SPEEDVALE TRAIL

RETAINING WALL
STRUCTURAL CONDITION ASSESSMENT REPORT

Prepared for:
City of Guelph.

Prepared by:
Amec Foster Wheeler Environment & Infrastructure
a Division of Amec Foster Wheeler Americas Limited

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Structural Retaining Wall Condition Assessment
Speed River West Retaining Wall
Guelph, Ontario

Submitted to:

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1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (“Amec Foster Wheeler”), was retained by City of Guelph to conduct a Structural Condition Assessment of the existing retaining wall along the west side of Speed River, north of Speedvale Avenue, Guelph, Ontario, refer to Figure 1.

Figure 1: Speed River

The City of Guelph is planning to construct a new pedestrian trail along the west side of the Speed River above the existing concrete retaining wall. The structural performance of the existing retaining wall should be investigated to determine if the retaining wall can support the proposed trail, assess if a new handrail can be constructed on top of the existing retaining wall, and to develop rehabilitation strategy if needed. As such, the purpose of Structural Condition Assessment Report is to provide an evaluation of the structural condition of the existing retaining wall, followed by appropriate recommendations, which serves as a basis for the decision-making pertaining to the rehabilitation of the structure.

A separate geotechnical investigation performed by Amec Foster Wheeler Environmental and Infrastructure (Geotechnical Investigation Report, Speedvale Trail, Speed River from Speedvale Avenue to Riverside Park, October 6, 2016) was undertaken to provide recommendations related to the wall stability, foundation conditions, and soil type and quality for existing backfill behind the wall.

1.1 DEFINITIONS

Concrete Conditions:

- Excellent — No observed material defects
- Good — Light material defects
  Example: Narrow cracks, light scaling, light honeycombing
- Fair — Medium defects
  Example: Medium scaling, medium cracks widths
- Poor — Severe defects
  Example: Spalls, delamination, severe scaling, wide cracks

2.0 SITE VISIT

On September 26th, 2016, Paulina Arczewska, EIT, Structural Designer and Dante Shawil, Structural Designer, Amec Foster Wheeler, visited the site and reviewed the retaining wall, refer Figure 2. The objectives of our site visit are to review the structural condition, provide recommendations for repair or replacement of the retaining wall, and explore the feasibility of a new handrail on top of the existing wall. It must be noted that original design drawings for the retaining wall were not available for this assignment. Our site visit and inspection services are limited to visual inspection of exposed elements only, no invasive or destructive review have been included in our work, as such our findings and conclusions presented herein are bound by these considerations.

Figure 2: Retaining Wall (South End)

The weather condition at the time of the visit was rainy with a temperature of 18°C. The inspection commenced at the north end of the retaining wall and progressed upward to the south end of the structure. The length of the inspected portion consists of approximately 400 meters of the retaining wall from Speedvale Avenue Bridge all the way to the Riverside Park. During the inspection, concrete surfaces were tested for delamination by striking the concrete with a hammer.

The concrete retaining wall was measured to be 450mm thick and approximately 400 meters long with an exposed height of 3 meters and 1.2 meters at its high and low ends respectively. The top of wall uniformly tapers from its high end to its low end. The wall appears to have been poured as a cast in place structure from the formwork joints visible on the concrete surface. There are no visible rust stains on the wall, what indicates a sufficient embedded depth of reinforcing steel or lack of reinforcement in the structure. As such, the type of the retaining wall cannot be determined just based on visual inspection. Drain holes were visible on the wall.

The classifications for material defects used in this report are in accordance with the Ontario Structure Inspection Manual (OSIM), April 2008 edition.

