LIMITED CONDITION ASSESSMENT REPORT

OKLAHOMA COUNTY DETENTION CENTER
201 N. SHARTEL AVENUE
OKLAHOMA CITY, OKLAHOMA

FOR:

BOARD OF COUNTY COMMISSIONERS

ZFI ENGINEERING CO.
PROJECT #24078-01

Date of Report:
September 20, 2024

Reported By:

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& Dale Metzinger

Structural **Solutions** that Work.

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of
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201 North Shartel Avenue
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On August 14, 2024, ZFI Engineering (ZFI) performed a limited-scope, visual-only condition assessment focused on the floors of the Oklahoma County Detention Center in Oklahoma City, Oklahoma. The purpose of the assessment was to identify and photo document any visual indicators of current damage or deflection of the floors and develop recommendations based on our observations. However, a detailed survey of the entire building (floor design elevations, LIDAR scanning, etc.) was NOT within the scope of this assessment. A structural evaluation of the entire building was also NOT within the scope of this assessment.

The scope of this assessment included the following:

- Review the available original construction documents provided by the client.
- Perform a limited-scope, visual-only structural condition assessment of representative portions of the building's elevated floors (Levels 2, 4, 6, 8, 10, 12, & 13) that can be observed without access to cells or secured areas. This visual survey included observation of representative portions of architectural finishes for indicators of structural distress or other issues.
- Survey a representative sample of the floor surfaces to obtain general deflection measurements relative to an established benchmark and document signs of deflection and settlement.
- Limited observations of the floor structural framing were conducted due to the constraints of the ceiling soffit and its height.

This assessment did NOT include any aspects of the mechanical, electrical, plumbing, or roofing systems. Nor did it include inspection for termites, asbestos, or any environmental assessment. The assessment did not include any analysis of structural members to determine load capacity, any material testing of structural elements, or the development of any repair drawings for any identified issues.

This report summarizes our observations, findings, opinions, and recommendations.

Description:

The Oklahoma County Detention Center building is an approximately 530,000 square feet building located at 201 North Shartel Avenue between NW 1st Street and Robert S. Kerr Avenue in downtown Oklahoma City (Figure 1). The "as-built" drawings provided to ZFI are dated March 1989, by HTB, Inc. and RGDC of Okahoma City, Oklahoma. Per the structural drawings, addendums and value engineering (VE) changes are dated November and December 1989, respectively. The drawings indicate that the building was originally designed per the 1987 BOCA National Building Code including amendments in the 1987 Oklahoma City Supplement. The building originally opened November 1991.

Figure 1 – Overall view of building (courtesy of OK County Jail)

The configuration of the upper floors of the building are a rotated cruciform or "X" that makes up four quadrants or "pods". At floor Levels 2, 4, 6, 8, 10, 12, & 13, our scope of work was primarily limited to the open floor area (Day Room) in each pod (refer Figure 2). At the partial mezzanine floors (Levels 3, 5, 7, 9, & 11), we only assessed the portions of the floor in front of the cells.

