EROSION CONTROL

TYPAR
GEOTEXTILES

TOUGH OVER TIME

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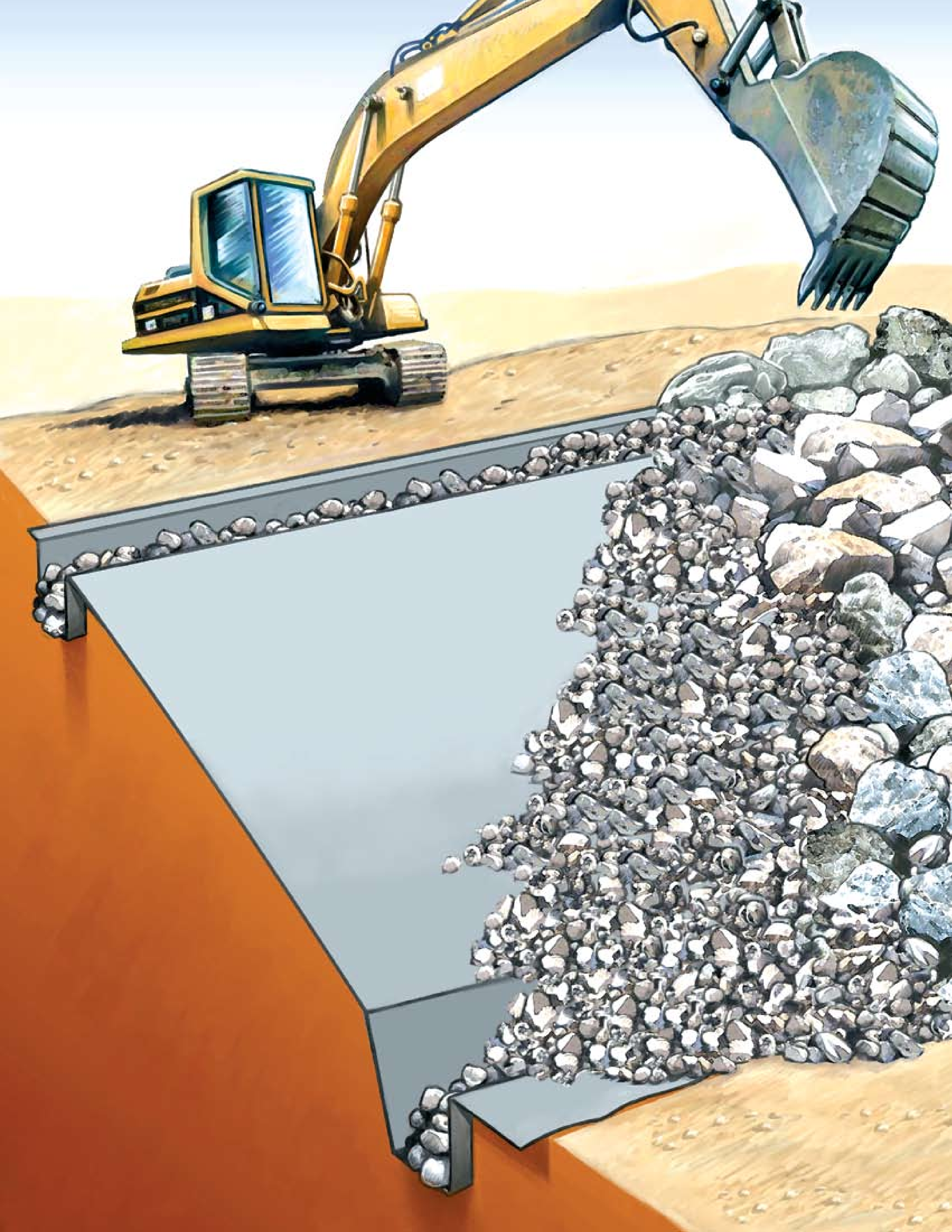

1.0 FEATURES OF PERMANENT EROSION CONTROL

A layer of heavy stone, broken rock (rip-rap), gabions or pre-cast blocks is often used to provide permanent erosion protection for:

- Stream banks (Figure 1)
- Coastal shorelines (Figure 2)
- Cut and fill slopes (Figure 3)
- Submerged bridge piers and foundations (Figure 4)
- Behind retaining walls (Figure 5)

Erosion protection structures or armor systems dissipate the hydraulic forces that cause erosion, and they preserve the sub-grade soil or fill soil behind it. A geotextile is required between the subgrade soil and the rip-rap, gabions or pre-cast blocks to prevent piping and erosion of the soil while allowing the free passage of water.

