

ANALYSIS OF TIE BACK PERFORMANCE
DURING TENSIONING AT THE BISHA
PROJECT, TORONTO.

Submitted by:

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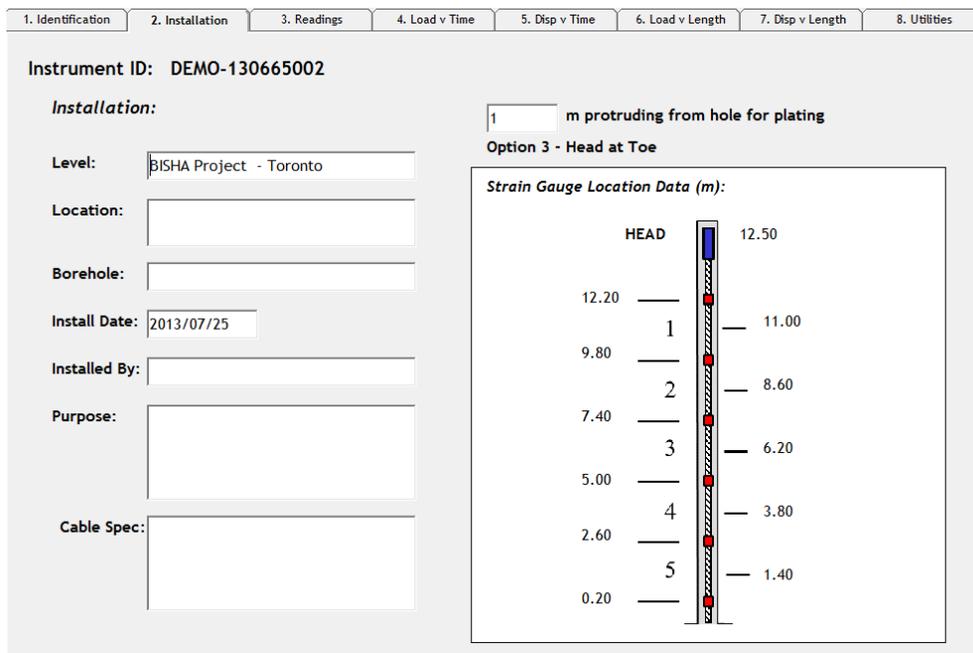
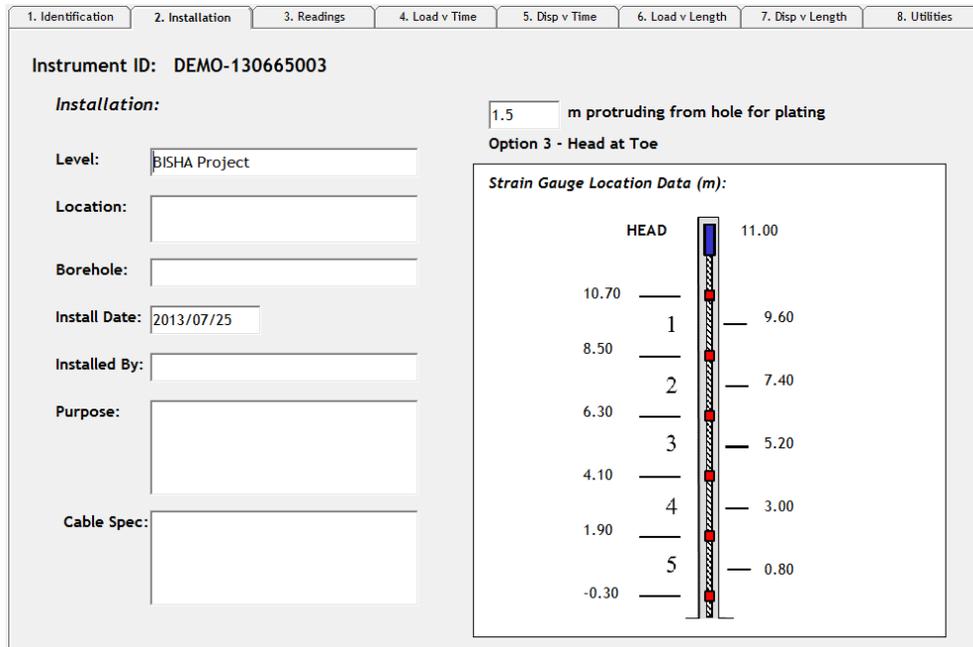


Figure 1: The configuration of the two tiebacks.

