CLARIFICATION OF SOIL SCOUR AND SEEPAGE FLOW BY USING A PARTICLE METHOD

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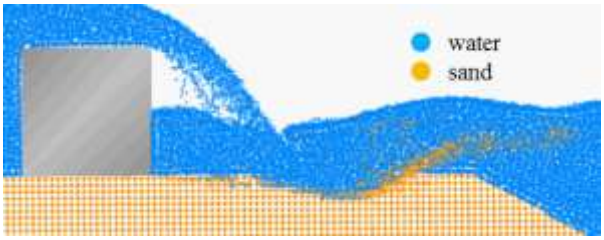
ABSTRACT

Fluid-Structure-Soil coupling simulation is desired for a systematic comprehension of seawall collapse mechanism, and it may help to develop next disaster prevention method. In this study, a particle simulation tool based on the SPH has been developed to solve the different soil damage mechanisms; soil sour and seepage flow problem. These simulations should treat the Fluid-Soil and Fluid-Seepage flow interactions, and the particle simulation tool has been modified and improved to solve each interaction problem.

Fluid is generally described Navier-Stokes equation, on the other hand, soil is generally described Darcy's law or extended Darcy's law. However, in case water particles penetrate into soil mound and change surface flow to seepage flow, there needs to be a unified formula between them. So, in this research, as a governing equation of Fluid-Seepage flow, Akbari equation (Akbari, H.,2014) is introduced .

$$\frac{C_r(\varepsilon)}{\varepsilon}\frac{D\boldsymbol{v}_D}{Dt} = -\frac{1}{\rho^0}\nabla P + \nu_E(\varepsilon)\nabla^2\boldsymbol{v}_D - a(\varepsilon)\boldsymbol{v}_D - b(\varepsilon)\boldsymbol{v}_D|\boldsymbol{v}_D| + \boldsymbol{g} \quad (1)$$

Soil scour depends on velocity of fluid of flow and particle size of the sand. In this study, soil scour is judged based on quicksand quantity formula. The velocity of threshold of sediment movement is shown below.



$$u_{bc} = \sqrt{\frac{2A_3\left(\mu_f \cos\theta - \sin\theta\left(\rho_{sp}/\rho_l - 1\right)\right)gd}{\left(C_D + \mu_f C_L\right)A_2}} \quad (2)$$

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