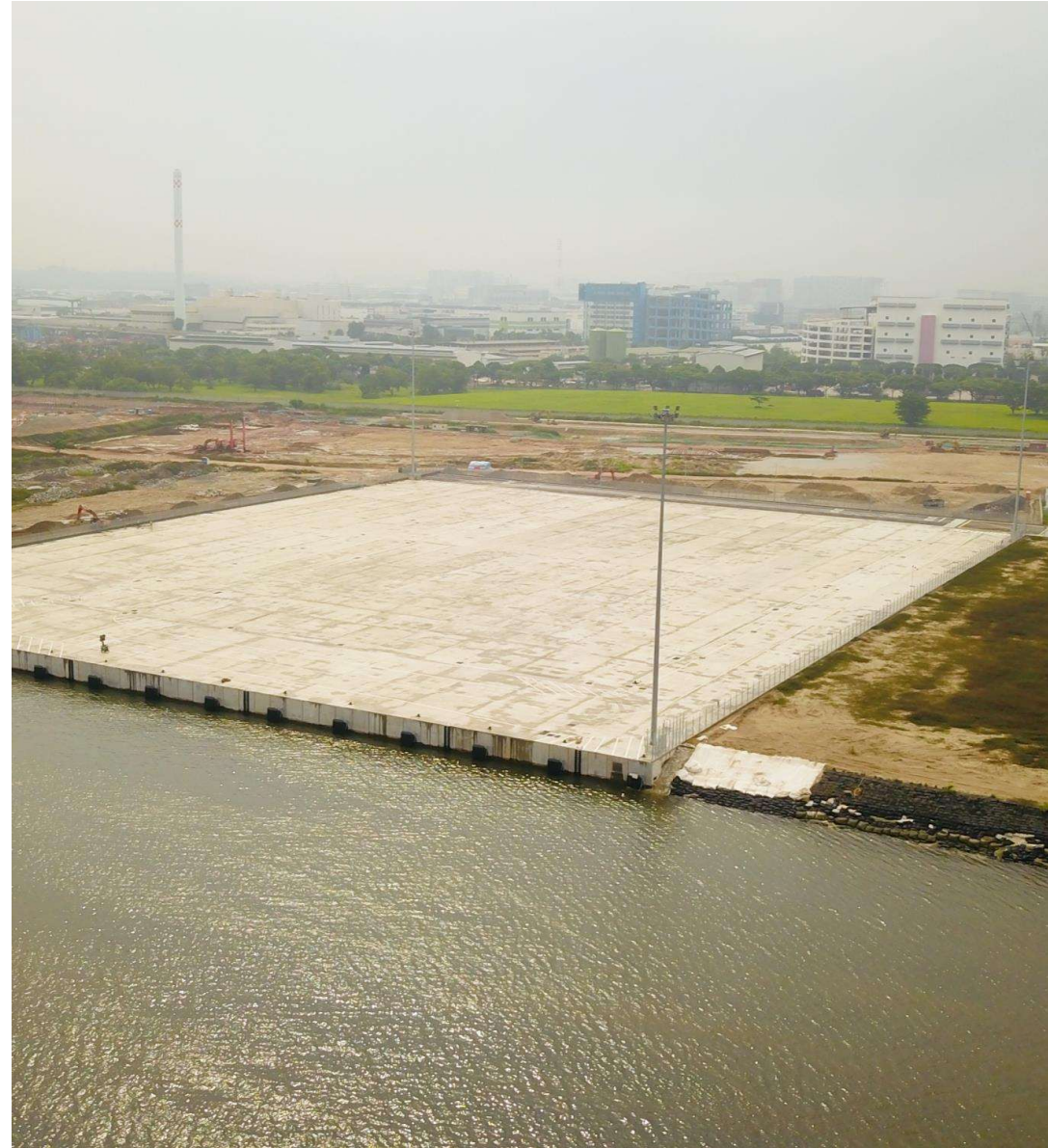


PIANC APAC 2024

Multi-Disciplinary Collaboration on Design and Construction of Offshore Marine Centre 2

Yin Shan Ho

29th August 2024



Goal

8 DECENT WORK AND
ECONOMIC GROWTH



How does this project demonstrate excellence in terms of its impact on the people involved with the project, and the end-users of the project?

