

## Exterior Conditions Assessment

### North Elevation

The North elevation of the Hall of Waters contains three different façade systems. First is the pitched face limestone, the second is cut stone, and the third is a color coated formed cast concrete with a stucco skim coat.



Fig. 62 North Elevation (SRJA 2012)



Fig. 63 North Elevation from terrace looking southeast. (SRJA 2012)

Observations made on-site revealed large portions of the limestone mortar joints have failed. The mortar has either separated from the stone or has cracked in the center portions. Additional mortar has flaked off which indicates a shallow surface-applied pointing repair during a previous project (Figure 64).



Fig. 64 North Elevation Deteriorated Mortar Joints. (SEA 2012)

The pitched face stones are experiencing the same deterioration as the East, West, and South façades from moisture infiltration and freeze thaw cycling. The stones have sections that have either de-bonded totally from the face or in a state of partial de-bonding at this time.

In most cases on the North Elevation of the structure the issues concerning the cast stone are mortar joints failures and severe organic staining. Mortar joints are experiencing the same high percentage of failure as noted in the rubble stone façade.

The North Elevation is experiencing the same types of organic and inorganic staining (Figure 65) as found on the East, West, and South Elevations. As this weathering process continues, dust particles and metal deposits are accumulating on the outer surface.



Fig. 65 North Elevation Biological Staining. (SEA 2012)

The cast-in-place concrete façade which encompasses the east end of the north façade has minor deterioration issues. Most of the issues found on this concrete façade are due to corrosion occurring in the reinforcing steel embedded in the concrete. From our observations most of this is occurring due to inadequate cover of concrete over the existing reinforcing steel.



Fig. 66 North Elevation at east end of the building. (SRJA 2012)

Some of the corrosion of the reinforcing bars at these locations may also be attributed to carbonation contamination due to environmental conditions.

In addition to the delamination and corrosion issues of the concrete façade the existing coating that has been applied to the concrete is beginning to de-bond and fall off the face of the building. As the coating ages it becomes brittle due to exposure to the environment and UV rays. When the coating becomes too brittle to move with the expanding and contracting substrate it loses the ability to adhere (Figure 67).



Fig. 67 North Elevation East End. Coating is de-bonding from concrete surface. (SEA 2012)

As with the other elevations of the structure, the windows and door way openings have various stages of steel lintel corrosion issues. All of the lintels in the stone and the stone portions of the building have exposed steel plates. These plates are welded to C channels that are embedded in the stone or cast stone along with the backup material. Corrosion has caused these plates to warp in some locations creating cracks and damage to the stone and mortar joints. In addition at some of these locations the inner embedded C channels may be experiencing corrosion which is allowing the plates to move outward and also displacing some of the stone (Figures 68 & 69).



Fig. 68 North Elevation, East of Entrance Second Floor Window. Corrosion of steel lintel. (SEA 2012)



Fig. 69 North Elevation First Floor window configuration. Embedded steel lintels are not exposed. (SRJA 2012)

**West Elevation**

The West elevation of the Hall of Waters contains two different façade systems. First being the pitched face limestone and the second being the cast stone.



Fig. 70 West Elevation. (SRJA 2012)



Fig. 71 West Elevation of the Hall of Springs and Ground/Ground Mezzanine Levels. (SRJA 2012)

Observations made on-site showed large portions of the limestone mortar joints have failed. The mortar has either separated from the stone or has cracked in the center portions. Additional mortar has flaked off which indicates a shallow surface mortar applied repair done during a previous project (Figure 72).



Fig. 72 West Elevation Lower Level. Mortar joint has thin mortar overlay. (SEA 2012)

The rubble stones are experiencing the same damage as the East, West, and South Façades from moisture infiltration and freeze thaw cycling. The stones have sections that have either de-bonded totally from the face or in a state of partial de-bonding at this time.

In most cases on the West Elevation of the structure, the issues concerning the cast stone are mortar joints failures and severe organic staining. Mortar joints are experiencing the same high percentage of failure as noted in the rubble stone façade.

The West Elevation is experiencing the same types of organic and inorganic staining as found on the East, West, and South Elevations. As this weathering process continues dust particles and metal deposits are accumulating on the outer surface.

