Harbour Pool

2018 Main Pool, Warm Pool and Whirl Pool Structural Assessment

10001 - 94 Avenue
Fort Saskatchewan, Alberta

March 2018
RJC No. EDM.118534.0002

Prepared for:

Grant Schaffer, Director, Project Management
City of Fort Saskatchewan
10001 – 94 Avenue
Fort Saskatchewan AB T8L 3V4

Prepared by:

Read Jones Christoffersen Ltd.
17415 - 102 Avenue, Suite 100
Edmonton AB T5S 1J8

James Wells, BEng, P.Eng.
Project Engineer

And

Enzo Vercillo, BSc P.Eng., LEED AP
Principal

Table of Contents

1.0 TERMS OF REFERENCE

At the request of Mr. Grant Schaffer of The City of Fort Saskatchewan, Read Jones Christoffersen Ltd. (RJC) has undertaken to perform a structural assessment of the Main Pool, Warm Pool, and Whirl Pool concrete structure at Harbour Pool, located in the City of Fort Saskatchewan.

It is our understanding the structural condition assessment is generally intended to update the present condition of the Main Pool, Warm Pool, and Whirl Pool reinforced concrete structures and provide recommendations and budget estimates for any structural concrete repairs.

RJC conducted a site assessment of the Main Pool, Warm Pool, and Whirl Pool structures on January 10, 2018. As part of our structural condition survey and evaluation, the following methodology, briefly described below, was performed:

- Review of provided original structural and architectural drawings.
- Detailed visual review of the Main Pool, Warm Pool, and Whirl Pool to examine the present condition of the structures. Our visual review included a review of the underwater window, inlet, and skimmers as they relate to their structural condition.
- Chain-drag survey of the pool surfaces to detect and quantify areas of debonded tile surfaces.
- Hammer-sound testing of walls and pool soffits, where we are able to access to detect and quantify areas of debonded tile surfaces, and unsound concrete delaminations along exposed concrete surfaces.

Note that the scope of this structural condition assessment did not include the following:

- Review of non-accessible and non-visible portions of the Pool concrete structures, such as foundation elements, concrete surfaces below the tile, or the condition of embedded structural elements such as reinforcing steel.
- Assessment of the main pool slide, stairs to the slide, or the super structure, including the roof structure and waterproofing.
- A mechanical condition review of the pool systems is not included as part of this report.
- Chloride content testing in concrete was not completed as part of this report.
- Detailed structural numerical analysis, as would be necessary to identify or confirm the load-carrying capacity or adequacy of existing structural concrete members to determine if the basin structures can be altered for expansion of the facility.
- Preparation of drawings detailing the results of the evaluation and condition surveys performed.

Representative figures are included in Appendix A and photographs of our observations are included in Appendix B.

2.0 HISTORY AND DESCRIPTION OF POOL STRUCTURE AND PROTECTION SYSTEMS

2.1 Overview of Building Structure

Original architectural and structural drawings were available for our review. Harbour Pool structure was constructed in 1982. The architect and structural engineer-of-record was Camrec Facilities Consultants Limited.

The swimming pool area of the structure is approximately 1,200 sq. m and is located at the east end of the structure (Appendix A, Figure 1). The main swimming pool (approximately 500 sq. m) consists of a water spray park area and a 25 m x 12.8 m swimming pool and deep end; warm pool (approximately 25 sq. m); and whirl pool (approximately 30 sq. m). A mechanical room with the water filtration and treatment equipment is located at the southeast corner of the structure.

The foundation system for the main pool and the pool deck at the west, north, and part of the south perimeter of the main pool is constructed on a ±125 mm thick reinforced cast-in-place concrete slab constructed on grade. The east and part of the south deck around the main pool deep end ranges from 175 to 250 mm thick suspended reinforced concrete slab spanning between the exterior foundation wall and interior main pool reinforced walls. Wall thicknesses range from 200 to 575 mm thick and are supported on strip footings below.

The warm pool and whirl pool structures are constructed on a +/- 500 mm thick reinforced cast-in-place concrete slab constructed on grade. Perimeter seating and walls are +/- 450 mm to 900 mm thick reinforced cast-in-place concrete.

Located at the northeast end of the main pool in the deep end are three wave pool chambers (Figure 2). The chamber is constructed between a 450 mm and 250 mm thick reinforced cast in place walls that form the wave chambers. The inner wave chamber wall is supported on a strip footing below. The wave pool chambers have been abandoned and sealed off from the interior corridor.

Two 600 mm x 900 mm underwater viewing windows are cast into the concrete walls, are located at the south east end of the main pool deep end (Figure 2).

We understand that the pool finishes are original to initial construction; however, repairs over the years have replaced select areas of the tile with new. Typical finishes include 25 mm x 25 mm mosaic tile, paper faced, set in thin set mortar and grouted in all pool floor and wall locations. The surrounding pool deck consists of 100 mm x 100 mm tiles set in thin set mortar and grouted and safety grip nosing tiles along the perimeter of the pool deck. Information regarding the type of grout used was not indicated on the drawings, and the presence of a waterproof membrane below the tile assembly was not identified on the drawings.

The pool was originally designed as a chlorine gas treatment system; however, modifications were made in approximately 2012 to change the system to a salt-cell chlorination treatment system.

