LAND PAC

BS 2010/005

BENEFIT STATEMENT

Case Analysis

MARKET SECTOR

Infrastructure Development

APPLICATION

Deep In-situ Compaction of Marine Fills

PROJECT PHASE

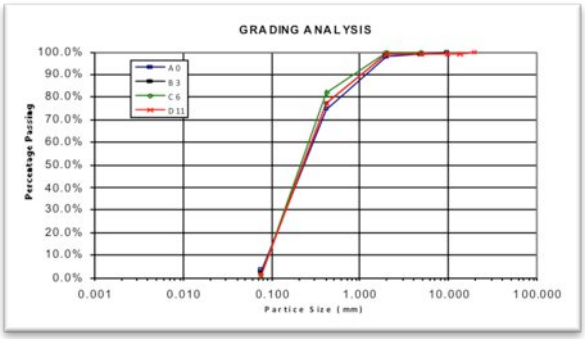
Design Phase

eliminating the need for excavation and compacting in thin layers

PROJECT and GEOLOGICAL REVIEW

The new quay area was created by firstly constructing sand-filled caissons with a mass reinforced concrete capping beam to act as the quay walls (SAICE 2004). The quay reclaim area was created by deposition of dredged sand to depth of approximately 12m between the quay walls.

Although collectively referred to as "sands" the marine sands are generally fairly heterogeneous, not only due to variability of the source but also as a result of the method of placement. Hydraulically placed fills lead to segregation of the coarser and finer particles. Sand placed by spigotting from a pipeline will also deposit larger grains close to the spigot (mouth) of the pipeline while the finer grains are deposited further away. This will result in a "beaching" effect and lenticular or layered fills are created. The vertical and lateral variations in composition (sand or silt) of the fill are expected to have an influence on the stiffness of the fill and the behaviour of the selected foundation solutions.



Property	Value	Property	Value
Moisture Content	3.0 – 4.2%	Percentage Sand	95.5 – 98.6%
Optimum moisture content	3.6%	Grading Modulus	1.17 – 1.23
Maximum dry density	1883 kg/m^3	D_{10}	0.088 – 0.092 mm
CBR @ 93% of modified AASHTO density	26 %	D_{30}	0.139 – 0.145 mm
Linear Shrinkage (LS)	0	D_{60}	0.265 – 0.295 mm
Liquid Limit (LL)	N/A	C_u	2.93 – 3.36
Plasticity Index (PI)	NP	C_c	0.78 – 0.81
TRH 14: 1985 Classification	G7	AASHTO Classification	A-3 (2)
Unified Classification	SP		

IMPACT COMPACTION PROCESS AND ALTERNATIVE

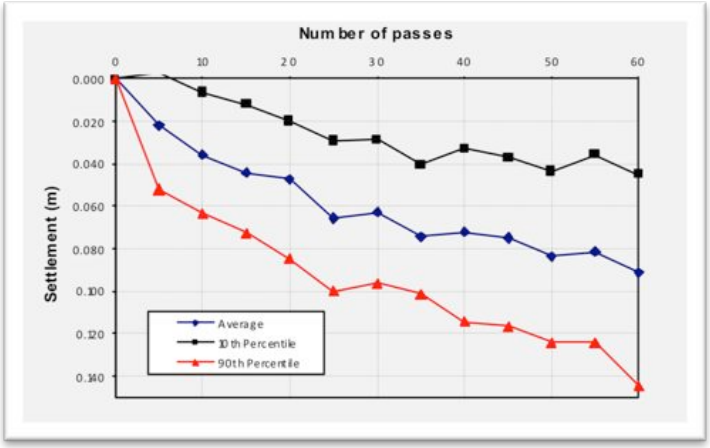
The conventional specification would have called for the removal of the top 1 to 1.5m of material and then have that built up in 150mm layers, treating each of the layers with a smooth drum vibratory roller. Post trials with an impact compactor, it was decided to treat the entire site with 35 roller passes of a 3 sided 25kJ impact compactor.

Some of the results recorded include:

SETTLEMENT

An average settlement of 89mm was recorded after 60 passes. It was evident that the material started reacting elastically after 35 passes.

Settlement at Depth:
- Settlement of 63.5mm was recorded at pass 60, 0.7m below the surface.
- Settlement of 42.5mm was recorded at pass 60, 1.3m below the surface.
- Settlement of 31.5mm was recorded at pass 60, 1.7m below the surface.



