

Spring 5-4-2018

# Meandering Structures | A Theatrical Take on Sonorous Environments

Jamilah-Renay Bouges

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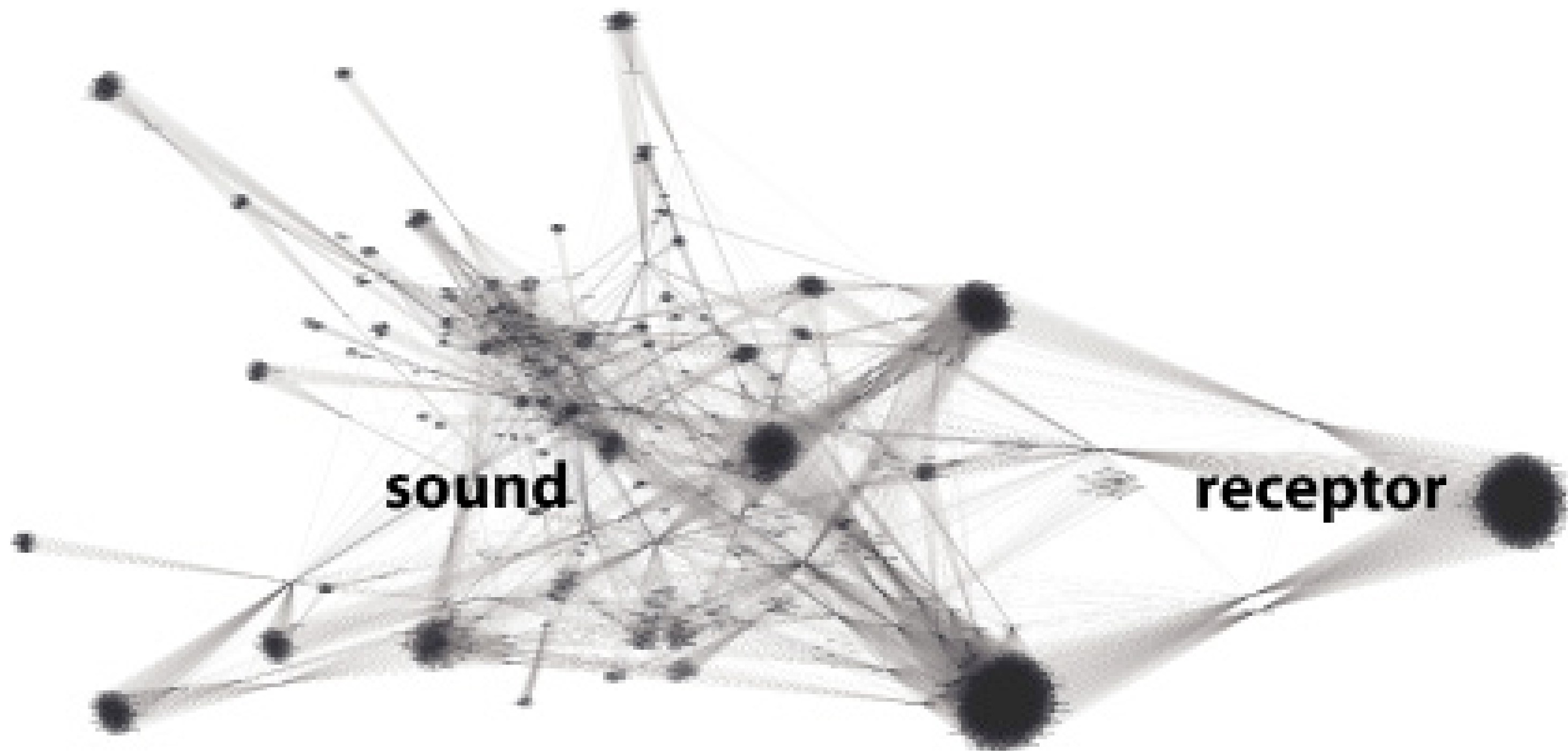
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**sound**

**receptor**

## ***Meandering Structures***

A Theatrical Take on Sonorous Environments

*Meandering Structures*

*Atlanta, GA*

Thesis Proposal is Presented to the  
Faculty of the Department of Architecture  
College of Architecture and Construction Management

By

*Jamilah-Renay C. Bouges*

In partial fulfillment of the requirements for the Degree  
Bachelor of Architecture

Kennesaw State University  
Marietta, Georgia

Spring Semester 2018

## - Thesis Collaborative 2018 -

Request for Approval of Project Book:  
College of Architecture and Construction Management | School of Architecture  
Kennesaw State University

Student's Full Name: Jamilah-Renay C. Bouges  
Project Title: Meandering Structures | A Theatrical Take on Sonorous Environments  
Thesis Summary:

This project studies the distinct patterns of sound created by specific activities in our day to day lives. Ways in which these sounds travel and impact the receptor will directly influence how this project performs and reacts to a given source's stimuli. Once this is understood, the environment of the final proposal will be more easily manipulated into a reflective and absorptive form which molds itself in order to provide more adequate clarity to an audience. This flexible form is applied as an interior skin for a travelling theater supplying a myriad of performing arts and musical acts as demanded by a client. All portions of this travelling theater shall be constructed as a kit of parts which can be assembled and disassembled on site in a given arrangement according to the intended acoustic program. Through configuring the supporting structure and interior skin, this proposal seeks to be adaptable to numerous sonorous environments from concerts, to lectures and even social functions.

Student Signature: \_\_\_\_\_ Date \_\_\_\_\_

Approved by:

Internal Advisor 1 \_\_\_\_\_ Date \_\_\_\_\_

Professor Bronne Dytoc

Internal Advisor 2 \_\_\_\_\_ Date \_\_\_\_\_

Professor Marietta Monaghan

Thesis Coordinator 1 \_\_\_\_\_ Date \_\_\_\_\_

Professor Elizabeth Martin-Malikian

## - DEDICATION -

First and foremost, this is dedicated to *my beautiful mother* for all of her unending support and consistent reaffirmation. You know I am stubborn, but your words mean more to me than you'll ever know.

Secondly, the rest of my immediate family for believing in me and tolerating my less than desirable moods throughout this process. *Alysha, Jasmine, dad*; you are genuinely more than I could ever ask for in a support system and I cannot wait to continue paying you back for all you have done for me.

Lastly, I would like to dedicate this to *Jessica Sanders* for being like a third sister to me and providing me with more candid positivity than I deserve. You inspire me to be better and I am forever thankful.

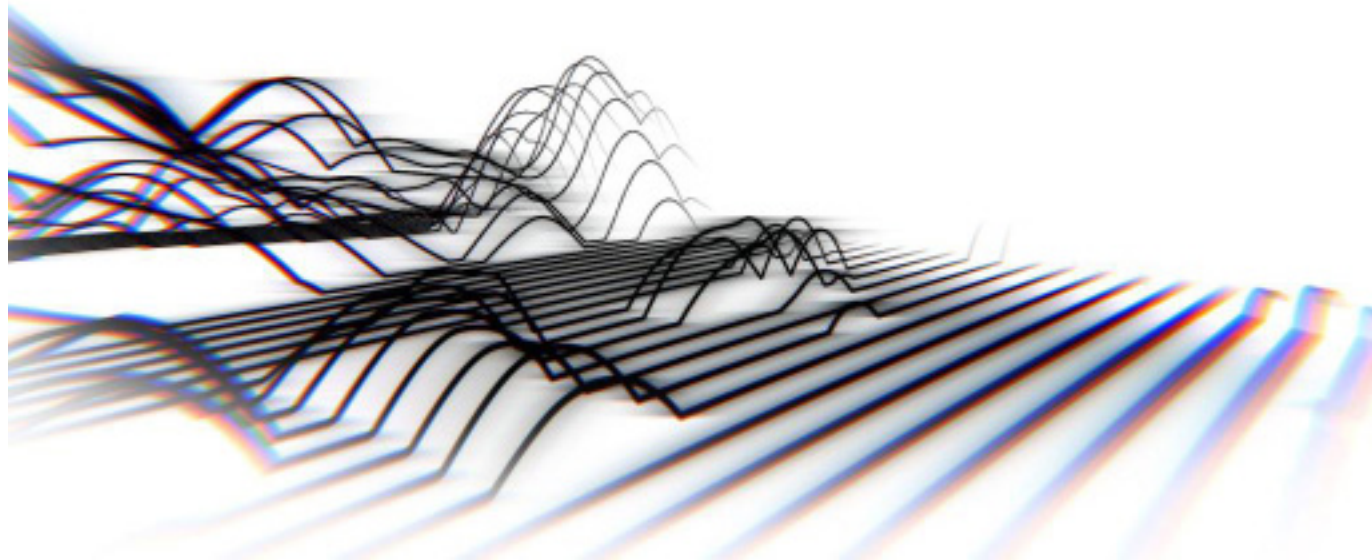
## **- ACKNOWLEDGMENTS -**

The author would like to acknowledge the following people for their varied levels of assistance and support throughout the years that led to this culmination:

Bronne Dytoc  
Marietta Monaghan  
Dr. Tony Rizzuto  
Dr. William Griffiths  
Ed Akins  
Tony Martin  
Kristen Eudy

Also, all of the friends who were immensely impactful, including:  
Alda + Mary, Bill Partridge, Danica Roberts, David Ash, Eva Wood,  
Heimar Miranda, Lia Hammond, Lisa Patsios, and Mary Soley

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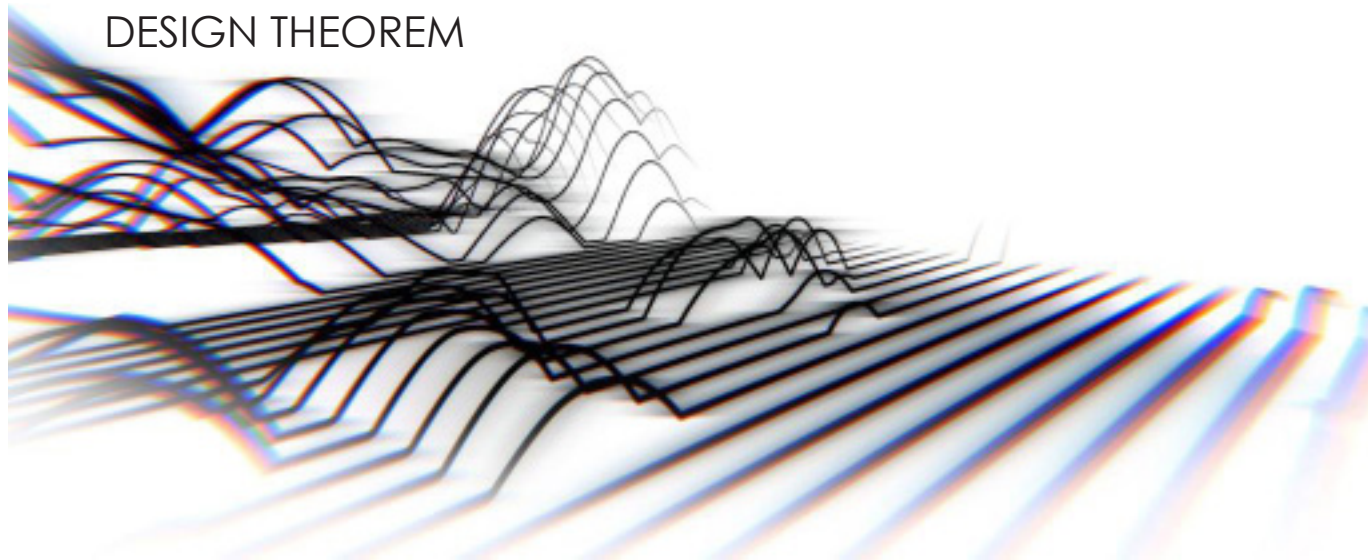
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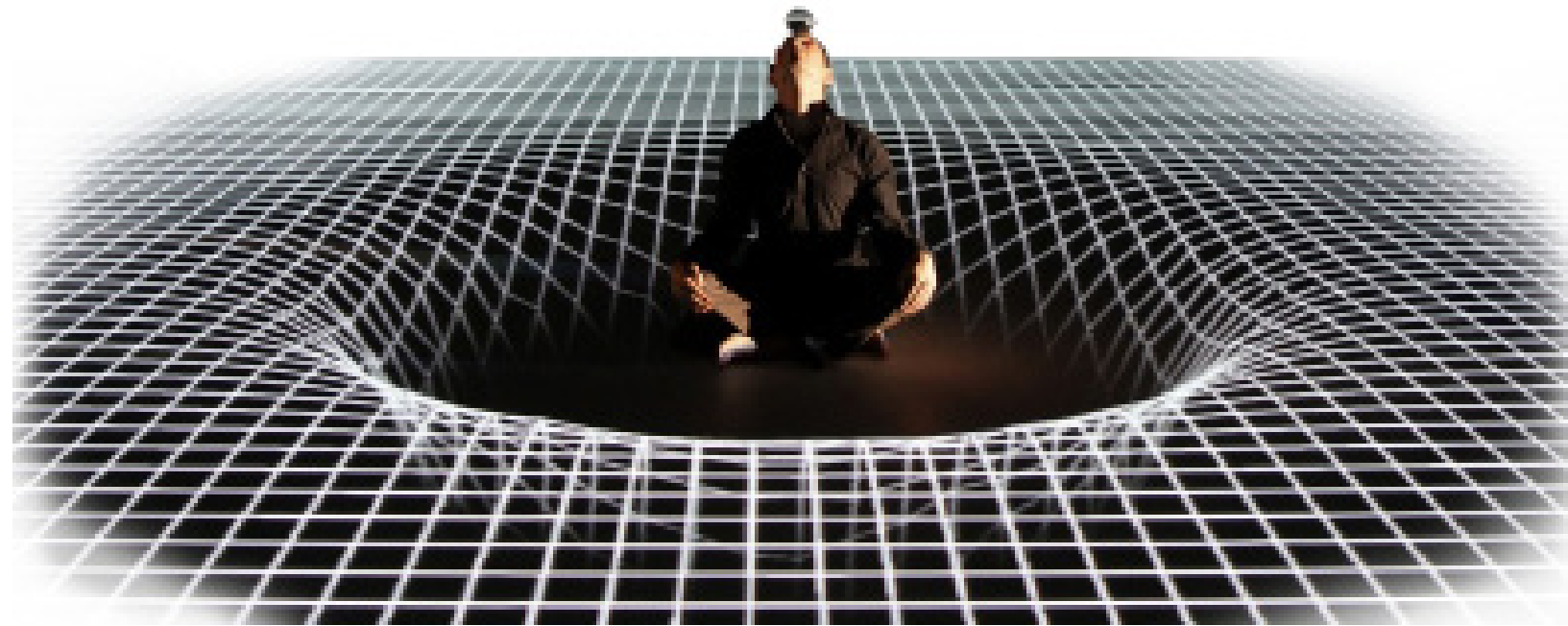
CHAPTER ONE.  
DESIGN THEOREM



## 1.1 THESIS STATEMENT + *DESIGN INTENT*

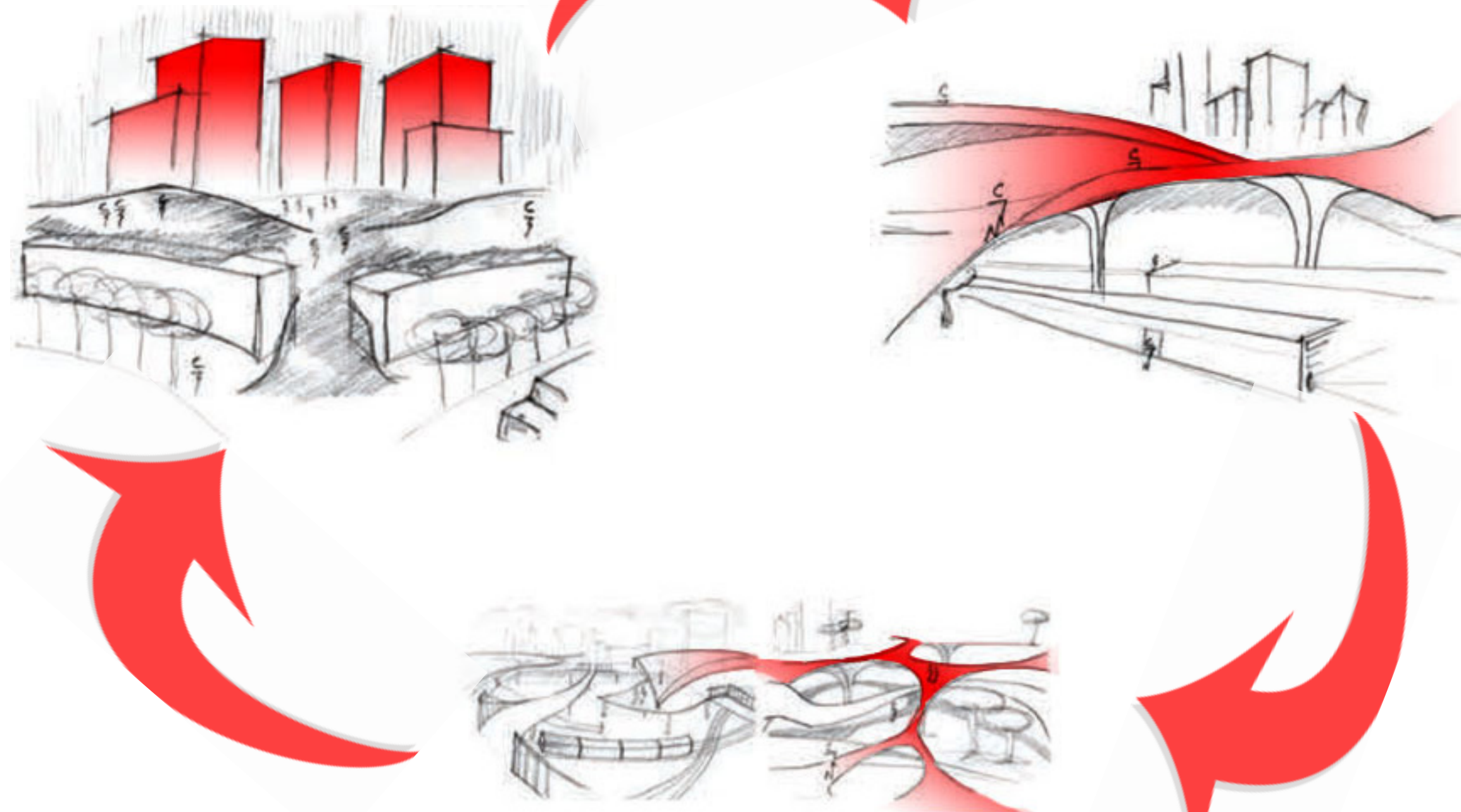
Whether the time is spent alone, socializing, or with leisurely activities somewhere in between, the average American spends over 85% of their time indoors. The nature of architectural space, especially those developed for interior functions, should cater to most, if not all, of the necessary functions of the inhabitant, this includes their visual, auditory, tactile, olfactory and proprioceptive senses. Architects have traditionally catered primarily to proprioceptive and visual senses first and foremost with careful consideration to tactile materials next before finally considering sound as a lesser valued design concept. The delicate relationship between sound and receptor can be considered earlier on in the design process for certain architectural typologies in order to facilitate a healthier connection with the design constructs within which we typically work and play.

This project studies the distinct patterns of sound created by specific activities in our day to day lives. Ways in which these sounds travel and impact the receptor will directly influence how this project performs and reacts to a given source's stimuli. Once this is understood, the environment of the final proposal will be more easily manipulated into a reflective and absorptive form which molds itself in order to provide more adequate clarity to an audience. This flexible form is applied as an interior skin for a travelling theater supplying a myriad of performing arts and musical acts as demanded by a client. All portions of this travelling theater shall be constructed as a kit of parts which can be assembled and disassembled on site in a given arrangement according to the intended acoustic program. Through configuring the supporting structure and interior skin, this proposal seeks to be adaptable to numerous sonorous environments from concerts, to lectures and even social functions.

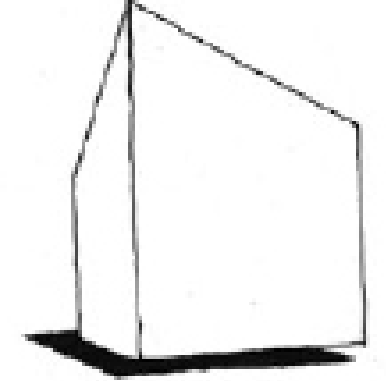
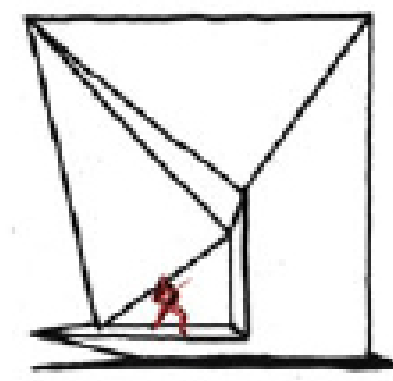
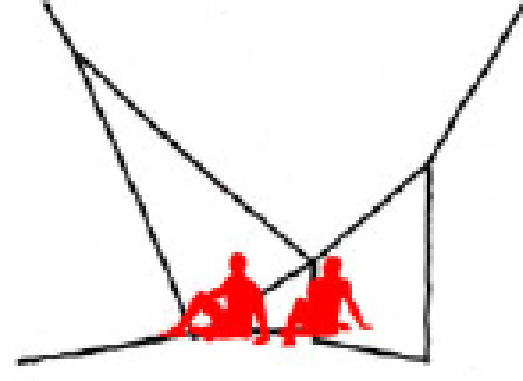
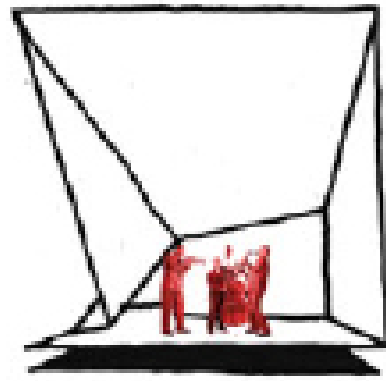
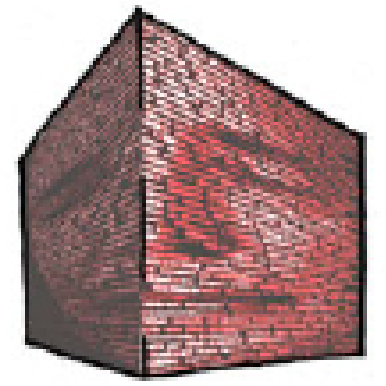
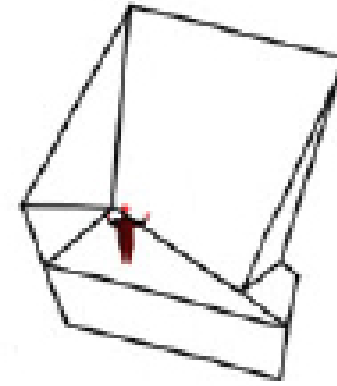
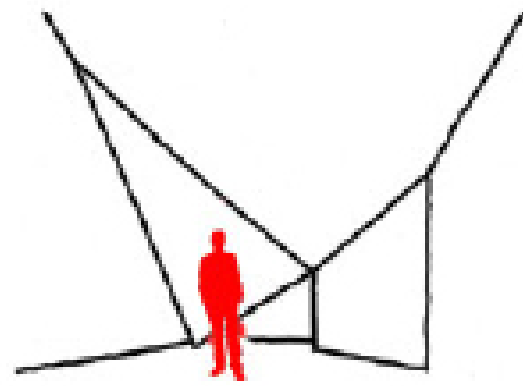
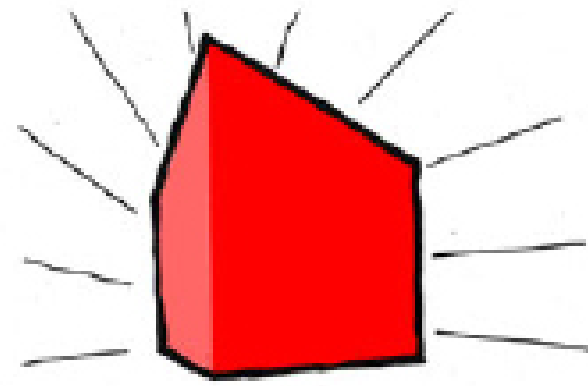


**Figure 1.1a**  
Transformative mesh as influenced by  
human form

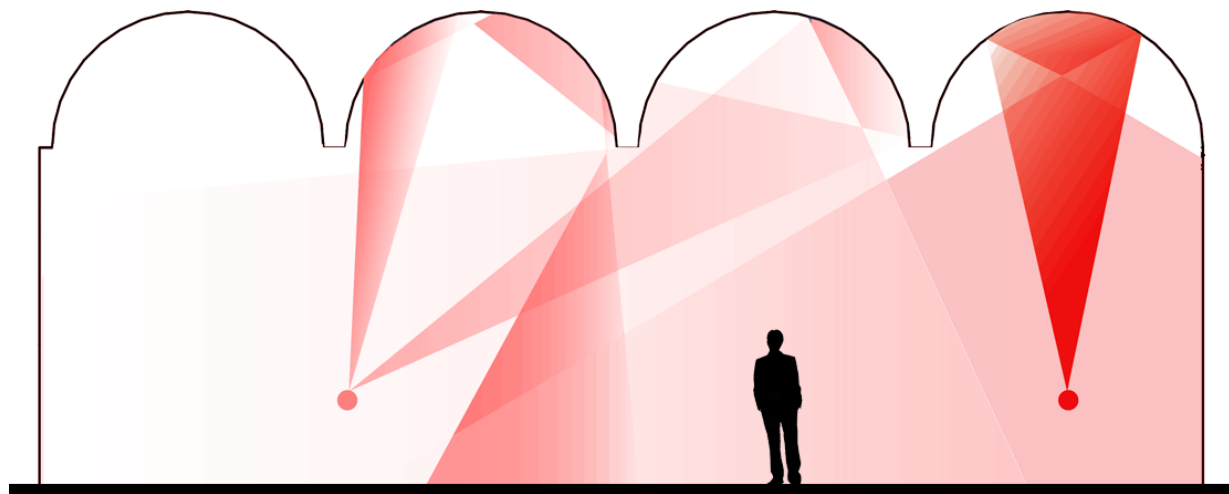
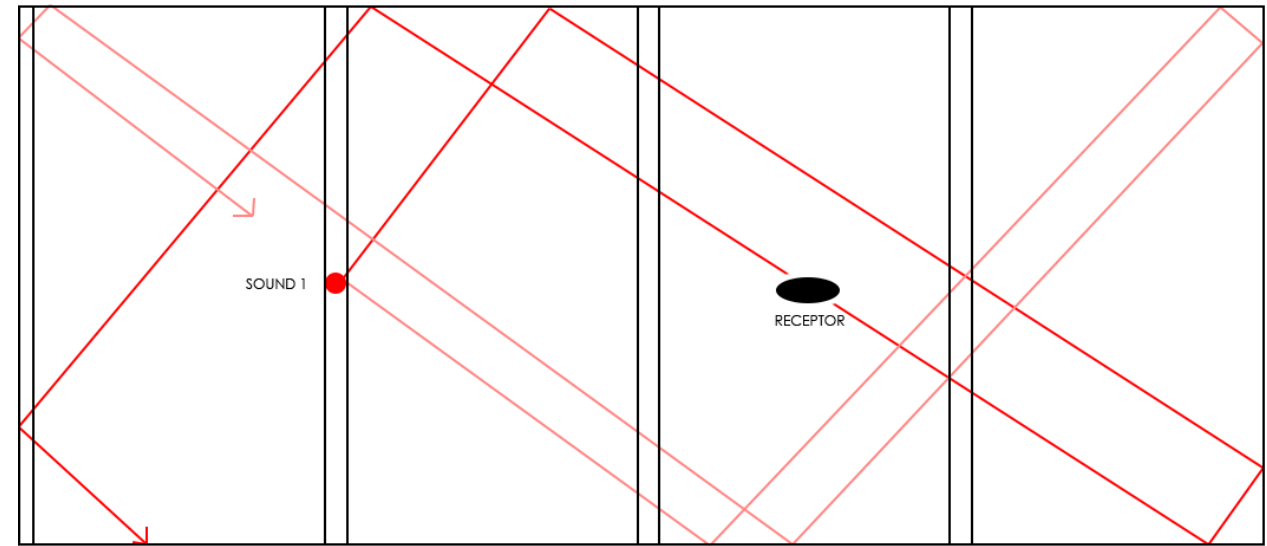
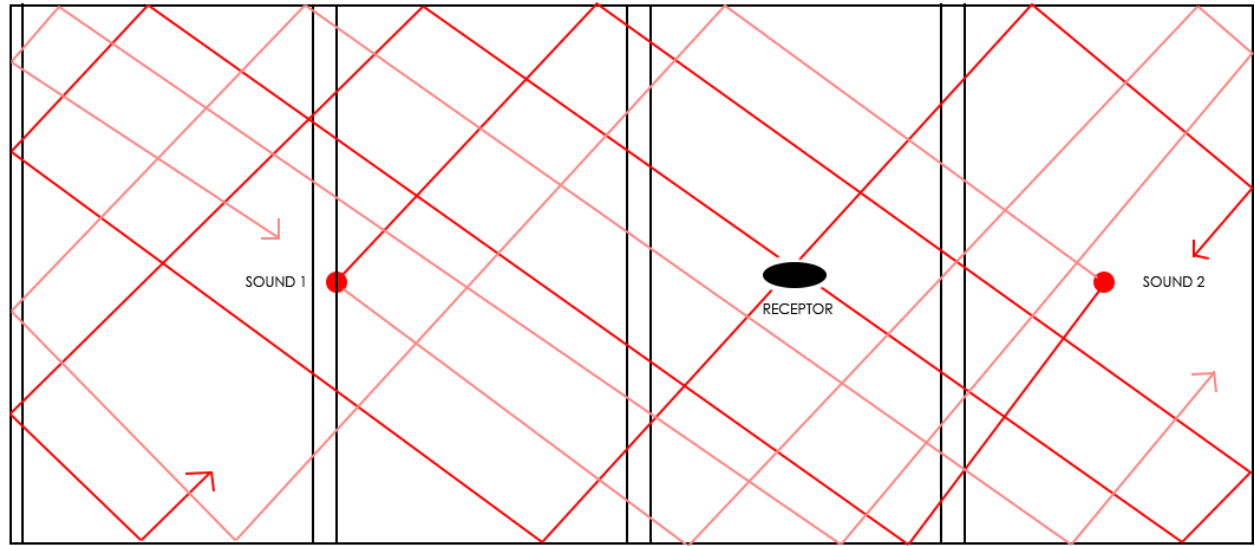
## 1.2 PROPOSED CONTEXT + **DESIGN RATIONALE**



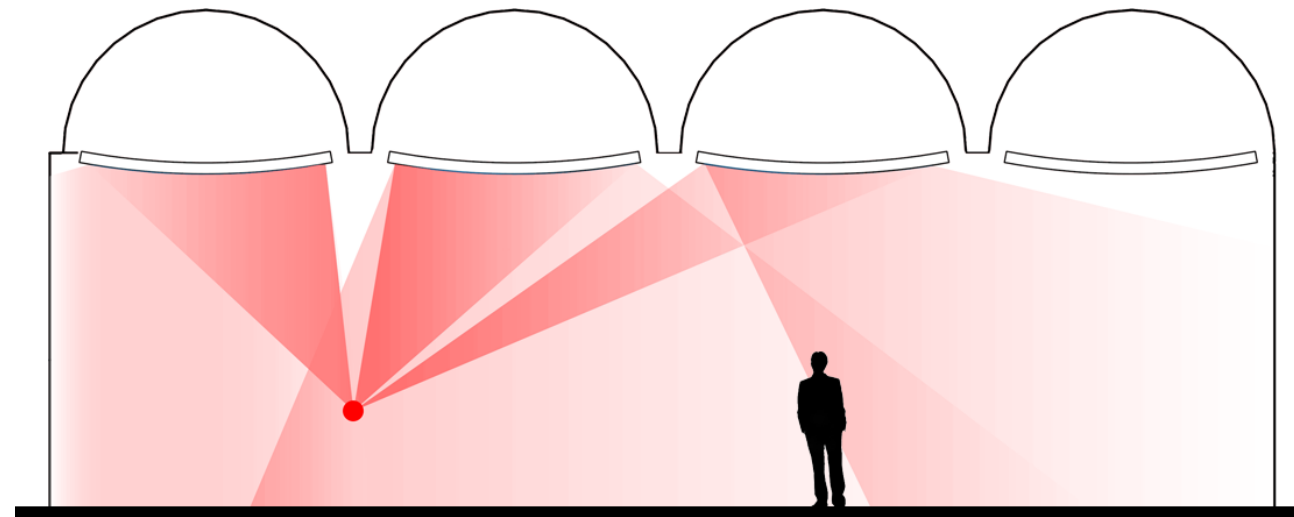
**Figure 1.2a**  
Sketches referencing the alignment of  
human movement through traditionally  
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**Figure 1.2b**  
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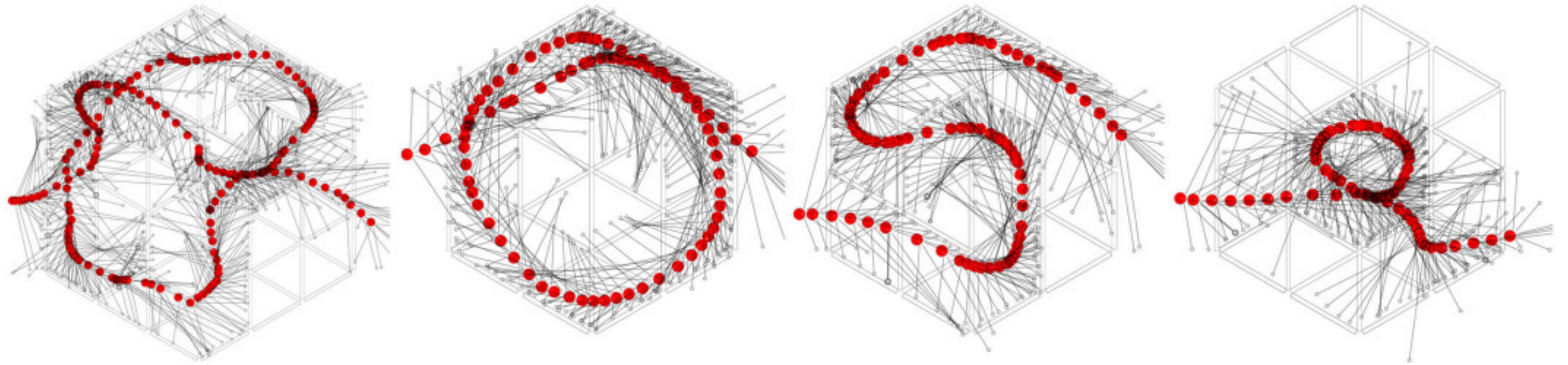


**Figure 1.2c**  
Sound "rays" shown bouncing around  
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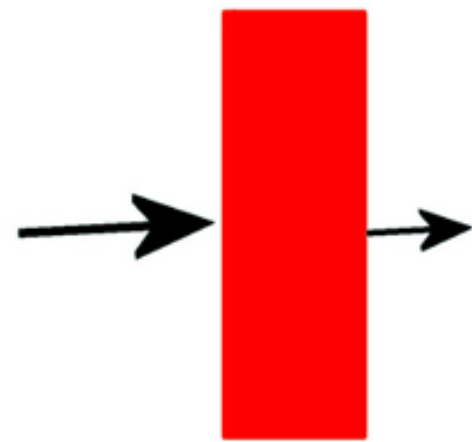


**Figure 1.2d**  
Sound "rays" shown bouncing around  
an acoustically treated interior space.

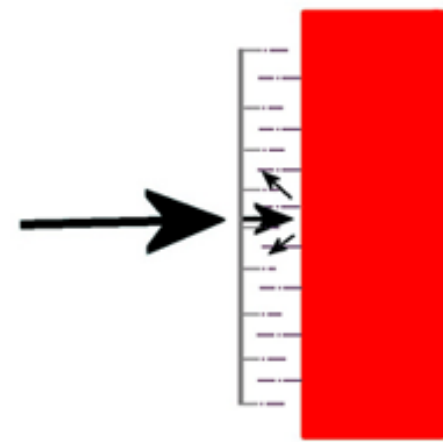
### 1.3 UNDERLYING PRINCIPLES + **DESIGN CLARIFICATION**



**Figure 1.3a**  
Studies of meandering forms inside and  
around a given structure.



TRANSMISSION



ABORPTION



REFLECTION



DIFFUSION

Figure 1.3b  
Diagram of sound absorptive  
coefficients and methodologies.

$0.35 > a > 0.95$



$0.1 > a > 0.2$



$0.02 > a > 0.04$



$0.45 > a > 0.75$



Figure 1.3c  
Various materials and their inherent  
sound absorptive or reflectie qualities.

### INTENSITY OF SPEECH RANGE + PATTERN BY MATERIAL (SOUND ABSORPTION COEFFICIENT)

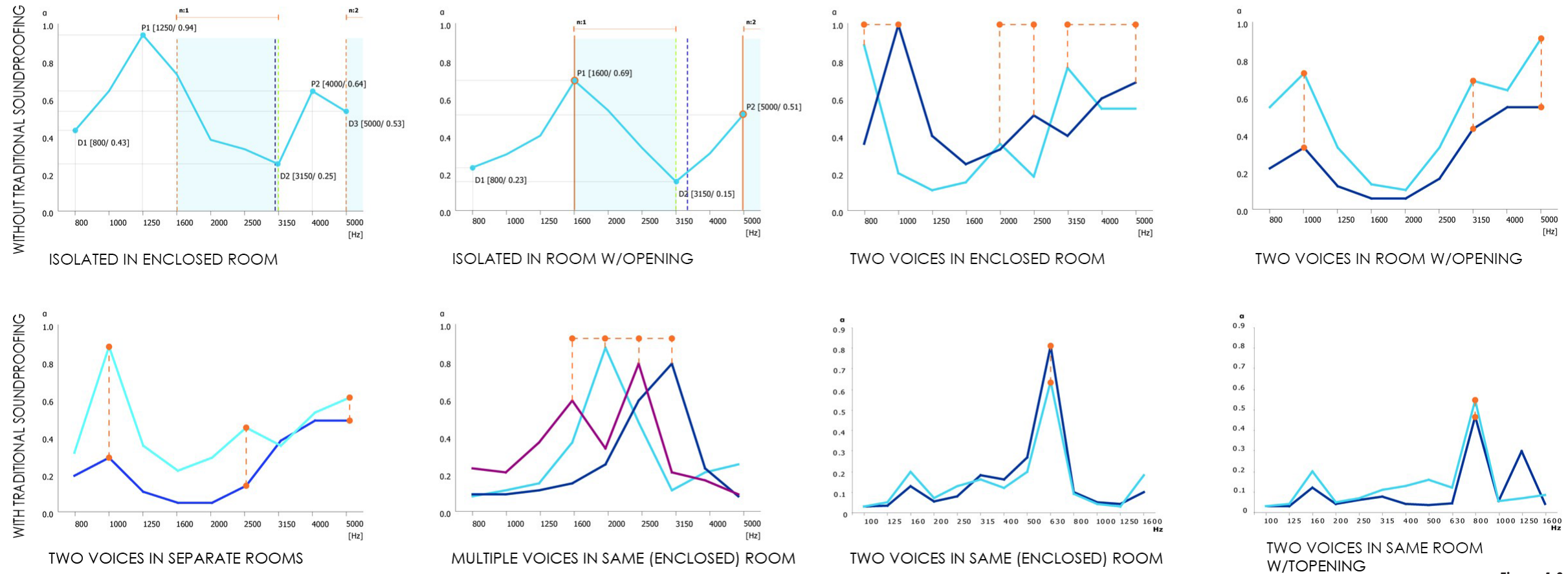


Figure 1.3d

Graphs depicting differences in effective methods of soundproofing and rooms left untreated.

