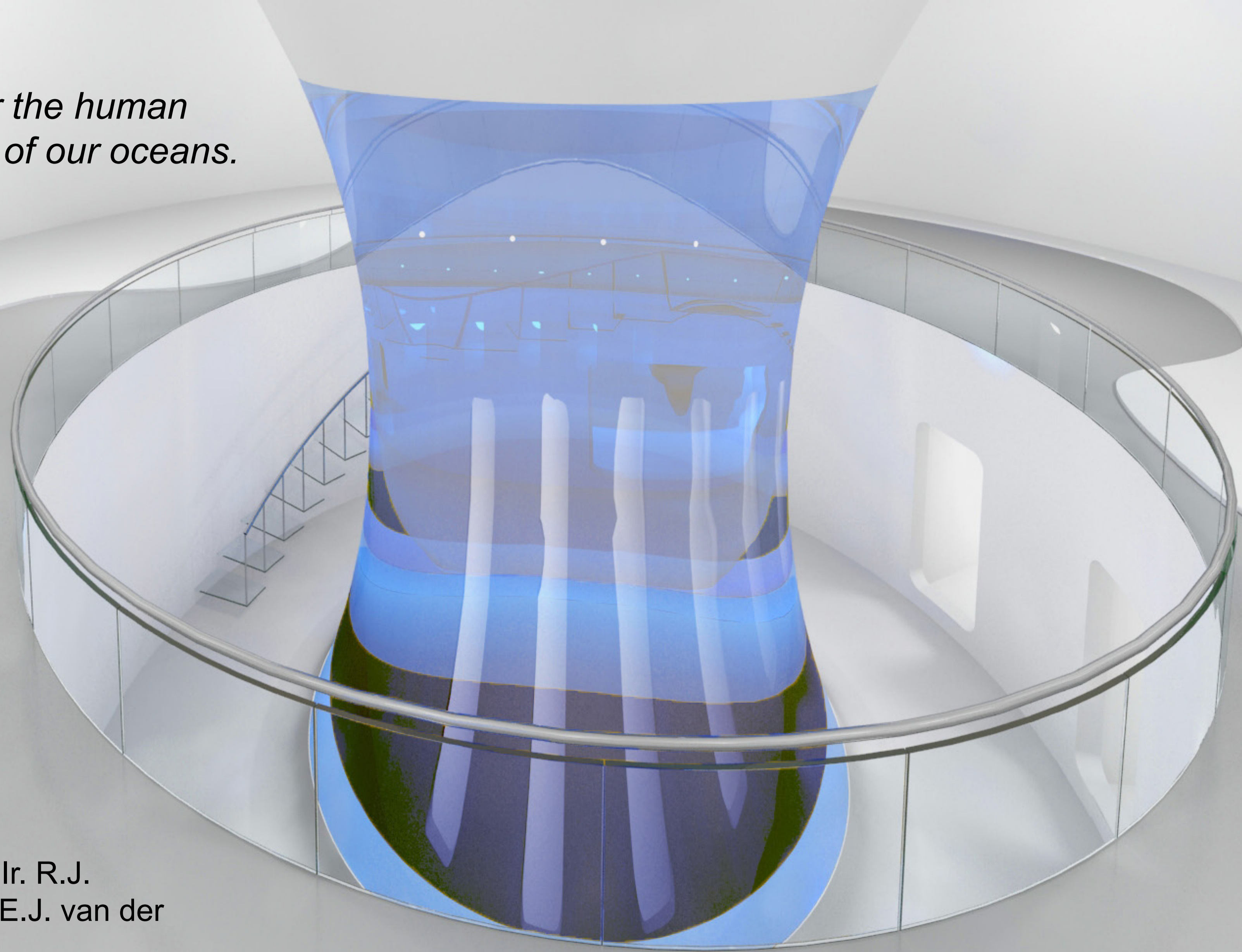


# UNDER THE SEA

*An underwater habitat for the human exploration and research of our oceans.*



Name: Julian Geelhoed

Student nr: 4012909

Date: 08 / 12 / 2015

Tutors: Architecture: Schroen, Ir. R.J.

Building Technology: Zaag, Ir. E.J. van der

Research: Schroen, Ir. R.J.

# Welcome

## Introduction

- Welcome
- Fascination
- Objective
- Problem Statement
- Relevance

## Research

- Research Question
- Methodologies
- Conclusions

## Design

- Design Question
- Location
- Program
- Starting Points
- Concept

## Architecture

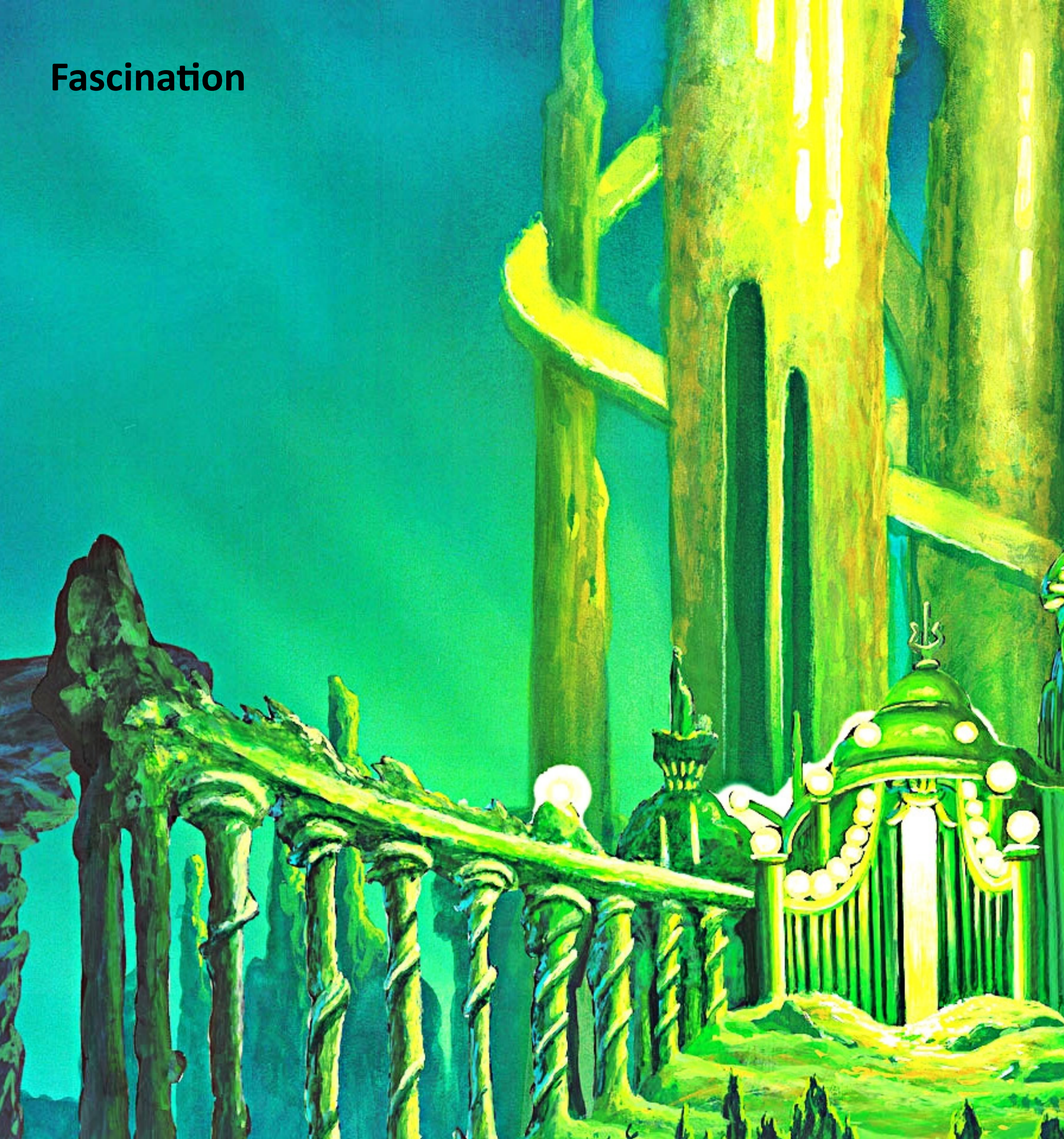
- Floor plans
- Sections
- Renders

## Technology

- Materials
- Production
- Assembly
- Details

## Questions

# Fascination



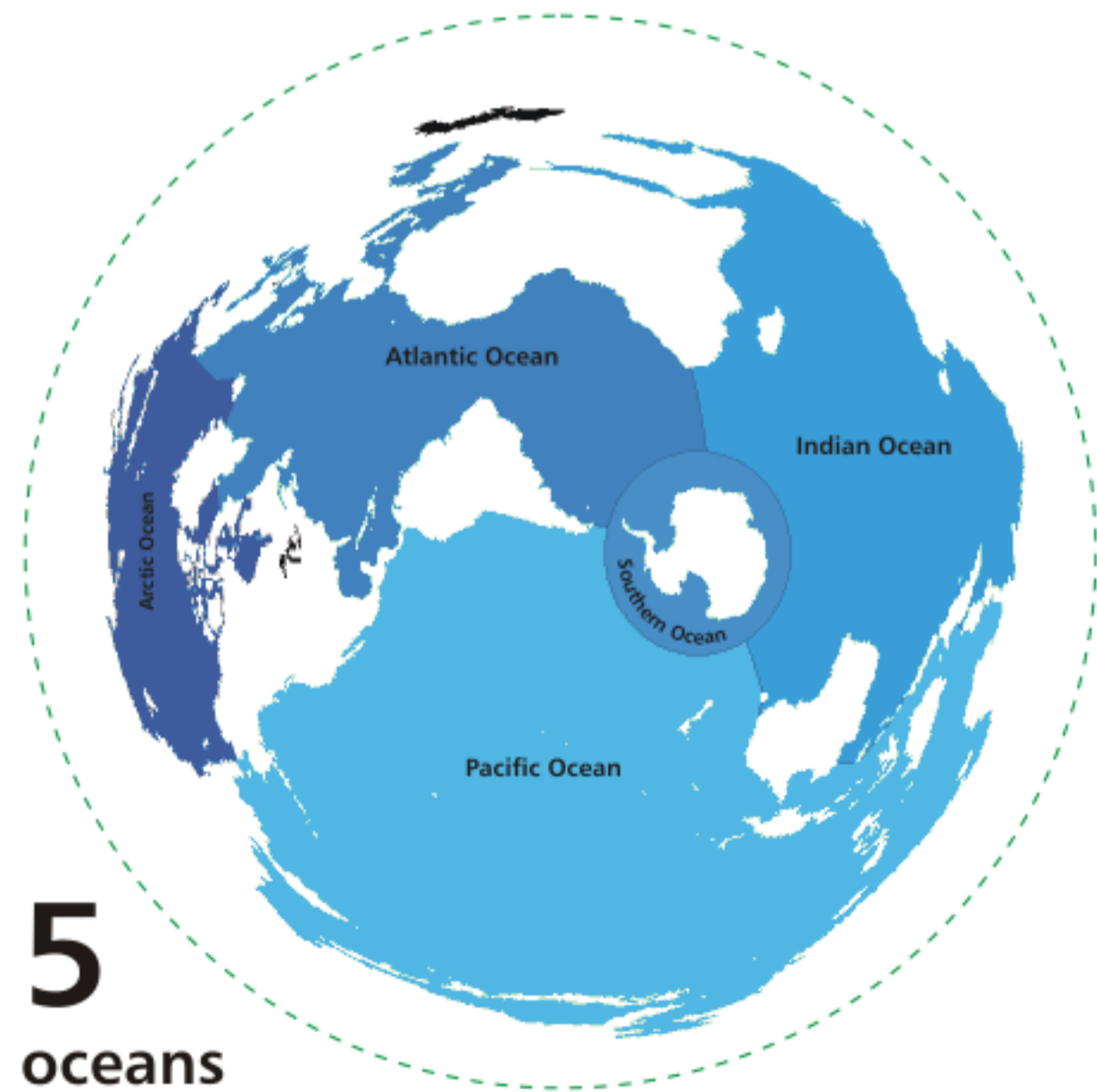
## Objective

To design an **underwater habitat** which can facilitate **saturation diving**, for research of marine life in the **Great Barrier Reef**.

## Problem Statement

The oceans cover **70%** of our planet's surface.

Yet only **5%** of this underwater world has been explored.



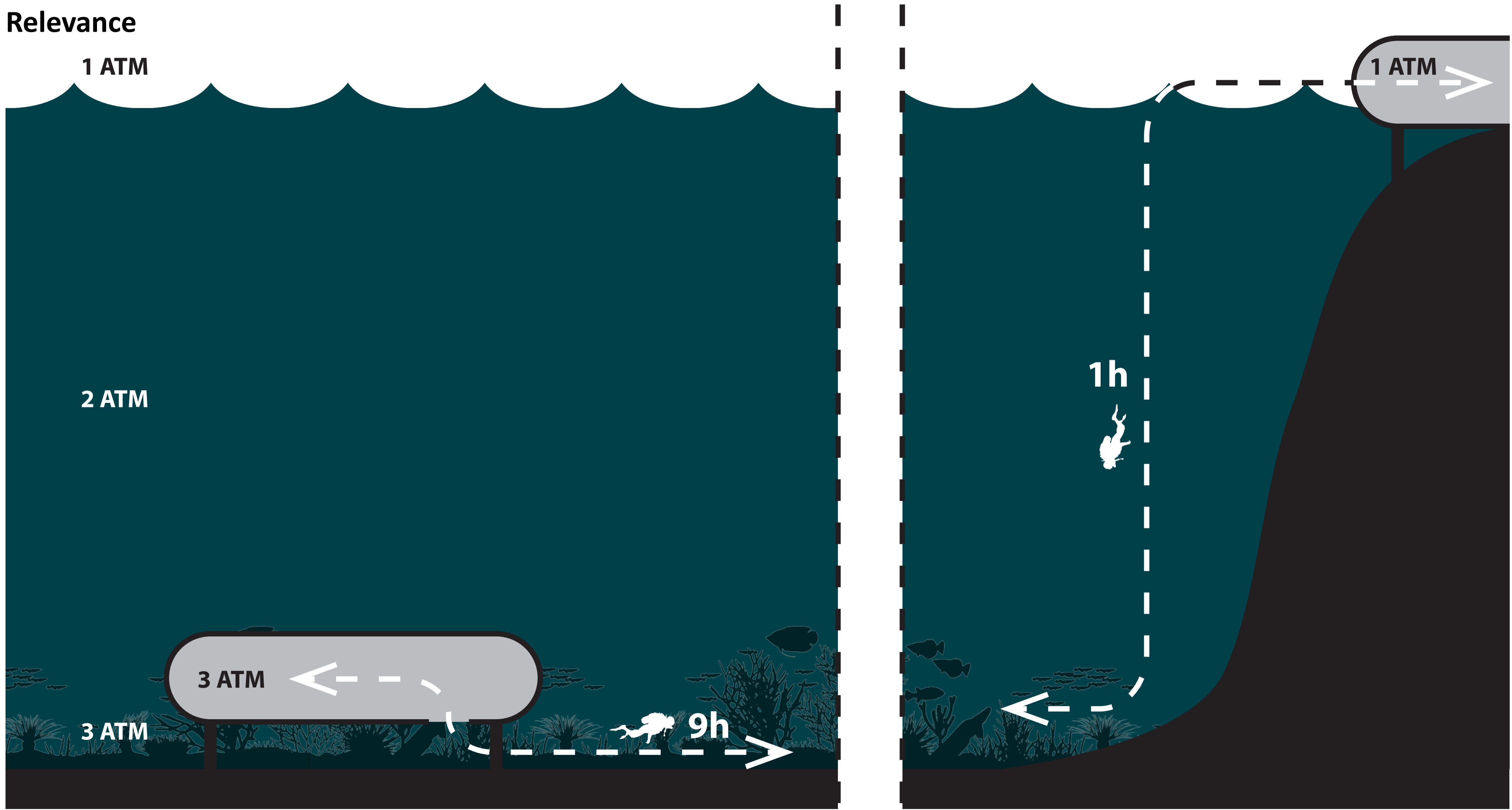


**THE UNIVERSITY  
OF QUEENSLAND**  
AUSTRALIA



**Australian Government**  
**Great Barrier Reef  
Marine Park Authority**

Relevance



1 ATM

2 ATM

3 ATM

3 ATM

9h

1h

1 ATM

Introduction

Research

Design

Architecture

Technology

Questions

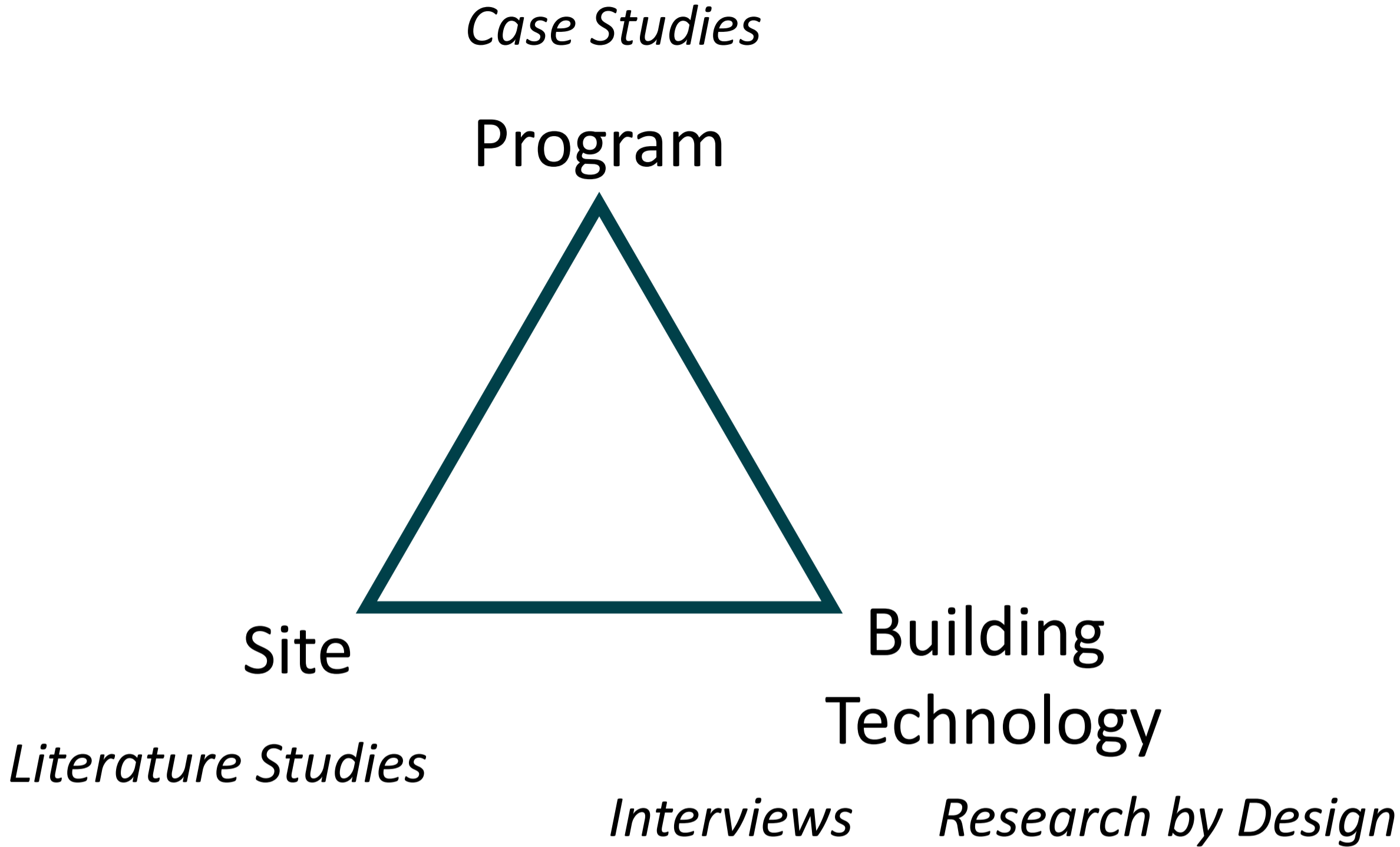
*What **factors** determine the **shape** of an  
**underwater structure**?*



***Technology, Economics, Material,  
Knowledge, Context, etc.***



# Methodologies



<http://i.ytimg.com/vi/UxB11eAl-YE/maxresdefault.jpg>

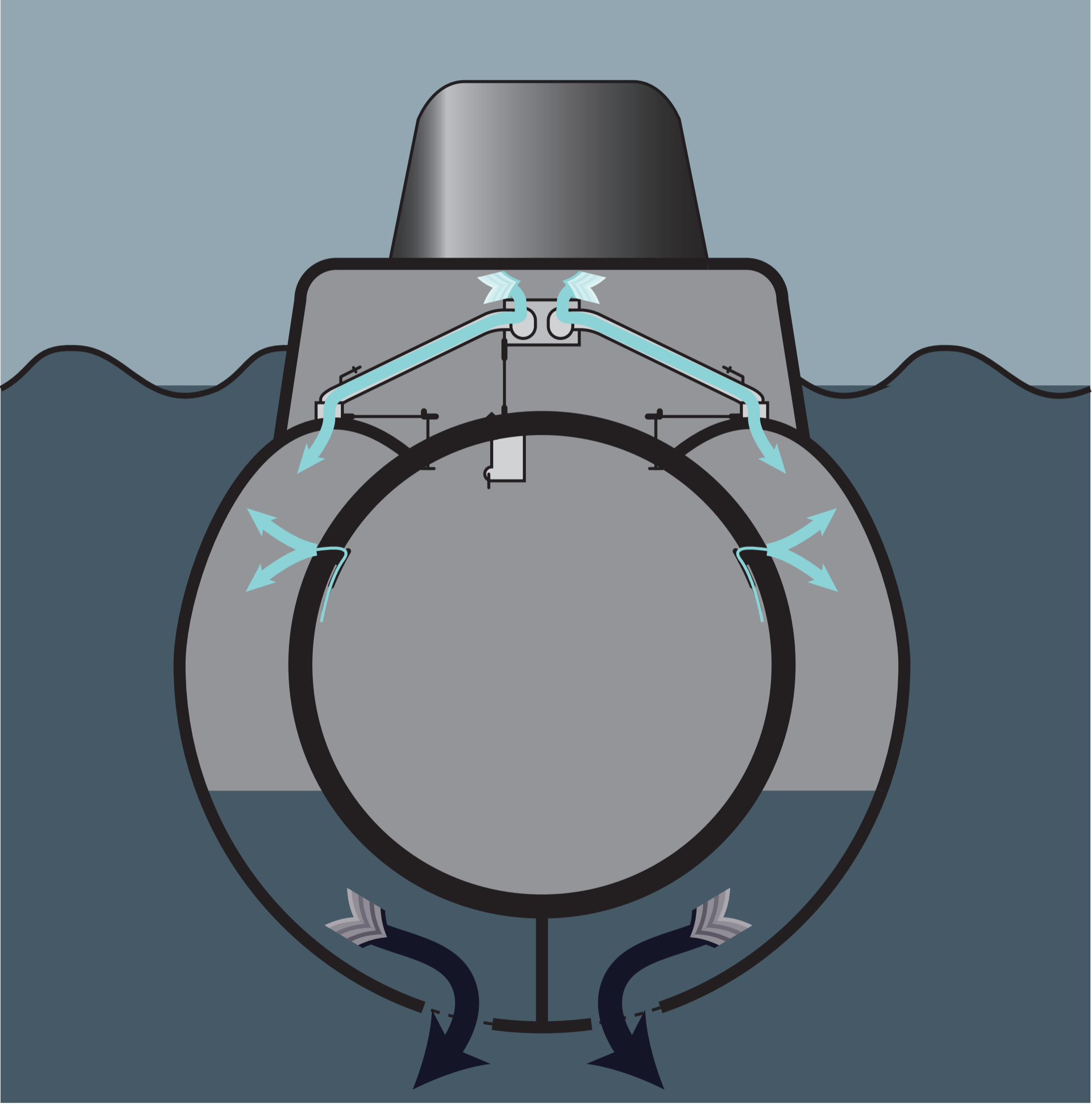
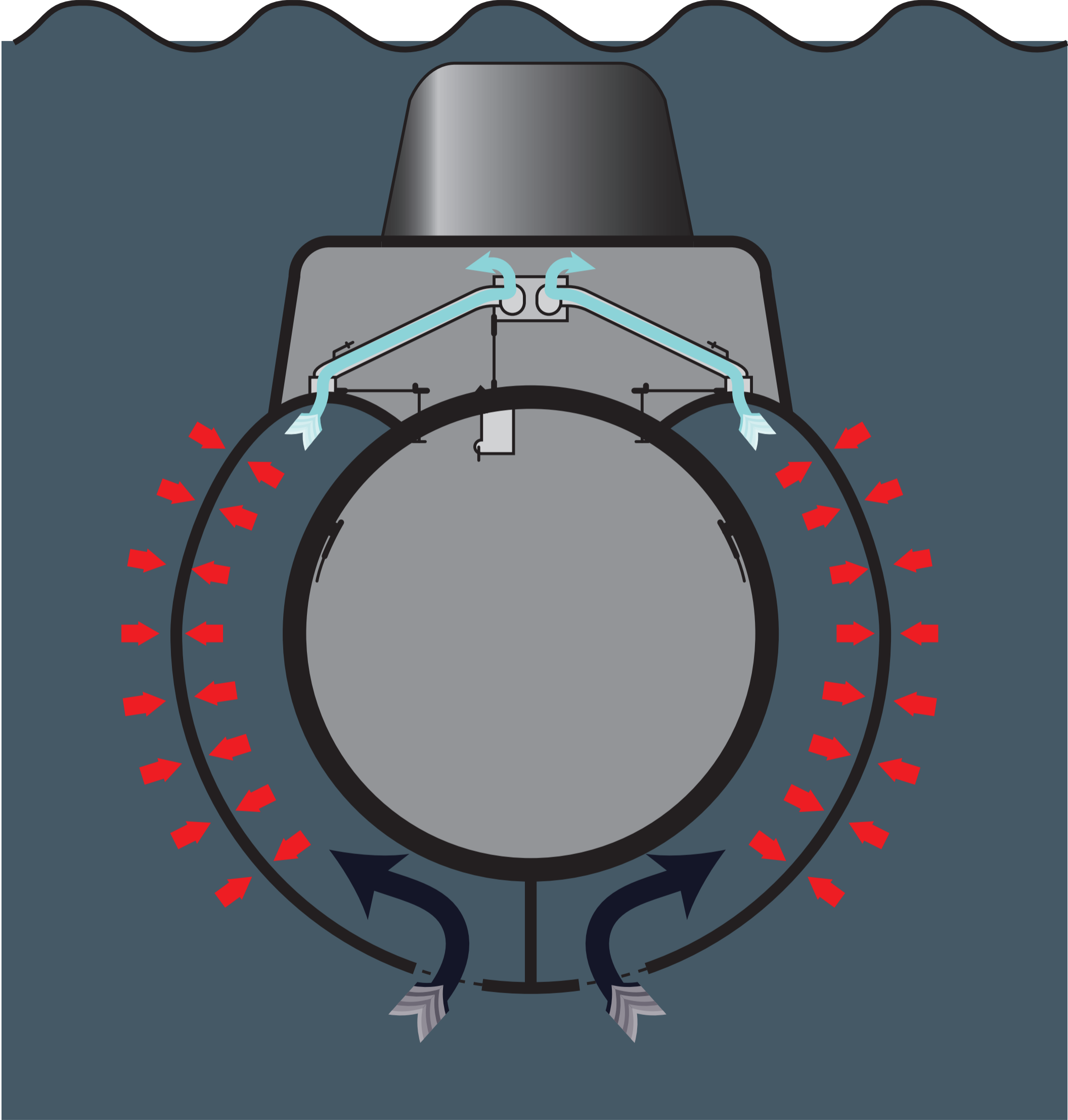


<http://tinyurl.com/npsvrlb>



<http://www.reynoldspolymer.com/images/galleries/003/153837.jpg>

Conclusions

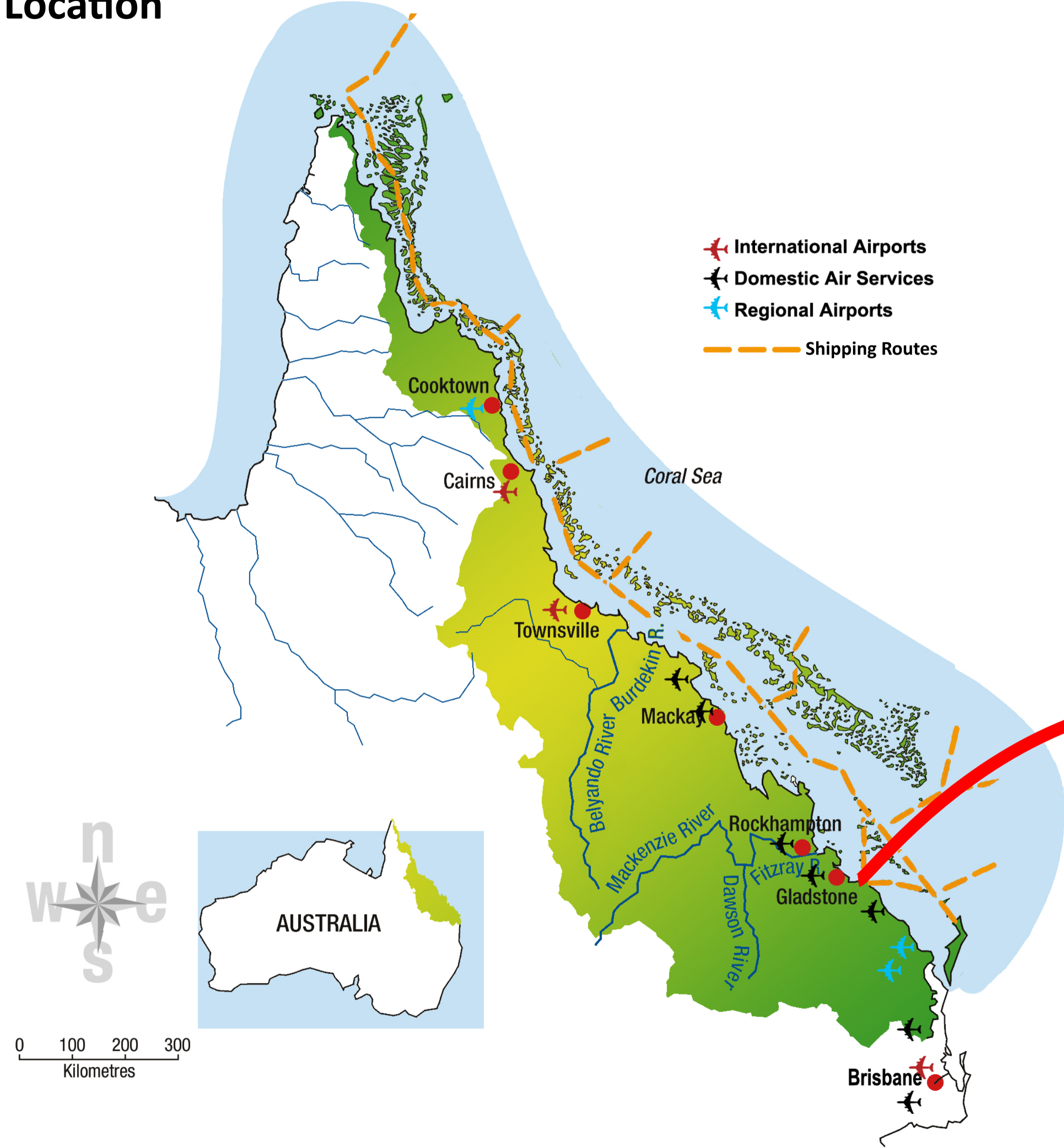


How to design an **underwater habitat** which can facilitate **saturation diving**, for research of marine life in the **Great Barrier Reef**?

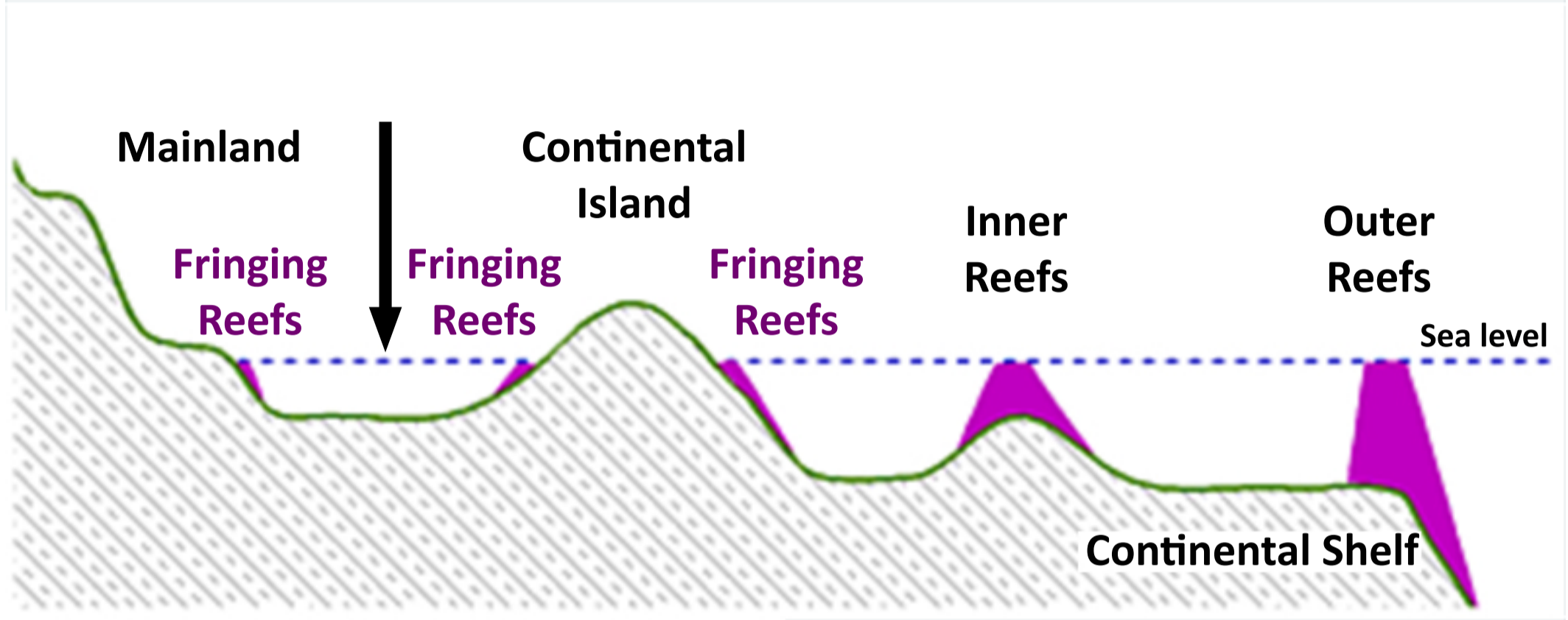
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Using **Glass Fibre Reinforced Polymer composites (GFRP)**.

