



AALBORG UNIVERSITY
DENMARK

Aalborg Universitet

Undrained Triaxial Tests on Eastern Scheldt Sand

Jakobsen, Kim Parsberg

Publication date:
1998

Document Version
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):
Jakobsen, K. P. (1998). Undrained Triaxial Tests on Eastern Scheldt Sand. Aalborg: Geotechnical Engineering Group. (AAU Geotechnical Engineering Papers : Laboratory Testing Paper ; No. 25, Vol. R9823).

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- ? Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- ? You may not further distribute the material or use it for any profit-making activity or commercial gain
- ? You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

Undrained Triaxial Tests on Eastern Scheldt Sand

K.P. Jakobsen

December 1998

Laboratory testing paper No 25



**GEOTECHNICAL ENGINEERING GROUP
AALBORG UNIVERSITY DENMARK**

Jakobsen, K.P. (1998). Undrained Triaxial Tests on Eastern Scheldt Sand

AAU Geotechnical Engineering Papers, ISSN 1398-6465 R9823.

Laboratory testing paper No 25

© 1998 AAU Geotechnical Engineering Group

Except for fair copying, no part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of the Geotechnical Engineering Group.

Papers or other contributions in AAU Geotechnical Engineering Papers and the statements made or opinions expressed therein are published on the understanding that the author of the contribution is solely responsible for the opinions expressed in it and that its publication does not necessarily imply that such statements or opinions are or reflect the views of the AAU Geotechnical Engineering Group.

Printed at: Schølin Grafisk

The AAU Geotechnical Engineering Papers – AGEP – are issued for early dissemination and book keeping of research results from the Geotechnical Engineering Group at Aalborg University (Department of Civil Engineering). Moreover, the papers accommodate proliferation and documentation of field and laboratory test series not directly suited for publication in journals or proceedings.

The papers are numbered ISSN 1398-6465 R<two digit year code><two digit consecutive number>. For internal purposes the papers are, further, submitted with coloured covers in the following series:

| Series | Colour |
|------------------------------------|--------|
| — Laboratory testing papers | sand |
| — Field testing papers | grey |
| — Manuals & guides | red |
| — Soil Mechanics papers | blue |
| — Foundation Engineering papers | green |
| — Engineering Geology papers | yellow |
| — Environmental Engineering papers | brown |

In general the AGEP papers are submitted to journals, conferences or scientific meetings and hence, whenever possible, reference should be given to the final publication (journal, proceeding etc) and not to the AGEP paper.

Undrained Triaxial Tests on Eastern Scheldt Sand

Kim Parsberg Jakobsen

Aalborg University, Aalborg, Denmark

1 INTRODUCTION

In the process of understanding and developing models for geomaterials, the stress-strain behaviour is commonly studied by performing triaxial tests. In the present study, several types of static triaxial tests have been performed to gain knowledge of the undrained stress-strain behaviour of frictional materials during monotonic loading. The tests conducted includes undrained and constant volume tests, starting from different initial states of stress and following various stress paths.

All the tests are performed on reconstituted loose to medium dense specimens of Eastern Scheldt Sand. Soil properties and test procedures are described in the succeeding sections, ending with a summary of the performed triaxial tests.

For information about the hydraulic properties, drained and cyclic loading response of Eastern Scheldt Sand please refer to Jakobsen (1998a), Jakobsen and Praastrup (1998) and Jakobsen (1998b), respectively.

2 EASTERN SCHELDT SAND

Eastern Scheldt Sand is a fine, well-sorted line shore quartz sand, with sub-rounded to rounded grains. The classification properties

are summarised in Table 1. For further information about grain size distributions refer to Jakobsen (1998a).

Table 1. Classification properties for Eastern Scheldt Sand.

| Property | Value |
|--|----------|
| Specific gravity, G_s | 2.650 |
| Maximum void ratio, e_{max} | 0.886 |
| Minimum void ratio, e_{min} | 0.591 |
| Maximum grain size, d_{100} | 0.500 mm |
| Mean grain size, d_{50} | 0.166 mm |
| Fines content | 1.3 % |
| Uniformity coefficient, $C_U = \frac{d_{60}}{d_{10}}$ | 1.52 |
| Curvature coefficient, $C = \frac{d_{30}^2}{d_{10}d_{60}}$ | 0.99 |

3 EQUIPMENT FOR STATIC TRIAXIAL TESTING

During the triaxial test axial load and deformation, volume changes as well as pore and cell pressures are electronically measured and transmitted to the computer for data processing and actuation of cell pressure or axial load adjustments, allowing any stress path to be followed. The triaxial tests can be conducted with

or without backpressure. Further information about the used equipment and its capabilities are found in Jakobsen and Praastrup (1998).

In order to avoid measuring errors due to false deformations of the apparatus, all measurements are performed as close to the specimen as possible. Thus, displacement transducers are mounted on the top and bottom pressure heads, the axial load is measured inside the cell and the pore pressure is measured in the bottom pressure head beneath the porous filter.

The traditional undrained (CU) or constant volume ($CU_{v=0}$) tests are performed by use of two different concepts. In the traditional undrained test, backpressure is applied to ensure a high degree of saturation before the drainage lines are closed (see Section 4.1). The backpressure is crucial for the undrained test as the inherent constant volume only exists for completely saturated soils. The constant volume condition might nevertheless be violated as the soil tends to dilate during shear, resulting in decreasing pore pressure and unintended release of dissolved gases.

Alternatively the volume of the specimen can be held constant by adjusting the cell pressure to ensure that no water enters or leaves the specimen. This procedure ($CU_{v=0}$) is performed with zero pore pressure change, preventing any change in the degree of saturation.

Besides the difference in testing techniques there is a distinct difference in the way the measured data are analysed. In the CU-test the effective stress path is deduced from the knowledge of cell pressure and developed pore pressure during shear. In the $CU_{v=0}$ -test the effective stress path is followed throughout the test and the pore pressure response equals the change in confining pressure.

4 SPECIMEN PREPARATION

As described in the companion report, Jakobsen and Praastrup (1998), it is of great importance to ensure a homogenous stress and strain state inside the specimen. Consequently,

the major parts of the tests are performed on 70×70 mm specimens using lubricated end plates (Jakobsen, 1970; Rowe and Barden, 1964; Kirkpatrick, 1974). The effect of inhomogenous stress and strain states on the undrained soil response is revealed by execution of a few tests on 140×70 mm specimens.

All the specimens are prepared by air pluviation in a split mould. In cases where the objective is to investigate the effect of pressure and stress path dependency the specimens are prepared with a tolerance on the initial void ratio of ± 0.001 .

4.1 Specimen Saturation

Specimen saturation plays an important role in the study of the undrained behaviour of geomaterials. To obtain reliable measurements of development of pore pressure during testing, a high degree of saturation is necessary. The development of pore pressure during an undrained triaxial test, simulating the condition of no volume change, depends on the resistance by the pore fluids to the tendency for volume change of the soil skeleton. The effect of insufficient saturation is most pronounced in this type of test, as the compressibility of the pore fluid is dominated by the free air. Thus, the free air will cause a violation of the no volume change condition and affect the magnitude of pore pressure developed. The specimen saturation is performed in one of two ways, depending on the type of test. For $CU_{v=0}$ -tests the water percolation procedure is used for specimen saturation (please refer to Jakobsen and Praastrup (1998)), whereas specimens for CU-tests are saturated using backpressure.

4.1.1 Saturation using backpressure

Traditional undrained tests (CU) are performed with backpressure. The specimen is first flushed with carbon dioxide (CO_2) through the bottom drain replacing the lighter air. Deaired and deionized water is then introduced through the bottom drain and as the water seeps up through the specimen the carbon dioxide is partly pushed out and partly dissolved into the

water. A positive effective confining pressure of 20 kPa is maintained throughout the saturation process. The backpressure is finally applied to force the carbon dioxide and eventual free air to dissolve completely into the water. The degree of saturation is afterwards checked by measuring the pore pressure coefficient, B , expressing the ratio between the resulting change in pore pressure and the imposed change in the cell pressure (Skempton, 1954). The pore pressure coefficient is strongly dependent on the degree of saturation and whereas a value of unity typically is interpreted as complete saturation, lower values may be indicative of incomplete saturation. Factors like the compressibility and porosity of the soil skeleton and membrane penetration may, however, affect the measured value in both downward and upward directions (Kiebusch and Schuppener, 1977; Martin et al. 1978).

5 PERFORMED TRIAXIAL TESTS

After saturation the specimen is isotropically consolidated at a maximum loading rate of 5-10 kPa per minute, and afterwards sheared at a maximum axial strain rate of 3 % per hour.

The test conditions for the performed $CU_{v=0}$ and CU triaxial tests are summarised in Tables 2 and 3, respectively.

6 PRESENTATION OF TEST RESULTS

The analysis of the test results is briefly discussed and parameters used for description of characteristic stress and strain states are defined in the following.

During the triaxial test simultaneous values of axial displacement, volume change, confining pressure, pore pressure and axial load are measured by the principles outlined in Section

Table 2. Initial conditions for constant volume triaxial tests ($CU_{v=0}$).

| Test No. | e_0 [-] | p'_0 [kPa] | Total stress path | Note |
|----------|--------------|-----------------|-------------------------|---|
| 9710.09 | 0.671 | 80.0 | $\Delta q/\Delta p = 3$ | |
| 9710.10 | 0.670 | 640.0 | $\Delta q/\Delta p = 3$ | |
| 9710.11 | 0.671 | 40.0 | $\Delta q/\Delta p = 3$ | |
| 9710.19 | 0.673 | 320.0 | $\Delta q/\Delta p = 3$ | |
| 9710.20 | 0.671 | 160.0 | $\Delta q/\Delta p = 3$ | |
| 9710.31 | 0.672 | 160.0 | $\Delta q/\Delta p = 3$ | |
| 9710.39 | 0.673 | 160.0 | $\Delta q/\Delta p = 3$ | |
| 9710.40 | 0.825 | 160.0 | $\Delta q/\Delta p = 3$ | |
| 9710.41 | 0.824 | 320.0 | $\Delta q/\Delta p = 3$ | |
| 9710.42 | 0.825 | 640.0 | $\Delta q/\Delta p = 3$ | |
| 9710.43 | 0.825 | 960.0 | $\Delta q/\Delta p = 3$ | |
| 9710.44 | 0.825 | 960.0 | $\Delta q/\Delta p = 3$ | Control system temporarily out of order |
| 9710.45 | 0.726 | 640.0 | $\Delta q/\Delta p = 3$ | |
| 9710.46 | 0.881 | 640.0 | $\Delta q/\Delta p = 3$ | |
| 9710.47 | 0.770 | 640.0 | $\Delta q/\Delta p = 3$ | |
| 9710.48 | 0.825 | 640.0 | $\Delta q/\Delta p = 3$ | Height to diameter ratio equal to 2 |
| 9710.49 | 0.826 | 960.0 | $\Delta q/\Delta p = 3$ | Height to diameter ratio equal to 2 |

Table 3. Initial conditions for undrained triaxial tests (CU).

| Test No. | ϵ_u [-] | p'_0 [kPa] | Total stress path | Note |
|----------|---------------------|-----------------|----------------------------|----------------------------------|
| 9710.26 | 0.671 | 271.8 | $\Delta p = 0$ | Drainage valve opened at $u = 0$ |
| 9710.27 | 0.669 | 494.2 | $\Delta q/\Delta p = -1.5$ | |
| 9710.28 | 0.670 | 104.3 | $\Delta q/\Delta p = 2$ | Drainage valve opened at $u = 0$ |
| 9710.29 | 0.633 | 104.3 | $\Delta q/\Delta p = 2$ | Wrong void ratio |

3. As both the measured loads and displacements coincide with the principal axes of stresses and strains the analysis is straight forward. The exact displacement field is established from the measured axial displacements and the volumetric change. From these quantities the radial displacement is determined by the relation:

$$u_2 = \frac{D_0}{2} - \sqrt{\frac{V_0 - \Delta V}{\pi(H_0 - u_1)}} \quad (1)$$

u_1 being the average value of the measured axial displacements and $V_0 - \Delta V$ the current volume of the specimen. The relative deformation can afterwards be expressed by any suitable strain measure. In geotechnical engineering or geomechanics it is common practice to use the simple and linear engineering strain measure. This measure is, however found to be inconsistent with the used measuring techniques and may lead to erroneous results (Praagstrup et al. 1998). It is therefore chosen to use the non-linear natural strain measure instead:

$$\epsilon_1 = \ln\left(\frac{H_0}{H_0 - u_1}\right) \quad (2)$$

$$\epsilon_2 = \epsilon_3 = \ln\left(\frac{D_0}{D_0 - 2u_2}\right) \quad (3)$$

$$\epsilon_v = \epsilon_1 + 2\epsilon_3 = \ln\left(\frac{V_0}{V_0 - \Delta V}\right) \quad (4)$$

The stresses are given as true stresses, expressing the ratio between current load and current area. The cross sectional area of the specimen is continuously corrected by:

$$A = \frac{\pi}{4}(D_0 - 2u_2)^2 = \frac{V_0 - \Delta V}{H_0 - u_1} \quad (5)$$

The test results are presented in terms of the deviatoric stress q and mean normal stress p' :

$$p' = \frac{1}{3}(\sigma'_1 + 2\sigma'_3) = \frac{1}{3}((\sigma_1 - u) + 2(\sigma_3 - u)) \quad (6)$$

$$q = (\sigma'_1 - \sigma'_3) = (\sigma_1 - \sigma_3) \quad (7)$$

in which primes denote effective stresses. The corresponding work conjugate strains are the volumetric strain ϵ_v and the shear strain ϵ_q :

$$\epsilon_v = \epsilon_1 + 2\epsilon_3 \quad (8)$$

$$\epsilon_q = \frac{2}{3}(\epsilon_1 - \epsilon_3) \quad (9)$$

In addition to the presentation in terms of stresses and strains the stress states corresponding to minimum mean stress and maximum pore pressure, are also given in terms of angles. The angles are determined from the linear Coulomb friction hypothesis:

$$q = \frac{6 \sin \varphi'}{3 - \sin \varphi'} p' \quad (10)$$

7 SUMMARY OF TEST RESULTS

Results of isotropic and anisotropic steps are summarised in Tables 4 and 5. Mean stress, axial and volumetric strain and void ratio are given for the isotropic compression step. For the undrained and constant volume steps the stress and strain states corresponding to the state of minimum mean stress and maximum pore pressure are given.

The graphical representation of the tests is found in Enclosure 1 to 21. Each enclosure consists of 4 to 5 pages, depending on the number of load steps. The first one or two pages contain information about test conditions, test program and a brief summary of the observed soil behaviour, i.e. minimum mean stress, maximum pore pressure and elastic properties if unloading have been performed. The final three pages contain the graphical presentation divided in total stress and strain paths and stress and strain paths for isotropic and anisotropic loading, respectively.

8 REFERENCES

- Jacobsen, M. (1970). New Oedometer and New Triaxial Apparatus for Firm Soil. *Danish Geotechnical Institute Bulletin No. 27*.
- Jacobsen, K.P. (1998a). Permeability Tests on Eastern Scheldt Sand. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9821.
- Jacobsen, K.P. (1998b). Cyclic Triaxial Tests on Eastern Scheldt Sand. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9824.
- Jacobsen, K.P., Praastrup, U. (1998). Drained Triaxial tests on Eastern Scheldt Sand. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9822.
- Kieckbusch, M., Schuppener, B. (1977). Membrane Penetration and its Effect on Pore Pressures. *Journal of the Geotechnical Engineering Division*, ASCE, Vol. 103, No. GT11, November, pp. 1267-1279.

- Kirkpatrick, W.M., Seals, R.K., Newman, F.B. (1974). Stress Distributions in Triaxial Compression Samples. *Journal of the Geotechnical Engineering Division*, ASCE, Vol. 100, No. GT2, February, pp. 190-196.
- Martin, G.R., Finn, W.D.L., Seed, H.B. (1978). Effects of System Compliance on Liquefaction Tests. *Journal of the Geotechnical Engineering Division*, ASCE, Vol. 104, No. GT4, April, pp. 463-479.
- Praagstrup, U., Jacobsen, K.P., Ibsen L.B. (1998). On the Choice of Strain Measures in Geomechanics. *12th. Young Geotechnical Engineers Conference*, Tallinn, Estonia.
- Rowe, P.W., Barden, L. (1964). Importance of Free Ends in Triaxial Testing. *Journal of the Soil Mechanics and Foundations Division*, ASCE, Vol. 90, No. SM1, January, pp. 1-27.
- Skempton, A.W. (1954). The Pore Pressure Coefficients A and B. *Géotechnique*, Vol. 4, January, pp. 143-147.

Table 4. Results from $CU_{u=0}$ tests on Eastern Scheldt Sand.

| Test No. | Total stress path | Isotropic compression | | | | Constant volume compression | | | | | | | | | | | |
|----------|-------------------------|-----------------------|---------------------|---------------------|------------|-----------------------------|--------------|---------------|--------------|---------------------|-------------------|-----------------------|--------------|---------------|--------------|---------------------|-------------------|
| | | p' [kPa] | ϵ_1 [%] | ϵ_v [%] | e [-] | Minimum mean stress | | | | | | Maximum pore pressure | | | | | |
| | | | | | | σ'_3 [kPa] | u [kPa] | p' [kPa] | q [kPa] | ϵ_1 [%] | φ' [°] | σ'_3 [kPa] | u [kPa] | p' [kPa] | q [kPa] | ϵ_1 [%] | φ' [°] |
| 9710.11 | $\Delta q/\Delta p = 3$ | 40.4 | 0.02 | 0.10 | 0.669 | 22.6 | 17.5 | 34.8 | 36.9 | 0.13 | 26.7 | 21.4 | 18.6 | 37.8 | 49.0 | 0.25 | 32.2 |
| 9710.09 | $\Delta q/\Delta p = 3$ | 80.5 | 0.10 | 0.25 | 0.667 | 43.0 | 37.1 | 67.0 | 72.1 | 0.28 | 27.1 | 40.7 | 39.4 | 70.7 | 90.2 | 0.42 | 31.7 |
| 9710.20 | $\Delta q/\Delta p = 3$ | 160.5 | 0.18 | 0.57 | 0.661 | 88.5 | 71.7 | 133.7 | 135.6 | 0.41 | 25.7 | 84.8 | 75.3 | 138.4 | 160.8 | 0.54 | 29.1 |
| 9710.31 | $\Delta q/\Delta p = 3$ | 160.5 | 0.15 | 0.48 | 0.664 | 86.9 | 73.2 | 130.0 | 129.3 | 0.44 | 25.2 | 84.5 | 75.6 | 134.0 | 148.6 | 0.59 | 27.9 |
| 9710.39 | $\Delta q/\Delta p = 3$ | 160.5 | 0.13 | 0.44 | 0.666 | 89.8 | 69.3 | 134.9 | 135.1 | 0.58 | 25.4 | 86.3 | 72.8 | 139.5 | 159.5 | 0.75 | 28.7 |
| 9710.19 | $\Delta q/\Delta p = 3$ | 320.4 | 0.24 | 0.84 | 0.659 | 173.3 | 146.6 | 263.9 | 271.8 | 0.53 | 26.1 | 163.8 | 156.1 | 272.2 | 324.9 | 0.74 | 29.9 |
| 9710.10 | $\Delta q/\Delta p = 3$ | 640.1 | 0.43 | 1.26 | 0.649 | 300.1 | 339.9 | 470.6 | 511.6 | 1.10 | 27.4 | 288.9 | 351.1 | 480.9 | 575.9 | 1.33 | 30.0 |
| 9710.40 | $\Delta q/\Delta p = 3$ | 160.5 | 0.24 | 0.56 | 0.815 | 54.0 | 106.0 | 83.6 | 88.8 | 1.13 | 26.8 | 53.4 | 106.6 | 85.5 | 96.4 | 1.41 | 28.3 |
| 9710.41 | $\Delta q/\Delta p = 3$ | 320.5 | 0.39 | 1.23 | 0.802 | 103.0 | 217.1 | 163.9 | 182.7 | 1.99 | 28.0 | 102.0 | 218.1 | 164.5 | 187.4 | 2.17 | 28.6 |
| 9710.42 | $\Delta q/\Delta p = 3$ | 640.7 | 0.60 | 1.70 | 0.794 | 204.8 | 435.4 | 323.4 | 355.7 | 3.01 | 27.7 | 202.8 | 437.4 | 328.3 | 376.6 | 3.53 | 28.8 |
| 9710.43 | $\Delta q/\Delta p = 3$ | 960.4 | 0.40 | 2.09 | 0.787 | | | | | | | 273.1 | 686.9 | 449.1 | 528.2 | 3.92 | 29.5 |
| 9710.44 | $\Delta q/\Delta p = 3$ | 960.4 | 0.59 | 2.02 | 0.788 | 263.3 | 696.7 | 426.4 | 489.3 | 3.50 | 28.8 | 260.8 | 699.2 | 429.3 | 505.5 | 3.94 | 29.5 |
| 9710.45 | $\Delta q/\Delta p = 3$ | 640.3 | 0.51 | 1.32 | 0.703 | 274.1 | 365.9 | 429.3 | 465.7 | 1.93 | 27.3 | 268.5 | 371.4 | 432.7 | 492.6 | 2.22 | 28.6 |
| 9710.46 | $\Delta q/\Delta p = 3$ | 640.5 | 0.73 | 1.86 | 0.846 | 188.8 | 451.1 | 292.5 | 311.0 | 2.91 | 26.9 | 185.6 | 454.3 | 293.9 | 325.1 | 3.41 | 27.8 |
| 9710.47 | $\Delta q/\Delta p = 3$ | 640.5 | 0.47 | 1.52 | 0.744 | 227.8 | 411.1 | 362.3 | 403.7 | 2.29 | 28.0 | 223.9 | 414.9 | 366.0 | 426.3 | 2.65 | 29.2 |
| 9710.48 | $\Delta q/\Delta p = 3$ | 640.5 | 0.47 | 1.76 | 0.793 | 158.0 | 482.0 | 258.2 | 300.6 | 2.82 | 29.2 | 157.2 | 482.8 | 259.7 | 307.5 | 3.09 | 29.6 |
| 9710.49 | $\Delta q/\Delta p = 3$ | 960.3 | 0.68 | 2.36 | 0.783 | 190.5 | 769.4 | 317.6 | 381.4 | 3.74 | 30.0 | 189.2 | 770.7 | 318.6 | 388.3 | 4.11 | 30.4 |

Table 5. Results from CU tests on Eastern Scheldt Sand.

| Test No. | Total stress path | Isotropic compression | | | | | Undrained compression | | | | | | | | | | |
|----------|----------------------------|-----------------------|------------------|------------------|---------|-------------------|-----------------------|--------------|-----------|------------------|-------------|-------------------|-----------|--------------|-----------|------------------|-------------|
| | | p'_i [kPa] | ϵ_1 [%] | ϵ_v [%] | e [-] | σ'_3 [kPa] | u [kPa] | p'_i [kPa] | q [kPa] | ϵ_1 [%] | ϕ' [°] | σ'_3 [kPa] | u [kPa] | p'_i [kPa] | q [kPa] | ϵ_1 [%] | ϕ' [°] |
| 9710.26 | $\Delta p = 0$ | 272.1 | 0.23 | 0.36 | 0.666 | 147.2 | 55.1 | 216.7 | 208.5 | 0.67 | 24.5 | 147.2 | 55.1 | 216.2 | 208.5 | 0.67 | 24.5 |
| 9710.27 | $\Delta q/\Delta p = -1.5$ | 494.7 | 0.47 | 0.58 | 0.659 | 231.7 | -105.7 | 353.9 | 366.6 | 1.11 | 26.2 | 52.9 | 72.9 | 96.3 | 130.1 | 0.67 | 33.5 |
| 9710.28 | $\Delta q/\Delta p = 2$ | 104.8 | 0.13 | 0.18 | 0.667 | 53.5 | 66.3 | 84.7 | 93.6 | 0.37 | 27.8 | 59.1 | 67.2 | 103.7 | 133.7 | 0.67 | 32.0 |
| 9710.29 | $\Delta q/\Delta p = 2$ | 104.7 | 0.13 | 0.17 | 0.630 | 58.6 | 60.2 | 87.8 | 87.7 | 0.35 | 25.4 | 59.1 | 67.2 | 103.7 | 133.7 | 0.67 | 32.0 |

9 NOTATION

- A [mm²] : area of specimen
 B [-] : Skempton's pore pressure parameter
 C [-] : curvature coefficient
 C_u [-] : uniformity coefficient
 d [mm] : grain size
 D_0 [mm] : initial diameter of specimen
 e [-] : void ratio
 e_0 [-] : initial void ratio
 e_{max} [-] : maximum void ratio
 e_{min} [-] : minimum void ratio
 E [kPa] : Young's modulus
 G_s [-] : specific gravity
 G [kPa] : shear modulus
 H_0 [mm] : initial height of specimen
 p'_i [kPa] : mean normal stress (effective)
 p'_0 [kPa] : initial mean normal stress (effective)
 q [kPa] : deviator stress
 u [kPa] : pore pressure
 u_i [mm] : principal displacements, $i=1..3$
 V_0 [mm³] : initial volume
 ϵ_q [%] : triaxial shear strain
 ϵ_v [%] : triaxial volumetric strain
 ϵ_i [%] : principal strains, $i=1..3$
 σ'_3 [kPa] : confining pressure (effective)
 σ'_i [kPa] : principal stresses (effective), $i=1..3$
 ϕ' [°] : effective friction angle

Enclosures

| | | |
|--------------|-----------------------|---------|
| Enclosure 1 | Triaxial Test 9710.09 | 4 pages |
| Enclosure 2 | Triaxial Test 9710.10 | 4 pages |
| Enclosure 3 | Triaxial Test 9710.11 | 4 pages |
| Enclosure 4 | Triaxial Test 9710.19 | 4 pages |
| Enclosure 5 | Triaxial Test 9710.20 | 4 pages |
| Enclosure 6 | Triaxial Test 9710.26 | 5 pages |
| Enclosure 7 | Triaxial Test 9710.27 | 4 pages |
| Enclosure 8 | Triaxial Test 9710.28 | 5 pages |
| Enclosure 9 | Triaxial Test 9710.29 | 4 pages |
| Enclosure 10 | Triaxial Test 9710.31 | 4 pages |
| Enclosure 11 | Triaxial Test 9710.39 | 4 pages |
| Enclosure 12 | Triaxial Test 9710.40 | 4 pages |
| Enclosure 13 | Triaxial Test 9710.41 | 4 pages |
| Enclosure 14 | Triaxial Test 9710.42 | 4 pages |
| Enclosure 15 | Triaxial Test 9710.43 | 4 pages |
| Enclosure 16 | Triaxial Test 9710.44 | 4 pages |
| Enclosure 17 | Triaxial Test 9710.45 | 4 pages |
| Enclosure 18 | Triaxial Test 9710.46 | 4 pages |
| Enclosure 19 | Triaxial Test 9710.47 | 4 pages |
| Enclosure 20 | Triaxial Test 9710.48 | 4 pages |
| Enclosure 21 | Triaxial Test 9710.49 | 4 pages |

