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USACE / NAVFAC / AFCEC / NASA UFGS-32 11 16.16 (November 2011)  
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Preparing Activity: NAVFAC Superseding  
UFGS-32 11 16.16 (July 2006)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2014

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### SECTION 32 11 16.16

[BASE COURSE FOR RIGID] [AND SUBBASE COURSE FOR FLEXIBLE] [SUBBASE COURSE FOR  
PERVIOUS] PAVING  
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NOTE: This guide specification covers the requirements for select-material base course for rigid pavement and select-material subbase course for flexible pavement and pervious pavement systems.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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NOTE: The guide title must be edited to suit project requirements where the pavement structures so dictate.

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## PART 1 GENERAL

### 1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C29/C29M	(2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft <sup>3</sup> ) (2700 kN-m/m <sup>3</sup> )
ASTM D1883	(2007; E 2009; E 2009) CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D2940/D2940M	(2009) Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports
ASTM D4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D5106	(2013) Steel Slag Aggregates for Bituminous Paving Mixtures
ASTM D6155	(2013) Nontraditional Coarse Aggregate for

## Bituminous Paving Mixtures

ASTM D6270	(2008; R 2012) Use of Scrap Tires in Civil Engineering Applications
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D698	(2012) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D75/D75M	(2009) Standard Practice for Sampling Aggregates

## U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System
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### 1.2 RELATED SECTIONS

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NOTE: Pervious pavement systems shall be installed in areas with gently sloping or flat ground, light traffic, limited heavy truck use, and where pavements will not receive snow and ice treatments (salt, sand, or chemical). Consult manufacturer's recommendations for cold regions, arid regions, and regions with high wind erosion. Parking lots are generally good pervious pavement applications. Installing pervious pavement systems contributes to the following LEED credit: SS6.

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Pervious pavement systems shall use Section 32 11 24 GRADED CRUSHED AGGREGATE BASE COURSE FOR [PERVIOUS] [FLEXIBLE] PAVEMENT, and Section 32 13 43 PERVIOUS CONCRETE PAVING or Sections 32 10 00 [PERVIOUS] BITUMINOUS CONCRETE PAVEMENT and 32 12 10 BITUMINOUS TACK AND PRIME COATS, in addition to this section.

### 1.3 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the

submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-03 Product Data

Materials; (LEED NC)  
Geotextile; (LEED NC)

Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

[ Local/Regional Materials; (LEED NC)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

#### SD-05 Design Data

Gradation curve

#### SD-06 Test Reports

Bearing ratio

Liquid limit

Plasticity index

Dry weight of slag

Percentage of wear

Gradation tests

Density tests

#### SD-07 Certificates

Source

Location and name.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site and store aggregates in a manner that will prevent segregation and contamination.

#### 1.5 CONSTRUCTION EQUIPMENT

Subject to approval of the Contracting Officer, special equipment as dictated by local conditions may be used. Calibrated equipment, such as scales, batching equipment, spreaders, and other similar equipment, shall have been calibrated by [a calibration laboratory approved by the Contracting Officer] [a state calibration laboratory] within [12] [\_\_\_\_\_] months of commencing work.

#### 1.6 ENVIRONMENTAL REQUIREMENTS

Do not construct course when atmospheric temperature is below 1.5 degrees C 35 degrees F or when weather conditions could detrimentally affect quality of finished course. When temperature falls below 1.5 degrees C 35 degrees F, protect areas of completed course against freezing.

#### 1.7 SUSTAINABLE DESIGN REQUIREMENTS

##### 1.7.1 Local/Regional Materials

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NOTE: Using local materials can help minimize transportation impacts, including fossil fuel consumption, air pollution, and labor. Using materials harvested and manufactured within a 500 mile radius from the project site contributes to the following LEED credit: MR5. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Use second option if Contractor is choosing local materials in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION. Use second option for USACE projects. Army projects shall include option only if pursuing this LEED credit.  
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[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [800] [\_\_\_\_\_] kilometer [500] [\_\_\_\_\_] mile radius from the project site, if available from a minimum of three sources.] [See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Course materials may be locally available.]

