Research and practice of historic mortars and concrete

Some background information

15 years as researcher at the Concrete and Silicate laboratory in the Research Centre of Finland (VTT)

Åbo Slott P-O Welin

Project with historical mortars, 1982 – 1985

Ancient and modern Mortars in the Restoration for Historical Buildings. Espoo 1985, VTT, Research Notes 450.

Deterioration in bricks due to salts - mechanisms of salt deterioration Espoo 1989, VTT Research Notes 1003

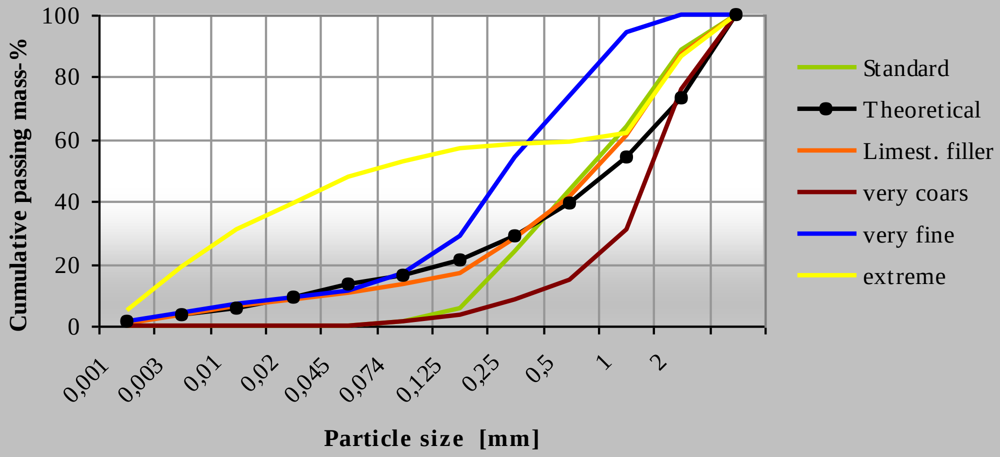
Betonin mikrosuhteitus /
The microproportion of concrete.
BY 301, Suomen Betonitieto Oy.
Jyväskylä 1992
Heikkinen Aino &
von Konow Thorborg.

The cement mortar got more and more popularity also in the restoration, from 1920 to 2000 – why?

Modern lime mortars had shown to have a very week durability, in praxis and in lab.tests.

Cement- and lime-cement mortars have a rough curing. They have additives – for the masons easy to work with.

How could the lime mortars used for restoration be improved?



The aggregate grain size distribution works

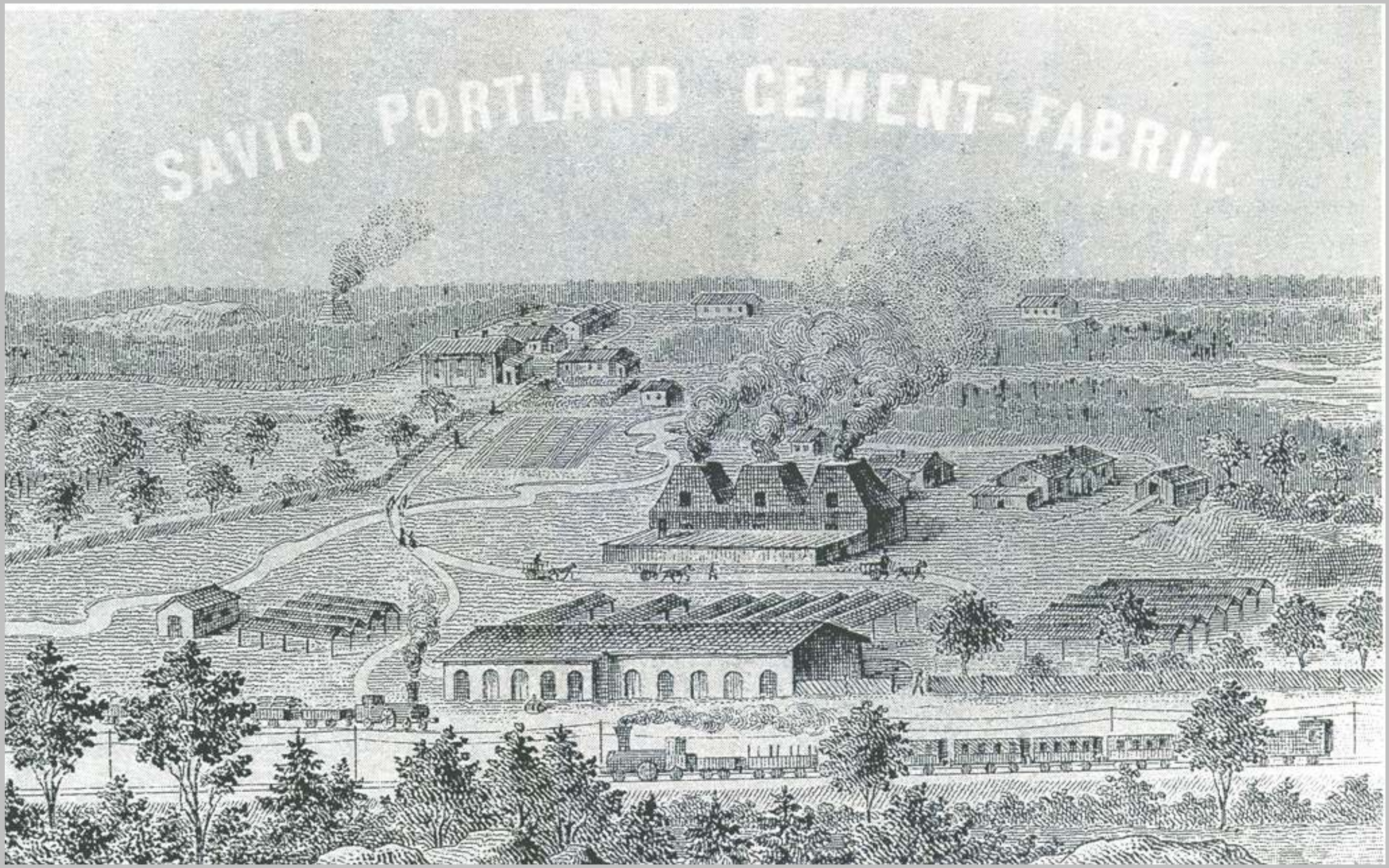
for lime mortars as for microproportioned

