a clear geometrical pattern on the floor plane that could be physically felt. Alongside this, the square and triangle waves were gently modulating and shifting, generating a fleeting experience that seemed to tease an occupant by constantly moving around the space.

As a way of physically engaging with the intervention and connecting with the installation, occupants were given inflated balloons and were instructed to walk through the space holding them with their fingertips. When entering an antinode, the wave oscillations of the sine waves excited the air molecules in the balloon, creating an almost electric vibration that clearly defined the spatiality. Engaging in something so ephemeral and invisible was an unexpected and powerful physical experience.







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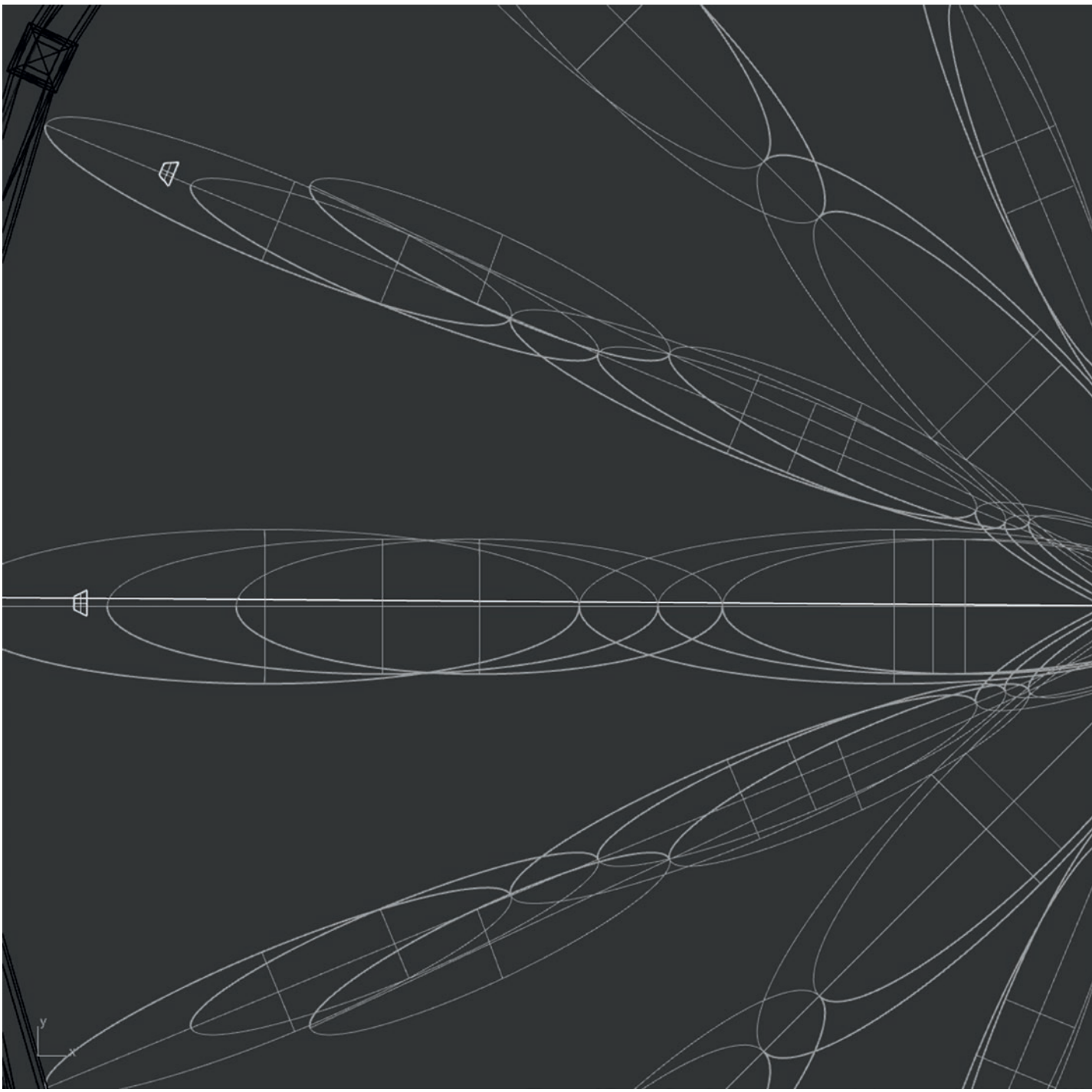
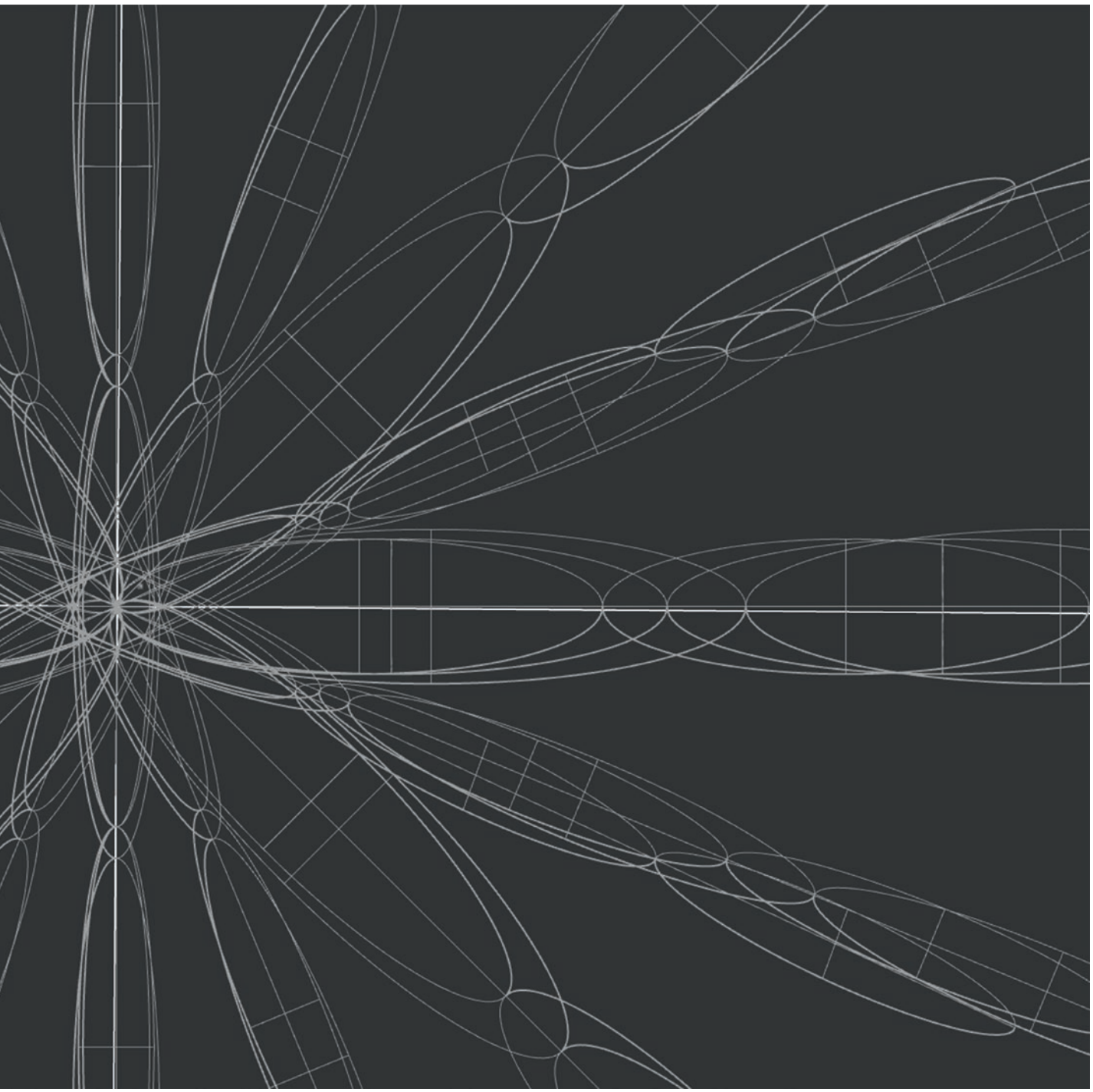
13 Silo 468, Helsinki, 2016. Illustration showing the perceived nodal response to the site shown arrayed using speakers, generating emergent architectures.





