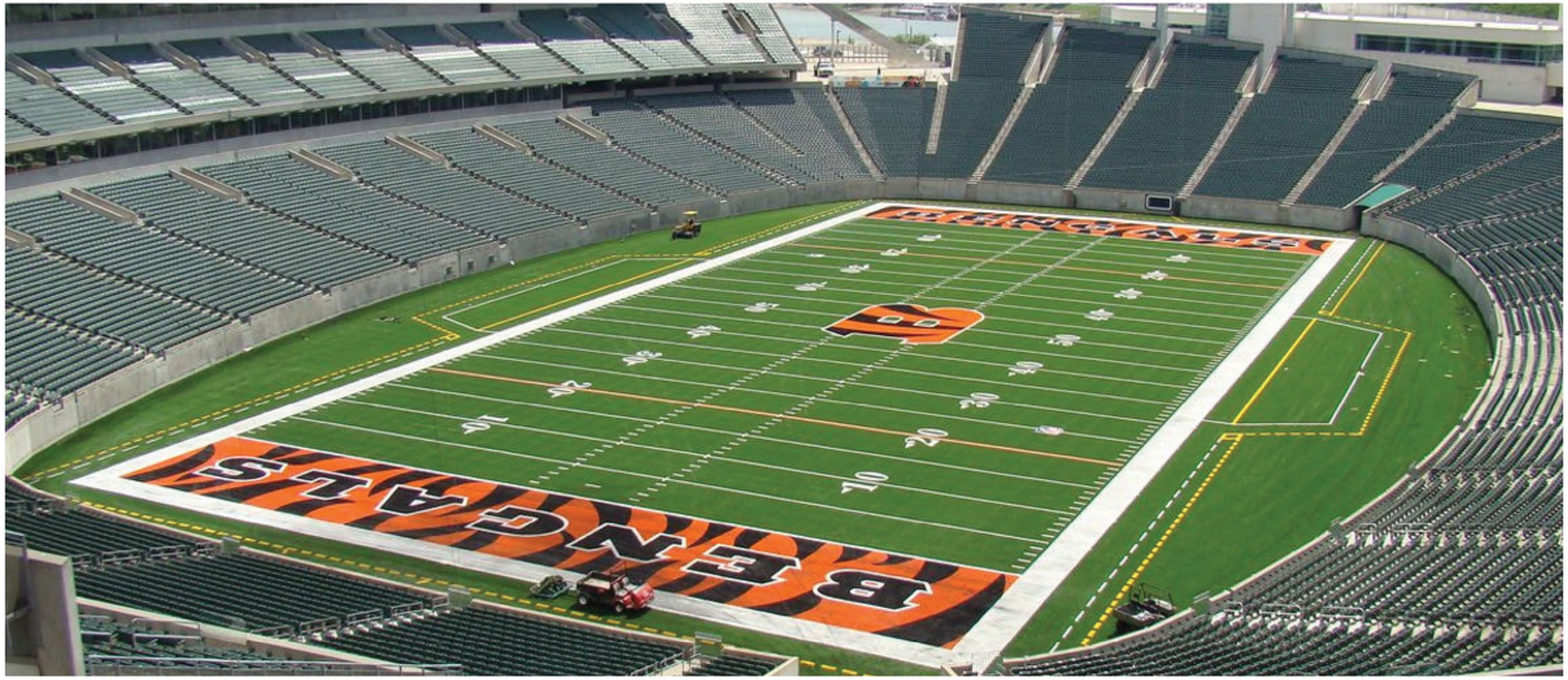
Facility Condition Assessment

FINAL – April 25, 2022

Paul Brown Stadium



Gensler

elevar DESIGN GROUP

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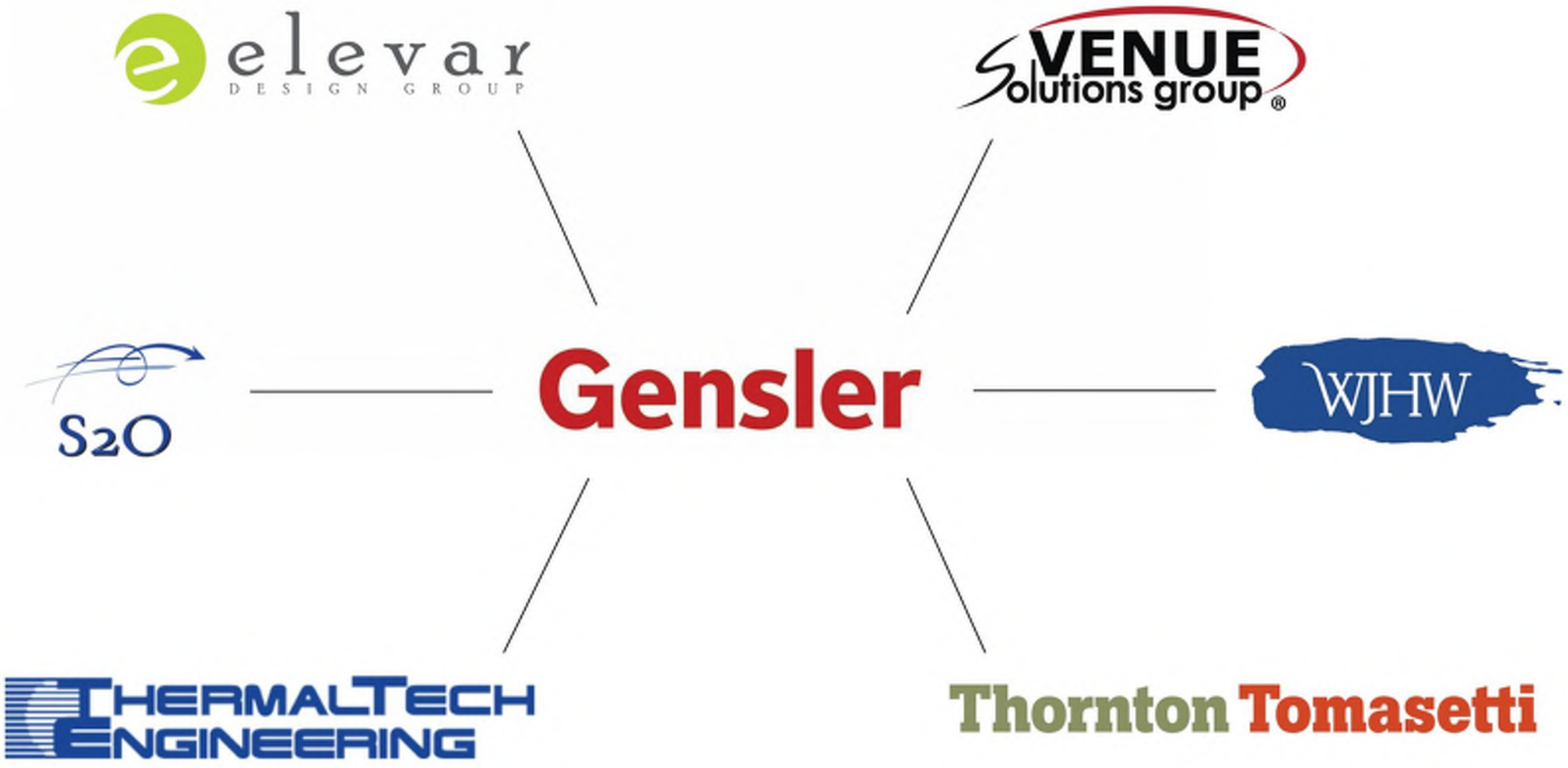
PROJECT TEAM



OVERVIEW & EXECUTIVE SUMMARY

Overview & Executive Summary

Venue Solutions Group (VSG)® was engaged by Gensler Sports on behalf of Hamilton County and the Cincinnati Bengals to provide a comprehensive facility condition assessment of Paul Brown Stadium that benchmarks the current condition of the facility. As part of the assessment, VSG, in partnership with their consultant team, has developed a 20-year capital expense matrix to assist the owner in establishing priorities for major repairs, potential upgrades and maintaining the facility in a professional manner. The ability to plan and maintain the stadium as it transitions from years 18 to 30 is crucial in extending the life of the facility as well as its relevance in the competitive and ever evolving regional and national marketplace. In addition to the facility assessment, VSG has also provided information related to the practice field, bowl cleaning and event-day trash removal.

As the stadium enters its third decade of operation, its ability to deliver a positive guest experience is crucial for it to remain relevant both locally and nationally. It is important to keep the facility in a first-class condition and well maintained for a great experience for fans, staff, and players.

The consultant team includes national firms with specific expertise in the design and operations of large stadiums with major professional sport franchises as major tenants or operators.

Gensler Sports, a globally recognized public assembly designer, is the overall project manager, ultimately responsible for both this assessment as well as a stadium master plan.

Elevar Design Group is a Cincinnati-based, minority owned design firm has performed renovation projects at Paul Brown Stadium and is well suited in this effort as they assessed the condition of public and team spaces, and the roofs.

ThermalTech a locally based MEP design firm, performed the review of the mechanical, electrical, plumbing and fire protection systems and at the same time provided strategies for more efficient operations of major systems.

Thornton Tomasetti, a global structural engineering firm, performed a structural review of the stadium that focused on load bearing walls, fireproofing, steel structures and exterior sidewalks and slabs.

Wrightson, Johnson, Haddon and Williams (WJHW) reviewed the entertainment and operations technology systems. The firm extensively reviewed video displays, sound, cabling infrastructure, IT and CCTV system.

The food and retail operational reviews were performed by S2O Consultants, a nationally recognized food and beverage design firm. They reviewed the condition of food service equipment, kitchens and concession stands, and reviewed new stadium trends with concessions.

VSG and a majority of the consultant team performed the on-site review prior to the 2021 NFL season, with follow up visits and virtual meetings conducted the following weeks. The review consisted of a visual inspection of equipment and spaces along with interviews with staff and a document review. It should be noted that the staff of Paul Brown Stadium and Hamilton County provided the review team with significant amounts of documentation. Facility staff were available during the on-site review to answer questions from the team. The on-site assistance contributed significantly to the depth of the report.

Facility Description

The stadium opened in 2000 and seats 65,515 on three public levels, including 7,495 club seats and 4,601 convertible club seats (which includes ADA). There are 119 Standard Suites, 6 Party Suites and 8 Player Suites. The stadium has seven (7) primary levels: the Service Level, which houses the loading dock, home and visiting team locker rooms, groundskeeping space, multiple auxiliary locker rooms, X-ray room, MRI facility, merchandise warehouse, team cafeteria, weight room/multifunction room, equipment room, broadcast studio, public relations space, Hamilton County offices and food production spaces; the Main Concourse, which serves the east and west sides and includes access to the Plaza Level, primary points of entry and egress as well as spaces for food and beverage offerings; the Plaza/Lower Suite Level offers 360° of circulation,. access to lower level seats, and suites; the Club Level has premium clubs on the east and west as well as suites (Mid Suites); another level of private suites called Bengal Suites; and the Upper Concourse, which provides concessions space.

The stadium was the first NFL facility to win an American Institute of Architects national design award and, in 2007, made the list of "America's favorite 150 buildings and structures."

It should be noted that recent improvements and renovations that results from the information in this assessment report will significantly contribute to local efforts in securing large scale events such as World Cup, US Men's National Team, and CONCACAF Gold Cup soccer matches, concerts, motorsports events, and City-wide festivals and at the same time provide a high-level experience to guests and fans.

Architecture & Interiors

Paul Brown Stadium is an open-air NFL stadium located in the southwest corner of downtown Cincinnati. The post-modern design has 7 levels topped by two fabric canopies above the upper deck seats on the east and west sides. The overall height is 195 feet and the footprint is 815 by 1023 feet.

The exterior façade is composed of precast concrete, glass, stainless steel perforated panels and painted tubular steel. The design is geometrically complex and futuristic, combining angular vertical elements with curved facades.

The stadium is composed of three major elements: The seating bowl; the Administration Building overlooks the Ohio River; and there is a surrounding Plaza. The Plaza provides circulation as well as access to the surrounding street grid.

Several major exterior components on the stadium are failing: these include the plaza deck waterproofing, cushioned seating in the club sections and the sliding glass wall system in the private suites. Spaces surrounding the seating bowl show signs of age such as rust and water damage and need to be updated in order to present a clean and proper environment.

The gates and arrival areas are in need of renovation to meet 20 years of security changes as well as future expanded parking at the west side of the stadium. Needed upgrades include folding auto barricades, magnetometers, lighting, canopies, larger queuing areas and wayfinding. Access from Elm Street to the eastern side of the Plaza is too small to accommodate the number of fans who use the parking and pregame areas to the east of the stadium plaza.

Several spaces seem underused and could be modified to improve revenue, improve event experience or provide solutions to other space problems. Areas such as the sponsored spaces, the catered event only concession areas and the concession area on the east 200 level seem underused. The Pro Shop's opportunities could also include upgrades to generate revenue. Masterplanning could include reviewing these spaces for evaluation of costs and benefits.

Architectural and interior finishes range from very utilitarian with sparsely used color and graphics on concourse levels to very sophisticated in private clubs and suites. Many finishes, especially within clubs and suites, would be well served to be refreshed. Even if they appear to be in good condition, the ongoing maintenance and labor costs are a major factor for recommendation of replacement or upgrade of finishes.

Administrative offices are a nice aesthetic and in acceptable condition. The finishes in the Pro Shop are appropriate for retail branding and although finishes are generally in good condition, many areas have suffered damage from the continued leaking of the plaza deck above. The player's spaces (locker room, showers, gym, auditoriums) are on par with the aesthetic and branding of other NFL team spaces.

Team spaces that have been expanded and updated in the past 10 years are adequately functioning and in good condition. This includes new locker room, weight room, practice gym, cafeteria and TV studio. Other areas need updating, including: visitors' locker room, trainer's treatment room with hydrotherapy, equipment areas and pick-up for team mail, packages and food. Overall repairs are needed to replace finishes, eliminate rainwater leakage, upgrade outdated lighting to LEDs, increase ventilation, add electric outlets (including USB) and improve the aging water supply system.

A major concern of shower rooms and locker rooms, especially those in the player's areas, is that the floor tile is no longer manufactured, meaning repairs have to be made with dissimilar materials.

Distribution of restrooms has some gaps. The average number of toilets in PBS is 40 fans per fixture. However, there are 4 specific areas which have far fewer fixtures than other parts of the stadium. The underserved locations are at Levels 300 North, 300 South, and the 400 level inside both East and West Clubs' North ends. A master plan exercise should address this situation.

Lighting, both interior and exterior, is old fashioned and not energy efficient. New LED fixtures have the potential to improve aesthetics as well as save money in maintenance and energy. LED lighting has been installed throughout the concourses. However, the lighting is dim and either needs higher output or more fixtures. As well, the lighting along the exterior plaza level is not producing enough lumens, resulting in the need for portable lighting for nighttime events.

Roof Systems

While not a part of this condition assessment report, it is worth noting that in 2020 an assessment was performed on the east and west canopy fabric roofs, the north and south scoreboard roofs and the three escalator canopies. Birdair inspected the PTFE membranes, clamping components, cables, and structural steel. Their observations and concerns include mold on the fabric, various punctures in the fabric, roof hatches needing repairs, numerous loose or broken gutter straps, missing related hardware, and the south scoreboard fabric edge had come loose from the perimeter attachment. Overall, the condition of the structural steel was deemed "Very Good" and all other components "Good." We recommend that a plan be developed which identifies costs and dates for replacement of these PTFE roofs.

In addition to its prominent fabric canopies, Paul Brown Stadium has individual roofs over the Administration Building, concession stands, scoreboards, and entrance gates. Interior spaces beneath the seating risers are protected by a galvanized metal subroof system. The subroof location is directly under the seating areas above the field level and at concessions and pantries throughout the facility.

Many of the outdoor spaces were originally roofed with Single-ply EP (Ethylene Propylene) which is being replaced on an ongoing basis. In the past 5 years, the EP roofing has been replaced in a majority of areas with TPO and Modified Bitumen.

Two other roof types are original to the facility. Metal roofs were constructed over the entry gates and camera booths and there is a small area of protected membrane roof adjacent to the upper suites.

The remaining EP roofing is near the end of its service life, and replacement is a high priority. Other roofing appears to be performing well with the exception of some roof drains that are missing their strainers.

The subroof system, which is under the seating, has failed in multiple locations at the lower seating bowl. Repairs are on-going. It leaks at the drains, gutters, flashing and at the roofing deck itself. We recommend that the system be improved so that the spaces beneath it can be protected from future damage.

We also recommend that some areas beneath the plaza deck be reviewed for installation of a subroof. Damage in these beneath-the-deck areas is caused by a variety of leaks. Sources include plumbing in concession stands and failed plaza deck waterproofing. Another source is currently being rectified; metal decking at exposed stair landings is being replaced/repaired prior to the 2021 football season. These corrective measures will continue until all decking has been repaired.

Mechanical, Electrical, Plumbing & Fire Protection

<u>Mechanical</u>

Many utilities are original to the stadium and are approximately 20 years old. The facility staff has maintained systems at proper working levels, and in 2014, various mechanical equipment was retrofitted and recommissioned at that time. While most equipment remains in good condition presently, water infiltration and corrosion in some areas may result in the replacement of certain equipment.

Main portions of the stadium heating, ventilation and air conditioning (HVAC) system are served by a water glycol loop that receives chilled water through district cooling heat exchangers. Hot water boilers replaced most electric heating elements in most air handler units (AHUs) in 2014. Precision control of the air handlers has been problematic due to control valve modulation responsiveness and building automation system (BAS) communication infrastructure. Smaller zones are served by rooftop units (RTUs), direct expansion (DX) mini-split systems, and fan coil units (FCUs), all with varying functionality,

and replacement of these smaller systems should be addressed upon unit failures. Similarly, exhaust fans should be replaced as they fail, but should undergo increased preventive maintenance now to limit bearing failures and belt breakage issues. The chilled water pumps should have seals replaced in the next two years with a full pump replacement considered in the next 5-10 years. The BAS system was recommissioned by Ameresco and Trane in 2014, but should be updated, and additional recommissioning and training should be included now to increase reliability, efficiency, and troubleshooting.

Electrical

The electrical distribution is largely unchanged from original construction except for limited added panels for serving loads, supporting later installed technology (DAS, Wi-Fi, etc.) and is in good to excellent condition depending on the area and exposure to weather and other conditions such as kitchen grease. Although not part of the scope of this project, a singular DAS system should be evaluated.

Service is adequate and running at lower loading than original construction due to energy efficiency improvements such as LED lighting conversion and HVAC re-control with VFDs.

Maintenance is generally good with limited exceptions as detailed below in the main report. A preventative maintenance program has been in place and generally covers most of the equipment.

Recommendations are detailed below and include additional "mid-life" testing of cabling, medium-voltage gear and circuit breakers, and substation transformers that are not a part of the existing preventative maintenance program.

The emergency power generation and distribution are in good condition but there are obsolescence issues with the generator controller. As well, the system is setup as a life-safety system that is not setup for load shedding of optional standby loads. It has been observed that optional loads exist on the system that should be on their own transfer switch with controls to shed.

Power monitoring exists on the substations but is not in place lower in the system. A networked monitoring system is useful for tracking energy usage and reducing costs as well as for understanding system demand when new loads are added.

The existing fire alarm is in good condition with the head end equipment and all associated peer to peer nodes having been replaced with new JCI/Simplex 4100-ES equipment and the upgrades being completed at the end of 2022.

Plumbing

Much of the plumbing system is original to the stadium construction and approximately 20 years old. City water is provided from the Greater Cincinnati Water Works on the service level and routed through a city water booster system to the stadium via galvanized and copper piping. Intermediate pressure natural gas is provided by Duke Energy and enters the stadium on the service level and is distributed throughout the stadium via carbon steel piping. Local NG regulators reduce the pressure at the end appliances while the new boiler plants run on 2 psi natural gas. Sanitary and storm systems are collected throughout the stadium down to the Service Level and exit the building below grade to the Metropolitan Sewer District of Greater Cincinnati (MSD). Three large storm water pumps located on the Service Level dewater the stadium during flood events and 21 additional deep well dewatering pumps remove water from below the stadium during normal operation.

The main plumbing equipment resides in two mechanical equipment rooms labeled North (Sector 1) and South (Sector 8) Water MER. The stadium is supplied by two 10" city water mains that enter the MERs through reduced pressure backflow preventers with 3" maintenance bypasses. City water booster pump packages (BP-1, BP-2) are in these rooms providing approximately 100 psig to the stadium and the hot water heat exchangers. The original construction drawings included water softeners for the hot water tanks, but do not currently exist and appear to have been removed. The sanitary system is generally routed around the stadium and collected in the southeast quadrant and exits the stadium in Sector 5 near column #21.5. The storm system is generally routed around the stadium and collected in the southwest quadrant and exits the stadium in Sector 8 near column #38. The groundwater system collects groundwater from 22 deep well dewatering pumps and various drains around the bowl of the stadium into a manhole system routed to a large underground sump and pump system in Sector 9 between columns #43 & #44. A 36" forced main exits the stadium at column #43. Three (3) deep well pumps are refurbished each year. However, the main controls for the deep well pump system are original to the stadium and will be included in future maintenance, updated or replaced in the next ten years.

To keep the plumbing system running effectively on game day, the staff flushes out the city water system on upper floors to remove brown water from the piping system prior to fan arrival. They also strive to insulate and heat trace potential frozen trap locations and have added drain pans to stadium areas where rainwater leaks have occurred.

In 2014, an energy efficiency project converted the four (2 per Water MER) PK domestic hot water storage heaters to storage tanks without integral heaters. A hybrid heating boiler plant with plate and frame heat exchangers was installed to provide domestic water heating. A No-Salt water treatment system was installed with new boiler plant for heating hot water and glycol feed systems were installed for makeup water during the project. Based on internal storage tank conditions discovered in the 2014 project, the South Plant domestic water storage tanks were replaced with a single new Lochinvar 940-gallon storage tank in 2017. In 2018 the same work was complete in the North Plant. In 2020 the north storage tank and plate and frame heat exchangers were examined for condition. The hot water tank was found to be clean and non-fouled while the HTXs were found to be coated with film which required cleaning prior to reassembly. A further study of the domestic water quality was commissioned and will be discussed later in this report.

Fire Protection

The fire protection system is original to the stadium with limited upgrades in types and coverages since 2000. The piping, components, valves, sprinkler heads, and pumps of the fire protection system are approximately 20 years old and have been maintained by the PBS staff and local fire protection companies since installation. Overall, the fire protection systems are in good working order and do not require wholesale replacements. It has been observed that most failures and repairs are associated with dry pipe systems serving outdoor areas, garage spaces, and egress ramps around the stadium.

Structure

Most structural elements throughout the stadium are in good condition, however there are locations in the stadium where enhanced maintenance is necessary. Primary structural elements, such as reinforced concrete framing, concrete raker beams, precast double tees, structural floor slabs, masonry walls, structural steel framing, and boomerang columns generally exhibit only isolated cracks, localized spalling and corrosion. Items in greater need of attention include cracked concrete topping slabs, corroded composite metal decking, corroded precast cladding attachments, localized exposed rebar in precast concrete elements, and deteriorated traffic coatings. These items require immediate attention and should be prioritized in the repair and maintenance plan.

There have been ongoing issues maintaining significant areas of the non-structural topping slabs throughout the facility, generally in areas exposed to weather and receiving traffic. In various areas, previous topping slabs repairs appear to be at the end of their service life. Water leaking was observed in areas of the Service Level located beneath the plaza concourse, indicating that water has penetrated through the waterproofing membrane beneath the topping slabs. Topping slabs should be prioritized during the stadiums annual concrete and waterproofing maintenance and capital projects. Without this maintenance and repair, further deterioration may occur to conditioned spaces below and to the structural floor framing. Cracked topping slabs located above conditioned spaces, especially areas that have experienced leaking, should be prioritized for repair, and the waterproofing between the structural slab and topping slab should be assessed and repaired as necessary to prevent further water infiltration through the floor assembly. Removal and replacement of the topping slab may not be practical to provide access and evaluate the existing waterproof membrane. Therefore, the existing waterproof membrane may need to be abandoned in-place and instead the stadium will rely on new traffic coatings applied over the top of existing topping slab. Waterproofing membrane installations have been ongoing and will continue each year to enhance the performance and longevity of the stadium. Areas of non-structural topping slabs with widespread cracking, such as the south Plaza Level concourse and areas of the upper concourses, will need to be properly cleaned, surface cracks and divots properly prepped for placement of a new waterproof traffic coating, which should be applied to the existing concrete topping. Any new replacement concrete topping slabs should be provided with adequate contraction joints to limit future cracking, and it is recommended the entire area also receive a traffic coating in order to limit water infiltration through any minor cracking that may occur. Localized cracks in the topping slabs that have been previously repaired with sealant may also require more extensive repairs.

Expansion joint covers and expansion joints are replaced as reviewed by stadium management and Hamilton County's engineer. The condition of the expansion joints themselves, especially those that occur over conditioned spaces and have experienced leaking, should be assessed for any deterioration and replaced as required. Our project team recommends a water tight system that accommodates wheelchairs, automobiles and snowplows with a rubber bottom blade. At the canopy level an optional moisture and fire rated barrier.

At the time of our site visit, corroded metal decking in composite slabs with concrete topping was widespread throughout all four pedestrian ramps and along the lower level stair landings. At the time of this report, some months later, we understand the replacement of metal decks at stairs and ramps replacement has already begun. Metal decking areas with severe corrosion requires either replacement of the metal deck or the placement of new additional steel framing members to divide, shorten and re-support the existing concrete slab spans. The concrete topping over metal deck throughout requires a traffic coating to prevent moisture from infiltrating through the concrete topping. The moisture can corrode the metal deck and supporting framing members. All coatings should be regularly inspected and maintained. These repairs are ongoing through cooperation with Hamilton County.

Additionally, corroded steel attachments at precast façade panel connections and at stair and ramp framing require a protective paint coating after all rust is thoroughly removed or require replacement depending on the severity of corrosion. Corroded steel ramp and stair framing also requires maintenance to remove and protect the steel structure. Any steel framing and fasteners that are exposed to weather require regular maintenance to prevent deterioration, and any corrosion should be addressed promptly.

There are several concrete spalls in the precast concrete double tees and elevated concrete framing that should be addressed, with priority given to elements with exposed reinforcing. A protective coating may be required for precast elements with a low concrete cover.

At the seating bowl precast risers, cast-in place concrete steps with large cracks or significant delamination from the precast unit require replacement. Traffic coatings should be applied to precast seating risers to protect the surface of the concrete and prevent water infiltration into spaces below. In addition, deteriorated sealants throughout the seating bowl and at precast concrete joints require replacement.

A detailed inspection of the facility and a testing program should be implemented to further investigate areas not easily accessible, and waterproofing membranes in select areas of the facility should be inspected. A detailed maintenance plan should be developed and implemented for items such as the topping slabs and topping slab coating, expansion joints, sealants, coatings to structural steel, and traffic coatings. Further lack of maintenance on items that are in poor condition will allow continued deterioration and may affect the condition of surrounding elements.

Technology

A/V Systems

By 2021 standards, there are limited capability Audio Video systems in private and public spaces including concourses, clubs, lounges, and suites with some areas having different generation and combination of equipment. The lack of options in larger premium spaces for local insertion of content on the television system forces staff to resort to using portable and rental solutions to satisfy event production requirements. The available A/V input locations are not in proximity to traditional head of table or main stage positions, so cables must be extended and taped down as needed and in some cases, those runs can be up to two hundred feet to satisfy event needs. Staff have found some creative ways to meet the event requirements but providing better display options and ways to address them in a more targeted fashion would increase revenue generating opportunities by making the spaces more attractive to event

planners, as well as competitive with other local facilities who pursue the same clientele.

Broadcast Cabling

The broadcast cable infrastructure is not consistent with the typical requirements of national broadcasters' coverage of NFL games. Existing locations have small compliments of camera and audio infrastructure including coax, Triax and single mode fiber, but the expectation would be for all locations to have SMPTE hybrid cabling as well as Triax, Single Mode Fiber Optic Cabling, XLR Audio, Coaxial and ethernet cabling.

The camera junction boxes, JBTs, are physically in good condition but the enclosures and connections are showing wear and corrosion from the harsh outdoor environment. As more network trucks that service the games become fitted with SMPTE/fiber cameras, the cabling infrastructure installed in the facility will need to be upgraded to meet the technology advancement. Installation of additional JBTs began in 2021 and continue in 2022, and additional scopes will be defined to ensure PBS is meeting the broadcast standards.

At the TV truck parking location, television remote production (TVRP) racks have a few connections marked out of service but overall, they are well maintained. The small number of connections in the TVRP racks immediately reveal the limited infrastructure options available to television broadcasters. Referee Replay, league equipment and outbound fiber circuits for video transmission to the TV network show's home location are easily accessible.

It is important to note that as of August 2021, the facility and CBS are currently performing a broadcast cable project/upgrade. However, this does not address the lack of overall camera positions or any expansion to the physical footprint of the TV Truck compound.

Distributed TV

The television system is an RF distribution plant with content for its channel lineup inserted from Spectrum, DirecTV and in-house video production (JungleVision). Signal is distributed over coaxial cable throughout the facility terminating at jacks behind individual televisions. Random locations tested found good signal with no artifacts in images. The system is well maintained but many areas have ad hock additions with no cable management and although it may satisfy current requirements, a move to an IPTV based solution will provide a feature-rich resource with greater opportunity for monetization of other scopes including concession menu boards and digital signage.

The televisions and mounting brackets used throughout the facility are a random mix and since the last upgrade many different TV sets were installed as part of location improvement opportunities. Replacements did not stick to the existing product line or manufacturer which has exacerbated the game day operational functions. There is no control system to turn the sets on remotely requiring multiple staff members with multiple remote types to turn the sets on and off manually for events. Many of the TV brackets are from original construction, designed to hold CRT displays that were substantially heavier with a larger profile and are not aesthetically pleasing when combined with flat panel displays. Many of the TVs are undersized for the spaces they are in.

LED Displays

The stadium bowl LED displays were replaced from original in 2014 and appear to be well maintained seven years into the ten-year life expectancy but are among the smallest NFL stadium main displays. The existing aspect ratio and resolution allows for two 16:9 images side by side or one 16:9 image centered with game and advertising information on either side. 4K HDR is all the buzz but a technology consideration to transition from the current 1080i configuration to 4K would require the main north and south displays at minimum to each increase in size from 36' x 130' to approximately 43' x 130' and increase resolution from the current virtual 13mm technology to 6mm to display pixel accurate 4K images. This change would come with a probable cost of more than $9M per display. Most NFL main bowl displays are not built to traditional aspect ratios such as 16:9 for a variety of reasons but because of limited opportunity to significantly increase these display sizes, 1080p HDR displays at 10mm resolution would be a good future replacement option for consideration but will still not fill the display with one 16: 9 image. That said, most displays are oversized to accommodate statistical data, score and advertising outside of the live video window.

The ribbon boards stand to benefit most when replaced due to significant price reductions of LED that will allow a higher resolution display in the same form factor. The available lower deck fascia presents a very good opportunity to add a second ring of ribbon boards at the plaza level for messaging, marketing, and game statistics purposes.

The exterior marquee was upgraded in 2021.

As the price of high-resolution LED displays begin to come down, pro sport facilities are adding displays in premium spaces for branding, on concourses for way finding and advertising and parking for improving traffic patterns. Combined with IPTV, these display systems can transform the entire stadium theme with simple keystrokes as well as increasing monetization opportunities.

Any near-term major upgrades to in stadium or bowl LED should coincide with upgrade of the in-house video production systems and in keeping with technology changes such as 4K and High Dynamic Range color space as well as the video industry shift to IP based workflows.

In House Video Production

Upgraded in 2013, the video production system remains the core for content delivery to the LED video displays and televisions deployed throughout the facility. It consists of game and field cameras, video production and routing switchers, slow motion/instant replay, communication intercom, servers, monitoring and control equipment. The production environment is laid out classroom style with Multiview on the front wall and rows of operator positions facing forward for a view of the bowl and field.

Video production is having another technology shift with more computer-based systems to accommodate digital signal processing, IP based control and communication, and microprocessor driven equipment. The computer-based systems generally have a 5 to 7-year life expectancy due to 24/7 operation, becoming electronically obsolete and shift away from interest in its intended function. Depending on whether the systems are covered under a service agreement or not, planning should begin to replace them after 5 years of service.

Digital signal processing, video production switchers, cameras and lenses have a slightly longer lifetime (assume 10 years nominally), but the challenge is after 10 years, the products may still function, but the manufacturers cease support which requires the venue to keep a replacement inventory or turn to secondary markets (e.g. E-bay, other venues whose products are being replaced) to support these aging systems.

The existing video production system is HD-SDI 1080i and while this system's signal resolution is typically influenced by the team's desire to keep up with the latest technology, few renovated or new facilities have implemented 4K solutions. The production switcher and video clips player were replaced for 2021, the first of the core systems being addressed outside the edge of its life expectancy.

Some equipment within the entirety of the system is newer and considered as within its life cycle and the brands selected would be considered "best in class". There is equipment nearing the end of usable life and has not exhibited any regular failures, but experience informs that it is just a matter of time. Overall, the systems are functioning because they are maintained by highly competent engineers who have implemented regular upgrades in step with technological advancements.

All 2021 and 2022 video production control room renovations are financially challenging because a premium is paid to follow the current trend as technology advancements move away from SDI/coax cable signal transport towards IP/Data Network signal transport. It is expected that IP video production systems will be completely adopted within five years, so core SDI systems replaced within this timeframe are predicted to have a shorter than expected lifespan. However, there are SDI/IP bridging technology devices and signal converters that may be deployed to create a hybrid solution, but they introduce on average an additional 25% cost and are of limited use once a complete IP conversion is implemented.

Sound

The stadium's distributed sound system is a Q-SYS solution with RCF speakers which have been replaced in phases over the last three years. Its audio signal distribution is via the building converged data network and although that was the preferred method of transport several years ago, many facilities are moving to an isolated data network for audio signal to protect this vital system that is supplemental to the life safety system from unintended outages due to unrelated building network maintenance. Game day bowl sound and speech intelligibility were good but there are areas outside of the audio coverage patterns that could benefit from the addition of local speakers. The back of house speakers serving entries, concourses, premium spaces, and restrooms were also replaced in the same project.

The stadium's audio contractor should verify if there are any aiming issues to alleviate dead zones. Multiple amplifiers were replaced during the recent audio project.

Security

The south main security office is manned 24/7 and is the primary monitoring and control location for the building access control, video surveillance and intrusion detection systems (which have been continuously upgraded annually with software licenses kept current). The security systems servers are in an equipment rack room in the security office and are on UPS which has capacity to transition to emergency power but have no redundancy built in. This office is also the location for the badging system. There is a secondary security office at the north end loading dock entry which has limited monitoring and control ability but does have the only emergency messaging/paging station in the building.

Entries and most critical locations are monitored by a total of ninety cameras with twenty-five to twenty-nine days of video storage compared to four hundred cameras in typical sized NFL stadiums that are monitored from thirty to thirty-five days. Most, but not all, exterior gates have door contacts which allow for remote monitoring for door propped condition. Many back-of-house spaces such as player entries, team spaces, and concessions offices are equipped with PIN code and/or card access, while most building operation spaces are strictly hard key accessed. Key access in critical spaces is problematic since it is difficult to audit who entered if an incident has occurred.

There are 103 magnetometers that are deployed to entries with different perimeter configurations required due to limited queueing space at some locations. A portable device is deployed for vehicle blocking, less than ideal solution, but a future permanent system would have to be developed to survive a flood since the entry is below the flood plain water level.

For the 2021 season, the game day security command center is being expanded to seat 28 officials of various law enforcement segments, building security, and building operation staff which is in-line with the capacity of other NFL facilities. This space should be configured to house eight to ten personnel workstations, two building security stations and multiple displays for focused camera monitoring by any occupant of the room.

Structured Cabling Systems, Infrastructure

The structured cabling system infrastructure appears to be from original construction and implemented in accordance with industry guidelines and standards, Building Industry Consulting Service International (BICSI), American National Standards Institute (ANSI) and Telecommunications Industry Association (TIA).

Networked systems are described to be using multimode fiber, single mode fiber, and Cat5e copper infrastructure. As facility operational requirements begin to utilize higher bandwidth to devices, a more robust single mode fiber plant with Cat6A copper will be required. Cat5e and newer Cat6A are not recommended to be installed near each other because of interference between them, so careful planning will be required when considering future implementation.

Telephony

The analog telephone exchange system is several generations old, but at the time of the facility survey was actively being replaced by Cincinnati Bell with an Avaya hybrid VOIP, digital and analog solution. The new phone system will provide two hundred IP phones and continue to support four hundred digital and analog phones throughout the stadium and team spaces. The new system will utilize existing copper and fiber optic cable infrastructure.

Local Area Network

The local area network is enterprise class utilizing the multimode fiber plant for connections between the IDF rooms and main MDF room. There is a mix of manufacturers technology between

the facility operator and team with some older devices seen to be abandoned in places.

Wireless Local Area Network

The high-density Wi-Fi network was implemented in the seating bowl, concourse, and Club levels for the 2014 season, intended to allow fans to stream content, upload photos, access social media and access in-venue mobile applications. This system is in the window for replacement as it nears the end of its hardware life expectancy, and in 2022 PBS is installing a new Wi-Fi system.

The new era of touchless transaction systems for a safer fan experience will place additional demand on Wi-Fi resources as well increase the expectation and need of fans and facility operator alike for it to be one hundred percent reliable.

Food Service

A facility assessment of the foodservice spaces at PBS was conducted on March 23, 2021 by S2O Consultants, Inc. The scope of review included the physical spaces, equipment, code compliance and general operational functions and its comparison to newer facilities.

Built in 1999, the stadium has not had any major upgrades since its initial opening. While some of the equipment has been replaced, overwhelmingly, it is the original equipment that remains and, more importantly, has outlived is average lifespan.

Aramark is currently contracted as the concessionaire for food and beverage. Stadium management has been proactive in repairing and maintaining the equipment, but the operator is programmatically limited by the age and state of the equipment and building.

The concessions have a good ratio cooking stands to non-cooking, well within industry standards. The premium clubs have seen some updates, but they are still dated both programmatically and aesthetically. In addition to the age of the equipment, there are multiple building issues that have a direct impact on the safety and sanitation in the foodservice spaces. Water leaks in concession stands and pantries are found in multiple locations.

There are several issues that will be addressed in the report, including but not limited to, laminate counters in the concessions, beer systems/beer lines that need replacement and walk-ins have lost their R-value/efficiency. Any non-compliance is primarily due to changes in health codes since the stadium opened, but it would be beneficial to bring Paul Brown Stadium into compliance with today's standards.

Overall, the amount of space and base infrastructure is adequate, however, the building and program need time, attention, and investment to bring the facility to its potential and begin to compare favorably with other, modern NFL stadiums.

Vertical Transportation

Paul Brown Stadium has a total of twenty-one (21) vertical transportation units, comprised of two freight elevators, 10 passenger elevators, and nine escalators, some of which are outdoor units.

All units are original to the opening of the stadium, and the only significant upgrades were performed on the two freight elevators. These had new gates and sensors installed within the last five years, and their performance has been acceptable to the operators. One freight elevator required a new drive unit due to flooding.

Building staff reports that all passenger elevators maintain acceptable performance, although the escalators have been troublesome since the beginning, especially the two large outdoor units. These outdoor escalators had their step chain rollers replaced in 2019 and do not have canopies or enclosures; therefore, they are susceptible to the effects of precipitation. We recommend that during a major renovation, canopies be included in the project.

Given the age of all units (20+ years), we suggest the County maintain communications with the service provider to understand potential challenges in obtaining spare or replacement parts in the future; this factor may determine the speed at which the modernization process occurs.

Preventive Maintenance Program

Paul Brown Stadium currently uses Archibus for their computerized maintenance management system (CMMS), which is the required building repairs and management platform of Hamilton County.

Currently the system is utilized by stadium Engineering, Grounds & Maintenance, Administrative Staff, and Security. Archibus is primarily used as a database for building maintenance work orders, and for employees to enter their time once the work is completed. There are many challenges with this system, including a lack of centralized process for entering work order requests, inefficient reporting, and it is not user friendly.

In order to better and more efficiently capture materials and labor costs, we recommend PBS evaluate options for a more robust CMMS and include Hamilton County in the licensing and training.

Short of a full replacement, we offer these recommendations: explore upgrades or alterations to existing Archibus interface, determine if additional employees can gain access (for the purposes of submitting work requests) to the Archibus system, consider using shared tools and documents (MS SharePoint, Google Docs) for working with live, updated information, research new payroll management systems that have the ability to track hours against assigned job codes.

Practice and Game Fields

The practice fields are currently in good condition, but the challenges with the practice fields and landscape include aging landscaping that is in a progressive sate of decline due to root competition which hinders the growth of new plantings. The practice fields are aging and although drainage grade and irrigation area acceptable, a full replacement should be expected in the next five to seven years in order to maintain proper operation of systems and a professional level of performance for the next 20 years. A major concern is the space restrictions that limit the ability to move and / or rotate fields to avoid overuse of certain areas of the fields and the limited run off areas that reduce team use in other areas.

One other practice field item of note includes a lack of Wi-Fi connectivity and coverage, however PBS is addressing this issue in 2022.

The current game field was installed in 2018. This is the third artificial system that has been installed over the original drainage and base of the initial natural grass playing surface. The field performs well, but drainage issues are evident as the percolation rate is on the very low end of recommendations. The heating system operates properly outside of a couple of malfunctioning sensors and the irrigation is effective, but not the most efficient design for this setting.

Operational Elements

Our project team was asked to review the methods and means of cleaning the seating bowl (i.e., power washing), picking trash from the bowl, and recycling game day waste. We interviewed the appropriate venue representatives and toured the venue in this light. As part of this exercise, we also surveyed four (4) peer stadiums to determine any consistency, or lack thereof, in approach. The peer stadiums were Nissan Stadium, M&T Bank Stadium, FirstEnergy Stadium, and Heinz Field.

We found that the operations at Paul Brown Stadium were generally consistent with the peer stadiums. That is, PBS' manner in accomplishing the work was similar that of the other stadiums, including having some of the same challenges and constraints. In the body of the report, we do offer suggestions for consideration that may increase efficiency, It should be noted that compared to some peer stadiums, Paul Brown Stadium employs fewer staff in certain areas (engineering, maintenance and security), yet must accomplish the same, and in some cases, a greater level of work.

ARCHITECTURE & INTERIORS

Architecture & Interiors

The stadium has three major components: The seating bowl, the adjacent Administration building that is to the south, and a large plaza that connects these two buildings to the surrounding street grid.

There are 7 major levels designated by numbers 000-700 on the original construction drawings. These are referenced in this report for consistent location. The levels and their functions are:

- 000- Service level (including playing field and loading docks)
- 200- Main Concourse and lower seating bowl access
- 300- Plaza Level (lower seating access)
- 400- Club Level (club seating access)
- 500- Mid- Level Suites and convertible club seating access
- 600- Upper Level Suites and convertible club seating access
- 700- Upper concourse (upper seating canopy)
- Other Levels: Level 100 is reserved for the Parking Garage under the East Concourse
- Level 900 is reserved for the upper canopy

Due to the sloping site, Levels 000, 100, 200 and 300 each have points of at-grade access.

The stadium is owned by Hamilton County, OH and managed by Paul Brown Stadium Limited (PBSL). The Cincinnati Bengals is the prime tenant.

Climate Influences

Cincinnati is situated at the confluence of three different weather regions: air moving from the southwest, the southeast, and the north. Weather moving from the southwest to the northeast is the most prevalent weather condition. As a result, the western side of the stadium typically receives the brunt of the weather.

The stadium also has pockets of space that create wind tunnels. The mid-level suites have operable windows and will produce a wind-tunnel effect when the door to the corridor is also open. Stadium staff regularly request guests in these suites to keep the door closed when these windows are open.

Food service management noted that in a few of the recently renovated concession areas, particularly in the 400 level north plaza, the wind will blow some of the pendent light fixtures. These fixtures are low enough to be a hazard to staff and guests.

Concession with pendant lights

Stadium Exterior

<u>Curtain Wall and Storefront Systems</u>

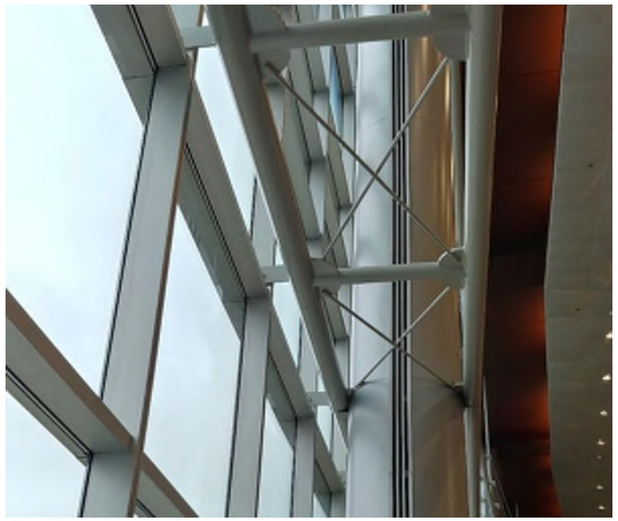
The curtain wall on the building is a Waltek 700 SSG two-sided SSG system with butt-glazed vertical and captured (aluminum cap mullions) horizontal members.

There are large sections of curtain wall in the Club Level (400 level) on the east and west side atriums. These span from the base of Club level to Bengal Suites Level (600 Level).

East Club Atrium exterior

West Club Atrium interior

These large curtainwalls have an exposed vertical span of approximately 50 feet. There are two steel horizontal truss frames that run the entire horizontal length and connect the curtainwall back to nearby steel columns. These provide lateral support to the curtainwall.



Curtain wall truss frame

There are other smaller curtain walls at the stairwells, above the club gates, elevator lobbies and in the conference rooms. In addition, the entire Administration Building is enclosed in a curtain wall system.

The curtain wall framing is clear anodized aluminum and the glass glazing is Viracon Low E insulating glass (IG) units. Glazing gaskets are extruded EPDM Corners are mitered not molded.

The glazing gaskets are one of the first curtain wall components to deteriorate through normal aging. Over time, EPDM glazing gaskets begin to deteriorate, shrink and develop surfaces crazing due to UV degradation and other atmospheric exposure. Shrinkage and crazing of the outside gaskets can cause seal loss which can allow water penetration into the system. Gasket shrinkage at the mitered corners can create gaps which can allow water penetration.

Curtain wall glazing gasket

The glazing gaskets should be inspected every five years to actively monitor the condition of the gaskets. Eventually, the outer gaskets, on the most weather prone exposure areas, will deteriorate to the point where they are no longer watertight.

Once the gaskets have reached the point of no longer providing a watertight seal, the curtain wall should be wet sealed or reglazed. We observed multiple leakage locations during a site visit in 2021 at the offices on the south side of the Administration Building. This means that many of the gaskets have or soon will reach the point of no longer providing a watertight seal. The curtain wall needs to be wet sealed or reglazed on a planned basis. This should be done in phases, starting immediately in the areas which are currently leaking. Choice of wet sealing or reglazing depends on projected service life for the entire building and potential benefits of new glazing.

Wet sealing is a process where silicone sealant, tapes, and preformed caps are installed over the existing gasketing. It is far less intrusive than reglazing. If properly installed, wet sealing is a viable option for extending the life of a curtain wall system. If all other components of a curtain wall system are in good condition, wet sealing can provide an additional 15-20 years of service.

Reglazing a curtain wall involves complete removal of the outside snap caps, pressure plates, glass and glazing. New gaskets are installed and the entire assembly is then reassembled. If done with a high quality system, this will increase insulation value during the winter, decrease solar heat gain during summer and should provide more than 25 years of service.

The glass in the curtain wall appeared to be in good condition. PBSL has replaced three different glazing panels in the last three years due to gasket failures/ongoing issues. At the time of the field investigation, we did not observe any failed IG units.

Along the side area of the large east and west curtain wall, some cracking was observed in the adjacent gypsum board walls.

Cracking in gyp board next to curtainwall

Cracking in adjacent gypsum walls could be due to midspan lateral deflection (wind loads) of the curtain wall, or from thermal expansion of the aluminum framing in the curtain walls. The curtain wall system is designed to deflect and expand at a higher rate than the adjacent gypsum board areas.

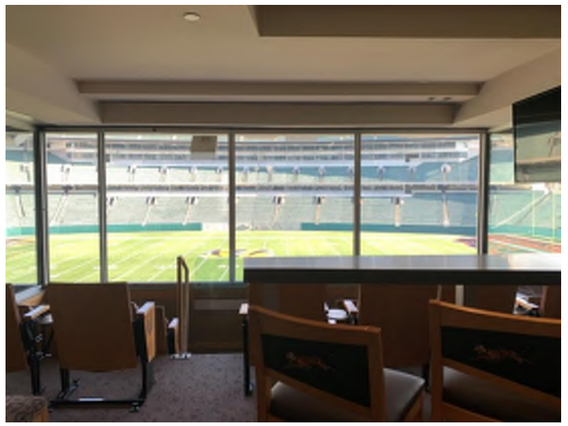
Clear anodized aluminum is a very durable finish. Anodizing is a chemical conversion process that changes the surface of the aluminum. It has excellent abrasion resistance and, unlike surface coatings (e.g. kynar or baked enamel), anodizing will not peel.

Some minor streak stains were observed on some interior mullions. These could be from curtain wall leaks but are more likely from window washing leaks above, or spilled items.

Water stains are visible on the curtain wall in the Administration Building stairs. Area of potential leaks should be confirmed and then tested and inspected to determine cause the cause. These may be localized conditions.

There are storefront systems at the pro shop retail area, smaller retail satellites throughout the stadium, and at the east and west club entrances. The framing for these systems is clear anodized aluminum and appears to be in good condition. No failed glazing units were noticed.

Sliding Glass Walls At All Private Suites



Applicable to all three suite levels, sliding glass walls separate individual suites from the field below and provide fans a view for the full width of the suite. Glass walls in the three different levels of suites; lower, mid and upper, vary slightly in height but are the same configuration of individual sliding panels for each of the 119 standard and 6 party suites. The Waltek panels are a maximum of 7 feet high, spanning from a sill 2 – 3 feet above the floor to the suite ceiling. Panel width varies, most are approximately 4 feet wide.

The sliding wall system consists of aluminum framed panels which are glazed with insulating glass, and each hung from an aluminum track by two steel trolleys. A track at the sill keeps the window panels in place and guides them when moving. Moving the panels is done manually by the stadium staff. The window panels are kept closed during non-game time and the suite owner is given the option to have glass wall open or closed for each game. Locks keep the window panels secure when panels are closed. When open, the panels store behind the rows of seats in single pocket against the suite demising wall. Suite owners can opt for a partial opening, with one panel swung partially open to hear the crowd while blocking the wind and weather.

For each game, opening and closing the panels is a labor-intensive process. Panels are heavy and can be damaged if the crew is not careful when opening them. The tracks are showing wear and damage from 20 years of use. Damage to the track at the turns requires caution and extra time in moving panels.

When Paul Brown Stadium first opened, the trolleys frequently fell out of adjustment and many broke. This has been improved by installing better replacement parts for the trolleys and lowering the bottom track on the entire east side of the stadium. Rust on the steel trolley wheels remains an issue. Silicone is used to lubricate the trolleys, and they still require adjustment on a regular basis.

After each game, the facilities crew regularly adjusts 3-4 suites. This takes a team of two about 3 hours. At the end of the season, all panels are checked and adjusted as needed. The east side is generally in worse condition than the west; the east gets afternoon sun and panels seize as the aluminum expands.

Weatherseals and gasketing come apart with use, then they have to be removed and replaced, and locks break occasionally. At this time there are about 6 broken locks in need of replacement. Upgrade of all locks is needed in order to prevent continuous repair.

These components of the insulated glass units are reaching the end of their service life. To prevent future failure and loss of visibility, it is time to begin annual inspections and periodic maintenance of the glazing seals. Alternately, PBS could consider replacement with a new design and installation of suite operable glazing.

Typical trolley for sliding glass wall panel

Precast Concrete Screen Walls

There are several precast concrete wall panels around the stadium that form part of the exterior wall system. Overall, the concrete appeared to be in good condition with no noticed cracking, rust spots (from internal reinforcing) or deterioration. The white concrete appeared to be clean and bright.

Precast concrete wall panels – Administration building

Precast concrete wall panels – concourse walls

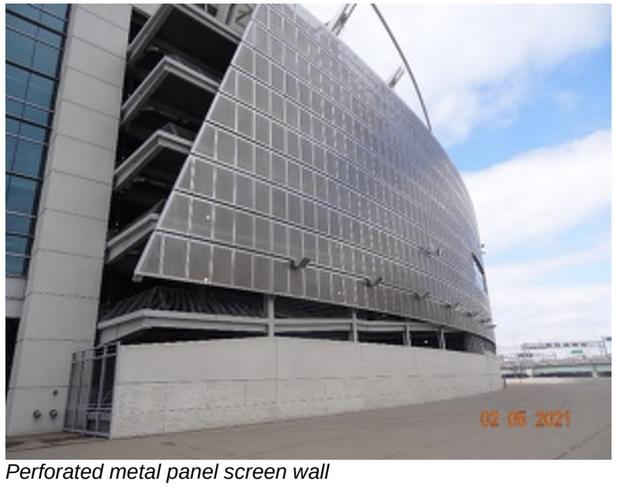
Precast concrete wall panels – stadium exterior

Joint sealants between the concrete panels are aged, weathered and showing early signs of failure. All joint sealants between precast concrete panels should be replaced. There is a plan to recaulk all joints between the panels on the Administration Building in 2021.


Precast concrete wall panels – sealant failure

Perforated Metal Panel Screen Walls

The perforated screen wall panels around the stadium are heavy gage 300-series stainless steel. These panels are connected to supporting framing made from hot-dipped galvanized steel support brackets, plates and bolts. The galvanized steel attachment pieces are unpainted. The perforated steel panels and their attachment brackets appear to be in good condition and received mechanical fastening replacements in 2020.



Perforated metal panel screen wall

Panel connection

The steel building columns that the brackets attach to are painted steel. They do not appear to be galvanized. The paint on the columns is peeling and needs to be repainted. Steel coating projects are ongoing at the facility on a yearly basis.

Open Air Concourses, Ramps and Stairs

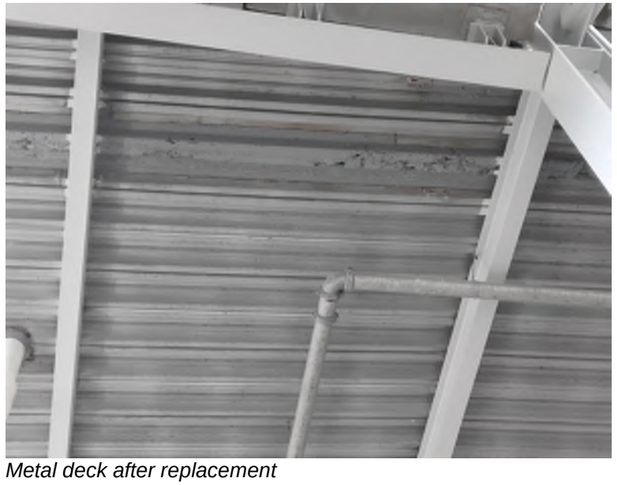
The open air sections of the concourses consist of a concrete topping over a waterproofing system over the concrete structure. The concourses slope to drains that tie into the storm drain system.

There are many cracks in the concrete topping. In addition, a variety of projects for both maintenance and upgrades to the stadium have required cutting and patching of the walkway assembly. Rainwater appears to have penetrated through the cracks in the topping and waterproofing and is leaking to the spaces below. See the Structural section of this assessment document for additional details.

Concrete ramps and stairs connect the levels from the main concourse up to the upper concourse. On the west side, the ramp extends down to the service level. The concrete along the edge of the slab areas near several stairs and ramps have cracks in the concrete. Rain water appears to have penetrated through the cracks in the slabs and is leaking to the spaces below. The metal decking supporting the concrete ramps and the concrete landings of the exterior stairs has rusted in several

locations. The rust is visible from the underside of the metal deck. However, capital improvements during 2021 addressed these issues and are continuing in 2022.

Exterior stair – rusting metal deck


Metal deck after replacement

The rain water is dripping on the stairs, landings, ramps, railing, and other components below. These components are rusting and are covered with deposits leaching from the concrete and the steel deck. Water is ponding on the landings.


Exterior stair – ponding from leak above

Joint sealants between the stair sections and at the base of the railing posts are aged, weathered and showing early signs of failure. The joint sealant between the walls of the ramps and doors and other materials is also aged and showing signs of failure. Joint sealants at these locations should be replaced.


Exterior stair – failing joint sealant

The concrete walls at the entrances to the ramps have been chipped and scraped from traffic. These areas will be patched and bollards or durable steel corner guards installed for protection during the next few years as a part of planned repairs.


Exterior ramps – damaged wall corner

North bridge / walkway

At the north end zone, a bridge at the 400 Level connects Sectors 1 and 2 above Gate C. The bridge is comprised of traffic-coated concrete slabs attached to a steel structure.

North Bridge over Gate C with water damage

The concrete has spalled at the edges where the railings have been installed and steel reinforcement within the concrete is exposed and rusting. In addition, water is draining to the expansion joint at the west end of the bridge and ponding is observed at the east end near the expansion joint.

Exterior Plaza Deck, Auto Entrances and Barricades

The automobile entrance from Elm Street to the East Plaza Deck serve as pedestrian access on game day. Temporary systems for bollards and an auto barrier are currently in use and require set-up for each game. These should be upgraded to accommodate a folding auto barrier and permanent bollards.

The exterior plaza decks become jammed with fans in the hour before the kick-off. Temporary barriers are used, but should be reconfigured for permanent pedestrian traffic control. Drop-in or retractable bollards are not desirable.

The design of the streets, opened in 2011, in The Banks development and the location of major game-day parking lots funnels a large majority of the team's 66,000 fans along Freedom Way and Elm Street to this point. There is one opening on the plaza level and it is 70 feet wide. From that point only one entry gate is visible to fans, and they tend to progress toward it. Wayfinding to other gates is not universally visible.

Egress is a similar problem. Capacity of the openings from this side of the plaza to the surrounding streets is only 2/3 the combined exit capacity from the east side of the Stadium. (Gate D, Gate E and Club East doors). This reduction in egress in the direction of travel results in a pedestrian jam on the plaza and a poor fan experience.

Wayfinding

Wayfinding should be provided at several locations. The exterior plaza should have wayfinding to direct visitors to the various gates. Wayfinding should also be located immediately inside the gates to direct visitors to the different sections. Existing wayfinding is dimly lit, easy to miss, and difficult to find or read at night.

In particular, crowds outside of Gate D fill the East Plaza and prevent fans from smoothly moving to other gates. There is almost no wayfinding signage on the plaza and this slows the entry sequence at critical points.

Bag Check

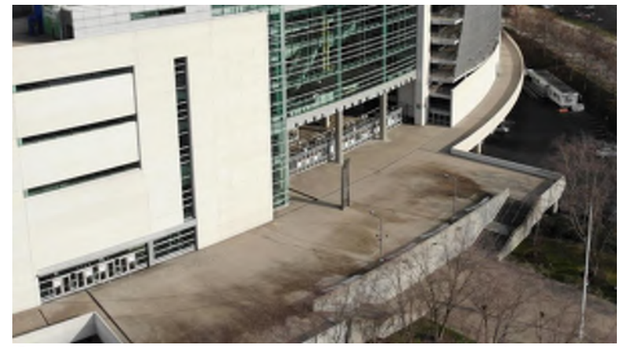
Bag check signage could be improved for greater visibility and coordinated with the redesign of wayfinding signage. Currently, mobile lockers are deployed to enhance the fan experience.

Pedestrian Flow

Fans can enter the stadium through one of eight public entry points. Fans headed to the East and West Clubs each have one entry with direct access up to the Club Level. The remaining six are open to all ticket-holders. The press may enter with laptops and cameras at Gate F (also open to the public) on the 000 Service Level. Peak entry time is 15-20 minutes prior to kick-off. Other than the Club gates' restriction, fans can enter any gate to access their seats. The most popular gates are those closest to the most parking; currently that is the East side of the stadium.

Tight areas outside the gates impinge on the flow of pedestrian traffic.

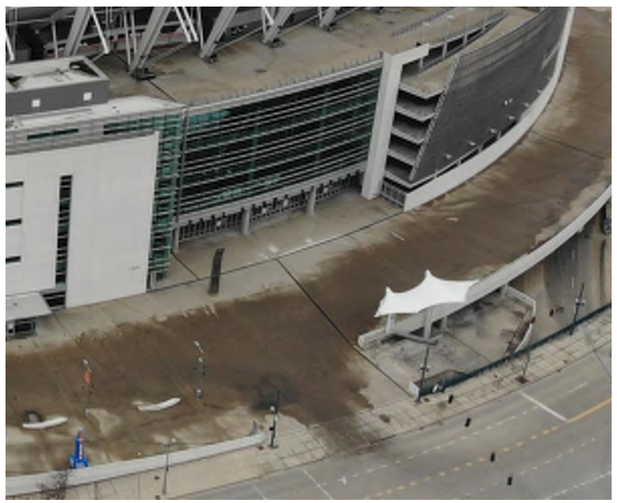
At Gate A there is a pinch point where the pedestrian ramp comes up from the south (river side). With the development of new parking at the Hilltop Site, the Bengals anticipate an increased use of Gate A as a result. Upgrades to this area should be scheduled to coordinate with the new parking area.



Gate A and West Plaza entry showing lack of space for approach from South (right)

Gate D accommodates up to 60% of entering fans due to location near tailgating lots and downtown parking. The spectators enter the exterior plaza at the auto entrance, which is not wide enough to accommodate these crowds. The fans queue at the nearest gate – Gate D – and quickly block access to other gates on the east side of the stadium. This exterior plaza at this gate should be reconfigured to improve flow of pedestrian traffic as well as providing wayfinding to direct visitors to other gates.

Future changes and gate configuration flexibility should be considered.



East Exterior Plaza - Gate D and automobile entrance

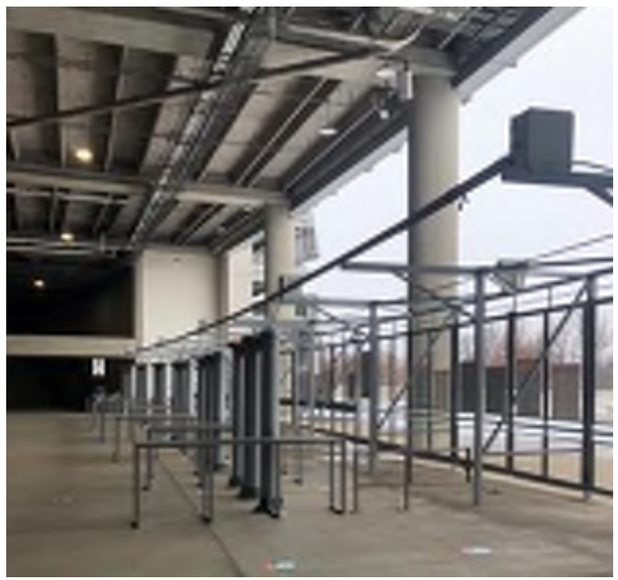
Service Level: Gate F

Gate F is on the lowest level in the north quadrant (Sector #2); in addition to fans, it is also used for media. On game days, security personnel put all packages through the X-ray machine, including laptops, located inside the tunnel. This is several hundred feet inside the gate itself. Rejection requires escorting the person out of building. This machine should be moved outside the gate and provided with an enclosure for weather protection.

Main Concourse and Plaza Level: Gates A through E

Gates should be upgraded to increase crowd safety, add after-hours security and provide consistent entry-security sequence.

Magnetometers were added after the stadium was built and are mostly temporary/portable. Due to lack of space at some gates, tickets are processed prior to security. Therefore, rejection during security clearance is a problem.



Gate A is one of the few with permanent Magnetometers

Fences surrounding these gates are 9'9" in height. At many locations there is limited ability for a patrol to see various hiding places.

Tight areas inside the gates slow the entry of fans. At Gate D more space should be developed at the Plaza Level overlook. At Gates B and E, the fence is too close to the escalators.

Gate E and Escalator: Inadequate clearance inside gate. No wayfinding present.

Plaza Level: East and West Club Entrances

These entrances have slate tile flooring which is a premium aesthetic but is easily damaged and costly to maintain. Several pieces of slate wall base have detached from the wall. Heating should be reconfigured.

Architecture & Interiors

Seating Bowl

There are two types of seats in the main bowl of the stadium: cushioned vinyl and hard-shell plastic. All seats are folding type and are on cast stanchions mounted to the concrete riser with 4 bolts. The seats vary in width from 17 inches to 20 inches. Some stanchions are up to 23 inches apart, with the extra width covered by using a longer mounting bracket. The manufacturer – American Seating – is no longer in business. Replacement parts are sourced from Irwin Seating; however, many replacement parts must be special ordered and are subject to minimum quantity requirements.

Typical upkeep includes broken retractors, torn seat covers, rusted pans, loose stanchion anchors, missing row numbers, deteriorated logos and rusted bolts. Maintenance of seating requires about 3,000 man-hours per year.

Anchor bolts come loose and need retightening generally once a year. The original anchors were epoxy type and are being upgraded to a sleeve type on an ongoing basis. The upper bowl seating is generally lasting longer than the lower bowl seating.

Club Level cushioned type seating

There are 16,500 cushioned seats at Club Level. The shaft which operates the spring-loaded retractor breaks on a regular basis. In 2019 there were 1,900 replacements of broken plastic retractor shafts. Materials are out of warranty and the shafts are in short supply. PBSL has about two years' supply of the metal pans for the seating backs. Irwin has given notice that they will be using plywood for replacement of the pans for the backs.

The vinyl upholstery is replaced on a constant basis, to date in the first 90 days of 2021 over 300 have been identified and replaced. Staff uses a jig and can recover up to 20 seats in a day's time.

The replacement of this seating should be a high priority due to the increasing cost of maintenance and lack of replacement parts. Seating is now available with a more durable rail type mounting design and will come with a warranty for the materials. In summary, the cushioned seats are nearing the end of their service life and should be replaced.

The Club Level seating metal backing plate is no longer manufactured and is currently fabricated from marine grade plywood. It is recommended that the Club Level seats be replaced with new industry standard premium seating.

Some of the issues with the hard plastic seats are loose anchors for the stanchions and broken seat backs. Other issues include the rusting of anchor bolts in the seat bottom and deterioration of the stanchions themselves.

Hard Plastic seating in Lower Bowl Level

Parts for the plastic seats, such as seat backs, are often adapted from other stadiums, and for PBSL need to be modified in the stadium shop. In general, the plastic seats have been more durable and easier to re-order than the cushioned seats. These seats are not yet at the end of their service life but should be replaced in the next 3-5 years. However, there is only a five year supply of replacement parts on hand, so if the source for more parts cannot be secured, replacement may need to be sooner.

The lack of availability for replacement cup holders is a continuing problem.

Service Level (000 Level)

This level is at field level. The constructed interior space at the service level at Paul Brown Stadium covers all of the building footprint except for the playing field. Approximately three-fourths of the interior space is subdivided into locker rooms, meeting rooms, media rooms, training spaces, loading docks, stadium maintenance offices, Hamilton County offices, food service storage and staging areas and mechanical / electrical rooms. The remainder of the space is open and used for storage.

Roofed, unconditioned service tunnels provide access to all of the major service spaces within the stadium. The tunnels are used seven days a week and serve everyone within the facility, therefore there is an expectation that they are dry and protected from leaks. The main tunnel circles the playing field and has

access to the field for vehicles and people at the northwest and southwest corners. The main tunnel also provides access by players, staff, patients to the Proscan MRI and the premium patron space near the field entry on the southwest quadrant (sector 9). Open storage space is primarily located on the east side of the stadium under the seating bowl with smaller areas interspersed along the tunnel. There is a secondary tunnel in the southwest quadrant for access from the Visiting team's loading dock and main security.

Cables, conduit and pipes run overhead. Finishes include exposed concrete floor, sound proofing sprayed on overhead deck and painted block walls.

Water leakage from sub-roofs has degraded the direct-applied soundproofing. There are large puddles after rain events in many locations (see Roofing portion of this section).

The MDF room is located off the secondary tunnel. The floor of the room is not raised and the racks are not raised off the floor. The tunnel has an inadequate number of floor drains in this area to address flooding. In addition, there is the potential for the sump pumps that are intended to respond to flooding to be delayed in responding. Stadium staff stated that a secondary water protection system should be installed at the MDF room. Examples include additional floor drains and / or a flood gate system similar to the primary flood gate system. This area should be reviewed to determine the best solution to prevent water damage to the equipment in the room.

Water infiltration from stair landings is also common throughout the stadium; these often have ponding water which is corroding the structural deck at many of the stairs (see Structural section). However, the steel deck at the stairs is being replaced/repaired in 2021.

In the mechanical rooms, the ceiling is the exposed concrete underside of the concourse deck above. Water is leaking through the cracks in the concrete topping and the failing water proofing to drip onto the mechanical equipment.

Rust was observed on the air handling unit in sector 1 from a leak in the concourse deck and mold was observed on the chiller in sector 7 from a leak at a stair landing.

Leaking water from Plaza above in mechanical room

<u>Team Spaces: Locker Rooms, Treatment, Auditoriums, Gym/Training, Food Service & Team Equipment, Coaches' offices</u>

Team spaces include all locker rooms, showers, weight room, training (gym) area, treatment rooms, auditoriums, players' food service areas, equipment rooms, laundry, mail room and coaches' offices on two levels. The TV studio is also included in this section.

The locker rooms and coaches' lockers have new carpet and are in excellent condition. The slip-resistant tiles in the locker room showers and the hydrotherapy room have been worn down over the course of their service life and should be replaced soon. All attic stock for these tiles has been exhausted and can no longer provide replacement tile. New tile should be selected to maximize slip resistance for player and staff safety.