### AVERAGE TIME SPENT BY ACTIVITY (SOCIAL + INDIVIDUAL)

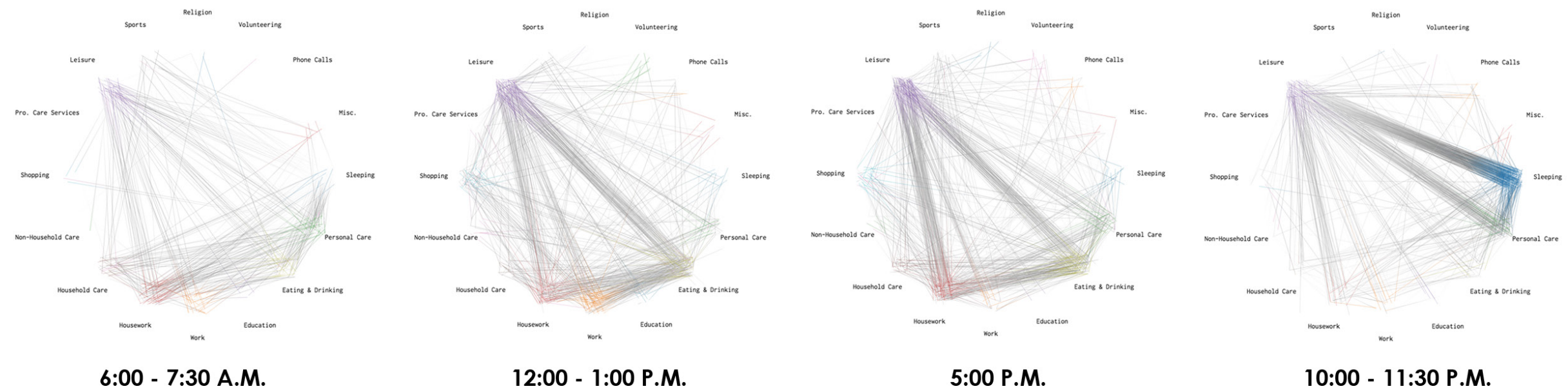
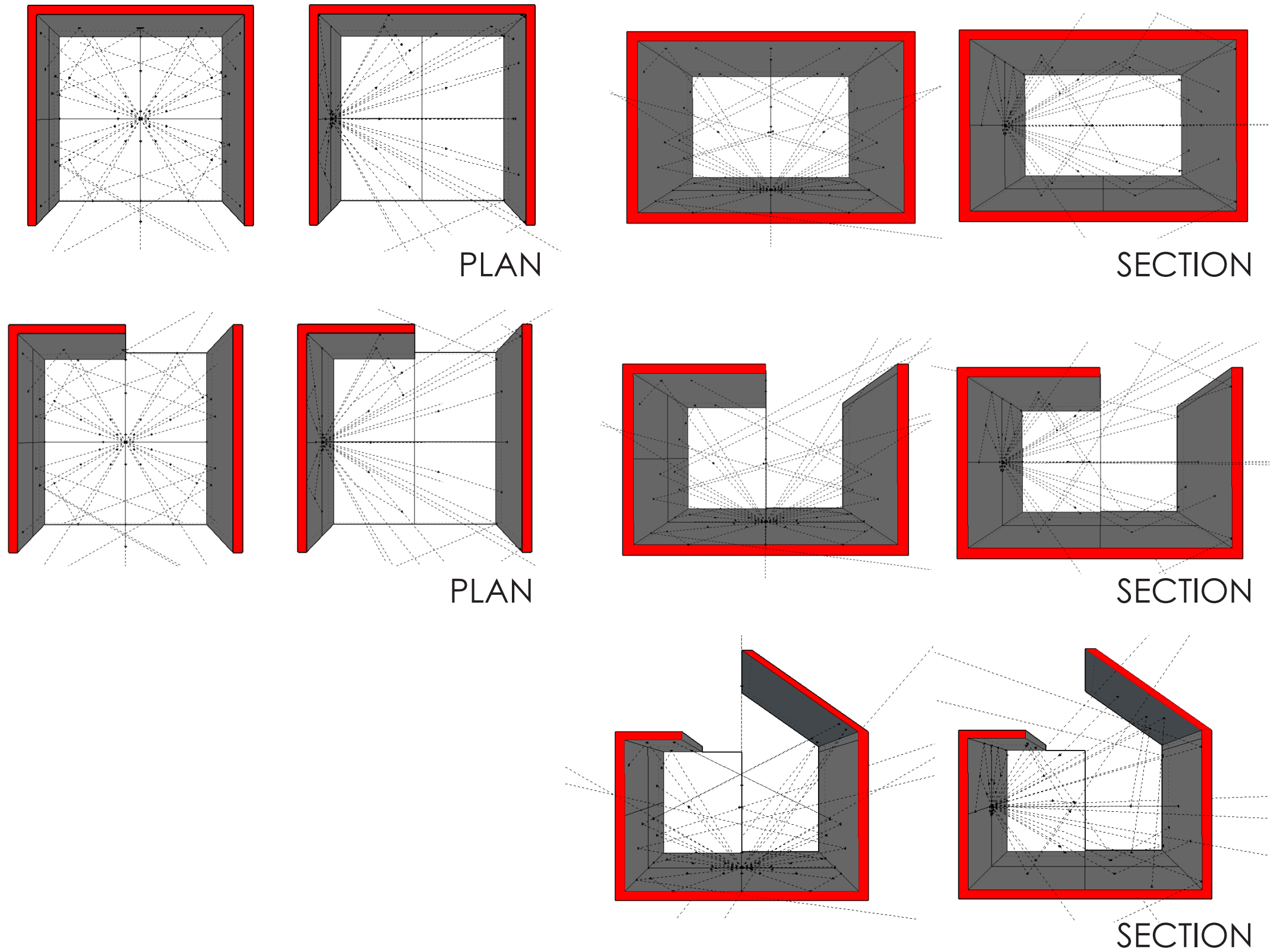


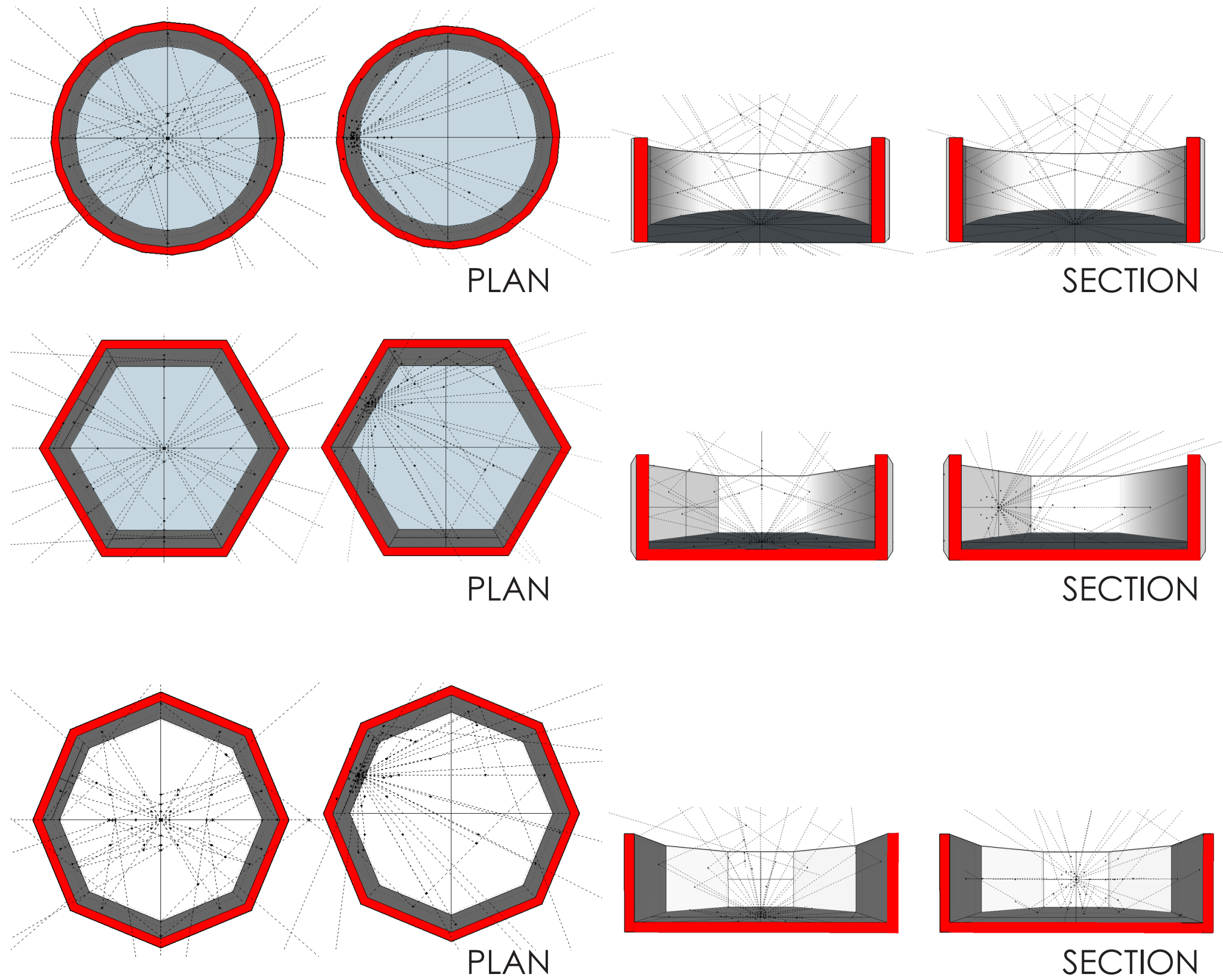
Figure 1.3e

Graphs showing how a set of typical Americans spend their time during the day.

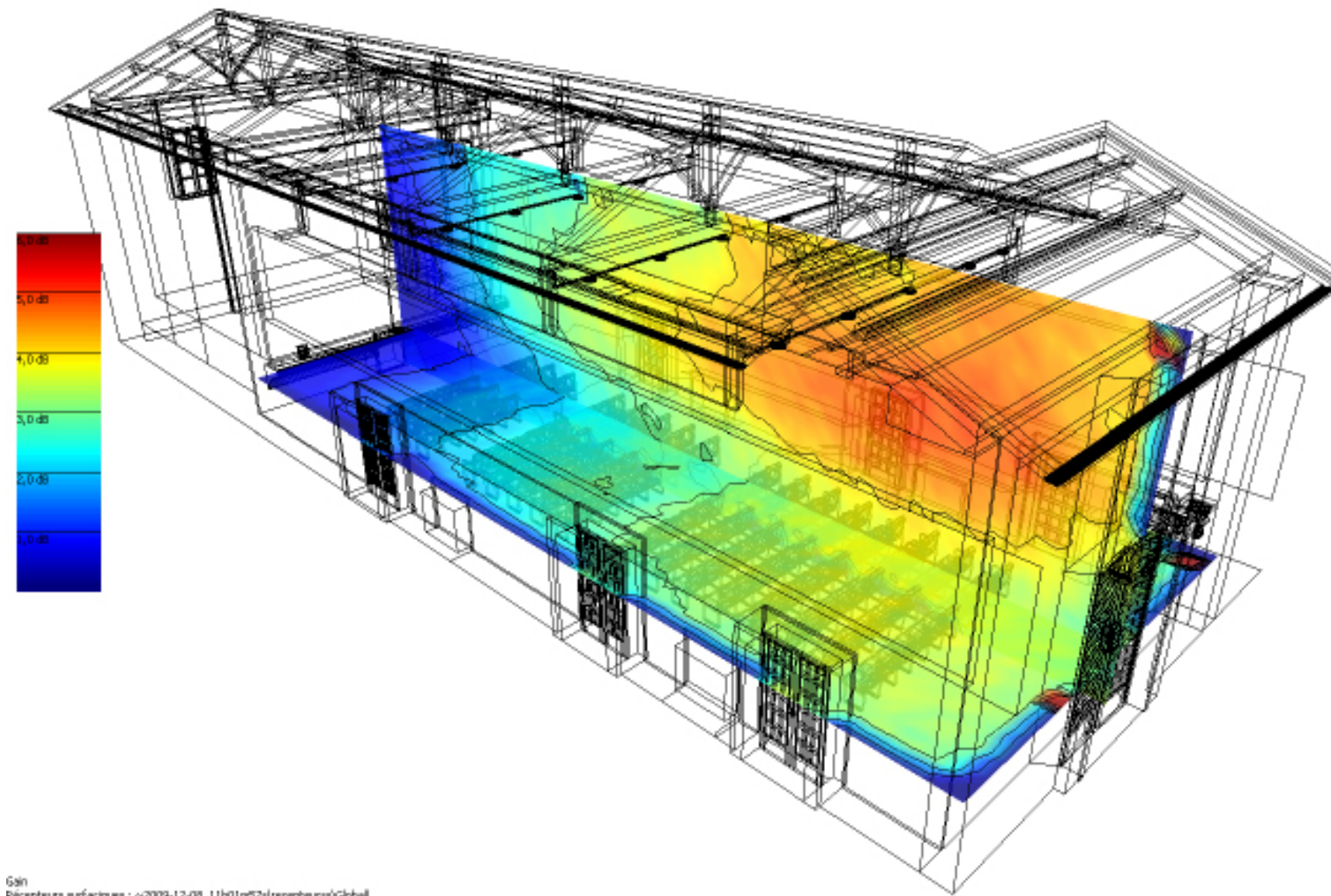




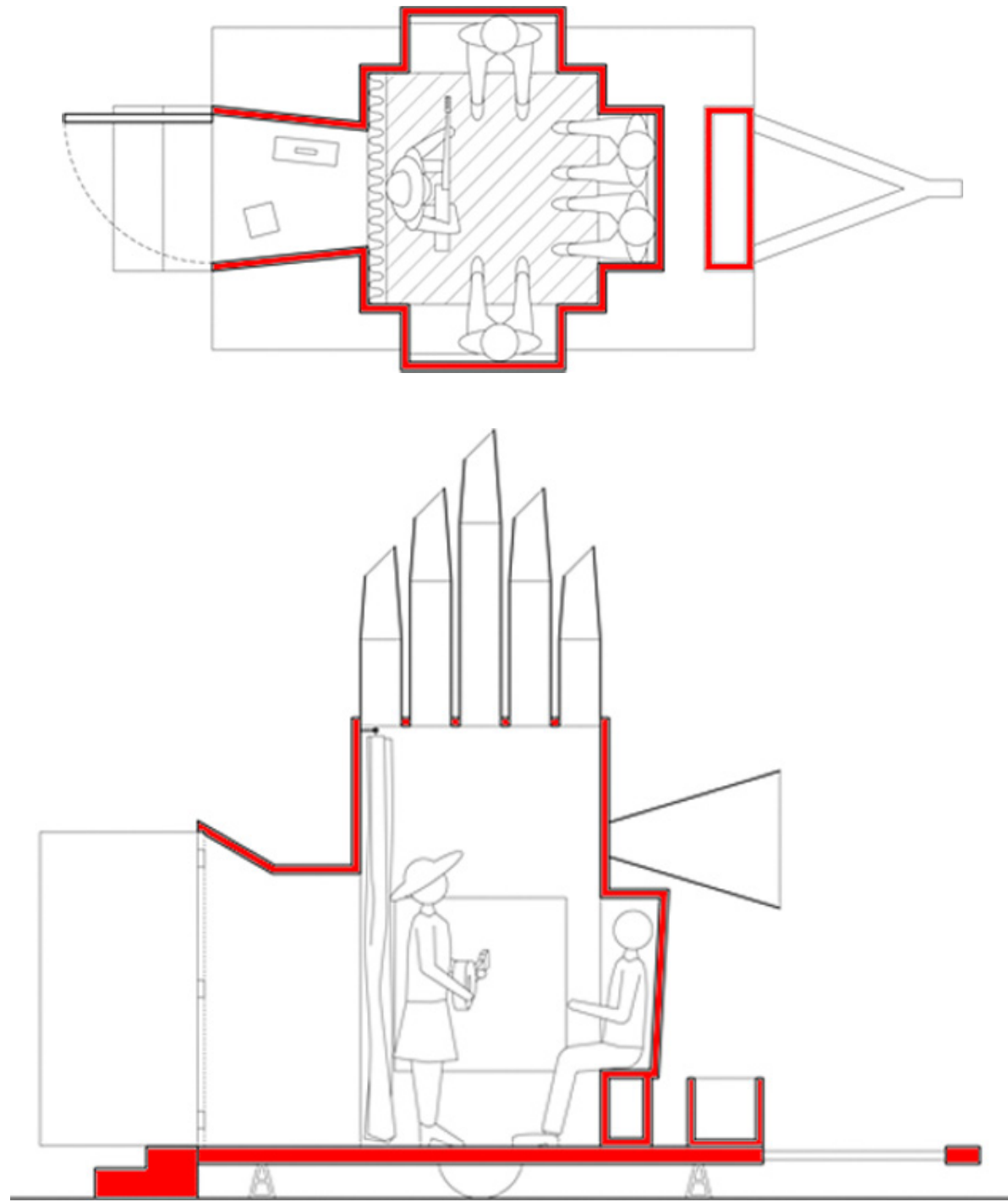
**Figure 1.3f**  
Plans and sections of "source" and "receptor". All images assume a 6' tall human in a 100 sf space.



**Figure 1.3g**  
Plans and sections of "source" and "receptor". All images assume a 6' tall human in a 100 sf space.



**Figure 1.4a**  
Axonometric model showing the decibel levels and associated zones within a school theatre room.



A miniature concert hall with a maximum capacity of 6 people can be found travelling through London and areas beyond with only a truck and a crew to pull off a chow on any coast one could imagine. Made of MDF and sheet metal, the exterior of the theater stands out and calls for your visual attention first, before any sound can even be heard as projected from its front "microphone".

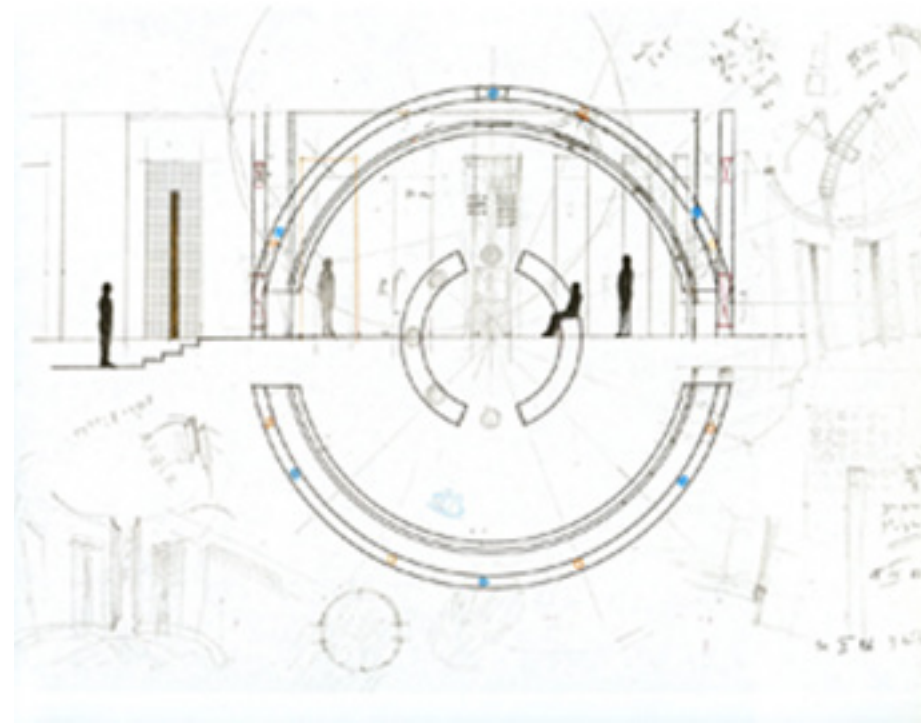
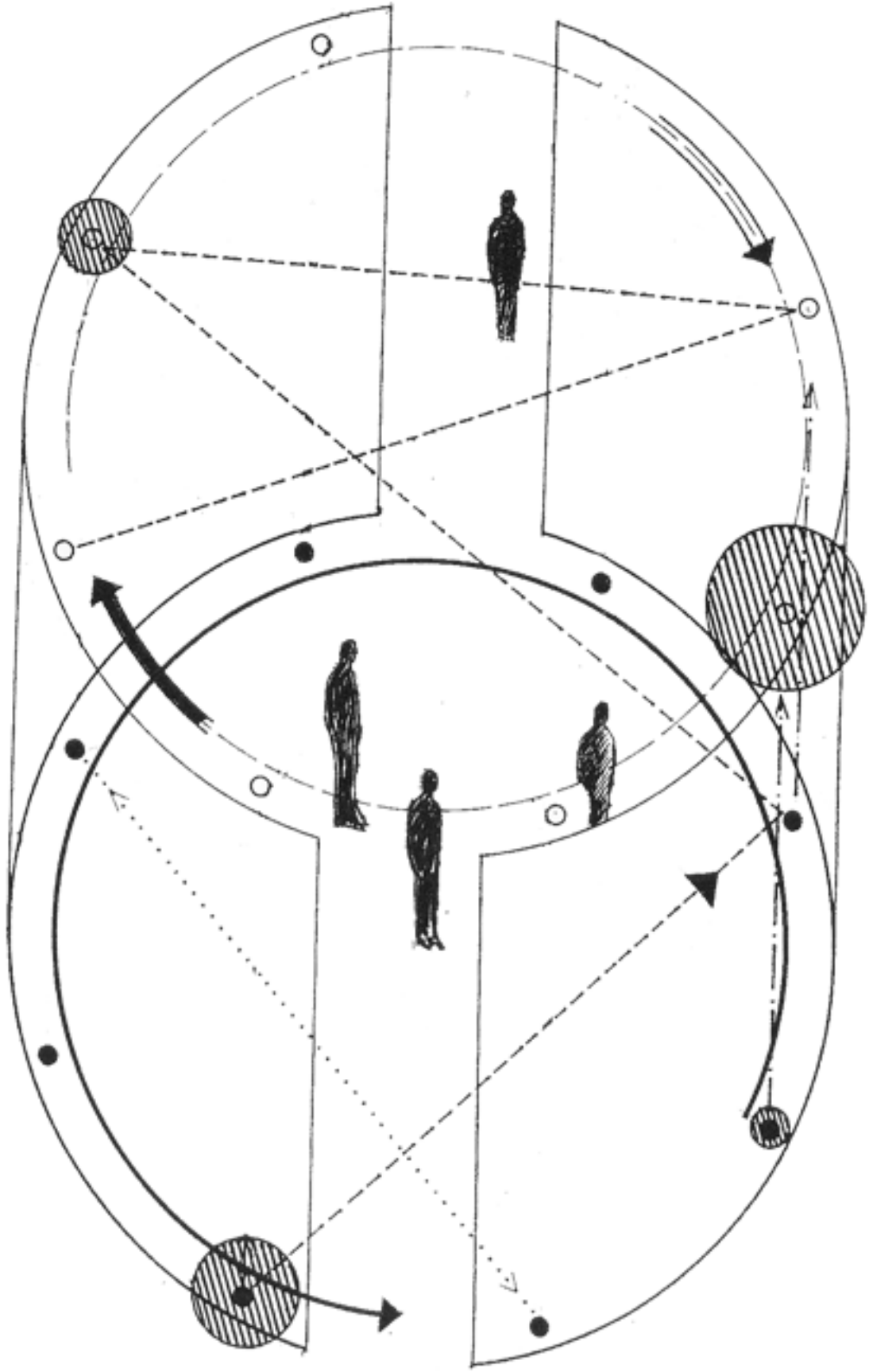
Designed by London studio Aberrant Architecture, the Tiny Travelling Theatre was inspired by contemporary accounts of the music club started by Clerkenwell resident and coal salesman Thomas Britton in 1678, which took place inside the miniature concert hall that he built above his coal-shed home.

Circular skylights were concealed within each of the theatre's chimneys, while a huge funnel on one side channelled out sound from the performances taking place inside. A door with a large circular handle led visitors inside the small venue, where they could sit down in one of three recessed booths in the chunky chip-board walls. The form is almost cartoon-esque on purpose, in coincidence with the frivolity of performance. Pulling from the ease of constructibility with this project, we can see how simple it would be for several theaters to be constructed and essentially go on their own tour together.

## Tiny Travelling Theater, Aberrant Architecture

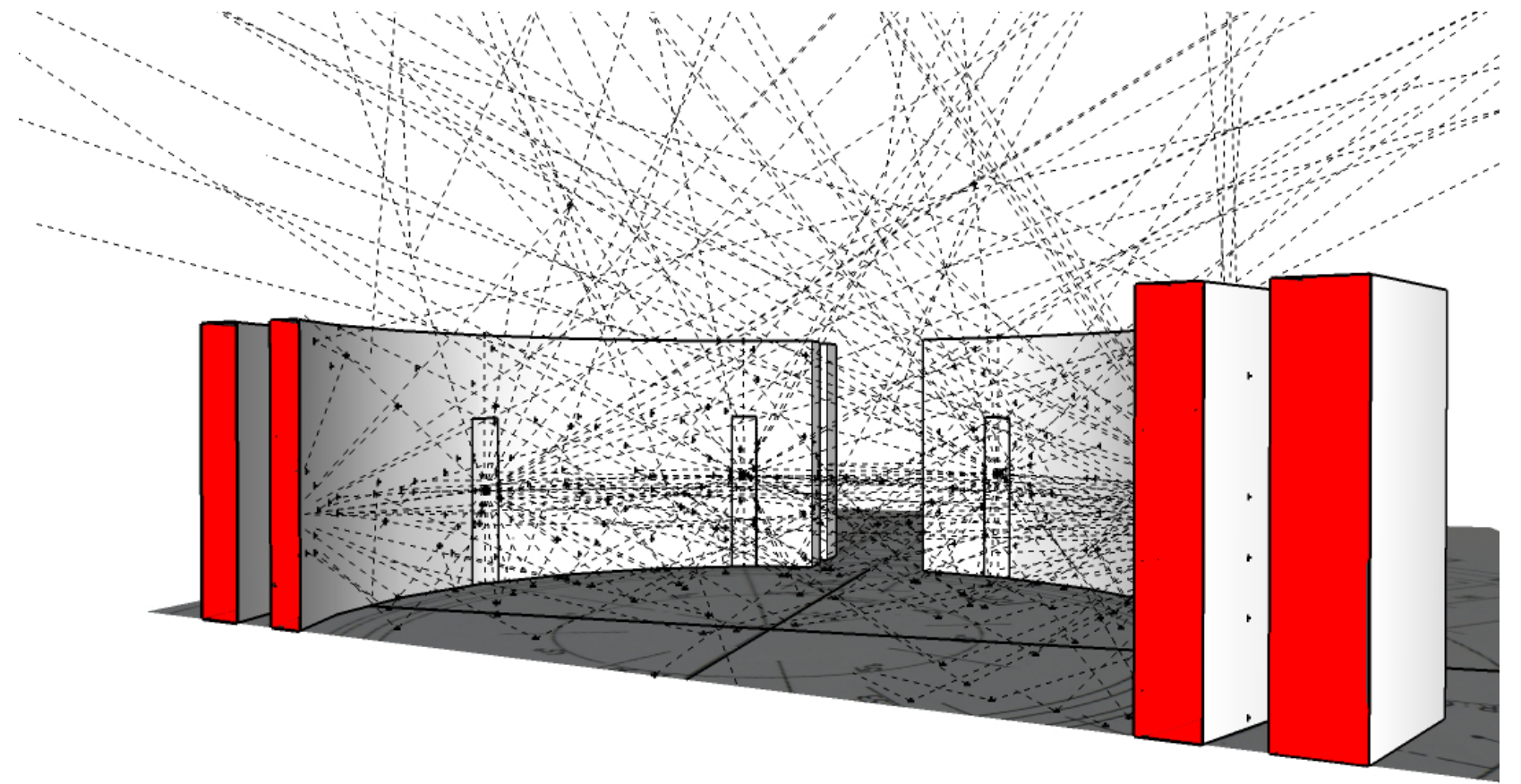






The topography further highlights a relationship between nature, man and architecture. Leitner's intent is solidified upon exiting the structure and looking back to only see trees, but the sounds resonating through nature still persist almost as if they are calling the visitor back.

The potential of harmonics in architecture can be further understood through this project. Although Leitner was not using this term specifically, he was still drawing careful connections between the human body and its receptiveness to sound and nature. The experience of the space was designed such that the visitor left with a more holistic contextual awareness that, hopefully, lasted throughout their day. This project is one that successfully bridges the phenomenal gap between the visual and auditory realms while continuing to have its own significant architectural presence.

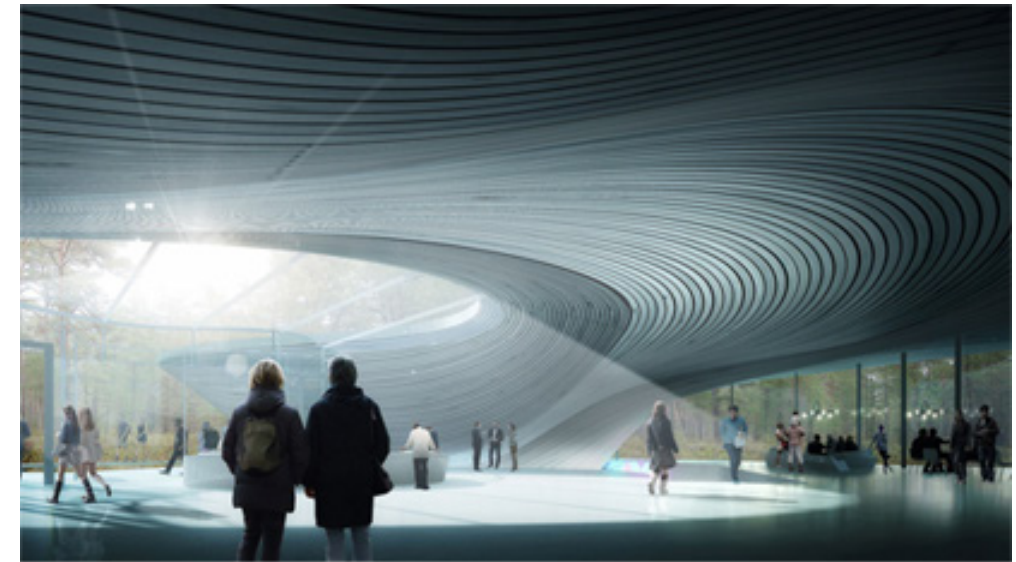
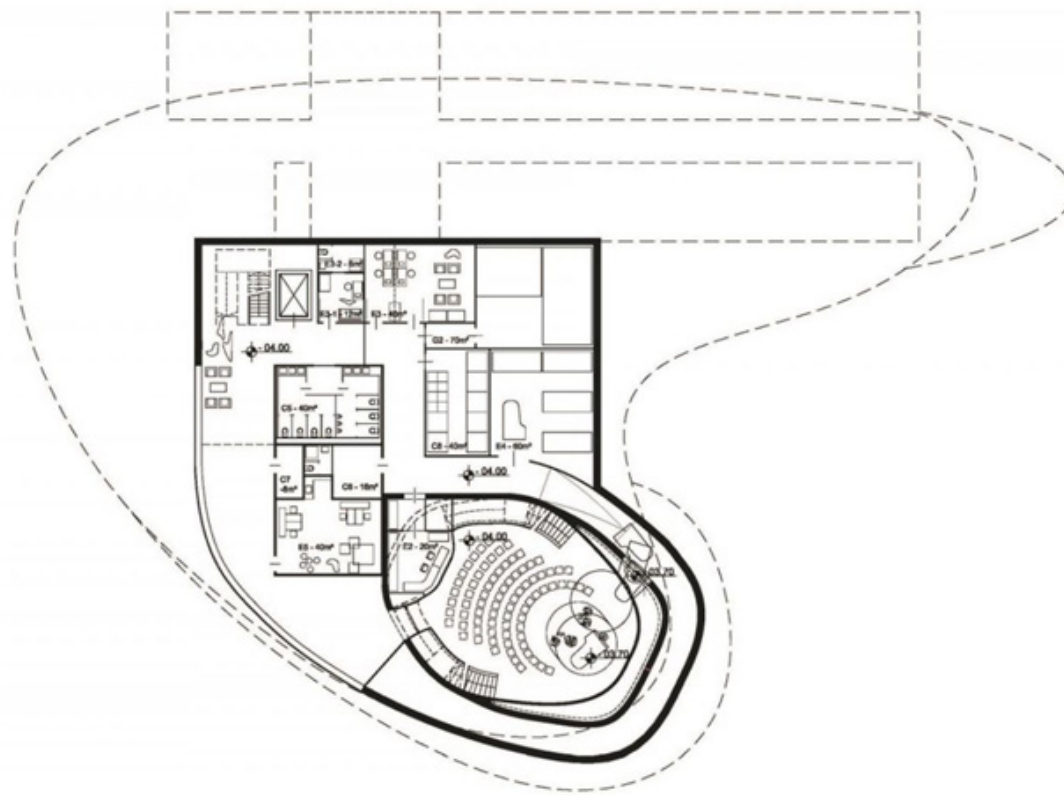
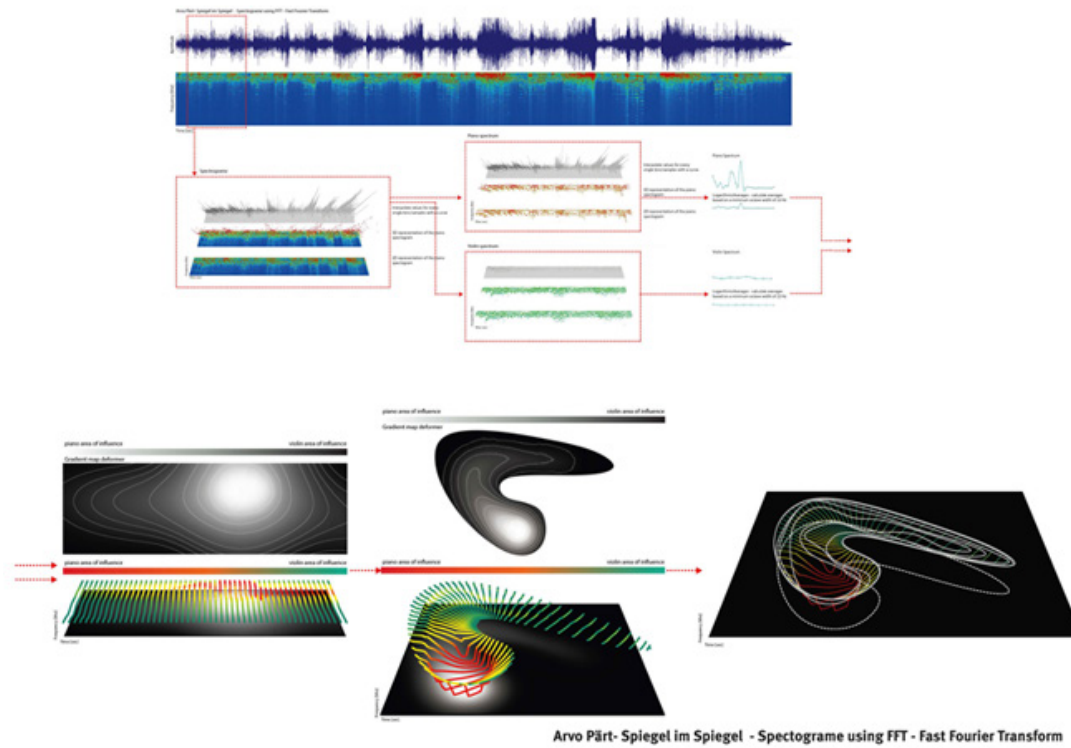


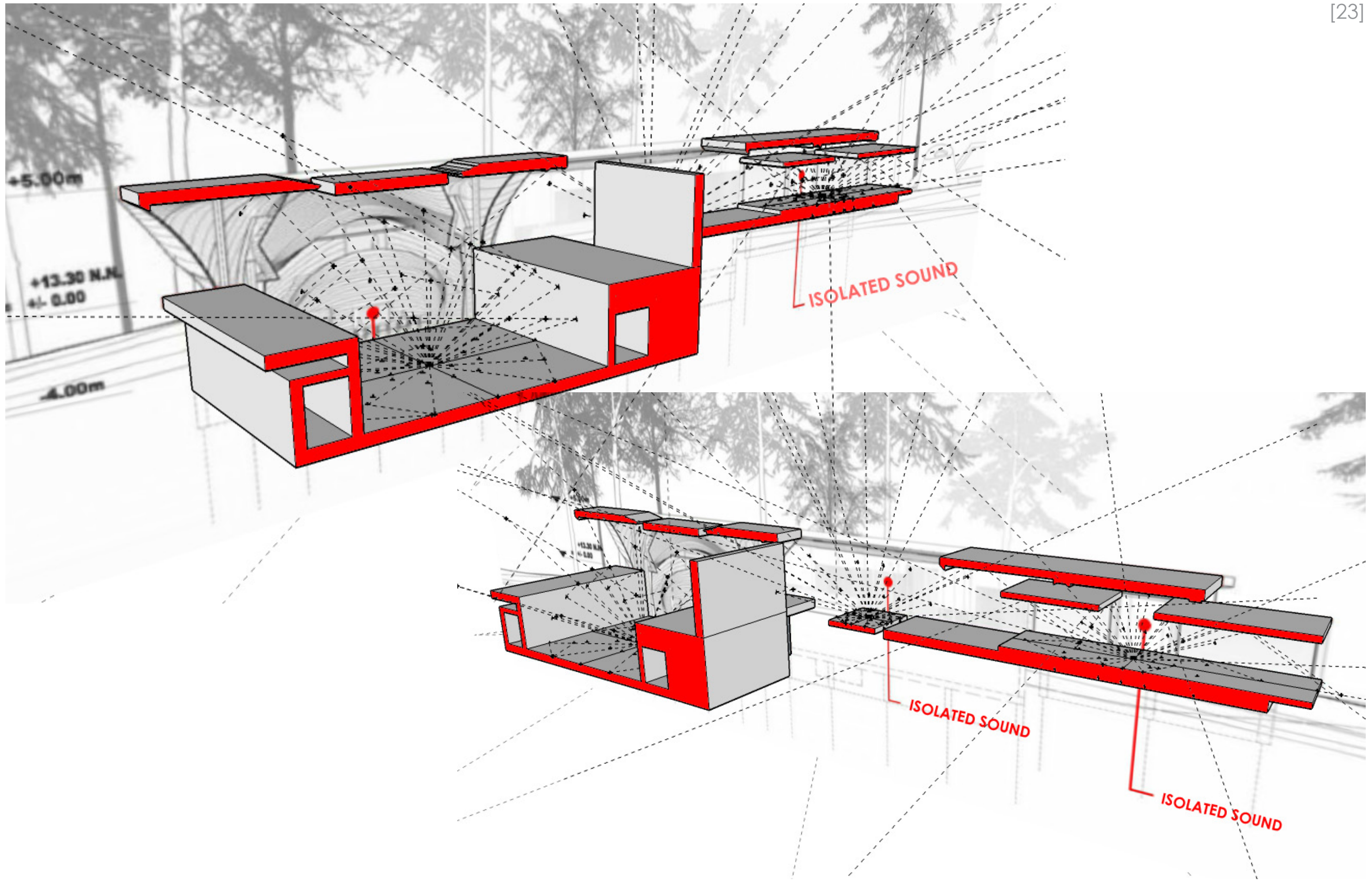
Its shape is derived from the song "Spiegel im Spiegel", consolidating the main sequence spectrogram of the song into the curves of a roof. This cloud of sound forms an introverted space within where the music is played and listened to and a space underneath that becomes the work and meeting place for the people interested in the legacy of the composer. The cloud only touches the ground where it is thickened to house the performance space, and otherwise hovers between the trees, like the tree house of the observation platform, suspended in the natural environment of the forest.

The complex rooms of the program are organized in their functional groups and combined into a box building that is placed underneath the roof. Underneath the roof and in the center of the overall courtyard shape a poetic space is created within nature, where the memory of Arvo Pärt can reside.

A sound study analysis of the different "zones" in this theatre reveal the systematic study of spatial division in order to further strengthen the design concept. Almost partitioned like movements in a symphony, the building's various functions are separated such that one does not necessarily disturb the other, but does not altogether ignore its existence either. The amphitheatre is connected to auxiliary spaces whose functions depend heavily on when a particular concert is beginning or ending. The guests can easily be signalled of the intermission's end not only by visual cues, but auditory ones as well.

## Arvo Pärt Sound Cloud, Coop Himmelblau







[24]

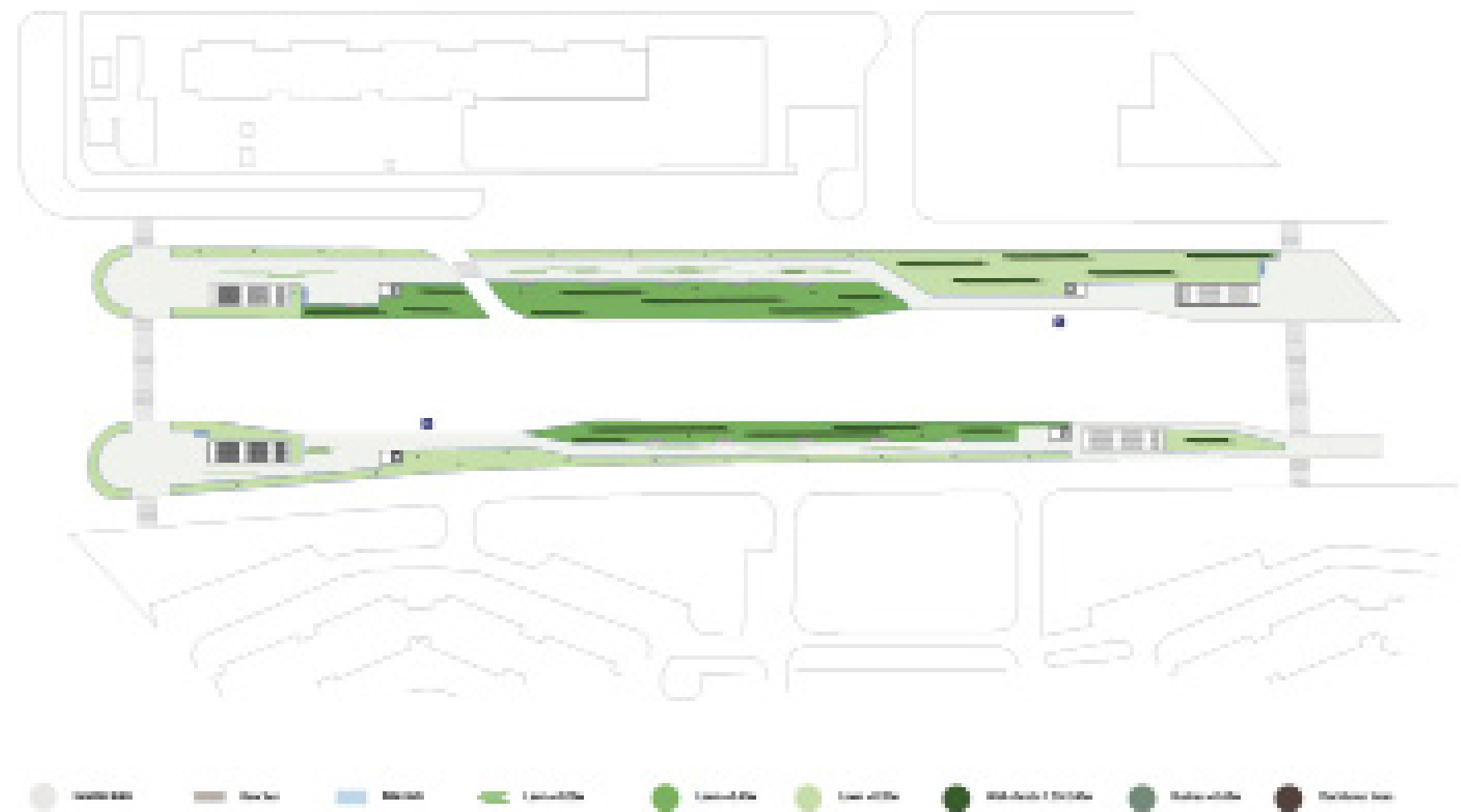
Through the use of three-dimensional panels in pyramid and prism shapes, the walls and ceilings of the station act as acoustic and sound absorbing elements, preventing sound waves from bouncing and creating echoes. Made from fire-safe porous ceramic, the panels not only absorb noise, but also compose a pattern of arrows to aid passenger navigation, pointing in the direction of platforms, exits, and train directions.

