



INSTITUTE OF ROCK MECHANICS AND TUNNELLING

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FACT SHEET of the research focus HSSR

SHORT TITLE / ACRONYM

HSSR

LONG TITLE

Hard Soil / Soft Rock

DESCRIPTION

Many engineering problems in geotechnics can be linked to excavations in hard soils or in soft rocks (hereinafter referred to as 'HSSR'). Challenges already arise within the characterization of the material in-situ, which is fundamental for all (numerical) calculations. Incomplete descriptions of the composite, its constituents and the material behaviour, or the use of unsuitable characterization methods, eventually result in an inadequate design. Unfortunately, standardized characterization methods are missing and the mechanical behaviour is strongly governed by the applied confining stress (e.g. brittle or ductile localization). The peculiar problem of modelling and testing such materials is the main topic of this research subject.

Our approach to this complex problem is interdisciplinary: by conducting experiments, material characterization, classification as well as numerical modelling on various scales, we attempt to provide a comprehensive understanding of the material and its (calculation) parameters and behaviour across multiple orders of magnitude. The range extends from rock and soil mechanics to i.e., mineralogy as well as micromechanics.

The research goals are the evolution of conventional testing techniques (lab & in-situ) in order to obtain reliable ground parameters, the identification of existing gaps in modelling HSSR, and the outline of strategies to overcome the main shortcomings in rock and rock mass characterization as well as the utilization of appropriate constitutive laws for numerical simulations.

PROJECT COORDINATOR

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RELATED MASTER'S THESES

YEAR	AUTHOR	TITLE
2026	Kleb	Numerical modelling of the Angath Test Gallery (<i>in progress</i>)
2026	Correa Kleuters	Experimental study on specimen aging of soft rock samples from the Angath Test Gallery (<i>in progress</i>)
2024	Zani	Photogrammetric Documentation in Tunnelling Case study of the Angath Test Gallery
2023	Bostjancic	Correlating Lab Data in Argillaceous Soft Rocks: Towards a Comprehensive Database
2020	Harmuth	In situ investigations of hard soil - soft rock (<i>in German</i>)
2020	Wallner	Numerical analyses of hard soil - soft rock considering different constitutive laws

RELATED PUBLICATIONS

YEAR	AUTHOR(S)	TITLE
2025	Metzler, Wölflingseder, Fernandes Couto & Marcher	Modeling the swelling extent of argillaceous soft rock using the PLAXIS swelling rock model
2025	Zani, Metzler & Marcher	Photogrammetric documentation in tunneling
2025	Marcher	The challenges of "hard soil and soft rock": an inside into this material's brittle to ductile behaviour
2024	Metzler, Frühwirt, Hölzl & Marcher	Argillaceous Soft Rock in-situ Test Program in Tunneling
2024	Kaspar, Latal, Frühwirt & Blümel	Assessment of factors controlling the slaking behaviour of rocks from the Rhenodanubian Flysch Zone, Austria, using mineralogical-geomechanical laboratory tests
2024	Siakouhi, Pletzer, Marcher & Schneider-Muntau	Investigation on shear strength parameters of soil and soft rock material in the low stress range
2024	Metzler, Bostjancic & Marcher	The challenge of classification argillaceous soft rock (HSSR)
2023	Kaspar, Latal, Blümel & Pittino	Is soft rock also non-abrasive rock? An evaluation from lab testing campaigns
2020	Kaspar, Blümel & Pühringer	Hard soil/soft rock from an ancient roman settlement, Vienna – properties, implications and limitations obtained by geological-geotechnical laboratory investigations
2020	Stauder & Marcher	Numerical modelling of "hard soil and soft rock" – a contribution towards the understanding of the mechanical behavior of weak rock
2019	Stauder & Marcher	The brittle to ductile behavior of "hard soil and soft rock" – experimental review and challenges for constitutive modelling

RELATED THIRD-PARTY FUNDED PROJECTS

YEAR	PROJECT DESCRIPTION	INFORMATION TO FUNDER(S), FUNDING PROGRAM(S) AND CO-OPERATION PARTNER(S)
2022 – 2025	Characterization and modelling of hard soil/soft rock considering anisotropy and swelling capacity (ChaMod-HSSR)	• Funders: FFG – Austrian Research Promotion Agency & ÖBB-Infrastruktur AG • Funding program: FFG BRIDGE • Co-operation partner: ÖBB-Infrastruktur AG
2019 – 2020	S7 freeway: Limits of conventional in situ testing techniques considering hard soils or soft rocks.	• Funder: ASFINAG – Austrian road construction authority • Funding program: - • Co-operation partners: ASFINAG & Institute of Soil Mechanics, Foundation Engineering and Computational Geotechnics, TU Graz