Goal

9 INDUSTRY, INNOVATION
AND INFRASTRUCTURE



How do the processes behind the design and construction of this project demonstrate excellence?

Goal

13 CLIMATE
ACTION



How does this project demonstrate excellence through its response to the impact that it will have had on our planet?

Emphasis on collaboration between project partners

Introduction

- Reclaimed site in North of Singapore
- Common-user fabrication centre for vessels requiring intermittent use of waterfront
- Onerous requirements:
 - 250 kPa live load on wharf and staging
 - -10mCD draft
- Area: ~48000m²
- Multi-Disciplinary One Arup Proposal
- Consultant with D&B Contractor



Welcome
Centre and
Electrical
Substation

Quayline
and
fenders

Staging Area

Wharf

Service trenches

Existing revetment
(slope with
sandbags and
geotextile)



Berthing and Mooring

What analysis did we do?

- Future proofing for expansion
- Design against 6 representative vessels that envelope the full range of proposed design vessels
- Modelling for bollards and fenders for OMC2 berths and future expansion



Maersk Valiant (drillship)



Posh Giant 3 (Submersible, Deck Cargo, Launch Barge)



Forge (Semi-submersible Barge)



Kim Heng 330 (Offshore Deck Cargo Ballastable Barge)



Transocean Mariana

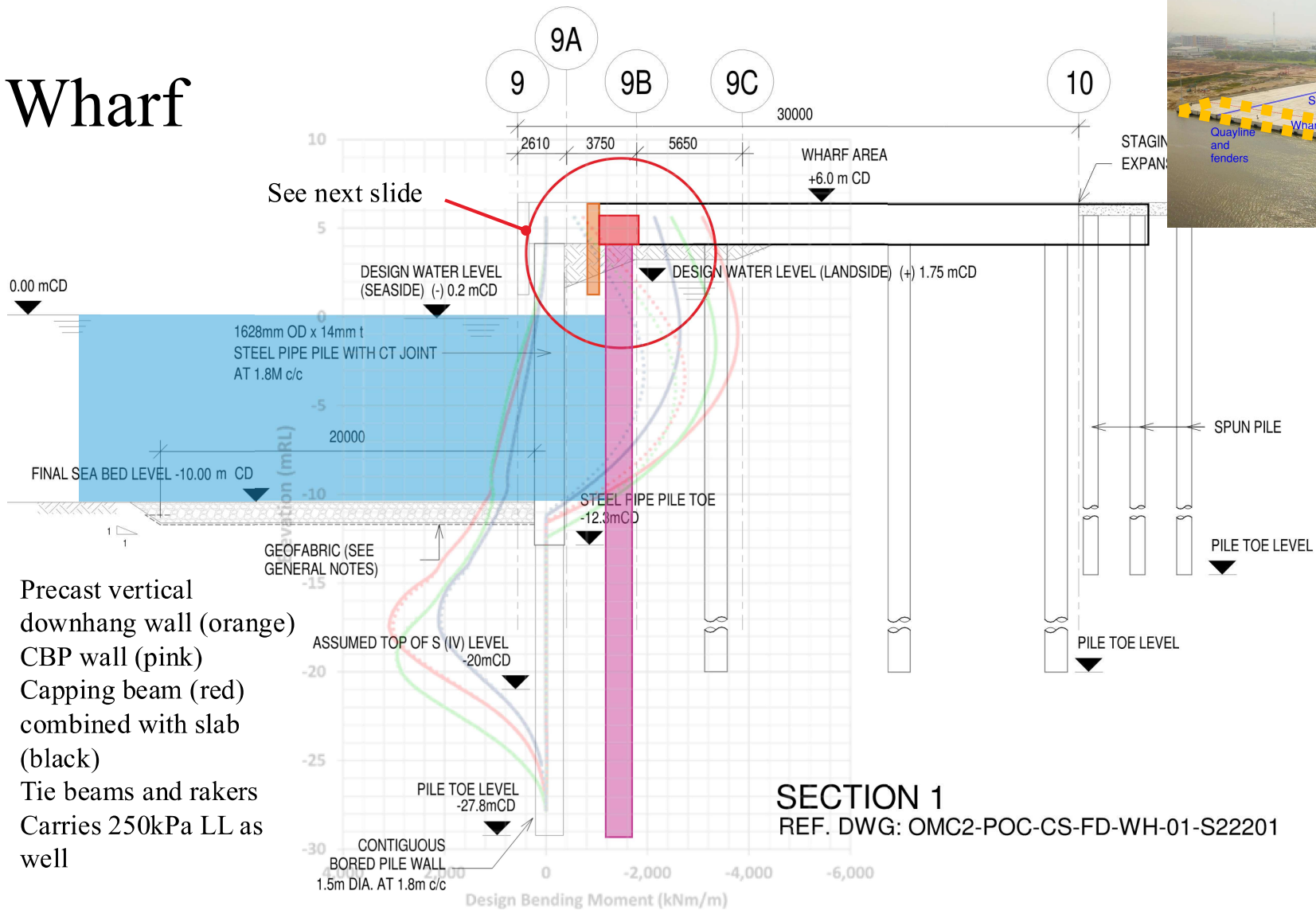


Transocean Barents

8 DECENT WORK AND ECONOMIC GROWTH



Wharf



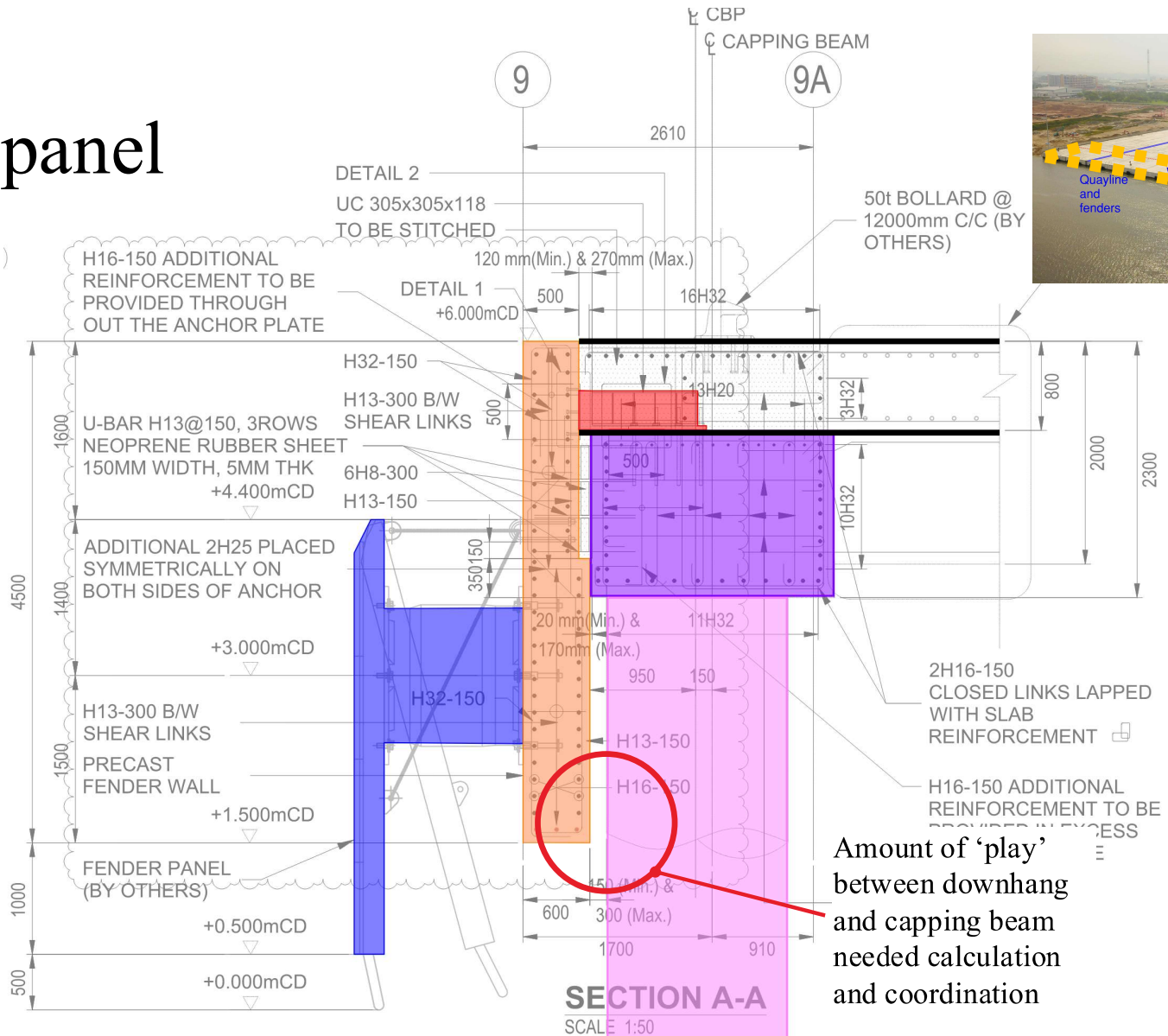
- Precast vertical downhang wall (orange)
- CBP wall (pink)
- Capping beam (red) combined with slab (black)
- Tie beams and rakers
- Carries 250kPa LL as well



