ESTOA **26** / pp. 31 - 42 / DOI: 10.18537/est.v013.n026.a02

Research Article
2024 July - December

Sound and space as compositional tools: using the reverberation of a basilica as part of a musical composition Sonido y espacio como herramientas compositivas musicales: el uso de la reverberación de una basílica como parte de una composición musical

02

JUAN PÉREZ MORA BOWEN
Universidad San Francisco de Quito, Ecuador
infoarqpmb@gmail.com

NICOLÁS FERNÁNDEZ PÉREZ
Universidad San Francisco de Quito y Universidad de las Américas, Ecuador
sonicopro@gmail.com

RESUMEN Compositores clásicos como Wagner, Mahler, Handel y Debussy, entre otros, identificaron que la acústica del espacio afectaba a sus obras durante su ejecución, entonces hicieron arreglos intuitivos en ellas para que se ajustaran al espacio de presentación. Por otro lado, compositores contemporáneos como Pauline Oliveros, John Butcher, y Paul Bavister, producen obras *específicas del sitio*, obras que incluyen al sonido del lugar como parte de ellas. Este proyecto usa la *estimulación del sitio* como metodología para extraer la reverberación de la Basílica del Voto Nacional, una iglesia neogótica en Quito, Ecuador, para producir una obra especifica de sitio: *Composición para Cuarteto de Jazz y para Basílica*. El propósito de esta investigación es, no solamente utilizar las cualidades sonoras del espacio como herramientas de composición musical, sino proponer una manera más amigable y cotidiana para aprender, como lo es el escuchar música.

ABSTRACT Classical composers such as Wagner, Mahler, Handel, and Debussy, among others, noticed that a space's acoustic qualities affected their compositions, so they made intuitive arrangements to their performances to suit the space. Some contemporary musicians, on the other hand, incorporate those sonic characteristics as part of their composition. Pauline Oliveros, John Butcher, and Paul Bavister are some composers who produce site-specific works, compositions that include the site's sound as part of their sound works. This project proposes site stimulation as a methodology to extract Basilica del Voto Nacional's reverberation, a neo-gothic church in Quito, Ecuador, to produce a site-specific sound work: Composition for a Jazz Quartet and for a Basilica. This research aims not only to use spatial sonic qualities for music composition but also to propose a friendly, day-to-day activity, such as listening to music, as a learning method to acknowledge spatial sound phenomena.

Received: 14/03/2024
Revised: 13/06/2024
Accepted: 17/06/2024
Published: 31/07/2024

PALABRAS CLAVE arquitectura, arte sonoro, específico del sitio, reverberación, música espacial

KEYWORDS architecture, reverberation, site-specific, sound art, spatial music

Cómo citar este artículo/How to cite this article: Pérez Mora Bowen, J. & Fernández Pérez, N. (2024). Sound and space as compositional tools: using the reverberation of a basilica as part of a musical composition. *Estoa. Revista de la Facultad de Arquitectura y Urbanismo de la Universidad de Cuenca, 13*(26), 31-42. https://doi.org/10.18537/est.v013.n026.a02

e - ISSN: 1390 - 9274
ISSN: 1390 - 7263

ESTOA 26 / Vol 13 / 2024
e - ISSN: 1390 - 9274
ISSN: 1390 - 7263

1. Introduction

To move from making a musical object or work to the construction of environmentally and architecturally active "music" entails a compositional and performative shift, for such work incorporates the complexity of acoustical events informed by the presence of a broader set of terms (LaBelle, 2015).

In this research, architecture and music are engaged simultaneously to produce a spatial/sonic composition aiming to deliver an experiential understanding of space and sound. Listeners are meant to perceive the emotive impact of spatial sounds as they experience the musical arrangement, *Composition for a Jazz Quartet and for a Basilica*. As the title of the spatial/sound composition suggests, the music arrangement is not only for a jazz quartet but also for a building: the Basilica del Voto Nacional in Quito, Ecuador. How can a building be part of a music composition? Each building, because of its form, materiality, and scale, has a certain sound to it: its *sound print*. Like a fingerprint, each structure's sound print is unique. This investigation proposes to use the site's sound print, or its reverberation, an acoustic property, as a compositional tool. According to Peter Lennox (2009), *spatial music* is a musical approach that adopts spatial acoustic qualities in its creation, which is what this research proposes.

