

Collingwood Terminals Foundation Pile Assessment

1 Heritage Drive
Collingwood, Ontario



Prepared by:



Project: TE-35355-20
August 2020

1. Background

Further to our June 2018 Collingwood Terminals Engineering Condition Assessment Report, Tacoma Engineers has been retained by Town of Collingwood to carry out a detailed assessment of the existing wood pile foundation system installed at Collingwood Terminals located at 1Heritage Drive, Collingwood, Ontario. The purpose of this assessment is to provide the Town a more comprehensive assessment of the wood piles as a pile assessment was beyond the scope of the previous general condition assessment.

While this report is complete on its own, referring to the 2018 assessment report will provide additional context including a history of the Terminal and its construction. An excerpt from the 2018 report:

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.



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 was constructed.

Conditions

While a direct inspection of the wood piles was beyond the scope of this report [previous 2018 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.

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. [2020 update – not currently feasible due to high water levels]*
- 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.

The site investigation, assessment and this report is a result of the findings and recommendations are based on two distinct structural investigations:

- December 17, 2019: Sub-surface (underwater) investigation of the wood piles at the west end of the terminal. Investigation include use of human divers and a remotely operated underwater vehicle (ROV)
- February 13, 2020: Excavations (test pits) at the perimeter of the Terminal foundations to expose the wood piles and allow a visual review of conditions

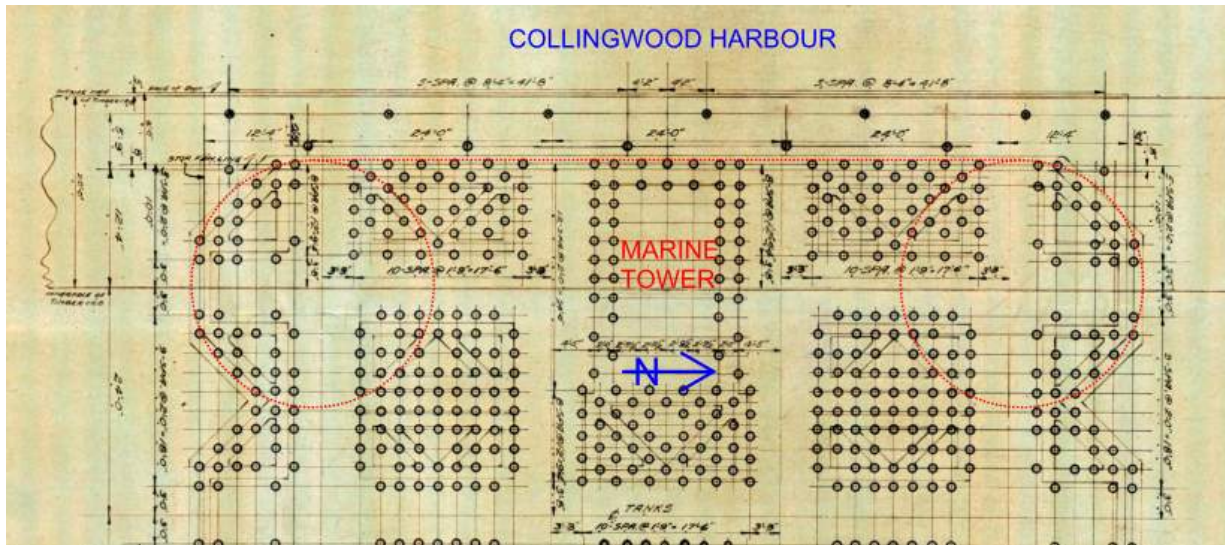
2. Structural Investigation

2.1. Underwater Investigation

The underwater inspection of the pile foundation system was completed from Collingwood Harbour through the services of Canadian Underwater Inspection Service. The purpose of the investigation was to confirm the geometry of the pile foundation system, determine the condition of the wood piles, determine the condition of the granular fill and determine the condition of the concrete slabs.

Construction

As per the June 1928 Piling Plan (excerpt below), prepared by C.D. Howe Consulting Engineers, the pile layout at the western end of the terminal (silos and marine tower) is characterized by tightly spaced piles below the primary structures and a more loosely spacing below the west wharf. All of the piles at the western end of the terminal are enclosed within a heavy timber crib system which is approximately 20' wide (8' below the wharf and 12' below the terminal) and extends the full length of the terminal (and beyond).



