ARMORFORM®
Fabric Formed Hard Armoring

INSTALLATION MANUAL

1. SITE PREPARATION

.1.1. Areas on which fabric forms are to be placed shall be constructed to the lines, grades, contours, and dimensions shown on the contract drawings. the areas shall be graded and uniformly compacted to a smooth plane surface with an allowable tolerance per specifications and indicated in the contract drawings.

.1.2. The areas shall be free of organic material and obstructions such as roots and projecting stones and grade stakes shall be removed. Where required by the Contract Specifications, soft and otherwise unsuitable subgrade soils shall be identified, excavated and replaced with select materials in accordance with the Contract Specifications. Where areas are below the allowable grades, they shall be brought to grade by placing compacted layers of select material. The thickness of layers and the amount of compaction shall be as specified by the Engineer.

.1.3. Excavation and preparation of aprons as well as anchor, terminal or toe trenches shall be done in accordance with the lines, grades, contours, and dimensions shown on the Contract Drawings.

.1.4. The terminal edges of the fabric form lining should be keyed into the subgrade to the lines, grades, and dimensions shown on the Contract Drawings.

.1.5. Immediately prior to placing the filter fabric, the prepared subgrade will be inspected by the Engineering and/or the Company's representative. No fabric or fabric formed concrete revetments will be placed thereon until that area has been approved.

.2. PLACEMENT OF GEOTEXTILE FILTER FABRIC

.2.1. Place geotextile filter fabric in accordance with the lines, grades, and dimensions shown of the Contract Drawings.

.2.2. At a minimum, the geotextile filter baric shall be placed directly on the prepared area, in intimate contact with the subgrade, and free of folds or wrinkles. The geotextile filter fabric shall be placed so that the upstream roll of fabric overlaps the downstream roll. The longitudinal and transverse joints will be overlapped at least two (2) feet or shall be field sewn with a minimum overlap of two (2) inches. The geotextile will extend at least one (1) foot beyond the top and bottom concrete lining termination points, or as required by the engineer.

.3. PLACEMENT OF FABRIC FORMS

.3.1. Factory assembled fabric form panels shall be placed over the geotextile filter fabric and within the limits shown on the Contract Drawings. Fabric forms panels are to be placed loosely, without folds, to allow for proper filling with fine aggregate concrete.

.3.2. When placing panels an allowance for approximately 10% contraction of the form in each direction which will occur as a result of fine aggregate concrete filling. The

contractor shall gather and fold the additional slope direction fabric form in the anchor trench to be secured in such a manner as to be gradually released as fabric forms contract during filling. The contractor shall gather the additional transverse direction fabric form at each baffle for self-release during filling.

.3.3. Adjacent fabric form panels shall be joined in the field by means of sewing or zippering closures. Adjacent panels shall be joined top layers to top layer and bottom layer to bottom. All field seams shall be made using two lines of U.S. Federal Standard Type 101 stitches. All sewn seams shall be downward facing. All seams sewn in the field shall not be less than 90 lbf/in when tested in accordance with ASTM D4884. Colored thread is advised for all field sewn seams to facilitate inspection.

.3.4. When conventional joining of fabric forms is impractical or where called for on the Contract Drawings, adjacent forms may be overlapped a minimum of 3 ft to form a lap joint, pending approval by the Engineer. Based on the predominant flow direction, the upstream form shall overlap the downstream form. In no case shall simple butt joints between forms be permitted.

.3.5. Curves or turns may be accomplished by panels with one or more angled mill widths. Panels with angled mil widths should be carefully pre-fabricated or field assembled by cutting and sewing the mill widths of the fabric form(s) to obtain true angles and edges.

.3.6. After the fabric form panels have been positioned, the designated sides of the panes should be folded into the anchor trenches, flank trenches and toe trenches.

.3.7. Immediately prior to filling with fine aggregate concrete, the assembled fabric forms shall be inspected by the Engineer, and no fine aggregate concrete shall be pumped therein until the fabric seams have been approved.

