APPENDIX A – ENTRANCE AND EXIT RAMP STUDY

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-FINAL REPORT-

MILLENNIUM LIBRARY PARKADE
ENTRANCE AND EXIT RAMP STUDY

Project No. 2016-150

251 DONALD STREET, WINNIPEG, MANITOBA

PRODUCED FOR: CITY OF WINNIPEG

PRODUCED BY: CONCENTRIC ASSOCIATES INTERNATIONAL INCORPORATED

CONCENTRIC REFERENCE NUMBER: 16-6990

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1.0 INTRODUCTION AND BACKGROUND

In accordance with our proposal dated September 9, 2016, enclosed is a report outlining our study of the entrance and exit ramps for the Millennium Library Parkade located at 251 Donald Street in Winnipeg, Manitoba.

The Millennium Parkade and Library were constructed circa 1974. It was reported that a vertical expansion of the Library facility occurred circa 2004. Concentric was involved in administering an extensive rehabilitation project that took place in the Parkade between 2011 and 2014. As part of this previous work, one (1) of the four (4) entrance and exit ramps underwent rehabilitation at that time. Ramp 2, the Smith Street entrance ramp was subject to this previous work.

On August 25th, 2016, the City of Winnipeg commissioned a study of the remaining three (3) entrance and exit ramps at 251 Donald Street. At the time, it was reported in the RFP that the glycol systems (snow melt systems) within the concrete appeared to be failing, and that the concrete on the ramps and adjacent walls and retaining walls was spalling. Concentric was engaged on December 9th, 2016 to undertake this study.

The intent of this study was to:

- Review the condition and function of the existing in-floor heat systems and concrete in and around three entrance and exit ramps;
- Provide a report with recommendations for repairs, and;
- Provide a Class 3 cost estimate (-20% + 30%) for the implementation of the recommended repairs.

The scope our study focused on the following elements:

- Three (3) of the four (4) entrance and exit ramps, specifically;
  - Ramp 3, the Smith Street Exit Ramp;
  - Ramp 5, the Donald Street Exit Ramp, and;
  - Ramp 6, the Donald Street Entrance Ramp.
- Cast-in-place concrete for the suspended ramp slabs listed above, and the surrounding walls and retaining walls;
- Architectural coatings for the cast-in-place concrete surfaces listed above;
- Drainage systems specifically for these ramps;
- The in-ramp snow melt systems specifically for these ramps, and;
- The mechanical systems operating the in-ramp snow melt systems.

The snow melting systems (glycol loops that are heated with natural gas fired boilers) were installed in 1991. The snow melting systems comprise (from the top) a 90 mm thick concrete topping, 25 mm layer of rigid insulation, hot rubberized asphalt waterproofing, and the ramp slabs.

The scope of our study included the following tasks:

1. A review of available record specifications and drawings as they relate to the construction of the garage, including any past condition survey reports and/or past repair programs undertaken at the garage;
2. A visual survey of the exposed surfaces of ramps 3, 5 and 6, including surrounding walls and retaining walls. This consisted of recording the visible cracks, concrete spalls, impending spalls and any exposed reinforcing steel on the exposed surfaces;
3. A visual review of all visible equipment in the two (2) applicable mechanical rooms, and a portion of the glycol distribution header hoses that could be exposed through removing the casings;
4. A written report summarizing our findings and recommendations, and;
5. A class 3 cost estimate (-20% + 30%) for the implementation of the recommended repairs.

2.0 VISUAL FIELD INVESTIGATION AND OBSERVATIONS

Over the course of the study, we did not observe any existing conditions in or around any of the ramp systems that would threaten the immediate safety and/or serviceability of the facility. Several concerns have been identified regarding the condition and function of the ramp systems which are discussed below.

During the execution of this study, we had the opportunity to visit the facility on two occasions, and interview City of Winnipeg maintenance staff responsible for the systems in question.

The following observations and findings were obtained from the site investigations and record documentation reviews:

2.1 Ramp 2 – Smith Street Entrance Ramp

1. The underside of the ramp exhibited areas of brown staining/streaks along the interior walls of the ramp, likely from the water stop or waterproofing failing and/or corrosion as shown in Figure 1.