The primary function of the Typar geotextile in erosion control is filtration to minimize erosion of the subgrade soil behind the armor system.

2.0 HOW TYPAR GEOTEXTILES WORK

Typar offers a combination of properties that make it ideally suited for permanent erosion control applications:

- Permittivity allows drainage
- Non-woven, thermally bonded fiber structure minimizes the piping and erosion of subgrade soils
- Tough, strong and durable

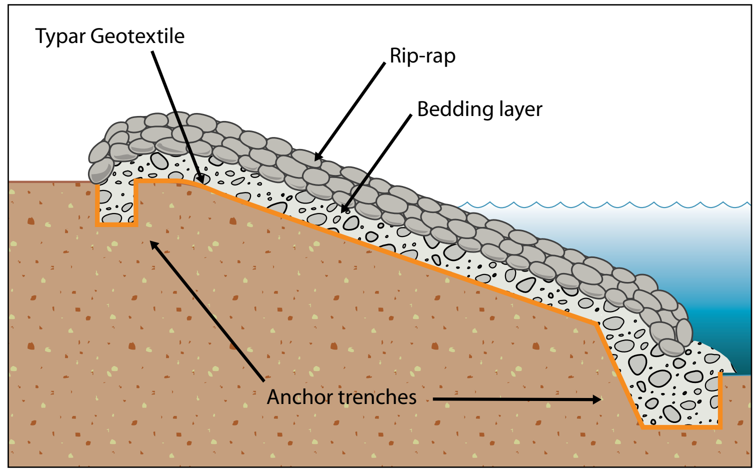

Figure 1: Stream bank erosion control.

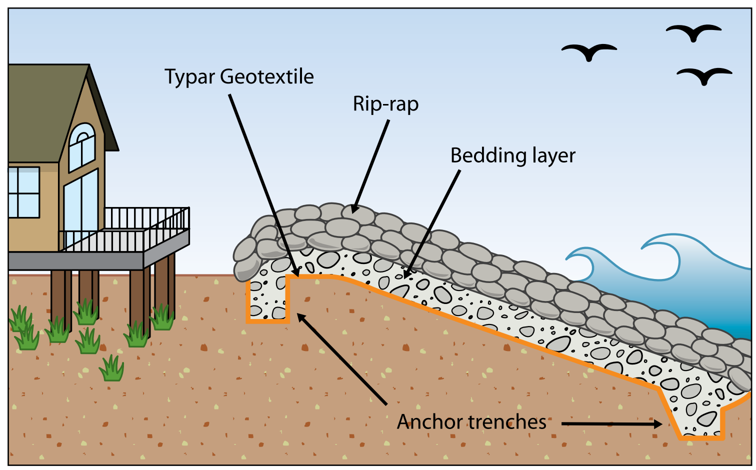

Figure 2: Coastal shoreline erosion control.

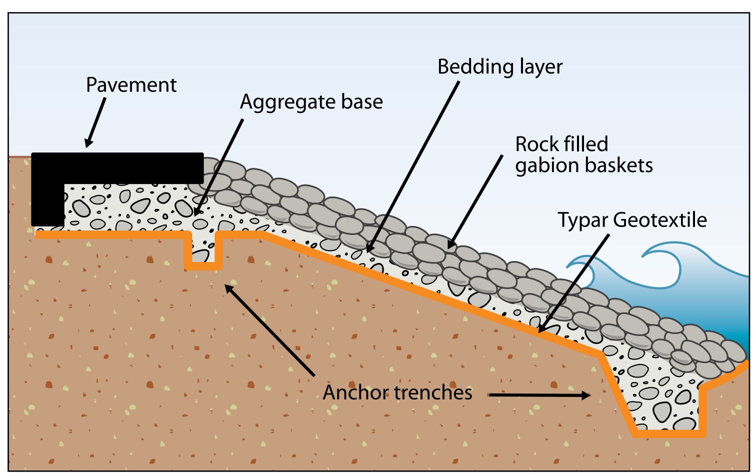

Figure 3: Cut and fill slope erosion control.

