MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 17-336 (project 315) | October 2017

Analysis of Compound Channel Flow with Two-Dimensional Models

the **ISSUE**

The main objective of the project is to determine if the computed stream flow velocities from two-dimensional river models and resulting scour predictions are comparable with field measurements. A second objective is to determine the optimal density of channel and overbank topography data needed to construct effective 2D flow models. Achieving these objectives would help engineers cost-effectively design improved structures and sstrategies for reducing erosion and bridge scour.

the **RESEARCH**

The research began with a literature review and a survey of current practice used by state DOTs around the country. The SD 13 bridge over the Big Sioux River near Flandreau and the SD 37 bridges over the James River near Mitchell were selected to conduct a 2D flow analysis. Two-dimensional flow models were created for each bridge site and validated using field measurements. A sensitivity analysis was conducted to determine the critical input parameters to develop an effective model. Modeling results were used to investigate the site conditions producing 2D flow effects and to predict pier and contraction scour. The results from the two case studies and findings from the literature review and telephone survey were summarized to provide a knowledge base for the development of procedures and guidelines for selecting hydraulic models and for creating an effective 2D model. Detailed instructions for creating a 2D river model in the Surface-Water Modeling System (SMS) are documented in two master of science theses completed under this research project.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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Project Title

Analysis of Compound Channel Flow with Two-Dimensional Models

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the FINDINGS

The telephone survey found that the decision to use 2D models is made primarily based on needs, information available, and time frame rather than costs. Training and motivation of the modeler, and support from management are the key factors in determining whether 2D flow models are used regularly in a state DOT office.

The case studies showed that 2D flow modeling provided substantial improvements in hydraulic analysis compared to 1D model. 2D models correctly predicted the flow velocity distributions at two bridge sites with complex channel/floodplain configurations. The benefits of 2D model become even more apparent when modeling results are used with advanced methodologies to predict bridge scour.

The project found that the density of topographic data in the floodplain can be reduced considerably without affecting the results of the 2D models. The project also found that LiDAR data can be used to create an accurate 2D flow model.

the IMPACT

SDDOT needs to define the types of channel configurations that produce compound channel flow and also determine the degree of data collection effort that is required to produce adequate 2D models. The potential benefits of this project would be new procedures and guidelines for bridge hydraulic analysis. The case studies in this report would serve as detailed examples on creating and using 2D flow models for bridge hydraulic analysis, including field data collection, mesh generation, model calibration, and analysis and interpretation of modeling results.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=893

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.