

Utilization of the contaminated sediment
as a part of the understructure
of the harbour field

Case Vuosaari Harbour, Helsinki, Finland

Seminarium om Förorenade sediment - problem och
möjligheter, Göteborg 19.11.2008

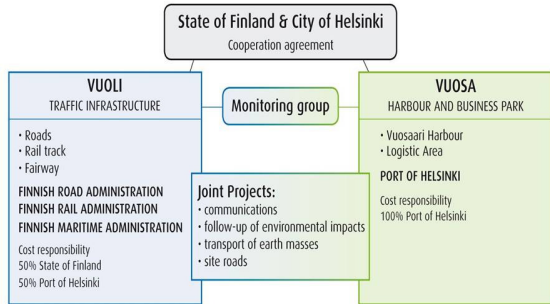
Ari Piispanen, Jorma Havukainen & Mikko Leppänen



All the cargo operations will be moved to new
Vuosaari Harbour from the city centre



Vuosaari Harbour
Organisation



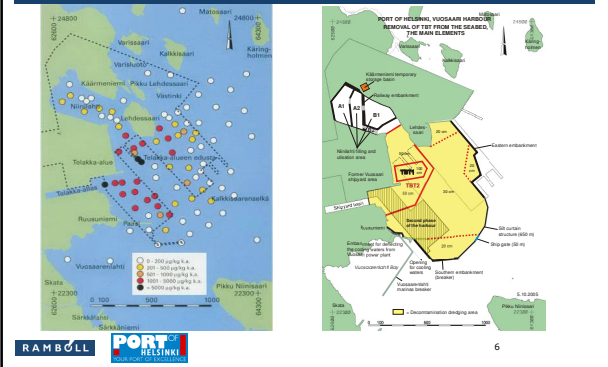
Vuosaari Harbour Starting situation in 2003



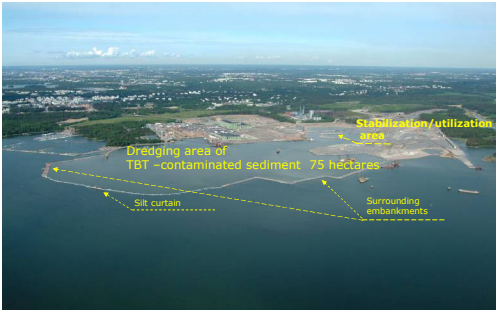
Vuosaari Harbour The operative harbour in 2009



Vuosaari Harbour Sediment sampling points, the decontamination dredging area and the filling area



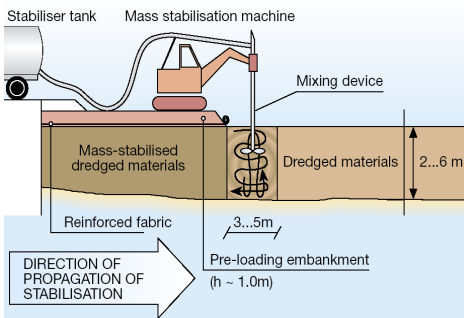
Vuosaari Harbour Preparatory works for the utilization



Vuosaari Harbour Preparatory works for the utilization



Principle of Mass Stabilization

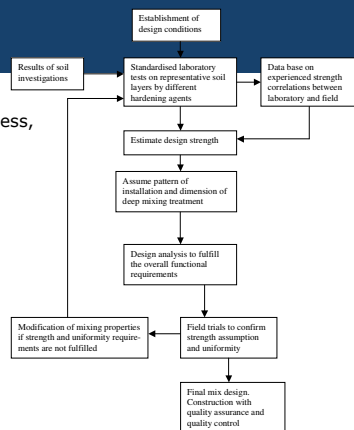


Mass Stabilization- Main purposes

- Increase strength of soil
- Improve deformation properties
- Remediate contaminated soil
- Save costs (transportation of masses etc.)
- Save disposal areas
- Save natural aggregates and rock ballast

