

NATM Vs NMT

New Austrian Tunnelling Method Vs Norwegian Method of Tunnelling



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Contents

1. NATM
2. NTM
3. Comparison of NATM & NTM





01

NATM

New Austrian Tunnelling Method

- This method was developed between 1957 and 1965 in Austria.
- Developed for weak ground where the rock around tunnel is unstable and overstressed.
- Based on principle “ **build as you go**”, wherein **the ground/rock mass strength is to be used as much as possible.** “ Not too stiff, Nor too flexible, Not too early, Not too late.
- Monitoring is an essential component to finalize the support system during construction.

NATM

New Austrian Tunnelling Method

➤ NATM has dual – lining support

- **Primary Support – Semi rigid lining**

- Systematic Rock bolting ,
- Shotcrete layer

Offer immediate support and flexibility to allow stress release through radial deformation.

- **Secondary Support**

- Concrete lining

Is permanent support, applied when deformation reduced to specific limit

02



In the initial stage it requires very small forces to prevent rock mass from moving in, but once movement has started, large forces are required. Therefore, NATM advocates installation of supports within stand-up time to prevent movements/deformations.

NMT

Norweigan Method of Tunneling

- NMT suitable for rockmass where **jointing** and **overbreak** are dominant.
- Method of excavation
 - **Drill and Blasting**
 - **Hard Rock TBM**
- Fast and cheap tunneling method
- Support system consist of **temporary support system** which utilized as permanent supports



Norweigan Method of Tunneling

➤ Support System based on **empirical method**

➤ Rock mass characterization is done to :

- Predict rock mass quality

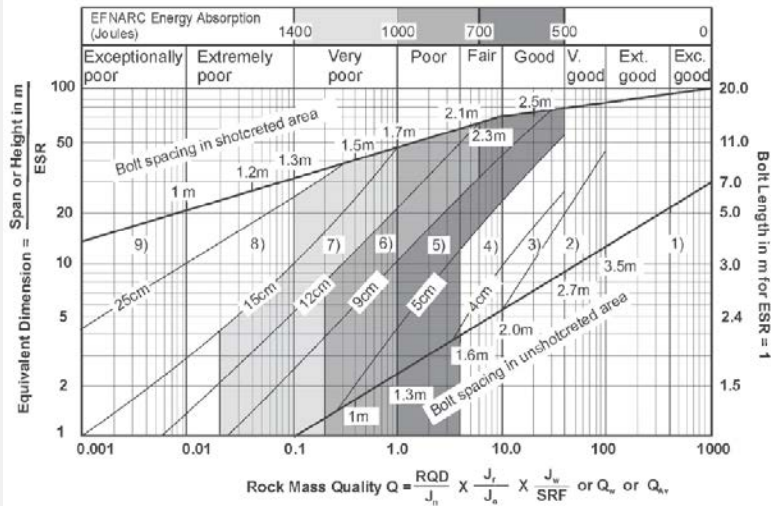
- Predicting support needs

➤ Updating both at the time of tunneling

➤ Most frequently used support measures : **Rock bolting and fiber reinforced shotcrete**

➤ **RRS – Reinforced Rib in shotcrete** is a thick load bearing ring, used in extremely poor rock condition

➤ RRS provides better uneven profile than lattice girder and steel ribs. It is a replacement of lattice girders and steel ribs.



REINFORCEMENT CATEGORIES

- 1) Unsupported
- 2) Spot bolting, sb
- 3) Systematic bolting, B
- 4) Systematic bolting (and unreinforced shotcrete, 4 to 10cm, B+S)
- 5) Fiber reinforced shotcrete and bolting, 5 to 9cm, S(fr)+B
- 6) Fiber reinforced shotcrete and bolting, 9 to 12cm, S(fr)+B
- 7) Fiber reinforced shotcrete and bolting, 12 to 15cm, S(fr)+B
- 8) Fiber reinforced shotcrete > 15cm, reinforced ribs of shotcrete and bolting, S(fr), RRS+B
- 9) Cast concrete lining, CCA

Fig. 2 - Grimstad and Barton (1993) chart for the design of support including the required

