SARB ISLAND PROJECT

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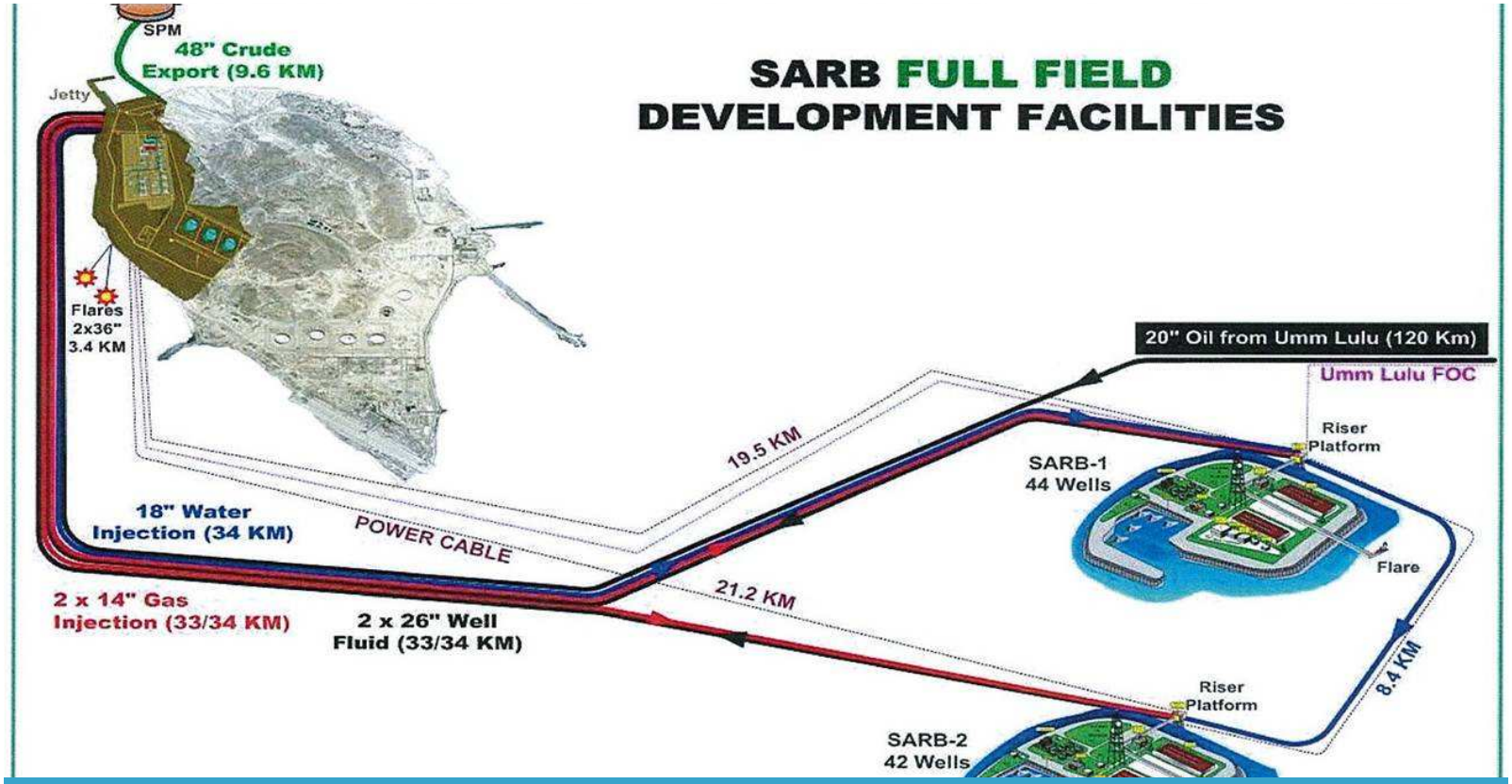
