Collingwood Terminals
Engineering Condition Assessment

1 Heritage Drive
Collingwood, Ontario

Prepared by:

TACOMA ENGINEERS EXPERIENCE TRUST

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Executive Summary

Tacoma Engineers has been retained by Town of Collingwood to carry out an engineering condition assessment of the Collingwood Terminals with the stated purpose to provide the Town a baseline assessment of the facility and allow for the development of an overall restoration strategy based on priority – life safety, structural integrity, durability, aesthetic considerations. This report is generally based on a visual inspection with only localized destructive testing in areas of particular concern. No further structural analysis or building code analysis has been carried out as part of this report unless specifically noted and a review of mechanical and electrical systems is specifically excluded from the scope of this structural assessment report.

The Collingwood Terminal Facility was constructed over a 9 month period in 1929 by Montreal contractor EGM Cape according to a CD Howe Consulting Engineers design. The construction includes a wood pile foundation, a massive concrete raft slab and 52 monolithic concrete silos rising approximately 100' above the base. The silos are topped with a large operations centre and large material handling towers at each end. The facility remained in active operation for 64 years until is closing in 1993. The facility was purchased by Town of Collingwood in 1993 and is effectively unoccupied with the exception of leased space for communication systems and a municipally run sailing school in one of the lower structures. The facility is currently listed on the Municipal Heritage Registry as part of the Collingwood Heritage District established in 2002.

Overall, the terminal facility structure was found to be in fair to good condition with localized areas where poor conditions were found. From a macro perspective, the structure is sound. The primary systems and conditions are as follows:

- Foundations: The primary foundation system is in good condition yet the basement perimeter walls are in fair condition with significant leakage. A sub-surface investigation and pile analysis was outside the scope of this report but there is no evidence of differential settlement or distress.
- Silos: The concrete silos are in good condition structurally but numerous cracks and concrete deterioration was identified. The concrete slabs (top of the silos) are in fair to poor condition with the exposed exterior slab in need of short term repairs.
- Bin Floor: The concrete structure over the bin floor is in good condition with localized leakage identified. The walls surrounding the Bin Floor are in poor condition.
- Towers: The tower structures are generally in good condition with localized concrete deterioration identified. As above, the perimeter walls are in fair to poor condition.
- Rail Shed: The rail shed structure is in good condition with the exception of the electrical sub-station area and the slab supporting the former rail lines which are in fair to poor condition.

While the primary building structure is generally in good condition, the secondary elements were frequently found to be in fair to poor condition including interior and exterior platforms, stairs, guards, ladders, doors and windows. The windows are in particularity poor condition and in many locations, they are at risk of failure and falling out of the surrounding concrete walls. Of note was the lack of a certified fall arrest system which will be required to provide safe access to exterior areas.

The existing roofing system is in poor condition and does not provide any effective protection. In many locations, we identified active leakage into the structure and these areas are the location of the most acute concrete deterioration.

As part of the condition assessment, Tacoma Engineers retained the services of an environmental engineer to complete a Designated Substances and Hazardous Materials Survey. The survey identified asbestos, lead, mercury, silica, PCBs, mould and guano within the facility. Of greatest concern is the very significant

accumulation of bird droppings within the Marine Tower. A comprehensive abatement program will be required.

The condition assessment included a preliminary analysis of the building life safety provisions. In summary, the analysis identified many areas where means of egress (path of travel, stair geometry and guard geometry) does not meet current regulations.

Our recommendations to maintain a safe and secure facility include:

- Immediate: maintain restricted access to areas deemed unsafe; complete the environmental abatement of the Marine Tower; provide required means of egress; complete detailed assessments of the window wall systems; and advise all users of the facility of the identified safety hazards.
- Short-term: Replace the roofing system on the Bin Floor, Marine and Shipping Towers roofs; install the steel reinforcing and roof deck over the exposed silo slabs; install a complete fall arrest system; complete detailed assessment and restoration programs for the exterior concrete, doors/windows, basement slab, stairs/guards.
- Medium-term: Repair the exterior concrete structure; waterproof the foundation system and replace doors and windows as required.
- Long-term: Complete a sub-surface investigation of the timber piles; complete any outstanding concrete repairs; and develop a comprehensive maintenance program.

Based on our assessment, we have identified four approaches or strategies for this facility:

1. Full Remediation & Repair: Complete a full restoration of the facility to address of all of structural and life safety concerns identified. While detailed cost estimates based on design development will be required, our initial estimate for the complete repair is $8,000,000 - $9,700,000 with components budget costs as follows:
    - Environmental Abatement: $1,500,000-$2,000,000
    - Roof Replacement: $3,000,000- $3,500,000
    - Concrete Restoration: $2,700,000 - $3,000,000
    - Windows and Doors: $300,000 - $500,000
    - Interior Upgrades: $200,000 - $300,000
    - Foundations: $300,000 - $400,000
2. Phased Remediation & Repair: This option is similar to the option noted above but extended over an extended period of time. The repairs would be completed on a priority sequence – life safety, structural integrity, durability, and finishes. It should be assumed that the extent of repairs will be greater than noted above as deterioration will continue until repaired and unit prices will increase with inflation and increased mobilization/schedule.
3. Abandon the Facility: This option would include no repairs but would require the facility to be completely vacated including the existing communication systems. Mothballing of the building to prohibit unauthorized entry would be required. Ultimately, this option would lead to demolition by neglect and increased safety concerns as the structure deteriorates.
4. Demolition: This option would include the complete demolition of the terminal structures to grade level. The above noted environmental abatement would be required in advance of demolition. An order of magnitude cost estimate for the demolition is $5,000,000 including abatement.

Our recommendation would be to pursue Option 1 but recognize that municipal resources may require Option 2 to be selected. Tacoma Engineers can provide ongoing engineering services to support the option selected by Town of Collingwood.

Table of Contents

List of Figures

1. Background

Tacoma Engineers has been retained by Town of Collingwood to carry out an engineering condition assessment of the Collingwood Terminals located at 1Heritage Drive, Collingwood, Ontario. The purpose of this Phase 1 assessment is to provide the Town a baseline assessment of the facility and allow for the development of an overall restoration strategy based on priority – life safety, structural integrity, durability, aesthetic considerations. This report will detail the existing conditions and identify those areas of greatest concern.

This report is based on a series of visual and material assessment surveys completed including:

- February 4, 2017; Tacoma Engineers
- April 4, 2017; Tacoma Engineers and ECOH Environmental
- June 21, 2017; Tacoma Engineers and specialist demolition contractors
- November 13, 2017; Tacoma Engineers and specialist demolition contractors
- February 14, 2018; Tacoma Engineers, CVD Engineering, and X-radar Services
- April 23, 2018; Tacoma Engineers.

As per the project scope of work, this Phase 1 report includes a summary of the following items:

- Principal structural systems and overall structural integrity;
- Secondary structural elements
- Hazardous materials
- Building safety including fall arrest and emergency egress
- Exterior enclosures including the roof, sealants and coatings

This report is generally based on a visual inspection with localized destructive testing in areas of particular concern. Where no concerns were noted the structure is assumed to be performing adequately. The structure is assumed to have been constructed in accordance with best building practices common at the time of construction. No further structural analysis or building code analysis has been carried out as part of this report unless specifically noted. A review of mechanical and electrical systems is specifically excluded from the scope of this structural safety assessment report.

