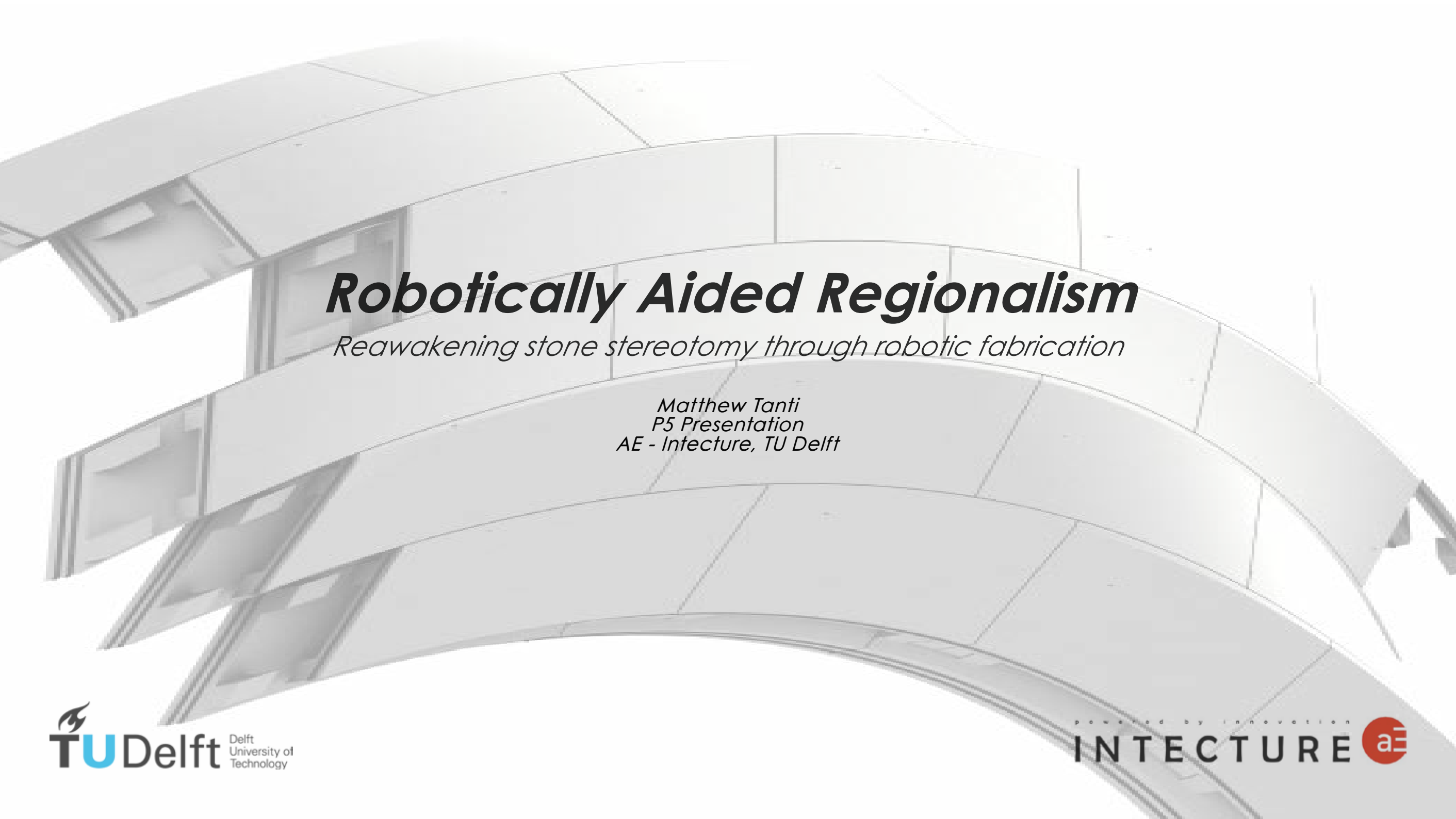




Robotically Aided Regionalism

Reawakening stone stereotomy through robotic fabrication

*Matthew Tanti
P5 Presentation
AE - Intecture, TU Delft*

Contents:

Research Setting

Fascination
Context
Opportunity
Technique

Design Case

Site
Program
Concept
Form finding
Elevations, Plans, Sections
Schemes
Details
Fabrication
Visuals

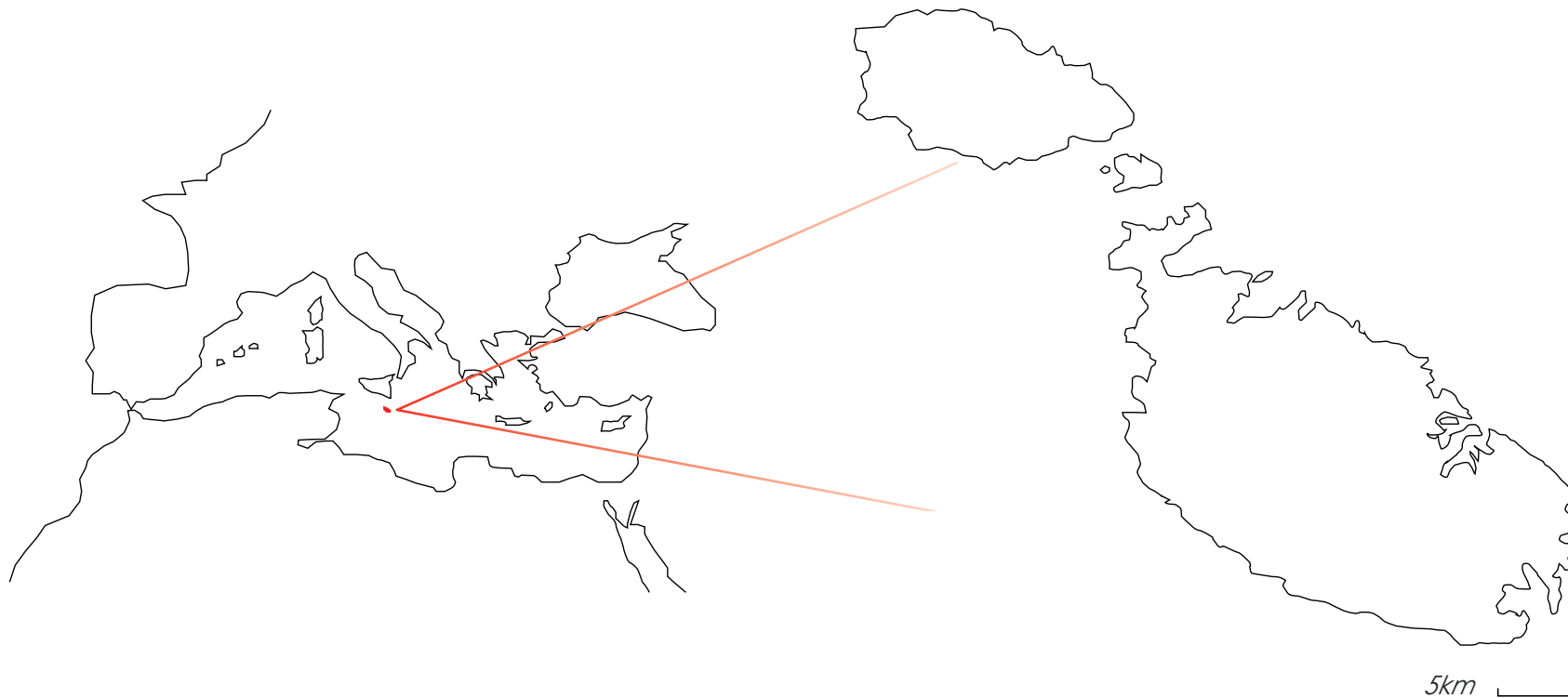
Research Setting - Fascination



*Combination of **Traditional Building Techniques** with **Digital Fabrication***

Research Setting - Context

The Maltese Islands



Basic Info:

Total Area: 316 km²

Population: 450,000

Language: Maltese and English

Independence: 21 September 1964

Predominant Religion: Roman Catholic

Climate: 270 days of Sunshine

Lowest Temperature: 7 °C

Highest Temperature: 35 °C

Only Building Material: Limestone

Research Setting - Context

Maltese Stone Architecture



Research Setting - Context

*"The most subtle and exquisite part of Architecture...
is the formation of every sort of Arches and vaults, cutting their stones, and adjusting them with surface artifice,
that the same gravity and weight which should have precipitated them to the earth,
maintain them constant in the air, supporting one another in virtue of the mutual complication which links them"*

Vincente on Stereotomy- 1707

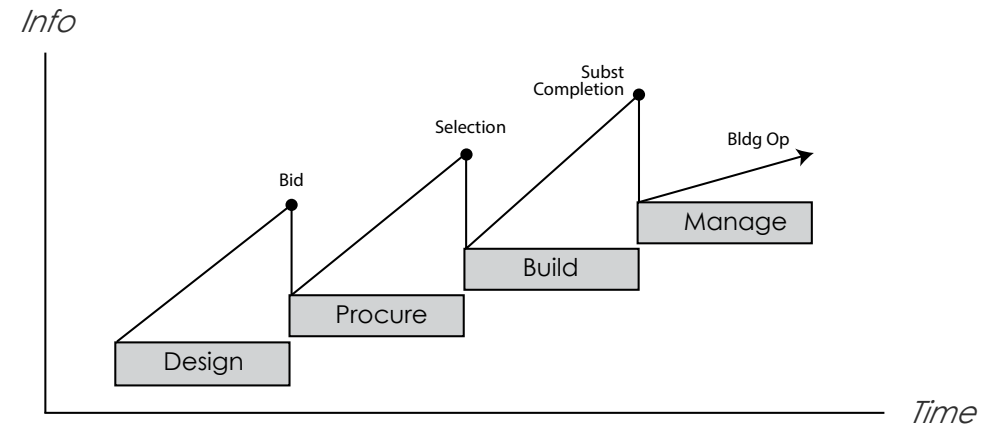


Guastavino stairs, King's Collage Chapel, Lady Gordon Chapel at Ta Braxia Cemetery, Colonia Guell - Gaudi.

Research Setting - Context

Problem: Loss of Architectural Heritage

An issue of Communication



Reasons:

Stone Stereotomy requires a high level of integration between design and craftsmanship.

Proposal:

*Attempt to prolong this building tradition in the future:
The re-introduction of the pre modern idea of 'Master Builder' through digital fabrication.*

Research Setting - Opportunity

Digital Fabrication

Offers a direct link between designing and making.

Not affected by economy of scale, therefore all parts can be different.

