

Current USACE Research Efforts Related to Seismic Stability of Dams

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Recent Research

- EQEN Research Program
 - Ground motions (software analysis, DEGAS)
 - Site characterization (Vs database; geophysical testing such as 3D sampling, high resolution tomography; improved data collection in gravels)
 - Performance assessment (physical & numerical modeling)
 - Remediation

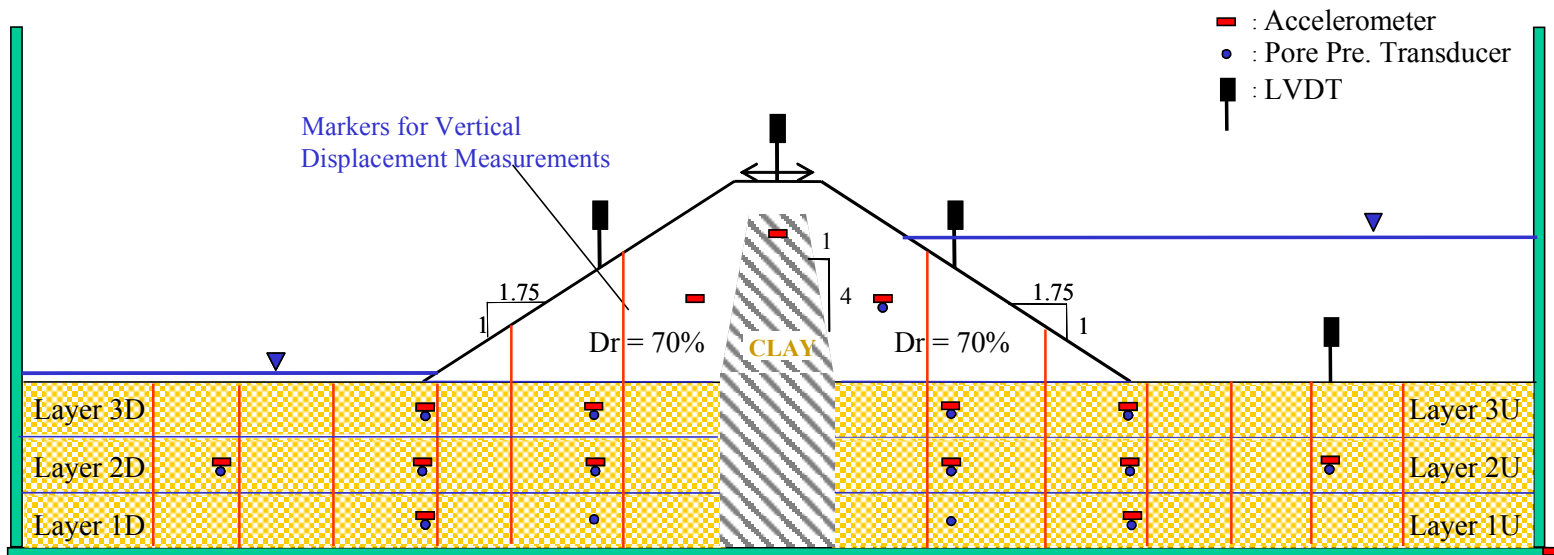


Current Research

- ITP Research Program
 - Performance assessment and remediation
 - Previous work looked at level ground conditions
 - Current work looking at structure/foundation system
 - Physical modeling to establish a database of information
 - Utilize the physical model data to enhance numerical models
 - Improve prediction of location and amount of deformation
 - Improve evaluation of remediation alternatives