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14 Silo 468, Helsinki, 2016. Modelling of apparent nodes and antinodes.

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15 Silo 468, 2016.
Using balloons to map
room response.

Gjallarhorn

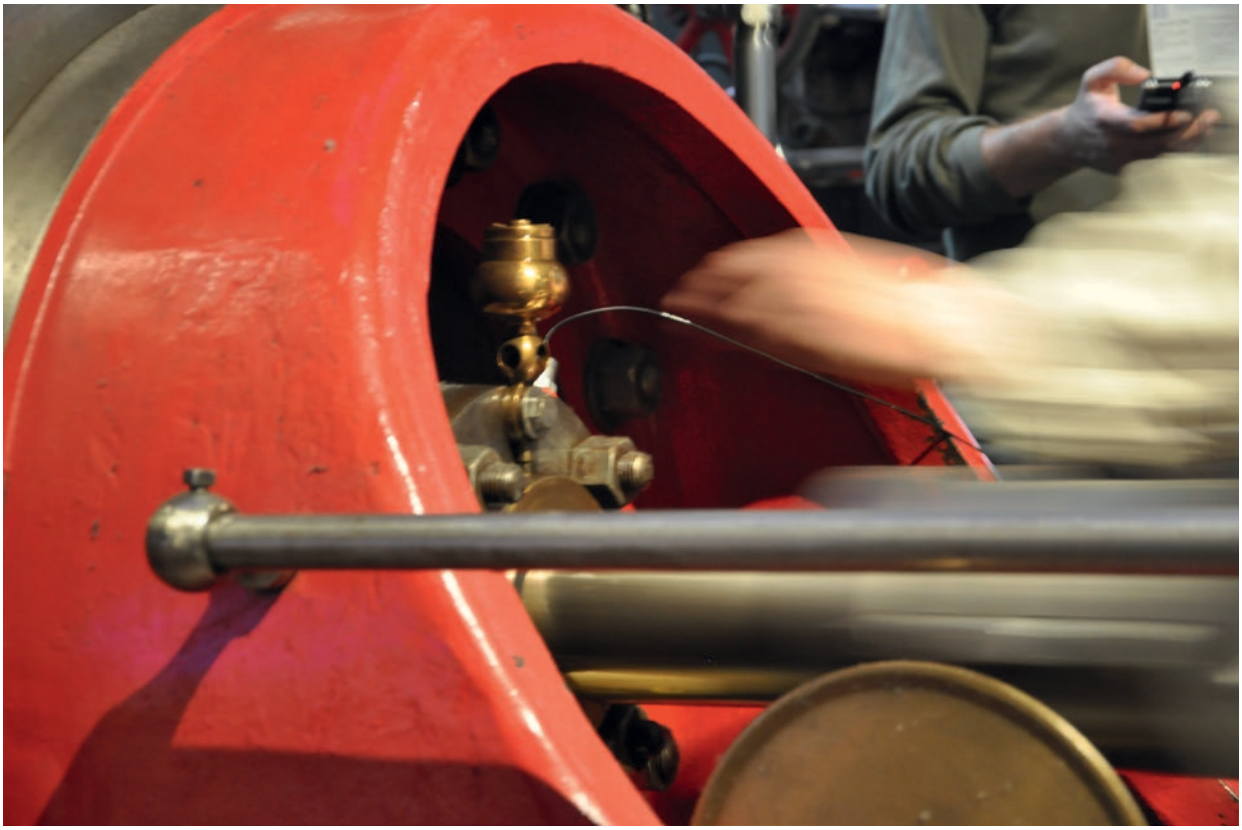
In the 2016 project, Gjallarhorn, we were very lucky to have access to the big engines on permanent display in the Science Museum. We wanted to extract the structural borne noise from the engines and play the sounds back into the gallery space. We wanted to make the sounds more site specific, rather than playing them back in a straight way, and in a subtractive way only play back frequencies that match the resonant frequencies of the gallery space.

We used contact microphones to extract the sounds from the engines. These are magnetic microphones that pick-up material resonances rather than air-borne frequencies, as typical microphones do. It is worthy of note that the mechanics who maintain the engines saw us use this technique and commented that for quick diagnostic purposes they insert the rounded handle of a screwdriver into an ear with the other end on the surface of the engine. They can then listen for any issue that may be invisible to the eye.

16 Gjallarhorn, Science Museum, London, 2014. Collecting data: different points yielded different sounds.

17 Gjallarhorn, Science Museum, London, 2014. Collecting data: powerful pressurised steam from boilers.

18 (overleaf) Collecting data in the Science Museum, London, for Gjallarhorn, 2014.