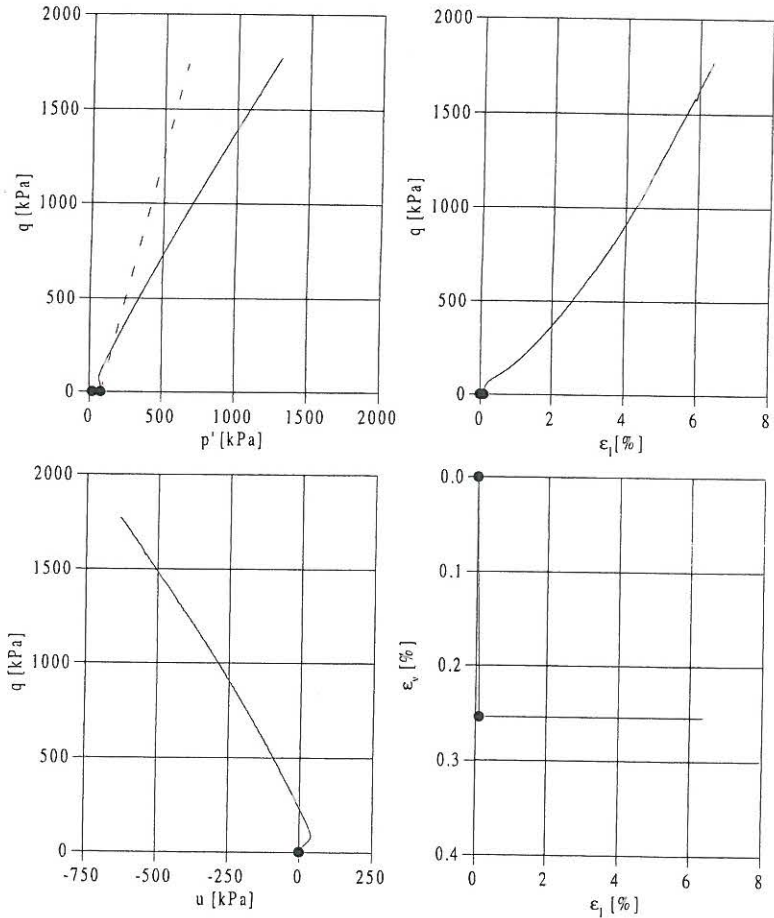
| | | | |
|---|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Air pluviation | Calibration file Cal97101.dat | Height | 71.48 mm |
| Saturation procedure Water percolation | Date 1998-02-02 | Diameter | 69.68 mm |
| | | Void ratio | 0.671 |

| | | | |
|--------------|--|-------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 80.0 | kPa |
| | Loading rate: | 2.5 | kPa/min |
| | Undrained compression Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 80.1 | kPa |
| Axial strain | ϵ_1 | 0.10 | % |
| Volumetric strain | ϵ_v | 0.25 | % |
| Void ratio | e | 0.667 | |

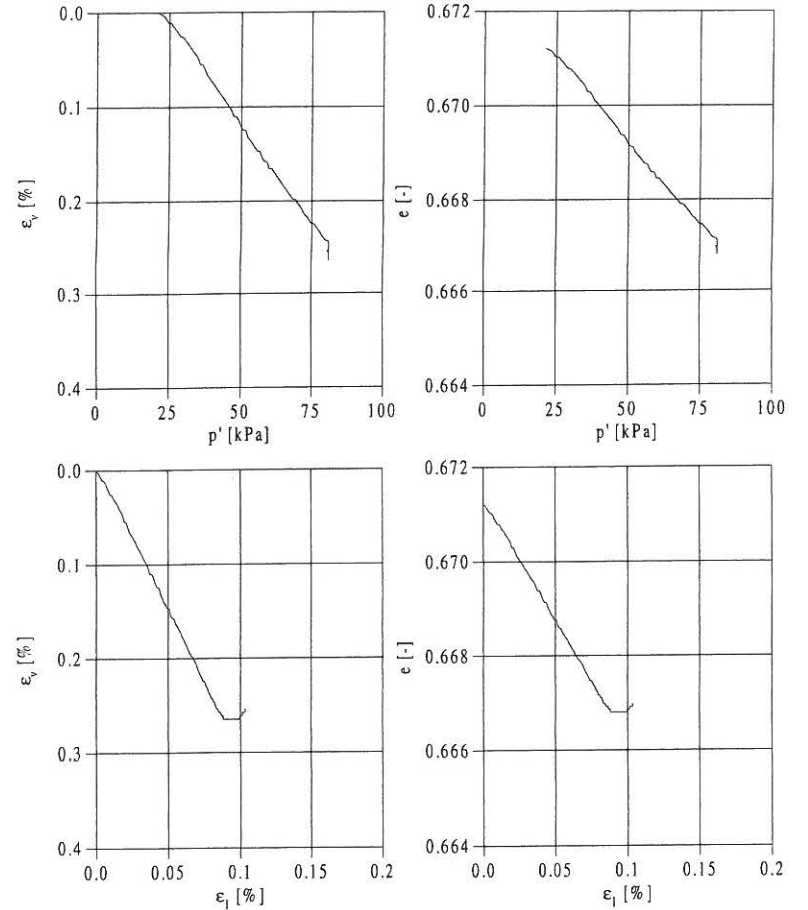
| | | | | | |
|-----------------------|-----------------------|----------------------|-----|---------------------|-----|
| Undrained compression | | Values at p'_{min} | | Values at u_{max} | |
| Stress ratio | σ'_1/σ'_3 | 2.68 | | 3.22 | |
| Confining pressure | σ'_3 | 43.0 | kPa | 40.7 | kPa |
| Pore pressure | u | 37.1 | kPa | 39.4 | kPa |
| Deviator stress | q | 72.1 | kPa | 90.2 | kPa |
| Mean normal stress | p' | 67.0 | kPa | 70.7 | kPa |
| Ratio | q / p' | 1.08 | | 1.28 | |
| Axial strain | ϵ_1 | 0.28 | % | 0.42 | % |
| Friction angle | ϕ' | 27.1 | ° | 31.7 | ° |

| | |
|--------------------|--------------------|
| Job: Ph.D. Project | Aalborg University |
| Executed: KPJ | Enclosure No. 1 |
| Evaluated: KPJ | Approved: KPJ |



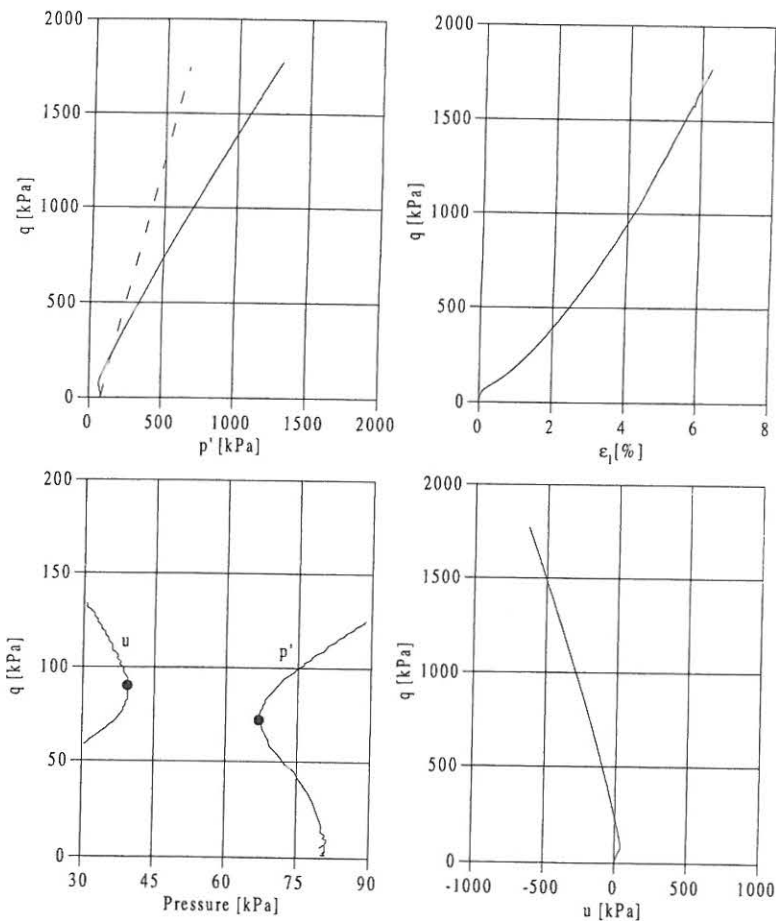
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 1
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 1
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 1
 Evaluated: KPJ Approved: KPJ

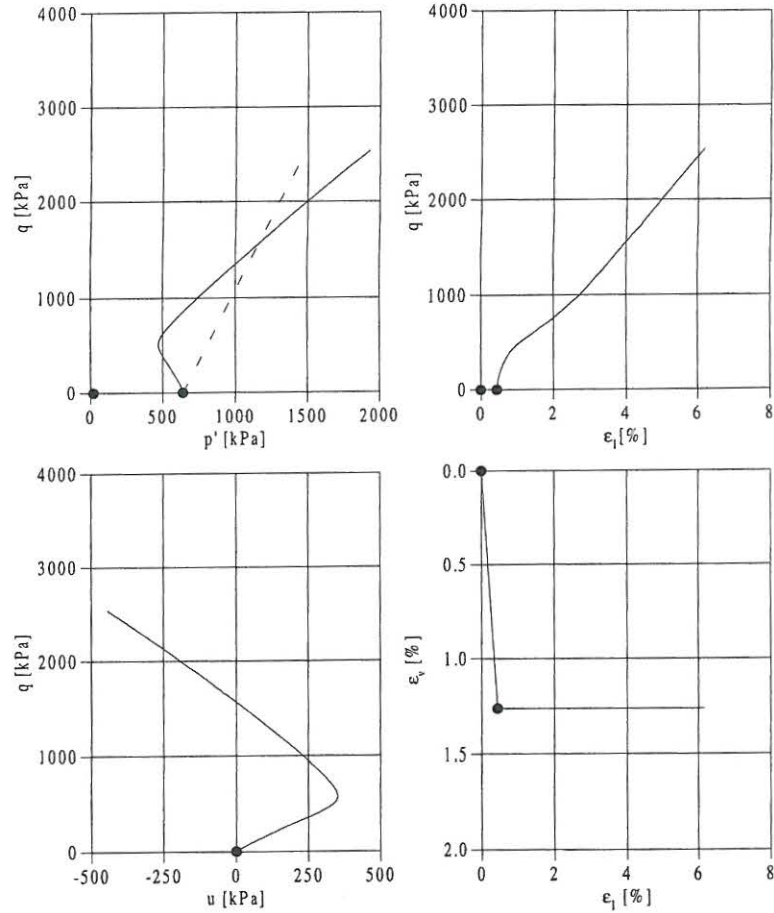
| | | |
|---|---------------------------------|--------------------------------------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties |
| Specimen preparation Air pluviation | Calibration file Ca19710.dat | Height 71.47 mm Diameter 69.67 mm |
| Saturation procedure Water percolation | Date 1998-01-28 | Void ratio 0.670 |

| | | |
|--------------|-------------------------------------|------------------|
| Test program | Isotropic compression, σ_3 : | 20.0 - 640.0 kPa |
| | Loading rate: | 5.0 kPa/min |
| | Undrained compression | |
| | Deformation rate: | 3.0 % ph. |

| | | |
|-----------------------|--------------|-----------|
| Isotropic compression | | |
| Confining pressure | σ_3 | 640.0 kPa |
| Axial strain | ϵ_1 | 0.43 % |
| Volumetric strain | ϵ_v | 1.26 % |
| Void ratio | e | 0.649 |

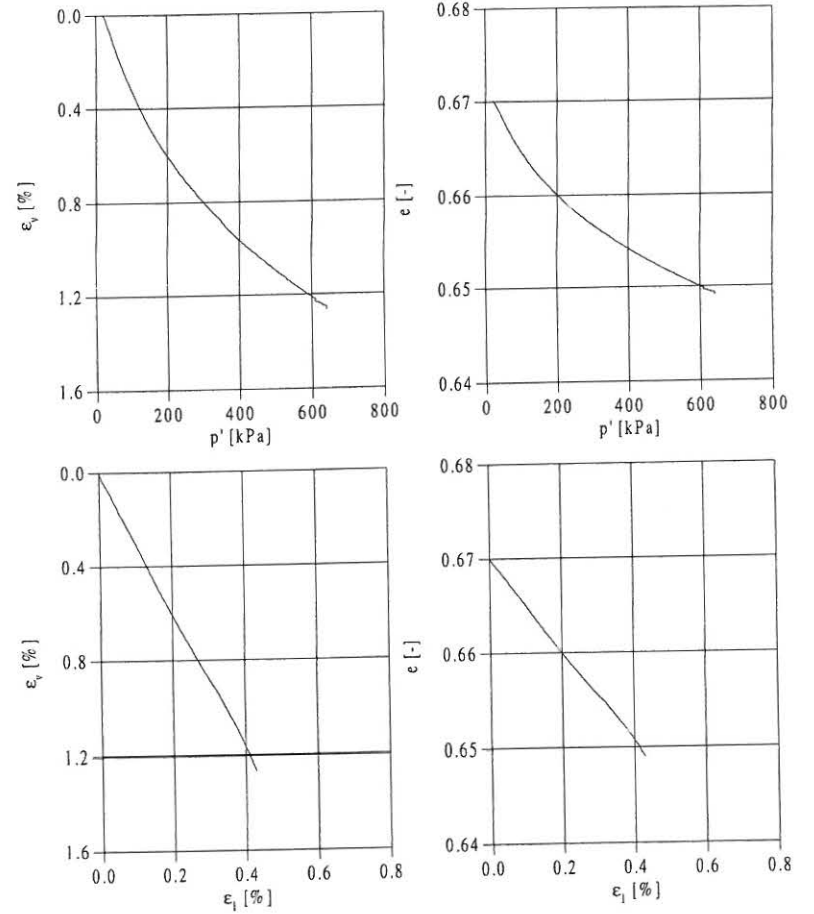
| | | | |
|-----------------------|----------------------|----------------------|---------------------|
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
| Stress ratio | σ'_1/σ_3 | 2.70 | 2.99 |
| Confining pressure | σ_3 | 300.1 kPa | 288.9 kPa |
| Pore pressure | u | 339.9 kPa | 351.1 kPa |
| Deviator stress | q | 511.6 kPa | 575.9 kPa |
| Mean normal stress | p' | 470.6 kPa | 480.9 kPa |
| Ratio | q / p' | 1.09 | 1.20 |
| Axial strain | ϵ_1 | 1.10 % | 1.33 % |
| Friction angle | ϕ' | 27.4 ° | 30.0 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 2
 Evaluated: KPJ Approved: KPJ



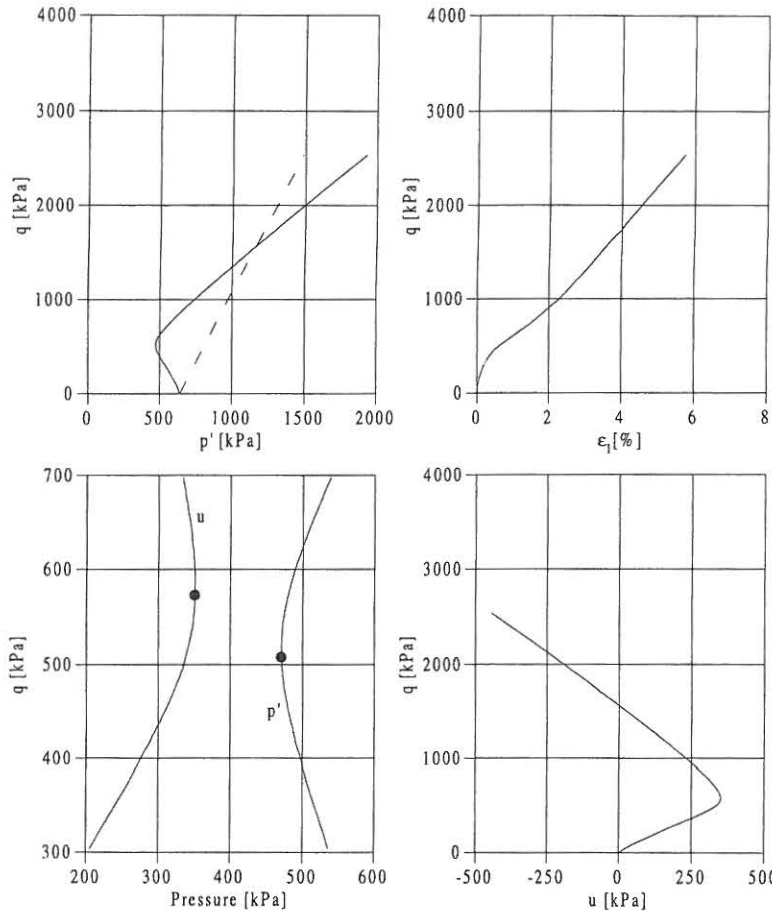
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 2
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 2
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 2
 Evaluated: KPJ Approved: KPJ

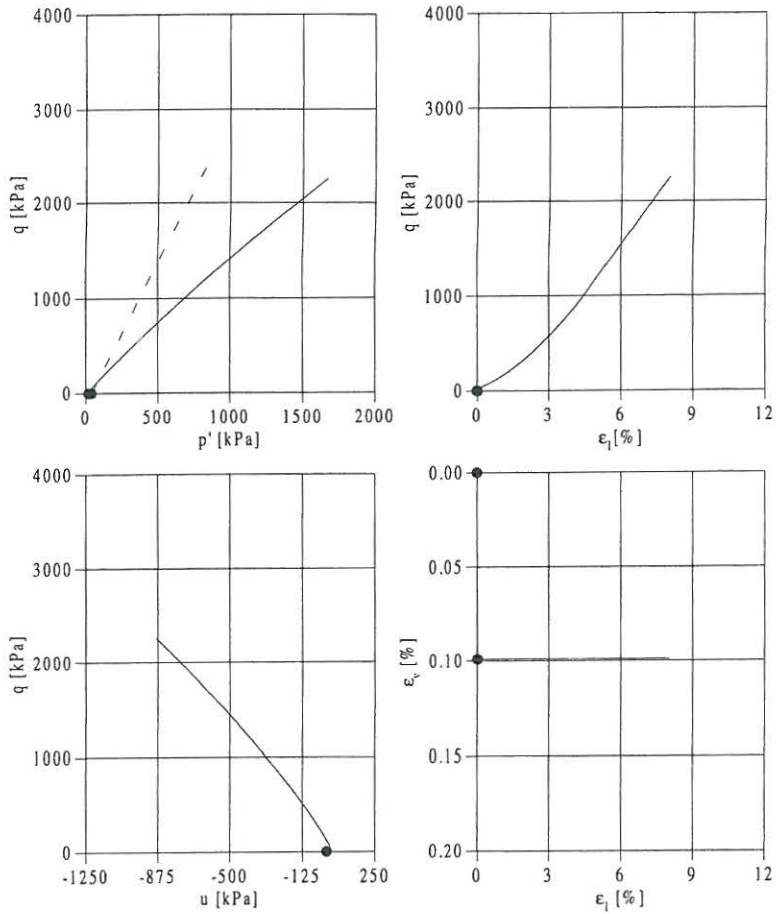
| | | | |
|---|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Air pluviation | Calibration file Ca197101.dat | Height | 71.48 mm |
| Saturation procedure Water percolation | Date 1998-02-01 | Diameter | 69.68 mm |
| | | Void ratio | 0.671 |

| | | | |
|--------------|--------------------------------------|-------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 40.0 | kPa |
| | Loading rate: | 1.0 | kPa/min |
| | Undrained compression | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 40.0 | kPa |
| Axial strain | ϵ_1 | 0.02 | % |
| Volumetric strain | ϵ_v | 0.10 | % |
| Void ratio | e | 0.669 | |

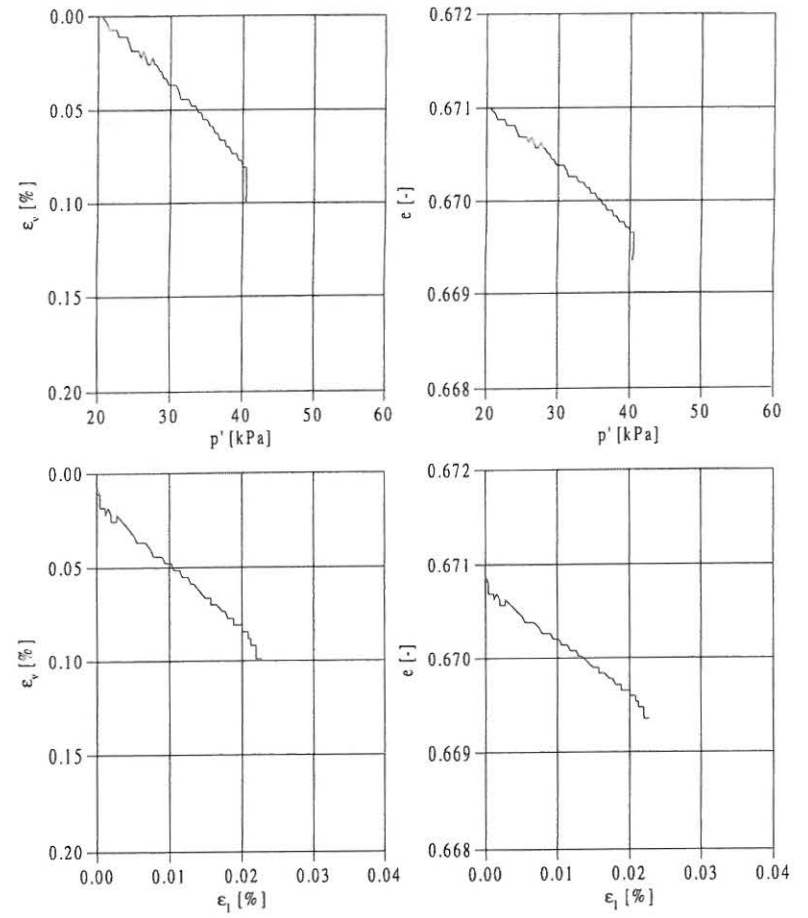
| | | | |
|-----------------------|-----------------------|----------------------|---------------------|
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
| Stress ratio | σ'_1/σ'_3 | 2.63 | 3.29 |
| Confining pressure | σ'_3 | 22.6 kPa | 21.4 kPa |
| Pore pressure | u | 17.5 kPa | 18.6 kPa |
| Deviator stress | q | 36.9 kPa | 49.0 kPa |
| Mean normal stress | p' | 34.8 kPa | 37.8 kPa |
| Ratio | q/p' | 1.06 | 1.30 |
| Axial strain | ϵ_1 | 0.13 % | 0.25 % |
| Friction angle | ϕ' | 26.7 ° | 32.2 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 3
 Evaluated: KPJ Approved: KPJ



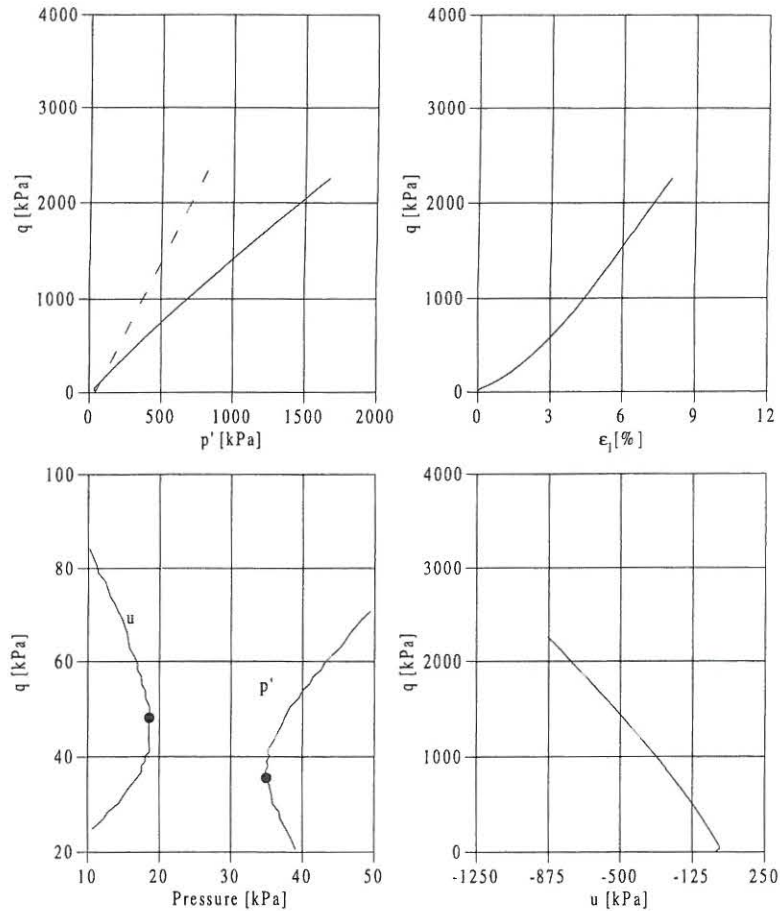
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 3
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 3
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 3
 Evaluated: KPJ Approved: KPJ

