PROJECT LOCATION

- United Arab Emirates (U.A.E)
- Between Abu Dhabi and Dubai
KHALIFA PORT INDUSTRIAL ZONE (KPIZ)

- Diversification of economy
- High added value economy
- Growth non-oil GDP

STAGE 1A DEVELOPMENT

- Offshore multi-cargo port
- Port platform > 2 million m²
- Causeway and bridges
- 12 km long approach channel
- 16 m deep port basin
- EMAL Platform
CLIENT AND CONTRACTOR

CLIENT
- Abu Dhabi Ports Company
- Bechtel Engineering (PMC)

KHALIFA PORT MARINE CONSORTIUM
- Boskalis Westminster Middle East
- Archirodon Construction Overseas
- Hyundai Engineering & Construction

KPMC SUBCONTRACTORS
- Halcrow – Design Engineer
- Royal Haskoning – Independent Checking Engineer
- Fugro – Additional soil investigation
KEY ELEMENTS AND SCOPE OF WORKS

- Design, procurement and construction
- Total construction time appr. 3 yrs
- Total contract value 1.2 billion euro
- Dredging 46 million m³
- Reclamation 38 million m³
- Quay wall construction 4.1 km
- Two bridges, each 1 km
- Revetments 10 km
- Wave Attenuation Breakwater 1 km
- Environmental Breakwater 7 km
KEY ELEMENTS AND SCOPE OF WORKS

- Construction of bunds
- Dredging 46 million m$^3$
- Reclamation 38 million m$^3$

appr. 12 km

3 km
QUAY WALL CONSTRUCTION

4.1 km quay wall
QUAYWALL CONSTRUCTION
BRIDGES, REVETMENT, BREAKWATERS, GROUND IMPROVEMENT

WAVE ATTENUATION BREAKWATER

ENVIRONMENTAL BREAKWATER
PRECAST YARD
MANY CHALLENGES...

- Reclamation construction with high fines content fill material
- Very strict environmental restrictions
- Very strict material and performance requirements
- Tight schedule
DREDGING OF CALCAREOUS ROCK

GEOLOGICAL UNITS

- Unit 1: Caprock
- Unit 2: Calcarenite & Calcareous Sandstone
- Unit 3: Calcisiltite, Gypsum, Mudstone

CaCO3 Content 75%

Cutter

Generation of fines

Reclamation
Two major environmental sensitive areas are situated in close vicinity of the Khalifa Port:

- The coral reef at Ras Ghanada;
- The ADWEA water intake.
<table>
<thead>
<tr>
<th>Sieve diameter</th>
<th>Percentage Passing (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>100%</td>
</tr>
<tr>
<td>125</td>
<td>10% to 100%</td>
</tr>
<tr>
<td>0.063 (clay &amp; silt)</td>
<td>0 to 10%</td>
</tr>
<tr>
<td>0.002 (clay)</td>
<td>0 to 2%</td>
</tr>
</tbody>
</table>

The contractor shall employ all methods necessary for the full thickness of reclamation fill and any soil beneath the original seabed. The treatment shall be effective for the full thickness of reclamation fill and any soil beneath the original seabed. The treatment shall be effective for the full thickness of reclamation fill and any soil beneath the original seabed.

Mitigation of the liquefaction for UBC Zone 2A with a magnitude of peak ground acceleration of 0.15g measured at bedrock.

Furthermore, in addition to the treatment described, the contractor shall ensure that fines not accumulate in lenses or pockets of soils that may exist beneath the original seabed. In addition, the contractor shall ensure that fines not accumulate in lenses or pockets of soils that may exist beneath the original seabed. In addition, the contractor shall ensure that fines not accumulate in lenses or pockets of soils that may exist beneath the original seabed.
CONTRACT SPECIFICATIONS

Functional Requirements

Performance requirements

Technical specifications
GEOTECHNICAL ENGINEERING

DEMONSTRATION OF RECLAMATION PERFORMANCE

- Establish work method
- Quality control and monitoring procedures
- Design parameters and calculation methods
- Lab and field testing
- Acceptance testing and handover

- Dedicated team for quality control
- Commitment to quality
DREDGING AND RECLAMATION PROCESS

OPTIMIZED PROCESS:

- Crescent shaped reclamation front
- Multiple discharge locations
- Use of Water Injection Dredger
- Clean up of fines by TSHD

Fines removal by trailer

Deposition of fill material

WID
Backhoe
Trailer
QUALITY CONTROL & MONITORING

MONITORING
- Material quality
- Performance quality

MEASURES
- Fines removal
- Ground improvement

ACCEPTANCE
- Final testing
- Handover

Check on performance
Ground improvement

KEY SUCCESS FACTORS
✓ Common responsibility
✓ Open communication
✓ Operations responsible for monitoring
✓ Monitoring and quality control 24/7
✓ Clear presentation of data
✓ Immediate distribution
CONCreTE PENETRATION IN CALCAREOUS SOILS

- High compressibility
- Particle crushing

Influence on measured cone resistance  
Cone correction factor
DESIGN PARAMETERS

SITE SPECIFIC CPT CLASSIFICATION

Boreholes and lab testing
ENGINEERING CONTROL

ASSESSMENT OF CPT DATA

- Settlement analysis
  - Uniform load
  - Distributed load
- Liquefaction analysis
- Accumulated fines layers
- Every 30 x 30 m

Ground Improvement?

Zone Load Testing

CPT Analysis
DATA MANAGEMENT AND REPORTING

MAIN FEATURES

- Automated data processing
- Fast processing of lab results
- Geotechnical database
- Integrated GIS system

- Fast response time
- Standard output
- Distribution within organisation
- Information to client
Questions?