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Selections of SUT OSIG London 2017:
Scour and Erosion Effects in Offshore Geotechnics

SIMSG ISSMGE

TC209 “Offshore Geotechnics”

TC213 “Scour and Erosion”

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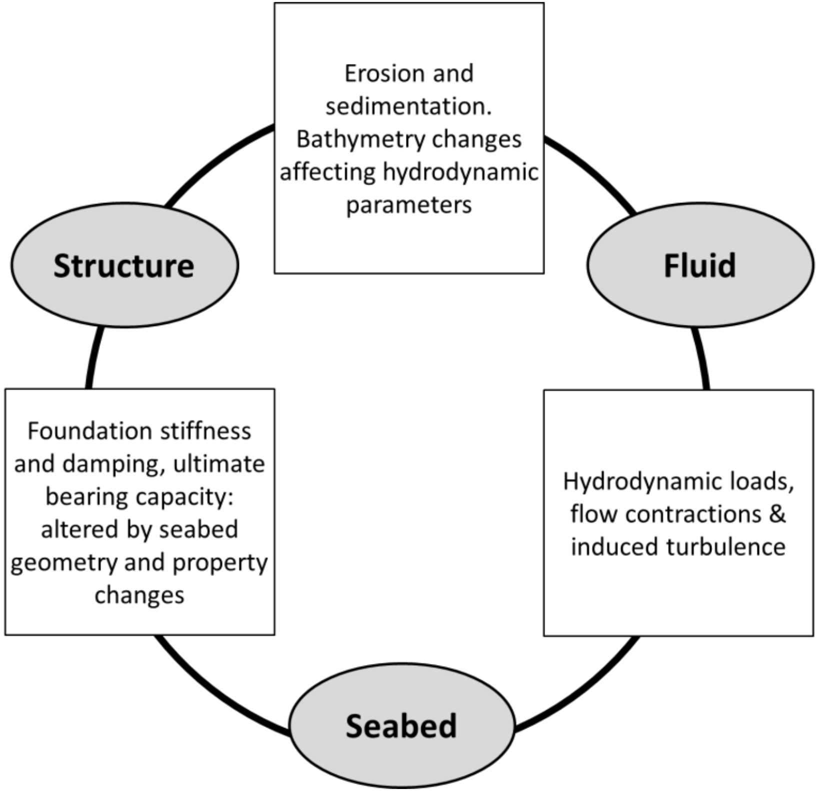
Multidisciplinary



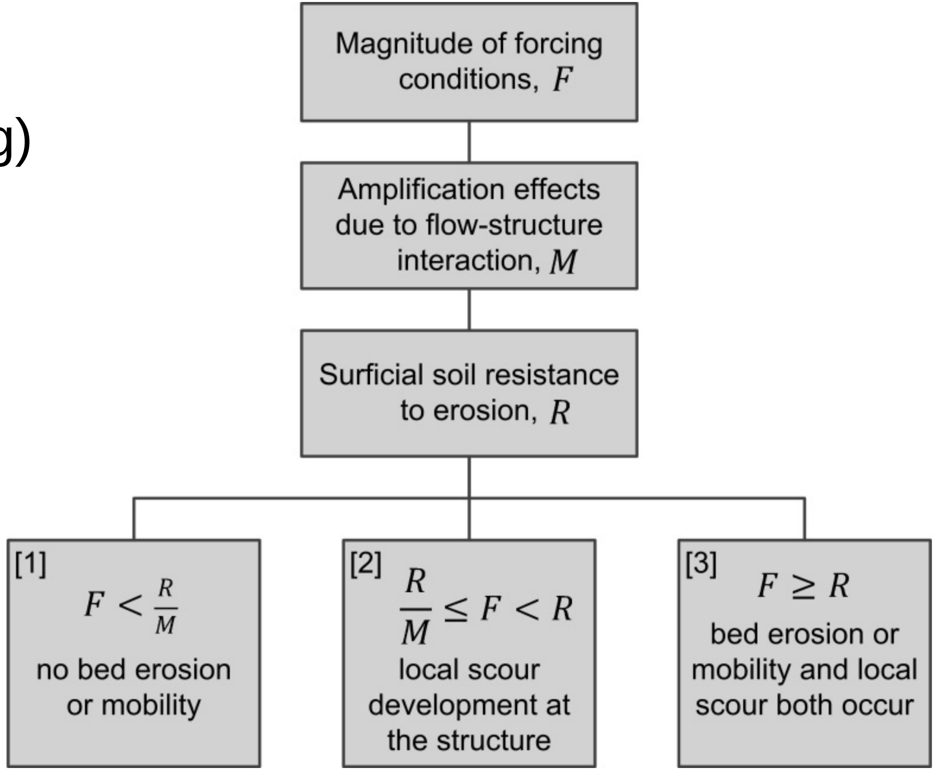
- Hydrodynamics
- Morphology, sedimentology
- Geotechnics
- Foundation engineering
- Structural engineering

