

Stability assessment of an abandoned underground chalk quarry

Temenuga Georgieva, Fanny Descamps, Nicolas Gonze, Jean-Pierre Tshibangu

Mining Engineering Department, FPMs, UMONS, Belgium

Email: temenugadimova.georgieva@umons.ac.be

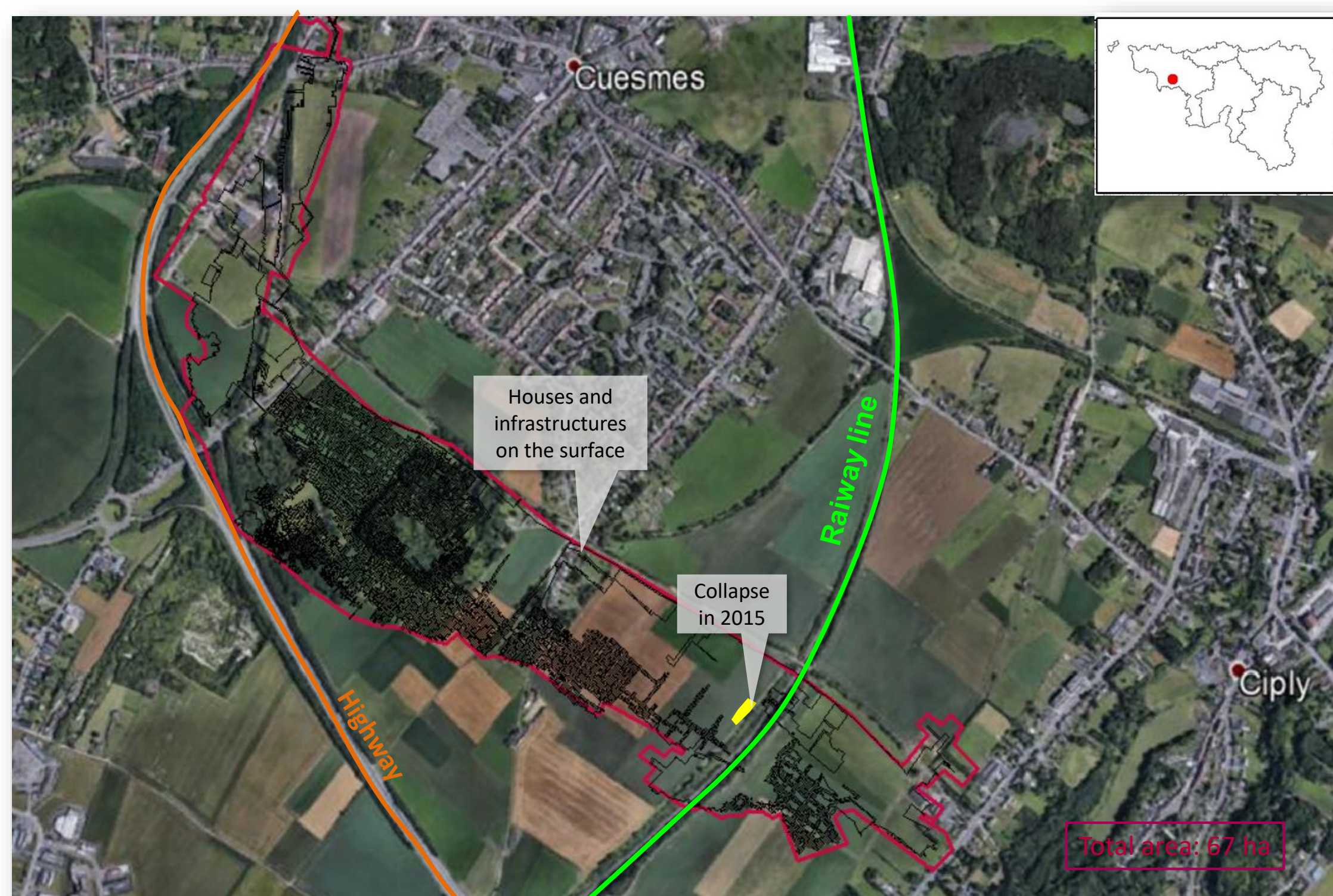
Introduction

Scope of work

- Rock and rock mass characterization (case study in Malogne underground quarry)
- Understanding of failure mechanisms of underground openings

Working method

- Data collection
- In situ and laboratory analyses
- Numerical modeling for simulation of different configurations for understanding the failure phenomena



