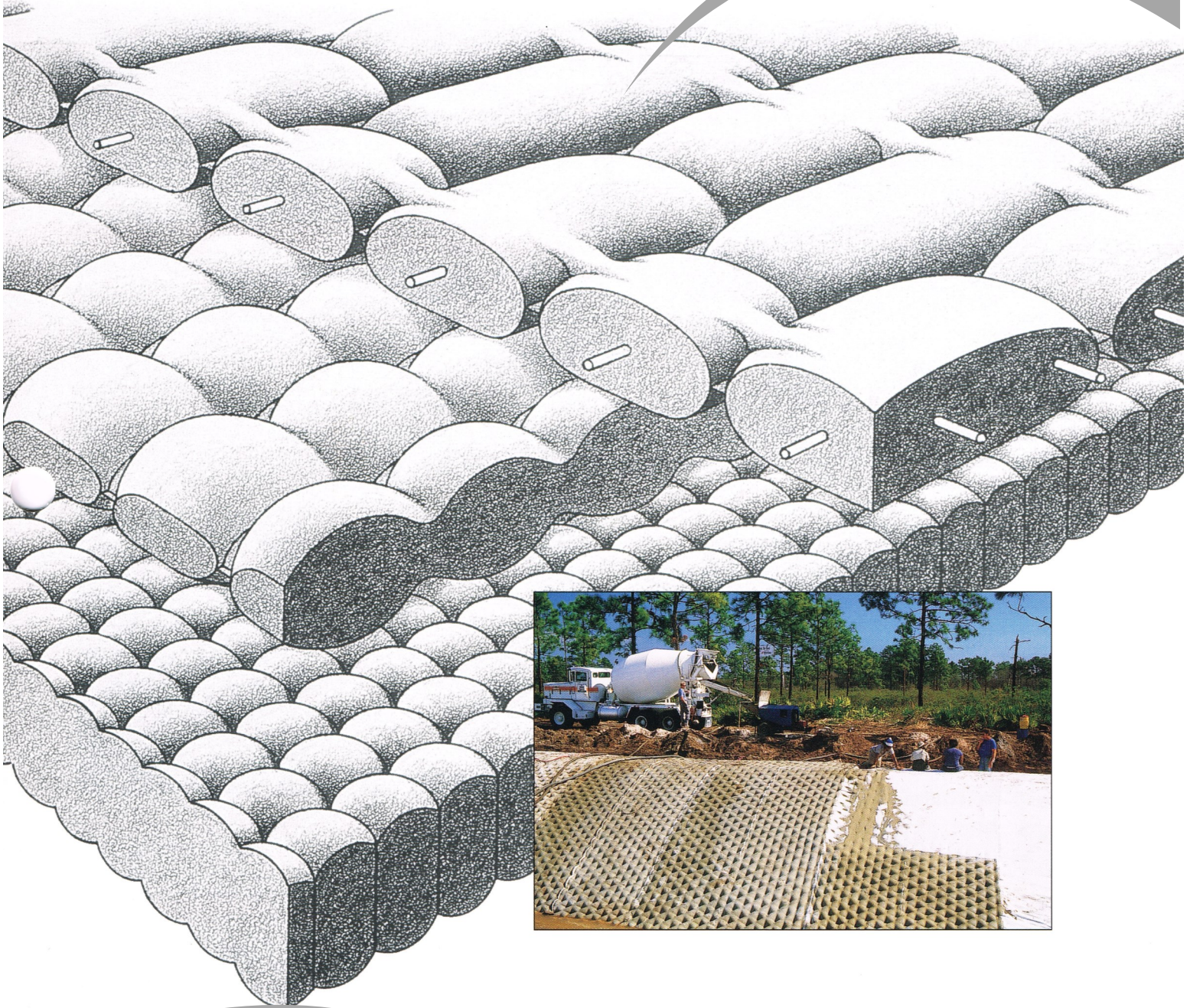


ARMORFORM[®]

YOUR SOLUTION TO PERMANENT HARD ARMOR EROSION CONTROL



ARMORFORM[®]
Fabric Formed Hard Armoring

Available Styles

The ARMORFORM® erosion control system utilizes double layer woven fabric geotextiles engineered exclusively to serve as forms for casting concrete erosion control revetments and linings. The forms are woven from nylon and/or polyester yarns and are designed with the required mechanical and hydraulic properties of a superior textile form. ARMORFORM® is positioned on the subgrade to be protected, where it is inflated with pumpable fine aggregate concrete (structural grout) to form an erosion control mat. ARMORFORM® mats perform best when used with a site-specific filter fabric.