Stadium staff indicated that additional outlets to charge devices would be desirable, especially at the Trainer's treatment tables and in the lockers.

Water supply is often discolored until allowed to run for a few minutes.

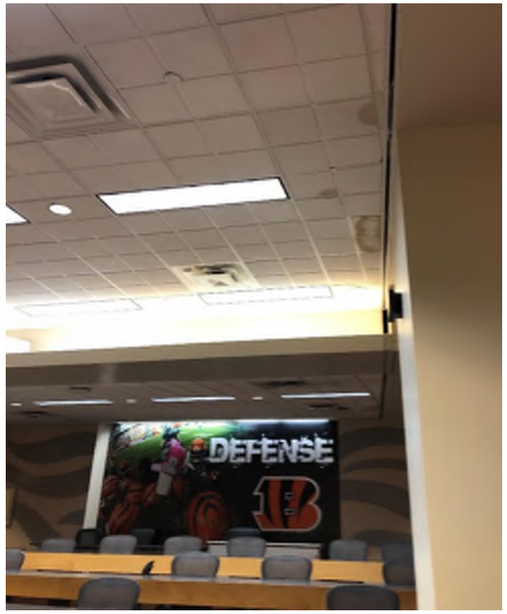
For 2021, the NFL has increased the required number of players' showers to 20 and PBS Ltd is in the process of making that upgrade.

Mail space outside of locker rooms near stairs was an afterthought. Combining mail/package delivery and food delivery in a single location should be considered.

Electrical outlet capacity is maxed for existing equipment and storage is lacking. Treatment room finishes are in acceptable condition, but ceiling tiles need replacement. Within the hydrotherapy space, compared to other NFL teams, the hot tub is too small and cryotherapy is inadequate. New treatment and recovery technology should be incorporated into the space, as the current equipment and systems are original to the stadium's construction and are not sufficient to meet current needs.

Hydrotherapy Room

The two main auditoriums have frequent leaks above ceiling that are a constant problem. The large auditorium has a nice wood veneer ceiling, but the small auditorium has acoustic ceiling tile that looks dated. The speaker system is also outdated and should be replaced. White boards are not functioning properly due to warping over years. Noise travels from Training Room (gym) and Locker Room.



Small Auditorium ceiling.

The team is planning to expand the coaching staff, but the offices are at maximum capacity and the mezzanine space lacks space to provide more offices. In addition, the staff noted that the existing small-group meeting rooms are too small and are the wrong proportion for presentations. The offices need more electrical outlets. The new, glass front offices are working well.

The Training/Weight Room is on par, or exceeds, NFL standards. Finishes are in good condition with the exception of leaks from above. Storage space, in a caged area outside of training/weight room, is adequate.

The cafeteria was added within past 10 years. The size is acceptable and finishes are in good condition.

Laundry equipment is near the end of service life and water quality and filtering has always been a problem. Dryer capacity is inadequate, although a dryer was added, which then took space from storage.

The team equipment working space is too small for 7 staff at once. Equipment storage shelving is inefficient but could be improved within the existing square footage. The ceiling/concourse deck above the storage space is leaking and should be addressed.

Accommodating female coaches is a recent change in the NFL. This has created a need for all stadia to provide a separate women's facility and should be considered during a renovation at Paul Brown Stadium.

Locker rooms are provided for the cheerleading squad and the halftime band. Designated Locker Room C and Locker Room B appear to be in good condition with adequate power and lighting.

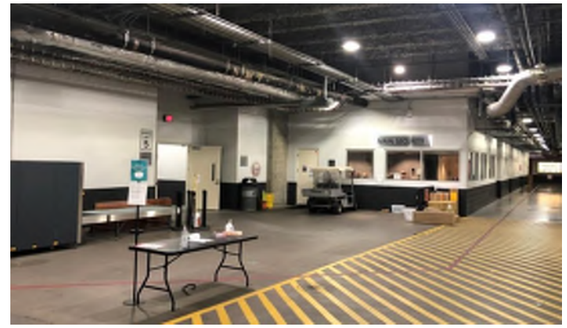
Visitor's Locker Room


Visiting Team Locker Room with water damaged ceiling

The Visitor's Locker room area includes a separate Locker Room and Shower Room for the visiting coaches, a Head Coach's office, an Interview Room and a Main Locker Room for players with adjacent shower room. The shower facility has 15 shower heads and accommodates two hot/cold treatment tubs. There is also a Trainer's room and an Equipment room.

Stadium Security Operations Office and Package Receiving

The main security office provides badges for visitors and visiting workers. New this year is an NFL requirement that all packages entering the building are cleared through an X-ray machine, which is set up at this location.


Security Office with X-Ray machine at left

Camera monitoring of the stadium is not sufficient for full coverage in a modern NFL stadium. As a result of adding a significant number of cameras, this office will need to expand and reconfigure for an increase in staffing and package holding. PBS currently has 96 cameras, although modern stadiums have anywhere from 300-600 cameras.

Premium Patron Location

This is a previously-sponsored lounge adjacent to the Bengals players' entrance to the field. The floor is covered with vinyl laminated planks which have lost adhesion to the concrete floor. The flooring should be reattached or replaced.

Retail Warehouse

The Retail (merchandise) Warehouse serves the Pro Shop, Upper-level vendor stations and portable kiosks. Portable kiosks themselves are stored in the warehouse or in the tunnel nearby. The warehouse office area was constructed after stadium was opened and is generally inadequate.

The entire space, including supplemental office space, is not heated or cooled adequately. The office partitions do not extend to the ceiling and allow unconditioned air into the office. Summers are hot and winters are cold.

Coiling overhead doors allow air infiltration into the warehouse from surrounding unconditioned spaces.

Water leaks from above on rainy days. Staff uses buckets to catch rainwater and moves merchandise out of way, water drips on electrical devices, and acoustical insulation drops down when it rains.

Additionally, the number of outlets for electrical devices is insufficient.

Retail Warehouse has water leaking from Plaza deck above

Main Concourse (200 Level)

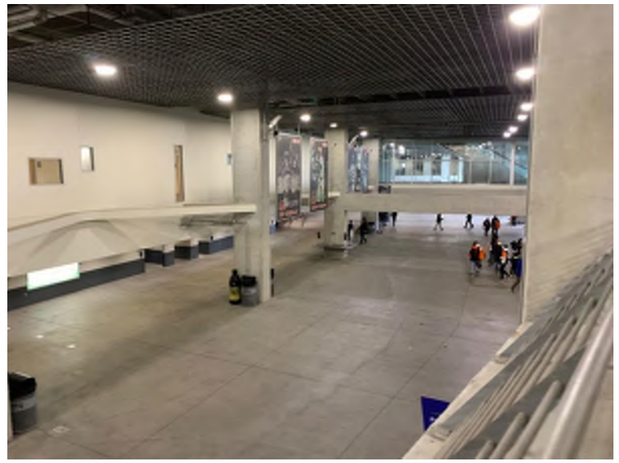
The main concourse is not continuous. One portion is on the west side and the other on the east side.

On the west side, a ramp connects the street level to a plaza in front of the west gates leading into the main concourse. Stairs and elevators provide access to the plaza concourse above. The concourse is an unconditioned space that is open to the outdoors at the west gates and to the plaza concourse. It has the appearance of a partially finished space due to the exposed concrete structure and the painted CMU walls at concession stands.

The east side has street level access from Elm Street but is normally accessed from the plaza concourse above. The concourse is an unconditioned space that is open to the plaza concourse. The space consists of exposed concrete structure and floor with painted CMU walls at concession stands and perimeter masonry walls.

Overall architectural finishes of main concourse spaces feel utilitarian, and usage of color and graphics are minimal. The ceiling tiles are starting to show their age. The lighting has been upgraded, but overall illumination is lacking at the high bay areas and low ceilings in front of concessions. Egg-crate type lighting needs upgrading.

There are 4 women's restrooms, 4 men's restrooms and 4 family restrooms at this level. In combination with the restrooms at the Plaza level they service the entire lower seating bowl.



Main Concourse

Plaza Concourse (300 Level)

The Plaza concourse is the only spectator level that fully circles the field. It contains an outer open-air space that is mostly roofed (under the upper levels) with open space at the south endzone. The plaza provides access to spectators at the north and east gates (Gates B-E).

Restrooms

The 300 level public restroom accommodations include 8 women's restrooms, 7 men's and 5 family restrooms. However, they are not evenly distributed. Fans are underserved in two specific locations: the north and south end zones.

At the north Plaza Concourse there are two sets of restrooms directly to the north of end zone seating. However, the ratio of end zone seats to toilet fixtures here is still only 50% of the stadium's average of 40 seats per toilet. In this location the women's restrooms have less than 1 toilet per 100 women fans. There is 230 feet between either of these over-loaded restrooms and the nearest restroom to either the east or west. At game time, the area between these four restrooms is jammed with vending queues, ProShop visitors and entry-gate cross-traffic.

At the South end zone there is half the average quantity of both men's and women's toilet fixtures. Travel distance is also a problem. Although there is a small women's restroom at the rear of the stands, the majority of women's rooms (and the only men's room) are on the west end of the concession stand. This results in a gap of over 380 feet between south and southwest men's rooms.

Pro Shop & Satellite Retail Spaces

The main retail space, the Pro Shop, is an 8,000 SF space located on the north side of the Plaza level and accessed from the stadium side on game days but open year-round and accessible from the exterior of the stadium. Both sets of doors are located on the eastern end of the long, narrow space. Satellite retail spaces, booths and kiosks are located throughout the stadium and operational on game days only.

The shape of the Pro Shop, combined with access only at one end, is awkward and dysfunctional on game day. The concourse to the south is a major connector for east-west movement of fans as well as a major location for concession sales. This space becomes jammed with crowds which block the Pro Shop entry doors. Buyers are discouraged by lines that look long due to the location of the cash registers near the doors, even though lines move quickly. The exterior doors need to be upgraded to accommodate ADA with an automatic door opener button.

Pro Shop

Rooftop units (RTUs) were replaced at the Pro Shop in 2020, but large west windows allow sunlight to overheat the space and potentially fade the merchandise. Lack of a vestibule at entry doors creates drafts. Supplemental heat is brought in as required but is noisy and in-effective in the winter months (See Mechanical Systems section).

The other finishes, including vinyl floor tiles, carpeting, wood paneling and metal ceiling tiles are in good condition. The overall space size is long and narrow and does not flow well. The sales fixtures are dated and not up to modern retail aesthetics. The shop should be benchmarked with other NFL teams in the division for size and configuration and display of merchandise.

The Pro Shop A/V and broadcast system needs to be updated and studied as part of the overall stadium system. Shoppers follow the game in the shop; however, the live action sound of the nearby crowd can interrupt shoppers who are listening on delay in the Pro Shop.

The Manager's Office is accessed through the storage space, and CCTV cameras were added in 2021 to enhance security.

Satellite retail spaces include small retail locations in Club Atriums. These shops are exclusive to club suite ticketholders and the location is not very visible. The small area limits amount of merchandise on display, and the sloped ceiling is hard to work around.

Satellite retail spaces also include stores on the upper concourse level. Signage is not prominent and water leaks in through under the counterfront wall at several locations. The casework is in poor condition and roll-down shutter doors do not close properly. Heating and lighting are in need of upgrade. Electric and data outlets are not located in areas facilitating ease of use, often requiring wires to be taped to the floor or walls.

Typical satellite retail space on upper concourse level

Suites (located on Plaza Level, Mid-Level and Upper-Level)

Paul Brown Stadium boasts 119 standard suites that are ticketed for 16 guests each. A few of these suites are connected with pocket doors to double the capacity. The stadium has six party suites that hold 24-32 guests and 8 Player Suites located on the Bengals Suite level on the west side. Suites located closest to end zones, specifically on Plaza Level are sold least frequently.

Each private suite includes a private restroom, bar area, lounge style seating, bar-height seating and stadium style seating within suite. Operable windows at all suite levels can be opened for games, but require facilities staff to accommodate the request.

The interior design has a very minimal and corporate aesthetic and not reflective of modern premium space design. The broadloom carpet has been frequently maintained but is showing age and wear. The slate tile flooring is a premium aesthetic but is easily damaged and costly to maintain. The wallpaper is a dated aesthetic and peeling in numerous locations. Maintenance staff prefers that wallpaper be removed entirely. A wall protection system could be added to reduce maintenance costs of repairing walls due to damage by furniture and equipment. The ceilings are partially gypsum board and partially acoustical ceiling tile. At certain suites, ceiling tiles are replaced due to water infiltration. Yearly concrete and waterproofing efforts assist in minimizing this issue."

The bar millwork is functional but could be improved for better use of the space. Catering operations and equipment has caused damage to countertops and walls, and both could be improved for better durability. The appliances are still functioning but at end of life and repair parts are difficult to find due to obsolescence. A larger capacity refrigerator is preferred in order to eliminate the need to restock beverages during the game. A built-in ice bin with a drain would be ideal for chilled drinks rather than bringing in and removing from various suites each game. Ice machines are original and at end of life; new ice machines or alternative avenues for ice will need to be explored. The bar sink and faucet are functional, and the trash location and capacity are acceptable. The lock on the liquor cabinet is a low-quality and easily broken into; a better lock or digital keypad is preferred.

Additionally, access to the suite is controlled by key lock which should be updated to a key card or computerized lock mechanism.

Private suite bar area, typical

The suite restroom fixtures are functional. A soap dispenser that could be refilled from counter or a hinged or magnetic sink panel would reduce maintenance time and hassle of refilling soap from under sink.

Administration Building

The Administration Building is the front door for daily team operations. Access for the public is from the Plaza Deck and access for staff and coaches is up the elevator from the Service Level and from the Coaches Mezzanine. For visitors, there are a total of 18 parking spaces plus two accessible spaces striped on the plaza to the east of the main doors.

Street side of the Administration Building

There is a ticket window co-located with the vestibule of the office and there are two floors of offices with conference rooms and restrooms on both floors. The Draft Room and chief executive offices are on the second floor (400 Level).

The office is well appointed and is in generally good condition.

A full flooring upgrade is in process as of Spring of 2021 and will be complete in 2022.

The impact of technology has dramatically shifted the type of work performed in the front office. Less space is needed for tickets and ticketing, more staff area is needed for sales and social media.

Private offices are functional and allow for separation. Floor and ceiling finishes are dated and electric outlets are maxed out. A phased update of the office furniture is now in process.

Open office space is at capacity and will need to be increased to accommodate the increase in staff. This is a high priority for team administration.

The ticketing area was designed during the paper ticket era. It needs to be renovated to accommodate the electronic ticket equipment.

The main conference room adjacent to reception has been renovated to provide more space, better access and more amenities.

The large special function room (Touchdown Room) is located on the first floor (300 Level). This room is occasionally used for outside groups, has access to the inside of the seating bowl stadium and is used for promotional events but needs to be updated with new technologies. During 2021, there was a complete renovation outside the Touchdown Room, which incorporated a new and expanded break room for employees.

Touchdown Room is in prime location

The Board Room is a nice space but lacks current technology.

The Draft Room has been recently provided with a new AV system to replace the old 'draft board.' Outlets and lighting controls are limited and could be increased and upgraded.

The number of conference rooms is acceptable and most are nice but not distinctive. Staff expressed a desire for a special place to use for signing large contracts and impressing visitors. The team's historical items are located in the Library conference room, which also functions as an in-house meeting room.

Storage is at a premium and other departments' storage spaces are utilized regularly for promotional items. The filing cabinets that line the office corridors should be repurposed as storage area since paper files are being replaced by electronic files.

Packages and deliveries no longer come through the front door; they come through service level security to be scanned. A package holding area is desired and some doors need to be increased in width and protection from delivery dollies.

Staff have reported odors from the mechanical system which is also connected to the team spaces. The mechanical system controls and distribution should be reviewed to provide more local control to the users of each space. The supply of electrical outlets is inadequate.

On the second floor (400 Level), there are 6 toilet rooms associated with private offices. For the remaining men at this level, (including all male visitors to the conference rooms) there is only one toilet.

The women's locker room includes 2 showers, which is a great amenity, but with increasing staff, additional locker space and facilities will be required.

Water problems occur throughout the north and south façade of the Administration Building. The curtainwall leaks in the stairs and door thresholds are leaking.

Club Level (400 Level)

The clubs, including concession areas, seating areas, bars for the suites, and the other two kitchens are located on the east and west sides of this level. The three-story atrium space along the perimeter of the stadium has views towards downtown Cincinnati on the east side and the Clay Wade Bailey Bridge over the Ohio River on the west side.

At the north and south end zones are additional general concession areas and restrooms.

The light poles at the north end of this level above the Pro Shop may have penetrated and damaged the waterproofing where they attach to the concourse and may be the source of some of the leaks in the Pro Shop. These areas should be investigated further.

<u>Club Atriums</u>

The East and West Club atriums connect the Plaza Level Suites, Club Level, Mid-Level and Upper-Level. The walls and columns in the atrium have been furred out with gyp board and wood paneling. The floor is primarily a mix of broadloom carpet and slate tile. Ceilings are a mix of acoustic ceiling tiles, perforated metal panels and gyp board soffits. The beams connecting from the columns to the floor slabs for the mid- and upper-level suites have also been furred out with gyp board. Several cracks have occurred in the gyp board soffits and in the furring around the beams. Cracking has also occurred around the gyp board near the elevator lobby at the curtainwall jambs.

Club Atrium space, with bar on left

An expansion joint runs through the atrium and the private suites. The infill material has worn away in several areas and is at the end of its service life and should be replaced.

The interior design of club spaces has a very minimal and corporate aesthetic, not reflective of a modern stadium, premium space, design. The broadloom carpet has been frequently maintained but is dated and showing wear. Carpets throughout the club and premium spaces have permanent stains. The slate tile flooring is a premium aesthetic but is easily damaged and costly to maintain. The vomitoriums have recently received epoxy flooring and epoxy base for durability and longevity. The acoustic ceiling tiles are in acceptable condition and are replaced when they show wear from leaks or stains. The metal ceiling tiles are in good condition and contribute to a premium aesthetic. The wood paneling and doors are in good condition except for sun-fading in the West Club.

Club space showing broadloom carpeting and slate tile flooring and movable food stands. The back of photo shows the unused countertop areas on the left, a satellite retail space with a gate in center and a concession stand on right.

Bar areas (Club and Mid-Level) are acceptable aesthetically but are underutilized due to suites having in-suite beverage service. They are typically only used for pre-game functions. The bars all have a sharp pointed corner that has been damaged. These spaces should be reviewed for maximizing the usage for revenue generation such as sponsor space or private rental space.

Concession areas are acceptable. An improvement would be more local, branded, or higher-end offerings (similar to Jean-Bob's) to elevate the experience. The food and beverage service provider sets up numerous temporary stations for events within the club atriums. They require additional preparation space for their operations than is currently dedicated "back of house" space, commonly setting up pipe and drape around additional space they use within the "front of house" in the Atrium or Club space on each level. If these temporary stations and temporary preparation spaces are used for every game, consider creating permanent spaces that could function for both games and private events to reduce labor and provide a more effectively used space and nicer aesthetic.

Built-in trash can spaces within millwork are not functional due to small capacity, the interior is not waterproofed or easily cleaned and locations are not readily visible or noted. Due to these issues, numerous large, freestanding cans are placed throughout the clubs for games for functionality and have to be removed for private events because they are not desirable. The removal of cans is labor intensive and causes floor damage. There is also no recycling program within the clubs as there is for bottles and cans throughout the rest of the stadium. There are built-in countertops between vomitoriums that are not functional for either game day or private events.

Private events often require different furniture and layout than the clubs have for game day, but there is no location to store the club's existing furniture. Each event requires numerous labor hours to either move the furniture to another floor via the freight elevator or move it to store in the vomitorium spaces on same floor which is not aesthetically pleasing to guests. An improvement would be having a storage space on Club levels for storage of furniture during private events.

The kitchens have undergone a few renovations over the years. The removal of some equipment has exposed sloped flooring to multiple floor drains, creating trip hazards. These floors should be re-graded to provide a more walkable surface.

<u>400 Level Restroom accommodations</u>

At the 400 level, there are 10 women's restrooms, 8 men's restrooms and 2 family restrooms. Of these, East and West Clubs each have two men's, two women's and 1 family restroom. At the north end of both clubs the quantity of fixtures is about 50% of the average quantity per seat for the stadium as a whole. There are no family restrooms at the north end of the Clubs. The distance a fan must travel to another restroom is over 300 feet. The result is long lines at the north restrooms in both clubs.

There is also general admission seating on the 400 Level: the Convertible Club seating. These seats have an above average quantity of toilets per seat, however, this level lacks family restrooms. Convertible Club patrons must go to the top of the section to the 600 level to access a family restroom.

<u>Party Deck</u>

At the west end of the Administration area is the PBS Party Deck. It is an outdoor, open-air, sponsored event space with a bridge connecting to the west, 400 Level concourse. Some cushioned seating on metal risers have been installed at the field side of the area. The rest of the deck is flexible space.

Seats at the east side of the Party Deck have limited views of the playing field. The Party Deck is lacking in power and communications access points. Food and beverages are served along the south side behind the seating. The party deck is exposed to wind and sun. Portable umbrellas are brought in to cover the food and beverage areas. Full scale wind screening and sun canopy is needed in this area. Ponding water on the ramp to the deck poses a problem.

Party deck

Mid-level Suites (500 Level)

Suites, the press box, Jungle Vision and Command Center are located on this level, connected by an interior corridor overlooking the Club Level atrium.

Upper-level Suites (600 Level)

Suites are located on this level, connected by an interior corridor overlooking the Club Level atrium. The north end of the west Upper-Level Club space has the Players Lounge and Suites premium space which was a space that was renovated to provide additional private club ticketing options at a different price point than the private suites. Suites in this space are for 6-10 or 10-15 guests and includes food and beverage in cost from

a shared buffet. The suites have glass fronts with graphics, built-in countertops with glass tops and an in-suite ice bucket which is oversized. Player Suites are self-contained with private (communal) bathrooms.

Upper Concourse (700 Level)

Public concession stands and restrooms are located on this level. These areas are open air with some overhead protection by the stands above.

At the doors to the elevator lobbies, ponding water was observed. The deck drains are located adjacent to the CMU partitions, and this causes problems with leakage under the partitions and with fan access to vending at this location.

The 700 Level has 4 women's, 4 men's and 4 family restrooms which are evenly distributed. This level has a slightly below average number of restroom fixtures: 50 seats per toilet for Women and 46 seats per toilet for men.

Non-structural walls

The walls on the service level and in the public areas are primarily painted concrete masonry units (CMU). These walls are in good condition overall although there is damage to them in several areas. Almost all of the walls have chipped corners from passing traffic (pedestrian, push carts, and golf carts). Older chipped areas have been painted over.

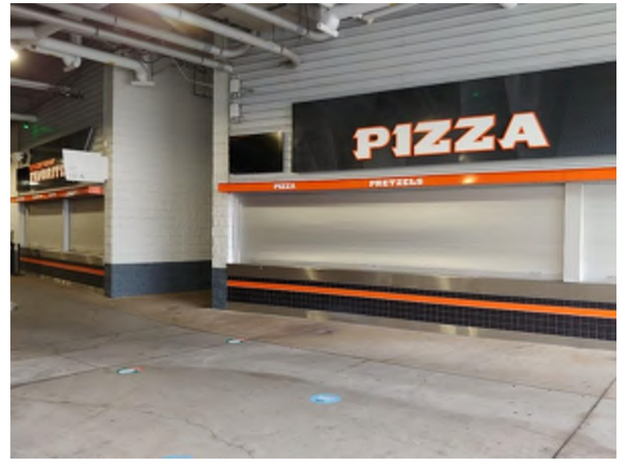
Typical condition of CMU wall corner

The paint scheme for the CMU walls is uniform throughout the stadium: Sherwin-Williams "Iron Ore" on the first 4-5 courses and white the rest of the way up. The result is a uniform appearance that can make wayfinding difficult. At several locations, the paint is peeling; moisture has entered the CMU walls, causing the paint to bubble and peel. Where bubbling has occurred previously, the peeling paint was removed and the CMU repainted. The freestanding wind block walls at the ends of the upper-level suite concourse are in particularly bad condition; some of the skyward facing joints are filled with mortar, not sealant, there is no flashing between the wall cap and the CMU, and the weeps at the base of the wall have been caulked at several locations.

The CMU walls are also open to moisture penetration at all sealed joints. The sealant has adhesive and cohesive failure and should be removed and replaced.

In a few areas the CMU has cracked due to moisture damage or local stresses.

General Concessions



Typical public concession stand

Public concession areas are located on the Main Concourse, Plaza Concourse, Club Level, Mid-Suites Level and Upper Concourse. The front façade has a steel countertop with overhead coiling doors. The overhead doors frequently have dents and/or erosion of the finish. Various doors are difficult to operate and do not seal well at the threshold, although stadium management allocates funds annually for replacement of the overhead doors. During the off-season, jacks will be installed at the overhead doors to fully close them and prevent outside air from entering the service and food prep areas.

Jack at overhead door

Overhead door after replacement

4x4 tile has been applied to the wall below the counter. Above the coiling doors is a decorative rail with signage above and corrugated metal paneling behind the signage. The tile, rail, and signage are in the team colors of orange and black. The uniformity of the concession stand facades contributes to challenges in wayfinding. Tile was damaged at one location on the upper concourse. Sealant at all edges of the counters has adhesive failure.

The doors to the inside of the concession areas are in poor condition. The door hardware has rusted, door silencers are at the end of their service life, and door sweeps are damaged or missing. The doors are sagging, scraping the paint on the frames and in some instances not closing fully or securely latching. The door frames are also rusting, particularly at the bottom of the jambs. The skin on a few doors has detached from the internal frame.

Water is seeping under the doors from pressure washing the concourse or from wind-driven rain as a result of no threshold or the concession floor residing lower than the concourse floor level.

The Sideline

This concession area is located on the east side of the main concourse. It is an area with a bright background and sectioned off from the rest of the concourse by field markings on the floor. The lighting in this area is inadequate and should be upgraded. As this area is enclosed on all four sides, options to obtain a sponsor and expand into the unused areas should be considered.

The Sideline

Queen City Taphouse

This Irish-style concession area is located at the southwest end of the main concourse. A faux pub façade separates the tap house from the rest of the concourse. Some of the trim has been damaged, come loose or is missing and should be addressed. On game day, the game is projected onto the wall above the area for those waiting in line. This is an unsponsored area.

Storage Spaces

There are a number of these spaces throughout the stadium. Specific locations include, one on each sideline, one on plaza north and one on each side of the upper canopy. Where they are accessed from public areas, the doors and frames are in poor condition with the same issues as the concession stand doors.

General Restrooms

The restrooms are spartan with concrete floors, painted CMU walls, and lay-in ceiling tiles. The stalls are divided by dark orange, metal toilet partitions. Sinks are individual, wall mounted fixtures. Lighting is inadequate and needs to be upgraded.

Club Restrooms

The restrooms are basic with neutral colored tile floors or epoxy flooring, painted gyp board walls, and lay-in ceiling tiles. The sinks are installed in a counter with wall tile below and above the counter. The stalls are divided by dark orange, metal toilet partitions. Ceiling tiles and grids are aging and need to be replaced.

Guest Services Spaces

The Guest Service spaces, such as first aid, are in acceptable condition, however, some components are showing the age of the facility, including doors, lighting and storage. The main first aid station is at the north end of the facility on the Plaza Level. There are two First Aid stations on the 700 level that do not include a toilet. We recommend upgrades to the existing facilities for longevity of use.

Once inside the gate, fans can be delayed by lack of an obvious place to find information. Guest Services at entry gates need to be coordinated with Wayfinding to ensure smooth progress to

amenities, seating and wheelchair accommodations. The function, quantity and locations of Guest Services should be compared to other stadiums as a part of the master plan.

Lighting

Interior Lighting System

The stadium has a mixture of incandescent, fluorescent, quartz, metal halide and halogen light fixtures. Over time, the stadium has replaced the bulbs in most of the incandescent downlights with LED replacement lamps throughout the facility in public areas. These fixtures (bulbs and housing) are nearing the end of their service life and will need replacement. All remaining incandescent fixtures should be replaced with LED as well. Replacement of all existing fluorescent, metal halide and halogen fixtures would provide substantial energy cost reduction. The majority of linear lighting throughout the facility is fluorescent and has not yet been replaced with LED. The high bay lighting in the service tunnel and the plaza concourse has been replaced with LED fixtures. Lighting levels in most areas are adequate for life safety purposes but appears dim from a guest and fan experience perspective. Replacement of lighting in this area would provide the benefit of allowing an increase in lighting level even with simple 1-1 fixture replacement.

Typical LED high bay lighting

The majority of office areas, including but not limited to individual offices, open offices, ticketing, press and administration areas, are lit by recessed fluorescent fixtures. These fixtures should be replaced with LED fixtures to conserve power and reduce energy costs. The best long-term, cost-effective solution are LED flat panel type fixtures. These areas are controlled with wall mounted timers. These timers should be replaced with wall or ceiling mounted occupancy sensors set to vacancy control.

All mechanical/electrical support areas are using fluorescent lighting and should be replaced with LED fixtures.

All existing food prep concession / kitchen areas have fluorescent lights. These areas should be reviewed with current layouts and usage to verify light levels are adequate. All fixtures should be replaced with LED fixtures.

Club entrances, along with the exterior plaza in general, need better exterior lighting for night games. The vestibule ceilings are extremely high and need to be reconfigured for better lighting. Downlights are left off due to maintenance difficulty. LED pendent fixtures for the new light fixtures should be considered for efficiency and ease of maintenance.

Club areas have a mixture of fixture types, many of which are dated product styles. All fixtures in these areas should be replaced with LED fixtures with a new modern style.

Suite and support areas have original fixtures and should be replaced with LED fixtures.

Group public restrooms are utilizing fluorescent lights and the lighting level in the area is very dim. Our recommendation is to replace existing with new LED fixtures and provide additional fixtures as needed to meet required light levels.

The entries to the First Aid areas need additional lighting for visual comfort.

The Pro Shop managers noted that better merchandise display lighting, including backlighting and spotlight capabilities, could be added to the shop.

Service Level

A few corner areas should be reviewed and light added to match surrounding area light levels. Stadium staff reported that the lighting levels in the team locker shower areas, the hydrotherapy and treatment spaces, and the coaches' offices seem dim.

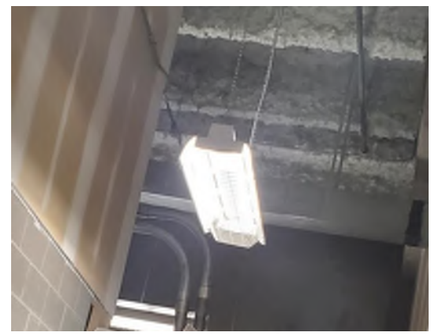
Staff reported that the lighting has been updated in both auditoriums. The Lutron lighting control panel and system are original and should be updated.

The following lists the facility's current light fixture types per space.

Service Level:

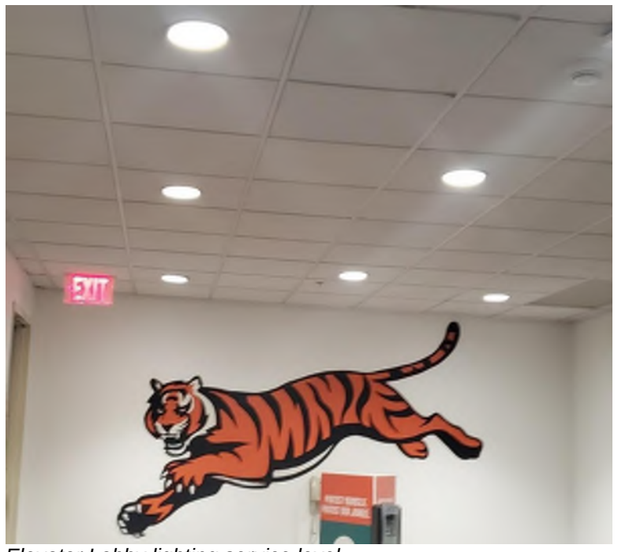
- Service Tunnel: LED high bays.
- Mechanical and Electrical Areas: Linear Fluorescent Pendants with a wall mounted control timer.
- Small Restrooms: Fluorescent recessed fixtures and incandescent downlights a with wall mounted control timer.
- Elevator Lobby: Downlights w/LED replacement lamps

Typical Service Tunnel LED high bay lighting



Typical mechanical/electrical area lighting

Typical lighting control timer



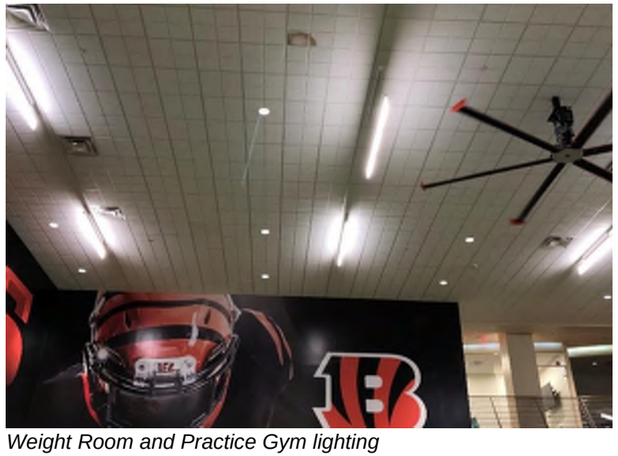
Elevator Lobby lighting service level

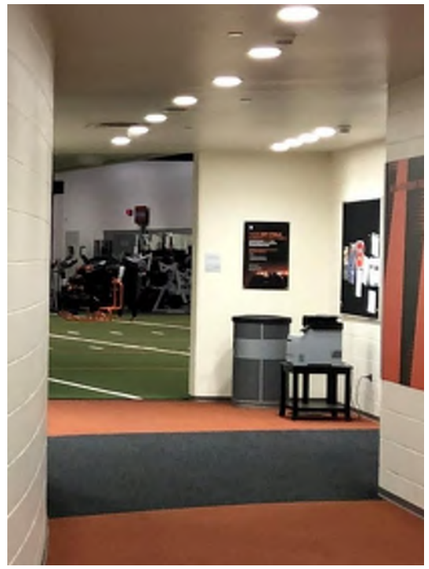
Many of the players' areas have been remodeled within the last 10 years and LED lighting was installed. These fixtures are approximately halfway thru their service life and should be replaced in the next 5-10 years. (Typical service life of an LED and driver is 50,000 hours)

Coaches/Player Areas:

- Locker Rooms: Various LED style fixtures.
- Weight Room and Practice Gym: Various LED fixtures.
- Cafeteria: Recently renovated with new LED fixtures.
- Large Auditorium: Various style fixtures with new LED replacement lamps. All lighting controlled by Lutron Grafik Eye System.
- Small Auditorium: Fluorescent recessed fixtures and incandescent downlights. All lighting controlled by Lutron Grafik Eye System.

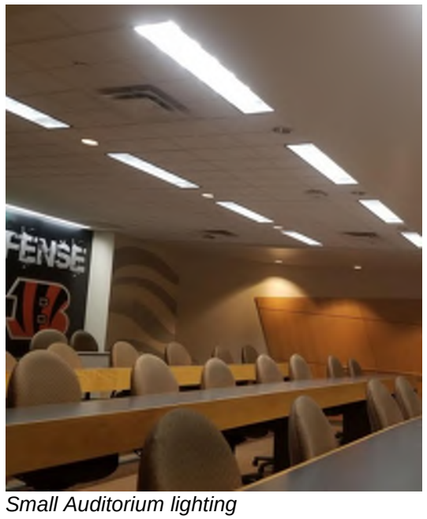

Home Locker Room lighting


Weight Room and Practice Gym lighting


Players' area corridor lighting


Cafeteria

Large Auditorium lighting



Small Auditorium lighting

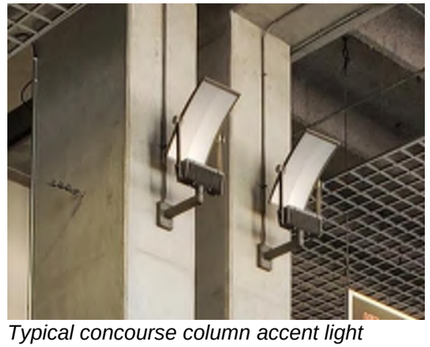

Auditorium step lights

Auditorium graphic accent light


Auditorium Lutron lighting control panels

General concourse levels:

- High ceilings: LED high bays with accent lights on the columns.
- Low ceilings: Linear fluorescent lights and downlights with LED replacement lamps

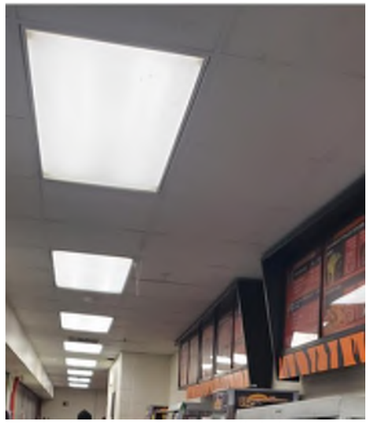

Typical concourse column accent light

Typical concourse low ceiling fluorescent linear lighting

Typical concourse low ceiling downlights

Concessions, Food Prep and Kitchen Areas:

- Fluorescent recessed fixtures

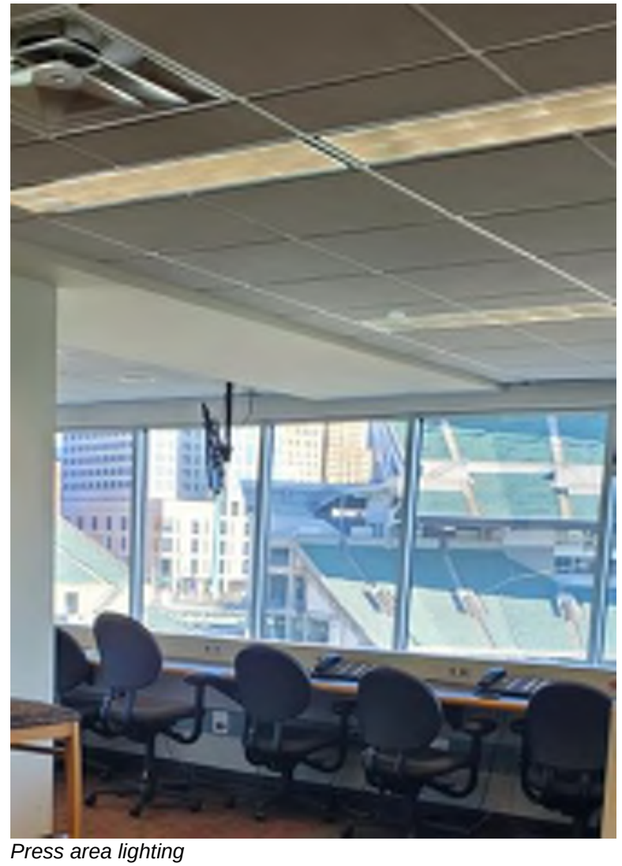


Typical concession area lighting

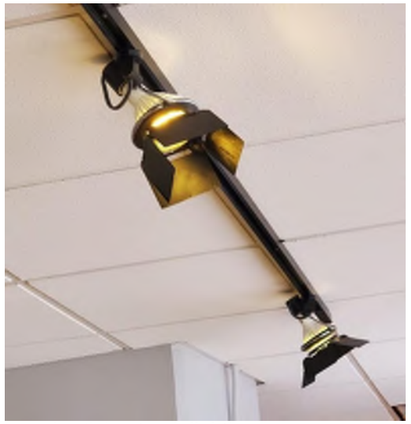
Typical kitchen lighting

Miscellaneous Concourse Areas:

- Press Room: Fluorescent recessed fixtures.
- Jungle Vision: Track mounted fluorescent and halogen lights with wall mounted rotary dimmers.
- Ticketing Office: Fluorescent recessed fixtures and downlights with LED replacement lamps
- Pro-Shop: Track mounted fixtures with LED replacement lamps and downlights with LED replacement lamps
- Group Public Restrooms: Linear recessed fluorescent fixtures and downlights with LED replacement lamps. All fixtures are controlled by ceiling mounted occupancy sensors

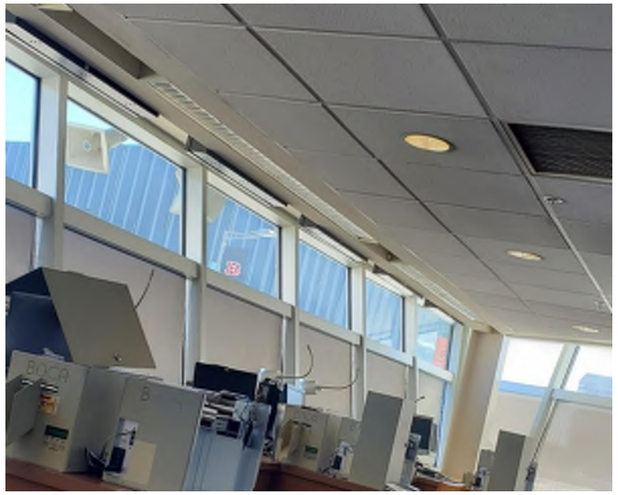


Press area lighting



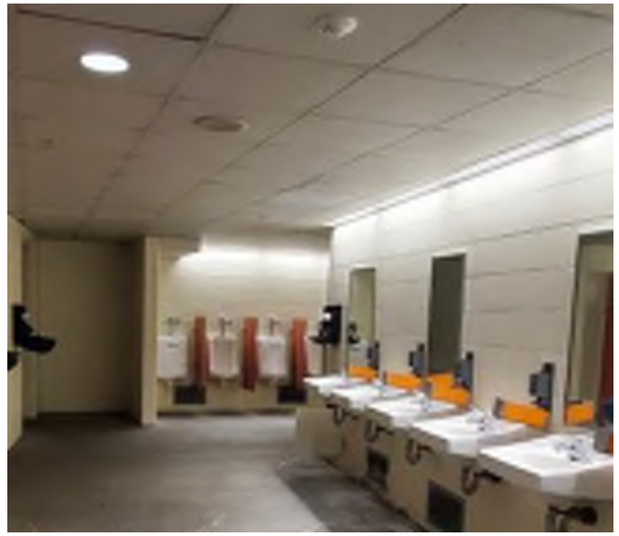
Jungle Vision track lighting

Jungle Vision rotary controls



Ticketing Office lighting

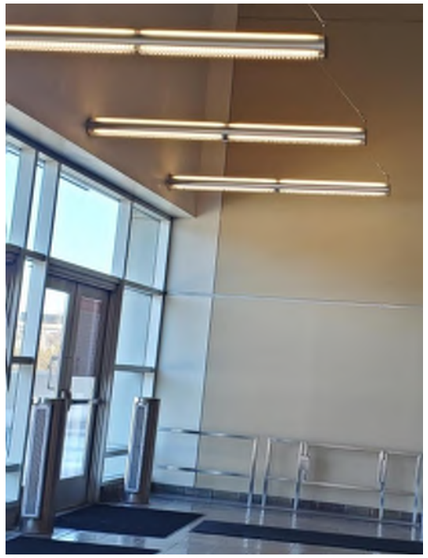
Pro Shop lighting



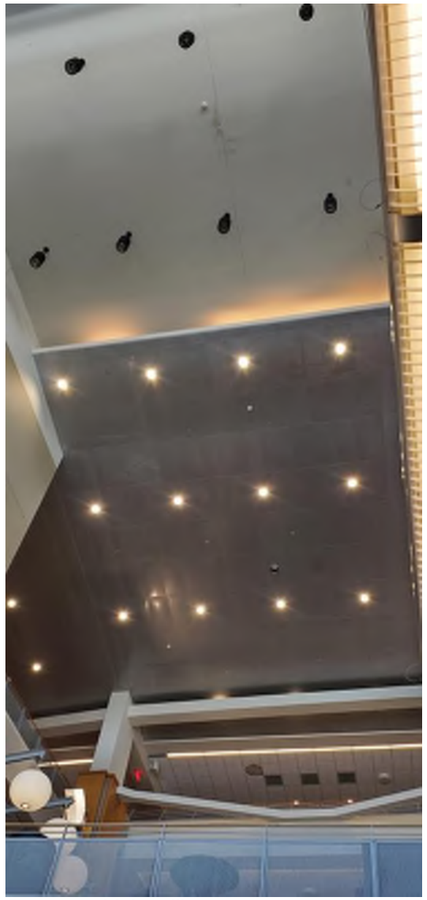
General restroom lighting

Club Entrances, Atrium and Suites:

- Entrances: Linear fluorescent pendants hanging over the exterior doors. Metal halide pendant cylinders and downlights in the high ceiling.
- Elevator Lobby: Linear fluorescent lights and downlights with LED replacement lamps.
- Atrium: Various decorative fixtures and downlights with LED replacement lamps, typically located over the concession areas.
- Corridor: Downlights with LED replacement lamps and linear fluorescent fixtures
- Suites: Original light fixtures with LED replacement lamps.

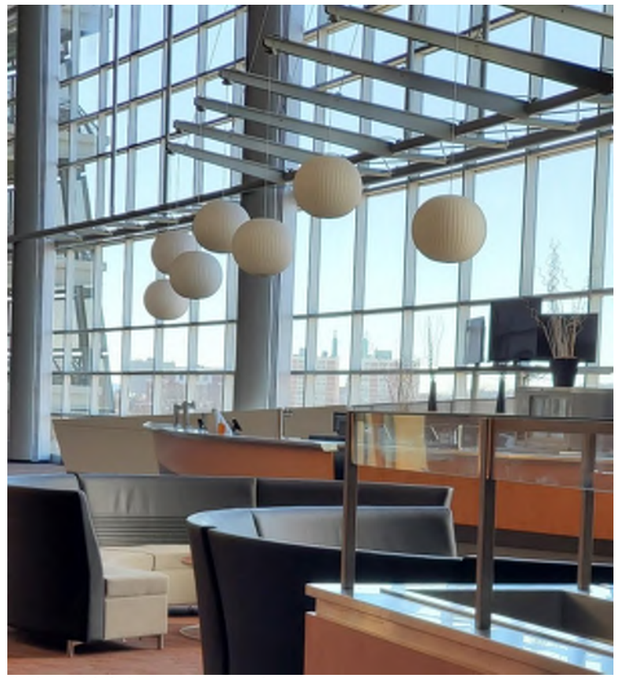


Club Entrance: Lighting at exterior doors; not seen in image is non-accessible lighting at high ceiling (see next image)



Entrance: high ceiling

Elevator Lobby lighting



Atrium: Lighting at concessions

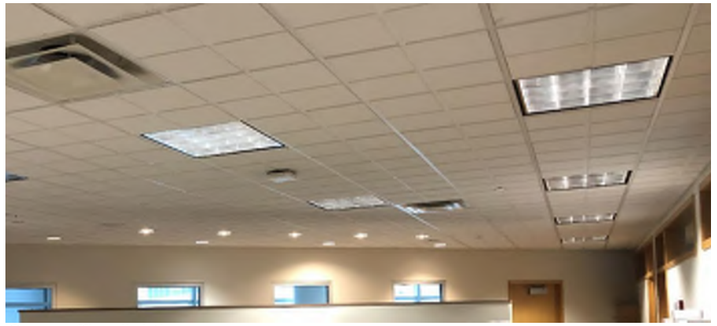
Club corridor lighting

Club Suite lighting, typical

Club Suite lighting controls, typical

Administration Building:

- Typical Open Office areas: Fluorescent recessed fixtures with a wall mounted control timer.
- Individual Office areas: Fluorescent recessed fixtures with a wall mounted control timer.



Open office lighting

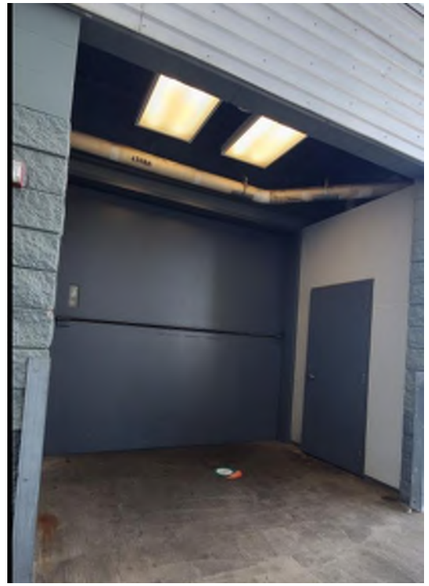
<u>Exterior Lighting</u>

Most of the original metal halide fixtures have been replaced with LED fixtures. The façade/accent light fixtures and plaza pole lights were replaced in 2014 and the pole light accent arms were replaced in 2019. The fluorescent pendants in the canopy area service entrances and a few quartz and other miscellaneous lamped fixtures still need to be replaced with LED.

During prime time (night) events, the assessment team was told that stadium operations must rent portable light banks in order to provide a well-lit environment on the exterior plaza for ingress and egress. This situation is a labor and material expense than can be corrected with proper exterior lighting throughout the exterior of the facility and is addressed in the Master Plan document.

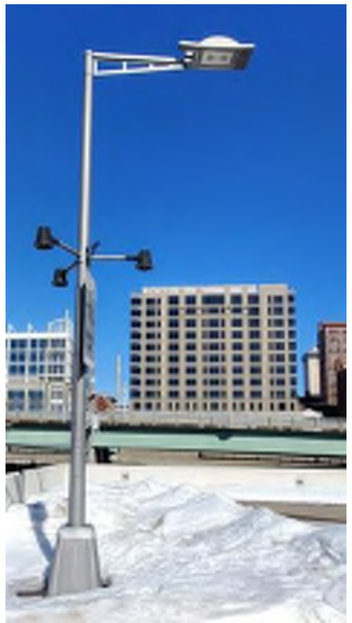
The fixtures throughout the pedestrian walkway and open spaces provide appropriate safety light levels in most areas. There are several pedestrian areas that are currently not providing adequate fan experience light levels. These areas are as follows:

- Gate B area – East/West ramp
- East / West Corners of Sideline area
- North / South ends of Sideline area
- West plaza exterior concourse west to south Z ramp
- Ped-way North Plaza
- Stair to Pete Rose Way
- Northeast Exterior Plaza between Gate C and D.
- Northeast Canopy near Ramp
- Gate E area
- Stadium Plaza perimeter step
- Gate A and D on concourse side of gate



Service area entrance light

Plaza & accent lighting


Plaza pole light with arm accent fixtures


Façade lighting


Column accent & Plaza light


Plaza step lights

Seating Bowl

The stadium seating stair area step lights do not provide adequate light and should be replaced.

The field lighting is currently in the process of being replaced with Musco LED fixtures and will have a 20-year warranty.

The light fixtures located on the catwalk are currently controlled by the same switch as the field lighting. PBS is in the process of switching these fixtures onto a separate control, and one quadrant of the stadium has been completed this switchover.

Lighting Control System

The lighting control system for the stadium is a computer based networked system manufactured by Greengate. Currently, the control system can be accessed via the security office, the building engineer's office and by the building engineer via VPN.

The lighting control panel and software Vision Touch 5 was replaced around 2014. The control software has a slow response time, lacks a visual interface that would allow for easier control, and generally does not function correctly. It is at

the end of its useful life related to the control and command of the system and should be updated / replaced.

The controls for each suite are located within the room but are not networked into a larger system allowing control from a remote location. Therefore, at the end of each game or event, staff must walk the suites to ensure all lights are turned off. Adding the level of control to the stadium system would reduce labor and provide real-time data.

Recommendations

Curtainwall and Storefront Systems

1. Inspect the glazing gaskets every year to actively monitor the condition of the gaskets.
2. Wet seal or reglaze the curtain wall on a planned basis, starting immediately with Administration Building.
3. Provide relief joints in the gypsum board where cracks have occurred.

Sliding Glass Walls

1. Replace locks with more durable hardware.
2. Annual inspection of glazing seals. Replace seals as required.
3. Replace trolleys and tracks with more durable system. This is an urgent need on the East side. The West side should be done in the next 5 years. Alternates: Replace entire system with high quality system or upgrade to a motorized system. This will limit or eliminate the labor-intensive opening and closing process. Perform cost analysis.

Precast Concrete Screen Walls

1. Replace all joint sealants in the panel system.

Perforated Metal Panel Screen Walls

1. Paint steel columns supporting metal panel screen walls.

Open Air Concourses, Ramps and Stairs

1. Repair concrete landings for exterior stairs and ramps. Repairs should include:
    a. Remove and replace damaged concrete.
    b. Apply corrosion inhibitors to exposed reinforcing and steel decking.
2. Replace all joint sealants at the stairs and railings.
3. Patch concrete wall corners at ramp landings to doors.
4. Provide bollard at wall corner at ramp landings.
5. Repair the club level north bridge. Repairs should include:
    a. Move railings inward, away from the edge of the concrete slab.
    b. Grind back exposed, rusted reinforcement.
    c. Sandblast concrete surface in preparation for traffic coating.
    d. Remove steel angles at edge of traffic coating.
    e. Grout all holes in the concrete.
    f. Apply new light-duty vehicular traffic coating. Extend coating over edges and terminate on underside of concrete slab.
    g. Develop a maintenance plan for reapplying the traffic coating.
    h. Provide gutter/ drainage system to manage water drainage.
    i. Replace expansion joint assembly.
    j. Repair damage walls / structure below expansion joint.
6. Alternate: Replace the existing concrete slabs in lieu of repairing them. New slabs should help direct and manage water drainage.

Exterior Plaza Deck, Auto Entrances and Barricades

1. Provide folding auto barrier at East exterior plaza.
2. Provide permanent bollards at East exterior plaza.
3. Provide more entry points at the eastern plaza. Study and coordinate with the upgrade of the entire plaza's security and water proofing.

Gates, Fences and Barricades

1. At Gate F, provide enclosure for x-ray machine at exterior of building.
2. Reconfigure Gates A-E for permanent magnetometers, shades or canopies, consistent traffic flow and improved fencing.
3. At Gate A, add space to the Main Concourse overlook.

Plaza Level: East and West Club Entrances

1. Replace slate tile with flooring that will reduce maintenance time and expense, contribute to a premium aesthetic and maintain acoustic benefits.
2. Renovate heating.

Wayfinding

1. Reconfigure bag check signage.
2. Provide wayfinding on the exterior plaza to the gates.
3. Provide wayfinding inside the stadium to the seating areas.
4. Allowance: Provide illuminated wayfinding.

Seating Bowl
1. Replace Club Level seating within 3 years.
2. Replace lower bowl level seating within 5 years.
3. Replace upper bowl level seating within 5 years.

Service Level
1. Install a reliable auxiliary drainage system at the IT room.

Team Spaces and Coach's Offices
1. Expand Coaches' Locker Area to include Women Coaches.
2. Renovate mail/parcel pick up to include food lockers.
3. Renovate the coaches' areas to provide additional office space. Provide acoustical isolation.
4. Renovate the coaches' areas to provide additional small-group meeting rooms for presentations.
5. Provide additional electrical outlets in coaches offices.
6. Replace ceiling tile.
7. Replace hot tub with larger hot tub.
8. Provide new cryotherapy equipment to meet NFL standards.
9. Auditoriums
    a. Fix leaks above ceiling at both auditoriums.
    b. Add subroof at areas where none has been installed.
    c. Replace ceiling system (small auditorium only).
    d. Replace speaker system.
    e. Replace white boards.
    f. Furr out wall(s) between training room and locker room and auditoriums to reduce sound transmission.
10. Replace laundry equipment.
11. Repair leak above team equipment storage space.

Visitor's Locker Rooms
1. Renovate adjacent space to provide for a new Women's Coaches' Lockers and shower.
2. Add locker room for women referees per NFL requirements.

Stadium Security and Package Receiving
1. Install additional cameras in accordance with current NFL standards and as noted in the general summary
2. Add / renovate space to provide for additional camera monitoring and increased staff.

Field Level Sponsored Space
1. Review area with sponsor.
2. Re-attach flooring to concrete.

Retail Warehouse
1. Upgrade the office area for comfort of occupants.
2. Add subroof to prevent damage to electrical devices and merchandise. (See Roofing report.)
3. Provide additional electrical outlets.

Plaza Level
1. Pro Shop:
    a. Revise entry areas and add vestibules.
    b. Add ADA automatic door opener to doors.
    c. Renovate Pro Shop to be a destination, not just for retail shopping, but for an experience and events to attract visitors.
    d. Replace glazing on West facing glass to block UV and IR.
    e. Alternate: Add window film on West facing glass to block UV and IR.
    f. Alternate: Add shading devices on West facing glass.
    g. Upgrade HVAC and add perimeter heat controls.
    h. Fix leaks in structure above ceiling and add subroof and drain lines.
    i. Replace sales fixtures.
    j. Update sound system to get speakers on real-time or acoustically separated from live action.
    k. Provide visual security system for manager's office.

2. Pro shop satellite spaces:
    a. Replace signage with more prominent signage.
    b. Repair leaks at front wall.
    c. Replace casework.
    d. Replace shutter doors.
    e. Replace heating.
    f. Replace lighting.
    g. Provide additional data outlets.
    h. Provide additional electrical outlets.

Suites
1. Replace broadloom carpet and slate tile with flooring that will reduce maintenance time and expense, contribute to a premium aesthetic and maintain acoustic benefits.
2. Remove wall paper and paint walls.
3. Provide maintenance program to repair gyp board walls damaged by furniture and equipment.
4. Suite Bar:
    a. Replace countertops with quartz.
    b. Provide wall protection and easily cleaned wall surfaces to reduce maintenance requirements.
    c. Replace appliances.
    d. Replace lock on liquor cabinet with a higher quality lock or a digital lock.
5. Suite Restroom:
    a. Replace the soap dispenser with a dispenser mounted above the sink.

Administration Building
1. Check structure for potential expansion of offices at the 2nd floor of Admin Building by enclosing the adjacent Party Deck.
2. Restripe the visitor parking due to the increased number and changing roles of administrative staff.
3. Expand Women's Locker area.
4. Decrease the Number of Ticket windows from 4 to 1. This space should be recaptured for other use.
5. Provide additional public display space for historic items.
6. Add dedicated Staff Break Room.
7. Add dedicated package receiving area.
8. Upgrade Touchdown room finishes and technology.
9. Upgrade technology in all conference rooms for usability.
10. Additional access to administrative storage.
11. Renovate men's room on 400 level by swapping one urinal for an additional toilet stall.

400 Level
1. Investigate light poles at north end to verify if penetrations are a source of leaks.

Club Atriums

1. Provide relief joints in gyp board where cracks have occurred (ceiling soffit, at beam furring, at curtainwall).
2. Replace expansion joint material.
3. Replace broadloom carpet and slate tile with flooring that will reduce maintenance time and expense, contribute to a premium aesthetic and maintain acoustic benefits.
4. Alternate: Add window film on West facing glass to block UV and IR.
5. Alternate: Add shading devices on West facing glass.
6. Provide recycling program.
7. Regrade kitchen floors at floor drains by front doors.

Non-structural Walls

1. Patch and paint chipped CMU wall corners.
2. Install heavy duty corner guards at wall corners.
3. Remove peeling paint and repaint.
4. Large cracks: sawcut joint and install backer rod and sealant.
5. Small cracks: grind out mortar and repoint.
6. Repair freestanding windblocks:
    a. Remove cap as required to installed 24 ga. stainless steel flashing. Reinstall cap with 2 pins min. per piece of cap. Caulk around each pin with non-hardening butyl sealant.
    b. Seal all skyward facing joints with sealant and backer rod.
    c. Remove caulk from weep holes.
    d. Remove loose paint on all surfaces and repaint.
7. Remove and replace all sealant (CMU walls, concession counters, stairs, etc.).

General Concessions

1. Replace overhead coiling doors.
2. Repair damaged wall tile.
3. Provide lubricant at door closers to improve operation.
4. Adjust door hinges.
5. Replace door silencers and sweeps.
6. Replace doors with detached skin.
7. Provide door thresholds where thresholds are not installed. Embed in non-hardening butyl sealant.
8. Replace all hollow metal doors, frames and hardware.
9. Introduce new technologies related to concession offerings (note: this item is not reflected in Capital Expense Matrix due to wide range of possibilities)

Queen City Tap House

1. Repair or replace damaged trim.

General Restrooms

1. Replace corroded ceiling grid.
2. Seal concrete floors
3. Update finishes

Interior Lighting

1. Replace incandescent light fixtures with LED.
2. Replace all other light fixtures with LED.
3. Replace all fluorescent linear lighting with LED.
4. Replace all fluorescent lighting in office areas with LED.
5. Replace timers in office areas with occupancy sensors.
6. Replace all fluorescent lighting in mechanical/electrical areas with LED.
7. Replace all fluorescent lighting in kitchens, concessions and other food prep areas with LED.
8. Upgrade lighting in club entrances for night games. New fixtures to be LEDs. Pendent fixtures are recommended.
9. Replace all fluorescent lighting in suites and suite areas with LED.
10. Replace all fluorescent lighting in general restrooms with LED.
11. Provide additional light fixtures in general restrooms to meet required light levels.
12. Provide additional light fixture(s) at First Aid areas.
13. Replace lighting and lighting controls in small auditorium.
14. Provide additional lighting in the Queen City Tap House
15. Restrooms (all) provide additional lighting to increase illumination

Exterior Lighting

1. Provide additional lighting in all areas listed below:
    a. Gate B area – East/West ramp.
    b. East / West Corners of Sideline area.
    c. North / South ends of Sideline area.
    d. West plaza exterior concourse west to south Z ramp.
    e. Ped-way North Plaza.
    f. Stair to Pete Rose Way.
    g. Northeast Exterior Plaza between Gate C and D.
    h. Northeast Canopy near Ramp.
    i. Gate E area.
    j. Stadium Plaza perimeter step.
    k. Gate A and D on concourse side of gate.
    l. Provide additional lighting or alter existing lighting to increase overall illumination related to events and overall security throughout the entire exterior plaza
2. Replace existing accent and façade light fixtures with LED fixtures.

Seating Bowl

1. Replace the stadium seating stair area step lights.

Interior and Exterior lighting Replacement

1. Provide comprehensive lighting analysis to determine location of new fixtures and location of 1 for 1 fixture replacement. LED fixtures have flexibility of multiple lumen packages in replacement fixtures.

Lighting Control System

1. Provide updated, lighting control software.
2. Replace suite lighting controls with controls that can be controlled by the building system software.

ROOF SYSTEMS

Roof Systems

There are currently five different roofing systems installed on various roof area at the stadium. These include:

- Single ply EP, white reinforced membrane
- Single ply TPO, white reinforced membrane
- Modified bitumen
- Standing seam metal
- Protected roof membrane assembly

These roofs are located above conditioned and non-conditioned spaces on levels 300, 400, 700, and 900 (scoreboards and cameras).

At the end of this section is the keyplan with a map of all roofs reviewed.

Single Ply EP

The original roof system for the low-sloped areas is a single ply, white, reinforced membrane. It is an EP (Ethylene Propylene) membrane that was manufactured and marketed by JP Stevens. The JP Stevens EP membrane was an early version of a TPO (thermoplastic polyolefin) membrane. The roof membrane is fully adhered over polyisocyanurate roof insulation boards.

Rain drainage is managed through internal roof drains that are spaced along the roof areas. There are also overflow roof drains for secondary overflow. Tapered insulation was used in most areas to create slope and promote positive drainage.

Based on the age of the roofs (20 plus years) they are not likely to be under any current warranties.

General

Several roof areas have serviceable rooftop equipment that are located within 10 feet of the roof edge without fall protection.

Equipment on roof

Currently, the Ohio Building Code, Section 1015.6 requires that guards or fall arrest systems be provided where serviceable mechanical equipment is located within 10 feet of the roof edge. While the stadium was originally built to code, over the last 20 years the building code has changed.

Any planned rooftop changes (materials, HVAC placement, etc.) should be reviewed for code compliance and budget for a fall protection system in the event it becomes required. A fall protection system is recommended as good building practice.

700 Level Upper Concourse

There are several roofs on the 700 Upper Concourse level of the stadium. These include roofs over concessions areas, elevators, chutes and service areas. The roofs along the outer sectors are fully exposed to weather while those along the inner sector sections are under some cover of the seating areas above.

700 level - Concession roof

700 Level – Inner Sector

All of the roof areas in the inner sector are original EP single ply membranes. These roof areas are generally beneath the seating bowl.

Typical EP membrane roof

These roofs have short parapets around the outer edge areas and metal copings. Roof areas have internal roof drains and secondary overflow drains. Some areas have ponding water.

Ponding water on EP membrane

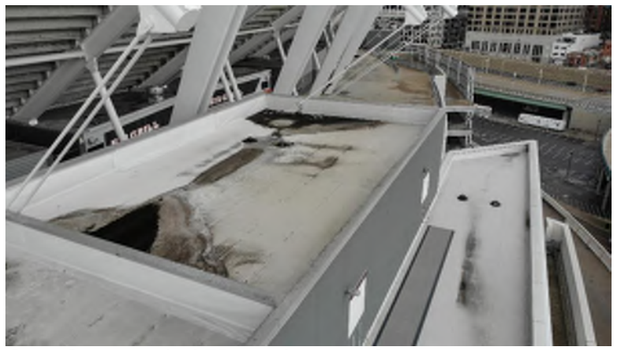
Several of these roofs have rooftop equipment that is within 10 feet of the roof edge without fall protection.

Equipment on roof near roof edge

These roof areas appear to have performed well but are nearing the end of their service life and should be replaced.

<u>700 Level - Outer Sector</u>

There are six roof areas along the east and west outer sector areas. Two areas along the east side still have the original EP single ply membrane.



Outer Sector: typical EP membrane roof

These roofs have short parapets around the outer edge areas and metal copings. Roof area have internal roof drains and secondary overflow drains. These roof areas are at the end of their service life and should be replaced.

<u>North Ticket Window and Pro Shop Canopy</u>

Roof at north ticket window and pro shop

The public ticket windows and entrance to the Pro Shop on the north side of the 300 Plaza Level has a narrow canopy over the storefront, windows and entrance.

The roof over this canopy is the original white EP membrane. There are three internal roof drains spaced along the roof area. There are no secondary overflow drains. The roof edge has a metal fascia. The back side of the canopy abuts the glazed curtain wall and the glass extends down to near the roof line.

Glazing above pro shop roof

Given the long narrow shape of the canopy, combined with low slope, a shallow roof edge fascia and lack of secondary overflow drains, the roof is vulnerable to ponding water and the potential for wind-driven rain to blow over the roof edge and onto the canopy cladding below. Ponding water and lack of effective roof slope has allowed for debris to collected in the field of the roof and created conditions for algae and moss to grow at the drains.

Biological growth at pro shop roof drain

On the day of the site visit there were icicles forming on the face and underside of the canopy.

Pro Shop canopy – icicle formation

Also, some dark soiling spots and white deposits exist on the underside of the canopy cladding.

Pro shop canopy – soiling and deposits

On the west end, outer edge of the canopy, there is an impact dent on the corner of the canopy. This may have been caused by a delivery truck.

Pro Shop canopy – dented corner

The roof over the canopy is at the end of its service life and should be replaced. Improving rain drainage as part of the roof replacement would be desirable, but given the small size, long shape and edge conditions (curtain wall behind and fascia edge along the front) it would be difficult to make any significant improvement.

South Scoreboard Roof

The roof over the long and narrow scoreboard is the original EP single ply membrane. There is a set of roof drains near the east end of the roof (primary and overflow). The roof membrane terminates into a metal edge fascia. Although there are roofs drains, given the long narrow shape and high wind location, it is likely that most rainwater blows off the roof edge before reaching the roof drains.

South scoreboard roof

North Side Scoreboard

There are a couple wedge shaped roofs on the backside of the north scoreboard. These roofs have similar conditions as the south scoreboard, and are at the end of their service life.

Wedge roof at north scoreboard

Wedge roof at north scoreboard

Administration Building Elevator

The roof over the Administration Building elevators (and under the south scoreboard) has the original EP single ply roof membrane.


Administration Building elevator roof

There are reports of roof leaks in this area. Leaks could be from this roof area or from other areas above that form the scoreboard and access stairs.

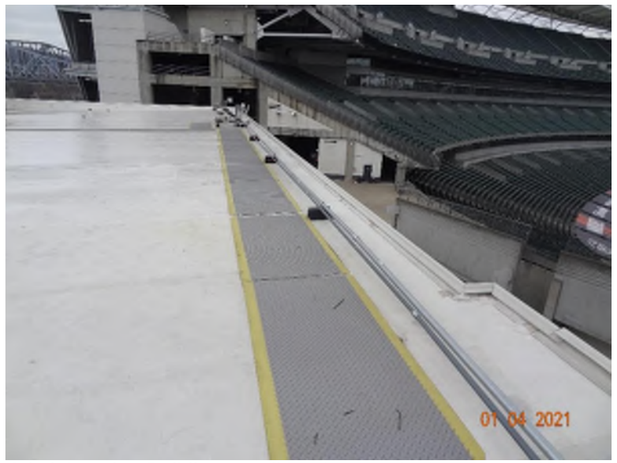
The original EP roof systems are either at or nearing the end of their service life and replacement should be scheduled. If roof replacement is to be completed over time in a phased sequence, the priority order recommendations are as follows:

1. East and west outer sector roofs (700 Level Upper Concourse level); Pro shop canopy roof (Plaza Level); scoreboard signs, advertising signs; elevator roof of Administration building. These outer sector roofs receive more weather exposure that those on the inner sector areas.
2. North, east and west inner sector roofs (700 Level Upper Concourse level).

Single Ply TPO

The EP roof over the Administration Building was replaced in 2016 with a TPO membrane manufactured by Carlisle. The roof system is in good condition and appears to be performing well.

