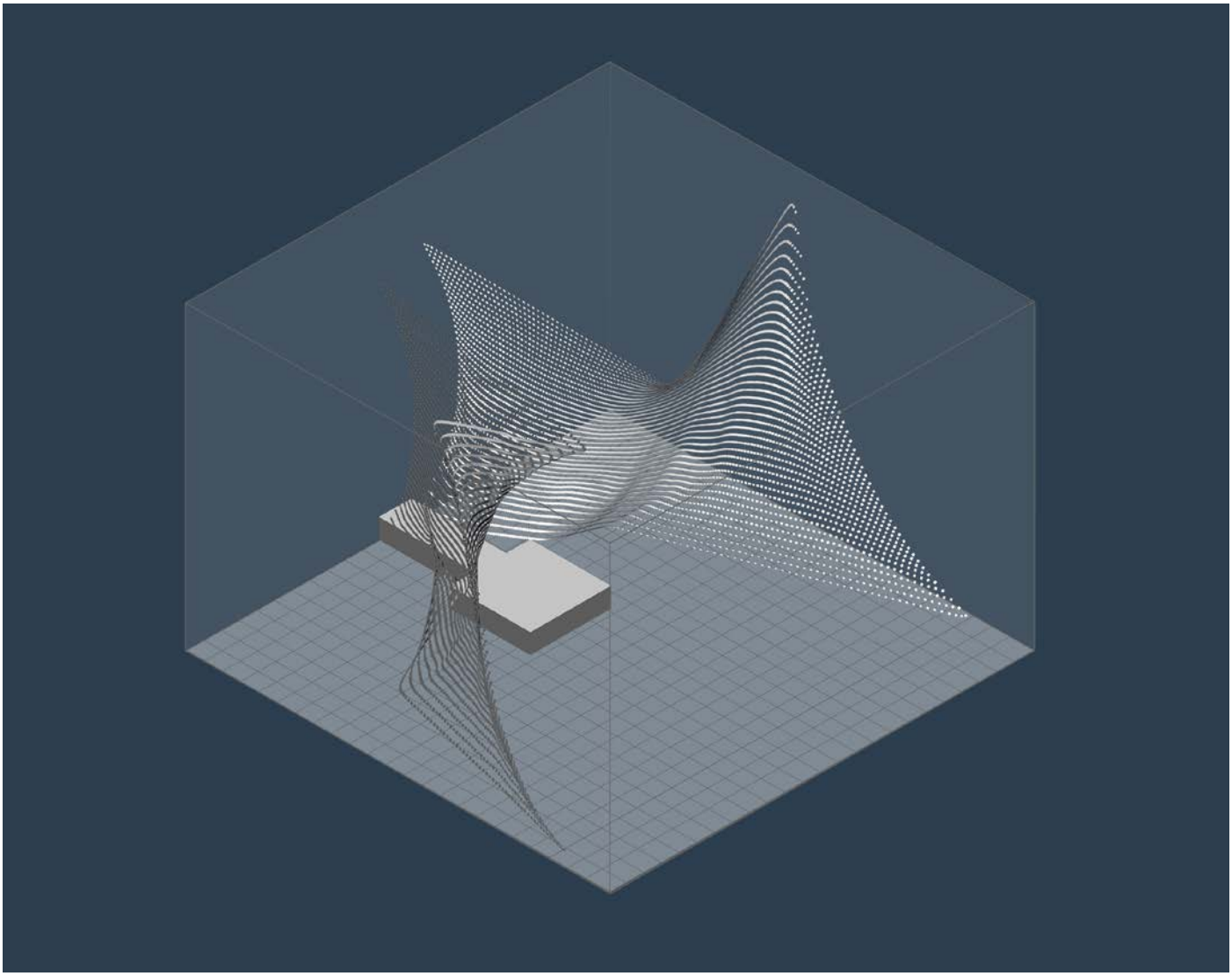

LIVE

EXPLORING MOTION IN LIVE MUSIC SHOWS AND ARCHITECTURE

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Master's Thesis at Chalmers
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CHALMERS

Table of contents

Introduction

Abstract

Live music shows may seem to be a typical occurrence: people, sharing common interest in particular music gathering to experience it firsthand. By looking at the expenses that some musicians putinto creating unimaginable, temporary structures the word 'absurd' comes into mind. But one can find a reason in this craziness, as the studies show that memories embed in our mind much stronger when they are affiliated with strong emotions.

What distinguish music and theater stages from regular architectural spaces is the fact that they are always in a state of constant change – movement of lights and props is always synced with the tempo and matches atmosphere of a given situation. This allows them to influence spectators on a level that is not achievable by static structures. This orchestrated spectacle can become a truly magical experience, taking the viewer out of his ordinary environment and pulling him into a reality created by a musician or a screenwriter.

This thesis aims to investigate the idea of creating a dynamic structure designed to enhance the experience of live music shows. New ways to go beyond typical spatial and visual settings of the concert halls are being researched through 3D animation, dynamic simulations, programming and various experiments. The final outcome is an experimental music venue located in Goteborg which mainly focuses on an adaptable and articulated structure, a "modern curtain". This apparatus creates a multiplicity of spatial and kinetic conditions that can be controlled by the musicians. The building becomes a polymorphous space that can adapt to its current user.

Aim

The aim of this thesis is to design a pavilion like structure alongside with a scenario for a live music show, that would become showcase of found solutions.

Background

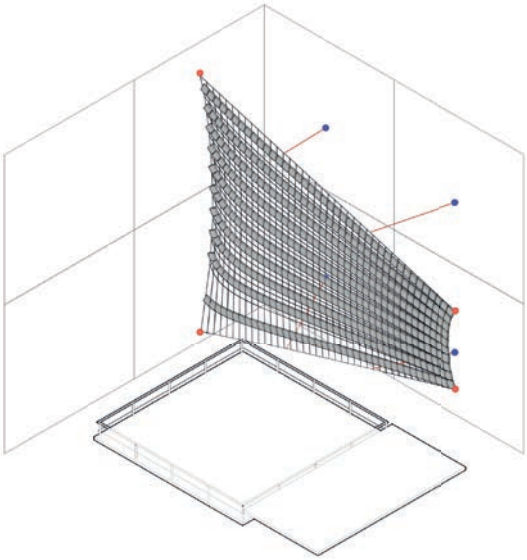
Looking for better ways to connect with habitants of environments designed by architects is in best interest of both mentioned parties. History of architects working with live music shows is not long, but it does exists. Searching for inspirations and solutions in unusual areas, such as live music shows, can result in finding completely new and unexpected paths of discourse.

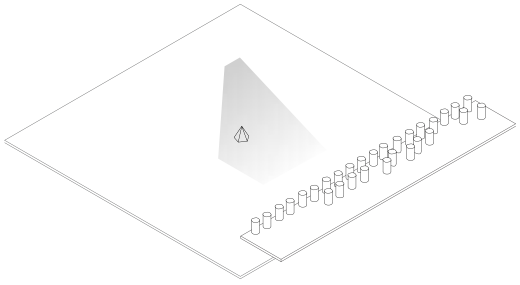
Main questions

How introduction of movement and various visual instruments can influence viewers of live music shows?

How can we enhance experience of live music shows using architectural knowledge?

How can architects use movement and artificial light in their designs not only for practical reasons, but also to influence emotions of its users?





Idea

“Modern curtain“

Main part of this thesis is an idea to create modern version of a curtain - element of music, cinema and theater that we all recognize and associate with live performances. Author’s goal was to create a dynamic element of the concert hall, that would be able to create different spatial and visual environments during the concert, allowing musician and visual artist to influence the audience on a new level.

This was achieved by incorporating a system consisting of tension wires, stretchable net, and small LED lamps, which allows it to change proportions of the concert hall, but also introduce dynamic light system. This feature allows for much more unexpected and immersive setups than regular concert halls.

new performer - audience relations

New performer-audience relationships
By combining modern curtain with new, unusual ideas for stage layouts, author of this thesis tried to present new ways to enhance or disrupt relation between the performer and the audience and also between audience members themselves.

This idea is showcased by six different spatial setups which show diverse ways in which simple transformations of the curtain shape combined with particular stage layouts create different types of scenarios.

a building that lives

Last goal of this thesis was to introduce a building which would be as alive as the music shows happening inside, which in theory would attract passersby to stop by and partially participate in the show and also propose a new way by which music venues should be designed.

Process

“ it is not the ear that hears, but intelligence ... [Music] is the art of thinking.”

“(...) there is no such thing as one unique organizational and architectural solution that could shelter several types and several sizes of audience-source relationships. Often, a multiplicity of places and of forms properly combined and linked together as an architectural complex can be the answer to the posed problems.”

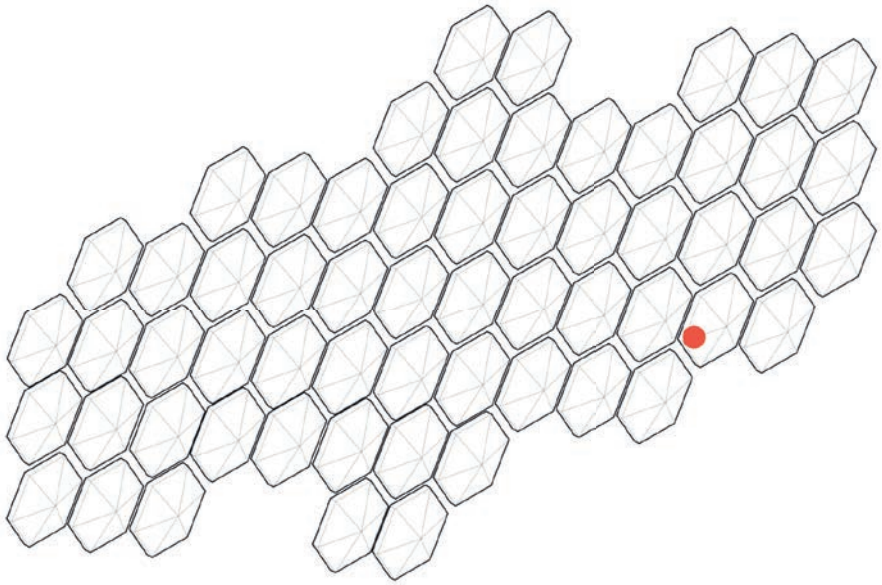
References

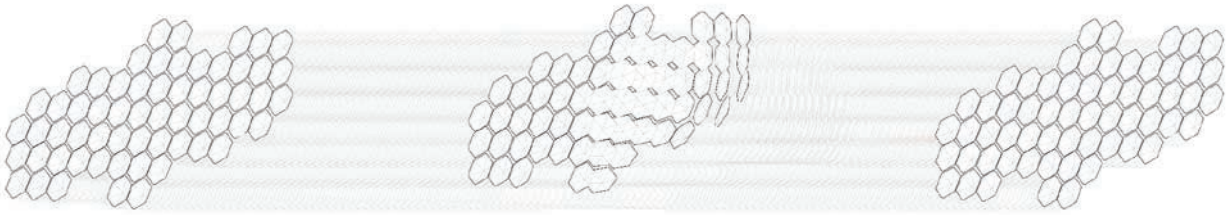
seeking references in architecture and design

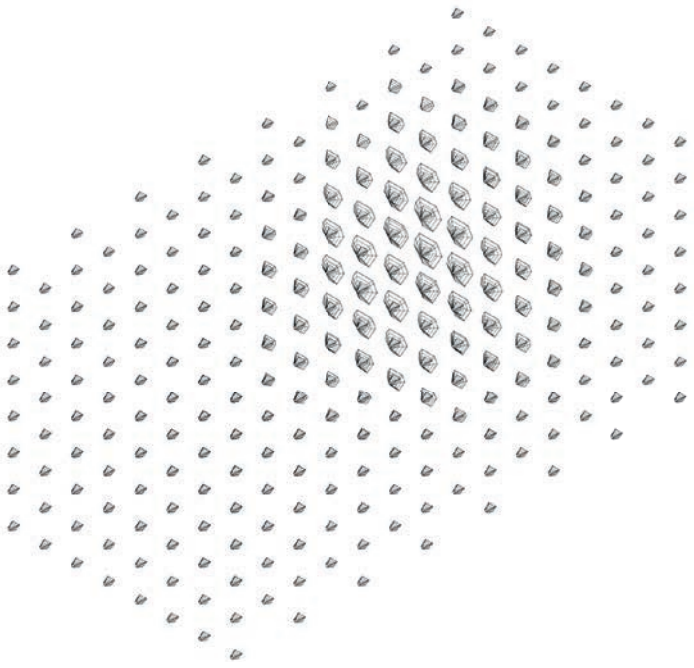
Iannis Xenakis was greek composer, music theorist, engineer but most of all – architect. He learned architectural craft while working with Corbusier on various projects, but the one that is most relevant for this thesis is the one he designed for Brussels World's Fair Expo of 1958. Corbusier was asked by Philips (light system company) to design a pavilion showcasing their products. Corbusier commissioned the project to Xenakis, who designed a structure which would not only become one of the first examples of 'volumetric' architecture, but also was Xenakis first attempt to combine music, light and architecture in one place and create a dynamic, living spectacle.

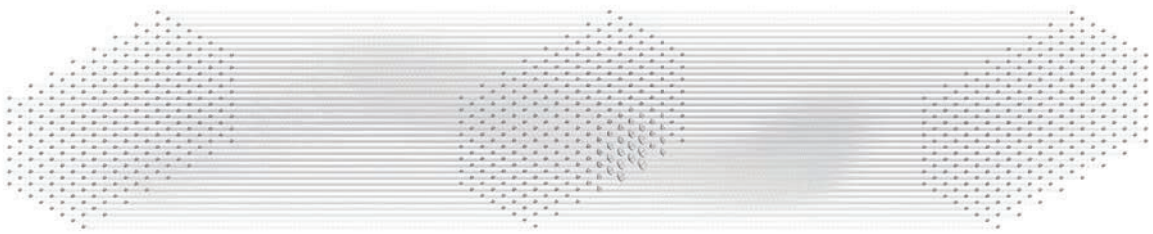
Xenakis was fascinated by idea of creating short live shows in pavilions designed by him, using newest technologies accessible at that time. With his vast knowledge in music theory, he was trying to prove that visual aspect of the live shows should be treated with same care as the acoustic aspect of it.

In one of his articles he stated that there is no such thing as one ideal space for live music. This thesis is trying to argue with that statement, proposing a dynamic, modern concert space.









reference #1

Hexi

by Thibaut Sld

motion sensor kinetic scultpure

Designed by a student interactive kinetic sculpture was coming to live by movement happening in front of it. Computer was recognising rapid movement in front of the sculpture, and based on the position of given input, it was sending a wave across whole wall.

This interaction was creating a sensation of influencing one's surroundings by ordinary gestures. This sculpture was studied by the author to try to recreate such behaviour in the final solution of this thesis. Findings were not used in the final outcome of the project as technical issues made it impossible to introduce this kind of movement.

reference #2

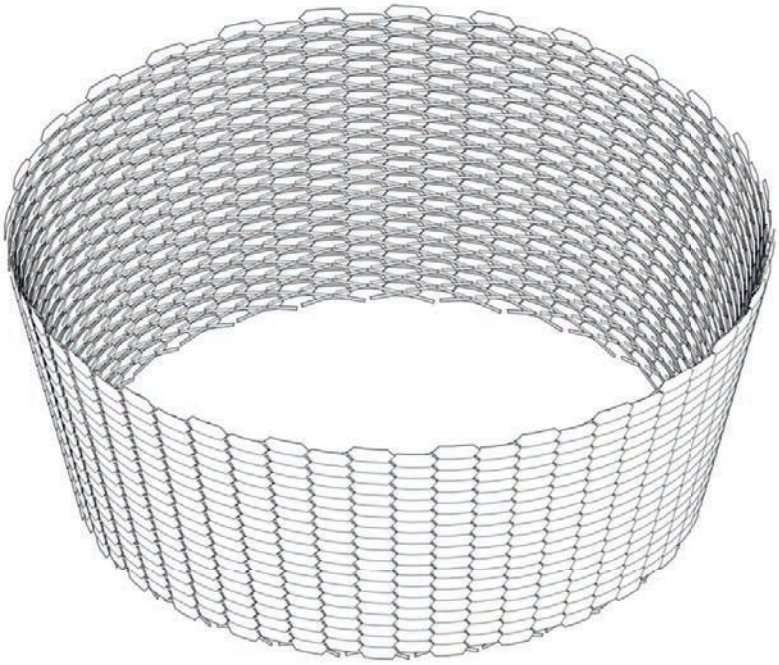
Diffusion Choir

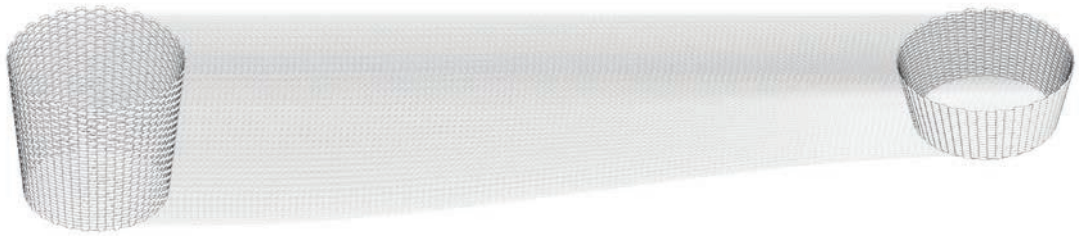
by Sosolimited

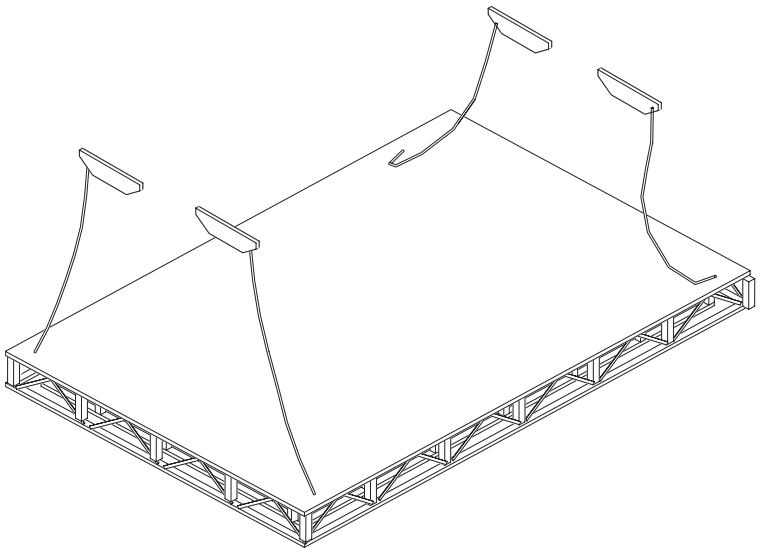
large scale kinetic sculpture

This kinetic sculpture creating three dimensional patterns, works like 3-D pixel screen allowing to create a movement resembling flock of birds.

It brings the idea of using series of identical moving elements to create movement similar to one created by "Hexi" but due to its larger measurements it brings third dimension to this idea. This study was done to practice recreating such effect in software used to develop this thesis.







reference #3

“Claw“

by Willie Williams and Mark Fischer

expanding backdrop

Instead of using flat backdrop Willie Williams and Mark Fischer designed circular, expanding screen that was becoming taller or smaller during the course of the concert. By extending mechanical arms, they were using gaps between the screens to show the inside of the construction.