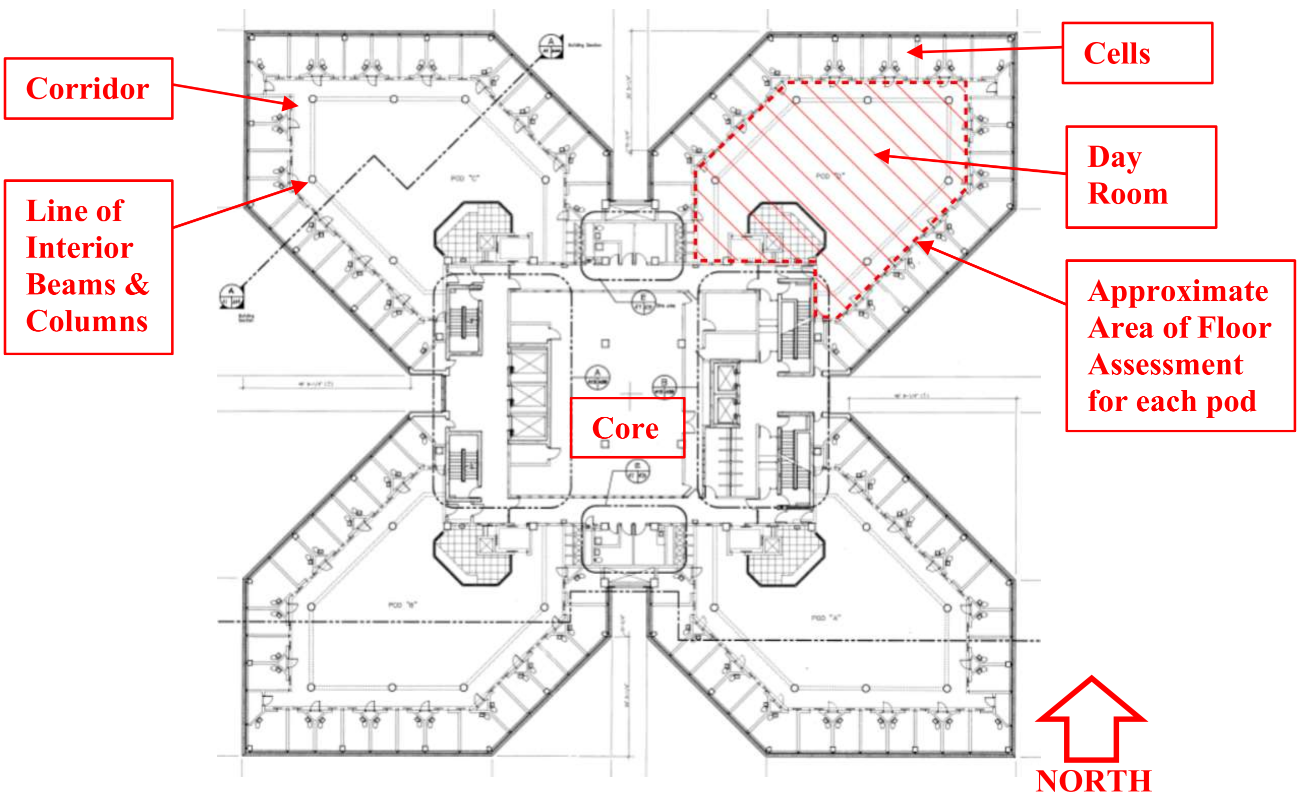

Figure 2 – General layout of the building from Sheet A-15

At the upper floors, the original drawings indicate that the structural floor system in the vicinity of the cells and corridors consists of an 8" cast-in-place one-way concrete slab spanning from the exterior 16"x44" concrete beams to an interior line of 12"x36" concrete beams. The exterior beams support the 8" concrete slab along with the exterior wall CMU and brick. The interior concrete beams support the 8" concrete slab and interior CMU walls on one side and a 9" wide concrete joist system on the other side. The total depth of the concrete joists is 28½", including a 4½" thick slab that spans between the joists. Both the exterior and interior beams are supported by either concrete columns or concrete wall (Refer Figures 3 & 4 for information).

At the partial mezzanine floors (Levels 3, 5, 7, 9, & 11), the structural floor system in the vicinity of the cells and corridors consists of an 8" cast-in-place one-way concrete slab spanning from the exterior concrete beams to an interior line of concrete beams. The exterior beams support the 8" concrete slab along with the exterior wall CMU and brick. The interior concrete beams support the 8" concrete slab and interior CMU walls on one side and, on the other side, are open to the floors below. The partial mezzanine floors are accessed by steel-framed stairs supported by the floors below.

