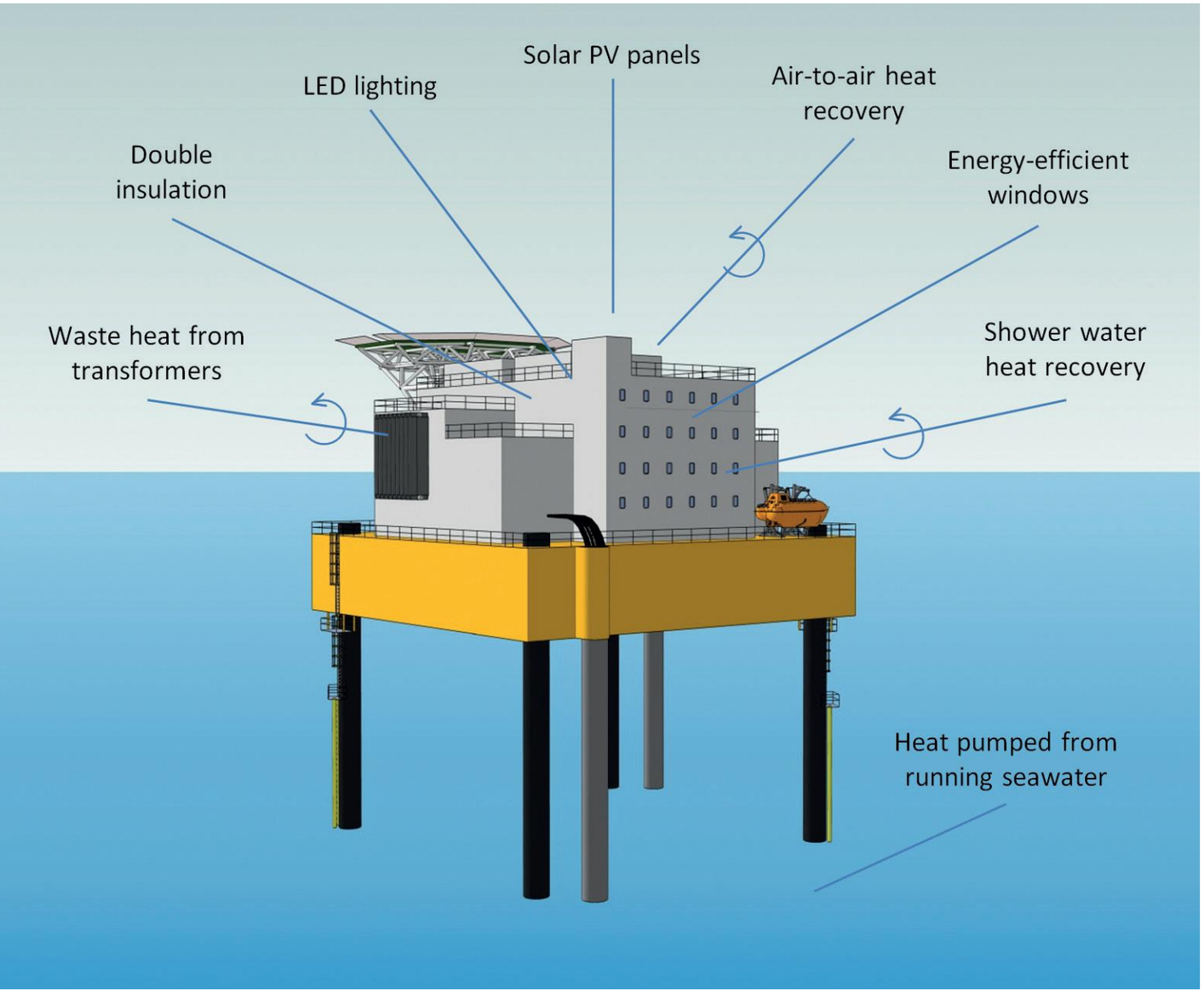
# Passive Offshore Accommodation

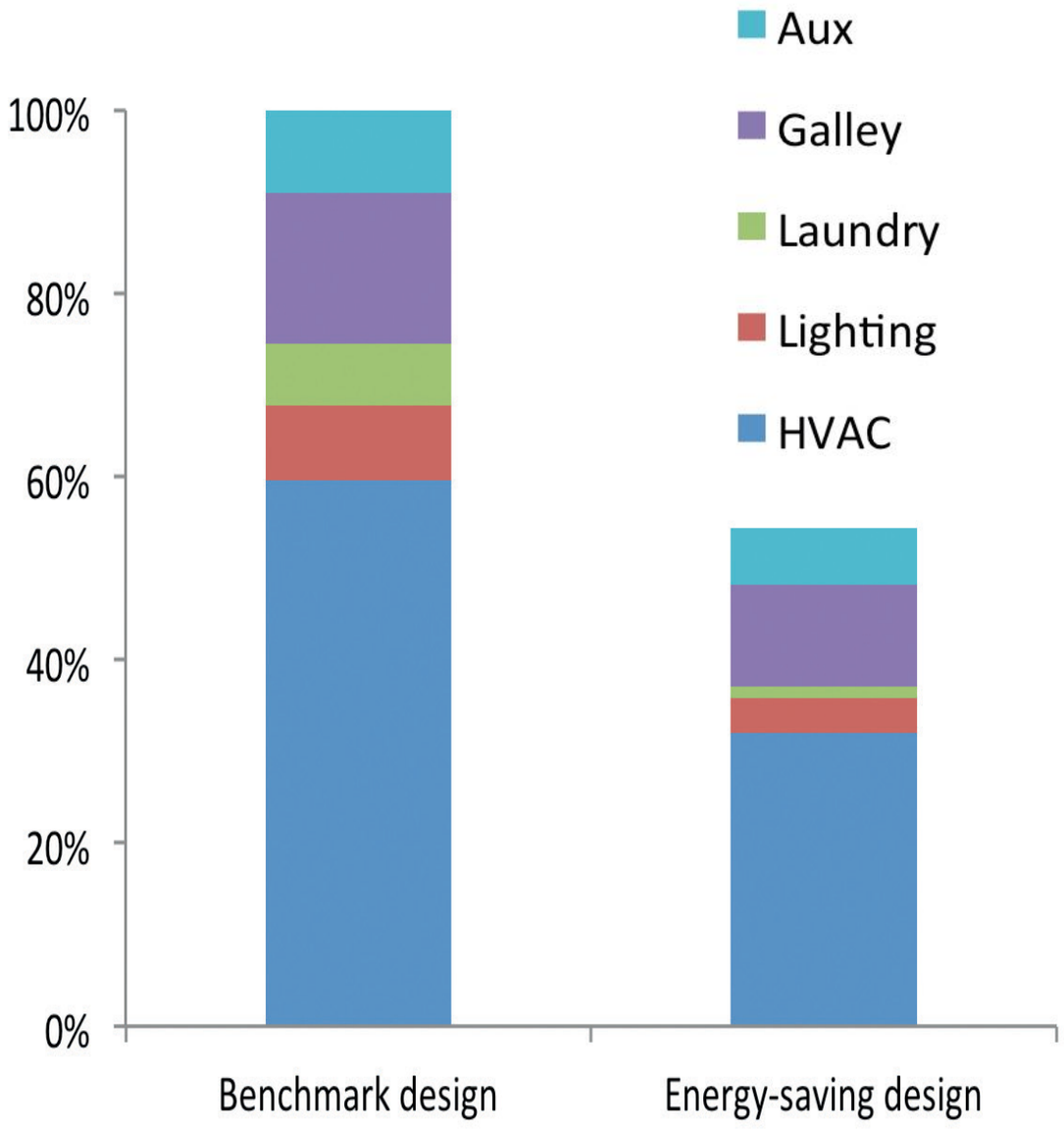
Lars Hammer
20th of May, 2016
P4 – presentation
Graduation Building Technology Track

TU Delft

Keppel Verolme

# Starting Point




*Source: KOMtech Technology Review 2014*

# Direction

*Jeroen Taen*
Student Ship Design

*Lars Hammer*
Student Building Technology

**Active**

| | |
|---|---|
| **Thermal Energy** | *Heat Pump* |
| **Solar Energy** | *PV Cells, Sun Boiler* |
| **Wind Energy** | *Wind Turbine* |
| **Wave Energy** | *Point absorber, Oscillating water column* |
| **External Energy Supply** | *Genset* |

**Passive**

| | |
|---|---|
| **Natural Ventilation** | *Atrium, Cross ventilation, stack ventilation* |
| **Natural Lighting** | *Atrium, Mirrors, Windows,* |

Only applicable to new build

Input

**Accommodation**

Output

Re-use energy

**Energy Demand**

| | |
|---|---|
| **Electricity** | *LED, Energy efficient appliances* |
| **Heat** | *Floor heating, smaller spaces, linked spaces* |
| **Water** | *Low flow showers and toilets* |

**Energy Losses**

| | |
|---|---|
| **Insulation** | *Internal, External* |
| **Windows** | *Triple glass, Orientation, Foil, Cold bridges, Size* |

**Waste Materials**

| | |
|---|---|
| **Sewage** | |
| **Cooking Oil** | |

**Waste Heat**

| | |
|---|---|
| **Waste Air** | Enthalpy wheel |
| **Waste Water** | Heat Recovery Pipe |