Additionally, some cracking has occurred to the south of the main entrance on the face of the cast stone. This crack is found in the upper corner of the entrance area above the water table. Since the crack does not go beyond the water table and only encompasses a few stones, settlement issues and foundation movement are not considered to be the cause. Most likely the brick back up at the parapet has experienced brick growth and caused the cracks to form on the face of the cast stone (Figure 73).



Fig. 73 West Elevation Crack at Cast Stone Entryway Southwest Corner. (SEA 2012)

Brick parapet walls and some brick veneers are problematic. When fabricated, the process of firing the brick in the kiln dries out all moisture within the brick. As it is extracted from the kiln, transported to the job site, and erected, the brick begins to absorb moisture and expand.

The Brick Industry Association indicates that brick growth should be anticipated on a structure of these dimensions. In contrast to the expansion of brick, concrete shrinks over time. Water is used in the chemical hydration of concrete. As time goes by additional moisture escapes the concrete and the concrete shrinks. As can be seen, the shrinkage of the concrete conflicts with the expansion of the brick. This often creates problems within the structure resulting in high stresses within the walls or movement along a failure plane. Stresses can also be created within a brick veneer. When the stresses become too great, the result is failure of the tie, and cracking or bulging in brick veneer panels.

The Brick Industry Association indicates that approximately 70 percent of the brick expansion occurs within the first four to five years. While the charts indicate that brick growth slows drastically after four to five years, there is no indication that it ever completely stops. While additional brick growth is not anticipated to be severe in magnitude, it is still possible. Moisture infiltration through the mortar joints on the walls will most likely aggravate this condition, as well as promote further deterioration of the brick veneer.

The West Elevation of the Hall of Springs has glazed 2"x2" tile installed above and around the doorway into the Hall (Figure 74). This is the same blue tile found on the East Elevation of the Hall of Springs. The tile is slightly recessed into the building. The glazed tile is experiencing some deterioration from exposure to weather and the grout joints have a slight skim coating of material in the joints over the original grout. This material is de-bonding and coming off the existing mortar joints in multiple locations.



Fig. 74 West Elevation detail view of blue exterior tiles. (SRJA 2012)

As with the other elevations of the structure, the windows and door openings have various stages of steel lintel corrosion issues. All of the lintels in the rubble stone façade and the cast stone façade have exposed steel plates. These plates are welded to C channels that are embedded in the stone or cast stone along with the backup material. Corrosion has caused these plates to warp in some locations creating cracks and damage to the stone and mortar joints. In addition at some of these locations the inner embedded C channels may be experiencing corrosion which is allowing the plates to move outward and also displacing some of the stone units (Figure 75).



Fig. 75 West Elevation Corrosion on Window Lintel Next to Entryway. (SEA 2012)

### South Elevation

The South elevation of the Hall of Waters contains three different façade systems. The first system is the pitched face limestone, the second is cast stone, and the third is a formed cast concrete with a color-coated stucco skim coat.



Fig. 76 South Elevation, west portion. (SRJA 2012)



Fig. 77 South Elevation looking Northeast. (SRJA 2012)

