Experimental dataset of triaxial tests with cemented sand

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This extensive dataset contains the results of 175 triaxial tests on dense cemented sand samples with measurements of a height of 72 mm and a diameter of 36 mm.

- The sands used include Hamburg Sand (HH), known for its coarser grain size, and Cuxhaven Sand (CX), which has a finer grain size as also shown in Figure 2.
- The cement paste consists of Dyckerhoff MIKRODUR R-U Mikrozement and water.

The tests were conducted to analyze the mechanical properties of cemented Hamburg sand and cemented Cuxhaven sand under various conditions, specifically focusing on the effects of confining pressure and cementation degree, as shown in Table 1. The sample preparation involved layering and compacting the sand-cement-water mixture in Plexiglas molds, followed by a curing process with initial sealing and subsequent water immersion for 28 days.

Table 1: Overview of the triaxial tests carried out

Confining Pressure (kPa)	Cementation Degree S (%)																			
	0		20		30		40		50		60		70		80		90		100	
	HH	CX	HH	CX	HH	CX	HH	CX	HH	CX	HH	CX	HH	CX	HH	CX	HH	CX	HH	CX
0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
					3				3	3								3		
200	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3			3									3							3
400	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
														3		3			3	3
600	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
				3			3						3	3		3		3		3

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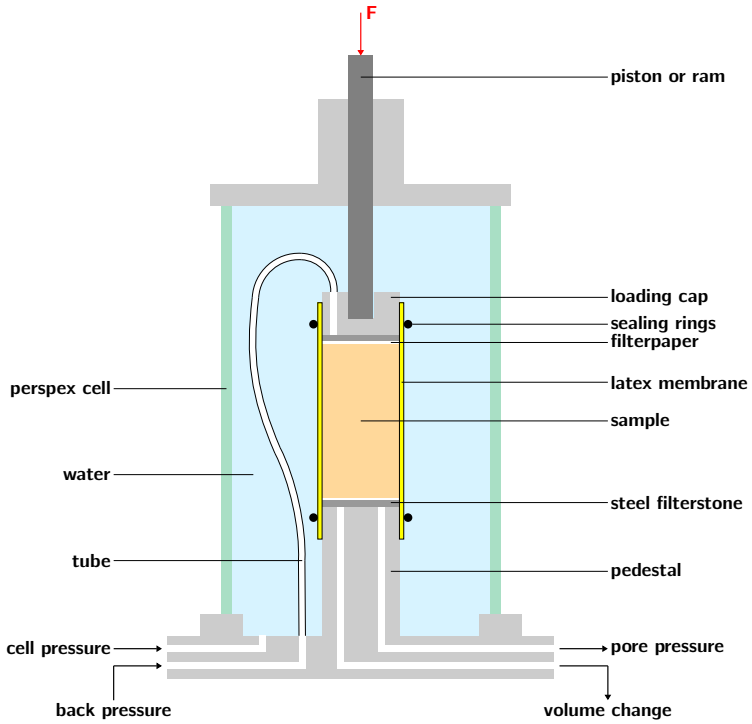
Data available at: https://doi.org/10.15480/882.14959

Experimental triaxial tests

After curing, the samples are ready to be installed in the triaxial cell (Figure 1a) and tested according to the procedure outlined in Figure 1b.



(a)

Basic Settings	Cell Pressure:	20	(kPa)
	Back Pressure:	2	(kPa)
Stage 1: Saturation	Cell Pressure:	410	(kPa)
	Back Pressure:	400	(kPa)
	Time to reach targe:	40	(min)
	Save Interval:	120	(s)
Stage 2: B-Test	Target Cell Pressure:	450	(kPa)
	under the condtion:	$B = \Delta u/\Delta\sigma_3 \lessapprox 1{,}0$	$(-)$
	Save Interval:	10	(s)
Stage 3: Consolidation	Cell Pressure:	410, 600, 800, 1000	(kPa)
	Back Pressure:	400	(kPa)
	Save Interval:	60	(s)
Stage 4: Shearing Consolidated Drained	Cell Pressure:	410, 600, 800, 1000	(kPa)
	Back Pressure:	400	(kPa)
	Loading Velocity:	0,01	$(^{mm}/_{min})$
	Save Interval:	120	(s)

(b)

Figure 1: Triaxial testing device setup and test phases: (**??**) Device setup, (**??**) Test phases.

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File Naming

The result file names are derived from the input parameters of the triaxial testing software, using specific formats tailored to each test variation.

Density	_	Sand Type	_	Cementation Degree	_	Confining Pressure	_	Number
dense		HH or CX		000 020 030 040 050 060 070 080 090 100		000 200 400 600		1 2 3

- **Density**

  refers to the relative density I_R of the sample, indicating how densely it is packed compared to its loosest and densest reference state, defined by e_{min} and e_{max}. This value can range from 0 % (loosest state) to 100 % (densest state). A density of 70 % is chosen for dense samples. This triaxial testing series focuses exclusively on dense samples with a cementation degree of 70 %.

