Concrete Property Test

Workability 1-7: Early Stiffening and False Set

National Concrete Pavement Technology Center
www.cptechcenter.org

Purpose – Why Do This Test?

Some portland cements and combinations of cement and pozzolans may be prone to false set. False set reduces the workability of the concrete mixture. Workability can be restored by remixing without the addition of water.

Since remixing is not normally possible when a central mix plant and dump trucks are used for delivery, the false set condition is usually offset by adding more mixing water, which increases the water-cementitious materials (w/cm) ratio. This is poor practice.

Performing the penetration resistance test on the cementitious materials and admixtures during the mixture design stage will indicate whether the mixture is prone to false set due to material incompatibilities.

Principle – What is the Theory?

As concrete mortar stiffens (sets), the resistance required for a 10-mm diameter rod to penetrate into the mortar will increase. The depth of penetration of the 10-mm rod into a mortar sample is measured and recorded at various times. If, after remixing, the 10-mm rod penetrates the mortar sample to a depth greater than was measured before remixing, then a false set condition is occurring.

Test Procedure – How is the Test Run?

ASTM C 359, the *Standard Test Method for Early Stiffening of Portland Cement (Mortar Method)* (false set), tests a laboratory-mixed mortar. The test method uses a Vicat apparatus to measure the depth of penetration of a 10-mm diameter plunger 10 seconds after it is released into the mortar at fixed time intervals.

Test Apparatus (figure 1)

- Vicat: A frame holding the 10-mm rod and an indicator to measure the depth of penetration in mm.
- Mortar mold: A box 51-mm wide x 51-mm high x 152-mm long (2- x 2- x 6-in.) used for containing the mortar sample.
- Mixer: A laboratory mixer used for remixing the mortar sample.

Test Method – Refer to ASTM C 359 for Comprehensive Guidance

1. Mix a mortar sample using materials from the project.
2. Place the mortar sample in the mold, consolidate it, and strike it off.
3. Using the Vicat, hold the 10-mm rod in contact with the top surface of the mortar by a set screw.
4. Release the rod from the set screw and allow it to penetrate into the mortar. Record the depth of penetration 10 seconds after the rod is released.
5. Take penetration readings 3 minutes, 5 minutes, 8 minutes, and 11 minutes after batching.
6. After the 11-minute reading, remix the mortar sample for 1 minute.
7. Replace the mortar sample in the mold, consolidate it, and strike it off.
8. Measure the penetration 45 seconds after completion of remixing.
9. Record the depths of penetration for each of the five repetitions.

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Figure 1. False set testing equipment

FOR MORE INFORMATION
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Output – How Do I Interpret the Results?

The depths of penetration are reported in tabular and graphical format, as in this example (figure 2):

Initial penetration	50 mm
5-minute penetration	40 mm
8-minute penetration	25 mm
11-minute penetration	10 mm
Remix penetration	25 mm

If, as shown in the example, the penetration after remixing is greater than the 11-minute penetration, false set is occurring. Also, if the penetration depth decreases from 50 mm to approximately 10 mm before re-mixing, flash set or severe early stiffening of the mixture is likely.

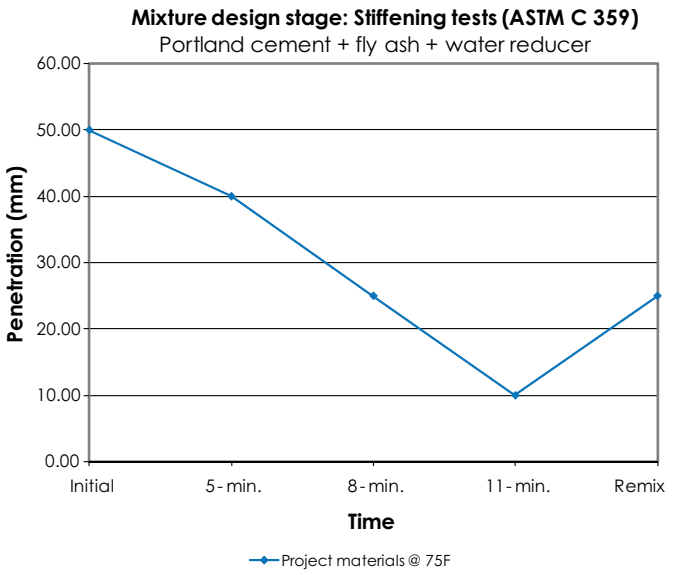

Figure 2. Example false set test results

Construction Issues – What Should I Look For?

Situations that may indicate the occurrence of false set include the following:

- Excessive vibration that essentially remixes the concrete.
- Loss of workability during moderate temperatures.
- Workability changes that occur when pozzolans and/or admixtures are removed or added.

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