

ALDOT-425 MATURITY METHOD TO DETERMINE EARLY-AGE STRENGTHS OF CONCRETE

1. General

- 1.1. This procedure provides a method for estimating the early-age strength of concrete by means of the maturity method. For a given concrete mixture, which has been properly placed, consolidated, and cured, the maturity method accounts for the effect of age and temperature history on the strength development. It is assumed that batches of a specific concrete mixture with the same maturity have equal strength, regardless of their temperature history.
- 1.2. Reference:
 - 1.2.1. AASHTO T-22, "Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens".
- 1.3. The maturity method consists of the following three steps:
 - 1.3.1. Develop the strength-maturity relationship (Section 3.)
 - 1.3.2. Estimate the in-place strength (Section 4.)
 - 1.3.3. Verify the strength estimated by the maturity method (Section 5.)
- 1.4. The maturity shall be defined by the following function:

$$M = \sum_0^t (T_c - T_0) \cdot \Delta t$$

Where: M = maturity in temperature-time factor (TTF) units (°C ·hr)
T_c = the average concrete temperature during the time interval (°C)
T₀ = the datum temperature = 0°C {32°F}
Δt = the time interval between temperature measurements (hr)

2. Apparatus

- 2.1. The Contractor shall supply all necessary equipment to use this procedure. The equipment will be approved by the Materials and Tests Engineer prior to use.
- 2.2. Commercial maturity-recording devices that automatically compute and display the maturity in terms of a temperature-time factor are acceptable. Acceptable devices include thermocouples connected to digital data-loggers, or embedded devices that record and store the data. All devices must be able to transfer the collected data to a computer for permanent storage.
- 2.3. The maturity-recording device shall be able to record the temperature accurately to within ± 1°C {2°F}.
- 2.4. The maximum recording intervals shall be every ½ hour for the first 48 hours, and every hour thereafter.

- 2.5. The same brand and type of maturity-recording device shall be used for all testing performed on a specific project, including both the development and construction phases.
- 2.6. A minimum of one maturity-recording device shall be provided for each maturity sensor location.
- 2.7. All maturity-recording devices shall be protected from theft, damage, and excessive moisture.
- 2.8. The maturity-recording device must have input capability to define the datum temperature. Verify that a datum temperature of 0 °C {32 °F} has been selected prior to each use.
- 2.9. If applicable, batteries in maturity-recording devices are to be adequately charged prior to use.

3. Procedure to Develop the Strength-Maturity Relationship

- 3.1. The strength-maturity relationship shall be developed by the Contractor within 60 days prior to start of concrete placement.
- 3.2. The strength-maturity relationship shall be submitted to the Materials and Tests Engineer for approval no later than 14 days prior to start of concrete placement.
- 3.3. A minimum of 16 cylinders shall be prepared for pavement and bridge construction applications.
- 3.4. A minimum of 19 cylinders shall be prepared for precast prestressed and non-prestressed concrete bridge member applications.
- 3.5. A set of cylinders is three (3) cylinders that are tested at the same age.
- 3.6. The mixture proportions and constituents of the concrete shall be the same as those of the job concrete whose strength will be estimated using this procedure.
- 3.7. A minimum batch size of three (3) cubic yards shall be used to produce the concrete to develop the strength-maturity relationship.
- 3.8. Fresh concrete testing for each batch shall include the recording of concrete placement temperature, slump, and total air content. The total air content of the concrete shall be based on a target total air content of 4.5%.
- 3.9. Embed two (2) maturity sensors in one cylinder.
 - 3.9.1. Maturity sensors shall be positioned close to the center of the cylinder.
 - 3.9.2. Immediately after casting the cylinders, activate the maturity-recording device(s) to start recording the maturity of the concrete. Do not stop recording until all the strength specimens have been tested. Data collection must be uninterrupted.

