integrus ARCHITECTURE

Riverfront Park

Pavilion Facilities
Conditions Assessment Report

Integrus Project No. 21134.01

June 4, 2012

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June 4, 2012

Ms. Debby Dodson
Riverfront Park Assistant Manager
507 N. Howard
Spokane, WA 99201

RE: Pavilion Facilities Conditions Assessment Report
Integrus Project No. 21134.01

10 South Cedar Street
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Dear Debby:

Enclosed you will find our condition assessment report for the Pavilion Cable Net Structure and the surrounding ground level facilities. This report is the result of our site observations made on and around April 19, 2012.

The assessment has been divided into chapters based on the portion of the facility being addressed. Each chapter includes the Architectural, Structural, Mechanical and Electrical observations and recommendations as they apply to that area. We have specifically noted areas of immediate concern, such as items that impact safety, and included intermediate and long term recommendations.

Thank you once again for the opportunity to serve you. We support your vision of a vibrant and active Riverfront Park and look forward to helping you achieve your goals.

Sincerely,

INTEGRUS ARCHITECTURE, P.S.

John D. Cuddy, S.E.
Principal

Preston S. Potratz, AIA, NCARB
Principal

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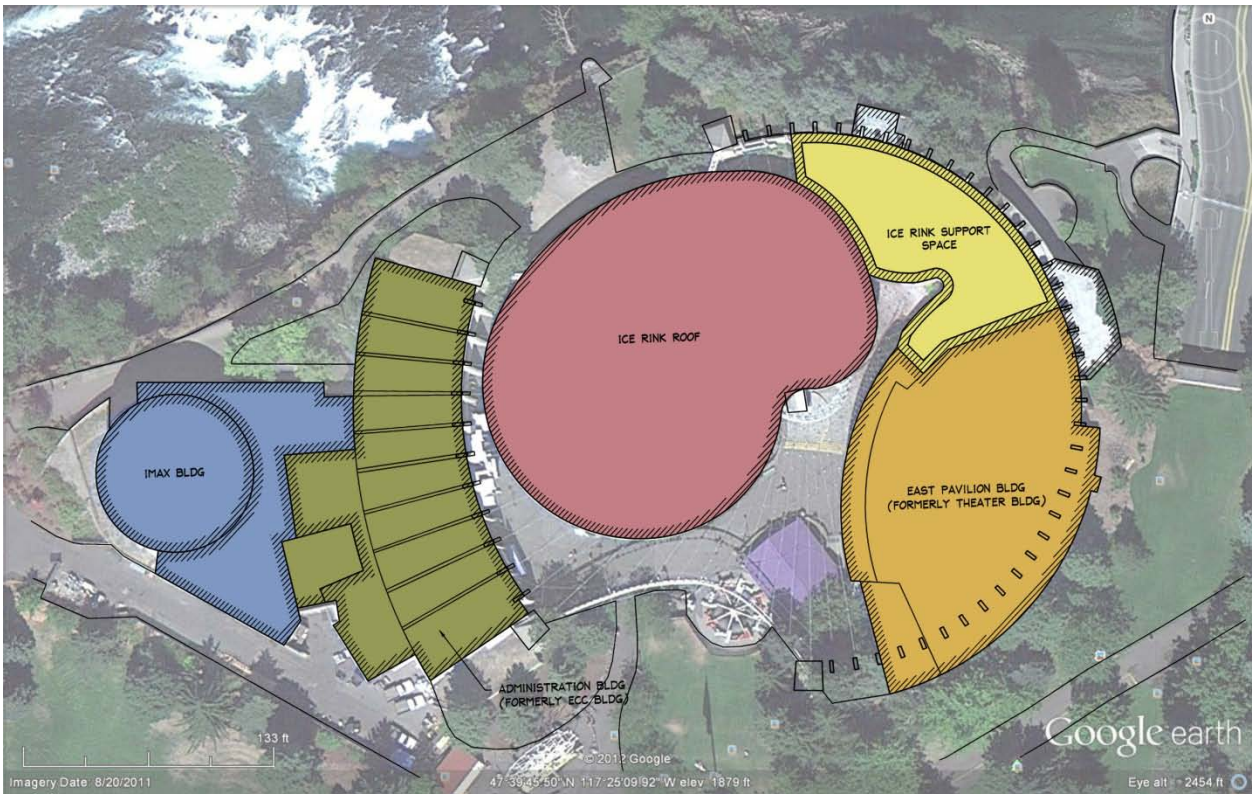
Section i Table of Contents

SECTION 1
INTRODUCTION

Section 1 Introduction

Integrus Architecture, P.S. was contacted in the fall of 2011 to perform a conditions assessment on the core facilities in Riverfront Park. This assessment was performed in April of 2012. The attached report represents the observations and findings of this assessment. The purpose of this report is to document the condition of the Riverfront Park Pavilion facilities in order to understand the steps necessary to maintain current operations. Those items that should be considered as future operations under the developing Riverfront Park Master Plan are briefly discussed.

The report separates the Pavilion proper into six areas: Five ground based facilities and the Pavilion cable net structure itself. The five ground based facilities are labeled in this report by function. It will be important to remember that they are, in reality, interconnected through structure, architecture, and building systems. This interconnectivity will be important to understand as plans are made to modify portions of the whole. The five ground facilities are shown in the graphic below:



Each area is addressed as a specific chapter in this report, with Structural, Architectural, Mechanical and Electrical observations combined. This format will allow the needs of each segment to be understood separately.

The recommendations in each section are further separated based on the urgency in addressing each condition. Critical issues are those that require immediate attention as they may constitute a safety concern to those in the area of, or providing maintenance to the facility. Short term issues are those suggested for action within approximately two years. Long term issues are those suggested for action in a time frame greater than two years.

This report is considered a due-diligence conditions assessment. Methodology and approach are based on the professional standard of care for each discipline. Architectural observations were made by representatives from Integrus Architecture, P.S. Mechanical and Electrical observations were made by engineering representatives from MW Consulting Engineers, Inc. Structural observations for the ground facilities were made by a representative from Integrus Architecture, P.S. Structural observations for the Pavilion Cable net structure were made by a representative of Magnusson Klemencic Associates, Inc. from Seattle, Washington.

SECTION 2
ADMINISTRATION BUILDING

Section 2 Administration Building

2.1 Structural

Description of Structure

The Administration Building is a two-story, cast-in-place concrete building. This arc shaped building forms the western quarter circle of the original Pavilion facility. The roof structure consists of a concrete topping slab over ribbed precast deck panels spanning between cast-in-place concrete frames. The concrete frames are built on the radial grid of the Pavilion tensile cable structure. The eastern leg of the concrete frames extends above the roof level and provides anchorage for the Pavilion tensile cables. Mezzanine level framing consists of wide flange steel girders supporting steel bar joists, metal deck, and concrete topping.

The west side of this facility consists of a mixture of original construction and infill additions. All construction appears to be cast-in-place concrete walls and roof. Construction documents were not provided for this portion of the facility. The sequencing and details of this construction is unknown.

Structural observations of the Administration Building were made by Tim Graybeal, P.E. on the afternoon of April 19, 2012. Observations and assessment were performed in accordance with ASCE 11 guidelines for preliminary condition evaluation and recommendations. A full structural analysis is beyond the scope of this report.
Design drawings by Naramore Bain Brady & Johanson dated April 10, 1973 were provided by the owner.
Observations were made from ground level with viewing distances of 5 to 15 feet. Observations were limited to visible structure only. No material testing was performed as a part of this evaluation.

Executive Summary

Evidence of water infiltration was noted at several locations throughout the facility. This issue appears to be caused by leaks in the roof, and should be addressed as soon as possible to avoid deterioration of the structure.

Observations

Observations began at the roof level. The surface of the roof and the outline of the radial concrete frames were covered with a thick, foam-like coating. Dave Randolph noted that this was a waterproofing material originally designed for below-grade application. He noted that this portion of the structure had originally been underground. The coating completely concealed the roof structure.

Interior observations were made at both the ground and Mezzanine levels. The underside of the precast roof structure is exposed through a majority of the facility. This structure appears to be in good condition, with no visible damage, decay or deterioration. In the mini-golf area, some discoloration and staining was observed immediately below the roof, on the surface of the precast roof deck panels, the concrete support frames and the interior walls (see Photo 2-1.) Some minor cracking was observed in the cast-in-place concrete walls, and in the stairwells at each end of the facility.

The exterior face of the west parapet wall also had some minor discoloration and staining (see Photo 2-2).

Discussion and Recommendations

The overall condition of the structure is good. There was staining observed on the underside of the roof structure that would indicate water infiltration. In addition, the west roof parapet, which forms the low side of the roof, appears to be weeping moisture. This is likely caused by standing water at the low point of the roof. This water appears to have migrated through the exposed concrete and left residual mineral stains on the opposite side of the parapet wall.

It will be important to eliminate the water infiltration into the building interior as well as the exterior concrete in order to alleviate potential damage due to expansion from freeze – thaw cycles as well as corrosion of reinforcement.

2.2 Architectural

Code Analysis

We are using the 2009 International Building Code (IBC) with Washington State Building Code Chapter 51-50 WAC Amendments to perform our code analysis.

Current drawings for the Administrative Building were not available to Integrus Architecture for the condition assessment. We were given a copy of the 1973 Naramore Bain Brady & Johanson drawings for Expo '74. These drawings give us a reference to the building shape and layout, but there appears to be many alterations and additions to the building since these drawings were issued. To complete a proper code analysis and determine code compliance or deficiencies issues associated with this building, a set of current record document with all alterations and additions will be needed.