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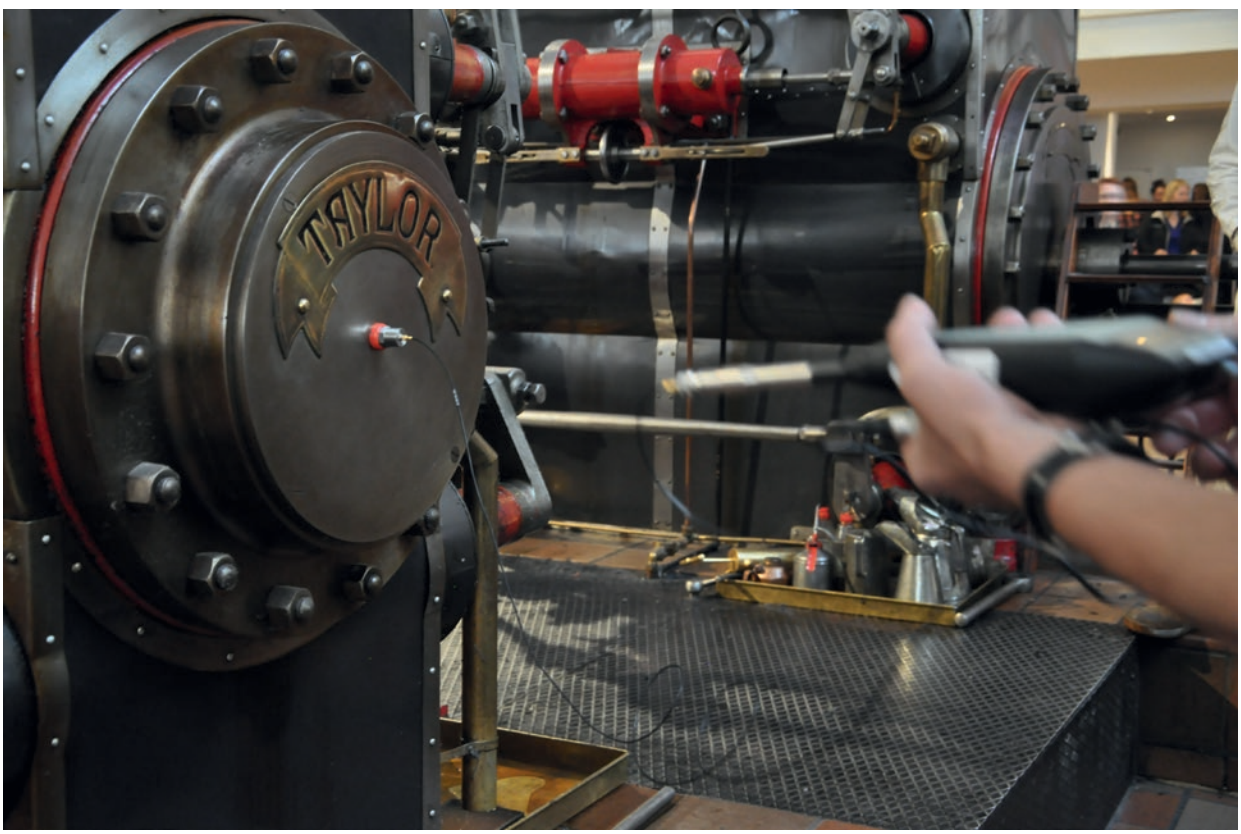

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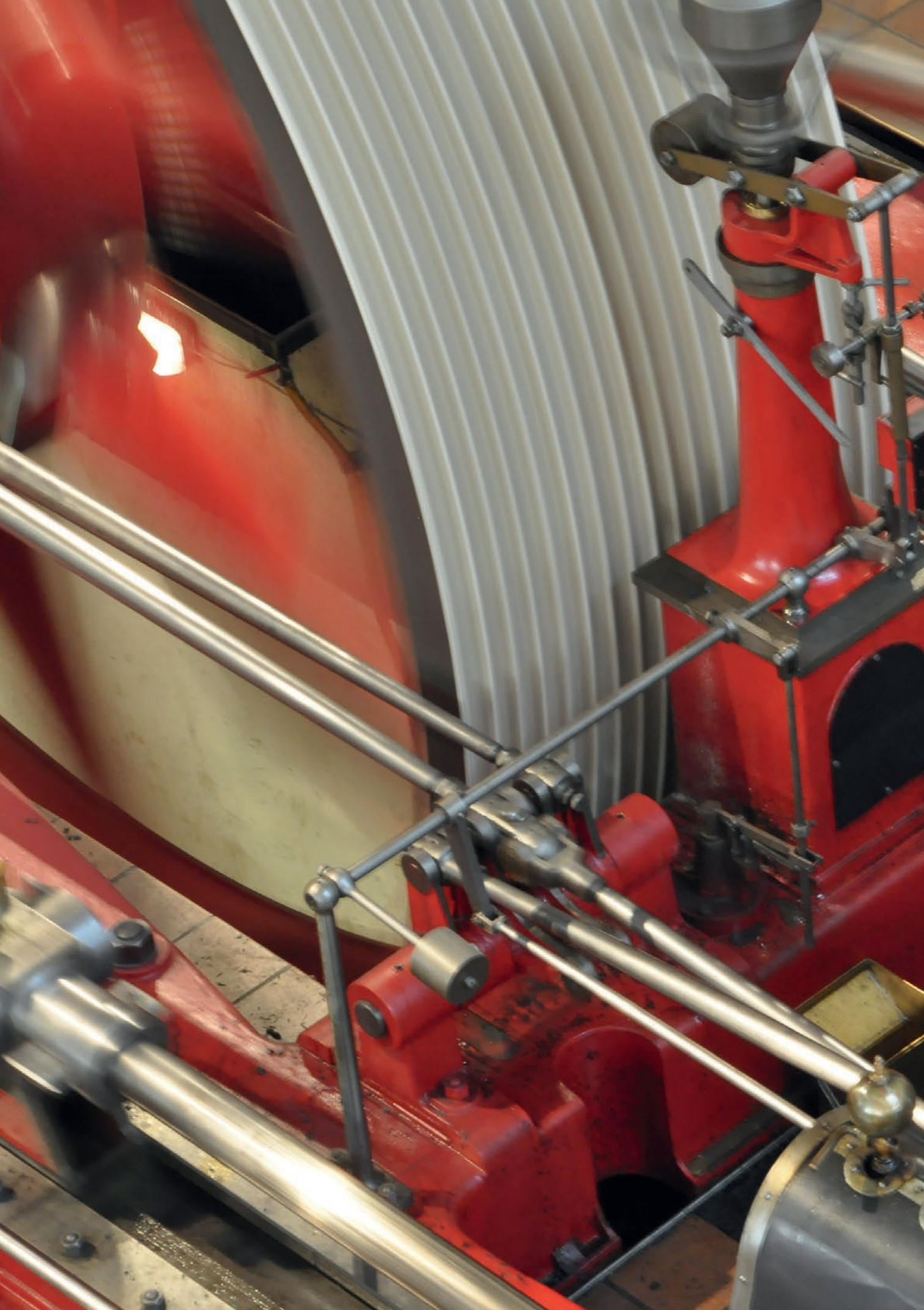

Gallery One

This installation was intended to build on the principles undertaken in Gjallarhorn, extracting the physical sounds of the building and playing them back into the space rather than using mechanically sourced noises and tuning into their resonant frequencies. Contact microphones were used to extract sounds from as many resonant surfaces as could be found: balustrades, lift linings, floor tiles, etc. The sounds were then used as the basis of a spatialised generative composition, bisecting and quartering the space on a quadraphonic sound system that provided flexibility to create sonic figures in the room.