Along the north roof edge there is a walking path (walk pads) that runs along the roof edge. There are no fall protection systems along the roof edge. The walk path was likely added along this area to allow service access to equipment that is mounted along the roof edge. Without fall protection, a walkway along the edge of a roof presents a potential fall hazard. To address this, a fall prevention system should be installed. This could include an active fall arrest (roof tie-off stations, harnesses and lanyards) or passive fall prevention (guard rail system).



Administration Building – walk pads at roof edge

There is a service cable running across the roof and lying on the roof membrane. Rainwater flows across the cable leaving debris against the cable. To address this, the cable should be raised above the roof surface and supported by a cable tray.

Administration Building – cable on roof

In addition to the main roof, there are higher raised roofs that serve the administration building. The stair roof over the west stairs was replaced when the Administration Building roof was replaced.

Administration Building – west stair roof

Modified Bitumen

Six small roof areas have been replaced with a two-ply SBS-modified bitumen system in the past few years. These include three roofs along the outer west side 700 Level Upper Concourse, one on the east outer sector and the Club East and Club West entrances.

Typical modified bitumen roof

The modified bitumen roof membrane is polyester reinforced and has a granulated cap sheet. The system was installed using cold adhesives.

- Manufacturer: Soprema - Bill Givens
- Installer: Imbus Roofing - John Parks

A modified bitumen roof system is an excellent choice for reroofing areas on this building. Modified bitumen systems are thick, durable, high performing, and typically provide a long service life. A two-ply modified bitumen roof membrane is commonly 225-250 mils (1/4") thick compared to a 60-mil (1/16") thick single ply membrane. The polyester reinforcing improves puncture resistance and adds tensile strength. The granular surfacing adds abrasion resistance for traffic, protects the asphalt from solar UV, improves the fire rating, and add solar heat gain reflectivity. Modified asphalt (bitumen) has proven waterproofing performance and longevity.

700 Level - Outer Roof Areas

Three outer west roofs and one outer east roof on this level have been replaced with a newer modified bitumen system. Although the roof membrane was replaced, it appears that the original metal copings were left in place or reused.

New roof over original metal coping

These copings have multiple penetrations, caulked joints and are age weathered. Light fixtures that hang over the concession area below are screw attached into the top of the coping and cantilevered outward.

Light fixture attachment at concession area

The connection between the light fixtures and coping relies solely on the pull-out strength of screw threads through the old sheet metal coping.

Electrical conduits that serve the lights are supported along the roof by wood blocks.

Wood blocking supports for electrical conduit on roof

Close up of wood blocking support

It appears that the wood support blocks are also remnants from the prior roof. Wood block supports are inadequate for piping or conduits. As pipes tend to move on the roof due to thermal expansion-contraction and wind, wood blocks tend to slide across the roof surface or rotate out of place, potentially causing damage to the roof membrane. As the wood weathers and deteriorates it loses its ability to provide support.

Standing Seam Metal

Areas with steel standing seam metal roofs include:

- Covered outdoor entry gates. These gate area roofs have a gutter along the lower edge and a single downspout that extends down one of the support columns.

Standing seam roof at gate

- The two small camera booth rooms on the north and west sides of the upper areas of stadium, within the seating bowl. These roofs do not have gutters so rainwater runs off the lower edge and onto the adjacent concrete seating areas. Not having gutters is not necessarily a problem in these areas considering that the entire area of the seating bowl is an outdoor exposure. It would be a problem if the concentration of rainwater flowing off the roofs caused leaks into the areas below. There is some rust along ends of the standing seams.

Camera booth roof, typical

Protected Roof Membrane

There is a roof area along the north-west areas of the 500 Level that has a single ply membrane roof protected by precast concrete pavers. The membrane extends up the parapet walls and terminates with a termination bar. There is no counterflashing to cover and protect the termination bar. No roof drains or scuppers are visible. The pavers appear to be wet in several locations and on the east side, there appears to be biological growth between and on the pavers. Further investigation is needed to determine the extent of moisture within the assembly.

Protected membrane roof

Close-up of protected membrane roof

Subroof System

Subroof

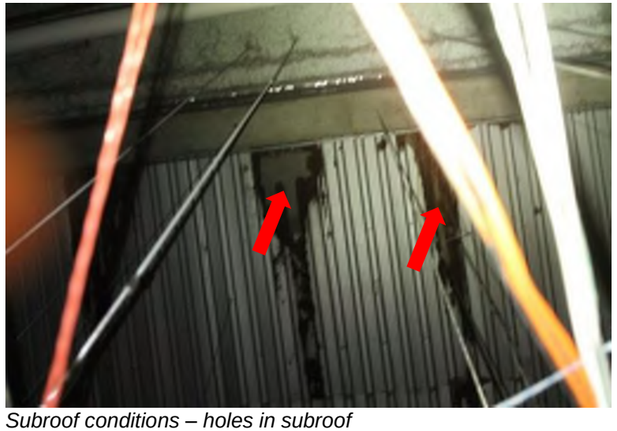
The lower level seating bowl, a precast concrete structure, is the ceiling / roof for the service tunnel. On the field level, leaks are prevalent along each column line and appear to be the result of leaking connections between the precast concrete supporting the seating above and the poured in place columns and beams supporting the precast sections. The horizontal joints between the sections of precast also appear to be leaking. Areas of sound attenuation blanket that were sprayed onto the underside of the concrete have fallen due to the leaks. The leaks have also damaged ceiling tiles and gypsum board ceilings. Every year, capital budget and maintenance budgets are appropriated for the sole purpose of ongoing proactive maintenance in the repair and replacement of vertical and horizontal sealant joints as well as concrete and waterproofing repair. Additionally, dedicated monies are used to replace the secondary gutter system at these locations.

Interior moisture damage – moisture on beam

Interior moisture damage – moisture on column

There are corrugated galvanized steel subroofs installed below the stadium seating areas in sections where finished interior spaces are located on the field level. These include but are not limited to an MRI clinic, X-Ray lab, lounge, the PBS Premium Patron Space, and maintenance office. The sub roofs appear to be in good condition except for the areas in the visiting teams' locker room. In this area, there are two large holes in the sub roofs attributed to a concentration of deicers, according to the maintenance staff.

Subroof conditions



Subroof conditions – holes in subroof

There are also subroofs at the 700 level at the back of the restrooms and prep areas. No leakage was reported and we did not observe this roof to verify. Due to this subroof, gutters and drains being a similar design to the lower levels, it should be monitored for leakage and repairs.

Interior Gutters

Interiors gutters are situated along the ends of the sub roof and radiate out along the column lines. Gutters are also located in areas that do not have sub roofs along vertical joints.

The subroofs drain into a series of galvanized gutters along the column lines closest to the field and are currently leaking in various areas throughout the service level. The leaking gutters have been reported to be a continual source of leaks since many are level and hold water laden with deicers that deteriorate the metal.

Rusting gutter

Rusting gutter

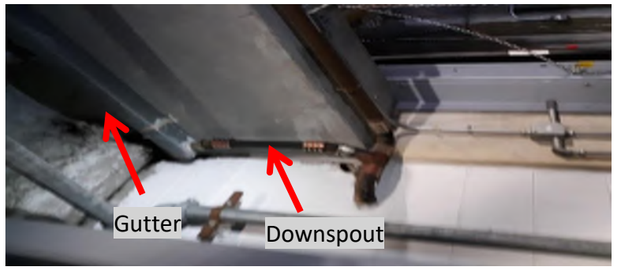
The direct applied spray on sound attenuation system from the underside of the seating bowl also becomes wet and falls down into the gutters clogging them and the downspouts. This backs up the water which lays in the gutters potentially causing more damage.

Leaks are also occurring due to the gutters failing at the end of the subroofs. These areas include the locker rooms, storage areas, mechanical spaces, Jack's Bar and Lounge by the Teams entry onto the field, maintenance work shops, MRI and team X-ray rooms.

Deteriorated gutter at end of subroof

The maintenance staff has replaced the galvanized gutters with prefinished gutters above the ceilings in several areas. In the maintenance offices, where the leaks are almost constant, maintenance has given up replacing ceiling tiles and installed metal mesh supported by wood framing. The metal mesh catches falling sound insulation while allowing the water to flow freely into containers.

Wood frame with screen mesh. Note stain on ceiling tile.



Gutter and downspout

In discussions with the maintenance staff, there is an ongoing gutter replacement effort where the deteriorated galvanized steel gutter is being replaced with new galvanized steel gutter lined with EPDM. The lining of the galvanized gutters is to counteract the effect of the deicers used extensively on the stadium.

The work of replacing the gutters is being performed by T.H.E. Roofing. Mr. von Korff, the facility maintenance manager, did state that a contract is going to be issued to T.H.E. roofing to continue the replacement of the gutters.

Downspouts

The downspouts connected to the gutters are cast iron with no hub connections. The cast iron downspouts do not appear to be leaking in the accessible areas examined. The maintenance staff has reported that piping, collecting storm water from the subroofs, has been replaced due to cracks in the past. The damage to the piping appears to be a combination of water with de-icer chemicals, the diameter of the pipe and the flatness of some of the runs of piping. The smaller diameter of pipe does not allow for the water to expand when it freezes. The areas in the stadium where this piping is located is not heated which contributes to freezing pipes. The downspout piping also has few cleanouts.

Recommendations

EP Roof

1. Replace EP roofs with single ply membrane. Roof replacement to include: East and west outer sector roofs (700 Level Upper Concourse level); Pro shop canopy roof (Plaza Level); scoreboard signs, advertising signs; elevator roof of Administration building
2. Replace EP roofs with single ply membrane. Roof replacement to include: North, east and west inner sector roofs (700 Level Upper Concourse level).

Single Ply TPO

1. Administration building: Install cable tray with supports.
2. Administration building: Replace roof at end of warranty.

Modified Bitumen

1. Replace wood blocking with pipe supports.
2. Replace roofs at the end of their service life.

Standing Seam Metal

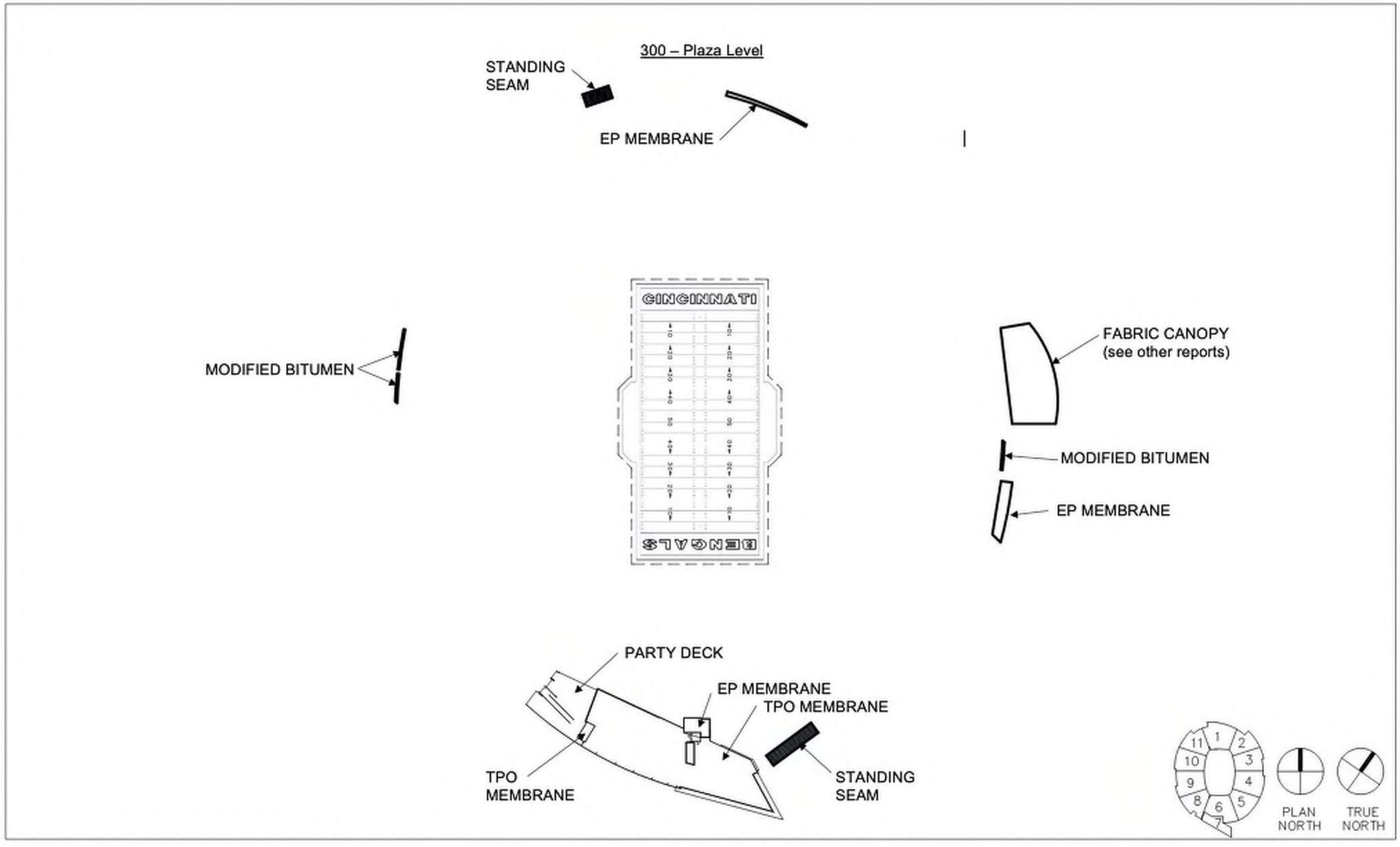
1. Replace camera booth roofs.

Protected Roof Membrane

1. Provide further investigation of the roof.
2. Replace the roof at the end of its service life.

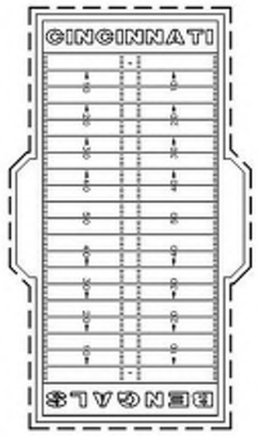
Subroof System

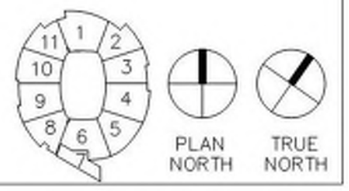
1. Line galvanized gutters with EPDM during gutter installation to protect from deicers.
2. Replace failing caulking above subroofs with new caulking.
3. Repair and coat existing concrete above subroofs with a pedestrian traffic coating.
4. Repair holes in sub roof with sections of galvanized steel decking with a matching profile including but not limited to:
    a. Under 300 level in sector 1.
5. Flexible Epoxy injection for cracks where water is entering the structure including but not limited to:
    a. Stair #3.08A at the 300 level landing.


300 – Plaza Level
STANDING SEAM
EP MEMBRANE
MODIFIED BITUMEN
CINCINNATI
FABRIC CANOPY
(see other reports)
MODIFIED BITUMEN
EP MEMBRANE
PARTY DECK
EP MEMBRANE
TPO MEMBRANE
TPO MEMBRANE
STANDING SEAM
11
1
2
10
3
9
4
8
6
5
7
PLAN NORTH
TRUE NORTH

400 – Club Level

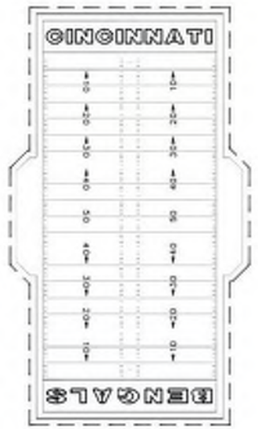
All roofs on this level are EP membrane u.o.n.

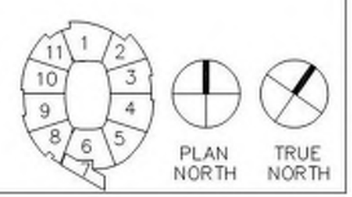




600 – Upper Level Suites

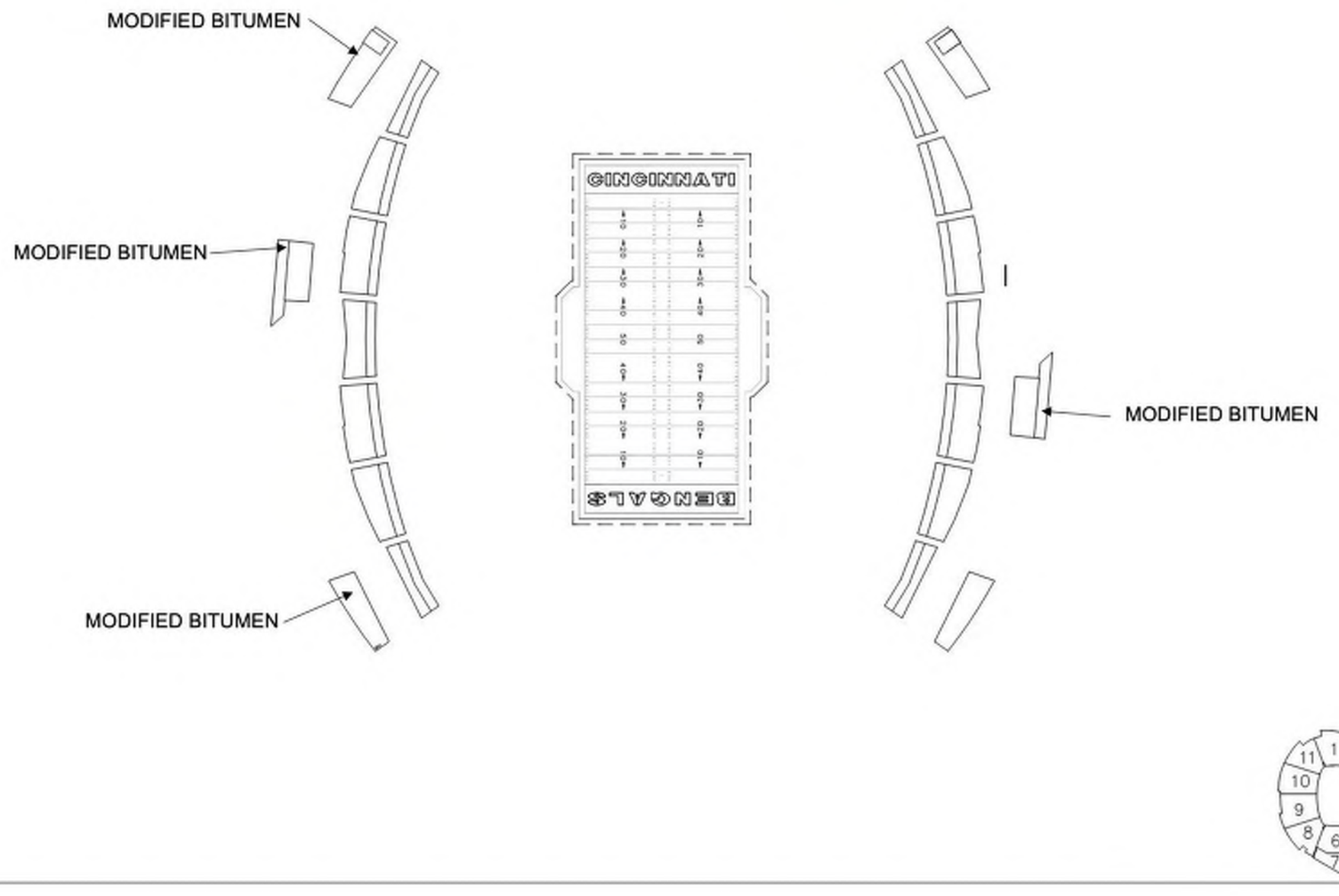
All roofs on this level are protected membrane u.o.n.





700 – Upper Concourse

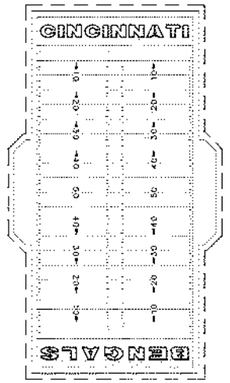
All roofs on this level are EP membrane u.o.n.



900 – Misc. Areas

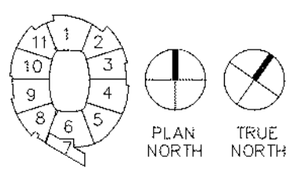
STANDING SEAM
(camera booth)

EP MEMBRANE
(scoreboard)



STANDING SEAM
(camera booth)

EP MEMBRANE
(scoreboard)



MECHANICAL, ELECTRICAL, PLUMBING & FIRE PROTECTION SYSTEMS

Mechanical, Electrical, Plumbing & Fire Protection

Mechanical

Glossary of Terms:

AC: Air Conditioning Unit
AHU: Air Handler Unit
BAS:Building Automation System
DX: Direct Exchange
FCU: Fan Coil Unit
HP: Horsepower
HV: Heating and Ventilating Unit
HWHX: Hot Water Heat Exchanger
PHX: Plate (and frame) Heat Exchanger
R-22: Refrigerant that has been phased out of use
VAV: Variable Air Volume Terminal
VFD: Variable Frequency Drive

The chilled water system, natural gas pipe, air handling units, and boilers were investigated for issues that might cause failure in the next 20 years. Most systems are in fair condition. Equipment upgrades and retrofits were performed in 2014 and included:

1. 25 new VFDs and Trane Controllers were installed on the AHUs to improve system efficiency.

2. Removal of electric heating coils in AHUs. Retrofit of existing chilled water coils to dual-temperature coils.

3. Four high efficiency boilers installed on the service level to provide on demand domestic hot water, and hot water to the water coils in the AHUs on the service level.

4. Replacement of the electric heating system in the Club level to hot water heating boilers and coils in the AHUs.

5. Spray foam insulation applied to the bottom of the concrete floors of the Club level.

6. Demand control applied to the Club level kitchen exhaust systems.

7. Installation of an Energy Recovery Ventilator for AHU-S-7, which serves the visiting locker room, maintenance locker room, and break areas.

8. Installation of AHUs to provide cooling to the Electric Switchgear Room.

9. Flushing of the chilled water plate and frame heat exchangers to improve efficiency.

Chilled Water System

Observations

The chilled water system is original to the stadium and is still functioning properly. Chilled water is purchased from the district for most of the cooling in the facility. District chilled water is sent through 2 plate and frame heat exchangers (PHX-1 and PHX-2) where a second stadium chilled water loop exchanges heat with the district chilled water. Stadium chilled water is distributed from the heat exchangers by 3 variable speed 100 HP centrifugal pumps (CHP-1, 2, 3) and sent to the AHUs throughout the facility. Maintenance on the chilled water system is focused on the heat exchangers and the main pumps on the stadium side.

The heat exchangers and pumps are operating in good condition but are showing signs of wear. All 3 pumps have seals that are leaking, leaving glycol residue around the pumps and reducing pump performance.

Stadium chilled water pumps with glycol residue from seal leakage

Pipe flanges at various points in the system are leaking. Chilled water that leaks from these flanges are creating mold in the pipe insulation, and possibly corroding the pipe below the insulation.



Pipe insulation mold and damage from water leakage at pipe flanges

Service Level

Air Treatment Observations

There are 9 AHUs on the service level and all are original to the facility, where they serve all conditioned spaces except for the clubs and suites. Originally, they utilized chilled water coils for cooling and electric resistance heating either inside the unit or via an external heating and ventilating (HV) unit. In 2014, the electric resistance heaters were removed, and the coils converted to dual temperature coils. These coils have the ability to run in either heating or cooling mode. Where the heating was external to the AHU via HV units, new hot water coils were installed into the HV units leaving AHUs as-is.

As part of the 2014 AHU coil retrofit project, the water control valves were inspected and either the actuator was replaced or the valve and actuator were replaced. Below is the current status of the AHUs and the control valves:

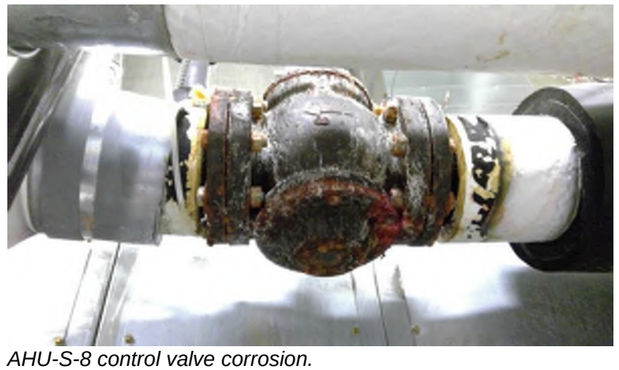
- AHU-S-1: Functions properly. VFD and control valve replacement in 2014. Still utilizes electric reheat.
- AHU-S-2: Functions properly, but the chilled water control valve does not fully close. The maintenance staff must actuate isolation valves on the chilled water line to reduce flow through the chilled water coils when cooling demand is low. VFD and separate hot water coil introduced in 2014. Leak at chilled water coil connections causing corrosion and glycol residue. Hot water control valve functions properly.


Chilled water leak at AHU-S-2 coil connection

- AHU-S-4: Functions properly. VFD installation and control valve replacement in 2014. Leak at ceiling level causing major corrosion at bottom of AHU shell.


AHU-S-4 shell corrosion

- AHU-S-5: Functioning with manual operation. Control valve is stuck closed, so automated operation is not possible. Currently maintenance staff operates the AHU coils as either fully open or fully closed via a manual valve, which can lead to discharge air temperature fluctuation. Control valve actuator replaced in 2014 but suspected to be undersized by maintenance staff. The valve actuator is scheduled to be replaced in late 2021 by maintenance staff. Leak at coil connection causing corrosion and glycol residue.
- AHU-S-6: Functioning with manual operation. Control valve is stuck open, so automated operation is not possible. Currently maintenance staff operates the AHU coils as either fully open or fully closed via a manual valve, which can lead to discharge air temperature fluctuation. Control valve actuator replaced in 2014 but suspected to be undersized by maintenance staff. The outdoor air damper actuator has failed, so maintenance staff has kept the damper open. The outdoor air damper and chilled water coil valve actuators are set to be replaced in late 2021 by maintenance staff. Leak at coil connection causing corrosion and glycol residue.
- AHU-S-7: Functions properly.
- AHU-S-8: Functions properly. Control valve is original to unit and heavily corroded. Leak at coil connection causing corrosion and glycol residue.


AHU-S-8 control valve corrosion.

- AHU-S-9: Functions properly.
- AHU-S-10: Functions properly.

AHUs are equipped with VFD fan motor control, which were either original to the unit or had one installed in 2014. The VFD's are still operating properly.

Some AHUs have HV units in series for high outside air demands. Below is the current status of these units:

- HV-S-1: Functions properly, hot water coil installed in 2014.
- HV-S-2: Functions properly. Leak at coil connection causing corrosion and glycol residue.
- HV-S-3: Functions properly.
- HV-S-4: Functions properly.

Other portions of the facility utilize fully contained or split system air conditioning units (AC), where a refrigerant is used instead of chilled water. All of these units are original to the stadium and are close to their end of life or do not function. Because most of these units utilize R-22, we recommend replacement to meet EPA requirements (final R-22 phase-out began in 2020. R-22 is currently available but new R-22 is not being manufactured or sold).

Natural Gas and Boiler Observations

Natural gas enters the building in the North boiler room into a fenced area that separates it from the other building utilities. The piping and meters appear to operate properly.

Natural gas entry into building

The natural gas piping throughout the stadium is painted carbon steel pipe and, in most cases, shows no deterioration.

Uncorroded natural gas pipe.

Where the natural gas pipe has encountered water on the outside of the pipe, corrosion is visible and sometimes extensive.

Natural gas pipeline corrosion due to water leakage onto pipe exterior. Damage to other exposed metal is evident, indicating external sources of water onto the pipe. Another indication of an external source is the white streaking down the duct shown in the lower right of the image.

The corrosion shown above is at the ceiling just outside of the chilled water mechanical room in sector 1 of the service level. The damage to pipe and duct in this room is extensive, where water from the ceiling has corroded pipe and duct throughout the room. Maintenance staff states that during heavy rainstorms, water leaks through the stadium structure throughout the stadium. Corrosion found in other areas indicates that this is the case. Below is an image of corroded garage exhaust duct that is close to the wall.

Corroded exhaust duct in sector 2 of the service level. Corrosion is external to the duct and close to areas with contact to the wall of the stadium.

Over time the external corrosion to pipe and duct from water leaking through the facility will cause leaks in the pipe and duct themselves.

There are 3 boiler rooms on the service level with two redundant boilers in each room that operate in parallel each. All 6 boilers were part of the 2014 upgrades to the facility. Currently all boilers function properly, although some minor issues were found.

- The domestic hot water skid HWHX-3 that uses heat from the field heating boilers in Sector 11 has glycol leaks from the pump seals and at the heat exchanger connections.

- Corrosion and scale are accumulating on Boiler #3 in the South Boiler Room (Sector 8). The damage is minimal.

Corrosion to boiler and flue from water accumulation

Controls for boilers are unique and proprietary to Thermal Process Solutions (TPC, Dave Johnson). Local users are able to change setpoints, but cannot access the logic related to setpoint control. Traditionally, the staff at PBS must contact Thermal Process Solutions if any changes to the boiler operations are desired.

Main Concourse

There are several AC units serving individual spaces that required conditioning (e.g. Nurse's Station, Elevator Equipment Room). The units are original to the building and utilize R-22. Maintenance staff at the facility have kept the units running and filters are replaced at least once a year. Local wireless controls have inconsistent communications to field controls and air handlers. When communications are online, the systems work well, however when communication is down spaces are not properly conditioned.

Kitchen hoods in the main concessions on both the east and west side of the stadium are served by a single exhaust fan each (KX-MC-1 & 2). The fans are original to the building and receive maintenance as needed. The exhaust hoods to these kitchens are cleaned by a contracted company on a regular basis. There are 2 main shutoffs for each fan, at the fan and at one of the kitchen hoods via a master switch. These master switches are immediately next to the individual hood shutoff switch and can be mistaken for one another. If this master switch is shut off, no kitchen hood can receive the necessary exhaust flow.

Plaza Level

<u>Air Treatment Observations</u>

There are 2 AHUs that serve the plaza level suites and the connecting hallways:

- AHU-P-1 (East): Functions properly, small leak at coil connection.

Leak at coil connection of AHU-P-1

- AHU-P-2 (West): Functions properly, new control valve. Minor glycol leak from valve stems and minor insulation wear.

Minor insulation wear and glycol leak at coil connection of AHU-P-2

Each suite has a local thermostat that controls a fan powered Variable Air Volume terminal (VAV). The VAV regulates airflow to the spaces and uses electrical resistance heaters to heat the space during cold weather. These electrical heaters are fixed or replaced when broken.

Club Level

Air Treatment Observations

The Main Club is conditioned from a group of Upper Level air handlers.

Destratifications fans were added in 2014 to assist with space temperature control in the main clubs. General space temperature in the main clubs have been recorded to 68 °F during a winter game day. There are still issues with cold air infiltration when sliding doors are opened.

It was reported during the walk through the previous supplementary electric heaters used in this space are no longer necessary.

The kitchens that serve the Club level spaces have makeup air heating coils that were retrofitted with hot water connections in 2014. Both coils (HVB-CB-1 and 2) are functioning properly.

Mid Suite Level

Air Treatment Observations

The Club Suites receive conditioned air from the Upper Level AHUs. Each suite has a local thermostat that controls a VAV, which regulates airflow to each space. Before the Upper Level AHUs had heating capabilities, the VAVs utilized electrical resistance heaters to reheat the space during cold weather. These electrical heaters are still in place. The VAVs are fixed or replaced when broken.

Upper Suite Level

East and West Boiler Rooms

In 2014, four boilers were added to provide hot water to the air handlers in the upper concourse mezzanines.

West Boiler Room:

Both boilers and the hot water pumps are functioning properly, supplying hot water to AHU-UL-9 through AHU-UL-16. Boiler #9 has condensate dripping down the exhaust stack, and the pump seals are leaking glycol. The leakage at the pump seals is considerable and will cause damage to the pumps. Both items should be corrected.

There is a fan coil unit (STX-US-2) combustion air fan that appears to be off and may need to be recommissioned. Currently boilers use their supply fans to pull air from outside through a small transfer grille between the outside and the boiler room. Variations in air temperature and humidity decrease boiler efficiency.

East Boiler Room:

Both boilers and the hot water pumps are functioning properly, providing hot water to AHU-UL-1 through AHU-UL-8. The pump seals are leaking glycol. Pump seal leakage in the East Boiler Room is minimal but should be addressed.

There is a fan coil unit (STX-US-1) combustion air fan appears to be off and may need to be recommissioned. Currently boilers use their supply fans to pull air from outside through a small transfer grille between the outside and the boiler room. Variations in air temperature and humidity decrease boiler efficiency.

Fan Coil Unit STX-US-1 inside the East boiler room

Air Treatment Observations

The upper suites receive conditioned air from the Upper Level AHUs. Each suite has a local thermostat that controls a VAV, which regulates airflow to each space. Before the Upper Level AHUs had heating capabilities, the VAVs utilized electrical resistance heaters to reheat the space during cold weather. These electrical heaters are still in place. The VAVs are fixed or replaced when broken.

Upper Concourse

Air Treatment Observations

There are 16 AHUs on mezzanines in the upper concourse level that serve different spaces in the club and suites areas. Each mezzanine holds 4 AHUs that were originally chilled water coil cooling and electric resistance coil heating units. In 2014 these AHUs were converted to dual-temp water coils with a common changeover valve (from hot to cold or vice versa) per mezzanine. Stadium operations replaces AHU bag filters once a year and pre-filters twice a year.

Mezzanine in Sector 2:

- AHU-UL-1: Proper function, no visible leaks, control valve replaced in 2014 and operates without issue.
- AHU-UL-2: Proper function, no visible leaks, control valve is original to building.
- AHU-UL-3: Proper function, control valve is original to building and leaks fluid from motor shaft.
- AHU-UL-4: Proper function, minor leak at coil connection, control valve is original to building and electronics are exposed.

Mezzanine in Sector 5:

- AHU-UL-5: Proper function, no visible leaks, control valve replaced in 2014. There is duct insulation damage at the discharge air duct.

- AHU-UL-6: Does not function properly, no visible leaks, control valve replaced in 2014 and permits unmetered flow. Maintenance staff currently uses isolation butterfly valves to reduce flow through the coils. Runaway heating is felt in the spaces served during winter months.

Butterfly valve almost completely closed to reduce flow through AHU-UL-6.

- AHU-UL-7: Proper function, control valve replaced in 2014 and leaks.

- AHU-UL-8: Proper function, control valve replaced in 2014; has significant leak collected in barrel. Insulation damage from leak is evident.

Major leak from control valve of AHU-UL-8

Mezzanine in Sector 8:

- AHU-UL-9: Proper function, no visible leaks, control valve replaced in 2014 and operates without issue.

- AHU-UL-10: Proper function, no visible leaks, control valve is original to building.

- AHU-UL-11: Proper function, control valve is original to building and leaks fluid from motor shaft.

- AHU-UL-12: Proper function, minor leak at coil connection, control valve is original to building and electronics are exposed.

- In the main dual temp coil serving the AHUs in Sector 8, there is evidence of a leak in the main.

Leak in the dual temp main in Mezzanine Sector 8. Rust coloring of insulation indicates possible pipe corrosion under insulation.

Mezzanine in Sector 11:

- AHU-UL-13: Proper function with new control valve. There is a leak at one pressure gauge connection.
- AHU-UL-14: Proper function with new control valve. Y-strainer is leaking.
- AHU-UL-15: Proper function with new control valve. Y-strainer is corroded and leaks glycol onto floor.
- AHU-UL-16: Proper function with new control valve, leak in pipe riser at coil connection.

Leak in pipe riser at coil connection of AHU-UL-16

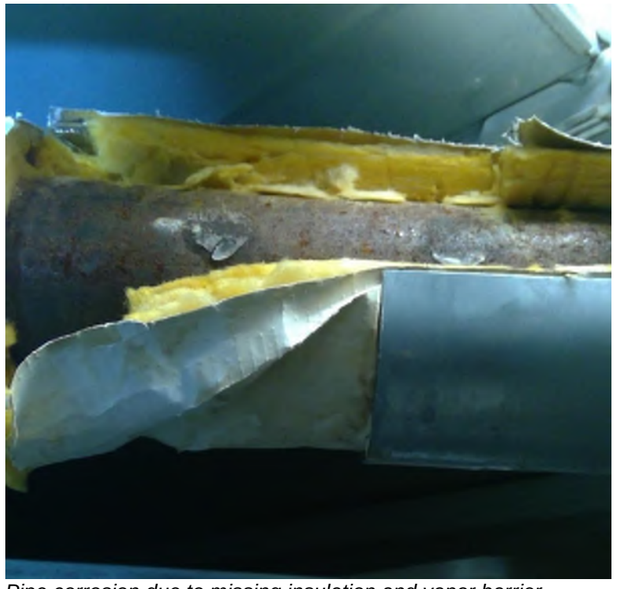
Damage to insulation may reduce heat transfer resistance. Pipe corrosion due to water leaks will eventually lead to local pipe failure.

In all AHU branch lines, a segment of insulation has been cut away for presumably testing purposes and has not been replaced.

Pipe corrosion due to missing insulation and vapor barrier. Water is condensing out of the air onto the pipe. Water will cause corrosion of the pipe over time.

Exposed pipe in dual temp main in mezzanine in sector 5.

Exposed pipe and valve flanges in dual temp main in mezzanine in sector 8.



Pipe corrosion due to missing insulation and vapor barrier

All piping should be reinsulated to preserve pipe longevity and energy savings.

There are 8 roof top units that supply conditioned air to the offices and concessions on the upper concourse. These units are original to the facility, have their filters replaced at least once per year, and have parts replaced upon failure. The units utilize R-22 and should be replaced via an acceptable phaseout replacement schedule.

RTU on roof in upper concourse

Most kitchen exhausts vent through the roofs in the upper concourse. A contractor cleans the ductwork from the kitchen hoods through the exhaust duct, fan, and vent. While the kitchen hoods are kept clean, a grease residue in the vents at the roof exists. Additional cleanup is required.

Elevator Lobbies

On each floor the elevator lobbies have a fan coil unit (FCU) that receives chilled water to cool the space. These FCUs sit above the ceiling and the drain pans are prone to overflow, causing ceiling water damage.

Aside from the service level elevator access, there are no heating units in the elevator lobbies.

Restrooms

Throughout the facility, restroom space conditioning and exhaust systems are original to the building. During the football season, exhaust fans are left on continuously. The makeup air for these restrooms comes in through opened doors or unconditioned space, making thermal comfort difficult. After football season, during the winter, the exhaust fans are manually shut off at the circuit breakers, and electric heating fan coil units are turned on to maintain temperatures above freezing. These units are controlled by a thermostat in each restroom. Game Day readings during the 2020 site visit found restrooms surface temperatures to be acceptable.

Vomitoriums

Vomitoriums between stadium seating and the outer walkway each have an electric fan coil unit in the ceiling. These fan coil units are fixed/replaced when complaints about lack of heat are reported (usually by stadium staff). Game Day survey found about 75% of the units operating and about 25% non-operating. Additional troubleshooting of the FCU is required.

Kitchens and Concessions

Kitchen and concession areas utilize electric heating fan coil units to maintain space conditions. These units recycle air in the kitchen, which allows grease to collect on the fan and electric heater inside the unit. Proper filtration and cleanup is required to prevent damage.

Stadium BAS

Most of the 2014 BAS system upgrade is working as designed. via the Trane Tracer system. The maintenance staff can use the BAS to identify/locate some issues, but through time some instrumentation and equipment data has become unreliable or disconnected. Current deficiencies include but are not limited to; schedules don't work and alarms can't be acknowledged. The staff must put things in override equipment to bypass these issues.

Parking Garage Exhaust System

The parking garages have exhaust fans that are controlled by carbon monoxide sensors placed throughout the parking garages. These exhaust fans are constant speed, not tied to the BMS, and only operate sporadically. The fans and the sensors are original to the facility.

Recommendations-Mechanical

Service Level

1. The district cooling chilled water plant plate and frame heat exchangers should be disassembled one at a time, fully cleaned, repaired, regasketed, reinsulated and put back into service. At that time, additional plates may be added pursuant to a further engineering study of stadium needs.

2. The sensors at the connections of the chilled water plate and frame heat exchangers should be calibrated to ensure proper controls.

3. The chilled water pumps should have their bearings and seals replaced, and total pump replacement should be considered in 5-10 years. Given the possible upgrades forthcoming as part of the Master Plan, larger pumps may be necessary.

4. Pipe flange gaskets should be replaced where they are currently leaking, and moldy/damaged pipe insulation replaced.

5. Diffusers and grilles should be thoroughly cleaned in all ductwork throughout the facility. Air filters should be replaced, and a replacement schedule should be created and enforced.

6. An air and water balance report should be commissioned for areas not included in 2014 work.

7. Natural gas pipe should be scraped, wire brushed and painted with a rust inhibitor product in areas where corrosion is present.

8. Additional local companies should be sought that understand and can assist with the Boiler PLC based controls in case TPC cannot assist with issues.

9. All R-22 DX air handling equipment should be put on a replacement schedule. Air conditioning units that do not function currently should be replaced with GHC and Low Ozone depleting units with modern refrigerants.

Main Concourse

1. Air conditioning units that do not function currently should be replaced with units that utilize modern refrigerants. All units should be placed on a regular filter replacement schedule. While the air conditioning units utilize outdated refrigerant, some are still functioning properly. Per industry standard, it is recommended that these units are replaced as they fail.

2. Kitchen exhaust master switches that are not local to the exhaust fan should be removed to prevent accidental shutoff by kitchen staff.

Plaza Level

1. AHU and VAV filters should be placed on a replacement schedule. VAVs should continue to be fixed/replaced as they break.

2. Both AHUs should have their CHWS/R pipe checked for corrosion under insulation at the coil connections. Extensive corrosion may require pipe replacements.

Club Level

1. Both HVB-CB-1 and 2 should be placed on a regular filter replacement schedule.

Mid Suite Level

1. VAVs should continue to be fixed/replaced as they break.

Upper Suite Level

1. Upgrade boiler controls with open source multi-vendor programming where possible. Provide additional staff training for owner directed changes.

2. Repair condensate leak on Boiler #9 before exhaust duct corrosion leads to boiler exhaust leakage inside the building.

3. In the East and West Boiler rooms, replace the hot water pump seals and place on a regular checkup/maintenance schedule. Consider full pump replacement in 5-10 years.

4. Re-commission STX-US-1 and STX-US-2 for combustion air duty.

Upper Concourse Level

1. Leaks in water pipe mains should be addressed and corroded pipe should be replaced.

2. Exposed water pipe used for heating or cooling should be insulated and covered in a vapor barrier. Corroded pipe from exposure should be replaced.

3. Roof top units should be placed on a regular filter replacement schedule. As these units break over time, they should be replaced with units that utilize modern refrigerants.

Elevator Lobbies

1. Where there are not heating units, heating units should be added or hot water coils added to FCU for better space temperature control.

Restrooms

1. Recommission or add additional heating to the restrooms, limit untreated outdoor air or add energy recovery system to the restroom groups where geography allows.

2. Exhaust fans should be connected to the BAS system and an occupation schedule should be implemented such that the fans only run during days of expected occupancy. This will reduce wear on the fan belts and motors, allowing the fans to last another 20 years.

Stadium Building Automation System (BAS)

1. Replace current BAS

Parking Garage Exhaust System

1. Exhaust fans CP-S-1 and CP-MC-1 should be placed on a testing schedule to ensure proper operation.

2. All sensors that activate the exhaust fans should be recalibrated and placed on a testing schedule.

3. Consider upgrading the CO monitoring system to current codes and standards including NO2 monitoring.

4. Based on the addition of new/calibrated sensors, the fans should have VFDs installed. This would allow for modulated flows based on sensor readings.

5. Parking Garage Exhaust study should be commissioned, and additional recommendations made. This should include both the fans and the sensors.

Electrical

Electrical Service Entrance

The 15kV medium-voltage service entrance is made up of two utility circuits served by Duke Energy. These two Duke Energy circuits, West End 01 (Meter #1080-50228) & West End 29 (Meter #1080-48757), feed into an automatic throw-over switching arrangements at a distribution primary service voltage of 12,470V. Power is delivered at the DP10 (Primary Service – Load Management) rider. Electricity is currently purchased through Dynegy at $0.0425/KWH through the CCAO program for Counties in Ohio.

Although the automatic throw-over switching arrangement is in place it is not currently enabled. Further it has been recommended that the system not be enabled without a complete documentation for procedure and testing of operation by the facilities electrical testing services provider. The Local Utility, Duke Energy, charges PBS extra to maintain "End User Selectable" dual feeds into the stadium through the Backup Distribution Point (BDP) Rider. Through negotiation the cost of this Rider has been reduced to $90,000 a year. This rate is reviewable by Duke Energy annually. Currently, Duke has asked for an increase in this rate due to peak usage changes in 2021.

Medium-Voltage Distribution

The 15kV medium-voltage service entrance circuits are terminated to a main-tie-main service entrance switchboard with power circuit breakers as well as metering equipment for both the utility (entrance side) and facility (customer side). This switchgear is in good visual inspection condition and manufactured by Eaton / Cutler-Hammer.

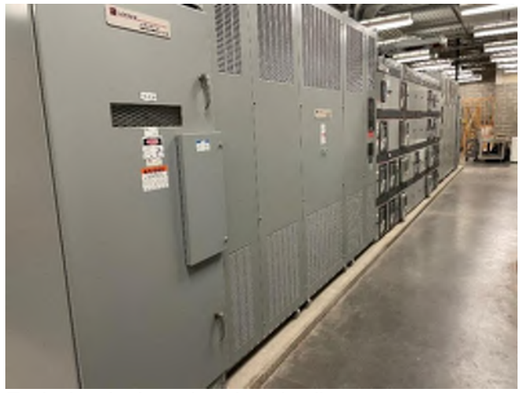
Medium-voltage service entrance main-tie-main and metering

The service entrance equipment feeds to 15kV metal-enclosed switchgear for each main distribution. These two switchgears each feed to one side of each of four primary fused switches on serving close-coupled substation lineup. The switchgear lineups are Eaton as well along with the entirety of all original construction power distribution panels, panelboards, and low voltage transformers.

Low- Voltage Distribution

The substations serving the stadium are Eaton / Cutler-Hammer fused medium-voltage switches protecting dry type transformers with power circuit breaker secondary protection. The distribution and tie breakers are also power circuit breakers, and all have digital trip units.

The substations are in visually good condition, are clear of debris and stored materials. Spare breakers are in every substation along with spare spaces. All spares are "racked out" meaning they are not electrically connected to the substations copper bussing.



Typical main-tie-main substation lineup

Metering is on incoming secondary only and displays instantaneous, demand, and peak loading along with power factor and power quality data for frequency and distortion.

Typical substation main meter

The substations are located on the Service or Field Level and the same rooms contain that levels distribution panels, some panelboards, and the emergency distribution. This distribution is also almost entirely Eaton / Cutler-Hammer Pow-R-Line.

Concession Power

Concession power is part or the low voltage distribution but is of note as the poorest condition equipment in some stands where adjacent to cooking, prep, and service areas. This is due to grease, concession worker access, and other factors that have resulted in damaged covers, broken locks, corrosion, grease covered circuit breakers, transformers with unknown condition of windings and ventilation.

While, generally, the low voltage distribution equipment is in good repair and having few issues to resolve, this is an area that should have attention paid during all renovations, reconfigurations, and for remediation / replacement as capital projects over the upcoming years.

Emergency Generation and Distribution

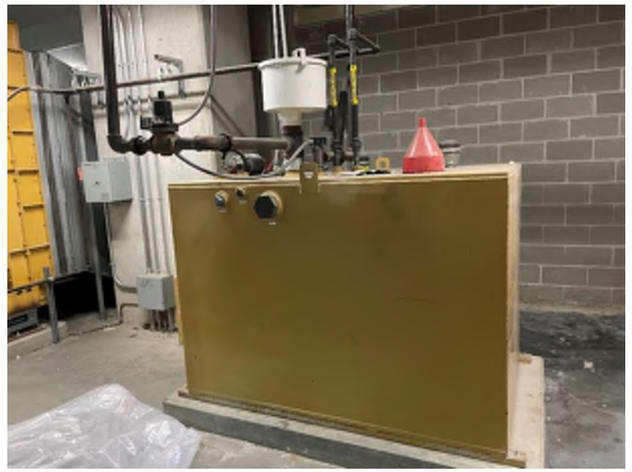
The facility emergency power system is comprised of a 2400V, 1825KVA/1500KW generator set delivering 5kV class power to emergency power distribution in each quadrant / electric room stack as well as the fire pump. The 2400V is transformed to 480V at the service level substation rooms and a power distribution panel in each room feeds panels on levels above. At each level above, power is transformed to 208/120V on each level as needed as well.

1500kW generator

The generator itself is in good condition and is maintained by a service company. One known issue is that the controller for the generator is obsolete and cannot be replaced but will need an upgrade. This work should be prioritized to prevent an extended delay in restoration of emergency power should the controller fail.

Generator distribution breakers to substations and fire pump

The fuel oil tank is in the generator room and is double-walled. The fill line is routed to the stadium exterior, inside the fencing. The tank is in good visual condition.



Generator day tank

Typical emergency transformer, ATS, and distribution panel

Grounding

The electrical system grounding is in good condition and no damage or known issues exist. The system should be verified with impedance testing as part of a mid-life testing and evaluation project.

Transformer grounding has had issues over the years with copper theft of the grounding conductor ran externally over flexible conduit connections. Stadium trades have worked to resolve these as found but should be priority restoration for safety.

Fire Alarm System

The existing fire alarm system is in good condition with first quarter 2021 upgrades to a JCI/Simplex 4100-ES system. The head end and all nodes throughout the facility have been replaced with current hardware, software, and firmware upgrades.

The original building notification appliances (i.e. Speakers, strobes, speaker/strobes) and the original building initiation devices (pull stations, flow switches, tamper switches, etc) have not been upgraded or replaced with the control equipment upgrades. The notification devices and initiation devices are in good condition and are currently still supported by the manufacturer.

The strobes in the building prior to the head end equipment upgrade were not synchronized. The Authority Having Jurisdiction (AHJ) has noted during inspections that non-synchronized strobes can be seen (i.e. the bowl). The 4100-ES panel has the ability to synchronize the strobes for the entire facility, but it is not programmed to carry out this feature at this time.

Maintenance and Testing

The electrical system is contracted for preventative maintenance on a 5-year cycle with medium-voltage on year one and each quadrant from service level to catwalk on each of years 2-5.

It is recommended that this work continue and be evaluated for any additional services that may be beneficial in the next contracted phase including more advanced testing procedures, re-labeling and reporting on any panels needing revised schedules, etc.

Observations

Service Level

Electric rooms are generally clear of materials that are not intended to be stored there. Rooms are clean and adequately ventilated.

The density of electrical distribution equipment is located on this level due to the service entrance, substations, and main distribution panels are located on this level.

Many panels are lacking on breaker spaces due to added loads over the years, but few are at or near capacity based on ampacity. This is due to the energy initiatives that have reduced loading on much of the lighting and HVAC systems. Some spaces could be freed up by determining where loads have been removed and potentially combining some circuits where loading has been reduced to a level adequate for a single feed. Additionally, many of the electrical rooms have free space on walls that would allow for sub-panels to be installed to add physical capacity where ampacity is available.

The lack of metering below the substation level makes evaluating these panels for loading difficult, often requiring 30-day demand metering. This is not difficult but the nature of the facility and the limited season and hours of use make it an impossibility during the NFL offseason. Historized metering would be a potential solution except would likely be cost prohibitive to expand to the panel level in each electric room.

Main Concourse through Upper Concourse Level

The electrical distribution in these areas is generally all in good condition with the noted exception of some concessions panels.

Catwalk

The power panels on the catwalk feed the field lighting, supplementary down lighting for seating in upper seating levels, subwoofers serving the audio system and a few miscellaneous loads. These panels are in a condition to be expected after 20 years of outdoor service under cover. There is surface corrosion, and the paint has begun to oxidize but are generally in good condition.

The panels on the catwalk are currently being unloaded as the field lighting is retrofitted to LED.

Recommendations-Electrical

General Facility

1. An update to the facility arc flash program is recommended. This should be conducted every 5 years or as an ongoing process when changes occur. The existing study is approximately 10 years old.

2. A procedure document on circuit switching the utility should be produced with input from, and coordination with, Duke Energy. There are requirements for notification so that the utility can ensure stability during the transition. Of more importance is the need to ensure any staff executing the changes is following the safest procedure to prevent a catastrophic electrical failure event. As well, it should be considered to modify the controls to allow switching from outside the room for added personnel protection.

3. Labeling corrections should occur where panels are incorrectly labeled. This is a relatively small issue with a few panels but makes finding the upstream source difficult. This could be problematic in a gameday scenario when quick responses are required.

4. Where NFL power is needed for higher production games such as Monday Night Football, there is power needed for various equipment such as skycams. This requires the temporary installation of cabling that is routed in a way that is difficult to install and not ideal with regards to strapping and fan access. Permanent power is recommended in locked boxes.

5. Cabinet heaters should be audited for their circuit source and separated where found to be on the wrong circuits or circuit types. An example is a lobby cabinet heater on a lighting circuit where the loading is excessive and has the added problem of being controlled off by the lighting panels resulting in under conditioned spaces.

6. Provide programming upgrades to the fire alarm system to ensure that all strobes in the entire facility are synchronized and all flash simultaneously.

Service Level

1. ARMS (Arcflash Reduction Maintenance System) is a newer technology and is required on new qualifying installations. The stadium has a high available fault current and retrofitting this to the substations would reduce the overall arc flash risk for electricians and other qualified workers.

2. Testing the medium voltage cabling and distribution equipment should be considered. This will help verify switchgear and cabling dielectric values are in spec and no equipment or cabling needs replacement.

3. Add metering to main distribution panels to track loading and demand on the system. This information is also required for all permitted work to justify added loads.

4. Commission substation transformer cooling systems. These fans and controllers were never wired at original construction. The relatively low loading on the substations have made this a lower priority issue but summer temps can be high in these rooms and cooling will ensure a longer life.

Non-functioning substation transformer cooling controls

5. Revise controls of heat trace in substation rooms as well as other areas where circuits exist. Tie into BMS with trending on power consumption and alarming when sudden changes indicate a failure.

Main Concourse through Upper Concourse Level

1. Add metering to main distribution panels to track loading and demand on the system. This information is also required for all permitted work to justify added loads.

2. Concession panels and transformers should be evaluated for replacement when found in poor condition.

Catwalk Level

1. Eight (8) existing outdoor panelboards, and four transformers, should be inspected during lighting replacement and after for condition, gaskets, and all openings being covered. Replace or add covers, gaskets, etc. as needed.

Exterior

1. Approximately six (6) exterior boxes for media trucks, of varying ampacities, should be cleaned, tested, and replaced when in found in poor condition. Visual inspection shows gutters with debris but adequately maintained mechanical connections and operators.

Exterior broadcast truck power panel with debris and uncovered openings

Plumbing

Sewage Pumps

1. Sewage Pumps (approx. 7' x 7' x 16') are in the North and South MER. The sewage pumps and lift rails are original while the controls have been upgraded. The equipment appears to be working but the sequence of operation of the upgraded controls is uncertain. Recommissioning/Training is required.

Rusted sewage pump rails

Sewage pump control panel

Domestic Water Heaters

1. North and South Domestic Storage Tanks were replaced in 2017 and 2018 and appear to be in good working order. The staff indicated there are water quality issues with the existing system; a water filtration system may be required and is discussed in the recommendations section.

2. Main kitchen water heaters are in need of repair or replacement. Heaters in both kitchens show corrosion around the bottom and water leaking out. Both heaters were replaced in 2017.

Main kitchen water heater

Domestic Water Pumps

1. North and South stadium domestic water booster pumps, controls, and valves are original.

   a. The PRV's show evidence of leaking, indicating failing seals.
   b. One pump/motor appears to be running poorly.

Domestic water pumps

Water Softeners

1. During the 2014 water heating upgrade, it was discovered that the original water softeners were no longer in operation.
   a. A new chemical free No-Salt water conditioner was installed on both domestic hot water heating plants via the cold-water inlet to the domestic hot water system.
   b. There is concern that the No-Salt system is not working but a recent water quality study indicated the film coating the HTX plates was zinc based, not typical water scale. The interior of the glass lined domestic water storage tank appeared to be clean. Further investigation is needed to resolve this issue, but our current belief is that water filtration may be needed to remove the residue permanently. See domestic water recommendation later in this report.

Water conditioners

Backflow Preventers

1. Building city water backflow preventers were rebuilt in 2019. Valve internals were replaced with plastic parts.
    a. The BFP's are tested on annually consistent with the Greater Cincinnati Water Works GCWW requirements.


Building backflow preventer (Rebuilt in 2019)

2. Irrigation backflow preventer (BFP-4) currently discharged into a bucket.
    a. Check seals and repair BFP.


Irrigation backflow preventer

Floor Drains

1. Floor drains, throughout the stadium, were generally in good condition.
    a. Some grate covers were rusted and collecting debris and should be cleaned to correct water flow.
    b. In a few location concourse area drains are "bulged" from water collecting and freezing under the grate. These conditions should be fixed to prevent tripping and encourage proper drainage.


Bulged concourse drain cover

Piping / Insulation

1. Waste and Vent Piping
    a. In general, the sanitary, storm, waste, and vent piping is in acceptable condition and will last another 20 years in the stadium. Exceptions to this condition are listed below with examples.
    b. In areas where the piping was exposed to moisture or leaks, the piping had surface rust present as seen in the image below. As this piping was observed from the ground, the extent of the top rust could not be determined.
    c. There have been cases reported where sanitary piping has ruptured along the top of the pipe causing sewage to overflow out of the pipe during peak usage. We believe that this may be due to "super flush" conditions inside the stadium causing higher than design flows in the sanitary piping.
        a. The pipe size can be recalculated for super flush conditions reducing diversity and increasing pipe size - this would alleviate this issue.


Rusted steel piping (Fire Line)

2. Copper Piping
    a. There are minimal areas showing corrosion on the exterior of the piping. It is assumed that the inside of the piping may be worn due to the presents of rust in the system.

b. Over time this worn piping will develop pin holes or burst. Most of the copper piping is installed in wall or exposed in finished spaces.

3. Steel Water Pipe

a. The galvanized coating inside all of the cold water piping has deteriorated over the years, and now the piping is oxidizing at an accelerated rate causing rust colored water to be present at every fixture.

b. Currently the maintenance staff is flushing the entire cold water piping system before events.

c. Pipe replacement and water filtration is recommended to assist in removal of the rust in the system.

4. Insulation

a. All exposed piping is insulated with fiberglass insulation. In some areas PVC jacketing has been installed to reduce deterioration of the fiberglass insulation.

Concessions/Prep Kitchens

1. Over time or due to freezing, some water pipes have failed, been capped, abandoned, and rerouted causing dead legs in the system.

a. All of this piping is served from the floor below, fed-up through the floor into walls or piping chases that have walls in common with exterior unconditioned space.

b. Due to capped and abandoned lines it has become a challenge to shut-off and turn on water to these areas not knowing which valve serves active, broken or abandoned lines.

2. Water is seeping between floor slab and drains during wash down/clean-up of the areas leaking into spaces below.

3. Floor mounted grease interceptors, the basins of all the grease interceptors show major deteriorated and rust. Many have completely rusted through and grease latent water is present on the floor under the interceptors.

Floor mounted grease interceptor

Main Kitchens

1. Grease Interceptor

a. The grease interceptor was replaced and moved from an in-floor mounted interceptor to a suspended below grade interceptor. The relocation of this interceptor has presented challenges for cleaning and general maintenance of the device. The interceptor is located approximately 40 feet above grade. The ceiling was cut open to allow access to the interceptor, but the opening was not cut large enough to allow access to the top of the device.

b. The interceptor was installed directly below the existing floor opening. It is recommended that the floor above be cut open, side extensions installed on the interceptor and a metal hatch installed to give access to the top of the device.

Suspended grease interceptor

2. Natural Gas Piping

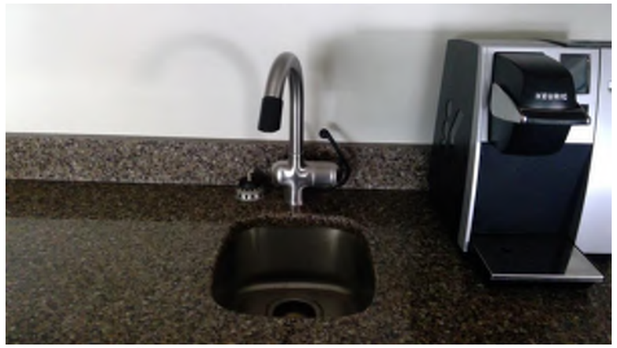
a. Main gas piping appears to be in good condition throughout the kitchen area.
b. Piping and equipment should be cleaned on a regular basis to extend life and prevent fire spread.

Club Suites

1. Discolorations on ceiling tiles indicate building or pipe leaks are present above the ceiling.

2. Plumbing fixtures are original and in good condition due to limited use.

3. Parts may be limited on discontinued fixtures, and upon failure should be replaced with newer equipment. Should aesthetics play a factor, such as in a premium space, consideration should be given to replacing all fixtures for a consistent appearance.


Discontinued fixture

Public Restrooms

1. Bathroom fixtures were generally observed to be in good condition.
2. Most public restrooms have pipe chase walls in common with exterior spaces. Freezing has always been an issue with the water systems at the stadium.
   a. Access panels have been added to repair behind-the-wall ruptures.
3. Flush valve water closets and urinals are predominately used throughout the stadium.
   a. The water closets are rated at 3.5 gallon per flush.
   b. Urinals are 1.0 gallon per flush.
4. Manual single lever faucets are used.
   a. Faucets are equipped with low flow aerators with 0.5 GPM rating. Multiple spray patterns were observed.


Areas where block has been removed to repair burst water piping

Recommendations-Plumbing

1. Sewage Ejectors
   a. Provide phased replacement of sewage ejector pumps within next 10 years keeping one pump running during repair of duplex pump. Keep system up and running during repair.
   b. Recommission controls; provide onsite training.
2. Domestic Water Heaters
   a. A recent water treatment study found a coating of film lining the plate and frame heat exchangers serving the domestic water heaters. Chemical testing indicated a higher than expected level of zinc potentially from the galvanized piping in the stadium. It appears that the hot water recirculation loop returns contaminated water to the heat exchanger loop and leaves a residue on the Plate and Frame equipment. The recommendation is to install passive water filtration systems near end users of the domestic water and filter out impurities in the system prior to use.
3. Domestic Water Booster Pumps
   a. A phased replacement of the booster pump package should be considered within the next 10 years. Technological improvements in this equipment have allowed new booster pump packages to come standard with stainless steel pumps, headers and VFD's. The system should be replaced during stadium downtimes.
4. Backflow Preventers
   a. Investigate reason for BFP condition on irrigation BFP, repair, or clean seal on BFP-4 drain. Or replace with double check backflow preventer without drain. A reduced pressure type backflow is not required at this location.
5. Floor Drains
   a. Clean and repair various floor drains throughout the stadium.
6. Sanitary Waste and Vent
   a. It is recommended a full study of the sanitary system be performed to determine the issue.
   b. Replace existing piping with PVC waste pipe in areas of concern.
7. Kitchens
   a. Replace all damaged and deteriorated grease traps and fixtures.
   b. Suspended Grease Intercept was installed directly below the existing floor opening. It is recommended that the floor above be cut open, side extensions installed on the interceptor and a metal hatch installed to give access to the top of the device.
   c. Seal wall and floor penetrations in prep kitchen with epoxy coating to prevent leaks into ancillary spaces.
8. Public Restrooms
   a. Provide limited heating or insulation into exterior chase walls to prevent cold weather freezing of piping in trouble zones in the stadium.
   b. Increase or provide better access into plumbing chase walls for long term repairs.
   c. Decrease urinal flush volumes to decrease the super flush conditions during game day and event schedules.
      i. Current EPA WaterSense standards are 0.5 gallons per flush (GPF) for urinals.
      ii. Reduced flushing saves water and decreases the load on the sanitary system that has experienced issues in the past.
   d. Decrease water closet (toilet) flush volumes to decrease super flush condition on game days where possible.
      i. Current EPA WaterSense standards are 1.28 GPF for toilets single or double throw.
      ii. Reduced volume saves water and decrease the load on the sanitary system.
9. Southeast Service Tunnel
   a. Reports of sewage smells at random times. Smells travel into offices.
   b. It is recommended a full study of the sanitary system be performed to determine the issue.
10. Bowl seating storm drains
   a. Storm drains at the front row seating area are getting clogged from food and other debris causing a build-up of water.
   b. Drains and grates need to be cleaned and repaired. Screens need to be added to the grates to limit the inlet of peanuts and other larger debris.

Fire Protection

Paul Brown Stadium fire protection water is provided through two fire pits on the property. The North Fire Pit has two fire mains, and the South Fire Pit has one fire main; all have tamper switches on OS&Y control valves that provide status to the fire alarm system. One 8" Fire Main enters the building in Sector 8 Column #36.2, and the two additional 8" Fire Mains enter the building in Sector 1 Columns #1/#2. These fire mains create a loop around the service level of the stadium and provide water to the Fire Pump (750 GPM/70 PSI) located in Room 0.10.35, Sector 10. Wet, Wet with heat trace, Dry Pipe, Clean Agent, Ansul, and Pre-Action fire suppressions systems protect the stadium. In general, all wet fire suppression piping is Schedule 40 black carbon steel while the dry pipe fire suppression systems are Schedule 10/Schedule 40 galvanized piping with Victaulic fittings. Sprinkler heads are Central and Viking Style heads. Tamper switches, flow switches, fire department connections, and hose valves are manufactured by Potter. Inspections are performed monthly on fire pits, bi-annually for dry pipe systems and annually for Ansul and pre-action systems. The water system pressure after the fire pump is 150 PSIG and the dry system pressure is 50 PSIG for this installation. Recent repairs on the fire system tend to be on the dry pipe piping. The latest repair procedure has been to keep 10'-6" sections of galvanized pipe in stock and replace as needed. In addition to pipe replacements on the dry system, many end of main drip legs and gate valves have been repaired or replaced with ball valves where freezing has occurred.

Stadium management provides annual budgets for the maintenance (contracts) and upkeep of all fire suppression systems.

Observations

Sprinklers & Testing

NFPA 25 -2014 Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems states that:
5.3.1.1.1.3 - Sprinklers manufactured using fast-response elements that have been in service for 20 year shall be replaced or representative samples shall be tested and then retested at 10-year intervals.

- This sprinkler type is not in use at Paul Brown Stadium.

5.3.1.1.1 - Where sprinklers have been in service for 50 years, they shall be replaced or representative samples from one or more sample areas shall be tested.

- The standard response wet sprinklers installed at the stadium are not required to be tested until 2050.
- Visual observations of these sprinkler types found them to be in good condition.

5.3.1.1.1.6 - Dry pipe sprinklers that have been in service for 10 years shall be replaced, or representative samples shall be tested every 10 years.

- The testing program was started in October 2020 on this schedule.
- Four dry pipe sprinkler head were sent out for testing and found in acceptable condition.
- Visual observations of these sprinkler types found them to be in acceptable to good condition.

Paragraph 5.3.1.2 outlines an acceptable test procedure:

- A representative sample of sprinklers for testing shall consist of not less than four sprinklers or 1 percent of the number of sprinklers per individual sprinkler sample whichever is greater.

Service Level/Grade

Wet and Dry Fire Sprinkler systems protect the Service Level tenants as the space dictates. In conditioned space, a wet sprinkler system exists with wet branches, standard heads (concealed and semi recessed), and sectional control valves. These areas include but are not limited to Bengals team spaces, visitors team spaces, security, kitchen, Proscan MRI, lockers rooms and cafeteria. In unconditioned spaces, the dry sprinkler system provides coverage. These spaces include the service tunnel, egress ramps and parking garages. Most of the fire sprinkler system, equipment, and piping is in good working condition. However, the galvanized piping is deteriorating faster than the black carbon steel and requires more frequent repair and maintenance.

Fire Pump Room, Sector 10 Valve Room - Fire pump and Dry and Wet System Risers.

1. The fire pump located in this room is a Patterson Pump Co., Model 6 x 6 VIP, Serial No. FP-C-19644, 750 GPM, 70 PSI, 40 HP, vertical In-line pump with a 7.125" Impeller. The jockey fire pump is a Grundfos Model No. CR2-5OU rated for 10 GPM and 80 PSI. Both appliances are 460V/3PH. The pumps appear to be in good working order and are tested monthly and inspected annually. The main fire pump shows signs of having a bad seal that was repaired in the past, a fire pump replacement should be considered in the future.

Fire Pump with repaired bad seal.

2. Wet and Dry system risers Sector 10 1-9 are in this room and generally serve the Service Level, NW stadium zones, and ramps.
3. Coverage for these zones varies from 0.10 GPM/SF over 1950 SF to 0.15 GPM/SF over 1950 SF with a 250 GPM hose allowance.
4. All equipment appears to be in good working order with no replacements noted on these systems' components.

Sector 3 Valve Room - Dry and Wet system risers.

1. Wet and Dry system risers Sector 3 1-10 are in this room and in general serve the Service Level, NE stadium zones, parking garage and ramps.
2. Coverage for these zones varies from 0.10 GPM/SF over 1950 SF to 0.15 GPM/SF over 1950 SF with a 100 GPM hose allowance.
3. Two air compressors provide air to the dry system valves in this room and appear to be in good working order. The newer air compressor is rated for 5.5 SCFM at 90 PSI with a 30-gallon reserve tank.
4. All equipment appears to be in good working order with no replacements noted on these systems' components.

