Amendments to the Specifications

Discussion of Changes to the Concrete Materials Specifications
What did we change?

- Portions of Section 90, “Portland Cement Concrete” of the Standard Specifications (portion of S1-020)
- SSPs S8-C04 and S8-C05
- All new SSPs S8-C02 and S8-C20
- Website for all specs:
No longer designating concrete by "Class", but by minimum cementitious material content and minimum strength.

Why?
Except for when a modulus of rupture is specified, the minimum required compressive strength for concrete shall be the strength specified, or 2,500 pounds per square inch, whichever is greater. Concrete shall be proportioned such that the concrete will attain the minimum required compressive strength.

For concrete not designated by compressive strength, the Engineer may test the concrete for compressive strength. The concrete will be accepted if the compressive strength at 28 days attains 85 percent or more of the minimum required compressive strength.

Default Compressive Strength = 2500 psi
Caltrans recently finished a study to evaluate the effect of limestone on concrete performance.

**Conclusion:**
- Cements tested with limestone had better short-term strength and less permeability, but slightly higher shrinkage (at 90 days).
- Accept the full 5 percent specified by ASTM C 150 but add shrinkage control.
Concrete shall be proportioned to conform to the following shrinkage limitations when tested in conformance with the requirements of AASHTO T 160, modified as follows:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Maximum Shrinkage of Laboratory Cast Specimens at 28 days Drying (average of 3, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paving and approach slab concrete</td>
<td>0.050</td>
</tr>
<tr>
<td>Bridge deck concrete</td>
<td>0.045</td>
</tr>
</tbody>
</table>

Note: Shrinkage requirement is waived for concrete that is used for precast elements.

What is a similar mix?
No cementitious material shall be used in the work unless it is on the Department's Pre-Qualified Products List at the time of mix design submittal. Information regarding cementitious material qualification and placement on the Department's approved list can be obtained at the Transportation Laboratory.
Blended cement shall conform to the requirements for Portland Blast-Furnace Slag Cement, Type IS (MS) or Portland-Pozzolan Cement, Type IP (MS) in AASHTO Designation: M 240, except that the maximum limits on the pozzolan content shall not apply. Blended cement shall be comprised of Type II or Type V cement and SCM produced either by intergrinding portland cement clinker and SCM, by blending portland cement and either finely ground granulated blast furnace slag or finely divided pozzolan, or a combination of intergrinding and blending.
SCMs

- Fly Ash A
- Fly Ash B
- UFFA
- Natural Pozzolan
- Metakaolin
- GGBFS
- Silica Fume
- RHA
The Equations

\[ E = m c^2 \]

\[ \frac{(25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL)}{MC} \geq 3.0 \]

\[ MC - MSCM - PC \geq 0 \]
Precast Options

A. \[ (25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL) \geq 3.0 \]

B. Fly Ash + LiNO₃

C. ASTM C 1567 (0.10% expansion)
To be considered "innocuous," aggregate must be on the Department's approved list, "Innocuous Aggregates for use in Concrete." Information regarding aggregate qualification and placement on the Department's approved list can be obtained at the Transportation Laboratory.

Both coarse and fine aggregate must be on the approved list for the aggregate used in concrete to be considered innocuous.

A. ASTM C 1293 -- 1 year -- 0.04% expansion
   or
B. ASTM C 1260 -- 16 days -- 0.15% expansion
Innocuous Aggregate…?

For Cast-In-Place Concrete (Equation 1):

\[
\frac{(25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL)}{MC} \geq 3.0 \ 1.8
\]

For Precast Concrete (Equation 3):

\[
\frac{(25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL)}{TC} \geq 3.0 \ 0.0
\]
Admixtures

A. Chemical Admixtures – ASTM C494
B. Air-entraining admixtures – ASTM C260
C. Lithium Nitrate shall be in an aqueous solution conforming to the following:
   1. Lithium Nitrate (LiNO₃) must be 30% +/- 0.5% by weight
   2. Sulfate (SO₄) must be less than 1000 ppm
   3. Chloride (Cl) must be less than 1000 ppm
   4. Alkalis (Na₂O + 0.658 K₂O) must be less than 1000 ppm

The Contractor may use a Type S admixtures conforming to the requirements in ASTM Designation: C 494.

- SRAs
- VMAs
- Lithium Nitrate
Other Exceptions to the Equations

Corrosion Control (S8-C04)  Freezing Conditions (S8-C05)
• The time allowed to obtain the minimum required compressive strength as specified in Section 90-1.01, "Description," of the Standard Specifications will be 56 days when the Contractor chooses cementitious material that satisfies the following equation:

\[
\frac{(41 \times UF) + (19 \times F) + (11 \times SL)}{TC} \geq 7.0
\]

ALLOW
56 days
Before using minor concrete or in advance of revising the mix proportions, the Contractor shall submit in writing to the Engineer a copy of the mix design. When required by the following table, the Contractor shall include compressive strength test results verifying the minimum specified compressive strength:

<table>
<thead>
<tr>
<th>SCM</th>
<th>Test Submittal Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fly Ash used alone</td>
<td>When portland cement content &lt;350 lbs/cy</td>
</tr>
<tr>
<td>GGBFS used alone</td>
<td>When portland cement content &lt;250 lbs/cy</td>
</tr>
<tr>
<td>Natural Pozzolan used alone</td>
<td>When portland cement content &lt;350 lbs/cy</td>
</tr>
<tr>
<td>More than 1 SCM</td>
<td>Always</td>
</tr>
</tbody>
</table>

Tests shall be performed by an ACI certified technician.

Cementitious material shall conform to the provisions in Section 90-1.01, "Description," and 90-2, "Materials."
Rice Hull Ash (S8-C02)

• The Contractor may use rice hull ash as a supplementary cementitious material (SCM) to make minor concrete. Rice hull ash shall conform to the requirements in AASHTO Designation: M 321 and the following chemical and physical requirements:

Only for
**SCC (S8-C20)**

- **self-consolidating concrete**: Flowing concrete capable of spreading to a level state without segregation and without the use of internal or external vibrators.

**TRIAL BATCH**

- J-ring test
- Bleeding
- Visual stability index
- Flow rate
- Column segregation
- Compressive strength
- Mock-up

- Slump flow
What does Caltrans get from these revisions?

- Stronger
- Longer Lasting
- More Dense
- More Durable

- Better ASR Protection
- More Corrosion Resistant
- Cheaper
- Sustainable

Greener (x2)
The Last Slide

E = mc²