ARMORFORM is Chosen to Protect a High Volume Spillway

In the summer of 1995, A large coal company in West Virginia was in the process of upgrading an overflow spillway at their coal refuse slurry impoundment facility. The new spillway would need to be constructed directly over coarse coal refuse, and provide a safe means of transporting large volumes of water over a distance of approximately 1,700 feet. The bed slope of the spillway would vary from 1% to 10% with the 10% section generating flow velocity of over 20 feet per second and a corresponding shear stress of nearly 40 pounds per square foot during a severe storm event. It was obvious that a substantial form of erosion protection would be necessary to combat the potentially destructive forces that would be present during these hydraulic conditions.

Product Selection and Design

The coal company enlisted the services of a local consulting engineering firm to design the spillway and confirm that the selected form of erosion protection would be adequate. Rock riprap was almost immediately ruled-out due to the large diameter required to resist the expected flow conditions, and the designer wanted a system that was less restrictive than large boulders. Although a properly installed (i.e. reinforced, freeze/thaw resistant, expansion joints, etc.) poured concrete spillway would provide sufficient hydraulic stability, it was believed that the cost would be higher than desired. With numerous, successful spillway projects under their belt, the engineering firm felt most comfortable in selecting **ARMORFORM Articulating Block Mat (ABM).**

Entrance point of the spillway. ABM mat is buried in a 10 feet deep trench at this location.

Completed spillway, looking downstream.

Due to the flow conditions that would be present at the coal refuse facility, the engineering firm determined that the ABM erosion protection would be required for the 40 foot wide bottom and both side slopes of the trapezoidal spillway. The "finished" average thickness requirement of the ABM will be 8 inches to produce individual block sizes of approximately 24 inches x 24 inches and a weight of 95 pounds per square foot. High strength, 3/8 inch diameter polyester cables, exhibiting a nominal breaking strength of 10,000 pounds will be inserted into the ABM at the factory. These cables will provide additional tensile strength to the system, as well as reinforcement during articulation.

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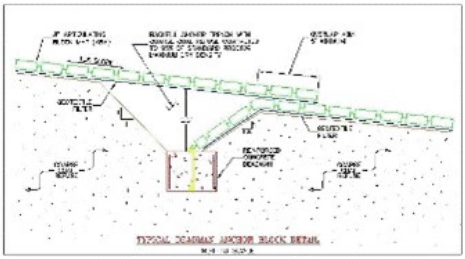
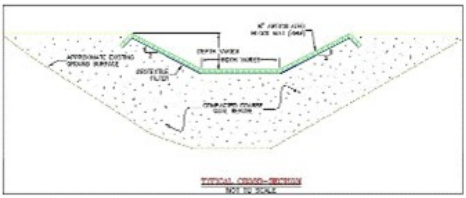
Spillway case study (continued)

In prior applications, 8 inch thick ABM has successfully withstood unit discharges in excess of 100 cubic feet per second/per foot, which is the approximate equivalent to the expected discharge of the spillway at this project site, however, as an added factor of safety, it was decided that intermediate anchoring would be necessary every 120 feet along the 10% slope section of the spillway to resist drag forces. A poured concrete "deadman" anchor, constructed approximately 5.5 feet below grade, will secure each 120 foot long section of ABM. Each subsequent ABM panel would then be positioned to provide a 5 foot minimum overlap of the previous panel to serve as an "expansion" joint. The panels along the sides of the spillway would be installed in a 3 feet deep terminal trench and subsequently buried to provide additional anchoring. The design analysis concluded that the 8 inch ABM, utilizing these methods of installation, would produce a factor of safety greater than the targeted 1.5 to 1.





Construction

A local contractor, McGraw & Son Construction Company, Inc., Glen Daniel, West Virginia, was chosen to construct the spillway and install the ABM. The installation of the ABM panels commenced at the bottom of the spillway and proceeded upwards. This "reverse-order" of installation was necessary to properly construct the intermediate anchor trenches and overlaps. More than 70 custom made panels of ABM were shipped to the project via motor freight. Each panel, up to 3,500 sq. feet in size, was fabricated to fit a specific section of the spillway. Proper placement of the panels was facilitated by cross-referencing each panel, identified numerically, with a panel layout plan prepared by ARMORFORM, Inc.

ABM panels were unrolled into position and joined together with a portable sewing machine prior to filling with concrete. The ABM was installed directly over a site specific geotextile filter to prevent the loss of underlying material through the openings around the perimeter of the blocks. For this project, a 5 ounce per square yard nonwoven geotextile was selected. A nonwoven geotextile was selected because it exhibited a higher angle of friction and greater hydraulic characteristics when compared to a woven geotextile. The fine aggregate concrete, supplied by a local ready mix plant, was injected into the panels, through a 3 inch diameter hose, utilizing a conventional grout pump. Once the ABM was filled with concrete to the required thickness and allowed to cure, coal refuse was utilized to backfill the terminal trenches along the sides of the spillway. The entire project required approximately 45 days to complete with more than 5,000 cubic yards of concrete being injected into the ABM panels.

Summary

For this high volume spillway, ARMORFORM ABM appeared to be the only practical solution. Riprap was not a viable option due to the extremely large diameter stone that would be required, and to properly install a poured concrete spillway would have been far too costly. This coal company is just one of several end users who have discovered the advantages of ARMORFORM. Coal refuse facilities operated by other firms have also benefited from this technology, as have the owners/operators of landfills and embankment dams.

This case study is a summarized version of an article "High Tech for High Volume" which appeared in the May 1998 issue of GFR magazine.