Marine operations in practice

Geotechnical

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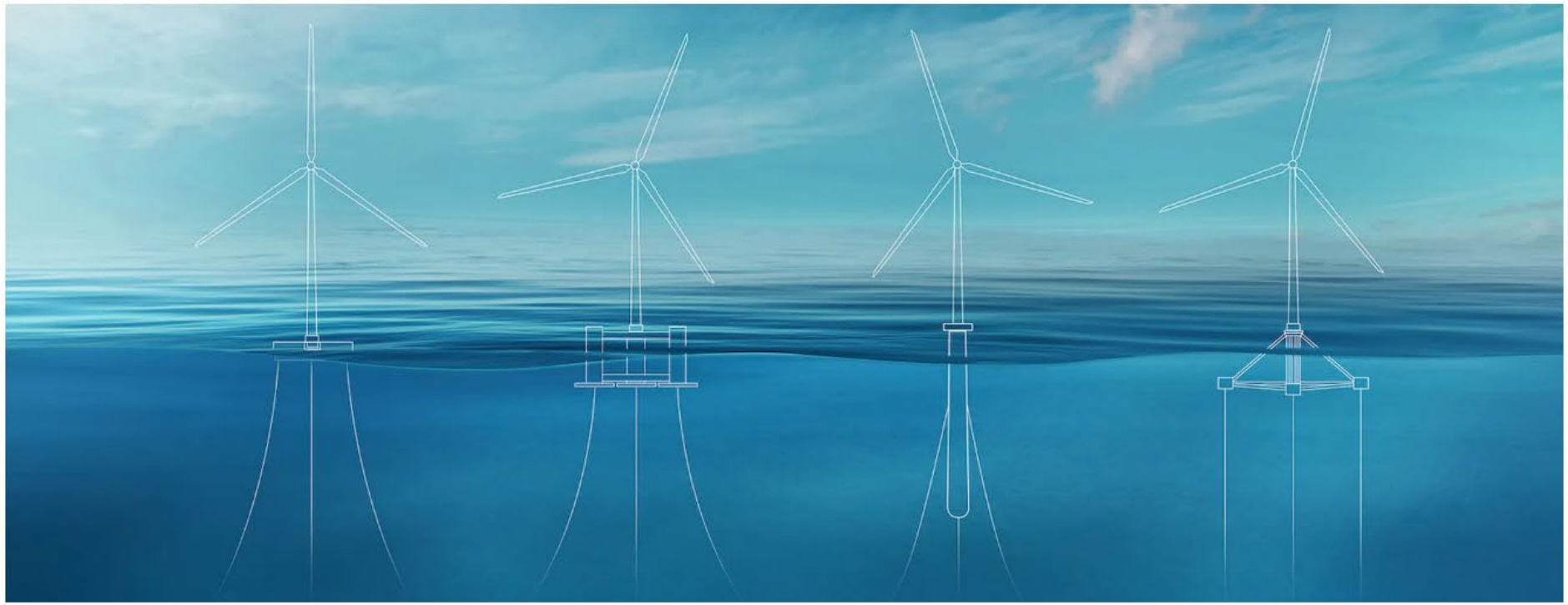
24 April 2025

CONTENT

- Can we help cutting cost for the industry?
- Status Fluke anchor in Sand
- Geotechnical remark regarding Stevmanta anchor test

