

Project	New Central Urban Waterfront and MEDIASPACE in Aarhus Design competition
Subject	Geotechnical note
Annex	11

In connection with the planning of building on Bastion Syd the Municipality of Aarhus has commissioned a geo-technical placing investigation. The investigation has been carried out by the company GEO and the results have been presented in:

Port of Aarhus (Århus Havn)
Building on the Royal Quay (Bebyggelse på Honnørkajen)
GEO project no. 28705. Report 3, 2006-11-22

This note contains a summary of the results of the geo-technical investigation, including guiding pile carrying capacity in the various landfill sites as well as geo-technical parameters.

The general conclusion is that the ground conditions are so unfavourable that for building, which does not permit subsidence, piling must be carried out. This will also apply to land which has been reclaimed.

The general layering is fill to level -3 m to -8.5 m. The fill mainly consists of sand to the east of the old pierre-perdue, see Figure 1, and of sand and clay to the west of the pierre-perdue. Below the fill there is a layer of very fat tertiary clay. The estimated level contours for the clay layer are given in Figure 2.

A view of the area and the building field as defined in the quality handbook are shown in Figure 1. The presentation of the building field is part of the architects' competition and the drafted area is only intended as a guide.

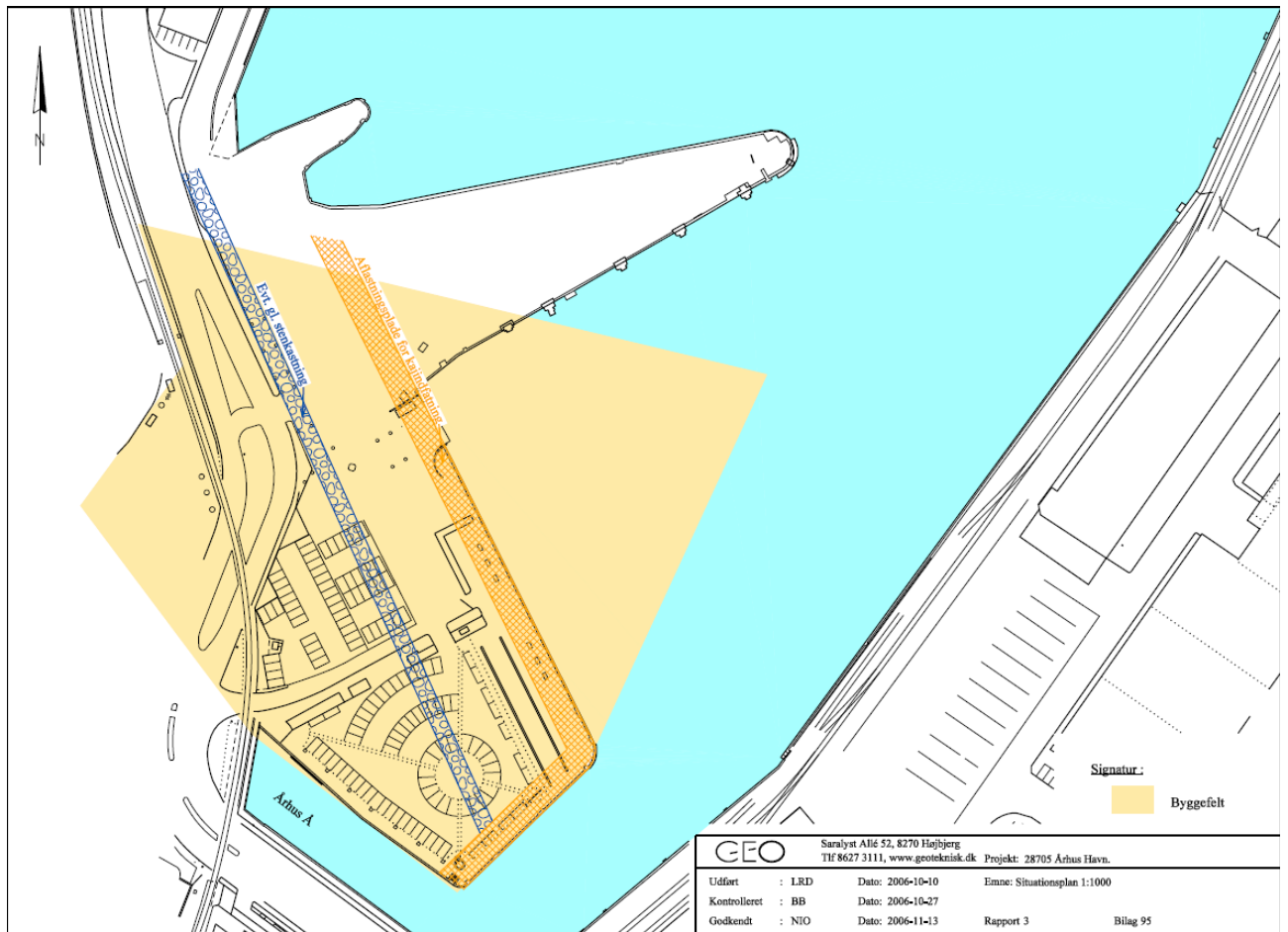


Figure 1: View of the Royal Quay. Source: GEO Århus Havn, Honnørkajen, project no. 28705 encl. 95

