RESILIENT HUB
Office Building Division

Team GSD4Climate

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Future Impact

Urbanization

8 million sq ft of commercial development
- Sasaki Architects, 2017

Global Warming

Increase in temperature by 4.1 °C
- Vox.com

Flooding

Sea level by almost 9 inches by 2030
- City of Boston (Boston.gov)
Future Impact Scenario

2025

2050

2080

- 2013
- 2030
- 2070

+2.2°C

+4.1°C
Geometry Evolution

1. Maximising the FAR
2. Connectivity & Roadfront
3. Daylight Optimization
4. Energy Generation
5. Ventilation
Flooding Design
Increase in daylight autonomy of 23%
Energy Generation

Covers 37% of the energy use.
Solar Chimney
Solar Chimney

Reduces cooling energy by 68%

Speed (m/s)

- 0.75 m/s
- 1.85 m/s
- 3.0 m/s
Envelope Strategy

South Facades: High Irradiation with large change through the years

North Facades: Less Irradiation with low change through years

40% WWR with exterior solar shading

Shading integrated in ETFE pillows
Southern Facade

Energy reduction for heating and cooling by 44%
Northern Facades

- ETFE Shading
- Timber frame
- Low-e glazing

NW & NE Facade

ETFE Solar Panel
Aluminum Frame
ETFE support Frame
ETFE shading
CLT Frame
Triple Pane Low-E Glazing
Aluminum Frame
CLT Envelope

Covers 14% of the energy use
# Life Cycle Assessment

## Structure

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End of Life: 102,000 Kg CO2 eq

Reduces embodied carbon by **55%**

## Envelope

### Simulation Modeling

<table>
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<tr>
<th><strong>Addition</strong></th>
<th><strong>Construction</strong></th>
<th><strong>Use</strong></th>
<th><strong>End of Life</strong></th>
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<tr>
<td><strong>A1</strong></td>
<td>Triple Pane Argon-filled glazing with aluminium spandrel (60% WWR)</td>
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<tr>
<td><strong>B1</strong></td>
<td>Aluminium solar shading</td>
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<tr>
<td><strong>C1</strong></td>
<td>Triple Pane argon-filled glazing (70% WWR)</td>
<td></td>
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</tbody>
</table>

### Simulation Results

- **Baseline**
  - **A1**: GWP
  - **B1**: Ozone Depletion
  - **C1**: Acidification
  - **Non-renewable depletion**

- **Proposed**
  - **A2**: Tinting with wood spandrel (40% WWR)
  - **B2**: Rated Si solar cells (80% coverage)

Reduces embodied carbon by **28%**
Energy Performance

2025

- Site EUI (KWh/m²/year): 30.99
  - Energy use: 15.75
  - Renewable energy generation: 15.24

2050

- Site EUI (KWh/m²/year): 38.73
  - Energy use: 12.22
  - Renewable energy generation: 26.51

2080

- Site EUI (KWh/m²/year): 44.15
  - Energy use: 12.18
  - Renewable energy generation: 32.07
Cost Assessment

Plug load efficiency: Building with the selected efficient lighting system and plug load management

Building geometry: Building size to increase daylight autonomy

Atrium and skylights: Atrium with 100% VSWR curtain wall facade

Solar chimney: Natural ventilation and heat recovery

Ground source heat pump

NW and NE facades: 60% VSWR and PV

SW and SE facades: With 100% VSWR ETFE pillow facade on Southern facades

Final design

IRR 21.7%

Cost analysis graph with added cost per ft² and value gain per ft² shown.
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