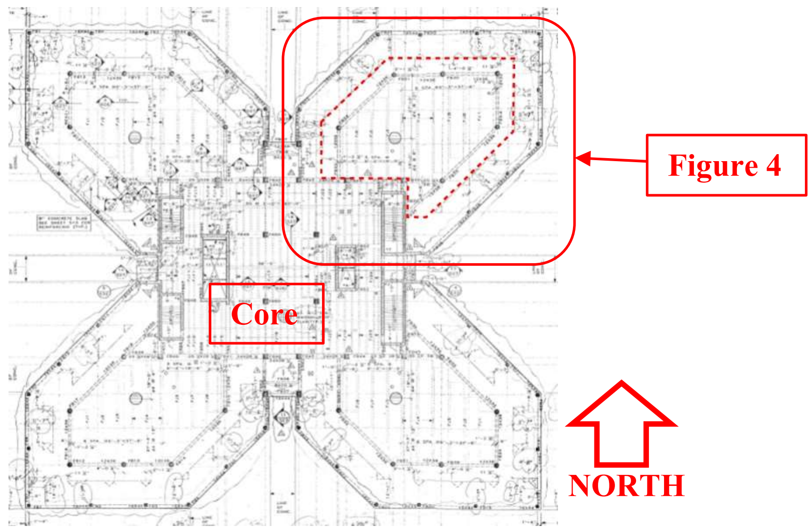

Figure 3 - Overall layout of typical floor structure from Sheet S-8

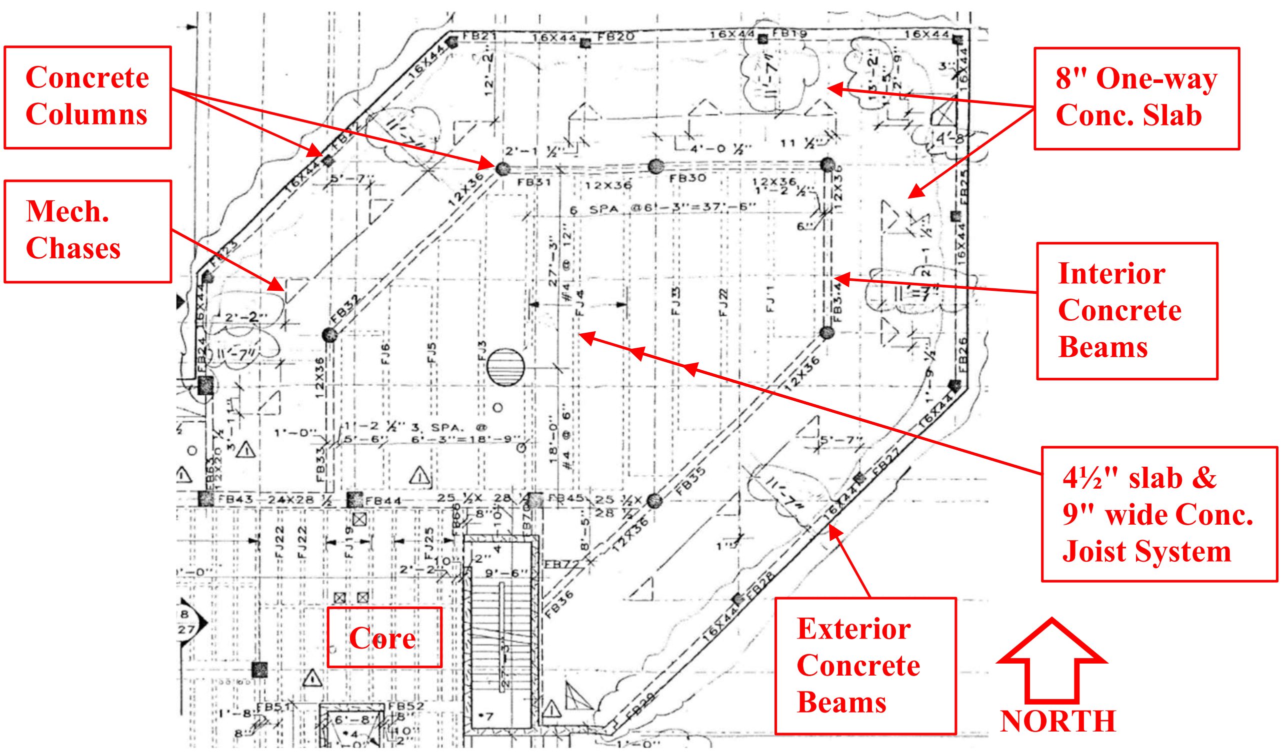

Figure 4 - General configuration of typical floor structure for a pod

Observations:

The limited-scope assessment relied on visual observation of the top surface of the floors and representative measurements of the floors' surfaces; it is not a comprehensive assessment of the entire floors due to security protocols, architectural finishes, furniture, and other obstructions. Observations of the floor's soffit above the ceiling were limited to representative portions to confirm the existing structure due to architectural finishes and proximity. Generally, the structural systems and members observed at each floor appear to be in good condition and consistent with the existing drawings. There was no visual evidence of overloaded or distressed areas of the floors.

