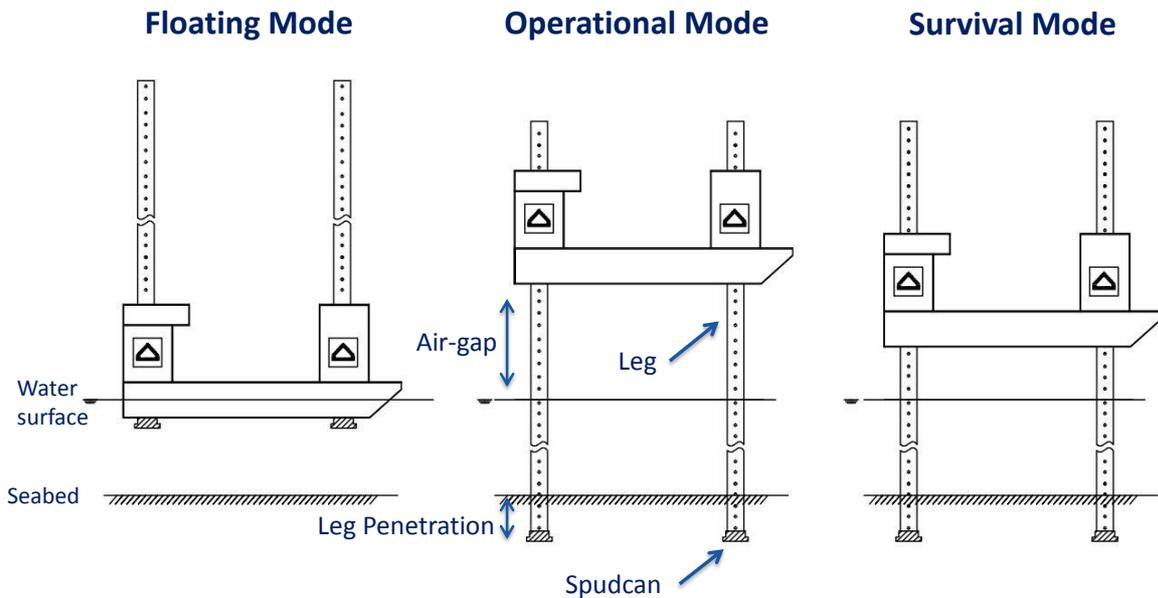# THESIS TOPIC

Global response analysis of the jack-up platform Odin
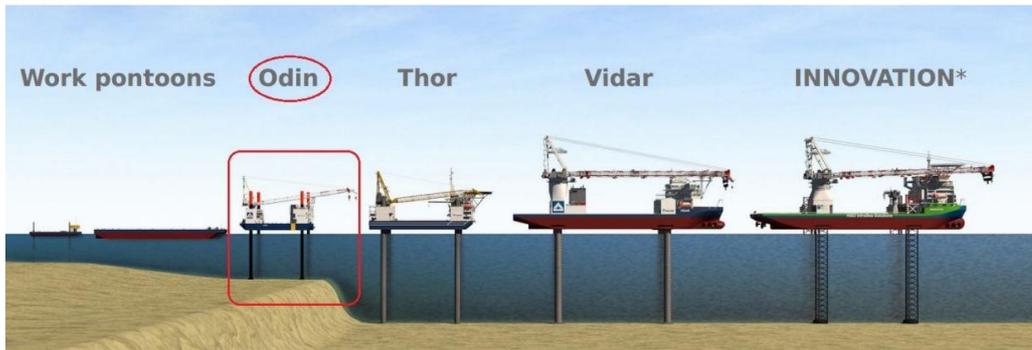
Student: Tran Viet Hai

Principle Supervisor: Prof. Patrick Kaeding, University of Rostock

Practical Supervisor: Mr. Sebastian Wenzel, HOCHTIEF Solutions AG

Introduction – Jack up vessels

Floating Mode   **Operational Mode**   **Survival Mode**

Air-gap

Leg

Water surface

Seabed

Leg Penetration

Spudcan

Introduction – Jack up ODIN

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

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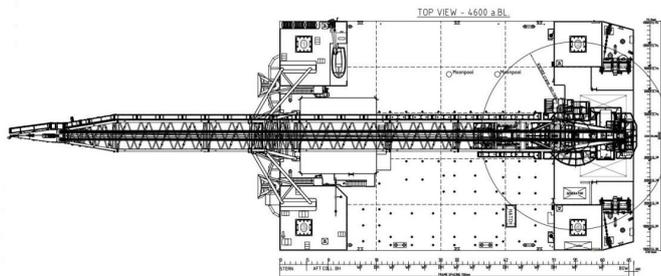