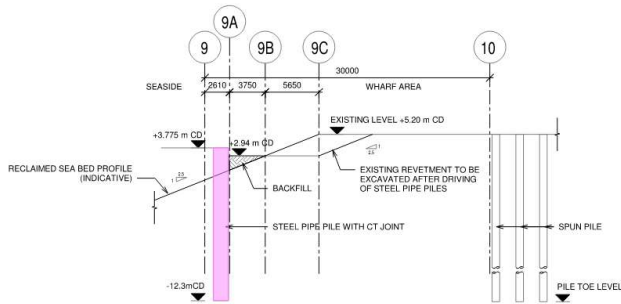
SECTION 1
REF. DWG: OMC2-POC-CS-FD-WH-01-S22201



Fender panel

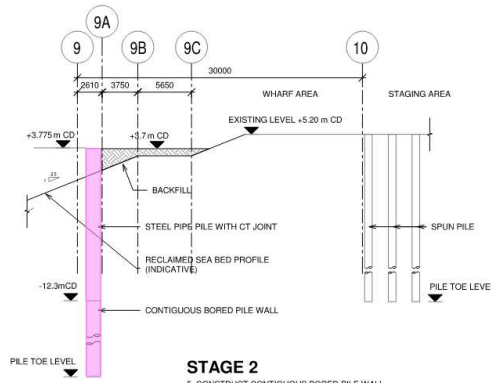


Sequence



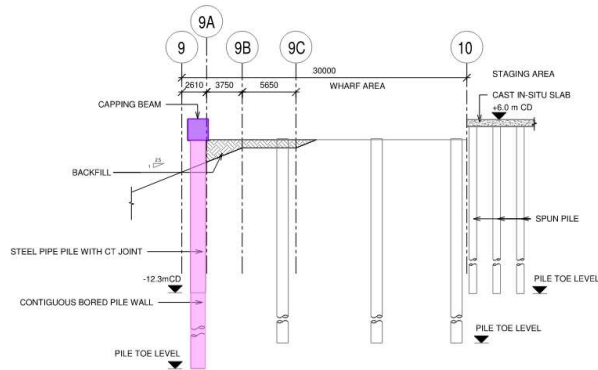
STAGE 1

1. REMOVE THE TEMPORARY SHORE PROTECTION.
2. DRIVE STEEL PIPE PILE TO -12.4m CD .
3. CUT EXISTING REVETMENT AT $1\text{V}2.94\text{H}$ TO $+2.94\text{m CD}$.
4. BACKFILL BEHIND CASING TO $+2.94\text{m CD}$.