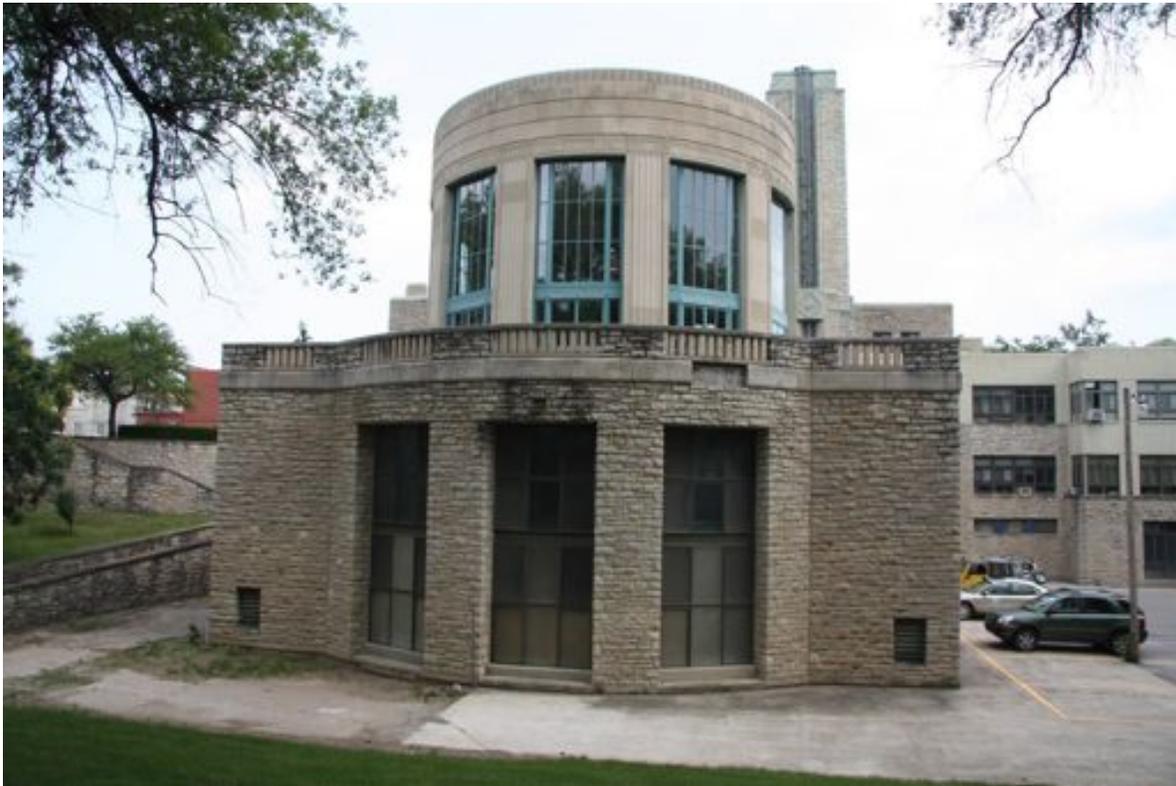


Fig. 78 South Elevation of the Hall of Springs and Ground/Ground Mezzanine levels. (SRJA 2012)



Fig. 79 South Elevation, east portion. (SRJA 2012)

Observations made on-site showed large portions of the limestone mortar joints have failed. The mortar has either separated from the stone or has cracked in the center portions. Additional mortar has flaked off which indicates a shallow surface applied repair done at a previous time.

The rubble stones are experiencing the same damage as the East, West, and North Façades from moisture infiltration and freeze thaw cycling. The stones have sections that have either de-bonded totally from the face or in a state of partial de-bonding at this time.

The South Elevation of the structure has additional concerns with the cast stone. Along the curved section of the façade some of the intermediate water table stones are severely deteriorating and one stone is completely missing (Figure 80). These cast stone pieces appear to be experiencing severe freeze thaw damage. Freeze/thaw damage is disintegration of the concrete paste holding the individual pieces of aggregate (crushed rock) together, resulting in concrete reverting back to its aggregate components. When water-saturated concrete freezes, the concrete is subjected to internal stress due to the expanding water. Normally, concrete that is subjected to freezing weather and moisture is air entrained. Air-entrained concrete is produced by adding into the concrete mix an admixture that creates millions of microscopic air bubbles that are distributed in the concrete. When the air bubbles are properly sized and distributed, they provide space for the freezing water to expand into, thereby minimizing stress build up. The degree of air entrainment is determined when the cast stone is produced and cannot be altered after the concrete hardens.



Fig. 80 South Elevation of South Wing detail showing stone deterioration. (SEA 2012)

The minor issues with the cast stone are mortar joints failures and severe organic staining. Mortar joints are experiencing the same high percentage of failure as noted in the rubble stone façade (Figure 81).



Fig. 81 South Elevation Deteriorated Mortar Joints. (SEA 2012)

The South Elevation is experiencing the same types of organic and inorganic staining as found on the East, West, and North elevations. As this weathering process continues dust particles and metal deposits are accumulating on the outer surface.

The cast concrete façade which encompasses the east end of the South Elevation has minor deterioration issues. Most of the issues found on this concrete façade are due to corrosion occurring in the reinforcing steel embedded in the concrete. From our observations most of this is occurring due to inadequate cover of concrete over the existing reinforcing steel.

Some of the corrosion of the reinforcing bars at these locations could also be attributed to carbonation contamination due to environmental conditions.

In addition to the delamination and corrosion issues of the concrete façade the existing coating that has been applied to the concrete is beginning to de-bond and fall off the face of the building. As the coating ages it becomes brittle due to exposure to the environment and UV rays. When the coating becomes too brittle to move with the expanding and contracting substrate it loses the ability to adhere.