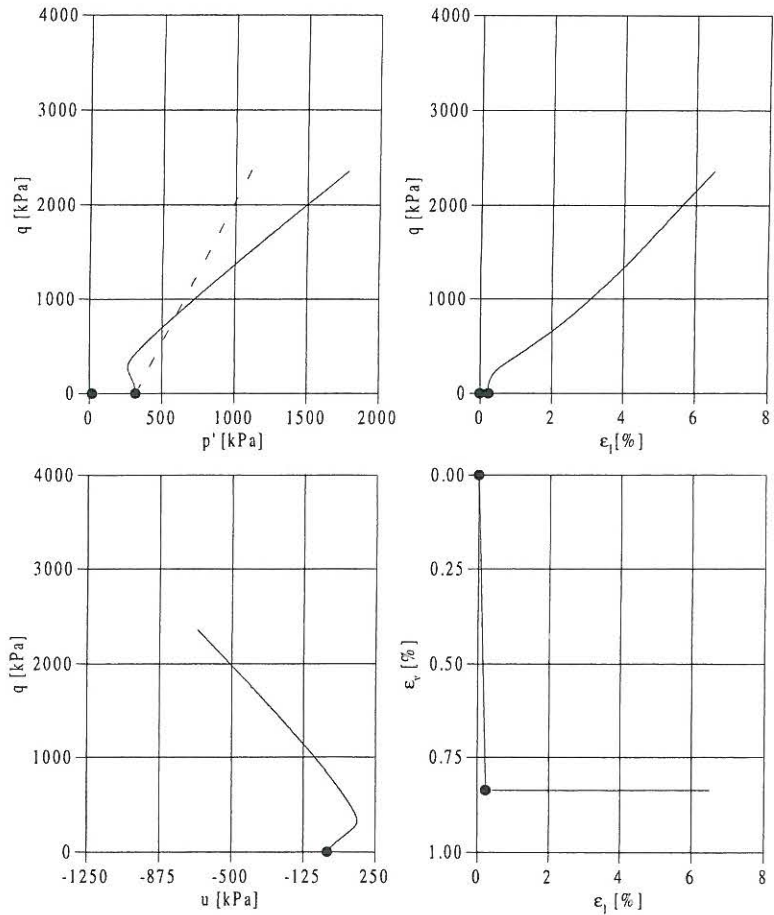
| | | |
|---|---------------------------------|----------------------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties |
| Specimen preparation Air pluviation | Calibration file Cal9710.dat | Height 71.51 mm |
| Saturation procedure Water percolation | Date 1998-01-15 | Diameter 69.71 mm |
| | | Void ratio 0.673 |

| | | | |
|--------------|--------------------------------------|--------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 320.0 | kPa |
| | Loading rate: | 5.0 | kPa/min |
| | Undrained compression | 3.0 | % ph. |
| | Deformation rate: | | |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 319.9 | kPa |
| Axial strain | ϵ_1 | 0.24 | % |
| Volumetric strain | ϵ_v | 0.84 | % |
| Void ratio | e | 0.659 | |

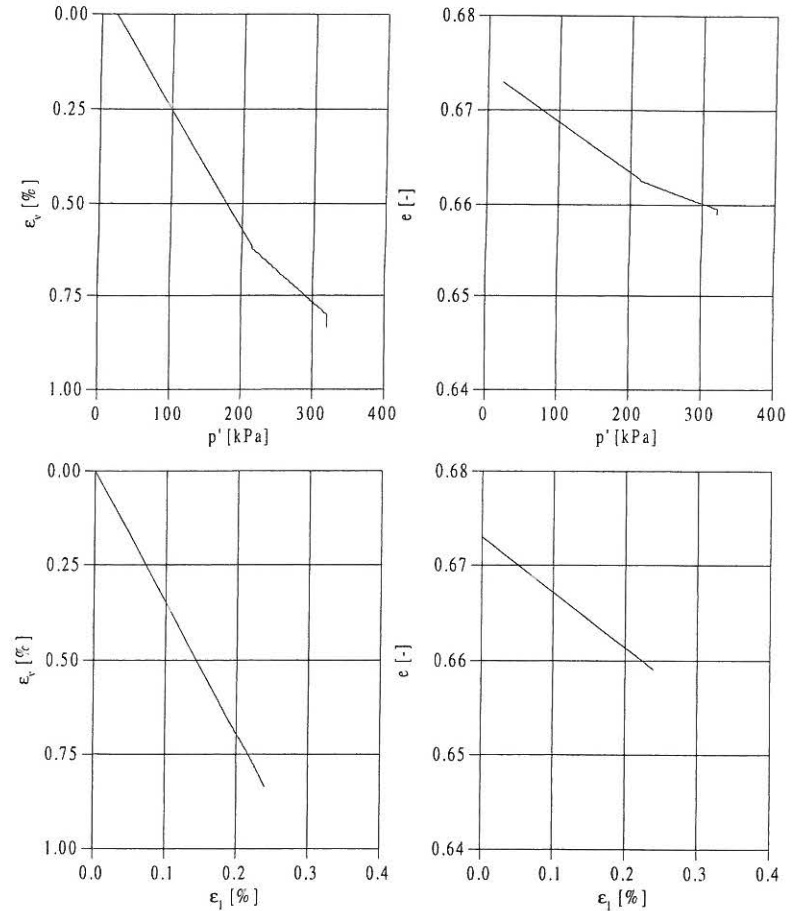
| | | | |
|-----------------------|-----------------------|----------------------|---------------------|
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
| Stress ratio | σ'_1/σ'_3 | 2.57 | 2.98 |
| Confining pressure | σ'_3 | 173.3 kPa | 163.8 kPa |
| Pore pressure | u | 146.6 kPa | 156.1 kPa |
| Deviator stress | q | 271.8 kPa | 324.9 kPa |
| Mean normal stress | p' | 263.9 kPa | 272.2 kPa |
| Ratio | q / p' | 1.03 | 1.19 |
| Axial strain | ϵ_1 | 0.53 % | 0.74 % |
| Friction angle | ϕ' | 26.1 ° | 29.9 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 4
 Evaluated: KPJ Approved: KPJ



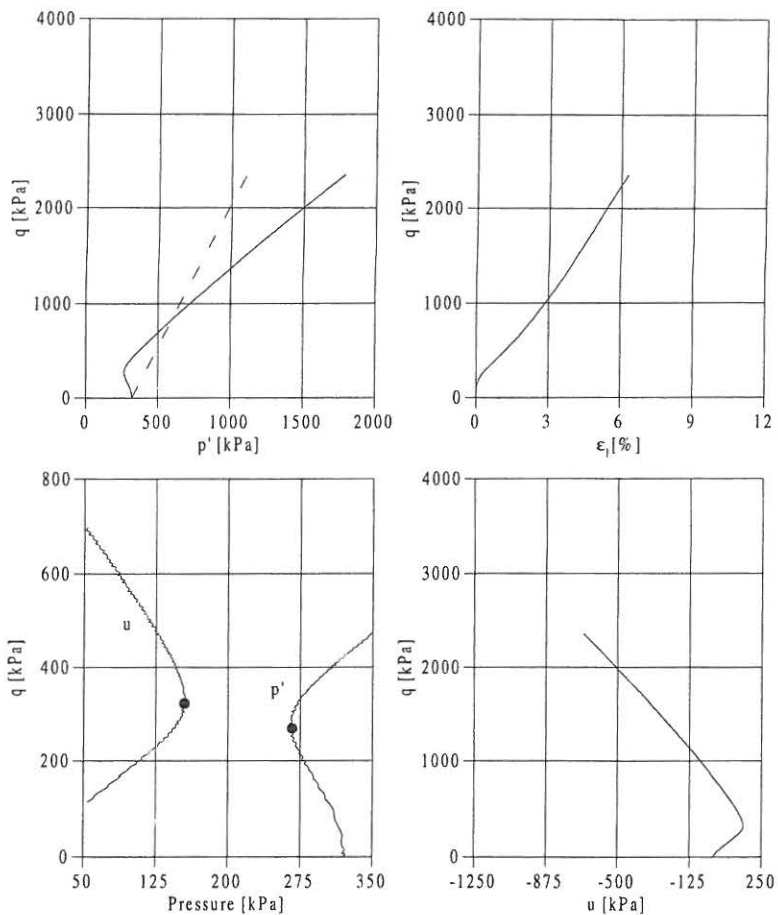
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 4
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 4
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University

Executed: KPJ Enclosure No. 4
 Evaluated: KPJ Approved: KPJ

| | | |
|---|---------------------------------|--------------------------------------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties |
| Specimen preparation Air pluviation | Calibration file Ca19710.dat | Height 71.48 mm Diameter 69.68 mm |
| Saturation procedure Water percolation | Date 1998-01-17 | Void ratio 0.671 |

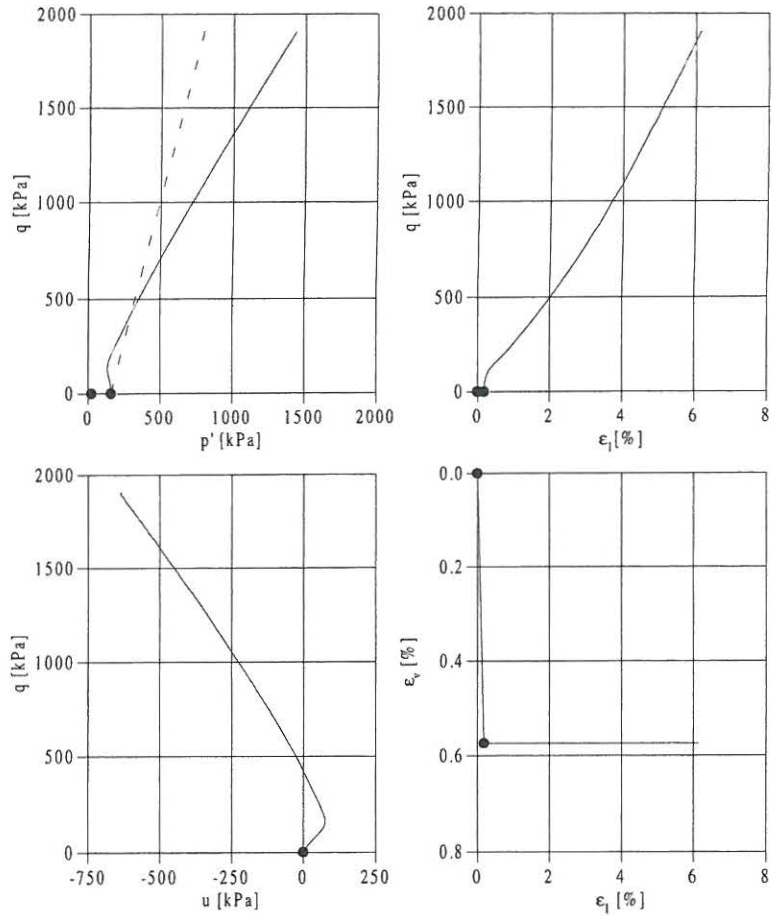
| | | | |
|--------------|--------------------------------------|--------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 160.0 | kPa |
| | Loading rate: | 5.0 | kPa/min |
| | Undrained compression | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 160.0 | kPa |
| Axial strain | ϵ_1 | 0.18 | % |
| Volumetric strain | ϵ_v | 0.57 | % |
| Void ratio | e | 0.661 | |

| | | | |
|-----------------------|-----------------------|----------------------|---------------------|
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
| Stress ratio | σ'_1/σ'_3 | 2.53 | 2.90 |
| Confining pressure | σ'_3 | 88.5 | 84.8 |
| Pore pressure | u | 71.7 | 75.3 |
| Deviator stress | q | 135.6 | 160.8 |
| Mean normal stress | p' | 133.7 | 138.4 |
| Ratio | q / p' | 1.01 | 1.16 |
| Axial strain | ϵ_1 | 0.41 | 0.54 |
| Friction angle | ϕ' | 25.7 | 29.1 |

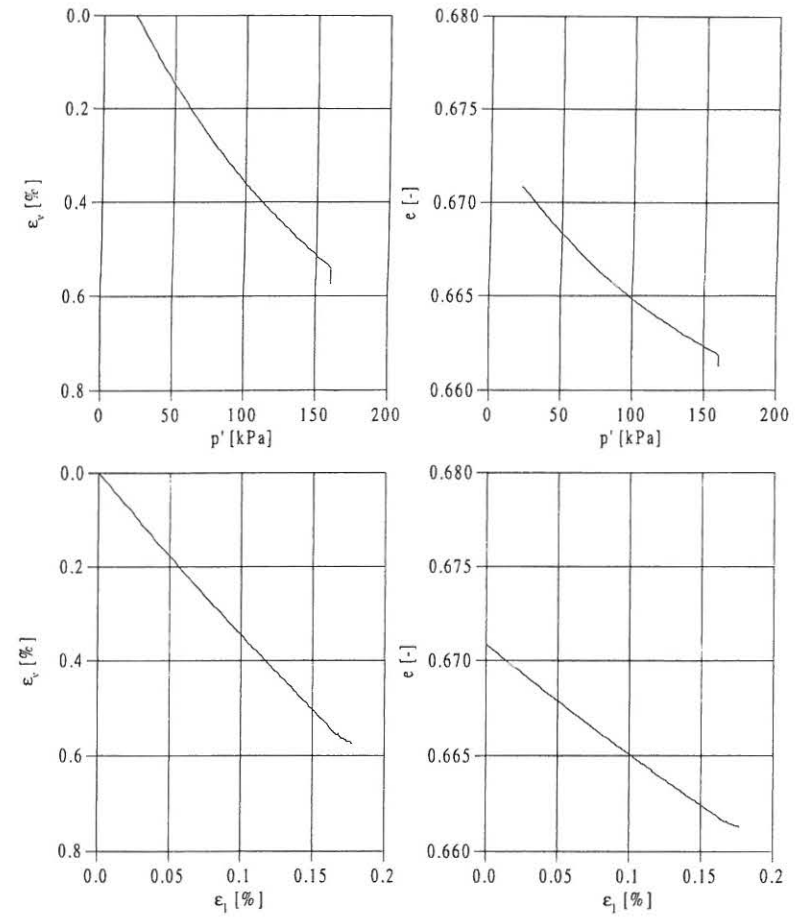
Job: Ph.D. Project Aalborg University

Executed: KPJ Enclosure No. 5
 Evaluated: KPJ Approved: KPJ



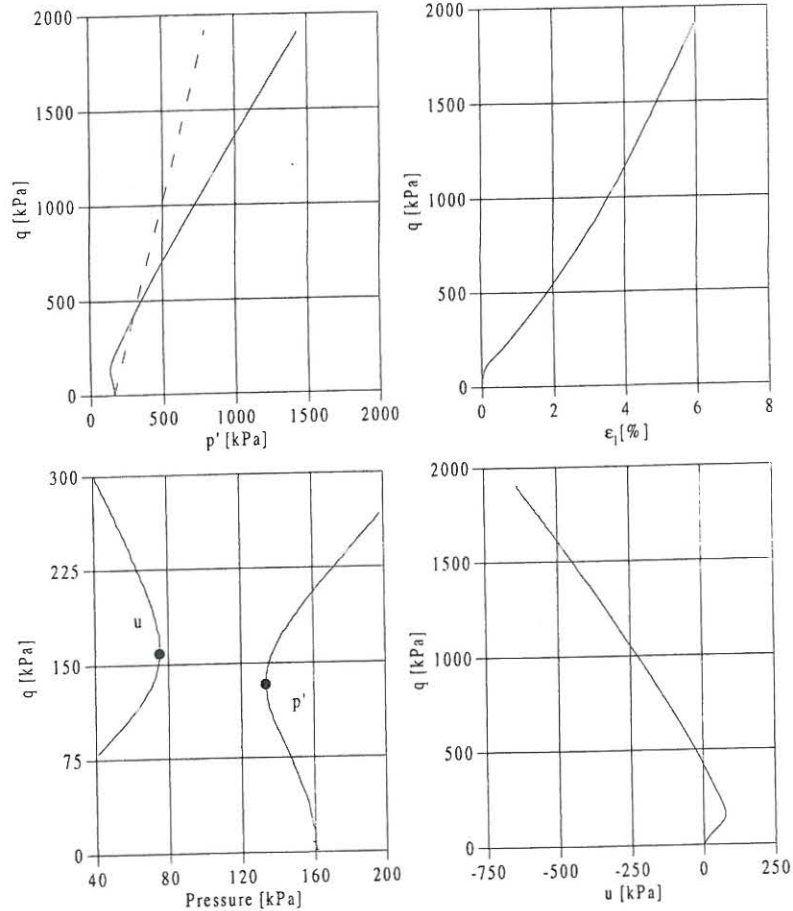
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 5
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 5
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 5
 Evaluated: KPJ Approved: KPJ

| | | | |
|--|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Air pluviation | Calibration file Ca197103.dat | Height | 71.49 mm |
| Saturation procedure CO ₂ / Backpressure | Date 1998-05-04 | Diameter | 69.69 mm |
| | | Void ratio | 0.671 |
| | | B-value | 0.980 |

| | | | |
|--------------|---|--------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 271.8 | kPa |
| | Loading rate: | 5.0 | kPa/min |
| | Undrained compression $\Delta p' = 0$ (TSP) | | |
| | Deformation rate: | 3.0 | % ph. |
| | Minimum pore pressure, u_{min} : | 0.0 | kPa |
| | Drained compression $\Delta p' = 0$ (ESP) | | |
| | Deformation rate: | 3.0 | % ph. |

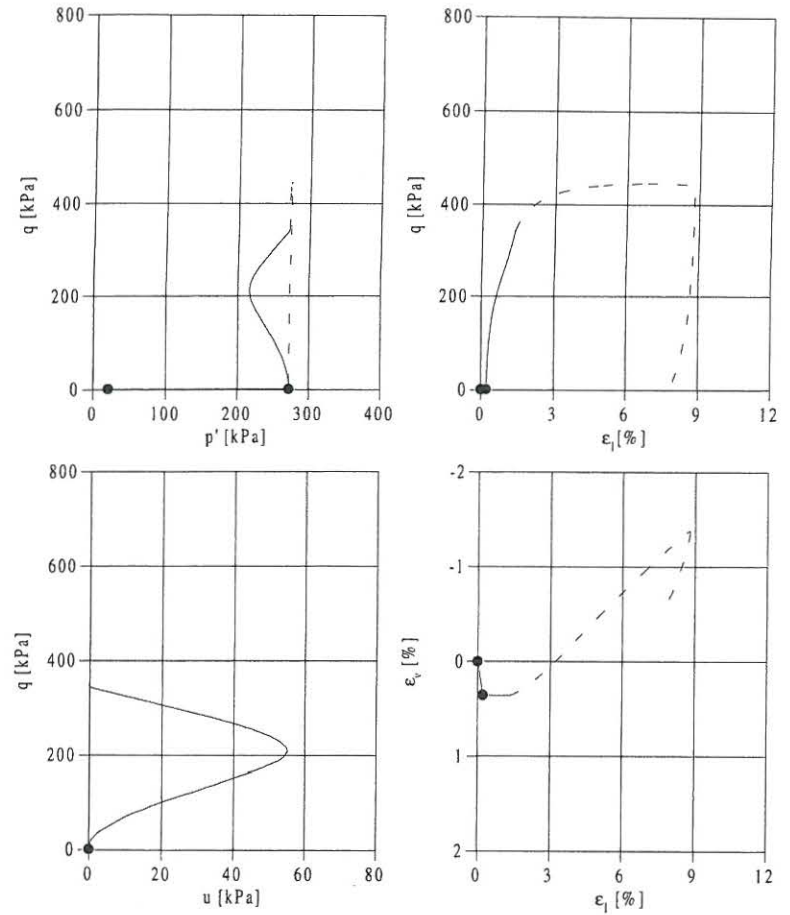
| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 271.7 | kPa |
| Axial strain | ϵ_1 | 0.23 | % |
| Volumetric strain | ϵ_v | 0.36 | % |
| Void ratio | e | 0.666 | |

| | | | |
|-----------------------|-------------------------|---------------------|---------------------|
| Undrained compression | | Values at p_{min} | Values at u_{max} |
| Stress ratio | σ'_1 / σ'_3 | 2.42 | 2.42 |
| Confining pressure | σ'_3 | 147.2 | 147.2 |
| Pore pressure | u | 55.1 | 55.1 |
| Deviator stress | q | 208.5 | 208.5 |
| Mean normal stress | p' | 216.7 | 216.7 |
| Ratio | q / p' | 0.96 | 0.96 |
| Axial strain | ϵ_1 | 0.67 | 0.67 |
| Friction angle | φ' | 24.5 | 24.5 |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 6
 Evaluated: KPJ Approved: KPJ

| Drained compression | | Values at failure |
|---------------------|-----------------------|-------------------|
| Stress ratio | σ'_1/σ'_3 | 4.56 |
| Confining pressure | σ'_3 | 124.9 kPa |
| Deviator stress | q | 445.3 kPa |
| Mean normal stress | p' | 273.4 kPa |
| Ratio | q / p' | 1.63 |
| Axial strain | ϵ_1 | 6.33 % |
| Volumetric strain | ϵ_v | -0.81 % |
| Void ratio | e | 0.685 |
| Friction angle | ϕ' | 39.8 ° |
| Angle of dilation | ψ | 6.4 ° |

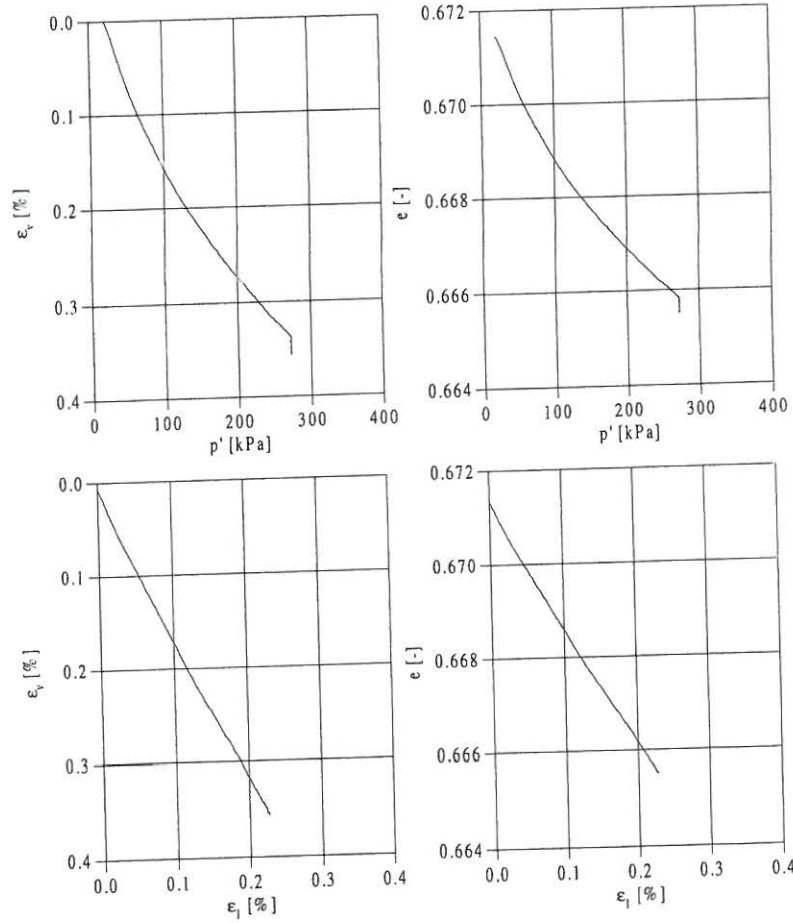
| Elastic properties | | |
|--------------------|----|-----------|
| Shear modulus | G | 76.7 MPa |
| Deviator stress | q | 372.5 kPa |
| Mean normal stress | p' | 273.6 kPa |



| | |
|--------------------|--------------------|
| Job: Ph.D. Project | Aalborg University |
| Executed: KPJ | Enclosure No. 6 |
| Evaluated: KPJ | Approved: KPJ |

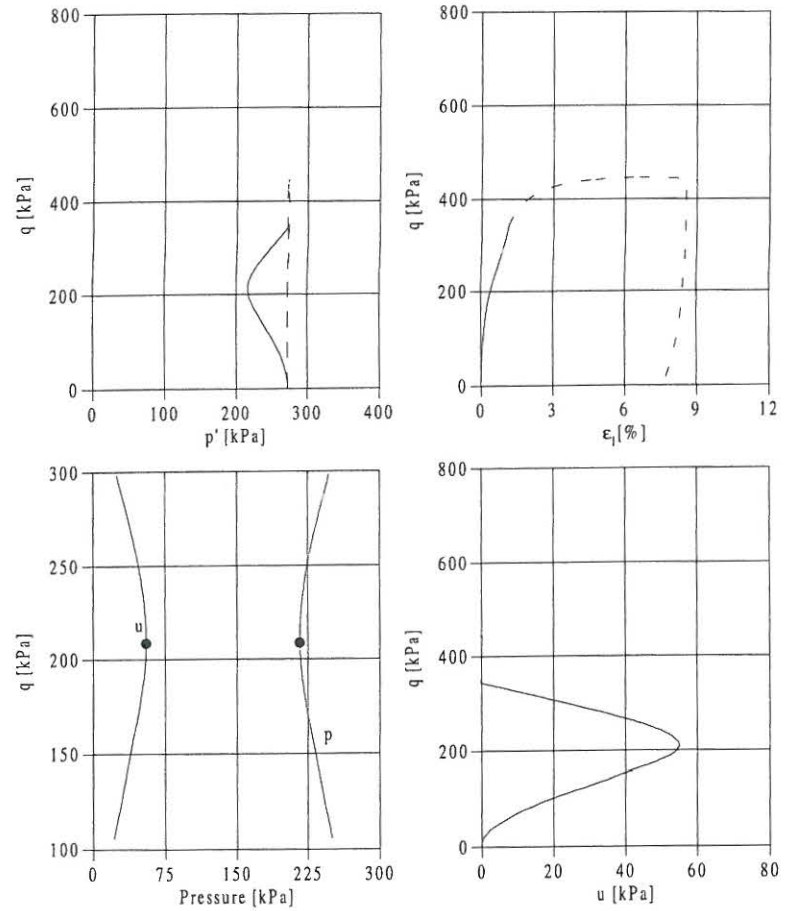
| | |
|--------------------|--------------------|
| Job: Ph.D. Project | Aalborg University |
| Executed: KPJ | Enclosure No. 6 |
| Evaluated: KPJ | Approved: KPJ |

| | |
|--------|-----------------------|
| Legend | |
| ● | Isotropic compression |
| — | Undrained compression |
| - - - | Drained compression |



| | |
|--------------------|--------------------|
| Job: Ph.D. Project | Aalborg University |
| Executed: KPJ | Enclosure No. 6 |
| Evaluated: KPJ | Approved: KPJ |

Remarks



| | |
|--------------------|--------------------|
| Job: Ph.D. Project | Aalborg University |
| Executed: KPJ | Enclosure No. 6 |
| Evaluated: KPJ | Approved: KPJ |

Remarks

| | | | |
|--|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Air pluviation | Calibration file Ca197103.dat | Height | 71.45 mm |
| Saturation procedure CO ₂ / Backpressure | Date 1998-05-06 | Diameter | 69.65 mm |
| | | Void ratio | 0.669 |
| | | B-value | 0.987 |

