

SPECIAL SPECIFICATION
3048
Permeable Concrete

1. Description. Furnish permeable concrete with hydraulic cement and chemical admixture for use in permeable concrete pavements.

2. Materials.

A. Cement. Furnish cement conforming to DMS-4600, "Hydraulic Cement." Select Type I or II (ASTM C-150) or Type IP or IS (ASTM C-595).

B. Chemical Admixtures. Furnish Ecocreto™ Admixture Type "1" or equivalent. Obtain from Ecocreto™ of Texas, Inc., 17050 IH 35, Buda, Texas 78610, Telephone 866-326-2738.

Use admixture in accordance with manufacturer's instructions and recommendations.

C. Water. Furnish mixing and curing water that is free from oils, acids, organic matter, or

other deleterious substances. Water from municipal supplies approved by the Texas Department of Health will not require testing. When using water from other sources, provide test reports showing compliance with Table 1 before use.

Water that is a blend of concrete wash water and other acceptable water sources, certified by the concrete producer as complying with the requirements of both Table 1 and Table 2, may be used as mix water. Test the blended water weekly for 4 weeks for compliance with Table 1 and Table 2 or provide previous test results. Then test every month for compliance. Provide water test results upon request.

Table 1

Chemical Limits for Mix Water

(Reference Table 1 of Item 421, "Hydraulic Cement Concrete")

Table 2

Acceptance Criteria for Questionable Water Supplies

(Reference Table 2 of Item 421, "Hydraulic Cement Concrete")

Do not use mix water that has an adverse effect on any other chemical admixture or on strength or time of set of the concrete. When using white hydraulic cement, use mixing and curing water free of iron and other impurities that may cause staining or discoloration.

D. Coarse Aggregate. Supply coarse aggregates that meet the definitions in Tex-100-E. Provide coarse aggregates from sources listed in the Department's Concrete Rated Source Quality Catalog (CRSQC). Provide coarse aggregate from non-listed sources only when tested and approved by the Engineer before use. Allow 30 calendar days for

the Engineer to sample, test, and report results for non-listed sources. Do not combine approved material with unapproved material.

Provide light-colored coarse aggregate consisting of durable particles of crushed stone that are free from frozen material and from injurious amounts of salt, alkali, vegetable matter, or other objectionable material, either free or as an adherent coating. Provide coarse aggregate of uniform quality throughout.

Provide coarse aggregate that, when tested in accordance with Tex-413-A, has:

- at most 0.25% by weight of clay lumps,
- at most 1.0% by weight of shale, and
- at most 5.0% by weight of laminated and friable particles.

Wear must not be more than 40% when tested in accordance with Tex-410-A.

Unless otherwise shown on the plans, provide coarse aggregate with a 5-cycle magnesium sulfate soundness of not more than 18% when tested in accordance with Tex-411-A. Crushed recycled hydraulic cement concrete is not subject to the 5-cycle soundness test.

The loss by decantation as tested in accordance with Tex-406-A, plus the allowable weight of clay lumps, must not exceed 1.0% or the value shown on the plans, whichever is smaller. In the case of aggregates made primarily from crushing stone, if the material finer than the No. 200 sieve is established to be the dust of fracture and essentially free from clay or shale as established by Tex-406-A, Part III, the limit may be increased to 1.5%. When crushed limestone coarse aggregate is used in concrete pavements, the decant may exceed 1.0% but not more than 3.0% if the material finer than the No. 200 sieve is determined to be at least 67% calcium carbonate in accordance with Tex-406-A, Part III.

Unless otherwise specified, provide aggregate conforming to the gradation requirements shown in Table 3 when tested in accordance with Tex-401-A.

Table 3
Coarse Aggregate Gradation Chart
Aggregate
Gradation
No.
Nominal
Size
Percent Passing on Each Sieve

1/2" 3/8" No. 4 No. 8

8 3/8" 100 95-100 20-65 0-10

E. Mortar and Grout. When required or shown on the plans, provide mortar and grout consisting of 1 part hydraulic cement, 2 parts sand, and sufficient water to provide the desired consistency. Provide mortar with a consistency such that the mortar can be easily handled and spread by trowel. Provide grout of a consistency that will flow into and completely fill all voids.

3. Equipment.

A. Concrete Plants and Mixing Equipment. Except for volumetric mixers (auger/mixer),

each plant and truck mixer must be currently certified by the National Ready Mixed

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Concrete Association (NRMCA) or have an inspection report signed and sealed by a licensed professional engineer showing that concrete measuring, mixing, and delivery equipment meets all requirements of ASTM C 94. A new certification or signed and sealed report is required every time a plant is moved. Plants with a licensed engineer's inspection require reinspection every 2 years. Provide a copy of the certification or the signed and sealed inspection report to the Engineer. When equipment or facilities fail to meet specification requirements, remove them from service until corrected.