Map of underground Malogne phoshatic chalk quarry with surface infrastructure

Methodology

Geometrical and geological 3D model
❖ Geological data
❖ 3D Model

Rock mass characterisation
❖ In situ
❖ Laboratory analyses

Geomechanical classification systems

Rock mass mechanical properties

Empirical approach

Numerical modeling

Behaviour of the underground openings and understanding of failure mechanisms

Data collection

Geometry

- Topography: 1865, 2013 (Lidarmap)
- Quarry: hangingwall
footwall
pillars geometry (2D map)

Geomechanical properties

- Laboratory analyses

Property	Unit	Tensile Strength	Friction Angle	Cohesion	Young's Modulus	Poisson's ratio
	MN/m ³	MPa	deg.	MPa	MPa	-
Hardground	0.019	0.065	35.37	0.39	1 429	0.14
Phosphatic Chalk	0.017	0.03	32.5	0.31	474	0.34

- In situ characterization

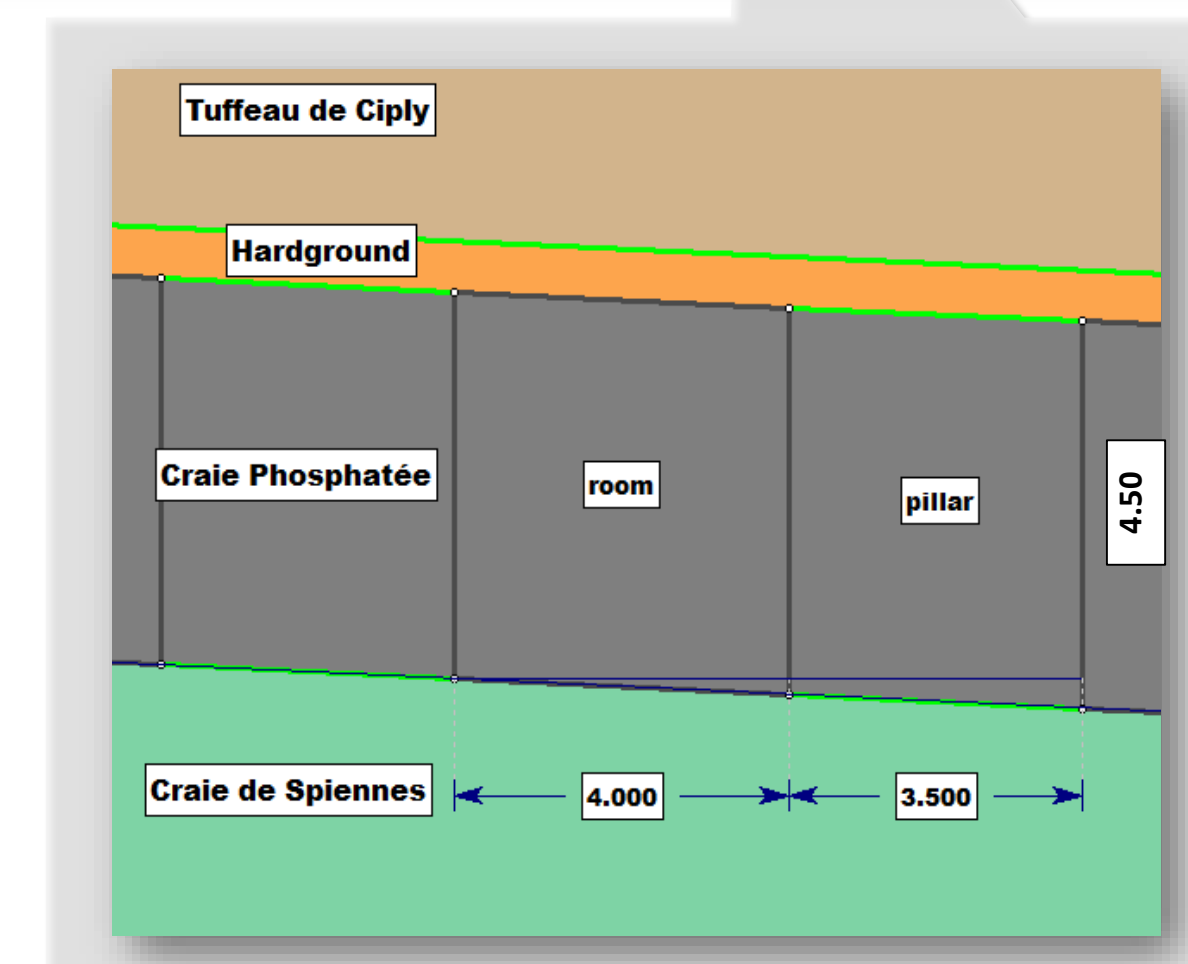
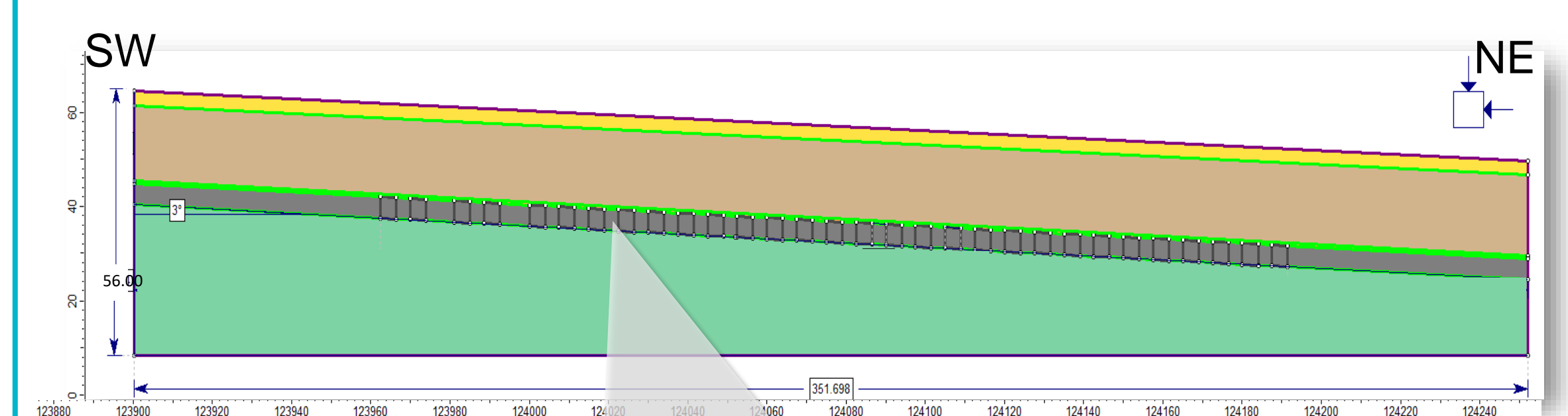
Land management