ARMORFORM® is available in various styles and thickness'. *Uniform Section Mat (USM)*, *Filter Point Mat (FPM)*, *Articulating Block Mat (ABM)*, and *Armor bags* are the four standard styles of ARMORFORM®. If required, ARMORFORM® mats can be produced to inflate up to 12 inches thick or even to allow revegetation of an eroded embankment.

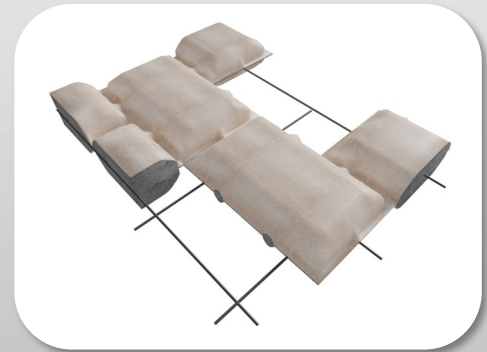
Filter Point Mat (FPM) is formed with a double-layer woven fabric, joined together by interwoven, spaced points. These spaced points serve as filter points to relieve hydrostatic uplift pressure.



Uniform Section Mat (USM) is formed with a double-layer woven fabric, joined together by spacer cords on closely spaced centers to produce a mat of uniform thickness.



Articulating Block Mat (ABM) is formed with a double-layer woven fabric, joined together into a matrix of rectangular compartments, each separated by a narrow perimeter of interwoven fabric and containing interconnecting high strength revetment cables.



Armor Bags are custom fabricated to fit job site requirements. Inlet valves, attached by fabric flange to a silt in the surface of the bag, provide positive self closure.



Installation

Once a contractor has been chosen there are four basic steps to be taken in any ARMORFORM® erosion control installation. They are: **site preparation, panel placement and field assembly, inspection before filling, and structural grout pumping.**

STEP 1: SITE PREPARATION

Slope grading equipment is used to excavate to required depths, contour the slopes to the specified slope ratio and form the anchor, toe and terminal trenches around the perimeter of the installation. The area to be protected must be free of rock, brush, roots or large soil clods. ARMORFORM® should be placed on a compacted subgrade and stable slope. The fabric forms are usually anchored into a trench approximately two feet deep, by one foot wide, at the top of the slope. The trench is located one to three feet from the top edge of the slope.



STEP 3: INSPECTION BEFORE FILLING

STEP 2: PANEL PLACEMENT AND FIELD ASSEMBLY

Once the slope and other related excavation conforms to finished grade and elevation specifications, installation of the filter fabric and the ARMORFORM® fabric may begin. After a site specific filter fabric has been installed, the custom sized ARMORFORM® panels are rolled down the slope and positioned for unfolding. The panels are positioned according to prepared drawings where each panel is identified for placement. The panel is then unfolded by a work crew and pulled into position. The ARMORFORM® panels should be positioned loosely along the slope. Once positioned, the upper edge of the panel is folded into the anchor trench atop the slope. The extra fabric provided for contraction during pumping should be accumulated and held at the top of the slope and gradually released as the panel is filled. Adjacent panels are joined by field sewing or zipping the double layer fabric forms, bottom edge to bottom edge, and top edge to top edge. When installing Articulating Block Mat (ABM), transverse revetment cables should be spliced together prior to joining of the top layers of fabric.

When inspecting the panels prior to pumping, wrinkles and loose fabric should be expected as they are necessary to compensate for form contraction. As much as 10% contraction in each direction may be experienced during the filling process. Carolina Yarn & Fabrics, Inc. can be contacted to determine the appropriate contraction factor for your site conditions. All field sewn seams, zipper connections and lap joints must be carefully inspected to assure that no holes in the forms are present. Colored thread is advised for all field sewn seams to facilitate inspection. For detailed installation guidelines contact Carolina



STEP 4: STRUCTURAL GROUT PUMPING

The upper edge of the ARMORFORM® panel that has been placed into the anchor trench should be weighted down with sandbags to prevent the panel from sliding down the slope as it is pumped with grout. Grout should then be injected into the lower mat area first, proceeding gradually up the slope and into the upper anchor trench until the entire panel has been filled. Structural grout is injected into the ARMORFORM® panels by inserting a 3" diameter grout hose through a small slit in the upper layer of fabric near the top of the slope. A grout tight seal is formed by wrapping the injection hose with burlap, or similar material, while the grout is being injected. When the hose is withdrawn, the burlap is stuffed into the hole where it remains until the grout is no longer fluid. The burlap is then removed and the concrete surface at the hole is smoothed by hand.

