Multi Generation house

A modulair facade system

Souad Bokzini

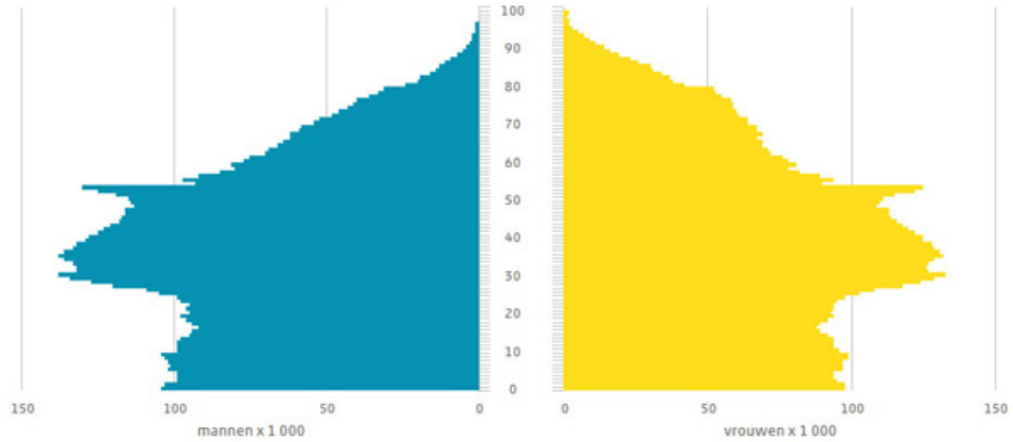
CONTENT

METHODOLOGY

Problem statement

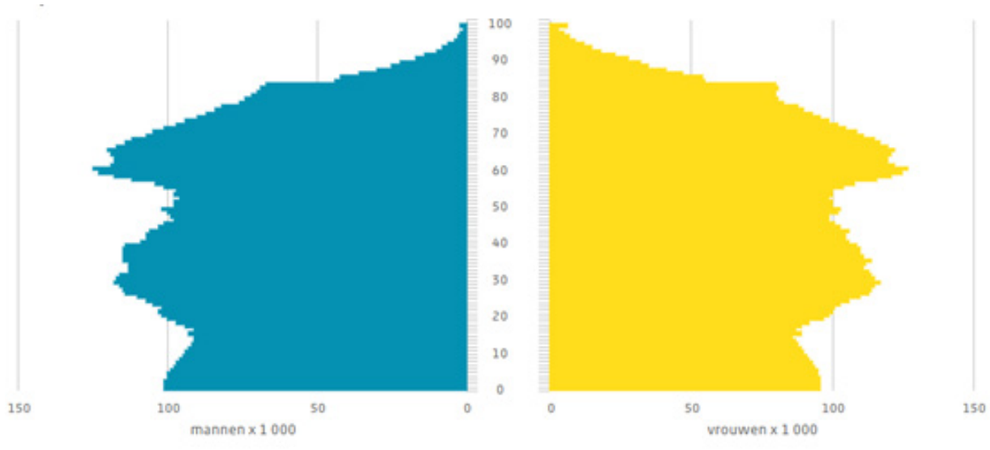
- Sharp rise of the ageing population -
- Netherlands count 200 different nationalitites -
- Changes in the behaviour and physiology of the human body -

- **65 year old born in 1934, year 2000 (CBS)**
  Man vs woman



- **65 year old born in 1951, year 2017 (CBS)**
  Man vs woman

- **65 year old born in 1964, year 2030 (CBS)**
  Man vs woman



METHODOLOGY

Research aim

- Design the facade of an independent house for the elderly in the Netherlands -

Research objective

- The design should be customizable to accommodate differences in standards of thermal and visual comfort, that exist within the elderly population of the Netherlands -

Research questions

- “ How can facade be designed for a house for elderly people, where their children can take care for them in close proximity, while being flexible enough to customize for the thermal and visual comfort of a multicultural population ? "-

sub-questions,

-What types of houses already exist for multi-generational families that want to live together?-
- Which ethnic groups live in the Netherlands?-
- What is thermal comfort? -
- To what extent can thermal comfort be regulated for the elderly?-
- What is visual comfort? -
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- What are the different standards of thermal and visual comfort within the different ethnic groups in the Netherlands?-
- To what extent do the elderly feel visually comfortable in their existing homes?-
- To what extent do the elderly feel thermally comfortable in their existing homes? -
- What are the possibilities for designing a façade? -

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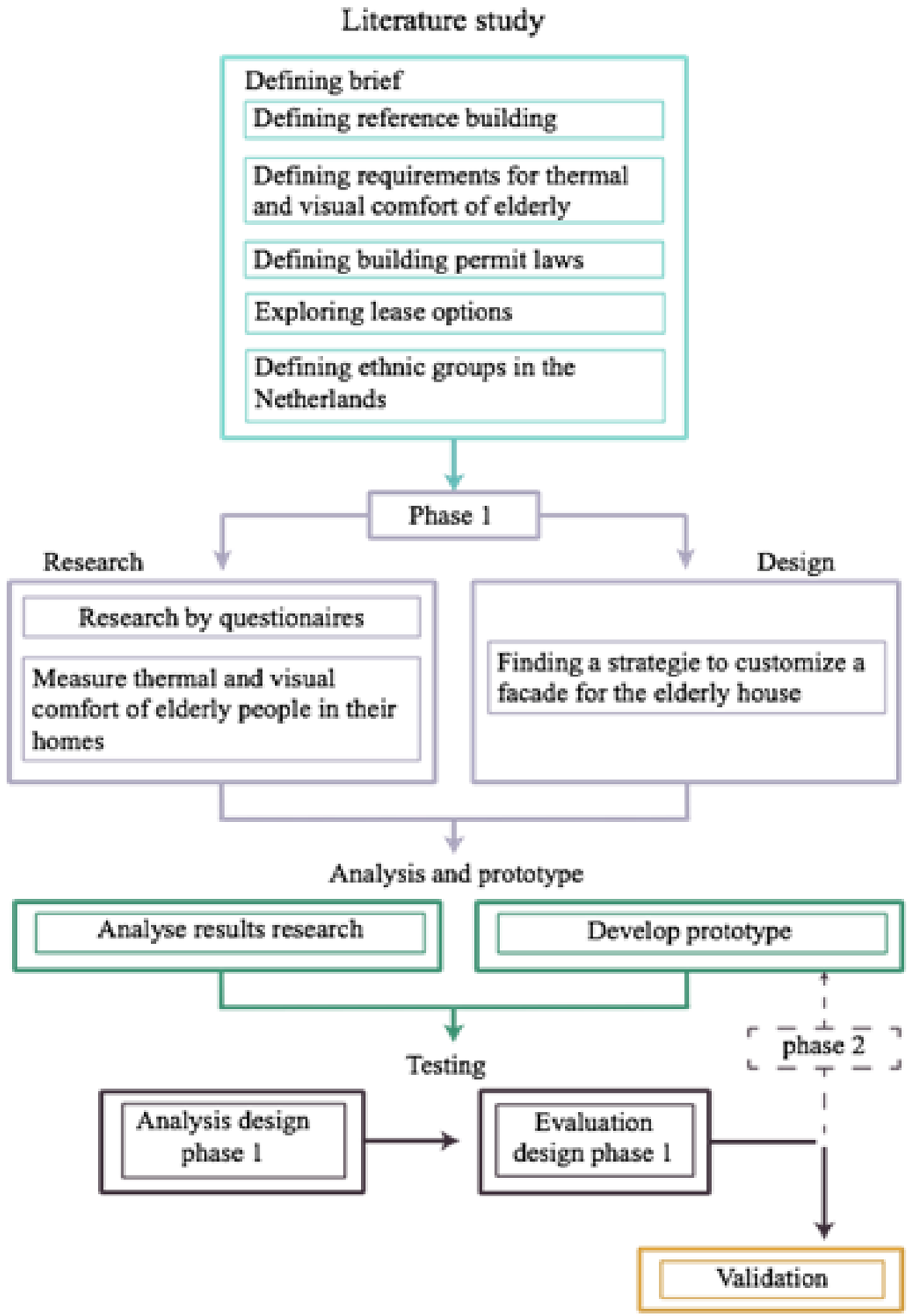
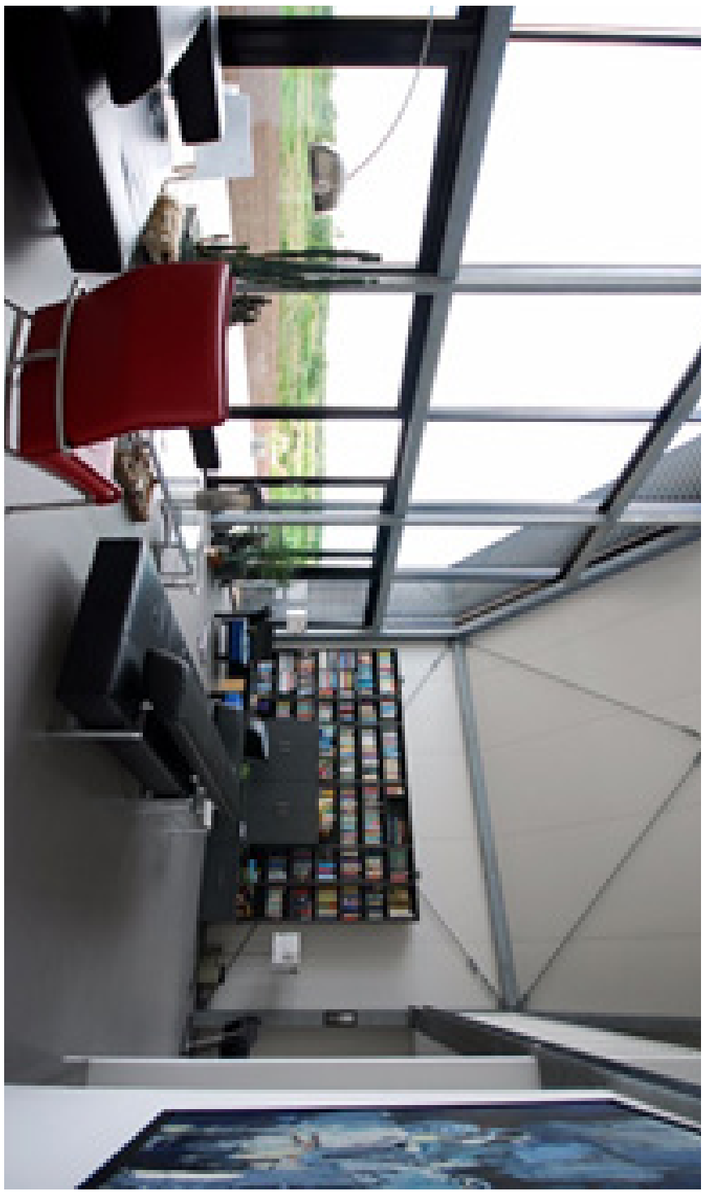