Types of scour and their prediction

- General scour (seabed lowering)
- Local (structure-induced) scour

Increasing difficulty to answer:

- Boundary conditions for onset?
- Magnitude?
- Rate?

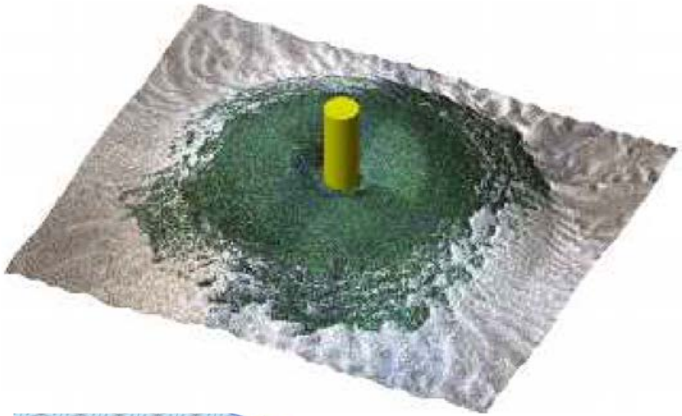


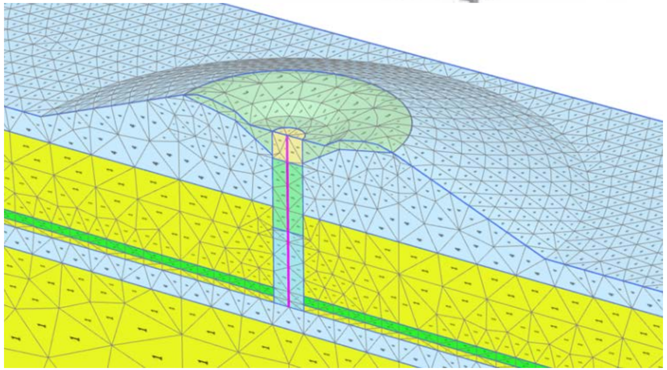
Mitigating measures

- Make the structure '*erosion proof*' up-front through:
  - Erosion protection
  - Creating reserve foundation and structural capacity.
- Observe and mitigate when needed during lifetime by:
  - Sediment supplementation and/ or application of erosion protection in scour holes.

Both should part of the design, but there are cases where inspection reveals unexpected scour issues….

