

STRUCTURAL CONDITION ASSESSMENT REPORT

FOR THE

RED, YELLOW, AND GREEN PARKING RAMPS

IN THE

City Of Appleton

Appleton, Wisconsin

DESMAN Project No. 50-19176

Prepared For

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EXECUTIVE SUMMARY

Based on our review of the available drawings from the original construction of the parking garages, results of the on-site condition assessment, results of the selective laboratory and field testing, and our analysis and experience with similar parking garages, DESMAN is providing the following summary and conclusions for the current condition of the Appleton Parking Structures.

Summary of Conditions and Repair and Maintenance Requirements

The recommended repair and maintenance plans provided in this report are comprehensive rehabilitation programs to extend the useful life of the three garages. The repair and maintenance plans have been divided into phases over multiple years, to show annual budgets. The repair and initial preventive maintenance for each garage is concentrated in the first 3-4 years of the budgets. The ongoing maintenance can be planned for 5 to 10-year intervals when the repair program includes spot repairs and sealant replacements following the completion of the initial phases. Considering the age and condition of the structural, architectural, plumbing, electrical, and other systems, a significant total initial cost is required for repairs and replacements.

A longer repair cycle (10 to 20 years) can be achieved when the repair program includes repairs and enhanced protection with preventive maintenance items that are further described in the report. The enhanced protection approach includes optimized preventive measures to improve the current materials and conditions for resiliency and durability. These preventive measures are to some extent, enhancements to the current systems present in the garages. However, the current systems have significant deterioration, contamination, and aging issues, and without enhanced preventive measures, the concrete will often show accelerated deterioration which often requires ongoing repairs at short intervals (5 years). We therefore recommend that the repairs, maintenance, and enhanced preventive maintenance items be considered as a complete package. If parts of the recommended plan are removed to reduce initial costs, the future repair costs are expected to increase and the remaining service life will also need to be reduced.

Red Parking Structure

The Red Parking Garage is a cast-in-place post tensioned structure. The garage generally exhibited typical age and chloride contamination related deterioration. This means that without corrective preventive measures, corrosion of concrete reinforcement is expected to increase and the amount of floor slab spalls requiring repairs are expected to increase. However, a portion of level 2 was found to have much higher levels of chloride contamination and higher levels of concrete spalls. The spalled concrete requires concrete repair and a maintenance program designed to arrest the rapid rate of deterioration present. Outside of level 2 the garage was found to be in need of control joint sealant and expansion joint sealant replacement in order to prevent excessive water infiltration. After concrete repairs are completed, continuing a repair and preventive maintenance program will be critical to avoiding escalating concrete repair quantities. Based upon our chloride ion content testing results preventive maintenance measures including the application of a silane sealer with and integral corrosion inhibitor (C.I.T.) and limited waterproofing membrane application was recommended.

Yellow Garage

The Yellow Garage is a precast double tee garage with pre topped pre-stressed concrete double tees supported by precast concrete beams and columns. The garage was found to exhibit extensive water leakage through deteriorated joint sealants and corrosion related concrete deterioration. The concrete deterioration included damage to a number of the shear connectors embedded into the double tee

flanges. Protection of the shear connectors is vital to maintain the condition of a double tee structure. As a result, a repair and maintenance program is required to address the concrete deterioration noted throughout the garage, replace the aging and deteriorated joint sealants, and restore existing deteriorated waterproofing systems. In addition to the required repairs, several enhanced preventive maintenance options are recommended. These options include the application of a silane sealer with C.I.T. and the addition of waterproofing membrane strips to the double tee flange edges.

Green Garage

The Green Garage is a precast double tee garage very similar to the Yellow Garage; however, it exhibits far more extensive concrete deterioration despite similar ages. Most of the double tee joints throughout the garage were found to exhibit some degree of water leakage. Also, extensive deterioration to the embedded shear connectors and chord steel connections between the double tees was noted. Based upon our observations we believe that between 8% and 33% of the connections in the garage may need extensive repairs. Due to this large range, the first year of the repair program for the Green Garage has been designed as an “exploratory program” with an initial work scope to refine the cost projections for the rest of the garage and future years. Once the initial program has been completed the repairs in the following years will address the concrete deterioration, shear connection damage, leaking double tee and expansion joints, and any other detected forms of deterioration. Due to the condition of the garage a series of preventive maintenance options are recommended, similar to those recommended for the Yellow Garage. The preventive maintenance items for the Green Garage are anticipated to be vital in slowing the accelerated rates of deterioration present in the garage. Lastly, ongoing repairs to the garage stair towers are anticipated in order to provide safe access to and egress from the garage for patrons.