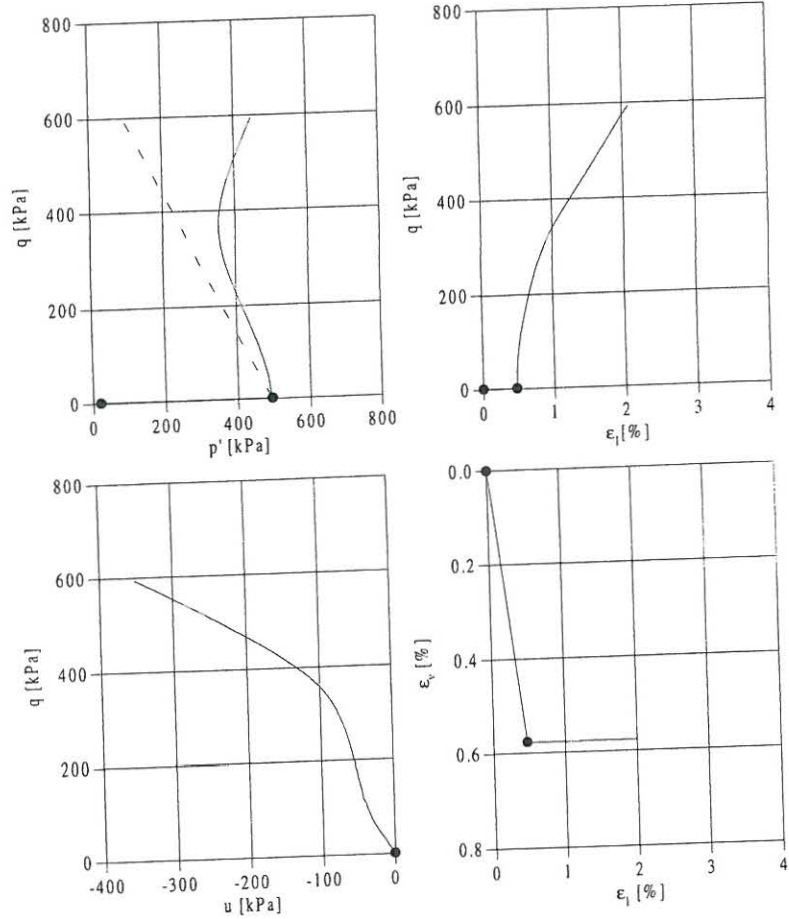
| | | | |
|--------------|---|--------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 494.2 | kPa |
| | Loading rate: | 5.0 | kPa/min |
| | Undrained compression $\Delta q / \Delta p' = -1.5$ (TSP) | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 494.2 | kPa |
| Axial strain | ϵ_1 | 0.47 | % |
| Volumetric strain | ϵ_v | 0.58 | % |
| Void ratio | e | 0.659 | |

| | | | |
|-----------------------|-------------------------|---------------------|-----|
| Undrained compression | | Values at p_{min} | |
| Stress ratio | σ'_1 / σ'_3 | 2.58 | |
| Confining pressure | σ'_3 | 231.7 | kPa |
| Pore pressure | u | -105.7 | kPa |
| Deviator stress | q | 366.6 | kPa |
| Mean normal stress | p' | 353.9 | kPa |
| Ratio | q / p' | 1.04 | |
| Axial strain | ϵ_1 | 1.11 | % |
| Friction angle | φ | 26.2 | ° |

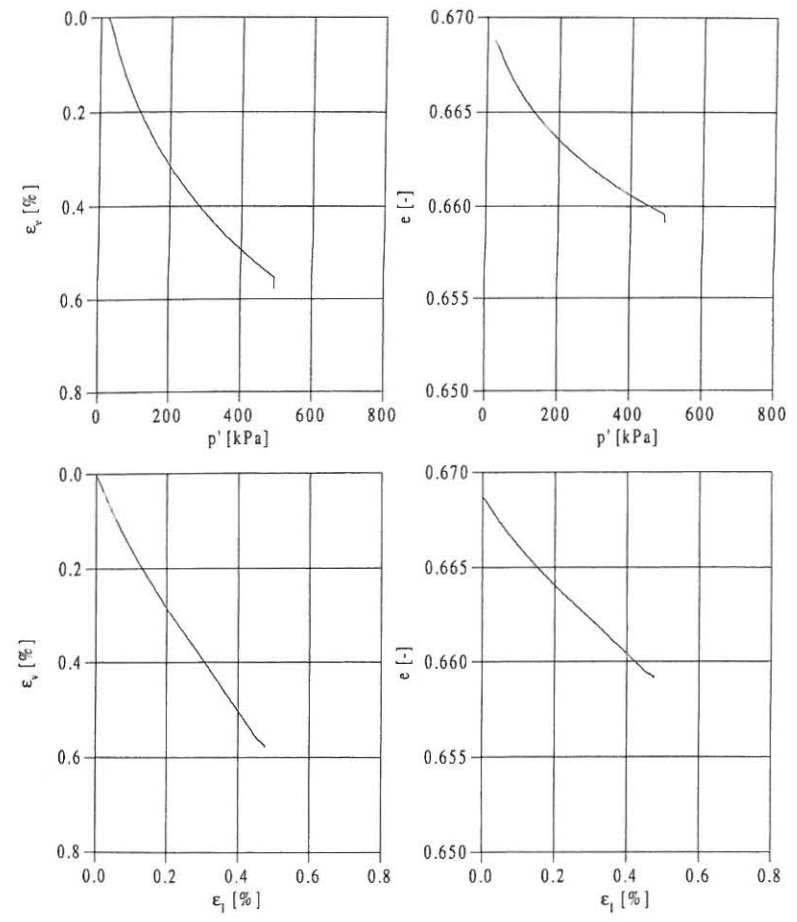
Remarks: B-value obtained at a backpressure of 200 kPa. Backpressure increased to 400 kPa before start of isotropic compression.

| | |
|--------------------|--------------------|
| Job: Ph.D. Project | Aalborg University |
| Executed: KPJ | Enclosure No. 7 |
| Evaluated: KPJ | Approved: KPJ |



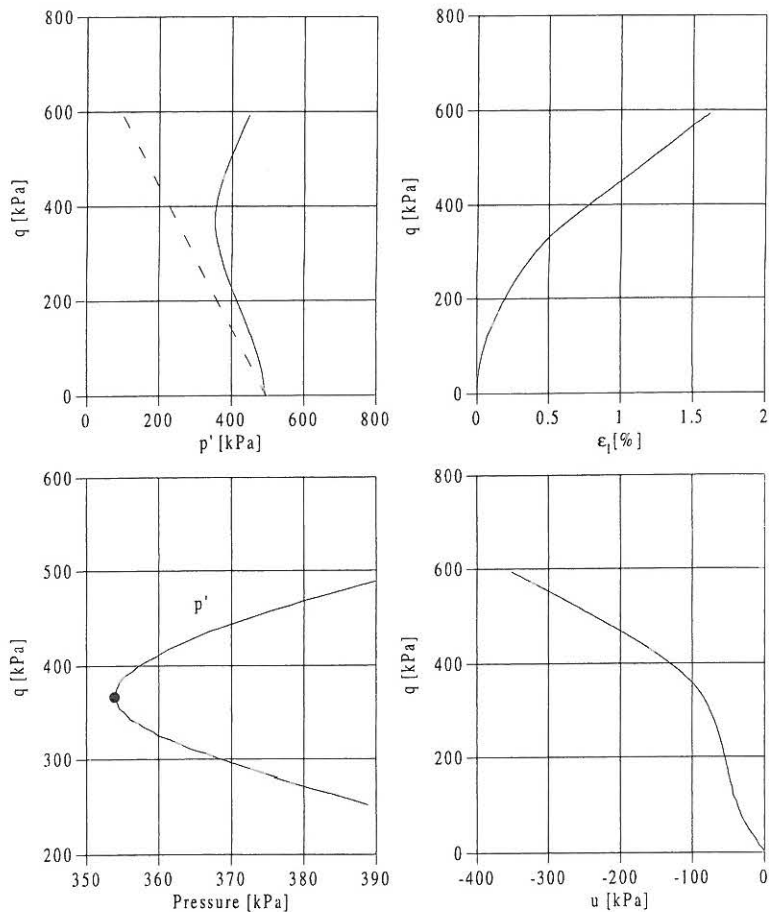
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 7
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 7
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 7
 Evaluated: KPJ Approved: KPJ

| | | | |
|--|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Air pluviation | Calibration file Ca197103.dat | Height | 71.48 mm |
| Saturation procedure CO ₂ / Backpressure | Date 1998-05-08 | Diameter | 69.68 mm |
| | | Void ratio | 0.670 |
| | | B-value | 0.987 |

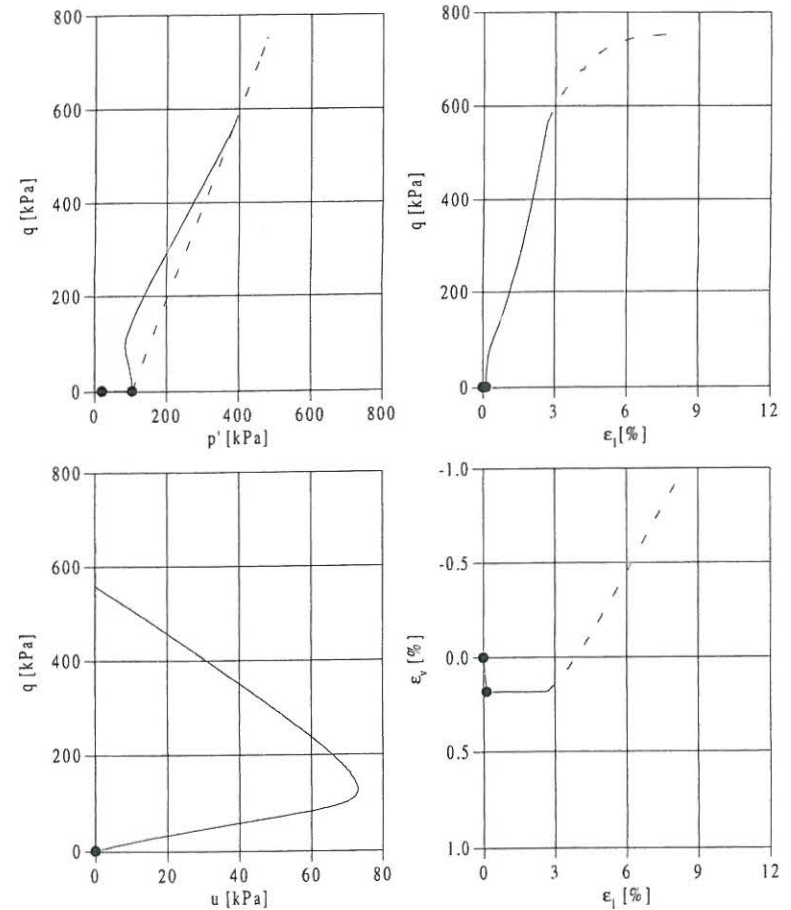
| | | | |
|--------------|--|--------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 104.3 | kPa |
| | Loading rate: | 4.0 | kPa/min |
| | Undrained compression $\Delta q / \Delta p' = 2$ (TSP) | | |
| | Deformation rate: | 3.0 | % ph. |
| | Minimum pore pressure, u_{min} : | 0.0 | kPa |
| | Drained compression $\Delta q / \Delta p' = 2$ (ESP) | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 104.4 | kPa |
| Axial strain | ϵ_1 | 0.13 | % |
| Volumetric strain | ϵ_v | 0.18 | % |
| Void ratio | e | 0.667 | |

| | | | |
|-----------------------|-------------------------|---------------------|---------------------|
| Undrained compression | | Values at p_{min} | Values at u_{max} |
| Stress ratio | σ'_1 / σ'_3 | 2.75 | 3.47 |
| Confining pressure | σ'_3 | 53.5 kPa | 52.9 kPa |
| Pore pressure | u | 66.3 kPa | 72.9 kPa |
| Deviator stress | q | 93.6 kPa | 130.1 kPa |
| Mean normal stress | p' | 84.7 kPa | 96.3 kPa |
| Ratio | q / p' | 1.10 | 1.35 |
| Axial strain | ϵ_1 | 0.37 % | 0.67 % |
| Friction angle | φ' | 27.8 ° | 33.5 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 8
 Evaluated: KPJ Approved: KPJ

| Drained compression | | Values at failure |
|---------------------|-----------------------|-------------------|
| Stress ratio | σ'_1/σ'_3 | 4.29 |
| Confining pressure | σ'_3 | 228.3 kPa |
| Deviator stress | q | 750.3 kPa |
| Mean normal stress | p' | 478.4 kPa |
| Ratio | q / p' | 1.57 |
| Axial strain | ϵ_1 | 7.04 % |
| Volumetric strain | ϵ_v | -0.69 % |
| Void ratio | e | 0.682 |
| Friction angle | ϕ' | 38.4 ° |
| Angle of dilation | ψ | 6.0 ° |

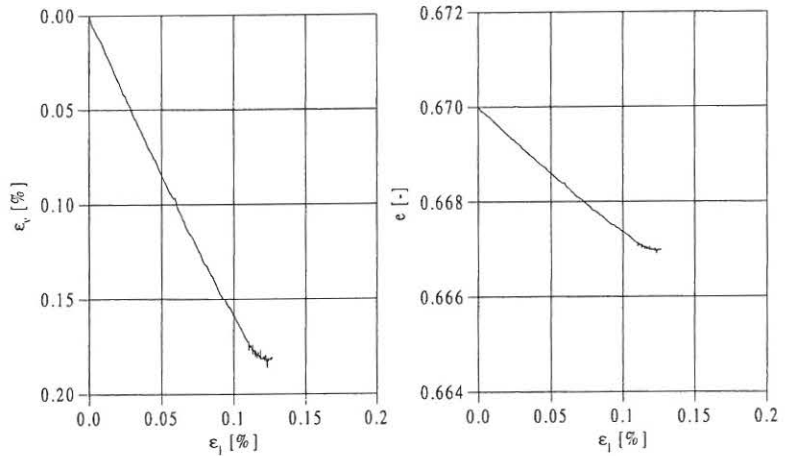
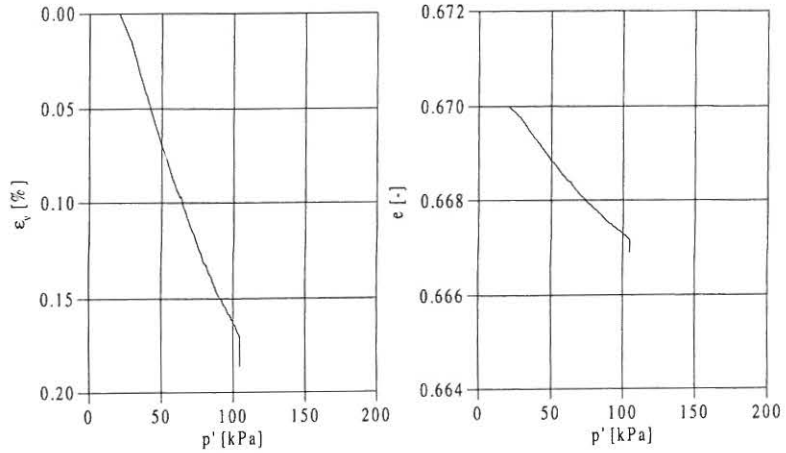


| | |
|--------------------|--------------------|
| Job: Ph.D. Project | Aalborg University |
| Executed: KPJ | Enclosure No. 8 |
| Evaluated: KPJ | Approved: KPJ |

| | |
|--------------------|--------------------|
| Job: Ph.D. Project | Aalborg University |
| Executed: KPJ | Enclosure No. 8 |
| Evaluated: KPJ | Approved: KPJ |

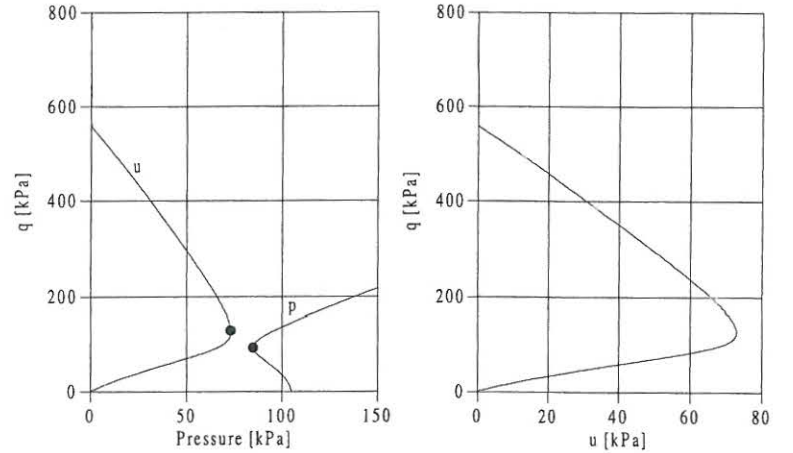
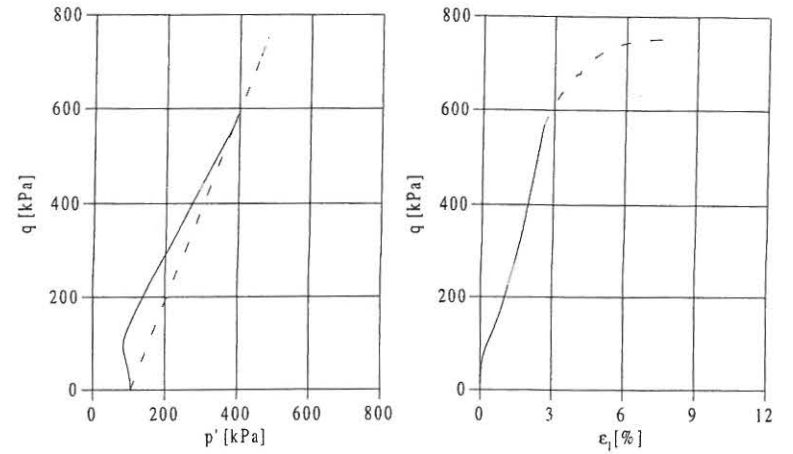
Legend

- Isotropic compression
- Undrained compression
- - - Drained compression



Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 8
 Evaluated: KPJ Approved: KPJ

Remarks



Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 8
 Evaluated: KPJ Approved: KPJ

Remarks

| | | | |
|--|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Air pluviation | Calibration file Cal97103.dat | Height | 71.48 mm |
| Saturation procedure CO ₂ / Backpressure | Date 1998-05-05 | Diameter | 69.68 mm |
| | | Void ratio | 0.633 |
| | | B-value | 0.976 |

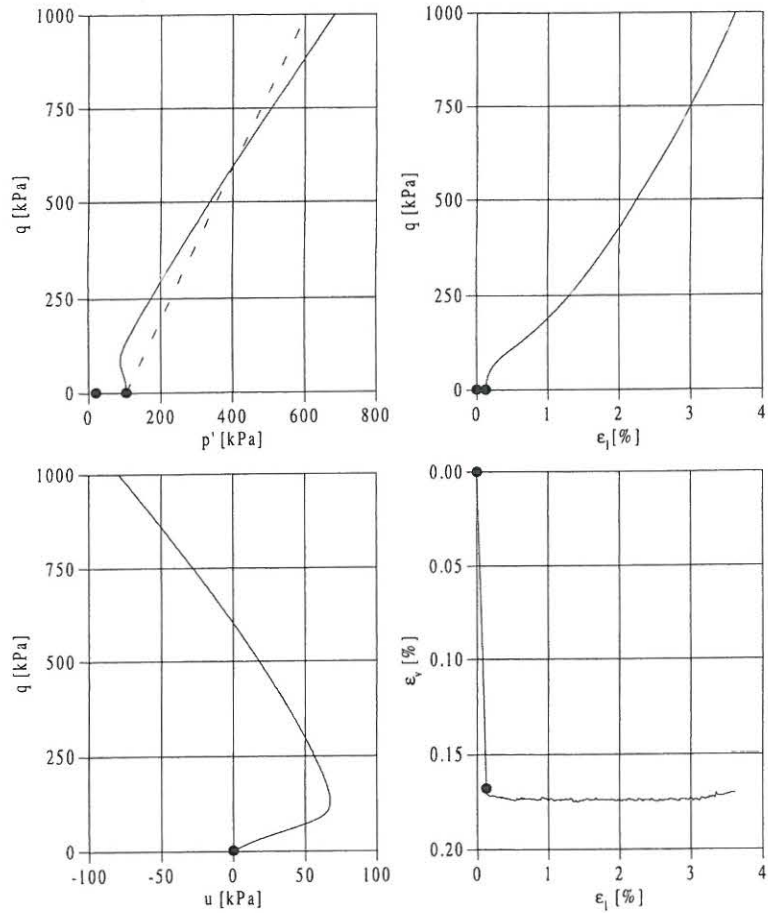
| | | | |
|--------------|--|--------------|---------|
| Test program | Isotropic compression, σ_3 : | 20.0 - 104.3 | kPa |
| | Loading rate: | 5.0 | kPa/min |
| | Undrained compression $\Delta q / \Delta p' = 2$ (TSP) | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ_3 | 104.2 | kPa |
| Axial strain | ϵ_1 | 0.13 | % |
| Volumetric strain | ϵ_v | 0.17 | % |
| Void ratio | e | 0.630 | |

| | | | |
|-----------------------|-----------------------|---------------------|---------------------|
| Undrained compression | | Values at p_{min} | Values at u_{max} |
| Stress ratio | σ_1 / σ_3 | 2.50 | 3.26 |
| Confining pressure | σ_3 | 58.6 kPa | 59.1 kPa |
| Pore pressure | u | 60.2 kPa | 67.2 kPa |
| Deviator stress | q | 87.7 kPa | 133.7 kPa |
| Mean normal stress | p' | 87.8 kPa | 103.7 kPa |
| Ratio | q / p' | 1.00 | 1.29 |
| Axial strain | ϵ_1 | 0.35 % | 0.67 % |
| Friction angle | ϕ' | 25.4 ° | 32.0 ° |

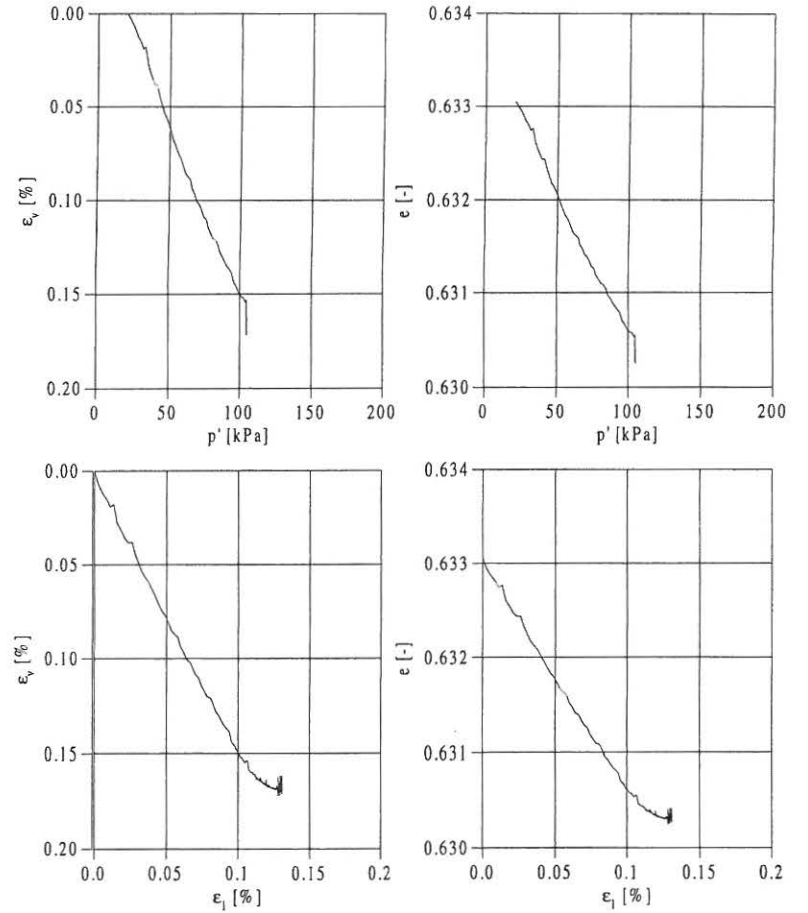
Remarks: B-value obtained at a backpressure of 200 kPa. Backpressure increased to 400 kPa before start of isotropic compression.

| | |
|--------------------|--------------------|
| Job: Ph.D. Project | Aalborg University |
| Executed: KPJ | Enclosure No. 9 |
| Evaluated: KPJ | Approved: KPJ |



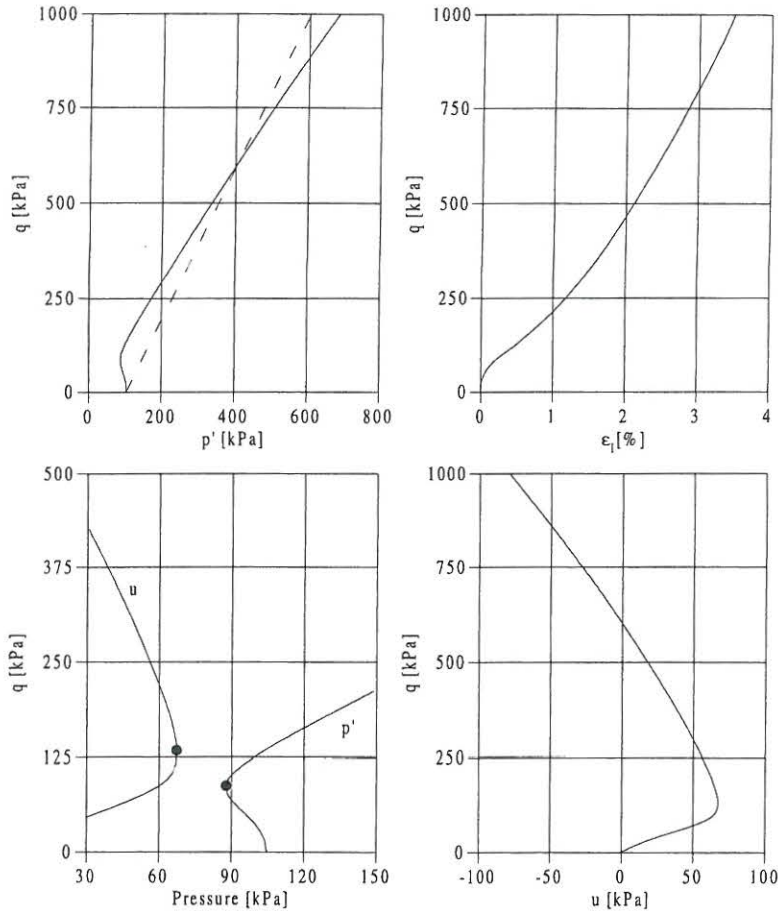
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 9
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 9
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 9
 Evaluated: KPJ Approved: KPJ