This solution, in contrast to regular backdrop, was providing not only affecting visual but also architectural settings of the stage, as the perception of the space around the stage was strongly influenced by extension of this mechanism, no matter what kind of visuals were projected on top of it.

reference #4

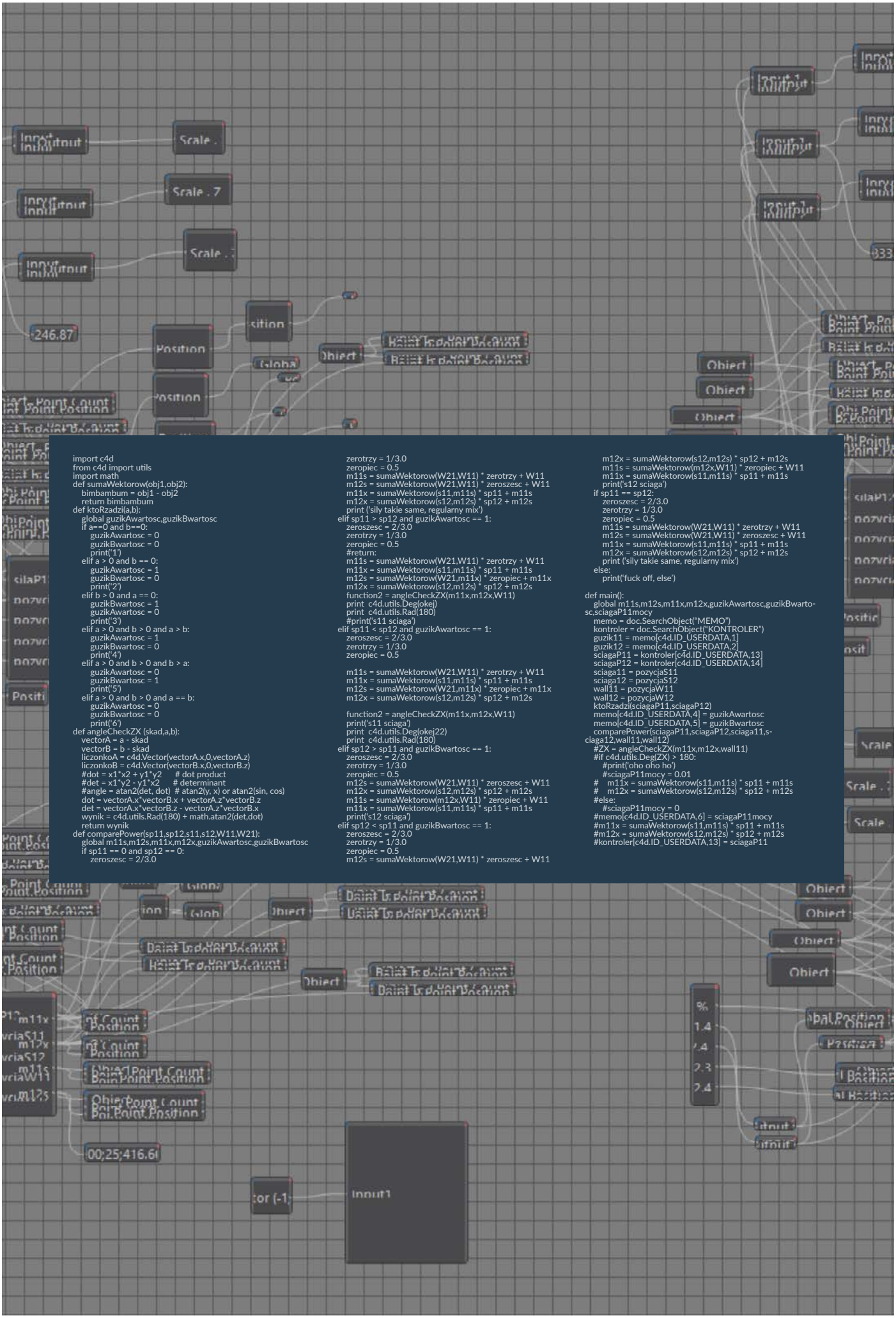
Floating stage

by Donda Surround

new spatial and visual qualities

Stage used during Life of Pablo tour was extraordinary because of completely new approach to stage layout. Platform on which New York based rapper was performing at was hanged from the ceiling and was constantly moving throughout the show. By introducing movement, Kanye’s team offered audience completely new way to experience the show and engage with its viewer.

Its horizontal and vertical movement was introducing not only everchanging stage layout, but was also engaging audience to adjust to it and depending on given situation focus on the performer or on each other.



```
import c4d
from c4d import utils
import math
def sumaWektorow(obj1,obj2):
    bimbambum = obj1 - obj2
    return bimbambum
def ktoRzadzi(a,b):
    global guzikAwartosc,guzikBwartosc
    if a==0 and b==0:
        guzikAwartosc = 0
        guzikBwartosc = 0
        print('1')
    elif a > 0 and b == 0:
        guzikAwartosc = 1
        guzikBwartosc = 0
        print('2')
    elif b > 0 and a == 0:
        guzikBwartosc = 1
        guzikAwartosc = 0
        print('3')
    elif a > 0 and b > 0 and a > b:
        guzikAwartosc = 1
        guzikBwartosc = 0
        print('4')
    elif a > 0 and b > 0 and b > a:
        guzikAwartosc = 0
        guzikBwartosc = 1
        print('5')
    elif a > 0 and b > 0 and a == b:
        guzikAwartosc = 0
        guzikBwartosc = 0
        print('6')
def angleCheckZX (skad,a,b):
    vectorA = a - skad
    vectorB = b - skad
    liczonkoA = c4d.Vector(vectorA.x,0,vectorA.z)
    liczonkoB = c4d.Vector(vectorB.x,0,vectorB.z)
    #dot = x1*x2 + y1*y2      # dot product
    #det = x1*y2 - y1*x2      # determinant
    #angle = atan2(det, dot)  # atan2(y, x) or atan2(sin, cos)
    dot = vectorA.x*vectorB.x + vectorA.z*vectorB.z
    det = vectorA.x*vectorB.z - vectorA.z*vectorB.x
    wynik = c4d.utils.Rad(180) + math.atan2(det,dot)
    return wynik
def comparePower(sp11,sp12,s11,s12,W11,W21):
    global m11s,m12s,m11x,m12x,guzikAwartosc,guzikBwartosc
    if sp11 == 0 and sp12 == 0:
        zeroszesc = 2/3.0
        zerotrzy = 1/3.0
        zeropiec = 0.5
        m11s = sumaWektorow(W21,W11) * zerotrzy + W11
        m12s = sumaWektorow(W21,W11) * zeroszesc + W11
        m11x = sumaWektorow(s11,m11s) * sp11 + m11s
        m12x = sumaWektorow(s12,m12s) * sp12 + m12s
        print ('sily takie same, regularny mix')
    elif sp11 > sp12 and guzikAwartosc == 1:
        zeroszesc = 2/3.0
        zerotrzy = 1/3.0
        zeropiec = 0.5
        #return:
        m11s = sumaWektorow(W21,W11) * zerotrzy + W11
        m11x = sumaWektorow(s11,m11s) * sp11 + m11s
        m12s = sumaWektorow(W21,m11x) * zeropiec + m11x
        m12x = sumaWektorow(s12,m12s) * sp12 + m12s
        function2 = angleCheckZX(m11x,m12x,W11)
        print  c4d.utils.Deg(okej)
        print  c4d.utils.Rad(180)
        #print('s11 sciaga')
    elif sp11 < sp12 and guzikAwartosc == 1:
        zeroszesc = 2/3.0
        zerotrzy = 1/3.0
        zeropiec = 0.5

        m11s = sumaWektorow(W21,W11) * zerotrzy + W11
        m11x = sumaWektorow(s11,m11s) * sp11 + m11s
        m12s = sumaWektorow(W21,m11x) * zeropiec + m11x
        m12x = sumaWektorow(s12,m12s) * sp12 + m12s

        function2 = angleCheckZX(m11x,m12x,W11)
        print('s11 sciaga')
        print  c4d.utils.Deg(okej22)
        print  c4d.utils.Rad(180)
    elif sp12 > sp11 and guzikBwartosc == 1:
        zeroszesc = 2/3.0
        zerotrzy = 1/3.0
        zeropiec = 0.5
        m12s = sumaWektorow(W21,W11) * zeroszesc + W11
        m12x = sumaWektorow(s12,m12s) * sp12 + m12s
        m11s = sumaWektorow(m12x,W11) * zeropiec + W11
        m11x = sumaWektorow(s11,m11s) * sp11 + m11s
        print('s12 sciaga')
    elif sp12 < sp11 and guzikBwartosc == 1:
        zeroszesc = 2/3.0
        zerotrzy = 1/3.0
        zeropiec = 0.5
        m12s = sumaWektorow(W21,W11) * zeroszesc + W11
        m11s = sumaWektorow(m12x,W11) * zeropiec + W11
        m11x = sumaWektorow(s11,m11s) * sp11 + m11s
        print('s12 sciaga')
    if sp11 == sp12:
        zeroszesc = 2/3.0
        zerotrzy = 1/3.0
        zeropiec = 0.5
        m11s = sumaWektorow(W21,W11) * zerotrzy + W11
        m12s = sumaWektorow(W21,W11) * zeroszesc + W11
        m11x = sumaWektorow(s11,m11s) * sp11 + m11s
        m12x = sumaWektorow(s12,m12s) * sp12 + m12s
        print ('sily takie same, regularny mix')
    else:
        print('fuck off, else')

def main():
    global m11s,m12s,m11x,m12x,guzikAwartosc,guzikBwarto-
sc,sciagaP11mocy
    memo = doc.SearchObject("MEMO")
    kontroler = doc.SearchObject("KONTROLER")
    guzik11 = memo[c4d.ID_USERDATA,1]
    guzik12 = memo[c4d.ID_USERDATA,2]
    sciagaP11 = kontroler[c4d.ID_USERDATA,13]
    sciagaP12 = kontroler[c4d.ID_USERDATA,14]
    sciaga11 = pozycjaS11
    sciaga12 = pozycjaS12
    wall11 = pozycjaW11
    wall12 = pozycjaW12
    ktoRzadzi(sciagaP11,sciagaP12)
    memo[c4d.ID_USERDATA,4] = guzikAwartosc
    memo[c4d.ID_USERDATA,5] = guzikBwartosc
    comparePower(sciagaP11,sciagaP12,sciaga11,s-
ciaga12,wall11,wall12)
    #ZX = angleCheckZX(m11x,m12x,wall11)
    #if c4d.utils.Deg(ZX) > 180:
        #print('oho oho ho')
        #sciagaP11mocy = 0.01
    #    m11x = sumaWektorow(s11,m11s) * sp11 + m11s
    #    m12x = sumaWektorow(s12,m12s) * sp12 + m12s
    #else:
        #sciagaP11mocy = 0
    #memo[c4d.ID_USERDATA,6] = sciagaP11mocy
    #m11x = sumaWektorow(s11,m11s) * sp11 + m11s
    #m12x = sumaWektorow(s12,m12s) * sp12 + m12s
    #kontroler[c4d.ID_USERDATA,13] = sciagaP11
```

Toolbox

Python and Xpresso coding, combined with animation

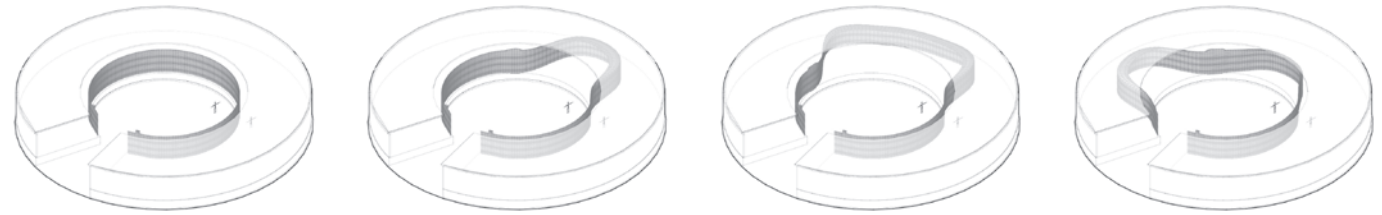
From the very beginning it was clear that this master thesis will involve working with animation. Just like design solutions from my references were going through different phases, the same must have been applied to my solutions and experiments from the start.

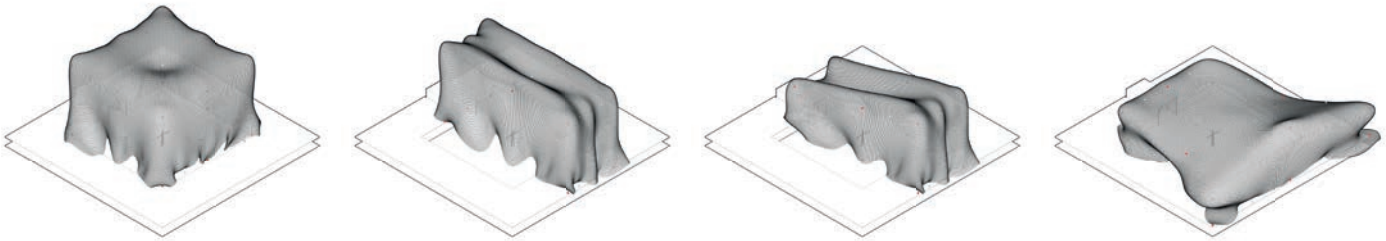
Regular animation doesn't require use of any kind of coding, as most of it works based on working with so called keyframes. In example to move given object from point A to point B, we would define its position as A in frame zero (that would be first keyframe), and then in frame further away on a timeline its position would be setted as B (second keyframe). Software would determine objects route between those two points and show it in a form of animation.

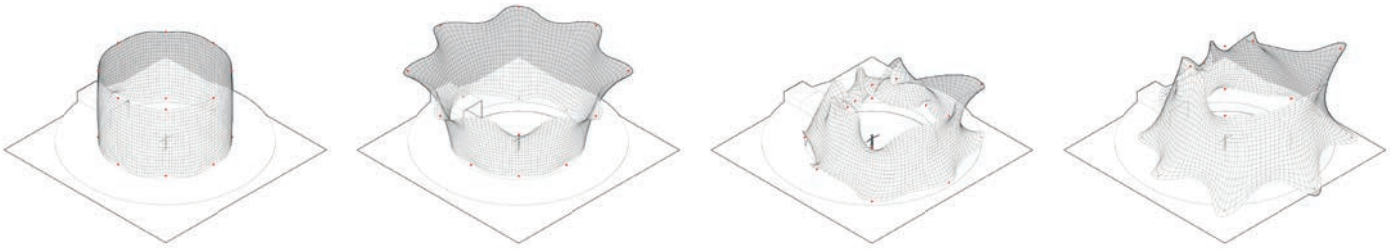
Keyframe based animation is being used in this thesis, but to allow recording and determining outcomes on more precise level, it was necessary to introduce series of scripts that would control constraining points and allow user to save or load different presets.

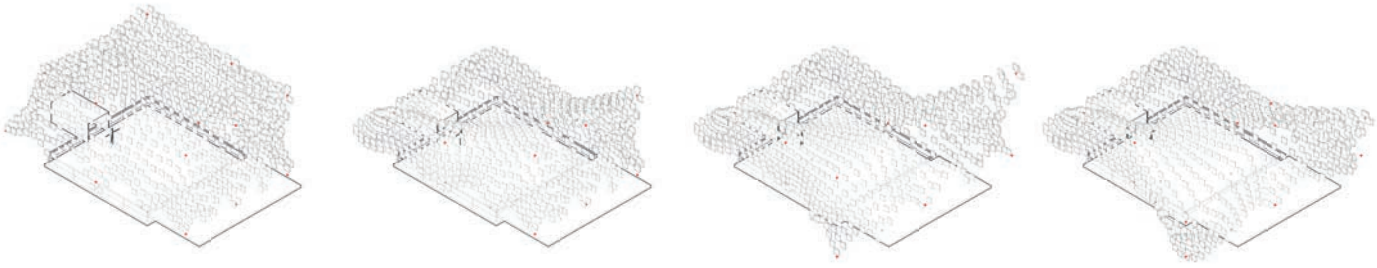
As it will be also shown later, coding was used to create special type of logic to determine the shape of main feature of this project - "modern cloth".

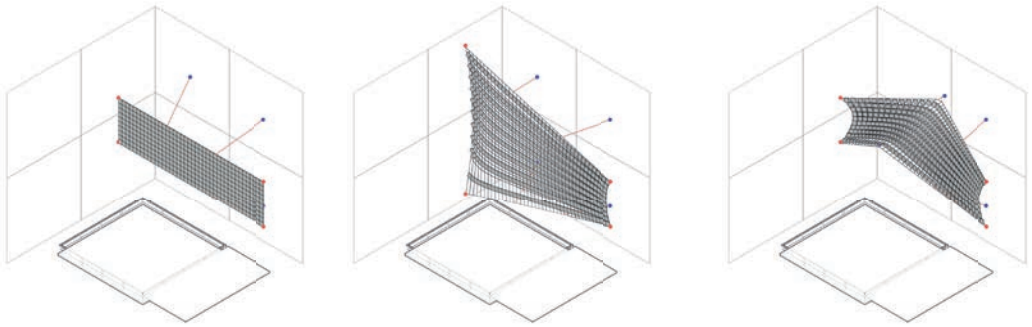
Software which was used to create all presented outcomes has its own node-based programming language called Xpresso, but due to its limitations it was essential to also use regular programming language - Python.











