Concretos Acelerados para la Construcción de Carreteras

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Concretos Acelerados

Introducción

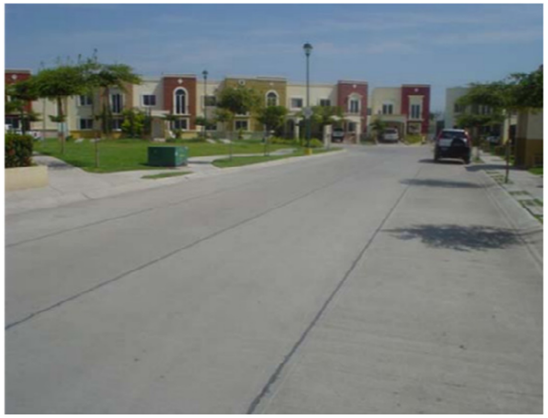
¿Cuál es la necesidad?

Hacer construcciones y reparaciones en tiempo mínimo para mantener tráfico en circulación y evitar costos excesivos de operación.

Concretos Acelerados
Introducción

¿Cuál es la solución?

Los pavimentos de apertura rápida…



Concretos Acelerados

Introducción

- **Ventajas**
  - **Minimiza costos** de operación del tráfico en rehabilitaciones.
  - **Mayor seguridad** (Menor riesgo de producirse accidentes).
  - **Incremento productividad** de contratistas, mayor volumen en menor tiempo.
  - Menor tiempo de maquinaría en obra.

- **Tiempos de Apertura**
  - Varían entre 8, 16, 24, 36 y 48 hrs.

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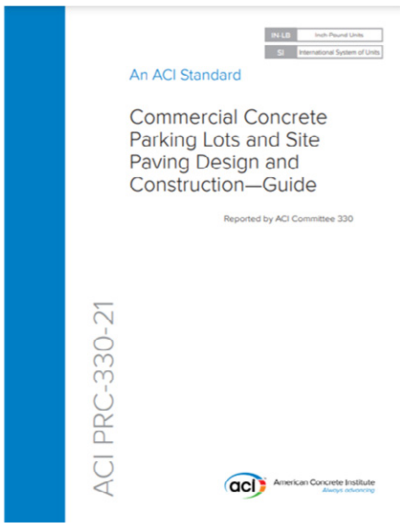
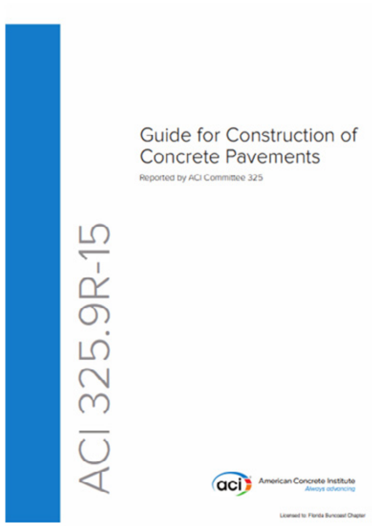
Códigos de Pavimento Viales o Estacionamiento

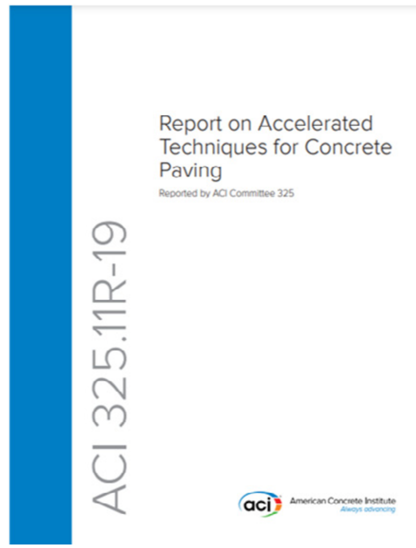
ACI PRC-330-21: Commercial Concrete Parking Lots and Site Paving Design and Construction



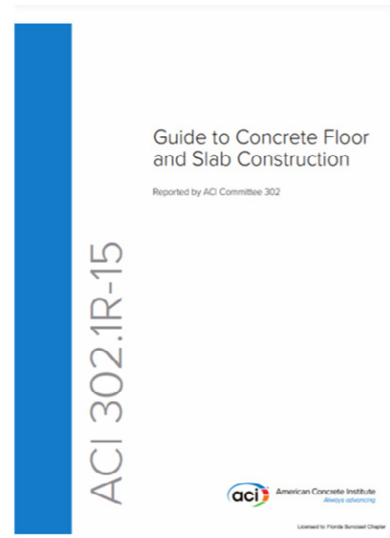
ACI PRC-325.9R-15: Guide for Construction of Concrete Pavements