Filter Point Mat (FPM)

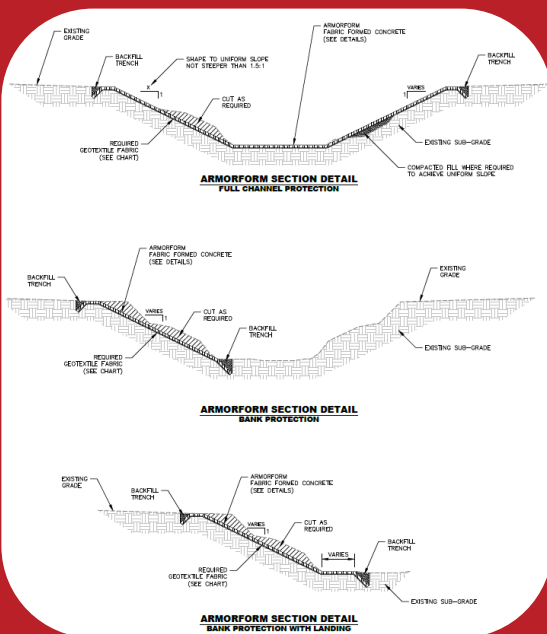


DESIGN CONSIDERATIONS

- FPM is used where velocities are low, bedload and ice formations are light and a roughness coefficient of $N = 0.025$ to 0.030 is acceptable.
- FPM is used where wave action is light.
- FPM is ideal for underwater placement.
- FPM should be installed on well compacted soil conditions only.

Filter Point Mat (FPM) fabric forms are constructed with spaced interwoven filter points to form a lining of required average thickness, deeply cobbled surface and specified weight to provide strength and erosion protection. The design criterion for selection of lining thickness is the same as that used to determine the thickness of conventional concrete slope paving. Relief of hydrostatic uplift pressure, caused by entrapped and ground water, is provided by the woven filter points which are on 5", 8" or 10" centers. Filter Point Mat (FPM) is custom fabricated into multiple mill width panels, designed to fit actual site dimensions and topography.

FILTER POINT MAT (FPM)				
FPM size	Filter Point Spacing	Average Thickness	Weight/sq. ft.	Coverage/cu. yard of Concrete
5" FPM	5"	2.2"	26 lbs.	115 sq. ft.
8" FPM	8"	4.0"	45 lbs.	73 sq. ft.
10" FPM	10"	6.0"	68 lbs.	49 sq. ft.
12" FPM	12"	8.0"	91 lbs.	36 sq. ft.

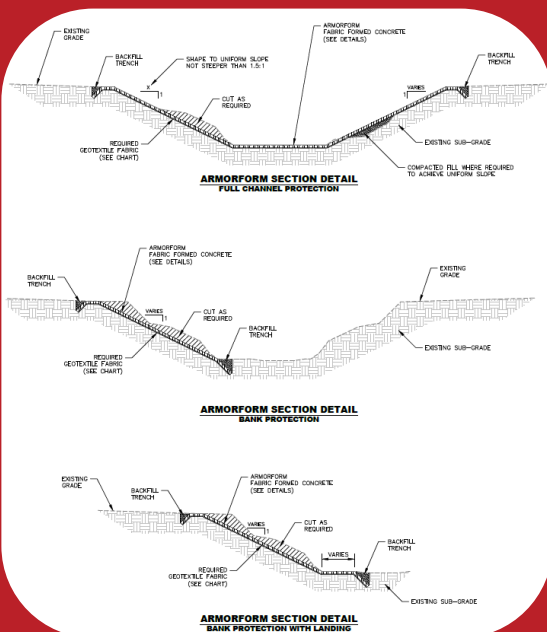


Uniform Section Mat (USM)



DESIGN CONSIDERATIONS

- USM is used where velocities are low to high, bedload and ice formations are light and a roughness coefficient of $N=0.015$ is required.
- USM reduces seepage losses in reservoirs, ponds, holding basins and channels.
- USM is ideal for underwater placement.
- USM is recommended for drainage flumes and spillways.
- USM should be installed on well compacted soil conditions only.

