December 3, 2021

Michael Queen
Aquatics Supervisor
The Keller Pointe
P: 817-743-4309
City of Keller, Texas

mqueen@cityofkeller.com

CC: Jennifer Oakes, CPRP

Re: Keller Pointe Pool Deck Report

Dear Mr. Queen,

Please see attached report and images. This work was performed in general accordance with the engineering agreement between the City of Keller and The C.T. Brannon Corporation. It follows our field discussions and observations.

Images have been provided in an Appendix but I have several more if you require.

If you have any questions, please feel free to contact me anytime.

Sincerely,

Travis Bozick PE
Aquatic Consultant

STATE OF TEXAS
TRAVIS A. BOZICK
104560
LICENSED
PROFESSIONAL ENGINEER
12/3/2021

TABLE OF CONTENTS

1 Introduction

1.1 November 18th Status

Work was previously underway by Sunbelt Pools to remove a granulated rubber pool deck surface and replace it with an acrylic modified skip troweled deck finish. During the work Sunbelt Pools indicated locations of concern based on visual observation, sounding, and rust staining of deteriorated concrete.

Brannon Corporation was contacted to provide an opinion based on site images and a discussion with Sunbelt Pools representative Dave Beverage.

1.2 Executive Summary

Members of The C.T. Brannon Corporation visited the site on November 23rd after receiving images from Michael Queen and discussing the potential risks of deck failure.

Failure of a suspended slab over a void is a risk to the public. Major horizontal cracking in the suspended slab is a cause for concern and should be fixed. Locations were determined where major remediation methods are necessary. Some locations may allow for less intrusive repair techniques. This report represents the conditions found and remediation recommendations.

2 On Site Observations

2.1 General

I met with City of Keller staff members on site and walked the project pointing out potential concerns, repair options, testing considerations, and potential causes.

The site appears to be in general conformance to the plans provided to Brannon Corporation. Layout and deck thicknesses appear to comply with S2.1 of the 2003 plan set provided. The existing pool had been drained and the granular rubber finish removed. Most locations still have a concrete coating finish. The existing deck had evidence of past repairs as shown in Figure 13 of the Appendix.

I observed several locations of ‘pop-offs’ Figure 12, locations where concrete has spalled away from the reinforcing. Some locations have been enlarged by demolition efforts during the removal of the granular rubber finish.

At the north wall adjacent to doors that access the pool mechanical equipment, the rebar is exposed and displays corrosion damage.

Further evaluation of the facility located cracking in the North CMU wall, Figures 5 & 8. Furthermore, the cove tile at the base of the wall indicates movement.

My primary concern, horizontal cracking, was observed in the field and measured, Figures 1 & 2. The deck has five leave outs with grating over the top to allow access to valves installed below the deck. Each of these locations have a horizontal crack midspan of the deck. I measured the largest approximately 3mm (1/10”). I was able to remove sections of rebar and concrete with my hand Figure 15. Corroded steel pieces are below the crack gauge for scale in the image. The cross sectional area of reinforcing has been corroded past allowable conditions.

I observed a failed butterfly valve flange below the pool deck as well at the north western leave out. The smaller of the two leave outs west of the double doors, Figure 11.

2.2 Concrete Cover

ACI 316 -Concrete for Building structures indicate 1.5” concrete coverage recommended for the installed condition. Rebar adjacent to the double doors does not appear to have adequate cover of concrete Figure 3, 4, 5, & 6.

Two of the leave outs for valves indicate rebar was installed to close to the formwork. In some cases, no concrete cover appears to have ever been provided Figure 10.

2.3 Rebar Corrosion

The aquatic facility uses chlorine to assist in water quality and sanitation. Chlorine and chloramines can corrode metallic structures such as concrete reinforcing. If adequate concrete coverage is not provided the reinforcing bars can corrode causing deterioration of the concrete by formation of iron oxides. Iron oxides can have a volume six times greater than the original bar and internal stresses in the concrete cause spalling.