concrete, but with a different starting point.

To improve the durability - frost resistance

Not to increase the compressive strength

Cement plant in Finland (1870 – 1894)



Restoration Concrete for Historical Concrete Constructions

– Scientific Studies of old Concrete Samples from Finland

Samples from 1870, 1895, 1905, 1906, 1907, 1917, 1930, 1940

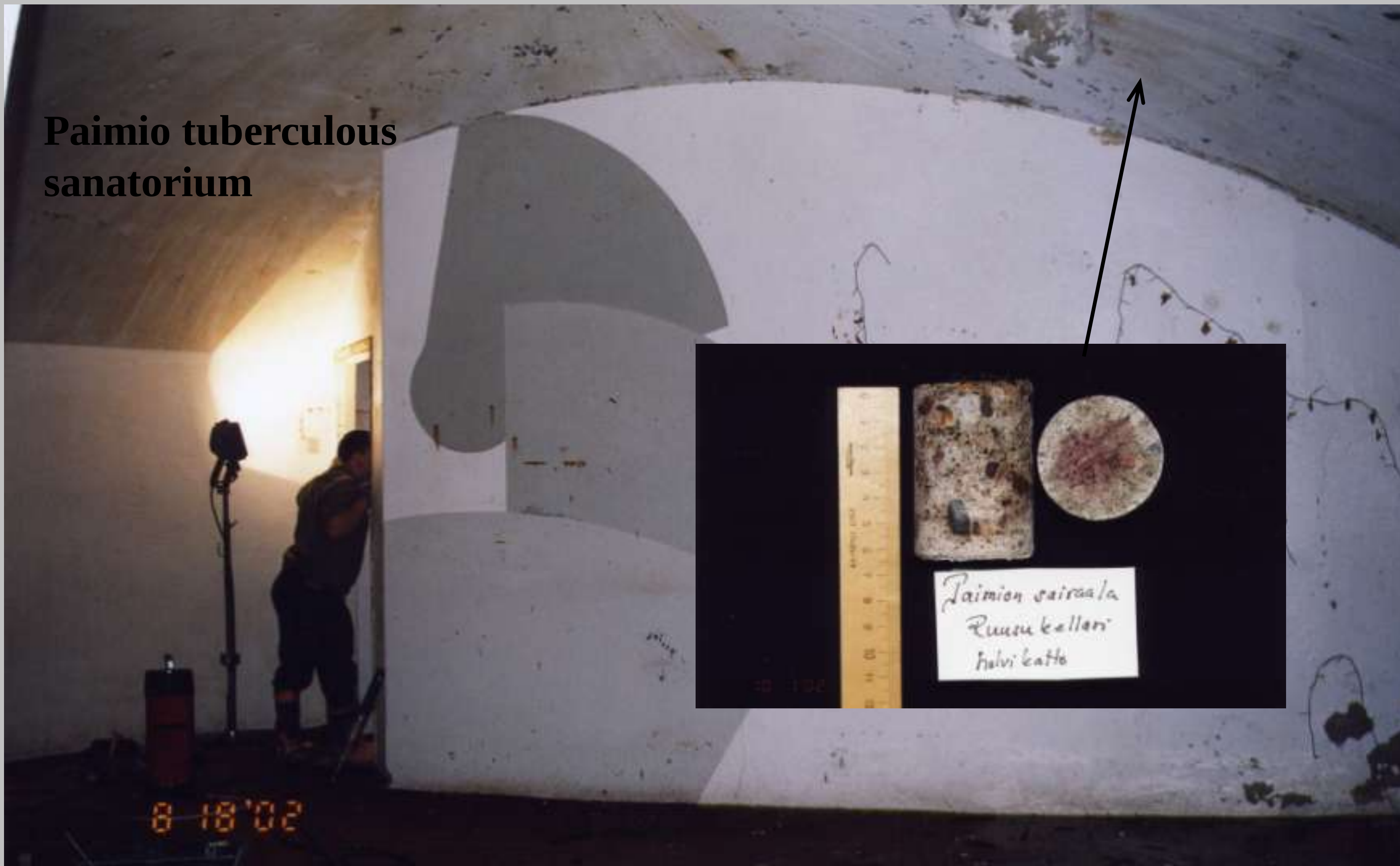
Hangö old bridge and Butter Storehouse the English Magazine

