THESIS TOPIC

Global response analysis of the jack-up platform Odin

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Introduction – Jack up vessels

Floating Mode

Operational Mode

Survival Mode

Water surface

Leg penetration

Seabed

Leg

Spudcan

Air-gap
Introduction – Jack up ODIN

- Being named after the Nordic Father God
- In service since 2004
- Maximum water depth: 35m

General Dimension:
- Length overall: 46.35m
- Width overall: 30.00m
- Hull Depth: 4.60m
- Light ship weight: 2700t

Leg Dimension:
- Length: 60.00m
- Box Section: 2mx2m
Thesis Summary

The scope:
• The Global Response of ODIN in operational and survival modes

Objective:
• Environmental limits depending on water depth and leg penetration

Requirements:
• Software package: ANSYS Mechanical 14.5
• Classification rules: SNAME 5-5A

Analysis Procedure

Equivalent Structure

Finite Element Model

Conducting FE Analyses and Checking

Results and Finding

Suggestion for Structure Improvement

Environmental Load

Improving Model
Equivalent Structure

Drawings → Original Structure → Equivalent Structure

Environmental Load

Self-Weight

Wind Load
• Different angles of attack

Wave and Current Load
• Different wave phases

Crane Load
• Only for Operational Modes
Finite Element Model

Equivalent Structure

Environmental Load

Finite Element Model

Conducting FE Analyses and Checking

Results and Finding

Suggestion for Structure Improvement

Improving Model

Finite Element Model

Full Model
Finite Element Model

Sub-structuring Model

- One super-element representing the hull form

Conducting FE Analyses and Checking

Equivalent Structure  
Environmental Load

Finite Element Model

Conducting FE Analyses and Checking  
Improving Model

Results and Finding

Suggestion for Structure Improvement
Conducting FE Analyses and Checking

**FE Analyses**
- Modal Analyses
- Linear Static Analyses
- Dynamic Analyses
- Non-linear static analyses (with inertial load)

**Checking**
- Overturning Moment
- Ultimate Strength (EUROCODE 3)

Results and Finding

[Diagram showing the process of conducting FE analyses and checking, followed by results and findings leading to suggestions for structure improvement.]
**Results and Finding**

**Main Results – Envelop of Environmental Condition**

<table>
<thead>
<tr>
<th>ELEVATED CONDITION</th>
<th>HIGH-RISK WEATHER CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Depth</strong></td>
<td><strong>Leg Penetration</strong></td>
</tr>
<tr>
<td>20m</td>
<td>3m</td>
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*Note: In order not to violate the Air-gap condition, only waves under 7m are tested*

→ **Big waves are not necessarily dangerous waves**

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**Results and Finding**

**Boundary condition and Natural Period**

- **Boundary Condition**
  - Pin Joints (free to rotate) ➞ Fixity (all fixed)

- **Natural Periods Decreases ~ 50%**

→ **What is the Boundary Condition?**
Suggestion for Structure Improvement

Typical Force/Moment distribution over legs

Shear Force

Bending Moment
Suggestion for Structure Improvement

Typical Stress distribution

Key Remark

- Dangerous waves are not big waves but the right waves
- The accuracy of natural periods is vital, however sensitive
- High stress is often found around leg-hull connection
Thank you for your attention!

Bibliography

1. HOCHTIEF Solutions AG, (2013) HOCHTIEF Fleet
2. HOCHTIEF Solutions AG, (2009) Jack-up Barge Odin