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There When Hear: Sound, Space, and Chance

By

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree

Master of Architecture

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ABSTRACT

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By

Ali Mahjouri

Sound forms environment more pungently than what is normally called material space. Sound scapes, from Steve Reich’s voice experiments, to John Cage’s performances of “silence” engage the space they displace. It is given that there is a wide spectrum when speaking of space in terms of sounds as realized in Steve Reich’s voice experiments and Cage’s ideas of Silence. The flexibility of all the component members of an orchestra, if compared metaphorically to architecture, outflexes the fluidity of materials used in architecture. The musical version of a building is dull compared to the spatial implications of a musical composition. My driving interest is in the slips of cognitions that take place in space. The moments of recollection, reorientation, and the unsure moments of perception are design criteria to create a more fluid architecture. A way to free up architecture is to approach its creation as one creates musical composition.
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Space has many definitions. Physical, material, spiritual, temporal, perceptual, and emotional descriptors contribute to various forms of spatial cognition. Architects claim to be the chief designers of space. In order to define space, we look to architects to describe spaces. The chief problem with this is that there are other levels of cognition, other ways to experience space.

Phenomenologically, space has a much freer range in music than it does in architecture. In the compositions of Tony Conrad, or Steve Reich, the space of the audio reception is displaced. When seeing Tony Conrad live, the space of the room is altered and redefined by the resonance of the tones acting against it. A vast space is manipulated through a small means.

In the case of pre-recorded music, that displaced space may be as minute as the inside of one’s ear or, as in the case of Cage’s 4’33” as vast as a concert hall in the middle of Manhattan. The levels of engagement of the body to space as defined by architects is more limited by the process of creating architecture. When composing a musical score, the composer has a wide range of fluid media to work with; each operated by an individual (as in an orchestra). The architect has the rigidity of two by four construction and poured concrete as his/her orchestral components.

Architecture is unlike a musical composition or any of the other arts in that it is fixed both physically and ideologically. Perhaps to begin altering the course of architecture, we must alter the tools of the trade.

**Why drawings do and do not help**

Throughout the course of this thesis, I produced a series of intuitive drawings attempting to implement loose compositional methods to describe very specifically what kinds of space I was suggesting. Although, all drawings were produced without a proper programmatic intent, a looser format resulted clearing the air of limitations presented by “what is right” and “what should be done” giving way to the mechanics of the moment. Like free jazz improvisation, architecture
needs to be rescued from the constraints of pragmatics, and we should be allowed to consider
the constraints of a looser organization. The drawings were not absolutely devoid of intent. Their
actual intent was now allowed to fully manifest itself. On one level, the drawings were
mechanical exercises moving rhythmically with my internal palpitations and intuitions. On the
other hand, they were intended to be taken literally as conventional architectural drawings are
understood. To be able to rationalize what is inside is to be able to truly understand what is
inside. This project is a highly personal attempt to understand the limitations of spatial
production. Architects at the end of the day are producing architecture, which is on, as minute a
level as possible, still personal interpretation. Let it be clear that this thesis holds know allegiance
to the thought of a “correct answer” or a “right way” of architecture. It is an attempt to so
completely describe my own personal intent so as to demonstrate the potential flexibility of
architecture. To return to the drawings, architecture is produced normally through a standardized
procedure of suggesting three-dimensional space within the format of two-dimensional drawing.

Models...general

I produced a series of models, which had specific internal logics, and a slim palette of materials. I
approached the problem of sound space construction in three ways: spatial representation of a
musical (literal, diagrammatic) architecture as having the appearance of being sound; architecture
as actual noise maker (walls make noise, floors bounce, architecture as physical instrument);
and, architecture as a container of the open fluid of sound.

Architecture as visual representation of music

The Model #1 was a folie of sorts. A major wall is the spine of the model. On one side, the
model appears tame with remnants of disturbance. No recognizable frame is perceived. Just a
flat wall with anomalous pieces sticking out of it. On the other side, as one passes through the
threshold of the model, the person starts out standing upright and goes through a series of shifts first shifting upside down and then continuing the turn but suddenly turning the opposite direction and being placed right side up. The shifts are both physical and mental.

