13.15: Borehole Stability in Unlithified Mudrocks

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ABSTRACT

The mud weight limits of borehole stability are computed using a number of mechanisms, such as the in situ pore pressure and the least principal stress. In unlithified mudrocks, borehole contraction due to undrained shear deformations may become the most critical lower limit for the mud weight.

In this laboratory study, a thick-walled hollow cylinder apparatus was used to measure the borehole response to increases and decreases in cavity pressure. Tests were performed on resedimented Boston Blue Clay. Borehole closure curves (Fig.1) were interpreted to obtain the stress-strain relationship which was then used to predict field closure response.

Undrained analysis based on the shape of the stress strain curve and the undrained strength ratio can be used to establish a lower limit of mud weight based on acceptable squeezing deformations of the borehole

CLICK ON IMAGE FOR LARGER VIEW

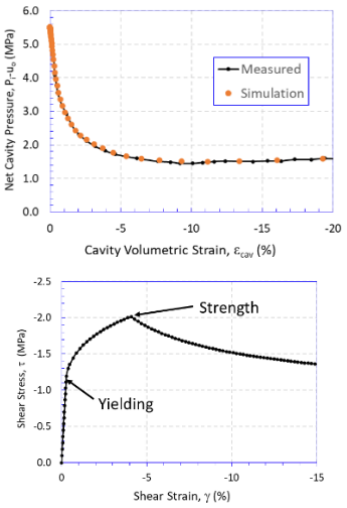

Fig 1: Top: measured borehole closure response for specimen of resedimented Boston Blue Clay compared to a numerical simulation of the experiment. Bottom: derived stress strain response from the simulation showing behavior for shearing in the horizontal plane.

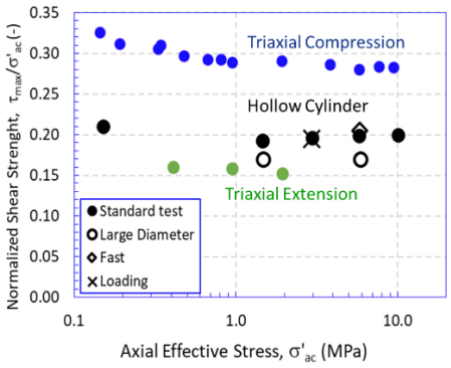

Fig 2 Variation of the normalized undrained strength ratio vs effective stress for various loading directions. Triaxial compression is the strongest. Shearing in the horizontal plane (Hollow Cylinder) is much weaker and close to triaxial extension.

