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# Report on the technical activities of TC 6, Committee on unsaturated soils

## Compte rendu des activités de la commission technique N° 6, sur les sols non saturés

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Evolution of the ISSMFE Committee on Unsaturated Soils and Arid Soils, is indicative of the widely accepted position that there is a need for geotechnical engineers to embrace a general theory framework for unsaturated soil mechanics. Traditionally, researchers and practitioners of unsaturated soils have tended to focus on fairly specific topics such as expansive soils, collapsible soils, residual soils, or arid soils. The mission of the TC6 Committee on Unsaturated Soils includes promotion of the emergence of unifying theories of unsaturated soil mechanics, based on recognition of the importance of soil moisture changes to the performance of unsaturated soils as an engineering foundation and geoenvironmental barrier material. Technical meetings and activities of the Committee have centered on the growing need and efforts of the geotechnical community to improve our general understanding and modeling of unsaturated soil response.

The first major event of the TC6 Committee was participation in the sponsorship of the First International Conference on Unsaturated Soils, UNSAT'95, September 6-8, 1995, Paris, France. At UNSAT'95, and at the first meeting of the TC6 Committee held just prior to the Paris Conference, geotechnical professionals were brought together to discuss advances toward addressing problems involving unsaturated soils. From these discussions emerged the fact that unsaturated soil mechanics has become a necessary tool for analyzing the behavior of soils in the relatively near-surface soil zone where pore-water pressures are negative. There appears to be a strong move towards numerical modelling many geotechnical problems as a single saturated/unsaturated soil continuum.

One important outcome of the Paris, 1995, meetings was the general agreement (based on an informal survey conducted by Professor Kent Wray at a conference session on measurement of soil suction), on the key state variables to be used in the development of constitutive relationships for unsaturated soils. The two normal stress state variables for unsaturated soil response were identified as the matric suction  $(u_a - u_w)$ , defined as the difference between the pore-air pressure and the pore-water pressure, and the net normal stress,  $(\sigma - u_w)$ . It was further proposed that Pascals, kPa and Mpa, be used henceforth for soil suction in particular, and soil stress states, in general. Consistent with these normal stress state variables is the use of two independent stress tensors, as shown in Figure 1.

Due to the importance of soil moisture changes on unsaturated soil response, flux boundary conditions were identified as extremely relevant to many geotechnical and geo-environmental problems. The Paris Conference saw the emergence of the soil-water characteristic curve (Figure 2) as an important tool in quantifying the relationship between soil suction and water content changes.

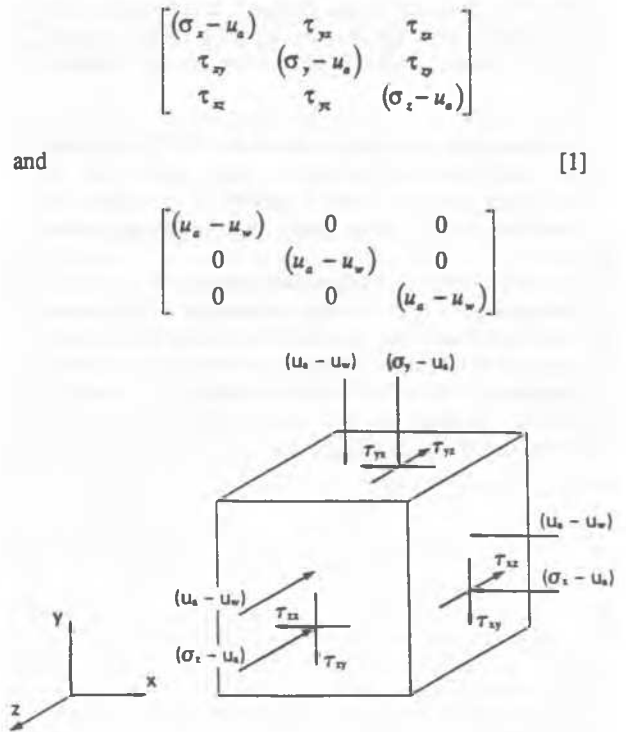


Figure 1. Definition of the stress state for an unsaturated soil.

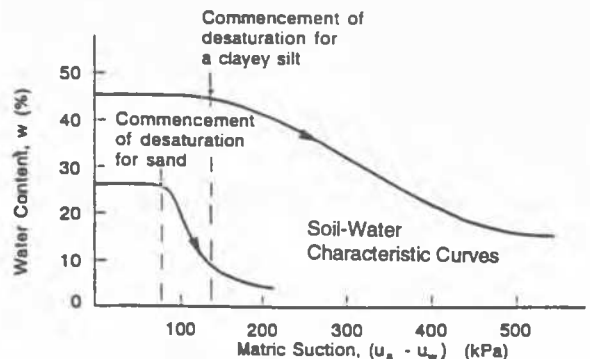


Figure 2. Soil-water characteristic curves for a sand and a clayey silt.

Ongoing and upcoming activities of the Committee on Unsaturated Soils are directed toward advancement of unsaturated soil mechanics and numerical modeling of unsaturated soils as a tool to address problems of arid soils,

including collapsible and expansive soils, residual soils, compacted soils, and transport and containment of contaminants in the vadose zone. The TC6 Committee is a sponsor of the Second International Conference on Unsaturated Soils to be held in Beijing, China, 1998, involving participation of the TC6 membership. Preparations for the 2001, Third International Conference on Unsaturated Soils, including selection of venue, are also presently underway.

Other TC6 activities include participation in the Unsaturated Soils Sessions for GeoLogan, 1997, along with the Subcommittee on Unsaturated Soils of the Soil Properties Committee and the Shallow Foundations Committee of the Geo-Institute, American Society of Civil Engineers. The conference was held from July 16-19, 1997 in Logan, Utah. The ISSMFE TC6 Committee is also affiliated, in cooperation with Dr. Ian Smalley, with the preparation of a special issue of *Engineering Geology*, dedicated to contributions on Collapsible Soils.

The TC6 committee has also promoted the NSAT '97, Third Brazilian Symposium on Unsaturated Soils, which will see research papers presented from a number of countries. The conference was held on April 22-26, 1996 in Rio de Janeiro, Brazil.

Recognizing the need for efficient dissemination of information on unsaturated soils research and conferences, TC6 members are evaluating the feasibility of use of the Internet for exchange of information. In particular, TC6 plans to come forward with a recommendation to the community for a home page format for organizations involved in the study and distribution of knowledge concerning unsaturated soils.