Overall views of the general layout of a typical pod are shown in Photos 1 and 2. The typical concrete floor joist system below the Day Room of a typical pod is shown in Photos 3 and 4. An example of the large rectangular beam and column system between the one-way concrete slab and the concrete joist system is shown in Photo 5. At isolated locations, we observed air vents near some large beams' mid-depth (Photo 5). These appear to be part of the original construction; no distress was observed near these vent openings. At one location, we observed a hairline crack near the midspan of a large beam at the soffit of Level 14 (Photo 6). This type of crack near the midspan is not uncommon for this beam span in concrete construction, and the size and configuration of the crack are not considered problematic.

Observations of types of damage or deficiencies at the various floors are summarized below. Unless specifically noted, observations are general for the floors observed and not specific to a particular area.

Floor Cracking

At Floor Levels 2, 4, 6, 8, 10, 12, & 13, we observed cracking in the surface of the concrete floor (Photos 7 to 16). Most of the cracking is located at approximately the interior edge of the interior column-to-column beams around the pan joist area. This observed cracking is likely due to the different structural systems and their transition across the floor beams. This transition is also a change in the structural stiffness (and often the orientation) between the one-way slab area and the concrete joist system on either side of the large beams. The original structural drawings indicate additional reinforcement was to be placed at this transition to mitigate the size of cracks that may occur. Based on the crack patterns (Figure 5) and widths observed (typically less than 0.1"), this phenomenon does not indicate a more significant structural issue or failure. No signs of reinforcing corrosion were visible at these cracks.

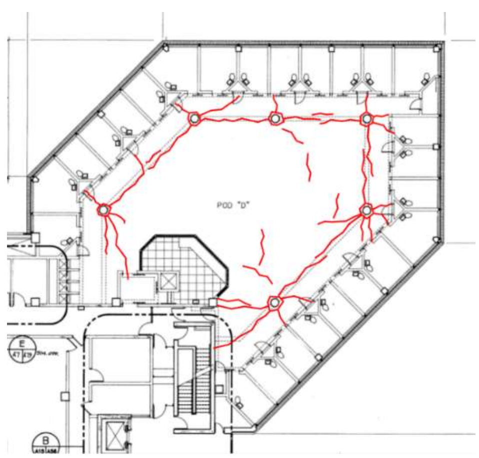

Figure 5 – Graphical image of cracking observed in the floor for a typical pod

In our opinion, the systemic and repetitive nature of the cracking is consistent with stiffness and orientation changes in monolithic concrete floor systems. The cracking along the top edge of the beams is likely the result of stress concentrations at the change in structural systems on either side of the beams (Figure 6). Some of these cracks have been aggravated over time by repeated foot traffic and water exposure. Typically, reinforcing bars are placed near the top of the slab to minimize the cracking due to negative flexural stresses that will likely occur at this transition region. According to the drawings, large reinforcing bars are typically distributed across these transition areas. The purpose of the bars is not explicit; however, they are likely included to serve both strength and serviceability demands. Larger bars are often utilized to account for higher bending stresses, while smaller, well-distributed bars are preferred for crack mitigation. The larger bars utilized here may be less effective than multiple smaller bars for the crack-control demands. Regardless, the crack widths are not excessive, nor do the cracks indicate a structural strength deficiency.

