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ATTACHMENT "C" 2

ERLIN, HIME ASSOCIATES

MATERIALS AND CONCRETE CONSULTANTS

311 SKOKIE BOULEVARD
NORTHBROOK, ILLINOIS 60062

(312) 272-7730

PETROGRAPHIC STUDIES OF CONCRETE

FOR

CONSTRUCTION ENGINEERING CONSULTANTS

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SUMMARY AND DISCUSSION

The specimen represented air-entrained concrete made with crushed fossiliferous coarse aggregate and siliceous fine aggregate and a low water-cement ratio paste. There was no evidence that the aggregates had been either chemically or physically unsound.

The specimen was from an area where fractures had existed for a period of time and where moisture had been present. That was demonstrated by secondary deposits on fracture surfaces.

The specimen was relatively small. Larger specimens from different areas of the structure would be desirable for examination in order to obtain a better representation of the concrete.

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INTRODUCTION

Reported herein are the results of petrographic studies of a concrete fragment submitted by J. Artuso of Construction Engineering Consultants. The specimen is from the dome of the containment structure of the Florida Power Corporation, Crystal River, Unit III.

Requested by Mr. Artuso were petrographic studies for evaluating the specimen, and particularly for evidence of features that would cause volume instability.

01102

STUDIES

Specimen - The specimen was an elongated fragment having nominal lateral dimensions of 5 inches, and a maximum thickness of about 3/4 inch.

All surfaces were fracture surfaces except for a shallow channel about 3/32 inch wide and 1/8 inch deep. The channel appears to be the terminal area of a saw cut.

Petrographic Studies - Coarse aggregate of the specimen was a buff to light brown, fine-grained, fossiliferous limestone having a maximum nominal size of 3/4 inch. The fine aggregate was a siliceous sand composed principally of quartz.

The aggregates were not particularly well graded, as evidenced by deficiencies of the finer sizes of the coarse aggregate and the coarser sizes of the fine aggregate.

There was no evidence that the aggregates had been chemically or physically unsound. Particular attention was directed to alkali-silica reactivity with respect to the coarse aggregate because a similar type of aggregate does contain a highly reactive variety of chert. Neither the chert nor the product of the reaction of the chert with alkalies (alkali-silica gel) was present.

Paste of the specimen was medium dark grey, firm, and contained abundant residual and relict cement. The quality of the paste reflects a low water-cement ratio.

Air occurred as small, discrete, spherical voids that occasionally were very slightly distorted, and as coarser irregularly shaped voids. The spherical voids are characteristic of entrained air voids; the irregularly shaped voids, of entrapped air. The air content of the specimen is estimated to be 5½ percent and the parameters of the air-void system are judged to be effective for protecting critically saturated concrete exposed to cyclic freezing.

On one of the lateral surfaces were secondary deposits composed of tufts of fine acicular (ettringite) ($3CaO \cdot Al_2O_3 \cdot 3CaSO_4 \cdot 31H_2O$), and calcite ($CaCO_3$). (Ettringite) was also present as tufts in some air voids just below the fracture surface.

The fragment was not uniformly thick; it tapered to a knife-like edge. Along that edge, were fine fractures

oriented subparallel to the long axis of the fragment. The fractures transected coarse aggregate particles. On those fracture surfaces were secondary deposits similar to those described above.

The secondary compounds demonstrate that the fragment was from an area where fractures present for a period of time had been exposed to moisture.

May 10, 1976

Erlin, Hime Associates, Inc.

Bernard Erlin wgl

by Bernard Erlin, President
Petrographer

DIRECT TENSILE STRENGTH TEST RESULTS

CORE	AREA SQ. IN.	NOMINAL DIAMETER IN.	TOTAL LOAD LBS.	P.S.I.	REMARKS
Granite aggregate concrete 5000 p.s.i. value	8.19	3 1/4	3400	415	
	8.14	3 1/4	3200	390	
Crystal River Cores			Average 400 p.s.i.		
N Pour XVI	10.69	3 3/4	2500	230	All Coarse aggregate soft
M Pour XVIII	10.69	3 3/4	4600	430	Hard Coarse aggregate except two soft pieces
L Pour XV	10.69	3 3/4	5400	505	All hard coarse aggregate
L Pour 9B	10.69	3 3/4	5400	485	Most coarse aggregate hard
P Pour XIII	10.69	3 3/4	5400	505	All hard coarse aggregate
N Pour XII	10.63	3 3/4	3800	360	All small soft coarse aggregate
			Average 420 p.s.i.		

Note: The Granite Aggregate concrete cores fractured surfaces indicated all coarse aggregate was hard and dense and several pieces of the CA pulled out of the Matrix, indicating greater tensile strength than the Matrix. There was no pull out of the Crystal River coarse aggregate - all fractured at the fractured surface.

ATTACHMENT E

Preliminary Report of Crystal River Coarse Aggregate

Sieve	Wgt. Ret.	% Passing	ASTM Spec # 67
1	0	100	100
3/4	1.0	97	90-100
1/2	15.8	58	------
3/8	28.4	24	20-55
4	35.8	4	0-10
8	36.3	3	0-5
Pan	37.3		

	Test	Result	ASTM Specification
C-117	200 Wash Loss	1.3% (Primarily dust of fracture)	1% Max*
C-131	Los Angeles Abrasion	42 %	50% Max
C-123	Lightweight Pieces in Aggregate	0.2%	0.5% Max
C-29	Unit Weight of Aggregate	85.68 lbs/cu. ft.	No Spec
C-142	Friable Particles	Later	5.0% Max
C-235	Soft Particles	Later	5.0% Max
C-88	Soundness (Sodium Sulphate)	Later	12.0% Max
C-127	Specific Gravity and Absorption	Later	No Spec

*This limit may be increased to 1.5% if the material finer than a No. 200 consists essential of dust from fracture