First, it must be clarified that, throughout history, spatial sonic attributes have been almost imperceptible for ordinary listeners and have been difficult to comprehend; consequently, the purpose of including one as part of a sound work is to make it more obvious, and thus easier for a broader audience to assimilate and understand. On the other hand, composers are different from ordinary listeners and have perceived these almost imperceptible sonic attributes for a long time; in fact, they have had to intuitively adapt their compositions to the performance space because of them. Dorothea Baumann (2011) argues that composers from the eighteenth and nineteenth centuries, such as Weber, Berlioz, Wagner, and Mahler, keenly analyzed the acoustics of the room they were going to play in beforehand and left comments to their musicians about how to play in the specific hall where they had a performance. Other composers, such as Beethoven, Schumann, and Hindemith, left fewer playing comments.

Baumann (2011) states that even in earlier times, music composers intuitively acknowledged the spatial qualities of their performance (although there was no technical understanding of acoustics until the nineteenth century). Guillaume Dufay's motet *Nuper Rosarum Flores* (1436), written for the consecration of Santa Maria del Fiore in Florence, was composed to acknowledge the church's reverberation. Dufay wrote slow choir passages, engaging with the church's sonic quality (a strategy also used for this project's composition), and fast duos with dissonant phrases, which barely stimulated the dome acoustically. According to Slavomir Horinka (2018), in *Glory to God*, from Handel's *Messiah* (1742), a much larger space is perceived due to the arrangement of the trumpet's dynamics inside the performance space. Actually, throughout Handel's life, the size of the ensemble had to be adapted to the size of the performance space to deliver the musical experience he wanted for the audience (Baumann, 2011). Finally, in Claude Debussy's *Prelude a l'apres-midi d'un faune* (1894), as the flute solo builds with the joining of oboes, clarinets, and the French horn, the space begins to resonate more and more (Horinka, 2018). The fusion of sound and space may have happened accidentally, but as soon as this phenomenon was noticed, it was used creatively.

This research aims to make reverberation obvious, not only to musicians and composers but to a broader audience, not by adapting a piece to a room but by using the space's emotive sonic qualities in the compositional process. This required a site with an obvious and long reverberation from which to extract a sound print to compose the spatial music piece. The building chosen was the Basilica del Voto Nacional in Quito, Ecuador, which, because of its scale, materiality, and geometrical form, has an evident sound print.

Site

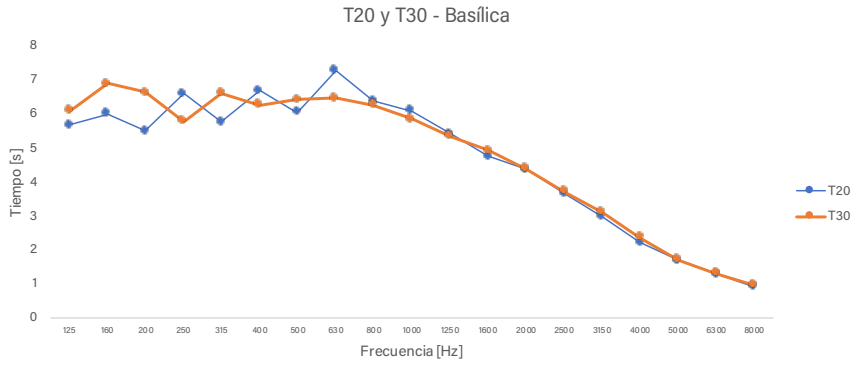
According to Ortiz Crespo (2004), the Basilica del Voto Nacional was designed by the French architect Emilio Tarlier and constructed by architects Francisco Schmidt, P. Pedro Bruening, Francisco Durini C., and Virgilio Flores and engineers Antonio Navarro and Galo Pazmiño. It is located on a hill called San Juan in Quito, between the streets of Carchi, Venezuela, and García Moreno, and is the city's only example of the Neo-Gothic style. Its ground plan design, inspired by the Bourges Cathedral in Spain, is based on a Gothic cross. It was designed from 1890–1896; construction began in 1883 and ended in 1988. Initially, it was supposed to be built in stone, but over the years, due to increases in the price of material and labor price increases over the years, it was constructed with reinforced concrete, cement, and prefabricated elements, which were later covered with stone.

