Verification of an instrument for non-destructive testing of cement grouted rock bolts

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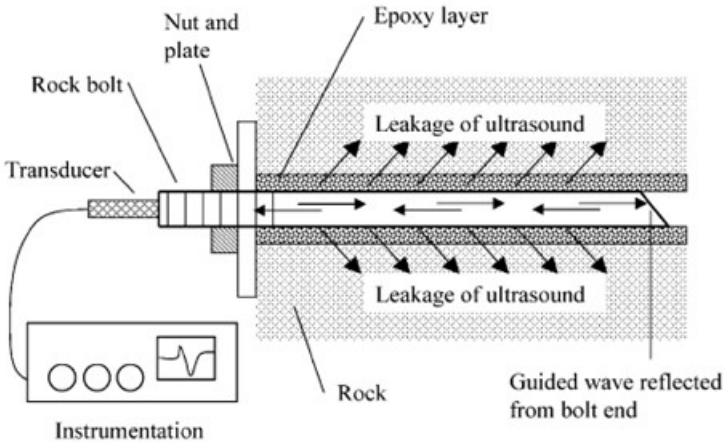
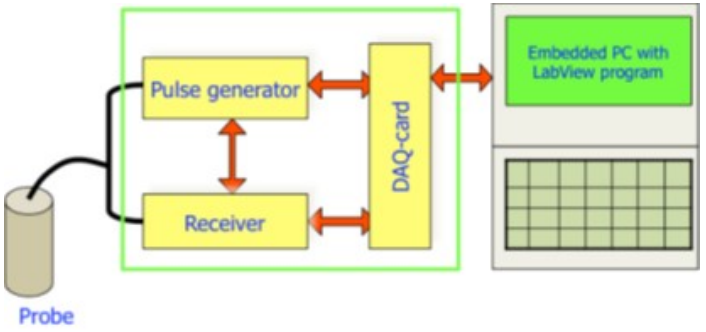
Background

- Only a few old instruments (Boltometer) are available in Sweden to test the cement grouting of rebar bolts
- The non-destructive test (NDT) technology using ultrasound works fine but the electronics and software are old and could be improved
- The RBT (Rock Bolt Tester) has been developed by Geosigma in cooperation with TSonic with the aim to complement and replace the Boltometern.

Main objective

- The main objective of the project is to verify the functionality and performance of the RBT to facilitate RBT's acceptance by the market as well as the Swedish Transport Administration (Trafikverket) as a complement and possibly replacement for the Boltometer.





What has been done

- Comparative measurements between the Boltometer and RBT at three different sites (Äspö HRL, Dannemora mine, Bypass Stockholm)

- Overcoring of bolts with defects according to RBT measurements

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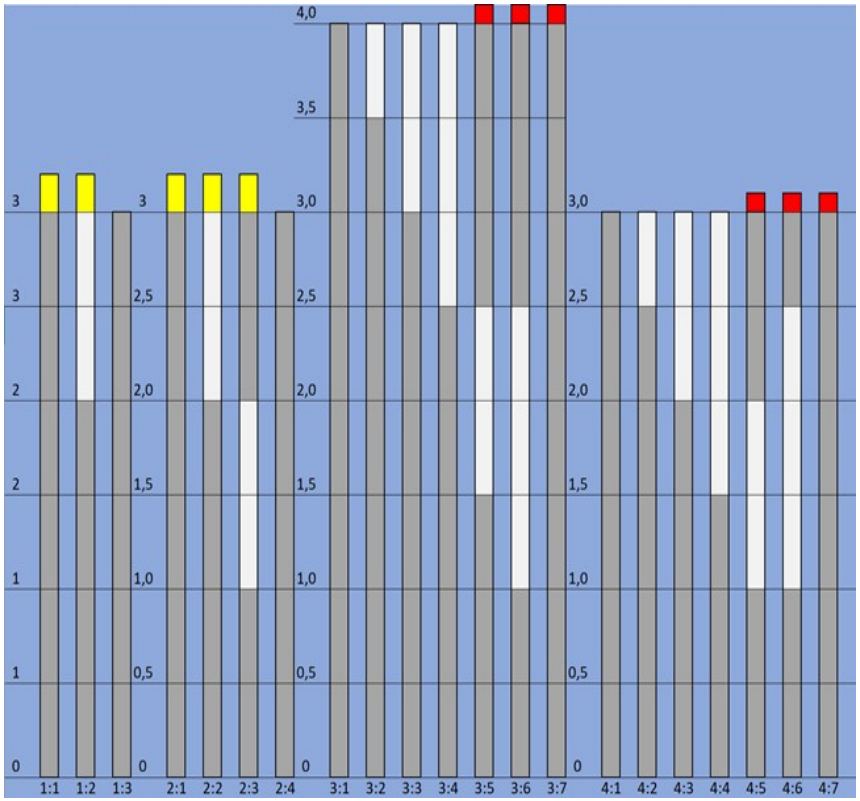
What has been done

