Installation Response of 5.5 m Diameter Driven Piles in Carbonate Soil – The Ichthys Development

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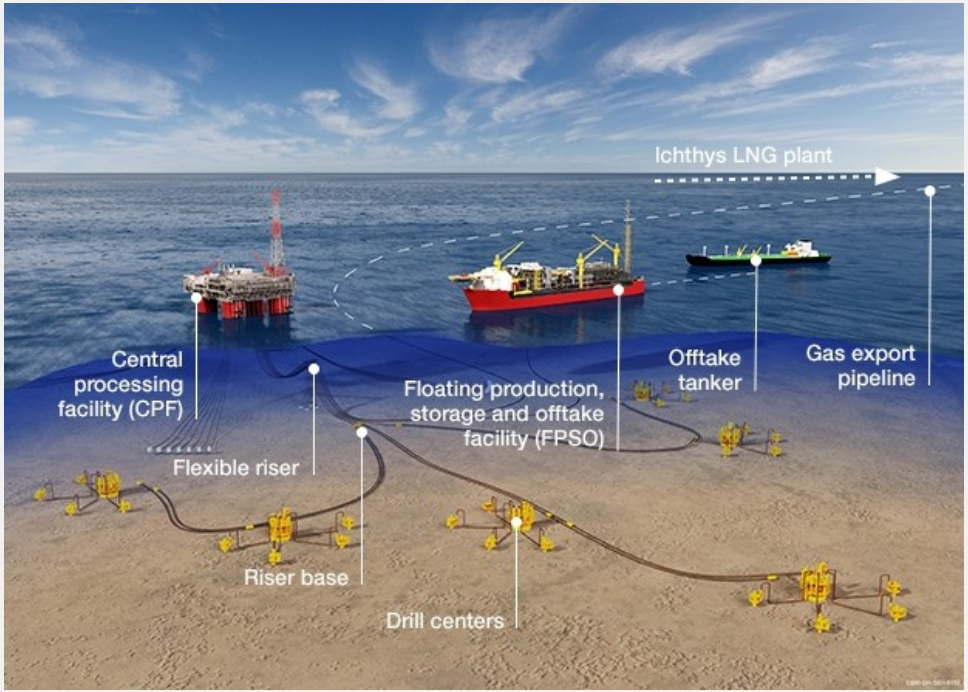

- 220 Km north-west of Western Australia in 250 m WD
- Central Processing Facility (CPF) and Floating, Production, Storage and Offtake (FPSO) facility, and subsea development
- Facilities designed to survive 10,000yr cyclonic event
- Facilities moored to seabed by 28 (CPF) and 21 (FPSO) driven anchor piles

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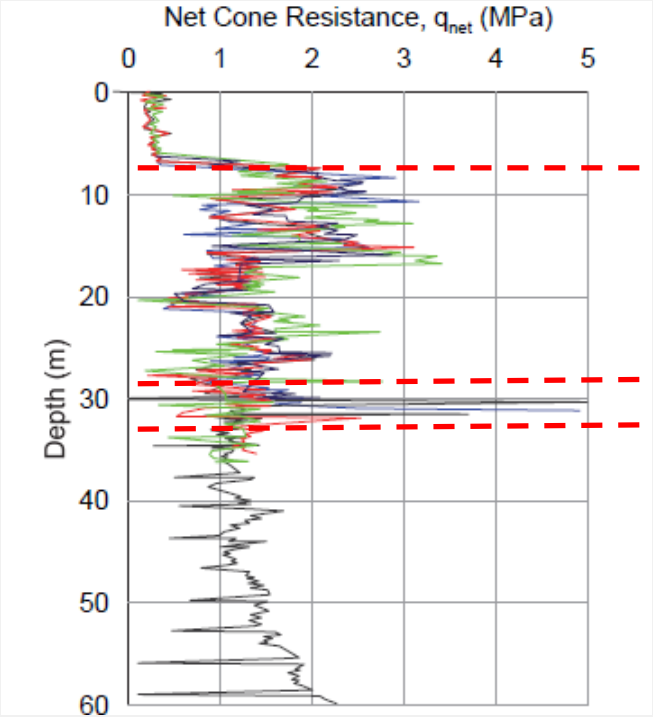
Soil Conditions



Carbonate SILT / MUD

Carbonate Silty SAND / SAND

LIMESTONE (Calcarenite)