- 3.9.3. The cylinder instrumented with maturity sensors shall not be used for strength testing.
- 3.10. All cylinders shall be cured in the field under conditions that reflect the anticipated exposure condition of the structure. Techniques to closely match the temperature of the cylinders to the structure may be used upon approval of the Engineer. Follow the applicable curing procedure below:
 - 3.10.1. Pavement and Bridge Construction Applications:
 - 3.10.1.1. Initial curing of the cylinders may last up to 48 hours after casting.
 - 3.10.1.2. During the initial curing period, cylinders shall be capped with plastic lids while exposed to ambient temperature conditions, direct sunlight, and a vibration free environment.
 - 3.10.1.3. Do not disturb the cylinders from 0.5 hour after casting until they are either 24 hours old or when they need to be moved for compression testing.
 - 3.10.1.4. Between 24 to 48 hours after casting, de-mold all untested cylinders and within 30 minutes immerse each cylinder in a calcium hydroxide saturated water tank.
 - 3.10.1.4.1. The water tank must be exposed to ambient temperature conditions, direct sun light, and a vibration free environment.
 - 3.10.1.4.2. Maintain the water level in the tank to ensure that the cylinders are completely submerged at all times.
 - 3.10.1.4.3. If the ambient temperature drops below 5° C {40° F}, then the water storage tanks shall be covered with insulation material to prevent freezing of the water.
 - 3.10.1.5. Transport and test a cylinder set within 4 hours of removal from the water tank.
 - 3.10.1.6. Drying of the cylinder surfaces is not allowed at any time. Moisture loss during transportation may be prevented by sealing the cylinders in plastic wrap, by covering them with wet burlap, or by surrounding them with wet sand.
 - 3.10.1.7. During transporting, protect the cylinders with suitable cushioning material to prevent damage.

- 3.10.1.8. During cold weather, protect the cylinders from freezing with suitable insulation material.
- 3.10.2. Precast Prestressed and Non-Prestressed Bridge Member Applications that use Accelerated Curing Techniques:
 - 3.10.2.1. The initial curing period of the cylinders shall last until 24 hours after casting.
 - 3.10.2.2. During the initial curing period, cylinders shall be capped with plastic lids, kept in a vibration free environment, and placed next to the casted precast bridge member.
 - 3.10.2.3. During the initial curing period cylinders shall not be disturbed, unless they need to be moved for compression testing.
 - 3.10.2.4. De-mold the untested cylinders 24 hours after casting. Cylinders shall be exposed to air-drying conditions, ambient temperature conditions, direct sunlight, and vibration free environment reflecting the anticipated exposure condition of the precast bridge member while stored in the manufacturing plant.
 - 3.10.2.5. Transport and test a cylinder set within 4 hours of removal from the curing location.
 - 3.10.2.6. During transporting, protect the cylinders with suitable cushioning material to prevent damage.
- 3.11. Testing ages are influenced by the initial exposure temperature and the type of structural application. Select one of the following applications to determine the testing ages:
 - 3.11.1. Pavement and Bridge Construction Applications:
 - 3.11.1.1. The maturity method can be used to estimate the in-place strength for the following:
 - Opening a bridge deck or pavement to traffic
 - Stripping of formwork
 - Continuation of construction directly on recently placed concrete
 - Start of concrete placement directly adjacent to a recently placed section of concrete pavement
 - Start of tie bar installation in a recently placed concrete pavement
 - Other applications approved by the Engineer

- 3.11.1.2. For these applications, the average initial ambient temperature is used to define the testing ages.
- 3.11.1.3. The average initial ambient temperature is defined as the average ambient temperature for the first 12 hours after the cylinders are made.
- 3.11.1.4. Test cylinders at the ages shown in the following table:

Average Initial Ambient Temperature	Real-Time Testing Ages				
	Set 1 (Hrs)	Set 2 (Days)	Set 3 (Days)	Set 4 (Days)	Set 5 (Days)
40 to 50 °F	36	3	6	10	28
50 to 60 °F	30	2½	6	10	28
60 to 80 °F	24	2	4	7	28
80 to 90 °F	20	1¾	3	6	28
More than 90 °F	18	1½	3	6	28

- 3.11.1.5. A revised cylinder testing schedule shall be required when the strength obtained from Set 1 exceeds the Required Design Strength for the intended application. If this occurs, then constructor shall submit a revised testing schedule for approval to the Engineer.
- 3.11.1.6. For applications that have very rapid strength gains (e.g. patches, accelerated construction), cylinders may be tested at earlier ages as approved by the Engineer.
- 3.11.2. Precast Prestressed and Non-Prestressed Bridge Member Applications that use Accelerated Curing Techniques:
 - 3.11.2.1. For these applications, real-time testing ages of 6, 12, 24 hours and 3, 7, 28 days shall be used.
 - 3.11.2.2. Different testing ages may be used as approved by the Engineer.
- 3.12. When the 28-day strength results are not yet available and the Required Design Strength is less than that of Set 4, then it will be permitted to temporarily use the strength-maturity relationship developed based on all the data excluding the 28-day results. This strength-maturity relationship must be updated with the 28-day results within 5 working days after obtaining these data.
- 3.13. Test a set of cylinders in accordance with AASHTO T-22 by using neoprene pads, and compute the average strength of the set.
- 3.14. When three cylinder strengths are available in a set, the data from one cylinder shall be discarded if its individual result exceeds ±10 percent the average of the other two cylinders.