Figure 1 – Staining along interior wall beneath Ramp 2.

2.2 Ramp 3 – Smith Street Exit Ramp

1. The exposed foundation walls on the exterior egress ramp exhibit localized areas of concrete delamination, spalls, freeze thaw deterioration, thin cracks and areas of previous repair as shown in Figure 2.

Figure 2 – Deteriorated concrete along outer wall of Ramp 3.

2. The exposed foundation walls on the exterior egress ramp have been coated with an architectural coating. The coating appears to be in good condition with a few localized areas of failure and exposed concrete.
3. The ramp is served by 2" copper supply and return headers in a curb on the side of the ramp. 3/8" rubber-type distribution hoses run in the ramp slabs and connect to the copper headers with clamps.
4. The underside of this ramp could not be accessed for investigation and observations since it is a slab on grade.

2.3 Smith Street Mechanical Room (Ramps 2 and 3)

1. The fluid levels for the glycol snow melt systems at this location were reported to be stable by the maintenance staff at this location. They had no reports of topping up the levels in this fluid reservoir.
2. The system consist of three Burnham natural gas boilers operating in parallel with individual boiler circulation pumps and a main circulation pump to distribute glycol to the in-slab ramp tubing.
3. The system is controlled on/off by outdoor air temperature with the boilers maintaining a constant glycol loop temperature.
4. The system is approximately 25 years old except for the components feeding Ramp 2, the Smith Street entrance ramp which had all the piping downstream of the mechanical room replaced in 2011.

2.4 Donald Street Mechanical Room (Ramps 5 and 6)

1. The fluid levels for the glycol snow melt systems at this location were reported by the maintenance staff to be declining when the system is run at full pressure.
2. To avoid fluid loss and topping up the levels in this reservoir, it was reported by the maintenance staff that they run the system at roughly half its standard operating pressure.
3. The system consist of three Burnham natural gas boilers operating in parallel with individual boiler circulation pumps and a main circulation pump to distribute glycol to the in-slab ramp tubing.
4. The system is controlled on/off by outdoor air temperature with the boilers maintaining a constant glycol loop temperature.
5. The system is approximately 25 years old.

2.5 Ramp 5 – Donald Street Exit Ramp

1. The exposed foundation walls on the exterior egress ramp exhibit localized areas of concrete delamination, spalls, freeze thaw deterioration, thin cracks and areas of previous repair as shown in Figure 3.

Figure 3 – Concrete along outer wall of Ramp 4.

2. The exposed foundation walls on the exterior egress ramp have been coated with an architectural coating. The coating appears to be in good condition with a few localized areas of failure and exposed concrete.
3. The ramp topping displayed the most visible signs of wear and deterioration at this location.
4. Failed sections of the snow melt system were clearly visible though the accumulation of snow and ice on regions of the ramp as shown in Figure 4.

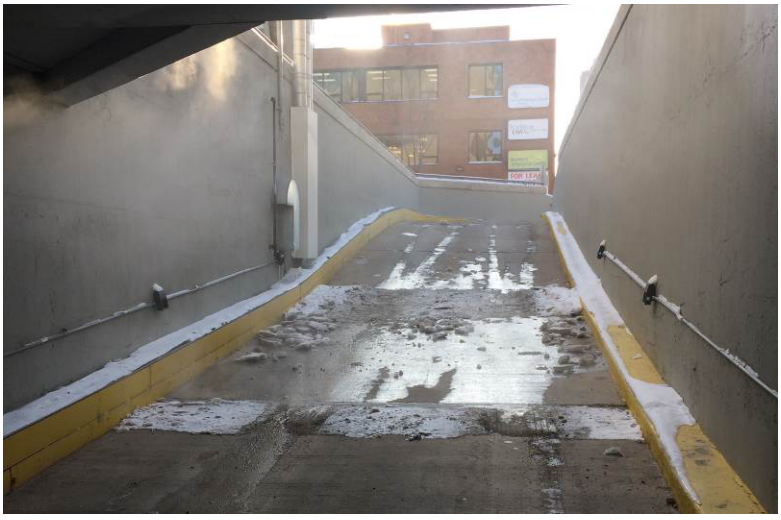


Figure 4 – Failed sections of Ramp 5 snow melt system

5. The ramp is served by 2" copper supply and return headers in a curb on the side of the ramp. 3/8" rubber-type distribution hoses run in the ramp slabs and connect to the copper headers with clamps.