In terms of design, the Basilica del Voto Nacional is a large building with three naves; it is one hundred meters long, thirty-four meters wide, and seventy-five meters high at the crossing. Its ceilings have Gothic vaults. As mentioned before, it consists of exposed stones, reinforced concrete, and cement. Finally, part of the basilica's interior walls and ceilings are covered with sculpted wooden and stone ornaments (Ortiz Crespo, 2004). These characteristics make this site a great example of a building rich in materiality, form, and scale, characteristics that also motivate richness in sound (Figure 1).

The Basilica del Voto Nacional's sound print is renowned, which differentiates it from the other important churches in Quito. Its reverberation time (RT60) is 6.2 seconds. This measurement (Figure 2) was determined through the recordings made by the project's acoustic engineer. The methodology section will explain how the measurement was made.

Figure 1: Basilica del Voto Nacional. Quito, Ecuador. The materials of the site are mainly stone and cement, it has high Gothic vaults, and it is large in scale: all qualities of a highly reverberant building

ESTOA 26 / Vol 13 / 2024
e - ISSN: 1390 - 9274
ISSN: 1390 - 7263



Average	Reverberation Time	Frequency [Hz]																		
		125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000
	T20 [s]	5.67	6	5.5	6.59	5.75	6.67	6.04	7.27	6.36	6.08	5.41	4.75	4.35	3.65	2.97	2.22	1.68	1.3	0.91
	T30 [s]	6.09	6.9	6.64	5.79	6.6	6.25	6.41	6.45	6.25	5.85	5.34	4.93	4.38	3.72	3.1	2.35	1.71	1.3	0.96

Figure 2: Basílica del Voto Nacional's Reverberation: 6.2 seconds

The site's long reverberation can be explained through its materials, form, and, mainly, its scale. On the one hand, the Basilica del Voto Nacional is covered with reflective materials (for example, concrete, plaster, glass, and marble. Absorbing materials would be carpet, glass wool, and Helmholtz resonators; Augoyard & Torgue, 2005). On the other hand, its form and scale motivate longer trajectories for reflected sound events, producing a longer reverberation as a result. A long reverberation has to do with sound propagation. Sound, like light, travels in every direction, in indirect paths, and in a spherical way, reflecting off a building's floor, walls, and ceiling. This means that in large buildings with irregular interior geometry, like the Basilica del Voto Nacional, it will take longer for a sound to reach a surface and bounce back to its source or the listener; consequently, it will take longer for it to dissipate (Augoyard & Torgue, 2005). In other words, the site's physical spatial characteristics (form, materiality, and scale) produce a long reverberation time.

Now that it is clear why, in general terms, the basilica's reverberation is evident, it is also understandable why its aural qualities were chosen for a sound and spatial composition. It was necessary to extract the site's sound print using a method called *site stimulation*, which is described in the next section, to use it.

2. Methods. Quantitative methodology

2.1. Bringing to light the aural properties of Basilica del Voto Nacional

Site stimulation aims to bring to light the site's sound print by sonically interacting with it. A sine sweep, an audio signal that contains every audible frequency (from 20 Hz to 20,000 Hz), was reproduced inside the building to stimulate the site. An omnidirectional full-range loudspeaker was used for this purpose. The particularity of this speaker is that it emits sound spherically, stimulating every surface of the room and in all directions (Figure 3). After the sine sweep had been reproduced and recorded, it was possible to obtain the site's acoustic *impulse response* (IR) for every audible frequency (in the sine sweep). The IR is the digital audio representation of the interior's acoustic characteristics (reverberation) minus the actual sound used to determine those characteristics (sine sweep). In other words, the product of this site's stimulation process is the specific room IR of the Basilica del Voto Nacional, or the digital audio representation of the site's reverberation. As said before, the site's sonic attributes depend on the acoustic properties of each surface material, the dimensions of the building (scale), and the geometry of the space, characteristics which, in the case of this site, motivate a long reverberation time.

The sound print of the building was extracted by capturing the sine sweep through several microphone arrays, such as mono, stereo, 5.1 surround, and Ambisonics setups (Figure 4). The microphone setups were connected to a digital audio interface, which was connected to a computer to digitalize the audio signals. These signals were recorded in a digital audio workstation (DAW), Pro Tools, for later processing. After the files were processed and transformed into acoustic impulse responses (deconvolution), they were ready to be used creatively in the compositional process.

