




1

Special Inspections

"Special inspections are observations of materials, installation, fabrication, erection or placement of components and connections requiring special expertise to evaluate whether work meets approved construction documents and referenced standards."
....as it relates to
the integrity of building
structure as dictated by the
design professional or
building official

**What was designed,
is what was built.**



2

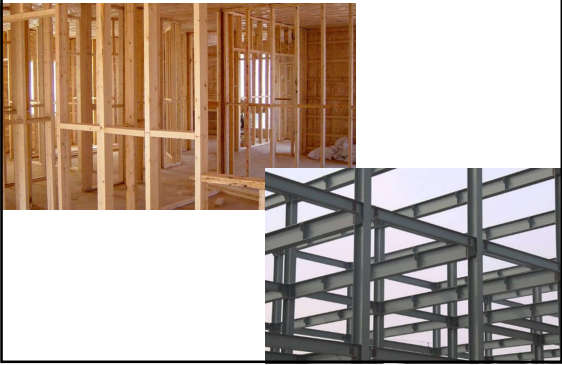


1

Concrete is Different

3

Steel and Wood Structures



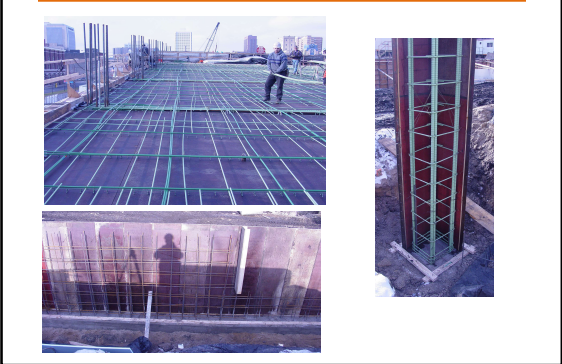
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Concrete Structures



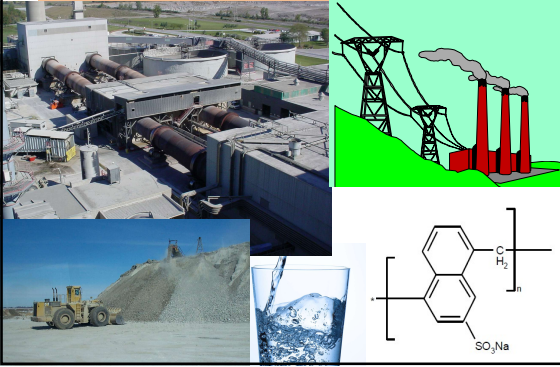
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Concrete Structures



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Concrete Materials



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Ready Mix



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Placing and Finishing



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Section 1705.3 Concrete

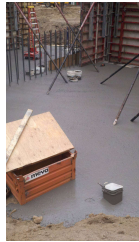
- ▶ Rebar, Post tensioning, Structural embedded items and bolts
 - Size, Spacing, Location
 - Grade
 - Free of dirt, grease
 - Lap length
 - Secured
 - Coverage
 - Detailing
 - Conduits/sleeves



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Section 1705.3 Concrete

- ▶ Concrete placement
 - Approved mix
 - Deposition/Consolidation
- ▶ Sample Preparation
 - Observe or serve as testing agency
- ▶ Curing
 - Cold and hot weather, moisture
- ▶ Shotcrete, Reinforcement weldability, precast erection
- ▶ General formwork
 - Dimensions, Joint locations
 - Not locations, not safety and stability of formwork



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Section 1705.3 Concrete

- ▶ Post-tension reinforcement
 - Profiles
 - Anchorage Zone
 - Observe for displacement during pour
- ▶ Application of stressing forces
 - Concrete has meet strength
 - Stressing sequence
 - Stressing forces
 - Elongation
- ▶ Precast
 - Construction & Erection

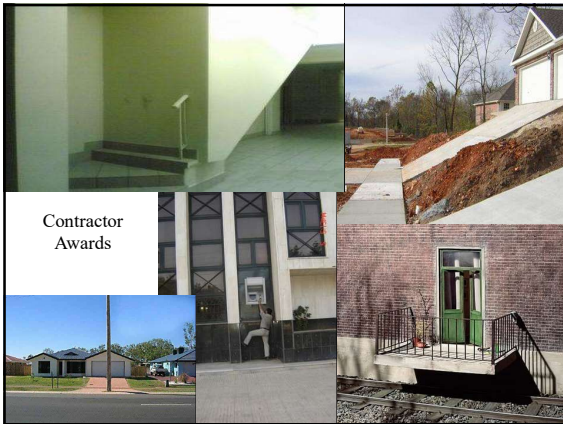


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Focus Today

- ▶ Reinforcement Consideration
- ▶ Mixture Properties and Testing
- ▶ Cold Weather
- ▶ Post Installed Anchors

