Rapid Bridge Deck Repair and the Use of Volumetric Concrete Mixer Trucks

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CTS Cement Manufacturing Corp.

Leader in advanced belitic CSA cement technology with an extensive history of providing innovative and high-performance cement products to the construction industry.

CTS Cement is the leading manufacturer of:

- A stand-alone, high performance, fast setting, high early strength Calcium Sulfoaluminate (CSA) cement

- A CSA-cement based expansive cementitious additive blended with local portland cement to create Type K shrinkage compensating concrete and grout materials
Leading manufacturer of belitic CSA (bCSA) cement technology

INFRASTRUCTURE
Highways, Roadways, Bridges and Viaducts

INDUSTRIAL
Water/Wastewater, Power & Energy, Manufacturing

INSTITUTIONAL
Schools, Universities, Healthcare, Correctional

GOVERNMENT
Federal, State & Local Agencies, Public Works

MARINE
Dams, Canals, Locks, Levees, Ports & Channels

COMMERCIAL
Retail, Hospitality, Recreation, Arenas, Convention Centers

MIXED USE
Urban Development, Multi-Family, Residential

AVIATION
Runways, Taxiways, Aprons, Hangars

MINING & TUNNELING
Shotcrete, Pumpable Grout, Cavity Fill, Pipe Liners

WHO WE ARE
Leading manufacturer of belitic CSA (bCSA) cement technology
1. What is Rapid Setting Cement?

2. RSC Testing

3. RSC Delivery via Volumetric Trucks

4. RS Mix Design vs. RS DOT Mix Design

5. RS Production & Placement
4 Main Categories of RSC

1. Accelerated portland cement
2. Calcium aluminate cement
3. Blended calcium sulfoaluminate cement
4. Non-blended belitic calcium sulfoaluminate cement (BCSA (Rapid Set®))
4 Main Categories of RSC

1. Accelerated portland cement
2. Calcium aluminate cement
3. Blended calcium sulfoaluminate cement
4. Non-blended belitic calcium sulfoaluminate cement
   *bCSA (Rapid Set®)*
A stand-a-lone, high performance, fast setting, high-early strength belitic-Calcium Sulfoaluminate (bCSA) cement
### Key Characteristics of Portland Cement Concrete

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strength Gain</strong></td>
<td>4350 PSI in 7 days</td>
<td>- Slow Return of Infrastructure to Service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Cost to traveling public and stakeholders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Safety concerns</td>
</tr>
<tr>
<td><strong>Shrinkage</strong></td>
<td>600-700 Microstrains</td>
<td>- Cracking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Slab Size (15-20 ft) - Distance Between Joints</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Cost of Joint Maintenance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Service Life (25-40 years)</td>
</tr>
<tr>
<td><strong>Porosity</strong></td>
<td>20-30% of Volume</td>
<td>- ASR, Ingress of Chlorides, Sulfates, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Service Life (25-40 years)</td>
</tr>
<tr>
<td><strong>Carbon Footprint</strong></td>
<td>0.9 t CO₂/ t cement</td>
<td>- Sustainability concerns</td>
</tr>
</tbody>
</table>
## Key Characteristics of BCSA Concrete

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Strength Gain</strong></td>
<td>**5070 PSI in <strong>1.5 hours</strong> <em>(w/o accelerators)</em></td>
<td>- Fast Return of Infrastructure to Service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Minimize Impact to traveling public and stakeholders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Minimize safety concerns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Ultimate compressive strength as high as 8700 PSI <em>(Higher strength than portland cement at equal w/c)</em></td>
</tr>
<tr>
<td><strong>Shrinkage</strong></td>
<td><strong>100-300 Microstrains @ 28d</strong> <em>(w/o shrinkage-reducing admixtures)</em></td>
<td>- Prevent Cracking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Slab Size *(up to 35 ft) - Distance Between Joints</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Reduce Cost of Joint Maintenance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Service Life <em>(80-100 years)</em></td>
</tr>
<tr>
<td><strong>Porosity</strong></td>
<td><strong>10-20% of Volume</strong></td>
<td>- Resistance to ASR, Ingress of Chlorides, Sulfates, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- High sulfate resistance due to absence of C₃A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Service Life <em>(80-100 years)</em></td>
</tr>
<tr>
<td><strong>Carbon Footprint</strong></td>
<td><strong>0.67 t CO₂/t BCSA cement</strong></td>
<td>- 32% Reduction in CO₂ Impact</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 65% Reduction in use of Natural Resources &amp; Energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- More Sustainable in Manufacture &amp; Service Life</td>
</tr>
</tbody>
</table>
FAST STRENGTH GAIN

