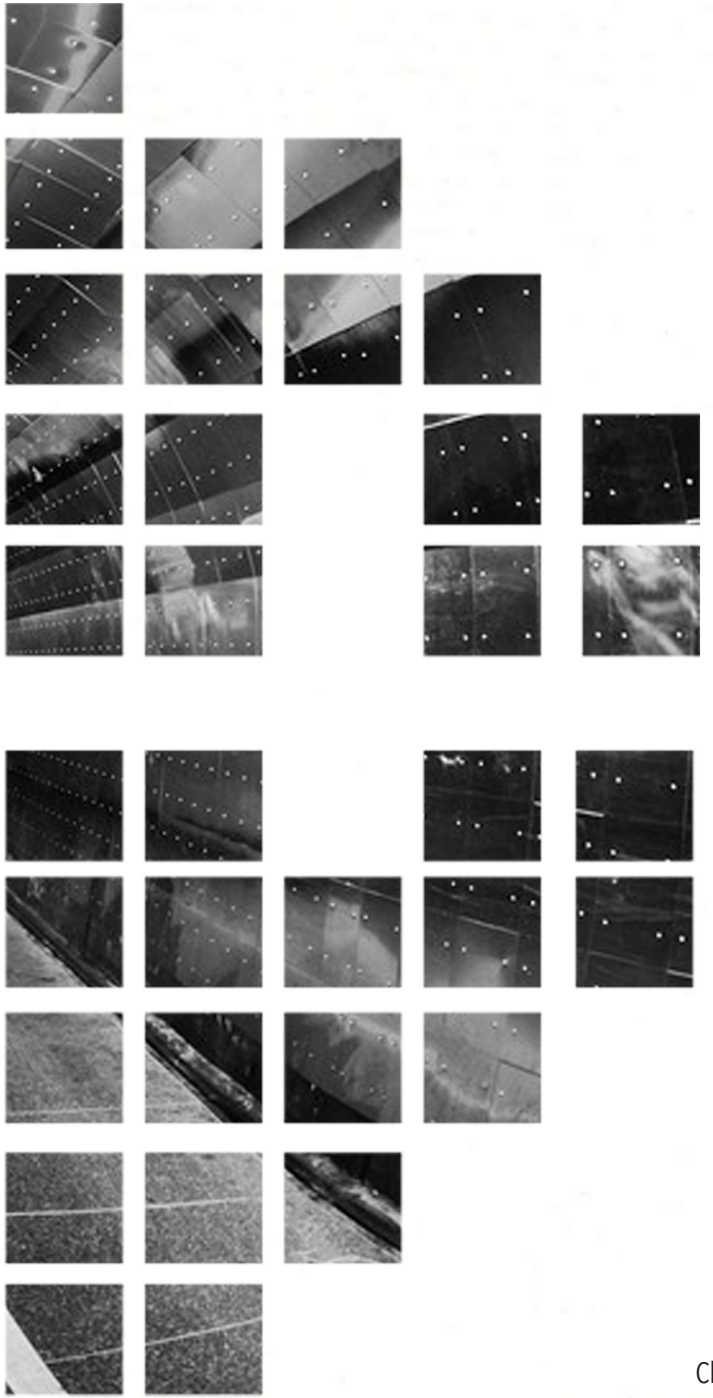

HAPTIC SPACE

Chalmers School of Architecture | Examiner : Jonas Lundberg | Supervisor : Kengo Skorick | Author: Louiza Papadimitriou-Douka

Louiza Papadimitriou-Douka

HAPTIC SPACE

Master Thesis | Chalmers School of Architecture | Autumn 2017

Material Turn Studio
Examiner: Jonas Lundberg
Supervisor: Kengo Skorick

MPARC

CHALMERS

Special thanks

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to Kengo Skorick, Jonas Rundberg, Jonas Lundberg, & Karin Hedlund for helping me developping it further,

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to Maja Kovacs for always finding time to listen and for always giving the best solution to any problem

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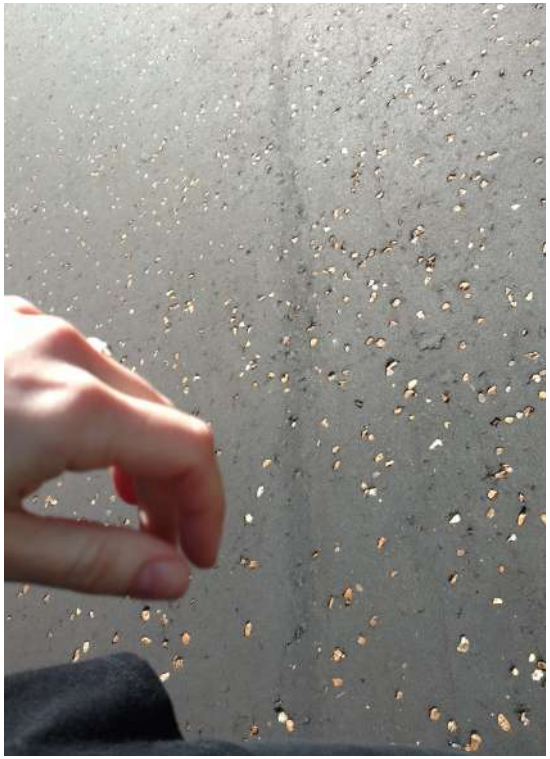
to my brother for always been there for me ,

to my dear friend Dimitris for working with me during the kinaesthetic investigations,

to Oana, Tung and Carlos for always encouraging me

and to all my friends in both Matter Space and Material Turn Studio.



Haptic Space

Haptic Cues Derived by means of Orchestrated Body Movements Creating Spatial Sequences when applied in a Visually Dominated Space of Transitions.

Reasserting haptics through a composition of different spatial sequences orchestrated by the user's body movements and levels of engagement in a visually dominated space.

1.1. TABLE OF CONTENT

1. INTRODUCTION

1.2. THESIS STATEMENT

The knowledge of the environment's non visual qualities that visually impaired people have can be used to reassert haptic experiences in Architecture today. Using the senses and more in specific the sense of touch as a foundation to rearrange today's hierarchy of the senses in one's experience of the built environment.

Haptic Space

Haptic Cues Derived by means of Orchestrated Body Movements in a Visually Dominated Space of Transitions.

Architecture today, is dominated by visual representation. A great number of buildings have become image products that lack existental depth with their appearance ruling over their experience. People that can not be seduced by the power of the image are visually impaired people. They interact with the built environment through their entre body and through this daily interacton they have built a knowledge of its non visual qualites. Their dominating sense is the sense of touch, the mother of all senses. It has the ability to promote object recognition, recognition of form or material as it is in vision. Also the basic tool for tactile perception which with kinaesthetic form the focus of this research, haptic perception.

Hand focused research started with a series of tactile experiments that were recording fingertips movement in order to understand the logic of the hand when moving along surfaces. Body focused research started with a series of hand movement observations (hand as part of the whole body) in specific body movement situations. These investigations were made in order to create a haptic system that when applied will demand a deeper sensory engagement in one's experience of the built environment.

The aim is reached by means of exploring the implications of the simple conceptual displacement: body (hand) - (movement / sensaton/sequence) - haptic reassessment. The chosen context for the application is the Brunkeberg Tunnel in Stockholm. A visually dominated site that could challenge the design and a site where redefining driven architectural archetypes such as An Entrance, A Staircase and A Corridor with haptic reassessment is possible. The proposal is a surface design applied in space with diferent rhythms and by engaging different body muscles, used as an instrument to reassert its haptcity

Examiner: Jonas Lundberg
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Master´s Programme:
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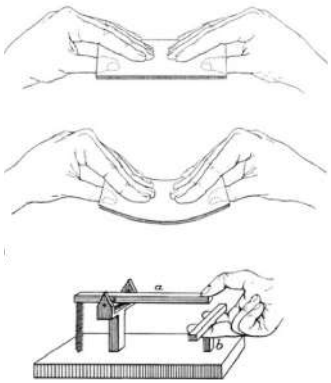
1.4. RELEVANT RESEARCH TOPICS

1.5. LITERATURE



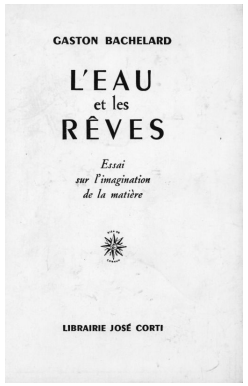
Human Haptic Perception: Basics and Applications, M. Grunwald

"The motion of the fingers is especially necessary to the sense of touch. These bend, extend or expand, moving in all directions like palpa, embracing the object and feeling it on all surfaces, sensible to its solidity."

Sir Charles Bell (1774-1842)

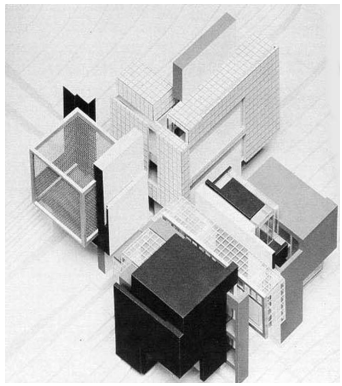
Hapticity and time J. Pallasmaa

"Our culture of control and speed has favoured the architecture of the eye, with its instantaneous imagery and distant impact whereas haptic architecture promotes slowness and intimacy, appreciated and comprehended gradually as images of the body and the skin. The architecture of the eye detaches and controls whereas haptic architecture engages and unites . Tactile sensibility replaces distancing visual imagery by enhanced materiality nearness and intimacy."



The Water and the dreams G. Bachelard

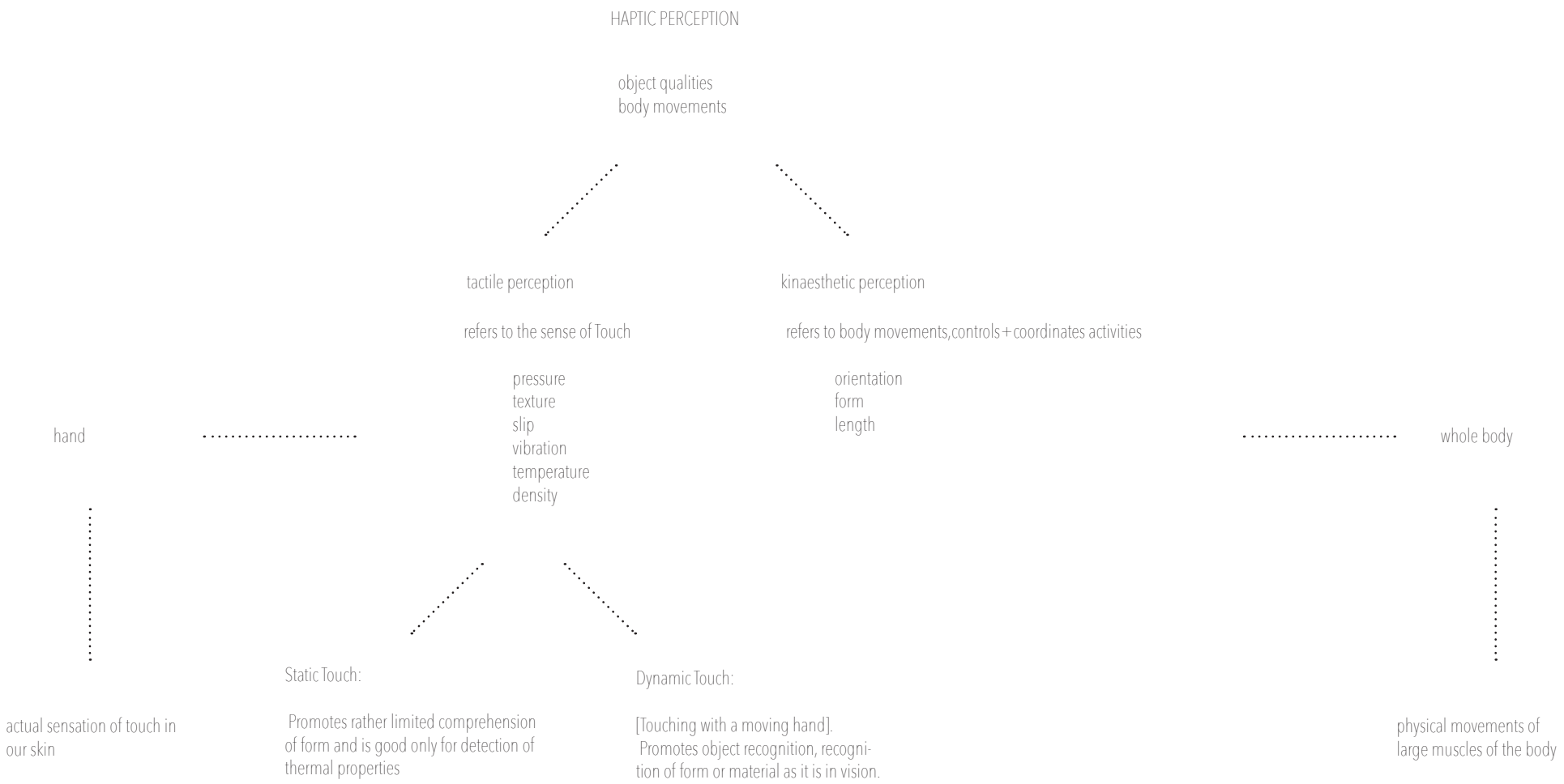
"...even the hand has its dreams and assumptions. It helps us understand the innermost essence of matter. That is why it also help us imagine forms of matter."



The architect's eye Tom Porter

"...as designers , our articulation of space could be far far richer if we became only slightly more aware of the tactile sense."