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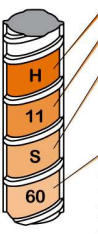
14



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Reinforcement Consideration

- ▶ Grade
 - 40 KSI
 - 60 KSI
 - 75 KSI
 - 100 KSI



Point of Origin
Letter(s) or symbol(s) of producing mill

Size Designation
3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 18
(10, 13, 16, 19, 22, 25, 29, 32, 36, 42, 57)

Type of Steel
C = Carbon Steel (A615/A615M)
W = Low-Alloy Steel (A706/A706M)
SS = Stainless Steel (A955/A955M)
R = Rail Steel (A996/A996M)
I = Rail Steel (A996/A996M)
A = Rail Steel (A996/A996M)
CS = Low-Carbon Chromium (A1025/A1025M)

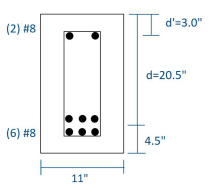
Minimum Yield Designation (Grade Mark or Grade Line)

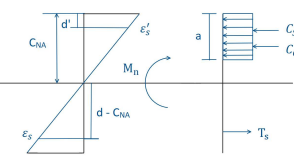
Inch-Pound Markings		Metric Markings	
60	Grade 60*	4	Grade 420*
75	Grade 75**	5	Grade 520**
80	Grade 80***	6	Grade 550***
100	Grade 100****	8	Grade 690****
120	Grade 120****	8	Grade 830****
None	Grade 40 or 60	None	Grade 280 or 350

*D 1 Grade Line / **D 2 Grade Line / ***D 3 Grade Line / ****D 4 Grade Line
For stainless steel (A955/A955M) reinforcing bars
* For Grade 60 (A201), ** For Grade 75 (A201)

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Reinforcement Consideration







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Why Increase of Steel Strength

- ▶ 12000, 15000, 16000 psi concrete strengths

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Placement



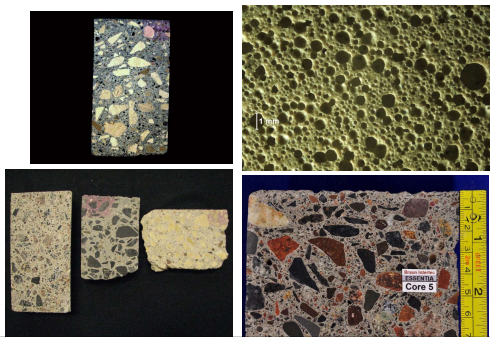
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Cover



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Concrete Material Properties



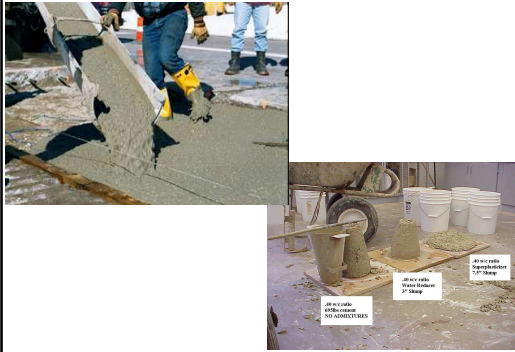
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Concrete Testing

- ▶ Specifications Require the Technician to hold ACI Concrete Field Technician Grade I
 - ASTM C172 – Sampling
 - ASTM C1064 – Temperature
 - ASTM C143 – Slump
 - ASTM C138 – Unit Weight
 - ASTM C231 – Pressure Meter Air
 - ASTM C173 – Volumetric Air Meter
 - ASTM C31 – Casting and Curing Cylinders and Beams
- ▶ Concrete.org

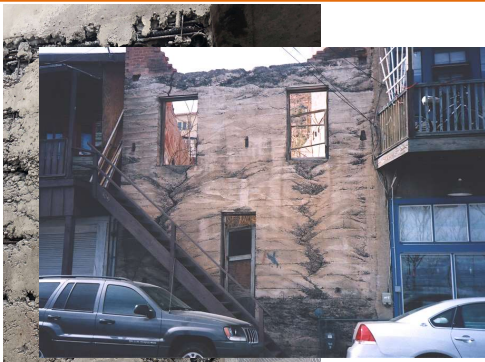
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What is Slump



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Slump is Important



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Failed Cylinders

Stay Calm

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What to do When Cylinders Fail

- ▶ Are you Calm?
- ▶ Yes – Great now what?
- ▶ Review the data ---- All the DATA!
- ▶ First example
 - Call came in with cylinder needing to meeting 5000 psi
 - What happened.