Summaries of the repair and maintenance programs with all of the recommended enhanced preventive maintenance options included are presented below. Detailed breakdowns of the repair programs with all of the enhanced preventive maintenance options broken out are presented in the “RECOMMENDATIONS” section of the report.

Table 1: Three Garages Recommended Repairs and Preventive Maintenance Summary

Garage	Year 1: 2020	Year 2: 2021	Year 3: 2022	Year 4: 2023	Year 5: 2024	Year 6: 2025	Year 7: 2026	Year 8: 2027	Year 9: 2028	Year 10: 2029	Totals
Red Garage	\$748,000	\$423,000	\$430,000	\$554,000	\$290,000	\$0	\$197,000	\$0	\$433,000	\$322,000	\$3,397,000
Yellow Garage	\$1,090,000	\$881,000	\$840,000	\$258,000	\$249,000	\$186,000	-	-	\$748,000	\$595,000	\$4,847,000
Green Garage	\$348,000	\$1,143,000	\$1,299,000	\$896,000	\$157,000	\$99,000	\$139,000	\$0	\$73,000	\$289,000	\$4,443,000
Totals	\$2,186,000	\$2,447,000	\$2,569,000	\$1,708,000	\$696,000	\$285,000	\$336,000	\$0	\$1,254,000	\$1,206,000	\$12,687,000

Phasing of Construction of Repairs and Preventive Maintenance

The required repairs and recommended maintenance program can be implemented in phases over multiple years and staged in relatively small work areas to allow the ongoing operation of the garage while construction is completed. The details for phasing and staging are typically further developed during the initial design for the repairs and maintenance.

Garage Expected Service Life after Repairs

After these items are completed, the garage is expected to need ongoing repairs and maintenance. Depending on the rate of concrete corrosion damage and the preventive measure selected, the repairs can be expected at a 5 to 15-year cycle.

CONDITION ASSESSMENT

At your request, Kyle Klepitch, Taha Macci, and Eugene Vlasenko of DESMAN visited the Red, Green, and Yellow Parking Garages in Appleton Wisconsin between December 3rd and 6th. Weather during the week was generally clear with temperatures in the lower to mid 30's F. Snow had fallen prior to our assessment and was melting throughout the week. The purpose of our site visit was to review the existing conditions in the structures as part of the performance of a condition assessment¹ and develop a repair and preventive maintenance plan with an estimated budget. To assist us in our review, Desman was provided with the original design drawings for the structures along with several previous condition assessment reports.

For the parking garage structural condition, the following terms are used in the evaluation of the building components as a whole:

- Excellent** Component is in a "like new" state and is performing its function as intended.
- Good** Component exhibits little deterioration and is performing its function as intended.
- Fair** Component exhibits minor deterioration and is performing its function as intended, but the component's rate of deterioration has begun to accelerate.
- Poor** Component has significantly deteriorated and/or is no longer functioning as intended.
- Obsolete** Component has completely deteriorated, and its state represents a potential hazard to the overall condition of the facility.

During the field condition assessment, DESMAN visually examined the top and bottom surfaces of the structurally supported parking slabs and the exterior facades of the parking structure. We also performed chain-drag sounding (testing) on the top surface of the concrete slabs to check areas for concrete delamination below the slab surface. A cursory visual examination was conducted for the structural members of the elevator-stair tower and staircases to identify operational or structural existing conditions. Visual examinations were also completed for the concrete slabs-on-ground (SOG) at the street level

Photographs

Photographs to document various conditions observed during our survey of the parking garage are included throughout this report with additional photographs located in Appendices A.1-A.3 of this report.

Concrete Testing

In addition, based on the agreed engineering services scope, various concrete material tests were performed to determine several engineering properties of the concrete mix used during the original construction of the supported parking slabs. These include soluble chloride ion content testing, and pachometer testing to estimate the depth of reinforcing steel from the slab top surfaces. This testing was performed on the Red Garage. Copies of the testing results and field tests performed by DESMAN are included in Appendix C of this report.

Electrical & Plumbing

Electrical, plumbing and fire protection systems were observed in cursory fashion as it relates to the weathering effects, and no system performance testing was included in our scope of services.

