ANEXO NO. 3. ENSAYO MORTERO DE RECUBRIMIENTO FALLA #1

Report
to

OPENAKA CORPORATION, INC.

EXAMINATION OF MORTAR COATING SAMPLE FROM A FAILED PRESTRESSED EMBEDDED CYLINDER PIPE, BOGOTA, COLOMBIA

Submitted
by

CONSTRUCTION TECHNOLOGY LABORATORIES
A Division of the Portland Cement Association
5420 Old Orchard Road
Skokie, Illinois 60077
May, 1984

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Construction Technology Laboratories
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TECHNICAL SERVICES REPORT

Project No.: CR-0673 Date: May 10, 1984

Re: Examination of Mortar Coating Sample from a Failed Prestressed Embedded Cylinder Pipe, Bogota, Colombia

One unlabeled mortar coating sample (Figure 1) was received March 12, 1984, from Mr. Robert Price, Openaka Corporation, Inc., Denville, New Jersey. The mortar sample was obtained from a failed section of the referenced prestressed cylinder pipe. Chloride content determination and petrographic examination of the sample were requested to aid in determining the cause(s) of pipe failure. Chloride content is given in a separate report.

FINDINGS AND CONCLUSIONS

Petrographic examination of the mortar reveals the following:

1. The interior surface of the mortar sample has impressions of wire strands. These impressions are coated with dark brown corrosion product; however, mortar in contact with the wire strands is uncracked. Corrosion of the wire strands is a possible cause of damage to the pipe.

2. Portions of the mortar contain very little paste, resulting in areas of high air content. This is interpreted to indicate less than optimal consolidation during mortar placement.

3. Due to high mortar porosity, much of the cement paste is carbonated and secondary calcite lines most voids, giving the mortar a mineralized appearance. The abundance of secondary calcite could be due to leaching of cement paste by water.

4. Unhydrated portland cement clinker particles (UPC's) are abundant (estimated as 15 to 20 percent by volume of paste). The paste is moderately hard and exhibits a vitreous luster. Paste-aggregate bond is tight. These data suggest a water-cement ratio in the range of 0.35 to 0.45.

Additional petrographic data are presented in the attached data form.

RECOMMENDATION

Petrographic examination of additional mortar coating samples and pipe core concrete is recommended to collect more information to aid in determining the cause of pipe failure.

METHODS OF TEST

Petrographic analysis was performed in accordance with ASTM C 856-77, "Petrographic Examination of Hardened Concrete." The analysis included:

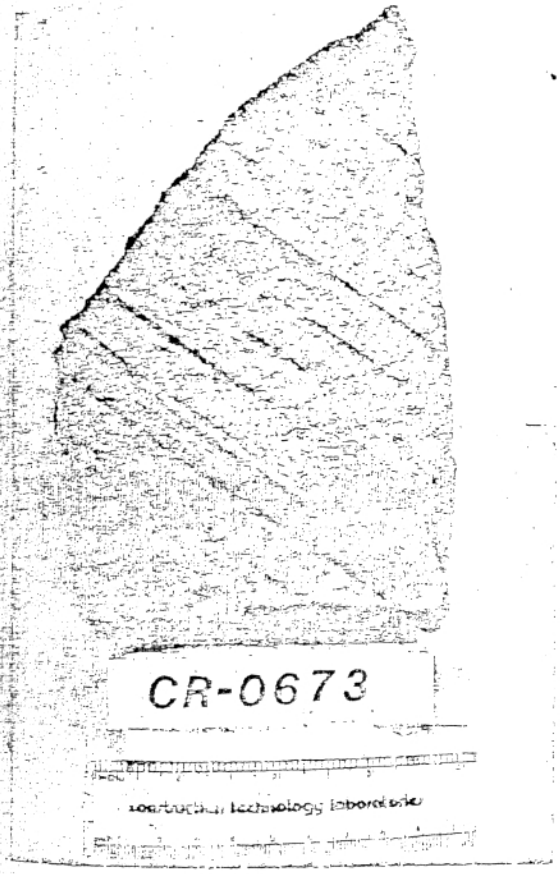
study of a longitudinally cut and polished mortar slice and freshly fractured mortar surfaces under a low-power (8x magnification) steroemicroscope; and

