

Standing Water and Concrete Placement

Q. A 5 ft (1.5 m) thick foundation mat slab has been prepared for concrete placement. Reinforcing steel was installed over a 3 in. (76 mm) thick mud (or working) slab with an area of approximately 25,000 ft² (2320 m²) finished flat (that is, no slopes or contours). There are puddles of standing rainwater deposited yesterday on top of the mud slab in random locations that range in depth up to 1/2 in. (13 mm). Are there any ACI requirements for placing concrete in such conditions?

A. ACI 318-14¹ introduced a new provision (26.5.2.1 (b)), also included in ACI 318-19,² that requires standing water to be removed unless a tremie is used “or unless otherwise permitted by both the licensed design professional [LDP] and the building official.” Unfortunately, some inspectors are applying this tremie requirement to “birdbaths” that are less than 1/4 in. (6 mm) deep. If tremie placement wasn’t anticipated during the design phase, it might not be possible to thread a pipe through several layers of reinforcement. Even though it might be possible to sweep or blow standing water using compressed air from a completely exposed surface, it may be impossible to remove standing water from the bottom of a footing, slab, or beam because interfering layers of reinforcement will limit access.

Section 4.4.3.2 of ACI 332.1R-18 provides support for avoiding tremie use by allowing the leading edge of the concrete mass to simply push incidental standing water out of the way: “In conditions where forming will permit water to be displaced by the greater mass of the concrete mixture, it can successfully be removed from the footing by the concrete placement. The placement of concrete into footing forms has sufficient hydrostatic pressure to displace standing water from the footing excavations, provided the footing form permits the water to exit. If this is not possible, standing water should be removed by draining or pumping. In either case, the bearing surface of the footing should be confirmed as firm before casting. Water that cannot be displaced by the concrete can alter the designed *w/cm* of the concrete mixture.”³

Similar recommendations can be found in Commentary Section R7.2.4 of ACI 332-20: “If the footing form permits water to exit, the hydraulic pressure of the concrete placement is sufficient to displace the water from the formed areas and prevent segregation.”⁴

In an article discussing standing water in residential concrete footings, Baty states that: “If the footings are excavated into the undisturbed soil and there is no point at which the slope produces a natural exit, the concrete placement force and weight is still likely to force the water to

exit over the top of the footing space. As long as the placement proceeds to fully displace the water, there should be no cause for concern.”⁵

In addition, based on the research and publications by Khayat, Gerwick Jr., and Hester:

- “Concrete similar to the STIFF mixture can be placed in a bottom-dumping skip that is covered and lowered gently in water over the repair area. The concrete may be allowed to fall a short distance through water. This drop should be limited to 15 in. (381 mm);”⁶ and
- “The free-fall of concrete through water must be minimized to reduce water erosion, even when the concrete is cast through an inclined tremie pipe. Free-fall distance of 6 in. (152 mm) can be tolerated in repairing shallow scour holes.”⁷

To help contractors deal with concrete placements when standing water is present, it would be advisable to include recommendations provided in ACI 332.1R-18 and ACI 332-20, as well as References 5, 6, and 7, in preconstruction meeting discussions until ACI can consider potential adjustments to the Code and Commentary.

References

1. ACI Committee 318, “Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14),” American Concrete Institute, Farmington Hills, MI, 2014, 519 pp.
2. ACI Committee 318, “Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19),” American Concrete Institute, Farmington Hills, MI, 2019, 624 pp.
3. ACI Committee 332, “Guide to Residential Concrete Construction (ACI 332.1R-18),” American Concrete Institute, Farmington Hills, MI, 2018, 61 pp.
4. ACI Committee 332, “Code Requirements for Residential Concrete (ACI 332-20) and Commentary,” American Concrete Institute, Farmington Hills, MI, 2020, 74 pp.
5. Baty II, J.R., “Standing Water in Prepared Footings: A Problem or a Precaution?” *Concrete Contractor*, May 6, 2020, <https://tinyurl.com/2u2mf8b3>.
6. Khayat, K.H.; Gerwick, Jr., B.C.; and Hester, W.T., “Self-Leveling and Stiff Consolidated Concretes for Casting High-Performance Flat Slabs in Water,” *Concrete International*, V. 15, No. 8, Aug. 1993, pp. 36-43.
7. Khayat, K.H.; Gerwick, Jr., B.C.; and Hester, W.T. “Concrete Placement with Inclined Tremie for Small Underwater Repairs,” *Concrete International*, V. 15, No. 4, Apr. 1993, pp. 49-56.

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