REVISION OF SECTION 601
MATURITY METERS

Subsection 601.05 shall include

The Contractor shall provide the Engineer a report of maturity relationships in accordance with CP 69 with the mix design submittal.

Subsection 601.17 (c) Shall include:

The Department is in the process of investigating the use of maturity meters for accepting structural concrete. Maturity meter strength determinations made in accordance with this subsection will be used for research and will not be used alone for acceptance or rejection of concrete. These maturity meter strength determinations may be used by the Engineer to supplement concrete cylinder compressive strength determinations.

When strength is specified for bridge elements, concrete box culverts, and specified structures, concrete compressive strength shall be determined by maturity meters in accordance with attached CP 69. A maturity meter shall be placed randomly for every 100 cubic yards of concrete placed in a structure. A minimum of 2 maturity meters shall be placed per mix design per structure per day. Placement shall be as directed by the Engineer. Maturity meters may be removed from the structure once the concrete has achieved the specified strength or after 29 days, whichever occurs first.

The Contractor shall provide maturity meters. The Contractor shall also provide maturity meter readers and/or cloud access to maturity meter data. The Contractor shall use maturity meters that wirelessly transmit maturity meter data to hand held readers or to cloud based internet storage. The meters shall be capable of collecting maturity data for a minimum of 28 days. The Contractor shall supply the Engineer with two identical hand held readers or access to the cloud based data for the duration of the project. Hand held readers will be returned at the end of the project. The Contractor shall provide all needed software and training for accessing the maturity meter data. The Contractor shall submit the make and model of the maturity meters to the Engineer for approval at least two weeks prior to placement of any concrete.

The Engineer will cast a set of 3 cylinders for maturity curve validation. The cylinders will be 6 inches in diameter and 12 inches in height. A maturity meter will be placed at the center of mass of one cylinder. All 3 cylinders shall be stored together in identical conditions. Cylinders may be field or lab cured. At the time that the compressive strength of the cylinders has achieved the specified strength, the compressive strength of the 2 cylinders without the maturity meter will be determined according to ASTM C39. If the average compressive strength of the 2 cylinders is greater than the compressive strength of the maturity meter or within 10 percent below the compressive strength of the maturity meter, the maturity meter curve will be considered acceptable. If the average compressive strength of the 2 cylinders is more than 10 percent below the compressive strength of the maturity meter, the maturity meter curve will be considered unacceptable and the Contractor shall create a new curve. The new curve will be applied to the data and the compressive strength will be recalculated for the structure.

Subsection 601.20 shall include the following:

All costs associated with maturity meters and their use in testing structural concrete will not be measured and paid for separately but shall be included in the work.

Colorado Procedure 69-17

 *Standard Method for*

**Estimating the In-Place Concrete Strength by a Maturity Method**

(This procedure modifies ASTM C 1074-11. The current ASTM C 1074 is to be used in conjunction with this procedure.)

**1. SCOPE**

1.1 This provides a procedure for estimating in-place concrete strength by means of the maturity method. The maturity index is expressed either in terms of the temperature-time factor or in terms of the equivalent age at a specified temperature.

1.2 This procedure is identical to ASTM C 1074 Estimating Concrete Strength by the Maturity Method, with the following exceptions:

**8. PROCEDURE TO DEVELOP STRENGTH-MATURITY RELATIONSHIP**

Delete Subsection 8.4 from ASTM C 1074 and replace with the following Subsections:

8.4 Test the cylinders in pairs at times that yield compressive strengths in which at least three sets are at or below 3000 psi (17 MPa), at least two set are between 3000 psi and 4500 psi and at least one set is above 4500 psi (17 MPa). Perform compression tests in accordance with ASTM C 39. When the specified compressive strength of the concrete is greater than 4500 psi, at least two sets shall have a compressive strength between 4500 psi and the specified compressive strength. If the range of the compressive strength of the two cylinders exceeds 10% of their average strength, test another cylinder and compute the average of three tests. If a test result is due to an obviously defective specimen, discard the test result.

8.4.1 When a strength other than 3000 psi is specified for opening a structure, at least three sets of cylinders shall be tested below the specified strength, and at least one set of cylinders shall be tested above the specified strength.

8.8 Testing to determine datum temperature or activation energy will not be required.

**9. PROCEDURE TO ESTIMATE IN-PLACE STRENGTH**

Delete Subsections 9.5 to 9.5.4 from ASTM C 1074 and replace with the following Subsections:

 9.5 Verification of the Strength Maturity Relationship. Verification of the Strength Maturity Relationship is performed when safety critical elements are identified by the Engineer.

9.5.1 Cast at least three field-molded cylinders. The size of the cylinders shall be 6” by 12”. A maturity meter will be placed in the center mass of one cylinder. The maturity meter will be activated when concrete comes in contact the meter.

9.5.2 These cylinders shall be cured together in identical conditions.

9.5.3 When the compressive strength of the cylinder as indicated by the maturity meter is 90 to 110 percent of the target compressive strength, the compressive strength of at least two of the remaining cylinders will be determined and averaged. If the average compressive strength of the cylinders deviates by more than 10 percent from the compressive strength of the maturity meter, the Strength Maturity Relationship is no longer valid. A new Strength Maturity Relationship shall be developed.

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**INSTRUCTION TO DESIGNERS** (delete instruction from final draft):

Use this special provision on projects having structural concrete. Include CP 69.