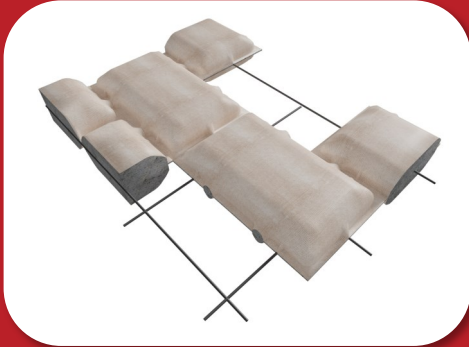


Uniform Section Mat (USM) fabric forms are constructed with spacer cords on closely spaced centers to form a lining of required nominal thickness, bonded cobbled surface and specified weight to provide strength and erosion protection. The design criterion for selection of lining thickness is the same as that used to determine the thickness of conventional concrete slope paving. Relief of hydrostatic uplift pressure, caused by entrapped and ground water, may be provided by inserting plastic weep tubes through the mat at specified centers. Uniform Section Mat (USM) is custom fabricated into multiple mill width panels, designed to fit actual site dimensions and topography.

UNIFORM SECTION MAT (USM)			
USM size	Nominal Thickness	Weight/sq. ft.	Coverage/cu. yard of Concrete
3" USM	3.0"	35 lbs.	97 sq. ft.
4" USM	4.0"	45 lbs.	73 sq. ft.
6" USM	6.0"	68 lbs.	49 sq. ft.
8" USM	8.0"	91 lbs.	36 sq. ft.
10" USM	10.0"	113 lbs.	28 sq. ft.
12" USM	12.0"	136 lbs.	22 sq. ft.



Articulating Block Mat (ABM)



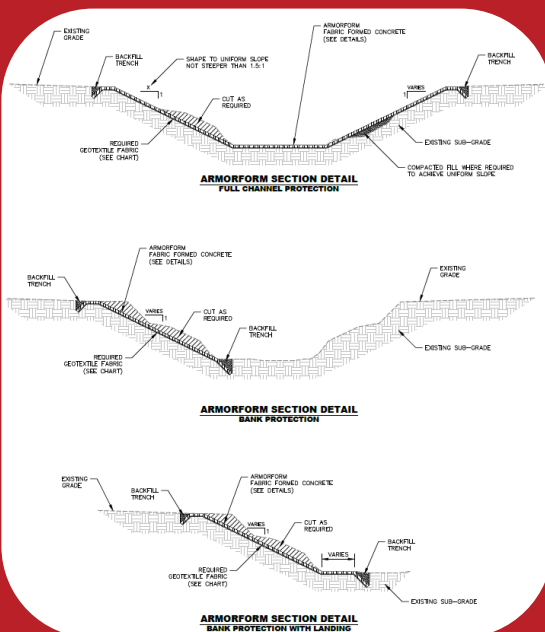
DESIGN CONSIDERATIONS

- ABM is used where velocities are low to high, bedload and ice formations are light to heavy and a roughness coefficient of $N = 0.045$ to 0.050 is acceptable.
- ABM is used where wave action is light to heavy.
- ABM is ideal for underwater placement.
- ABM is recommended where subgrade deformation is expected.
- ABM is available in custom sizes.

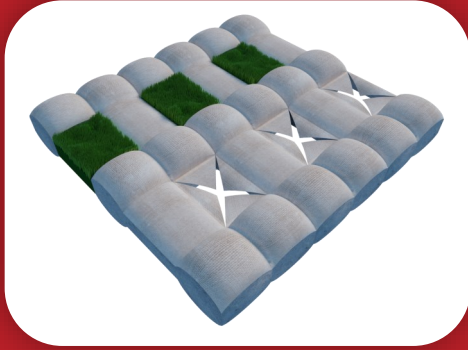
Articulating Block Mat (ABM) is formed with a double layer woven fabric, joined together into a matrix of rectangular compartments each separated by a narrow perimeter of interwoven fabric and containing interconnecting high strength revetment cables. Articulating Block Mat forms are positioned on the area to be protected, where they are filled with pumpable fine aggregate concrete (structural grout) to form a mattress of individual blocks in a bonded block pattern. The high strength revetment cables become embedded in the blocks to tie the blocks together and enable the revetment to resist tension in all directions. Patented separate cable duct design assures that the revetment cables will be positioned securely in the center of each block. Relief of hydrostatic uplift pressure, caused by entrapped and ground water, is provided through the narrow perimeter of interwoven fabric after the grout has hardened. Articulating Block Mat (ABM) is custom fabricated into multiple mill width panels, designed to fit the actual site.