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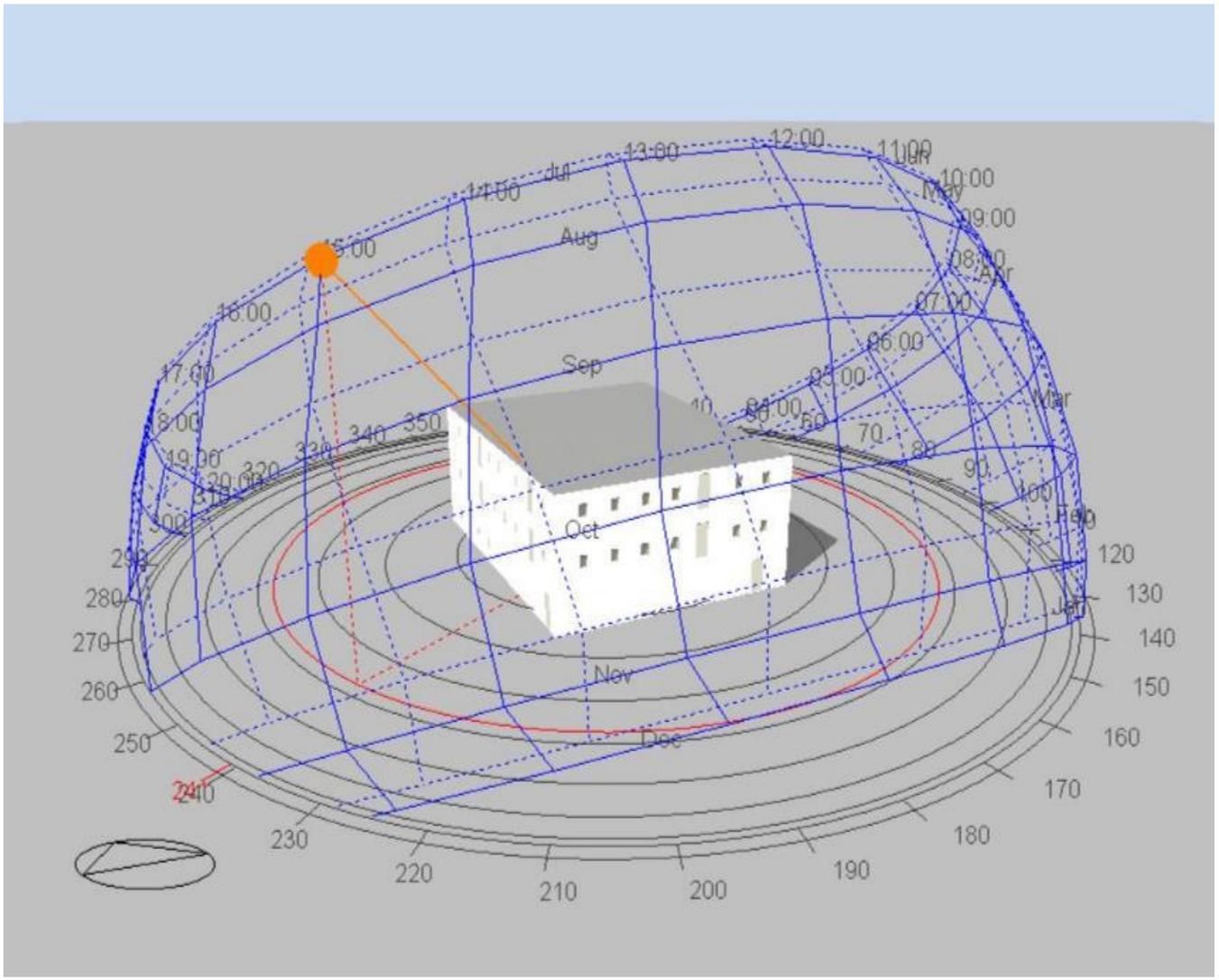
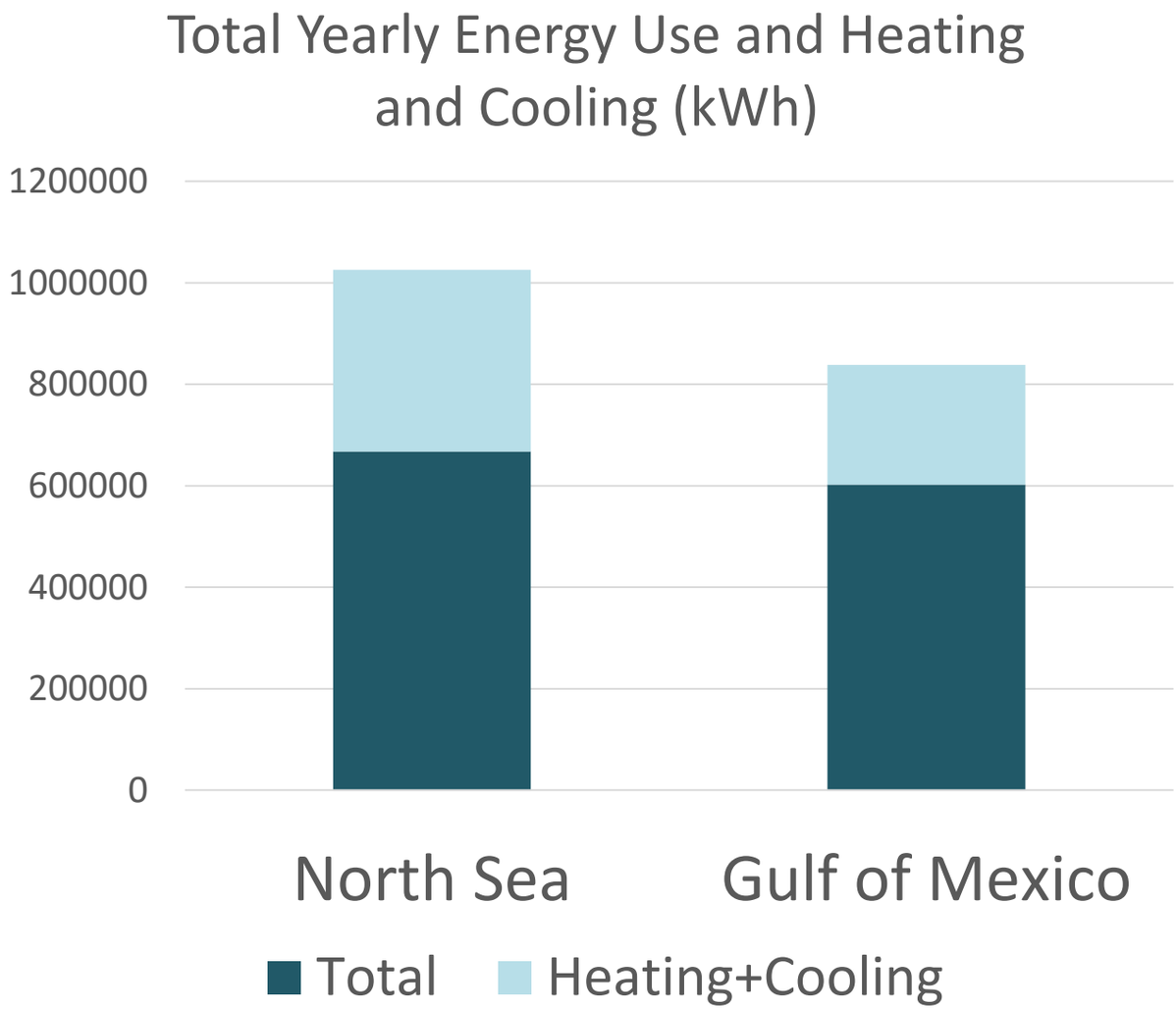
The North Sea,
Cold Climate
The Gulf of Mexico,
Tropic Climate

# Simulation Results



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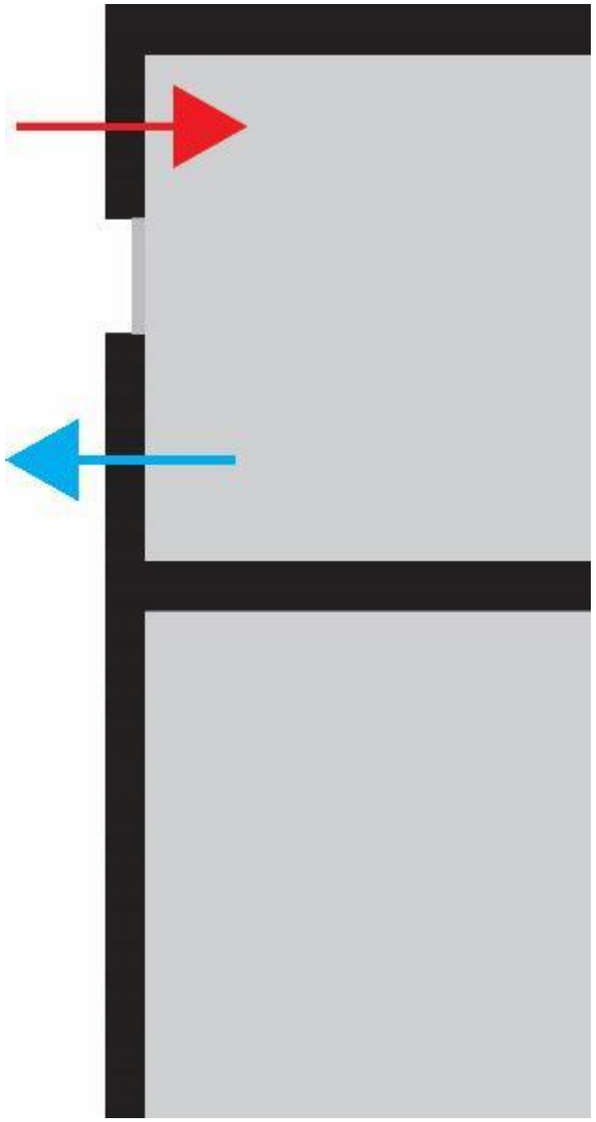