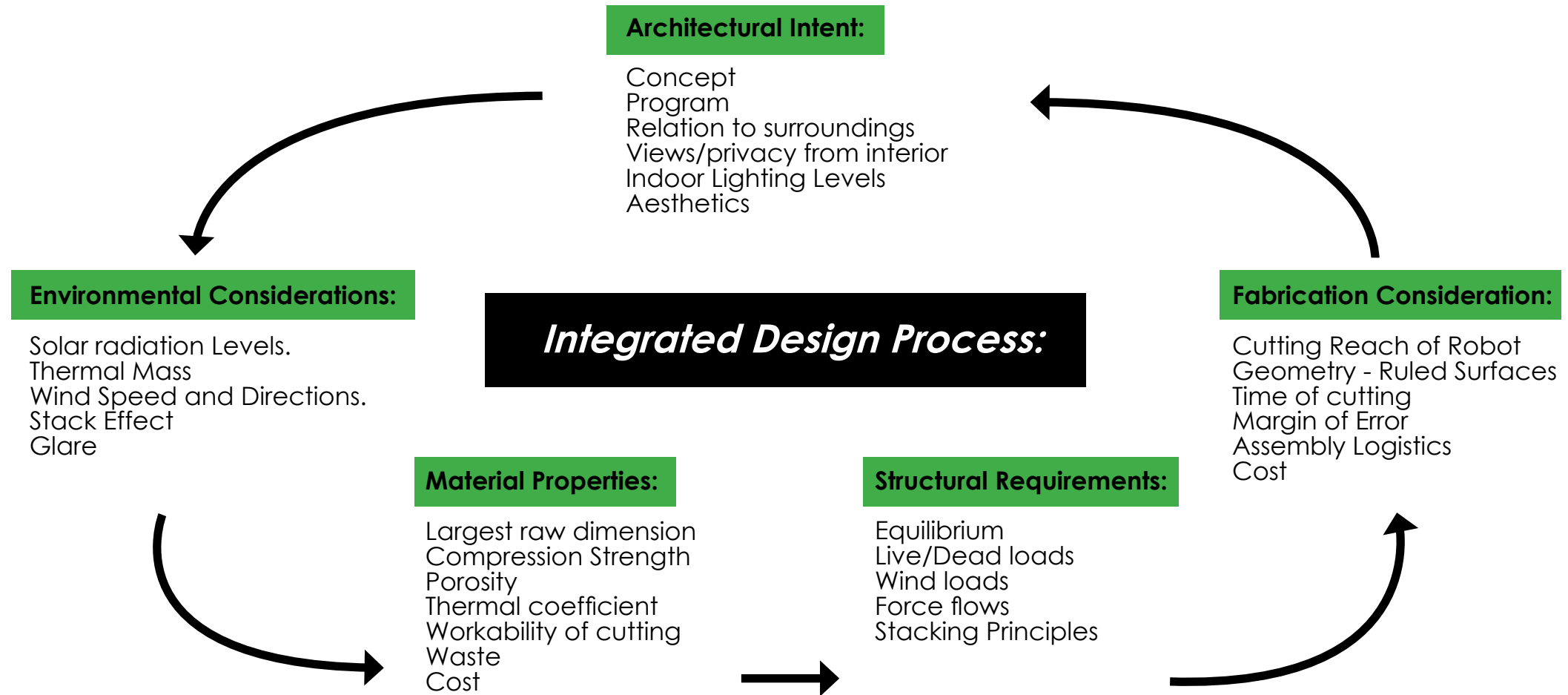
Not affected by complexity



Left) RDM Rotterdam Robotics Lab Right) Gramazio and Kohler at ETH, Zurich

Research Setting - Opportunity

Integrated design process



Research Setting - Technique

Research

Stone Properties

*Compression Only
Thermal Mass*



Craftmanship

*Robotic Fabrication
Assembly*

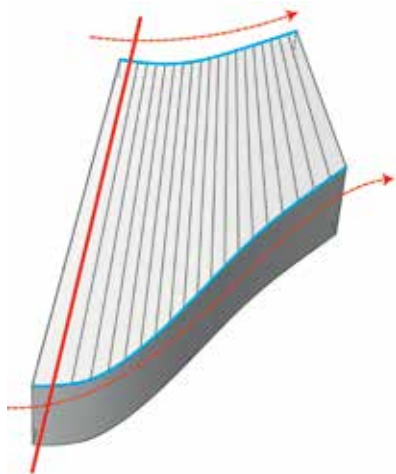
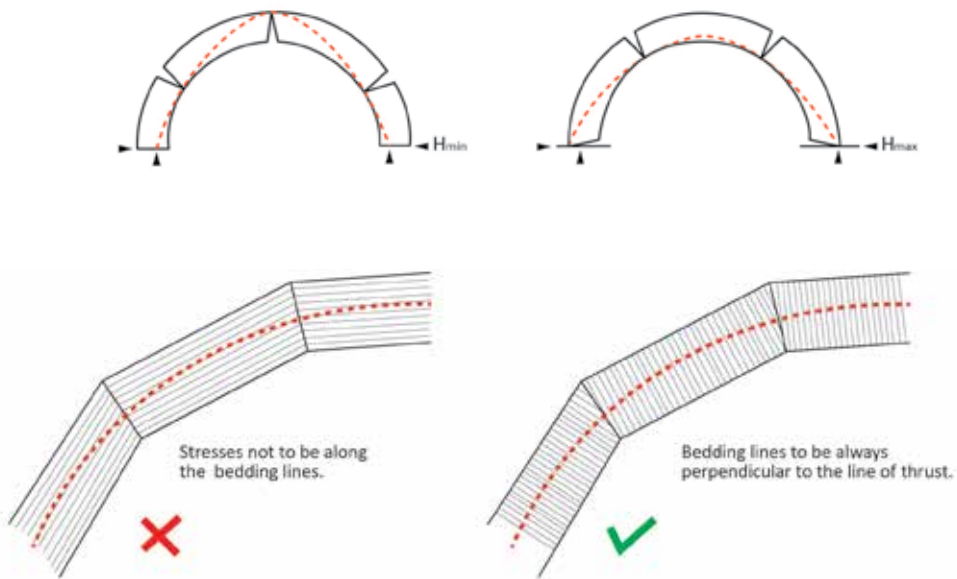


Research Setting - Technique

Research

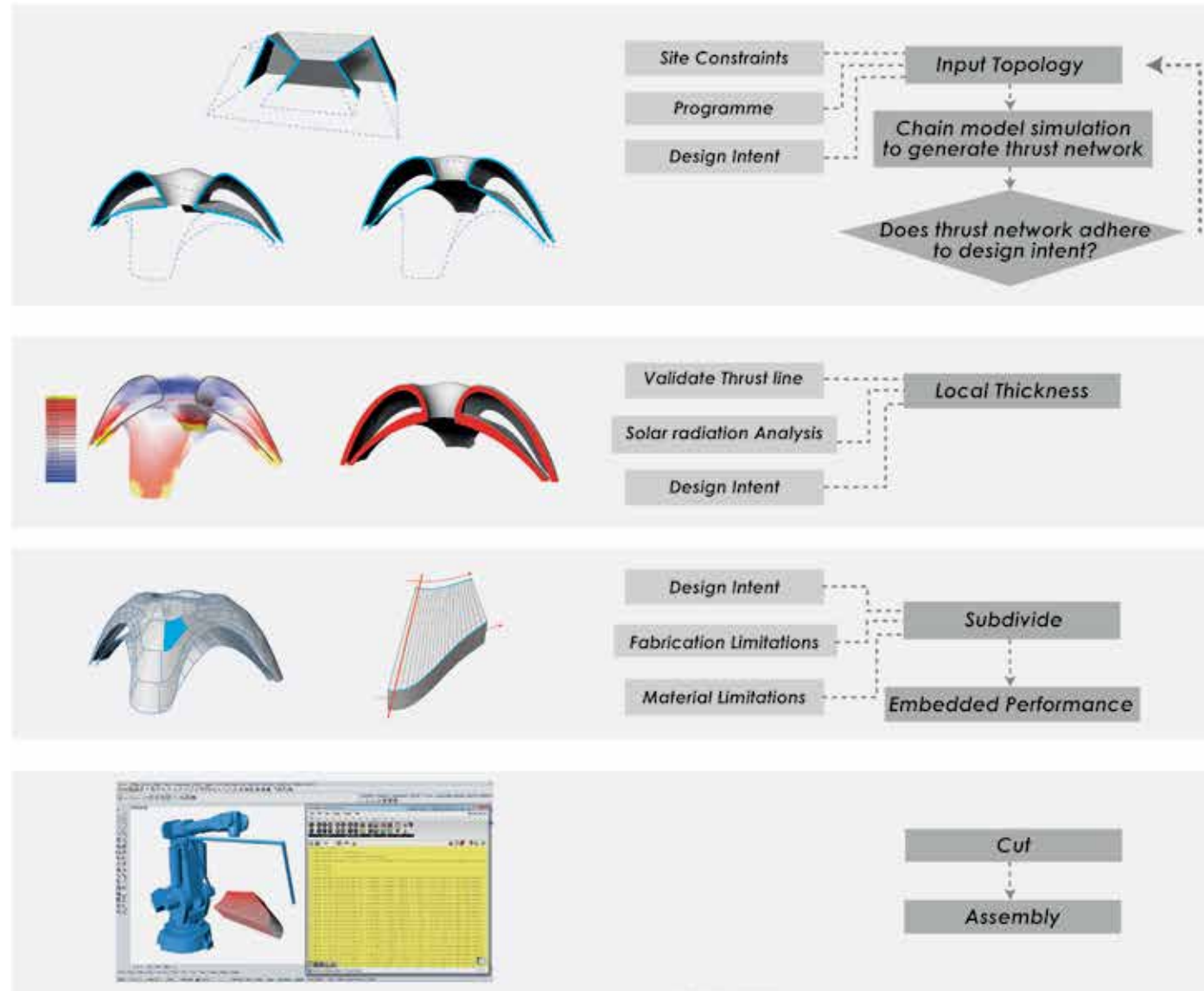
Stone Properties

Craftmanship



Research Setting - Technique

The System



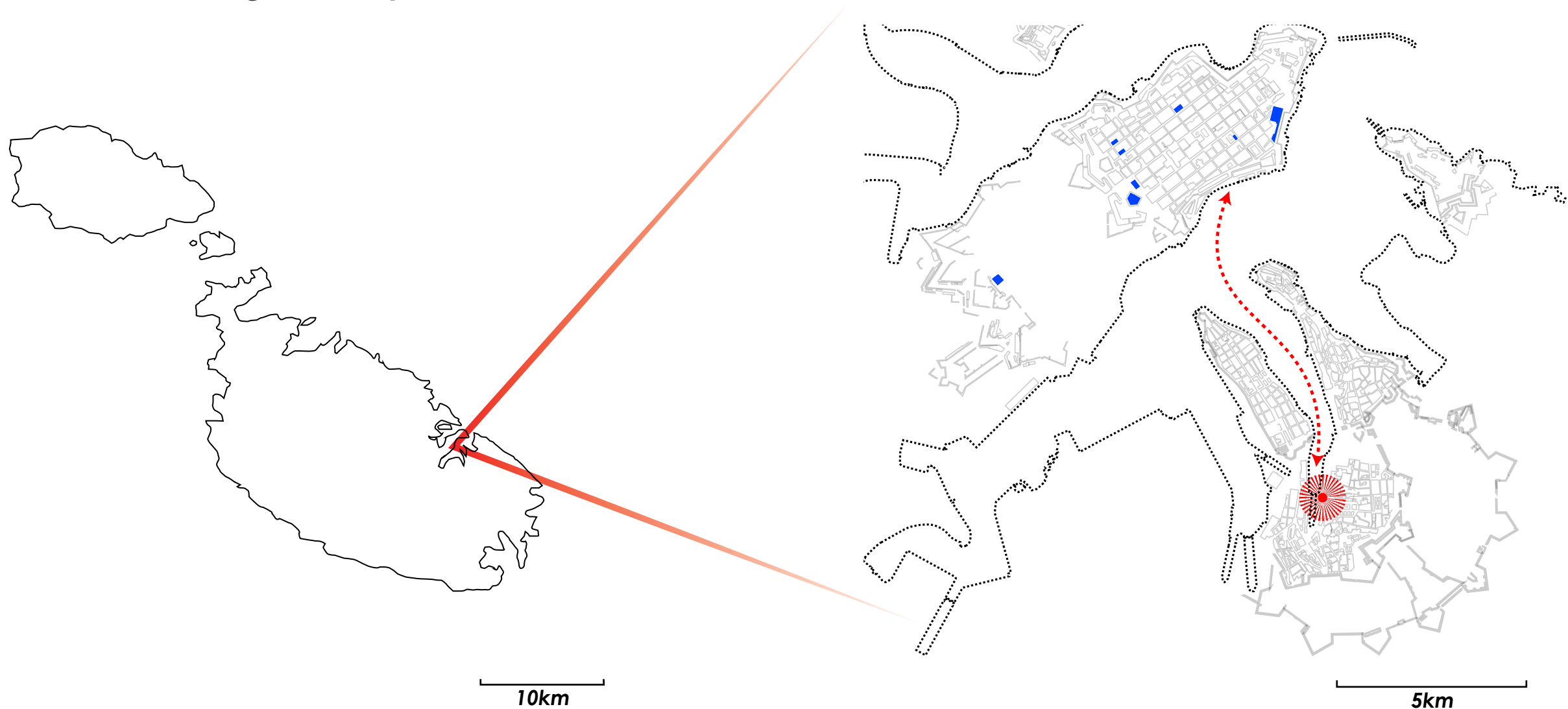
- ① Compression Only Geometry
- ② Shell Thickening
- ③ Tectonic of parts
- ④ Fabricate

