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REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
MANILA

097.13 DPWH
01.27.2016

DEPARTMENT ORDER)

26)

NO. _____)
Series of 2016)

SUBJECT: DPWH Standard Specification for
Item 741 – Interlocking Precast
Concrete Blocks

In line with the mandate of the Department in providing effective standard specifications in the implementation of various infrastructure projects and in view of the need of setting a standard specification for the proper installation of Interlocking Precast Concrete Blocks, the attached **DPWH Standard Specification for Interlocking Precast Concrete Blocks, Item 741** is hereby prescribed, for the guidance and compliance of all concerned.

This specification shall form part of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

This Order shall take effect immediately.

ROGELIO L. SINGSON

Secretary

Department of Public Works and Highways
Office of the Secretary



WIN6U01210

5.5.2 FET/JFS

ITEM 741 – INTERLOCKING PRECAST CONCRETE BLOCKS

741.1 Description

This work item shall consist of constructing/installing Interlocking Precast Concrete Blocks for paving and for the protection of coastal areas and riverbeds, in conformity with the lines, grades and dimensions shown in the plans and specifications.

The works will involve incidental excavation/trimming and embankment build-up; slope stabilization and installation of appropriate Interlocking Precast Concrete Blocks; Precast Concrete Paving Blocks for paving works; and, Articulated Precast Concrete Blocks for protection of coastal areas and riverbeds.

741.2 Material Requirements

741.2.1 Interlocking Precast Concrete Blocks

741.2.1.1 Concrete Paving Blocks

Concrete paving blocks shall be free from defects that would interfere in the interlocking property or impair the strength or performance of the units, individually or as a whole. It shall conform to ASTM C 936M, Standard Specification for Interlocking Concrete Paving Units.

Aggregates for concrete paving blocks shall be either lightweight or normal weight or a mixture of both. It shall be lifted and placed with one hand, and have an exposed face area of less than or equal to 0.065 m^2 with an aspect ratio (length divided by thickness) of less than or equal to 4.

A thickness of 60mm shall be given to concrete paving blocks laid along and over pedestrian areas and driveways while 80 mm for areas under constant vehicular traffic.

Samples tested using ASTM C 418, Standard Test Methods for Abrasion Resistance of Concrete by Sandblasting shall have a volume loss of not more than $15 \text{ cm}^3 / 50 \text{ cm}^2$ and average thickness loss shall not exceed 3mm. The average absorption shall not be less than or equal to 5%, with individual unit of no greater than 7%.

The length or width of concrete paving blocks shall not differ by more than $\pm 1.6 \text{ mm}$ from approved samples. Heights of units shall not differ more than $\pm 3.2 \text{ mm}$ from the specified standard dimension.

741.2.1.2 Articulated Concrete Blocks

Articulated concrete blocks shall conform to the requirements of ASTM D 6684, Standard Specification for Materials and Manufacture of Articulated Concrete Block (ACB) Revetment Systems.

Table 1 Physical Requirements

Minimum Compressive Strength, Mpa		Maximum Water Absorption, kg/m ³		Minimum Density (in air), kg/m ³	
Average of 3 units	Individual unit	Average of 3 units	Individual unit	Average of 3 units	Individual unit
28	24	146	187	2082	2002

Width, height and length of articulated concrete blocks shall not differ by more than ± 3.2 mm from the specified standard dimension.

Interlocking articulated concrete blocks for coastal and riverbank protection shall be open-cell type having a void rate of approximately 15% to 17% to allow re-vegetation.

The articulated concrete blocks, considering proper installation and well compacted subgrade, shall maintain hydraulic stability of approximately 6.10 m/s under high velocity of flow, with corresponding bed shear stresses of 1.44 kN/m² to 1.92 kN/m².

741.2.2 Aggregate Base Material

Aggregate base materials shall conform to the applicable requirements of Item 703, Aggregates.

741.2.3 Bedding Sand

Bedding sand shall be clean, washed natural or manufactured sand which conforms to ASTM C 33M, Standard Specification for Concrete Aggregates.

741.2.4 Joint Sand

Joint sand shall conform to ASTM C 144, Standard Specification for Aggregate for Masonry Mortar.

741.2.5 Edge Restraints

Edge restraints are a key part of interlocking concrete paving blocks. By providing lateral resistance to loads, they maintain continuity and interlock among the paving blocks. For pedestrian areas and driveways, edge restraints shall be steel, aluminum, timber, troweled (hidden) concrete curb or plastic edging specifically designed for concrete paving blocks. Formed or precast concrete restraints are required for streets, parking lots and roads.