This is similar to the potential twists and turns that music takes from establishing certain orientation and tempo to quickly altering the rhythm and leading to a fork but then reverting back to the original starting point. Space achieves this in the most sublime of ways. The first model represents the formal description of music. Rhythm described in architectural terms often has been interpreted on a very formal surface way. In Corbusier's La Tourette, the window mullions, spaced “arhythmically”, are supposed to recall musical compositional diversions. Throughout this thesis, my models were an attempt to transcend a formal definition of sound as related to space.

**Architecture as actual noise maker**

Here the thesis became manifest in the actual full-scale construction. The idea that movements can set off certain triggers, to set off certain sounds interested me. I am tired of the visual noisiness of “dangerous” architecture. The contemporary state of what is called “radical architecture” is simply visual cacophony. In my full-scale construction, walls became drums that were set off by triggers in the floor. The actual sounds of the space were compositions of the mechanical parts being acted on. It was a polyphony (or cacophony) of architecture being violated or space being used. I produced two models to this effect that spoke of different ways setting trigger sand musically activating a space (in the most literal way).

**Architecture as sound envelope**

Sound is a fluid that is contained by the envelope of architecture. Without walls, a ceiling, or a roof, sound escapes and becomes dormant (it still exists but is spread more thin). This being the
most complicated category deals with the miscellany of my process. Here I would place my trumpet drawings. Here is also the synthesis model of a space creating a sound in one area resulting in sound retrievals in another area. The removal of sound reception from sound source creates a spatial envelope. A contained space results from this envelope even if the actual space of the sound is an open field. Here sound begins to approximate architecture.

**Architecture as synthesis of perceptions**

In the final space, a synthesis of artificial sound, real sound, absent visuals, intensified attention to hearing, and noisemaking architecture resulted in a synthesis of spatial cognizance through confusion. The lights were out and looped CDs of the noisemakers played while people walked in the space making noise themselves. Tones played live from an electric bass then disrupted the environment further. A polyphonic event and a confusing time for everybody. Rich, dense, confusing, excessive, and complicated space can still be registered as space. Space is not only about circulation nor is it about total feeling either. There are certain thresholds one crosses (both literally and mentally) when walking through a space. The idea of experiencing the dark brought with it certain perceptual limitations (the visual, obviously) but it enhanced the audio. Besides, the associations of dark space versus light space (or recognizable space) leveled the intentions.

Also the hearing was amplified. Touch was highly sensitized and people got used to the actuality of not being able to see. The intention was not to be the “Stomp” (New York Dance Troupe that uses found objects to create sounds) of architecture but to shake the jury of highly trained architectural critics up and to take them away from their normal conventions of perceiving. I tried to tap into less accessible or accessed regions of spatial definition.

Here the transcendental quality of music comes in and space is formed as an amorphously recognized thing. It escapes the tyranny of the straight wall of architecture. There is no
orthogonal perception of this kind of space. The person is liberated from the constraints of normal “architectural perceptions”.

Space becomes closer to a musical composition.

In an attempt to describe space musically or sound spatially, certain given definitions had to be reconsidered. Architects are not accustomed to considering space on non-physical terms. The sense of vision rules the process of creating architecture. As a framework, I replaced the dominant sense of vision with hearing. This created a whole new set of design constraints.

But how do we design physical space using sound? How do we get to the point of perceiving space without vision dictating our reception of space? How can we get from what looks cool to what feels cool in architecture?

The ideas herein are all pointed at expanding givens in architecture and creating new definitions of space without losing sight of what architectural space is. All the constraints of space (from its physical construction to the conceptual limitations of a space “making sense”) help describe space. But it must not be forgotten that these are constraints. In order to push the definition of what is architectural space, it is necessary to expand the constraints and to explore territory which is unfamiliar.

The driving force behind this project was based on an investigation of how to design non-prescriptively. How do we design something that has a physicality to it without displacing its environment (on all levels – physical, mental, and emotional)?

