Gabion Mattress

Gabion mattress systems are an example of a flexible lining that can provide a means of stabilizing roadside channels. They are suitable for a range of hydraulic conditions and can conform to changes in hydraulic channel shape. These monolithic gravity mass structures are ideally suitable for erosion control, slope protection and site stability. The gabion baskets are typically made of compartmented rectangular containers (baskets) made of galvanized or PVC-coated (to prevent corrosion) hexagonal steel wire mesh filled with stone riprap. The wire baskets are connected and anchored to the channel side slope. Gabions are especially useful in stream and channel applications where high amounts of water flow are expected.

Relation to Adaptation and Resiliency

Addresses the increased risk of landslides, land subsidence and erosion washing away transportation infrastructure.

Benefits

Gabion mattresses are beneficial when rock riprap is either not available or not large enough to be stable. Smaller size rock materials may be used in gabion mattresses than would otherwise be required for riprap design. Additionally, the required thickness of the gabion mattress may be less than the thickness of an equivalent riprap lining. Therefore, gabion mattresses require less excavation of riverbed than riprap. These mattresses are flexible, can deform and adapt to the changes in the subgrade while maintaining stability. Therefore, they can accommodate changes to the hydraulic channel. Gabions can be made on site using local labor with minimal cost for materials. Gabion mattresses are more durable than unreinforced vegetation and provide a more natural look than a concrete lined channel.

Limiting Factors (Constraints)

In streams with high sediment concentrations or with rocks moving along the bed of the channel, the wire mesh may be abraded and eventually fail. Under those conditions, the gabion mattress will no longer behave as a single unit. It will just behave as individual stones. Therefore, gabion mattresses should not be used under these conditions. Other constraints are related to rock size. The rock gradation used in gabion mattresses must be such that larger stones do not protrude outside the mattress and that wire mesh retains the smaller stones. Rock size should be at least 1.25 times larger than the aperture size of the wire mesh that comprises the mattress. Additionally, the rock materials used for the stone rip rap must be durable and not subject to slaking. For instance, slate, shale, mudstone, and claystone are not good materials for gabion mattresses. Gabion mattresses are typically used on steep gradient stream beds. The extent of the gabions should be sufficient to protect transition regions of the channel both above and below the steep gradient section.

Design & Preliminary Costs

When gabions are used, the need for an underlying filter material must be evaluated. This could be a granular filter blanket or a geotextile fabric. Gabions should be placed flush with the invert of a culvert. A plunge pool or other energy dissipation structure may be required when transitioning from a steep gradient channel to a lesser gradient channel.

The following pricing for gabions was included in the Maryland Department of Transportation State Highway Administration Price Index dated from January 2020: Temporary Gabion Outlet Structures: Median Unit price $5,100/EA for 6 contracts. Unit prices ranged from $2,200 to $13,352.57.

- 12 in. Gabion: Unit Price $200/CY for one contract of 8 units
- 36 in. Gabion: Unit Price $98.61/CY for one contract of 82 units

Permits & Approvals

- Review/Approval by MDOT MTA Environmental Planning Division
- Maryland Department of the Environment (MDE) Permitting

Implementation

Gabion mattresses can be constructed quickly, provided the stone riprap and wire mesh basket materials are readily available. Depending on the size of the project, gabion baskets can be manufactured in a matter of days or weeks. Manual labor is required; however, it can be supplemented with backhoes and front-end loaders.

Maintenance Requirements

There are minimal maintenance requirements for gabion mattresses. Periodic inspection should document whether supplemental gabions are required or if wire mesh baskets are corroding or failing and need repair.

Useful Life

If designed properly, gabion mattresses should have a useful life of 30 to 50 years, depending on coating material on wire baskets and environmental conditions. It should be effective immediately upon construction completion.

References/Specifications

MDE - Guidelines to Waterway Construction – Nov. 2000, MGWC 2.3 Gabions
MDE - Maryland Stormwater Management Program
MDOT - Maryland Department of Transportation State Highway Administration Price Index (January 2020)
FHWA - FHWA-NHI-09-112 HEC 23 Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance – 3rd Edition (Sept. 2009) – Section 2 – Design Guideline 10 – Gabion Mattresses
FHWA - FHWA-NHI-05-114 HEC 15 Design of Roadside Channels with Flexible Linings Hydraulic Engineering Circular Number 15, Third Edition (Sept. 2005)