ARTICULATING BLOCK MAT (ABM)

ABM size	Nominal Block Thickness	Weight/Block	Weight/sq. ft.	Coverage/cu. yard of Concrete
3" ABM	20" x 11" x 3"	52 lbs.	34 lbs.	97 sq. ft.
4" ABM	20" x 14" x 4"	88 lbs.	45 lbs.	73 sq. ft.
6" ABM	20" x 20" x 6"	189 lbs.	68 lbs.	49 sq. ft.
8" ABM	30" x 22" x 8"	416 lbs.	91 lbs.	36 sq. ft.
10" ABM	30" x 26" x 10"	614 lbs.	113 lbs.	28 sq. ft.
12" ABM	30" x 28" x 12"	793 lbs.	136 lbs.	22 sq. ft.



VegeMat (VMat)

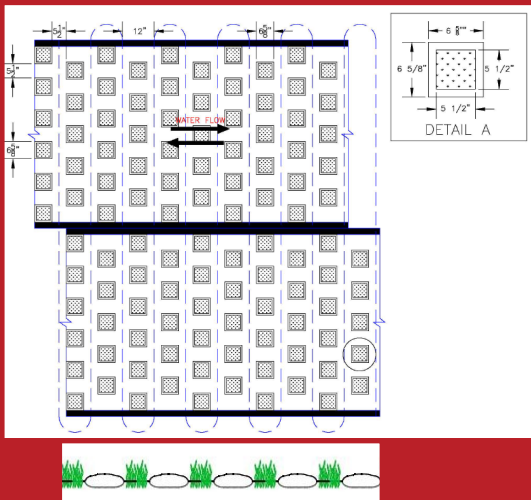


DESIGN CONSIDERATIONS

- VegeMat is used where an eco-friendly approach to erosion protection is desired.
- Open-cell allows for re-vegetation and a more natural look.
- Reduces impervious cover.
- Roughness coefficient of $N = 0.045$ to 0.050 is acceptable.
- VMat is available in custom sizes.

VegeMat (VMAT) is formed with a double-layer woven fabric, joined together into a matrix of rectangular compartments, each separated by open-cell voids to allow for re-vegetation. VegeMat can be selected with either a 25% or 35% open-cell voids that can be opened and planted, resulting in a system providing environmentally compatible protection with the necessary hydraulic, ecological and aesthetic features desired. VegeMat (VMAT) is available with uni-directional high strength revetment cabling and designed to match either the 3" Articulating Block Mat (SYSTEM35) or 4" Articulating Block Mat (SYSTEM25) to form a combination of full coverage and partial coverage. After filled with concrete, the cables remain embedded in the concrete to facilitate articulation. VMAT is customized fabricated into multiple mill width panels, designed to fit actual site dimensions and topography.

VEGEMAT (VMAT)				
STYLE	VOID RATIO	MAX THICKNESS (IN.)	UNIT WEIGHT	CONCRETE COVERAGE
VMAT35	35%	3.5	24 lbs./ft ²	160 sq. ft./cy
VMAT25	25%	4.5	35 lbs./ft ²	108 sq.ft./cy