Sector 5 Valve Room - Dry and Wet System Risers

1. Wet and Dry system risers Sector 5 1-11 are in this room and in general serve the Service Level, SE stadium zones, parking garage, and ramps.
2. Coverage for these zones varies from 0.10 GPM/SF over 1950 SF to 0.15 GPM/SF over 1950 SF with a 250 GPM hose allowance.
3. Two air compressors provide air to the dry system valves in this room and appear to be in good working order. The newer air compressor is rated for 5.5 SCFM at 90 PSI with a 30-gallon reserve tank.
4. All equipment appears to be in good working order at this time, although it appears that two dry valves have been previously replaced (#10 and #11).

Replacement dry valve with new gauges and trim.

Sector 8 Valve Room - Dry and Wet system risers.

1. Wet and Dry system risers Sector 8 1-10 are in this room and in general serve the Service Level, SW stadium zones, and ramps.
2. Coverage for these zones varies from 0.10 GPM/SF over 1950 SF to 0.15 GPM/SF over 1950 SF with a 100 GPM hose allowance.
3. Two air compressors provide air to the dry system valves in this room and appear to be in good working order.
4. All equipment appears to be in good working order with no replacements noted on these systems components.

Bengals Weight Room

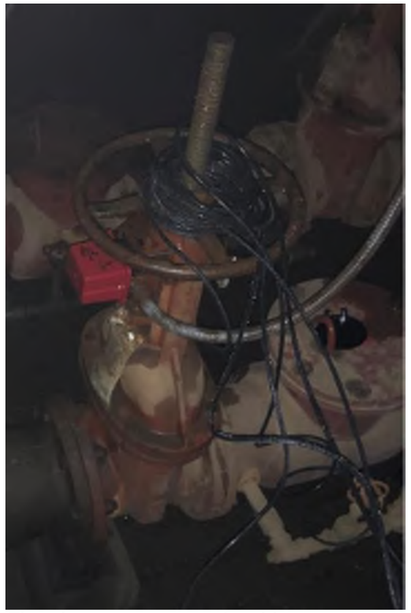
The weight room renovation from 2014 & 2015 converted a large storage room into the new Bengals Weight Room. The renovation extended and modified the existing wet sprinkler system in this area to new sprinkler heads and layout with piping above new ceilings which included integral drain pans that directed water infiltration to the side walls and down to grade. The piping above this ceiling is subject to degradation in this space from the water infiltration and it is hard to find until a leak occurs as it is hidden form sight. The pipe below was from a recent replacement. Other failures may continue to occur until leak remediation is complete.

Sprinkler pipe removed and replaced above Bengals Weight Room.

Fire Pit

1. Fire Pits are located on grade and appear to be in acceptable condition. They are damp and muddy, but no standing water is on the bottom of the pit.
2. In the past, floods have shorted out water-resistant tamper switches which have been replaced.
3. It appears that remote meter readers have been installed on the city water and fire protection meters. Cabling should be strapped together and moved out of the way of ingress and egress for better access and protect the cabling from damage in the future.

Fire pit remote meters & cables



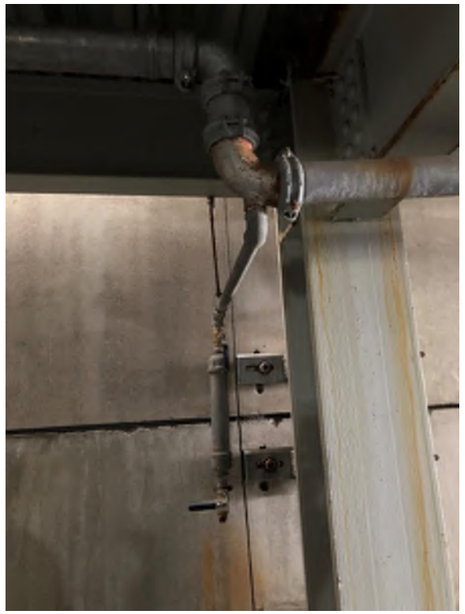
Fire pit remote meters & cables

Dry system drain, upgraded with ball valve. Ball valves are used to replace gate valves upon failures.

Upper Levels (Concourse, Plaza, Suites, Club Levels)

Wet and Dry Fire Sprinkler systems protect the upper levels of the stadium. In conditioned space, a wet sprinkler system with wet branches, standard heads (concealed and semi recessed), and sectional control valves is in use. These areas include but are not limited to Main Club, Club Level Suites, restrooms, and Press Boxes. In specialty rooms such as Scoreboard Control and Video Production, a pre-action or clean agent system is in use. In unconditioned spaces, the dry sprinkler system provides coverage; these spaces include open concourse, egress ramps and stairs. Most of the fire sprinkler system, equipment and piping are in good working condition. As with the lower floors, the galvanized piping is deteriorating faster than the black carbon steel and requires more frequent repair and maintenance. Dry system drains should be drained bi-annually and perhaps quarterly during cold weather. The upper drain should remain open to allow the header to collect condensation. Additional information on special areas and systems is included below.

Upper ball valve should be opened on dry system drains.



Corroded Victaulic fittings

Scoreboard Control Room (Jungle Vision)

1. The Scoreboard Control Rooms (Video Production and Scoreboard Control) are protected by a Pre-Action Fire Suppression system installed by Fyr-Fyter in 2000. The system consists of the following equipment:
    a. (2) Pull Stations.
    b. (1) Alarm Bell
    c. (1) Alarm Horn Strobe
    d. (6) Detectors
    e. (1) AutoPulse 442-D Control Panel.
2. The Sequence of Operations for the Pre-Action system operates as follows:
    a. A single detector sounds the alarm bell and sends a signal to the fire alarm panel.
    b. A second detector in an opposite zone will sound the horn/strobe and open the pre-action valve.
    c. A manual pull will immediately open the pre-action valve, send an alarm signal, and sound the horn/strobe.
3. The system is inspected annually.
4. The system is well maintained and in good working order and does not require upgrade or replacement at this time. System pressure logged at 100 PSIG water and 50 PSIG air side.

Pre-Action System & Air Compressor

Rack Room

1. A new room for high-end audio-visual equipment associated with Jungle Vision was built in 2014 from open concourse adjacent to the Jungle Vision room.
2. The dry sprinklers in this area were rerouted to provide space for a Clean Agent system installed in the Rack Room.
3. The Clean Agent System is an FM-200 system and includes the following equipment:
    a. (1) Notifier - Fire Alarm Control Panel RP-2002.
    b. (11) Photoelectric smoke detectors
    c. (2) Alarm bells
    d. (6) Horn strobes indoor, (1) outdoor
    e. (2) Abort stations
    f. (2) Pull stations
    g. (1) 600 lbs. of FM-200 Clean Agent stored in a single tank
4. The system is well-maintained and appears new although the room that hosts the equipment has collected equipment in front of the FACP and should be de-cluttered.

Clean Agent Storage Room Clearances

Kitchens and Concessions (all Levels)

Kitchen and Concessions are served by wet sprinkler systems in the spaces and Ansul fire protection systems for the cooking equipment. These systems were installed around 2000 and continue to operate today.

1. The equipment is in good working order and tested annually.
2. No reported failures or long-term issues have been reported with the fire protections systems in these spaces.

Recommendations-Fire Protection

Immediate Needs (Years 1-5):

1. Replace corroded and damaged dry sprinkler pipe around the stadium.
2. Repair small leaks in dry valve rooms and around the parking garage area.
3. Seal leaks that drip on fire protection piping (see other sections for leak narrative).
4. Provide cable management on remote meter readers inside fire pits to improve fire pit access.
5. Replace degraded dry system piping and collection drains; potentially create a deferred maintenance schedule to budget for replacements in Year 5-20.
6. Install protective guards over strobes in Visitor Locker Room

Intermediate Needs (Years 6-10):

1. Churn fire pump monthly and provide annual flow test to ensure compliance with NFPA requirements. Schedule replacement of fire pump prior to Year 10.
2. Replace fire system gauges every 5 to 10 years.
3. Provide dry sprinkler head test in Year 10.

Long Term Needs (Years 11-20):

1. Replace dry system air compressor between Years 1 and 19 until all are replaced.
2. Repair or replace heat tapes as it fails on piping outside conditioned spaces.
3. Study the long-term cost and feasibility to replace air based dry pipe systems with nitrogen-based system if maintenance cost escalates.
4. Provide wet sprinkler head test in Year 30 (2050).

STRUCTURAL SYSTEMS

Structural Systems

The evaluation performed at the stadium assessed the current visual condition of the structural systems and related components at Paul Brown Stadium. Interior and exterior structural elements throughout the facility, including the parking areas and walkways outside the stadium, were observed. The assessment was visual in nature and limited to readily accessible areas. No intrusive investigations were performed.

Visual observations of the facility were intended to identify potential structural defects, deterioration, and any other structural causes for concern.

The following was conducted in the course of the assessment:

- Review of original structural drawings
  - Review was cursory for visual verification of building structure
- Visual observations of the following structural elements:
  - Elevated concrete framing
  - Precast seating units
  - Precast concrete framing
  - Precast double tee flooring
  - Exterior ramp composite slabs (concrete topping over metal deck) and supporting steel framing
  - Expansion joints
  - Scoreboard framing
  - Parking areas
- Discussions with building maintenance personnel, as appropriate

Summary

Most structural elements throughout the stadium are in good condition, however there are locations in the stadium where enhanced maintenance is necessary. Primary structural elements, such as reinforced concrete framing, concrete raker beams, precast double tees, structural floor slabs, masonry walls, structural steel framing, and boomerang columns generally exhibit only isolated cracks, localized spalling and corrosion. Items in greater need of attention include cracked concrete topping slabs, corroded composite metal decking, corroded precast cladding attachments, localized exposed rebar in precast concrete elements, and deteriorated traffic coatings. These items require immediate attention and should be prioritized in the repair and maintenance plan.

There have been ongoing issues maintaining significant areas of the non-structural topping slabs throughout the facility, generally in areas exposed to weather and receiving traffic. In various areas, previous topping slabs repairs appear to be at the end of their service life. Water leaking was observed in areas of the Service Level located beneath the plaza concourse, indicating that water has penetrated through the waterproofing membrane beneath the topping slabs. Topping slabs should be prioritized during the stadiums annual concrete and waterproofing maintenance and capital projects. Without this maintenance and repair, further deterioration may occur to conditioned spaces below and to the structural floor framing. Cracked topping slabs located above conditioned spaces, especially areas that have experienced leaking, should be prioritized for repair, and the waterproofing between the structural slab and topping slab should be assessed and repaired as necessary to prevent further water infiltration through the floor assembly. Removal and replacement of the topping slab may not be practical to provide access and evaluate the existing waterproof membrane. Therefore, the existing waterproof membrane may need to be abandoned in-place and instead the stadium will rely on new traffic coatings applied over the top of existing topping slab. Waterproofing membrane installations have been ongoing and will continue each year to enhance the performance and longevity of the stadium. Areas of non-structural topping slabs with widespread cracking, such as the south Plaza Level concourse and areas of the upper concourses, will need to be properly cleaned, surface cracks and divots properly prepped for placement of a new waterproof traffic coating, which should be applied to the existing concrete topping. Any new replacement concrete topping slabs should be provided with adequate contraction joints to limit future cracking, and it is recommended the entire area also receive a traffic coating in order to limit water infiltration through any minor cracking that may occur. Localized cracks in the topping slabs that have been previously repaired with sealant may also require more extensive repairs.

Expansion joint covers and expansion joints are replaced as reviewed by stadium management and Hamilton County's engineer. The condition of the expansion joints themselves, especially those that occur over conditioned spaces and have experienced leaking, should be assessed for any deterioration and replaced as required. Our project team recommends a water tight system that accommodates wheelchairs, automobiles and snowplows with a rubber bottom blade. At the canopy level an optional moisture and fire rated barrier.

At the time of our site visit, corroded metal decking in composite slabs with concrete topping was widespread throughout all four pedestrian ramps and along the lower level stair landings. At the time of this report, some months later, we understand the replacement of metal decks at stairs and ramps replacement has already begun. Metal decking areas with severe corrosion requires either replacement of the metal deck or the placement of new additional steel framing members to divide, shorten and re-support the existing concrete slab spans. The concrete topping over metal deck throughout requires a traffic coating to prevent moisture from infiltrating through the concrete topping. The moisture can corrode the metal deck and supporting framing members. All coatings should be regularly inspected and maintained. These repairs are ongoing through cooperation with Hamilton County.

Additionally, corroded steel attachments at precast façade panel connections and at stair and ramp framing require a protective paint coating after all rust is thoroughly removed or require replacement depending on the severity of corrosion. Corroded steel ramp and stair framing also requires maintenance to remove and protect the steel structure. Any steel framing and fasteners that are exposed to weather require regular maintenance to prevent deterioration, and any corrosion should be addressed promptly.

There are several concrete spalls in the precast concrete double tees and elevated concrete framing that should be addressed, with priority given to elements with exposed reinforcing. A protective coating may be required for precast elements with a low concrete cover.

At the seating bowl precast risers, cast-in place concrete steps with large cracks or significant delamination from the precast unit require replacement. Traffic coatings should be applied to precast seating risers to protect the surface of the concrete and prevent water infiltration into spaces below. In addition, deteriorated sealants throughout the seating bowl and at precast concrete joints require replacement.

A detailed inspection of the facility and a testing program should be implemented to further investigate areas not easily accessible, and waterproofing membranes in select areas of the facility should be inspected. A detailed maintenance plan should be developed and implemented for items such as the topping slabs and topping slab coating, expansion joints, sealants, coatings to structural steel, and traffic coatings. Further lack of maintenance on items that are in poor condition will allow continued deterioration and may affect the condition of surrounding elements.

DESCRIPTION OF STRUCTURE

The facility features seven levels, as listed below:

- Service Level – Lower (Level 000) Elevation 480’-0” (Below Grade)
- Service Level - Upper (Level 100) Elevation 480’-0” (Below Grade)
- Main Concourse Level (Level 200) Elevation 501’-0” (Lower Street Level)
- Plaza Level (Level 300) Elevation 515’-0” (Upper Street Level)
- Club Level (Level 400) Elevation 535’-6”
- Mid Level Suites (Level 500) Elevation 553’-6”
- Upper Level Suites (Level 600) Elevation 565’-0”
- Upper Concourse (Level 700) Elevation 589’-10”

The stadium complex features exterior pedestrian walkway ramps that are located at the north and south ends of the east and west elevated concrete framed concourse levels, scoreboard structures at the north and south ends, gate structures along the perimeter, and an upper seating level featuring boomerang columns with fabric shade covering. Elevator banks are located on the west and east sides to serve the upper concourses; the service level is accessible only via the west elevator.

The service level is located at grade level and extends around the entirety of the stadium. Most of the service level consists of 5” thick reinforced concrete slab, with 7” thick reinforced concrete slabs present at the locations of loading docks. The stadium foundations consist of cast-in-place pile caps with tie beams and 16” diameter piles located beneath columns, reinforced concrete service level walls, and reinforced concrete flood walls.

The main concourse is located along the west side, east side, and southwest corner of the stadium and is supported by cast-in-place reinforced concrete columns, walls, and beams. The west entrance is located on the main concourse level with vomitories leading to the lower bowl and consists of precast double tees with 4” non-structural concrete topping over a waterproofing membrane over 2 1/2" reinforced concrete structural topping. The east side of the main concourse allows for vomitory accessibility to the lower bowl and also consists of precast double tees with 2 1/2" structural topping. Between the precast vomitory walls, the flooring consists of precast planks. A 4” non-structural concrete topping over a waterproofing membrane is only located within a pair of the men’s and women’s restrooms that are located just to the north and just to the south of the 50 yard line on both the west and east sides of the stadium. The southwest corner of the main concourse, located above the service level auditoriums and containing offices, consists mainly of precast double tees with 2 1/2" structural topping. The southeast corner of this level including the walkway to the elevator bank and stairwell, consists of 6” and 8” precast concrete planks with 2 1/2" structural topping.

The plaza level is elevated above grade and extends around the entire stadium, with the north entrance being accessible through an elevated street level. The structure consists of precast double tees with 2 1/2" structural topping supported by cast-in-place concrete columns, beams and walls. Areas of the plaza level that are exposed to open air or are not covered by the upper bowl structure have a 4” non-structural topping over a waterproofing membrane. Precast concrete slabs are located along the edge of the east, west and south lower seating bowls. A 10” structural slab is located between the vomitory walls of the south seating bowl.

The east and west club levels consist of cast-in-place concrete girders and columns, precast beams, and a precast double tee floor system with 2 1/2" structural topping. Precast plank flooring is located only along the edge of the seating bowl. The floor slabs located in the two outer grid lines of the north and south ends of the east and west club levels, in addition to the exposed northwest plaza area, are topped with a 3” sloped structural topping. The remaining framing is covered by 2” rigid insulation and 2” non-structural concrete topping.

The north club level consists of cast-in-place concrete girders and columns and precast beams with precast double tee floor system between gridlines H and R with steel framing located beneath the upper seating bowl. A 4” non-structural topping over a waterproofing membrane covers the concrete framing of the north club level, while composite slabs cover the steel framing.

The east and west lower and upper suite levels consist of cast-in-place concrete girders with precast double tee floor system.

The east and west mid suite levels consist of cast-in-place concrete girders and columns, precast beams and spandrel walls, reinforced concrete walls, and a precast double tees floor system with 2 1/2" structural topping. Exterior flooring has a 4" non-structural topping over a waterproofing membrane. Composite slabs are located adjacent to the edge of the seating bowl is some locations. Tiered flooring inside the suites consists of precast slabs

Upper Level suites consist of cast-in-place concrete girders and columns, precast beams and walls, reinforced concrete walls, steel columns and precast double tees floor system with 2 1/2" structural topping. Steel columns are located along gridlines L.7 and G in the double height club areas, with pipe trusses supporting the exterior curtain wall. Steel framing is located between gridlines 8 and 9, 22.4 and 21, 38 and 37, and along gridline 53 to support triangular areas of composite slabs. Exterior slabs covered by the upper concourse above have 3 1/2" of structural concrete topping and slabs that are exposed are sloped to fall with a thickness of 3". Neither slab contains a waterproofing membrane.

The upper concourse is supported by steel framing, trusses, and bracing. The floor system consists of composite slabs covered with 4" non-structural concrete and waterproofing. A cantilevered steel structure supports Teflon-coated fiberglass fabric that covers the upper decks. Steel raker beams and boomerang columns support the roof with secondary "x" bracing for lateral stability. Catwalks are located underneath the fabric roof to access stadium lighting located along the length of the covering.

The lower bowl and club seating is constructed of precast seating units supported by cast-in-place concrete columns, beams, and precast rakers.

The north seating bowl consists of steel girders, pipe bracing, and boomerang columns with precast concrete seating units. The south seating bowl consists of precast seating units supported by reinforced concrete vomitory walls.

The lower seating bowl of the upper concourse consists of precast seating units supported by cantilevered steel beams. The upper bowl framing consists of steel plate girders, pipe bracing, and boomerang columns.

The exterior pedestrian ramps are at the northwest, northeast, southwest, and southeast corners of the stadium consist of 4 1/2" normal weight concrete on 3" composite metal deck supported by structural steel beams, girders, column, and reinforced concrete walls. The ramps extend from the main concourse to the upper concourse and stop at all levels between. Additionally, the northwest ramp exits down to the service level and the ramps located on the east side of the stadium exit out to grade level parking.

Pedestrian bridges are located at the northeast and southwest corners of the stadium. The northeast bridge connects the east club level to the north club level and consists of a 6" thick precast concrete plank slabs and a pipe truss platform with tension/compression pyramid members, anchored into reinforced concrete beams. The southwest bridge connects the west club level to the party deck and consists of 4" thick precast planks on top of a similar pipe truss platform structure. The platform is anchored into reinforced concrete beams.

The scoreboard structures consist of steel framing and trusses supported by two welded steel plate columns on the main concourse level. The steel columns are supported by concrete columns that bring the load down to the pile caps located at the service level. The scoreboard structures are accessible through several levels of catwalks to service the boards.

The lateral load resisting system of the primary framing consists of uniformly distributed, cast-in-place concrete moment frames in the concrete superstructure.

There are ten primary expansion joints throughout the stadium structure. From discussions with facility management and maintenance staff, several expansion joint covers (metal and rubber) have been replaced within the last year.

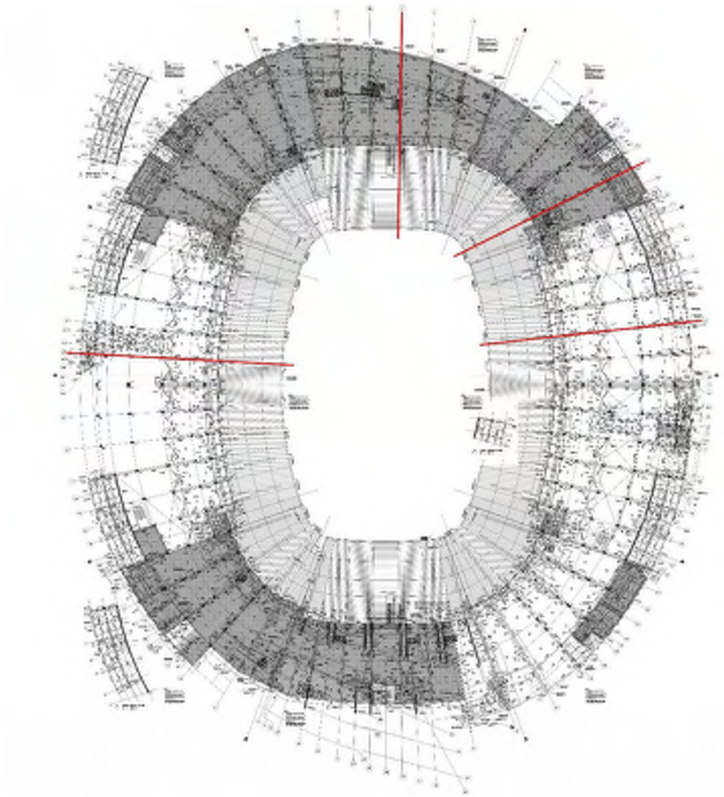
The stadium façade consists of precast concrete panels and glazing. Steel members throughout the stadium had been recently painted.

Please see the following page for select plan view and sections from the structural set of drawings.

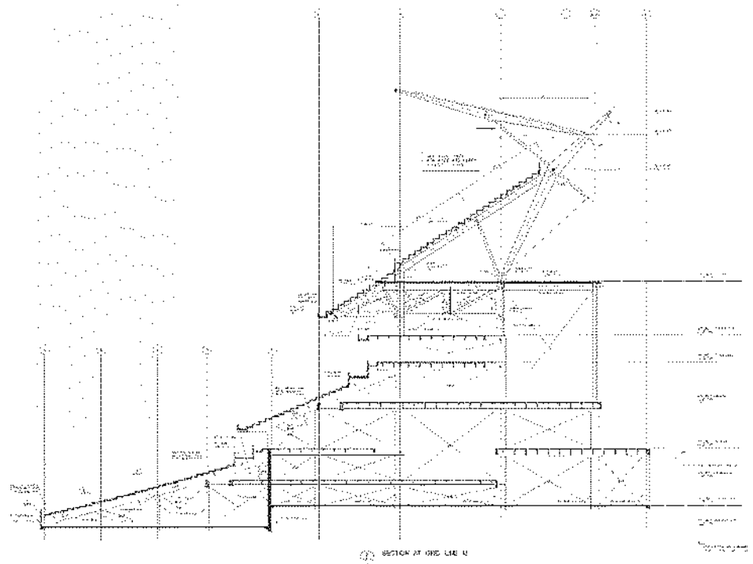
Visual Observations

From our visual observations of the stadium structure, we concluded that the overall condition of the structural elements was fair. The primary structural elements observed (floor slabs, beams and girders, columns, masonry walls, precast seating units, and raker beams) did not exhibit significant or widespread cracking, spalling or evidence of active corrosion or other damage except as noted below. The facility appears to have been adequately maintained to prevent damage or deterioration to most critical structural elements. There was, however, notable areas of water intrusion throughout the stadium, including along the exterior ramps, stairs, and through exposed areas of the plaza level slab that had leaked into condition spaces below. Many instances of deteriorated composite steel decking and corroded steel fasteners were observed throughout the ramp and stair structures and cracking was located throughout the topping slabs on the plaza level. In addition, the actual service life of previously selected repair materials used to repair cracked concrete steps and topping slabs throughout the stadium appears to have been very limited.

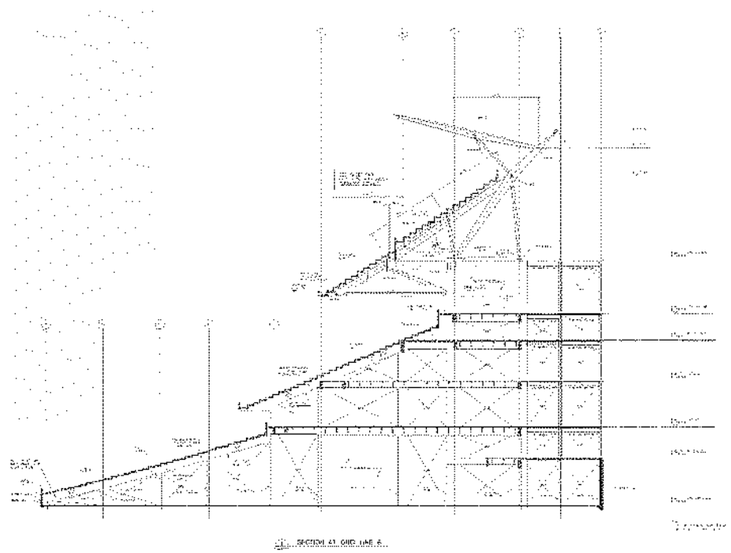
We were also informed that multiple expansion joint covers on the plaza level were replaced as well as the expansion joint on the 50 yard line west. Based on conversations with maintenance personnel, the conditions beneath the expansion joints were not assessed. The condition of the expansion joints, especially those that occur over conditioned spaces, should be assessed for any deterioration and replaced as required.



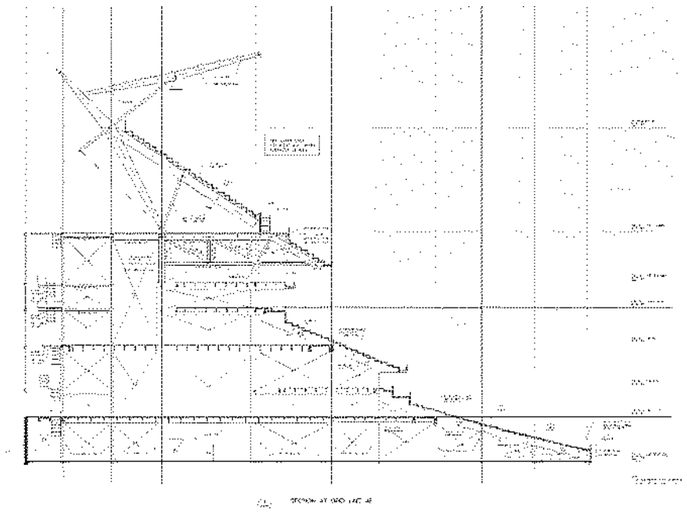
Plan view at Level 300 - Plaza Level, Sheet 230, taken from the record set of drawings dated 11/17/2003; grid lines where building sections occur are highlighted in red.



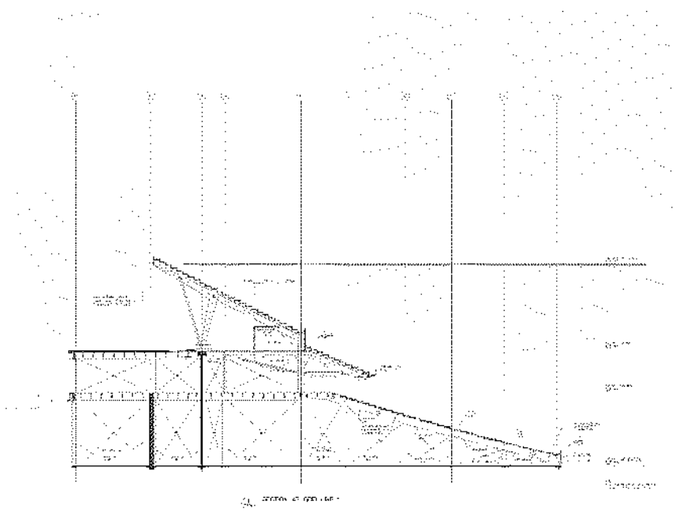
Section at grid line 13, Sheet S301, taken from the record set of drawings dated 11/17/2003.



Section at grid line 8, Sheet S302, taken from the record set of drawings dated 11/17/2003.



Section at grid line 45, Sheet S303, taken from the record set of drawings dated 11/17/2003.



Section at grid line 1, Sheet S304, taken from the record set of drawings dated 11/17/2003.

Concourses

Leaching was visible along the underside of the precast double tees. Efflorescence is induced by moist conditions and unsealed concrete is particularly susceptible. The efflorescence observed appears to be following the length of reinforcing bars and it is likely that the rebar beneath has begun to corrode.

Leaching along the underside of precast double tees (Club Suites West, northwest concourse)

Delaminated concrete and exposed reinforcing steel were present on the underside of precast double tee members and along precast beams. Delamination may be caused by thin concrete cover, poor concrete consolidation, and/or concrete expansion and contraction due to the freeze/thaw cycle.

Localized concrete delamination on the underside of a precast double tee member (Club Level, northwest concourse)

Multiple locations of exposed reinforcing steel along the length of a precast beam (Plaza Level, southeast concourse)

Corrosion was present at some locations along the bases of the steel boomerang structure at the upper concourse level. Most structural steel had been painted within the last year.

Corrosion present at the interface between the steel boomerang column base and concrete topping; boomerang steel was painted in 2019.

Gapping was present between the pin end caps and upstand plates at the base of the boomerang columns, which gives a path for water to flow between the two surfaces and potentially corroding the pinned connection. Bolts throughout all boomerang columns were replaced within the past two years.

Gap present along steel pin end cap and upstand plates that receive the boomerang column (Club Level, north concourse)

Failed concrete patches were located throughout the architectural topping slab on the exposed concourse levels. Sealant or caulk was used to repair cracks had worn away or dislodged from the crack. This material does not appear to properly adhere to the concrete substrate for any significant time duration. Remedies may range from simply applying a new topcoat to the most expensive option of replacing entire topping slabs and waterproofing material.

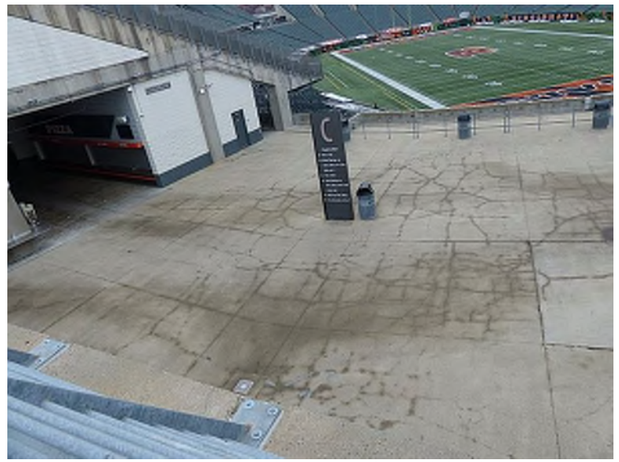
Cracking along a previous concrete patch with failed sealant along one crack (Upper Concourse, west)

Failed concrete patch beneath deteriorated traffic coating (Club Level, north concourse)

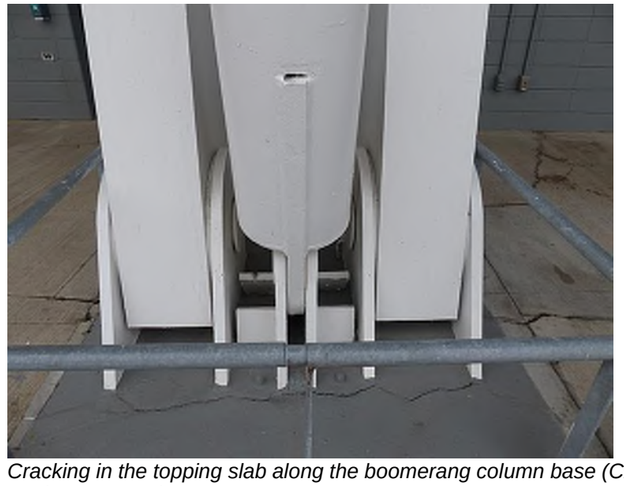
Failed concrete patches adjacent to the traffic coating along the floor drain (Upper Concourse, west)

Cracked topping slab was located throughout the exposed concourse levels. Cracking may be due to high water content in the concrete mixture, environmental conditions, de-icing salts and/or wear due to high traffic and hard-wheeled carts. The topping slab is a protective topping over the structural concrete slab and cracking does not affect the structural integrity of the structural floor slab except when the waterproofing membrane has been compromised below the topping slab. Once the membrane is compromised, besides water leaking in to the level below, the presence of water, de-icing salts residue, etcetera, can begin deterioration of the supporting structural framing members.

Waterproofing membrane installation began in 2021 on 400 north (club) and is continuing through 2022 (south plaza).



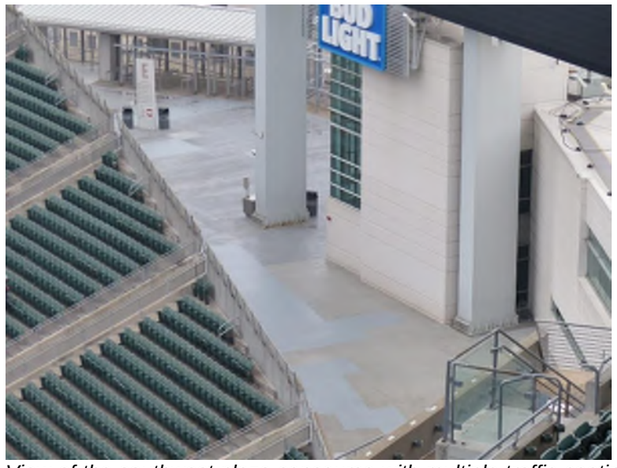
Extensive cracking throughout topping slab (Plaza Level, northeast concourse)



Cracking in the topping slab along the boomerang column base (Club Level, north concourse)

Deteriorated traffic coating was present throughout the stadium and is likely past its lifespan. Traffic coatings may deteriorate more rapidly by service carts driving over with hard wheels, de-icing salts and standing water.

Multiple patches of traffic coating present with a crack in the coating along the construction joint (Plaza Level, south concourse); coating is scheduled to be replaced in 2022 at this location and the south end zone in general



View of the southwest plaza concourse with multiple traffic coating patches visible (Plaza Level, south concourse)

The exposed drain covers that feature the Bengals logo are fastened on top of the original cast iron drain covers. A majority of the logoed drain covers have buckled but do not have compromised fasteners. The issue is architectural in nature and it is possible that there is an incompatibility of materials.

Buckled drain cover adjacent to concessions (Plaza Level, northeast concessions)

Corrosion residue was present along exposed slab edges where water had drained between the topping slab and structural slab. It is likely that the presence of corrosion is due to exposed reinforcing steel within the topping slab assembly and due to poor detailing.

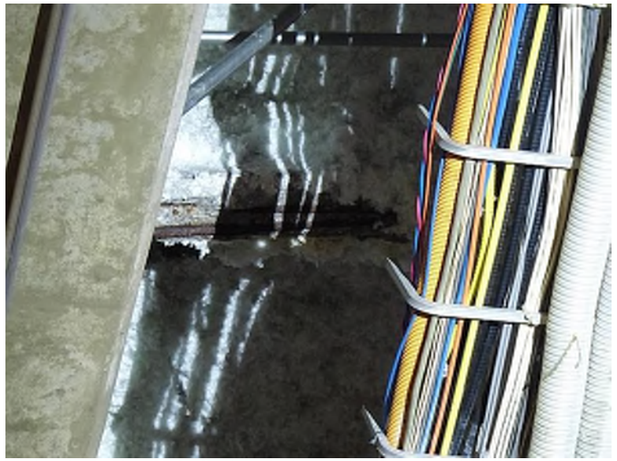
Corrosion residue along slab edge where water drains into the attached gutter (Club Level, north concourse)

Service Level

Water infiltration was present throughout the field level concourse, beneath both the lower seating bowl and the plaza concourse level.

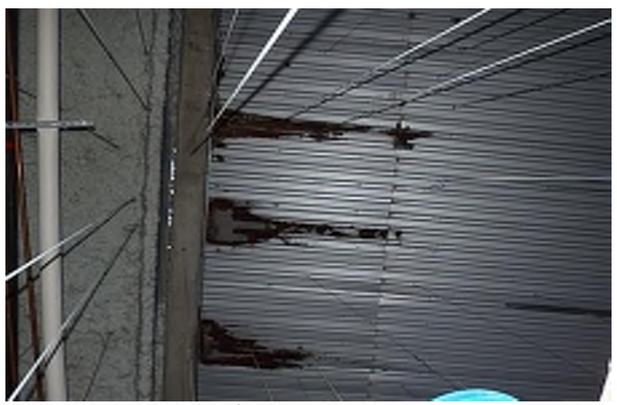
Delaminated direct applied sound attenuation system spray on material was located along the underside of the precast seating risers throughout the field level concourse. In some areas, the concrete beneath had deteriorated, exposing the reinforcing steel. The delamination of the system is due to water infiltration from between the individual precast riser units and between where the precast risers rest on the raker beams that has leaked through and de-bonded the fireproofing. Sustained moisture on the underside of the riser can deteriorate the concrete, causing spalling and exposure of reinforcing steel.

Delaminated acoustic insulation on the underside of precast seating risers (Service Level, adjacent to column line 15)



Delaminated acoustic insulation with exposed reinforcing steel on the underside of a precast seating riser (Service Level, adjacent to Vis Team Locker Room)

Corroded secondary roofing, located on the underside of precast seating risers in conditioned spaces, was seen in several areas that had ceilings that were easily removable and accessible. Water infiltration can occur between precast seating risers, precast risers and raker beams, and between precast elements and concourse levels. The purpose of the secondary roof is to add a second layer of protection in the event that leaking occurs beneath the seating bowl, however, corrosion of the metal secondary roof can occur if there is continued moisture. It also is an indication of failure of the primary waterproofing system on the structure above.



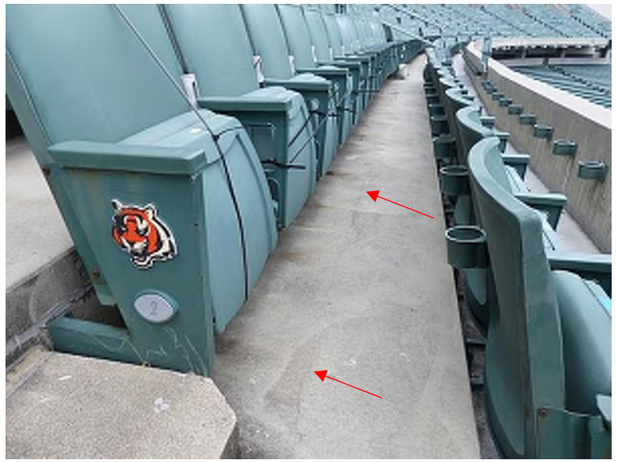
Corroded secondary roofing located above the visitor team's locker room

Water staining was visible along ceiling finishes in enclosed spaces located beneath the seating bowl and beneath the plaza concourse. Additional investigation is necessary to determine the source of water leaks and determine the extent of any damage to the structure above.

Water staining visible on ceiling tiles located in the fitness area, located below the plaza concourse

Seating Bowl

Cracking located along the top surface of the precast seating risers was not widespread but occurred in select areas throughout the stadium bowl. Cracking in the precast risers may be caused by shrinkage, expansion and contraction due to excessive temperature differences, or poor quality control during casting.



Longitudinal crack on surface of precast seating risers (Club Level, Section 211 Row 2)

Close-up view of longitudinal crack adjacent to precast riser joint (Club Level, Section 204 Row 4)

Cracks occurred throughout many of the intermediate concrete steps at the location of the railing stanchions. Cracking may be the result of stresses incurred from movement of the railing when in use. Any cracking that was formed will be exacerbated through water infiltration, which may also cause corrosion at the base of the stanchion or the rebar within the step due to water infiltration. Water may also seep through the unsealed edges of the step, causing further deterioration.

Transverse crack through the intermediate step at the location of the stanchion (Club Level, Section 211 Row 5)

Cracking at the bottom corner of the intermediate step at the location of the stanchion (North Seating Bowl, Section 228 Row 8); sealants should be installed to prevent "freeze/thaw" issues from occurring

Water leaking beneath steps at north end of stadium (North Seating Bowl, Section 230 Row 10)

Delaminated concrete occurred along precast seating risers, precast raker beams, and cast-in-place intermediate steps and corrosion was often visible along the surface of the delaminated concrete elements. Delamination, especially with the presence of residue from corrosion, can be caused by improper concrete cover over the reinforcing steel.

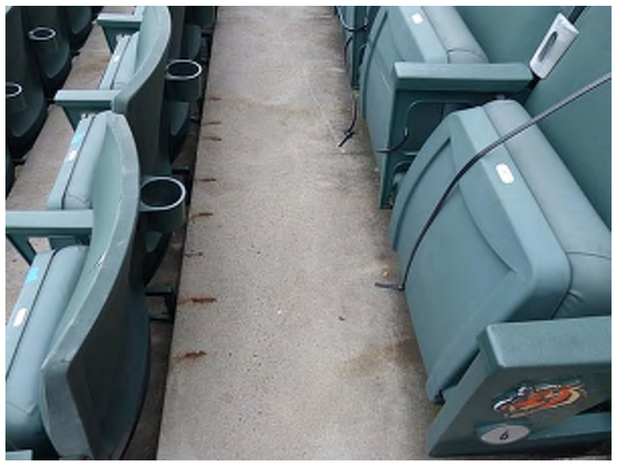
Concrete and corrosion delamination along edge of precast riser beam (Club Level, Section 202 Row 31)

Delamination and corrosion along the exposed side of the raker beam (Club Level, south end of east seating bowl)

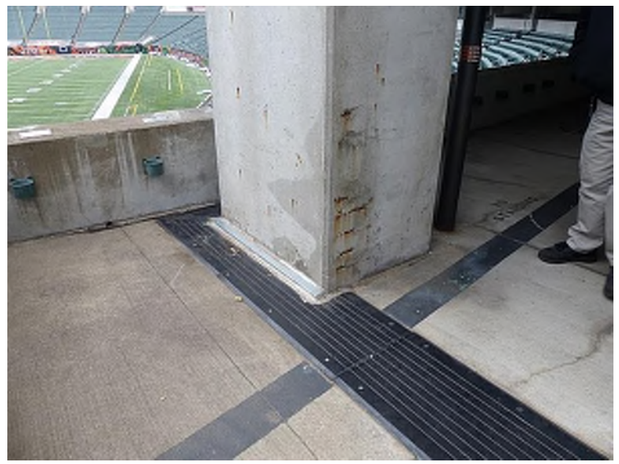
Exposed longitudinal reinforcing steel along the vertical surface of a precast seating riser (Lower Seating Bowl, Section 140, back rows)

Exposed transverse reinforcing steel along the vertical surface of a precast seating riser (Club Level, Section 202 Row 14)

Delaminated concrete with exposed corroded rebar on the edge of the intermediate step (Club Level, Section 241 Row 14)



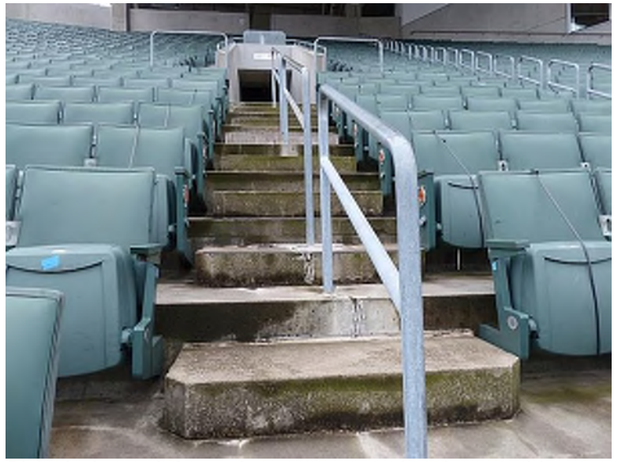
Exposed transverse reinforcing steel along the surface of a precast seating riser (Club Level, Section 204 Row 6)



Exposed ties along the precast raker column (Plaza Level, Section 120 Row 37W Seat 16)

Exposed reinforcing steel was evident in various precast risers and visible rakers throughout the stadium. This is due to a very thin concrete cover from poor quality control during casting. The exposed reinforcing steel does not appear to affect the structural integrity of the precast risers at this time.

Biological growth was found throughout the stadium seating, precast risers, and intermediate steps and is the result of sustained moisture present on the surface of the concrete. This can be caused by poor drainage, improper slope of surfaces, and clogged surface drains.



Biological growth located on precast seating risers and intermediate steps (Club Level, Section 202/203)

Biological growth along the top surface of precast seating risers (Club Level, Section 203 Row 3)

Cracks occurred in concrete wall elements, such as the barrier wall along handicap seating and vomitory walls. Cracking adjacent to a railing is caused by shallow embedment of the connection plate, allowing for concrete to spall and additional cracks to propagate outward. A cold joint is located between the top of the precast portion of the wall and the sloped capping and the presence of water running along the joint can cause cracking and spalling along the joint over time. Cracking in vomitory walls is likely due to shrinkage, expansion and contraction due to excessive temperature differences, poor quality control during casting, or a combination of the two.

Cracked and spalled concrete located at the embedment plate of the railing wall (Lower Bowl, Section 140 Row 32W Seat 11)

Spalled concrete with exposed rebar near the embedment plate of the railing wall (Lower Bowl, Section 140 Row 32W Seat 12)

Cold joint located between the top of the precast wall panel and the sloped concrete cap (Lower Bowl, Section 139 Row 32W Seat 3)

Concrete cracking along the top of the vomitory wall (South Seating Bowl, Section 154)

Cracks in the architectural topping slab and precast risers were repaired using some type of sealant or caulk. This material is not the recommended repair method for horizontal concrete surfaces, as the sealant or caulk appears to have a limited lifespan, deteriorates or dislodges because the material does not properly bond to the substrate for any significant time period. Some previously applied concrete coatings are building up causing water to disperse away from the drains resulting in ponding water in the seating aisles.

Deteriorated sealant used for repair in topping slab adjacent to a vomitorium (South Seating Bowl, Section 152)

The material used to repair cracks in the precast risers has been worn away (Lower Bowl, Section 142 Row 1). Concrete coating build ups are causing water to disperse away from drains causing ponding water in the seating aisles.

Cracks in the topping slab are located throughout vomitories and walkways adjacent to the bowl seating. Cracking may be due to high water content in the concrete mixture, poor workmanship and lack of sufficient shrinkage control joints when topping slab was originally placed, environmental conditions, de-icing salts and/or wear due to high traffic. The topping slab is a protective topping over the structural concrete and cracking does not affect the structural integrity of the structural floor slab. Cracking does, however, allow for water to permeate below the topping slab and possibly impact the structural slab below if there are leaks in the waterproofing system.

Crack and spall located in the topping slab of the vomitorium (South Seating Bowl, Section 152)

Crack in topping slab extending though the slab edge (Plaza Level and Lower Bowl, Section 129)

Spalling adjacent to a previous repair in the topping slab along plaza level suites (Plaza Level, Section 140)

Exposed wire mesh in architectural and structural topping slab may be the results of poor concrete consolidation and localized impact damage.

Exposed mesh in architectural topping slab at the plaza level (Upper Level Suites, west at south end)

Exposed mesh in structural topping slab at the plaza level (Plaza Level, Section 148)

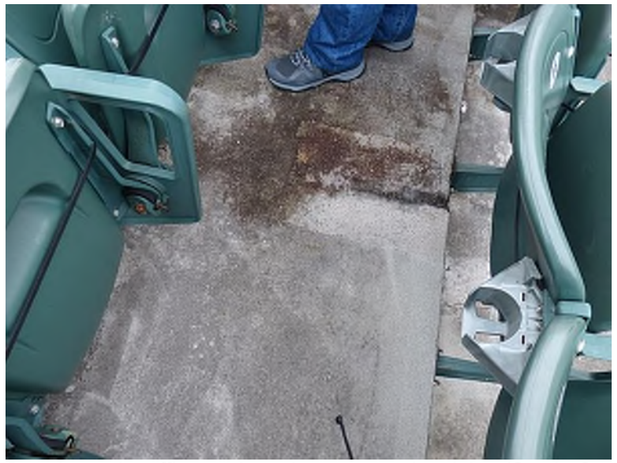
Exposed mesh in precast slab adjacent to plaza suites (Plaza Level, Section 136)

Leaching was visible along various precast riser beams, particularly along the underside of the risers. Efflorescence is induced by moist conditions and unsealed concrete is particularly susceptible. The efflorescence observed appears to follow the length of reinforcing bars within the precast risers. This often is an indication that the rebar beneath the concrete surface has begun to corrode. This needs to be further investigated / repaired as required.

Leaching along the underside of the bottom tier of the precast concrete riser (as seen from Plaza Level, Section 140)

Leaching along the underside of the bottom tier of the precast concrete riser (Upper Concourse, east)

Traffic coating throughout the stadium appeared to be at the end of its lifespan and has further deteriorated due to standing water and de-icing salts.



Deteriorated traffic coating along expansion joint (South Seating Bowl, Section 158)

Deteriorated traffic coating on precast riser surface (North Seating Bowl, Section 126 Row 1)

Deteriorated sealants were located along precast riser beams, vomitory walls, and precast walls. The missing sealant is consistent throughout all vertical precast joints at all levels of the stadium.

Sealant missing along the top portion of the railing wall (North Seating Bowl, Section 226), and is consistent throughout all vertical precast joints at all levels

Deteriorated sealant between the precast vomitory walls and steps (North Seating Bowl, Section 226)

Deteriorated and missing sealant between the top precast riser beam and topping slab (South Seating Bowl, Section 158)

Corroded edge metal was located at the end raker beams along the railings. The edge piece has a lip that is made to prevent water from draining over the edge of the precast seating units onto the concourse below, however it appears that water is able to pool on top of and below the metal piece, causing corrosion.

Corded edge metal along end raker beam (Club Level)

Railings along precast seating risers often had corroded fasteners at the base plate, in addition to missing bolts in some locations.

Corroded railing fasteners with one bolt missing (Club Level, Section 202)

At the Plaza Level, metal pans were placed along the bottom of the precast seating units above throughout the entire length of the Club Level bowl in order to catch leaking water from above. Concrete efflorescence and corroded metal decking were visible in areas where water leaking was evident.

Staining and efflorescence on precast concrete members in the location of water leak locations above metal pans used to collect the leaking water (Plaza Level, north end of east concourse)

Corroded metal decking and staining on metal framing above metal pans used to collect leaking water (Plaza Level, north end of east concourse). Note that owner has begun metal decking replacement at stairs and ramps during 2021.

Several clip angles anchoring a precast slab to the concrete superstructure exhibited corrosion. The steel angles require a high-performance paint or sealant.

Corroded clip angle between precast slab and concrete beam (Upper Concourse)

The assessment team was informed that metal decking replacement at stairs and ramps has begun during 2021.

Pedestrian Ramps

Deteriorated traffic coating was prevalent throughout all levels of the pedestrian ramps. Deterioration may be due to carts with hard wheels driving over the surface, de-icing salts and standing water. Areas of traffic coating may also be past their lifespan.

Cracked and deteriorated traffic coating at the upper concourse level

Cracked and deteriorated traffic coating at the plaza concourse level

Biological growth was present on some areas of the pedestrian ramp and along a CMU wall that is adjacent to an enclosed space. Presence of biological growth is due to sustained moisture on a surface. The surface of the ramp may be slightly sloped towards the edge, allowing water to collect along railings, causing the concrete to be constantly damp. Cracks in the surface of the concrete would also allow water to collect, causing the concrete to stay wet.

Biological growth located on the CMU wall along the landing on the ramp (northwest ramp)

Biological growth along the edge of the pedestrian ramp (southeast ramp)

Delaminated concrete was present on a few areas along the surface of the concrete ramps. Delamination is likely due to poorly consolidated concrete or thin concrete cover.

Delaminated concrete adjacent to the railing anchorage (northwest ramp)

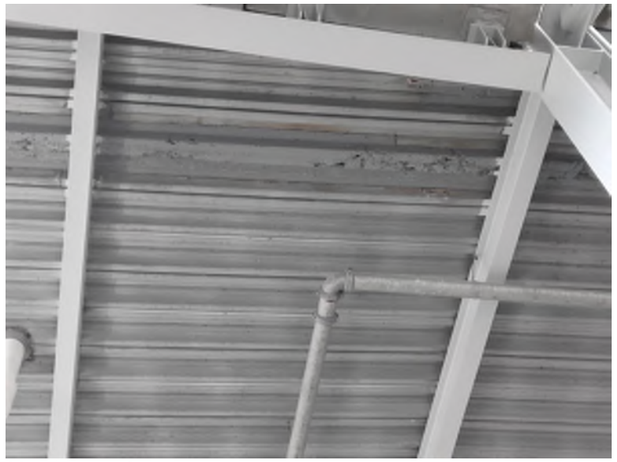
Cracking was present in some of the CMU blocks along ramp walls. The CMU walls are not a part of the main structural system and are located primarily along concessions, bathrooms, and along ramps. The cracking that was observed does not appear to be of structural concern, but repair is recommended to prevent further cracking and deterioration.

Cracked CMU blocks adjacent to railing at the upper concourse level (southeast ramp)

Corroded metal decking was prevalent throughout all pedestrian ramps. Steel elements in some areas also experienced corrosion. Corrosion of metal decking is likely caused by water infiltrating through cracks in the concrete slab due to lack of a protective coating, allowing for water to be trapped between the concrete and metal decking. Corrosion on structural steel elements, such as angles, is due to sustained moisture from water flowing down the edge of the ramps. Additional investigation will be required in order to mitigate water flow over the edge of ramps. Decking replacement and repair is an ongoing capital project at PBS.

Corroded metal decking along the supporting steel beam of the pedestrian ramp (southeast ramp)

Corroded metal decking on the underside of the pedestrian ramp (near Field Level West)



Metal deck after replacement

Corroded steel angles along the edge of the pedestrian ramp (near Field Level West). This is at the NW ramp, level 200.

Paint had chipped off or deteriorated on some of the ramp structural steel elements, allowing for the steel beneath to corrode. Deterioration of the protective paint is likely due to sustained moisture on the steel elements.

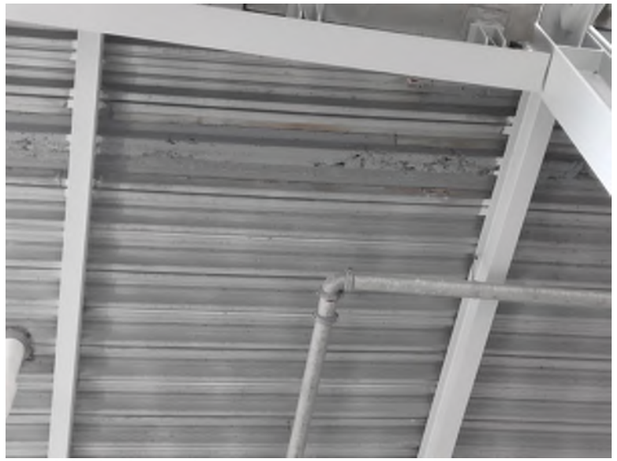
Corroded ramp structural steel (southeast ramp); steel correction and re-coating is an ongoing, yearly capital project at PBS

Stairs

Corroded metal decking was located along the underside of exterior stair landings and is likely caused by water infiltrating through cracks in the concrete slab, allowing for water to be trapped between the concrete and metal decking.

Corroded metal decking located beneath a stair landing above the plaza concourse (Club Level, southwest stairs); steel correction and re-coating is an ongoing, yearly capital project at PBS

Corroded metal decking located on the underside of the upper concourse stair landing (southwest stairs, looking towards Upper Concourse); steel correction and re-coating is an ongoing, yearly capital project at PBS



Metal deck after replacement

Pedestrian Bridge

Leaching was located on the underside of the precast planks of the pedestrian bridges. Efflorescence is induced by moist conditions and it is likely that water is able to flow over the edges of the bridge in addition to water penetrating through spalled concrete at the locations of the railing anchorage.

Efflorescence on the underside of the pedestrian bridge precast concrete plants

Bent and corroded railing fasteners were visible at some locations of railing anchorage.

Bent threaded rods and rusted rods and nuts at the handrail attachment for the pedestrian bridge leading to the party deck

Poor detailing has allowed water to flow along the cover at the termination of the pedestrian bridges, also allowing for water to flow along the edge of precast concrete planks and structural steel, causing corrosion.

Deteriorated concrete and rusted steel where the bridge terminates

Scoreboard Structures

Corrosion was present along the baseplate of the scoreboard support columns. The steel was said to have been painted sometime in 2020. It is likely that sustained moisture along the baseplate has deteriorated the protective coating

Corrosion along the baseplate of the south scoreboard support column

Exterior

Corroded precast façade panel fasteners are due to water leaking down from corroded ramp or stair composite decking.

Corroded bolt, nut, and washer at the connection between the precast faced panel and steel support structure (Southeast Ramp)

Concrete leaching was located along exterior concrete surfaces. It is likely water is entering the concrete structure through cracks or deteriorated sealant. Leaching can occur due to moist conditions, especially since the concrete is exposed to the elements and likely unsealed.

Concrete leaching below the exterior stairs that lead to parking on the east side of the stadium

Concrete delamination occurred on several exterior concrete elements. Water staining was seen along the surface of the wall and is likely the cause of deterioration of the concrete cover over time due to freeze-thaw cycles (we recommend investigating further).

Delaminated concrete on column along exterior concrete masonry wall at service level

Surface Parking Lots

Cracks were present in the topping slab of the elevated parking level surrounding the north and east sides of the stadium. The cracks were primarily occurred at the locations of the concrete beams and girders below. Cracking is likely due to the slab located over the beams having more stiffness and the adjacent area of slab having more flexibility, so cracking gradually occurs as cars drive over the surface.

Cracking in parking lot topping slab that follows edge of concrete beam below

Recommendations

1. Pressure wash concrete effected by efflorescence in order to remove any residue or clean with a chemical solution that removes calcium and lime build up. After the efflorescence is removed, the concrete surfaces should be sealed to prevent efflorescence from reappearing.

2. Pressure wash concrete surfaces with biological growth present and inspect for any concrete degradation once cleaned.

3. Repair delamination concrete by removing any loose concrete and install approved repair material following per International Concrete Repair Institute (ICRI) guidelines.

4. Remove and replace failed concrete patches along concourse surfaces ICRI guidelines.

5. Repair spalled concrete by breaking out damage concrete and re-cast following ICRI guidelines.

6. If rebar is exposed and exhibits corrosion, remove corroded material with a wire brush. If there is more than 20% section loss of reinforcement, contact the structural engineer.

7. Repair cracks in concrete elements between 8 mils and 40 mils in width with approved epoxy following ICRI guidelines. Cracks less than 8 mils in width should be sealed to prevent moisture ingress.

8. Replace broken CMU blocks or inject crack with approved epoxy and repoint cracked joints.

9. Caulk around concrete steps in seating bowl to prevent water intrusion. A few of the concrete steps may need to be replaced if they can't be properly prepped for caulking and applying traffic coating.

10. Remove all corrosive materials along all exterior stairs and ramps, prepare with a corrosion inhibitor, and recoat with a high-performance coating.

11. Areas of extensive corrosion along composite decking of the exterior stairs and ramps may require replacements or supplemental structural framing members to divide, shorten and re-support the existing concrete slab spans. See Appendix D for diagram of this process.

12. Areas of topping slab with extensive cracking and/or have received multiple patches, especially where located above condition spaces, may have to be replaced if they can't be properly prepped for a new traffic coating to adhere to. Where the topping slab is replaced, adequate contraction joints should be implemented to minimize cracking. Refer to the architectural section of this report for waterproofing related repairs.

13. Repair minor cracks in non-structural topping slab with applicadtion of traffic coating over the affected surface. Cracks and divots shall be properly prepped prior to the traffic coating being applied and any fills or caulking used shall be compatible with the traffic coating.

14. Areas with waterproofing membrane below a topping slab would ideally be inspected to ensure the membrane is performing adequately, especially where corrosion is present. Where this is not practical, the waterproofing system will have to dependent on a waterproofing traffic coating that is placed over the topping slab.

15. All slabs exposed to the outdoor elements should have a protective coating applied to prevent potential water and deterioration to structural elements below, such as the structural concrete slab, structural framing, or metal decking. A maintenance plan should be implemented to ensure the coating is adequately maintained and replaced as needed.

16. Recoat areas with deteriorated traffic coating in seating bowls, along concourse surfaces, and on pedestrian ramps.

17. Inspect corroded steel angles along the pedestrian ramps and seating bowls for the severity of deterioration. Replace angles if necessary.

18. Apply approved sealant along gaps in pin caps and upstand plates of the boomerang columns.

19. Remove and replace all failed and deteriorated sealants. Install or replace backer rods where appropriate.

20. Wire brush corroded material from seating bowl railing fasteners or replace. Replace all missing nuts and bolts.

21. Wire brush corroded material from raker beam edge metal or replace.

22. Replace sheets of corroded secondary roofing.

23. Remove and replace sections of delaminated fireproofing.

24. In elevated parking lots, seal cracks in the topping slab per ICRI guidelines.

25. Intermediate concrete step risers should be fully sealed and not partially sealed to keep water from freezing and expanding (freeze / thaw) under the riser, to prevent separation from the precast seating risers.

As you consider necessary repairs and maintenance, we support the use of the following products:

- Traffic Coating: Lymtal International (CRU Microflake System) and Neoguard Corporation (FC System).
- Joint Sealants: Sika 2C NS-EZ with TG Additive by Sika
- Dimeric Sealant: 240 FC by Tremco and Isoflex by Lymtal
- Silicone sealants: Dow 790 or 795 or Pecora 801
- Backer rod: SOF by Nomaco.

The project team agrees with the related specifications in the County's ITB No.: 001-22 for Drainage and Membrane Installation. This document can be found in Appendix B.

We also offer the following comments:

1. We understand Capital and Maintenance projects are established annually related to sealant / caulking replacements. As water leakage is a major issue, as much of the caulking replacement should be done in year one as possible, particularly those that show tears and sign of failure. We assume vertical caulk joints likely suffer less failure than horizontal caulk joints as water typically can't sit on the caulking in the vertical position. Locations where people walk the most or vehicles travel are likely to deteriorate more rapidly and are areas of high priority.

2. The expansion joint assembly replacement combines several parts, so assume the surface cover takes the most abuse, but the interior bladder underneath to capture the water/ice/salt might deteriorate sooner, or its connection to drain lines. Controlling the speed of vehicles over the expansion joints will likely extend the lifespan of the cover and attached assembly below.

3. The waterproofing occurring under the wearing slab has failed someplace, as water is leaking through to the occupied spaces below. A new waterproof traffic coating should be placed over the topping slab to seal it. Removal of the topping slab to expose the old waterproofing and allowing it to dry out or be replaced, prior to reinstalling the topping slab is likely not practical. Sealing the existing topping slab with a waterproof traffic coating to prevent further water intrusion should be done after the topping slab has dried out. When replacing the wearing slab is determined to be required, control joint spacing needs to be determined to help reduce the extent and size of shrinkage cracks.

4. Where metal deck has rusted through, that will require either removal of the topping slab to install new pieces of deck in those areas, or provide new structural framing members to divide, shorten and re-support the concrete slab and remaining metal deck. Where slabs are removed and replaced, some additional rebar in the concrete topping slab over the metal deck will be required.

5. For informational purposes, Appendix C contains the tracking maps that PBSL utilizes to memorialize locations where waterproofing and structural issues are being identified and addressed.

We understand that PBS has an established annual maintenance program in place related to sealants, waterproofing, concrete, decking and steel repair. This effort is established and maintained between the organization, Hamilton County and County engineering firms.

While we don't know the specifics of the annual maintenance program and annual financial budget, we recommend every year redoing a section of the stadium, in a sequential order, until the whole stadium has been renovated and effectively sealed. As much repair / sealing as possible should be done as soon as possible to minimize future damage due to delay in implementing the repairs over a longer time period. We understand this may be a lengthy process due to potential limited annual maintenance budgets. The maintenance program is to remain on-going, so once all the stadium waterproofing / repair renovation is completed, the cycle starts again, as the original repaired sections are likely to have reached the end of their useful lifespan and require replacement. A conditional assessment should be performed each year by a qualified structural engineer and architect to evaluate how the structural and waterproofing/sealing repairs are proceeding and performing, as well as determining if any remaining repair item prioritization needs to be adjusted.

Glossary of Terms

The definition of terms used in this report are listed below.

BIOLOGICAL GROWTH: A generic term for the presence of an organism that appears on building surfaces due to moisture, such an algae or mold.

CONCRETE: A composite material that consists of fine and course aggregates, Portland cement and water, and may contain admixtures.

CORROSION: Deterioration of steel through an electrochemical process that requires moisture and oxygen simultaneously.

DELAMINATION: The separation of the paste layer at the surface of a concrete element, creating an un-bonded concrete layer. Delamination may be caused by corrosion of the reinforcing steel, inadequate concrete cover, poor concrete

consolidation, or concrete expansion and contraction due to freeze and thaw cycles.

DETERIORATION: The decomposition of a material due to exposure during its lifetime.

DOUBLE TEE: Precast concrete structural member with two thin flanges connected by a top surface.

EFFLORESCENCE: A crystalline or powdery deposit of salts visible on the surface of concrete or masonry due to the migration of soluble salts caused by moist conditions.

ICRI: International Concrete Repair Institute

LEACHING: Draining of lime compounds from the concrete matrix as a result of water infiltration, resulting in the presence of efflorescence. It may also be the result of alkalis draining due to alkali-silica reaction.

MAINTENANCE: Taking periodic actions to prevent or delay damage and/or deterioration.

PILE FOUNDATION: A deep foundation that consists of slender columns made of concrete or steel that are used to support a structure and transfer the loads to a soil depth with adequate conditions.

PILE CAP: A concrete mat that provides a larger area of distribution for piles and forms a deep foundation.

PRECAST CONCRETE: Concrete that is cast and cured in a controlled environment then transported to site.

RAKER: An angled, notched beam that supports stadium riser units.

SPALL: A break away of a portion of concrete from the surface of a concrete elements and may extend to the depth of the reinforcing steel. Concrete spalling occurs when the embedded reinforcing steel experiences corrosion but may also be attributed to poor quality control of the concrete mixture, freeze and thaw cycles, inadequate concrete cover of reinforcing steel, or expansion due to the reaction between the cement past and silica found in aggregates.

TOPPING SLAB: the non-structural overlay which is designed in order to provide a dense, abrasion-resistant, and finished floor surface for multiple purpose use such as providing a wearing course to support traffic and pedestrian loads.

VOMITORY: An opening in a stadium that allows for the passage of people.

TECHNOLOGY

Technology

In House Video Production

Summary

Upgraded in 2013, the video production system remains the core for content delivery to the LED video displays and televisions deployed throughout the facility. It consists of game and field cameras, video production and routing switchers, slow motion/instant replay, communication intercom, servers, monitoring and control equipment. The production environment is laid out classroom style with Multiview on the front wall and rows of operator positions facing forward for a view of the bowl and field.

Video production is having another technology shift with more computer-based systems to accommodate digital signal processing, IP based control and communication, and microprocessor driven equipment. The computer-based systems generally have a 5 to 7-year life expectancy due to 24/7 operation, becoming electronically obsolete and shift away from interest in its intended function. Depending on whether the systems are covered under a service agreement or not, planning should begin to replace them after 5 years of service.

Digital signal processing, video production switchers, cameras and lenses have a slightly longer lifetime (assume 10 years nominally), but the challenge is after 10 years, the products may still function, but the manufacturers cease support which requires the venue to keep a replacement inventory or turn to secondary markets (e.g. E-bay, other venues whose products are being replaced) to support these aging systems.

The existing video production system is HD-SDI 1080i and while this system's signal resolution is typically influenced by the team's desire to keep up with the latest technology, few renovated or new facilities have implemented 4K solutions. The production switcher and video clips player were replaced for 2021, the first of the core systems being addressed outside the edge of its life expectancy.

Some equipment within the entirety of the system is newer and considered as within its life cycle and the brands selected would be considered "best in class". There is equipment nearing the end of usable life and has not exhibited any regular failures, but experience informs that it is just a matter of time. Overall, the systems are functioning because they are maintained by highly competent engineers who have implemented regular upgrades in step with technological advancements.

All 2021 and 2022 video production control room renovations are financially challenging because a premium is paid to follow the current trend as technology advancements move away from SDI/coax cable signal transport towards IP/Data Network signal transport. It is expected that IP video production systems will be completely adopted within five years, so core SDI systems replaced within this timeframe are predicted to have a shorter than expected lifespan. However, there are SDI/IP bridging technology devices and signal converters that may be deployed to create a hybrid solution, but they introduce on average an additional 25% cost and are of limited use once a complete IP conversion is implemented.

Findings

The last video production system upgrade was performed in 2013, parallel to the industry technology trend moving from standard definition video SD-SDI to HD-SDI at 1080i. The room is now within the life expectancy window of 7 to 10 years when access to equipment replacement parts and repair is no longer available. Although incremental device replacements have been made to keep up with changing requirements, a video production technology upgrade will bring the show in line with the 4K HDR format that the top tier sports teams are moving to. Until the upgrade occurs, there are core video components operating at great risk to the game production. Some key elements of the system in need of replacement are the clips playback system, slow motion replay system, multi-viewer monitors, core video router and production switcher. All of these devices are end of life and no longer supported by their manufacturers. There is a plan to replace all but the slow motion and core video routing system prior to the 2021-2022 season.