Physical (Centrifuge) Modeling Completed



Centrifuge Tests

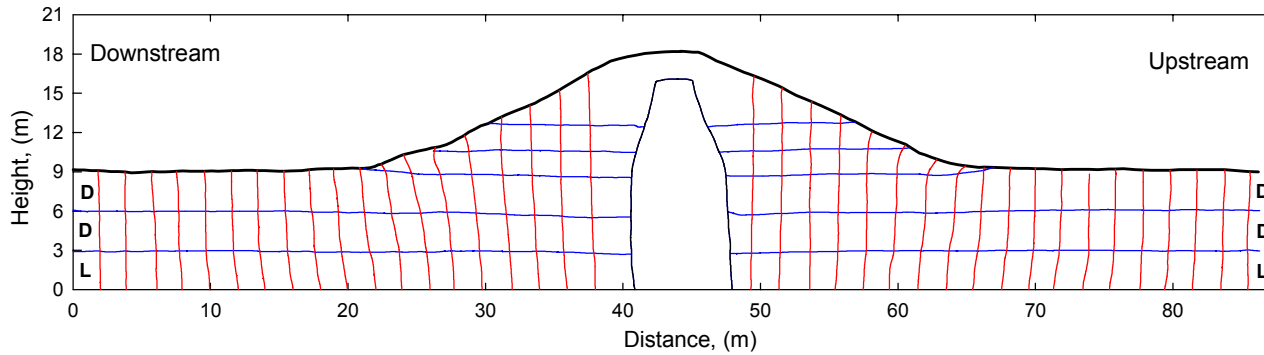
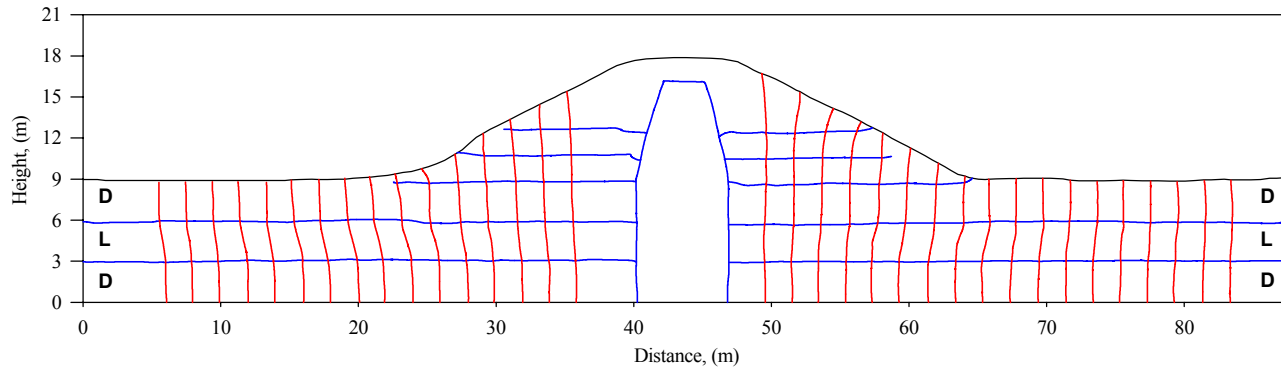
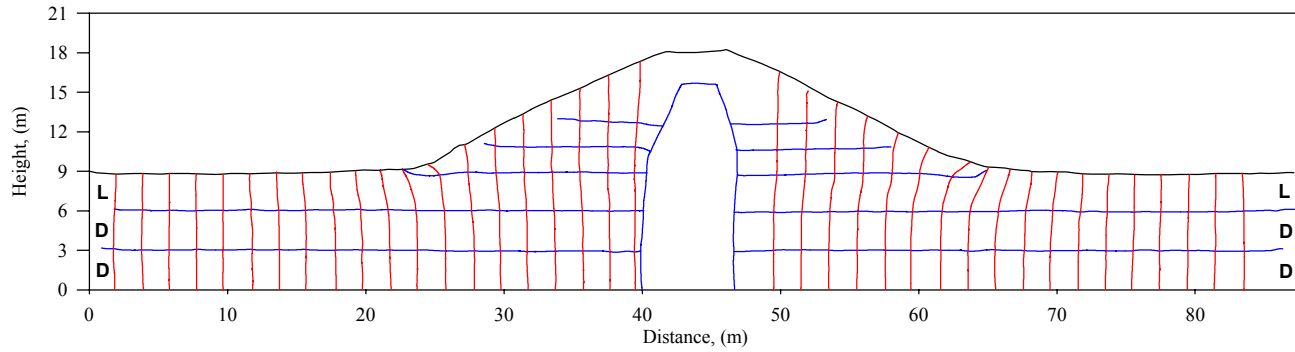
Configuration

