

## FSG rock bolt stressmeter

### Description

Model 4350 **FSG rock bolt stressmeter** can precisely measure load delivered in rock bolt and is to inspect the efficiency of rock bolt (effective depth, quantity, and stress). In the interior of rock bolt anchor that is to fix bedrock with grouting, it has high precision of foil strain gage in 4 equally divided places of anchor length, which are waterproof and moisture proof.

When load by the movement, relaxation or joint of rock happens, there happen minute deformation in anchor, attached foil strain gage sensor absorbs this displacement, If horizontal displacement happens, the strain gage perceive this, the resistance factor changes slightly in proportion to displacement of anchor and it is transmitted into output device and displayed in suitable mechanical unit.

Model 4350 FSG rock bolt stressmeter of our company is four station system and easy to calculate distribution of stress and volumes precisely.

And the rock bolt anchor is divided into 2~6m of lengths that you can choose according to condition of construction site. Rock bolt anchor is used carbon steel of diameter  $\varnothing 25.4\text{mm}$  that it is easy to set into  $\varnothing 38\text{mm}$  of inner diameter, usual size of perforation.

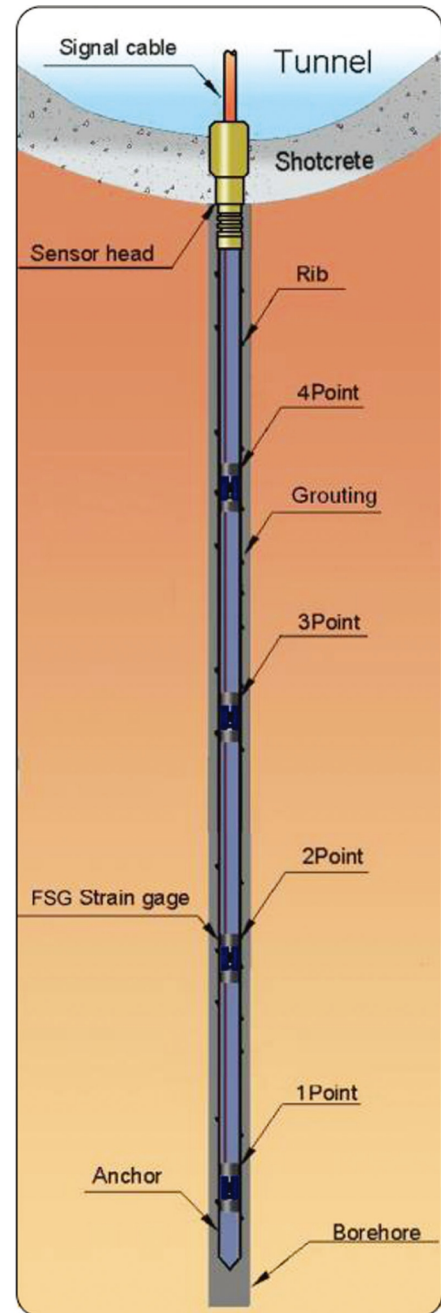
Foil strain gage type rock bolt stressmeter has not measurement error or difficulty that is in hand operated mechanical system. And it is waterproof and rustproof that it is possible to measure permanently.

### Applications

FSG rock bolt stressmeter is designed to measure axial force given to rock bolt that is set to strengthen bed rock in the construction site of tunnel, mind, hangar, or common duct.

### Features

- Small design to apply in  $\varnothing 38\text{mm}$  of the inside diameter of borehole
- Have high precision of foil strain gage in it
- 4 station system length of 2~6m of anchor
- 50m H<sub>2</sub>O waterproof
- Possible to dynamic and automatic measuring.