Removal of chlorine from the facility is not a possibility. Generally, concrete's alkalinity and hydroxyl ions provide a passive protective layer to reduce the corrosion rate to a negligible level. The insufficient concrete cover and exposure of pool water to the reinforcing is the primary cause of failure. The slide water collection trough has adequate cover and a waterproofing material. This trough represents no corrosion damage.

Most of the observed conditions from the top of the deck should be repairable. The extent of the internal corrosion damage is indeterminate from the site visit.

Corrosion of the reinforcing steel may be the cause or result of the horizontal cracking visible from the leave outs for valves. The original designers provided reinforcing steel to resist tension loading in the suspended deck. If this steel is reduced in strength, the deck may not be able to resist anticipated loading.

3 Conclusion

3.1 Conditions

Based on the on site observations the City of Keller should perform repairs to the suspended deck substrate prior to the continuation of work. The locations of repair and technique of repair is indeterminate due to the lack of information.

4 Options

4.1 Removal, Evaluation, and Repair

While on site, we discussed removing known locations of larger failures & evaluating the reinforcing exposed during the demolition process. If the corrosion of the reinforcing is throughout the demolished work, we would recommend a complete removal of the suspended deck.

However, if corrosion and horizontal cracking in the slab are limited to the valve leave out locations, then removal and replacement could be limited to panels rather than the entire deck.

Smaller spalls and pop-offs (<2 sq. ft.) can be hydro-demolished with high pressure water to reveal corroded rebar to determine the extent of corrosion. If corrosion is limited, splicing in new reinforcing and grouting with a hydraulic cement can resolve several of the smaller spalled locations.

Valves should also be evaluated for condition while they are exposed.

I have provided a rough plan over the existing S2.1 sheet that indicates limits of removal so an evaluation could be performed. See Appendix

While this method of work does not provide a known value of cost, it has the potential to be performed quickly and resolve the failures. It could have the smallest cost or match the complete removal and replacement option.

4.2 Testing & Repair

Third party testing firms can perform x-ray testing to try and determine the locations where voids may occur in an existing concrete slab. The locations and condition of rebar can be evaluated as well.

Data collection is always preferred for remediation of an existing facility but this will require time to engage a third party testing agency and perform the work.

Once the limits of repair are defined, a contractor can be hired to remove known quantities of deck and replace them on a lump sum cost. If testing represents a total failure of the suspended deck this option could be the highest cost due to total replacement costs and the costs of testing. I however believe there are several locations worthy of salvage. A visual evaluation from the top of the deck though, is insufficient to know the internal reinforcing conditions.

4.3 Complete Removal and Replacement

If a nuclear option is desired it would be possible to declare a complete removal as the best method forward. This would allow the contractor to quickly get back to work and resolve all potential problem locations.

This option would have the highest initial cost and provides a completely new installation. In my opinion, the original design materials and reinforcing schedule could be re-utilized. Care should be given to reinforcing coverage during the replacement of the work.