Introduction – Jack up ODIN

General Dimension:
- Length overall: 46.35m
- Width overall: 30.00m
- Hull Depth: 4.60m
- Light ship weight: 2700t
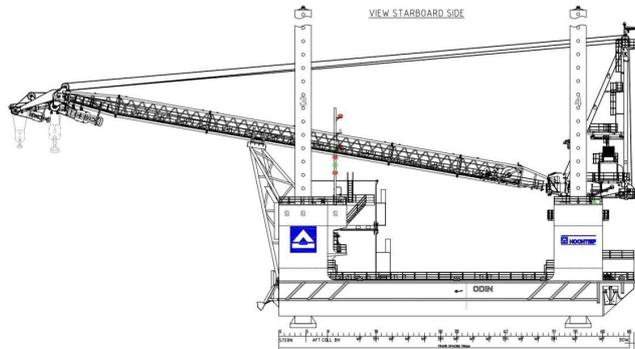
Leg Dimension:
- Length: 60.00m
- Box Section: 2mx2m

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Thesis Summary

The scope:

- The Global Response of ODIN in operational and survival modes

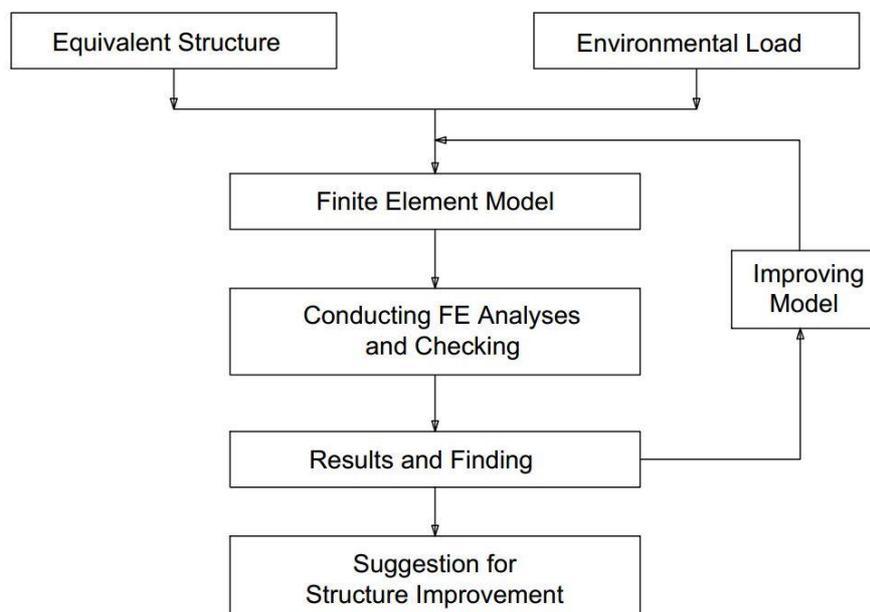**Objective:**

- Environmental limits depending on water depth and leg penetration
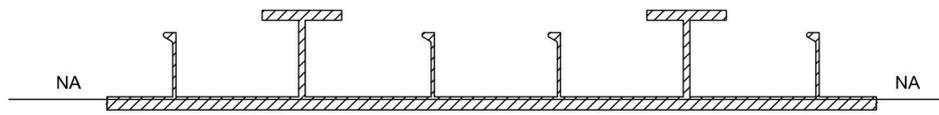
Requirements:

