MULTI-LAYER SHOTCRETE DESIGN FOR TUNNEL CONSTRUCTION

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Shotcrete linings have been applied successfully for a large number of tunnel constructions within the last couple of decades all around the world. While up to the 1980’s the structural design of the shotcrete linings mainly was based on experience gathered throughout the construction and some simplified analyses in the following years the application of the Finite Element Method lead to much more sophisticated design and more accurate estimation of deformations and stress state in the shotcrete lining. This was amongst others achieved by considering the time and construction sequence-dependent development of the deformations as well as by applying simplified time dependent material laws for shotcrete. The design verification as such is commonly done by using the methods as stated in Eurocode 2 for ULS and SLS.

The design becomes even more complex for cases in which during a first construction stage one shotcrete layer is applied and stressed and only later additional, stress free layers are applied in order to carry additional loads caused by further construction stages. With such situations tunnel designers have to deal frequently in cases when cross sections between two main tunnels need to be installed or a second, parallel tunnel is driven while the first tunnel is already in place.

Within this paper the special case of such multi-layer shotcrete linings is discussed and proposals for the calculation of the stress state in the lining and the design verification are made.