2. Building History

The origins of Collingwood Terminals dates to 1928 when Collingwood Terminals Limited retained C.D. Howe Consulting Engineers of Port Arthur Ontario to design a new grain terminal to address the rapidly growing grain commerce from Western Canada to Central Canada. By that date, Howe's firm had come to dominate the industry for the design of large scale grain elevators across the prairies and along the shores of the Great Lakes. His elevators were deemed to be a superior design that could be built more quickly at a lower overall cost using progressive slip form concrete construction methods. The success of the Collingwood Terminals facility is a prime example. The construction of the 52-silo elevator began in the Winter of 1928 with the installation of over 4000 wooden piles driven into the lakebed of Georgian Bay by the Montreal contractor E.G.M Cape. This phase of the project was particularly challenging as the construction had no effective land base to work from given that the location of the terminal at the time was at the end of an earthen spit and wooden railway trestle. Following completion of the piling, the construction of the monolithic concrete super structure was assigned to Carter-Halls-Aldinger Company Limited of Winnipeg Manitoba. Based on the photographic records available, the pile cap and foundation construction started in April 1929 and by July 1929 the massive structure to the roof level was complete. The construction progress would be remarkable by today's standards but truly outstanding given that all raw materials were delivered by train, concrete mixed on site and placed by hand. It is reported that the first ship delivered grain to the facility in September 1929, only 9 months after construction started.

The Collingwood Terminal operated continuously for 64 years until its closing in October 1993. Following a brief dormant state, major equipment was removed or sold prior to the abandonment of the site by the previous owners. This iconic structure along Collingwood's waterfront was purchased by Town of Collingwood in 1997. Currently the facility is effectively unoccupied except for leased roof space for municipal and commercial communication systems and a portion of the rail shed by the sailing school.

The building is currently listed on the Municipal Heritage Register as part of the Collingwood Heritage District established in 2002.

Historic photos on the subsequent pages are courtesy of Town of Collingwood and Collingwood Museum.

Figure 1: Pile Construction, December 1928

Figure 2: Foundations, April 1929

Figure 3: Silo Base, May 1929

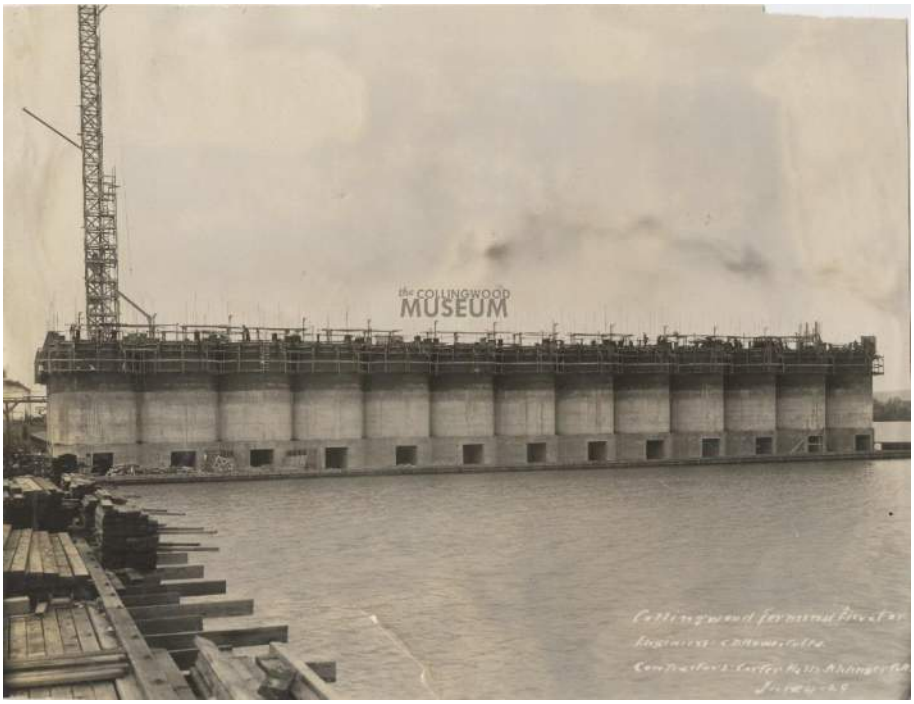

Figure 4: Silo Construction Level 2, June 1929

Figure 5: Silo & Bin Floor, July 1929

Figure 6: Engineer's Rendering, 1928-29

3. Definitions

For the purpose of this report, reporting of conditions and recommendations are based on the following definitions:

Conditions

- Excellent – Element(s) in "new" condition. No visible deterioration type defects present and remedial action is not required.
- Good – Element(s) where the first signs of minor defects are visible. These type of defects would not normally trigger remedial action since the overall performance is not affected.
- Fair – Element(s) where medium defects are visible. These types of defects may trigger a "preventative maintenance" type of remedial action where it is economical to do so.
- Poor – Element(s) where sever or very sever defects are visible. These types of defects would normally trigger rehabilitation or replacement if the extent and location affect the overall performance of that element.

Recommendations

- **Immediate remedial action:** it is recommended that items listed as immediate remedial action are acted on within the next 6 months. These items generally represent a safety concern or postponement of these items will likely result in significant deterioration or failure of a major structural system.
- **Short term remedial action:** it is recommended that items listed as short term remedial action are acted on within the next 12 months. The postponement of these items will result in the further degradation of the structural systems and finishes.
- **Medium term remedial action:** it is recommended that items listed as short term remedial action are acted on within the next 24 months. The postponement of these items will likely result in the further degradation of the structural systems and finishes.
- **Long term remedial action:** it is recommended that items listed as long term remedial action are acted on within the next 5 years. The postponement of these items could result in the further degradation of the structural systems and finishes. Many of these items include recommendations of further review.

4. Structural Conditions

The Collingwood Terminal facility is constructed as a monolithic concrete grain elevator with an overall dimension of approximately 97' wide by 316' long. The primary structure consists of:

- Timber piles with a mass concrete pile cap and foundation.
- Cylindrical concrete silos arranged in 4 rows of 13 cylinders. The silos are capped with reinforced concrete slabs.
- Atop the silos, central grain handling systems are enclosed in a large area known as the 'bin floor'. This area is toped with a reinforced concrete roof slab supported on concrete columns.
- At the west end, a multi-storey concrete tower known as the Marine Tower
- At the east end, a multi-storey concrete tower known as the Shipping Tower
- At the far east end, a two-storey concrete and masonry structure known as the Rail Shed.

Overall, the structure was found to be in fair to good condition with only localized areas where poor conditions were identified. From a macro perspective, the structure is sound with no evidence of major structural deficiencies.

The following section is a summary of the construction, structural conditions and recommended remedial actions for each of the discrete structural components.

4.1. Foundation

Construction

The base of the foundation system consists of over 4000 timber piles installed at approximately 2' on centre in a systematic pattern to accommodate the geometry of the grain silos above. Based on the historic design document reviewed, these piles are assumed to have been driven through overburden to bedrock below Georgian Bay at an approximate depth of 6-10 feet below chart datum (standardized water elevation of 176m AMSL). It is reported that once the piles were installed, a gravel grout mixture was placed to encase the piles and serve as a pile cap. Above the cap, a robust concrete foundation system to distribute the stored grain loads and form passage ways for grain carts and other process equipment was constructed. Finally, a concrete base slab was placed within the basement level.

Conditions

While a direct inspection of the wood piles was beyond the scope of this report, our survey of the basement level slab did not identify significant settlement that would be indicative of a general deficiency.

The interior concrete foundation walls were found to be generally in good condition with no structurally significant deficiencies identified. Localized concrete spalling and minor cracks were noted but this was generally associated with a lack of concrete cover over embedded reinforcing steel. Vertical wall cracks were identified at the west end of the structure.