Monopile design for scour



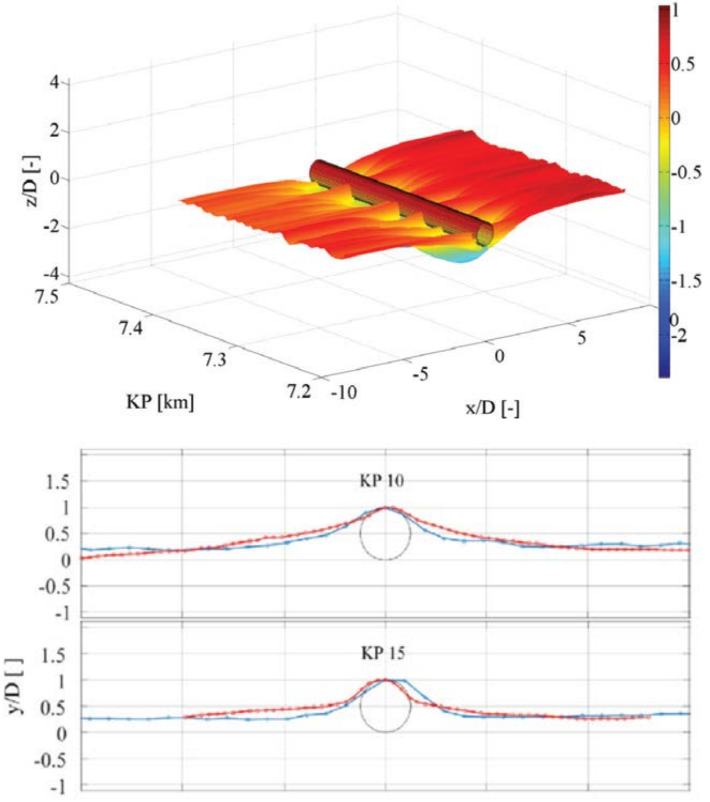


- Nordergründe Offshore Wind Farm.
- Large general scour potential (> 5 m), in addition to local scour.

Approach:

- Required extent of scour protection determined on basis of model tests and numerical assessment of seabed shape on pile performance.
- Improved geotechnical performance of foundation through adoption of rock apron for scour protection.

Scour near pipelines



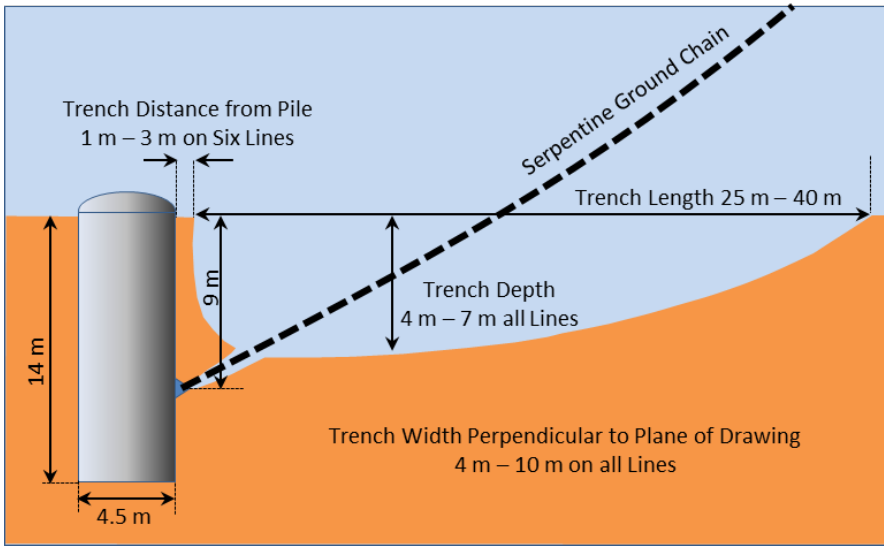
Self-burial or de-burial due to sedimentation and scour affects pipeline on-bottom stability, changes the thermal boundary conditions, affects seabed resistance for buckling design, and can create free-spans.

Changes in the pipe-seabed contact condition can happen in short time after lay (months), even in ambient metocean conditions (tidal flows, solitons).

Top: pipeline laid with embedment ~0.1D; after some time, alternating 0.8D local embedment with free-spanning sections (30 – 40 m in length).

Bottom: pipelines with additional 0.4D embedment due to sedimentation (sediment deposition).

Trenching around suction anchors



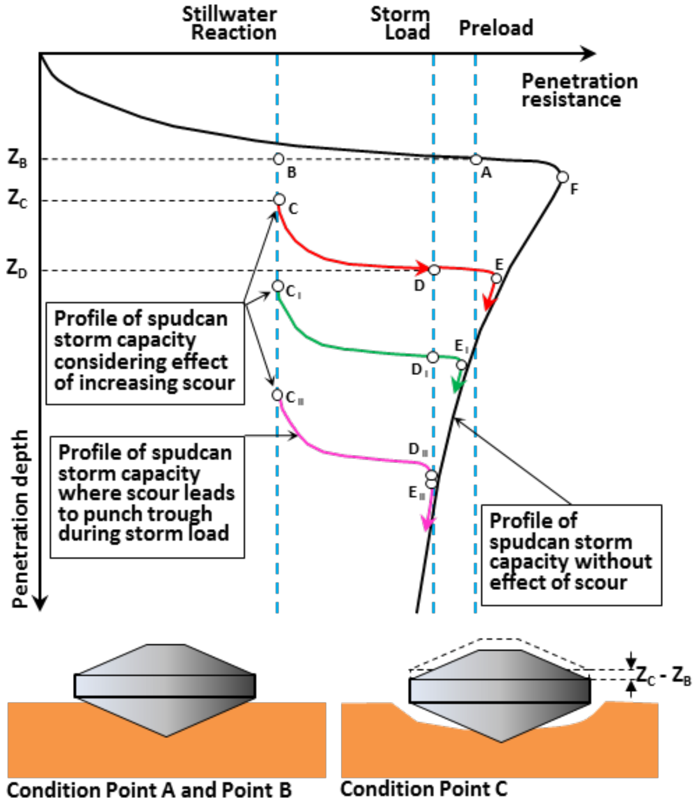
Unexpected scour in view of cohesive properties of seabed.