6. Discussions with maintenance staff indicate that the in-slab rubber hoses have been the main point of failure. Leaks have occurred in the hoses, and the failed circuits have been capped off at the copper headers. The hoses were described as extremely brittle.
7. The underside of the ramp exhibited several areas of light brown staining around cracks, potentially from the waterproofing failing and/or corrosion in conjunction with the leaking in-slab rubber hoses.
8. The underside of the trench drain exhibits leakage and general distress.

2.6 Ramp 6 – Donald Street Entrance Ramp

1. The exposed foundation walls on the exterior egress ramp exhibit localized areas of concrete delamination, spalls, freeze thaw deterioration, thin cracks and areas of previous repair.
2. The exposed foundation walls on the exterior egress ramp have been coated with an architectural coating. The coating appears to be in good condition with a few localized areas of failure and exposed concrete.
3. Failed sections of the snow melt system were clearly visible though the accumulation of snow and ice on regions of the ramp as shown in Figure 5.

Figure 5 – Failed sections of Ramp 6 snow melt system.

4. The ramp is served by 2" copper supply and return headers in a curb on the side of the ramp. 3/8" rubber-type distribution hoses run in the ramp slabs and connect to the copper headers with clamps as shown in Figure 6.

Figure 6 – Glycol distribution hoses from header in Ramp 6.

5. Discussions with maintenance staff indicate that the in-slab rubber hoses have been the main point of failure. Leaks have occurred in the hoses, and the failed circuits have been capped off at the copper headers. The hoses were described as extremely brittle.

6. The underside of this ramp could not be accessed for investigation and observations since it is a slab on grade.

The previously listed observations that were recorded as part of the field investigations have been used to arrive at the following recommendations.

3.0 RECOMMENDATIONS

The most cost effective method of extending the life of a garage structure, particularly one exposed to deicing salts, is to reduce to a minimum the potential for chloride contamination. A repair program, which does not involve the complete removal of all concrete contaminated by chloride ions with concentrations above the threshold values, will not prevent continued concrete deterioration, although the rate may be reduced. Therefore, if initial repairs of this nature were performed, it would be expected that a future repair program would be required.

Based on the conditions observed and the results of our study, we recommend the following repair and rehabilitation work be conducted on the Millennium Parkade with the additional considerations listed below, also accounted for in the scope of the work:

3.1 Asbestos Containing Materials (ACM):

1. If ACM's are suspected in the areas requiring rehabilitation work, than a survey should be conducted to conclude the presence or absence of such substances prior to undertaking any repairs. Concentric can provide these services upon request; however, we have not included any construction costs in the estimate below for abatement of ACM's at this time since the current status of the asbestoses management plan is unknown to us.
2. Given that rehabilitation work could disturb Asbestos Containing Material (ACM) within the garage, the City should provide a copy of the asbestos management plan to the successful general contractor to comply with the requirements of Workplace Safety and Health Act (W210), and Parts 36 & 37 of the Workplace Safety and Health Regulation (M.R. 217/2006).

3.2 Mechanical and Electrical Systems:

1. Implement upgrades based on the recommendations of SMS Engineering, which have been included below in this report, and are also attached separately within Appendix A.
2. Replace all the original glycol distribution piping downstream of the both mechanical rooms, including the in-slab rubber hoses, with crosslinked polyethylene (PEX-a) tubing and installing a distribution header in each mechanical room. This excludes the Smith street piping that was replaced in 2011. Costs for complete replacement of these items have been included in the estimate below.
3. Consideration could be given to replacing only the in slab rubber hoses and keeping the copper headers running along the side of the ramps but balancing valves would need to be installed in the curb for each loop which may not be possible given the limited space. This reduced scope option has not been included in the estimate below.
4. Replacement of the boilers should also be considered as they have reached the end of their projected service life (25 years). Separate costs for replacement of these items have been included in the estimate below.
5. A contingency allowance for potential repair of electrical systems damaged during localized repairs has been included in the estimate below.