Design process

- Iterative design process, including:
- laboratory testing
- functional design
- field trials and
- process design

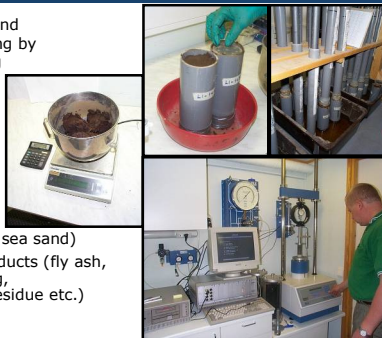


The importance of laboratory tests

Technical, economical and environmental optimizing by careful stabilizer testing

Stabilizers:

- Cement
- Lime
- Cement-Lime
- Aggregates (e.g. sea sand)
- Industrial by-products (fly ash, blast furnace slag, desulfurization residue etc.)



Main phases of Mass Stabilization work

1. Test stabilization, if needed
2. Stabilization according to the design, control of binder amount and first step preloading (0,5-1,0 m)
3. Quality control soundings and - if needed - other quality testings
4. Corrective actions, if needed
5. Preloading
6. Acceptance of the work

Vuosaari Harbour Mass Stabilization of TBT-sediment, 2005-2006



Vuosaari Harbour Mass Stabilization of TBT-sediment, 2005-2006



The largest mass stabilization project in Finland

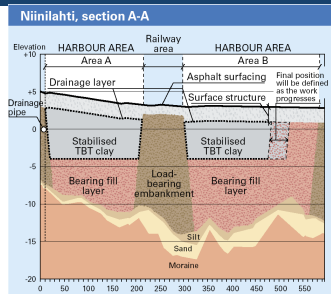
Total area ~ 11 hectares
Mean depth was 5 m
Total volume ~ 500 000 m³
Stabilizer agent was cement (CEM II/A-M (S-LL) 42,5 N);
130 kg/m³ of sediment; total ~ 60 000 tons

Vuosaari Harbour Mass Stabilization of TBT-sediment, 2005-2006



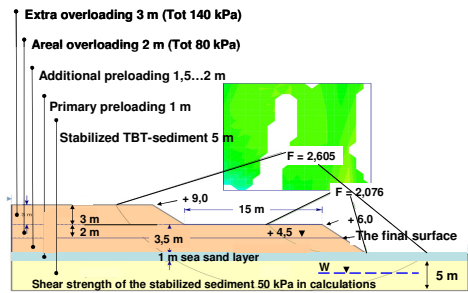
- The feeding and mixing of cement was carried out by two units (7 000 kg/hour)
- The whole area was divided in 5 500 blocks (20 m²/5 m); 13 tons of cement was mixed in each block
- Target 1: 90 day shear strength > 70 kPa
- Target 2: Permeability $k \leq 5 \times 10^{-9}$ m/s

Vuosaari Harbour, Mass Stabilization of TBT-sediment, Principle of the mass stabilized construction



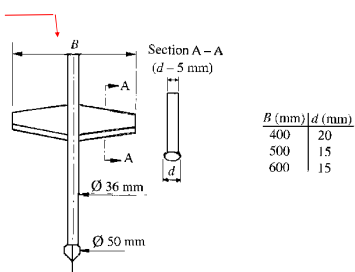
The stabilised TBT clay is deposited as a layer about five metres in thickness on a bearing fill layer. The stabilised layer is covered with a drainage layer and a surface layer, with an asphalt layer on top. The stabilised structure is surrounded by a system of drainage pipes.