5 Appendix Images

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

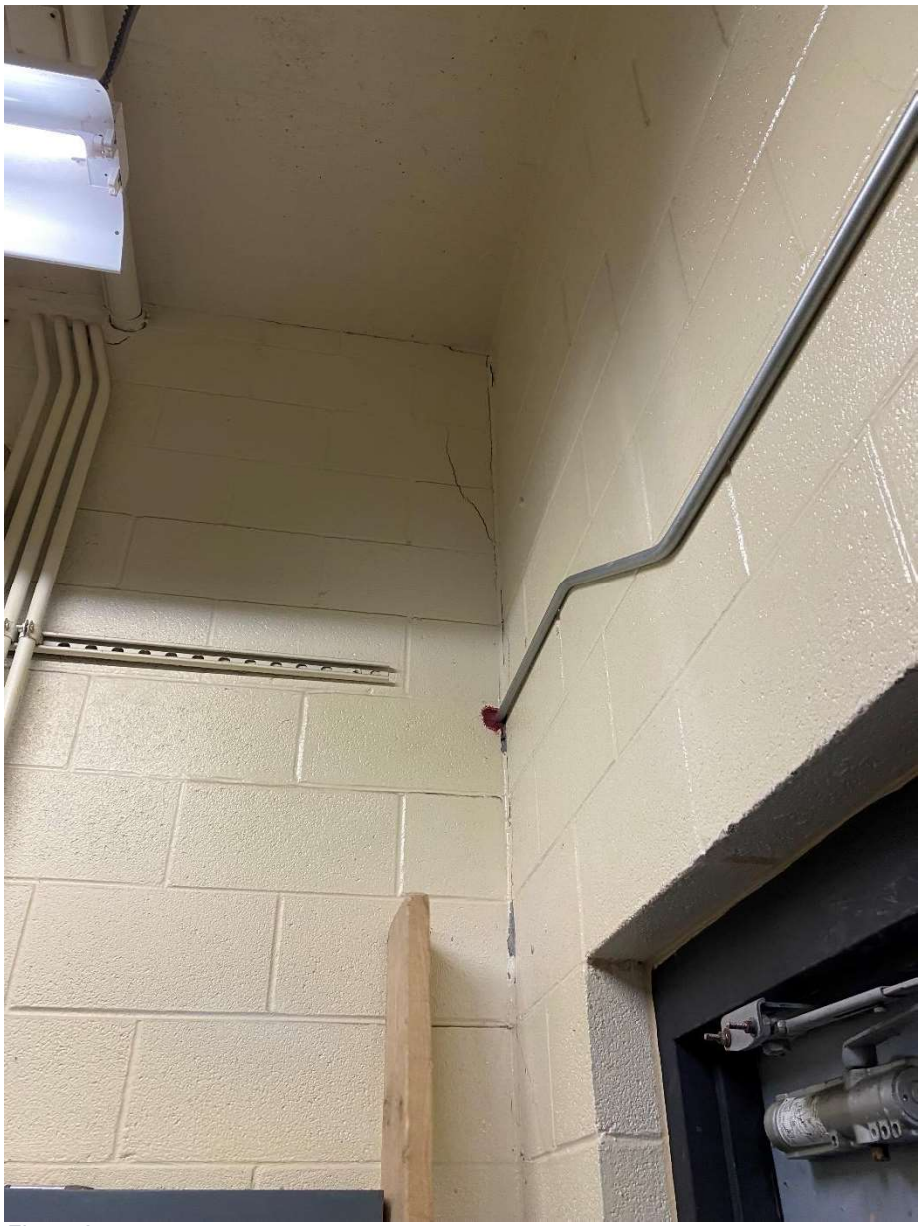


Figure 8


0.120
0.100
0.080
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
CONCRETE WATERPROOFING BY CRYSTALLIZATION
XYPEX
CRACK WIDTH RULER
Email: info@xypex.com
Web: www.xypex.com
0 inches
0.5
1
2

Figure 9

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14


XYPEX
CRACK WIDTH RULER
Email: info@xypex.com
Web: www.xypex.com
CONCRETE WATERPROOFING BY CRYSTALLIZATION
inches