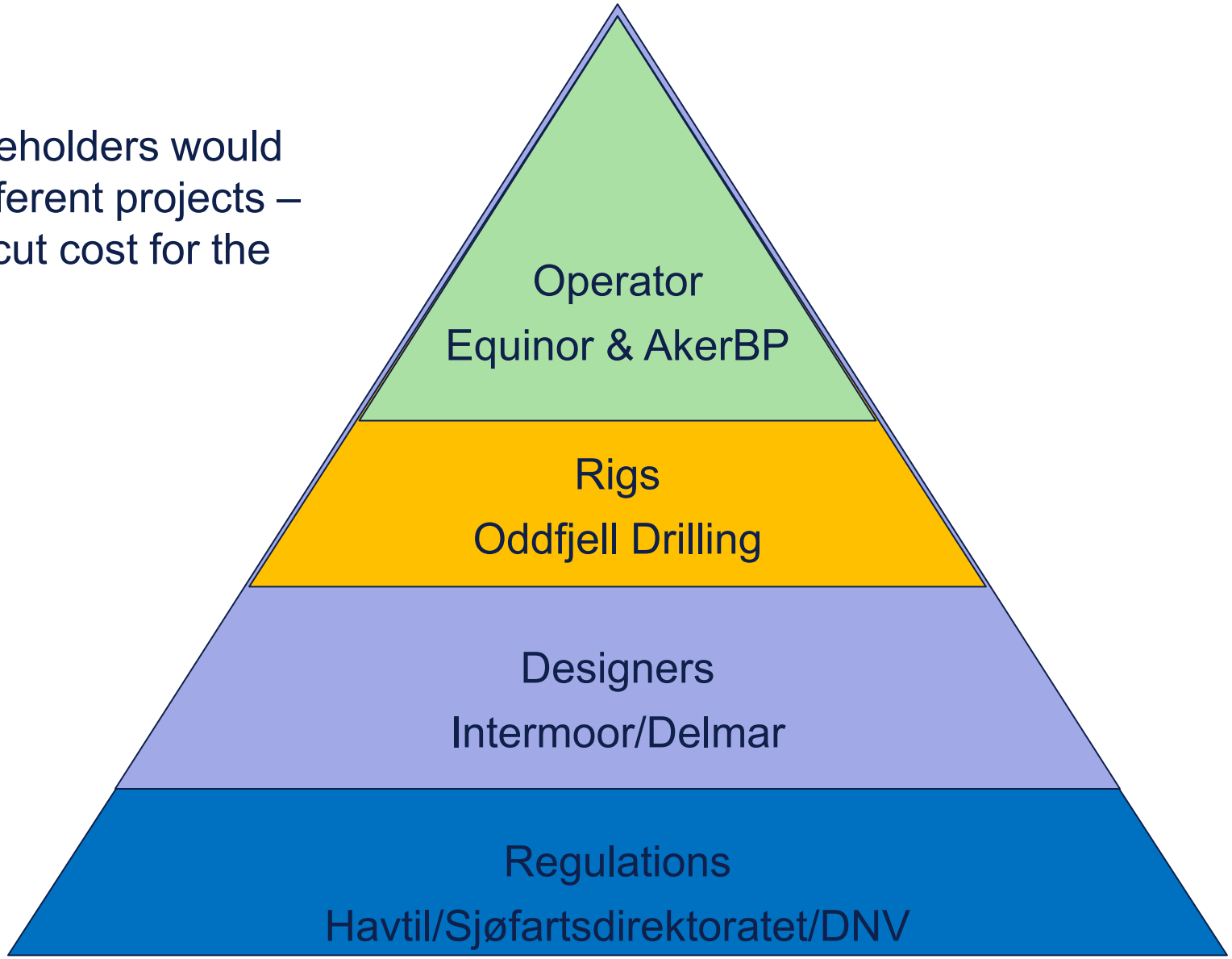
Can DNV help cutting cost for the industry?

DNV launches joint industry project on ground investigations for offshore wind turbines



Going forward with the DNV RP E301 projects

- It is a hope that stakeholders would like to pay for the different projects – that we believe can cut cost for the industry.



DNV RP E301 suggested projects

1) Risks related to type of rig and infrastructure (Ongoing)

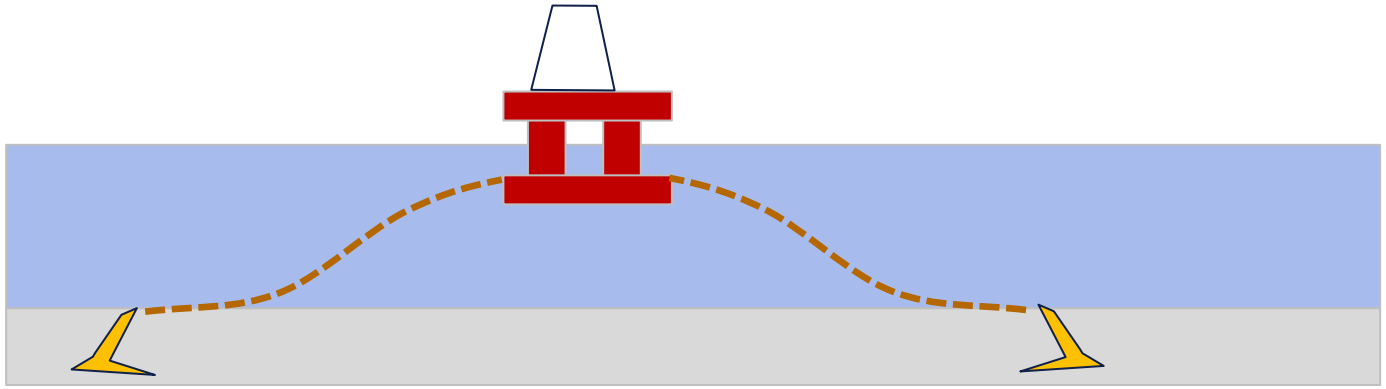
2) Clay – with homogeneous soil conditions – Troll

3) Sand – contractant or dilatant behaviour - Alvheim

4) Measurement pulses above ULS when soil conditions are unknown.