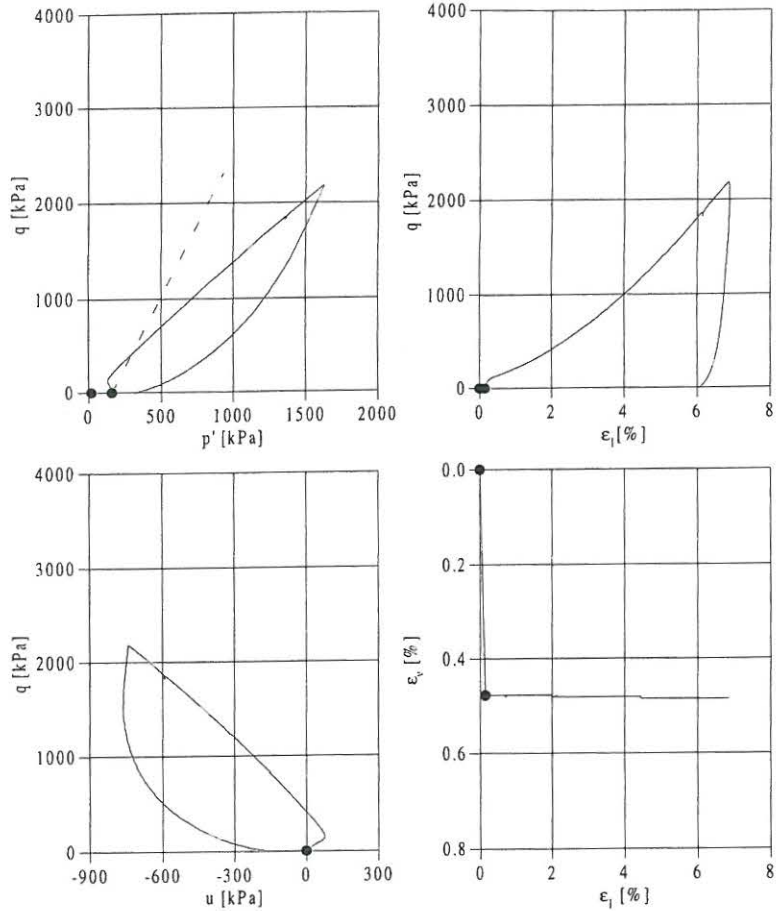
| | | |
|---|----------------------------------|---|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties |
| Specimen preparation Air pluviation | Calibration file Cal97105.dat | Height 71.50 mm Diameter 69.70 mm Void ratio 0.672 |
| Saturation procedure Water percolation | Date 1998-05-09 | |

| | | |
|--------------|--------------------------------------|---------------------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 160.0 kPa |
| | Loading rate: | 3.0 kPa/min |
| | Undrained compression | |
| | Deformation rate: | 3.0 % ph. |

| | | |
|-----------------------|--------------|--------------|
| Isotropic compression | | |
| Confining pressure | σ'_3 | 160.0 kPa |
| Axial strain | ϵ_1 | 0.15 % |
| Volumetric strain | ϵ_v | 0.48 % |
| Void ratio | e | 0.664 |

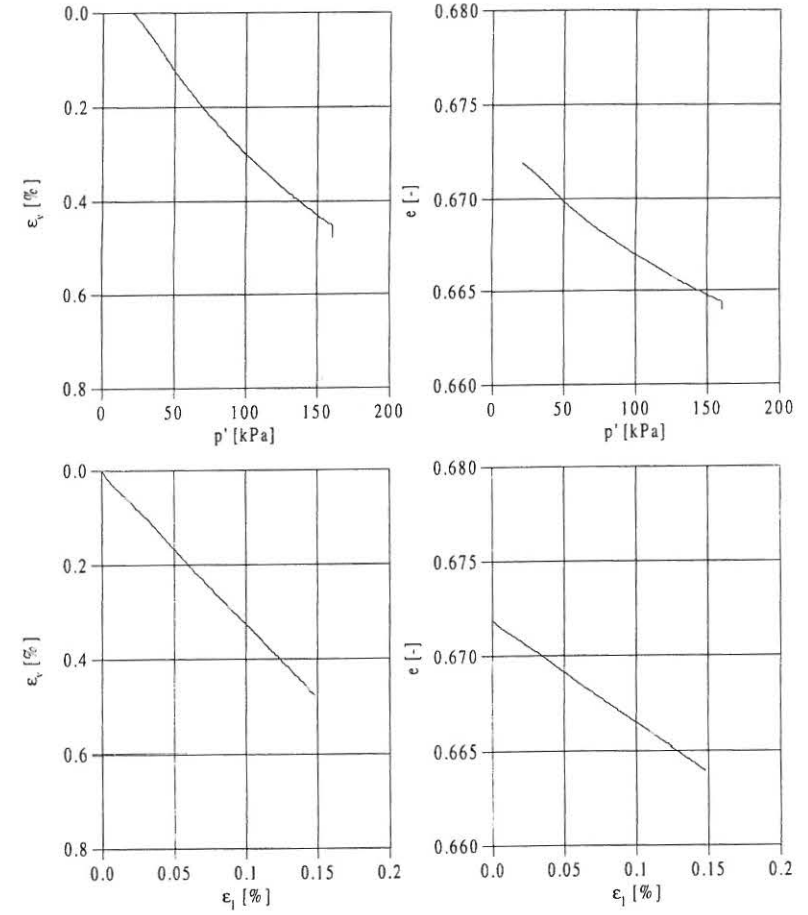
| | | | |
|-----------------------|-----------------------|----------------------|---------------------|
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
| Stress ratio | σ'_1/σ'_3 | 2.49 | 2.76 |
| Confining pressure | σ'_3 | 86.9 kPa | 84.5 kPa |
| Pore pressure | u | 73.2 kPa | 75.6 kPa |
| Deviator stress | q | 129.3 kPa | 148.6 kPa |
| Mean normal stress | p' | 130.0 kPa | 134.0 kPa |
| Ratio | q / p' | 0.99 | 1.11 |
| Axial strain | ϵ_1 | 0.44 % | 0.59 % |
| Friction angle | φ' | 25.2 ° | 27.9 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 10
 Evaluated: KPJ Approved: KPJ



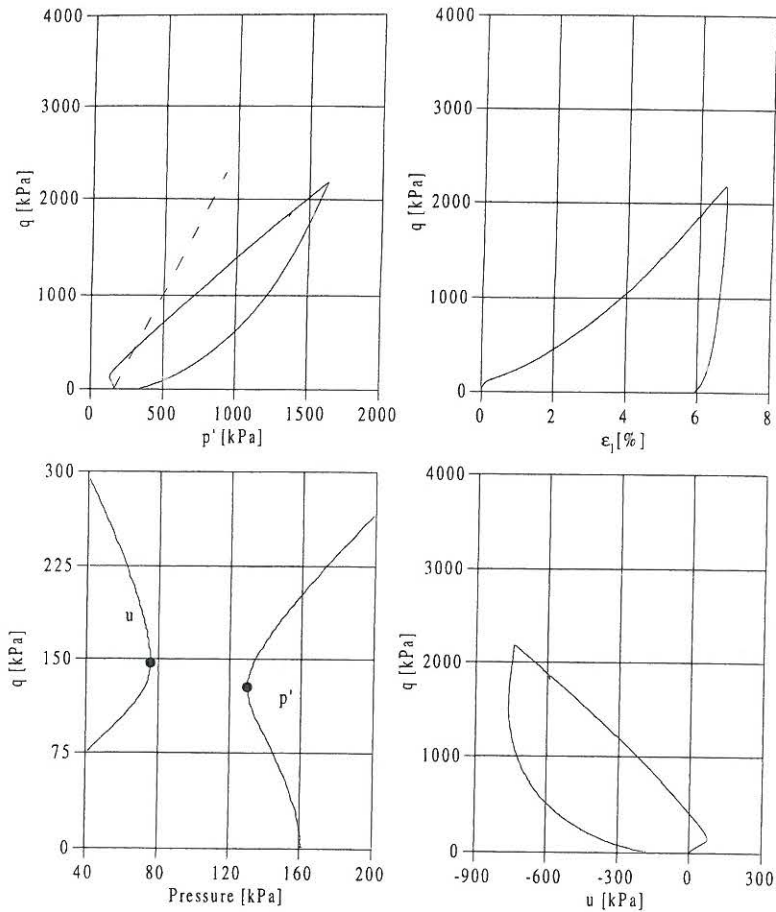
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 10
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 10
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 10
 Evaluated: KPJ Approved: KPJ

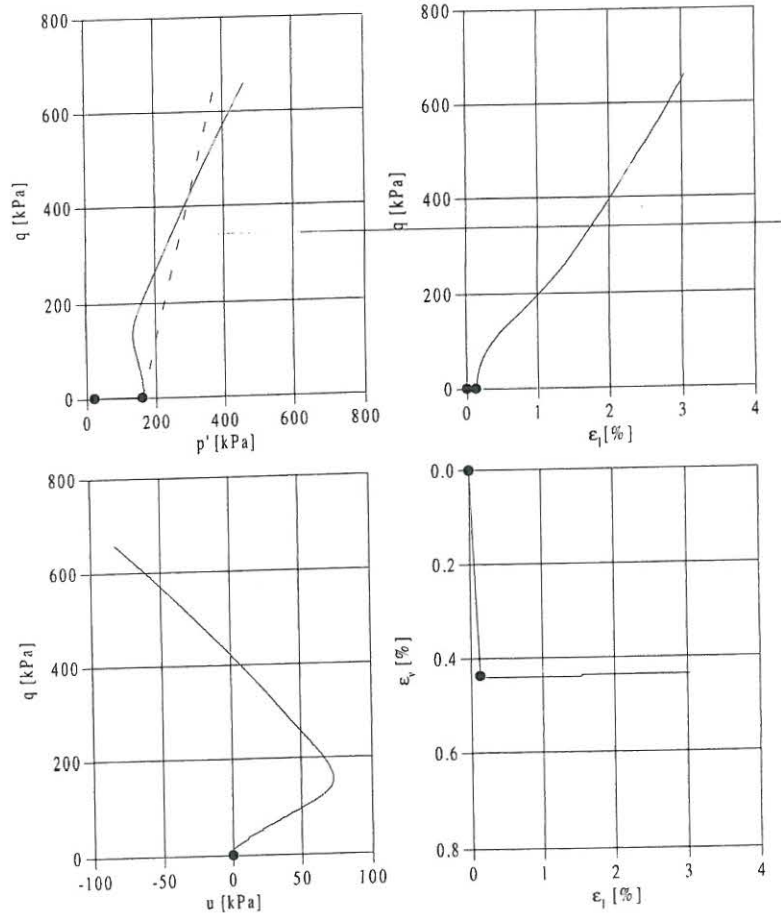
| | | | |
|---|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Air pluviation | Calibration file Ca197105.dat | Height | 71.52 mm |
| Saturation procedure Water percolation | Date 1998-06-10 | Diameter | 69.72 mm |
| | | Void ratio | 0.673 |

| | | | |
|--------------|--------------------------------------|--------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 160.0 | kPa |
| | Loading rate: | 5.0 | kPa/min |
| | Undrained compression | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 160.0 | kPa |
| Axial strain | ϵ_1 | 0.13 | % |
| Volumetric strain | ϵ_v | 0.44 | % |
| Void ratio | e | 0.666 | |

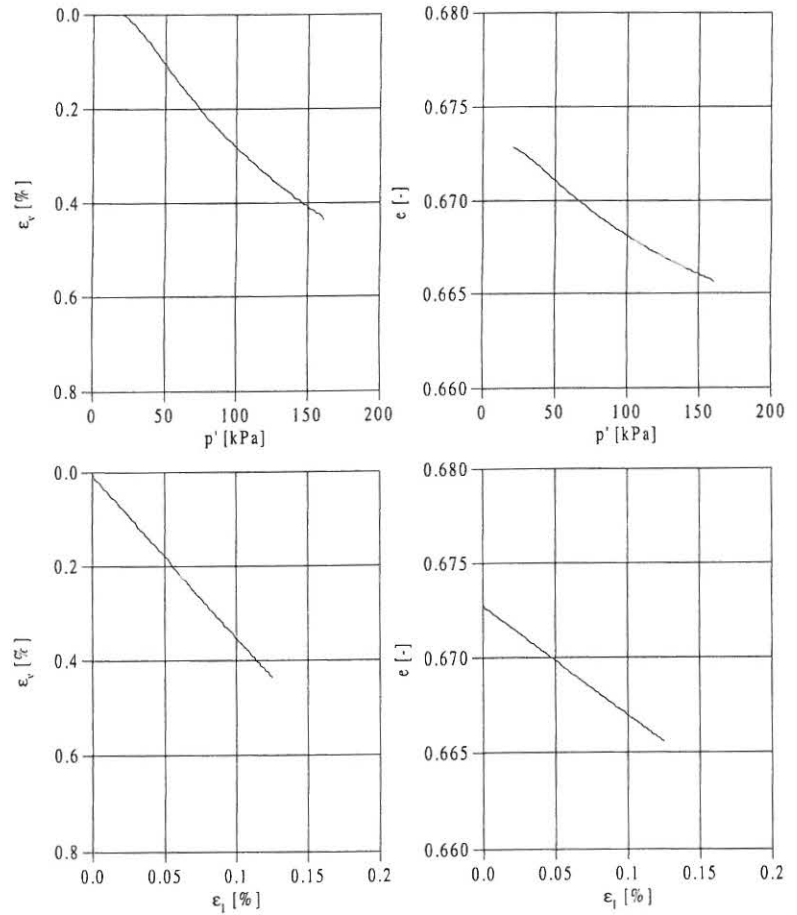
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
|-----------------------|-----------------------|----------------------|---------------------|
| Stress ratio | σ'_1/σ'_3 | 2.50 | 2.85 |
| Confining pressure | σ'_3 | 89.8 kPa | 86.3 kPa |
| Pore pressure | u | 69.3 kPa | 72.8 kPa |
| Deviator stress | q | 135.1 kPa | 159.5 kPa |
| Mean normal stress | p' | 134.9 kPa | 139.5 kPa |
| Ratio | q/p' | 1.00 | 1.14 |
| Axial strain | ϵ_1 | 0.58 % | 0.75 % |
| Friction angle | ϕ' | 25.4 ° | 28.7 ° |

Job: Ph.D. Project Aalborg University
 Executed: UP, KPJ Enclosure No. 11
 Evaluated: KPJ Approved: KPJ



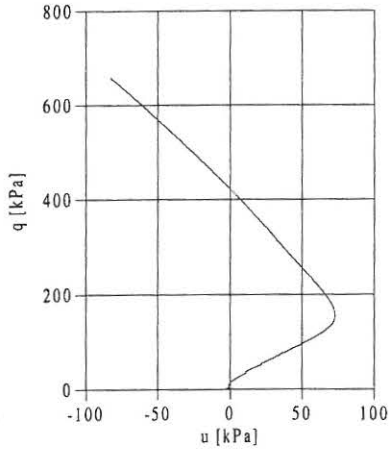
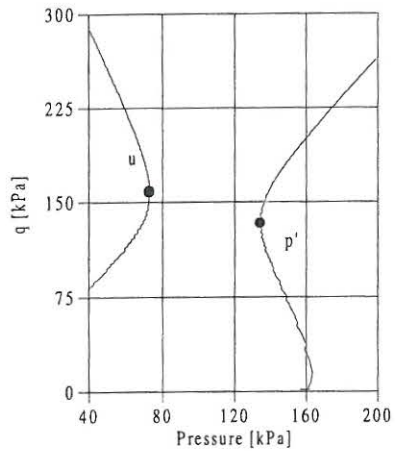
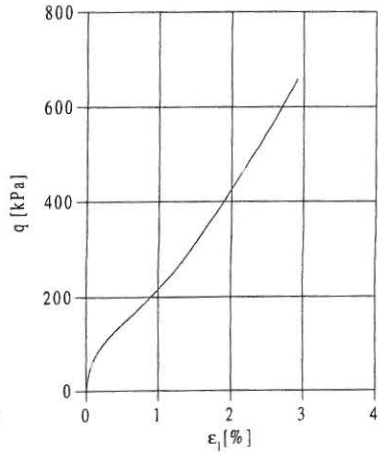
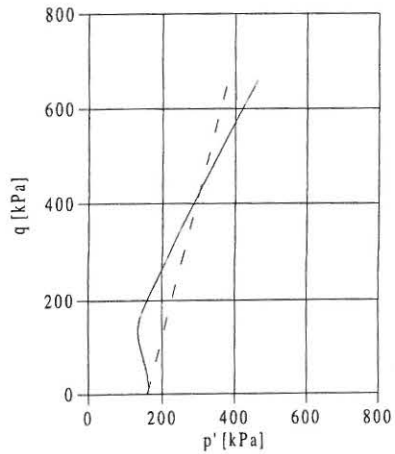
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: UP, KPJ Enclosure No. 11
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: UP, KPJ Enclosure No. 11
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: UP, KPJ Enclosure No. 11
 Evaluated: KPJ Approved: KPJ

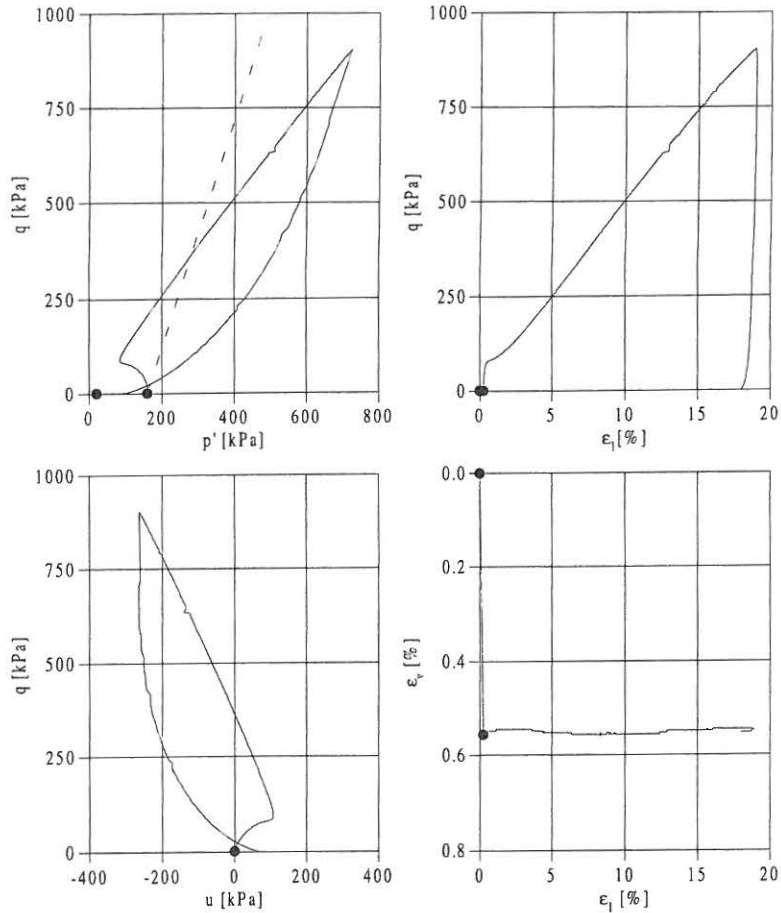
| | | | |
|---|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Pluviation | Calibration file Cal97106.dat | Height | 71.46 mm |
| Saturation procedure Water percolation | Date 1998-09-04 | Diameter | 69.66 mm |
| | | Void ratio | 0.825 |

| | | | |
|--------------|--------------------------------------|--------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 160.0 | kPa |
| | Loading rate: | 5.0 | kPa/min |
| | Undrained compression | 3.0 | % ph. |
| | Deformation rate: | | |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 160.1 | kPa |
| Axial strain | ϵ_1 | 0.24 | % |
| Volumetric strain | ϵ_v | 0.56 | % |
| Void ratio | e | 0.815 | |

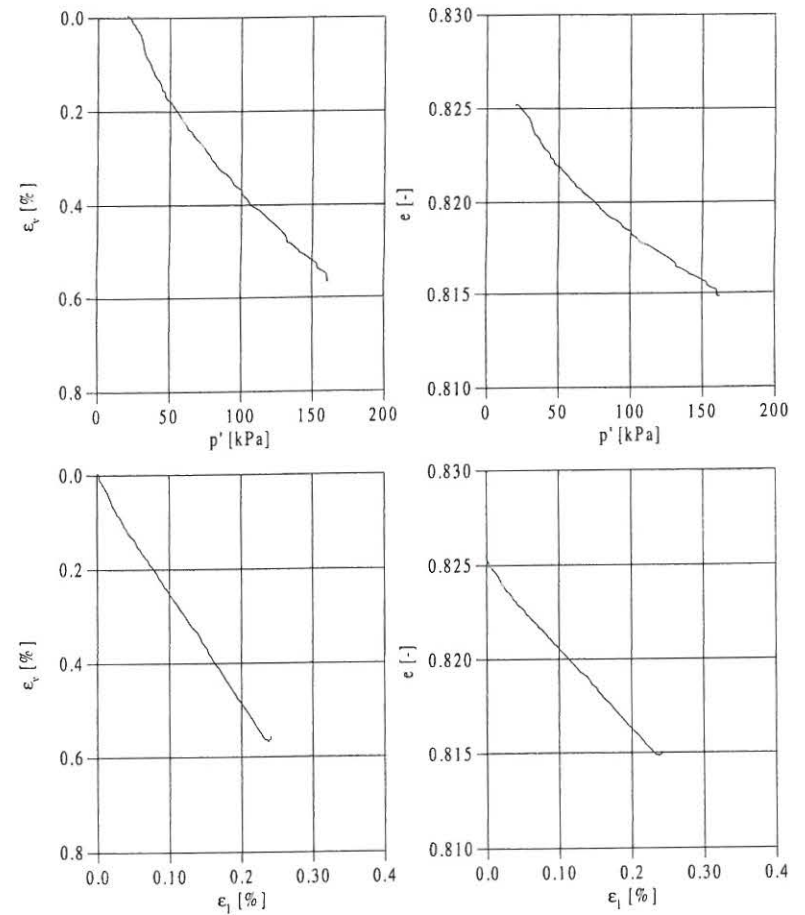
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
|-----------------------|-----------------------|----------------------|---------------------|
| Stress ratio | σ'_1/σ'_3 | 2.65 | 2.81 |
| Confining pressure | σ'_3 | 54.0 kPa | 53.4 kPa |
| Pore pressure | u | 106.0 kPa | 106.6 kPa |
| Deviator stress | q | 88.8 kPa | 96.4 kPa |
| Mean normal stress | p' | 83.6 kPa | 85.5 kPa |
| Ratio | q / p' | 1.06 | 1.13 |
| Axial strain | ϵ_1 | 1.13 % | 1.41 % |
| Friction angle | ϕ' | 26.8 ° | 28.3 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 12
 Evaluated: KPJ Approved: KPJ



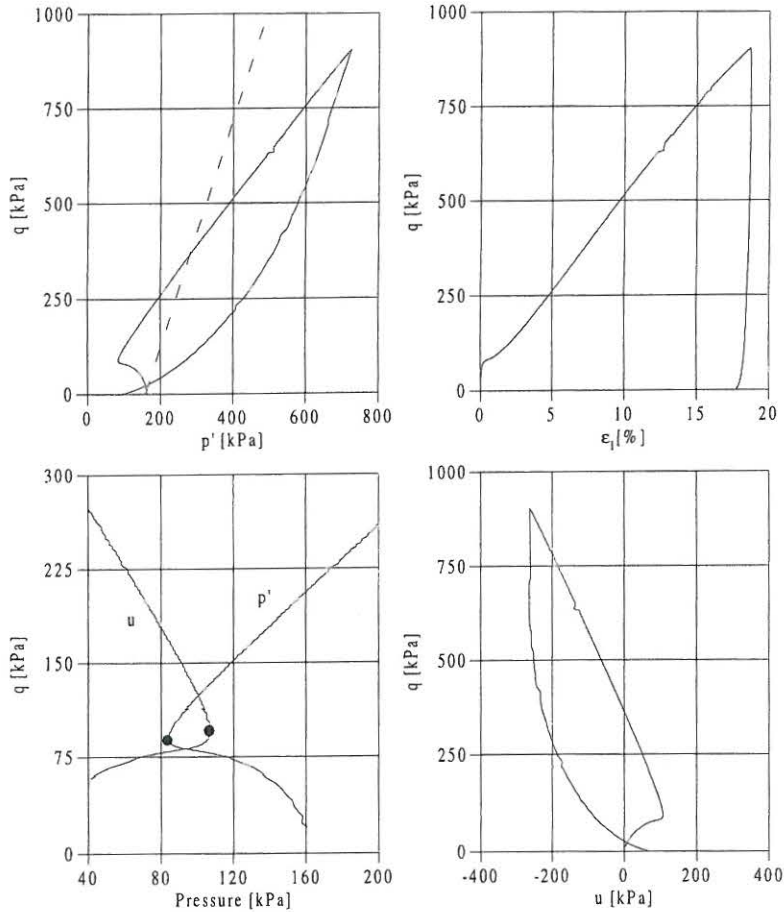
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 12
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 12
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 12
 Evaluated: KPJ Approved: KPJ