• Easy installation
• Made of polypropylene, which resists rot, mildew, microorganisms and chemicals

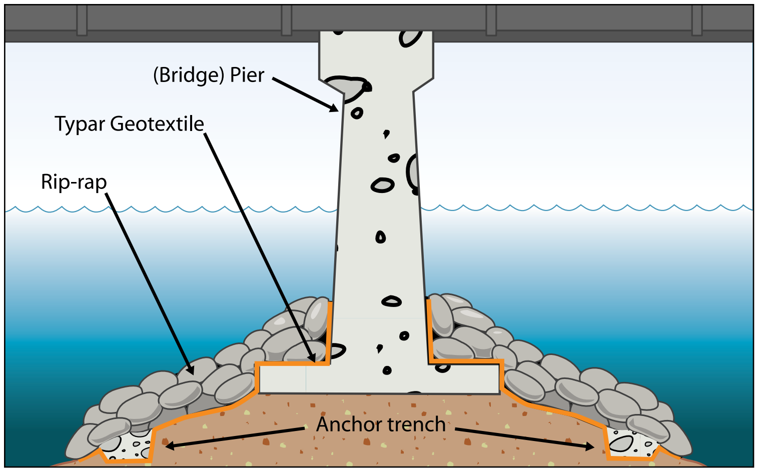

Figure 4: Submerged bridge pier and foundation erosion control.

Typar's tensile strength, puncture resistance, tear resistance, opening size and hydraulic properties make it an ideal filter fabric for permanent erosion control systems.

The primary design requirement of a permanent erosion control system is the development of a graded aggregate filter layer in the subgrade soil (Figure 6). Typar promotes development of such filter layers because its unique bonded fibers create a pathway that resembles a well-graded aggregate filter. Typar provides an effective filter structure since it has both high permeability and the ability to retain soil particles adjacent to it, which minimizes the piping of subgrade soils and reduces fine particles from entering the watercourse.

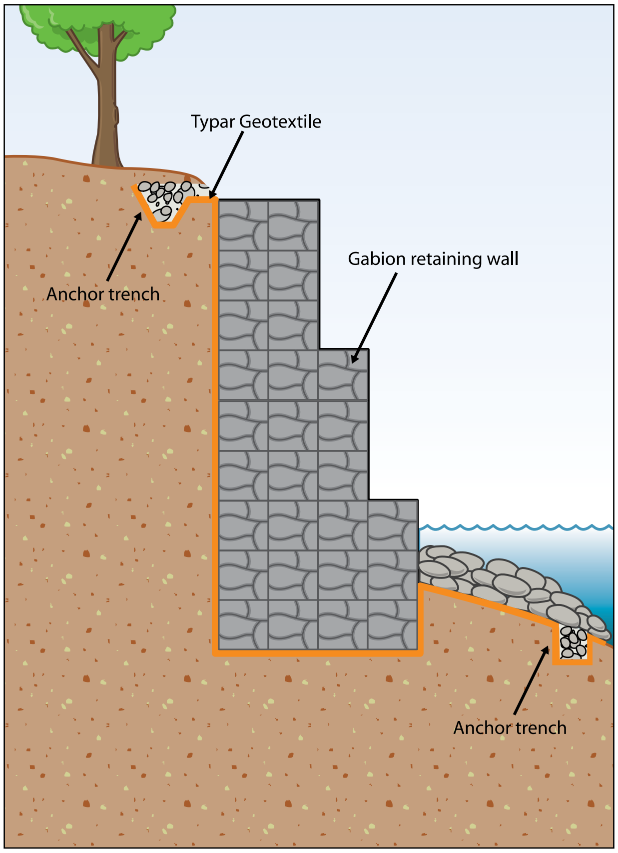

Figure 5: Behind retaining wall erosion control.