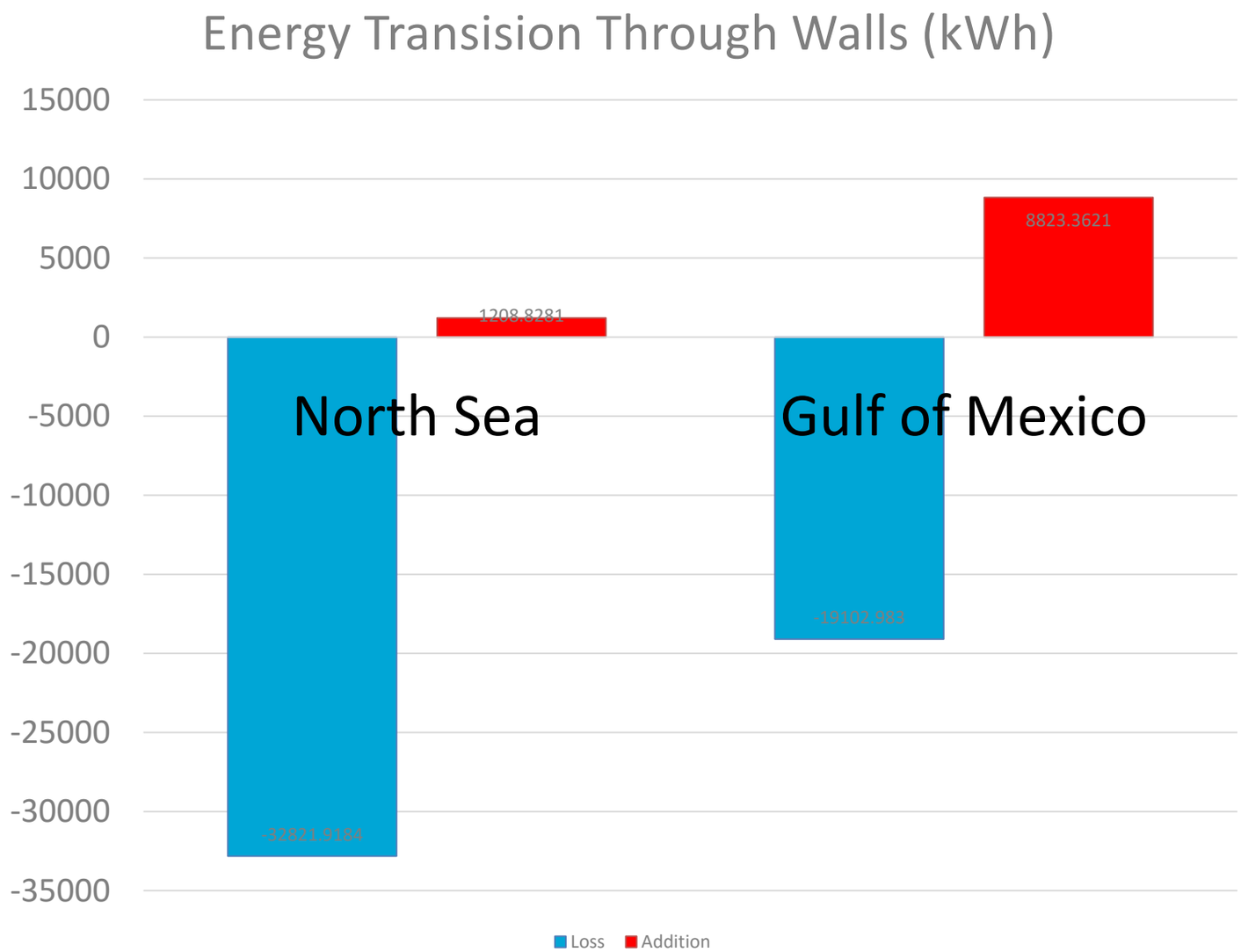

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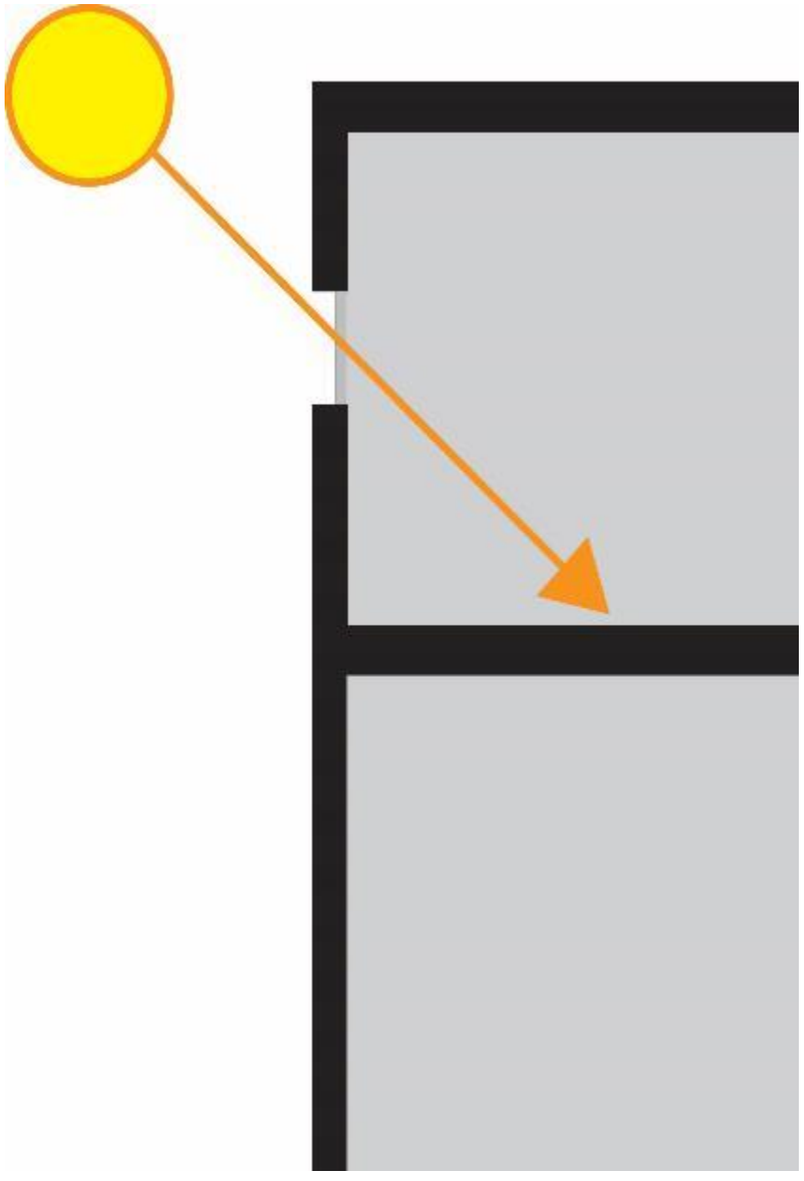
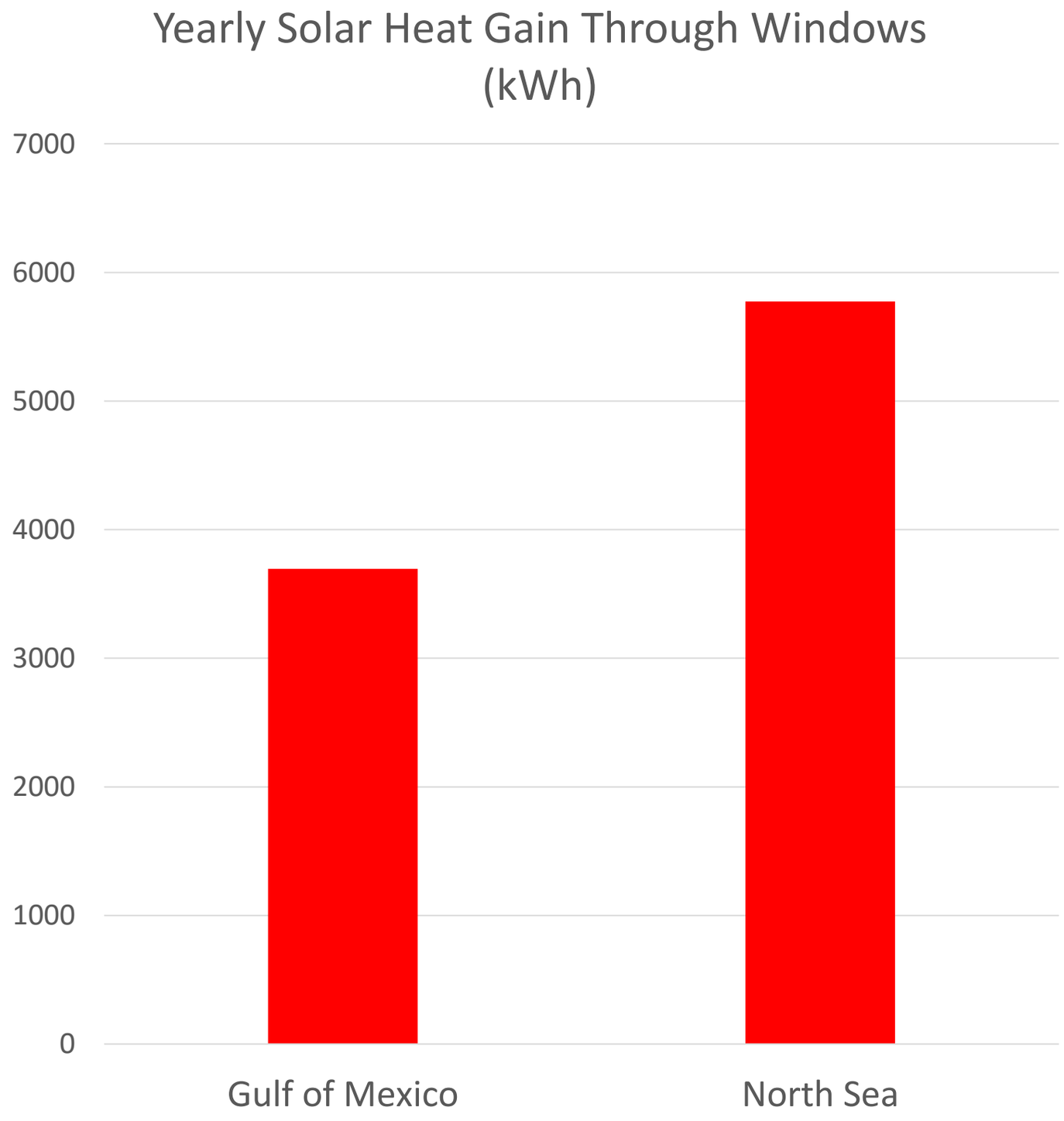


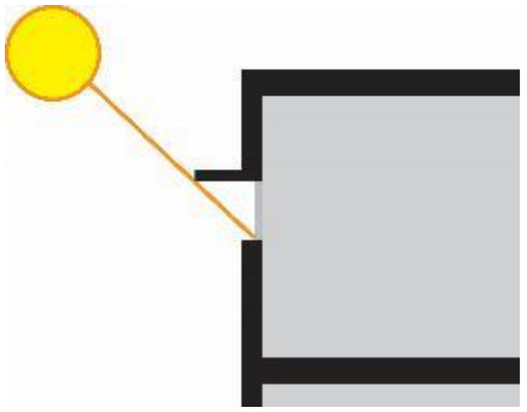


# Influence the Heating and Cooling

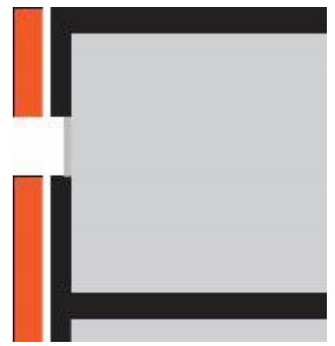
- Reducing Solar Heat Gain
- Reducing Heat Loss through the Walls
- Generating Sustainable Energy

# Influence the Heating and Cooling

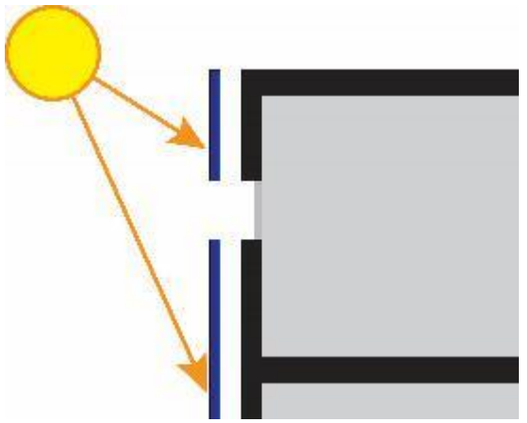
- Reducing Solar Heat Gain
  - *Applying Shade*



- Reducing Heat Loss through the Walls
  - *Thicker Insulation*



- Generating Sustainable Energy
  - *PV - Collectors*



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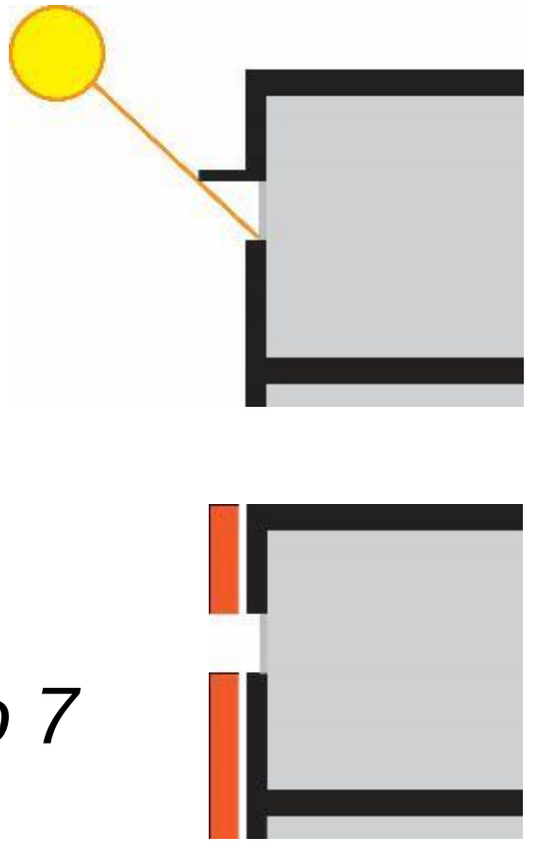
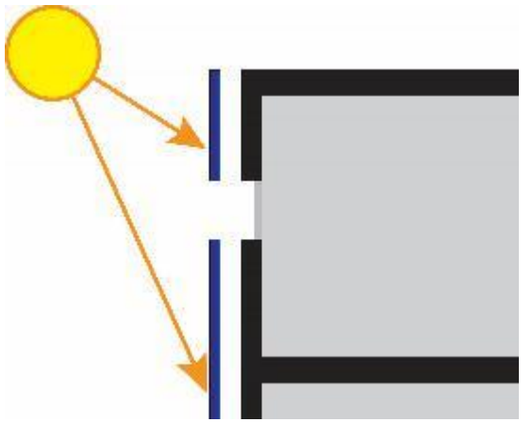
# Influence the Heating and Cooling