Carbonate Silty MUD / Sandy MUD

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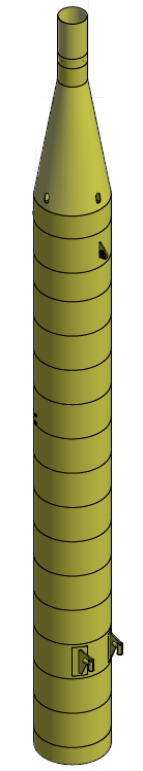
Anchor Piles – Key Features



- Diameter = 5.5 m
- Embedded Length = 48.0 m (63.6 m total)
- Padeye = 3.0 m (CPF) / 3.5 m (FPSO) b.m.l.
- Submerged Weight = 400 t (CPF) & 426 t (FPSO)
- Dynamic freefall arrestors
- Static freefall arrestors

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Vent area = 1.2 m^2 – 1.7 m^2
To restrict pile freefall to maximum of ~1 m/s

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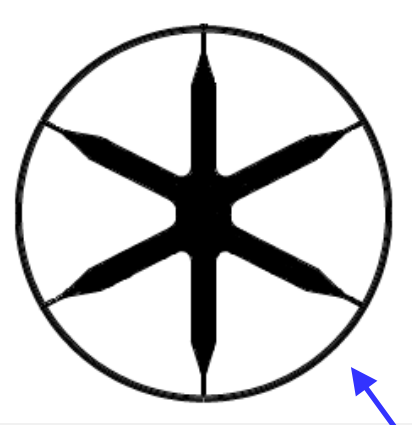
Anchor Piles – Key Features



C-S through pile at base of cruciform

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- Embedded Length = 48.0 m (63.6 m total)
- Padeye = 3.0 m (CPF) / 3.5 m (FPSO) b.m.l.
- Submerged Weight = 400 t (CPF) & 426 t (FPSO)
- Dynamic freefall arrestors
- Static freefall arrestors
  - Located to be above Calcarenite layers at final penetration
  - Additional bearing areas of 3.3 m^2 (CPF) and 4.1 – 5.1 m^2 (FPSO)

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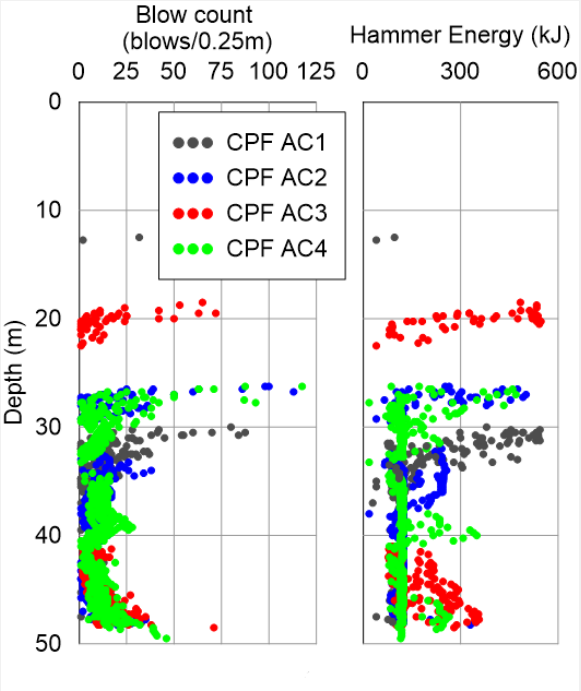
Pile Installation Response – Blow counts



- Piles mostly installed under self weight to depth of calcarenite layer
- Limited driving to advance piles through calcarenite, often followed by pile freefall
- Relatively easy driving (< 25 blows/0.25m at 100 - 200 kJ) thereafter

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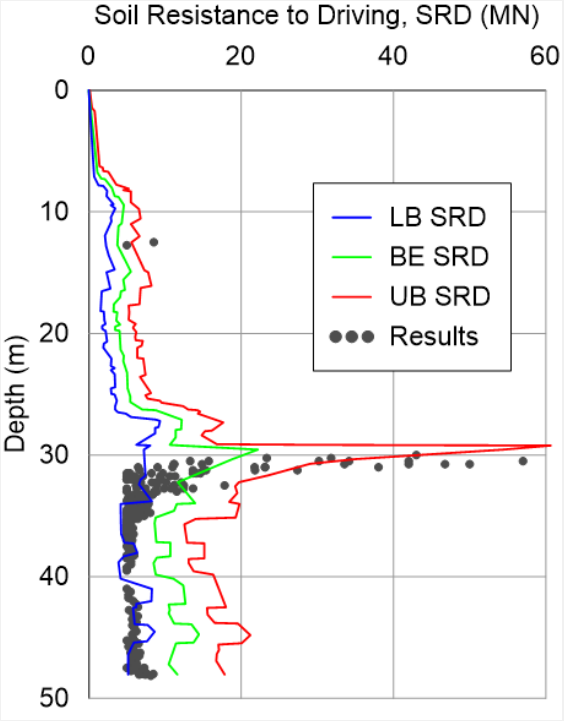
Pile Installation Response - SRD



