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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100 North Appleton Street
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December 20th, 2019



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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 test 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 competed 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.





OPINION OF PROBABLE CONSTRUCTION COST

		Table 2: Re	ed Garage	Recommer	ided Repai	Table 2: Red Garage Recommended Repairs and Preventive Maintenance Options	entive Mair	ntenance Op	ofions		
		Vear 1: 2020 Year 2: 2021 Year 3: 2022 Year 4: 2023 Year 5: 2024 Year 6: 2025	fear 2: 2021	Year 3: 2022	fear 4: 2023	Year 5: 2024	fear 6: 2025	Year 7: 2026	Year 8: 2027	Year 9: 2028	Year 10: 2029
						- Property		Mainhamana		Reapplication of	Reapplication of
	Brief Scope Summary	vels	Repair Level Repair Level		Repair Level	Renair		Renairs As		Sealer to Levels 1-	Recoat Membrane
		1-2	m	4	n	Allowance		Necessary		2, and Ongoing	on Level 2, and
Item #	Repair Items		1							Kepairs	Ongoing Repairs
	Structural Repair Items	/									
-	Horizontal Concrete Repairs	\$108,000	\$10,000	\$10,000	\$10,000	1		\$25,000		\$25,000	\$10,000
2	Vertical and Overhead Concrete Repairs	\$11,000	\$22,000	\$24,000	\$11,000		•	\$10,000	•	\$10,000	\$10,000
က	Post-Tensioning Repair Allowance	\$140,000	\$20,000	\$20,000	\$20,000	3	,	\$20,000	3	\$20,000	
4	Concrete Curb Repairs	\$5,000	\$5,000	\$5,000	\$5,000			\$5,000		\$5,000	
2	Rout and Seal Concrete Cracks	\$3,000	\$3,000	\$3,000	\$5,000	1	•	\$5,000		\$5,000	
9	Stair Tower Repair Allowance		1		\$38,000					•	
7	Masonry Repair Allowance				\$10,000				•	•	
00	Stair Repair Enclosure Repair Allowance	1-1		,		\$50,000		10	•		
စ	Façade Repair Allowance					\$50,000		048	t	\$50,000	
	Required Waterproofing Replacements		The state of the s								
10	Replace Control Joint Sealants	\$3,000	\$3,000	\$3,000	\$3,000				,	•	•
11	Replace Expansion Joints	\$68,000	\$72,000	\$72,000	\$60,000	(.				•	•
12	Apply Silane Sealer with C.I.T.	\$15,000				14				•	•
13	Apply New Waterproofing Membrane	\$74,000			1			\$5,000			•
14	Recoat Existing Waterproofing Membrane		-		1	1-1					\$51,000
15	Clean and Repaint Stair Handrails				\$20,000	-			•	•	•
	Enhanced Preventive Maintenance Items						•				
16	Install Sacrificial Anodes	\$17,000	•			-/-					•
11	Apply Waterproofing Membrane to Exposed Stair Towers		•	χ(∎έ	\$15,000	- 6	1	./	•	•	
18	Silane Sealer with C.I.T to Supported Levels	\$50,000	\$68,000	\$68,000	\$61,000		1-1			\$50,000	\$68,000
19	Waterproofing Membrane Strips to Expansion Joints	\$3,000	\$5,000	\$5,000	\$5,000	/ - /	>	/.		•	•
20	Additional Soft Costs Related to Item 22*	\$18,000	\$24,000		\$21,000		1.			\$18,000	
	Subtotal Structural Repair Items	\$267,000	\$60,000		299,000	\$100,000	\$0°	\$65,000	0\$	\$115,000	\$40,000
Su	Subtotal of Structural Repairs and Required Waterproofing Replacement	\$427,000	\$135,000	\$137,000	\$182,000	\$100,000	09	\$70,000	0\$	\$115,000	\$91,000
Subtotal	Subtotal of Structural Repairs, Required Waterproofing										
Replac	Replacement, and Enhanced Preventive Measures	\$515,000	\$292,000	\$296,000	\$383,000	\$200,000	20	\$135,000	08	\$298,000	\$223,000
24	Project Mobilization and General Conditions (~15%)	\$77,000	\$44,000	\$44,000	\$57,000	\$30,000	0\$	\$20,000	0\$	\$45,000	\$33,000
22	General Construction Allowance (~10%)	\$52,000	\$29,000	\$30,000	\$38,000	\$20,000	80	\$14,000			
23	Project Contingency (~10%)	\$52,000	\$29,000		\$38,000	\$20,000	80	\$14,000	0\$	\$30,000	
24	Allowance for Engineering and Testing Fees (~10%)	\$52,000	\$29,000	\$30,000	\$38,000	\$20,000	\$0	\$14,000	DS .	\$30,000	\$22,000
Total Co	Total Cost of Recommended Repair and Maintenance Program	\$748,000	\$423,000	\$430,000	\$554,000	\$290,000	8	\$197,000	0\$	\$433,000	\$322,000