3.0 EXISTING CONDITION

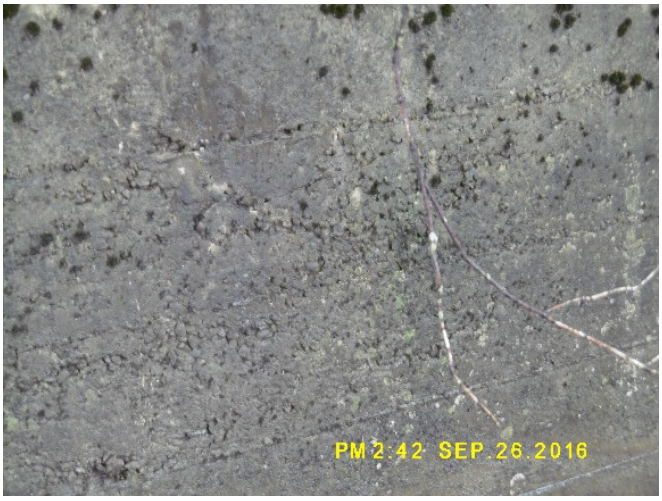
The retaining wall structure is approximately 40 – 50 years old, and in mostly good structural condition. The structure is exhibiting some signs of deterioration typical for the structure of this age. The deterioration observed has been presented below in the following table:

Table 1: Structural Condition Assessment

No.	Photograph	Condition Assessment
1		End of the retaining wall (north side): North side of the investigated portion of the retaining wall ends on the storm water pipe outlet. Concrete above the pipe separated from the retaining wall and wide cracks can be observed on the both sides of the pipe. Medium size spalls are visible on the top end of the retaining wall. In overall this portion of the retaining wall is in a fair to poor condition.

No.	Photograph	Condition Assessment
2		Face of the retaining wall (north side): Longitudinal small to medium cracks with white efflorescence were observed on the face of the north side of the retaining wall. Cracks occur only on a limited area, and wall in this portion in overall is in a good condition. Rehabilitation work should be undertaken in the next 5 years to avoid concrete further deterioration.
3		Top of the retaining wall (north side): Medium to wide full height and depth transverse cracks were observed along the retaining wall. The cracks occur at approximately the same distance, creating a pattern. This type of cracks occur in a structure when no construction joints are provided, and temperature or shrinkage stresses need to be released.
4		Face of the retaining wall (north side): Occasionally, medium size spalls associated with transversal cracks were observed. Areas of light vegetation occur on the top of the retaining wall, partially covering its depth. Light mold was observed on the face of the north side of the retaining wall along the whole length

No.	Photograph	Condition Assessment
5		Stormwater pipe outlet (middle portion): At the middle portion of the retaining wall (approximately 250 meters north of Speedvale Avenue Bridge), large spalls and delamination were observed nearby storm water pipe outlet. Delamination occurred at the concrete cold joint, probably due to impact load. This portion of the retaining wall is in a poor condition and needs to be rehabilitated in the nearest future.
6		Culvert outlet (middle portion) A round 1500mm diameter CSP pipe culvert is located at the middle portion of the retaining wall (approximately 160 meters north of Speedvale Avenue Bridge). The cold joint between the older a newer portion of the retaining wall is clearly visible, however, there are no signs of delamination and concrete in overall is in a good condition. Medium size mold and mass areas were observed at the bottom of the retaining wall along its length.
7		Face of the retaining wall (middle portion) Large areas of the mass and mold were observed at the face of the wall in a middle section, along with the wall length. Heavy debris of the natural origin in form of fallen branches and entire trees were observed on the top of the retaining wall. There are no signs of structural distress from impact or additional dead load, however, it is recommended to clean out that area in the nearest future.

No.	Photograph	Condition Assessment
8		Face of the retaining wall (south side) The face of the retaining wall on the south side is mostly covered in light to moderate mold and mass, causing deterioration of the concrete surface. Heavy vegetation covering the full depth of the retaining wall can be noticed on the top of the structure. In overall wall in this portion is in a good condition. Some maintenance work should be undertaken in the nearest future to prevent further deterioration
9		Face of the retaining wall (south side) Characteristic transversal cracks also were observed at the south side of the retaining wall Occasionally, medium size spalls and concrete delamination associated with the transverse cracks were observed. Wall in this areas is in a fair to poor condition.
10		Face of the retaining wall (south side) Light to moderate honeycombing was observed at the south side of the retaining wall. In overall, retaining wall in this portion is in a good condition

No.	Photograph	Condition Assessment
11		Face of the retaining wall (south end) South side of the investigated portion of the retaining wall ends on the Speedvale Avenue Bridge. Medium spalling at the connection face between the retaining wall and the bridge were observed.
11		Top of the retaining wall (escarpment) Heavy vegetation at the escarpment behind the retaining wall was observed at 70% of the total length of the wall, including fully grown trees just behind the retaining wall.
12		Escarpment Approximately 270 meters of the wall retains the relatively steep and unstable, due to heavy vegetation, escarpment.