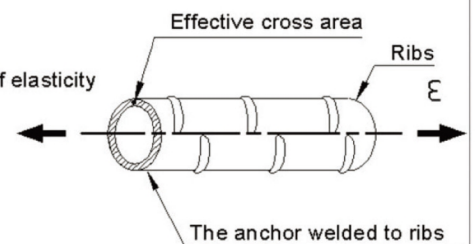
[Installation of FSG rock bolt stressmeter]

$\epsilon$  : Strain  
 $F$  : Force  
 $E$  : Modulus of elasticity  
 $A$  : Area  
 $\sigma$  : Stress

$$\sigma = F / A$$

$$E = \sigma / \epsilon$$

$$\epsilon = F / (E \cdot A)$$



[Theory of calculation]

## FSG rock bolt stressmeter

### Specification

Model	4350				
Sensor element	FSG sensor (foil strain gage type)				
Range	Total 5,000 microstrain (tension 2,500, compression 2,500 microstrain)				
Rating output	5mV/V ( $5,000 \times 10^{-6}$ )				
Accuracy	$\pm 0.5\%$ FSR				
Nonlinearity	$\pm 1.0\%$ FSR				
Resistance	350 $\Omega$				
Insulation resistance	More than 100 M $\Omega$ / 500 V				
Exciting voltage recommended	Less than 5 VDC				
Exciting voltage allowable	Less than 10 VDC				
Operating temperature	-30~80°C				
Measuring points	4 points (standard)				
Minimum borehole diameter	More than $\varnothing 38\text{mm}$ (EX Drill)				
Waterproof	50 m H <sub>2</sub> O				
Anchor dimension	ID $\varnothing 16.2 \times$ OD $\varnothing 27.2\text{mm}$				
Cross sectional area of anchor	374.95mm <sup>2</sup>				
Modulus of elasticity	$2.1 \times 10^6$ kg/cm <sup>2</sup>				
Yield point of anchor	About 17 on · f (assumed that is has 4,500 kg/cm <sup>2</sup> limit ratio of elasticity)				
Full length	2m	3m	4m	5m	6m
Gage length	500mm	750mm	1,000mm	1,250mm	1,500mm
Weight	6kg	9kg	12kg	15kg	18kg
Material	Carbon steel pipe				
Signal cable	$\varnothing 13\text{mm}$ , 0.3mm <sup>2</sup> $\times$ 16C shielded PVC sheath cable				

### The readout

It is electric resistance sensor that generates mV and can be used by connecting with strain meter or data logger that can read strain

- ACE-600A (FSG readout)
- ADL-200A (Smart logger)

### Ordering information

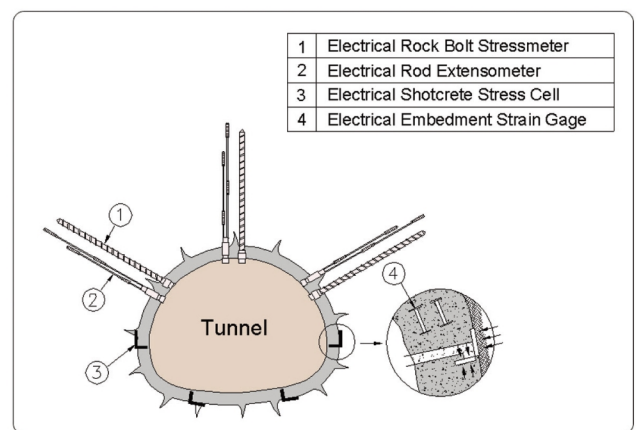
- Anchor length
- Keeping FSG readout unit
- Cable length
- The FSG rock bolt stressmeter can be manufactured up to 6 measurement points along the borehole and up to 20 meters long by order of customer.

### Ancillary equipments

- Universal terminal box (model 7012/7024)
- Portable water pressure pump (model 7050)
- Nylon tube for grout

### Recommendation

In bedrock, output efficiency is decided by the adhesion between rock bolt and mortar (grouting material) and mortar and bedrock not by the strength of rock bolt. So grouting is better if possible and in case of using couple resin, please use enough quantity of it so that it can improve adhesive power for precise measurement.



[Installation at the tunnel]