2.2. Convolution process

The convolution process consists of combining the audio information from two sources:

1. The performed and reproduced musical composition (.mp3, .wav, or any other audio file), and:
2. The captured acoustic impulse response (IR), or the sound print of the site.

In technical terms, convolution consists of multiplying the frequency spectra of two audio sources: 1) the input signal (a dry or anechoic audio signal), which in the case of this research is a musical composition, and 2) an acoustic impulse response (IR), which is the space's aural qualities, or its unique reverberation. By doing this, frequencies shared between the two sources are accentuated, while those not shared are attenuated. Through this procedure, the acoustic characteristics of a room will be printed into the input signal (musical composition) and interact with it, forming a spatial-aural musical composition.

It must be remembered that the general aim of this project is to use the space's reverberation as another compositional tool besides harmony, melody, and rhythm. So, although the reverberation of the Basilica del Voto Nacional was technically added to the spatial/sound composition at the end of the procedure, the site's reverberation was acknowledged in the composition's early stage.

Finally, a *sound level meter/acoustic analyzer* was used to measure the site's reverberation time (RT60) (Figure 5). This method is like the impulse response (IR) capturing method, except the audio signal emitted is called *pink noise* (not a sine sweep). The difference is that when the signal reproduction starts, all the frequencies (20 Hz–20,000 Hz) are reproduced at the same time and the same average level (not in order, from the lowest to highest frequency, as in a sine sweep), and these audio signals abruptly stop. The remaining sounds (after the pink noise is no longer emitted) are the acoustic reflections interacting with the room and decaying into silence. The time it takes for those acoustic waves to decay by 60 decibels (dB) is the RT60, which is the common specification for calculating the reverberation time. The average RT 60 of all the audible frequencies for the Basilica del Voto Nacional is 6.2 seconds.

Figure 3: Omni/directional full range loudspeaker: emits sound in a spherical way, stimulating every surface of the room and in all directions

Figure 4: Microphone arrays: Mono, Stereo, 5.1 Surround and Ambisonics setups

2.3. Equipment

The equipment used comprised the following:

- A laptop (MacBook Pro 15") and software (Pro Tools HD)
- Audio Interface: Focusrite Saffire Pro 40: Eight microphone preamp Firewire/ Thunderbolt.
- Two Neumann KM184 cardioid small diaphragm condenser microphones (matched pair) for stereo recording.
- Five Senal SCI-3212 small diaphragm condenser microphones with interchangeable omnidirectional cardioid and super-cardioid capsules for
- 5.1 surround recording.
- An omnidirectional, high-power, full-range loudspeaker.
- An NTi Audio XL2 sound level meter and acoustic analyzer.

Once the site's sound print was recorded, stored, and transformed into acoustic impulse responses, it was analyzed in terms of its side effects (expressive qualities), which were later acknowledged while composing the musical work. When the spatial/sound composition was finished, an audio file was created, which the reader should listen to as part of this article (the time for this will be specified later).

3. Results. Literary review

3.1. Expanded field, site-specific, and relational aesthetics

The idea of writing a music composition for a jazz quartet and a specific building was influenced by three concepts used and developed during the second half of the twentieth century: *expanded field*, *site specificity*, and *relational aesthetics*. These concepts have influenced the development of sound art, situated compositions, and spatial music. As LaBelle (2015) says, sound artists tried to broaden the understanding of music and criticize its traditional approach by introducing contextual sounds. John Cage's iconic *4'33"* and many later sound works represent a shift from traditional music (harmony, melody, and rhythm) to sound (as an environmental phenomenon) (LaBelle, 2015). Simultaneously, situated compositions and spatial music composers began to use "*space* as a direct musical

parameter" (Lennox, 2009, p. 4). Before presenting *Composition for a Jazz Quartet and for a Basilica*, this article will explain how these three concepts, expanded field, site-specificity, and relational aesthetics, were applied to the different art practices mentioned, practices which inspired and developed the idea behind composing with spatial sound phenomena.

