Excavation damage from blasting with emulsion explosives

Quality control and macro fracturing in the remaining rock

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Excavation Damage in tunnels

- Regulated in Swedish infrastructure contracts
- In the nuclear waste industry:

Excavation Damage Zone (EDZ):

“Permanent changes to the mechanical and hydraulic transport properties of the rock surrounding the excavation”

(Martino and Chandler 2004)

(Source: Svensk Byggtjänst)
byggtjanst.se

(Andersson and Halen 1978)
Case study on quality control:

Äspö HRL Expansion

Data Collection:

• Blast fractures
• Natural fractures
• Blast design

Analysis:

• Statistical analysis (Multivariate)

Location of the tunnel sites

1) Äspö HRL
2) Gerum tunnel in Tanumshede
3) Kista tunnel
4) Subway depot in Norsborg
5) Sandvik’s Test Mine near Tampere
Field work - Data collection

Diamond-sawing

Mapping

Interpretation and digitalization
Analysis

Design variables

- Primer and detonator (bottom charge)
- Contour hole
- Emulsion string (column charge)

Geomechanical variables

Blast fracture results variables
Some concluding remarks

- Fracture length for the column charge in line with existing blast damage tables
- Fracture length for the bottom charge shorter then expected
- Longest blast fractures influenced by geology
- Charge concentration most important parameter
- Simultaneous initiation gives shorter but not fewer blast fractures
- Low influence from design hole spacing

Further reading:

*Multivariate evaluation of blast damage from emulsion explosives in tunnels excavated in crystalline rock*

Available in "Tunneling and Underground Space Technology" vol 85. (Open Access)
Thanks for your attention!