¹ - ACI 364.1R-19 *Guide for Assessment of Concrete Structures Before Rehabilitation* by the American Concrete Institute, 2019, www.concrete.org

Report Purpose

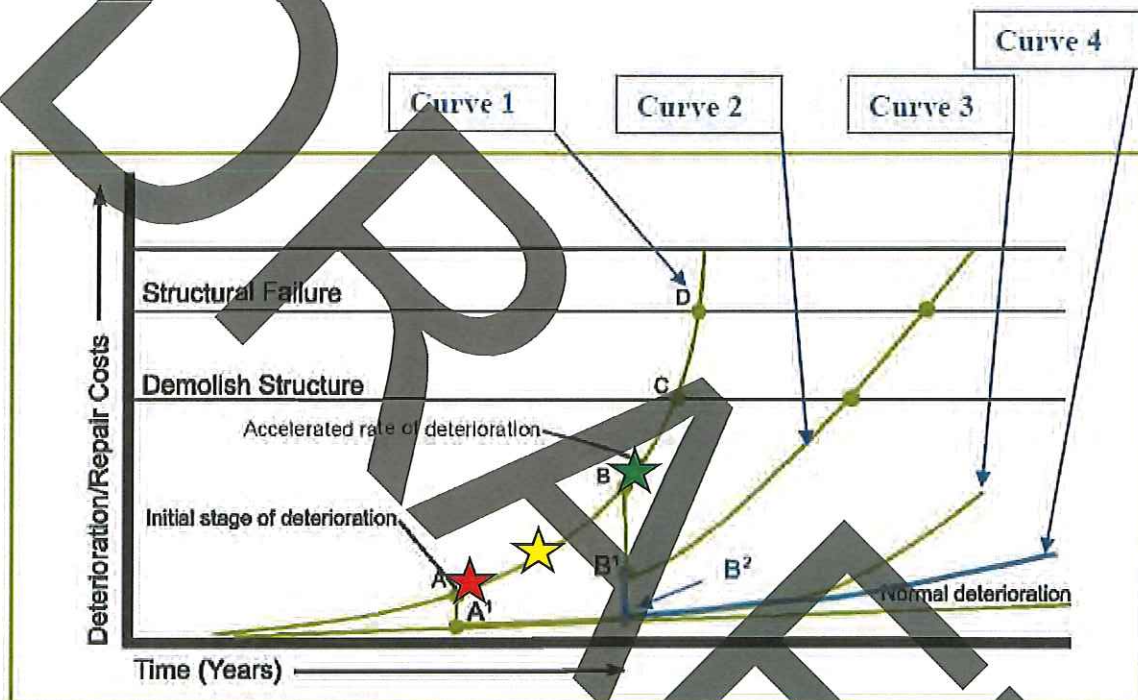
This report is intended to summarize our findings on the current structural and waterproofing system conditions of the parking garage and to present recommendations with regard to the currently required 'priority repairs', future five-year preventive maintenance repairs and repairs to maintain the structural integrity and the garage service life for several years to come.

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Table 3: Yellow Garage Recommended Repairs and Preventive Maintenance Options