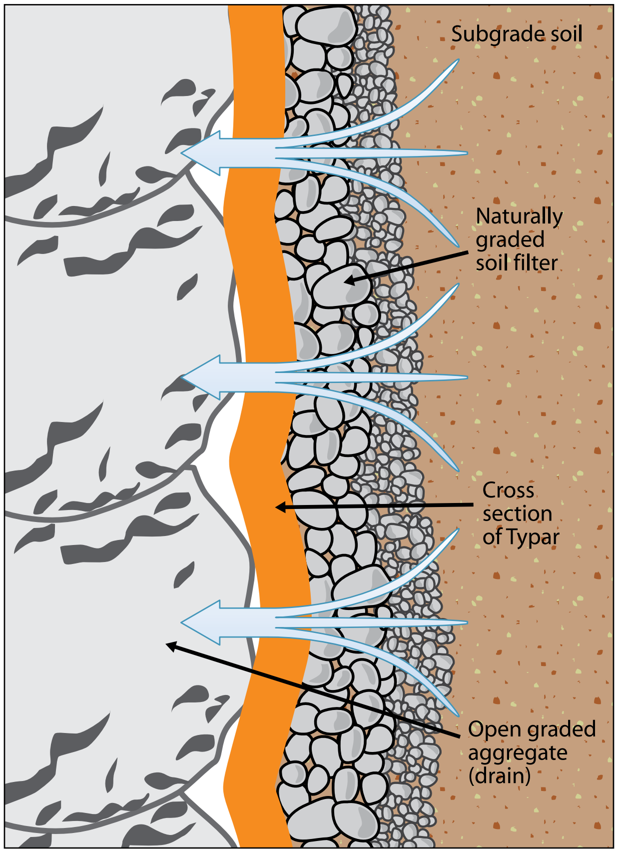

Figure 6: Graded soil filter formed next to the Typar.

SOIL NAME	DIAMETER		US STANDARD SIEVE SIZE	FAMILIAR EXAMPLE
	mm	inches		
Boulders	Over 300	Over 12	> 12″	Larger than basketball
Cobbles (rounded)	76-300	3-12	3-12″	Grapefruit
Coarse gravel	19-76	0.75-3.0	0.75-3″	Orange or lemon
Fine gravel	4.75-19	0.19-0.75	No. 4-0.75	Grape or pea
Coarse sand	2.0-4.75	0.08-0.19	No. 10-No. 4	Rock salt
Medium sand	0.42-2.0	0.016-0.08	No. 40-No. 10	Sugar or table salt
Fine sand	0.074-0.42	0.003-0.016	No. 200-No. 40	Powdered sugar
Silt sizes	0.002-0.074	0.0008-0.003	Rock flour and finer; particles cannot be distinguished with naked eye at distances of 20cm (8″).	
Clay sizes	< 0.002	< 0.00008		

Figure 6: Soil description based on typical grain size.

MAJOR DIVISIONS	SUBDIVISIONS	TYPICAL NAMES	LABORATORY CLASSIFICATION CRITERIA
Coarse-grained soil (More than 50% retained on No. 200 sieve)	Gravel (More than 50% of coarse fraction retained on No. 4 sieve)	Well-graded gravel or gravel-sand mixture, little or no fines	Less than 5% fines
		Poorly-graded gravel or gravelly sand, little or no fines	Less than 5% fines
		Silty gravel, gravel-sand-salt mixtures	More than 12% fines
		Clay-like gravel, gravel-sand-clay mixtures	More than 12% fines
	Sand (50% or more of coarse fraction passes through No. 1 sieve)	Well-graded gravel or gravelly sand, little or no fines	Less than 5% fines
		Poorly-graded sand or gravelly sand, little or no fines	Less than 5% fines
		Silty sand, sand-silt mixtures	More than 12% fines
		Clay-like sand, sand-clay mixtures	More than 12% fines
Fine-grained soil (50% or more passes No. 200 sieve)	Silt and clay (Liquid limit less than 50)	Inorganic silt, rock flour, silt of low plasticity	Inorganic soil
		Inorganic clay or low plasticity, gravelly clay, sandy clay	Inorganic soil
		Organic silt and organic clay or low plasticity	Organic soil
	Silt and clay (Liquid limit 50 or more)	Inorganic silt, micaceous silt, silt of high plasticity	Inorganic soil
		Inorganic, highly plastic clay, fat clay, silty clay	Inorganic soil
		Organic silt and organic clay or high plasticity	Organic soil
Peat	Highly organic	Peat and other highly organic soil	Primarily organic matter, dark in color and organic color