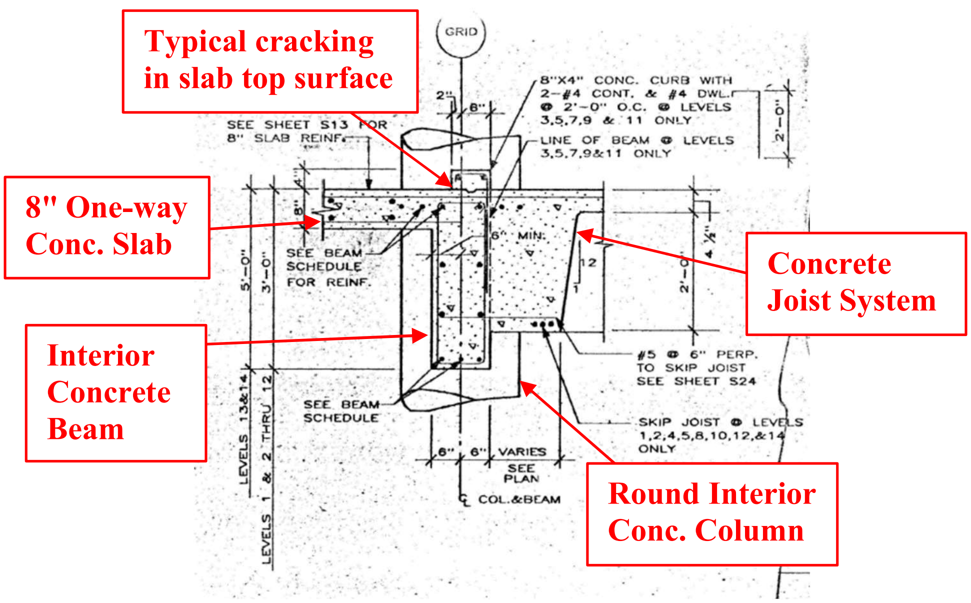

Figure 6 - Typical section at large interior floor beam

At the surface of several floors throughout the building, a circular hairline crack or surface irregularity was observed around most interior round columns (Photos 17 to 22). This concentric "halo" is evidence of a type of construction joint between the column and floor concrete. The concrete for columns in multi-story buildings often requires much higher compressive strength than the concrete for the floor slabs. The higher-strength column concrete is also placed in the slab immediately around the columns, allowing the column to be continuous through the floor slab. This technique accommodates construction sequences while maintaining the differing concrete strengths. Sometimes this construction technique, often known as "puddling," leaves the appearance of a minor "cold joint" in the floor slab where the different concrete strengths have been placed. Concrete finishing can sometimes mask this transition, but as the two concrete mixes may have different cured visual appearances, they often remain visible.

Around several columns and along the beams parallel with the cells, the cracking gives the appearance or illusion that the floor may be settling relative to the rest of the building, specifically with respect to the core of the building. We utilized simple means to obtain local elevation measurements on several floors in representative areas in the pods in an effort to determine if there were any significant relative deflections in the floor framing. We used a benchmark directly adjacent to the building core on each floor. At the center of the building, the concrete framing associated with the tightly spaced joist system and the central elevator and stair towers creates a "strong" central core with a significantly greater mass relative to the pods. Most of the measurements obtained typically ranged between approximately 0.4" to 0.6" at the large beams, 0.4" to 0.8" at the floor joists, and 0.2" to 0.6" at accessible portions of the one-way slab relative to the benchmark. These magnitude of deflections are not uncommon for the spans in these types of systems and are within acceptable tolerances for this type of construction and building live load or occupancy. In addition, based on our observations, the CMU walls of the cells and other architectural finishes for a typical floor did not exhibit signs of deflection or distress that would indicate settling or deflection associated with relative building settlement.

At the partial mezzanine floors at Levels 3, 5, 7, 9, & 11, there was isolated cracking observed in the floor slab in front of the cells (Photo 23) and a construction joint in the slab surface parallel to the large concrete beam along the edge of the floor (Photo 24). These cracks and joints occur at transitions and slab orientation changes and are similar to the observations described above.

Damage at Metal Stairs

The partial floors at Levels 3, 5, 7, 9 & 11 are accessed by steel-framed stairs supported from Levels 2, 4, 6, 8, & 10, respectively. At the stair landings at the partial levels, there is a joint separating the concrete floor structure and the steel-framed landing. At this joint, exposure to water has resulted in significant corrosion of the steel edge member (Photos 25 & 26). There appears to be some minor steel section loss in the steel at several locations. We also observed minor corrosion on the exposed grating treads of the stair (Photo 27). This corrosion is likely due to repeated exposure to water and regular cleaning operations. Concrete damage was observed at the base of one stair column at the base plate anchorage to the floor (Photo 28).

Isolated Floor Damage

There are some areas of isolated concrete damage throughout the floors consisting of damaged/delaminated concrete (Photos 29 to 32). Most of the damage observed was near floor drains in front of the mechanical chases. In most instances, the observed cracking or damaged concrete is likely caused by water intrusion and deterioration of the concrete surrounding the drain. From conversations with detention personnel, we understand that it is not uncommon for portions of the floor structure to be exposed to water due to plumbing issues. It is also possible the drain hardware or concrete around the drain was finished differently during construction. The exposed concrete appears porous due to repeated wear and water exposure. This type of damage to the slab can worsen and eventually progress into a trip hazard or cause corrosion damage to reinforcing in the slab. No significant corrosion damage was visible in the concrete at the few spalls we observed.

At isolated locations, minor concrete damage was observed at some of the cracks in the floor surface described previously (Photo 33). Water intrusion into the surface cracks likely contributed to the damaged/delaminated concrete.

