



## GDSCTS Consolidation Testing System

User: The Faculty of Geotechnical Engineering at the University of Zagreb

**The University of Zagreb** (1669) is the oldest and biggest university in South-Eastern Europe. With its comprehensive programmes and over 50,000 full-time undergraduate and postgraduate students.

The University is the strongest teaching institution in Croatia. It offers a wide range of academic degree courses leading to Bachelor's, Master's and Doctoral degrees. It is also a strong research-oriented institution, contributing to over 50 percent of the country's total research.

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### The Problem

The aim of this research was to prove that the soil materials from the so called flysch deposits (which are locally available on the Istrian peninsula at low cost), can be used as the components of the liner layers in municipal landfills.

### The Solution

To obtain the coefficient of permeability the constant rate of flow method was used within the GDSLAB standard hydrocon module.

The original reason for purchasing the GDSCTS system was to study the creeping behaviour of clays as part of a scientific project which was supported by the Croatian Ministry of Science. However, up until January 2009, the Rowe and Barden Consolidation cell was almost exclusively used for educational purposes, until this new research project was introduced by professor Davorin Kovačić.

Due to limited resources it took the faculty of Geotechnical Engineering at the University of Zagreb 4 years to complete their full consolidation system. Purchased in stages, it was ready for use in 2008. Two advanced pressure/volume controllers, a data logger, pore pressure and displacement transducers a copy of GDSLAB software with the standard hydrocon module, alongside full on-site training were purchased from GDS during this 4 year period, to complement the Universities existing Rowe & Barden consolidation cell.

### Results / Testimonial

The flow rate was controlled with GDS's advanced pressure/volume controllers connected to the top and bottom of the specimen. The cell pressure on top of the specimen was applied through the air/water constant pressure system operated by an air compressor. The results prove that tested compacted marl material can achieve permeability less than  $1 \times 10^{-7}$



Fig.1 Faculty of Geotechnical Engineering at the University of Zagreb complete consolidation system

cm/s. The results of this research were published at ISRM Regional Symposium EUROCK 2009.



Fig. 2 Marl exposure at Paz site

In the meantime, as a part of a scientific project “Characterization of Municipal Solid Waste” (also financially supported by Croatian ministry of science, education and sports), the University developed a large oedometer device with sample diameter of 500 mm and sample height of 200 mm, with a maximum pressure capacity of 2000 kPa. The main purpose of this device was to measure stiffness of mechanically and biologically pre-treated municipal solid waste (Mechanical Biological Treatment, or MBT waste). It is also possible for this oedometer to measure soil stiffness. In order to verify the reliability of results obtained with the device.



Fig. 3 GDS's Instruments advanced pressure controllers

The University compared its results with results published from other authors, and had a very satisfactory outcome. In order to verify the reliability of results obtained with the Universities oedometer, the University plans to compare its results with those obtained using the GDS consolidation system. The University considers the results obtained from the GDS consolidation system as a reference ‘bench mark’ value. They hope that results will be in positive agreement just as it was the case for the MBT samples. The ongoing research is planned to be complete in the summer of 2010.

### Conclusion

Igor Petrović, MSc, from the faculty of Geotechnical Engineering at the University said “At the end, I am very happy that the primary reason why we bought GDS consolidation system, that is for the study of creep behaviour of clays, will be finally realised. I am very happy that I can say after almost eight years we have made a full circle and I hope that we have shown that even with small amounts of money it is still possible to achieve respectable results as long as we have the opportunity to work with people who are enthusiastic and dedicated to their work.”

### Testing Equipment Purchased

- : 2 x ADVDP
- : Data Logger
- : Pore pressure / displacement transducer
- : GDSLAB
- : Hydrocon Software Module
- : Rowe & Barden Consolidation Cell