1. Scales. Check all scales prior to beginning of operations, after each move, or whenever their accuracy or adequacy is questioned, and at least once every 6 mo. Immediately correct deficiencies, and recalibrate. Provide a record of calibration showing scales in compliance with ASTM C 94 requirements. Check batching accuracy of volumetric water batching devices and admixture dispensing devices at least every 90 days. Perform daily checks as necessary to ensure measuring accuracy.

2. Volumetric Mixers. Provide volumetric mixers with rating plates defining the capacity and the performance of the mixer in accordance with the Volumetric Mixer Manufacturers Bureau or equivalent. Provide volumetric mixers that comply with ASTM C 685. Provide test data showing mixers meet the uniformity test requirements of Tex-472-A.

3. Agitators and Truck and Stationary Mixers. Inspect and furnish inspection reports on truck mixers and agitators annually. If an inspection within 12 mo. is not practical, a 2-mo. grace period (for a maximum of 14 mo. between inspections) is permitted. Include in the report the condition of blades and fins and their percent wear from the original manufacturer's design. Repair mixing equipment exhibiting 10% or more wear before use. Provide truck mixers and agitators equipped with means to readily verify the number of revolutions of the drum, blades, or paddles. Provide stationary and truck mixers capable of combining the ingredients of the concrete within the specified time or the number of revolutions specified into a thoroughly mixed and uniform mass and capable of discharging the concrete so that at least 5 of the 6 requirements of Tex-472-A are met.

As directed, to resolve issues of mix uniformity and mixer performance, perform concrete uniformity tests on mixers or agitators in accordance with Tex-472-A.

Perform the mixer or agitator uniformity test at the full rated capacity of the equipment and within the maximum mixing time or maximum number of revolutions. Remove from service all equipment that fails the uniformity test.

Inspect and maintain mixers and agitators. Keep them reasonably free of concrete buildup, and repair or replace worn or damaged blades or fins.

Ensure all mixers have a plate affixed showing manufacturer's recommended operating speed and rated capacity for mixing and agitating.

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B. Hauling Equipment. Provide hauling equipment capable of maintaining the mixed concrete in a thoroughly mixed and uniform mass and of discharging the concrete with a satisfactory degree of uniformity.

When using non-agitating equipment for transporting concrete, provide equipment with smooth, mortar-tight metal containers equipped with gates that prevent accidental

discharge of the concrete.

C. Testing Equipment. Unless otherwise shown on the plans or specified, in accordance with the pertinent test procedure, furnish and maintain:

- test molds,
- curing facilities,
- maturity meters if used, and
- wheelbarrow or other container acceptable for the sampling of the concrete.

Provide strength-testing equipment in accordance with the Contract controlling test unless shown otherwise.

4. Construction.

A. Mix Design. Furnish mix design. Engineer will provide mix design to Ecocrete™ of Texas to insure design is proper for available aggregates in region. Commence with work only after Engineer's written approval of mix design.

1. Cementitious Materials. Use cementitious materials from prequalified sources; otherwise, request sampling and testing for approval before use. Unless otherwise specified or approved, limit cementitious material content to between 564 to 700 lb. per cubic yard.

2. Chemical Admixtures. Mix Ecocrete™ Admixture Type "1" amount in accordance with manufacturer's instructions and recommendations.

3. Water. Mix water quantity shall be such that the cement paste displays a wet metallic sheen without causing the paste to flow from the aggregate. Mix water quantity yielding a cement paste with a dull-dry appearance has insufficient water for hydration. Insufficient water results in inconsistency in the mix and poor aggregate bond strength. High water content results in the paste sealing the void system primarily at the bottom and poor aggregate surface bond.

B. Trial Batches. Perform all preliminary trial batches and testing necessary to substantiate the proposed mix designs, and provide documentation including mix design, material proportions, and test results substantiating that the mix design conforms to specification requirements.

Make all final trial batches using the proposed ingredients in a mixer that is representative of the mixers to be used on the job. Make the batch size at least 50% of the mixer's rated capacity. Perform fresh concrete tests for slump and make, cure, and test strength specimens for compliance with specification requirements. Test at least 3 sets of design strength specimens with 2 specimens per set in accordance with both Tex-4-8 3048

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418-A and Tex-448-A for each test age (ex. six 7-day cylinders, six 7-day beams, six 28-day cylinders, and six 28-day beams). Before placing, provide the Engineer the option of witnessing final trial batches, including the testing of the concrete. If not provided this option, the Engineer may require additional trial batches, including testing, before the concrete is placed.