- 3.15. When only two cylinder strengths remain in a set, the difference in their results, expressed as a percent of their average, shall not exceed ±10 percent.
- 3.16. When the two remaining cylinders in a set do not meet the criteria in 3.16, then a new batch must be evaluated unless additional cylinders cast from the same batch are available for testing at this age.
- 3.17. At each testing age, record the maturity of the cylinders on BMT-188, "Record Log to Develop the Strength-Maturity Relationship". This form is available from the Bureau of Materials and Tests Concrete Engineer.
- 3.18. Use the "Perform Analysis" button on BMT-188 to generate the following data:
 - 3.18.1. Plot the average strength versus average maturity values for all test ages.
 - 3.18.2. Use BMT-188 to calculate the best-fit parameters (S_u , A, and B) for the Exponential Strength-Maturity Function (defined below) for this data set.

$$S(M) = S_u \cdot e^{\left(-\left[\frac{A}{M}\right]^B\right)}$$

- Where:
- | | | |
|--------|---|--|
| $S(m)$ | = | compressive strength (psi) |
| M | = | maturity in temperature-time factor units (hr·°C) |
| S_u | = | ultimate compressive strength (psi) |
| A | = | time constant for the strength-maturity relationship (hr·°C) |
| B | = | slope constant for the strength-maturity relationship |

- 3.18.3. Use BMT-188 to calculate the Coefficient of Determination (r^2) (as defined below).

$$r^2 = 1 - \left(\frac{\sum (S_m - S_{est})^2}{\sum (S_m - S_{m,avg})^2} \right)$$

- Where:
- | | | |
|--------------|---|---|
| S_m | = | measured compressive strength at each test age (psi) |
| $S_{m, avg}$ | = | average of all measured compressive strengths (psi) |
| S_{est} | = | estimated compressive strength at each test age (psi) |

- 3.18.3.1. A new strength-maturity relationship shall be developed if the r^2 value is less than 0.95.
 - 3.18.4. Use BMT-188 to adjust the best-fit strength-maturity relationship by multiplying the best-fit S_u by 0.95. The adjusted strength-maturity relationship is the strength-maturity relationship that will be used to estimate the strength of the concrete.
- 3.19. The following minimum data shall be submitted for approval:
 - BMT-188
 - ALDOT Certified Concrete Technician name

- ALDOT Certified Concrete Strength Technician name
 - Concrete testing laboratory name
 - Raw material types and sources
 - Mixture proportions
 - Graph of the best-fit and adjusted strength-maturity relationship, plotted with average data points, and the graph for the adjusted Strength-Maturity relationship, both generated by BMT-188.
 - Diagram showing the proposed location of maturity sensors in the structure.
- 3.20. The data shall be signed by the Contractor or his representative and submitted to the Materials and Tests Engineer for review and approval.
- 3.21. The approved strength-maturity relationship is only valid for the submitted mixture proportions and raw materials used to produce the concrete.
- 3.22. A new strength-maturity relationship must be developed if changes of the materials, proportions, and mixing equipment occur.
- 3.23. If the water-to-cementitious materials ratio is changed by more than 0.02 then a new strength-maturity relationship must be developed.
- 3.24. The development of the strength-maturity relationship shall be performed by Concrete Technicians certified by the Department. Tests shall be performed by an independent laboratory qualified by the Department or the concrete producer's laboratory qualified by the Department.
4. Procedure to Estimate the In-Place Strength During Construction
- 4.1. The Engineer will be responsible for connecting the maturity-recording device(s), recording the maturity data, and testing the verification cylinders. The Contractor shall be responsible for installing the maturity sensors.
- 4.2. The Engineer will use BMT-189, *"Record Log for Verification Testing"* to determine the Required Maturity to achieve the Required Design Strength from the adjusted strength-maturity relationship. This form is available from the Bureau of Materials and Tests Concrete Engineer.
- 4.3. Prior to concrete placement, install a minimum of two maturity sensors at locations in the structure that are critical in terms of structural considerations or geometry as per approved location diagram. Critical maturity sensor locations may include thinner sections of a slab, members exposed to the most severe weather, the last concrete poured, or concrete adjacent to prestressing strand.
- 4.4. Maturity sensors shall not be in direct contact with reinforcing steel or formwork. Sensors may be attached to insulated wire that is tied between reinforcing bars.

