MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

RESEARCH SUMMARY

Evaluating the Success of Meeting Design Objectives on Previously Constructed OOS Stream Stability Projects

WHAT WAS THE NEED?

The treatment of stream channel instability and selection of countermeasures are dependent on the physical conditions at the bridges, such as reach-wide channel degradation, aggradation, sediment transport, or lateral channel movement or widening. The feasibility of and confidence in each of the various components and countermeasures is a function of multiple factors, including effectiveness, cost, maintenance, constraints, and the ability to detect failure. The ability to detect failure or impending failure of a stream stabilization project or its components is important to assuring that the bridge will be protected during high flow events.

WHAT WAS THE GOAL?

The objectives of this project were to assess the degrees of success of stream channel transition designs through bridge reaches and the suitability of these projects to transport sediment through the bridge opening.

WHAT DID THE RESEARCH TEAM DO?

The research team completed the following tasks:

1. Evaluation of selected field sites to determine the stability, current damage states, and success in meeting the goals of the channel construction projects;
2. Examination of current literature and other state DOT practices for developing stable transitions at bridges;

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3. Development of a method for identifying the feasibility of developing stable, resilient streams channels in the bridge reach; and
4. Development of recommendations to improve upon current practices.

Eight structures situated in three physiographic regions across Maryland were studied. The first site visits were conducted in April-July 2016, and the second in February 2017. Bar sediment samples were collected from four of the eight sites. Stability assessments were conducted.

WHAT WAS THE OUTCOME?

In addition to creating a methodology for assessing existing transitions, a methodology was developed that guides the design type selection process at new bridges or new channel transition projects. This process uses a rapid channel stability assessment to initially assess a site for instabilities that need to be addressed by the design. Two design checks are included as part of the method. The first check is the V/Vc analysis for assessing general trends in sediment mobilization through the bridge opening. Due to the use in this study of one dimensional HEC-RAS models to provide inputs for channel depth and velocity, the V/Vc results provide only an average-based mobilization. The second design check is the Failure Modes and Effects Analysis. This requires the designer to systematically analyze all the potential failure modes of the design and to consider solutions that reduce the risk priority numbers of design components. Incorporating these checks in the design process should help increase the likelihood of a successful channel transition design. Several observations and recommendations were made based on field observations at a limited number of sites, comparisons of imagery, and analyses described in this report.

HOW WILL THE RESULTS BE USED?

The MDOT SHA's Structure Hydrology and Hydraulics Division (SHHD) plans on incorporating into its design practice both the methodology for assessing existing transitions, and the methodology that guides the design type selection process at new bridges, or new channel transition projects. Appropriate parts of the Hydrology and Hydraulics Design Manual will be revised accordingly. Additionally, the SHHD will add a requirement to perform as-built surveys of the reconstructed channels and occasional field checks to evaluate the effectiveness of such projects.

In a longer run the SHHD plans to collect stream channel conditions at additional fields sites to expand the empirical data points in evaluating the success of constructed stream stability projects.

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