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Dominion Hills Area Recreation Association

Structural Evaluation of Existing Swimming Pools

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Table of Contents:

Section		Page
1.0	Scope of Work	**3**
2.0	Review of Existing Documentation	**3**
3.0	Field Observations	**3**
4.0	Structural Assessment, Evaluation & Recommendations	**4**
	4.1 Swimming Pools	**5**
	4.2 Pool Decks	**13**
5.0	Priorities	**19**
6.0	Summary	**19**

1.0 SCOPE OF WORK

At the request of Dominion Hills Area Recreation Association (DHARA), Elliott LeBoeuf & McElwain (EL&M) was tasked by Studio 3 Architects, P.C. (Studio 3) to perform a structural evaluation of the existing swimming pools and immediately adjacent concrete pool decks.

This report is limited to structural evaluation of the existing swimming pools and immediately adjacent concrete pool decks. Evaluation of the Bathhouse, Filter Building, elevated wood deck, and site conditions and components is not included.

2.0 REVIEW OF EXISTING DOCUMENTATION

EL&M reviewed the following existing drawings:

1955 Original Pool Drawings (Main Pool & Wading Pool) prepared by McGaughan & Johnson architects and dated 15 March 1955 (Sheets 2-6 of 6 were reviewed)

1955 Civil Drawings prepared by McGaughan & Johnson architects and dated 6 May 1955 (Six Sheets, including Sheets 2, 6, and 7, plus additional sheets with missing numbers, were reviewed)

1988 Pool Renovation Drawings prepared by Paddock Swimming Pool Company and dated 11 November 1988 (Sheets 1-5 of 5 were reviewed)

2007 Pool Renovation & Filter Building Repair Drawings prepared by Linton Engineering LLC with latest revision dated 14 March 2007 (Sheets S1, S2, and S3 were reviewed)

3.0 FIELD OBSERVATIONS

Jonathan McElwain of EL&M performed a visual survey of the two existing swimming pools (Main Pool and Wading Pool) and the immediately adjacent existing concrete pool decks on 6 April 2022. The weather was overcast, with intermittent light rain, and temperatures in the 50's. Access to the facility was provided by John Aldonas, Pool Manager.

The survey was limited to visual observations and sounding. No selective demolition, sampling of materials and/or testing were performed.

At the time of the survey, the Main Pool was drained, but rain prior to the survey resulted in some standing water in the diving well. The pool shell was sounded with a chain and hammer, except where there was standing water within the diving well. The walls were sounded with a pole-mounted rotary sounding wheel.
At the time of the survey, the Wading Pool was full of water, so sounding of the shell was not possible.

The existing concrete pool decks were sounded with a chain and hammer.

4.0 STRUCTURAL ASSESSMENT, EVALUATION, & RECOMMENDATIONS

The existing pool facilities within the scope of this assessment are the Main Pool, which is subdivided by a bulkhead, the Wading Pool, and the immediately adjacent concrete pool decks. Based on review of the existing drawings, as well as discussion with the Pool Manager and DHARA Board Members, our understanding of the chronology and methodology of the pool and pool deck construction is as follows:

Main Pool

- 1955 – Original Pool Construction – The original pool construction utilized conventional cast-in-place concrete walls footings and slabs, which was the typical methodology for pool construction of that time period.
- Unknown – Filter Building Expansion – At some point between the original 1955 construction and the 1988 renovation, the Filter Building was expanded towards the west.
- 1988 – Pool Renovation – This was a major renovation which essentially constructed a new pool shell within the original pool, utilizing shotcrete (gunite) construction methodology. Most of the original pool shell remains in place beneath the new pool shell. In some places, the 1988 shell is directly against the 1955 shell, while in other locations the shell is separated by gravel. At this time, the Main Pool was subdivided with a bulkhead. Also at this time, the traditional perimeter coping and skimmer system was largely replaced with a stainless steel gutter system.
- 2007 – Pool Renovation and Filter Building Repair – The pool was expanded in width approximately 8’-6”. The dive well was extended approximately 14’-0” in length at the same time. The dive wall expansion encapsulated the footprint of the original Filter Building construction from 1955.
- The pool shell is protected with a multi-layer pool plaster finish system. Our understanding is that the current white coat is at least 7 years old.