Literature study
Defining brief
Defining reference building
Defining requirements for thermal and visual comfort of elderly
Defining building permit laws
Exploring lease options
Defining ethnic groups in the Netherlands
Phase 1
Research
Research by questionaires
Measure thermal and visual comfort of elderly people in their homes
Design
Finding a strategie to customize a facade for the elderly house
Analysis and prototype
Analyse results research
Develop prototype
Testing
phase 2
Analysis design phase 1
Evaluation design phase 1
Validation

GENERATION HOUSE



THERMAL COMFORT

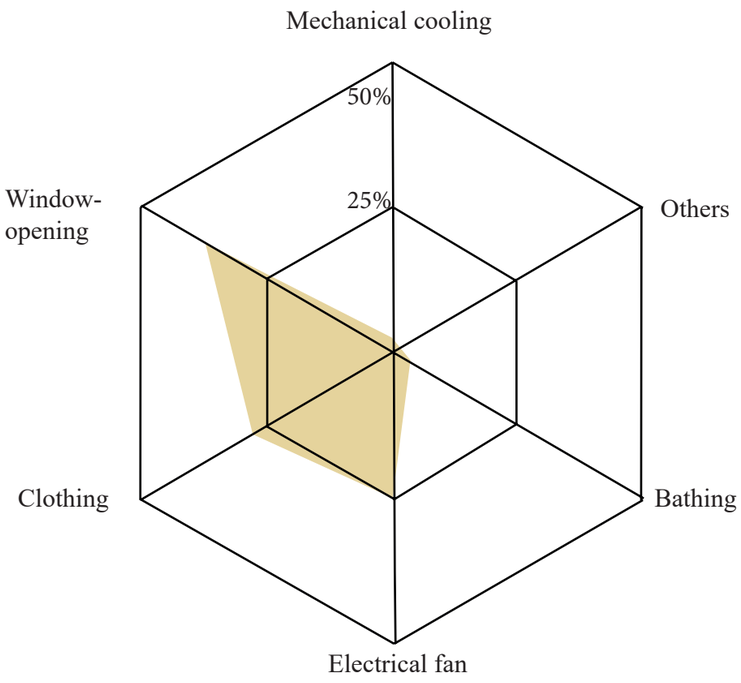
- mean radiant temperatuur -
- relative air velocity -
- humidity -
- activity level -
- clothing thermal resistance-

Pyschological comfort

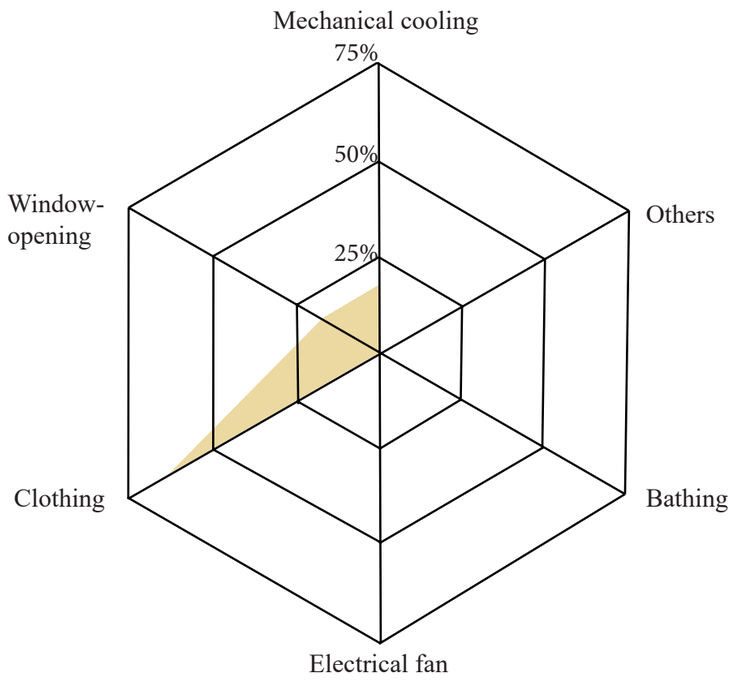
- perzonalization -
- freedom -
- space -
- warmth -

Internal heat gain = External heat loss

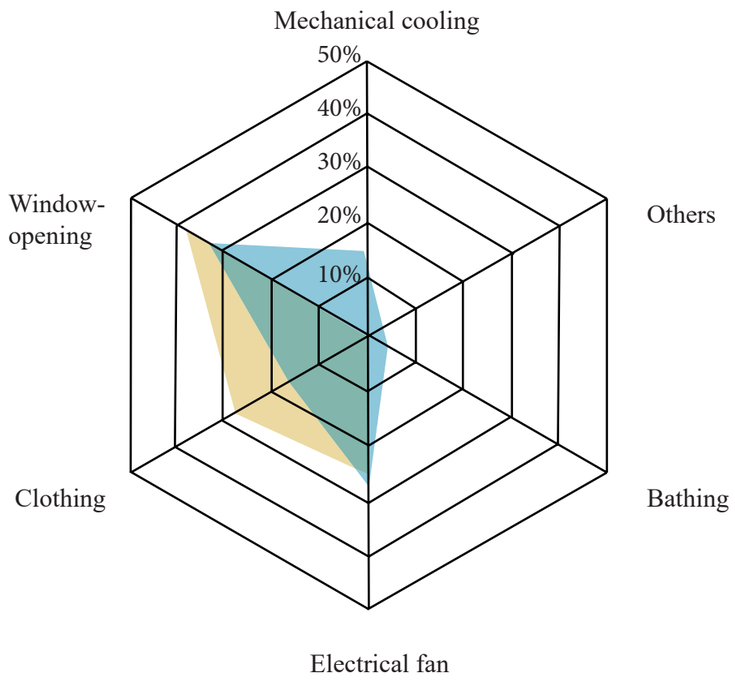
Summer



Winter



Summer



Elderly

Non-elderly

Study	Mean age (yr)	Preferred ambient temp. (C)$_{\circ}$	Mean skin temp. at comfort (C)$^{\circ}$	Evaporative weight loss during comfort (g/m^2/hr)	Number of subject
Nevins et al. [23]	21	25,6			720
Fanger [2]	23	25,6		19,2	128
Fanger [2]	68	25,7		15,3	128
Rohles and Johson [30]	74	24,5			228
Fanger Langekilde [30]	23	25,0	33,5	18,0	64
Langekilde [30]	84	25,4	33,2	12,4	16
Comfort equation, Fanger [2]		25,6			