Armor Bags

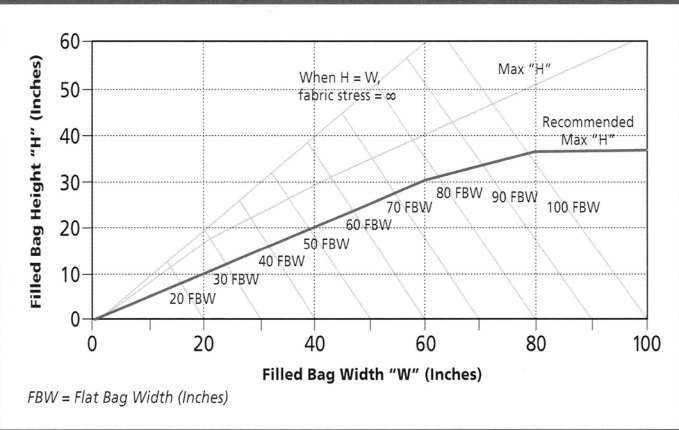


DESIGN CONSIDERATIONS

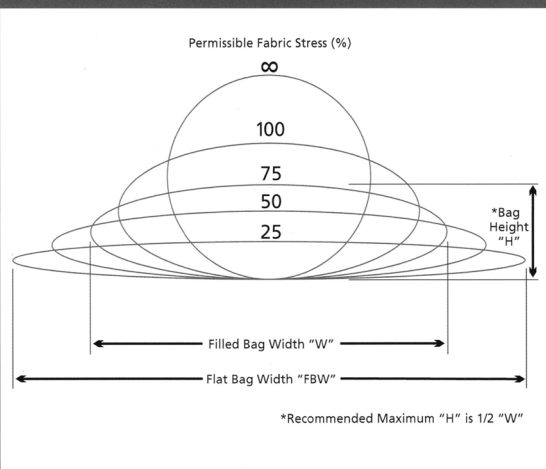
- Ideal for underwater placement.
- Building groins and breakwaters.
- Protecting shorelines against heavy wave erosion.
- Protecting buried pipelines against scour.
- Supporting and weighting underwater pipelines.
- Repairing stone jetties.
- Custom Sizes to Fit Job Dimensions

Armor Bags (ABags) are custom fabricated to fit job site requirements. Inlet valves, attached by fabric flange to a slit in the surface of the bag, provide positive self closure. Inlet tubes may be added to extend outside the bag if desired. Durable nylon straps may be attached to the outside of Armor Bags to serve as thickness controllers and to permit filling tapered or irregularly shaped bags.

Bag Dimensions Calculated as:
 $C = 2 \text{ "FBW"} = \pi H + 2(W-H)$



Fabric Stress



CONCRETE MIX DESIGN

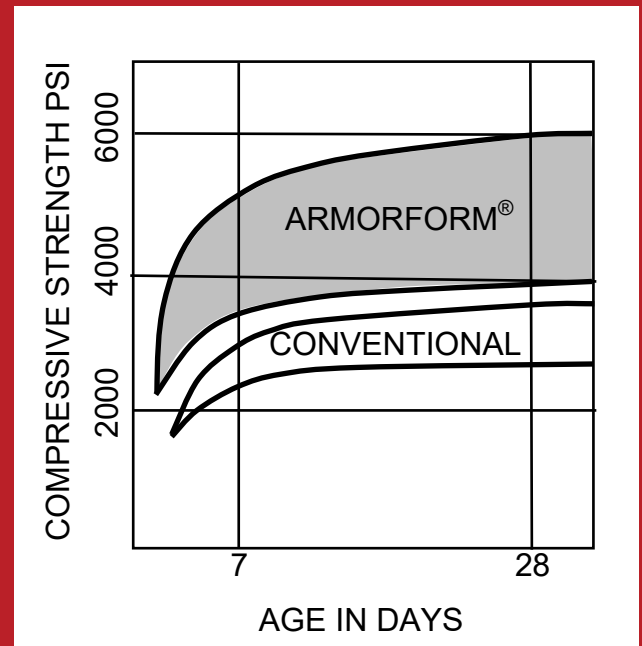
A pumpable fine aggregate concrete (structural grout) is utilized in the construction of all ARMORFORM® revetments. As an aid to pumpability, a pozzolan grade fly ash may be substituted for up to 35% of the cement. Mixes designed with 5% to 8% air content will have improved pumpability and resistance to freeze-thaw. A retarding admixture may be used in hot weather.

Excess mixing water expelled through the permeable ARMORFORM® fabric will reduce the volume of fluid structural grout from 27 cu. ft. to approximately 25 cu. ft. of hardened grout and also reduce the water/cement ratio from approximately 0.7 to approximately 0.4.

Fine aggregate concrete consistency should be in the 9-11 second range when passed through the 3/4" orifice of the standard flow cone described in ASTM C-939-93. Tests utilizing a concrete slump cone are not appropriate.

TYPICAL RANGE OF MIX PROPORTIONS

Material	Mix Proportions lbs./cu. yd.	After Placement lbs./cu. yd.
Cement	750-850	810-920
Sand	2030-2120	2195-2290
Water	485-555	360-430
Fly Ash	Up to 25% of Cement	



ARMORFORM® is pumped and formed under pressure. This method provides superior strength and durability when compared to conventional concrete forming. Tests show that structural grout pumped into ARMORFORM® is 1.5 to 1.75 times stronger, plus it absorbs 5% less water.

The ARMORFORM® system is ideal for situations requiring resistance to mild concentration of acid, alkali, salt or petrochemicals. With minimal water absorption, ARMORFORM also resists freeze - thaw action.

ARMORFORM®

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