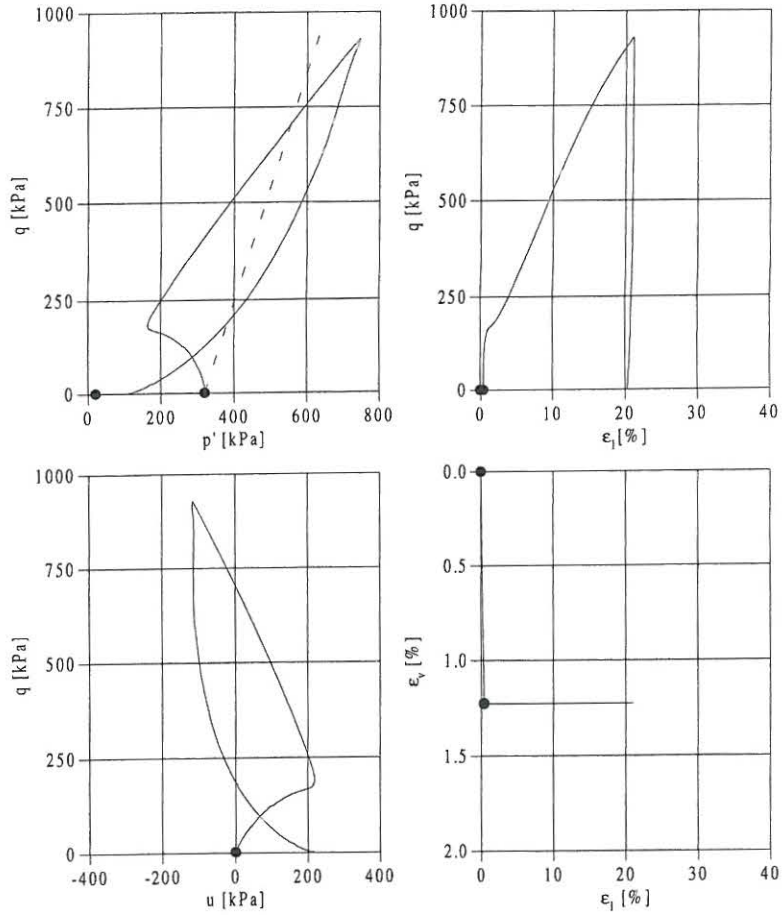
| | | | |
|---|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Pluviation | Calibration file Ca197107.dat | Height | 71.44 mm |
| Saturation procedure Water percolation | Date 1998-09-06 | Diameter | 69.64 mm |
| | | Void ratio | 0.824 |

| | | | |
|--------------|--------------------------------------|------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 320 | kPa |
| | Loading rate: | 5.0 - 10.0 | kPa/min |
| | Undrained compression | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|--|-----------|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | | 319.9 kPa |
| Axial strain | ϵ_1 | | 0.39 % |
| Volumetric strain | ϵ_v | | 1.22 % |
| Void ratio | e | | 0.802 |

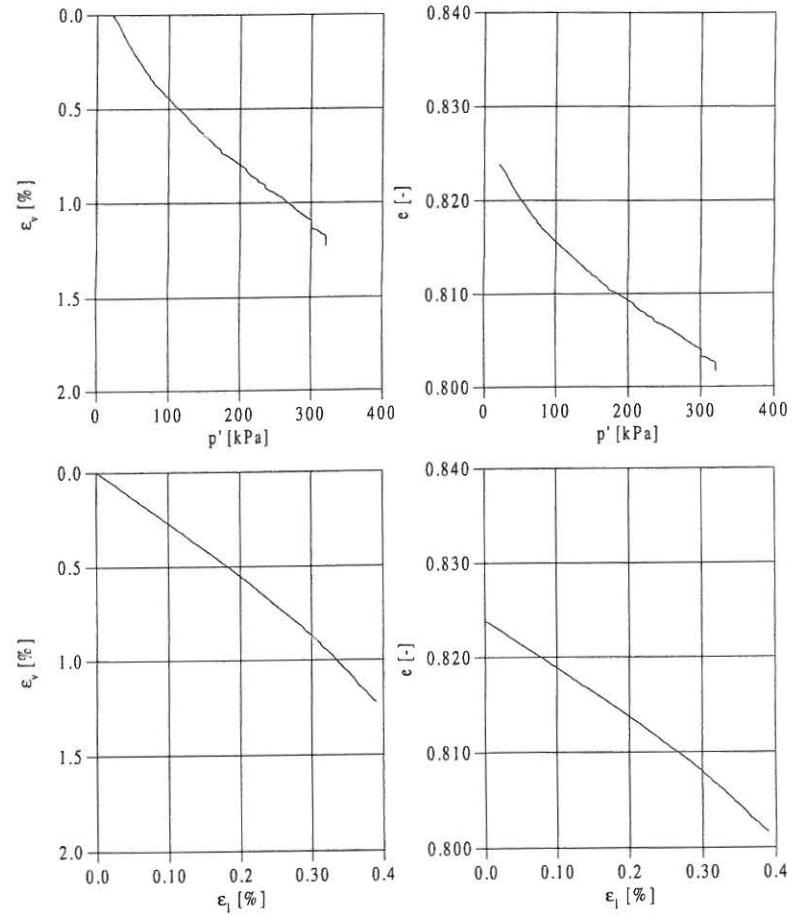
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
|-----------------------|-----------------------|----------------------|---------------------|
| Stress ratio | σ'_1/σ'_3 | 2.77 | 2.84 |
| Confining pressure | σ'_3 | 103.0 kPa | 102.0 kPa |
| Pore pressure | u | 217.1 kPa | 218.1 kPa |
| Deviator stress | q | 182.7 kPa | 187.4 kPa |
| Mean normal stress | p' | 163.9 kPa | 164.5 kPa |
| Ratio | q / p' | 1.12 | 1.14 |
| Axial strain | ϵ_1 | 1.99 % | 2.17 % |
| Friction angle | ϕ' | 28.0 ° | 28.6 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 13
 Evaluated: KPJ Approved: KPJ



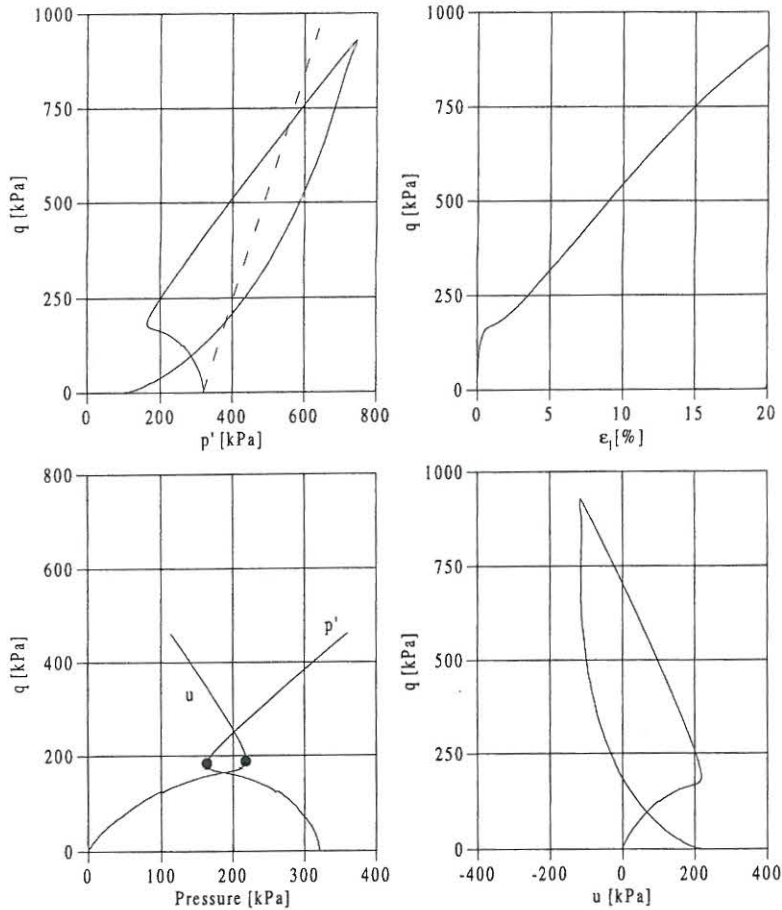
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 13
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 13
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 13
 Evaluated: KPJ Approved: KPJ

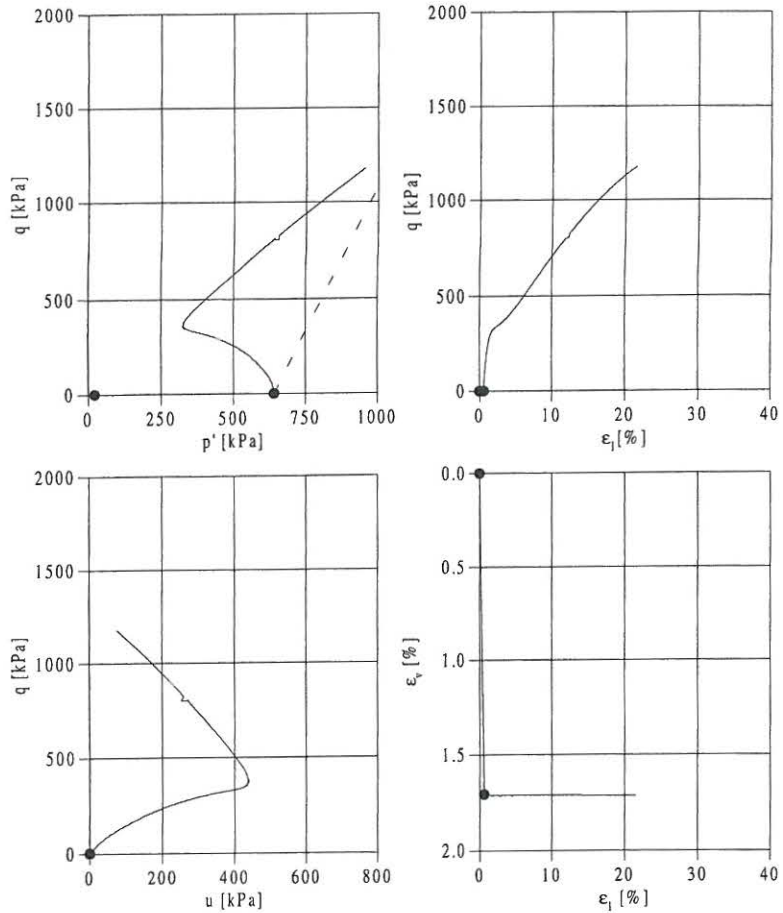
| | | | |
|--|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand Specimen preparation Pluviation Saturation procedure Water percolation | Triaxial Apparatus No. 2 | Specimen properties | |
| | Calibration file Ca197107.dat | Height | 71.45 mm |
| | Date 1998.09.06 | Diameter | 69.65 mm |
| | | Void ratio | 0.825 |

| | | | |
|--------------|--------------------------------------|--------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 640.0 | kPa |
| | Loading rate: | 5.0 - 10.0 | kPa/min |
| | Undrained compression | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 640.3 | kPa |
| Axial strain | ϵ_1 | 0.60 | % |
| Volumetric strain | ϵ_v | 1.70 | % |
| Void ratio | e | 0.794 | |

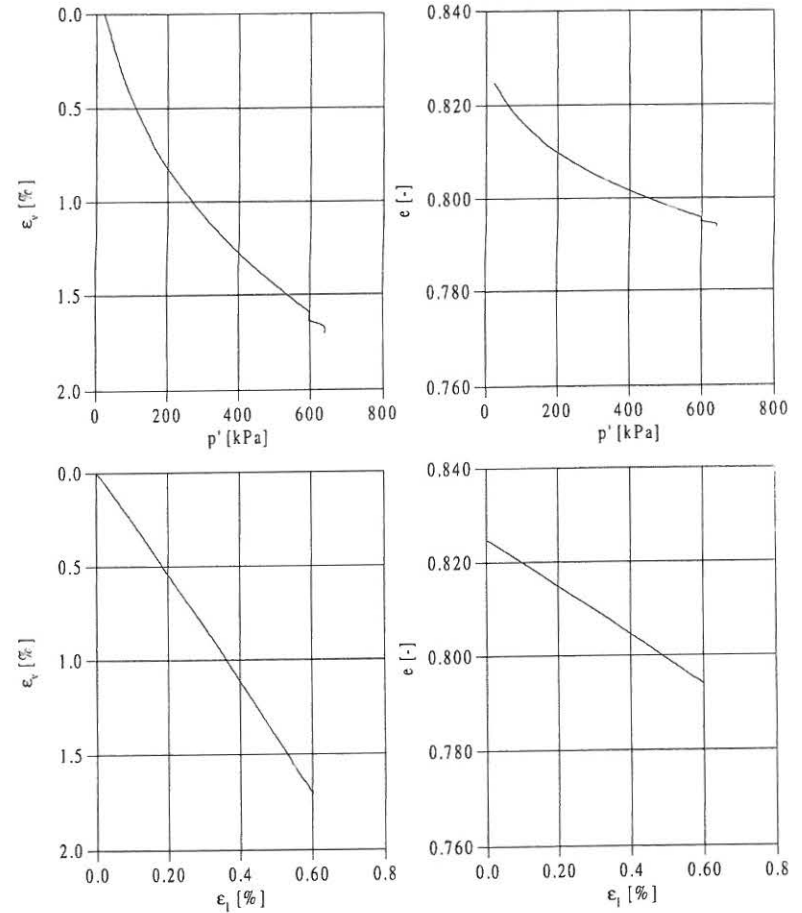
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
|-----------------------|-----------------------|----------------------|---------------------|
| Stress ratio | σ'_1/σ'_3 | 2.74 | 2.86 |
| Confining pressure | σ'_3 | 204.8 kPa | 202.8 kPa |
| Pore pressure | u | 435.4 kPa | 437.4 kPa |
| Deviator stress | q | 355.7 kPa | 376.6 kPa |
| Mean normal stress | p' | 323.4 kPa | 328.3 kPa |
| Ratio | q / p' | 1.10 | 1.15 |
| Axial strain | ϵ_1 | 3.01 % | 3.53 % |
| Friction angle | ϕ' | 27.7 ° | 28.8 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 14
 Evaluated: KPJ Approved: KPJ



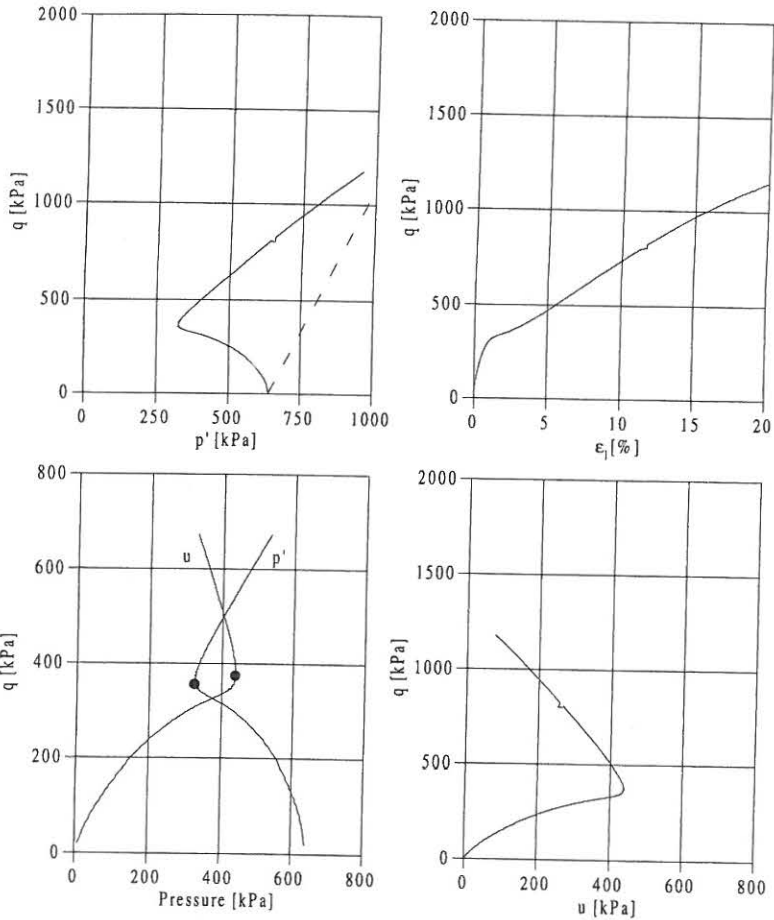
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 14
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 14
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 14
 Evaluated: KPJ Approved: KPJ

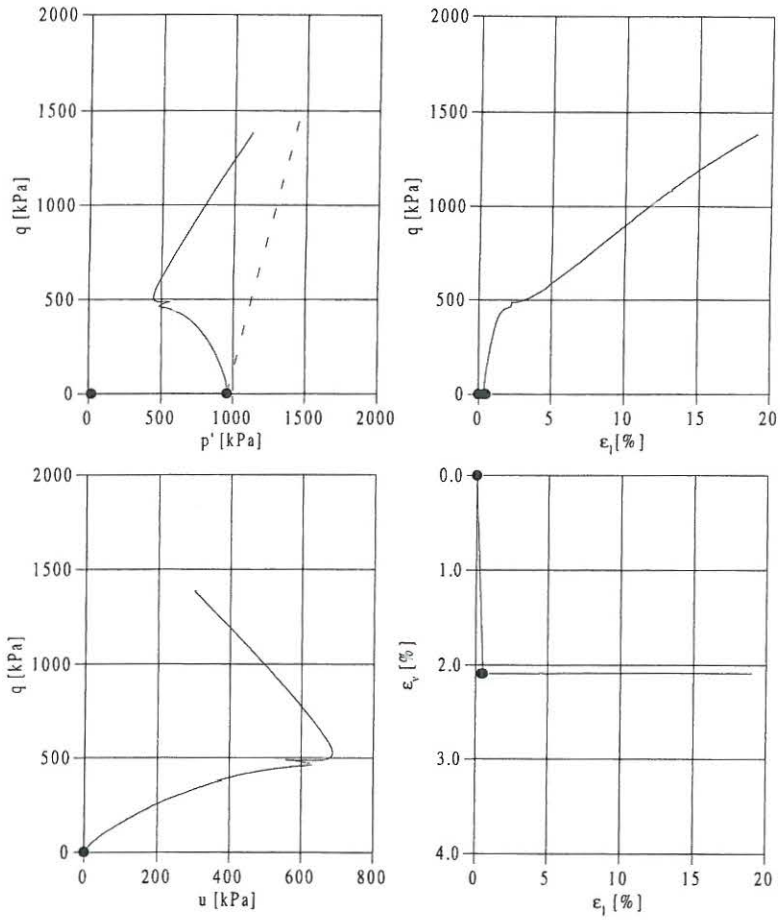
| | | |
|---|----------------------------------|--------------------------------------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties |
| Specimen preparation Pluviation | Calibration file Cal97107.dat | Height 71.45 mm Diameter 69.65 mm |
| Saturation procedure Water percolation | Date 1998-09-08 | Void ratio 0.825 |

| | | | |
|--------------|--------------------------------------|--------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 960.0 | kPa |
| | Loading rate: | 5.0 - 10.0 | kPa/min |
| | Undrained compression | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 960.0 | kPa |
| Axial strain | ϵ_1 | 0.51 | % |
| Volumetric strain | ϵ_v | 2.09 | % |
| Void ratio | e | 0.787 | |

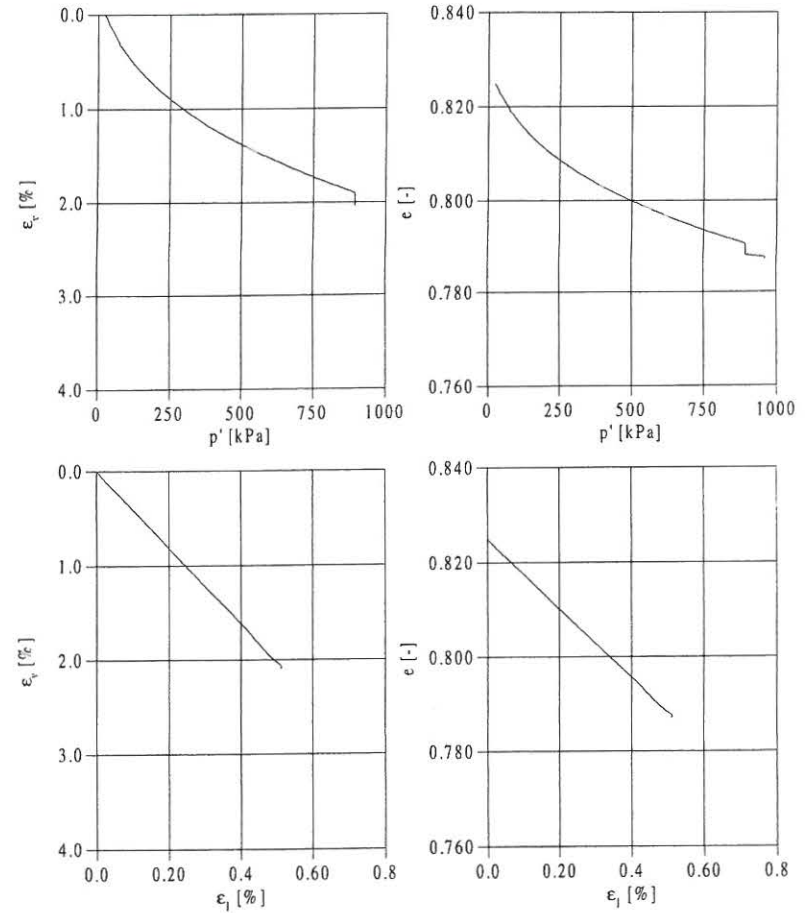
| | | | |
|-----------------------|-----------------------|---------------------|-----|
| Undrained compression | | Values at u_{max} | |
| Stress ratio | σ'_1/σ'_3 | 2.93 | |
| Confining pressure | σ'_3 | 273.1 | kPa |
| Pore pressure | u | 686.9 | kPa |
| Deviator stress | q | 528.2 | kPa |
| Mean normal stress | p' | 449.1 | kPa |
| Ratio | q / p' | 1.18 | |
| Axial strain | ϵ_1 | 3.92 | % |
| Friction angle | ϕ' | 29.5 | ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 15
 Evaluated: KPJ Approved: KPJ



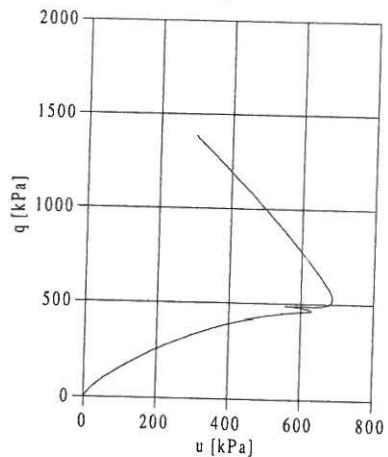
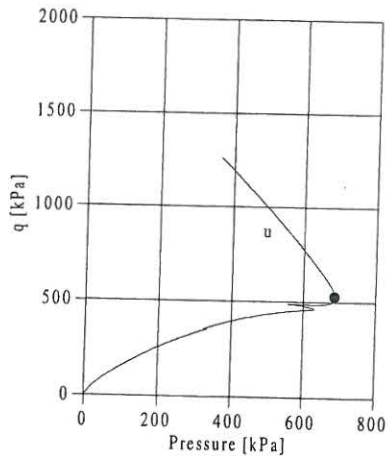
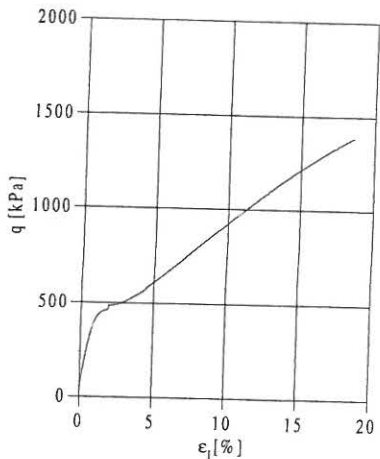
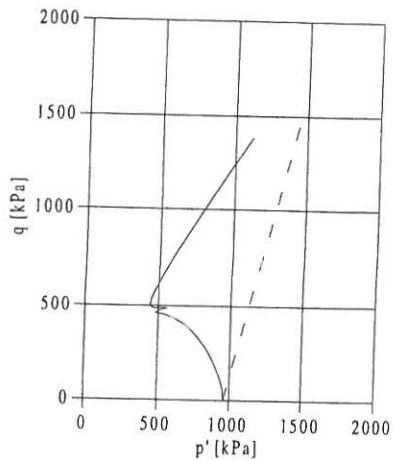
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 15
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 15
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 15
 Evaluated: KPJ Approved: KPJ

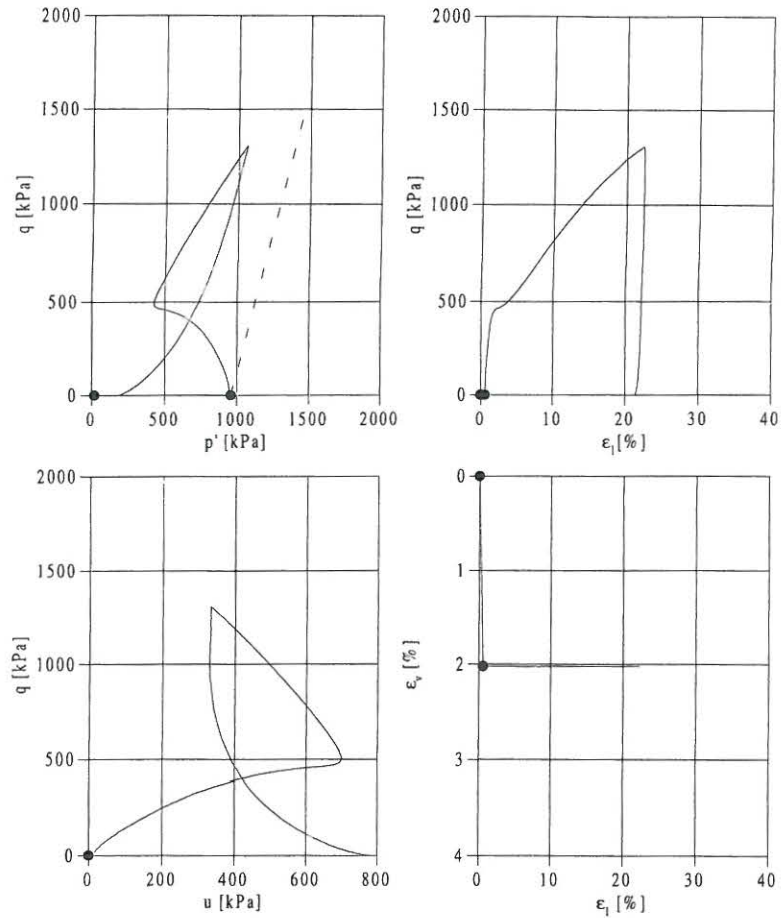
| | | |
|---|----------------------------------|--------------------------------------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties |
| Specimen preparation Pluviation | Calibration file Ca197107.dat | Height 71.45 mm Diameter 69.65 mm |
| Saturation procedure Water percolation | Date 1998-09-24 | Void ratio 0.825 |

| | | |
|--------------|--------------------------------------|--------------------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 960.0 kPa |
| | Loading rate: | 5.0 - 10.0 kPa/min |
| | Undrained compression | |
| | Deformation rate: | 3.0 % ph. |

| | | |
|-----------------------|--------------|-----------|
| Isotropic compression | | |
| Confining pressure | σ'_3 | 960.0 kPa |
| Axial strain | ϵ_1 | 0.59 % |
| Volumetric strain | ϵ_v | 2.02 % |
| Void ratio | e | 0.788 |