- Land ownership and access permission
- Roads, railway, buildings

Geology

- Geological map
- Drillholes
- Structural analysis
- Hydrogeology (piezometric data)

Building a preliminary numerical model

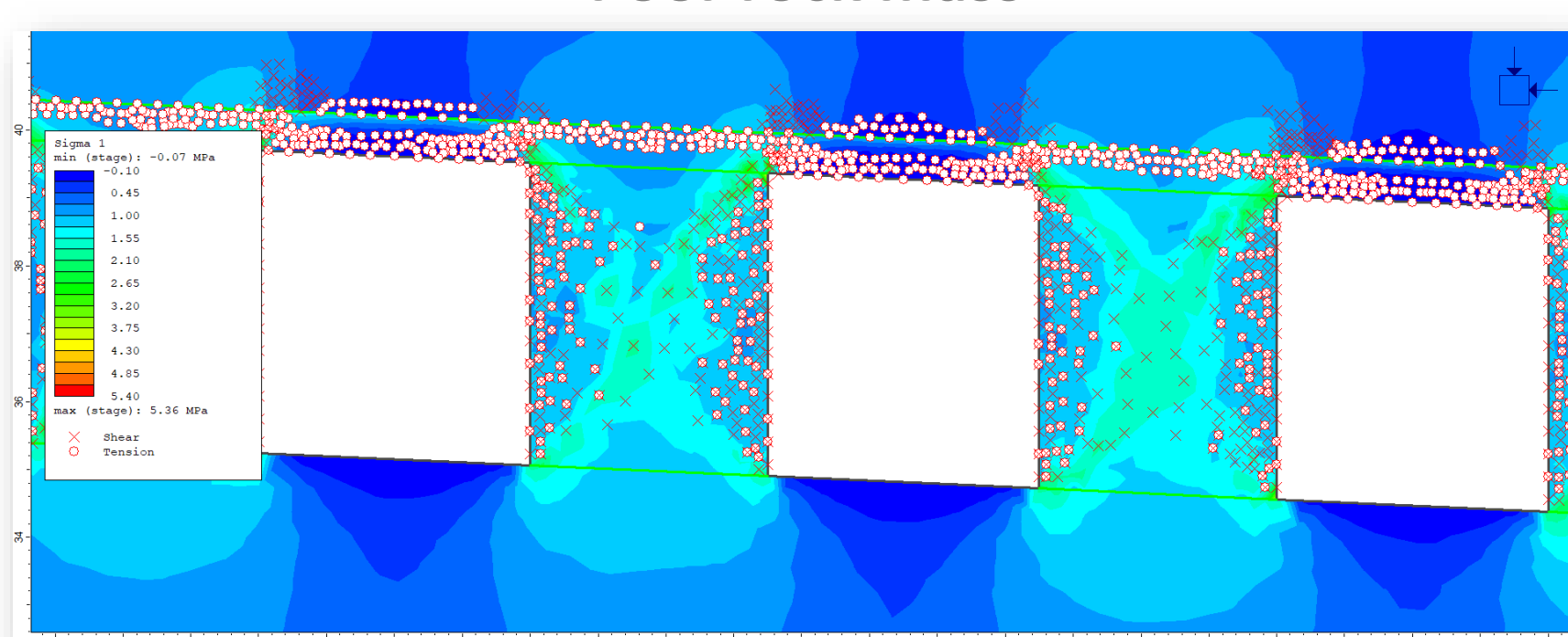


- Pillar width = 3.50 m
- Pillar w/h ratio = 0.78
- Room width = 4.00 m
- Room height = 4.50 m
- Dip = 3°

