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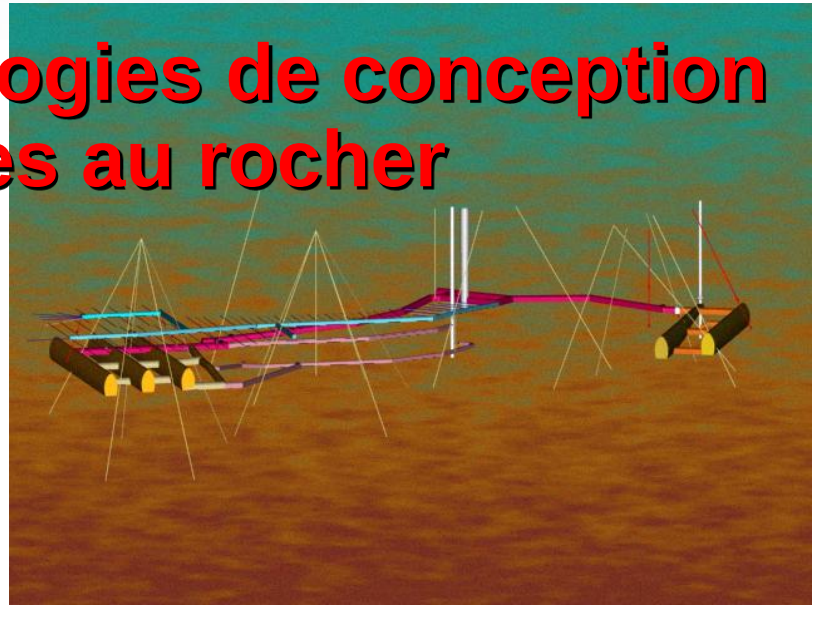
Underground storage experts

Normes et méthodologies de conception des ouvrages au rocher



Méthodologie/Normalisation pourquoi faire?

Figure 2.1: Rockbolting alternatives based on individual judgement. (Drawings from a cartoon in a brochure on rockfalls published by the Department of Mines of Western Australia.)

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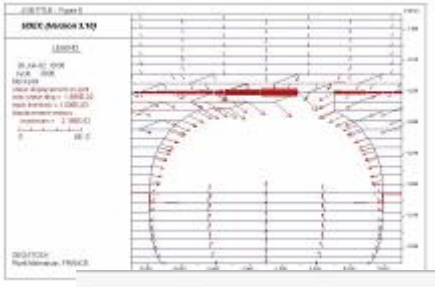
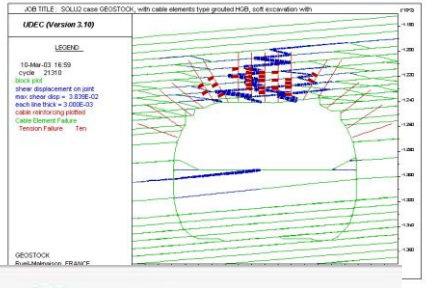
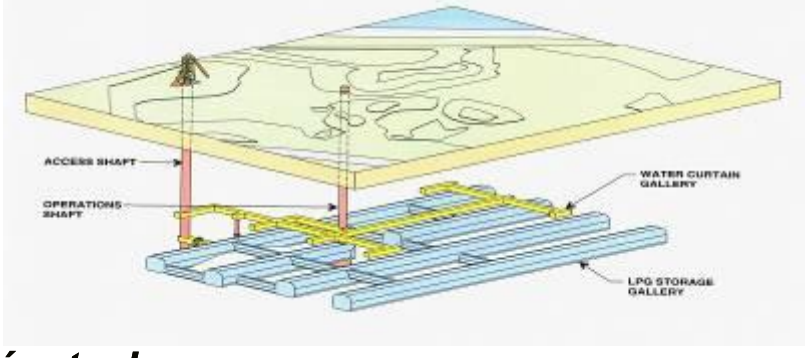
SYDNEY (Australia)

Mined caverns







Owner: ELGAS
83 000 m³ Propane

- **Main features:**

Parallel galleries - Sandstone
Length: 910 m - Section 142 m³
Depth: 124 m
Beginning of construction: 1996
Commissioning: 2000

- **Main Geotechnical features:**

Highly anisotropic environment
High horizontal stresses
Roof falls
Grouting works
Smooth blasting and tolerance control
Difficult construction supervision and contractual environment
Design 'model' difficulties
Post construction environment

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ROCK FALL EXPLANATIONS (20+)

- A large number of explanations were put forward by the parties involved, many of them with ulterior motives: unsuitable section, inappropriate and damaging explosive, poor workmanship (drilling, bolting, etc.), untested rock bolts, too differed bolt grouting, poor site organisation, unsuitable numerical and structural models, underdesigned rockbolts, inappropriate bolting patterns, unsuitable excavation sequence, poor and inefficient quality control, lack of design methodology (EC7), lack of monitoring and inspection, unforeseen stress release, random vertical joints, lack of spot bolt decision on visible instabilities, inclined defects in sheet facies, too high water pressure imposed in the fissures, etc.