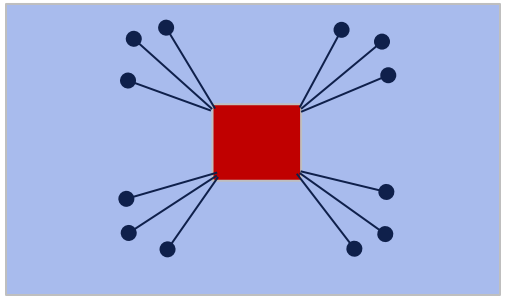
5) DIGIN analyses for sand

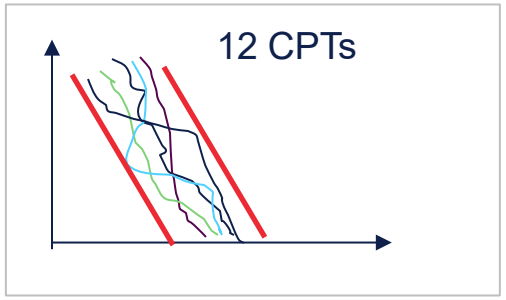
1) Risks related to type of rig and infrastructure (ongoing)

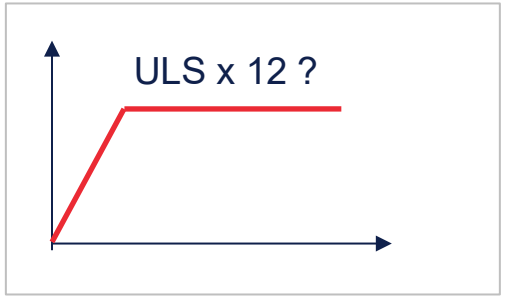


- If there is no harm if a storm is coming and Rig operator can drop the anchors (disconnect) and sail on DP, the risk is minimal, and this should be reflected in the RP.

2) Clay – with homogeneous soil conditions - Troll



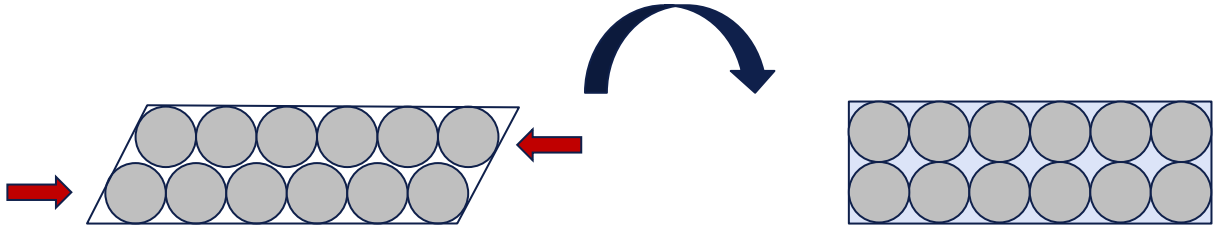




- Do we need to test 12 anchors if we know the soil is the same for all anchors?

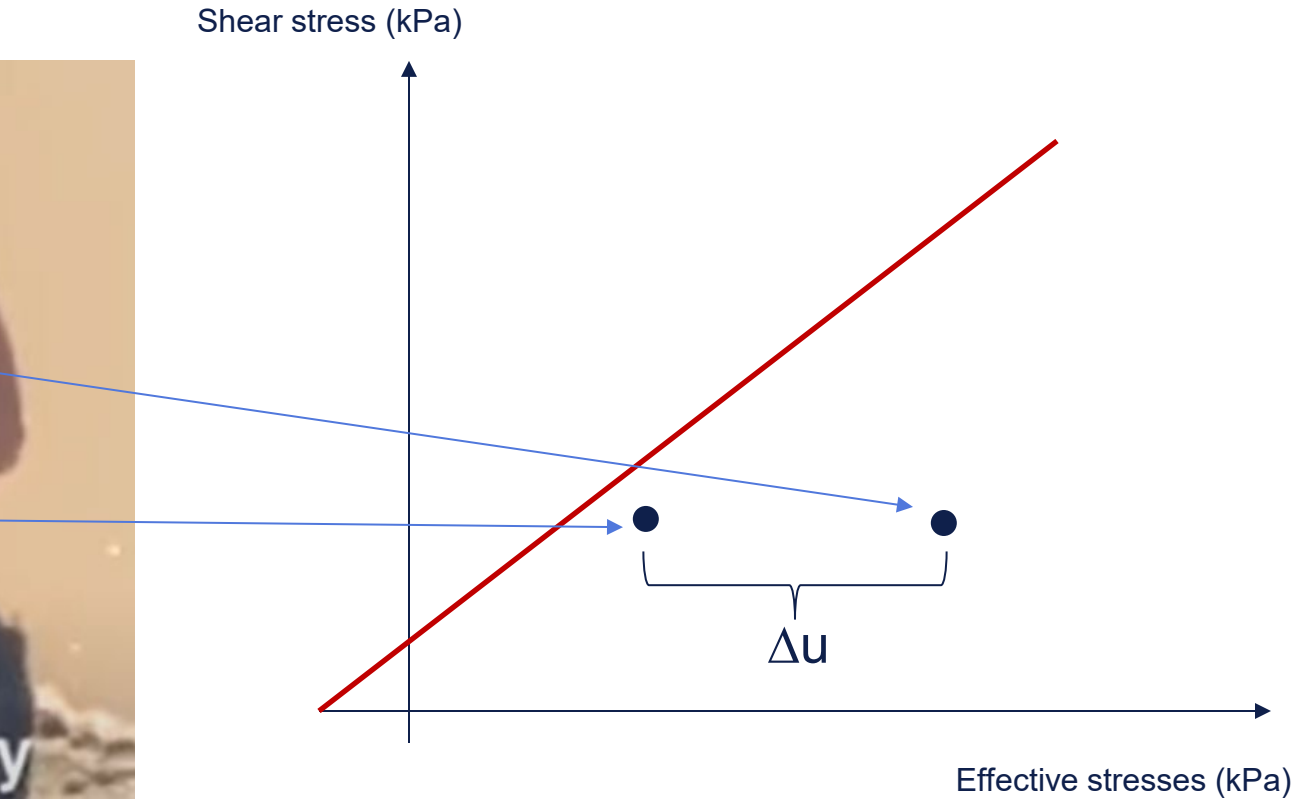
3) Sand – contractant or dilatant behaviour - Alvheim