3.2. Expanded field

In 1983, Rosalind Krauss introduced the notion of *expanded field*, a concept where artwork (sculptures in her text) embraces its context and *absorbs it* to develop a new reading of both artwork and context as a whole. Krauss (1983) suggested a practice involving landscape and sculpture, where the sculpture embraced the landscape to complete the experience/idea, or landscape and architecture, where the built space embraced the landscape. She was interested in a product that "is not dictated by the conditions of a particular medium" (Krauss, 1983, p. 41) but on its "outer limits." According to Krauss (1983), the study of a specific discipline is enriched by studying others. This project, and many other sound art projects, proposes a practice that involves not landscape and sculpture or landscape and architecture but one that engages music (sound) and architecture (space).

3.3. Sound art through site stimulation. The building as a partner in composition

As previously stated, sound art includes contextual sounds as part of a work, such as a building's reverberation in this particular case. Because spatial aural qualities are difficult to perceive, different forms of site stimulation (addressed in the methodology section) have been used by different artists to bring these almost imperceptible sound qualities to light. The work of several sound artists, such as La Monte Young, Alvin Lucier, and Michael Brewster, will be presented in the next section to illustrate this.

Young, in his work *The Magenta Light,* activated the acoustic properties of a building through the loud reproduction of several tuned frequencies to make them part of the composition (LaBelle, 2015). In other words, the frequencies were *composed* or designed by

Figure 5: Sound Level Meter and Acoustic Analyser: used to do the RT60 measurement

Young to interact with the installation's physical space to enhance its acoustic qualities and, therefore, to make them more evident. In a similar case, Lucier, interested in the acoustic phenomenon created by the interaction of his speech and the surrounding space, stimulated a site only with his voice in *I Am Sitting in a Room* (LaBelle, 2015).

Using a somewhat different strategy, Brewster's *See Hear Now* stimulated a site using his music compositions, with the difference that he also designed the stimulated site. Brewster architecturally and sonically designed the sound sculpture to which his audience was exposed, a sound sculpture characterized by sound propagation and added reflections (LaBelle, 2015). What is key in Brewster's approach is that he recognized that a site's physical design influences the resulting sound phenomenon. For him, the space is a "sound producing object" (LaBelle, 2015, p. 167).

Iannis Xenakis' Philips Pavilion further develops Brewster's idea of stimulating a space designed in relation to how it would respond to a musical composition. The hyperbolic paraboloid-shaped pavilion aims to enhance Edgar Varese's and Xenakis' sound work while also relying on an innovative sound amplification system designed by Philips (LaBelle, 2015). In other words, similar to Brewster, Xenakis intended to use the pavilion's design and the sound diffusion system to stimulate and enhance musical compositions reproduced in it.

Site stimulation excites a space's aural qualities by reproducing a sound event or musical composition so that these sonic properties can be perceived. However, there are times when, because the space's aural qualities are already evident, there is no need for site stimulation to awaken a site's aural properties. In these cases, musicians interact with the site's sound print as if interacting with another musician. This way of engaging a site's acoustic properties produces a different spatial and music practice: spatial music.

3.4. Spatial music. Sound phenomena as musical elements

Pauline Oliveros and John Butcher are contemporary artists with a similar *musical* approach to space. During their performances, they interact with the evident spatial sonic qualities in *real time*. The spatial acoustic phenomenon with which they interact becomes an element of their composition/improvisation, from which the name *spatial music* originates.

Oliveros developed a technique called *deep listening*, which is "listening in every possible way to everything possible" (Oliveros, 1995, p. 19). Through this practice, she became aware of the spatial sonic qualities which became part of her compositions. In 1988, Stuart Dempster invited her to record in Fort Worden's cistern in Washington State, which had a 45-second reverberation. This recording demonstrates how she interacted live with the site's aural characteristics. For her, it was "the smoothest reverberant chamber ever" (Oliveros, 1995, p. 22). She went on to say, "As I gradually became more and more sensitized to acoustic phenomena and its effects on my sound as a performer and composer, I began to listen carefully to each space" (Oliveros, 1995, p. 20).

According to Stuart Broomer (2009), saxophonist John Butcher's *Resonant Spaces* (2009), a project in collaboration with Japanese musician/instrument builder Akio Suzuki, explores the interaction between his playing and several resonant spaces (a cave, a fuel storage tank, an underground reservoir, a standing stone circle, an icehouse, and a mausoleum). For Butcher, as for Oliveros, the site's resonance is part of his performance/improvisation.

