





Rock Scour Evaluation using Block Theory Int. Conf. on Scour & Erosion 2012

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The Issue...

- Dam safety
- High remediation costs, loss of life





Rock Scour Mechanisms: Block Removal





Rock Scour Mechanisms

Block failure modes



Block Theory Basics

(Goodman & Shi, 1985)



Hydraulic Forces

 For variable flow conditions, assume pressure can be applied to any combination of surfaces on removable blocks



Hydraulic Forces



An Example: Dam Site in Northern CA

Unlined rock spillway





Field Data

- Field investigation to get joint orientations and spacing
 - Scan-line surveys
 - Aerial LiDAR survey

10 removable block types



Hydraulic Forces

 Pressure head determined from USBR hydraulic jacking study (USBR, 2007) in spillway channels



Figure 29.—Mean uplift pressure, radius-edged geometry, sealed cavity, 1/2-inch gap.

3D Stability

For each block, stability is assessed for sliding (1 and 2 planes) and lifting to find most critical failure mode



Stability Summary

- 10 blocks total
- Range of critical flow velocities from ~ 4 to 12 m/s
- 3 blocks stable for all flow velocities
- Compare with flow velocity in spillway channel

Summary

- Block theory provides a simplistic way to incorporate 3D site specific rock structure into scour assessment
- Judgment is required to estimate water forces
- Critical areas can be targeted with detailed mapping leading to more efficient remediation designs
- Used as a planning tool to optimize orientation of new spillways with respect to rock structure

Questions?