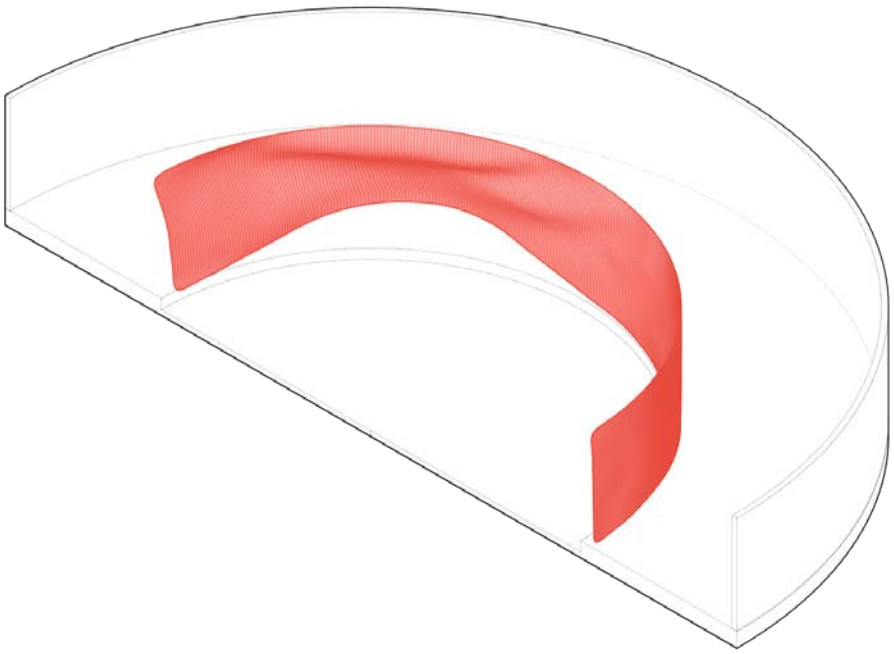
Research experiments

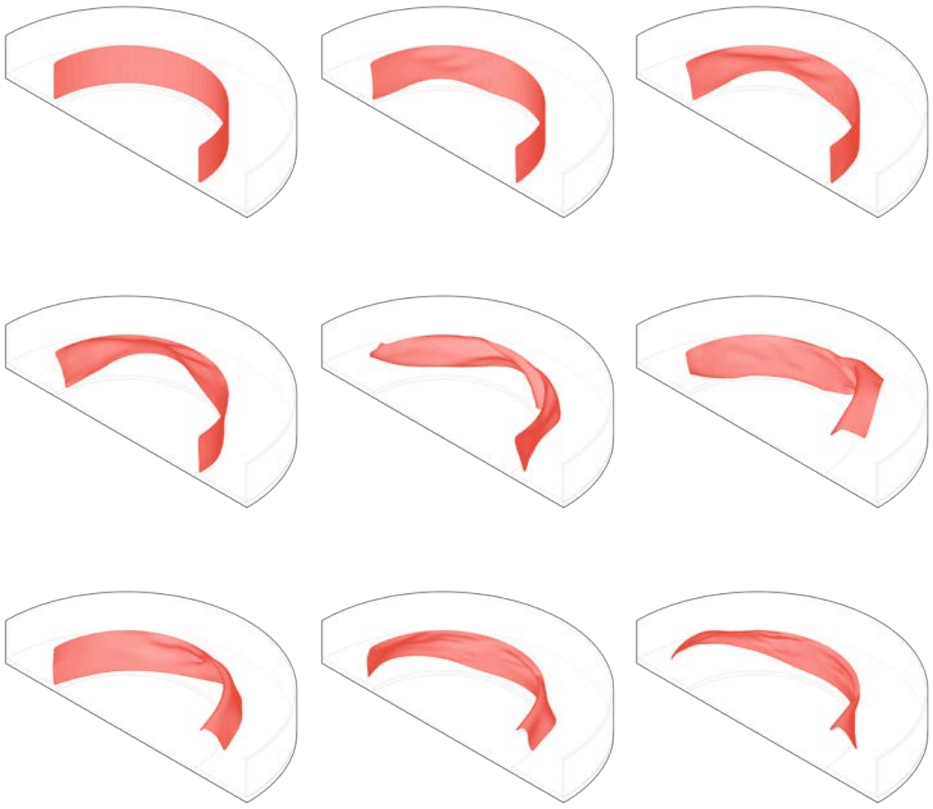
path to "modern curtain"

Research experiments were important part of this thesis and resulted in creating final shape of its main feature - modern curtain.

Goal of those experiments were to find best way to bring someway forgotten element of live performances (a curtain) to new era and determine best way to control it, but also determine what kind of logic would create most interesting and most versatile spatial solutions.

Experiments were all done with the use of special scripts created in order to fully control them and record different results found mostly interesting.





experiment #1

Simulation by collision

tools used: *Cinema 4D simulation engine*
controlling elements: *polygon objects*

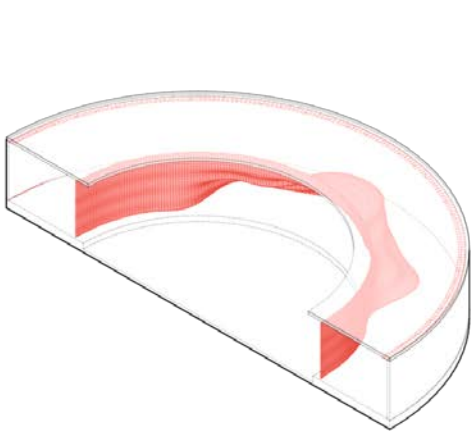
Experiments began with simple simulation of a real curtain being deformed by different (invisible in final render) objects. Curtain was placed in a circular stage, as first drafts pointed to creating 360* type of experience.

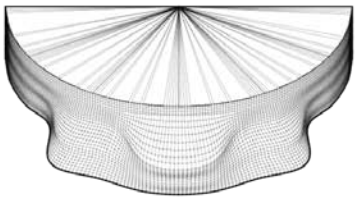
Plane representing the curtain was constrained by multiple, still points. This resulted in a situation where cloth was deformed mostly in its base area.

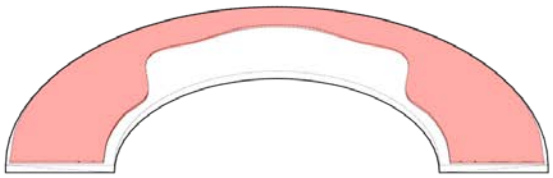
This experiment also showed, that working without any kind of movable constraining points would be difficult, as the final outcome was hard to determine and sometimes even hard to recreate precisely in next attempts. Another issue was the amount of computing power required to properly simulate all collisions between the curtain and colliding with it elements.

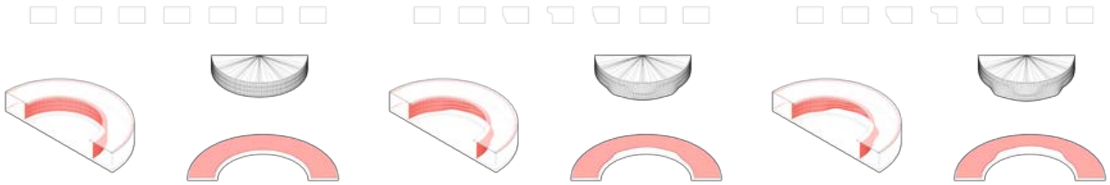
Last and most important revelation was the almost invisible difference between different phases of the simulations. Despite the fact that curtain was changing it overall shape, the spatial qualities were remaining the same.

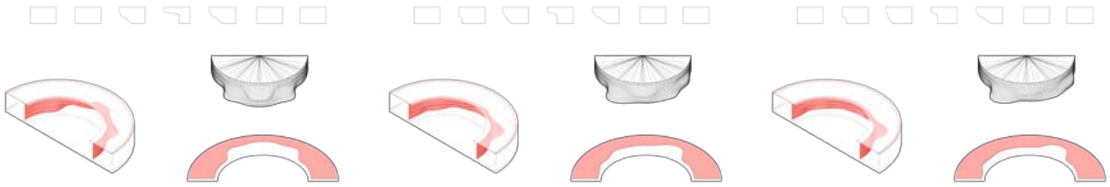
Although visually intriguing, this workflow was quickly abandoned due to its unpredictability, difficult controls, high CPU-usage and most important, its incapability to create diverse architectural settings.

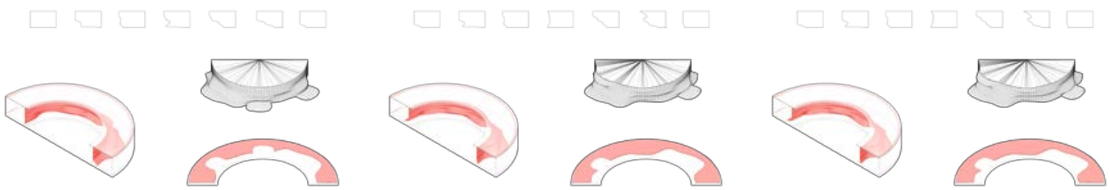












experiment #2

Profile control

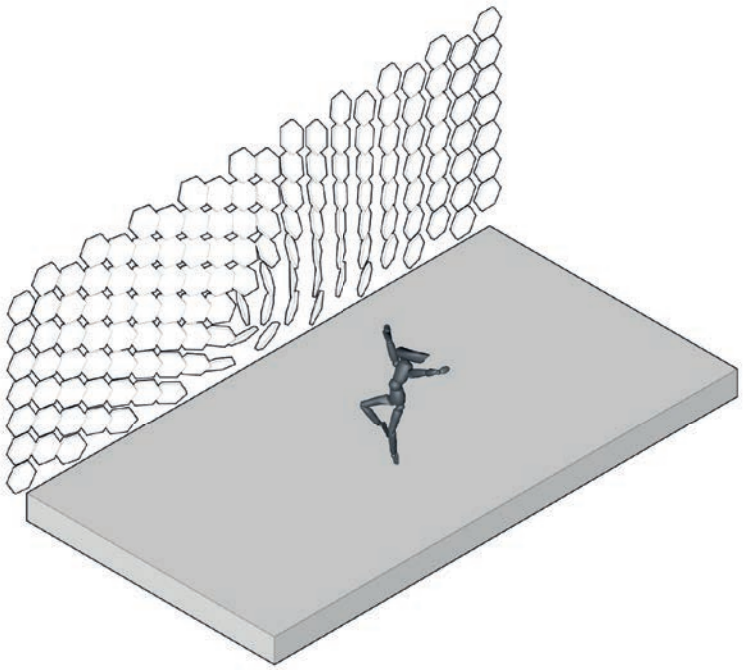
tools used: *Xpresso script, lofting*
controlling elements: *6 movable points of 7 profiles*

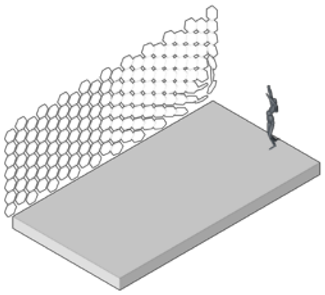
Trying to move away from highly unpredictable simulations, second experiment tried to answer this problem by introducing higher amount of control in the process.

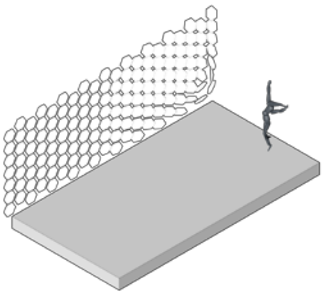
Curtain was created by lofting seven profiles and placing them inside circular stage. Each profile consisted of seven control points, five of which were able to move on XY axis and by this affect the overall shape of the curtain.

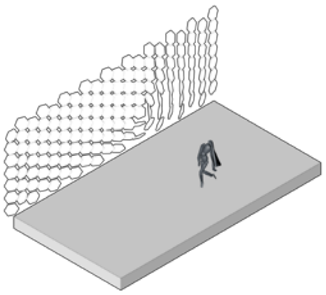
This experiment proved that introducing vector-based control points adds required level of control, but at the same time proved that trying to keep amount of control points as low as possible is crucial to create easy to interact with interface. By operating with numbers instead of position of polygonal objects, it was easier to create alignment between different parts of the curtain or easily create symmetrical setups.

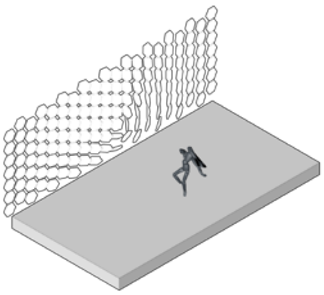
This system was much more effective in creating different architectural conditions, as it was affecting horizontal proportions of the space on bigger scale than previous experiment.

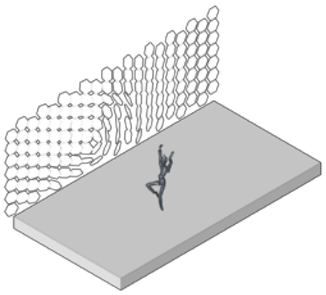


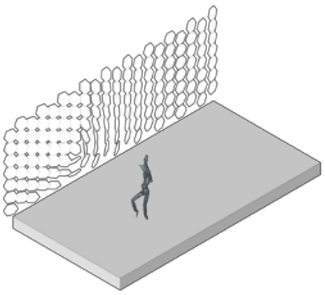












experiment #3

Interactive system

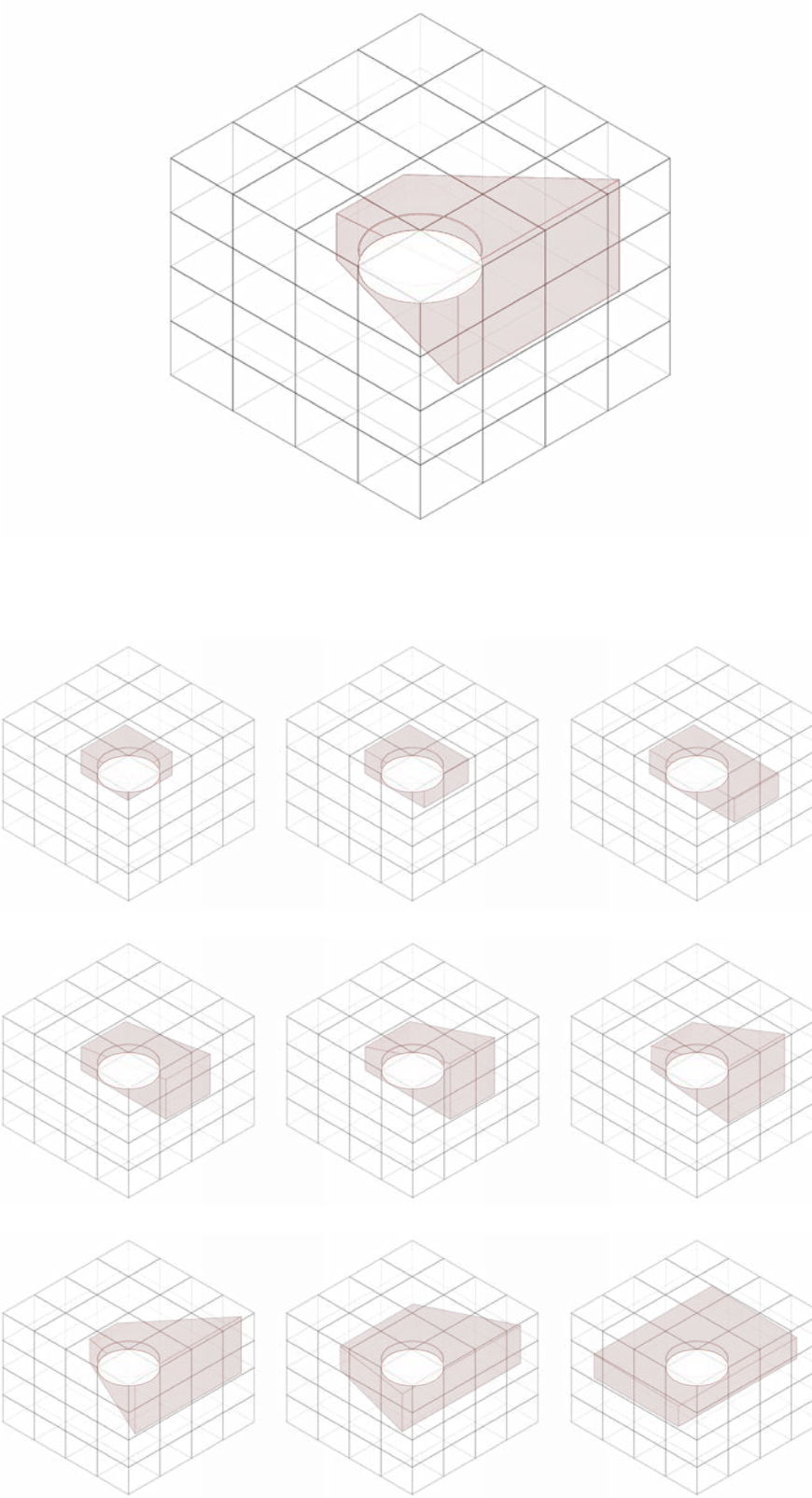
tools used: *Xpresso script*
controlling elements: *performers position, bass level*

Initial idea for the modern curtain suggested incorporating interactive elements, similar to ones studied in referenced kinetic sculpture "Hexi".

Experiment was executed to better understand how can one control a series of objects to imitate a dynamic shock wave effect. Using parts of referenced sculpture, author created a special script that was using as an input performers position and bass level to induce required movement.

Idle hexagonal wall was only turning into dynamic sculpture once predetermined bass level was reached. Then, using performer's position as a starting point, script was adjusting rotation of every hexagonal element, thus creating desired shockwave movement.

Main idea behind this experiment, although applicable on theoretical level, was abandoned in final solution as introducing motors placed on top of the designed curtain would greatly impact the overall weight and would require more extensive research into technical aspects of the curtain.



experiment #4

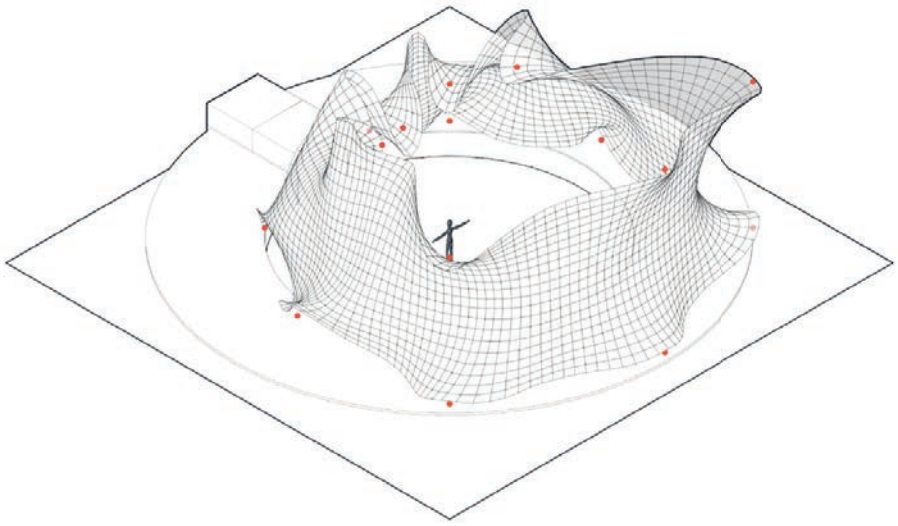
Affecting proportions

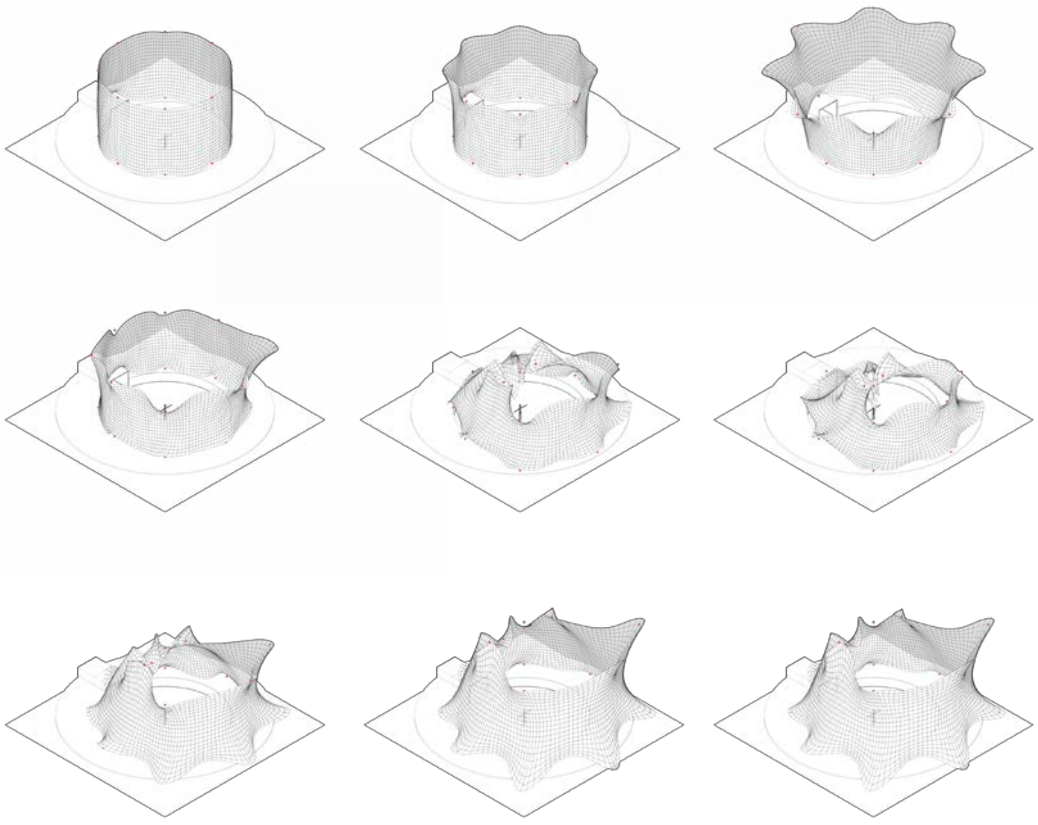
tools used: *point based keyframe animation*
controlling elements: *polygon points*

Fourth experiment although least sophisticated concerning tools and amount of work putted in to, proved to be most important in defining required actions to progress towards final result.