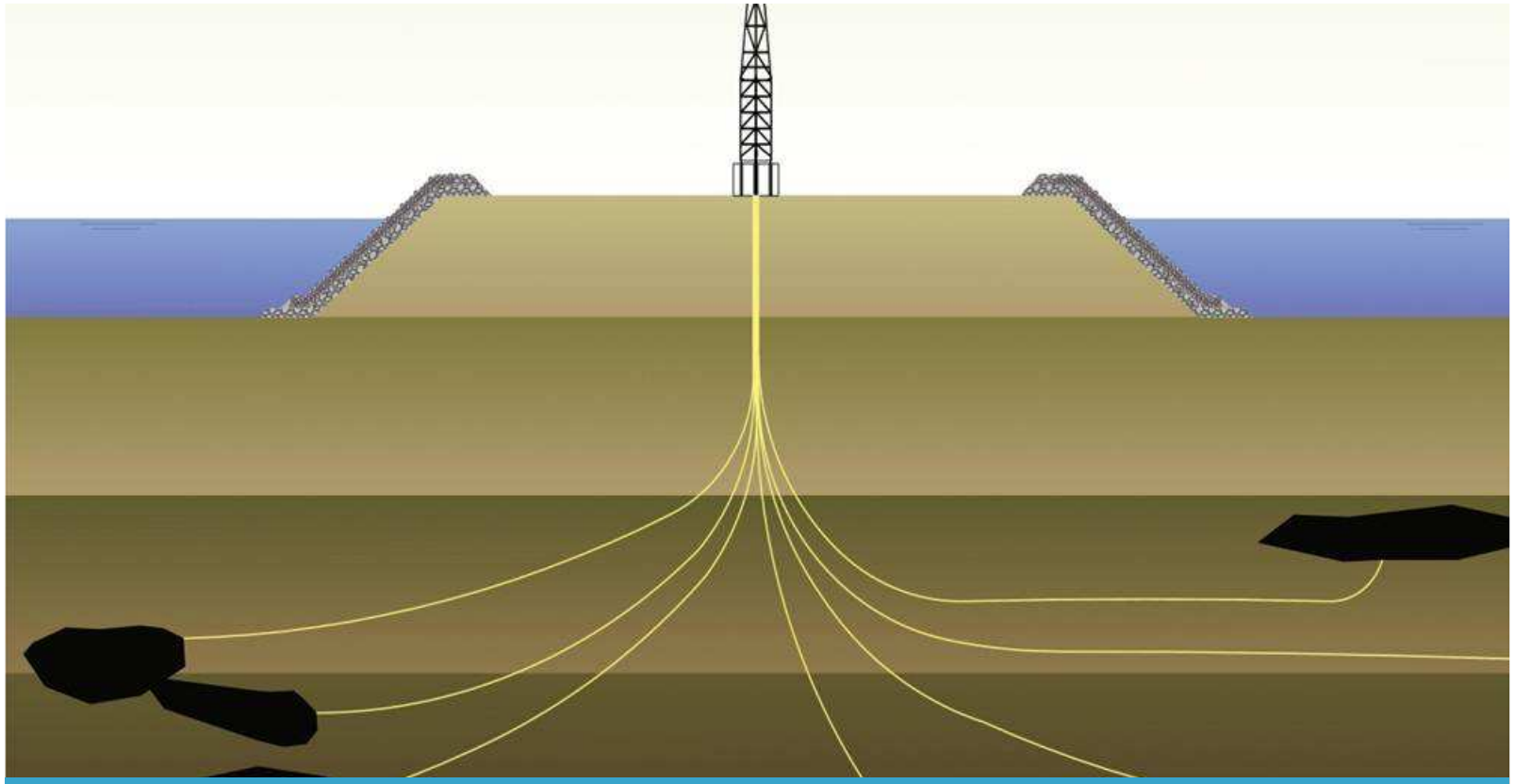
1. INTRODUCTION SARB FIELD DEVELOPMENT