Attributed to chain movements that remould the sediments, thus lowering the surficial soil resistance to erosion.

Holding capacity may have been reduced by up to 45%.

Other anchor types (e.g. drag anchors) with relatively dynamic mooring lines could behave similarly.

Jack-up footing compromised by erosion

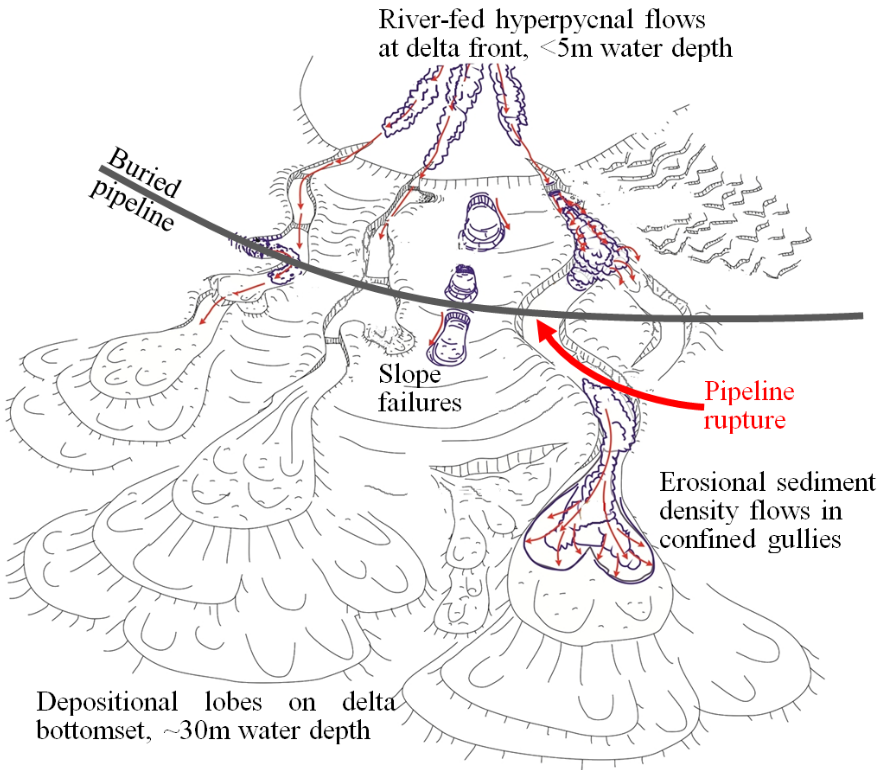


Interaction between placement, preload and subsequent scouring around the footing.

After pre-load to A, the footing is at load B, with reserve relative to punch through load F.

Scour brings the footing under still-water reaction force to condition C, C_I and C_{II} decreasing punch through capacity to E, E_I and E_{II}; at E_{II} punch through during the storm event can be expected.

Scour due to sediment density flows



Different driving force. Typically, considered in a geohazard analysis:

- Changing seabed geometry triggering slope failures.
- Mass movements and density flows exerting impact and drag forces on subsea infrastructure.
- Erosion exposing buried cables and pipelines.

Closure

Scour and Erosion in the context of Offshore Geotechnics:

- An interesting and challenging subject where mechanisms can still surprise us.
- The sample cases in the paper and the extensive reference list aim to raise this interest and promote further multidisciplinary R&D efforts.
- Further work is required to firm-up our understanding of the mechanisms and boundary conditions, to be able to make reliable predictions of its onset and effects.
- Sharing of field experiences amongst industry partners is essential.

Acknowledging: