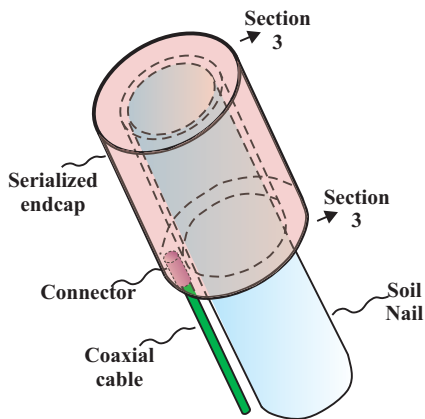
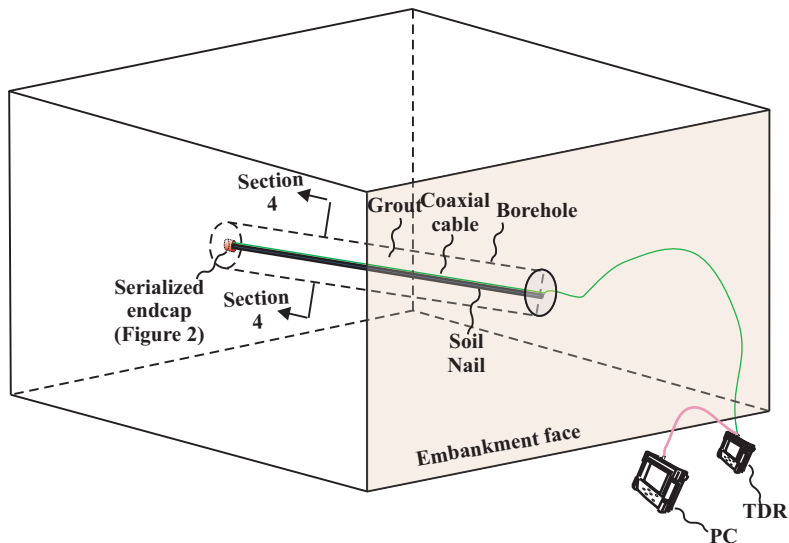
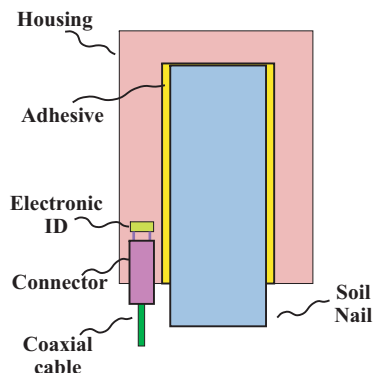


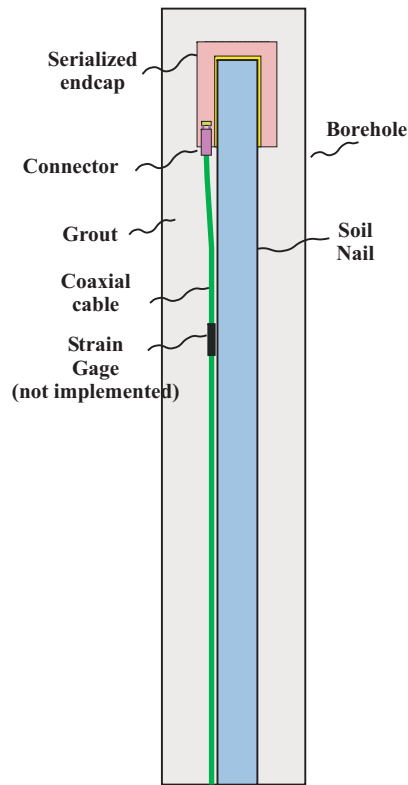
# TDR VERIFIED ROCK BOLT AND SOIL NAIL LENGTH



**FIGURE 2**



**SECTION 3**



**SECTION 4**

Rock bolts and soil nails are length dependent support devices. The length is an engineering specification. However, once the support is installed, it is difficult, if not impossible, to verify the actual installed length.

We have developed a system for determining the installed lengths of rock and soil anchors utilizing modern electronics, ingenuity, TDR principles, and some glue.

First, we created a device, which we call a serialized end cap, that is attached to the downhole end of the rock bolt/soil anchor. This device contains a connector (coaxial, twisted pair, or fiber optic) and a small chip with a unique electronic serial number.

Attachment of the serialized end cap is done with a strong adhesive, such that the cap cannot be removed without breaking it.

A coaxial (or twisted pair or fiber optic) cable is then attached to the connector and the bolt and attached cable inserted into the borehole.

The entire assemblage is then grouted in place, as per standard procedure. Once the grouting is completed, it is possible to attach a TDR device to the cable and measure the length of the cable, and thus the bolt. A separate reader unit reads the unique serial number to insure that the cable was a certified attachment.

Other devices can be attached along the length of the cable. For example, if fiber optic or twisted pair is utilized, strain gauges can be placed on the bolt in various locations. If one desires to serialize each section of steel installed, a serialized collar can be attached to each section of bolt/nail upon insertion.



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