VISUAL COMFORT

Term that is related to lightening performance and human pyschology

Daylight

Quality of the eye decrease with age

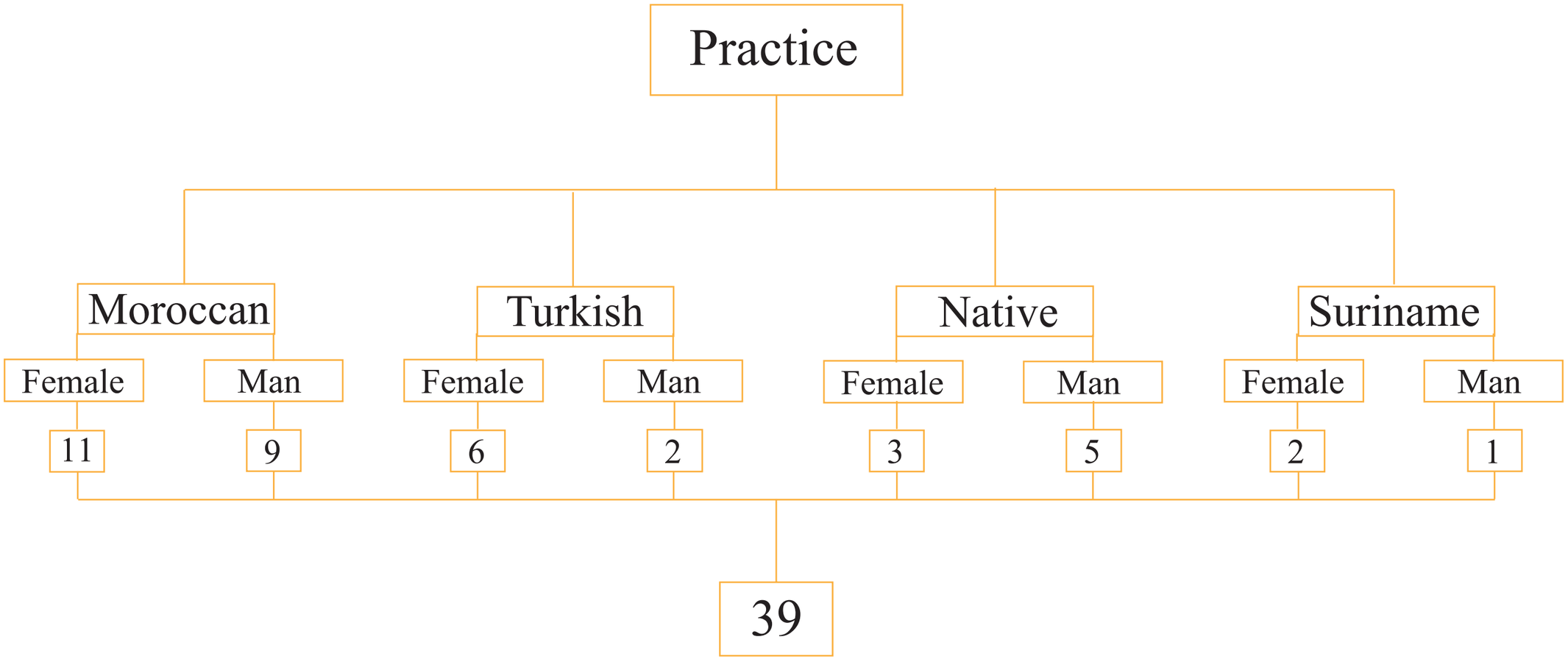
- Contrast sensitivity -
- Poor color discrimination -
- Elderly need more effort to see object sharper -

	% persons with min. 1 limitation (period 2013)	% limitation in view (period 2013)	% limitation in view (period 2016)
65 – 75 years	18.4	8.4	3.4
75 years +	38.3	11.4	11.4
Native	12.3	5.6	-
Western- foreign 1e generation	17.7	8.4	-
Western- foreign 2e generation	13.4	6.6	-
Nonwestern- foreign 1e generation	18.9	9.9	-
Nonwestern- foreign 2e generation	7.0	3.8	-

Practice

- Questionnaire -
- Measurement -

Respondents

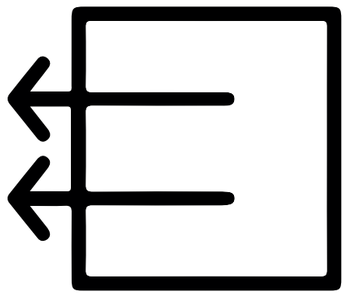


Questionnaire and results

	Most Comfortable		Average temp. inside		Average temp. prefer	
Native	75 %	→	19 ° C	→	18 °C	↓
Moroccan	57%	→	21 ° C	→	22 °C	↑
Turkish	50%	→	21 ° C	→	22 °C	↑
Surinamese	0,33%	→	19 ° C	→	22 °C	↑

Questionnaire and results

Man more comfortable then woman.



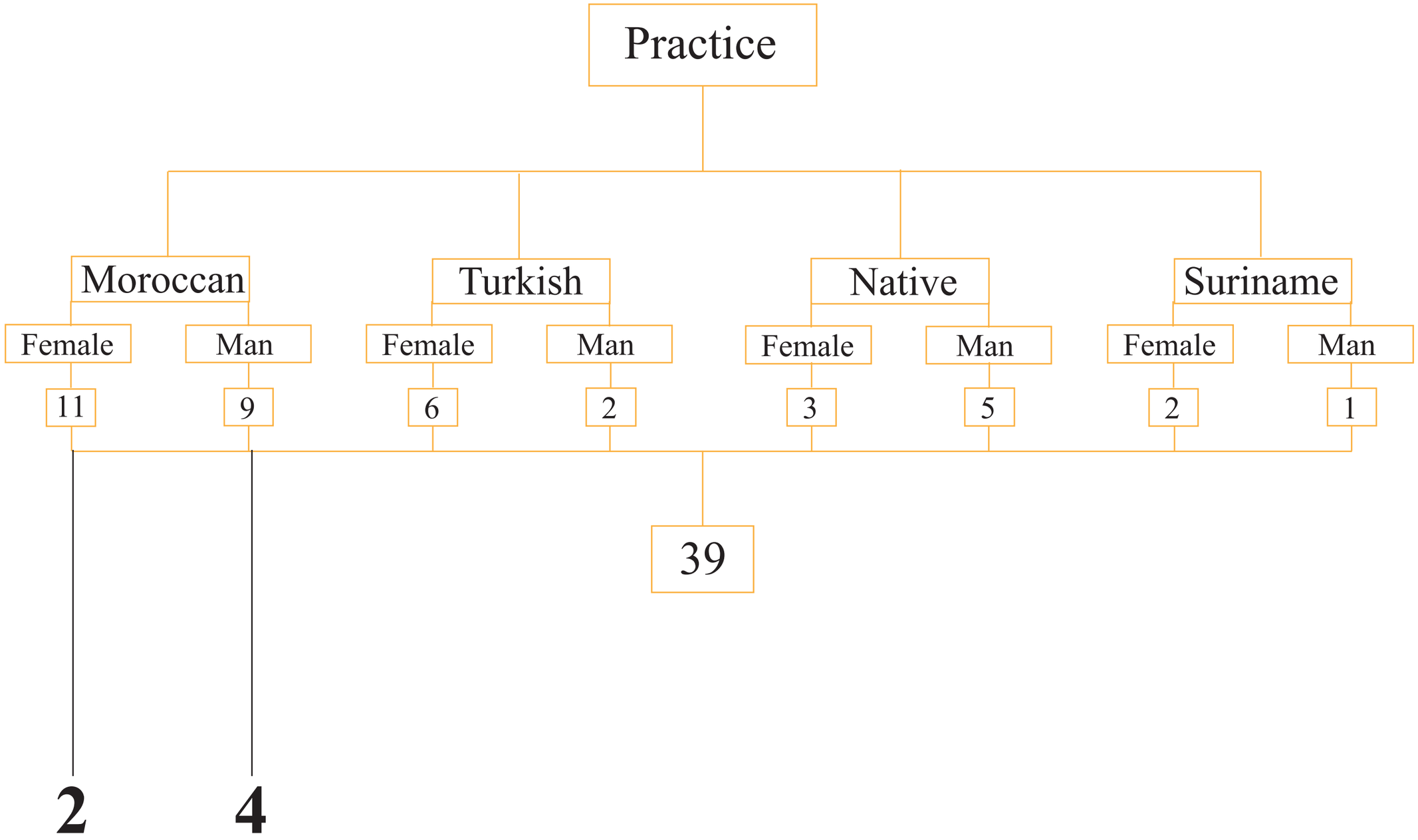
Moroccan and Turkish woman more inside then outside.

