CONCISE REPORT

REPORT OF PETROGRAPHIC EXAMINATION

Date: July 15, 2005

CTLGroup Project No.: [redacted]

Re: Petrographic Examination of Concrete Curb and Gutter Samples

Two concrete samples, designated B101 Curbs A and B, were received June 22, 2005 from Ms. [redacted], [redacted], West Chicago, Illinois. According to Ms. [redacted], the samples were removed from a curb and gutter because of concern with premature cracking. Reportedly, curb joints were spaced 8-feet apart and they were saw cut (2.5-in. deep) the following morning. Cracks reportedly were observed within 15 minutes of placement by a curb machine.

A 3-in.-diameter core (Figs. 1 and 2) was taken by CTLGroup from one of the submitted samples for examination. Petrographic examination was requested on this core to evaluate concrete properties and to investigate potential materials-related causes for the cracking.

FINDINGS AND CONCLUSIONS

Results of the petrographic examination are summarized below, with additional details presented in the attached data sheets.

Based on petrographic findings, the general nature and characteristics of the cracks strongly suggests they occurred while the concrete was still plastic. The cracks (Fig. 3) are discontinuous, pass around aggregate particles and do not extend full gutter thickness (9.7-in. depth). The cracks are not straight or sharp, as would be expected if cracking occurred at a later age (while the concrete was in the hardened state). A definitive cause for the observed cracks is not determined, although the cracks do not appear to be materials related. A site visit by an engineer is recommended to confirm joint spacing and establish a map of the overall crack pattern to assist in determining a definitive cause for the early-age cracking.

The concrete appears to be in general compliance with the submitted mixture information. The quality of the concrete is good, however, the condition of the concrete has been locally compromised do to cracking. With exception to the cracks, no other distress or major abnormalities are observed.

The concrete was produced using a relatively well-graded, ¾-in. top size, crushed limestone coarse aggregate and a natural sand fine aggregate dispersed fairly uniformly (Fig. 4) in a air-entrained, portland-cement paste. No supplementary cementitious materials, such as fly ash, are observed in the hardened paste matrix. The concrete is well consolidated.

Water-cementitious materials ratio, based on paste properties, is 0.40 to 0.50. Cement paste along surfaces of freshly fractured concrete is medium gray, hard to moderately hard and exhibits subvitreous luster. Paste-aggregate bond is tight to moderately tight.

The concrete is air entrained, based on the presence of small, spherical voids. Air content is estimated at 3 to 5%. Air-void distribution is uniform.

METHODS OF TEST

Petrographic examination was performed in general accordance with ASTM C 856-04, "Standard Practice for Petrographic Examination of Hardened Concrete." The core sample was visually inspected and photographed. The core sample was then cut longitudinally and one of the surfaces was lapped and examined using a stereomicroscope at magnifications up to 45X. Surfaces of freshly fractured concrete were also studied with the stereomicroscope.

A small rectangular block was cut from the top surface of the core sample to a depth of approximately 1.6 in., placed on a glass microscope slide with epoxy, and reduced to thickness of approximately 20 micrometers (0.0008 in.). This thin section was studied using a polarized-light (petrographic) microscope at magnifications up to 400X to determine aggregate and paste mineralogy and microstructure.