Vuosaari Harbour Mass Stabilization of TBT-sediment, 2005-2006 ...stability OK



Quality controlling of Mass Stabilisation

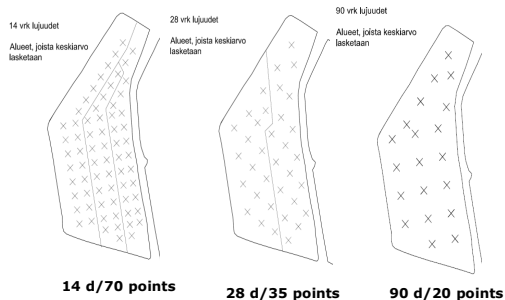
- Column penetration test
- Column vane test
- Cone penetration tests (CPT)
- Core samples
- Special methods



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19 **PORT HELSINKI**

Vuosaari Harbour Mass Stabilization of TBT-sediment, 2005-2006, test sounding points of lagoon A1 (14, 28 and 90 days)

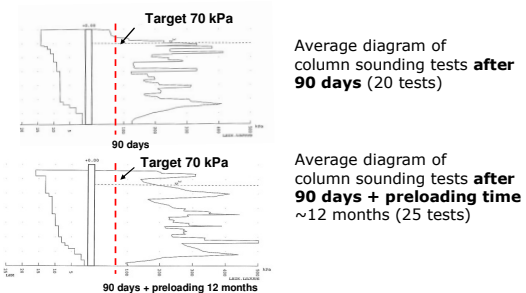


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20

Vuosaari Harbour Mass Stabilization of TBT-sediment, test soundings in the lagoon A1

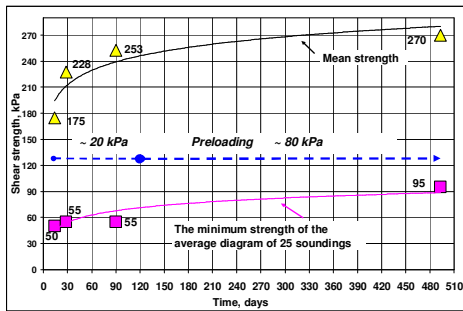


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21

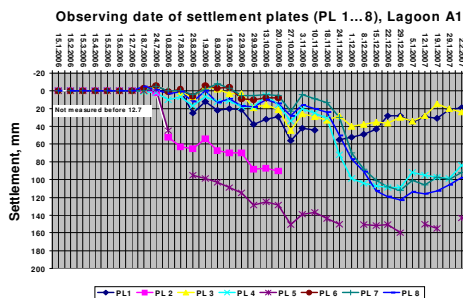
Development of the shear strength of the Mass Stabilized TBT-sediment - preloading has increased the minimum strength significantly



Vuosaari Harbour Excavated Mass Stabilized TBT-sediment



Vuosaari Harbour, Mass Stabilization of TBT-sediment, settlement observations at lagoon A1



Removal of tributyltin (TBT) from the seabed and Mass Stabilization project in Vuosaari Harbour Summary

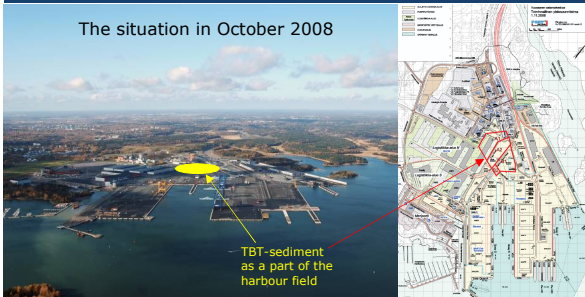
- 99 % of TBT was removed from the seabed and transferred to the Niinilahti filling area
- The contaminated sediment (~500 000 m³) was mass stabilized and utilized as harbour field structure
- The costs of the TBT removal and stabilization process was ~10,5 million euros
- The removal of TBT was a seamless part of the construction work and Vuosaari Harbour will go into operation in the end of November 2008



25

The new Vuosaari Harbour will be opened 28th of November 2008

The situation in October 2008



TBT-sediment as a part of the harbour field

For more information about the Vuosaari Harbour Project see:
www.vuosaarentatama.fi



Thank You!

26