325.11R-19: Report on Accelerated Techniques for Concrete Paving



302.1R-15: Guide to Concrete Floor and Slab Construction



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Códigos: 325.11R-19: Report on Accelerated Techniques for Concrete Paving

Table 1.1.1—Changes to project components useful to shorten concrete pavement construction time

Project component	Possible changes
Planning	a) Implement partnering-based project management. b) Implement lane rental charges, which is an innovative contracting practice that encourages contractors to lessen the construction impact on road users. c) Allow night construction. d) Allow contractor to use innovative equipment or procedures to expedite construction (for example, minimum-clearance machines, dowel inserters, and ultra-light saws). e) Specify more than one concrete mixture for varied strength development. f) Provide options to contractors, not step-by-step procedures to allow the contractor to provide options based on their experiences in paving, instead of prescribing how to perform the work. g) Use time-of-completion incentives and disincentives.
Concrete materials	a) Try different cement types (particularly Type III). b) Use accelerating and water-reducing admixtures. c) Use a well-graded aggregate that has a uniform distribution of aggregates on each sieve. d) Keep water-cementitious materials ratio (*w/cm*) below 0.45 for durability and strength. e) Use a prewetted lightweight aggregate sand to cause a higher-early-age and long-term strength.
Jointing and sealing	a) Allow early-age sawing, which is done during the initial concrete. set stage after compressive strengths reach about 150 psi (1.0 MPa) b) Use dry-sawing blades. c) Use step-cut blades for single-pass joint sawing. d) Use a sealant that is unaffected by moisture or reservoir cleanliness.
Concrete curing and temperature	a) Suggest blanket curing to aid strength gain when beneficial. b) Monitor concrete temperature and understand relationship of ambient, subgrade, and mixture temperature on strength gain. c) Improve characteristics caused by less than optimum temperature through internal curing by use of prewetted lightweight aggregate sand to improve early age and longer results.
Strength testing	a) Use nondestructive methods to replace or supplement cylinders and beams for strength testing. b) Use concrete maturity or pulse velocity testing to predict strength.
Traffic opening criterion	a) Revise from a time criterion to a strength criterion; channel early loads away from slab edges. b) Restrict truck traffic.

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Códigos: 325.11R-19: Report on Accelerated Techniques for Concrete Paving

ACI 228.1: In-Place Methods to Estimate Concrete Strength

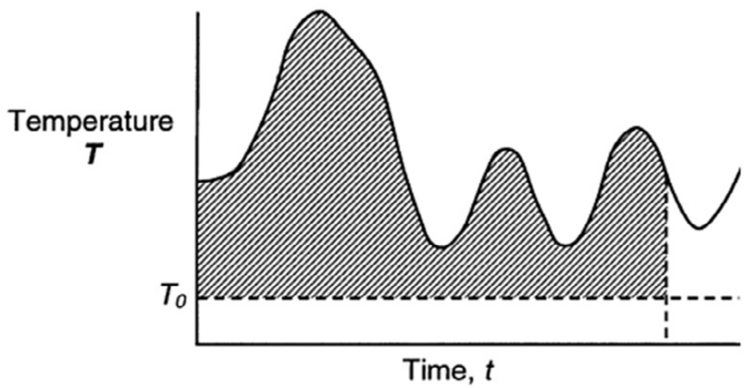

Fig. 2.12—Maturity function based on assumption that the initial rate of strength gain varies linearly with temperature; shaded area is the temperature-time factor (Eq. (2-1)).

