

## Cone bolt

The cone bolt is a yielding tendon capable of providing effective support in areas prone to seismic events and high stress changes. Damage to tunnels normally resulting from, or associated with, rockbursts and large quasi-static rock deformations are consequently reduced.



### CONSTRUCTION

The end of the tendon remote from the collar of the hole, has a conical enlargement, forged onto it. The opposite end is either threaded like a conventional end-anchored tendon, or may have a 'shepherd's crook' eye to facilitate cable lacing. The entire length of the tendon is coated with a debonding agent. The short leg of the 'shepherd's crook' is left uncoated to prevent unravelling of the eye under load.

Both types of tendons are used in conjunction with a suitable bearing plate and in the case of the threaded tendon, a nut and spherical seat is also used.

### PRINCIPLE OF OPERATION

The forces generated by the dilating rock are transferred to the tendon via the bearing plate. As this force reaches the yielding point of the tendon, the cone is drawn through the surrounding grout. In so doing, work is done and energy absorbed from the surrounding rock.

Once all of the energy has been absorbed, a state of equilibrium is achieved and the tendon stops yielding. Any subsequent build up of force in the tendon, will result in the yielding process being reinitiated.

### TYPES AND SIZES AVAILABLE

Type	Shank dia. (mm)	Thread	Length (m)	Average yield load (kN)
Stud	16	M18	1.5 - 2.4	100
Stud	22	M24	1.8 - 3.0	200
'Shepherd's crook'	16	-	1.5 - 3.0	100

Cone bolt studs are used in conjunction with 125 x 125 x 6 x 40 domed washers and spherical seats.

Cone bolt 'Shepherd's crooks' are used in conjunction with 125 x 125 x 6 domed slotted washers.

## PERFORMANCE

- Yields for 0.5m or more at displacement rates ranging from very low to > 7m per second, whilst still maintaining support loads of up to 200kN
- Readily integrates with other elements of the support system thus requiring minimum training of personnel
- As easy to install as conventional end-anchored or grouted tendons
- Not highly sensitive to grout strength, will perform effectively in grouts with uniaxial compressive strength ranging from 25 to 60MPa
- Easily meeting the criteria of being able to absorb 25kJ of energy, the 16mm cone bolt will absorb 40kJ of energy over a yield length of 500mm and the 22mm unit, up to 100kJ without failing.