741.2.6 Geotextile

Geotextile shall conform to the applicable requirements of Item 715, Geotextiles.

741.2.7 Revetment Cable

Cable shall be made of high tenacity and low elongated wires that exhibit good to excellent resistance to most concentrated acids, alkalis and solvents. It shall be impervious

to rot, mildew and degradation associated with marine organisms with high resistance to deterioration for long period of fresh/saltwater immersion.

Revetment cable shall be selected so that the cable and all connections result in a minimum factor-of-safety of 5.0 with respect to lifting.

741.2.8 Anchors

Anchors shall be provided to fix blocks on the slope. These are usually reinforced concrete, one (1) meter in length, inserted through its centrally disposed holes at certain interval. GI pipe filled with concrete, reinforced by steel bars may be used as alternative. Installation shall be in accordance with the specifications shown on the Plan.

741.2.8.1 Reinforced Concrete Anchor

Concrete shall be Class B as specified in Item 405, Structural Concrete.

Reinforcing material shall be Deformed Billet-Steel Bars for Concrete Reinforcement as specified in Item 710, Reinforcing Steel and Wire Rope.

741.2.8.2 Galvanized Iron Pipe

Galvanized Iron (GI) Pipe shall conform to the applicable requirements of Item 733, Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

741.2.9 Vegetation

Vegetation shall be a choice of vetiver grass or any equivalent deep-rooting species planted on each gap of interlocking blocks to complement its anti-erosion function. Vetiver grass shall conform to the applicable requirements of Item 622, Coconet Bio-Engineering Solutions.

741.3 Construction Requirements

741.3.1 Concrete Paving Blocks

Compaction of subgrade shall be at least 98% of standard Proctor density as specified in ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³). However, modified Proctor density (ASTM D 1557, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700 kN-m/m³)) is preferred, especially for areas under constant vehicular traffic.

In moist or wet areas, and where the soil is expansive, geotextile shall be installed to separate the soil from the aggregate base.

Bases for pedestrian areas and residential driveways shall be compacted a minimum 98% of standard Proctor density. For vehicular areas, compaction shall be at least 98% of modified Proctor density as determined by ASTM D 1557, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700 kN-m/m³).

Variation in final base surface elevations shall not exceed +10 mm when tested with a 3 m straightedge.

Edge restraints shall be set at the correct level, especially if the tops of the restraints are used for screeding the bedding sand. Their elevations shall be checked prior to placing the sand and concrete paving blocks. Edge restraints are typically installed before the bedding sand and paving blocks are laid.

The sand shall be spread evenly over the base course and screeded to a nominal 25 mm thickness, not exceeding 40 mm thickness. After the sand is screeded, it shall not be disturbed.

Concrete paving blocks shall be installed in accordance with patterns shown on the drawings. Typical joints between the paving concrete blocks shall be between 2 mm to 5 mm wide on average. Cut concrete paving blocks shall be used to fill gaps along the edge of the pavement. Gaps less than 10 mm shall be filled with sand or filled by shifting courses of concrete paving blocks.

After a substantial area of concrete paving blocks have been placed, the concrete paving blocks shall be compacted into the sand using a vibrating plate compactor which is capable of exerting a minimum of 22 kN of centrifugal compaction force and operate at 75-90 hertz. Simultaneously, dry joint sand is swept into the joints and the paving blocks shall be compacted again until the joints are full.

Final surface elevations shall not vary more than +10 mm under a 3 m straightedge, unless otherwise specified. The top of the concrete paving blocks shall be 3 to 10 mm above adjacent catch basins, utility covers, or drain channels. The top of the installed concrete paving blocks shall be 3 to 6 mm above the final elevations to compensate for possible minor settling. Sealers or joint sand stabilizers shall be applied if needed.

741.3.2 Articulated Concrete Blocks

The subgrade shall be well-compacted; and, free of voids, pits and depressions. Obstructions such as roots and projecting stones larger than 2.5 cm left visible on the surface, shall be removed. Soft or low density pockets of material removed shall be filled with embankment material and compacted up to the desired minimum proctor density.

The base foundation shall be designed considering actual site conditions and slope stability analysis is considered. Base footing shall be made from interlocking block layers, assembled horizontally on the riverbed from the toe of the embankment extended down to a specified length towards the river centerline, interconnected using revetment cable. The length may vary, depending on the computed value from scour analysis. The construction shall proceed after graded foundation bed is fully covered with geotextile.

