

EGU2020-10115

<https://doi.org/10.5194/egusphere-egu2020-10115>

EGU General Assembly 2020

© Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.



## Effect of a heterogeneity on tensile failure: interaction between fractures in a limestone

**Anne Pluymakers**, Richard Bakker, and Auke Barnhoorn

TU Delft, Geoscience & Engineering, Delft, Netherlands (anne.pluymakers@tudelft.nl)

Not all rocks are perfect. Frequently heterogeneities will be present, either in the form of pre-existing fractures, or in the form of sealed fractures. Tensile strength and strength anisotropy of rocks has been investigated for strongly layered rocks, such as shales, sandstones and gneisses, but data is lacking on the effect of single planar heterogeneities, such as pre-existing fractures or stylolites. We have performed Brazilian Disc tests on limestone samples containing pre-existing fractures and stylolites, investigating Brazilian test Strength (BtS) and fracture orientation. We used Indiana limestone samples, pre-fractured with the Brazilian Disc method, and Treuchtlinger Marmor samples which contained central stylolites. All experiments were filmed. The planar discontinuity was set at different rotation angles of approximately 0–20–30–45–60–90°, where 90° is parallel to the principal loading direction, and 0° to the horizontal axis of the sample. Pre-fracturing Indiana limestone samples results in a cohesion-less planar discontinuity, whereas the stylolites in the Treuchtlinger Marmor samples are discontinuities which have some strength.

The results show that our imperfect samples with a planar discontinuity are always weaker than an intact sample. For the Indiana limestone, with a cohesion-less interface, there is 10 to 75% of weakening, which is angle-dependent. Once the angle is 30 or lower there is no influence from the initial fracture for the orientation of the new fracture. The stress-displacement pattern followed the expectation for Brazilian Disc testing. However, in the samples with a stylolite, strength is isotropic and between 25 and 65% of the strength of an intact sample. For all cases several new cracks appeared, of which the orientation is influenced by the orientation of the stylolite. The fracture pattern and associated stress drops are more complex for high angles. Interestingly, in the samples with stylolites, always more than one fracture was formed, whereas in the samples with a cohesionless interface usually only one new fracture formed, which for natural settings suggests a potential for higher fracture density when hydrofracturing a stylolite-rich interval.

A second difference between these datasets is the amplitude of the pre-existing interface. The effect of amplitude will be qualitatively investigated with a 2D Comsol model, to investigate the location of the first fracture occurring, which can then be compared to the camera data of the experiments.