Observations and Conditions

The existing conditions allowed for a review by the marine diver and ROV of the western face of the wharf crib and a limited review of the wood piles located below the concrete wharf and marine tower structure. The review was limited as the area below the wharf is filled with granular material and it was deemed unsafe to send a diver into this confined space.

The underwater investigation confirmed that the geometry of the crib and piles is generally consistent with the original 1928 design drawing. The only notable variation was a marginal increased quantity of piles installed below the wharf section.

The western edge of the pile foundation system was enclosed within a heavy timber crib system. Based on the subsurface investigation, approximately 25% of the crib face has been damaged to the point where significant timbers are missing. The damage is likely due to a combination of ship impact, wave action and ice jacking. It is through the area with the missing timbers that the balance of these observations were possible. If the timbers were in place, the area below the wharf would be completely sealed off.

From the vantage of the displaced crib facing, it was confirmed that the crib was filled with mixed heavy granular material (boulders to gravel). Significant washout of the granular fill was noted where the crib face allowed wave action and prop wash below the wharf. The washout, at the extreme, extended the full 20' width of the crib. This washout allowed for a review of wood plies that would otherwise be buried within the granular fill.

Based on the diver and ROV survey, approximately 50% of the piles reviewed had visible deterioration. The deterioration ranged from relatively minor surface decay (less than 1" deep) to complete pile decay.

Photo with time stamp 10:19:58 illustrates a pile in relatively good condition which is fully engaged in the concrete wharf slab above.



Photo 10:20:32 illustrates a pile with significant deterioration where over 75% of the pile section is completely decayed.



Photo 10:17:40 illustrates 3 adjacent piles where the top of the pile has completely decayed and is no longer in contact with the wharf slab above.



Assessment

The damage and deterioration identified during the sub-surface investigation is structurally significant. Approximately 25% of the crib face is damaged and/or deteriorated; there is considerable granular washout adjacent to these areas; and approximately 50% of the piles exposed exhibited a certain degree of wood decay and/or deterioration with over 10% exhibiting significant or complete decay.

Note that the pile decay and deterioration noted above is based on a small sample area. This area is adjacent to the area of crib deterioration and as such, these piles are subject to wave and ice exposure that may not have been anticipated when originally designed and installed.

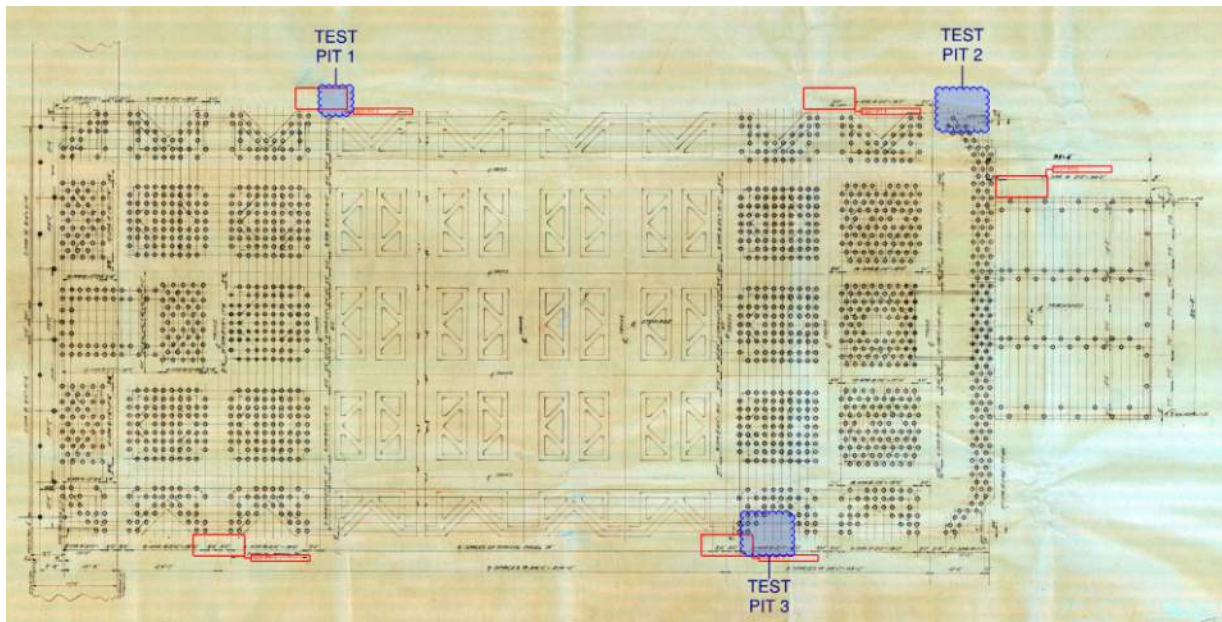
While significant deterioration of the piles was identified during the sub-surface investigation, the 20” thick concrete wharf slab is generally in good condition with no evidence of structurally significant damage, deterioration or deflection. This would suggest that the remaining piles are providing adequate support given the current load demands.