- 4.5. In pavement and bridge deck construction applications, a minimum of 2 maturity sensors shall be placed in the last concrete batch of the day. Maturity sensors shall be placed 2 to 4 inches from the bottom surface or form. The sensors shall also be placed approximately 2 to 4 feet from the longitudinal and transverse edges of the structure.
- 4.6. For bridge elements, such as columns, footings, column caps, and diaphragms, a minimum of 2 sensors shall be installed in the upper corner, 2 to 4 inches from any exposed surface.
- 4.7. For precast prestressed bridge member applications, a minimum of 2 sensors shall be installed in the bottom flange or lower section of the pile 2 to 4 inches from the side and bottom forms and 1 to 2 feet from the girder or pile ends.
- 4.8. For precast non-prestressed bridge member applications, a minimum of two sensors shall be installed following the guidelines in items 4.4, 4.5, and/or 4.6 depending on the type of bridge member casted.
- 4.9. If the location of a sensor needs to be changed, the final location of the sensors will be determined by the Engineer.
- 4.10. As soon as practical after concrete placement, connect and activate the maturity-recording device(s). Do not stop recording until the required maturity values are achieved and the strength estimated by the maturity method has been verified. Data collection must be uninterrupted.
- 4.11. The Engineer will periodically record maturity data from the structure and strength verification cylinders on BMT-190 *Record Log for Field Maturity Data*. This form will show the Required Design Strength and the Required Maturity for the specified operation. This form is available from the Bureau of Materials and Tests Concrete Engineer.
 - 4.11.1. The Engineer will record on BMT-190 the date, time, and maturity value for each reading. The data point at which the Required Maturity is reached or exceed in the structure shall be noted on the BMT-190.
- 4.12. The Engineer will verify the strength estimated by the maturity method by testing the verification cylinders using the procedure described in Item 5. The decision process associated with verification testing and maturity readings from the cylinders and in-place structure is presented in Figure 1.
- 4.13. Once the adjusted strength-maturity relationship is verified appropriate to use for the concrete delivered to site, and the structure's maturity is equal to or greater than the Required Maturity, then the structure is considered to have reached its Required Design Strength stated on BMT-189.