In some cases, especially for silty fine sand, that is dense and compact, shearing causes a volume increase.



Water will fill the voids between particles after shearing. If we assume that water is coming from the outside of the box, this means that there is suction and higher effective stresses outside the box. This can be illustrated on the picture next slide, with a man walking on a sandy beach.

Dilatancy



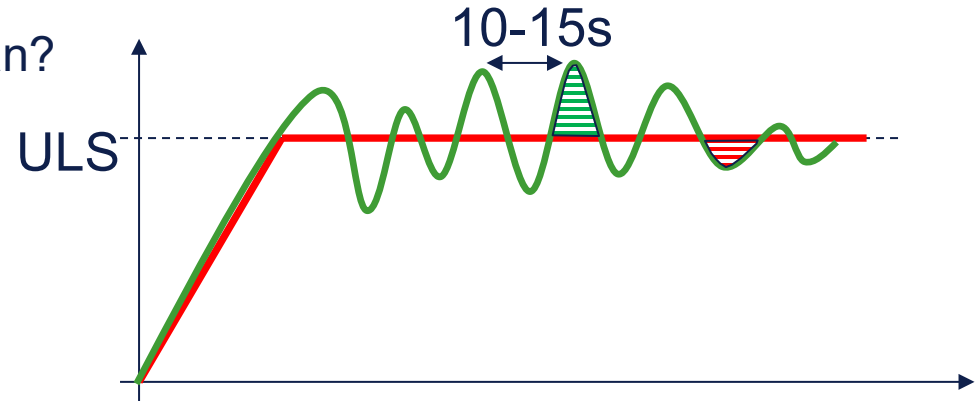
The soil around the foot gets an increased strength (due to suction)

But this strength will disappear with time when water is coming back.

This is why we should hold the anchors in sand for some time!

4) Measurement pulses above ULS when soil conditions are unknown.

- Work in collaboration with Kongsberg offshore.
- Questions to be considered: Peak above ULS, what does it mean?
- Number of peaks above ULS?
- Can you stop if peak is 10% above ULS?
- What will DNV accept?
- Where do we measure?