The output data from the d_CABLES is generated directly in tons (1.00 ton = 1.01 metric tonnes). Data was collected using a d¹LOGGER and provides an example of how datalogging adds value to the instruments. The data has been analyzed using YieldPoint's MineScope software.

<http://www.yieldpoint.com/minescope.php>

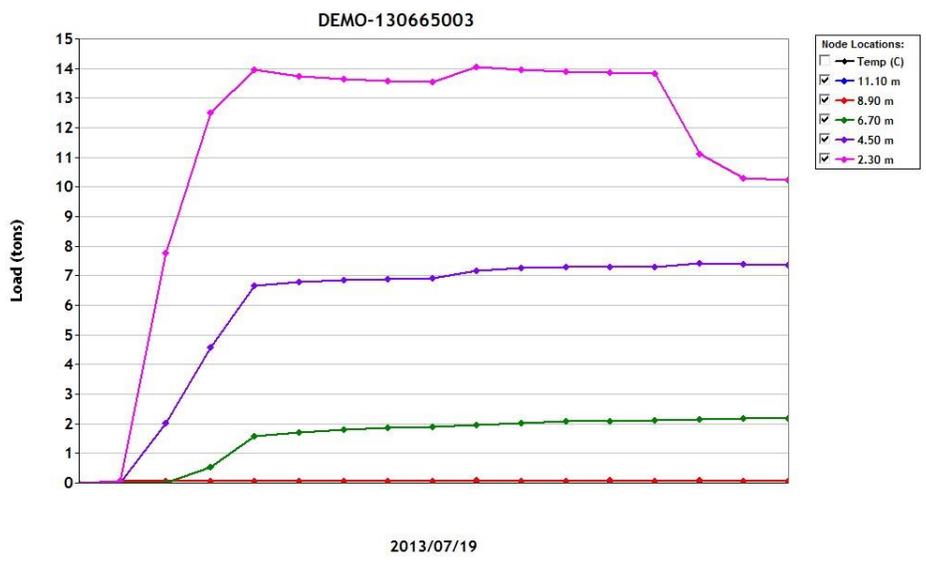
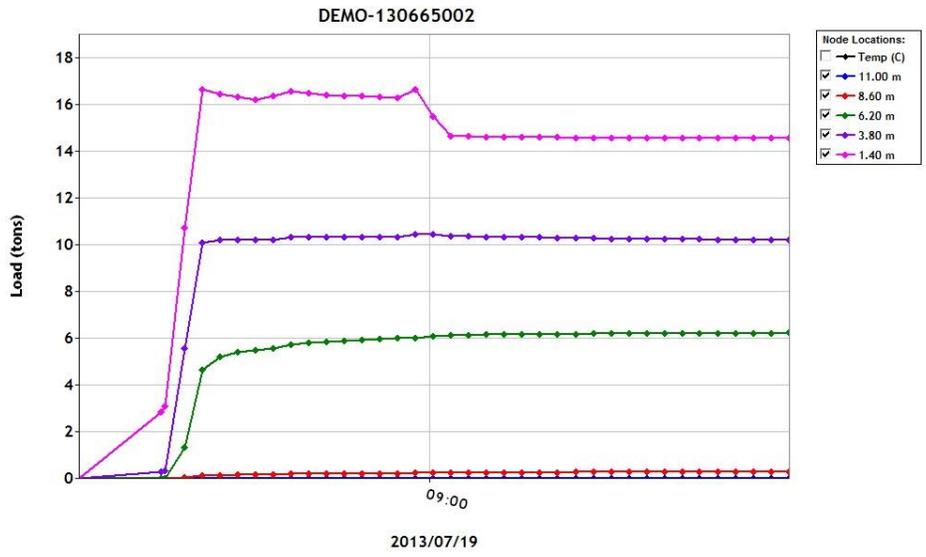


Figure 2: The variation of load over time registered by the two tiebacks during tensioning. Each point represents a 1 minute interval.