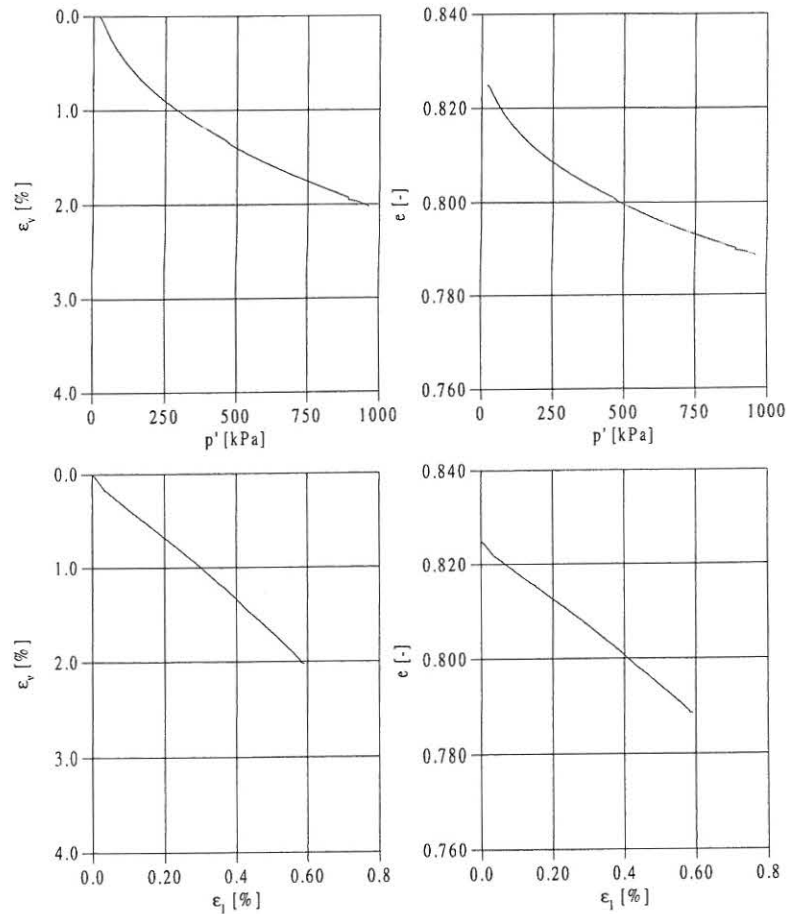
| | | | |
|-----------------------|-----------------------|----------------------|---------------------|
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
| Stress ratio | σ'_1/σ'_3 | 2.86 | 2.94 |
| Confining pressure | σ'_3 | 263.3 kPa | 260.8 kPa |
| Pore pressure | u | 696.7 kPa | 699.2 kPa |
| Deviator stress | q | 489.3 kPa | 505.5 kPa |
| Mean normal stress | p' | 426.4 kPa | 429.3 kPa |
| Ratio | q / p' | 1.15 | 1.18 |
| Axial strain | ϵ_1 | 3.50 % | 3.94 % |
| Friction angle | ϕ' | 28.8 ° | 29.5 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 16
 Evaluated: KPJ Approved: KPJ



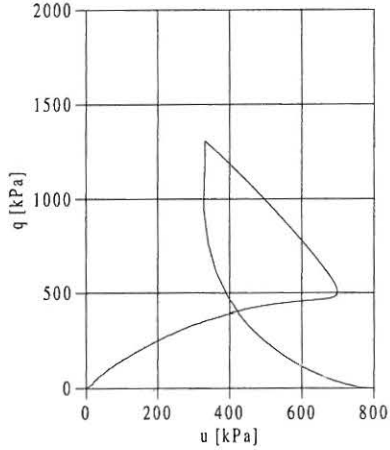
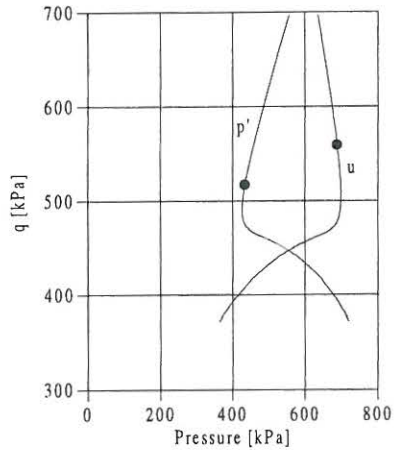
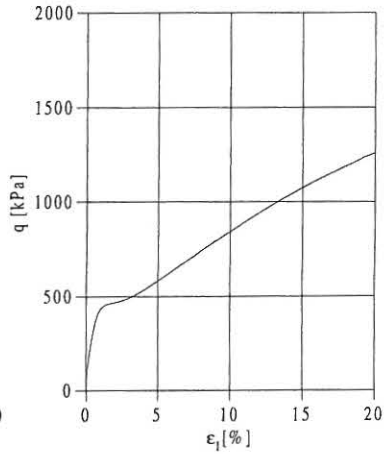
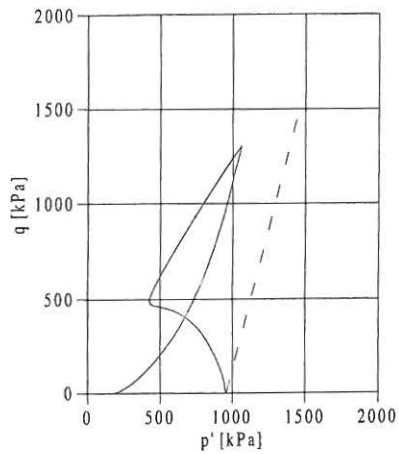
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 16
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 16
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 16
 Evaluated: KPJ Approved: KPJ

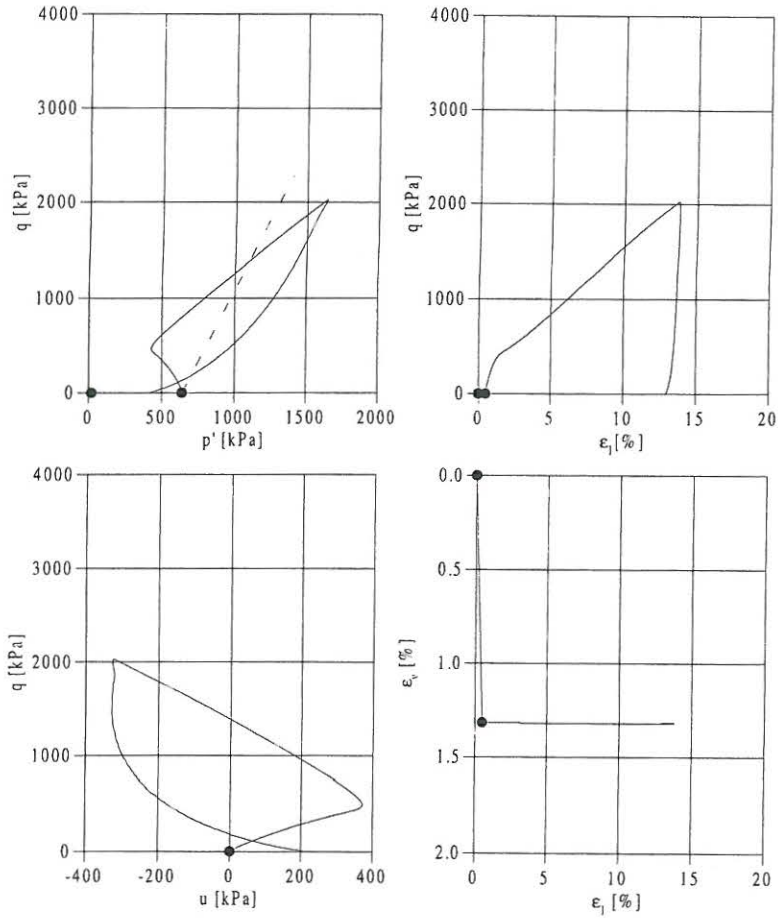
| | | | |
|---|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Pluviation | Calibration file Cal97107.dat | Height | 71.44 mm |
| Saturation procedure Water percolation | Date 1998-09-13 | Diameter | 69.64 mm |
| | | Void ratio | 0.726 |

| | | | |
|--------------|-------------------------------------|--------------|---------|
| Test program | Isotropic compression, σ_3 : | 20.0 - 640.0 | kPa |
| | Loading rate: | 5.0 - 10.0 | kPa/min |
| | Undrained compression | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ_3 | 640.0 | kPa |
| Axial strain | ϵ_1 | 0.51 | % |
| Volumetric strain | ϵ_v | 1.32 | % |
| Void ratio | e | 0.703 | |

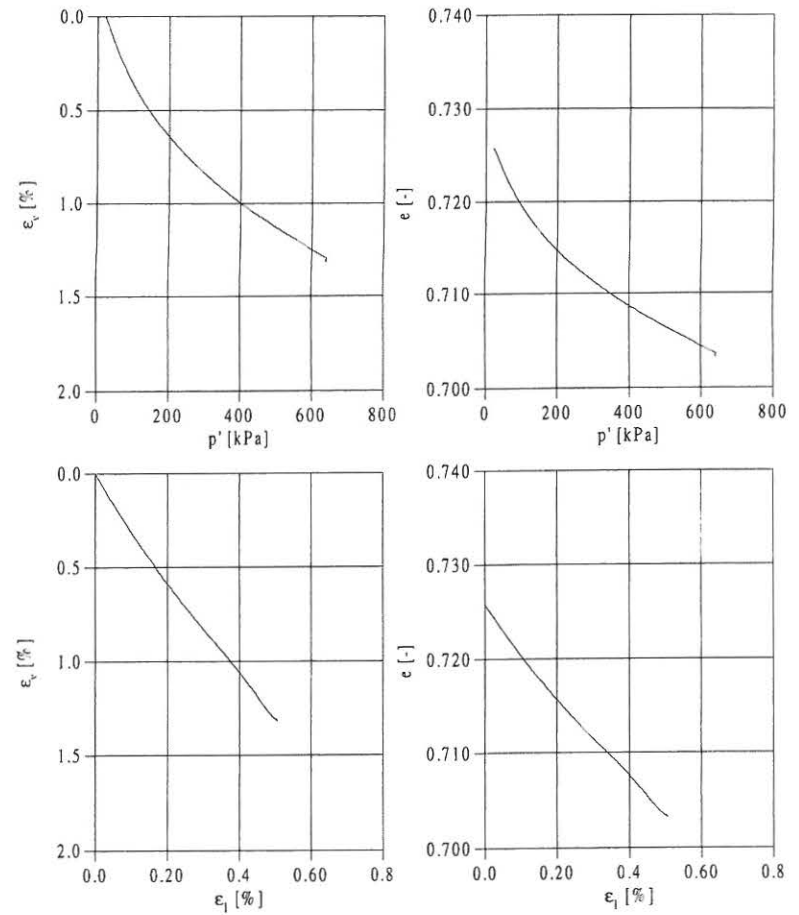
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
|-----------------------|-----------------------|----------------------|---------------------|
| Stress ratio | σ'_1/σ'_3 | 2.70 | 2.83 |
| Confining pressure | σ'_3 | 274.1 kPa | 268.5 kPa |
| Pore pressure | u | 365.9 kPa | 371.4 kPa |
| Deviator stress | q | 465.7 kPa | 492.6 kPa |
| Mean normal stress | p' | 429.3 kPa | 432.7 kPa |
| Ratio | q/p' | 1.09 | 1.14 |
| Axial strain | ϵ_1 | 1.93 % | 2.22 % |
| Friction angle | ϕ' | 27.3 ° | 28.6 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 17
 Evaluated: KPJ Approved: KPJ



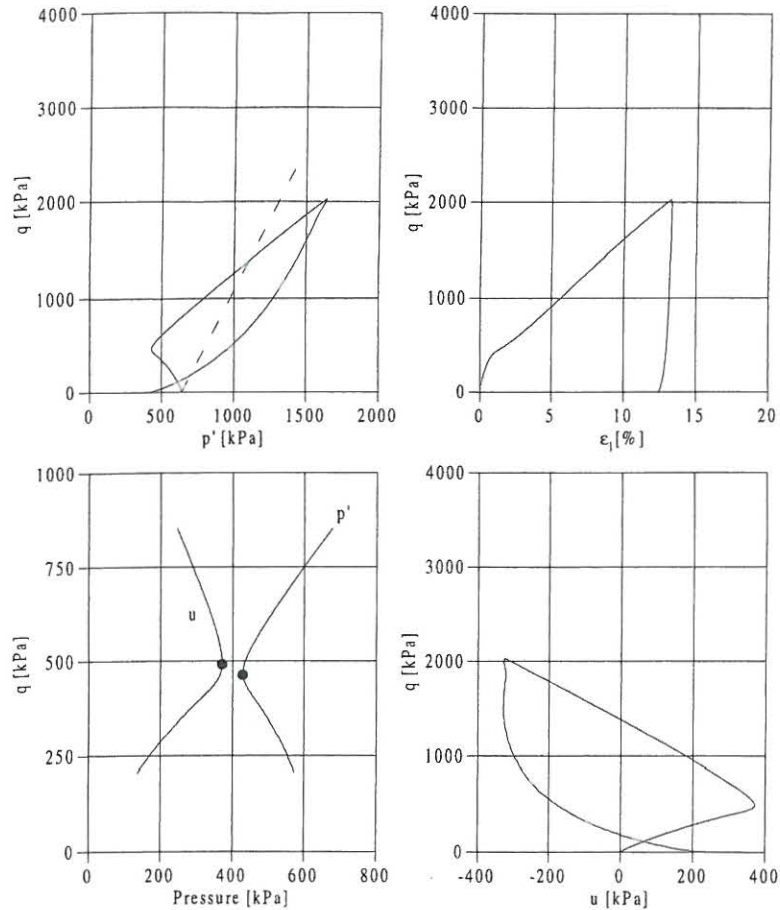
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 17
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 17
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 17
 Evaluated: KPJ Approved: KPJ

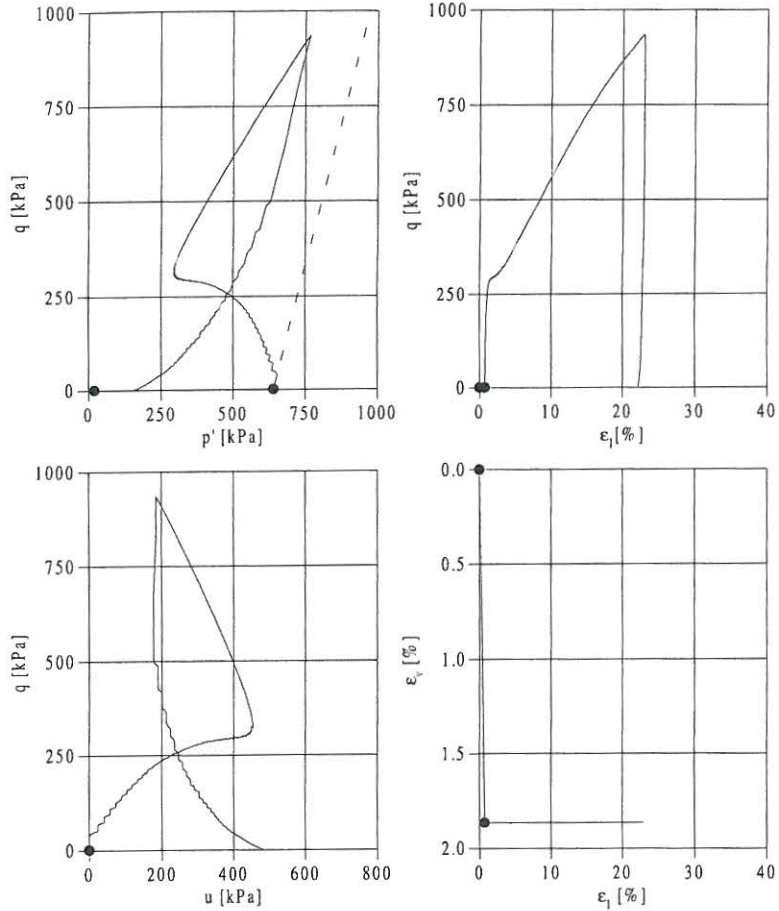
| | | | |
|---|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Pluviation | Calibration file Ca197107.dat | Height | 71.43 mm |
| Saturation procedure Water percolation | Date 1998-09-18 | Diameter | 69.63 mm |
| | | Void ratio | 0.881 |

| | | | |
|--------------|--------------------------------------|--------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 640.0 | kPa |
| | Loading rate: | 5.0 - 10.0 | kPa/min |
| | Undrained compression | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|--|-----------|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | | 640.0 kPa |
| Axial strain | ϵ_1 | | 0.73 % |
| Volumetric strain | ϵ_v | | 1.86 % |
| Void ratio | e | | 0.846 |

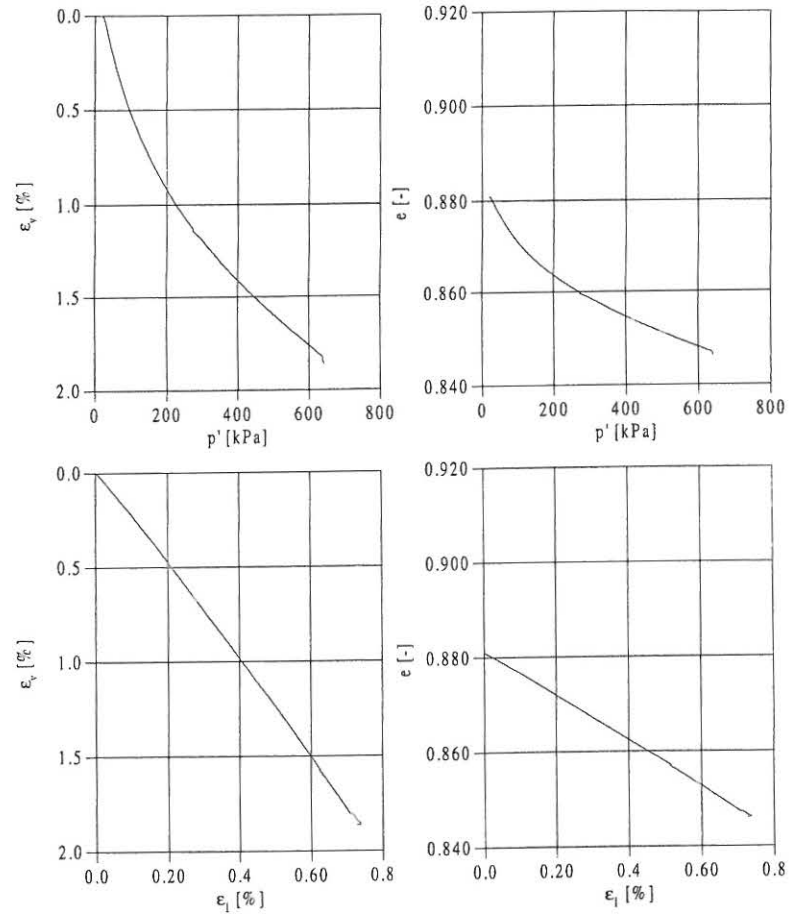
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
|-----------------------|-----------------------|----------------------|---------------------|
| Stress ratio | σ'_1/σ'_3 | 2.65 | 2.75 |
| Confining pressure | σ'_3 | 188.8 kPa | 185.6 kPa |
| Pore pressure | u | 451.1 kPa | 454.3 kPa |
| Deviator stress | q | 311.0 kPa | 325.1 kPa |
| Mean normal stress | p' | 292.5 kPa | 293.9 kPa |
| Ratio | q / p' | 1.06 | 1.11 |
| Axial strain | ϵ_1 | 2.91 % | 3.41 % |
| Friction angle | ϕ' | 26.9 ° | 27.8 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 18
 Evaluated: KPJ Approved: KPJ



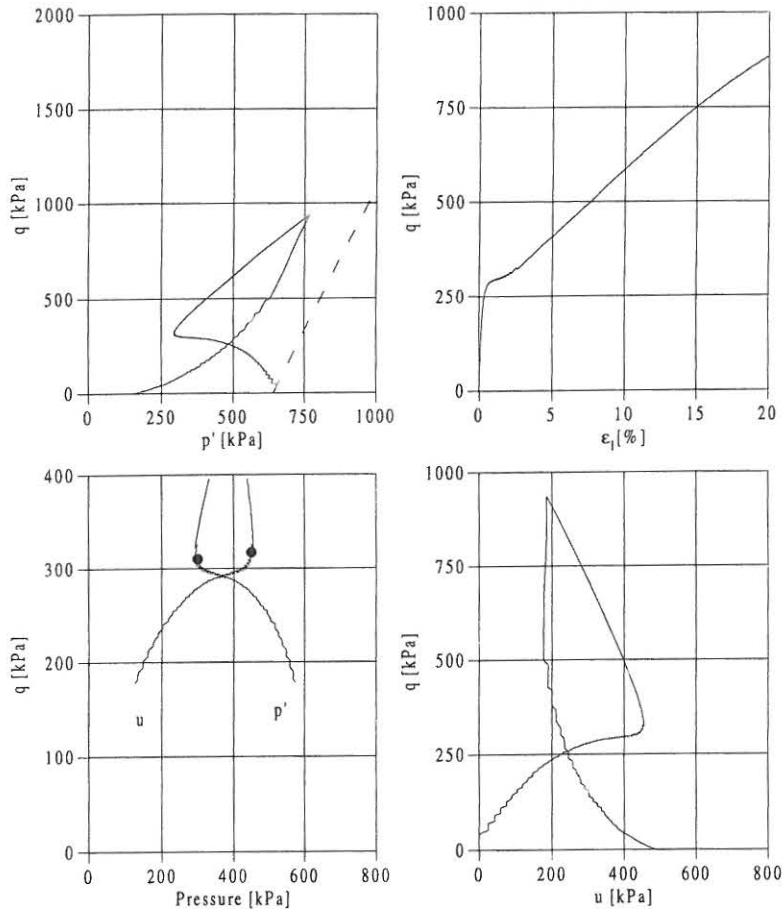
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 18
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 18
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 18
 Evaluated: KPJ Approved: KPJ

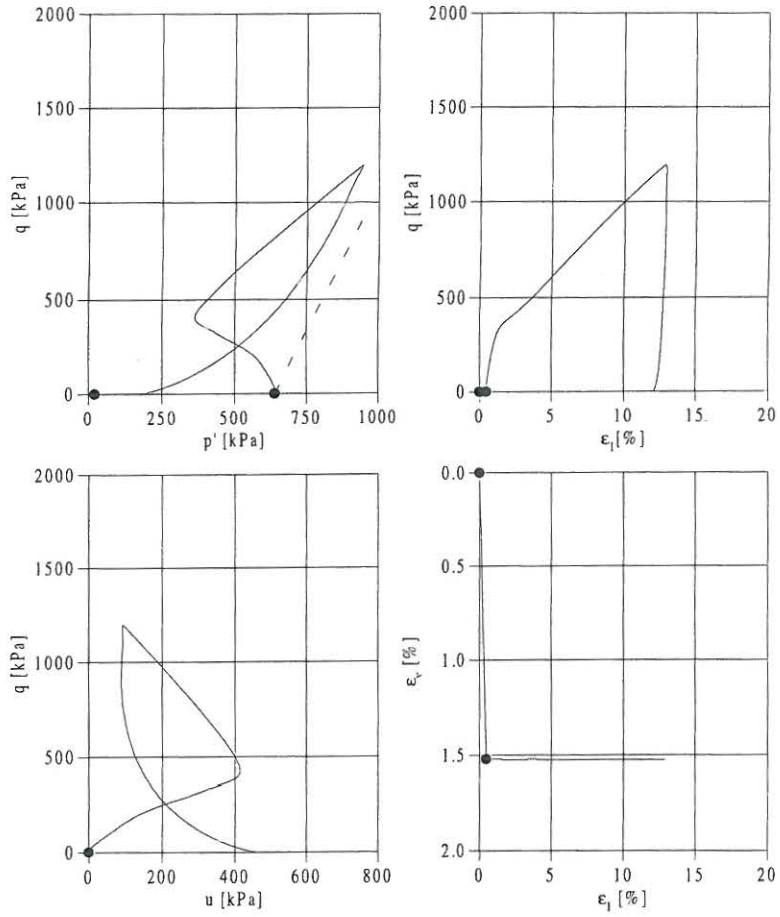
| | | | |
|---|----------------------------------|---------------------|----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Pluviation | Calibration file Ca197107.dat | Height | 71.35 mm |
| Saturation procedure Water percolation | Date 1998-09-16 | Diameter | 69.55 mm |
| | | Void ratio | 0.770 |

| | | | |
|--------------|-------------------------------------|--------------|---------|
| Test program | Isotropic compression, σ_3 : | 20.0 - 640.0 | kPa |
| | Loading rate: | 5.0 - 10.0 | kPa/min |
| | Undrained compression | 3.0 | % ph. |
| | Deformation rate: | | |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ_3 | 640.0 | kPa |
| Axial strain | ϵ_1 | 0.47 | % |
| Volumetric strain | ϵ_v | 1.52 | % |
| Void ratio | e | 0.744 | |

