

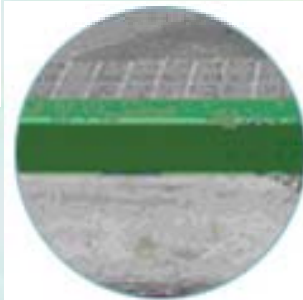
Amendments to the Specifications



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:
 - <http://www.dot.ca.gov/hq/esc/oe/specifications/SSPs/2006-SSPs/>



$$E = mc^2$$



Class Concrete

- No longer designating concrete by "Class", but **by minimum cementitious material content and minimum strength.**

- Why?



Compressive Strength

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

Intergrinding Limestone

❖ ASTM C150

❖ 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.

Shrinkage

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:

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

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

❖ What is a similar mix?



The List

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

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

SCM

SCM

S
C
M

SCM

SCM

SCM

SCM

SCM

SCM

The Equations

$$E = mc^2$$

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

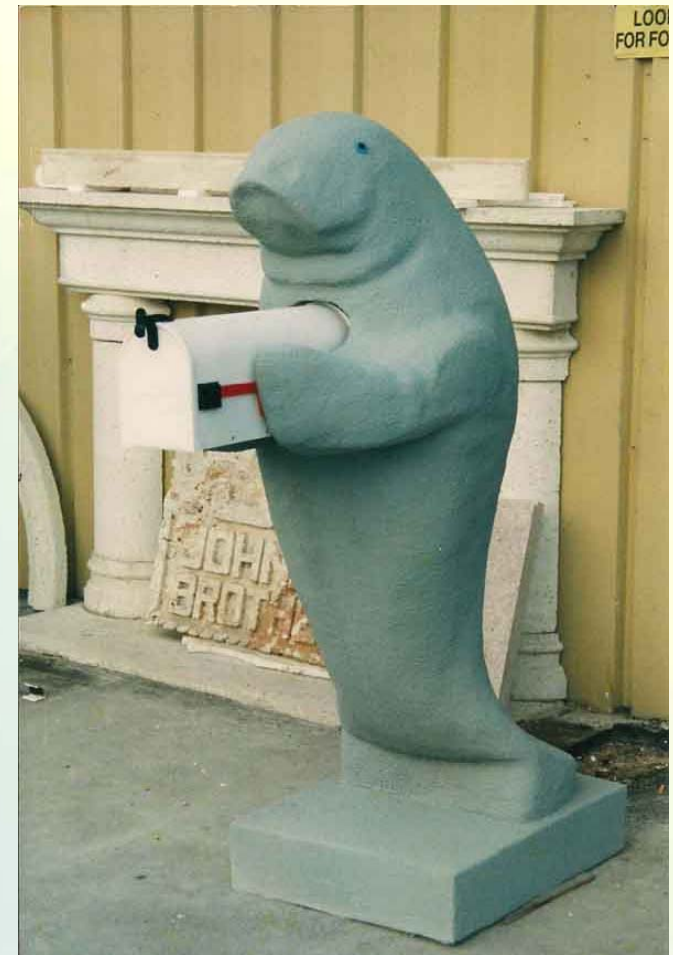
$$\text{MC} - \text{MSCM} - \text{PC} \geq 0$$

Precast Options

A.
$$\frac{(25 \times \text{UF}) + (12 \times \text{FA}) + (10 \times \text{FB}) + (6 \times \text{SL})}{\text{TC}} \geq 3.0$$

B. Fly Ash + LiNO_3

C. ASTM C 1567 (0.10% expansion)



Innocuous Aggregate

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):

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

For Precast Concrete (Equation 3):

$$\frac{(25 \times \text{UF}) + (12 \times \text{FA}) + (10 \times \text{FB}) + (6 \times \text{SL})}{\text{TC}} \geq \cancel{3.0} 0.0$$

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 (LiNO_3) must be 30% +/- 0.5% by weight
2. Sulfate (SO_4) must be less than 1000 ppm
3. Chloride (Cl) must be less than 1000 ppm
4. Alkalis ($\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$) must be less than 1000 ppm

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

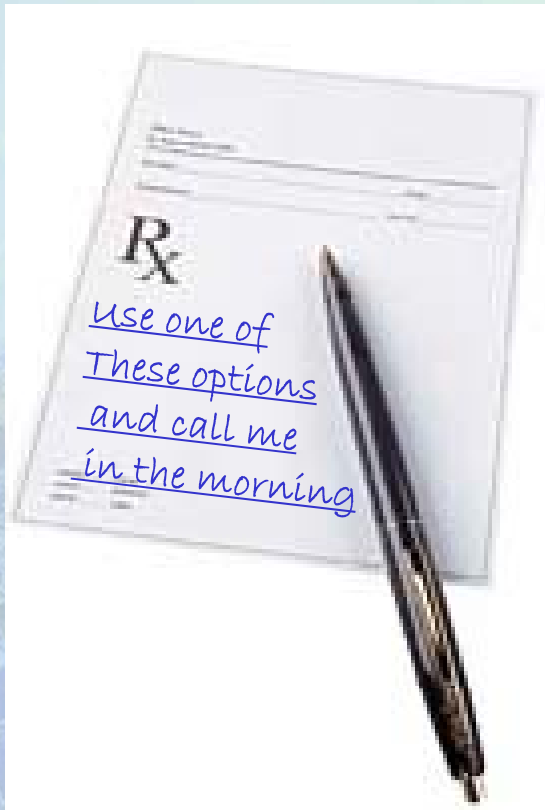


- **SRAs**
- **VMAs**
- **Lithium Nitrate**

Other Exceptions to the Equations

Corrosion Control (S8-C04)

Freezing Conditions (S8-C05)



Strength Development Time (S8-C02)

- 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



Minor Concrete

- 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:

<u>•SCM</u>	<u>•Test Submittal Required</u>
<u>•Fly Ash used alone</u>	<u>•When portland cement content <350 lbs/cy</u>
<u>•GGBFS used alone</u>	<u>•When portland cement content <250 lbs/cy</u>
<u>•Natural Pozzolan used alone</u>	<u>•When portland cement content <350 lbs/cy</u>
<u>•More than 1 SCM</u>	<u>•Always</u>

- 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**

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

What does Caltrans get from these revisions?

Stronger

Longer Lasting

More Dense

More Durable

Better ASR Protection

More Corrosion Resistant

Cheaper

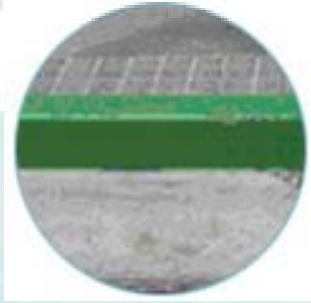
Sustainable

Greener (x2)





The Last Slide



$$E = mc^2$$