A Review of Effects of Bedding Plane and Anisotropy on Indirect Tensile Strength Test of Rocks

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Abstract. Indirect tensile strength (ITS) test is the recommended standard test by the International Society for Rock Mechanics (ISRM) to determine the uniaxial tensile strength of a rock sample. ITS is typically calculated from the theory of elasticity, assuming the rock to be linear elastic and homogeneous. It is estimated from the applied load and the specimen dimensions but since some rock exhibit anisotropic mechanical properties, depending on the coring direction of the disk the measurement can be greatly affected. Some of the factors that may affect ITS measurement are:

1. Bedding Plane
2. Anisotropy Angle
3. Preexisting Fractures
4. Water Content

The objective of this study is to look at available data of ITS test from different studies to see the variation in measurement in disc samples as a function of loading direction to the bedding plane and anisotropy angle. Testing were also conducted on Mountain sandstone, Clayey Sandstone, Marcellus shale, Mancos shale, Alabama limestone and Carthage limestone. Bedding plane and anisotropy can affect the mechanical properties of rocks, also preexisting fractures and water content can significantly lower ITS measurement.

Bedding plane can have a significant effect on ITS especially when the rock exhibit a vertical transverse isotropy (VTI). This is especially true in some shale plays and the ITS measured can be significantly different depending on the coring direction with respect to bedding plane. Transverse isotropy is a kind of anisotropy in which there exists an axis of symmetry so that any measured properties perpendicular to this axis appears to be the same as it is isotropic in this transverse direction. However, measured property will change at an angle to the axis of symmetry.

Based on the tests reviewed and tested it was observed that the loading direction to the bedding plane or anisotropy angle of the rock changes the measured value of ITS and these changes are more significant in anisotropic rocks. It can be seen that ITS performed on vertical samples (bedding plane parallel to the disk surface) have the highest strength because under diametrical loading, vertical samples behave isotropically. Similarly observed was that ITS measurement on disc loaded perpendicular to the bedding planes are typically higher than on core plugs loaded parallel to bedding planes.

These observations are very important for planning coring operations and should be greatly considered in selecting samples for ITS testing in rocks with bedding planes and exhibiting anisotropy.