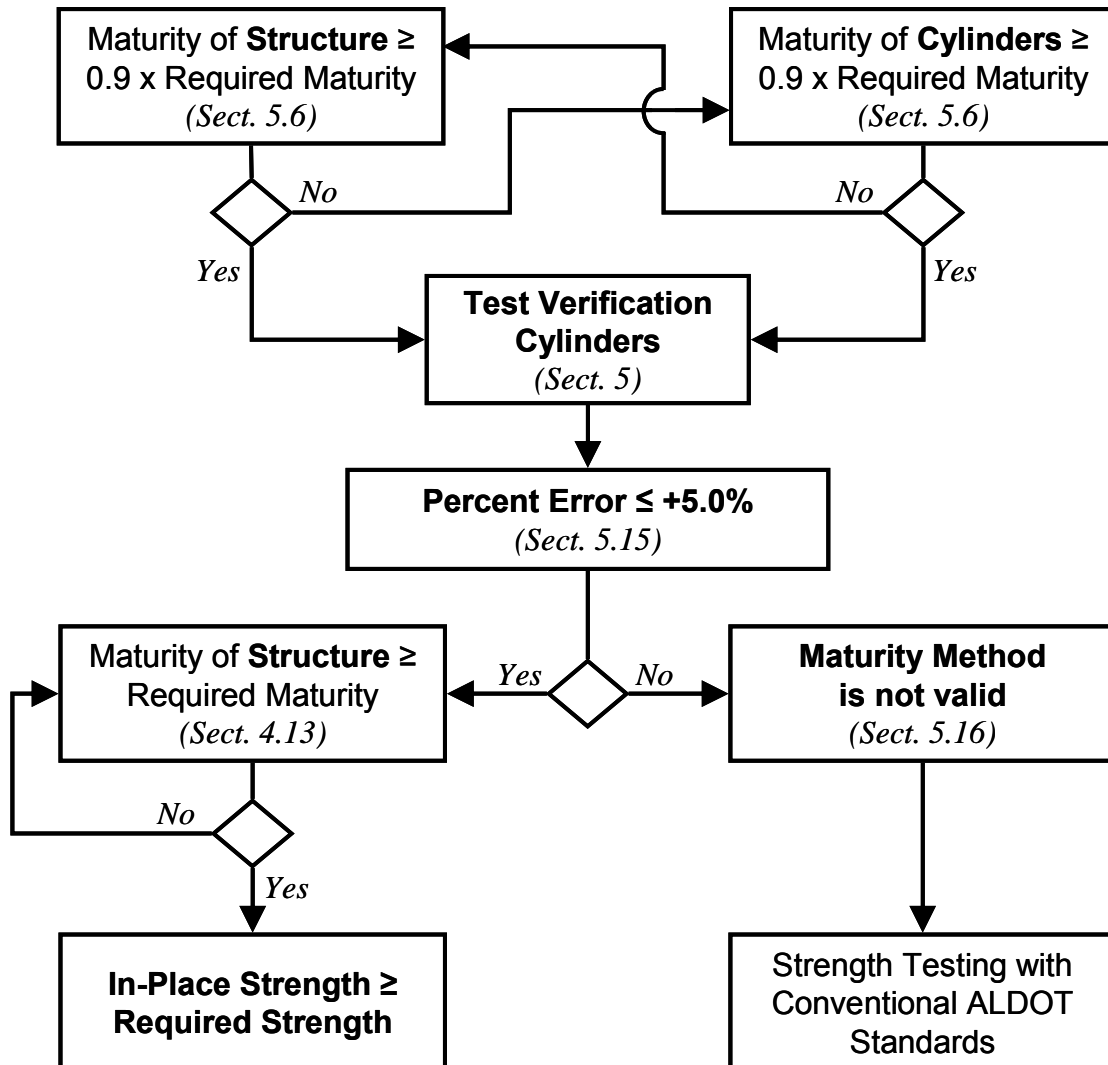


Figure 1: Flowchart of the decision process associated with verification testing

5. Procedure to Verify the Strength Estimated by the Maturity Method

- 5.1. From the concrete used in the structure, make a minimum of four (4) verification cylinders for every location in the structure where maturity probes are installed.
- 5.2. Embed two (2) maturity sensors in one of the four cylinders.
- 5.3. Maturity sensors shall be positioned close to the center of the cylinder.
- 5.4. Immediately after casting the cylinders, activate the maturity-recording device(s) to start recording the maturity of the concrete. Do not stop recording until the strength specimens have been tested. Data collection must be uninterrupted.

- 5.5. Cure, transport, and protect the verification cylinders using the same procedure outlined for the cylinders in Item 3.
- 5.6. When the strength verification cylinders are cured at lower temperatures than the structure, the structure will first reach the Required Maturity, and vice versa at higher temperatures.
- 5.7. Perform compression testing on a set of cylinders, when the maturity of the cylinder is more than 90% of the Required Maturity, or when the maturity of the structure is more than 90% of the Required Maturity, which ever occurs first.
- 5.8. Transport and test the cylinder set within 4 hours of removal from the curing location.
- 5.9. The cylinder instrumented with maturity sensors shall not be used for strength testing.
- 5.10. Test a set of cylinders in accordance with AASHTO T-22 by using neoprene pads, and compute the average strength of the cylinders.
- 5.11. When three cylinder strengths are available, the data from one cylinder shall be discarded if its individual result exceeds ± 10 percent the average of the other two cylinders.
- 5.12. When only two cylinder strengths remain, the difference in their results, expressed as a percent of their average, shall not exceed ± 10 percent.
- 5.13. When the two remaining cylinders do not meet the criteria in 5.12, then the estimated strength of this batch cannot be verified unless additional cylinders cast from the same batch are available for testing. If the strength estimated by the maturity method cannot be verified, then compressive strength testing in accordance with conventional ALDOT standards shall be required.
- 5.14. Record the individual and average values of maturity and measured verification cylinder strengths on BMT-189.
 - 5.14.1. Use BMT-189 to generate the following data:
 - 5.14.1.1. Estimate the average compressive strength of the cylinders based on their average maturity at the time of testing.
 - 5.14.1.2. Compute the percent error, as defined below, between the estimated and measured verification cylinder strengths.

$$\text{Percent Error} = \left(\frac{S_{est} - S_m}{S_m} \right) \times 100$$

Where: S_m = average measured compressive strength (psi)
 S_{est} = average estimated compressive strength (psi).

- 5.15. If the percent error between the estimated and measured verification cylinder strengths is less than or equal to +5.0%, then the adjusted strength-maturity relationship is appropriate to use for the concrete delivered to site.
- 5.16. If the percent error between the estimated and measured verification cylinder strengths is greater than +5.0%, then the adjusted strength-maturity relationship is invalid for the concrete delivered to site.
- 5.17. When a verification test result indicates that the strength-maturity relationship is invalid, then compressive strength testing in accordance with conventional ALDOT standards shall be required. There will be no additional compensation for this work.
- 5.18. When three consecutive verification test results indicate that the strength-maturity relationship is invalid, then maturity testing shall be discontinued until a new strength-maturity relationship has been approved for use in accordance with this procedure. Until that time, compressive strength testing in accordance with conventional ALDOT standards shall be required. There will be no additional compensation for this work.