CIP 39: Maturity Methods to Estimate Concrete Strength

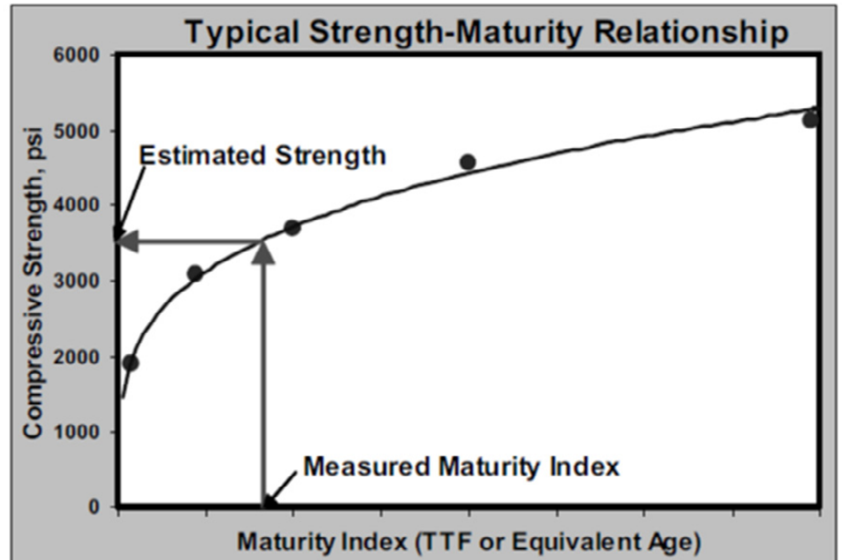

Figure 1: Strength-Maturity Relationship from lab tests used to estimate in-place strength from measured maturity index.

Match curing – Sistema de medición de temperature donde se transmite el calor de la losa al cilindro

Concretos Acelerados

ASTM C1074: Standard Practice for Estimating Concrete Strength by the Maturity Method1

ASTM C1074: Standard Practice for Estimating Concrete Strength by the Maturity Method1

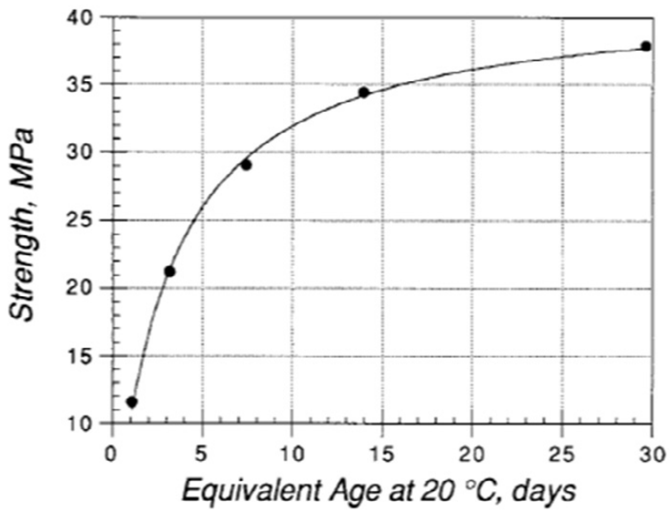

FIG. 2 Example of a Relationship Between Compressive Strength and Equivalent Age at 20 °C

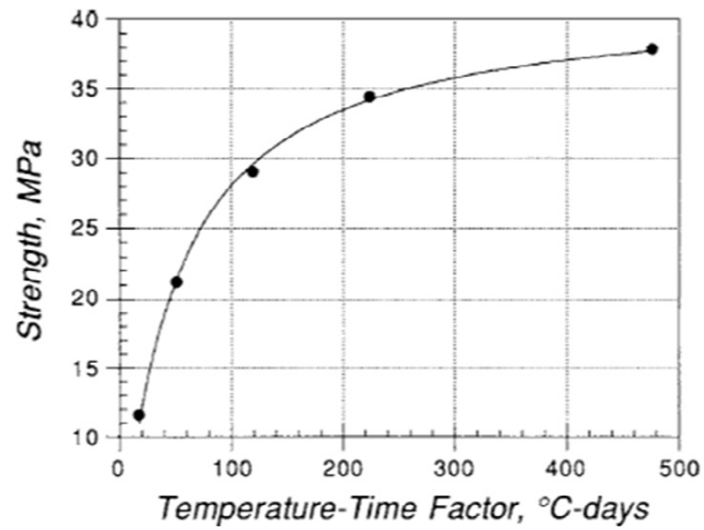

FIG. 1 Example of a Relationship Between Compressive Strength and Temperature-Time Factor

Concretos Acelerados

Códigos: 325.11R-19: Report on Accelerated Techniques for Concrete Paving

Curado

6.4.3 Mantas aislantes: las mantas aislantes proporcionan un entorno de temperatura uniforme para el hormigón. Las mantas aislantes reducen la pérdida de calor , amortiguan el efecto de la temperatura del aire y la radiación solar en el pavimento, pero **no eliminan la necesidad de un compuesto de curado**.