Compressive Strength: ASTM C109

- **Days**
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7

- **PSI**
  - 80
  - 1000
  - 2000
  - 3000
  - 4000
  - 5000
  - 6000
  - 7000
  - 8000

**Lines:**
- Red: Rapid Set®
- Gray: Portland Cement

**Legend:**
- Rapid Set®
- Portland Cement
**Best Approach for RSC concrete:** Specify Early strength AND Low Shrinkage

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### Specified via ASTM C1600

**Standard Specification for Rapid Hardening Hydraulic Cement**

- **Compressive Strength (See Section 9 for procedures), min, MPa [psi]**
  - 6 h: . . . . . . 14 [2000] 10 [1500]

- **Drying Shrinkage, max %**
  - 7 days: 0.06 0.06 0.08 0.10
  - 28 days, air storage: 0.07 0.07 0.09 0.12

- **Min Time of Final Set C191 apparatus**
  - Minutes: 10 10 10 10
  - Autoclave, max expansion %: 0.8 0.8 0.8 0.8

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*The initial setting time typically ranges from 10 to 45 min for rapid hardening cements of various types and composition.*
Specified via ASTM C1600

Designation: C 1600/C 1600M – 08

Standard Specification for Rapid Hardening Hydraulic Cement¹

<table>
<thead>
<tr>
<th>TABLE 2 Optional Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sulfate expansion² (C 1012)</strong></td>
</tr>
<tr>
<td>6 months, max %</td>
</tr>
<tr>
<td>1 year, max %</td>
</tr>
<tr>
<td><strong>ASR Expansion²B (C 441)</strong></td>
</tr>
<tr>
<td>14 days, max %</td>
</tr>
<tr>
<td>56 days, max %</td>
</tr>
<tr>
<td><strong>Heat of Hydration (C 186)</strong></td>
</tr>
<tr>
<td>7 days, max, kJ/kg (kcal/kg)</td>
</tr>
<tr>
<td>28 days, max, kJ/kg (kcal/kg)</td>
</tr>
<tr>
<td><strong>Expansion in Water (C 1038)</strong></td>
</tr>
<tr>
<td>14 days, max %</td>
</tr>
</tbody>
</table>
### PRIMARY DIFFERENCES

- Early Strength Gain Element Achieves a Significantly Different Performance
- Exceptional Long-Term Strength Gain
- Durability is NOT Compromised for Speed
- Negligible $C_3A$ Content Achieves Absolute Sulfate Resistance

**Portland Cement Composition**

<table>
<thead>
<tr>
<th>ASTM C150 Type</th>
<th>C3S</th>
<th>C2S</th>
<th>C3A</th>
<th>C4AF</th>
<th>CS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>59</td>
<td>15</td>
<td>12</td>
<td>8</td>
<td>2.9</td>
</tr>
<tr>
<td>II</td>
<td>46</td>
<td>29</td>
<td>6.8</td>
<td>12</td>
<td>2.8</td>
</tr>
<tr>
<td>III</td>
<td>60</td>
<td>12</td>
<td>12-15</td>
<td>3.9</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>30</td>
<td>46</td>
<td>5-7</td>
<td>13</td>
<td>2.9</td>
</tr>
<tr>
<td>V</td>
<td>43</td>
<td>36</td>
<td>4-5</td>
<td>12</td>
<td>2.7</td>
</tr>
</tbody>
</table>

