Emtunga Offshore AB

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Lightweight construction application at sea

LÄSS

Lightweight in Living Quarters

SP, Borås, Sweden

31-OCTOBER-2007

Peo Svärd

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- What is a Living Quarter
- Fabrication - Modular concept
- Why lightweight
- Weight of a Living Quarter
- Weight saving in a Living Quarter
- Aluminum design

What is a Living Quarter?

- **A living Quarter consists of:**
  - **Accommodation for crew**
  - **Safe area (Fire/gas/blast)**
  - **Dining area**
  - **Recreation**
  - **Central Control Room**
  - **Airport (baggage handling, sky lobby, etc)**
  - **Medical center**
  - **Office**
  - **Galley**
  - **Laundry**
  - **20-250 POB**
  - **500-4000m^2**
  - **250-2000 metric ton**

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What is a Living Quarter?

- **Characteristics**
  - **Assembly phase**
  - **Load out**
  - **Sea transport**
  - **Installation (Lifting/skidding/etc.)**

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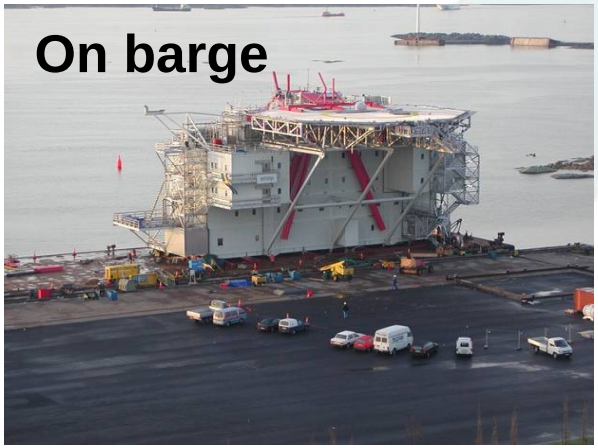
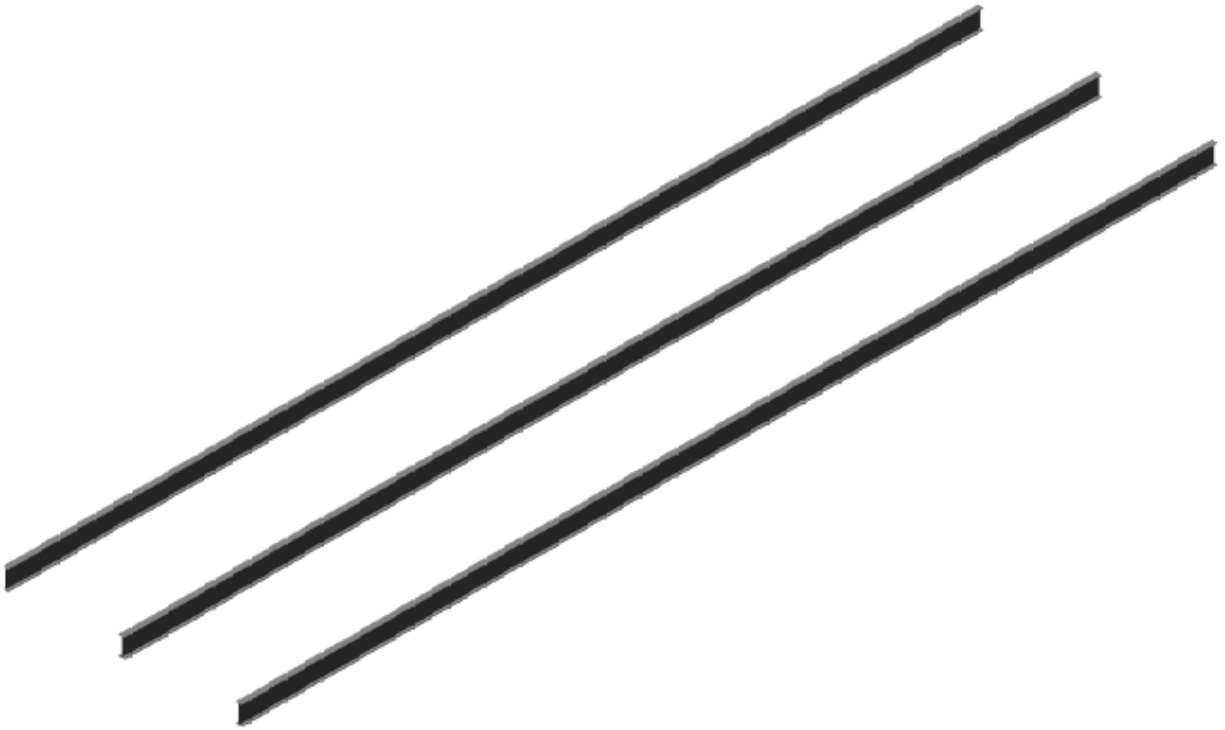
What is a Living Quarter?



Overview – Modular concept



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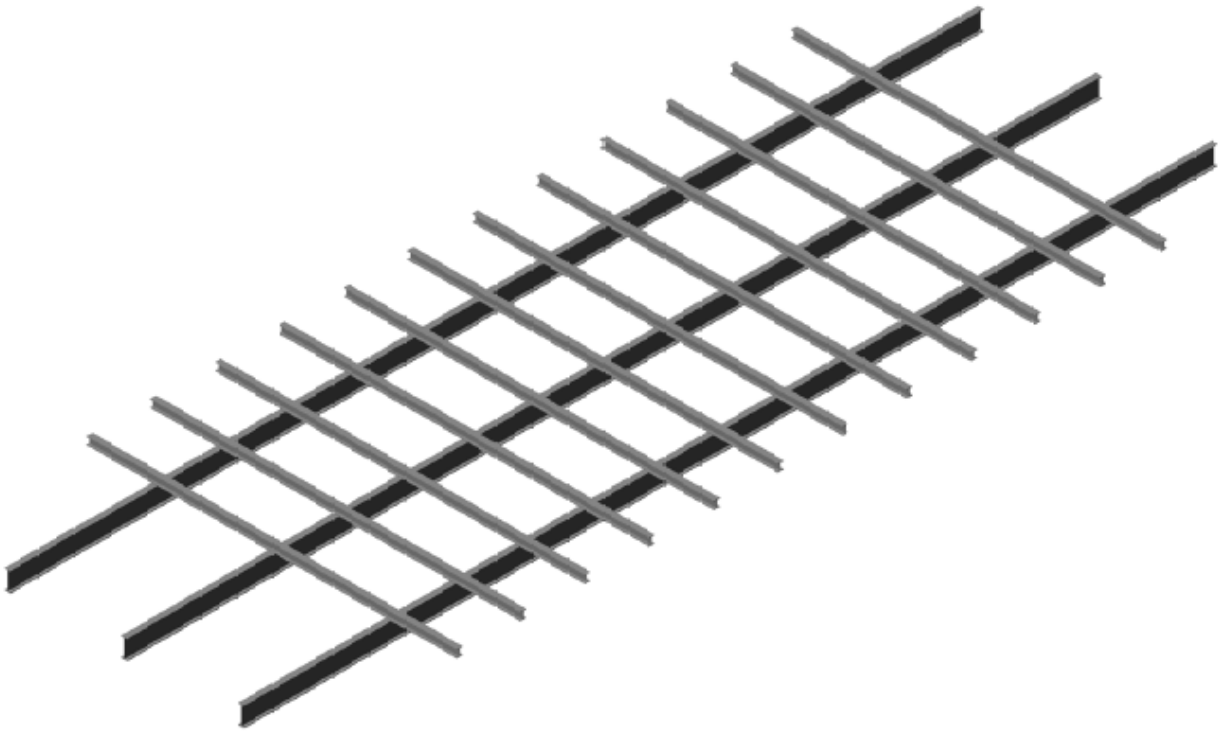

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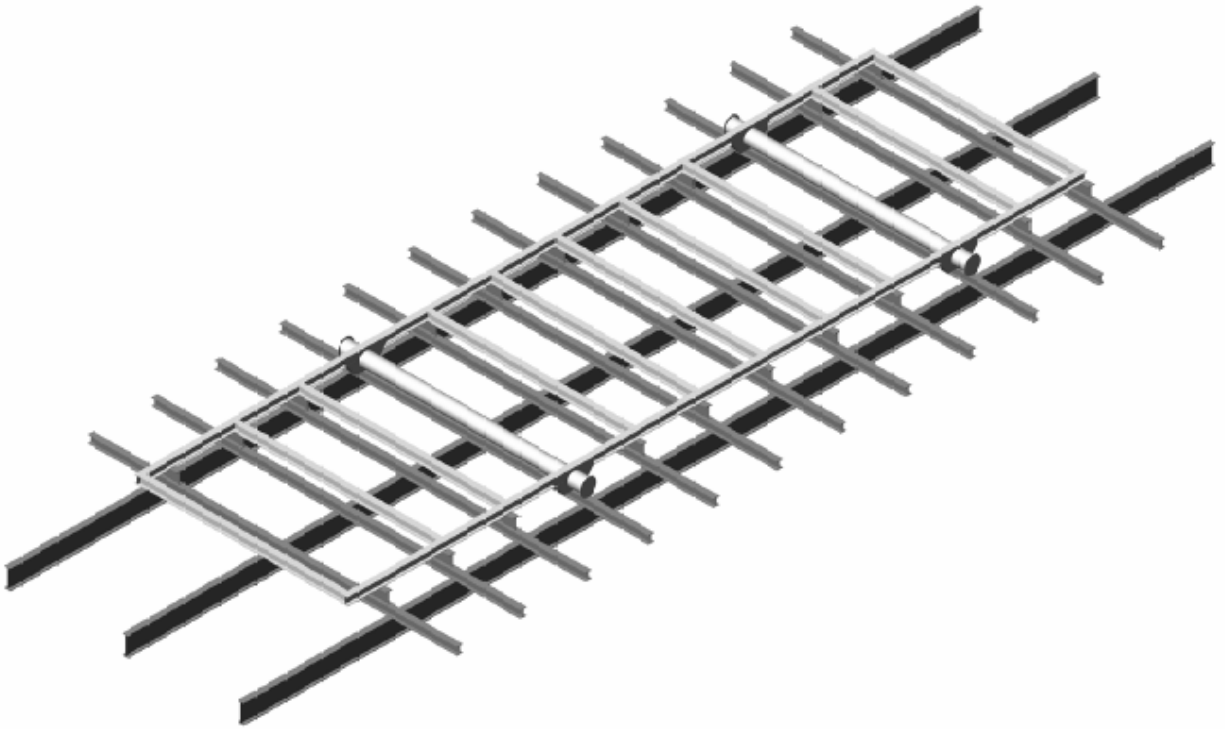