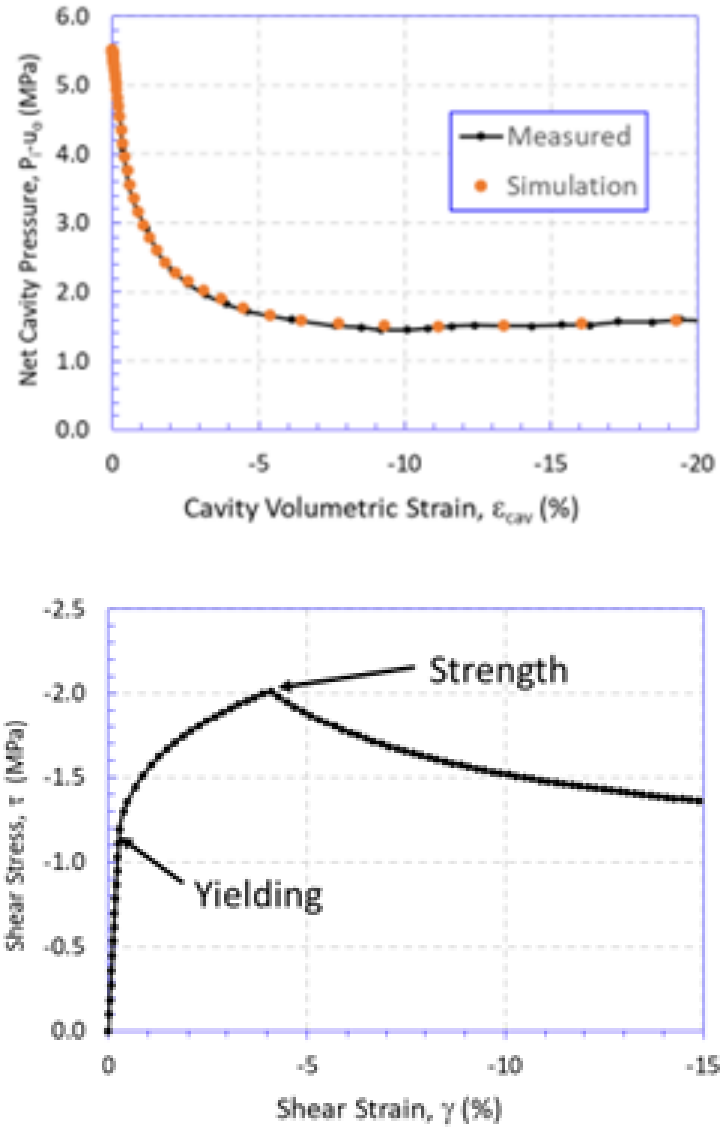

Fig. 1: Top: measured borehole closure response for specimen of resedimented Boston Blue Clay compared to a numerical simulation of the experiment. Bottom: derived stress strain response from the simulation showing behavior for shearing in the horizontal plane.

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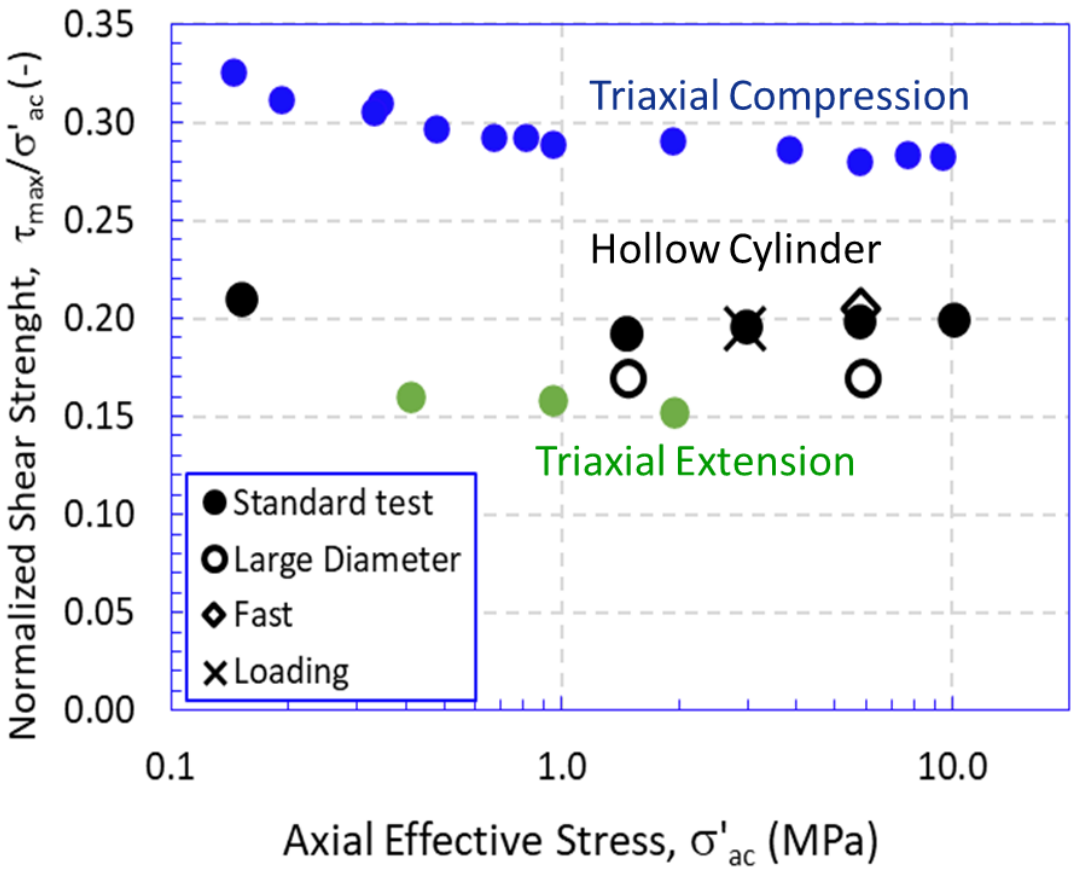

Fig. 2: 2 Variation of the normalized undrained strength ratio vs effective stress for various loading directions. Triaxial compression is the strongest. Shearing in the horizontal plane (Hollow Cylinder) is much weaker and close to triaxial extension.

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