This experiment consists of four elements: clearly defined and stationary audience and performers space, three dimensional cube grid and abstract shape defining proportions of the room. By animating corner points of the shape defining the room, it became clear that to create diverse spatial settings the proportions (both horizontal and vertical) of the room would have to be modified on bigger scale than before.

That meant that the tool possible to fulfil such criteria had to be developed what was pursued in next experiments.





experiment #5

Cylinder simulation

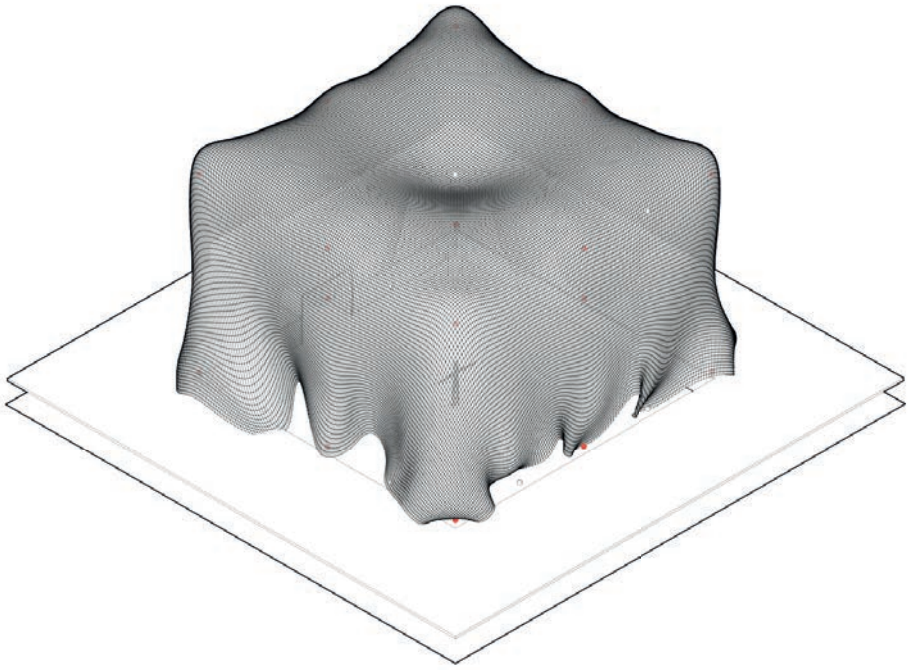
tools used: *Xpresso scripts, simulation*
controlling elements: *16 control points*

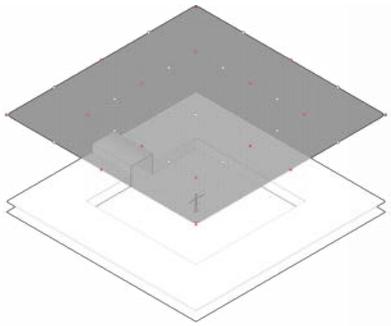
By combining two approaches from before, simulation and control points, first successful experiment was conducted.

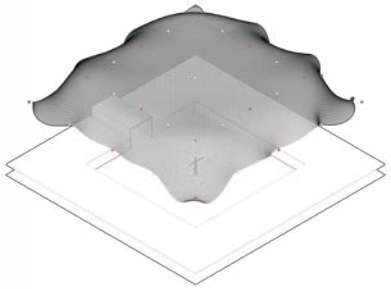
Experiment consisting of barrel shaped cloth, sixteen control points placed on top and bottom edge of the cloth and circular stage was first one that resulted in satisfying spatial qualities .

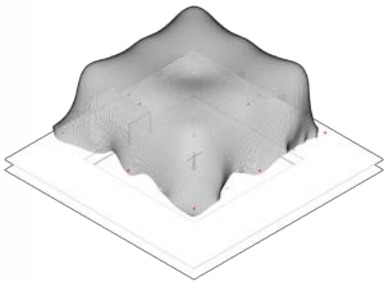
By stretching cloth in XYZ directions with moving constraining points it become easier to noticeably modify both audience and performer space. However, by using cylinder as a starting shape of the cloth, all results were resembling that figure. This occurrence wasn't perceived as an issue, but rather as a constraint element limiting the future possibilities in creating diverse spatial setting, decision was made to use less distinguishable starting shape.

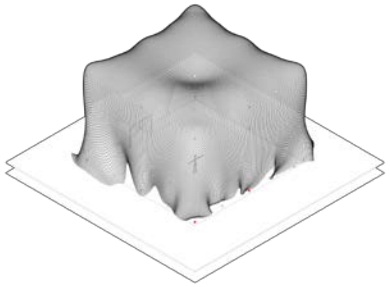
Another issue with this approach, was that by removing bottom and top part of the cylinder, it become hard to clearly define ceiling of the space what was again limiting future possible solutions.

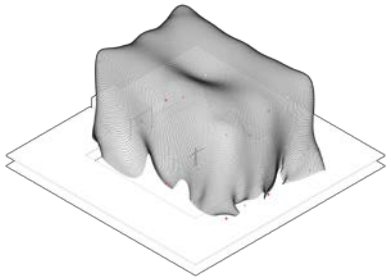


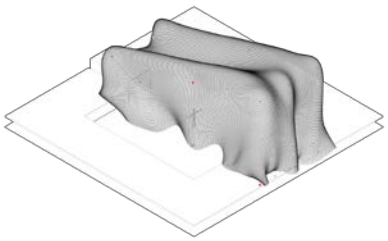


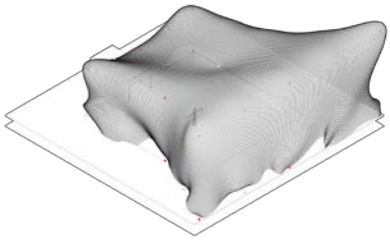


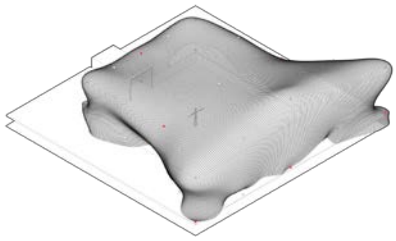


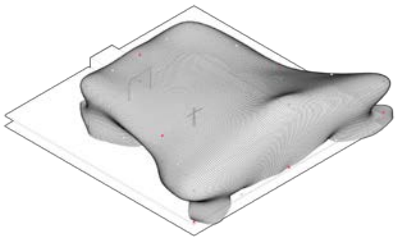












experiment #6

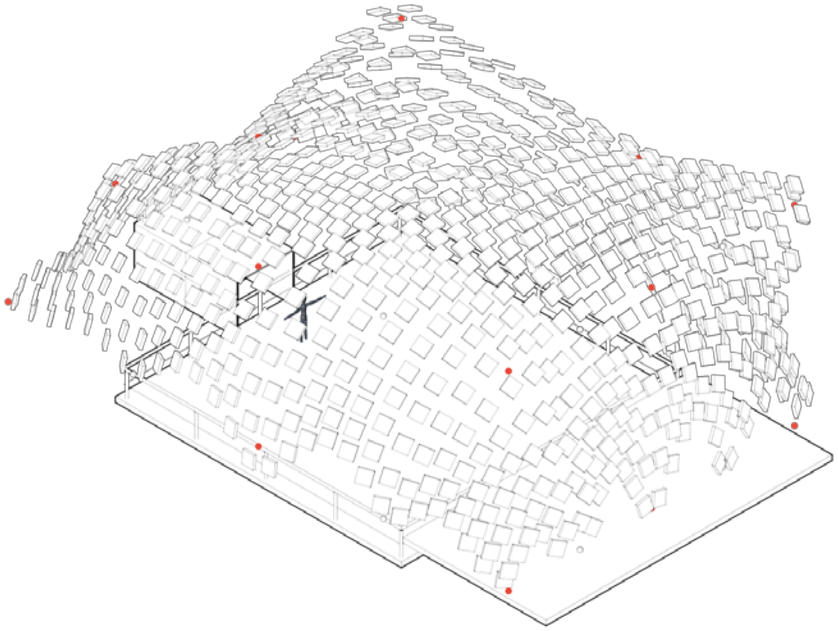
Rectangular cloth

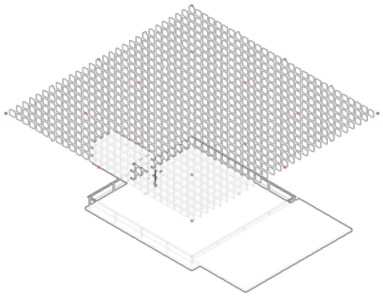
tools used: *Xpresso scripts, simulation*
controlling elements: *16 control points*

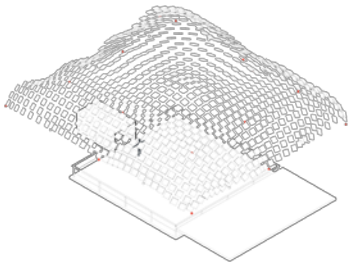
By using same logic as in experiment #5 but modifying the stage layout and starting shape of the curtain, similar but more satisfying results were achieved.

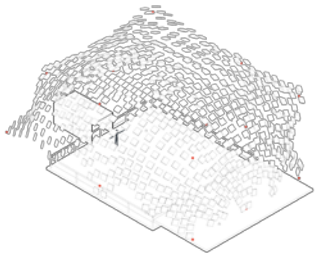
Constraint points were placed on all four edges of the cloth, but also some of them closer to the center of the cloth to assure possibility of defining clearer edges between walls and ceiling.

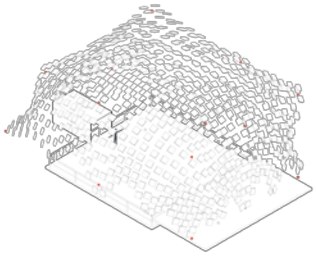
Besides proving that using less distinguishable shape like rectangle would be better way to progress, this experiment also indicated that using more constraining points would be necessary. Edges of the cloth that were not constrained were stretching out and thus the were created unwanted, abstract shapes around the edges. This behaviour is natural property of stretchable cloths, but it was seen as unwanted and unnecessary by the author of this thesis. In this particular experiment to downsize this effect, author created a simple script which was placing additional constraint points, which positions was based upon the location of neighbouring it control points that were defined by the user.

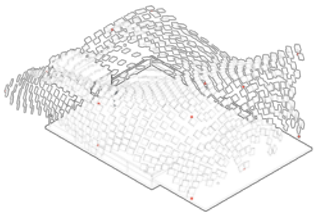


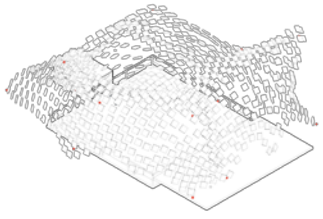


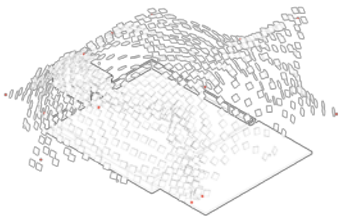


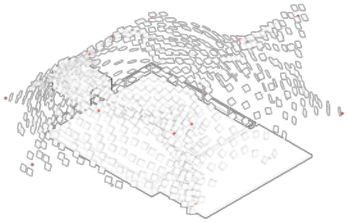


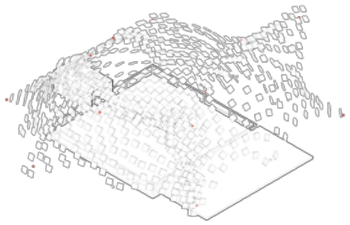












experiment #7

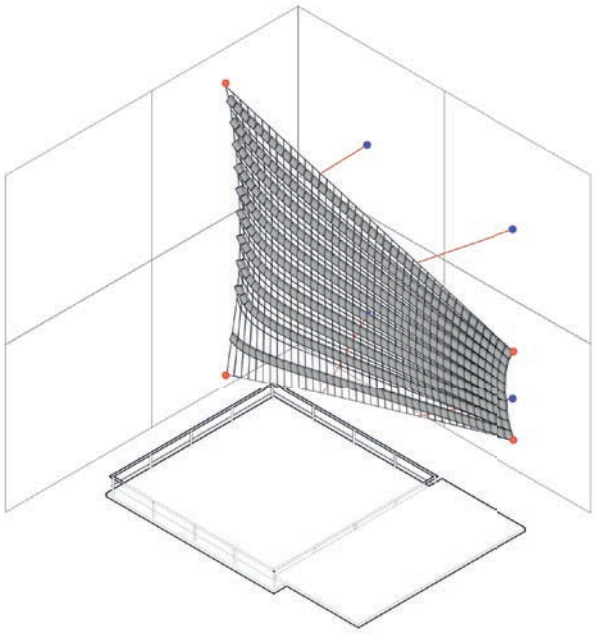
Adding extra elements

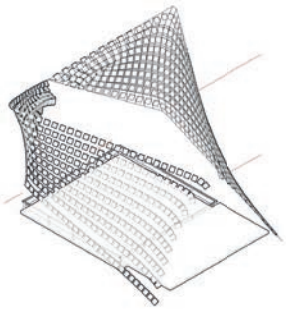
tools used: *Xpresso scripts, simulation*
controlling elements: *16 control points*

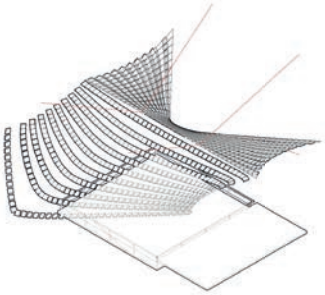
Initial idea for the modern curtain suggested using separate elements that would be placed on top of the stretchable cloth and be able to create small kind of movement. This idea was already described and investigated briefly in the experiment #3. Before working with the real life technical problems posed by this approach, it was necessary to create a reliable way of positioning those elements and adjusting them in real time to the shape of the cloth.

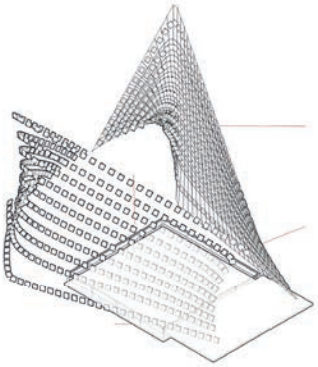
This was achieved by several features of the software used in this thesis and depending on the amount of objects, it became great tool to see in real-time how shape of the cloth would affect position of over 600 separate elements.

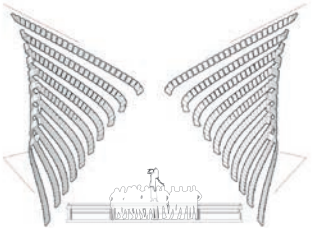
This experiment shown that stretchability of the cloth had much bigger impact on the space perception that assumed before. After placing additional elements on the cloth surface, it was observed that spots were cloth was stretched out more, become more transparent and created interesting possibilities of creating not completely solid surfaces.