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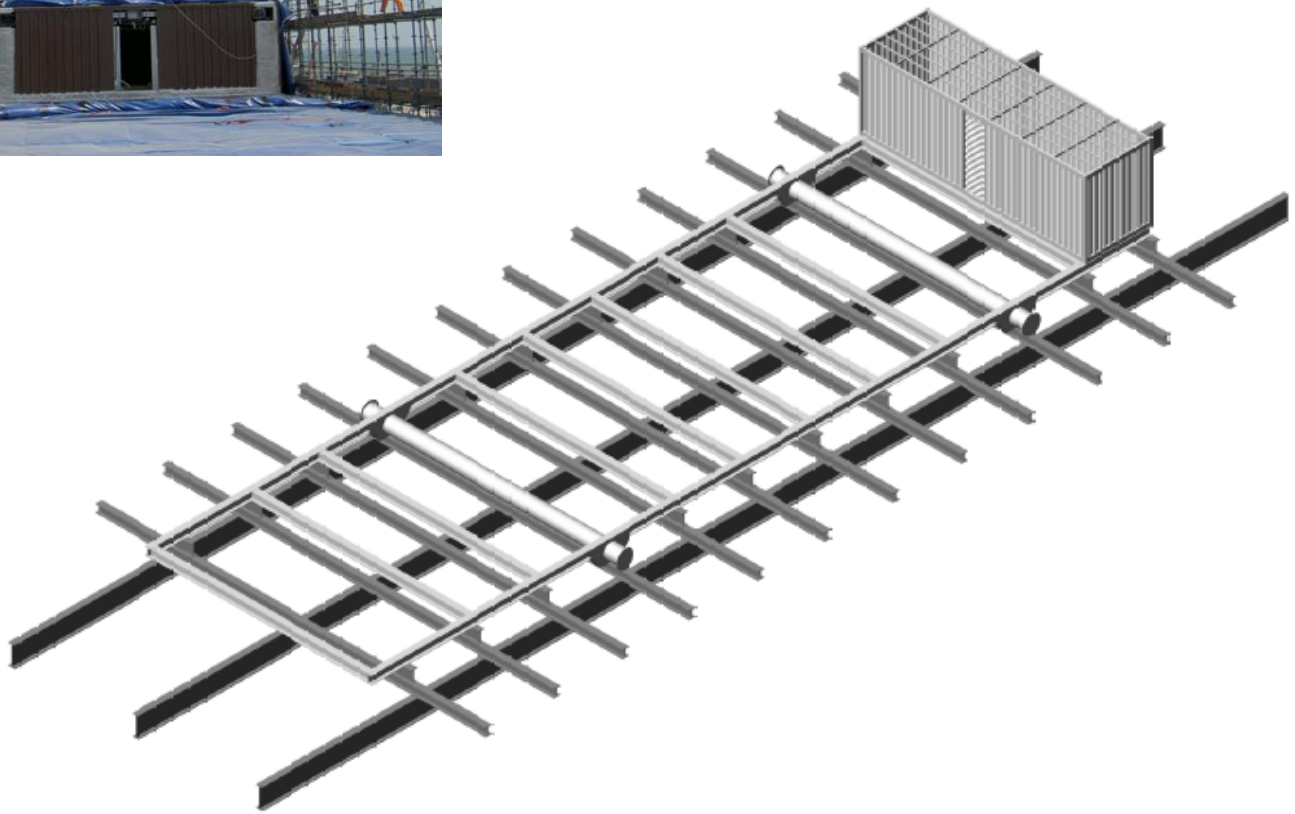

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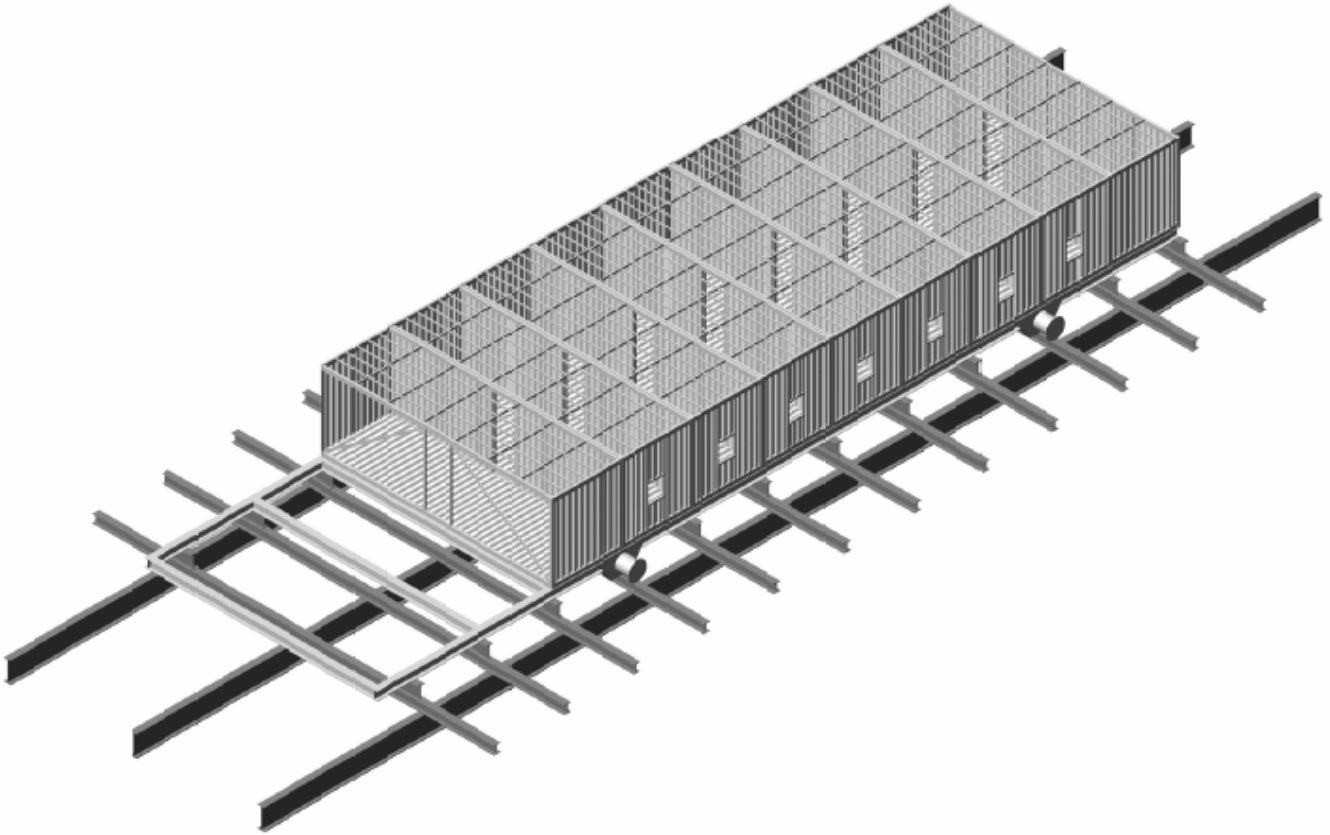

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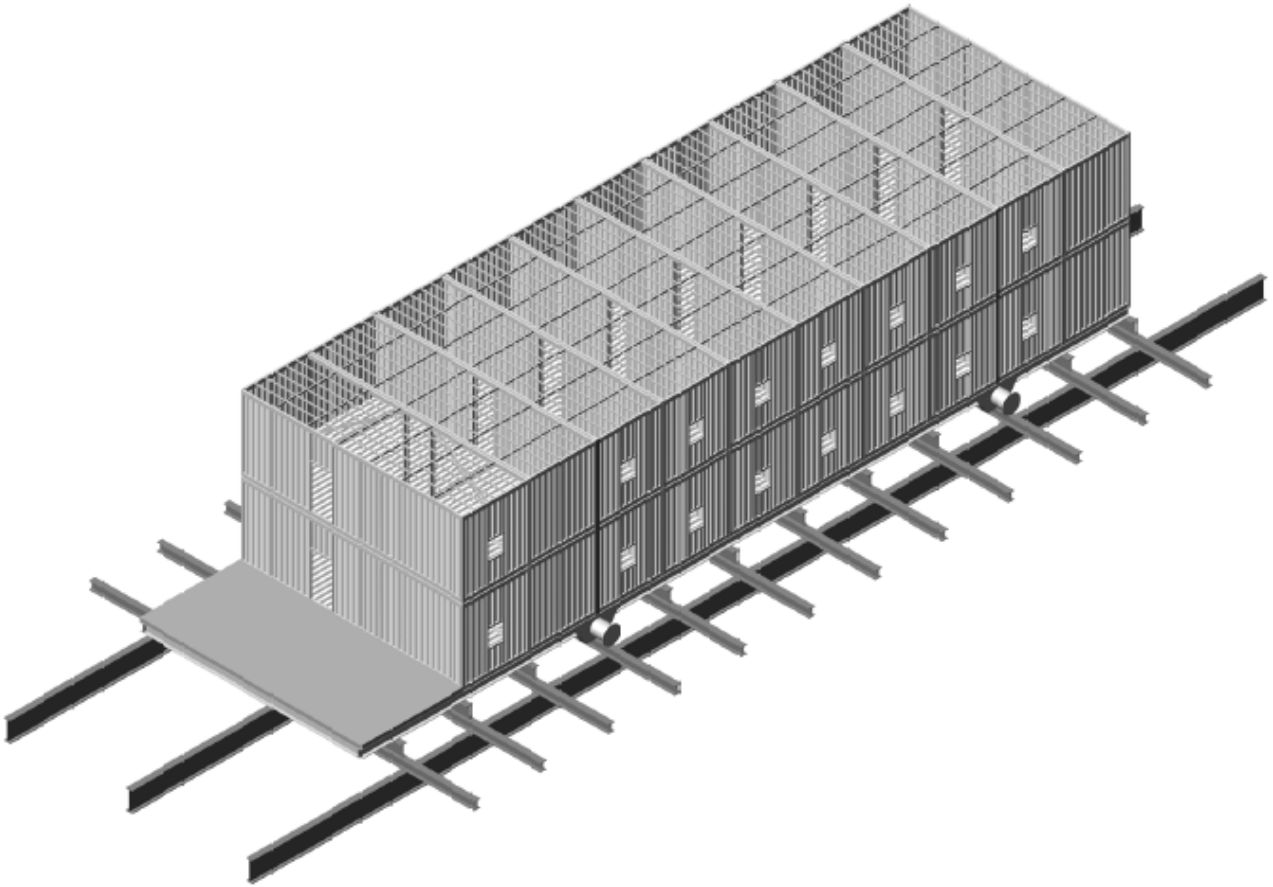