**Belitic CSA Cement Composition - Rapid Set**

<table>
<thead>
<tr>
<th>ASTM C1600</th>
<th>C4A3S</th>
<th>C2S</th>
<th>C3A</th>
<th>C4AF</th>
<th>CS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid Set</td>
<td>30</td>
<td>45</td>
<td>0</td>
<td>2</td>
<td>15</td>
</tr>
</tbody>
</table>

Quantities represent % composition
Advanced Hydration Mechanism

- Mix water is chemically retained (“bound”) within the ettringite structure
- More efficient use of mix water (minimal water of convenience)
- Contributes to rapid hydration process and strength gain
- Rapid formation allows fast repair & quick in-service turnaround
- Increases density
- Lowers porosity & permeability
- Enhances resistance to chloride penetration
**Portland Cement Concrete**

Only hydrates approximately 55% of the mix water leaving approximately 45% for evaporation.

**CSA-Based Cement Concrete**

Hydrates approximately 98% of the mix water leaving approximately 0-2% for evaporation.
LOW SHRINKAGE

Shrinkage: ASTM C157

% Length Change

Days

Rapid Set®
Accelerated OPC
### RING TEST | C1857 RESULTS

- **Net Time to Cracking**
  - Rapid Setting Belitic CSA – Average 1.66 psi/day
  - Accelerated Portland – Averaged average 22.53 psi/day

- **Stress Rate**
  - Accelerated Portland 14% higher
  - Higher Stress = Higher Probability of Cracking

- **Potential for Cracking**
  - Rapid Setting Belitic CSA: Low
  - Accelerated Portland: Moderate-High

- **ASTM C157 | Length Change**
  - Rapid Setting Belitic CSA exhibited only ~1/2 the shrinkage exhibited by Accelerated Portland
  - 0.20% RSBC vs. 0.045% AP

- **Performance Summary**
  - **Low Shrinkage**
  - **High Performance**

---

<table>
<thead>
<tr>
<th>METHOD</th>
<th>TRADITIONAL OPC + ADDITIVES</th>
<th>RS BELITIC CSA CEMENT</th>
<th>PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C157</td>
<td></td>
<td></td>
<td>Less than 1/2 the Shrinkage of OPC Concrete</td>
</tr>
<tr>
<td>• Length Change</td>
<td>Average -0.049%</td>
<td>Average -0.020%</td>
<td></td>
</tr>
<tr>
<td>• 3x Shrinkage Bars</td>
<td>29 Day Water Cure</td>
<td>29 Day Air Cured</td>
<td></td>
</tr>
<tr>
<td>ASTM C1581</td>
<td></td>
<td></td>
<td>Exceptional Crack Resistance</td>
</tr>
<tr>
<td>• Restrained Shrinkage, Not Time to Cracking</td>
<td>Average Cracked at 8.00 Days</td>
<td>Average None at 90 Days</td>
<td></td>
</tr>
<tr>
<td>• 3 Ring Specimens</td>
<td>50% RH, 73°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTM C1581</td>
<td></td>
<td></td>
<td>14x Lower Stress Rate</td>
</tr>
<tr>
<td>• Restrained Shrinkage, Cracking Potential</td>
<td>Average 22.53 psi/day</td>
<td>Average 1.06 psi/day</td>
<td></td>
</tr>
<tr>
<td>• 3 Ring Specimens</td>
<td>50% RH, 73°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTM C1581</td>
<td></td>
<td></td>
<td>Exceptional Crack Resistance</td>
</tr>
<tr>
<td>• Restrained Shrinkage, Cracking Potential</td>
<td>Moderate to High</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Results:</th>
<th>Belitic CSA Cement Mix #2013-006</th>
<th>Accelerated Portland Mix #2013-010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net Time to Cracking</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specimen 1</td>
<td>none @ 90.00 days</td>
<td>cracked @ 7.94 days</td>
</tr>
<tr>
<td>Specimen 2</td>
<td>none @ 90.00 days</td>
<td>cracked @ 8.54 days</td>
</tr>
<tr>
<td>Specimen 3</td>
<td>none @ 90.00 days</td>
<td>cracked @ 9.21 days</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td>none @ 90.00 days</td>
<td>cracked @ 8.80 days</td>
</tr>
<tr>
<td><strong>Stress Rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specimen 1</td>
<td>1.36 psi/day</td>
<td>33.16 psi/day</td>
</tr>
<tr>
<td>Specimen 2</td>
<td>0.27 psi/day</td>
<td>13.15 psi/day</td>
</tr>
<tr>
<td>Specimen 3</td>
<td>3.56 psi/day</td>
<td>36.28 psi/day</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td>1.66 psi/day</td>
<td>22.53 psi/day</td>
</tr>
<tr>
<td><strong>Potential For Cracking</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specimen 1</td>
<td>Low</td>
<td>Moderate-High</td>
</tr>
<tr>
<td>Specimen 2</td>
<td>Low</td>
<td>Moderate-High</td>
</tr>
<tr>
<td>Specimen 3</td>
<td>Low</td>
<td>Moderate-High</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td>Low</td>
<td>Moderate-High</td>
</tr>
</tbody>
</table>