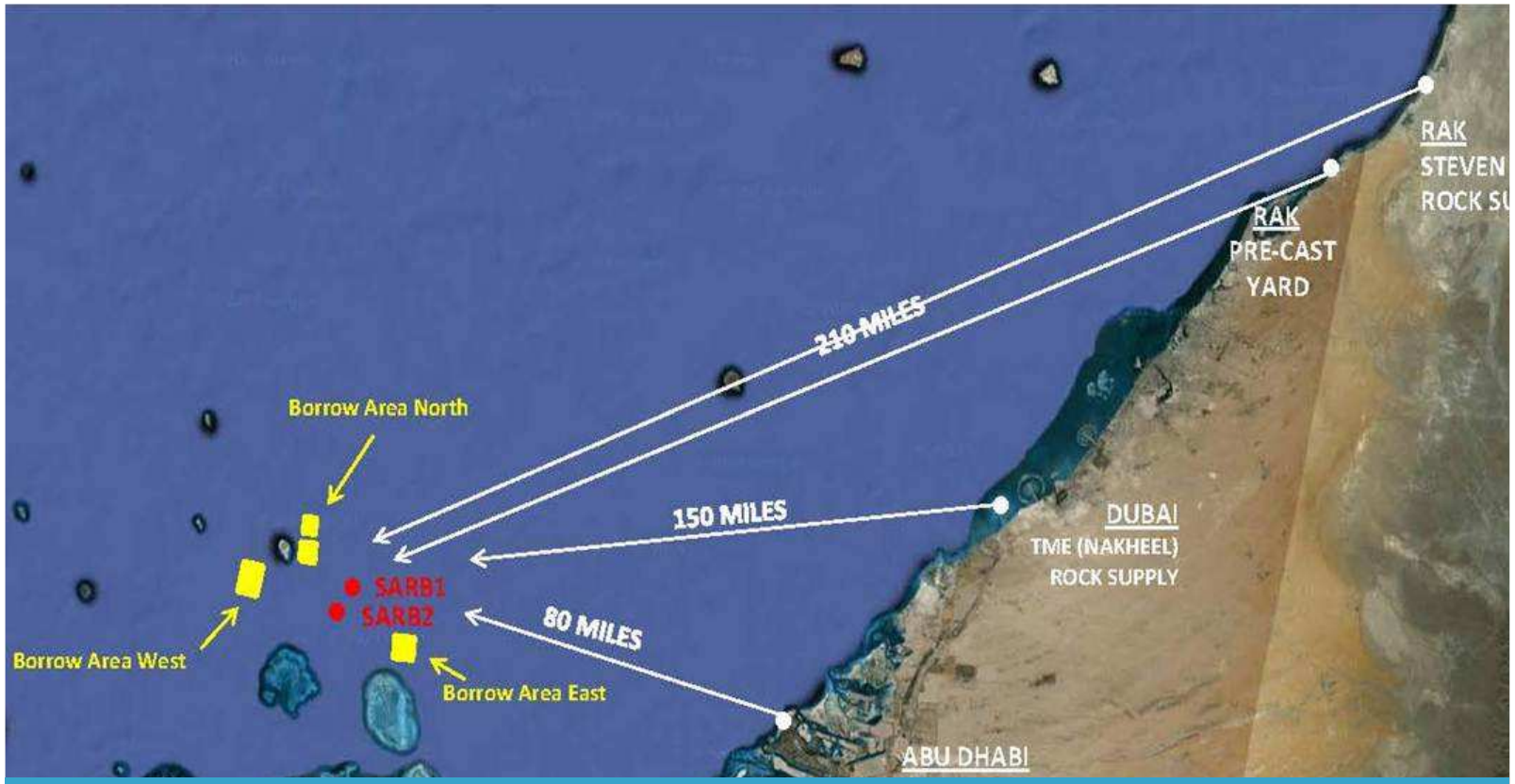
SARB full field development facilities

1. INTRODUCTION SARB FIELD DEVELOPMENT



Principle of directional drilling at SARB oil fields

1. INTRODUCTION SARB FIELD DEVELOPMENT



Location map of SARB development and related shore bases in UAE

1. INTRODUCTION SARB FIELD DEVELOPMENT

- Marine development project, located fully offshore

➢ Huge impact on LOGISTICS

- Marine environment is the Gulf ~ sudden storm conditions occur, typical NW direction resulting from the waves built up by long fetch from Iran

➢ High impact on OPERATIONS

- Risk for earth quakes in the region => seismic design criteria

➢ High impact on DESIGN

SARB = PIONEERING and CHALLENGING MARINE PROJECT

SARB 1: Image taken on 7 October 2013

SARB 2: Image taken on 7 October 2013

2. CONTRACT DATA

- Employer: ADMA-OPCO
- Manager: ADNOC
  with design review engineer COWI
- Contractor: Dredging International – Medco JV
  with design and engineering consultant Halcrow
- Contract award: February 2011
- Expected end date: December 2013

3. DESIGN AND BUILD CONTACT => DESIGN PROCESS

1. Hydraulic
   - Edge protection (100 years)
     - Numerical modeling / 2D & 3D modeling in a hydraulic laboratory
   - Wave climate in inner harbour
     - Numerical modeling / 3D scale modeling in a hydraulic laboratory
   - Sedimentation analyses

3. DESIGN AND BUILD CONTACT => DESIGN PROCESS

2. Geotechnical
   - Settlement and liquefaction of calcareous soil
     - Centrifugal CPT/CPT Chamber
   - Stability of slopes
   - Stability of quay wall
     - Including Zone Load test for E-modules determination of limestone core bund material

3. DESIGN AND BUILD CONTACT => DESIGN PROCESS

3. Nautical
   - Design mini harbour including turning basin
   - Design of navigation aids

4. Structural
   - Quaywall and slipway
   - Apron slabs
   - Fenders and bollards
   - Heavy duty loading jetty

3. DESIGN AND BUILD CONTACT => DESIGN PROCESS

Dredging International
Marine & Waterway Solutions

MEDCO
MIDDLE EAST DREDGING COMPANY
شركه الشرق الاوسط للجرف

Some illustrations of the hydraulic design process

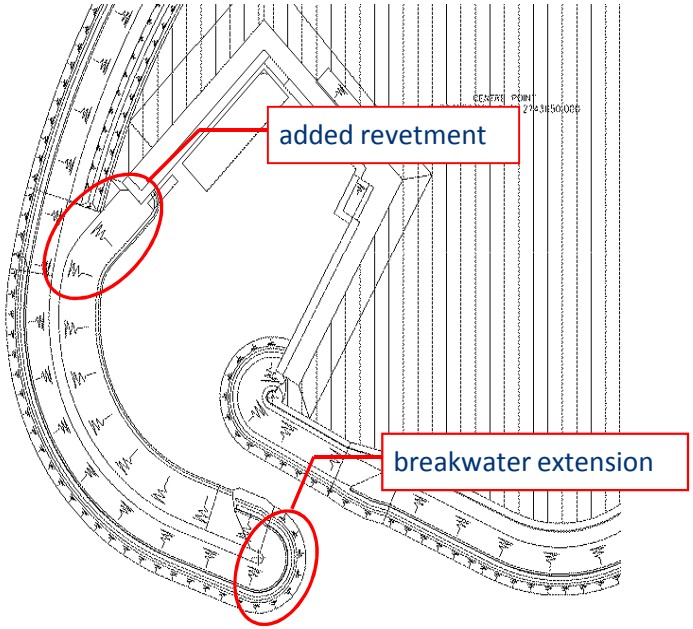
Final design before testing in the 3D basin.