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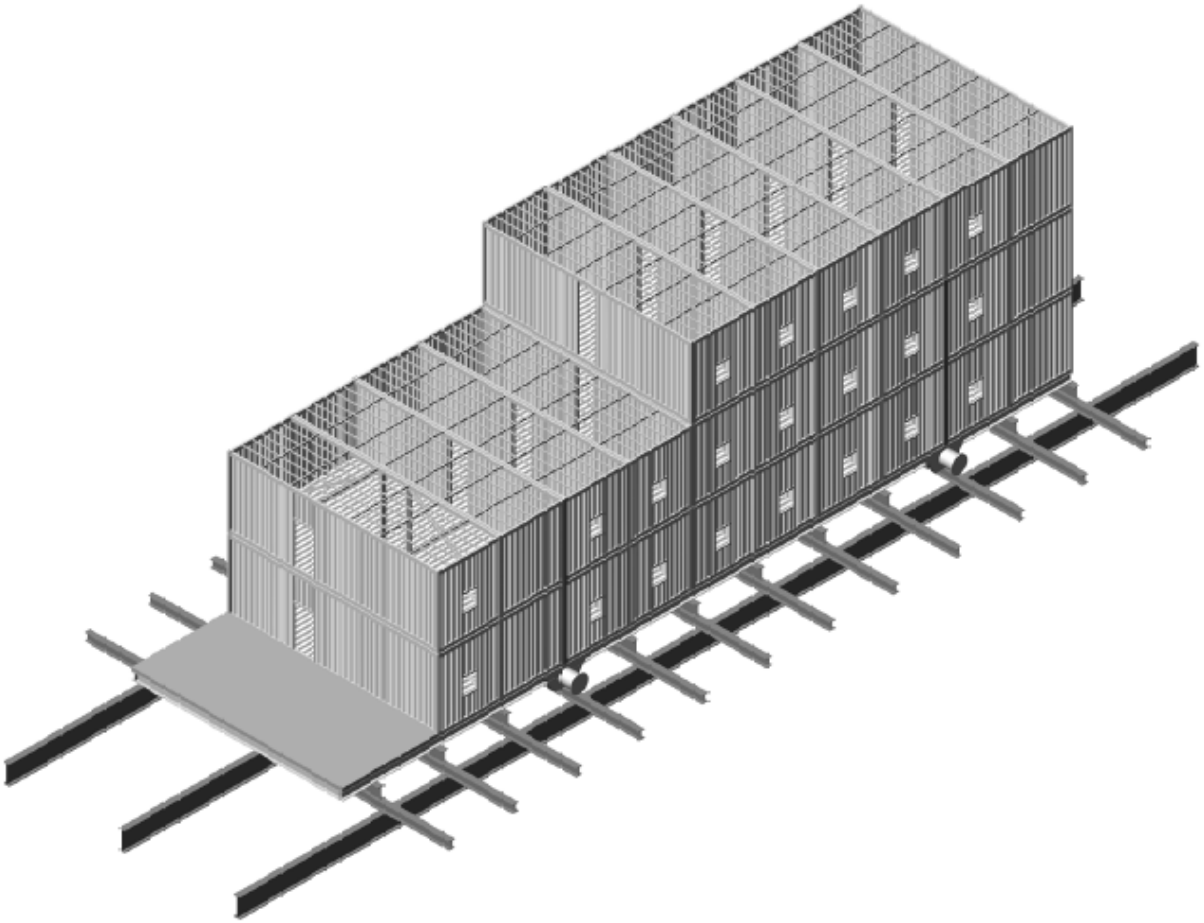

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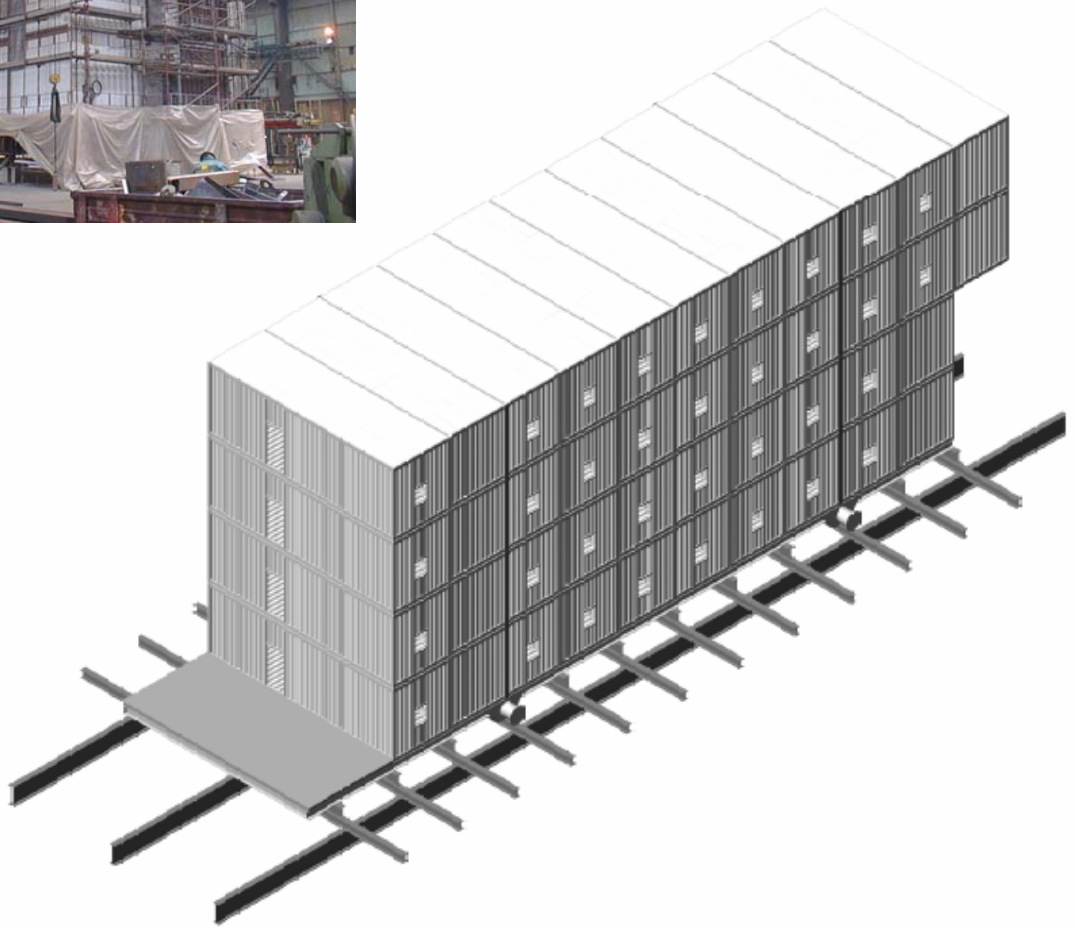

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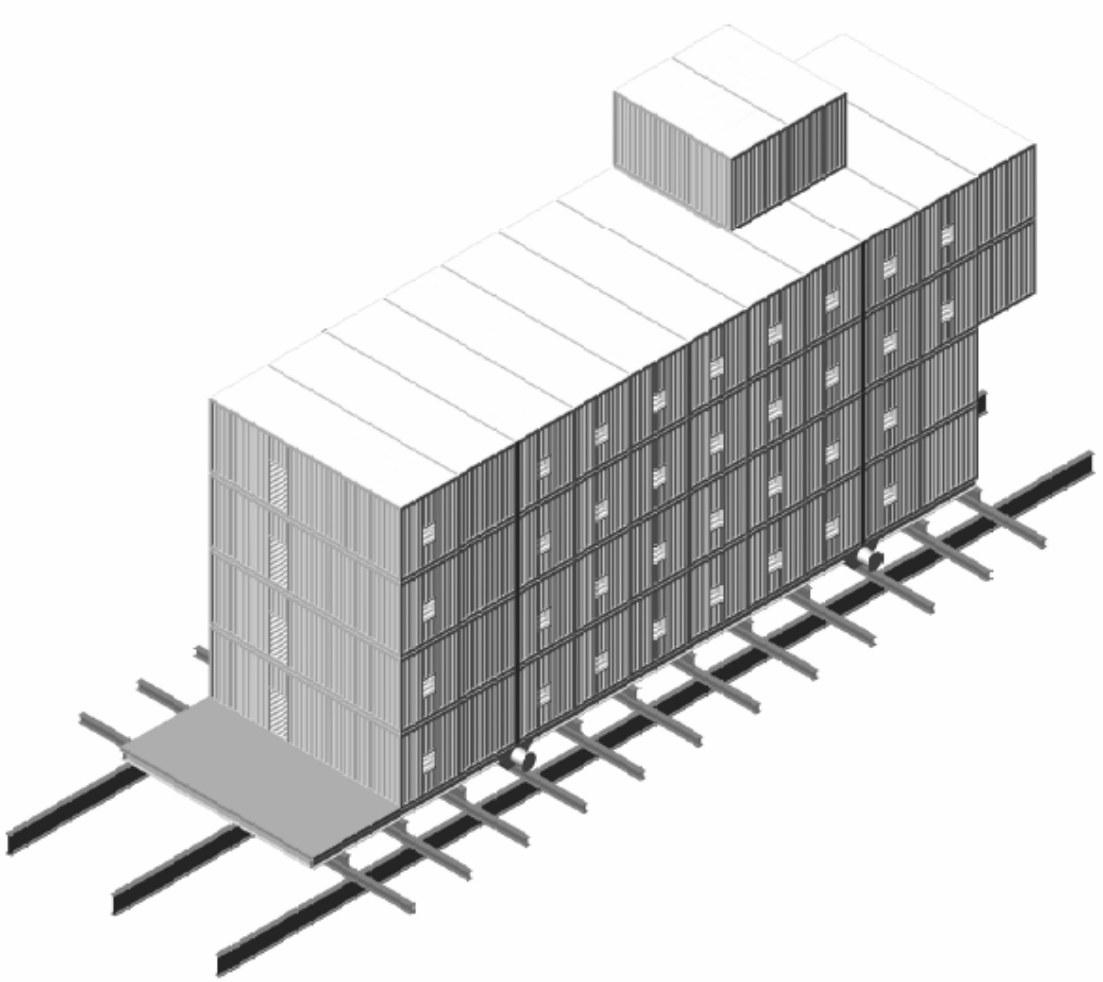