Based on information in the "Riverfront Park U.S. Pavilion Study" prepared by Integrus Architecture, P.S. and dated June 1997, this building is of Type III – 1-hr. construction and has an A2.1 occupancy on the first floor with a B occupancy on the second floor based on the 1994 U.B.C. This translates to Type III-A construction and an A-1 occupancy on the first floor with B occupancy on the second floor in the current 2009 IBC.

Building Code Deficiencies / Questions

- Exit doors located on grade of the north and south stair wells have devices installed that disable the function of the panic hardware on the egress side. These doors serve as an emergency exit for building and the disabled function of the panic hardware is in direct violation of the code. These devices should be removed to allow the panic hardware to function properly.

- In the service corridor located on the west side of the building, it looks like walls and doors have been added to create on office within the space of the existing corridor. This corridor serves as exit path for staff and others in the mechanical and storage areas of the building. Furniture and other items have been placed in the office that render the doors inoperable, and drastically reduce the width of the corridor. The addition of this office also creates a 40 foot dead end corridor. Per code the maximum length of a dead end corridor is 20 feet.

  We recommend that the walls, doors, and furniture installed in the existing corridor be removed to allow the corridor to continue as originally designed. The addition of this office is a violation to the code and creates a potential safety hazard to staff and others.

- Along the west side of the second floor walls and doors have been added in the open walkway that connects the north and south exit stairs. From information provided by Riverfront Park Maintenance staff, the door located north of the central stair in the open walkway remains unlocked during business hours and the door located south of the central stair remains locked during business hours. Per code, it is permitted to have locks on egress doors, if the locking device is readily distinguishable as locked, and a readily visible durable sign is posted on the egress side on or adjacent to the door stating: THIS DOOR TO REMAIN UNLOCKED WHEN BUILDING IS OCCUPIED. The sign shall be in letters 1 inch high on a contrasting background.

We recommend that a sign be added to the north and south door that states: THIS DOOR TO REMAIN OPEN UNLOCKED WHEN BUILDING IS OCCUPIED. The south door should also be operated the same as the north door, it should remain unlocked during business hours, to provide access to both the north and south exit stairs.

- There are 3 pairs of male and female restrooms in the building, 1 on the first floor and 2 on the second floor. None of the restrooms are ADA compliant. There are no stalls with a minimum dimension of 5'x5' or a 5' diameter floor area for a wheel chair turning radius.

  If any major remodel work was to take place in this building, it may be required to add an ADA accessible bathroom or remodel one of the exiting bathrooms to be ADA compliant.

- The second floor of the building is not accessible. There are two central stair cases and two exit stair wells that access the second floor, but there is no means for a person in a wheel chair to access the second floor. The Expo '74 drawings show a future elevator pit, but an elevator was never installed.

  If any major remodel work was to take place in the building, it may be required that an accessible route to the second floor be added. The code does allow an exception if the cost of providing the accessible route exceeds 20 percent of the cost of the alterations or affects an area of primary function.

Building Conditions

- The roof over this building is a mid sloped roof with what appears to be a spray on roofing system. From information provided by Dave Randolph, the spray on roofing system has a foam base. The spray on roofing system looks to be well past the end of its useable life. Signs of cracking, discoloration, peeling and build up of grime are visible over the entirety of the roof (see Photo 2-3). From visual evidence on the interior of the building and information provided by Riverfront Park maintenance staff, the spray on roofing system has failed in many places, allowing water to penetrate into the interior of the building.

  We would recommend that the existing spray on roofing system be stripped down to the structure and a new roofing system be installed to prevent further water damage to the interior of the building. We would also recommend that an investigation be done to determine the extent of the water damage to the interior.

- At the joint between the parapet wall and the concrete roof located on the west side of the building at the low end of the roof slope, it appears that water is leaking through this joint (see Photo 2-2). There is mineral staining and discoloration to the concrete at multiple spots along the length of this joint

- We recommend installation of a new roofing system that wraps up the parapet wall to prevent water from penetrating this joint.

- All the exterior windows installed in this building appear to be single pane windows. This system does not meet current energy code requirements.

  In the event of a remodel, it may be required that these single pane windows be replaced in order to meet current energy code requirements.

2.3 Mechanical

Critical Issues

- Code requirements for refrigerant detection, room ventilation, emergency purge mode, and exiting should be reviewed. Refrigerant leakage monitoring and emergency ventilation should be installed as a leak could cause a dangerous condition for personnel in the room.
- The size and/or occupant load of this building may require that a fire sprinkler system be installed.

Short Term Issues

- None.

Long Term Issues

- The existing Trane water chiller was installed in the mid 1970's. It is functioning but the age of the unit exceeds the service life (20 years) for this type of equipment. Replacement is recommended.
- The existing cooling tower was installed in the mid to late 1970's. It is functioning but at the time of this report had significant water leaks. Maintenance personnel pointed out that the leaks usually stop over a period of time, probably due to lime deposits at the point of leakage. The age of the unit exceeds the service life (20 years) for this type of equipment. Replacement is recommended.
- The two existing Bryan flex-tube water boilers were installed in 2000 and one of the fire boxes was replaced in 2011. The units use natural gas fuel. Service life for this type of equipment is usually 25 to 30 years, but there is no chemical treatment system on these units and the condition will tend to deteriorate more rapidly than normal as attested to by the need to replace a firebox after only 11 years of use. Exiting from the boiler room to meet current code should also be reviewed.
- The existing heating and cooling system air handling unit was installed in the mid to late 1970's. The age of the unit exceeds the service life (25 years) for this type of equipment. Replacement is recommended. The main building air handling unit received a new cooling coil in 2009.
- The kitchen hood exhaust system appears to be adequate and the fire suppression system was inspected and passed in April of this year. The roof mounted exhaust fan for the hood is old (exact age unknown – no labeling on the unit) and replacement is recommended. There is no direct make-up air system for the kitchen. A make-up system is required by code.
- The existing temperature control system is a pneumatic type. The pneumatic controls date from the mid to late 1970's and replacement with a direct digital type control system is recommended.

2.4 Electrical

Critical Issues

- Stored materials in the electrical rooms (i.e. vending machines, concessions products, rubbish, etc.) obstructing the required working clearances.
- There are an insufficient quantity of appropriately configured self-illuminated exit signs to facilitate proper exiting. The existing self-illuminated exit signs utilize either incandescent or fluorescent lamp technology and are of a mixture of colors (RED and GREEN). Additional signs are required and the existing signs should be replaced with new LED type signs of a consistent color.
- Emergency lighting consists primarily of emergency lighting units and fixtures with integral emergency battery packs. These units appear to have exceeded anticipated service life of 3 to 5 years. There is an insufficient quantity of such units to provide the required illumination of means of egress.

- Quantity and placement of audible/visual fire alarm notification appliances is insufficient to comply with ADA requirements.
- Quantity and placement of fire alarm initiating devices (smoke and detectors) is insufficient to comply with applicable code.

Short Term Issues

- Inadequate labeling of electrical distribution equipment and missing or incomplete circuit directories inhibit ongoing maintenance activities. Appropriate labeling and complete circuit directories should be provided.
- Replacement of distributed battery power self-illuminated exit signs and emergency lighting units with a UL924 listed lighting inverter is recommended. This will centralize maintenance and allow for programmed self-diagnostics and testing.
- As indicated in the previous report, the electrical panels in the main concession kitchen are compromised by grease infiltration and should be replaced. These panels are partially recessed into the wall further impinging upon working clearances.
- As indicated in the previous report, the main service switchboard rated at 1600A, 480Y/277V does not have ground-fault protection, which while not required at the time of construction is now required by NEC.

Long Term Issues

- As indicated in the previous report, the working clearance between the main switchboard and the adjacent distribution switchboard are insufficient to meet code and represent a potential hazard for safe maintenance and operation. Replacement of the fusible switch assemblies in this and the adjacent switchboard section with circuit breakers may allow all devices to populate the adjacent (unobstructed) section.
- Replacement of distributed battery power self-illuminated exit signs and emergency lighting units with a UL924 listed lighting inverter is recommended. This will centralize maintenance and allow for programmed self-diagnostics and testing.

2.5 Photos

Administration Building – Photo 2-1

Administration Building – Photo 2-2

Administration Building – Photo 2-3

SECTION 3
EAST PAVILION BUILDING

Section 3 East Pavilion Building

3.1 Structural

Description of Structure

The East Pavilion Building is a multi-level cast-in-place concrete building that occupies the majority of the southeast corner of the original Pavilion facility. The eastern exterior walls are cast-in-place concrete and were a part of the original 1973 Pavilion structure. They continue to act as the foundation anchorage for the cable net structure. The remaining exterior walls are constructed of fractured fin CMU. They appear to be a part of a later addition. There are isolated locations within the building where cast-in-place concrete beams and columns can be viewed. In the absence of any construction drawings, it is impossible to thoroughly describe the interior framing systems.

Structural observations of the East Pavilion Building were made by Tim Graybeal, P.E. in the afternoon of April 19, 2012. Observations and assessment were performed in accordance with ASCE 11 guidelines for preliminary condition evaluation and recommendations. Interior observations were made by flashlight with viewing distances from 5 to 25 feet. The construction drawings provided for this facility were created by Naramore Bain Brady & Johanson and dated 1973. They describe the first iteration of construction and do not represent the current building.

Executive Summary

- A structural conditions survey of the interior framing of this building is not feasible due to the interior "Haunted House / Maze" build out, the lack of building lighting and the lack of current drawings. Building lighting should be restored and current building drawings located.
- There is evidence of water intrusion throughout the interior of the building. This can cause significant structural deterioration and decay if left alone. A full interior structural assessment should be made prior to opening the facility to the public.
- A water tight roof should be added to this facility as soon as possible.
- Exterior building walls and roof appear structurally sound with only minor cracking typical of this type and age of construction.