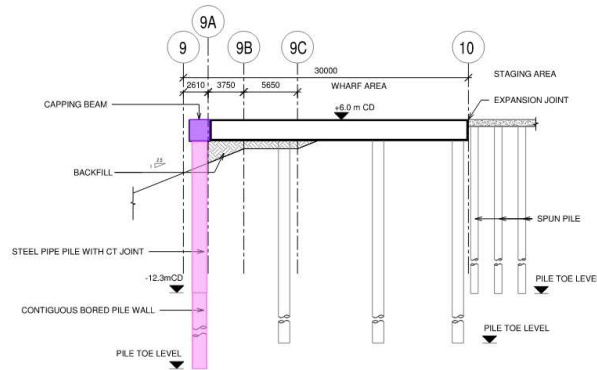
STAGE 2

5. CONSTRUCT CONTIGUOUS BORED PILE WALL.
6. BACKFILL TO $+3.7\text{m CD}$.



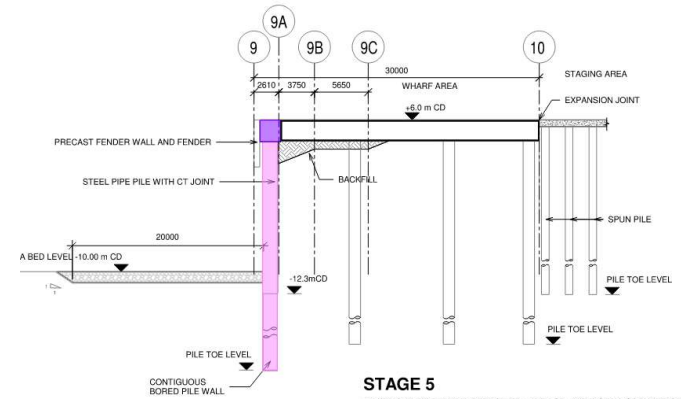
STAGE 3

7. CAST CAPPING BEAM FOR CONTIGUOUS BORED PILE WALL.
8. FILL THE AREA TO THE SOFFIT OF WHARF AREA STRUCTURE.
9. CONSTRUCT BORED PILE AT WHARF AREA.
10. CAST STAGING AREA SLAB.