**How is a free space designed?**

This thesis uses sound to generate one answer to that question.
Model #1

Transitional Space

Diagram of a spatial model of colliding rhythms. As in a musical composition, rhythm dictates a tempo which describes a mood or pace at which one can experience the music. In a given piece, rhythm changes fluctuate propelling the set given mood into different states of experience. Space cognition occurs similarly. This model demonstrates three different rhythms of circulation. Of a similar tempo, these delineations shift suddenly at transition points.

The transition is a powerful vehicle in musical composition. It provides a pivotal point for a composition to change a direction or mood. In this model, one starts out walking right side up. Through the transition point, the path flips upside down twisting towards another direction suggesting a new continuous course. Once the inhabitant settles on this new course, a reverse flip occurs placing the user back to original right side up orientation.

The elements coming off the wall are metaphor for Free Improvisation (jazz music). The power of music is its ability to change one's orientation instantaneously. This model is a spatial equivalent to that phenomenon.
Space as Instrument

Following from the model of transitional space, these drawings use sound moving through an instrument as the material of space itself. A French Horn contains pipes which house and manipulate the material of unorganized sound. In moving through this housing, the unorganized bursts of sound become organized into an element of "desirable" sound. In the same way, architecture houses and contains space. It demarcates unorganized space and transforms it into "usable" space. Spatial organization in architecture is often encumbered by constraints that limit and perhaps strip space of its phenomenological qualities. The drawing below uses the model of the French Horn to create a model of space in plan. Besides the obvious formal interpretation, space here is regarded as a fluid pulled from the outside and manipulated through a series of circulation patterns. Pivotal walls, sliding doors, and chambers on rolling tracks free up the physical stasis of the architecture. Space is organized within the free framework of sound composition.
Model #2

Meandering Structure

This model diagrams the anatomy of a standard musical composition. The wall is the reference point of the song. In a pop song, for example, a driving rhythm section provides the basis for other instruments to respond to. Without the base rhythm or tempo, deviations are not registered; they hold no relative meaning. In spatial formation, there must also be a constant structure for deviant elements to exist. In this case, this is a diagram of a circulation path. The person walks through this hallway, establishing a rhythm of movement with the visual cues of the frames. The deviating ceiling structure infiltrates the serenity of a straight corridor resulting in visual confusion and disorientation. The underlying structure makes the meandering structure known.
Model #3

Sound's navigational importance in space

This model describes a series of spatial changes occurring with the movement of a major stylus. A framework describes a hallway. As a person walks towards a pivot door, the sound of footsteps on the corrugated material sets up a subtle "sound map". The rhythm of the footsteps becomes less obvious when the flooring changes materials. As the person pushes the pivot door with the attached armature, a stylus scratches on different floor materials and pushes through the flexible wall ending on a corrugate floor surface. The sound of the person's footsteps deceives the resultant sounds. Similar surfaces are being acted upon by different materials. In one instance, the footsteps, while simultaneously in the other, the sound of the stylus scratching on corrugated metal. In spatial navigation, sound governs our movements in the most subtle way. This model is an attempt to extend the sound from the source to the ear. A slip of sound recognition animates the usefulness of sound in spatial formation.
Model # 3 Views. This model was made of many different materials which have acoustic elements: basswood corrugated metal, plastic, metal rods, and wood veneers. When struck the stylus (pivot door), the sound of plastic is that of a drum. Metal rods scratching against the corrugated metal "flooring" produces a washboard sound.

a series of sound disruptions animates sound's importance in architecture.
These are two in a series of six drawings taken from the same section on a hypothetical site. Different sounds were recorded in the architecture school: the sound of keys, footsteps up stairs, door swings, skateboard wheels rolling in the hallway, distant lecturing, and multiple voices echoing on the opposite side of the building. These sections take those sounds and try to retroactively form spaces. Six sections corresponded to six different musical combinations (not necessarily all containing the same number of elements). Each musical combination was composed of anywhere from five to ten spaces organized around correspondent sounds. For example, a room in Drawing #3 is designed on the sounds of a drafting brush moving back and forth.
List of Sounds

