Tex-424-A, Obtaining and Testing Drilled Cores of Concrete

Overview


This method covers the procedures for obtaining, preparing and testing cores drilled from concrete for length or compressive or splitting tensile strength determinations, and to determine the length of a core drilled from a concrete structure, particularly pavement. Except for editorial differences the procedures in ‘Part I, Obtaining Drilled Concrete Cores’ and ‘Part III, Compressive Strength of Drilled Concrete Cores’ are identical with ASTM C 42. The procedures in ‘Part II, Measuring Length of Drilled Concrete Cores’ are identical to ASTM C 174.

Part I, Obtaining Drilled Concrete Cores

This part describes the method for obtaining drilled concrete cores.

Apparatus

The following apparatus is required:

♦ core drill for obtaining cylindrical core specimens.
  • For specimens to be removed by drilling downward perpendicular to a horizontal surface, a shot drill may be satisfactory.
  • For specimens taken by drilling in other directions or when the test specimen diameter is to be determined for more precise calculation of compressive strength, a diamond drill should be used.

Sampling

Below are the sampling requirements for concrete cores used in compressive strength tests:

♦ General
  • Samples of hardened concrete for use in the preparation of strength test specimens shall not be taken until the concrete has become hard enough to permit sample removal without disturbing the bond between the mortar and the coarse aggregate.
  • In general, the concrete shall be 14 days old before the specimens are removed.
  • When preparing strength test specimens from samples of hardened concrete, samples that show abnormal defects or samples that have been damaged in the process of removal shall not be used.

(continued...)
Sampling (continued)

- Specimens containing embedded reinforcement shall not be used for determining splitting tensile strength.

NOTE: Cores to determine compressive strength that contain embedded reinforcement can yield either higher or lower values than cores without embedded steel and should be avoided if possible or trimmed to eliminate the reinforcement provided an L/D of 1.00 or greater can be attained.

Core Drilling

- A core specimen taken perpendicular to a horizontal surface shall be located, when possible, so that its axis is perpendicular to the bed of the concrete as originally placed and not near formed joints or obvious edges of a unit of deposit.
- A specimen taken perpendicular to a vertical surface, or perpendicular to a surface with a batter, shall be taken from near the middle of a unit of deposit when possible and not near formed joints or obvious edges of a unit of deposit.

Part II, Measuring Length of Drilled Concrete Cores

This part details the steps for measuring the length of drilled concrete cores.

Apparatus

The following apparatus is required:

- caliper device, to measure the length of axial elements of the core, that conforms to the requirements specified herein, so designed that it will be possible to make a length measurement at the center of the upper end of the specimen, and at eight additional points spaced at equal intervals along the circumference of a circle whose center point coincides with that of the end area of the specimen and whose radius is not less than one half nor more than three fourths of the radius of the specimen. The caliper device:
  - shall provide for the accommodation of specimens of different nominal lengths over a range of at least 100 to 250 mm (4 to 10 in.).
  - shall be stable and sufficiently rigid to maintain its shape and alignment without a distortion or deflection of more than 0.25 mm (0.01 in.) during all normal measuring operations.
- supports, three short posts or studs of hardened steel, designed so the specimen will be held with its axis in a vertical position. The ends that bear against the surface of the specimen should be rounded to a radius of not less than 6.4 mm (0.25 in.) and not more than 12.7 mm (0.5 in.).

(continued...)
Apparatus (continued)

♦ measuring rod, or other device that makes contact with the end surface of the specimen for measurement, rounded to a radius of 3.2 mm (0.125 in.).

♦ scale, on which the length readings are made, marked with clear, definite, accurately spaced graduations. The spacing of the graduations should be 2.5 mm (0.1 in.) or a decimal part thereof.

Test Specimens

Below are the requirements for test specimens used in length measurement:
♦ Cores used as specimens for length measurement shall be in every way representative of the concrete in the structure from which they are removed.
♦ The specimen shall be drilled with the axis normal to the surface of the structure, and the ends shall be free from all conditions not typical of the surfaces of the structure.
♦ Cores that show abnormal defects or that have been damaged appreciably in the drilling operation shall not be used.

