MnDOT Concrete Unit Guidance
Evaluation of Concrete Strength Results
MnDOT 2016 Spec Book

The 2016 contractor mix designs requirements have a minimum 28-day compressive strength (psi) requirement. The MnDOT Concrete Engineering Unit has provided the guidance below for evaluating the strength results.

Individual Strength Test Results Evaluation:

A 28-day individual strength test is an average of 3 cylinders all cast from the same sample of Concrete, unless:

1) If 1 of the set of 3 cylinders shows a strength variability of greater than 10% outside of the initial calculated three cylinder average strength. That cylinder will not be included in the average strength calculation. The remaining two cylinders will be averaged and reported as the 28-day compressive strength.
2) If 2 or more of the set of 3 cylinders shows a strength variability greater than 10% outside of the initial calculated average strength. The report will revert back to averaging all three cylinder results to calculate the 28-day compressive strength.

NOTE: The MnDOT cylinder report will make these adjustments prior to reporting the strength test result and will note the adjustment on the report.

Compression Test Strength Requirements:

According to 2461.3.G.5.e, concrete strength must meet both of the following criteria:

1) **Individual Strength Test–** No greater than 500psi below the 28-day compressive strength requirement stated in Table 2461-6, and
2) **Moving Average of 3 Individual Strength Tests** - At or above the 28-day compressive strength requirement stated in Table 2461-6.

If Low Individual Strength Test Occurs:

1) If an individual strength test shows a compressive strength deficiency of ≤ 500 psi, check the moving average:
   a) If there is a moving average failure, apply monetary adjustment, and document as a material exception, or
   b) If there is no moving average failure, further action is **not** required.

2) If an individual strength test shows a strength deficiency of greater than 500psi, determine if the compressive strength achieved is adequate to meet the concrete structure design requirements.
   a) If the compressive strength is adequate to meet design requirements, check the moving average:
      i) If there is a moving average failure, apply the standard monetary adjustment, and document as a material exception, or
      ii) If there is no moving average failure, document low compressive strength as a material exception.
   b) If the compressive strength is not adequate to meet the design requirements:

3) Investigation the validity of the individual strength test results. That may include coring the suspect concrete. *See Standard Specification 2461.3.G.5.e(1) & 2461.3.G.5.e(3).*

a. If the low compressive strength is proven valid, remove and replace the concrete structure in question.

If Low Moving Average Strength Occurs:

1) If the moving average of 3 individual strength tests falls below the concrete mixture's required strength, the quantity represented by the test that brought the moving average into non-conformance will be subject to the monetary adjustments outlined in Table 2461-19. *See Standard Specification 2461.3.G.5.e(2).* It is **not** the Concrete Engineering Unit's intent to core concrete that has caused a moving average failure.

2) **Removal of strength tests from the moving average:**
Do not use the results of an individual strength test to calculate the moving average if:
   a) The individual strength test is found to be an erroneous/invalid test result, or
      i) **Reasons for finding erroneous test results as determined by the Concrete Engineer:**
         (1) Cylinders were kept in the field **longer than 7 days**,
         (2) Improper handling/curing of the cylinders, and/or
         (3) Improper testing of the cylinders.
   b) The suspect concrete structure is removed and replaced.

Materials Exception Documentation:

1) MnDOT Designed Mixes with Low strength – **NOT** a Material Exception
2) Contractor Designed Mixes with Low strength:
   a) If ≤ 500 psi below the required strength – **NOT** a Material Exception
   b) If > 500 psi below the required strength – Requires Documentation of a Material Exception with a Corresponding Resolution
3) Moving average failure - Requires Documentation of a Material Exception with a Resolution of Applied Standard Monetary Adjustment per Specification 2461

Monetary Adjustment Calculation Spreadsheet:

The Concrete Unit has developed a spreadsheet to aid in determination of monetary adjustments.

Please contact the Concrete Unit to discuss strength failures and get a copy of the spreadsheet.

Gordy Bruhn
Concrete Field Engineering Specialist
(Office) 651-366-5523
Gordon.bruhn@state.mn.us

Maria Masten, P.E.
Concrete Engineer
(Office) 651-366-5572
maria.masten@state.mn.us