UNDER THE SEA
An underwater habitat for the human exploration and research of our oceans.

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Welcome

Introduction
- Welcome
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- Methodologies
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Design
- Design Question
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- Sections
- Renders

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Questions
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.
Relevance
What **factors** determine the **shape** of an **underwater structure**?

Technology, Economics, Material, Knowledge, Context, etc.
How to design an **underwater habitat** which can facilitate **saturation diving**, for research of marine life in the **Great Barrier Reef**?

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

The University of Queensland, Heron Island Research Station

Sea level

Mainland

Continental Island

Inner Reefs

Outer Reefs

Continental Shelf

Fringing Reefs

Fringing Reefs

Fringing Reefs

Introduction

Research

Design

Architecture

Technology

Questions
Starting Points

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

**Program** - Spacious, privacy.

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

Introduction
Research
Design
Architecture
Technology
Questions

Integated Ducts

Umbilical
Compressed Air
Power
Communications

Generators
Compressors

Emergency:
Power & Air

Storage:
Water
Waste

Sea Bed

WIFI

LSB

CO2

H2O

Heat

Scrubber

Production
CO2 H2O Heat

Dehumidifier

Air Mixture

H2O

Heat

O2
O₂ is supplied to the air. Air circulates. CO₂ is removed. Air is recycled and heated/cooled. O₂ is supplied to the air. Umbilical power.
Architecture
Ground Floor
Glass Fibre Reinforced Polymer Sandwich Composite

**What are the properties of a sandwich construction?**

<table>
<thead>
<tr>
<th>Solid material</th>
<th>Core thickness 1</th>
<th>Core thickness 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stiffness</td>
<td>1.0</td>
<td>37.0</td>
</tr>
<tr>
<td>Flexural strength</td>
<td>1.0</td>
<td>9.2</td>
</tr>
<tr>
<td>Weight</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**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.

**Glass Fibre Reinforced Polymer**

**PVCU Tough Foam Reinforcement**

**Corecell Soft Foam**

**ADHESIVE**
Resin Infusion Method

1 Resin
2 Lower part of mould
3 Upper part of mould
4 Spacer
5 Layers of fibre reinforcement
6 Finished laminate
7 Heating
8 Release agent
9 Mould
10 Vacuum vessel for excess resin
11 Vacuum pump valve

1 Seal
2 Screw clamp
3 Tensioning frame
4 Perforated plate
5 Channel for excess resin
6 Vacuum bag
7 Layers of fibre reinforcement plus resin
8 Release agent
9 Mould
10 Vacuum vessel for excess resin
11 Vacuum pump valve
Component Assembly
Component Assembly
Assembly Seams
Detail A 1 on 5

- Acrylic glass sheet
- PVCU tongue
- Glass-fiber-reinforced polymer face ply 30 mm
- Adhesive
- Cellular insulation foam 100 mm
- Adhesive
- LEAF face ply 1.5 mm
- Inflatable Gaskets
- Steel door frame
- Inflatable Gaskets

Introduction  Research  Design  Architecture  Technology  Questions
Detail D 1 on 5
Questions?
Light Affected By
- Depth
- Subject Distance
- Weather
- Surface Conditions
Mission Control Centre
- Emergency recompression chamber
- Watch Desk
- Store
- Living accommodations for staff & visitors
- Office space
- Docks

Life Support Buoy
- Air Compressors
- Generators
- O₂ 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