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Análisis de Combinación de Agregados

Concretos Acelerados

Análisis de Agregados

ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

- Maximum Allowable Quantity of Material Retained on a Sieve

TABLE 1 Maximum Allowable Quantity of Material Retained on a Sieve, kg

Sieve Opening Size, mm	Nominal Dimensions of Sieve[A]				
	203.2-mm dia[B]	254-mm dia[B]	304.8-mm dia[B]	350 by 350 mm	372 by 580 mm
	Sieving Area, m^2				
	0.0285	0.0457	0.0670	0.1225	0.2158
125	C	C	C	C	67.4
100	C	C	C	30.6	53.9
90	C	C	15.1	27.6	48.5
75	C	8.6	12.6	23.0	40.5
63	C	7.2	10.6	19.3	34.0
50	3.6	5.7	8.4	15.3	27.0
37.5	2.7	4.3	6.3	11.5	20.2
25.0	1.8	2.9	4.2	7.7	13.5
19.0	1.4	2.2	3.2	5.8	10.2
12.5	0.89	1.4	2.1	3.8	6.7
9.5	0.67	1.1	1.6	2.9	5.1
4.75	0.33	0.54	0.80	1.5	2.6

Concretos Acelerados

Análisis de Agregados

ASTM C33 - Standard Test Method for Concrete Aggregates

- Límites de las granulometrías de las arenas y piedras

FINE AGGREGATE

5. General Characteristics

5.1 Fine aggregate shall consist of natural sand, manufactured sand, or a combination thereof.

6. Grading

6.1 *Sieve Analysis*—Fine aggregate, except as provided in 6.2 and 6.3 shall be graded within the following limits:

Sieve (Specification E11)	Percent Passing
9.5-mm (⅜-in.)	100
4.75-mm (No. 4)	95 to 100
2.36-mm (No. 8)	80 to 100
1.18-mm (No. 16)	50 to 85
600-µm (No. 30)	25 to 60
300-µm (No. 50)	5 to 30
150-µm (No. 100)	0 to 10

TABLE 2 Grading Requirements for Coarse Aggregates

Size Number	Nominal Size (Sieves with Square Openings)	Amounts Finer than Each Laboratory Sieve (Square-Openings), Mass Percent													
		100 mm (4 in.)	90 mm (3½ in.)	75 mm (3 in.)	63 mm (2½ in.)	50 mm (2 in.)	37.5 mm (1½ in.)	25.0 mm (1 in.)	19.0 mm (¾ in.)	12.5 mm (½ in.)	9.5 mm (⅜ in.)	4.75 mm (No. 4)	2.36 mm (No. 8)	1.18 mm (No. 16)	300 µm (No.50)
1	90 to 37.5 mm (3½ to 1½ in.)	100	90 to 100	...	25 to 60	...	0 to 15	...	0 to 5	...	...	...	...	...	...
2	63 to 37.5 mm (2½ to 1½ in.)	...	...	100	90 to 100	35 to 70	0 to 15	...	0 to 5	...	...	...	...	...	...
3	50 to 25.0 mm (2 to 1 in.)	...	...	...	100	90 to 100	35 to 70	0 to 15	...	0 to 5	...	...	...	...	...
357	50 to 4.75 mm (2 in. to No. 4)	...	...	...	100	95 to 100	...	35 to 70	...	10 to 30	...	0 to 5	...	...	...
4	37.5 to 19.0 mm (1½ to ¾ in.)	...	...	...	...	100	90 to 100	20 to 55	0 to 15	...	0 to 5	...	...	...	...
467	37.5 to 4.75 mm (1½ in. to No. 4)	...	...	...	...	100	95 to 100	...	35 to 70	...	10 to 30	0 to 5	...	...	...
5	25.0 to 12.5 mm (1 to ½ in.)	...	...	...	...	...	100	90 to 100	20 to 55	0 to 10	0 to 5	...	...	...	...
56	25.0 to 9.5 mm (1 to ⅜ in.)	...	...	...	...	...	100	90 to 100	40 to 85	10 to 40	0 to 15	0 to 5	...	...	...
57	25.0 to 4.75 mm (1 in. to No. 4)	...	...	...	...	...	100	95 to 100	...	25 to 60	...	0 to 10	0 to 5	...	...
6	19.0 to 9.5 mm (¾ to ⅜ in.)	...	...	...	...	...	...	100	90 to 100	20 to 55	0 to 15	0 to 5	...	...	...
67	19.0 to 4.75 mm (¾ in. to No. 4)	...	...	...	...	...	...	100	90 to 100	...	20 to 55	0 to 10	0 to 5	...	...
7	12.5 to 4.75 mm (½ in. to No. 4)	...	...	...	...	...	...	...	100	90 to 100	40 to 70	0 to 15	0 to 5	...	...
8	9.5 to 2.36 mm (⅜ in. to No. 8)	...	...	...	...	...	...	...	...	100	85 to 100	10 to 30	0 to 10	0 to 5	...
89	9.5 to 1.18 mm (⅜ in. to No. 16)	...	...	...	...	...	...	...	...	100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5
9[A]	4.75 to 1.18 mm (No. 4 to No. 16)	...	...	...	...	...	...	...	...	...	100	85 to 100	10 to 40	0 to 10	0 to 5