4.0 COMMENTS AND RECOMMENDATIONS

In overall, retaining wall along the west side of the Speed River is in a good to fair condition with few medium to severe localized defects, and light to moderate surface deterioration. Rehabilitation and maintenance work is recommended to restore the retaining wall good condition. Based on the visual inspection, the structure is capable of supporting the proposed pedestrian trail. However, it should be noted that no original design drawings of the existing structure were available at the time of this assignment, and no structural stability assessment was performed.

A heavy vegetation on top of the retaining wall, approximately on 70% of the wall length, prevented closer investigation of the top portion of the structure. The feasibility of new handrail installation was investigated based on the visual inspection of the exposed sections (refer Figure 3). In overall, the top portion of the retaining wall is in a good condition, the total width of the wall (450mm) is suitable for new handrail installation, and there was no evidence of concrete deterioration. However, further investigation should be performed to check the concrete condition under covered areas. If needed rehabilitation work should be performed prior new handrail installation.

Figure 3: Top of the Retaining Wall (South End)

The foundations were not exposed at the time of the site inspection and therefore they were not reviewed as a part of this assignment.

The following table summarizes the recommended structural repairs to restore the retaining wall along the west side of the Speed River. All the noted repairs should be completed prior to any work on the new trail path can be undertaken.

Table 2: Recommendations and repairs requirements

Item No.	Repair	Action
1	Repair cracks by mortar/epoxy injections	Within 5 years
2	Repair spalled areas by concrete patching	Within 5 years
3	Clean out the wall surface from mold and mass to avoid further deterioration	Immediate
4	Clean out the top of the retaining wall from fallen branches and trees	Immediate
5	Remove the loose concrete from delaminated areas and rebuild the sections by patching repairs	Immediate
6	Clean out the escarpment from fallen trees and branches, stabilize the slope	Immediate

Approximate quantities of proposed repairs and rehabilitation work have been presented in the following table (Table 3). It should be noted that quantities have been obtained based on the visual inspection and not exposed elements of the retaining wall are not included. The cost of wall rehabilitation can increase after exposure of covered areas.

Table 3: Rehabilitation Work Quantities and Cost

Item No.	Item Description	Unit	Unit Cost	Quantity	Cost
1	Crack repair	m	$ 150.00	75	$ 11,250.00
2	Concrete removal Type A – partial depth of top of the wall	m^3	$ 3000.00	3	$ 9,000.00
3	Concrete removal Type C – partial depth of vertical surface	m^3	$ 5000.00	2.5	$ 12,500.00
4	Concrete removal – full depth	m^3	$ 2000.00	5.5	$ 11,000.00
5	Concrete patches form and pump	m^3	$ 8000.00	11	$ 88,000.00
6	Reinforcing steel	t	$ 2500.00	3	$ 7,500.00

Sub – Total	$ 139,250.00
Contingency (10%)	$ 13,925.00
Total	$ 153,175.00

The periodical inspections are recommended to monitor the condition of the wall.

In order to construct a new pedestrian trail on the west side of the Speed River, an additional retaining wall is necessary to retain the slope of the existing escarpment. Proposed Option A (refer to Appendix A), which includes 3.5m wide pedestrian trail and stepped wall with palnters is feasible. The height of the additional retaining wall will vary based on the escarpment slope from the highest point on the south side to the lowest on the north side of the trail. An armor stone or concrete block retaining wall seems to be a suitable solution for this localization.

5.0 CONCLUSIONS

Based on the discussion above, Amec Foster Wheeler are of the opinion, that noted retaining wall along the west side of the Speed River is generally in a GOOD to FAIR structural condition. It is recommended to provide some minor structural repairs to improve the structural condition to GOOD.

We trust that this report is adequate for your purposes. If you have any questions or concerns, please feel free to contact the undersigned.

Yours truly

,

Amec Foster Wheeler Environment & Infrastructure
a Division of Amec Foster Wheeler Americas Limited

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APPENDIX A

PRELIMINARY TRAIL OPTIONS