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BRAUN Compressive Strength of Concrete Report Date: 12/22/15
Sample: 10000
INTERTEC Client: _____ Project: _____

Sample Details

Job #	0	Construction	Subcontract
Specimen Size	6" x 12"	Cast By	000019
Specimens to Test	6	Sample From	Core
Test #	0100	Prepared By	000019
Test #	000000	Prepared By	000019

Location: _____

Location Details: _____

Sample Location Notes: _____

Batch Log

Inspector	_____	Strength	_____
Site Safety Administrator	None	Notes	_____

Field Measurements

Moisture	_____	Moisture	_____
Air Temperature (°F)	_____	Air Temperature	_____
Min. Min. Temp (°F)	_____	Min. Min. Temp (°F)	_____

Lab Test Results

Specimen	Age	Test	Load (kN)	Load (lb)	Strength (MPa)	Strength (psi)	Failure Type	Break	Compressive
201	7	000019	11.9	2.68	26.37	3820	SP	SL	N
202	7	000019	11.9	2.68	26.37	3820	SP	SL	N
203	7	000019	11.9	2.68	26.37	3820	SP	SL	N
204	7	000019	11.9	2.68	26.37	3820	SP	SL	N
205	7	000019	11.9	2.68	26.37	3820	SP	SL	N
206	7	000019	11.9	2.68	26.37	3820	SP	SL	N
207	7	000019	11.9	2.68	26.37	3820	SP	SL	N
208	7	000019	11.9	2.68	26.37	3820	SP	SL	N
209	7	000019	11.9	2.68	26.37	3820	SP	SL	N
210	7	000019	11.9	2.68	26.37	3820	SP	SL	N

10. The test result is for informational purposes.
 11. The test result shall be used for design purposes. Test cylinder will be tested at 28 days of age.
 12. The test result shall be used for design purposes as per ACI 308, Chapter 3.

Figure 1: THREE THREE THREE THREE THREE THREE

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-
- ▶ Cylinders cast 2/4 - set #39 - w/o 1300744. These cylinders had a high max temp of 113F. Had heater set at about 70 according to thermometer in box before I left site, when picked them up temp was a lot higher. Cylinders were from an Interior s.o.g pour at grids A.2 to B – 2.9 to 4.

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Data Review

- ▶ The data looks accurate and correct!
- ▶ Now what?

- ▶ **Remain Calm!**

- ▶ WE are going to follow the Building Code Requirements

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ACI 318 26.12.3.1

- ▶ ...satisfactory if both the following requirements are met
 - (a) Every arithmetic average of **any** three consecutive strength tests equals or exceeds f'_c

 - (b) No strength test falls below f'_c by more than 500 psi when f'_c is 5,000 psi or less; or by more than $0.10f'_c$ when f'_c is more than 5,000 psi

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What is a test?

- ▶ A test result is define as the average of two 6 by 12 inch cylinders or the average of three 4 by 8 inch cylinders.

	Age at time of Test	Specimen Size	Specimen	Compressive Strength (psi)
Specimen	7	4 by 8	A	2800
Specimen	28	4 by 8	B	4230
Specimen	28	4 by 8	C	4490
Specimen	28	4 by 8	D	4370
Average 28 day Compressive Strength				4360 Test Result

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Are all things Equal

Age at time of Test	Specimen Size	Specimen	Compressive Strength (psi)
7	4 by 8	A	2800
28	4 by 8	B	3500
28	4 by 8	C	4490
28	4 by 8	D	4370
Average Compressive Strength			4120 4430

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Example analysis

- ▶ Test result = Average of the cylinder in a set at a specific age

Set No.	Test Results (psi)	Running average of 3 Tests (psi)
1	4500	
2	4740	4300
3	3670	
4	4690	4450
5	4980	

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Example Analysis

- Remember the word "any"

Set No.	Test Results (psi)	Running average of 3 Test (psi)
1	4500	
2	4740	4300
3	3670	

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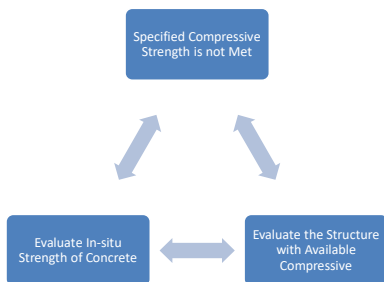
What's Next?

