

# Freeze-and-Thaw Durability of Air-Entrained Concrete Using Indiana Aggregates

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## SYNOPSIS\*

This paper reports a study of the freeze-and-thaw durability of seven Indiana aggregates used in concrete with varying air contents. The purpose of the study was to determine the effect of air-entrainment on the durability characteristics of concrete made with certain aggregates which were chosen for their absorptive and performance characteristics as being fairly representative of those available in Indiana. Two aggregates used by Bugg were used as a means of correlating results of the two studies.

Each of the seven aggregates was divided into two groups. One group was vacuum-saturated and the other was subjected to 24-hour immersion before mixing. The air content from batch to batch for each aggregate was varied by increments of approximately 1 percent. Seventy-five batches were mixed with air contents ranging from 0.1 percent to 10.9 percent as determined by the pressure method.

Three 3 x 4 x 16-inch beams from each batch were subjected to freeze-and-thaw tests. Two of the three beams were cured 28 days in water, while the third was cured 14 days in water followed by 14 days dry-curing with one 4-inch side in damp sand. The dry-cured beam from each batch lost from 60 to 250 grams weight depending upon the absorption of the coarse aggregate used and the percentage of air entrained in the mix. This loss in weight was assumed to be the result of the evaporation of free water. The laboratory durability of the dry-cured beam, made with aggregates with poor performance records, was

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\* Reprints of the complete paper, appearing in the *Highway Research Board Proceedings*, 1948, may be secured from the Joint Highway Research Project, Purdue University. Since it has been printed elsewhere, we are omitting it here in the interest of economy.

improved several hundred percent in comparison with the two companion beams cured in water. A saturation coefficient has been devised to evaluate this marked increase in resistance to freeze-and-thaw testing.