[A] Size number 9 aggregate is defined in Terminology C125 as a fine aggregate. It is included as a coarse aggregate when it is combined with a size number 8 material to create a size number 89, which is a coarse aggregate as defined by Terminology C125.

Concretos Acelerados

Análisis de Agregados

302.1R-15: Guide to Concrete Floor and Slab Construction

La mezcla de agregados para cumplir con los criterios para una clasificación combinada es otro método de dosificación utilizado. Los procedimientos utilizados para determinar las proporciones y las características potenciales del concreto debido a las gradaciones de los agregados combinados incluyen:

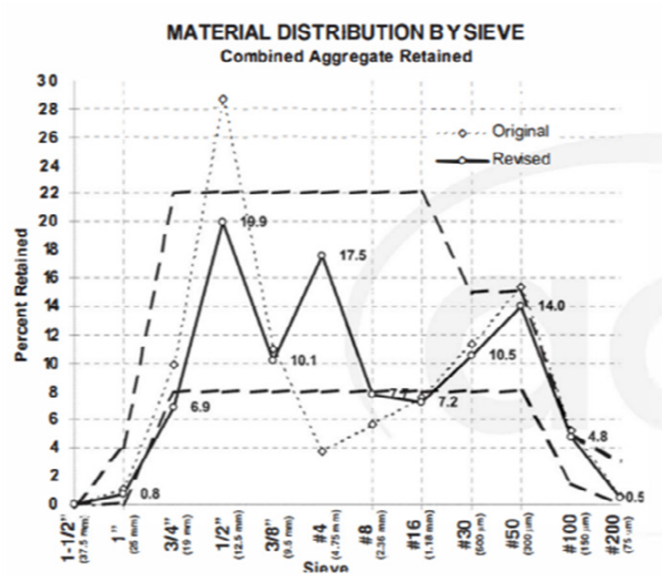


Fig. 8.9.4a—Material sieve analysis showing change in aggregate distribution with blending of 3/8 in. (9.5 mm) aggregate.

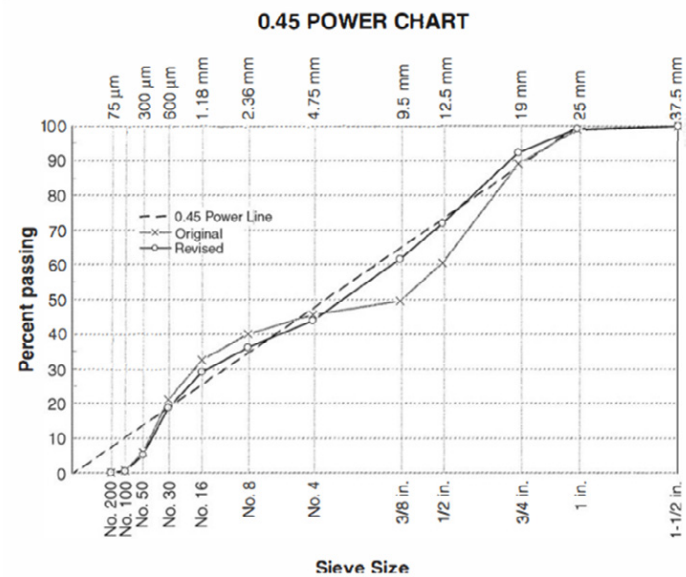


Fig. 8.9.4b—The 0.45 power chart showing change in combined gradation of aggregates after blending of 3/8 in. (9.5 mm) aggregate.

