

RECLAMATION

Managing Water in the West

Roughened Channels Research

Physical and Numerical Modeling of Steep Rock Ramps



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Bureau of Reclamation

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Overview

- The primary purpose of roughened channel (rock ramps) design and installation is to provide effective fish passage upstream while maintaining a suitable water surface elevation for diversion.
- Steeper ramps require larger rocks for stability, increasing the potential for interstitial flow through the ramp.
- Interstitial flow decreases the surface water available for fish passage.

Research Questions to be Answered

- Over the range of potential rock ramp design situations, can stable rock ramps be constructed that provide enough surface flow to allow fish passage during critical low flow periods without the use of grout, geomembranes, soil cement, etc?
- For various ramp configurations, what is the recommended stable rock size gradation for a given discharge hydrograph?
- For various ramp configurations, what is the depth to which fines are removed?
- For various ramp configurations and riprap gradations, what methods should be applied to predict the transport of fine particles through the interstitial spaces in the rock substrate?

Physical Modeling

Control Variables:

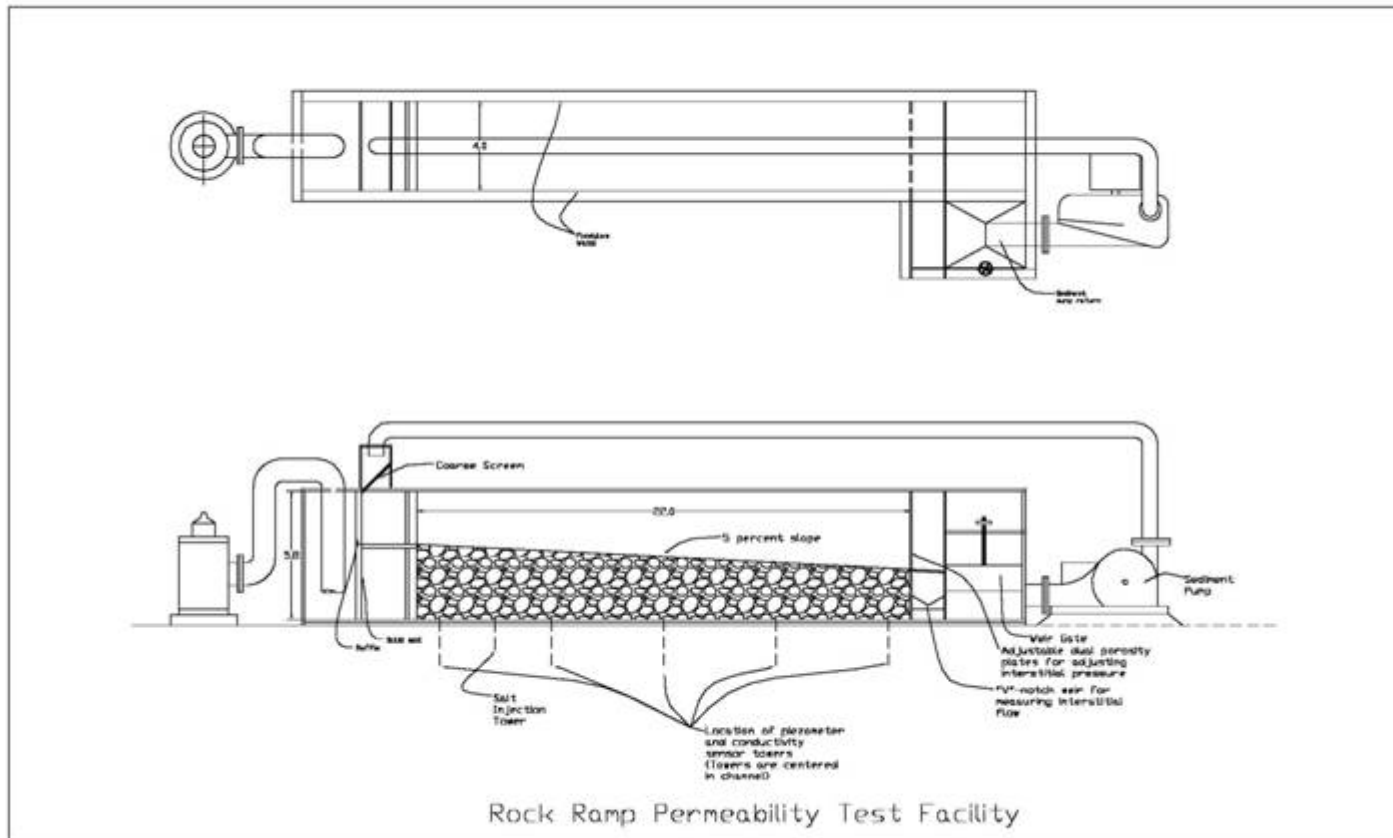
1. Longitudinal Slope
2. Rock Gradation
3. Unit Discharge
4. Cross Section Geometry

A testing matrix will be developed to cover the potential range of values for these design variables.

Selected ramp configurations will be tested to answer research questions and establish design guidelines.

Physical Model Test Facility

Conceptual Drawing of Testing Flume



Courtesy of Brent Mefford, Hydraulics Lab, Denver Technical Service Center

Numerical Modeling

- A predictive numerical sediment transport model (GSTAR-1D) will be developed to evaluate conditions not modeled in the laboratory.
- Numerical model will be calibrated to match physical model results. This will provide numerical model validation as well.
- GSTAR-1D results will extend the physical testing data, providing a more complete set of design guidelines, reducing the overall development cost
- Predictive capabilities of GSTAR-1D can be used to quickly and cheaply evaluate proposed rock ramp designs in the future.