Legacy slow motion system

Video production is the "engine" that drives the LED video displays as well as provides content to the televisions deployed throughout the facility. The system consists of game and field cameras, video and routing switchers, slow motion/instant replay, graphics computers and monitoring and control equipment.

The challenge to video production after almost a decade is the products may still function, but the manufacturer may have ceased support which requires the venue to undertake a sparing inventory (buy spares) or turn to secondary markets (e.g. E-bay, other venues whose products are being replaced) to support the system.

Legacy core video router

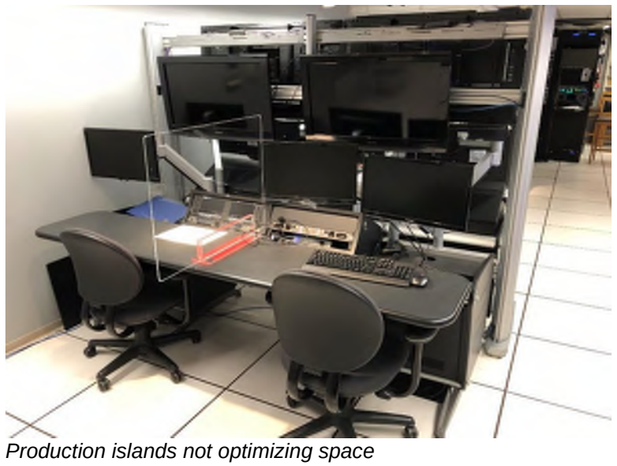
The control room upgrades should focus around a SMPTE 2110 upgrade. All newly constructed and renovated NFL teams have adopted the 2110 format as well as HLG HDR. This upgrade will need to occur in parallel to other systems within the stadium such as LED displays and the replacement of the DTV system with IPTV to create a unified video approach throughout the facility.

Although some smaller facilities are still being built using the HD-SDI signal technology, most peers currently in design or deployment are moving towards an IP based system architecture.

The planned video production upgrade should take into consideration trends seen in recent NFL renovations and new construction that utilize up to eight manned cameras. The increase in camera quantities has followed an increase in camera uses with some of the same cameras (and recording devices) being suitable for high frame rate (HFR) “super-slow motion”. Recent NFL scoreboard control rooms (e.g. Raiders, Rams, Colts, and Falcons) have created HFR islands to support that playback. High frame rate slow motion yields more compelling replays with little change to the existing workflow. There is an additional drive in all camera formats to shift to high dynamic range (HDR) content and wide color gamut (WCG) which results in more vivid images much closer to the how our eyes would perceive the original subject. Additionally, adding dedicated 4K or even 8K HFR POV cameras should be considered as these additional angles not only enhance the story telling element of the game but have, at times, influenced the outcome of certain plays.

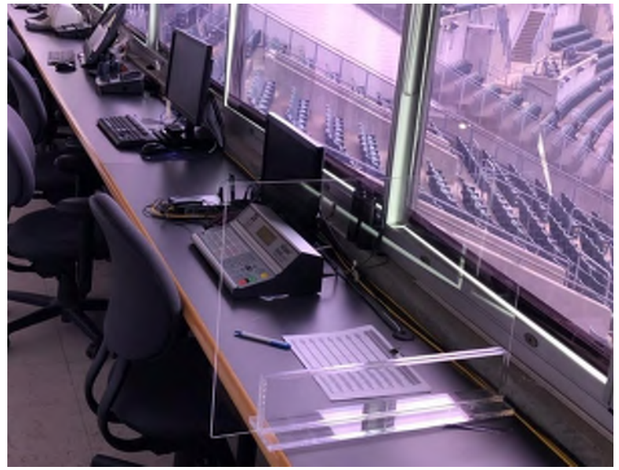
Camera control station supports (6) manned cameras

The video production room at Paul Brown stadium has both adequate operator and equipment rack space, but will need modifications to the layout of the room to solve several of the challenges in upgrading the production system as seen in newer NFL facilities. The chief complaint of the current room is not enough dedicated operational positions and multi-viewer monitor systems to expand. This could easily be remedied with minor spatial modifications to remove the production islands and replace with long rows of operators. With additional cameras and high frame rate cameras, more operators will be required to support those technical systems.

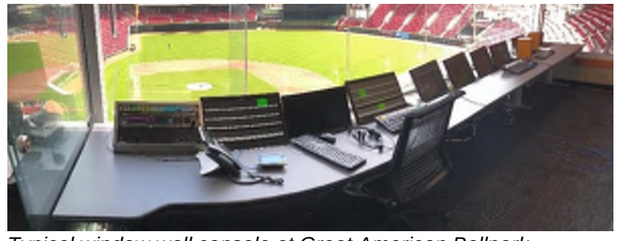


Production islands not optimizing space

Additionally, a trend among most scoreboard control rooms is replacing milled counter tops with narrow production millwork. This would allow all monitors at the front control bench to be recessed into the counter and thus allow better sightlines to the field with a more efficient operational space to control the stadiums LED displays.



Paul Brown Stadium window wall counter



Typical window wall console at Great American Ballpark

The current control room system at Paul Brown Stadium in comparison to many similar peer NFL facilities does lack in its show presentation ability. There is currently no connectivity to fan interaction zones (party decks, entrances etc.), show production infrastructure such as IFB’s, monitors, etc. are non-existent and there are minimal confidence or show enhancing PTZ cameras to interact with the fans pre and post-game or monitor events in the stadium not visible from the control room or existing camera locations.

The current control room production system is HD-SDI at 1080i 59.94. There are (8) Grass Valley LDX 80 cameras with (6) being hardwired and (2) wireless. The cameras are equipped with (4) Fujinon 77x lenses and a variety of smaller 24x and 13x ENG style lenses for handheld and wireless operation. The cameras are supported with Vinten large camera tripods for game day use and Sachtler for portable ENG use. The camera lenses and support are in good condition. However, 77x glass is typically undersized for modern stadium production. When shooting in HFR it is best practice to use 88x – 102x lenses so that when you're shooting at night the amount of light loss thru the lens is less at the current zoom ratio, thus resulting in more vibrant imagery when played back in slow motion speeds.

The video production switcher is a 4M/E Ross Ultrix Acuity switcher sized with 80 inputs and 80 outputs, installed prior to the 2021 season.

Ross Vision switcher

The slow-motion replay system is based off the now-discontinued Grass Valley DYNO replay system. There are ten inputs and four outputs. For the existing system this is sufficient, but the technology used is aging and no longer supported. A new replay system that should be considered should be almost doubled in the number of inputs to support multi-phase high frame rate recording. Additional features such as automated clip tagging, collaborative replay, real-time slo-mo editing and export to a master media asset system are all features not currently had on the existing systems that all modern NFL teams are able to capitalize on. Not only do these new replay features make game day production more efficient but they also help to ensure that all plays are captured, analyzed and used for maximum revenue generation.

The current CG systems are based on the Chyron Prime Lyric platform. This is an older platform with plans to migrate to a new Ross Xpression based platform for the 2021 season while maintaining one lyric box. During a renovation these systems should be standardized with the LED content & playback system to maximize efficiency. By utilizing the same graphics system, content can be shared between systems without having to recreate each individual item per system. This saves time and maximizes content development hours.

The video production system core is based around a Grass Valley NVision routing system with Evertz, Ross & Grass Valley distribution equipment. While this equipment is suitable for baseband production, the future of video production has moved away from large scale central RF video routers and components. Updated IP SMPTE 2110 systems rely on high performance network switches for core routing and reprogrammable FPGA software-based processing to accomplish what used to require dedicated specialized hardware. Additionally, this routing platform has been discontinued by the supplier and while reliable, is beginning to show its age. As these products no longer receive software updates/patches and as computer technology progresses, they become more difficult to control and run the risk of no longer being able to be accessed by their control systems due to the software not being executable. Additionally, should a failure occur, replacement cards will from the manufacturer will no longer be available after 2021.

A sizeable amount of Rackspace and power is currently being utilized by AJA FS1 frame synchronizers. Not only have these devices been upgraded over time, they have also become more dense to allow more processing per RU. Upgrades to these systems to newer hardware will result in a decrease in power and cooling consumption.

Frame synchronizer rack

The production intercom system is based around the RTS Adam platform with wireless being provided by Clear Com tempest. While the matrix intercom solution is efficient and still in production, the technology is showing its age. Modern matrix intercom systems utilize AES 67 across network switches for communication. The current system is currently operating over analog four-wire technology with serial control to each panel. Over time and as the cabling degrades more noise will be noticeable on each of the channels and point-to-point cross points within the system. A modernization of the system to a comparable RTS Odin or Riedel Artist is recommended. Additionally, the Clear Com Tempest system has been discontinued for a number of years now and will soon be almost inoperable. As cellular networks have evolved and FCC frequencies adapted to allow for a larger amount of spectrum to be used for wireless services, this has made the tempest system almost unusable. A modern matrix based wireless intercom solution utilizing the DECT bands with multiple access points installed throughout the stadium is required to allow for communication between the control room and production staff elsewhere in the building. A minimum of fifteen belt packs is desired for this production group and a DECT based system allows more to be added in the future.

Discontinued wireless intercom system

The critical system that connects remote servers in the dedicated equipment room to operational positions in the control room known as a KVM, or Keyboard, Video & Monitor, extension system is based on the Adder Infinity KVM system and was updated prior to the 2021 season.

At time of this survey the post-production technology was planned to be Iconik with 200TB of Edit Share storage being installed prior to the 2021 season. During a production room upgrade, additional effort should be made to expand this system and ensure that all real-time assets can transfer into it, with appropriate production metadata and all finished post-production assets can transfer to their respective live production systems with integrated and trackable workflows. Additionally, a multi-tier archive system should be considered for installation into the Bengals workflow. We anticipate the archive system to consist of local object storage and off-site cloud-based archive.

Covered in depth in the broadcast cable portion of this report, but noted here, is how limited camera positions and video distribution are within Paul Brown Stadium. Consideration should be given to increasing the amount of available camera positions, additions of set locations and connectivity to the control room added. There are only a handful of locations such as the TV Truck Dock and Press Conference Room that are connected to the video control room. Additional cable to add is Dedicated SMPTE & Single Mode fiber to each broadcast location directly ran to the production control room. A minimum of (1) SMPTE, (12) SMFO per location and additional tie lines to the TV Truck Dock with a minimum of (8) SMPTE and (48) SMFO should be considered.

Bengals TV Studio

Not only do modern NFL facilities construct production control rooms that focus on live game day entertainment, but they are increasingly investing in post & social media entertainment production. Paul Brown Stadium would benefit from the addition of a production studio and workspace for the post-production staff including dedicated edit suites, audio recording booth, green screen room and network live shot room. The approximate footprint of this space would be around 3,000 sq/ft in total and ideally would be all in a similar area, but not a requirement.

Equipment at Great Risk

The following sections of gear are at great risk, and efforts to replacement them should begin immediately. These items are either well outside their useable life cycle or have already begun to have intermittent failures.

Slow-Motion Replay System

The Slow-Motion system is based off the Grass Valley K2 DYNO server family and was installed with the control room upgrade in 2015. As these are server-based systems it is at the end of its life with the vendor discontinuing it in January of 2018. The slow-motion system is a key component in adequate storytelling and should be replaced in the next purchase cycle.

Wireless Intercom System

The wireless intercom system is functioning as designed and was discontinued in 2017. While the units are functioning, they sit in an area of spectrum that will eventually be utilized by 5G and no longer able to operate legally.

Equipment That is Stable, Reaching End of Life

The following equipment has reached or will within the next season reach the end of its usable life cycle. Although the gear is not currently exhibiting major failures, it is to be anticipated that this will begin to happen and plans to budget for replacement within the next two offseasons at most should be prepared.

Cameras

The cameras, while in fair condition are beginning to show their age. Updated camera technology will not only aid in the visual appeal from the upgraded image sensors but additional features such as High Dynamic Range and Super Slow Motion are a standard in modern NFL facilities.

Matrix Intercom System

The RTS ADAM core, while still in production is based off of an analog matrix in a four-rack unit (4RU) high chassis. While still functional this amount of technology has been replaced with digital and fits into a 1RU package. Additionally, new matrix

cores also support DECT based wireless, which will be a necessity in the future replacement of the wireless intercom system.

Core SDI Router

The core SDI router is based on a discontinued Grass Valley NVision Router series. While baseband routers are still in production, this technology is being abandoned in lieu of IP based systems. All new NFL facilities being constructed or renovated have adopted IP based core routing and Paul Brown Stadium should consider this as a platform moving forward.

Equipment in Good Condition

Camera Lenses

The lenses are original at 6 years old but still working. It is advisable to have them factory recertified and, unless production needs desire a different lens compliment or the show transitions to 4K, the existing lenses should serve well for several more years.

Distributed TV & AV

Summary-Distributed TV

The television system is an RF distribution plant with content for its channel lineup inserted from Spectrum, DirecTV and in-house video production (JungleVision). Signal is distributed over coaxial cable throughout the facility terminating at jacks behind individual televisions. Random locations tested found good signal with no artifacts in images. The system is well maintained but many areas have ad hock additions with no cable management and although it may satisfy current requirements, a move to an IPTV based solution will provide a feature-rich resource with greater opportunity for monetization of other scopes including concession menu boards and digital signage.

The televisions and mounting brackets used throughout the facility are a random mix and since the last upgrade many different TV sets were installed as part of location improvement opportunities. Replacements did not stick to the existing product line or manufacturer which has exacerbated the game day operational functions. There is no control system to turn the sets on remotely requiring multiple staff members with multiple remote types to turn the sets on and off manually for events. Many of the TV brackets are from original construction, designed to hold CRT displays that were substantially heavier with a larger profile and are not aesthetically pleasing when combined with flat panel displays. Many of the TVs are undersized for the spaces they are in.

Findings-Distributed TV

There are only a few locations within the east and west clubs to insert an audio or video signal into the in-house cable television system, and once added there are further limitations on which televisions in the clubs as to where those signals can be displayed. There are clusters of four televisions that have very large gaps between them so they could not, if the necessary electronics were available, be used as video walls.

Four display TV cluster

During prime-time television slots in a premium sports venue space, one would expect to be able to see the Bengals game, away games or major events, fantasy stats and RedZone, so a higher display count narrow bezel video wall or large segmented LED display would be better suited to draw and keep fans in these areas.

Concourse concession displays

This concession would benefit from a refresh of AV technology tied to the larger stadium system to benefit from dynamic messaging. Cisco, TriplePlay and VITEC have digital menu

board solutions that may be developed as standalone or full-blown building IPTV solutions.

Television Displays

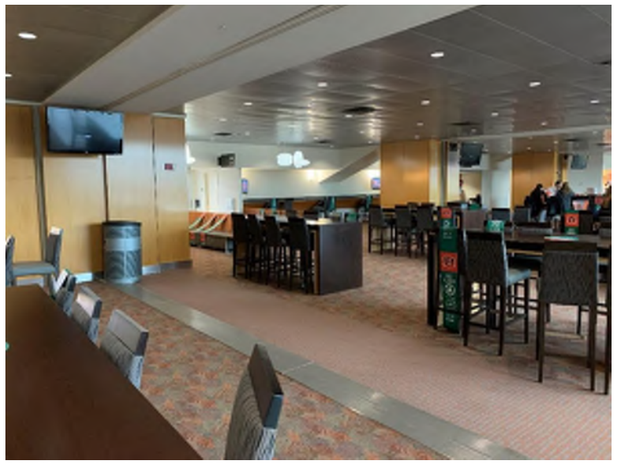
There are approximately 500 televisions distributed through the clubs, bars, concourses, and premium spaces, all of which must be operated locally by remote control. Compounding the issue is having multiple display manufacturer's products throughout the stadium which adds significant time, operationally, to configure the facility for a game. The sets range from commercial grade to consumer displays purchased as an expedited replacement or marketing opportunity. There are outdoor fully weatherized displays in use in some locations with some consumer grade displays installed in a weatherized housing to consumer displays being installed outside in a semi-exposed to the element environment with no enclosure. There are no elevator displays. The vast majority of the displays are installed on mounts designed with large arms with weight capacity to support very heavy legacy CRT displays.

Fully exposed non-outdoor rated television

The television displays throughout the stadium are functional, but with so many different makes and models there are no standards for image quality, any type of remote management and no common metrics for latency or channel setting. In order for operations to turn on all displays they must carry at least five different remote controls from various manufacturers/types.

With such a wide range of displays and various ages the following is a list of things to consider when continuing this method of replacement/operation:

- Warranty support, technology in use (as relates to backlight technology and power consumption as well as things like 4K support)
- Aesthetic appeal (small profile, ultra-thin bezels)
- Reliable usage
- Costs of staff to operate and support displays
- High risk of targeted marketing revenue loss due to the inability to remotely monitor display operating condition, is the display on/off or getting signal


Multiple displays on with no signal

A plan should be developed to replace these displays in the next 12-16 months as failure rates will begin to increase after the current winter season, especially for the displays near concession stands and exterior concourses. That said, the majority of displays still look reasonably good, so complacency in planning this step must be avoided.

NFL stadiums that have installed IPTV systems with one majority television display manufacturer's product or upgraded from the traditional cable TV system to IPTV include AT&T Stadium - Cowboys, Lambeau Field - Green Bay Packers, Ralph Wilson Stadium - Buffalo Bills, Metlife Stadium - NY Giants, Levi Stadium - SF 49ers, Mercedes Benz Stadium - Atlanta Falcons, Allegiant Stadium - Las Vegas Raiders and SoFi Stadium - Los Angeles Rams/Chargers.

Summary-A/V

By 2021 standards, there are limited capability Audio Video systems in private and public spaces including concourses, clubs, lounges, and suites with some areas having different generation and combination of equipment. The lack of options in larger premium spaces for local insertion of content on the television system forces staff to resort to using portable and rental solutions to satisfy event production requirements. The available A/V input locations are not in proximity to traditional head of table or main stage positions, so cables must be extended and taped down as needed and in some cases, those runs can be up to two hundred feet to satisfy event needs. Staff have found some creative ways to meet the event requirements but providing better display options and ways to address them in a more targeted fashion would increase revenue generating opportunities by making the spaces more attractive to event planners, as well as competitive with other local facilities who pursue the same clientele.

Findings-AV

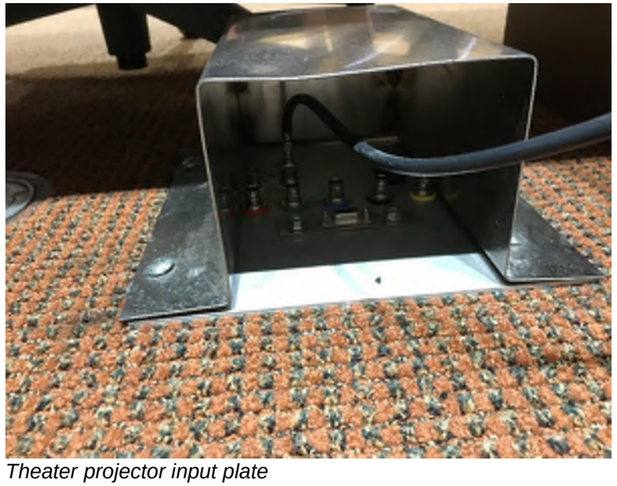
Team A/V

The Offense and Defense team theatres are set up in classroom style with teaching podium, workstation source selector and workstation at the front of the room and projector overhead mid-room.

Teaching workstation

Offense Team Theatre

While the computers have been kept current, the projector cable infrastructure is from original construction. The existing projectors are commercial grade rated at 6000 ANSI lumens for larger venue use but this relatively bright environment needs a projector rated closer to or greater than 15,000 ANSI lumens to not be washed out by overhead lights.



Theater projector input plate

The theatre wireless microphone base stations, processors and amplifiers for the sound systems are housed in equipment racks at the front of the room. These systems are at end of life and should be replaced.

Team theatre equipment rack

There is a significant amount of equipment that is swapped in and out of coaches teaching stations during a season which makes cable dressing next to impossible.

Viewing high resolution images and video is critical to the training process for all team spaces. A challenge in the smaller team meeting rooms is a combination of computer monitors, televisions and projectors must be employed to satisfy the need. In some of the rooms it appears that the projected images would not be easily viewed by players in the front row.

Position meeting room

Distributed TV Headend

The head end is located adjacent to the MDF on the Service Level near main security. The distributed TV system at Paul Brown Stadium is based on an RF-QAM hardline distribution system with the primary system launch from the headend. The system was upgraded in 2014 with a new UCrypt for management of the cable feeds being provided by Charter Spectrum with an ATX UCrypt device.

Cable TV provider demark

Additional sources in the cable plant are several DirecTV receivers attached to QAM modulators as well as four (4) feeds that originate from the in-house video production system. The average latency on the in-house feeds is around 2-4 seconds. This amount of latency, while somewhat of a distraction if in the sightline of the live event, has come to be appreciated by those not in view of the field as a way to quickly review an exciting play based on crowd noise.

Satellite receivers & in-house feed encoders

Upon observation of the DTV head end equipment racks it is clearly noticeable that the system has been upgraded several times within the life span of the facility. There are numerous abandoned pieces of equipment, cables, etc. that are no longer in operation and should be removed and recycled. The environmental control system in the space does not appear to be properly filtering air as the majority of the equipment was extremely dusty. RF equipment does not need to be in a perfect clean room, but standard care of electronics equipment does apply, and the equipment should be cleaned regularly. This will allow additional lifespan and optimal operational standards. Overall, the room would benefit from a deep cleaning, removal of all decommissioned equipment and cable management inside the racks and onto the walls.

The overall RF performance of the distributed TV system within Paul Brown stadium is acceptable. Multiple displays were spot checked by adding 10dB pads in line of the display. All displays tested did not show any signs of signal degradation, meaning the overall RF performance of the system is acceptable.

While the RF plant is in good condition considering its age, the system as a whole is outdated. Every new NFL stadium that operates today utilizes IPTV. The reason for utilizing IPTV comes down to a greater ROI over the current system. IPTV makes it possible for operators to more effectively distribute branded and paid for content throughout an entire facility. While IPTV relies on the building data network, it is widely considered a greater benefit and easier to manage than an RF QAM system for the following reasons:

- Completely custom channel lineup
- Video On Demand and paid subscription upgrades
- Brandable overall and by area
- Low Latency
- Interactive
- Combines digital signage and TV distribution in one system
- Allows remote management of all end point & displays
- Is expandable wherever a data jack exists today or can be added
- Open API capable, allowing custom apps and interfaces for control of devices and viewing of targeted video content.

Broadcast Cable System

Summary

The broadcast cable infrastructure is not consistent with the typical requirements of national broadcasters' coverage of NFL games. Existing locations have small compliments of camera and audio infrastructure including coax, Triax and single mode fiber, but the expectation would be for all locations to have SMPTE hybrid cabling as well as Triax, Single Mode Fiber Optic Cabling, XLR Audio, Coaxial and ethernet cabling.

The camera junction boxes, JBTs, are physically in good condition but the enclosures and connections are showing wear and corrosion from the harsh outdoor environment. As more network trucks that service the games become fitted with SMPTE/fiber cameras, the cabling infrastructure installed in the facility will need to be upgraded to meet the technology

advancement. Installation of additional JBTs began in 2021 and continue in 2022, and additional scopes will be defined to ensure PBS is meeting the broadcast standards.

At the TV truck parking location, television remote production (TVRP) racks have a few connections marked out of service but overall, they are well maintained. The small number of connections in the TVRP racks immediately reveal the limited infrastructure options available to television broadcasters. Referee Replay, league equipment and outbound fiber circuits for video transmission to the TV network show's home location are easily accessible.

It is important to note that as of August 2021, the facility and CBS are currently performing a broadcast cable project/upgrade. However, this does not address the lack of overall camera positions or any expansion to the physical footprint of the TV Truck compound.

Findings

Introduction

As part of the ongoing stadium in house video production system and other improvements, the broadcast cabling system has been identified as one of most pressing concerns for game day operations as the existing connectors within the broadcast cabling junction boxes (JBT) are exhibiting corrosion along with loose panels and damaged enclosures that are affecting the functioning of the cabling system that is used to connect cameras and other devices used for both the in-house video production system scoreboard show and the network, play-by-play broadcasters. To help mitigate this situation, a planned project will replace the field junction boxes, panels and connectors in addition to adding new infrastructure.

Current Conditions

There are five categories of cabling that fall under the general term "broadcast cabling". These include:

- Network Cabling – This cabling and infrastructure is used by the NFL play by play broadcasters for live, televised games.
- NFL/Team Coaching Game Operations Cabling – This includes NFL technologies cabling to support Bengals and visiting team coaching cabling (video coaching and intercom, ring down phones). The infrastructure includes connectivity to provide signals to the league offices.
- Jungle Vision/In-House Production Cabling – This cabling and infrastructure is used to support the in house-video show for the stadium's LED displays.
- Local TV (ENG) Cabling – Provided so regional TV stations and an occasional visitor (more likely during playoffs) can provide live and prerecorded video to their local markets. This cabling is not used for play-by-play broadcasts.
- Play by Play Radio Cabling – The smallest of the categories, for live game radio broadcasts.
- Cable Tray – The existing tray is a center splined supported type, and triple stacked on the Service Level. There does not appear to be a clear assignment of cable to specific levels. The cable management is what one would expect after 20 years of additions and revisions. There has been cable added to support new technology (DAS and Wi-Fi). To our knowledge there has not been a running accounting/record keeping of the changes to the system over the life of the stadium.

Broadcast Network Cabling

The play-by-play cabling system used by CBS, ESPN, NBC, Fox, NFL Network, etc. was installed by CBS subcontractors during the original construction of the building. It has been added onto over the years, but the majority of it remains intact. Multi-mode fiber optic (MFMO) cabling was installed originally. Single Mode Fiber (SMFO) was added several years later to accommodate larger broadcast shows (such as Monday/Thursday Night Football).
Cable that has been abandoned (primarily MMFO and some copper (coax and audio) has not been removed. The original network junction boxes (JBT) are largely as originally installed, and connectors show tarnish and rust on the connectors with loose panels with missing racks screws which are rusted as well. There are loose cables in the bottom of the JBT boxes. The original video coaching infrastructure was all based on triax and coax and can be removed.

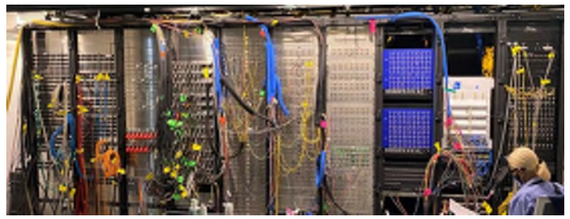
The main follow position can only accommodate a single camera. New NFL stadiums accommodate up to 5 cameras (college supports 3). These might include 2-network, 1-Jungle Vision and up to 2 NFL Film cameras). Depending on the long-term goals for Jungle Vision, the main follow 25-yard line positions may want to be expanded to handle 2 cameras versus single cameras. Many of the in-house production facilities are placing cameras at the main camera positions.

Existing network racks, AT&T (common carrier), and NFL Technology racks

As can be seen from the photo above, the existing network racks (4 racks on the left) are installed on the loading dock platform. The right single rack is the NFL Technology rack. As part of a 2021 capital project, Paul Brown Stadium will be performing upgrades to the TV truck dock and selected field junction boxes. Upon completion, the network broadcasters should be consulted to identify additional areas that may benefit from future upgrades.

CenturyLink and The Switch (Common Carriers)

The fiber optic back haul carrier's equipment has been added. These companies take signals from the TV trucks and leagues and send them over high-speed fiber optic networks to league replay systems and broadcast network home studios. The photo below shows the cable termination rack compliment at SoFi stadium for comparison with a brand-new stadium installation



Cable termination room at SoFi stadium, for comparison of NFL Standards. Sliver panels are network installed, black/blue are in-house and common carrier I/O panels

The interior TV truck parking was originally configured for two trucks. For larger shows, the other vehicles are typically parked in the yard outside.

Satellite uplink trucks are also parked in the dock yard.

NFL Technology

This cabling and equipment include NFL instant replay, injury review, coaching video, and coaching intercom systems.

The current NFL technology equipment rack is located on the loading dock as shown in the photo below. In new construction projects, the NFL has additional equipment racks and is requesting a dedicated room or a fenced/secure space within a shared room. Starting with the 2021 season it is anticipated that the NFL will switch to the Hawkeye review system which may require additional cabling to the Hawkeye camera locations and additional rack space required for servers.

NFL Technology rack at truck dock (nearest rack)

The NFL instant replay cabling has been continuously upgraded as the league has evolved the system over the years. This will continue. Other than the overall NFL technology equipment space requirements, the existing pathways are sufficient to accommodate future (known) changes. The NFL technology cabling needs to be identified to keep it from being removed. We recommend contacting John Cave or Chris Vassallo with the NFL to see if any changes can be coordinated with the broadcast cabling update.

The images below illustrate the additional cabling now being installed by the NFL for the sideline instant replay junction box. The newer stadiums have more single mode fiber to support future NFL technology changes.

SoFi Stadium sideline NFL box

Paul Brown Stadium

Like the other systems above, the coaching intercom system has been updated over many seasons by NFL-hired installers. The new NFL technology fiber appears to have been re-located to the old ENG field wall boxes. The following picture shows the old analog cabling panels. The old cabling and panels can be removed, and the boxes potentially re-allocated for something else.

Old analog coaching cabling at visitor field sideline

Jungle vision/In-House Broadcast/Video Production Cabling

Dedicated stadium video production cabling is largely as originally installed with updates for the in-house video production system. The newer stadiums are typically utilizing SMPTE with 6 or 12 strands of single mode fiber going back to the video production rack room.

A significant amount of in-house fiber optic cabling has been added to the TV truck dock cabling room on top of the existing network cabling racks as there is currently not the horizontal width available for additional racks.

ENG Cabling and Mobile Unit Parking

The original cabling plant with dedicated cabling for each regional TV station extends from multiple locations in the stadium, and the parking location has been largely abandoned as technology and TV's station budgets have changed. Most stations are now using stadium provided Internet access and bonded cell phone system service to transmit live and prerecorded video out of the stadium to their home studios rather than using microwave or satellite transmission. This has been a consistent trend in most NFL markets around the league.

Radio Cabling

Radio cabling is not part of the network broadcast cabling update. It is recommended that 6 SFMO and 4 audio lines be run from the TV network racks to home, visitor, and national radio booths.

Bengals Radio. A new sound board and rack will be installed for iHeart radio for the 2021 season.

Cable Tray, Cable Pathways and Infrastructure

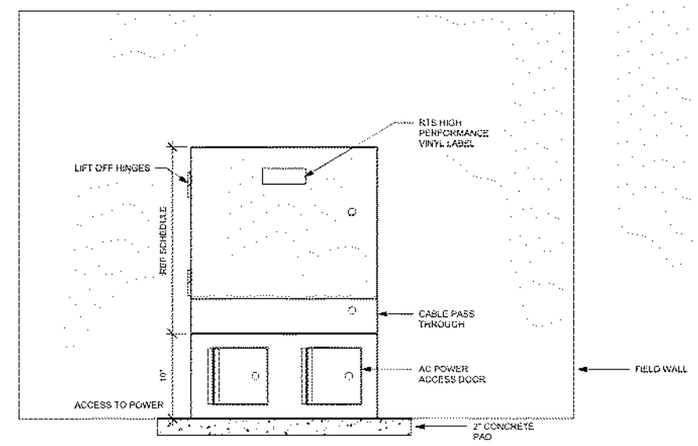
The existing cabling tray system appears to be in good condition, but additional small trays are needed (with review and approval by a structural engineer). Given the age of the building, the cabling changes and adds that have occurred over time, the trays, compared to other stadiums, are not severely overcapacity or messy. It should be feasible to identify what cables are where and which have been abandoned.

With removal of unused cable as part of any broadcast/AV projects, the tray system should have sufficient capacity for expected new cabling.

The existing broadcast cabling junction boxes are showing their age. With CBS wanting to add SMPTE cabling and additional SMFO it is recommended to go with a deeper box to accommodate SMPTE and fusion splicing behind the panels. The field boxes will likely need to be taller to accommodate some of the additional cable that CBS desires.

AC Power

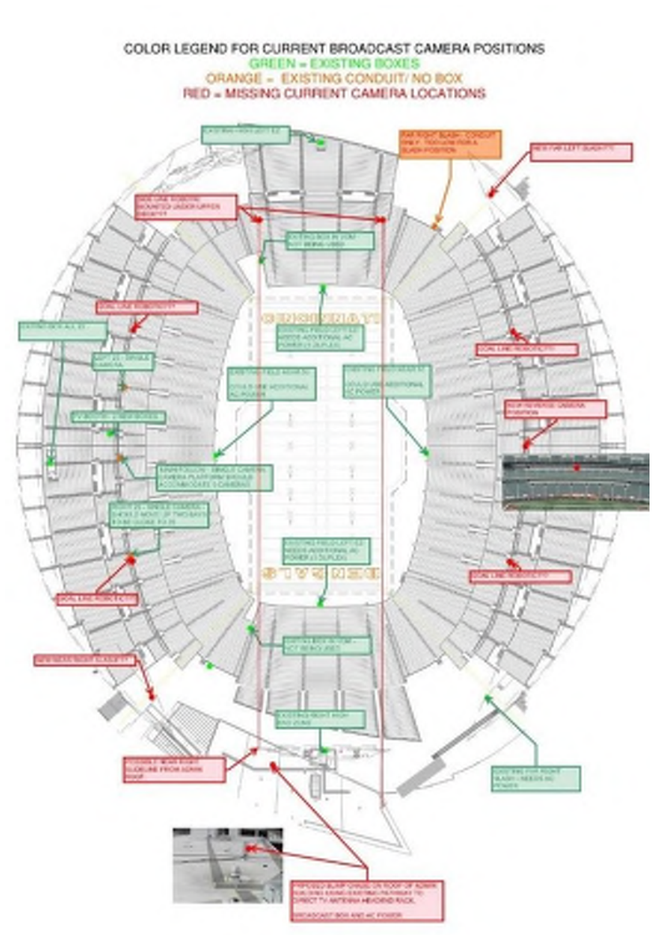
The newer stadiums have two 20A circuits terminating to quad outlet boxes at each JBT box. This is especially important on the field level with pylon cameras and RF setups. The increasing use of portable technology at traditional camera positions has placed additional demand for power, requiring an increase in total number of circuits to 16 at the traditional 8 JBT boxes located on around the field. The traditional football stadium's field layout now have JBTs at the hash lines in each end zone camera position built into the seating section and two sideline boxes at the 25-yard lines. Locating the sideline boxes at the 25-yard lines creates less congestion behind the players benches making it safer for camera carts.



1 FIELD WALL PEDESTAL MOUNT (PM) FRONT VIEW

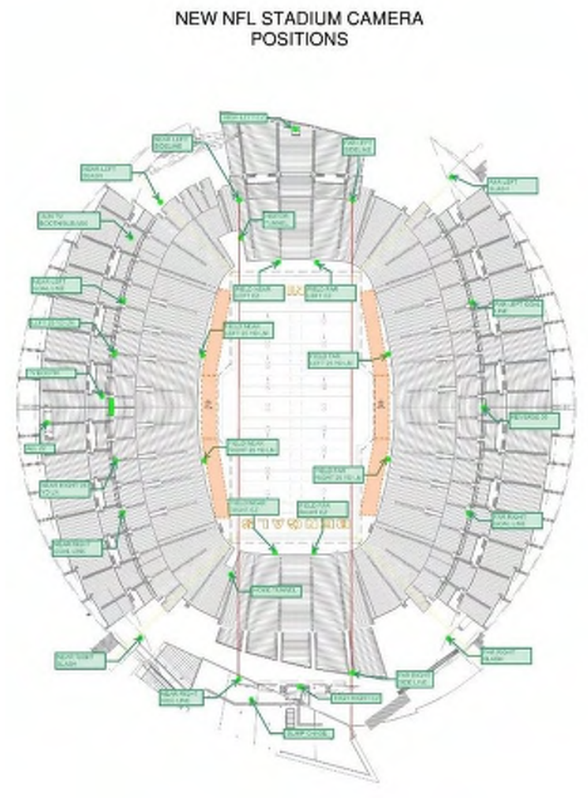
Camera Location Comparison to New NFL Stadium

The diagram below[1] shows the existing broadcast box locations with green dots. The red dots indicate broadcast camera positions in a new NFL stadium. Technology such as the pylon cameras and more wireless cameras and microphones has upped the number of locations and type and quantity of cable.



Existing Paul Brown Stadium Camera Positions

The diagram below shows the box locations for a new NFL stadium. The biggest difference is twice as many boxes around field wall versus the existing scenario. There are several reasons for this. All new stadiums have the low-end zone platforms built into the seating. This allows a broadcast box to be mounted within the camera platform providing convenience for the broadcaster and safety for the players. The last 6 new stadiums have the broadcast boxes located at the 25-yard lines. This helps remove congestion behind the players box to meet the 12-foot-wide camera cart pathway. One of the near 25 yard line boxes is typically dedicated for the broadcaster RF setup for field coverage.



Current NFL Stadium Camera Positions

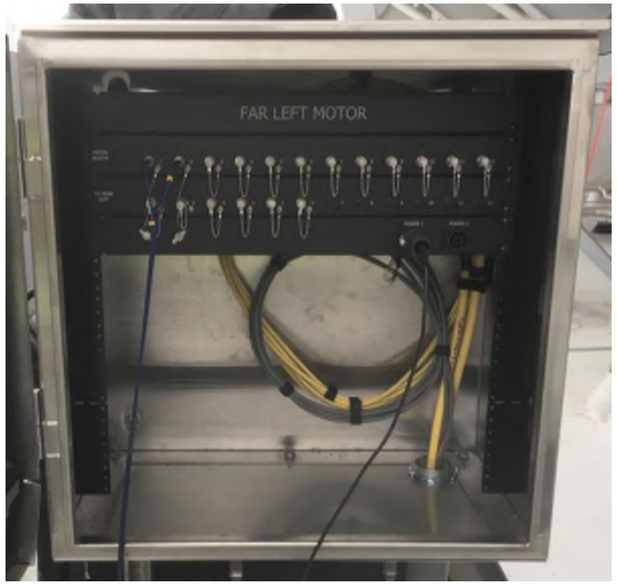
At PBS, the old boxes are semi-flush mounted into the field wall. To accommodate the new cable most of the old boxes will need to increase in height which will require the boxes to be surfaced mounted. This raises a concern about safety with a surface mount box. There are several stadiums of this era that have surface mount boxes: Arrowhead Stadium, Gillette Stadium and Nissan Stadium.

Potential New Camera Locations

The current aerial camera (SkyCam or SpiderCam) operator position is located at the All 22 position (currently located outside of the video coaching camera booth for COVID-19). The latest stadiums have the winch motor locations wired back to the aerial camera operator location. This eliminates temporary cabling running around the stadium.

Example of permanent SkyCam motor location

[1] *For ease of viewing, these diagrams can be found in a larger format at the end of this section.*



Example of permanent Motor Control Cabling

Broadcasters have requested manned positions at these locations and Paul Brown Stadium may be able to support that request with minimal impact to seating or concourse space, however the NFL has not mandated these locations be manned cameras and most of the leagues' stadiums with this feature utilize unmanned cameras. The north end zone unmanned cameras would be expected to be mounted to the underside upper seating level seating structure.

South end zone side-line camera locations

A south end sideline camera position can be accommodated on the existing coaching camera platform but will require the addition of a coiling/rollup door. The north end can be accommodated on the existing top of scoreboard and bridge positions. Each location only needs to accommodate a single camera.

South end zone potential sideline camera positions

The goal line cameras are typically robotic cameras. We envision that broadcasters wanting to locate under one of the seating decks on the east and west sides.

Typical goal line broadcast camera locations for robotic or manned (East Side)

The main follow camera at the 50-yard line has space for a single camera. Current NFL guidelines for new stadiums recommend that the camera platform supports 5 cameras: 2 Network, In House camera (Jungle Vision) and up to 2 NFL Film cameras. The wider platform will provide Jungle Vision a camera position for most of this season games with the required COVID-19 separation.

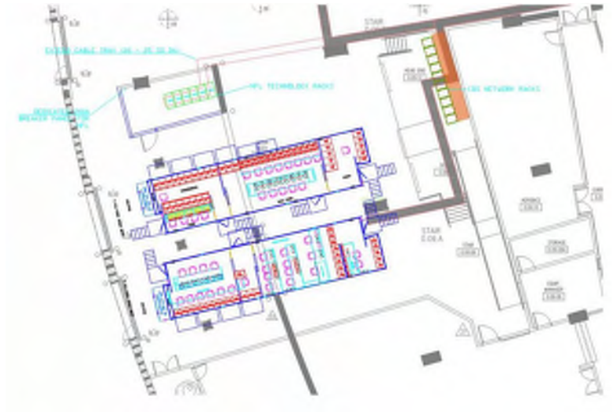
<u>TV Truck Dock Revisions</u>

The single biggest space constraint for the systems is the current size of the loading dock platform. The rack count was sized at the time of the original stadium design for a broadcast production and cable types and counts that have grown considerably in the last 20+ years.

Fortunately, there is room in the current loading dock to increase the size of the platform. Removing the block wall on the platform and filling in the platform would allow additional space for more racks.

Option 1 – TV Truck Dock

1. Remove CMU bump out wall on loading dock platform, fill in floor to utilize space for racks
2. Convert the existing network rack area for up to 6 NFL Technology racks
3. Move the network racks down to the loading dock floor level and build new room to house the network racks with large rollup door
4. NFL Technology requests a 200A breaker panel in their NFL Technology room
5. New CBS network racks will require (16) to (20) 20Amp circuits



Option 2 – TV Truck Dock

1. Remove CMU bump out wall on loading dock platform, fill in floor to utilize space for racks.
2. Convert the existing network rack area for up to 10 network racks.
3. Move the NFL Technology racks down to the loading dock floor level and build new room to house the racks.
4. NFL Technology requests a 200A breaker panel in their NFL Technology room.
5. New CBS network racks will require 16 to 20 20Amp circuits.

LED Display System

Summary

The stadium bowl LED displays were replaced from original in 2014 and appear to be well maintained seven years into the ten-year life expectancy but are among the smallest NFL stadium main displays. The existing aspect ratio and resolution allows for two 16:9 images side by side or one 16:9 image centered with game and advertising information on either side. 4K HDR is all the buzz but a technology consideration to transition from the current 1080i configuration to 4K would require the main north and south displays at minimum to each increase in size from 36' x 130' to approximately 43' x 130' and increase resolution from the current virtual 13mm technology to 6mm to display pixel accurate 4K images. This change would come with a probable cost of more than $9M per display. Most NFL main bowl displays are not built to traditional aspect ratios such as 16:9 for a variety of reasons but because of limited opportunity to significantly increase these display sizes, 1080p HDR displays at 10mm resolution would be a good future replacement option for consideration but will still not fill the display with one 16: 9 image. That said, most displays are oversized to accommodate statistical data, score and advertising outside of the live video window.

The ribbon boards stand to benefit most when replaced due to significant price reductions of LED that will allow a higher resolution display in the same form factor. The available lower deck fascia presents a very good opportunity to add a second ring of ribbon boards at the plaza level for messaging, marketing, and game statistics purposes.

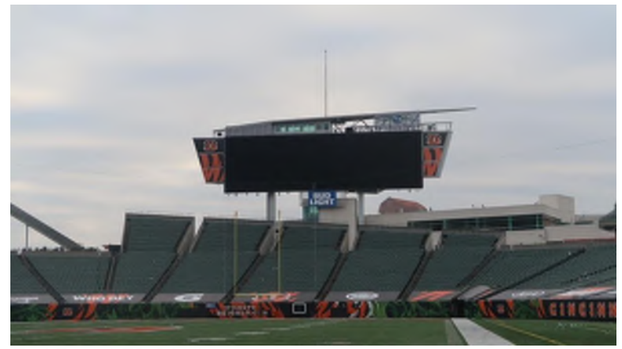
The exterior marquee was upgraded in 2021.

As the price of high-resolution LED displays begin to come down, pro sport facilities are adding displays in premium spaces for branding, on concourses for way finding and advertising and parking for improving traffic patterns. Combined with IPTV, these display systems can transform the entire stadium theme with simple keystrokes as well as increasing monetization opportunities.

Any near-term major upgrades to in stadium or bowl LED should coincide with upgrade of the in-house video production systems and in keeping with technology changes such as 4K and High Dynamic Range color space as well as the video industry shift to IP based workflows.

<u>Findings</u>

<u>Main Displays</u>



End Zone LED Display

The two main displays were installed in 2014 and are both 36' tall by 130' wide Daktronics HD13 virtual pixel pitch systems configurable as two side by side 16:9 images, 16:9 image centered with game in progress and advertising on either side or center cut of camera video filling the entire display. There are separate game and play clocks so portions of the displays do not have to be given up for those functions. In terms of size, the displays are currently 24th out of thirty NFL stadiums and, regionally, although similar product and square footage to the Pittsburg Steelers, their displays are closer to the fans reducing viewing distances and configured by width and height to have a larger 16:9 image capability. The Cleveland Browns main display is lower resolution but approximately one third larger in square footage.

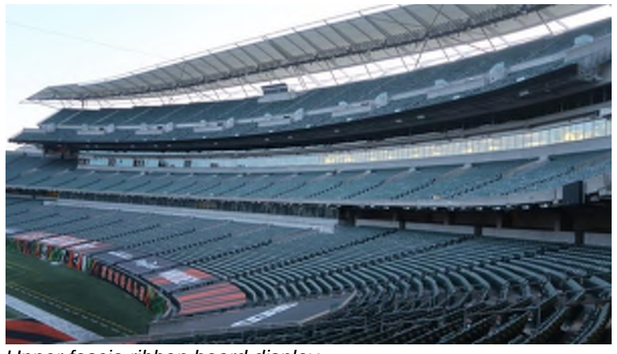
The Daktronics HD13 virtual 13mm technology is a proven product and widely used within the professional sports industry because it currently gets significantly brighter than most similar resolution surface mount display technology and appears to give a better black background because it has less surface area covered by LEDs and blacker substrate material exposed than a traditional discrete LED product would have. HD13 displays have a minimum viewing distance of approximately thirty feet so all fan viewing locations meet the requirement.

Most LED display manufacturers are moving to Surface Mount Device, SMD, for resolutions of 15mm and higher with indoor product down to 1.2mm. By 2024 when the current displays approach end of life, 10mm SMD LED technology should get closer to the 9000nits brightness of the HD13 at a more reasonable price point.

As the sports fan's desire for more real time statistical data increases, higher resolution or larger displays must be considered to keep them entertained and for reference:

- 13mm 4K = 163.78' Wide x 92.13' High
- 10mm 1080p = 130' Wide x 35.43' High
- 10mm 4K = 125.98' Wide x 70.87' High
- 6mm 4K = 75.59' Wide x 42.52' High

Ribbon Displays



Upper fascia ribbon board display

The 558' wide by 3' tall east and west fascia ribbon displays were also installed in 2014 and are lower resolution than the main displays with Daktronics HD15 virtual 15mm product. The displays are currently functioning as intended but their control system, like the main bowl displays, is also within the five-to-seven-year window for replacement.

The trend is to add ribbon displays to as much available fascia as possible, leveraging it for as much marketing and messaging opportunities as possible. A regional example would be the Indianapolis Colts who have ribbons on 3 levels, tier 1 being a 360 display with some static signage, tier 2 has ribbons in each corner and the upper level has ribbons on the diagonal corners for closed captioning.

The existing exterior marquee display is beyond end of life and the system is being replaced in the fourth quarter of 2021. The adjacent rotating advertising sign will be decommissioned.

Marquee and Rotating Sign

Control System

LED display control system

The main LED display control systems are currently fully functional but are in the five-to-seven-year window of consideration for replacement of computer/server-based systems. At minimum their power supplies and any other components deemed critical by service should be replaced and full assessment performed by Daktronics to minimize the possibility of failure during the football season. Coordination of replacement must be done with video production systems since LED control systems have become more integrated with them. The control systems is scheduled for replacement in 2021 pending equipment availability.

The Daktronics All Sport 5000 system located in the press box provides game scoring data to game and play clocks, video control room equipment, TV trucks and back of house clocks. There were some possible communication issues reported and technicians were on site troubleshooting. The equipment appears to be working properly so it is possible that signal cable may need to be replaced.

Daktronics play clock

Daktronics game clock

Except for firmware, including sport related template revisions, the scoring system and its displays should align with future replacement of the bowl LED displays.

Security Systems

Summary

The south main security office is manned 24/7 and is the primary monitoring and control location for the building access control, video surveillance and intrusion detection systems (which have been continuously upgraded annually with software licenses kept current). The security systems servers are in an equipment rack room in the security office and are on UPS which has capacity to transition to emergency power but have no redundancy built in. This office is also the location for the badging system. There is a secondary security office at the north end loading dock entry which has limited monitoring and control ability but does have the only emergency messaging/paging station in the building.

Entries and most critical locations are monitored by a total of ninety cameras with twenty-five to twenty-nine days of video storage compared to four hundred cameras in typical sized NFL stadiums that are monitored from thirty to thirty-five days. Most, but not all, exterior gates have door contacts which allow for remote monitoring for door propped condition. Many back-of-house spaces such as player entries, team spaces, and concessions offices are equipped with PIN code and/or card access, while most building operation spaces are strictly hard key accessed. Key access in critical spaces is problematic since it is difficult to audit who entered if an incident has occurred.

There are 103 magnetometers that are deployed to entries with different perimeter configurations required due to limited queueing space at some locations. A portable device is deployed for vehicle blocking, less than ideal solution, but a future permanent system would have to be developed to survive a flood since the entry is below the flood plain water level.

For the 2021 season, the game day security command center is being expanded to seat 28 officials of various law enforcement segments, building security, and building operation staff which is in-line with the capacity of other NFL facilities. This space should be configured to house eight to ten personnel workstations, two building security stations and multiple displays for focused camera monitoring by any occupant of the room.

Findings

<u>Security Offices</u>

The south main security office is staffed 24/7 and is the primary monitoring and control location for the building utilizing current, widely available access control and video management platforms that are in use within other NFL stadiums. Of the ninety existing cameras, four (4) are 4K, one in each corner of the bowl for monitoring the seating area.

South Security Office

There are no monitor walls in either of the security offices so all of the cameras cannot be simultaneously monitored. Although there are multiple work stations in the main security office, not all have access to all of the security software solutions.

The security systems servers are in an equipment rack room in the security office and are on UPS which has capacity to transition to emergency power but have no redundancy built in. This is problematic because should a server fail in proximity to a football game, it would be challenging to get systems back online and fully functional in time for the game. When the surveillance system was upgraded, all of the old infrastructure appears to have been abandoned in place and although this could have provided a cost savings at the time, future removal may be more costly.

Security systems equipment rack and abandoned analog security camera cables

The badging and credentials system is also located in the south security office. The system allows for the creation of new badges, editing and deleting of profiles. There is one badging station and one badging camera.

The secondary security office at the south end loading dock entry has limited monitoring and control ability but does have the only emergency messaging/paging station in the building. Consideration should be given to locating another emergency paging panel in closer proximity to the game day emergency responders and operations group.

Security Command

The existing bowl-facing Command Center is very small but is scheduled to be enlarged this off season to seat twenty-four to twenty-six which will be in line with the current number observed in other NFL facilities. The new space should be capable of supporting eight to nine workstations as well as a security camera workstation connected to multiple monitors in the rear second tier to share important views with the group.

Command Center

Security Equipment

South security gate

A portable vehicle barrier is deployed at the south entry gate where there is a PIN pad, card reader and intercom on the exterior and a free exit loop on the interior. An additional scheme may need to be deployed to address vehicle piggybacking on entry. A pedestrian gate with card access is also available adjacent to the south parking gate.

South entry player parking

There are cameras located on either end of the player parking areas that can monitor the space. Other cameras monitor the south vehicle and pedestrian gate.

Entries and most critical locations are monitored by a total of ninety IP cameras with twenty-five to twenty-nine days of video storage compared to four hundred cameras in typical sized NFL stadiums that are monitored from thirty to thirty-five days. Most exterior gates have door contacts which allow for remote monitoring while the player entry has PIN pad and card access.

Axis PTZ IP camera

Axis fixed IP camera

Security camera power injectors

Entry gates with magnetometers

Two west entrances have IP video intercoms which are answered by video phone. The five primary gates have emergency exits that are not monitored while the four ramps have emergency exits that are monitored. The club entrances are alarmed and monitored. Elevators have card readers and access credentials are always required for access into Bengals space.

Multiple strategies are used to secure sensitive spaces within the stadium. The suite level is staffed for monitoring entries on either end during events, but should that post become unmanned there is opportunity for free access to the premium space without having a premium ticket. The three Ticket Offices have card access and are surveilled internally and externally. Safes are monitored locally and by offsite station through the Secure 9000 system.

There are one hundred magnetometers that are deployed to entries with different perimeter configurations required due to limited space at some locations. A portable device is deployed for vehicle blocking, less than an ideal solution, but a future permanent system would have to be developed to survive a flood since the entry is below the flood plain water level.

Sound System

Summary

The stadium's distributed sound system is a Q-SYS solution with RCF speakers which have been replaced in phases over the last three years. Its audio signal distribution is via the building converged data network and although that was the preferred method of transport several years ago, many facilities are moving to an isolated data network for audio signal to protect this vital system that is supplemental to the life safety system from unintended outages due to unrelated building network maintenance. Game day bowl sound and speech intelligibility were good but there are areas outside of the audio coverage patterns that could benefit from the addition of local speakers. The back of house speakers serving entries, concourses, premium spaces, and restrooms were also replaced in the same project.

The stadium's audio contractor should verify if there are any aiming issues to alleviate dead zones. Multiple amplifiers were replaced during the recent audio project.

Findings

Control room audio equipment, including the sound operator's mixing console, was recently updated; amps were refurbished in order to maintain consistency with the system and per recommendations from the County engineer. The public-

address systems in more recently built or renovated stadiums have been designed to meet a standard for speech intelligibility and while the Paul Brown Stadium sound system does sound good, tuning records were not available to verify if it meets the standard of 0.55STI-PA in all areas. These types of systems perform best when tuned annually to compensate for normal performance changes as well as identifying failed speaker components for repair to provide maximum intelligibility to all fixed spectator seating.

Control Room Equipment

The audio equipment in the control room has been appropriately updated. Older wireless microphone systems have been replaced with current professional grade systems for both the referees and the in-game entertainment microphones. The mixing console has been upgraded to an Allen & Heath digital model and there is also a rack mounted backup mixer.

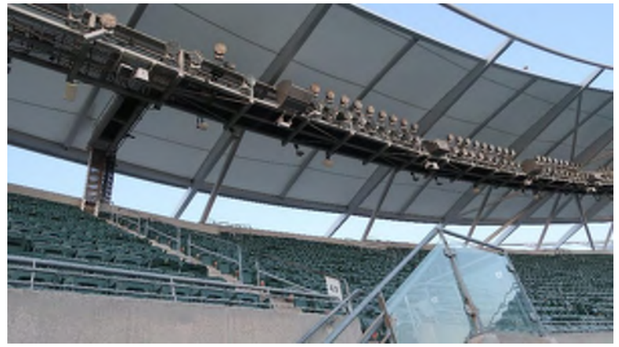
The message repeaters and other audio playback equipment have also been updated to current products and technologies while the amplifiers and digital signal processing (DSP) system that processes and distributes the audio going to the loudspeaker amplifiers have been replaced over time as failures have occurred.

Replacing devices over time due to obsolesce or failure is tolerable, but this strategy increases the possibility of event critical equipment failure in close proximity to events which can incur significant costs for expedited repair or replacement.

Control Room sound system console

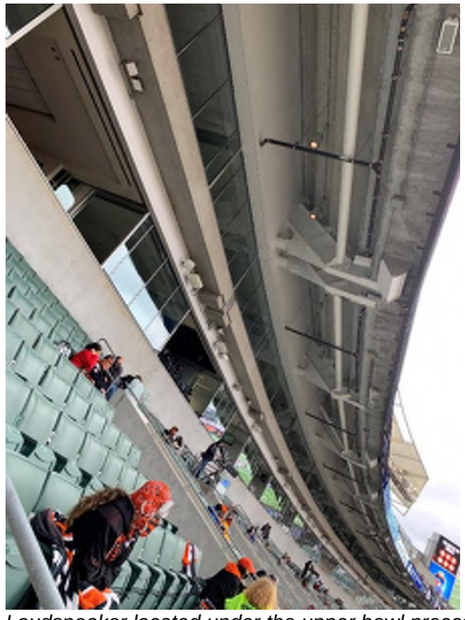
Seating Bowl Loudspeakers

The stadium speaker system is a distributed cluster solution where individual speakers and clusters of speakers are distributed throughout the canopy above to provide sound to the seating decks immediately below.



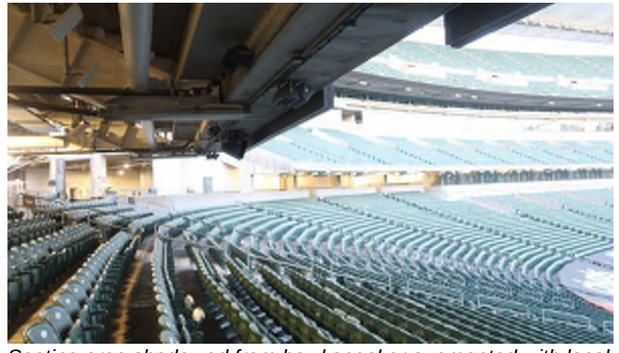
Catwalk-mounted loudspeakers

These loudspeakers mounted high on the catwalks serve most spectator seats. Seating areas that are acoustically shadowed from these main speakers are covered by smaller speakers mounted under the ceiling and precast overhangs. The speakers in the seating bowl were built and intended for outdoor direct exposure type service with speaker cabinets reinforced and covered in fiberglass by the manufacturer for extreme durability and protection, and the custom rigging hardware appears to be galvanized steel.



Loudspeaker located under the upper bowl precast overhang serve the lower deck.

Most of the stadium bowl speakers are installed in such a manner that they are protected from direct exposure to the elements which promotes functional longevity barring improper operation. The internal components of the speaker cabinets and speaker cones are made of paper and rubber, the voice coils are copper which are all materials that deteriorate and change properties over time. Typical speaker failure maintenance includes replacing the drivers to restore original performance. Repairing the stadium speakers is not easy or inexpensive as the devices are difficult to reach and must be brought down from locations high in the stadium for inspection and/or service. Good maintenance practice is for the seating bowl loudspeakers to be inspected and serviced on regular intervals to ensure they are working for ticketed events and reduce the chance of outright failure during use. It is recommended that the speakers be thoroughly tested prior to each NFL season. Any components that are found to be non-functional or out of compliance should be repaired or replaced.



Seating area shadowed from bowl speaker augmented with local speakers.

Loudspeaker service should be recorded each season and charted to identify trends that help plan for system wide renovations. While the aging components in the speakers may still provide sound, they should be tested and adjusted to be sure they continue to provide clear intelligible voice announcements and music programs.

Amplifiers

Amplifier Room

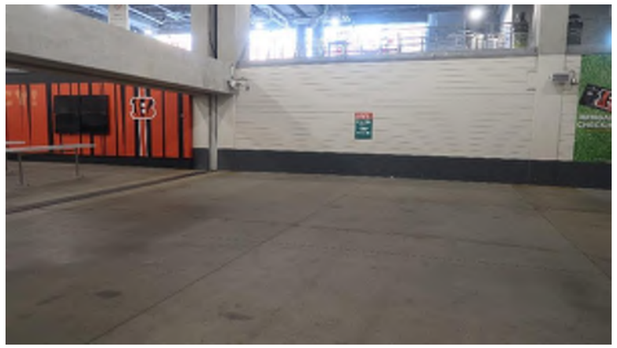
The amplifiers driving seating bowl loudspeakers are in a dedicated conditioned equipment room and monitored. The amplifiers and amplifier interfaces are refurbished products and were not replaced which puts them out of sequence with the predicted life cycle of new equipment. The dedicated equipment room provides a very good environment for the devices and effectively extended the useful life of the system.

Original QSC CX series audio amplifiers still in use

Although refurbishing has extended the life of the system, an amplifier replacement project could take advantage of current technologies to provide more power with less wasted heat and control the amplifiers over the same network used for the DSP equipment.

Concourses

The public concourses get sound and voice announcements from distributed loudspeakers which were replaced in phases over the past three years. The mounting of these speakers should be inspected to determine if the fasteners are rated for outdoor long-term application. It is quite possible that some speakers and their attachments have not been closely inspected since the initial installation as some were observed to be misaimed, not pointing in the expected general direction.



Concourse speakers

Concessions

Concession stands typically have local speakers in addition to audio from televisions in some locations. The current loudspeaker strategy employs a significant distance between devices. If the distance between speakers is reduced, more uniform coverage would be achieved.

Digital menu board technology should be added as part of either a distributed TV system upgrade or standard concessions technology upgrade program. Digital menu boards allow dynamic pricing or items per location as well as additional revenue streams from targeted advertising and allow fans to continue to see the field action by incorporating video feeds from the stadium production group. The addition of this technology typically results in increasing per capita spending.

Concession speakers

Club A/V

There are two identical clubs on either side of the stadium, and each has a sound system that includes overhead speakers, and a wall mounted input plate to support microphones, DJ equipment, or a small mixer. The TV distribution systems allow for local video sources to be plugged in and shown on some of the local TV's. These areas also serve as rental spaces for non-game day use. Each space has a local equipment rack with a mixer connected to an input plate on the wall with tie lines from the PA control room. The input plate is located near the head of the room near a quad TV wall while the local equipment rack is behind the bar which requires cable to be run across the floor to set up equipment at the front of the room for some private events.

Club sound system rack in local Amp room

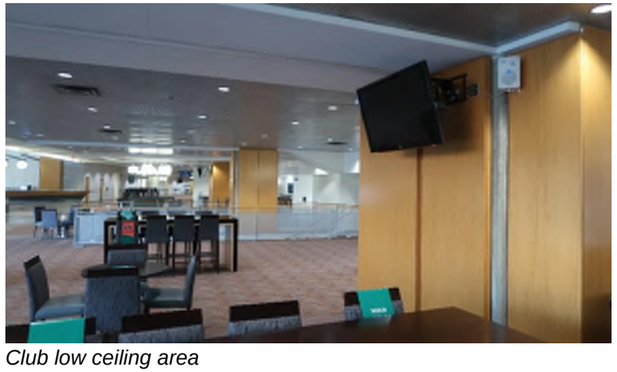
Local source input rack behind the bar

There are very limited presentation resources currently built into the club and premium spaces which makes them very difficult to set up or promote for non-game day events. With the equipment rack by the main bar and input plate across the club, cables must be run across the floor to accommodate any seating scheme that does not align with the source input plate. Content inserted on to the TV system locally cannot be distributed to all the displays because the systems are not integrated.

The quad TV wall displays cannot be configured as a wall/single canvas and even if they could, have very large gaps between them so are not effective for a presentation. Fine pixel pitch LED displays are becoming more competitively priced with video walls and should be considered when planning upgrades for the clubs.

The combination of high and low ceilings requires the use of local wall column and ceiling mounted speakers to provide adequate coverage. Sound is provided by overhead speakers and controlled by Crestron touch panels. The overhead speakers provide background music and game day sound but are mounted too high and away from the audience to perform well as support for a person speaking to a group or a small band/music act. Portable sound speaker systems are brought in to support most club events.

Club high ceiling area



Club low ceiling area

Large club bar with two small speakers adjacent to the recessed wall mounted television

Column mounted speaker

Suites

No speaker systems are provided inside the luxury suites and audio program is only on the TV set speakers. When the windows are open, sound from the bowl distributed speakers and fans wash into the space for an inclusive experience.

Bowl fill speakers covering the suites when the windows are open

Structured Cabling

Summary

The structured cabling system infrastructure appears to be from original construction and implemented in accordance with industry guidelines and standards, Building Industry Consulting Service International (BICSI), American National Standards Institute (ANSI) and Telecommunications Industry Association (TIA).

Networked systems are described to be using multimode fiber, single mode fiber, and Cat5e copper infrastructure. As facility operational requirements begin to utilize higher bandwidth to devices, a more robust single mode fiber plant with Cat6A copper will be required. Cat5e and newer Cat6A are not recommended to be installed near each other because of interference between them, so careful planning will be required when considering future implementation.

Findings

The building backbone infrastructure is copper, single mode and multimode fiber radiating from the main telecommunications room to each remote phone room, four per level with one in each quad. Some single mode fiber has been added to support Wi-Fi and the NFL's game related systems but is not enough to support future growth and technology needs. Cat3 for analog phones and building systems such as intercom and Cat5e for network attached devices radiate horizontally from the remote phone rooms. Most cable trays and cables in them are well organized but some transition areas are becoming congested, and many vertical chases are full beyond recommended capacity. As technology advancements are adapted and legacy systems decommissioned, effort must be made to uninstall unused cables as the process becomes exponentially more difficult if new infrastructure is laid on top of old. Additionally, the cost to remove old equipment as it is decommissioned is less expensive than trying to accomplish at a future date and accidentally bringing down other systems whose infrastructure gets damaged from being tangled or severed in the process.

Telephony

Summary

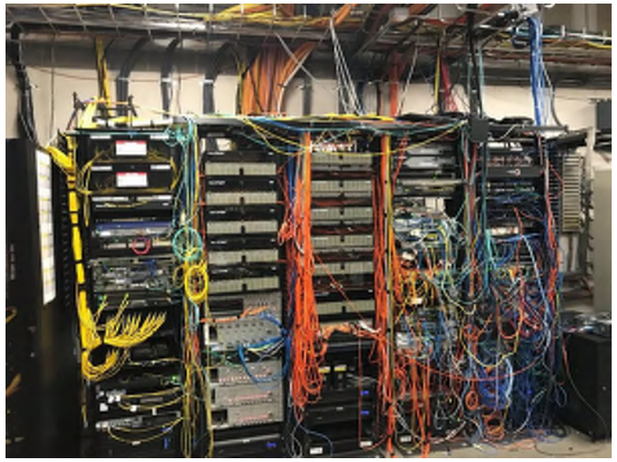
The analog telephone exchange system is several generations old, but at the time of the facility survey was actively being replaced by Cincinnati Bell with an Avaya hybrid VOIP, digital and analog solution. The new phone system will provide two hundred IP phones and continue to support four hundred digital and analog phones throughout the stadium and team spaces. The new system will utilize existing copper and fiber optic cable infrastructure.

Findings

MDF Room (as relates to VOIP system)

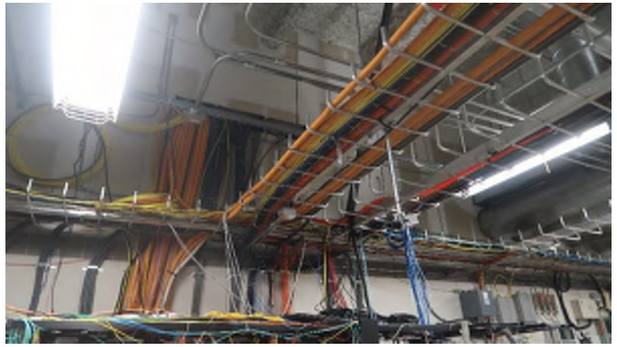
The main phone room is appropriately sized, and cooling was noted to have been improved. Cable trays convey infrastructure overhead, but not enough vertical or horizontal cable management systems exist within the racks to allow for proper management. Fiber patch cables overflow the vertical management while Category 5e patch cables snake between network switches and patch panels. There is limited documentation of building operations systems and infrastructure which creates a very difficult troubleshooting challenge for anyone other than those familiar with the installation. Some Bengals networked systems are also housed in the MDF and they are reported to have documentation for maintenance tracking and upgrade purposes.

In 2021, stadium management began a cable review and re-organization related of equipment in the MDF room.



Rack mounted core building network infrastructure

Wall mounted building copper infrastructure for the 700 building phone drops



MDF cable tray system

There is a lot of old equipment stored in the room with no organization. Due to the building critical nature of systems located in this space, an effort should be made to dispose of equipment no longer needed and relocate other devices to appropriate storage. Future projects should standardize equipment rack manufacturer, models and their infrastructure management systems. Redundant scalable internet services/products are available to both team and building operations delivered by Cincinnati Bell.

Remote Telecom Room (IDF)

Although there are IDFs in each quad on each level, they do not stack so vertical cable conveyance must take several ninety degree turns between floors. The existing vertical conduits are completely full of cable with no room to accommodate forecasted upgrades. Solutions would include adding new vertical chases or auditing and removing any cable abandoned in place, each option having their unique and significant challenges.

Typical IDF

IDF equipment racks observed had uninterrupted power supplies in alarm state and legacy network equipment abandoned in place. Although fenced off from the larger space, the equipment is still relatively easily accessible by anyone capable of climbing over the fence. There is a lot of dust buildup in the room which, if it gets into the equipment, can at minimum reduce the life expectancy of the electronics.

There are multiple cellular carriers in different locations around the stadium and some of their DAS equipment shares space in IDFs observed, care must be taken to ensure that heat loads do not exceed available HVAC capacity of the spaces. A neutral host solution should be considered where the carriers share one headend that also accommodates their proprietary equipment. This consolidation would make future upgrades or system repairs easier.

Upper cable tray and conduits in the IDF are full

Press level IDF floor penetrations all full beyond industry recommended capacity

Wireless Network

Summary

The high-density Wi-Fi network was implemented in the seating bowl, concourse, and Club levels for the 2014 season, intended to allow fans to stream content, upload photos, access social media and access in-venue mobile applications. This system is in the window for replacement as it nears the end of its hardware life expectancy, and in 2022 PBS is installing a new Wi-Fi system.

The new era of touchless transaction systems for a safer fan experience will place additional demand on Wi-Fi resources as well increase the expectation and need of fans and facility operator alike for it to be one hundred percent reliable.