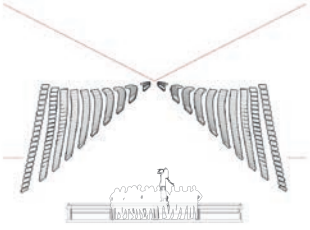


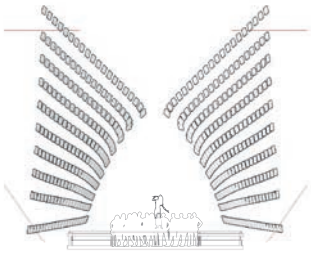


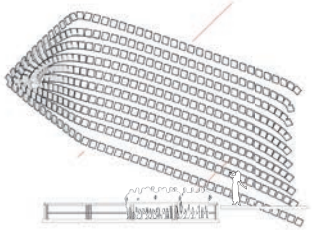


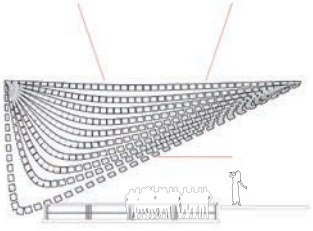


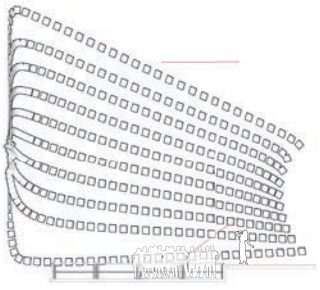












experiment #8

Searching cloth logic

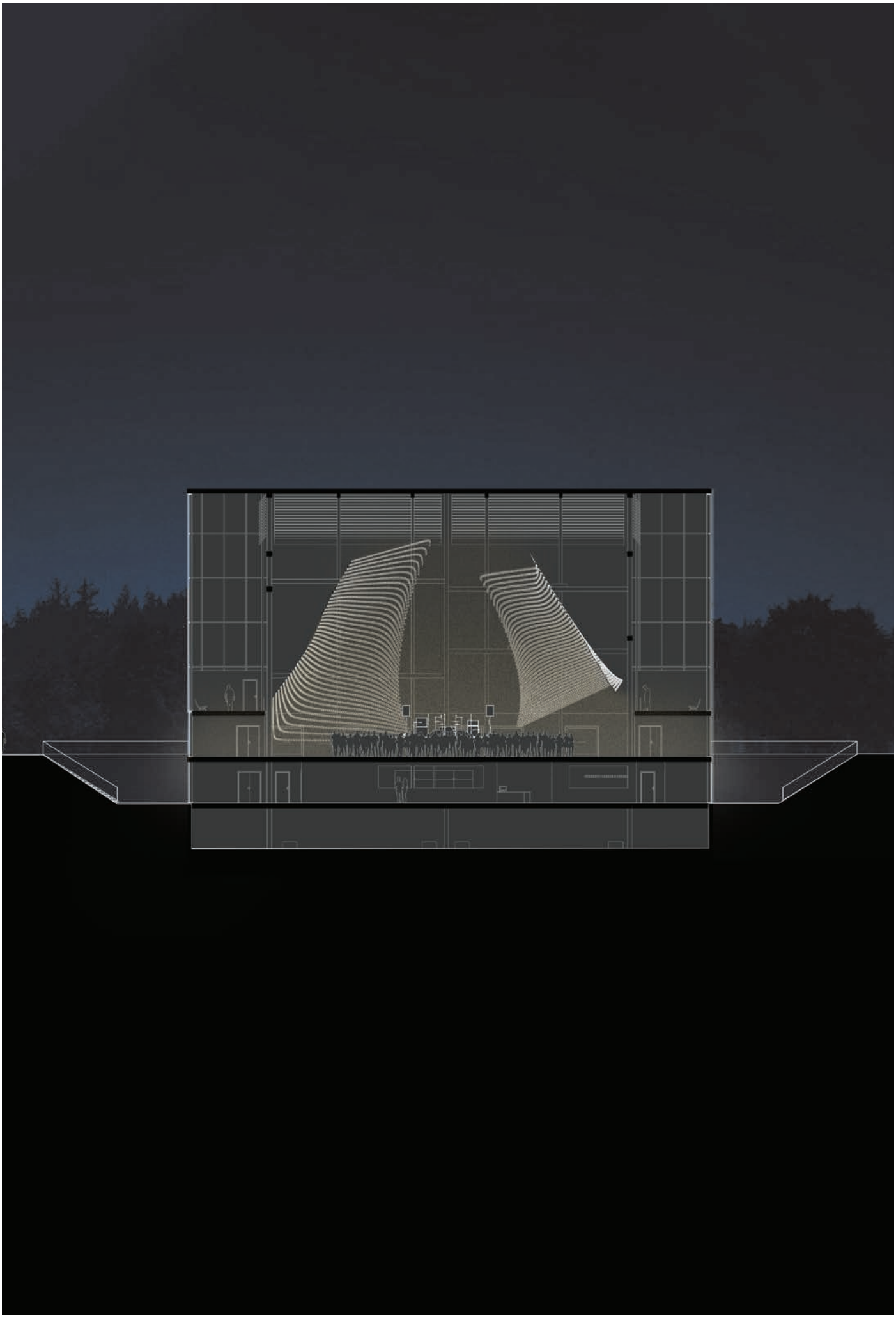
tools used: *Xpresso scripts, Python, simulation*
controlling elements: *16 control points*

All previous experiments were based on a simulation of a cloth controlled by several moving constraint points controlled by the user. This approach allowed to create different spatial qualities, but was lacking logic that was based in real, existing technical possibilities. Previously all constraining points were loosely floating in the air, with no visible way of moving in that space. Last experiment tried to answer this problem by introducing system that would bring this solution closer to realisation.

Second stretchable element was introduced to allow more diverse solutions. The results came satisfyingly close to expected outcomes shown in the experiment #4 as the spaces created by two stretched curtains were creating environments varying both in horizontal and vertical proportions.

Logic behind this solution is more clearly explained in upcoming chapter devoted to that topic.

Result



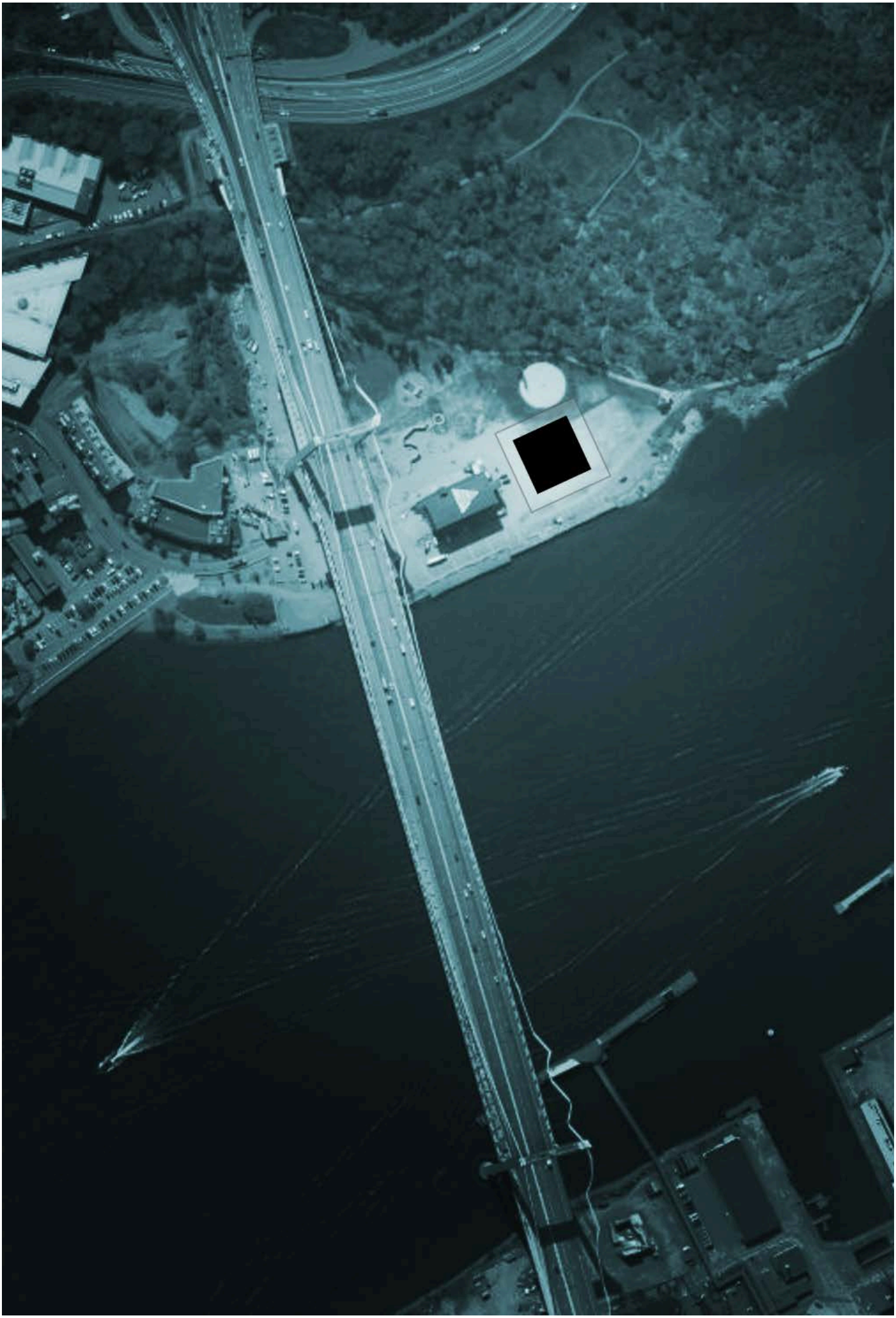
Home for the curtain

creating a building that lives

One of the goals of this thesis was to provide an answer for better architecture design of the concert venues in general, by providing a structure that would be more intriguing and in sync with music played inside of it than regular solutions.

Because of that, alongside developing the modern curtain, author of this thesis was designing a building to accommodate it.

Main intention in designing it was to make the curtain most important feature that would either bring the building to life or make it become empty shell waiting for new performer. The goal was to take away the attention from the architecture, and focus it on the performer and show happening inside, making the building only as good as what was happening inside it.



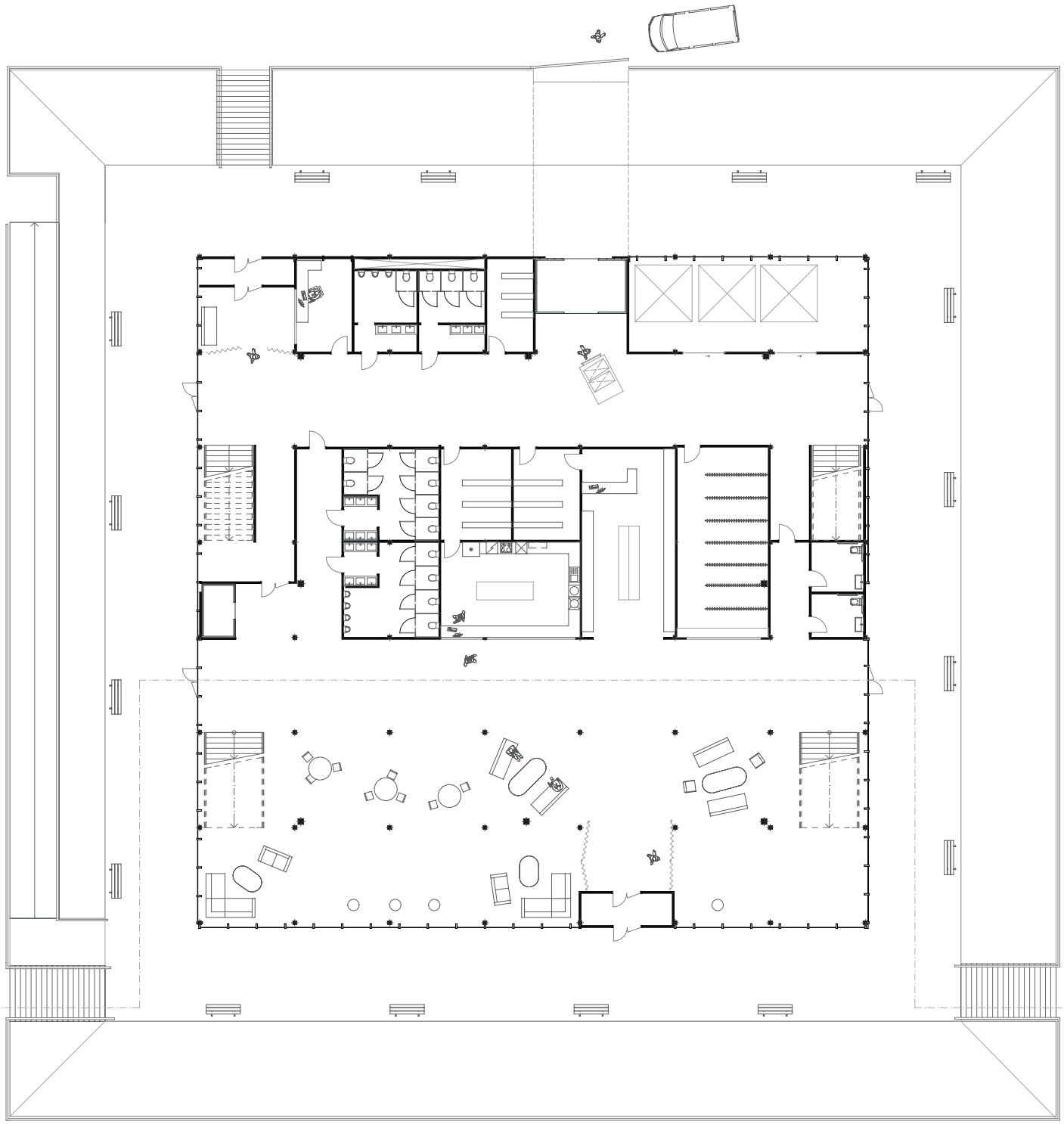
Site to accommodate the building is right next to Rödasten Konsthall, a popular art exhibition space in Goteborg. Goteborg is hometown of many popular musicians so it seemed adequate to design a building that could bring something new to music scene in that town.

Proximity to Rödasten is a great chance for both parties to collaborate with one another as they target audiences are almost identical.

Rödasten is important building on Goteborgs map, so it was crucial to adapt new structure to the existing neighbour.

To ensure that the height of new building won't overcome Rödasten height, entrance was placed three meters beneath ground level and also whole machine room was placed beneath the entrance level, making its lowest point around 6 meters below ground level.

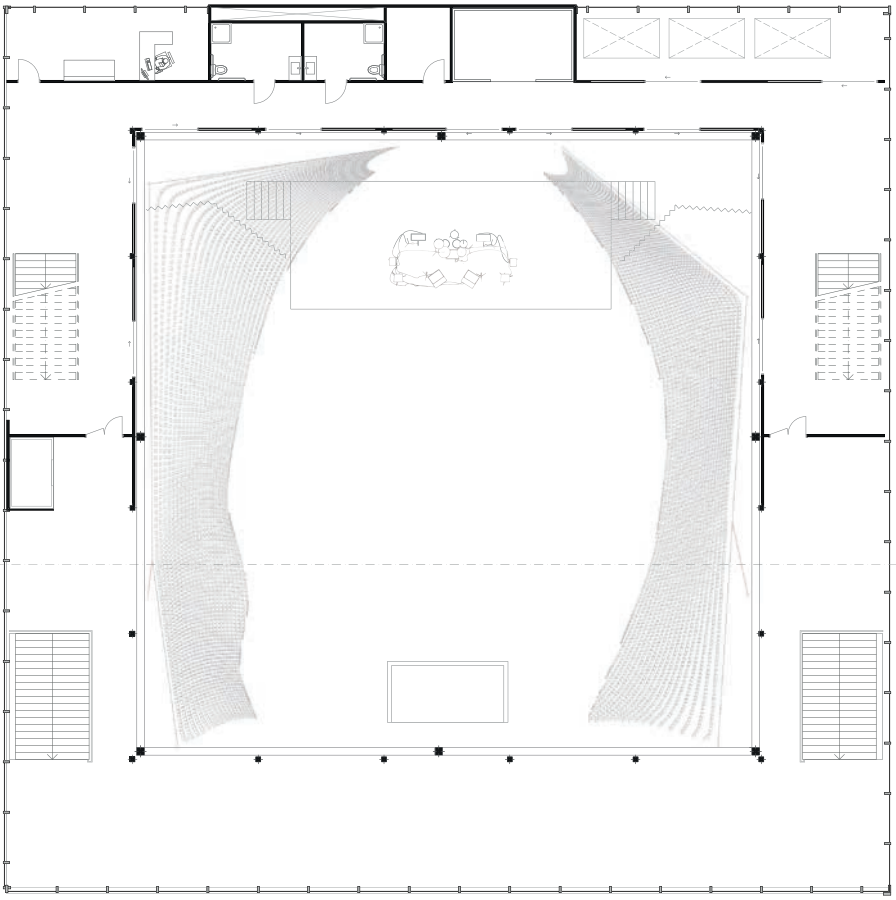
Placement of the entrance is a result of adjusting to existing walking paths and trying to make the space in front of the building part of the existing infrastructure.



Entrance level

Entrance level of the building consists of clearly divided front and back space. Audience enters through north-faced entrance which allows them to access restrooms, coffee shop, vinyl store, cloak room and lounge area. To access upper floor they can use staircases placed on both sides of the building or use the elevator.

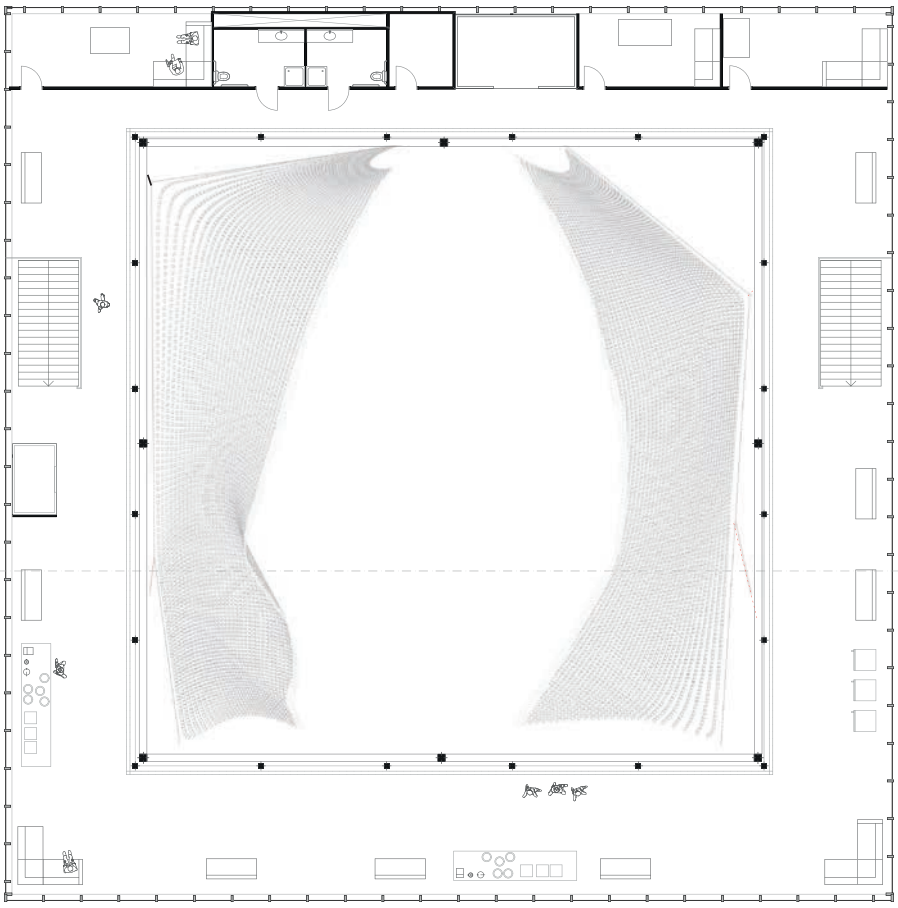
Performers and working staff enters the building from the back. Performers are guided directly to stairs leading them to their own separate floor.