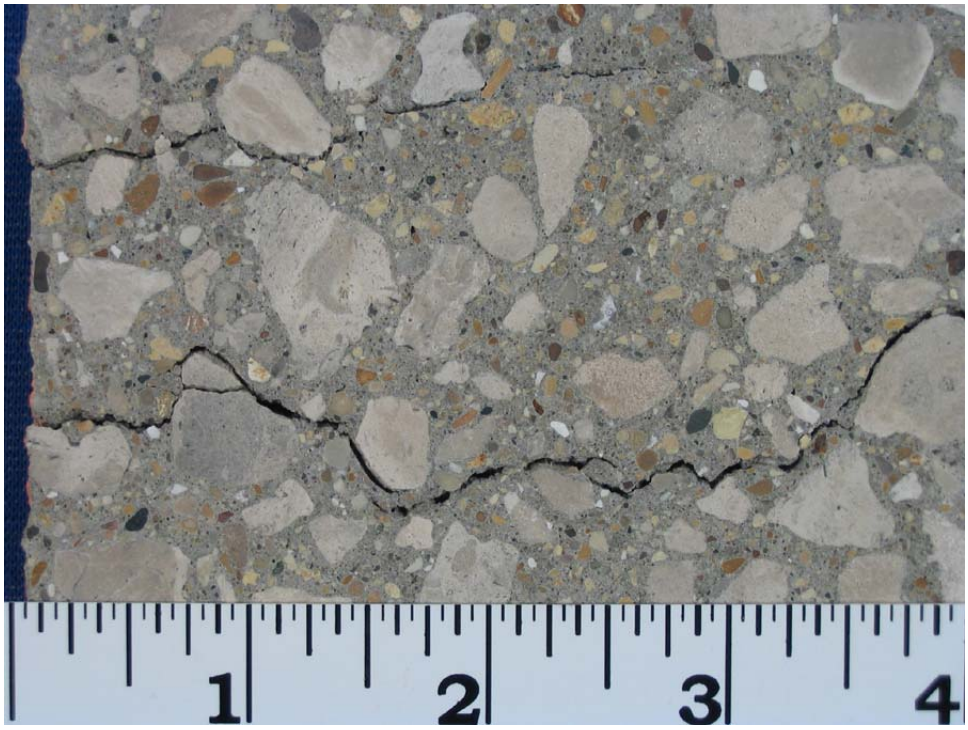
SAMPLE RETENTION

Your samples will be retained for 90 days when they will be discarded, unless we hear otherwise from you.

[redacted]
Senior Petrographer
Microscopy

Fig. 1 Top surface of core sample, as received.

Fig. 2 Side view of core sample, as received. Top surface is to the left.



3a. Lapped surface.

3b. Cored cylindrical surface

Fig. 3 Photomicrograph of near-surface concrete showing the crack(s).

Fig. 4 Lapped cross-section of the core sample showing the general appearance and condition of the concrete. Top surface is to the left.

PETROGRAPHIC EXAMINATION OF HARDENED CONCRETE, ASTM C 856

CTLGROUP PROJECT NO.: [redacted] *DATE*: July 15, 2005

CLIENT: [redacted] *REPORTED PROBLEM*: Cracking

STRUCTURE: Curb *EXAMINED BY*: [redacted]

LOCATION: Not stated

SAMPLE

Identification: Core Sample 1.

Dimensions: Diameter 2.9 in. Length13.5 in.; partial curb thickness.

Top Surface: Broom-finished surface exhibits discontinuous cracks.

Bottom Surface: Fracture surface passes through and around aggregate particles.

Cracks, Joints or Large Voids: A few discontinuous cracks observed on core top surface extend nearly vertically to depths as much as 9.7 in., and passing around aggregate particles. No joints or unusually large voids observed.

Reinforcement: None observed in core sample examined.

Unit Weight: 148 pcf, as received.

AGGREGATES

Coarse: Crushed carbonate rock composed of limestone.

Fine: Natural sand composed mainly of quartz, limestone, feldspar, quartzite, granite, chert, and small amounts of various other rocks and minerals.

Gradation & Top Size: Relatively well graded to a top size of ¾ in.

Shape & Distribution: Coarse aggregate particles are angular to sub-rounded, elongate or bladed to equant; distribution is fairly uniform. Fine aggregate particles are angular to well rounded, elongate to spherical; distribution is fairly uniform.

PASTE

Color: Medium gray.

Hardness: Hard to moderately hard.

Luster: Subvitreous.

Paste-Aggregate Bond: Tight to moderately tight.

Air Content: Estimated at 3 to 5%. Concrete is air entrained. Air-void system is fine (small voids). Air-void distribution is relatively uniform.

Depth of Carbonation: Approximately 0.015 in. from core top surface; deeper along surface cracks.

Calcium Hydroxide*: Estimated at 5 to 10%.

Unhydrated Portland-Cement Clinker Particles*: Estimated at 5 tom 10%.

Supplementary Cementing Materials*: None observed.

Secondary Deposits: None observed.

MICROCRACKS: A few randomly-oriented microcracks are observed in the body of the concrete.

ESTIMATED WATER-CEMENT RATIO: 0.40 to 0.50.

MISCELLANEOUS: Moderate amounts of carbonate-rock dust are present in the paste matrix.

*percent by volume of paste