



US Army Corps
of Engineers®

Water Resources Infrastructure R&D Program

Simplified Probabilistic Models for Concrete Dam Failure

Description

This effort provides for engineering methodologies and corresponding PC-based software for enhancing the Risk Assessment for Dam Safety (RADS) package of software allowing for probabilistic analysis of concrete dam failure to hydraulic and earthquake hazards while supporting their use in screening the USACE Portfolio of dams. The four PC-based software packages consist of (1) GDLAD_Sloping_Base, (2) GDLAD_Foundation, (3) Newmark, and (4) CorpsDamSlip. (GDLAD is Gravity Dam Layout And Design.) The

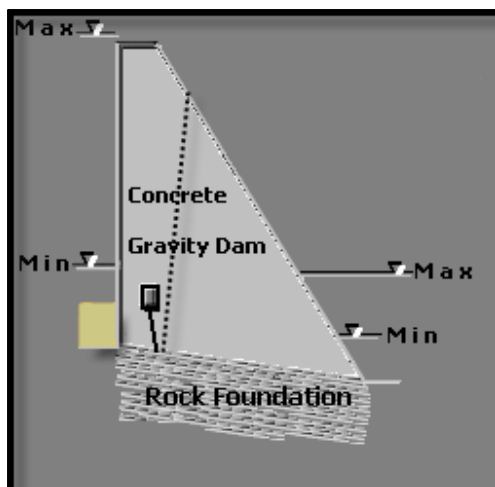


Figure 1. GDLAD_Sloping Base

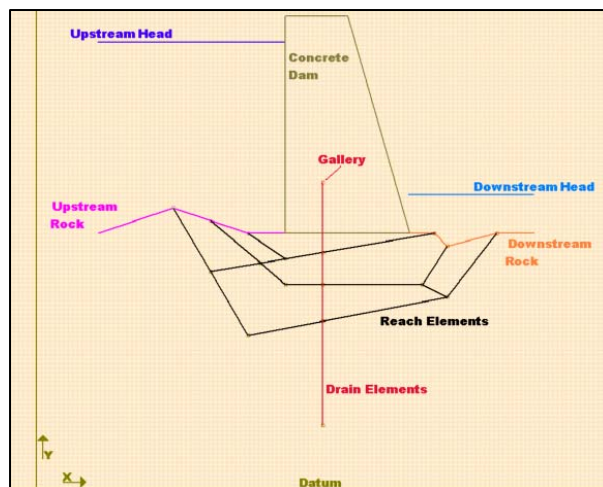


Figure 2. GDLAD_Foundation

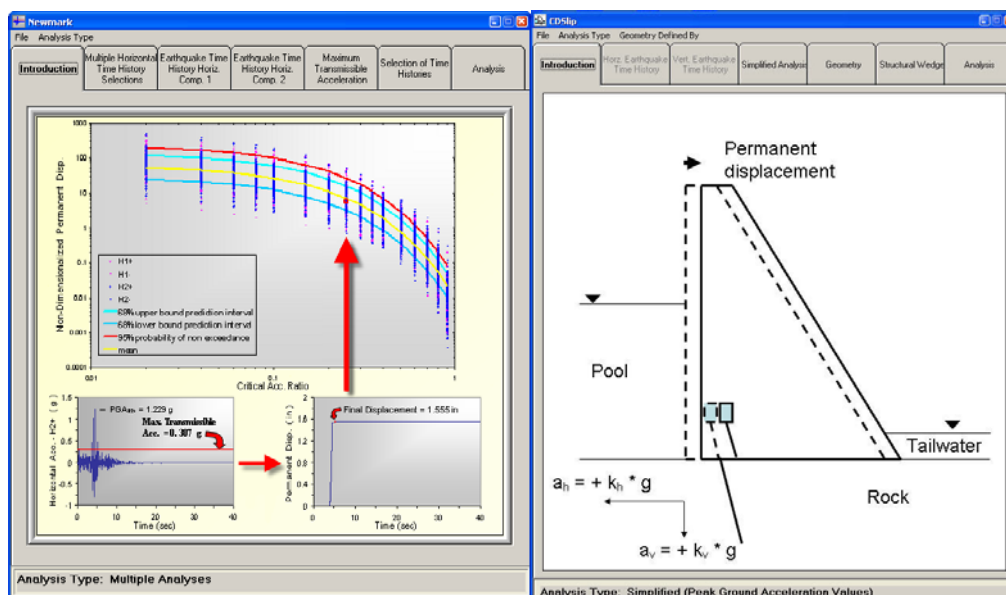


Figure 3. Newmark

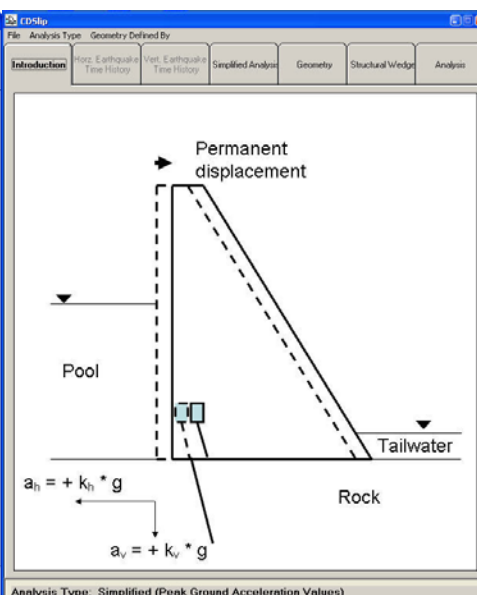
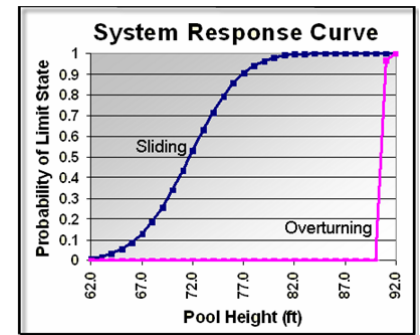


Figure 4. CorpsDamSlip

first two are used to construct fragility curves for concrete gravity dams founded on or founded in rock with the probability of dam failure expressed in terms of fragility curves. GDLAD_Foundation allows for the analysis of the uncertainty in uplift pressures via the analysis of seepage within rock joints (unique software). Newmark and CorpsDamSlip address the seismic hazard in terms of permanent displacements; a critical item with regards to maintaining a functional foundation drains system and uplift pressure relief during and after an earthquake. Specifically, Newmark is used to develop simplified permanent deformation analysis relationships for rock-founded structures using regression based methods of analysis that result in permanent deformation relationships that need only values for peak acceleration and peak velocity on rock. The resulting Newmark simplified permanent deformation relationships are then implemented in CorpsDamSlip and used for the seismic permanent deformation analysis of a site-specific concrete gravity dam. CorpsDamSlip, is also used to construct fragility curves for use in Portfolio Risk Assessments. All four PC-based programs have a user friendly graphical user interface (GUI) for both input and viewing computed results.