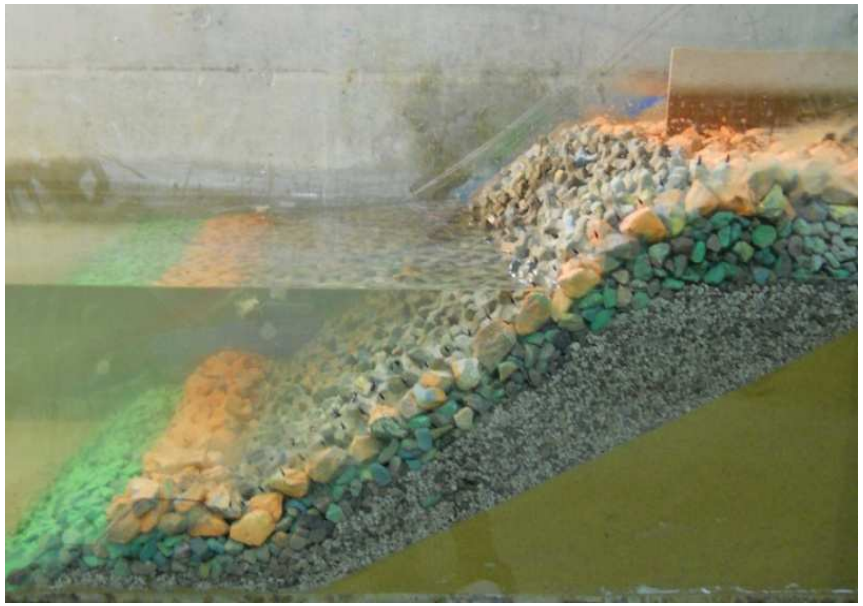
The blue arrows explain how overtopping water is drained off in lateral direction through the channel.

3D Scale model for testing wave agitation.

3. DESIGN AND BUILD CONTACT => DESIGN PROCESS

Some illustrations of the hydraulic design





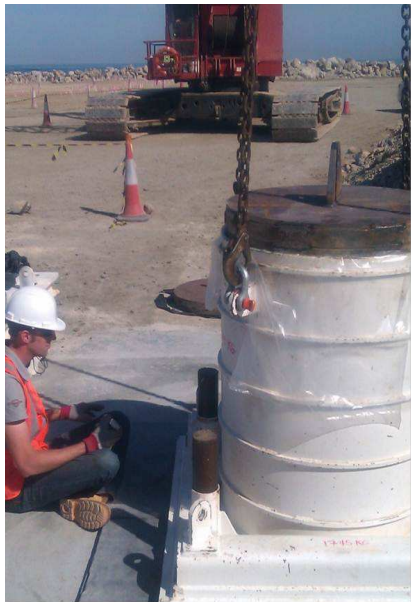
2D model of the edge protection showing sand bund covered by various rock layers (QR/UL/AR).

3. DESIGN AND BUILD CONTACT => DESIGN PROCESS

Some illustrations of the geotechnical design process

Calibration chamber equipment and sand spread out for drying

Pluviation method



Compaction of sample

3. DESIGN AND BUILD CONTACT => DESIGN PROCESS

Dredging International
Marine & Waterway Solutions

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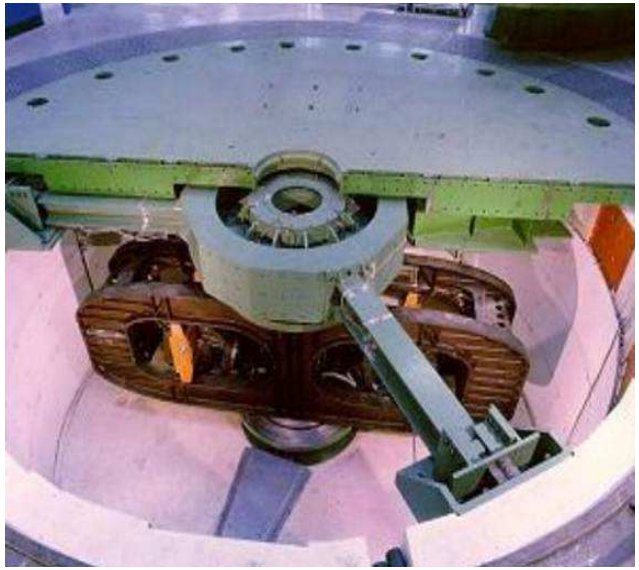
MIDDLE EAST DREDGING COMPANY
شركه الشرق الاوسط للجرف