The perimeter concrete foundation walls were found to be in fair condition. In many locations, chronic leakage has resulted in deterioration of the concrete foundation wall. This leakage is generally related to improper exterior grading and a lack of waterproofing.

The basement floor slab is also in fair condition with numerous cracks identified and areas of ponding water.

The suspended concrete slab forming the ceiling of the basement level was also in fair condition. In many areas, concrete delamination, cracking and spalling was identified.


Figure 7 a, b: Perimeter wall and ceiling concrete leak and deterioration

Assessment

The existing foundation system appears to be performing adequately and our analysis did not identify any structurally significant deficiencies.

It was reported that a water based sub-surface investigation identified washout at the shore's edge. While our review did not identify any signs of settlement, below slab erosion could lead to future settlement related issues – voids below the floor slab. Similarly, there have been reports of concern over cyclical wetting and drying of the timber piles which could lead to accelerated deterioration. Again, our survey did not identify any structural concerns but a below slab investigation was not completed.

The ongoing water infiltration through the perimeter foundation walls and ceiling slab are of concern. Chronic water infiltration will lead to corrosion of the embedded reinforcing steel and deterioration of the concrete matrix. The source of water for the foundation walls is the area immediately exterior of the walls while the source of the water leaking through the ceiling slab is from the upper level roofs.

Recommended Actions

The following **medium-term** remedial actions are recommended for the foundation system:

1. Foundation wall drainage and waterproofing should be installed to minimize water infiltration.
2. See recommendations for the roofing system to address leakage through the basement ceiling slab.

The following **long-term** remedial actions are recommended for the foundation system:

1. Undertake a below slab investigation of the wood pile system to document the existing conditions and implement any required remedial actions.

4.2. Concrete Silo Structure

Construction

The concrete silos or 'bins' are the principal structural and operational element at Collingwood Terminals. The core structure includes 52 silos arranged in 4 rows of 13 cylinders with a height of approximately 100 feet and a diameter of approximately 24 feet. Two of these silos at the west end of the structure have been truncated to accommodate the marine tower structure. The concrete silo walls are approximately 6" thick. Two openings are provided at the base of each silo. At the top of these silos, reinforced concrete slabs (7-9" thick) are provided as lids for the bin and floor for the area above.

Conditions

At a macro scale, the concrete silos walls were found to be in good condition with no evidence of structurally significant damage, distress of deterioration. From the interior, our review identified only isolated areas of concrete degradation due to long term contact with stored materials. From the exterior, numerous vertical and horizontal cracks were identified as well as localized concrete spalling.

Figure 8 a, b: Interior and exterior of typical concrete silo

As a result of our initial condition survey, detailed investigations were completed of both the interior and exterior concrete structure.

From the interior, significant floor cracks telegraphing the supporting structure were identified. Our survey indicated, that many of these concrete slabs had deflected more than 1" across the width of the silo below. To verify the as-built conditions, Tacoma Engineers retained a concrete testing firm and a concrete scanning firm to assist with material testing. The testing confirmed the slab thickness varies from 7"-10" and includes a concrete topping in localized areas, determined the concrete strength and placement of reinforcing steel. The review also confirmed structurally significant deterioration of the silo concrete slabs. From the underside, approximately half of the slabs had considerable leakage evident and over a quarter of the slabs had evidence of concrete delamination associated with corrosion of the embedded reinforcing steel. In many of these locations, large areas of exposed reinforcing steel were identified.

Figure 9 a, b: Silo Top Slab Cracking

Figure 10 a, b: Slab Investigation (coring and scanning)

From the exterior, our concrete survey identified vertical and horizontal cracking as well as concrete spalling on most silos. These deficiencies were generally found to be surface defects with a depth of less than 1".

Assessment

From a structural perspective, the silo wall structures are sound but in need of remedial work to ensure longterm durability.

Interior slab (bin floor area): Our structural analysis indicates that the concrete slab has been designed to support a specified live load of 50 psf. While this is less than would be specified under current building codes for an industrial occupancy, the capacity does not represent a safety concern with the current limited occupancy. If an alternate occupancy is proposed, structural reinforcing of the slab may be required. Note that the crack pattern observed is indicative of long term settlement (creep) and is predicted by analysis. Again, these cracks are not a result of a structural deficiency.

Exterior slab: The concrete slabs outside of the bin floor area are in an advanced stage of deterioration and no longer have the structural adequacy to support a superimposed live load. Structural reinforcing is required – see section 8.2 which details a solution to both reinforce these slabs and provide a waterproof cover.

Silo walls: The observed cracking and spalling is significant but has not resulted in a reduction of the load bearing capacity of the silos. We recommend that concrete restoration (repair) be completed and the walls be sealed and coated to ensure longterm durability.

Recommended Actions

The following **short-term** remedial actions are recommended for the silo structure:

1. Complete the exterior concrete slab structural reinforcing strategy.

The following **medium-term** remedial actions are recommended for the silo structure:

1. Complete the exterior wall restoration and weatherproofing as identified above.

4.3. Bin Floor

Construction

The area known as the bin floor covers an enclosed area 66’ wide and the full length of the structure constructed above the silo structure. The area covers the two central rows of bins plus half of the two exterior bins. The structure includes a regular grid of reinforced concrete columns (24’ on centre) supporting reinforced concrete beams and roof slab. The area is enclosed around the perimeter with concrete spandrel panels and large windows installed between the perimeter columns.

Conditions

The bin floor structure was found to be good condition except for the perimeter walls which were in fair to poor condition. The principal structure (columns, beams and roof slab) did not present any structurally significant deterioration. In localized areas, chronic roof leakage (see comments in sections 7) has resulted in concrete spalling.

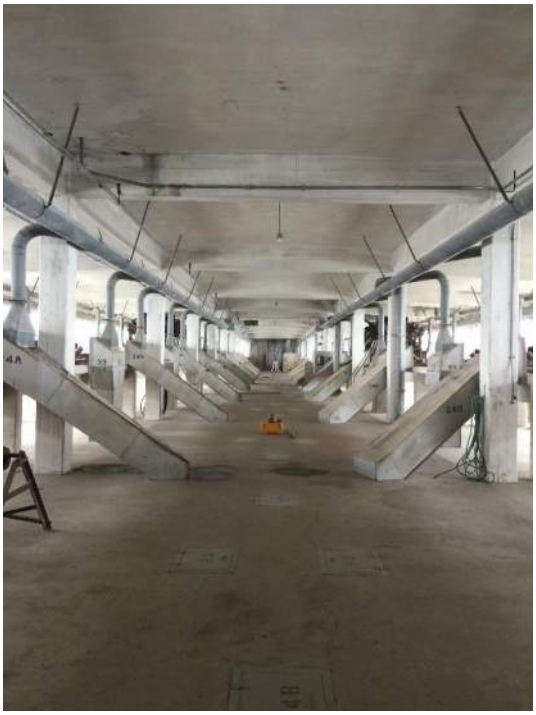

Figure 11 a, b Bin floor structure and localized roof leakage

At the perimeter walls, significant water infiltration was identified which has resulted in deterioration of the concrete wall panels and adjacent concrete columns.

Figure 12 a, b: Bin floor perimeter wall leakage and deterioration

Assessment
The primary bin floor concrete structure was found to be structurally sound with only minor areas requiring any remedial work. The remedial work should be completed after the roof leakage has been addressed (see section 7).