As with the other elevations of the structure the windows and door way openings have various stages of steel lintel corrosion issues. All of the lintels in the pitched face stone and the cast stone portions of the building have exposed steel plates. These plates are welded to C channels that are embedded in the stone or cast stone along with the backup material. Corrosion has caused these plates to warp in some locations creating cracks and damage to the stone and mortar joints. In addition at some of these locations the inner embedded C channels may be experiencing corrosion which is allowing the plates to move outward and also displacing some of the stone facades (Figure 82).



Fig. 82 South Elevation. Corroding lintel at first floor. (SEA 2012)

In addition the concrete topping slab and waterproofing material at the 1<sup>st</sup> floor exterior terrace that surrounds the south wing Hall of Springs is deteriorating. The waterproofing material is a tar based system that was applied over the structural slab and then a thinner concrete topping slab was applied over the top for protection and to create a walking surface. This material becomes brittle as it ages and loses the ability to expand and contract with the concrete surface. Cracks form and moisture travels through creating leaks to the space below and cause deterioration to the structural slab.

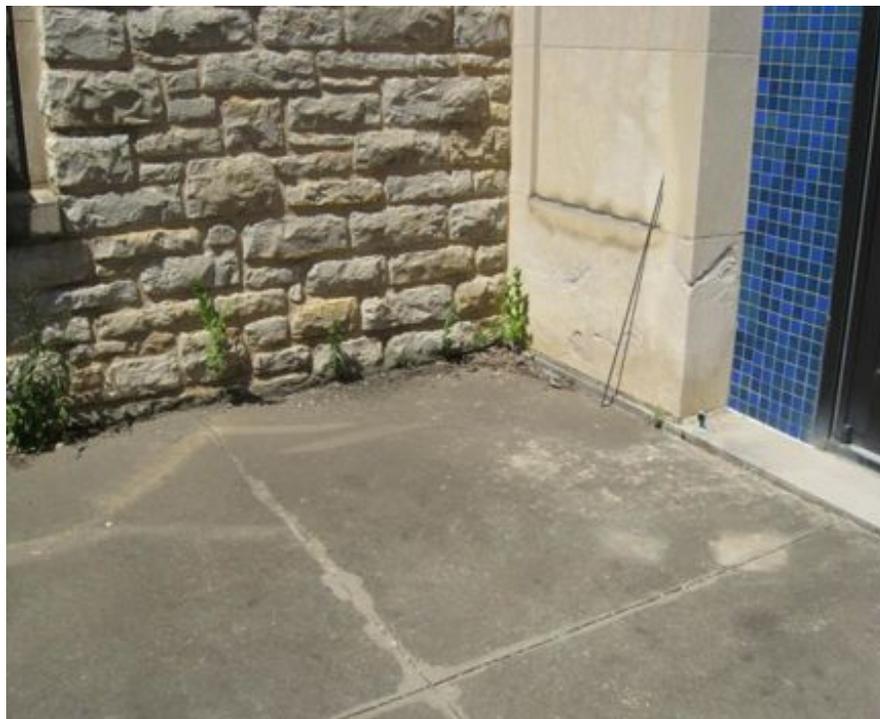


Fig. 83 South Elevation Hall of Springs deck with plants growing in the joint between the deck and the building. The deck has cracks which allows water to seep in between the topping slab and the structural concrete slab beneath. (SEA 2012)

### East Elevation

The East Elevation of the Hall of Waters contains three different façade systems. The first system is pitched face limestone, the second is cast stone, and the third is a formed cast concrete with a color-coated stucco skim coat.



Fig. 84 East Elevation of the Hall of Springs. (SRJA 2012)



Fig. 85 East Elevation of east portion of the building. (SRJA 2012)

The rubble stone façade has multiple types of deterioration that is occurring. Observations on-site revealed that large portions of the limestone mortar joints have failed. The mortar has either separated from the stone or has cracked in the center portions. Additional mortar has flaked off which indicates a shallow surface mortar repair was applied during a previous project.

The stones also are experiencing damage from moisture infiltration and freeze-thaw cycling as indicated in (Figure 86). The stones have sections that have either de-bonded totally from the face or are in a state of partial de-bonding at this time.