*Specimens cast from Mix 1
**Specimen cast from Mix 2*
Concrete in new construction requires dimensional stability to ensure long-term performance is achieved.

For repairs, dimensional stability requires a strong bond between existing material and new material.

Bond failure is usually caused by shrinkage. Commonly soon after the new concrete material is cast.

Repair materials must be essentially “shrinkage-free” to maintain a strong bond.

RS Belitic CSA Cement provides dimensional stability by providing:

- Ultra low shrinkage
- Tenacious bond making it ideal for concrete repair, renovation and restrained placement applications
- Compatible with portland cement-based materials
- Creates a strong bond that eliminates shrink-back at patch or repair perimeters
- Prevents de-bonding
RS Belitic CSA Cement offers absolute sulfate resistance

- Contains negligible C3A content

**Sulfate Attack**

**After 2 Years**
- Type II Portland (8% C₃A)

**After 6 Years**
- C₂A₃₅ Cement (0% C₃A)
RS Belitic CSA Cement helps prevent corrosion due to chloride ion penetration by reducing common penetration points (shrinkage cracks, voids & capillary channels)

- Minimizing or eliminating drying shrinkage cracking
- Reducing the porosity and permeability* of the concrete
- *Mix design compatibility and versatility to achieve permeability requirements

- This destroys the protective film on metal reinforcement.
- When oxygen and moisture reach the unprotected reinforcement, corrosion begins.
Swelling reaction that occurs over time

Reaction between highly alkaline cement paste and reactive non-crystalline aggregates in the presence of moisture

RS Belitic CSA Cement helps mitigate ASR effects

- Ultra-low alkaline cement
When water freezes it expands, producing pressure in the pores of the concrete.

If pressure exceeds the tensile strength of the concrete, the cavity will expand and rupture.

Cumulative freeze-thaw cycles and disruption of paste and aggregate eventually cause cracking, scaling, and crumbling of the concrete.

RS Belitic CSA Cement helps prevent freeze/thaw deterioration by advanced, rapid hydration mechanism and rapid strength gain

- Rapid strength gain is ideal for lower temperature installations
- Ideal for emergency repairs in lower temperature conditions
- Efficient and essentially complete consumption of mix water
  - Helps prevent detrimental freeze/thaw effects (voids & capillaries within the concrete are prevented)
  - Addition of entrained air provides exceptional freeze/thaw performance (more consistent “small bubbles”)
Due to the high aggregate and sand content in concrete mix designs the coefficient of thermal expansion performance, as well as modulus of elasticity are substantially the same.