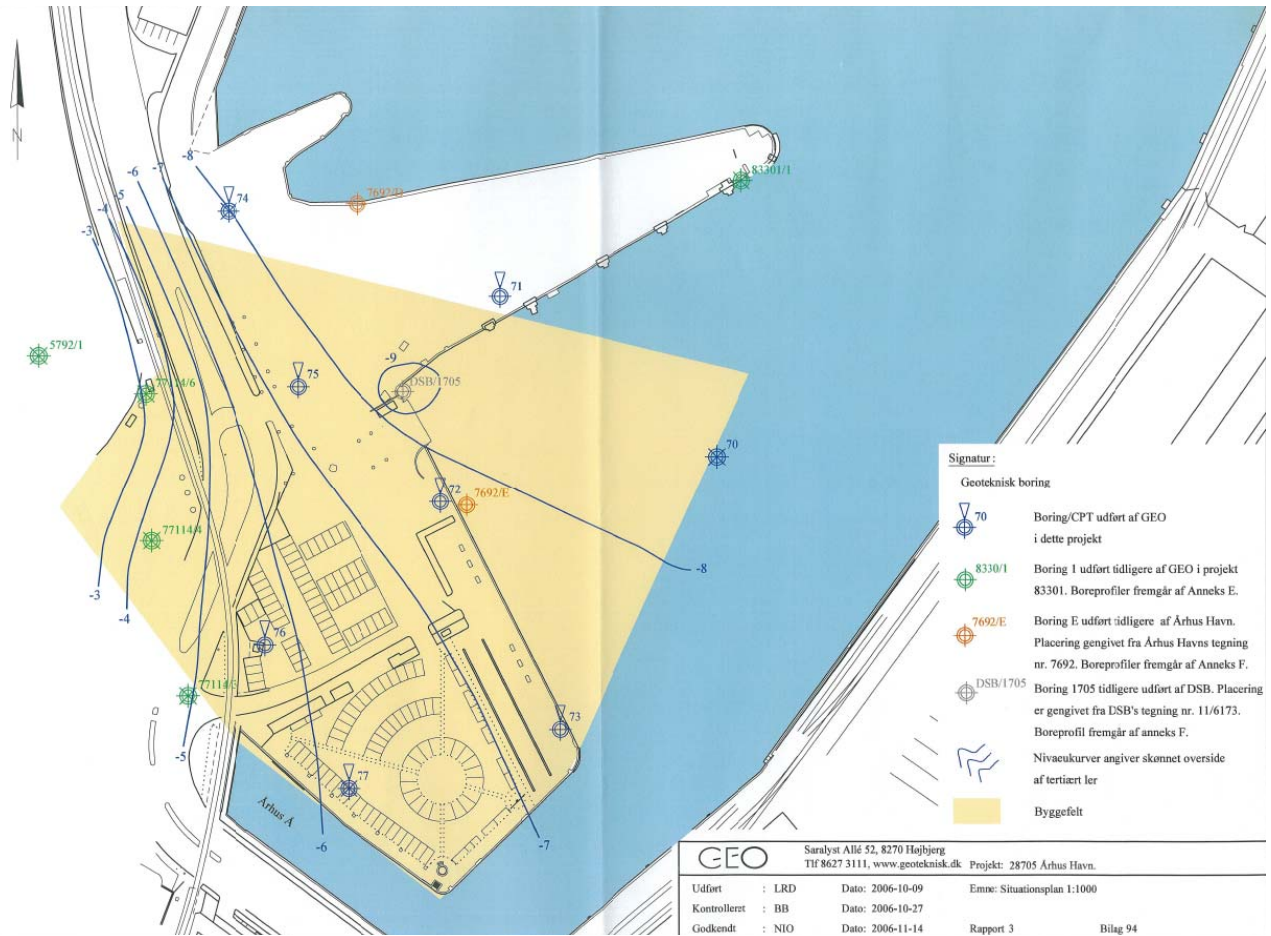


Figure 2: Estimated top of tertiary clay. Source: GEO Århus Havn, Hønnørkajen, project no. 28705 encl. 94

GEO has presented guiding pile carrying capacities in the prepared geo-technical report 28705, see Table 1 to Table 3. A detailed design must be carried out based on the actual project. Please note that the existence of very fat, tertiary clay requires that the piling project is treated as extended pile classification.

Table 1: Land area to the east of the pierre-perdue, cf. Figure 1. The piling depth is given in m below the top of the carrying tertiary clay layer, the levels of the clay layer are drafted in Figure 2.

Piling depth below top of tertiary clay layer	Calculated carrying capacity			
	No asphalt		Asphalt	
	25 x 25 cm pile	30 x 30 cm pile	25 x 25 cm pile	30 x 30 cm pile
8 m	190 kN	230 kN	390 kN	470 kN
9 m	260 kN	320 kN	440 kN	530 kN
10 m	400 kN	490 kN	540 kN	660 kN
11 m	550 kN	660 kN		770 kN
12 m		830 kN		900 kN

Table 2: Land reclamation area to the east. The piling depth is given in m below the top of the carrying tertiary clay layer, the levels of the clay layer are drafted in Figure 2

<i>Piling depth below top of tertiary clay layer</i>	<i>Calculated carrying capacity</i>	
	<i>Asphalt</i>	
	<i>25 x 25 cm pile</i>	<i>30 x 30 cm pile</i>
11 m	160 kN	200 kN