Establish 7-day compressive strength target values using the following formula for each concrete mix to be used:

Target Value= (4,400 psi)*(7-day avg. trial batch strength)/(28-day avg. trial batch strength)

When there are changes in aggregates or in type, brand, or source of cement or chemical

admixtures, reevaluate the mix as a new mix design. A change in vendor does not necessarily constitute a change in materials or source. When only the brand or source of cement is changed and there is a prior record of satisfactory performance of the cement with the ingredients, new trial batches may be waived by the Engineer.

C. Storage of Materials.

1. Cement. Store all cement in weatherproof enclosures that will protect them from dampness or absorption of moisture.

When permitted, small quantities of sacked cement may be stored in the open, on a raised platform, and under waterproof covering for up to 48 hours.

2. Aggregates. Handle and store concrete aggregates in a manner that prevents contamination with foreign materials. If the aggregates are stored on the ground, clear the sites for the stockpiles of all vegetation, level the sites, and do not use the bottom 6-in. layer of aggregate without cleaning the aggregate before use.

Where space is limited, separate the stockpiles using physical barriers. Store aggregates from different sources in different stockpiles unless the Engineer authorizes pre-blending of the aggregates. Minimize segregation in stockpiles. Remix and test stockpiles when segregation is apparent.

Sprinkle stockpiles to control moisture and temperature as necessary. Maintain reasonably uniform moisture content in aggregate stockpiles.

3. Admixtures. Store admixtures in accordance with manufacturer's recommendations and prevent admixtures from freezing.

D. Measurement of Materials. Except for volumetric mixers, measure concrete materials

by weight. Measure mixing water, consisting of water added to the batch, ice added to the batch, water occurring as surface moisture on the aggregates, and water introduced in the form of admixtures, by volume or weight. Measure ice by weight. Measure cement and supplementary cementing materials in a weigh hopper and on a separate scale from those used for other materials. Measure the cement first when measuring the cumulative weight. Measure concrete chemical admixtures in powdered form by weight. Measure concrete chemical admixtures in liquid form by weight or volume. Measure batch materials within the tolerances of Table 4.

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Table 4

Measurement Tolerances – Non-Volumetric Mixers

(Reference Table 9 of Item 421, "Hydraulic Cement Concrete")

When measuring cementitious materials at less than 30% of scale capacity, ensure that the quantity measured is accurate to not less than the required amount and not more than 4% in excess. When measuring aggregates in a cumulative weigh batcher at less than 30% of the scale capacity, ensure that the cumulative quantity is measured accurate to $\pm 0.3\%$ of scale capacity or $\pm 3\%$ of the required cumulative weight, whichever is less. For volumetric mixers, base tolerances on volume–weight relationship established by calibration, and measure the various ingredients within the tolerances of Table 5.

Correct batch weight measurements for moisture.

When approved, under special circumstances, measure cement in bags of standard weight. Weighing of sacked cement is not required. Do not use fractional bags except for small hand-mixed batches of approximately 5 cu. ft. or less and when an approved

method of volumetric or weight measurement is used.

Table 5

Measurement Tolerances – Non-Volumetric Mixers

(Reference Table 10 of Item 421, “Hydraulic Cement Concrete”)

E. Mixing and Delivering Concrete. The use of an Ecocreto™ Certified Installer is a requirement. If the installing contractor and concrete producer do not have sufficient experience with Ecocreto™, the installing contractor shall retain an experienced consultant to monitor production, handling, and placement operations at the contractor’s expense.

Mix and deliver concrete (without Ecocreto™ admixture) by means of one of the following operations:

- central-mixed,
- shrink-mixed,
- truck-mixed,
- volumetric mixer-mixed, or
- hand-mixed.

Add Ecocreto™ admixture at site and mix a minimum of 40 revolutions or to required consistency.

Operate mixers and agitators within the limits of the rated capacity and speed of rotation for mixing and agitation as designated by the manufacturer of the equipment.

Re-tempering or adding concrete chemical admixtures is only permitted at the job site when concrete is delivered in a truck mixer. Do not add water after the introduction of mixing water at the batch plant except on arrival at the job site, with approval, to adjust the slump of the concrete. Turn the drum or blades at least 30 additional revolutions at mixing speed to ensure thorough and uniform mixing of the concrete. Do not add water or chemical admixtures to the batch after any concrete has been discharged.