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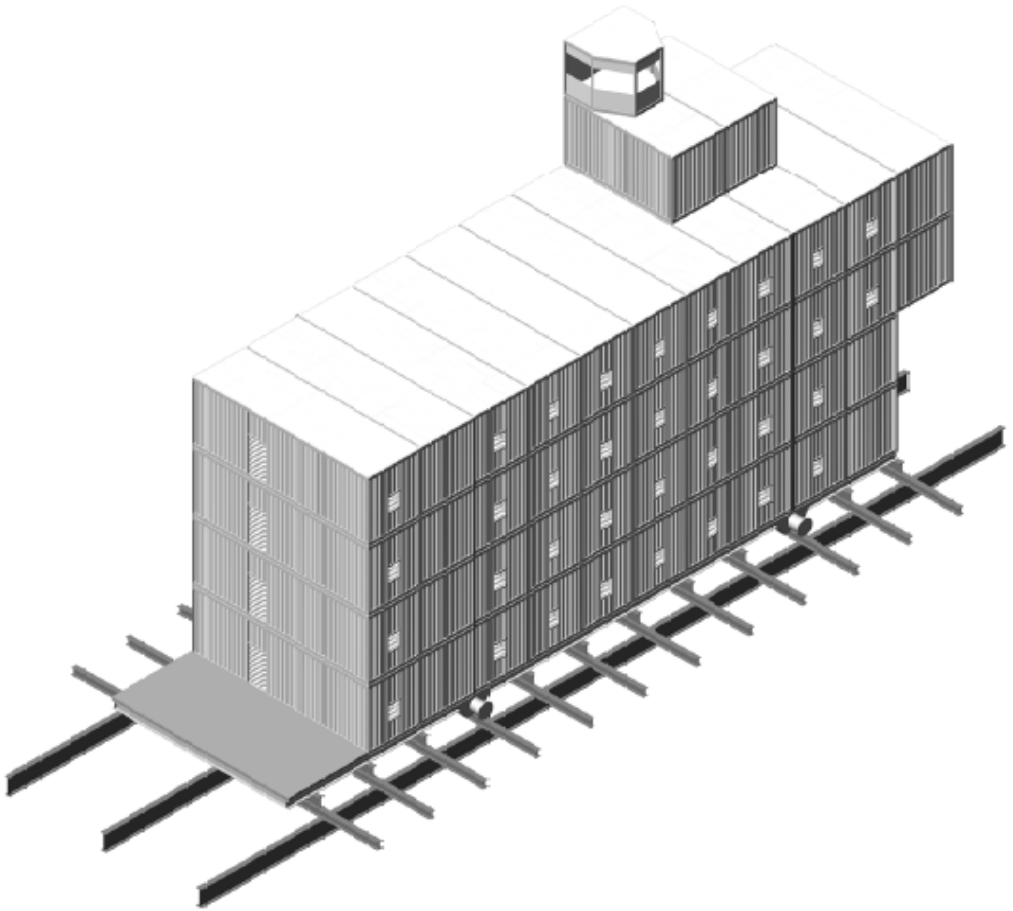

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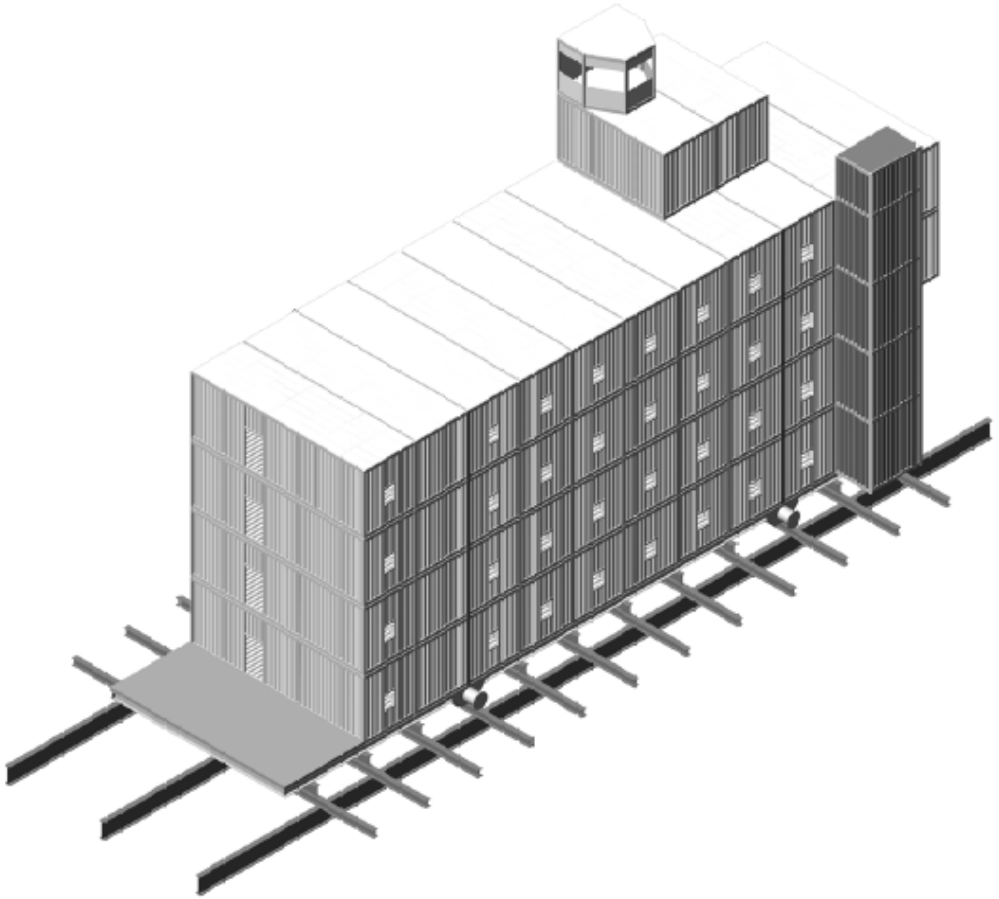

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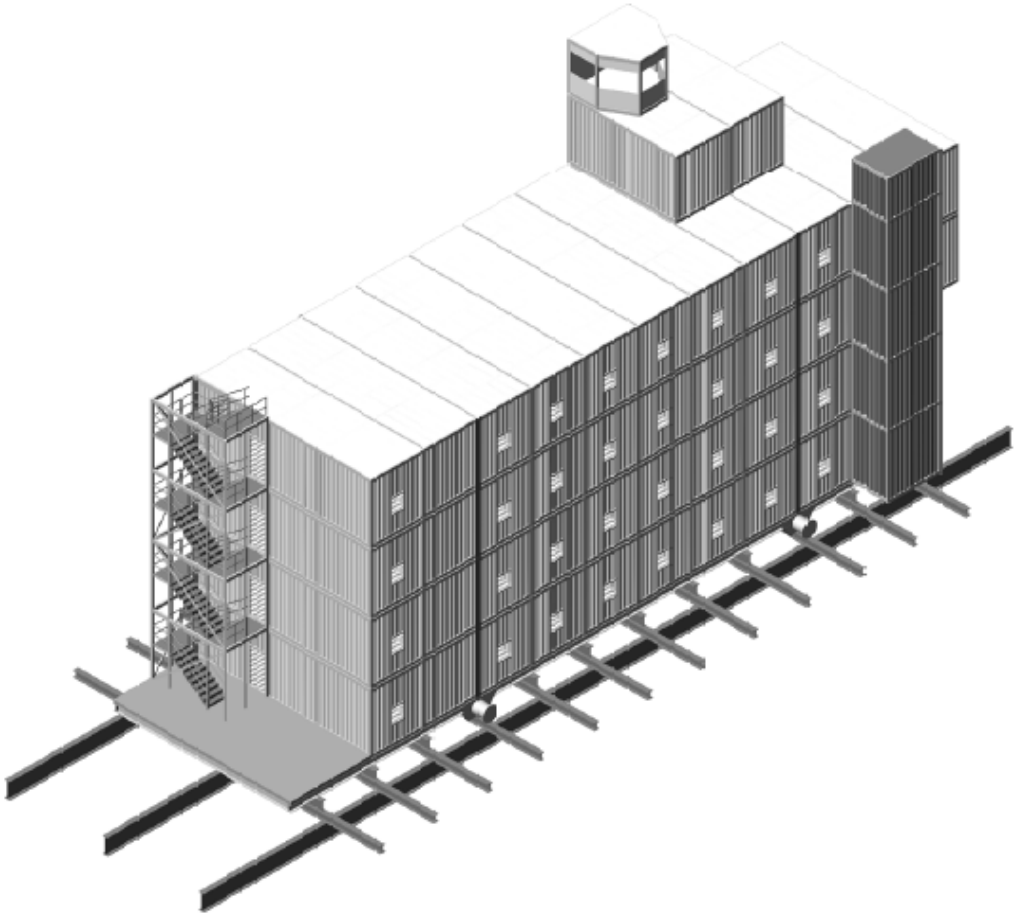