12 m	300 kN	370 kN
13 m	440 kN	540 kN
14 m		710 kN

Table 3: Area to the west of the pierre-perdue. The piling depth is given in m below the top of the carrying tertiary clay layer, the levels of the clay layer are drafted in Figure 2

<i>Piling depth below top of tertiary clay layer</i>	<i>Calculated carrying capacity</i>	
	<i>Asphalt</i>	
	<i>25 x 25 cm pile</i>	<i>30 x 30 cm pile</i>
7 m	310 kN	370 kN
8 m	380 kN	460 kN
9 m	440 kN	540 kN
10 m	540 kN	660 kN
11 m	640 kN	770 kN
12 m		900 kN

In GEO project No. 28705 are also mentioned guiding characteristic parameters of strength and density for usage in connection with earth pressure calculations.

Table 4: Parameters of strength and density

	$\bar{\epsilon}' / \bar{\epsilon}_{pl}$	c_u / c'	g / g'
<i>Mixed fill</i>	25 °	0 / 0 kN/m ²	18 / 10 kN/m ³
<i>Existing sand fill</i>	35 °	0 / 0 kN/m ²	18 / 10 kN/m ³
<i>Pumped sand fill</i>	35 °	0 / 0 kN/m ²	18 / 10 kN/m ³
<i>Very fat clay fill</i>	15 °	40 / 4 kN/m ²	18 / 8 kN/m ³
<i>Tertiary clay</i>	15 °	80 / 8 kN/m ²	18 / 8 kN/m ³
<i>Gyttja (active side)</i>	30 °	30 / 0 kN/m ²	14 / 4 kN/m ³
<i>Gyttja (passiv side)</i>	13 °	30 / 0 kN/m ²	14 / 4 kN/m ³

Normally, only c' is used for calculation of the passive earth pressure. During the detailed design it may be considered whether c' may be used for some calculations of the active side.