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

BRS 263

DEPARTMENT ORDER )

SUBJECT: DPWH Standard Specification for  
Item 743 – Geofoam as an Alternative  
Embankment Material

NO. 126 )

Series of 2017 <sup>10.23.17</sup> )

In line with the continuing efforts to upgrade the construction technology thru adoption of successful research studies, this Department has approved the **DPWH Standard Specification for Item 743 – Geofoam as an Alternative Embankment Material**, subject to the specifications hereto attached. A Certificate of Conditional Approval has been issued by this Department allowing the use of geofoam as alternative embankment material in DPWH road projects from September 8, 2017 until September 7, 2022.

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Secretary

  
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Department of Public Works and Highways  
Office of the Secretary



WIN7U01523

## **DPWH Standard Specification of Item 743 – GEOFOAM AS AN ALTERNATIVE EMBANKMENT MATERIAL**

### **743.1 Description**

This Specification shall consist of furnishing and installing expanded polystyrene (EPS) geofoam as an alternative embankment material. It shall be in accordance with the lines, grades and dimensions in the Plans and Specifications.

### **743.2 Definition**

**743.2.1** Expanded Polystyrene (EPS) – A type of foamed plastic formed by the expansion of polystyrene resin beads in a molding process.

**743.2.2** Geofoam – A block or planar rigid cellular foam polymeric material used in geotechnical engineering applications.

### **743.3 Material Requirements**

#### **743.3.1 Geotextile**

Geotextile shall conform to the applicable requirements of Item 715, Geotextiles of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II.

#### **743.3.2 Sand**

Sand used for bedding shall conform to the applicable requirements of Item 703, Aggregates of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II.

#### **743.3.3 Geofoam**

Geofoam shall be expanded polystyrene (EPS) type. It shall conform to the requirements of ASTM D 6817M, Standard Specification for Rigid Cellular Polystyrene Geofoam. The dimensions and physical property requirements of geofoam are listed in Tables 1 and 2, respectively. Geofoam is resistant to fungi and mold and offers no nutritional value to insects. Protection methods for termites include adding a termiticide during the manufacturing process.

The compressive resistance at 1% strain is typically within the elastic limit of geofoam in Table 1 and is accepted as the compressive resistance to limit long-term deformation under structural load.

Geofoam shall contain sufficient flame retardants to meet a minimum oxygen index as required in Table 1.

**Table 1 Dimensions of Geofoam**

| <b>Property</b> | <b>Dimension, mm</b> |
|-----------------|----------------------|
| Width           | 305 to 1219          |
| Length          | 1219 to 4877         |
| Thickness       | 25 to 1219           |

**Table 2 Physical Property Requirements of Geofoam<sup>A,B</sup>**

| Property   | Test Method  | Type  |       |       |       |       |       |       |
|--|--------------|-------|-------|-------|-------|-------|-------|-------|
|  |              | EPS12 | EPS15 | EPS19 | EPS22 | EPS29 | EPS39 | EPS46 |
| Density, min., kg/m <sup>3</sup>                             | ASTM D1622 M | 11.2  | 14.4  | 18.4  | 21.6  | 28.8  | 38.4  | 45.7  |
| Compressive Resistance, min., kPa at 1% strain               | ASTM D1621   | 15    | 25    | 40    | 50    | 75    | 103   | 128   |
| Compressive Resistance, min., kPa at 5% strain               | ASTM D1621   | 35    | 55    | 90    | 115   | 170   | 241   | 300   |
| Compressive Resistance, min., kPa at 10% strain <sup>A</sup> | ASTM D1621   | 40    | 70    | 110   | 135   | 200   | 276   | 345   |
| Flexural Strength, min., kPa                                 | ASTM C203    | 69    | 172   | 207   | 240   | 345   | 414   | 517   |
| Oxygen Index, min., volume%                                  | ASTM D2863   | 24.0  | 24.0  | 24.0  | 24.0  | 24.0  | 24.0  | 24.0  |

<sup>A</sup> If yield occurs prior to 10% deformation, report compressive resistance and deformation at yield in addition to compressive resistance at 1%, 5%, and 10% deformation.

<sup>B</sup> For products that have an external skin, testing shall be undertaken with skins intact.

Unless otherwise specified, the acceptable dimension tolerance criteria on geofoam shall not exceed  $\pm 0.5\%$ .

### 743.3.3.1 Sampling of Geofoam

Sampling of geofoam shall conform to the requirements of ASTM D7557M, Sampling of Expanded Polystyrene Geofoam Specimens.

### 743.3.4 Load Distribution Slab (LDS)

The load distribution slab (LDS) layer shall be made from a reinforced concrete slab placed between the top of the geofoam blocks and the overlying pavement system.

#### 743.3.4.1 Structural Concrete

Concrete used in the construction of LDS shall be Class A concrete conforming to the requirements of Item 405, Structural Concrete of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II.

#### **743.3.4.2 Reinforcing Steel Bars**

Reinforcing steel bars used in the construction of LDS shall conform to the requirements of Item 710, Reinforcing Steel and Wire Rope of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II.

#### **743.4 Design Considerations**

Design considerations on the use of geofoam which assist in the determination of the appropriate geofoam for geotechnical applications shall be in accordance with the applicable requirements of ASTM D7180M, Standard Guide for Use of Expanded Polystyrene (EPS) Geofoam in Geotechnical Projects or with the recommendations of the designer.