.4. PLACEMENT OF FINE AGGREGATE CONCRETE

.4.1. Following the placement of the fabric forms over the geotextile filter fabric, fine aggregate concrete shall be pumped between the top and bottom layers of the fabric form through small slits to be cut in the top layer of the fabric form or manufacturer supplied valves. The slits shall be of the minimum length to allow proper insertion of a filling pipe inserted at the end of a 2-inch I.D. concrete pump hose. Fine aggregate concrete shall be pumped between the top and bottom layers of fabric, filling the forms to the recommended thickness and configuration.

.4.2. Beginning at the designated staring point, check and adjust the fabric form panel's seams to assure that they are perpendicular to the longitudinal alignment line. Care should be exercised in the alignment and securing of the first fabric form panel. This will ensure the aesthetics of the concrete lining or mat and will also hasten the installation of subsequent panels. Fabric should be placed loosely at the connection or anchor to allow for contraction in both directions during filling.

.4.3. A tight seal will be made by wrapping a piece of nonwoven fabric around the pipe. When the pipe is withdrawn, the nonwoven fabric will be stuffed into the hole to provide

a temporary closure. When the concrete has stiffened and is no longer fluid, the fabric must be removed, and the concrete surface smoothed by hand.

.4.4. Fine aggregate concrete shall be pumped in such a manner that excessive pressure on the fabric forms is avoided. Baffles shall be installed by the Manufacturer to facilitate the pumping process by providing a termination point at pre-determined locations within a single fabric formed panel. Cold joints shall be avoided. A cold joint is defined as one in which the pumping of the fine aggregate concrete into a given section of form is discontinued or interrupted for an interval of forty-five (45) or more minutes.

.4.5. The sequence of fine aggregate concrete shall be such as to ensure complete filling of the fabric formed concrete lining to the thickness specified by the Engineer. The flow of the fine aggregate concrete shall first be directed into the lower edge of the fabric form and working back up the slope, followed by redirecting the flow into the anchor trench.

.4.6. Prior to removing the filling pipe from the current concrete lining section and proceeding to the fine aggregate concrete filling of the adjacent lining section, the thickness of the current lining section shall be measured by inserting a length of stiff wire through the lining at several locations from the crest to the toe of the slope. The average of all thickness measurements shall be not less than the specified average thickness of the concrete lining. Should the measurements not meet the specified average thickness, pumping shall continue until the specified average thickness has been attained.

.4.7. Excessive fine aggregate concrete that has inadvertently spilled on the concrete lining surface shall be removed. The use of a high-pressure water hose to remove spilled fine aggregate concrete from the surface of the freshly pumped concrete lining shall not be permitted.

.4.8. Foot traffic will not be permitted on the freshly pumped concrete lining when such traffic will cause permanent indentations in the lining surface. Walk boards shall be used where necessary.

.4.9. After the fine aggregate concrete has set, all anchor, flank and toe trenches shall be backfilled and compacted flush with the top of the concrete lining. The integrity of the trench backfill must be maintained to ensure a surface that is flush with the top surface of the concrete lining for its entire service life. Toe trenches shall be backfilled as shown on the Contract Drawings. Backfilling and compaction of trenches shall be completed in a timely fashion to protect the completed concrete lining.

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RE: Fabric Penetration Means and Methods
Pipes, Piles, Culverts, Trees and other Appurtenances