APPENDIX A - EXAMPLE OF CALCULATIONS

Alabama Department of Transportation

BMT-188

Record Log to Develop the Strength-Maturity Relationship

Version 1.0 - 6/17/2008

GENERAL INFORMATION			
Project Number:	To be completed		
Contractor Name:	To be completed		
Concrete Producer:	To be completed	Vendor Number:	34
Sensor/Meter ID No.:	13383 A		
Maturity Sensor Location:	Mid-depth of 6 x 12 in. Cylinder		
Concrete Class & Type:	Type A-1c	Mixture Number:	17
Batch Date:	06/12/2003	Batch Time:	8:21 AM
Batch Size (cu.yd):	4.0		
Temperature at Casting:	Ambient (°F): 70	Concrete (°F):	81
Test Results at Casting:	Slump (in.): 2.5	Total Air (%):	4.6

STRENGTH AND MATURITY DATA								
Set	Date	Time (HR:MIN)	Actual Age (Days)	STRENGTH			MATURITY	
				Specimen No.	Compressive Strength (psi)	Strength Difference (%)	Sensor No.	Maturity (°C-hr)
1	06/13/2003	8:21 AM	1.0	1	2,260	-0.2	1	720
				2	2,210	-3.5	2	730
				3	2,320	3.8		
				Average	2,260		Average	725
2	06/14/2003	8:15 AM	2.0	1	3,100	-4.6	1	1,481
				2	3,200	0.0	2	1,509
				3	3,300	4.8		
				Average	3,200		Average	1,495
3	06/16/2003	10:00 AM	4.1	1	3,840	2.7	1	2,852
				2	3,780	0.3	2	2,868
				3	3,700	-2.9		
				Average	3,770		Average	2,860
4	06/19/2003	8:50 AM	7.0	1	4,380	1.2	1	4,760
				2	4,060	-9.6	2	4,768
				3	4,600	9.0		
				Average	4,350		Average	4,764
5	07/11/2003	1:37 PM	29.2	1	5,310	3.8	1	18,500
				2	5,000	-5.1	2	18,600
				3	5,230	1.5		
				Average	5,180		Average	18,550
6				1			1	
				2			2	
				3				
				Average				

Note : Clear all date, time, strength, and maturity cells in Set 6 for non-prestressed applications.

CALCULATIONS TO DETERMINE THE BEST-FIT STRENGTH-MATURITY RELATIONSHIP			
Perform Analysis	Ultimate Compressive Strength, S_u =	6,113	psi
	$0.95 \times S_u$ =	5,807	psi
	Time Constant, A =	710.7	°C-hr
	Slope Constant, B =	0.552	
	Coefficient of determination (r^2) =	0.998	
$S(M) = S_u \cdot e^{\left(-\left[\frac{A}{M}\right]^B\right)}$			