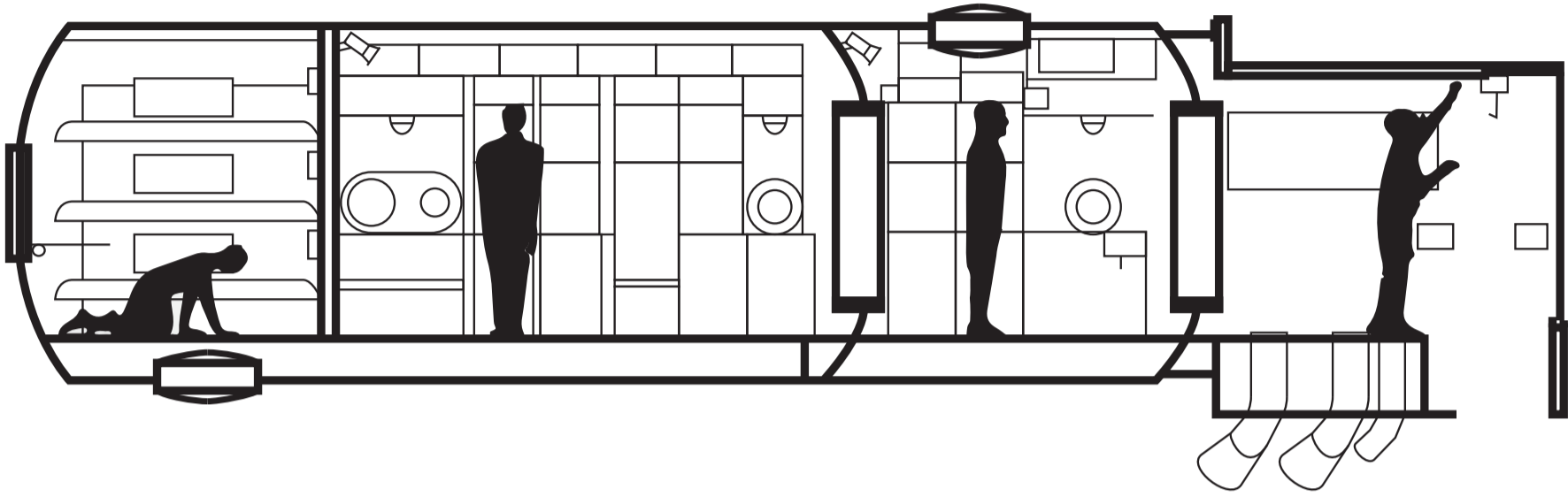
# Location



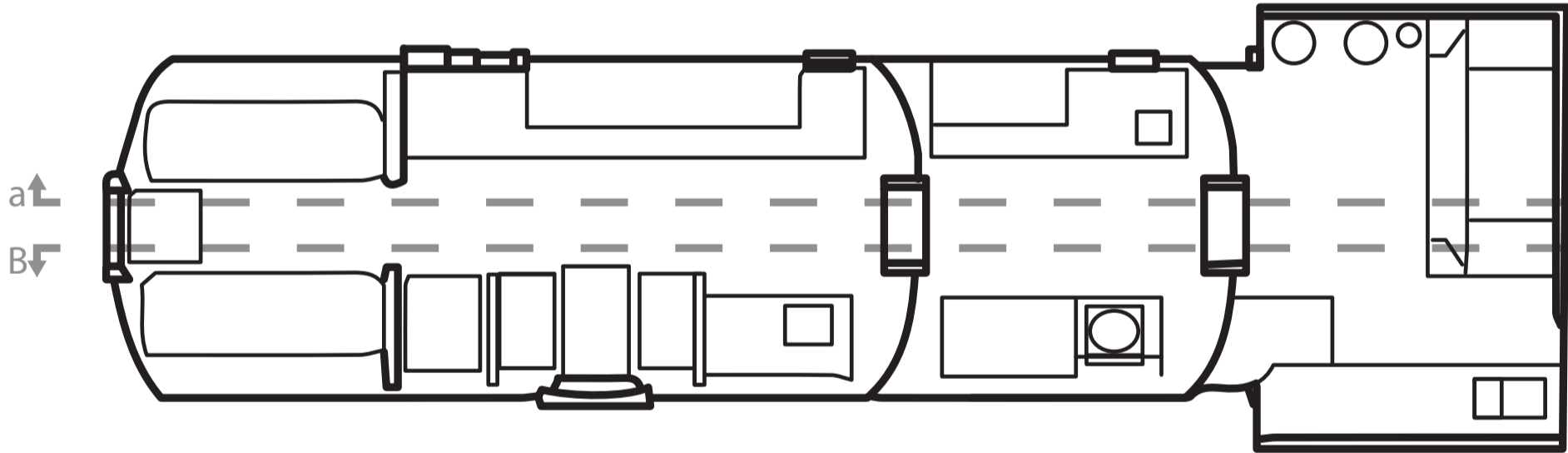
# The University of Queensland, Heron Island Research Station



# Program



Section aA



Floorplan



Section bB



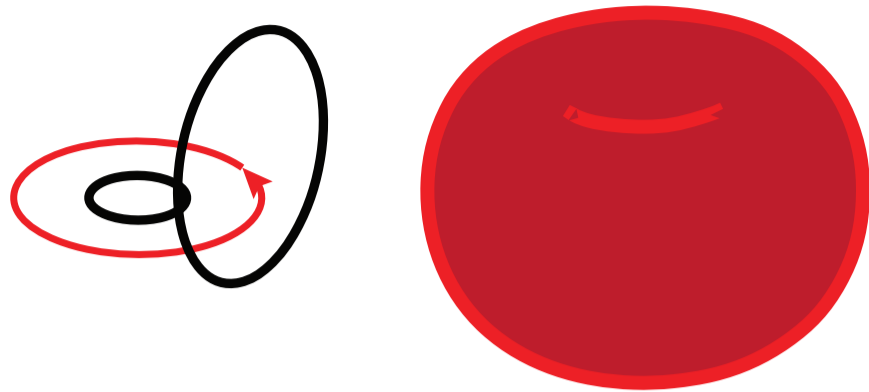
## Starting Points

**Location** - World Heritage Site, minimize impact, limited sunlight.

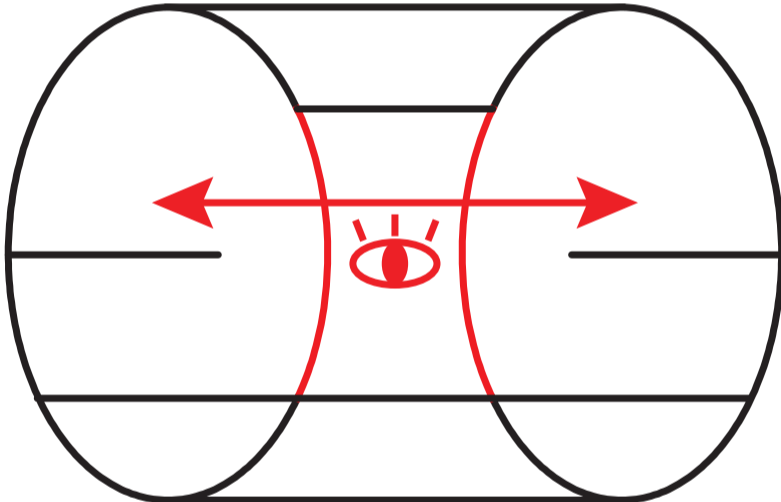
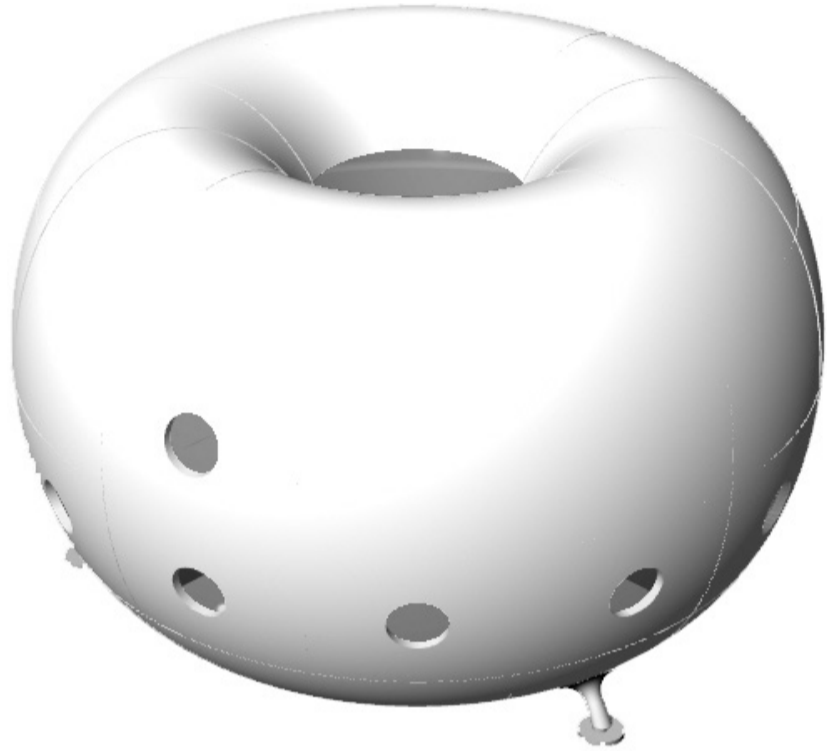
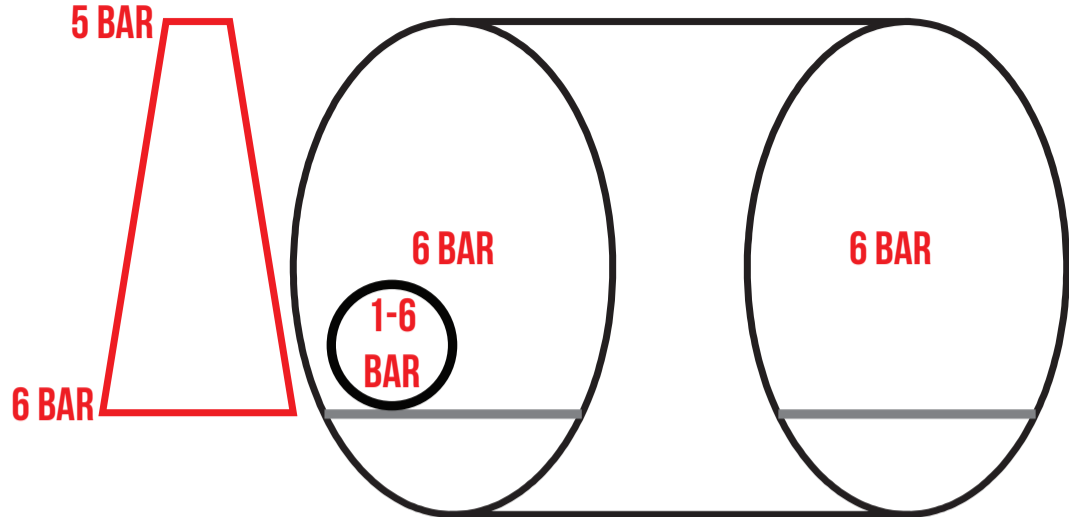
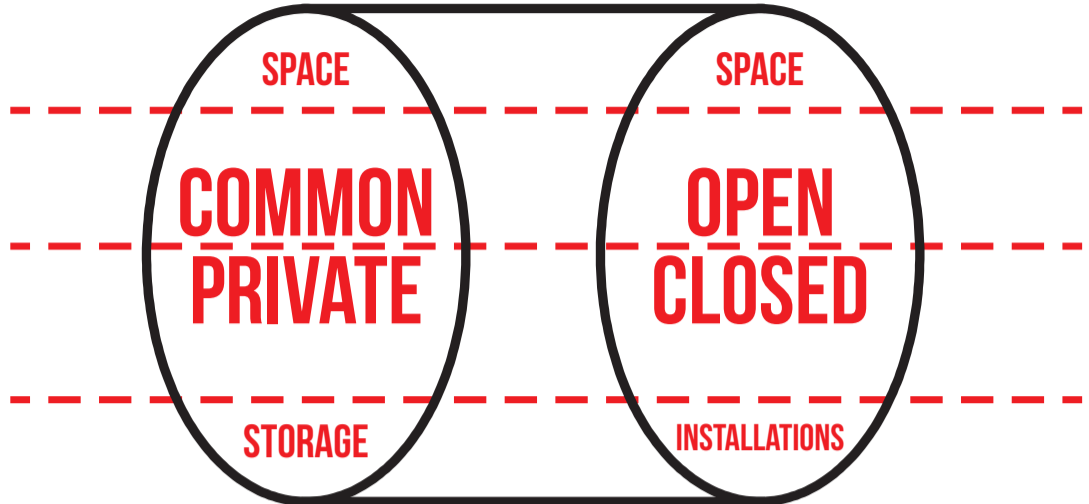
**Program** - Spacious, privacy.

**Building Material** - Glass Fibre Reinforced Polymer Sandwich Composites.

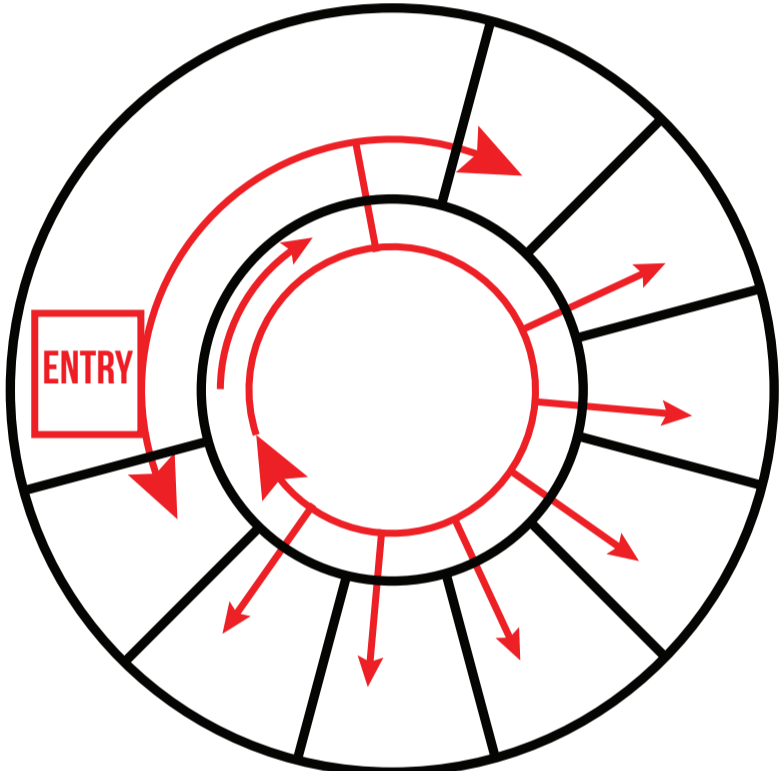
**Concept**



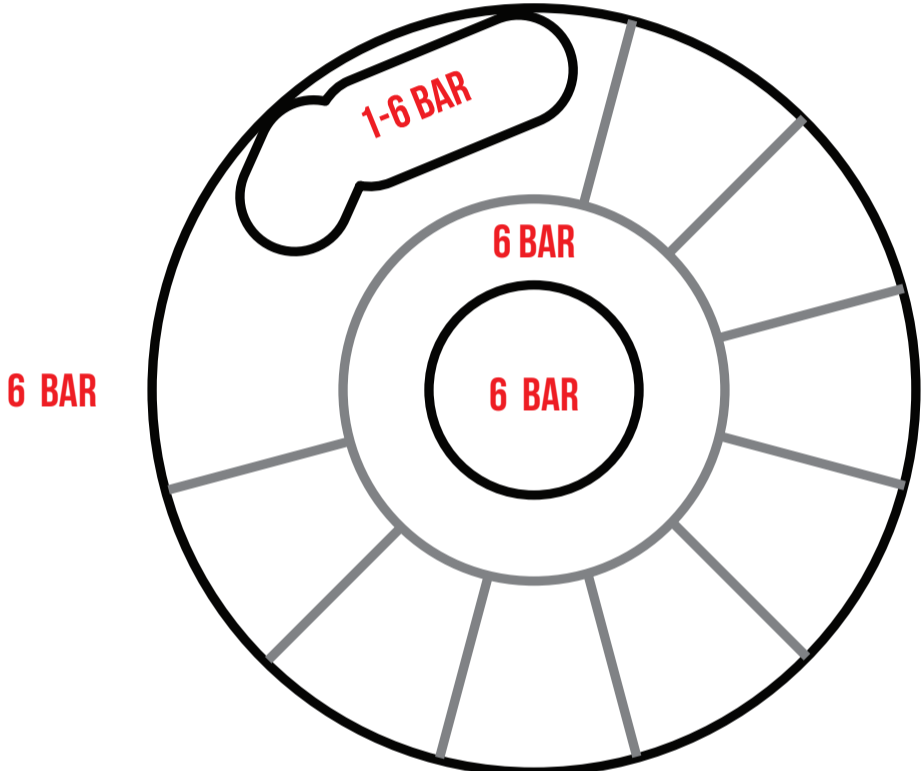
**REVOLUTION**



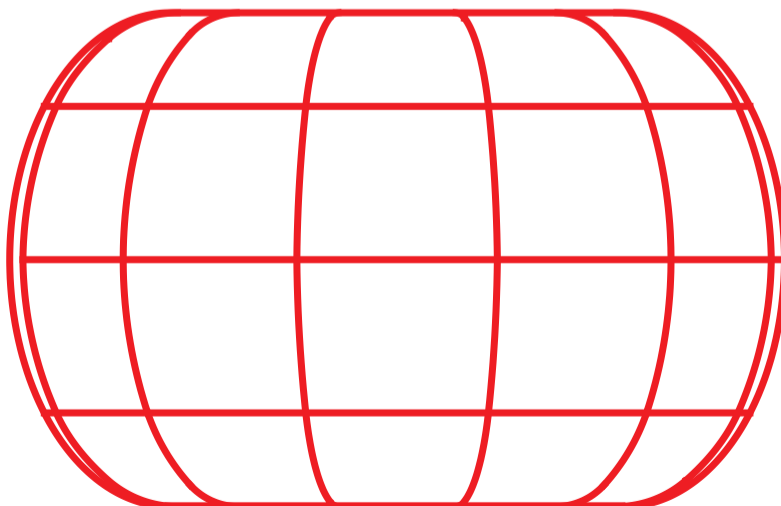
**TRANSPARENT CORE**



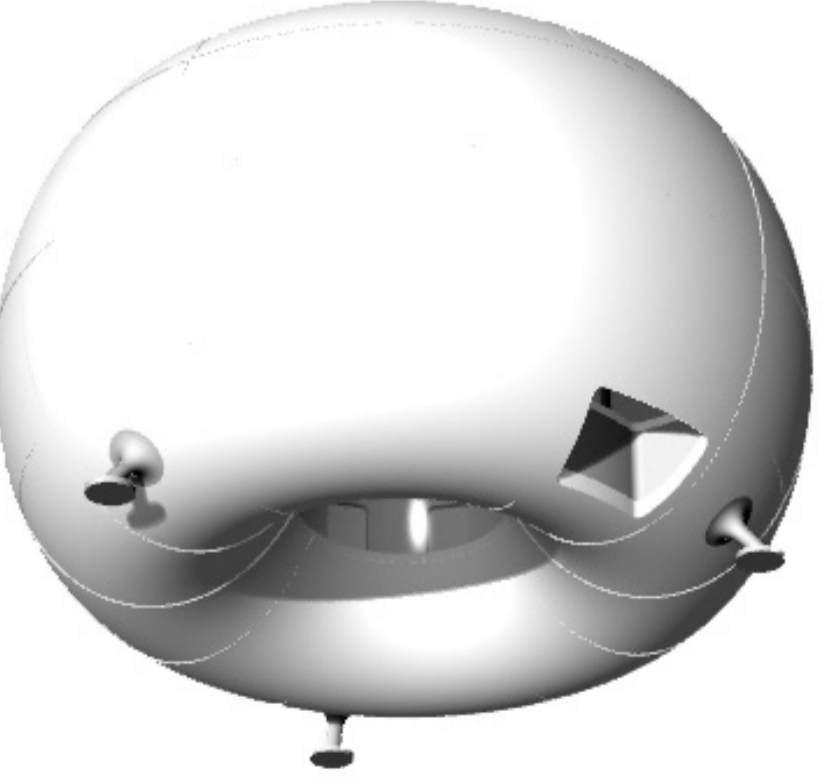
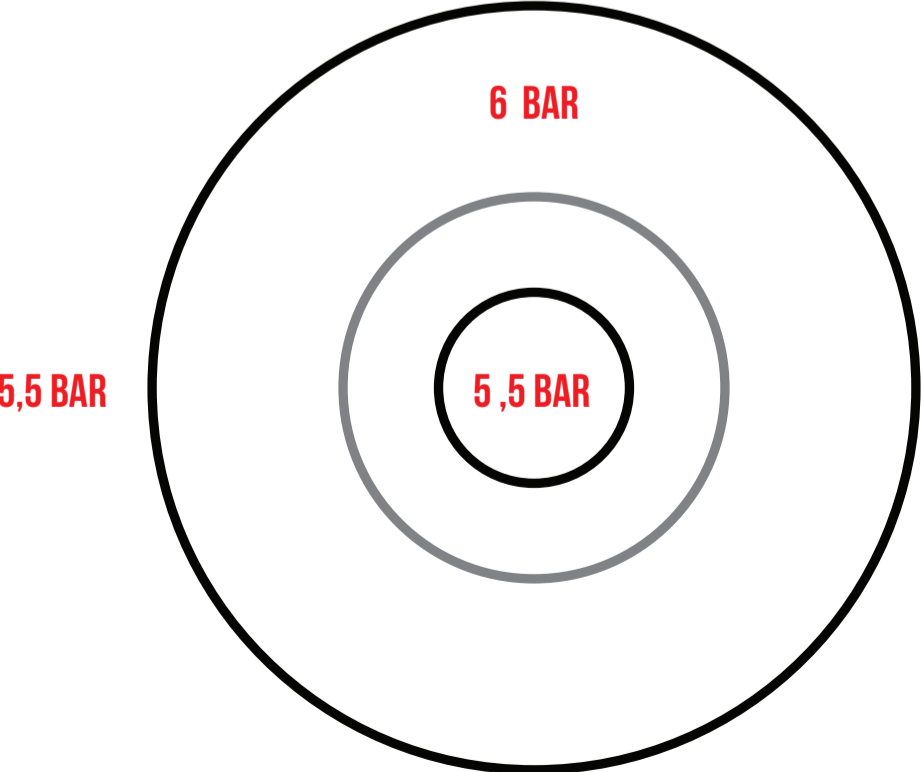
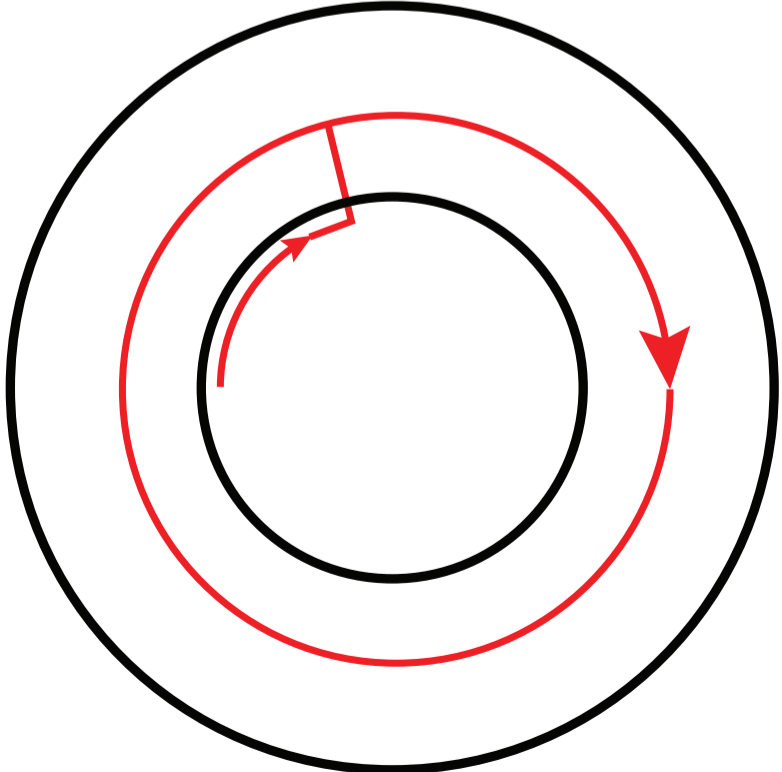
**ROUTING**



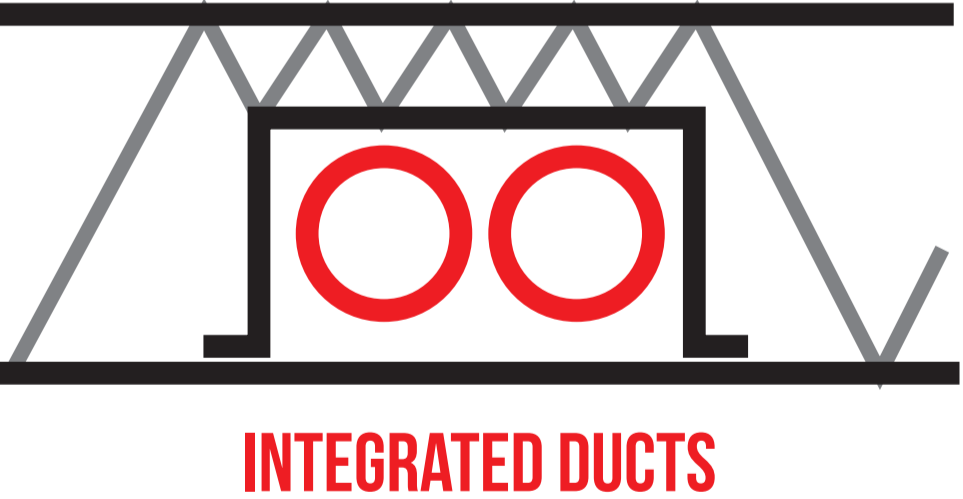
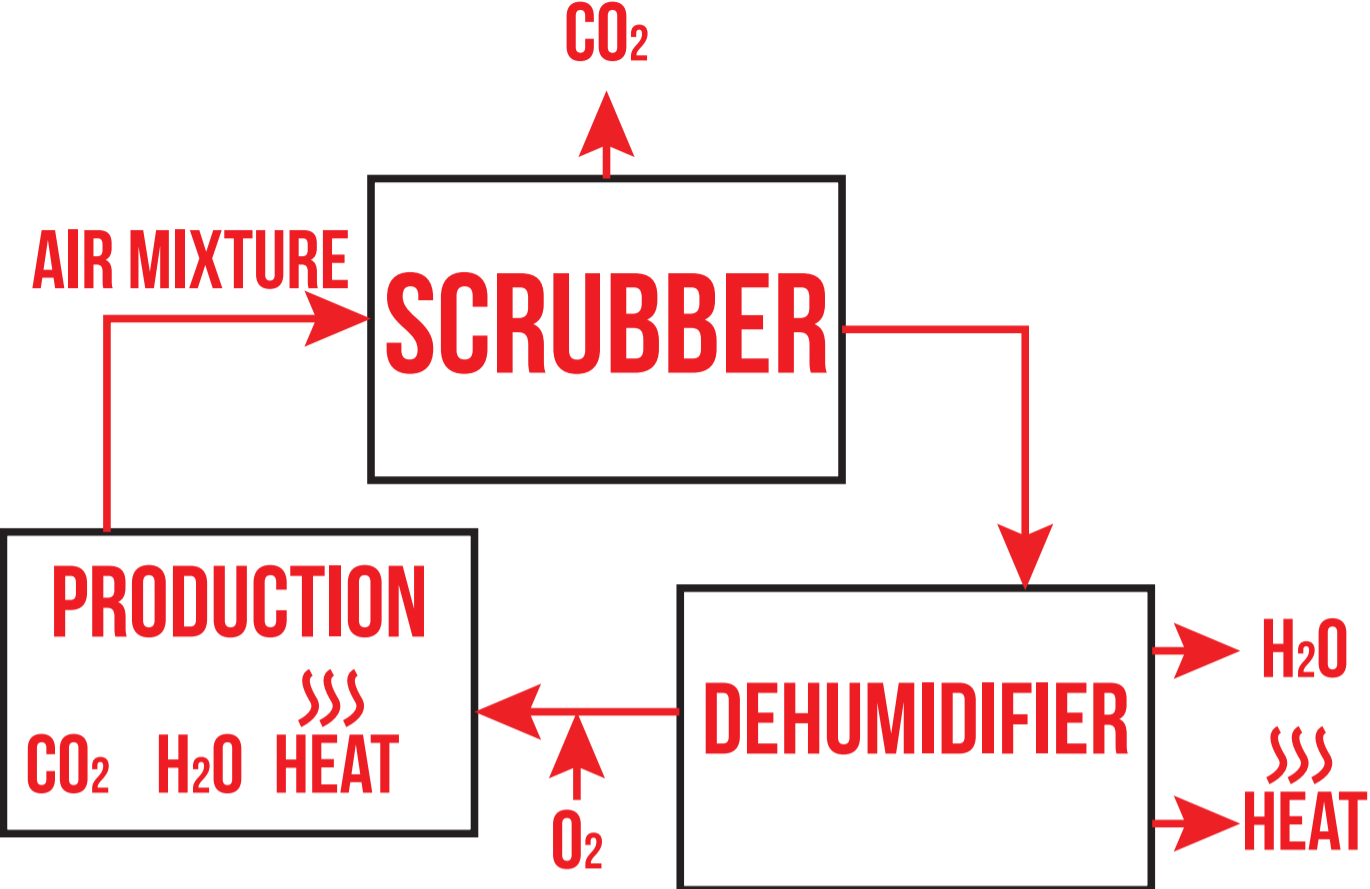
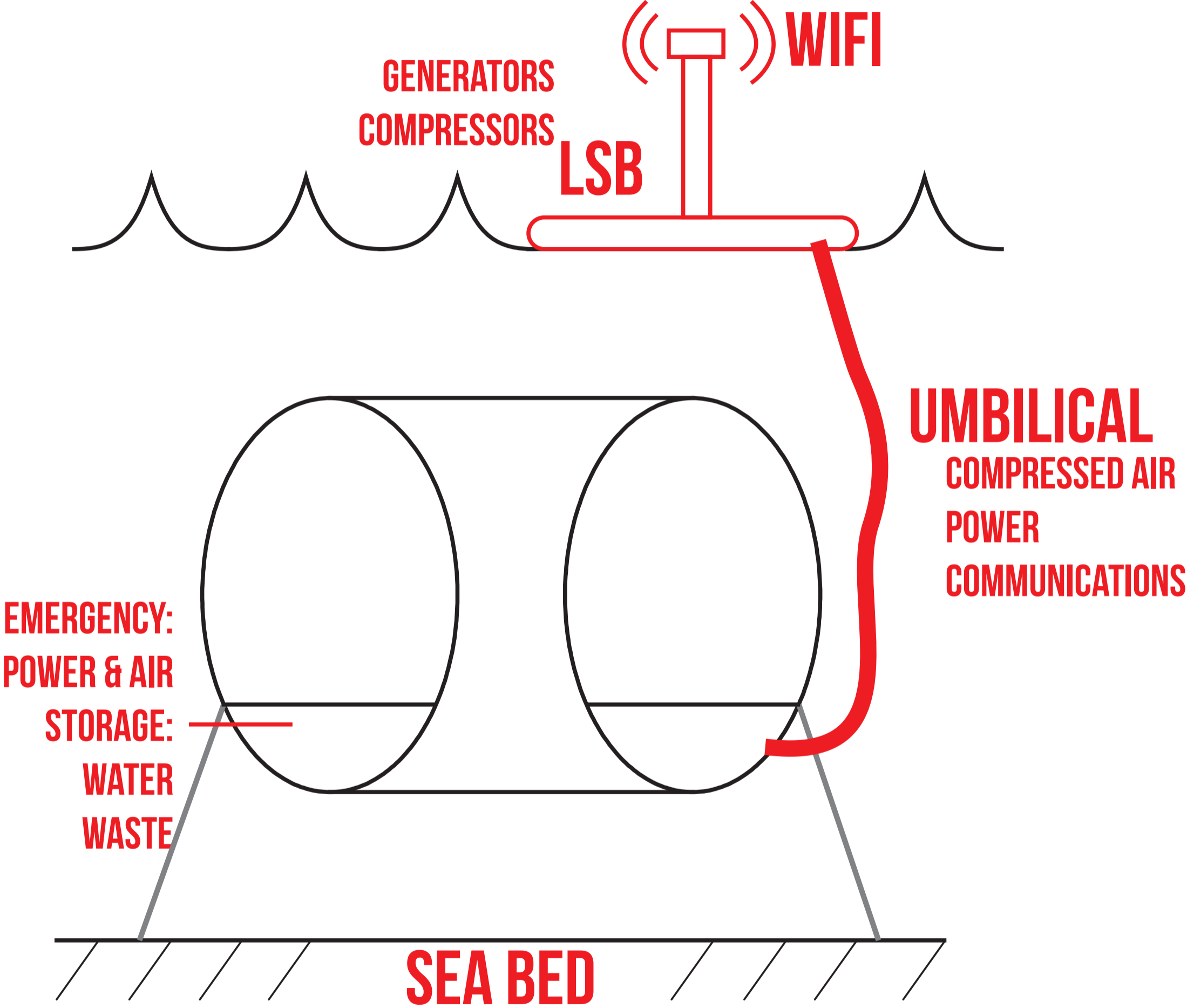
**PRESSURE**