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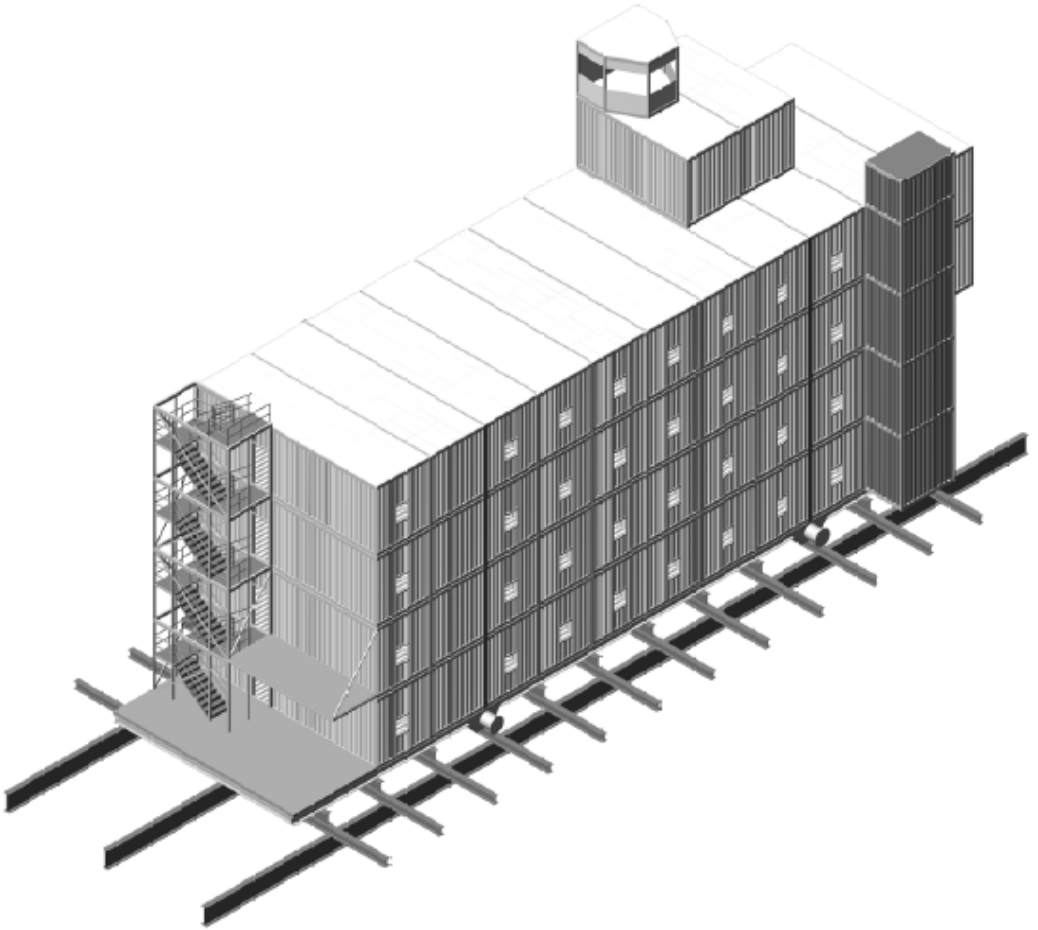

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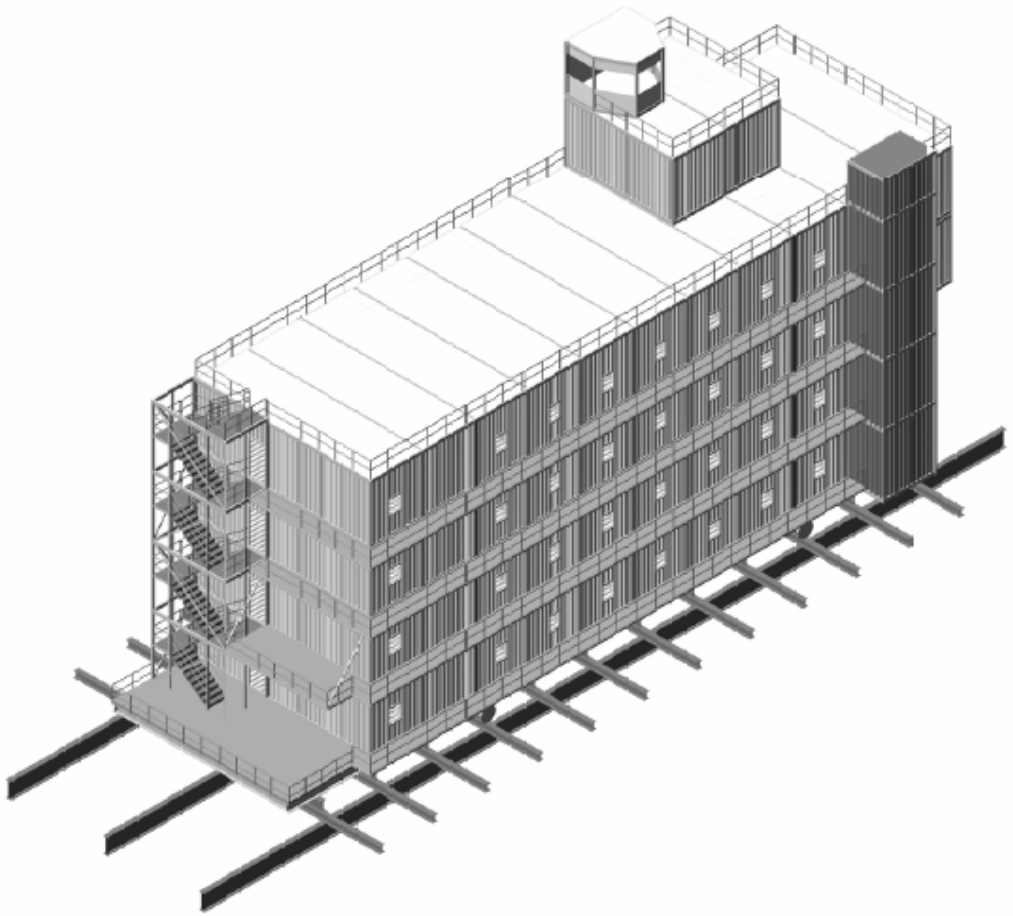

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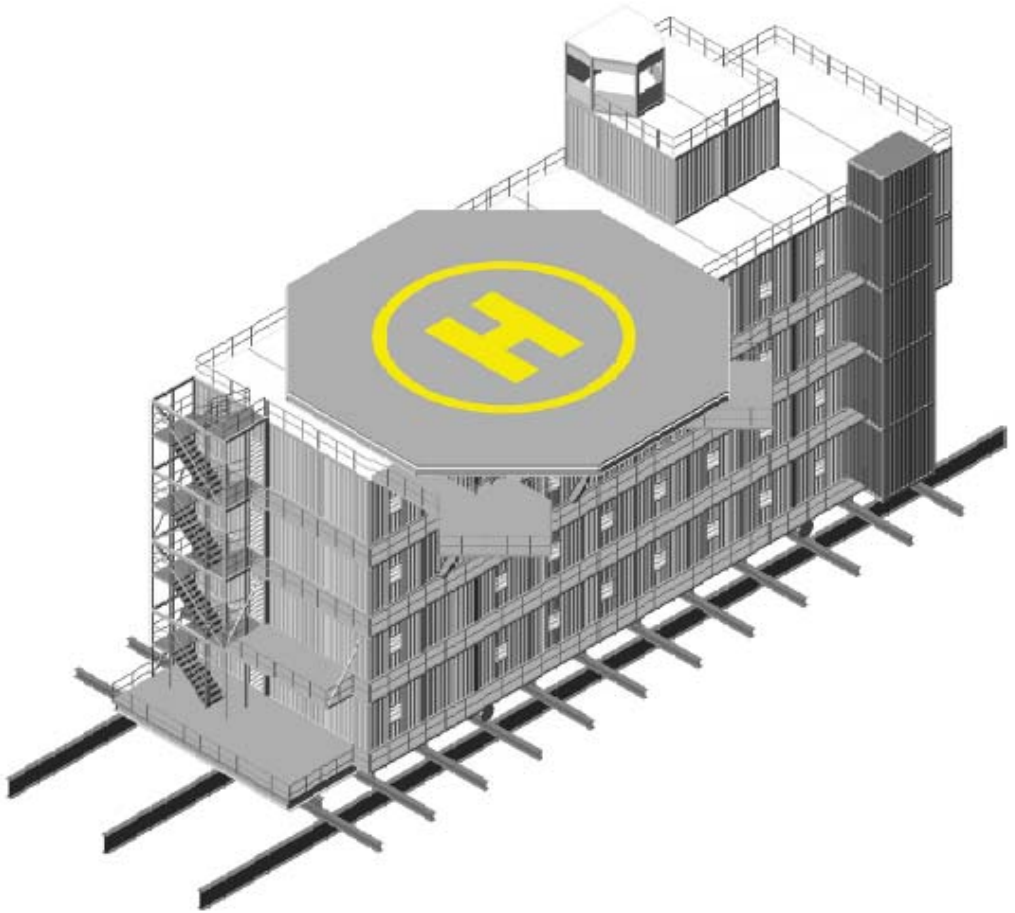

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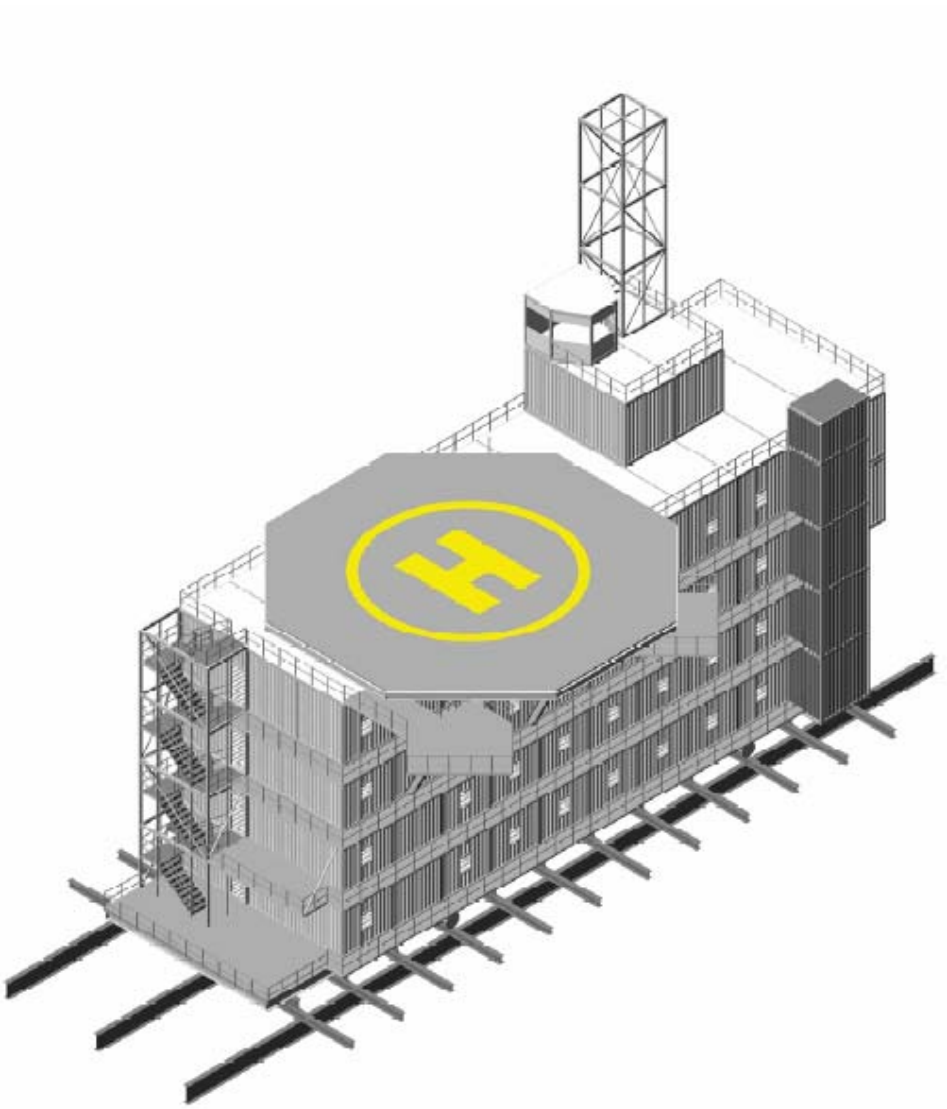