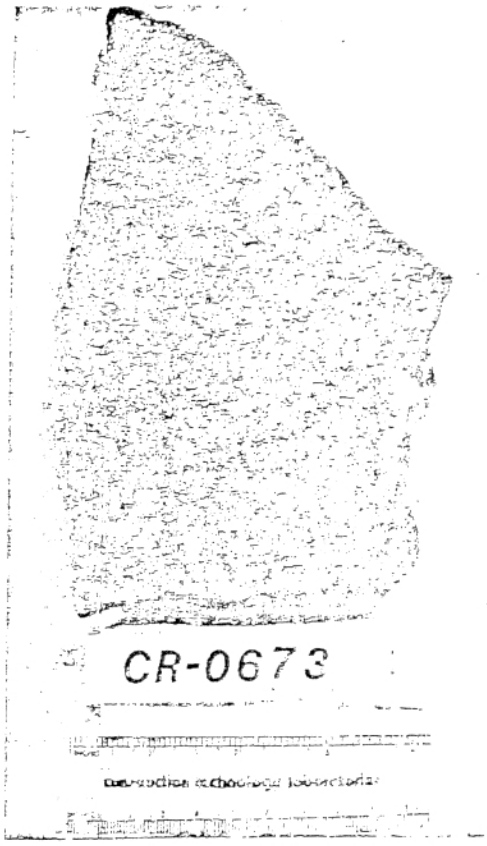
2. examination of a thin section (20 microns thick) using a high-power (200x magnification), polarizing-light microscope.

James W. Schmitt
Petrographer
Technical Services Department

JS/tf
CE-0673
Attachment

Copies to--
D. C. Sikes
A. A. Alonzo





Exposed surface

Interior surface showing impression of wire strands

Figure 1. Mortar coating sample as received for petrographic examination.

CONSTRUCTION TECHNOLOGY LABORATORIES
A Division of the Portland Cement Association

Project No.: CR-0673
Problem: Pipe Failure
Examined by: J. W. Schmitt J.W.S.

Client: Openaka Corporation, Inc.
Structure: Mortar coating prestressed embedded concrete cylinder pipe

Date: April 16, 1984
Location: Bogota, Columbia

Petrographic Examination of Hardened Concrete, ASTM C 856

Sample Designation, Dimensions	Reinforcement	Cracks, Joints, Large Voids	Sample Exterior	Sample Interior	Aggregates (A)			
					Coarse (C)	Fine (F)	Gradation & Top Size	Shape & Distribution
nlabeled mortar oating sample. aximum mortar hickness = 1.4 in.	Impression of wire strands along interior sample end. Corrosion product occurs in strand impressions.	Some areas of little paste and high air content, suggesting less than optimal consolidation.	Somewhat irregular surface partially covered with soil.	Somewhat irregular surface with impression of corroded wire strands.	Not applicable	Natural sand composed of quartz.	Fairly well-graded within sand sizes; measured maximum aggregate size is 2.5 mm.	Subangular t well-round; even aggregate distribution

Paste (P) Color	Paste Hardness	Paste Luster	Calcium Hydroxide*	Unhydrated Portland Cement Clinker Grains (UPC's)*	Carbonation	Miscellaneous
ght- ownish ay	Moderately hard	Vitreous	Not determined due to intense paste carbonation	15 to 20%	Patchy throughout sample.	Estimated air content = 8 to 10%. Estimated paste proportion = 15 to 17%. Estimated water-cement ratio = 0.35 to 0.45. Tight paste-aggregate bond. Much secondary calcite lines voids.

*Calcium hydroxide and UPC's expressed as percent by volume of paste.

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REPORT OF CHLORIDE ANALYSIS

Project No.: CR-0673-4110 Date: April 9, 1984

Sample(s): One Unlabeled Mortar Coating Sample

Submitted by: Openaka Corporation (Mr. Robert Price)

Water-Soluble Chloride Analysis by Potentiometric Titration with Silver Nitrate

Determined	Estimated
% Cl^- by Wt. of Mortar	% Cl^- by Wt. of Cement
< 0.003	---

The chloride concentration reported for the mortar sample analyzed is below detection limits by the method of analysis employed and is considered negligible.

A. Aboyade-Cole

A. Aboyade-Cole
Associate Research Chemist
Technical Services Department

AAC/jlr

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