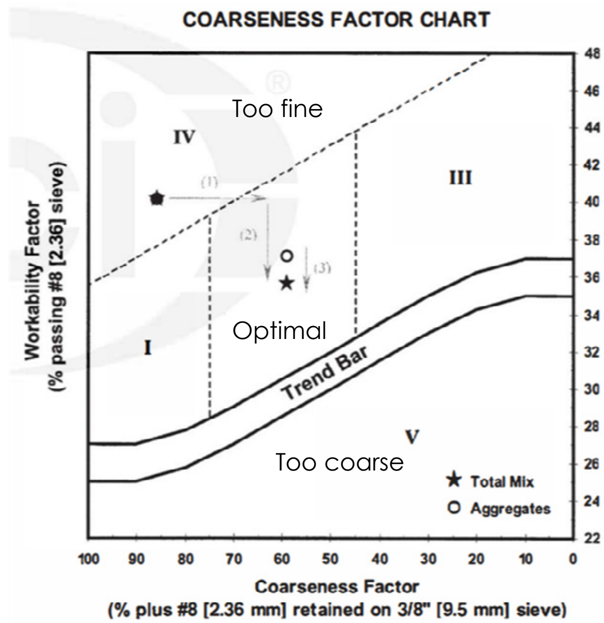


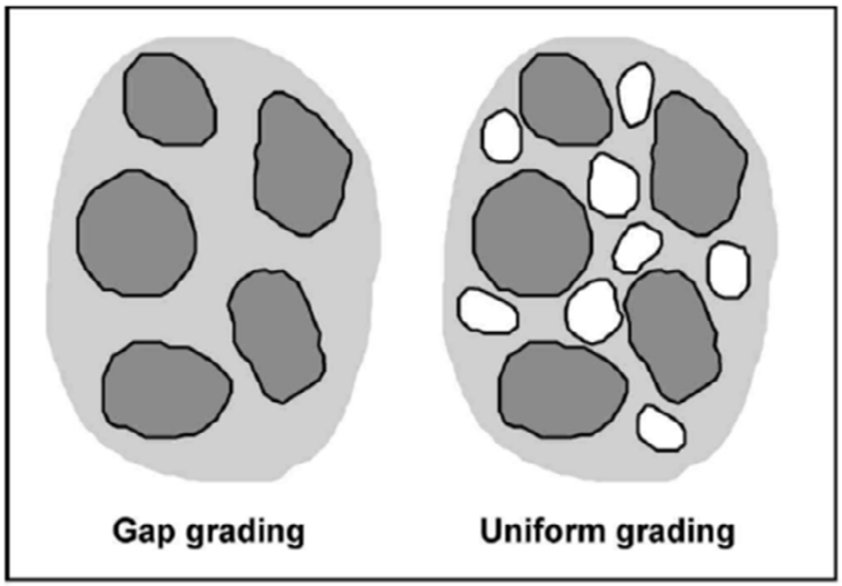
Fig. 8.9.4c—Coarseness factor chart showing the impact of blending 3/8 in. (9.5 mm) aggregate.

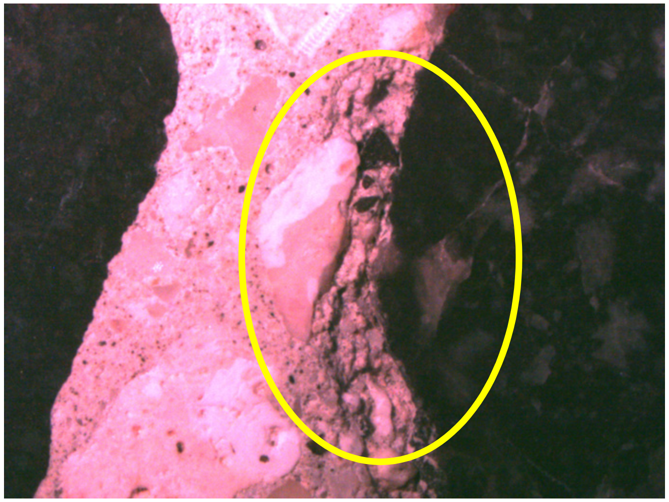
Concretos Acelerados

Análisis de Agregados

302.1R-15: Guide to Concrete Floor and Slab Construction

El sangrado ocurre en el concreto cuando los **agregados del** concreto tienden a asentarse y el agua libre sube a la superficie. Este movimiento ascendente del agua al atravesar de abajo hacia arriba, forma canales continuos. Si la relación agua-cemento utilizada es de **0.6 o más**, el canal de sangrado permanecerá continuo.