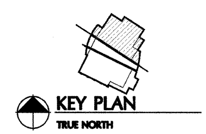
Figure 15


PURPLE INDICATES REMOVAL FOR EVALUATION
MAJOR POP OFF
EXISTING PVC TRENCH DRAIN TO WASTE
MAJOR SPALLING
VALVE LEAVE OUT
VALVE LEAVE OUT. FAILED VALVE FLANGE IDENTIFIED.
VALVE LEAVE OUTS
VALVE LEAVE OUT
SPALLED CONCRETE
PREVIOUS REPAIR
LIMITS OF CONCRETE SLAB BELOW
18" SLAB ON 8" CARTON FORMS REINF. WITH #7 @ 12" OC EW T & B
14" SLAB ON 8" CARTON FORMS REINF. WITH #7 @ 12" OC EW T & B
ADDITIONAL 6-#7 CONT. T & B @ 4" OC EA. WAY @ PIER CL (TYP. PIERS @ POOL)
PROVIDE THE SAME REINF. AS O/M INTERIOR @ THIS AREA
SEE POOL DWGS. FOR BACKWASH PIT
1-1/2" RECESS FOR STONE TILE
SEE DWG. S2.1
SEE DWG. S2.2

01 INDOOR POOL FOUNDATION PLAN
SCALE: 1/8" = 1'-0"

FOUNDATION PLAN NOTES:

1. [ ] DENOTES TOP OF CONCRETE ELEVATION.
2. SEE DWG. S1.1 FOR GENERAL NOTES.
3. SEE DWG. S3.1 FOR PIER SCHEDULE AND TYPICAL DETAILS.
4. SEE DWG. S4.4 FOR BASE PLATE DETAILS. SEE SECTION 7 FOR COLUMNS W/TRUSS CONNECTIONS. SEE SECTION 8 FOR COLUMNS W/BRACING. SEE SECTION 9 FOR TUBE COLUMNS. SEE SECTION 10 FOR UNO.
5. SUBMIT REBAR PLACEMENT SHOP DRAWINGS TO ARCHITECT/ENGINEER FOR REVIEW.
6. FOR TYPICAL GRADE BEAM CONSTRUCTION AND CONTROL JOINTS SEE DWG. S3.1
7. FOR TYPICAL CORNER BARS AT GRADE BEAMS SEE DWG. S3.1.
8. ALL PIERS SUPPORTING COLUMNS SHALL BE 24" DIA. WITH 6' PENETRATION INTO THE ROCK LAYER.
9. ALL PIERS SHALL BE 18" DIA. WITH 4' PENETRATION INTO THE ROCK LAYER. UNO.
10. ALL THE PIERS SHALL BE BELOW THE DEEPEST CROSSING GRADE BEAM OR PIER CAP. DETERMINE THE TOP OF PIER ELEVATION WITH THE PROVIDED STRUCTURAL MEMBER DEPTH REF. FOUNDATION PLAN AND DETAILS FOR SLAB, PIER CAP AND GRADE BEAM DEPTH.
11. SEE SHEET S3.6 FOR CMU WALL SCHEDULE. ALL INTERIOR CMU WALLS ARE W4 (TYPE 4) UNO.
12. △1 SLOPE TO DRAIN, DO NOT EXCEED 1/50 SLOPE. SEE ARCH. AND PLUMBING DWGS.
13. SLOPE AWAY FROM BUILDING. DO NOT EXCEED 1/50 SLOPE.
14. SLOPE POOL DECK TO DRAINS. DO NOT EXCEED 1/50 SLOPE.



BRINKLEY SARGENT ARCHITECTS
A Texas Corporation

Architectural:	Brinkley Sargent Architects	(972) 960-9970
Aquatics:	Counsilman/Hunsaker Assoc.	(314) 894-1245
Structural:	Thornton Tomasetti Engineers	(972) 387-8393
MEP:	CCRD Partners	(214) 521-1661
Civil:	Teague, Nall & Perkins	(817) 336-5773
Landscape:	Mesa Design Group	(214) 871-0568

KELLER RECREATION CENTER

City of KELLER

STATE OF TEXAS — GREGORY EDWARD BIEBERLY — 51072 — REGISTERED PROFESSIONAL ENGINEER
STAMP

INDOOR POOL FOUNDATION FRAMING PLAN
SHEET DESC.

REVISIONS		
NO.	DATE	DESCRIPTION
△1	04/29/03	Addendum #1

20118
04-15-03
S2.1