STAGE 4

11. CONSTRUCT BEAM & SLAB AT WHARF AREA.

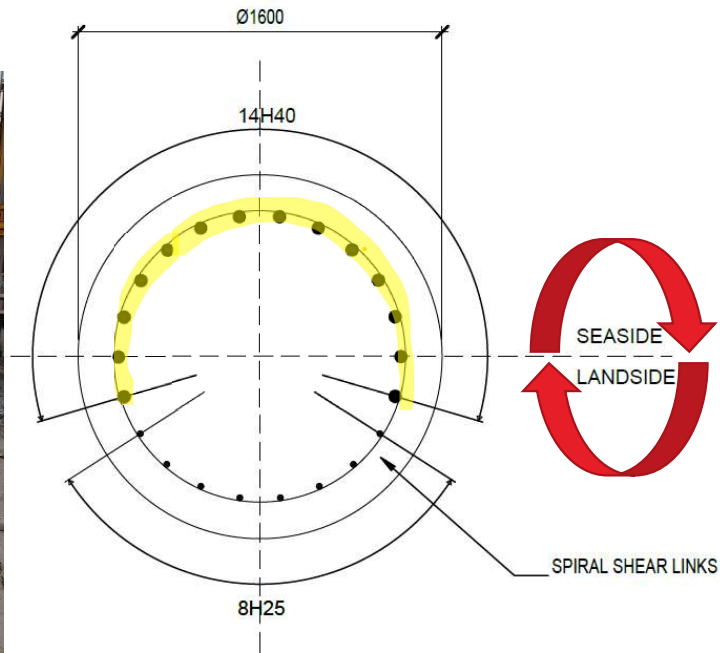
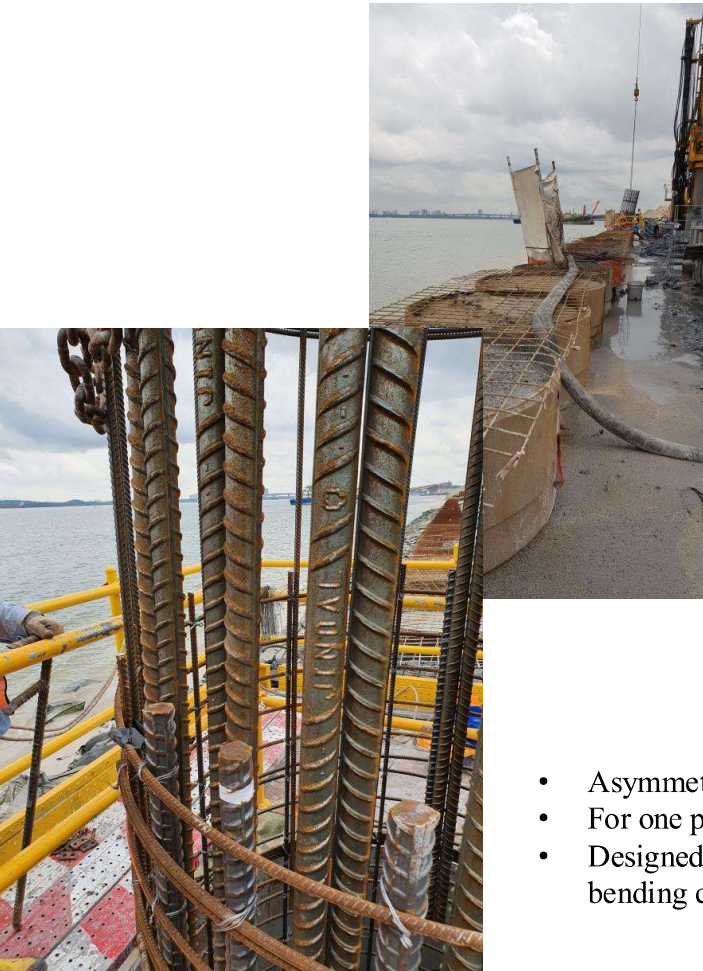


STAGE 5

12. REMOVE REVETMENT, DREDGE TO -11.35m CD AND INSTALL SCOUR PROTECTION UNTIL -10m CD .
13. INSTALL PRECAST FENDER WALL & FENDER.

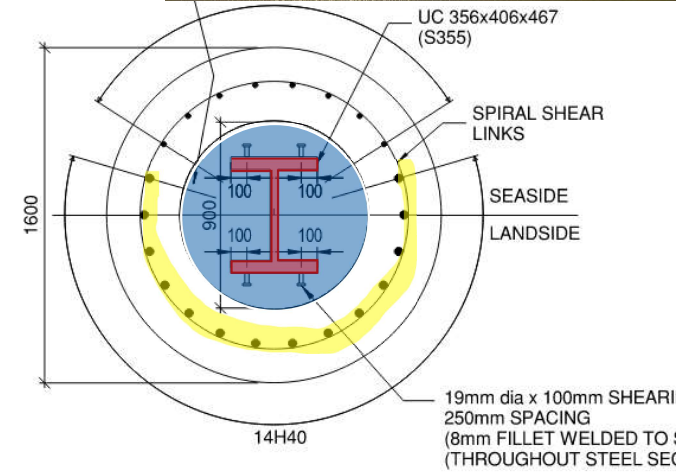


CBP-23



SECTION A
 SCALE : 1:25
 NOTE : REFER TO CBP REINFORCEMENT DETAIL
 FOR SPIRAL SHEAR LINK DETAIL.

