PLACING, COMPACTING, FINISHING, AND CURING FOR HIGH QUALITY CONCRETE (HQC) CONSTRUCTION

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Report No. CBU REP-318
May 1997

Presented and published at the Cement and Concrete Institute of Mexico Symposium
"World of Concrete - Mexico," Guadalajara, Mexico, June 4-7, 1997.
PLACEMENT OF HQC

Since HQC mixtures are made at very low water-to-cementitious materials ratio and pozzolanic additives and superplasticizer, they generally exhibit high viscosity. Thus the mixtures tend to be very cohesive and sticky. Therefore, proper care must be exercised to optimize bleeding while placing concrete in forms for slabs and for paving of roads. Segregation may also result leading to the formation of rock pockets and honeycombing. Segregation is known to increase with free fall drop distance of non-cohesive concrete during placement. Therefore, it is desirable to place ready-mixed concrete close to the final position at the job site. This is generally accomplished through the use of a drop pipe or chute. Additionally, rate of placement of concrete should be high enough to allow concrete to remain plastic while placing a new layer. This avoids formation of cold joints and planes of weakness between the various layers of placement. Concrete should be placed in uniform layer thickness and each layer should be compacted before placing the next layer.

COMPACATION OF HQC

Proper compaction of concrete is necessary to obtain HQC construction. This is especially true for concrete in the corners of the forms and around the steel reinforcement to eliminate pockets of entrapped air. Blistering should be minimized with proper use of form oil to allow migration of released air pockets. Sand content should be increased to minimize entrapment of air pockets against the forms. Since HQC mixtures are stiff, mechanical methods such as power tampers, vibrating screeds, or vibrators would be appropriate for obtaining improved compaction. Power tampers may also be desirable for walls and columns forms. Vibrators are commonly used to consolidate HQC mixtures. However, excessive vibration may cause segregation, more cement paste accumulating at the surface, an increase in bleeding, and loss of entrained air. It is also said
that a cohesive mix cannot be over vibrated with a proper selection of a vibrator (e.g., size of the vibrator, frequency of the
vibrator, and spacing of the insertion of the vibrator).

The vibrators can be either internal vibrators (immersion-type vibrators) or external vibrators (form vibrators) [1]. The
internal vibrator is more commonly used. In the case of heavy reinforcement and narrow clearance spaces, curved sections,
or in slip forming, external vibrators are used due to difficulties encountered when using the internal vibrators [2]. External
vibrators consume greater amounts of energy and are less effective compared to internal vibrators. External vibrators are
clamped to formwork. Therefore, they also require strong, rigid, and watertight formwork. The energy supplied by an
internal vibrator causes movement of solid particles (coarse aggregates) in the concrete. A diagrammatic representation of
the consolidation process of concrete during high frequency operation of an internal vibrator is shown in Fig. 1.
Fig. 1: Idealized Representation of the Influence of a High-Frequency Vibrator on Concrete Consolidation: (a) The mix is introduced into the form. (b) The vibrator moves aggregates closer together at the form face and cement-sand mortar begins to move outward. Air pockets collect on the face of the form. (c) The mortar continues to move through the coarse aggregate towards the face of the form. (d) The movement of mortar toward the face is complete. As the operator moves the vibrator down and up, air bubbles move upward along the form face and out of the concrete [2].

FINISHING OF HQC

Finishing of concrete is essential to produce a dense, compacted, well-graded surface for flatwork, especially slabs and pavements. This is accomplished through various steps. First, top surface of concrete is brought to the desired grade by striking off excess concrete through screeding. Then, bullfloating is performed to firmly embed large aggregate particles, compacting the surface and removing any imperfection that might be present. For obtaining high abrasion resistance, the
surface should be trowled after the bullfloating operation. Additional wear resistance can be obtained through treatment of the surface with chemicals. This treatment causes precipitation of insoluble compounds in the pores of surface layers.

**CURING OF HQC**

Generally, HQC exhibits a high rate of strength development and it is more susceptible to plastic shrinkage due to low bleed water resulting from use of pozzolanic additives, HRWA, and low water to cementitious materials ratio. This is particularly true with the use of silica fume.

Therefore, adequate water curing must be provided for HQC to avoid creation of any significant microcracks during curing.

Recently Naik and his coworkers [3,4] used a variable temperature curing environment (VTCE) for summer curing of high-performance concrete. The temperature fluctuation during the summer curing is shown in Fig. 2. Specimens cured in the VTCE showed a rapid rate of early
Fig. 2: Recorded Temperature for VTCE [3,4]

strength development, but long-term performance was inferior to moist-cured specimens. Based on a previous investigation, Mehta [5] reported that 7-day moisture curing was necessary for high-strength concrete. The concrete became impervious at 7 days of moist-curing which helped retain moisture needed for further hydration [6,7]. A longer curing may be desirable for concrete incorporating fly ash, slag, silica fume, or natural pozzolans.

REFERENCES