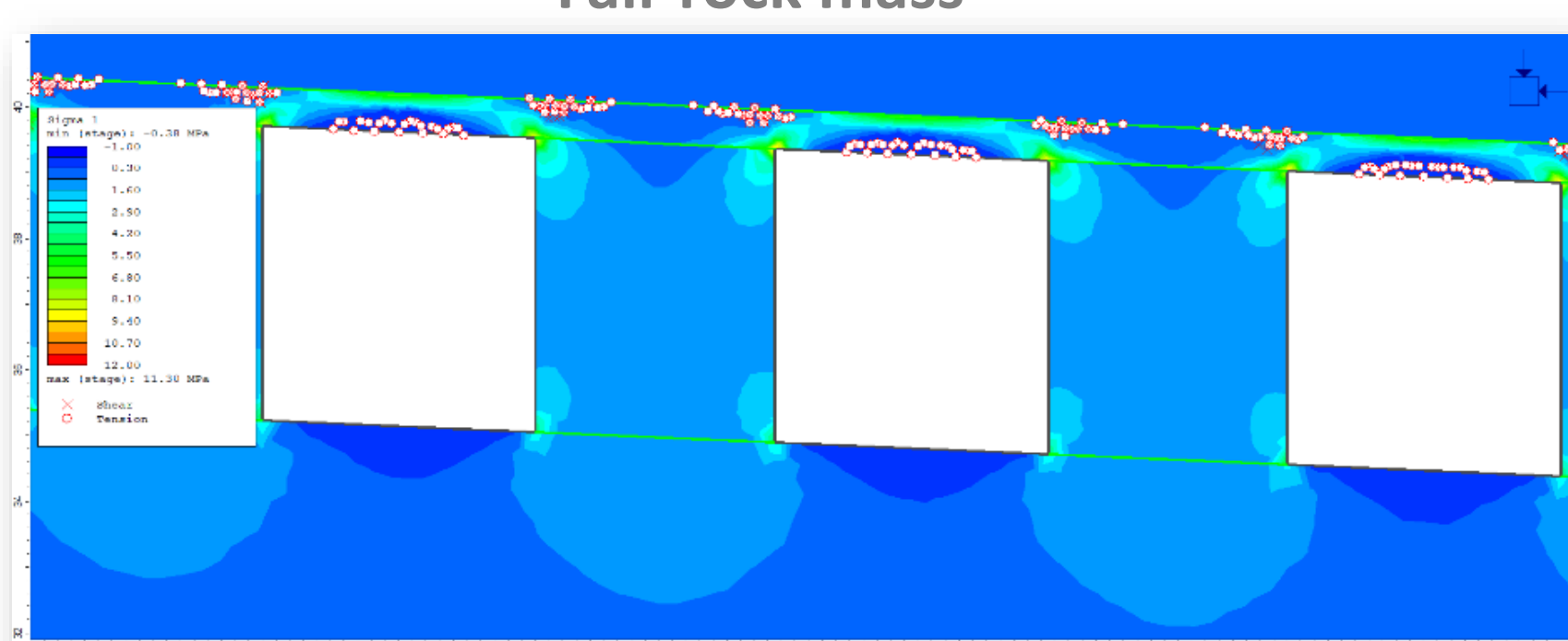
Numerical model

Parametric study

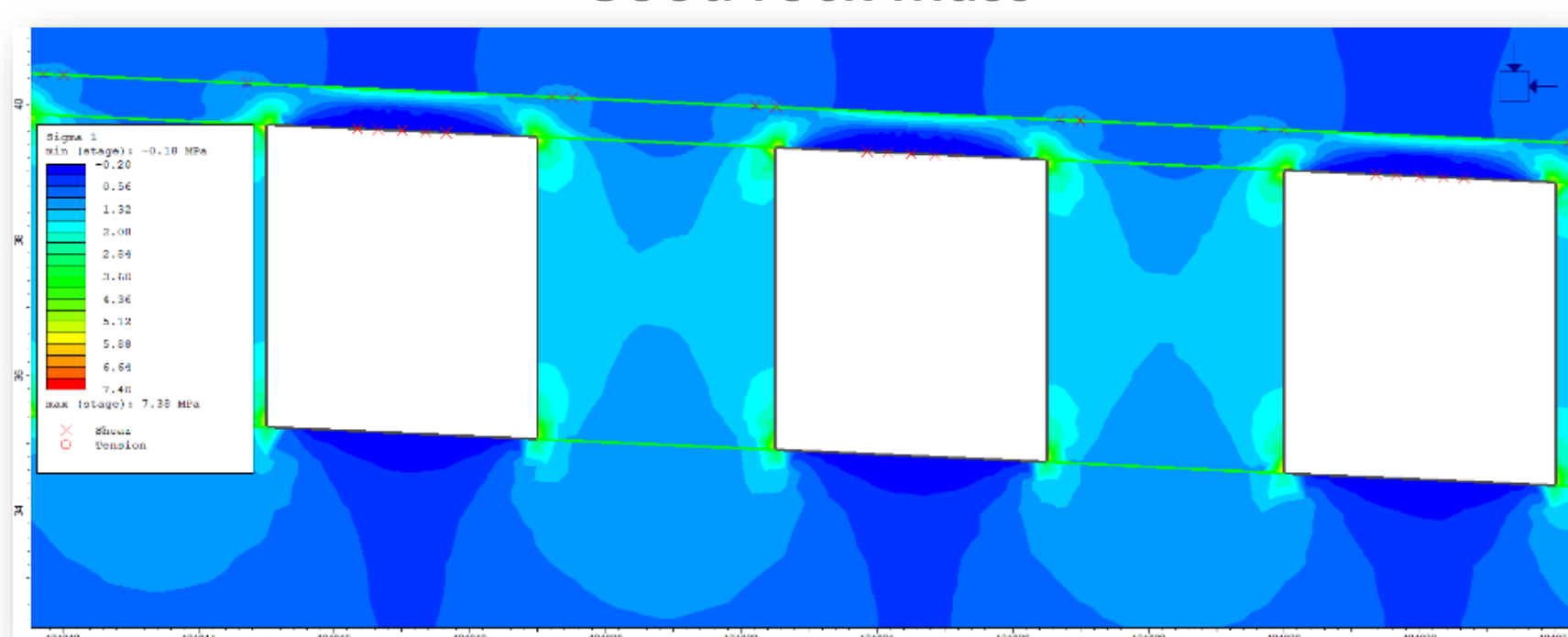
Poor rock mass



Fair rock mass



Good rock mass



Poor rock mass:

