

STRUCTURAL CONCRETE SUBDIVISION

JULY 1973

MASS CONCRETE

A PRELIMINARY INVESTIGATION OF LOW CEMENT CONTENT CONCRETE MIXES

Introduction

At the request of the Bridge Design Division, tests were conducted to determine the feasibility of obtaining 3000 psi concrete mixtures exhibiting lower heat of hydration for massive concrete structures. This objective was investigated by using Type II cement, reduced cement content, and a water-reducing admixture. Several mix designs were tested and compared to our normal Class B (6 bag) concrete.

MATERIALS

Following are listed the materials used in this investigation and their sources:

Aggregates:

Coarse and Fine

Caledonia Inc.
Waterford, Vermont

Cement:

Type II

Glens Falls Portland Cement Co.
Glens Falls, New York

Water Reducing Admixture:

W.R.D.A.

W. R. Grace & Co.
Cambridge, Massachusetts

Air Entraining Admixture:

N.V.X.

Hercules Powder Co.
Wilmington, Delaware

Procedure

Mix designs using 5 bags/c.y. and $5\frac{1}{2}$ bags/c.y. of cement were compared with Vermont standard Class B (6 bags/c.y.) concrete. In addition, the same reduced cement mix designs containing a water-reducing admixture were investigated.

A total of ten batches were mixed - two for each variation in design. Each batch was tested for air-content, consistency, and compressive strength at the ages of 3, 7, 14, and 28 days.

The mix designs followed procedures outlined in ACI 211.1-70 (Recommended Practice for Selecting Proportions for Normal Weight Concrete) and the quantities met the tolerances allowed in Vermont Standard specifications. The water-reducing admixture was used according to the manufacturers suggested rate of addition of 7 oz/sack.

Results

The objective of this investigation was to ascertain whether 3000 psi concrete could be obtained using less than 6 bags of cement per cubic yard. The results shown in the following table illustrate that the desired aim can be achieved with $5\frac{1}{2}$ bags/c.y. along with the addition of a water-reducing admixture.

This should result in a lower heat of hydration as would be desirable for mass concrete construction.

REFERENCE MIXES

5 Bag Mixes

	3 Days	7 Days	14 Days	28 Days	Air Content Percent	Slump inches
Batch #1	1556	2308	2732	3174	5½	2
Batch #2	1415	2122	2600	2821	6	3½
Average	1486	2215	2666	2998		

5½ Bag Mixes

	3 Days	7 Days	14 Days	28 Days	Air Content Percent	Slump inches
Batch #1	1910	2529	2971	3289	5½	3
Batch #2	1680	2157	2776	*2555	7	3½
Average	1795	2343	2874	3289		

* Not used in average

6 Bag Mixes

	3 Days	7 Days	14 Days	28 Days	Air Content Percent	Slump inches
Batch #1	2131	2891	3183	3634	5½	2½
Batch #2	1972	2741	3333	3218	5½	3 3/4
Average	2052	2816	3258	3426		

WRDA MIXES

5 Bag Mixes

	3 Days	7 Days	14 Days	28 Days	Air Content Percent	Slump inches
Batch #1	1645	2299	2723	2865	7½	2½
Batch #2	1273	2140	2600	2785	7½	3
Average	1459	2220	2662	2825		

5½ Bag Mixes

	3 Days	7 Days	14 Days	28 Days	Air Content Percent	Slump inches
Batch #1	2033	2847	3466	3784	7	2½
Batch #2	2175	3210	3519	3528	6	2
Average	2104	3029	3493	3656		