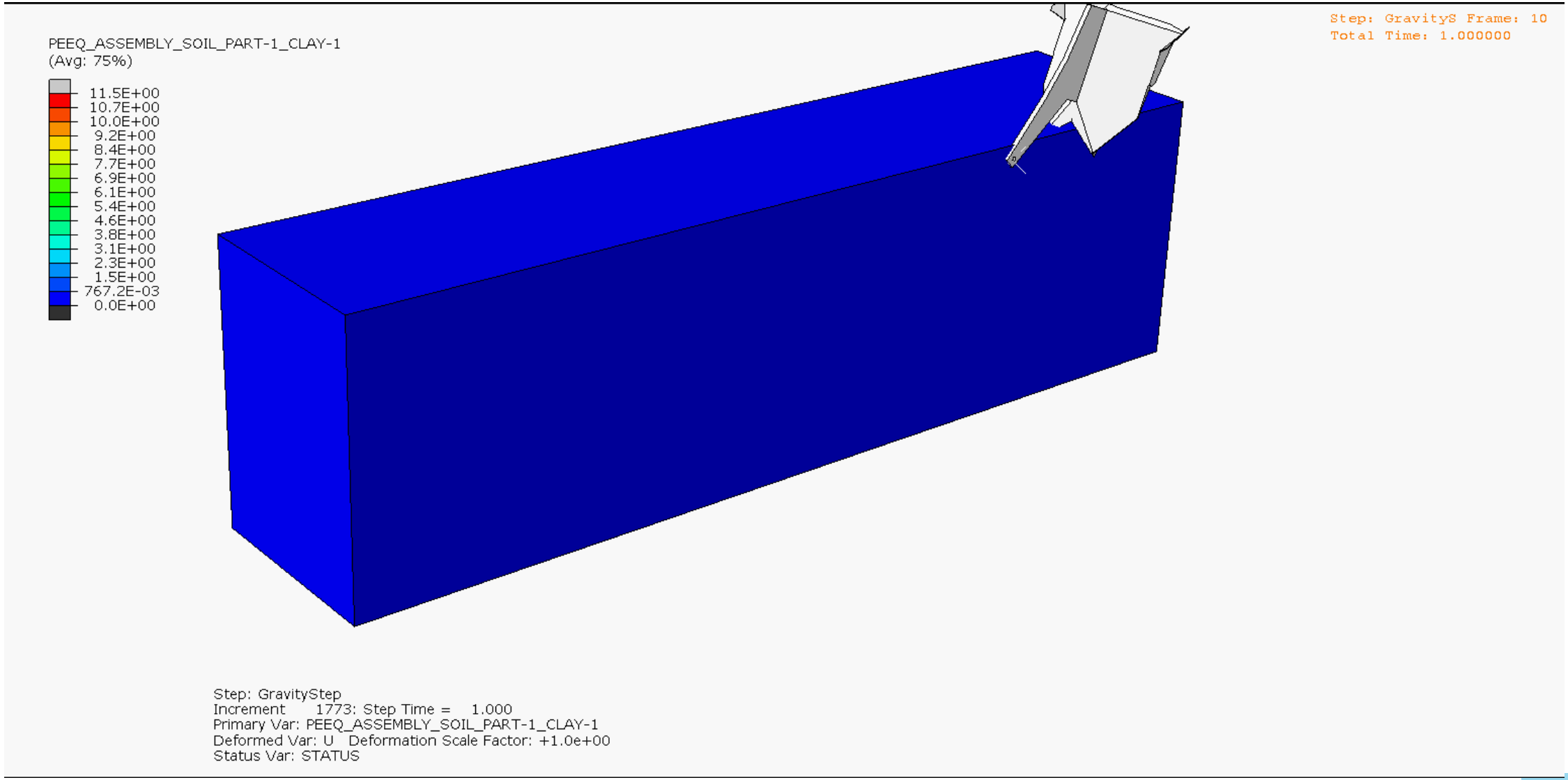


- DNV will look at received data for harsh conditions and evaluate for different soil conditions. What will be the case if clay? What will be the case if sand? The most conservative soil approach will set the standard.

Magnus Wahl

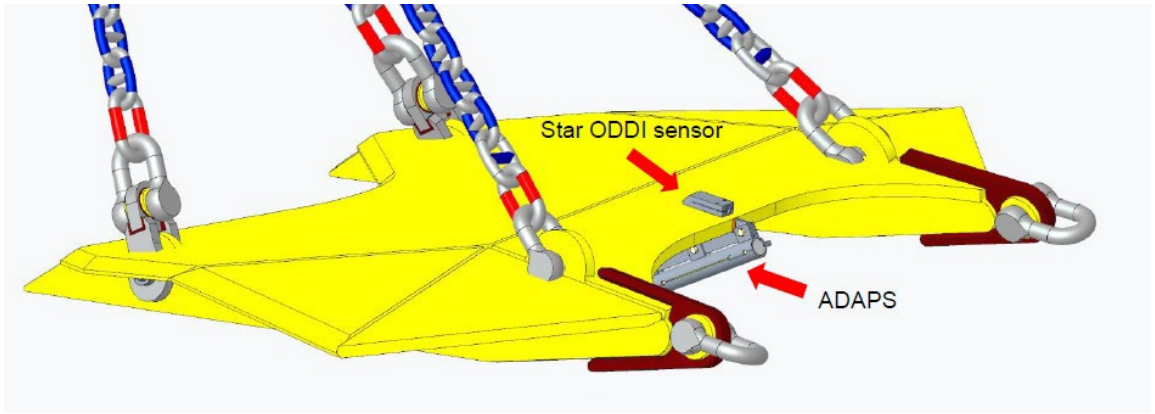
- Working on new concept for fluke anchors in sand
- Responsible for the Utsira High project
  - Suction bucket design assistance
  - Dense sand and variable soil conditions
- Experience with anchors for floating solar
- Experience with verification of suction anchors in different soil conditions