Hangö butter storehouse (1907)

Hangö old bridge (1905)

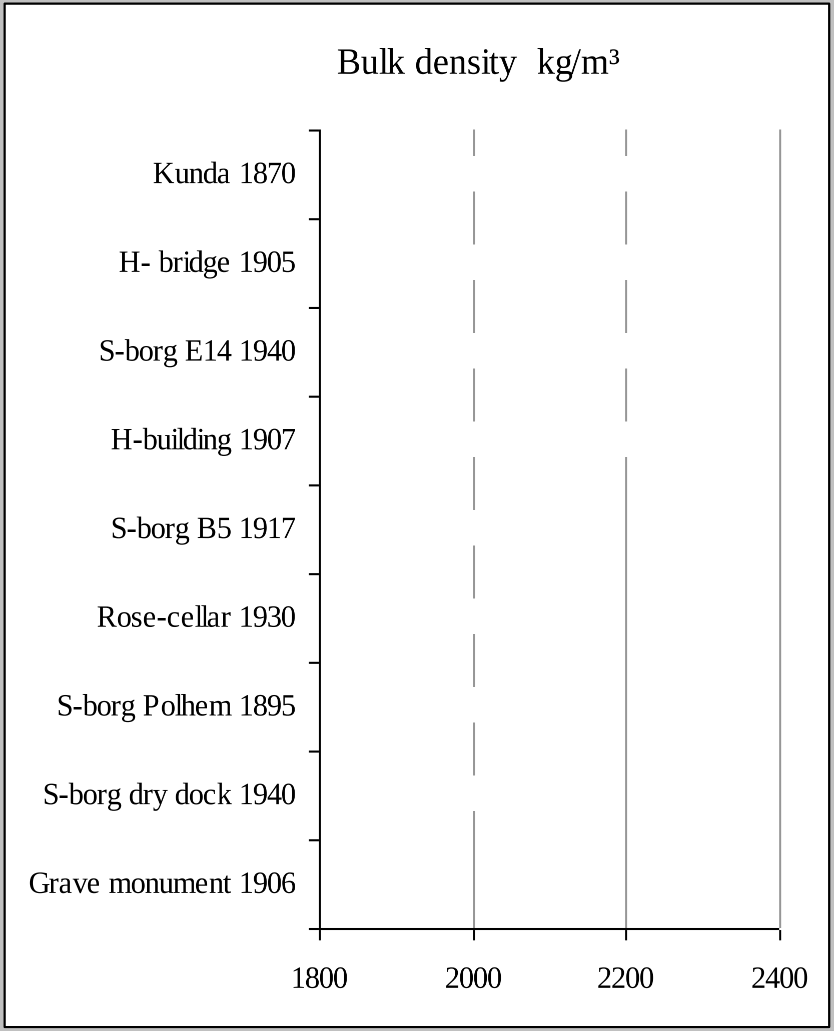
Grave monument from 1906 and its pointing cement mortar

Rose-cellar designed by Alvar Aalto (1930)