Observations

Observation began at the east side of the facility, outside the Pavilion structure. The east walls of the building are formed by the original concrete structure known as the Theater Building. The concrete walls and piers were discolored with minor cracking observed throughout.

Roof access was gained from the east side lawn. The building roof was severely worn, exposing the underlying structure in approximately half the roof area. The exposed cast in place concrete structure was dry. Minor cracking was observed throughout the roof slab.

Interior observation began at the west facility entrance, in the building lobby. The light through the exterior windows and doors allowed viewing of the ceiling and interior walls. Interior walls were non-structural partition walls while exterior walls appeared to be CMU. Walls and ceiling were painted. The finished ceiling in this space was a rough and irregular coating spray applied to the bottom of the structure. The coating was painted brown and was covered with white stains throughout. In isolated locations the ceiling coating was missing, exposing cracks in the concrete structure above. The concrete adjacent to the cracks appeared to be damp (see Photos 3-1 and 3-2).

Access further into the interior of the building was made by way of a winding stair that led out of the north side of the lobby. There was no interior lighting in the building which made observation very difficult. At several locations, buckets partially filled with water were noted along the edge of the walkway. The access hallway ended at a doorway to the main portion of the facility.

The main interior portion of the facility has been built out in a Haunted House maze. Due to the lack of interior building lighting and the viewing obstructions created by the maze walls and ceiling decorations, no interior structural observations could be made.

Discussion and Recommendations

The exterior building walls and roof appear structurally sound with only minor cracking typical of this type and age of construction. The roof structure observed also appears structurally sound. The roof slopes significantly to the west which has helped shed water quickly, avoiding moisture infiltration across the unsealed surface of the face of the roof.

There is evidence of water infiltration and damage throughout the facility. On the interior of the building, in the Haunted House maze area, there were several locations where the floor coverings were saturated with water. Water was pooled at one location along the east wall (see Photo 3-3). This is a significant structural concern, especially in those areas where wood framing has been used to build out the maze. Organic decay is a process that will continue as long as moisture and oxygen are present. This can create a dangerous situation in a building with intermittent occupancy as framing continues to deteriorate unnoticed.

Although a full walk through of the facility was performed, due to the lack of lighting, the interior build out of the Haunted House maze, and the absence of current building drawings, no assessment of the interior framing is currently possible. We recommend that current building drawings be located and building lighting be restored in order to make an interior assessment feasible. We strongly recommend that this be accomplished prior to allowing any public access to the facility.

3.2 Architectural

Introduction

The construction drawings provided for this facility were created by Naramore Bain Brady & Johanson and dated 1973. They describe the first iteration of construction and do not represent the current building. In the absence of accurate record drawings we are unable to provide a complete code analysis. To complete a proper code analysis, a set of current record documents including any alterations and additions will be needed.

The main portion of the facility is currently unoccupied. A small maintenance shop is located at the ground level. The remainder of the facility has been built out with interior partitions, ceilings and decorations to create a haunted house maze. Based on our conversation with Dave Randolph, this is the only event in the facility and it operates for a short period of time in the fall.

The site investigation was performed using flashlights as there are currently no operable house lights.

Due to the lack of illumination, the absence of as built documents and the configuration of the interior build out, it is not possible to make a full and informed assessment of the code compliance or building condition. Those observations that were possible are noted below.

Code Analysis

We are using the 2009 International Building Code (IBC) with Washington State Building Code Chapter 51-50 WAC Amendments to perform our code analysis.

Based on information in the "Riverfront Park U.S. Pavilion Study" dated June 1997 this building is of Type III – 1-hr. construction and has an A2.1 occupancy based on the 1994 U.B.C. This translates to type III – A construction and an A-1 occupancy in the current 2009 IBC.

Building Code Deficiencies / Questions

- The building is not equipped with any type of house lights. In the event of an emergency, there is no way to illuminate the space to allow people to find their way to the nearest exit. Per code, it is required that the means of egress be illuminated at all times while the building is occupied with a minimum of 1 foot-candle at the walking surface. This can be reduced to 0.2 foot-candle at the walking surface during the use of the Haunted House, as long as the lights are automatically restored to the required illumination level upon activation of the facility fire alarm. The absence of working house lights is a major safety hazard to staff and occupants, as well as a non-compliant code issue. We recommend that this issue be addressed immediately.

- With the exception of the lobby, the building is not handicap accessible. The stair case that forms the entrance to the haunted house prevents access to the majority of the building.

  In the event of a remodel, it may be required that a handicap accessible route to all of the primary functions be added. The code does allow an exception if the cost of providing an accessible route exceeds 20 percent of the cost of the alterations or affects an area of primary function.

Building Conditions

- The wood floor system near the east wall of the building located at the back of the camping scene area looks to have a significant amount of water damage. As I stepped off of the main path to look at an area of pooled water, the floor support shifted under my weight (see Photo 3-3). After further examination of this spot, the wood floor was saturated and flexible. This condition, and the potential of others like it, is a safety hazard.

  We recommend that further structural investigation be done to determine the extent of the water damage to the wood floor.

- The roof over this building is a low sloped roof with exposed, bare concrete. There are some visible remains of what appears to be a spray on roofing system, although based on the water infiltration noted on the interior of the building, the system has completely failed (see Photos 3-4 and 3-5).

  We recommend that the existing spray on roofing system be stripped down to the structure and a new roofing system be installed to prevent further water damage to the interior of the building. We also recommend that an investigation be done to determine the extent of the water damage to the interior.

3.3 Mechanical

Critical Issues

- Existing wet fire sprinkler system is in place but due to multi-level, overlapping interior ceilings, there are locations within the building that do not have adequate coverage from the sprinkler heads.
- There is a leaking steam pipe in the main mechanical room. This is a potential source of injury to people in that room. It may also be indicative of additional failures in the piping and valves for the steam system.

Short Term Issues

- As stated in a previous report, the fan bearings on the air handling unit have now reached or exceeded their service life. Failure would cause immediate and complete loss of the ventilation system.
- Current code requires an emergency shutdown switch at all exits from boiler rooms. The switch interrupts the power supply to the boiler and associated equipment, including the gas supply, and prevents additional fuel being supplied to the room in the event of an emergency.
- There is no water treatment for the steam make-up water system. Boiler life would be extended with the installation of a treatment system.
- There is a leak in the steam piping between the East Pavilion and the changing rooms at the Ice Rink. The steam supply has been valved off and, as a result, there is no heat in the changing rooms.

Long Term Issues

- The existing Trane water chiller was installed in the mid to late 1970's. It is not functioning and hasn't for at least 15 years. The age of the unit exceeds the service life (20 years) for this type of equipment. Replacement is recommended.
- When the chiller system is placed in operation, code requirements for refrigerant detection, room ventilation, emergency purge mode and exiting should be reviewed. Additional refrigerant leakage monitoring and ventilation will be required and additional exiting may be required.
- The existing Peerless low pressure steam boiler is a functional sectional cast iron type using natural gas fuel. It is 15 to 20 years old. Service life for this type of equipment is usually 25 to 30 years but there is no chemical treatment system on this unit and the condition of the equipment appears to be marginal.
- The existing heating and cooling system dual duct air handling unit was installed in the mid to late 1970's. The age of the unit exceeds the service life (25 years) for this type of equipment. Replacement is recommended.
- The existing temperature control system is a combination of a pneumatic type and a direct digital control system. The pneumatic controls date from the mid to late 1970's and replacement with a direct digital type control system is recommended.

3.4 Electrical

Critical Issues

- The electrical equipment spaces do not appear to be adequately protected from the elements. Plywood scraps are used to close openings above switchboards. There is evidence of water ingress into electrical spaces and equipment. Appropriate measures should be made to ensure these spaces are weather-tight.
- Missing covers on switch and outlet boxes and pulling ells represents an immediate hazard of shock, fire, or electrocution.
- Missing panel dead-fronts and switchboards filler panels results in an incomplete electrical enclosure.
- Combustible material (i.e. cardboard) used to close openings left behind when electrical apparatus were removed results in an incomplete electrical enclosure and represents an immediate hazard.
- Debris in the electrical rooms (i.e. pine cones and needles, rubbish, electrical cords, pallets, rags, etc.) obstructing the required working clearances.
- There are an insufficient quantity of appropriately configured self-illuminated exit signs to facilitate proper exiting. The existing self-illuminated exit signs utilize either incandescent or fluorescent lamp technology and are of a mixture of colors (RED and GREEN). Additional signs are required and the existing signs should be replaced with new LED type signs of a consistent color.

- Emergency lighting consists primarily of emergency lighting units and fixtures with integral emergency battery packs. These units appear to have exceeded anticipated service life of 3 to 5 years. There is an insufficient quantity of such units to provide the required illumination of means of egress.
- Parabolic reflector lamp is dangling from track head by socket wiring directly above public entrance lobby.
- Replace rusting and inadequately unsupported conduits on the exterior ramp and upper platforms.
- Quantity and placement of audible/visual fire alarm notification appliances is insufficient to comply with ADA requirements.
- Quantity and placement of fire alarm initiating devices (smoke and detectors) is insufficient to comply with applicable code. Access to existing initiating devices which might exist is obstructed by the "layering" of ceilings and compartments within the overall larger volume of the Exhibit Hall.