Table 3: Yellow Garage Recommended Repairs and Preventive Maintenance Options

	60 H									
	Year 1: 2020	Year 2: 2021	Year 3: 2022	Year 4: 2023	Year 5: 2024	12020 Year Z: 2021 Year 3: 2022 Year 4: 2023 Year 5: 2024 Year 6: 2025 Year 7: 2026 Year 8: 2027	lear 7: 2026	Year 8: 2027	Year 9: 2028	Year 10: 2029
					Notice Holf Declared	Parlac Half			Replace Roof Joint	Donnelly Confee
Brief Scope Summary	Repair Levels	Repair Levels Repair Levels 4-5 6-7	Repair Levels 6-7	Repairs to Stair Towers	of Expansion of Expansion	of Expansion			Sealants, Reapply Sealer to Levels 1-	to Levels 5-7,
No. of Boards Rome			- AAD 1907		JOINTS	COLLICS			4, Periodic Repairs	Penodic Repairs
Mein # Kepair nems										
Too to Too Competion Donning	C24 000	618 MM	640 000		AE 000	960 39			640 000	948 848
T	000,000	00000	20000		200,000	200,000			910,000	310,000
T	000,74	20,000	26,000	•				•	\$10,000	\$10,000
	\$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	
5 Vertical and Overhead Concrete Repairs	\$8,000	\$5,000	\$5,000	4	\$5,000	\$5,000	•	•	\$5,000	\$5,000
6 Stair Tower Repair Allowance		S		\$55,000					\$55,000	•
7 Masonry Repair Allowance	\$10,000	\ - \	-	\$10,000	•		•		\$10,000	
8 Façade Repair Allowance	1	1		0\$	\$50,000	•				\$50,000
Required Waterproofing Replacements										
9 Replace Double Tee and Cove Sealants	\$169,000	\$138,000	\$132,000	-			•		\$63,000	
	\$5,000	\$5,000	\$5,000	•			•	•	\$5,000	\$5,000
П	\$39,000	\$24,000	\$24,000	•	•(•	•	•	\$79,000
	•		•		\$102,000	\$108,000	•	•	•	•
13 Clean and Repaint Stair Handrails	•	y -	•	\$28,000	11/				•	
Enhanced Preventive Maintenance Items										
14 Widen Existing Waterproofing Membrane	\$45,000	\$43,000	\$43,000	-	1					
15 Silane Sealer with C.I.T to Supported Levels	\$181,000	\$160,000	\$153,000		-		,		\$261,000	\$233,000
Waterproofing Membrane Strips to Roof Level Tee Joints	0\$	OS	\$78.000		- /4	.	·		\$78.000	
17 Waterproofing Membrane Strips to All Supported Tee Joints	\$203.000	\$171,000	\$85,000			K.				
18 Apply Waterproofing Membrane to Stair Towers		•		\$84,000				## (F	# # 4	
Subtotal Structural Repair Items	\$110,000	\$66,000	\$59,000	\$65,000	\$70,000	\$20,000	80	\$0	\$108,000	\$93,000
Subtotal of Structural Repairs and Required								K		
Waterproofing Replacement	\$323,000	\$233,000	\$220,000	\$63,000	\$172,000	\$428,000	\$0	\$00	\$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	\$0	\$0	\$515,000	\$410,000
Project Mobilization and General Conditions (~15%)	\$113,000	\$91,000	\$87,000	\$27,000	\$26,000	\$19,000			\$77.000	\$62,000
20 General Construction Allowance (~10%)	\$75,000	\$61,000	\$58,000		\$17,000		•	1-1	\$52,000	
	\$75,000	\$61,000	\$58,000			\$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	-/	-/	\$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			\$748,000	\$595,000