No existe buen bonding entre agregados y pasta o mortero

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Diseños de Mezclas

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Concretos Acelerados

W/C

- Una relación w/cm lo suficientemente baja es fundamental para lograr la resistencia y la durabilidad necesarias para los pavimentos de hormigón

- W/C: 0.40 – 0.50
  - » Generalmente, un w/cm entre 0,40 y 0,50 proporciona una permeabilidad moderada al cloruro.
- W/C < 0.40
  - » Proporciona baja permeabilidad al cloruro,

- Concretos Acelerados están por debajo de W/C=0.45, pero no menores de 0.30.

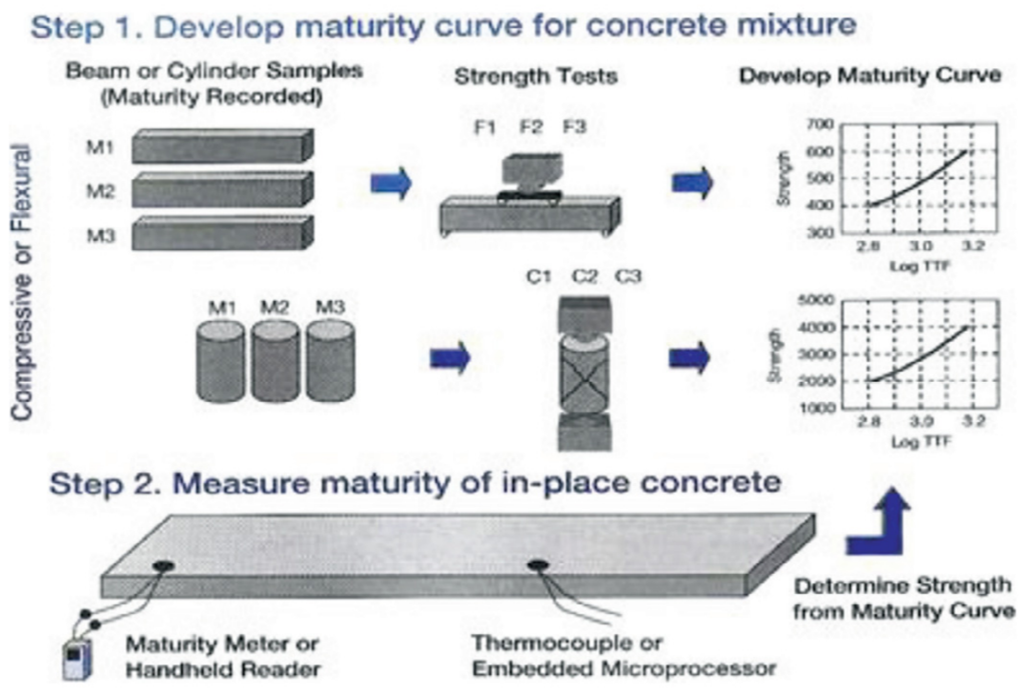

Fig. 7.2a—Maturity testing process (ACPA IS257P).

Concretos Acelerados

Aditivos

Reductor de Agua de Alto Rango

- Aditivo basado en la química de policarboxilato

Aditivo reductor de agua de rango completo

- Aditivo basado en la química de policarboxilato

Inhibidores de corrosión

Aditivo acelerador de fraguado y endurecimiento para concreto

  - Diseñada para impulsar el proceso de hidratación del cemento de edad temprana (6-12 horas). Acelera fuertemente el crecimiento esencial de los cristales de hidrato de silicato de calcio utilizando una tecnología de siembra única e innovadora.