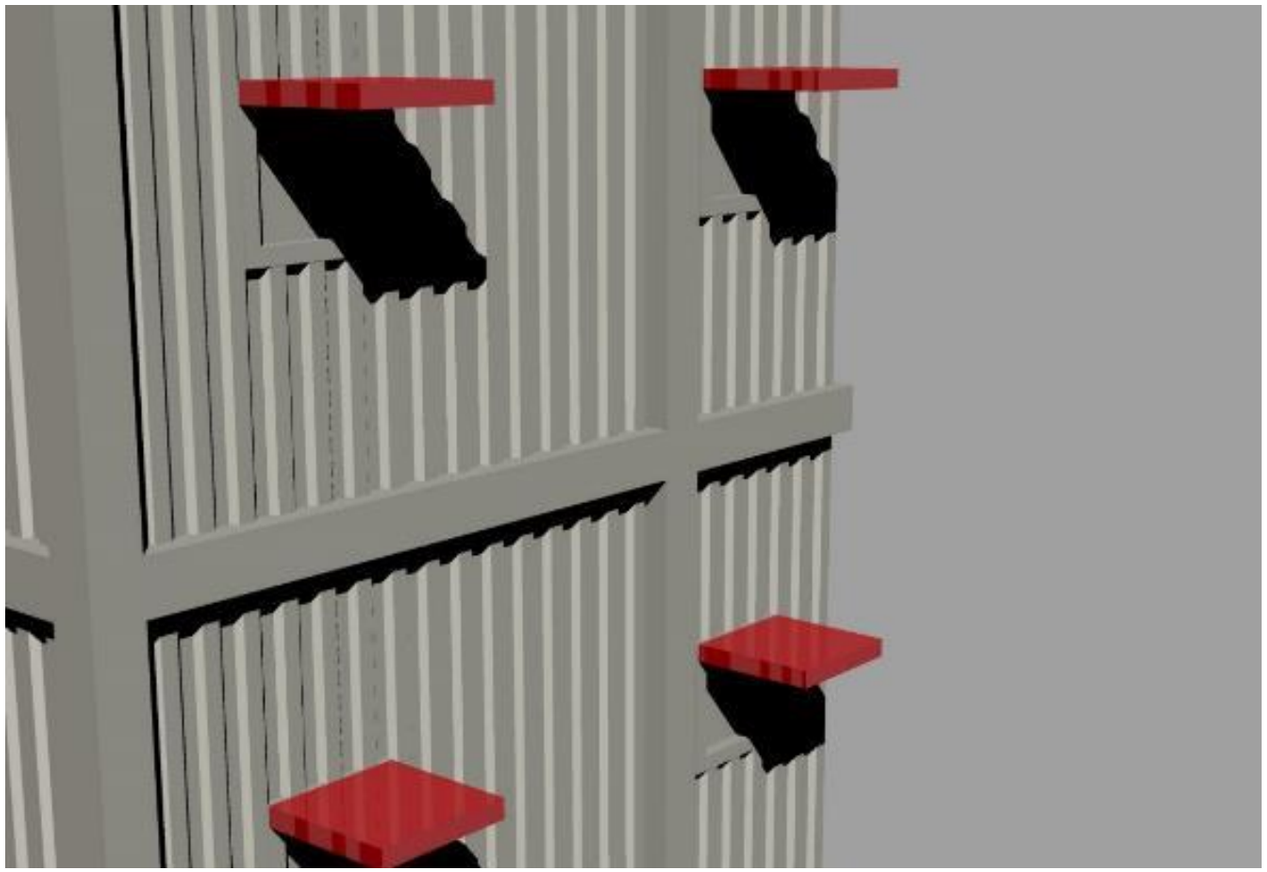
- Reducing Solar Heat Gain
  - *Applying Shade*
    - *Overhang, Total Façade Shading Vertical Lamellae*
- Reducing Heat Loss through the Walls
  - *Thicker Insulation*
    - *Insulation added with R-Value 1 to 7*

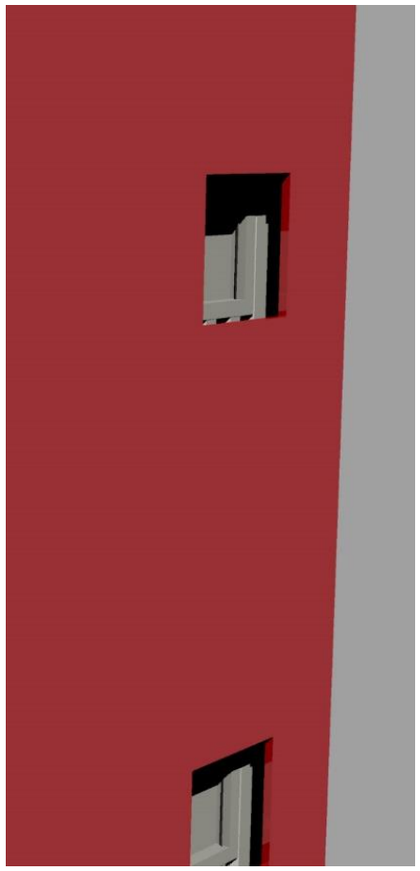


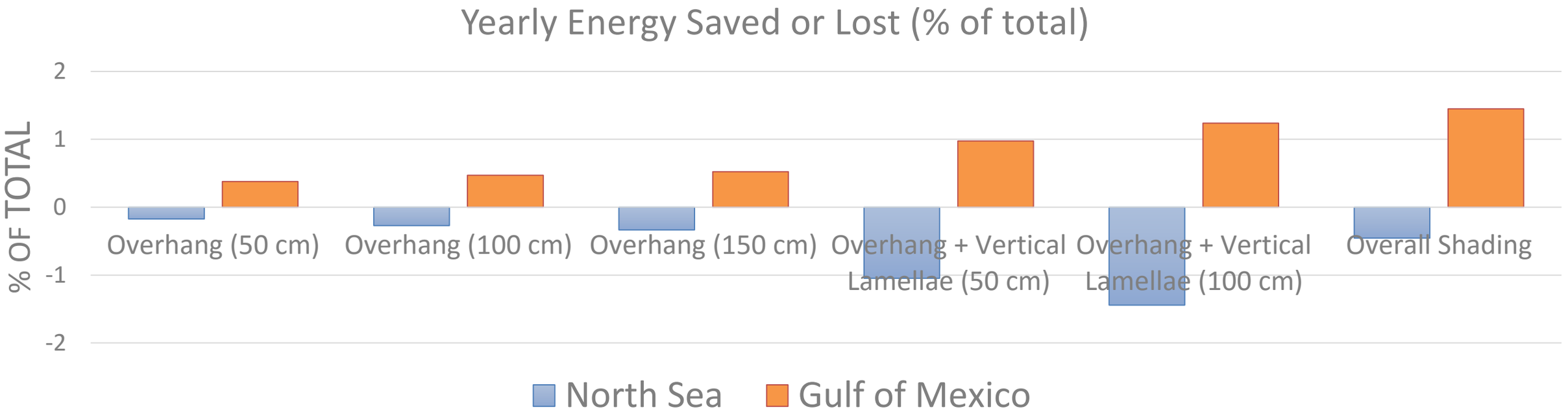
- Generating Sustainable Energy
  - *PV - Collectors*
    - *Building Integrated Panels, or Optimized Panels*



# Effect of Shading





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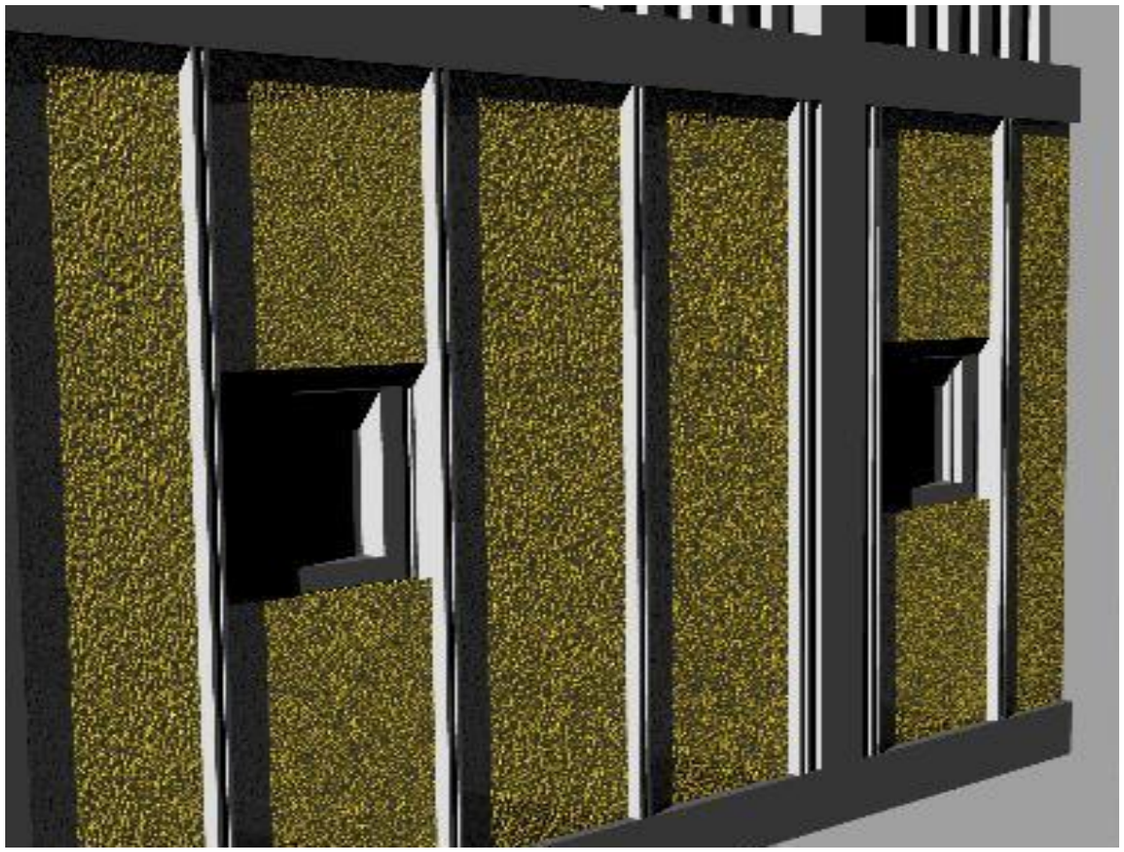
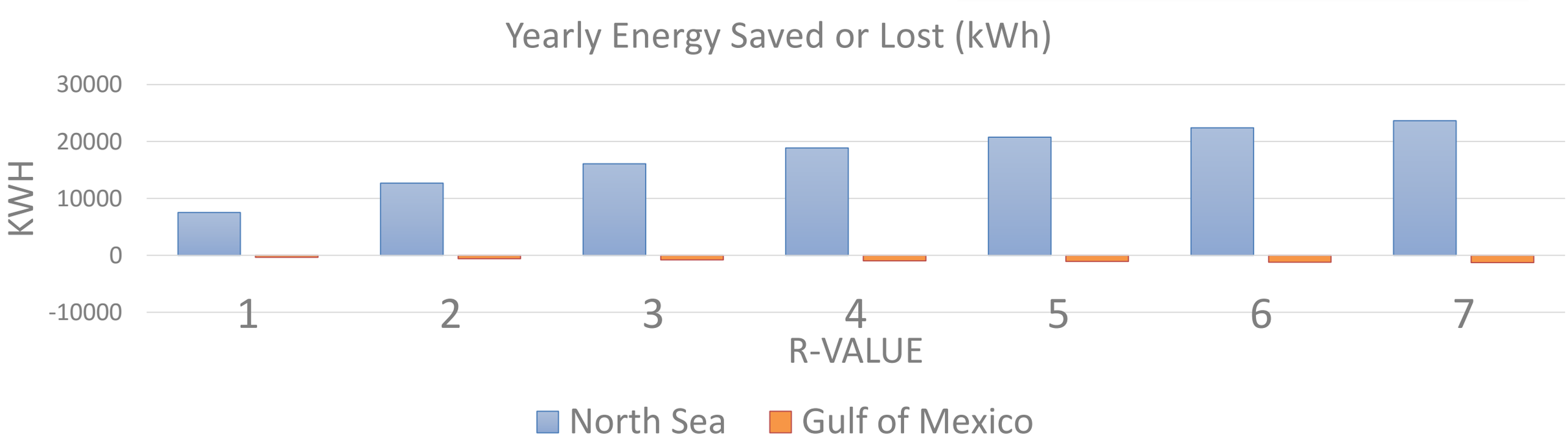
# Effect of Additional Insulation