Findings

The Extreme Networks wireless solution is deployed to provide coverage throughout the stadium and appears to broadcast consistent signal strength based on random tests during the site walk. Wireless access points were observed at regular intervals in most spaces. The seating bowl coverage strategy for wireless access points is placement on walls and overhead structure which currently satisfies the needs for upper seating sections, but the lower bowl is confirmed to have coverage issues due to the long distances from access points to the targeted area of coverage. As Wi-Fi 6 technology is adopted higher density of wireless access points near fans will be required, current deployment strategies in similar venues place the access point under seat or in the handrail or a combination of both.

Many sports facilities are beginning to depend on mobile apps for communicating information about all aspects of events including ticketing and merchandising, in seat ordering via a touchless and cashless solution supported on the Wi-Fi solution. This will require a robust solution that provides coverage in all fan areas.

Access point on the suite ceiling grid

Access point next to speaker on concession stand fascia

Access points are provided near concession queues to allow fans use of their cellphones to keep them engaged, browse the web, or use their favorite apps while waiting to purchase food.

Access points and panel antennas on the bowl fascia precast

A significant number of antennas on the precast are aimed at specific bowl seating sections to maintain uniform coverage across the area.

Extreme Networks switch connecting access points

Single mode fiber backbone with Category 5e data cables was installed in 2014 for the Wi-Fi system. An upgrade of the Wi-Fi system can reuse the single mode fiber backbone. The Category 5e data cables may limit the Wi-Fi solution to support 2.5 Ghz. If higher backhaul bandwidth is required, the cable will need to be replaced Category 6 or 6A meeting the Wi-Fi access point solution requirements.

RECOMMENDATIONS

<u>In House Video Production</u>

1. Replace existing production millwork with new operational consoles including a narrow window wall console for the producers & LED control row
2. Upgrade the video production system to ST2110 & HLG HDR
3. Replace all cameras and lenses including 2-3 with 4x HFR technology
4. Replace and expand all slow motion and clips playback systems
5. Replace all LED control system components (graphic render systems, scalers etc.)
6. Replace Clear Com Wireless Intercom System with Matrix Wireless Intercom and increase the amount of available belt packs to 15
7. Replace the existing wireless cameras
8. Construct a post-production space with a studio, chroma key room and edit suites/production offices Increase the amount of operational positions & multiviewers

<u>Distributed TV & AV</u>

1. Replace the existing DTV distribution system with a modern IPTV system. This will require the installation of a new IPTV headend system with network drops and end points at each displays location
    a. This can be done in phases with an RF keep alive approach.
2. Upgrade all displays to a common make and model.
3. Remove all consumer grade television displays
4. Remove all legacy CRT television brackets
5. Provide outdoor rated displays in all exterior locations

Note: A significant portion of an RF to IPTV system conversion is from the addition of cable and conduit which may be utilized for subsequent upgrades.

Broadcast Cable System

Given the age and the change in video production technology and production styles, an entirely new cable plant is requested by CBS. This would include:

1. Addition of SMPTE cabling to all locations
2. Replacement of existing audio, coax, triax, and single mode fiber
3. Removal of abandoned broadcast, video coaching and unused audio cabling
4. Add cabling for a Blimp Chase position on roof of administration building
5. Add additional AC power at field and southeast slash position
6. Add racks for network cabling, may require re-locating the racks down from the loading dock platform
7. Add space for up to 6 future NFL Technology server racks.
8. Add In-House cabling to the main follow, Left and right 25-yard lines, new plaza location and new field locations
9. Remove Abandoned Cabling
10. Replace Broadcast Junction Boxes
11. Consideration for Additional Camera Locations
12. Consideration for Modifications to TV Truck Dock

LED Display System

1. Increase the size of the main displays
2. Upgrade the main displays to 10mm
3. Upgrade the ribbon displays to non-virtual 15mm
4. Add LED displays to premium and high traffic spaces

Security Systems

1. Add a monitor wall to the main security office for easy viewing of a larger grouping of cameras.
2. Commission an independent physical security system audit to bring surveillance cameras and access control device counts up to quantities necessary for staff to monitor and secure all areas of the stadium.
3. Bring current access control and video surveillance system software and hardware up to current revisions to include system licensing.
4. Add approximately sixty-five to ninety additional video surveillance cameras to provide surveillance of forty to sixty pixels on target for every seat in the seating bowl.
5. Add redundancy to the control systems for cameras and access control.
6. Replace POE injectors with switches that can support POE.

Note: A significant portion of adding new devices is from the addition of cable and conduit which may be utilized for subsequent upgrades.

Sound System

1. Annual pre-season tuning of the system
2. Replace amplifiers and processors with new
3. Verify aiming on concourse loudspeakers
4. Increase concourse loudspeaker density
5. Add coverage at premium space bars
6. Add an emergency paging panel to the Press Level Command Center or other location with easier access for those responsible for making announcements.

Club Audio Visual

1. Add LED displays or larger video walls
2. Add larger TVs/displays behind the bars
3. Add additional source input plate locations
4. Upgrade local A/V equipment systems
5. Add A/V floor boxes to make the space reconfigurable for events
6. Reconfigure TV layout

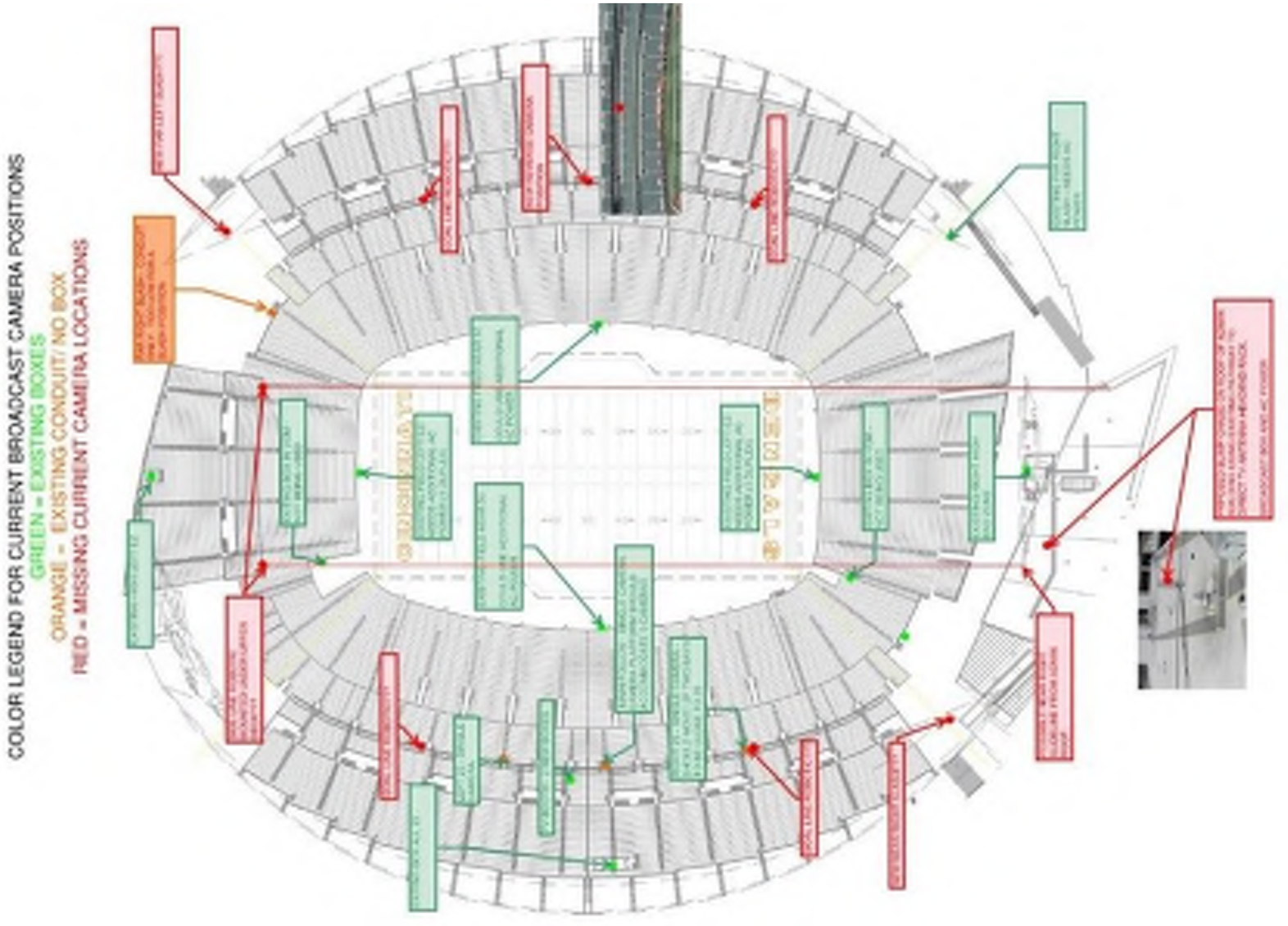
Structured Cabling

1. Remove abandoned in place equipment
2. Add single mode fiber from MDF to IDFs
3. Standardize equipment racks and cable management
4. Identify and remove abandoned cable
5. Audit equipment and infrastructure to create current operations records

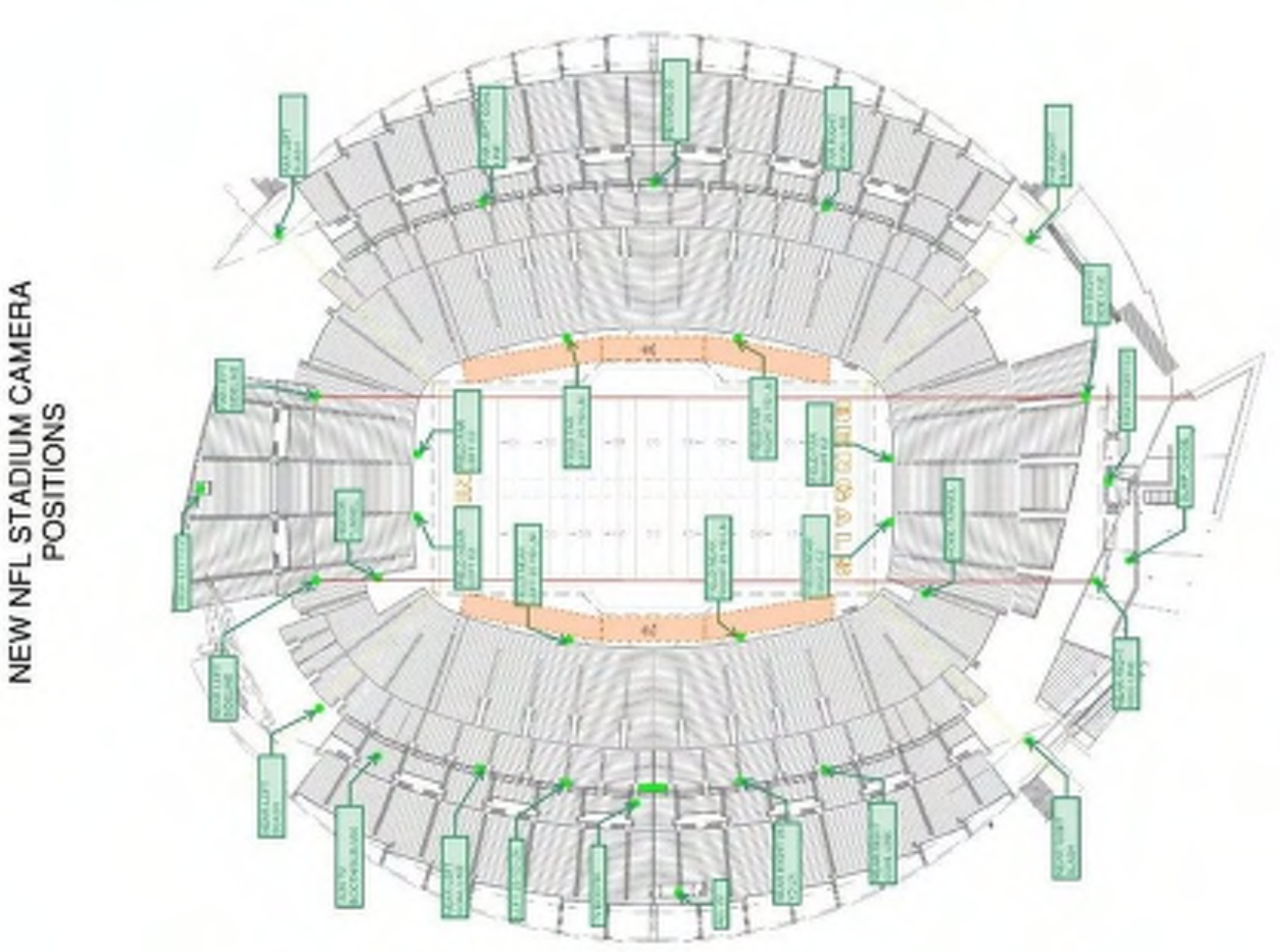
Wireless Network

1. Upgrade the Wi-Fi system, as the current system is nearing end of life
2. Increase Wi-Fi coverage in the lower bowl.

Note: A significant portion of adding new devices under seats or in rails to increase density is from the addition of cable and conduit which may be utilized for subsequent upgrades.



Existing Paul Brown Stadium Camera Positions



Current NFL Stadium Camera Positions

FOOD SERVICE

Food Service

The assessment team was tasked with reviewing the current condition of spaces, equipment and maintenance issues for the following food and beverage areas:

- Kitchens and Commissary
- Concessions
- Pantries and support spaces
- Clubs

General Food and Beverage Issues

- General wear and tear on facilities and equipment
- Cooking equipment, refrigeration, ice machines and hoods
- Counters
- Menu boards

Summary

Built in 1999, the stadium has not had any major upgrades since its initial opening. While some of the equipment has been replaced, overwhelmingly, it is the original equipment that remains and, more importantly, has outlived is average lifespan.

Aramark is currently contracted as the concessionaire for food and beverage. Stadium management has been proactive in repairing and maintaining the equipment, but the operator is programmatically limited by the age and state of the equipment and building.

The concessions have a good ratio cooking stands to non-cooking, well within industry standards. The premium clubs have seen some updates, but they are still dated both programmatically and aesthetically. In addition to the age of the equipment, there are multiple building issues that have a direct impact on the safety and sanitation in the foodservice spaces. Water leaks in concession stands and pantries are found in multiple locations.

There are several issues that will be addressed in the report, including but not limited to, laminate counters in the concessions, beer systems/beer lines that need replacement and walk-ins have lost their R-value/efficiency. Any non-compliance is primarily due to changes in health codes since the stadium opened, but it would be beneficial to bring Paul Brown Stadium into compliance with today's standards.

Overall, the amount of space and base infrastructure is adequate, however, the building and program need time, attention, and investment to bring the facility to its potential and begin to compare favorably with other, modern NFL stadiums.

Findings

CURRENT BUILDING CONDITIONS

Water Leaks

Currently, water leaks into the gutters in the upper concourse and flows into the back of house in several upper concourse concessions. Annual water infiltration (structural and sealant) repairs need to be incorporated to remedy these areas.

Security gates

Stadium management designates annual budgets related to concession coiling door replacement. However, additional funds may be required, as overhead security gates at several concession front counters no longer function properly. This is creating difficulty in opening and closing the gates. In addition, rainwater is entering under the gates and causing flooding into the foodservice spaces during inclement weather. One set of gates has been replaced. The replaced gates obstruct guests' view of the menu boards due to the gate's mounting height.

Grease Traps

Grease traps are original to the building construction. Many are rusting causing rust stains on the floors. There has been an effort to replace them, however not all have been replaced. This has created another maintenance cost. Although grease traps not part of the food service scope the rusting units does affect the aesthetics of foodservice spaces.

Concession Atmosphere/Temperature

Another issue affecting the concessions is the lack of heat in cold months. Our understanding is the ceiling mounted heaters are undersized and do not provide a reasonable amount of heat to keep the staff warm. A valid concern is extended cold periods resulting in frozen pipes leading to damage and issues related to overall stadium function / operations which include game day and events.

INFLUENCERS & TRENDS

Social Media/Lighting

Social media has become a major consumer influencer. “Instagram worthy” photos to promote and reinforce consumer choices allows people, particularly millennials to relate to the product / brand, and share their experiences. These influencers have resulted in updated photo worthy package branding. It will be important to consider facility design decisions (ex. reconsideration of area lighting for photo worthy opportunities, photo opportunity areas, etc.) to support this.

CONCESSION STAND DESIGN EVOLUTION

There are two types of concession stands, a belly-up (traditional) style concession and speed (also known as order fulfillment) of service concession. The belly-up style includes multiple POS on a front counter with soda fountains. Guests form lines at each POS, place their orders with staff and are handed the completed order by the same staff member. The speed of service stands reduces the number of POS and typically shift them to one side of the stand. Guests order at one of the POS and step down to a pickup area to retrieve their completed order. The back of the stand is similar in both instances.

Walk-in Markets are becoming quite popular through the industry and offer packaged food and beverages for the customer to select from. Upscale Markets can offer hot foods prepared in the back of the market space. And the most recent technology includes contactless check out: https://www.mobilesportsreport.com/2021/01/zippin-checkout-free-system-debuts-at-stadiums-in-sacramento-denver/

Traditional Concessions

The front counter at each concession includes multiple points-of-sale (POS) based on 5’ of length each. Each POS shares a fountain drink/ice station, floor model provided by the soda vendor, with the next POS. The space below the front counter is used for beer and soda lines, carbonators, warming drawers, and storage of paper goods. Customers line up behind each individual POS, creating several lines perpendicular to the front counter. For example, this is how McDonald’s used to function.

Speed of Service (Order fulfillment)

This consists of the guest ordering at one end of the front counter, then stepping down to wait to have their order fulfilled. The front counter would have a slightly different configuration of equipment and require kitchen display units (KDS) units for the expediter and a monitor at the ceiling to let the guest know when their order is ready. Customer order entry can be incorporated into this concept with a POS unit on the front counter facing them. A remote beverage station where customers fill their own sodas helps draw customers away from the front counter to wait for their orders to be filled. This is how McDonalds currently functions.

The space below the front counter is used for warming drawers, and storage of paper goods. The back counters have storage bases with hinged doors. On the back counters is the food warmers, pretzel warmers, coffee makers, nacho stations, hot wells, iced tea machines, bottled beverage refrigerators, popcorn makers and warmers, and similar equipment. Pass-through windows with built-in warming cabinets hold prepared items for sale.

BUILDING OBSERVATIONS

Storage

Kitchen

There are three kitchens and the ambient, refrigerated and freezer storage is sufficient. There is ample dry storage, and the walk-ins are large and allow the operation to hold large amounts of cold and frozen products.

Suite Pantries

The suite level pantries are undersized. Game days require Aramark to park heated mobile cabinets on concourses, empty suites, and meeting rooms. On the concourse they are in the guest’s sight, which distracts form the premium experience.

Plaza Level

There are adjacent storage rooms located on this level. We recommend the foodservice operation consider taking part or all these rooms to store/stage the heated mobile cabinets to allow them to be kept out of fans’ view.

If additional space is required, dependent on future program, the ice makers could potentially be downsized to provide additional space.

Concession storage

Certain locations provide adequate storage for the current concessions program. Most concessions include a walk-in cooler and shelving units in the back of house.

Walk-ins

Walk-ins are all original to the building’s construction. Although 90% of the coolers / freezers were holding temperature; the air-cooled condensers are a constant source of cost due to repairs. The walk-ins and condensers have outlived their normal life expectancy and are no longer efficient due to technological developments and the deterioration of the walk-in wall and floors.

The condensers generally are located on top of the box except for three on the suite level that are mounted in an exterior hallway.

The upper concourse concessions get extremely hot in the summer months through October. The location of the condensers adds to the rooms’ heat. We recommend when the spaces are updated to mount the condensers on the roof above the concessions. The space is ideal as it is easy to access and out of sight of fans.

Many walk-ins are under the bowl, this results in low height ceilings, and some very low height doors. There are doors as low as 42”, which makes it difficult to enter / exit the walk-ins and poses injury risks.

The original main kitchen walk-ins are slab on grade with insulated floors at the freezers. The walls are damaged from

being struck with pallet jacks and carts. Floor guard rails have been installed in the issue cooler to protect the walls from further damage. Additionally, this walk-in “sweats” and leaks at the floor. Sliding doors are in poor condition; some have damaged tracks which has caused the doors to be difficult to close.

All walk-ins located in concession stands include an insulated floor. The walk-ins’ walls and ceilings are in very poor condition. Ramps are spongy and raised at the doors which poses a tripping hazard, as do the floors where the diamond tread is curled up at the corners.

Exhaust Hoods

The main kitchen includes three (3) Type 1 exhaust hoods. Overall, the hoods are in good condition, however, newer hoods are being designed with additional front overhang to increase capture and containment of grease laden vapors. Minimally, 6” front overhang is required, but 12”-18” front overhang is recommended.

The kitchen hoods range from 48” deep to 66” deep. The 66” deep section is over a 6’ charbroiler. The 48” deep hoods cover the remaining 33’ of cooking line. At 48” deep there is limited flexibility in the equipment that can be installed under the hood. Typically, the average hood depth starts at 60” deep. The limited depth is currently creating a code issue on overhang at the double stack convection oven. This is also the case with a large triple stack conveyor oven in one of the suite kitchens.

Aramark expressed interest in one day adding combination ovens to the cooking line. This is a multi-use, flexible piece of equipment that is typically included in kitchens. This would require a 66” deep hood.

All other existing equipment sits under the hoods with a 6" overhang at the sides and front.

55% of the concessions are cooking concessions and include a Type 1 exhaust hood. They are typically 9' long by 51" deep. The concession stands hoods' depth limits the equipment that can be placed under the hood. This will need to be considered during future renovations.

Annual inspections of concession ductwork systems are performed. We recommend all fans and duct work be inspected and cleaned by an independent professional as soon as possible. While we have included replacement of vent hoods in the Capital Expense Matrix based on typical operation, an inspection by a qualified contractor will dictate when the hoods require replacement.

The Ansul fire suppression systems are inspected annually.

There are several hoods that do not capture and contain exhaust as expected. All are where char-broilers are located. The amount of pull or CFM's a hood is required to draw is dependent on the equipment under the hood. The main kitchen char-broiler hood was originally for a pizza oven. Char broilers, due to the excessive heat and grease laden vapor discharge, require a substantially higher CFM than a pizza oven. We recommend the system be reviewed to ensure proper capture and containment.

We were informed that there is also an issue with capture in the following rooms: Concession 2W2 and 2E3. We recommend that an independent technician inspect any hoods that are having capture and containment issues.

Ice Program

Ice machines are located in all kitchens and concession stands. Ice production is supplemented with vendor provided ice cabinets in some of the vendor commissaries. The supplemental ice is used for portables and bars. Per Aramark they purchase 300 lbs. of ice per game. However, they are only charged for the ice used and can return the balance. Aramark finds the amount of ice produced is acceptable to support game day operations.

The age of the ice makers is an issue. Many have been replaced in the last ten years, however 90% of the icemakers show signs of rust on the back vents. Some rust is so bad the venting material is completely gone. All ice bins are original and should be replaced.

Aramark expressed they change the water filters annually and clean the ice makers and bins after every season. Due to the age of the filters, replacement cartridges are difficult to obtain. New filters should be considered as proper water filtration greatly extends the ice machines life.

We recommend that the preventive maintenance continue based on usage and manufacturer recommendations.

The upper concourse ice makers are challenged in the summer months due to heat. The heat expelled from the ice makers and walk-ins adds to the already hot conditions. This makes the working environment very difficult. Units slow down or stop producing ice due to the hot conditions. We recommend when replacing the upper concourse ice makers, the facility move to remote condensers, outside of the space, to help reduce the heat in these stands. As already noted, the condensers could be placed on top of the concession roofs. If not possible, then the heat gain should be addressed though the HVAC system.

Beer Systems

All concession stands offer draft beer on tap. A two-faucet tower sits between two POS. The keg coolers are in the back of the stand. The beer lines are original to 1999 and are, according to Aramark, cleaned monthly. There are four different beer chiller manufacturers used throughout the building.

Bars typically include 3-faucet beer towers. The club space bars include very long line runs and there are several line leaks throughout the building. This results in leaks in offices at ceilings and concession stands. If draft beer is a desired element, all beer systems and beer lines should be inspected and potentially replaced as needed.

It was noted that none of the keg coolers, nor the CO2 farm included CO2 monitoring. In recent years CO2 monitoring has become standard and required by the local authorities. We highly recommend a CO2 monitor with connectivity to the building management system be added to all areas where CO2 is dispensed.

One option, moving forward, is to remove the long beer run lines and beer systems and offer packaged products. In areas where the amount of product is minimal, draft beer can also be offered using direct draw beer coolers or localized keg coolers. Should the move to package beer take place, a can and bottle recycling program should be developed to address the removal of empties.

Freight Elevators

There is one freight elevator located on each side of the facility. The placement and size of the elevators are adequate for food service operation. In the past the main issue with the elevators is breakdowns due to age. When used heavily they tended to break down, which also aligned with games days. Our understanding is this has been corrected.

Stadium management provides annual maintenance agreements related to freight elevator repair and upkeep.

All deliveries are received at the northwest loading dock. Dock space is adequate for two trucks. During the season deliveries arrive daily. They are brought to the concession stand and suite

warehouses and held for distribution. This is acceptable to the operator.

Kitchens

General Comments

The facility includes three kitchens. The kitchen on the Service Level includes the commissary and is considered the “main” kitchen. It is the main support for press dining, players dining and concessions. Two additional kitchens are on the suite level. These kitchens support the club spaces, as well as a chef driven concession stand in front of the kitchen. They are all very well equipped to produce a multitude of menu items.

Although the east and west kitchens include the same equipment, on game day the west kitchen acts as the “cooking” kitchen with the east kitchen acting as the “cold” kitchen. Aramark expressed they are very happy with this arrangement. Both kitchens are also used to support catering events which occur throughout the year. Catered events can include from 25 to 300 guests.

Kitchen Equipment

The kitchen commissary houses many heated mobile carts. Approximately 60% of the carts use sterno, as their electrical components have failed.

Overall, the kitchens include enough space and storage, however, the equipment is all original to initial construction. Although it is all working it is very old and requires continual repairs. It has outlasted its average lifespan of 10-15 years. When planning, most of the equipment should be considered for replacement and advancements in equipment types should be considered.

Popcorn Program

There is a large popcorn plant in the main kitchen. This supplies the popcorn to all the concession stands. Popcorn is held in popcorn warmers on the back counters at 50% of stands. Aramark is happy with the program as it stands. If there is a desire to provide fresh popped corn in all stands, poppers would need to be added to support the program change.

Warewashing

All three kitchens include a 63” conveyor warewasher. All warewashers are original to the building and have had multiple repairs but are currently functioning. They are sized correctly for the operations. The main challenge is the equipment age and costly repairs; all require replacement.

Included in the soiled dish tables are disposers which are no longer functioning. We recommend replacing the disposers with waste collectors as disposers have fallen out of favor with local jurisdictions due to the FOG’s that run into the waste stream. Fats, oils, and grease (often referred to as FOG) are universal problem substances in wastewater. Most FOG is not soluble; meaning it does not mix well with water. Due to this, FOG floats on water and clings to surface areas void of water. Therefore, grease collects on the top of drain lines first.

Although the kitchens include an acceptable amount of hand sinks and worktables, they did lack prep tables with sinks. The main kitchen included only one double sink outside the warewashing area for produce cleaning and prep washing. The suite level kitchens did not include any prep sinks. To work around this, the staff uses the warewashing area to wash produce and other items.

Ice

The commissary ice factory functions and the ice makers have been replaced within the last five years. However, the large bin is in very poor condition with patches over holes.

Walls

Walls are epoxy painted CMU. Overall, the condition of the walls is pitted and gouged and requires repainting. There are multiple stands where wallpaper is in the front of the house. Unfortunately, it is peeling and in view of guests. Upon updates we recommend the wallpaper be removed and replaced with epoxy paint.

The warewashing area has areas of peeling paint due to water spray.

We recommend adding fiberglass reinforced panels (FRP) at all warewashing areas. The floors are concrete and are generally in good condition when considering their age. We could not determine if the concrete has ever been sealed. Current code requires sealed concrete in foodservice areas. We recommend a thorough scrubbing and sealing the floors.

Team Dining

Team dining was updated approximately six years ago. The space includes an island hood with a show cooking line, a built-in pizza oven, a salad bar and a grab-and-go area finishes the foodservice space. A pantry is located adjacent to the dining space. Most of the cooking is done in the main kitchen and finished in front of the players. It is our understanding Aramark would like to see the addition of fryers in the pantry. However, due to the high cost of the island hood adding the fryer at the current cook line has not been an option. The addition of a fryer could be accomplished, without providing a Type 1 hood system and running ductwork, by using ventless fryers. However, the ventless fryers require a specific amount of space above the equipment and the ceiling height would need to be verified for this style of equipment.

Additional issues include the pizza oven's maximum temperature is too low to be used as a speed oven. The space is lacking a full-scale chef's service station, the space is lacking receptacles for warming plates, and the space lacks a location for temperature-controlled food delivery for individual players. This could be solved with a food locker system to hold items at the correct temperature.

Concession Stands

The general condition of the concession stands could be improved. Most equipment is original to initial stadium construction, has been repaired multiple times and has exceeded the expected life cycle. The typical life cycle for food service equipment in this environment is 7-10 years. Because the stadium is not used daily, the time frame may extends to ten to fifteen years. Most equipment is twenty-two years old and has exceeded its useful life span.

Of the 49 concession stands, 27 are cooking stands. This represents cooking to noncooking stands is 55%. The current trend for cooking stands is 50%-75%. Three of the cooking stands have recently been renovated to offer speed of service ordering. The balance of the concessions are traditional belly up style. .

The current POS ratio is 1:180 guests. This does not include bars and portables which will lower the ratio closer to the industry stand of 1:150. As more concession stands are changed to a speed of service style the ratio will increase. However, speed of service does reduce transaction times and we do not feel the overall affect is negative.

Front counters are stainless steel with vendor-provided soda stations between two POS units. Also on the front counter are two faucet beer towers. The back counters are laminate. Most stands include 1 to 2 hand sinks in the front of house. Some of the larger stands will likely require additional hand sinks to meet code.

The ceramic cove base is cracked and has been replaced in certain sections with rubber cove base. This results in a patchwork of coved base. We recommend replacing all cove base in all concession stands when the spaces are updated. This can be integral to the floor instead of a separate piece.

In several stands the CMU walls have been opened to repair water leaks behind hand sinks and mop sinks. The CMU has been patched using a heavy metal mesh. Although it is out of sight of guests when the stands are updated, the walls require patching.

Recently Renovated Stands

There are three stands (2W2, 2E3, 3S2) that have been renovated within the last six years. The overall appearance is very appealing.

It is our understanding that the existing back wall hoods were relocated and are now used as an island style. These are different types of hoods and are not functionally interchangeable without creating operational issues. The wall hood utilizes the back wall to assist in capture and containment. The island style has a different set of filter banks and pull because there is no back wall. The decision to use wall type hoods without a wall is probably one of the causes for the lack of smoke capture at these hoods. In addition, the fans were not updated to accommodate the additional CFMs required.

Bars

All but three bars are located on the premium levels. The three bars located outside of the premium spaces reside on the main concourse and Service Level.

Front counters are stainless-steel, and the back counters are a combination of laminate bases with stainless steel counters.

Service Level Premium Patron Space

Located just outside the Service Level locker room, the Service Level Premium Patron Space is considered a bar although it lacks bar equipment, electricity, and plumbing. It is a front bar and back laminate cabinet base with folding tables. The bar is not code compliant without a hand sink and other functional pieces of equipment.

The space has potential because fans can watch the players exit the locker room as they run onto the field. We recommend the space be brought up to code with proper underbar (including hand sinks) and back bar equipment. Front and back bar counters should be provided with a non-porous, code compliant surface.

Concourse Bars

The two main concourse bars have a beer garden feel. They consist of laminate counters with vendor-provided full height coolers in lieu of back counters. Although the addition is a well-used element, we recommend updates to the areas with more permanent finishes.

There are several code issues at the bar, one of which is that some of the back counters and POS stands are laminate which is not code compliant and requires replacement upon any updates.

An ADA section was not included in the original design. Renovations to the bar will require the addition of an ADA section. Although there a several ways to accomplish, typically it is a section that is 60”L x 34”H.

The underbar equipment is in good condition and appears it could be used in a renovation. The back bar coolers are original to the building, have outlived their live expectancy and require replacement.

Press Dining

Press dining is located on the suite level. It includes mobile buffets with hot wells and a laminate counter with beverages. Mobile buffets appeared very old and require replacement. The overall look of the space is dated, and lighting did not appear adequate for the space.

We recommend the lighting be studied to determine if it meets the required foot candles of illumination and replacing the hot wells with undermount induction warmers set in mobile counters. Undermount induction warmers are not visible to the public as they are mounted under the countertop. This allows for an upscale look and flexibility with the counter spaces.

Premium Spaces

The East and West Clubs on the plaza level include multiple bars and concession stands. All items are pay as you go; there are no buffets or premium menu items associated within the spaces. Although the spaces have been updated, they still appear somewhat dated compared to other NFL stadiums.

The concession stands equipment is all original to initial stadium construction and requires replacement.

Suite Level

The suite level includes one catering bar on each side of the building. These bars are only used during catered events and do not include POS units.

According to Aramark the spaces, as designed, work well. One of the vendor commissaries has been modified to a liquor room. This approach has been successful as the commissary is adjacent to the club spaces.

Point-of-Sale System (POS)

The POS system was updated within the last two years and is by Appetize with Elavon payment processing in an effort to advance efficient F&B offerings.

The system also provides mobile ordering with an app. Fans can order general concessions through the app, and when ready the app directs fan to one of twelve mobile locations. Club guests order from the app and staff deliver their order to the guest. The operator is reviewing the adoption rate.

Other Items

Menu Boards

Menu boards are not connected to the POS system. The current menu boards are static and are mounted inside the concession stands. Although the facility has actively maintained the boards, they are antiquated. We recommend moving, at minimum, to a video monitor system, and ideally, it would be tied to the POS system. This allows for instant menu board changes, adding specials toward the end of games and assists with inventory management.

Vendor Commissaries

There are 23 vendor commissaries, and all include a walk-in cooler. In addition, some include vendor-provided ice cabinets and/or icemakers. The quantity of vendor spaces adequately supports the operation. The major issue with the spaces is the age of the walk-ins and building. Some of the commissaries include floor mounted receptacles and these did not appear to be functioning and pose a tripping hazard as well.

We recommend that when the spaces are updated, ceiling pendant receptacles be added in place of the floor mounted receptacles.

Hot Chocolate Program

The original Hot chocolate program will be updated prior to the 2021 season. The facility will be utilizing the Grindmaster hot water dispensing system program.

Pretzel Program

All concession stands offer soft pretzels. They are held in vendor-provided warmers on the back counters. The current program does not offer a way to heat the pretzels prior to placing in the warmers. We recommend adding a small speed oven that would allow the pretzels to be heated which affords a better tasting product.

Broken equipment

Broken equipment is evaluated to determine if it can be repaired or retired. If it is retired the county picks it up to be auctioned or discarded. All broken equipment is held in a storage room on the Service Level.

RECOMMENDATIONS

1. Address updating foodservice areas to bring up to current code. When the building was completed in 1999 current codes were met. As time has gone by codes have changed.
2. Concessions' remodel; Consider a staged approach. Determine several concession locations to update. The stands will require gutting, repairing infrastructure and other building conditions to bring the spaces up to code
3. Priority should be placed on ice makers and walk-in replacement
4. Clean and balance the exhaust hood fans and have them inspected to determine if the fans are sized correctly for the current equipment
5. Replace and improve cooking equipment

VERTICAL TRANSPORTATION

Vertical Transportation

Paul Brown Stadium has a total of twenty-one (21) vertical transportation units, comprised of two freight elevators, ten passenger elevators, and nine escalators, some of which are outdoor units.

All units are original to the opening of the stadium, and the only significant upgrades were performed on the two freight elevators. These had new gates and sensors installed within the last five years, and their performance has been acceptable to the operators. All vertical transportation units receive annual funding for continued maintenance, repair and upkeep through stadium management.

Building staff reports that all passenger elevators maintain acceptable performance, although the escalators have been troublesome from the outset, with the two outdoor escalators, especially problematic. These two units had their step chain rollers replaced in 2019 and do not have canopies or enclosures; therefore, they are susceptible to the effects of precipitation. We recommend that during a major renovation, canopies be included in the project.

Should the appropriate entities determine they seek a deep assessment for vertical transportation, we recommend that escalators are the top priority, followed by the freight elevators, and finally the passenger elevators.

In the capital expense matrix, we recommend Year 1 full modernization of the two large exterior escalators with an upgrade of canopies, and the remaining escalators and elevators subject to modernizations sporadically throughout the next twenty years.

During a significant renovation, there may be a benefit to adding a third freight elevator to the south end of the stadium. This could increase efficiency when moving trash or food to that end of the stadium.

We compared the current state of vertical transportation at Paul Brown Stadium with a peer group (Heinz Field, Nissan Stadium, M&T Bank Stadium, FirstEnergy Stadium). Our findings are in the table at right. Note, quantities with no accompanying narrative indicate no significant work has occurred.

	Paul Brown Stadium	**Stadium A**	**Stadium B**	**Stadium C**	**Stadium D**
# Freight Elevators	2 (gates & sensors replaced 2019; east FE new drive unit pre-2017)	2 (motors replaced in 2017)	2	2 (1 had new motor 2010; both scheduled for refurb next 3 years)	2 (new cabling in 2019); also 1 service elevator added 2015
# Passenger Elevators	10	6 original (2 had new cabs in 2019, 2 others will get new cabs 2021) 18 express added 2012	7	10 original; refurb in next 3 yrs 3 new in 2018 for ADA	9 (new cab controls, hoistway wiring, cab interiors in 2015)
# Interior Escalators	3	4			(see note below)
# Exterior Escalators	6 (replaced step chain rollers in 2 large units 2019)	0	17 (12 original, 5 installed 2004). Modernization of all, including trusses, to occur 2022 at cost of $9.577M	2 original 18 new in 2018 to assist with upper deck access	8 original; 4 installed 2015 Replaced all step treads and risers in inner bowl 4 exterior escalators 2013
Notes					*Distribution of exterior vs. interior not determined. Larger exterior escalators are encased*

An important note about elevator modernization and replacements is that while the vertical transportation units may currently be functional and serviceable, at some point the components will no longer be available due to advances in technology (obsolescence). We suggest the County maintain communications with the service provider to understand potential challenges in obtaining spare or replacement parts in the future; this factor may determine the speed at which modernization occurs.

PREVENTIVE MAINTENANCE PROGRAM

Preventive Maintenance Program

Public assembly facilities that are well maintained and upgraded when appropriate remain contemporary and competitive with their local and regional rivals. On the other hand, poorly maintained facilities have a negative impact on the operator and owner's ability to attract regional and national events that have large economic impacts.

Well-maintained facilities do not happen by accident and require an actionable plan, resources to implement the plan, and staff with proper skill sets to execute the work, which includes tracking and capturing data, transferring knowledge, and implementing training and professional development.

The plan should have a set of objectives on how the operator\ wants to execute preventive maintenance for the facilities, and the following items should be part of the overall plan:

1. Develop policies for preventive maintenance (which would start with a list of equipment by facility)
2. Utilization of a computerized maintenance management software (CMMS)
3. Develop a set of checklists for equipment maintenance
4. Establish who does the work
5. Establish process for employee feedback
6. Establish quality assurance process to ensure work is actually being done
7. Establish performance metrics for department employees and contractors

Preventive maintenance (PM) is not an attractive or high-profile function, and decisions to defer preventive maintenance are made every day by well-intentioned people when prioritizing resources. More resources are typically allocated toward revenue generation. Poorly maintained systems and equipment typically results in more rapid, untimely breakdowns, expensive emergency service calls, and higher utility costs. Proper preventive maintenance procedures require investments in staff and materials; however, an effective program will save the operator money over the life of the facility by limiting repairs and replacements, therefore avoiding costly breakdowns and accelerated equipment replacement, and facilitating lower utility costs.

Employees tasked with executing preventive maintenance require training and updating on the systems they are to maintain. Mechanical, electrical, plumbing and fire protection systems require specific training that is ongoing, and this takes a commitment from the employer and employee in the investment of time and financial resources. Well trained employees and a continued commitment to maintaining certification in their respective disciplines will lay the foundation for adherence to a sound preventive maintenance program. As technology advances, the commitment to training will ensure that employee skills do not become dated and obsolete.

One of the most critical aspects for effective asset preservation is the utilization of a computerized maintenance management software (CMMS) that allows for the implementation of preventive maintenance along with the necessary tracking and budgeting for preventive maintenance. Daily work orders can be produced through the system, employee hours tracked, and materials required to perform preventive maintenance can be identified and managed. The software can assist the operator administratively as it can be used for contract and insurance tracking, purchase orders, inventory ordering and scheduling.

Paul Brown Stadium currently uses Archibus for their computerized maintenance management system, which is the required building repairs and management platform of Hamilton County.

Currently the system is utilized by Engineering, Grounds & Maintenance, Administrative Staff, and Security. Archibus is primarily used as a database for building maintenance work orders, and for employees to enter their time once the work is completed. Ideally reports could be pulled to view hours of work, and costs associated with the work orders and projects. It is not used for incident management during events, mobile incident reporting, inventory management, or other types of services which are provided by competing computerized maintenance management systems.

<u>Work Order Requests</u>:

Archibus is not widely used across Paul Brown Stadium for entering work order requests, as most departments and employees do not have access to the system. Work order requests are generated outside of Archibus through an online form, which is emailed to the appropriate department for assignment. In addition to the emailed form, work order requests are informally made through radio transmission, phone calls, texts, email correspondences, and face to face conversations. The lack of a centralized process for work order requests creates various challenges for the Stadium.

Work order requests are then manually assigned by management to the appropriate trade or contractor to complete the assignment.

<u>Generating and Assigning Work Orders in Archibus</u>:

Work orders are entered into the Archibus database two different ways:

- Management enters the information from the emailed Work Order Request Forms, most commonly on a quarterly basis, not in real time. The work orders are assigned to employees for time worked to be entered as they get completed.
- The working staff enters information as they complete repair/maintenance projects, and input their time worked on the project.

CMMS Challenges

Lack of centralized process for entering work order requests

- Due to limited access to the system across Paul Brown Stadium, Archibus is not utilized as a centralized location for issue reporting
- A "Work Order Request Form" is manually filled out and sent by way of email
- Work orders are requested through many informal and inconsistent forms of communication, as stated in the above process
- Not having a consistent centralized process for entering work order requests causes inefficiencies in receiving accurate requests, communication, completing work in a timely manner, and tracking updated data across all work orders.

Inefficient reporting

- It is highly important to both Hamilton County and Paul Brown Stadium to have the ability to pull comprehensive and accurate reports to show billable hours in order to track cost and hours worked. This information has not been able to be generated through Archibus.
- Real-time reporting can be difficult, as work orders are typically fully updated on a quarterly basis

Not a user-friendly platform

- Complaints on the system range from an overall poor interface, limited and vague dropdown menus for entering work orders, cumbersome process to close out work orders, inefficient tracking of time worked, and inability to produce viable reports on billable hours.

CMMS Recommendations

Paul Brown Stadium and Hamilton County would benefit greatly from a new and improved computerized maintenance management system. A new system will increase efficiency and provide the necessary reporting on work orders and billable hours. The current program Archibus does not appear to be the correct platform for Paul Brown Stadium, which produces world-class, and dynamic, live professional sporting and entertainment events.

Below is a list of features which many new computerized maintenance management systems provide:

1. Improved Work Order Management
    a. Centralized platform for all employees and contractors to create work order requests
    b. Track and edit work orders on a user-friendly interface
    c. Efficient process for closing out work orders upon completion
    d. Schedule preventative maintenance, store equipment history information, track hours

2. Improved Communication and Alerts
    a. Devices mounted at concession stands, kitchens, and key areas throughout the stadium for employees to utilize when needing to enter a work order
    b. Individual devices issued to select staff and contractors, or the apps/programs can be downloaded on personal devices
    c. Customized alerts for specific work order types
        i. Example – Director of Operations is always notified when a “leak” work order request is generated

3. Improved Reporting
    a. Search and view information on individual trades, departments, and specific work order types to help obtain information on time worked and billable hours

4. There are also many additional features with new systems including, but not limited to, Incident Management during events, Inventory Control, Inspections and Testing, Lost and Found, and Guest Services Optimization.

For informational purposes, the following CMMS products are used in many public assembly facilities, including peer stadiums.

https://www.247software.com
(FirstEnergy Stadium-incident tracking; Heinz Field)

https://www.buildingengines.com/facility-and-venue-management/
(M&T Bank Stadium)

Other software used in NFL stadiums include:

- MicroMain (www.micromain.com)
- ProTeus (www.eaglecmms.com)
- FMX (www.gofmx.com)
- Dude Solutions (www.dudesolutions.com)

Additional Recommendations

1. Discuss existing challenges with representatives with Archibus, and Hamilton County. Identify if there are system upgrades that can be completed, or if alterations can be made to how the existing interface is built (Work Order Request options, Close Out Process, etc.)

2. Research capabilities to grant stadium employees and contractors access to Archibus in order to complete work order requests and eliminate/reduce usage of the manual work order request form.
    a. Identifying specific employees within each department to generate work orders will help streamline the process. Training specific employees will be more efficient, and less cumbersome, than training all employees.

3. Use shared tools and documents on Microsoft SharePoint, Google Docs, and/or DropBox for Work Order Request Forms. This will provide live updated information and will remove the manual process of sending/receiving emailed forms.

4. Currently PBS has a payroll system, PayCorp, that does not use codes to track hours spent on tasks. Research new payroll management systems with abilities to track hours against assigned job codes from employee timesheets. This will provide a platform of tracking time worked and billable hours.

PRACTICE & GAME FIELDS

Practice & Game Fields

Practice Fields

There are three total practice fields

- Field 1 - Farthest from stadium; 10 yards short of a full field
- Field 2 - Center field (primary)
- Field 3 - Closest to stadium

The three practice fields are made up of 6.5 acres of bermudagrass, with a base of sand and pea gravel. The fields were changed from Kentucky bluegrass approximately 6-8 years ago. Fields 2 and 3 are overseeded with rye seed in the fall to keep the fields green through the colder weather.

The entire practice field complex is wrapped in landscaping made up of a variety of trees and bushes, which also serves as a privacy screen from the public.

The fields are used from April through the middle of June for OTA's and mini-camps. From the middle of June through July is considered the recovery time period, which is a limited timeframe to replace sod as needed and rejuvenate the fields for the following season. In-season practice begins in July and runs through the remainder of the season. Following the end of the season, approximately January, the stadium crew winterizes the fields by blowing out the irrigation and installing grow covers in order to prep for spring OTA's and mini-camps.

There are currently no issues with irrigation or drainage, and the most current feedback from the Bengals is very positive, as the fields are kept in excellent condition.

Most recently, upgrades were made to the irrigation controls. The upgrades now allow the irrigation system to be operated in the stadium manager's office, as well as remotely via cell phone.

Practice Field Challenges

There are two main access points to the practice field complex, and both access points would be blocked during a flood. Only the patron/media access point (stairs only, no ramp) would be accessible.

Landscaping was originally planted too close together. These trees are choking themselves and dying, and newly planted trees are not growing due to lack of space for roots. This is causing poor aesthetics, various sizes in landscaping, and may create privacy issues as you can now see through the perimeter fencing in various locations.

Field 2 (center field) has been replaced annually since the change from bermudagrass to Kentucky bluegrass 6-8 years ago. It can be a difficult process to replace sod mid-June through July and still be prepared for the wear and tear of an NFL season.

It can be difficult to manage wear areas on fields as the team tends to run similar drills in specific locations, on a highly repetitive basis. Limited real estate surrounding the fields prevents the grounds crew from adjusting the lines to move the fields.

Practice Field Recommendations

1. Although there are no current issues with the drainage and irrigation system, the life span has surpassed 20 years and various failures within the system may soon occur. It is recommended to begin planning an RFP process with the goal of understanding the current cost and scope of work to replace the system.

2. The Head Groundskeeper has had discussions on installing a well system to move off of city water. As an RFP process is developed regarding replacement of the irrigation system, it would be ideal to analyze the ROI of eliminating city water, compared to the service and maintenance of the mechanical equipment of a well system.

3. Potentially look at altering the orientation of the concrete steps at the patron/media entrance on the south side. This may result in more real estate to allow flexibility of moving Field 3 (10) yards north for a period of time, then back to its current location to help change wear areas of the field. As a field that is heavily used, it would greatly increase the grounds crew's ability to manage wear areas and keep the field in a high performing condition for the Bengals.

4. Remove and replace all landscaping, or potentially look to install screening on perimeter fencing for added privacy for the team during practice. At this point many trees are dying, and newly planted trees do not grow. For financial considerations, a phased approach of removing and replacing the landscaping may be another option. Keep in mind a phased approach may show landscaping growing at different rates during each phase.

5. Eliminate practice of replacing sod every year. In an ideal situation, the sod is maintained longer and replaced less frequently. This would also save on capital project money each year.

Game Field

This is the 3rd turf field since the stadium opened 20 years ago with natural grass. It was last replaced in 2018.

The base consists of six inches of sand and six inches of pea gravel. The six-inch layer of sand and pea gravel is original from the time of the stadium opening with natural grass, which had an original base of twelve inches of sand. During the install of the first turf field, the top six inches of sand was removed and replaced with six inches of pea gravel.

There are issues with the current system, including the percolation rate of the base material, static electricity causing an aesthetic issue and a hydrophobic condition. The lowering percolation rate is a result of the age of the original base material and the multiple surface renovations.

On Fridays prior to a Sunday game, the field is sprayed with a diluted solution of detergent and water to help reduce

hydrophobic tendencies between the rubber infill and turf fibers and improve drainage. There is a glycol system in place to heat the subsurface of the field, and all mechanical systems are working well. Outside of a couple of malfunctioning sensors, there are no leaks or major issues at this time.

There is a water cannon system is in place to reduce static electricity, which to date is all original plumbing. Rubber infill tends to rise up creating a darker look to the field. Water removes the static electricity and allows the rubber infill to fall back down through the fibers. Currently the water cannons are not evenly spread around the field.

There are six water cannons, and all cannons are working well. The grounds crew typically only use one water cannon at a time as pressure drops when multiple cannons are operating simultaneously.

Game Field Recommendations

1. There are no immediate recommendations for replacement at this time. Although the system below the turf was replaced in 2018, it is recommended to investigate the condition of the drainage system when the turf field is next replaced in approximately 4-5 years.

2. Water cannon placement could be adjusted to place one at each corner, and one on each sideline at the 50-yard line. This would allow the cannons to spray more evenly throughout the field.

SEATING BOWL CLEANING

Seating Bowl Cleaning

Paul Brown Stadium has a cleaning contract with Aramark, which schedules and manages part-time cleaners for the stadium bowl cleaning. During a typical week, cleaning begins on the Thursday prior to Sunday's game. Pre-washing with pressure washers takes place on Thursday and Friday, rinsing any additional debris that may have naturally accumulated through the week. Along with pre-washing, the crew also wipes down all seats by hand. Following Sunday's game, the post-game clean begins Monday morning with a full trash pick which consists of two full picks. The first pick is for recycling, where the crew picks all bottles and cans in clear bags and brings all the clear bags down to a separate 30-yard open top dumpster. The crew goes back through the bowl for a second pick for trash (full process explained in "Trash Removal" section). In conjunction with Monday's trash/recycling pick, a small team of blowers clean the south end of the stadium near the administrative building.

Following the completion of the trash pick, on Tuesday/Wednesday the cleaning crew performs the blow down process. Starting in the upper rows, the team blows the debris down to the lower rows where it is swept and picked up.

Thursday is the start of the post-clean pressure washing which takes place over four days (Thursday, Friday, Monday, and Tuesday). Thirteen pressure washers are moved around the bowl in a coordinated fashion to reach all seating areas with the right amount of water pressure.

On back-to-back Sundays, the wash starts on Tuesday and finishes on Saturday. In addition to the routine washing, deep cleaning of the concrete floors with pressure washers occurs on a scheduled basis through the year

Bowl Cleaning Challenges

Challenges arise in multiple areas including, but not limited to, hooking up to the hose bibs, usage of hose through the seating areas, location of pressure washers for water access, and clogged floor drains.

When water keys are not used properly, the hose bibs can be stripped and unable to be turned on. As hose bibs become damaged, it would be ideal to install a Y-connection at neighboring hose bibs to reduce the length of hose needed for cleaning. The existing design of the hose bibs point downward at a 45-degree angle recessed into a box, making it extremely difficult to install these connectors. Lack of hose bib connections results in staff needing access to bathrooms for additional water sources. Besides repairs needed to be made on the damaged spigots, additional problems arise with longer hose runs and unsecured bathrooms which inevitably get dirty and need to be recleaned.

In many cases, water access is not an issue, however spigot access is not ideal on the Club Seat Level. Since the closest spigots in these seating areas are inside the finished Club, pressure washers are placed on adjacent ADA platforms with additional lengths of hose run to accommodate the cleaning. Similar access challenges could be said for the East Employee Parking Lot, as access to water sources becomes limited when the flood walls are installed.

The logistical challenges discussed, which lead to running additional lengths of hoses for the washing process, greatly exacerbate the inherent problem of hose lines falling between seat backs.

Poor drainage in the seating bowl, namely at the Club Seat Level, add time to the overall cleaning process. Many of these current drains fail during washing and/or rainstorms, resulting in the need for repairs and additional clean-up, including using a pressure washer to cut the concrete in the Plaza following the clearing of the drainage pipes.

Additional hurdles with power washing involve environmental conditions. As temperatures drop below freezing, washing does not occur as it would create additional problems in the stadium. During these conditions, and additional blow down is performed, and spot washing occurs as needed.

Recommendations

1. Consider developing and documenting a training program tailored towards the set-up, execution, and breakdown of pressure washers and all components (water keys, hoses, machines, etc.). Staff would need to complete and pass the training before being assigned pressure washing duties.
2. Consider evaluating the washing process of both the post-game wash and pre-wash. It may prove to be more cost efficient to eliminate the post-game wash, and do a full complete wash down of the seating bowl in the days leading up to the following game.
3. Investigate the means to install hose bibs inside the vomitories outside of the glass doors of the Club Seat Level, specifically between sections 209/210.
4. Engineer existing hose bibs inside boxes to accommodate a Y-hose connection or investigate an extension that could be manually installed to allow room for a Y-hose connection.
5. Install a hose bib halfway down the East Employee Parking Lot as existing hose bibs are more difficult to access when flood walls are installed after the season ends.
6. Replace damaged and worn drain covers throughout concourses.
7. Relocate existing drains to come out from under condiment stations, or redesign condiment stations to provide better access to drains.
8. Redesign Club Seat Level drainage system by creating more pitch in order to prevent the constant blockages during rain storms, and during pressure washing.
9. Explore the feasibility of installing a separate water supply system dedicated for cleaning, with enough PSI to eliminate pressure washers, and to utilize fire hoses for cleaning.

TRASH REMOVAL PROCESS

Trash Removal Process

The staff for in-game trash removal typically starts on the south end of Paul Brown Stadium, working their way to the north end to access the trash chutes. During a standard football game, the trash cans are typically emptied two to three times per game. Due to lack of access to the trash chutes, trash from the South Plaza Level is transported directly down to the trash room by smaller black and red bins which are more aesthetically pleasing. With similar access issues to trash chutes, the main kitchen trash is transported directly down to the trash room as well.

Post-game trash removal in the stadium bowl starts the morning after a Bengals game. On a regular game week, the process would start Monday morning with Aramark's staff performing a pick of all trash and recycling. The trash bags are then picked up by a gator pulling a gondola train, which transports all bags to two trash chutes located on the north end of the stadium. Recycling bags are transported down to the trash room, typically down the freight elevators, and discarded separately into a 30-yard open container for pick-up.

The two trash chutes are located at the northwest and northeast corners of the stadium, and dump directly into their respective trash compactors. There are access doors for the chutes on all floors, except the South Plaza Level. The access doors are located immediately adjacent to the freight elevator landings on each floor. The large majority of trash bags are sent into the two trash chutes, however there is a portion of trash that gets transported directly into each trash room by staff.

There are two trash rooms located on the northwest and Northeast corners of the stadium. In total, the two trash rooms contain three compactors, and one 30-yard open container which are all provided by the trash hauler Rumpke. The northwest trash room has two compactors. One compactor is connected to the trash chute, the other compactor is dedicated for cardboard. The northeast trash room has one trash compactor and has loading dock access to a 30-yard open container which is designated for the bottles/cans recycling bags collected by Aramark.

It is important to note, that in both cases the trash compactors do not have loading dock access. In order for staff to discard trash into the compactors inside the trash rooms, they are required to utilize a metal staircase to walk up and place trash bags by hand.

Trash Removal Challenges

Trash chutes get clogged at the base near the compactor due to the angle from main chute to compactor. This typically occurs more often in the northeast trash room, and the base of this trash chute is more difficult to access to clear the blockage than the northwest trash chute. There is an access door to reach in and pull the trash to clear blockage. However, staff needs to use stairs and a platform without handrails, which are typically greasy and slippery.

The trash chutes are located next to both freight elevators, which presents a variety of challenges. It not only disrupts traffic flow on and off the elevator, but it also makes cleaning the floors and surrounding areas difficult. To prevent water from entering the freight elevator shaft, the staff keeps the freight doors open and stands in the freight car to pressure wash the floors. Cleaning is extensive on each floor at chutes, resulting in the freight elevator being out of service during the process. This process typically takes two people four hours with a pressure washer and a squeegee.

Many of the access doors to the chutes are bent and damaged. The full bags from the 55 gallon trash cans are larger than the access holes, which causes staff to shove the trash into the hole. This can result in bags tearing and leaving a mess at the entrance to the freight elevator. Also, the door stops on the main exterior doors leading to the trash chute access doors are broken, which makes the process more logistically difficult for staff.

The northwest trash room presents various challenges due to its minimal size and overall design. The room is difficult to maintain and clean for various reason. Insufficient floor drainage causes significant water build-up which then needs to be removed by scrubbers and mops. Poor location of the hose bib, which is on a wall behind the cardboard compactor, makes water access difficult. In order to sufficiently clean the room, both the trash and cardboard compactors need to be removed. Although this is an understandable requirement to completely clean the floor, ideally this would not have to be done each time the main paths are washed and cleaned.

In both trash rooms, there is no loading dock access to the compactors. This presents a significant challenge as staff cannot dump trash from the gondolas into compactors. The current set-up causes staff to have to pull bags out of a bin, walk up metal steps, open the side hatch to the compactor, and hand place trash into compactor. There are currently no handrails on these stairs, and the metal becomes slippery very quickly due to the trash.

The lack of loading dock access to the compactors to discard trash has created enough inconvenience to foster poor behavior. It was reported to us that on many occasions kitchen staff has dumped the trash directly on the floor of the northwest trash room, instead of into the compactor. This creates an unsafe and unsanitary condition for all employees during the game, and for the post-clean.

It is reported that concession stand staff often don't place their trash in adequate bags or separate their cardboard trash. These poor habits add inefficiencies to the trash removal process on the post-clean.

Recommendations

1. Provide clear standard operating procedures for the concession stand staff to follow when placing trash outside of the stands.

2. Provide clear standard operating procedures at the northwest trash room for kitchen staff and other employees to discard trash properly inside the compactor, and not dump trash on the floor inside the room.

3. Develop and install printed signage at each concession stand, kitchen, and inside the trash rooms to provide clear and visible instruction on discarding trash.

4. Explore moving the cardboard bailer from the northwest trash room to the northeast trash room, which would create space for another trash

compactor. Work closely with Rumpke on ideas for what style of compactor, or open container, that would work well for staff to discard trash. This would provide easier and more efficient access to discard trash inside the compactor, rather than dumping the trash on the floor.

5. Explore feasibility of requiring kitchen staff and other departments to utilize the northeast trash room during in-game trash removal. The northeast trash room has dock access, and Rumpke could provide a compactor or packer truck during the game for staff to discard trash that is not pushed down the chutes.

6. Add handrails and signage to improve safety at existing stairs and platforms of each compactor inside each trash room.

7. Although the two trash chutes function well, there is room for improvement. Investigate redesigning the access doors on each floor of the chutes to create larger openings on each level to throw trash into chutes. This could also be done on the floors with the higher volumes of trash to reduce cost, but still be an effective change.

8. Alter the location of trash chutes to no longer be adjacent to both freight elevators to eliminate the issues associated with dumping trash at elevator car entrances.

9. Improve design at base of trash chutes to compactors to allow for less clogging and blockage.

10. Add signage with specific safety protocols on how to open the access hatches to remove clogged trash.

11. Add or adjust locations of hose bibs inside northwest trash room for easier access to hook up power washers for cleaning the floors.

Peer Stadiums

For the benefit of Paul Brown Stadium management, we surveyed a peer group of venues to provide insight into other means and methods of removing trash and power washing the seating bowl. Below are our findings.

M&T Bank Stadium

Similar to PBS, there is a blow down process that occurs top to bottom once the two picks for trash and recycling are complete. It is worth noting, they indicated should composting ever establish on a wide commercial scale in the Baltimore region, they anticipate scaling up for a third pick which would consist of organic material collectors. Trash is transported down to compactors via freight elevators and ramps. Internal brainstorming has occurred around designing a portable chute that could potentially sit on the stadia rails, similar to the functionality of snow removal chutes. Power washing (top to bottom) does not begin until the days leading up to the next game. They have learned performing this task just after the game results in rework on the days leading up to the game. Similar to PBS, environmental conditions such as sustained freezing temperatures will result in power washing schedule adjustments or cancellation. There have been no down sides to the change in washing schedule, including no issues with pest control. They too have challenges with hose bibs located inside finished spaces and having to move machines and add hoses to compensate. After an evaluation period it was determined after the mechanical blowing takes place on the concourse ramps and steps, they are in good condition and do not require power washing every game. This adjustment created a savings in both labor, and overall water consumption.

Heinz Field

During the trash pick, the sections are split between the cleaning staff as one person will start up top and the other will start in the middle working their way down. Upon completion of the pick, a blow down is performed. Trash bags are loaded into carts and either transported directly down to the trash room or pushed down the trash chutes. The washing process is not done with pressure washers, as simple hose pressure is utilized throughout the stadium. There are challenges with the level of pressure as cleaning takes place towards the top of the stadium.

FirstEnergy Stadium

The trash pick is performed directly after each game, with the goal of completing the pick the night of each game. Trash bags are loaded into the compactors the night after a game. Only if the compactors become full, does the process get expanded to the following morning. The blow down is performed top to bottom over two days, starting the day after a game. Power washing is a pre-game function and is almost always completed the days leading up to a game. Twelve power washers are used, and the process is highly dependent on environmental conditions. Hose bib access is not typically an issue, as many are located in nearby janitor closets. In locations where access is a challenge, power washers and additional hoses are used to accommodate.

Nissan Stadium

Nissan Stadium has a new cleaning company, and 2020 season did not allow for what will ultimately be their final process. With so few fans, they swept everything – no picking by hand.

A complete top down power washing occurs once before the season starts, using an out of state company (pressureproswash.com). They bring 14 people and water trucks (filled up at the stadium), then spend two weeks pressure washing the bowl as well as the 100 level concourse. During the season, they only spot-pressure wash when needed, using the building's cleaning contractor.

RECYCLING

Recycling

Recycling cans are spread out in the concourse areas for guests to utilize during events. Bottles and cans from the containers, as well as the stadium seating bowl post-clean, are picked and brought down to a separate 30-yard open container in the northeast trash room. The concourse recycling cans are emptied during games and brought down the freight elevators to the 30-yard open container as well. In addition, carboard is collected throughout the stadium and brought down the freight elevator to the dedicated cardboard compactor inside the northwest trash room.

Recycling Challenges

Although recycling is taking place at the stadium, there are several challenges with the current program. The existing tall plastic bottle containers on the concourses for the guests are from an expired sponsorship agreement. Due to their design, they aren't user-friendly to the guests, and occasionally fall over in the wind. In addition, the flaps at the bottle hole are rigid, often resulting in the guests touching the container.

There are limited opportunities for guests to recycle as there are currently no recycling cans in other locations of the stadium including suites, clubs, bars, and back of house areas like concessions, kitchens, and pantries.

From a back of house operation, staff from the kitchens, clubs, suites, concession stands, and bars do not currently sort their recycling. Staff will only sort on "pour only" nights as they discard the cans and bottles into a recycling container as they serve the guests their drinks.

Recommendations

During the site visits, the operations staff discussed their desire to increase recycling practices throughout the stadium. Ideally these practices are expanded without increase overall labor costs.

1. Initiate discussions with Rumpke, the trash hauling service, to better understand their opportunities and limitations for a more comprehensive stadium recycling program. Rumpke should be asked to provide a detailed description of their recycling capabilities and services using their labor, equipment, and resources. They will also provide a big picture view of their processes around sorting and recycling at their facilities, and how/where the recycling goods are exported. Further understanding and collaboration with Rumpke will allow Paul Brown Stadium to understand their opportunities within the stadium.

2. Increase opportunities for guests to recycling. Explore more containers for guests throughout the stadium in suites, clubs, and at bars.

3. Replace existing plastic containers with more aesthetically pleasing containers that combine well with the trash containers and are more user-friendly for guests.

4. Add recycling cans to entrance gates or parking lots for guests to recycle tailgating trash.

5. Improve signage throughout stadium to enhance communication and provide clear instruction around process and procedures for both guests and staff. Partner with the Department of Sanitation and Rumpke, along with food service staff, on verbiage for signage to best communicate which items get recycled. When placing printed signage above trash and recycling cans, it is extremely important to correctly identify the products and where they should be discarded.

6. Partner with the food service operator to gain cooperation regarding recycling back of house goods. Establish policies and procedures for the staff. Create and install signage in all concessions, kitchens, pantries, and other back of house locations where trash is discarded.

7. There is a large area of real estate in the northeast trash room currently utilized as overflow storage for expired event presentation signage and old grey round trash cans. Once cleared, this area could be utilized to assist trash removal and recycling. One concept would be to move the cardboard compactor to this location, which would designate the northeast trash room as the centralized recycling location, and clear up much needed space in the northwest trash room. Creating more space in the northwest trash room could provide opportunity for the main kitchen to begin composting (via digester or containers for removal).

8. Establishing a well-rounded recycling program encompassing Rumpke, the Department of Sanitation, internal groups and departments, proper signage and containers, and documented policies and procedures will allow the ability to scale up at a pace that doesn't strain the Operations department.

We understand Paul Brown Stadium is a finalist for the 2026 World Cup, and there may be sustainability requirements for the award. The requirements will likely include a minimum level of recycling that could current exceed what is currently in place.

Peer Stadiums

For the benefit of Paul Brown Stadium management, we surveyed a peer group of venues to provide insight into other means and methods of recycling. Below are our findings.

M&T Bank Stadium

There are ample amounts of recycling containers for guests in suites, concourses, and all perimeter locations. Public announcements are made in-game to the guests, and recycling is promoted and collected in tailgating lots. Concessions and Suites are in full cooperation with sorting trash, cans/bottles, cardboard, and cooking oil. They also contribute to their own composting operation. A great example regarding their relationship with their trash hauler is the process around recycling glass. Currently there is not a market for glass, however the trash hauler understands it would be a large and complicated lift for the stadium personnel and guests to be retrained. Consequently, the trash hauler accepts glass with their recycling, and performs their own sorting offsite at their facility.

Heinz Field

The cleaning company currently recycles cardboard on gamedays. Dry cardboard is flattened, stacked on carts and loaded into a bailer. Aramark composts food scraps and leftovers from the main kitchen and clubs. The compost is put

into yellow containers which are brought into the trash room and loaded into larger containers for the trash hauler.

FirstEnergy Stadium

Stadium management has implemented policies that have the buy in of all team departments and partners to recycle cardboard. Detailed procedures have been established with staff in concessions, suites, the warehouse, and kitchens. The kitchens have a composting program, where the food scraps are picked up and put into a digester a few miles from the stadium.

Nissan Stadium

The stadium only recycles plastic bottles and cans via concourse receptacles; they do not believe fans really use them appropriately. The stadium operations manager expects the new cleaning company to use two bags when they pick trash this fall – one for recyclables and one for trash.

TRENDS IN STADIUM DESIGN & OPERATION

TRENDS IN STADIUM DESIGN & OPERATION

Food Service

Walk-in Markets

This mixes a retail concept with a traditional concession concept. They can be all pre-packaged items (grab-n-go only) or implement a display cooking area that feeds display units (hot, cold, and ambient) for self-service of pre-packaged items by the customer. These allow customers to put together their own food and beverage needs from self-service refrigerators, freezers and warmers and bring them to a cashier position for check-out, like a convenience store operation.

It can include self-swiping pay kiosks as well as manned POS positions. It provides concourse relief as the patrons queue inside the stand vs. outside the stand. This concept has been proven to increase customer throughput and has been incorporated at most of the new /remodeled sports venues in the last 18 months.

We recommend the concession stands and stadium be studied to determine the best locations for future modernization opportunities.

Digital Ordering and Alternate Delivery Methods

The last seven years have seen a rapid growth of digital ordering and alternate product delivery methods. In a time where finding labor can be challenging, new concepts about food delivery need to be considered.

One of the newest trends is the ability for remote ordering/pick-up. This concept can be incorporated into a stand with traditional points of sale as well as “dark stands”. Dark stands are areas where there are no live POS/staff, just the ability to pick up orders.

Remote ordering puts the decision making into the hands of the consumer in a more intimate/technology-based process. Several methods include self-serve kiosks that upsell and the development of facility specific custom apps for phone/tablet ordering. There is also an integration of ordering and simultaneous marketing with this concept.