- Software package: ANSYS Mechanical 14.5

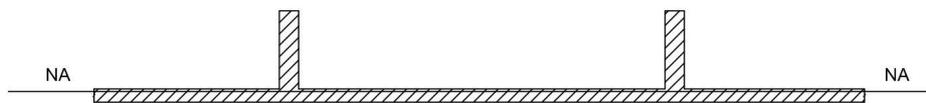- Classification rules: SNAME 5-5A

Analysis Procedure

Equivalent Structure

Drawings → **Original Structure** → **Equivalent Structure**

Original Structure

Equivalent Structure

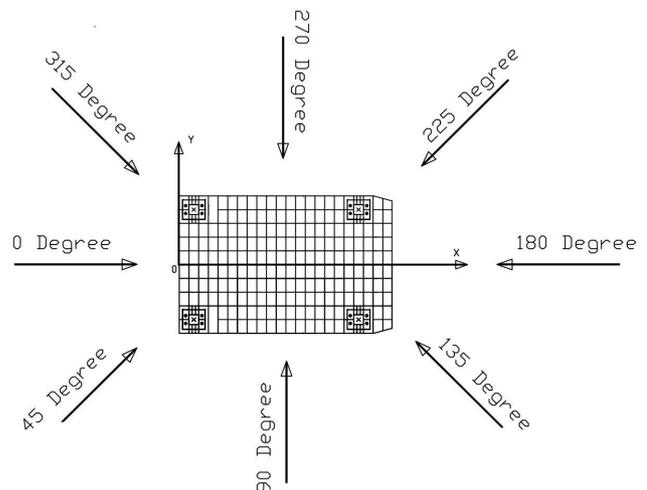## Environmental Load