Design Case

Design Case - Site

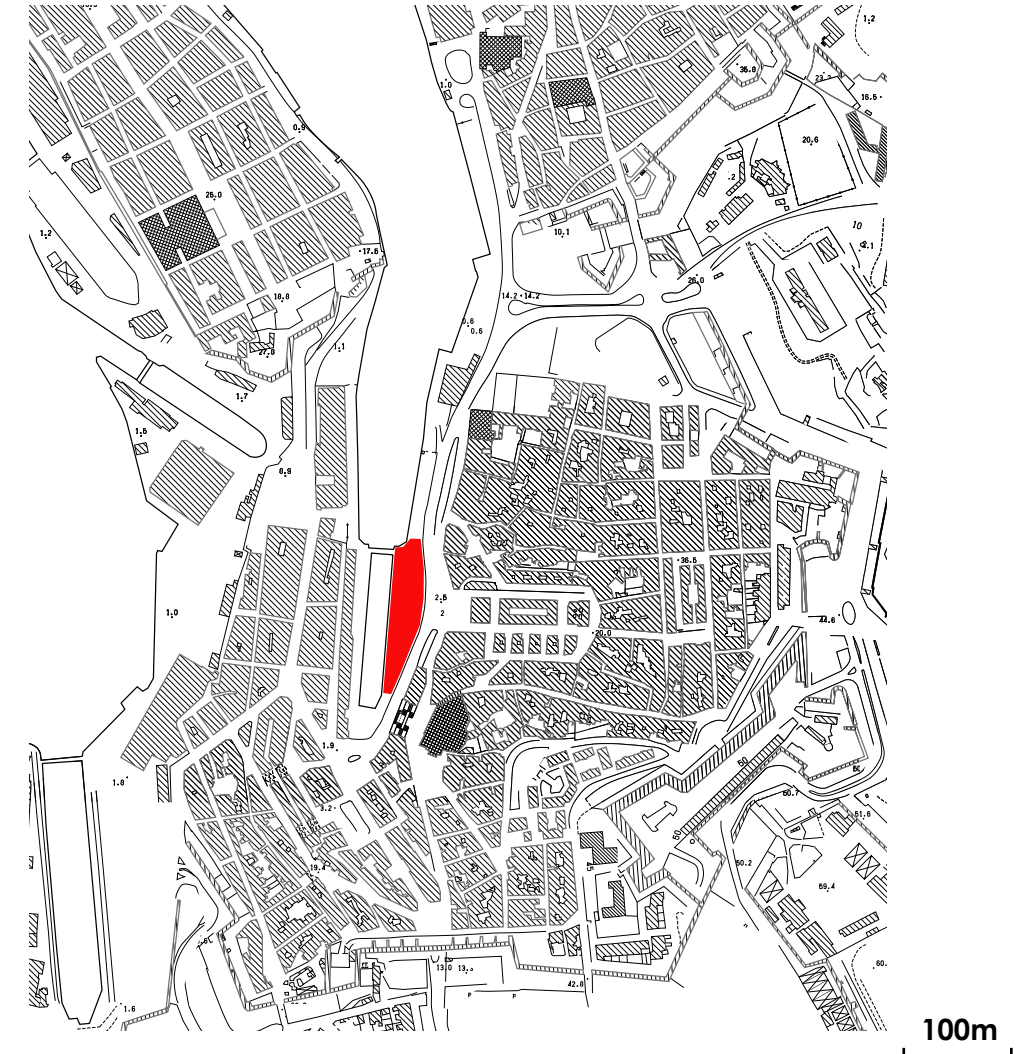
Grand Harbour Region, Cospicua/Bormla

V.I8 VALLETTA
EUROPEAN CAPITAL
OF CULTURE 2018

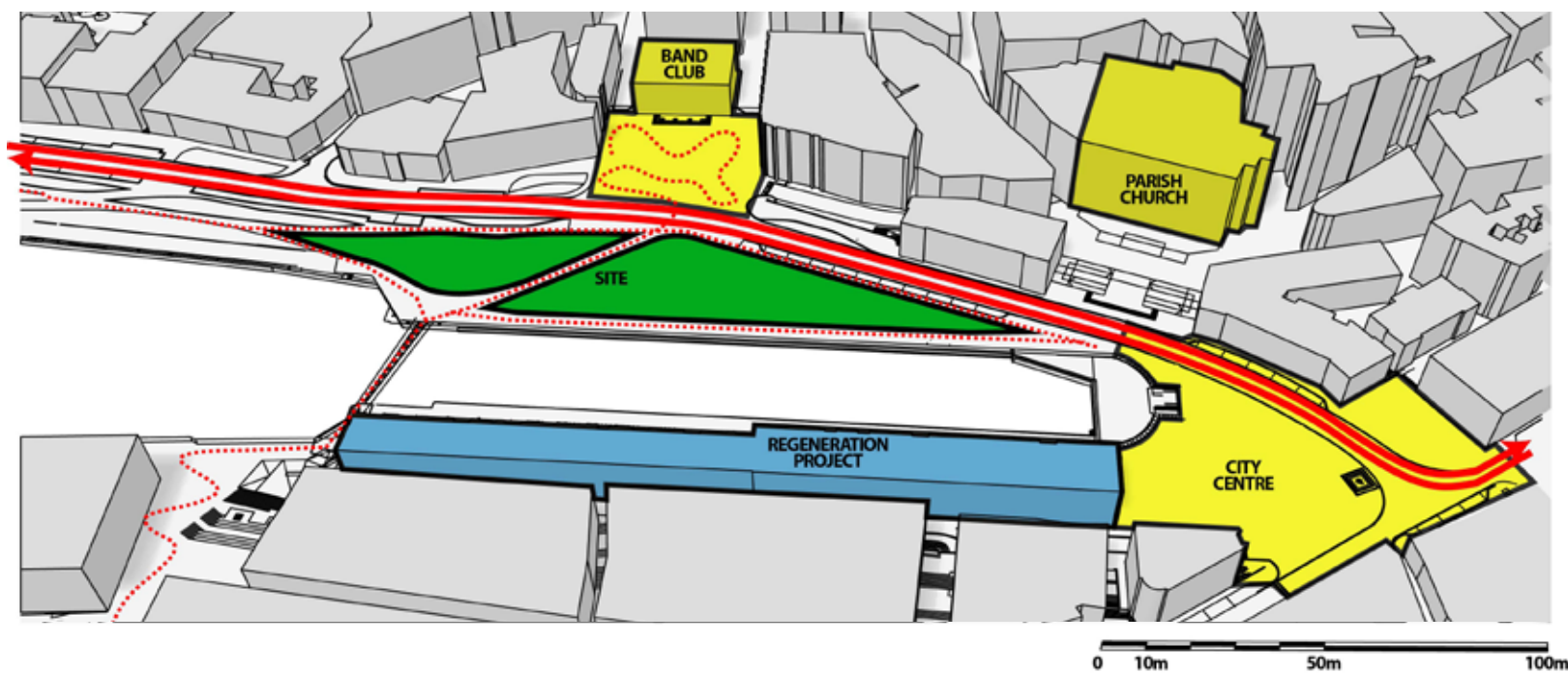


Design Case - Site

Grand Harbour Region, Cospicua



Design Case - Site

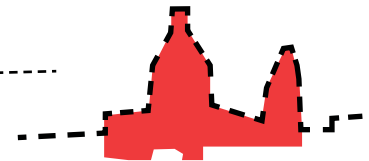
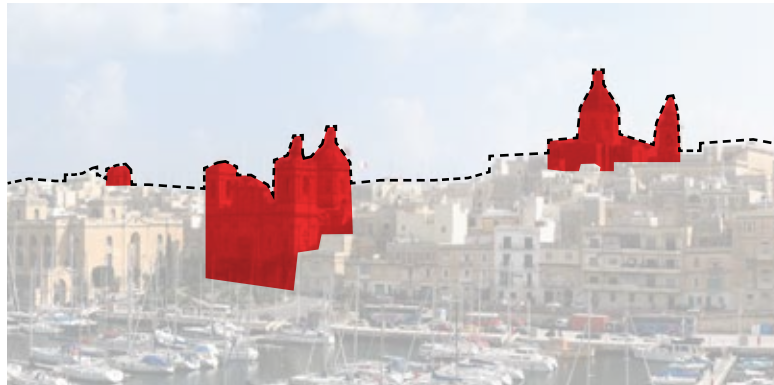


Design Case - Program

A Statement for a post colonial Identity.

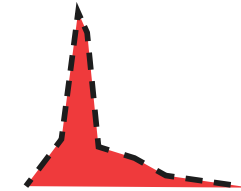
A House for Maltese Literature.

A place where people gather to celebrate Maltese literature. Preserving its past and embracing its future.

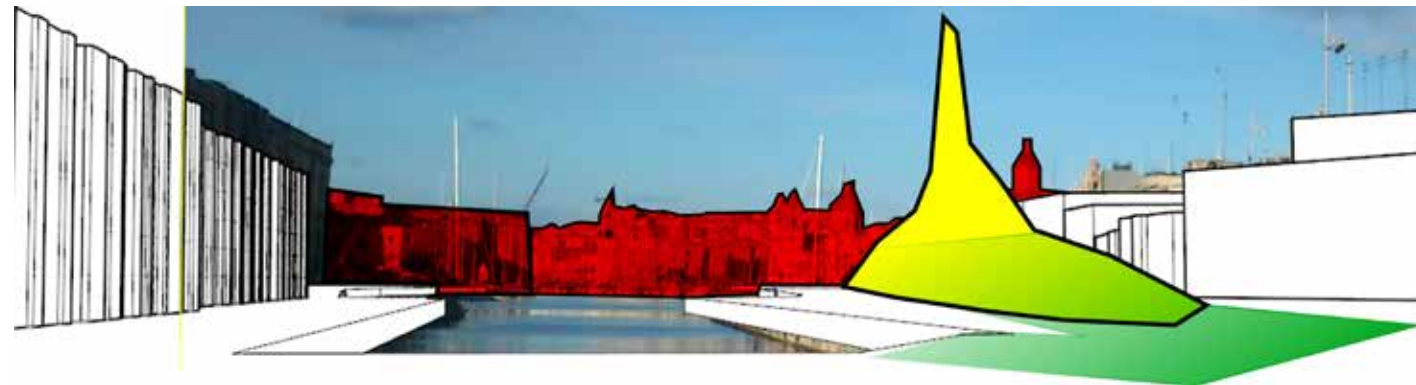


*Offices &
Apartments*

Why Not?



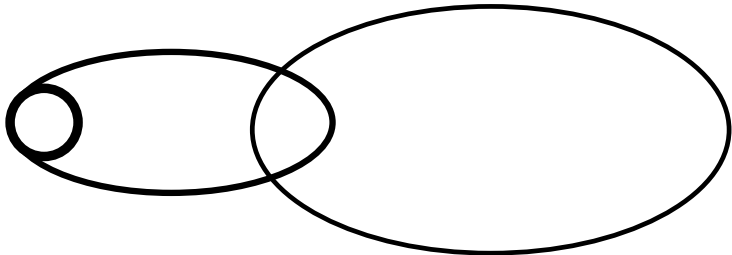
*An Architectural Statement
Representing the culture
of a secular Malta*



Design Case - Concept

Typology Study

SPACE



STATUS

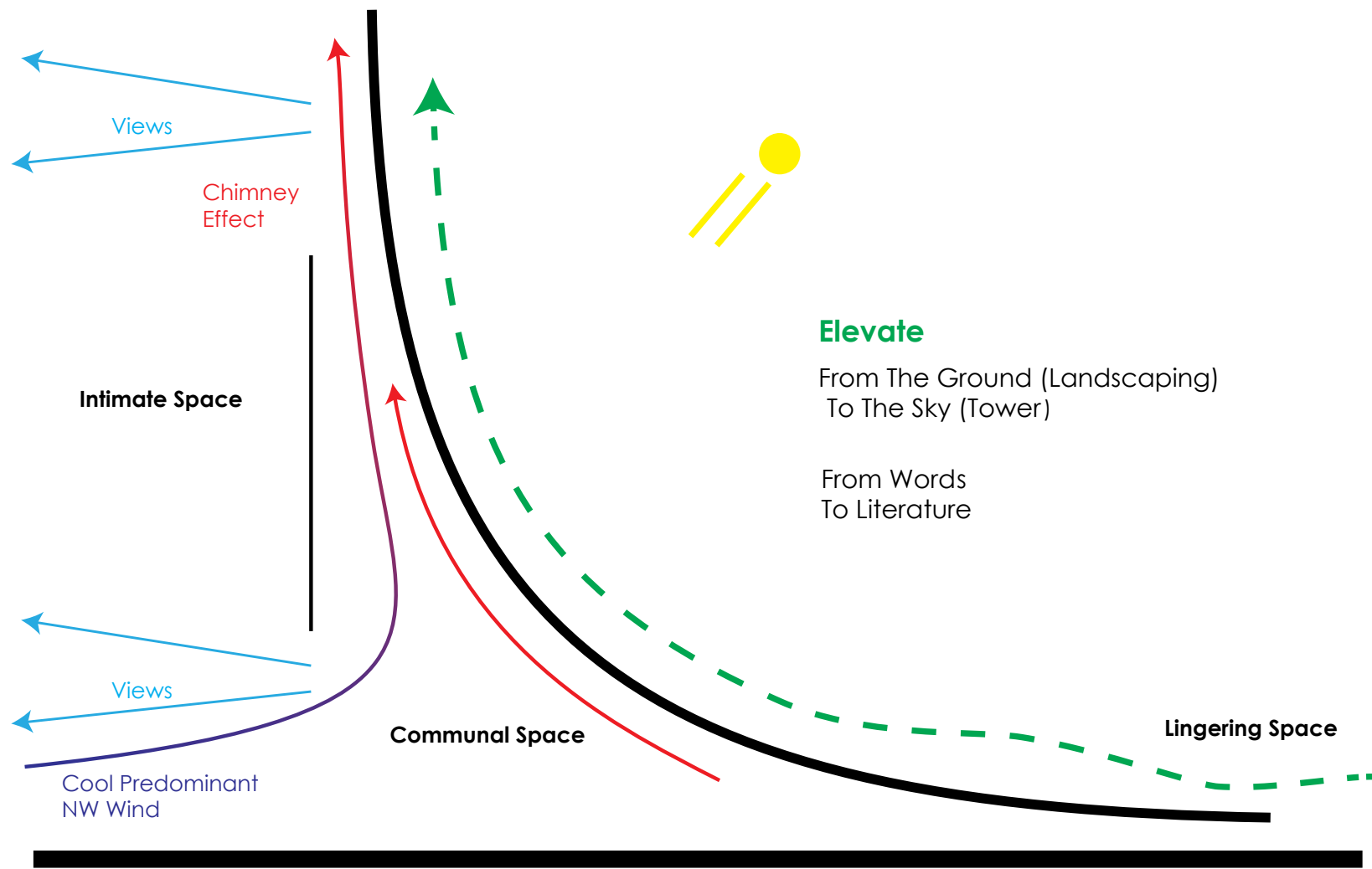
Private Communal Public

ACTION

Reflect Gather Linger

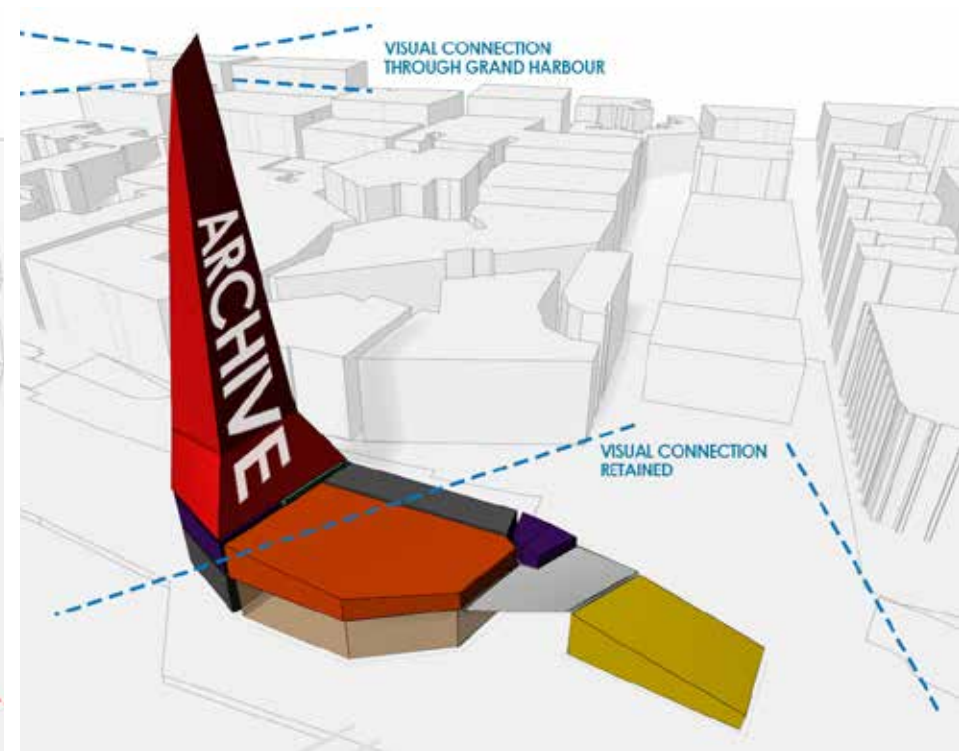
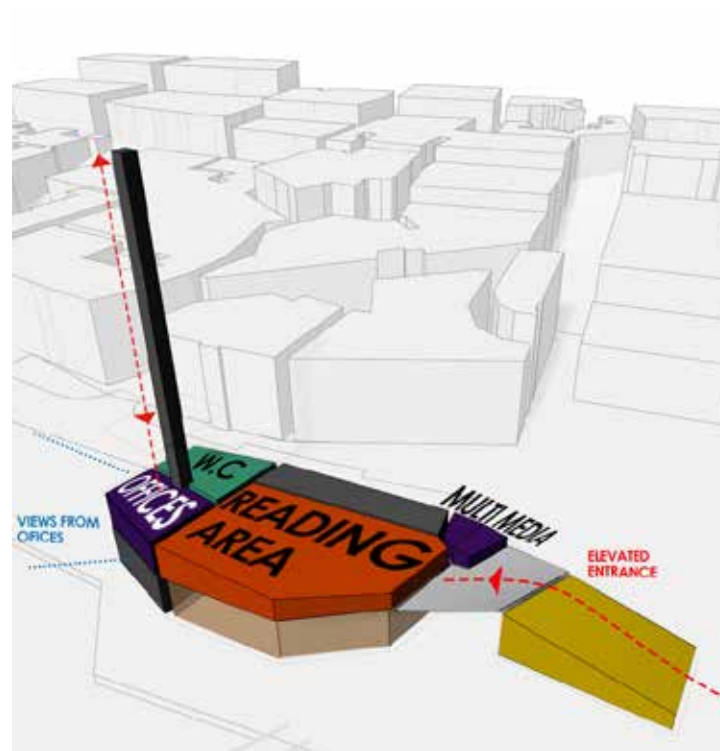
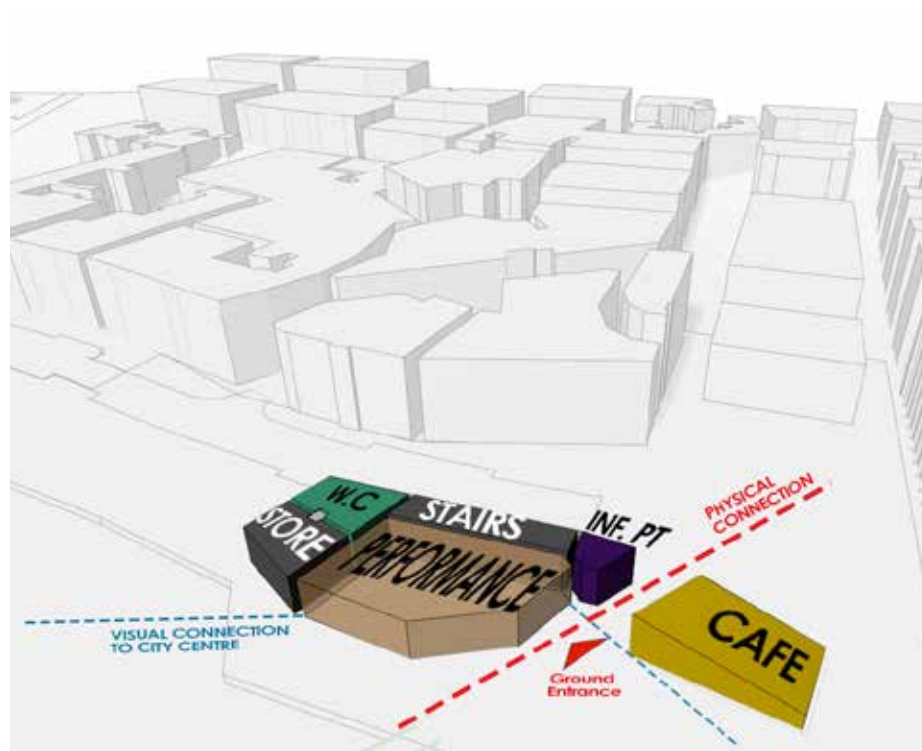