The acoustic phenomena generated in Gjallarhorn and Gallery One question and creatively use a common failing in architectural projects – structure-borne sound – that is usually designed out. The Building Regulations Approved Document E defines structure-borne sound as 'sound that is carried via the structure of a building'. While insufficiently insulated vibrating materials will generate audible noise that can be annoying, Gjallarhorn and Gallery One use these sonic phenomena creatively.

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19 Gjallarhorn live at the Science Museum, London, 2014.

20 Gjallarhorn installation with the Denman Horn, Science Museum, London, 2014.

21 Listening for nodes onsite at the Science Museum, London, 2014.

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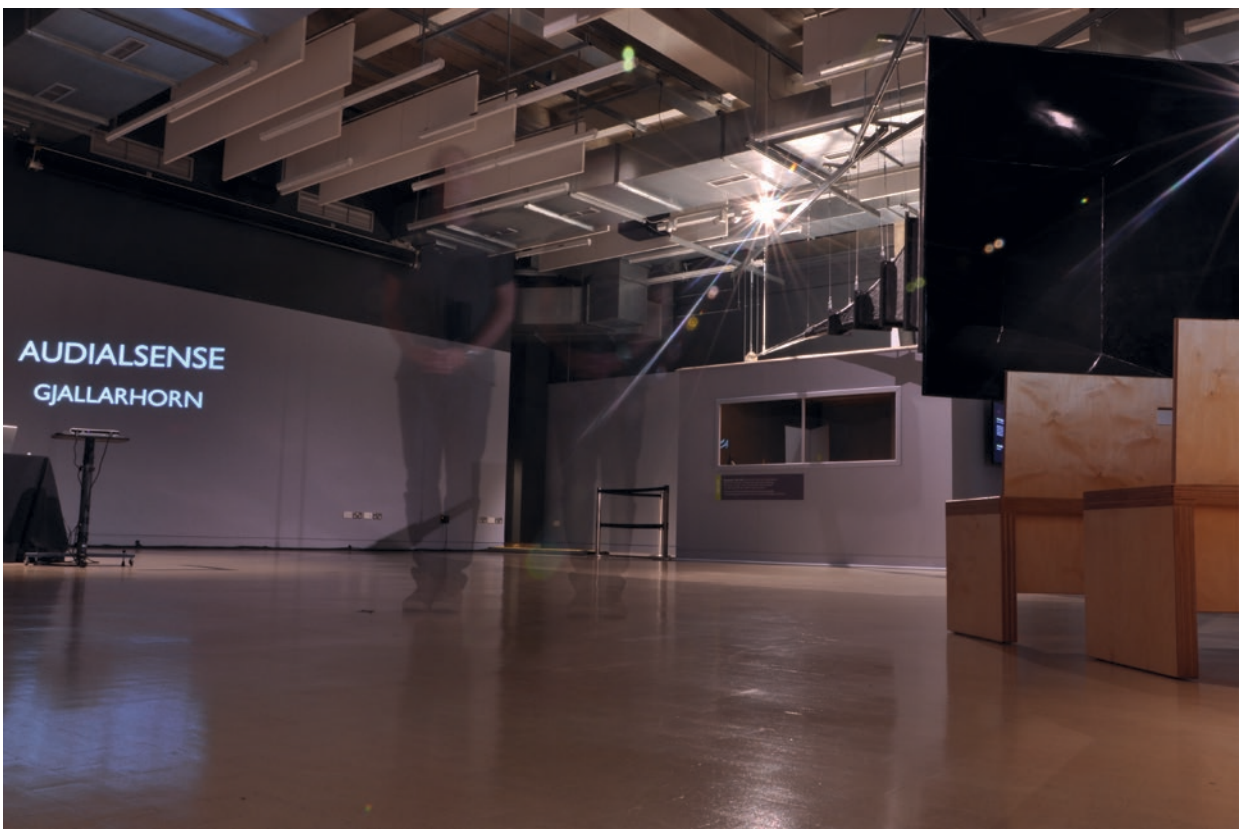

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2. Acoustic research with acousticians, testing, surveying and developing performance parameters of sites that are not traditional acoustic spaces

Musicity

For the Musicity, different processes and technologies were developed and employed to choose, survey and simulate specific spaces for musicians to respond to acoustically. The aim was to enable musicians and composers to write for the acoustics of a specific space and generate a unique piece of music that is intrinsically linked to the site.

First, a series of spaces were selected for use by musicians, chosen for specific qualities that may positively inform a creative process. Once the spaces were selected, they were acoustically tested: in some cases (Musicity Southwark 2017 and Musicity x MEMU) by a balloon-pop impulse response and in others (Musicity Southwark 2018 and Musicity x Culture Mile 2019) by a team of world-leading acoustic consultants at Arup. The acoustic test is commonly used in surveys of concert halls and other acoustically critical spaces. For the tests undertaken by Arup, a sine sweep was played into the room; a pure tone that rises from 20 Hz to 20 kHz over 20 seconds. The sweep is recorded, and then analysed for acoustic properties: reverberation, clarity, definition, etc. The locations of the speaker and the receiving four-channel microphone are called the 'source' and 'receiver' positions respectively. These also represent the spatial relationship between a performer and a listener or audience.

By use of B-format impulse responses taken from specialist surveys, it was possible to develop acoustic simulations of spaces via acoustic virtual reality (AVR). This allowed musicians to engage musically with a space without visiting it.