Concert hall

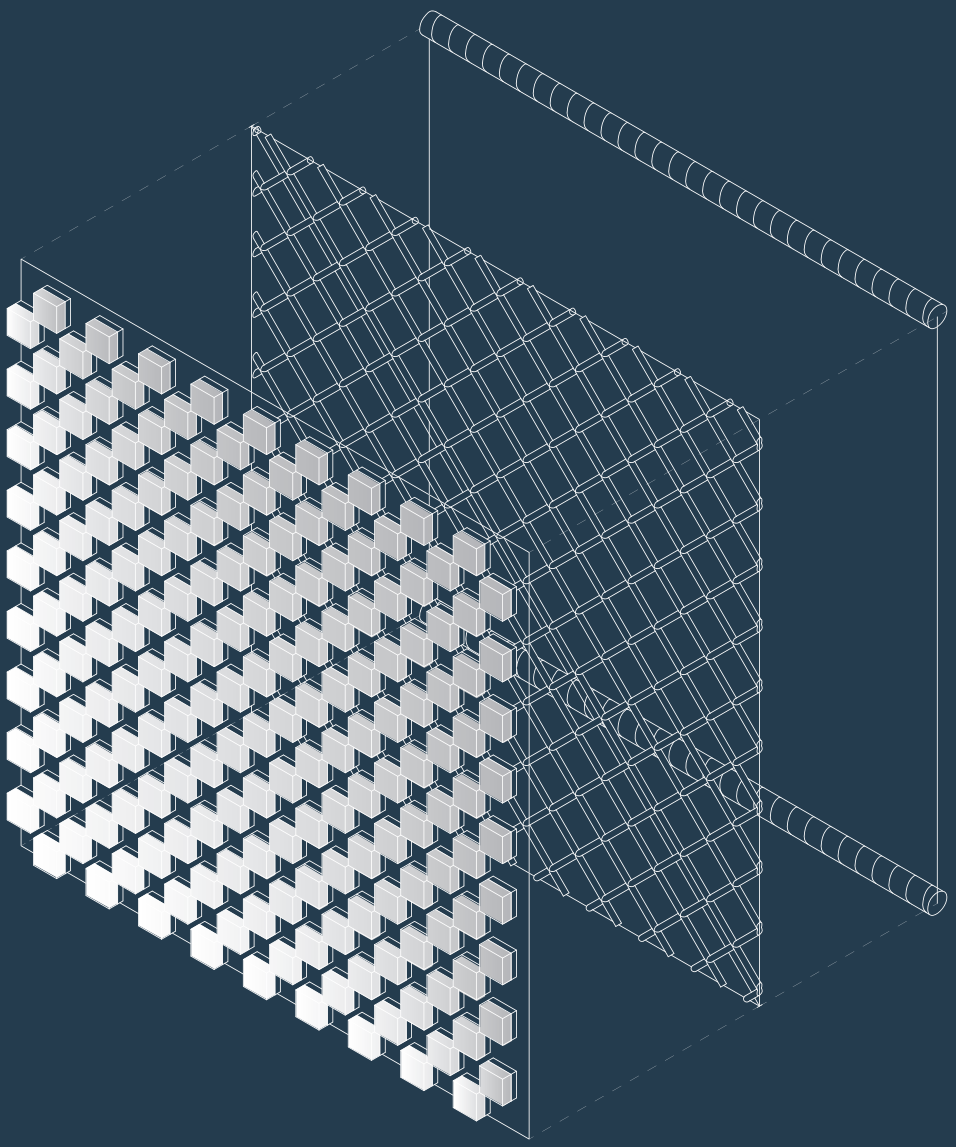
Concert hall was designed in a way so it would be visible from every side of the building outside and also allow different layouts inside it which combined with moving curtain, creates long list of possible scenarios for a show.

Because of that, access to concert hall is possible from almost every possible side, both for performers and the audience.



Backstage

Last floor is devoted only for the performers. It is a space where they can relax before the show in their private rooms or kill time by enjoying the view onto the riverfront.



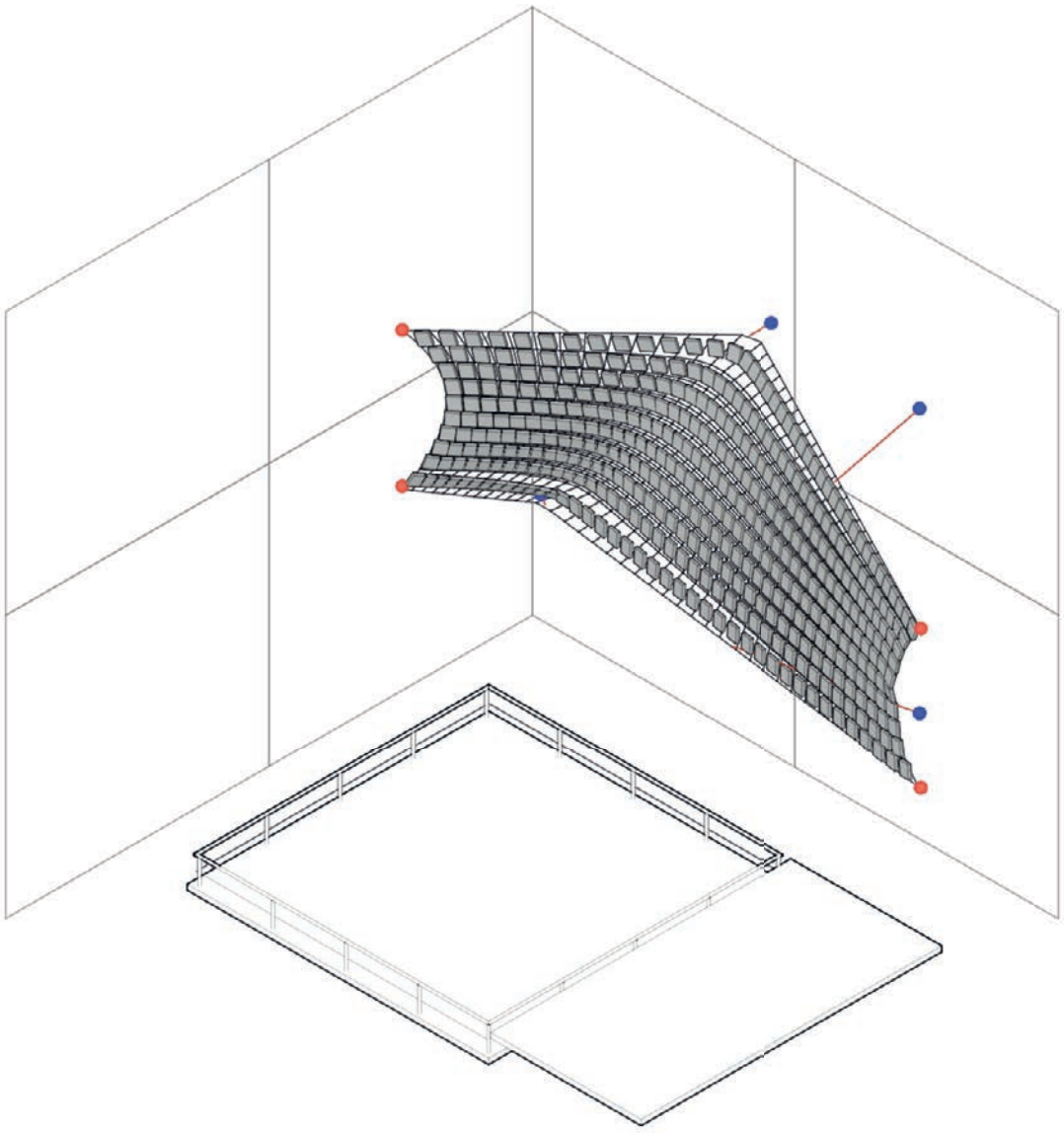
Three layers of motion

tensioning, stretching and light

Main feature of this experimental concert hall is a modern curtain, which consists of three layers.

First layer is made of two steel wires that are connected to two sides of the concert hall. They have to be always tensed as they are main structural element of the cloth and also their shape determines the final shape of the curtain. Second layer is a stretchable net connected to starting points of the wires behind it. Net is evenly spreaded out on the wire and adjusts to the curves determined by the shape of the main wires. On top of that, a series of small led-lamps is being placed, and is also evenly placed on the stretched net.

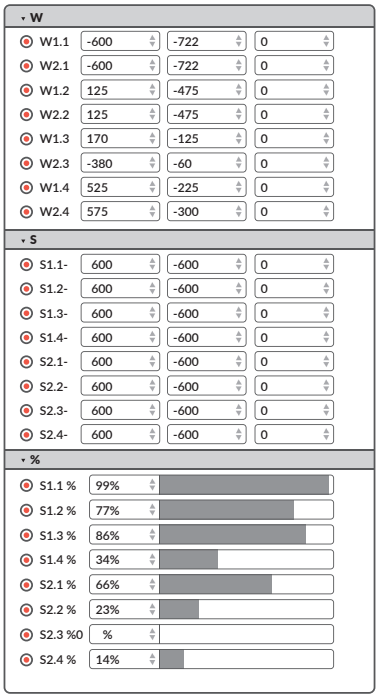
This technique creates a mechanism consisting of three types of movement. One that is being controlled by adjusting the position of control points and tension of the wires, second one determined by stretchability of the net, and third one which is not only creating a tangible barrier but also provides light and can be used as a screen for projections.

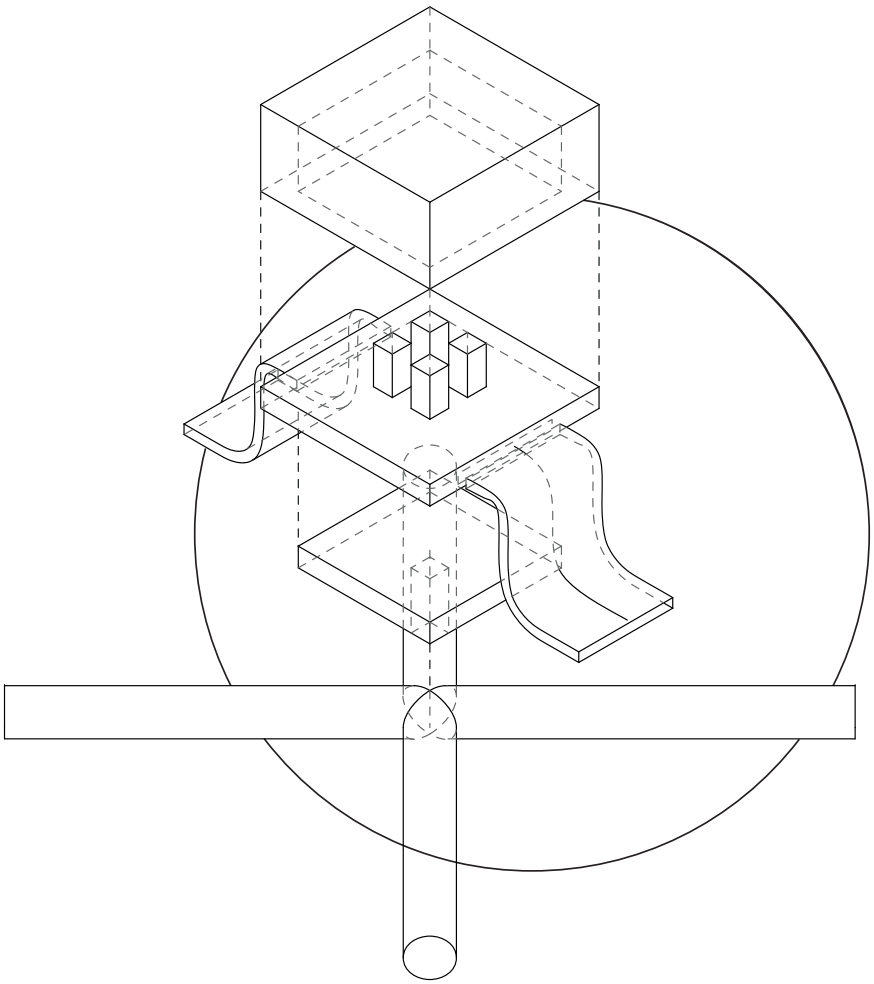


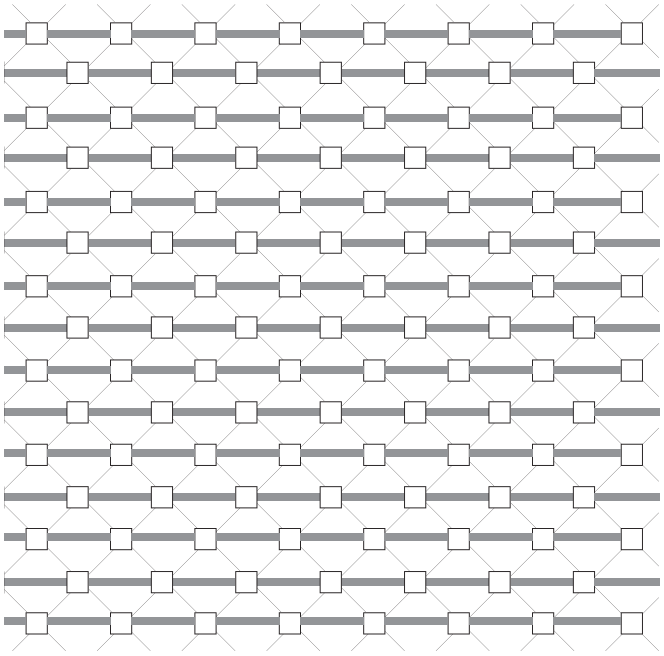
To create different spatial qualities, two curtains are being shaped by XYZ position of 8 control points and 4 percentage values each, creating a system controlled by 24 factors in total.

User interface shown above was necessary to ensure quick and reliable interaction with the created system. Another part of this interface allowed its user to save and load spatial setups which he or she found interesting, and let him use them in the future.

All of those tools were created with multiple Python scripts and a node-based programing language called Xpresso, which is an integral part of software used in all simulations (Cinema 4D). All scripts were made specifically for this system and done by the author of this thesis.



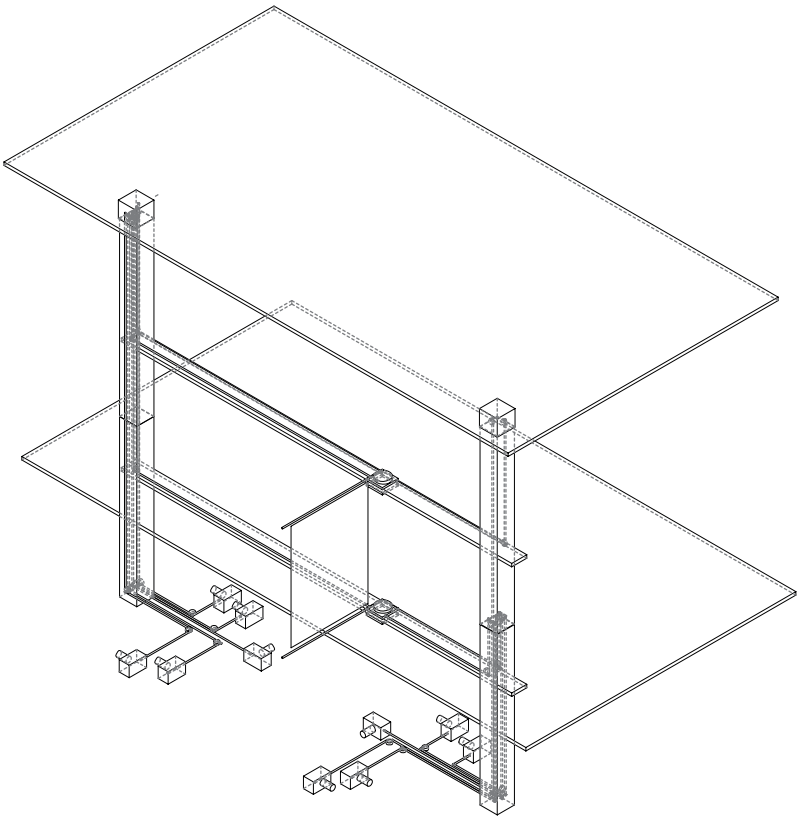


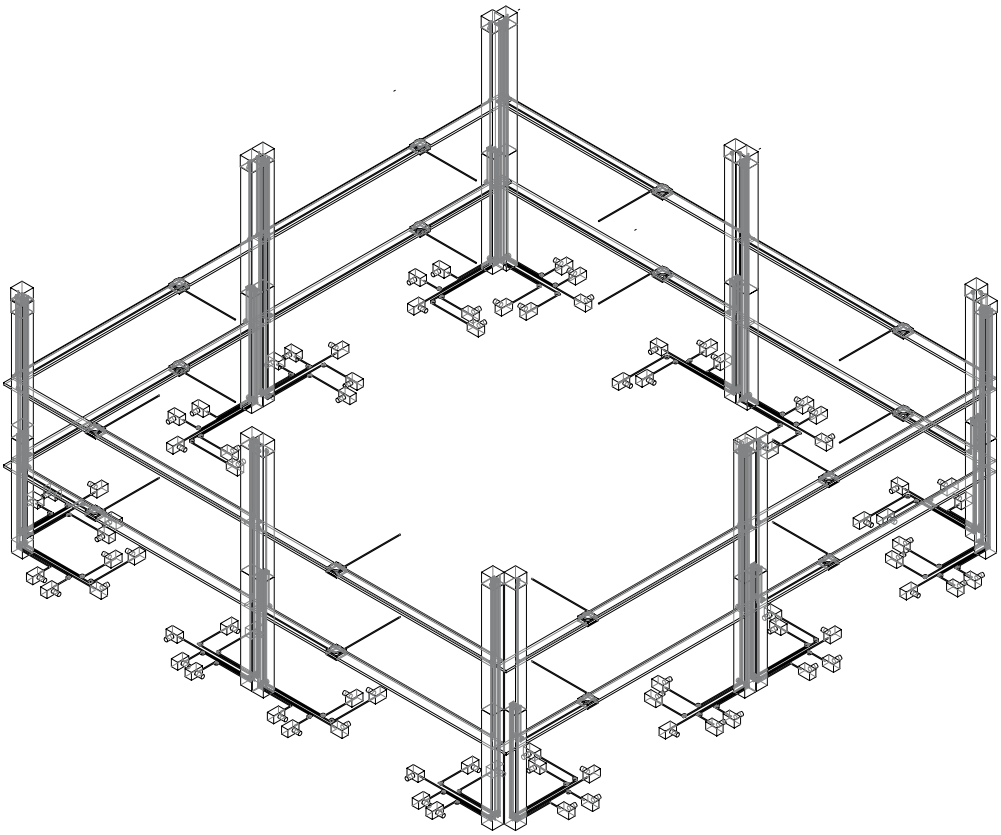


Technology used in designed “modern curtain“ does exists but in proposed design it does have one major tweak. In typical LED curtains, each lamp is connected to its neighboring unit by plastic handle which ensures keeping same distance between the units.

In that case it was crucial to allow every unit move freely to adjust to the shape of the stretched net. Because of that, LED lamps are not connected to each other by any kind of plastic element but they are simply connected to intersections on the stretched net.

To allow data and energy supply to every unit placed on deforming net, every lamp is connected to its neighbour with cable which length is longer than the initial distance between units (before stretching). Amount of the cable surplus defines the distance which every unit can move away from its neighbour.