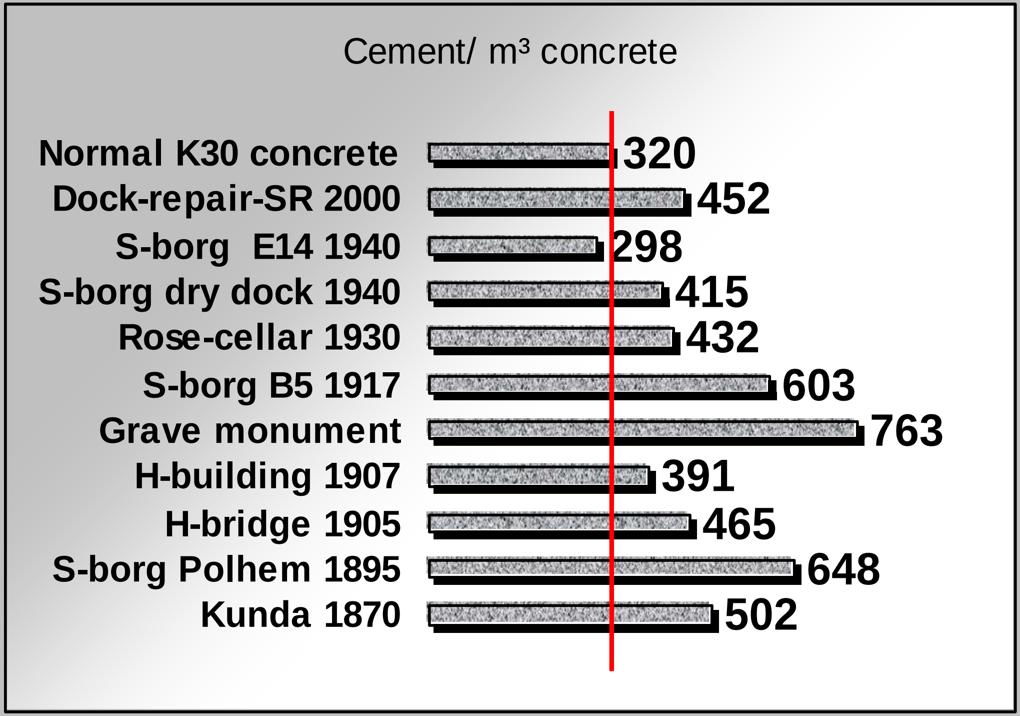


The galley (dry) dock (1931) at the fortress of Sveaborg

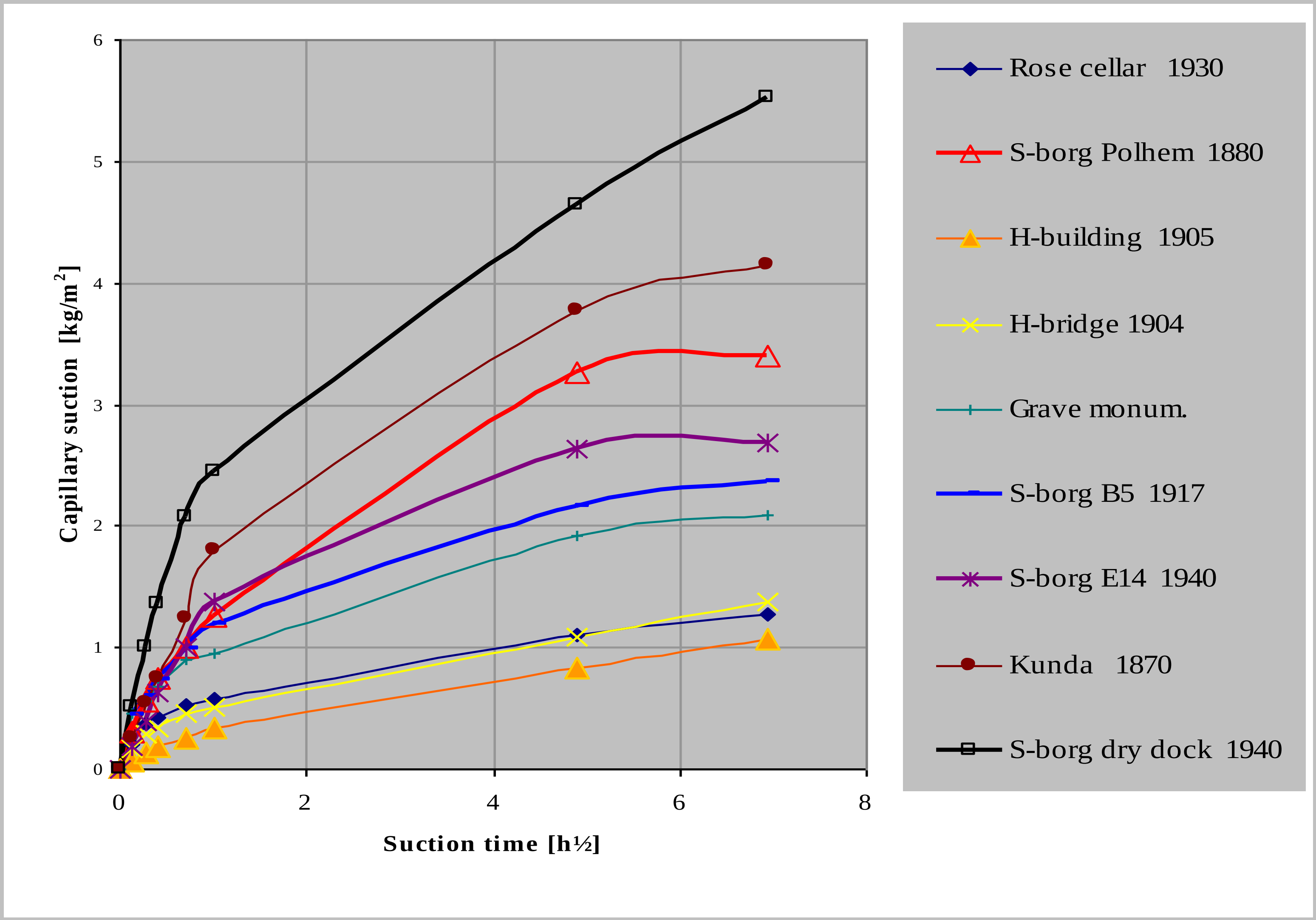
Bulk density



Cement content of the samples

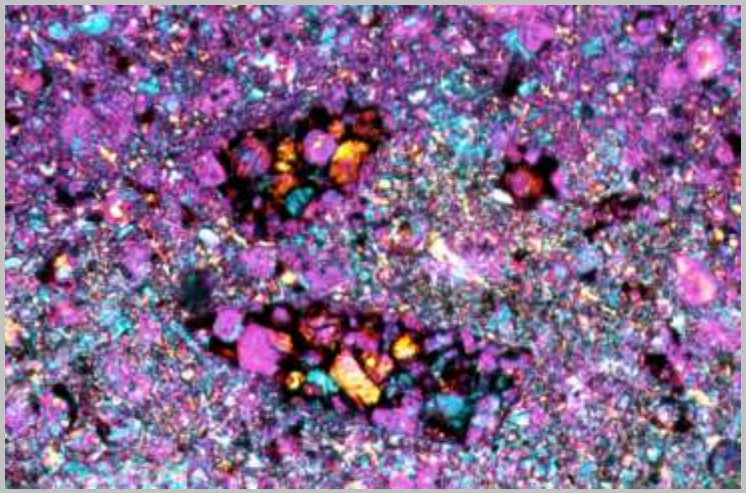


Capillary suction of the concrete samples