The entrance pavilions, as well as the space between the pavilions, follow the same design principles, with simplicity and sound-absorbing elements, including groomed bushes capable of absorbing 40 decibels of noise from nearby roads.

In line with the idea of simplicity, the station would be maintained using a car wash-inspired method, cleaning the walls of the platforms with incorporated brushes that remove train grease.

Unfortunately, the sound analysis study proves a slightly different concept wherein the material of the transit center's walls may be harming the inherent function of the space.

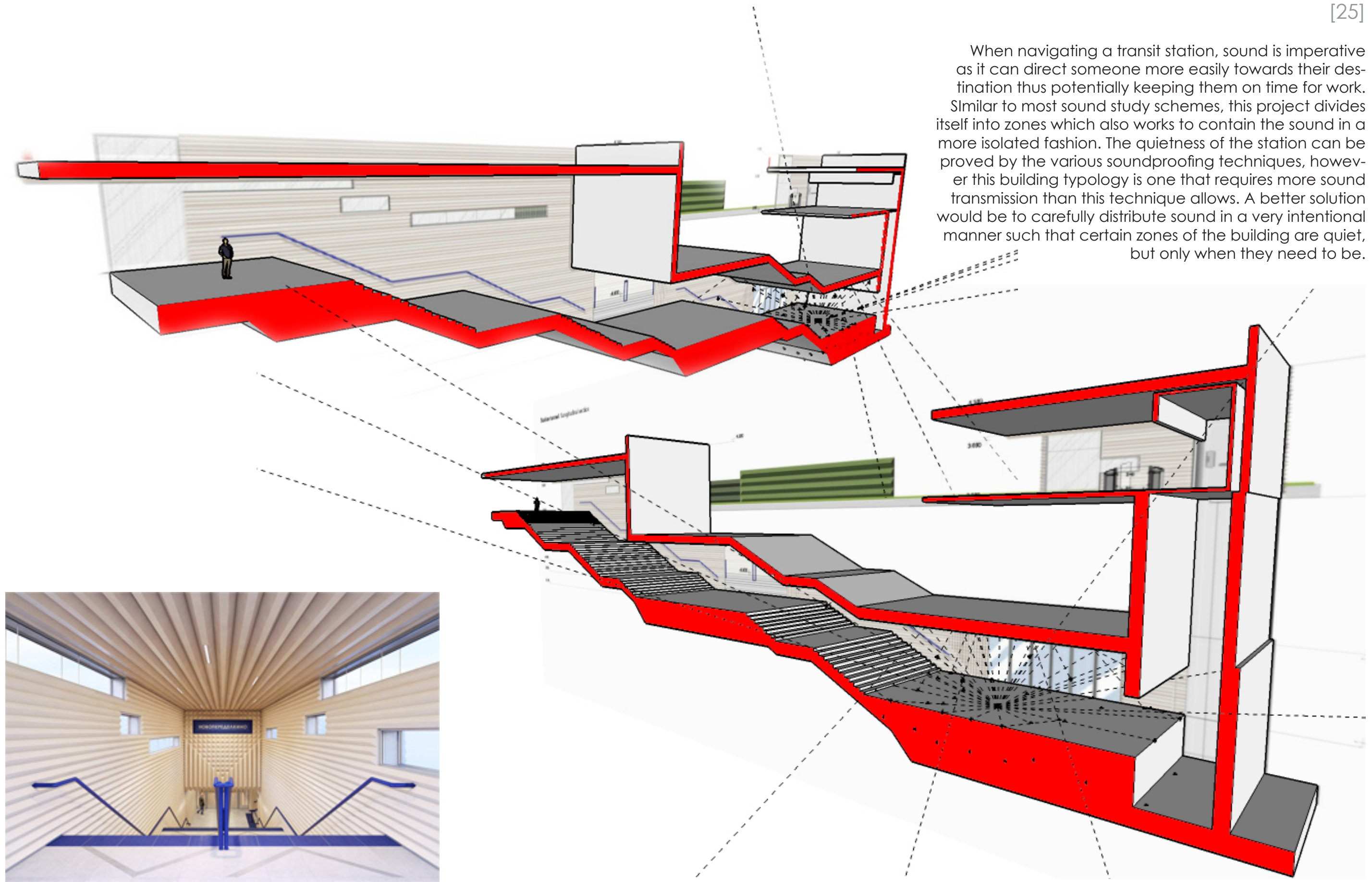
Planned Station / Area plan



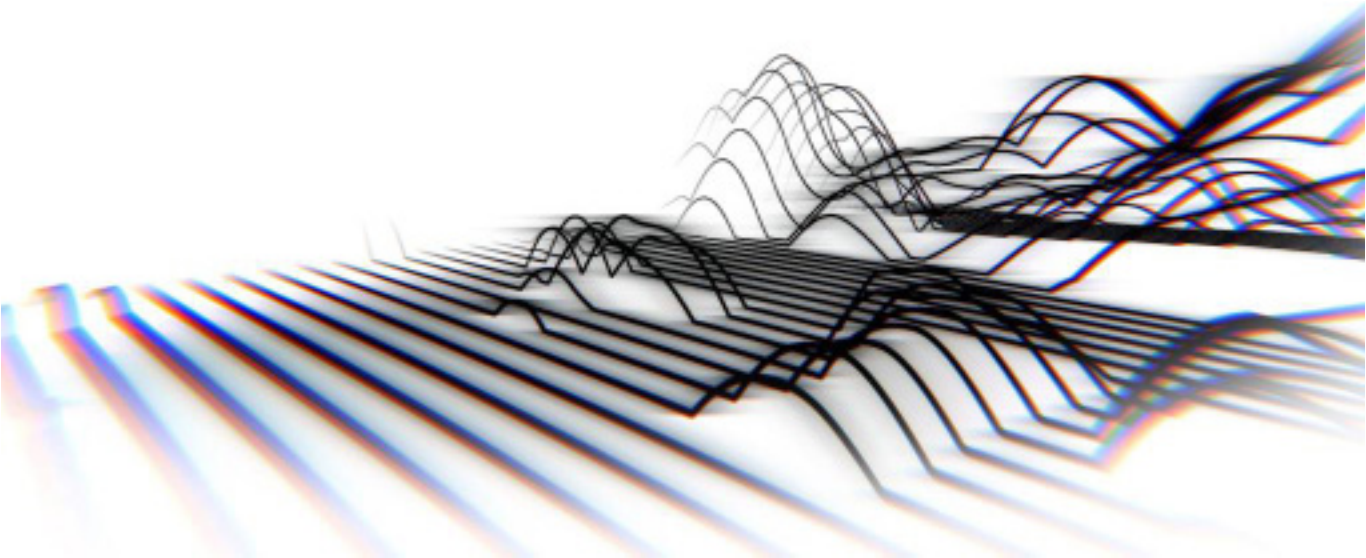
## Moscow Metro Proposal, Variant Studio



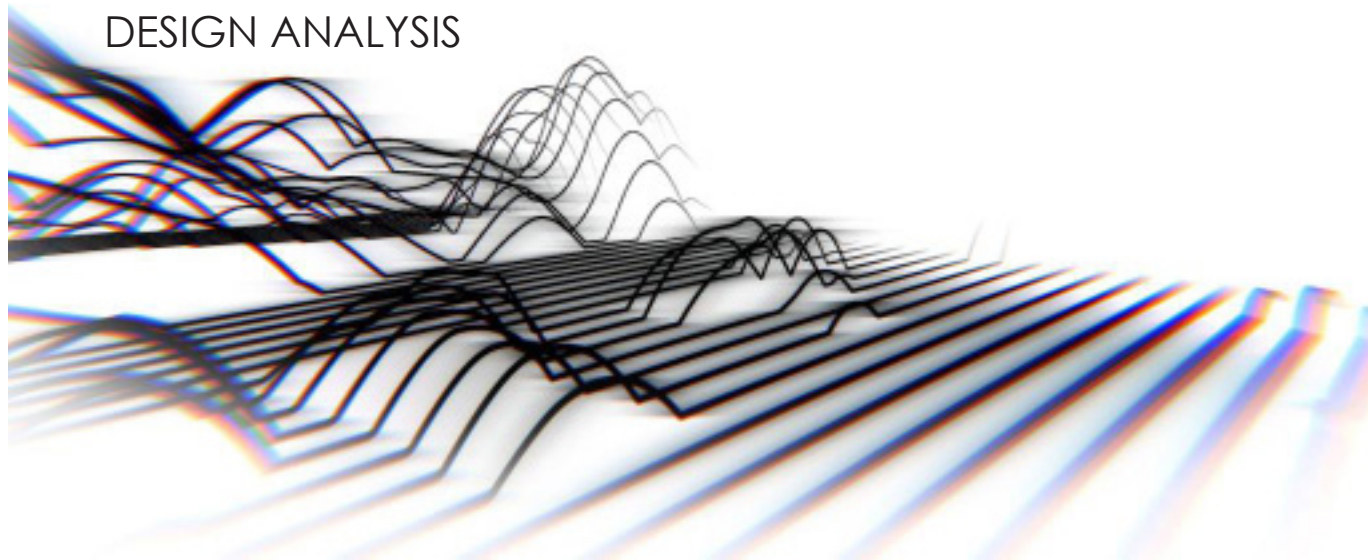
When navigating a transit station, sound is imperative as it can direct someone more easily towards their destination thus potentially keeping them on time for work. Similar to most sound study schemes, this project divides itself into zones which also works to contain the sound in a more isolated fashion. The quietness of the station can be proved by the various soundproofing techniques, however this building typology is one that requires more sound transmission than this technique allows. A better solution would be to carefully distribute sound in a very intentional manner such that certain zones of the building are quiet, but only when they need to be.







CHAPTER TWO.  
DESIGN ANALYSIS



# COMMUNITY

## CELEBRATION



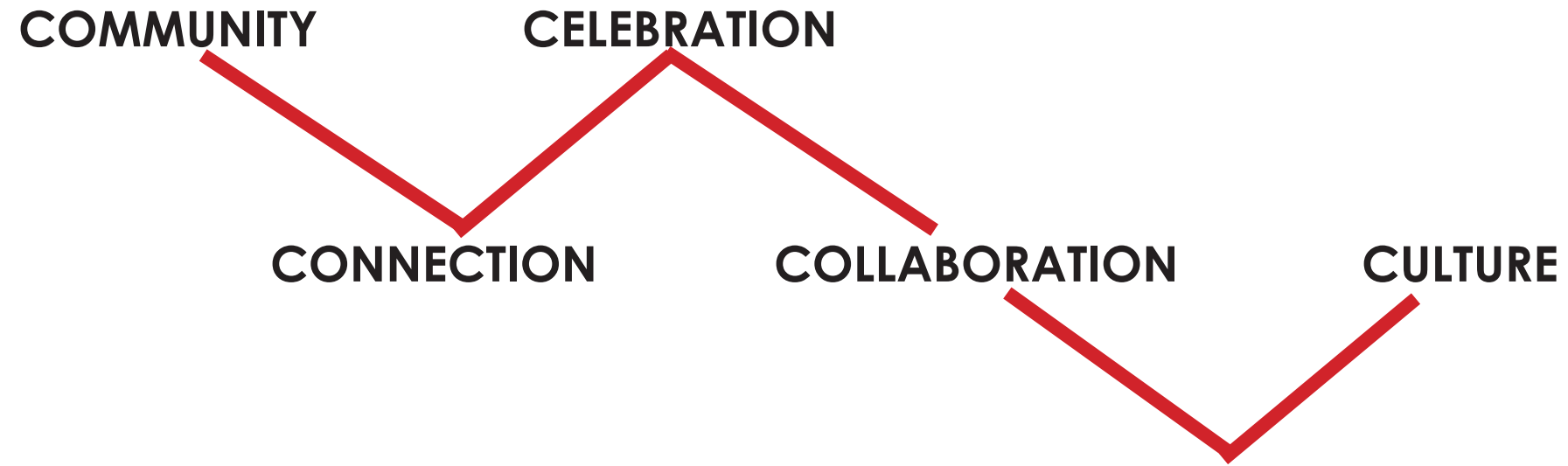
## CONNECTION

## COLLABORATION

**Figure 2.0a**  
Collage of sculptures and artwork  
on the Atlanta Beltline.

# CULTURE

# SITE SELECTION CRITERIA



For a site to be suitable, it must adhere to these criteria:



Figure 2.1a  
New York, NY, USA



Figure 2.1b  
Johannesburg, South Africa



Figure 2.1c  
Berlin, Germany



Figure 2.1d  
Florence, Italy



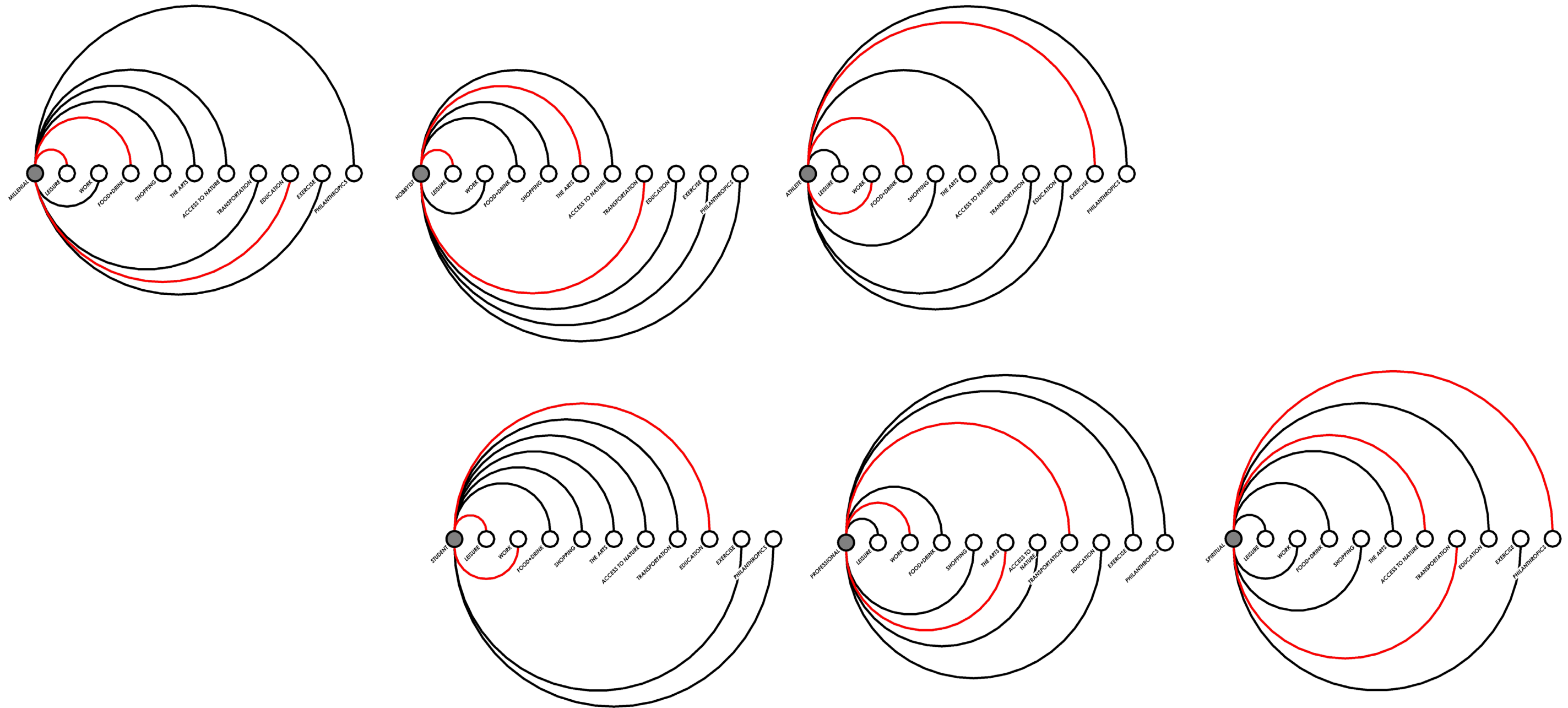
Figure 2.1e  
Tokyo, Japan

# SAMPLE SITE: OLD FOURTH WARD | VACANT LOT ATLANTA, GA

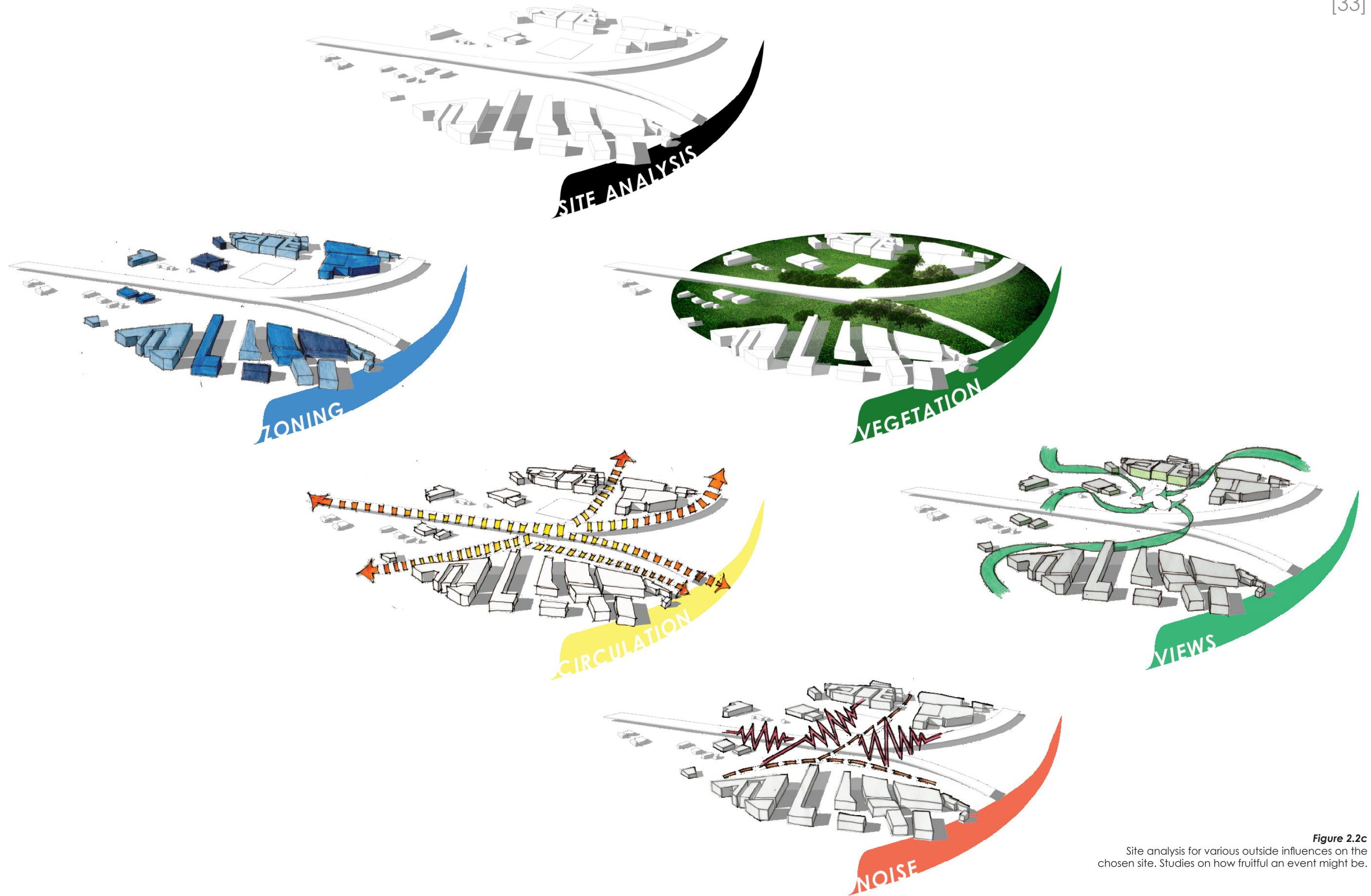


**Figure 2.2a**  
Collage of chosen sample site of Old Fourth Ward vacant lot in Atlanta, GA. All images sourced from Atlanta Beltline's primary website.

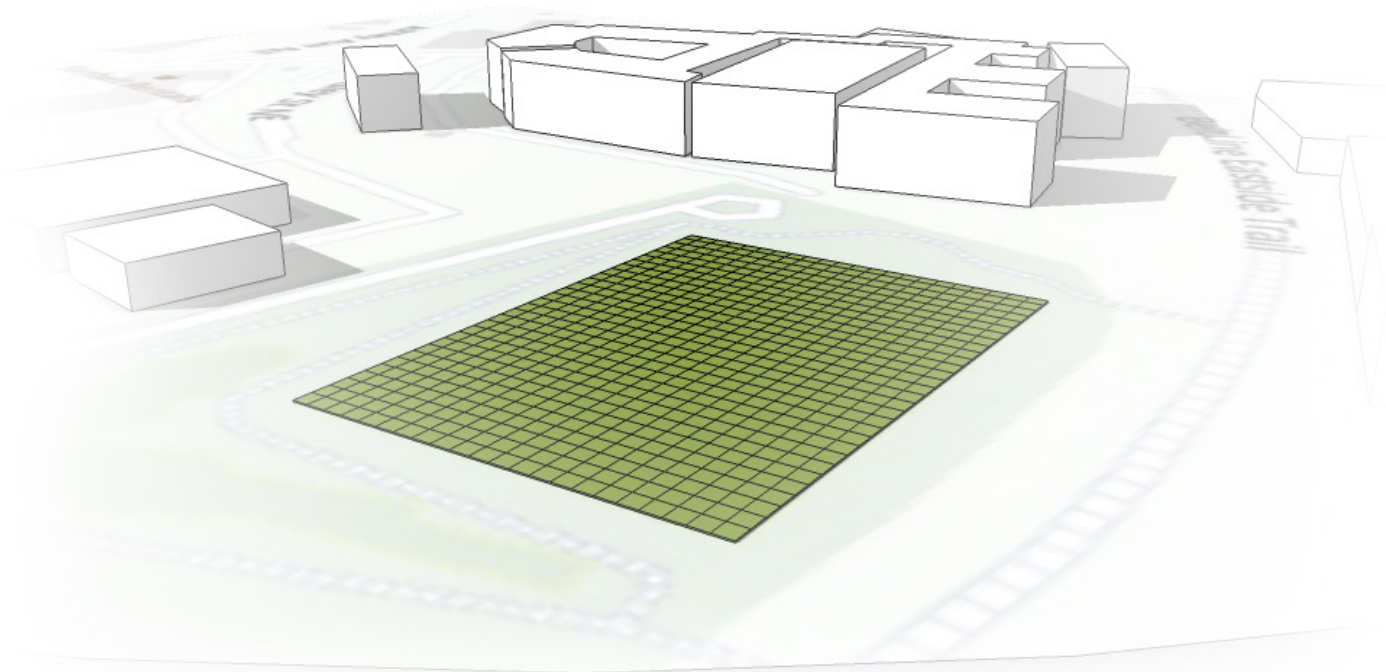




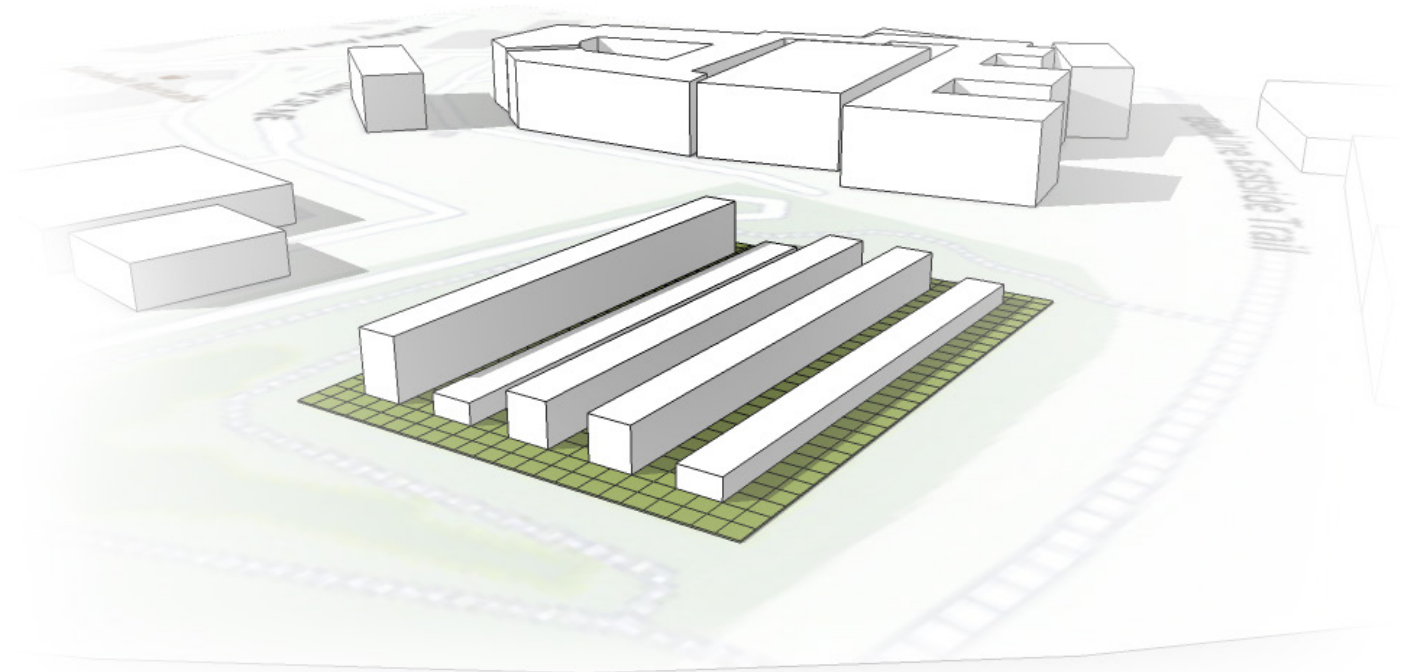
**Figure 2.2b**  
Correlations between 6 main influencers in a cities resident-scape and a chosen set of criteria that may draw or divert their attention to a particular site or event.



**Figure 2.2c**  
Site analysis for various outside influences on the chosen site. Studies on how fruitful an event might be.



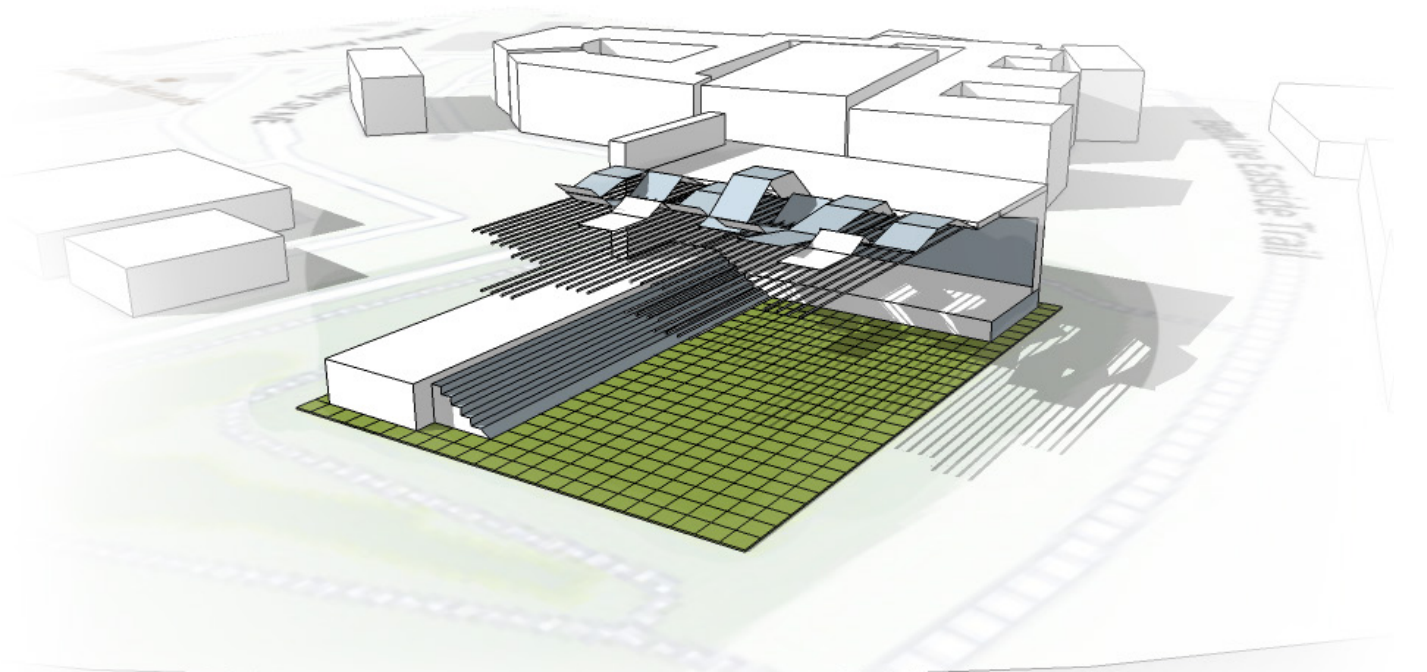
**Figure 2.3a**  
Site sketch model of empty lot in relation to its surrounding buildings and transportation paths.



**Figure 2.3b**  
Site sketch model with an initial layout for strips of activity with breaks for green space and audience meandering.



**Figure 2.3c**  
Site sketch model with an initial ayout for enumerated interior spaces for collaboratoin and community.



**Figure 2.3d**  
Site sketch model with an initial amphitheatre configuration as determined by earlier site analysis.

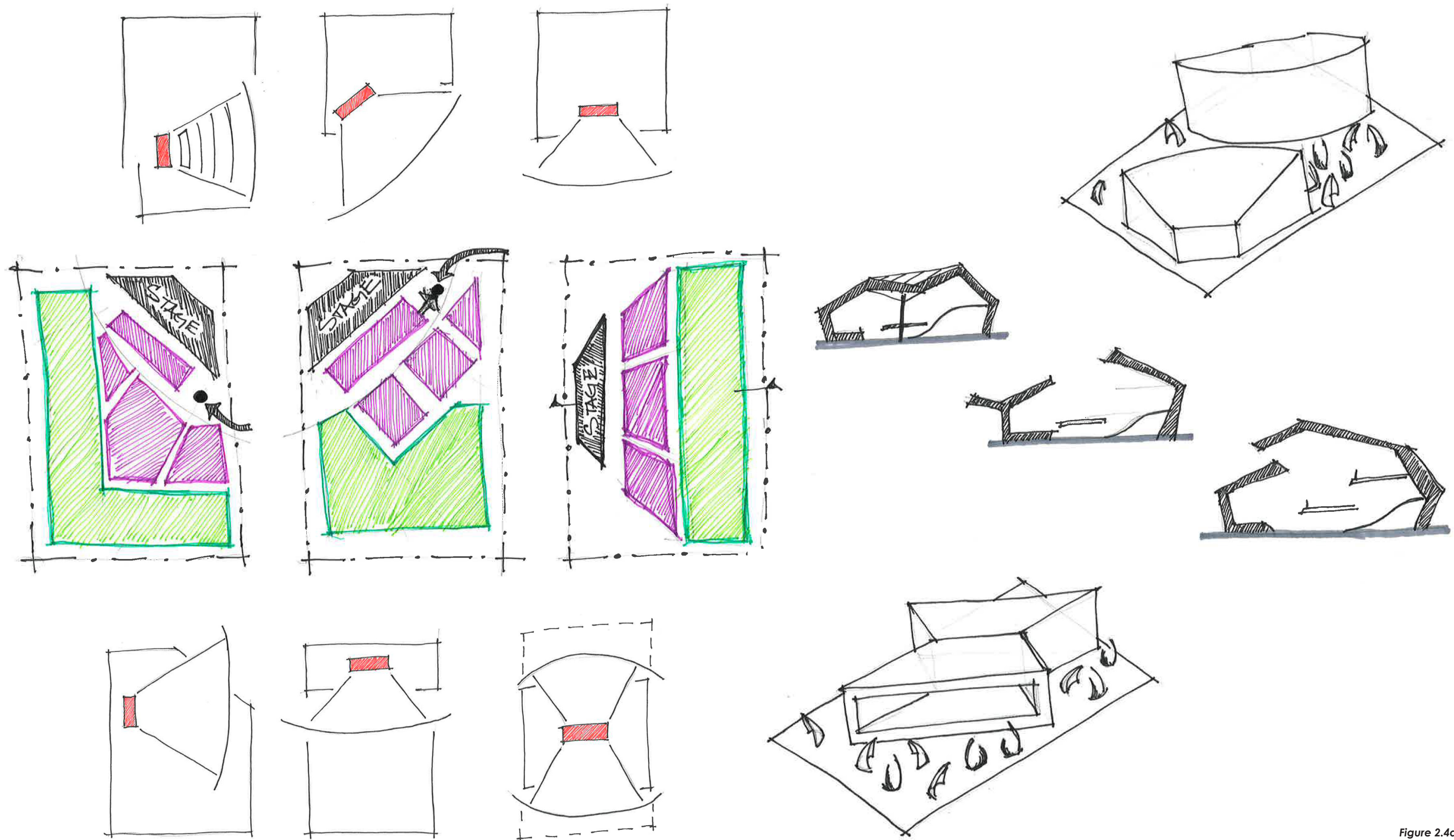


Figure 2.4a  
Sketches for layout of an amphitheatre, green space  
and individual workshops and smaller performance  
spaces.

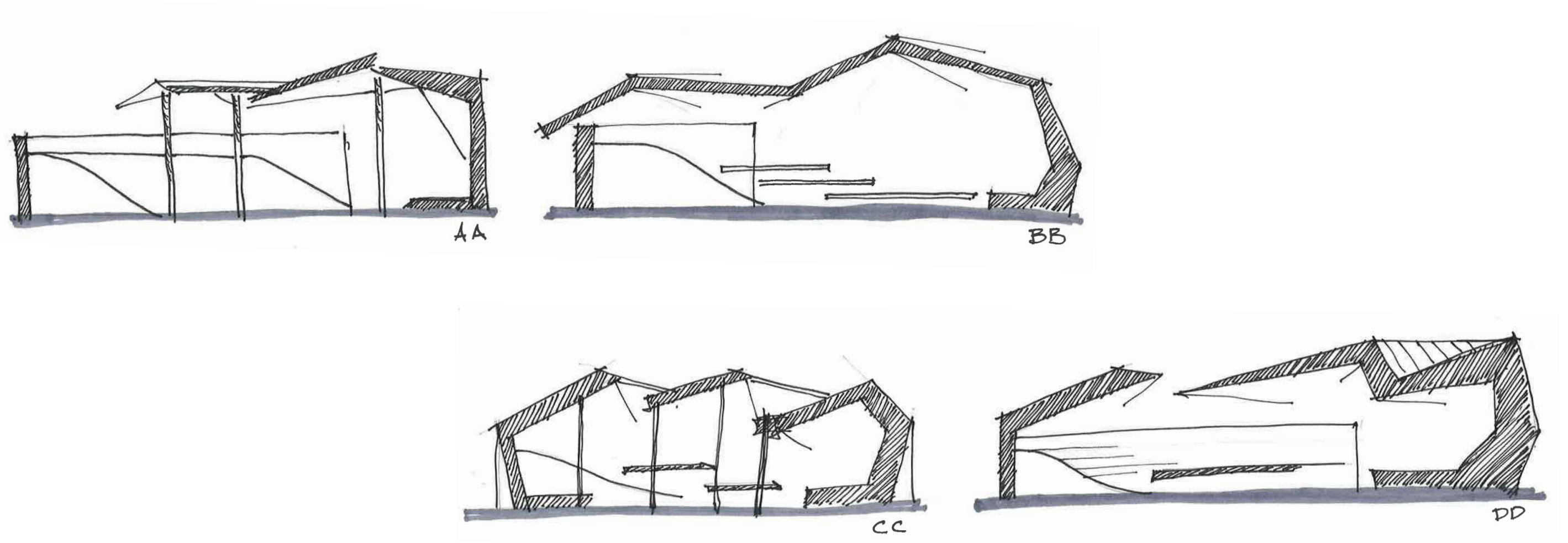
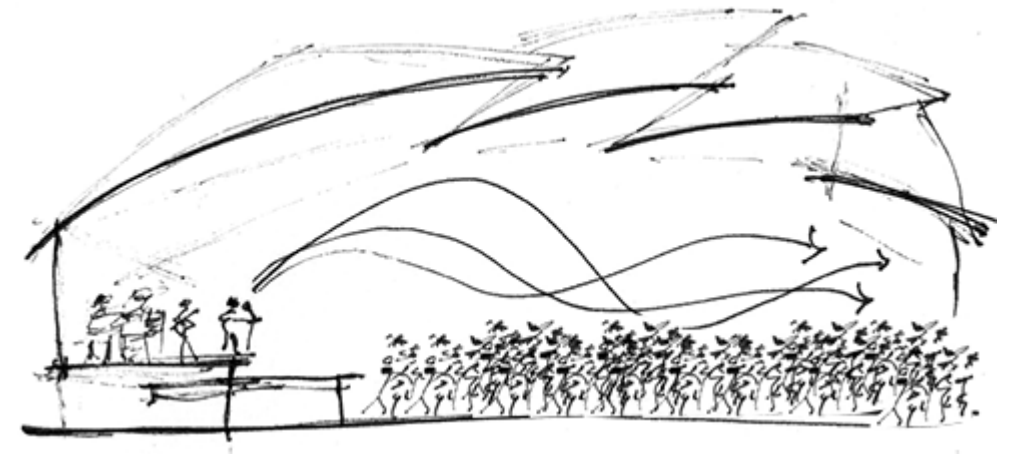
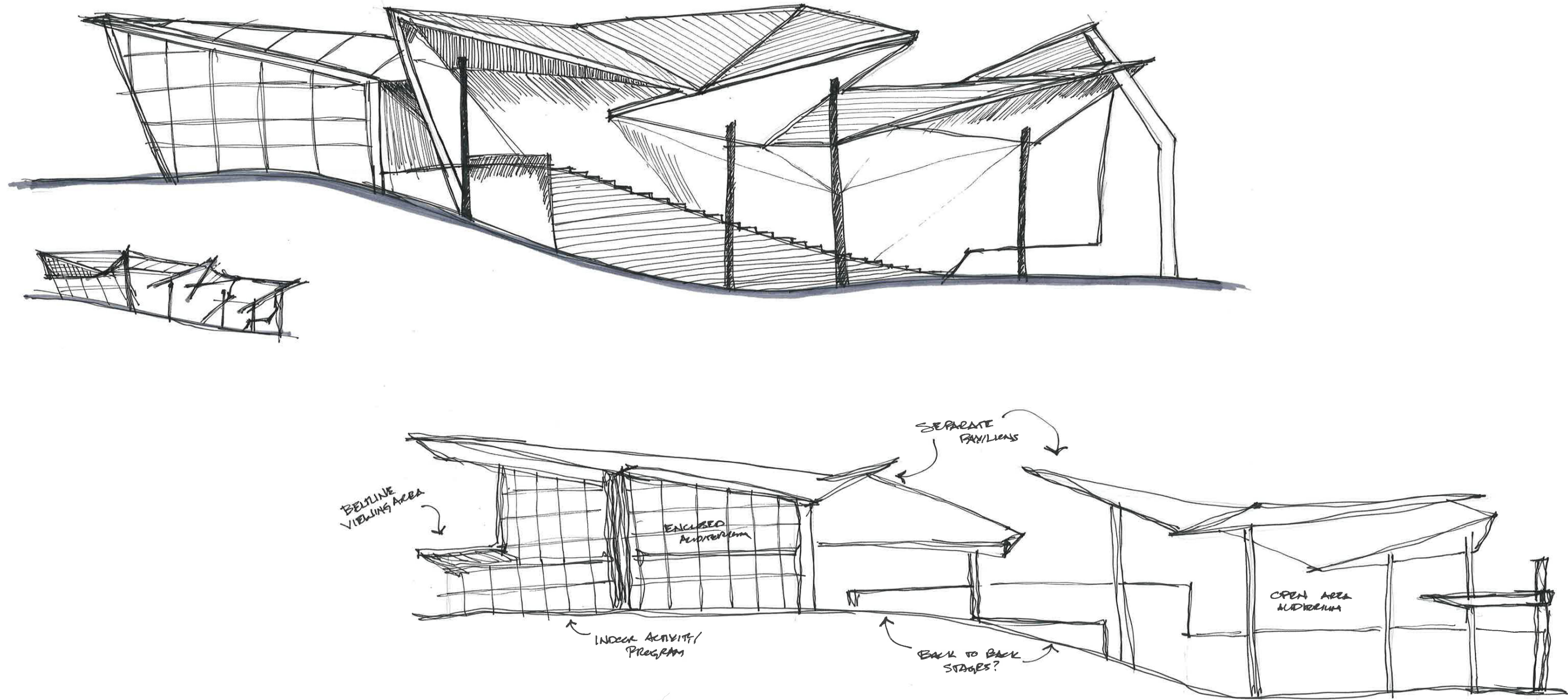


Figure 2.4b  
Sketches for interior form of an amphitheatre whose structure absorbs and reflects sound and provides clarity to every audience member.





