

# Applied Research

## Second Winner

- **Project Title:**  
Localization phenomena in saturated and semi-saturated earth dams
- **Researcher**  
Dr. Amir R. Khoyee
- **Contributors:**  
Iran Water Resource Management Organization (IWRMO) Sharif University of Technology

### Abstract:

The behavior of all geomaterials and in particular of soils, is governed largely by the interaction of their soil skeleton with the pore fluid, generally water, present in the pore structure. This interaction is particularly strong in dynamic problems and may lead to a large pore pressure build up and so catastrophic softening of the material known as liquefaction, which frequently occurs under earthquake loading. Negative pore pressure existing in semi-saturated condition provides a substantial cohesion of soil, this cohesion is important in the dynamic response of earth and rockfill dams.

One of the most important components of numerical computations is the mathematical description of relationship between states of stress and strain, called constitutive model.

Most of geomaterials under normal engineering conditions presents a mechanical behaviour which depends on the level of stress, pore pressure, past history, direction of geomaterials is related to pore fluid (generally water) flow. For these reasons, plasticity based theories provide a consistent framework in which the behaviour can be accurately understood and predicted.

In this research, a unified finite element solution to static and dynamic problems of saturated and semi-saturated media (two-phase behaviour) is derived from five basic equations, 1- total equilibrium for soil-pore fluid mixture, 2- the equations equilibrium for the pore fluid which is generalized of the Darcy's equation, 3- the mass balance of flow equation, 4- concept of effective stress and 5- the constitutive relation. Assuming that the air pressure in semi-saturated zones remains in atmospheric pressure the generalization of U-P formulation to conduct semi-saturated behavior is presented.