Fabric forms should be tailored in the field to fit around pipes, piles, culverts, trees and other appurtenances. An opening should be cut in the fabric-form that is slightly smaller than the object and the perimeter of the opening is sewn closed. The hole should be cut using either a burner or razor knife. An optional method is to cut in a cross pattern with one horizontal and one vertical slit. The length of each slit is determined by the size of the appurtenance and the slope of the embankment (if any). Each section of the cut fabric is rolled up from the center of the hole towards the outside perimeter and hog ringed. The perimeter can be sealed using ±1" copper hog rings spaced every 2". If the fabric form has tendons, loop and tie cables back together using aluminum compression sleeves. Fabric form panels should be placed loosely, but without folds, to allow for proper filling with fine aggregate concrete. The extra fabric form provided for form contraction should be gathered into temporary tucks around perimeter of appurtenance. Panels that are stretched or taut will not permit the required fabric contraction, therefore the fabric forms will not fill to their required thickness. The fabric form panel's tailored opening is either slid over or wrapped around the object. As fine aggregate concrete is pumped into the section of the panel with the tailored opening it will form snugly around the object (Fig. 1). Any annular gaps not completely sealed by the pumped fabric will need to be filled using fine aggregate concrete.

FIGURE 1

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Requirements for Installing and Anchoring Liners and Mats

Slopes

The prepared areas should not be more than 2.5 inches below the grades indicated on the Contract Drawings and should not vary more than 1.5 inches in 10 feet as measured with a straightedge. Where such areas are underwater, they should be backfilled with crushed rock or stone conforming to the grading and quality requirements of 0.75-inch maximum size coarse aggregate for concrete.

Note: *Though fabric-formed concrete can be installed on slopes steeper than those suitable for quarry stone or precast concrete blocks or for compacted soil or soil cement construction, fabric formed concrete linings and mats are not designed to improve slope stability. Their inherent weights are selected for the purposes of hydraulic stability and are not to be considered sufficient to impart stability to slopes subject to rotational, global or sliding failure or where severe consolidation of the subgrade is anticipated.*

Flank, Anchor (side), and Toe Trenches or Aprons

Flank, anchor (side), and toe trenches or aprons should be excavated along the lines, grades and dimensions shown on the Contract Drawings. Trenching equipment works well provided the upper inside edge of the trench is rounded by hand in order that the fabric formed concrete lining or mat extends over a curve rather than a corner at the slope-to-trench transition (Fig. 1).

Crown Protection
Rivers and Channels

The top elevation of a fabric-formed concrete lining or mat installation should be extended to the top of the slope or to a point above the maximum design high water elevation plus a freeboard of a minimum of 2 ft (24”) with an additional allowance for run up from waves or boat wakes (Fig. 2).

It is recommended that fabric-formed concrete linings and mats should be extended horizontally at the top of the slope or onto a bench for a minimum distance of 2 ft (24”) and then placed in an anchor trench a minimum depth of 1.5 ft (18”) (Fig. 26). For sandy soils, a rounded shoulder and sloped trench side is normally used (Fig. 2.1).

Shorelines, Lakes, Reservoirs and Retention Basins

The top elevation of a fabric-formed concrete lining or mat installation should be extended to the top of the slope or to a point above the maximum run up from design waves or boat wakes (Fig. 3).

It is recommended that fabric-formed concrete linings and mats should be extended horizontally at the top of the slope or onto a bench for a minimum distance of 2 ft (24”) and then placed in an anchor trench a minimum depth of 2 ft (24”) (Fig. 3).

