DAMAGED EMBANKMENTS

Concrete Culvert Overview Flowchart
Structural Defects Flowchart (Concrete)
Bedding Deficiencies Flowchart (Concrete)
Hydraulic Capacity Flowchart (Concrete)

1. SUMMARY

Chen and Anderson (1986) discussed predominant modes of embankment failure during floods (the most common type of failure is caused by excessively high flood waters overtopping and eroding the embankment) evaluation effectiveness of some embankment protection measures (vegetated embankments, gabion mattresses, soil cement, geoweb, and enkmat). They developed a methodology to quantitatively determine embankment damage (a computer model to determine hydraulics of overtopping flow and associated erosion damage) and assess protective measures.

Channel degradation is a general and progressive (long-term) lowering of the channel bed due to erosion, over a relatively long channel length. Headcutting is channel degradation associated with abrupt changes in the bed elevation (headcut) that generally migrates in an upstream direction. In contrast, aggradation is the vertical raising of the streambed over relatively long distances and time frames primarily due to sediment deposited from the streamflow. FHWA's HEC 20 (Lagasse et al., 2001) provided quantitative techniques for channel stability analysis, including degradation analysis, and introduced channel restoration concepts.

A manual by the U.S. Army Corps of Engineers (Watson et al., 1999) covered the selection and design of channel rehabilitation methods. The principle methods employed in channel rehabilitation projects for controlling erosion and sedimentation are:

- Bank stabilization, e.g., stone armor; flexible mattress made of concrete blocks, fabric and gabions, etc; dikes (a system of individual structures which protrude into the channel, generally transverse to the flow) and retards (a continuous structure approximately parallel to the streamflow), vegetative methods, etc.
- Grade control, e.g., dumping rock, concrete rubble, or some other locally available non-erodible material across the channel to form a hard point (structures often referred to as rock sills, or bed sills)
- Flow control, e.g., dams and reservoirs, and diversion canals.

2. REFERENCES

Chen, Y.H. and B.A. Anderson, 1986. *Development of a Methodology for Estimating Embankment Damage Due to Flood Overtopping*, FHWA/RD-86-126, Mar 1983, 220p

Lagasse, P.F., M.S. Byars, L.W. Zevenbergen, and P.E. Clopper, 1997. *Bridge Scour and Stream Instability Countermeasures*, HEC 23, July 1997, FHWA-HI-97-030, Arlington, VA, 116p

Watson, C.C., D.S. Biedenharn, and S.H. Scott, 1999. *Channel Rehabilitation: Processes, Design, and Implementation*, July 1999, U.S. Army Engineer Engineering Research and Development Center, Vicksburg, MS

Concrete Culvert Overview Flowchart
Structural Defects Flowchart (Concrete)
Bedding Deficiencies Flowchart (Concrete)
Hydraulic Capacity Flowchart (Concrete)