

# CHANNEL FLEX™ P-BD SERIES

Class 600 Closed Cell  
6.00" CELLULAR CONCRETE BLOCK MAT SYSTEM

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FOR  
ARTICULATED CONCRETE BLOCK REVETMENT**

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1.1 DEFINITIONS:

This work shall consist of furnishing and installing Channel Flex™ Class 600 Cellular Concrete Mat System in accordance with lines, grades design and dimensions shown on the drawings. The Cellular Concrete Blocks shall be interlocking and have penetrations in the blocks for revetment cables as necessary to bind the individual blocks into mattresses in both the longitudinal and lateral directions. Cable penetrations shall prevent any exposure to potential UV degradation within the dimensions of the individual blocks. The mat system shall be in accordance with the lines, grades, design and dimensions shown on the plans and be able to articulate when formed into mattresses.

1.2 REFERENCES:

Channel Flex meets or exceeds specifications with regards to the publications listed below. The publications are referred to in the text by the basic designations only.

**American Society for Testing and Materials (ASTM) Publications.**

<u>ASTM C 33-97</u>	Concrete Aggregates
<u>ASTM C 140-91</u>	Sampling and Testing Concrete Masonry Units
<u>ASTM A 153/A 153M</u>	Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM A 36/A 36/M	Standard Specification for Carbon Structural Steel
ASTM C 42/C 42M	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

**US Federal Highway Administration (FHWA) and US Bureau of Reclamation (USBR)**

<u>FHWA RD-89-199</u>	Hydraulic Stability of Articulated Concrete Block Revetment Systems During Overtopping Flow.
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1.3 DELIVERY, STORAGE AND HANDLING OF MATERIALS:

Materials delivered to the site will be inspected for damage, unloaded and stored with a minimum of handling. Contractor may designate a storage site at the project for materials to be delivered and stored prior to placement if needed. Storage site to be approved by the Contracting Officer, if necessary. Materials shall not be stored directly on the ground and shall be kept free of dirt and debris. Materials shall be so handled as to ensure delivery to the site in sound undamaged condition. Synthetic geotextiles that are not to be installed immediately shall be protected from the direct sunlight in accordance with the SECTION entitled GEOTEXTILES.

1.4 MEASUREMENT:

Unit of measurement and payment for the Articulated Cellular Concrete Mats will be by the square foot or as per the specifications.

2.1 ARTICULATING CONCRETE BLOCKS:

Hydraulic Test Data and block performance according to FHWA-RD-89-199 shall be provided to the Engineer. The cellular concrete block system must have been tested under controlled flow conditions for hydraulic performance utilizing a 2:1 slope in the direction of flow.

Channel Flex Class 600 according to FHWA RD-89-199 meets the following minimum requirements:  
Closed Cell Block Without Cables as Tested on Soil Embankment with Geotextile Filter Fabric.  
(No Drainage Layer Utilized During Testing - 4" Gravel or Synthetic Matting).

Void Ratio	10%
Critical Velocity – FPS	22.2 ft/sec
Critical Shear Stress – Lbs/Ft <sup>2</sup>	18.0 Lbs.
Weight per Block, Minimum	93 Lbs
Block Thickness:	6.00"

2.1.1 Matrix Assembly – Cabled Systems

The Channel Flex System shall be pre-assembled into mattresses as an assembly of concrete blocks when connected into mattresses by the use of revetment cables. Individual blocks may be installed at the site in the dry and the revetment cables threaded through the blocks to bind the entire system by the use of revetment cables. Two (2) integral longitudinal cables per block are required as well as one (1) lateral transverse cable. No partial or half blocks will be allowed without the use of a transverse cable to bind the blocks together into mattresses. The final revetment system must be tied continuously throughout with cables in both longitudinal and lateral directions.

2.1.2 Structural Requirements:

The compressive strength of the concrete blocks will be a minimum of 4000 PSI at 28 days. The core compressive strength shall not be less than the minimum and test cores shall be tested at the engineer's option. Test procedures shall be in accordance with ASTM C 140-91. Cores failing to meet the minimum compressive strength requirements shall be cause for rejection of the represented lot by the engineer.

The maximum water absorption will be 10 pcf for an average of 3 units, and 12 pcf for an individual unit. Water absorption will be determined according to ASTM C 140.

The minimum saturated surface-dry density will be 130 pcf for an average of 3 units.

2.1.3 Aggregate:

The aggregate shall meet the requirements of ASTM C 33-97, except for grading. Aggregate grading shall be reasonably consistent and shall be well-graded from the maximum size which can be conveniently handled with available equipment

2.2 CABLE:

Cable shall be constructed of high tenacity, low elongation and continuous filament polyester fibers. Cables shall consist of a core construction comprised of parallel fibers contained within an outer jacket or cover. The weight of the parallel core shall be between 65 to 70 percent of the total weight of the cable. The revetment cable shall have the following minimum physical properties:

Nominal Cable Diameter:	27 mm
Approximate Strength Lbs.	7,200
Weight	Yield – 15.7 ft/lb.

2.41 The revetment cable shall exhibit good to excellent resistance to most concentrated acids, alkalis and solvents. Cable shall be impervious to rot, mildew and degradation associated with marine organisms. The materials used in the construction shall not be affected by continuous immersion in fresh or salt water.