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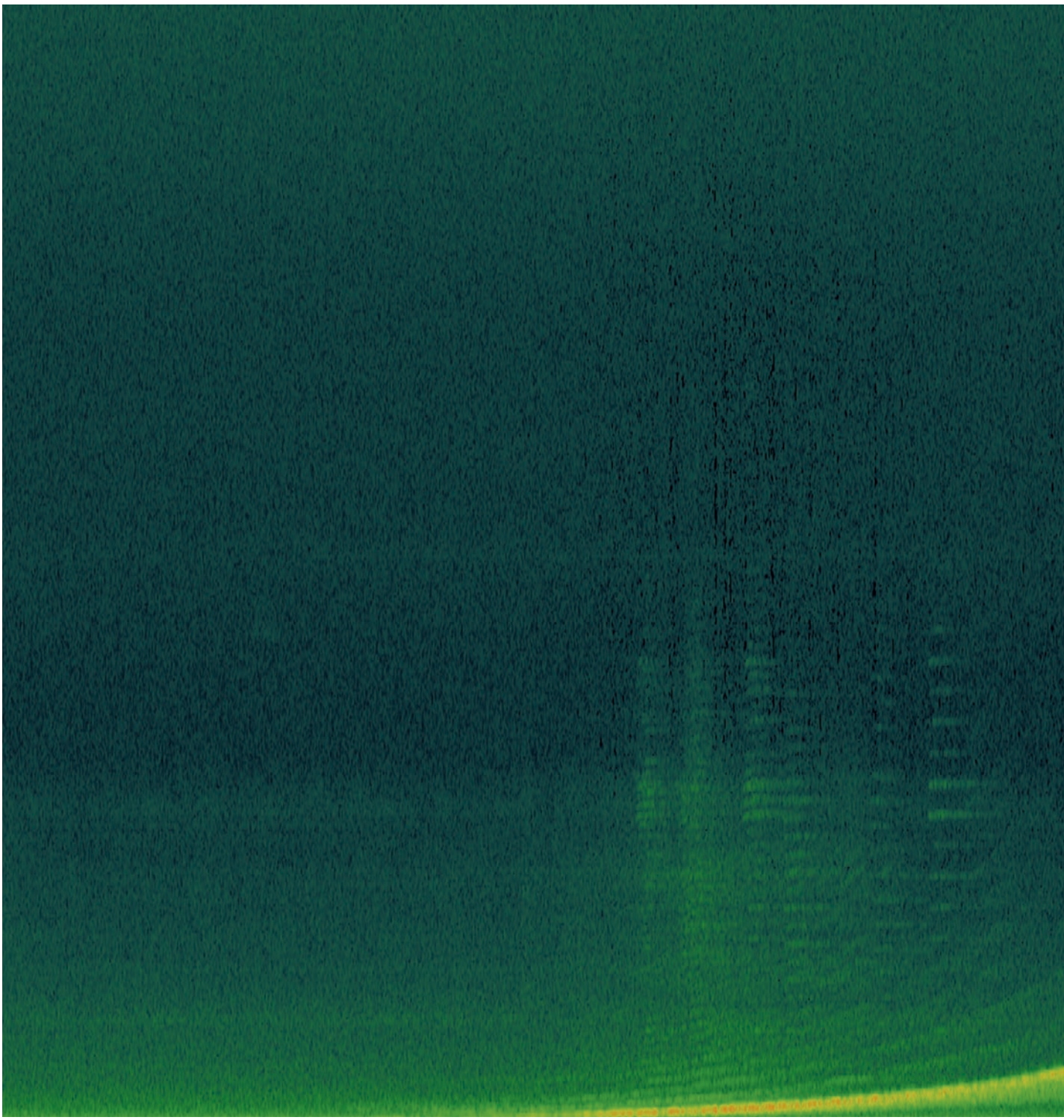
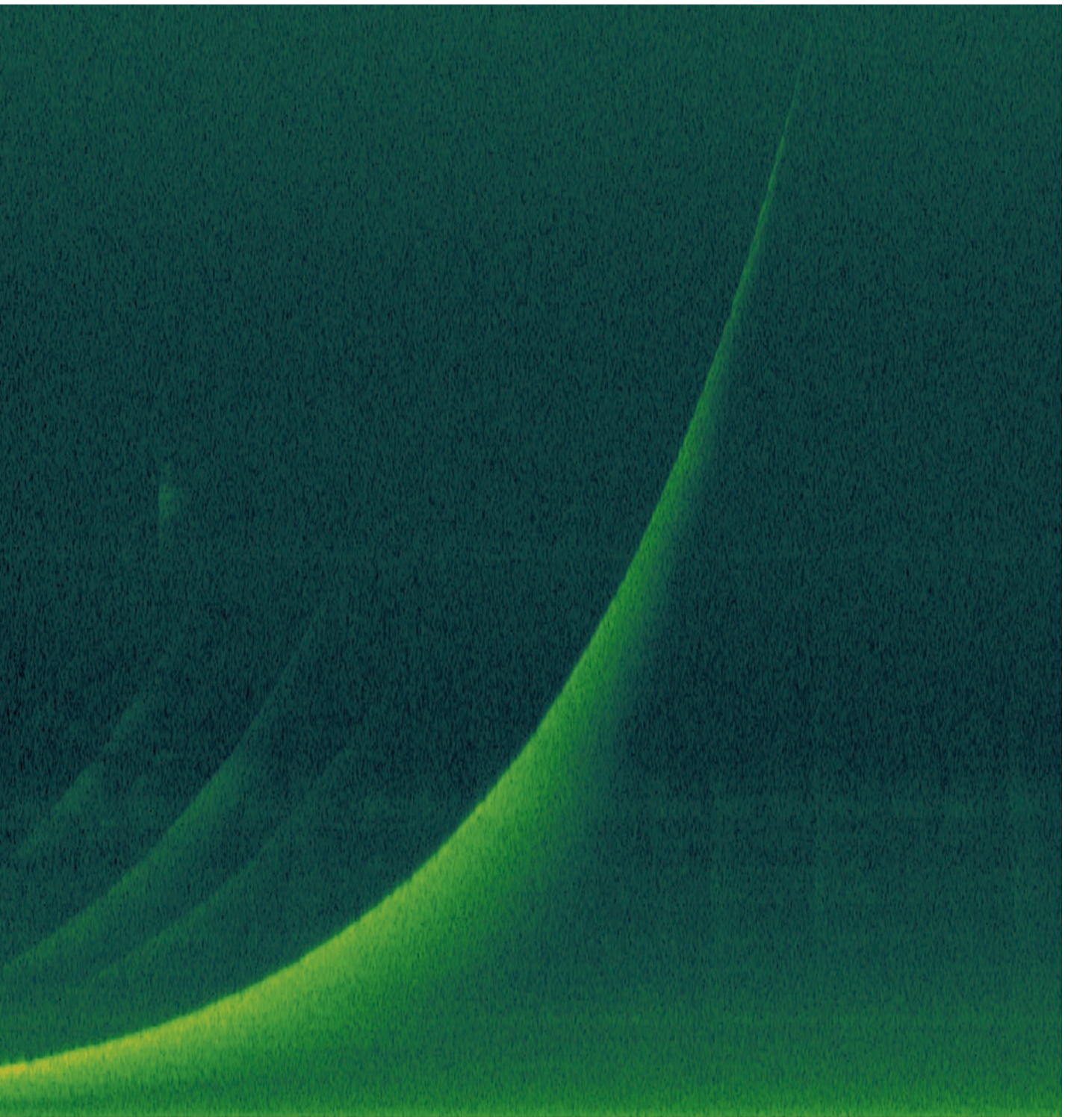
22 The Musicity logo.

23 Musicity Southwark, London, 2018. Acoustic survey of White Cube Bermondsey, site of Hatis Noit's 'White Cube'.

24 (overleaf) Spectrum analysis of a sine sweep.





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25 Musicity, testing a four-channel omnidirectional microphone at UCL, 2018.