Native sport twice as often participants.

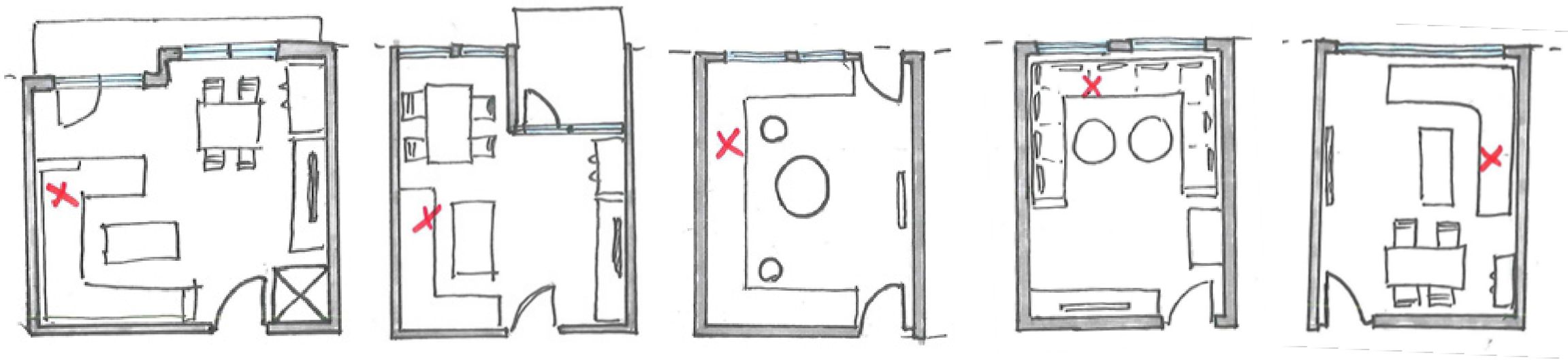
Questionnaire and results

Able to control the temperature.

Spend most of the time in the livingroom.


Practice
Moroccan
Turkish
Native
Suriname
Female
Man
Female
Man
Female
Man
Female
Man
11
9
6
2
3
5
2
1
39
2
4

Questionnaire and results



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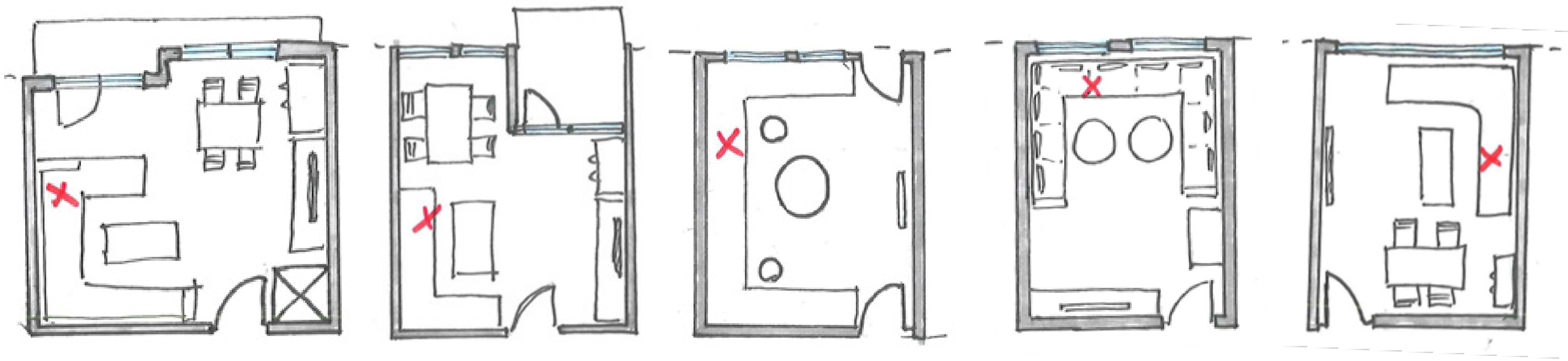
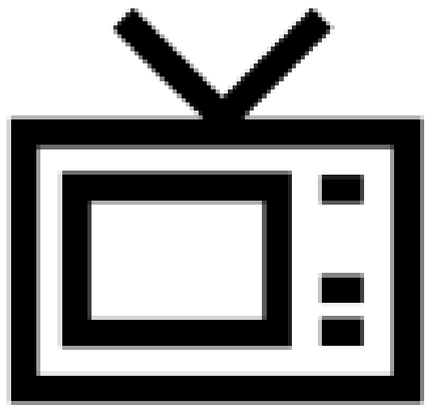
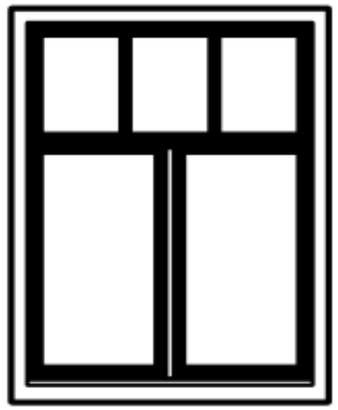




Television



W i n d o w
opening

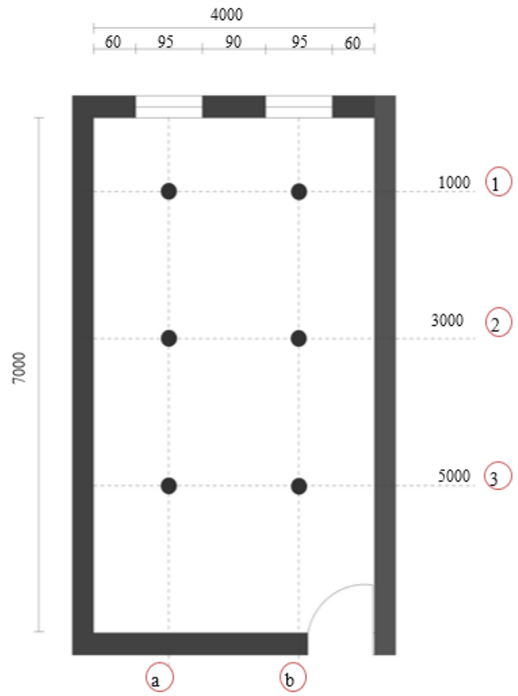
Visual comfort

Room	Date	Time	Weather
Nr.1	15/11/2017	12:30h	□ Clear sky □ No rain
Nr.2	15/11/2017	13:05h	□ Clear sky □ No rain
Nr.3	16/11/2017	11:10h	□ Clear sky □ No rain
Nr.4	17/11/2017	12:05h	□ Clear sky □ No rain
Nr.5	23/11/2017	12:03h	□ Clear sky □ Strong wind
Nr.6	25/11/2017	12:30h	□ Cloudy □ Drizzling rain