1.5.1.DEFINITIONS



1.6. INSPIRATIONAL REFERENCES

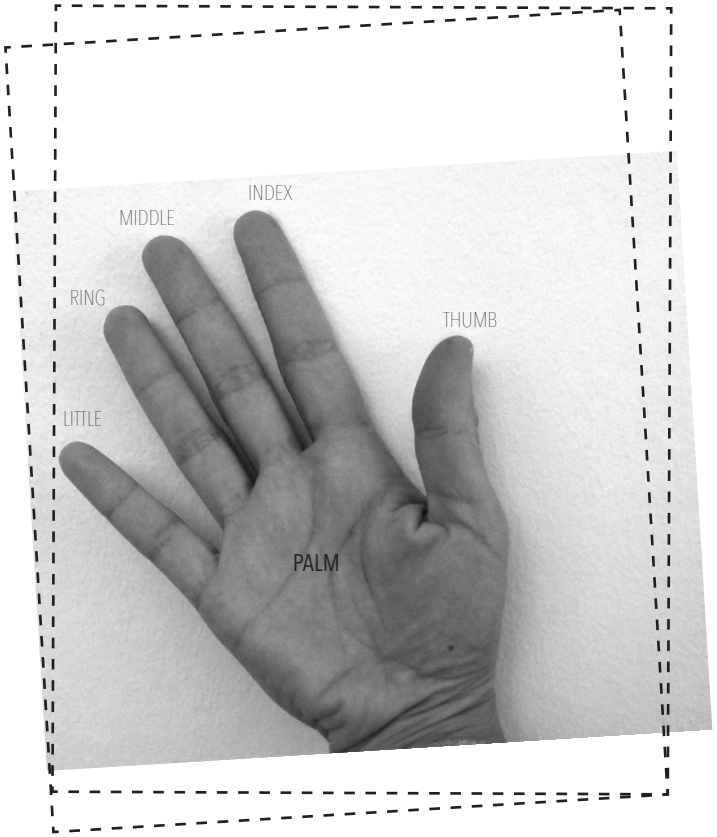
fig.1

fig.2

2. INVESTIGATIONS RELATED TO HAPTICITY

2.1 TACTILE PERCEPTION

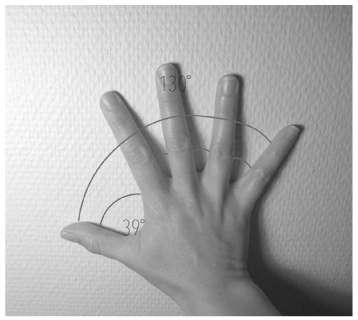
2.1.1.2. HAND MEASUREMENTS



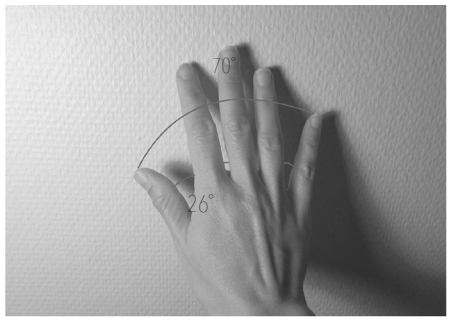
Open palm size [120x170mm]

Dynamic touch

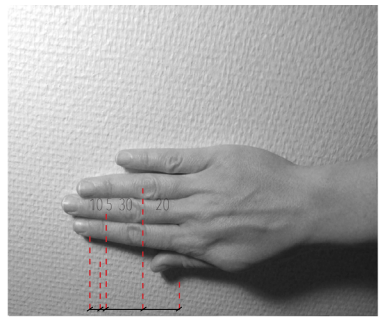
Fingers spread

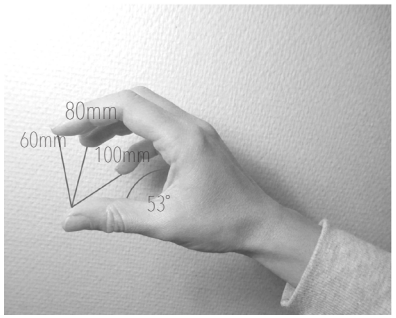


Fingers semi spread

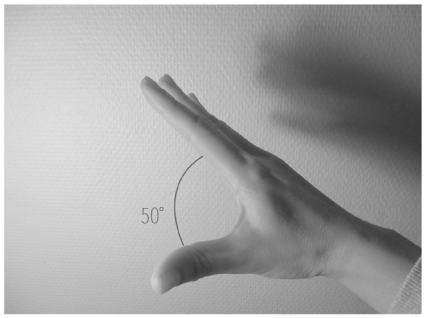


Fingers closed

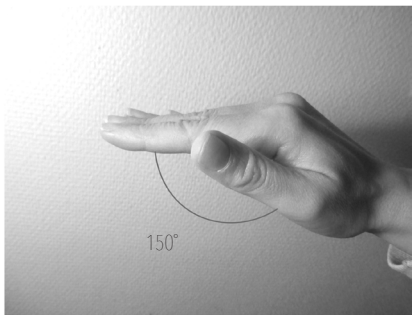




Normal fist opening



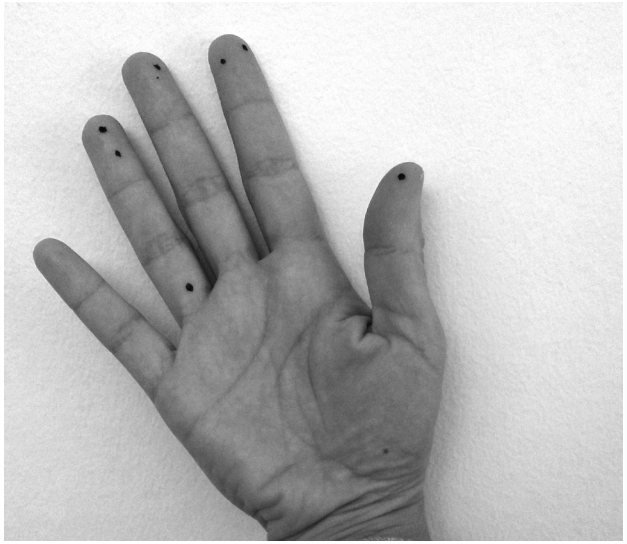
Maximum fist opening



Fingers-Palm Angle

Static touch

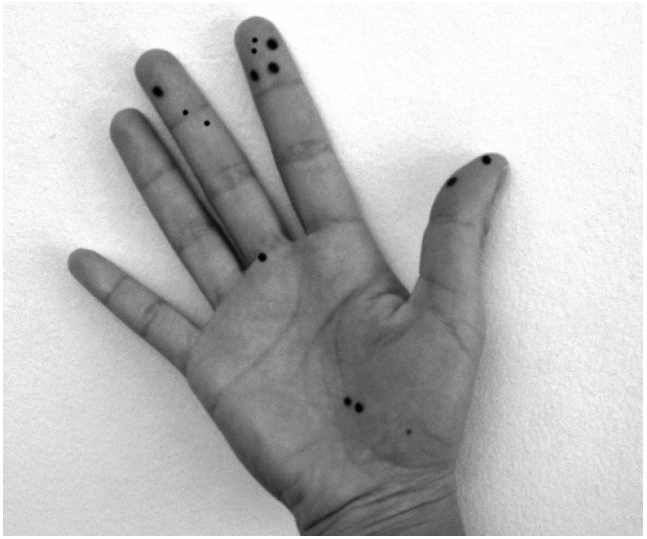
2.1.1.3. RECEPTORS



Merkel-neurite complex|provides the information on which texture perception is based

sensitive to: points
edges
corners
curvature

resolving spatial features as small as 0.5mm or even less



Meissner's corpuscles|also known as tactile corpuscles

sensitive to: light touch
low sequence vibration

adapts rapidly to: changes in texture

2.1.1.4.1.REFERENCE 1A, AN EXPERIENCE RICH TO THE EYE AND THE SKIN

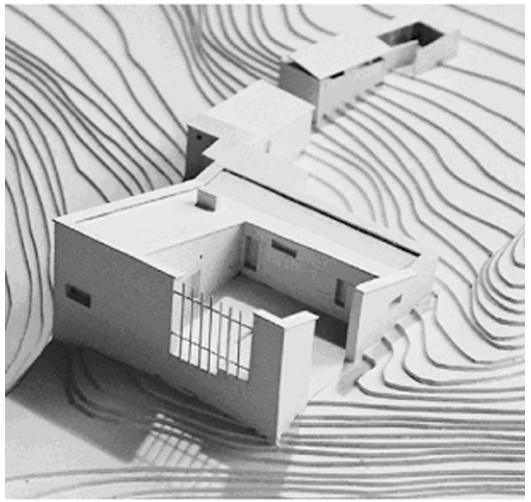


fig3.MUURATSALO SUMMER HOUSE, A.AALTO,1953

fig.4 Detail of the wall

TACTILE SEQUENCE

Tactile Sequence /vision activated (from left to right):
– Void – metal – void – plant – bricks density A – bricks density B – bricks projected – bricks density C – wooden frame – glass – wooden door – bricks density C – blue bricks – bricks density E – wooden door – bricks density C – bricks density F – dark bricks- black&white bricks –

Tactile Sequence /touch+vision activated (from left to right):
– Void – metal – void – green – protruding bricks – bricks density B – bricks projected – bricks density C – wooden frame – glass – wooden door – bricks density C – blue bricks – bricks density E – wooden door – bricks density C – bricks density F –dark bricks- black&white bricks

Tactile Sequence /touch activated (from left to right):
– Void – cold – void – tickling – protruding volume – bricks – bricks – bricks – linear – cold/fragile – warm/friendly– bricks –bricks – bricks – warm/friendly – bricks – bricks –bricks- bricks

2.1.1.4.2. REFERENCE 1B, AN EXPERIENCE ENGAGING GAZE DIRECTION & BODY MOVEMENT

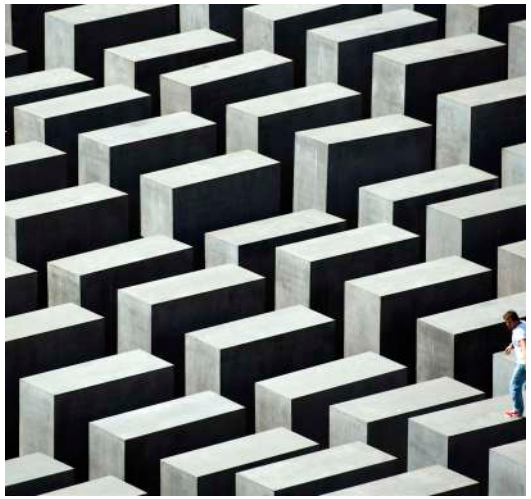


fig 5+6 Berlin Holocaust Memorial, P.Eisenman, 2005

2.1.1.5. INVESTIGATION/MOVING HAND/FINGERTIPS/RECORDING

Thumb (f1)

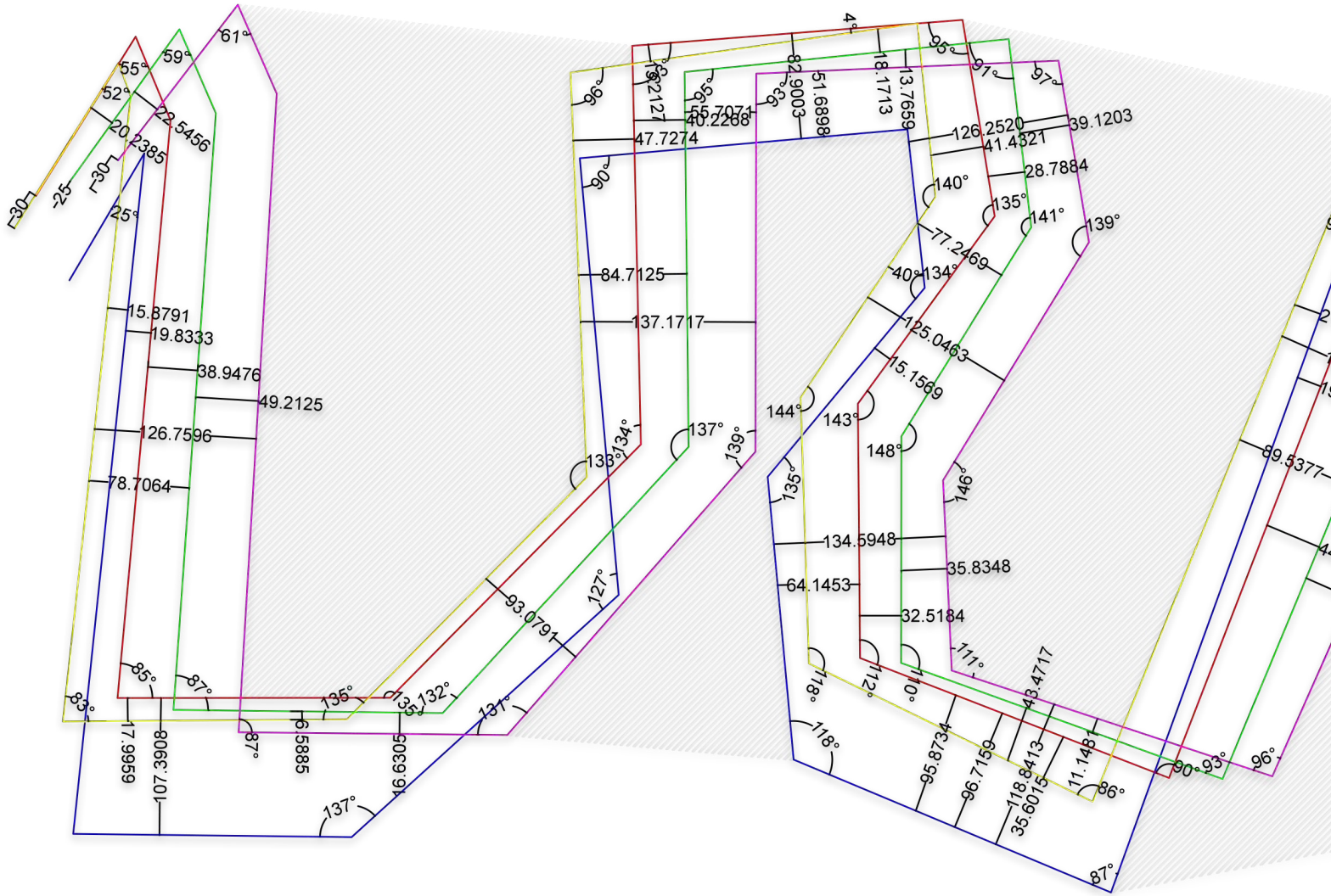
Index (f2)

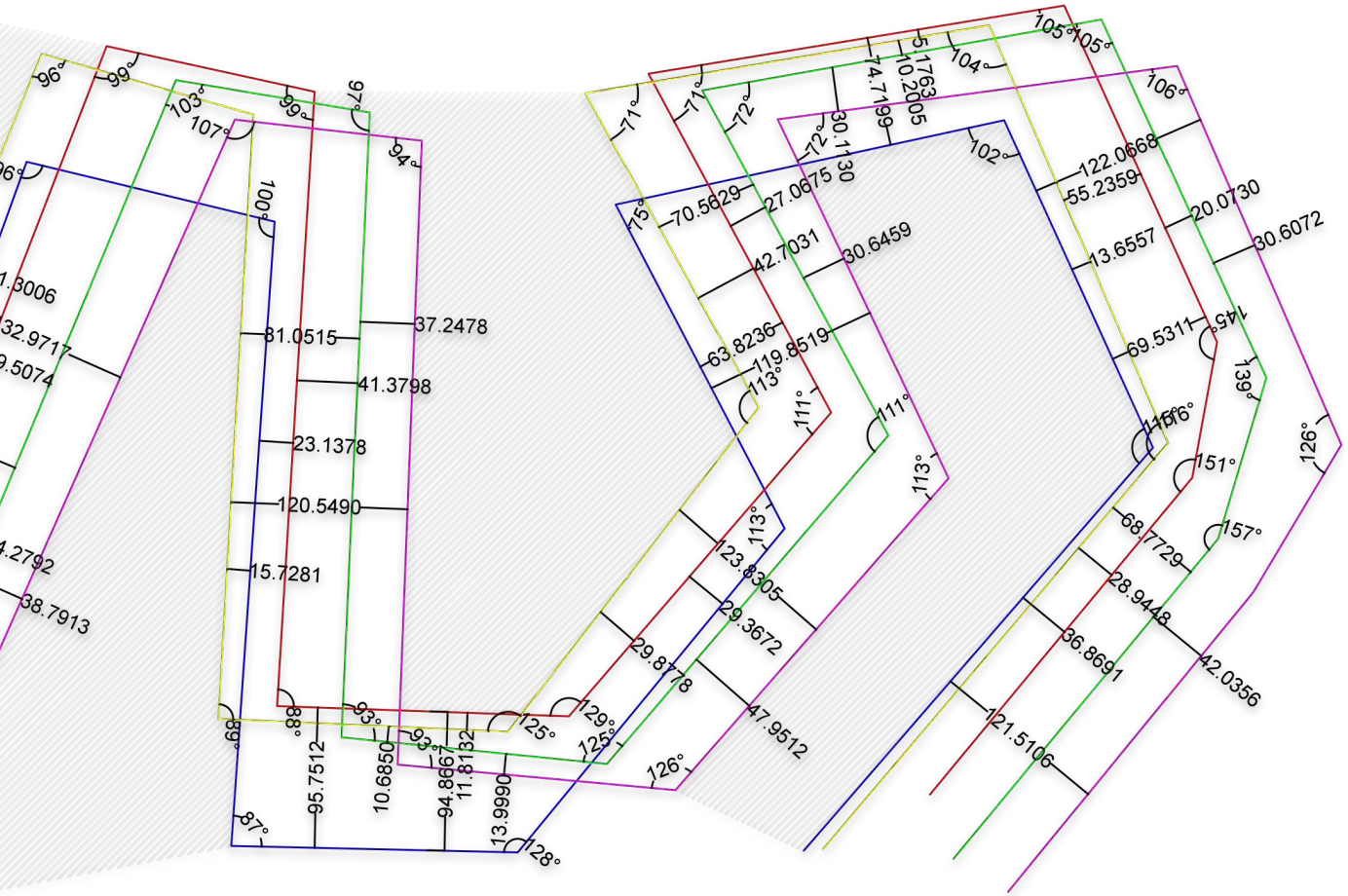
Middle (f3)