The perimeter walls are in fair to poor condition with substantial areas requiring significant remediation. As with the primary structure, this concrete restoration work should be completed in conjunction with the reinstatement of the building enclosure (weather proofing and windows) as the bulk of the deterioration is related to chronic water infiltration. Note that the concrete deterioration is sufficiently advanced that the retention of the window system has been compromised.

Recommended Actions
The following **medium-term** remedial actions are recommended for the bin floor:

1. Complete concrete structural remediation of the bin floor perimeter walls.

The following **long-term** remedial actions are recommended for the bin floor:

1. Complete concrete structural remediation of the bin floor concrete columns and slab.

4.4. Towers

Construction
The construction of the two towers (west end Marine Tower and east end Shipping Tower) consists of a reinforced concrete frame (columns, beams and slabs) extending above the silo structure below. While structural drawings are not available for review, both appear robust.

Note that access to the Marine Tower was severely restricted due to environmental concerns. An assessment of the Marine Tower is therefore outside the scope of this report.

Conditions
The Shipping Tower structural elements were generally found to be in good condition with no structurally significant damage, distress or deterioration identified. Similar to the Bin Floor, the perimeter walls had areas of advanced deterioration due to chronic water infiltration.

From the exterior, localized areas of concrete surface deterioration were identified. This deterioration is largely related to a lack of concrete cover over the embedded reinforcing steel.

Assessment
The primary Shipping Tower concrete structure was found to be structurally sound with only minor areas requiring any remedial work. The remedial work should be completed in conjunction with the repair of other concrete areas.

The perimeter walls are in fair to poor condition with substantial areas requiring significant remediation. As with the primary structure, this concrete restoration work should be completed in conjunction with the reinstatement of the building enclosure (weather proofing and windows) as the bulk of the deterioration is related to chronic water infiltration. Note that the concrete deterioration is sufficiently advanced that the retention of the window system has been compromised.

Recommended Actions
The following **medium-term** remedial actions are recommended for the towers:

1. Complete concrete structural remediation of the Shipping Tower perimeter walls.

4.5. Rail Shed & Warehouse

The brick masonry Warehouse building on the east side of the facility consists of two storeys above grade with a basement below. The main floor level is used as a warehouse and the second floor level is currently used as a classroom.

The Rail Shed building in between the two-storey brick building and the Storage Bins is a three-storey reinforced concrete structure above grade with a basement below.

Walls & Columns

Construction

The walls in this area of the building are a combination of reinforced concrete and multi-wythe brick masonry.

Conditions

The walls were found to be in generally good condition with a few exceptions. The shared wall between the Rail Shed (Storage) and the Warehouse Shop was pinned together using wall tie plates. The wall tie anchors had become loose above the double door opening.

Localized spalling and cracking of the reinforced concrete wall of the Rail Shed (Storage) was observed up against the Storage Bins and within the two-storey Electrical Substation area.

Figure 13: Spalling of Reinforced Concrete Wall Adjacent Storage Bins

Figure 14: Spalling Observed at Interior Concrete Column in Rail Shed

Assessment
It is our opinion that the observed concrete deterioration is not structurally significant but should be repaired while other concrete restoration work is being undertaken at the facility.

Beams / Suspended Slabs

Construction
Beams in Warehouse (Shop) below the Warehouse (Classroom) were constructed out of structural steel. The beams supported wood floor framing of the Warehouse (Classroom). The floor framing of the Warehouse (Shop) consisted of reinforced concrete columns, slabs and beams.

The beams in the Rail Shed (Storage) and Bagging Area were constructed out of reinforced concrete. The reinforced concrete columns and beams supported reinforced concrete suspended slabs.

Conditions
Above grade the conditions were generally good, except for the beam supporting the Bagging Room floor on the south side of the Rail Shed (Storage). This floor beam was in poor condition. Severe spalling to the underside of the beam was observed.

Evidence of previously completed repair work was noted to the reinforced concrete suspended roof slab in the Bagging Area. Roof openings had been patched in several locations.

The conditions of the reinforced concrete beams and slabs in the basement was poor. Wide cracking, severe spalling and evidence of reinforcement corrosion was prevalent.

Figure 15: Damaged Reinforced Concrete Beam in Basement (Shop) below Warehouse

Figure 16: Very Severe Deterioration of the Suspended Slab in Basement (Shop) below Warehouse

Assessment

The observed beam and slab deterioration is structurally significant. Based on our review, the deterioration is largely related to infiltration of salt laden water through the floor structure. The chlorides (salts) lead to accelerated corrosion of the embedded reinforcing steel and premature deterioration of the concrete elements. Concrete restoration is required in these areas to minimize the risk of damage to persons and property from falling concrete and to reinstate the integrity of the structural elements.

Recommended Actions

The following **short** remedial actions are recommended within the Rail Shed:

1. Perform detailed review of the existing reinforced concrete slab in the basement to determine locations of loose concrete. Remove or secure loose concrete to mitigate the risk of falling concrete.

The following **long-term** remedial actions are recommended within the Rail Shed

1. Locally repair damaged reinforced concrete slabs, beams & columns.

5. Structural Conditions – Secondary Building Elements

The following is a summary of the construction, structural conditions and recommended remedial actions for the secondary structural elements of the Collingwood Terminals facility. Elements reviewed include: stair and access platforms, windows, guards, access ladders and their anchorage details.

5.1. Exterior Platforms

Construction

Two different types of exterior platforms were observed outside the two-storey brick building on the south side of the facility. The first was a wood framed extension of the second floor of the Bagging Room. The roof framed platform was suspended from the wood framed roof directly above.

The second exterior platform was located on the east side of the two-storey red brick building. The platform was constructed out of reinforced concrete and was supported on concrete piers.

Conditions

The wood platform on the south side of the building was is poor condition. Access to the platform from the second floor was restricted at the time of our review.

The reinforced concrete shipping platform on the north side of the building was in good condition.

Figure 17a, b: Suspended Exterior Platform (Outside Second Floor of Bagging Room)

Figure 18: Exterior Shipping Platform

Recommended Actions
The following **immediate** remedial actions are recommended for the exterior platforms:

1. Access to the wood framed second floor platform has already been restricted. The next recommended action item is a detailed review to determine if any of the existing framing poses a risk as a falling hazard. Loose framing should be secured or carefully removed to mitigate this risk.

The following **short-term** remedial actions are recommended for the exterior platforms:

1. Remove and replace the wood-framed second floor platform if this space is deemed necessary to the future use of the building. Alternatively, this platform could be completely removed.

5.2. Windows and Window Openings

Construction
The large windows consisted of metal frames dividing individual single panes of glass. The window style was generally consistent throughout the facility. Window sizes varied throughout the structure. The walls around the window openings in the reinforced concrete structure were locally reinforced to accommodate the windows.

Conditions
The conditions of the windows and window openings varied greatly throughout the facility. The majority of the windows and window openings were in fair condition with several noted to be in poor condition. Most the window sills throughout the facility had been repaired to some degree but wide cracking and severe concrete spalling was observed even in previously repaired sills.

Wire ties had been added in several locations to fasten the steel window muntins to the reinforced concrete sills. Several of the window panes throughout the facility had been replaced. Replacement panes of glass were held in place with silicon.

Widespread organic growth was observed below several of the windows throughout the facility.

Figure 19a, b: Window at East End of Electrical Substation

Figure 20: Multiple Repairs at Window Sill in Shipping Tower

Assessment

The observed deterioration to the windows and window sills is the result of water infiltration due to lack of regular maintenance and failed sealants. Active water infiltration allows for freeze-thaw cycles to occur within the concrete and over time result in damage to the wall openings. The window system has effectively failed and are beyond salvage in many locations.