Remote Pick-up

While there are several ways to accomplish this, food lockers are gaining traction in the sports market. Essentially, the operator/owner would develop an app that can be used for marketing as well as order entry. The customer would order on their phone/tablet and when the order is ready, they would receive a text with the code to unlock their order. The food would be held in an ambient “locker”. Several models of lockers are available. We typically see 8 lockers replace a single POS.

Another approach that is effective is an area on the counter that is designated for remote order pick-up. It requires equipment to support this station; hot holding shelves, refrigeration, POS printer/ order screen and space to assemble orders.

Remote Ice/Soda Stations

Another current trend is moving the ice/soda stations from the front concession counters to a remote location within close to the food service point. While initial concerns over the “theft” of product seemed it would add cost, the benefits are proving this to be offset by the gains in service improvement, reuse of front counter space and labor savings. It transfers the labor from the staff to the customer. It also allows for an increased number of POS in a smaller footprint for two reasons: First, the soda/ice machines have been relocated from the front counter to a remote beverage station allowing extra space for POS equipment; second, it requires approximately half the number of soda ice stations. When on the front counter, they need to be placed between two POS to eliminate travel when producing a drink. When remoted, only one ice/soda dispenser per four (4) POS is required. We recommend that this be considered during design.

APPENDIX A

CAPITAL EXPENSE MATRIX

The Capital Expense Matrix does not include annual inflation escalators.

Contingency (manual input) 15%

Paul Brown Stadium 20 Year Capital Plan

Note: This Cap Ex does not include escalators for CPI increases

	Grouping	Subcategory 1	Subcategory 2	Subcategory 3	Function or Upgrade	Priority (High, Medium, Low)	Frequency of repairs & replacement in years	Estimated Cost per occurrence in FY 2021 Dollars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Total Cost
									0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
									100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
									2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	
1	Architecture	400 Level	Investigate light poles at north end to verify if penetrations are a source of leaks	19 light poles @$500 per pole	Function	High	20	95,000	95,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***95,000***
2	Architecture	Administration Building	Restripe the visitor parking due to the increased number and changing roles of administrative staff		Function (was formerly Upgrade)	Medium	15	4,000	-	-	4,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,000	-	-	***8,000***
3	Architecture	Administration Building	Expand Women's Locker area		Upgrade (MP)	Medium	One time	150,000	-	150,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150,000	-	-	***300,000***
4	Architecture	Administration Building	Provide additional public display space for historic items		Upgrade (MP)	Medium	15	10,000	-	-	10,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,000	-	-	***20,000***
5	Architecture	Administration Building	Add dedicated package receiving area		Upgrade (MP)	Medium	One time	70,000	-	-	70,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***70,000***
6	Architecture	Administration Building	Upgrade Touchdown room finishes and technology		Function	Medium	15	500,000	-	-	-	500,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	500,000	-	***1,000,000***
7	Architecture	Administration Building	Upgrade technology in all conference rooms		Function (was formerly Upgrade)	Medium	15	150,000	-	-	-	150,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150,000	-	***300,000***
8	Architecture	Administration Building	Additional access to administrative storage		Upgrade (MP)	Medium	One time	30,000	-	-	30,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***30,000***
9	Architecture	Administration Building	Renovate men's room on 400 level by swapping one urinal for an additional toilet stall		Upgrade (MP)	Medium	One time	35,000	-	-	35,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***35,000***
10	Architecture	Club Atriums	Provide relief joints in gyp board where cracks have occurred (ceiling soffit, at beam furring, at curtainwall	5000 lf @ $8 p/lf	Function	Medium	20	40,000	-	-	40,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***40,000***
11	Architecture	Club Atriums	Replace expansion joint material	350 lf @ $1200 p/lf	Function	High	15	420,000	420,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	420,000	-	-	-	-	***840,000***
12	Architecture	Club Atriums	Replace broadloom carpet and slate tile	Carpet = $400,000 / Slate 11600 sf	Function (was formerly Upgrade)	Medium	20	620,400	-	-	-	620,400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***620,400***
13	Architecture	Club Atriums	Alternate: Add shading devices on West facing glass	75 shades / electric $1000 per shade / Shade $1200	Upgrade (MP)	Medium	20	165,000	-	-	165,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***165,000***
14	Architecture	Club Atriums	Provide recycling program		Function	High	20	25,000	25,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***25,000***
15	Architecture	Club Atriums	Regrade kitchen floors at floor drains by front doors	New floor drains and grinding 4 locations	Function	High	20	52,000	52,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***52,000***
16	Architecture	Concessions	Replace Cabinetry	92 Stands @ 60 lf pistand @ $725 p/lf	Function	Medium	20	2,697,000	-	-	-	2,697,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***2,697,000***
17	Architecture	Curtainwall	Replace glazing gaskets	Location: offices	Function	High	15	189,600	189,600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	189,600	-	-	-	-	***379,200***
18	Architecture	Curtainwall	Wet Seal or reglaze curtain wall	Location: main stadium	Function	Medium	20	512,000	-	-	512,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***512,000***
19	Architecture	Curtainwall	Provide relief joints at cracks in gypsum	Location: main stadium / 400 lf @ $120 p/lf	Function	Medium	20	48,000	-	-	48,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***48,000***
20	Architecture	Exterior Lighting	Provide additional lighting at areas listed		Function	High	20	250,000	250,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***250,000***
21	Architecture	Exterior Lighting	Replace existing accent and façade light fixtures with LED fixtures		Function (was formerly Upgrade)	Medium	20	300,000	-	-	300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***300,000***
22	Architecture	Exterior Plaza Deck, Auto Entrances and Barricades	Provide folding auto barrier at East exterior plaza	Mifram folding barrier product, 3 @ $80,000	Function	High	10	240,000	240,000	-	-	-	-	-	-	-	-	-	240,000	-	-	-	-	-	-	-	-	-	***480,000***
23	Architecture	Exterior Plaza Deck, Auto Entrances and Barricades	Provide permanent bollards at East exterior plaza	12 @$4000	Function	High	20	48,000	48,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***48,000***
24	Architecture	Gates, Fences and Barricades	At Gate F, provide enclosure for x-ray machine at exterior of building	20' x 25' = 500sf @ $250 p/sf	Function	High	20	125,000	125,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***125,000***
25	Architecture	Gates, Fences and Barricades	Reconfigure Gates A-E for permanent magnetometers, shades or canopies, consistent traffic flow and improved fencing		Upgrade (MP)	High	20	4,500,000	-	4,500,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***4,500,000***
26	Architecture	Gates, Fences and Barricades	At Gate D, add space to the Main Concourse overlook to alleviate congestion	8800 sf @ $75 p/sf	Upgrade (MP)	Medium	20	660,000	-	-	660,000	660,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***1,320,000***
27	Architecture	General Concessions	Replace overhead coiling doors	110 OH Doors / $15,000 per door	Function	High	10	1,650,000	1,650,000	-	-	-	-	-	-	-	-	-	1,650,000	-	-	-	-	-	-	-	-	-	***3,300,000***
28	Architecture	General Concessions	Repair damaged wall tile	92 Locations / $1,800 per	Function	High	5	111,600	111,600	-	-	-	-	-	111,600	-	-	-	111,600	-	-	-	-	-	111,600	-	-	-	***446,400***
29	Architecture	General Concessions	Provide lubricant at door closers to improve operation	62 locations, 2 doors per location, $150 per door	Function	High	1	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	***372,000***
30	Architecture	General Concessions	Adjust door hinges	124 doors, $150 per door	Function	High	5	18,600	18,600	-	-	-	-	-	18,600	-	-	-	18,600	-	-	-	-	-	18,600	-	-	-	-	***74,400***
31	Architecture	General Concessions	Replace door silencers and sweeps	124 doors, $700 per door	Function	High	20	86,800	86,800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***86,800***
32	Architecture	General Concessions	Replace doors with detached skin	92 Doors, $1,800 per door	Function	High	20	111,600	111,600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***111,600***
33	Architecture	General Concessions	Provide door thresholds. Embed in non-hardening butyl sealant	62 doors, $1,500 per door	Function	High	20	93,000	93,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***93,000***
34	Architecture	General Concessions	Replace all hollow metal doors, frames and hardware	124 door, $3,500 per door	Function	Medium	20	434,000	-	-	-	-	-	434,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***434,000***
35	Architecture	General Restrooms	Replace burned out bulbs	70 Public Restroom @ $500 per restroom	Function	High	10	35,000	35,000	-	-	-	-	-	-	-	-	-	35,000	-	-	-	-	-	-	-	-	-	***70,000***
36	Architecture	Interior Lighting	Replace incandescent light fixtures with LED		Function (was formerly Upgrade)	High	20	1,500,000	1,500,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***1,500,000***
37	Architecture	Interior Lighting	Replace all other light fixtures with LED		Function (was formerly Upgrade)	High	20	3,500,000	-	3,500,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***3,500,000***
38	Architecture	Interior Lighting	Replace all fluorescent linear lighting with LED		Function (was formerly Upgrade)	High	20	2,000,000	-	2,000,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***2,000,000***
39	Architecture	Interior Lighting	Replace all fluorescent lighting in office areas with LED		Function (was formerly Upgrade)	High	20	1,500,000	1,500,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***1,500,000***
40	Architecture	Interior Lighting	Replace timers in office areas with occupancy sensors	150 timers @ $225 each	Function (was formerly Upgrade)	Medium	20	33,750	-	-	33,750	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***33,750***
41	Architecture	Interior Lighting	Replace all fluorescent lighting in mechanical/electrical areas with LED		Function (was formerly Upgrade)	Medium	20	500,000	-	-	-	500,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***500,000***
42	Architecture	Interior Lighting	Replace all fluorescent lighting in kitchens, concessions and other food prep areas with LED		Function (was formerly Upgrade)	High	20	2,200,000	-	2,200,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***2,200,000***
43	Architecture	Interior Lighting	Renovate club entrances to provide better lighting for night games		Upgrade (MP)	Medium	20	150,000	-	-	-	150,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***150,000***
44	Architecture	Interior Lighting	Replace all fluorescent lighting in club areas with LED		Upgrade (MP)	High	20	750,000	750,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***750,000***
45	Architecture	Interior Lighting	Replace all fluorescent lighting in suites and suite areas with LED	133 suites @ $2500 per suite	Upgrade (MP)	Medium	20	332,500	-	-	332,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***332,500***
46	Architecture	Interior Lighting	Replace all fluorescent lighting in general restrooms with LED	90 Gen Restrooms @ $7500 per restroom	Upgrade (MP)	High	20	675,000	675,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***675,000***
47	Architecture	Interior Lighting	Provide additional light fixtures in general restrooms to meet required light levels	90 Gen Restrooms @ $2500 per restroom	Upgrade (MP)	High	20	225,000	225,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***225,000***
48	Architecture	Interior Lighting	Provide additional light fixture(s) at First Aid areas	6 First Aid Areas @ $2500 per station	Upgrade (MP)	High	20	15,000	15,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***15,000***
49	Architecture	Interior Lighting	Replace lighting and lighting controls in small auditorium		Function	High	20	35,000	-	-	35,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***35,000***
50	Architecture	Lighting Control System	Replace lighting control software		Function	High	20	2,000,000	2,000,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***2,000,000***
51	Architecture	Lighting Control System	Replace suite lighting controls with controls that can be controlled by the building system software		Upgrade (MP)	Medium	20	1,500,000	-	-	-	1,500,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***1,500,000***
52	Architecture	Non-structural Walls	Patch and paint chipped CMU wall corners	6x6x3/8 x 8 corner guard F& I = $1300	Function	High	10	650,000	650,000	-	-	-	-	-	-	-	-	-	650,000	-	-	-	-	-	-	-	-	-	***1,300,000***
53	Architecture	Non-structural Walls	Install heavy duty corner guards at wall corners	6x6x3/8 x 8 corner guard F& I = $1300	Function	High	10	650,000	650,000	-	-	-	-	-	-	-	-	-	650,000	-	-	-	-	-	-	-	-	-	***1,300,000***
54	Architecture	Non-structural Walls	Remove peeling paint and repaint	300,000 sf @ $2.50 p/sf	Function	High	2	750,000	750,000	-	750,000	-	750,000	-	750,000	-	750,000	-	750,000	-	750,000	-	750,000	-	750,000	-	750,000	-	750,000	***7,500,000***
55	Architecture	Non-structural Walls	Large cracks: sawcut joint and install backer rod and sealant	Cut @$3.50 lf / Backer @ $2. lf / Sealant @ $6 lf @ 150,000 lf	Function	High	15	1,725,000	1,725,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,725,000	-	-	-	-	***3,450,000***
56	Architecture	Non-structural Walls	Small cracks: grind out mortar and repoint	$11 p/sf @ 100,000 sf	Function	High	5	1,100,000	1,100,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***1,100,000***
57	Architecture	Non-structural Walls	Repair freestanding windblocks	16 @ $3000 per	Function	High	20	48,000	48,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***48,000***
58	Architecture	Non-structural Walls	Remove and replace all sealant (CMU walls, concession counters, stairs, etc.)	$5 p/lf to remove / $7 p/lf Sealant @ 100,000 lf	Function	High	20	1,200,000	1,200,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***1,200,000***
59	Architecture	Open Air Concourses, Ramps and Stairs	Repair concrete landings for exterior stairs and ramps.	Ramps 165600 sf, Stair landings 28800 sf, demo to topping slab, repair metal deck, patch concrete and traffic coating @75 p/sf	Function	High	20	14,580,000	-	14,580,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***14,580,000***
60	Architecture	Open Air Concourses, Ramps and Stairs	Replace all joint sealants at the stairs and railings	Stairs & Landings 42900 sf @ $12 p/sf	Function	High	20	514,800	514,800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***514,800***
61	Architecture	Open Air Concourses, Ramps and Stairs	Patch concrete wall corners at ramp landings to doors	500 lf @ $30 p/lf	Function	Medium	20	15,000	-	-	15,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***15,000***
62	Architecture	Open Air Concourses, Ramps and Stairs	Repair the club level north bridge (Sector 2)	1500sf, demo to structrual steel, repair steel, new deck and concrete and traffic coating @175 p/sf	Function	High	20	262,500	262,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***262,500***
63	Architecture	Perforated metal Panel Screen Walls	Paint steel columns	52 columns @ $800 per	Function	High	10	416,000	416,000	-	-	-	-	-	-	-	-	-	416,000	-	-	-	-	-	-	-	-	-	***832,000***
64	Architecture	Plaza Level: East and West Club Entrances	Replace slate tile	4920 sf @ 19 p/sf	Upgrade (MP)	Medium	20	93,480	-	-	-	93,480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***93,480***
65	Architecture	Plaza Level: East and West Club Entrances	Renovate heating	Install Air Curtains 4 x $9500	Function	High	20	38,000	38,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***38,000***
66	Architecture	Plaza Level: Pro Shop	Revise entry areas and add vestibules		Function	High	20	250,000	250,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***250,000***
67	Architecture	Plaza Level: Pro Shop	Add ADA automatic door opener to doors		Function	High	20	20,000	20,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***20,000***
68	Architecture	Plaza Level: Pro Shop	Renovate Pro Shop to be a destination, not just for retail shopping, but for an experience and events to attract visitors	8510 sf @ $350 p/sf	Function	Medium	20	2,978,500	-	-	-	2,978,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***2,978,500***
69	Architecture	Plaza Level: Pro Shop	Alternate: Add shading devices on West facing glass	29 shades / electric $1000 per shade / Shade $1200	Upgrade (MP)	Medium	20	63,800	-	-	63,800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***63,800***
70	Architecture	Plaza Level: Pro Shop	Upgrade HVAC and add perimeter heat controls		Function (was formerly Upgrade)	Medium	20	300,000	-	-	300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***300,000***
71	Architecture	Plaza Level: Pro Shop	Fix leaks in structure above ceiling and add subroof and drain lines		Function	High	20	75,000	75,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***75,000***
72	Architecture	Plaza Level: Pro Shop	Replace sales fixtures		Upgrade (MP)	Medium	20	70,000	-	-	-	70,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***70,000***
73	Architecture	Plaza Level: Pro Shop	Update sound system to get speakers on real-time or acoustically separated from live action		Function	Medium	20	60,000	-	-	-	60,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***60,000***
74	Architecture	Plaza Level: Pro Shop	Provide visual security system for manager's office		Upgrade (MP)	Medium	20	150,000	-	-	-	150,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***150,000***
75	Architecture	Plaza Level: Pro Shop Satellite Spaces	Replace signage with more prominent signage		Function	Medium	20	45,000	-	-	-	45,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***45,000***
76	Architecture	Plaza Level: Pro Shop Satellite Spaces	Repair leaks at front wall		Function	High	20	8,000	8,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***8,000***
77	Architecture	Plaza Level: Pro Shop Satellite Spaces	Replace casework		Function	Medium	20	70,000	-	-	70,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***70,000***
78	Architecture	Plaza Level: Pro Shop Satellite Spaces	Replace shutter doors		Function	Medium	20	25,000	-	-	25,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***25,000***
79	Architecture	Plaza Level: Pro Shop Satellite Spaces	Replace heating		Function	High	20	90,000	90,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***90,000***
80	Architecture	Plaza Level: Pro Shop Satellite Spaces	Replace lighting		Function	High	20	25,000	25,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***25,000***
81	Architecture	Plaza Level: Pro Shop Satellite Spaces	Provide additional data outlets		Function	High	20	20,000	20,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***20,000***
82	Architecture	Plaza Level: Pro Shop Satellite Spaces	Provide additional electrical outlets		Function	High	20	30,000	30,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***30,000***
83	Architecture	Precast Concrete Screen Walls	Replace all joint sealants in the panel system	45700 sf precast @ $12 p/sf	Function	High	20	548,400	548,400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***548,400***
84	Architecture	Premim Patron Sponsored Space (Level 000)	Re-attach flooring to concrete		Function	High	15	6,000	6,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,000	-	-	-	-	***12,000***
85	Architecture	Premium Patron Sponsored Space (Level 000)	Review area with sponsor for new finishes		Upgrade (MP)	Medium	10	10,000	-	-	10,000	-	-	-	-	-	-	-	-	-	10,000	-	-	-	-	-	-	-	***20,000***
86	Architecture	Queen City Tap House	Repair or replace damaged trim		Function	Medium	10	4,000	-	-	-	4,000	-	-	-	-	-	-	-	-	-	4,000	-	-	-	-	-	-	***8,000***
87	Architecture	Retail Warehouse	Upgrade the office area for comfort of occupants		Upgrade (MP)	Medium	20	140,000	-	-	140,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***140,000***
88	Architecture	Retail Warehouse	Repair subroof to prevent damage to electrical devices and merchandise		Function	High	20	40,000	40,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***40,000***
89	Architecture	Retail Warehouse	Provide additional electrical outlets		Function	High	15	25,000	25,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25,000	-	-	-	-	***50,000***
90	Architecture	Seating Bowl	Replace Club Level seating	15,590 fixed seats @ $300 p/seat	Function	High	20	4,677,000	4,677,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***4,677,000***
91	Architecture	Seating Bowl	Replace lower bowl level seating	28,379 fixed seats @ $300 p/seat	Function	Medium	20	8,513,700	-	-	8,513,700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***8,513,700***
92	Architecture	Seating Bowl	Replace upper bowl level seating	19,965 fixed seats @ $300 p/seat	Function	Medium	20	5,989,500	-	-	-	-	5,989,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***5,989,500***
93	Architecture	Seating Bowl	Replace the stadium seating stair area step lights		Function	High	20	75,000	75,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***75,000***
94	Architecture	Service Level	Install a reliable auxiliary drainage system at the IT room		Function	High	20	25,000	25,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***25,000***
95	Architecture	Sliding Glass Wall	Replace locks with more durable hardware, replace trolleys and tracks	133 Sliding opening, demo existing glass system, prep for new system. = $30,000 glass, $8,000 demo / prep per opening	Function	High	15	5,054,000	-	5,054,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,054,000	-	-	-	***10,108,000***
96	Architecture	Stadium Security and Package Receiving	Install 100 cameras throughout the stadium	95500 per camera	Function	High	10	650,000	-	650,000	-	-	-	-	-	-	-	-	-	650,000	-	-	-	-	-	-	-	-	***1,300,000***
97	Architecture	Stadium Security and Package Receiving	Renovate space to provide for additional camera monitoring and increased staff	5600 sf @ $300 p/sf	Function	High	20	1,680,000	-	1,680,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***1,680,000***
98	Architecture	Suites	Replace broadloom carpet and slate tile	250 sf Tile @ $19 p/sf / 400 sf Carpet @ $7 p/sf / 133 Suites	Function	Medium	20	1,004,150	-	-	1,004,150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***1,004,150***
99	Architecture	Suites	Replace locks with electronic access device	133 suites @ $2500 p/suite	Function (was formerly Upgrade)	Medium	20	332,500	-	-	332,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***332,500***
100	Architecture	Suites	Remove wall paper and paint walls	160 lf x 10' = 1600 sf @ $4 p/sf / 133 suites	Function	Medium	10	851,200	-	-	-	851,200	-	-	-	-	-	-	-	-	-	851,200	-	-	-	-	-	-	***1,702,400***

101	Architecture	Suites	Provide maintenance program to repair gyp board walls damaged by furniture and equipment	$1,500 per Suite p/yr	Function	High	1	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	199,500	***3,990,000***
102	Architecture	Suites	Replace Cabinetry	133 suites @ $25000 p/suite	Function	Medium	20	3,325,000	-	-	-	3,325,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***3,325,000***
103	Architecture	Suites: Bar	Replace countertops with quartz	65 sf per suite @ $130 p/sf	Upgrade (MP)	Medium	10	1,123,850	-	-	-	1,123,850	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***1,123,850***
104	Architecture	Suites: Bar	Provide wall protection and easily cleaned wall surfaces	80 lf x 4' = 320 sf @ $8 p/sf = $2560 / 133 Suites	Upgrade (MP)	Medium	10	340,480	-	-	340,480	-	-	-	-	-	-	-	-	-	340,480	-	-	-	-	-	-	***680,960***
105	Architecture	Suites: Bar	Replace appliances	Ice Maker = $2100 and Fridge = $1500	Function	High	20	478,800	-	478,800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***478,800***
106	Architecture	Suites: Bar	Replace lock on liquor cabinet	133 @ $75	Function	High	10	9,975	9,975	-	-	-	-	-	-	-	-	9,975	-	-	-	-	-	-	-	-	-	***19,950***
107	Architecture	Suites: Restroom	Replace the soap dispenser with a dispenser mounted above the sink	133 @$150	Upgrade (MP)	Medium	10	19,950	-	-	19,950	-	-	-	-	-	-	-	-	-	19,950	-	-	-	-	-	-	***39,900***
108	Architecture	Team Space	Add electric outlets in Equipment area		Upgrade (MP)	Medium	20	50,000	-	-	50,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***50,000***
109	Architecture	Team Space	Add dishwasher to hydrotherapy room		Upgrade (MP)	Medium	20	75,000	-	-	75,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***75,000***
110	Architecture	Team Space: Treatment Roomn	Add new treatment and recovery technology		Upgrade (MP)	Medium	15	4,000,000	-	-	4,000,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***4,000,000***
111	Architecture	Team Spaces and Coaches' Offices	Renovate mail/parcel pick up	Increase to 100 mail slots	Upgrade (MP)	Medium	20	50,000	-	-	50,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***50,000***
112	Architecture	Team Spaces and Coaches' Offices	Replace floor tile in locker room showers	60' x 35' = 2100 sf @ $19 p/sf	Function	High	20	39,900	39,900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***39,900***
113	Architecture	Team Spaces and Coaches' Offices	Replace floor tile in hydrotherapy	45' x 70' = 3150 sf @ $19 p/sf	Function	High	20	59,850	59,850	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***59,850***
114	Architecture	Team Spaces and Coaches' Offices	Renovate the coaches' areas to provide additional small-group meeting rooms for presentations, replace ceiling tile, provide addtional electrical outlets in coaches offices	Existing space = 13,800 sf, complete renovation @ $300 p/sf	Function	Medium	20	4,140,000	-	-	-	4,140,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***4,140,000***
115	Architecture	Team Spaces and Coaches' Offices	Replace hot tub with larger hot tub	8' x 14' tub	Function	High	20	150,000	150,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***150,000***
116	Architecture	Team Spaces and Coaches' Offices	Provide new cryotherapy equipment to meet NFL standards		Function	High	15	100,000	100,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100,000	-	-	-	***200,000***
117	Architecture	Team Spaces and Coaches' Offices	Replace laundry equipment	Equipment = $240,000 plus Renovations	Function	High	20	480,000	-	480,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***480,000***
118	Architecture	Team Spaces and Coaches' Offices	Repair leak above team equipment storage space		Function	High	20	10,000	10,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***10,000***
119	Architecture	Team Spaces and Coaches' Offices: Auditoriums	Fix leaks in structure above ceiling at auditoriums		Function	High	20	50,000	50,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***50,000***
120	Architecture	Team Spaces and Coaches' Offices: Auditoriums	Add subroof at areas where none has been installed	West 1/2 of the bowl =13,200 sf @ $50 p/sf	Function	High	20	660,000	-	660,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***660,000***
121	Architecture	Team Spaces and Coaches' Offices: Auditoriums	Replace ceiling system (large auditorium only)	40' x 50' = 2,000sf @ $200 p/sf	Function	High	20	400,000	400,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***400,000***
122	Architecture	Team Spaces and Coaches' Offices: Auditoriums	Replace speaker system / AV Systems	2 @ $400,000	Function	High	15	800,000	800,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	800,000	-	-	-	***1,600,000***
123	Architecture	Team Spaces and Coaches' Offices: Auditoriums	Replace white boards with SmartBoard		Function	High	15	65,000	65,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	65,000	-	-	-	***130,000***
124	Architecture	Team Spaces and Coaches' Offices: Auditoriums	Fur out wall(s) between training room and locker room and auditoriums for sound mitigation		Function	High	One Time	250,000	250,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***250,000***
125	Architecture	Visitor's Locker Rooms	Renovate adjacent space to provide for a new Women's Coaches' Lockers and shower	30' x 15' = 450 sf @ 300 p/sf	Function	High	One Time	135,000	135,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***135,000***
126	Architecture	Wayfinding	Reconfigure bag check signage	Signage at Gates A - F @9,000 p/gate	Function	Medium	20	54,000	-	-	-	54,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***54,000***
127	Architecture	Wayfinding	Provide wayfinding on the exterior plaza to the gates	5 Gate Locations @ $9000 per gate	Function	High	20	45,000	45,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***45,000***
128	Architecture	Wayfinding	Provide wayfinding inside the stadium to the seating areas	450 signs @ $650 per sign material & labor	Function	Medium	20	292,500	-	-	-	292,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***292,500***
129	Architecture	Wayfinding	Allowance: Provide illuminated wayfinding	5 Gate Locations @ $5500 per gate	Upgrade (MP)	Medium	20	27,500	-	-	27,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***27,500***
130	**Architecture - Total plus 15% Contingency**								***29,730,634***	***41,573,535***	***20,982,245***	***23,210,485***	***8,001,240***	***899,645***	***1,113,315***	***250,815***	***1,113,315***	***250,815***	***5,461,666***	***998,315***	***1,539,310***	***1,234,295***	***1,113,315***	***4,230,735***	***6,925,415***	***439,415***	***1,860,815***	***250,815***	***151,180,139***
131	MEP & Fire Protection	Mechanical	CHW Plate and Frame clean, rebuild, & recalibration		Function (was formerly Upgrade)	Medium	15	25,000	25,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25,000	-	-	-	-	***50,000***

132	MEP & Fire Protection	Mechanical	CHW pump rebuild, & replacement		Function	High	20	90,000	-	-	-	90,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***90,000***
133	MEP & Fire Protection	Mechanical	Pipe, insulation, and fitting maintenance/replacement		Function	High	20	7,500	7,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***7,500***
134	MEP & Fire Protection	Mechanical	Diffuser & grille maintenance		Function	Medium	20	3,100	-	3,100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***3,100***
135	MEP & Fire Protection	Mechanical	Air filter replacement (recurring)		Function	High	1	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	***2,500,000***
136	MEP & Fire Protection	Mechanical	Air and water balance report		Function (was formerly Upgrade)	Low	20	25,000	-	-	-	25,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***25,000***
137	MEP & Fire Protection	Mechanical	Boiler PLC controls support outreach		Function (was formerly Upgrade)	Low	20	5,000	-	-	-	-	-	-	-	-	-	5,000	-	-	-	-	-	-	-	-	-	-	***5,000***
138	MEP & Fire Protection	Mechanical	Replace R-22 DX AH equipment (recurring)	10% annual replacment occuring over Years 1-10	Function	High	20	285,900	28,590	28,590	28,590	28,590	28,590	28,590	28,590	28,590	28,590	28,590	-	-	-	-	-	-	-	-	-	-	***285,900***
139	MEP & Fire Protection	Mechanical	Kitchen exhaust fan control correction		Function	High	50	3,100	3,100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***3,100***
140	MEP & Fire Protection	Mechanical	FPB replacement (recurring)		Function	High	20	24,000	24,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***24,000***
~~141~~	~~MEP & Fire Protection~~	~~Mechanical~~	~~Plaza Level AHU CUI inspection~~		~~Upgrade~~	~~Low~~	~~Annual~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~5,000~~	~~100,000~~
142	MEP & Fire Protection	Mechanical	Boiler #9 repair condensate leak on flue		Function	High	30	1,200	1,200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***1,200***
143	MEP & Fire Protection	Mechanical	Boiler water pump rebuild, & replacement		Function	Medium	20	45,000	-	-	45,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***45,000***
144	MEP & Fire Protection	Mechanical	Boiler Air MAU recommissioning		Function	High	20	6,000	6,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***6,000***
145	MEP & Fire Protection	Mechanical	Replace 8 Rooftop Unit replacement R-22	One annual replacment occuring over Years 1-8	Function	Medium	20	184,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000	-	-	-	-	-	-	-	-	-	-	-	***184,000***
146	MEP & Fire Protection	Mechanical	Elevator lobby heater installation		Upgrade (MP)	Medium	One Time	17,200	-	17,200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***17,200***
147	MEP & Fire Protection	Mechanical	Restroom heat & EF controls upgrade		Upgrade (MP)	Low	20	175,000	-	-	-	175,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***175,000***
148	MEP & Fire Protection	Mechanical	BAS Study and recommissioning		Upgrade (MP)	Medium	20	75,000	-	-	-	-	-	-	-	-	-	75,000	-	-	-	-	-	-	-	-	-	***75,000***
149	MEP & Fire Protection	Mechanical	Parking garage exhaust fan sensor upgrade	Should be addressed for life safety reasons	Function	High	20	75,000	75,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***75,000***
150	MEP & Fire Protection	Mechanical	Parking garage CO recommission		Function	High	1	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	***50,000***
151	MEP & Fire Protection	Electrical	Generator controls upgrade		Function	Medium	20	35,000	-	-	35,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***35,000***
152	MEP & Fire Protection	Electrical	MV cabling testing		Function	Low	20	17,500	-	-	-	-	-	-	17,500	-	-	-	-	-	-	-	-	-	-	-	-	-	***17,500***
153	MEP & Fire Protection	Electrical	Substation transformer testing		Function	Low	5	15,000	-	-	-	-	-	15,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***15,000***
154	MEP & Fire Protection	Electrical	Substation transformer cooling system Cx		Function	Medium	One Time	10,000	-	-	-	10,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***10,000***
155	MEP & Fire Protection	Electrical	Electrical distribution annual cleaning and PM	Work is spread out over 5 years	Function	High	5	68,500	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	13,700	***274,000***
156	MEP & Fire Protection	Electrical	Arc flash program update		Function	High	5	100,000	100,000	-	-	-	-	100,000	-	-	-	-	100,000	-	-	-	-	100,000	-	-	-	-	***400,000***
157	MEP & Fire Protection	Electrical	Procedure documentation and testing of Duke Energy Circuit Switching (revised every 3 years)		Function	High	3	10,000	10,000	-	-	10,000	-	-	10,000	-	-	10,000	-	-	-	10,000	-	-	10,000	-	-	10,000	-	***70,000***
158	MEP & Fire Protection	Electrical	Installation of remote controls for Duke Circuit Switching		Function (was formerly Upgrade)	Medium	One Time	50,000	-	50,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***50,000***
159	MEP & Fire Protection	Electrical	Labeling corrections and panel schedule updates		Function	High	One Time	5,000	5,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***5,000***
160	MEP & Fire Protection	Electrical	Substation ARMS (Arcflash Reduction Maintenance System) retrofits		Function (was formerly Upgrade)	Medium	One Time	200,000	-	-	-	200,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***200,000***
161	MEP & Fire Protection	Electrical	Catwalk panel PM service for gaskets, etc.		Function	Medium	5	6,000	-	6,000	-	-	-	-	6,000	-	-	-	-	6,000	-	-	-	-	6,000	-	-	-	***24,000***
162	MEP & Fire Protection	Electrical	Exterior media truck power panel PM		Function	High	5	4,500	4,500	-	-	-	-	4,500	-	-	-	-	4,500	-	-	-	-	4,500	-	-	-	-	***18,000***
163	MEP & Fire Protection	Electrical	Replace Building Automation System		Function	High	15	4,000,000	4,000,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***4,000,000***
164	MEP & Fire Protection	Electrical	Replace Sewage Ejector, upgrade controls		Function	Medium	25	82,000	-	-	-	-	-	-	-	-	-	82,000	-	-	-	-	-	-	-	-	-	***82,000***
165	MEP & Fire Protection	Plumbing	Water Filtration System		Upgrade (MP)	High	20	31,000	-	-	31,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***31,000***
166	MEP & Fire Protection	Plumbing	Replace Domestic Water Booster system		Function	High	25	144,000	-	-	144,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***144,000***
167	MEP & Fire Protection	Plumbing	Replace BFP-4		Function (was formerly Upgrade)	Low	One Time	2,500	-	-	-	-	2,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***2,500***
168	MEP & Fire Protection	Plumbing	Fix Grease Trap Access		Function (was formerly Upgrade)	High	One Time	15,000	15,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***15,000***
169	MEP & Fire Protection	Plumbing	Replace Kitchen Grease Traps (Replace 1 per year x 8 years)		Function	High	20	36,000	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	-	-	-	-	-	-	-	-	-	-	-	-	***36,000***
170	MEP & Fire Protection	Plumbing	Replace (2) Kitchen Hot Water Heaters		Function	Medium	10	78,000	-	78,000	-	-	-	-	-	-	-	-	-	-	-	-	-	78,000	-	-	-	-	***156,000***
171	MEP & Fire Protection	Plumbing	Replace Urinal with low flow flush valve (572)		Upgrade (MP)	Low	One Time	135,000	-	-	-	-	-	-	-	135,000	-	-	-	-	-	-	-	-	-	-	-	-	***135,000***
172	MEP & Fire Protection	Plumbing	Replace Water Closet with low flow flush (1135)		Upgrade (MP)	Low	One Time	475,500	-	-	-	-	-	-	475,500	-	-	-	-	-	-	-	-	-	-	-	-	-	***475,500***
173	MEP & Fire Protection	Plumbing	Upsize Sanitary for super flush condition		Upgrade (MP)	Low	One Time	600,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	600,000	-	-	-	-	***600,000***
174	MEP & Fire Protection	Plumbing	Deep Well Pump Maintenance (recurs annually)		Function	Medium	20	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	***500,000***
175	MEP & Fire Protection	Plumbing	Deep Well Control Panel Upgrade (Qty 4)		Function	Medium	25	35,000	-	-	-	-	-	-	-	-	-	35,000	-	-	-	-	-	-	-	-	-	-	***35,000***
176	MEP & Fire Protection	Plumbing	Deep Well BMS Integration (100 points)		Upgrade (MP)	Low	One Time	100,000	-	-	-	-	-	-	-	-	-	100,000	-	-	-	-	-	-	-	-	-	-	***100,000***
177	MEP & Fire Protection	Fire Protection	Repack Seals on Fire Pump		Function	High	5	5,000	5,000	-	-	-	-	5,000	-	-	-	-	5,000	-	-	-	-	-	5,000	-	-	-	***20,000***
178	MEP & Fire Protection	Fire Protection	Replace Fire Pump		Function	Medium	30	35,000	-	-	-	-	-	-	-	-	-	35,000	-	-	-	-	-	-	-	-	-	-	***35,000***
179	MEP & Fire Protection	Fire Protection	Replace 50FT Sch 40 Galv Dry Pipe (2-1/2")		Function	High	1	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	***18,000***
180	MEP & Fire Protection	Fire Protection	Replace 100FT Sch 10 Galv Dry Pipe (4")		Function	High	1	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	***22,000***
181	MEP & Fire Protection	Fire Protection	Dry Sprinkler Head 10 Yr Test	Current 10 year test being performed 2021	Function	High	10	3,500	-	-	-	-	-	-	-	-	-	3,500	-	-	-	-	-	-	-	-	-	-	***3,500***
182	MEP & Fire Protection	Fire Protection	Repair Miscellaneious Water & Air Leaks		Function	Low	1	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	***50,000***
183	MEP & Fire Protection	Fire Protection	Replace system gauges (NFPA Code Req)		Function	Medium	5	5,000	-	-	-	-	5,000	-	-	-	-	5,000	-	-	-	-	-	5,000	-	-	-	5,000	***20,000***
184	MEP & Fire Protection	Fire Protection	Replace Failed Drip Vavles (2 per year)		Function	High	1	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	***10,000***
185	MEP & Fire Protection	Fire Protection	Replace Dry System Air Compressor		Function	Medium	15	15,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15,500	-	-	-	-	***15,500***
186	MEP & Fire Protection	Fire Protection	Cable Management		Function (was formerly Upgrade)	Low	One Time	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***500***
187	MEP & Fire Protection	Fire Protection	Replace Dry System Valve Assembly		Function	Medium	20	8,000	-	-	-	-	-	-	-	-	-	8,000	-	-	-	-	-	-	-	-	-	-	***8,000***
188	**MEP & Fire Protection - Total plus 15% Contingency**								***5,191,204***	***444,579***	***560,384***	***853,634***	***275,759***	***410,309***	***852,484***	***422,384***	***235,509***	***647,784***	***328,555***	***209,530***	***214,130***	***202,630***	***1,034,655***	***340,055***	***209,530***	***202,630***	***214,130***	***208,380***	***13,058,250***

189	Structure	Traffic Coating	Plaza Level Concourse	Spread over 2 yr period / 51620 sf @ $9 p/sf	Function	High	5	464,580	232,290	232,290	-	-	-	232,290	232,290	-	-	-	232,290	232,290	-	-	-	232,290	232,290	-	-	-	***1,858,320***
190	Structure	Traffic Coating	Club Level Concourse	Spread over 2 yr period / 23500 @ $9	Function	High	5	211,500	105,750	105,750	-	-	-	105,750	105,750	-	-	-	105,750	105,750	-	-	-	105,750	105,750	-	-	-	***846,000***
191	Structure	Traffic Coating	Upper Concourse	Spread over 2 yr period / 78200 @ $9	Function	High	10	703,800	351,900	351,900	-	-	-	-	-	-	-	-	351,900	175,950	-	-	-	-	-	-	-	-	***1,231,650***
192	Structure	Inspect Expansion Joints (inspection will determine if replacement is necessary)	Plaza Level Concourse		Function	High	15	5,500	5,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,500	-	-	-	-	***11,000***
193	Structure	Inspect Expansion Joints (inspection will determine if replacement is necessary)	Remaining expansion joints		Function	Medium	15	9,000	-	9,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,000	-	-	-	***18,000***
194	Structure	Repair/Replace Corroded Metal Decking	Pedestrian Ramps	82800 sf @ $60 p/sf x 10%	Function	High	20	496,800	496,800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***496,800***
195	Structure	Repair/Replace Corroded Metal Decking	Exterior Stairs	14400 sf @ $60 p/sf x 10%	Function	Medium	20	86,400	-	86,400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***86,400***
196	Structure	Repair and Paint Corroded Steel Connections	Precast Façade Panels	500 connections @ $750 per	Function	High	5	375,000	375,000	-	-	-	-	375,000	-	-	-	-	375,000	-	-	-	-	375,000	-	-	-	-	***1,500,000***
197	Structure	Repair and Paint Corroded Steel Connections	Pedestrian Ramps	17 ramps / 60 per ramp 4 ramps @ $750 per (paint 10% per year)	Function	High	1	3,060,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	306,000	***6,120,000***
198	Structure	Repair and Paint Corroded Steel Connections	Exterior Stairs	28800 sf stair landings @ $150 p/sf	Function	High	10	4,320,000	4,320,000	-	-	-	-	-	-	-	-	-	4,320,000	-	-	-	-	-	-	-	-	-	***8,640,000***
199	Structure	Repair and Paint Corroded Steel Connections	Pedestrian Ramps	165600 sf ramps @ $150 p/sf	Function	High	10	24,840,000	24,840,000	-	-	-	-	-	-	-	-	-	24,840,000	-	-	-	-	-	-	-	-	-	***49,680,000***
200	Structure	Repair and Paint Corroded Steel Framing	Exterior Stairs	115200 sf stair @ $150 p/sf	Function	High	10	17,280,000	17,280,000	-	-	-	-	-	-	-	-	-	17,280,000	-	-	-	-	-	-	-	-	-	***34,560,000***
201	Structure	Repair Spalled Concrete	Precast Double Tees - Service Level	10000 sf @ $250 p/sf x 10%	Function	Medium	10	250,000	-	250,000	-	-	-	-	-	-	-	-	-	250,000	-	-	-	-	-	-	-	-	***500,000***
202	Structure	Repair Spalled Concrete	Precast Double Tees - Concourse Levels	30000 sf @ $250 p/sf x 10%	Function	Medium	10	750,000	-	750,000	-	-	-	-	-	-	-	-	-	750,000	-	-	-	-	-	-	-	-	***1,500,000***
203	Structure	Repair Spalled Concrete	Precast Concrete Framing	15000 sf @ $250 p/sf x 10%	Function	Medium	10	375,000	-	375,000	-	-	-	-	-	-	-	-	-	375,000	-	-	-	-	-	-	-	-	***750,000***
204	Structure	Repair Spalled Concrete	Precast Concrete Railing Walls	25000 sf @ $250 p/sf x 10%	Function	Medium	10	625,000	-	625,000	-	-	-	-	-	-	-	-	-	625,000	-	-	-	-	-	-	-	-	***1,250,000***
205	Structure	Repair Spalled Concrete w/Exposed Rebar	Precast Double Tees - Service Level	6000 sf @ $300 p/sf x 10%	Function	High	10	180,000	180,000	-	-	-	-	-	-	-	-	-	180,000	-	-	-	-	-	-	-	-	-	***360,000***
206	Structure	Repair Spalled Concrete w/Exposed Rebar	Precast Double Tees - Concourse Levels	8000sf @ $300 p/sf x 10%	Function	High	10	240,000	240,000	-	-	-	-	-	-	-	-	-	240,000	-	-	-	-	-	-	-	-	-	***480,000***
207	Structure	Repair Spalled Concrete w/Exposed Rebar	Precast Concrete Framing	8000sf @ $300 p/sf x 10%	Function	High	10	240,000	240,000	-	-	-	-	-	-	-	-	-	240,000	-	-	-	-	-	-	-	-	-	***480,000***
208	Structure	Repair Spalled Concrete w/Exposed Rebar	Precast Concrete Railing Walls	10000 sf @ $300 p/sf x 10%	Function	High	5	300,000	300,000	-	-	-	-	300,000	-	-	-	-	300,000	-	-	-	-	300,000	-	-	-	-	***1,200,000***
209	Structure	Replace Sealant	Precast Concrete Railing Walls	75000 sf @ $12 p/sf	Function	Low	5	900,000	-	-	900,000	-	-	-	-	900,000	-	-	-	-	900,000	-	-	-	-	900,000	-	-	***3,600,000***
210	Structure	Replace Sealant	Precast Façade Panels	45700 sf precast @ $12 p/sf	Function	Medium	10	548,400	-	548,400	-	-	-	-	-	-	-	-	-	548,400	-	-	-	-	-	-	-	-	***1,096,800***
211	Structure	Replace Sealant	Precast Riser and Framing Joints	90500 sf @$12 p/sf	Function	High	5	1,086,000	1,086,000	-	-	-	-	1,086,000	-	-	-	-	1,086,000	-	-	-	-	1,086,000	-	-	-	-	***4,344,000***
212	Structure	Install Sealant	Boomerang Column Pin Caps	34 locations, 8 caps per, @ $40 per cap	Function	High	5	10,880	10,880	-	-	-	-	10,880	-	-	-	-	10,880	-	-	-	-	10,880	-	-	-	-	***43,520***
213	Structure	Repair Delaminated Concrete	Precast Double Tees	40000 sf @ $250 p/sf x 10%	Function	Medium	10	1,000,000	-	1,000,000	-	-	-	-	-	-	-	-	-	1,000,000	-	-	-	-	-	-	-	-	***2,000,000***
214	Structure	Repair Delaminated Concrete	Precast Seating Risers	90500 sf of seating risers @ $250 p/sf x 10%	Function	Medium	10	2,262,500	-	2,262,500	-	-	-	-	-	-	-	-	-	2,262,500	-	-	-	-	-	-	-	-	***4,525,000***
215	Structure	Repair Delaminated Concrete	Precast Raker Beams	25000sf @ $250 p/sf x 10%	Function	Medium	10	625,000	-	625,000	-	-	-	-	-	-	-	-	-	625,000	-	-	-	-	-	-	-	-	***1,250,000***
216	Structure	Repair Delaminated Concrete	Concrete Columns	20000 sf @ $250 p/sf x 10%	Function	Medium	10	500,000	-	500,000	-	-	-	-	-	-	-	-	-	500,000	-	-	-	-	-	-	-	-	***1,000,000***
217	Structure	Repair Cracked Topping Slab	Pedestrian Ramp Surface	Ramps 165600 sf, remove & replac topping slab and traffic coating @75 p/sf x 5% of surface	Function	High	10	621,000	621,000	-	-	-	-	-	-	-	-	-	621,000	-	-	-	-	-	-	-	-	-	***1,242,000***
218	Structure	Replace Corroded Secondary Roofing	Service Level	12000 sf @ 125 p/sf	Function	Medium	One Time	1,500,000	-	1,500,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***1,500,000***
219	Structure	Seal Cracks in Parking Slab	Elevated Parking Lots	100000 lf @ $12 p/lf	Function	Medium	5	1,200,000	-	1,200,000	-	-	-	-	1,200,000	-	-	-	-	1,200,000	-	-	-	-	1,200,000	-	-	-	***4,800,000***
220	Structure	Repair Cracked CMU	As Required	20000 sf @ $30 p/sf	Function	Low	10	600,000	-	-	600,000	-	-	-	-	-	-	-	-	-	600,000	-	-	-	-	-	-	-	***1,200,000***
221	**Structure - Total plus 15% Contingency**								***58,639,788***	***12,336,326***	***2,076,900***	***351,900***	***351,900***	***2,778,308***	***2,120,646***	***1,386,900***	***351,900***	***351,900***	***58,062,143***	***10,299,274***	***2,076,900***	***351,900***	***351,900***	***2,784,633***	***2,130,996***	***1,386,900***	***351,900***	***351,900***	***158,894,914***

222	Technology	Audio Systems - Main PA	Wireless microphones		Function	High	7	20,000	20,000	-	-	-	-	-	-	-	20,000	-	-	-	-	-	-	20,000	-	-	-	-	***60,000***
223	Technology	Audio Systems - Main PA	Seating bowl, concourses & gates speaker system		Upgrade (MP)	Medium	10	3,500,000	-	3,500,000	-	-	-	-	-	-	-	-	-	-	3,500,000	-	-	-	-	-	-	-	***7,000,000***
224	Technology	Audio Systems - Back of House	Home Press Interview		Function	Medium	5	25,000	-	25,000	-	-	-	-	25,000	-	-	-	-	25,000	-	-	-	-	25,000	-	-	-	***100,000***
225	Technology	Audio Systems - Back of House	Visiting Press Interview		Function	Medium	5	25,000	-	25,000	-	-	-	-	25,000	-	-	-	-	25,000	-	-	-	-	25,000	-	-	-	***100,000***
226	Technology	Audio Systems	Maintenance		Function	High	1	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	***440,000***
227	Technology	AV Systems	East Club racks		Function	High	10	35,000	35,000	-	-	-	-	-	-	-	-	-	35,000	-	-	-	-	-	-	-	-	-	***70,000***
228	Technology	AV Systems	West Club racks		Function	High	10	35,000	35,000	-	-	-	-	-	-	-	-	-	35,000	-	-	-	-	-	-	-	-	-	***70,000***
229	Technology	A/V Systems	Replace Club A/V systems		Function	High	10	2,200,000	2,200,000	-	-	-	-	-	-	-	-	-	2,200,000	-	-	-	-	-	-	-	-	-	***4,400,000***
230	Technology	Broadcast Cable	Removal of legacy infrastructure		Function	High	One time	300,000	300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***300,000***
231	Technology	Broadcast Cable	Complete rewire		Function	High	20	2,000,000	2,000,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***2,000,000***
232	Technology	Broadcast Cable	Maintenance		Function	High	1	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	***300,000***
233	Technology	Distributed TV	RF to IPTV system replacement		Upgrade (MP)	High	7	3,000,000	3,000,000	-	-	-	-	-	-	3,000,000	-	-	-	-	-	-	-	3,000,000	-	-	-	-	***9,000,000***
234	Technology	Distributed TV	Television sets replacement		Function	High	7	800,000	800,000	-	-	-	-	-	-	800,000	-	-	-	-	-	-	-	800,000	-	-	-	-	***2,400,000***
235	Technology	LED Displays	Main North and South		Function	Medium	10	6,000,000	-	-	6,000,000	-	-	-	-	-	-	-	-	-	6,000,000	-	-	-	-	-	-	-	***12,000,000***
236	Technology	LED Displays	Ribbon boards		Function	Medium	10	2,000,000	-	-	2,000,000	-	-	-	-	-	-	-	-	-	2,000,000	-	-	-	-	-	-	-	***4,000,000***
237	Technology	LED Displays	Control systems		Function	High	5	220,000	-	220,000	-	-	-	-	220,000	-	-	-	-	220,000	-	-	-	-	220,000	220,000	-	-	***1,100,000***
238	Technology	LED Displays	Marquee		Function	Low	10	570,000	-	-	-	-	-	-	-	-	-	-	570,000	-	-	-	-	-	-	-	-	-	***570,000***
239	Technology	LED Displays	Warranty and maintenance		Function	High	1	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	***1,000,000***
240	Technology	Information Technology	Replacement Wireless network throughout Building		Function	High	7	10,500,000	10,500,000	-	-	-	-	-	-	10,500,000	-	-	-	-	-	-	-	10,500,000	-	-	-	-	***31,500,000***
241	Technology	Information Technology	Phone system replacement		Function	Low	10	575,000	-	-	-	-	-	-	-	-	-	-	575,000	-	-	-	-	-	-	-	-	-	***575,000***
242	Technology	Security/Video Surveillance	Video Surveillance System replacement		Upgrade (MP)	High	10	550,000	550,000	-	-	-	-	-	-	-	-	-	550,000	-	-	-	-	-	-	-	-	-	***1,100,000***
243	Technology	Security/Video Surveillance	One time add X-Ray machines		Function	High	One time	150,000	150,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***150,000***
244	Technology	Security/Video Surveillance	One time add gate cameras		Function	High	One time	150,000	150,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***150,000***
245	Technology	Security/Video Surveillance	Ongoing maintenance and upgrades		Function	High	1	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	***500,000***
246	Technology	Security/Video Surveillance	Command center screen upgrade		Function	High	7	25,000	25,000	-	-	-	-	-	-	25,000	-	-	-	-	-	-	-	25,000	-	-	-	-	***75,000***
247	Technology	Security/Access Control	Access control system replacement		Function	Medium	10	550,000	-	550,000	-	-	-	-	-	-	-	-	550,000	-	-	-	-	-	-	-	-	-	***1,100,000***
248	Technology	Security/Access Control	One time add portable barrier		Function	High	One time	60,000	60,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***60,000***
249	Technology	Security/Access Control	Magnatometers replacement		Function	Low	10	690,000	-	-	-	-	-	-	-	-	-	690,000	-	-	-	-	-	-	-	-	-	-	***690,000***
250	Technology	Security/Access Control	One time add (7) magnetometers		Function	High	One time	45,000	45,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***45,000***
251	Technology	Security/Access Control	Ongoing Maintenance and Upgrades		Function	High	1	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	***500,000***
252	Technology	Security/Access Control	Intrusion Detection		Function	High	10	150,000	150,000										150,000										***300,000***
253	Technology	Jungle Vision	One time high risk equipment replacement		Function	High	One time	610,000	610,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***610,000***
254	Technology	JungleVision	Control room replacement		Function	Medium	20	11,000,000	-	-	11,000,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***11,000,000***
255	Technology	JungleVision	Maintenance		Function	High	1	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	60,400	***1,208,000***
256	Technology	JungleVision	TV Studio Production Equipment		Function	Low	7	220,000	-	-	-	-	220,000	-	-	-	-	-	-	220,000	-	-	-	-	-	-	220,000	-	***660,000***
257	Technology	JungleVision	Edit system		Function	Medium	5	300,000	-	-	-	300,000	-	-	-	-	300,000	-	-	-	-	-	300,000	-	-	-	-	300,000	-	***1,200,000***
258	Technology	Team Building Technology	Team Theatre (Offense)		Upgrade (MP)	High	7	250,000	250,000	-	-	-	-	-	-	250,000	-	-	-	-	-	-	-	-	250,000	-	-	-	***750,000***
259	Technology	Team Building Technology	Team Theatre (Defense)		Upgrade (MP)	High	7	250,000	250,000	-	-	-	-	-	-	250,000	-	-	-	-	-	-	-	-	250,000	-	-	-	***750,000***
260	Technology	Team Building Technology	Team Meeting Rooms (Each)		Upgrade (MP)	Medium	7	85,000	85,000	-	-	-	-	-	-	85,000	-	-	-	-	-	-	-	-	85,000	-	-	-	***255,000***
261	Technology	Team Building Technology	Weight Room Typical		Upgrade (MP)	Medium	7	200,000	200,000	-	-	-	-	-	-	200,000	-	-	-	-	-	-	-	-	200,000	-	-	-	***600,000***
262	Technology	Team Building Technology	Locker Room Typical		Upgrade (MP)	Medium	7	350,000	350,000	-	-	-	-	-	-	350,000	-	-	-	-	-	-	-	-	350,000	-	-	-	***1,050,000***
263	**Technology - Total plus 15% Contingency**								***25,256,760***	***5,195,010***	***22,077,010***	***572,010***	***480,010***	***227,010***	***537,510***	***18,006,010***	***595,010***	***1,020,510***	***5,591,760***	***790,510***	***13,452,010***	***572,010***	***16,700,760***	***1,555,260***	***537,510***	***480,010***	***825,010***	***227,010***	***114,698,700***

264	**Food Service - Total plus 15% Contingency**	See accompanying spreadsheet							***6,350,617***	***4,762,461***	***2,526,369***	***1,341,370***	***869,118***	***1,453,469***	-	***21,638***	-	-	***7,707,987***	***5,548,837***	***2,198,733***	***2,702,867***	***414,628***	***1,953,341***	-	***29,079***	***208,713***	-	***38,089,228***
265	Vertical Transportation	Service Level	Section 11/West	Freight Elevator	Function	Medium	22-25	350,000	-	-	-	350,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***350,000***
266	Vertical Transportation	Service Level	Section 2/East	Freight Elevator	Function	Medium	22-25	350,000	-	-	-	350,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***350,000***
267	Vertical Transportation	Service Level	Section 10/West side, 1 of 4 units	Passenger Elevator	Function	Low	22-25	320,000	-	-	-	-	-	320,000	-	-	-	-	-	-	-	-	-	-	-	-	-	***320,000***
268	Vertical Transportation	Service Level	Section 10/West side, 2 of 4 units	Passenger Elevator	Function	Low	22-25	320,000	-	-	-	-	-	320,000	-	-	-	-	-	-	-	-	-	-	-	-	-	***320,000***
269	Vertical Transportation	Service Level	Section 10/West side, 3 of 4 units	Passenger Elevator	Function	Low	22-25	320,000	-	-	-	-	-	320,000	-	-	-	-	-	-	-	-	-	-	-	-	-	***320,000***
270	Vertical Transportation	Service Level	Section 10/West side, 4 of 4 units	Passenger Elevator	Function	Low	22-25	320,000	-	-	-	-	-	320,000	-	-	-	-	-	-	-	-	-	-	-	-	-	***320,000***
271	Vertical Transportation	Service Level	Section 7/South end	Passenger Elevator	Function	Low	22-25	320,000	-	-	-	-	-	-	320,000	-	-	-	-	-	-	-	-	-	-	-	-	***320,000***
272	Vertical Transportation	Service Level	Section 7/South end	Passenger Elevator	Function	Low	22-25	320,000	-	-	-	-	-	-	320,000	-	-	-	-	-	-	-	-	-	-	-	-	***320,000***
273	Vertical Transportation	Level 200/Main Concourse	Section 4/East side, 1 of 4 units	Passenger Elevator	Function	Low	22-25	320,000	-	-	-	-	-	-	320,000	-	-	-	-	-	-	-	-	-	-	-	-	***320,000***
274	Vertical Transportation	Level 200/Main Concourse	Section 4/East side, 2 of 4 units	Passenger Elevator	Function	Low	22-25	320,000	-	-	-	-	-	-	320,000	-	-	-	-	-	-	-	-	-	-	-	-	***320,000***
275	Vertical Transportation	Level 200/Main Concourse	Section 4/East side, 3 of 4 units	Passenger Elevator	Function	Low	22-25	320,000	-	-	-	-	-	-	-	320,000	-	-	-	-	-	-	-	-	-	-	-	***320,000***
276	Vertical Transportation	Level 200/Main Concourse	Section 4/East side, 4 of 4 units	Passenger Elevator	Function	Low	22-25	320,000	-	-	-	-	-	-	-	320,000	-	-	-	-	-	-	-	-	-	-	-	***320,000***
277	Vertical Transportation	Exterior	Pete Rose Way to Plaza (Upper)	Escalator	Function	Medium	25-30	300,000	-	-	-	300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***300,000***
278	Vertical Transportation	Exterior	Pete Rose Way to Plaza (Lower)	Escalator	Function	Medium	25-30	300,000	-	-	-	-	-	-	-	300,000	-	-	-	-	-	-	-	-	-	-	-	***300,000***
279	Vertical Transportation	Level 200/Main Concourse	Section 10/West side	Escalator	Function	Low	25-30	300,000	-	-	-	-	-	-	-	300,000	-	-	-	-	-	-	-	-	-	-	-	***300,000***
280	Vertical Transportation	Level 300/Plaza Level	Section 10/West side	Escalator	Function	Low	25-30	500,000	-	-	-	-	-	-	-	500,000	-	-	-	-	-	-	-	-	-	-	-	***500,000***
281	Vertical Transportation	Level 300/Plaza Level	Section 4/East side	Escalator	Function	Low	25-30	500,000	-	-	-	-	-	-	-	500,000	-	-	-	-	-	-	-	-	-	-	-	***500,000***
282	Vertical Transportation	Level 300/Plaza Level	Section 6/SE	Escalator	Function	High	25-30	800,000	800,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***800,000***
283	Vertical Transportation	Level 300/Plaza Level	Section 11/NW	Escalator	Function	High	25-30	800,000	800,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***800,000***
284	Vertical Transportation	Level 600/Bengal Suites	Section 11/NW	Escalator	Function	Medium	25-30	500,000	-	-	-	-	-	-	-	-	500,000	-	-	-	-	-	-	-	-	-	-	***500,000***
285	Vertical Transportation	Level 600/Bengal Suites	Section 5/SE	Escalator	Function	Medium	25-30	500,000	-	-	-	-	-	-	-	-	500,000	-	-	-	-	-	-	-	-	-	-	***500,000***
286	Vertical Transportation	Level 300/Plaza Level	Section 6 and Section 11	Two Escalators (large) - install canopies	Upgrade (MP)	High	20	250,000	250,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***250,000***
287	**Vertical Transportation - Total plus 15% Contingency**								***2,127,500***	**-**	**-**	***1,150,000***	**-**	***1,472,000***	***1,472,000***	***2,576,000***	***1,150,000***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	***9,947,500***

288	Roof	EP Roof	Replace EP roofs with single ply membrane. Roof replacement to include: East and west outer sector roofs (700 Level Upper Concourse level); Pro shop canopy roof (Plaza Level); scoreboard signs, advertising signs; elevator roof of Administration building	700 level 13,580 sf, Club level 8,200 sf, Admin elevator and stairwell 1,150 sf, Scoreboards 3,000 sf @ $15 p/sf	Function	High	20	388,950	388,950	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***388,950***
289	Roof	EP Roof	Replace EP roofs with single ply membrane. Roof replacement to include: North, east and west inner sector roofs (700 Level Upper Concourse level	700 level inner roofs 23,950 @ $15 p/sf	Function	Medium	20	359,250	359,250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***359,250***
290	Roof	Single Ply TPO	Administration building: Install cable tray with supports	250 lf @ 150 p/lf	Function	Low	20	37,500	-	-	-	37,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***37,500***
291	Roof	Single Ply TPO	Administration building: Replace roof at end of warranty	19,000 sf @15 p/sf	Function	Low	20	285,000	-	-	-	285,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***285,000***
292	Roof	Protected Membrane	Provide further investigation of the roof		Function	High	20	7,500	7,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***7,500***
293	Roof	Protected Membrane	Replace roof at the end of its service life	25000 sf @ $30 p/sf	Function	High	20	750,000	750,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***750,000***
294	Roof	Modified Bitumen	Replace wood blocking with pipe supports	100 locations at $120 per	Function	Medium	20	12,000	-	-	12,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***12,000***
295	Roof	Modified Bitumen	Replace roofs at end of service life	25000 sf @ 20 p/sf	Function	Medium	20	500,000	-	-	500,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***500,000***
296	Roof	Standing Seam Metal	Replace press box roofs	15000 sf @$28 p/sf	Function	Low	20	420,000	-	-	-	420,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***420,000***
297	Roof	Subroof System	Line galvanized gutters with EPDM during gutter installation to protect from deicers	5000 lf @ $12 p/lf	Function	High	20	60,000	60,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***60,000***
298	Roof	Subroof System	Repair holes in sub roof	30000 sf @ $125 p/sf	Function	High	20	3,750,000	-	3,750,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***3,750,000***
299	Roof	Subroof System	Flexible Epoxy injection for cracks	15000 lf @ $60 p/lf	Function	High	20	900,000	900,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***900,000***
300	**Roof - Total plus 15% Contingency**								***2,835,555***	***3,750,000***	***512,000***	***742,500***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	***7,470,200***
	GRAND TOTAL								$ 130,132,057	$ 68,061,910	$ 48,734,907	$ 28,221,898	$ 9,978,027	$ 7,240,741	$ 6,095,955	$ 22,663,746	$ 3,445,734	$ 2,271,009	$ 77,152,111	$ 17,846,466	$ 19,481,082	$ 5,063,702	$ 19,615,258	$ 10,864,024	$ 9,803,451	$ 2,538,034	$ 3,460,568	$ 1,038,105	$ 493,708,785

Total Architecture	$	29,730,634	$	41,573,535	$	20,982,245	$	23,210,485	$	8,001,240	$	899,645	$	1,113,315	$	250,815	$	1,113,315	$	250,815	$	5,461,666	$	998,315	$	1,539,310	$	1,234,295	$	1,113,315	$	4,230,735	$	6,925,415	$	439,415	$	1,860,815	$	250,815	$	151,180,139
Total MEP & Fire Protection	$	5,191,204	$	444,579	$	560,384	$	853,634	$	275,759	$	410,309	$	852,484	$	422,384	$	235,509	$	647,784	$	328,555	$	209,530	$	214,130	$	202,630	$	1,034,655	$	340,055	$	209,530	$	202,630	$	214,130	$	208,380	$	13,058,250
Total Structure	$	58,639,788	$	12,336,326	$	2,076,900	$	351,900	$	351,900	$	2,778,308	$	2,120,646	$	1,386,900	$	351,900	$	351,900	$	58,062,143	$	10,299,274	$	2,076,900	$	351,900	$	351,900	$	2,784,633	$	2,130,996	$	1,386,900	$	351,900	$	351,900	$	158,894,914
Total Technology	$	25,256,760	$	5,195,010	$	22,077,010	$	572,010	$	480,010	$	227,010	$	537,510	$	18,006,010	$	595,010	$	1,020,510	$	5,591,760	$	790,510	$	13,452,010	$	572,010	$	16,700,760	$	1,555,260	$	537,510	$	480,010	$	825,010	$	227,010	$	114,698,700
Total Food Service	$	6,350,617	$	4,762,461	$	2,526,369	$	1,341,370	$	869,118	$	1,453,469	$	-	$	21,638	$	-	$	-	$	7,707,987	$	5,548,837	$	2,198,733	$	2,702,867	$	414,628	$	1,953,341	$	-	$	29,079	$	208,713	$	-	$	38,089,228
Total Vertical Transportation	$	2,127,500	$	-	$	-	$	1,150,000	$	-	$	1,472,000	$	1,472,000	$	2,576,000	$	1,150,000	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	9,947,500
Total Roof	$	2,835,555	$	3,750,000	$	512,000	$	742,500	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	7,840,055
	$	**130,132,057**	**$**	**68,061,910**	**$**	**48,734,907**	**$**	**28,221,898**	**$**	**9,978,027**	**$**	**7,240,741**	**$**	**6,095,955**	**$**	**22,663,746**	**$**	**3,445,734**	**$**	**2,271,009**	**$**	**77,152,111**	**$**	**17,846,466**	**$**	**19,481,082**	**$**	**5,063,702**	**$**	**19,615,258**	**$**	**10,864,024**	**$**	**9,803,451**	**$**	**2,538,034**	**$**	**3,460,568**	**$**	**1,038,105**	**$**	**493,708,785**

SUMMARY

Paul Brown Stadium 20 Year Cap Ex - Summary

	Years 1-5	Years 6 -10	Years 11-15	Years 16-20	Totals
Architecture	$ 123,498,138	$ 3,627,905	$ 10,346,901	$ 13,707,195	$ 151,180,139
MEP & Fire Protection	$ 7,325,558	$ 2,568,468	$ 1,989,500	$ 1,174,725	$ 13,058,250
Structure	$ 73,756,814	$ 6,989,654	$ 71,142,117	$ 7,006,329	$ 158,894,914
Technology	$ 53,580,800	$ 20,386,050	$ 37,107,050	$ 3,624,800	$ 114,698,700
Food & Beverage + Retail	$ 15,849,935	$ 1,475,107	$ 18,573,052	$ 2,191,134	$ 38,089,228
Vertical Transportation	$ 3,277,500	$ 6,670,000	$ -	$ -	$ 9,947,500
Roof & Envelope	$ 7,840,055	$ -	$ -	$ -	$ 7,840,055
Totals	$ 285,128,799	$ 41,717,184	$ 139,158,619	$ 27,704,183	$ 493,708,785

APPENDIX B

HAMILTON COUNTY ITB No.: 001-22

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 071400

FLUID APPLIED WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. All labor, material, equipment, special tools, and services required to complete the work required for the project as indicated on the Drawings and in the Specifications, including but not limited to:

a. Hot-applied waterproofing system

B. Related Sections

1 Section 030100: Concrete Repair.

2. Section 079200: Sealants.

3. Section 221400: Drains and Piping.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM D-1621: Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

2. ASTM D-4491: Standard Test Method for Water Permeability of Geotextiles by Permittivity.

3. ASTM D-4632: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

4. ASTM D-4716: Standard Test Method for Determining the (in-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of Geosynthetic Using a Constant Head

5. ASTM D-4751: Standard Test Method for Determining Apparent Opening Size of a Geotextile

6. ASTM D-4833: Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.

1.3 DEFINITIONS

A. The term "manufacturer's recommendations," or variations thereon shall mean "manufacturer's recommendations which are found in publications available to and commonly used by the general architectural and consulting professions."

1.4 SUBMITTALS

A. Literature for manufactured products, including manufacturer's specifications, test data.

installation instructions and applicator's manual.

B. Letter of applicator approval from the manufacturer per Paragraph 1.5.B.

C. Letters of experience per Paragraph 1.5.C.

D. Letter from manufacturer stating their system as specified is suitable for use in this project.

E. Safety Data Sheets on all materials.

F. Upon completion of the work and before final payment provide fully executed warranties.

G. Materials and procedures to be used in the repair of the existing waterproofing membrane and expansion joint flashing.

1.5 QUALITY ASSURANCE

A. Applicable Codes

1. The Contractor shall comply with all Federal, State and Municipal laws, codes, ordinances and regulations applicable to the Work in this Contract and also with all requirements of the National Fire Protection Association, the National Electric Code, and the Occupational Safety and Health Administration (OSHA). If the above laws, codes or ordinances conflict with this Specification, then the laws, codes or ordinances shall govern, except in such cases where the Specification exceeds them in quality of materials or labor, then the Specifications shall be followed.
2. If the above laws, codes or ordinances conflict with the Specification, then the laws, codes or ordinances shall govern, except in such cases where the Specification exceeds them in quality of materials or labor, then the Specifications shall be followed.

B. The membrane system applicator shall be approved by the manufacturer prior to the start of work.

C. Membrane applicator's lead personnel (field superintendent and foreman) in charge of the work shall each have the following experience:

1. Three (3) verifiable years of experience supervising the application of the membrane system being provided on this project.
2. Successfully installed three (3) membrane projects of similar size, type and using the same membrane system being provided on this project.

D. Membrane applicator's lead personnel shall be present for all field operation pertaining to this waterproofing system installation.