Some illustrations of the geotechnical design process

Applying overburden stress

ISMGEO centrifuge



Pluvial deposition in air

3. DESIGN AND BUILD CONTACT => DESIGN PROCESS

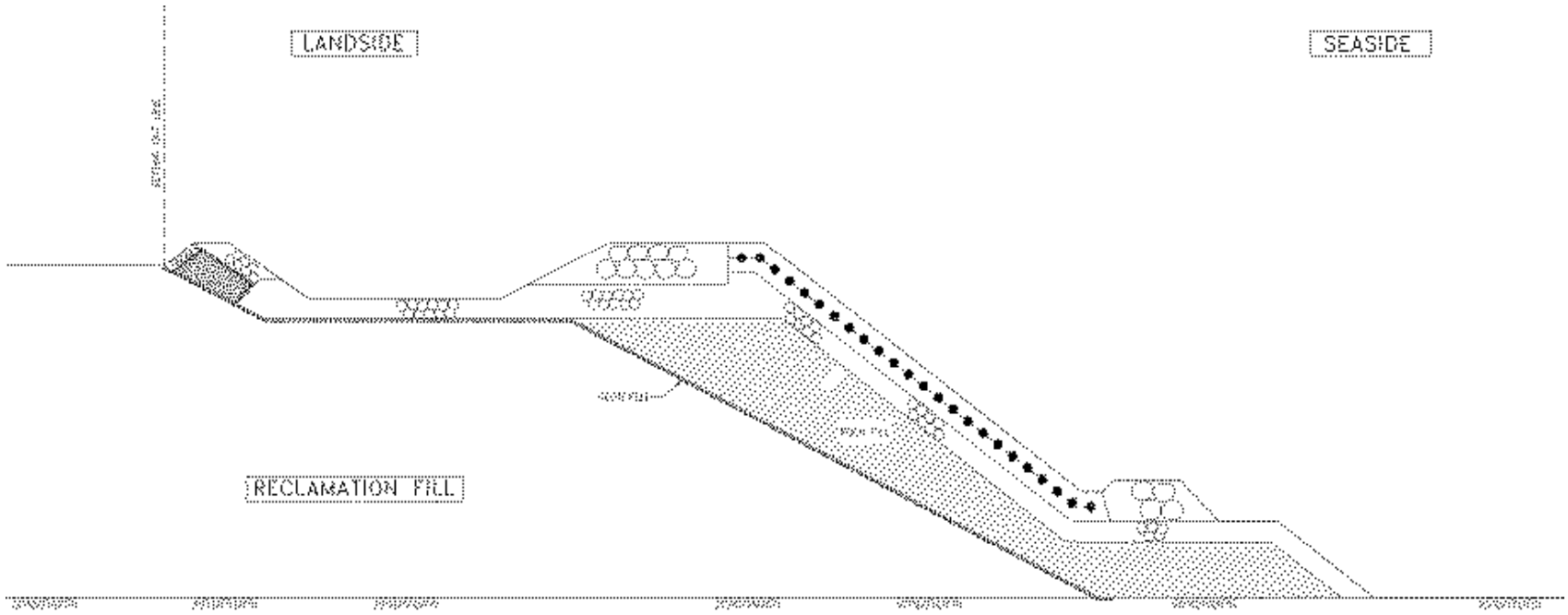
Some illustrations of the geotechnical design process

Excavated pit for test setup on settlement of quarry run foundation under quaywall

Load test applied to quarry run bund of 9m height 160 kPa load for 3 weeks, increased to 210kPa

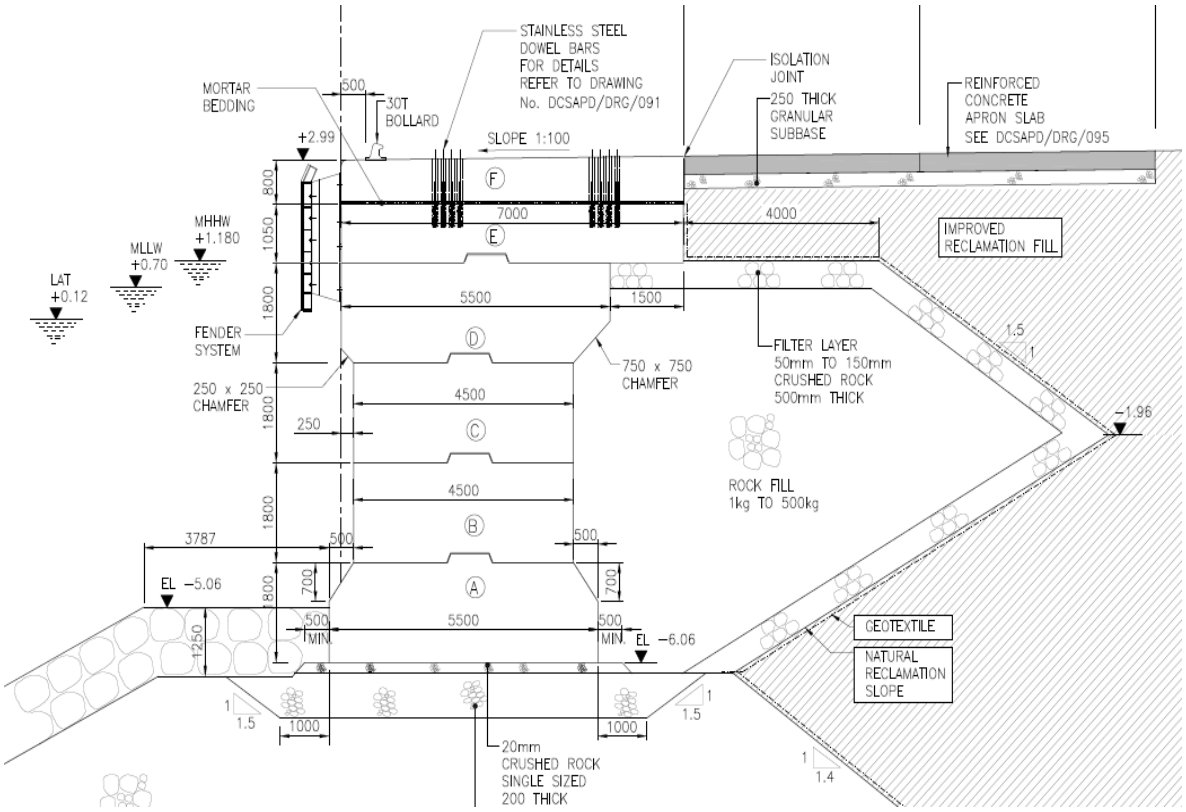
3. DESIGN AND BUILD CONTACT => RESULTING DESIGN