Wading Pool

- 1955 – Original Pool Construction – The original pool construction utilized conventional cast-in-place concrete walls footings and slabs, which was the typical methodology for pool construction of that time period.
- 1988 – Pool Renovation – The Main Drain and Skimmers were replaced, and the pool received a new white coat. The renovation included replacement of the coping stones.
- The pool shell is protected with a multi-layer pool plaster finish system. Our understanding is that the current white coat is at least 7 years old.

Concrete Pool Decks

- 1955 – Original Pool Deck Construction – The original pool deck construction utilized conventional cast-in-place concrete slabs. Based on the drawings, the original pool decks are 4" thick concrete slabs reinforced with welded wire fabric.
- 1988 – Pool Renovation – Surrounding both the Main Pool, new 4" thick concrete slabs were constructed over 3" to 4" of gravel fill over top of the original concrete pool decks. Although the drawings indicate a new slab at the Wading Pool, the Pool Manager clarified that a new slab was not provided in this area.
- 2007 – Pool Renovation and Filter Building Repair – The concrete topping slab over the existing Filter Building was replaced.
- 2020 – Filter Building Repairs – A waterproofing and concrete repair project included replacement of the concrete topping slab over the existing Filter Building.

The following is a summary of the assessment, evaluation, and recommendations for the pools included in the scope of work.

4.1 SWIMMING POOLS

Observations, evaluations, and recommendations for repair of the Main Pool are below.

There were no specific observations for the Wading Pool, however it is likely that there are some areas of plaster delamination which could not be observed due to the pool being full at the time of the field observations.

4.1.1 Main Pool – Pool Plaster Delamination

Observations

There were numerous locations throughout the pool floor and a few locations on the walls where the pool shell sounded hollow. Most of these areas were relatively small, on the order of 1 to 2 square feet, while others were larger. In a number of locations, the hollow sounding area was adjacent to an area where the white coat was previously patched.

Main Pool – Previously Patched White Coat

Evaluation

It is most likely that the hollow sound is a delaminated area, where a portion of the pool plaster has separated from the surrounding plaster, with the underlying structure undamaged. A less likely possibility is that the hollow sound indicates deterioration of the underlying pool shell. If this were the case, we would expect the damage to be more extensive than what was observed.

Recommendations

Remove the pool plaster in the hollow sounding areas deep enough to remove all of the delaminated plaster and provide a multi-layer repair with a scratch coat and finish coat(s). As part of the removal process, it will be determined if the delamination extends all the way to the concrete shell (potentially requiring concrete repair), or if the damage is limited to the pool plaster, as expected.

4.1.2 Main Pool – Loose Plaster Beneath Stainless Steel Gutter

Observations

A typical condition is that the pool plaster at the top of the wall beneath the stainless steel gutter is separated from the gutter and, in many cases, damaged and loosened.

We understand from the Pool Manager that the typical condition utilizes sealant between the top of the wall and the bottom of the gutter, behind the pool plaster along the interface. In most locations, this could not be observed, except for a few locations where the plaster has spalled off above tiles.

Main Pool – Loose Plaster Beneath Stainless Steel Gutter

Evaluation

The interface between the pool wall and the stainless steel gutter is a vulnerable condition subject to differential thermal movements (cyclical temperature related expansion and contraction). Brittle plaster layered over sealant in a moving condition is not a suitable detail for this condition.

Recommendations

The interface between the pool wall and the gutter must be properly sealed to prevent pool water from entering the joint and leading to corrosion of the pool shell structure. A repair detail will need to be developed that can accommodate the complex movements at this interface. Refer also to Item 4.1.5 below.

4.1.3 Main Pool – Rust Staining Beneath Stainless Steel Gutter

Observations

There is rust staining on the pool plaster beneath the stainless steel gutter. Frequently this occurs at weep holes in the gutter as well as in some other isolated locations.