3.0 DETERIORATION PROCESSES IN REINFORCED CONCRETE STRUCTURES

Cracking and spalling of reinforced concrete structures can occur due to several reasons, including high chloride ion levels, carbonation, and inadequate concrete cover over the reinforcing steel bars.

A brief description of the corrosion processes of reinforcing steel embedded in concrete are provided below.

3.1 Chloride Ion Contamination and Reinforcement Corrosion

Corrosion of the structure is an issue in any pool facility; however, problems can occur at a more rapid rate in a salt-cell system due to the higher concentration of chloride ions in the water. A pool facility using a salt-cell chlorination system tends to be a more aggressive environment than a gaseous chlorine system. This can affect the concrete structures as well as the metallic elements in the facility.

Concrete members are typically reinforced with steel bars to resist the tension stresses due to flexure, shear, and other forces imposed on the structure. When reinforcing bars are cast directly into the fresh concrete, it is defined as bonded reinforcement.

The steel reinforcing in concrete is susceptible to the exposure to chloride ions in the water. Concrete is a porous material and has a tendency to crack due to shrinkage of the material during setting and curing. If not properly protected, the salt water can infiltrate into the concrete and, through electrochemical processes, attack the reinforcing steel causing it to corrode.

Reinforcing steel bars in conventionally reinforced, cast-in-place concrete structures are normally protected against corrosion by the presence of lime in the cement, which causes the formation of a protective passive layer on the surface of the steel. As long as this thin oxide film is maintained in a stable alkaline environment, the steel reinforcement will remain in a passive and non-corroding condition. However, if a sufficient quantity of chloride-contaminated water penetrates the concrete it breaks down this protective passive layer, subsequently causing corrosion of the embedded reinforcing steel.

As the steel rusts, the volume of the steel increases due to the formation of the expansive corrosion products, thus exerting splitting forces within the concrete. This causes the concrete to crack and separate (referred to as a “delamination plane”), and eventually spalling of the concrete surface becomes evident. After the concrete’s surface cracks and spalls, the reinforcing steel can be directly exposed to salt water, thus accelerating the corrosion activity. If the ongoing corrosion activity is allowed to continue, a significant loss of steel cross-sectional area can result, requiring that extensive structural repairs or replacement of the concrete member is required.

4.0 VISUAL OBSERVATIONS

The following items were noted during our visual review:

4.1 Tile and Grout Finishes

The tiles and grout in the pools and pool deck areas form part of the protection for the underlying reinforced concrete structure reducing the risk of moisture and chemicals penetrating into the structure. The existing tiles and grout may have been selected to meet the exposure criteria of the original system.

Typically, tiles used in swimming pools should have a very low absorption.

Grout typically comes in three different classes based on exposure and intended application. The first class is a normal cementitious grout (CG1). The second class, is an improved cementitious grout (CG2) (non-sanded cementitious grout with additional water-retentive additives) and is typically used for pool tiled surfaces as it has a higher abrasion resistance and reduced water absorption than the CG1. The third class called reaction resin grout (RG) (epoxy based) is typically used in harsher exposures where resistance to chemical attack is important. It is not clear which class of grout was originally used or if it meets the requirements of the new salt water system, which is a more aggressive exposure condition.

The aggressiveness of the environment is increased by higher temperatures, higher pressures, wetting and drying exposures, mechanical abrasion by fast-flowing water, and by increasing concentrations of relevant substances (i.e. chlorides). Elements of the pool that are kept in a continuously immersed condition are generally regarded as being in a protected exposure, as the continuous immersion provides a uniformity of environment. The surrounding pool deck, considered a wet trafficked area is exposed to wetting and drying conditions, causing volume changes and increased concentrations of relevant substances. These increased concentrations can affect the durability performance of the tile and grout system and failure of this system would allow moisture and chlorides to penetrate into the structure.

Generally, the mosaic tiles and grout in the main pool, warm pool, and whirlpool appear to be in good condition. Minor deterioration of the pool deck tiles and moderate deterioration of the pool deck tile grout was observed. Specifics are included below in Sections 4.2 to 4.4.

4.2 Main Pool

The main pool (Appendix B, Photo 1) generally appears to be in good condition except for the following:

- Generally the mosaic tiles and grout appear to be in good condition, however damage to the tile and grout finishes at anchor penetrations for drain covers was noted at multiple locations (Photo 2) and debonded tile locations were identified during chain drag and hammer sounding testing as described in Section 5.0 below. Debonded tiles were not visibly deteriorated or lifted. Near-term repairs are not considered a requirement, however, for budgeting purposes probable costs for removal of the existing main pool tile and grout assembly, allowance for concrete repairs, and application of a new waterproof finish designed to protect the structure beneath have been provided below for long-term durability of the pool structure.