Design Case - Concept



Design Case - Concept

Program on site

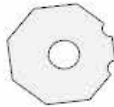
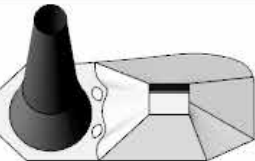
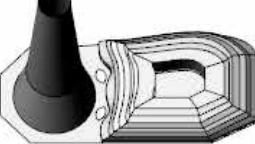


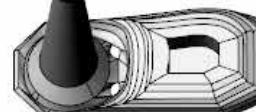
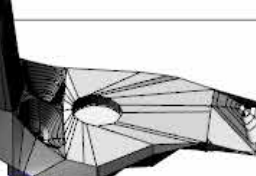
Design Case - Form Finding

Topological Search

Digital Chain Simulation:

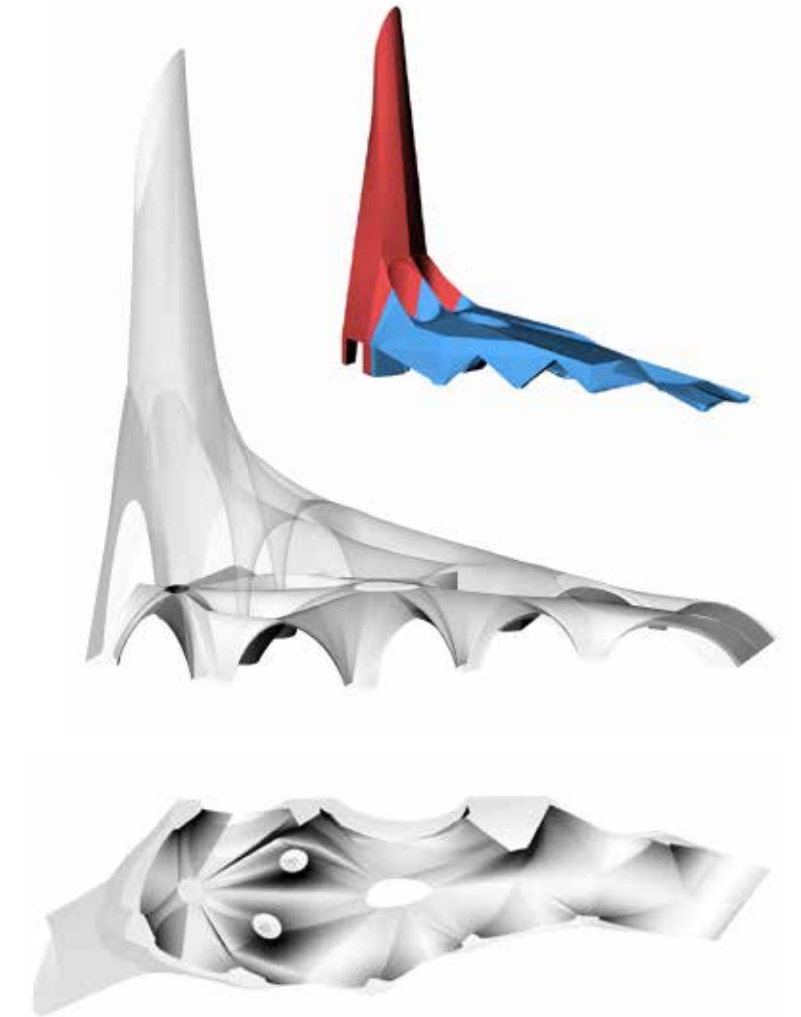
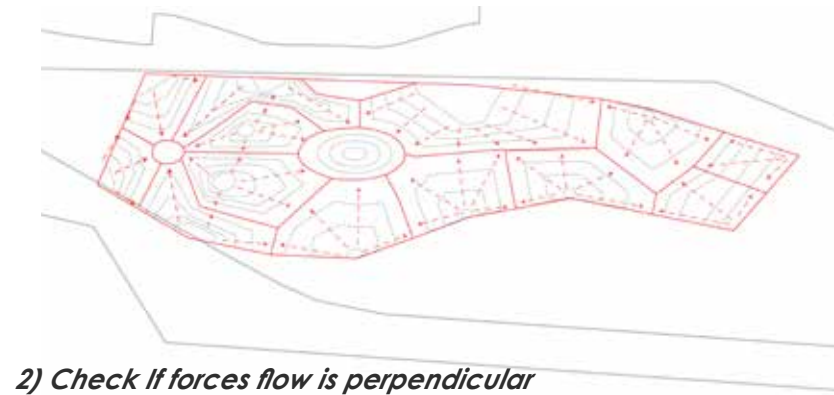
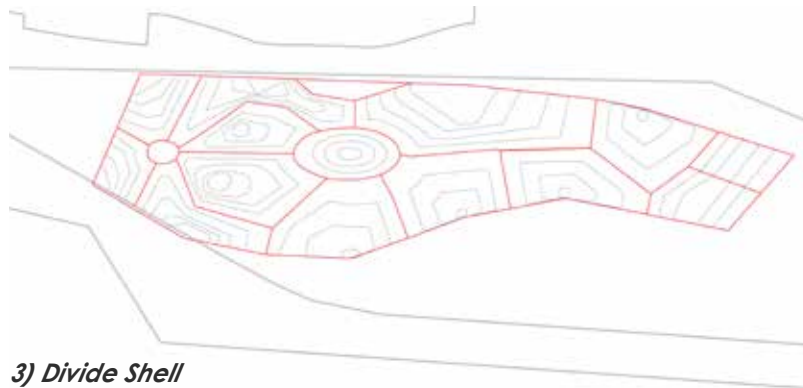
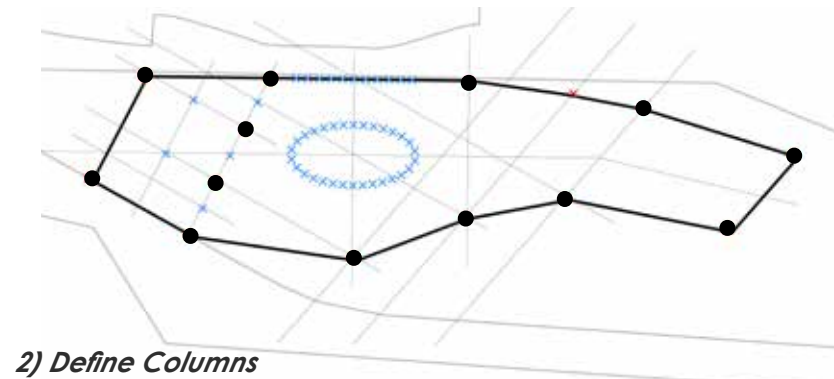
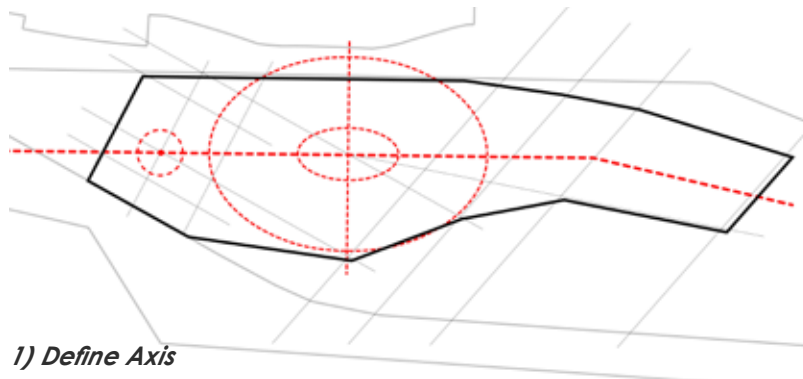
Not imposing a form on a material,
but have a dialoge between form
and structure

	Chain Simulation Input	Chain Simulation Output
①		
②		
③		
④		
⑤		

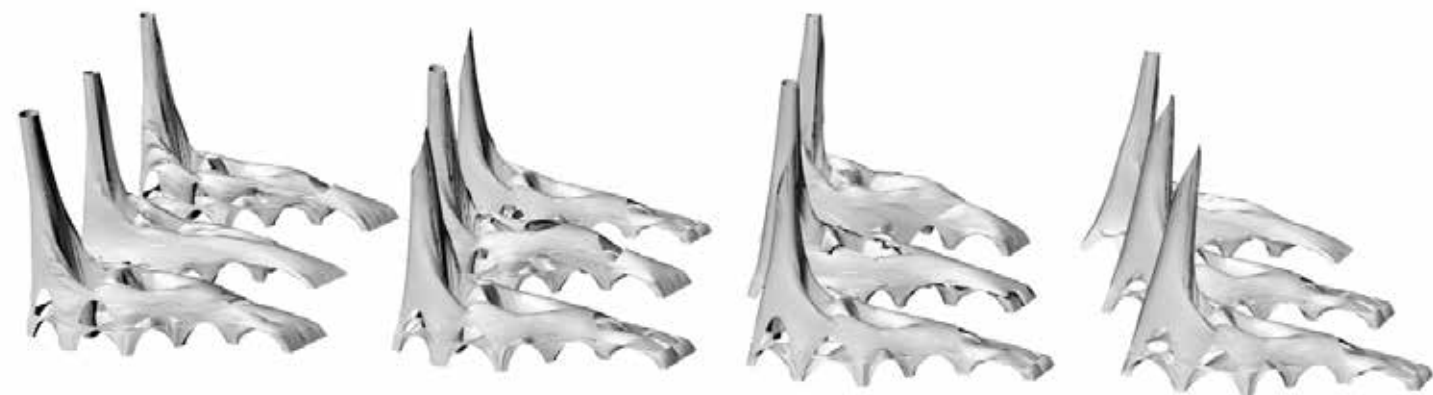
	Chain Simulation Input	Chain Simulation Output
⑥		
⑦		
⑧		
⑨		
⑩		

Design Case - Form Finding

Shell Division Logic



Design Case - Form Finding

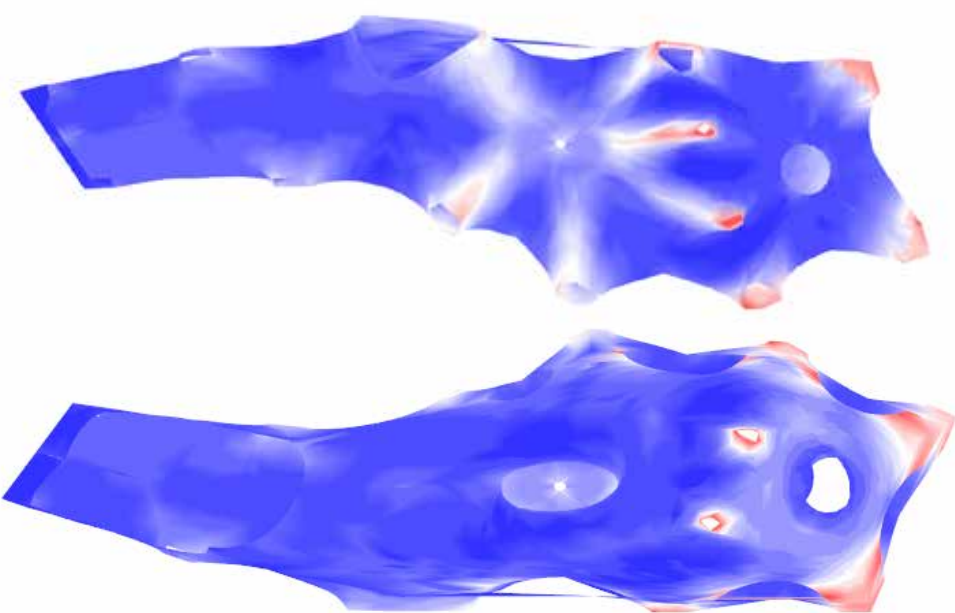


LIMESTONE FROM SIGGIEWI QUARRY:

MEAN COMPRESSIVE STRENGTH: 23.5N/MM2
@ DRY OVEN STATE.