26 An omnidirectional sound source.

3. Deploying technology to simulate specific spaces for musicians to respond to acoustically

Acoustic parameters developed from site surveys are important to both acousticians and architects. They inform how a space works acoustically and what interventions are to be undertaken to optimise the space for use. For creative use, however, it is critical that a musician uses their ears to develop an intuitive response to a space. In addition to the acoustic parameters, the sine sweep from the acoustic survey can produce what is called an impulse response. This is a computer-generated retort or snap that contains 3D spatialised acoustic data from the space. It is fairly meaningless on its own but allows a space to be convolved in real time when dropped into a convolving reverb effect in a studio environment, which digitally simulates the acoustics of the space.

Convolution is a process that is getting much more common in studios and can be used to generate differing effects, from outlandish sounds to the simulation of space. Most software has the ability to import impulse responses, e.g. Logic Pro's Space Designer, turning them into reverbs defined by physical space. This allows a musician to use their intuitive responses in the creative process without having been in the space or having any prior knowledge of it. The process generates a unique piece of music, linking site and sound.

As the sites chosen for Musicity are working spaces, and have considerable practical limitations for live performance, the music that was generated via this process could not be performed live, creating considerable problems with dissemination. This was solved by making the tracks available online, downloadable via geotagging. The music is available for download when a listener is on the site that was used for the composition.

Musicity Southwark

In the spring and early summer of 2017 |and 2018, as part of the London Festival of Architecture, Musicity commissioned a series of music by artists linked to the London Borough of Southwark. Spaces included The Shard and Tate Modern, as well as smaller more intimate spaces such as Hopton's Almshouses. These spaces were used as sites for musical intervention.

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27 Musicity Southwark, London, 2018. Hopton's Almshouses, site of Shamus Dark's 'Bank Side Story'.

28–9 Musicity Southwark, London, 2018. Acoustic surveys of the Switch House and Turbine Hall, Tate Modern, site of Langham Research Centre's 'Terminal Voltage Traces'.

30 (overleaf) Musicity Southwark, London, 2018. Acoustic survey of Flat Iron Square, site of The Memory Band's 'Flat Iron Square'.


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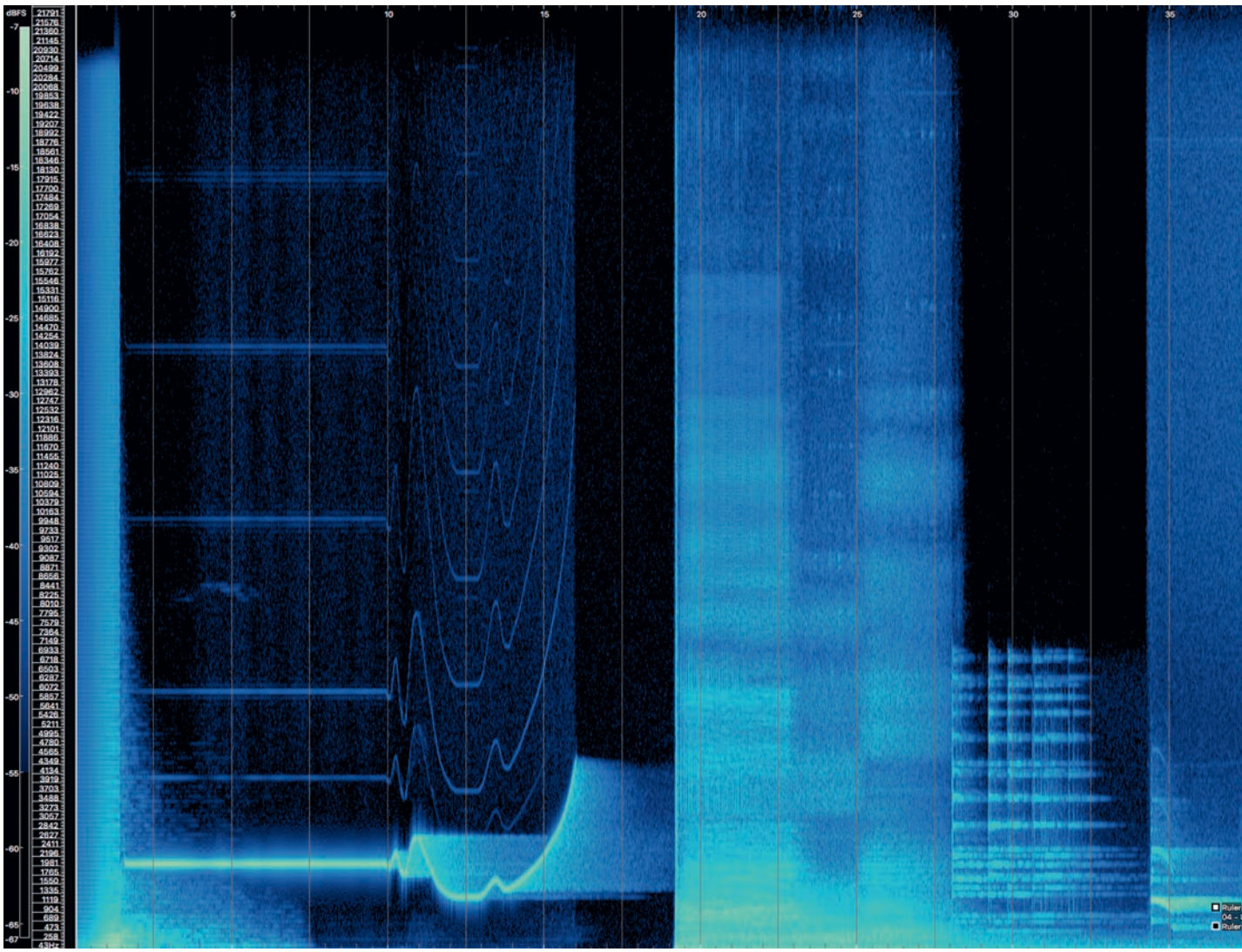

