FINAL SET TIME

IMPORTANCE OF FINAL SET TIME

The strength and the modulus of elasticity of PCC as well as the mechanical stresses and strains that develop within the concrete slab depend upon the PCC's final set time. Final set time is the time when the PCC completes its transition from a plastic material to a solid one. Before final set time, it is assumed that no stresses develop in the pavement because the concrete is plastic. After final set time, the mechanical properties of the PCC develop as do tensile and compressive stresses.

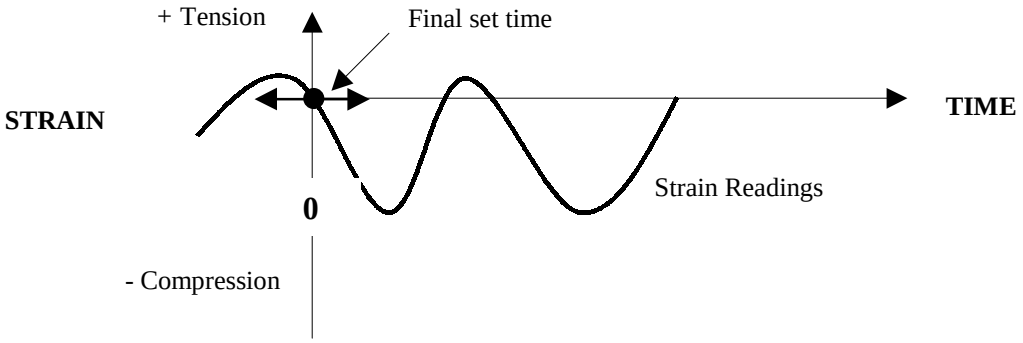

Figure 1. Influence of final set time on PCC strain measurements.

The model predicts the performance of PCC pavements by comparing the concrete strength to the stresses that develop within the pavement as a function of time. If the stresses are greater than PCC strength, the model predicts a crack will form.

OBJECTIVE

Determine the field set time of the portland cement concrete (PCC) slabs instrumented in Texas, North Carolina, Minnesota, Arizona and Nebraska. Final set time is used to analyze the field data collected to verify the HIPERPAV model.

PROCEDURE TO DETERMINE FINAL SET TIME

In the field, two techniques were used to estimate the PCC final set time. They were:

1. Split cylinder measurements.
2. Pulse velocity readings.

Field implementation of these two methods is described here. To compare the two set times, the temperature histories of the concrete in the split cylinder and at the location of the pulse velocity data acquisition must be known for the equivalent age calculation. If the equivalent ages are the same for both techniques, then the final set times are deemed accurate and will be used in the HIPERPAV model. These two procedures (split cylinder and pulse velocity) were used to measure final set time for every field slab.[1,2,3]

The set times and equivalent ages for the typical split cylinder data and the pulse velocity are summarized in table 1.

Table 1. Comparison between final set times and equivalent ages for split cylinder and pulse velocity measurements.

	Split Cylinder	**Pulse Velocity**
Set time (h)	7.4	4.1
Equivalent age t_e (h)	5.9	5.2

The equivalent ages are within 13 percent of each other, so the final set times are deemed reasonably accurate. This final set time procedure is applied to all the PCC slabs tested in the field. The HIPERPAV model can now be validated. All set times for the Texas (TX), Minnesota (MN), Nebraska (NE), North Carolina (NC) and Arizona (AZ) slabs are summarized in table 2.

Table 2. Summary table of set times for Nebraska (NE), Minnesota (MN), Texas (TX), North Carolina (NC) and Arizona (AZ)

State	**Slab**	**Pulse Velocity Set time (h)**	**Pulse Velocity Equivalent time (h)**	**Split Cylinder Set time (h)**	**Split Cylinder Equivalent time (h)**	**Average Equivalent time (hr)**
MN	1	-	-	**13.4**	**9.9**	**9.9**
	2	**10.0**	**8.9**	**13.0**	**9.2**	**9.0**
	3	**10.5**	**7.2**	**10.3**	**8.1**	**7.6**
	4	-	-	**8.6**	**7.0**	**7.0**
NE	1	-	-	**6.0**	**9.2**	**9.2**
	2	-	-	**6.4**	**7.3**	**7.3**
AZ	1	-	-	**6.6**	**7.4**	**7.4**
	3	**10.5**	**8.4**	**8.9**	**9.3**	**8.9**
	4	-	-	**14.9**	**9.2**	**9.2**
	5	**7.4***	**6.4**	**11.1**	**8.3**	**8.3**
	6	-	-	-	-	**8.4****
TX	1	**5.0**	**5.5**	**6.4**	**6.9**	**6.2**
	2	**5.5**	**6.0**	**5.7**	**6.1**	**6.1**
	3	**4.1**	**4.9**	**5.1**	**5.6**	**5.2**
	4	**3.1**	**4.5**	**4.3**	**7.4**	**5.9**
NC	1	**4.6**	**7.9**	**5.1**	**7.4**	**7.7**
	2	**6.2**	**9.1**	**6.7**	**8.3**	**8.7**
	3	**6.5**	**8.7**	**7.3**	**9.8**	**9.2**
	4	**7.5**	**10.6**	**8.4**	**11.9**	**11.2**

(no data denoted by -, *Not enough information, **Average from above).

REFERENCES

(1) Technical Memorandum No. 2, *General Description of HIPERPAV Data Collection Program and*
(2) Technical Memorandum No. 8, *Field Instrumentation Details and Data Collected - Texas Construction Site*
(3) Technical Memorandum No. 13, *Final Set Time*