Self-Weight

Wind Load

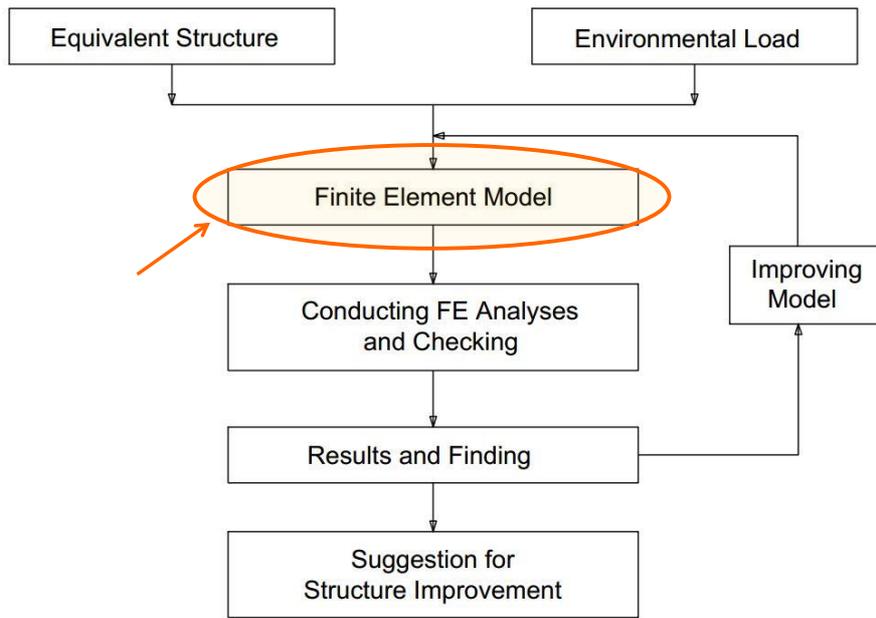- Different angles of attack

Wave and Current Load

- Different wave phases
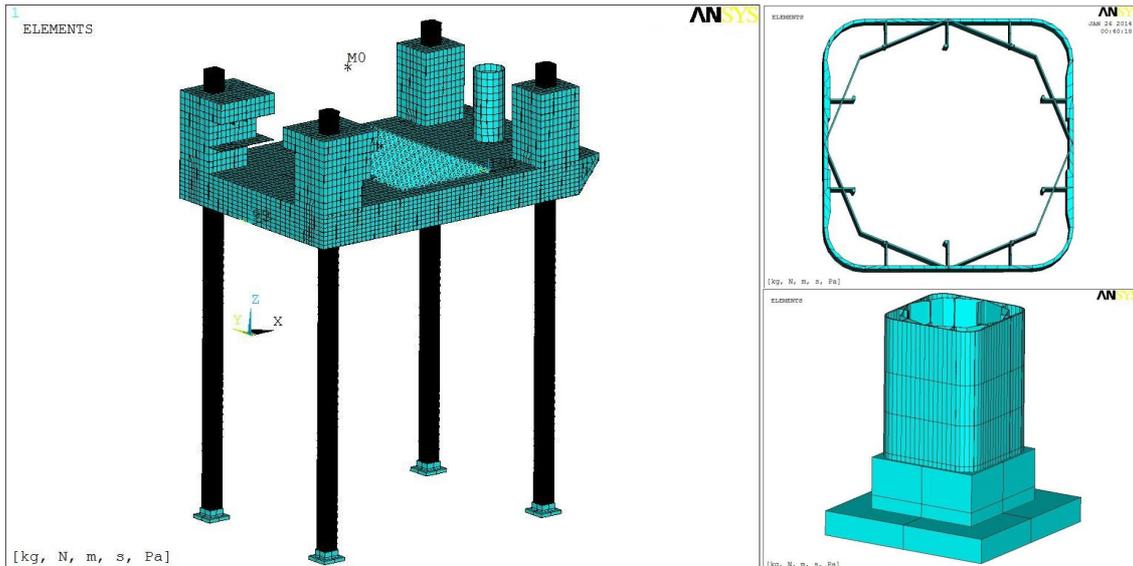
Crane Load

- Only for Operational Modes
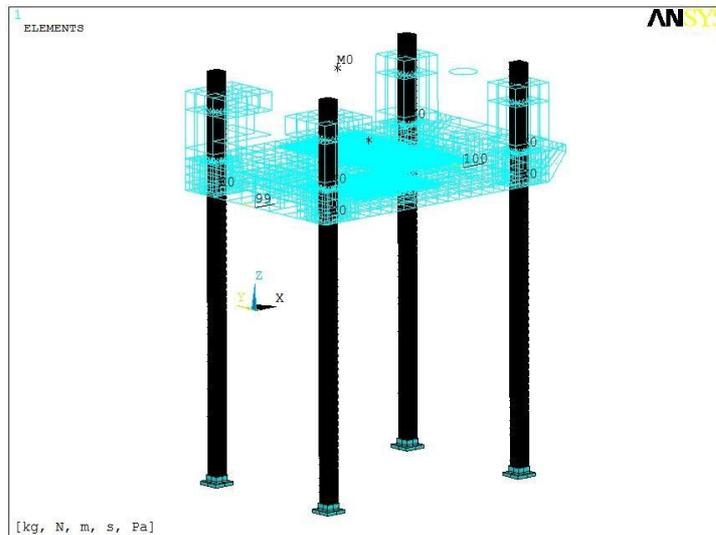
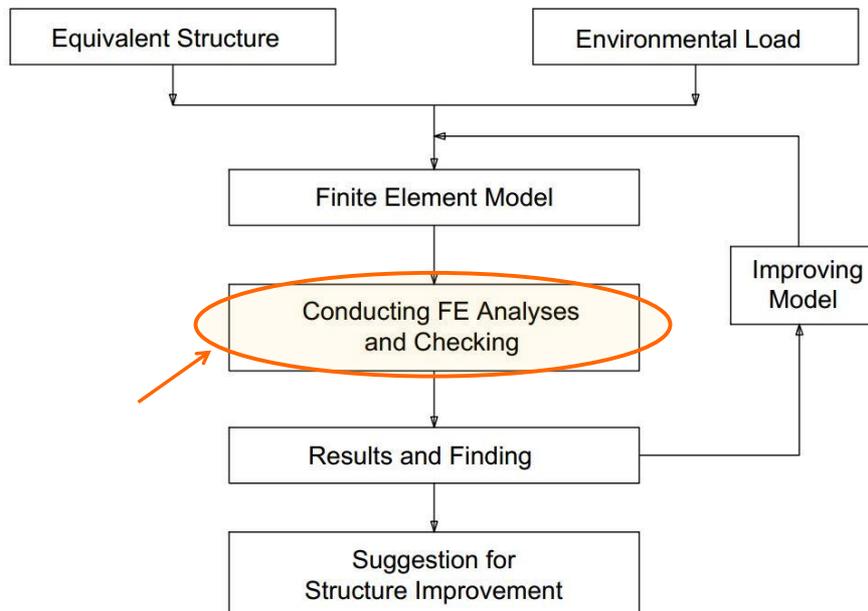# Finite Element Model

