



Challenges and Solutions in Dredging and Reclamation with Cohesive Materials



Geotechniekdag

11 – 11 – 2025

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Introduction

- Dredging
 - Capital
 - Maintenance
 - Borrow
- Reclamation
 - Granular materials
 - Drainage, removing process water
 - Compaction methods
 - Limited bearing capacity issues
- Projects
 - Maasvlakte 2, Palm Islands, Tuas View, Hong Kong Airport



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Introduction



Maasvlakte 2



Dynamic Compaction



Palm Island



Vibro Compaction

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Introduction

- Re-use of dredged materials
- Restrictions on offshore dumping
- Circular construction
- Contaminated materials
- Shortage of granular borrow material
- Reclamation with cohesive materials becoming more common
- What challenges does this pose?



Mechanical Dredging

- Backhoe dredger
- Grab dredger
- Limited additional water
- Limited remolding during dredging process
- Applicable in soft and stiff soils
- Applicable when dealing with contaminated materials



Hydraulic Dredging

- Trailing Suction Hopper Dredger (TSHD)
- Cutter Suction Dredger (CSD)
- Significant additional process water (bulking)
- Significant remolding during dredging process
- Applicable in soft and stiff soils
- CSD applicable in soft rock



Material Transport

- Pumping through Pipelines
 - Applicable to hydraulic dredging methods
 - High Production
 - Additional process water
 - Further remolding expected
 - Behavior in pipeline (clay balls?)
- Transport in Barges
 - Applicable to mechanical and hydraulic dredging methods
 - Hydraulic methods, require overflowing to reduce water



Reclamation - Filling

- Pipeline Pumping
 - High production
 - Process Water
 - Slurry fill – less variability
 - Segregation
- Barge Dumping
 - Low production
 - Draft limitations
 - Lumpy fill – high variability
- Reclamation from Land
 - Low production
 - Requires stable working platform



Reclamation - Filling

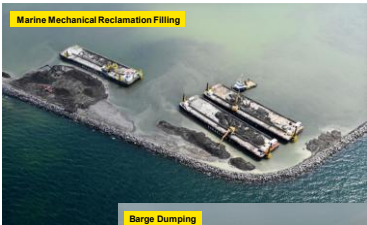
Slurry Dominated Fill



Clay balls in reclamation after pumping



Marine Mechanical Reclamation Filling



Barge Dumping



Reclamation - Capping

- Direct capping
 - With competent cohesive materials
 - Dry earth moving equipment
 - Stability and Accessibility
 - With granular materials
 - Hydraulic / dry earth moving equipment
 - Mixing and losses
- Other solutions
 - Geotextile
 - Bamboo
 - Crust forming
 - Ripening (time)
 - Accelerated dewatering



Reclamation - Capping

Capping of soft materials



Capping of soft materials



Ripening with Mudbot

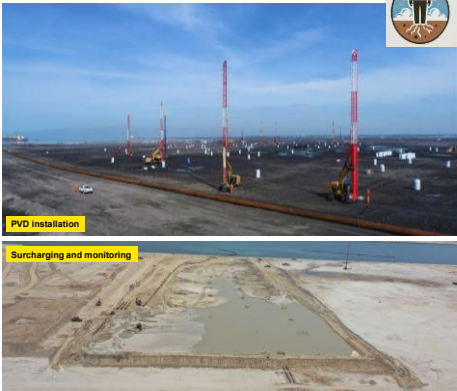


Dewatering Ditch

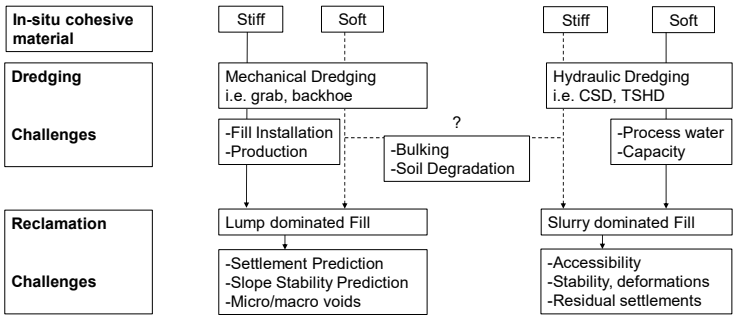


Reclamation - Treatment

- Settling/selfweight consolidation
- Soil Improvement
 - PVDs and surcharge
 - Reduce residual settlements
 - Liquefaction?
- Prediction
- Monitoring
- Prediction of future behavior



Overview



Conclusions

- Reclamation with Cohesive Materials is possible
- Change in dredging and transportation methods?
- Change in Soil Improvement Methods
 - Consolidation instead of compaction
 - More time required
- Change in Requirements
 - Less focus on material quality
 - More focus on performance criteria (residual settlements, bearing capacity)
- Improvement verification methods
 - From compaction to (residual) settlement verification



Further Research

- Behaviour of Cohesive Material
 - Dredging
 - Transport
- Behaviour of lumpy (highly heterogenic) fill
- Behaviour of slurry
 - After reclamation: Testing methods
 - During capping: Failure mechanisms
- Behaviour of reclamation fill after handover
 - Settlement predictions
 - Liquefaction susceptibility
- Alternative capping methods
 - Crust formation
 - Bamboo mattresses