## PART 2 PRODUCTS

### 2.1 MATERIALS

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NOTE: Use of materials with recycled content, calculated on the basis of post-industrial and post-consumer percentage content, contributes to the following LEED credit: MR4. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Designer must verify that products meeting the indicated minimum recycled content are available, preferably from at least three sources, to ensure adequate competition. If not, write in suitable recycled content values that reflect availability and competition. Use second recycled content option if Contractor is choosing recycled content products in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION.

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NOTE: Use the first grading option when installing a pervious pavement system.

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ASTM D2940/D2940M, except as modified herein. Material shall consist of natural, processed or blends of waste concrete, masonry, cement, tile, or other waste material from on-site work as specified; rock, crushed concrete, concrete block, or crushed slag from off-site grading or demolition work; recycled porcelain, concrete, stone, or other recycled material complying with ASTM D6155; [Class I Fill] [Class II Fill] tire complying with ASTM D6270; steel slag complying with ASTM D5106; gravel; stone; slag; chert; caliche; limerock; coral; shell; quarry and mine waste; sand; or screenings; and soil or other similar binding or filler material. Material [shall contain a minimum of [5] [10] [\_\_\_\_\_] percent post-consumer recycled content, or a minimum of [20] [40] [\_\_\_\_\_] percent post-industrial recycled content, and ]shall be free-draining. [See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Material may contain post-consumer or post-industrial recycled content. ]Obtain materials from sources approved by the Contracting Officer. Preliminary approval of pits shall not mean that material found in the deposit will be acceptable. Maximum dimensions of material particles shall not be greater than two-thirds the compacted thickness of the layer in which it is to be placed. Coarse aggregate shall have a percentage of wear of not more than 40 as determined by ASTM C131. Material shall have a bearing ratio of at least [30] [\_\_\_\_\_] as determined by laboratory test on a four day soaked specimen in accordance with ASTM D1883; compact the specimen in accordance with ASTM D1557, Method B, C, or D. Material passing the 425 micrometers No. 40 sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 5 in accordance with ASTM D4318. Slag shall be an air-cooled blast furnace product having a dry weight not less than 1041 kg per cubic meter 65 pounds per cubic foot when tested in accordance with ASTM C29/C29M and consisting of angular fragments uniform in density and quality and reasonably free from thin and elongated pieces, dirt, or other objectionable material. [Grading shall be a minimum of 19 mm 3/4 inch and a maximum of 38 mm 1.5 inches.] [Gradation of the final composite mixture shall conform to the following size and shall be

the basis of the [gradation curve](#):

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NOTE: The gradation shown in the following table is the minimum recommended to obtain a California Bearing Ratio (CBR) of 30. If a CBR greater than 30 is required, specify a gradation to suit. Where possible, select a gradation to suit local materials and project requirements. To provide adequate drainage under rigid pavements, the base course should contain little or no fines (material that passes the **75 micrometers No. 200** sieve).

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Sieve Size (Square Openings)	Design Range (Percent Passing)	Job Mix Tolerance (Percent)
<b>50 mm 2 inch</b>	100	-3
<b>38 mm 1 1/2 inch</b>	90-100	+5
<b>4.75 mm No. 4</b>	30-60	<u>+10</u>
<b>75 mm No. 200</b>	0-15	+5

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## 2.2 [SOURCE](#) QUALITY CONTROL

Prior to production and delivery of aggregates, take at least one initial sample in accordance with [ASTM D75/D75M](#). Collect each sample by taking three incremental samples at random from source material to make a composite sample of not less than **22 kg 50 pounds**. Repeat sampling procedure when source of material is changed or when deficiencies or variations from specified grading of materials are found in testing.

### 2.2.1 [Geotextile](#)

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NOTE: Geotextile fabric shall be required for pervious pavement systems only. Designer must verify that products meeting the indicated minimum recycled content are available, preferably from at least three sources, to ensure adequate competition. If not, write in suitable recycled content values that reflect availability and competition. Use second option if Contractor is choosing recycled content products in accordance with Section **01 33 29** LEED(tm) DOCUMENTATION.

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[Fabricated from 100 percent post-consumer recycled plastic.][See Section **01 33 29** LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Geotextile may contain post-consumer or post-industrial recycled content.]



## PART 3 EXECUTION

### 3.1 GRADE CONTROL

Provide line and grade stakes for control. Place grade stakes in lanes parallel to centerline of areas to be paved and space for string lining or other control methods.