The influence of the performance of the cement paste itself will be immaterial.
• Maximum Utilization of $H_2O$ Used in Hydration
  – Eliminate Capillary Channels and Voids
  – Low Shrinkage

• Maximum Formation of Ettringite Crystals Achieves High 1 to 1.5 Hr. Strength (Up to 8,700 PSI)

• Can Have Expansive Qualities (Type K)

• High Sulfate Resistance (No C$_3$A)

- Low Porosity = Low Chloride Diffusion
- Low Permeability
- Maximum Durability
LOW CARBON FOOTPRINT

Global Warming Potential (kg CO₂e/metric ton)

- Reduce GWP of concrete mix designs using CSA cements
- Lower CO₂-equivalent per metric ton
- Reduced emissions from raw materials
- Fewer natural resources consumed
- Reduced energy consumption
- Meets GSA’s definition of top 20% of low embodied carbon (LEC) cement
- EPDs available
Fast-Setting Hydraulic Cement Materials ASTM C1600

- Concrete Mixes
- Concrete Resurfacers & Underlayments
- Mortar Mixes & Repair Mortars
- Non-Shrink Construction Grouts
- Smoothing & Patching Compounds
- DOT & FAA Concrete Paving & Overlays
- Polishable Concrete Toppings
- Stucco Materials
- Tunneling & Mining Products
- Shotcrete
- Flowable Fill (CLSM)
- Cementitious Slurry
- Hardscape Mortars
• Approach / Departure Slabs
• Control Density Fill
• Dowel Bar Retrofits
• Spall Repairs
• Bridge Joint Seals
• Closure Pours
• Pavement Notch Extensions
• Bridge Deck Hinge
• Partial & Full Depth Repairs
• Cast-in-Place (CIP) Pavement
• Continuous Reinforced Pavement
• Panel Replacements
• Bridge Deck Overlays
CSA cement can be used wherever OPC is used

- Greatest Value is Realized…
  - Anywhere Fast Strength Gain is Required
  - Where In-Service Time is Paramount
  - Re-Align Critical Path (Recapture Time)
  - When Project Schedules Fall Behind
  - When Delay Penalties are Impending
  - Opening On Time is Critical
  - Early Formwork Removal is Necessary or Beneficial
  - Revenue Generating Asset
  - Emergency Repairs
  - Fast-Track Projects
• Collapse of Interstate 10 Overpass
• Approach Slab Repairs
• Re-opened 74 days ahead
• $14.5m bonus for the contractor
Tyndall AFB
Laboratory Crater Repair
f. Rapid Set is recommended as the user’s choice for crater repairs due to its ease of use, controllable set time, performance, and fast cure time.

g. Future exercises should be conducted to determine if the recommended repairs could be completed in the 4-hr time frame using manpower and equipment similar to that available during expedient and sustainment operations.

h. The required cap thickness as a function of backfill strength and expected aircraft loading should be explored through additional field testing and/or the use of finite element models. Until this testing is complete, Table 34 provides a matrix of layer thicknesses for standard pavement sections for typical design aircraft, traffic levels, conservative material properties, and relevant environmental conditions for expedient and sustainment repair.
• Rapid Set Repair Mix is used by US Military all over the World at Bases for Concrete Repairs
• Shipped in one-ton sacks
Highway 280
San Francisco

```
Structural Repair of 4 Bridge Hinges
60' W x 25' L x 5' H Thick Sections
Self-Consolidating Mix Design
```

“Replacement work went without a hitch.”
- Joon Kang, Project Manager - CalTrans
Highway 280
San Francisco

**Specification**

1 Hour Workability  
Yes

Max. Shrinkage 0.045%  
0.019%

1,200 psi @ 3 hrs.  
2,957 psi @ 3 hrs

3,500 psi @ 4 hrs.  
4,000 psi @ 4 hrs

28” to 35” Displacement  
30”
Remove & Replace Hinges

1 Hinge Memorial Day

1 Hinge July 4th

2 Hinges Labor Day Weekend

Opened 3 Hours Early

Opened 10 Hours Early

Opened 7 Hours Early

“We used Rapid Set to improve efficiencies and meet the deadline at it is performing beautifully.”