The determination of the design thickness of the LDS and pavement shall be based on the recommendations of the designer.

#### **743.5 Construction Requirements**

##### **743.5.1 Site Preparation**

The natural soil subgrade shall be cleared of vegetation and any large or sharp-edged soil particles and shall be planar prior to placing the geotextile and/or sand bedding layer. If no sand bedding is used, the natural subgrade shall be cleared such that there shall be no vegetation, or particles of soil or rock larger than coarse gravel, exposed at the surface.

Regardless of the subgrade material, the subgrade surface on which the geofoam blocks will be placed shall be sufficiently planar prior to the placement of the first block layer. The required smoothness shall be defined as a vertical deviation of no more than 10 mm over any 3 m distance. There shall be no debris of any kind on the subgrade surface when the geofoam blocks are placed.

##### **743.5.2 Installation of Geotextile**

There shall be no standing water on the subgrade within the area where the geotextile shall be placed. The installation of geotextile shall be in accordance with the requirements of Section 715.7, Installation of Item 715.

##### **743.5.3 Laying of Sand Bedding**

The main purpose of the sand bedding is to level the surface where the geofoam blocks shall be placed. Sand shall be spread evenly over the area where the geofoam blocks shall be placed. It shall be laid to its required thickness of 150 mm.

##### **743.5.4 Placement of Geofoam**

The placement of geofoam shall be done after sand bedding was laid to its required thickness and after utilities such as drainage pipes were installed. Geofoam blocks shall be placed at locations shown on the approved Plans.

The blocks shall be placed so that all vertical and horizontal joints between the blocks are tight. To provide interlock between blocks, the principle of shear keys shall be considered. It shall be done by interchanging the position of certain blocks between the bottom layer and the blocks on the succeeding layer directly above it. The spacing of shear keys shall be 3 m to 4.5 m.

The surfaces of blocks shall not be directly traversed by any vehicle or construction equipment during or after placement of the blocks. At no time shall heat or open flames be used near the blocks so as to cause melting or combustion of the geofoam blocks.

### **743.5.5 Load Distribution Slab (LDS) Construction**

The LDS shall be constructed above the installed geofoam blocks as shown on the Plans. It shall provide sufficient lateral confinement of unbound pavement layers when using geofoam blocks.

#### **743.5.5.1 Installation of Reinforcing Steel Bars**

Installation of reinforcing steel bars shall be in accordance with the applicable requirements of Section 404.3, Construction Requirements of Item 404 – Reinforcing Steel of the DPWH Standard Specifications for Highways, Bridges and Airports. The spacing of bars shall be in conformance with the approved Plans.

#### **743.5.5.2 Placing of Concrete Slab**

The placing of the concrete slab shall be in accordance with the applicable requirements of Section 407.3, Construction Requirements of Item 407 – Concrete Structures of the DPWH Standard Specifications for Highways, Bridges and Airports.

No vehicles or construction equipment shall traverse directly on the geofoam blocks or the LDS.

### **743.5.6 Pavement System Construction**

The pavement system shall be constructed above the LDS as shown on the Plans. The construction of the pavement system shall be in conformity with the Plans and Specifications.

### **743.6 Delivery, Storage and Handling**

The geofoam blocks shall be handled in a manner so as to minimize physical damage to the blocks. No method of lifting or transporting the blocks that creates dents or holes on the block surfaces or losses of portions of the block shall be allowed.

If the geofoam blocks are to be stockpiled at the project site until placement, a secure storage area shall be designated for this purpose. The storage area shall be away from any heat source or construction activity that produces heat or flame. In addition, personal tobacco smoking shall not be allowed in the storage area. Geofoam blocks in temporary on-site storage shall be secured with sandbags and similar "soft" weights to prevent being

dislodged by wind. The blocks shall not be covered in any manner that might allow the buildup of heat beneath the cover.

**743.7 Method of Measurement**

The quantity to be paid for under this item shall be the actual furnished and installed geofoam measured in cubic meters as shown on the Plans.

**743.8 Basis of Payment**

The quantity as determined in Section 7.0 – Method of Measurement 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 geofoam as alternative embankment material, labor cost and all the incidental expenses necessary to complete the work.

Payment will be made under:

| <b>Pay Item Number</b> | <b>Description</b> | <b>Unit of Measurement</b> |
|------------------------|--------------------|----------------------------|
| 743 (1)                | Geofoam            | Cubic Meter                |

*References:*

1. Final Report – Pilot Research on the Use of Geofoam as Alternative Embankment Material
2. DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition
3. American Society for Testing and Materials (ASTM)
  - ASTM D 1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics
  - ASTM D 1622M – Standard Test Method for Apparent Density of Rigid Cellular Plastics
  - ASTM D 2863 – Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastic (Oxygen Index)
  - ASTM D 6817M – Standard Specification for Rigid Cellular Polystyrene Geofoam
  - ASTM D 7180M – Standard Guide for Use of Expanded Polystyrene (EPS) Geofoam in Geotechnical Projects
  - ASTM D 7557M – Standard Practice for Sampling of Expanded Polystyrene Geofoam Specimens
4. National Cooperative Highway Research Program Report 529 – Guideline and Recommended Standard for Geofoam Applications in Highway Embankments