Main Pool – Rust Staining Below Stainless Steel Gutter

Evaluation

The staining is the result of corrosion. It is likely that there are hidden fasteners or anchors that are either carbon steel or a stainless steel alloy that is less resistant to corrosion than the stainless steel alloy used to fabricate the gutter.

Recommendations

Ideally, any carbon steel or less corrosion-resistant components should be removed and replaced with highly corrosion-resistant stainless steel. However, in practice, it may be very difficult to find and remove these components without a significant demolition effort that would likely involve removing large sections of the gutter. At a minimum, any corroding fasteners or anchors exposed as part of the repair of Item 4.1.2 above should be replaced.

4.1.4 Main Pool – Wall Crack at Southwest Corner of Training Area

Observations

There is hairline vertical crack at the southwest corner of the Training Area on the east side of the bulkhead that subdivides the Main Pool.

Main Pool – Wall Crack at Southwest Corner of Training Area

Evaluation

The crack is the result of thermal movement (cyclical temperature related expansion and contraction). It is likely the result of expansion and contraction of the intersecting gutter sections and/or thermal expansion and contraction of the gutter itself.

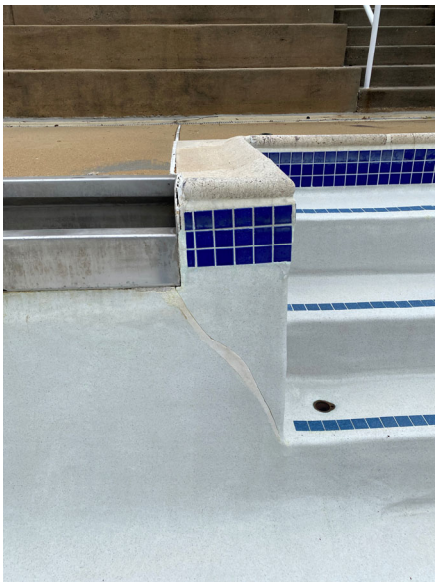
Recommendations

Remove the pool plaster in the corner and provide a multi-layer repair with a scratch coat and finish coat(s).

4.1.5 Main Pool – Thermal Movement of Stainless Steel Gutter

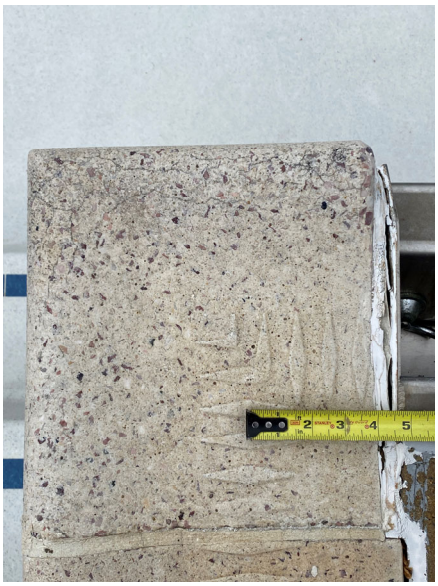
Observations

At the stair on the north side of the Main Pool, adjacent to the bulkhead, there is cracking of the wall on the west side of the stair.

Main Pool – Cracking of Wall on West Side of North Stair

On top of the same wall, the coping has separated from the pool deck, with failed sealant.

Main Pool – Separation of Coping from Pool Deck with Failed Sealant

On the south side of the pool, the gutter had a visible horizontal bow to it at the time of the site visit.

On the south side of the Training Area on the east side of the bulkhead, within the Main Pool, there is cracking of the pool deck around the east end of the gutter where it transitions to a concrete wall with coping.

None of the stainless steel gutters have expansion joints that correspond with the expansion joints in the pool or at other locations that would accommodate movements.

Evaluation

The wall cracking, coping separation from the pool deck, and failed sealant are the result of thermal movements of the stainless steel gutter. The gutter on the west side of the damaged wall at the stair undergoes a change in length of approximately 0.6” for an 80 degree temperature swing. The gutter is 0.6” longer on the typical hottest summer day versus the coldest winter day.