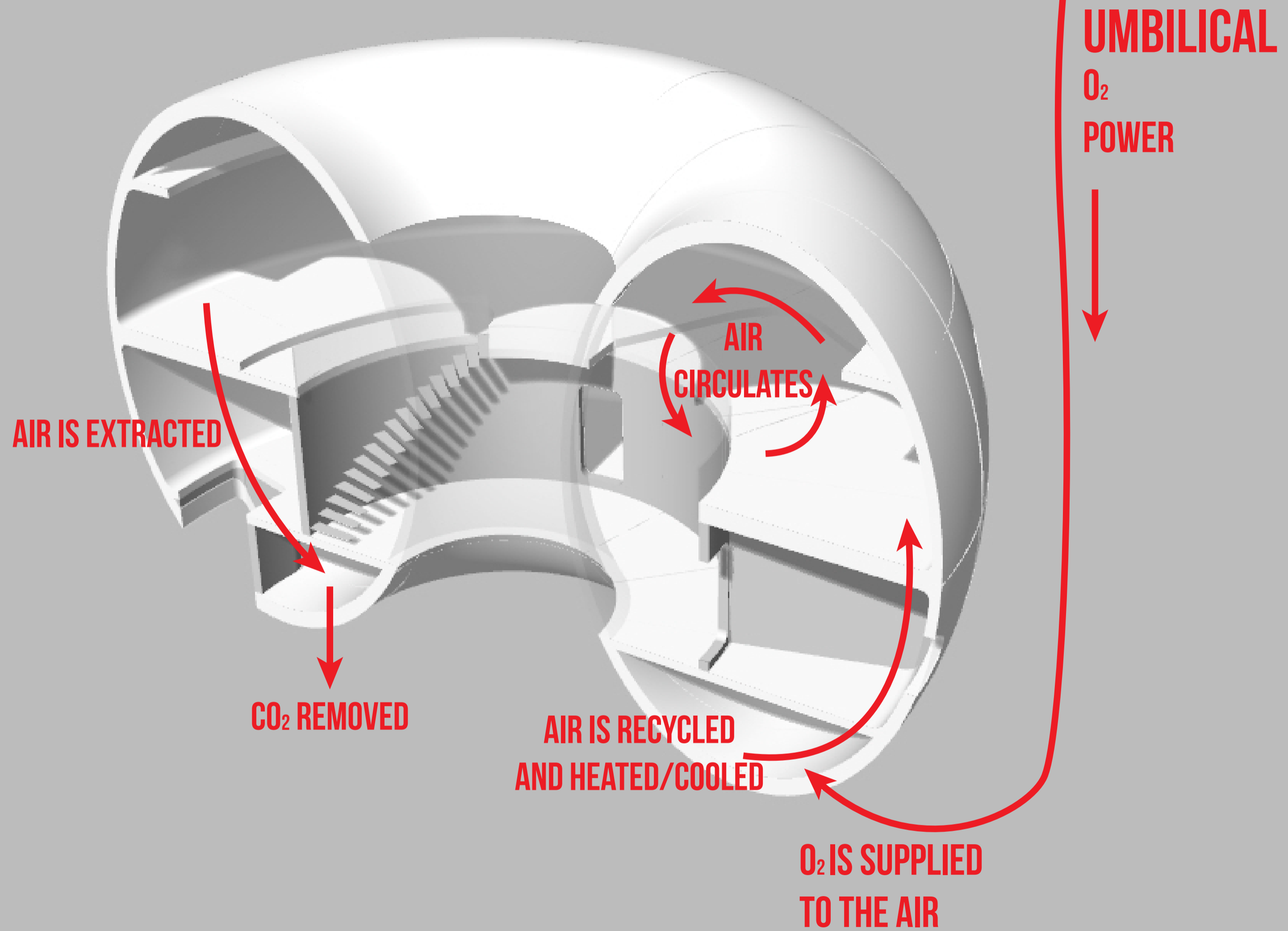
**GFRP SANDWICH PANELS**



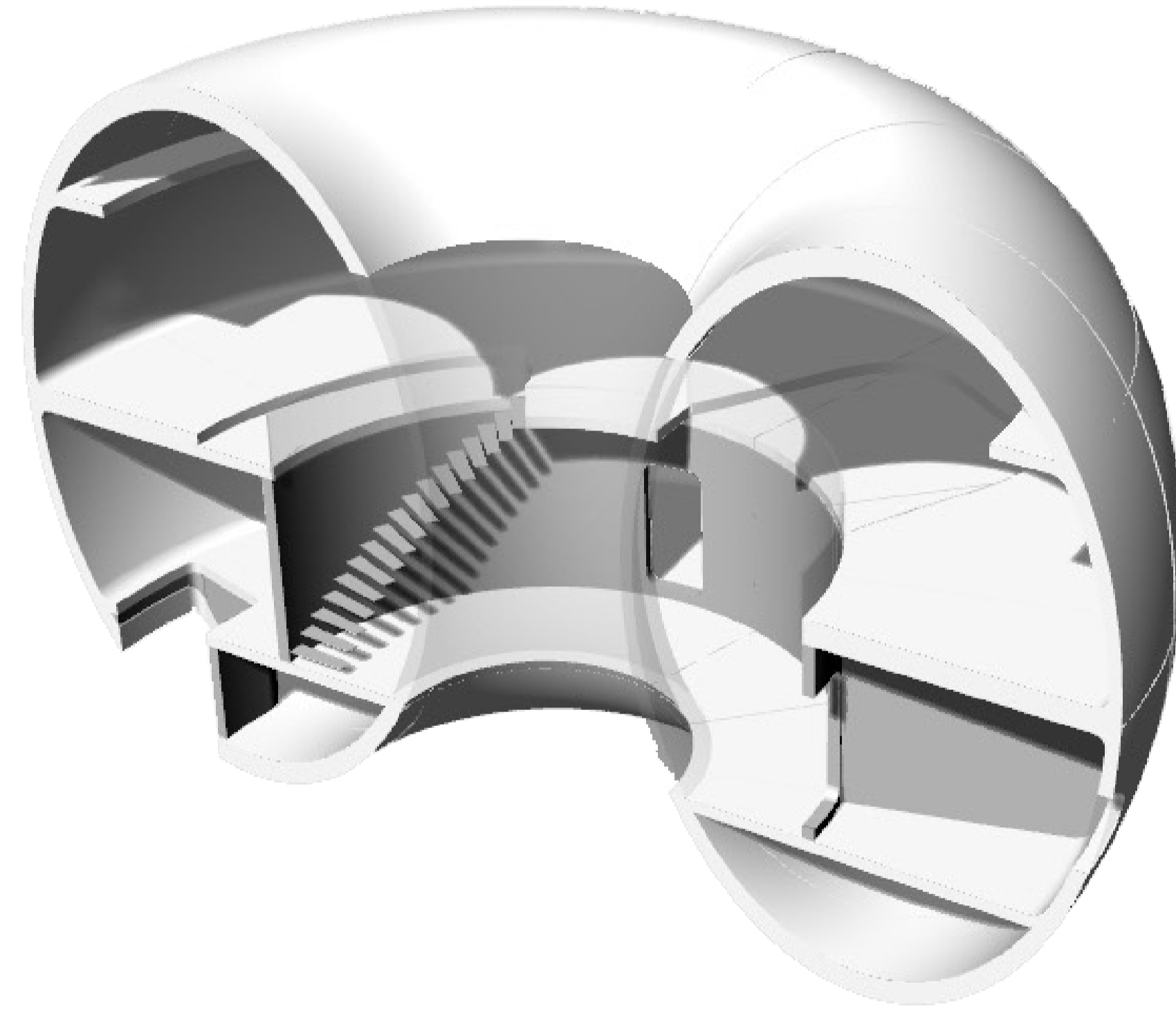
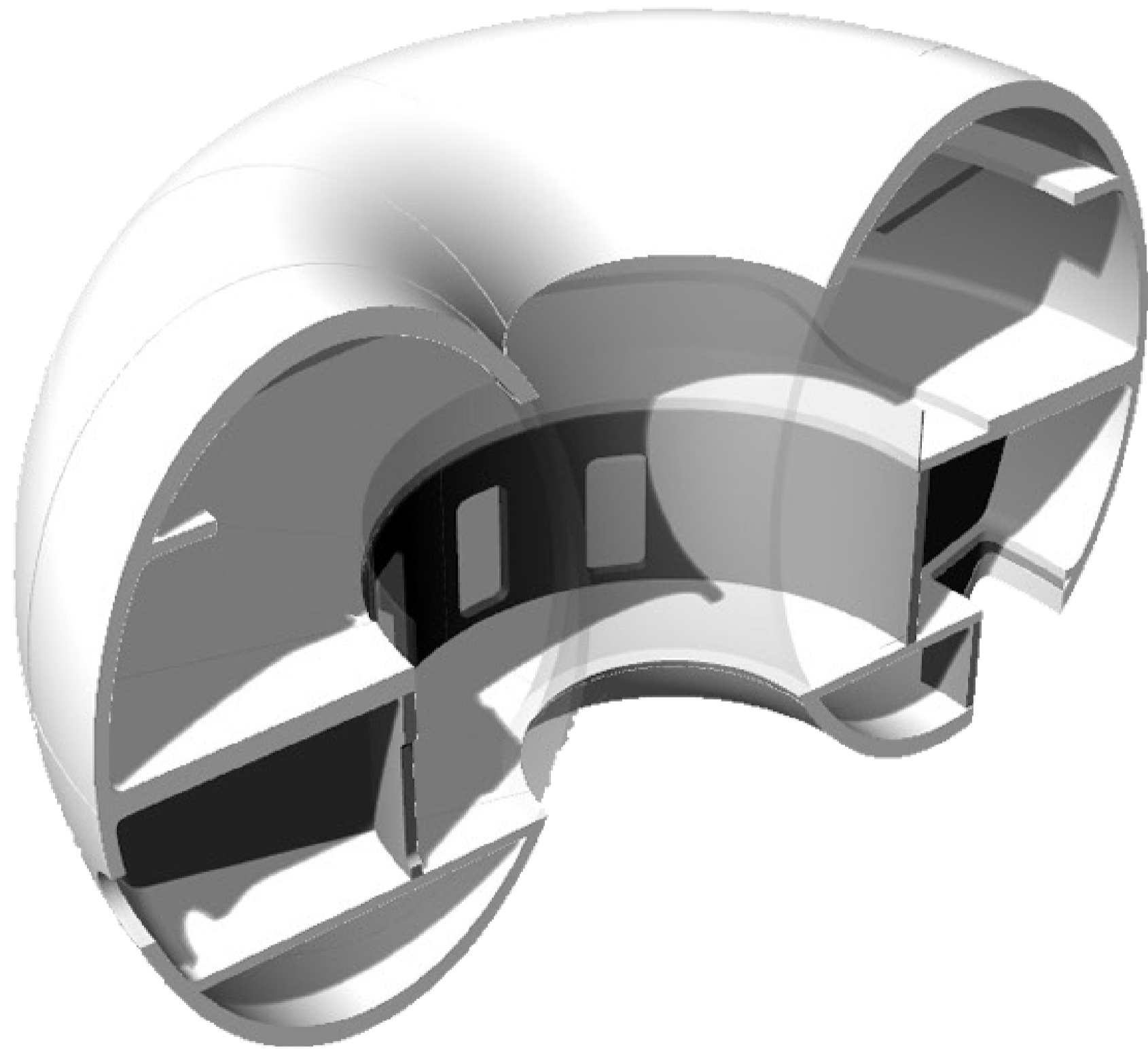
**Concept**



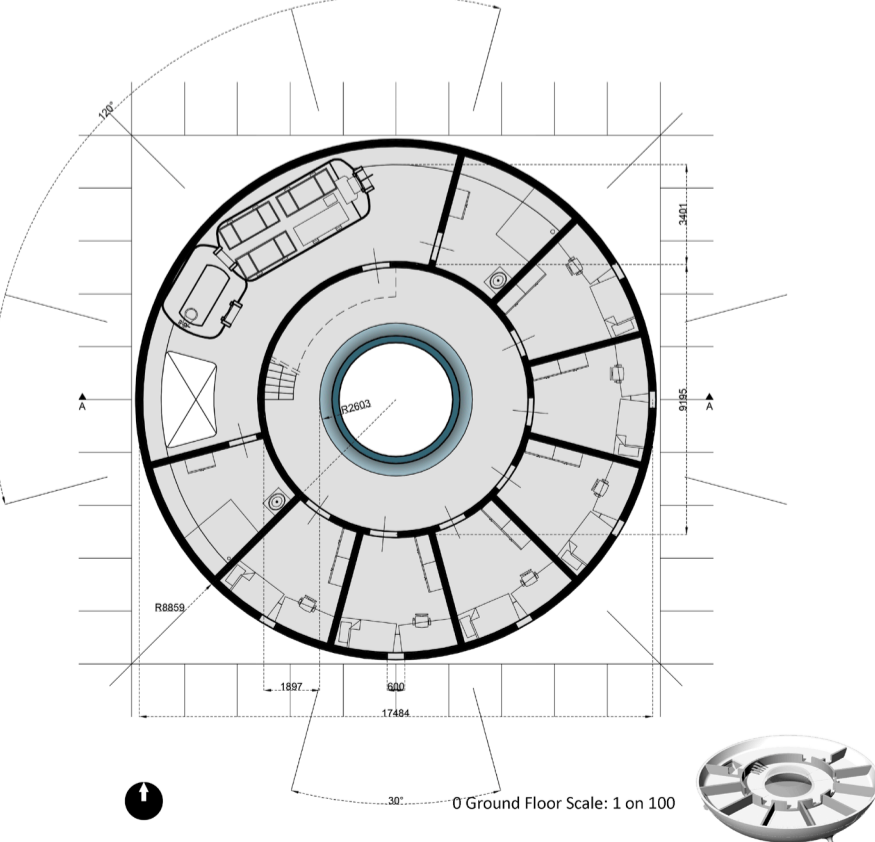
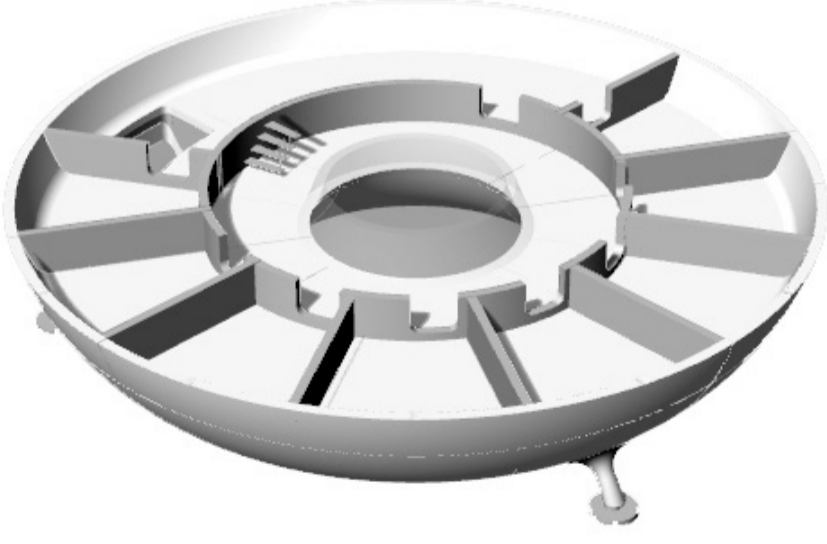
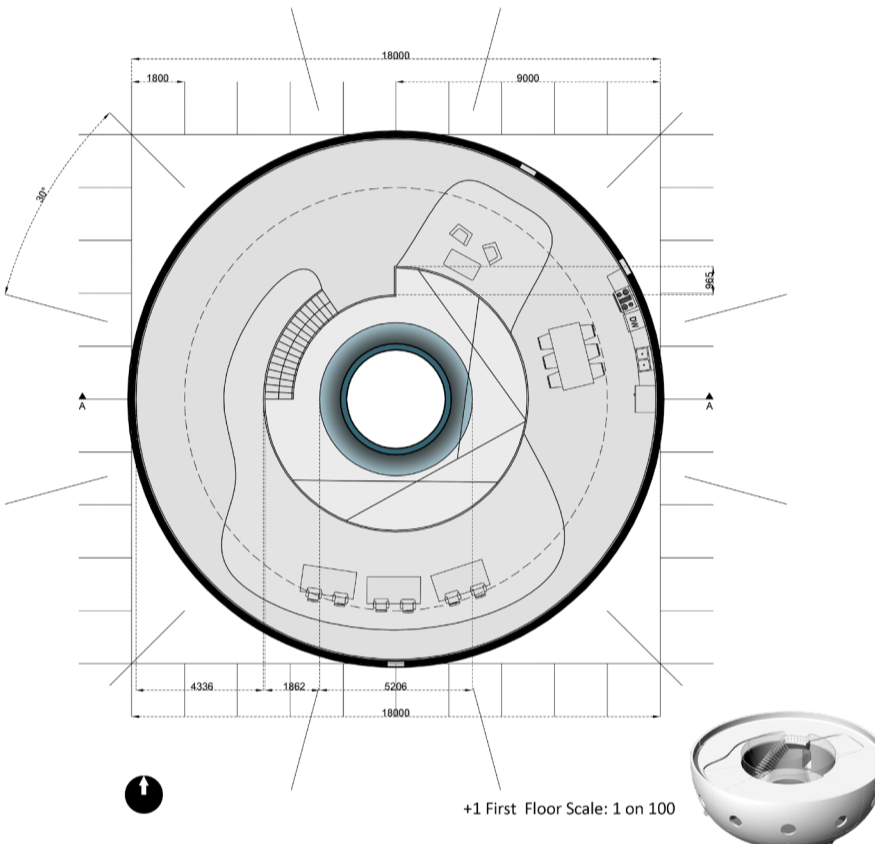
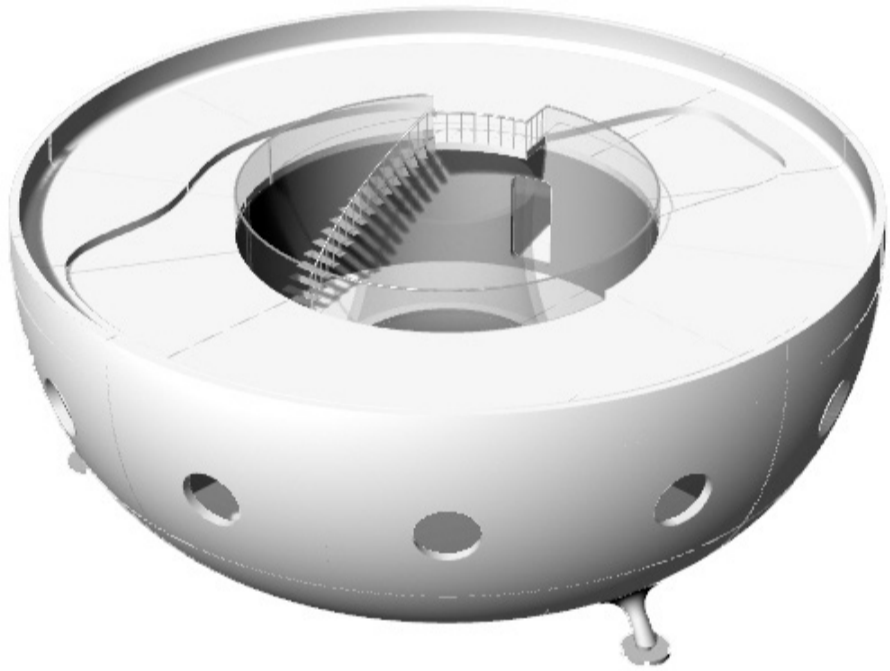
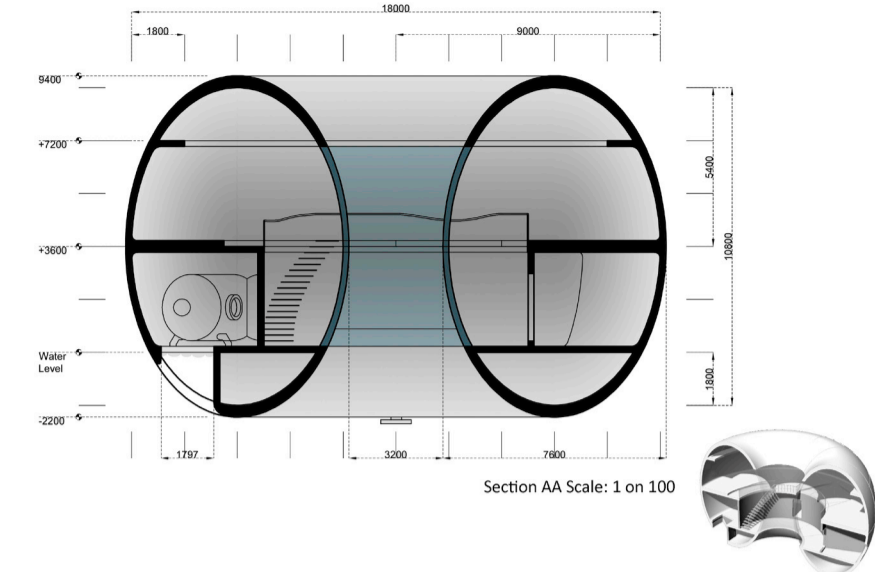
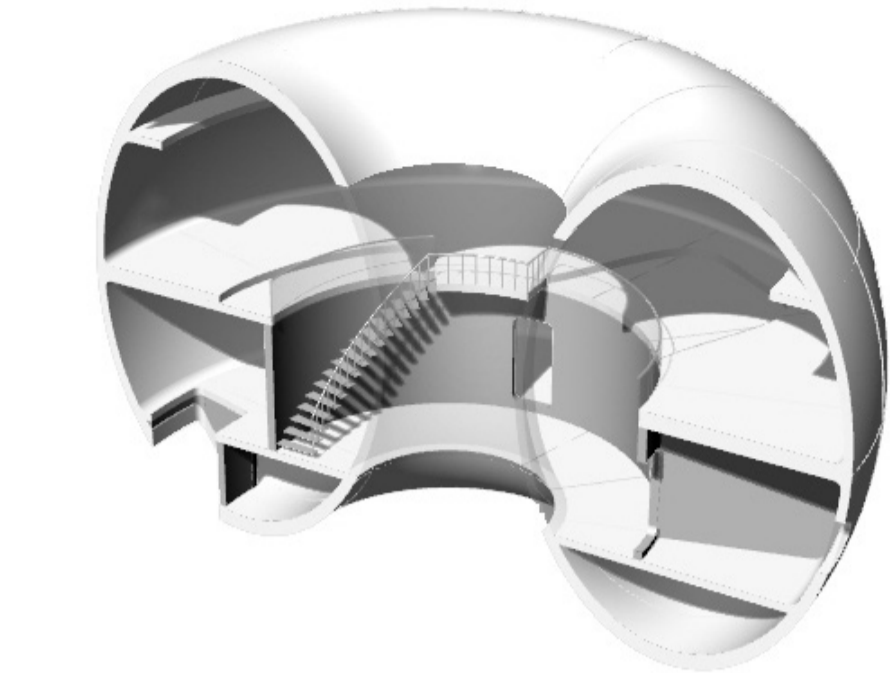
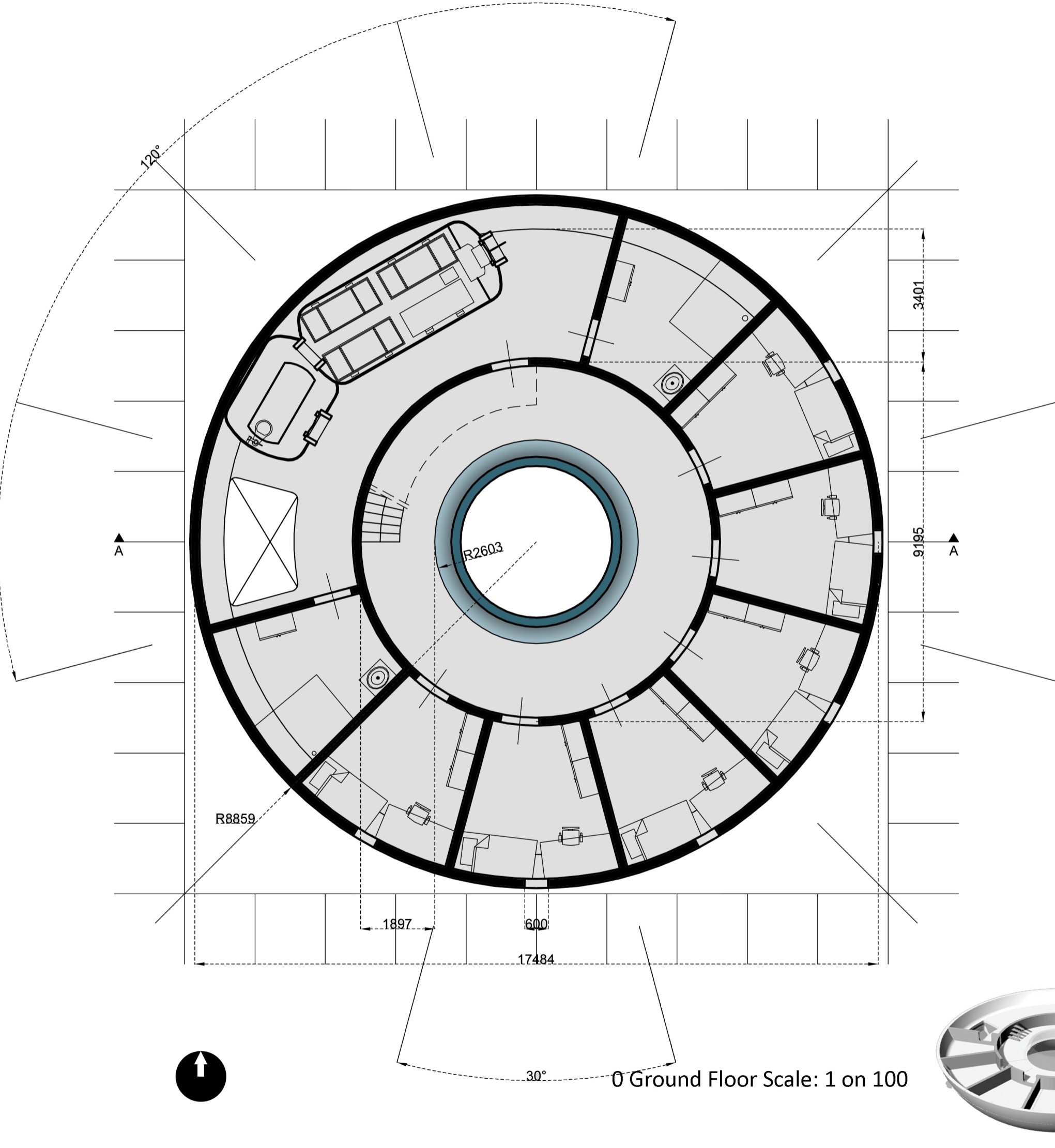




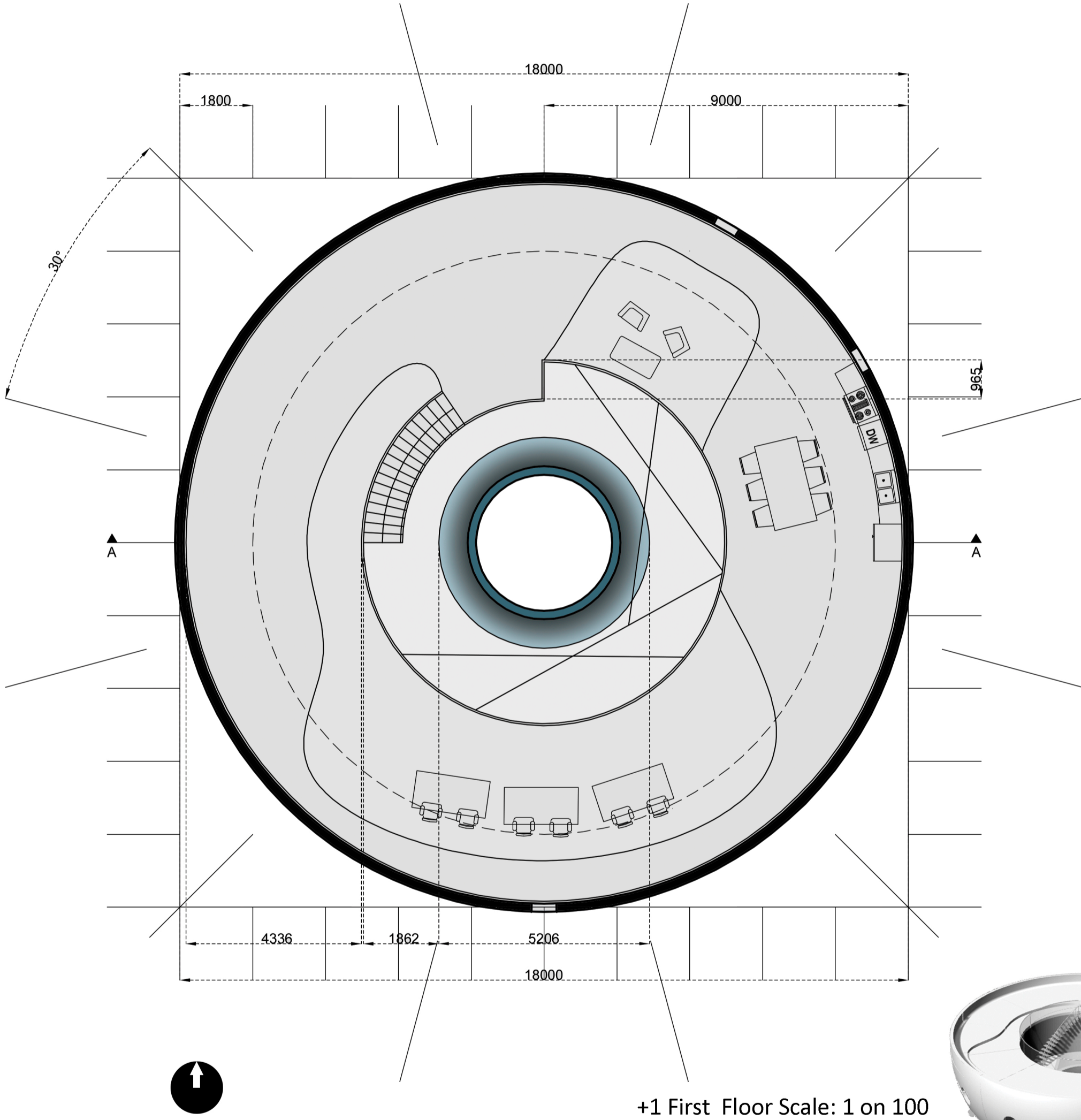
# Architecture



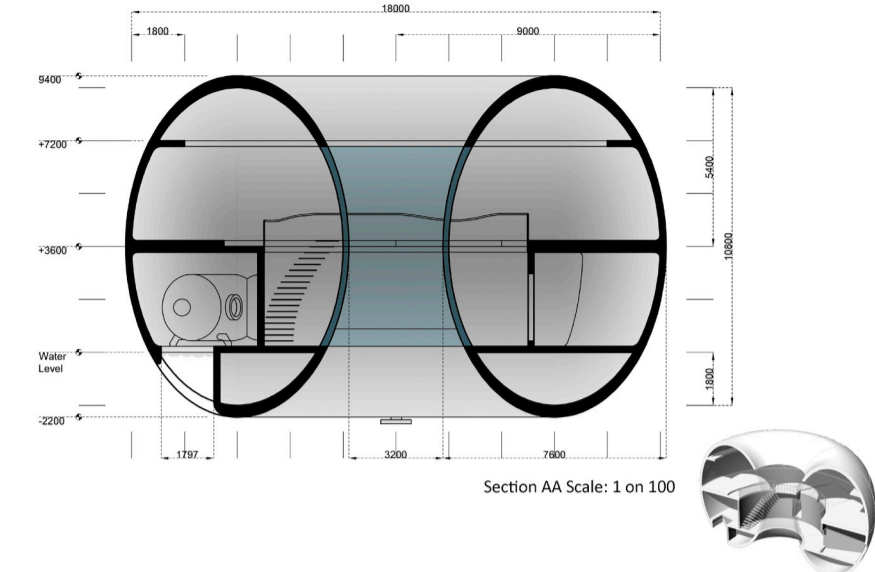
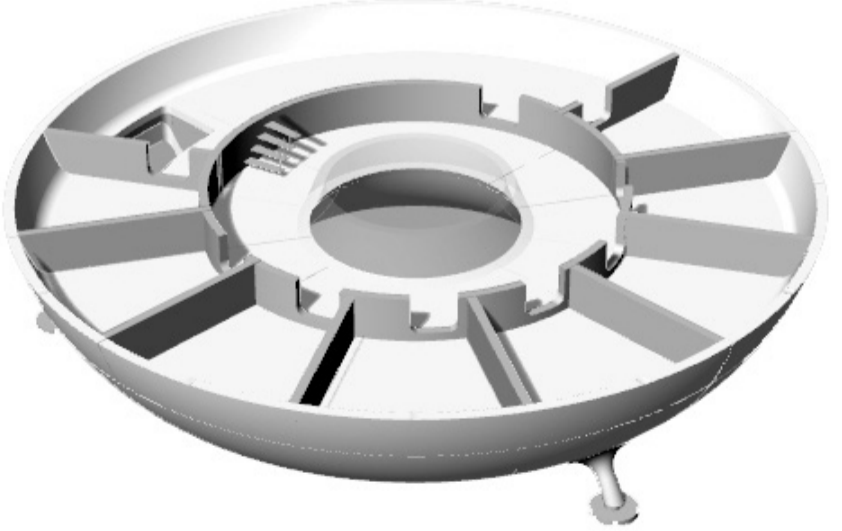
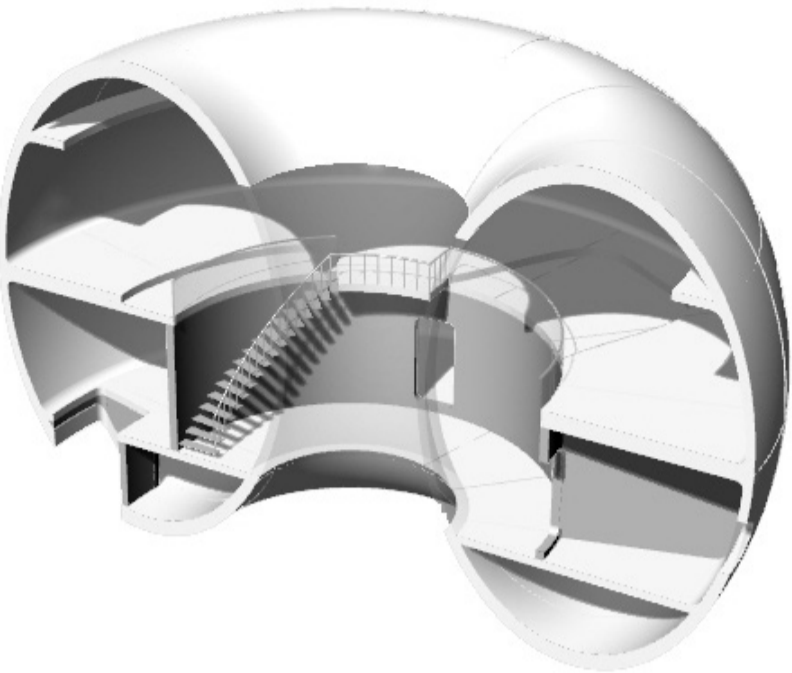
# Ground Floor