E. The Owner reserves the right to request different lead personnel if, in the Owner's opinion, those assigned to the project are not qualified by way of experience or ability to perform the Work. Comply with the Owner's request at no additional cost.

F. Substrate Compatibility

1. The manufacturer and contractor shall:
   a. Jointly review and inspect the substrate materials to which the new waterproofing membrane is intended to be applied.
   b. Perform tests as necessary to ensure compatibility and verify the absence of materials, visible and invisible, detrimental to the application or performance of the waterproofing membrane.
   c. Review materials specified elsewhere in the Construction Documents to which the waterproofing membrane is intended to be applied.
2. If inspections, tests or review of materials and substrate reveal conflicts of compatibility with the intended waterproofing membrane provide written evidence of the compatibility conflict to the Owner prior to ordering of materials.
3. By beginning the waterproofing system (including substrate preparation), the Contractor accepts the responsibility for ensuring the performance of the waterproofing system.
4. If the Contractor fails to submit proof of incompatible materials, and if failure of the waterproofing system is a result of chemical or physical incompatibilities with existing or specified products or materials, the Contractor is responsible for all costs related to correcting the deficient work and for all direct and indirect costs to the Owner.

G. Testing

1. The Owner may perform tests to ensure compliance with the Contract Documents and manufacturer's requirements.
2. If tests reveal noncompliance, correct deficiencies in a manner approved by the Owner and the manufacturer at no additional cost.
3. Except as otherwise specified, the Owner will pay the cost of the tests, including repair and patching of test areas.
4. Where tests reveal deficiencies in the membrane materials or installation, the costs of the tests, and repair and patching of the test areas shall be borne by the Contractor.

H. Air compressors shall be equipped with functional oil and water separators.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to job site in sealed, undamaged containers, identify each container with the material's name, lot number and date of manufacture.

B. Store membrane materials in a place specifically assigned for that purpose and which is well ventilated, lighted and not subject to direct sunlight.

C. Heat or cool the storage area to maintain temperatures within the range recommended

by the membrane manufacturer.

D. Keep membrane materials sealed in original containers when not in use.

E. Keep storage area neat and clean.

F. Do not overload or otherwise distress the structure.

G. Handle membrane system materials in strict accordance with safety and weather limitations required by product literature or as modified by applicable rules and regulations of Local, State and Federal authorities having jurisdiction.

H. When using toxic or flammable solvents, take necessary precautions as recommended by the manufacturer. The handling and use of toxic or flammable solvents, including adequate ventilation and personal protective equipment, shall conform to the requirements of the applicable safety regulatory agencies.

1.7 EXISTING CONDITIONS

A. The existing buried waterproofing membrane system consists of…

1. Approximately 80 to 90 mil thick original installation fluid applied hot rubberized asphalt buried waterproofing system.
2. Protection board or drainage mat.
3. Filter fabric.

1.8 JOB CONDITIONS – WEIGHT RESTRICTIONS AND MOVEMENT

A. The Contractor shall use equipment for membrane installation on structured concrete slab areas with the following weight restrictions:

1. The maximum wheel load shall not exceed 2,000 lbs.
2. The maximum distributed load shall not exceed 90 psf.
3. Wheel base of loaded equipment shall not exceed 5 feet.
4. Equipment positioning, movement and orientation is subject to Engineer and Owner review.

1.9 WARRANTY

A. The completed installation shall be warranted by the manufacturer against defects of materials, and by the Contractor for defects in workmanship for a period of ten (10) years, beginning with the date of substantial completion for the Project.

B. The warranty shall not require the signature of the Owner.

PART 2 PRODUCTS

2.1 MEMBRANE MATERIALS

A. Hot applied reinforced waterproofing membrane, approved products:

1. Monolithic Membrane 6125 by Hydrotech, Inc.

2. 790-11 by Henry Company.
3. TREMproof of 6100 by Tremco.

B. Primer: Required. Product as recommended by the waterproofing membrane manufacturer.

C. Flashing/reinforcing sheet: Spunbonded polyester fabric as recommended by the membrane manufacturer. Use uncured neoprene reinforcement sheet where required by the waterproofing manufacturer and at all membrane penetrations.

D. Protection Course: Required. Product as recommended by the waterproofing membrane manufacturer.

E. Drainage Board

1. Profile: Dimple board with high impact polystyrene core and woven filter fabric bonded to individual dimples.
2. Board Thickness: 0.25 to 0.38 inches.
3. Board Compressive Strength: Minimum 36,000 psf.
4. Board Flow Rate: 15 gallons/min/sq.ft at 3600 psf and hydraulic gradient 1.0 per ASTM D-4716.
5. Fabric opening size: US standard sieve 80 per ASTM D-4751.
6. Fabric Tensile Strength: 205 lbs. per ASTM D-4632.
7. Fabric Flow Rate: 95 gallons/sq.ft. per ASTM D-4491.

F. Filter Fabric: Woven drainage fabric with the following characteristics:

1. Weight: 6.5 oz/sq.yd.
2. Grab Strength: 400x250 per ASTM D-4632.
3. Puncture Strength: 80 lbs. per ASTM D-4833.
4. Equivalent Opening Size: 70-100 US Standard sieve per ASTM D-4751.
5. Water.

G. Adhesives and Sealants: As recommended and approved by the membrane manufacturer.

H. Neoprene Flashing Sheet: Fabric reinforced, minimum 60 mil thick material as recommended by waterproofing membrane manufacturer.

PART 3 EXECUTION

3.1 PROTECTION

A. Do not allow construction equipment or other trades on prepared concrete substrate or existing waterproofing system.

B. Do not store materials or equipment on prepared concrete substrate or existing waterproofing system.

C. Do not allow construction traffic personnel to traverse across prepared concrete substrate or existing waterproofing system.

3.2 PREPARATION

A. General

1. Perform surface preparation and cleaning procedures in accordance with this Section unless the waterproofing system manufacturer has more stringent requirements. Apply membrane to clean, dry, prepared surfaces.
2. Patch or detail voids and other surface defects as required providing a uniform, smooth substrate for the membrane application. Follow the membrane manufacturer's written recommendations.
3. Clean substrate surfaces to the standard of cleanliness required by the membrane manufacturer.
4. Clean substrate surfaces free of oil, grease, loose concrete, dirt, and any other debris that will inhibit bond or be detrimental to the system. Leave the prepared surface with a uniform texture and no more than 1% of the total surface area in noncompliance.
5. Do not use acids for surface preparation.
6. Do not use water (high pressure or low pressure) for surface preparation.

B. New Concrete

1. Do not prepare substrate surfaces until the new concrete has reached adequate cure. Verify in writing the acceptable cure time from the membrane manufacturer.
2. Immediately prior to waterproofing installation, mechanically sweep and brush surfaces to loosen laitance and debris. Blow clean with oil-water free compressed air.

C. Existing Concrete

1. Hand scrape to remove all remaining remnants of the previous waterproofing membrane not removed during demolition.
2. Shotblast with vacuum process or grind and vacuum surfaces to remove previous membrane residue from the concrete surfaces.
3. Immediately prior to waterproofing installation, clean surfaces to remove laitance and debris per manufacturer's requirements.

D. Metals

1. Sandblast metal surfaces that will be in contact with membrane system.

3.3 APPLICATION OF NEW MEMBRANE SYSTEM

A. General

1. Provide a total membrane system which the manufacturer recommends for this project. This Section specifies the minimum membrane mil thickness and system installation specifics required for the work.
2. Heat and apply the membrane in accordance with the manufacturer's instructions. Use materials and application techniques to prevent pinholing and blistering.
3. Terminate membrane on vertical surfaces 1/2" below the top of finish surfaces or grade which will be installed after the work of this Section.
4. Mask vertical surfaces as required to protect the adjacent surface finishes. Use temporary steel sleeves to protect newly installed reinforcing dowels, rods and tree tie-down eyelets during membrane installation.
5. Provide surface condition or primers on substrate as required by the membrane manufacturer.
6. Ensure specified application rates of liquid products on vertical and steeply sloped surfaces by using multiple applications of material over previous applications which are fully cured.

B. Reinforced Membrane Waterproofing

1. In general floor areas, provide a minimum 90 dry mil membrane detail coat and continuous reinforcement sheet as required by the membrane manufacturer.
2. Provide a minimum 90 dry mil membrane detail coat and reinforcement sheet at interior and exterior corners and other changes in the substrate direction.
3. Provide a minimum 90 dry mil membrane detail coat and reinforcement sheet on all unit masonry walls, continuous with detail coat at adjacent wall to floor intersections.
4. Provide a minimum 90 dry mil membrane coat and uncured neoprene flashing sheet around drains and other slab penetrations at interior corners where slabs meet perimeter retaining walls, and at metal angles at expansion joints.
5. While membrane is hot, install reinforcing fabric and completely embed into liquid membrane.
6. Provide a minimum 125 dry mils second coating of membrane, for a total reinforced membrane thickness including the detailing of 215 dry mils. Modify coverage to account for existing surface roughness.
7. Otherwise refer to requirements of paragraph 3.3.A.

C. Protection Course

1. Soon as possible following second coating of membrane, provide protection board on the membrane in compliance with the membrane manufacturer's

recommendations.

2. Install no pieces less than ten (10) square feet in size.
3. Ensure the protection board lays flat and in contact with the membrane.

D. Drainage Board

1. Provide drainage board on all surfaces, including vertical surfaces, as indicated.
2. Begin installation at low point of deck area and proceed to high point. Panels shall be butted tightly.
3. Overlap drainage fabric in shingle fashion between abutting panels. Minimum overlap of fabric onto adjoining panel shall be 2".
4. Seal fabric overlap to abutting panel fabric with mastic as approved by the drainage board manufacturer. Install a minimum 1/4" wide continuous bead of mastic between overlap areas.
5. Where drainage board terminates at walls or other projections, wrap filter fabric over exposed edge and terminate on underside of board. Extend filter fabric a minimum of 1-1/2 inches onto underside of board.
6. Temporarily weight drainage board to maintain in place until next phase of work. Size and type of weight provided shall not damage previously complete waterproofing work or drainage board.
7. Cover drainage board promptly with next phase of work. Do not allow drainage board to be exposed for more than seven days. If drainage board is scheduled for exposure beyond seven days, install a supplemental layer of filter fabric to protect against excessive dirt and debris buildup as well as UV exposure. Remove and discard filter fabric prior to the installation of permanent overburden materials.

3.4 FIELD QUALITY CONTROL

A. Site Tests

1. Water Test
   a. Prior to installation of drainage board, water test membrane by ponding a minimum of 2 inches for a period of 24 hours to ensure a watertight system.
   b. At sloped areas of greater than 2% or ramp areas, maintain a curtain of water flowing continuously over the area for a period of 24 hours.
   c. Provide means of water containment during water testing to prevent flooding of adjoining areas and areas below the work area.
   d. Verify that the structure can support the dead load weight of the water prior to testing.
   e. If leaks occur, drain area and repair membrane. Retest.

f. Construct water containment barriers as approved by the membrane manufacturer.
g. Water tests can be waived jointly by the Owner and the Manufacturer, only after the Contractor has demonstrated the ability to provide successful system installation in previous application areas.

2. Application Monitoring
   a. Keep at the site and maintain in proper condition an adequate number (at least one per application crew) of durable, wet film thickness gauges.
   b. Continuously use gauges during the application process to ensure the specified thickness.
   c. Owner will periodically monitor the application rates of the membrane components and will notify the job foreman of noted discrepancies.
   d. Owner's periodic monitoring of the application rates shall not relieve the Contractor of the responsibility to provide the specified membrane thickness.

B. Manufacturer's Field Service

1. A technically competent employee of the waterproofing membrane manufacturer (the technician), not associated with the Contractor, the installation crew, product distributor or sales representative shall be on site before the first installation of the membrane system. Provide resume of experience and credentials for approval by the Owner.
2. The technician shall remain on site for the length of time necessary to observe the preparation and installation of 90% of the waterproofing membrane system (including drainage board).
3. Do not begin application of the waterproofing membrane system until the technician has approved the preparation, cleanliness and surface texture of the substrate.
4. The technician shall review all Contractor application techniques and procedures and shall advise the Contractor when, where and as required to obtain specification compliance.
5. Owner reserves the right to request the presence of the same technician on site for installation of the remainder of the waterproofing membrane system or related work if difficulties are encountered, as determined by the Owner, at no additional cost to the Owner.
6. Owner reserves the right to request a different technician if the one at the site fails to perform the duties herein specified. The Contractor and manufacturer shall comply with the Owner's request at no additional cost to the Owner.

3.5 CLEAN-UP

A. During the progress of the work, remove from the project all discarded materials and

debris.

B. Clean all surfaces affected by work of this Section and repair all damage caused to adjacent construction or property, at no cost to the Owner.

C. Leave adjacent premises clean and free of construction dirt and debris which resulted as part of the construction process.

D. Remove empty containers from the facility at the end of each working day.

E. Place soiled cloths that constitute fire hazards in suitable metal safety containers or remove them from the site at the end of each working day. Take special care in storage or disposal of flammable materials. Comply with health and fire regulations.

END OF SECTION

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 071800

PEDESTRIAN TRAFFIC MEMBRANE

PART 1 GENERAL

1.1 SUMMERY

A. Section Includes

1. All labor, material, equipment, special tools, and services required to complete the work required for the project as indicated on the Drawings and in the Specifications, including but not limited to:

a. Chemical Resistant Urethane (CRU) Microflake traffic membrane system.

B. Related Sections

1. Section 011000: Summary of Work.
2. Section 015600: Barriers.
3. Section 030100: Concrete Repairs.
4. Section 079200: Sealants

1.2 DEFINITIONS

A. The term "manufacturer's recommendations" or variations thereof, shall mean "manufacturer's recommendations which are found in publications available to and commonly used by the general architectural and consulting professions."

1.3 SUBMITTALS

A. Joint and Several Warranty Form meeting the requirements of Article 1.7.

B. Skid Resistance Addenda Form to Joint and Several Warranty meeting the requirements of Articles 1.7 and 3.4.

C. Bond Test Addenda Form to Joint and Several Warranty meeting the requirements of Articles 1.7 and 3.4.

D. Literature for all manufactured products, including manufacturer's specifications, test data and installation instructions or applicator's manual.

E. 12" x 12" samples of each membrane system to be used. Sample shall be applied to plywood or similar rigid material.

F. 1/4 lb. (±) samples of Microflake intermediate coat filler and top coat aggregate types intended to be used. Forward additional samples of both materials to the membrane manufacturer for review and approval.

G. Letter from Membrane Manufacturer stating samples of the Mircoflake and aggregate were received, if appropriate tested, and reviewed, and are approved for use for the specified system and jobsite conditions.

H. If requested, copy of letter of approval per Article 1.4.B.

I. If requested, resume per Article 1.4.C.

J. Provide letters of Certification per Article 1.4 Paragraphs E, F, and G.

K. Safety Data Sheets on all materials which are classified as hazardous materials.

L. Maintenance manuals with the following information:

1. Project name.
2. Project location.
3. Date.
4. Owner's name
5. Coating system(s)
6. Drawings indicating the coating systems and their location in the structure.
7. Schematic drawing of each membrane type identifying each element of the membrane system by dry film thickness and manufacturer's reference number or name.
8. Recommendations for routine care and maintenance.
9. Identify common causes of damage and instructions for temporary patching until permanent repair can be made.
10. Upon completion of the Work and prior to final payment, provide a fully executed warranty

1.4 QUALITY ASSURANCE

A. Applicable Codes

1. The Contractor shall comply with all Federal, State and Municipal laws, codes, ordinances, and regulations applicable to the Work in this Contract and also with all requirements of the National Fire Protection Association, the National Electric Code, and the Occupational Safety and Health Administration (OSHA). If the above laws, codes, or ordinances conflict with this Specification, then the laws, codes or ordinances shall govern, except in such cases where the Specification exceeds them in quality of materials or labor, then the Specifications shall be followed.

B. The membrane applicator shall be approved by the manufacturer and shall have been an approved manufacturer's applicator for the membrane products, as identified on the subcontractor supplemental proposal form, for a minimum of three consecutive years. If requested, the contractor shall provide written confirmation from the manufacturer within three calendar days of the request

C. The membrane applicator and its superintendent shall meet the following minimum requirements:

1. Installed the approved CRU Microflake membrane materials in a traffic membrane

system in three previous similar projects. Each of the three projects shall have been a minimum of 10,000 square feet in size.

2. Installed the approved CRU Microflake membrane materials in a traffic membrane system currently in use within the last two years.

D. Conform to the Field Quality Control requirements in Part 3 of this Section.

E. Membrane manufacturer to certify that Microflake filler and aggregate specified are acceptable for use in the membrane system.

F. Membrane manufacturer to certify that sealants in contact with membrane are compatible with membrane system.

G. Membrane manufacturer to certify that substrate surfaces in contact with any component of the vehicular traffic membrane are compatible.

H. Field Samples

1. Prior to beginning surface preparation, prepare a sample area in the initial phase work area for the project to be used as the minimum standard of acceptability for cleanliness and surface texture to be achieved throughout the work. The area shall be at least 400 sq. ft. Size and location shall be as directed by the Engineer. The standard shall be jointly reviewed and approved by both the Engineer and the Manufacturer relative to Article 3.2 paragraph B.a prior to start of full scale surface preparation work. The approved standard shall remain uncoated until all surface preparation work is completed

2. After approval, the sample area shall be covered with 6 mil thick plastic sheets. Edges shall be continuously taped, as well as splices, and the perimeter shall be weighted down. The sample area shall be kept covered unless viewing is needed for comparative purposes or until final preparation for membrane application. Contractor shall monitor the area to ensure the integrity of the covering. Neither foot nor vehicular traffic shall be allowed on the covering unless additional protective measures are taken to protect the cleanliness of the sample area.

I Manufacturer's Representation

1. For installation of membrane materials, a technically competent employee of the membrane manufacturer, approved by the Engineer and not associated with the installation crew, shall be on site before and during the installation of the membrane system initial Mock Up trial, and before and during the first full scale Work Area.

2. Application of the membrane shall not begin until the manufacturer's technician has approved the cleanliness and surface texture of the substrate.

3. The technician shall remain on site for the length of time necessary to observe the installation of the total membrane system.

4. The technician shall review all Contract application techniques and procedures and shall advise the Contractor when, where and as required to obtain specification

compliance

5. The Contractor and the membrane Manufacturer shall comply with the terms set forth in items 1 through 4 above at no additional cost to the Owner.

J. An employee of the applicator who has been trained by the membrane manufacturer on the installation of the approved membrane system shall be present during all applications of the membrane system.

K. Within twenty-four hours of application of membrane materials submit log required by Article 3.4 Paragraph F to Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to job site in sealed, undamaged containers. Each container shall be identified with material's name, date of manufacture and lot number.

B. Only those materials being used during any one work shift may be stored in the current work area. Materials being used for shift work shall be uniformly distributed throughout the intended work area so as to not overload or otherwise distress the structural system. All other materials, if stored on site, shall be stored at the designated staging area.

C. Coating materials shall be kept sealed when not in use.

D. Storage and handling of materials shall conform to the manufacturer's requirements and the requirements of the applicable environmental protection and safety regulatory agencies.

E. Storage areas shall be heated or cooled as required to maintain the temperatures within the range recommended by the coating manufacturer.

F. The handling and use of toxic or flammable solvents shall conform to the requirements of the applicable safety regulatory agencies, recommended by the manufacturer.

1.6 JOB CONDITIONS

A. A majority, but not all, of the work areas identified on the drawings are split slab construction, with a continuous subsurface waterproofing system beneath the topping slab.

B. All existing surface membrane systems in work areas are to be removed.

C. Additional subsurface drainage efforts will be installed prior to the start of new membrane work.

1.7 WARRANTY

A. Completed installation shall be warranted jointly and severally on a single document by manufacturer and applicator against defects of materials and workmanship. The length of the warranty period shall not be less than (5) years from the date of substantial completion of the Project.

B. Manufacturer and installer shall further warrant the skid resistance and bond strength of the installed systems. The test may be measured at any single location and shall meet

the specified criteria in Article 3.4. The length of the warranty period shall not be less than five (5) years from the date of substantial completion of the Project.

C. Warranty documents shall not require the waiving of the Owner to be effective, shall not limit the Owner's legal remedies otherwise allowed per the project contract, and shall not limit the venue of any potential legal jurisdiction.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Cymtal International

B. Neogard Corporation

2.2 MATERIALS

A. CRU Micoflake Membrane System

1. Iso-flex 760 Aliphatic System by Cymtal International, comprised of:

a. Vapor Barrier

1) Iso-Flex Barrier Coat 650-HD

2) Apply at manufacturer's recommended application rate.

b. Primer

1) Iso-Flex Epoxy SF, Primer 757.

2) Apply at manufacturer's recommended application rate.

c. Base Coat

1) Iso-Flex 750 Base Coat.

2) Apply at a minimum 40 mils dry film thickness or thicker as required by manufacturer.

d. 1st Intermediate Coat

1) Iso-Flex 200 Epoxy Resin Intermediate Coat

2) Apply at a minimum 12 mils dry film thickness or thicker as required by manufacturer

3) Torginol Domino Micro-flake seeded to rejection. Remove excess after system set up.

e. 2nd Intermediate Coat

1) Iso-Flex 630HD Intermediate Coat--Clear

2) Apply at a minimum 12 mils dry film thickness or thicker as required by manufacturer.

3) Torginol Domino Micro-flake light broad cast.

f. Top Coat

1) Iso-Flex 630HD Lock Coat.
2) Apply at a minimum 10 mils dry film thickness or thicker as required by manufacturer.
3) Aggregate seeded and back rolled to provide slip resistant surface.

g. Aggregate
1) Clear synthetic aggregate (U16)
2) Install at membrane manufacturer's maximum application rate.
3) Uniformly distributed with no bare spots.

2. FC System by Neogard Corporation, comprised of:

a. Vapor Barrier
1) Neogard 70700/01 epoxy.
2) Apply at manufacturer's recommended application rate.

b. Primer
1) Neogard 7760/7761 VOC.
2) Apply at manufacturer's recommended application rate.

c. Base Coat
1) Neogard FC7500/FC7960.
2) Apply at 40 mils dry film thickness.

d. Intermediate Coat
1) Neogard FC7540/FC7854 Clear.
2) Apply at a minimum of 20 mils dry film thickness.
3) Microflake filler approved by the Owner, Bengals and Engineer, seeded to rejection. Remove excess after system set up.

e. Top Coat
1) Neogard FC7540/FC7964 Clear.
2) Apply at 18 mils dry film thickness.
3) Aggregate seeded and back rolled to provide slip resistant surface.

f. Aggregate
1) Clear synthetic aggregate or aluminum oxide, approved size.
2) Install at membrane manufacturer's maximum application rate
3) Uniformly distributed with no bare spots.

B. Localized Leveling Repairs.
1. Lymtal Systems:
a. Primer per 2.2.A.1.b.
b. Leveling Material.
i. Iso-Flex 750 Base Coat.
ii. Pre-mix with manufacturer approved aggregate.
iii. Install in multiple lifts up to 1" thickness.
2. Neogard Systems:
a. Primer per 2.2.A.2.b.
b. Leveling Material.
i Neogard FC7500 Base Coat.
ii. Pre-mix with manufacturer approved aggregate.
iii. Install in multiple lifts up to 1" thickness.

C. Individual steps of any systems inclusive of greater than 5 percent solvents by either weight or volume calculations shall require monitoring by a licensed industrial hygienist for fumes and odors within work areas, at open air intakes within 200 ft. of work areas, and inside occupied spaces adjacent to work areas. Credentials of licensed hygienist and a monitoring plan must be approved by the Engineer in advance of the start of any membrane work.

D Membrane exposed and visible intermediate and topcoats shall be clear color.

E. Exposed intermediate coat and topcoat materials shall be U.V. stable.

PART 3 EXECUTIONS

3.1 EXAMINATION

A. Contractor and membrane manufacturer shall jointly review existing substrates (original concrete, past or new concrete repairs or overlays, past membrane or coating systems) to ensure compatibility with the specified membrane system. Submit in writing any materials which may cause membrane adhesion to substrate less than normally anticipated or other compatibility or performance difficulties. Failure to review and identify deleterious products/materials, and if failure of the membrane is a result of adhesion difficulties or chemical or physical incompatibilities with substrate materials, the Contractor and Manufacturer shall be responsible for all costs related to correcting the deficient Work. Manufacturer is bound to meet the above noted responsibilities equally with the Contractor regardless of the provisions of other agreements.

B. Inspect deck surface for any visibly distressed or rust stained concrete. If encountered, chain drag area to determine extent of distressed or delaminated area and repair as indicated on the Drawings, and Specification Section 030100.

C. Examine areas for slab cracks to be routed and sealed.

D. Confirm concrete repair and crack routing locations with Engineer prior to work.

3.2 PREPARATION

A. Protection

1. Erect barriers and barricades to protect adjoining areas from dirt, steel shot and debris generated from this work. Refer to Section 015600. Remove 100% of all residual steel shot from work areas, including in depressions and routed cracks or joints.

2. Cover exposed drain grates during shotblasting/grinding operations. Recoat with approved rust inhibitive or galvanizing paint grates damaged by blasting operations. Similarly protect and recoat if necessary other, in place metal elements. Drains to be functional during non-working hours and during periods of inclement weather.

3. Cover exposed drain grates to protect from membrane material. Drains to be functional during non-working hours and during periods of inclement weather. Do not allow membrane material to enter drain piping system.

B. Concrete (General)

1. Preparation and cleaning procedures shall be in strict accordance with this Specification unless more stringent requirements are recommended by the system manufacturer.

2. Surface must be dry. New concrete shall be at least 28 days old and proven dry via mat tests, to be considered for membrane system installation without installation of a vapor barrier. Review manufacturer requirements relative to site conditions in advance of performing the work.

3. Surfaces shall be free from all traces of dirt, salt, grease, oil, asphalt, laitance, curing compounds, paint stripes, coatings, and other foreign materials. Use manufacturer approved degreasing agents if necessary.

4. Concrete surfaces shall be cleaned using shotblast equipment (with integral vacuum process) to achieve standard of cleanliness per Article 1.4. The size of shot and travel speed of the equipment shall be chosen to provide a uniformly clean surface and profile; bases for bid must be two perpendicular normal speed passes, or one slow speed pass.

5. Areas which cannot be adequately cleaned by shotblasting shall be cleaned by grinding with accompanying vacuum procedures.

6. Surfaces that become contaminated by dirt or moisture after initial shotblasting or grinding, shall be cleaned again by shotblasting, or grinding to manufacturer's requirements at no additional cost to the Owner.

7. Minimum standard of acceptability applies to all surfaces intended to receive membrane regardless of surface preparation procedure or process.

8. The use of acids in surface preparation procedures and techniques is prohibited.

9. After completion of shotblasting/grinding, and prior to application of overlayment materials, repair all scaled, freeze-thaw damaged and loose, pop-out areas, cracks and all damage made apparent by the shotblasting/grinding procedures, in a manner approved by the Engineer. Such repair work shall be part of the Base Bid without unit price adjustment. Areas requiring patching will be subject to re-shotblast or re-grinding where a patch exceeds one (1) square foot in area.

10. Grind all high spots or transition grind all depressions per details, and clean to manufacturer's requirements.

C. Membrane Removal

1. If existing membrane system scheduled to be removed, the criteria for acceptance are 5% of the existing membrane remaining on horizontal surfaces. 5% of the existing membrane may remain on the vertical curb faces with no area larger than 3 square inches.

2. The membrane removal is to be done with a dry cutting process only.

3. After removal, perform surface preparation the same as for Concrete, Article 3.2.B.

3.3 INSTALLATION

A. General

1. Install materials in strict accordance with all safety and weather conditions required by product literature and Local, State and Federal regulations.

2. Fumes and dust shall be controlled to prevent harmful or undesirable effects in surrounding areas. All potential avenues for penetration of fumes or dust into surrounding occupied areas shall be sealed prior to the start of the work.

3. All exposed membrane edges and termination details shall be taped to provide straight, neat edges.

4. Install vapor barrier and base coat membrane materials on concrete surfaces only when concrete temperature has stabilized or is falling. Do not install membrane materials on concrete surfaces when surface temperature is rising.

5. Install membrane materials only if the temperature of the surfaces to be coated is 5 degrees or higher than the dew point temperature measured at the job site.

B. Sealants: Refer to Section 079200.

C. Membrane

1. Where necessary to locally level surfaces and after approval by Owner, install membrane leveling materials in depressed areas. Refer to Article 2.2.B.

2. Install detail coat 4" wide by 20 mil thick (dry film thickness) over properly primed cracks, caulked cracks or joints, joints between concrete pours, or leveling repairs, junctures and other locations in the membrane area which is a deviation from the

nominal membrane plane, except where otherwise indicated by the Specifications or Drawings.

3. The membrane system shall turn up 4" at all vertical surfaces unless shown otherwise on the drawings. Detail coat is required at all turn-ups to vertical surfaces. Detail coat at turn-ups shall be the same as the detail coat required by Article 3.3 Paragraph C.1.

4. Contractor shall ensure the specified/recommended application rates of all components of the membrane system. Base coat(s), intermediate coat, and lock coat of each application of the membrane system shall be distributed onto the deck by calibrated, notched squeegees. Squeegees showing signs of wear shall be discarded.

5. Contractor shall ensure specified/recommended application rates of liquid products on vertical or sloped surfaces by the use of non-sag grade materials or by multiple applications of material over previous applications which are fully cured.

6. Each fluid-applied component of the membrane system shall be back-rolled to properly distribute materials across the deck and eliminate squeegee marks.

7. Use of power rollers either to distribute the membrane system or to back roll squeegee marks shall not be permitted.

8. No traffic shall be allowed on membrane areas for at least 72 hours after completion of membrane installation. Provide extended cure time with no traffic exposure if temperatures fall below 50°F.

3.4 FIELD QUALITY CONTROL

A. Bond Test

1. Bond tests of the installed membrane systems may be performed by the Engineer during and after the membrane work on this project. Tests shall be conducted using a calibrated instrument which measures in-place bond strength by applying a direct axial pull on a 3 inch diameter steel disk epoxied to the completed membrane top surface.

2. A membrane phase for the purpose of bond testing is an area of base coat installed in a single work shift. If examined, a membrane phase will be tested at (3) locations per phase no sooner than 10 days after completion of the entire membrane system and no sooner than 14 days if temperatures fall below 40°F for two or more days. Contractor shall assume a total of 8 test locations in the Base Bid.

3. The acceptance criteria for initial tests of a Phase shall average bond strength of 200 psi for all locations, with no single location testing below 150 psi. Any Phase failing to meet the initial acceptance criteria may be retested at a later date by the Engineer. Retests of Phase shall include at least 4 separate test locations not sooner than 14 days after the initial tests. The acceptance criteria for retests of a Phase shall average bond strength of 200 psi for all locations, with no single location

testing below 175 psi.

4. Any Phase failing to meet the initial test and retest acceptance criteria shall be considered "deficient" and shall be cause for the Contractor to execute or provide one of the following remedies.
   a. Extend Standard Guarantee to include an additional 5 years (for a total of 10 years) on membrane system intercoat bond and bond to the concrete for the "deficient" areas.
   b. Removal and replacement of the "deficient" area, including all necessary preparatory work and Engineering costs to coordinate and observe the work, at no additional cost to the Owner.

5. Any additional bond testing requested by the Contractor to limit the extent of the "deficient" area(s) as determined by initial tests and retests as defined above shall be paid for by the Contractor.

6. Contractor shall include as part of his proposal the costs of repairing all test locations.

B. Skid Test

1. Prior to any membrane preparation work and after membrane installation, the Engineer may conduct tests to determine values of the static coefficient of friction between the coated and uncoated floor surfaces and the neoprene base of the Engineer's test equipment.

2. Determination of the coefficient of friction will consist of a series of individual tests for each surface type. The initial coefficient of friction is defined as the average of the tests performed on the concrete surfaces prior to membrane preparatory work. The final coefficient of friction is defined as the averages of the tests performed on each type of completed membrane system surface.

3. The final, average static coefficient of friction shall be a minimum of 0.85 under wet and dry conditions and equal to or greater than 110% of the initial coefficient of friction. No individual test area shall have a coefficient less than 0.80 or 95% of the initial coefficient of friction. Any membrane system that does not conform, as determined by the Engineer, to the specified acceptance criteria shall be subject to rework, upgrading or replacement of the deficient areas, including necessary preparatory work, at no additional cost to the Owner.

C. The Engineer may direct the Contractor to make test cuts in the membrane for testing purposes. Tests cuts shall be 2" x 2" and will be in partially-completed or fully-completed membrane. A maximum of 3 total tests per separate installation phase may be made. Contractor shall include as part of his Proposal the costs of taking test cuts as directed and located by the Engineer and the costs of patching test cut areas.

D. The Engineer will periodically monitor application rates of the membrane system individual components and will notify job foremen of discrepancies noted.

E. The Contractor shall keep at the site and maintain in proper condition an adequate number (at least one per application crew) of wet film thickness gages and shall continuously use such to ensure the specified thickness of each membrane coat is uniformly maintained. The periodic monitoring of application rates per Article 3.4 Paragraph D shall not relieve the Contractor of the responsibility of verifying specified coating thickness.

F. Contractor shall provide information required by Article 3.6.

3.5 CLEANING

A. Empty containers shall be removed from the project work areas at the end of each working day. Cloths soiled with coating that might constitute a fire hazard shall be placed in suitable metal safety containers or shall be removed from the structure at the end of each working day. Special care shall be taken in storage or disposal of flammable materials. Comply with health, fire, and environmental regulations.

B. All spilled coating material shall be completely removed from hardware, adjacent floor areas, metal work, etc. Remove spilled coating by approved methods.

C. Repaint in matching color all curbs, columns, walls, etc., where existing paint was removed during preparation for membrane application.

D. All hardware, adjacent floor areas, metal work, etc., and the general premises shall be left clean and free of all construction dirt and debris.

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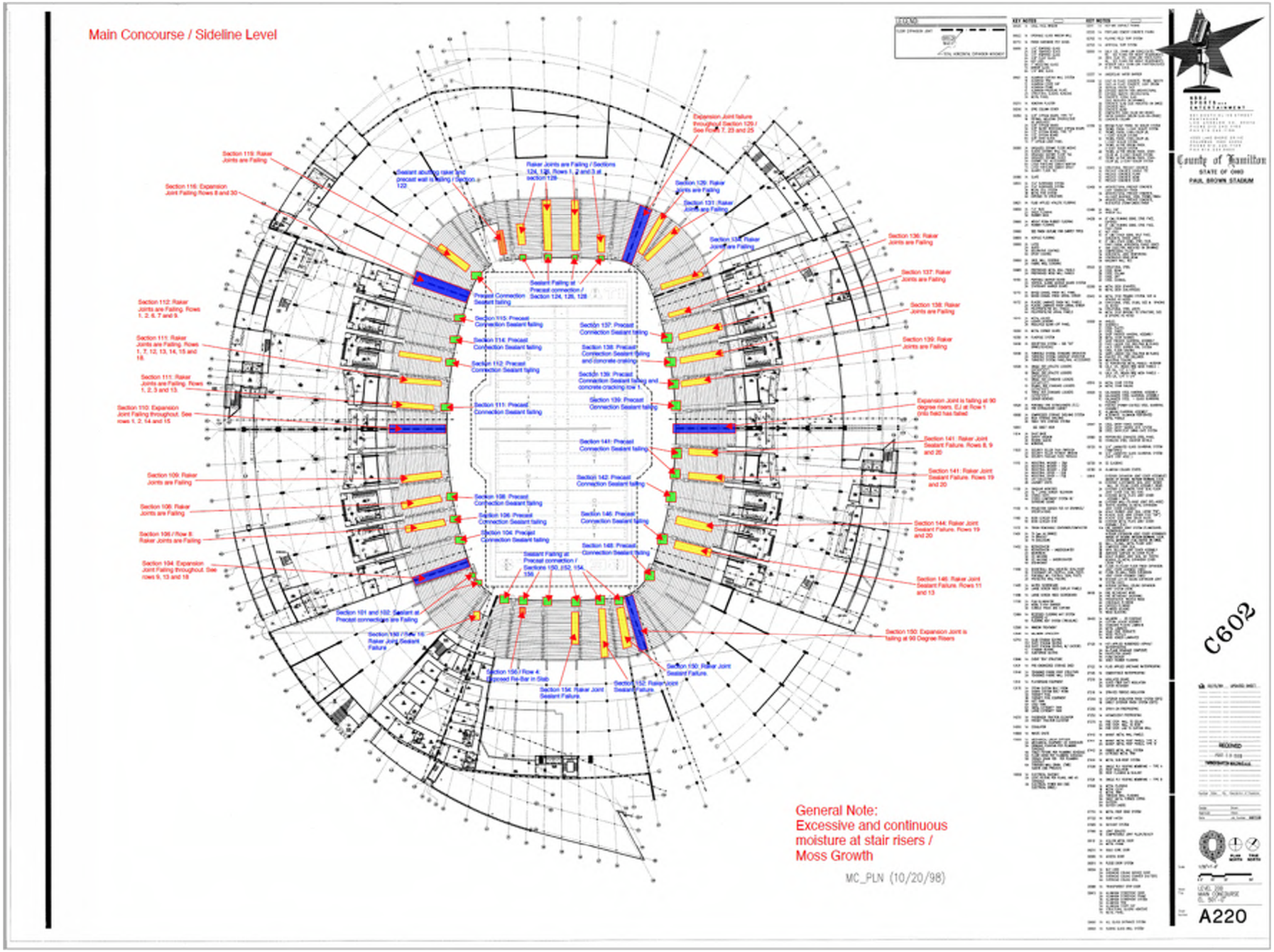
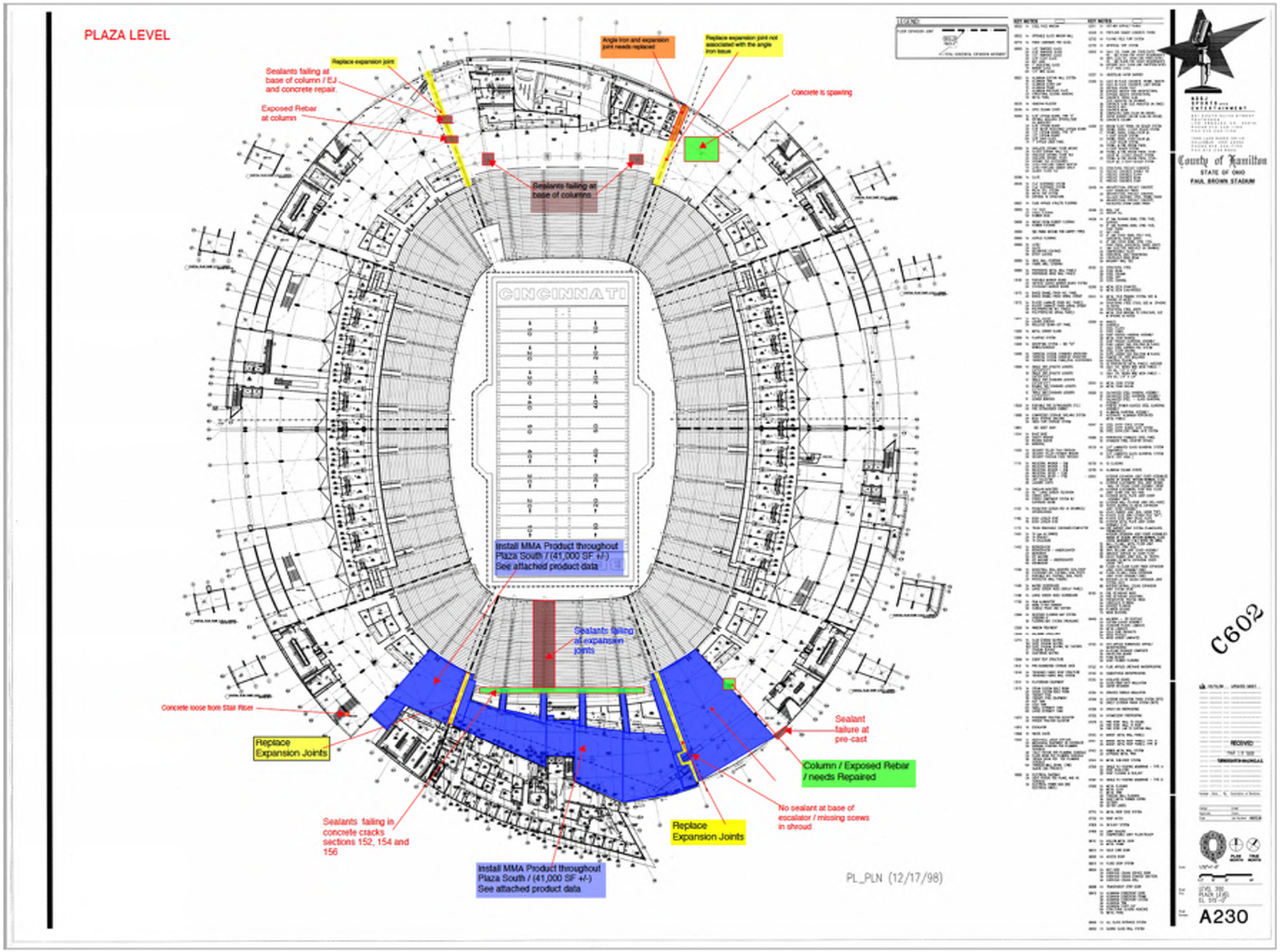
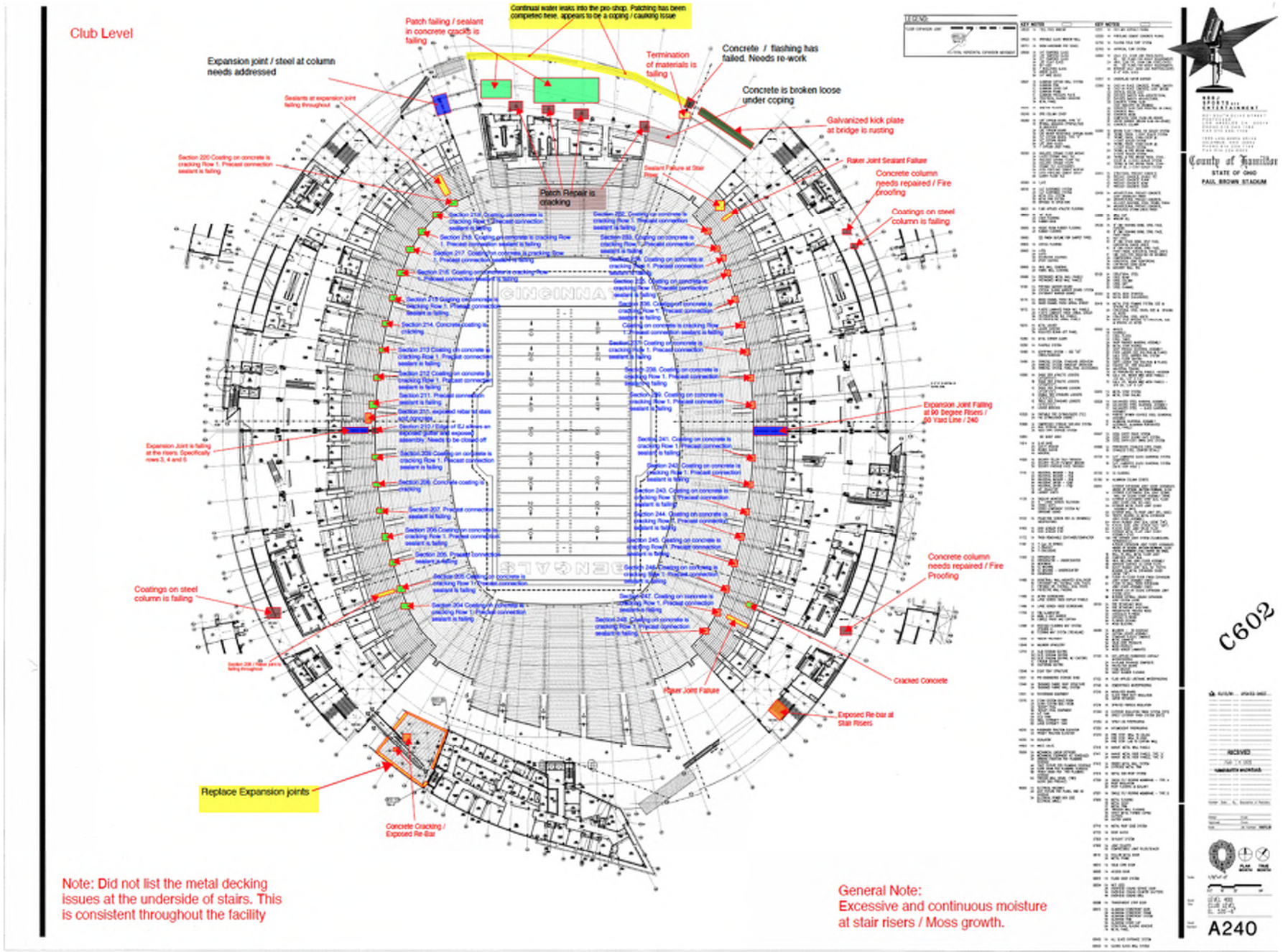
APPENDIX C

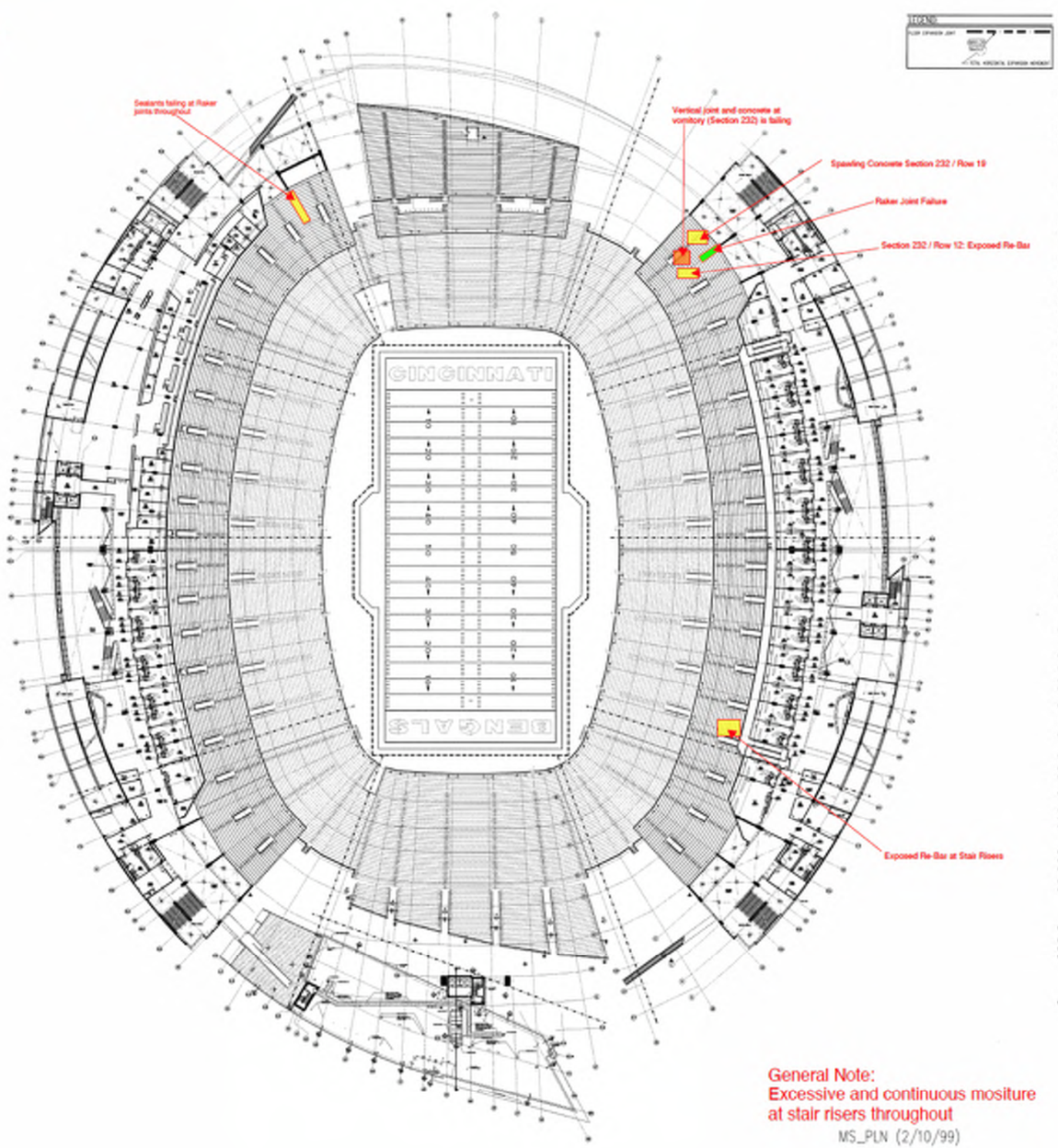
TRACKING MAP


Main Concourse / Sideline Level
Section 119: Raker Joints are Failing
Section 116: Expansion Joint Failing Rows 8 and 30
Sealant abutting raker and precast wall is failing / Section 122
Raker Joints are Failing / Sections 124, 126, Rows 1, 2 and 3 at section 128
Expansion Joint failure throughout Section 129 / See Rows 7, 23 and 25
Section 129: Raker Joints are Failing
Section 131: Raker Joints are Failing
Section 133: Raker Joints are Failing
Section 136: Raker Joints are Failing
Section 137: Raker Joints are Failing
Section 138: Raker Joints are Failing
Section 139: Raker Joints are Failing
Section 112: Raker Joints are Failing. Rows 1, 2, 6, 7 and 9.
Section 111: Raker Joints are Failing. Rows 1, 7, 12, 13, 14, 15 and 18.
Section 111: Raker Joints are Failing. Rows 1, 2, 3 and 13.
Section 110: Expansion Joint Failing throughout. See rows 1, 2, 14 and 15
Section 109: Raker Joints are Failing
Section 108: Raker Joints are Failing
Section 106 / Row 8: Raker Joints are Failing
Section 104: Expansion Joint Failing throughout. See rows 9, 13 and 18
Sealant Failing at Precast connection / Section 124, 126, 128
Precast Connection Sealant failing
Section 115: Precast Connection Sealant failing
Section 114: Precast Connection Sealant failing
Section 112: Precast Connection Sealant failing
Section 111: Precast Connection Sealant failing
Section 108: Precast Connection Sealant failing
Section 106: Precast Connection Sealant failing
Section 104: Precast Connection Sealant failing
Section 137: Precast Connection Sealant failing
Section 138: Precast Connection Sealant failing and concrete cracking
Section 139: Precast Connection Sealant failing and concrete cracking row 1
Section 139: Precast Connection Sealant failing
Section 141: Precast Connection Sealant failing
Section 142: Precast Connection Sealant failing
Section 146: Precast Connection Sealant failing
Section 148: Precast Connection Sealant failing
Sealant Failing at Precast connection / Sections 150, 152, 154, 156 /
Section 101 and 102: Sealant at Precast connections are Failing
Section 150 / Row 16: Raker Joint Sealant Failure
Section 156 / Row 4: Exposed Re-Bar in Slab
Section 154: Raker Joint Sealant Failure
Section 152: Raker Joint Sealant Failure
Section 150: Raker Joint Sealant Failure
Expansion Joint is failing at 90 degree risers. EJ at Row 1 (mb field has failed
Section 141: Raker Joint Sealant Failure. Rows 8, 9 and 20
Section 141: Raker Joint Sealant Failure. Rows 19 and 20
Section 144: Raker Joint Sealant Failure. Rows 19 and 20
Section 146: Raker Joint Sealant Failure. Rows 11 and 13
Section 150: Expansion Joint is failing at 90 Degree Risers
General Note:
Excessive and continuous moisture at stair risers / Moss Growth
MC_PLN (10/20/98)
County of Hamilton
STATE OF OHIO
PAUL BROWN STADIUM
C602
A220

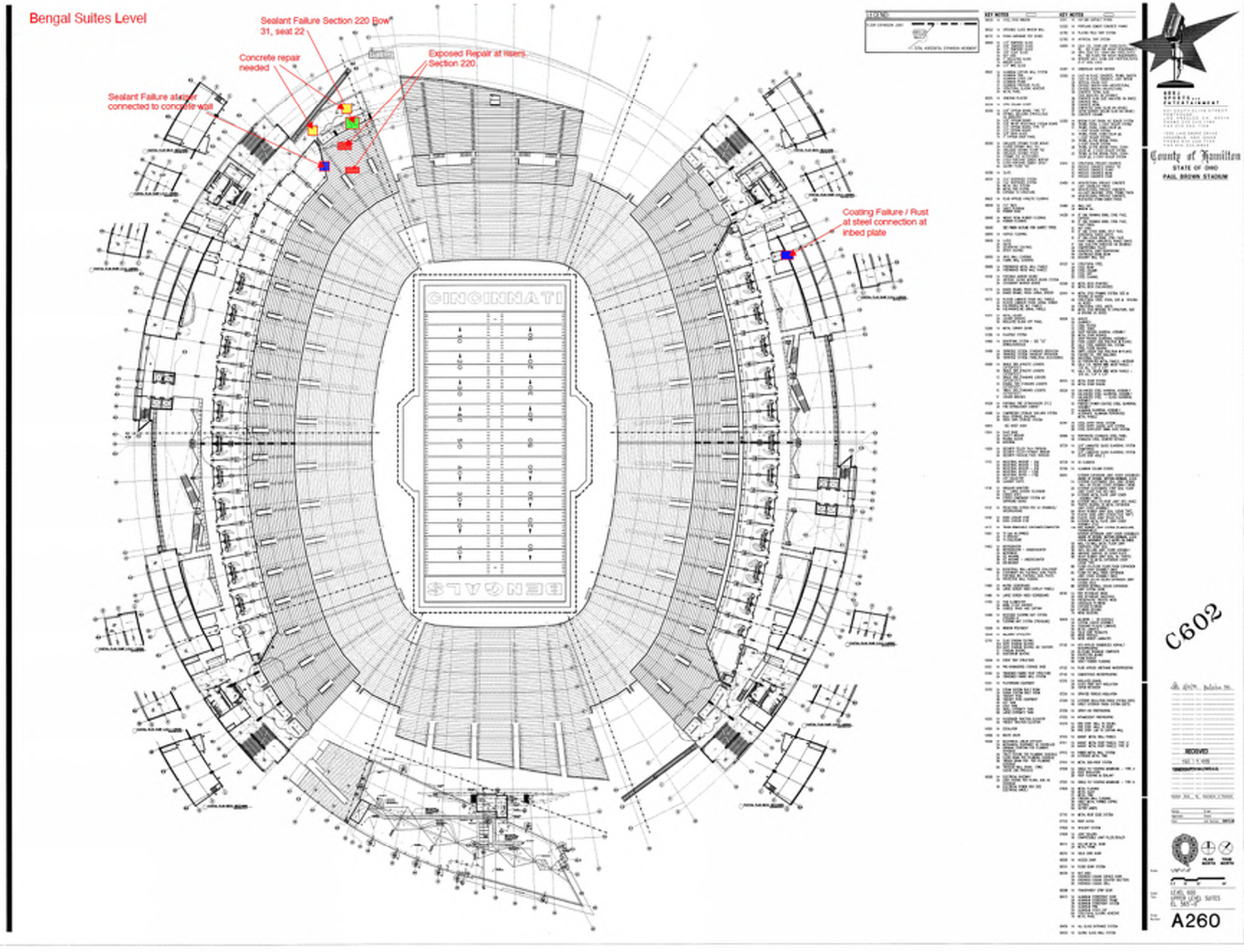

PLAZA LEVEL
Replace expansion joint
Sealants failing at base of column / EJ and concrete repair.
Exposed Rebar at column
Angle iron and expansion joint needs replaced
Replace expansion joint not associated with the angle iron issue
Concrete is spawling
Sealants failing at base of columns
CINCINNATI
Install MMA Product throughout Plaza South / (41,000 SF +/-) See attached product data
Sealants failing at expansion joints
Concrete loose from Stair Riser
Replace Expansion Joints
Sealants failing in concrete cracks sections 152, 154 and 156
Install MMA Product throughout Plaza South / (41,000 SF +/-) See attached product data
Replace Expansion Joints
Sealant failure at pre-cast
Column / Exposed Rebar / needs Repaired
No sealant at base of escalator / missing screws in shroud
PL_PLN (12/17/98)
LEGEND
County of Hamilton
STATE OF OHIO
PAUL BROWN STADIUM
C602
A230

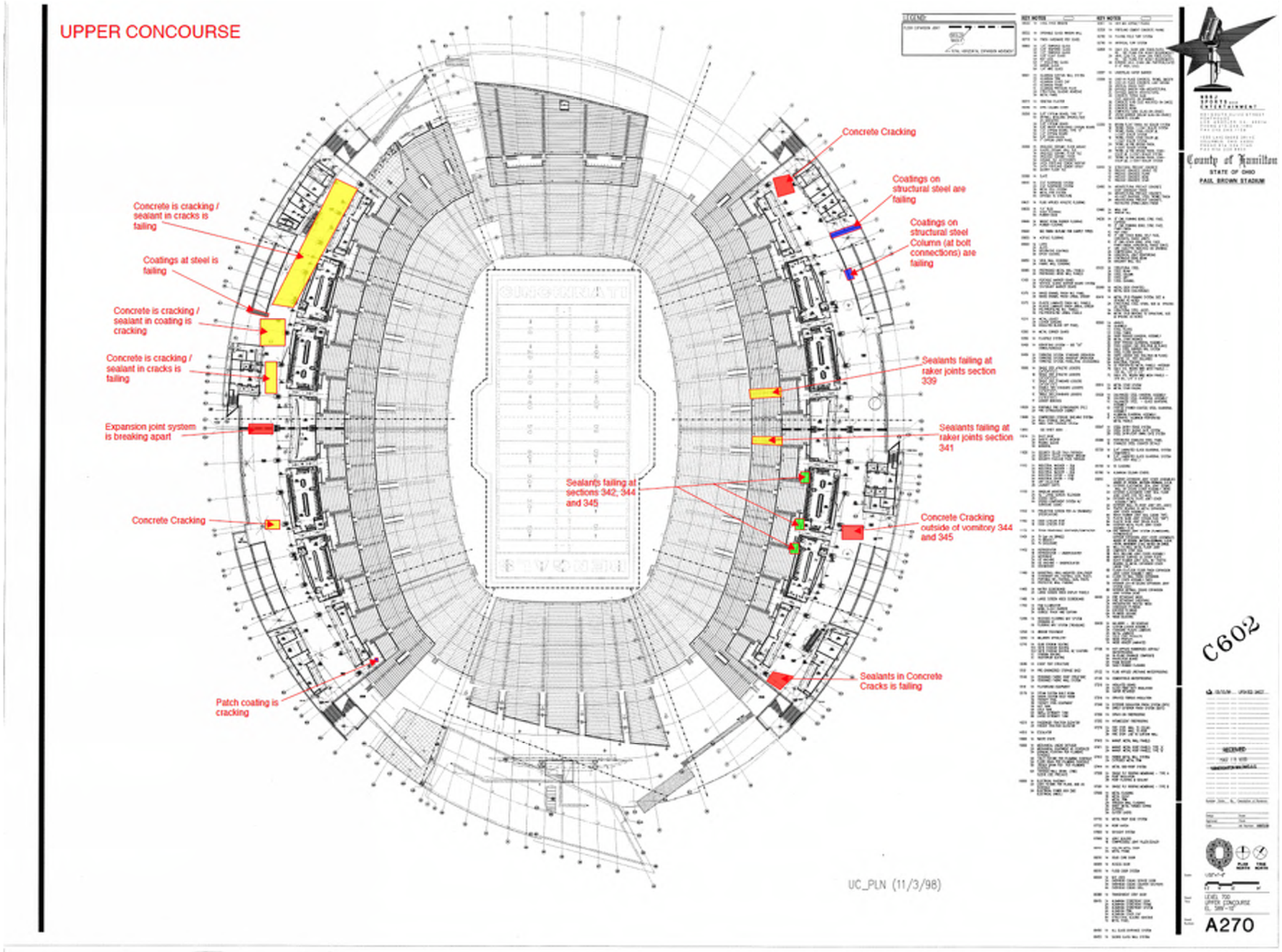

Club Level
Continual water leaks into the pro-shop. Patching has been completed here, appears to be a coping / caulking issue
Patch failing / sealant in concrete cracks is failing
Expansion joint / steel at column needs addressed
Termination of materials is failing
Concrete / flashing has failed. Needs re-work
Concrete is broken loose under coping
Galvanized kick plate at bridge is rusting
Raker Joint Sealant Failure
Concrete column needs repaired / Fire proofing
Coatings on steel column is failing
Patch Repair is cracking
Expansion Joint Failing at 90 Degree Risers / 50 Yard Line / 240
Concrete column needs repaired / Fire Proofing
Coatings on steel column is failing
Cracked Concrete
Exposed Re-bar at Stair Risers
Replace Expansion joints
Concrete Cracking / Exposed Re-Bar
Note: Did not list the metal decking issues at the underside of stairs. This is consistent throughout the facility
General Note:
Excessive and continuous moisture at stair risers / Moss growth.
County of Hamilton
STATE OF OHIO
PAUL BROWN STADIUM
C602
A240

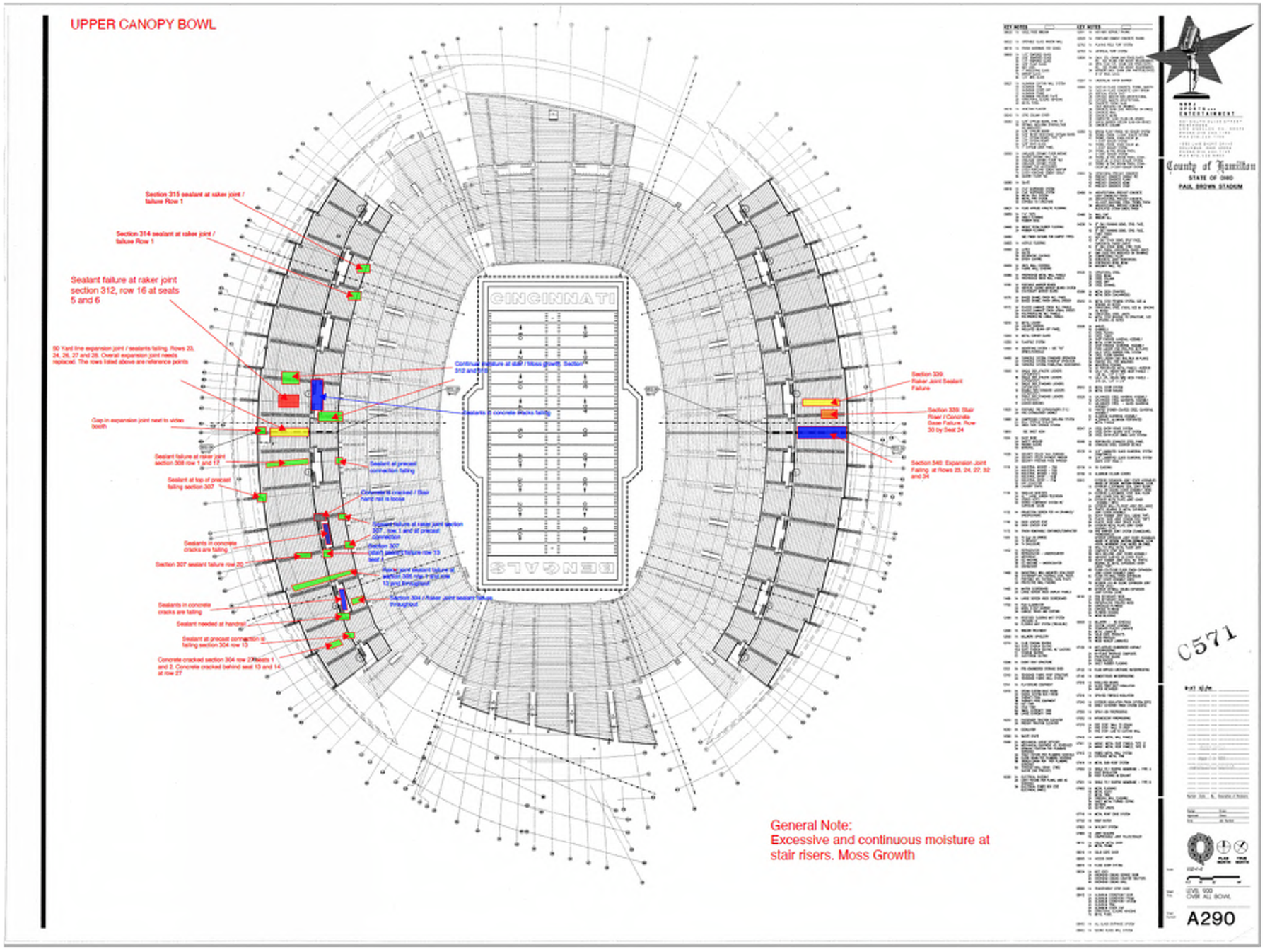
CLUB SUITES LEVEL



General Note:
Excessive and continuous mositure at stair risers throughout
MS_PLN (2/10/99)

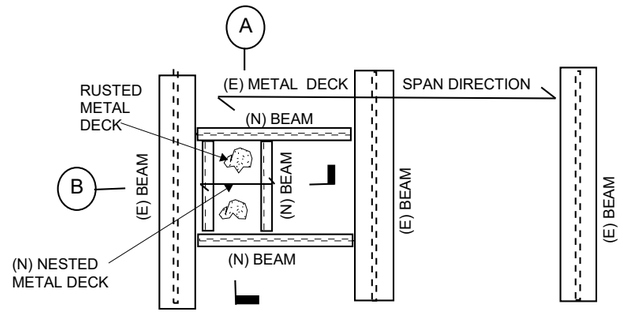

Bengal Suites Level
Sealant Failure Section 220 Bow 31, seat 22
Concrete repair needed
Exposed Repair at risers Section 220
Sealant Failure at pier connected to concrete wall
Coating Failure / Rust at steel connection at inbed plate
CINCINNATI
County of Hamilton
STATE OF OHIO
PAUL BROWN STADIUM
C602
A260


UPPER CONCOURSE
Concrete Cracking
Coatings on structural steel are failing
Coatings on structural steel Column (at bolt connections) are failing
Concrete is cracking / sealant in cracks is failing
Coatings at steel is failing
Concrete is cracking / sealant in coating is cracking
Concrete is cracking / sealant in cracks is failing
Expansion joint system is breaking apart
Sealants failing at raker joints section 339
Sealants failing at raker joints section 341
Sealants failing at sections 342, 344 and 345
Concrete Cracking
Concrete Cracking outside of vomitory 344 and 345
Patch coating is cracking
Sealants in Concrete Cracks is failing
UC_PLN (11/3/98)
County of Hamilton
STATE OF OHIO
PAUL BROWN STADIUM
C602
A270

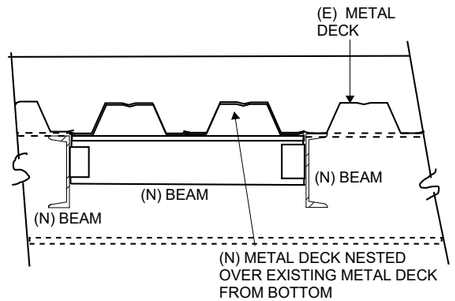

UPPER CANOPY BOWL
Section 315 sealant at raker joint / failure Row 1
Section 314 sealant at raker joint / failure Row 1
Sealant failure at raker joint section 312, row 16 at seats 5 and 6
50 Yard line expansion joint / sealants failing. Rows 23, 24, 26, 27 and 28. Overall expansion joint needs replaced. The rows listed above are reference points
Gap in expansion joint next to video booth
Sealant failure at raker joint section 308 row 1 and 17
Sealant at top of precast failing section 307
Sealants in concrete cracks are failing
Section 307 sealant failure row 20
Sealants in concrete cracks are failing
Sealant needed at handrail
Sealant at precast connection is failing section 304 row 13
Concrete cracked section 304 row 27 seats 1 and 2. Concrete cracked behind seat 13 and 14 at row 27
Continue moisture at stair / tiles growth. Section 312 and 313
Sealants in concrete cracks failing
Sealant at precast connection failing
Concrete cracked / Stair hand rail is loose
Section 307 cracks passing failure row 13 seat 4
Section 304 / Raker joint sealant failure throughout
Section 339 Raker Joint Sealant Failure
Section 339 Stair Riser / Concrete Base Failure. Row 30 by Seat 24
Section 340 Expansion Joint Failing at Rows 23, 24, 27, 32 and 34
CINCINNATI
BENGALS
County of Hamilton
STATE OF OHIO
PAUL BROWN STADIUM
General Note:
Excessive and continuous moisture at stair risers. Moss Growth
C571
A290

APPENDIX D

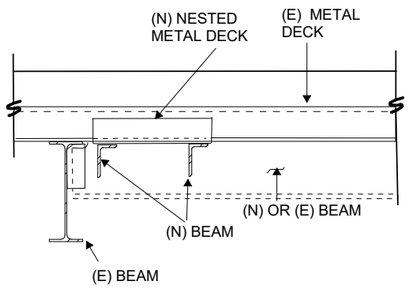
RE-SUPPORTING CORRODED METAL DECK



FRAMING PLAN VIEW



SECTION A



SECTION B

EXAMPLE OF RESUPPORTING CONCRETE TOPPING OVER CORRODED METAL DECK

NOTES

1. NEW METAL DECK TO MATCH EXISTING METAL DECK PROFILE AND TO BE VENTED
2. NEW METAL DECK TO HAVE G-90 GALVANIZING COATING
3. NEW FRAMING MEMBERS TO BE DESIGNED BY ENGINEER PROVIDING REPAIR DESIGN
4. NEW NESTED METAL DECK TO BEAR ON NEW FRAMING MEMBERS.