

### Purpose – Why Do This Test?

Measuring the maturity of concrete pavements is a nondestructive test method for estimating in-place concrete strength. It is quickly becoming standard practice. Maturity may be used as a criterion for opening a pavement to traffic and for quality control purposes.

### Principle – What is the Theory?

The degree of hydration (leading to strength) of a given mixture design is a function of time and temperature. Correlation curves can be developed for a mixture design that estimate concrete strength based on its maturity. The in-place strength of a pavement can be estimated by monitoring the temperature of the slab over time and using the correlation curve that was developed for that mixture.

A maturity curve (strength estimate based on maturity) is only applicable to a specific mixture design.

### Test Procedure – How is the Test Run?

The maturity curve is developed by casting, curing, and testing standard strength specimens while measuring and recording the temperature of those specimens over time (ASTM C 1074).

Maturity testing is performed by inserting a temperature sensor in the slab and then downloading the temperature data to a computer that compares the slab temperature data to the maturity curve.

### Test Apparatus (figure 1)

- Beams, cylinders, and hydraulic loading frame for strength testing to develop the maturity curve.
- Sensors to measure the temperature of the test specimens and of the pavement.
- Computer software to analyze strength, temperature, and time data for developing the maturity curve and estimating the pavement strength.

### Test Method – Refer to ASTM C 1074 for Comprehensive Guidance

- Maturity Curve:
  - Cast 13 strength specimens from materials that are mixed at the project site.
  - Completely embed a temperature sensor in one of the specimens. This specimen is used only for recording the temperature over time and will not be broken.
  - Cure all the strength specimens in the same location.
  - Test the strength of the specimens at one, three, five, and seven days, or at four intervals that span the pavement opening strength. Break and average three specimens at each age.
  - Download and record the time/temperature factor (TTF) for each set of strength specimens when they are broken.
  - Plot the strength and TTF data for the strength specimens on a graph, with log TTF on the x-axis and concrete strength on the y-axis.
  - Fit a smooth curve through the plotted points.
- In-Place Maturity (estimated strength):
  - Completely embed a temperature sensor in the pavement.
  - Download the TTF from the sensor at any time.
  - Estimate the strength of the concrete pavement using computer software and the appropriate maturity curve.

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Figure 1. Measuring in-place maturity

### Output – How Do I Interpret the Results?

Commercially available maturity systems normally include software that provides the estimated concrete strength based

on the maturity of the concrete (TTF). A sample maturity curve is shown in figure 2 and a sample in-place maturity graph is shown in figure 3.

Specimen #	Date broken	Time broken	Age at break (h)	TTF at time of break (°C-h)	Specimen temp. at time of break (°C)	Flexural strength (lb/in <sup>2</sup> )
1	30-May-08	4:00 PM	30.50	820	29.0	315
2	30-May-08	4:10 PM	30.67	826	29.0	330
3	30-May-08	4:20 PM	30.83	832	29.0	300
4	31-May-08	4:00 PM	54.50	980	26.3	390
5	31-May-08	4:10 PM	54.67	984	26.3	395
6	31-May-08	4:20 PM	54.83	987	26.3	380
7	2-Jun-08	7:30 AM	94.00	1,820	25.2	505
8	2-Jun-08	7:40 AM	94.17	1,823	25.2	510
9	2-Jun-08	7:50 AM	94.33	1,826	25.2	520
10	3-Jun-08	8:45 AM	119.25	2,229	23.4	580
11	3-Jun-08	8:55 AM	119.42	2,233	23.4	585
12	3-Jun-08	9:00 AM	119.50	2,236	23.4	575