Recommended Actions

The following **immediate** remedial actions are recommended for the windows and window sills:

1. Complete a detailed survey of the facility windows in order to determine which windows pose a falling risk.

The following **short-term** remedial actions are recommended for the windows and window sills:

1. The windows and the surrounding concrete that are in poor condition should be stabilized until they can be repaired or replaced.

The following **medium-term** remedial actions are recommended for the windows and window sills:

1. The windows should be replaced and the concrete sills, jambs and heads should be repaired. Flashing with a drip edge should be installed below any replacement windows to divert water away from the interior of the building.

5.3 Interior Stairs

Construction

The stringers and treads that made up the interior steel stairs throughout the facility were constructed of structural steel channels. The size of the channels remained consistent throughout the facility.

Guards consisting of hollow steel pipe sections were slotted into over-sized pipe sections fastened to the steel stair stringers on each side of the stairs.

Conditions

The majority of the interior stairs were in fair condition. Light corrosion was observed. In a few locations stairs and stair guards were noted to be in poor condition. The most significant deterioration was observed at the base of mezzanine stair at Shipping Tower Floor 4. Medium Corrosion was observed at this location. In other locations where poor conditions were observed, the stair guards had been damaged or were missing railings.

Figure 21a, b: Steel Stair to Shipping Tower Mezzanine in Poor Condition (Floor 4)

Figure 22: Missing Guard Railing at Floor 3 Mid-Landing of Shipping Tower

Recommended Actions

The following **short-term** remedial actions are recommended for the interior stairs:

1. Reinstate/ repair the missing/ damaged elements of interior steel stair guards.
2. Address the issue of water infiltration at the roof of the Shipping Tower. While not a structural concern itself, active water infiltration can greatly accelerate the structural condition of a building and its secondary elements if not addressed.

The following **long-term** remedial actions are recommended for the interior stairs:

1. The condition of the interior steel stairs should be monitored on an ongoing basis. It is recommended that review of these elements be added to the regular facility maintenance program.

5.4 Service Platforms

Construction

Service platforms within the facility were located were access to a specific building element or mechanical / electrical equipment.

These platforms were constructed out of structural steel angles and open grating. Support for the platforms varied throughout the facility and range from robust to very informal (wall brackets & suspended from reinforced concrete slabs).

Conditions

In general, the platforms were in poor condition. Open steel grating had deteriorated resulting in concerns about the adequacy to support a person. The anchorage to the building was also a concern. Medium corrosion of the steel framing and anchorage points was noted. Guards around service platforms were found to be in poor condition.

Figure 23: Service Platform from Floor 3 Mid-Landing of Shipping Tower

Assessment

Our initial review indicates that the platforms are in poor condition and would not satisfy building code and occupational safety standards. These platforms should not be used until a comprehensive analysis is complete and any required reinforcing implemented.

Recommended Actions
The following **immediate** remedial actions are recommended for the service platforms:

1. Restrict access to all service platforms.
2. Complete a detailed survey of the facility to determine which service platforms pose a falling risk. These platforms are to be stabilized.

The following **long-term** remedial actions are recommended for the service platforms:

1. All service platforms (including their guards) should be removed or replaced as specified.

5.5 Guard Railings

Construction
Steel guards around floor openings (both stairs and service) were constructed of hollow steel pipe sections. Guards consisted of a top rail and mid-rail with vertical posts spaced at approximately 5'-0" (1525 mm). Guard posts were slotted into over-sized sections of steel pipe that were embedded into the reinforced concrete floor slabs. Guard posts were connected to over-sized slots with cotter pins.

Conditions
Guards were found to be in generally good condition. As previously noted, missing railing elements were observed at a few of the interior steel stairs in the Shipping Tower.

Figure 24: Guard Around Floor Opening in Shipping Tower

Assessment
While the guards are generally in good condition, missing elements must be replaced to ensure the safety of all occupants. In addition, our review indicated that kick plates are not installed around openings. Occupational safety standards required that these be in place to increase safety for occupants below.

Recommended Actions
The following **short-term** remedial actions are recommended for the guard railings:

1. As stated previously, reinstate/ repair the missing/ damaged elements of interior steel stair guards.

The following **long-term** remedial actions are recommended for the guard railings:

1. Install kick plates around all openings and service platforms.

5.6 Interior Spiral Stairs

Construction

Spiral stairs within the facility were located within the central "star bins". The spiral stairs consisted of cast iron treads that were stacked on a central steel support core. The exterior edges of the fan-shaped treads were fastened to the bin walls at regular intervals to provide lateral stability to the stairs.

There were two sets of spiral stair within the facility. The first spiral stair went from the Rail Shed (Storage) to the Bagging Room. The main stair for the building went from the Basement to the Bin Floor.

Conditions

The main stair was in good condition. The smaller stair was in fair condition. The connections for the smaller stair to the bin walls were noted to have medium corrosion. Lateral movement of the smaller spiral stair was noted when walking up the treads.

Figure 25a, b: Spiral Stair in Star Bin between Rail Shed and Storage Bins

Assessment

The spiral stairs may have provided the facility adequate vertical transportation within the facility but these stairs no longer satisfy the requirements of building code and occupational safety standards. Refer to section 6 for further discussion.

Recommended Actions

The following **short-term** remedial actions are recommended for the spiral stairs:

1. Locally review the connections from spiral stair treads to bin walls. Reinforcement to stabilized the smaller spiral stair likely required.

The following **long-term** remedial actions are recommended for the spiral stairs:

1. The regular review of the connections from the spiral stair treads to the bin walls should be added to the routine maintenance program for the facility.

5.7 Exterior Stairs

Construction
The exterior stairs were constructed out of structural steel. The specific structural configuration of the exterior steel stairs varied by location. Stairs outside the Shipping Tower, Marine Tower and Warehouse (Classroom) appeared to have all been constructed at different times. It is likely that the exterior stairs outside the Marine and Shipping Towers have been replaced previously.

Conditions
Although it was difficult to review the conditions of the Marine and Shipping Tower exterior stair as access has been restricted. From grade, the stair appeared to be in fair to poor condition.

The exterior stair outside the Warehouse (Classroom) appeared to be relatively new and was in good condition.

Figure 26a, b: Exterior Steel Stair Outside Marine Tower

Assessment
Until a comprehensive analysis of the stairs has been completed, we support the restricted access. Based on our review, remedial work to reinforce the stairs and their connections will likely be required.

Recommended Actions
The following **immediate** remedial actions are recommended for the exterior stairs:

1. Restrict access to the Marine Tower and Shipping Tower exterior steel stairs.

The following **medium-term** remedial actions are recommended for the exterior stairs:

1. Replace exterior steel stairs outside Marine Tower and Shipping Tower with new galvanized steel stair.
2. Ensure regular review of the exterior stairs are a part of the facility maintenance program.

5.8 Access Ladders

Construction
Steel access ladders were constructed out of structural steel. Ladders were bolted to the main building.

Conditions

Anchorage of access ladder from Switchgear Room to Substation Mezzanine was in poor condition with moderate steel corrosion was observed.

Figure 27: Corrosion of Substation Mezzanine Access Ladder Anchorage

Assessment
Our preliminary analysis indicates that the ladders are not safe for continued use. The observed deteriorated to the access ladder from Switchgear Room to Substation Mezzanine was the result of active water infiltration from the window above and must be addressed as part of any remediation.