Finite Element Model

Full Model

Finite Element Model

Sub-structuring Model

- One super-element representing the hull form

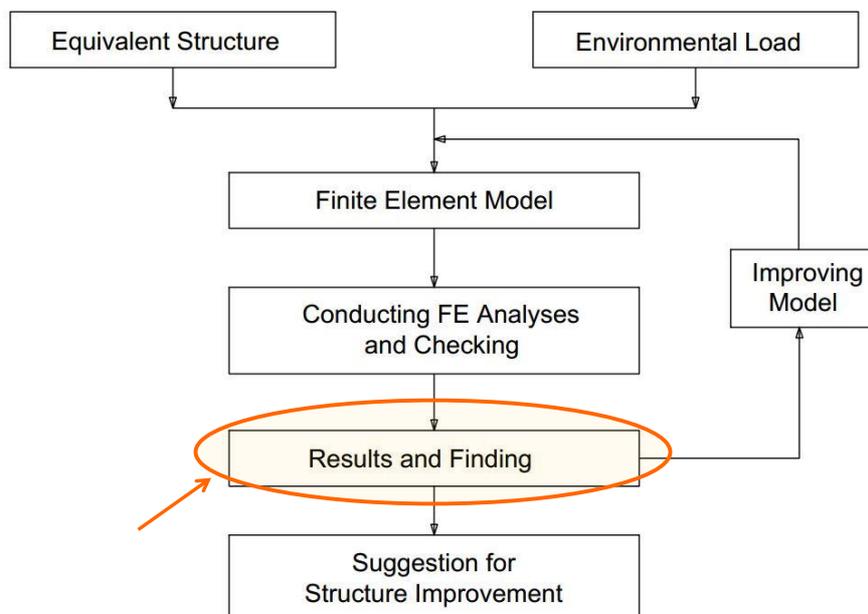# Conducting FE Analyses and Checking

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)

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Results and Finding

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Results and Finding

Main Results – Envelop of Environmental Condition

ELEVATED CONDITION				HIGH-RISK WEATHER CONDITION		
Water Depth	Leg Penetration	Mode	Air-gap	Wind Speed	Current Speed	Wave Height Max
20m	3m	Operational	15m	12m/s	1m/s	2.9m – 5.6m
		Survival	5m	23m/s	1.5m/s	3.3m – 3.5m

*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

Water surface
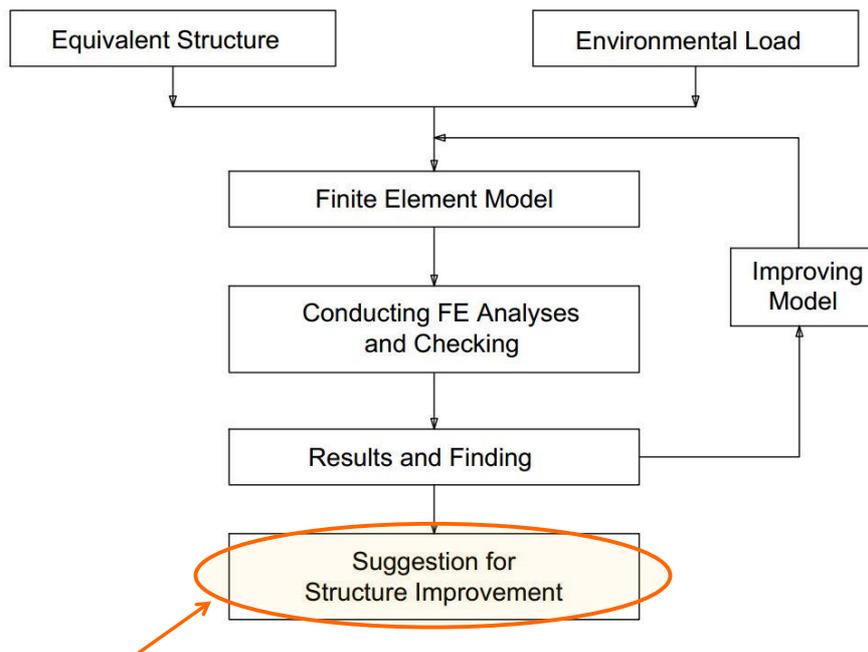
Seabed

Soil
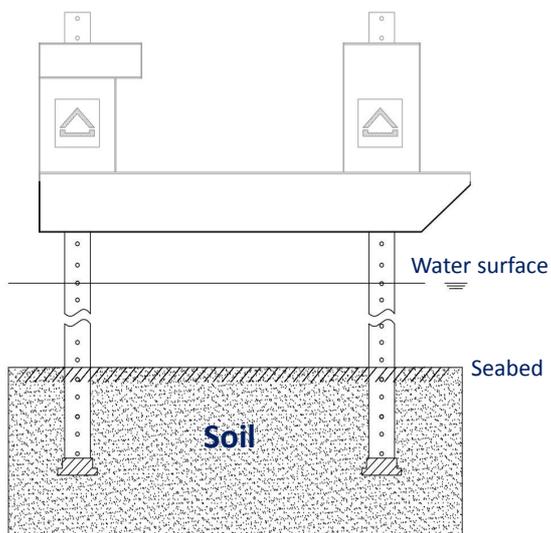
Boundary Condition
Pin Joints (free to rotate) ⟶ Fixity (all fixed)