Item #	Repair Items	Year 1: 2020		Year 2: 2021		Year 3: 2022		Year 4: 2023		Year 5: 2024		Year 6: 2025		Year 7: 2026		Year 8: 2027		Year 9: 2028		Year 10: 2029		
		Repair Levels 1-3	Repair Levels 4-5	Repair Levels 6-7	Repairs to Stair Towers	Replace Half of Expansion Joints	Replace Half of Expansion Joints	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Replace Roof Joint Sealants, Reapply Sealer to Levels 1-4, Periodic Repairs	Reapply Sealer to Levels 5-7, Periodic Repairs
Brief Scope Summary																						
Structural Repair Items																						
1	Tee to Tee Connection Repairs	\$34,000	\$18,000	\$10,000	-	\$5,000	-	\$5,000	-	-	-	-	-	-	-	-	-	-	-	-	\$10,000	\$10,000
2	Broken Tee Connection Weld Repairs	\$7,000	\$6,000	\$6,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\$10,000	\$10,000
3	Double Tee Lifting Point Repair Allowance	\$26,000	\$22,000	\$21,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\$10,000	\$10,000
4	Horizontal Concrete Repairs	\$25,000	\$15,000	\$15,000	-	\$10,000	-	\$10,000	-	-	-	-	-	-	-	-	-	-	-	-	\$8,000	\$8,000
5	Vertical and Overhead Concrete Repairs	\$5,000	\$5,000	\$5,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\$5,000	\$5,000
6	Stair Tower Repair Allowance	-	-	-	\$55,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\$55,000	-
7	Masonry Repair Allowance	\$10,000	-	-	\$10,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\$10,000	-
8	Facade Repair Allowance	-	-	-	\$0	\$50,000	-	\$50,000	-	-	-	-	-	-	-	-	-	-	-	-	-	\$50,000
Required Waterproofing Replacements																						
9	Replace Double Tee and Cove Sealants	\$169,000	\$136,000	\$132,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\$63,000	-
10	Rout and Seal Concrete Cracks	\$5,000	\$5,000	\$5,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\$5,000	\$5,000
11	Recast Existing Waterproofing Membrane	\$39,000	\$24,000	\$24,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\$79,000
12	Expansion Joint Replacement	-	-	-	\$28,000	-	-	\$102,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Clean and Repaint Stair Handrails	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Enhanced Preventive Maintenance Items																						
14	Widen Existing Waterproofing Membrane	\$45,000	\$43,000	\$43,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	Silane Sealer with C.I.T to Supported Levels	\$181,000	\$160,000	\$153,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\$261,000	\$233,000
16	Waterproofing Membrane Strips to Roof Level Tee Joints	\$0	\$0	\$78,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\$78,000	-
17	Waterproofing Membrane Strips to All Supported Tee Joints	\$203,000	\$171,000	\$85,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	Apply Waterproofing Membrane to Stair Towers	-	-	-	\$64,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal of Structural Repair Items		\$110,000	\$66,000	\$59,000	\$65,000	\$70,000	\$20,000	\$20,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$108,000	\$53,000
Subtotal of Structural Repairs and Required Waterproofing Replacement		\$323,000	\$233,000	\$220,000	\$93,000	\$172,000	\$428,000	\$128,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$176,000	\$177,000
Subtotal of Structural Repairs, Required Waterproofing Replacement, and Enhanced Preventive Measures		\$752,000	\$607,000	\$579,000	\$177,000	\$172,000	\$128,000	\$128,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$515,000	\$410,000
19	Project Mobilization and General Conditions (~15%)	\$113,000	\$91,000	\$87,000	\$27,000	\$26,000	\$19,000	\$19,000	-	-	-	-	-	-	-	-	-	-	-	-	\$77,000	\$62,000
20	General Construction Allowance (~10%)	\$75,000	\$61,000	\$58,000	\$18,000	\$17,000	\$13,000	\$13,000	-	-	-	-	-	-	-	-	-	-	-	-	\$52,000	\$41,000
21	Project Contingency (~10%)	\$75,000	\$61,000	\$58,000	\$18,000	\$17,000	\$13,000	\$13,000	-	-	-	-	-	-	-	-	-	-	-	-	\$52,000	\$41,000
22	Allowance for Engineering and Testing Fees (~10%)	\$75,000	\$61,000	\$58,000	\$18,000	\$17,000	\$13,000	\$13,000	-	-	-	-	-	-	-	-	-	-	-	-	\$52,000	\$41,000
Total Cost of Recommended Repair and Maintenance Program		\$1,090,000	\$881,000	\$840,000	\$258,000	\$249,000	\$186,000	\$186,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$748,000	\$555,000

1. Curve 1 – Expected deterioration or repair costs increases without the recommended repairs (Currently at B & Failure would be expected at D)
2. Curve 2 – Expected ongoing deterioration after recommended repairs move structure from B to B¹
3. Curve 3 – Expected ongoing deterioration after recommended repairs and preventive maintenance move the structure from B¹ to B² and deterioration continues at a reduced rate.
4. Curve 4 – Expected ongoing deterioration after recommended repairs, preventive maintenance, and corrosion inhibitors, and waterproofing membrane move the structure from B¹ to B² and deterioration continues at a further reduced rate (blue line).



Deterioration of Parking Garages

Points A–D represent stages of accelerated deterioration in parking structures. Structures repaired at Point A cost less overall and last longer than structures repaired at Point B. Compare curve at A¹ to curve at B¹.
Figure 1- Deterioration of Parking Structures and Ongoing Repair Costs

Each of these curves represent increased repair and maintenance costs to achieve increased durability and reduced ongoing deterioration. The color-coded stars represent the estimated position of each garage on the deterioration curve. The red garage is at position A which represents a point in time where the deterioration of the garage has remained relatively small. Once repaired the red garage will then move down to point A¹ and follow either curves 3 or 4 depending on which level of preventive maintenance was chosen. The red garage could follow a curve similar in nature to curve 2, but starting from point A¹, if no preventive measures are taken. The Green Garage is roughly located at point B on curve 1. A repair program without preventive maintenance would bring the garage to point B¹ and then follow curve 2. While the repair programs with preventive maintenance programs would bring it point B² and then follow either curve 3 or 4 depending on the extent of preventive maintenance items chosen. The Yellow Garage is located between the Red and Green Garages on curve 1 based upon its level of deterioration. With the initiation of a repair and preventive

Figure 1 is adapted from the *Parking Garage Maintenance Manual – 5th Edition*, by National Parking Association – Parking Consultants Council (NPA-PCC), Washington DC www.weareparking.org/page/PCC