Recommended Actions
The following **immediate** remedial actions are recommended for the access ladders:

1. Restrict use of Switchgear Room access ladders.

The following **short-term** remedial actions are recommended for the access ladders:

1. Remove and replace existing access ladders with new.

The following **long-term** remedial actions are recommended for the access ladders:

1. Ensure that the regular review and repair of all access ladders is added to the facility maintenance program.

5.9 Doors

Construction
The doors frames construction varies throughout the facility with both steel and wood assemblies identified. Exterior doors are typically light-gauge steel.

Conditions
Many door frames were found to be in poor condition with severe corrosion was observed at the base of the hollow structural steel (HSS) columns.

It was raining at the time of our structural assessment. Significant rain water infiltration below and around doors was identified. While not a structural concern itself, active water infiltration can eventually lead to structural issue if not mitigated.

Figure 28a, b: Corrosion of Steel Door Jambs in Warehouse (Shop)

Figure 29a, b: Water Infiltration Under Overhead Doors in Rail Shed (Storage)

Recommended Actions

The following **short-term** remedial actions are recommended for the doors:

1. Locally repair seals at doors to mitigate water infiltration.
2. Reinforce steel door as required.

The following **medium-term** remedial actions are recommended for the doors:

1. Remove and replace deteriorated doors with new.

5.10 Roof Equipment Anchorage

Construction

The roof of the Collingwood Terminal is used for a wide variety of communications and other equipment. This equipment is typically secured to the roof with through roof anchors.

Conditions

Active water infiltration at numerous roof top anchors was identified.

Figure 30a, b: Roof Top Equipment Anchorage in Shipping Tower

Assessment

While the design, installation and maintenance of the equipment and its anchorage is the responsibility of the communication firms and as such outside the scope of this report, active water infiltration will eventually lead to structural issues if not addressed.

Recommended Actions

The following **short-term** remedial actions are recommended for the roof equipment anchorage:

1. Contact the owners of the various communications equipment to highlight concern of active water infiltration at locations of equipment anchors.
2. Remove roof top equipment that is not in use and locally patch waterproof membrane.
3. Refer to section 8 for comments regarding the roofing membranes

The following **long-term** remedial actions are recommended for the roof equipment anchorage:

1. Ensure that any company leasing roof space is responsible to regularly maintain their equipment anchorage in a way that does not have an adverse affect on the surrounding building.

6. Hazardous Materials

A Designated Substances and Hazardous Materials Survey (DSHMS) was by completed by ECOH Environmental Services as part of this Phase 1 Condition Assessment Report. A copy of the report is included in Appendix A.

As an overview, the survey identified the following materials as present within the facility: Asbestos, Lead, Mercury, Silica, PCBs, Mould, Guano plus additional Designated and Hazardous materials in less concentrations. The report includes detailed recommendations for the abetment of these substances.

This DSHMS report should be circulated to all workers and firms that occupy or work within with the facility.

7. Building Safety

This assessment provides a cursory assessment of the existing building egress provisions. The overall building consists of multiple zones and several egress facilities:

- *Marine Tower* – Extends the full height of west end of the building, and has access to the Bin Floor and Bin Basement. Site access to the Marine Tower was limited.
- *Shipping Tower* – Located above the bins at the east end. Access is provided to the Bin Floor.
- *Bin Floor* – Located above the bins. No current site access to the lower Marine Tower levels at the west end. An egress stair and elevator at the east end provides access down to the Bin Basement.
- *Bin Basement* – Located below the bins, forms part of egress path from Bin Floor and Towers above
- *Warehouse and Rail Shed Building* – Separate access from Bin structure, includes upper electrical substation area, upper classroom, and basement.

The Building Code classification for the Terminals would have been Medium or High Industrial Occupancy (F1 or F2) when the facility was in operation. Since the facility is no longer in operation and no grain or other combustible content is stored, it can be classified F3 Low Hazard Industrial Occupancy.

The configuration of the building is unique. Although it may have met past safety regulations when in operation, the current conditions do present deficiencies with today's regulations. However, if the building is not regularly occupied under its current use, extensive upgrades to egress facilities are not necessarily required (as outlined below).

The current edition of the Building Code applies to construction of new buildings and renovations. Therefore, its requirements do not directly apply to conditions of existing buildings. However, the Ontario Health and Safety Regulation for Industrial Establishments does reference certain requirements of the Building Code to apply to existing buildings, such as the exiting items outlined below.

7.1. Exiting from Floor Areas

Exit Regulations

Ontario Health and Safety Regulation for Industrial Establishments (Reg. 851) requires:

- That access to exits, exit from floor areas, and fire resistance rating for access to exit conform to the Building Code. [S.120]

The Ontario Building Code (OBC) requires:

- That every floor area in a building of more than 2 storeys be served by two exits. [3.4.2.1.(1)]
- That exits from floor areas be protected from fire exposure from the building and lead to an exterior open space (exterior grade) [1.4.1.2. *exit*, 3.4.4.].

Exit Conditions from Floor Areas

Shipping Tower – The various floor areas generally have access to two means of egress:

- A series of interior steel stairs is the main egress facility. However, the stairs are not fully enclosed to provide a fire separated path of travel leading to exterior grade, therefore, do not conform to OBC as an exit.
- An exterior exit stair provides secondary egress from upper floor areas to the Roof Over Bin Floor. Egress can be accessed across the roof into the Marine Tower. However, the exterior exit stair is currently not accessible due to structural conditions, and the Marine Tower is not currently accessible beyond the bin floor level.

Bin Floor – Two means of egress are possible:

- A spiral stair located beside the elevator provides egress at the north end down to the Bin Basement. However, the path of egress through the Bin Basement to exterior is not enclosed as a fire separation, therefore, does not conform to OBC as an exit.
- The interior Marine Tower stairs could provide a second means of egress from the west end. However, the Marine Tower is not accessible under its current conditions.

Bin Basement – A single exit to exterior grade is provided below Bin 31. A single exit from this floor area does not satisfy the number of exits or travel distance requirements from the OBC.

Electrical Substation 2nd Floor – This floor area is only provided with one means of egress:

- A spiral stair provides egress down to the Rail Shed Storage room. However, the path of egress through the Rail Shed to exterior is not enclosed as a fire separation, therefore, does not conform to OBC as an exit.

Warehouse Classroom 2nd Floor – Exiting is compliant. Two exits are provided:

- Enclosed exit stair leading directly to exterior at south end.
- Open exterior exit stair leading to grade at north end.

Rail Shed and Warehouse Ground Floor – Exiting is compliant. Three exit doors provide direct access to exterior.

Warehouse Basement – A single exit stair is provided at the east end leading to exterior grade. Two exits are required from the floor area to conform to OBC.

Recommendations, Unoccupied Floor Areas

The first priority to maximize safe exiting from the structure is to develop a Fire Safety Procedure to include which areas can and cannot be occupied and provide a Safe Means of Egress from all occupied areas including appropriate signage and emergency lighting (is case of a loss of power).

The requirements for exiting noted above are based on floor areas intended for occupancy [OBC 3.4.1.1]. If there is no occupancy intended on certain floor levels (with the exception of occasional maintenance/inspection), the OBC exiting requirements do not necessarily need to apply. However, we offer the following recommendations to address egress of unoccupied floor areas:

- Further analysis of exit facilities be provided based on the frequency of access for occasional maintenance/inspection. Provide upgrades as determined to ensure a reasonable level of safety for worker egress and evacuation.
- Orientation is provided to workers so they are familiar with the facility egress/evacuation procedures.
- Egress/evacuation procedures and recommended upgrades are reviewed with the local Fire Department.