At a few locations, distress was observed on the floor surface directly adjacent to a cell door (Photo 34). This abrasion or distress is likely due to the heavy cell door deflecting and engaging (rubbing against) the floor, wearing on the floor surface. This deflection in the cell door may be a result of the door connection or frame to the CMU walls being compromised.

The top surface of the concrete on each floor is coated with what appears to be a protective coating or membrane, such as paint (Photos 15, 16, 22, and 23). This coating is worn and most likely beyond its useful life. If the finish is intended to also serve as a protective coating for the concrete, this coating should be replaced and maintained.

Miscellaneous Observations

Minor cracking was observed in the sealant and/or finishes at some of the joints between differing materials of interior walls (Photos 35 & 36). These joints typically occur between CMU walls and sheetrock walls. At Level 6, we had access to observe the floor and wall surfaces in some typical cells (Photo 37). In a few cells, minor cracking was observed in the joints between CMU cell walls and the concrete structure (Photo 38). The cracking and distress observed are likely due to aged or improper detailing of the interior finishes to accommodate any movement or relative shrinkage or deflection in those systems.

Distress was observed above the door frame and at the floor's surface in a stairwell at one location (Photos 39 & 40). The door wearing on the concrete stair landing may be due to improper door frame installation.

At a few stairwells, minor cracks and distress were observed in the finish material on the soffit of some stair stringers (Photos 41 & 42). In these areas, the combination of the long aspect ratio of the finish material and possible moisture intrusion has likely contributed to the material relieving stresses in the form of a crack or hump near the mid-span of the soffit.

Surface distress or imperfections were observed in some previously repaired stairwell walls (Photos 43 & 44). It appears that these imperfections were likely the result of the finishing techniques of the repair material.

Summary and Recommendations:

The nature of a concrete structure and its construction can directly influence its durability and performance. The unique operations and usage of this building can directly impact its long-term performance. The building is over 30 years old and has experienced wear and tear over its lifetime.

We did not observe any visual signs of significant structural problems in the floor systems throughout the pods. The cracking and deflections observed do not indicate significant rotation or movement associated with overstressed members or overall building settlement. Most of the cracking observed results from the transition between different structural systems and orientations in the floor framing. The observed cracking is an aesthetic and serviceability issue. Based on our observations described above, we believe the conditions and issues noted above can be repaired or mitigated with reasonable effort. The observed damage can be repaired using typical concrete and maintenance repair techniques.

Below is a list of recommendations to address the structural issues discussed above. These recommendations intend to address the isolated damages observed with the use of maintenance personnel. Routine inspections and ongoing maintenance are also recommended.

Repair Items:

- The cracking in the floors should be periodically reviewed for any change in widths, lengths, patterns, or quantity. Due to the cracking being in areas of constant foot traffic, mounted crack monitors are not recommended.

- The existing floor coating is aged and worn. Consideration should be given to removing the old coating and applying a crack-bridging or elastomeric waterproof coating. The size and orientation of the cracks should be considered when selecting a coating. Water exposure and finish traction should also be considered due to the frequent cleaning operations a floor undergoes. It is important to note that the removal of the existing coating with media blasting techniques will amplify the visual width of the top surface cracks. This is to be expected and is the basis for a crack-bridging or elastomeric system recommendation.
- In areas of isolated concrete damage, we recommend standard concrete repair techniques using the following repair procedure: chip to sound concrete, saw cut the perimeter, place cementitious patching material, and place membrane coating over the repair area for protection. ZFI can provide appropriate materials and procedures for different applications on floor surfaces.
- We recommend maintenance personnel routinely check and clean surface drains to prevent clogging.
- At the metal stairs, corrosion staining on the steel elements should be cleaned by mechanical means down to clean steel material and repainted. Notify a structural engineer for additional evaluation and recommendations if significant section loss in the steel is revealed.
- The cracking in joints formed between differing wall systems (such as sheetrock to CMU) can be repaired with typical wall joint repair techniques. These techniques include removal and replacement of sealant, resizing the joints (if necessary), and proper backer rod sizing and installation.

If you have any questions or concerns regarding the findings or recommendations contained in this report, please do not hesitate to contact our office.