Procedure

The following table describes steps used in measuring the length of drilled concrete cores.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Before any measurements of the core length are made, calibrate the apparatus with suitable gauges so that errors caused by mechanical imperfections in the apparatus are known. When these errors exceed 0.25 mm (0.01 in.), suitable corrections shall be applied to the core length measurements.</td>
</tr>
</tbody>
</table>
| 2    | ♦ Place specimen in the measuring apparatus with the smooth end of the core, that is, the end that represents the upper surface of a pavement, the upper surface of a pavement slab or formed surface in the case of other structures, down against the three hardened-steel supports.  
♦ Place the specimen on the supports so the central measuring position of the measuring apparatus is directly over the mid-point of the upper end of the specimen. |
| 3    | ♦ Make nine measurements of the length on each specimen, one at the central position and one at eight additional positions spaced at equal intervals along the circumference of the circle of measurement described in Calipering Device under ‘Apparatus.’  
♦ Read each of these nine measurements directly to the nearest millimeter (tenths of an inch and either directly or by estimation to five-hundredths of an inch). |

NOTE 1: If, in the course of the measuring operation, it is discovered that at one or more of the measuring points the surface of the specimen is not representative of the general plane of the core end because of a small projection or depression, rotate the specimen slightly about its axis and make a complete set of nine measurements with the specimen in the new position.
NOTE 2: When it can be determined that the length of the concrete core is not deficient more than 5 mm (0.2 in.) from plan thickness, alternate methods may be used to measure the length of the concrete core.

NOTE 3: A drawing of the core measuring apparatus is available upon request from CSTM.

Report

Record individual observations to the nearest 1 mm (0.05 in.). Report the average of the nine measurements, expressed to the nearest 3 mm (0.1 in.), as the length of the concrete core.

Part III, Compressive Strength of Drilled Concrete Cores

This part determines the compressive strength of drilled concrete cores.

Test Specimens

Below are the requirements for specimens used in compressive strength tests:

♦ Core Specimens
  • The diameters of core specimens for determining compressive strength should be at least 3 times the maximum nominal size of the coarse aggregate used in the concrete, and must be at least twice the maximum nominal size of the coarse aggregate;
  • the length of the specimen, when capped, shall be as nearly as practicable twice its diameter.
  • A core having a maximum height of less than 95% of its diameter before capping or a height less than its diameter after capping shall not be tested.

♦ End Preparation
  • The ends of core specimens to be tested in compression should be essentially smooth, perpendicular to the longitudinal axis, and of the same diameter as the body of the specimen. If necessary, saw or tool the ends of the specimens until these requirements are met:
    • Projections, if any, shall not extend more than 5 mm (0.2 in.) above the end surfaces.
    • The end surfaces shall not depart from perpendicularity to the longitudinal axis by more than 5 degrees.
    • The diameters of the ends should not depart more than 2.5 mm (1/10 in.) from the mean diameter of the specimen.

(continued...)
Test Specimens (continued)

♦ Moisture Conditioning
  • Submerge the test specimens in lime saturated water at 23.0 ± 1.7 °C (73.4 ± 3 °F) for at least 40 hours immediately prior to making the compression test.
  • Test the specimens promptly after removal from water storage.
  • During the period between removal from water storage and testing, keep the specimens moist by covering with a wet blanket of burlap or other suitable absorbent fabric.

NOTE: When the agency for which the testing is being done so directs, cores may be tested in a moisture condition other than that achieved by soaking for at least 40 hours. Length-diameter correction factors for dry concrete appear to depart considerably from those applicable to soaked concrete, but they have not been firmly established; therefore, when cores are to be tested dry, their lengths should be twice their diameters and no correction factors should be applied.

♦ Capping
  • The specimen shall be capped according to Test Method “Tex-450-A, Capping Cylindrical Concrete Specimens,” prior to testing in compression.

♦ Measurement
  • Prior to testing, measure the length of the capped specimen to the nearest 2.5 mm (1/10 in.).
  • Determine the average diameter by averaging two measurements taken at right angles to each other about the mid-height of the specimen.
  • Measure core diameters to the nearest 0.25 mm (1/100 in.) whenever possible, but at least to the nearest 2.5 mm (1/10 in.).

NOTE: Most shot drilled cores will not be smooth enough to justify measuring of diameter closer than the nearest 2.5 mm (1/10 in.).