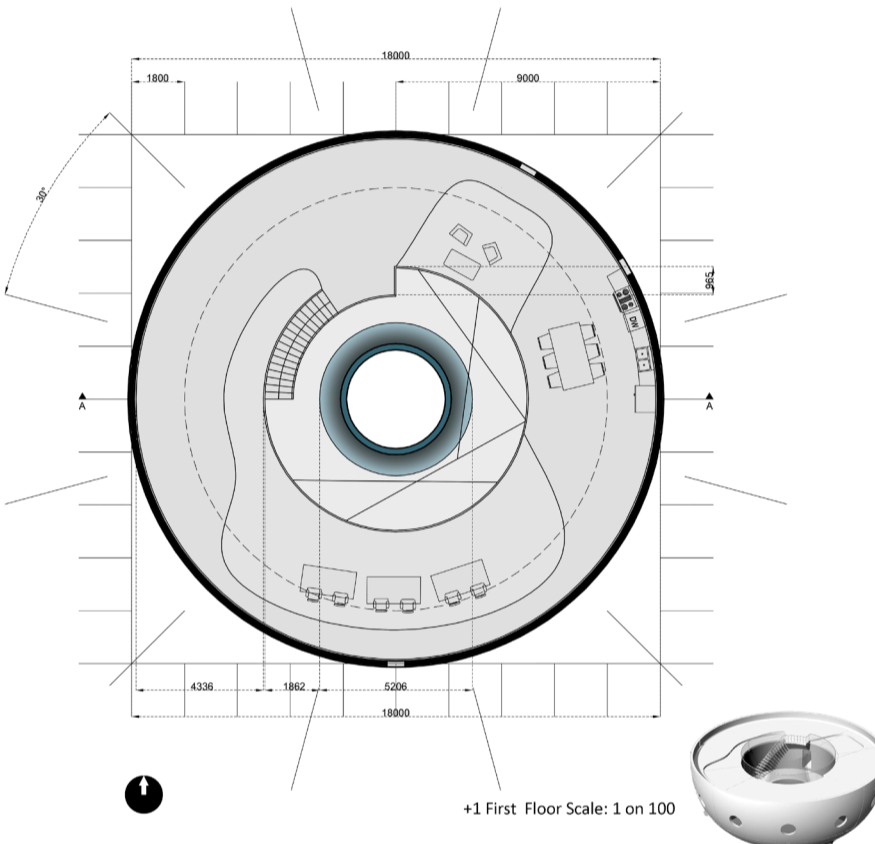
# First Floor



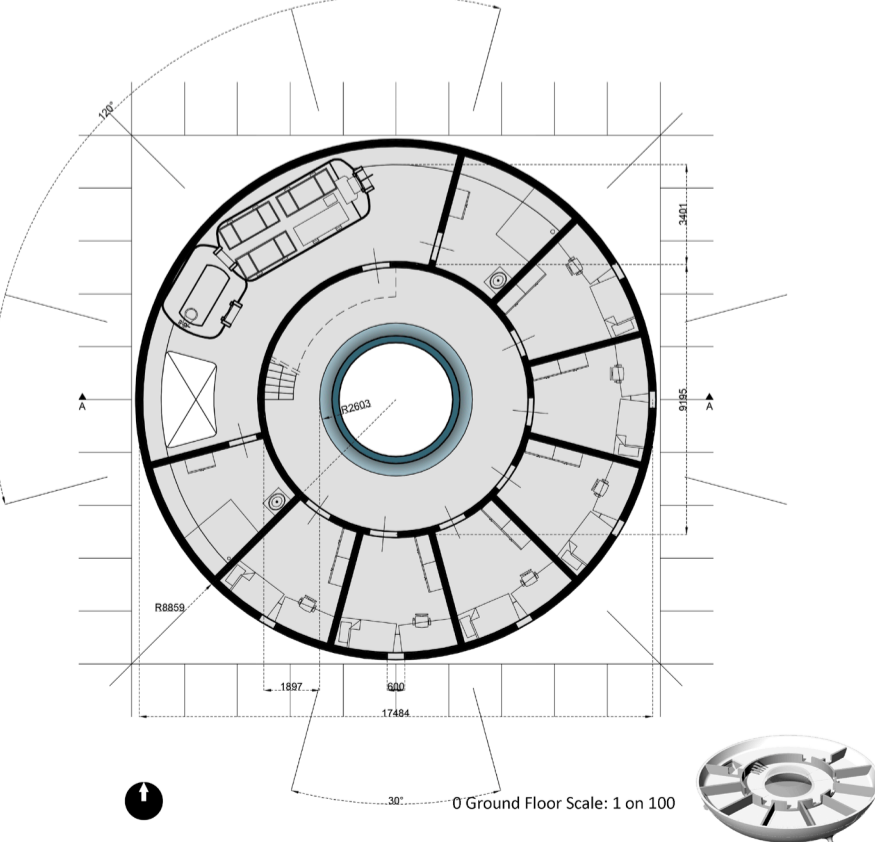
+1 First Floor Scale: 1 on 100



Section AA Scale: 1 on 100

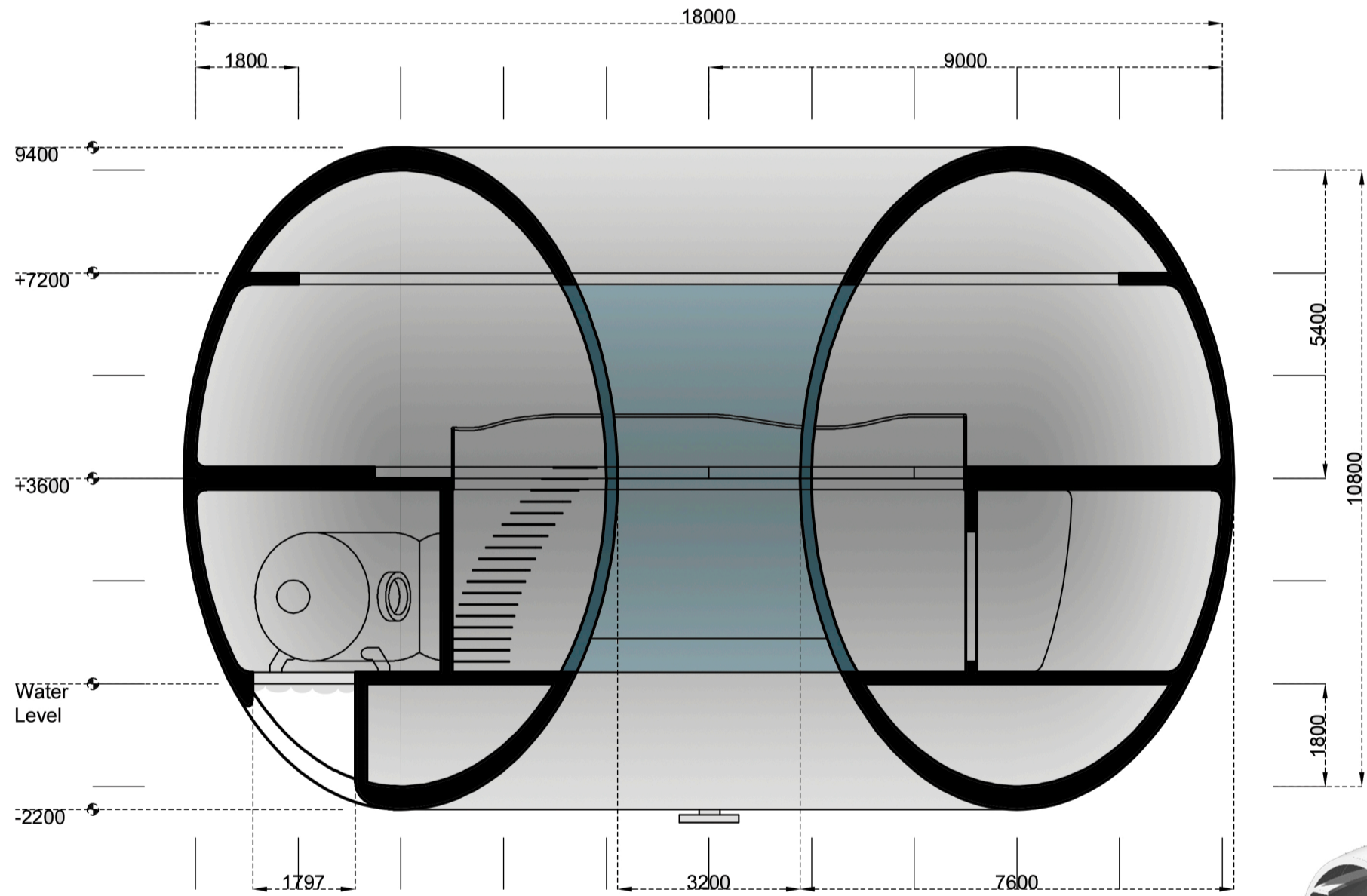
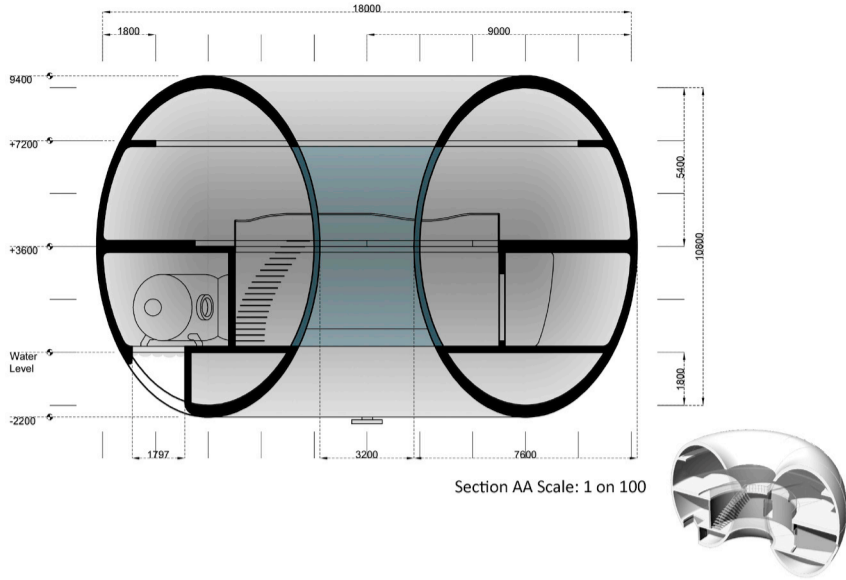
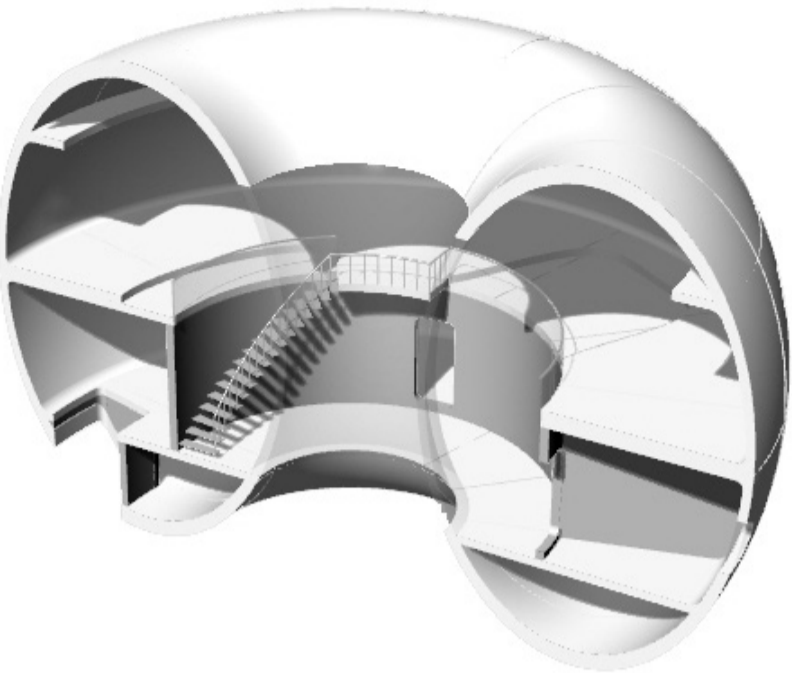


+1 First Floor Scale: 1 on 100

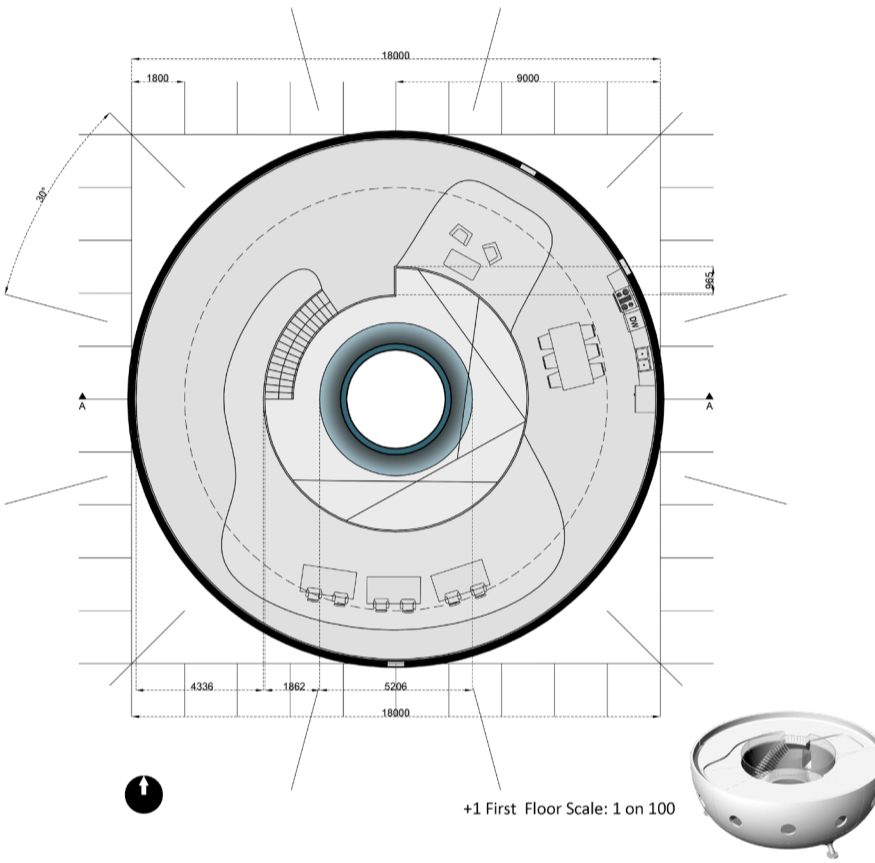
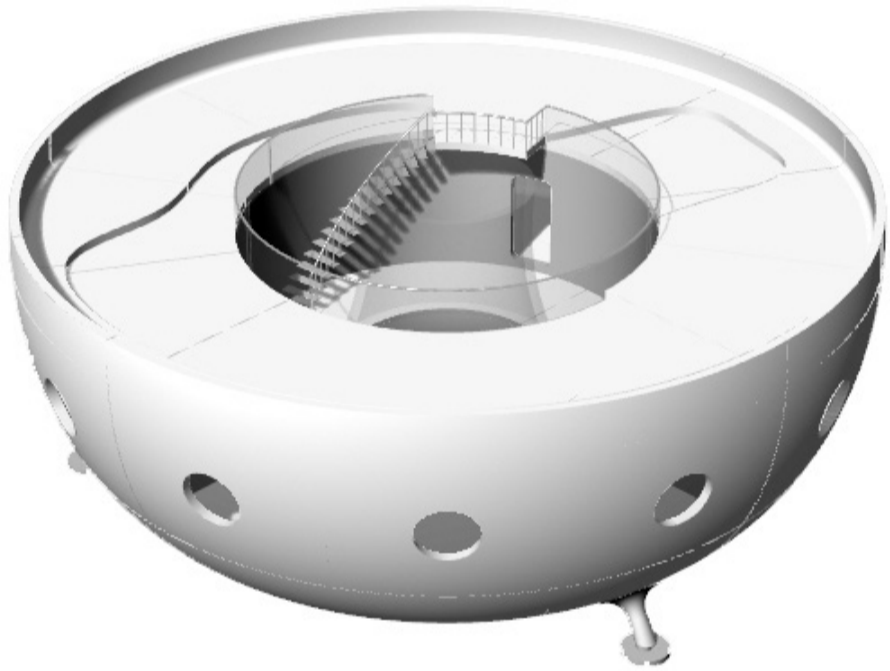
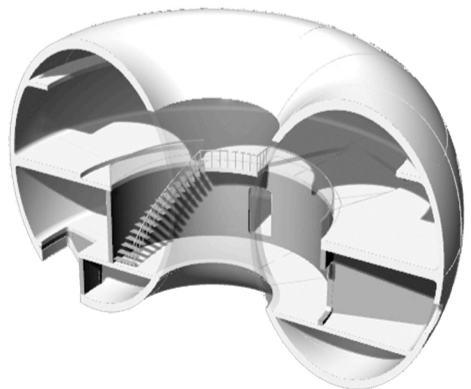


0 Ground Floor Scale: 1 on 100

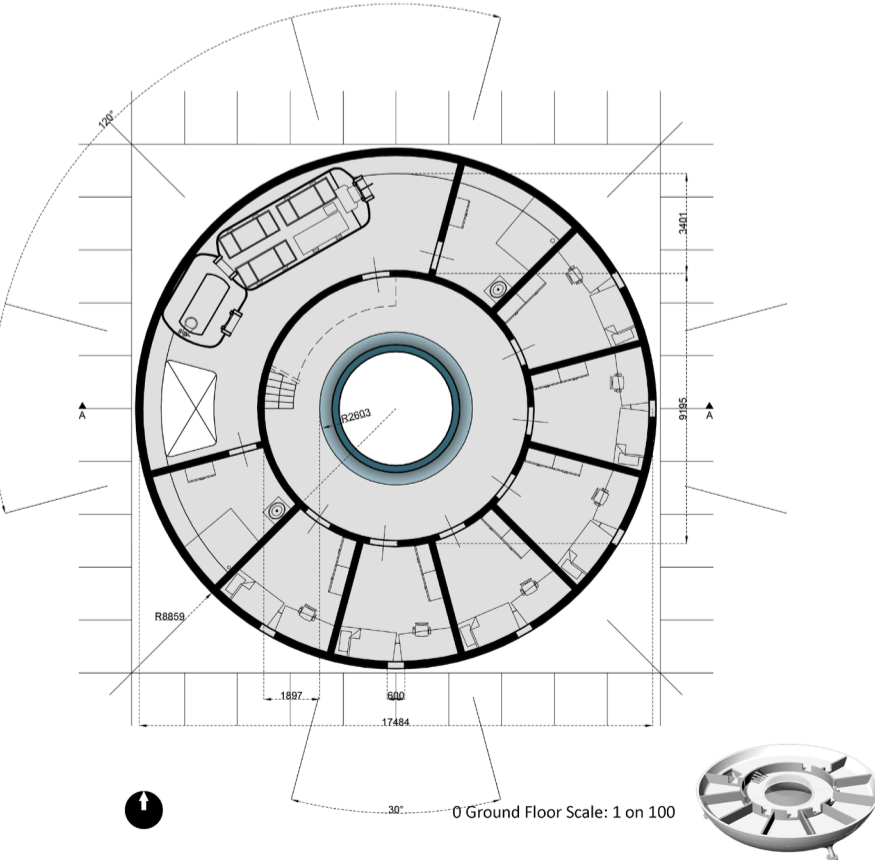
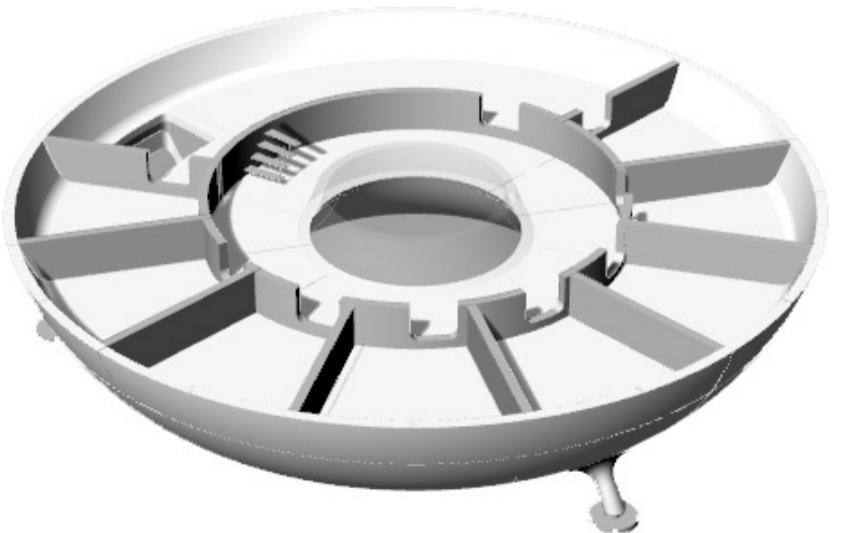
# Section



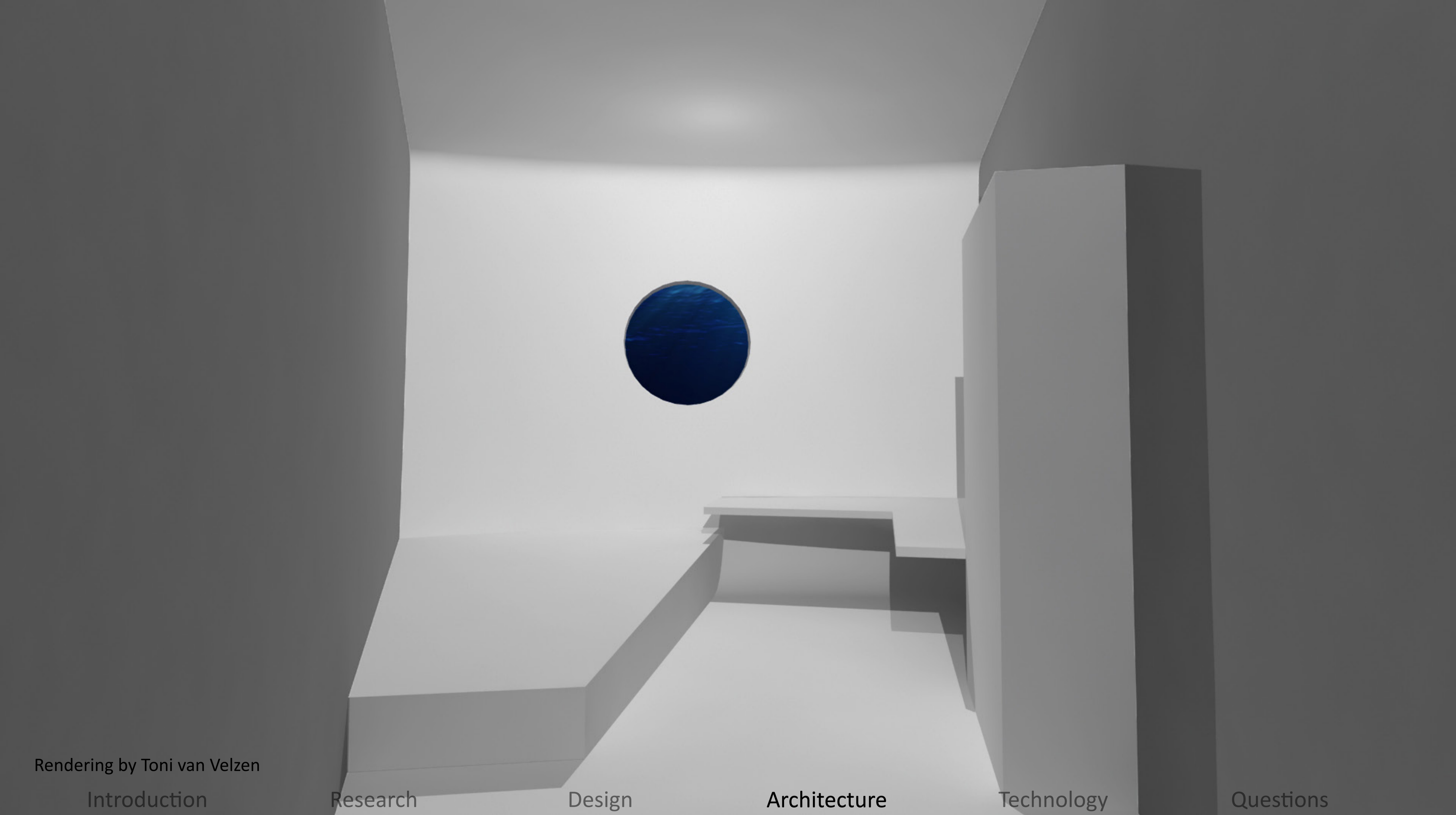
Section AA Scale: 1 on 100



+1 First Floor Scale: 1 on 100



0 Ground Floor Scale: 1 on 100



Rendering by Toni van Velzen

Introduction

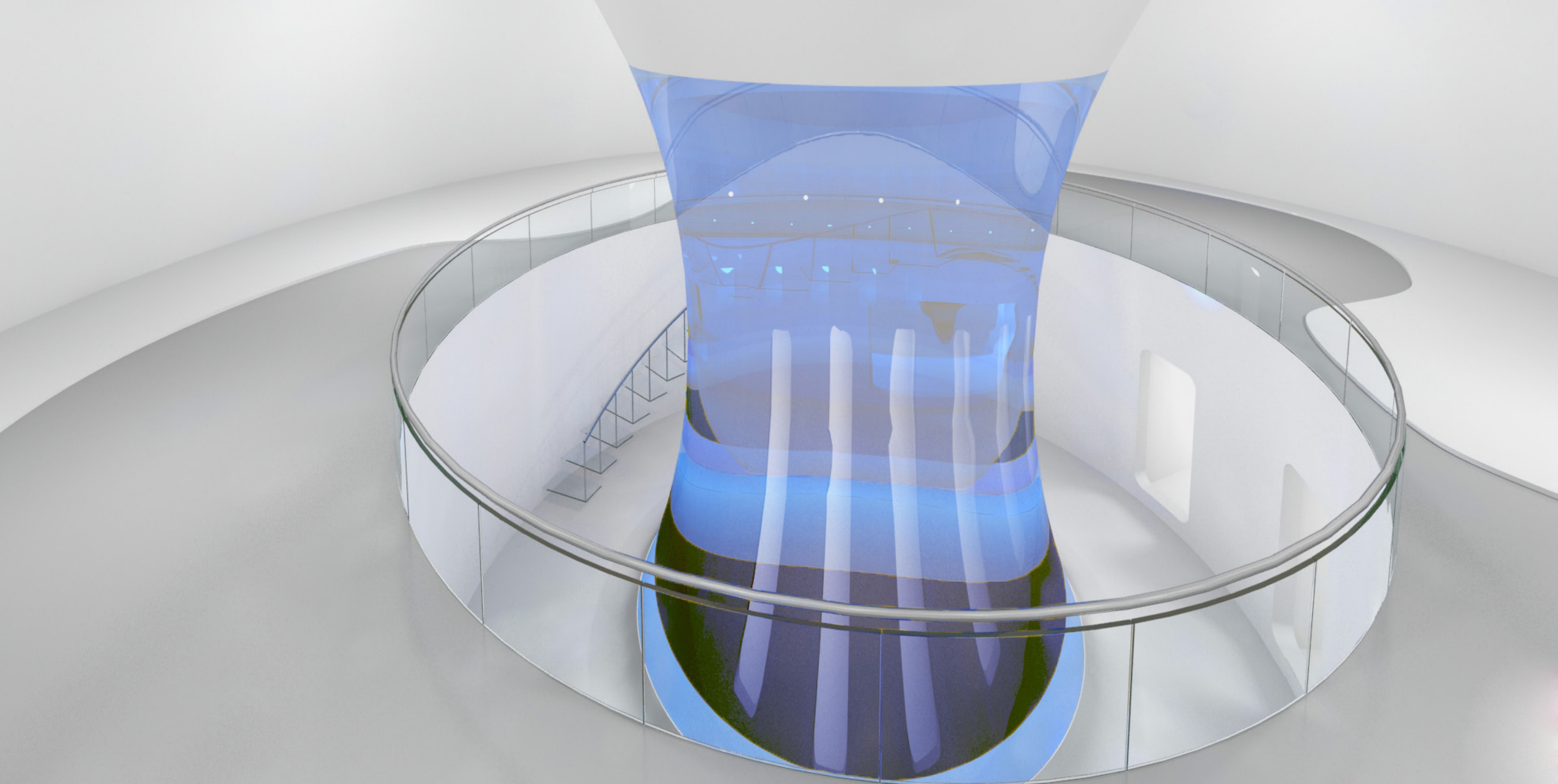
Research

Design

Architecture

Technology

Questions



Rendering by Toni van Velzen

Introduction

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Questions



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[Research](#)

[Design](#)

