

## CVEN 5768 - Lecture Notes 9

### Ground-Support Interaction and NATM Concepts for the Design of Underground Excavations in Rock

#### References:

- (1) Brown, E.T. et al. (1983). Ground response curves for rock tunnels, *ASCE J. Geotech. Div.*, **109**, 15-39.
- (2) Hoek, E and Brown, E. T. (1980) *Underground Excavations in Rock*, Institution of Mining and Metallurgy, London.
- (3) Hoek, E. and Brown, E.T. (1980b) Empirical strength criterion for rock masses. *ASCE J. Geotech. Eng.*, **106**, 1013-1035.

Strength/stress ratio contours in rock surrounding powerhouse caverns of different shape. Horizontal *in situ* stress = 0.5 x vertical stress (after Hoek and Brown, 1980).

Results of a two-dimensional stress analysis conducted by Eissa (1980) using the boundary element method. The extent of the potential overstressed zone around a horseshoe opening in a biaxial stress field with a vertical component,  $p$ , and a horizontal component,  $0.5p$ , was determined for different values of the ratio between the vertical stress,  $p$ , and the intact rock compressive strength,  $\sigma_c$ . The rock mass was assumed to be under plane strain and its strength was defined using the criterion proposed by Hoek and Brown with two parameters,  $m$  and  $s$ . Three rock masses of decreasing strength were considered and are defined as A, B and C. This figure shows clearly an increase in the extent of the overstressed zone around the opening as the rock mass strength decreases. Also, for given values of the parameters  $m$  and  $s$ , the extent of the overstressed zone increases with the ratio  $p/\sigma_c$ .

