THE FUTURE OF ROCK MECHANICS

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Urban projects - transport tunneling, roads, underground parking, flood water gallery …
Large scale ground & underground projects
New technologies and innovations in rock excavation
Geohazards due to anthropogenic intervention
Landslides (rock slides, rock falls, mud flows, avalanches) in both urban and mountainous areas
Deep excavation: ground mining, tunnelling, sea mining
Clean energies
CHALLENGES
New technologies – Tunnelling

Improvements in TBM machines due to advances in mechanical/hydraulic/electronic engineering and heavy machinery

NOW  →  Retractable telescopic shield to allow ground treatment in front or close to the face while providing the protection of a shield body

NEAR FUTURE  →  Progress expected in operations and machine-innovations

(ROBBINS (Willis, 2012)
CHALLENGES

TBM tunnelling

- Rock squeezing
- Rock burst
- Improvement of rock reinforcement
- Complicated geological conditions

Single shielded TBM jammed in squeezing ground (Ramoni 2012)
CHALLENGES
New technologies – Grouting

**NEED** ➔ more efficient pre-injection techniques for water sealing and ground stabilisation

**NOW** ➔ these needs are acknowledged by TBM manufacturers!

**NEAR FUTURE** ➔ High Progress is expected in this area (ROBBINS Willis, 2012).
Mudflow in Rio de Janeiro, Brazil, 2011 – >500 deaths

Landslides 24 June 2017 in Maoxian, China. 8 Mm3, >1 km slide height, 2.5 km H-displ. >120 deaths, 62 houses buried. Village built after 2008 Wenchun earthquake (8.2 Mn)

CHALLENGES
Engineering & Natural Slopes

- Risk analysis
- Realistic modelling
- Intelligent monitoring technology

Before

After
CHALLENGES
Clean Energies

- Hydropower: environmental issues, large caverns, water tunnels
- Nuclear power: radioactive waste repositories, underground plant
- Deep geothermal energy: drilling efficiency, drill bit life
- Storage of hydrocarbons
- Storage of CO2
CHALLENGES
Deep Mining

- High ground pressure – rock burst, squeezing
- High temperature
- Ventilation
CHALLENGES

Other issues

- In situ rock stresses: measurements and evaluations
- Permeability
- 3D visualization of rock discontinuities and weakness zones
- Physical and mechanical anisotropies in rock masses
- Realistic estimation of the rock mass quality
Rock burst and rock squeezing in TBM tunnels
Challenges of rock reinforcement in TBM tunnels
High ground pressure in deep mines
New technologies in grouting
Engineering and natural slopes: risk analysis, intelligent and real-time monitoring
Clean energies: underground hydropower caverns, effective deep geothermal drilling, safe nuclear waste repositories and underground nuclear power plant, CO2 storage
Realistical estimation of rock mass quality
Rock discontinuities and weakness zone
Measurements and estimation of in situ rock stresses
International collaborations are extremely important to solve the issues

We need ISRM to reach the goals!

Thank you!