Series I	Vary thickness of liquefiable layer in foundation, 4 tests
Series II	Vary depth of liquefiable layer in foundation, 3 tests
Series III	Vary location of liquefiable zone in foundation, 4 tests
Series IV	Clay interlayer and larger shaking, 3 tests



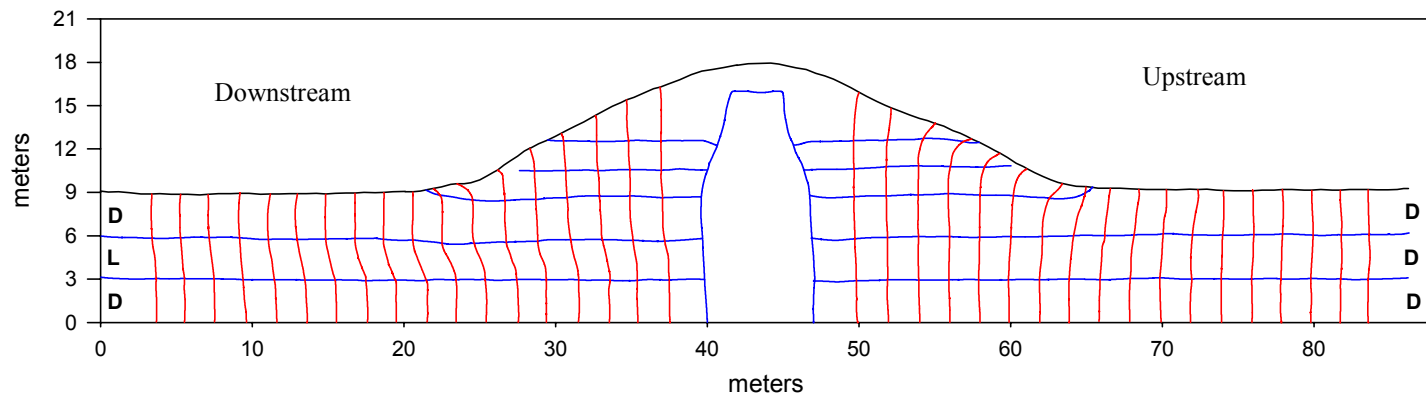
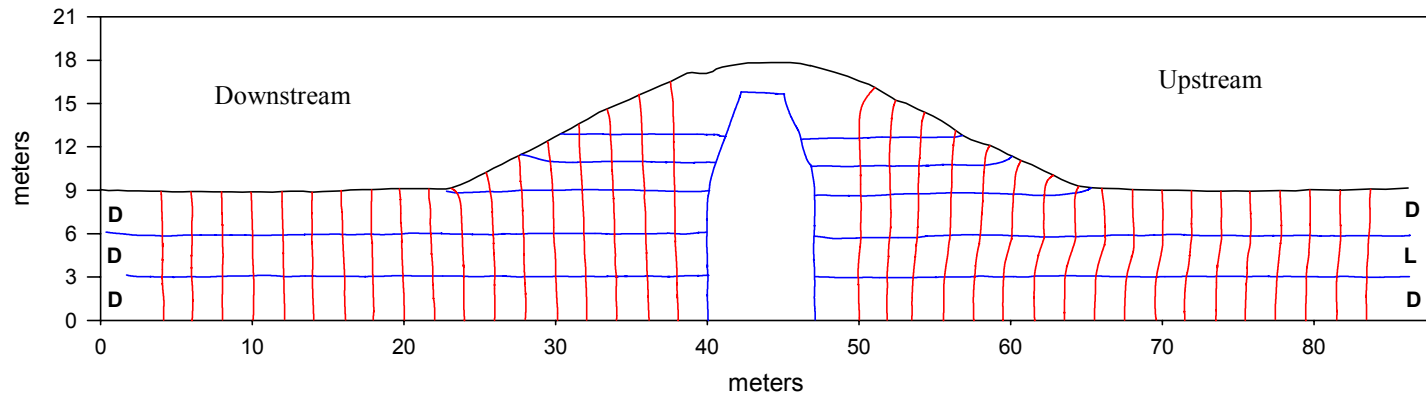
Varying thickness of liquefiable layer



