



US Army Corps
of Engineers®

Flood&Coastal Storm Damage Reduction R&D Program

Design and Performance of Ice Affected Stream Restoration Structures

Description

Channel restoration and streambank stabilization efforts are increasingly turning to "green" approaches, using natural materials and vegetative treatments not only to control erosion but to also improve habitat for fish and wildlife. Little to no guidance is available to address the needs of District personnel planning, designing, operating, and maintaining channel restoration and streambank stabilization projects in cold climates. As a result, catastrophic failures after a single ice event have been documented.

Channel stabilization structures such as rock vanes, cross vanes, and rock weirs decrease the effective flow area. They are often constructed in populated areas to reduce the stream degradation caused by urbanization. The potential for these structures to increase the risk of ice jams is investigated in order to minimize future damages that could result. This study addresses the impact of ice in the form of break-up ice jams or major ice runs on in-stream structures as well as how that structure might change the ice regime in the reach. Physical and numerical models are used to develop design guidance for in-stream structures and ice.



1:50 scale cross vane structure built in CRREL's Ice Engineering Flume

The approach was to test a common in-stream structure, the cross vane, in a straight model flume with a moveable bed. For this study, the cross vane structure was tested under

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conditions of an ice run. Once open water baseline conditions were documented, three model cross vanes were built and discharge was increased to promote the scour and deposition in the vicinity of the structures. A series of ice conveyance tests were carried out for both the baseline and with-structures conditions. Physical model results were then compared to numerical simulations using the state-of-the art DynaRICE ice-hydraulic model. The results of this work will provide preliminary design guidance and numerical modeling techniques for channel restoration and streambank stabilization project in ice-affected rivers.

Benefits Increased understanding of winter impacts on channel stabilization methods will allow ERDC to better respond to District needs. Improved design tools for channel stabilization on ice-affected rivers will allow Districts to realize cost savings during winter operation. This research will broaden the range of reliable environmental technologies that can be applied in cold-affected areas. Direct savings will result from lower construction and maintenance costs. This work should yield a high return on investment.

Status The flume study of ice-affected cross-vane structures was performed in 2006. Further testing of additional structures and configurations is scheduled for this year in the Flume and in the Research Area of the Ice Engineering Research Facility. A representative model channel with a moveable sand bed will be constructed in the Environmental Research Area at the Ice Engineering Research Facility. The model will be used to assess the performance of channel stabilization methods placed in river bends. The study reach will have similar characteristics to field sites currently under observation in the FCSDR Ice Affected Structures work unit.

Distribution Source(s) Contact the POC for more information.

Available Documentation Vuyovich, Carrie M., Andrew M. Tuthill and John J. Gagnon, (in draft), *Physical model of cross vane structures in ice*, ERDC Technical Report.

Available Support Guidance support for designing ice-affected stream stabilization structures is available to all Corps employees by contacting the POC.

Application Improved design tools for channel stabilization on ice-affected rivers will allow Districts to realize cost savings during winter operation. This research will broaden the range of reliable environmental technologies that can be applied in cold-affected areas.

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Partners N/A.