

Progress Report No. 1 (November 1, 2000 to June 30, 2001)

Lumps and Balls in High Slump Concrete: Reasons and Remedy

Selected Pictures



Picture 1: Composition of Concrete Balls



Picture 2: Concrete Lumps and Balls found from a Single Concrete Load

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Submitted to:



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Review of Activities (November 01, 2000 to June 30, 2001)

This interim report includes description and brief summary results of the activities completed during the first eight months of the project. The tasks that were undertaken: (1) Detailed literature review; (2) Feedback from the Department of Transportation (DOT) in other states on this problem; (3) Development of test models and protocol; and (4) Conduct first phase of tests at the selected concrete batching plant.

In the following, descriptions, brief results and status of each of the tasks are given:

Detailed Literature Review

In the first phase of the project, a comprehensive search was made to collect all published or unpublished literature on this topic from the research journals, conference proceedings, special reports and personal notes. Concrete suppliers and contractors were also contacted during this stage. It was found that very little literature is available on this topic and many researchers were unaware about this issue. However, some good references were found and used while preparing the test models.

Feedback from the Department of Transportation (DOT) in Other States

E-mails were sent to the Department of Transportation in 26 other states, inquiring them about this issue and asking their feedback. It was found that none of the states have any particular specifications on the remedial of lumps and balls in high slump concrete. They expect lumps-free concrete at the construction site and the concrete supplier is solely responsible.

Development of Test Models and Protocol

After consultation with professionals from CSR Rinker (Concrete Supplier) and Florida Department of Transportation (FDOT), the following variables were selected as the possible causes of lumps and balls in high slump concrete.

- Discharge rate
- Loading methods
- Plant type
- Sequence of mixing
- Head water/tail water ratio
- Mixing time

Using these variables, the test program was designed. The aim of the test program was to find out the following information about lumps and balls.

- What are they composed of?
- How big they are?

- When are they formed in the process?
- What are they caused by?

Test Results from the First Phase of Experiments

The first phase of experiments was completed at the CSR Rinker Concrete Batching Plant in Miami during April-May, 2001. A total 11 concrete loads were investigated by incorporating the following variables.

- Discharge rate (3 loads@ 150 lbs/sec, 200 lbs/sec and 250 lbs/sec)
- Load size (4 loads@ 3 yds³, 5 yds³, 7 yds³, and 9 yds³)
- Head water/tail water ratio and sequence of mixing.

The following tests were performed on each concrete load.

- Slump test (slump should be between 7.50-8.50 inches)
- Compacted density test
- Concrete surface temperature test
- Amount of entrapped air
- Compressive strength test at 7 and 28 days.
- Number of balls and their size-distribution.

The detailed test results are provided in Table 1 of the Appendix.

The tests were supervised by Dr. Irtishad Ahmad (FIU), Mr. Jerry Haught (CSR Rinker), Mr. Alberto J. Romañach, District Technical Manager (CSR Rinker), and Ms. Robbin Dano (FDOT).

The test results reveal that the head water/tail water ratio and the sequence of mixing play a vital role in the formation of lumps and balls in the high slump concrete. The number of lumps and balls were found to be reduced by reducing the amount of head water. However, since only one concrete load was

tested for each test condition (head water/tail water ratio), the results cannot be considered conclusive and further experimentation is necessary.

The ball sizes varied from 3 inches to 12 inches and no regular pattern was found. The balls were examined at the site for ingredients and found to be composed of wet mortar and aggregates with dry cement in the middle.

Future Activities Planned for the Next Quarter

After discussion with all the project partners during a meeting held in FIU on June 27, 2001, it was decided to exclude the variable “Plant Type” from the future experimentation due to limited budget and time and conduct the second phase of experimentation at the CSR Rinker Concrete Plant in Sweetwater. In the second phase the effect of the amount of head water and mixing sequence will be investigated further.

Remaining activities

Task 5: Second Phase of Experimentation

Task 6: Analyze Results

Task 7: Prepare Draft Final Report

Task 8: Review of Draft Final Report

This report represents a percentage of completion for the project of 40%

Appendix

Table 1: Test Results

Set	Load (Cu. Yd)	Discharge (lbs/sec)	Slump (in.)	Air (%)	Density (lbs/ft ³)	Balls					Total	fc'7 (psi)	fc'28 (psi)
						3"-4"	5"-6"	7"-8"	8"-10"	>10"			
A	9	150	7.75	2.00	142.0	11	4	7	1	0	23	6030	7600
	9	200	8.25	2.00	140.8	12	3	0	0	0	15	5970	7275
	9	250	8.50	2.00	142.0	13	8	9	5	5	40	5800	7775
B	3	200	8.0	2.25	139.6	0	0	0	0	0	0	--	6705
	5	200	7.5	2.00	141.2	2	0	0	0	0	2	5540	6983
	7	200	7.5	2.00	140.4	12	12	11	0	0	35	--	--
	9	200	7.5	2.00	140.8	17	15	8	2	3	45	--	--
C	9	200 (90% HW) ^{\$}	7.75	2.25	140.4	2	3	3	0	1	9	5910	7185
	9	200 (80% HW)	8.50	2.50	140.0	13	17	6	2	6	44*	5420	6765
	9	200 (70% HW)	8.00	2.00	141.2	3	1	1	0	0	5	5810	7125
	9	200 (65% HW)	7.50	2.50	140.0	0	0	0	0	0	0	--	--

\$ HW= Head Water

* Around 30% balls were flat or plate shape