In the same location on the west side of the damaged wall at the stair, the concrete pool shell also changes dimensions with changes in temperature, but at approximately 55% of the change for stainless steel. So, as the gutter changes in length by 0.6”, the pool shell will change by about 0.33”. The differential movement between the two materials is a contributing factor for Item 4.1.2 and will be a challenge to incorporate into a suitable detail for the interface between the pool wall and the gutter.

The amount of movement for each individual gutter section (or length of pool wall) will vary. The longer the length of the gutter (or pool wall), the greater the movement will be.

For the bowed gutter on the south side of the Main Pool, it is possible that the gutter was bowed when fabricated. However, it seems likely given the other observations that the bow was caused by thermal movements.

The pool deck cracking around the east end of the gutter on the south side of the Training Area is consistent stresses induced by thermal movement of the stainless steel gutter.

It is atypical for stainless steel gutters to be used in exterior concrete shell pools. More typically, stainless steel gutters are used for indoor pools where the pool shell is either stainless steel or a concrete/shotcrete shell. Indoor pools are at a relatively constant temperature year-round and, as a result, they are not subject to the same magnitude of movements that exterior pools go through with daily and seasonal temperature changes.

Recommendations

There are two approaches that can be taken:

Option 1 – Modify Stainless Steel Gutter and Repair Cracked Stair Wall

Repair as follows:

1. Cut the gutter back at the stair to allow for thermal expansion without exerting pressure on the wall.
2. Seal with the gap between the gutter and the stair. Note that this will become a maintenance item.
3. Repair the wall. It is likely that the concrete wall has been damaged. The plaster should be removed down to the concrete so that the wall can be assessed and repaired if warranted by any damage that is uncovered.

This option only addresses the damage at the stair on the north side of the Main Pool. It does not address the other observed conditions.

Option 2 – Replace Stainless Steel Gutters

Consideration should be given to replacing the stainless steel gutters and returning to the traditional skimmer and coping condition. However, it should be noted that this would involve a significant amount of demolition of the existing pool walls in order to tie in new pool beams and pool piping at the perimeter.

4.2 POOL DECKS

Observations, evaluations, and recommendations for repair of the concrete Pool Decks are as follows:

4.2.1 General Pool Deck Conditions

Observations

The pool decks immediately adjacent to the Pools are showing signs of aging with some limited cracking and areas where the concrete is spalling (surface breaking off) and previous patching is failing. In some areas, the surface of the concrete is eroded. It should be expected that these conditions will gradually worsen as the slabs age.

Pool Deck – Cracking, Failing Patches, and Surface Erosion

There is a hollow sound to the throughout the concrete Pool Decks. The hollow sound is fairly consistent, with the exception of a few areas specifically addressed in Items 4.2.2 and 4.2.3 below.

Evaluation

The cracking observed is consistent with thermal movement and/or shrinkage of the concrete from the original curing process. In some cases, cracks radiate from penetrations and other changes in geometry, which are natural places for cracking to occur.

Spalling is the typical end state of the deterioration of reinforced concrete, where the reinforcing steel within the slab corrodes, leading to separation of the concrete surface (delamination) from the underlying concrete, eventually resulting in spalling.

Chlorinated water tends to exacerbate the deterioration of concrete. In addition to causing corrosion of the reinforcing steel, the chlorine eats away at the cement component within the concrete. This is apparent in the areas where the surface is eroded. Similar deterioration can be, and likely is, happening within the concrete, where cracking or spalling serves as a pathway for water to enter deeper into the concrete.

The hollow sound is due to the nature of the double slab construction which consists of the 1988 concrete slab over top of gravel over top of the 1955 concrete slab.

Recommendations

Route and seal cracks to prevent water penetration.

Remove spalled areas and failed previous patches down to sound concrete. Patch with a high-quality patch material suitable for this application, following manufacturer's recommendations for surface preparation, application, and curing.