- Covers on the recesses for the drain outlets located in the main pool area were removed while onsite (Photo 3). Concrete deterioration was observed inside the outlets (Photo 4) and the tiles along the perimeter of the drain were debonded. Repair is recommended and would include removal of unsound concrete material, concrete repair, application of a coating, and sealing of perimeter joints and anchor penetrations.
- Underwater viewing windows are located in the deep end of the main pool area (Figure 2). Viewing windows generally appear to be in fair condition (Photo 5). Efflorescent staining was observed around the viewing window (Photo 6). A cementitious parging material has been installed around the window block out. The parging material was loose during review; however, the underlying concrete appeared sound. We were informed that during filling operation of the pool, leakage at the windows occurs until sufficient pressure is obtained to seal the windows but that leakage does not occur once the pool is full. Immediate repairs are not required, however, probable costs for replacement have been provided in our recommendations.
- A scupper cover was removed by the pool staff while we were onsite (Photo 7). Cementitious grout was observed around the perimeter of the scupper, which may allow water infiltration into the structure at these locations. No present deterioration was identified during our review.
- Wave pool chambers are located at the northeast end of the deep end (Figure 2). A bonded thin concrete topping appears to have been applied onto the concrete structure (Photo 8). Debonding and failure of the thin concrete topping was observed at multiple locations in the wave pool chambers. Water staining and efflorescence at crack locations was observed on the hallway opposite the wave pool chamber (Photo 9). Hammer sounding of the underlying structural concrete structure was not possible during review, however, corrosion was observed at one small location. We note that the wave pool chambers are exposed to wetting and drying conditions and exposed to higher mechanical forces due to movement of water in these chambers, resulting in more severe exposure conditions than adjacent areas. Removal of the loose material, concrete repairs, application of a waterproofing membrane system on the exposed concrete structure, and sealing the wave pool chamber openings is recommended.
- Water staining and efflorescence at crack locations in the pool wall was observed at a couple locations in the corridor adjacent the main pool deep end (Photo 10). Application of a cementitious material was observed on the corridor wall, which prevented visual assessment of the underlying concrete. Hammer sounding identified minor locations of unsound cementitious material (Photo 11). The staining on the concrete surface appears to indicate that water penetration is occurring at crack locations in the pool wall or at mechanical openings. Removal of the cementitious material would be required to determine extent of unsound concrete if any and / or presence of moisture between the concrete and cementitious material. Probable costs for removal of the cementitious material at locations of water staining are included in our recommendations.
- Surface corrosion staining was observed at a couple of the pool ladder anchor locations (Photo 12). Ladder connections were loose at a couple locations. Tightening loose anchors and installation of new sealant is recommended as part of general maintenance, and are not included in the costs presented below.

4.3 Warm Pool and Whirl Pool

- Warm pool and whirl pool generally appear to remain in good condition (Photos 13 and 14). Selective replacement of the mosaic tile was observed in the whirl pool floor area. Debonded tile locations were identified during chain drag and hammer sounding testing as described below. Debonded tiles were not visibly deteriorated or lifted. Near term repairs are not considered a requirement, however, for budgeting purposes probable costs for removal of the existing warm pool and whirl pool tile and grout assembly, allowance for concrete repairs, and application of a new waterproof finish designed to protect the structure beneath have been provided below for long term durability of the pool structure.

4.4 Pool Deck (Slab-on-Grade and Suspended Slab)

- A pool drainage trench is located at the entrance to the main pool area (Photo 15). We observed a cementitious parging material within the bottom of the trench at select locations where the plastic trench grating was removed. The parging material has debonded and become loose at multiple locations (Photo 16). Removal of the existing grout material and installation of a new sloping material and waterproofing membrane is recommended.
- Minor damage was observed at select tiles. Deterioration of the grout between tiles was noted throughout (Photo 17). Debonded tile locations were identified during chain drag testing as described below. Select areas of the debonded tiles were visibly deflected upward around one drain (Photo 18) and around the base of a column. Replacement of damaged tiles is recommended.
- Previous repairs were observed at several locations throughout the pool deck (Photo 19). We understand that replacement is being completed on an as needed basis where damage to the tile is observed.
- Tile vertical terminations along the outer perimeter wall were visibly debonded / loose (Photo 20). Removal and replacement of the damaged tiles is recommended.
- Debonded tiles were identified at each pool deck floor drain location. Review of the underside of the floor drains at suspended slab locations, identified areas of crack injection and staining (Photo 21). Removal of the tiles around the floor drains, repair of any deteriorated concrete, and installation of new membrane and tile system at the drains is recommended.
- Epoxy and crack injection was observed at multiple locations below the suspended slab, located on the east and south side of the main pool structure (Photo 22). Review of the surfaces appeared to line up with areas of previously replaced tiles as noted on Photo 19.

4.5 Mechanical Room and Water Treatment Tanks

- The mechanical room contains a reinforced cast in place, unprotected concrete slab suspended and metal grating surfaces above the corridor below (Photo 23). Concrete deterioration around the metal grating flooring was observed. Repairs are recommended and would include the repair of deteriorated concrete and installation of a waterproof membrane on the suspended slab to minimize water infiltration into the slab.

- Concrete deterioration was observed around one existing floor drain (Photo 24) in the mechanical room. Replacement of the floor drain and installation of waterproof membrane is recommended.
- Saltwater treatment tanks are located in the mechanical room area, which consist of three concrete walled compartments. An epoxy coating has been applied within each compartment. It is our understanding that this coating is periodically reapplied. Existing epoxy coating in the compartments was debonded and failing in two of the three compartments. Visible concrete deterioration was also observed (Photo 25). Review of the opposite wall to the tanks from the corridor below identified significant crack sealant work and staining around pipe penetrations (Photo 26). Removal of the failed coating, repair of any deteriorated concrete, and application of a new membrane is recommended at all three compartments to protect the concrete structure.
- The existing metal ladders and metal supports located in the treatment tank areas are showing signs of surface corrosion, staining around anchor locations into the concrete was also visible. Removal of corrosion on the metal surfaces and application of a protective coating on exposed metal components is recommended.

