



TECHNICAL ADVISORY

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Determining Required Concrete Cylinder Size Acceptable Methods for Permitting the Use of 4-in. x 8-in. Cylinders for Aggregate Grades 2 and 3

When conducting compressive strength testing, numerous studies have looked at the effects of deviating from the requirement to using a cylinder diameter at least three times the nominal maximum aggregate size. The studies concluded that deviating from the "3-times rule" impacts the strength results in two ways by:

1. greatly increasing the variability of the testing and
2. somewhat decreasing the average strength.

➔ CYLINDER SIZE REQUIREMENTS BASED ON AGGREGATE SAMPLE

The Texas Department of Transportation uses "Tex-447-A, Making and Curing Concrete Test Specimens" to select cylinders to determine the acceptability of concrete. Tex-447-A Part I (ASTM C 31) requires the cylinder diameter to be at least three times the nominal maximum size of the coarse aggregate. The nominal maximum size of the aggregate is defined as the smallest sieve opening through which the entire sample of the aggregate will pass.

According to the Coarse Aggregate Gradation Chart in Item 421 of TxDOT's [2004 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges](#), aggregate Grades 2 and 3 have a nominal maximum aggregate size of 1½ inch. To adhere to Tex-447-A, the minimum cylinder size needed for these two aggregate grades would be 6-in. x 12-in. To reduce the cylinder size to 4-in. x 8-in., the nominal maximum aggregate size must be less than 1.33-in.

➔ METHODS TO DETERMINE CYLINDER SIZE REQUIREMENT

In terms of both labor and storage required, the difference between 6-in. x 12-in. cylinders and 4-in. x 8-in. cylinders is significant, especially on larger projects or large bridge pours. To reduce the labor and storage impact when Grade 2 or Grade 3 aggregate is to be used on a project, use one of the following methods to determine the cylinder size requirement:

1. Use 6-in. x 12-in. cylinders as required in Tex-447-A. The contractor is required to provide adequate curing facilities. If additional tank space is needed; the contractor is obligated to provide it.
2. When testing the aggregate gradation, insert a 1¼-in. sieve.
 - a. If no aggregate is retained on the 1¼-in. sieve, then 4-in. x 8-in. cylinders may be used for testing.
 - b. If a minimal amount of material is retained on the 1¼-in. sieve, the concrete may be wet sieved over a 1¼-in. sieve, which allows 4-in. x 8-in. cylinders to be used for testing.
 - c. If a minimal amount of material is retained on the 1¼-in. sieve, the Area Engineer may review the concrete design, trial batch results and gradation results to make an engineering judgment. If the Area Engineer determines that the amount of larger rock is insignificant, then the Area Engineer could determine that 4-in. x 8-in. cylinders may be used for testing. A letter documenting this decision and signed by the Area Engineer should be placed in the project files for documentation.
3. The Area Engineer may use engineering judgment to use 4-in. x 8-in. cylinders even with aggregate retained on the 1¼-in. sieve by accounting for the higher variability of test results by increasing the number of cylinders per test to three or more. This decision should be documented by a signed letter and placed in the project files.

NOTE: TxDOT's (Construction Division [CST]) recommended options are highlighted.

➔ CONCLUSION

This document is intended to provide the Area Engineer some guidance on rational options for deviating from standard test methods and specifications. However, the Area Engineer should only do so after careful consideration of the situation.

Should the compressive test results from non-standard testing practices not meet specification requirements, additional testing (coring) must be done, at TxDOT expense, before a final decision could be made on acceptance.

➔ CONTACT INFORMATION

For any further questions, please contact:

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- Inspector Development Program (IDP) team at (512) 416-2428.