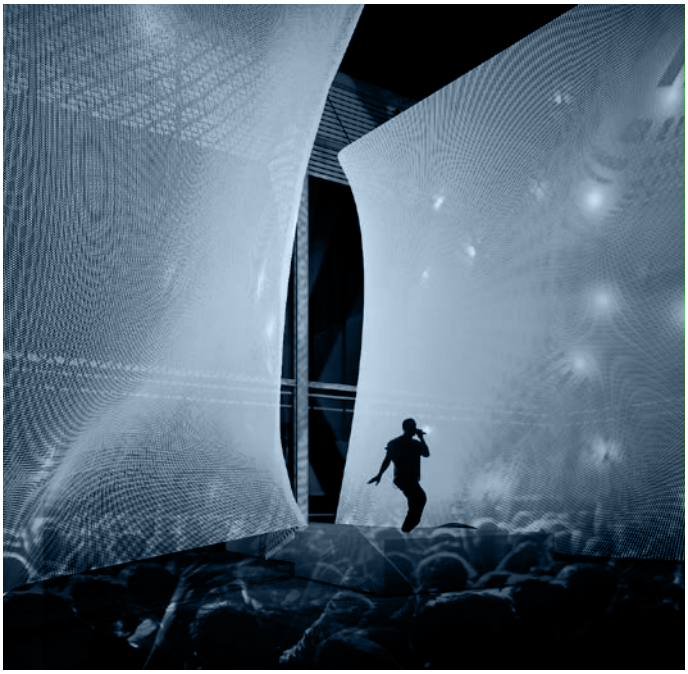


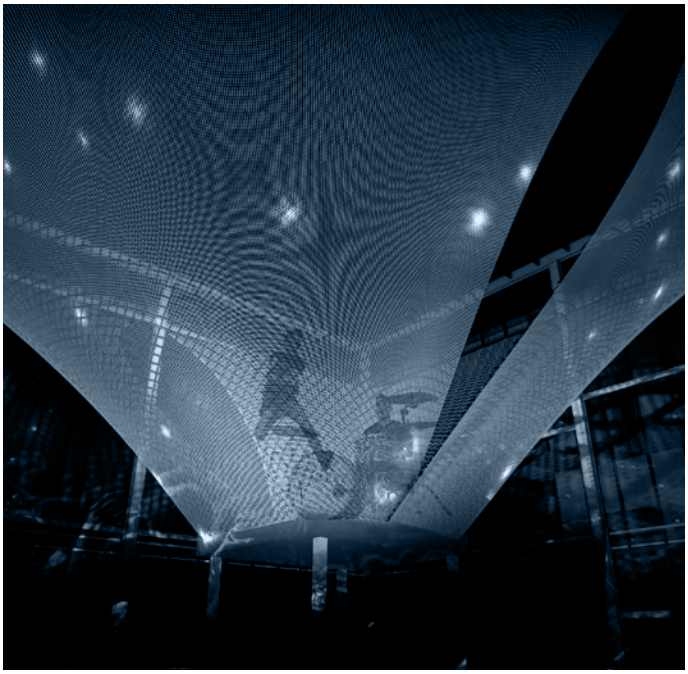
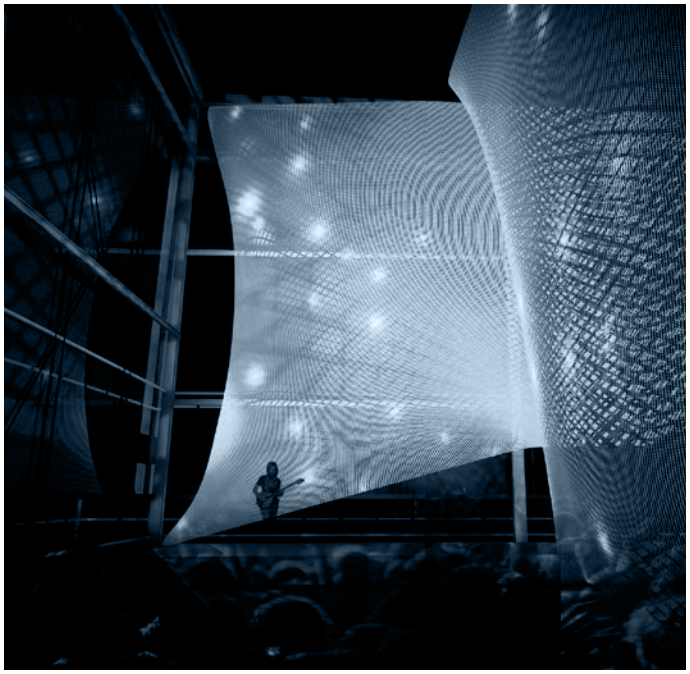
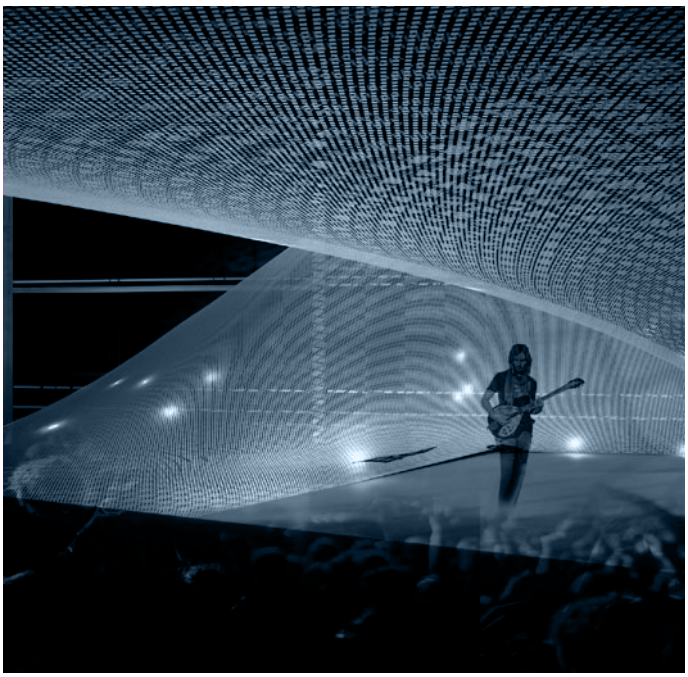


Lowest floor of this music venue is filled with 80 electric winches that are responsible for translating simple digits describing all 24 parameters of the curtains into physical world. Winches have different functions as they are either controlling position on XZ plane, position in Y plane, ensuring tension of the wire or adjusting wires length.

Wires are travelling across all floors of the building through empty space in pillars supporting the structure. Starting from electric winch, through series of small pulleys they end up on a beam on top of which final pulley is placed. Since every winch has to adjust its power to several other winches to ensure right tension of the wires, it would be necessary to introduce a software that would be able to control all those machines simultaneously and in real time.

Author of this thesis had to propose one custom-made element that would have to be implemented in the system to allow its right behaviour. Since main curtain wires have to at the same time provide right conditions for the net to be spreaded out while at the same time change it's length and allow another wire to pull it, it was crucial to provide a small object that would allow for all those actions to happen.

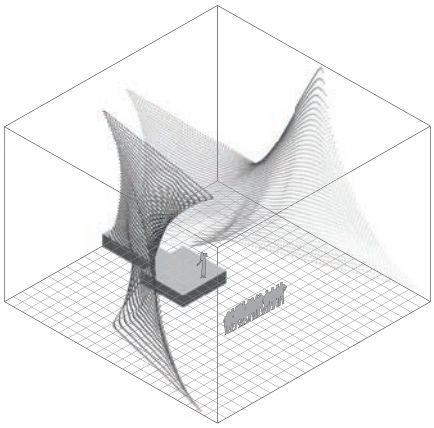


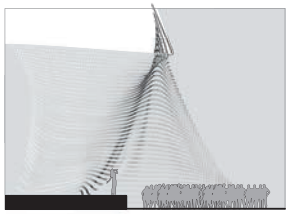




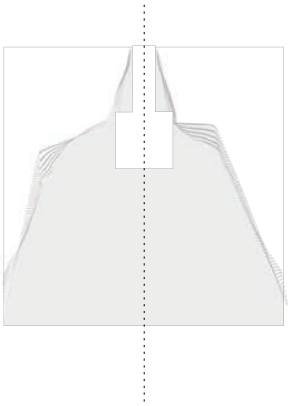

Spatial setups

enhancing performer - audience connection

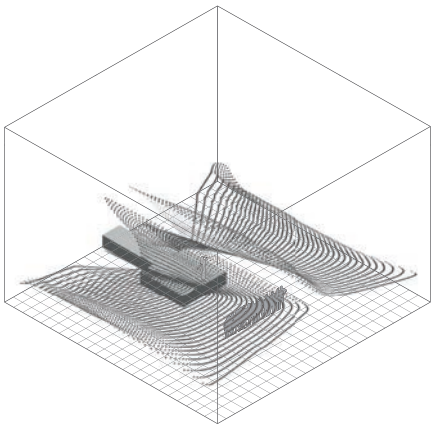
To fully support claims stated in the beginning of my presentation I created six different setups taking place in my building and taking use of all qualities of the modern curtain.

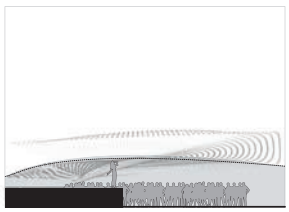


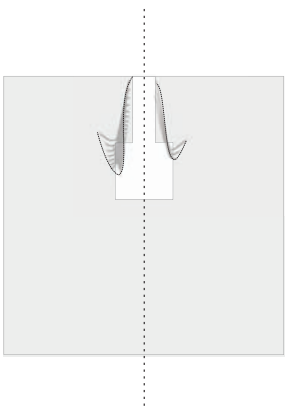




phase 1







phase 2

space perceived

accessible space

spatial setup #1

"Come Thru"

by Drake

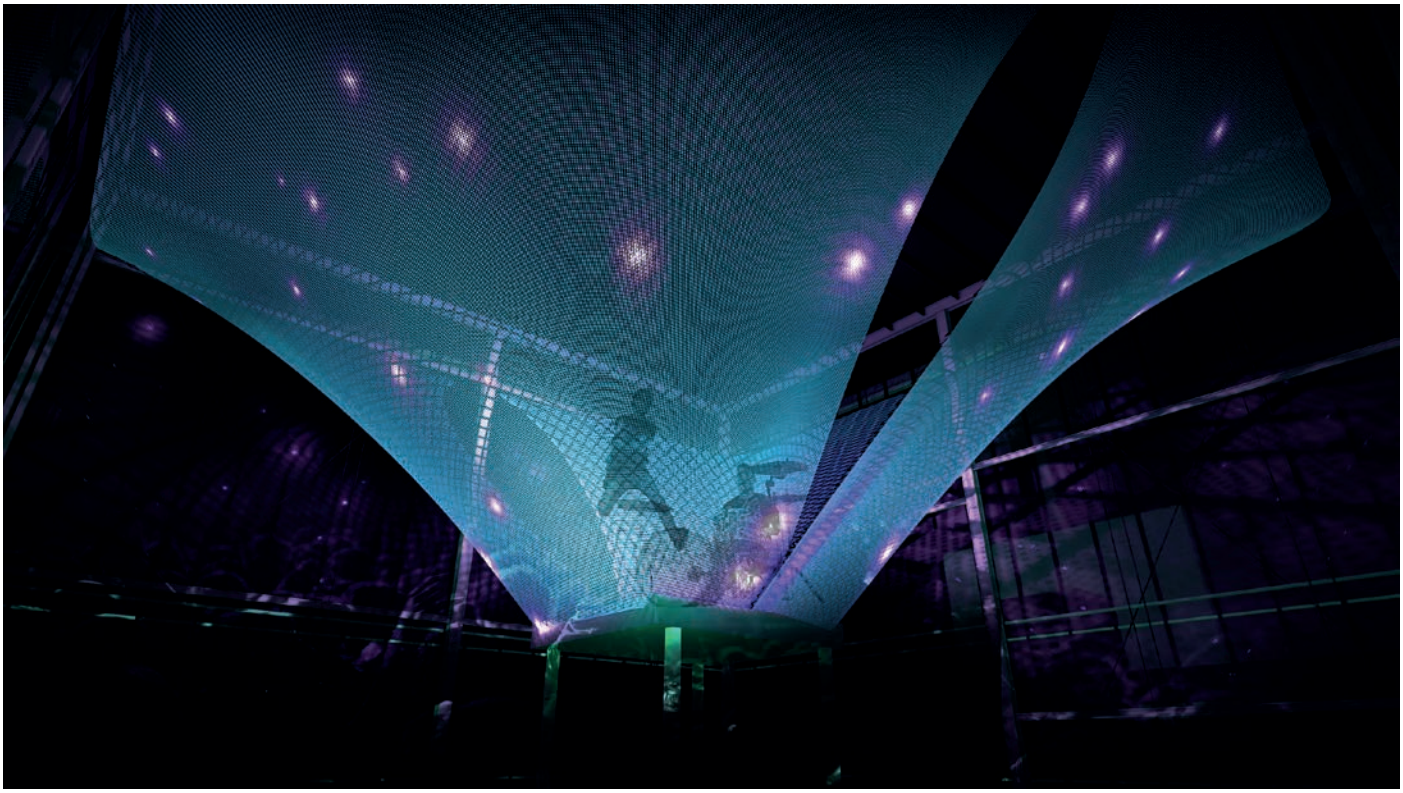
enhancing performer - audience connection

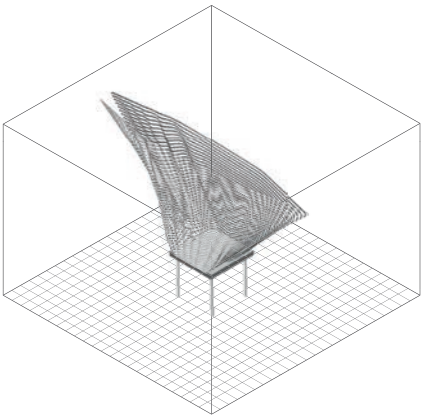
There are many different ways to create sense of closeness during a concert, but how could it be done by changing the shape of the room? Idea behind this spatial setup was to achieve this by contrast between two setups and by taking away the attention from the performer.

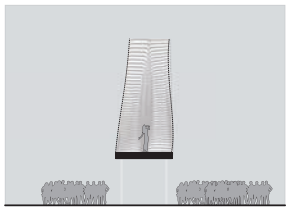
First phase puts a strong emphasis on the performer by creating symmetrical stage layout, and shapes the curtains so that they point directly at the performer. By using big vertical planes behind musician, we can make audience focus just on the performer and a "wall" behind him. This makes performer stand out from the audience around him.

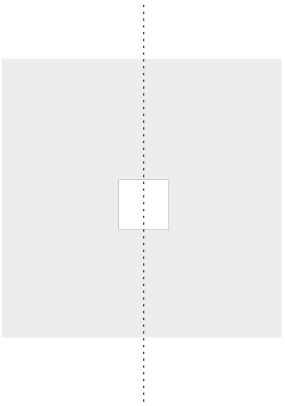
To create a sense of unity, second phase takes the attention away from the performer and creates space strongly enclosed from the top, making audience feel like sharing same space as their idol. Tall vertical surfaces turn into vast horizontal planes and performer no longer stands out as much as before. Thanks to this transition we also strongly influence plan of the space.

By enlarging area accessible to audience, we create two radically different situations which influence distance between separate audience members and possible viewing points.

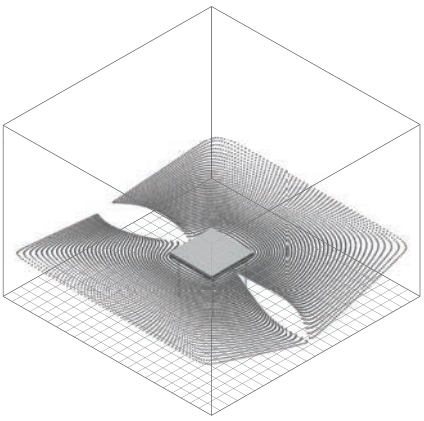


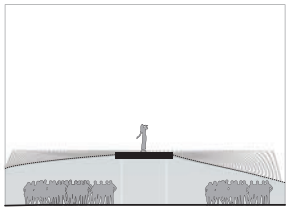


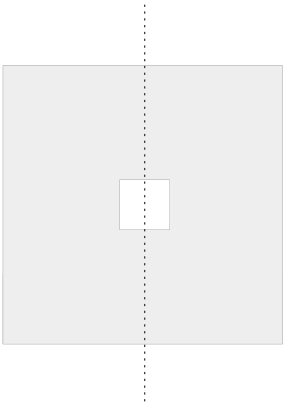




phase 1







phase 2

space perceived

accessible space

spatial setup #2

"I Bet You Look Good On The Dancefloor"

by Arctic Monkeys

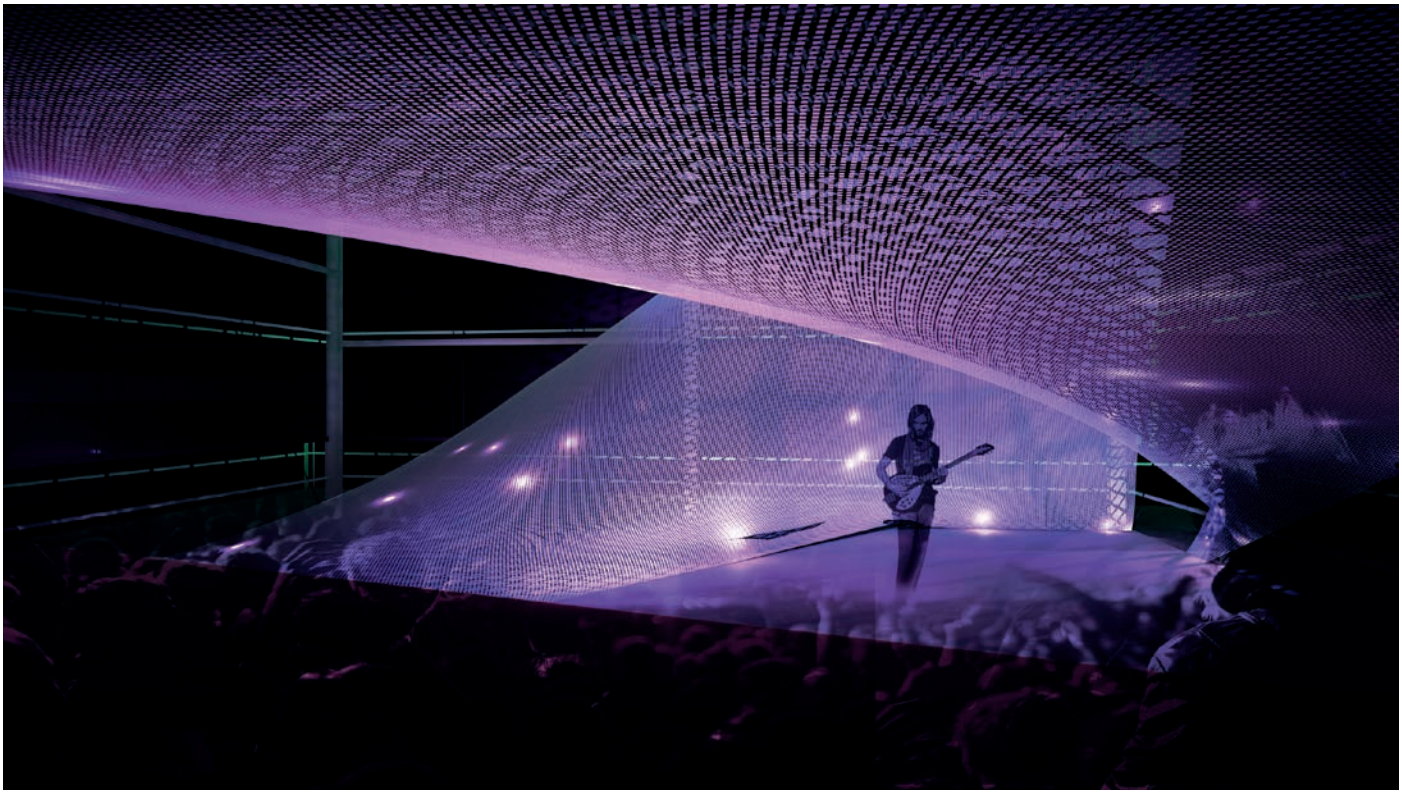
forcing audience to move

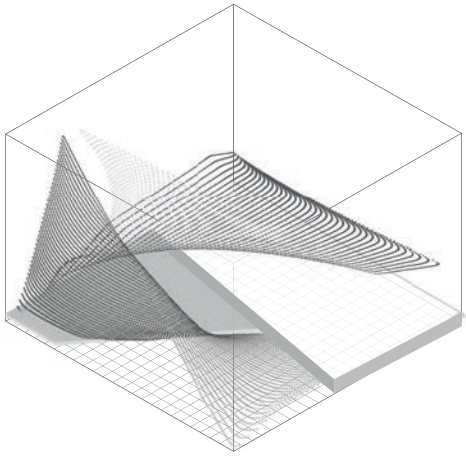
Second setup is proposing a scenario in which small adjustments in the proportions of the room make audience members stop focusing on the star of the show and forces them to simply dance around and focus on each other.