Orange Layer
- taut fabric
- walking
- scratching on chalkboard
- knives slashing
- rock dropping in water
- static
- walking on broken glass
- pulling on hair
- hopping on feet

Red Layer
- trestles (train creaking)
- rope creaking
- walking on rocks
- muscles flexing
- vacuum
- percussive whacking
- moving through brush
- doors closing
- repeated glass wipes (as on a windshield)
- steps - long and rhythmic
- echoes of hollow stone
- computer static - almost silent

Violet Layer
- sticks
- bubbles (buoyancy)
- cange dropping
- ball bouncing
- bowling ball hitting floor
- wire vibrating
- silence braking a climax

Green Layer
- megaphone
- calm fluid
- explosion
- accordion bounce
- shuffling papers
- multiple brushes
- washboard
- xylophone
- flags flapping in wind
- wind moving through sails
- boiler room
- multiple machines running simultaneously
- bottle echo
- empty space (cave)

Blue Layer
- gong
- glass shards (breaking glass)
- fire cracking
- scissors
- tying knots
- triangle (instrument)
- bodies squeezing through turnstiles
- exhaust muffler

Yellow Layer
- white noise
- helicopter
- grabbing monkey bars
- rolling pins
- walking in forest
- rubber band stretched
- hopping, jumping (hopscotch)
- broken clay
- crack, snap
- stirring in a bowl

This final conglomerate drawing took all the sections (each one color coded) and combined them into one section to create a polyphonic composition of space. The red section marks were from one section, the blue section marks were from another section, etc. This becomes the architectural equivalent of a sound collage.
Model #4

**Multiple rhythm(s), Multiple space(s)**

A simple corridor was created. The floor was a series of different sized planks placed side by side in a somewhat haphazard fashion. Using the ends of the planks, frames were built creating multiple thresholds (deliberately excessive). The speed of musical cognition exceeds the speed of spatial cognition in regards to orientation. Within the same minute of a polyphonic composition, the listener is being instantly oriented and reoriented. Similarly, when walking through the hallway of this model, a person passes through an exceeding amount of thresholds, each signaling a change of direction. The multiplicity of thresholds does not override the singularity of the hallway. As in a musical composition, the unified form remains recognizable.
Also in this model, a visual saturation does not hinder the cognition of the overall hallway. But like a nagging pop song, after repeated listenings, the person recognizes new anomalies to the song. This space is retains that effect.
Blurry elevation, transitions

An elevation of a blurring building. The material of the skin appears in motion registering a time slippage. During the transitions of a musical piece, at the precise moment of the transition, a disorientation occurs followed by an immediate reorientation. This elevation demands a double take. Perhaps through the use of visual orientating elements, the transitions of architecture can register.
Model #5

**Soundmaker Space #1**

In this model, ideas of architecture as noisemaker, acoustical enclosure and disenclosure, and transitional space guided the process.

Oblique view showing the green sliding wall between the raised metal platform and the faceted flooring. As one walks over the faceted flooring, triggers are set off to strike an adjacent metal wall. This was an architectural version of a piano key.

Using existing "noisy" elements, the space becomes naturally more polyphonic.

Plan view of Soundmaker #1

The active "piano key" wall. The people in the space effectively perform a composition while moving through the space.
Model #5
View through the corridor of Soundmaker Space #1. A series of faceted flooring as well as conveyor pipes form an unstable space. The resultant composition recalls improvisation in music.
Model #5

View through of both the different flooring intersected by the sliding green wall. On the left, the faceted flooring and on the right the raised metal flooring. In addition to the sounds of people using the different floorings, the sound of the sliding wall adds to the architectural composition.
Model #6

**Soundmaker Space #2**

A sort of continuation of the ideas of the first soundmaker. This model tries to expand the distance between the source of the object producing the sound and the source of the emanation of the sound. The flooring on the left side (top in plan) triggers lightweight poles to tap on a perforated, raised floor on the right (bottom in plan). Some poles may poke through the perforated flooring while others may butt up against the bottom of the perforated flooring. Some poles just barely vibrate within the holes of the perforation.