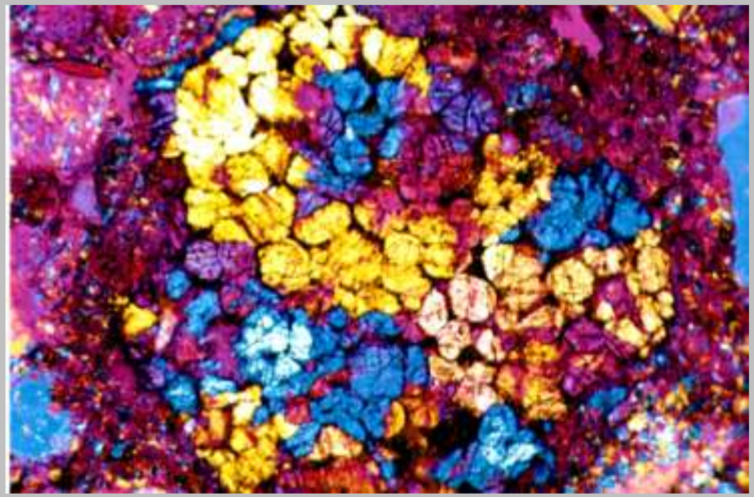


Clinker grains in mm 10^{-3}

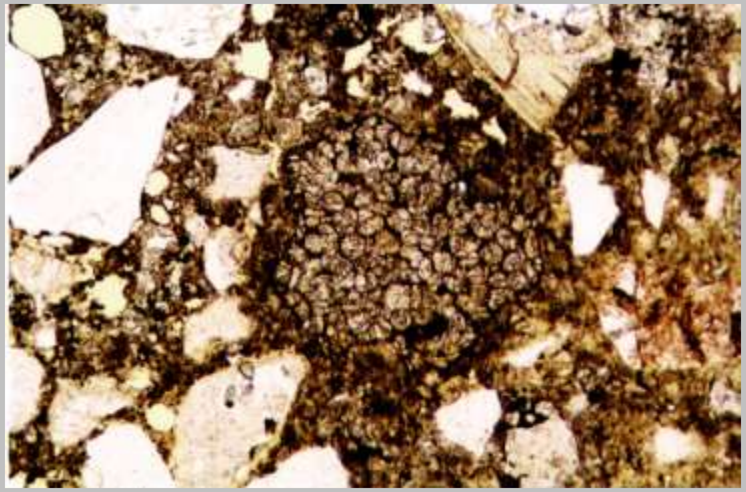
20x XPL with λ-plate

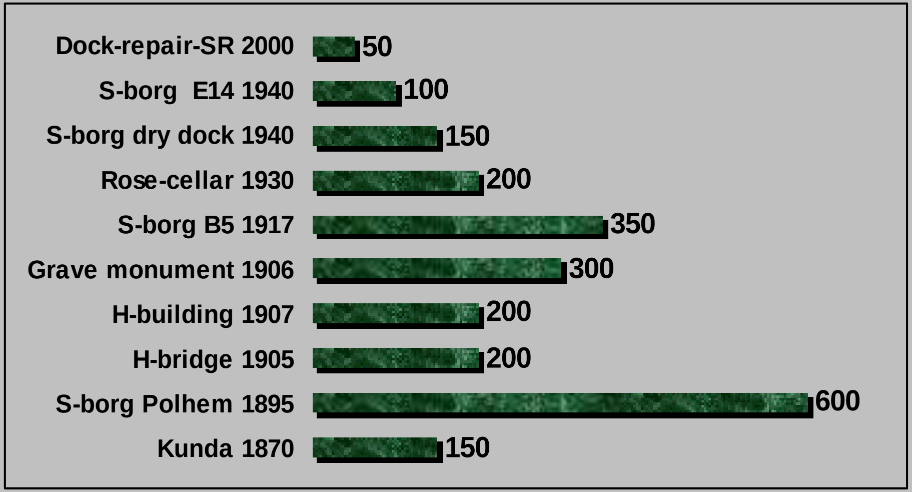


20x XPL with λ-plate



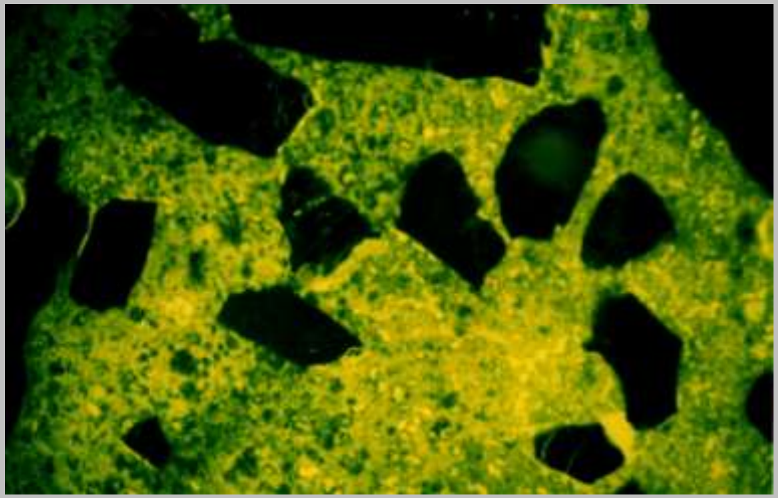
10x PPL



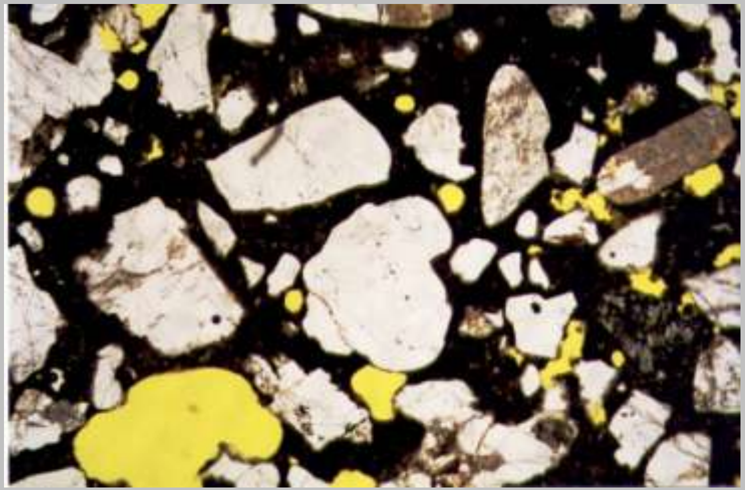


