



ONTARIO CHAPTER
Tunnelling Association of Canada
Association Canadienne Des Tunnels

INVITATION

Distributed Fiber Optics Strain Monitoring of Support Members

- Presenters:** Pierre Ballester, YieldPoint Inc.
- Date & Time:** Thursday, November 21, 2019
Doors and registration: 5:30pm
Presentation: 6:00pm
- Location:** Lone Star Texas Grill
930 Dixon Rd, Toronto, Ontario
- Cost:** TAC Members: \$5 at the Door
Non-Members: \$10 at the Door
Government Employees: \$5 at the Door
- RSVP:** It isn't required to RSVP, but please notify onttac@gmail.com if you plan to attend.

Presentation Overview

Temporary support systems are commonly employed in order to mitigate and control tunnel deformation. This temporary support regime includes a combination of support including steel-sets, shotcrete, rock bolts, forepoles, and other face stabilizing technologies. YieldPoint developed strain monitoring instrumented rock bolts, cable anchors, spiles and forepoles that use optical fiber as sensors, offer a 1mm spatial resolution. This permits high quality monitoring of the strain profile along such elements. The optical instrumentation is embedded into machined grooves along the length of the support elements

Speakers Bios:

Dr. Andrew Hyett, CEO & Owner

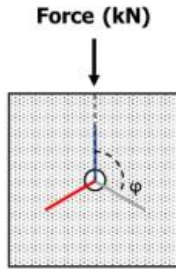
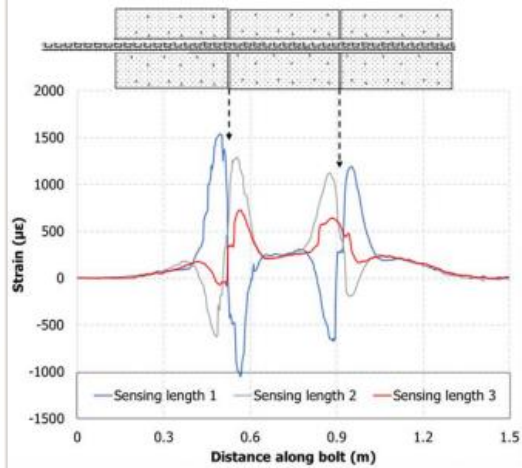
- Ph. D. Imperial College, London, UK, • Post Doc Queen's University, Kingston, ON
- Founder, YieldPoint, 2002, Co-Founder, MDT, Kingston, 1990
- Driving force behind YieldPoint, well published expert, Working relationships with mines and Academia, Frequent peer reviewer

Bradley Forbes, MASC, Ph.D. Candidate, Queen' University

The application of distributed optical strain sensing to measure the strain distribution of ground support members - A DFN-LiDAR-optical sensor method for the estimation of rockmass conditions in underground projects - A new optical sensing technique for monitoring the shear of rock bolts A new look at cable bolt and d-bolt support under axial load - Determination of grout-soil interaction parameters for ground support elements - The geo-mechanical response of axially loaded rock bolts using fiber optic technology - An optical sensor for capturing the three-dimensional bending of bolts Improving Ground Support Design with Distributed Strain Monitoring - The application of distributed optical sensing for monitoring support in underground excavations - Temporary Support Strategies: Optimization and Testing.

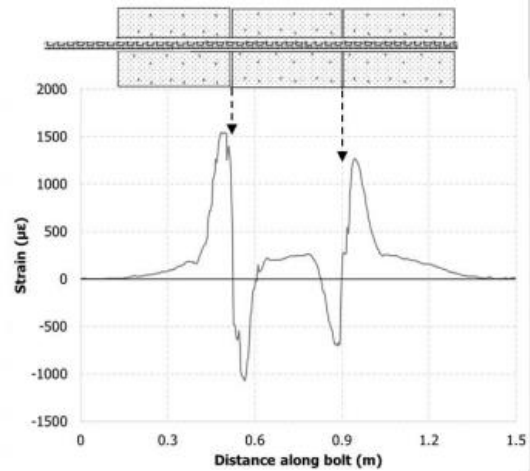
Laboratory Testing

Optical rock bolts with three sensing lengths



- Sensing length 1
0 deg
- Sensing length 2
120 deg
- Sensing length 3
240 deg

$$\varepsilon_{total}^i = \varepsilon_{axial} + \varepsilon_{lateral} \cos(\theta + \varphi)$$



$$\varepsilon_{total}^i = \varepsilon_{axial} + \varepsilon_{lateral}$$

Optical Cable Bolts

Installation at 2.5km depth