Plan view of model with overhead rolling door open. A linear green element provides a visual fixed reference as a person moves through the corridor. This reference point makes obvious the disruption of walking on the floor surface. It is also fixed loosely enough that it vibrates (similar to a guitar string).
Entrance view showing the sliding metal door on the right.

Model #6

Plan view with overhead door closed.
Model #6
This model was made from cardboard, metal sheeting (the same used in the final installation), basswood, chipboard, and metal rods. Following from earlier models, I employed the acoustical qualities of these materials to make an audible model of space.
Sound Room (Installation)

All of the models and drawings resulted in a full-scale installation at the Rice School of Architecture Student Lounge. The installation occurred once in full form. Various components in the space were recorded and burned to compact discs and looped. With four borrowed disc players, one electric bass guitar, one amplifier, and no light, the installation was complete. In addition to those elements, a full scale soundmaker was constructed. The dimensions of the room were approximately 16' by 25' with a ceiling height of approximately 15'. The construction of the installation was built out of 2 x 4's, 2 x 2's, and 1 x 2's. An excessive amount of string, washers, galvanized metal sheeting, and aluminum sheeting, foam (rescued from a local warehouse) were used. The installation took a total of about one month to complete. It lasted approximately 15 minutes with about 7 minutes of a note on the electric bass reverberating the dark space. All fenestrations were covered to the best capacity with available resources. The entrance was made of foam. Thank you to all those involved (all those with ears) for your patience. The following documentation will discuss the specifics.
The subject in the room walks carefully over a floor composed of wood frames, heavy duty steel cables, and soft foam. The wood flooring triggers blocks of wood to clank against the wall on the left side of the person. In the dark, the materials take on a new form. The conversation between the elements in the floor, soft and hard, rigid and flexible, dense and light, signal an active floor system. The dark confuses the placements of these elements and the subject is further jarred by the consequent sound produced from the floor system. Small blocks of wood bang against a luan wall structure, some at ear level, some at knee level. Orientation is reorganized. The space becomes alive through audio displacement and disorientation.

The entirety of the floor system acts as a xylophone where the person's feet become analogous to the mallets of a xylophone. Rather than the sound expelling below, it emits out of the wall on the left.
Clank Wall

A series of wooden pieces hanging from metal rods bang against a makeshift framework of luan wall pieces placed in a haphazard matrix. On the right side of the wall, the soft floor system provides the trigger. The pape beyond acted an adeterrent to people wikaing through this space in the dark. This part of the installation was minimumally accessible due to safety concerns. This idea was abuilt manifestation of Soundmaker Space #1.
Potentially painful arms of the clank wall create a clanking triggered from people walking through the space.

View of the clank wall from the entrance. The paneling system on the right had a total dimension of 12' x 8' high.
Pedal Trigger

The first in a series of foot operated devices used to create various sounds. As soon as the people entered, this was to the immediate left with a radio behind it playing a sampled version of this pedal in action. As the person steps on the device, a string holding a $1 \times 2$ is tensed up causing the wood to bow. Upon release of the foot, the wood springs back and smacks against an existing door jamb.
View of Light above the small metal chamber. A hanging luan ceiling nestles within the framework of the metal walls. The light is red. In this space, there is a small sitting area. The floor of this space was composed of eight layers of foam.
Metal Chamber

This space was adjacent to the Clank wall. The dimensions of the space are 6' x 2'6" x 6' high. There is a small sitting area where a person can sit and listen to the vibrations of the metal around. The metal sheets used were about 2' wide by 5' long. They were attached to a minimal framework of 2 x 2's. In this space, the second compact disc was playing a loop of metal shaking the actual metal from this room).
View of metal chamber to the right form the side opposite the entrance to the main room. Clank wall is on the left.

View of the whole metal chamber with hanging red light. The lights were an early idea which did not make it to the final presentation.
Plywood Lever Trigger

After walking through the clank wall area, there are two triggers, one on the left and one on the right. The one on the right is attached by string hanging a 2 x 2. When stepped on, the string pulls the hanging 2 x 2 and releases it causing it to bang into the metal sheeting covering the fenstration. The loud banging comes from the opposite side of the trigger. This idea comes from model #3. See "sound's navigational importance", page 4.