DIGIN - 3D fluke anchor in sand



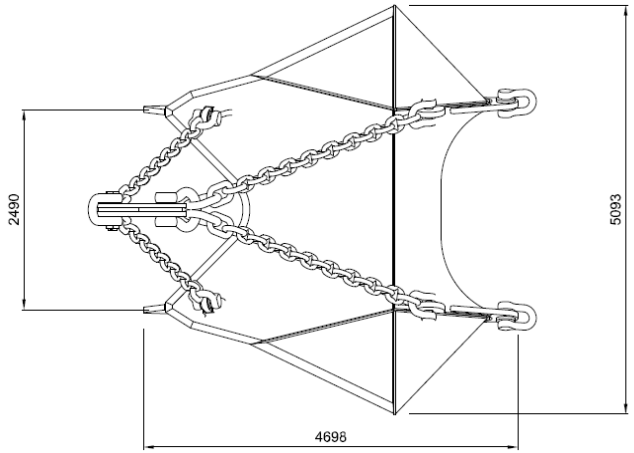
Daniel Hammer

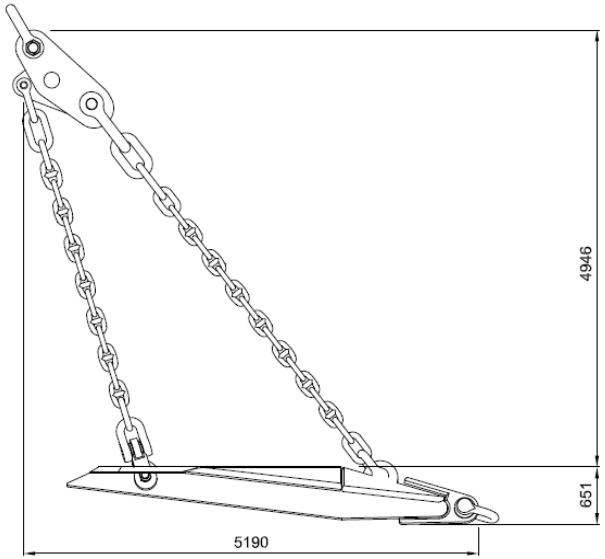
- Started in DNV 2024
- Done several DIGINs
- Been offshore testing Stevmanta anchor

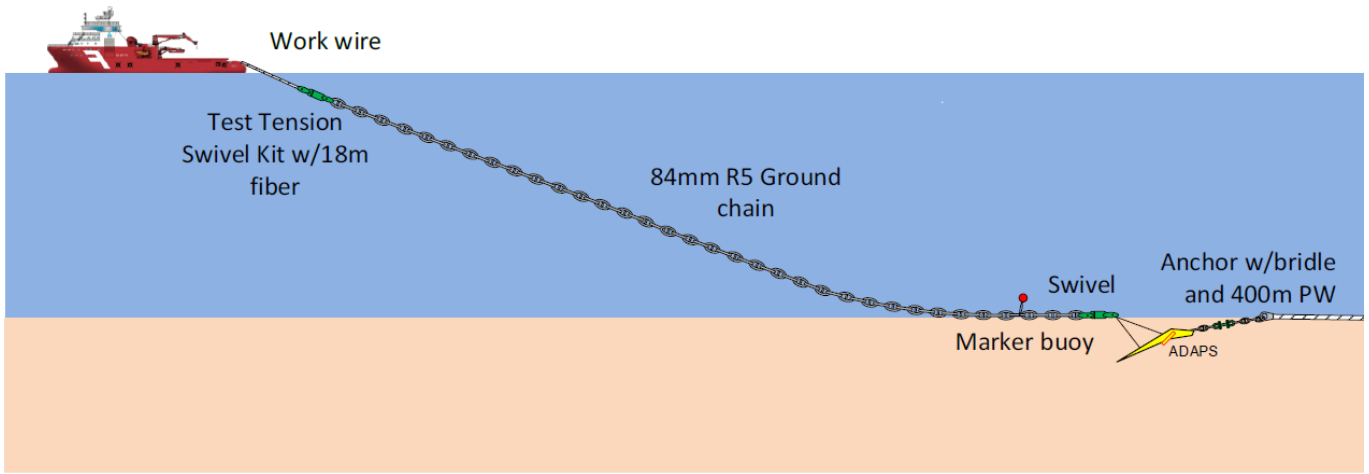


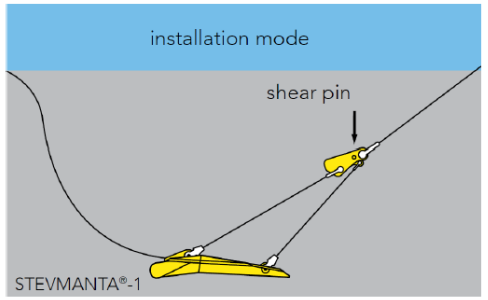
Anchor Test Setup

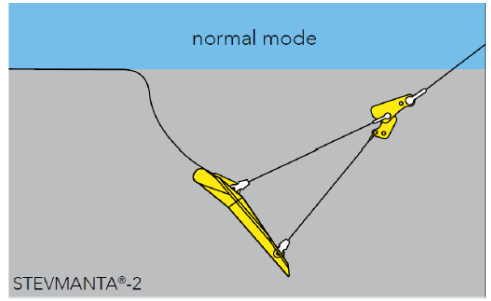
- Fixed pin test:
  - 350m work wire
- Installation with shear pin breakage:
  - 25 m work wire