Fig. 86 East elevation South end, rubble stone deterioration. (SEA 2012)

Pitched face stone is quite susceptible to moisture infiltration and freeze-thaw cycling due to the manufacturing techniques required to produce this particular surface. During this process micro-cracking occurs from the blunt impacts placed upon the faces of the stones in order to create the desired finish. These micro-cracks thru time allow moisture infiltration into the stone and as the stone weathers and freeze-thaw cycling occurs damage begins to separate the outer layers of the stone creating the de-bonded material to slough off.

The cast stone has color and texture that mimic a cut limestone product. In most cases on the East Elevation of the structure the issues concerning the cast stone are mortar joints failures and severe organic staining. Mortar joints are experiencing the same high percentage of failure as noted in the rubble stone façade. At some of these locations the joints are completely void of the outer tuckpointing material (Figure 87).



Fig. 87 East Elevation of the South Wing. Mortar missing from joints. (SEA 2012)

The large amount of organic and inorganic staining occurring on this face indicates the stone surface is becoming more susceptible to moisture infiltration. As the weathering process continues, dust particles and metal deposits are accumulating on the outer surface. Cast stone and limestone often mimic each other when exposed to the same harsh environments (Figure 88).



Fig. 88 East elevation of South wing. Biological staining. (SEA 2012)

The East Elevation of the Hall of Springs has glazed 2"x2" tile installed above and around the doorway into the Hall (Figure 89). This is the same blue tile found on the West Elevation of the Hall of Springs. The tile is slightly recessed into the building. The glazed tile is experiencing some deterioration from exposure to weather and the grout joints have a slight skin coating of material in the joints over the original grout. This material is de-bonding and coming off the existing mortar joints in multiple locations.



Fig. 89 East Elevation blue tile at Hall of Springs. (SRJA 2012)

The cast concrete façade which encompasses the east wing or the northern section of the east façade has minor deterioration issues. Most of the issues found on this concrete façade are due to corrosion occurring in the reinforcing steel embedded in the concrete. From our observations most of this is occurring due to inadequate cover of concrete over the existing reinforcing steel (Figure 90).



Fig. 90 East Elevation of East Wing. Reinforcing bars for lintel at window opening are corroded. (SEA 2012)

Some of the corrosion of the reinforcing bars at these locations could also be attributed to carbonation contamination due to environmental conditions. Carbonation contamination occurs as buildings are exposed to natural pollutants in the air over time. This can occur from emissions, from petrochemical or coal-powered equipment. In some conditions if concrete is exposed to carbon dioxide at an early age, the uncured concrete can be more susceptible to infiltration of the carbonation. This can occur when concrete is cured with open flame heaters.

The carbon dioxide gas in the atmosphere interacts with the calcium hydroxide in the hydrated cement paste. This chemical process reduces the alkalinity of the concrete to a pH as low as 8.5. This low pH breaks down the protective layer surrounding steel in the concrete. Once the protective layer around the steel is broken down, corrosion can begin to occur. With reinforcing bars inadequately placed reducing the amount of concrete cover available as carbonation contamination reaches the reinforcing steel thru driven rains and environmental conditions the corrosion process can accelerate.

The loading dock area at the north end of the East Elevation was also found to exhibit deterioration. Along with the possible deterioration mechanisms listed above which are associated with the cast concrete, some additional deterioration forces may be occurring here (Figure 91).



Fig. 91 Loading Dock East Elevation. Delaminated concrete beam and soffit. (SEA 2012)

With the excessive amount of surface cracks at the beam and column supports Alkali Silica Reaction (ASR) contamination may be occurring. ASR reaction is a chemical reaction which takes place in aggregate particles between the cement paste and silica in the aggregate particles. When water is added into the reaction a alkali-calcium silica gel is formed. This gel begins to occupy more space than the original silica so the surface of the concrete is put under pressure. At a certain point in time these stresses exceed the strength and cracks propagate. The cracks radiate from the interior of the aggregate out into the surrounding paste. Over time freeze-thaw cycling open up these cracks and accelerate the deterioration of the concrete and corrosion of reinforcing steel (Figure 92).