- Asymmetric pile cage because bending moment bigger on seaside than landside
- For one pile, cage was installed back to front
- Designed remedial: core out middle of bored pile, insert H-section with shear studs to increase bending capacity

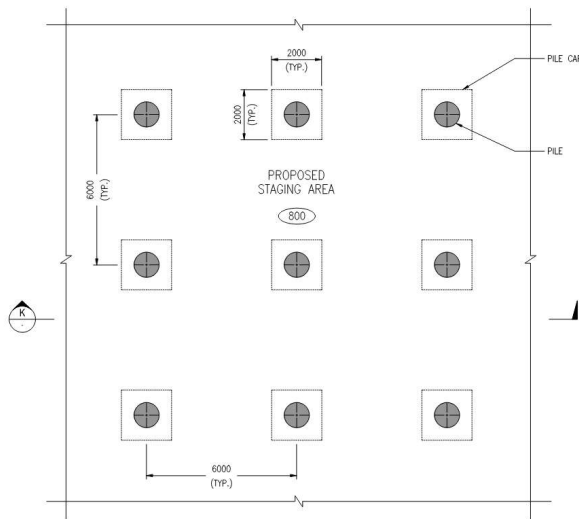


SECTION A1-STRENGTHENING SECTION



Staging area piles + slab

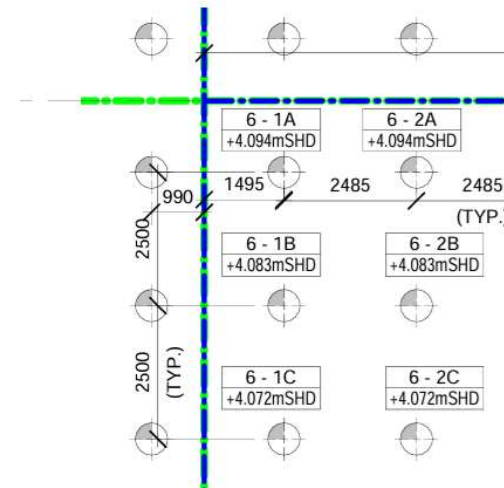
Tender design



D&B refined design

Tender design

- 800mm thk slab with 1m dia bored piles at 6m spacing
- Contractor wanted to change to spun piles for productivity