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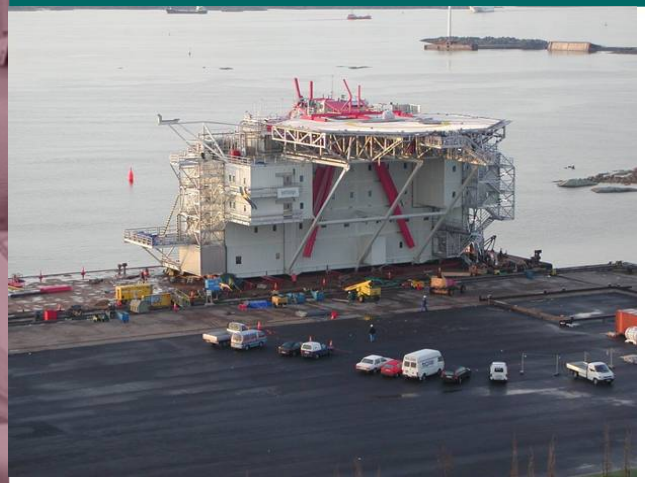

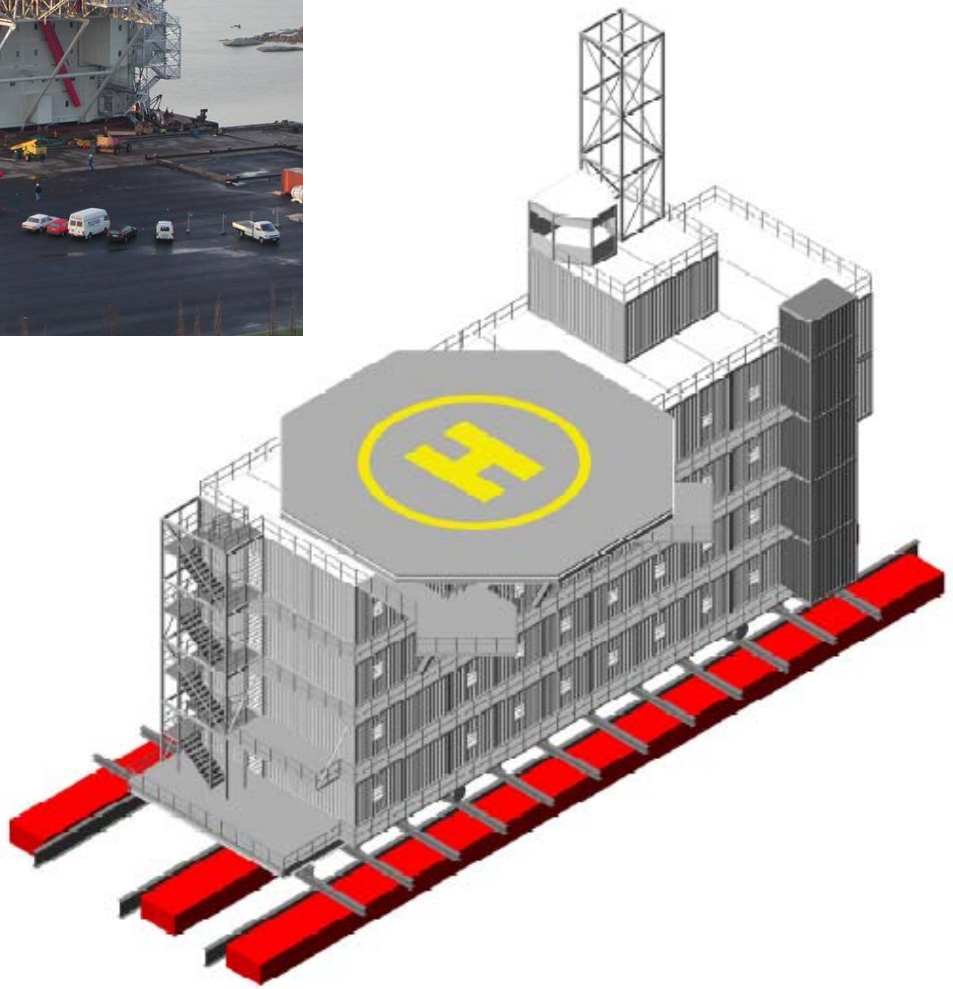

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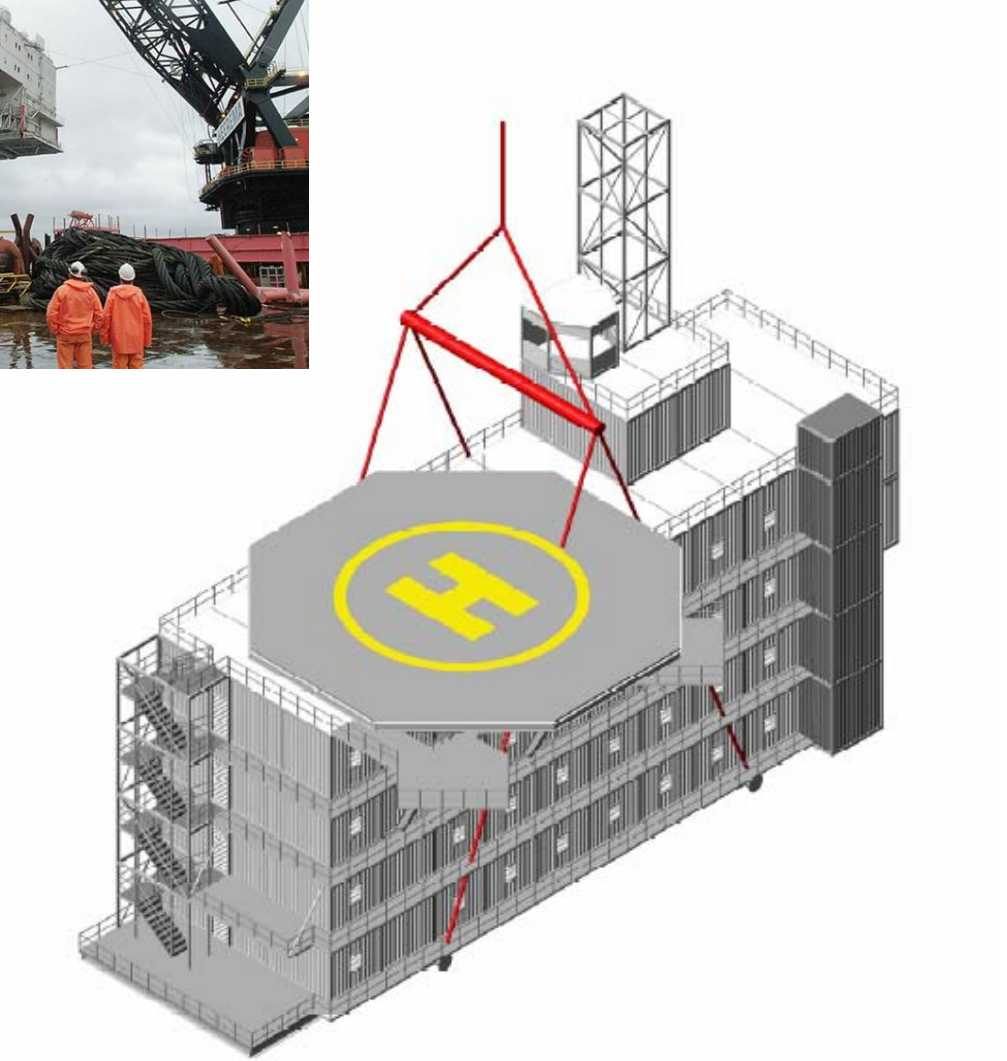

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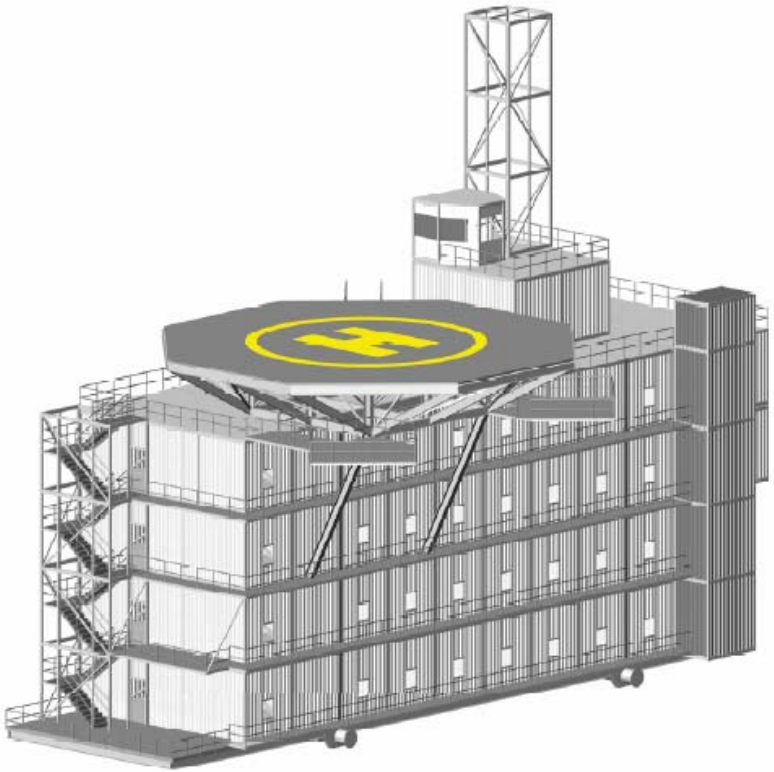