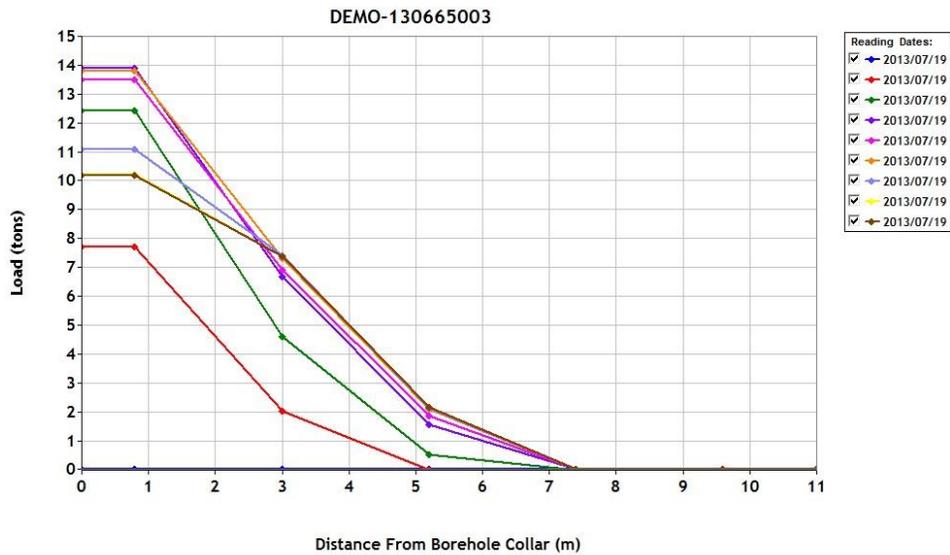
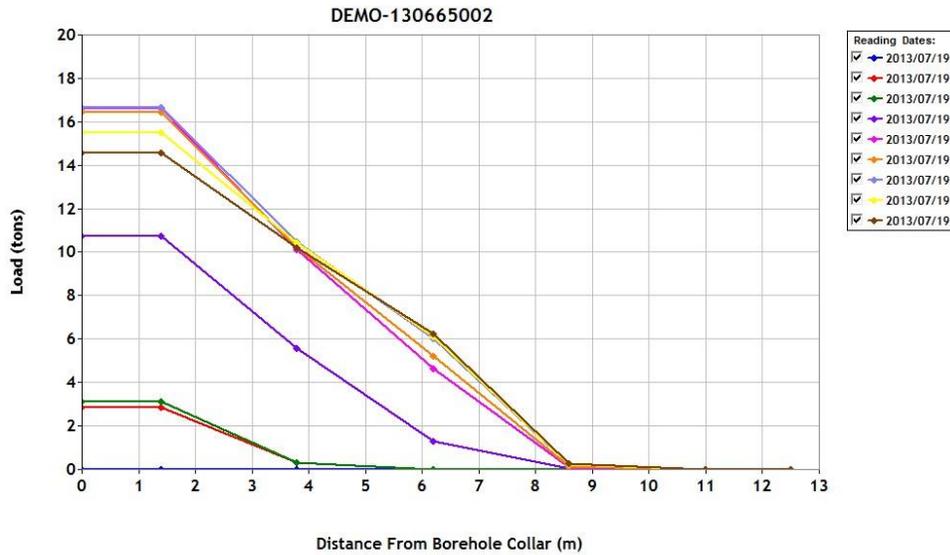


Figure 3: Tieback load versus length. The legend shows the order of the plots in time

The response for the two tiebacks is shown in Figures 2 and 3. Although the magnitudes are somewhat different, as would be realistically expected when a bundle is tensioned, the form of the plots is very similar. It appears that a constant load is applied with a jack for approximately 10mins and is then released so that the tension is maintained at the faceplate. The detail of how the tension is transferred along the tie-back during the application of tension is consistent with expectations. During the jacking period (constant load) a gradual increase in load is observed down the tieback for the Gauges 4 and 3 (at approx. 4.0 and 6.0m depth) whereas at Gauge 5 the load decays slightly and adjustments appear to be made by the operator to maintain a constant value. This is exactly as would be expected as the load transfers down the tieback in a time dependent manner. A 2-3ton relaxation occurs at the end of the

jacking period which only affected gauge 5. Tieback 130665002 which measured higher loads indicates a slightly deeper transfer of load along the anchor, which is expected.