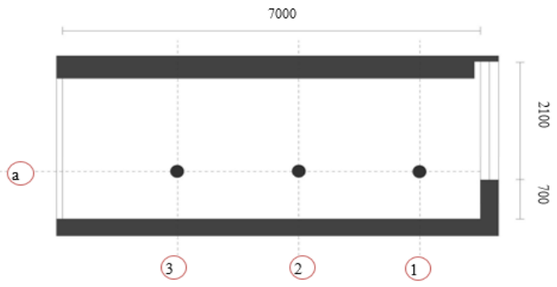
Konica Minolta T-10

Measurement and results

Room 1

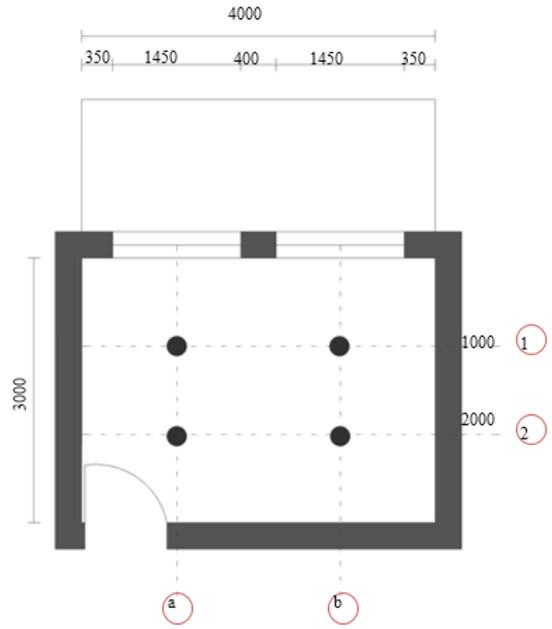


Plan room 1

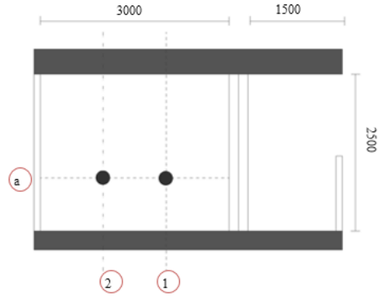


Section room 1

Room 2

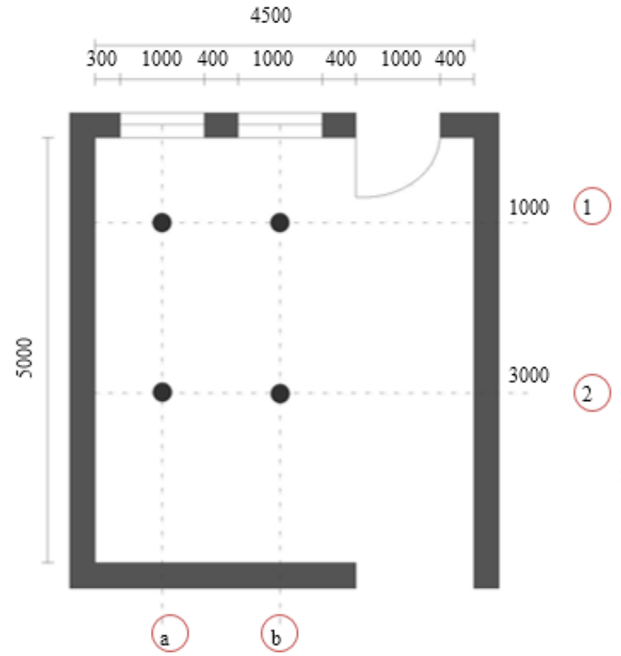


Plan room 2

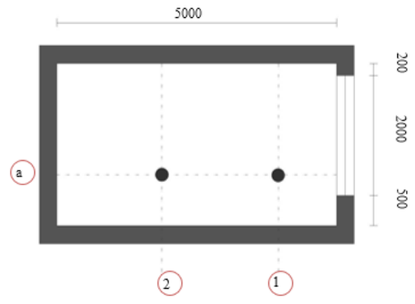


Section room 2

Room 3



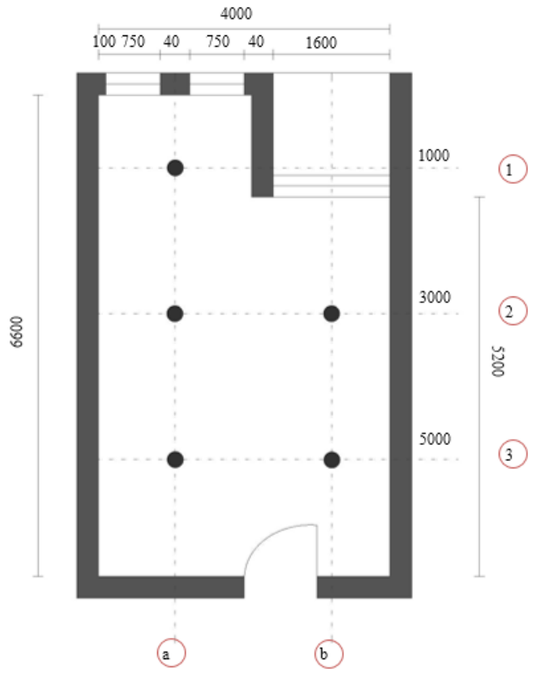
Plan room 3



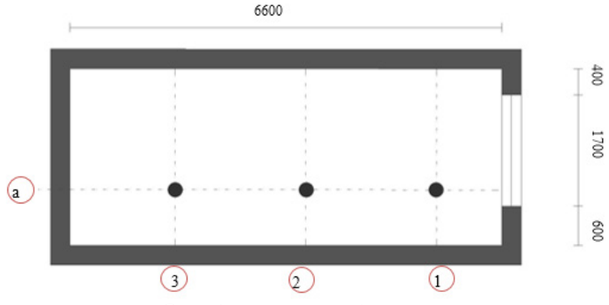
Section room 3

Measurement and results

Room 4

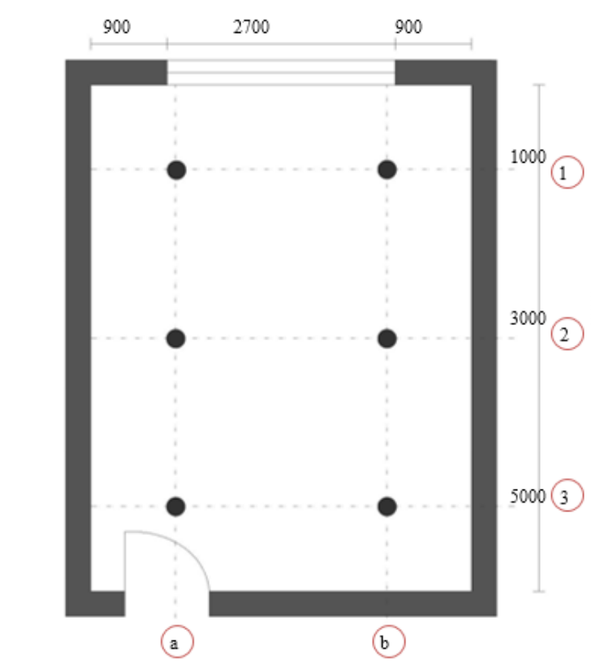


Plan room 4

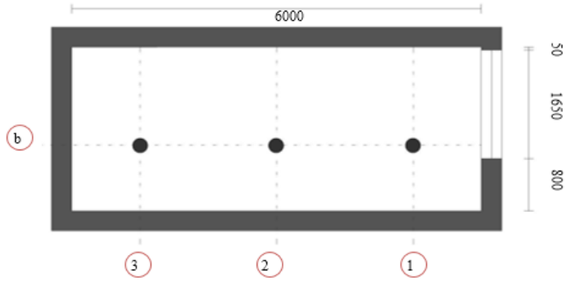


Section room 4

Room 5

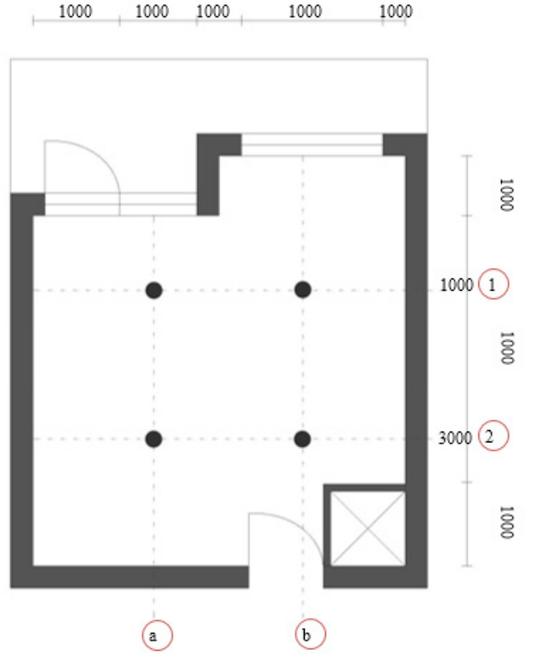


Plan room 5

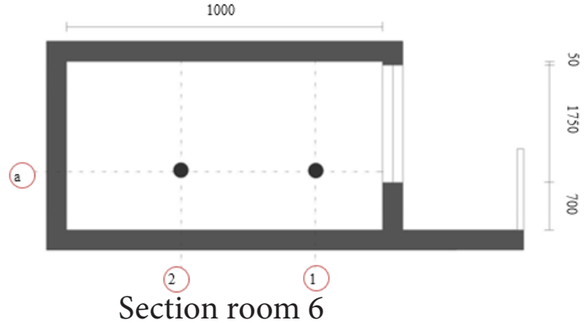


Section room 5

Room 6



Plan room 6



Section room 6

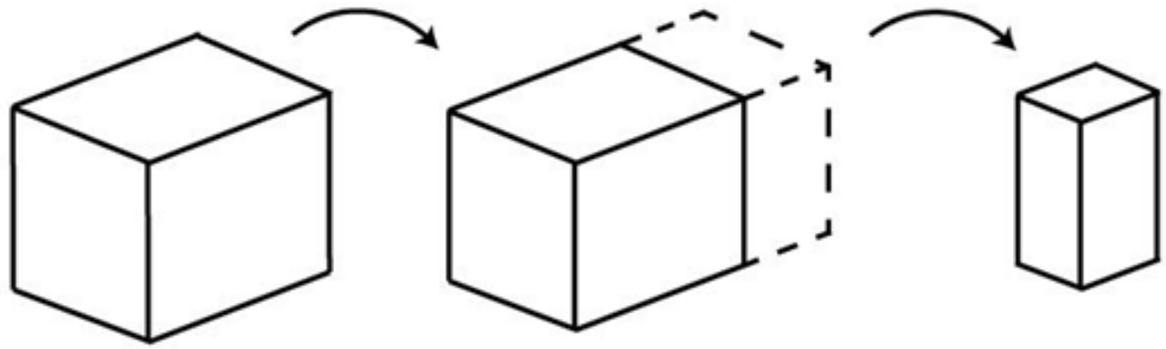
Measurement and results

Room 1			**Room 2**			**Room 3**			**Room 4**			**Room 5**			**Room 6**		