- At that stage, none of the specified monitoring measures that had been prepared for design validation (geological joint mapping, convergence measurement, profile mapping, pull-out test, etc.), that certainly would have helped as new design basic data, had been implemented.

- Maintaining roof integrity was crucial for stability, as was established latter (You et al. Johannesburg ISRM2003)

ENGINEERING CONSTRAINTS

Function , Size, Shape, Layout,
Method of Excavation

OBJECTIVES

Safety, Stability, Economy

DETERMINATION OF INPUT DATA

Geologic Structure
(engineering geological mapping and geotechnical core logging)
Rock and Rock Strata Properties
(strength, deformability and factors of influence)
Groundwater In situ Stress Field)
Applied Loads

DESIGN METHODS

Analytical
(numerical and
physical modeling,
failure criteria)

Empirical
(rock mass
classifications
and experience)

Observational
(field measurements)

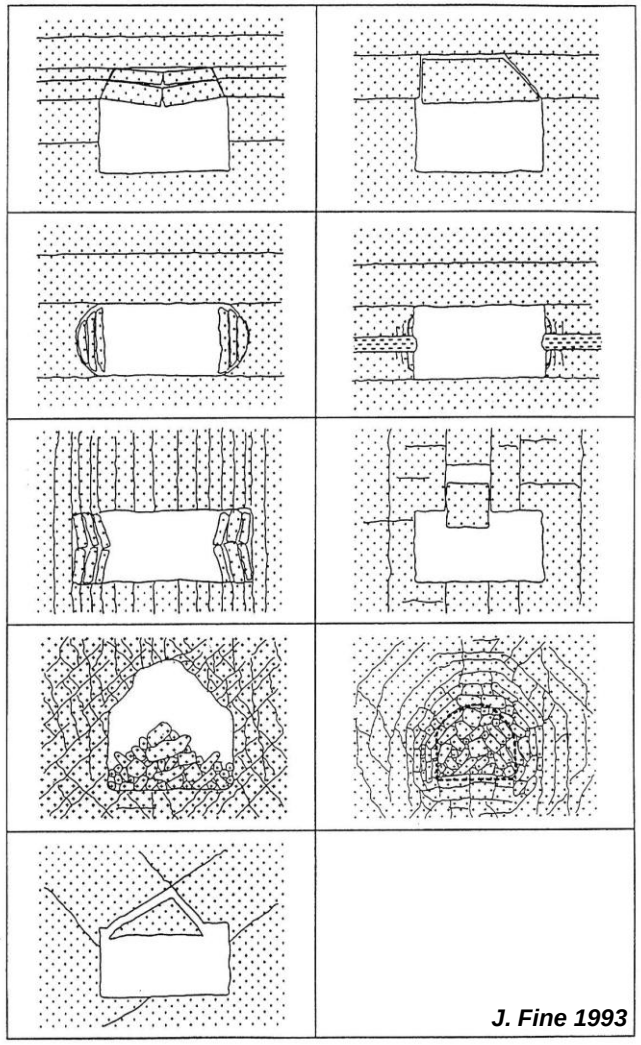
OUTPUT SPECIFICATIONS

For mines and tunnels :
Roof spans; stand-up time; support guidelines
For slopes and foundations :
Rock mass cohesion and friction; deformation modulus

FEEDBACK

Selection of Instrumentation for Performance Monitoring
Remedial Measures in Case of Instability

Typical mode of failure, rock falls



- Questions:

L'EC7 Calcul Géotechnique ou Geotechnical Design peut il répondre à nos besoins en termes de clarifications des approches par le calcul, comparatives, et/ou par les observations.

Le rocher est il un matériau comme les autres au sens des EC et comment les notions de facteurs partiels et de résistance caractéristiques s'appliquent 'elles.

Les faisabilité d'ouvrages sont elles bien des missions G11, les DFS sont elles des missions G12+ estimation sommaire des coûts, et les conceptions générales ou BD sont elles des G2 au sens de la NF 94-500. Quels niveaux de reconnaissances (EC vs NF ?) et saura-t-on alors qui est responsable de quoi lors d' une conception d'ouvrage?

Le Q system est il une approche 'prescriptive' 'conventional and generally conservative'????