

PROJECT DESCRIPTION

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In the framework of the development of a subsea tidal turbine, the design of the foundations has to be optimal. Cathie Associates, on behalf of HydroQuest, wanted us to investigate the penetration of a single steel foundation pin in a granitic rock mass by using a discrete numerical approach and follow the state of the damaged zone around the tip during penetration.

The sea floor is a complex system because of fractures in the rock mass and the irregularity of the rocky surface. To make the discrete numerical model usable, it is first necessary to calibrate the micro-mechanical properties of the contact laws by reproducing the desired elastic properties and the strength properties of the rock.

ITASCA'S ROLE

Model and calibrate in collaboration with Cathie Associates an “intact” granite block (without any initial fracture network) by reproducing the desired elastic properties and the strength properties of the intact rock.

Model a blocky granite rock by inserting simplified pre-existing fracture networks.

Compare the responses of the synthetic rock mass with the relevant measured responses of the material being modeled using unconfined compressive test and direct tensile test and calibrate the model parameters.

PROJECT RESULTS

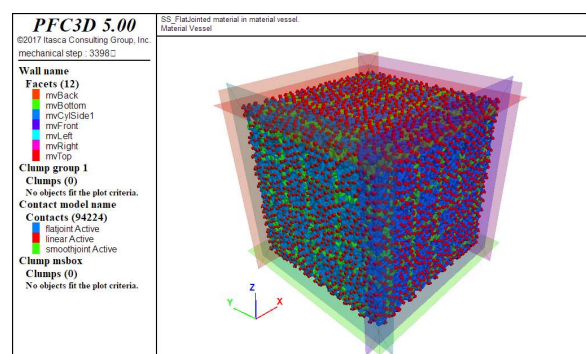
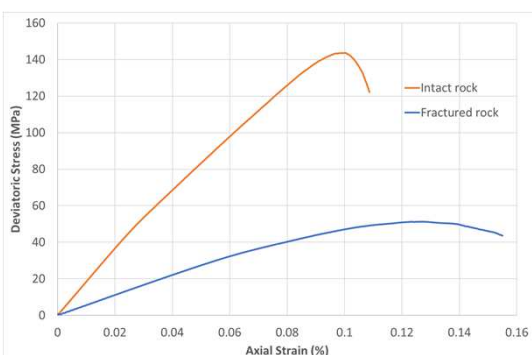
To calibrate an “intact” granite block, we use the “Flat-joint” contact model (Potyondy D.O., 2012). The model has been shown to be able to capture the essential features of intact rock mass behaviour such as large UCS/Tensile strength ratio and progressive damage.

The fracture behavior is modelled using the “Smooth joint” contact model (Mas Ivars D. et al., 2011), which simulates the behavior of a planar interface with dilation regardless of the local particle contact orientations along the interface.



Example of a granite rock surface

Stress-strain behavior modeled for intact and fractured rock mass



View of contact model used at each contact

REFERENCES

- Potyondy, D.O. (2012) “A Flat-Jointed Bonded-Particle Material for Hard Rock,” paper ARMA 12-501 in Proceedings of 46th U.S. Rock Mechanics/Geomechanics Symposium, Chicago, USA, 24–27 June 2012
- Mas Ivars, D. et al. (2011) “The synthetic rock mass approach for jointed rock mass modelling”, International Journal of Rock Mechanics and Mining Sciences, 48 (2), 219–244.