Ring (f4)

Little (f5)

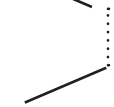
2.1.1.6. SYSTEM OF THE FINGERTIPS MOVEMENTS




96°
99°
103°
107°
99°
97°
94°
100°
1.3006
32.9717
9.5074
4.2792
38.7913
81.0515
37.2478
41.3798
23.1378
120.5490
15.7281
88°
89°
93°
93°
95.7512
10.6850
94.8667
11.8132
13.9990
87°
128°
125°
129°
125°
126°
47.9512
29.8778
29.3672
123.8305
113°
113°
111°
111°
113°
71°
71°
72°
72°
30.1130
14.7199
10.2005
5.1763
104°
105°
105°
106°
102°
75°
70.5629
27.0675
42.7031
30.6459
63.8236
119.8519
122.0668
55.2359
13.6557
20.0730
30.6072
69.5311
145°
139°
126°
151°
157°
68.7729
28.9448
36.8691
42.0356
121.5106

Scale 1:5

2.1.1.7. OBSERVATIONS

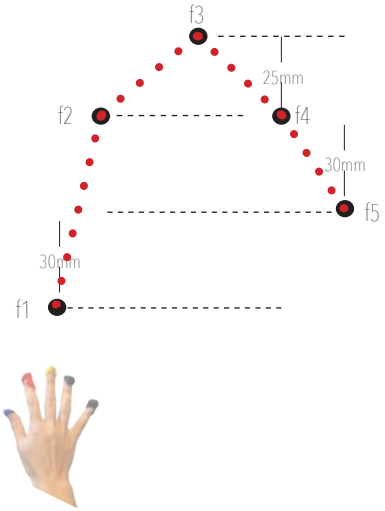
Fingers track	Fingers position	max/min distance between	Angle	Overlapping tracks	Order in moving
	f1-f2-f3-f4-f5	80-100mm	–	f2-f3-f4	f2-f3-f4-f5-f1
	f5 f4	80-100mm	–	–	f1-f2-f3-f4-f5
	f1-f2-f3-f4-f5	80-100mm	–	–	f1-f2-f3-f4-f5
	f5 f4	125mm	–	f2-f4	f3-f1-f2-f4-f5
	f1-f2-f3-f4-f5	93mm	110°-118°	f1-f4	f3-f2-f4-f1-f5
	f1-f2-f3-f4-f5	120mm	115°-151°	f1-f2	f1-f3-f2-f4-f5
	f1-f2-f3-f4-f5	118mm	110°-118°	–	f5-f4-f2-f3-f1
	f1-f2-f3-f4-f5	125mm	134°-140°	f1-f3	f1-f3-f2-f4-f5

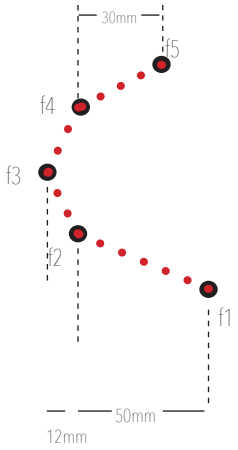
 previous move direction

f1=thumb f2=index f3=middle f4=ring f5=little

2.1.1.7. OBSERVATIONS

	HORIZONTAL MOVES	VERTICAL MOVES
	f2 f4 f3 f5 f1	f3 f1 f2 f4 f5
max/min DISTANCE between fingers	70-120mm	126-170mm
ANGLE	Obtuse 10° declination between different finger tracks	
VOIDS	44%	
STARTING POINTS		





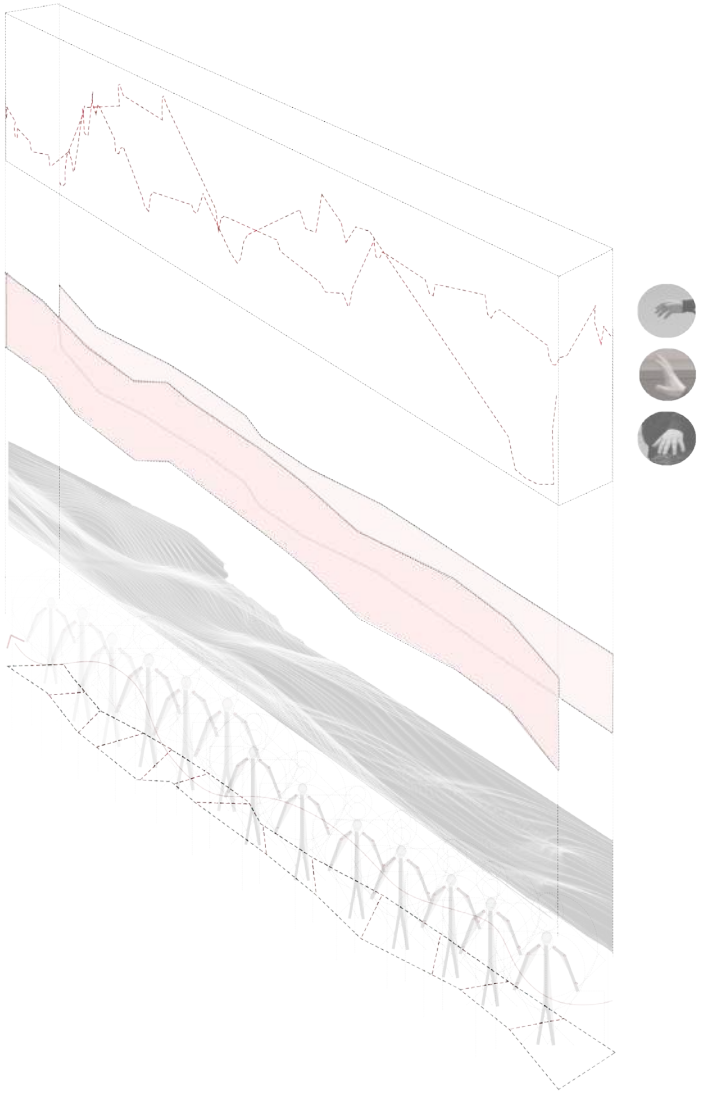
2.2 KINAESTHETIC PERCEPTION

[BODY CONDITIONS]

"The Architectural Body. An architect internalises a building in his body; movement, balance and scale are felt unconsciously through the body as tensions in the muscular system and in the positions of the skeleton and inner organs. Consequently, architecture is communication from the body of the architect directly to the body of the inhabitant".