points	Lamp off	*Lamp on*	*Points*	Lamp off	*Lamp on*	*Points*	Lamp off	*Lamp on*	*points*	*Lamp off*	*Lamp on*	*Points*	*Lamp off*	*Lamp on*	*Points*	*Lamp off*	*Lamp on*
1a	0.9	0.9	*1a*	1.1	2.3	*1a*	0.3	0.5	*1a*	4	5.7	*1a*	1.9	2.3	*1a*	0.3	0.8
1b	1	1.7	*1b*	2	1.2	*1b*	0.2	0.2	*2a*	1	1.9	*1b*	4	4.7	*1b*	0.2	0.6
2a	0.5	0.7	*2a*	0.5	1.3	*2a*	0.5	0.6	*2b*	1.3	1.9	*2a*	0.7	0.8	*2a*	0.1	1
2b	0.5	0.7	*2b*	1	1.3	*2b*	0.2	0.2	*3a*	0,5	0.7	*2b*	0.6	1	*2b*	0.1	0.7
3a	0.2	0.4							*3b*	0.6	0.6	*3a*	0.2	0.7			
3b	0.2	0.4										*3b*	0.2	2.3			

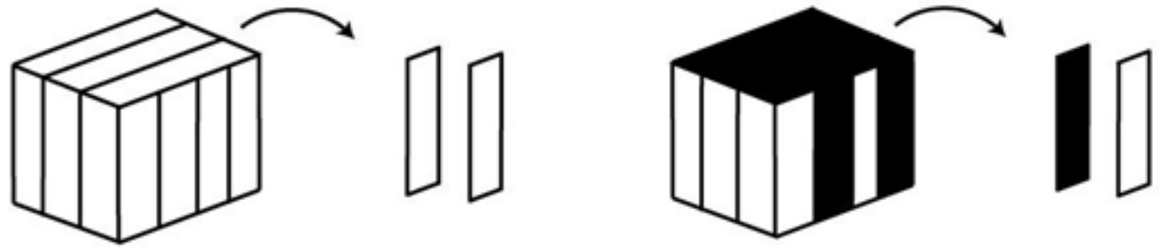
$$\text{Daylight level} = \frac{\text{Illuminance inside}}{\text{Illuminance in free field}} \text{ x } 100\%$$

Daylight level (DL)	Quality of the daylight
	Abundant daylight
	Good daylight
	Rational daylight
	On the gloomy side
	Too little for a living space.