- **Sand Type**

  specifies either Hamburg Sand, a coarser sand, or Cuxhaven Sand, a finer sand. Both grain size distributions are displayed in Figure 2.

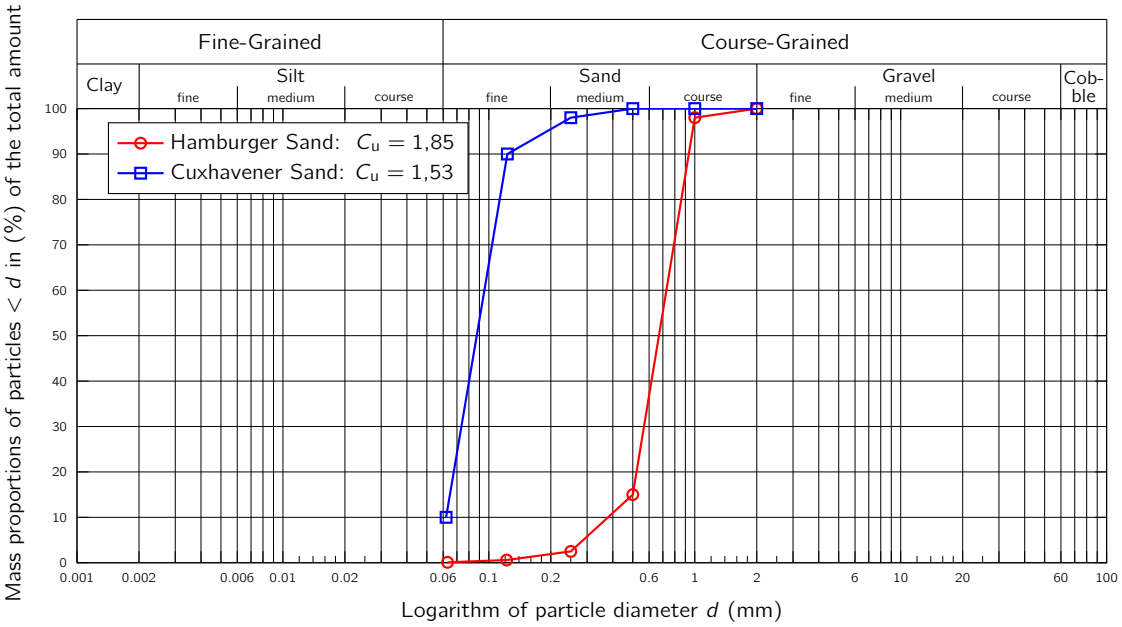

Figure 2: Grain Size Distributions of the Hamburg and Cuxhaven Sand

- **Cementation Degrees**

  Tested are 0 %, 20 %, 30 %, 40 %, 50 %, 60 %, 70 %, 80 %, 90 %, and 100 %. The cementation degree S represents the percentage of sand pores filled with cement paste. It is calculated as $S = \frac{V_g}{V_v} \cdot 100$, where V_g is the cement paste volume and V_v is the total pore volume. The sample preparation followed the methodology of Komodromos et al. (2023) [1].

- **Confining Pressures**

  Tested are 0 kPa (10 kPa), 200 kPa, 400 kPa, and 600 kPa.

- **Number**

  Represents the test number, ranging from 1 to 3.

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Content Structure of Result Files

Each result file contains several columns representing different outcomes of the simulations. The focus is on the following columns with their respective headers:

- Axial Displacement (mm):
  The axial displacement of the sample, measured in millimeters.
- Load Cell (kN):
  The load applied to the sample, measured in kilonewtons.
- Back Volume (mm^3):
  The volume change of the sample, measured in cubic millimeters.
- Back Pressure (kPa):
  The pressure of the sample, measured in kilopascals.
- Radial Pressure (kPa):
  The radial pressure applied to the sample, measured in kilopascals.
- Pore Pressure (kPa):
  The pressure within the pores of the sample, measured in kilopascals.

List of Files

The data set includes the following items:

- Triaxial test results of the dense cemented samples of the Hamburg Sand: 85 csv-files,
- Triaxial test results of the dense cemented samples of the Cuxhaven Sand: 90 csv-files.

References

[1] Michail Komodromos et al. “Investigation of the load sustaining micro mechanisms of cemented sand using the mesoscale FEM approach”. In: *Computers and Geotechnics* 162 (Oct. 2023), p. 105656. ISSN: 0266-352X. DOI: 10.1016/j.compgeo.2023.105656. URL: https://www.sciencedirect.com/science/article/pii/S0266352X23004135 (visited on July 17, 2024).

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