Measuring Air Content in Non-Air-Entrained Concrete

ASCC Position Statement #44

"Building Code Requirements for Structural Concrete (ACI 318-14)" and "Specifications for Structural Concrete (ACI 301-16)" specify minimum air contents for concrete to resist damage from cycles of freezing and thawing. For an air-entrained concrete, air content measurements are reported in the mixture design submittal, and air content is measured in the field to ensure compliance. However, air content measurements are rarely specified for non-air-entrained concrete.

Specifications such as ACI 301 and MasterSpec 033000—Cast-in-Place Concrete, however, require a *maximum air content* in concrete floors to receive a hard-troweled finish. ACI 301, Provision 4.2.2.4(d), for example, states that: "Concrete for slabs to receive a hard-troweled finish shall not contain an air-entraining admixture or have total air content greater than 3 percent."

"Guide to Concrete Floor and Slab Construction (ACI 302.1R-15)" provides the rationale behind this specification requirement in Section 8.4.7: "Air-entraining admixtures should not be specified or used for concrete to be given a smooth, dense, hard-troweled finish because blistering or delamination could occur. These troublesome finishing problems can develop any time the total air content is in excess of 3 percent. This is particularly true when embedded hardeners are applied." ASCC Position Statement #1, "Hard Trowel Finish on Air-Entrained Concrete," published in *Concrete International* in January 2003, detailed that organization's support for this recommendation.

Design professionals may assume that measurement of air content is not necessary for non-air-entrained concrete. That assumption, however, is *not true*.

"Report on Chemical Admixtures for Concrete (ACI 212.3R-16)" states in Section 6.7.2 that: "Some water-reducing admixtures may entrain air. Lignosulfonates entrain air to various degrees ranging from 2 to 6 percent, although higher amounts have been reported."

The 2017 report of RILEM Technical Committee TC 268-SIF titled "Surface Delamination of Concrete Industrial Floors and Other Durability Related Aspects Guide" also states that: "It can be concluded that some types of polycarboxylate-based admixtures can lead to a rather high level of air content of over 7%. For one type, this high level was present almost directly; for another type, this high level occurred after more than half an hour."

When water-reducing admixtures and waterproofing admixtures are used in concrete to receive a hard-troweled finish, ASCC concrete contractors have noted air contents exceeding 3%. In many cases, the contractors are not alerted to this issue because air content is not reported in the concrete mixture design submittal or measured during placement.

The investigations, repairs, and schedule delays associated with delamination are detrimental to any project. These issues can be avoided by measuring the air content of concrete mixtures that are to receive a hard-troweled finish. As previously noted, industry specifications require that the air content is no greater than 3%. This is a fixed limit—the ±1.5% tolerance provided by the Code, when a target (average) air content is specified, *does not apply*.

ASCC concrete contractors encourage owners to direct specifiers to require the measurement of air content of concrete that is to receive a hard-troweled finish. Enforcement of air content limits will help to avoid delamination issues, and benefit owners, specifiers, and contractors.

If you have questions, contact your ASCC concrete contractor or the ASCC Technical Hotline at +1.800.331.0668.

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