3.5. Site specificity. Situated compositions

The second concept that explains sound art, particularly Paul Bavister's Musicity Project, is *site-specificity*. This concept describes the practice Krauss identified through her *expanded field* analysis, in which the artwork expands itself toward its context to enhance it or one of its qualities. The artwork is no longer only a self-referential tangible object but also relates to its physical location (Kwon, 2002).

Bavister's Musicity project can be described as a site-specific work, a "situated composition, where a site defines a more consolidated musical response" (Bavister, 2022, p. 10). According to Bavister, Musicity and Musicity x MEMU are both situated composition projects where the musicians and composers had to develop site-specific sound work based on specific given sites. The sites' acoustic phenomena (reverberation, clarity, and definition) were carefully analyzed and recreated using a methodology similar to that of this project. Emma Kate Matthews, one of the participant composers (Musicity x Culture Mile), developed a composition inspired by the nodal frequency of the Barbican's Lower Ground Foyer; in other words, a site-specific sound work (Bavister, 2022).

Bavister has built on his site-specific work, and most recently, he has inverted the prompt: in one of his most current projects, he proposes not that musicians acknowledge and incorporate the site's acoustics into their sound works, as in earlier site-specific approaches, but that the unconscious emotional response of a listener can and will influence the production of a musical composition by using evolutionary composition and virtual acoustics (Bavister, 2023a). In other words, the music composition evolves with the listeners' emotional response, which depends on how successfully the composition reacts to the (virtual) space in which it is performed (Bavister, 2023a). Another of Bavister's most recent projects proposes that the listener's experience informs a spatial form (that of an auditorium, for example) to suit their music taste (Bavister, 2023b). Again, the listeners' emotional response, this time to a musical environment, can inform the development of a parametric architectural environment (Bavister, 2023b).

This research differs from Young, Lucier, Brewster, and Xenakis' methodology, which consisted of stimulating a site (in real time) to awaken its aural qualities, and Oliveros and Butcher's approach of musically interacting with resonant spaces. It proposes a scientific version of site stimulation. Like Bavister's newest projects, this work proposes to use the audience's input, not as an emotional response to fabricate an evolutionary composition or to determine the form of an architectural environment but to understand an aural phenomenon through the listening experience.

4. Results: quantitative methodology

4.1. Using reverberation (and its expressive potential) as compositional tools

As said earlier, the purpose of using site stimulation for extracting and independently studying the site's reverberation was to understand it objectively in a quantitative manner. Only after this process was this acoustic quality used creatively in *Composition for a Jazz Quartet and for a Basilica.* The sound phenomenon was studied in terms of its expressive characteristics. The characteristics found were lengthening, amplification, and blending (when two or more sound events fuse together).

Lengthening, amplification, and blending are caused by or are by-products of reverberation. Lengthening, as its name suggests, lengthens the duration of a sound event and is directly related to the reverberation time (if the reverberation time is long, the lengthening effect will also be). Sound events will be perceived as if they were amplified since, after they are produced, they will begin to reflect in space; the energy of the primary sound event joins that of its reflection (and so on), producing the sensation of a higher volume. Lastly, according to Barry Blesser and Linda-Ruth Salter (2007), blending is when independent sonic events fuse similarly to when they amplify each other. Blesser and Salter (2007) argue that blending could be problematic if not used correctly since this phenomenon reduces clarity. For example, during Gregorian chants (slow, monophonic, unison singing), the earlier parts of the executed vocal composition are amplified and lengthened by the site's reverberation; these parts then blend with the middle parts, then the middle parts merge with the ending

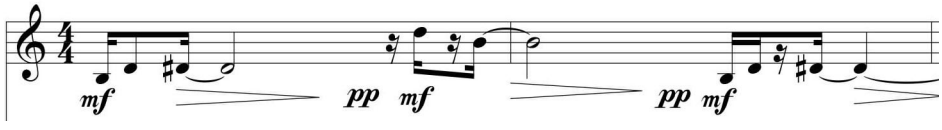


Figure 6: Melodic strategies. The melodic phrase is one beat long and it ends with a long note that engages with the site's reverberation to reach its expressive potential