- Specified Strength = 5000 psi

Age at time of Test	Specimen Size	Specimen	Compressive Strength (psi)
7	4 by 8	A	2800
28	4 by 8	B	4230
28	4 by 8	C	4490
28	4 by 8	D	4370
Average Compressive Strength			4360

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Still not meeting strength !!!!!



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Coring

- ▶ Concrete in an area represented by core tests shall be considered structurally adequate if (1) and (2) are satisfied:
 - The average of three cores is equal to at least 85 percent of f_c' .
 - No single core is less than 75 percent of f_c' .

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Cores don't equal Cylinders



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Strength of Cores

f_c' (psi)	3000	4000	5000	6000
85%	2550	3400	4250	5100
75%	2250	3000	3750	4500

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Specification vs Construction Method

- ▶ Slump
- ▶ Pumpability
- ▶ Time between trucks
- ▶ Vibration

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When in Conflict



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Proper Planning



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Can't Plan for Everything



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No. 1 Call



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3

Cold Weather Concreting

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Work Must Continue



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ACI Documents

- ▶ 306R-10 – Guide to Cold Weather Concreting
- ▶ 306.1-90 – Standard Specification for Cold Weather Concreting

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Interesting Notes on 306.1-90

- ▶ Standard Specification ACI 306.1 is intended to be used by reference or incorporation in its entirety in the Project Specifications. Individual sections, articles, or paragraphs shall not be copied into the Project Specifications, since taking them out of context may change their meaning.
- ▶ NOT UP TO DATE ON DEFINITIONS

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Cold Weather - Definition



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Cold Weather -Definition

- ▶ Cold weather exists when the air temperature has fallen to or is expected to fall below 40°F during the protection period
- ▶ Protection period is the time required to prevent concrete from being affected by exposure to cold weather.

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ACI 306R – Guide Cold Weather Concreting

1. Prevent damage to concrete due to freezing
2. Assure concrete develops the required strength for safety
3. Maintain curing conditions that fosters strength development
4. Limit rapid temperature changes
5. Provide protection consistent with the intended serviceability of the structure

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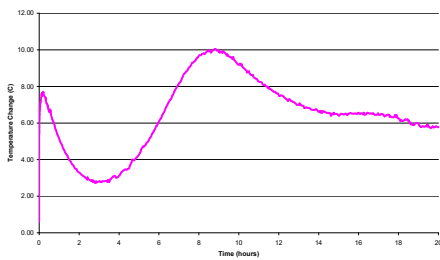
Initial Freezing of Concrete

- ▶ Concrete must be at least 500 psi prior to initial freezing cycle
- ▶ If frost damage occurs before then the damage is not reversible



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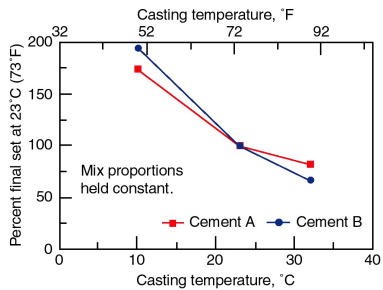
Heat Evolution During Hydration



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Affects on mixture Temperature

- ▶ Mix Temperature vs Initial Set



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Concrete Mixture Temperatures

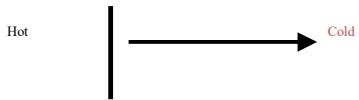
Table 5.1 - Recommended concrete temperatures					
Line	Air temperature	Section size, minimum dimension, in.			
		< 12 in.	12-36 in.	36-72 in.	> 72 in.
Minimum concrete temperature as placed and maintained					
1	-	55 F	50 F	45 F	40 F
Minimum concrete temperature as mixed for indicated air temperature*					
2	Above 30 F	60 F	55 F	50 F	45 F
3	0 to 30 F	65 F	60 F	55 F	50 F
4	Below 0 F	70 F	65 F	60 F	55 F
Maximum allowable gradual temperature drop in first 24 hr. after end of protection					
5	-	50 F	40 F	30 F	20 F

*For colder weather a greater margin in temperature is provided between concrete as mixed and required minimum temperature of fresh concrete in place.