Possible upgrades to exit facilities could include:

- Repair or replace exterior exit stairs on the Shipping Tower and Marine Tower.
- Restore access to the interior Marine Tower stairway, so that two means of egress are available out of the building from the Bin Floor.
- Provide fire separation of exit stair compartments in the basement.
- Provide additional exit(s) from basement to exterior.
- Provide an egress door between the Warehouse Basement and Rail Shed basement areas.

7.2. Stair Construction

The Ontario Health and Safety Regulation for Industrial Establishments does not provide detailed dimensional requirements for existing stair construction, nor does it directly reference those requirements in the Building Code. However, the Building Code is commonly used as the guideline for egress and exit stair requirements. Below is a brief assessment of how the existing stairs in the facility compare to the OBC requirements.

Stair Building Code Requirements

OBC requirements for Straight Stairs:

- Minimum tread run of 10” [3.4.6.8.(1)]
- Maximum stair riser of 7-7/8” [3.4.6.8.(2)]
- Minimum stair width of 35” or 43”, depending on storeys served by stair [3.4.3.3.(7)]
- Maximum vertical rise of a flight of stairs between landings of 12’ [3.4.6.3.(1)]

OBC requirements for Curved Stairs:

- Have an inside radius not less than twice the stair width. [3.4.6.9.(2)]

Stair Conditions

Straight Stairs – Straight steel stair flights are the common means of egress from Shipping Tower and Marine Tower floor areas. The existing stair deficiencies to current OBC requirements include:

- Common stair treads of 7”
- Stair risers exceeding 8”
- Stairs widths of 28”
- Vertical rise of stair flights exceeding 12’. The highest vertical rise is the Shipping Tower stair extending from the Scale Bin Floor to a mid-landing, which vertical rise of about 24’ in a single flight.

Spiral Stairs – Spiral stairs are located in two areas, providing egress from the Bin Floor and the Electrical Substation.

- The radius (width) of the spiral stairs is 2’-10”. Spiral stairs are not permitted by current Building Code, and the tread dimensions do not conform to the requirements for a curved stair.
- No intermediate landings are provided for the entire height of the spiral stairs.

Recommendations, Unoccupied Floor Areas

The OBC permits stairs that are used only for occasional servicing to not comply with the dimensional requirements for exits as prescribed in the OBC [3.3.1.13.(2)]. Therefore, stairs located in normally unoccupied areas are not specifically required to be upgraded to meet current code requirements.

- It is recommended that workers who are required to access the normally unoccupied floor areas be provided orientation so they are aware of the hazards associated with the existing egress stair conditions and configurations.

7.3. Guardrails

Guardrail Requirements

Ontario Health and Safety Regulation for Industrial Establishments (Reg. 851) requires guardrails to be installed around the perimeter of a floor opening, along the open side of a raised floor or other surface that a worker has access to. Guardrail construction requirements include:

- A top rail between 36” and 42” above floor.
- A mid rail.
- A 5” toe board where tools or other objects may fall onto workers.

Guardrail Conditions

Openings in floors and along open sides of floors are generally equipped with a guardrail consisting of a top and mid rail. Some guardrail deficiencies that were observed on site include:

- Gaps in the floor around penetrations through the Shipping Tower Head Gallery mezzanine that were not protected.
- Several locations where low windows were located along a surface without being protected by a guard. Locations include windows on the Shipping Tower Head Gallery mezzanine, and windows along the east end of the Bin Floor Tripper Conveyers.
- Guard railings throughout the facility are not equipped with toe boards.
- In numerous locations, the guard height does not meet current regulations

Recommendations

Recommended upgrades to guardrails include:

- Block gaps in Shipping Tower Head Gallery floor if workers access this area.
- Provide guardrails along low windows where hazards exist in areas that workers access.
- Install 5" toe boards along the base of guardrails in areas where regular work or maintenance is expected to prevent tools/objects from falling.

7.4. Primary Roof Fall Arrest System

Construction

There is no effective fall arrest system installed on the roof of the Collingwood Terminal. Temporary guards have been provided to restrict travel on the roof and provide a delineated path of safe travel for service personnel.

Figure 31a, b: Primary roof without fall arrest system

Assessment

While the installation of permanent fall arrest systems are not required by Code, the installation of such a system would be prudent given that the roof is used on a periodic basis and there may be considerable exterior remedial work at the facility over the next 5 years.

Recommended Actions

The following **short-term** remedial actions are recommended for the fall arrest system:

1. Install a roof top fall arrest system. We recommend that the system be designed to provide both traditional fall arrest anchors for elevated platform tie offs and a horizontal lifeline to allow safe travel across the roof.

7.5. Shipping Tower Fall Arrest System

Construction

Steel fall arrest anchors were observed outside the Shipping Tower Penthouse. The anchor consisted of a d-ring, a threaded rod and steel plate that was bolted to the exterior wall of the Penthouse.

Conditions

While the anchor itself appeared to be in good condition and suitably located, there is no certified Roof Anchor drawing posted at the access to the roof level as required by OHSA. Without posted documentation about design of the fall arrest system, instructions for use and certified inspections, the fall arrest system should not be used.

Figure 32a, b: Fall Arrest Anchor at Shipping Tower roof

Recommended Actions

The following **immediate-term** remedial actions are recommended for the fall arrest anchors:

1. Advise the communication firms that the existing system is not compliant and have this condition rectified.

8. Building Envelope

This section is a summary of the preliminary Phase 1 assessment of the building envelope construction and conditions at the Collingwood Terminals facility.

8.1. Roof

Construction

The existing primary roofing at Collingwood Terminals consists of a traditional hot applied asphaltic membrane (commonly know as a 'tar' roof). The warehouse roof is a modern modified bitumen system.

Conditions

The tar roofs have exceeded their service life and can be deemed to have failed. Typically, the membrane has become brittle and extensive cracking was identified. In many locations, the membrane has completely delaminated from the concrete roof. Considerable concrete delamination was identified at areas of complete membrane failure.

The roof over the warehouse was relatively new and was found to be in good condition with recent repairs having been completed.

Figure 33a, b: Upper roof membrane failure

Figure 34a, b: Bin roof membrane failure

Assessment

The failure of the roof membrane is allowing considerable leakage into the structure. This leakage is resulting in accelerated deterioration of the concrete structure and if not mitigated could lead to premature failure including the bin top slabs. Replacement of the roof system is required. Failure to replace the membrane system will result in an exponential increase in concrete deterioration.

As noted above, the concrete slab over the exterior bins is in an advanced stage of deterioration and is not suitable to support a new membrane system. Due to very restricted access within the silos, concrete restoration is cost prohibitive. As an alternate, we have developed a steel framing system that will both reinforce the concrete slab and provide a waterproof roof over these areas.

Recommended Actions

The following **short-term** remedial actions are recommended for the roof:

1. Remove and replace the existing roofing membrane including all associated flashings and sealants.
2. Install the new steel roof system over the exterior silos.

8.2. Exterior Coatings and Sealants

Construction

The exterior façade of the Terminal facility is dominated by exposed concrete including the above grade foundations, elevator silos, Marine and Shipping Towers. An exterior coating has been applied to the concrete surface.

Conditions

In general, the existing coating has failed and no longer provides any effective protection for the concrete substrate. Similarly, the existing sealants have become brittle and have completely failed and no longer provide an effective weather tight enclosure.

Figure 35a, b: South & North Elevations

Figure 36a, b: Shipping Tower Elevations

Assessment

While the existing coating (paint) may have been installed only as a decorative finish, we conclude that that the concrete structure would benefit considerably by the application of a new coating that would both return an aesthetically acceptable finish and provide longterm protection to the concrete. A new coating would minimize water infiltration while allowing the concrete to breathe.