3.3 Structural and Architectural Systems:

1. To allow the replacement of the in-slab components listed above, the removal and replacement of the entire area of concrete topping on ramps 3, 5 and 6 will be required. As part of this work the waterproofing and rigid insulation should also be removed and replaced. Costs for replacement of these items have been included in the estimate below.
2. Remove and replace the concrete curbing that boarders the outer laneway on ramps 3, 5, and 6.
3. Remove and replace the glycol loop encasements that boarders the inside laneway on ramps 3, 5, and 6.

4. The exposed cast-in-place foundation walls on ramps 3, 5 and 6 require some localized concrete repair. The existing architectural coating on the exposed cast in place foundation walls is in good condition. This was part of the previous repair program conducted. Consideration should be given to removing the coating and exposing the concrete only in areas where surface repairs are required. Cost allowances for repairs of these items have been included in the estimate below.
5. The trench drain at the base of ramp 5 should be removed and replaced by virtue of the condition of the concrete surrounding the underside of the drain. This will require concrete and plumbing demolition and replacement.
6. The joint between the ramp 2 suspended slab, and the interior retaining wall requires an injectable repair to address the water stop or waterproofing that is potentially failing.

3.4 Materials Testing and Investigation:

It is likely that the concrete slabs are structurally sound; however, a contingency allowance has been included in the estimate below for top surface repairs identified or caused during demolition and construction. Based on our review of the ramp soffits, we do not anticipate any through slab repairs on the ramps, and have not been accounted for them in the estimate below.

Based on the observations and recommendations presented herein, a preliminary construction cost estimate has been assembled for consideration when planning subsequent phases of this project.

4.0 COST ESTIMATES

The following are preliminary class 3 construction cost estimates (-20% + 30%), which do not include engineering fees or GST:

TASK	FEES
Mobilization /Demobilization	
Based on a single phase where the ramps are worked on sequentially	$25,000
Structural and Architectural Systems (Ramp 3, 5 and 6)	
Remove and replace concrete topping (550 m^2 x $450 per m^2)	$247,500
Remove and replace waterproofing (550 m^2 x $100 per m^2)	$55,000
Remove and replace rigid insulation (550 m^2 x $50 per m^2)	$27,500
Allowance for top surface repairs (50 m^2 x $450 per m^2)	$22,500
Remove and replace approx. 130 m of glycol loop encasements	$18,000
Remove and reform approx. 130 m of concrete curbing	$15,000
Miscellaneous ramp and wall repairs (8 m^2 x $1,500 per m^2)	$12,000
Patch architectural coating on ramp walls at concrete repair locations	$4,000
Remove, replace and reform one (1) trench drain	$12,000
Structural and Architectural Systems (Ramp 2)	
Repairs between Ramp 2 suspended slab and wall	$4,000
Mechanical and Electrical Systems (Ramp 3, 5 and 6)	
Replace in-slab piping with (PEX-a). Connect to manifolds in boiler rooms	$22,000
Replace all boiler room equipment (boilers, pumps, piping, venting, etc.	$86,000
Contingency for electrical repairs	$10,000
Materials Testing and Investigation	
Contingency allowance for materials testing	$5,000
10% Contingency	$57,000
TOTAL	**$623,000**

Concentric is not a professional cost estimator or construction contractor, nor should Concentric's estimates of construction costs be considered equivalent to an estimate prepared by a professional cost estimator or construction contractor.

Preparation of a construction cost estimate requires making a number of assumptions as to actual conditions that may be encountered on site.

Factors over which we have little or no control include the contractor's methodology, economic volatility, the construction season, inclement weather, and the supply and demand of raw materials, finished goods, labour and the competitive nature of the construction business during the tendering process.

Construction cost estimates are considered budgetary figures only, based on recent industry data and experience on similar projects. The actual costs of construction may vary considerably from what has been estimated.

In determining the total estimated costs, the repair of a structure which is in use can result in significant costs due to the disruption of use to owners and others. The estimates presented herein only account for construction costs. We have estimated the construction costs based on the present deterioration and on the work being completed

on the three (3) ramps sequentially (One ramp at a time). These areas would be closed off to the building occupants and public for the duration of the repairs.