R-Value
from 1 to 7

| | |
|---|---|
| 10.00mm | White-painted steel(not to scale) |
| 1.00mm | Test Insulation(not to scale) |
| 80.00mm | Rockwool Marine Slab 55 (80mm) |
| 25.00mm | Rockwool Marine Lamella mat 32 (25mm)(not to scale) |
| 399.00mm | Air gap (R=0.18m2/K/W) |

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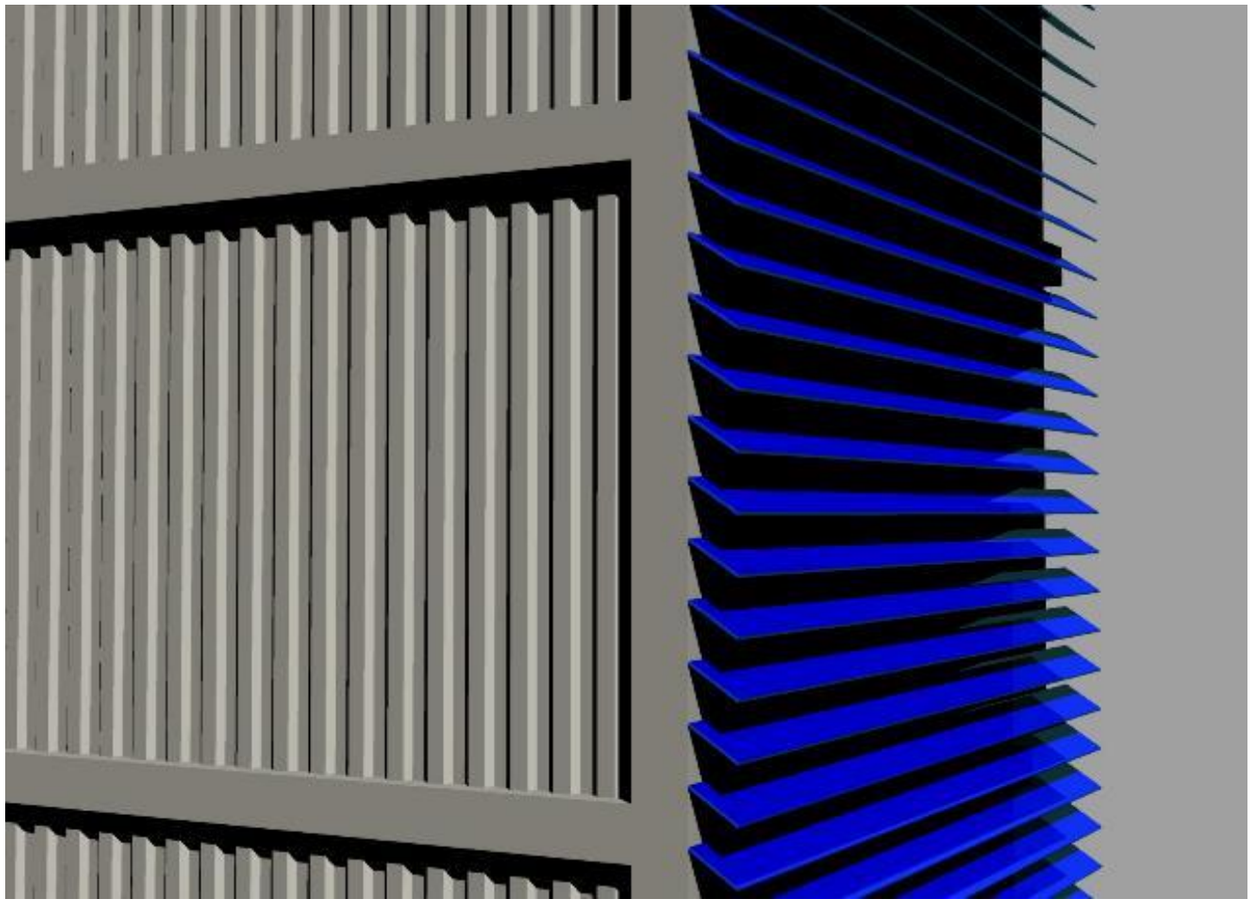
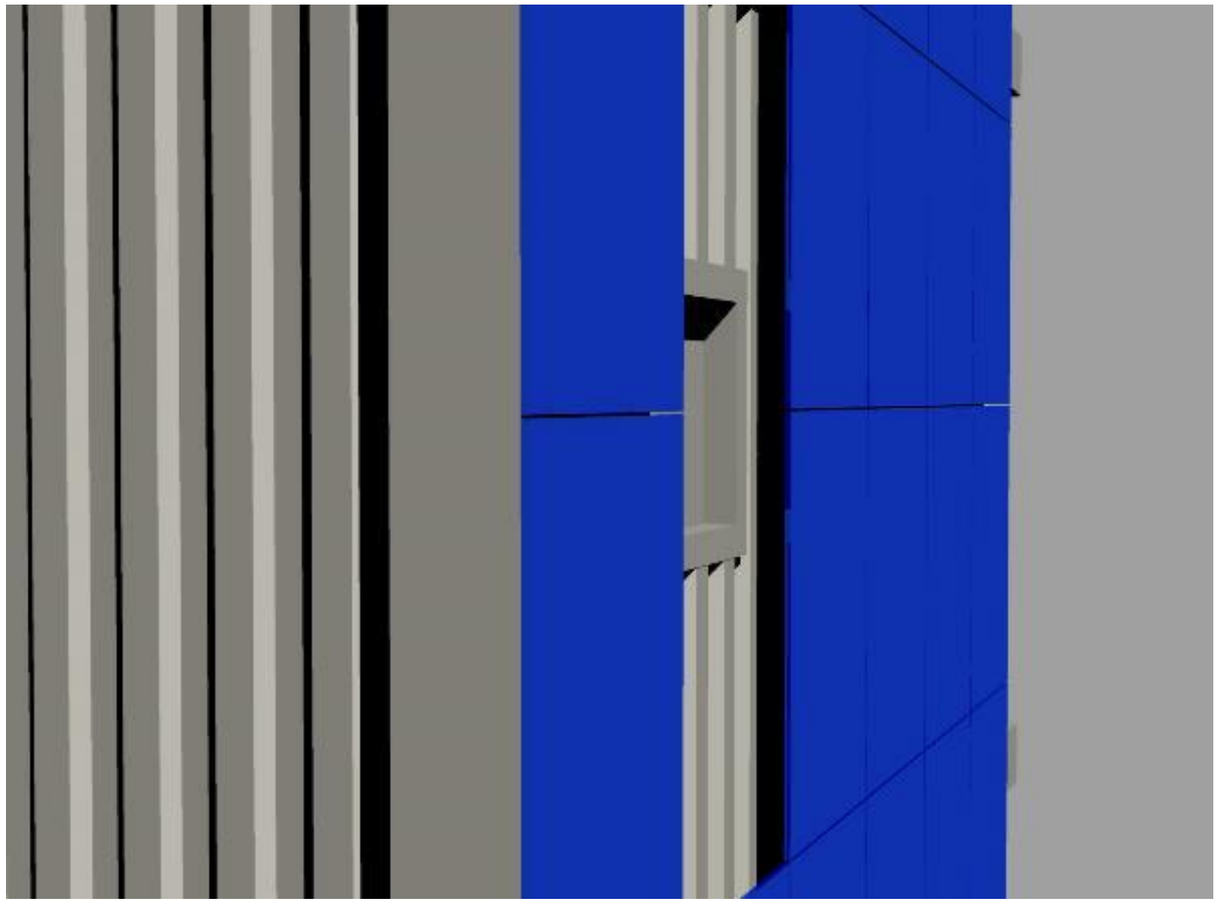
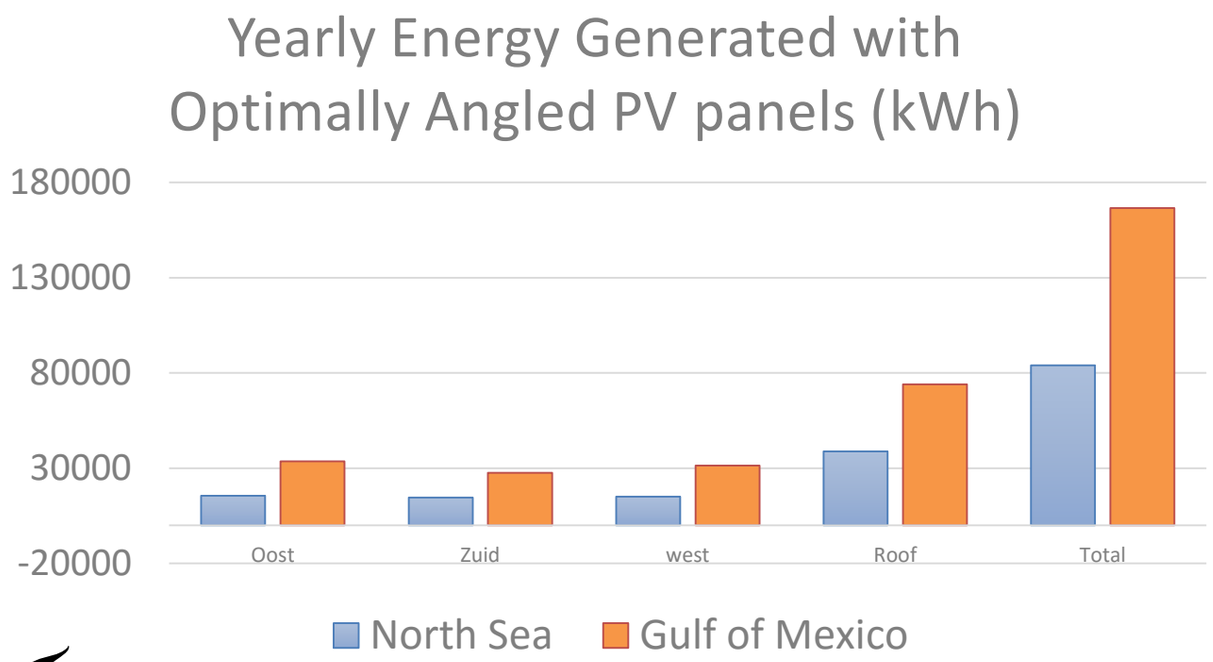
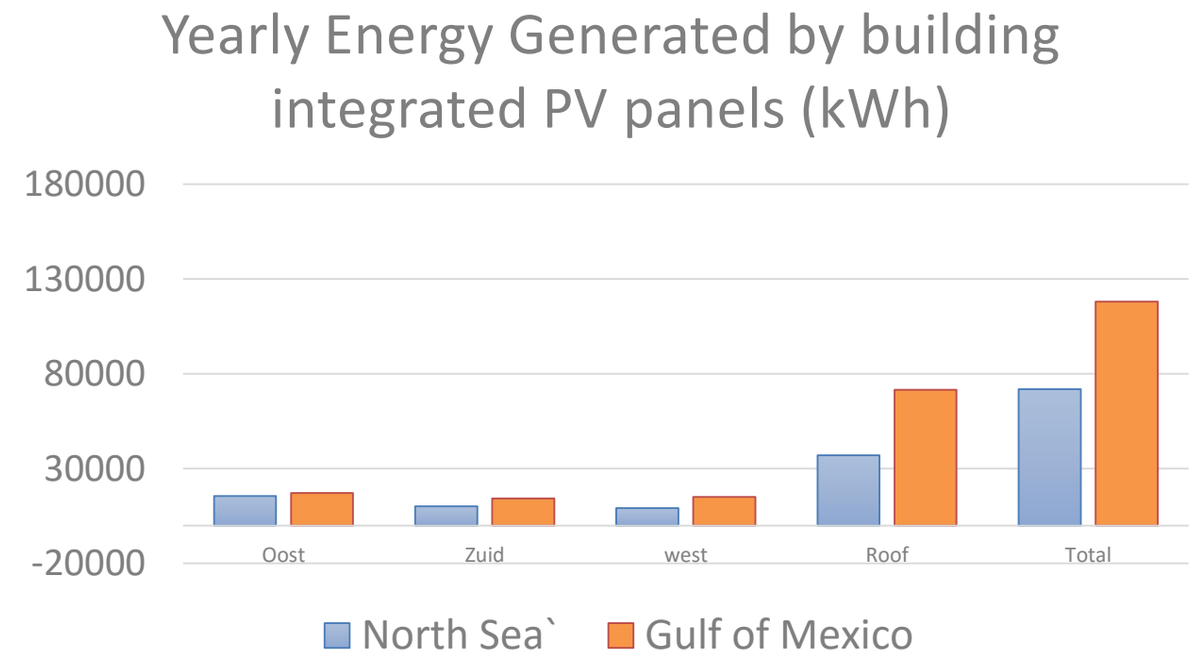
# Effect of Adding Solar Power





