Research Project

02-7GT

Capsule

LTRC

Technology Transfer Program

March 2003

Microfocus Real-Time Radiography: A Potential Technology to Study Micro-Structure of Geomaterials

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Duration: 12 months

Completion date: 3/31/03

Funding: State

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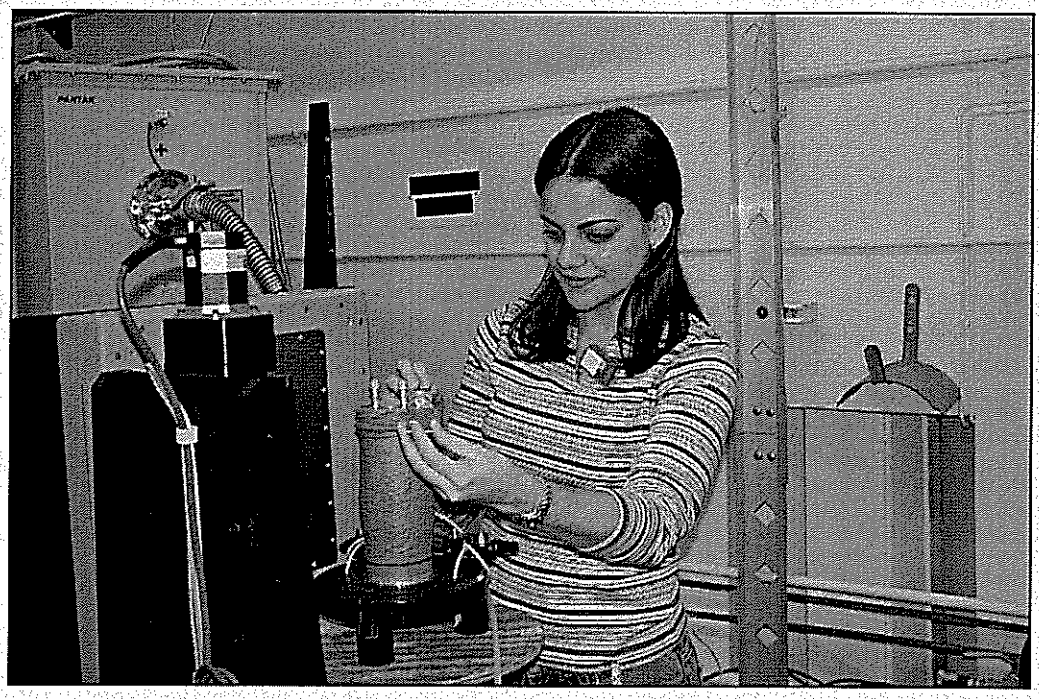
Problem

The strength and deformation characteristics of most engineering materials are derived from the forces of interaction between the constituent particles. The behavior of uncemented granular materials (aggregate) is influenced by the particle structure and the interparticle friction that result from normal forces acting on the material.

Coulomb theory suggests that a soil's resistance to shearing is dependent on applied normal forces. This theory has been widely used in soil mechanics and geotechnical engineering, but it neglects any kinematic contribution to the strength of granular materials.

A microscopic visualization of the interaction (sliding, rolling, interlocking) between particles subjected to shearing will contribute to a greater understanding of granular material behavior. Computed Tomography (CT) is a non-destructive technique that can be used to capture three-dimensional



Preparing a sand specimen for computed tomography analysis

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Louisiana Transportation Research Center

Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

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images of materials at a microscopic level, but this process is very slow. The feasibility of using real-time microfocus radiography to obtain similar images will be investigated during this study.

Objective

This research project consists of an investigation into the feasibility for using real-time microfocus radiography to study the structure of granular materials.

The following specific objectives will be achieved:

1) The feasibility of using real-time microfocus radiography as a technique to characterize the structure of granular materials during loading will be investigated.

2) Particle interaction at the microscopic level will be studied.

3) The contribution of particle interaction to the overall shearing resistance of granular materials will be evaluated and quantified.

Description

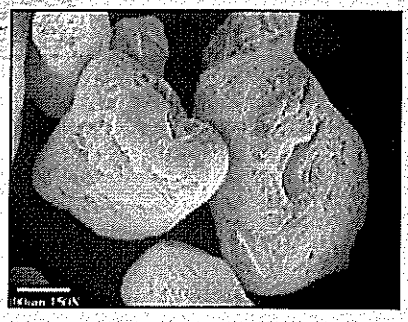
F-75 Ottawa sand will be used for this study. Suitable specimens will be prepared for microfocus radiography analysis. The specimens will be loaded under a plane strain (biaxial) condition. A constant displacement rate will be provided along the direction of the major principal stress, while a constant minor principal stress is maintained.

A series of biaxial experiments will be conducted on the sand specimens to gain a better understanding of the behavior of the material. Based on the results of these experiments, test parameters will be chosen for use during experiments to be performed using a CT and Digital Radiography system. Real-time microscopic images of the specimen will be captured while testing is in progress.

Implementation

This project was initiated as a "proof-of-principle" study. Further research may lead to the development of unique measurements of particle interaction, utilizing innovative non-destructive technology. The research may also result in new theories that describe the behavior of engineering materials.

Louisiana DOTD will benefit from this research through a better understanding of the strength and deformation characteristics of engineering materials used on its projects.



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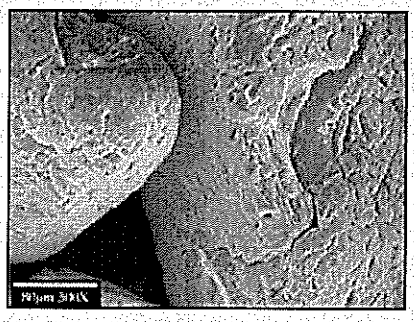
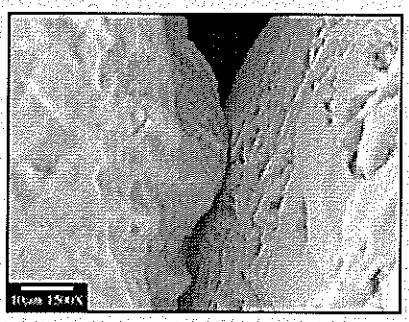


(b) 300X



(c) 1500X

Microscopic images of Ottawa sand particles taken at different magnification levels