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Prevention of Early-age Freezing

- Concrete should be covered, insulated, housed or heated as soon as possible after placement



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Need to get it covered



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Concrete Temperatures

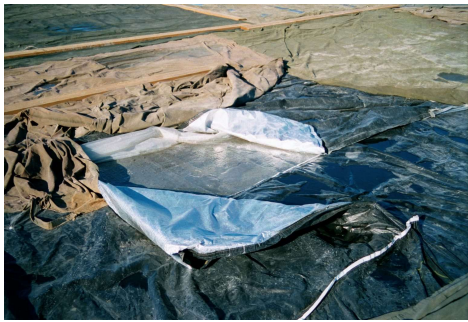
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2	Above 30 F	60 F	55 F	50 F	45 F
3	0 to 30 F	65 F	60 F	55 F	50 F
4	Below 0 F	70 F	65 F	60 F	55 F
Maximum allowable gradual temperature drop in first 24 hr after end of protection					
5	-	50 F	40 F	30 F	20 F

*For colder weather a greater margin in temperature is provided between concrete as mixed and required minimum temperature of fresh concrete in place.

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Curing



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Maintain Curing



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ACI 306 Does No Cover



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Develop a Plan



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Execute the Plan



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Heaters - Dusting



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Pre-Placement Preparation

- ▶ Surfaces in contact with concrete
- ▶ Embedment's
- ▶ Subgrade

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Remove Ice and Snow



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Large Embedment's

- ▶ Need to warm to above freezing.



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Subgrade

- ▶ NOT FROZEN
- ▶ Less than 20F Gradient with Concrete (Slabs)
 - Affects concrete
 - Settlement
 - Cracking
 - Set time
 - Heat Sink



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Field Cure Cylinders



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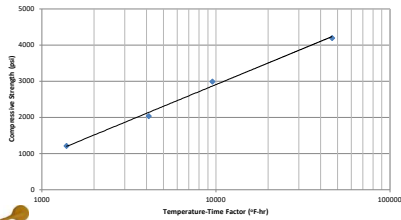
Size Matters



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How to Measure In-situ Strength

► Maturity



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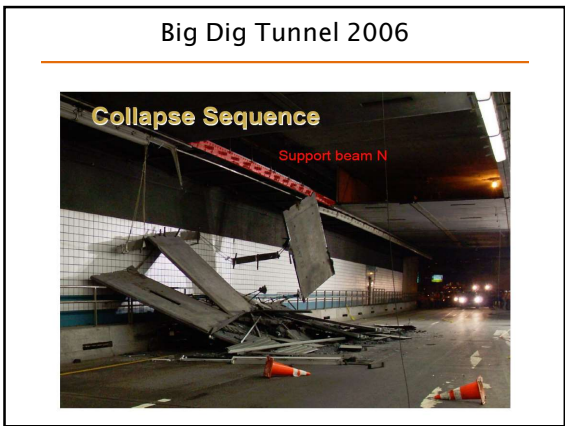
Worth Noting



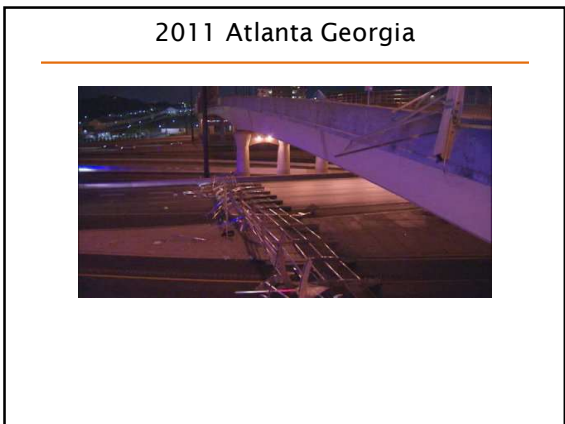
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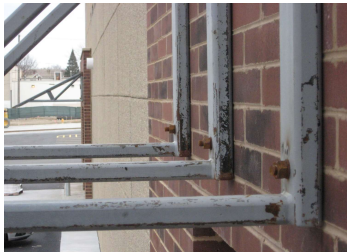
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Japan Sasago Tunnel 2012



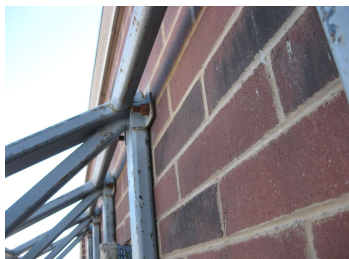
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Something Closer To Home



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How'd They Get the Nut On?



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Not Tight



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Pullout Test



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ACI Adhesive Anchor Certification



84

ACI Post Installed Anchor Inspector



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QUESTIONS?

agardiner@braunintertec.com



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