Aditivo retenedor de trabajabilidad

  - Aditivo que conserva la trabajabilidad con grados variables de retención del asentamiento

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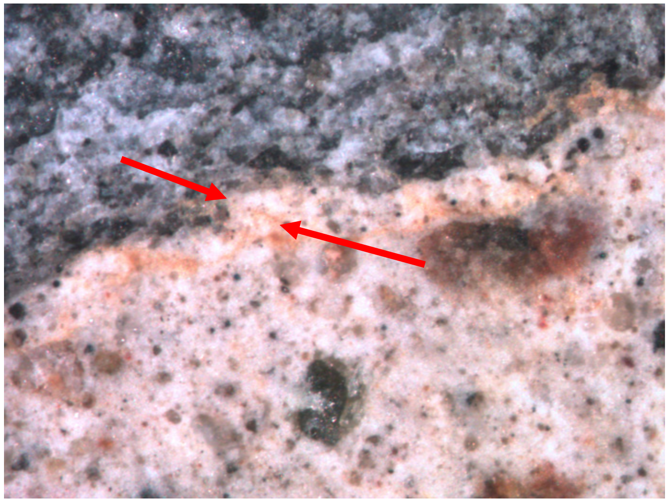
Retos para pavimentos acelerados

Concretos Acelerados

RETOS

Baja Resistencia por agregado sucio



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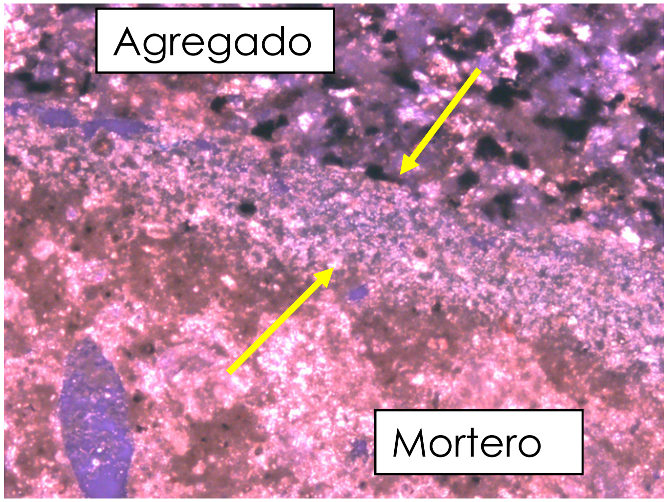
Ajustes con agua



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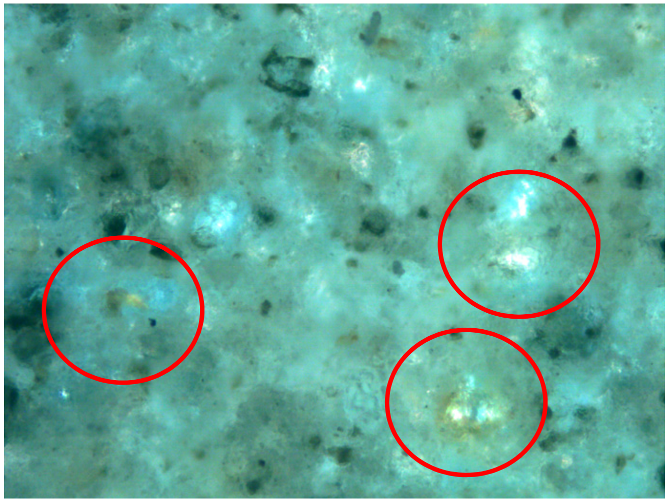
Partículas de cemento sin hidratar



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Concretos Acelerados

RETOS

Fisuras

- Se deben esperar fisuras plásticas y se debe trabajar para controlarlas
- Se puede utilizar fibras para reducir y controlar la propagación

Curado

- El uso de mantas ayuda a mantener el calor en temperaturas bajas o medianas, pero, estaría poco tiempo. Por debajo de 80 F.

Corte de juntas

- Aceleración del fragüe final. Se debe trabajar con la cantidad de máquinas adecuadas.

Tiempos de trayecto

- La adición de aditivos en obra puede ser una opción para reducer la pérdida de asentamiento y problemas en el tráfico.

RCC

- El Sistema de colocado de RCC es una alternativa, pero, require tener una planta cercana al proyecto.
- La terminación superficial sin pulido de diamante, el perfil y la suavidad pueden no ser deseables para pavimentos que transportan tráfico de alta velocidad.

Preguntas…

GRACIAS

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