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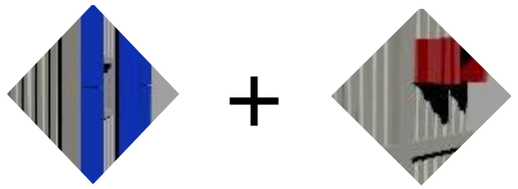
# Choosing The Right Variant

- Criteria
  - Saving Costs
  - Applicable for Refurbishment
  - Applicable for New Build
  - Applicable for Fixed Platform
  - Applicable for Mobile Platform
  - Applicable in Cold Climate
  - Availability of off the shelf products
  - Complexity of Maintenance
  - World Wide Usage

# Choosing The Right Variant

Concept 1  = 66

Concept 2  = 123

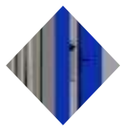
Concept 3  = 117

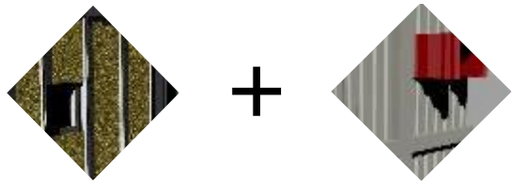
Concept 4  = 128

= 128 Score

 Shading

 Insulation

 PV - Panel

Concept 5  = 51

Concept 6  = 64

| | 9 | 6 | 3 | 4 | 2 | 1 | 8 | 5 | 7 | Priority (1-5) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Concepts** | 100% | 60% | 40% | 40% | 40% | 40% | 40% | 40% | 40% | Relative Wei |
| Insulation | Saving Cos | Refurbishn | Fixed Platf | Mobile Pla | Hot Climate | Cold Clima | Availability | Maintainanc | World Wid | Result |
| C-1 PV | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 66.2 |
| C-2 PV + SHAD | 4 | 6 | 5 | 5 | 6 | 4 | 6 | 6 | 5 | 123.2 |
| C-3 PV + INSULATION | 5 | 5 | 4 | 4 | 4 | 6 | 5 | 5 | 4 | 117 |
| C-4 PV + INSULATION + SHAD | 6 | 4 | 6 | 6 | 5 | 5 | 4 | 4 | 6 | 128.8 |
| C-5 INSULATION + SHADING | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 51.2 |
| C-6 SHADING | 1 | 5 | 1 | 2 | 3 | 1 | 1 | 3 | 1 | 46.2 |

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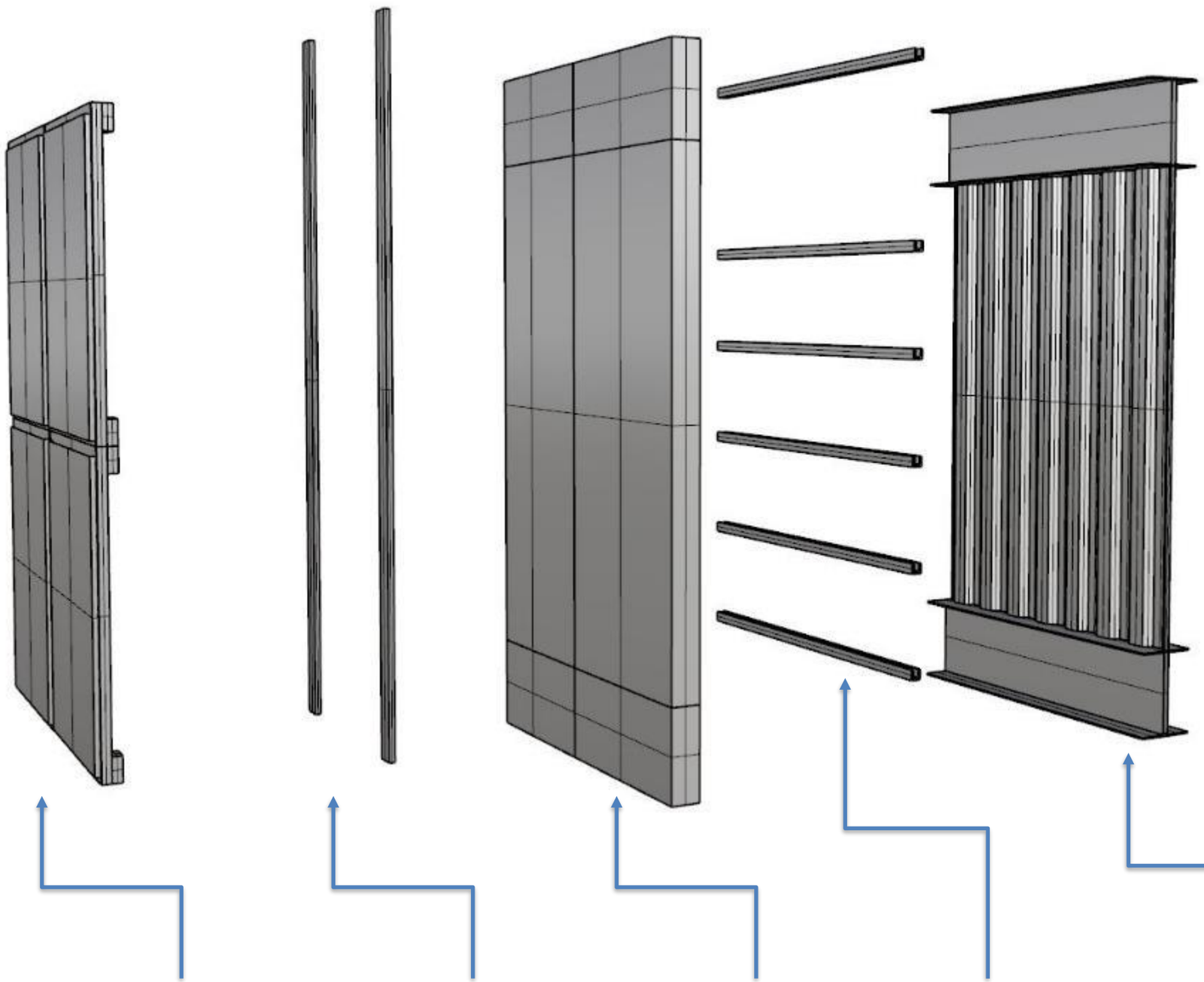
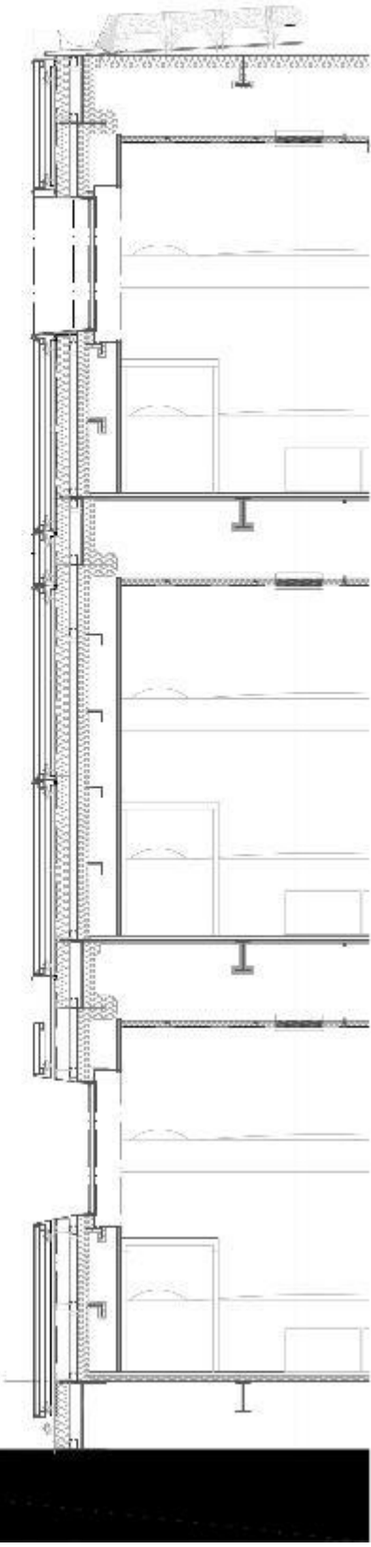
# Final Design



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# Final Design

- 140 mm Insulation Panel
  - R – value of 7
  - Fireproof Rigid Panels
  - Polyisocyanuratefoam (PIR)
  - Aluminum Layered
  - External Weather Shield

- PV panel from Solar Frontier
  - 170 WattPeak
  - Building Integrated

- Additional Thickness to wall
  - 325 millimeter
  - Passively creates shading at windows