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Maintain concrete delivery and placement rates sufficient to prevent cold joints.

Before unloading, furnish the delivery ticket for the batch of concrete containing the information required on Department Form 596, “Concrete Batch Ticket.”

1. Central-Mixed Concrete. Provide concrete that is mixed completely in a stationary mixer. Mix concrete for a period of 1 min. for 1 cu. yd. and 15 sec. for each additional cu. yd. of rated capacity of the mixer unless mixer performance test data demonstrate that shorter mixing times can be used to obtain a uniform mix in accordance with Tex-472-A. Count the mixing time from the time all the solid materials are in the drum. Charge the mixer so that some water will enter before the cement and aggregate. Ensure that all water is in the drum by the end of the first 1/4 of the specified mixing time. Adjust the mixing time if necessary to achieve a uniform mix. Concrete mixed completely in a stationary mixer must be delivered to the project in a truck mixer, truck agitator, or non-agitating delivery vehicle. When a truck mixer or truck agitator is used for transporting concrete, use the manufacturer’s designated agitating speed for any turning during transportation. Non-agitating delivery vehicles must be clean and free of built-up concrete with adequate means to control concrete discharge. Deliver the concrete to the project in a thoroughly mixed and uniform mass, and discharge the concrete with a satisfactory degree of uniformity. Resolve questions regarding the uniformity of the

concrete by testing when directed by the Engineer in accordance with Tex-472-A.

2. Shrink-Mixed Concrete. Provide concrete that is first partially mixed in a stationary mixer and then mixed completely in a truck mixer. Partially mix for the minimum time required to intermingle the ingredients in the stationary mixer, and then transfer to a truck mixer and mix the concrete at the manufacturer's designated mixing speed for an adequate amount of time to produce thoroughly mixed concrete. Deliver the concrete to the project in a thoroughly mixed and uniform mass, and discharge the concrete with a satisfactory degree of uniformity.

3. Truck-Mixed Concrete. Mix the concrete in a truck mixer from 75 to 100 revolutions at the mixing speed designated by the manufacturer to produce a uniform concrete mix. Deliver the concrete to the project in a thoroughly mixed and uniform mass and discharge the concrete with a satisfactory degree of uniformity. Additional mixing at the job site at the mixing speed designated by the manufacturer is allowed as long as concrete is discharged before the drum has revolved a total of 300 revolutions after the introduction of the mixing water to the cement and the aggregates.

4. Volumetric Mixer-Mixed Concrete. Unless otherwise specified or permitted, perform all mixing operations in accordance with manufacturer's recommended procedures. Provide an accurate method of measuring all ingredients by volume, and calibrate equipment to assure correct measurement of materials within the specified tolerances.

5. Hand-Mixed Concrete. When permitted, for small placements of less than 2 cu. yd., mix up to a 2-sack batch of concrete by hand methods or in a small motordriven mixer. For such placements, proportion the mix by volume or weight.

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F. Placing, Finishing, and Curing Concrete. Place, finish, and cure concrete in accordance with the pertinent Items.

G. Sampling and Testing of Concrete. Unless otherwise specified, all fresh and hardened

concrete is subject to testing as follows:

1. Sampling Fresh Concrete. Provide all material to be tested. Fresh concrete will be sampled for testing at the discharge end if using belt conveyors or pumps. When it is impractical to sample at the discharge end, a sample will be taken at the time of discharge from the delivery equipment and correlation testing will be performed and documented to ensure specification requirements are met at the discharge end.

2. Testing of Fresh Concrete. Results of tests will not determine acceptance.

a. Slump. Tex-415-A.

b. Temperature. Tex-422-A.

c. Making and Curing Strength Specimens. Tex-447-A.

3. Testing of Hardened Concrete. Results of tests will not determine acceptance.

a. Compressive Strength. Tex-418-A.

b. Flexural Strength. Tex-448-A.

4. Certification of Testing Personnel. Contractor personnel performing testing must be either ACI-certified or qualified by a Department-recognized equivalent written and performance testing program for the tests being performed. Personnel

performing these tests are subject to Department approval. Use of a commercial laboratory is permitted. All personnel performing testing using the maturity method must be qualified by a training program recognized by the Department before using this method on the job.

5. Test Sample Handling. Unless otherwise shown on the plans or directed, remove forms and deliver department test specimens to curing facilities, in accordance with pertinent test procedures. Clean and prepare forms for reuse.

H. Adequacy and Acceptance of Concrete. The Engineer will sample and test fresh concrete for acceptance in accordance with Section 4.A.3, "Water."

5. Measurement and Payment. The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but will be subsidiary to pertinent Items.

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