The foundation bed shall also be prepared by providing excavation at the base of the slope and thereby, the initial layer of assembled blocks shall be positioned 1-meter below the riverbed line. The excavated area shall follow the designed embankment H:V ratio from the baseline up to the desired excavation depth. Upon the preliminary block installation, excavated trench shall be backfilled with soil and compacted to a minimum required compaction ratio.

Other forms of interlocking articulated concrete block foundation shall be made of construction materials such as gabion, boulder fill, and reinforced concrete provided that the design and construction method will produce the same effect to what is specified in this Item.

Areas where geotextile and interlocking articulated concrete blocks are to be placed shall be laid parallel to the lines and grades as specified in the Plans. Prior to articulated concrete block installation, geotextile shall be placed and anchored on a smooth graded surface approved by the Engineer. The geotextile shall be placed in such a manner that placement of the overlying materials will not excessively stretch or tear the geotextile. Coverage area for geotextile shall be equal to the computed slope area subject for block installation.

Interlocking articulated concrete blocks shall be placed within the limits as described on the Plans. The blocks shall be well-fastened to prevent vertical or horizontal displacement. No more than 61 linear meter of geotextile shall be laid before covered with interlocking blocks. Geotextile installed more than two (2) days not covered by blocks shall be lifted and the surface of the slope shall be inspected for slope defects.

The interlocking articulated concrete blocks shall be installed in the field by the use of revetment cables. These cables shall be extended up to a required length. Anchors shall be provided to fix blocks on the slope. These are usually installed at 2-meter interval upon placing the blocks with cable. Anchor depth may vary depending on the computed length as required from the conducted slope stability analysis.

Gaps noticed after the block-laying shall be filled with topsoil, grass and fertilizer in accordance with the Plans and Specifications. Grass shall conform to the applicable requirements of Item 622, Coconet Bio-Engineering Solutions. Prior to grass planting, the block's surface shall be inspected for damage. Individual blocks with noticeable cracks resulting to a reduced individual block weight of $\frac{1}{3}$ shall be replaced.

741.4 Sampling and Testing

Sampling and Testing for Interlocking Concrete Blocks shall conform to ASTM C 140M, Sampling and Testing Concrete Masonry Units and Related Units.

741.5 Delivery, Storage and Handling

Materials delivered to the site shall be inspected for damage, unloaded and stored at least through proper handling. The Contractor shall designate storage site ready for use before the materials are delivered. Avoid leaving the delivered materials placed unattended on the ground where probable contact and/or exposure to dirt and debris may occur. Materials shall be so handled with utmost care to ensure undamaged condition upon delivery.

741.6 Method of Measurement

The quantity to be paid for under this item shall be the number of square meter unit comprising the areas shown in the plans where the Interlocking Precast Concrete Blocks will be laid and shall be determined by direct measurements of the actual dimensions.

741.7 Basis of Payment

The quantity as determined in Section 741.6 shall be paid for at unit price stipulated in the Contract's Bill of Quantities. The payment shall constitute the full compensation for furnishing all the necessary materials, providing necessary equipment and tools in installing the appropriate Interlocking Precast Blocks, labor cost and all the incidental expenses necessary to complete the work.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
741 (1)	Concrete Paving Blocks	Square Meter
741 (2)	Articulated Concrete Blocks	Square Meter

References:

1. DPWH Standard Specifications for Highways, Bridges and Airports (Volume II)
2. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - C 936M - Standard Specification for Interlocking Concrete Paving Units
 - C 33M - Specification for Concrete Aggregates
 - C 144 - Standard Specification for Aggregate for Masonry Mortar
 - C 140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related
 - C 418 - Standard Test Method for Abrasion Resistance of Concrete by Sandblasting
 - D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³(600 kN-m/m³))
 - D 1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - D 6684 - Standard Specification for Materials and Manufacture of Articulating Concrete Block (ACB) Revetment Systems
3. Hydraulic Stability of Articulated Concrete Block Revetment Systems during Overtopping Flow (FHWA-RD-89-199)
4. Cocogreen Interlocking Blocks
5. Internet

http://www.resourcebuildingmaterials.com/products/SpecData_UnitPavers02780.pdf
https://www.shawbrick.ca/files/documents/3945_Pavers.pdf