- Aluminum Lightweight Panels
  - Environmental Load Protection panel

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# Final Design

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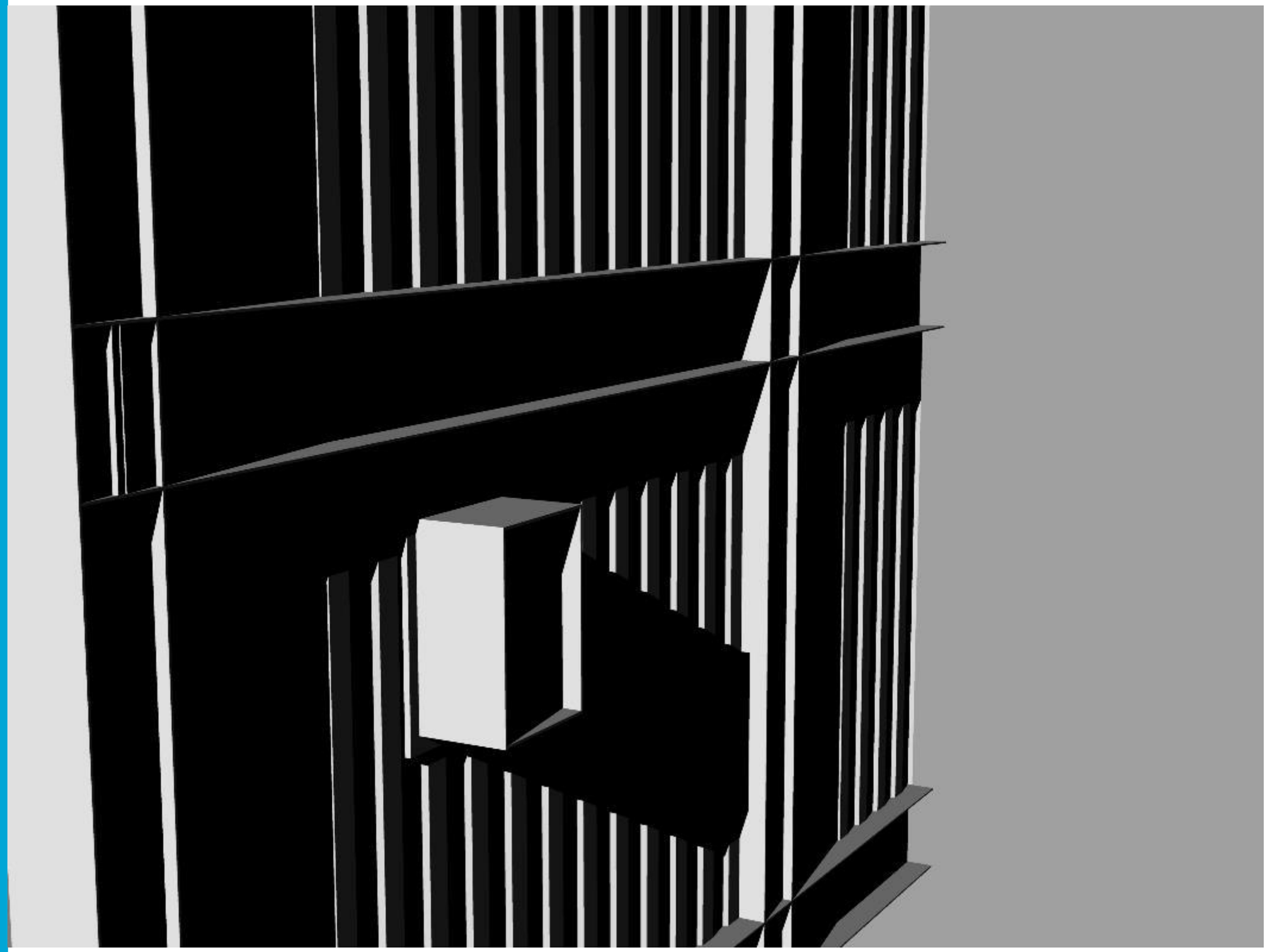

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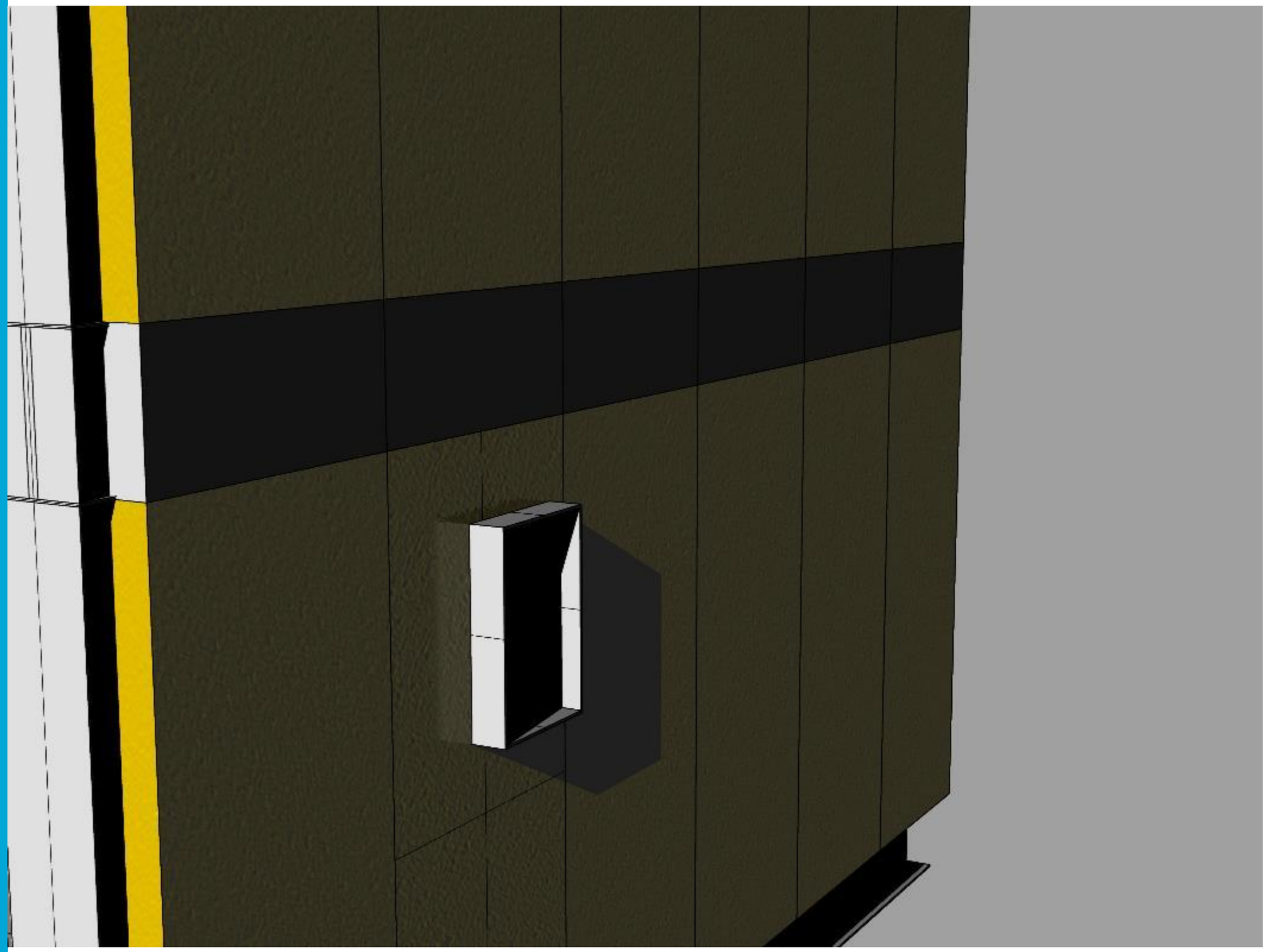

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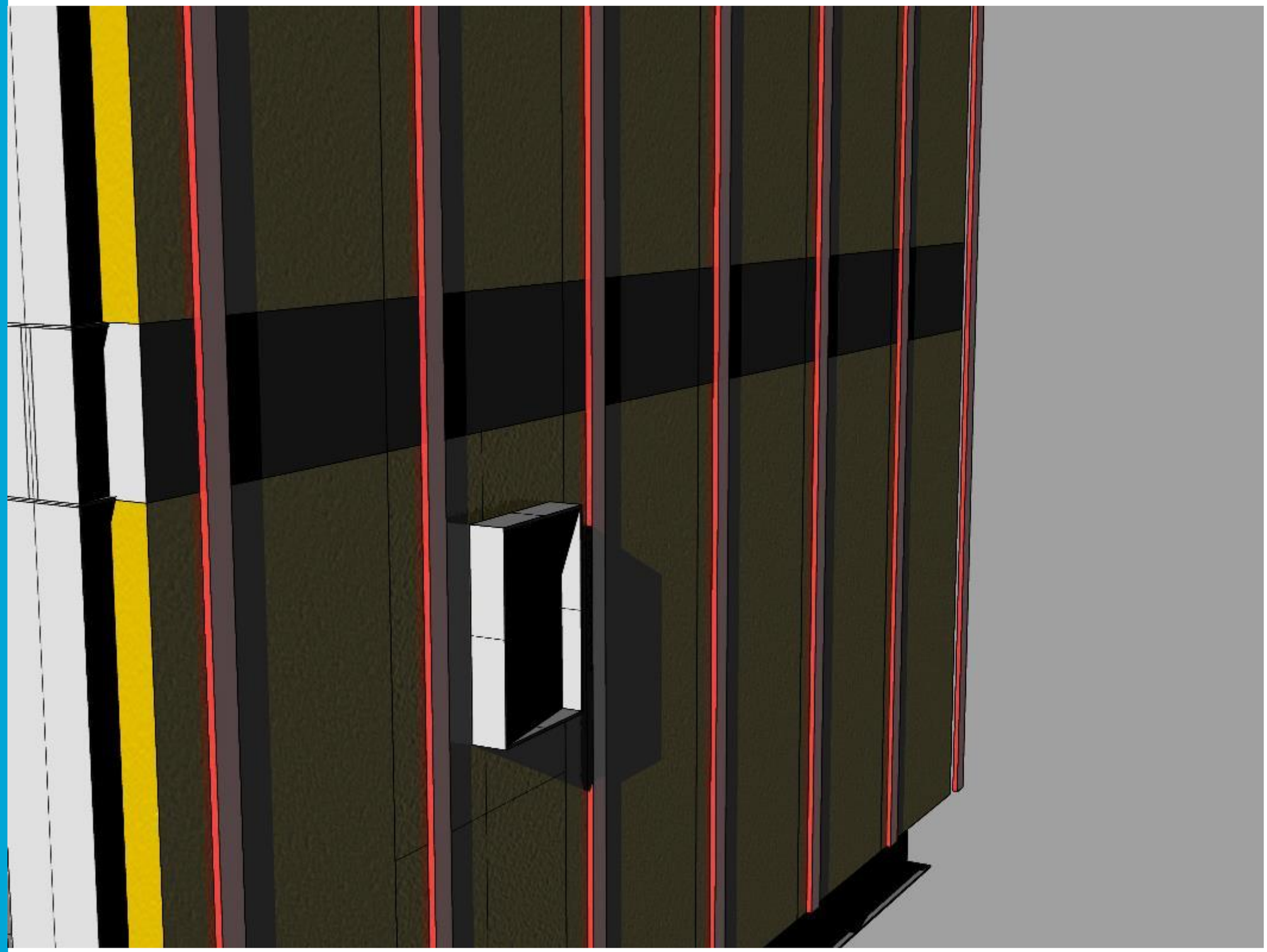