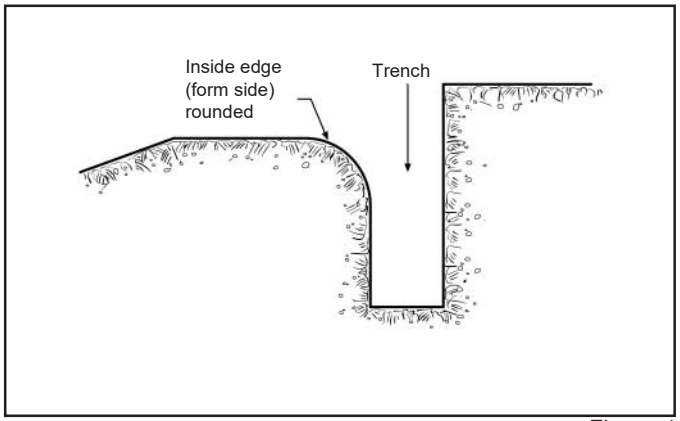


Figure 1

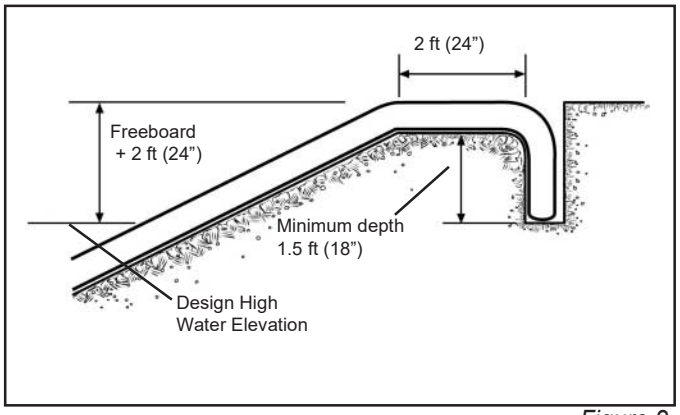


Figure 2

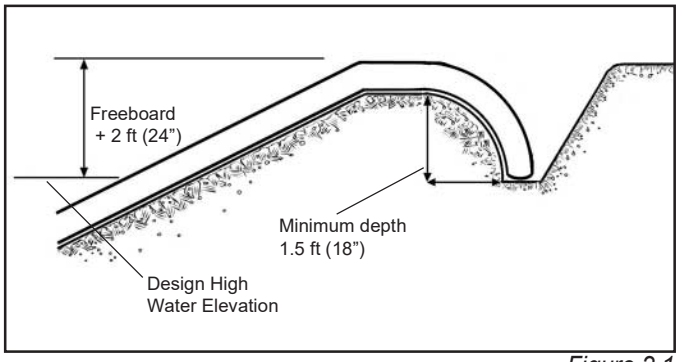


Figure 2.1

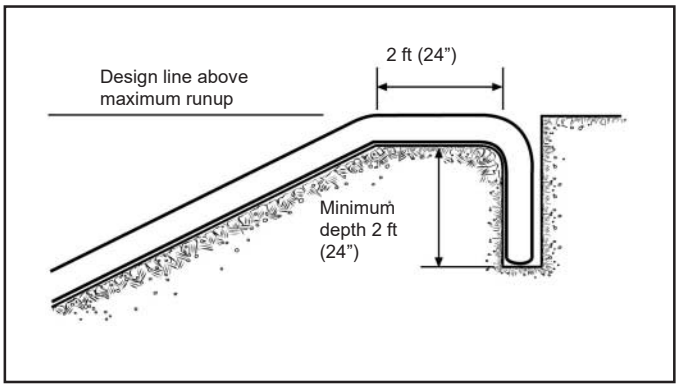


Figure 3

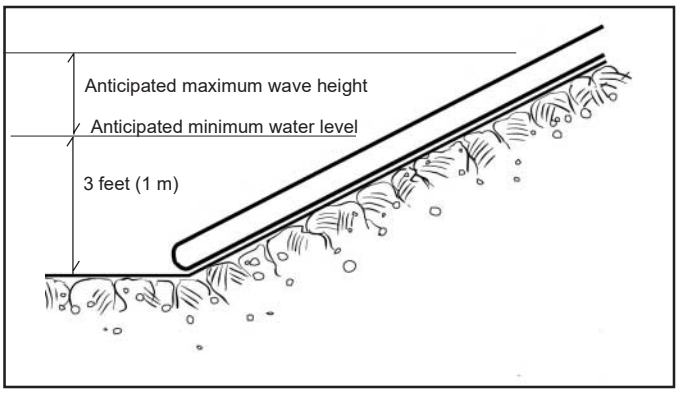


Figure 4

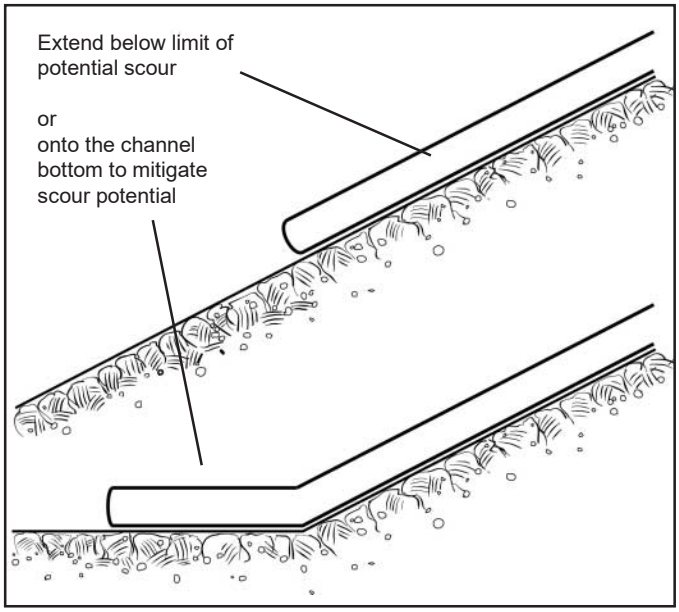


Figure 5

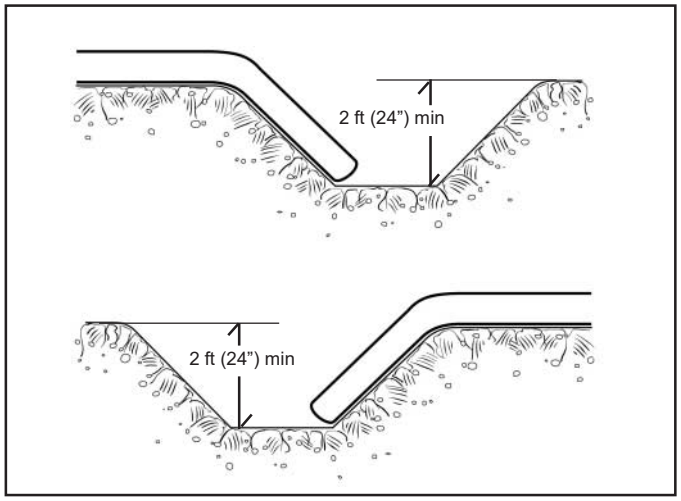


Figure 6

When constructing crown protection for either rivers and channels or shorelines, lakes, reservoirs and retention basins it is important to note that overtopping may cause erosion immediately above the protection that may eventually undermine and collapse the concrete linings, mats and armor units.

Toe Protection

The lower edges of a concrete lining or mat installation should be extended a minimum vertical distance of 3 ft (36") below anticipated minimum water level plus a distance equal to the anticipated maximum design wave height (Fig. 4). Additional toe protection may be required where the structure is in the vicinity of commercial shipping or where toe scour is known to be severe. The lower edge of the mat should extend to an elevation below that at which scour might occur or extend onto the channel bottom to mitigate scour (Fig. 5). This procedure will reduce the possibility of washout of soil from beneath the lining or mat.

Flank Trenches

The terminal ends of a fabric formed concrete lining or mat installation should be placed in a flank trench that is excavated at an angle of about 45° from the normal angle of the subgrade.