Short Term Issues

- Inadequate labeling of electrical distribution equipment and missing or incomplete circuit directories inhibit ongoing maintenance activities. Appropriate labeling and complete circuit directories should be provided.
- Corroded electrical enclosure and outlet box covers are evidence of recurring and prolonged moisture problems. The interiors of electrical equipment were not investigated for signs of corrosion. A thorough inspection of the interior of all equipment is recommended.
- Replacement of distributed battery power self-illuminated exit signs and emergency lighting units with a UL924 listed lighting inverter is recommended. This will centralize maintenance and allow for programmed self-diagnostics and testing.
- As indicated in the previous report, there is a small 120/240V, 1-phase natural-gas/propane-fired engine generator set which had been used, under the original construction or Post-Expo renovation, for emergency lighting. This generator is no longer operational and the fuel gas supply valve is closed. Lack of use indicates that this equipment has not been regularly maintained or tested for some time.
- As indicated in the previous report, the main service switchboard rated at 1600A, 480Y/277V does not have ground-fault protection, which while not required at the time of construction is now required by NEC.

Long Term Issues

- Load centers are a residential/light commercial grade product due to the absence of a dead-front enclosure. Load center should be replaced with commercial panel boards.
- Replace existing light fixtures utilizing T12 fluorescent lamps with T8.

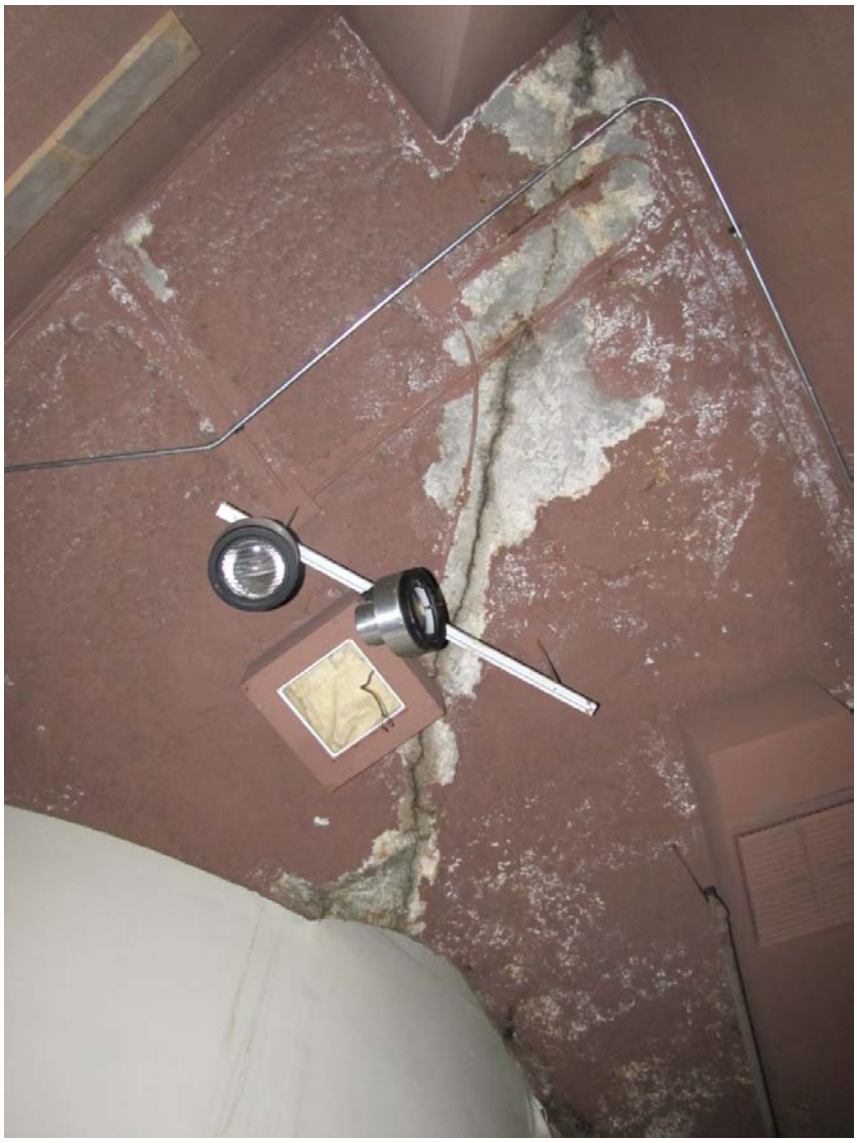
3.5 Photos

East Pavilion – Photo 3-1

East Pavilion – Photo 3-2

East Pavilion – Photo 3-3

East Pavilion – Photo 3-4



East Pavilion – Photo 3-5

SECTION 4
ICE RINK ROOF

Section 4 Ice Rink Roof

4.1 Structural

Description of Structure

The Ice Rink roof structure is an open structure consisting of a kidney shaped roof supported by clear span steel tube trusses on steel pipe columns. Pipe columns are approximately 11 inch diameter and are spaced along the perimeter of the roof at approximately 45 feet on center. Roof trusses are composed of HSS square bottom and top chords with steel pipe web members. All visible truss connections are welded. Roof trusses have a shallow arch across their span of approximately 135 feet.

The roof deck is supported by roof joists spanning between the main roof trusses. Neither the roof deck nor the roof joists can be clearly identified due to the coating material that has been applied to the bottom surface. A soffit is framed across the entire underside of the roof deck using c-shaped light gage channels.

Structural observations were made by Tim Graybeal, P.E. on the morning of April 19, 2012. Observations and assessment were performed in accordance with ASCE 11 guidelines for preliminary condition evaluation and recommendations. A full structural analysis is beyond the scope of this report. No design or construction documentation was available for review. Observations were made from ground level with viewing distances of 5 to 30 feet. Observations were limited to visible structure only. No material testing was performed as a part of this evaluation.

Executive Summary

- A close visual inspection of the upper portion of the main roof trusses, the roof joists and roof deck should be made to observe and document their condition. The roof undercoating should be checked to determine the presence of trapped moisture.
- One column on the north side of the structure appears to have been partially buried in fill material. This material should be pulled back, the soundness of the column verified, and a below grade corrosion inhibitor applied to the steel.
- In the absence of design documentation, a structural analysis should be performed to verify the adequacy of the structure to resist code prescribed lateral forces (typically wind and seismic forces).

Observations

Pipe columns appear freshly painted and showed no signs of deterioration or damage. A concrete base (see Photo 4-1) was observed at the bottom of all the columns except one located on the north side of the structure (see Photo 4-2). This column appears to be surrounded by fill material that has covered the concrete base.

Roof trusses were visible along the bottom two thirds of their depth. No damage or deterioration was observed.

Roof joists and deck are covered by a coating material similar to cellular soundproofing. This covering hides the type and configuration of both the joist and deck. Intermittent white patches on the dark green coating material were observed from the ground.

The architectural soffit framing has numerous locations where the channels have been bent down. The fascia around the roof has numerous locations where patches have been made. These are typically located around roof overflow drains (see Photos 4-3 and 4-4).

Section 4 Ice Rink Roof

Discussion and Recommendations

The primary structure appears to be in good condition. All visible elements were free from obvious damage or deterioration. Those primary elements that were not visible but should be considered are noted below. The damaged soffit material is not structural in nature.

One column on the north side of the structure appears to be buried in fill. The fill material can trap moisture and hide corrosion. We recommend removing the fill material, verifying the soundness of the column and coating the steel with a below grade corrosion inhibitor.

The top chord of the main trusses and the roof joist and roof deck were not visible. Their condition is unknown. A close visual inspection should be made of a representative portion of these elements to observe and document their condition.

The roof joist and deck appear to be covered with spray on soundproofing. When exposed to the exterior this material typically absorbs moisture. The white patches on this material may be an organic growth that is feeding off the trapped moisture. The presence of trapped moisture in this coating material should be determined by a close visual inspection.

Lateral forces caused typically by earthquakes and wind must have a viable pathway to exit the structure and enter the surrounding ground. This open structure appears capable of developing frame action in the north-south direction. The east-west direction appears to act as a cantilever column system. While this may be a viable system, we recommend verifying the adequacy of this system through further analysis.

4.2 Photos

Ice Rink Roof – Photo 4-1

Ice Rink Roof – Photo 4-2

Ice Rink Roof – Photo 4-3

Ice Rink Roof – Photo 4-4

SECTION 5
ICE RINK SUPPORT BUILDING

Section 5 Ice Rink Support Building

5.1 Structural

Description of Structure

The Ice Rink Support Space is an irregularly shaped single-story structure that fills the northeastern corner of the Pavilion site. The building contains an array of spaces primarily used for storage. There are also restrooms and mechanical space. The structure is a cast-in-place concrete roof slab supported by a mix of cast-in-place concrete and CMU walls. The roof also acts as the floor of an exterior plaza overlooking the Ice Rink below.

On the afternoon of April 19, 2012 Tim Graybeal, P.E., made structural observations of the Ice Rink Support Space. Observations and assessment were performed in accordance with ASCE 11 guidelines for preliminary condition evaluation and recommendations. A full structural analysis is beyond the scope of this report. No design or construction documentation was available for review. Observations were made from ground level with viewing distances of 5 to 10 feet. Observations were limited to visible structure only. No material testing was performed as a part of this evaluation.

Executive Summary

- There is evidence of water damage throughout the interior of this building. Steps should be taken in the near term to seal the roof slab and concrete joints in order to prevent further deterioration and decay.
- Damage to the CMU coiling door jamb should be repaired and some measure of additional protection added—corner guards or a bollard.

Observations

The majority of the roof slab concrete is exposed to the weather. A grey applied surfacing material has worn through and remains in only sporadic patches (see Photo 5-1). Concrete surface is sound though minor cracking and some surface spalling is observed throughout the slab.