In advance of re-coating the facility, concrete restoration work is required (as previously noted). In addition, the re-coating should be scheduled to coincide with replacement of sealants, flashing and other water shedding elements.

Recommended Actions

The following **long** term remedial actions are recommended for the exterior:

1. Recoat all the exposed concrete surfaces with a water shedding yet breathable coating including all associated flashings and sealants.

9. Summary of Recommendations

The following provides a summary of the recommendations for the existing structure.

Items requiring immediate remedial action (within the next 6 months):

1. Maintain restricted access to the following areas due to unsafe condition. A detailed Code, Safety Standard and Structural analysis in these areas is recommended to determine if these areas can be reinforced, replaced or permanently removed from service:
    a. Exterior access ladders at the Shipping and Marine Towers.
    b. Interior access ladder in the rail shed (switchgear room)
    c. All service platforms
    d. Rail shed exterior wood framed platforms
2. Complete an environmental abatement of the Marine Tower to facilitate access to this area to undertake a condition assessment and to provide exit facilities for the Bin Floor. Note that this work must be completed in advance of any other remedial work within the Marine Tower. At the completion of the abatement, all openings should be sealed to prevent further animal entry and contamination.
3. Provide a second means of egress from the basement area.
4. Complete a detailed assessment of the existing windows to identify those windows at risk of short-term failure. Further to the survey, install reinforcing or secondary restraints as required.
5. Provide orientation to all users of the facility indicating the site-specific hazards and the mitigating measures.
6. Inform the communication firms using the facility that the existing Shipping Tower Fall Arrest system is not compliant with regulations. Engineered drawings must be posted at the exit to roof level.
7. Distribute the Designated Substance and Hazardous Materials Survey to all firms actively using the Collingwood Terminals facility. Ensure that all recommended safety measures are implemented.

Items requiring short-term remedial action (within the next 12 months):

1. Remove and replace the existing roof membrane system above the bin floor and both Marine & Shipping Towers. Install the new exterior bin slab reinforcing system complete with new steel roof deck.
2. Install a roof fall arrest system to facilitate safe working conditions for the assessment and subsequent remediation of the concrete structure.
3. Prepare a concrete restoration strategy for the silo exterior concrete and for the window/door replacement program to address the significant deterioration along the perimeter walls.
4. Complete a detailed assessment of the basement slab structure.
5. Complete a comprehensive assessment of all interior and exterior stairs and implement all required remedial measures including replacing stairs, reinforcing stairs, replacing guard members, installing toe-kicks, etc. to provide code compliant stairs, ladders and guards. This work may be deferred depending on the frequency and intensity of use within the facility.
6. Contact the communication firms with equipment installed on the Terminal and ensure that all anchor points are sealed to minimize water infiltration.

Items requiring medium-term remedial action (within the next 24 months):

1. Complete the exterior concrete restoration program including repair, seal and coat the bin & tower walls.
2. Complete the bin floor wall concrete repairs and window/door replacement program.
3. Complete foundation waterproofing and grading upgrades as required to mitigate water infiltration to the basement level.
4. Inspect exterior doors and windows. Replace as required.

Items requiring long-term remedial action (within the next 5 years):

1. Undertake a sub-surface investigation to document the condition of the existing wood piles.
2. Complete interior concrete restoration in areas not previously addressed (bin floor, shipping tower, etc.)
3. Prepare and implement a comprehensive maintenance program for the upkeep of the Collingwood Terminal facility.

10. Restoration Strategy

The recommendations detailed in this report represent the restoration work required to provide a structurally sound and durable structure. They are based on the continued use of the facility as essentially an abandoned industrial site with limited access. The only contemplated use is support for the roof top communication systems currently installed.

As detailed above the restoration work includes the following primary items:

- An environmental abatement of the accumulated bird droppings within the Marine Tower. This work is required to permit free access into this portion of the facility to facilitate a structural condition assessment and any required repairs plus to provide a secondary means of egress from the upper portion of the structure. Following abatement, the large Marine Tower openings are to be sealed to minimize ongoing occupancy by birds.
- Installation of a roof fall arrest system to facilitate safe roof inspections and to facilitate safe access for roof/concrete restoration.
- Replacement of the roof membranes to provide a weather tight enclosure.
- Concrete restoration for the bins, slabs, columns and perimeter walls. Chronic water infiltration has caused concrete deterioration which will continue to propagate and could lead to localized structural failures.
- Replacement of windows and doors to provide a weather tight enclosure. This item is of concern as many of the windows have effectively failed and are at risk of falling.
- Maintenance and localized replacement of stairs, platforms and other means of egress to provide a safe working environment for the limited access maintenance personnel.

Note that the Designated Substance and Hazardous Materials Survey completed identified asbestos, lead, guano (bird droppings) and other hazardous materials. The presence of these materials will have a significant impact on the cost and schedule for restoration works. Regardless of the approach selected for the facility, the environmental abatement is required. As an extension of the abatement program, all openings should be sealed to minimize animal access and a reoccurrence of environmental contamination. Based on the survey completed, the environmental consultant estimates that the abatement costs including removal and disposal of the designated substances would be $1.2 million to $1.8 million.

Based on the Phase 1 condition assessment completed, we have identified four approaches for this facility:

1. Full Remediation and Repair: This option would include completing all the recommended restoration work within the next 5 years (as per the proposed schedule). While detailed cost

estimates will require further design development, our initial estimates indicate that the cost of the repairs will be in the $8.0 million to $9.7 million range including environmental abatement. In more detail the budget costs are as follows:

a. Environmental abatement including temporary enclosure of the marine arm openings: $1,500,000-$2,000,000
b. Roof replacement including exterior bin steel roof and fall arrest system: $3,000,000-$3,500,000
c. Concrete restoration (bins & tower walls) and coatings: $2,700,000-$3,000,000
d. Window & door replacement: $300,000-$500,000
e. Interior systems upgrades: $200,000-$300,000
f. Foundation waterproofing and drainage: $300,000-$400,000

2. Phased Remediation and Repair: This option would include the same scope of work noted above but be extended over a longer time frame. This strategy would be based on a priority sequence – life safety (environmental abatement, means of egress, fall arrest); structural integrity (concrete slab stabilization); durability (concrete slab restoration, roof and window replacement); and finishes (coatings, sealants). Each phase would be preceded by detailed engineering assessment and design development. The overall scope of work in this option would be greater as deterioration will continue until areas are protected and repairs are completed. By extension the cost of this option would be greater than noted above due to the increased scope of work and the extended construction schedule.
3. Abandon the Facility: This option would include none of the recommended remediation measures and would require the facility to be completely vacated including the currently installed communication systems. With this option, we would recommend 'mothballing' the facility and ensuring measures are in place to secure the facility from unwanted intruders. Ultimately, this option would lead to 'demolition by neglect' and increased safety concerns as the structure deteriorates. The only benefit of this alternative is that it minimizes short term capital outlays and would leave the structure standing for a limited period in case an alternate solution becomes preferred.
4. Demolition: This option would include complete demolition of the terminal structure to grade level. As noted above, environmental abatement would be required prior to the demolition of the concrete structure. The order of magnitude cost estimate for the demolition is $5,000,000 including the environmental abatement work.

Our recommendation would be to pursue Option 1 but recognize that municipal resources may require Option 2 to be selected. Tacoma Engineers can provide ongoing engineering services to support the option selected by Town of Collingwood. Please contact the undersigned with any further questions or comments.

Per: _____
Will Teron, P.Eng., CAHP
Director – Heritage & Investigation, Principal
Tacoma Engineers Inc.