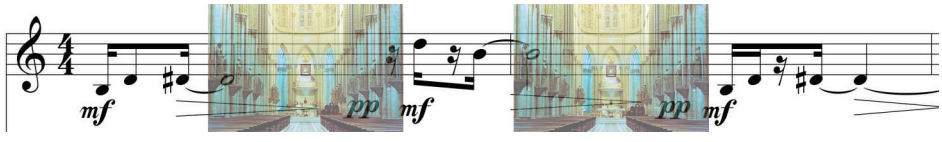


Figure 7: Melody. A visual representation of where the site's reverberation engages with the musical composition

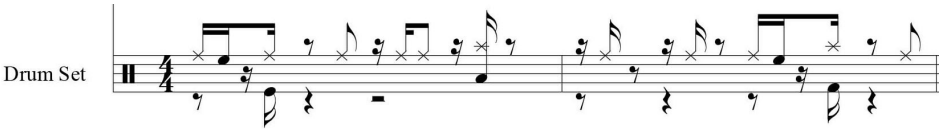


Figure 8: Drum Part. Open playing (not accentuating every beat) and the use of rests allow the site's acoustics to complete the interpretation

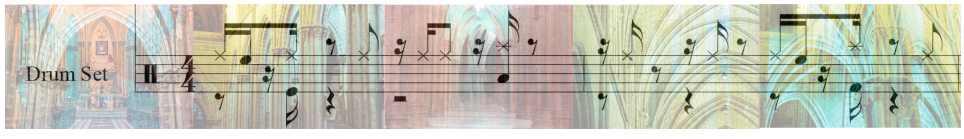


Figure 9: Drums. A visual representation of the site's reverberation engaging with the drum part

parts, and so on. If the chants were not composed in accordance with the space's aural qualities, they would probably be chaotic and indecipherable for the listener (Blesser & Salter, 2007). Lengthening, amplification, and blending are some of reverberation´s expressive qualities.

4.2. Expressive qualities

*"The reader should now listen to the spatial/sound composition".*One can hear how the site's reverberation is part of *Composition for a Jazz Quartet and for a Basilica*. As said earlier, this sound phenomenon and its expressive qualities (lengthening, amplification, and blending) were acknowledged in the creative process and composition. The traditional musical tools, harmony, melody, and rhythm, were also acknowledged, although greater emphasis was placed on the site's acoustic spatial qualities as more experimental creative tools.

Shorter melodic phrases followed by long rests (silences) were employed as a compositional strategy to use reverberation's lengthening effect (Figure 6). After the melodic instrument's short phrase, the site's reverberation complements it during the long rests, lengthening its duration (Figure 7). This strategy was employed for each instrument used in the composition: alto sax, piano, string bass, and drums (see the complete score). A similar strategy has been used in the past during religious services or concerts; priests and musicians leave enough time for reverberation after their speech/playing to avoid unintelligibility and deliver clearer messages/melodies to the audience (Blesser & Salter, 2007). Conversely, if the melodies, harmonies, or rhythms were saturated and fast, the listener's experience would be unpleasant because of the lengthening effect.

A different approach was used for the drums besides the aforementioned strategy. They were written in an open style: they do not mark the pulse, but they suggest playing around the beat (Figure 8). Normally, in popular music, the drums are supposed to play a groove and keep time, allowing the rest of the instruments to move freely. However, their role is different in this composition; they respond to the space and the rest of the instruments. This implies that there is no steady pulse, creating more space between notes for the site's reverberation to lengthen them. Therefore, this strategy also allows the site's acoustic qualities to interact with each musical instrumental part, including the drum part, making the building a participant in the composition (Figure 9).

The next strategy employed in the spatial/sonic work was using a slow tempo (40 bpm). Slow tempos were often used for Gregorian chants (Blesser & Salter, 2007) and are still used for ballads and sentimental compositions, which suggest a reflexive and contemplative feel to the song. In this style, musicians tend to interact with each other in a more relaxed way, using different techniques to produce textures while playing their instruments. In this case, a slow tempo not only helps produce a clearer blending of the harmonic, melodic, and rhythmic phrases but also emphasizes the presence of the building as a musical instrument during the composition's entire duration. Whenever there are silences for the saxophone, piano, string bass, or drums, that implicitly means that there is a *melody* for the building. More importantly, the basilica's reverberation becomes the composition's overall envelope. The background silence heard in most studio recordings is, in this composition, occupied by the expressiveness of the building's reverberation.