- END -

Photo 1 – Overall view of Day Room at Level 12

Photo 2 – Overall view of Day Room at Level 8

Photo 3 – Soffit of slab & joist floor system at Level 13

Photo 4 – Soffit of slab & joist floor system at Level 13

Photo 5 – View of large rectangular beams & round interior column at Level 13

Photo 6 – Hairline crack in rectangular beam at Level 14

Photo 7 – Cracking in slab top surface at Level 13

Photo 8 – Cracking in slab top surface at Level 13

Photo 9 – Cracking in slab top surface at Level 13

Photo 10 – Approximate width (0.060") of crack in slab top surface at Level 13

Photo 11 – Cracking in slab top surface at Level 10

Photo 12 – Cracking in slab top surface at Level 10

Photo 13 – Cracking in slab top surface at Level 8

Photo 14 – Approximate width (0.050") of crack in slab top surface at Level 8

Photo 15 – Cracking in slab top surface at Level 4

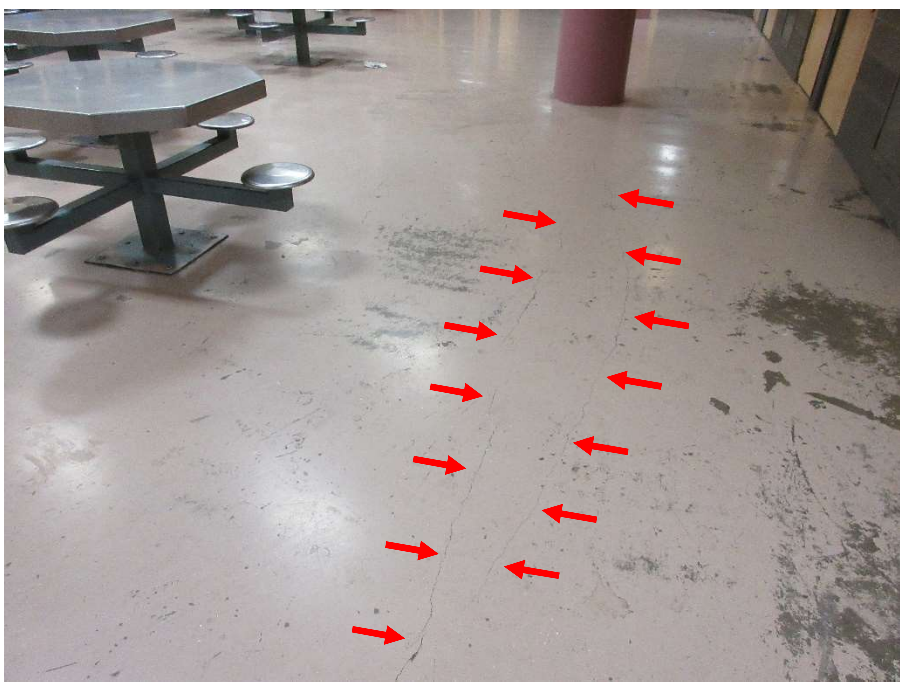

Photo 16 – Cracking in slab top surface at Level 2

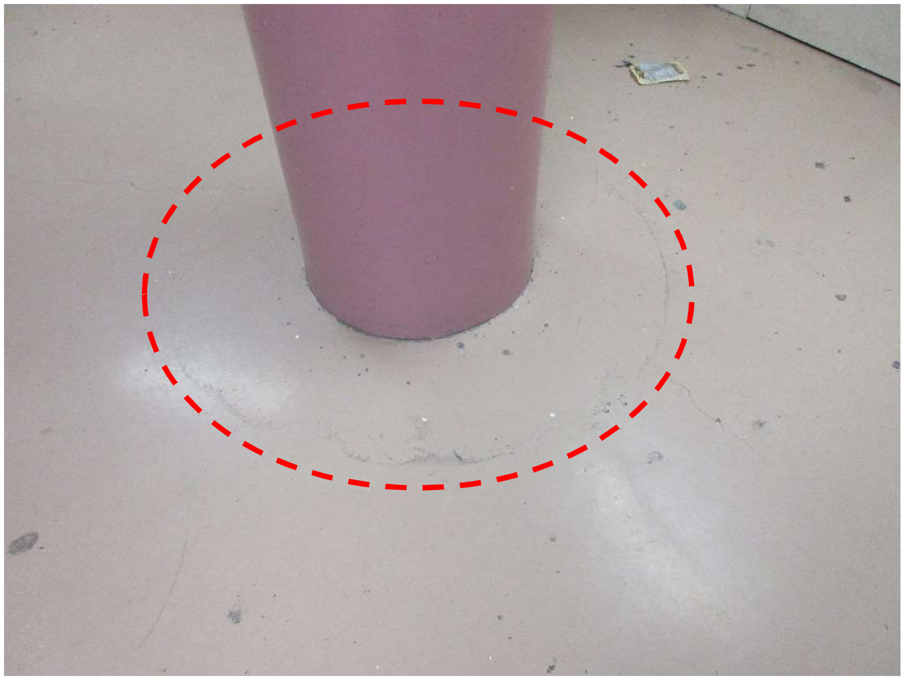

Photo 17 – Circular construction joint around column at Level 13

Photo 18 – Circular construction joint around column at Level 13

Photo 19 – Circular construction joint & cracks at Level 12

Photo 20 – Approximate width (0.040") of crack in slab top surface at Level 12

Photo 21 – Circular construction joint & cracks at Level 10