Typical cross section of shore protection – exposed side



3. DESIGN AND BUILD CONTACT => RESULTING DESIGN

Typical cross section of gravity quay wall



4. SUMMARY OF SCOPE OF WORKS

2 artificial islands: SARB 1 (SARB “North”) and SARB 2 (SARB “South”)

- Original depth of sea bed:
  - 15 m CD at SARB 1
  - 13 m CD at SARB 2
- Inner island platform dimensions: 450 m * 350 m
- Reclamation level:
  - Drill Pad area: + 6.5 m CD
  - Accomodation Area: + 8.0
- Inner harbour with 450 m quaywalls and slipway

4. SUMMARY OF SCOPE OF WORKS

Scope of construction works

- Dredging and reclamation:
  - 9.6 million m³ net fill by TSHD from offshore borrow area
  - 3.5 million m³ by CSD

- Harbour with quaywall, slipway and apron slabs:
  - Quaywall foundation in quarry run, including accurate bedding layer
  - 450 m quaywall lenght per island
  - 2,342 pre-cast concrete blocks per island, weight 50 T to 70 T
  - 324,000 m³ concrete

- Shore protection and breakwater, after compaction of the slope:
  - Perimeter length: 1500 m per island, plus 350 m long breakwater
  - 4.5 million tons of rock, various grades
  - 39,000 accropode II units, 7 T

5. CONSTRUCTION METHODOLOGY AND CONCEPTS

- Reclamation: “pan-cake” overfill construction method
  - Dissociation of activities (reduce interfacing risk)
  - Quality of fill is improved (no fines “trapped”)
  - Economy in quantities of rock material

- Shore protection
  - Sand slope trimming with CSD ‘Al Jarraf’ – automated process, high accuracy
  - Super long reach excavators for placing/trimming QR and UL rock
  - Customized long reach balance crane for accropodes

- Quaywall
  - Sequenced placing methodology
  - Pre-load
  - Grouted pre-cast capping beam

5. CONSTRUCTION METHODOLOGY AND CONCEPTS

Removal temporary bund followed by sand slope trim CSD

5. CONSTRUCTION METHODOLOGY AND CONCEPTS

Placement of geotextile with customized barge after slope trim by CSD

6. SPECIFIC PROJECT CHALLENGES AND INNOVATIVE SOLUTIONS

SARB is a multi-disciplinary offshore construction project, requiring a multitude of skills, complex planning and continuous interface management to realize it, in an offshore environment that requires in many fields an “out of the box” approach:

- Safety challenge: 1,300 people with a multitude of simultaneous activities, both marine and dry.
  - Offshore Safety Standards
  - Safety stats: 7.4 Million LTI free hours; 10 Million man hours end Oct. ‘13, 2 LTI’s

- Quality challenge in respect of performance requirements:
  - Tolerance specifications to the highest Oil & Gas standards
  - Geotechnical performance criteria of the highest Offshore standards, incl. seismic criteria (earth quake exposure)

6. SPECIFIC PROJECT CHALLENGES AND INNOVATIVE SOLUTIONS

- Logistical challenge: project location is 120 km offshore from Abu Dhabi
  - Marine fleet of over 60 vessels / 5 diving teams / dry equipment: up to 160 units
  - Temporary jetties at SARB 1 & 2, at Zirku and at RAK
  - Base and pre-cast yard at Ras-Al-Kaymah (RAK)
  - Camp at Zirku island for accommodation and offices, at 20 km from SARB islands
  - Complemented by “mini-camps” and accommodation barge *see illustration next slide*