5. Discussion: listening

5.1. Active listening: relational aesthetics

In the 1980s, Nicholas Bourriaud introduced *relational aesthetics*, a modern concept for a new interpretation of *aesthetics*, which is the outcome of the interaction between people and the space they occupy. This notion suggests that artwork is completed by its social context and, more importantly, by spectators' relationships with it (visitor's experience plus context plus artwork) (Bourriaud, 2006). In this light, the participant's listening experience is required to complete this investigation. Listening to *Composition for a Jazz Quartet and for a Basilica* motivates a closer understanding of reverberation, an otherwise difficult-to-perceive aural phenomenon, through a day-to-day activity, listening to music.

In sum, *Composition for a Jazz Quartet and for a Basilica* embraces the site's aural attributes by including one of them (reverberation) in its creation. By doing so, it produces a site-specific spatial sound work meant to be experienced by listening. The aim of listening to such a composition is to motivate a creative and artistic way of engaging and understanding spatial aural phenomena. If understood better, a building's acoustic qualities could be used either to improve its design or as a creative musical tool, as in this research.

6. Acknowledgements

This project was possible thanks to San Francisco de Quito University, specifically the CADI Grants, which are research funding from the Faculty of Architecture.

Conflict of Interests. The author declare no conflict of interests.

7. Bibliographic references

Augoyard, J., & Torgue, H. (2005). *Sonic experience: A guide to everyday sounds*. McGill-Queen's University Press.

Baumann, D. (2011). *Music and space: A systematic and historical investigation into the impact of architectural acoustics on performance practice followed by a study of Handel's Messiah*. Peter Lang.

Bavister, P. (2022, april 29). Audialsense. Issuu. https://issuu.com/bartlettarchucl/docs/design-research-bavister-audialsense-04

Bavister, P. (2023a, september 11–15). *Biometrically evolved site-specific music as a response to localised acoustic conditions* [Conference presentation]. Forum Acusticum 2023, Turin, Italy. http://dx.doi.org/10.61782/fa.2023.0306

Bavister, P. (2023b). Biometric evolution of space. *Proceedings of the Institute of Acoustics, 45*(2). http://dx.doi.org/10.25144/16031

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

Bourriaud, N. (2006). Relational aesthetics. In C. Bishop (Ed.), *Participation* (pp. 160–171). Whitechapel.

Broomer, S. (2009). *Ezz-thetics.* John Butcher. https://johnbutcher.org.uk/downloads/Resonant%20Spaces%20-%20Ezz-thetics.pdf

Horinka, S. (2020). Changing the scale of perception: A composer's view on spatial composition strategies and the spiritual aspect of music. In I. Moody (Ed.), *Enlightenment & illumination: Essays on sacred music east and west* (pp. 221–243). https://www.researchgate.net/publication/378862232_Changing_the_Scale_of_Perception_A_Composer's_View_on_Spatial_Composition_Strategies_and_the_Spiritual_Aspect_of_Music

Krauss, R. (1983). Sculpture in the expanded field. In H. Foster (Ed.), *Postmodern culture* (pp. 31–42). Pluto.

Kwon, M. (2002). Genealogy of site specificity. In M. Kwon (Ed.), *One place after another: Site-specific art and locational identity* (pp. 11–31). MIT Press.

LaBelle, B. (2015). *Background noise: Perspectives on sound art*. Bloomsbury Academic.

Lennox, P. (2009, september). *The emotional contents of the "space" in spatial music* [Conference presentation]. International Conference on Music and Emotion, Durham, UK. https://www.academia.edu/10686872/The_emotional_contents_of_the_space_in_spatial_music

Oliveros, P. (1995). Acoustic and virtual space as a dynamic element of music. *Leonardo Music Journal*, *5*, 19–22. https://doi.org/10.2307/1513156

Ortiz Crespo, A. (2004). *Ciudad de Quito: Guía de arquitectura* [Quito City: Architecture Guide]. Municipio del Distrito Metropolitano de Quito.