- SRD back-calculated considering actual hammer energies during driving
- Driving through calcarenite indicated end bearing pressures (q_b) of ~40 MPa reducing to ~20 MPa very quickly
- Confirms the 'easy driving' expectation indicated by Puech et al (1990) based on experience from Persian Gulf
- Subsequent driving consistent with LB predictions by geotechnical designer, further highlighting the low skin frictions mobilised in these soils.

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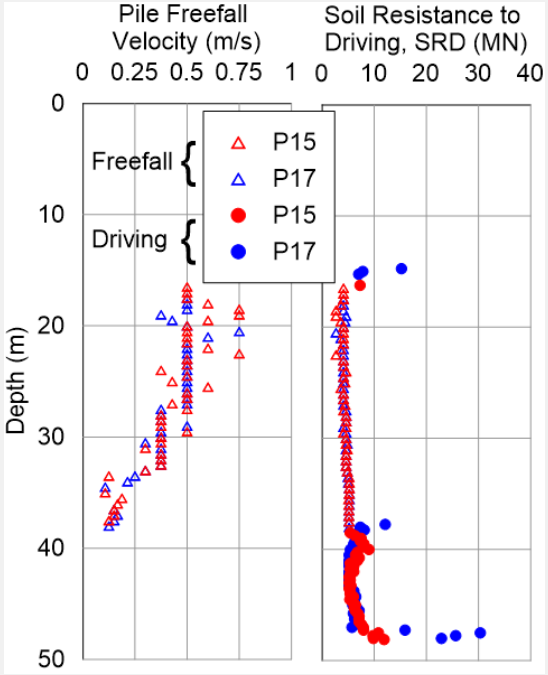
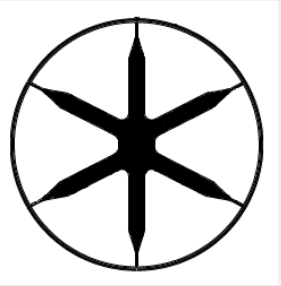
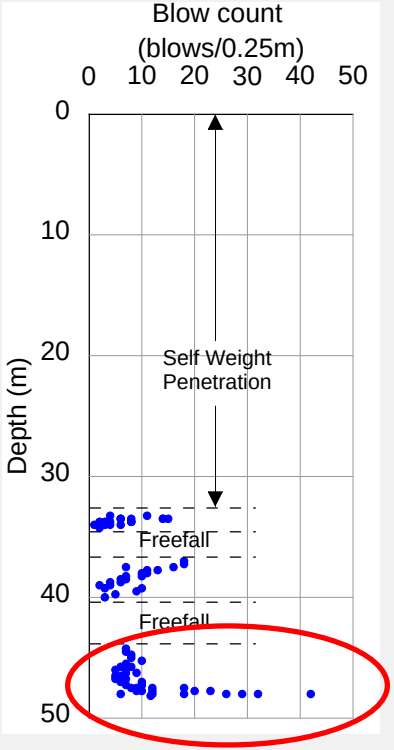
Freefall Arrestor Performance

Dynamic Freefall Arrestor





Static Freefall Arrestor



Increased resistance as cruciform reaches target horizon

Conclusions

- Ichthys anchor piles represent some of the largest piles installed in carbonate soils offshore Australia
- Installation response consistent with general experience of driving in region, and other parts of the world (i.e. Persian Gulf)
- Installation response consistent with LB estimates made in design, highlighted the low skin friction mobilised in these soils during pile installation
- Dynamic and static free fall arrestors used to control pile freefall and provide additional axial capacity at target depth performed as expected by design

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Thank you for listening

Heerema Aegir DCV (2013)

Lifting from barge

Upended pile

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