- Juhani Pallasmaa, An Architecture of the Seven Senses

2.2.1. PROCESS



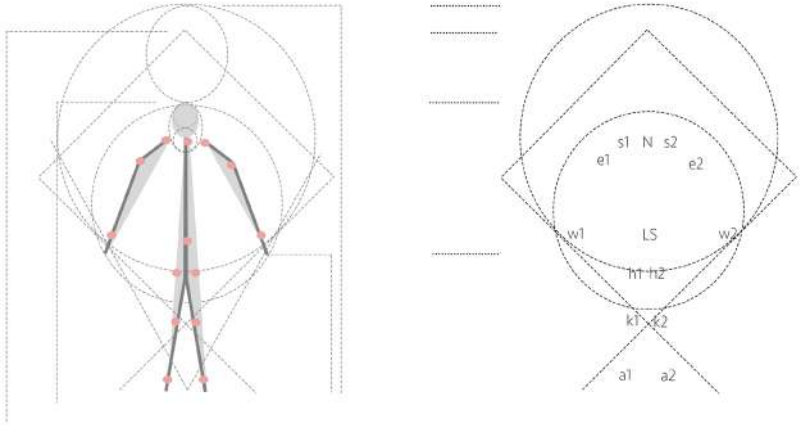
Hands movement tracing/haptograms

Active touch zones

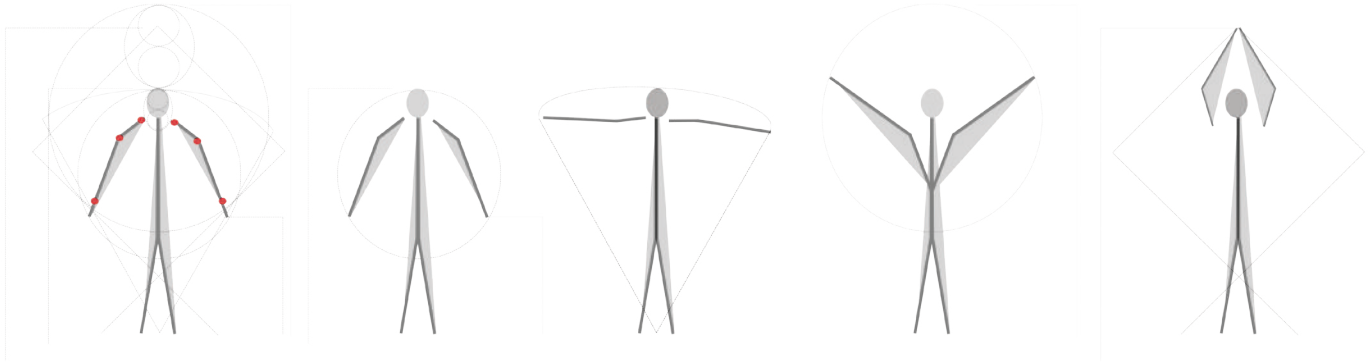
Haptic movements translation

Body movement /bodygrams

2.2.2. THE BODY [BODY PROPORTIONS - IMPORTANT JOINTS]

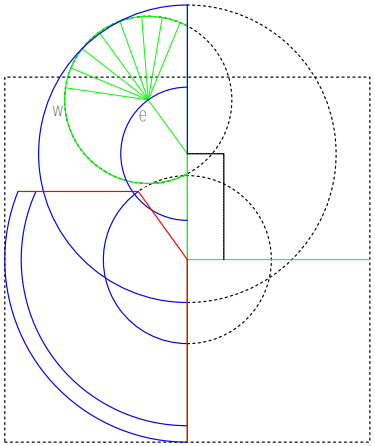


s=shoulder|e=elbow| w=wrist| h=hip| k=knee| a=ankle| N=neck| LS=Lumbar Spine

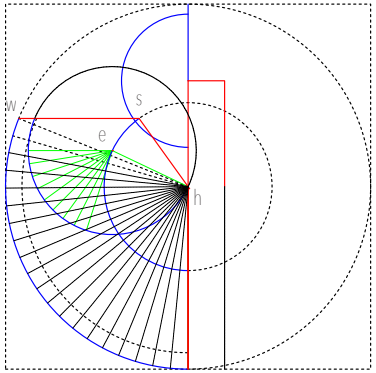


2.2.2.1. IMPORTANT JOINTS MOVEMENT SPECTRUM

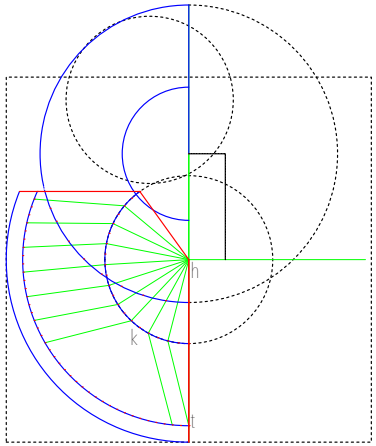
E
W



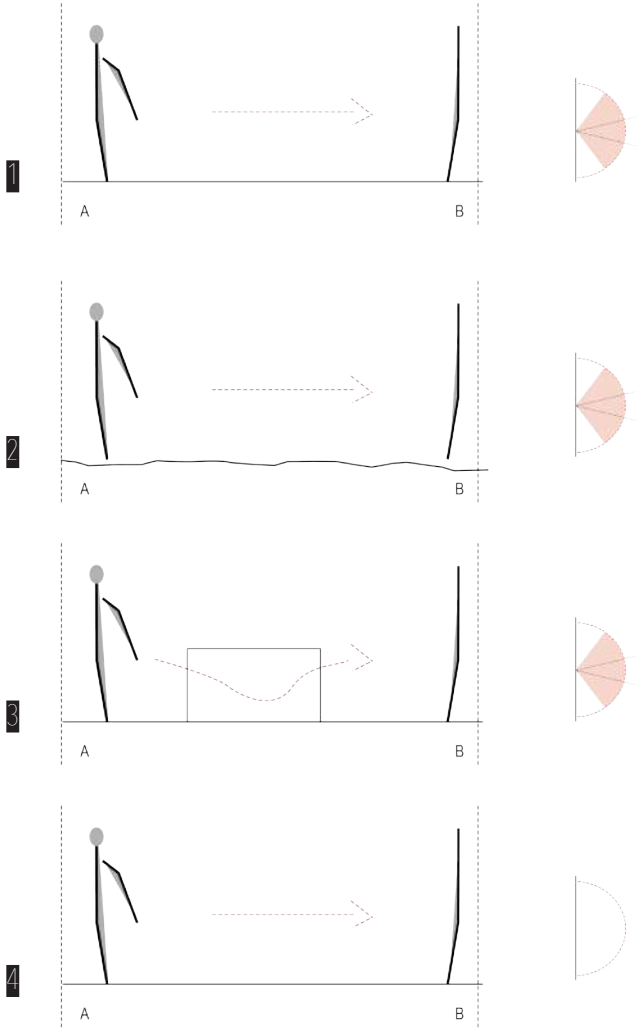
SE
E W



HK
KT

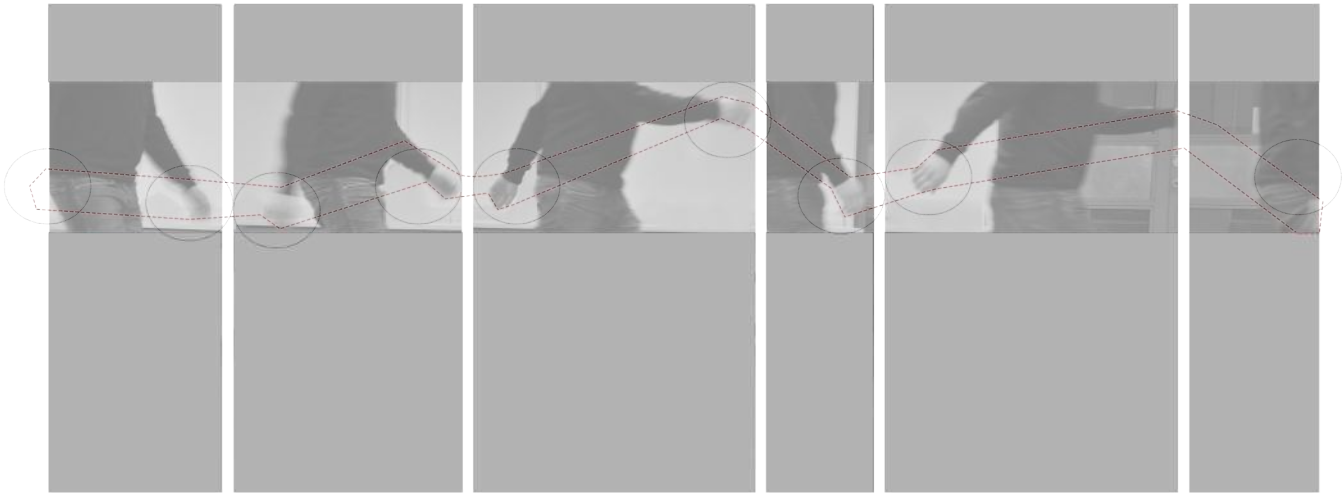


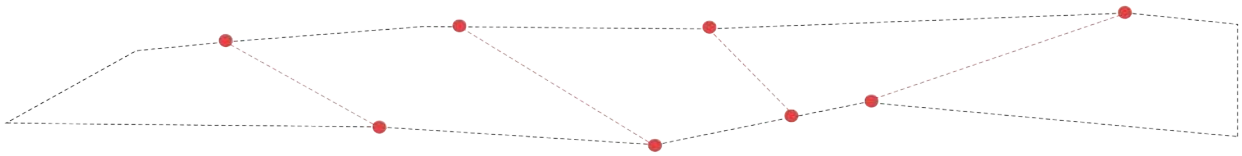
2.2.3. INVESTIGATION 2 - RECORDING OF HAND MOVEMENTS AS PART OF BODY MOVEMENTS



2.2.3.1. VERTICAL+SAGGITAL DIRECTION /ADVANCING/SPREADING

Hand movement in space





Plan view

open fist\tension-insecurity

semi open fist\standby

hand position/specific sequence

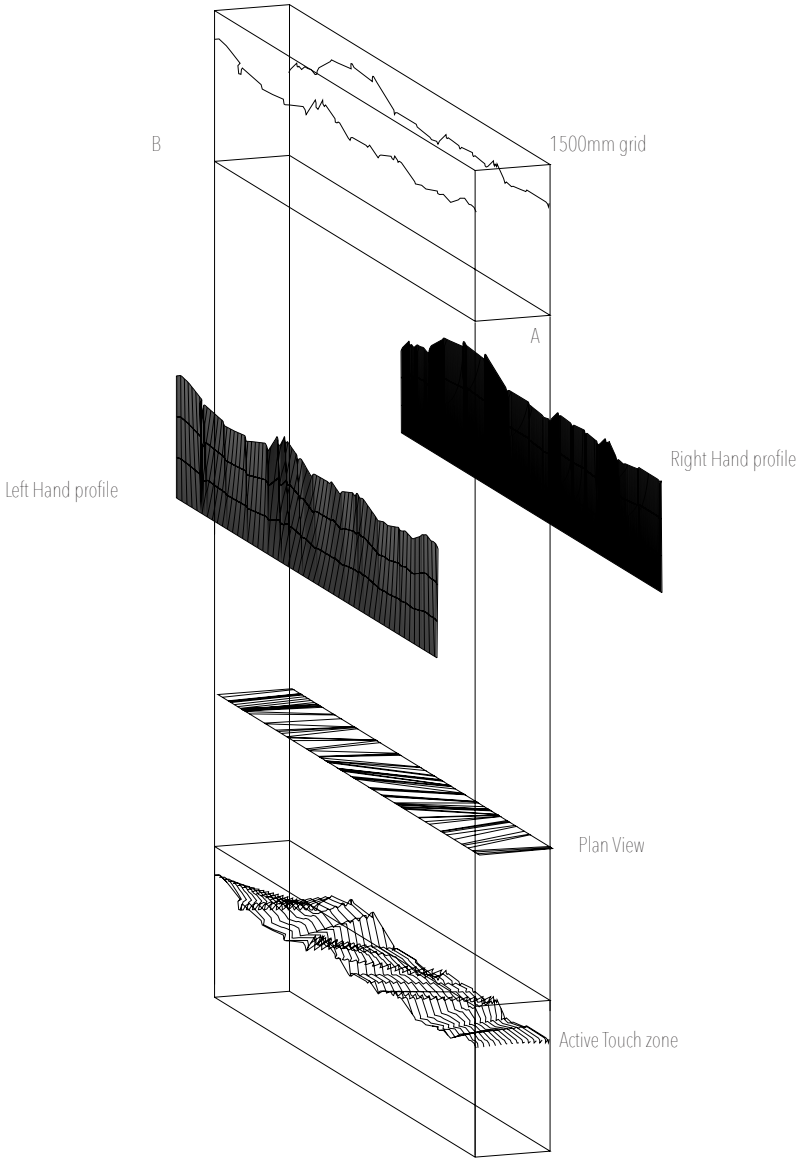
2.2.3.1.a. HAPTOGRAM

right hand profile

left hand profile

intersections

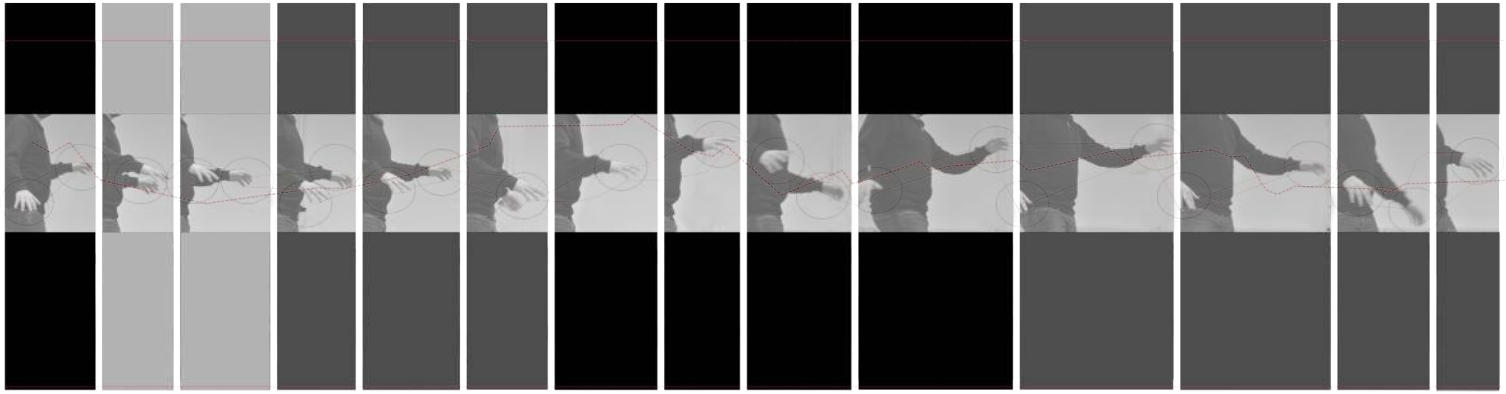
2.2.3.1.b. ACTIVE TOUCH SURFACE



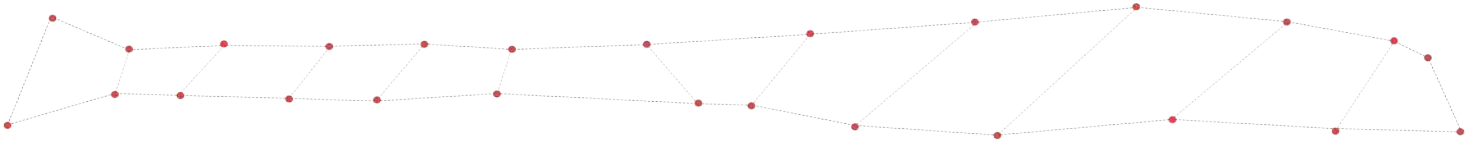
Active Touch Surface

2.2.3.2. HORIZONTAL DIRECTION/ WIDENING/NARROWING [LACK OF BODY BALANCE]

Hand movement in space



Plan view

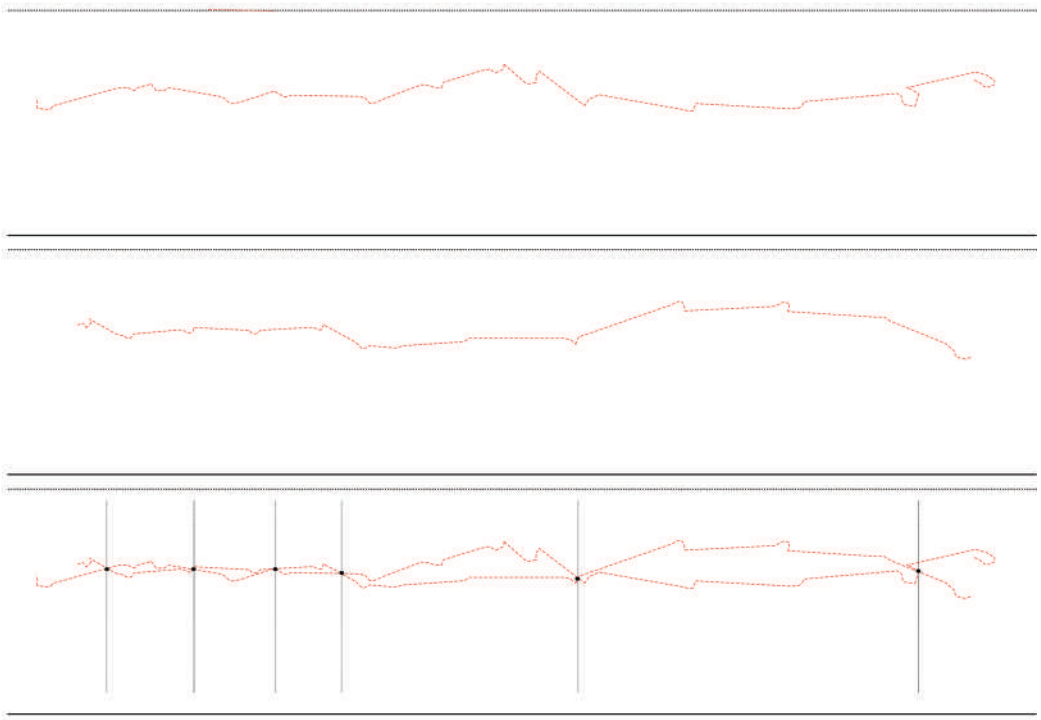


open fist\tension-insecurity

semi open fist\standby

closed fist \safety

2.2.3.2.a. HAPTOGRAM



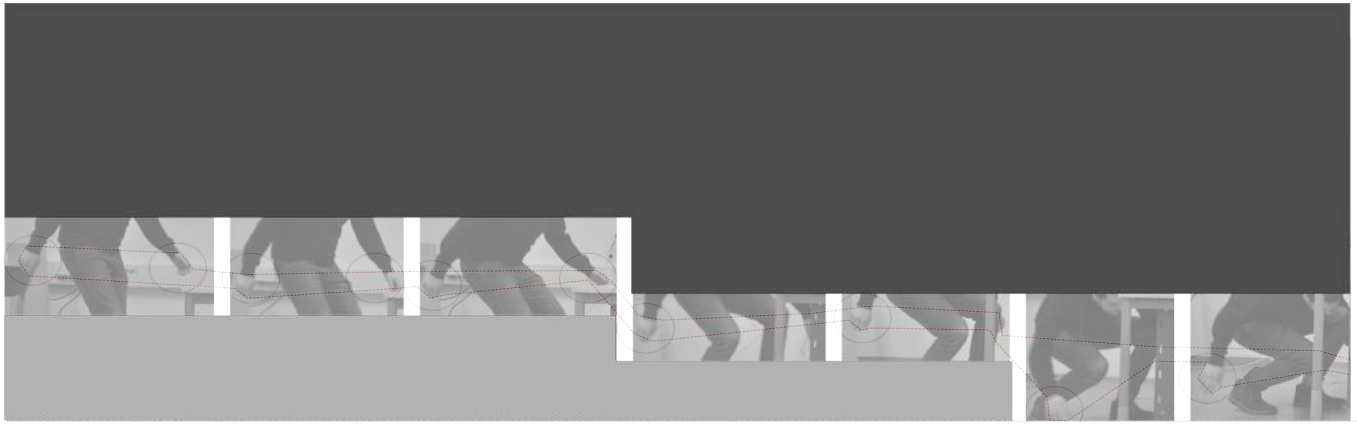
left hand profile

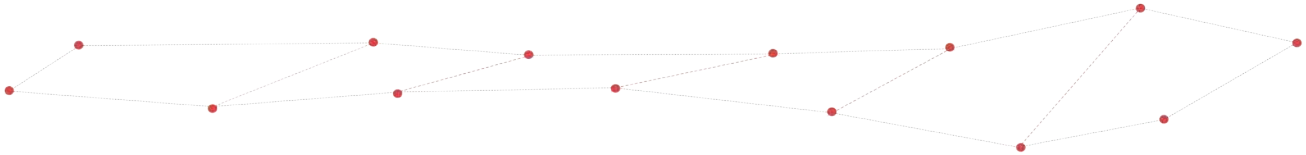
right hand profile

intersections

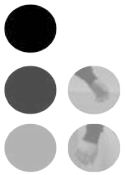
2.2.3.3. Vertical Direction/Rising Sinking

Hand movement in space





Plan view



open fist\tension-insecurity

semi open fist\standby

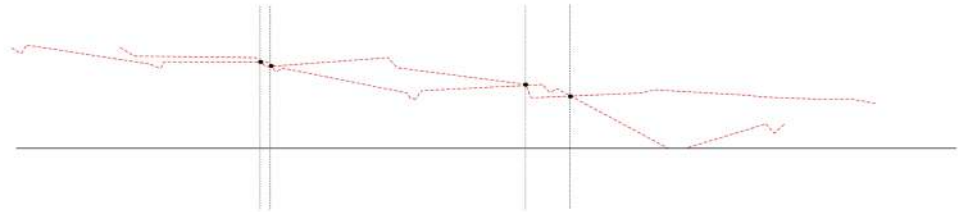
closed fist \safety

2.2.3.3.a. Haptogram

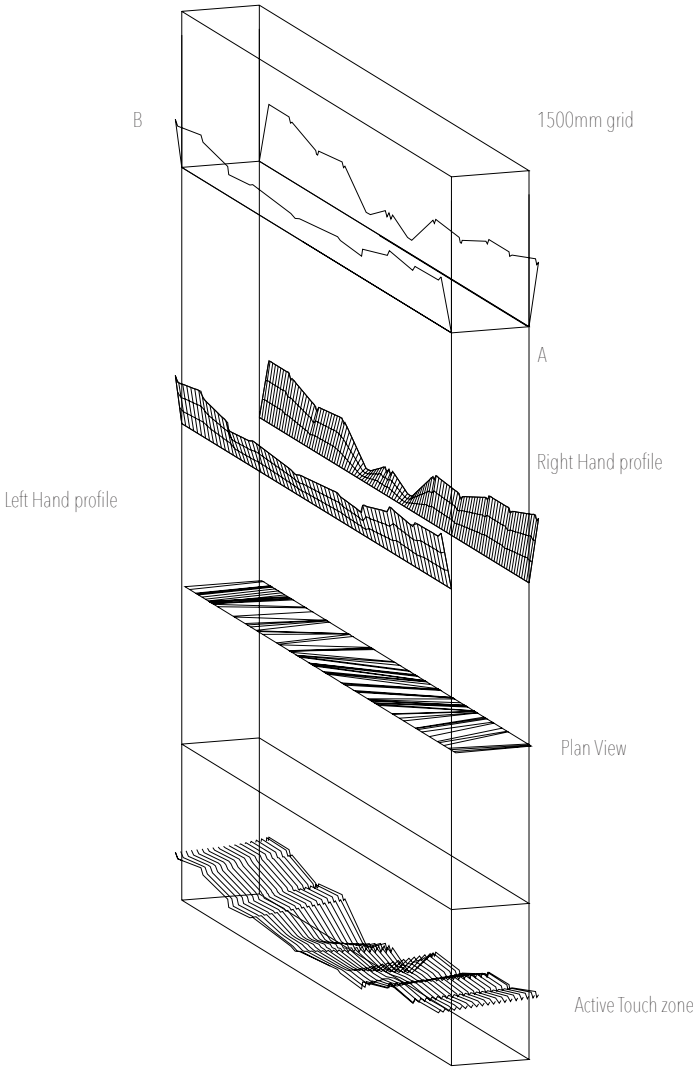
left hand profile

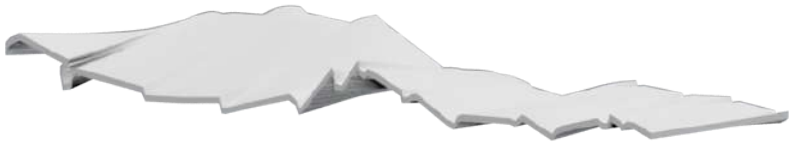
right hand profile

intersections



2.2.3.3.b. ACTIVE TOUCH SURFACE

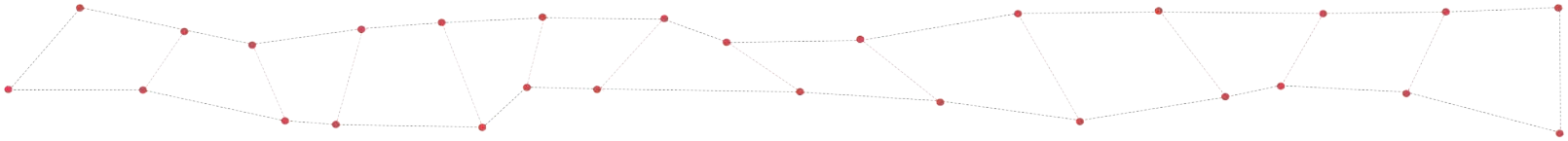




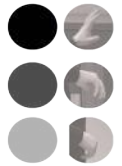
Active Touch Surface

2.2.3.4. Blindfolded

Hand movement in space



Plan view

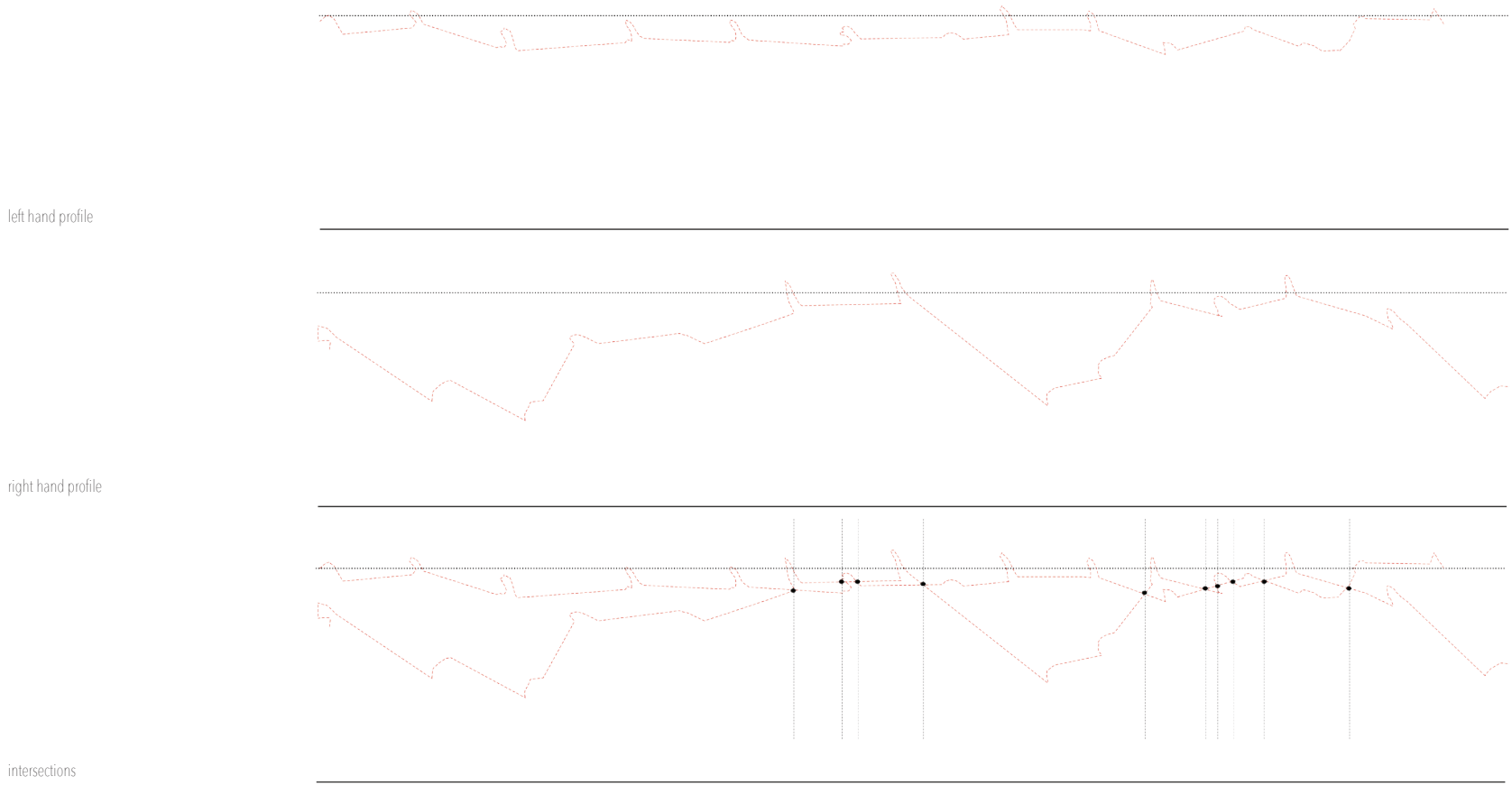


open fist\tension-insecurity

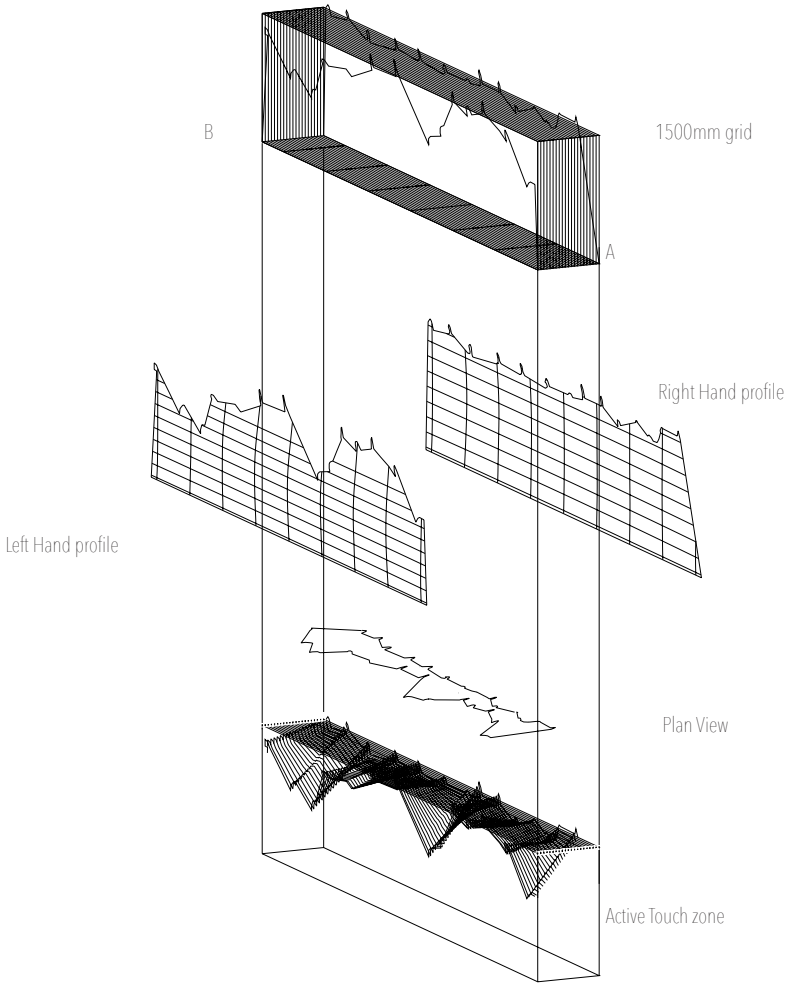
semi open fist\standby

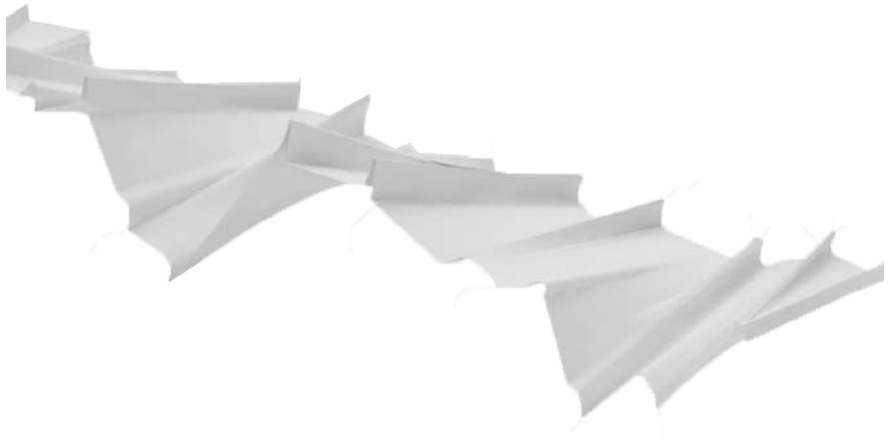
closed fist \safety

2.2.3.4.a. Haptogram



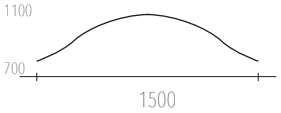
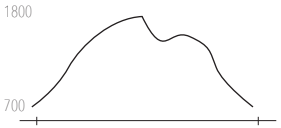
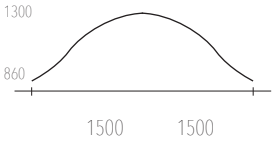
2.2.3.4.b. ACTIVE TOUCH SURFACE





Active Touch surface

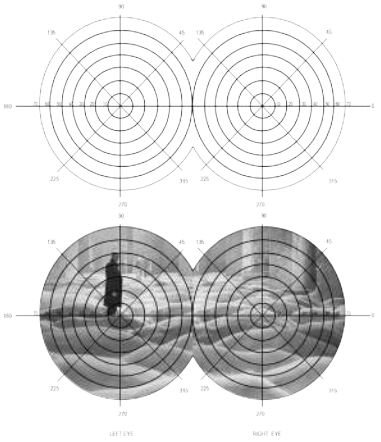
2.2.4. SYSTEM

Scenarios	Condition/Transition from AtoB Changing Parameters	Fluctuations in height	Repetition/Rhythm	Spatial Tension
VISUALLY GUIDED /NO OBSTACLE	Floor stable/stability ■ Visual Contact ON ■ Physical barriers ■	1100 Heighest Point 700 Lowest Point		R L 70° 70°
BLIND MOVEMENT /NO OBSTACLE	Floor stable/stability ■ Visual Contact ON Physical barriers	1800 Heighest Point 700 Lowest Point		R L 130° 130°
VISUALLY GUIDED /OBSTACLE	Floor stable/stability ■ Visual Contact ON ■ Physical barriers ■	1300 Heighest Point 860 Lowest Point		R L 130° 70° 50° 50°
VISUALLY GUIDED /CROUCHING	Floor stable/stability ■ Visual Contact ON ■ Physical barriers ■	700 Heighest Point 0 Lowest Point		R L 70° 50°

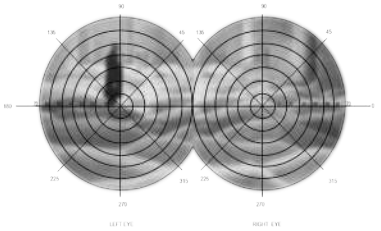
3. VISUALLY IMPAIRED/SIGHTED

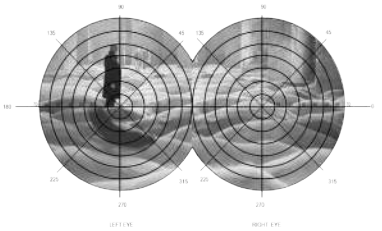
3.1. VISUAL FIELD

Full visual field.



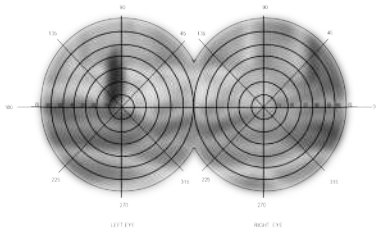
Full visual field. 20/20 acuity

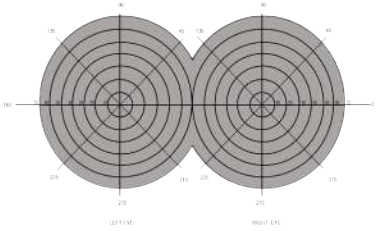




20/40 acuity

Scotoma

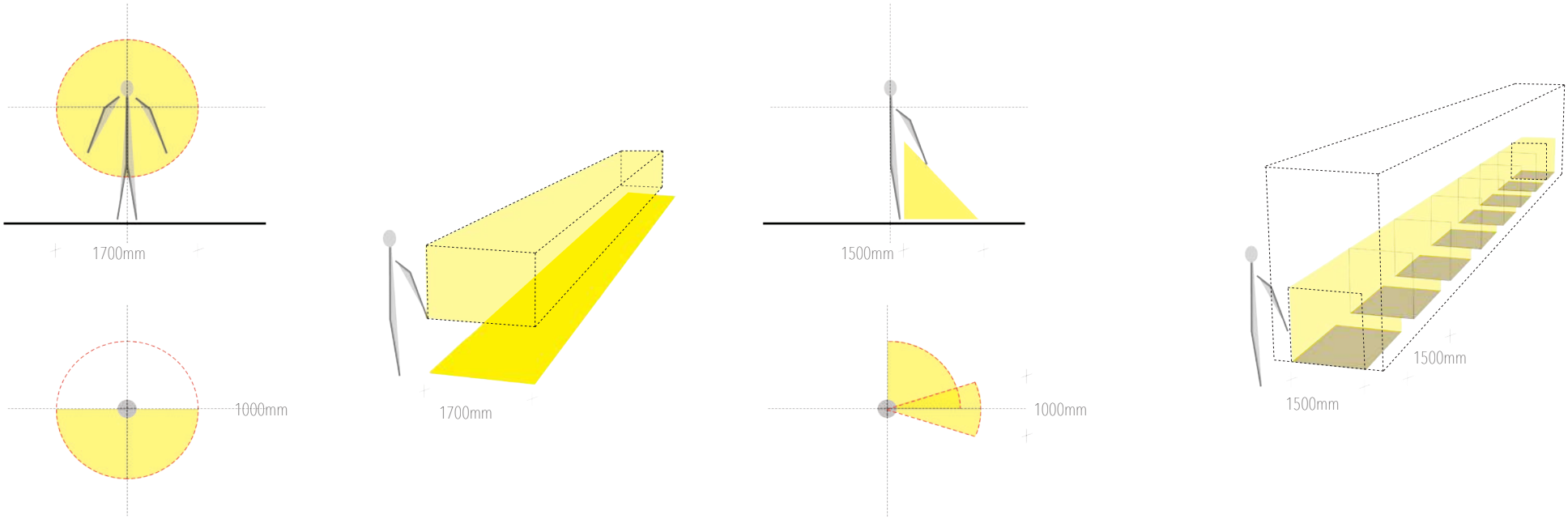




20/100 acuity

Total Blindness

3.2. SIGHTED COMPARED TO VISUALLY IMPAIRED/TACTILE ZONES



3.3. JOHN M. HULL

John Martin Hull (22 April 1935–28 July 2015) was Emeritus Professor of Religious Education at the University of Birmingham. He was the author of a number of books and many articles in the fields of religious education, practical theology and disability. The latter interest arose from his experiences, and personal and theological reflections, on becoming blind in mid-career.
The following fragments are from his book Touching the rock, his unique exploration of that distant, infinitely strange 'other world' of blindness.

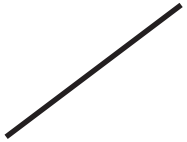
12 July 1984

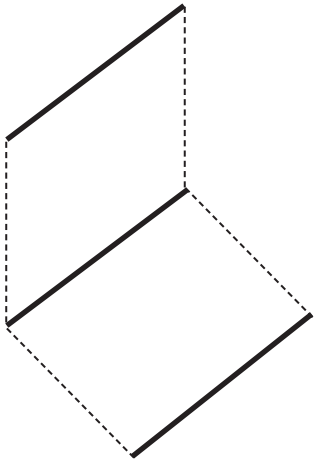
"Touch is not the same for the sighted person as it is for the blind person. Deleting sight but leaving touch untouched gives a false impression, because touch is affected when sight is deleted. In other words, the blind person sees with his fingers."