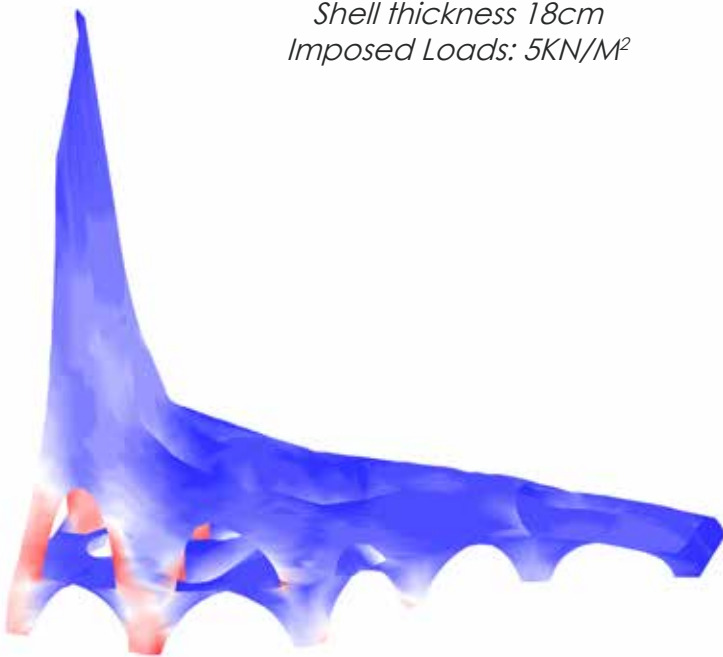
SAFE ASSUMPTION: 21N/MM2

==
$$\frac{-2.1\text{KN/cm}^2}{\text{MEAN DENSITY: } 1724\text{KG/M}^3}$$



Analysis Info:

Shell thickness 18cm
Imposed Loads: 5KN/M²

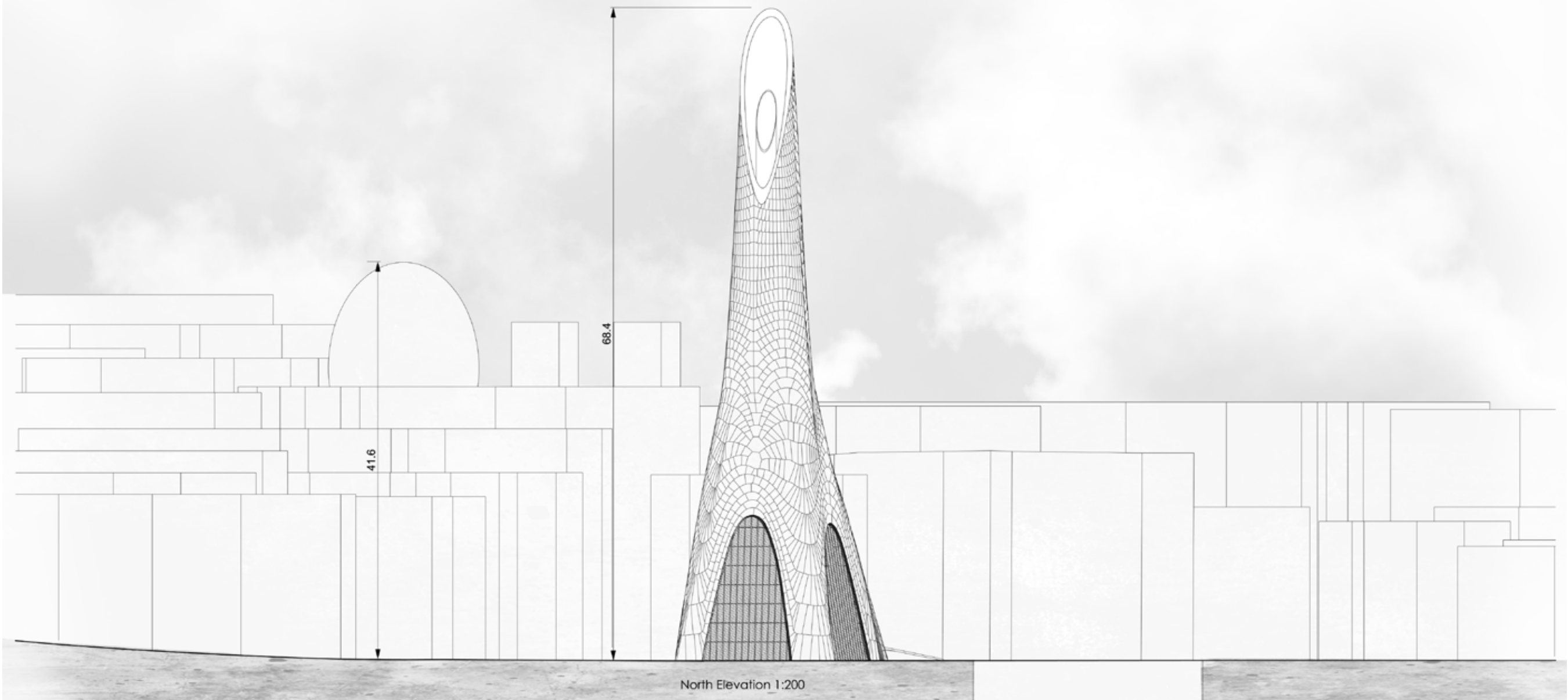


stress[kN/cm2]
-8.32e-01
-7.87e-01
-7.43e-01
-6.99e-01
-6.55e-01
-6.11e-01
-5.66e-01
-5.22e-01
-4.78e-01
-4.34e-01
-3.89e-01
-3.45e-01
-3.01e-01
-2.57e-01
-2.13e-01
-1.68e-01
-1.24e-01
-7.98e-02
-3.56e-02

