

***Molecular Interactions Influence  
Macroscale Properties of Swelling Clays***

***Dinesh R. Katti  
Professor, North Dakota State University***

**Abstract:** Swelling clays are found all over the world and cause enormous damage to the infrastructure and light structures due to their swelling and shrinkage behavior. Swelling properties of these clays play an important role in the use of these clays for barrier applications, as drilling mud in petroleum exploration, as nanoparticles in nanocomposites etc. The accurate prediction of clay response and ability to control the behavior of these clays would allow for safe and economical construction in expansive soil areas and for the effective use of these clays for other applications. The focus of our research group is to bridge molecular scale interactions to macroscale properties of swelling clays. The research involves a close synergy between modeling and experiments to expound the key mechanisms that influence the macroscale properties. We have used molecular dynamics, and steered molecular dynamics simulations to evaluate molecular scale response of clays with fluids, and developed innovative discrete element modeling and simulation framework to relate molecular scale response to particulate scale. Concurrently, we have conducted macroscale experiments using specially designed and fabricated apparatus. Together, this fundamental work provides an unprecedented insight into the mechanisms of swelling and the role of molecular interactions on the engineering properties of these clays.

**Bio:** After receiving his doctoral degree from the University of Arizona in 1991, Prof. Dinesh Katti joined the industry as a geotechnical consulting engineer for two companies in the Seattle area, Dames and Moore and Terra Associates where he worked on over 125 projects. He joined North Dakota State University in the department of civil engineering in the fall of 1996. He served as chair of the department of civil engineering at NDSU for about 10 years. He has also served as Associate Dean of Research for the College of Engineering and Architecture for four years. Prof. Katti's research expertise is in the area of multiscale modeling of materials. His research contributions are in a number of materials systems such as swelling clays, nacre, bone, polymer clay nanocomposites, bone tissue engineering, and oil shales. He was awarded the 2011 John R. Booker excellence award from IACMAG for "major contributions to geomechanics". He has also received the Fred Waldron award for excellence in research. He has served as chair of the Engineering Mechanics Institute Poromechanics, Properties of Materials, Molecular Scale Modeling and Experimentation and Biomechanics Committees.

**Monday, April 8th, 4:00-5:00pm  
1310 Yeh Student Center**