5.0 CHAIN DRAG AND HAMMER SOUNDING SURVEYS

In addition to the visual review, the top surfaces of the slabs and vertical wall surfaces were surveyed for areas of unsound tile using the chain-drag test and selective hammer sounding on the vertical surfaces. This test involves dragging a heavy chain across the slab surfaces and tapping surfaces with a hammer. When unsound / debonded tile is encountered, a hollow sound is evident.

Based on our survey, there are a number of areas where the tile has debonded. Also, the areas of debonded tile may be an indication of underlying concrete deterioration. The extent of deterioration noted has not significantly affected the load carrying capacity of the structure. However, since the tile is intended to protect the concrete structure from exposure to salt water, and also to prevent water leakage, these areas of debonded tile may have compromised the protection system. Additional testing is recommended, as presented below.

A summary of each section is noted as follows:

5.1 Main Pool

- The testing indicates that moderate amount of unsound tile occurred on the main pool slab surfaces. A total of approximately 30 sq. m of unsound tiles were detected on the slab and vertical surfaces.

5.2 Warm Pool

- The testing indicates that minor amounts of unsound tile occurred on the warm pool slab surfaces. A total of approximately 5 sq. m of unsound tiles were detected on the slab and vertical surfaces.

5.3 Whirl Pool

- The testing indicates that moderate amount of unsound tile occurred on the whirl pool slab surfaces. A total of approximately 15 sq. m of unsound tiles were detected on the slab and vertical surfaces.

5.4 Pool Deck

- The testing indicates that significant amount of unsound tile occurred on the pool deck surfaces. A total of approximately 65 sq. m of unsound tiles were detected on the slab surfaces.

6.0 RECOMMENDATIONS AND PROBABLE COSTS

Based on our observations and testing, it is our opinion that the swimming pool's reinforced concrete structure generally appears to remain in good condition at the present time and the deck tiles generally appear to be in fair condition; however, moderate quantities of debonded tiles were detected throughout, as well as some water staining and efflorescence observed at crack locations around the pool structure. Due to the signs of water leakage through the structure, further deterioration of the structure is anticipated to occur. The concrete structure around the pool and in the saltwater treatment compartments are the most likely areas for deterioration to occur, due to the proximity to salt water as chlorides penetrate into the concrete structure.

Further testing requiring removal of selective areas of the tiles would be required to determine the current extent of chloride content in the concrete and the condition of the underlying concrete structure in areas of debonded tiles.

In order to maximize the remaining service life of the concrete structure, the following repairs are required to address the concrete deterioration and waterproofing system in the near future.

6.1 Additional Testing

- Chloride contamination of the concrete can lead to corrosion-induced deterioration of the structure. In order to assess the extent of contamination, further testing of the structure is recommended. Removal of selective areas of existing debonded tile to obtain 20 chloride tests throughout the pool and pool deck areas is recommended to allow for chloride testing. Chloride testing would assist in determining if the chloride content level within the exposed concrete and the levels are high enough to initiate corrosion throughout the pool structures.
- Debonded tile and parging was detected during our testing; however, it is not known whether the underlying concrete is also deteriorated. Removal of selective areas of the debonded tile in the various pools and existing cementitious material at stained locations on the corridor wall, opposite the main pool deep end, is recommended to allow for assessment of the concrete structure.
- Hammer-sounding and visual review of the concrete surfaces would be performed once the tile and parging have been removed.

- A short letter report summarizing our findings would be provided upon receipt of lab testing results. The cost below includes engineering fees only. Removal and replacement of tiles and parging is excluded from the probable costs below.

Additional Services Fee: $10,000
Contractor Costs: By Owner

6.2 Near-Term Concrete and Waterproofing Repair Requirements

The existing structure is approximately 36 years old. In older pools, a durable chloride resistant concrete mix was likely not used during construction. Therefore, it is imperative that water is prevented from penetrating the structural concrete surfaces. The near term repair requirements addresses areas of current deterioration observed in the pool structure and protection of the exposed concrete surfaces, to minimize further water and chloride penetration into the structure. Since tile is used as the primary method of protection, new tile and grout would be re-applied where lifting or deterioration was observed. In areas of exposed concrete, a waterproof coating is suggested. The recommended program includes:

- Concrete repair in pool drain outlets and re-application of tile and grout (6 locations)
- Removal of the concrete topping in within the wave chamber, repair the delamination present, and apply a waterproof membrane (3 chambers).
- Removal of grout in the bottom of the main pool trench and application of new sloping material and waterproof membrane (± 21 lin. m).
- Removal and replacement of one floor drain in the mechanical room.
- Installation of a new waterproof membrane in the mechanical room floor, including allowance for repair of delaminated concrete in the area of coating.
- Removal and replacement of waterproofing within saltwater treatment compartments, includes an allowance for repair of delaminated concrete within the compartments.
- Protection of existing exposed metal components within the treatment compartments exposed to salt water.
- Removal of staining along underside of structure to allow for future monitoring of leaks.
- Costs include for an allowance for concrete repair. The extent of concrete repair will not be known until the debonded tiles and coatings have been removed.

