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DRAFT

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City of Industry, CA 91746

Subject: Mapping of Wall Cracks of Reservoir 5C
Subject: Reservoir 5C, City of Pomona, California

Dear Mr. Lam:

In accordance with your request we have reviewed the reports provided to us and performed a visual observation of the existing Reservoir 5C located in the City of Pomona. The subject reinforced concrete rectangular reservoir was designed in 2002 and placed in operation in 2004. The reservoir is approximately 305 feet long by 207 feet wide and approximately 27 feet high. The exterior walls are approximately 3-feet thick and the baffle walls are approximately 2-feet thick. Based on information provided by the City and our visual observation of the facility, it is clear that there are issues pertaining to the reservoir specifically with the extent of cracking and consequent leakage from the reservoir walls.

The contents of this report are strictly based on the information gathered from the reports provided to us and a visual observation during our site visits. Preparation of any calculations or laboratory tests and analysis were beyond the scope of our work. A report based on engineering analysis dated February 16, 2007 was prepared by Exponent Failure Analysis and later supplemented by a report dated January 28, 2008 titled "Cracking and Leakage at Reinforced Concrete Pomona Water Reservoir 5C." In the preparation of the later report results of laboratory testing have also been included. This report basically recommends monitoring, inspecting, and maintaining the existing repaired wall cracks. It also recommends repairing the concrete patch material on the inside of the tank. The first report, however, recommends the use of a liner as opposed to the repairing of cracks as the better option. The third report titled "Report on the Review of Exponent Reports Related to Cracks in Reservoir 5C – City of Pomona", dated September 9, 2009, provided to us, was prepared by AKD Consulting for SEMA Construction. This report rejects the liner option since it "treats the symptoms and not the root cause of the problem which are the cracks in the structure." It proposes an alternative method of repair by sealing cracks greater than 1/8-inch.

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In accordance with the results of the analysis presented in the aforementioned reports by Exponent Failure Analysis, cracks have developed in the wall because of lack of adequate temperature and shrinkage steel as mandated by ACI-350. These cracks are visible in both the exterior and interior baffle walls.

The reservoir was drained and made available for inspection for about a week. Inspections were done by ARC Engineering Staff (Dr. Bains and Mr. Dawedi) on 5-4-10 and 5-5-10, and by Mr. Dawedi on 5-7-10 and 5-10-10 while the reservoir was empty. Because of the limited time available for inspection only the interior walls could be mapped. As such, it is our opinion that the exterior walls are more critical at this juncture, therefore, it is imperative that these walls be maintained and rehabilitated before the interior baffle walls. Another inspection was done from the exterior of the reservoir once it was filled, on 5-27-10 by Dr. Bains, Mr. Dawedi, and Mr. Dhingra (AKD Consulting).

During inspection of reservoir from the interior, it was noticed that the walls were coated with a cementitious material similar to Xypex which has masked the visibility of cracks. However, cracks were mapped from the interior by the presence of sulphur/calcium leachate at the location of cracks. It was also noticed that an attempt has been made in the past to repair some of the cracks by grinding the cracks and filling with an elastomeric sealant. After the reservoir was filled, cracks which showed the presence of moisture were mapped from the exterior. In the attached drawings interior cracks are shown thinner than the exterior cracks. Moisture filled cracks have been labeled "wet" on the exterior thicker lines.

It is our understanding that at this stage, the City is looking for ways to rehabilitate the reservoir by getting a longer useful life for the least amount of money. In line with this ideology, and the fact that with the presence of coating on the interior walls it is difficult to assess the width of cracks, it is our opinion that the City should begin by addressing cracks which are leaking and at the same time adopt a maintenance program wherein, the reservoir is inspected on the exterior (for any signs of water leakage) once a month and probably twice a year from the interior. If however, the City wishes to address cracks based on the crack width (say 1/8-inch and larger for instance), then it would be recommended to remove the coating by water jetting or another similar method (water blasting) along cracks represented by the lechate (a 6 to 8-inch wide strip along the crack would be adequate). Once the crack is exposed and its width measured, the crack can be sealed by the method recommended in the paragraph below.

Most cracks that are actively leaking can be traced to cracks on the interior. Once the corresponding interior crack has been identified, approximately 2-inches of coating

material along the crack should be removed by water-jetting or a similar approach to completely expose the crack. Thereafter, use the following steps to seal the crack:

- Grind and chase the crack from the interior for a minimum of ¼-inch. If crack is still visible and crack width is 1/16 or larger, grind crack from the exterior also for a depth of ¼-inch to prepare for filling it with polyurethane elastomeric sealant. Should the crack width be greater than 3/8-inch the use of epoxy injection should be considered.
- Seal crack from the outside with polyurethane elastomeric sealant. Before sealing crack, Vee out the crack so that width at base is twice the depth (and width at surface is ¼-inch more than width at base).
- Inject crack from the inside with epoxy.
- Vee out crack from inside as outlined above.
- Thoroughly clean groove from inside and seal crack from the inside with polyurethane elastomeric sealant.
- Let sealant cure per manufacturer's recommendation before filling reservoir.

Summary and Conclusion:

Reservoir 5C located in the City of Pomona has been leaking since the day it was bought into service. Reports prepared in the past have contributed the leakage to cracks which developed due to inadequate temperature and shrinkage reinforcement in the walls. These reports have proposed solutions in the form of liner or sealing of cracks, with the sealing of cracks being the preferred choice.

After review of these reports and our site visit, cracks have been mapped to the extent feasible from the interior and exterior of the reservoir. Since the width of cracks cannot be determined from the interior due to the presence of coating on the walls, it is recommended to initially seal the cracks which are leaking (by preparing a "Vee" groove and filling with a elastomeric polyurethane non sag sealant) and at the same time adopting a maintenance program wherein, the reservoir is inspected on the exterior (for any signs of water leakage) once a month and probably twice a year from the interior.

We thank you for the opportunity to be of service to you. If you have any questions or need further information, please feel free to contact me at (626) 574-1425.

Very truly yours,
ARC Engineering

Gagan Bains, Ph.D., P.E., S.E.
Principal

APPENDIX



Photograph 1



Photograph 2



Photograph 3



Photograph 4



Photograph 5



Photograph 6



Photograph 7



Photograph 8



Photograph 9



Photograph 10



Photograph 11



Photograph 12



Photograph 13



Photograph 14



Photograph 15



Photograph 16



Photograph 17



Photograph 18



Photograph 19



Photograph 20



Photograph 21