♦ Testing
  • Test the specimens according to the applicable provisions of Test Method “Tex-418-A, Compressive Strength of Cylindrical Concrete Specimens.”
Calculations

Use the following to calculate the compressive strength:

Calculate the compressive strength of each specimen using the computed cross-sectional area based on the average diameter of the specimen. If the ratio of length to diameter of the specimen is appreciably less than two, make allowance for the ratio of length to diameter by multiplying the compressive strength by the applicable correction factor as follows:

<table>
<thead>
<tr>
<th>H/D</th>
<th>Factor</th>
<th>H/D</th>
<th>Factor</th>
<th>H/D</th>
<th>Factor</th>
<th>H/D</th>
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<td>0.933</td>
<td>1.56</td>
<td>0.965</td>
<td>*1.84</td>
<td>0.987</td>
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<td>0.966</td>
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<td>0.988</td>
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<td>1.30</td>
<td>0.936</td>
<td>1.58</td>
<td>0.966</td>
<td>*1.86</td>
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<td>0.877</td>
<td>1.31</td>
<td>0.937</td>
<td>1.59</td>
<td>0.967</td>
<td>*1.87</td>
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<td>0.880</td>
<td>1.32</td>
<td>0.938</td>
<td>1.60</td>
<td>0.968</td>
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<tr>
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<td>0.939</td>
<td>1.61</td>
<td>0.969</td>
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<td>0.970</td>
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<td>0.971</td>
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<td>0.944</td>
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<td>1.95**</td>
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<td>1.96**</td>
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<td>1.13</td>
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<td>1.14</td>
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<tr>
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<td>2.00**</td>
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<tr>
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<td>0.978</td>
<td>2.01**</td>
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<tr>
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<td>0.980</td>
<td>2.03**</td>
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</tr>
<tr>
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<td>1.48</td>
<td>0.957</td>
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<td>0.981</td>
<td>2.04**</td>
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</tr>
<tr>
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<td>0.958</td>
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<td>0.982</td>
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<tr>
<td>1.22</td>
<td>0.923</td>
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<td>2.06**</td>
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<tr>
<td>1.23</td>
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<td>1.51</td>
<td>0.961</td>
<td>1.79</td>
<td>0.983</td>
<td>2.07**</td>
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<tr>
<td>1.24</td>
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<td>1.80</td>
<td>0.984</td>
<td>2.08**</td>
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<tr>
<td>1.25</td>
<td>0.930</td>
<td>1.53</td>
<td>0.962</td>
<td>*1.81</td>
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<td>2.09**</td>
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<tr>
<td>1.26</td>
<td>0.931</td>
<td>1.54</td>
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<td>0.986</td>
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<td>1.27</td>
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<td>0.964</td>
<td>*1.83</td>
<td>0.986</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Test results of cylinders with a length to diameter ratio (H/D) less than 1.8 will be corrected using this chart. [(load/area) x Factor].

** Test results of cores with a length to diameter ratio (H/D) less than 1.94 will be corrected using this chart. [(load/area) x Factor].

(continued...)
Calculations (continued)

NOTE: Cores with length to diameter ratio (H/D) more than 2.10 will be reduced to fall within the ratio limits of 1.94 to 2.10.

These correction factors apply to lightweight concrete weighing between 1600 and 1920 kg/m$^3$ (100 and 120 lb/ft$^3$) and to normal weight concrete. They are not applicable to autoclaved concrete or to concrete dry at the time of loading. Values not given in the ‘Concrete Cores Factor Table’ shall be determined by interpolation. The correction factors are applicable for nominal concrete strengths from 13.8 to 41.4 MPa (2000 to 6000 psi). (Correction factors depend on various conditions such as strength, moisture content, and elastic moduli. Average values are given in the ‘Correction Factors’ table).

Report

Report the results as required by Test Method “Tex-418-A, Compressive Strength of Cylindrical Concrete Specimens,” with the addition of this information:

- Length of test specimen before and after capping
- Compressive strength to the nearest 50 kPa (10 psi) when the diameter is measured to the nearest 0.25 mm (0.01 in.) and to the nearest 345 kPa (50 psi) when the diameter is measured to the nearest 2.5 mm (0.1 in.), after correction for length-diameter ratio when required
- Direction of application of the load on the specimen with respect to the horizontal plane of the concrete as placed
- The moisture condition at the time of testing
- Nominal maximum size of concrete aggregate.