View of the overall rear platform area of the room. Plywood lever trigger in the middle.

before...

after...
View of the rod set off by the plywood lever trigger. Here it is pulled back, getting ready to bang against the metal sheeting covering the fenestration.
Pedal Drum Trigger
This trigger is opposite the plywood lever trigger. Upon leaving the clank wall area to the left, a subtle trigger pulls a horizontal piece of plywood up. As the plywood is pulled up, the metal attached to it vibrates and creates a windlike sound. This also employs the idea of the sound
Metal Chain Trigger

As the person passes the plywood lever trigger, a platform to the right leads to trigger which is subtle (the movement is hardly recognizable). However, the effect is highly noticeable. Metal sheets are attached at the top to a 2 x 4 cantilever system with chains hanging every 2'. When this trigger is activated, a string pulls the metal sheeting away from the wall causing the whole cantilever to whip back. A tambourine sound is created while the springing action of the cantilever nudges the person's leg.
Amplification Chute
During the beginning of this installation, I tried to build a chute for the amplifier to guide the sound through the structure of the installation. This area is a physical framework for the extrusion of sound into the space. The heart of the strongest sound came from the chute. During the installation, this area was inaccessible to the participants. It acted as a physical and audio barrier. The sound in the center of the chute overwhelmed the rest of the space.

View of the space towards the amplifier from the left side of the metal chamber. The string system is a series of multiple strings tied to a rod at the top of the two vertical supports. The idea is that the strings will vibrate when the note is plucked on the electric bass. This was also an idea which started out before the decision was made to put the lights out.

View from the entrance to the amplifier. This region was inaccessible to the people.
View of the area off the amplifier chute. Here rods are resting in holes in the wood. As the room vibrates, the rods lightly strike the metal sheet creating a sound similar to a triangle.

**Amplification Chute**

View of metal sheeting covering fenestration with hanging wood in the foreground set off by the plywood lever trigger.
Amplification Chute

View from the amplifier towards the front entrance. The metal sheeting on the right is covering up the fenstration.

View of the amplifier. A metal sheet is stapled to the front of the amplifier which then vibrates when the bass note is played. A layering of materials in front of the amplifier causes strange resistances when the bass is played. Here the sound is perhaps the most visual.
View of the amplifier scene with the rods and the chute in the foreground.
End

Throughout the course of this thesis, I attempted to materialize sound, to make sound something it is obviously not: a physical object with tactile (in the sense of touch) qualities. I tried to pull its physicality out and bring it into architecture. Concurrently, I also tried to make architecture, space, less of a physical object with more fluidity. It was a merging of two things trying to become the other. The models interpreted sound into space formally. The drawings objectified sound and tried to describe the components of musical composition graphically. The installation was my first attempt at housing sound and giving space a voice. In making the installation, I learned several things about building space, trapping sound, and making space out of sound. But one thing I also learned (and sort of already knew) is that you cannot move a rigid 2 x 4 structure by playing a bass on volume 27. Some things you just accept. Given that, this was not necessarily a literal attempt at making a kinetic object out of varied noise frequencies, nor was it an attempt at making sound into concrete walls. It was an attempt to look at the in-between, a space too often ignored in the creation of architecture. More than ever, architecture (as well as most occupations) is becoming multi-disciplinary. Definitions of things are expanding. Accepted “rights” and “wrongs” are dissolving. Architecture is interesting. Music is interesting. But the space of a song and the sound of a space are much more interesting to me. I have always been a music lover. The space created by tonal manipulations reaches further than most of the architecture I see around me. But it remains in my mind. This thesis was an attempt to translate music into space (using architecture as the framework for defining space). The excitement and surprise I feel from listening to a loud fast part of a song build up to a quiet calm can be achieved in space. Sound reaches you from the furthest point away (on all sides) to the space in between your ears. It is a totally open fluid with an undeniable presence. This thesis was my first attempt to “physicalize” sound space and “amplify” built space. If architects could design spaces as though they were musical compositions, perhaps more spaces of unpredictable experience and chance would result.
Sources


Sources (continued)