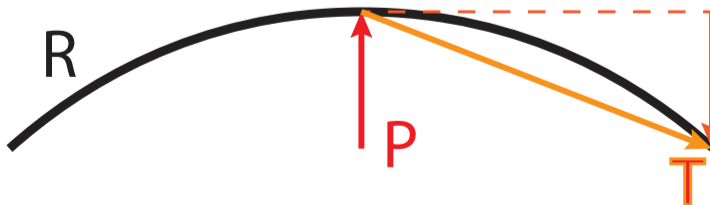
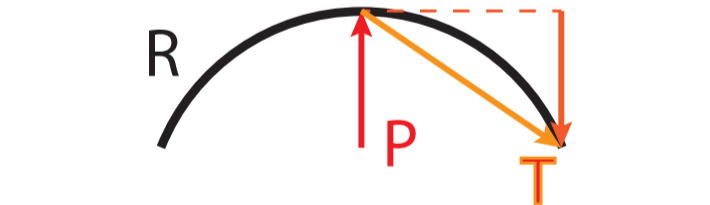
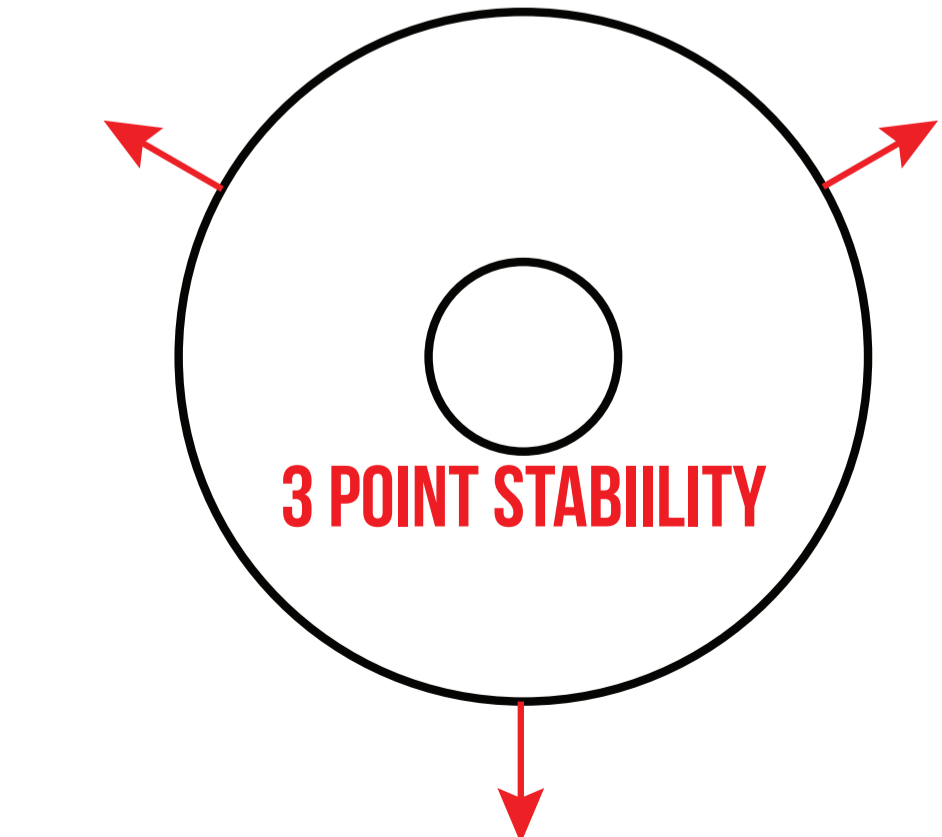
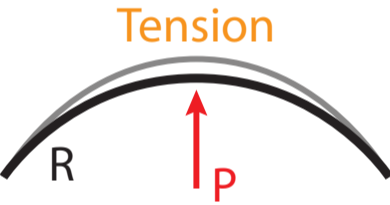
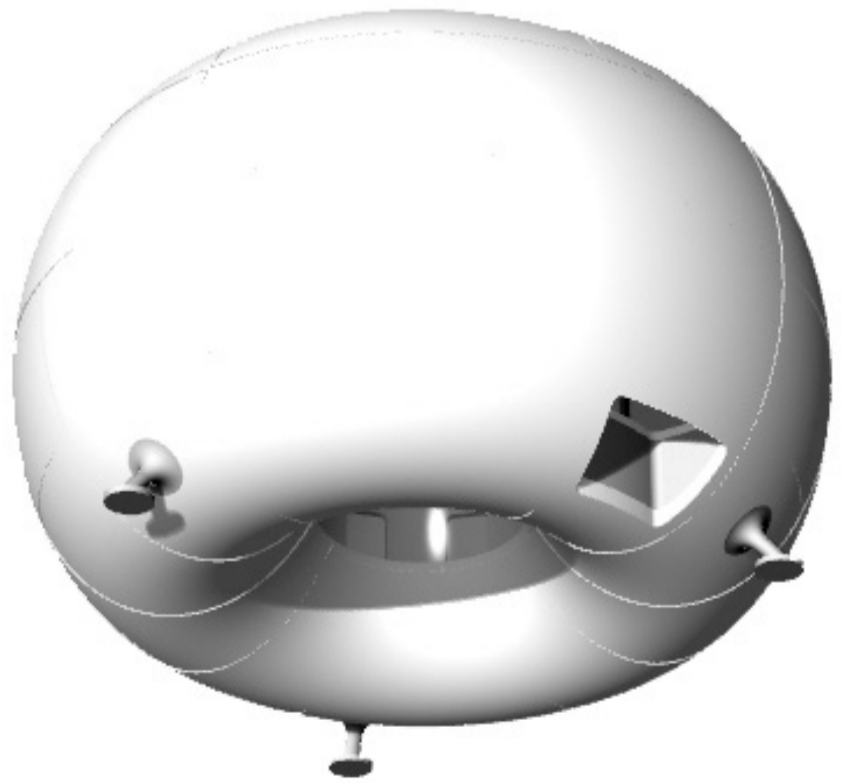
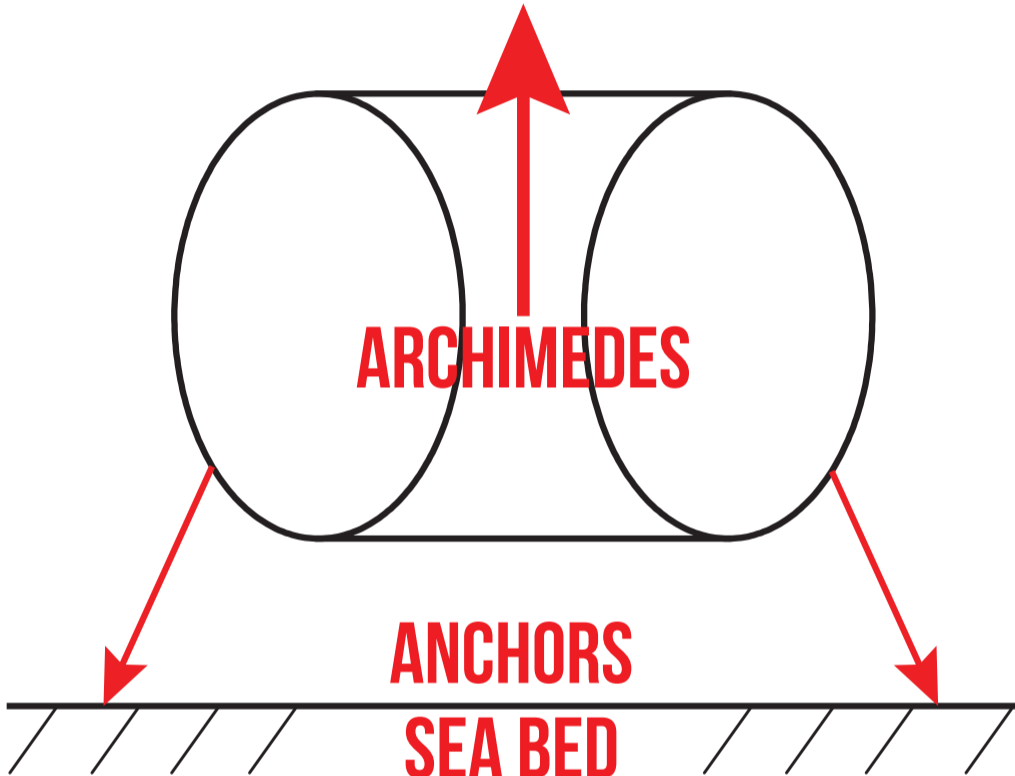
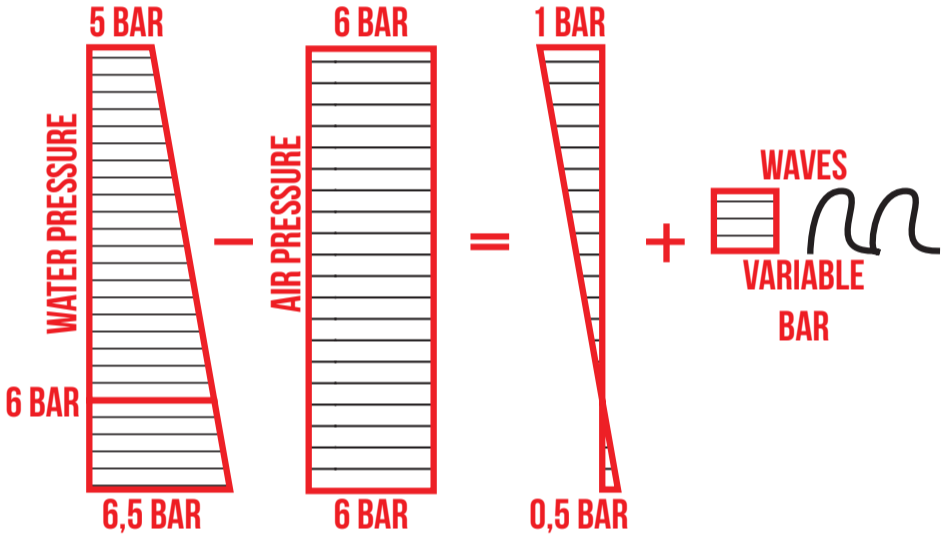
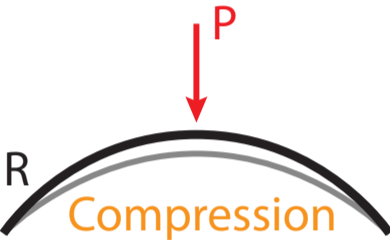
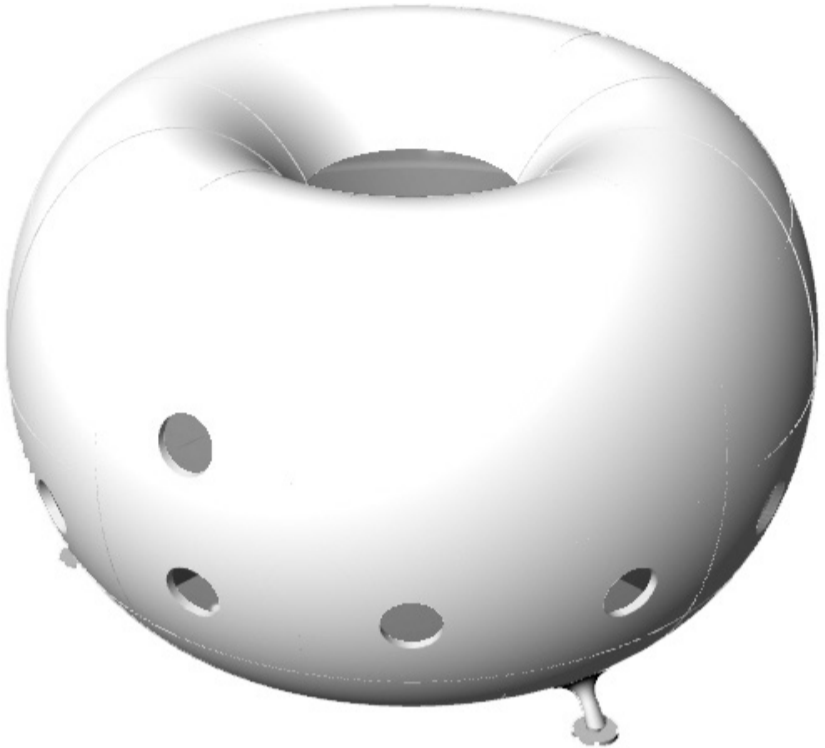
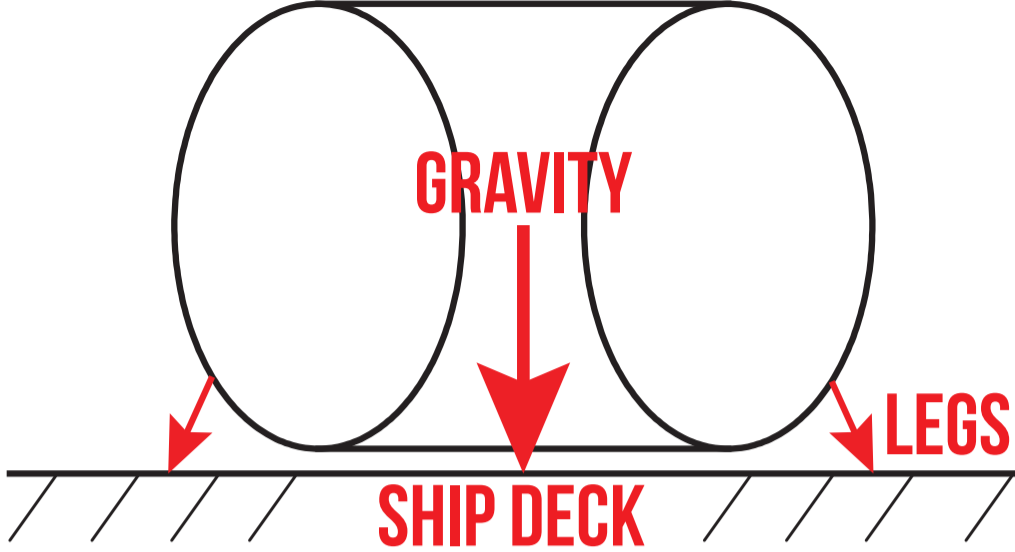
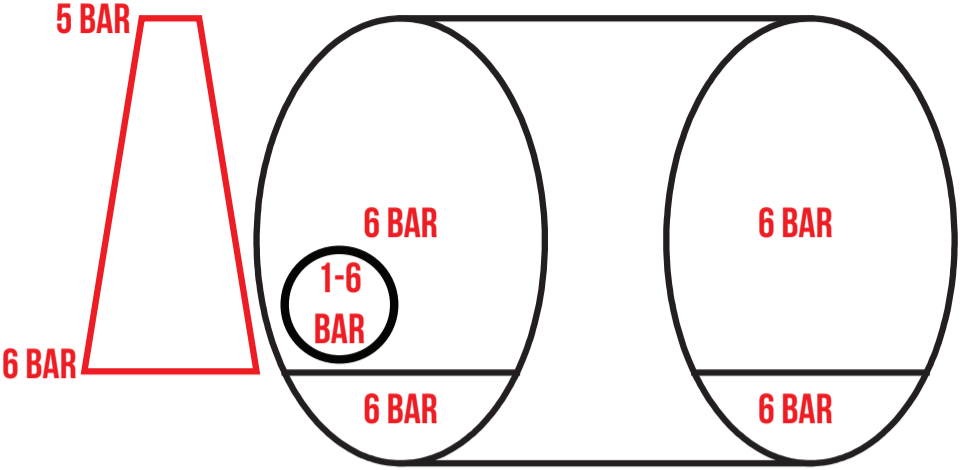
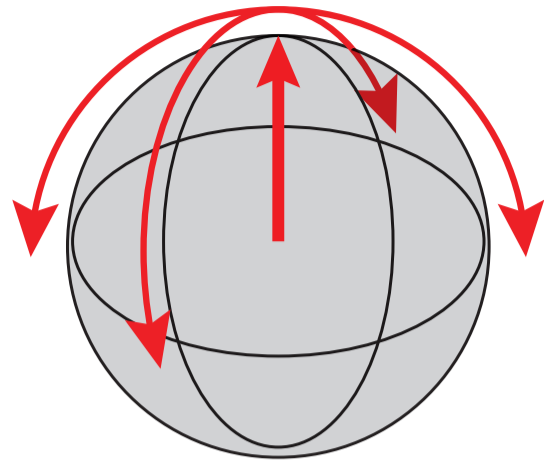
[Architecture](#)

[Technology](#)

[Questions](#)



# Construction Principles

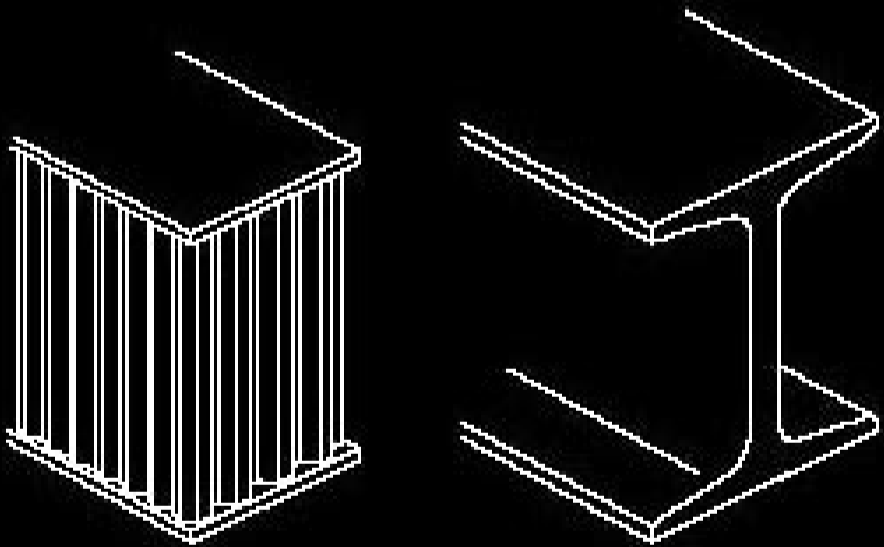


# Glass Fibre Reinforced Polymer Sandwich Composite

What are the properties of a sandwich construction ?

	Solid material	Core thickness $t$	Core thickness $3t$
Stiffness	1.0	7.0	37.0
Flexural strength	1.0	3.5	9.2
Weight	1.0	1.03	1.06

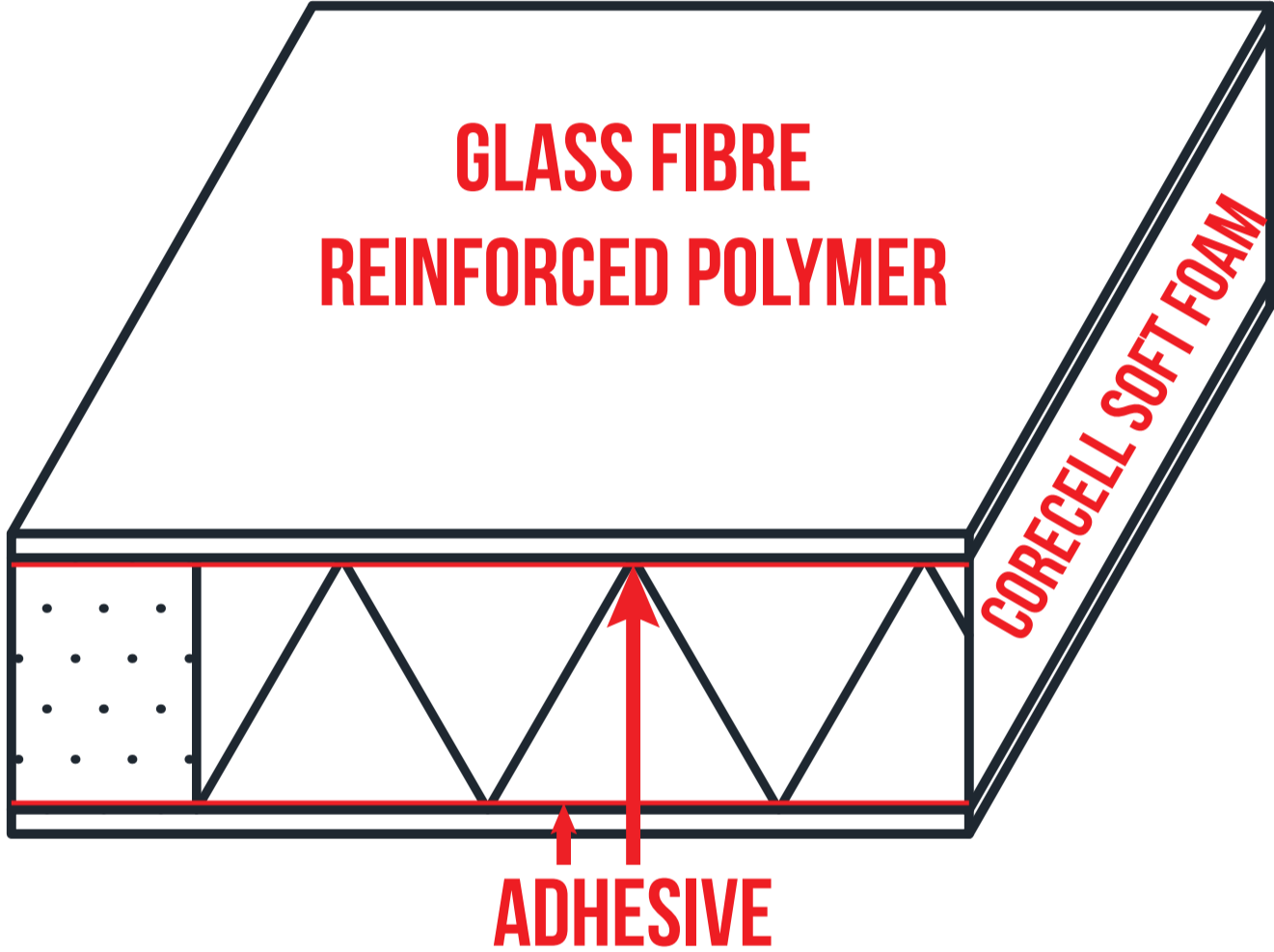
ANALOGY BETWEEN AN I-BEAM AND A HONEYCOMB SANDWICH CONSTRUCTION



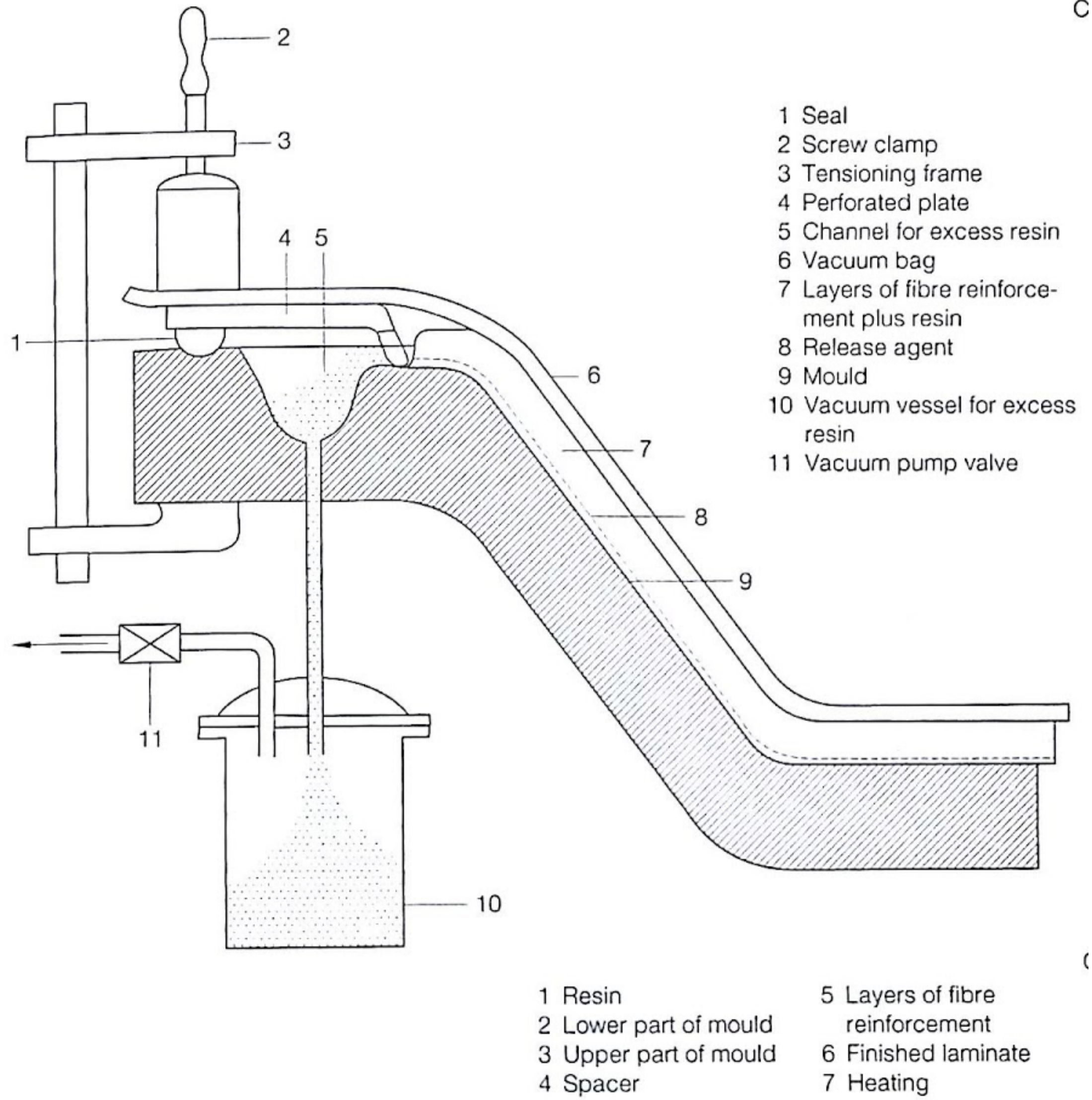
Benefits of honeycomb sandwich :

- Tensile and compression stresses are supported by the skins
- Shearing stress is supported by the honeycomb
- The skins are stable across their whole length
- Rigidity in several directions
- Excellent weight saving

PVCU TOUGH FOAM REINFORCEMENT



# Resin Infusion Method

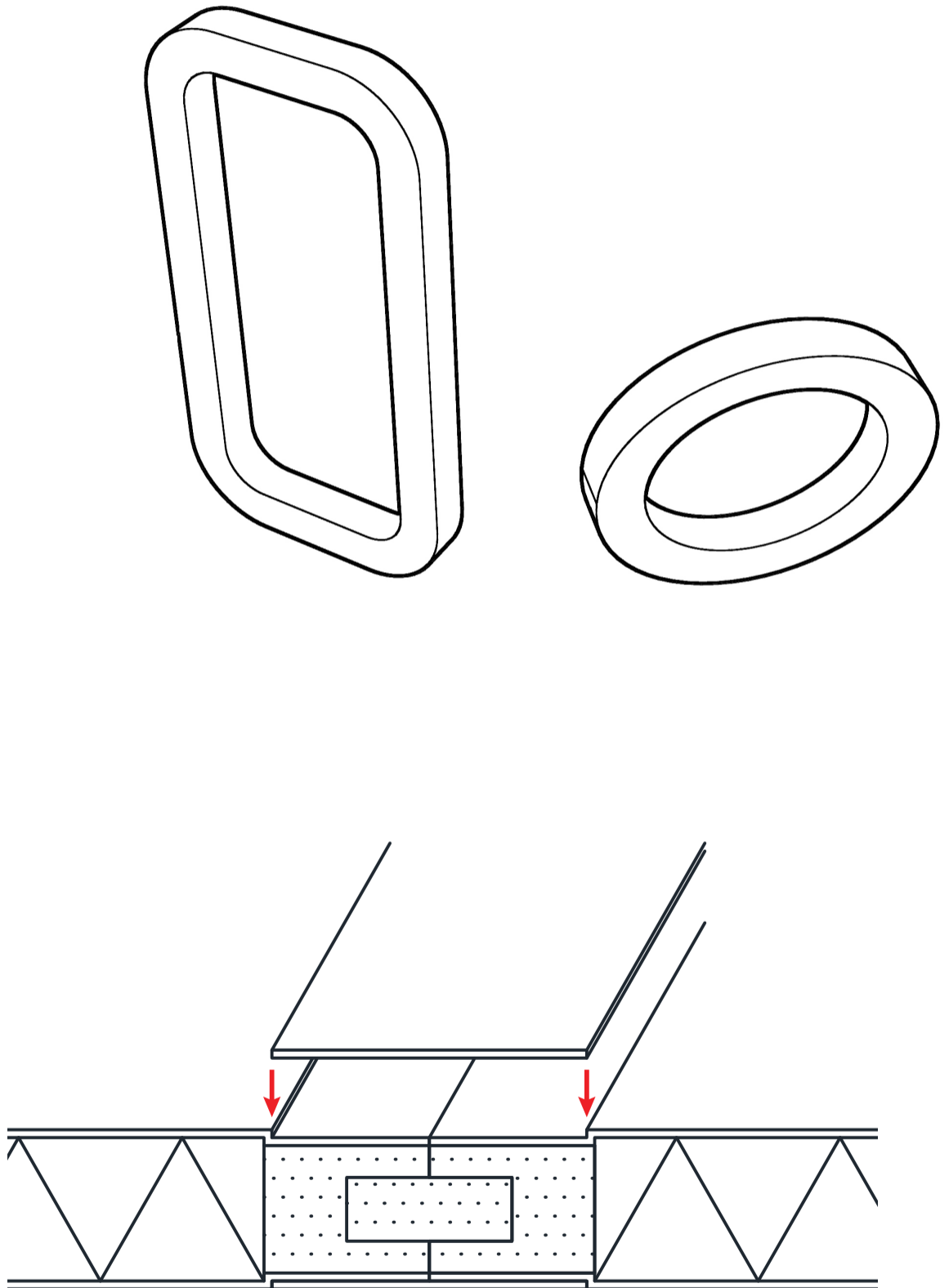
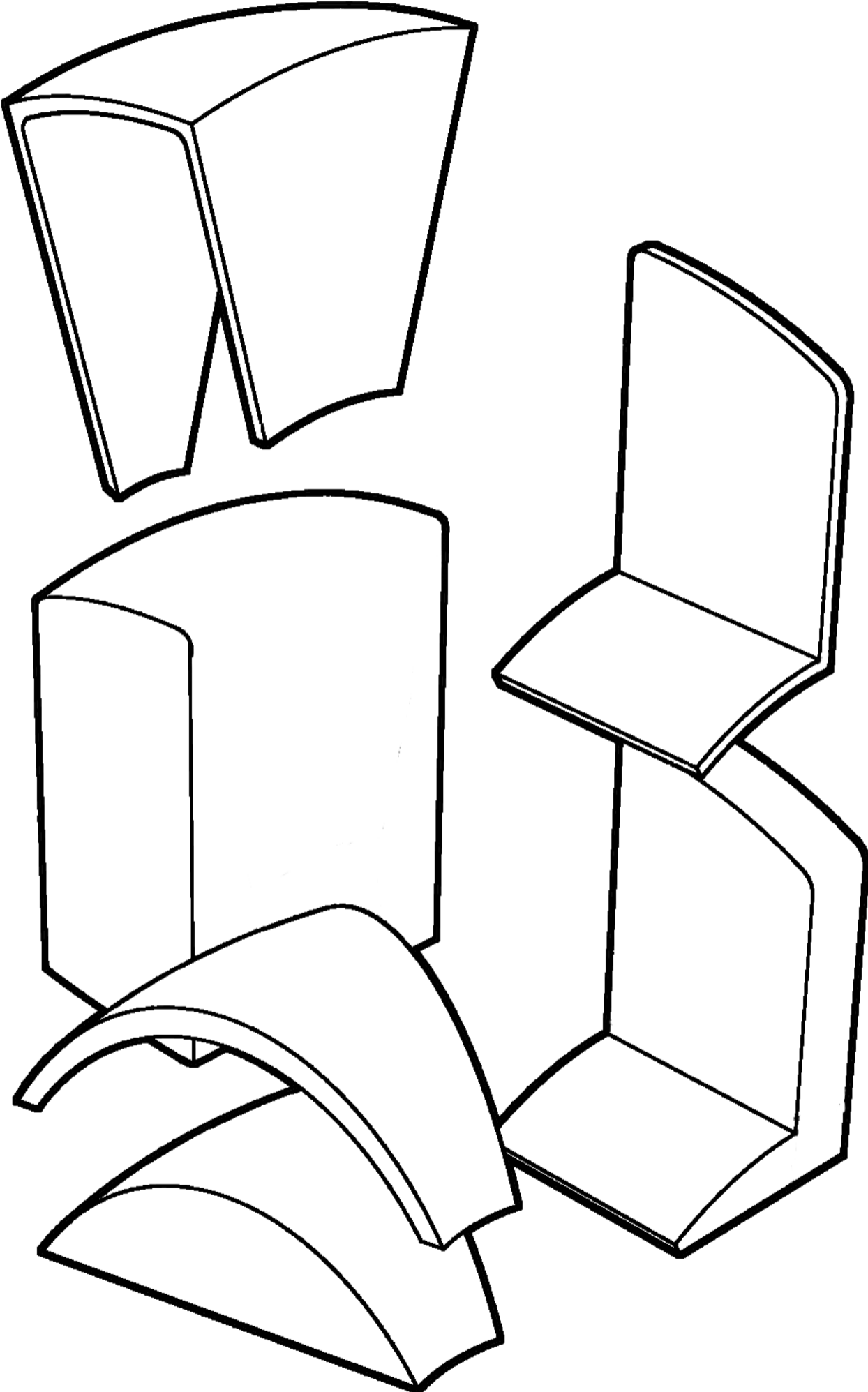
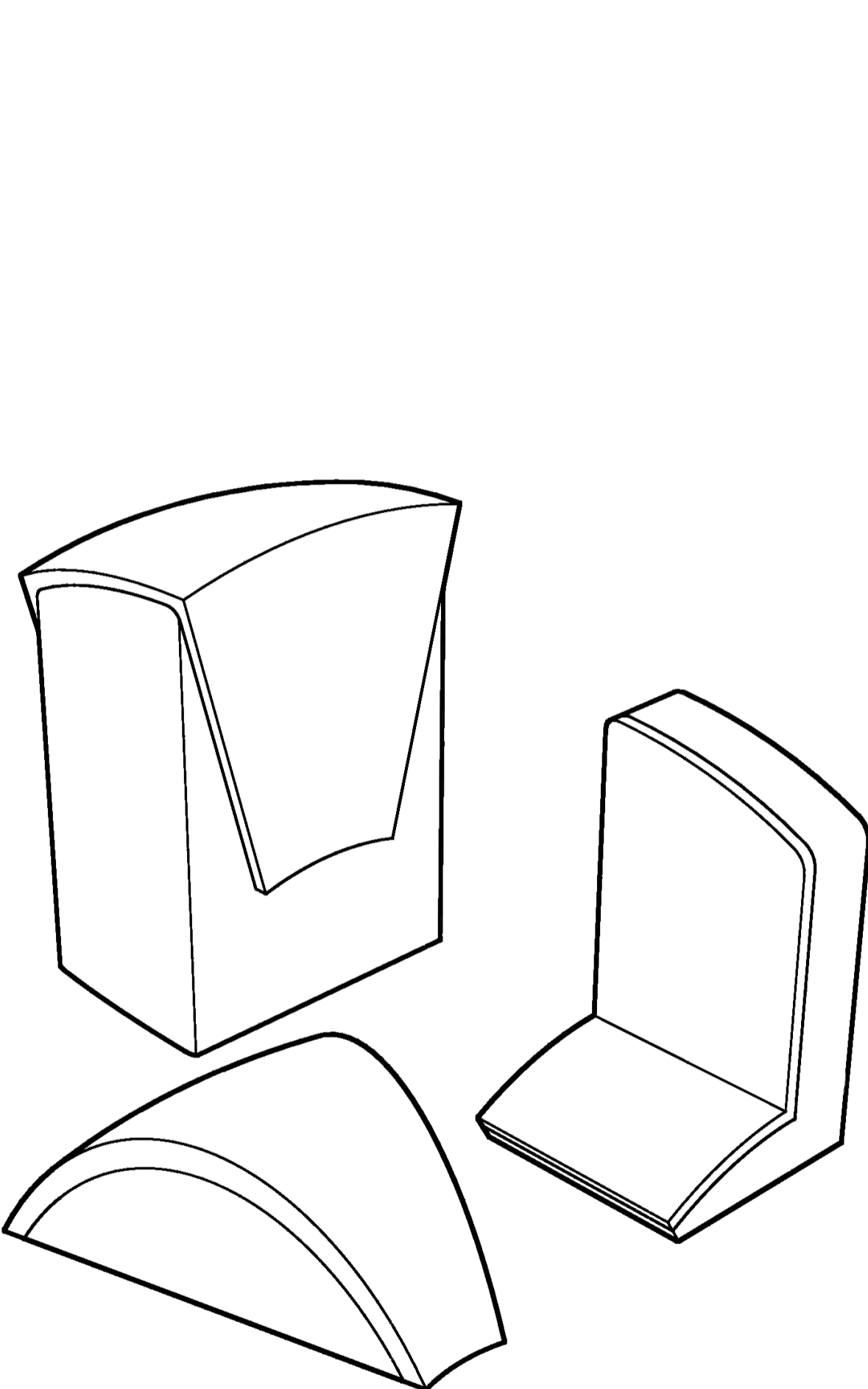