- Laboratory data for the rock mass properties
- Yielded rock mass

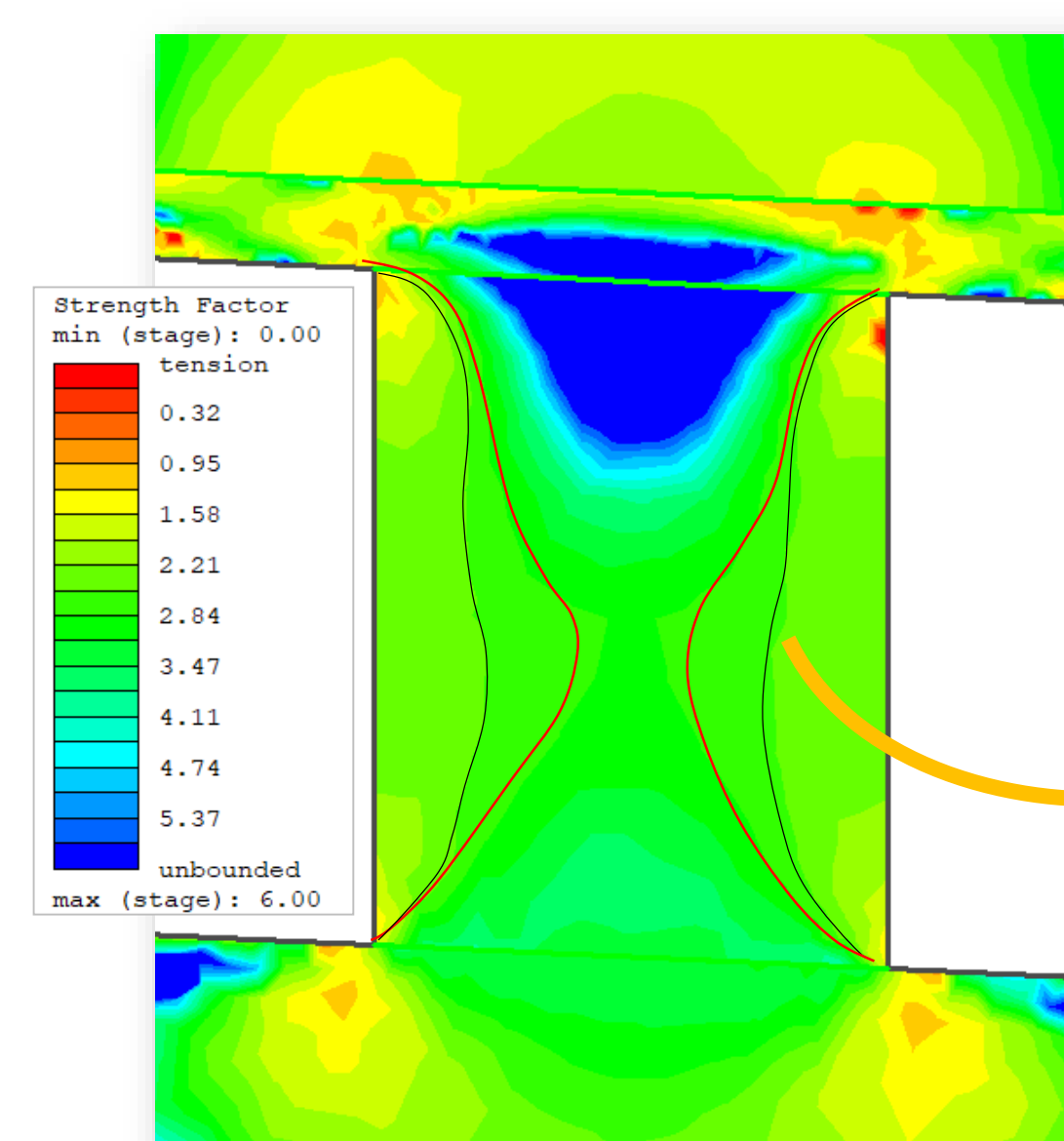
Fair rock mass:

- Slightly increased rock mass properties
- Several yielded elements

Good rock mass:

- Increased rock mass properties
- Sporadic yielded elements

Focus on a pillar



Numerical modeling of pillar (vertical section) with data about the SF



Photo of spalling pillar from Malogne underground quarry

Conclusions and perspectives

- Multi-approach assessment for rock mass characterization and numerical modeling are instruments to understand the failure mechanism
- Parametric study allow better understanding the sensitivity of the rock mass properties and their influence on the rock mass behaviour
- Preliminary results are in agreement with the underground observations

Future work:

- Rock mass characterization/in situ and additional laboratory analysis
- Effect of water
- 3D numerical modeling: BEM
- Study the influence of old deep mining activities on underground cavities
- Understanding the failure mechanisms
- Develop risk management solutions