Relationship between energy per impulse and dynamic capacity of a rockbolt

© Copyright 2018 Innovative Mining Products (Pty) Ltd t/a New Concept Mining (“NCM”). All rights reserved. This document is confidential and may not be reproduced or shared without the express written permission of NCM.
Dynamic Capacity

The amount of energy a rockbolt will absorb before it breaks.
What is the Dynamic Capacity of a Rockbolt?

Define Specification Energy & Velocity

Test

Repeat

Sum Results Add the absorbed energies

Qualify

Quantify

© NCM 2018
Testing Regime

MP1 Rockbolt

Grout
Bar
Test Tube
Patterned Sleeve
Sample Performance

New Concept Mining

© NCM 2018
Sample Performance
Sample Performance

8.1kJ Applied Energy

Load (kN) vs Displacement (mm)

- MP1-05 (OD)
- MP1-05 (OG)
- MP1-05 (OM)
- MP1-05 (AL)
- MP1-05 (AM)

© NCM 2018
Sample Performance

37.4kJ Applied Energy

Load (kN) vs. Displacement (mm) graph

- MP1-02 (OK)
- MP1-02 (OS)
- MP1-02 (OT)
- MP1-02 (0Y)
- MP1-02 (0W)

© NCM 2018
Sample Performance

46.7kJ Applied Energy

Load (kN) vs. Displacement (mm)

- MP1-01 (OC)
- MP1-01 (OI)
- MP1-01 (OR)
- MP1-01 (OO)
- MP1-01 (OU)

© NCM 2018
Result Summary

Final Deformation vs Max. Absorbed Energy

Final Deformation (mm)

Max Absorbed Energy (kJ)

R² = 0.993

© NCM 2018

Final Deformation
Linear (Final Deformation)
Result Summary

Max. Absorbed Energy vs. Impulse Duration

- Maximum Absorbed Energy
- Final Displacement

Linear (Final Displacement): $R^2 = 0.8908$
Linear (Max. Absorbed Energy): $R^2 = 0.863$
Result Summary

\[ t = \frac{1}{\sigma_a A} M \]

\[ t = 1.38 \times \frac{M}{A} \]

Fig. 9 Impact duration versus normalised impact momentum for bolt specimens of different lengths and diameters

Testing Regime

MP1 Rockbolt

Grout
Bar
Test Tube
Patterned Sleeve
Testing Regime

MP1 Rockbolt

\[ t = \frac{1}{\sigma_a} \cdot \frac{M}{A} \]

\[ \sigma_a = \frac{F_{AVG}}{(A_{Bar} + \frac{A_{Sleeve}}{\alpha})} \]

\[ \alpha = 2.15 \]

\[ t = 1.53 \cdot \frac{M}{A} \]
Result Summary

Normalised Momentum vs. Impact Duration

$t = 1.53 \cdot \frac{M}{A}$
The true dynamic capacity of a rockbolt is the amount of energy a rockbolt will absorb, (at a given impact velocity) such that the rockbolt slows the impact mass velocity to zero, at the point that the rockbolt breaks.
Thank you.

Any questions?