Photo 22 – Circular construction joint & cracks at Level 4

Photo 23 – Cracking in slab top surface at Level 9

Photo 24 – Construction joint in slab top surface at Level 9

Photo 25 – Corrosion of edge framing at stair landing

Photo 26 – Corrosion of edge framing at stair landing

Photo 27 – Minor corrosion of steel treads at stair

Photo 28 – Concrete damage at base of stair column

Photo 29 – Concrete damage near floor drain at Level 13

Photo 30 – Concrete damage near floor drain at Level 12

Photo 31 – Concrete damage near floor drain at Level 10

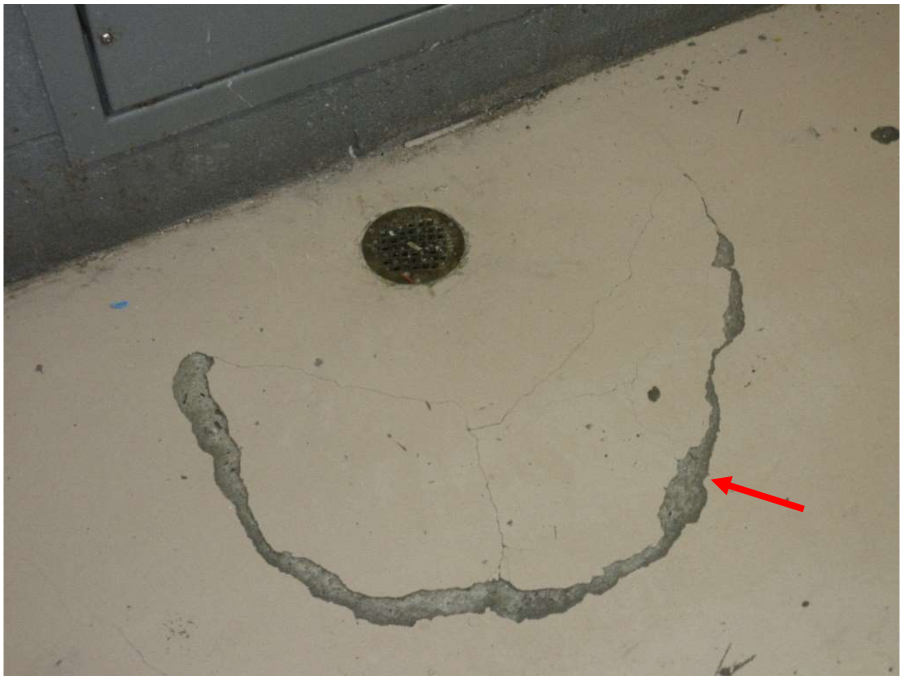

Photo 32 – Concrete damage near floor drain at Level 2

Photo 33 – Concrete delamination along crack at Level 10

Photo 34 – Significant abrasion of concrete surface at Level 4

Photo 35 – Cracking in sealant of vertical joint at interior wall @ Level 13

Photo 36 – Cracking in finishes at interior wall @ Level 4

Photo 37 – General view of typical cell at Level 6

Photo 38 – Cracking in sealant of vertical joint at cell wall

Photo 39 – Distress at door frame of stairwell

Photo 40 – Abrasion in floor surface from door at stairwell

Photo 41 – Distress in finishes on soffit of stair stringer

Photo 42 – Distress in finishes on soffit of stair stringer

Photo 43 – Surface imperfections in stairwell wall

Photo 44 – Surface imperfections in stairwell wall