21 September 1984

"At five o' clock this morning I woke up to the sound of rain. I stood by the window, motionless, hardly breathing, concentrating everything upon the sound of the rain. First, I noticed differences of place. Some sounds came from the left of the window, some from the right, and I can trace these as far as the corner of the house and around it. Now I pay attention to the higher sounds, as the rain splatters on the wall above the window and on the roof of the house itself.[...]
Is it true that the blind live in their bodies rather than in the world? I am aware of my body as I am aware of the rain. My body is similarly made up of many patterns, many different regularities and irregularities, extended in space from down there to up here. These dimensions and details reveal themselves more and more as I concentrate my attention upon them.Nothing corresponds visually to this realization. Instead of having an image of my body, as being in what we call the human form, I apprehend it now as these arrangements of sensitivities, a conscious space comparable to the patterns of the falling rain.[...]
If the rain were to stop, and I remain motionless here, there would be silence. My awareness of the world would again shrink to the extremities of my skin."

3.4. LINE PERCEPTION IN VISION&TOUCH





Direction

location
connection/separation
orientation
scale
rhythm
corner
open/closed

Form

Straight
Curved
Inclined
Round

Line perception in **vision**

Line perception in **touch**

Line is seen as a **line**

Line is experienced as a **transition** between surfaces.

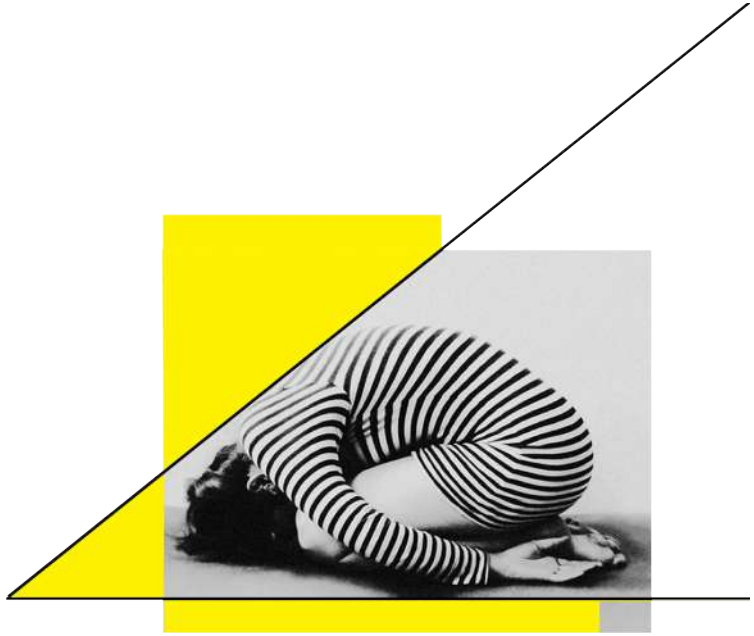
Surfaces ..... **Direction**

Angle (in relation to the user's body) Impact on the experience and the orientation

Materiality

Spatial Characteristics ..... Space

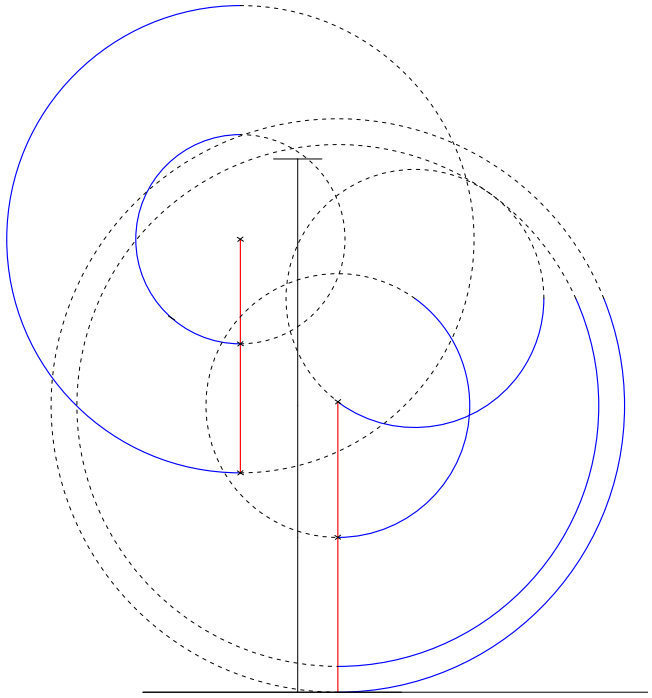
4. PROPOSAL/SURFACE DESIGN

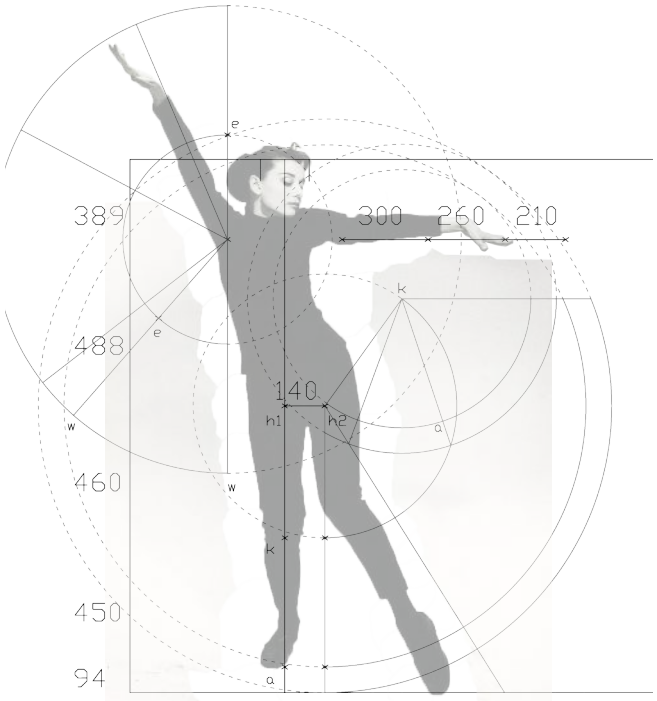


"The Architectural Body. An architect internalises a building in his body; movement, balance and scale are felt unconsciously through the body as tensions in the muscular system and in the positions of the skeleton and inner organs. Consequently, architecture is communication from the body of the architect directly to the body of the inhabitant".

Juhani Pallasmaa, An Architecture of the Seven Senses

4.1.BODY ANGLES SPECTRUM





4.2. MOVEMENT+RHYTHM

We create rhythm through :

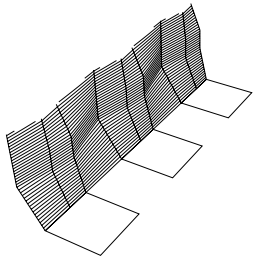
Repetition : which creates patterns through predictability
Alternation : which creates patterns through contrasting pairs (thick/thin, dark/light)
Gradation : which creates patterns through a progression of regular steps

Entrance [alternation] : Transition from in to out, from static to movement, from wide to narrow space, from bright to dark from a flowing rhythm to a regular one. Angle, change of the movement s direction. The pattern is created by contrasted pairs. Visual field suddenly changes

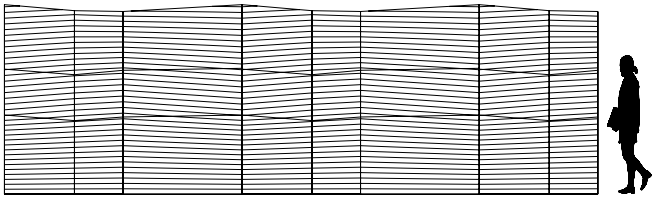
Corridor [repetition] : Regular pace of rhythm , moving to a linear path, predictability, the intervals between the elements are similar in size or length. The patterns are created through predictability. Tactile field suddenly changes / visual field steady.

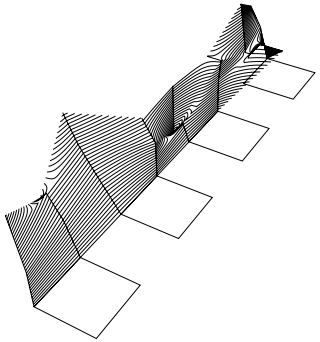
Staircase [gradation] : Going upwards or downwards, the patterns are created by a progression of regular steps. Visual field/surroundings gradually change .

4.3.SURFACE DESIGN

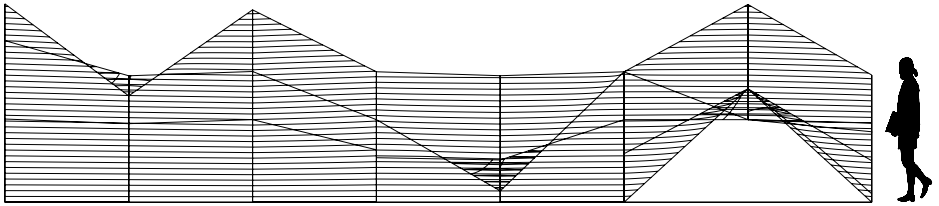


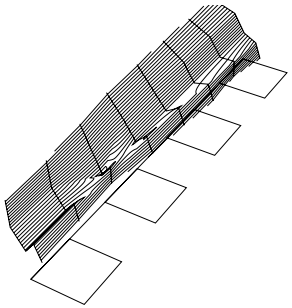
REPETITION



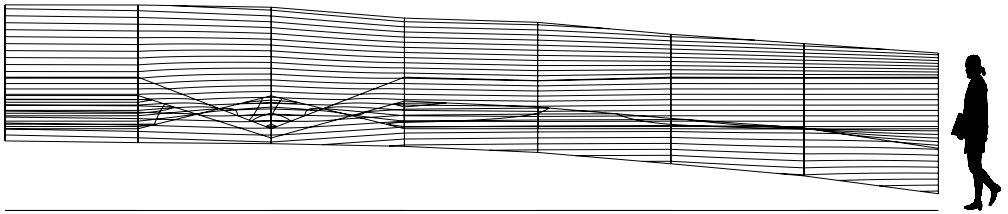


ALTERATION





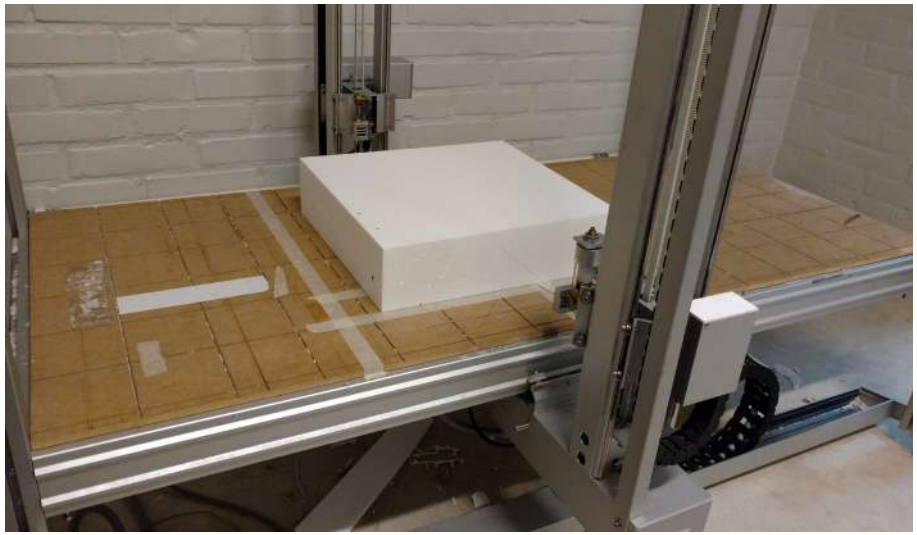
GRADATION



5. TEXTURE DESIGN

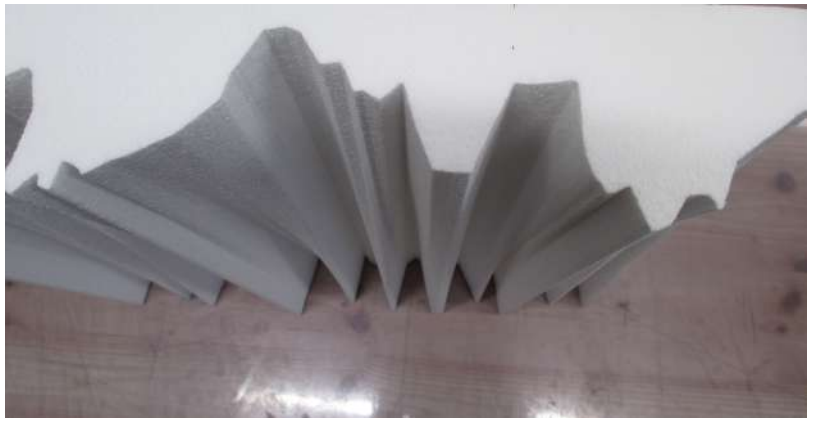
5.1. DIRECTIONALITY

5.2. PROTOTYPING /HOT WIRE CNC FOAM CUTTER



5.3. PROTOTYPE 1

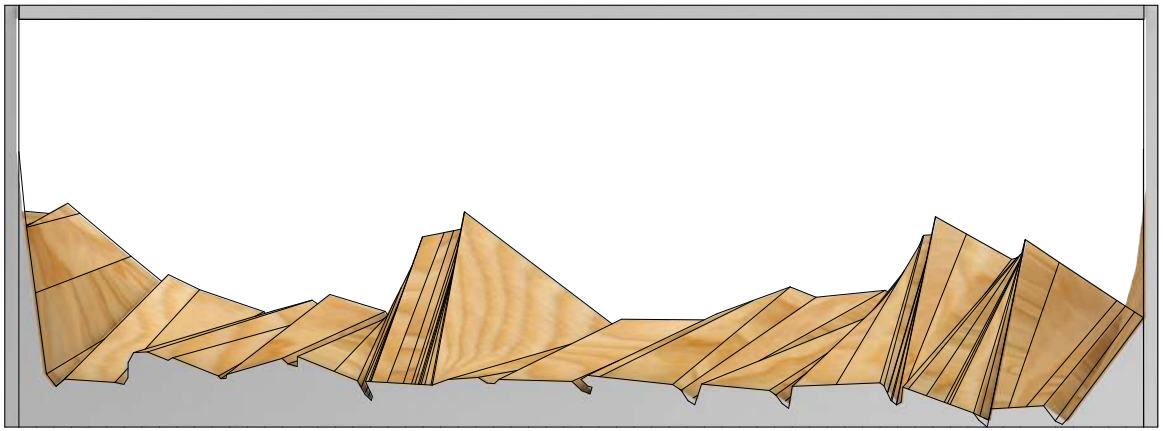
5.4. PROTOTYPE 2



5.5. COMBINING PROTOTYPES

6. MATERIALITY

wood metal plaster concrete stone



Where there is close vision, space is not visual, or rather the eye itself has a haptic , non optical function.