**Figure 2.4c**  
Sketches for interior form of an amphitheatre whose structure absorbs and reflects sound and provides clarity to every audience member.

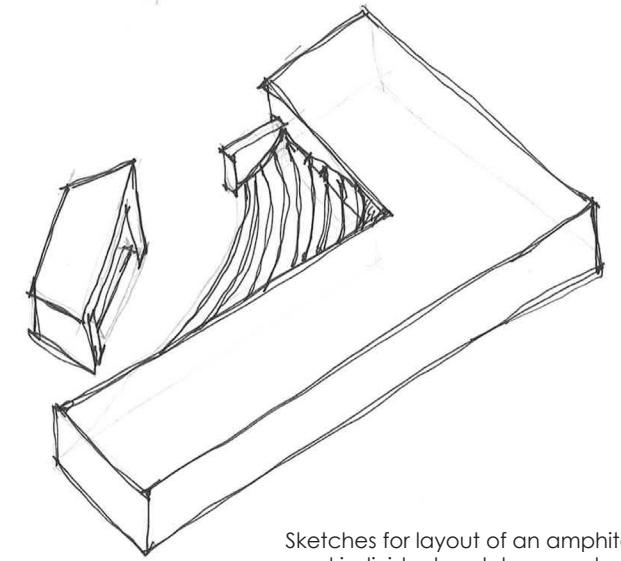
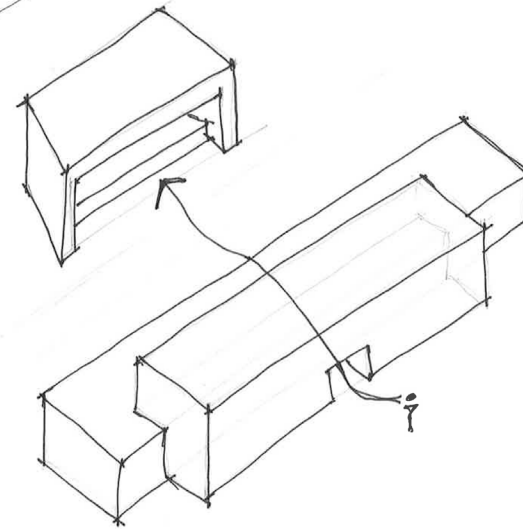
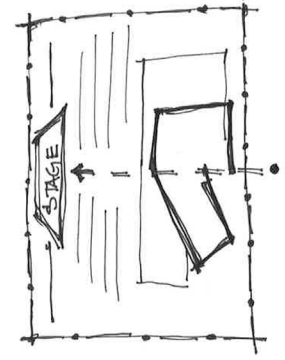
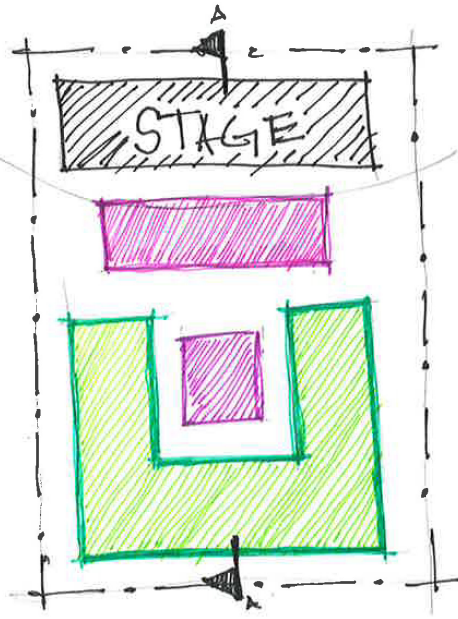
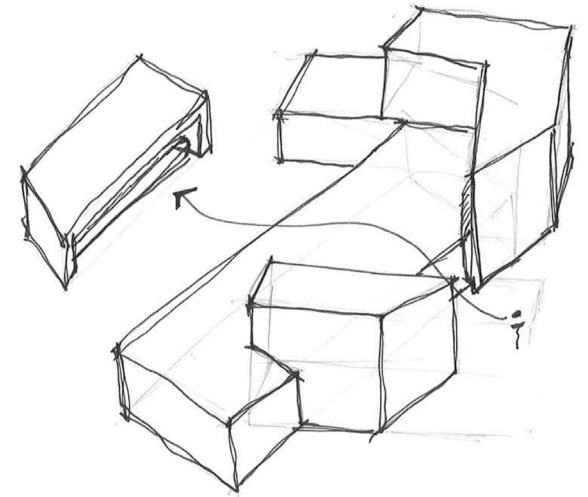
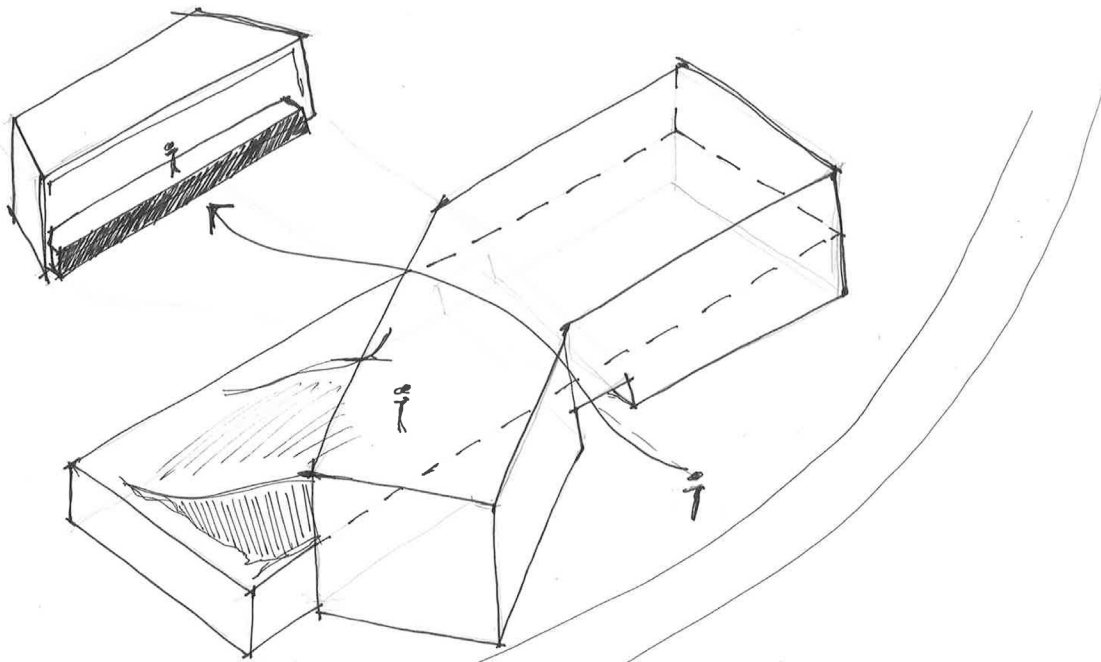
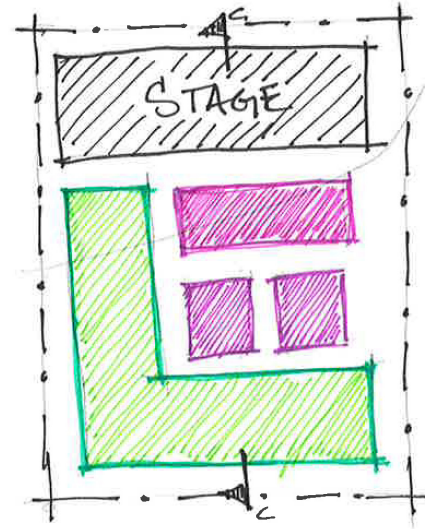
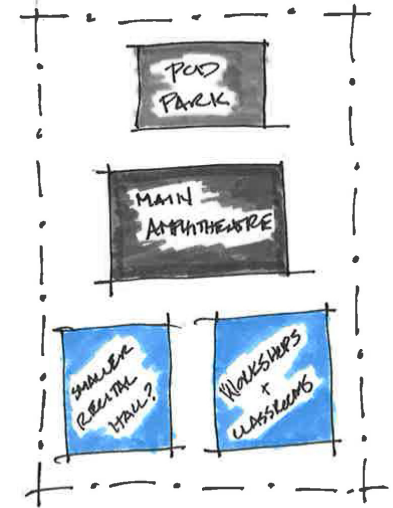
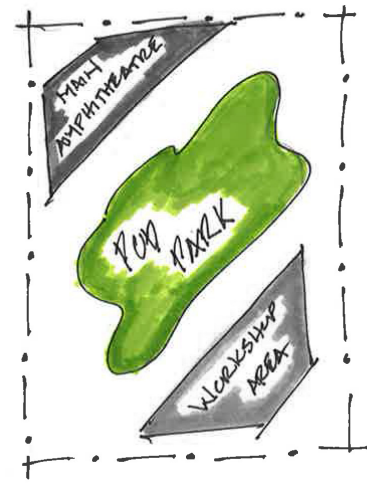
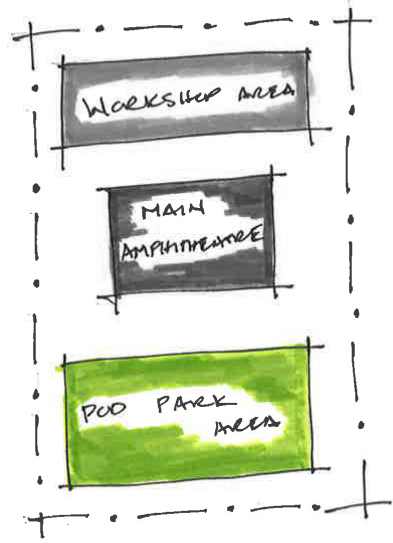
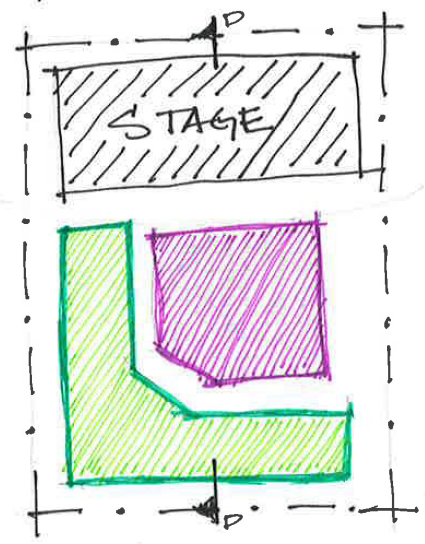
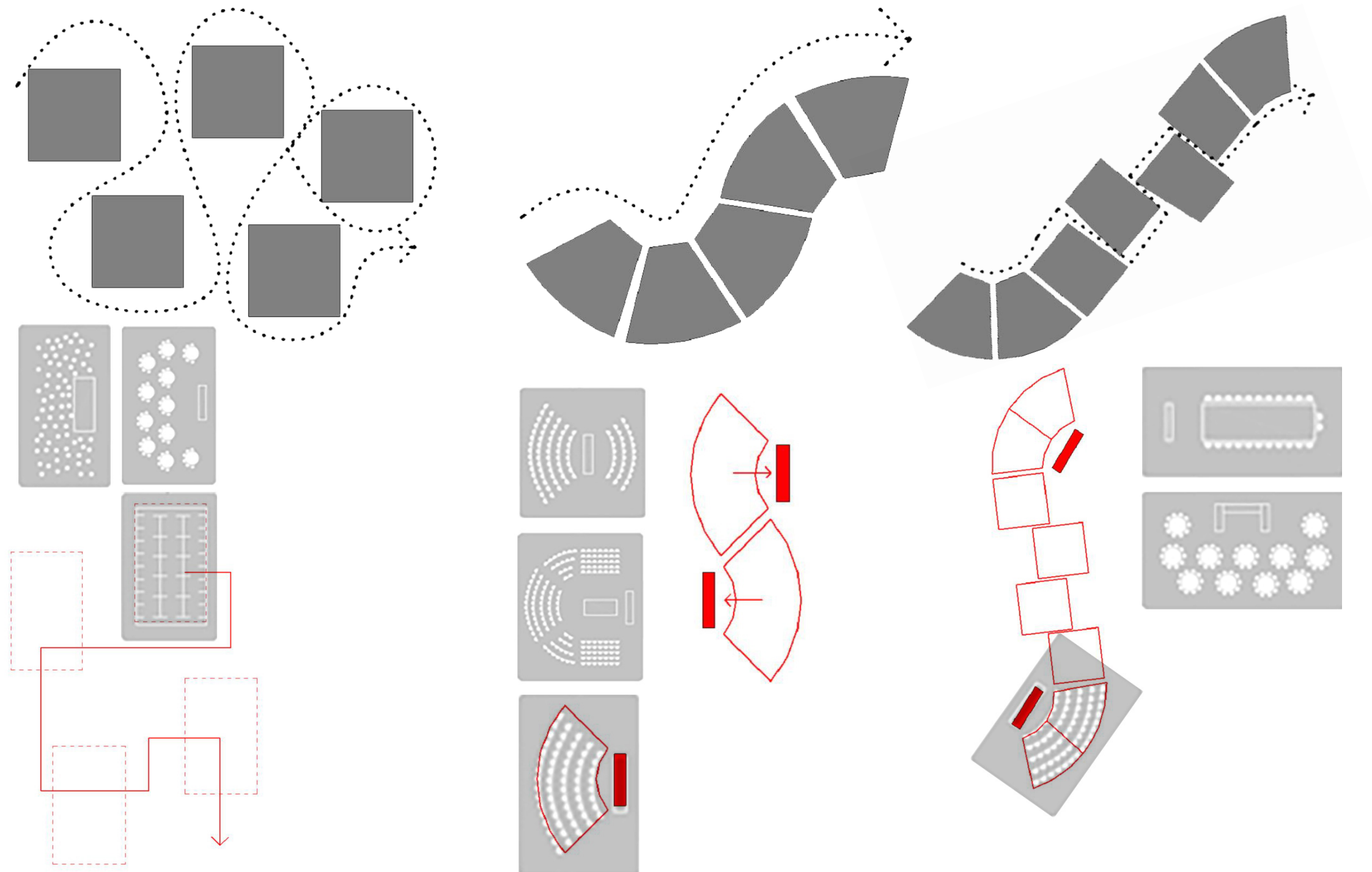


Figure 2.4d  
Sketches for layout of an amphitheatre, green space and individual workshops and smaller performance spaces.

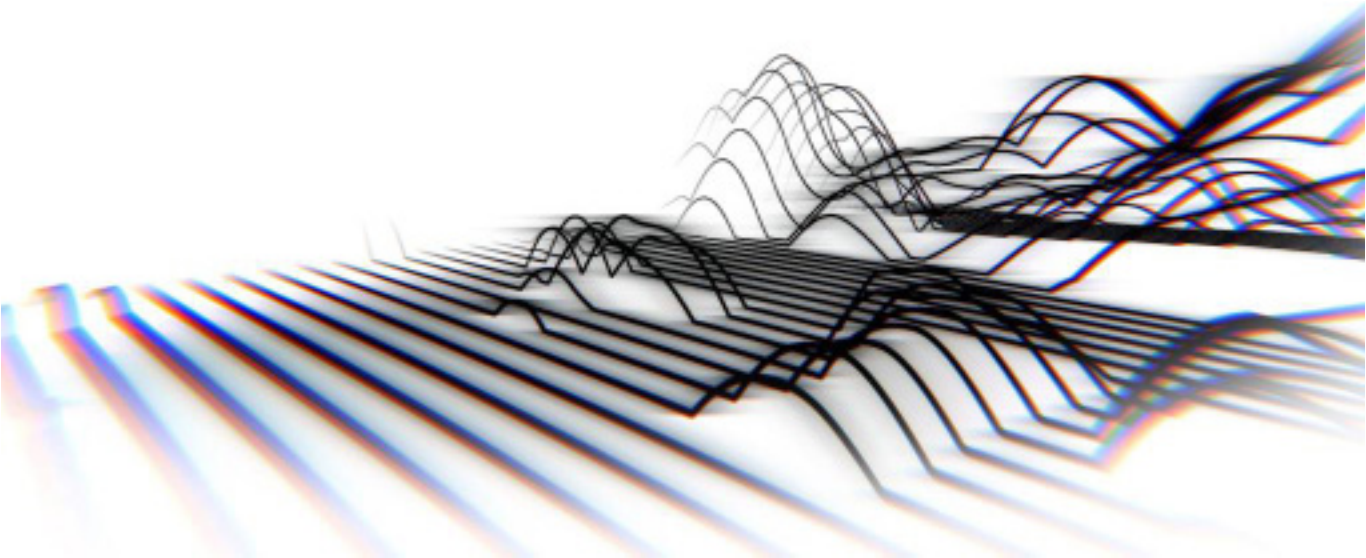




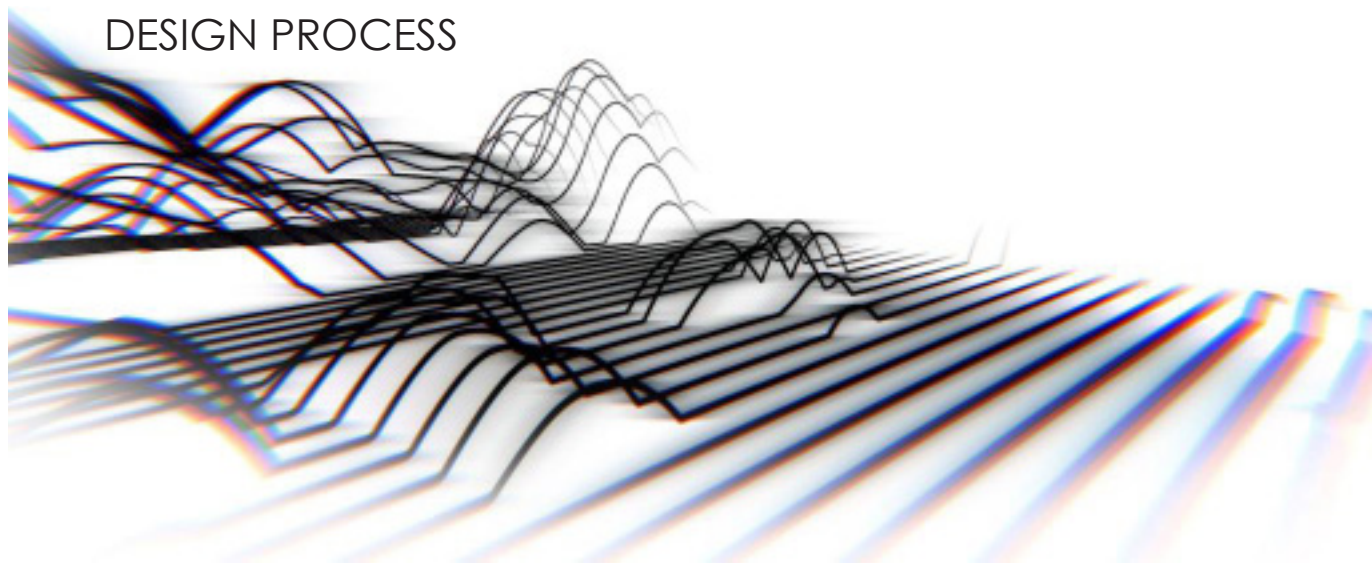


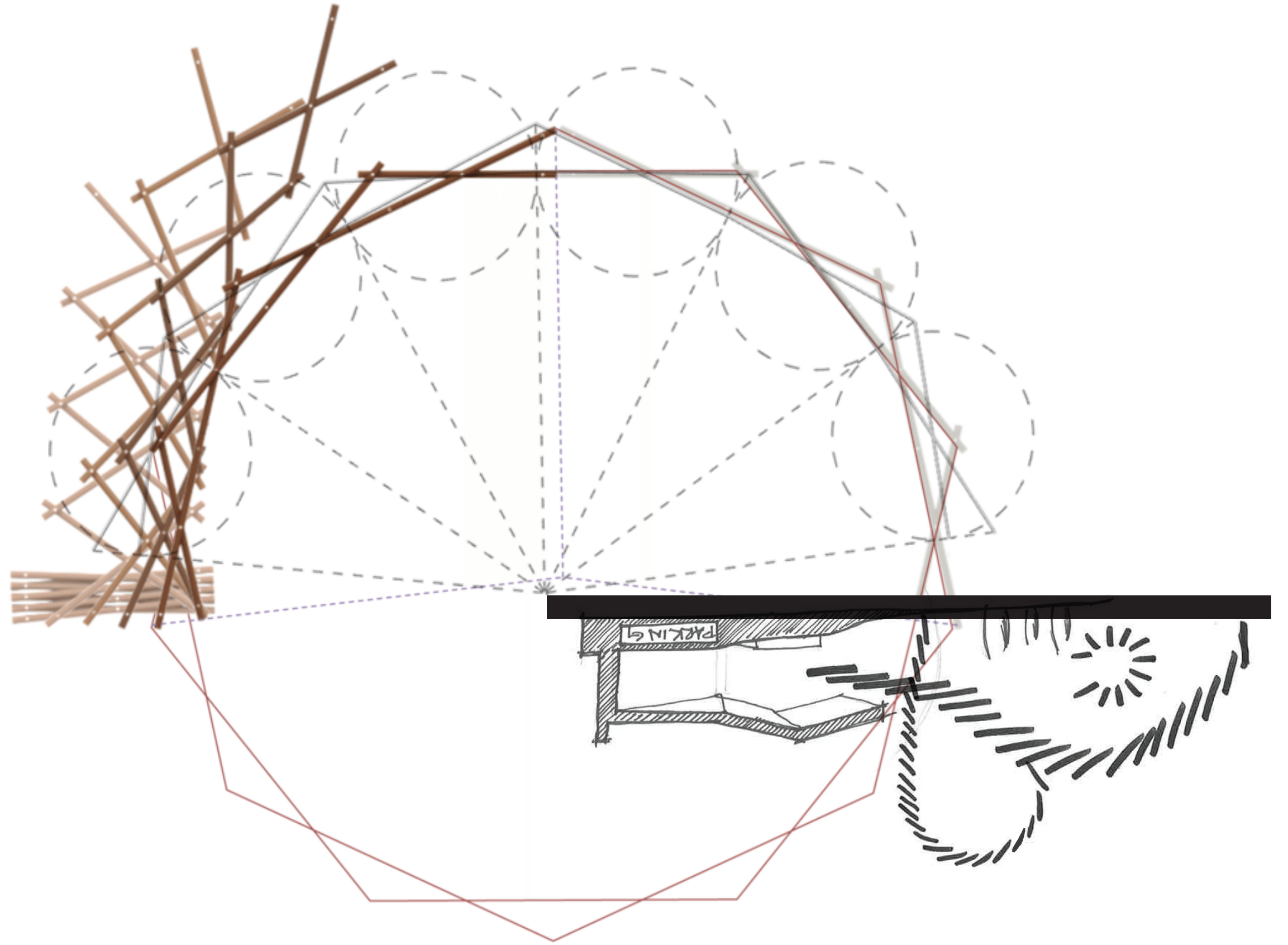
**Figure 2.5a**  
Diagrams for intended configurations of how an audience can and should interact with a performer on a given platform or stage.



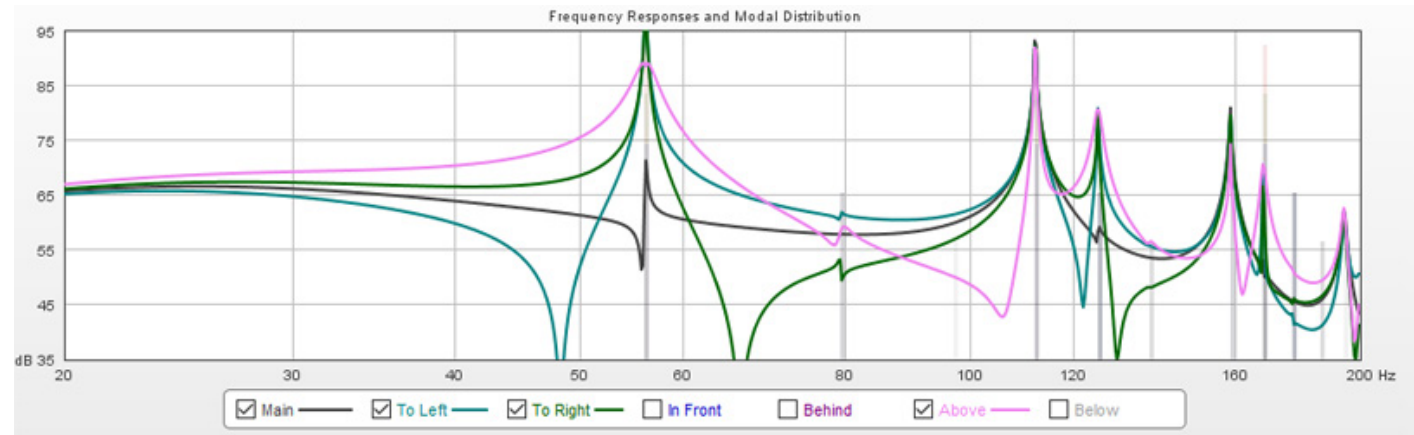


CHAPTER THREE.  
DESIGN PROCESS

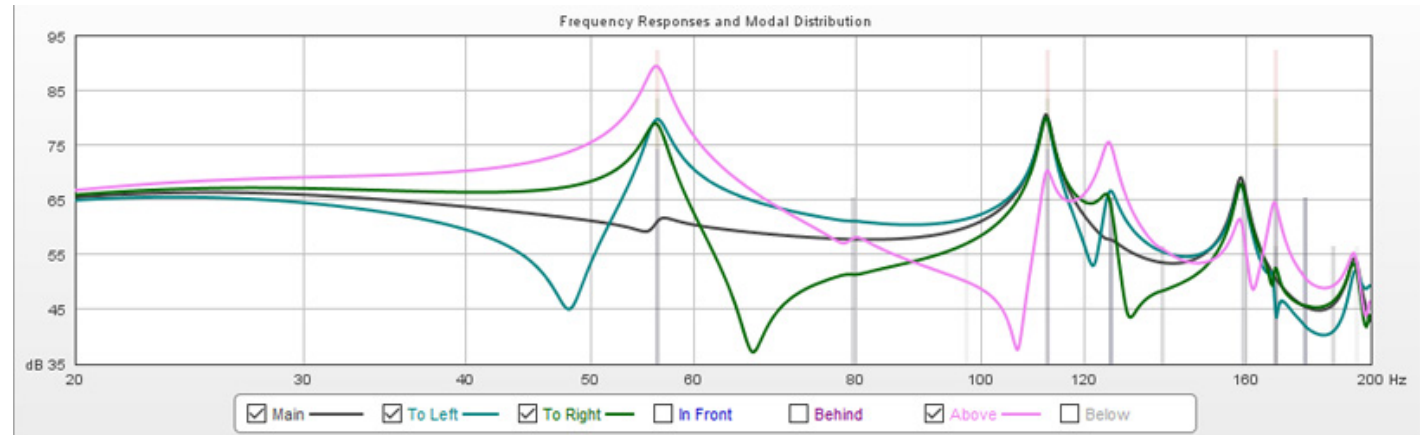




**Figure 3.0a**  
Collage of form ideas for a portable performance theater.

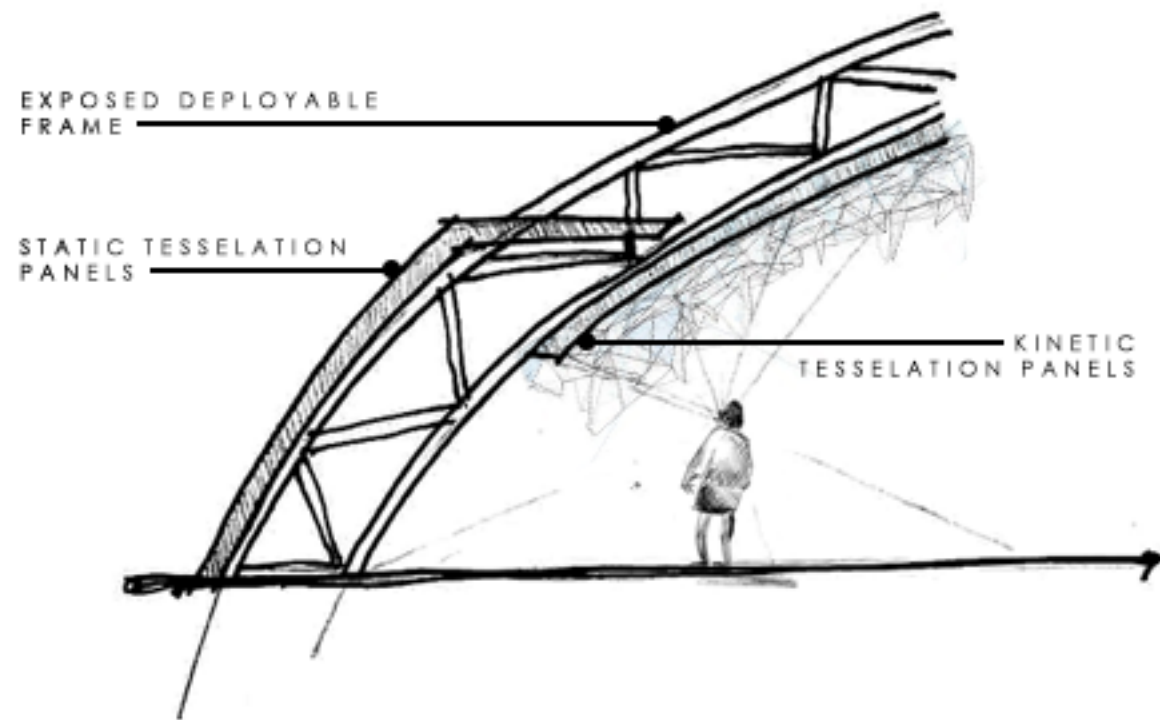


**Figure 3.1a**  
The decibel levels of a theatrical event in an untreated 100 sf space with a sound absorption coefficient of 0.00

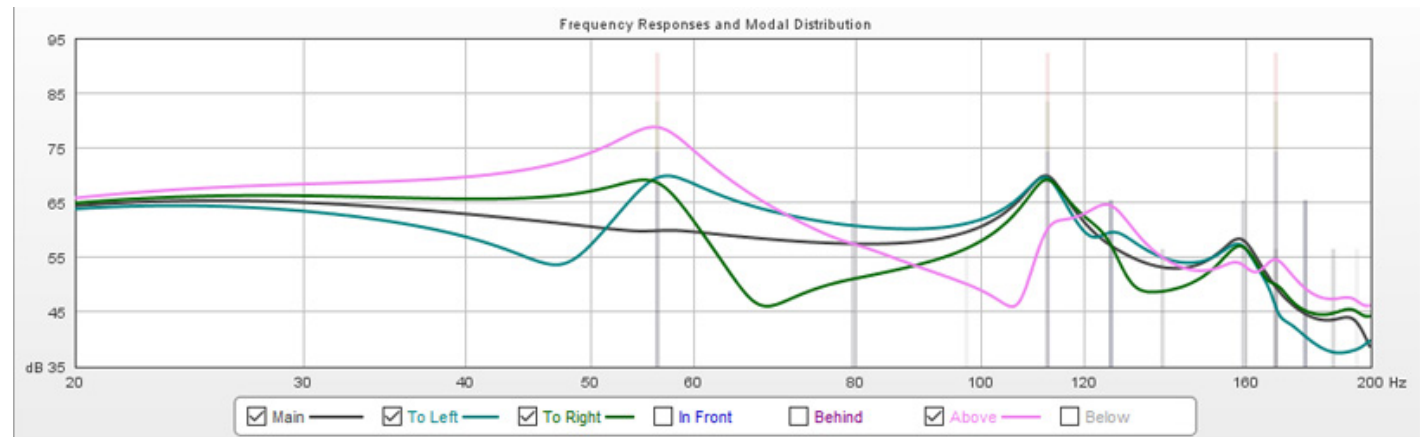


**Figure 3.1b**  
The decibel levels of a theatrical event in an treated 100 sf space with a sound absorption coefficient of 0.10

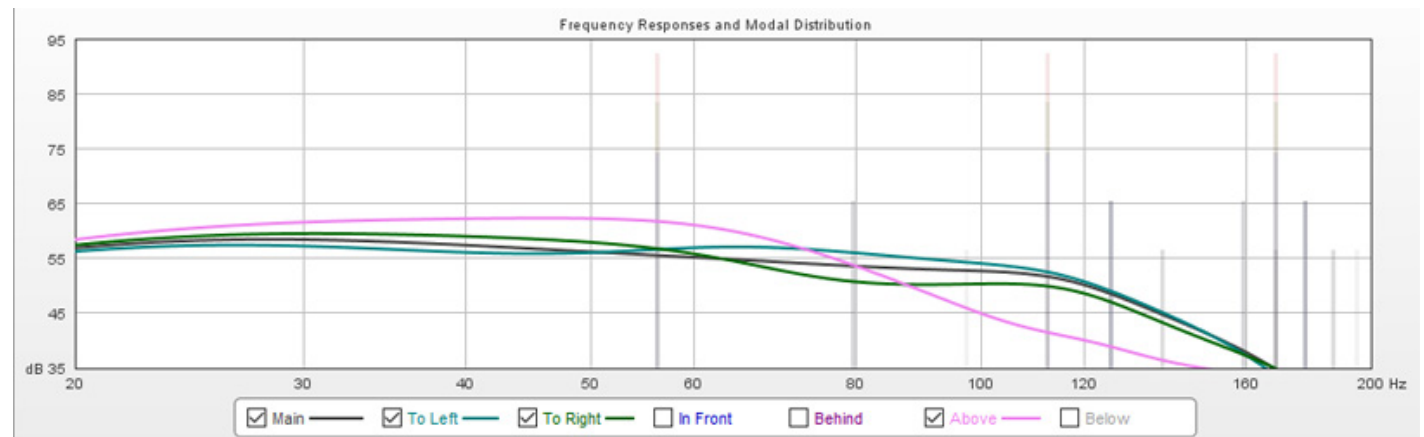
**THEATRICAL EVENTS**  
PLAYS  
PERFORMING ARTS  
SPOKEN WORD



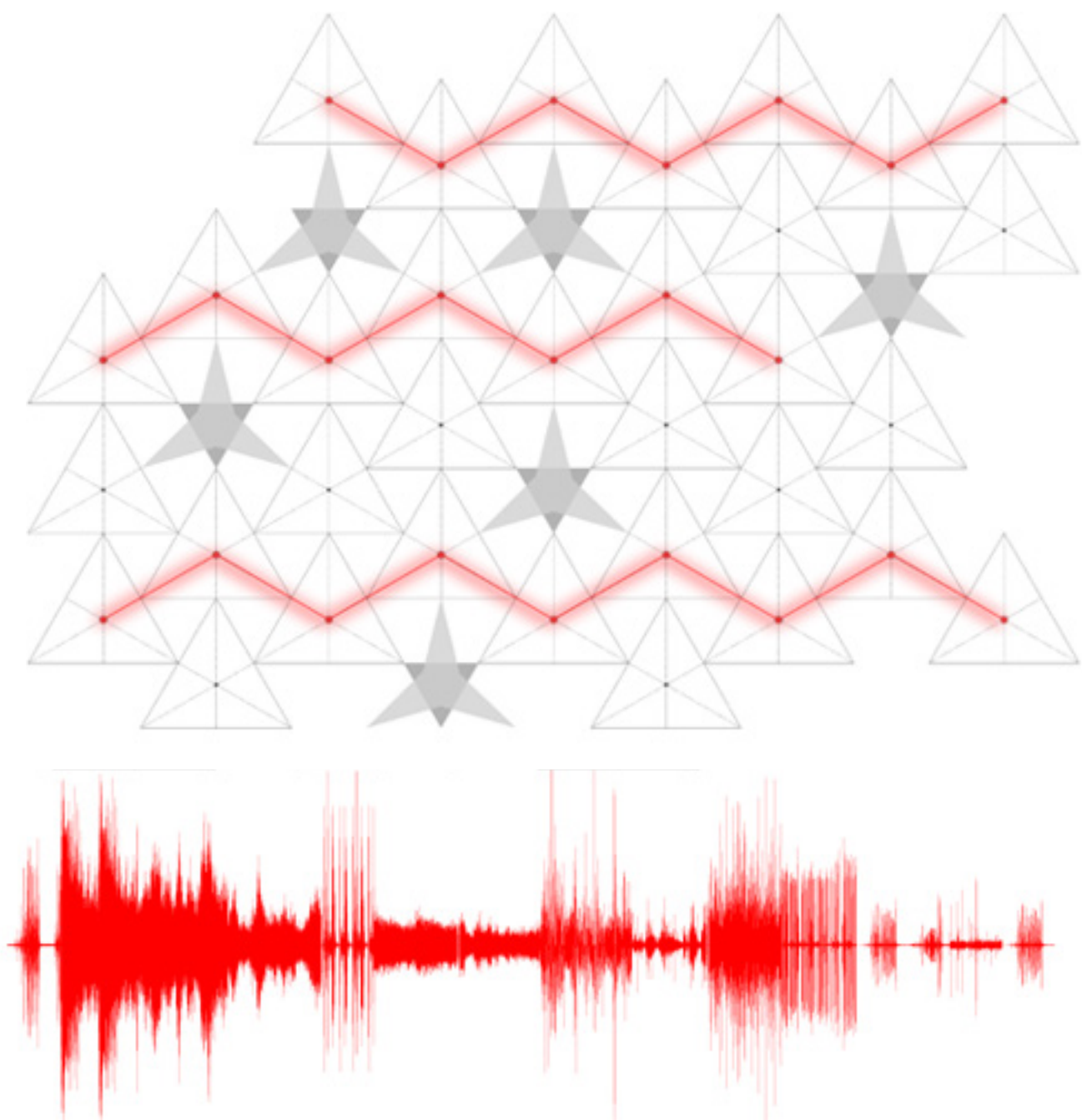
**Figure 3.1e**  
The proposed structural frame configuration with exterior and interior skins for a schematic understanding.