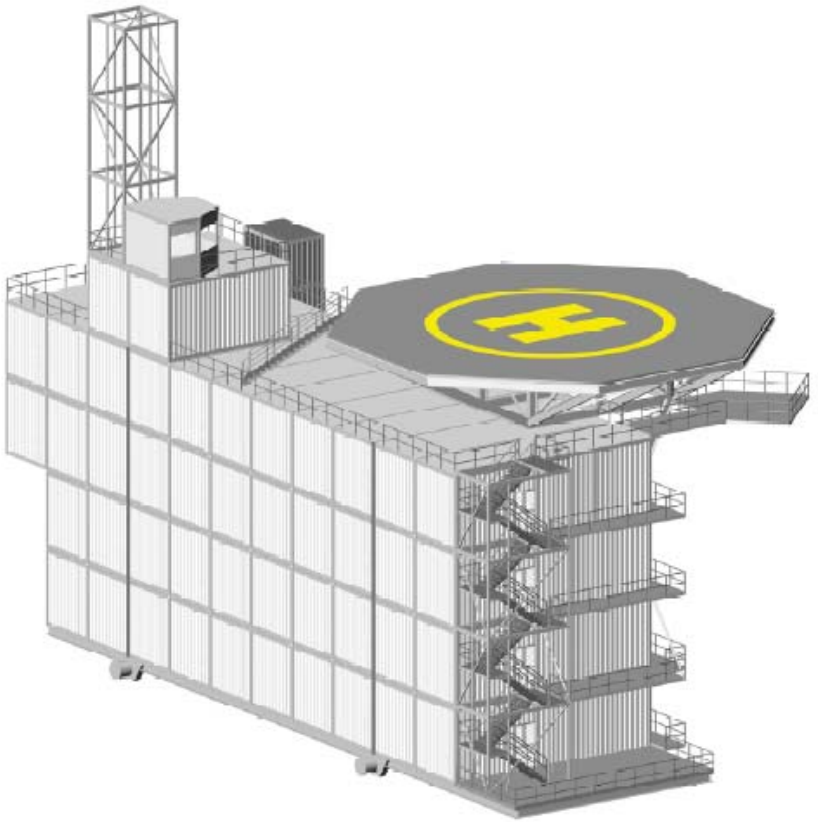

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Why lightweight?

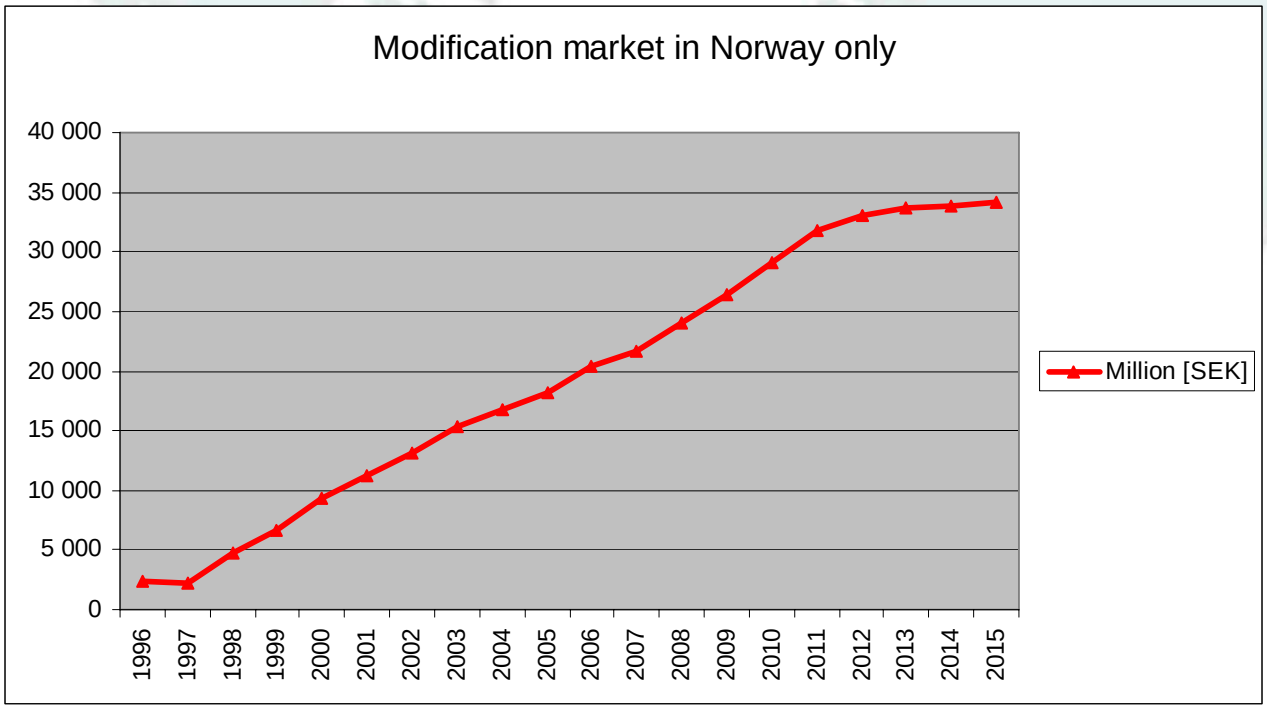
- **Customer requirements**
  - **Increased capacity – POB**
  - **Modification**
  - **New regulations**
  - **HSE requirements (regulations/Company)**

- **Challenge – Cover all new requirements using same support structure.**

- **This trend are global – Lightweight is important**

Why lightweight

- **Investment in modification project in Norway are expected to increase by near 100% next 8 years.**



50% Production increase
25% HSE
25% Maintain integrity

- This trend are global – Lightweight design has a market

Weight of a Living Quarter

- **Weight drivers**
  - **Temporary construction phases**
  - **Blast requirements**
  - **Deformations**
  - **Fire and Gas requirements**
  - **Wall panels**
  - **External items (HD, staircases, walkways, platforms, laydown areas.**

Weight of a Living Quarter

Weight distribution in a LQ (typical)

Reference project **1000 ton** Stressed skin by Emtunga

	Structure	Archutectural	HVAC	EIT	Piping	Total	Exteral Items	Helideck
UDW	180	125	20	15	5	345		
%	52	36	6	4	1	100		
Weight	470	326	52	39	13	1000	40	60

- **Hot spots**
  - **Structure**
  - **Temporary phases**
  - **Architectural – wall panels**

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Weight saving in a Living Quarter

- **Structure**
  - **High strength steel**
    - **Applicable in a few areas since deformation is the driver.**
    - **Possible items is limited to lifting points/support points.**
  - **Aluminum**
    - **1/3:rd weight and 1/3 stiffness - equal?**
    - **Form section properties that is suitable for deformation. d=5*qL^4/384/E/I**
    - **The structure is approximately a factor of 3 more expensive compared to steel**
    - **Longer lead time**
    - **Require more Passive Fire Protection**
    - **Typical structural weight saving is 25% compared to steel. Overall weight saving is 12-13%**

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Weight saving in a Living Quarter

- **Wall panels**
  - **Saving is up to approximately 3 %**
  - **Generates questions from customer regarding references, certification, etc. but possible**
  - **Rule of thumb – heavy material good acoustic properties…….!**
  - **Can be adopted for both aluminum and Steel alternative**

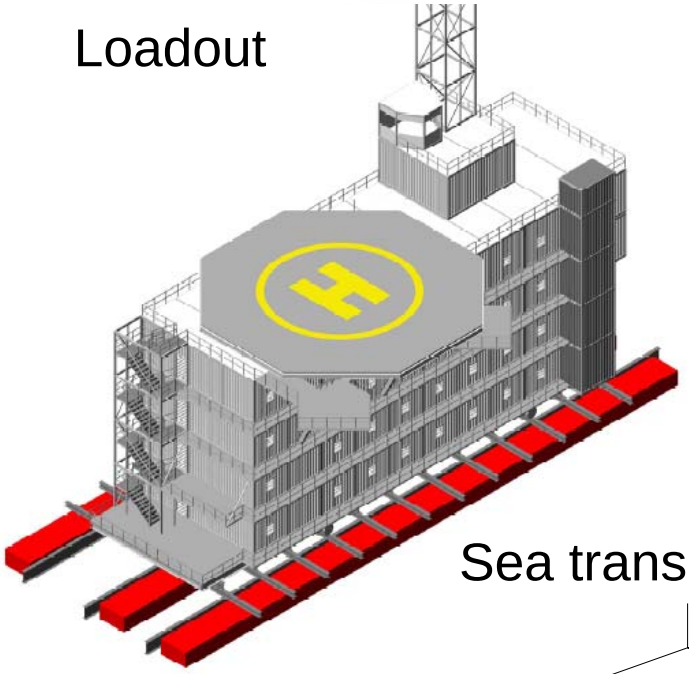
Weight saving in a Living Quarter

- **Temporary construction phases**
  - **Newer accept that temporary phases adds on structural material that are dead weight during in-place operation**
  - **Focus on (Spend money on):**
    - **temporary structures**
    - **Lifting aids**
    - **Installation aids**
    - **Bottom lift**
  - **Weight saving is ~6%**