Exterior walls appear sound, though minor cracking is observed throughout. At the west wall adjacent to the roll up door, impact damage was observed at the CMU door jamb (see Photo 5-2).

Interior rooms exhibit no signs of structural damage, however evidence of water intrusion is noted throughout. Evidence of water intrusion includes white staining on the surface of the concrete consistent with mineral deposits, dark staining of the ceiling tiles, organic growth on the walls and ceiling, and a significant dank and musty smell throughout.

Discussion and Recommendations

The main structure appears sound. There is no significant evidence of damage. The CMU should be repaired at the damaged door jamb and some measure of additional protection provided for the structure.

There is significant water intrusion into this area. This infiltration can lead to structural damage through water expansion during freeze thaw cycles or from the expansion of the reinforcing during corrosion. Steps should be taken in the near term to seal the roof slab and concrete joints in order to prevent further deterioration and decay.

5.2 Mechanical

Critical Issues

- Code requirements for refrigerant detection, room ventilation, emergency purge mode and exiting should be reviewed. Refrigerant leakage monitoring and emergency ventilation should be installed as a leak could cause a dangerous condition for personnel in the room.

Short Term Issues

- None.

Long Term Issues

- The existing electric domestic water heater was installed in 2005. The service life is 10 to 15 years. Replacement is at least 3 to 5 years away.
- An instantaneous water heater was installed in 2012 for the Zamboni. The service life and expected time to replacement is at least 10 to 15 years.
- The ice making chiller has two reciprocating compressors. One is being rebuilt at the time of this report. The other was rebuilt about 10 years ago. Service life for a new compressor is 10 years but may be somewhat shorter for re-built units. The 10 year old compressor appears to be in satisfactory condition. Replacement is not required at this time.
- The plumbing fixtures in the public toilet rooms are an older style with higher flow rates than are allowed by current code. “Low flow” fixtures for water closets (toilets), urinals and sink faucets are now a code requirement.
- Also, most of the plumbing fixtures in the public toilet rooms are china and subject to vandalism. The sinks are metal and less prone to damage. Replacement of the china fixtures with “prison grade” fixtures would increase usable life.
- There are no toilet or shower facilities in the changing rooms at the Ice Rink.

5.3 Electrical

Critical Issues

- Add GFCI protected outlet at score keepers’ booth for scoreboard controller. An extension cord in this application results in a potential shock hazard.
- The existing LED flood lights at the base of the pavilion "mast" have been damaged by vandalism and require repair or replacement.
- Water leakage resulting in staining of locker room ceilings and accumulation of a white powdery substance.
- Interior grade flush service electrical outlet used in outdoor application violates UL listing. Removal of the wiring device and associated wiring back to the source will remedy.

Short Term Issues

- The existing switching pattern above the Ice Rink area is irregular due to previous undocumented wiring revisions. An updated lighting control scheme which provides pattern switching and daylight harvesting capabilities is recommended.
- Replacement for failed and abandoned lighting fixtures on ramp.

Long Term Issues

- Remove abandoned/disabled scoreboard.

5.4 Photos

Ice Rink Support – Photo 5-1

Ice Rink Support – Photo 5-2

SECTION 6
IMAX BUILDING

Section 6 IMAX Building

6.1 Structural

Description of Structure

The IMAX Building is a single-story, flat roof building that surrounds a two-story circular theater. The exterior walls of the single-story structure are cast-in-place concrete. The low roof framing is not exposed. The two-story theater appears to be a single-story, circular concrete ring base with precast, single tee wall panels, placed stems out, on top of the ring to form the second story. In the absence of design or construction documentation, the remaining framing elements are unknown.

On the afternoon of April 19, 2012, Tim Graybeal, P.E. made structural observations of the IMAX Building. Observations and assessment were performed in accordance with ASCE 11 guidelines for preliminary condition evaluation and recommendations. A full structural analysis is beyond the scope of this report. No design or construction documentation was available for review. Observations were made from ground level with viewing distances of 5 to 15 feet. Observations were limited to visible structure only. No material testing was performed as a part of this evaluation.

Executive Summary

The top of the exterior walls show significant weathering and deterioration. We recommend removing and repairing the deteriorated concrete at the top of the exterior walls. In addition, a sloping metal parapet cap should be provided.

Observations

No structure is visible on the interior of the facility.

Exterior concrete appears sound with minor cracking noted throughout. However, the top of the exterior walls show significant weathering and deterioration. The concrete at one location along the southwest wall has deteriorated and fallen away, exposing the top layer of horizontal reinforcing (see Photos 6-1 and 6-2).

The theater framing appears sound with no evidence of damage or deterioration. A portion of the high roof flashing has been torn away from the wall and is hanging loose (see Photo 6-3).

The northwest exit door has a large spall missing from the exterior corner of the door opening (see Photo 6-4). The surface of the spall has been painted, indicating that it occurred prior to the last repaint.

Discussion and Recommendations

Exterior concrete walls show significant weathering and deterioration. This process can lead to structural damage through water infiltration and corrosion of the concrete reinforcement. We recommend removing and repairing the deteriorated concrete and providing a sloping metal parapet cap to eliminate the possibility of water standing on the top surface of the parapet.

6.2 Architectural

Code Analysis

We are using the 2009 International Building Code (IBC) with Washington State Building Code Chapter 51-50 WAC Amendments to perform our code analysis.

Section 6 IMAX Building

Drawings for the IMAX Building were not available to Integrus Architecture for the condition assessment. Due to the lack of record drawings we will not be able to determine many of the code compliance or deficiencies issue. To complete a proper code analysis and determine code compliance or deficiencies issues associated with this building a set of current record document with any alterations and additions will be needed

Based on information in the "Riverfront Park U.S. Pavilion Study" provided by Integrus Architecture, P.S. and dated June 1997, this building is of Type III – 1-hr. construction and has an A2.1 occupancy based on the 1994 U.B.C. This translates to type III – A construction and an A-1 occupancy in the current 2009 IBC.

Building Code Deficiencies / Questions

- Exit doors located on the exterior of the north and south walls of the building have devices installed that disable the function of the panic hardware on the egress side. These doors serve as an emergency exit for the IMAX Theater and the disabled function of the panic hardware is in direct violation of the code. These devices should be removed to allow the panic hardware to function properly.

- We were unable to determine the occupant load for this building based on the square footage of spaces, but during the site investigation a sign posted in the lobby of the IMAX Theater stated that the theater area and the lobby together have a maximum occupancy of 420 people. Determining the occupant load for the building is required to determine the number of exits required, exit width, and required plumbing fixtures.

  The maximum occupancy sign does not include support space and therefore does not give us an exact occupant load to perform a complete analysis. Current record drawings will be needed to perform a complete analysis.

- Based on information from the "Riverfront Park U.S. Pavilion Study" dated June 1997, the IMAX Building was added to the Administration Building, formerly ECC Bldg, sometime after Expo '74. From visual observation, there is no sign of separation between these two building. The doors between the IMAX lobby and the Administration lobby were not UL listed and there appeared to be no continuous fire wall separating the two buildings. This would lead us to conclude that the IMAX addition and the Administration Building is one large building. The code determines maximum allowable building area based on construction type and occupancy. For a building of Type III-A construction and of occupancy A-1 the total allowable building area without increases is 14,000 square feet. The code allows area increases for installing fire sprinklers and separation distance. During the site investigation there were no visible signs of fire sprinklers installed in either building and the building only meets the separation requirements on three sides. These building together seem to exceed the maximum allowable building area.

  The maximum allowable building area should be investigated further. Current record drawing will be needed to complete this work.

- The restrooms located in the lobby of the IMAX Building look to meet the requirement for ADA accessibility based on observation from our site investigation. Both restrooms have a 5'x5' stall and a 5' diameter floor are for a wheel chair turning radius. The male restroom contains 2 water closets, 1 urinal, and 2 lavatories with one water closet being ADA accessible. The female restroom contains 3 water closets and 2 lavatories with one water closet being ADA accessible. The female restroom does not meet the requirement of the current code for the required number of plumbing fixtures. Per the current code for Group A occupancies for females, 1 water closet is required per every 25 female occupant. Based on the maximum occupancy sign, there are 420 occupants, half of which are assumed to be female, giving us 210 female occupants. When we divide 210 by 25 we get 9 required water closets for females. The current female restroom only contains 3 water closets, which is 6 less than required.

If any major remodel work is to take place in this building, additional fixtures may be required to bring the building up to code.

Building Conditions

- The high roof over the circular portion of the building is sloped roof with a membrane roofing system and from information provided by Dave Randolph carries a 30 year warranty. The membrane roofing system looks to be recently installed and the membrane itself looks to be in very good shape no sign of weathering, discoloration or buildup of grime is visible. But, at the low end of the slope on the east side of the building, the metal flashing has been ripped off or folded back over itself. Dave Randolph stated that the damage to the flashing was due to snow sliding off of the roof (see Photo 6-5).

- We would recommend removing the existing flashing and replacing it in a manner that allows the snow to slide off the roof without catching on the metal flashing. Any measure taken will need to be coordinated with the entity that holds the roof warranty to make sure that revisions to the flashing do not void the roof warranty.

- The low roof over the remainder of the building is a low sloped roof with what appears to be a spray on roofing system. This spray on roofing system looks to be well past the end of its useable life. Signs of cracking, discoloration, peeling and build up of grime are visible over the entirety of the roof (see Photo 6-6). From visual evidence on the interior of the building the spray on roofing system has failed in many places, allowing water to penetrate into the interior of the building.