Deleuze & Guattari, 1987, p.494

6.1. CONCRETE

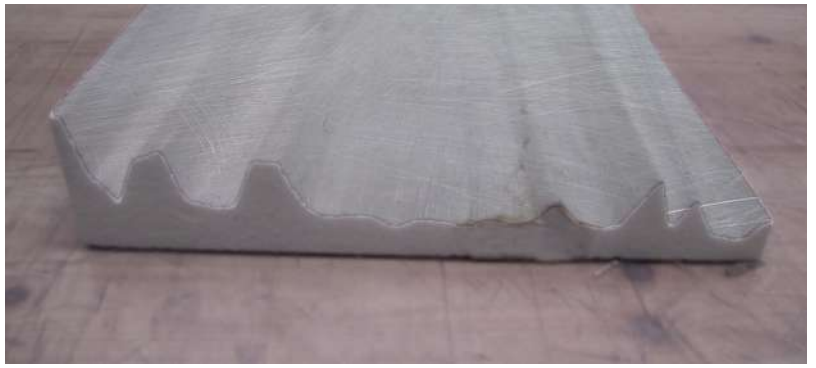
Physical Model scale 1:1

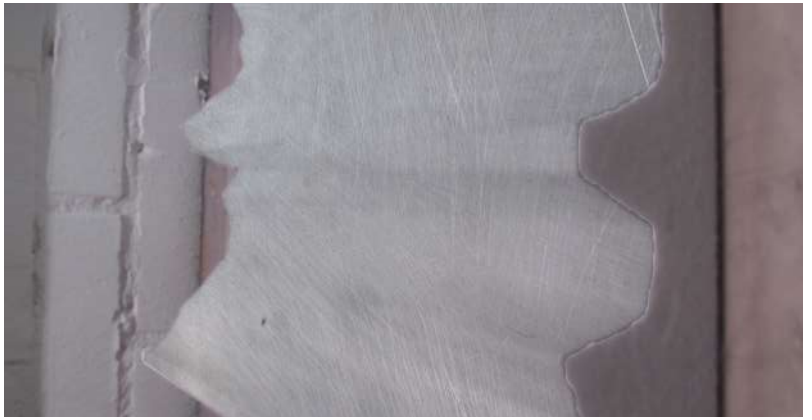
6.2. PLASTER

Physical Model scale 1:1

6.3. WOOD

Physical Model scale 1:1





Physical Model scale 1:1

6.5.STYROFOAM

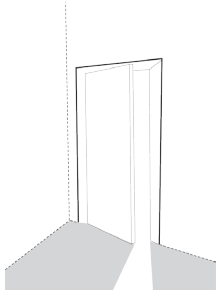
Physical Model scale 1:1

7. CONTEXT

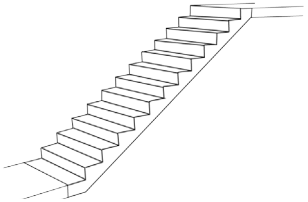
Physical Models

7.1.1. CONTEXT ARCHITECTURAL QUALITIES

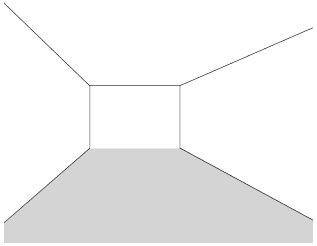
ARCHITECTURAL ARCHETYPES



An entrance

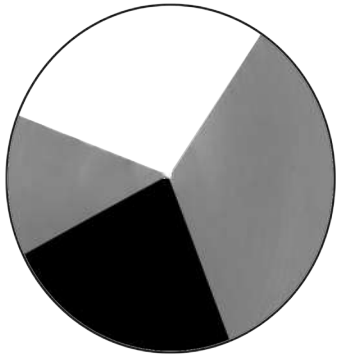


A staircase

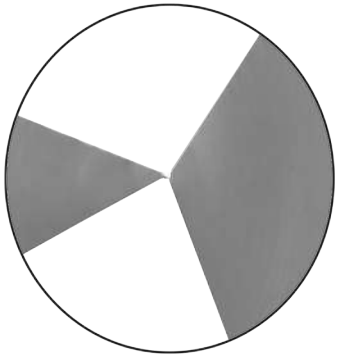


A corridor

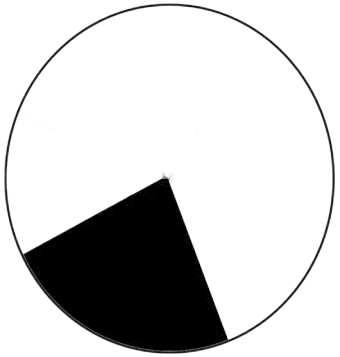
Brunkeberg Tunnel, Stockholm



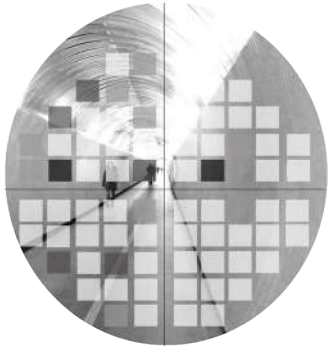
Haptic space

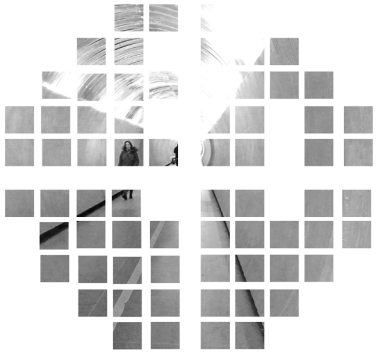


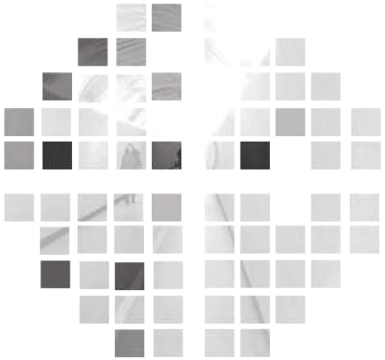
Tactile space



Kinesthetic space

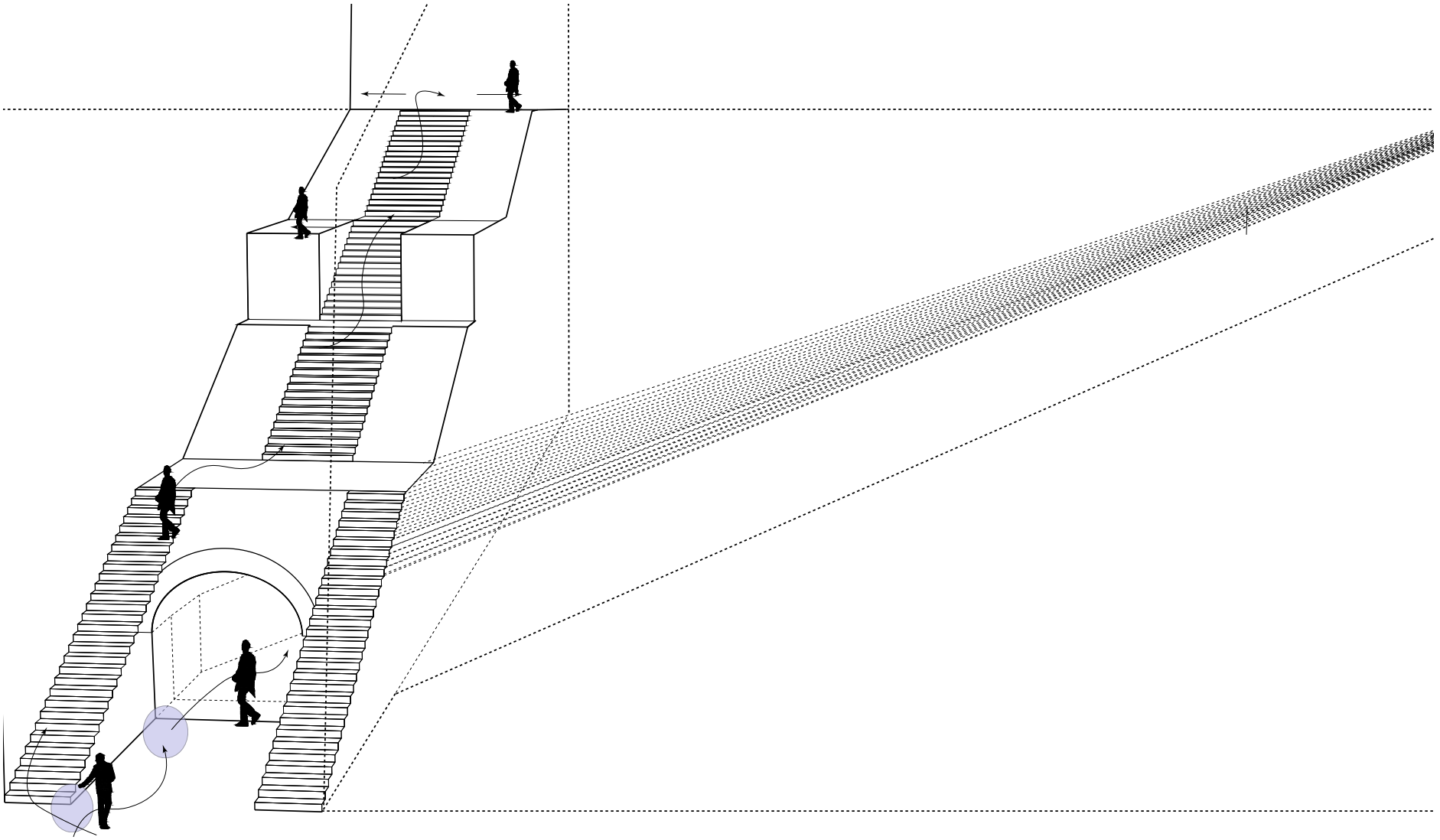






Analysis based on visual field studies

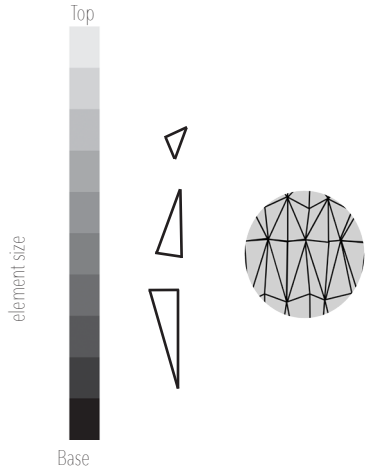
7.3.CONTEXTUAL MOVEMENT&RHYTHM



7.4. CONTEXTUALISATION ARGUMENT

OLAFUR ELIASSON|TAKE YOUR TIME EXHIBITION 2008-2009

Optic sequence one way
Haptic sequence both ways



8. FORMATION

8.1. JOURNEY IN SPACE/SEQUENCES

1. AN ENTRANCE

Function \ Preparing for the transition
Texture \ Diverse, Wide, Extreme
Haptic Perception \ Conflicting
Material \ Rough shape/soft material
Smooth shape/rough material

2. A STAIRCASE

Function \ Gradation
Texture \ Flawed, Dented
Haptic Perception \ Progression in size, shape , roughness,
Material \ Various, Temperature gradients

3. A CORRIDOR

Function \ Sequential Movement
Texture \ Varied
Haptic Perception \ Sequential
Material \ Various

3A. THE TURN

Function \ Preparing for the upcoming sequential movement
Texture \ Cold, thin
Haptic Perception \ Sensation of enclosure
Material \ Metal

3B. THE TRIANGULAR SPACE

Function \ A space that engages the whole body
Texture \ Clear-cut, jagged
Haptic Perception \ Tunnel within a tunnel
Material \ Metal

3C. THE STOP

Function \ Sitting area
Texture \ Corrugated,
Haptic Perception \ Sensation of wide space
Material \ Wood

3D. THE LUMINOUS SPACE

Function \ A bright directional space
Texture \ Neat, angular, thin
Haptic Perception \ Sensation of wide, bright space
Material \ Various

3E. THE SLICK CURVED SPACE

Function \ A warm space
Texture \ Smooth / Rough
Haptic Perception \ Slippery feeling
Material \ Wood/concrete

3F. SHARP EDGES

Function \ A space with open possibilities of use
Texture \ Acute
Haptic Perception \ Unpredictability
Material \ Wood, Concrete

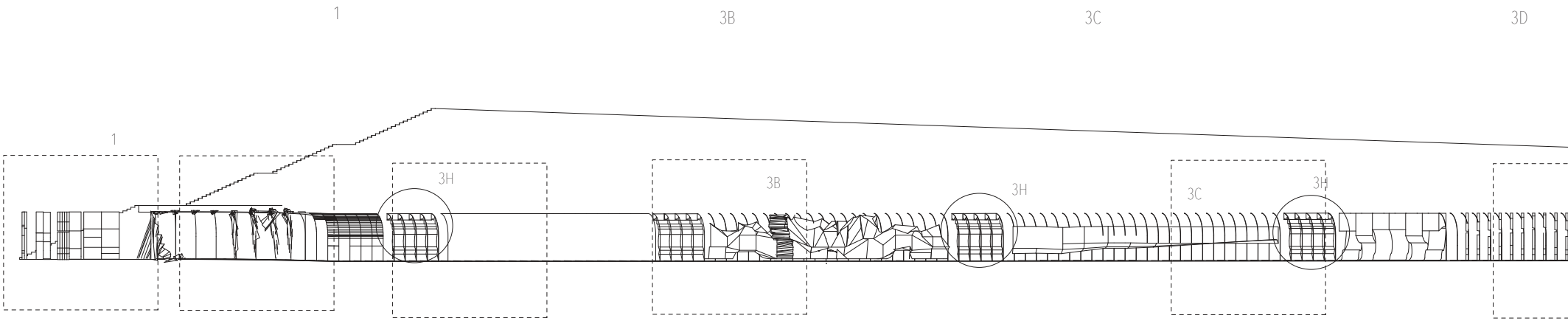
3G. THE REPETITIVE FLOW SPACE

Function \ A repetitive walkway
Texture \ Layered
Haptic Perception \ Safety , Intimate feeling
Material \ Wood, Plaster, Concrete, Stone

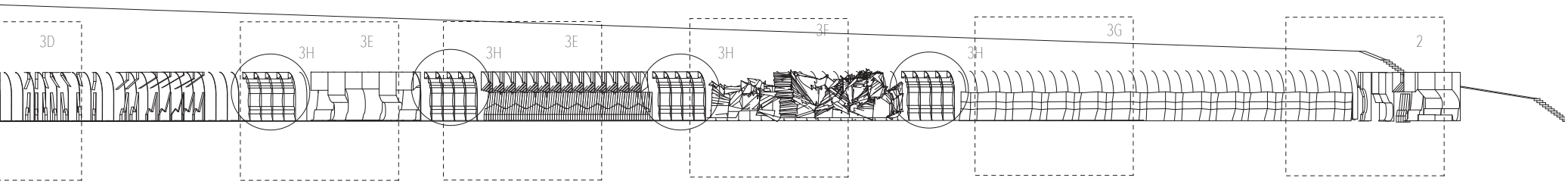
3H. THE INTERVAL

Function \ The intervals in the tunel's rhythm
Texture \ Rugged
Haptic Perception \ Cave feeling
Material \ Stone /initial material

8.2. SECTION/SEQUENCES



3E 3G 2



8.3. SEQUENCIAL MOVEMENT IN SPACE BEFORE


Photo taken by me (-9)m


Photo taken by me (+20)m


Photo taken by me (+90)m


Photo taken by me (+120)m


Photo taken by Marie-Lou (+140)m


Photo taken by Marie-Lou (+180)m


Photo taken by ehrsa (+211)m

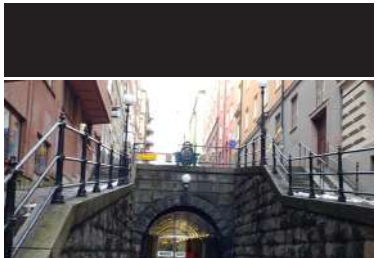
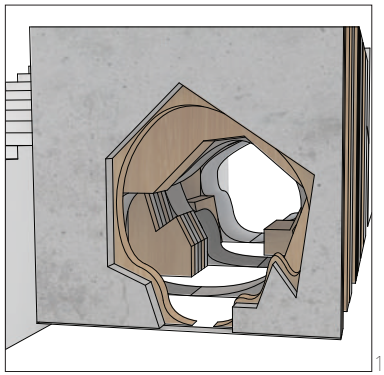