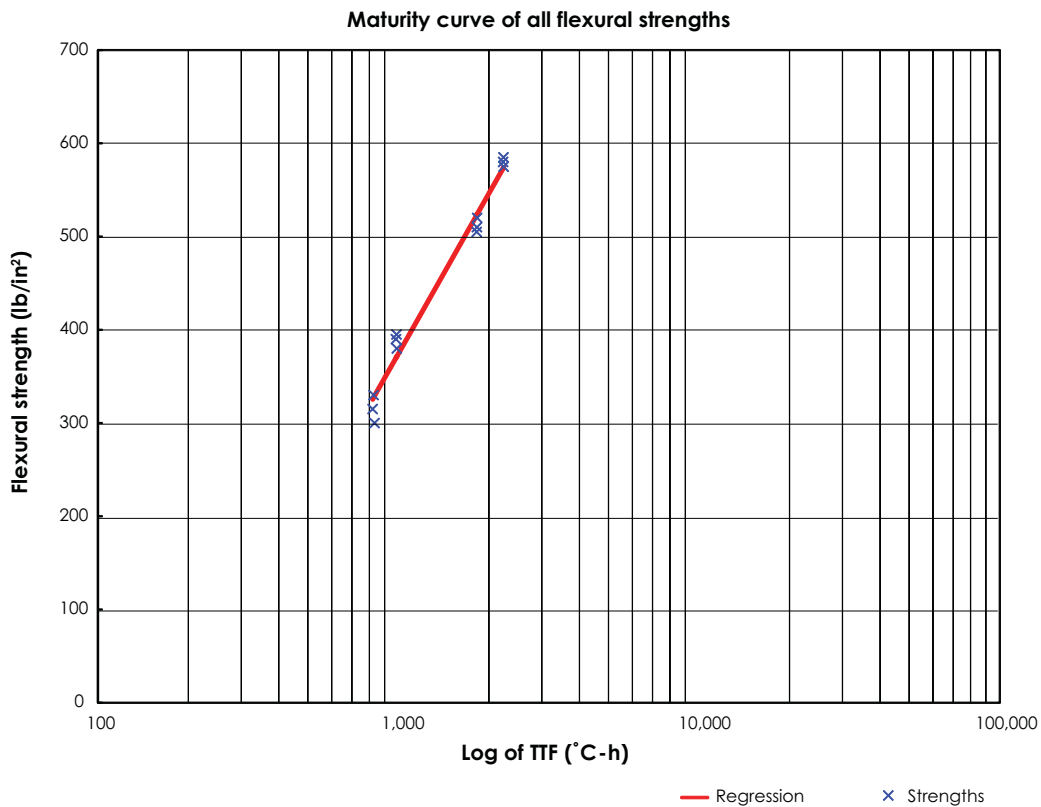


Figure 2. Maturity curve

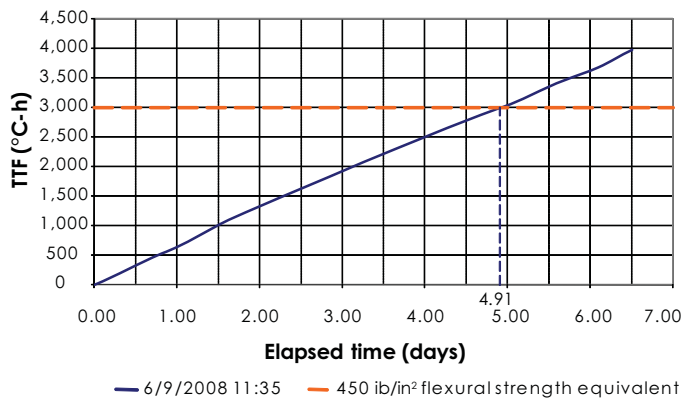


Figure 3. In-place pavement maturity

## Construction Issues – What Should I Look For?

Maturity testing is a way of nondestructively estimating the early-age strength of a concrete pavement.

It cannot be overemphasized that the maturity vs. strength relationship is mixture-specific. Maturity estimates of in-place strength are valid only if the pavement being tested is constructed using the same mixture proportions that were used to develop the maturity curve.

Changes in the water-cementitious materials ratio, air content, grading, aggregate proportions, admixtures, etc., may introduce some inaccuracy in the estimate of the strength of the pavement.

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