- Joon Kang, Project Manager/CalTrans
METHOD OF DELIVERY

Most Common

- Standard trade practices for transporting, placing and consolidating apply
- Must provide enough time to allow for transport & placement
Volumetric On-Site Batch Plant

• Most common method for RS Concrete
• Mixed on-demand; produce the precise amount needed (“fresh concrete every time”)
• On site control of set time and slump
• Reduces waste
• Measures by volume instead of by weight
• Uniform proportioning
• Prevent short load challenges - Pay for actual usage
• Unaffected by traffic delays
• Ideal for remote locations
• Produced at a local batching plant
• Delivered to job site by tuck mounted in-transit mixers
• Measured by weight of ingredients
• Final quality & working time influenced by time in transit
• Retarders must be used
• Additional fees can apply
Figure 1. Typical mobile volumetric mixer.
• 25° - 30° for optimal mixing
• As low as 15°
• Higher angle = longer mixing time
• Lower angle = less mixing time
• Remember, mixing occurs on average between 10-15 seconds
• Maintaining optimal mix angle is key
Calibration
KEY TO SUCCESS

ASTM C685-17 “Standard specification for concrete made by volumetric batching and continuous mixing”

- Verify calibration of mix design
- 1/4 cu yd yield box
- Slump
- Air
Pros for RSC:
- Fresh concrete ALWAYS
- On-the-fly adjustments
- Less waste
- Easier for remote locations
- Emergency repairs
- Different mixes, same truck
- Several repair locations

Cons for RSC:
- Truck calibration can make or break performance
- Heavily reliant upon operator
- Auger can lock up if material is left inside
#1 Key to Success for Placing and Finishing RSC

Workers MUST be organized with a placement game plan.

Placing, finishing, and curing will occur in an accelerated time frame.
Placing of RSC is Similar to Portland Cement Concrete
PLACING & FINISHING

Proper surface prep

Effective removal of concrete to be replaced
Then clean and patch well
STANDARD HOT & COLD WEATHER PRACTICES

As Temperatures Increase
- Evaporation increases
- Set time decreases
- Water demand increases

As Temperatures Decrease
- Evaporation can vary
- Set time increases
- Water demand usually decreases

ACI 306R-16 Specification for Cold Weather Concreting

“The conditions of cold weather concreting exist when the air temperature has fallen to, or is expected to fall below, 40°F (4°C) during the protection period. The protection period is defined as the time required to prevent concrete from being affected by exposure to cold weather.”

ACI 305R-20 Specification for Hot Weather Concreting

“One or a combination of the following conditions that tends to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration, or otherwise causing detrimental results: high ambient temperature; high concrete temperature; low relative humidity; and high wind speed.”
With RSC

- Protection from evaporation when evaporation rate exceeds 0.2 lb./ft²/hr.
- Excessive surface drying and plastic shrinkage cracks can occur if not protected properly.
HOT WEATHER MITIGATION

- Liquid nitrogen
- Ice/chilled water
- Fogging
- Wet burlap / poly burlap
- Wind breaks
- Curing blankets
- Shade cement silo
- Moisten and turn aggregate piles
- Fill up with H₂O just before leaving for jobsite
- Use a retarder
COLD WEATHER MITIGATION

- Hot water
- Heat/dethaw subgrade
- Wind breaks
- Curing blankets (insulated and/or heated)
- Heat aggregate piles
- Portable heaters
- Heat curing box for cylinders
One of the Easiest Way to Improve the Longevity of Concrete…
…Often the Most Neglected Aspect of a Concrete Job

- Maintaining adequate moisture in the concrete
- Maintaining a proper concrete temperature range

- Durability
- Strength
- Water tightness (permeability)
- Abrasion resistance
- Volume stability
- Resistance to freezing and thawing
• Wet cure
  (burlap, poly burlap, curing blankets)

• Curing compound
  • PAMS (ASTM C309, Type 2, Class B)

• Others are not as effective

• Apply ASAP after final finish has been applied
• Not marring top surface
• Not washing away top paste
Thank You!

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