31 Spectrum analysis of Langham Research Centre's composition for the Turbine Hall, Tate Modern, London.


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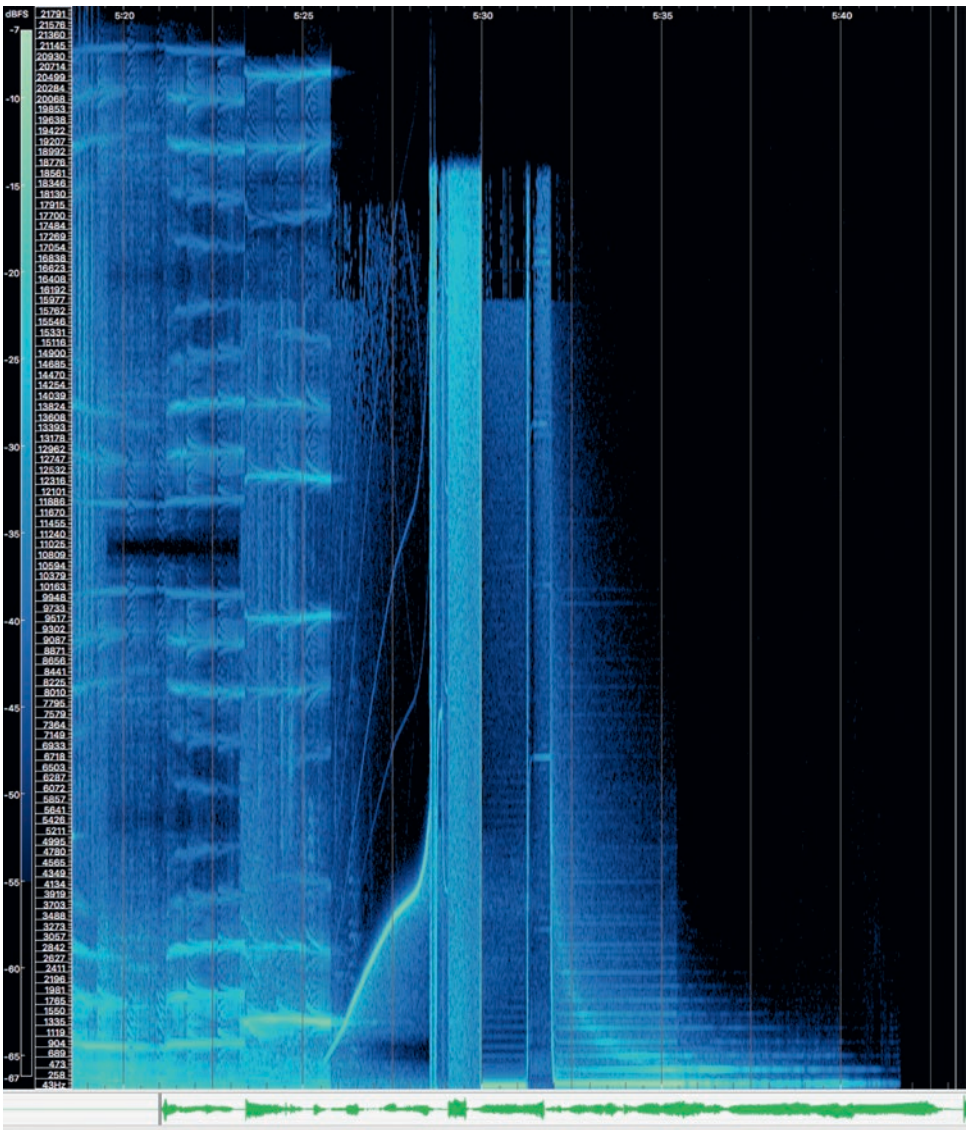
45
Langham Research Centre - Terminal Voltage Traces (Tate Switch House).wav: Spectrogram


dBFS
5:20
5:25
5:30
5:35
5:40

31

Musicity x Culture Mile

As part of the Sound Unbound festival held at the Barbican in Spring 2019, Musicity commissioned ten pieces of music by ten artists linked to the Barbican site.

Asking an artist to fully engage with an unfamiliar process has its particular challenges. Each artist developed a track in their studios using equipment that they were familiar with, creating a unique series of results. Emma Kate Matthews developed her track to be coincident with the nodal frequency of the Barbican's Lower Ground Foyer, which emerged from the impulse response. This created an intense bass response:

> The low clarinet and bowed bass parts provide frequencies which sit below the majority of the foyer's ambient noise; from air handling units, conversation and catering. The low register in which the music is written, deliberately coincides with the most intense region of the impulse response file, as visualised by the spectral frequency display. This means that the music contains a lot of energy around the frequencies which the foyer is particularly reflective to, capitalising on the reverberant potential of the space and thus its ability to *blend* sounds as they are reflected, as if the foyer has the ability to become an instrument itself (Matthews 2019).

32

32 Musicity x Culture Mile, Barbican, London, 2019. Interior of St Bartholomew the Great, London, site of Kassia Flux's 'Rahere'.

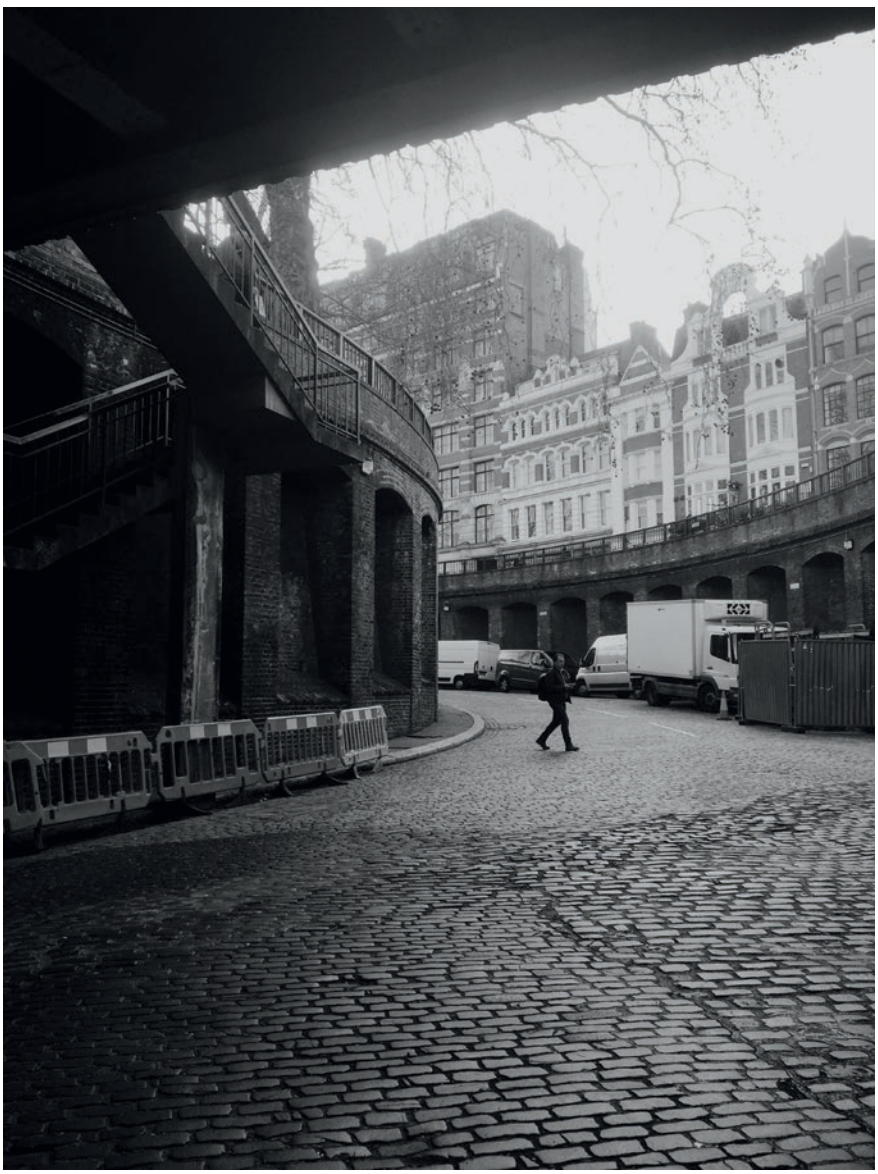
33 Musicity x Culture Mile, Barbican, London, 2019. Acoustic survey of Beech Street Tunnel, site of Howlround's 'Heavy Works'.