Table 4: Green Garage Recommended Repairs and Preventive Maintenance Options

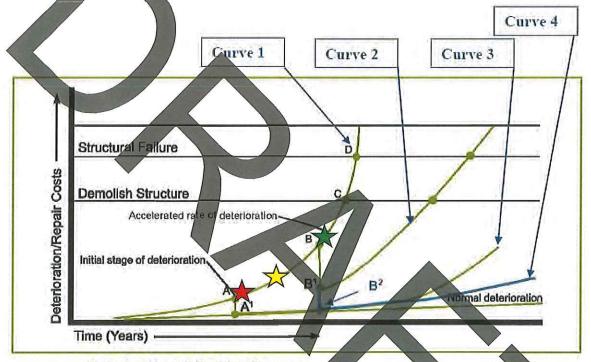
		Papie T.	Olecii Galage	Necolline in	ed ivepalls at	Ē	Inclination	chanding			
		Year 1: 2020	Year 2: 2021	Year 3: 2022	Year 4: 2023	Year 5: 2024	Year 6: 2025	Year 6: 2025 Year 7: 2026 Year 8: 2027	Year 8: 2027	Year 9: 2028	Year 10: 2029
		Exploratory Repain				Ongoing Stair				4	0
	Brief Scope Summary	Program on Level 4 Between Columns	Repair Levels 18-2	Repair Levels 3-4 Repair Level 5	Repair Level 5	ge	Ongoing Stair Repairs			Assessment	to Levels 1B-2,
llem #	Repair Items	A-B and 1-6						Kepairs		Kepails	Ongoing Repairs
-	Tee to Tee Connection Repairs	\$17,000	\$71,000	\$76,000	\$160,000	•	i	\$30,000		ē	\$30,000
7	Double Tee Connection Weld Repairs	\$15,000	\$104,600	\$119,000	\$64,000	•	ı	\$20,000		ř	\$20,000
ო	Clean and Paint Corroded Connections	\$10,000	\$52,000	\$57,000	\$32,000	٠	٠	\$20,000	2.00		\$20,000
4	Double Tee Lifting Point Repairs	\$4,000	1	\$15,000	\$10,000	N.E.	•	•		•	\$10,000
വ	Horizontal Concrete Repairs	\$5,000	\$10,000	\$10,000	\$10,000		•	\$10,000	,		\$10,000
9	Vertical and Overhead Concrete Repairs	\$7,000		\$25,000		•		\$10,000			\$10,000
7	Stair Tower Repair Allowance	\$100,000		\$50,000	\$50,000	\$50,000	\$50,000			,	
8	Architectural Repairs to Stair Towers	\$10,000	\$10,000	-	•		\$10,000	•		٠	
6	Façade Repair Allowance	1		- 1		\$50,000	34			\$50,000	
	Required Waterproofing Replacements										
10	Replace Double Tee and Cove Sealants	\$18,000	\$115,000	\$111,000	\$65,000		•			×	
11	Rout and Seal Concrete Cracks	\$5,000	\$5,000	\$10,000		•	•	\$5,000			\$5,000
12	Replace Existing Waterproofing Membrane		\$12,000				•	•		•	•
13	Repaint Handrails	\$10,000	\$10,000	\$10,000	•		•				
14	Replace Expansion Joint Seal	•	\$70,000	\$86,000	\$29,000	- / /		•	•	•	•
	Enhanced Preventive Maintenance Items			'	1						
15	Silane Sealer with C.I.T to Supported Levels	\$12,000	\$94,000	\$127,000	\$63,000		•	•		•	\$94,000
16	Waterproofing Membrane Strips to Roof Level Tee Joints	0\$	051	OS S	\$88,000	- (٠	ě	٠	•	
4	Waterproofing Membrane Strips to All Supported Tee Joints	s12,000	\$136,000	\$176,000	OS		~				
\$	Widen Existing Waterproofing Membrane		\$5,000				1. <			•	
19	Apply Waterproofing Membrane to Stairs	\$15,000		\$8,000		000'8\$	\$8,000			ı	
	Subtotal Structural Repair Items	\$168,000	\$332,000	\$352,000	000/8888/	000/0015	\$60,000	\$30,000	20	\$50,000	\$100,000
Subtotal	Subtotal of Structural Repairs and Required Waterproofing Replacement	\$201,000	\$545,000	\$579,000	8453,000	000,001.8	\$60,000	000,968	OS	\$50,000	\$105,000
Subtot	Subtotal of Structural Repairs, Required Waterproofing Replacement, and Enhanced Preventive Measures	\$240,000	\$788,000	2895,000	\$617,300	\$108,000	\$68,000	\$95,000	0\$	\$50,000	\$199,000
5	Project Mobilization and General Conditions (~15%)	\$36,000	\$118,000	\$134,000	000 588	\$16,000	\$10,000	\$14,000		\$8,000	
7	General Construction Allowance (~10%)	\$24,000	\$79,000	000'06\$		201		\$10,000		\$5,000	
12	Project Contingency (~10%)	\$24,000			\$62,000	\$11,000	\$7,000		× /	\$5,000	\$20,000
13	Allowance for Engineering and Testing Fees (~10%)	\$24,000	879,000	000'06\$	\$62,000	\$11,000	87,000	\$10,000		\$5,000	
Total (Total Cost of Recommended Repair and Maintenance										
	Program	2348,000	\$1,143,000	51,289,000	2886,000	000,/612	000'66\$	\$139,000	20	\$73,000	\$289,000

Notes:

- The costs in the above tables are presented in 2019 dollars based upon prices from similar projects and discussion with qualified contractors.
- The above costs tables represent Engineer's Estimates, and do not represent an offer to perform the work or a guarantee of contractor pricing. Contractor pricing can be affected by market fluctuations.
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- 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 A' to curve at B' 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 <u>www.weareparking.org/page/PCC</u>