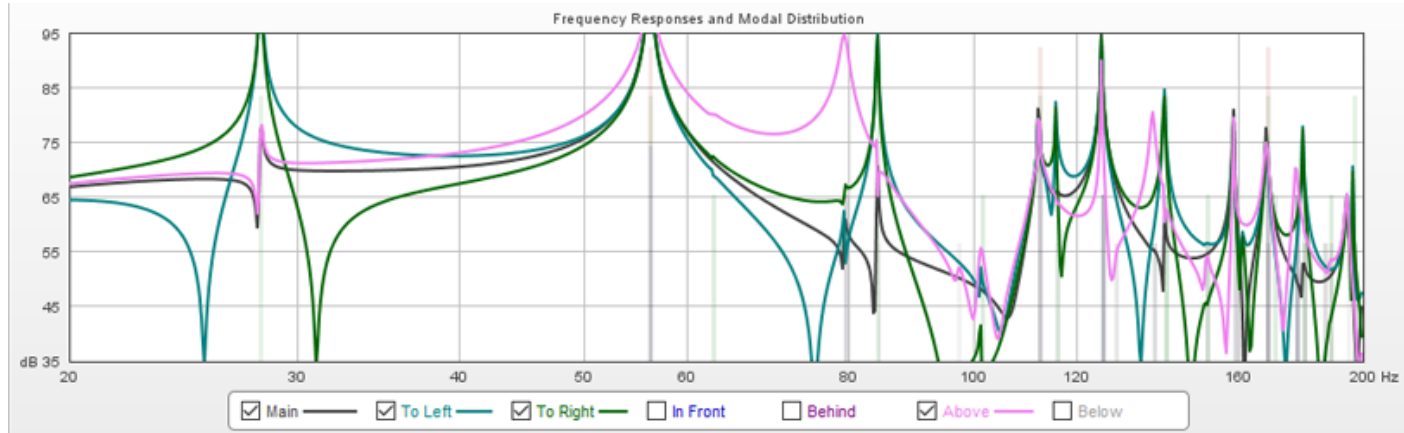
**Figure 3.1c**  
The decibel levels of a theatrical event in an treated 100 sf space with a sound absorption coefficient of 0.30



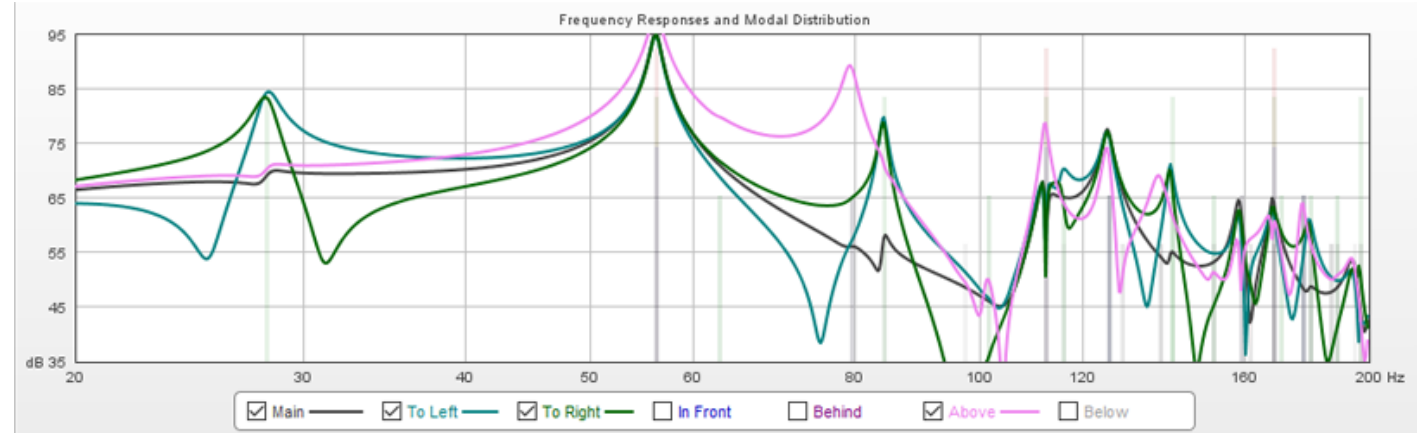
**Figure 3.1d**  
The decibel levels of a theatrical event in an treated 100 sf space with a sound absorption coefficient of 0.90





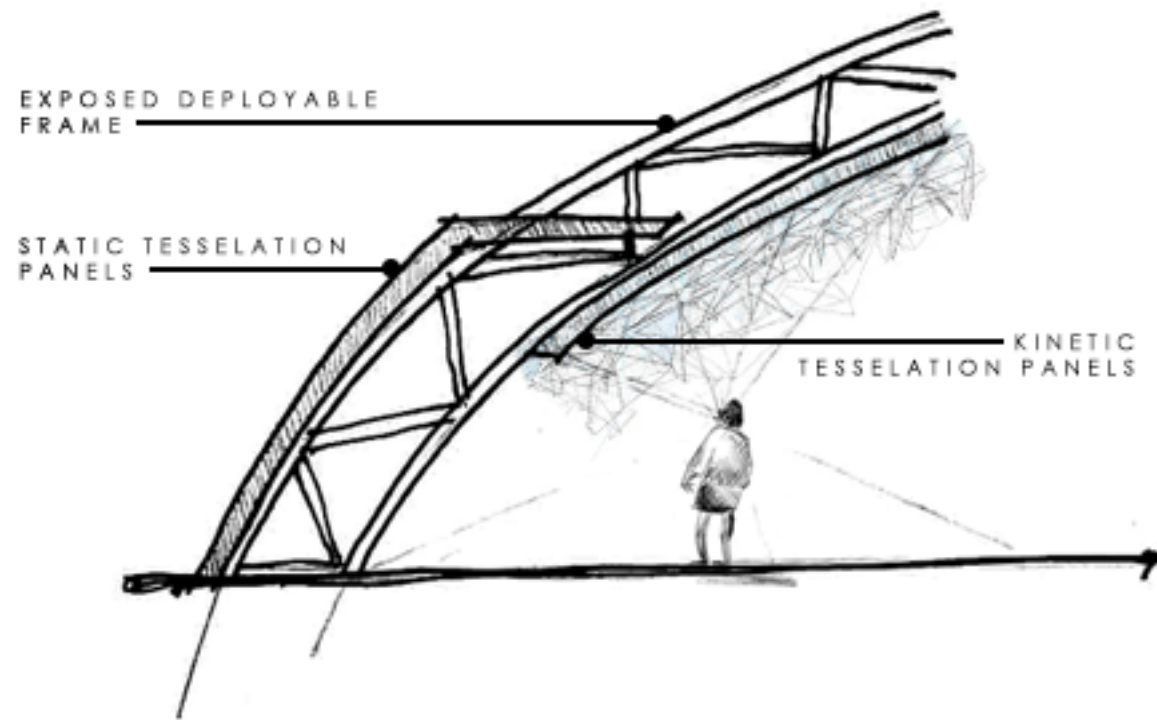


**Figure 3.2a**  
The decibel levels of a musical event in an untreated 100 sf space with a sound absorption coefficient of 0.00

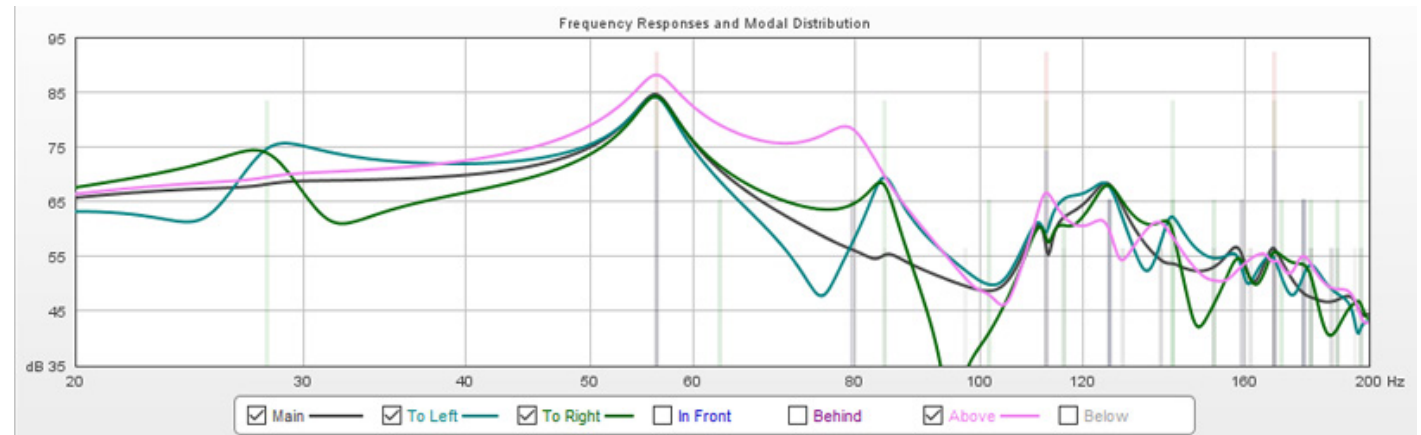


**Figure 3.2b**  
The decibel levels of a musical event in a treated 100 sf space with a sound absorption coefficient of 0.10

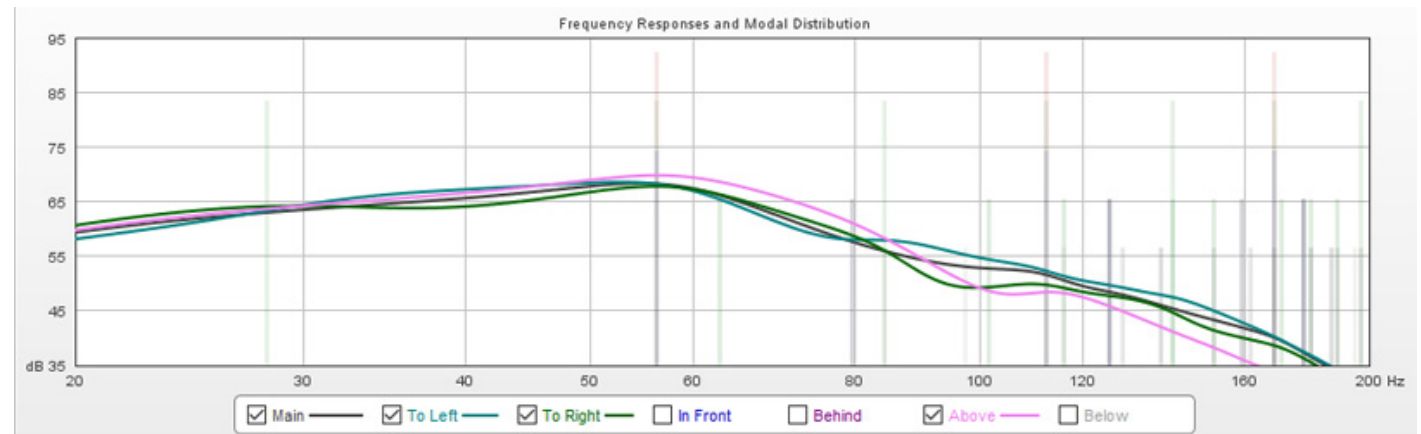
**RECITALS**  
CONCERTS  
INDIVIDUAL PRACTICE SESSIONS  
MUSIC CLASSES



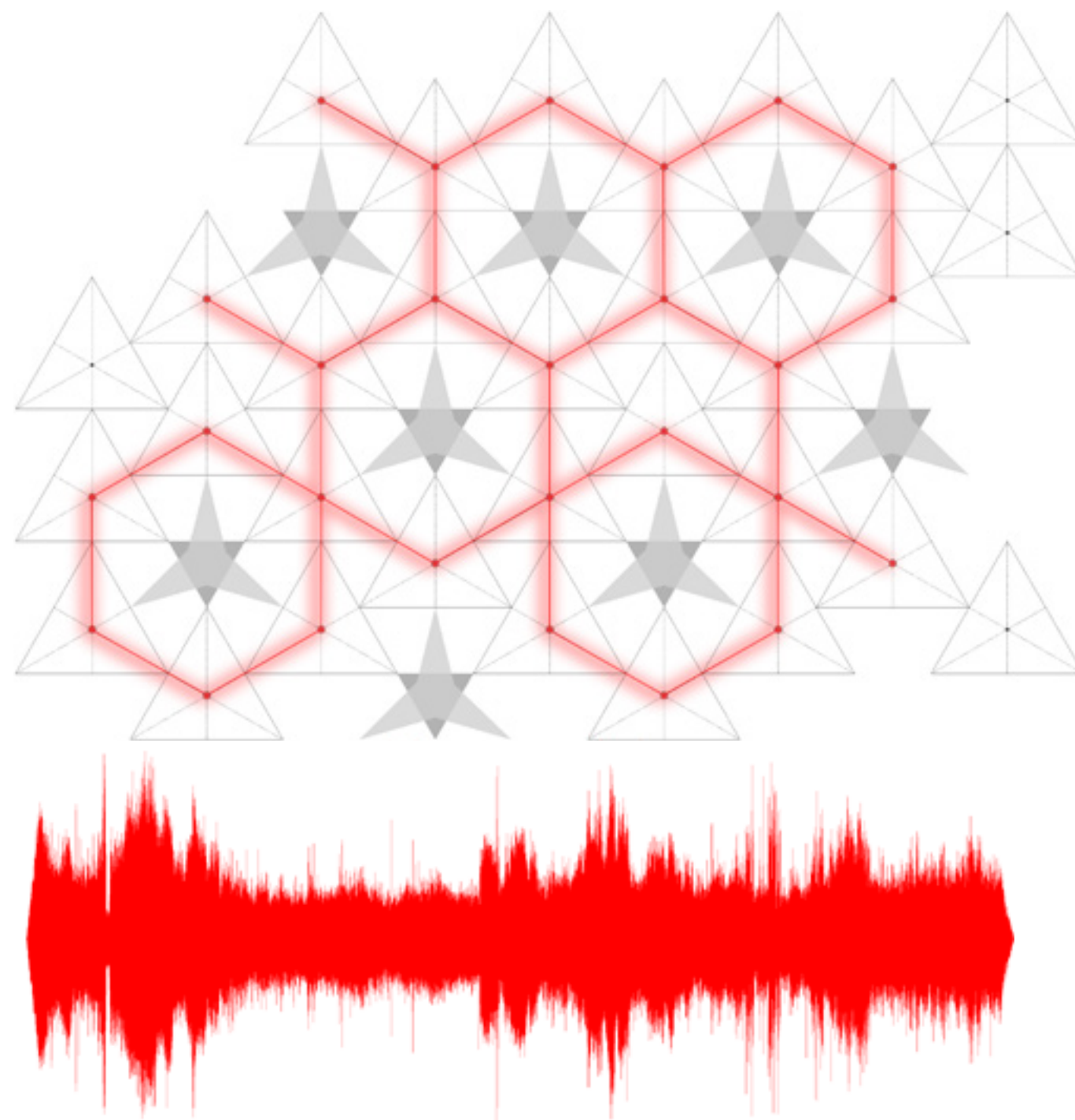
**Figure 3.2e**  
The proposed structural frame configuration with exterior and interior skins for a schematic understanding.

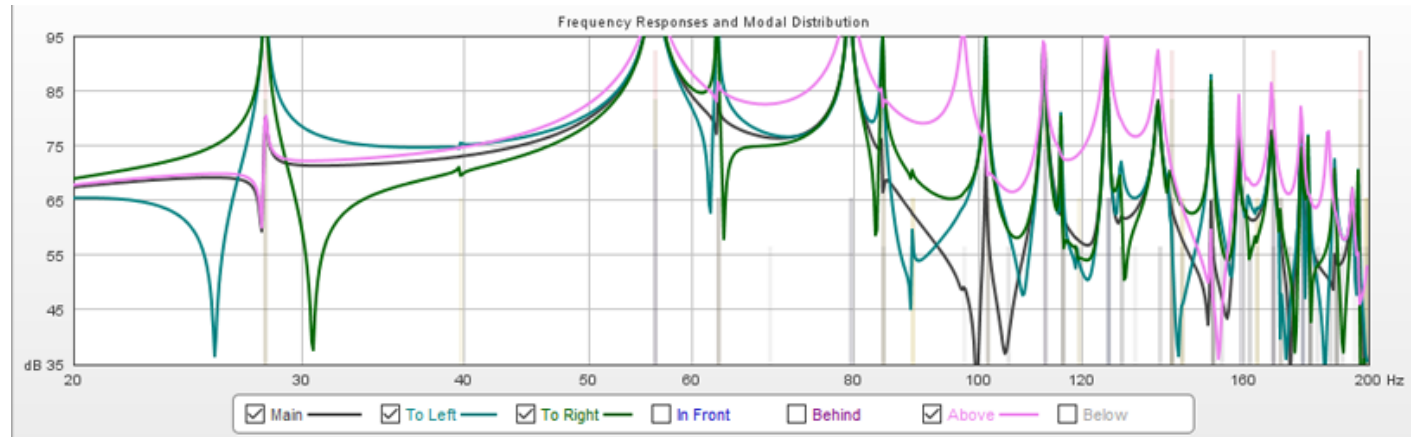


**Figure 3.2c**  
The decibel levels of a musical event in a treated 100 sf space with a sound absorption coefficient of 0.30

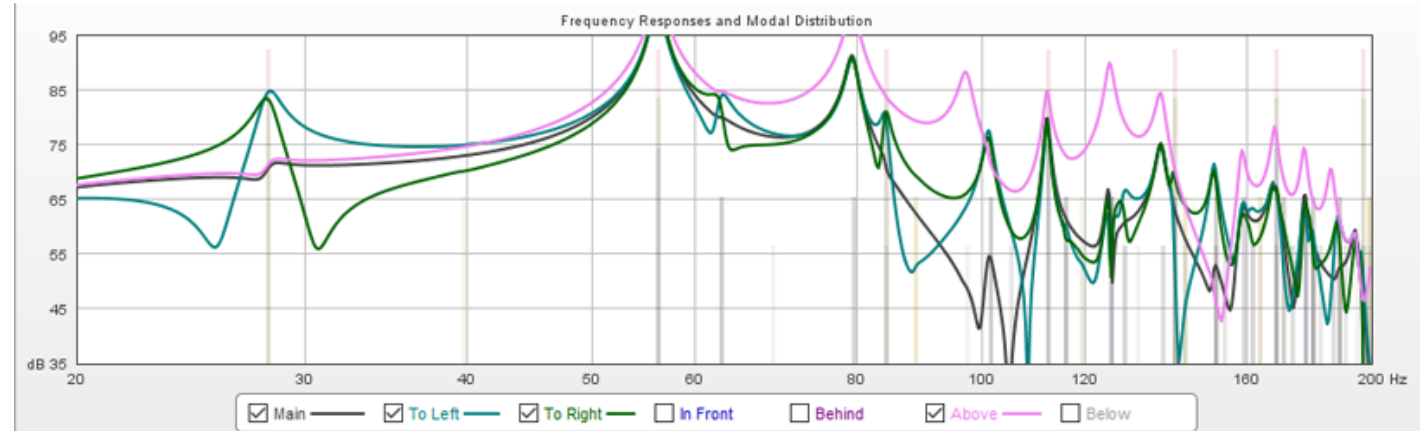


**Figure 3.2d**  
The decibel levels of a musical event in a treated 100 sf space with a sound absorption coefficient of 0.90

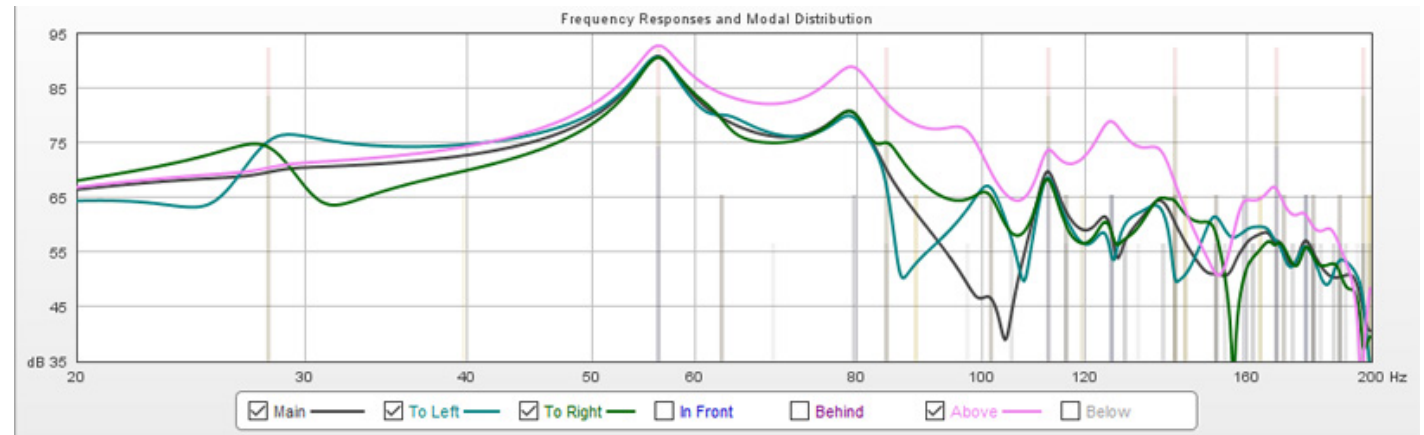




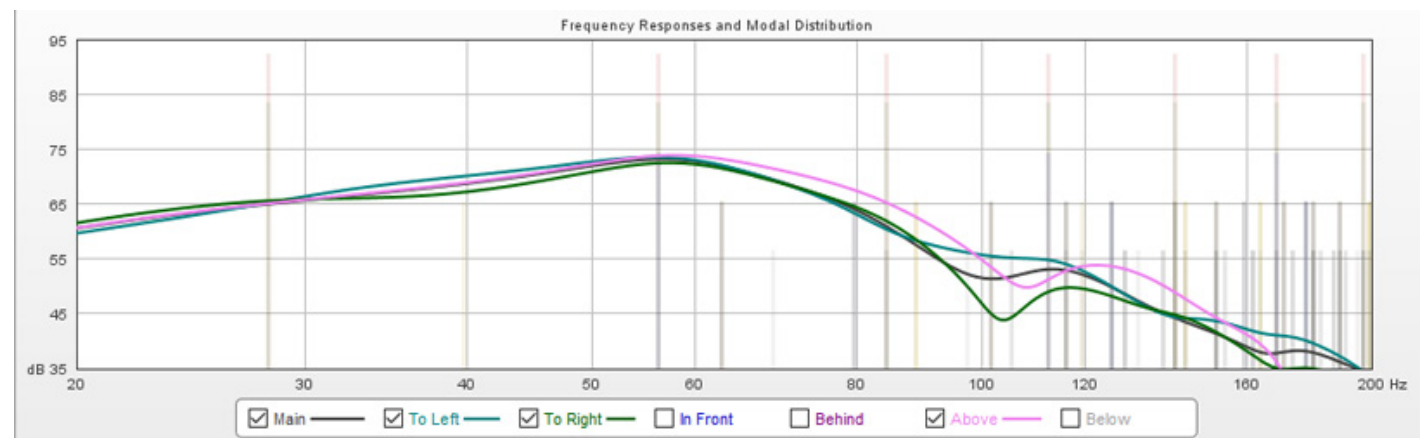
**Figure 3.3a**  
The decibel levels of a social event in an untreated 100 sf space with a sound absorption coefficient of 0.00



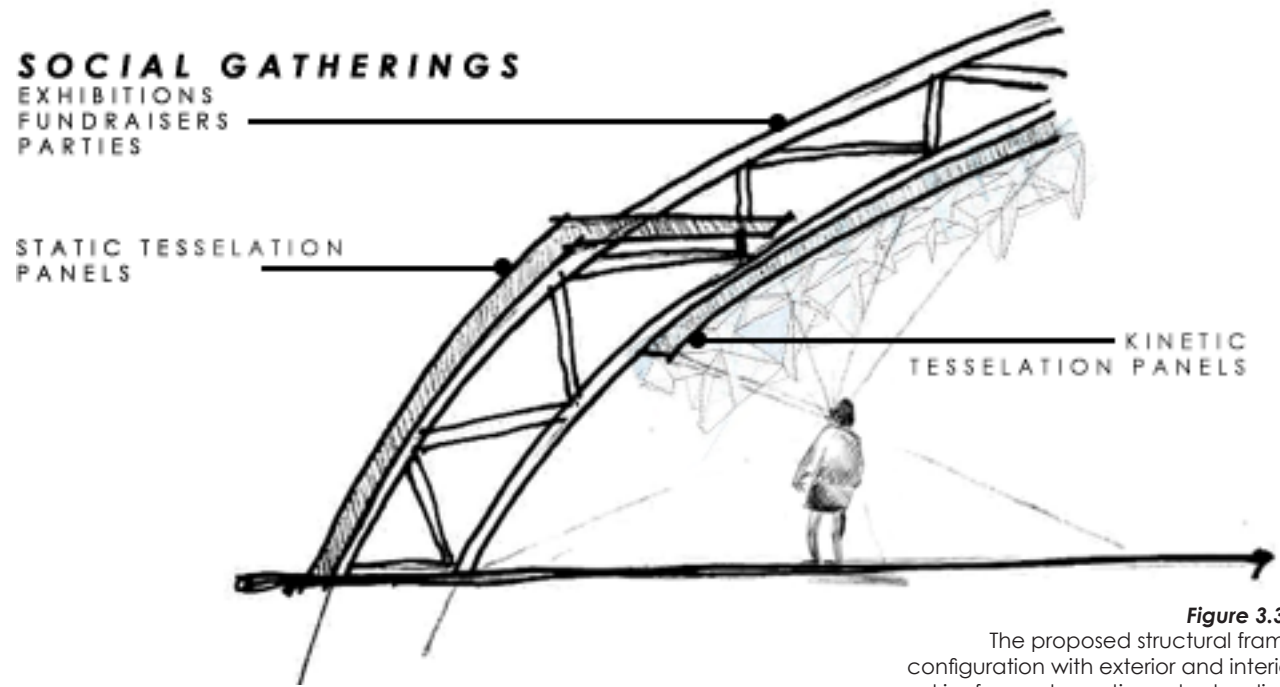
**Figure 3.3b**  
The decibel levels of a social event in an treated 100 sf space with a sound absorption coefficient of 0.10



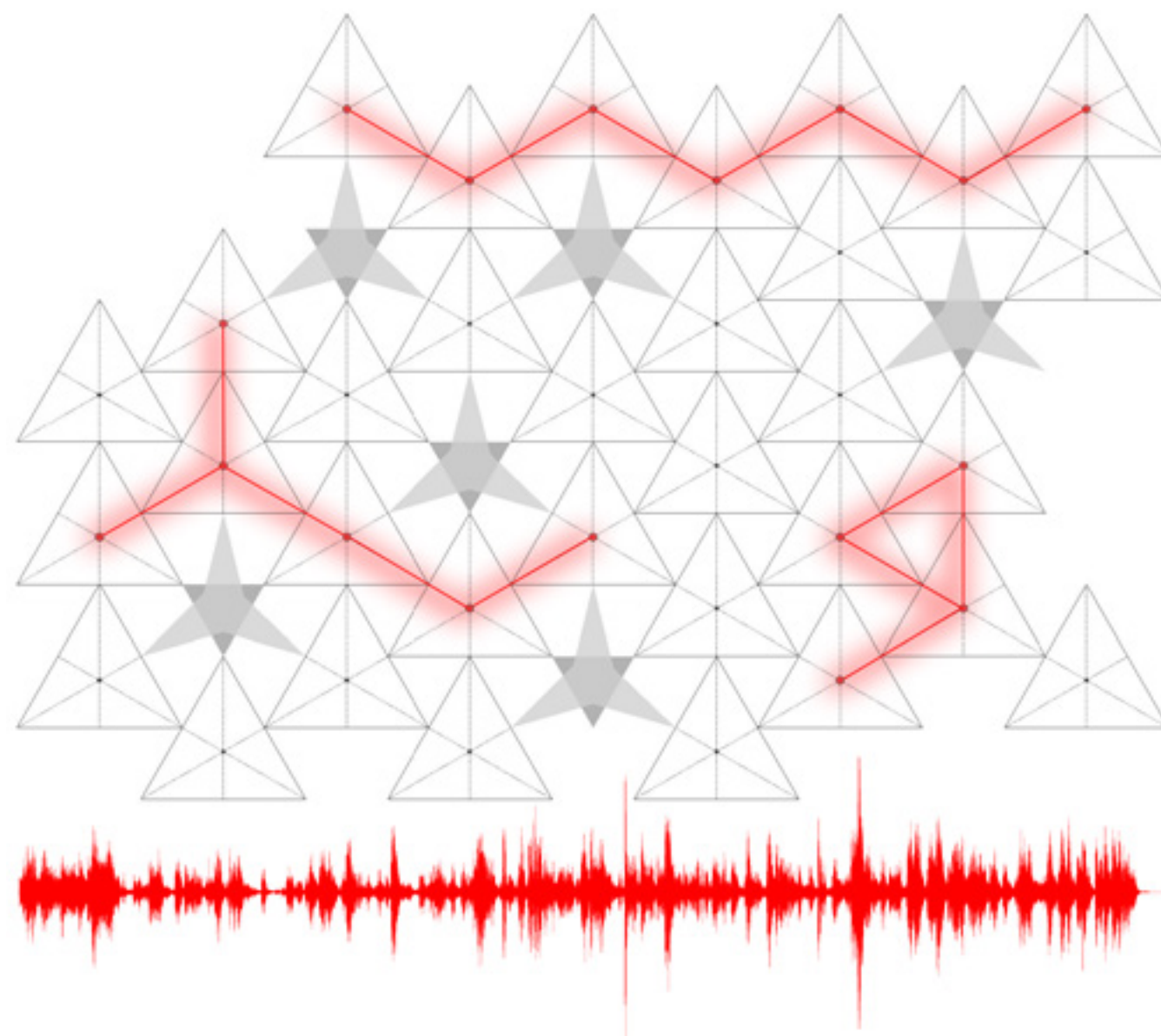
**Figure 3.3c**  
The decibel levels of a social event in an treated 100 sf space with a sound absorption coefficient of 0.30



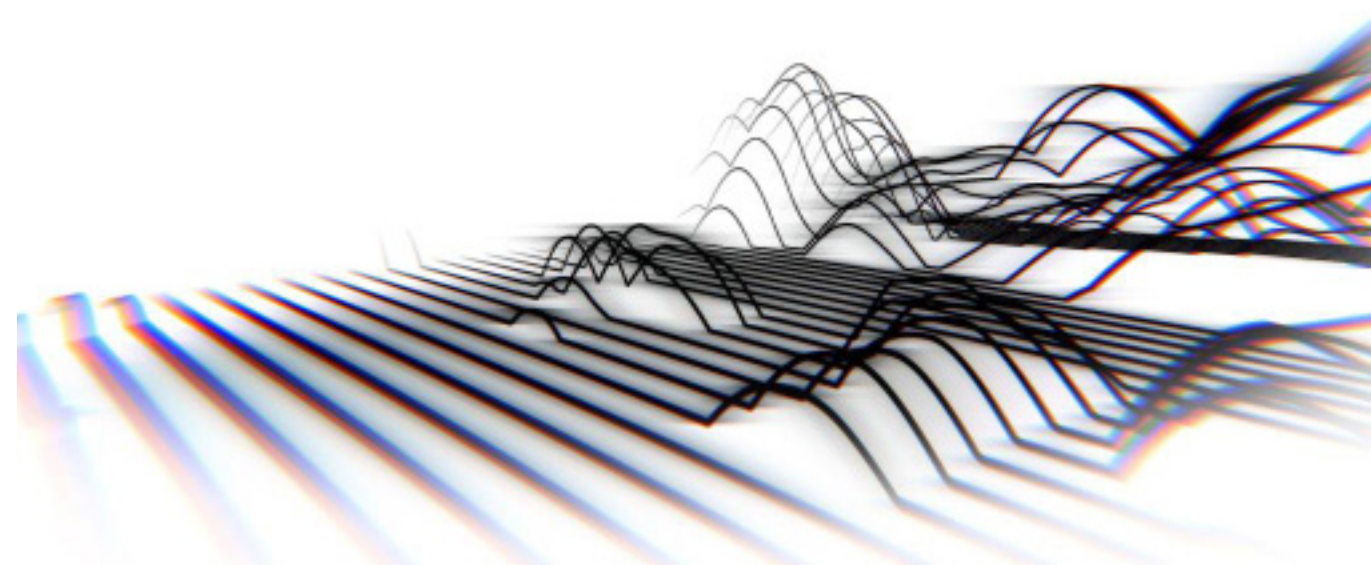
**Figure 3.3d**  
The decibel levels of a social event in an treated 100 sf space with a sound absorption coefficient of 0.90



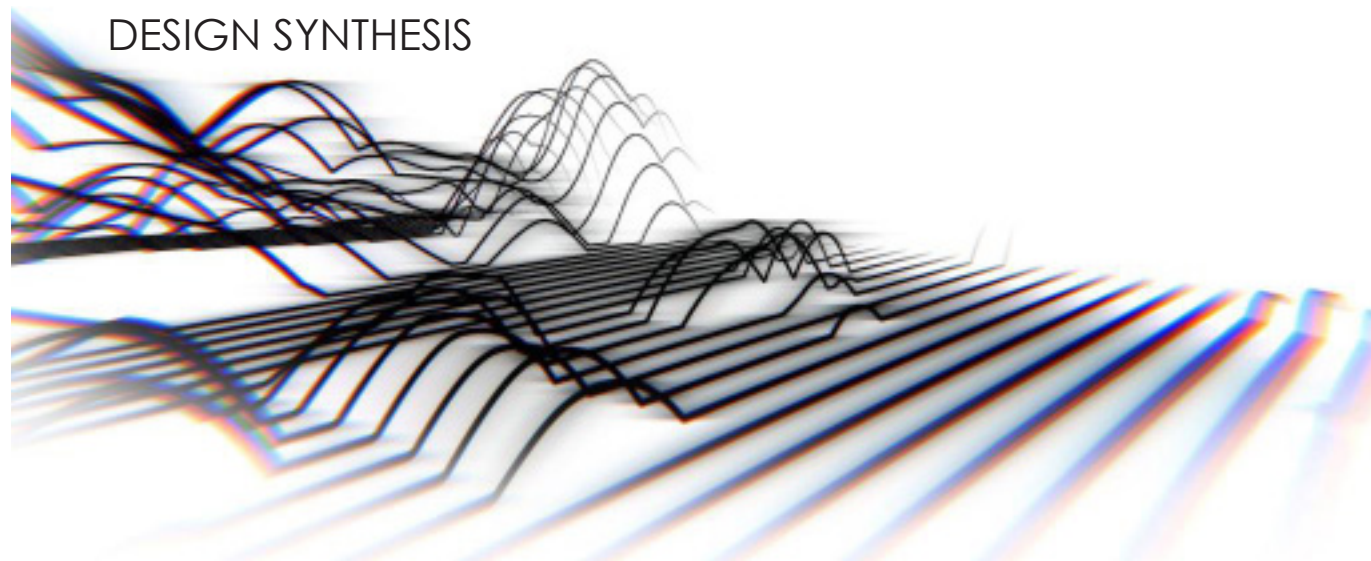
**Figure 3.3e**  
The proposed structural frame configuration with exterior and interior skins for a schematic understanding.

