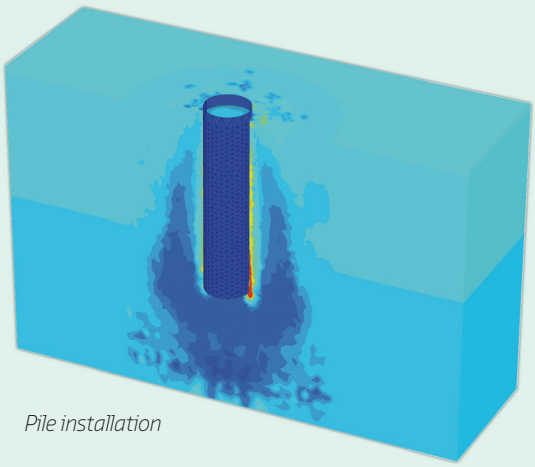
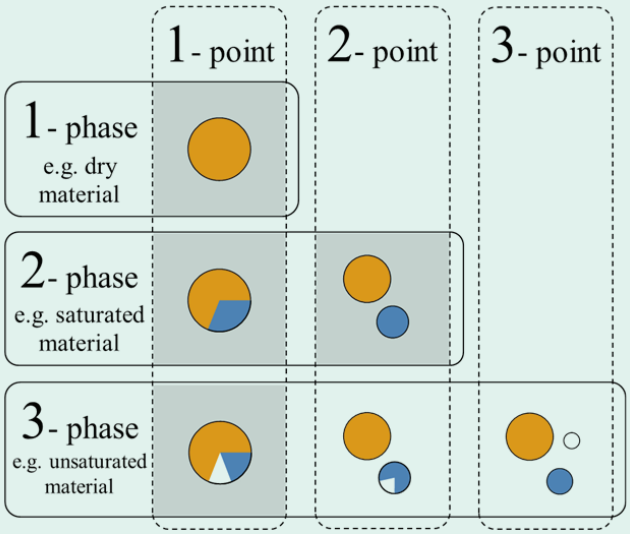


Pile installation



Multi-phase problems in Anura3D

ANURA3D MPM FOR LARGE-DEFORMATION GEOTECHNICAL AND HYDRAULIC ENGINEERING

The first international conference on the material point method (MPM) for modelling large deformation and soil-water-structure interaction (MPM2017) took place at Deltares on 10–12 January 2017. On this occasion, the Anura3D MPM Software was launched. The software can be used for the numerical modelling of a wide range of geotechnical and hydraulic engineering problems. The results demonstrate the applicability of Anura3D MPM and will help to further its use in the academic world and engineering practice. Some highlights are described here.

Pile installation in saturated sand (Galavi V., Beuth L., Zuada Coelho B., Tehrani F.S., Hölscher P., Van Tol F.): Offshore monopile installation was modelled to capture the mechanical behaviour of saturated sand for impact and vibratory driven installation techniques. The capabilities of MPM were demonstrated with reference to field tests carried out in Cuxhaven, Germany.

Cone penetration in clay (Ceccato F., Beuth L., Simonini P.): The contact algorithm in MPM has been extended to include adhesive contact, which is essential for cohesive soils under undrained conditions, and applied to the simulation of cone penetration testing. The adhesion at the cone-soil interface significantly affects the measured cone resistance. The Anura3D results were compared with analytical and experimental data, and its effectiveness in describing undrained penetration in clay was demonstrated.

Dike seepage flow failure (Martinelli M., Rohe A., Soga K.): The onset and evolution of the failure of a sand dike due to seepage flow was analysed. The double point MPM formulation with an elastic, perfectly-plastic soil model and the Mohr-Coulomb failure criterion was adopted. For comparison purposes, the onset of failure was also simulated with the standard finite element method. It was shown that MPM can satisfactorily model the essential features of the failure mechanism of the dike.

Installation of geocontainers (Zuada Coelho B., Rohe A., Soga K.): One- and two-dimensional poro-elastic solid flows were modelled. The MPM model was validated by comparing the solid flow velocity with the analytical solution. It was shown that the soil stiffness has an effect on the poro-elastic flow velocity due to swelling and bending for the 1D and 2D cases respectively.

Water jetting of soil bed (Liang D., Zhao X., Martinelli M.): The jetting process for constructing pipe trenches for buried offshore pipelines was simulated. The effect of the water jet speed on the trenching process was analysed. The advantages of the MPM model when handling the free surface and soil-water interaction problems were illustrated and the results are useful for the offshore oil and gas industry.

Internal erosion (Yerro A., Rohe A., Soga K.): Internal erosion involving processes such as piping, soil contact erosion, or suffusion (in a bimodal internally unstable soil specimen) were modelled using Anura3D. The fine soil fraction was eroded from the solid skeleton by the prescribed water flow in line with the erosion law and it was transported as a fluidised material through the saturated porous media. This process is one of the main causes of the failure of water-retaining structures such as dikes and dams and it also controls the amount of sand production in oil-producing wells.

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Further reading:
www.mpm2017.eu