HEROLD
ENGINEERING LIMITED
Consulting Engineers

September 28, 2009 2360-001/01

Deep Bay Water District
5031 Mountainview Road
RR #1, Site 150, C4
Bowser, BC V0R 1G0

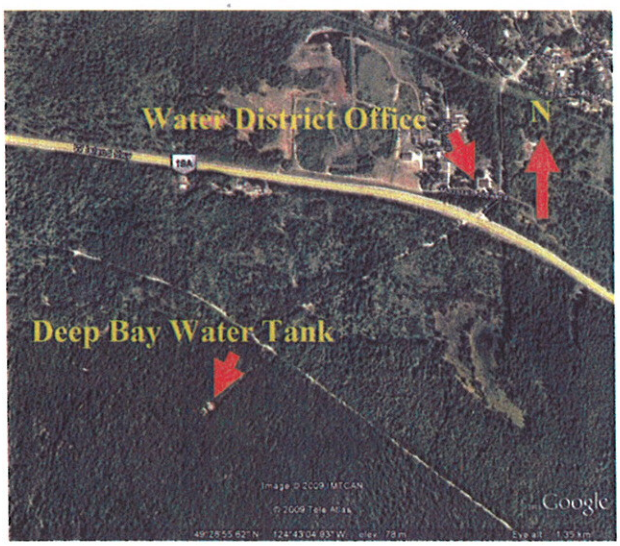
Attn: Leslie Carter, Board Administrator

Re: Deep Bay Water Tank
Preliminary Review of Cracking in Tank Walls

Dear Leslie:

As requested, we visited the above tank on September 8, 2009 to make a preliminary visual review of its condition and in particular, the cracking located at the corners of the tank. We also made a visit with a Sika products representative, Jim Caruth, P.Eng. on September 18, 2009 to discuss repair strategies for the deficiencies noted on the exterior of the tank. Below is a summary of our comments.

Location



The two chamber reinforced concrete tank was constructed in 1977. The tank is located off a gravel track just south of Highway 19a opposite the Water District Offices.

Drawings of its construction were provided, including the reinforcing details. Originally the tank was designed to be expanded and reinforcing from the walls of both cells extends out and is left exposed for this purpose.

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Observations

The general concrete surface of the tank appears in reasonable condition. There are some cracks which are leeching salts which are midspan of the tank and may require repair.

No spalling could be seen and the significant defects appear confined to the corners of the tank. It is understood that these defects are not evident on the inside of the tank; however it is recommended that a review of the interior be made to confirm this as it may help define the appropriate repair strategy.

The defects also coincide with what appears to be previous concrete repair work. It is understood from the board that there is some record of these repairs being carried out in around 2001.

The defects are in the form of cracking and spalling of the repair which appears to have been done to address cracking to the original concrete.

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Comments

A brief review of the original design drawings indicate that there is sufficient reinforcing in the walls; however the corners could have been detailed to better accommodate thermal and shrinkage stresses. Also on some walls, the reinforcing on the inside face of the wall is a greater spacing than that of the outside face. This wider spacing would be less able to control cracking; however we understand that no cracking is evident on the inside face. Whether these drawings reflect the true construction would need verification.

The repairs made around 2001 are beginning to delaminate and there is seepage through the walls at these points with significant efflorescence. The wet concrete in these locations is therefore vulnerable to freeze/thaw action and it is expected to get worse each winter. There is also parging around the repairs which is delaminating and appears to have been done to surface protect the repair and cover and defects in the concrete surface. This is particularly evident on the north wall of the tank.

As far as could be ascertained from a visual inspection, there did not appear to be any spalling as a result of reinforcing corrosion and the defects appear related to original construction/ detailing issues at the corners (likely shrinkage or thermal cracking at the corners of the tank where the associate stresses would be high).

Recommendations

Ideally the cracks would be repaired both inside and outside of the tank. The interior repairs would prevent the water penetrating the concrete with the exterior repair being the impermeable barrier. It is considered better to stop the water penetrating the cracked concrete as early as possible and then the exterior repairs can be cosmetic. This would require a review of the inside of the tank to identify any cracking.

The tank should also be reviewed after this winter as it may suffer further damage from freeze/ thaw attack. Ideally repairs should be done in the spring to improve curing of the repair products.

In some cases, the concrete is cracked to a point where the concrete needs replacing (lower north east corner) as a patch or crack repair would be uneconomic due to the volume of material required.

At this moment in time, I would estimate the cost of the repairs to be in the range of $20,000 to $30,000. However we advise talking to a contractor to discuss costs as costing is not our field of expertise. With ongoing monitoring, the work could be phased, dealing with the worst areas first. In this case, the northeast corner appears to be the most damaged area.

There are many repair products on the market; however in most cases the repair strategies would be similar. In this instance, we made a second visit with Jim Caruth, P.Eng. of Sika to get comment in terms of repair strategy. Jim made the following recommendations with which we concur:

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- Find and seal the cracks inside the tank using Sikaflex 2C NS and Sika Primer 202. Note that the concrete must be dry before application of Sikaflex 2c and cracks should be routed to give a well for the sealant. If cracks in corners cannot be found, then a corner bead to seal the corners where water is apparently coming through should be applied. Same sealant with same primer.

- Once cracks have been sealed, repair concrete spalls on the outside of the tank. Trowel repairs - Sika MonoTop 623, include SikaCem Accelerator if ambient or surface temps below 5C

- Bonding Bridge:
  - If ambient and surface temps are over 10C - SikaTop Armatec 110 Epocem
  - If ambient and surface temps are below 10C - Scrub coat with full strength Sika MonoTop 623

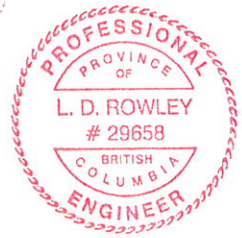
- Form and Pour Repairs - SikaCrete 08SCC

Whichever material supplier is used, you should seek advice from them on contractors familiar with the use of their products as this significantly improves the outcomes of the repairs.

We trust this meets your requirements. Should you have any questions, please do not hesitate to contact the writer.

Yours truly,

HEROLD ENGINEERING LIMITED



Lee Rowley, P.Eng., M.I.Struct.E., MICE

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