### 3.2 PLACING AND MIXING

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NOTE: In pervious pavement systems, water is conveyed to the subbase (stone reservoir) through the surface of the pavement and infiltrates into the ground through the bottom of this stone reservoir. A geosynthetic liner and sand layer should be placed below the stone reservoir to prevent preferential flow paths and to maintain a flat bottom. Delete geotextiles statement when not installing a pervious system.

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Clean underlying surface of foreign substances and ensure proper compaction and smoothness before placement of course. Verify subsoils have a permeability between 13 and 74 mm 0.5 and 3.0 inches per hour. Recondition, reshape, and recompact areas damaged by freezing, rainfall, or other weather conditions. [Place geotextiles in accordance with specifications and drawings. ] Mix and place materials to obtain a uniform course for the water content and gradation specified. Construct course in one or more layers. Make each layer between 75 and 200 mm 3 and 8 inches in compacted thickness. Tire shall be installed in accordance with ASTM D6270.

### 3.3 COMPACTING AND FINISHING

Compact each layer to at least [100] [\_\_\_\_\_] percent of the maximum laboratory density determined in accordance with ASTM D1557 for areas subject to heavy vehicular traffic. Compact each layer to at least [95] [\_\_\_\_\_] percent Standard Proctor Density per ASTM D698 for pedestrian areas. Compact material inaccessible to rolling equipment by mechanical tamping. Finish surface of the layer by blading and rolling. Blade, roll, and tamp until surface is smooth and free from waves and irregularities. Aerate material excessively moistened by rain during construction. Aerate using blade graders, harrows, or other equipment until the moisture content is that needed to obtain specified density. Place and compact earth at edges of course for at least 300 mm one foot of the shoulder.

### 3.4 FIELD QUALITY CONTROL

#### 3.4.1 Sampling During Construction

Take one random sample of each [1000] [\_\_\_\_\_] metric tons [1000] [\_\_\_\_\_] tons of material placed, but not less than one random sample per day's run. Take samples in accordance with ASTM D75/D75M.

### 3.4.2 Testing

#### 3.4.2.1 Material

Make [gradation tests](#) from each sample in accordance with [ASTM C136](#). Determine material passing the [75 micrometers](#) No. 200 sieve in accordance with [ASTM C117](#).

#### 3.4.2.2 Smoothness Test

Test with a [3 m 10 foot](#) straightedge applied parallel with and at right angles to centerline of the rolled area. Correct surface deviations in excess of [\[10\] \[ \] mm \[3/8\] \[ \] inch](#) by loosening, adding or removing material, reshaping, watering, and compacting. When course is constructed in more than one layer, smoothness requirements apply only to the top layer.

#### 3.4.2.3 Field [Density Tests](#)

[ASTM D1556](#) or [ASTM D6938](#). Take one field density test for each [\[400\] \[ \] square meters \[500\] \[ \] square yards](#) of each layer of course. When using [ASTM D6938](#) to test field compaction densities, verify the results of the tests by performing one test per day using [ASTM D1556](#) at locations previously tested by [ASTM D6938](#) and one additional test using [ASTM D1556](#) for every ten tests performed at locations previously tested by [ASTM D6938](#) .

#### 3.4.2.4 Laboratory Density Tests

[ASTM D1557](#), Method B, C, or D, for all material.

#### 3.4.2.5 Thickness Test

Determine thickness of course from test holes not less than [75 mm 3 inches](#) in diameter. Obtain a thickness test for each [\[400\] \[ \] square meters \[500\] \[ \] square yards](#) of course. Where course deficiency is more than [13 mm 1/2 inch](#), correct by scarifying, adding mixture of proper gradation, reblading, and recompacting. Where the measured thickness exceeds the indicated thickness by more than [13 mm 1/2 inch](#), consider the measured thickness as the indicated or specified thickness plus [13 mm 1/2 inch](#) for determining the average. The average thickness shall be the average of the depth measurements and shall not underrun the thickness shown by more than [6 mm 1/4 inch](#).

### 3.5 MAINTENANCE

After construction is completed, protect and maintain all areas of course against detrimental effects. Maintenance includes drainage, rolling, shaping, watering, or other action required to maintain course in proper condition. Maintain sufficient moisture by light sprinkling with water at the surface to prevent a dusty condition.

-- End of Section --