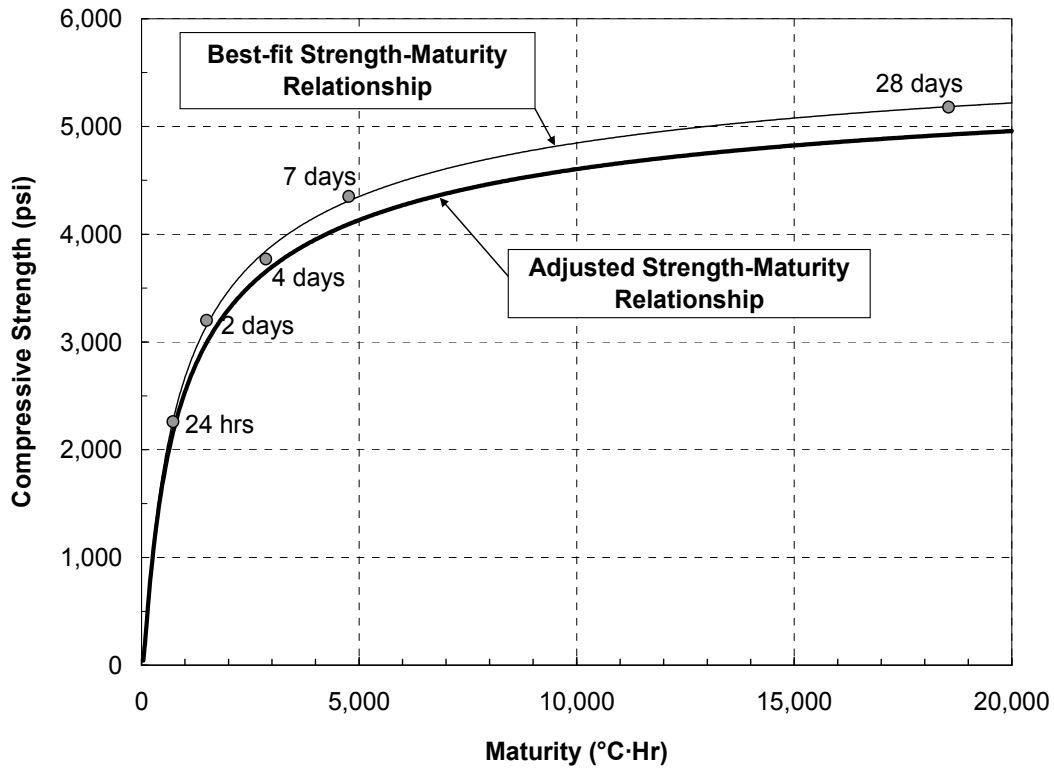


Figure A: Strength-Maturity Relationship generated by BMT-188 for the example problem

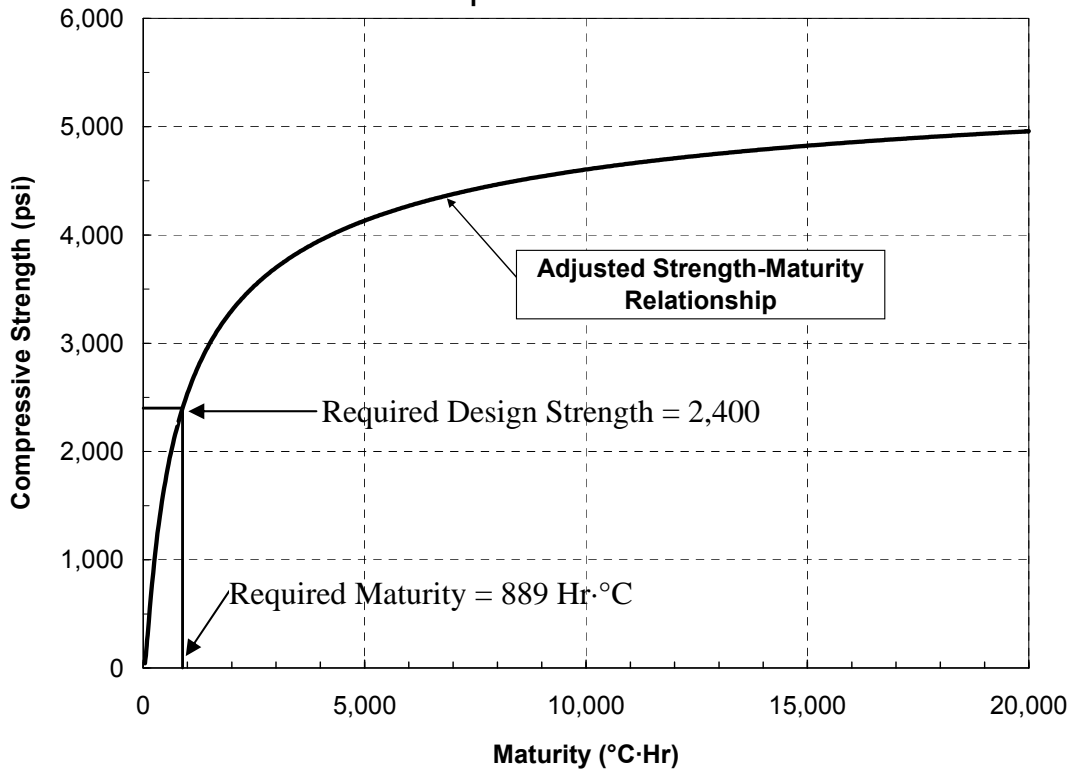


Figure B: Calculation of the Required Maturity by BMT-189 for the example problem

Alabama Department of Transportation
 BMT-189

Record Log for Verification Testing

Version 1.0 - 6/17/2008

GENERAL INFORMATION			
Project Number:	To be completed		
Contractor Name:	To be completed		
Concrete Producer:	To be completed	Vendor Number:	34
Sensor/Meter ID No.:	13383 A		
Maturity Sensor Location:	Center of Bridge Deck, Between Pier 33-34		
Concrete Class & Type:	Type A-1c	Mixture Number:	17
Batch Date:	07/14/2003	Batch Time:	10:15 AM