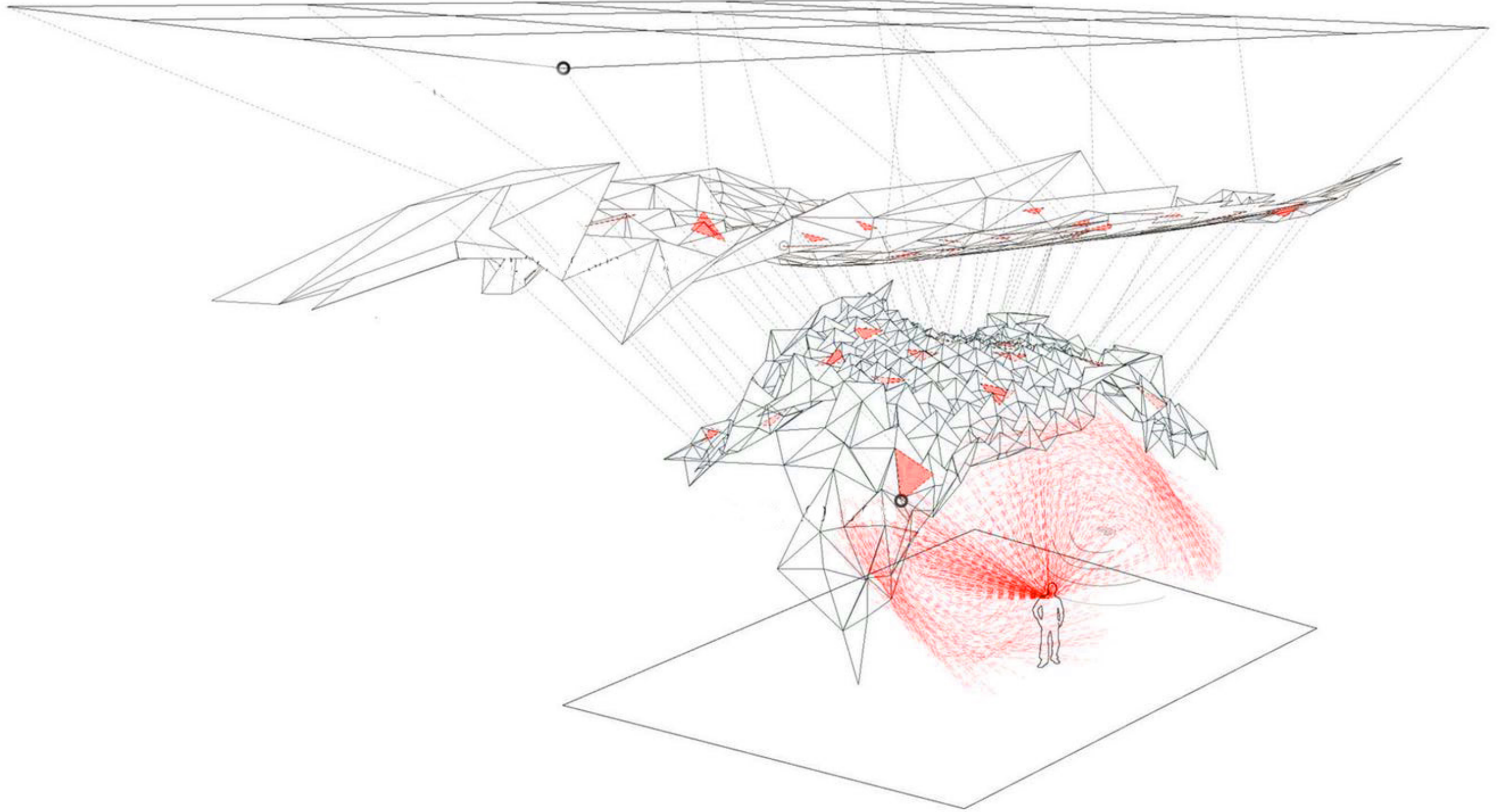






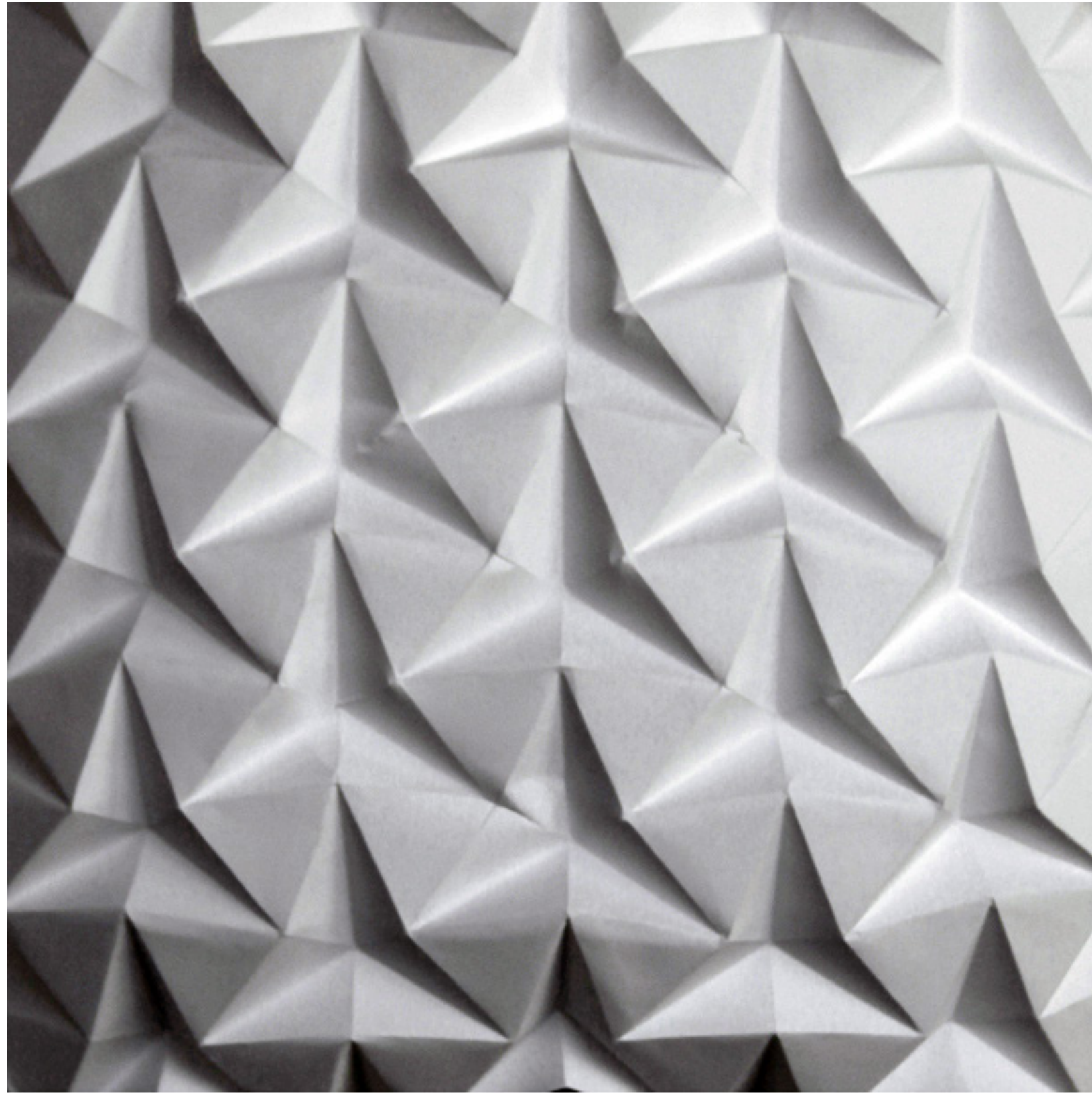
CHAPTER FOUR.  
DESIGN SYNTHESIS

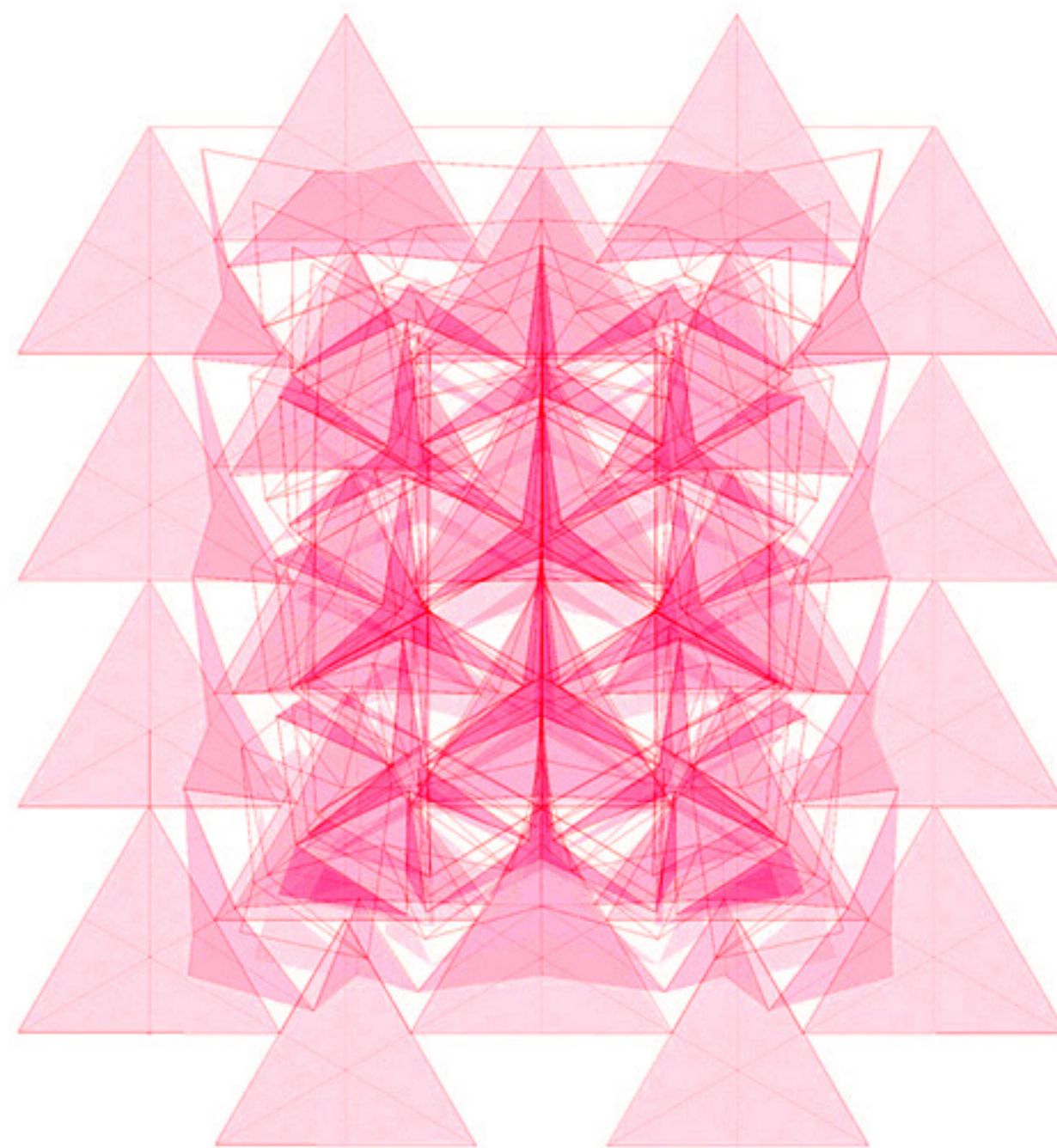


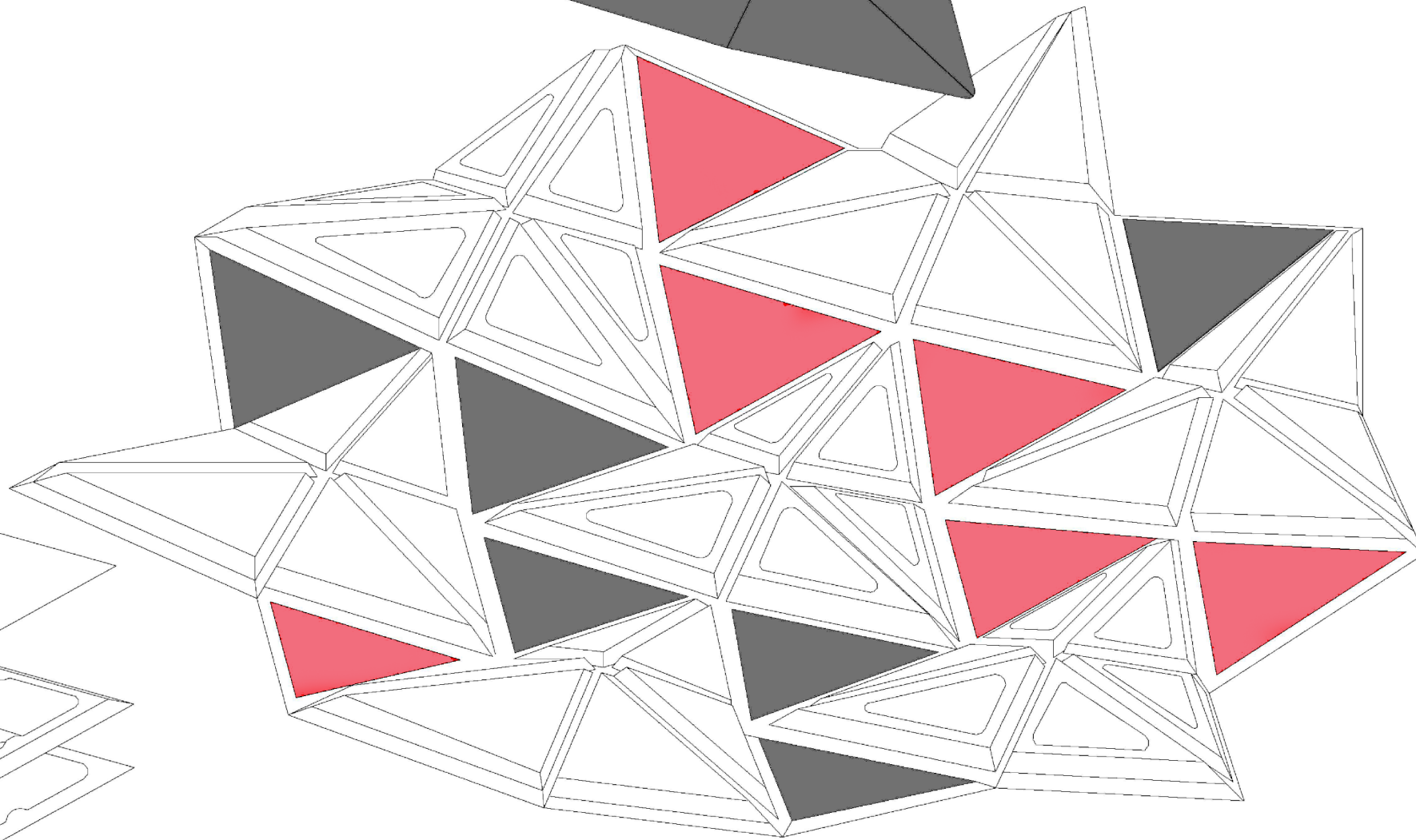
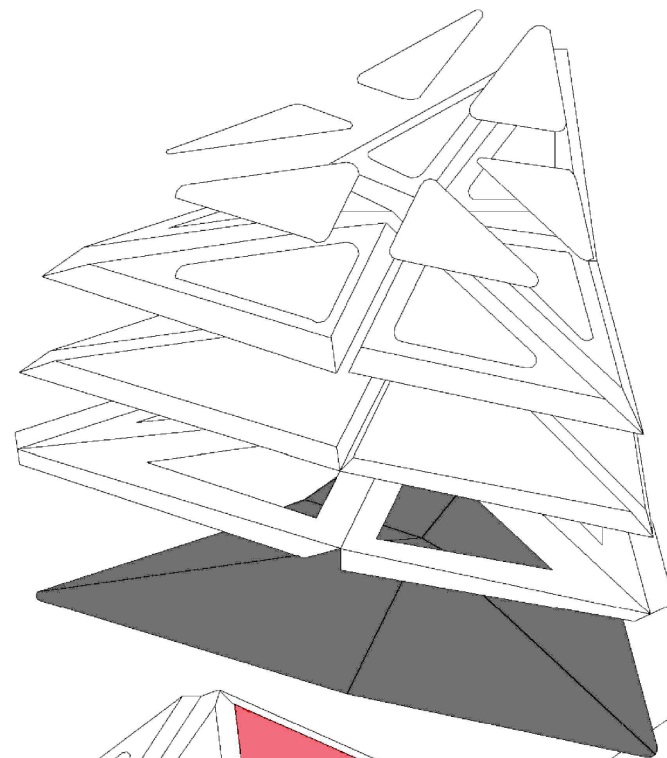
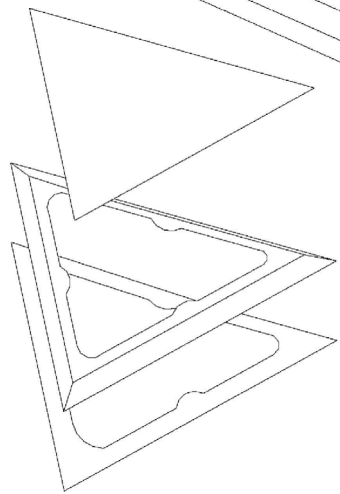
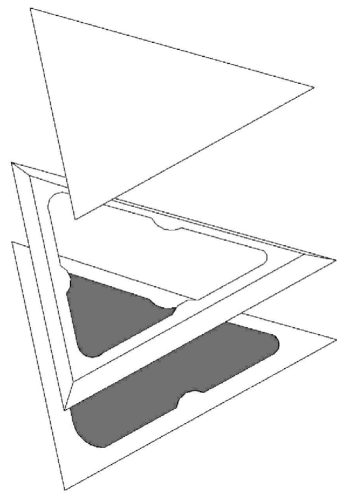
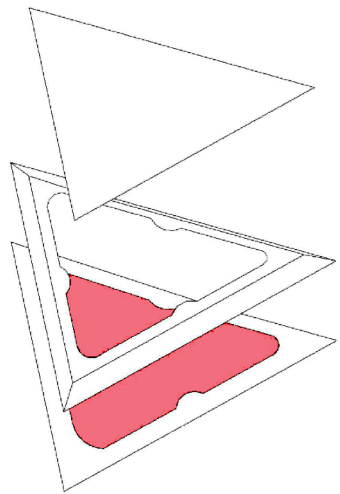


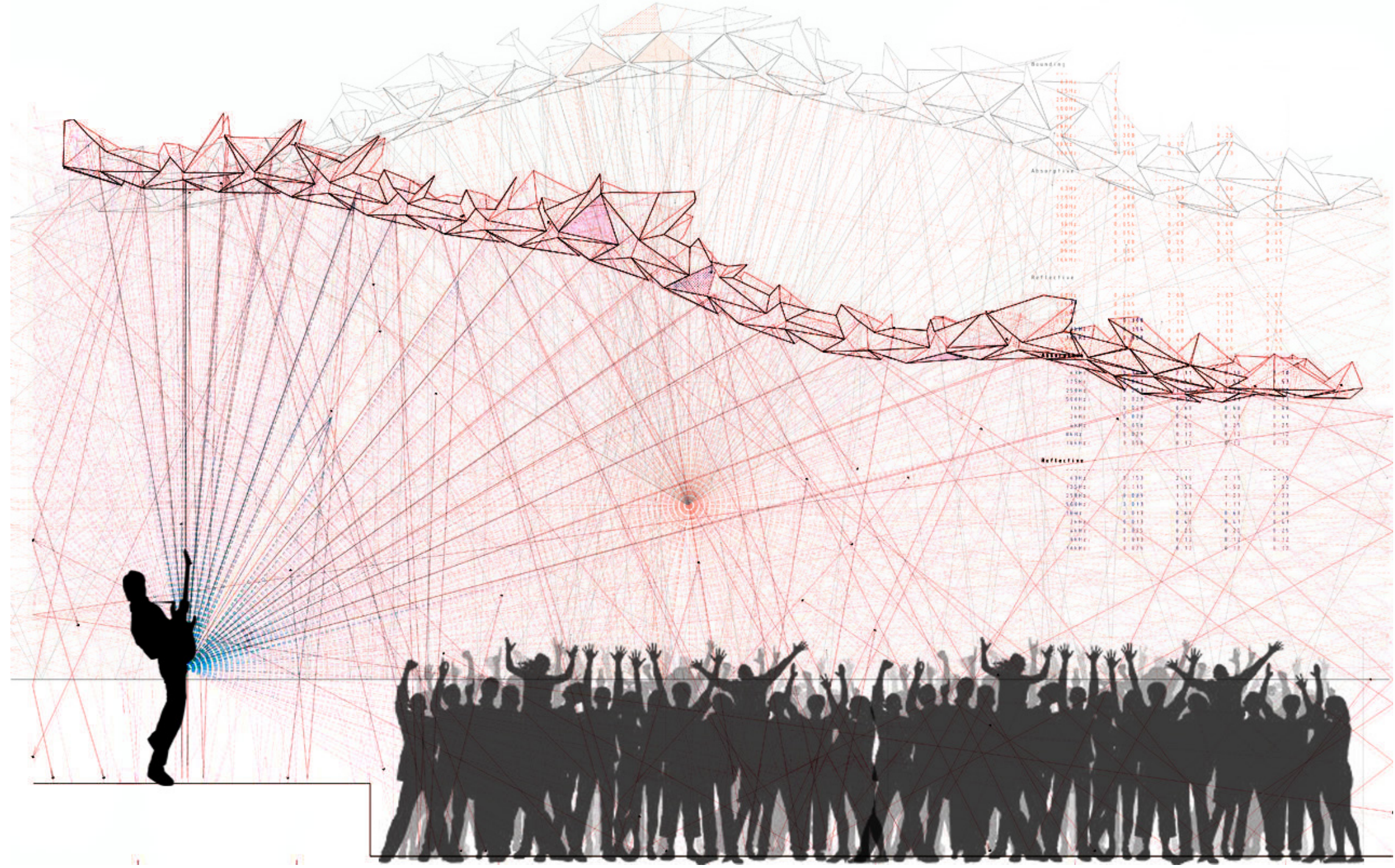
**Figure 4.0a**  
Skin formation from a trasportable planar figure to a tessellated  
interactive shape catering to the acoustic environment.

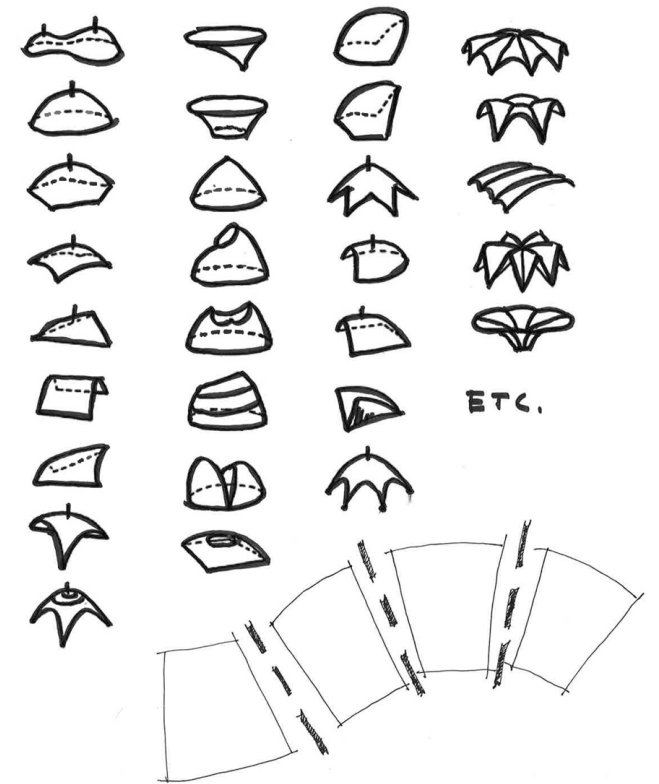
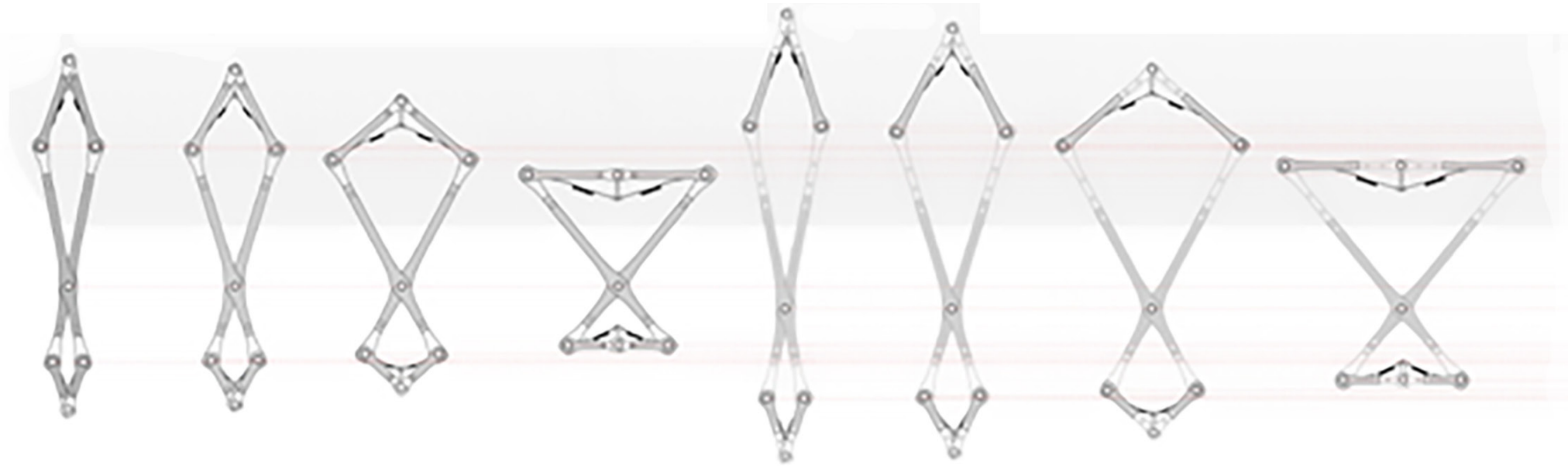
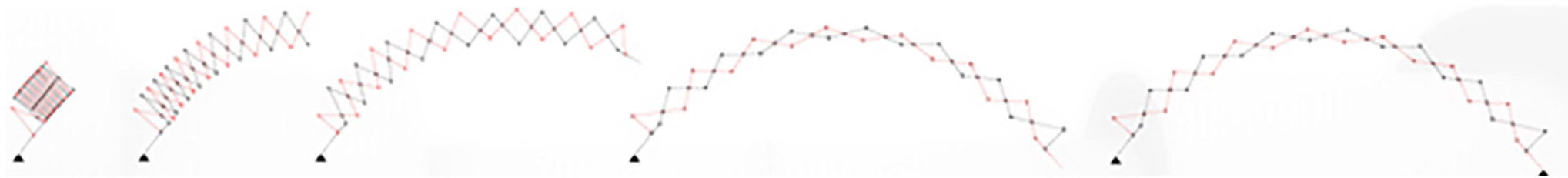
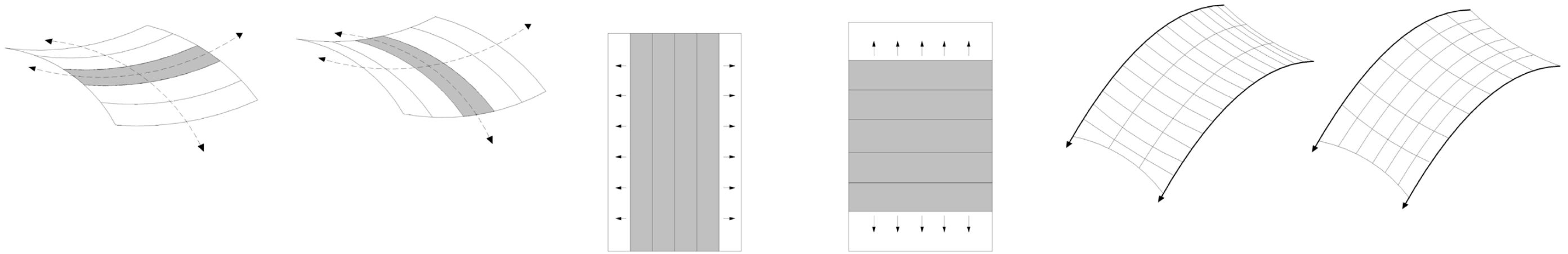


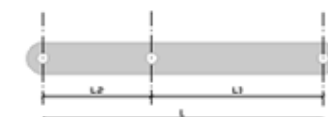
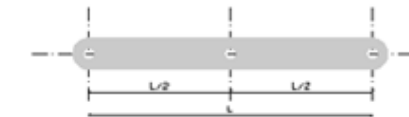
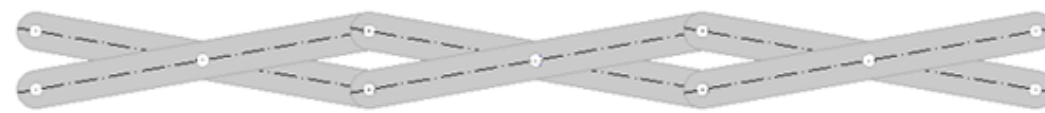
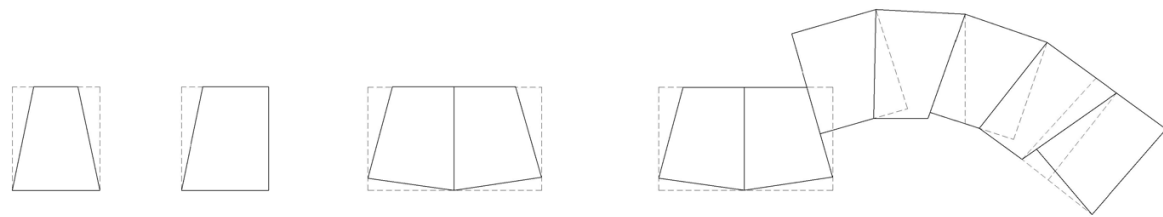
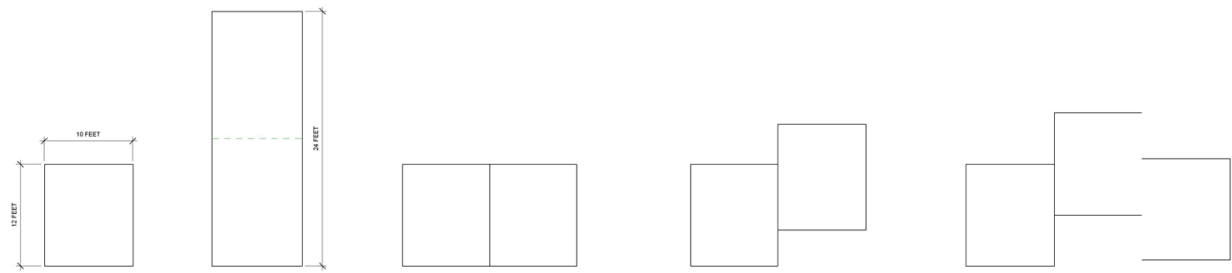
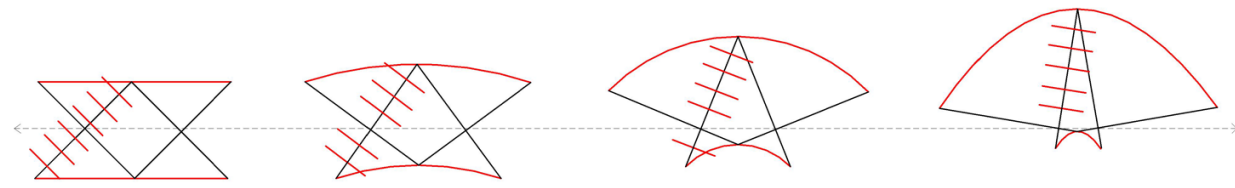


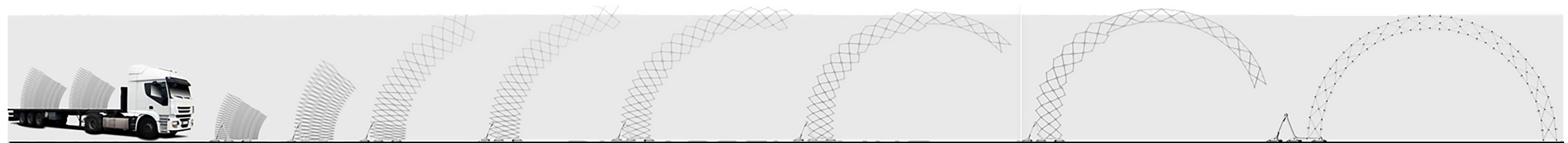
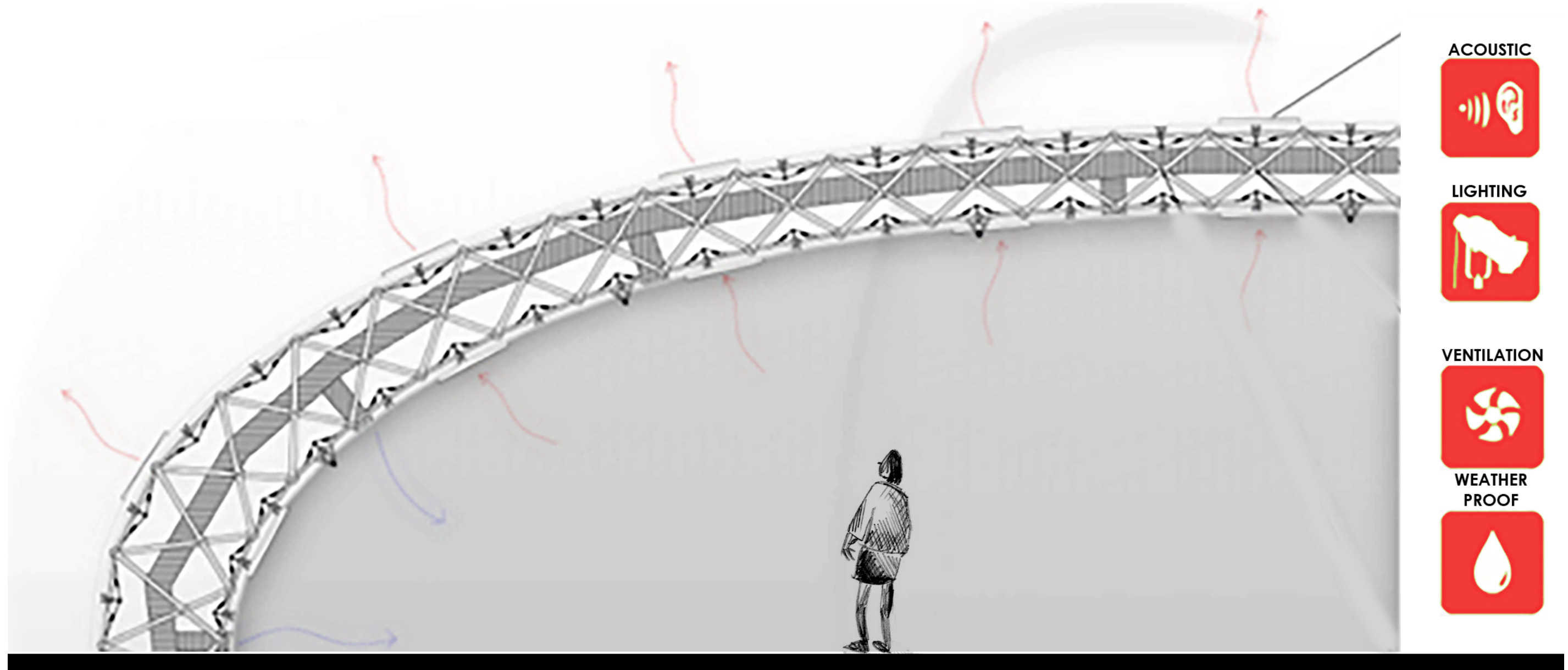


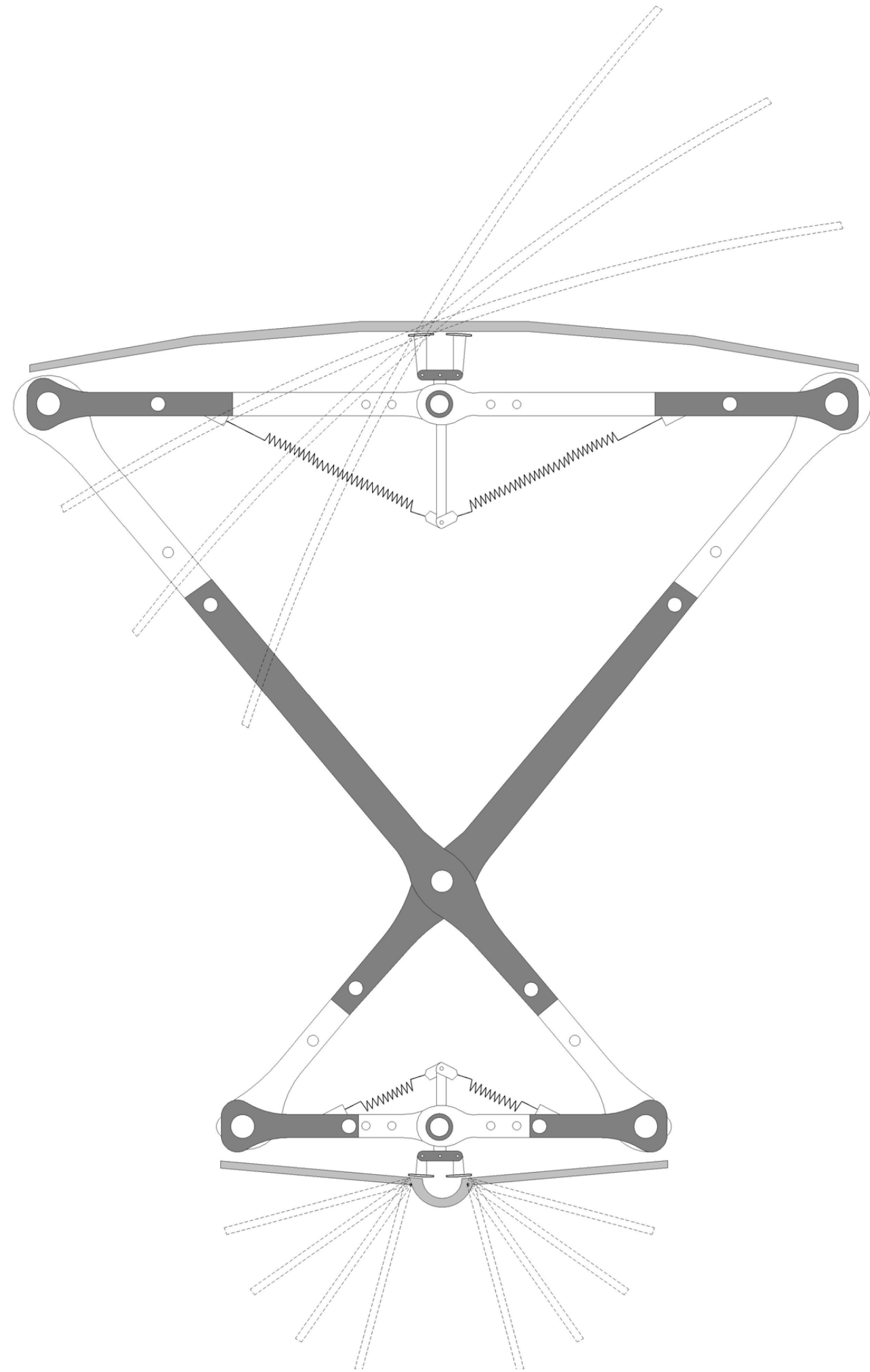




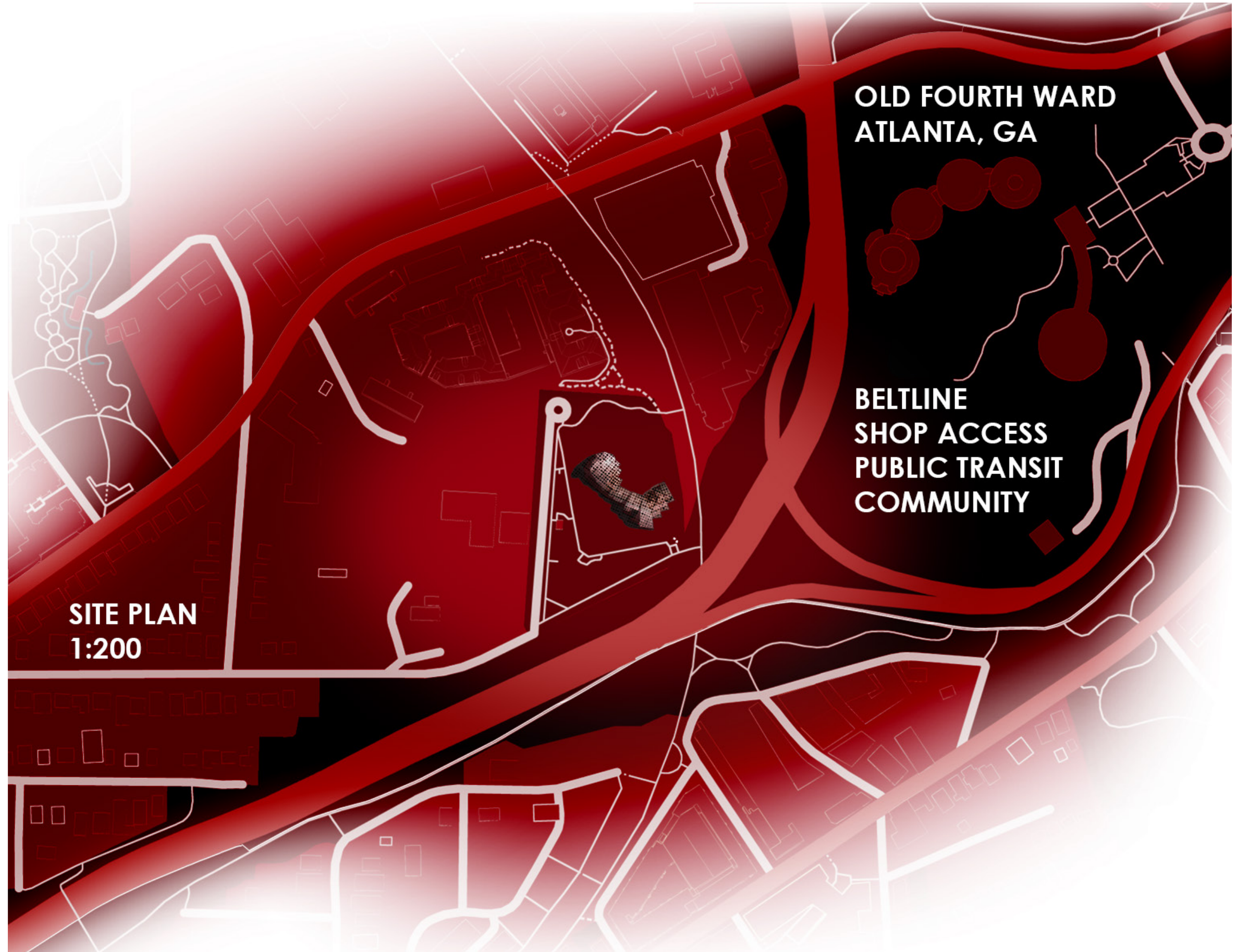


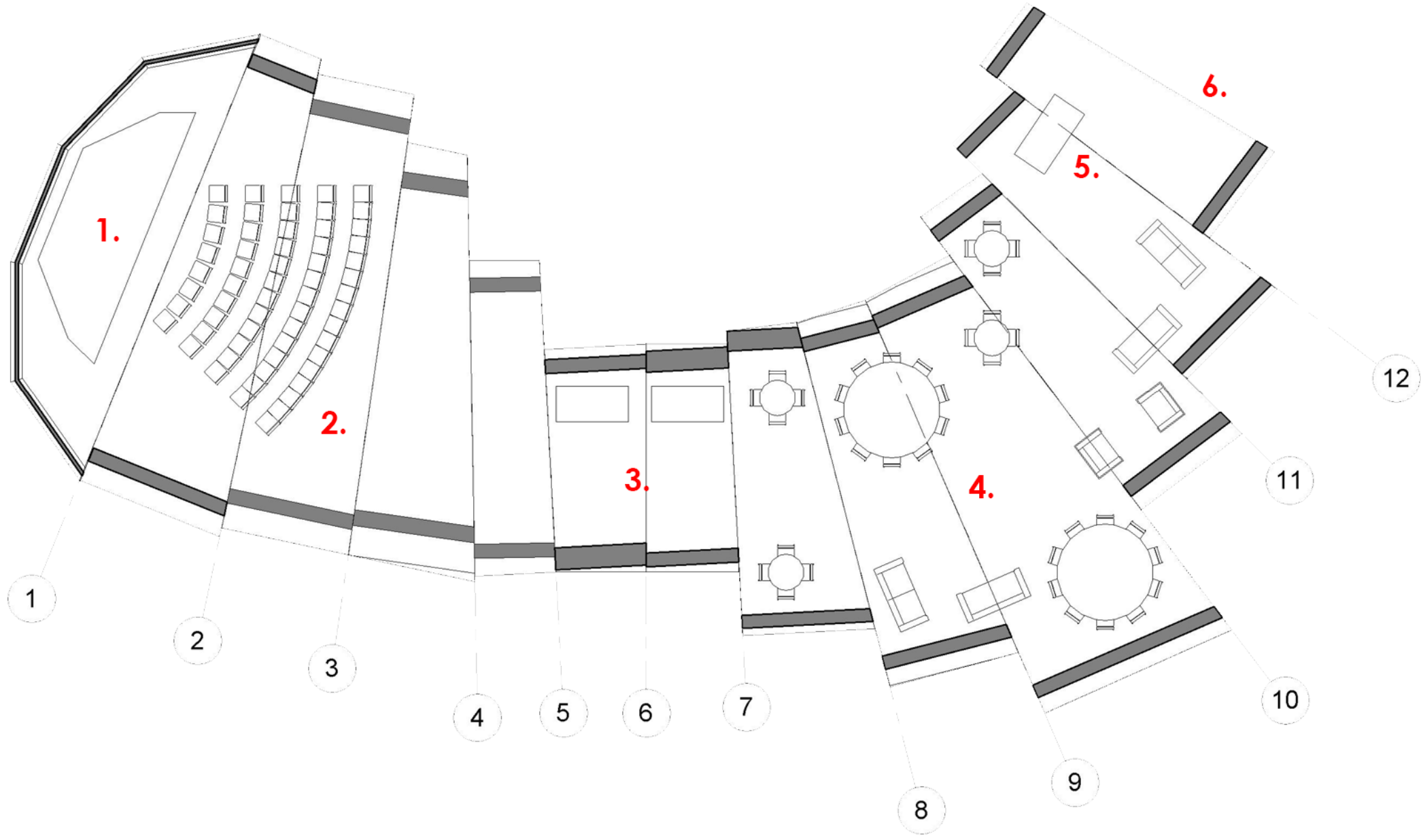




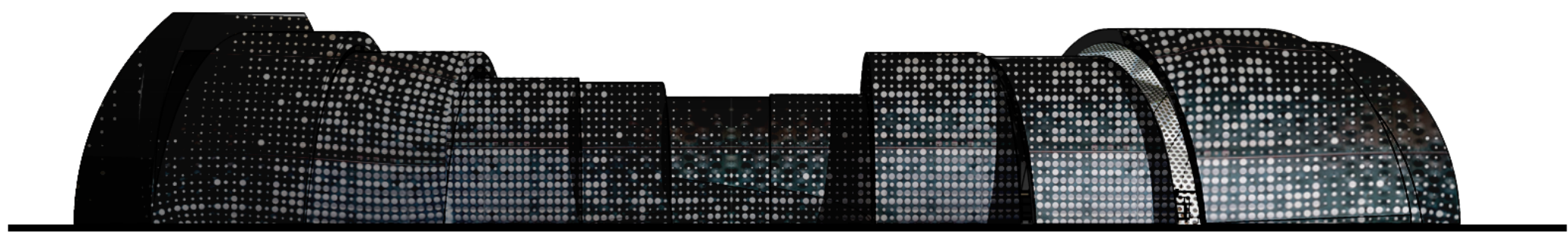


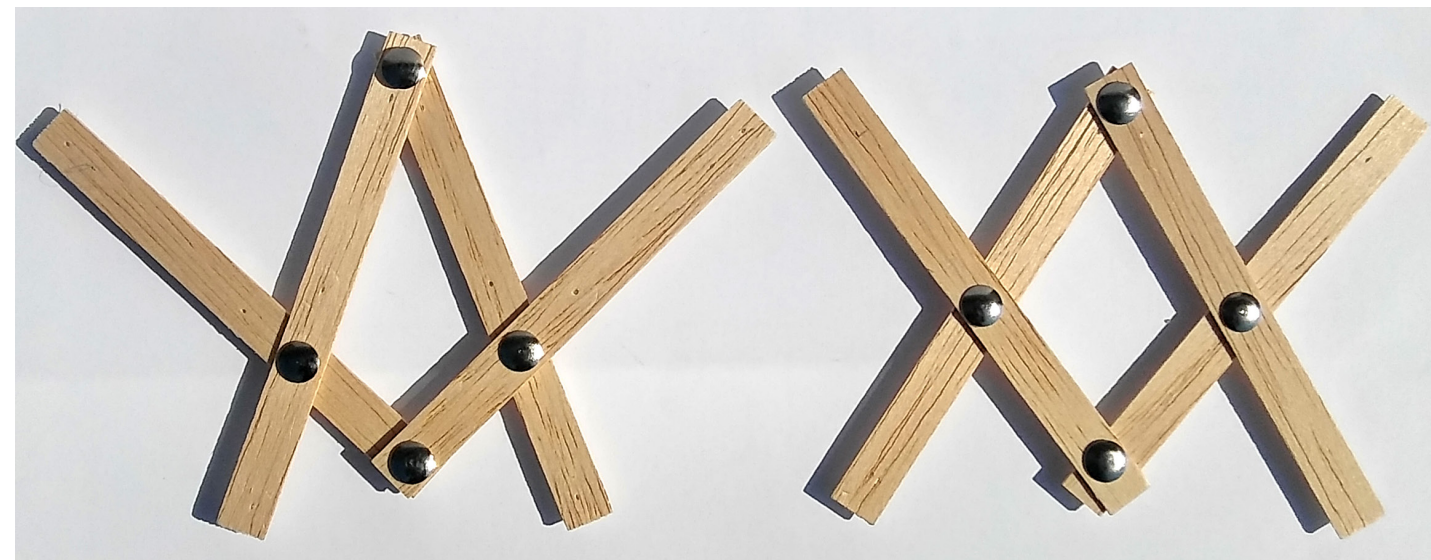
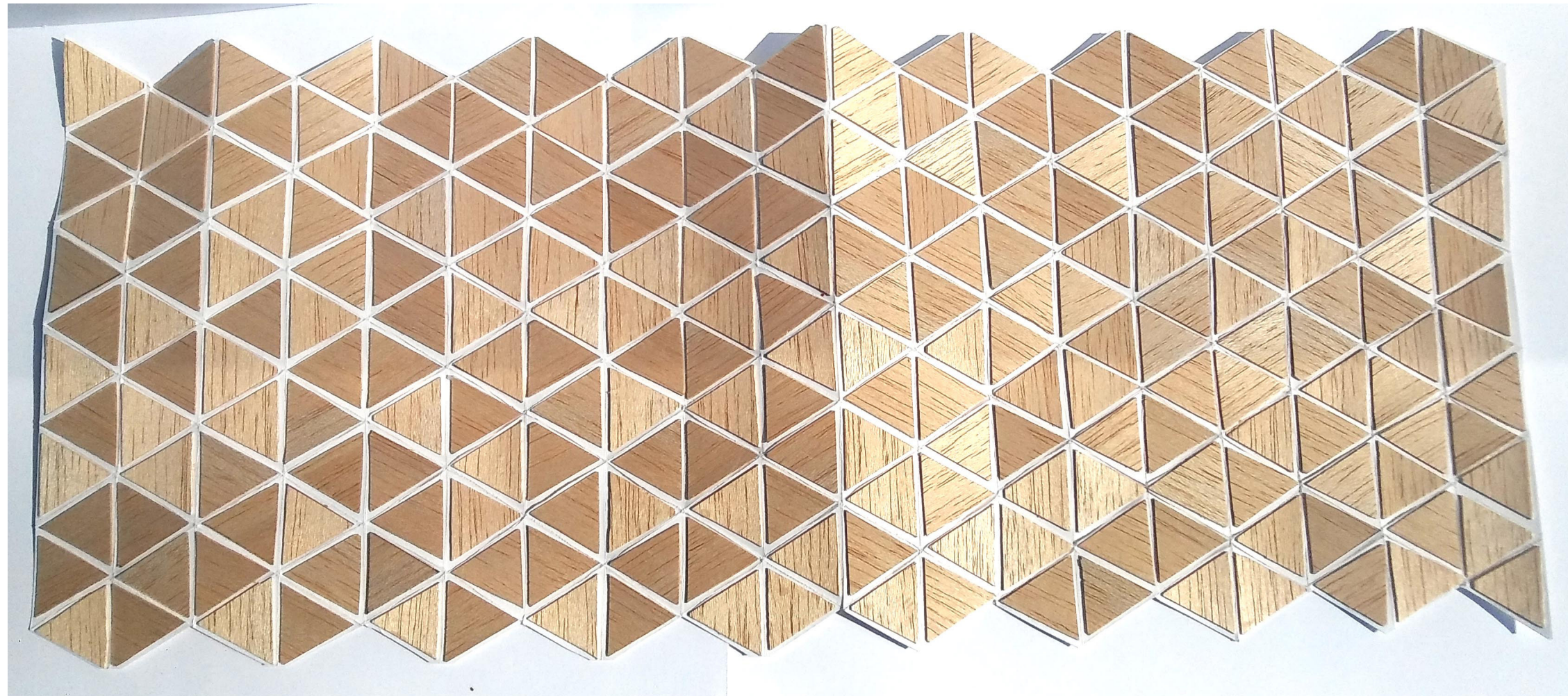