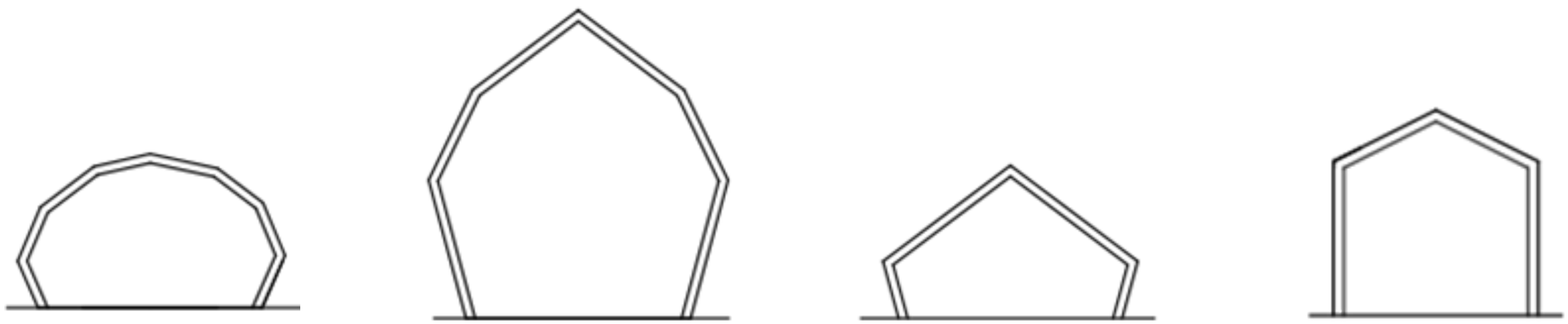
Design



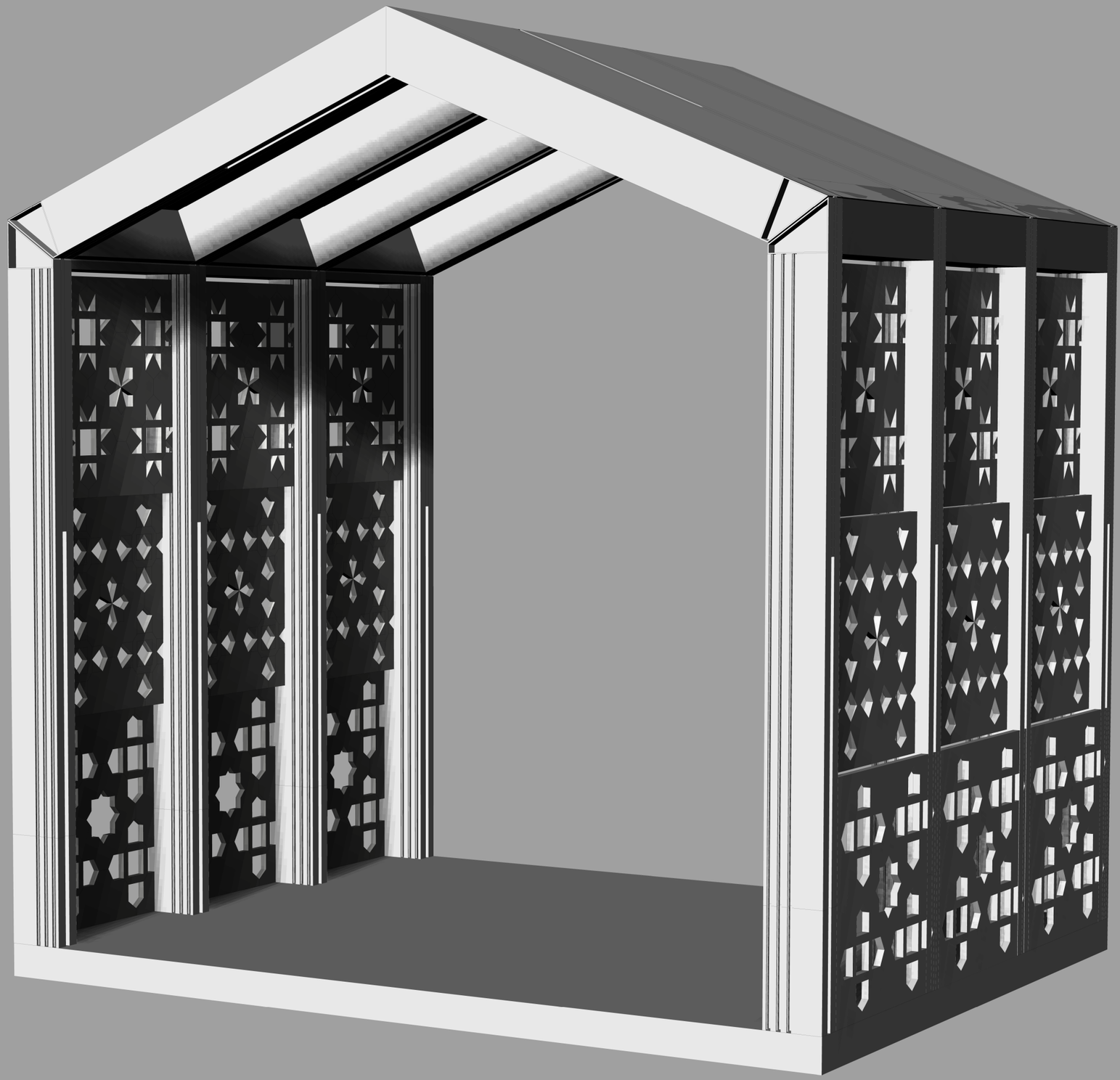
Possibility of the size of the hosue



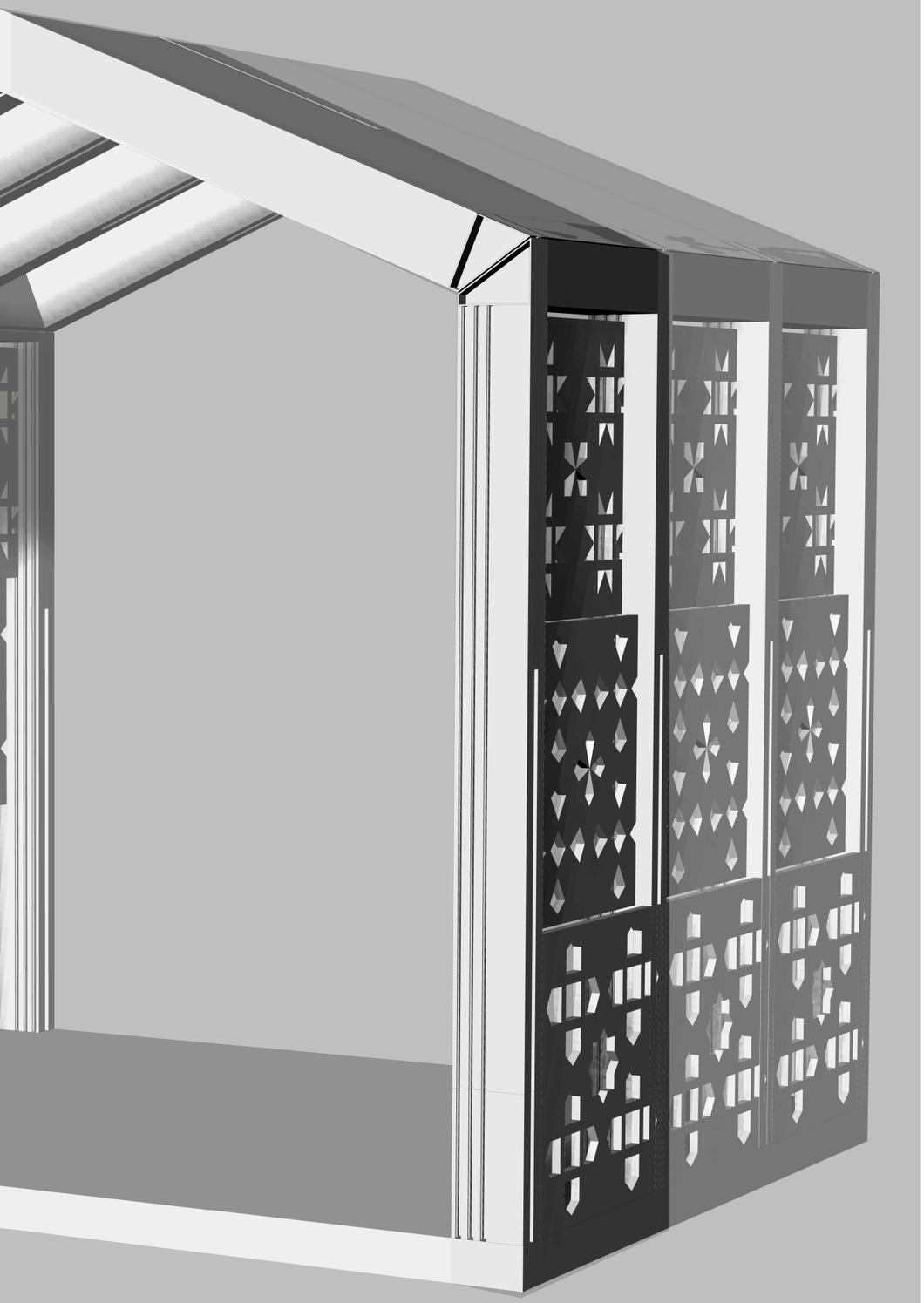
Construction and climate strategy



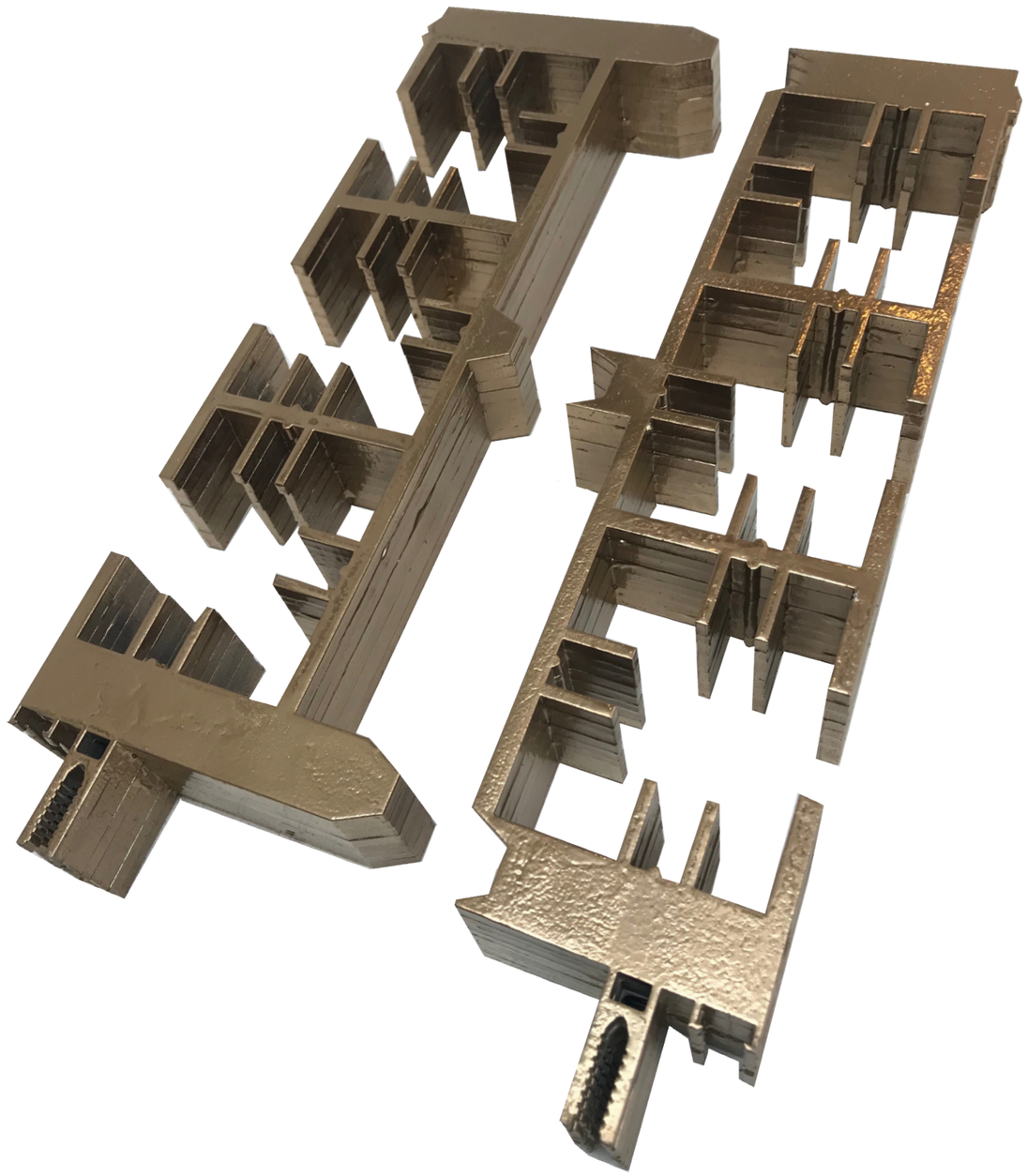
Shape

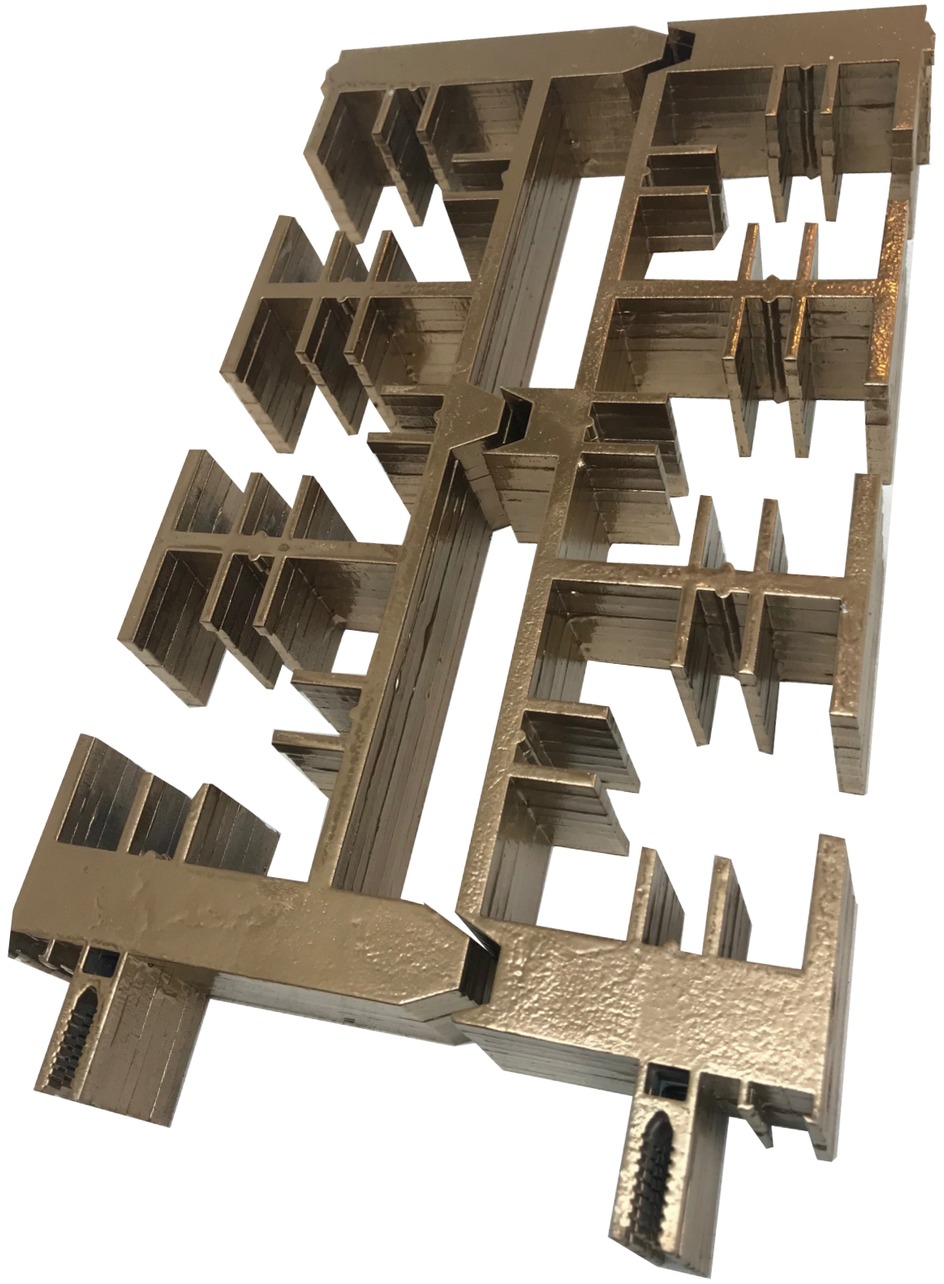


Design



Design





Design

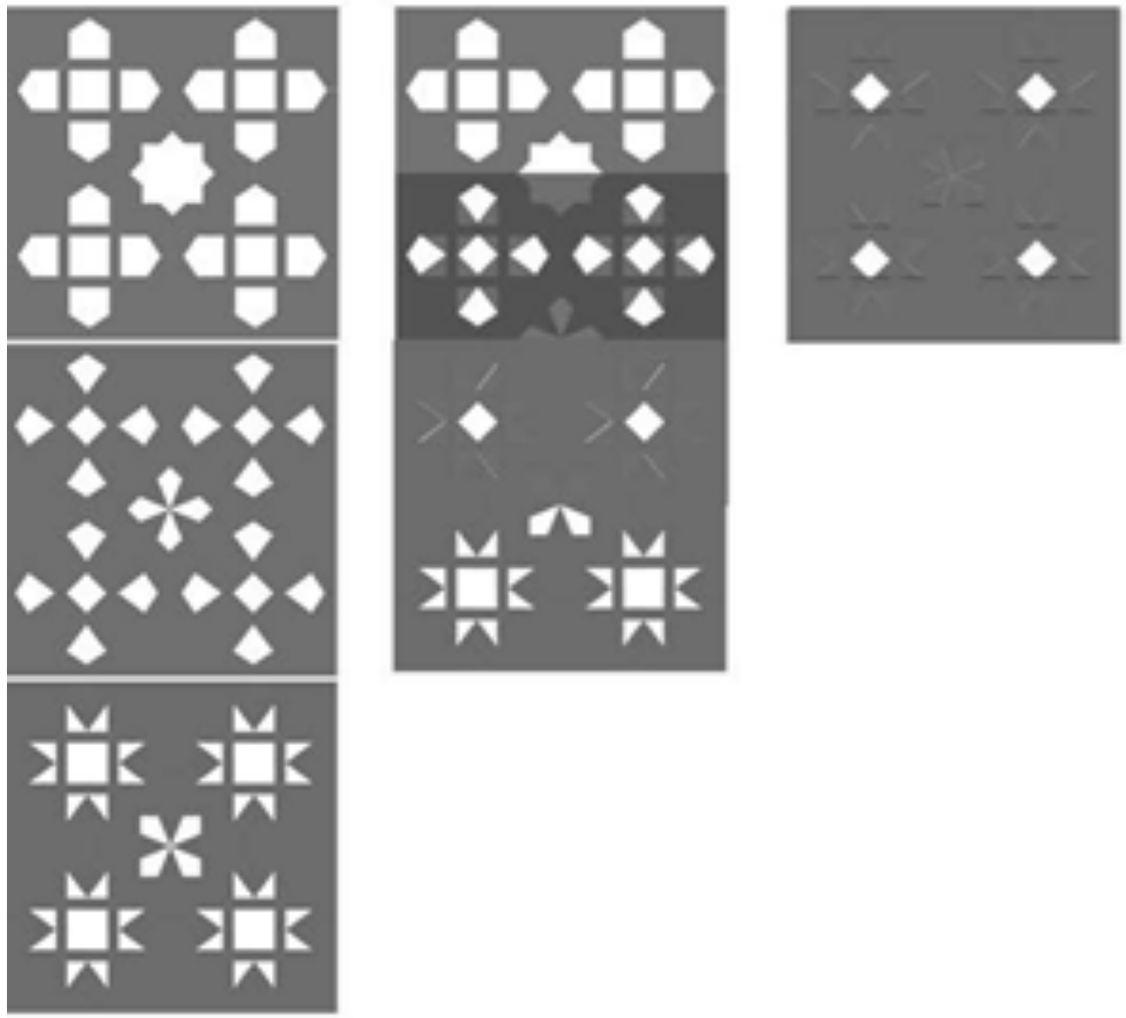
Steel vs Aluminium

Positive effect

- Light in weight
- Strong
- Weatherproof
- Sustainable
- Decorative
- Easy to work
- Good conductive material

Negative effect

- Cost
- Buckling
- Temperature
- Fatigue
- Thermal expension
- Corrosion
- Deflection



Conclusion

- “ How can facade be designed for a house for elderly people, where their children can take care for them in close proximity, while being exible enough to customize for the thermal and visual comfort of a multicultural population ? "-

Recommendations for a follow-up study

• A model of the entire proposed building should be made and tested for thermal and visual comfort in the programme ‘Design Builder’.

• A site could be chosen in order to fully develop the design, from its exterior relationship to the context, to its interior manifestation. is report began this process by looking at the strategies for construction that would allow the building to be exible.

• The questionnaires should be conducted with a larger sample size, with equal participants in the various ethnic groups. e measurements can also be taken at di erent times of the year, so that various weather conditions are captured. is will allow for rmer conclusions to be drawn.