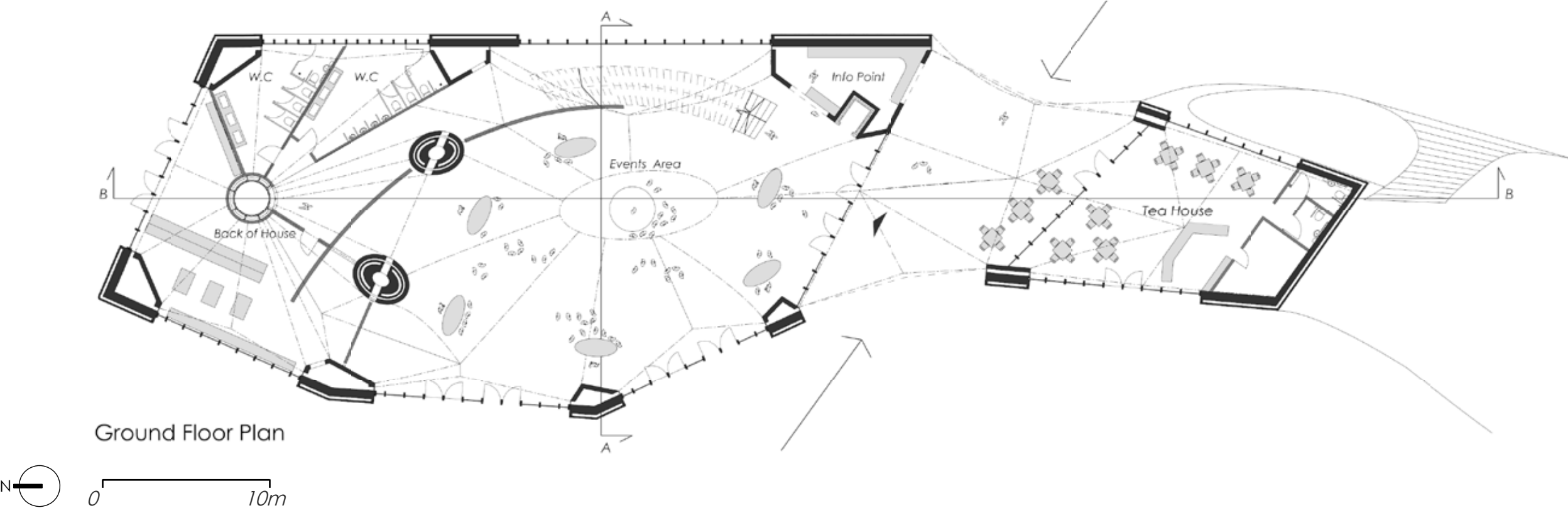
Design Case - Elevations



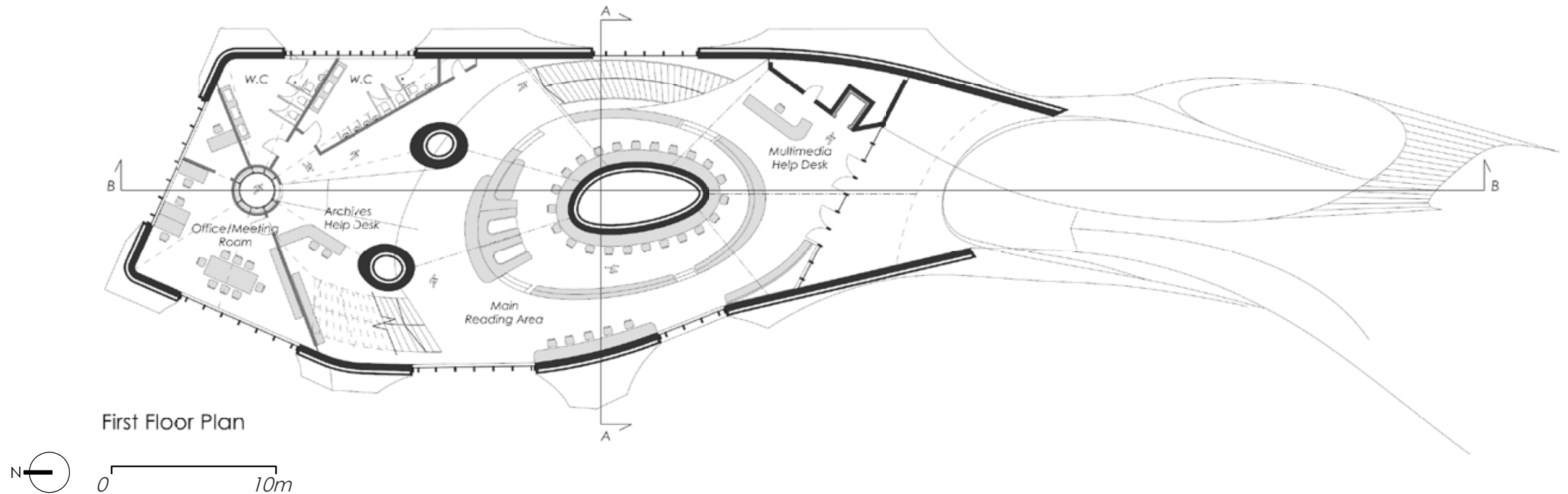
Design Case - Elevations



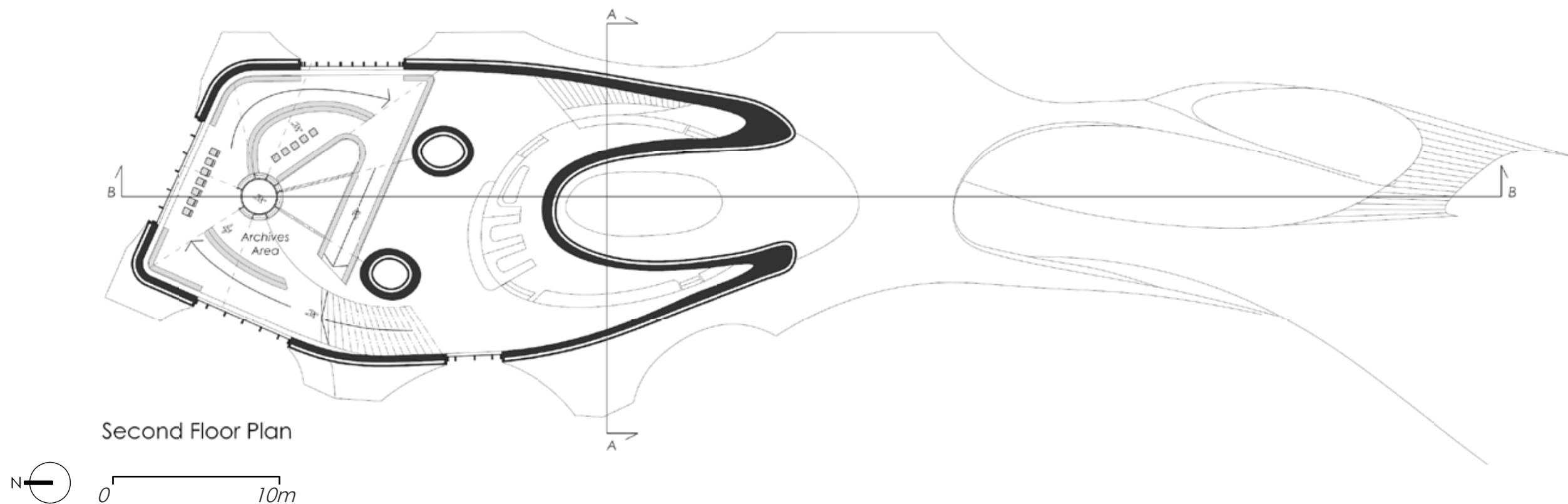
Design Case - Plans



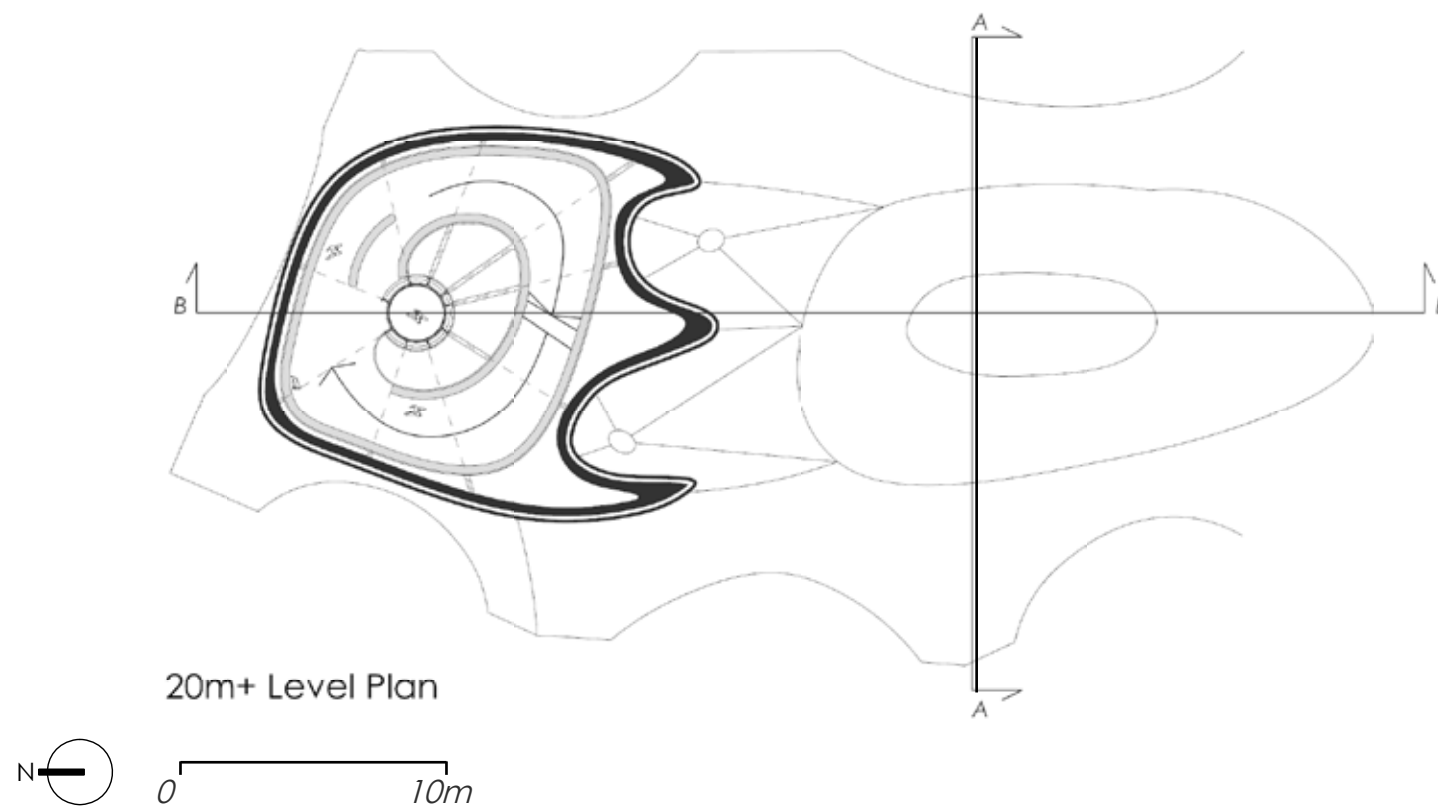
Design Case - Plans



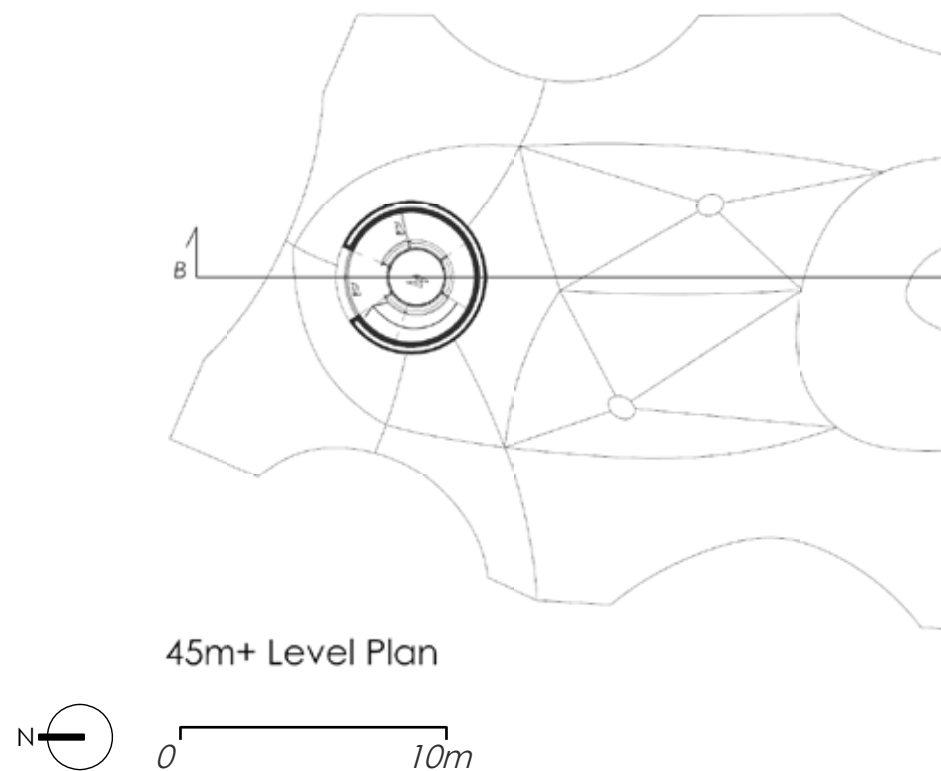
Design Case - Plans



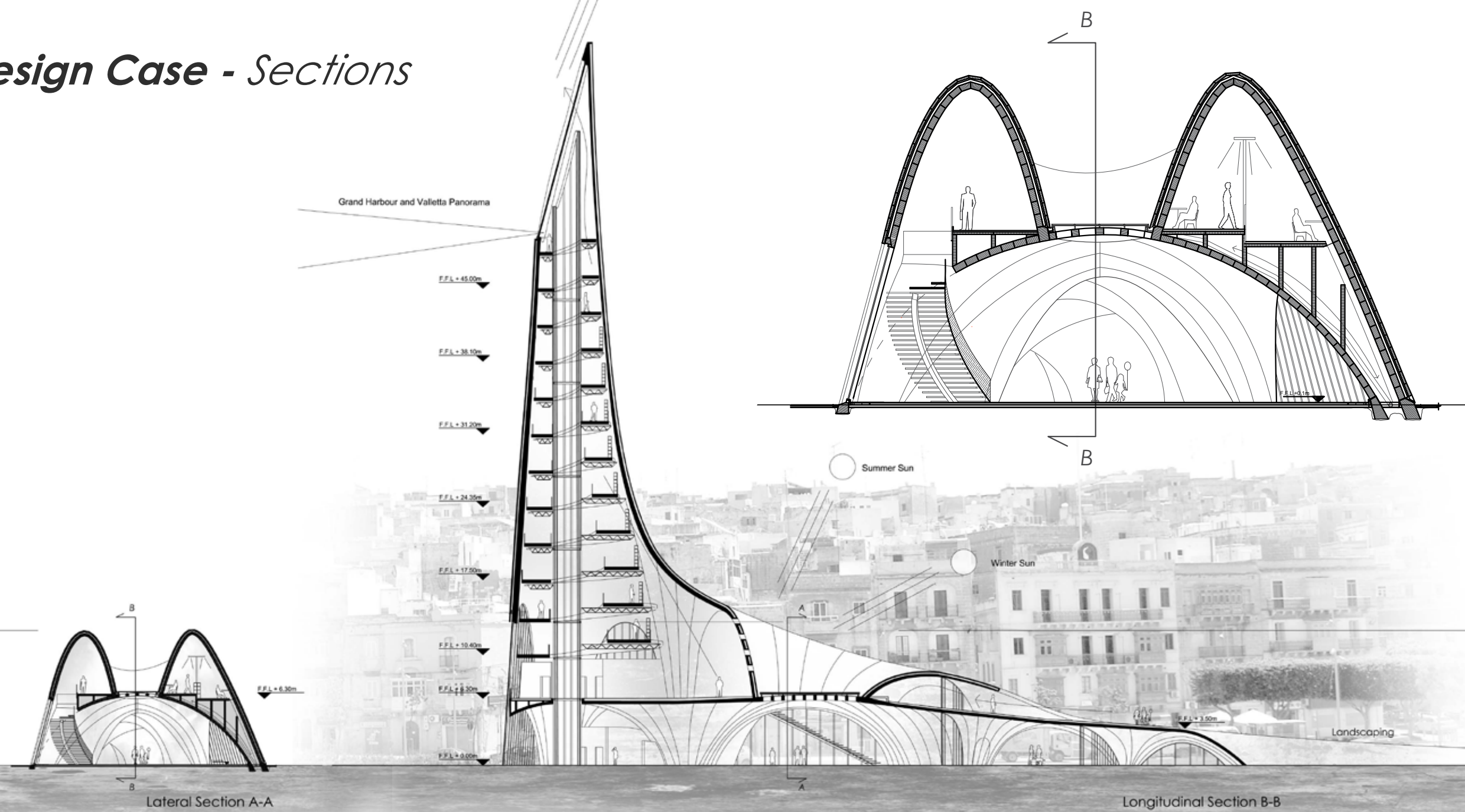
Design Case - Plans



Design Case - Plans

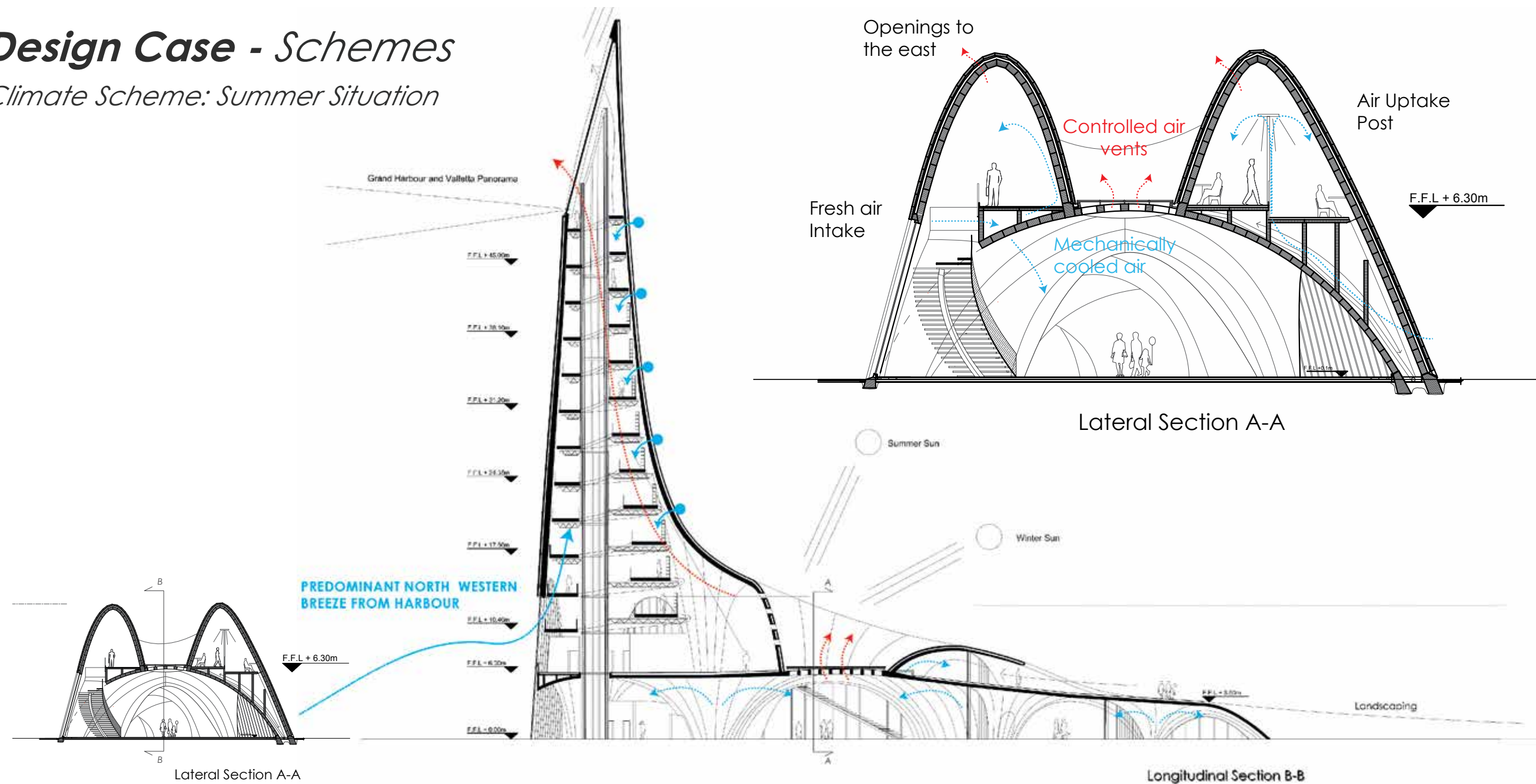