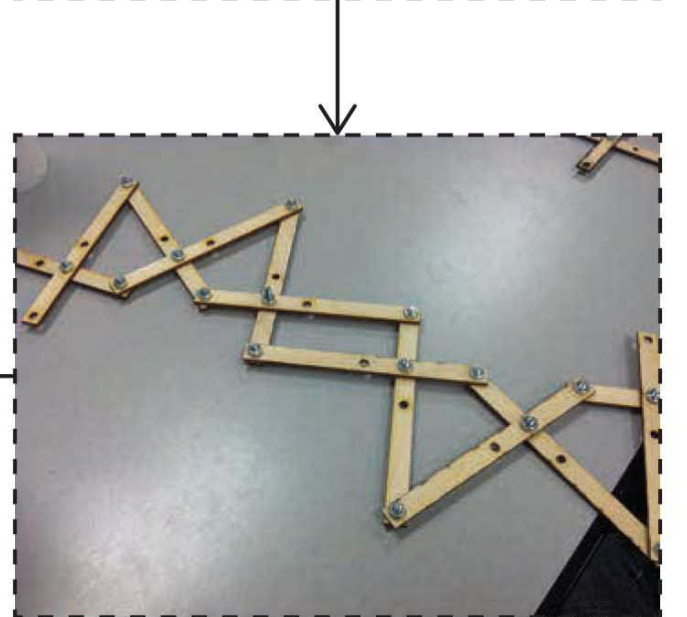
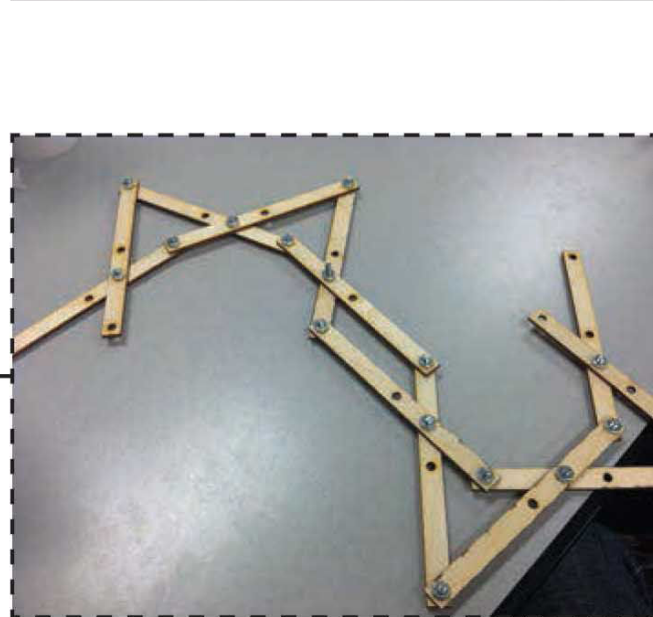
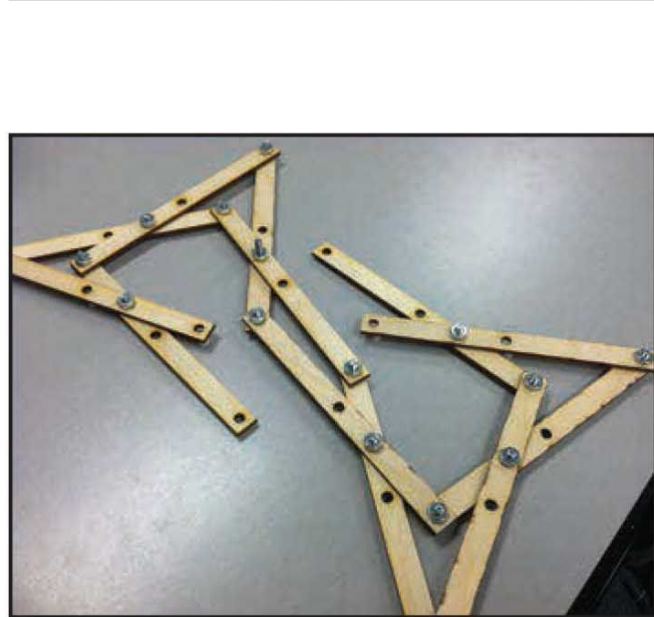
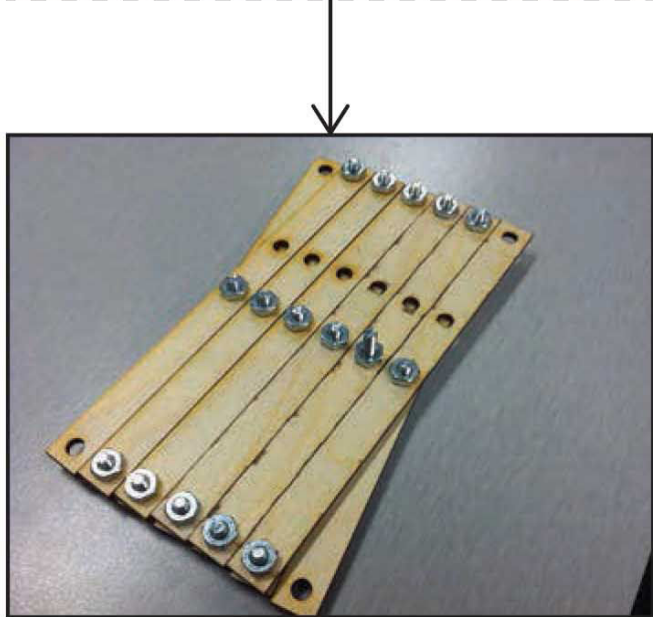
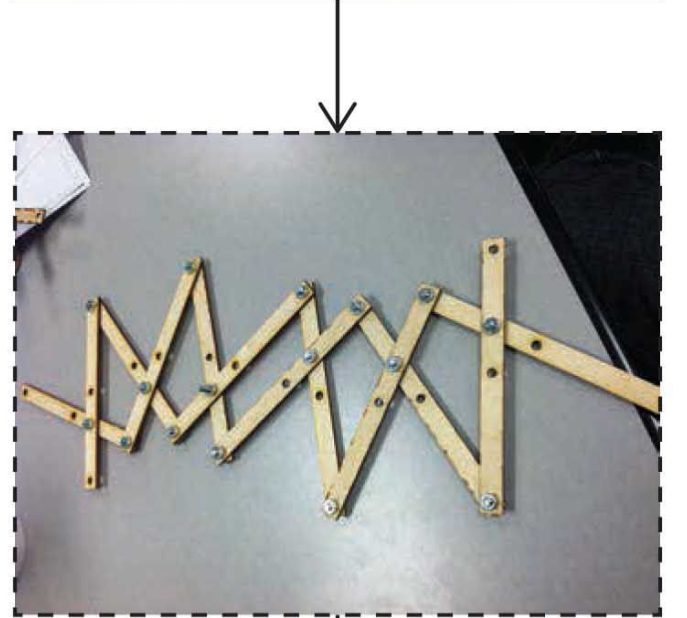
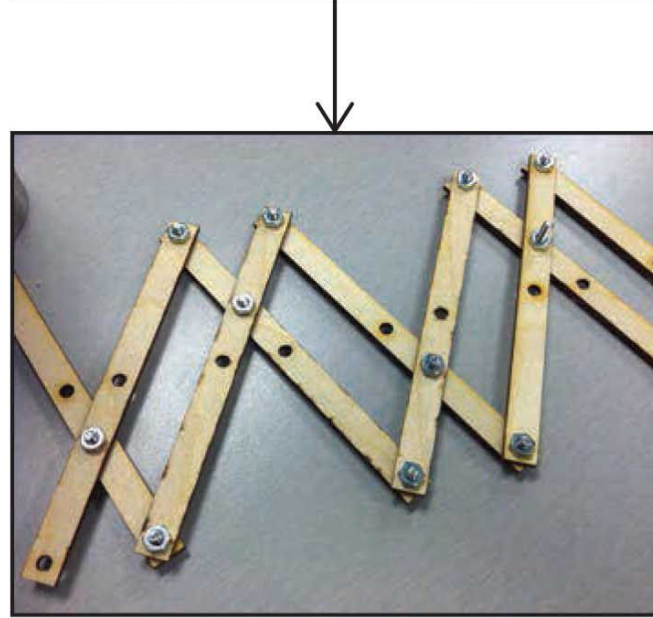
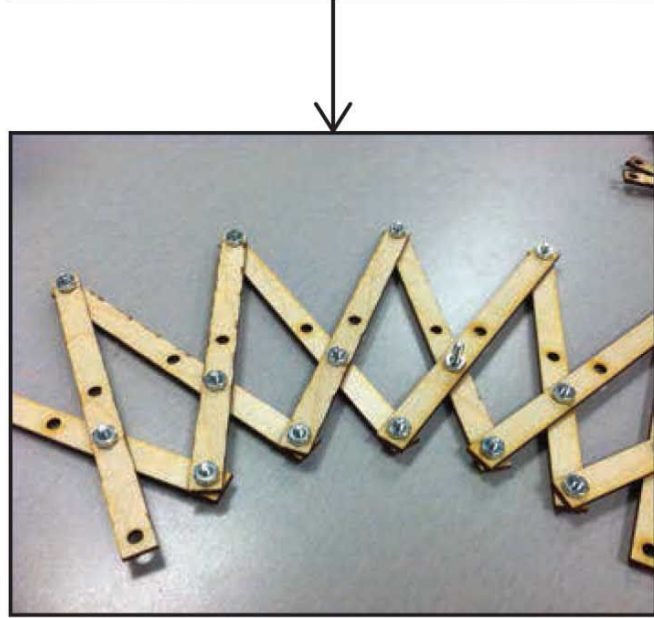
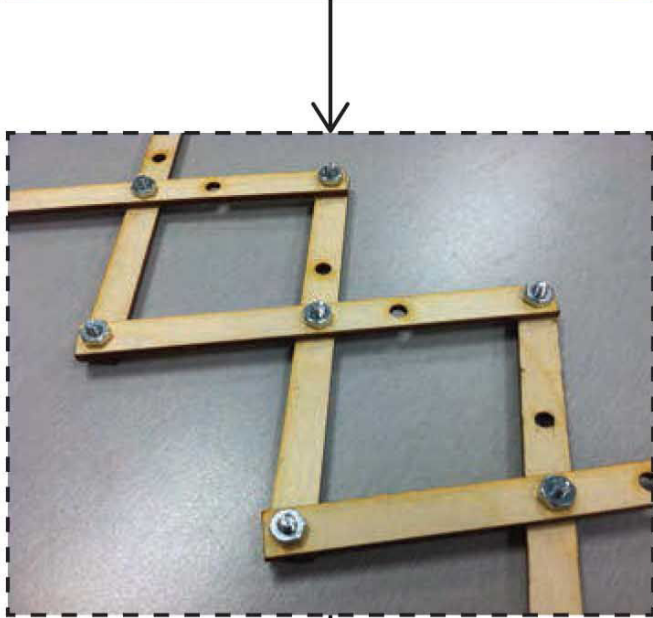
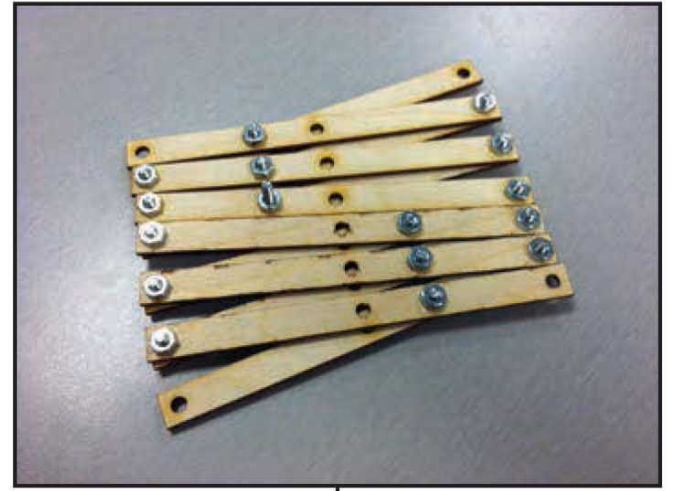
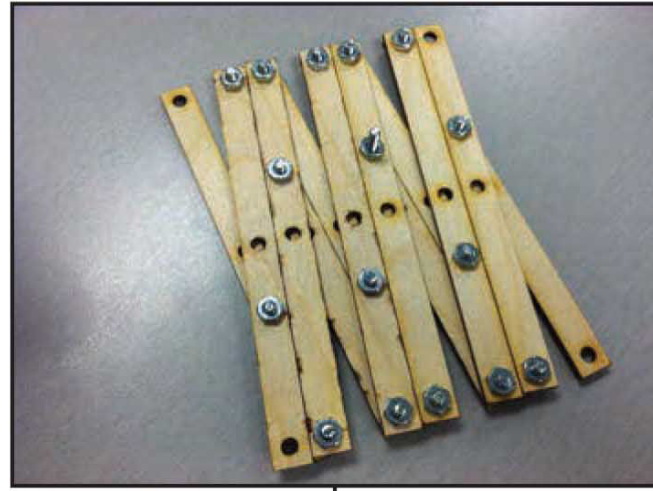


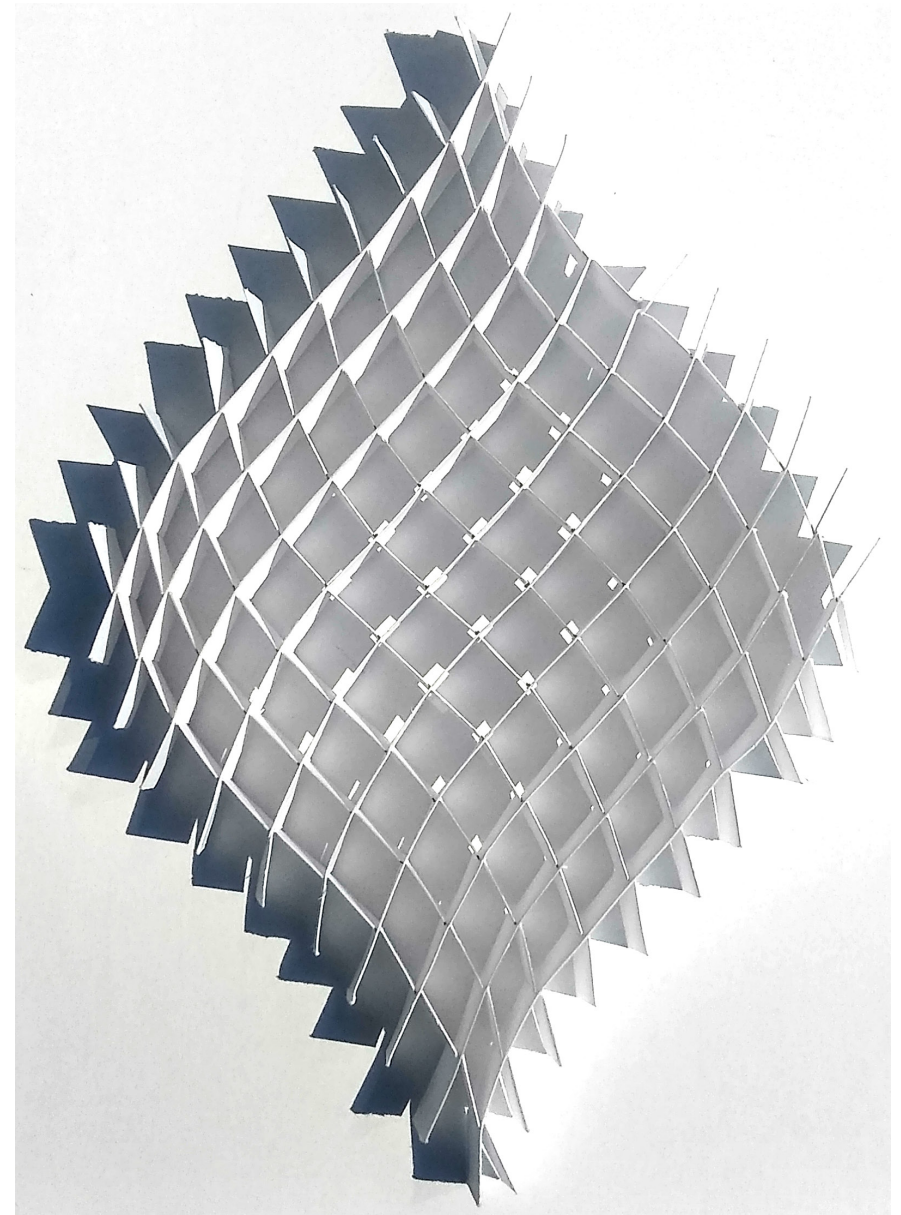
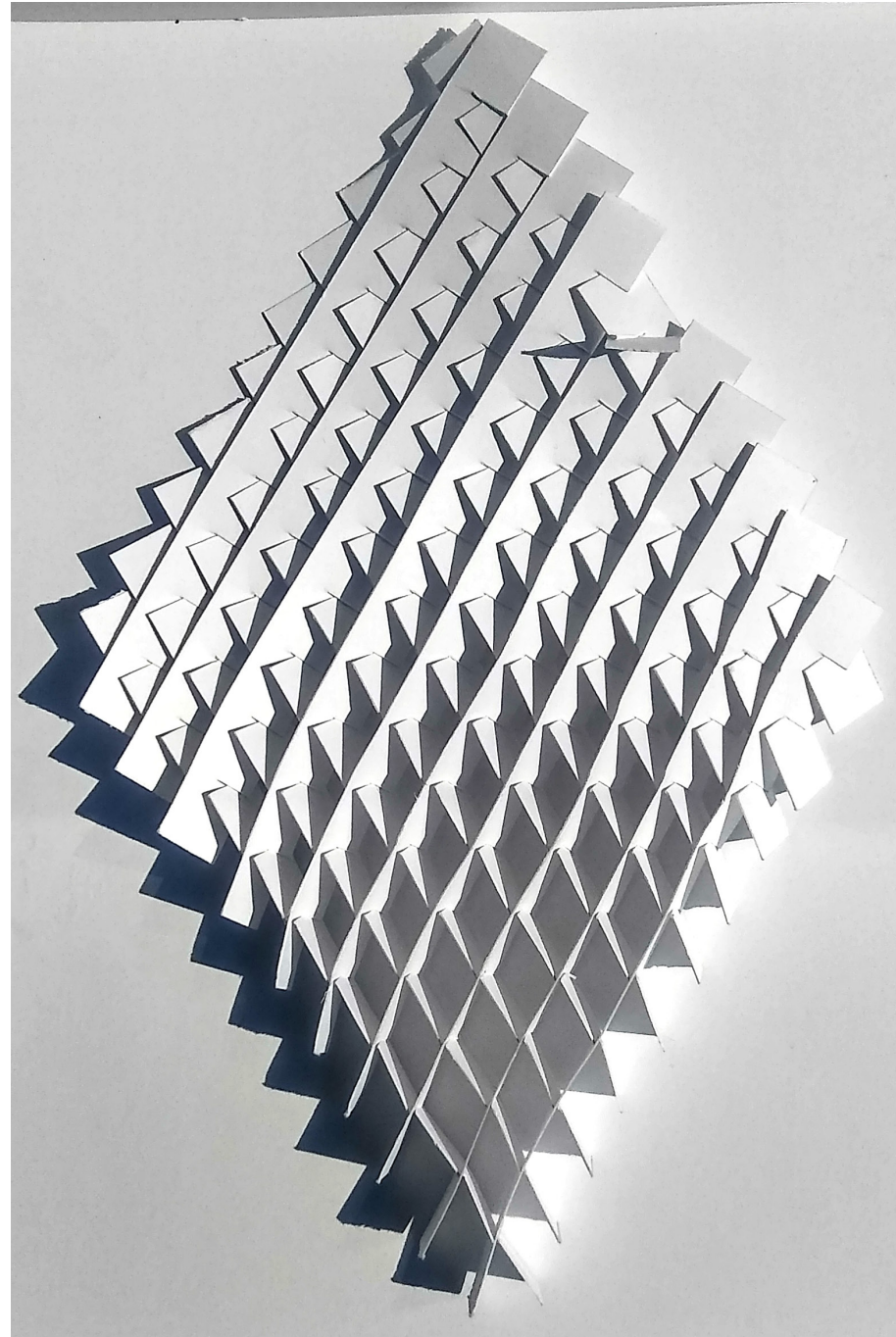
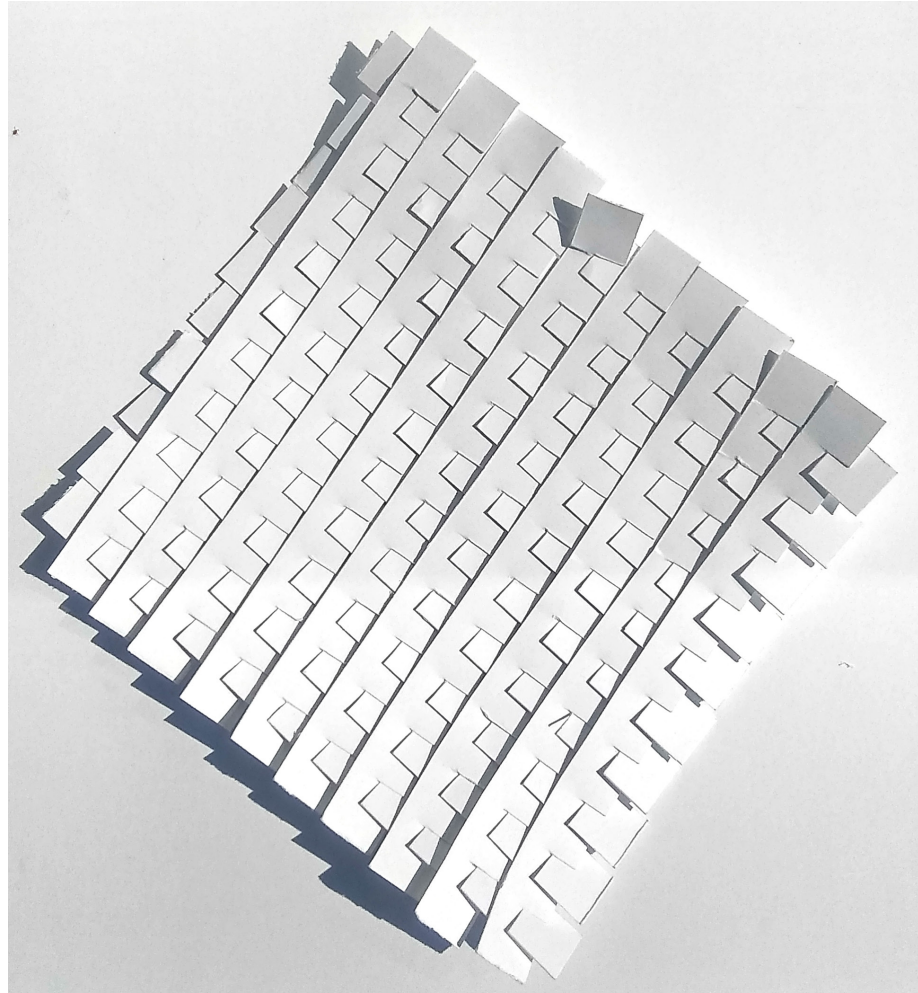


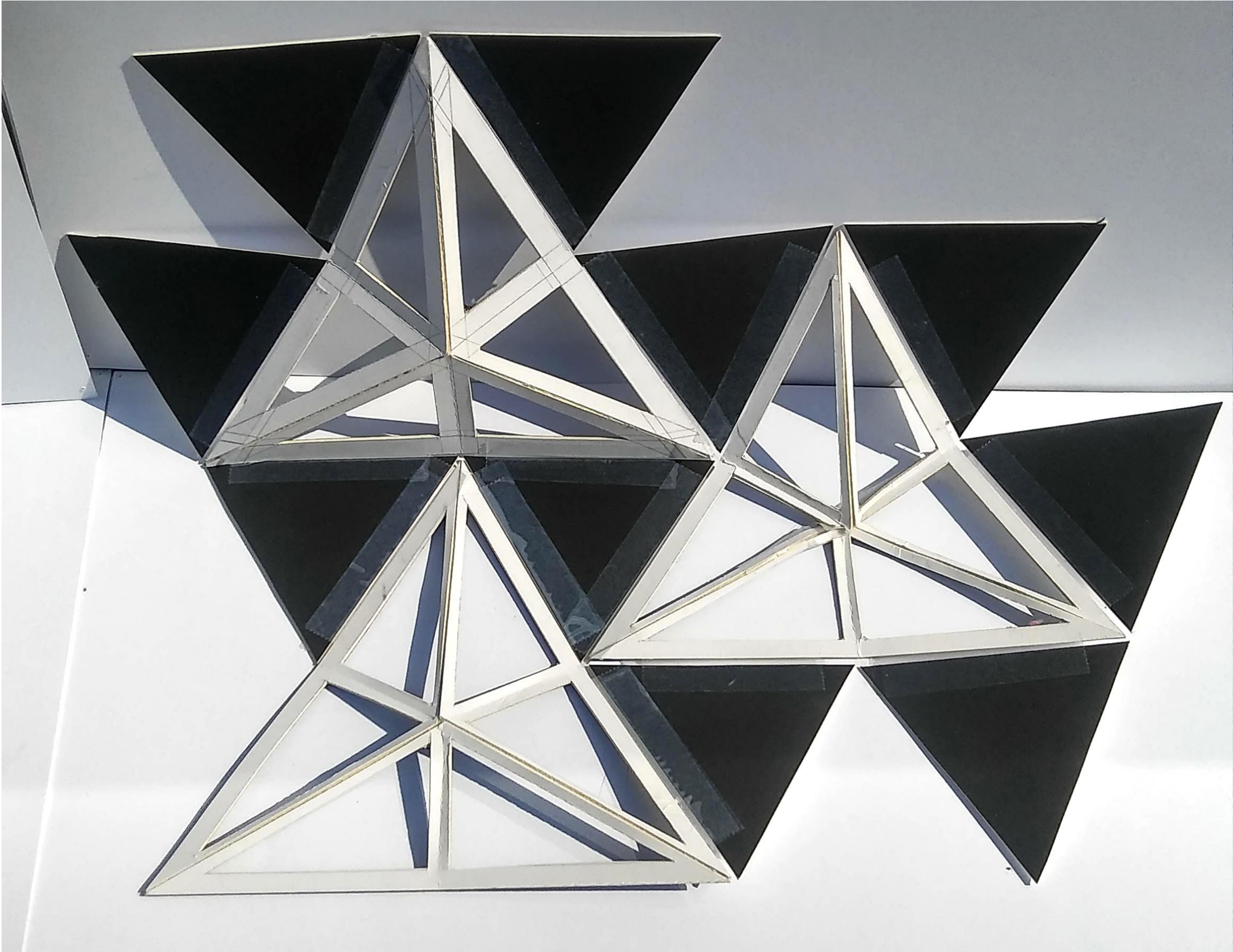
- LEGEND**
- 1. STAGE AREA
  - 2. AUDITORIUM SEATING
  - 3. MERCH TABLES
  - 4. GENERAL SEATING
  - 5. TICKET LOBBY
  - 6. MAIN ENTRY

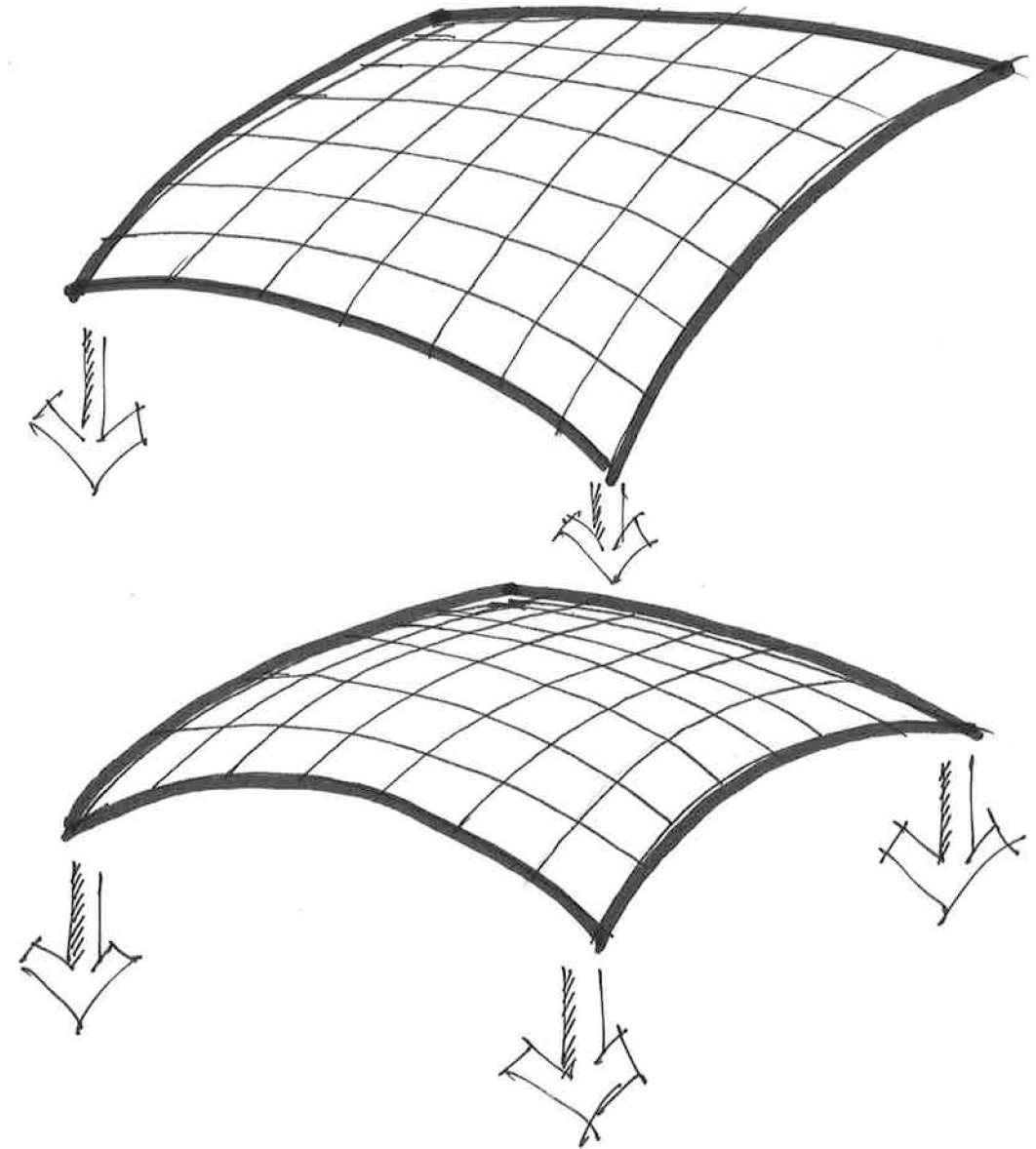
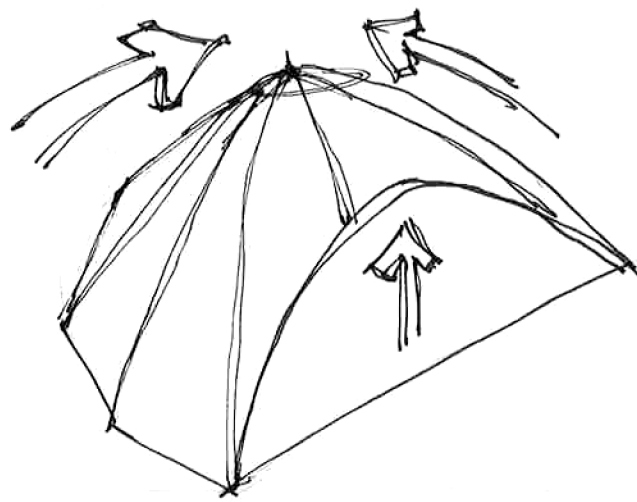
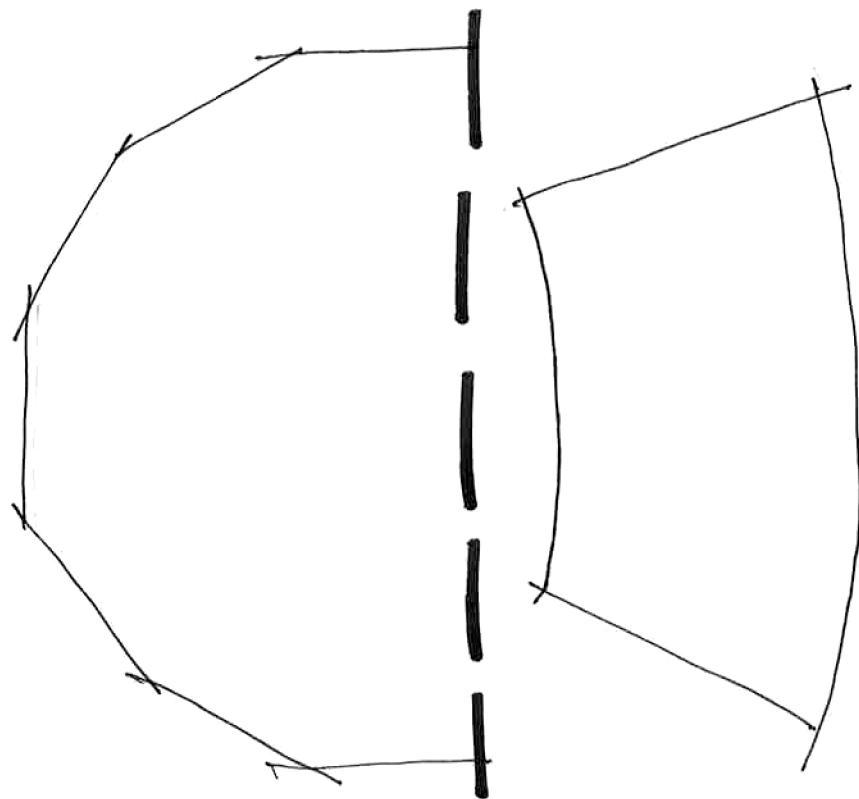
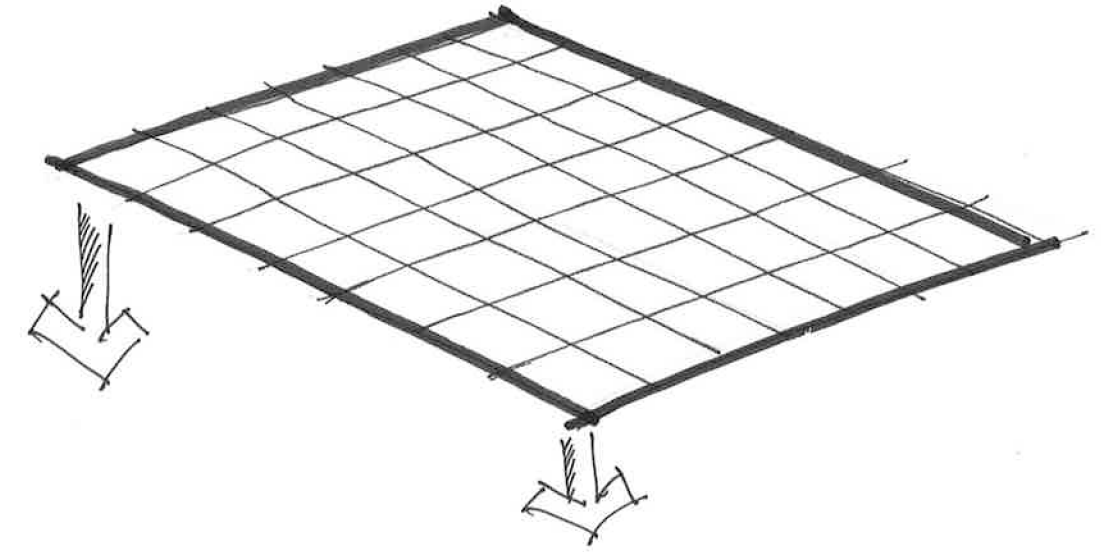
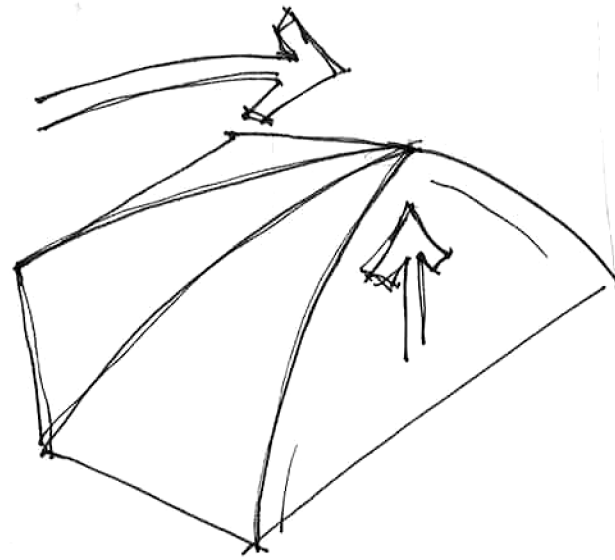
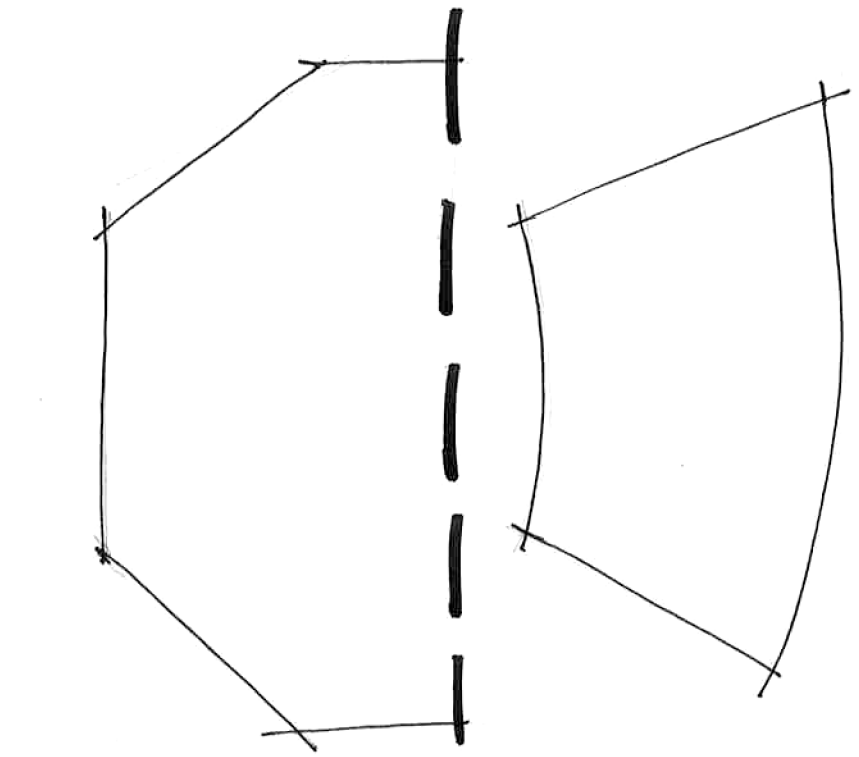