No repair is required to address the hollow sound at the typical double slab condition. It should be noted however that the double slab condition is prone to problems. Water can (and likely already is) trapped between the slabs, especially considering the downward slope of the topography on the north side of the pool deck.

Repairing the slab is feasible in the short term. However, ideally, the Pool Decks should be replaced, including full removal of both the 1955 and 1988 slabs.

4.2.2 Undermining of Bulkhead Slab

Observations

The Pool Deck slab at the bulkhead which subdivides the Main Pool sounds very hollow.

Pool Deck –Bulkhead Slab

Evaluation

Based on the 1988 Pool Renovation drawings, this slab was designed as slab-on-grade, intended to be permanently supported by gravel from below, and not designed to span between pool walls. Presumably the gravel fill beneath the slab has consolidated (settled) away from the bottom of the slab. This separation causes the slab to sound hollow.

Unless the slab was constructed differently from what the drawings show, this is a potential safety concern. While the amount of consolidation beneath the slab is likely to be small, the slab could crack and drop. The slot drain that runs down the middle of the slab is at the point of maximum flexural stress, which does not improve the situation.

Recommendations

The bulkhead slab-on-grade should be repaired as soon as possible. There are two approaches that can be taken:

Option 1 – Remove and Replace Bulkhead Slab

Repair as follows:

1. Remove the existing slab-on-grade.
2. Consolidate the gravel fill beneath the slab.
3. Provide a new slab-on-grade. Design the slab-on-grade with sufficient thickness and reinforcing steel so that the slab can safely span wall to wall, if future consolidation of the underlying gravel occurs.

Option 2 – Grout Beneath Bulkhead Slab

An alternative to removal and replacement is to core holes in the slab and pump grout beneath the slab to fill the voids. Some limitations of this alternative are 1) care must be taken to avoid lifting the slab (which can cause cracking) and 2) the potential for future consolidation of the underlying gravel remains possible.

4.2.3 Undermining of Pool Deck Near Wading Pool

Observations

The Pool Deck surrounding the Wading Pool sounds very hollow around the perimeter of the pool and adjacent to the retaining wall between the Main Pool and the Wading Pool, below the canopy structure.

Pool Deck –Wading Pool

Evaluation

The hollow sound adjacent to the Wading Pool is likely due to settlement of soil adjacent to the pool wall, beneath the slab. The hollow sound adjacent to the retaining wall is likely due to settlement of soils behind the wall, beneath the slab.

This is a potential safety concern. While the amount of consolidation beneath the slab is likely to be small, the slab could crack and drop.

Recommendations

The slab-on-grade surrounding the Wading Pool should be repaired as soon as possible. Given the age, condition, and relatively small size of the slab, it is recommended that the existing slab be removed and replaced with a new soil-supported slab-on-grade.

4.2.4 Debonded Coping

Observations

Approximately 25% of the coping sounded hollow.

Pool Deck –Coping at Wading Pool

Evaluation

The hollow sound indicates that the coping segments are debonded from the underlying pool wall.

Recommendations

Remove and re-set all loose coping segments. All coping stones must be fully bedded below without gaps, except at expansion joint locations.

5.0 PRIORITIES

The intent of this section is to provide prioritization of the required repair work.

Level I – Repair As Soon As Possible

Due to the safety concerns, Items 4.2.2 Undermining of Bulkhead Slab and 4.2.3 Undermining of Pool Deck Near Wading Pool should be addressed as soon as possible.

Level II – Future Repairs

The balance of items do not present a safety concern at this time and can be performed as future maintenance items. It should be expected, however, that deferral of the repairs will lead to an increase in severity.

6.0 SUMMARY

Repair of the Undermining of Bulkhead Slab and Undermining of Pool Deck Near Wading Pool should be scheduled as soon as possible due to the potential for the undermined slabs to crack and drop.

The other repairs should be scheduled in the near future, so that the conditions do not significantly increase in severity.

It should be noted that this report is not intended for, nor is it suitable for, use as a bid document.