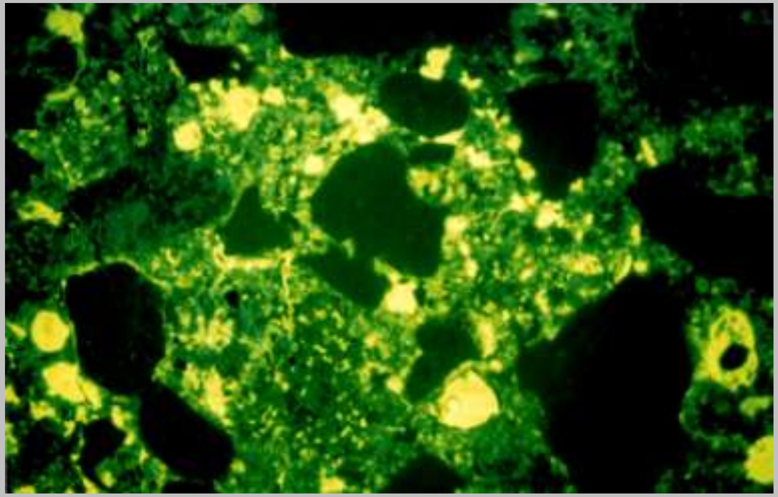
Porosity by microscope

H-building UV light 10x

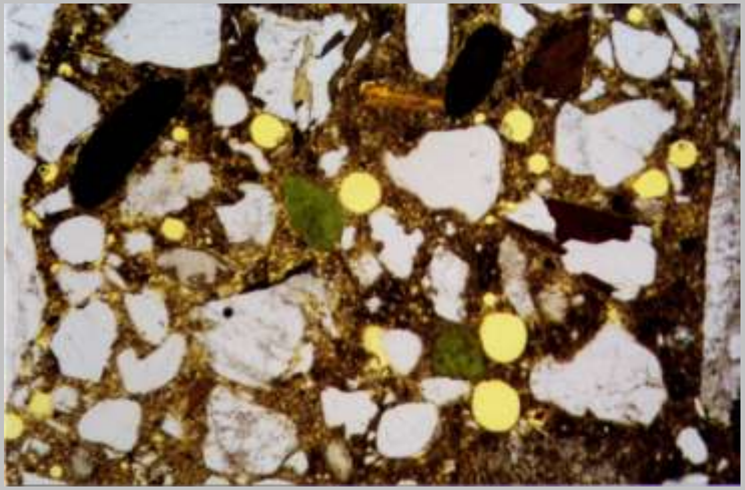


Rose-cellar 4x PPL



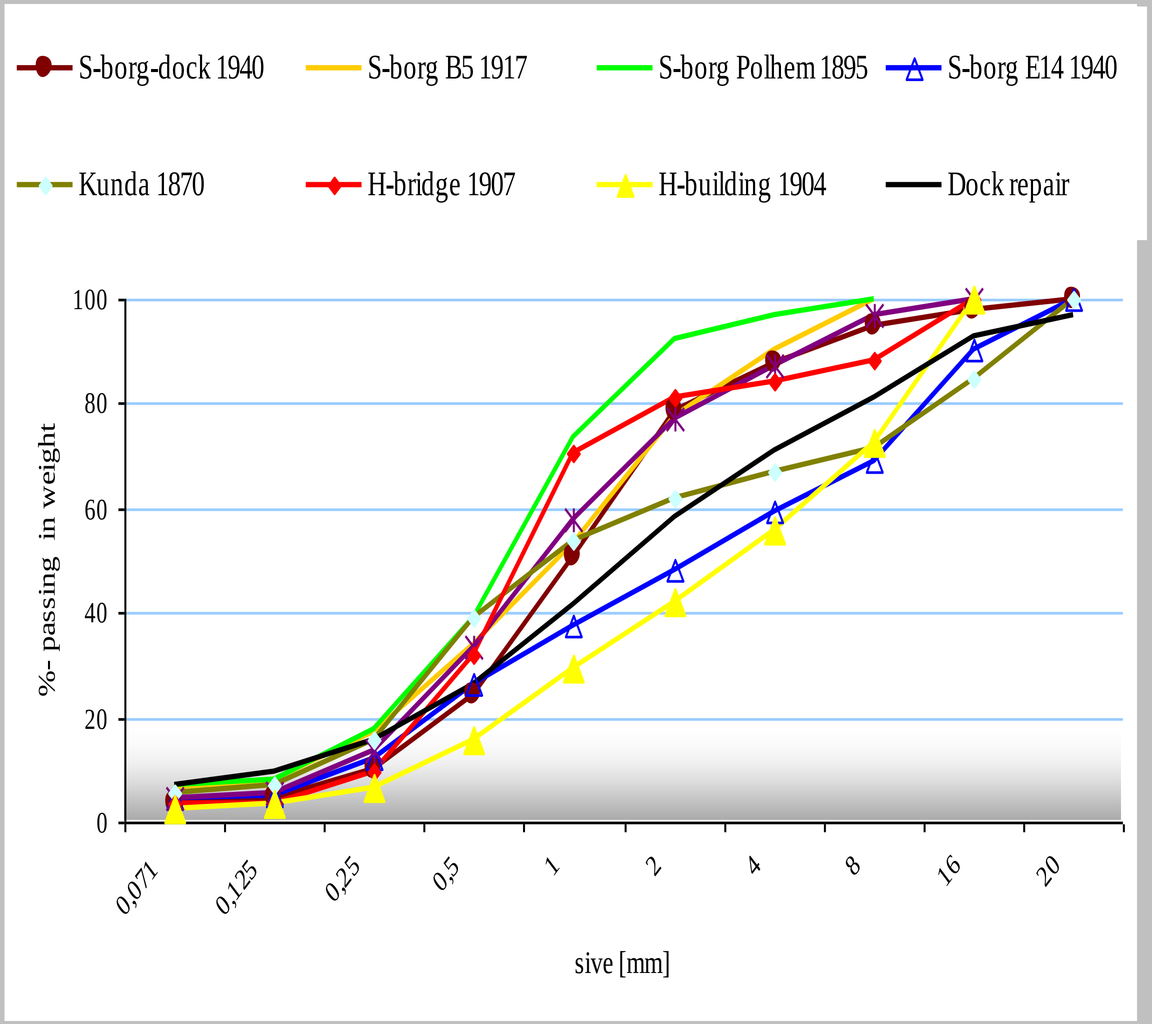


Polhem UV light 10x



Kunda 4x PPL

Grain size distribution of the aggregate

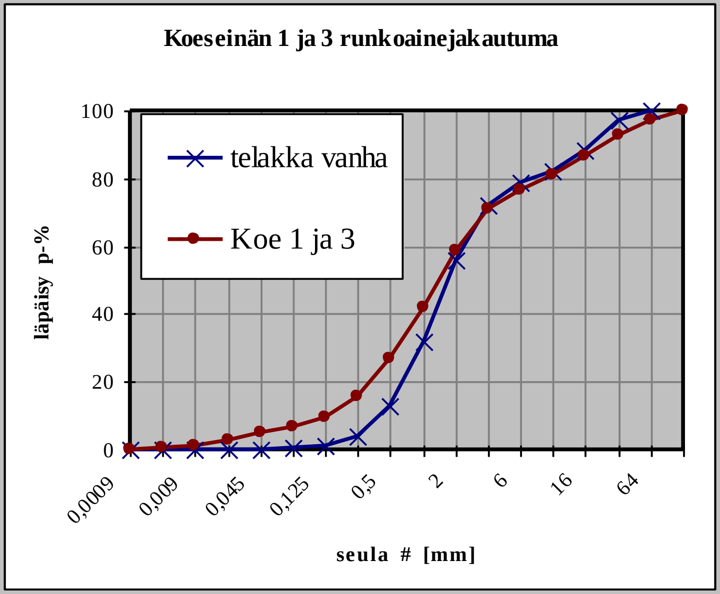


Tests in situ on the walls of the dry dock

Concrete mixtures with 450 kg cement / m^3

Special sand grading with quartsfiller

No chemical additives



Koeseinän 1 ja 3 runkoainejakautuma
telakka vanha
Koe 1 ja 3
läpäisy p-%
100
80
60
40
20
0
0,0009
0,009
0,045
0,125
0,5
2
6
16
64
seula # [mm]

Special “concrete” on top of the defence walls

Concrete layer
NHL 5 with special graded sand 0 – 6 mm incl. quarts powder
1 : 2 by volume
without artificial additives

12 month curing in 65% RH Density 1970 kg/m ³

Compressive strength 8,8 MPa Flexural strength 2,3 MPa