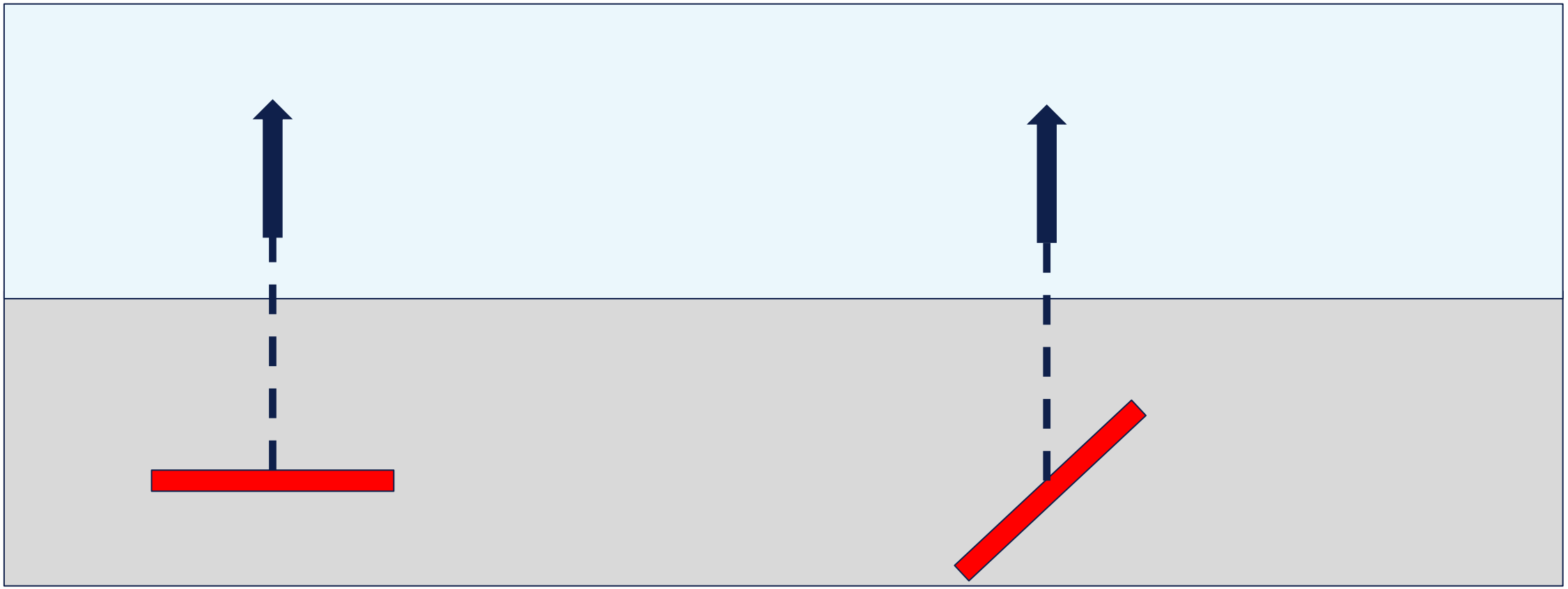




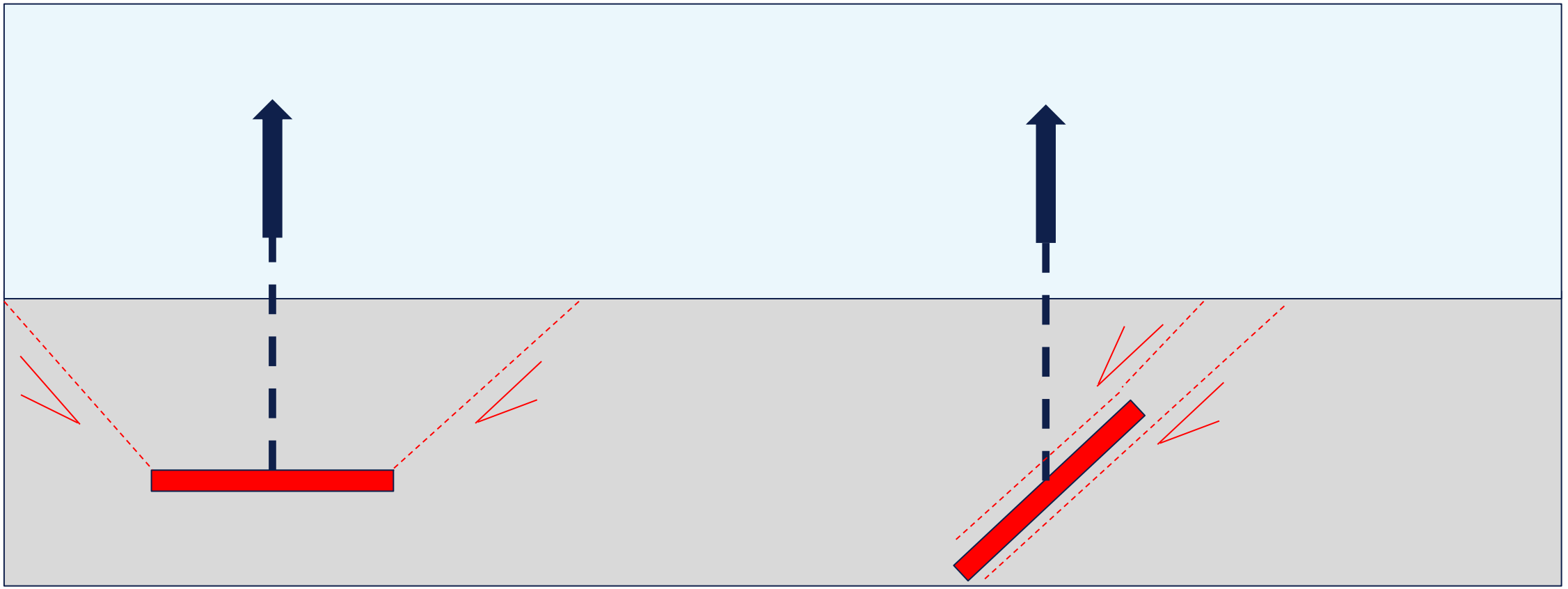




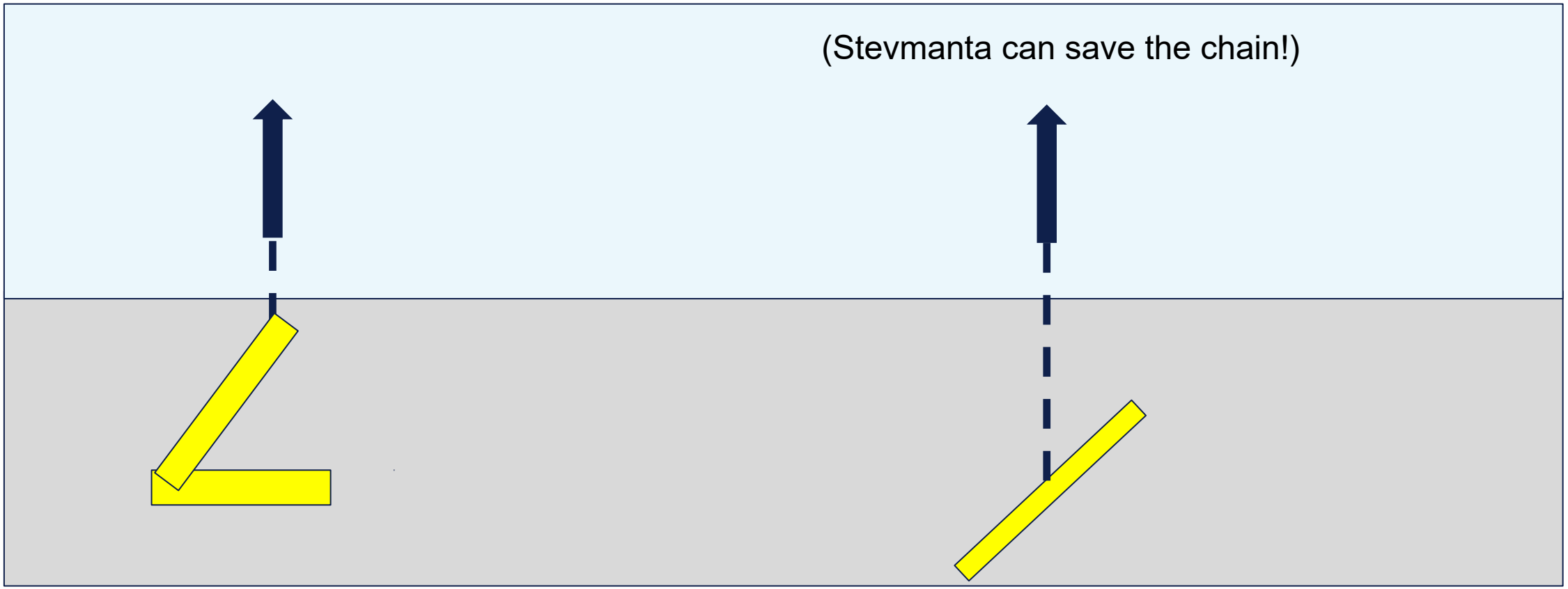
Geotechnical considerations



Geotechnical considerations



Removing Fluke vs Plate



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