Dismantling the Tallest Reinforced Fill in North America - The Observational Method Applied at the Yeager Airport

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October 12, 2016
Geo-Virginia 2016
Due to ongoing legal proceedings regarding the Runway 5 Slope Failure at the Yeager Airport, we will not and cannot discuss the design, construction or any opinions regarding the causes of the issue.
History of Yeager Airport

- Yeager Airport was constructed in 1947
- Typical of most West Virginia construction, work involved cutting the tops off of three mountains and filling in the two valleys
- Original construction included two runways
  - RW 5-23 – 6,300’ x 150’
  - RW 15-33 – 4,300’ x 100’
- Runway 15-33 was closed in 2008 and converted to a taxiway to serve the General Aviation Area
Runway Safety Area requirements caused a need for a fill at the end of Runway 5

Reinforced fill was selected with an Engineered Materials Arresting System (EMAS)

An additional 500’ of runway length was added to RW 23 to extend the total runway length to 6,801’

Project completed in 2008

Project was touted as the largest reinforced fill in North America
EMAS Reinforced Fill Construction
Statistics

- Height of 240 feet
- 1H:1V outslopes with Geogrid every 3 feet vertical
- Lengths of as much as 175 feet
- Volume of >1,000,000 cy
Completed EMAS Installation
Problems Develop

- Crack noticed in 2013
- Southwest corner drops a few feet
- Drops a couple of feet each day in early March 2015
Problems Develop
Emergency Planning

- The day before the failure Airport officials convened a meeting with local emergency responders
  - Discussed worst case scenarios, flooding, evacuations, emergency public information, reverse 911

- The morning of the failure (March 12th) Airport officials again met with local emergency responders

- Given the amount of movement emergency management officials took the threat of a collapse very seriously
Emergency Planning
Day of the Failure – March 12th

- An Airport employee was stationed at the base of the fill in parking lot of the Keystone Apostolic Church to watch for movements.
- At approximately 12:15 PM the employee noticed significant movement and notified Airport management.
- The Airport immediately responded and closed Keystone Drive.
Day of Slope Failure
**Slide Impact**
- 132 lives affected/approx 60 households
- 38 folks were able to return home within a couple of days
- 56 able to go home within a week

**Elk River Flooding:**
- 30 houses
- 62 residents
- 12 businesses
- 60+ employees
CHALLENGES

Schedule
- Mitigation plan
- Bid package
- Contractor selection
CHALLENGES

Available data limitations, unknowns

- Materials used
- In-place density and strength
- Water
- Grid limits
- Failure mechanism
CHALLENGES

Safety

- No one gets hurt
- 140 feet high vertical face below runway
- Massive, creeping debris field below vertical face
DESIGN

- Temporary cut slopes to be left in place
- Removal of hanging wedge/vertical face
TEMPORARY CUT SLOPES

- Balance safety factor with minimizing removal of remaining fill
- Based on perceived nature of material, used cut slopes of 1.5H:1.0V with benches approximately 50 feet vertical
REMOVAL OF HANGING WEDGE/VERTICAL FACE

- Not easily explained
- Remaining sheared grid was a benefit
- Concerns about equipment/personnel safety
- Practical limitations of equipment reach vs. oomph
OBSERVATIONAL APPROACH

- Excavate enough material to balance weight of equipment
- Monitor/restrict access in front of known cracks in remnant fill
OBSERVATIONAL APPROACH

- Survey points on outer edge of face with continuous monitoring
- Visual observations
Phase 3
Phase 3
Emergency Public Information

- No substitute for being on-site
- No Controlling Social Media.
- Disseminating Information to the Press via Media Releases.
- The Press Abhors a Vacuum.
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