33

34 (overleaf) Musicity x Culture Mile, London, 2019. Acoustic Survey of Barbican Lakeside, site of Alex Ho's 'Upon Brick'.

35

35–6 Musicity x Culture Mile, Barbican, London, 2019. Acoustic survey of Smithfield Rotunda Gardens Ramp, site of EMS Collective's 'Eternal Descent'.



36

37 Musicity x Culture Mile, Barbican, London, 2019. Acoustic survey of Fabric nightclub, site of Craig Richards' 'At Home at Fabric'.

37

38

38 Musicity x Culture Mile, Barbican, London, 2019. Lower Ground Foyer, Barbican, site of Emma Kate Matthews' 'Similis'.

39

39 Musicity x Culture Mile, Barbican, London, 2019. The Charterhouse cloister, site of Fari B's 'The Visitor Book'.

4. Workshops and collaborative engagement with site owners, managers and musicians, investigating suitable sites for acoustic and musical interaction(s) and how volume and materiality can influence compositions that can be listened to on headphones or multi-channel auditory systems.

MEMU

In July 2019, we undertook a series of workshops at the MEMU Earth Lab in Japan. The focus of the research was to look at the complex interrelationships of sound, space and the body. Experiments with multiple participants were undertaken, both indoors and outdoors, in order to develop a situated and environmental approach to sound.

The example documented here focuses on room acoustics and music. Due to the inaccessibility of the site, the acoustic testing methodology used a balloon-pop retort as an impulse response, rather than a full sine sweep as used previously. The results were not as high resolution but were good for sketch purposes.

40 Même by Kengo Kuma and Associates, Hokkaido, 2019.

41 (overleaf) MEMU site, Hokkaido.

40

41

42

42 The interior of Même, Hokkaido, by Kengo Kuma and Associates, 2019. A very quiet, almost anechoic environment.

43

43 Nest We Grow by UC Berkeley College of Environmental Design at MEMU Earth Hotel, Hokkaido, 2019.

For MEMU, a series of sites were selected according to relevance, visual interest, accessibility and sound. Spaces were chosen that show a blend of rich acoustic qualities, from the intimate to the cavernous. We wanted spaces that have a voice and that could be a creative springboard for writing music. Once selected, they were acoustically tested by the workshop participants. The output of the tests provides acoustic data that can tell us how the space performs acoustically and how it could be used by others.

The impulse responses generated by the workshop attendees are available on the MEMU website and are available for open download. We have encouraged artists to use these to develop their own compositions based on the site and its architecture. We encourage the sharing of these tracks to broaden the understanding of what music works well in spaces not necessarily designed for it. This project opens up the methods defined by the Musicity project and democratises the process so that anyone with access to music-writing software can engage with situated composition.

44

45

44 Planning balloon-pop acoustic tests at MEMU Earth Lab, Hokkaido, 2019.

45 Workshop in progress at MEMU Earth Lab, Hokkaido, 2019.

46–7 Balloon-pop acoustic test, MEMU Earth Lab, Hokkaido, 2019.

46

47

Dissemination

Installations

- Musicity x Culture Mile, Barbican, London (2019)
- Musicity x MEMU, Hokkaido (2019)
- Musicity Southwark, various locations, London (2017, 2018)
- RIBA, London (2017)
- Silo 468, Helsinki (2016)
- Gjallarhorn, Science Museum, London (2014)

MEMU Workshops

- A Recipe to Live, Waseda University, Japan
- Barn House, Darko Radović Laboratory, Keio University, Japan
- Colobockle Nest, Kyushu University, Japan
- Horizon House, Mark Mulligan Laboratory, Harvard University, USA
- Infinite Field, PAN-Projects, Japan
- Inverted House, The Oslo School of Architecture and Design, Norway
- Même, Kengo Kuma and Associates, Japan
- Nest We Grow, UC Berkeley College of Environmental Design, USA
- Studio MEMU, Toyo Ito & Associates, Japan

The impulse responses generated by the MEMU workshop attendees are available at: https://memuearthlab.jp/2019/07/30/musicity/

Conference Papers

- Bavister, P. (2019). 'Evolutionary Processes and the Latent Aesthetic Potency of Sound and Space'. Sound of Space Symposium. Bartlett School of Architecture, UCL

Lectures

- Bartlett School of Architecture, UCL (2019)
- Architectural Association, London (2019)
- Innsbruck University (2018)
- World Architecture Festival, Berlin (2017)
- Westminster University, London (2015, 2014)

Events and Media

- The work featured in the London Festival of Architecture in 2017, 2018 and 2019;
- The author was part of a live conversation about Musicity hosted by the Barbican in Sound Unbound 2019, where Emma Kate Matthews, one of the musicians involved in the project, was also interviewed;
- The ideas featured in this folio were presented at the World Architecture Festival 2017 in Berlin. This was mentioned as one of the highlights of the festival in an editorial by Paul Finch in *Architects' Journal*;
- The work has been featured on national television (BBC News and London Tonight) and on BBC Radio 4 where the process was undertaken live on the *Today* show;
- It has been published in *The RIBA Journal* (2017) and *Architecture Today* (2019), as well as on various online platforms, including *The Quietus* (2017).

Project Highlights

Collectively, the importance of this set of projects lies in how they have advanced our understanding of the ways in which sound affects the architectural design process and our occupancy of spaces. Its role in this regard has been recognised through international workshops in Japan, Finland, Austria and the UK, and in public outputs such as the source recordings from the Science Museum installation, Gjallarhorn. These recordings were subsequently released on Touch Radio – the UK's national collection of radio recordings – and are part of the British Library's sound archive.

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Related Publications by the Researchers

Bavister, P. and Gage, S. (2018). 'Artificial Intelligence and the Generation of Emotional Response to Sound and Space'. *Proceedings of the Institute of Acoustics*. **40**. pp. 427–34.

Related Writings by Others

Architecture Today (2019). 'Envisioning Acoustics'. *Architecture Today.* 9 January.

Barbican (2019). 'Musicity X Culture Mile'. *Barbican.*

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