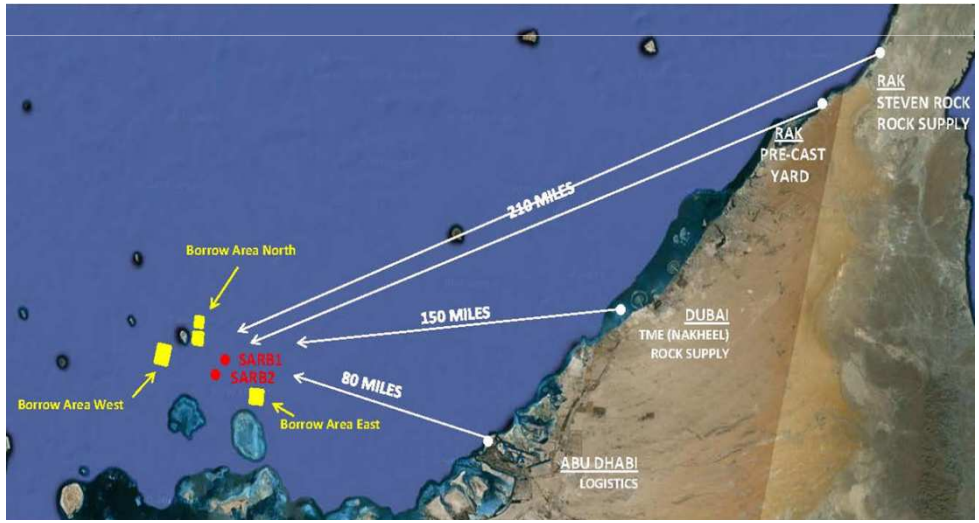
- Programme challenge:
  - Major variations forced an impact on the schedule; timely handover to the follow-on contractors

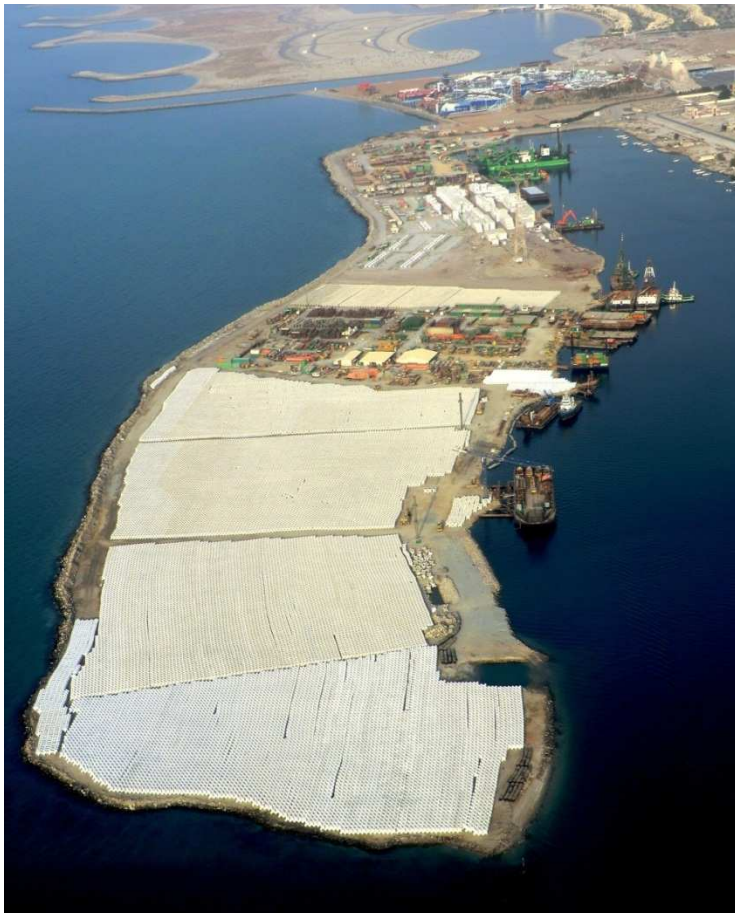
- Multi-cultural challenge: 46 nationalities of various cultures and religions

6. SPECIFIC PROJECT CHALLENGES AND INNOVATIVE SOLUTIONS

Logistical challenge:

- Project location SARB is 120 km offshore from Abu Dhabi
- RAK base and pre-cast yard at 300 km distance





6. SPECIFIC PROJECT CHALLENGES AND INNOVATIVE SOLUTIONS

- Innovative solutions – customized tools
  Refer to some examples in next slides

- “One contractor does all”: the complete multi-disciplinary scope of an offshore design & build project, all executed by one contractor.

- Conclusion: DEME acts as a one stop solution provider

6. SPECIFIC PROJECT CHALLENGES AND INNOVATIVE SOLUTIONS

- Innovative solutions – customized tools
  1. Under water remote controlled screeder frame for prepartion of foundation layer of quaywall

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6. SPECIFIC PROJECT CHALLENGES AND INNOVATIVE SOLUTIONS

- Innovative solutions – customized tools
  2. Quaywall bloc placing device allowing high accuracy on placing the underwater blocs