2.42 Selection of cable and fittings shall ensure a safe design factor for mattresses being lifted from both ends, thereby forming a catenary. Consideration shall be taken for the bending of the cables around hooks or pins during lifting. Revetment cable splicing fittings shall be selected so that the result splice shall provide a minimum of 75 percent of the minimum rated cable strength. Fittings such as sleeves, stops and washers shall be in accordance with manufacturer’s recommendations unless otherwise shown.

2.43 Elongation Requirements:

Requirements listed below are based upon stabilized new and dry cable. The tolerance of these values is plus or minus 5 percent.

	% Breaking Strength		
	<u>10%</u>	<u>20%</u>	<u>30%</u>
Permanent Elongation (While Working)	0.7	1.8	2.6
Elastic Elongation	0.6	1.4	2.2
Total Stretch	1.3	3.2	4.8

2.3 **FILTER FABRIC:**

The filter fabric used for cellular concrete blocks shall be in accordance with the SECTION entitled GEOTEXTILES.

2.4 **FOUNDATION PREPARATION:**

Areas on which filter fabric and cellular concrete blocks are to be placed shall be constructed to the lines and grades shown on the plans and in accordance with the specifications.

2.4.1 **Perimeter:**

Excavation and preparation for anchor trenches, side trenches, toe trenches and aprons shall be done in accordance to the lines, grades and dimensions shown on the plans.

2.4.2 **Inspection:**

Immediately prior to placing the filter fabric and cellular concrete blocks, the prepared area shall be inspected by the Contractor and approved before the fabric or blocks are placed thereon.

## 2.5 INSTALLATION OF CELLULAR CONCRETE MATTRESSES:

### 2.5.1 Filter Fabric:

Placement of filter fabric shall be installed in accordance with the SECTION entitled GEOTEXTILES or as stated herein.

### 2.5.2 Placement of Cellular Concrete Mats:

Cellular concrete mats shall be placed within the limits shown. The cellular concrete mats shall be placed on the filter fabric in such a manner as to produce a level surface. Cable used for preassembled mattresses shall be sufficiently sized and fastened for the size/weight of the assembled mattresses such that the assembled mattresses can be placed in compliance with OSHA standards. The mattresses will be placed with a maximum space or gap of 2 inches in excess of the nominal joint spacing of the blocks within the mattress. No overlapping of mats will occur and blocks will not protrude more than .50 inches beyond the adjacent blocks for installations in the dry. As adjacent mats are placed, they will be secured by fastening the protruding horizontal cable connections together along each side of the mats. Individual blocks which are hand placed shall be subject to the spacing and level parameters as stated in Placement of Cellular Concrete Mats. Revetment cables shall be threaded into the blocks as the placement proceeds and fastened with approved sleeves, fittings or fasteners. Extended lengths or runs of cable threaded into the blocks will be permitted provided the connections of cables are fastened with approved sleeves, fittings, or fasteners. Individual blocks hand placed must have two (2) longitudinal cables and one (1) transverse cable per each block per the SPECIFICATIONS. The Contracting Officer will require uncovered fabric to be lifted after heavy rainfall to inspect for slope damage. The Contractor and Owner shall discuss subgrade preparation, geotextile and cellular block placement at the pre-construction meeting to ensure that all parties are aware of the issues regarding installation. The Contractor shall furnish a certificate from the manufacturer or an authorized representative thereof stating that the blocks were installed correctly. Final acceptance and approval of the installation will be made by the Contracting Officer.

### 2.5.3 Quality Control:

Equipment shall be minimized on the installed concrete blocks until backfill or topsoil is placed over the revetment system to refrain from breaking or damaging any blocks. Any blocks broken or damaged shall be repaired prior to final inspections.

### 2.5.4 Grouting:

Any areas where there are partial blocks (to avoid small blocks with reduced hydraulic stability) shall be grouted. Joints where block interlock is discontinuous shall be grouted. Joints between cabled tied mattresses where the joint exceeds 2 inches shall be required to be grouted. Field placed grout shall be non-shrink and have a compressive strength of 4,000 psi, the durability properties of the ACBM concrete, and shall meet the ACBM manufacturer's requirements. All cable ties and anchoring shall be completed prior to placing the grout.

## 2.6 FINISHING:

### 2.6.1

The voids of the cellular concrete blocks for the limits shown shall be filled with topsoil and seeded for re-vegetation or gravel per the specifications. Prior to backfill, the blocks surface shall be inspected for damage. Individual blocks which are cracked and do not meet the specifications shall be replaced prior to the placement of backfill.

## 2.7 CONTRACTOR QUALITY CONTROL:

### 2.7.1

The Contractor shall inspect for compliance with contract requirements and record the inspection of operations including but not limited to the following as applicable:

- (1) Preparation of surface to receive cellular concrete blocks or mattresses.
- (2) Individual concrete blocks and filter fabric soundness and free of defects.
- (3) Cables and fittings - breaking strength.
- (4) Assembly of cellular concrete blocks bound by cables to form cellular concrete mattresses.
- (5) Placement of blocks or mattresses and filter fabric on the prepared subgrade.
- (6) Individual blocks hand placed and cables hand threaded.
- (7) Embedment of cables in the anchor trenches, side trenches and toe trenches.
- (8) Tie-in to existing structures such as concrete, pipes, etc.