Photo taken by me (+231+5)m

8.3. SEQUENCIAL MOVEMENT IN SPACE AFTER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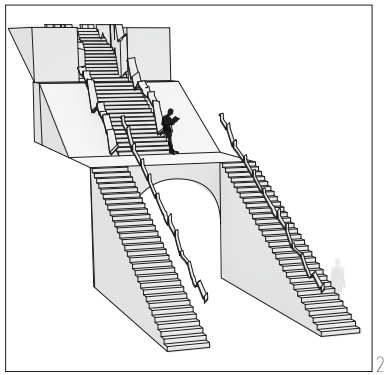
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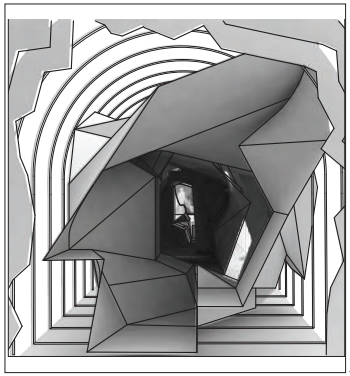
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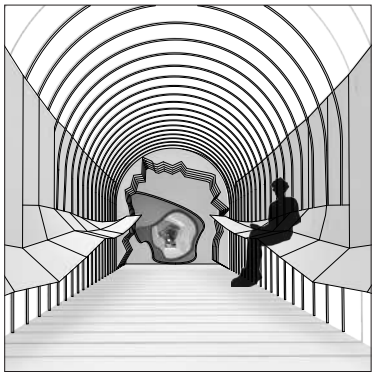

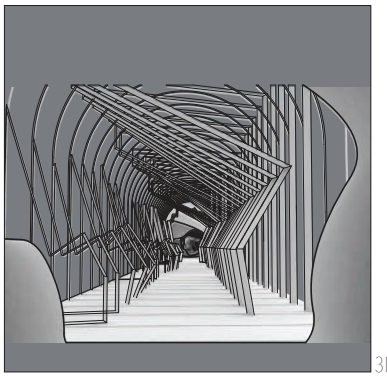
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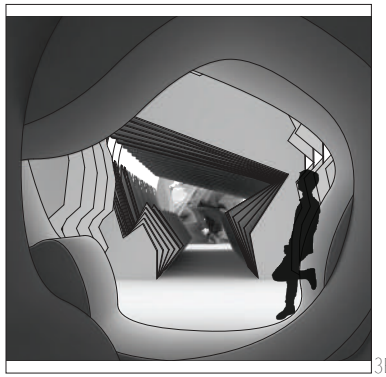
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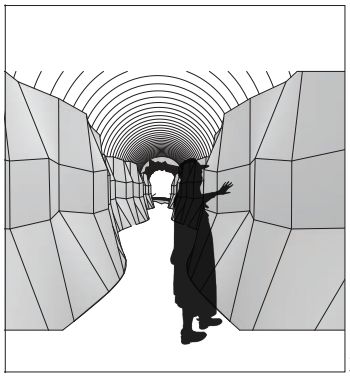
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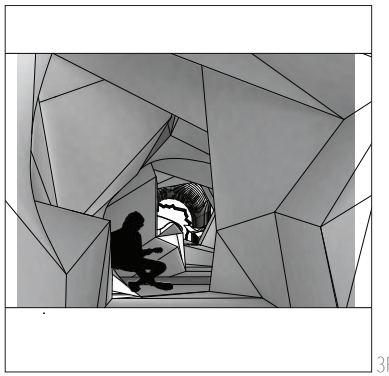
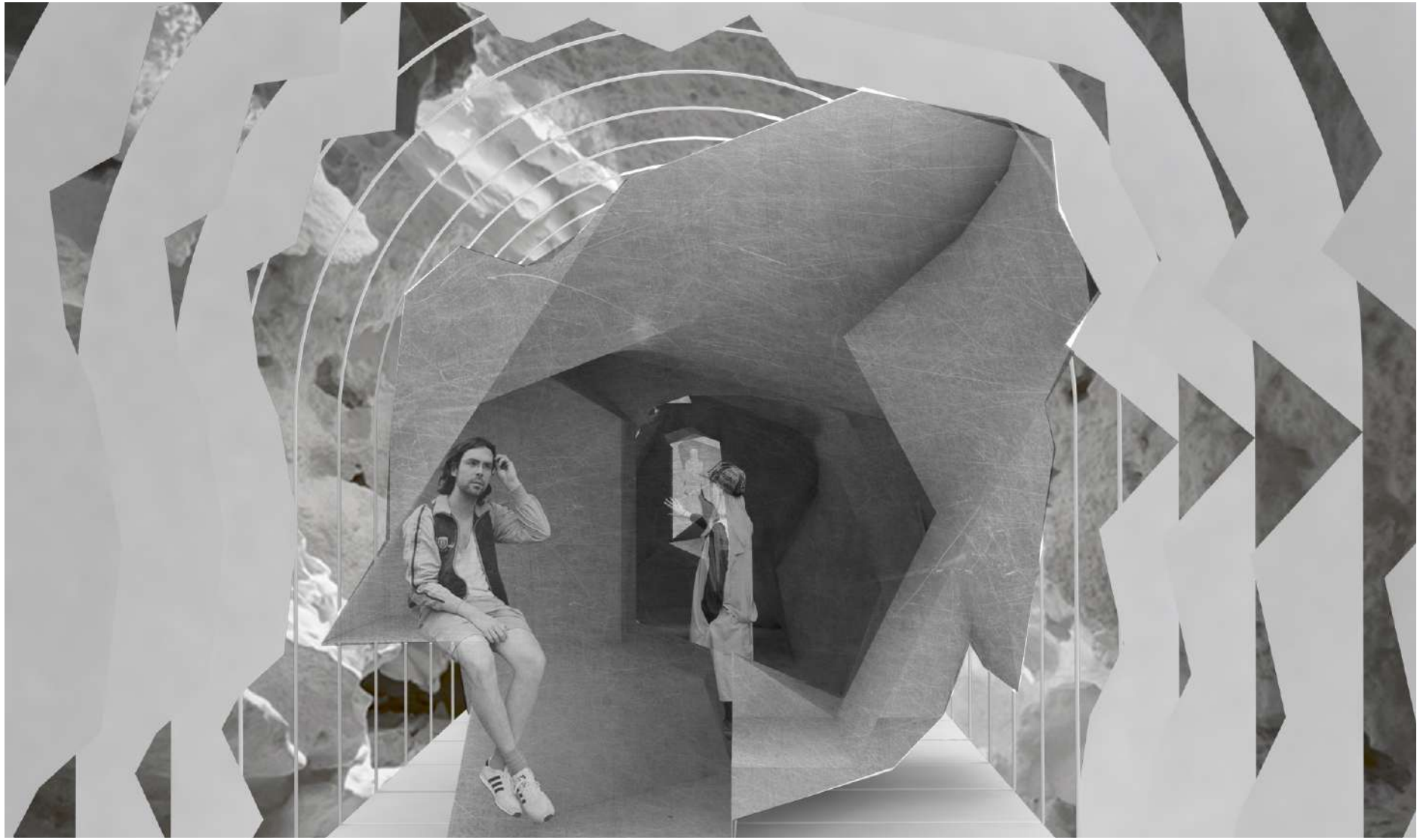
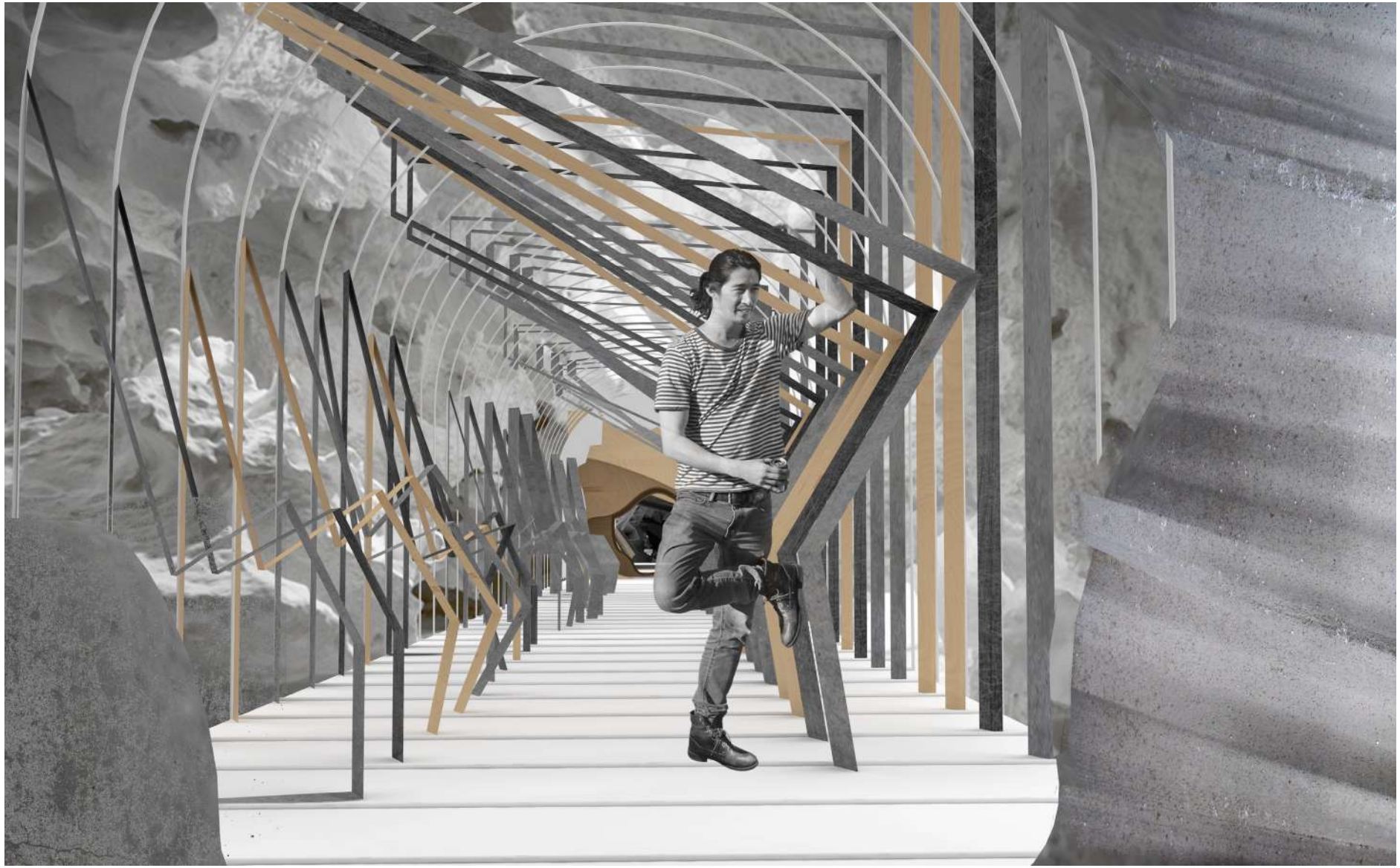
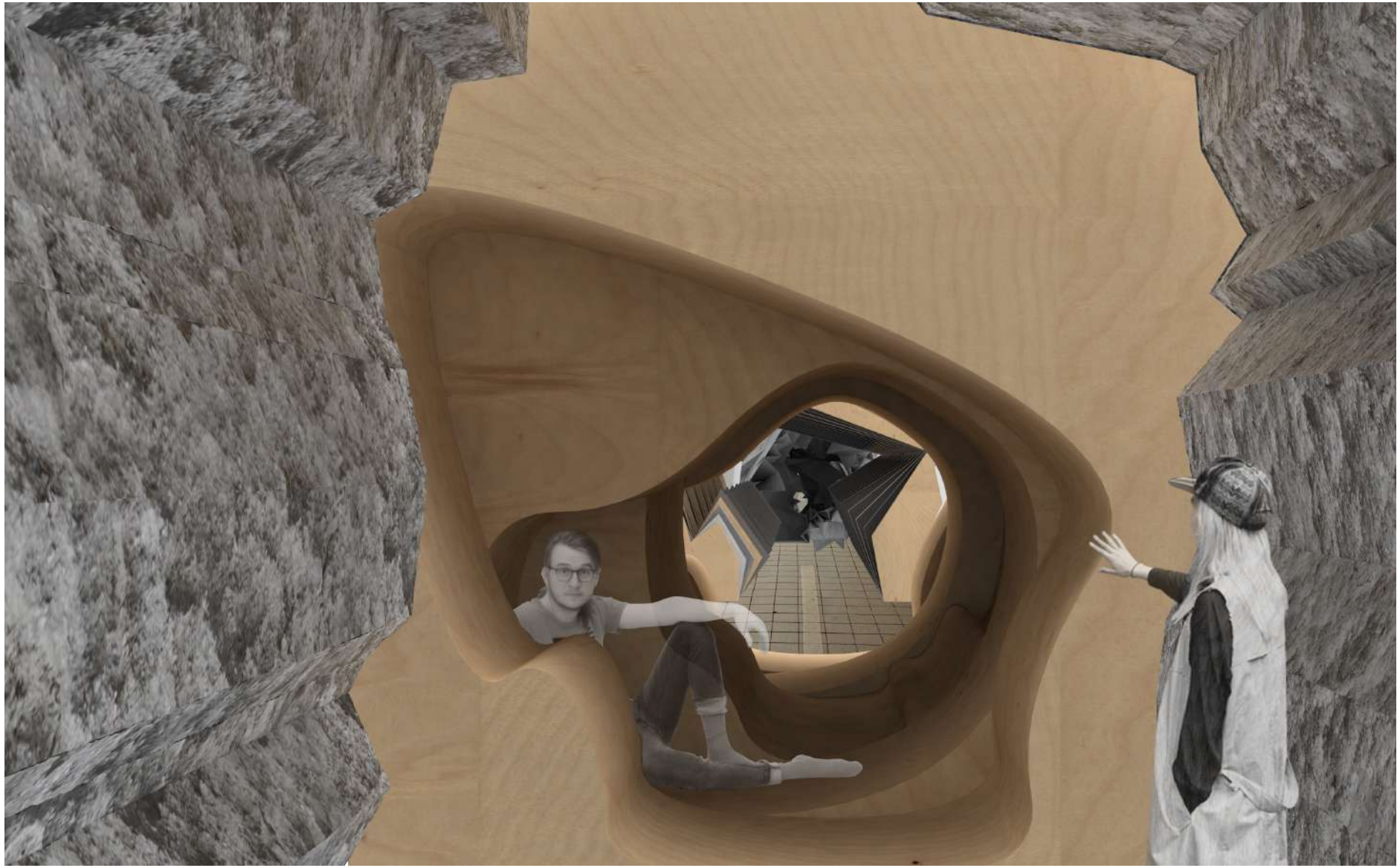

3F

1. A N ENTRANCE

3B THE TRIANGULAR SPACE AS SEEN FROM THE TURN







10. CONCLUSIONS

In my so far professional experience I was lucky to get in touch with visually impaired children as the office I was working in, was designing a daily care center for them.

It was then when I started wondering is that really all an architect can provide them with? Are the qualities of the the space he can design for them so limited to rules and numbers?

The aim of this thesis is not only to use the knowledge of visually impaired people in order to reassert haptic experiences in Architecture today but also to approach the Design for visually impaired people from a different perspective that does not only include handrails and tactile paving surfaces.

Of course the journey in space as it is formulated is inadequate for visually impaired people but with the intergration of Universal Design on it that could be achievable. This is something I will take with me from this thesis and I will try to add this layer later on in my professional career.

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Article/Space, Haptics and the Blind, John M. Kennedy, Scarborough, Canada

Pictures

fig.1 Rebecca Horn |http://www.harvardartmuseums.org/visit/exhibitions/4972/rebecca-horn-work-in-progress
fig.2 Julien Previeux| http://www.previeux.net
fig. 3+4 https://www.pinterest.se/damienpfroussel/models-arch/?lp=true
fig. 5+6 https://www.thoughtco.com/the-berlin-holocaust-memorial-by-peter-eisenman-177928

(The rest of the pictures are taken by me)

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