- Installation of bolts with pre-prepared damages at Äspö Hard Rock Laboratory



CT-bolts PC-bolts 4-m Rebar bolts 3-m Rebar bolts

White = prepared parts

Grey = grouted parts

Red = end caps

Yellow = anchors (PC and CT-bolts)

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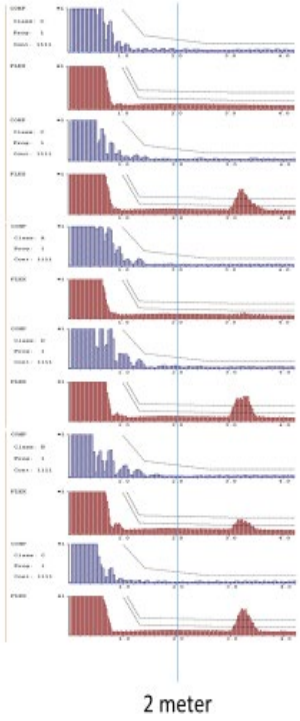
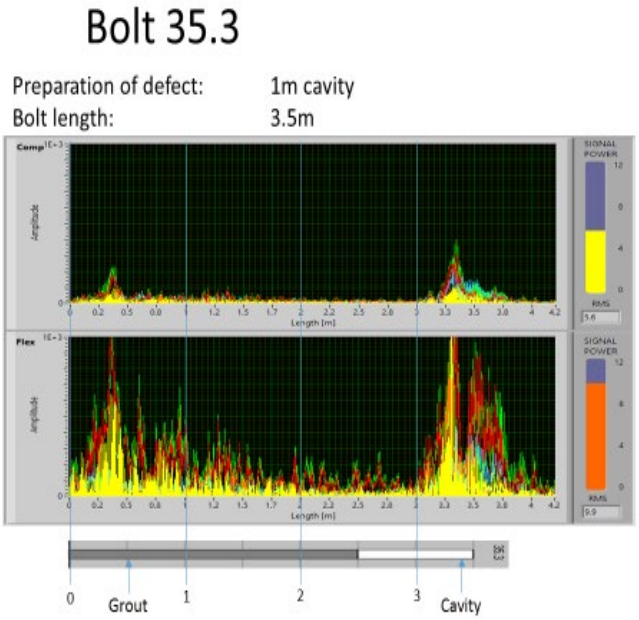
Results

- Good agreement between Boltometer and RBT at all sites (300 bolts)
- RBT is more sensitive to defects in the grouting than the Boltometer



Boltometer



RBT

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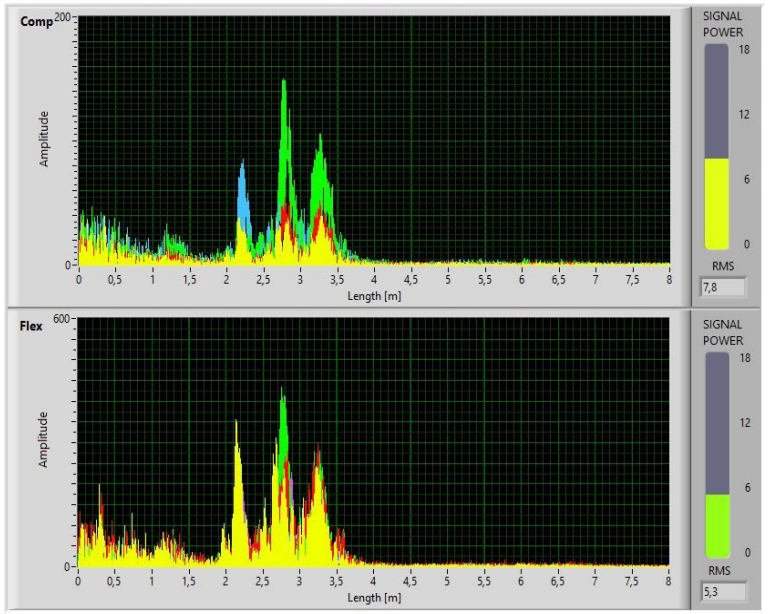
Results

- Overcoring of three bolts showed good agreement between defects in the grouting and results from RBT measurements



RBT

Conclusions

- RBT is a new PC-based instrument for testing and classification of grouted rebar bolts which can complement and replace the old Boltometer
- RBT is built on modern analog electronics, advanced signal filtering and a new piezoelectric probe with high sensitivity and magnetic attachment to the bolt end
- RBT is more sensitive than the Boltometer which also requires more experience and knowledge by the operator – training is important!
- Reliable classification of bolts require good reference bolts, which ideally should be installed by the contractor at each site.
- RBT showed promising results on new types of combination bolts (PC- and CT-bolts)