5.12 RAPID STRENGTH CONCRETE

5.12.1 GENERAL

This BDM provides information and guidance on the use of Rapid Strength Concrete (RSC) in reinforced concrete structures.

In the Standard Specifications [2], RSC is a type of concrete that gains strength quickly. Concrete strengths above 3,000 psi can be attained in as little as two hours.

The *Standard Specifications* allow two alternatives for fast-setting hydraulic cement used for the creation of RSC. The first is to use the cements specified in Section 90-1 including Type III portland cement. With this approach, the strength gain rate is accelerated using a chemical admixture. The second alternative is to use other hydraulic cement having chemistry that inherently achieves a rapid strength gain, such as modified high-alumina cement (MHAC) or calcium sulfoaluminate (CSA) cement.

5.12.2 GUIDANCE

Though concrete strength can be attained rapidly with RSC, its use has additional challenges, risks, and costs. Thought should be given to verify the need for its use and to selecting practical and realistic age and strength requirements. The following provides guidance for when it is appropriate to allow or require RSC and for issues that need to be considered:

1) When a concrete compressive strength of 3 ksi or more is required in less than 24 hours, allow or require the use of RSC.
2) Show on the plans the strength or strengths, as appropriate, required for any intermediate loading conditions, the strength required before opening the structure to traffic (i.e., opening age), and the 28-day compressive strength. For example, the designer of a deck-on-deck overlay might require 1,200 psi be obtained prior to applying the barrier rail construction loads, 3,600 psi prior to opening the structure to traffic, and a 28-day compressive strength of 4,000 psi.
3) MHAC and portland cement-based RSC will generally have a 0.3 water to cement ratio. From this, an approximate 28-day compressive strength of 10,000 psi can be anticipated. The CSA cement-based RSC strength curve is accelerated, but the ultimate strength is similar to conventional portland cement concrete. If a higher ultimate compressive strength of the concrete is problematic for the design, the special provisions will need to require a limit to the 28-day strength.
4) Accelerated strength gain can also produce higher curing temperatures. Mass concrete specifications should be considered when the least dimension exceeds 2 feet. Note that this does not necessarily mean cooling pipes will be needed.

The Contractor will be required to do a thermal analysis and determine what measures are to be utilized to prevent peak temperature from exceeding 160°F and prevent cracking due to thermal differentials during curing and hardening.

5) Type III and accelerated portland cement concretes are prone to having higher drying shrinkage when compared to conventional concrete. If additional shrinkage would be detrimental to the concrete performance, special provision shrinkage requirements need to be provided in addition to the existing RSC Standard Specifications and Standard Special Provisions.

Additional information and project experiences can be found in the Caltrans Concrete Technology Manual, Chapter 7 Caltrans Advancements/High Performance Concrete, High Early Strength. [1]

5.12.3 REFERENCES

1. Caltrans. (2013). *Concrete Technology Manual*, California Department of Transportation, Sacramento, CA.
2. Caltrans. (2018). *Standard Specifications*, California Department of Transportation, Sacramento, CA.