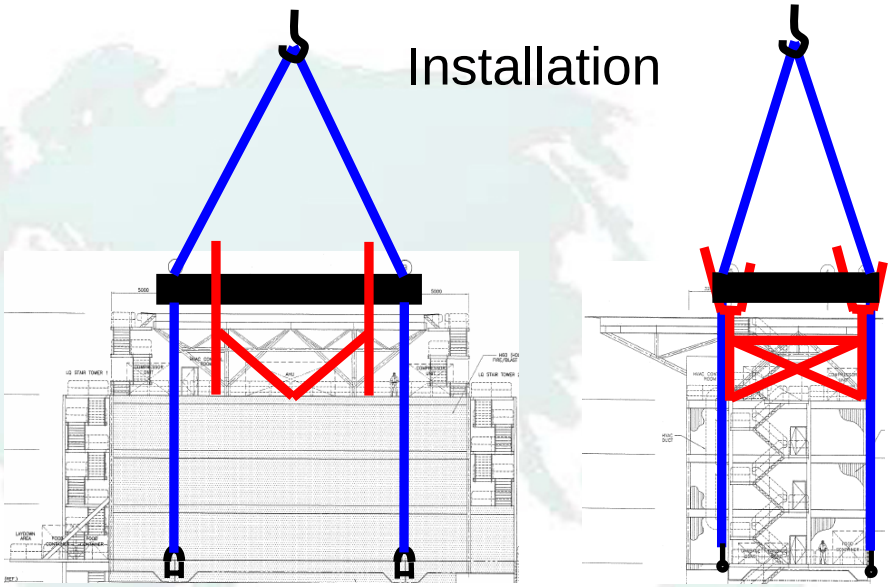
Weight saving in a Living Quarter

- **Temporary construction phases**

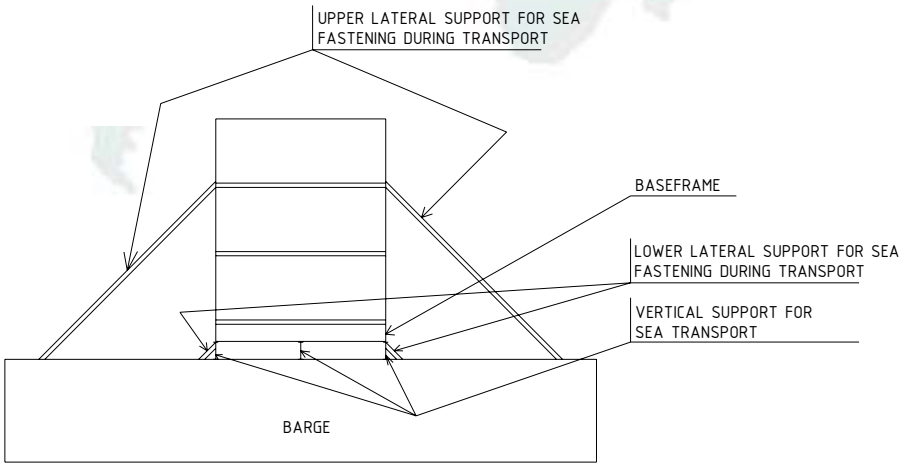
Loadout



Installation



Sea transport



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Weight saving in a Living Quarter

- **Temporary construction phases**

  Bad example !!

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Weight saving in a Living Quarter

- **Weight saving on hot spots**
  - **Using aluminum structure ~13%**
  - **Temporary construction phases ~6%**
  - **Using light weight wall panels ~3%**

Total: ~22%

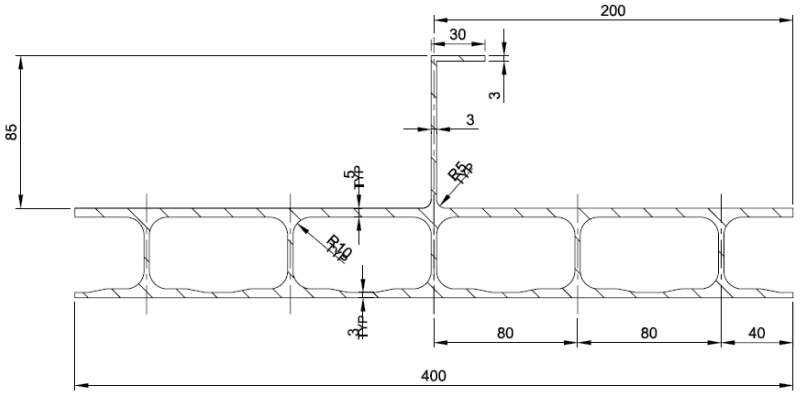
- **It should be noted that additional weight saving is possible in the support structure.**

Aluminum design

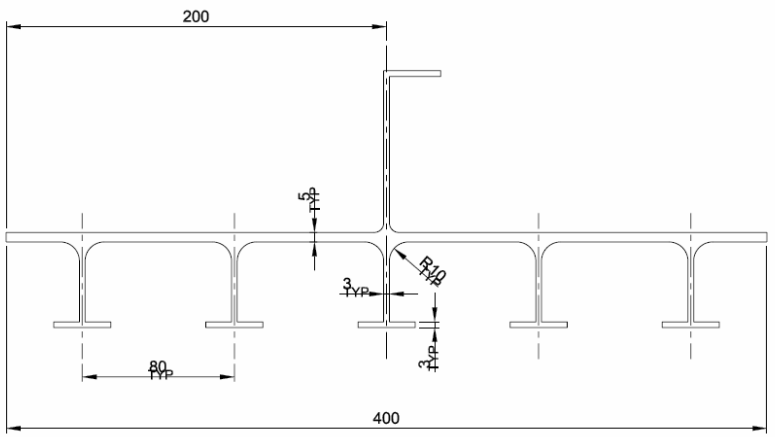
- **Focus on aluminum solution and wall panels in LÄSS project**
  - **New structural design adopted to modular construction (Emtunga)**
  - **Development in conjunction with SAPA**

Aluminum design

- **Basic panel alternatives investigated**
  - Extruded panels 400mm
  - FS welded
  - Both alternatives can be used as wall panel as well as floor panel. Final design decided in each individual project.



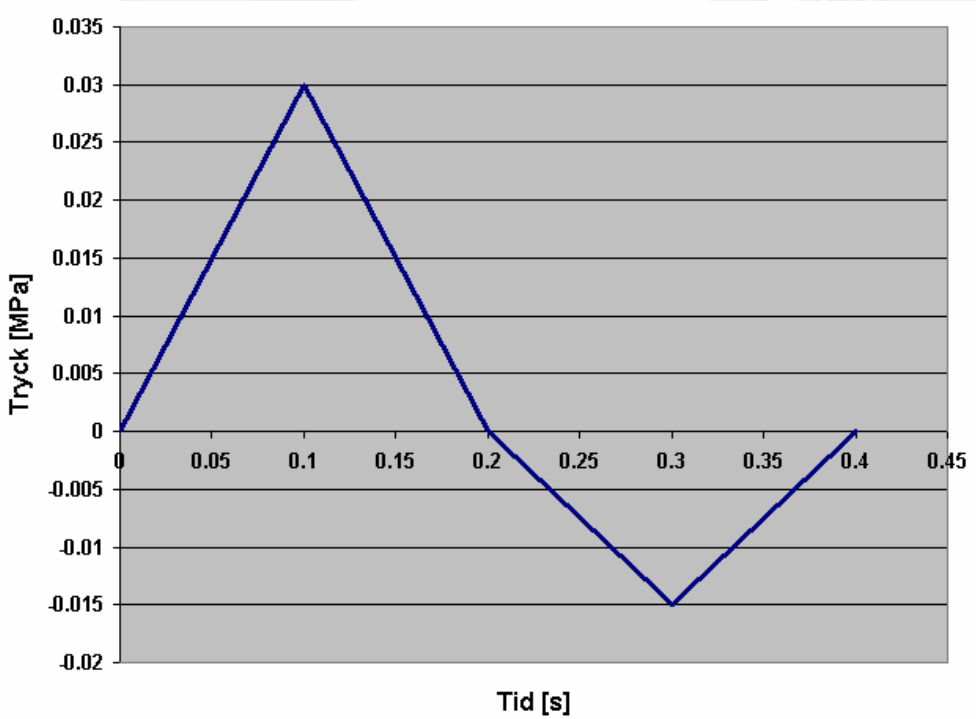
ALUMINIUMPROFIL
Alternativ A



ALUMINIUMPROFIL
Alternativ B

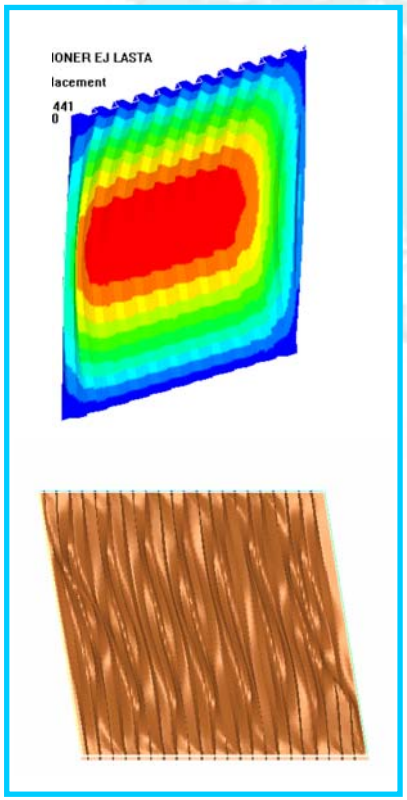
Aluminum design

- **Basic panel alternatives investigated**
  - Both alternatives meet following criteria's.
    - Shear load of 550 kN/m
    - Blast load of 30 kN/m^2 as shown below

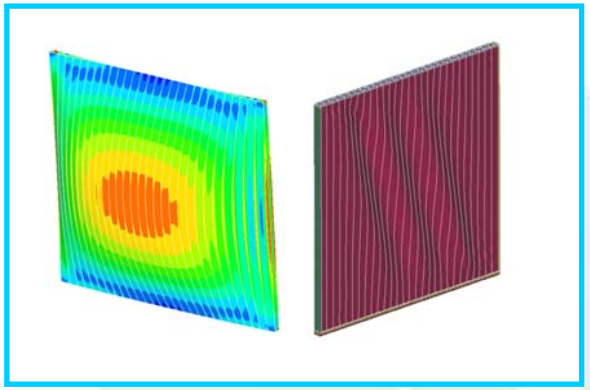


Aluminum design

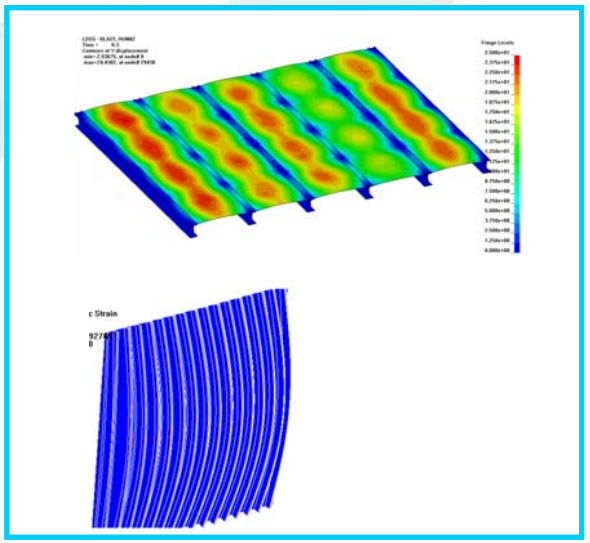
- **Basic panel alternatives investigated**



Reference - Steel



Solid panel Alt A



Solid panel Alt B

Aluminum design

- **Basic panel alternatives investigated**
  - Structural calculations and production feasibility study performed by SAPA shows following
    - Possible weight saving of 40-50% in the panel
    - Possible embedded feasibility to decrease fabrication time

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- **Next step?**
  - **Improve/verify/approve PFP design**
  - **Detail design**
  - **Temporary support structure for lifting and handling of each module**

End of presentation!

Questions?

Thanks for listening!