Design Case - Sections



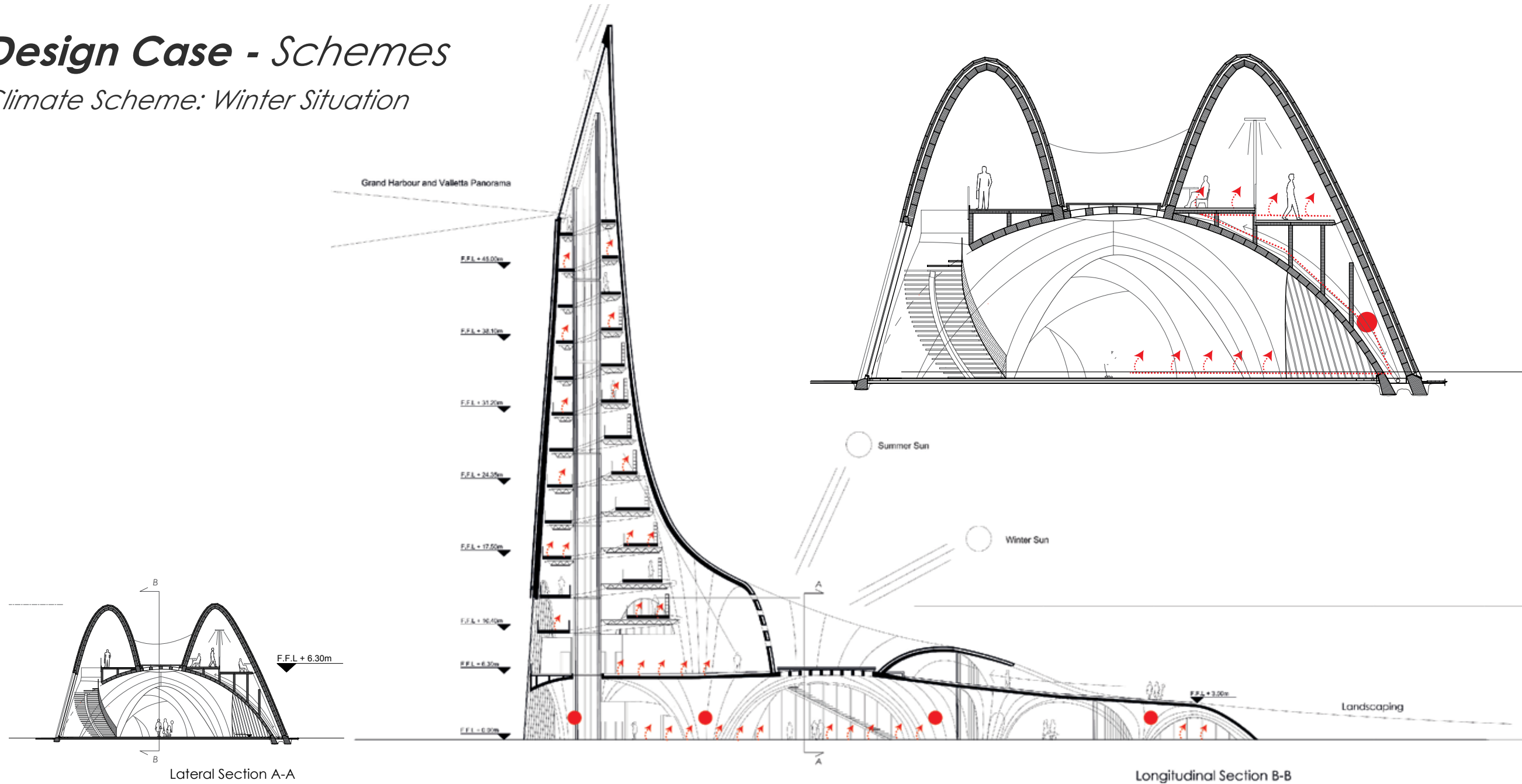
Design Case - Schemes

Climate Scheme: Summer Situation



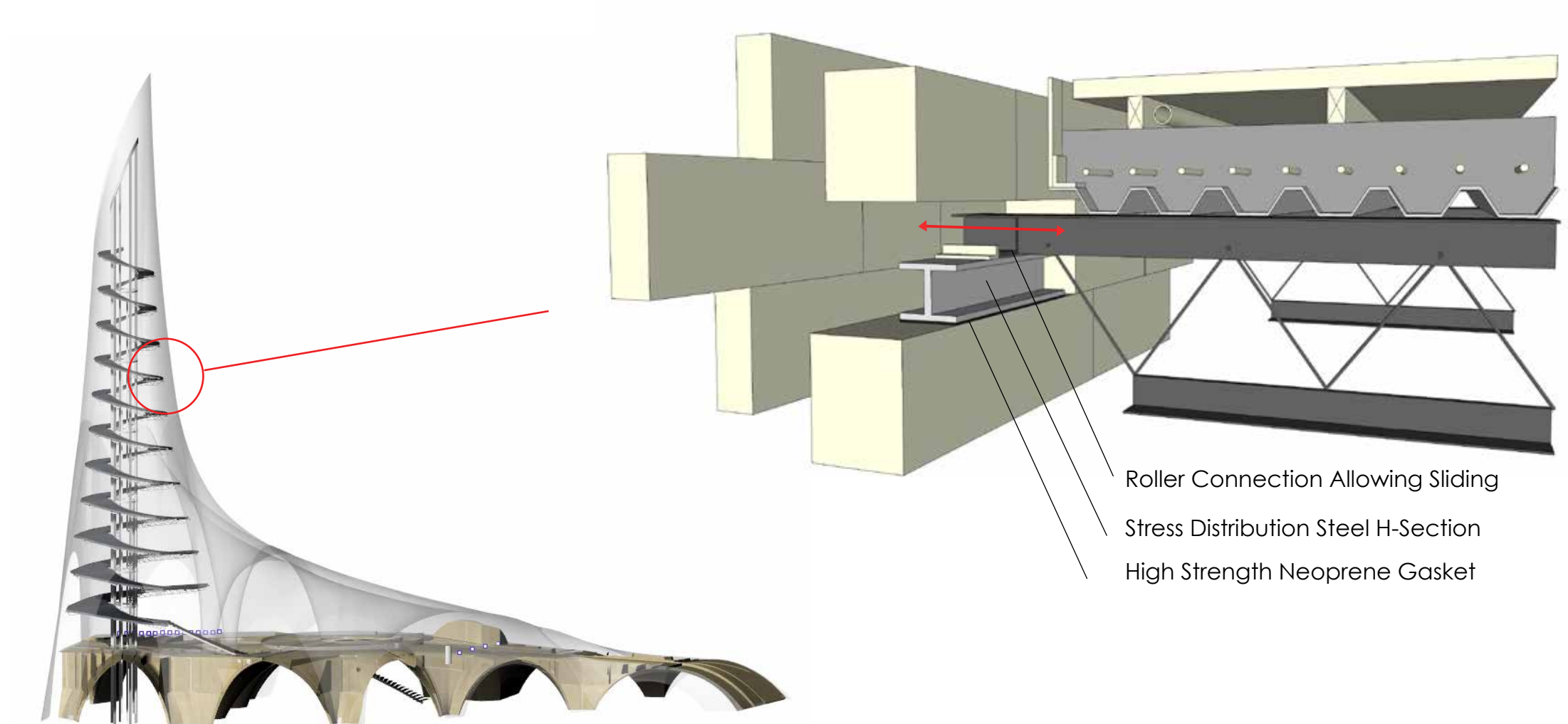
Design Case - Schemes

Climate Scheme: Winter Situation



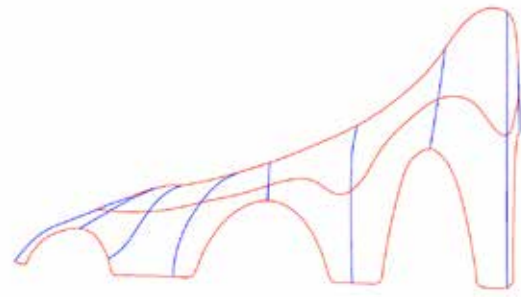
Design Case- Schemes

Stone - Steel Connection

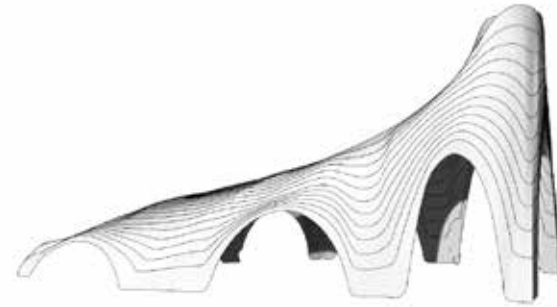


Design Case - Schemes

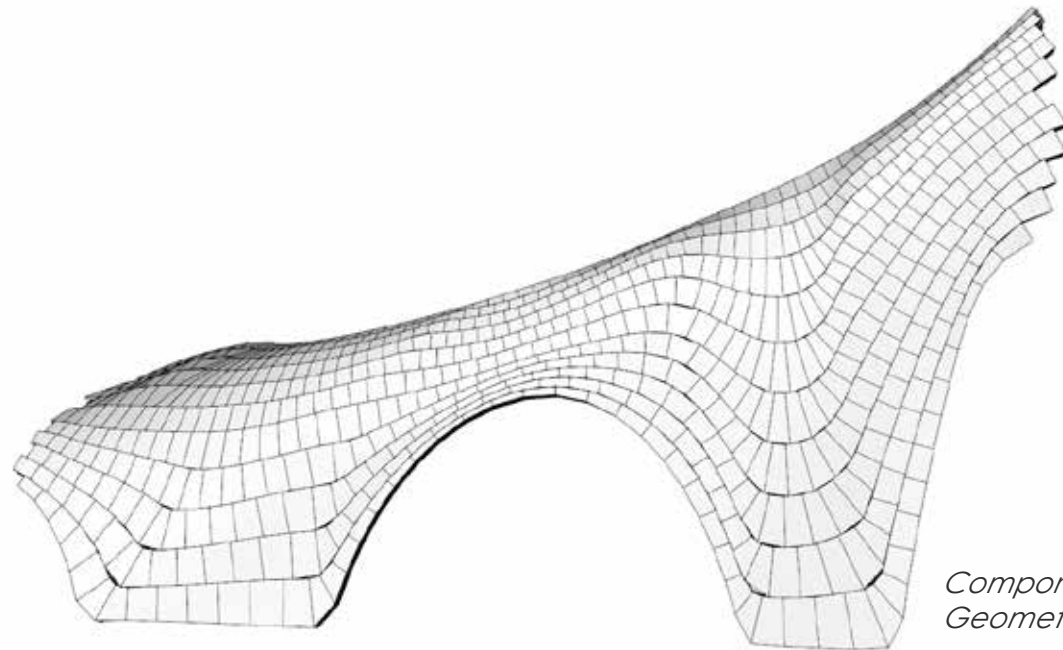
Stone Geometry on Shell - Following Thrust network