Opinion of Probable Repair Cost: $125,000 to $200,000.

6.3 Replacement of Main Pool, Warm Pool, Whirl Pool, and Pool Deck Tiles

The existing tile assembly is experiencing deterioration of the grout and debonded tiles at multiple locations. While total replacement of the tiles and coatings is not considered an immediate requirement, consideration should be given to protecting the concrete pool structures and deck, in order to maximize the remaining service life of the pool. Although tile was used as protection in this complex, consideration should be given to the newer coatings and waterproofing systems available for pool applications. This would need to be assessed prior to implementing a restoration program.

We have provided probable repair costs for full removal of the existing 36-year-old tile system and application of a new integrated waterproofing system in the main pool, warm pool, whirl pool, and the pool deck area, suitable for a salt-water exposure.

Repairs would include removal of existing tiles, grout, and thin set to expose the entire concrete surfaces. The pool structure and deck would be reviewed for delamination of the concrete and repairs completed as required (an allowance for concrete delamination repairs has been included in the probable costs below). Following concrete repairs, the surfaces would be prepared, cracks and joints would be detailed to ensure water tightness, and a waterproof membrane or finish suitable for a salt-water environment would be applied to minimize salt-water contact with the concrete. The intent of this program is to repair existing deterioration and to protect the structure from further exposure to water and chlorides. The structure has been contaminated with chlorides in various areas. Since the chlorides will not be removed, it is anticipated that on-going corrosion-induced deterioration of the structure may continue and periodic maintenance will be required throughout the life of the facility.

Deck accessories, such a ladders and handrails, would be removed and fastened back to the structure using stainless steel anchors.

Probable costs include an allowance to replace the two underwater viewing windows during tile and waterproofing work. Upgrades to the mechanical equipment, lights, scuppers, water slide, etc., are not included in the costs below. The aesthetic look of the pool finishes would vary depending on the waterproofing system chosen during the design stage. Probable costs below are based on the installation of a spray-applied thermal-polymer coating system and do not include installation of new tiles.

Opinion of Probable Repair Cost: $1,100,000 to $1,375,000.

The opinion of probable costs presented are based on 2018 dollars, excluding GST. Allowances for engineering and testing services to prepare tender packages, contract documents, or to perform site review or construction administrative services have been included.

The presented probable cost range is intended to reflect potential seasonal variations in pricing due to Contractor's workloads, and local economic climate at the time of bidding, in addition to variations in repair methodologies that could be considered for this project. A 10% contingency allowance has been included in the probable costs, however the cost do not include allowances for lost revenue during pool closure or other related "soft costs" to the City of Fort Saskatchewan as a result of the repair and rehabilitation work on the site. The probable costs presented do not include for any cost escalation factors should the recommended repair and protection measures be deferred to a future date or performed over more than one phase.

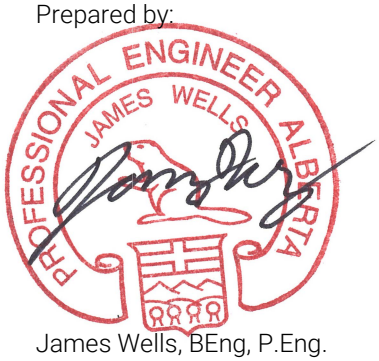
Read Jones Christoffersen Ltd. would be pleased to assist you with the implementation of the recommendations presented. We can assist you with the technical and administrative requirements for this project. Our services would include the preparation of specifications and drawings for the contractor's pricing of the project, site review services during construction, and contract administration.

We trust the above meets with your present requirements. Should you have any questions or comments regarding this assessment, or if we may be of further service, please contact this office.

Yours truly,

READ JONES CHRISTOFFERSEN LTD.

Prepared by:



James Wells, BEng, P.Eng.
Project Engineer

Reviewed by:

Enzo Vercillo, BSc, P.Eng., LEED AP
Principal

APEGA PERMIT NUMBER: P152

APPENDIX A

Figures

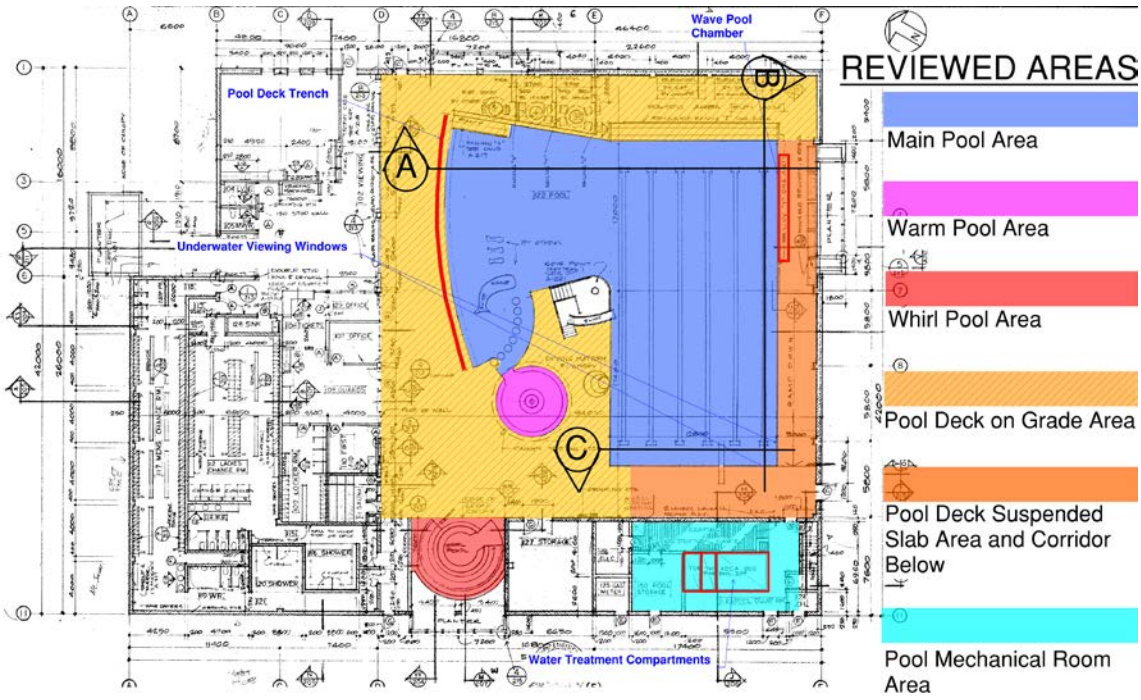


Figure 1 – Harbour Pool Area

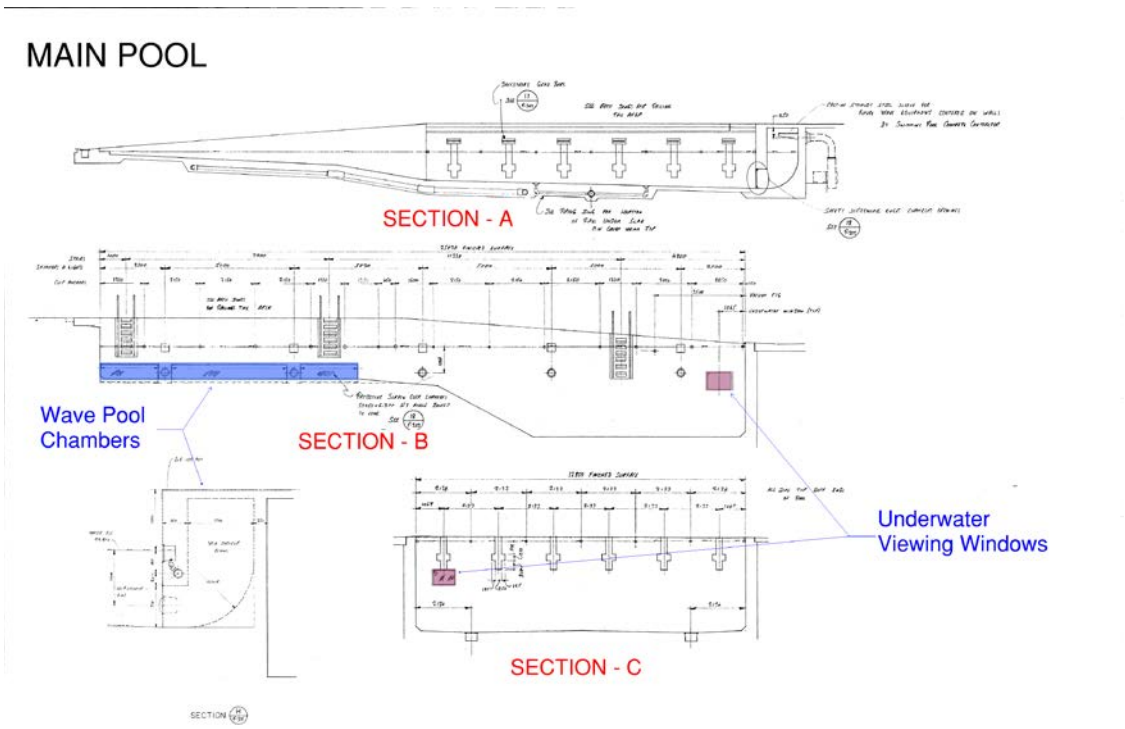


Figure 2 – Main Pool Sections

APPENDIX B

Photographs

Photo 1: Main pool

Photo 2: Anchor penetrations through mosaic tiles

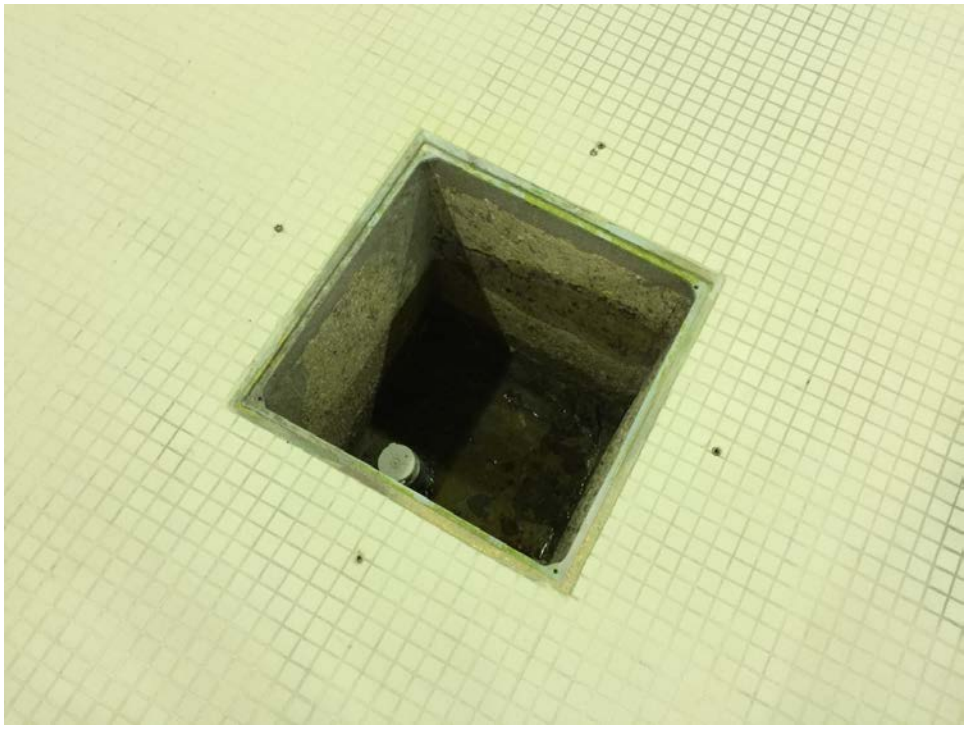


Photo 3: Drain outlet

Photo 4: Deteriorated concrete at drain outlet

Photo 5: Underwater viewing window – within pool

Photo 6: Staining and efflorescence at interior of underwater window – dry side of pool

Photo 7: Pool scupper

Photo 8: Wave pool chamber – staining and loose concrete

Photo 9: Opposite wall of wave pool chamber – staining and efflorescence at cracks

Photo 10: Main pool deep end wall as viewed from below grade corridor – staining and efflorescence at cracks

Photo 11: Main pool deep end wall from below grade corridor – cementitious material applied onto wall