  We would recommend that the existing spray on roofing system be stripped down to the structure and a new roofing system be installed to prevent further water damage to the interior of the building. We would also recommend that an investigation be done to determine the extent of the water damage to the interior.

- Paint at the base of the circular portion of the building is peeling leaving the concrete exposed and unsealed (see Photo 6-7). If the concrete is left exposed and unpainted, it could allow water to penetrate to the interior of the building causing water damage.

  We would recommend that the paint be stripped down to the bare concrete and be repainted

6.3 Mechanical

Critical Issues

- The size and/or occupant load of the theater may require that a fire sprinkler system be installed.

Short Term Issues

- None.

Long Term Issues

- The existing water chiller was installed in the mid to late 1970's. It is functioning, but the age of the unit exceeds the service life (20 years) for this type of equipment. Replacement is recommended. The compressor is scheduled to be repaired at the time of this report.
- The existing temperature control system is a pneumatic type. The pneumatic controls date from the mid to late 1970's and replacement with a direct digital type control system is recommended.
- The existing heating and cooling system air handling unit was installed in the mid to late 1970's. The age of the unit exceeds the service life (25 years) for this type of equipment. Replacement is recommended.

6.4 Electrical

Critical Issues

- Missing covers on switch, outlet, and junction boxes represents an immediate hazard of shock, fire, or electrocution.
- Repair inadequately unsupported conduits on the roof and site area west and north of the IMAX theatre.
- There are an insufficient quantity of appropriately configured self-illuminated exit signs to facilitate proper exiting. The existing self-illuminated exit signs utilize either incandescent or fluorescent lamp technology and are of a mixture of colors (RED and GREEN). Additional signs are required and the existing signs should be replaced with new LED type signs of a consistent color.
- Emergency lighting consists primarily of emergency lighting units and fixtures with integral emergency battery packs. These units appear to have exceeded anticipated service life of 3 to 5 years. There is an insufficient quantity of such units to provide the required illumination of means of egress.
- Repair or replace failed lamps in step lighting fixtures in the IMAX theatre.
- Quantity and placement of audible/visual fire alarm notification appliances is insufficient to comply with ADA requirements.
- Quantity and placement of fire alarm initiating devices (smoke and detectors) is insufficient to comply with applicable code. Access to existing initiating devices which might exist is obstructed by the "layering" of ceilings and compartments within the overall larger volume of the Exhibit Hall.

Short Term Issues

- The adequacy of emergency illumination in the IMAX theatre is unknown. The emergency lighting in the theatre does not appear to be interfaced with the fire alarm system to automatically illuminate the means of egress upon activation of the fire alarm system. An automatic interface is recommended.

Long Term Issues

- The existing IMAX theatre lighting fixtures (above the seats) are difficult to access for routine lamp replacement and a suitable lift is not readily available. Replacement of the existing lighting fixtures with new dimmable, long-life, low-maintenance light fixtures (i.e. LED) is recommended.
- The existing low intensity step lights (illumination of the means of egress) appeared to be failing in certain areas. It is unclear the extent to which these lights can be controlled.
- The existing lighting control system for the IMAX theatre system will likely require replacement to support new LED lamp technology and fire alarm interface.
- Facade lighting mounted to the roof and parapet wall around the IMAX theatre are low wattage metal-halide (MH) and have poor efficacy, lamp life, and color-rendering index. These fixtures also appear to be subject to periodic vandalism. Replacement of these light fixtures with appropriately vandal-resistant LED flood lights is recommended.

6.5 Photos

IMAX – Photo 6-1

IMAX – Photo 6-2

IMAX – Photo 6-3

IMAX – Photo 6-4

IMAX – Photo 6-5

IMAX – Photo 6-6

IMAX – Photo 6-7

SECTION 7
PAVILION CABLE NET STRUCTURE

MAGNUSSON
KLEMENCIC
ASSOCIATES

May 31, 2012

Mr. Tim Graybeal
Integrus Architecture
10 South Cedar
Spokane, Washington 99201

Subject: **Pavilion Structural Assessment**
Riverfront Park
Spokane, Washington

Re: Assessment of Pavilion Cable Net Structure

Dear Tim:

Attached please find Magnusson Klemencic Associates' report on the condition of the Riverfront Park Pavilion Cable Net Structure. This report is based on a review of the original documents and site observations performed on April 19, 2012.

No conditions were observed that constitute an immediate safety hazard. We believe that the structure is in a suitable condition to remain in place provided appropriate maintenance measures are taken.

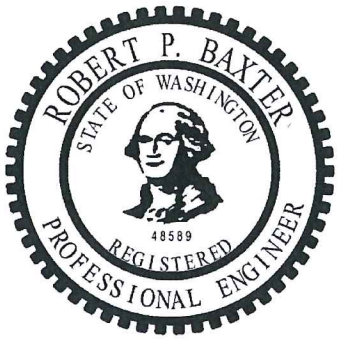
Please contact me if you would like to discuss any aspect of the report.

Sincerely,

Magnusson Klemencic Associates, Inc.

RBaxter

Robert P. Baxter
rbaxter@mka.com



RPB/dah

Attachment

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Structural + Civil Engineers
1301 Fifth Avenue, Suite 3200 Seattle, Washington 98101-2699
T: 206 292 1200 F: 206 292 1201 www.mka.com

Section 7 Pavilion Cable Net Structure

7.1 Structural

Description of Structure

The Pavilion Roof at the Spokane Riverfront is an exposed steel and cable tension structure that was constructed in 1973 for Expo '74 World's Fair Spokane. The structure consists of a Mast, Ties, Cable Net, Arch Truss and Cable Anchorages. The structure was originally covered with fabric that has since been removed.

Magnusson Klemencic Associates (MKA) in collaboration with Integrus Architecture performed a limited review of the existing structure. The purpose of the review was to evaluate the condition of the existing structure to identify any immediate structural safety issues and establish what conditions may require maintenance or repair to extend the useful life of the structure. Structural observations were made by Robert Baxter, P.E. on April 19, 2012.

Observations and assessment were performed in accordance with ASCE 11 guidelines for preliminary condition evaluation and recommendations. MKA reviewed the original design documents prior to performing the visual observation.

Executive Summary

A complete listing of recommendations is included in the body of this report. A summary of findings is included below.

- Based on this review, it is believed that the structure is in suitable condition to remain in place provided that appropriate maintenance measures are taken.
- No conditions were observed that are critical in the sense of immediate safety.

Observations

MKA performed a review of the available structural drawings of the existing structure. During this review, the primary load path was determined and critical locations for observation noted. Following this review, structural observations were performed on April 19, 2012 with the assistance of a boom-lift truck which provided access to the underside of the crown ring, the cable-net, the tower, and the north and south trusses (see Photos 7-1 through 7-3 for overall layout). The majority of the cable anchorages were accessible from the ground and adjacent roofs.

The intent of the review and observations was to establish the structural condition of the Pavilion Roof, identify any immediate safety issues, and establish what maintenance and repair work might be necessary for the ongoing viability of the facility.

A considerable amount of corrosion has occurred, as evidenced by the visible rust and paint flaking. Corrosion protection of the various parts of the structure was provided by either galvanizing or painting. Galvanizing is a process where steel parts are coated in zinc, which sacrificially corrodes instead of the steel, protecting it. The galvanizing is slowly consumed as it provides this protection. Because the galvanic protection is an electro-chemical process, small breaks in the galvanizing do not compromise the protection of the steel parts. Painting provides protection to steel solely by providing a barrier between the steel and the environment. Once this barrier is broken, corrosion will occur in the exposed steel.

Surface corrosion of steel is not necessarily a structural concern, provided it does not penetrate into the section beyond the surface. However, once surface corrosion occurs, it is only a matter of time before penetration begins.

Considerable effort was spent during the investigation determining whether surface rust, which was widely seen, had begun penetration.

Specific review of the various structural components of the Pavilion follows.

Mast:

The mast is constructed of three columns built up from steel plate and laced together with pipe bracing. These components are painted for corrosion protection. Overall the condition of the mast is good, with minor corrosion observed at many locations on the surface and inside the pipes (evidenced by rust streaks on the paint) but nothing to indicate a structural problem (Photo 7-4). The top of the mast appears sound with minor visible surface rust (Photo 7-5). The top surface of the mast was not observed due to access limitations. However, only minor rust streaks were observed on the sides of the mast top, and the welded on seal-plate per the structural drawings should serve to keep water out. The bearing at the base of the mast shows signs of corrosion around the edge but appears to be in good shape (Photo 7-6).

Crown Ring Hangers:

The Crown Ring Hangers connect the top of the mast to the Crown Ring. These hangers are galvanized wire strand with galvanized clevises and pins. The overall condition of the wire strands and clevises appears excellent with minimal surface discoloration and no broken wires observed. A few pins have evident surface corrosion, apparently due to bolts being welded to the galvanized metal during construction, which compromised the galvanizing (Photo 7-7). However, this does not appear to compromise the integrity of the pins. Slight pull-through was observed at several of the poured clevices. This likely occurred during stressing and is not a structural concern, but does allow water to enter the connections (Photo 7-8). As would be expected with the heavy galvanizing in this area, no signs of significant corrosion were observed.

Crown Ring:

The crown ring has extensive surface corrosion, clearly visible from the ground. This corrosion primarily occurs on the three 10" pipes that run around the ring, with limited corrosion on the 3" pipes that lace these rings together (Photos 7-9, 7-10, 7-11). This is primarily because the 3" pipes are sloped and free-draining, while the 10" pipes are nearly horizontal and have gusset plates connecting to them that impede the free draining of water (Photo 7-12).