⬇

Natural Periods Decreases ~ 50%

➡ **What is the Boundary Condition ?**

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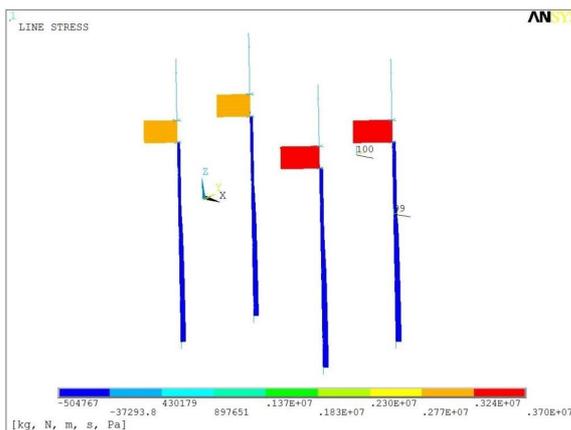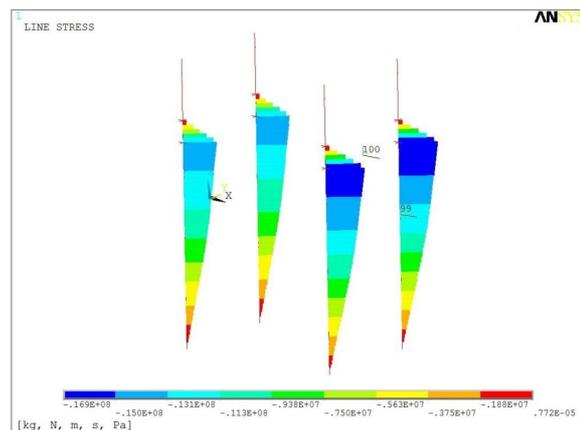
Suggestion for Structure Improvement

Suggestion for Structure Improvement

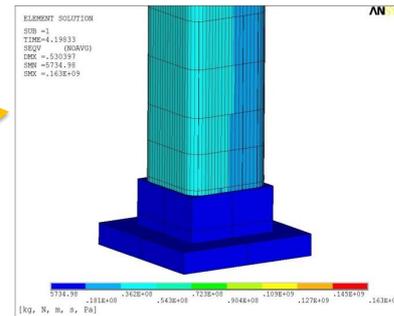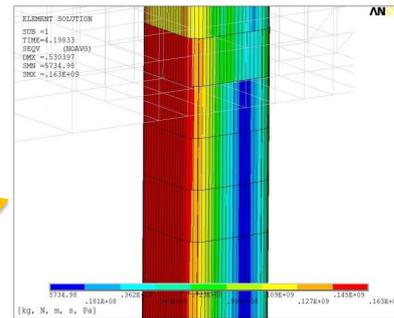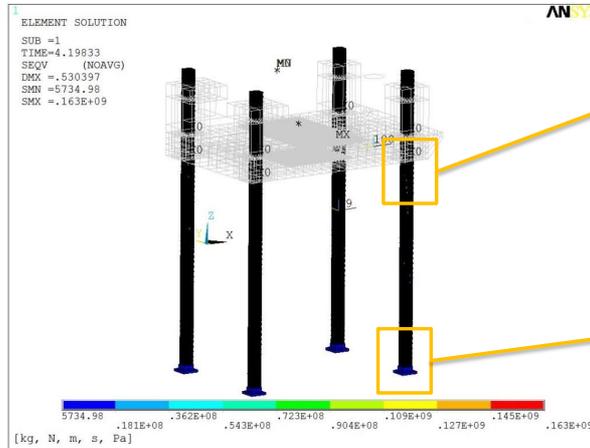## Typical Force/Moment distribution over legs

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
3. HOCHTIEF Solutions AG, (2009) Odin Drawing: General arrangement
4. HOCHTIEF Solutions AG, (2009) Odin Drawing: Jack-up legs extension