PENETRATION RATES/CBRs

0-600mm: The consistency of the material was not increased significantly. The average penetration rate increases from pass 0 to 30, indicating that impact compaction is loosening the material in this depth range. As the number of passes increase, the penetration rate is decreased to levels exceeding the original penetration values.

600-1200mm: The consistency of the in-situ material was slightly increased. The average penetration rate decreases at a larger rate from pass 0 to 20, where after the rate is gradually decreasing to pass 40. The penetration rate does not decrease significantly between pass 40 and 60.

1200-1800mm: The consistency of the material was increased from dense to very dense. The average penetration rate decreases at a larger rate from pass 0 to 10, where after the rate is gradually decreasing to pass 40. The improvement in penetration rate between pass 40 and 60 is not significant. The results further indicate that impact compaction effected improvement of at least 1.8m.

The DCP testing indicates that impact compaction will improve secondary creep characteristics by improving the consistency of layers in the depth range 600mm to 1200mm.

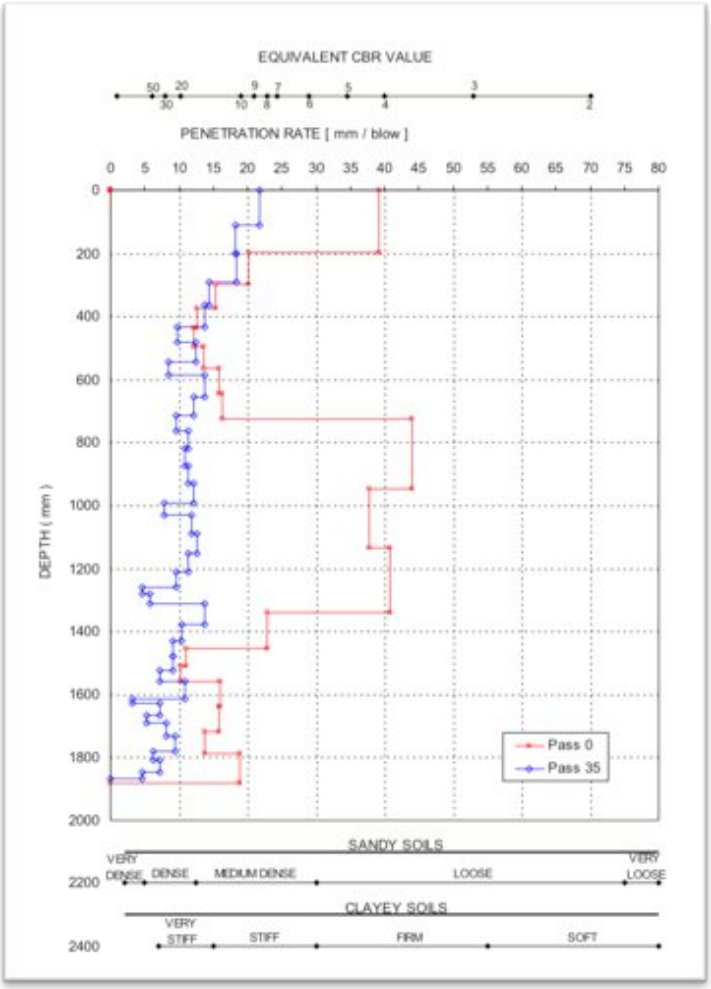


PLATE LOAD TEST RESULTS

All the plate tests were conducted to a maximum plate stress of 454kPa without inducing failure. The ultimate bearing pressure of the soil at a depth of 380mm is therefore in excess of 454kPa. If a factor of safety against bearing failure of 3 is considered, the allowable bearing pressure would be 151kPa. The soaked secant modulus in the stress range 227-454kPa improved from 35MPa to 43MPa. Secant moduli in the other stress ranges did not improve significantly.

The collapse settlement was not significant in relation to the total settlement and did not reduce with additional passes. Total settlement reduced slightly with additional passes.

CONSTRUCT AT 40% OF THE ORIGINAL COST AND SAVE SUBSTANTIALLY ON CONSTRUCTION TIME.

SUMMARY

- Eliminating the need to excavate to depth and recompact in conventional layer thicknesses.
- Superior subgrade strength.
- Construction time savings.
- Substantial cost savings.