The results indicate that the deepest anchor points register very little load. For 130265002 the deepest anchor registers only 200N during tensioning.

The Free-Zone

In the original specification for the project a free-zone was specified that would include at least the first 5m of the cable (Gauges 4 and 5 were designed to be within this free zone). The load measured for Gauges 4 and 5 should exhibit an identical response since the load/tension is constant in the absence of bond. The results in Figure 1 do not exhibit this response. In fact the results are consistent with only the first gauge being within the free-zone. Three characteristics of the data consistent with this are:

- (i) only Gauge 5 properly displays the tensioning activity,
- (ii) the 2-3ton relaxation at the end of the jacking period is only measured at Gauge 5,
- (iii) the lower load measured for Gauge 4 compared to Gauge 5 must be caused by bond .

In other words the results may indicate that the holes have been somewhat overfilled so reducing the free-zone. The effect of this is shown in Figure 4.

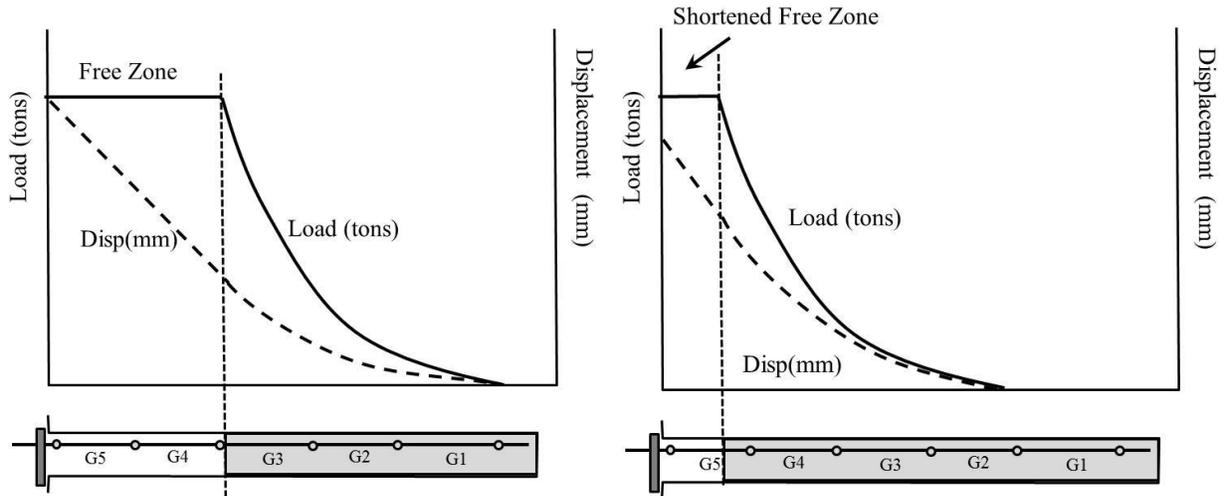


Figure 4: A schematic plot of the expected load and displacement profiles indicating the effect of a shortened free-zone.

The Displacement Profile

The corresponding displacement profiles along the two tiebacks are shown in Figure 4. The tieback 130665002, which measured higher load, exhibits 25mm of stretch, and 130765003 16mm. In both cases the tieback exhibits no movement beyond 7m which again is consistent with a reduced free-zone length. The migration of displacement during the application of tension is consistent with the load profiles.

Future Monitoring.

