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Modelling of the long-term behavior of the damaged zone around the underground storage works in argilites

Sophie Jung

Challenges in the Lyon-Turin base tunnel project

Alessandra Insana

26th January 2022 (17:00 GMT)

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Upcoming session:

22th February 2022

Development of Coupled Thermal-Hydraulic-Mechanical-Chemical (THMC) Models for Predicting Rock Permeability Change.
Dr. Sho Ogata (Japan)
Comprehensive in-situ stress estimation for a fractured geothermal reservoir from drilling, hydraulic stimulations, and induced seismicity.
Dr. Sehyeok Park (South Korea)

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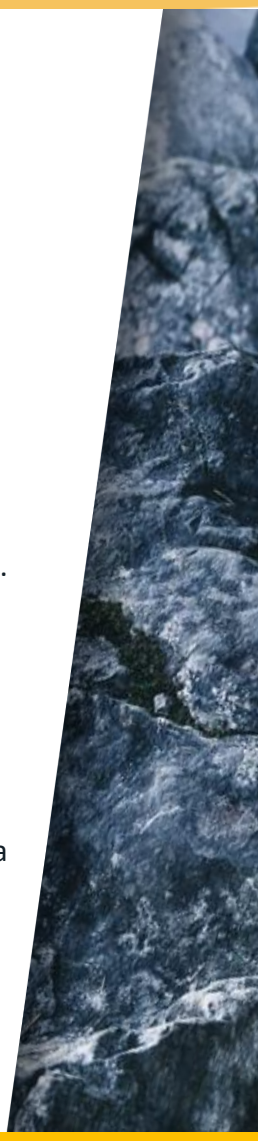
Modelling of the long-term behavior of the damage zone around the underground storage works in argilites



Abstract

The French Radioactive Waste Management Agency (Andra) has built an Underground Research laboratory at Bure in order to demonstrate the feasibility of the Cigeo project. The underground structure is composed of a network of galleries whose drilling generates stress redistribution, damage and fracture in the surrounding medium. The damage and fracturing in excavation damaged zone have a direct effect on the displacement field and on the interaction between the formation and the lining support. The design of the support system requires a precise knowledge in order to be as efficient as possible.

In the presented work we aim to model the drifts excavated in the direction of the minor principal horizontal stress and in the direction of the major principal horizontal stress. The fractures of the damaged zone are taken into account by homogenization techniques. The damaged zone is separated into different zones in which the density and orientation of the fractures are different. In each zone the medium is modelled as a transverse isotropic material and the parameters of the threefold anisotropy (elasto visco plastic) are calibrated in order to take the effects of the fractures into account. An experimental campaign is led to investigate the viscous properties of a fracture in the Callovo Oxfodian claystone. Pictures are recorded during the shearing of the rock under creep condition and the pictures are analyzed with Digital Correlation Image.

Speaker

Sophie Jung is currently doing a PhD at Laboratoire Navier at Ecole Nationale des Ponts et Chaussées on Modeling the long-term behavior of the fractured zone around deep drifts excavated in Callovo-Oxfordian claystone. She has a master degree in engineering from l'Ecole des Ingenieurs de la Ville de Paris. She did her Final year internship between Laboratoire Navier and Penn State University on Numerical Analysis of Flowback after Hydraulic Fracturing.

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Challenges in the Lyon-Turin base tunnel project

Abstract

The ambition to cross the Alps dates from centuries ago and still continues today, albeit in a new guise, but with the same aim: linking the mountain to the future of the continent. 150 years after the inauguration of the Fréjus railway tunnel between France and Italy, at the time the longest in the world and today the oldest in Europe, new challenges are being dealt with in the project of the Lyon-Turin railway base tunnel that is being built 800 meters lower. Among such challenges, understanding and predicting the squeezing behaviour of the surrounding rock mass during tunnel excavation is of critical importance. To address the problem properly, careful time dependent testing of the rocks and numerical analyses based on time dependent constitutive modelling are needed and are here presented. Time-dependent behaviour is reproduced thanks to an advanced viscoplastic constitutive law previously developed and implemented into a finite difference code to allow performing numerical analyses. The identification of the constitutive parameters at the laboratory scale is described, as well as the development of the numerical model to predict the tunnel response. Additionally, the infrastructure will meet uncommon climate conditions, reaching a temperature peak value of 47 °C, due to its significant overburden. Thus, in view of the project sustainability and innovativeness, a numerical study is also carried out to assess the energy performance of a thermo-active lining installed in a portion of the tunnel that would be able to profit from the otherwise unmined noticeable deep geothermal potential.

Speaker

Alessandra Insana is research assistant at Politecnico di Torino, Italy, since 2019. She got her Ph.D. in Civil and Environmental Engineering at Politecnico di Torino and Université Paris-Est in 2020 with a thesis entitled “Thermal and structural performance of energy tunnels” for which she received the “My research in three minutes” award in 2018 and was among the finalists of Prix Pierre Londe. Her current research activities are mainly devoted to the study of the behaviour of thermoactive tunnels, both for application to new tunnel projects, as in the case of Turin Metro Line 2 where she also investigates interferences at the urban scale, and for retrofitting of existing urban and motorway infrastructures, thanks to a European project involving an experimental site in the city of Trento and to a PhD project in collaboration with Autostrade per l’Italia. She also developed an interest in research related to geostructures adaptation to climate change, carried out in the framework of ELGIP (European Large Geotechnical Institutes Platform) Working Group on Climate Change Adaptation. The topic of tunnelling in difficult conditions (squeezing, swelling) and fiber optics monitoring of debris flows are also among her research branches. Since 2018 she is working as a consultant for an engineering company in Torino. She is assistant for the Master course of “Numerical Methods in Geotechnical Engineering” and for the PhD course “Energy Geostructures”. She is a member of the Editorial Board of the International Journal of Geomechanics and is actively involved in the Organizing Committee of IACMAG2022.