Photo 12: Pool ladder connection – rust staining

Photo 13: Warm pool

Photo 14: Whirl pool

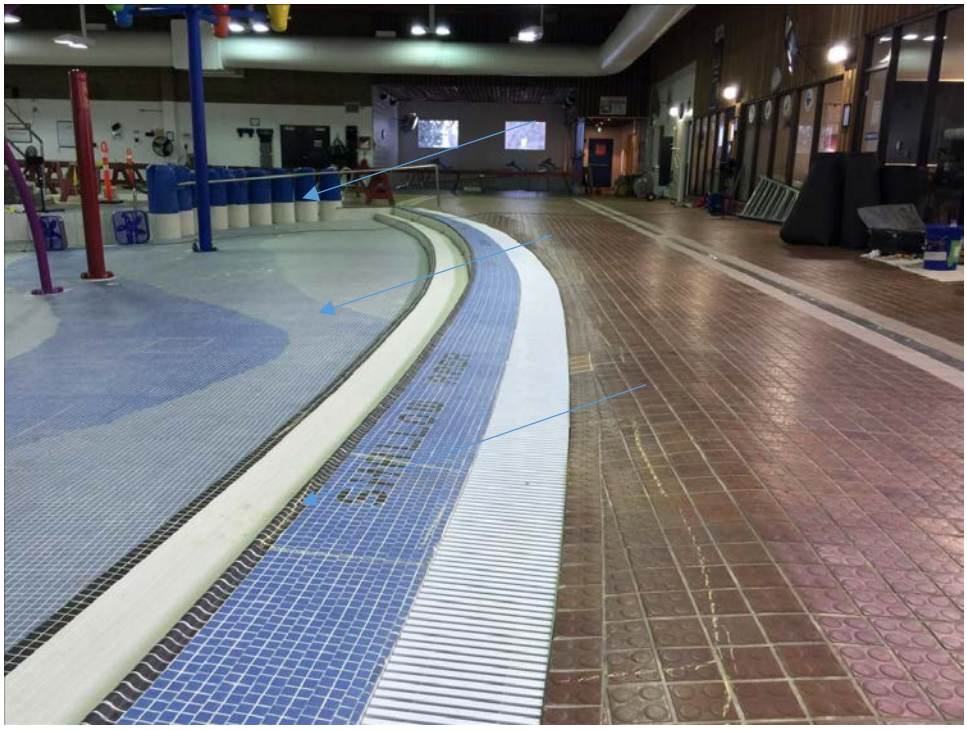


Photo 15: Pool deck and trench drain

Photo 16: Debonded grout in pool deck trench drain

Photo 17: Failing grout at pool deck tiles

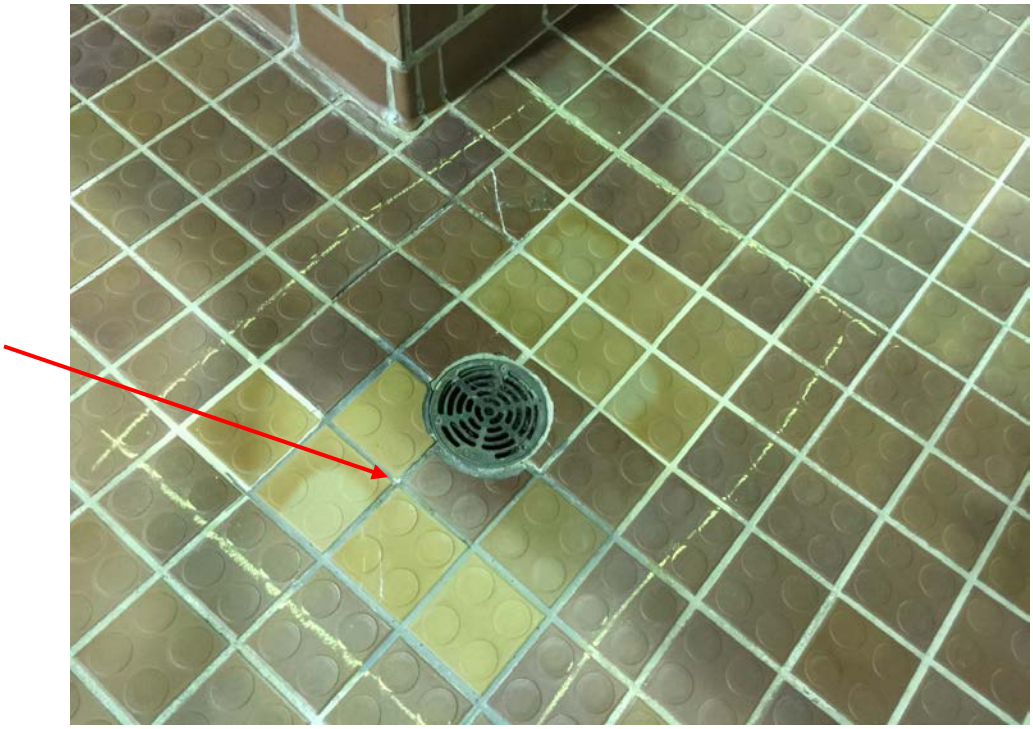


Photo 18: Failing grout at pool deck tiles

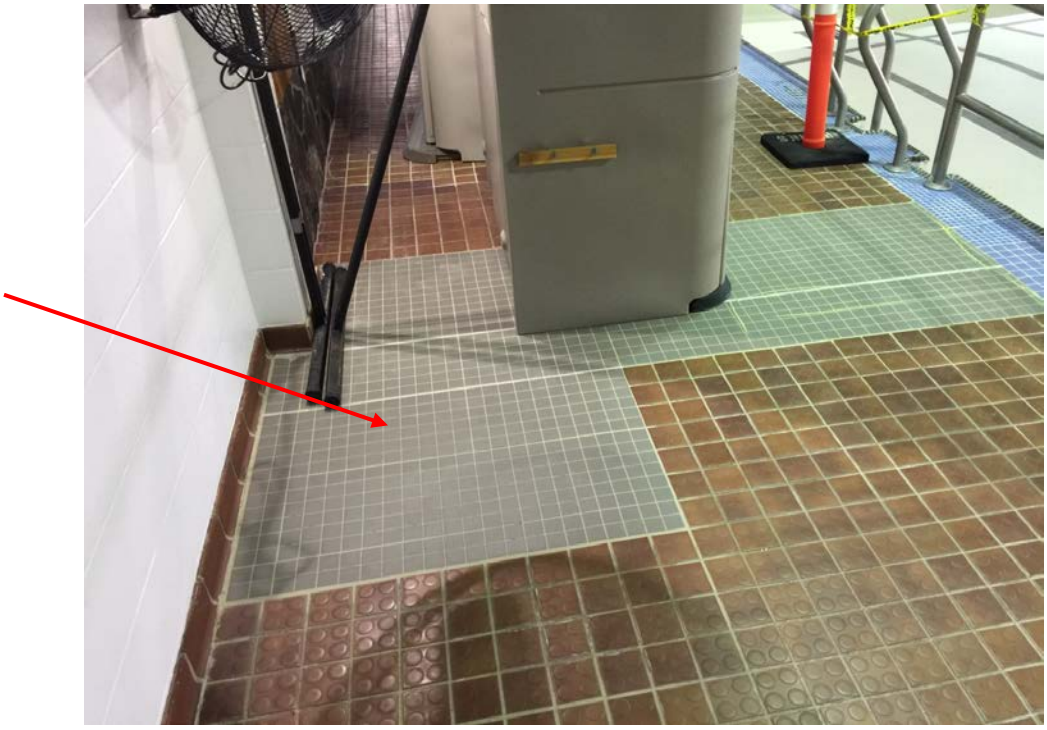


Photo 19: Tile replacement on pool deck

Photo 20: Debonding tiles on vertical upturn along building perimeter

Photo 21: Crack injection at pool deck drain

Photo 22: Epoxy filler at crack location on underside of pool deck

Photo 23: Unprotected concrete slab and metal grating in mechanical room

Photo 24: Concrete deterioration around floor drain in mechanical room

Photo 25: Failed coating and visible concrete deterioration in mechanical room treatment tanks

Photo 26: Crack injection work and staining at crack locations opposite mechanical room treatment tanks