Rivers and Channels

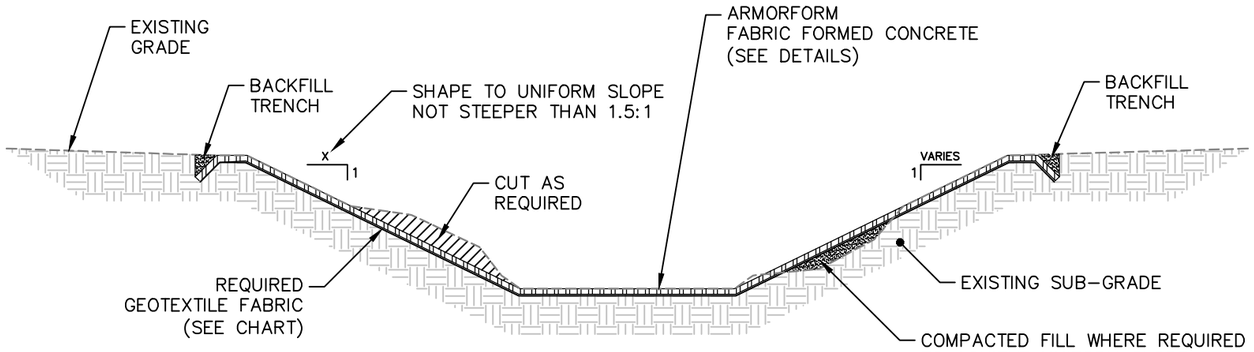
Though the downstream flank of a concrete lining or mat installation is the most vulnerable point to the tractive forces of flowing water, it is recommended that both the downstream and upstream flanks be protected with flank trenches with a minimum depth of 2 ft (24") (Fig. 6).

Shorelines, Lakes, Reservoirs and Retention Basins

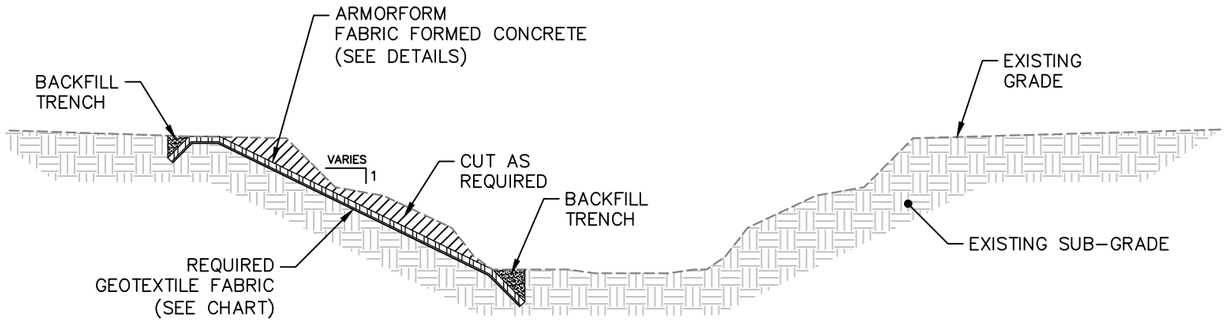
Both flanks of a concrete lining or mat installation are equally vulnerable to the erosive forces of wave action and currents. They should both be protected with flank trenches with a minimum depth of 2 ft (24") (Fig. 6).

Note:

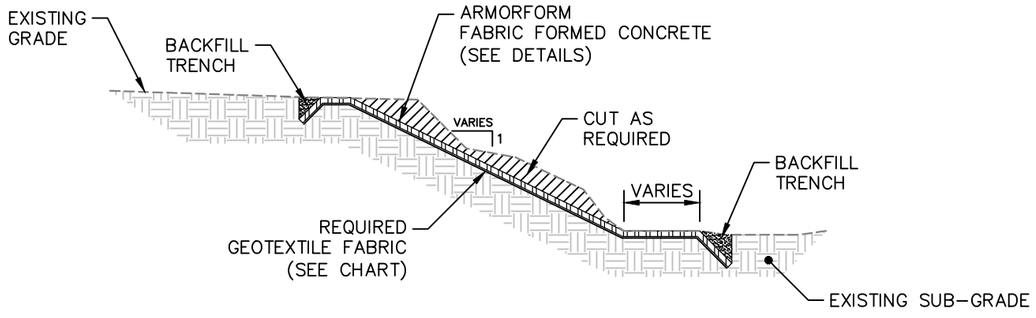
The requirements listed on these pages for the anchoring and protection of linings and mats are given for guideline purposes only. For an actual installation, these parameters must be established by a qualified Hydraulics Engineer, based on his calculations of the requirements for a specific project.