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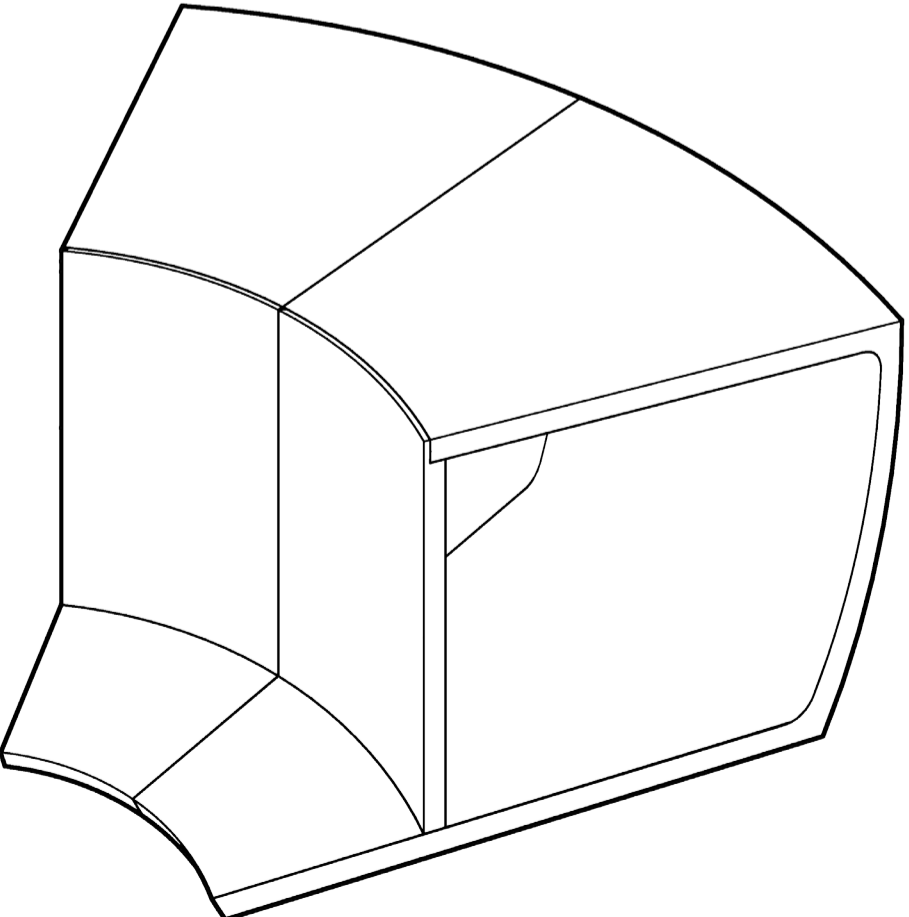
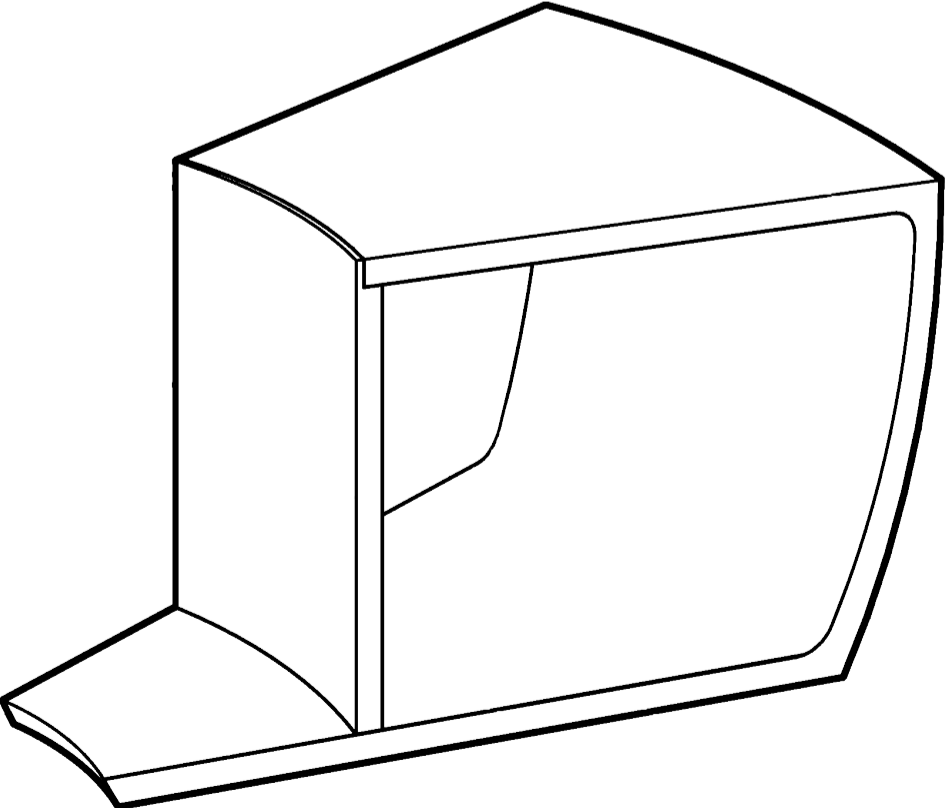
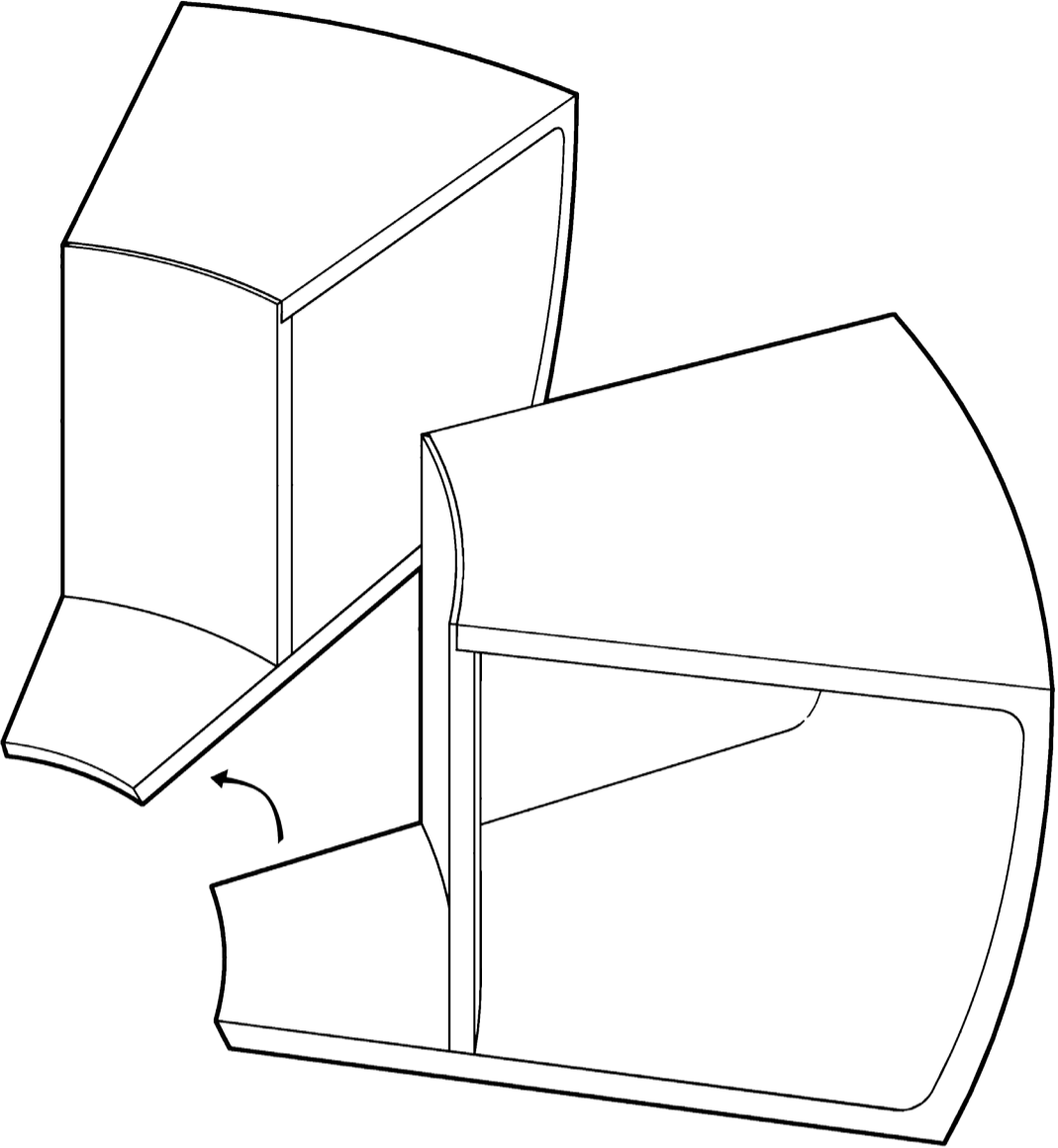
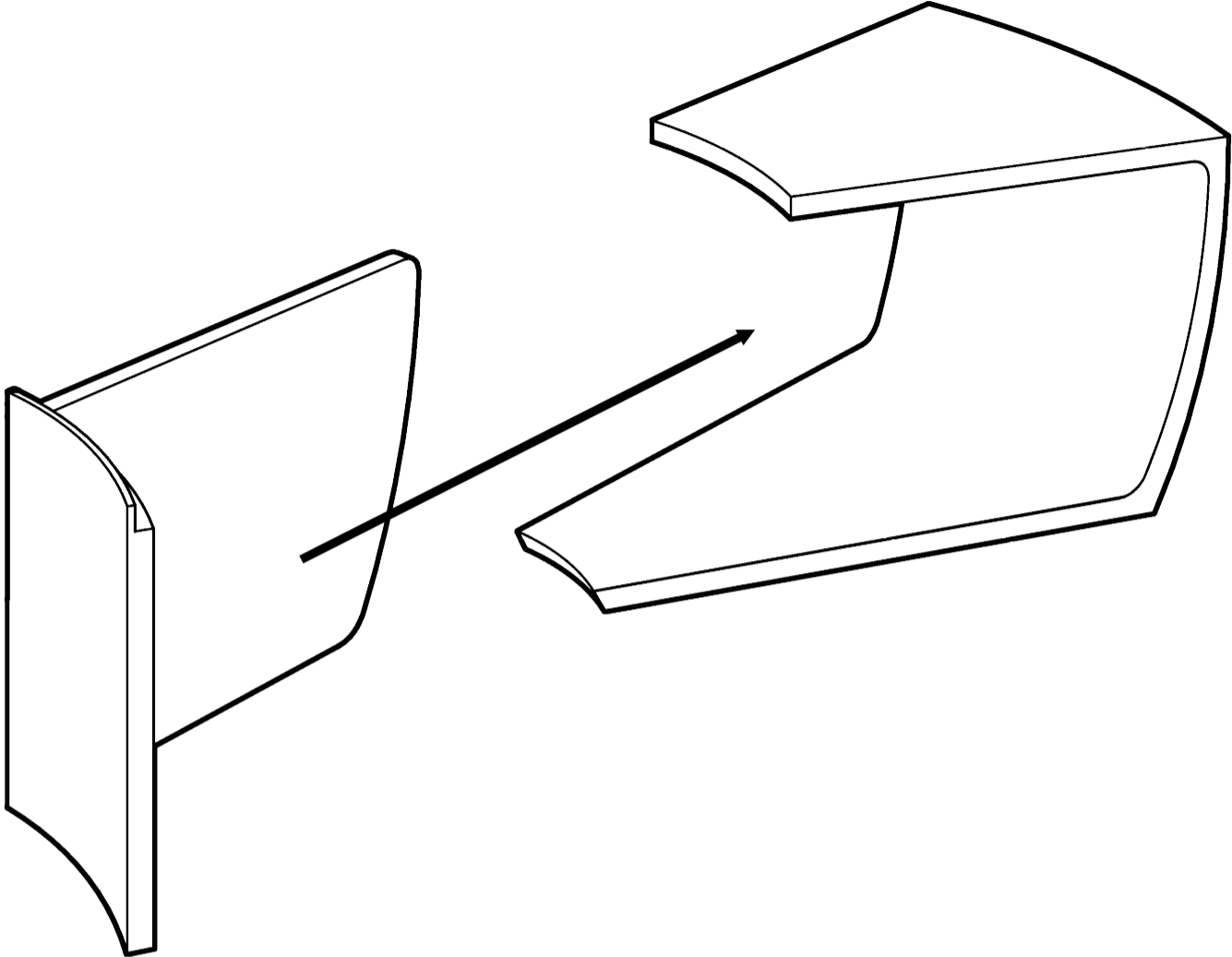


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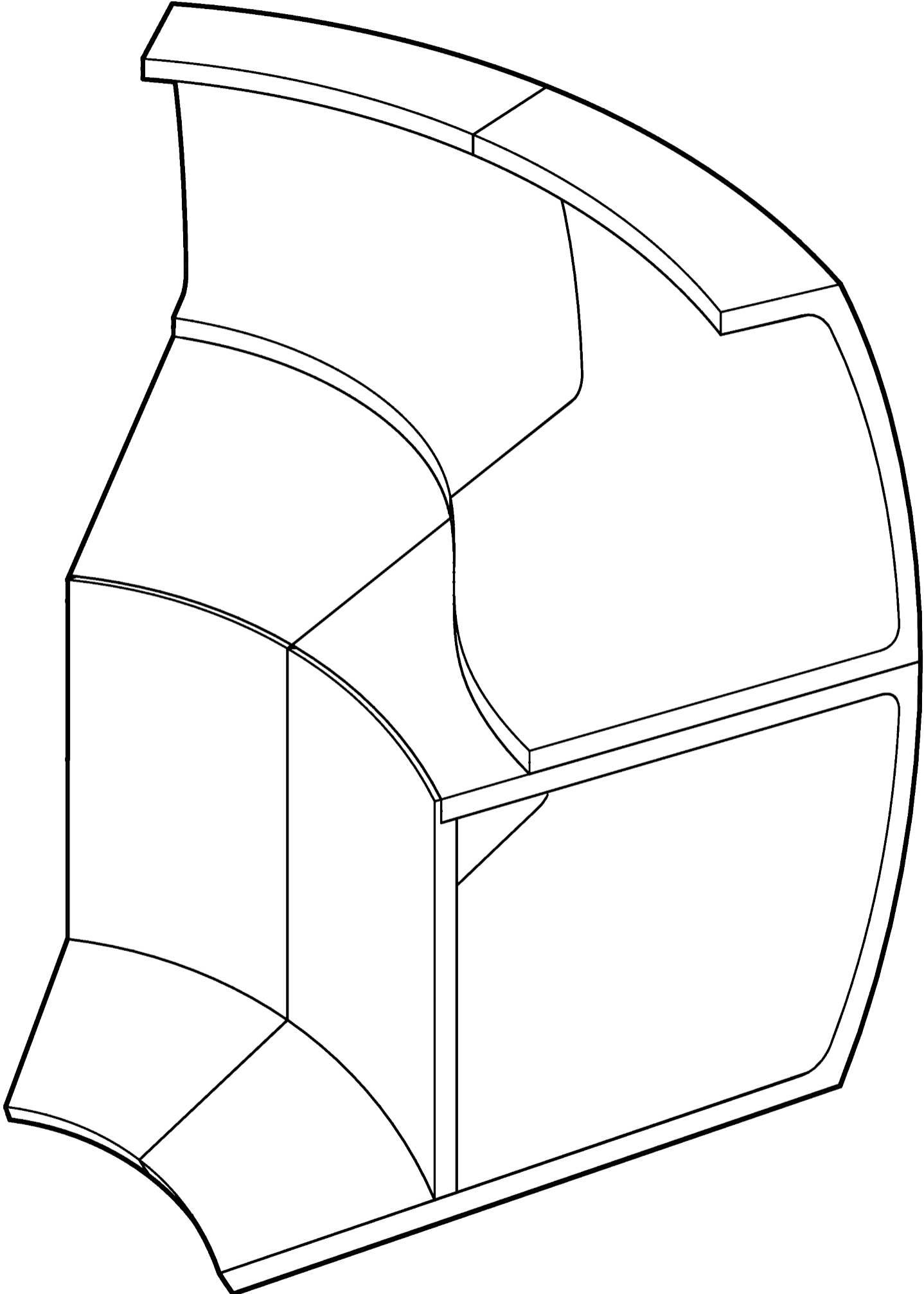
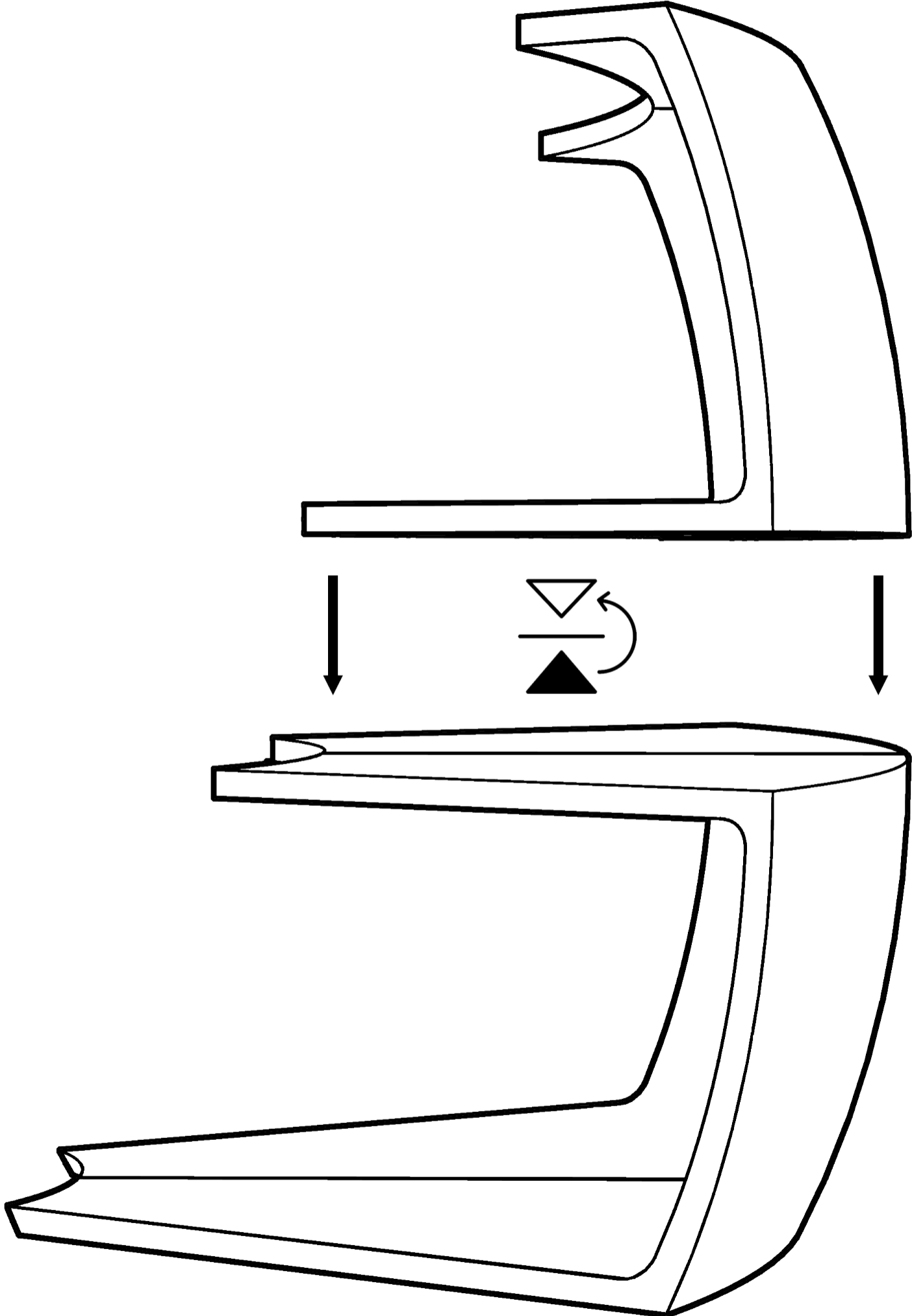
Plug / Mould



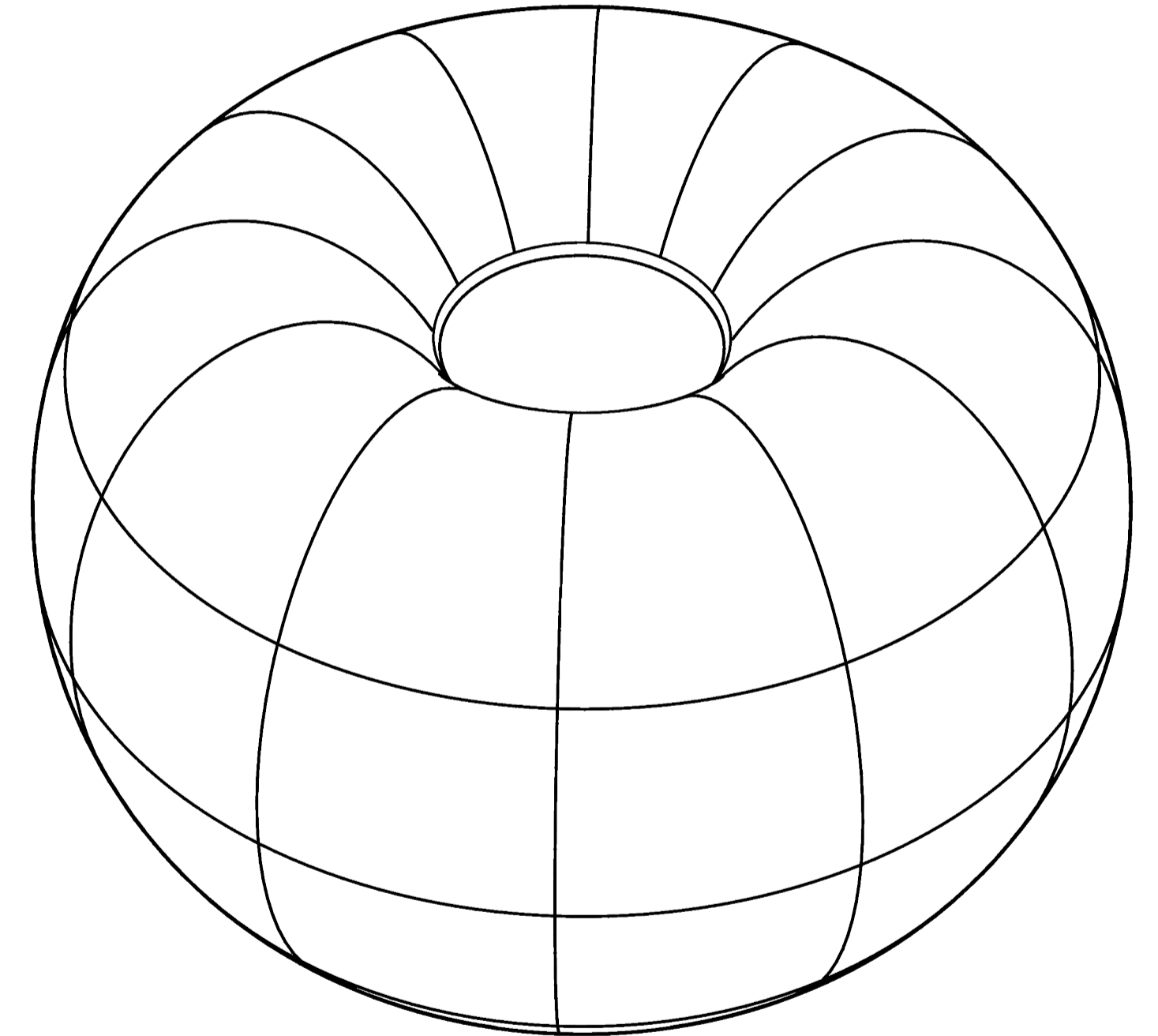
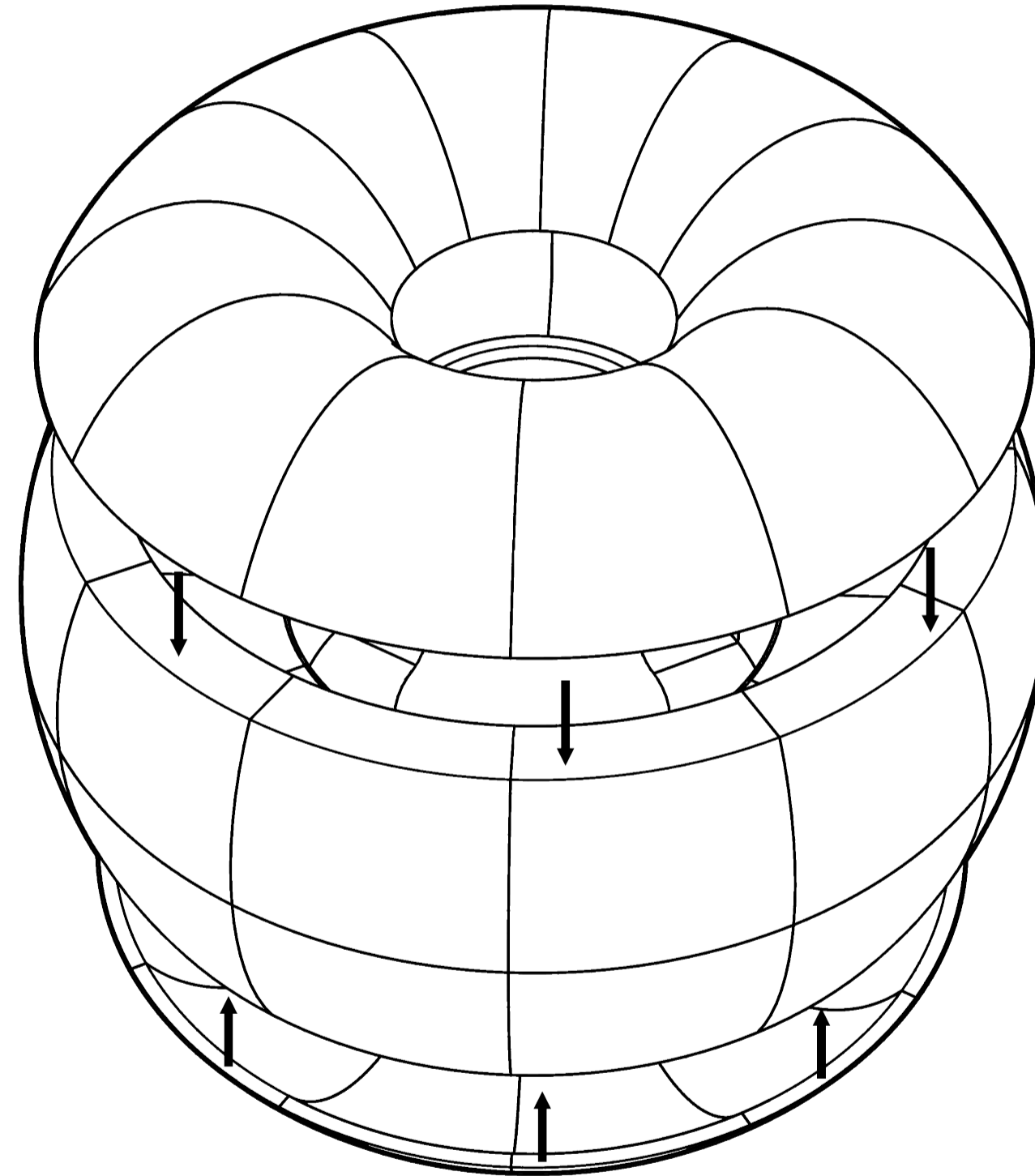
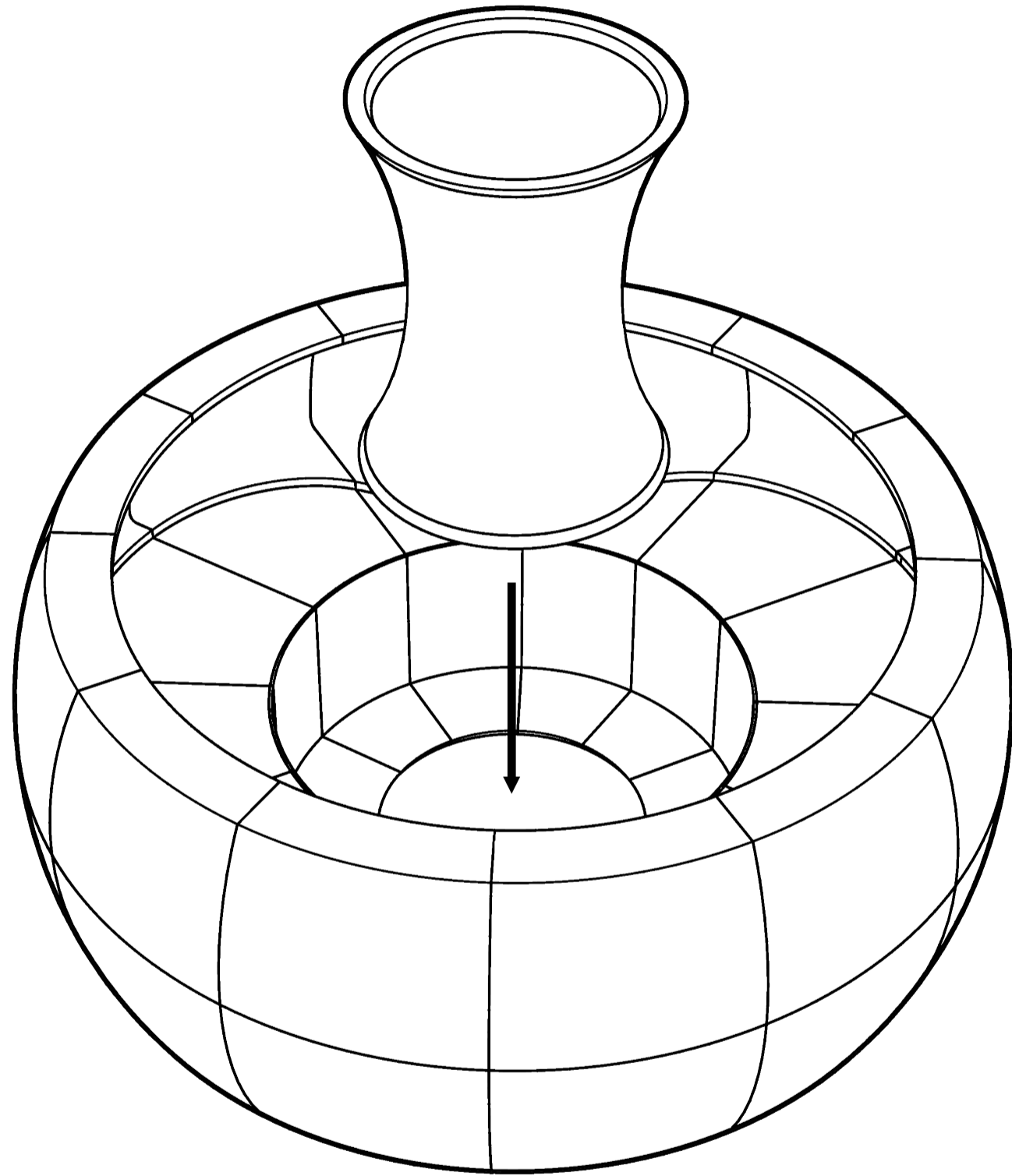
# Component Assembly