Network Lines



Split Surface

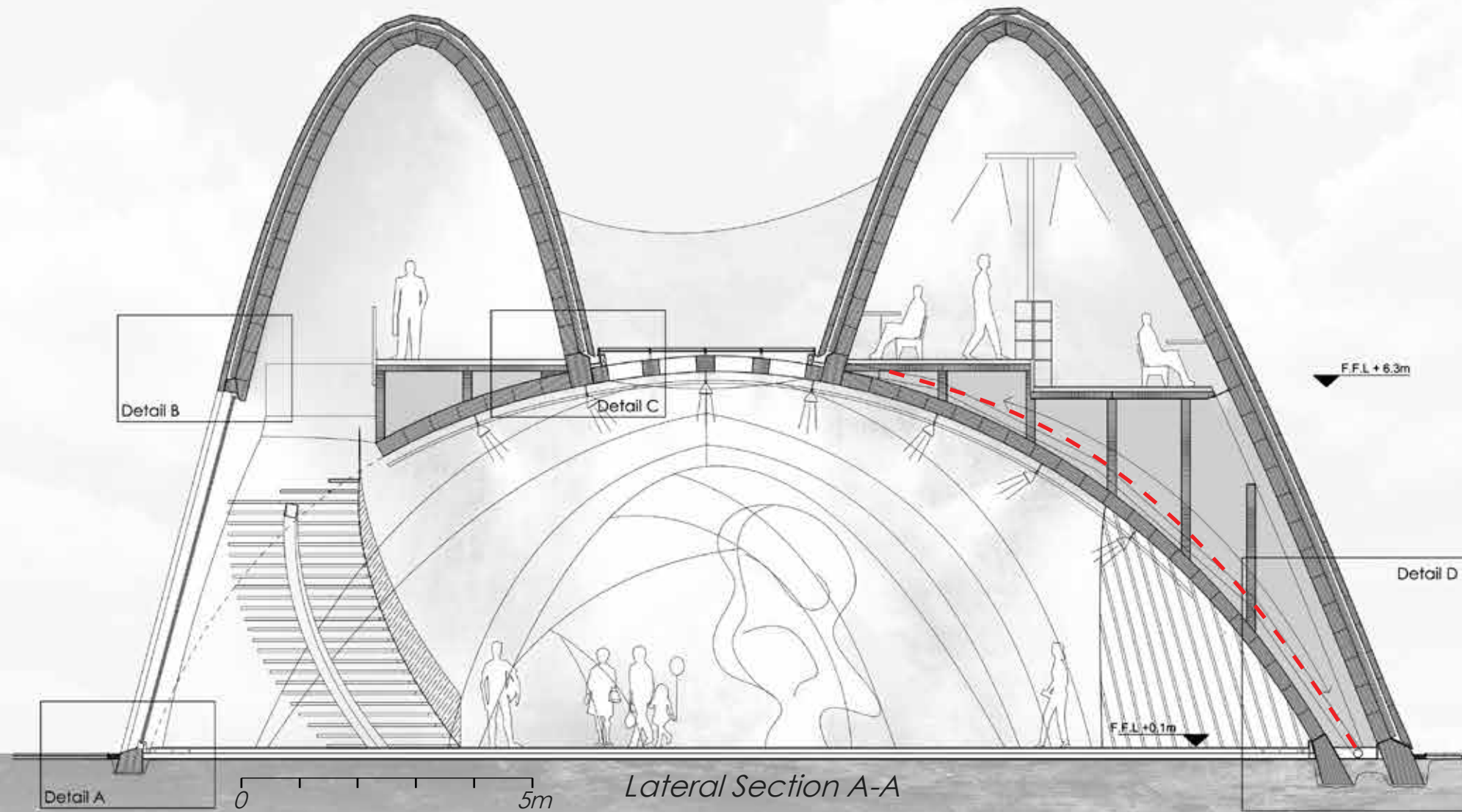


Component Geometry

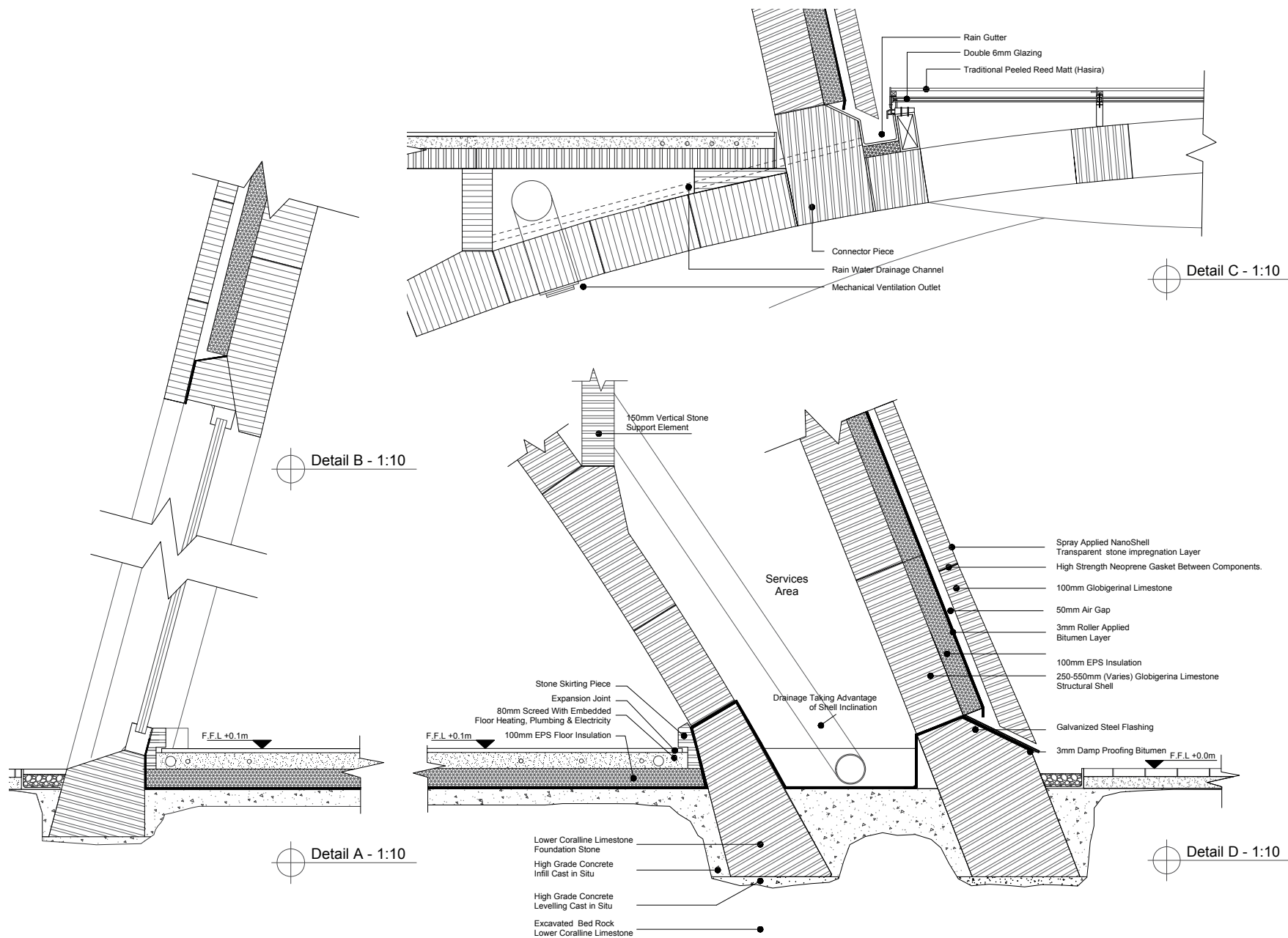


Leuven Pavillion. Technique: Robotically cut EPS modules.

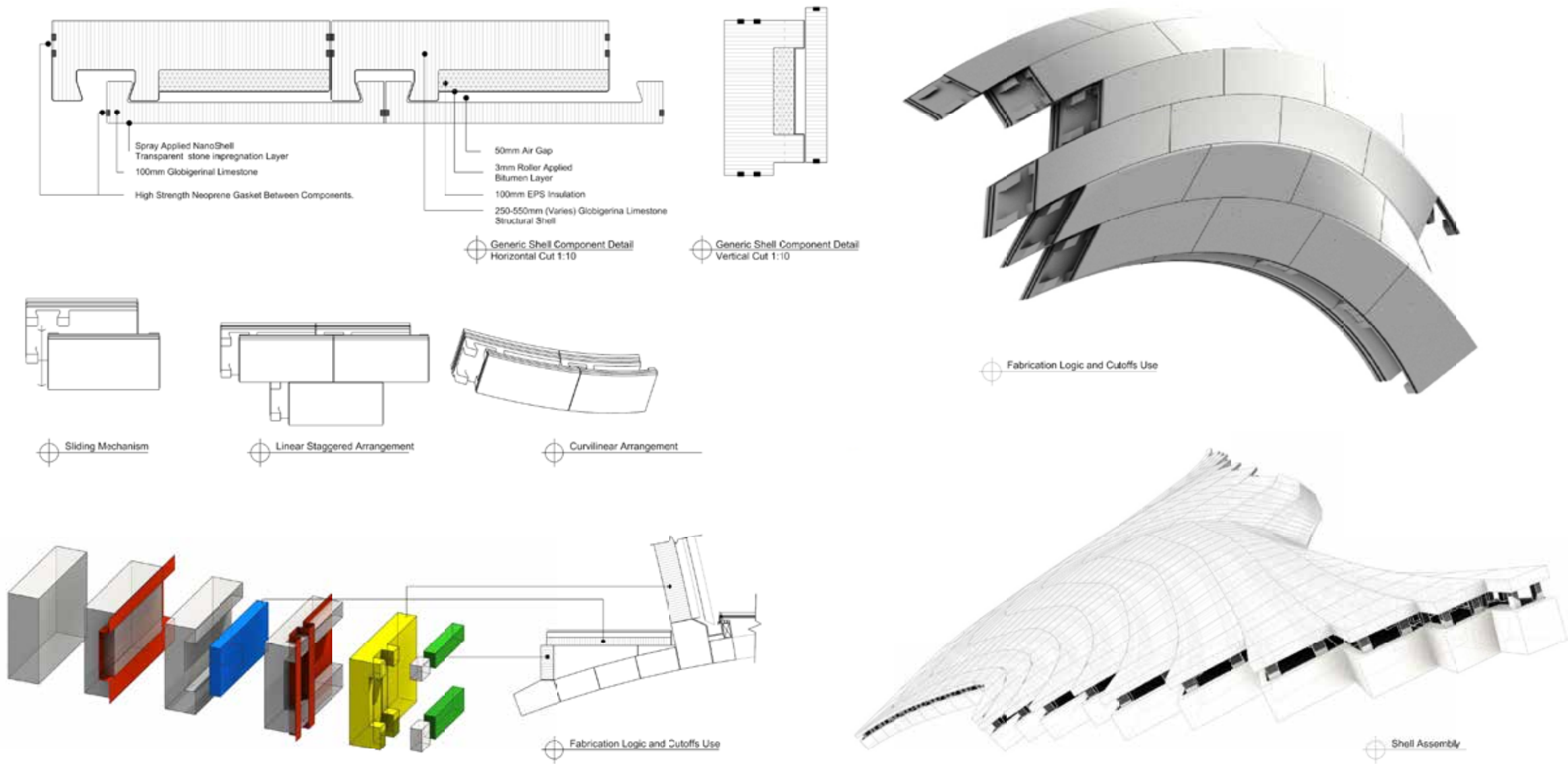
Design Case - Details



Design Case - Details



Design Case - Fabrication



Design Case - Visuals



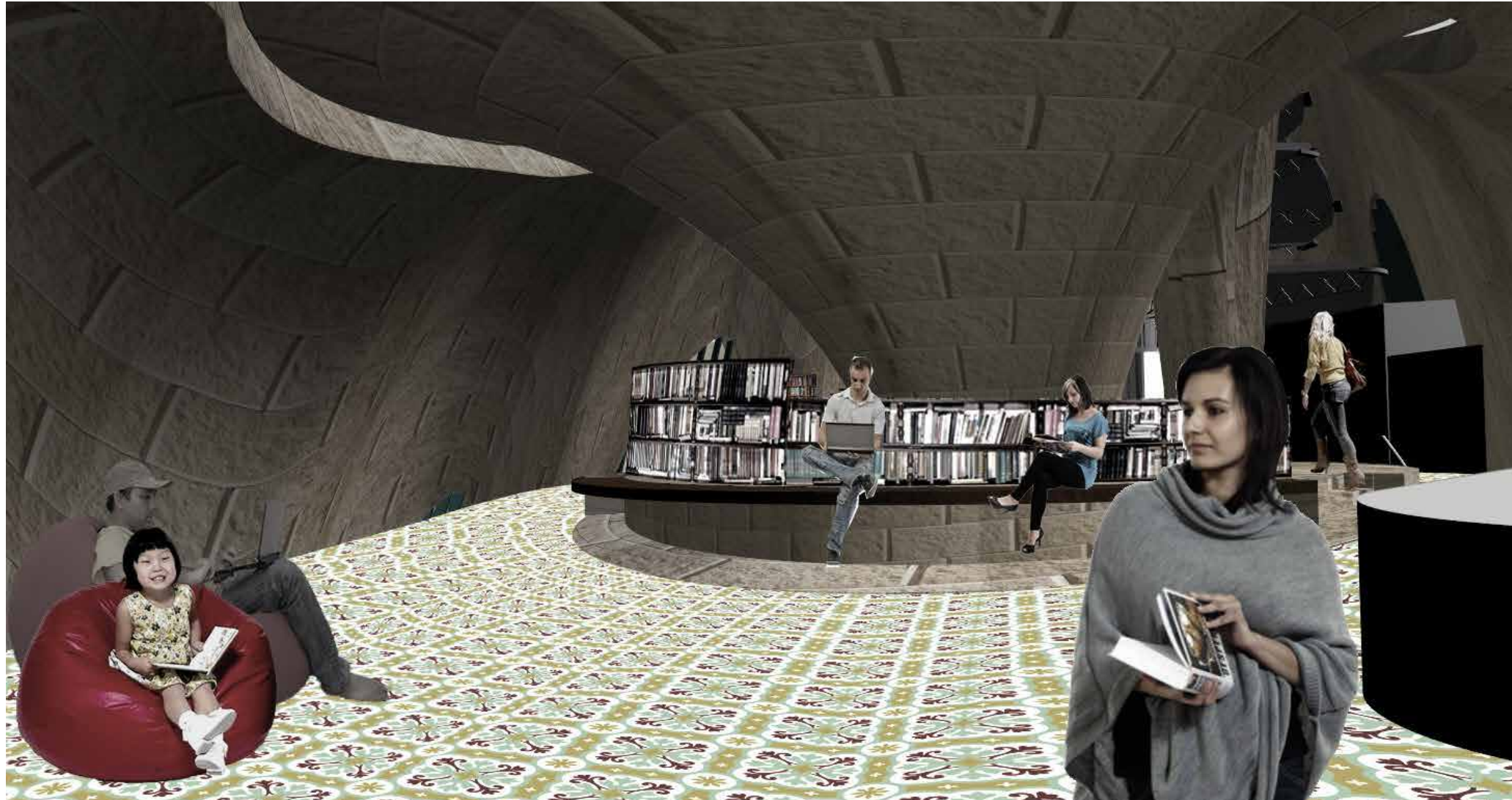
Design Case - Visuals



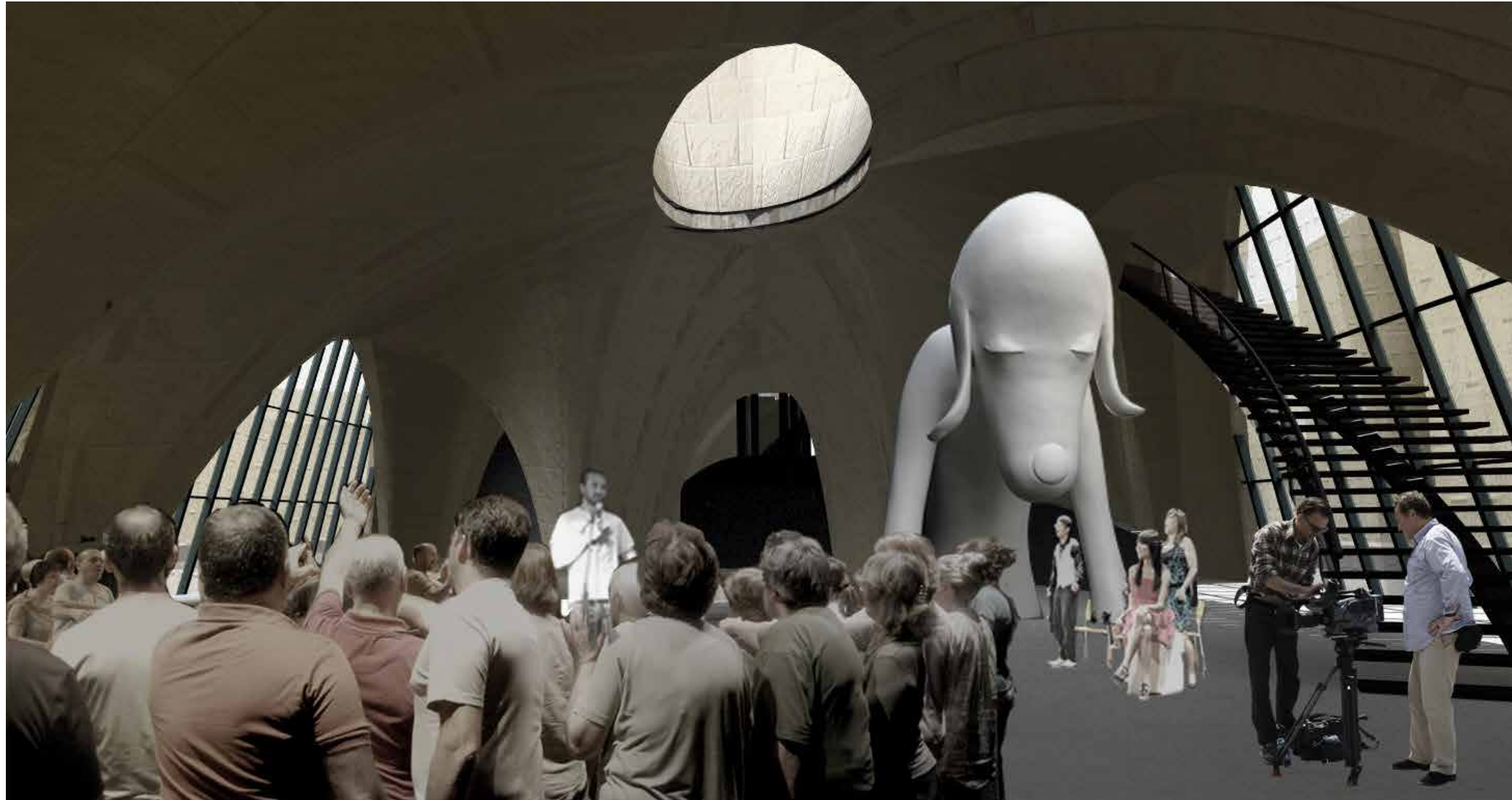
Design Case - Visuals



Design Case - Visuals



Design Case - Visuals



Design Case - Visuals



Design Case - Visuals



Design Case - Visuals



Thanks for your attention