2.2. Perimeter Investigation

The perimeter inspection of the pile foundation system was completed by digging 3 test pits at strategically located random locations. The purpose of the investigation was similar to the underwater investigation - to confirm the geometry of the pile foundation system, determine the condition of the wood piles, determine the condition of the granular fill and determine the condition of the concrete slabs.

Construction

The perimeter excavation investigation indicated that the piles were installed consistent with the C.D. Howe Consulting Engineers’ 1928 Piling Plan (copy below). Further the excavation confirmed a generally uniform base slab with a thickness of 14-18” and a projection from the perimeter wall of approximately 16”. The slab is constructed directly on the top of the wood piles.



Observations and Conditions

At three unique locations, north-west quadrant, north east quadrant, and south-east quadrant, test pits were excavated in two stages: 1) to an elevation level with the underside of the foundation base slab; and 2) to a level approximately 3' below the underside of the slab. The purpose of the two stages was to allow a close inspection of the slab followed by a close inspection of the underlying piles.

Unfortunately, Lake Huron and Georgian Bay are at historic high levels. The high lake water level is resulting in a correspondingly very high ground water level. During the excavation, the static ground water level was approximately 10" above the top of the concrete base slab which significantly limited the effectiveness of the pile inspection.

Through the use of high capacity pumps and rapid entry/exit from the excavations, it was clear that the conditions at all three excavations were similar. The foundation walls and concrete slabs were found to be in good condition. The top of the base slab is approximately 5'-0" below the basement windowsills which is consistent with the geometry measured on the interior.





Similarly, our review of the exposed wood piles in the three test pits did not identify any significant damage, deterioration or decay. All of the exposed piles were fully engaged with the concrete slab and penetration probes found the wood to be sound.

3. Conclusion & Recommendations

Based on both the sub-surface investigation completed at the west end of the Terminals and our perimeter investigation completed at three test pits, we are of the opinion that the existing foundation system is in fair condition given the age of the structure. Note that these comments are based on a limited visual review of the foundation system and are subject to revision if conditions change (exposure or use).

While our sub-surface review identified significant pile deterioration, the deterioration appears limited to a localized area below the wharf that is exposed to more severe conditions. The damaged/missing face of the cribbing allows significant wave and ice action to impact the piles. Given there is no evidence of any slab settlement or distress and the fact that the Terminals are empty, there is no significant risk to persons or property. We would recommend that if the Terminal was to remain vacant for an extended period of time, it would be prudent to prepare and implement repair strategies to mitigate further decay to the exposed piles and granular fill.

The perimeter investigation indicated that the typical Terminal piles are in good condition and likely bearing consistent with the original design. Again, given that the Terminals are empty and therefore the actual loads are significantly less than the design loads, there is no significant risk to persons or property as a result of any nominal pile deterioration.

As previously noted, the lake water levels are at historic high levels. These high levels hinder exterior excavations and prohibit completing an interior sub-slab investigation. Once water levels have receded, further investigation from the interior could be undertaken to verify and document the condition of interior piles and to determine the extent of granular washout (possible voids) below the interior concrete slab. Similarly, the 2018 recommendation to install foundation drainage and waterproofing is not feasible until water levels recede.

In summary, our foundation pile review indicates that the piles are currently in a condition that provides structurally adequate support for the Terminal facility above. Currently, no substantive work is required for the foundation system. This assessment is based on the assumption that the facility continues in it's current use with limited access by authorized personnel or contractors only. A detailed structural analysis would be required in advance or part of any facility redevelopment or recommissioning.

In closing, we recommend that the Terminals be monitored on a regular basis and any evidence of new damage, deterioration or displacement be reported to Tacoma Engineers so further investigation can be undertaken.

Please feel free to contact the undersigned at any time to discuss these findings or any other matter related to this facility and our Condition Assessment Reports.



Per:

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