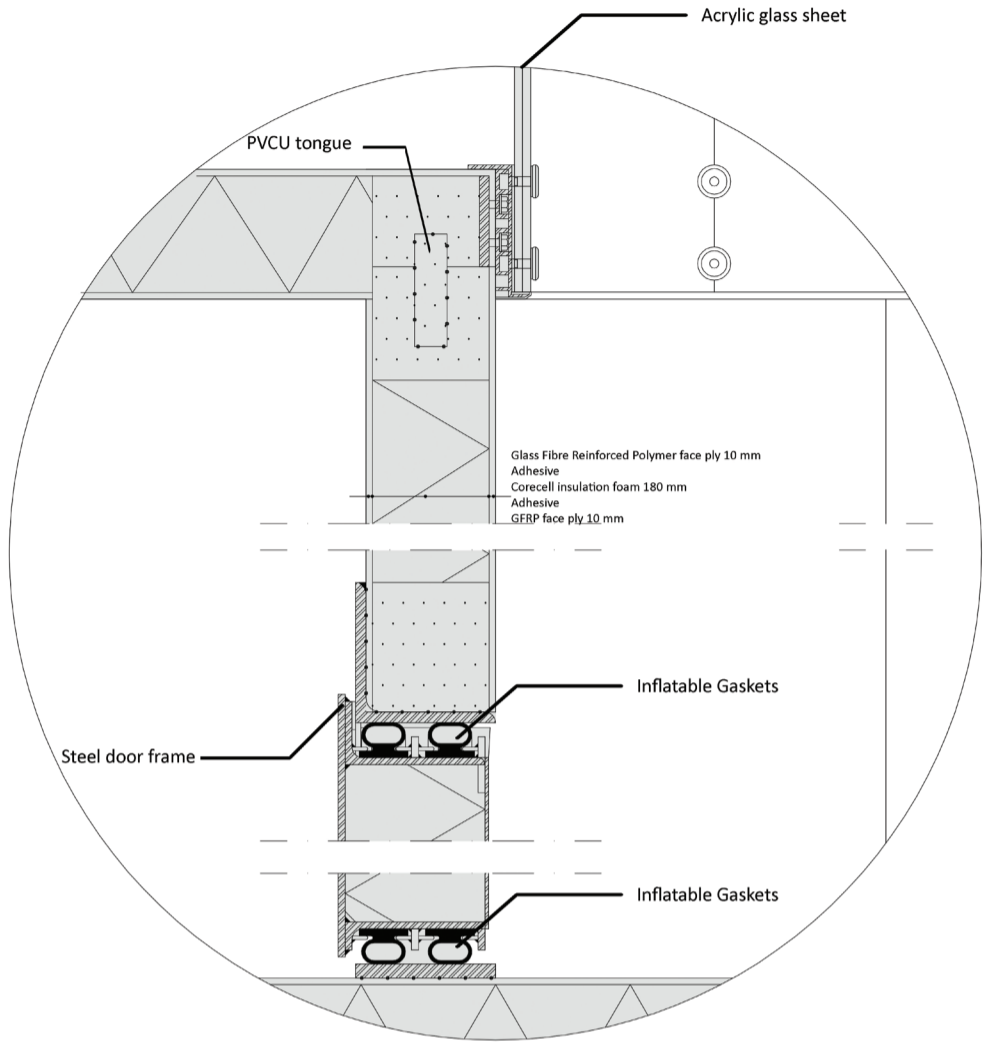
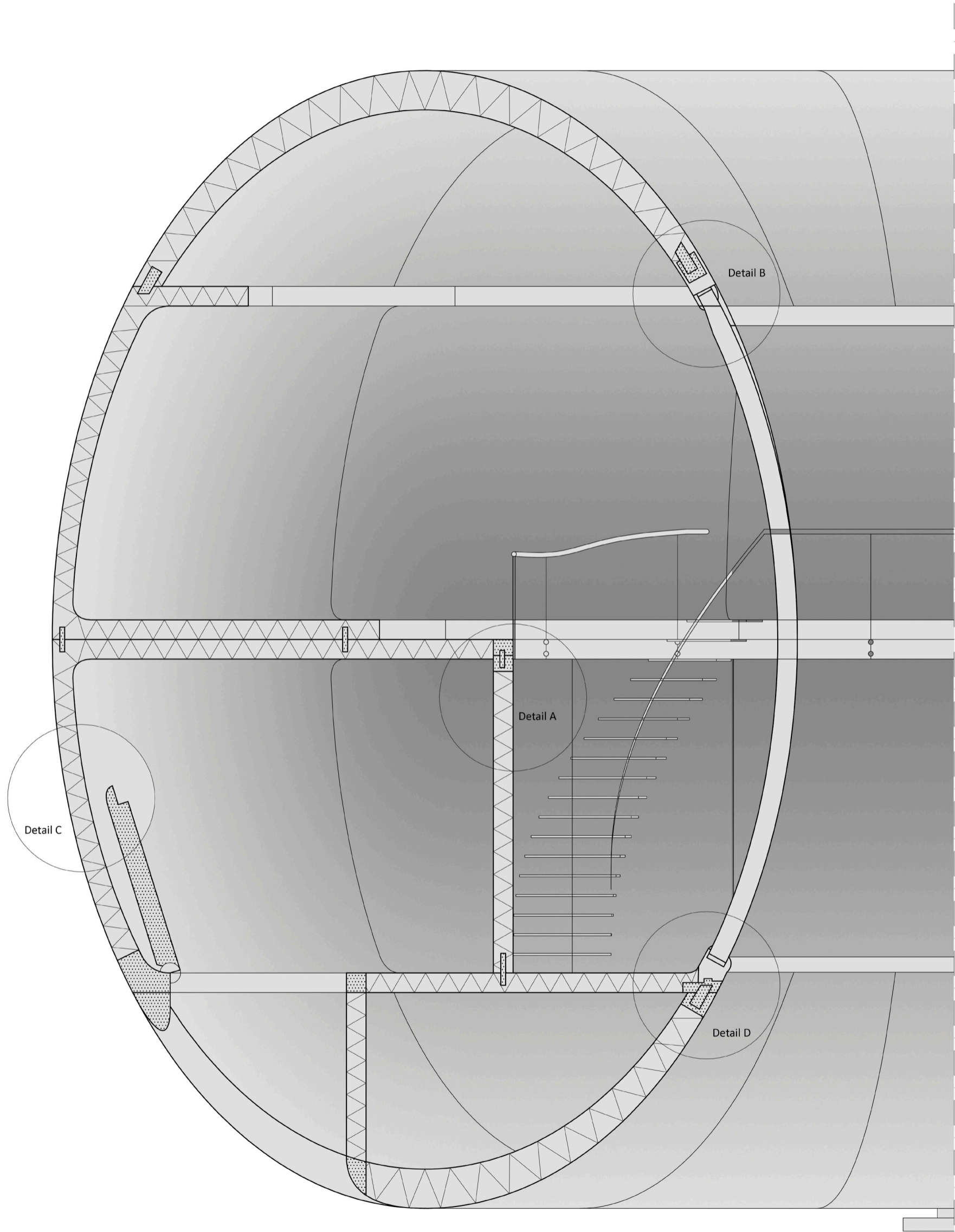
# Component Assembly



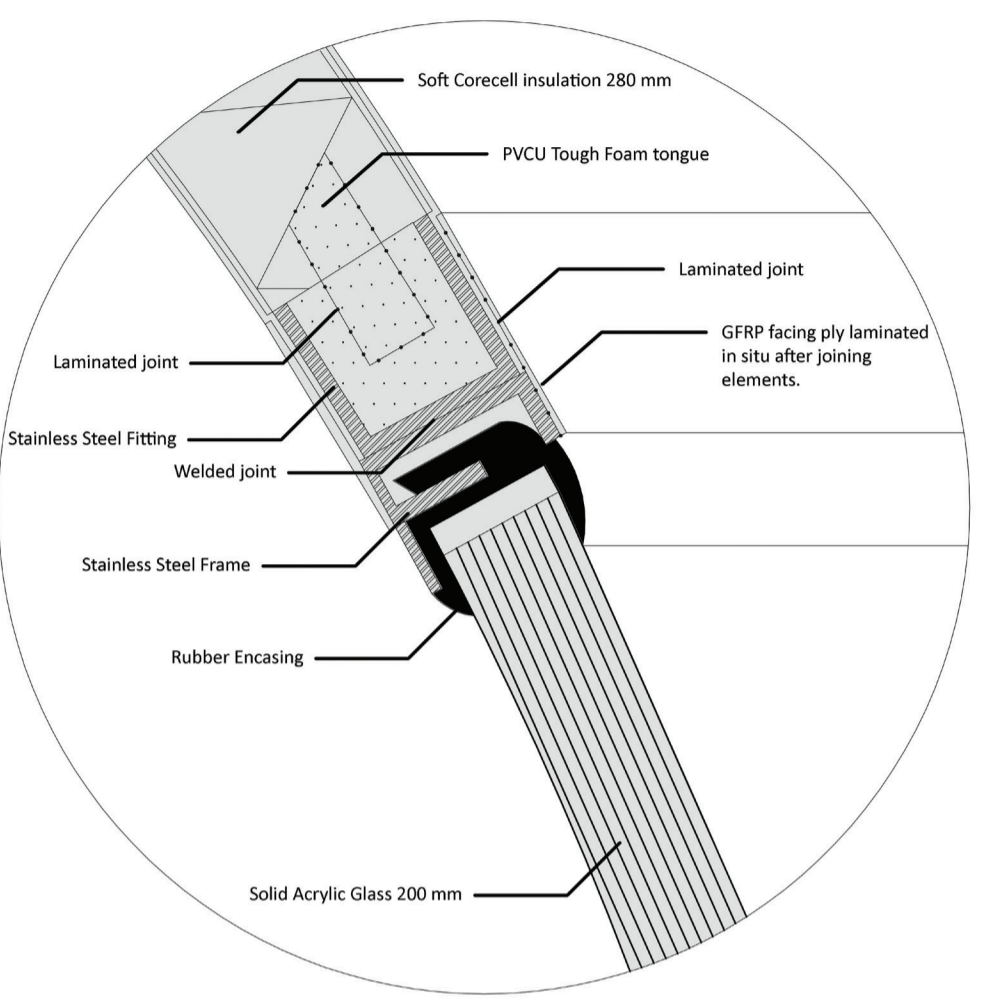
# Assembly Seams



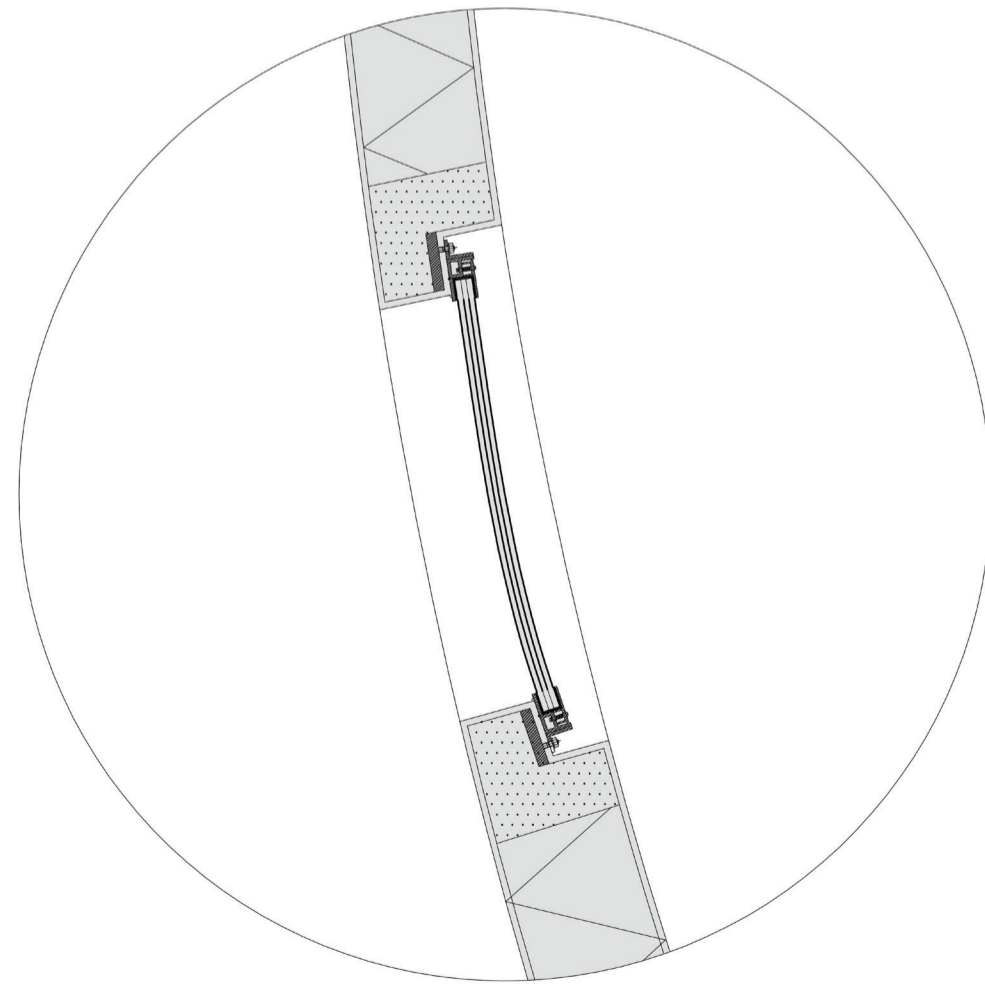
# Section and Details



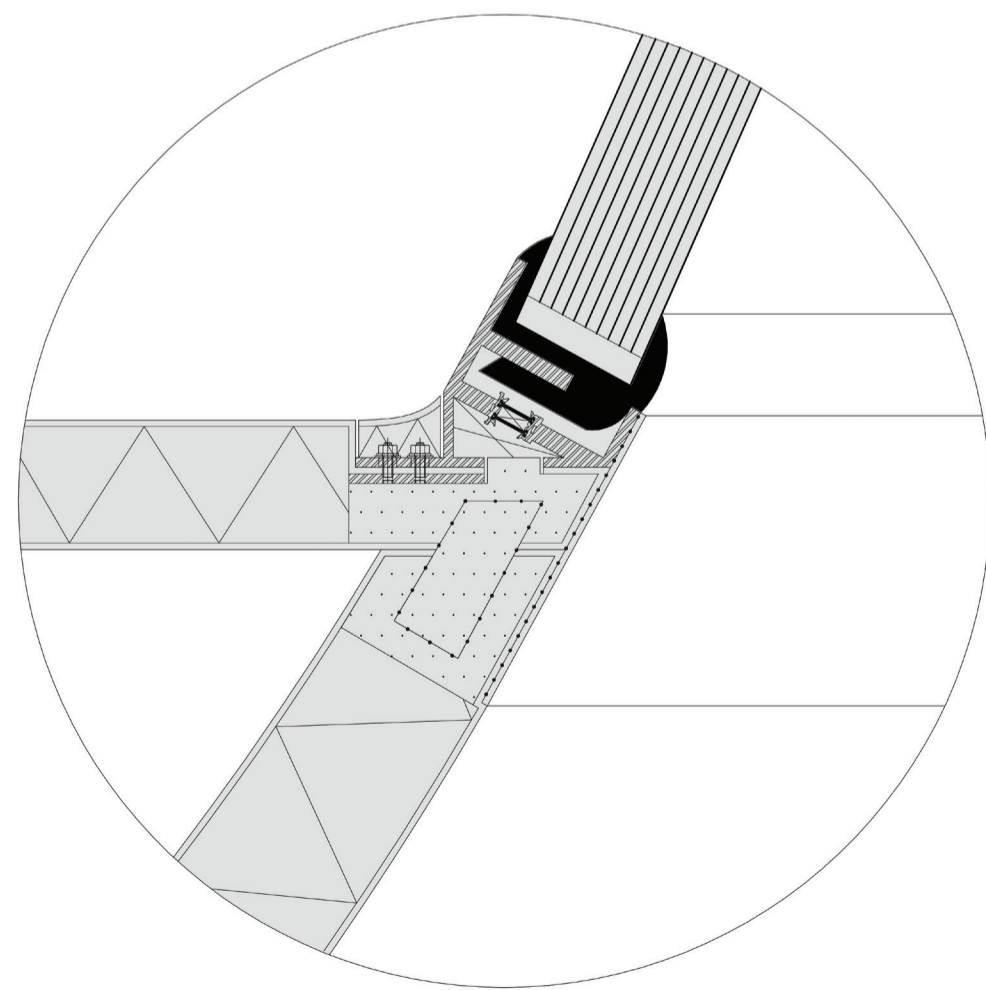
Detail A



Detail B



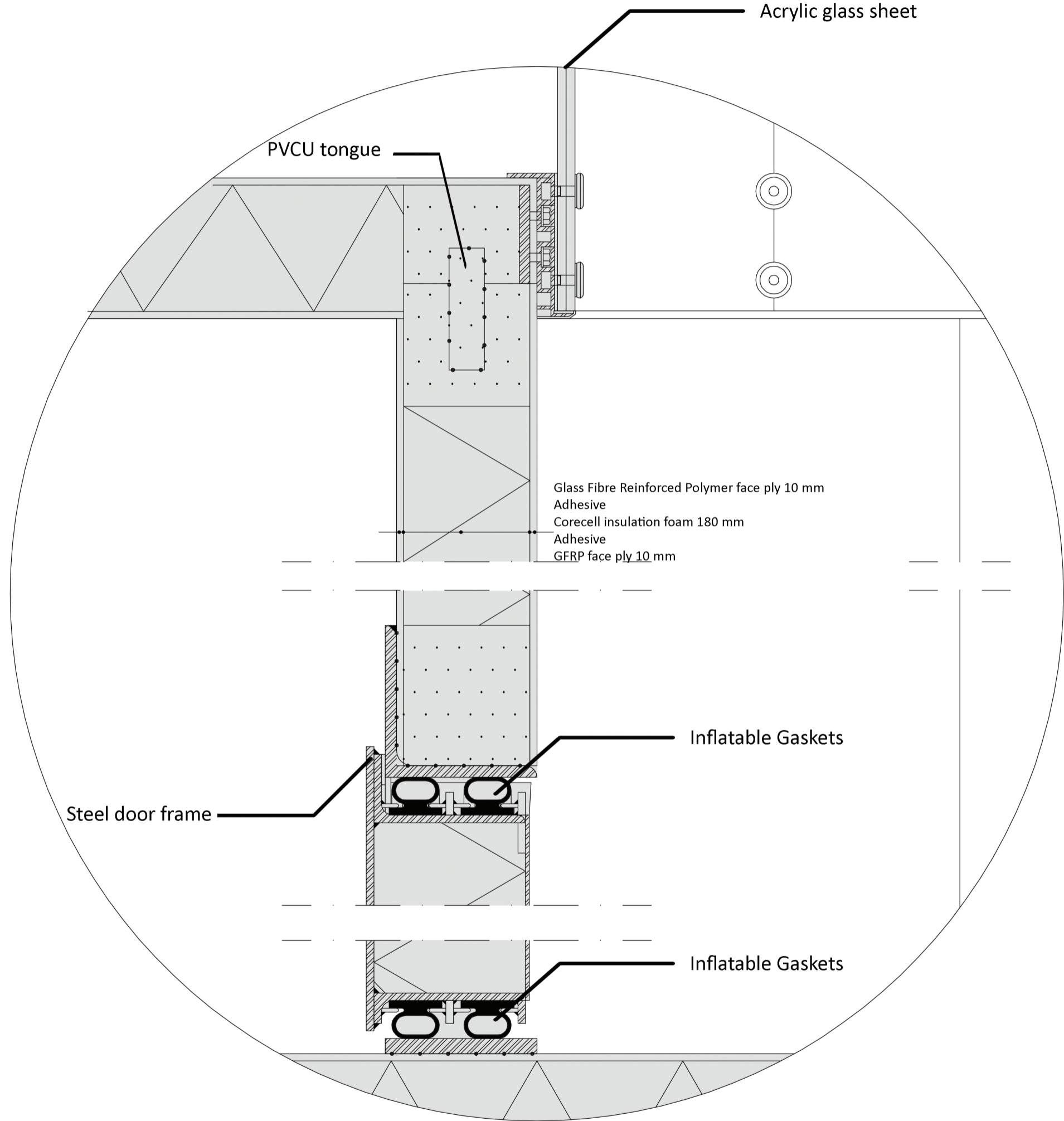
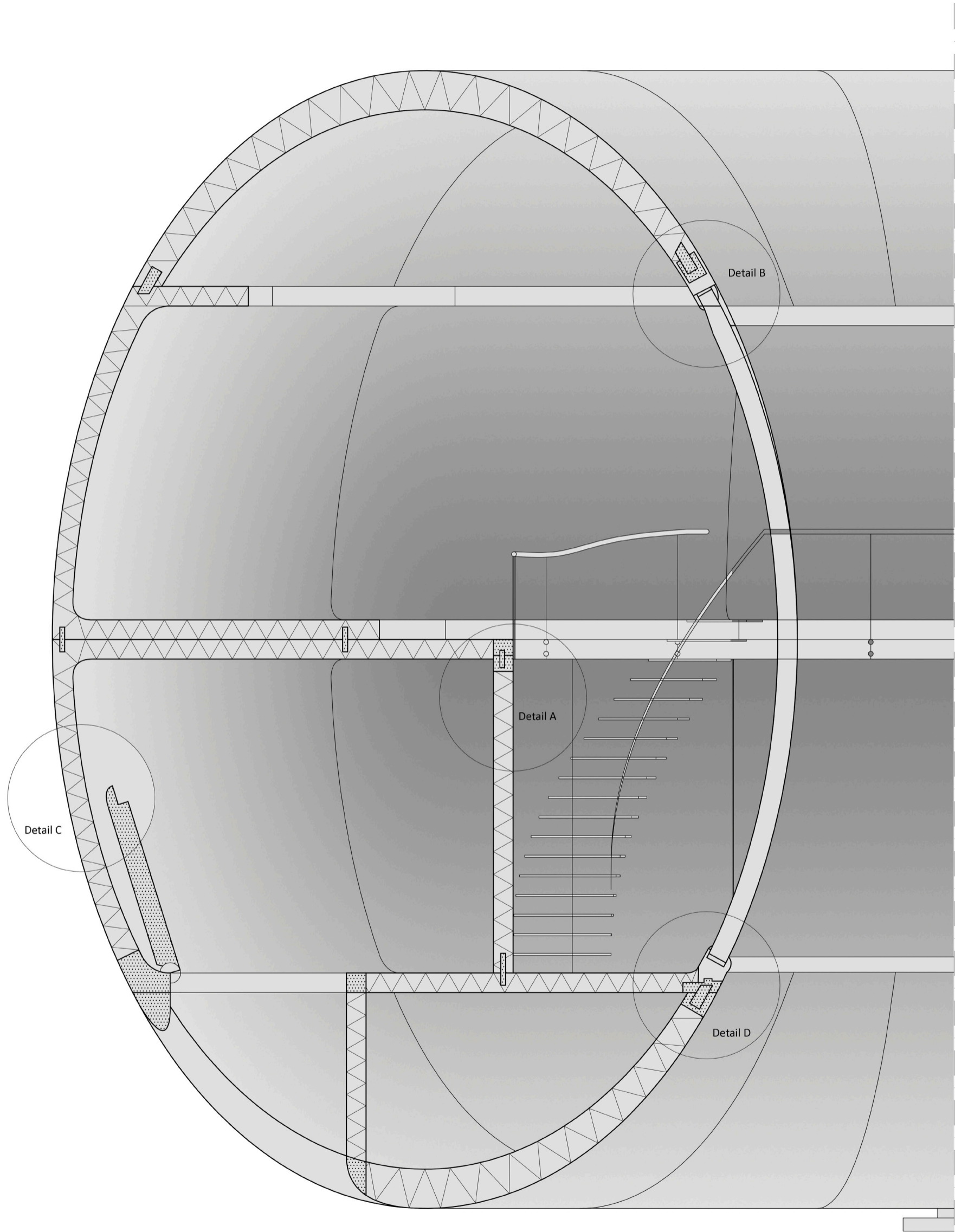
Detail C



Detail D

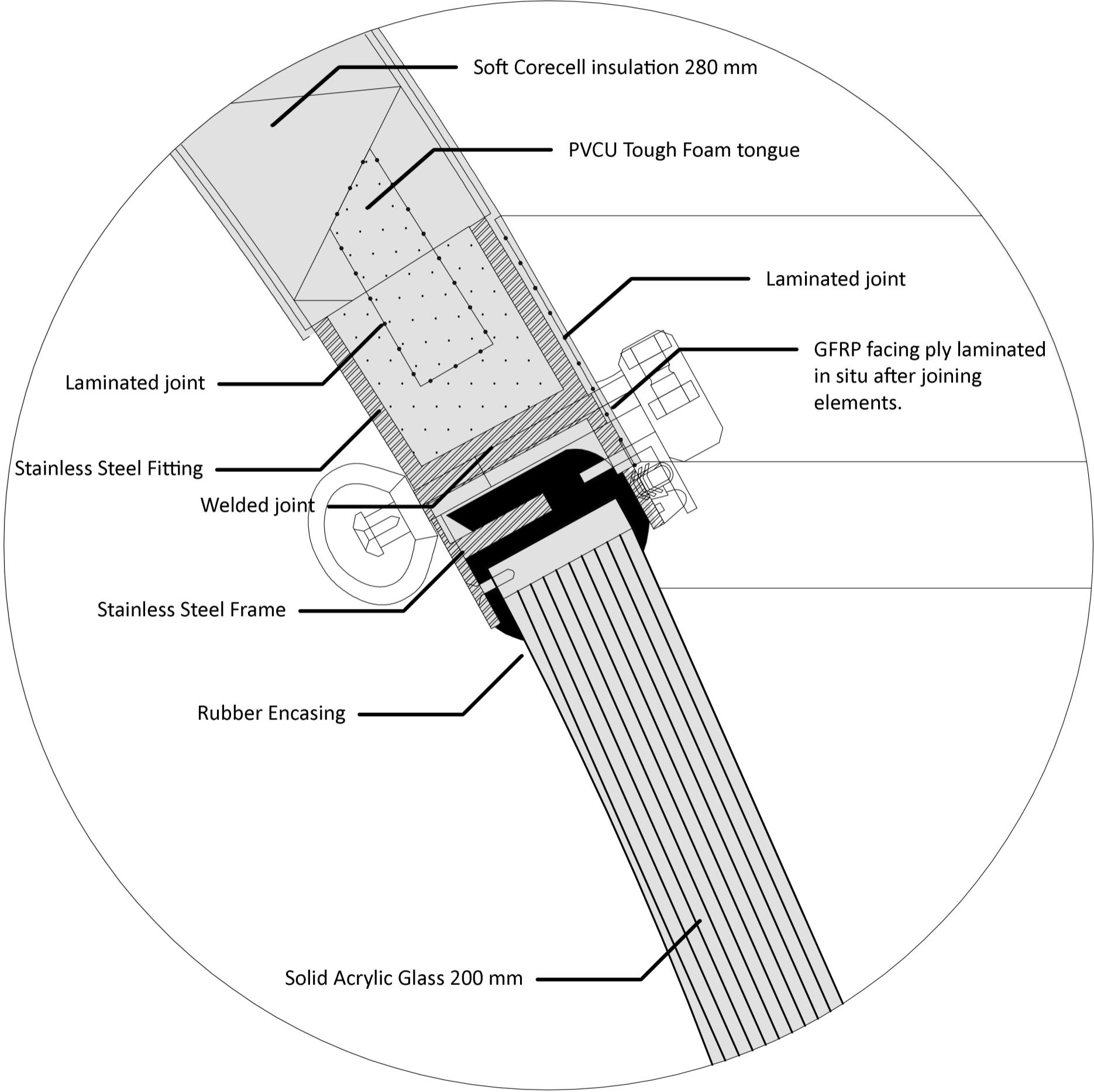
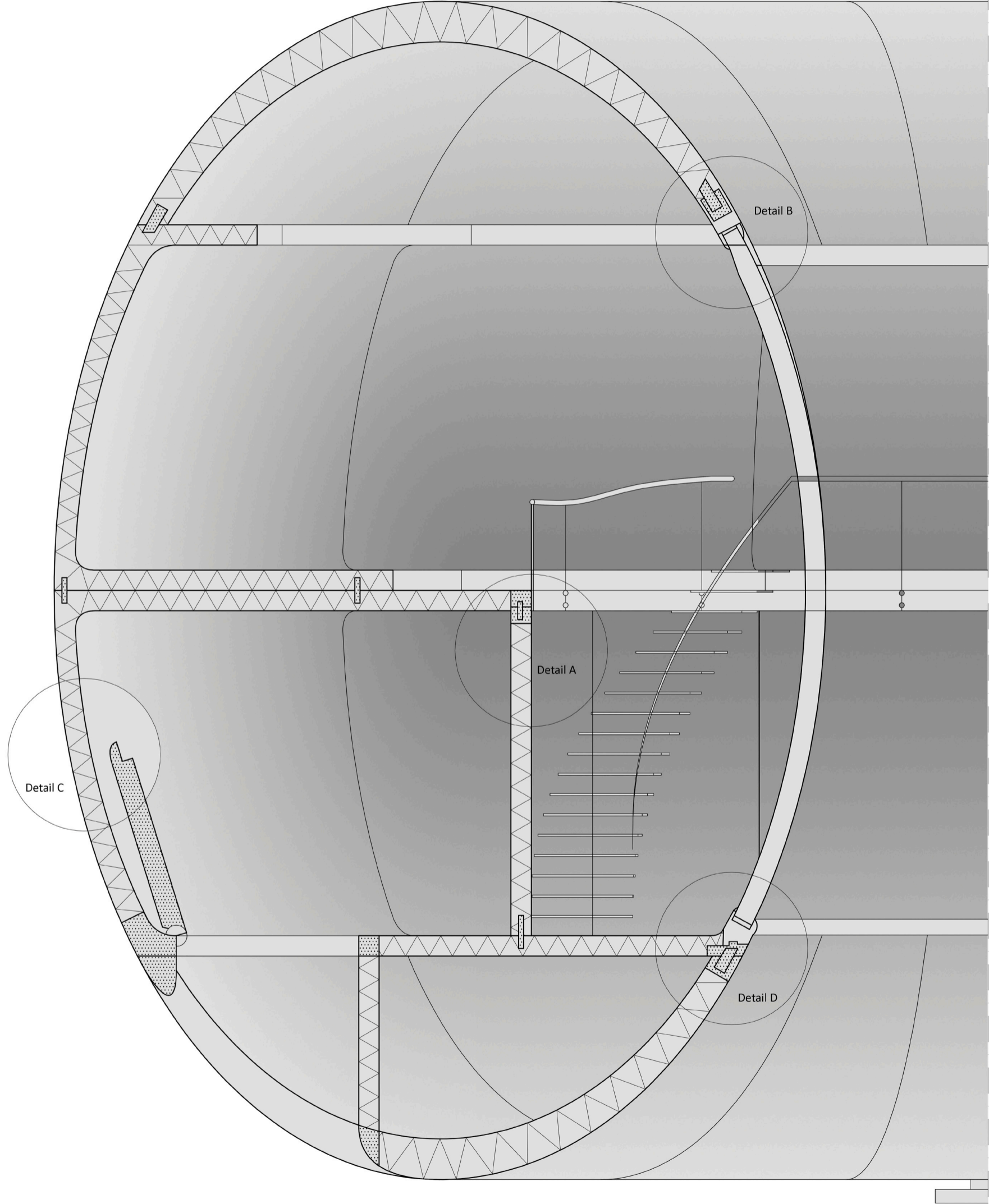