The accuracy and resolution of the technology are evident based on the results obtained and it is expected that as the excavation proceeds then even very minimal effects on the tieback will be measured if a data logger is attached to the d-CABLE. Changed of less than 0.1kN can be followed and the resolution of the instrument is 0.01kN.

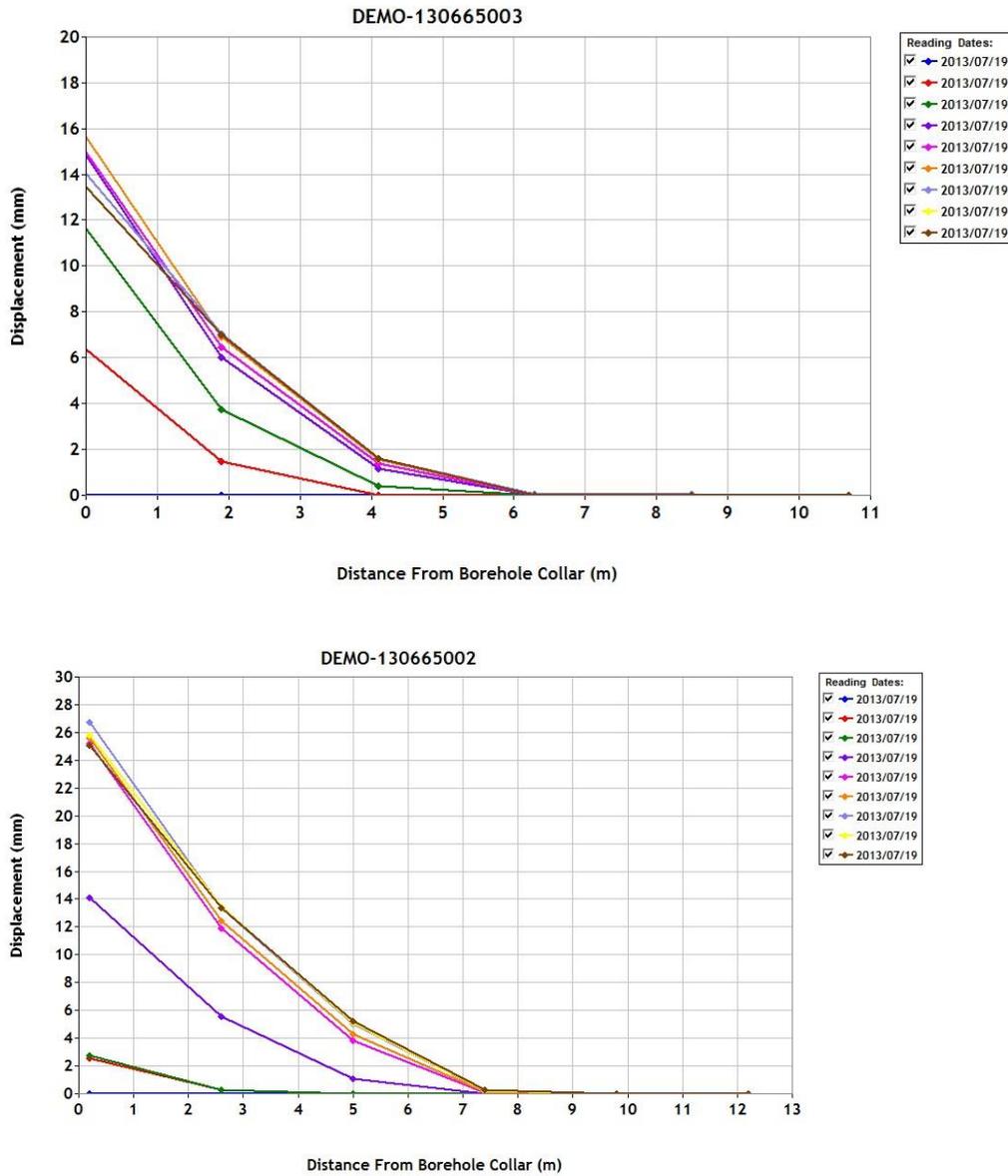


Figure 5: Tieback displacement or stretch versus length. The legend shows the order of the plots in time

