The need for large scale tests to support breach model development and validation

Levee and dam erosion processes can be considered at both macro and micro scales. The erodibility of the body material is fundamental to the rate and style of erosion; less erodible materials tend to demonstrate a headcut erosion process, whilst more erodible materials demonstrate a surface erosion process. Since the surface erosion process typically leads to an earlier, progressive erosion of the levee crest level, which affects the rate and characteristics of flood water release through the breach, it is important to understand when and how the erosion process transitions between these different processes and the effect of hydraulic and geotechnical factors on this transition.

In order to ensure that test material is correctly represented, controlling the grading, moisture content and compaction, leading to a defined state for erodibility, it is considered that a test section of ~2m high is required. Such a test section also allows for the clear development of headcut and surface erosion processes to develop.

Investigation into the erodibility of coarse grained materials

The following programme of research is therefore being implemented:

- Development of jet testing equipment for testing coarse grained materials
- Literature review on erosion processes and analysis of coarse grained materials
- Large scale laboratory testing of erosion processes for coarse grained materials
- Review and collation of field test and case study data
- Breach model review, development and validation for industry use

As part of the collaborative programme of research two lines of investigation are being followed to help determine the erodibility of coarse grained materials:

1. Development of erosion testing equipment for coarse / gravel materials

EDF is in partnership with GeoCom/Consult in developing a larger scale version of the JET testing equipment to allow analysis of graded soils, with particle sizes up to several centimeters. The diameter of the erosive jet will allow testing using 6.35, 12 or 20mm jets against soil samples of up to 200mm diameter. The equipment is intended to allow analysis of soil samples from mixed, coarse grained materials as might be found within dams and levees, so providing direct measurement values for use on breach model development and validation.

2. Large scale laboratory testing of erosion processes for coarse grained materials

In parallel, the US Army Corps Engineering Research and Development Center (ERDC) at Vicksburg, MS is initiating a programme of research investigating the erosion of coarse-grained materials through large scale flume testing of different grades and mixtures of material with varying percentages of fines. Two types of test will be undertaken: (i) Smaller scale surface erosion of a box sample, intended to allow calculation of soil erodibility parameters; (ii) Larger scale (~2m high, 2m wide) overflow erosion tests on a 1:2 slope, representing overflow of a levee surface and allowing headcut (Hanson et al at 2001) and / or surface erosion (Van Rijn 1984) processes to develop. Both soil erosion and sediment transport models will be investigated for their applicability to the erosion mechanism and erosion rate of the tested materials.