Fig. 92 Loading Dock - Delaminated Concrete Beam. (SEA 2012)

Another possibility for the excessive deterioration occurring at the loading dock is cast in place accelerators used during the original construction. It was common to add accelerators in concrete to reduce the curing time. One of these accelerators was Calcium Chloride. This particular chemical is also one of the main ingredients for corrosion development in steel. Corrosion is an electrochemical process that deteriorates metals. Typically, reinforcement embedded in concrete is protected by a thin oxide film on the surface of the metal resulting from the concrete's naturally high alkalinity. However, aggressive ions can penetrate the concrete and break down the oxide film. These ions are typically chloride ions from de-icing salts or chloride-bearing concrete admixtures. The corrosion process results from the formation of a corrosion "cell" that is an electrical circuit composed of an anode, a cathode, electrolyte (concrete in our case) and a metallic path from the anode to the cathode (the reinforcing bar itself). Similar to an ordinary battery, current flows from the anode through the electrolyte onto the cathode and completes the circuit through the metallic path to the anode. Metal loss occurs at the anode where current is discharged (Figure 93).



Fig. 93 Loading Dock. Delamination and corrosion at back of column. (SEA 2012)

In addition to the delamination and corrosion issues of the concrete façade, the existing coating that has been applied to the concrete is beginning to de-bond and fall off the face of the building. As the coating ages it becomes brittle due to exposure to the environment and UV rays. When the coating becomes too brittle to move with the expanding and contracting substrate it loses the ability to adhere.

As with the other elevations of the structure, the windows and door way openings have various stages of steel lintel corrosion issues. All of the lintels in the pitched face stone and the cast stone sections of the building have exposed steel plates. These plates are welded to 'C' channels that are embedded in the stone or cast stone along with the backup material. Corrosion has caused these plates to warp in some locations creating cracks and damage to the stone and mortar joints. In addition at some of these locations the inner embedded 'C' channels may be experiencing corrosion which is allowing the plates to move outward and also displacing some of the stone facades (Figure 94).



Fig. 94 East Elevation of South Wing. Steel lintel corroding and perimeter window sealant failure. (SEA 2012)

### **Tower**

The Tower at the Hall of Waters contains three different façade systems. First is the pitched face limestone, the second is cut stone, and the third consists of glass tile blocks with wood blocking and metal cladding and fascias.



Fig. 95 Hall of Waters Tower looking southeast. (SEA 2012)

Visual observations on-site indicated that large portions of the limestone and glass block mortar joints have failed over time. The mortar has either separated from the stone/block or has cracked in the center portions. Additional mortar has flaked off which indicates a shallow surface applied repair done at a previous time (Figure 96).



Fig. 96 Tower East Elevation. Deteriorated mortar joints between cut stone and rubble stone. (SEA 2012)

The pitched face stones are experiencing the same damage as the building façades from moisture infiltration and freeze thaw cycling. The stones have sections that have either de-bonded totally from the face or in a state of partial de-bonding at this time (Figure 97).



Fig. 97 Typical Deteriorated Mortar Joints in Pitched Face Stone Wall. (SEA 2012)

In most cases with this structure, the issues concerning the stone are mortar joints failures and severe organic and copper staining. Mortar joints are experiencing the same high percentage of failure as noted in the pitched face stone elevations.

In addition to missing mortar joints, there are multiple glass block units either missing or broken. The missing glass is contributing to the moisture infiltrating the structure and has also allowed

pigeons to enter and roost within the tower and penthouse areas. The pigeon infestation appears to have been a long term issue due to the extent of issues found during the investigation (Figure 98).



Fig. 98 Tower South Elevation. Note broken glass block and deteriorated copper cladding. Exposed wood framing is deteriorated and is missing the metal cladding. (SEA 2012)

All elevations of the tower are experiencing the same types of organic and inorganic staining as found on the building façade with an addition of higher amounts of copper stains likely from the metal fascias (Figure 99).



Fig. 99 Typical Copper Staining at Tower Stones. (SEA 2012)

The copper flashing and wood backup found at the top and bordering the glass blocks have failed on the Tower. The copper is either missing in some locations or the soldered seams have failed. These open joints and missing flashing pieces have allowed moisture to infiltrate the structure and deteriorate the wood backup that once anchored the copper flashing (Figure 100).



Fig. 100 Tower North Elevation. Missing copper flashing and exposed wood backup. (SEA 2012)

The large diameter metal pipe that contains the smoke has severe corrosion issues at the upper section above the structure portion of the smokestack. From our field investigation, it was discovered that large portions of the metal were completely corroded away leaving holes in the metal pipe at the stack's exhaust (Figure 101). The tower roof is also copper and is discussed in the Roof Section of this report.



Fig. 101 Tower North Elevation. Severely corroded steel exhaust pipe. (SEA 2012)