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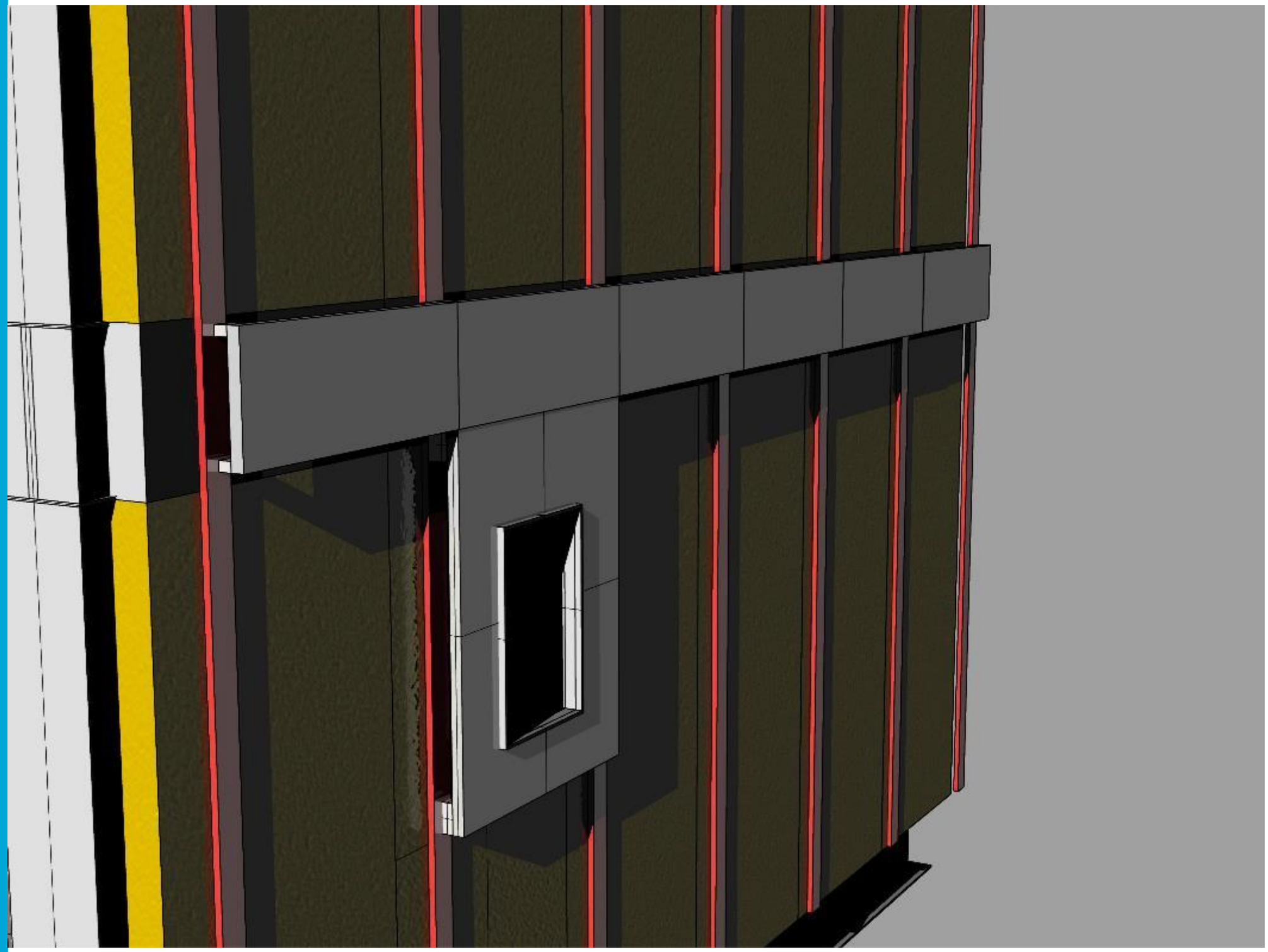

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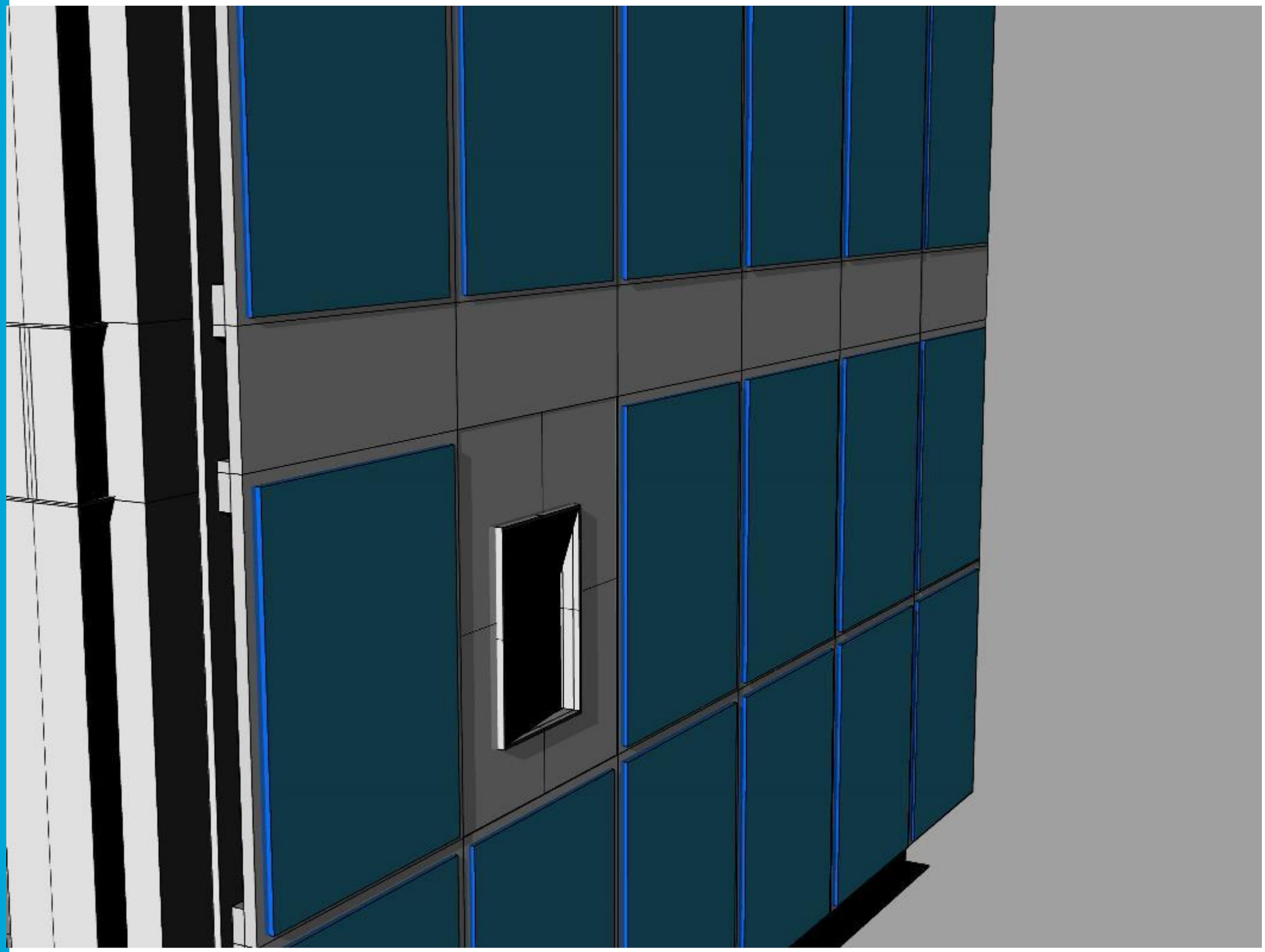
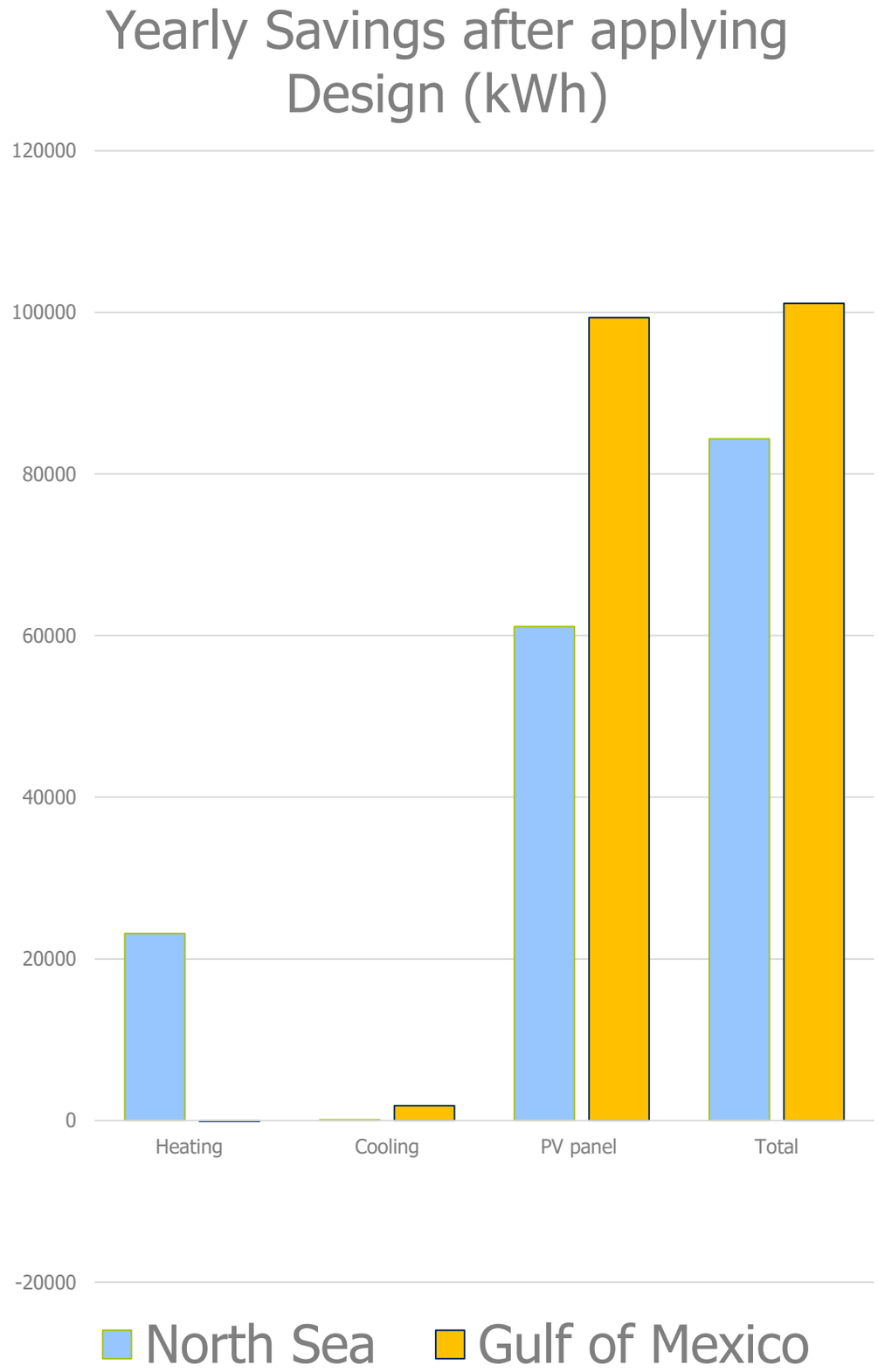


# Savings implementing new Design

- Savings (kWh);
  - 84336 kWh North Sea
  - 101114 kWh Gulf of Mexico
  - North Sea 23 % on Heating and cooling
  - Gulf of Mexico 43 % on Heating and Cooling

- Savings (Euro) per year
  - 16876 Euro at North Sea
  - 20222 Euro at Gulf of Mexico
  - * At 20 cents per kWh

- Which means a 5 Year Pay Back time (6 year in North Sea) is a investment of **101114 Euro**

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# Future

- Redestined Oil Rigs for Housing

- Further specific research for only hot and cold climates.

# Thank You.

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