The 10" pipes are penetrated by the gusset plates for the Crown Ring Hangers, and for the Cable Net cables. During construction, these slots at these penetrations were welded all around to provide the necessary strength and to prevent the ingress of water.

One location on the crown ring was accessible to MKA. At this location no cracking of these welds was seen, and the water-tightness of the pipes appears to be maintained. All of the visible corrosion was surface rust, with no pitting of the base metal visible and clean metal easily exposed with a wire brush. Garco's rigger was able to make a full circuit of the Crown Ring, and reported no locations with corrosion worse than the location MKA was able to view directly (Photos 7-13 and 7-14) and no cracking at the gusset plate connections.

The crown ring has several non-structural items connected to it, mostly relating to the lighting of the mast (Photo 7-14). At some locations, the connections of these to the ring promote water collection and will initiate corrosion. The upper edge of the original fabric is still connected to the crown ring. This fabric was connected with galvanized turnbuckles and bolts (Photo 7-15). The turnbuckles appear to be generally sound. However, some of the small bolts connecting the turnbuckles to the Crown Ring appear significantly corroded. This is not a part of the primary structure, and a bolt failure would have a strictly local effect.

Overall, the Crown Ring appears to be fundamentally structurally sound.

Cable Net:

The cables in the Cable Net appear to be in excellent condition. Minor surface discoloration was observed, but no corrosion and no broken wires were observed at any location (isolated broken wires are not a major concern in cable structures). At the cable intersections, two types of cable connection occur. The larger "Type A" connection consists of three plates bolted together (Photo 7-16) and forms a structural connection between three cables, determining the form of the net. The smaller "Type B" connection consists of a small plate and a U-bolt (Photo 7-17) and forms a connection between two cables.

Both of these connections appear to have been galvanized. This has provided considerable protection, and while surface rust is apparent, no deep corrosion appears to have occurred. All bolts appear tight and no missing nuts were observed.

Cable Net Anchorages:

The Cable Net anchorages are a simple yet robust design. The cables connect to a clevis on a threaded rod which runs through the top of concrete columns and is anchored on the backside (Photos 7-18 and 7-19). Because the threaded rod runs through an oversized sleeve, water can run inside the sleeve along the rod, but the configuration of the plates at the backside limits the amount of water that will pool.

Approximately two-thirds of the anchorages were accessible. At each of these, the threaded rod extension and anchorage plate displayed considerable surface corrosion but no penetration into the rod or plate was observed. Because the design of the anchorage transfers load to the concrete in compression, minimal cracking of the concrete columns was evident.

Arch Trusses:

To provide open access to the pavilion, Arch Trusses are provided at the north and south sides, allowing Cable Net support columns to be omitted. A 3-5/8 " strand resists the tension loads of the Cable Net, and a curved Pipe Truss consisting of two 8" pipes laced together with 2-1/2" pipes resists perpendicular loads. Each chord of the truss is connected to the strand by a 5/8" wire rope, and the truss is stabilized by flat eyebar outriggers to the Cable Net cables. See Photo 7-2 for layout. The North Arch Truss is largely hidden from view from ground level by the Ice Rink Roof.

The primary load path in the trusses is the Cable Net tension being resisted by the strand, with the Pipe truss being there primarily to minimize deflections due to vertical loading. With the removal of the fabric, the vertical loading is far smaller than was anticipated in the original design.

Minor surface corrosion is visible on the pipe trusses, with no evidence of deep corrosion. The galvanized connections between the cable net and the strand have similar loss of galvanization and surface corrosion as the cable net connectors (Photo 7-20).

The wire rope between the strand and pipe trusses appears to have relaxed over time and is visibly slack in locations (Photo 7-21). The condition of the wire rope itself appears to be good.

At some locations on both the north and south trusses, the eyebars that clamp the cable net and stabilize the truss have buckled (Photo 7-22). At two locations on the North Truss the pin connection between the eyebar and truss was either completely or effectively sheared off (Photo 7-23). The structural drawings indicate that the eyebar outriggers were to be clamped to the Cable Net cable after stressing was completed. However, eyebar lengths were determined prior to stressing and will not necessarily have exactly aligned to the cable slope. It is possible that the force required to deflect the cable after stressing locked considerable force into these bars, and this will have

increased the tendency to buckle. Furthermore, the bar connection points do not always align well with the cables along the length of the truss, inducing moments in these bars. Finally, the pins that connect these eyebars are long, which allows the pin to rotate considerably, causing additional moment in the bars. To sum up, there are several factors that could have caused the eyebars to buckle, none of which necessarily indicate large movements by the truss itself. Furthermore, the eyebars are elements that are provided predominantly for truss stability and are outside the primary load path.

Loose nuts were observed at a clamp connection to the cable on the South Arch Truss.

The connections of the truss and strand to the concrete pylons appear to be in good condition with minimal surface corrosion observed on the plate elements and threaded anchor rods. Some rust staining is observed at the end of the pipe truss due to water entering the pipes through various holes along their length, but the scale of this is not cause for concern. A stiffener detail creates a pocket where material can accumulate (Photo 7-24). Removing this material found no evidence of significant corrosion beneath. The strand clevis pins have surface corrosion, apparently due to the welding on of bolts.

Fabric Support Cables:

The Fabric Support Cables are suspended below the Cable net with turnbuckles. The connection to the Cable Net is by a plate that wraps around the cable and has a single bolt. At some locations the turnbuckle is bent or broken, and at least one turnbuckle body is missing, having assumedly fallen at some point (Photo 7-25). The bolts that connect the turnbuckles to the Cable Net, and the bolts that connect the ends of the Fabric Support Cables to the Crown Ring, Anchorages and Arches are generally small and several of them appear to be significantly corroded.

The cables themselves appear to be in excellent condition with only minor discoloration and no broken wires observed. These cables do not form part of the primary structural system.

Findings

The Pavilion Roof is in surprisingly good shape considering its vintage and limited recent maintenance. No major immediate safety concerns were found. However, corrosion will limit the safe useful life of the structure unless maintenance is performed in the next few years. Recommended maintenance items are discussed below.

Mast:

The mast should be cleaned, any surface rust removed, and painted.

Crown Ring Hangers:

The pins with evident surface corrosion should have this removed and a paint-on galvanizing compound applied.

Crown Ring:

The Crown Ring should be cleaned, any surface rust removed, and painted. Non-structural items that are no longer in use should be removed.

Cable Net:

The Type A and B cable connections have surface corrosion and the galvanizing has been partially consumed at most locations. Ideally each of these connections would be painted or regalvanized, but accessing the connections to carry this out would be problematic. Instead, the connections should be monitored regularly for signs of corrosion

beyond surface corrosion. All cable net clevises at the top and bottom of the net should have the cotter pins that secure the main pins inspected and replaced if corrosion is found.

Cable Net Anchorages:

The cable net anchorages should be cleaned, any surface rust removed, and painted. Further corrosion could be minimized by sealing up the hole where the rod enters the column to prevent water intrusion (see Photo 7-18).

Arch Trusses:

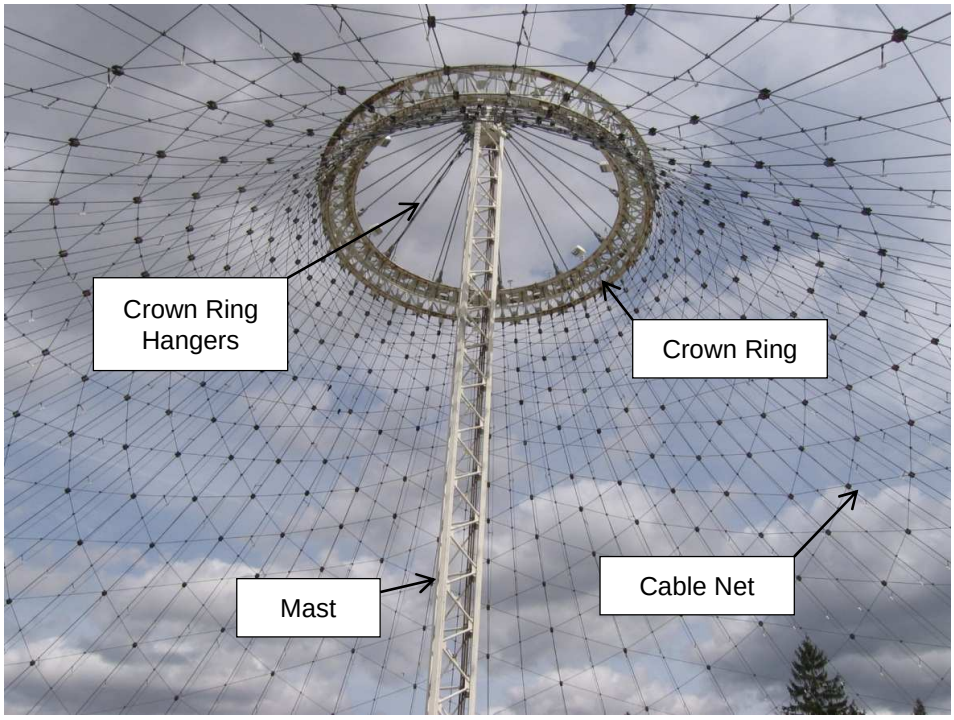
The cable net anchorages should be cleaned, any surface rust removed, and painted. The connections between the cable net and the strand, and the strand to anchorage, should have surface rust removed and a paint-on galvanizing compound applied. The wire rope lacing should be tightened. Where eyebars have buckled or broken free of the pipe truss, they should be replaced and tight-fit pins installed at the eyebar to truss connection. The detail at the anchorage that is collecting material should be covered and sealed. Any loose nuts at the clamp connection between the eyebars and the cable net should be tightened or replaced.