# Detail A 1 on 5



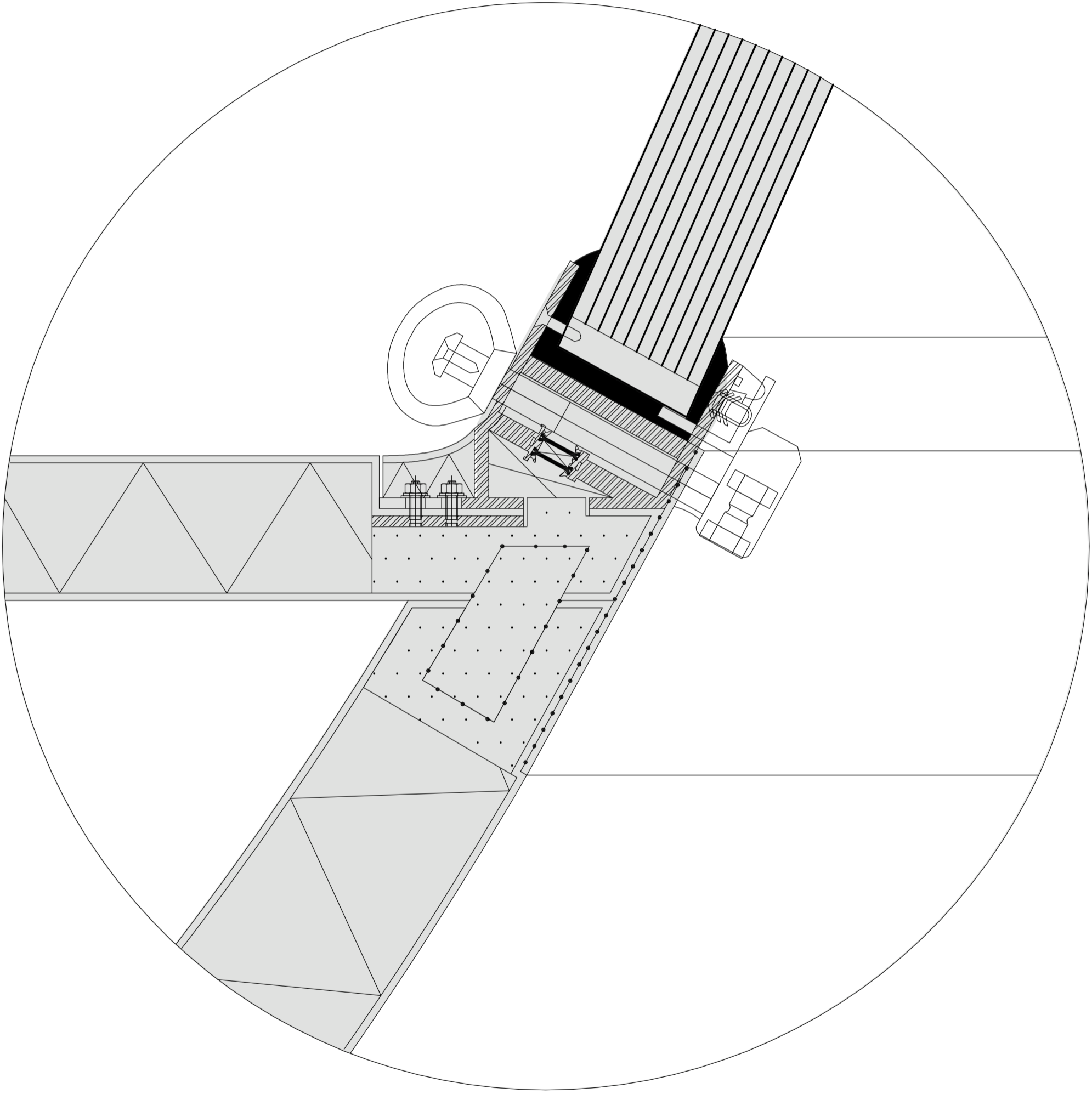
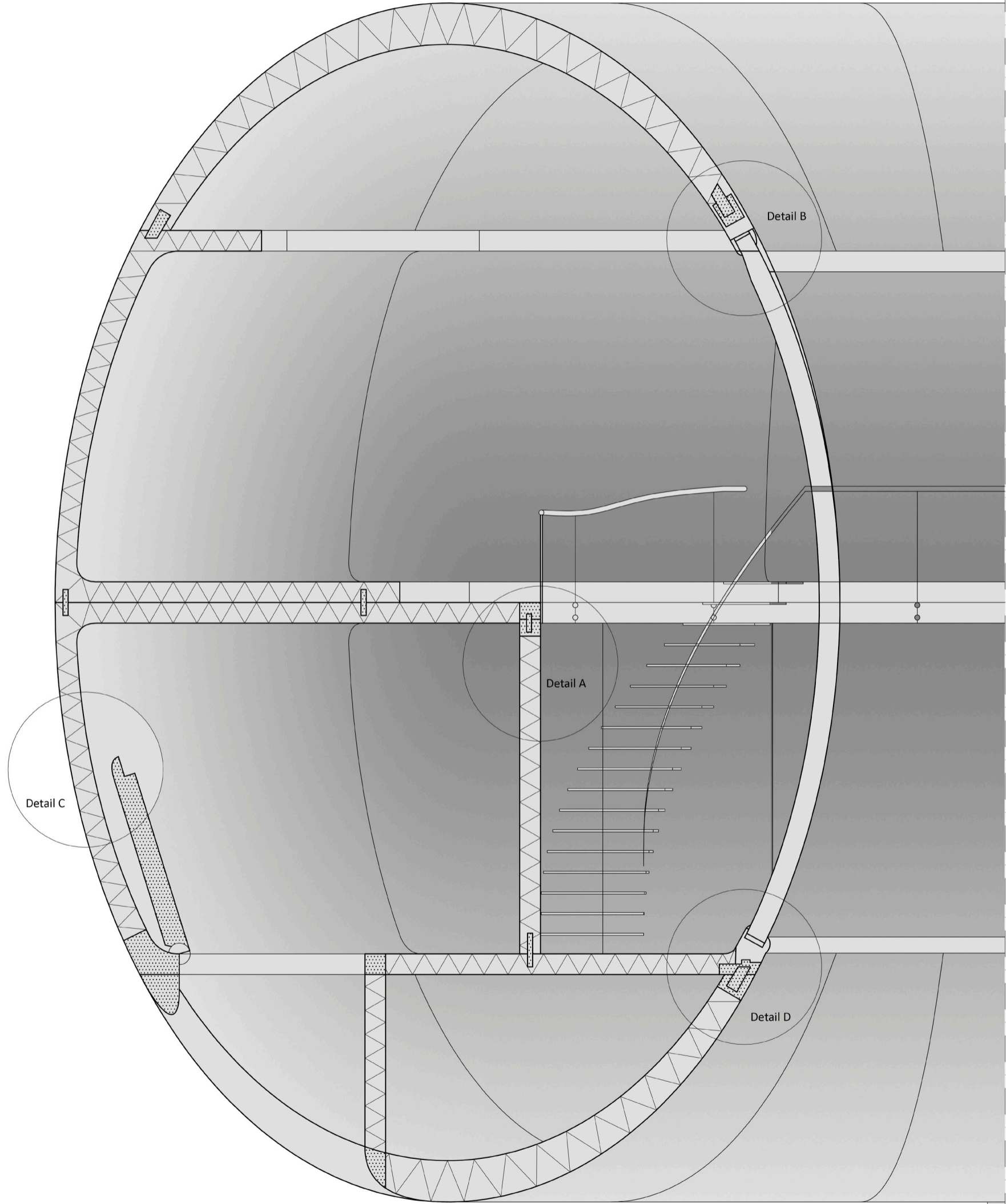
Detail A

# Detail B 1 on 5



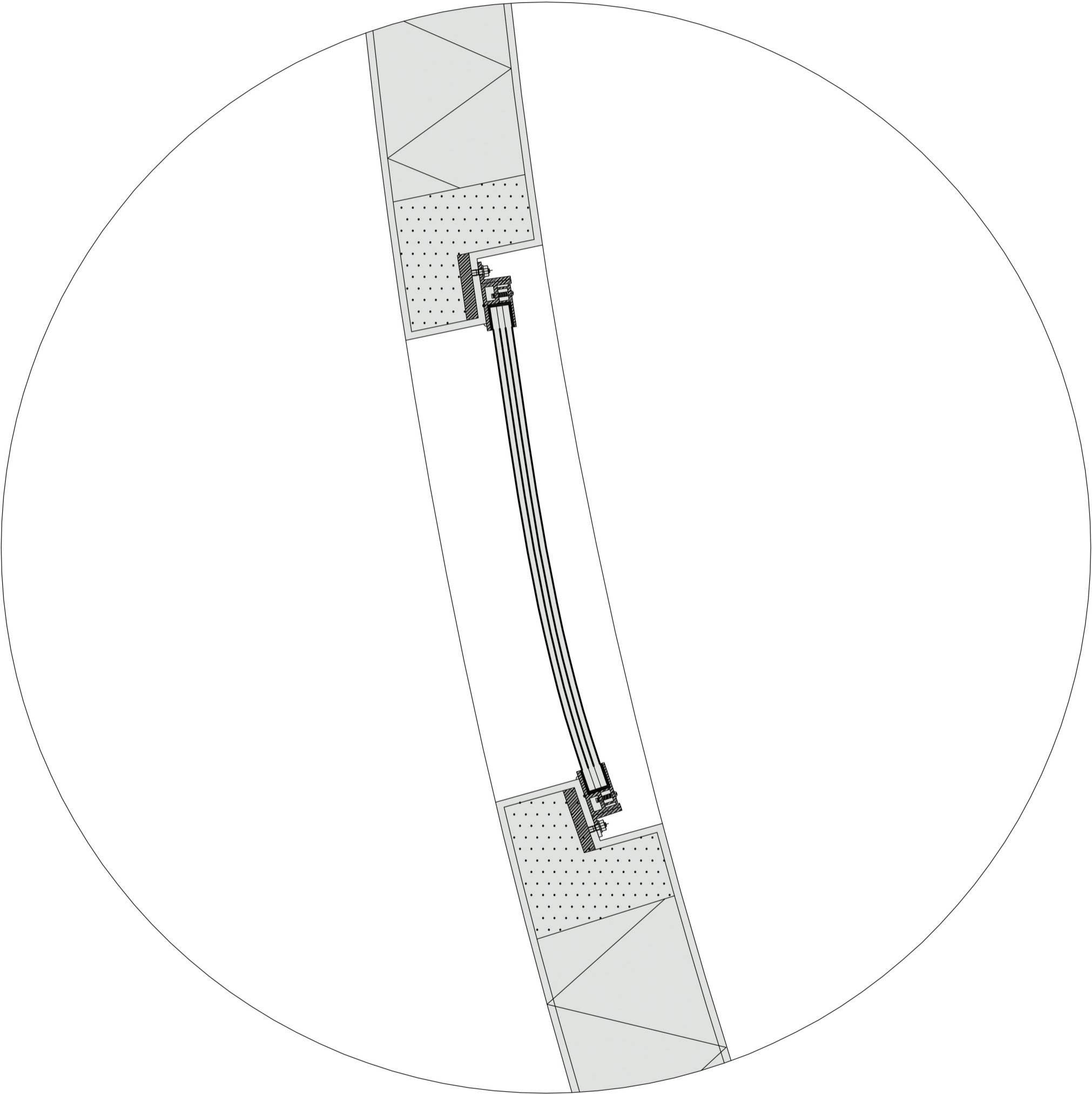
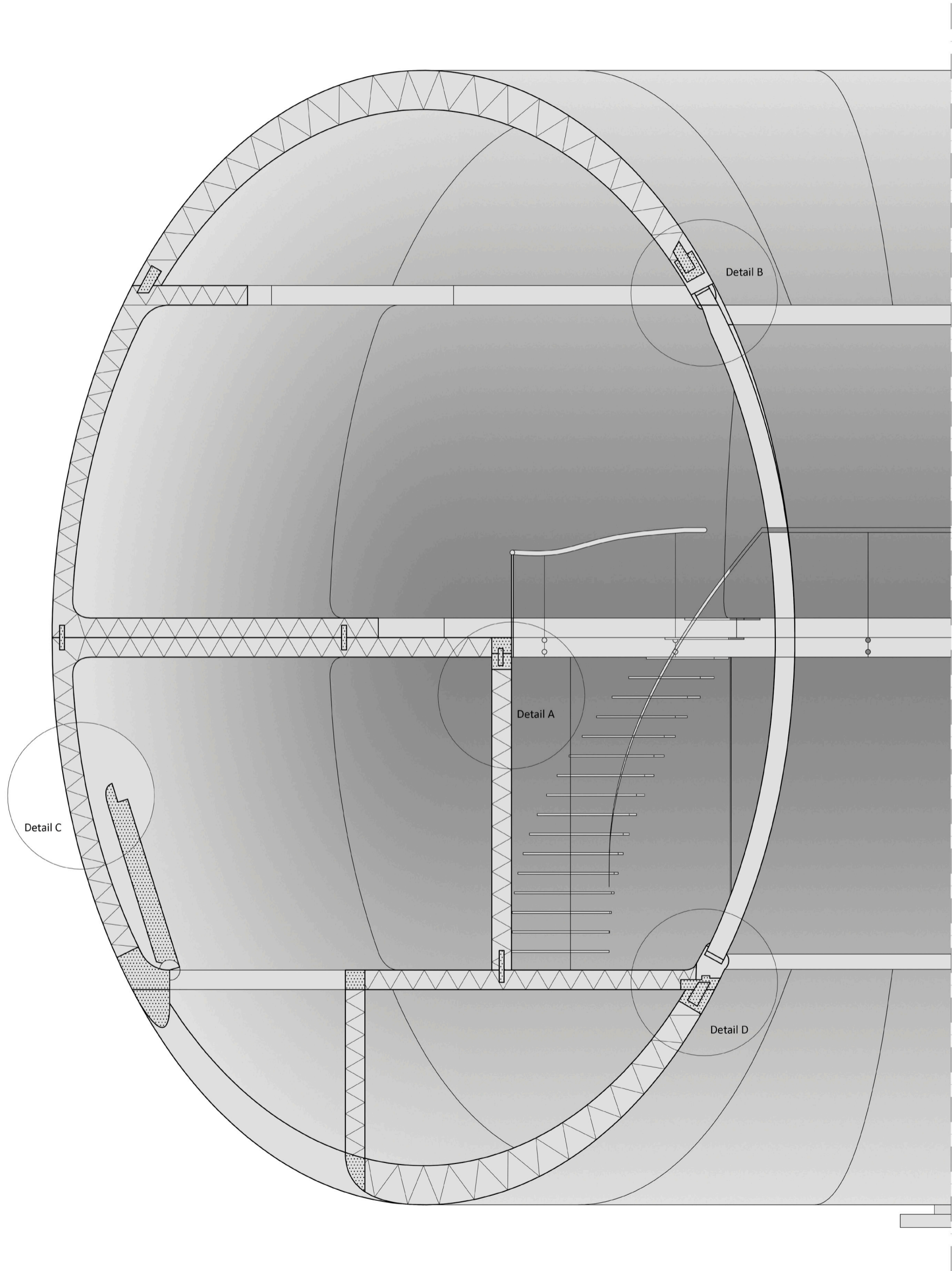
Detail B

Detail D 1 on 5



Detail D

**Detail C 1 on 5**

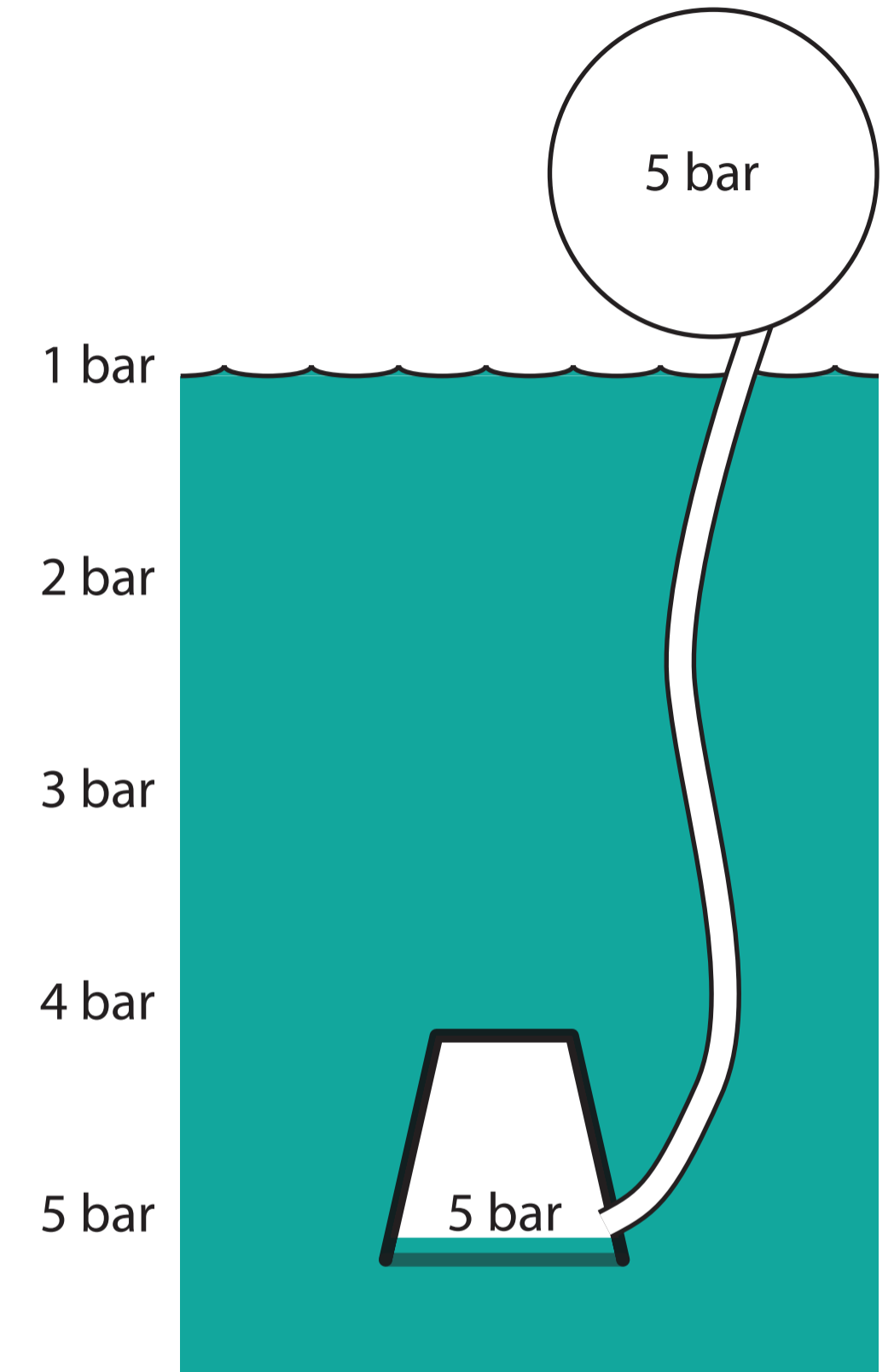
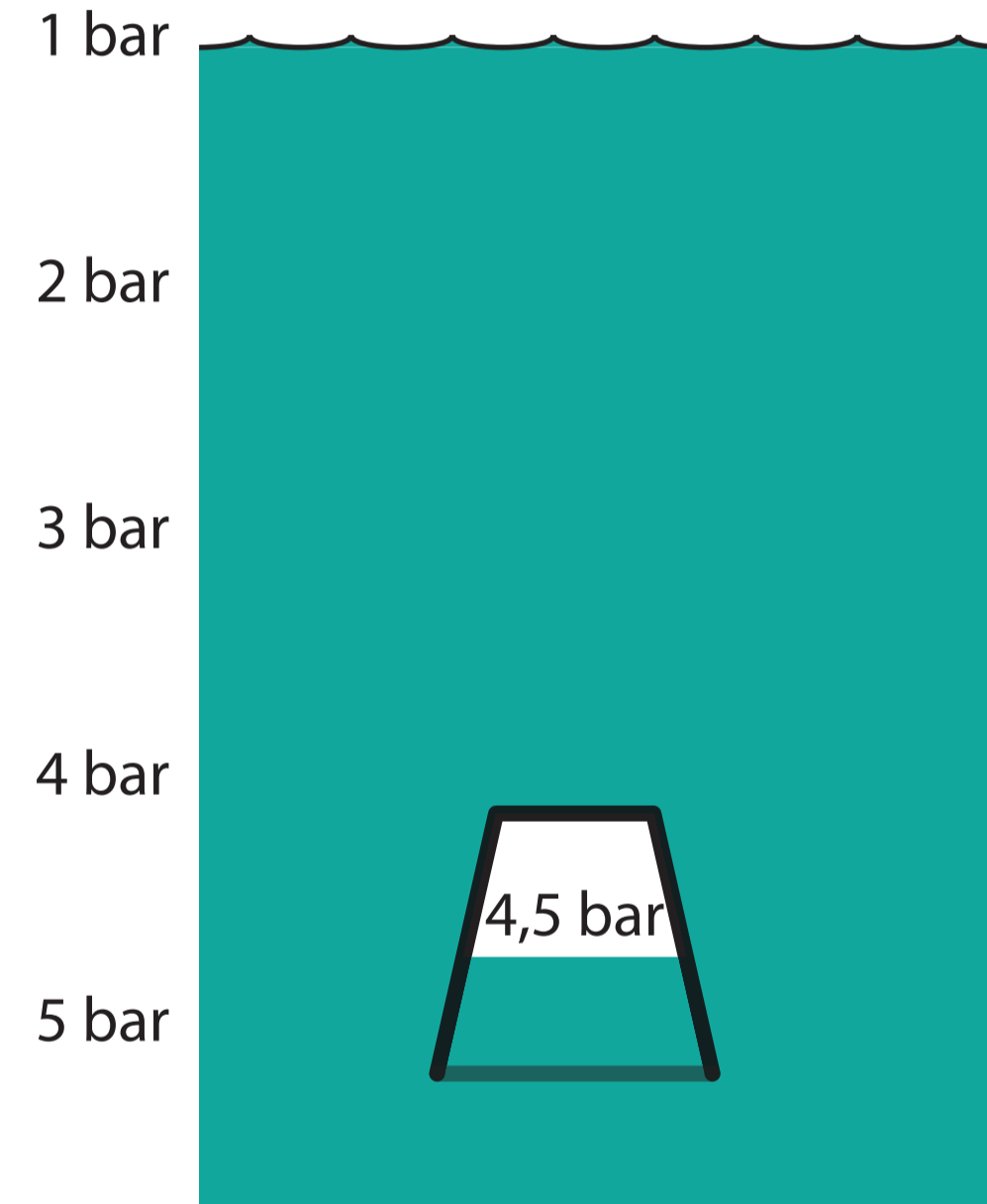
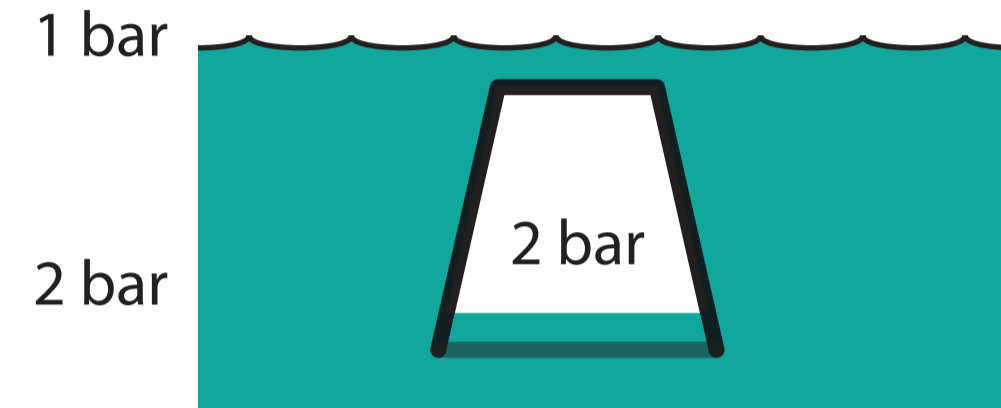
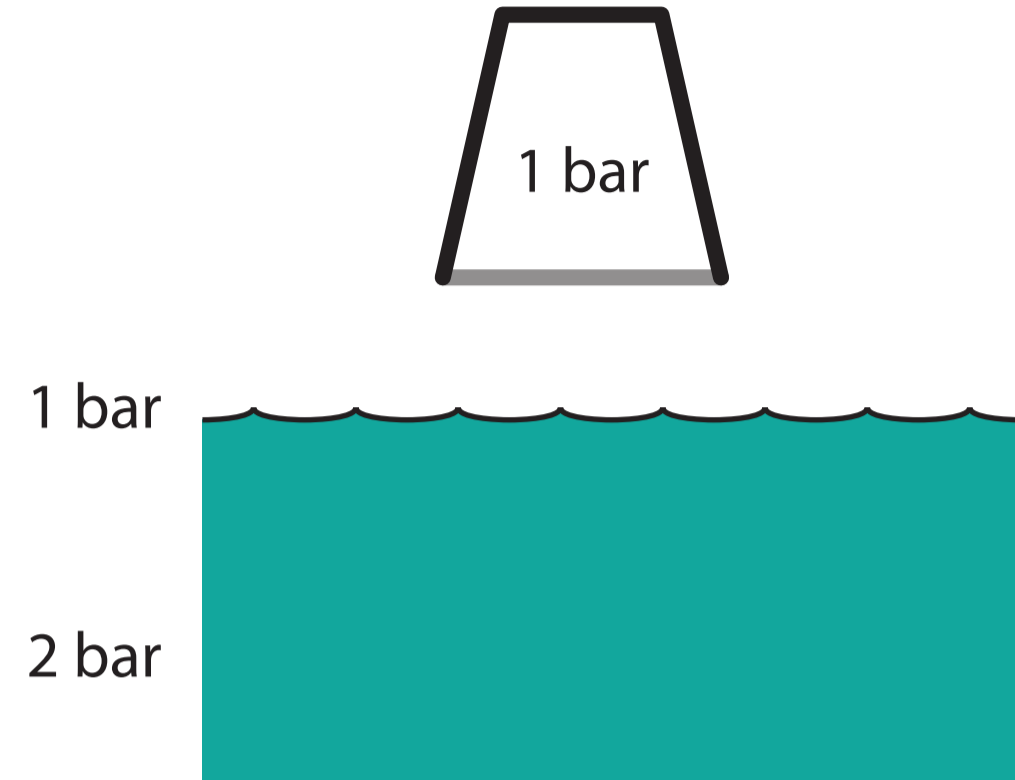


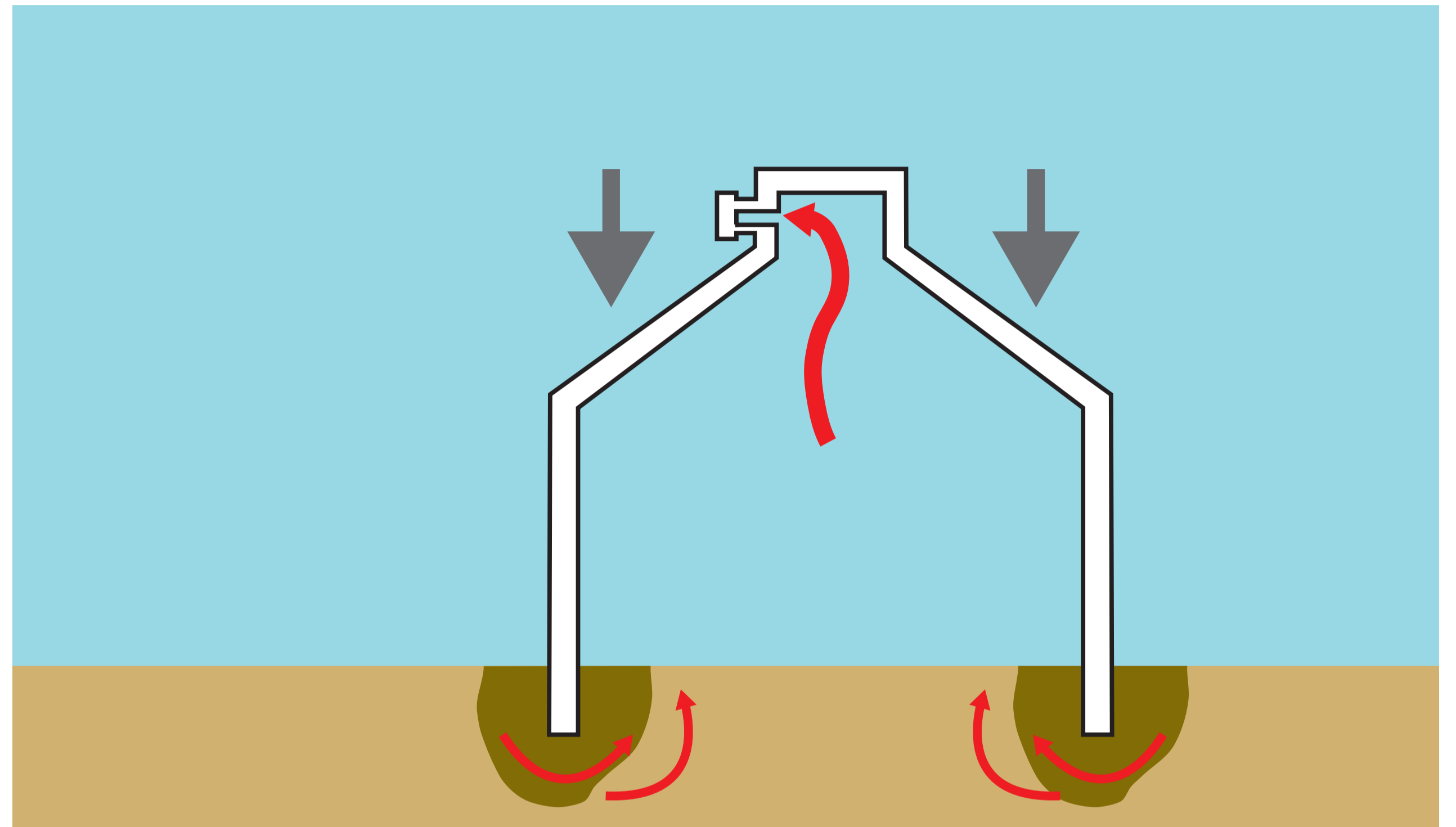
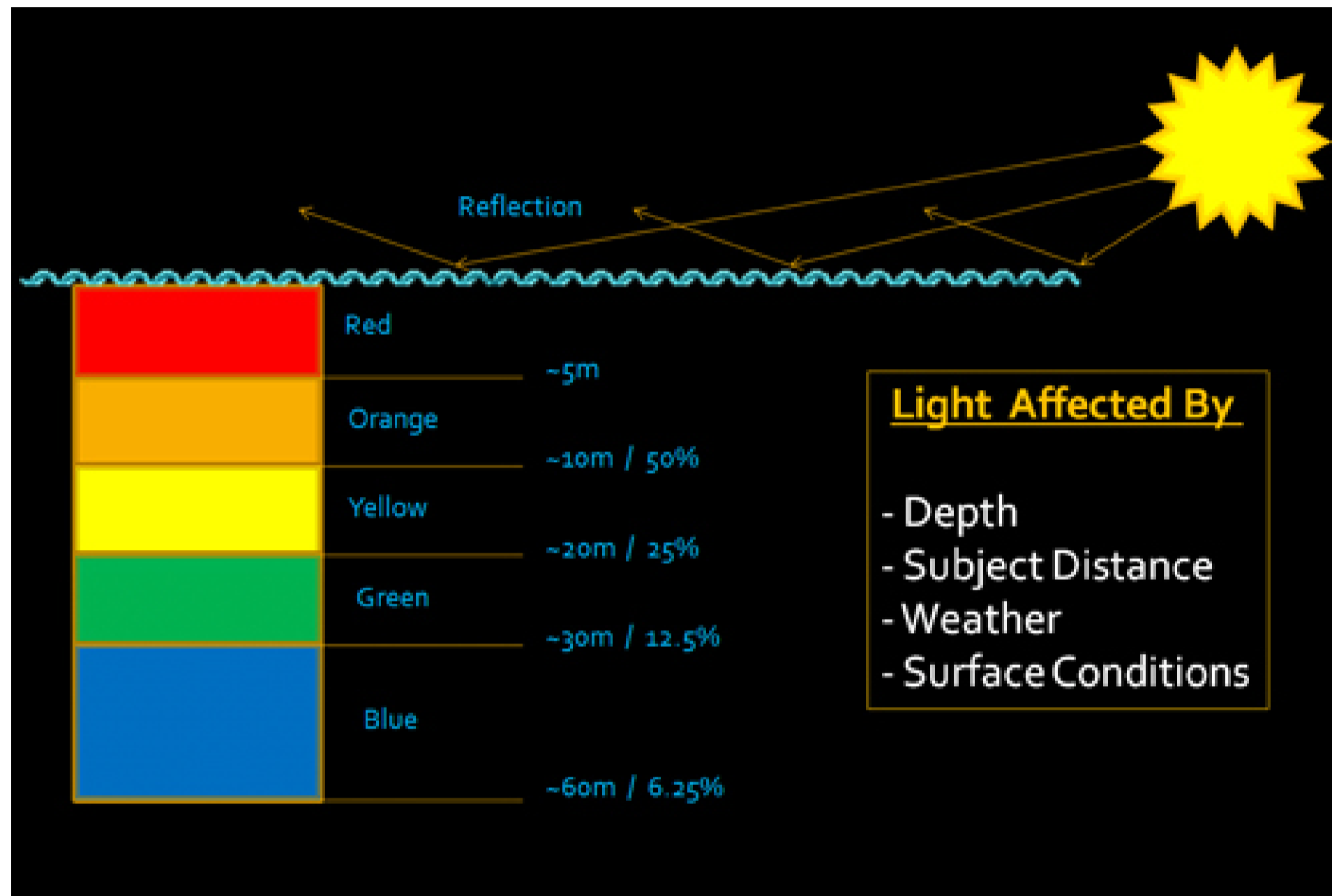
Detail C





Questions?







## Mission Control Centre

- Emergency recompression chamber
- Watch Desk
- Store
- Living accommodations for staff & visitors
- Office space
- Docks

## Life Support Buoy

- Air Compressors
- Generators
- O<sub>2</sub> Storage
- Work Space
- Communication Tower

## *Umbilical*

## Aquarius

- Back up power and oxygen
- Main lock (life support, communications)**
  - Sleeping bunks
  - Kitchen
- Entry lock (life support, communications)**
  - Laboratory
  - Workspace
  - Toilet
- Wet porch (life support)**
  - Shower
  - Umbilical diving
  - Storage

*Excursion line, rope navigation system*

