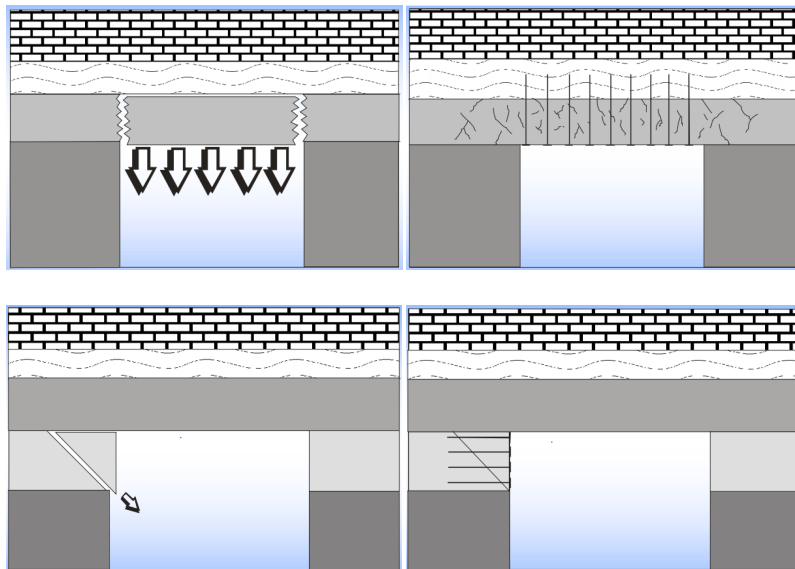


# Rock bolting

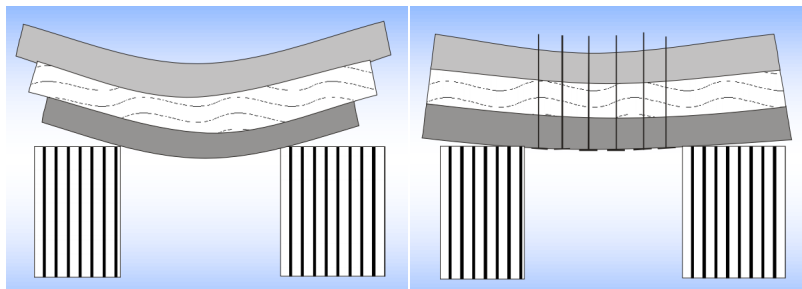
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## Bolting concepts

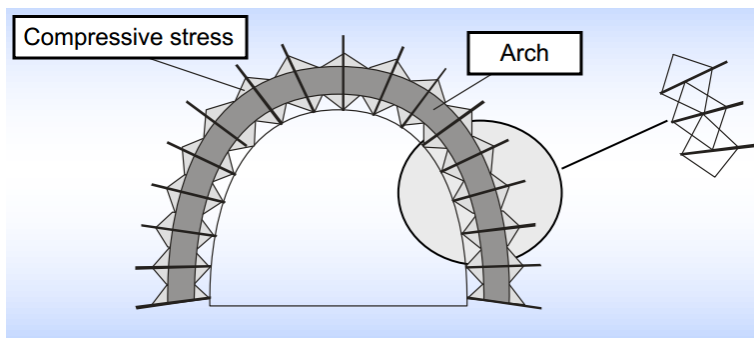
### Hang up concept



### Beam concept



### Rock arch concept



## Types of bolts

### Expansion bolts

#### Advantages

- Relatively inexpensive
- Immediate support action after installation
- Torque applied to bolt head by rotating → tension accumulates in bolt
- High bold loads can be achieved

#### Disadvantages

- Limited use in moderately hard to hard rock
- Looses reinforcement capacity as result of blasting
- Only for temporary reinforcement unless corrosion protected

### Cement grouted cablebolt – twin steel strand

#### Advantages

- Inexpensive
- Competent and durable
- Can be installed to any length in narrow areas

#### Disadvantages

- Using standard cement requires several days curing before cable can take full load
- Quality of grouting difficult to check
- Not to be used in water carrying boreholes

### Resin grouted rockbolt – rebar

#### Advantages

- Durable reinforcement when properly installed
- High load bearing capacity in hard rock conditions
- Rapid support after installation

#### Disadvantages

- Borehole diameter crucial to proper mixing and setting of resin
- Difficulties with resin cartridges in underground environment
- Resin can be messy and hazardous to handle
- Resin has a limited shelf life

### Friction anchored rockbolts - Swellex

#### Advantages

- Rapid and simple installation
- Immediate support action after installation
- Can be used in a variety of ground conditions

### Disadvantages

- Relatively expensive
- Long term installation requires coated Swellex
- Requires a pump for installation

## Friction anchored rockbolts – Split set

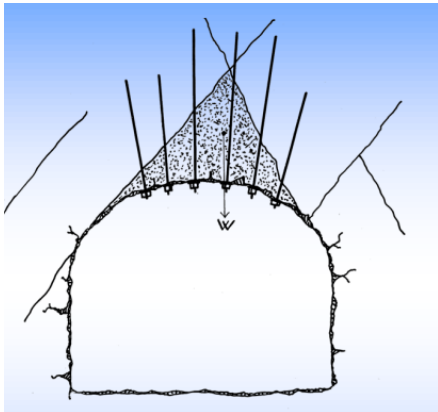
### Advantages

- Simple installation
- Immediate support action after installation
- No hardware other than jackleg or jumbo boom for installation
- Easy application of wire mesh

### Disadvantages

- Relatively expensive
- Borehole diameter is crucial in prevention of failure during installation
- Successful installation of longer bolts can be difficult
- Cannot be used in long term installations unless protected against corrosion

## Support design



$$n = (SF \times W) / F$$

- n = number of rock bolts  
SF = safety factor  
W = weight of wedge (= area x depth x specific gravity of rock)  
F = load bearing capacity of one bolt