Fabric Support Cables:

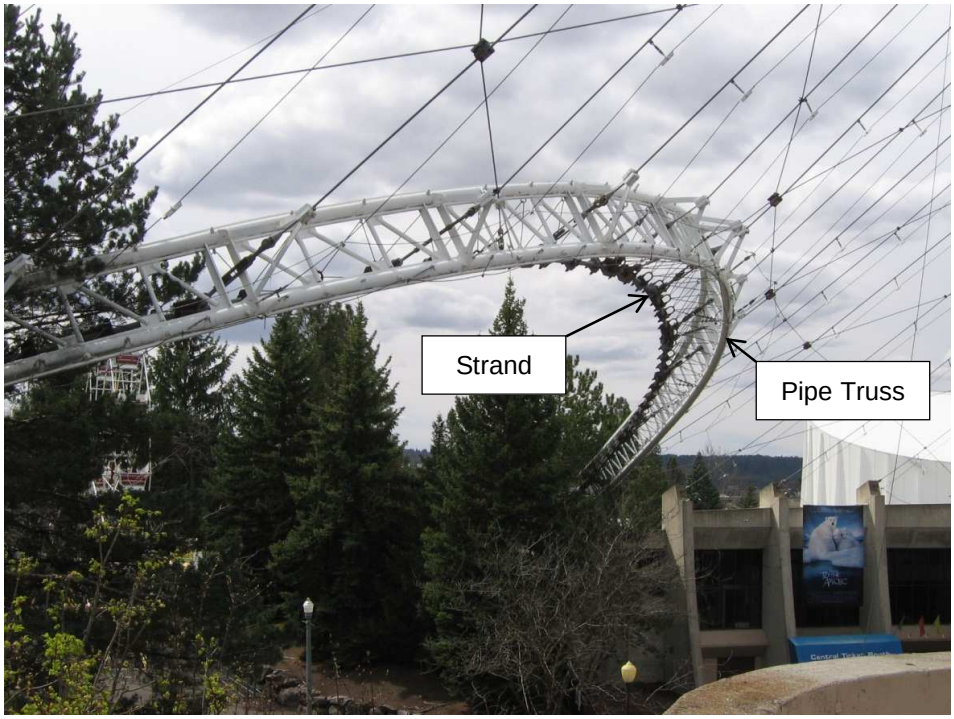
The fabric support cables should be removed, including at the Crown Ring. Corrosion of the fabric supports is fairly advanced at some locations, with rusted bolts and broken turnbuckles apparent. One turnbuckle body is missing and likely fell at some point, which is a potential safety hazard. The cables serve no structural purpose, and their removal will improve the look of the structure.

Existing corrosion and the consumption of galvanizing will increase the potential rate of corrosion. We recommend that the Pavilion Roof be re-inspected at regular intervals for signs of advancing corrosion and potential safety hazards.

7.2 Photos



Pavilion Cable - Photo 7-1 – Mast, Crown Ring Hangers, Crown Ring, Cable Net



Pavilion Cable - Photo 7-2 – Arch Truss

Pavilion Cable - Photo 7-3 – Cable Net Anchorages

Pavilion Cable - Photo 7-4 – Mast detail showing limited surface corrosion

Pavilion Cable - Photo 7-5 – Top of Mast

Pavilion Cable - Photo 7-6 – Bottom of Mast and bearing plates

Pavilion Cable - Photo 7-7 – Crown Ring Hanger corrosion at clevis due to welding on pin

Pavilion Cable - Photo 7-8 – Slight pull-through at clevis

Pavilion Cable - Photo 7-9 – Crown Ring corrosion extent

Pavilion Cable - Photo 7-10 – Crown Ring corrosion detail

Pavilion Cable - Photo 7-11 – Crown Ring corrosion detail

Pavilion Cable - Photo 7-12 – Crown Ring corrosion detail

Pavilion Cable - Photo 7-13 – Crown Ring corrosion detail

Pavilion Cable - Photo 7-14 – Crown Ring corrosion detail and nonstructural items

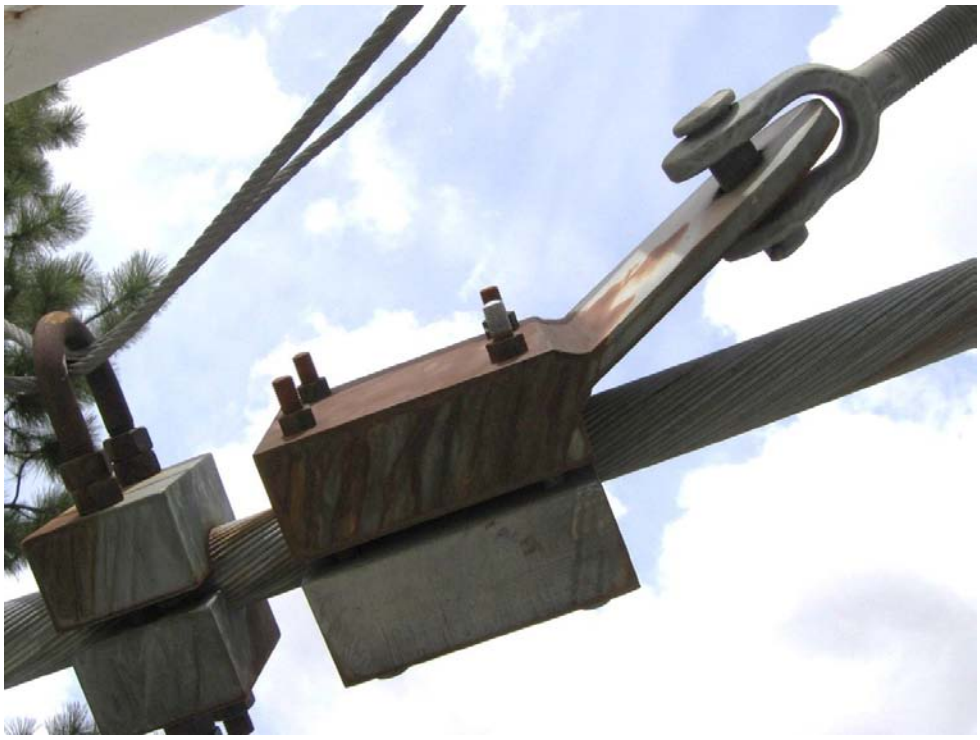
Pavilion Cable - Photo 7-15 – Crown Ring fabric connection

Pavilion Cable - Photo 7-16 – Cable Net Type A connection

Pavilion Cable - Photo 7-17 – Cable Net Type B connection

Pavilion Cable - Photo 7-18 – Cable Net Anchorage front view

Pavilion Cable - Photo 7-19 – Cable Net Anchorage rear view



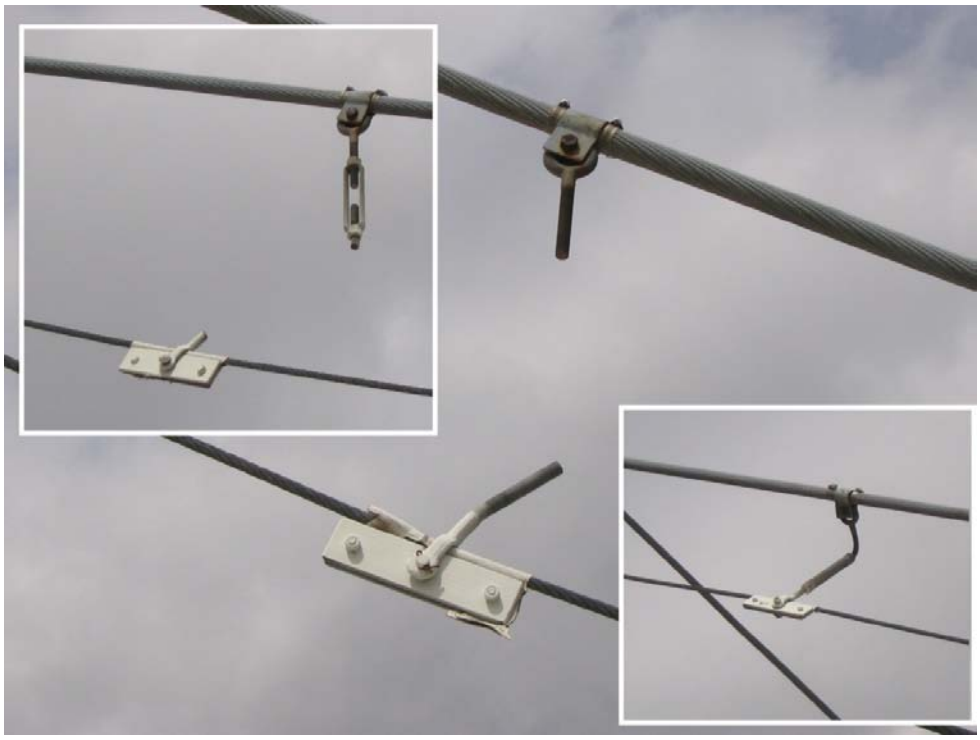
Pavilion Cable - Photo 7-20 – Arch Truss connection – Cable Net to Strand

Pavilion Cable - Photo 7-21 – Arch Truss wire rope lacing

Pavilion Cable - Photo 7-22 – Arch Truss buckled eyebar

Pavilion Cable - Photo 7-23 – Arch Truss missing pin at bottom eyebar

Pavilion Cable - Photo 7-24 – Arch Truss anchorage collecting material



Pavilion Cable - Photo 7-25 – Fabric Support Cable connection failures