Figure 8: Unified soil classification system sieve.
Courtesy of McGraw Hill and Robert W. Day, Soil Testing Manual, pg. 81.

*Fines are those soil particles that pass the No. 200

3.0 DESIGN CONSIDERATIONS AND SELECTION OF GEOTEXTILES

Geotextile design for hard armor erosion control systems is essentially the same as geotextile design for filters in subsurface drainage systems. The primary function of the geotextile is filtration. The design requires the evaluation of two criteria:

- Retention criteria that ensures geotextile openings are small enough to prevent migration of soil particles (piping).
- Permeability criteria that ensures geotextile is permeable enough to allow liquids to pass freely through. "Permeability" of a geotextile is measured by permittivity (or cross-plane flow rate). The geo-textile must pass water as fast as the subgrade soil.

3.1 RETENTION CRITERIA

Soil identification based on grain size distribution is a useful indicator of the soil behavior when filtered by a geotextile. The selection of a geotextile is normally based on the percent of the soil passing 0.075 mm sieve (No. 200 sieve). Figure 7 describes the different types of soil based on typical grain size.

SOIL TYPE	PERMEABILITY COEFFICIENT K (CM/SEC)
Uniform coarse sand	0.4
Uniform medium sand	0.1
Clean, well-graded sand and gravel	0.01
Uniform fine sand	0.004
Well-graded silty sand and gravel	0.0004
Silty sand	0.0001
Uniform silt	0.00005
Sandy clay	0.000005
Silty clay	0.000001
Clay	0.0000001
Colloidal clay	0.000000001

Figure 9: Typical permeability of soil types.

	PERMITTIVITY (D4491) sec^{-1}	PERMEABILITY (D4491) cm/sec	WATER FLOW (D4491) gal/min ft^2	APPARENT OPENING SIZE (MAX) (D4751)	
				mm	US Sieve
TYPAR 3801	0.1	0.01	8	0.09	170
TYPAR 3631	0.2	0.01	20	0.10	140
TYPAR 3601	0.1	0.01	15	0.10	140
TYPAR 3501	0.5	0.03	50	0.20	70
TYPAR 3401	0.7	0.03	60	0.21	70
TYPAR 3341	0.7	0.03	85	0.25	60
TYPAR 3301	0.8	0.03	95	0.30	50
TYPAR 3201	1.0	0.03	190	0.59	30
TYPAR 3151	1.5	0.04	235	0.84	20

Note: The ability of a geotextile to pass water is indicated by the permittivity–therefore it should be used to compare the ability of various types (needlepunched, SRW, and heatbonded), NOT PERMEABILITY. For comparisons, permittivity of fabrics should be measured UNDER_LOAD. See ASTMD-4491. To get permeability, you multiply permittivity by the fabric thickness. Therefore, if the fabrics pass the same amount of water and one is twice as thick, it will appear to pass water twice as fast which could be misleading.

Figure 10: Hydraulic properties of Typar Geotextiles (Minimum average roll values except AOS).

IN SITU SOIL PASSING .075 mm (No. 200 sieve)	MINIMUM PERMITTIVITY sec^{-1}	MAXIMUM AOS mm	TYPAR GEOTEXTILE SELECTION AASHTO M288 CLASS						
			-	-	3	2	1	1	1
<15%	0.5	0.43	3301	3341	3401	3501			
15% - 50%	0.2	0.25		3341	3401	3501		3631	
>50%	0.1	0.22			3401	3501	3601	3631	3801

Figure 11: Selection of TYPAR Geotextiles (Adopted from AASHTO M288).