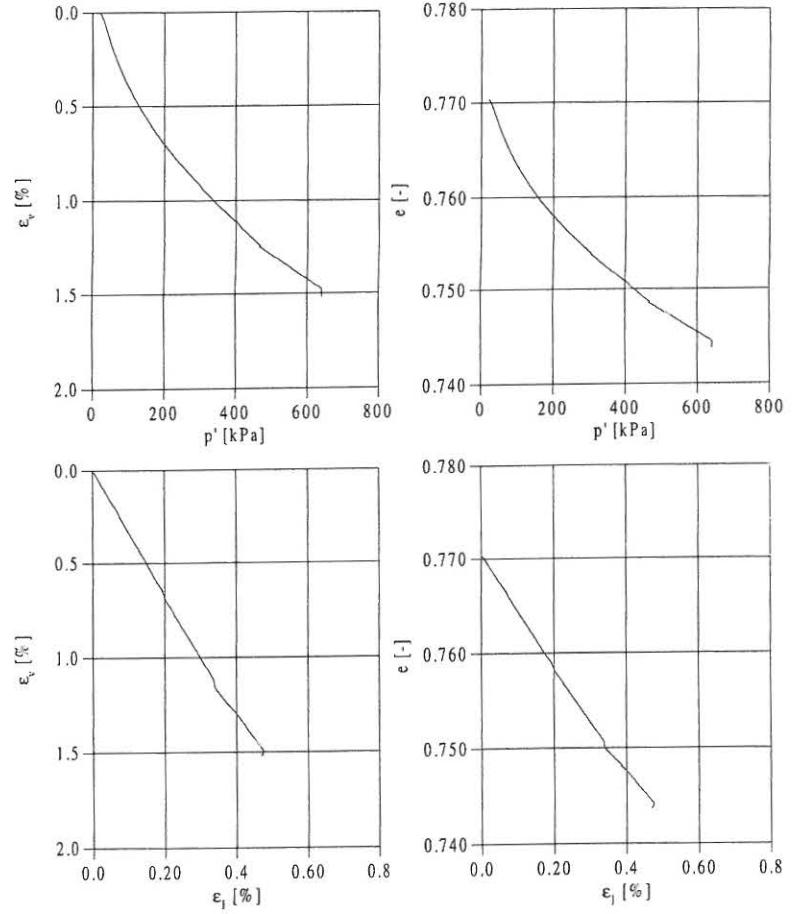
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
|-----------------------|---------------------|----------------------|---------------------|
| Stress ratio | σ_1/σ_3 | 2.77 | 2.90 |
| Confining pressure | σ_3 | 227.8 kPa | 223.9 kPa |
| Pore pressure | u | 411.1 kPa | 414.9 kPa |
| Deviator stress | q | 403.7 kPa | 426.3 kPa |
| Mean normal stress | p' | 362.3 kPa | 366.0 kPa |
| Ratio | q/p' | 1.11 | 1.17 |
| Axial strain | ϵ_1 | 2.29 % | 2.65 % |
| Friction angle | ϕ | 28.0 ° | 29.2 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 19
 Evaluated: KPJ Approved: KPJ



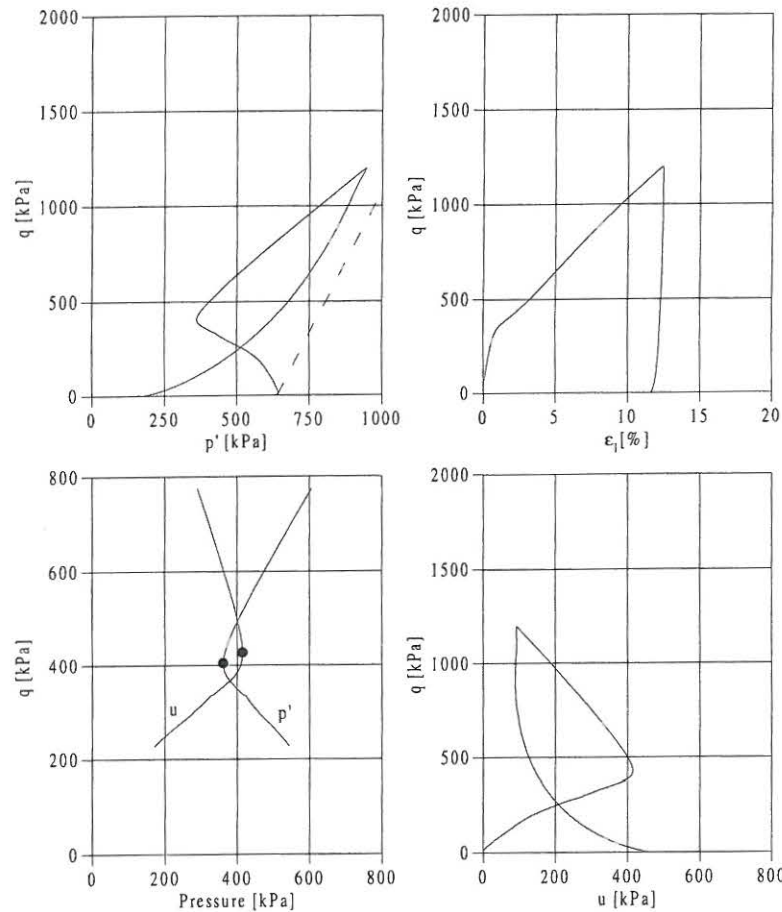
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 19
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 19
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 19
 Evaluated: KPJ Approved: KPJ

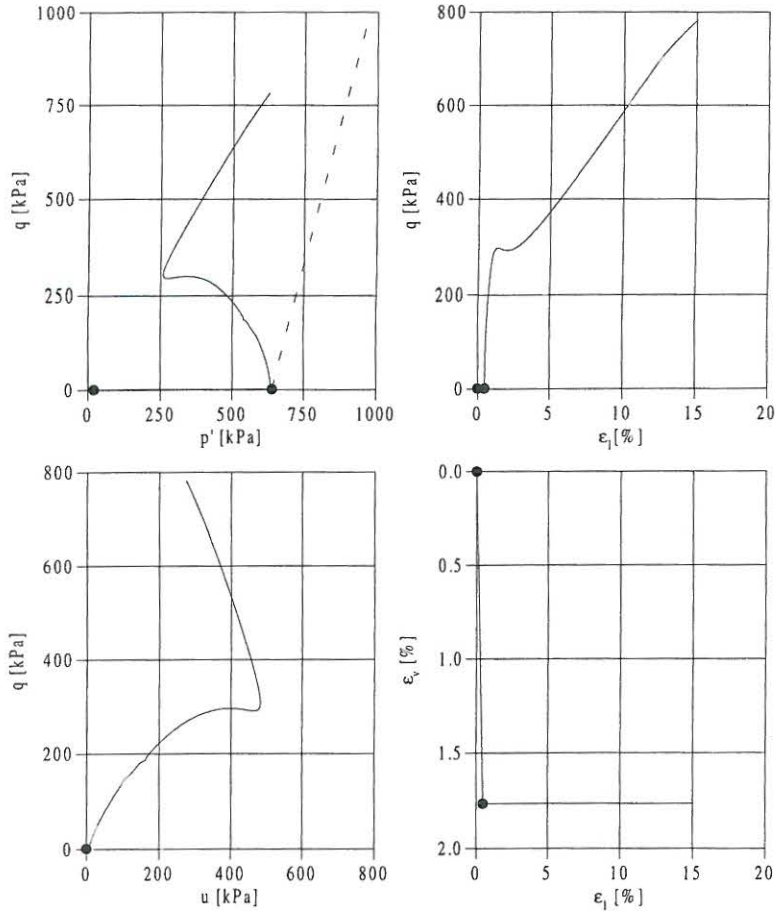
| | | | |
|---|----------------------------------|---------------------|-----------|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties | |
| Specimen preparation Pluviation | Calibration file Ca197108.dat | Height | 139.50 mm |
| Saturation procedure Water percolation | Date 1998-09-20 | Diameter | 69.35 mm |
| | | Void ratio | 0.825 |

| | | | |
|--------------|--------------------------------------|--------------|---------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 640.0 | kPa |
| | Loading rate: | 5.0 - 10.0 | kPa/min |
| | Undrained compression | | |
| | Deformation rate: | 3.0 | % ph. |

| | | | |
|-----------------------|--------------|-------|-----|
| Isotropic compression | | | |
| Confining pressure | σ'_3 | 640.0 | kPa |
| Axial strain | ϵ_1 | 0.47 | % |
| Volumetric strain | ϵ_v | 1.76 | % |
| Void ratio | e | 0.793 | |

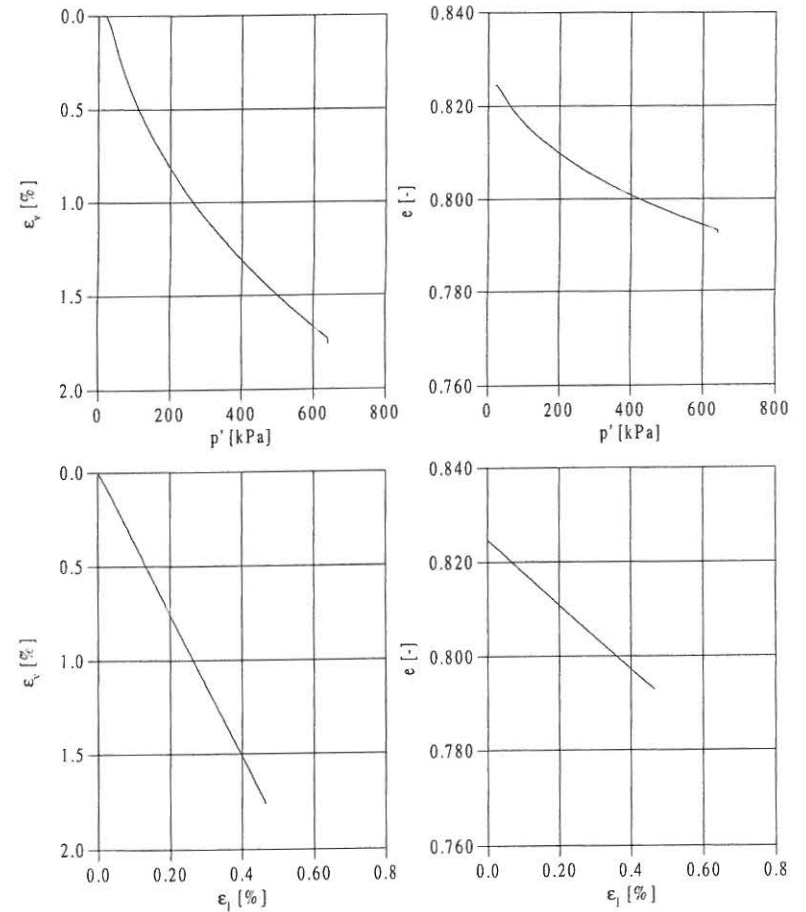
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
|-----------------------|-----------------------|----------------------|---------------------|
| Stress ratio | σ'_1/σ'_3 | 2.90 | 2.96 |
| Confining pressure | σ'_3 | 158.0 kPa | 157.2 kPa |
| Pore pressure | u | 482.0 kPa | 482.8 kPa |
| Deviator stress | q | 300.6 kPa | 307.5 kPa |
| Mean normal stress | p' | 258.2 kPa | 259.7 kPa |
| Ratio | q/p' | 1.16 | 1.18 |
| Axial strain | ϵ_1 | 2.82 % | 3.09 % |
| Friction angle | φ' | 29.2 ° | 29.6 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 20
 Evaluated: KPJ Approved: KPJ



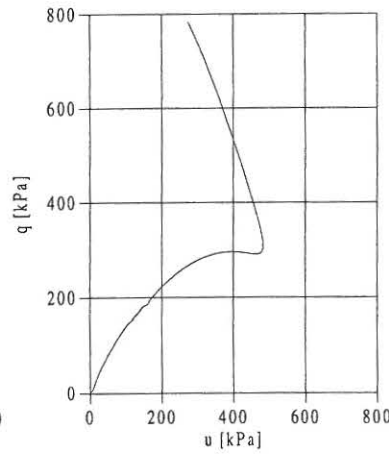
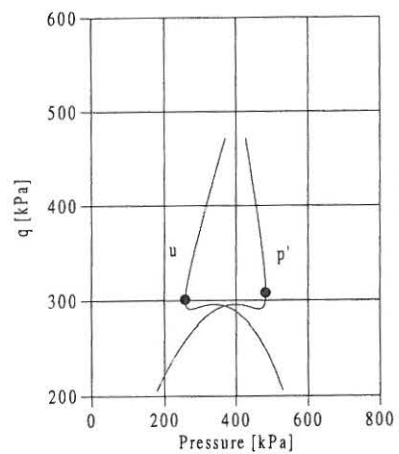
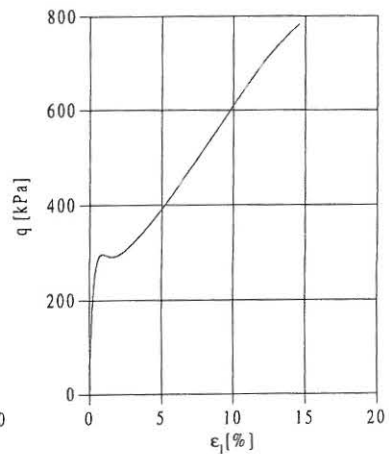
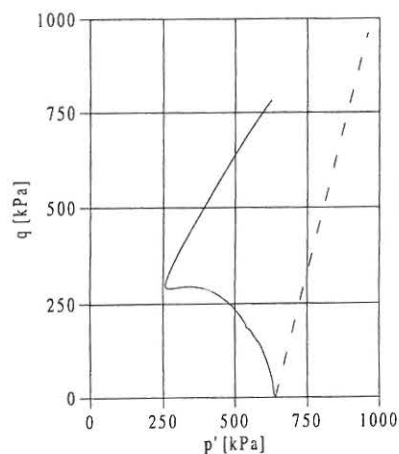
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 20
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 20
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 20
 Evaluated: KPJ Approved: KPJ

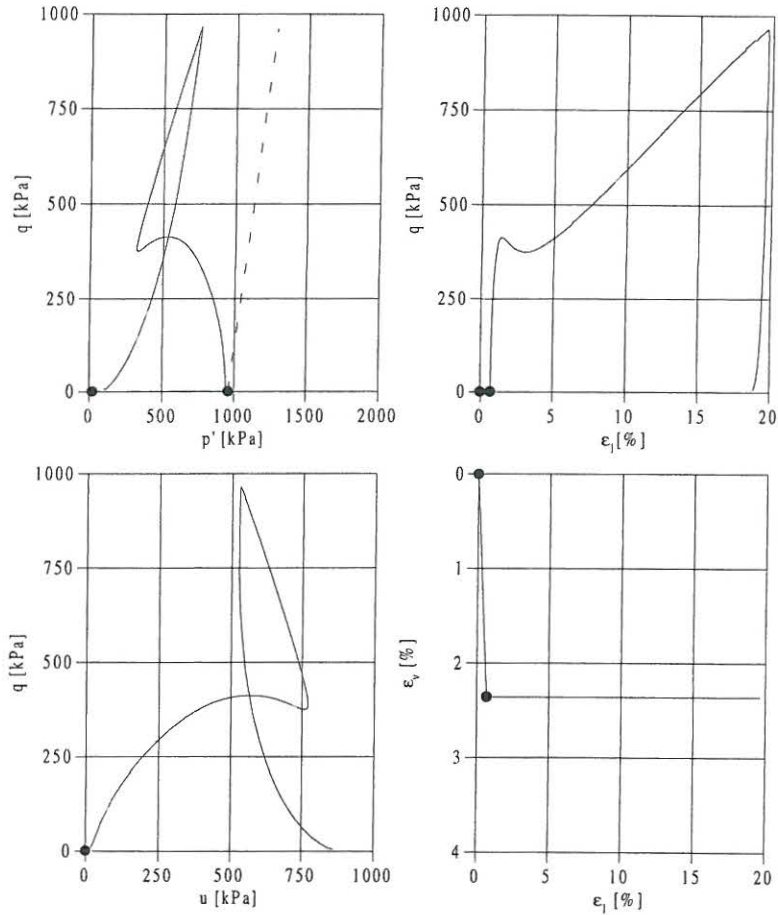
| | | |
|---|----------------------------------|--|
| Description of soil Eastern Scheldt Sand | Triaxial Apparatus No. 2 | Specimen properties |
| Specimen preparation Pluviation | Calibration file Ca197108.dat | Height 139.53 mm Diameter 69.37 mm Void ratio 0.826 |
| Saturation procedure Water percolation | Date 1998-09-21 | |

| | | |
|--------------|--------------------------------------|---------------------------|
| Test program | Isotropic compression, σ'_3 : | 20.0 - 960.0 kPa |
| | Loading rate: | 5.0 - 10.0 kPa/min |
| | Undrained compression | |
| | Deformation rate: | 3.0 % ph. |

| | | |
|-----------------------|--------------|----------------|
| Isotropic compression | | |
| Confining pressure | σ'_3 | 959.9 kPa |
| Axial strain | ϵ_1 | 0.68 % |
| Volumetric strain | ϵ_v | 2.36 % |
| Void ratio | e | 0.783 |

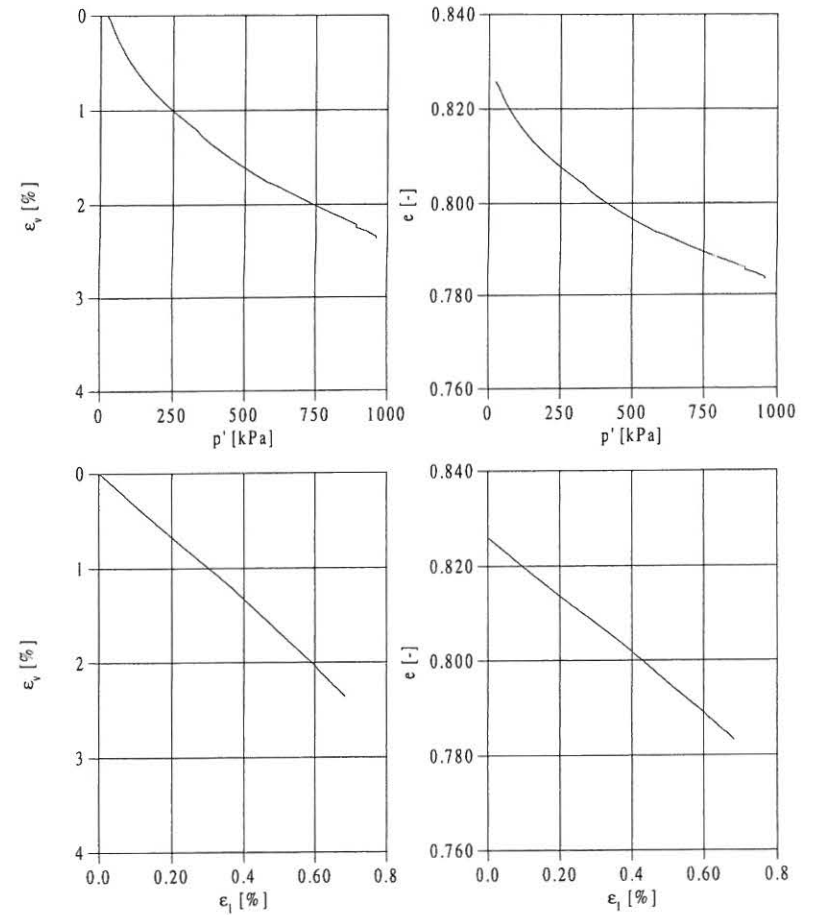
| | | | |
|-----------------------|-----------------------|----------------------|---------------------|
| Undrained compression | | Values at p'_{min} | Values at u_{max} |
| Stress ratio | σ'_1/σ'_3 | 3.00 | 3.05 |
| Confining pressure | σ'_3 | 190.5 kPa | 189.2 kPa |
| Pore pressure | u | 769.4 kPa | 770.7 kPa |
| Deviator stress | q | 381.4 kPa | 388.3 kPa |
| Mean normal stress | p' | 317.6 kPa | 318.6 kPa |
| Ratio | q / p' | 1.20 | 1.22 |
| Axial strain | ϵ_1 | 3.74 % | 4.11 % |
| Friction angle | ϕ' | 30.0 ° | 30.4 ° |

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 21
 Evaluated: KPJ Approved: KPJ



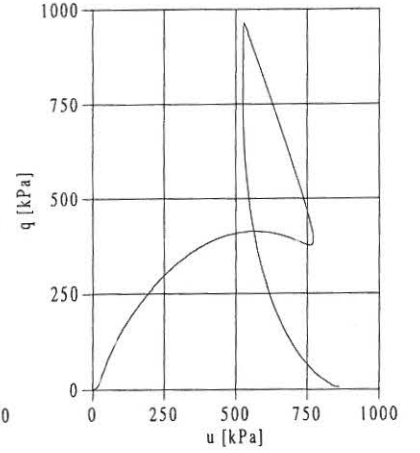
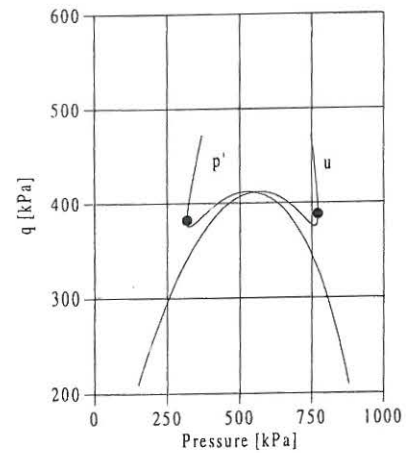
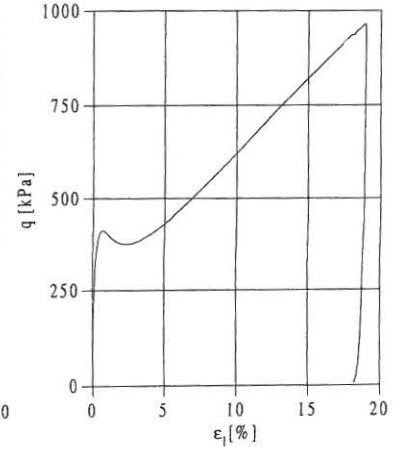
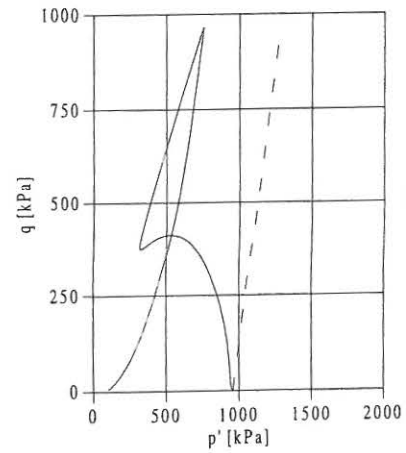
Legend
 ● Isotropic compression
 — Undrained compression

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 21
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 21
 Evaluated: KPJ Approved: KPJ



Remarks

Job: Ph.D. Project Aalborg University
 Executed: KPJ Enclosure No. 21
 Evaluated: KPJ Approved: KPJ

AGEP: Laboratory testing papers

- 1 Ibsen, L.B., Borup, M., Hedegaard, J. (1995). Triaxial tests on Baskarp Sand No 15. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9501
- 2 Ibsen, L.B., Lund, W., Jacobsen, F.R. (1995). Triaksialforsøg på yoldia ler (Triaxial tests on Yoldia Clay; in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9502
- 3 Ibsen, L.B., Bødker, L. (1995). Triaxial tests on Blokhush Sand. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9510.
- 4 Ibsen, L.B., Jacobsen, F.R. (1995). Triaxial tests on Lund Sand No 0. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9511.
- 5 Ibsen, L.B., Jacobsen, F.R. (1995). Triaxial tests on Portland Gravel. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9512.
- 6 Ibsen, L.B., Lund, W., Bødker, L. (1995). Bender element and triaxial tests on coral sand. Fort George Power Station, Mauritius. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9513.
- 7 Rasmussen, M.S., Sørensen, C.S. (1995). New Large Test Setup for Dynamic Testing of Soils. Proc. 1st Int. Conf. on Earthquake Geotechnical Engineering. Tokyo, Vol 2, pp 749-754. Also in *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9516.
- 8 Ibsen, L.B., Steenfelt, J.S. (1995). Triaxial and True Triaxial tests on Pleistocene clay. The Mississippi Canyon Area, the Gulf of Mexico. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9519.
- 9 Steenfelt, J.S., Ibsen, L.B., Jacobsen, F.R. (1995). Triax- og konsolideringsforsøg på Branden ler. Hovedlandevej 472, Vium-Sundsøre (Triaxial and oedometer tests on Branden Clay; in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9520.
- 10 Bødker, L., Steenfelt, J.S., Lund, W. (1995). Triaxforsøg på stærkt siltet sand. Gl. Løkkensvej, Hjørring (Triaxial tests on very silty sand; in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9521.
- 11 Bødker, L. (1996). G_{max} for sand by bender elements at anisotropic stress states. *Proc. Nordic Geotechnical Meeting, NGM-96, Reykjavik*, Vol 1, pp 93-122. Also in *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9602.
- 12 Ibsen, L.B., Lund, W., Steenfelt, J.S. (1996). Konsolideringsforsøg på tørv. Skjern Å - Naturprojekt (Oedometer tests on peat). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9610.
- 13 Steenfelt, J.S., Lund, W. (1997). Ødometerforsøg, Fibo letklinker (10-20) (Oedometer tests on Fibo light weight aggregates; in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9703.
- 14 Steenfelt, J.S. (1997). Ødometerforsøg, Fibo letklinker (specialsortering) (Oedometer tests on Fibo light weight aggregates (special grade); in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9704.

AGEP: Laboratory testing papers

- 15 Steenfelt, J.S., Ibsen, L.B. (1997). Konsolideringsforsøg på moræneler. DORAS - Fredericia Terminal (Oedometer tests on clay till; in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9705.
- 16 Steenfelt, J.S., Thøgersen, L.(1997). Konsoliderings- og triaxforsøg på fyld/gyttje med skaller. Forlægning ved Kolind (Oedometer and triaxial tests on fill/gyttja with shell fragments; in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9711.
- 17 Steenfelt, J.S. (1998). Konsolideringsforsøg på senglacialt ler. Ostemejeri i Taulov (Oedometer tests on late glacial clay; in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9801.
- 18 Steenfelt, J.S. (1998). Konsolideringsforsøg på silt og ler. Ostemejeri i Taulov (Oedometer tests on silt and clay; in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9806.
- 19 Steenfelt, J.S. (1998). Konsolideringsforsøg på gyttje. Renovering af Skive Stadion (Oedometer tests on gyttja; in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9807.
- 20 Steenfelt, J.S., Jakobsen, K.P. (1998). Triaxial tests on heavy sand. Namibia. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9808.
- 21 Lund, W.P., Jakobsen, K.P. (1998). Permeability tests on Silkeborg Sand No 0000. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9811.
- 22 Steenfelt, J.S. (1998). Konsolideringsforsøg på okkerpræget tørv/gyttje. Skjern Å - Naturprojekt. (Oedometer tests on ochreous peat/gyttja; in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9812.
- 23 Jakobsen, K.P. (1998). Permeability tests on Eastern Scheldt Sand. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9821.
- 24 Jakobsen, K.P., Prastrup, U. (1998). Drained triaxial tests on Eastern Scheldt Sand. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9822.
- 25 Jakobsen, K.P. (1998). Undrained triaxial tests on Eastern Scheldt Sand. *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9823.