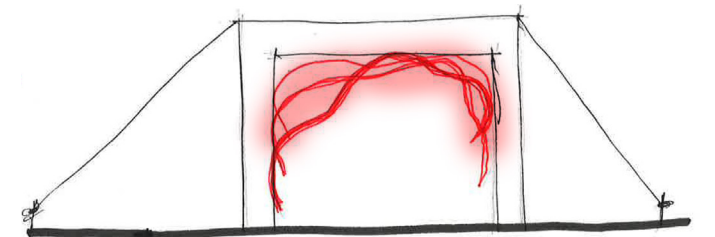
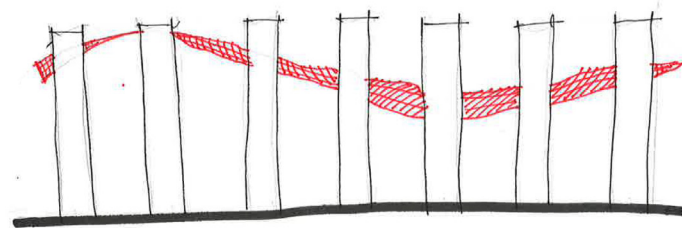
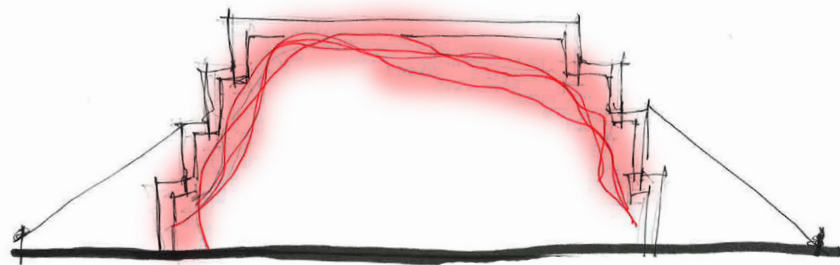
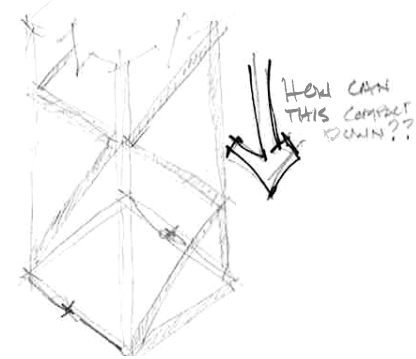
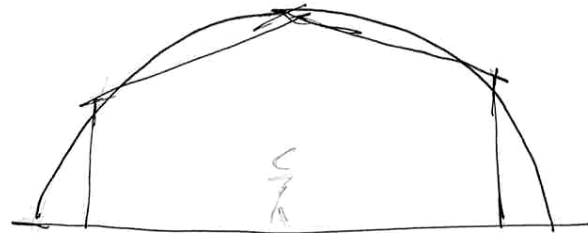
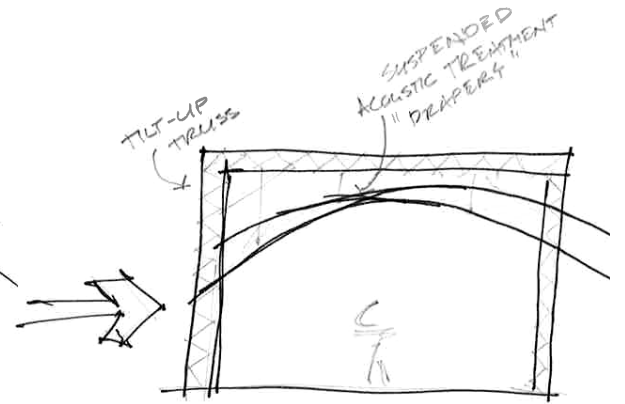
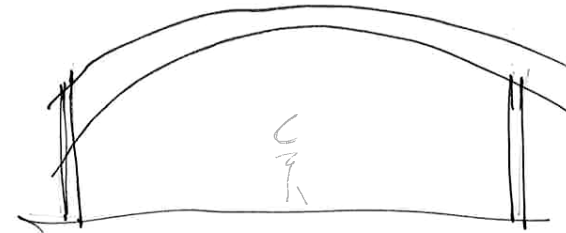
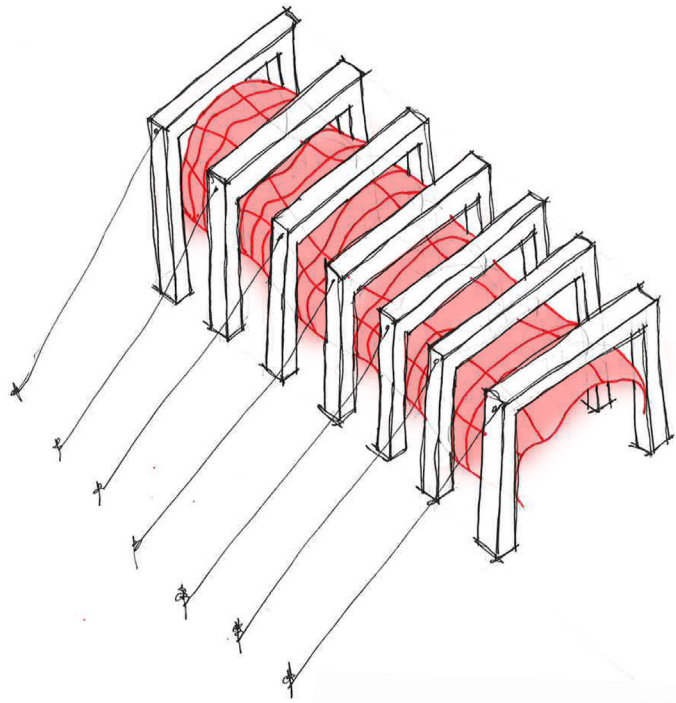
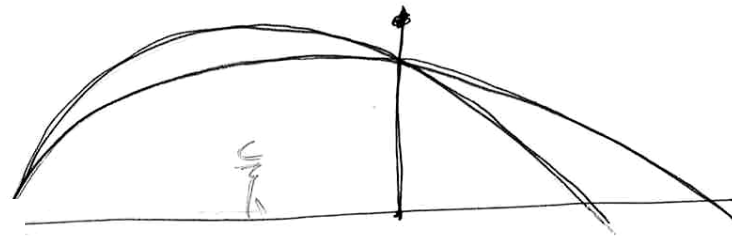
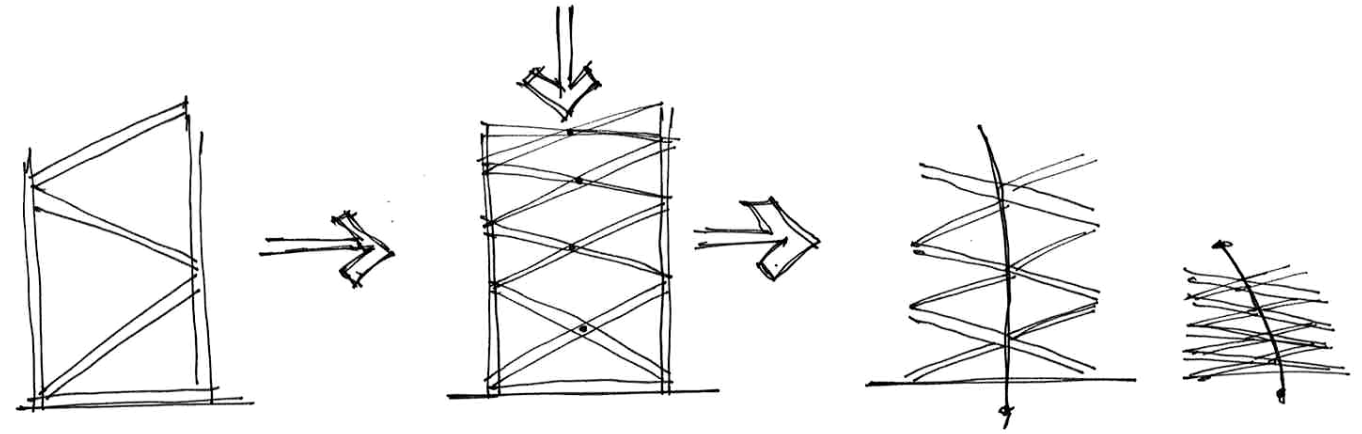
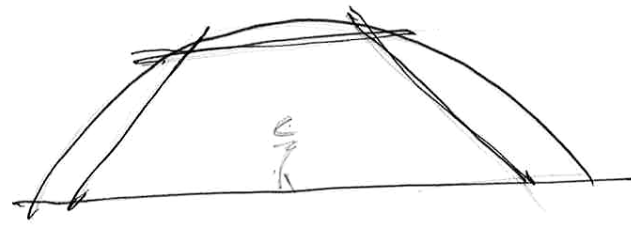




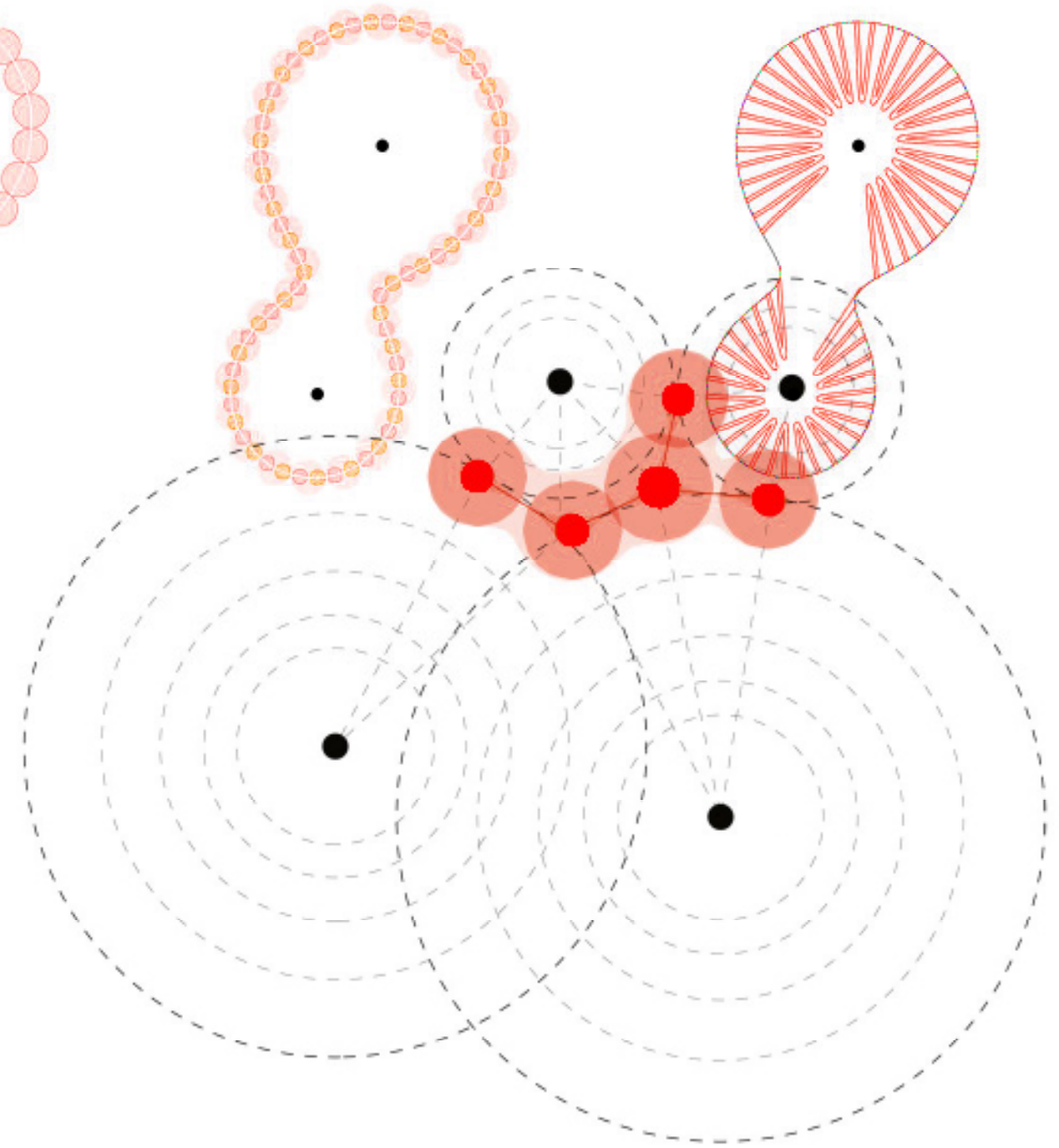
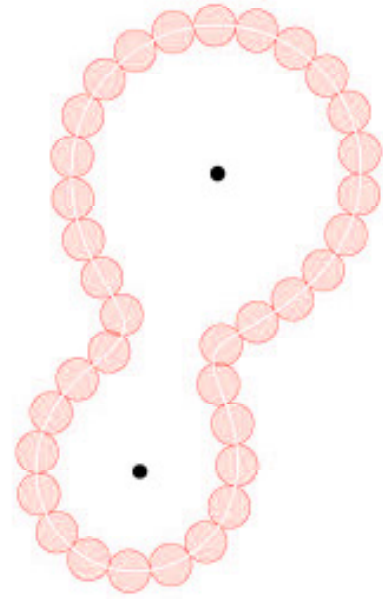
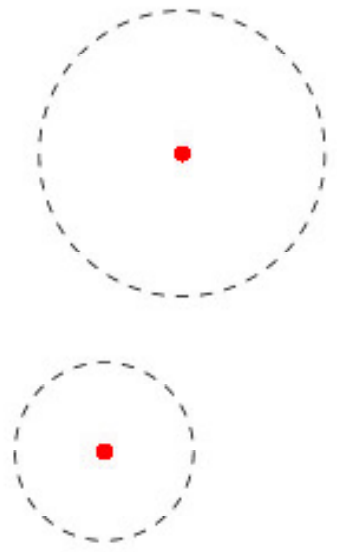


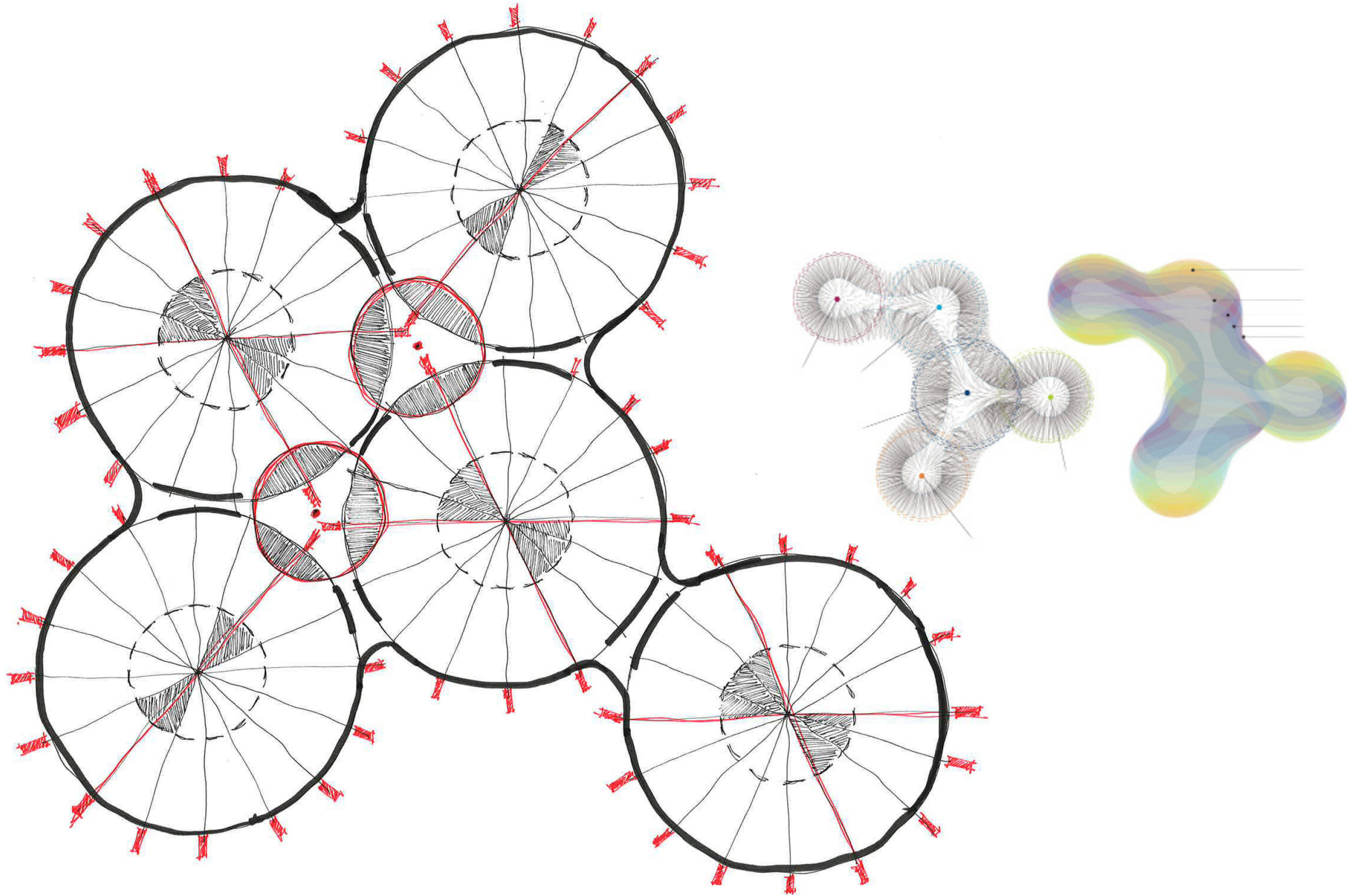












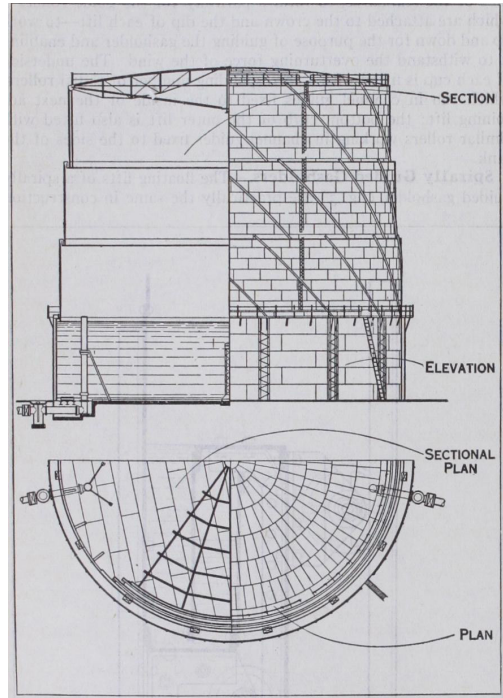
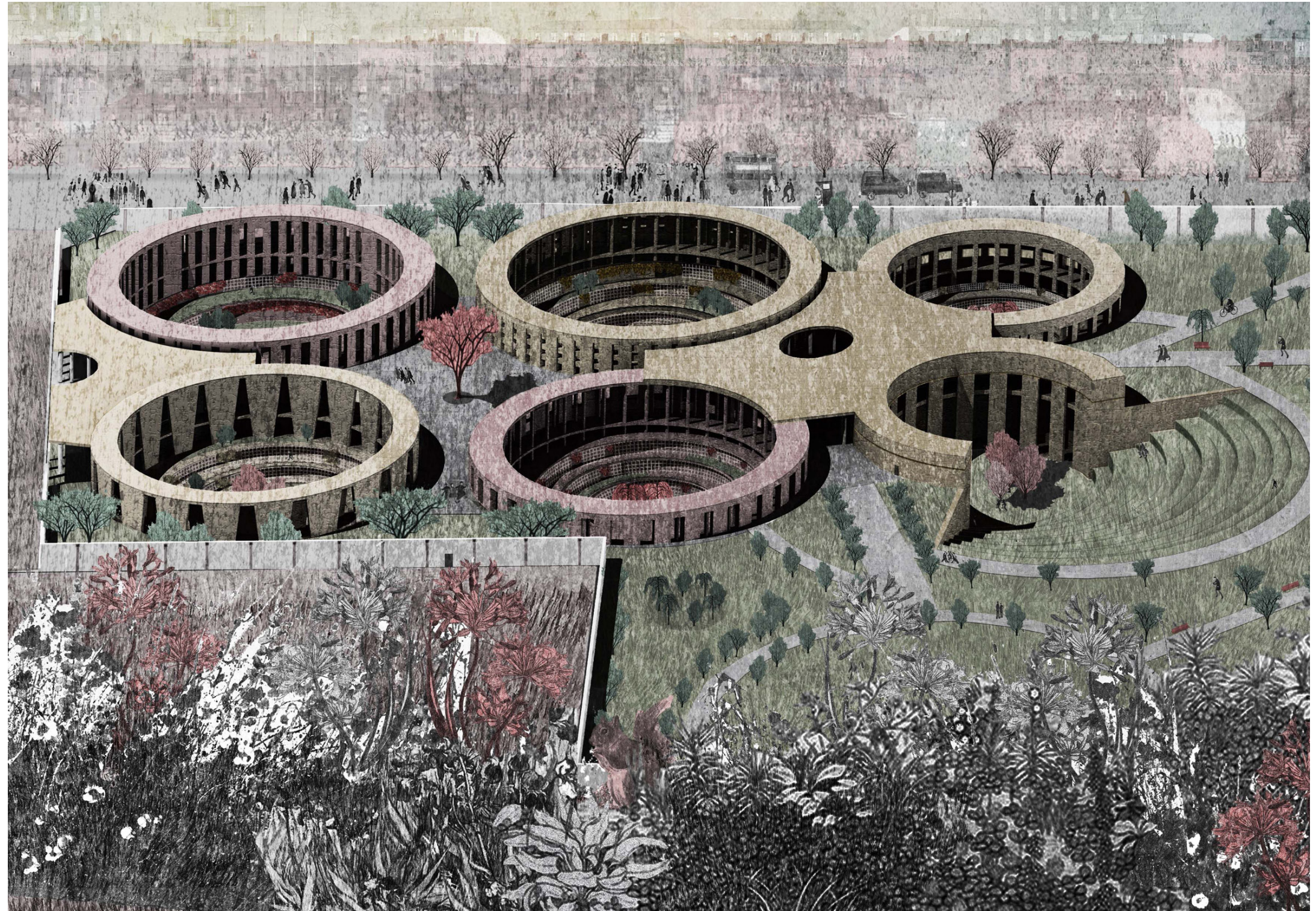
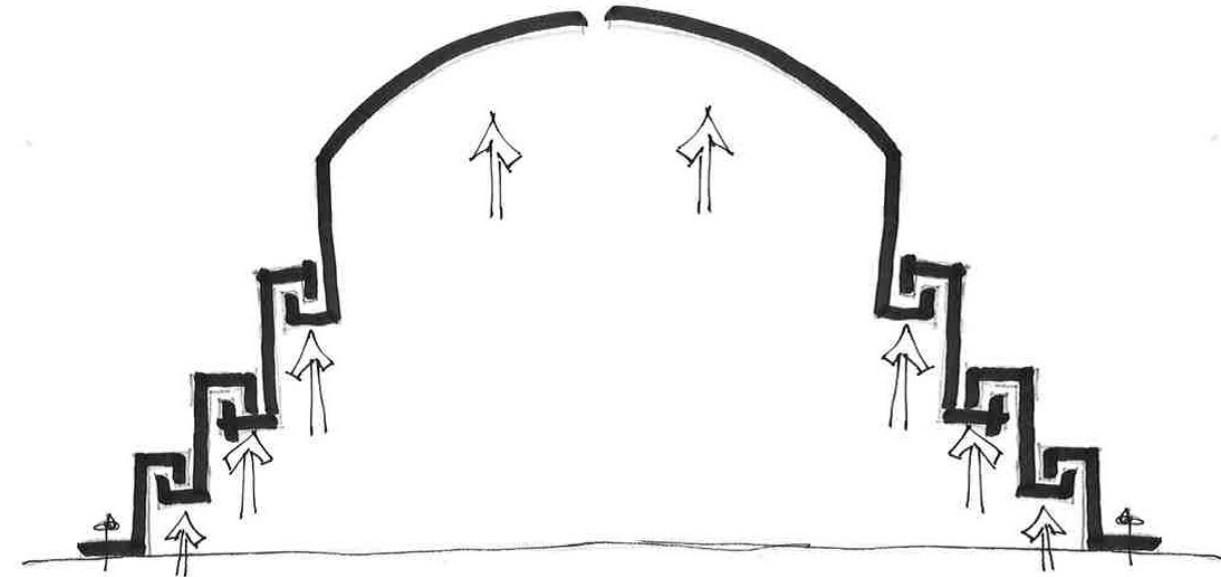
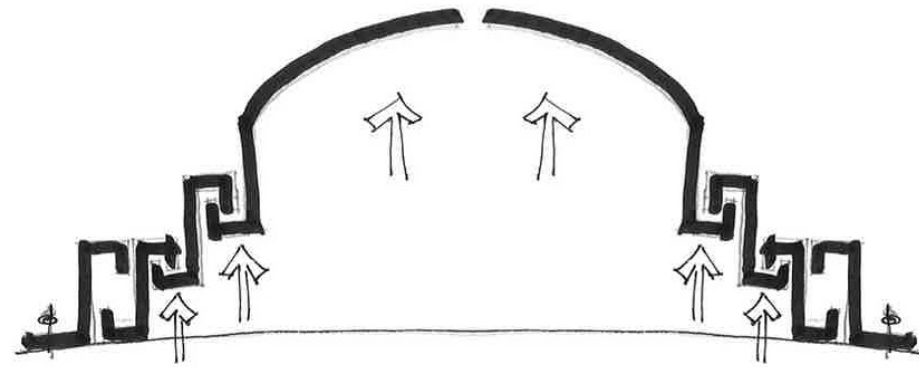
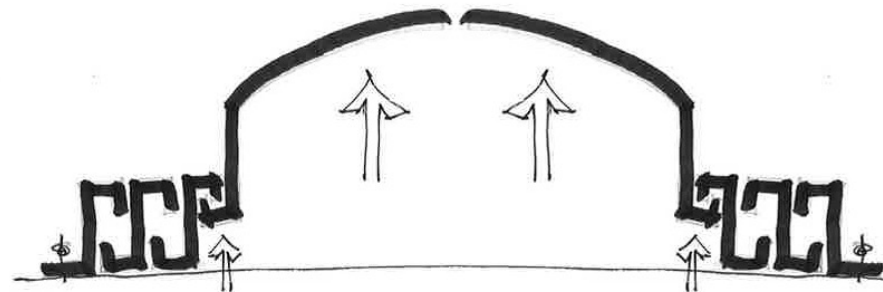
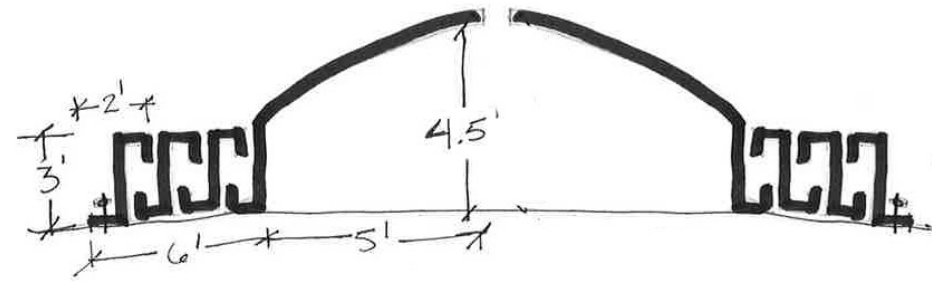
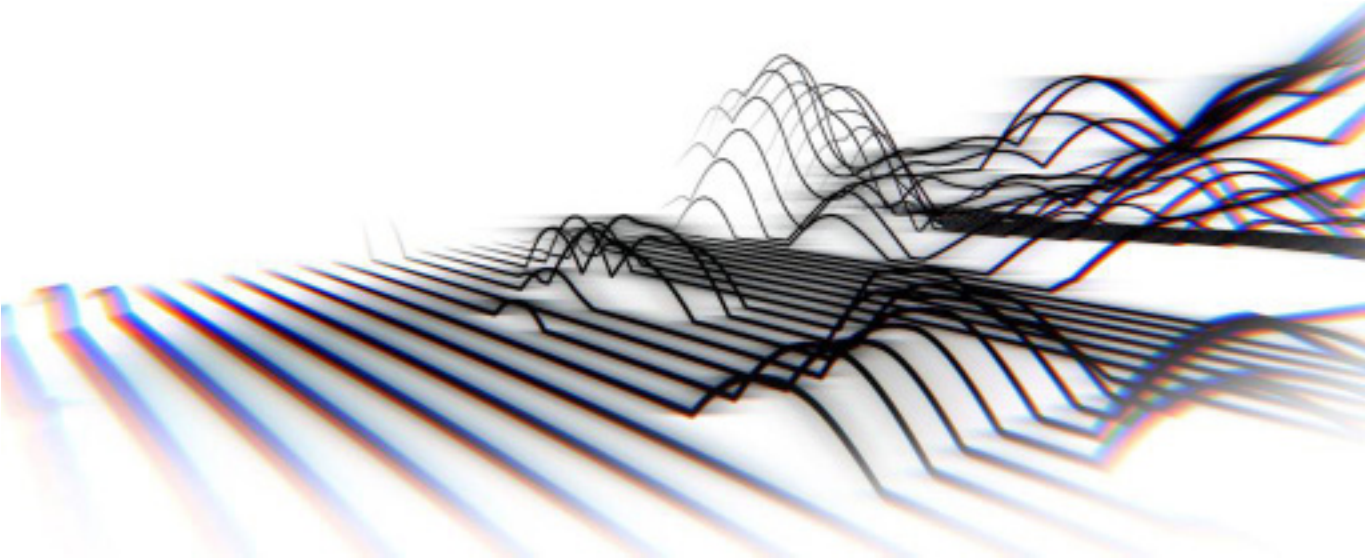


FIG. 3.—THE ELEVATION AND PLAN OF SPIRALLY GUIDED GASHOLDER  
The construction differs from the telescopic type in having a number of double-flanged rails, inclined at 45°, secured to the side sheeting of each lift



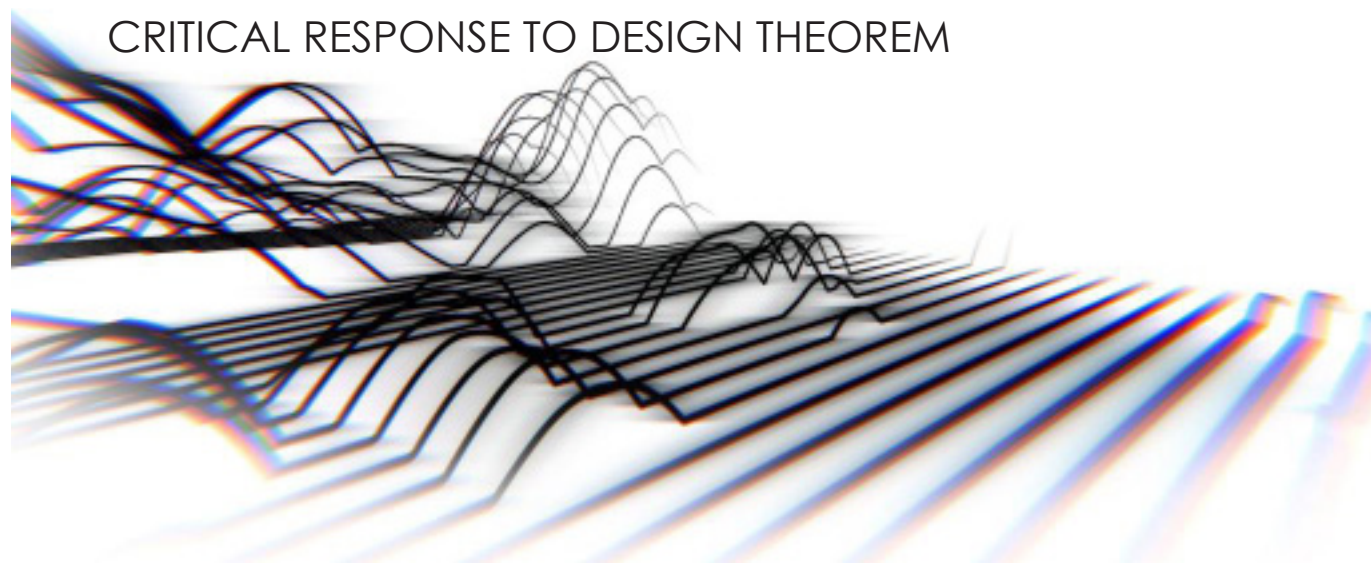






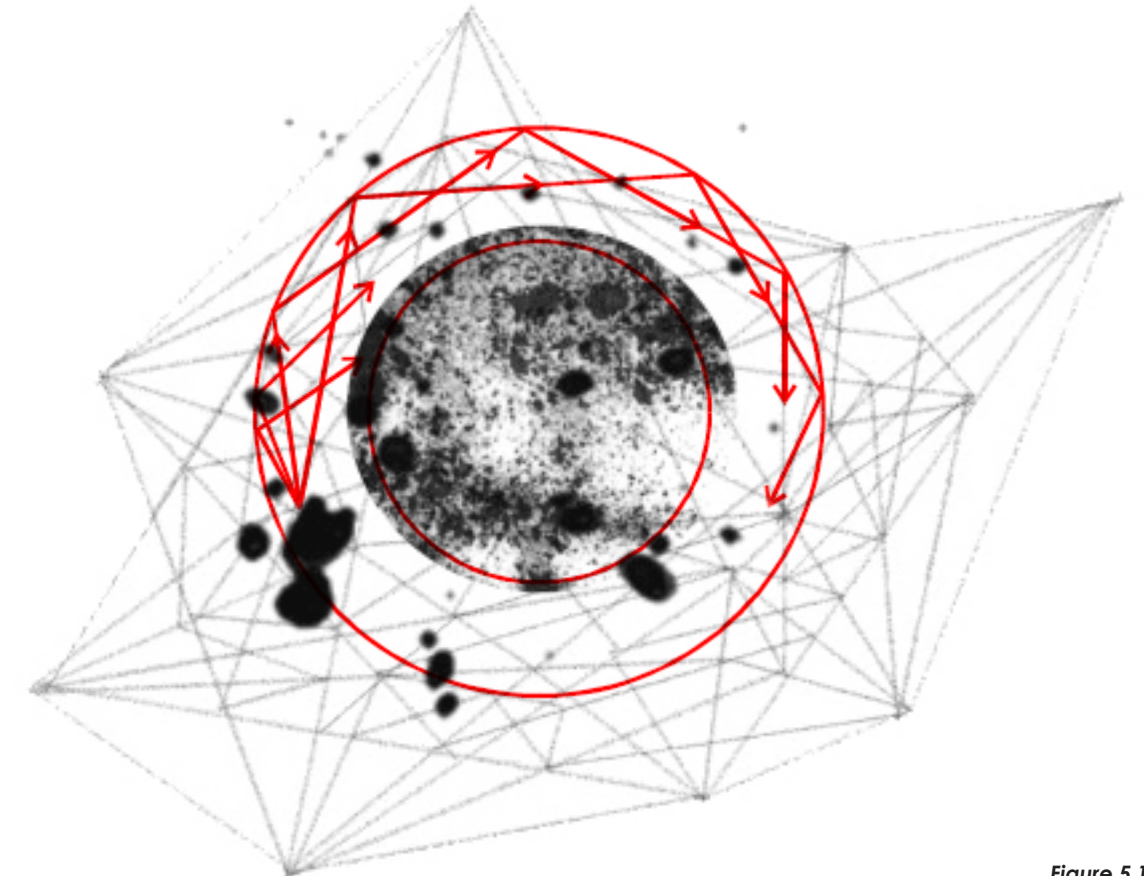
## CHAPTER FIVE.

### CRITICAL RESPONSE TO DESIGN THEOREM



In summation, this project aims to provide culture, collaboration, connection, and community in celebration of music, spoken word and all performing arts with respect to the intelligibility of all sounds associated with each performance. By studying acoustical data in a given interior volume, a set of rules and criteria have been developed in order to allow clarity within a particular acoustic zone. By using reflective and absorptive panels integrated with lighting, ventilation and aesthetically pleasing materials, the interior skin is allowed to cloak the event with architectural interest while still remaining performative in nature. The ease of constructing and deconstructing the supporting frame pulls the event's various zones together and provides flexibility in arrangement and program on site. Rounding out the project is the transportable nature of the end result which allows a 2-10 person team to erect a full assembly for approximately 50-100 people within hours. Being able to plug in to larger productions as needed or to stand alone mimics the richness of architecture as it relates to the inherently transformative nature of human interaction and exploration.

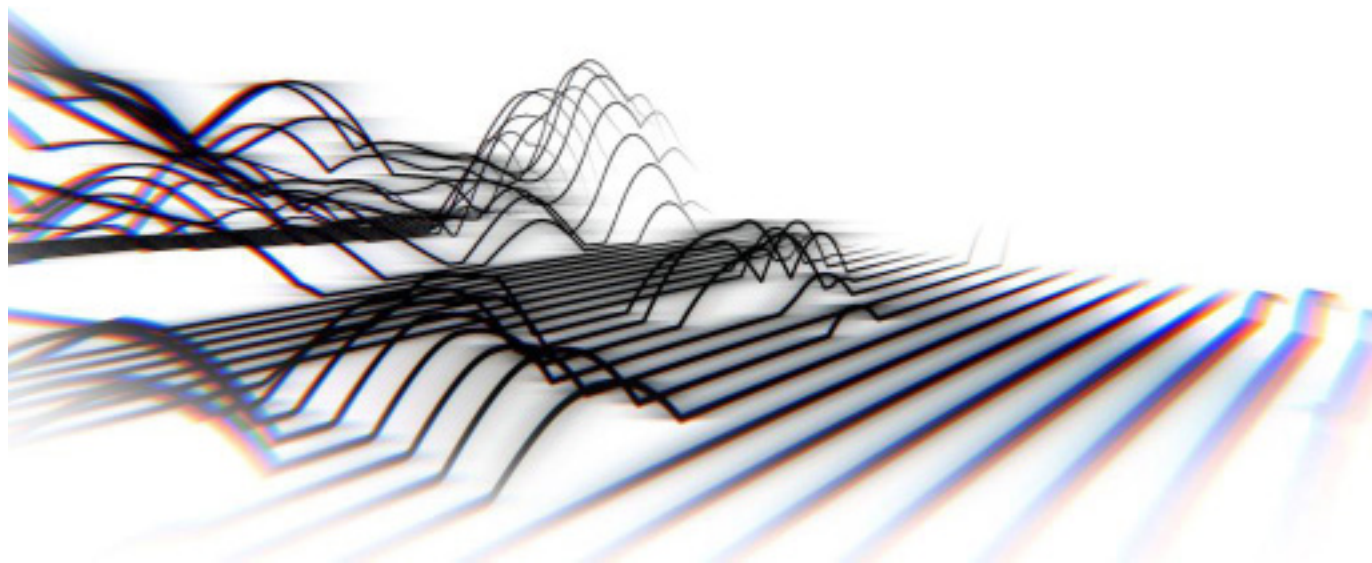
In the pursuance of acoustic clarity – first and foremost – in addition to kinetic and manufacturable structures accompanied by all variables associated therein, the initial proposal suffered a loss of its own precision and alignment with the main goal of creating a captivating sonorous interior environment. With that being said, simplifying the structure to one typology both enhances the strength of form and the flexibility of the end program. Once one “dome” is deployed, the nature of the construction method lends to a more controlled enumeration of acoustic zones. Treating each zone with the predetermined skinning method allows for stronger clarity during separate event moments. The site selection criteria can expand and contract due to the client's vision without compromising schedule and transportation. Finally, disassembling and transporting the theater from city to city for a major festival is as inherently simple as a one-man band seeking to entertain a niche audience. Expanding further, this concept could easily be adapted to other types of environments not discussed in this thesis, such as public transit terminals, restaurants or open office spaces with an understanding of the necessary software to manipulate and configure the interior acoustic cloak.



**Figure 5.1a**  
Collage of sound raytraces inside and around a spherical object.



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