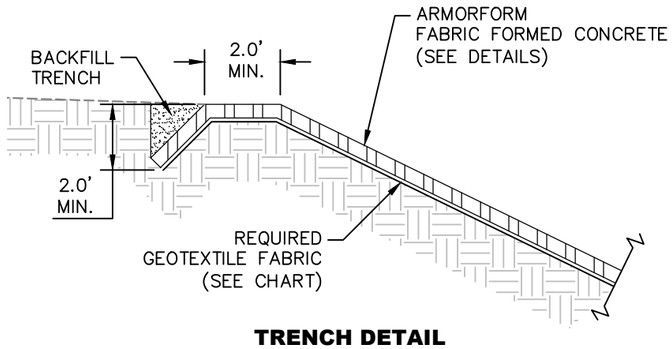
ARMORFORM SECTION DETAIL
FULL CHANNEL PROTECTION



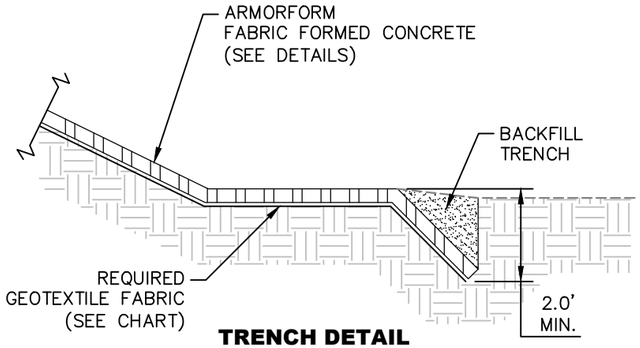
ARMORFORM SECTION DETAIL
BANK PROTECTION



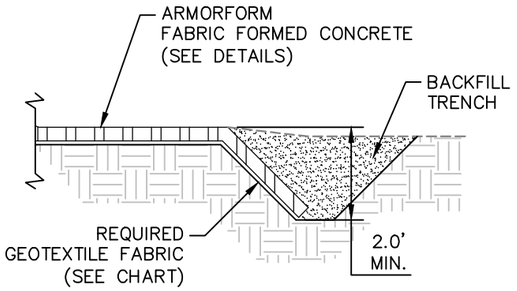
ARMORFORM SECTION DETAIL
BANK PROTECTION WITH LANDING



TRENCH DETAIL
TOP OF BANK (TYP)



TRENCH DETAIL
BOTTOM OF BANK (TYP)



FLANK TRENCH DETAIL
UPSTREAM & DOWNSTREAM ENDS (TYP)

MINIMUM FILTER FABRIC PROPERTY REQUIREMENTS			
PROPERTY	TEST METHOD	UNITS	VALUES
GRAB TENSILE STRENGTH	ASTM D 4632	LB	90
ELONGATION AT BREAK	ASTM D 4632	%	15
TRAPEZOIDAL TEAR STRENGTH	ASTM D 4533	LB	30
PERMITTIVITY	ASTM D 4491	SEC-1	0.5000

NOTE:
FILTER FABRIC AS PER ENGINEER'S RECOMMENDATIONS. MINIMUM FABRIC REQUIREMENTS SHALL BE IN ACCORDANCE WITH "MINIMUM FILTER FABRIC PROPERTY REQUIREMENTS TABLE.

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1118 OLD AIRPORT ROAD
LAURENS, SC 29360

05-25-21		
Survey		
Drawn	OP	KW
Check		

ARMORFORM DETAILS

Drawing Scale:
Vert: N.T.S
Horz: N.T.S.

Sheet No:
DETAILS