Contribution ID: **16** Type: **Talk**

Geotechnical Characterization Campaign for Design of ET Underground Infrastructures - Tunnelling Aspects and Challenges

Tuesday, 9 November 2021 10:30 (30 minutes)

The Einstein Telescope (ET) is an advanced gravitational-wave observatory, currently in the planning stage that allows to further understanding the Universe through the observation of gravitational waves. The border region between the Netherlands, Belgium and Germany (Euregio Meuse-Rhine) is being considered as a possible location to host the third generation gravitational wave observatory due to its tranquility and stable ground. The ET project involves construction of a triangular shape underground facility with 10 kilometers long arms at a depth of 200-300 meters below surface. The subsurface structure will then host multiple laser interferometers. As an initial step, a feasibility study to determine whether the Einstein telescope can be built in the Euregio Meuse-Rhine is planned to be carried out, involving a number of in-situ and laboratory tests to define the geological, structural, hydrological and mechanical characteristics of rocks that may be encountered during construction of the underground excavation.

The Einstein telescope sub-surface infrastructures involve constructing a series of large caverns (up to 30 m in height) at each corners and long tunnel drives with estimated length of 10 km to connect the corners. To allow for comprehensive planning, development of a preliminary tunnel design including alignment options, layout of the underground facilities, and time needed for construction are crucial. A detailed understanding of the geological, structural, hydrogeological and geotechnical conditions of the ground should be carried out to develop a rock mechanical and tunnel behavior model. These models allow the identification of problematic and cost-intensive geological zones in underground excavations and provide the basis for of the investigation of tunnel alignment options, tunnel excavation methods and schedule, estimate uncertainties and costs based on support classes, initial and long term water inflow rates and time dependent rock deformations (i.e. swelling or consolidation).

The presentation provides and overview of the current works being carried out in the framework of the prefeasibility study of Einstein Telescope in EMR region with the main focus on tunneling aspects and challenges. Here, we discussed the preliminary assessment of required underground layouts, potential excavation methods and their cost and benefits and particular challenges with respect to the ET project.

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Session Classification: Civil Engineering, layouts, prospects