



Removing the Requirements of CA Test 515 from Structural Concrete

California Test 515, *Method of Test for Relative Mortar Strength of Portland Cement Concrete Sand*, (CT 515) is for the purpose of determining the compressive strength developed by mortar using a given concrete sand, in relation to that developed by mortar using Ottawa sand, and indirectly measures the concrete-making properties of the sand being tested.

At the time this test was developed, the Department was responsible for producing a basic mix design and specifying the cement content. To concrete mix designers, the results of CT 515 provided assurance that the sand proposed for use would not result in an excessive amount of water to obtain the required workability. Currently, Portland cement concrete (PCC) is specified by either strength or by cementitious material content and requires the Contractor to propose mix designs and supply cementitious materials to meet those requirements.

Per CT 515, test samples are prepared with a fixed amount of cement and sand, while water is added until a required flow is achieved. This produces different water/cement ratios which affects compressive strength. When manufactured sands are tested, their angularity and surface profiles require additional water to achieve the required flow, lowering the mortar compressive strength results. This can lead to rejection of otherwise suitable sand for PCC.

The concrete industry and specifications have evolved so that PCC produced today is more than a mixture of aggregate, water, and cement. It is more commonly a mixture of aggregate, water, admixtures (i.e. water reducers, plasticizers, etc.), cementitious, and supplementary cementitious materials that are designed for a given strength and workability.

Provided that fine aggregates meet soundness, durability, sand equivalent, and organic impurity tests, and concrete mix designs meet the other specified requirements, the Department is confident that the requirements of CT 515 can be removed from the Specifications. Engineering needs will still be met, and removal of this requirement can produce additional benefits of utilizing the existing aggregate supply.

When compared to natural sands, manufactured sands are generally characterized as having sharp, angular shaped particles. These properties may result in higher water demand, and concretes that are generally hard to pump or finish. Increased angularity of the fine aggregate in a concrete mix may produce concrete that requires extra effort to place, consolidate and finish. These potential issues can be managed with proper proportioning (mix design) of concrete which may include the use of chemical admixtures such as water reducers and superplasticizers.

Contracts Using the 2006 Standard Specifications

For contracts using the 2006 Standard Specifications (SS), the specifications¹ requires fine aggregates used in concrete to meet quality requirements and one of those is mortar strengths relative to Ottawa sand (CT 515).

Concrete for structures that was not specified by compressive strength was to contain a minimum amount of cementitious material based upon the element of the structure. The specifications² states that if the specified 28-day compressive strength is greater than 3,600 pounds per square inch, the concrete shall be designated by compressive strength and 42 days will be allowed to obtain the specified strength.

The *Construction Manual*³ requires that the frequency of sampling for compressive strength of concrete for bridges and major structures be 1 set of cylinders for every 300 yd³ or as required for acceptance. Minimum 1 set per job and class (mix design) of concrete for each day's production of critical structural elements.

Contracts Using the 2010 Standard Specifications

For contracts using the 2010 Standard Specifications, the specifications⁴ no longer requires that fine aggregates used in concrete meet the mortar strengths relative to Ottawa sand (CT 515).

The minimum required compressive strength for all concrete elements in structures is specified⁵ as follows:

Except for minor structures, the minimum required compressive strength for concrete in structures or portions of structures shall be the strength specified, or 3,600 pounds per square inch at 28 days, whichever is greater.

If the specified 28-day compressive strength is 3,600 pounds per square inch or greater, the concrete is designated by compressive strength. For concrete with a 28-day compressive strength greater than 3,600 pounds per square inch, 42 days are allowed to attain the strength described.

The specifications⁶ requires that if the concrete has a described 28-day compressive strength greater than 3,600 pounds per square inch, or if prequalification is specified, prequalification of materials, mix proportions, mixing equipment, and procedures proposed for use will be required prior to placement of the concrete.

¹ 2006 SS, Section 90-2.02B, *Fine Aggregates*.

² 2006 SS, Section 90-1.01, *Description*.

³ <http://www.dot.ca.gov/hq/construc/constmanual/>

⁴ 2010 SS, Section 90-1.02C(3), *Fine Aggregate*.

⁵ 2010 SS, Section 90-1.01D(5), *Compressive Strength*.

⁶ 2010 SS, Section 90-1.01D(5)(b), *Prequalification*.

Projects advertised after December 1, 2010 includes the 2010 Standard Specifications. Division of Construction, *Construction Manual Procedure Directive (CPD) 10-14, Relative Mortar Strength of Fine Aggregate*, provides procedures to allow this change by Contract Change Order if requested by the Contractor.

All Structure Construction personnel should continue to ensure that quality assurance testing for structural concrete is kept current with the requirements of the Construction Manual, i.e. compressive strength tests for every 300 yd³ or as required for acceptance and that job sampled compressive strength tests are taken on the earliest use of a concrete mix.