Safety Evaluations of Hidden Dam – Seepage Models Meet Reality

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Kleinfelder
i=0.7

NOTE: This flow net assumes the 100' wide horizontal drainage blanket has no effect on the seepage. Flow Net No. 3 assumes it is relatively highly effective. This net is given to permit comparison.
“Since it is never possible to know the true level of safety of dams with seepage problems such as appear to exist at the Hidden Dam and Reservoir project, I urge that every effort be made to secure funds to accomplish a substantial fix in the next construction season....”

Very Truly Yours, Harry R. Cedergren, 1980
- Site Geology
- Construction Records
- Instrumentation Data
- Previous Studies
Potential Problem Areas:

1. Weathered Bedrock
2. Leveling Course
3. Seepage Blanket/Geotextile
Explorations:  
• Borings  
• Piezometers  
• Test Pits
Grout Curtain
Monitoring Well
Geotextile
Seepage Blanket

Leveling Course ok
Drainage Blanket?
Working Hypotheses

- Out of Spec Material?
- Contamination and Breakage due to Sonic Drilling?
- Movement of Fines?
Instrumentation

- 16 open tube piezometers
- 51 observation wells
- Parshall flume
- 3 v-notch weirs
- Over 30 years of data
- Reliable readings
- Representative
- Outliers
- Trends
- Triggers
Computer Model Calibration

- Observation well readings at high pool
- Seepage quantities at the toe
- Response to pool fluctuations
- Initiation of artesian conditions
- Combination of dry test pits with overflowing wells
Model Setup
Computer Model Sensitivity

- Presence of open fractures
- Effective/ineffective grout curtain
- Confining layer in upper part of bedrock
- Combination of fractures and confining layer
- Clogged blanket drain
- Local pressure relief from observation wells
Model A: Uniform Foundation
Model B: Confining Layer

Gross Pool El. 540

Select Fill

Blanket/Chimney Drain

Seepage Blanket

Random Fill

Core

Shallow DcG

Deep DsG

Fresh/Slightly Weathered Bedrock
Model C: Rock Fracture Flow
3 models with 3 answers
Seepage Analysis Results

- Seepage through discrete rock fractures or joint intersections
- Seepage pathways open to reservoir and continuous
- Confining layer in shallow bedrock foundation
- Grout curtain inefficient
- High exit gradients
Conclusions

- Insight into complex seepage conditions
- Key influence parameters
- Supported current risk rating
Thank You!