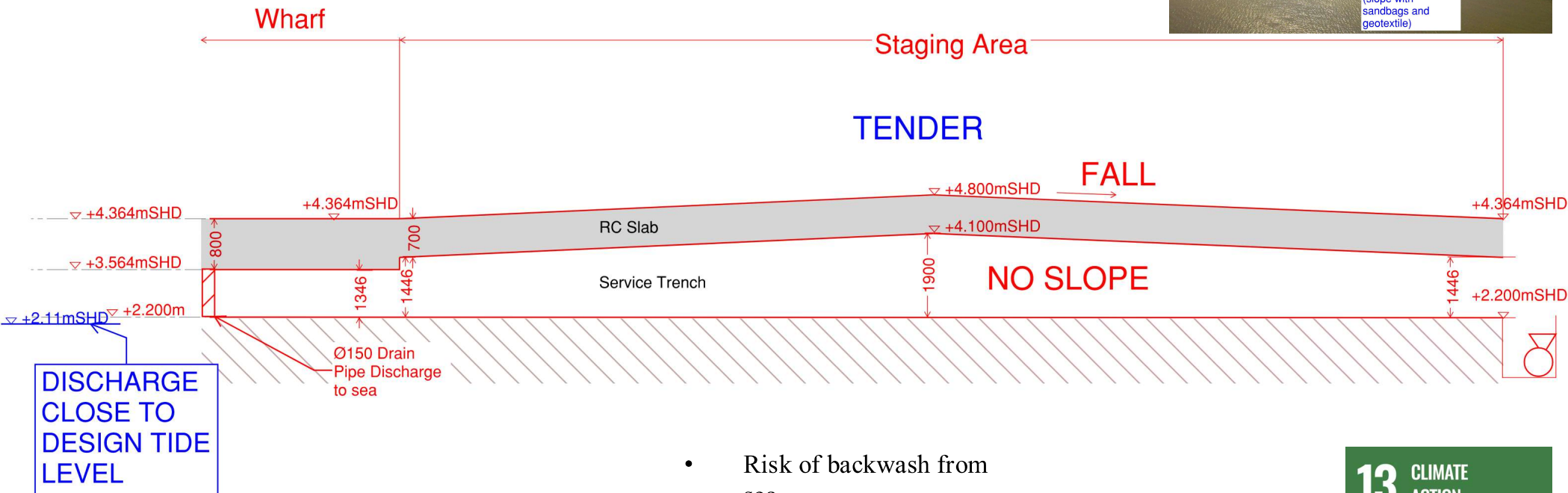


Final design

- Refine design to 700mm thk, smaller precast piles (0.6m)
- 4000m³ concrete saved
- Use 50% GGBS, 45% eCO₂ on OPC



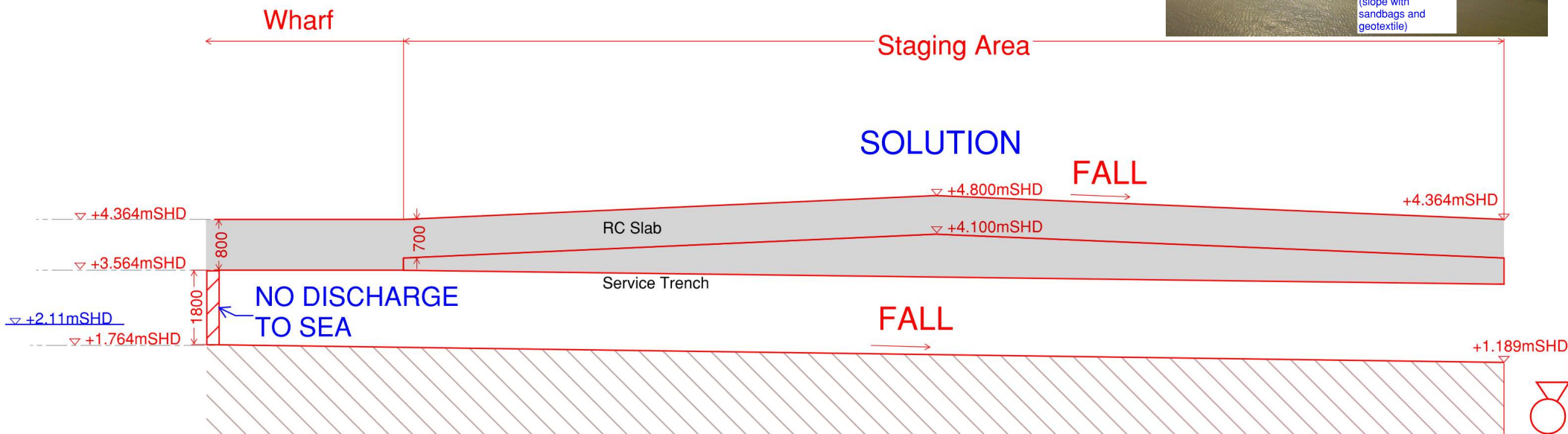
Service trench before optimisation



- Risk of backwash from sea
- Vulnerable to rising sea levels
- Insufficient and varying headroom in most parts
- No slope



Service trench after optimisation



- No discharge to sea
- More resilient to sea level rise due to climate change
- Constant maintainable headroom
- Not taxable GFA



Collaborators

ARUP



Client

JTC Corporation

Contractor

Penta-Ocean
Construction Co.
Ltd



**C&S and M&E
Engineer**

Arup Singapore Pte
Ltd

Architect

Fujinami Architects
& Associates

ARUP