3.2 PERMEABILITY CRITERIA

The default geotextile selection is based on the simple premise that permeability of the geotextile under load is greater than the permeability of the soil. All grades of Typar geotextiles are more permeable than clean well-graded sand and gravel (Figure 9 and Figure 10).

3.3 SELECT THE GEOTEXTILE

AASHTO M288 is the specification applicable for the use of geotextiles and specifically erosion control, allowing for long-term passage of water while retaining the soil. Selection of the appropriate geotextile and Typar style is dependent on the subgrade soil.

Use Figure 10 and 11 as a guide to select the appropriate Typar geotextile. The engineer should always refer to the full AASHTO M288 specification for final selection of the geotextile based on all design requirements.

4.0 INSTALLATION GUIDE

Successful use of geotextiles in permanent erosion control design requires proper installation. Follow the sequence of instructions below.

Grade the area and remove debris to provide a smooth slope surface. For stream bank and channel protection, place the geotextile parallel to the direction of water flow, which is normally parallel to the stream or channel. The geotextile should be placed in contact with the soil without wrinkles or folds and anchored to the smooth, graded surface. Terminal ends of the geotextile should be anchored by using trenches or aprons at the toe and crest of the slope (Figures 1 – 5).

To expedite construction, 18-inch anchoring pins positioned at 2 to 6 feet centers may be used to prevent movement or sliding of the geotextile especially during construction or installation.

If the geotextile will be placed between the subgrade soil and rip-rap, place a 3 to 6-inch sand or gravel bedding layer prior to installation of the rip-rap. The purpose of this bedding layer is four-fold:

1. Ensure close continuous contact of the fabric with the subgrade soil to prevent piping and turbulence (soil classification).
2. Protect the geotextile from damage during installation of the rip-rap.
3. Protect the geotextile from exposure to sunlight (UV).
4. Minimize risk of damage from vandalism.

If no bedding layer is used and the rip-rap stones or rocks weigh more than 200 pounds each, then use a heavier weight of geotextile, such as Typar 3631. Steps must be taken to ensure that there are no holes created in the fabric.

The armor system placement should begin at the toe of the slope and proceed up the slope. Rip-rap and heavy stone should be placed and not dropped from any height. Smaller stone filling should not be dropped from a height of more than 3 feet. Stone with a mass of more than 200 pounds should not be allowed to roll down the slope. Any void spaces in the armor system should be backfilled with small stone to ensure full coverage.

In underwater applications, the geotextile should be placed and pinned and the backfill material should be placed during the same day because the polypropylene geotextile will float (specific gravity is less than 1.0).

Care should be taken during installation to avoid damage to the geotextile. Should the geotextile be damaged during installation, a patch must be placed over the damaged area extending 4 feet beyond the perimeter of the damage. Field monitoring should be performed to ensure the geotextile is not damaged during placement of the armor system.

5.0 OVERLAP AND JOINING

Overlaps provide continuity between adjacent sections of the geotextile and are required to prevent separation of the fabric during stone placement. Overlaps at roll ends and adjacent rolls should be overlapped by 2 feet and, where placed underwater, by 4 feet.

Successive sheets should be overlapped upstream over downstream and upslope over downslope. Where wave action or multidirectional flow is anticipated, all seams perpendicular to the direction of the flow should be sewn. All overlaps can be replaced by sewn seams.

6.0 SETTING SPECIFICATIONS

Specifications should generally follow the design considerations in sections 3.0 to 3.3. Primary considerations include the minimum geotextile requirements for the design retention, filtration and survivability.

For erosion control, the engineer should specify an AASHTO M288 Class of geotextile as follows:

AASHTO M288 Class 1 or TYPAR 3631,
AASHTO M288 Class 2 or TYPAR 3501, or
AASHTO M288 Class 3 or TYPAR 3401.

Additional requirements should reference the AASHTO M288; i.e. "for certification, sampling, testing and acceptance, shipment and storage requirements of AASHTO M288."

When specifying Typar geotextiles for stream banks; coastal shorelines; cut and fill slopes; submerged bridges, piers and foundations; and behind retaining walls, specify the appropriate Typar grade with the confidence that all Typar geotextiles are manufactured to the high quality standards required by erosion control.