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## Optimal design and geo-disaster prevention of underground rock engineering

Xia-Ting Feng

State Key Laboratory of Geomechanics and Geotechnical Engineering

Institute of Rock and Soil Mechanics, Chinese Academy of Sciences, Wuhan, China

John A Hudson

Imperial College, London, UK

### ABSTRACT

Firstly, a modern design method is introduced. This method includes several steps such as recognition of project purpose, recognition of key features of project, rockmass and site, establishment of modeling strategy, selection of modeling methods and codes, establishment of initial design, establishment of integrated modeling and feedback analysis strategy, and establishment of final design and verification. In the design flowchart, potential failure modes of underground rock engineering are recognized. The corresponding analysis methods and prevention measures are suggested for each potential failure mode. A global optimal design method is recommended to reduce excavation damaged zone, excavation disturbed zone, accumulation and release of energy to reduce failure intensity of rockmass. Typical applications to large underground powerhouses in China have been illustrative.

### KEYWORDS

Underground rock engineering, optimal design, geo-disaster prevention, neural networks, failure modes.

## 1. INTRODUCTION

There are a lot of large underground rock engineering are or will be constructed in China, such as large underground powerhouses (see Fig.1), large and deep tunnels, large underground spaces, and large mining stopes. For example,

- More than 20 world large scale hydropower projects,
  - more than 5000km length railway and high way tunnels, and
  - about 300 mines: mining depth will be larger than 1000m
- Jinping II hydropower station tunnels:
- Class II~III marble, UCS 80-114MPa, Young's modulus 25-40×10<sup>3</sup>MPa
  - Overburden 1500-2525m, Geostress:  $\sigma_1$  about 70 MPa
  - Water pressure: 10.22MPa, flow 4.9m<sup>3</sup>/s

The failure of rock mass occurred during the construction. Even though, there are a lot of design methods [1-10], there are still have the following key questions raised for large underground rock engineering projects under the complicated geological conditions:

- How to avoid the failure of rock mass?
- How to reduce to excavation damaged zone and excavation disturbed zone to reduce support costs?
- How to catch accurately geological conditions for such large rock slopes, deep tunnels and cavern group before construction?
- How to fully understand mechanism of rockmass fracturing process under complicated conditions before design and construction?