Benefits

GDLAD_Sloping_Base, GDLAD_Foundation rapidly produce system response curves (i.e., fragility curves) for hydraulic hazards for use by Districts in their Portfolio Risk Assessments to prioritize the limited funds available for Corps projects and justify economic dam safety investments to reduce the overall public risk from the Corps’ inventory of dams. Without Newmark and CorpsDamSlip, the Corps has no method to compute the permanent seismically induced displacement of a rock-founded concrete gravity dam due to earthquake hazards.



Status

District requested changes were implemented in GDLAD_Sloping_Base and it was completed in FY08, its user’s guide is in publication. Newmark has the same status. The focus in FY09 is on the formulation and programming of GDLAD_Foundation. An initial functional version of CorpsDamSlip was developed in FY08 and the implementation of the fragility curve procedure of analysis is yet to be done.

Distribution Source(s)

This software will be distributed through the CASE web site and will also be made available via the RADS portal and will also be located on a Corps server with access controlled by the Risk and Reliability DX.

Available Documentation

GDLAD_Sloping_Base and Newmark user’s guides and examples are available in ERDC Technical Reports. Corps_Dam_Slip and GDLAD_Foundation user’s guides are incomplete and in partial draft forms.

Available Training

Training will be made available though RADS training classes for the National Teams.

Available Support

Application support can be obtained by contacting Dr. Robert Ebeling at ERDC-ITL.

Application

The Dam Safety Methodology Team as well as all District engineers will be able to use the PC-based software.

Point of Contact

Dr. Robert Ebeling, Information Technology Laboratory, US Army Engineer Research and Development Center, 3909 Halls Ferry Road, Vicksburg, MS 39180 E-mail: Robert.M.Ebeling@usace.army.mil

Partners

Dr. Robert Ebeling and Ms.Moira Fong of ERDC-ITL and Dr. Johannes Wibowo and Mr. Don Yule of ERDC-GSL.