Geotechnical Engineering Lecture Series

Speaker: **Guillermo A. Narsilio**
University of Melbourne

Title: **Electro-Diffusive transport in charged porous media From the particle level to the macros-scale**

Date: Monday June 4

Time: 11:30pm

Location: Mason 142A

Abstract:

The Poisson-Nernst-Planck (PNP) system of equations may be used to describe electro-diffusive multi-ion transport through uncharged porous materials. Phenomenological formulations have been proposed for *charged* porous media (e.g. clays), usually disregarding the links to particle level scale. However, using the volume averaging of microscale governing equations, we are developing a new set of generalized macroscopic PNP equations that are valid for both charged and uncharged porous materials. These equations successfully account for non-homogeneous ionic distributions at the microscale, but they reduce to the standard PNP system of equations for the special case of uncharged porous materials. As a result, macroscopic parameters such as effective diffusion coefficients of ions are linked to so called "*intrinsic effective concentrations*" rather than actual concentrations. The estimation of effective diffusion coefficients of ions are also related to ion self-diffusion coefficients and the tortuosity of the porous media. This last parameter accounts for the morphology of pores. The derivation of the macroscopic PNP equations, analytical and numerical examples are included in this work. It is shown that intrinsic effective concentration depends on the actual charge distributions, background electrolyte concentration levels and surface charge. In general, differences between the standard macroscopic effective diffusion coefficient and generalized effective diffusion coefficients increase with decreasing electrolyte concentration and increasing surface charge density, as does the ratio between actual and effective concentrations increases.

Vitae:

Guillermo A. Narsilio was born in Cordoba, Argentina, and received his Diploma in Civil Engineering from Universidad Nacional de Cordoba in March 2001 with Summa cum Laude distinction. His graduate education took place at the Georgia Institute of Technology where he received Master degrees in Civil Engineering (December 2003) and in Mathematics (May 2006), and the Ph.D. degree in Civil Engineering (May 2006). His current research at The University of Melbourne addresses the chemo-mechanical properties of clays (For more information visit: www.civenv.unimelb.edu.au/~narsilio).