Once again first phase focuses audience view on stage. By creating single, strong element in the middle of the hall we ensure that audience will focus their sight on that object. Performers placed behind the curtain can be either invisible (hidden behind the cloth) or seen through the gaps between LED lamps once the curtain is being stretched out.

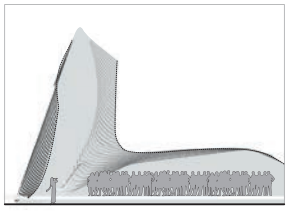
To make audience focus on themselves, we can take away the attention from performers by turning high vertical planes into horizontal ones. This creates a clear distinction between artists and audience. Low positioned ceiling not only makes the performers invisible but also shines strong light on audience members, what gives them no choice but to acknowledge each other existence. This spatial configuration if synced properly with music would create perfect encouragement to "go wild" with other audience members.

Another way of influencing the public, not shown on the schematics on the side, would be to guide them into particular parts of the room. This could be achieved by lowering ceiling so low, that it would become unpleasant or even impossible to inhabit given space and thus force one to move to space with higher ceiling.

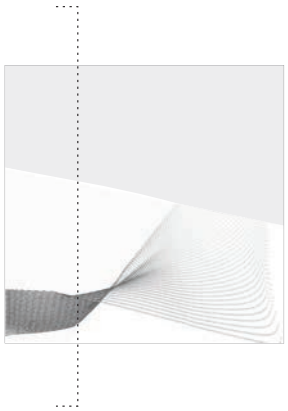




phase 1



space perceived



accessible space

spatial setup #3

“Endors Toi”

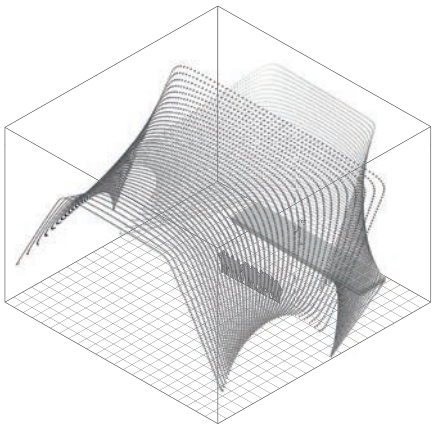
by Tame Impala

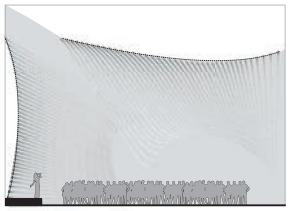
fading the boundaries away

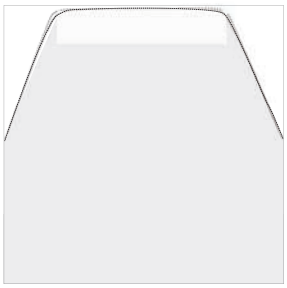
Thanks to curtain properties it is possible to create spaces which even without the use of motion can surpass regular stages with its complexity.

In this setup audience is situated slightly above performance area, which allows the curtain to be placed underneath them. Cloth is being stretched in a way which creates an unusual, abstract space where boundary between walls, ceiling and floor is fading away.

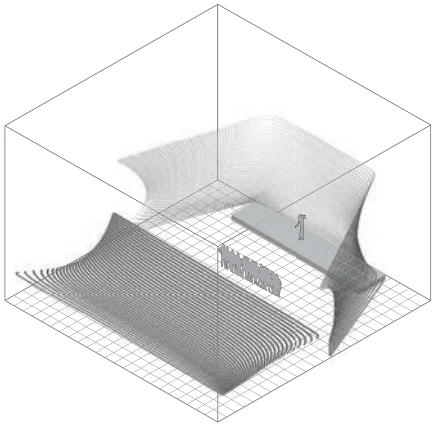
Audience members and performers are surrounded with fluid, smooth surfaces which starting points are hidden from their sight. This “womb” is creating cosy yet dynamic environment, which despite clear division line between stage and floor in front of it, makes both parties feel that they share equally important and coherent space.

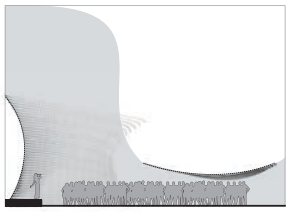






phase 1





phase 2

space perceived

accessible space

spatial setup #4

"The Sky Is Falling"

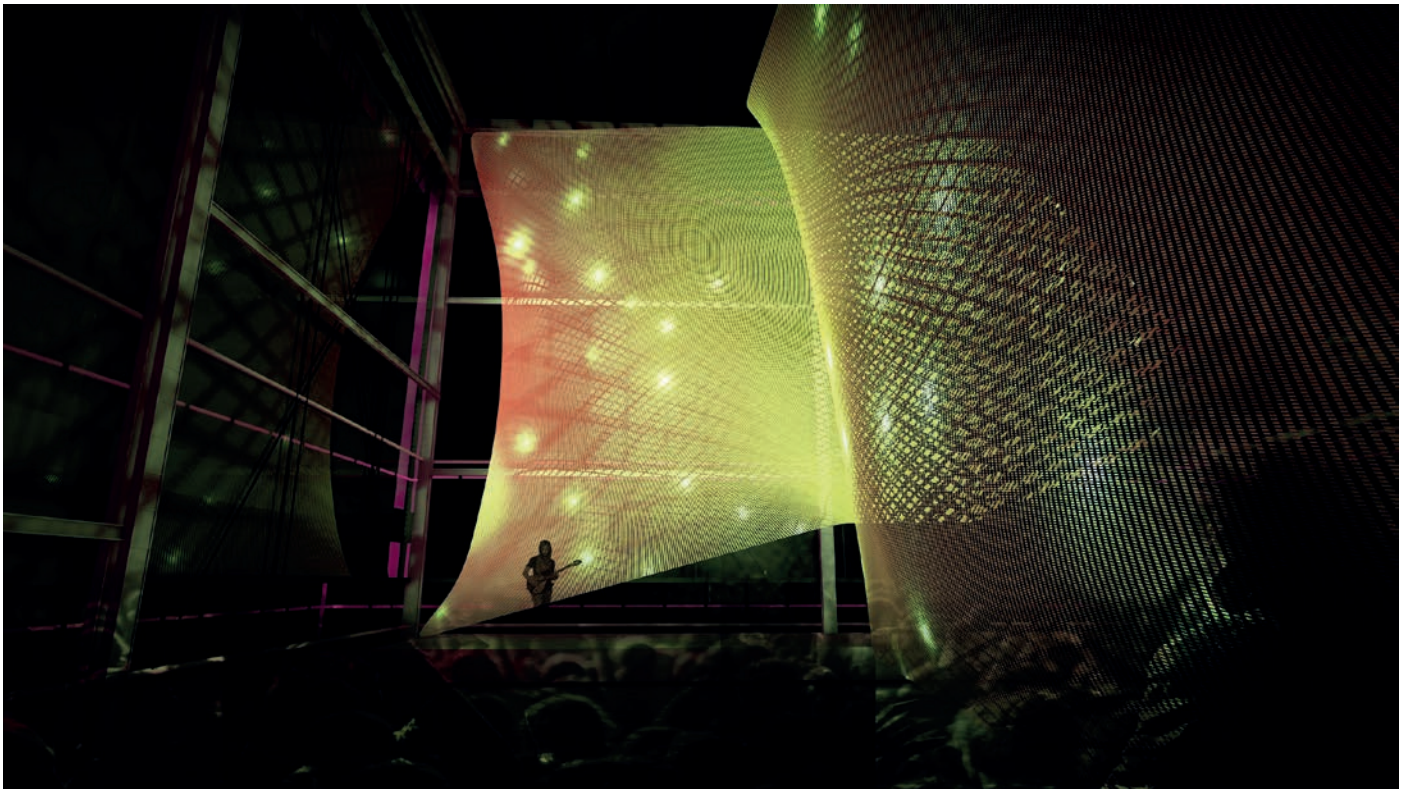
by Queens Of The Stone Age

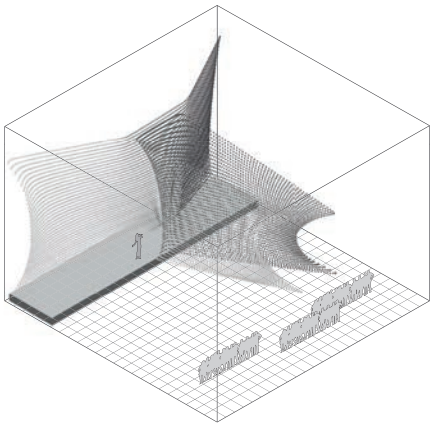
framing the view

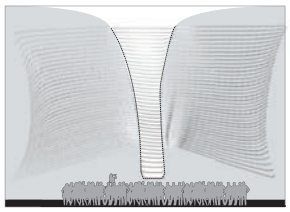
Another stage setup tried to enhance typical stage layout by introducing one new element in a form of adjustable ceiling.

By adjusting the height of the second cloth used in this setup, we dramatically change the feeling of the space. First phase creates proportions similar to typical concert hall, while second phase creates ones resembling more low-key, cosy environment, one that we could expect i.e. in small, underground club.

Although neither first or second phase are creating any kind of unusual spatial settings, the experience of being inside this space during a transition is what makes this setup so strong. By compressing the space we make crowd acknowledge their environment and also realize the change of the mood. Just like in setups shown before, simple adjustments of the elements of the stage design can become great tool of communication between performer and the audience.







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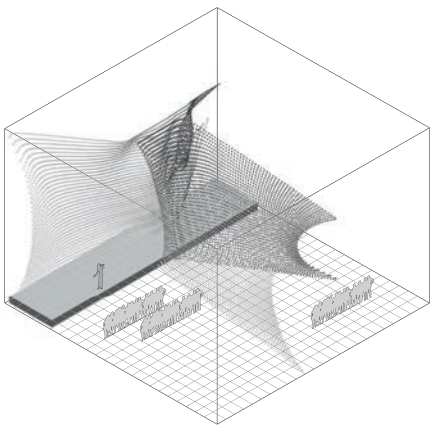
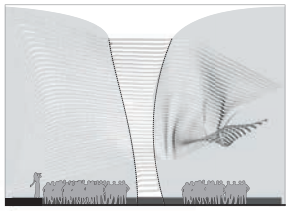




phase 2

space perceived

accessible space

spatial setup #5

"Controlling crowds"

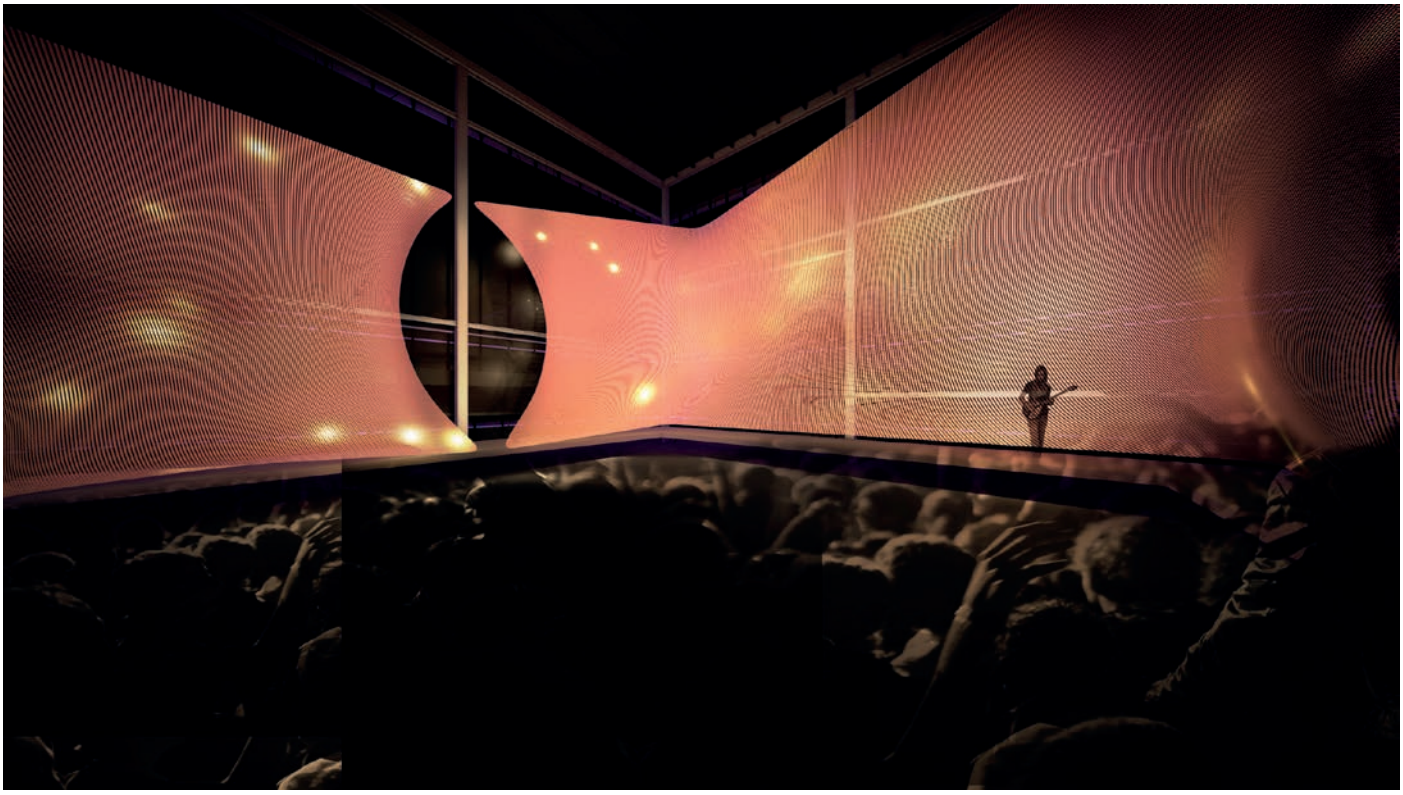
by Arcade Fire

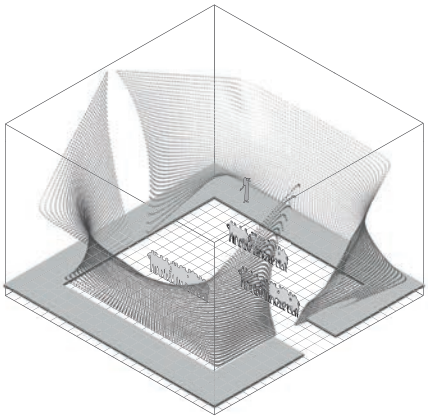
creating rivalry

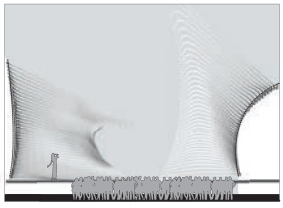
Inspiration for this setup was a quite common way of interacting with crowds used by performers. During concert frontman asks both sides of the audience to compete against each other by shouting or clapping louder that the other side. In such competition there is no real winner as it is only a simple way to energize the crowd, but what if we could actually reward one side that would win?

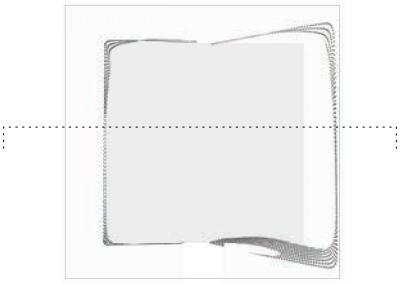
Layout of this stage does not indicate nothing unusual, as it is typical one-directional stage-audience relation. After mentioned "clapping" competition, once the winning side is determined, layout of the stage can be literally divided in two. Audience space is being split by vertical surface which was previously hovering above audience's heads and seemed to be just a regular ornament. Dividing curtain is being lowered down which makes audience members access only half of the space available before and is partially obstructing their view at the stage. To make the division even more clear, horizontal surface behind the performers is also adjusting to become bigger on "winning side" and smaller on the other.

This chaos-inducing transition is great example that this modern cloth can be treated as an architectural element, as it is influencing spatial qualities on such level that it makes audience members adjust to its placement.









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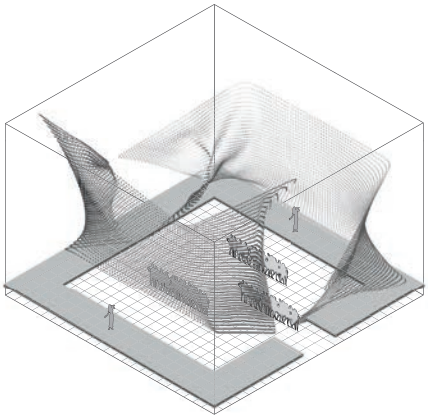

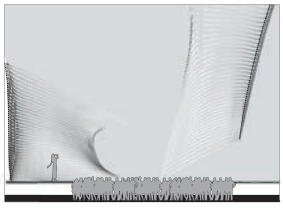

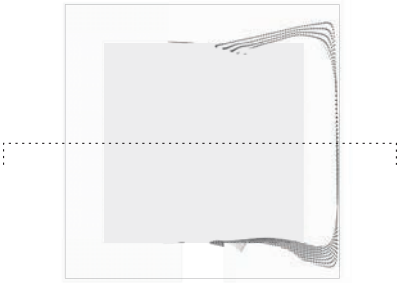

phase 2

space perceived

accessible space

spatial setup #6

"Around The World"

by Daft Punk

360 degrees experience enhanced

Last featured setup is introducing yet another enhancement to well known stage layout. Stage that surrounds audience from every side is not a new phenomenon, but with right cloth adjustment, this setting can create new possibilities for the performer to affect the audience.

First phase creates proportions of a regular room. Although the ceiling is not formed by cloth, and is rather open and determined by the roof of the building, the proportions of the room are clearly determined by the expansion of the cloth. That is why in second phase thanks to stretching out the cloth, we can create a much higher and vertical space, which makes both performers and the audience feel much smaller and insignificant in that environment.

Beside spatial transitions, curtain can be used in more traditional way, which is to introduce new performers on the stage. This can be achieved by slightly stretching out the lower part of the cloth, and creating an entrance for another performer to emerge on the stage. Such transition combined with 360* nature of this stage plan, can create interesting situations where new performer can appear on another side of the hall. Those two factors combined force audience to stop being completely passive during the show, and makes them decide which side of the stage they want to focus on.

Conclusion

How can introduction of movement can influence live music show experience? How can architectural elements provide better experience for performer and the audience during a concert? Can a music venue be more connected to the event which it accommodates?

Those were the questions posed by this master thesis and author believes that by research, conducted experiments and proposed solution, those questions were answered with success.

Result of this thesis proves that by using motion and operating with simple architectural elements such as wall, ceiling or abstract variations of those, one can greatly influence audience by changing their behaviour, making them feel solitaire or more as a whole, make them acknowledge their surroundings, surprise them or just provide them spatial conditions which they have never experienced before. All of that during one night in ever changing structure in Goteborg.

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