For the purpose of scheduling this work, it is reasonable to allow 4-6 weeks' time per ramp from start to finish assuming the ramp is entirely closed down for this duration. Adjustments to the sequence of construction, such as working on multiple ramps concurrently has the potential to influence the construction costs.

5.0 CONCLUSIONS

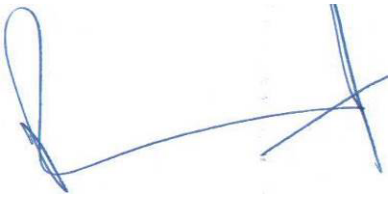
The recommendations presented in this study should be implemented in order to restore the failing systems back to a state where they function in a manner which satisfies their design intent. Additional engineering services will be required prior to selecting a general contractor and undertaking construction. The completion of a conceptual design, detailed design and tender/construction documents based on this study will be required to enact the recommendations presented herein.

Executing the repairs and rehabilitation work on the ramps within in the next 6 - 8 months would help ensure the work is conducted during optimum construction season, and prior to the ramps being required again for the following winter season.

Should there be any questions please contact the undersigned.

Yours sincerely,

Concentric Associates International Incorporated



Andrew Grierson, P.Eng., PMP
Project Manager

Paul Matergio, C.E.T.
Partner

APPENDIX A

SMS Mechanical Report

Concentric Engineering
1600 Ness Avenue, Unit 300
Winnipeg, MB, R3J 3W7
andrew@concentriceng.com

Attention: Andrew Grierson, P.Eng., PMP

Dear Andrew:

Re: MILLENIUM LIBRARY - 251 DONALD – ENTRANCE AND EXIT RAMP STUDY

SMS Engineering Limited was commissioned to review the mechanical systems associated with the in-ramp snow melt systems at 251 Donald as sections of the system have been failing. The report below details our findings and outlines our recommendation for repairs.

Background

The Millennium Library Parkade is a 2 level below grade heated parking garage with four entrance and exit ramps for the facility. Two ramps are located on Donald Street and two on Smith Street, with each street being served by a glycol snow melt system located in a mechanical room below one of the ramps. Both systems consist of three Burnham natural gas boilers operating in parallel with individual boiler circulation pumps and a main circulation pump to distribute glycol to the in-slab ramp tubing. Systems are controlled on/off by outdoor air temperature with the boilers maintaining a constant glycol loop temperature. All systems are approximately 25 years old except for the Smith St. entrance ramp which had all the piping downstream of the mechanical room replaced in 2011.

The remaining three ramps are served by 2" copper supply and return headers in a curb on the side of the ramp. 3/8" rubber-type distribution hoses run in the ramp slabs and connect to the copper headers with clamps as shown in Figure 1.

Figure 1 - Glycol distribution hoses from header

During our site review, we observed that sections of the Donald street snow melt system have failed and no longer keep the ramps free of snow as shown in Figure 2. Both Smith street ramps were fully operational, though the exit ramp is of the same age as the Donald street ramps.

Figure 2 - Failed Sections of Donald street snow melt system

Based on discussions with City of Winnipeg maintenance staff, the in-slab rubber hoses have been the main point of failure. Leaks occurred in the hoses and the failed circuits were capped off at the copper headers. The hoses were described as extremely brittle and the Donald street glycol system was operating at one half its design pressure as higher system pressures caused additional leaks in the hoses. This type of system has been noted for the failure of the rubber tubing system in many installations over the years.

Recommendation

Based on the site conditions described above, we recommend replacing all the original glycol distribution piping downstream of the mechanical rooms, including the in-slab rubber hoses, with crosslinked polyethylene (PEX-a) tubing and installing a distribution header in each mechanical room. This excludes the Smith street piping that was replaced in 2011. Consideration could be given to replacing only the in slab rubber hoses and keeping the copper headers running along the side of the ramps but balancing valves would need to be installed in the curb for each loop which may not be possible given the limited space.

Replacement of the boilers should also be considered as they have reached the end of their projected service life (25 years).

Yours truly,

SMS Engineering Ltd.
Per:

Colin Tait, P.Eng.
Mechanical Engineer