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Plastic Mass Flow of Sand Under Action of Pore Pressure Gradient

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Fundamental principles of elastic-plastic mechanics of soils and rocks are given on the base of the author original publications (1971) where non-associated flow rule was developed for solid friction and dilatancy effects in now well-known form. Here the model of poroplasticity is suggested for fluid-saturated materials. The model generalizes the Frenkel–Biot poroelasticity but the solid matrix equilibrium is determined by the effective Terzaghi stresses. As usual, additional terms and equations are used for pore (fluid) pressure field. To illustrate the theory possibilities, some practical solutions for failure and mass sand flow, driven by the pore pressure gradient, are selected. The sand production of oil/gas wells, disposal of wastes into weak artesian seams and computer design of the fracpack operation are discussed. The generalization of the Dupuit formulae is given for stationary regimes of well production. The self-similar solutions are permissible for basic unsteady regimes because the plasticity effects do not increase the physical dimensions of the problem.

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