DEFINE THE STRENGTH-MATURITY RELATIONSHIP	
$S(M) = S_u \cdot e^{-\left[\frac{A}{M}\right]^B}$	Ultimate Compressive Strength, $S_u =$ <input type="text" value="6,113"/> psi $0.95 \times S_u =$ <input type="text" value="5,807"/> psi Time Constant, A = <input type="text" value="710.7"/> °C·hr Slope Constant, B = <input type="text" value="0.552"/>
<i>Comment: These values define the mixture-specific strength-maturity relationship. If the raw materials or proportions are changed, then these may need to be re-determined for the mixture.</i>	

REQUIRED MATURITY	
Required Design Strength:	<input type="text" value="2,400"/> psi
Required Maturity to Achieve the Required Design Strength:	<input type="text" value="889"/> °C·hr
90% of Required Maturity:	<input type="text" value="800"/> °C·hr

INPUT STRENGTH AND MATURITY DATA								
Set	Date	Time (HR:MIN)	Actual Age (Days)	STRENGTH			MATURITY	
				Specimen No.	Compressive Strength (psi)	Strength Difference (%)	Sensor No.	Maturity (°C·hr)
1	07/15/2003	9:40 AM	0.98	1	2,200	5.3	1	762
				2	2,150	1.7	2	774
				3	2,030	-6.7		
				Average	2,130		Average	768

STRENGTH ESTIMATED BY THE MATURITY METHOD	
Estimated Compressive Strength of the Cylinders, $S_{est} =$	<input type="text" value="2,230"/> psi
Average Measured Cylinder Strength, $S_m =$	<input type="text" value="2,130"/> psi
Percent Error =	<input type="text" value="4.7%"/>
Is the Strength-Maturity Relationship Valid?	<input type="text" value="Yes"/>
<i>Comment: Negative (-) errors are conservative as the strength is underestimated. Positive (+) errors are unconservative as the strength is overestimated.</i>	

**BMT-190
 RECORD LOG FOR FIELD MATURITY DATA**

Version 1.0 – 6/17/2008

GENERAL INFORMATION:			
Project Number:	<i>To be completed.</i>		
Contractor Name:	<i>To be completed.</i>		
Concrete Producer:	<i>To be completed.</i>	Vendor Number:	<i>34</i>
Sensor/Meter ID No.:	<i>13445 G</i>		
Maturity Sensor Location:	<i>Station +50.0, Mid-depth, Last pour</i>		
Concrete Class & Type:	<i>Type A-1c</i>	Mixture Number:	<i>17</i>
Batch Date:	<i>6/12/2003</i>	Batch Time:	<i>8:21 AM</i>
Temperature at Placement:	Ambient (°F): <i>70</i>	Concrete (°F):	<i>81</i>
Test Results at Placement:	Slump (in.): <i>2.5</i>	Total Air (%):	<i>3.5</i>

STRENGTH AND MATURITY INFORMATION:	
Required Design Strength (psi):	<i>2,400</i>
Required Maturity (°C·hr):	<i>889</i>
90% of Required Maturity (°C·hr):	<i>800</i>

Reading (2)	Inspector Initials	Date & Time	In-Place Structure		Verification Cylinders		Required Maturity Reached?
			Sensor	Maturity (°C·Hr)	Sensor	Maturity (°C·Hr)	
1	<i>Initials</i>	<i>07/14/2003 @ 5:15pm</i>	1	<i>300</i>	1	<i>245</i>	<i>No</i>
			2	<i>316</i>	2	<i>261</i>	
			Average	<i>308</i>	Average	<i>253</i>	
2	<i>Initials</i>	<i>07/15/2003 @ 6:10am</i>	1	<i>665</i>	1	<i>608</i>	<i>No</i>
			2	<i>676</i>	2	<i>621</i>	
			Average	<i>671</i>	Average	<i>615</i>	
3	<i>Initials</i>	<i>07/15/2003 @ 9:00am</i>	1	<i>815</i>	1	<i>730</i>	<i>No</i>
			2	<i>835</i>	2	<i>742</i>	
			Average	<i>825</i>	Average	<i>736</i>	
4	<i>Initials</i>	<i>07/15/2003 @ 11:10am</i>	1	<i>890</i>	1		<i>Yes</i>
			2	<i>918</i>	2		
			Average	<i>904</i>	Average		

Note (1): Attach copy of batch ticket.

Note (2): When each reading is taken, verify that the specified curing procedures are being followed.