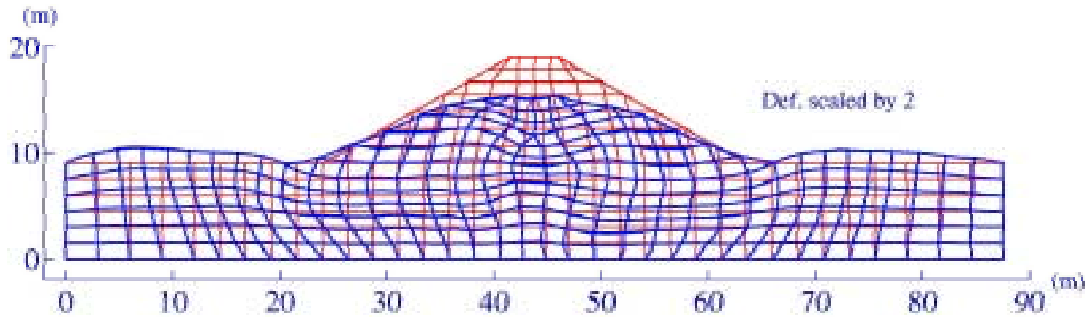


Varying depth of liquefiable layer

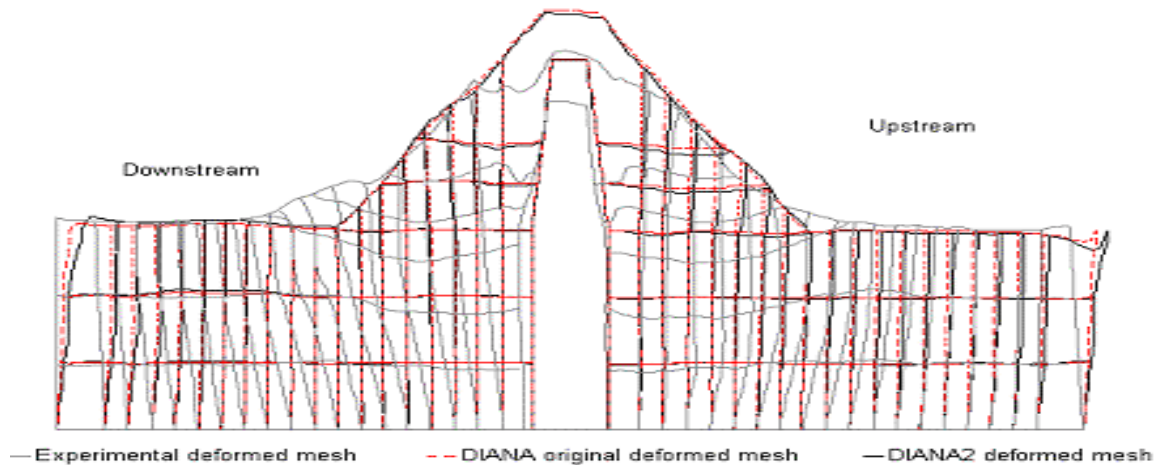




Numerical Modeling Completed



Elgamal and Yang
UCSD, CYCLIC



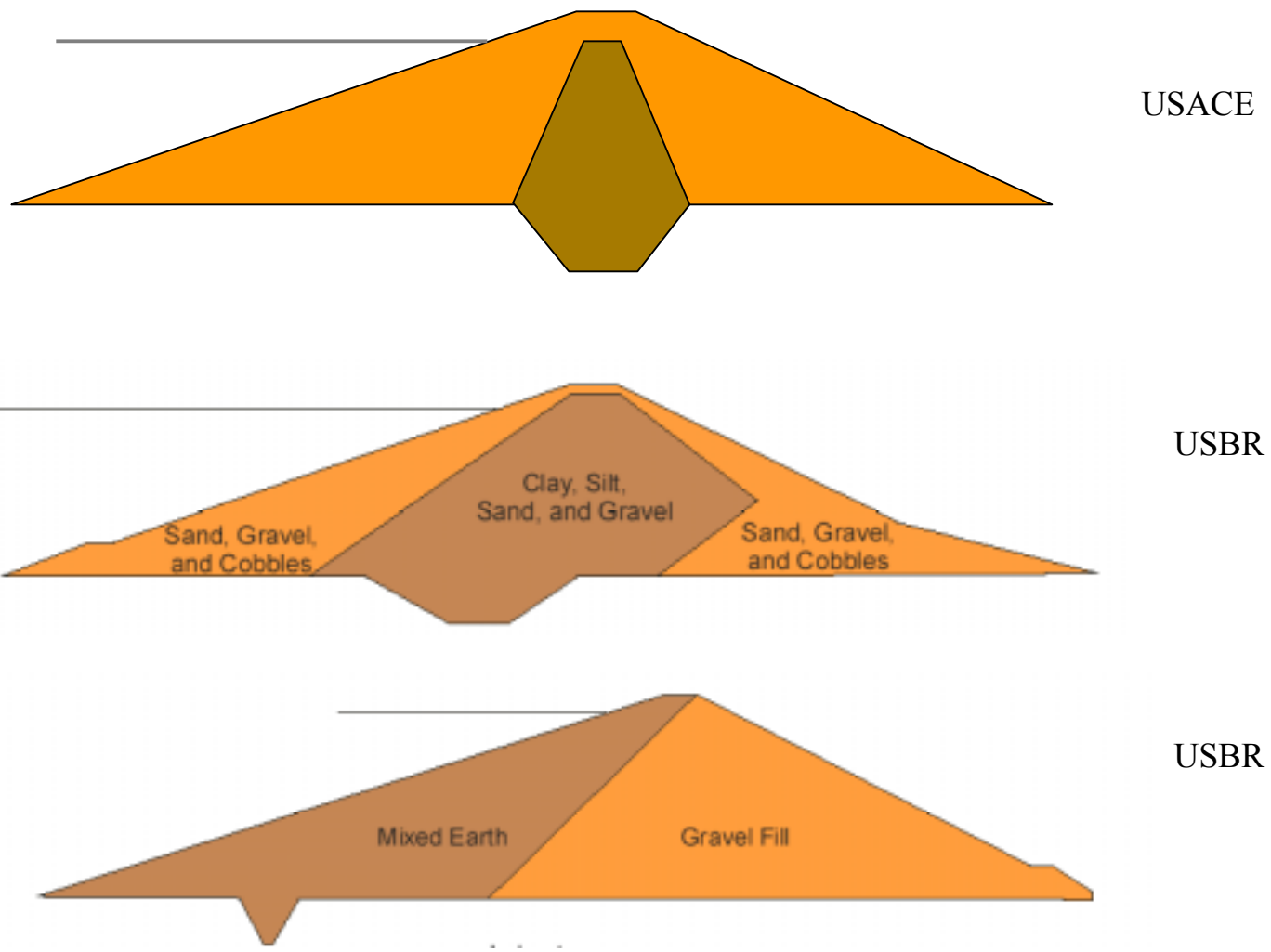
Mendez and Ramos
UPRM, DIANA

Snorteland et al
USBR, FLAC



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Physical (Centrifuge) Modeling Planned



Initial Research Goal

- Guidance for field on deformation analysis
- Guidance on remediation alternatives
 - USACE has remediated 2 dams
 - Sardis Dam (piles in upstream weak layer)
 - Mormon Island Dam (deep dynamic compaction upstream, stone columns downstream, berm)
 - USACE has two remediation efforts underway
 - Tuttle Creek Dam (deep soil mixing, upstream weak layer)
 - Success Dam (in remediation design)



Current USACE Efforts

- Updating Seismic Manuals
 - Ground motion manual (Yule)
 - Deformation analysis manual (Sharp)
- Key component in the deformation manual is required validation and verification of numerical modeling results



Validation ???

- Physical model testing (centrifuge)
- Multiple numerical models
- Reduced scale field test

- Expert review panel