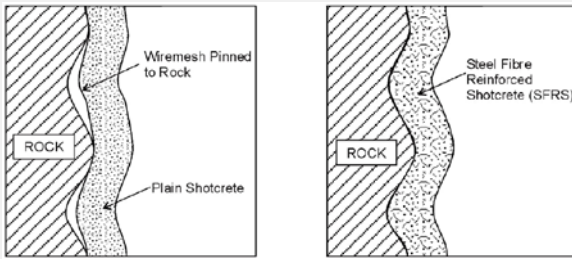


Fig. 3 - Difference in application of shotcrete with (a) wire mesh and (b) steel fibre (Vandevall, 1990)

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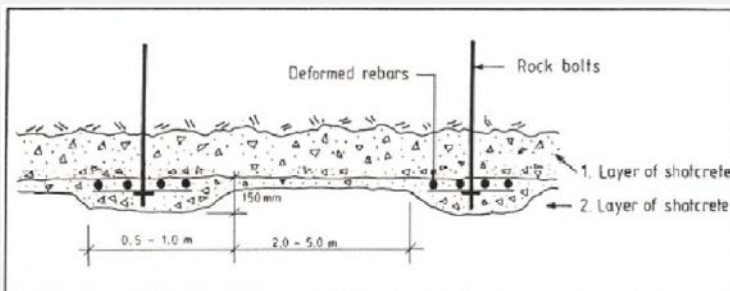
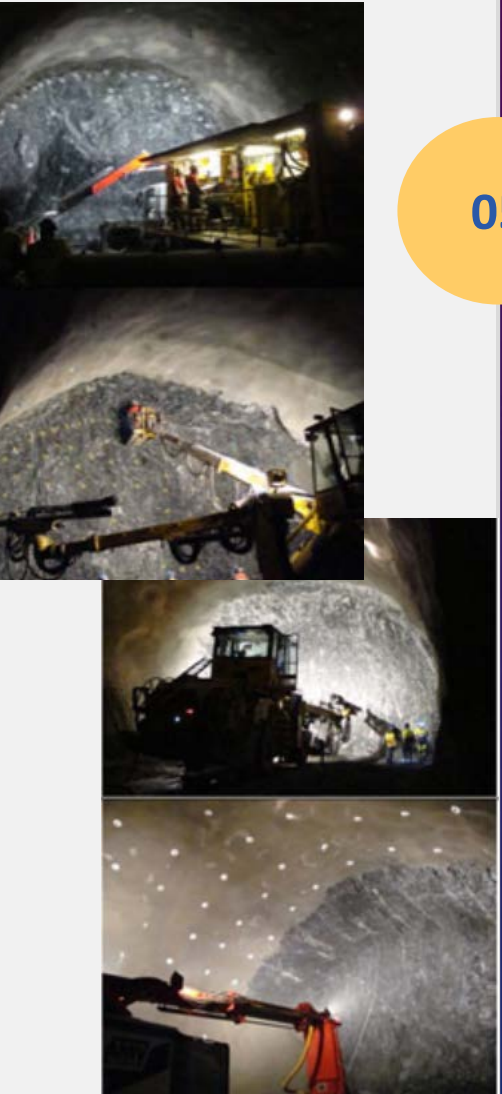


Fig. 4 - Reinforced rib of sprayed shotcrete (RRS) (Barton et al., 1992)

NATM Vs NMT

05



	NATM	NMT
1.	Good for soft ground which can be excavated by D&B, machine or hand .	Suitable for harder ground . Excavated through D&B and TBM .
2.	Rock mass classified on the basis of expected behavior .	Classified on the basis of Q System
3.	Support design on the basis of expected rock mass behavior by geological, and geotechnical observations and deformation monitoring	Supports on the basis of Q-system and estimated support pressure as per geology and compared with predicted support pressure
4.	Depends on monitoring and so the secondary support.	As per Q system. Prediction for unexpected ground condition
5.	Dry or wet sbotcrete with wire mesh; rock bolts; lattice girders, steel ribs.	Wet fibre reinforced shotcrete; rock bolts; reinforced rib in shotcrete (RRS)
6.	Design through ground reaction and support reaction concept and numerically.	Design numerically to check support system derived from Q-system .
7.	Comparatively longer time of construction.	Shorter time of construction .
8.	An expensive approach in overbreak conditions.	A comparatively economical approach

THANK YOU FOR YOUR PRECIOUS TIME

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06

