Zero Slump Grout for Remote Closure of Mine Openings

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OVERVIEW

• Case study of closure technique
  – Low slump grout
  – Remote closure procedure

• Application to
  – Mine closures
  – Subsidence prevention
PROJECT BACKGROUND

• Overland conveyor
  – Heavy steel truss supports
  – Concrete foundations

• Karst features discovered
  – Shale/limestone contact
SITE SURVEY

- Extensive network
- Mapping required
PROBLEM STATEMENT

- Extensive karst network
- Additional loading
- Weathering of shale
- Structural analysis required
ANALYSIS

- Rocscience Examine2D
  - 2D stress analysis
  - Simplified uniform
- 11 cross sections
  - 6 longitudinally
  - 4 perpendicular
  - Centerline of primary cave
ANALYSIS

- Material properties
  - Drilling campaign
  - Grassy Creek
    - 4,679 psi UCS
  - Maquoketa Shale
    - 4,210 psi UCS
  - Generalized Hoek-Brown
    - 4,000 psi
    - Poisson ratio 0.19

- Additional loading
  - Pier tower load
    - 105,000 lb
    - 218.75 psi
ANALYSIS RESULTS

Graph 1: Von Mises (psf) vs Distance (ft) for Lat 2 Section with and without Pier Load.

Graph 2: Von Mises (psf) vs Distance (ft) for Lat 3 Section with and without Pier Load.
CLOSURE PROCEDURE

• Karst network monitored
  – Formation of cracks
  – Longitudinal within shale
  – Weathering induced
  – Superficial in nature

• Closure plan
  – Low slump grout dam
  – Flowable concrete backfill
GROUT PROPERTIES

• 4.5 bag mix
• 2,500 psi compressive strength
• 2 inch max slump
• Superplasticizer
  – 2 gallons modified in field
  – Resulted in minus 2 inch slump
CLOSURE PROCEDURE

- Grout pumped a distance of 30 ft. from highwall
- Low slump pressure bulb
- Flowable fill to full height
CLOSURE PROCEDURE

• Minimal clearance between backfill and roof
SUMMARY

• Mine Closure and Subsidence Prevention
  – Low slump grout pressure bulb
  – Flowable high strength backfill
    • Minimize voids between fill and crown
    • Provide structural support
  – Ability to pump distances
  – Minimize risk to personnel