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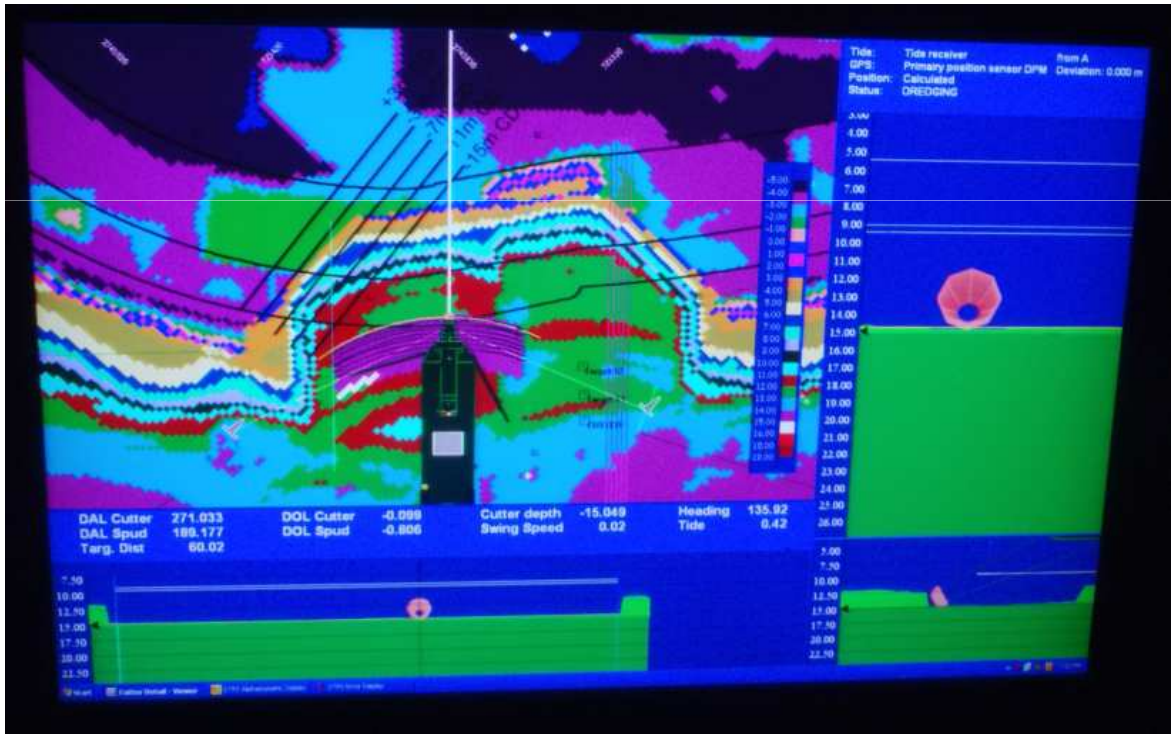
6. SPECIFIC PROJECT CHALLENGES AND INNOVATIVE SOLUTIONS

- Innovative solutions – customized tools
  3. Multi-purpose custom-built spud pontoons with offloading ramps: Naseem and Al Dana 1

6. SPECIFIC PROJECT CHALLENGES AND INNOVATIVE SOLUTIONS

- Innovative solutions – customized tools
  4. Sand slope trimming by CSD Al Jarraf, reaching high accuracy using the SCADA system



6. SPECIFIC PROJECT CHALLENGES AND INNOVATIVE SOLUTIONS

- Innovative solutions – customized tools
  5. Combination of fleet of dry equipment and marine equipment providing high versatility: 2 Super Long Reach Excavators (Hit.1900 SLR and CAT385 SLR “Rockbuster”) / 3 spud pontoons with Hit.1200 LR

6. SPECIFIC PROJECT CHALLENGES AND INNOVATIVE SOLUTIONS

- Innovative solutions – customized tools
  6. Custom made balance crane with camera and echographic image recognition for efficient placing of accropodes underwater, from land or from pontoon

7. KEY PHASES OF THE PROGRAM

A. Design and engineering phase
B. Materials supply:
    1. Rock supply from SR quarry at RAK
    2. Concrete pre-cast blocs, slabs and accropodes: pre-cast yard at RAK
C. Construction sequence:
    1. Reclamation by TSHD incl. overfill and temporary rock bund
    2. Priority on construction of Quaywall and Breakwater
    3. Deep compaction (Vibro- & Dyn.Comp.) and surface compaction
    4. Removal temporary bund, slope trimming by CSD and placement QR profile
    5. Permanent shore protection works

Parallel construction of islands SARB 1 and SARB 2, each following the sequence above.

8. PROJECT PHOTOGRAPHS AND VIDEO

1. Selection of photos included showing the various stages and activities on the project
2. Arial video-clip dd. 30 June 2013

SARB 1: 30 June 2013

SARB 2: 30 June 2013

SARB - Sandfill by TSHD

SARB 1 – Shore protection train

SARB 1 – Shore protection; Accropodes train

SARB 1 – Shore protection; Accropodes train

SARB 1 – Completed harbour and accomodation area

SARB 1 – Completed harbour and accomodation area

SARB 2 – multitude of activities, incl. vibro-compaction

SARB 2 – multitude of activities; shore protection, quaywall works,…

SARB 2 – multitude of activities; shore protection, quaywall works,…

Why such offshore island as opposed to the typical steel well head structures for oil drilling?

- Capacity of the SARB oil fields in UAE: over 100 years.
- It is much cheaper, safer and more sustainable to develop a multi-purpose island as drilling platform annex harbour annex accommodation area.
- There is large potential for more artificial island projects offshore in the Gulf, subject to successful commissioning and operation of the first ones.
- Why not similar concepts in the North Sea?
  For example, a multi-purpose island for renewable energy (water storage), combined with other functions.