CONDITION SURVEY REPORT
& REPAIR RECOMMENDATIONS

for the

PHOENIX PLAZA & PARKING GARAGE
Pontiac, MI

Prepared for:
City of Pontiac
Pontiac, MI

Submitted by:
DESMAN Associates
May 2012

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1. INTRODUCTION

1.1 Authorization

DESMAN Associates ("DESMAN") has been retained by the City of Pontiac, MI, ("The City") to provide a condition survey of the Phoenix Plaza & Parking Garage in Pontiac, MI. DESMAN's survey and scope of services was performed in accordance with the Professional Services Contract between The City and DESMAN dated March 23, 2012.

1.2 Scope of Services

The scope of services is detailed in the above mentioned Professional Services Contract. In summary, the scope of services is as follows:

- Visually inspect the general composition and condition of the structurally supported slabs, slab soffits, slab-on-grade, beams, columns, walls, façade, and stair towers, in the parking structure. Note that canopy and canopy support structure located on the plaza were excluded from our scope of services.
- Visually review the condition of the existing utilities (i.e. lighting, drainage, etc.)
- Perform a limited sounding evaluation of the structurally supported floor slabs to determine the amount of delaminations in the concrete floor slab.
- Perform limited sounding of slab soffits, beams, columns, walls, etc.
- Investigate the configuration and degree of deterioration of the existing structural components.
- Develop a prioritized list of cost-effective repair options.
- Preparation of this report documenting the results of the field survey along with analysis of observations and recommendations for further course of action.

1.3 Objective

The objective of the survey, as performed by DESMAN Associates, is to evaluate the present condition of the facility and its overall structural integrity and develop repair options along with cost estimates. From this study, recommendations will be made as to the approximate extent of repair, repair materials/techniques, and their associated costs. While the condition survey was performed with care by experienced persons, DESMAN makes no warranty that all defects or existing conditions were discovered. The purpose of the information presented here is to report on the present condition of the parking garage and is not to be used for construction. Preparation of engineering/construction documents to implement the recommended structural repairs and improvements is not part of this task.

1.4 Definitions

Unless noted otherwise, condition appraisals are based in part upon visual observations made at the time of the condition survey. The following terms shall apply in the evaluation of the facility's components:

Very Good	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.

2. EXECUTIVE SUMMARY

The structural elements of the garage displayed deterioration throughout the facility. We observed concrete cracking, delaminations, and spalling at various locations throughout the garage. The concrete deterioration was predominantly seen on the structurally supported slabs and columns, with minor deterioration observed to the concrete beams, walls, and stair towers. A majority of the slab deterioration occurred around columns and at column strips. At these locations, reinforcing steel is nearest to the top surface making it more likely that chlorides reach the reinforcing steel.

The primary structural system of this facility consists of un-bonded post-tensioned cast-in-place concrete. At a number of locations broken and/or de-tensioned post-tensioned cables were observed associated with the structurally supported floor slabs. The post-tensioned cables are typically stressed between 25,000 lbs to 30,000 lbs and, as a result, when they de-tension a significant amount of force is released. Due to the amount of force that is released, sections of the de-tensioned cable can protrude from the slab and/or the anchor assemblies become horizontally displaced – the displacement can range from several inches to a few hundred feet. A significant amount of damage can occur, both to property and individual, when a post-tensioned cable is de-tensioned due to the large amount of force that is released - this is particularly true when it is unexpected or not performed when utilizing controlled methods.

A thin elastomeric traffic bearing waterproofing membrane exists on all structurally supported levels of the garage. A moderate amount of wear was observed to the membrane on the south half of the garage, with little to no wear observed to the membrane on the north half of the garage.

The expansion joint seals throughout the garage displayed signs of deterioration. The deterioration consisted of missing joint seals, splits in the seals, and/or leaking through the joint seal.

The top surface of the structurally supported slab of the Plaza was not directly viewed during this survey due to the overburden. However, the underside of the structurally supported slab was observed and, as a result, areas of concrete deterioration were identified. The deterioration was primarily in the form of concrete cracking, delaminations, and spalling.

The existing deterioration observed in the structural elements will only accelerate the corrosion of the embedded reinforcing steel, which may result in additional structural problems in the future. A repair program needs to be instituted to maintain the structural integrity of the facility, provide a parking facility that can safely be used without the possibility of falling concrete, isolated deck failures, tripping hazards, water leaking, etc., and develop a repair program so as to optimize the life expectancy of the products utilized in the repairs and extend the useful life of the garage. The recommended repair program would include performing full and partial depth concrete repairs to the structurally supported slabs; performing partial depth repairs to the columns and beams; performing repairs to the walls; the application of a top coat to the existing waterproofing membrane; expansion joint repairs; etc. Repairs to the broken/de-tensioned post-tensioning cables will be performed to those that are discovered during the implementation of concrete repairs.

Currently only a small percentage of the garage is being utilized and the Plaza has only been utilized on a very limited basis in the recent past. In order for the full extent of this facility to be safely utilized by the public, all of the "Short Term Priority Repairs" as identified in Section 4 of this report, should be addressed. Also, it is strongly recommended that prior to utilizing this facility to its full extent items not directly part of our scope will need to be reviewed, addressed, or need to be operational, which include, but may not be limited to, the elevators, revenue control system, security system, fire alarm & suppression system, lighting (both non-emergency and emergency), signage (both vehicular and pedestrian), and structural steel framing for canopy.

3. DESCRIPTION OF FACILITY

The Phoenix Plaza & Parking Garage consists of an open parking structure that essentially occupies several city blocks in downtown Pontiac, MI. The parking garage is partially bounded by Water Street to the North, Woodward Avenue (south bound) to the West, Judson Street to the South, and Woodward Avenue (north bound) to the East. Orchard Lake Road/Auburn Avenue bisects the garage in the east-west direction. **Photo #3.01** was taken near the intersection of Woodward Avenue (south bound) and Orchard Lake Road/Auburn Avenue and is considered a west elevation. A finished plaza is situated on the roof level and consumes the entire footprint of the garage.

Photo #3.01

The structure consists of three structurally supported levels and one slab-on-grade level. As mentioned, the upper most structurally supported level consists of a finished Plaza. The remaining levels are primarily utilized for parking. The Plaza primarily consists of precast concrete pavers, concrete planter boxes, and an amphitheater that is covered by a synthetic fabric canopy supported by a structural steel frame and cable system – see **Photo #3.02**. The Plaza is accessed by six sets of stairs located around the perimeter of the structure. Access to the Plaza is also provided from the three multi-story buildings adjacent to the structure. Access within the footprint of the Plaza is provided by stair & elevator towers, which

Photo #3.02

also service the garage. At the time of our survey the only means of accessing the Plaza was from the external stairs located at the north end of the garage near the corner of Water Street and Saginaw Street – at all other access locations the doors and/or gates were locked.

The parking garage currently provides parking for the residential high rise building located to the east of the structure, for the two office towers located to the south and west of the structure, for events held on the Plaza, and public parking for downtown businesses. The layout of the facility consists of four flat levels. The parking levels are connected to one another by a series of internal ramps; one set of ramps are located in the north half and one set of ramps are located in the south half. As mentioned, the Plaza Level can be accessed from locations within the garage as well as external stair towers. A portion of Level 3 of the garage and the Plaza Level extend over Orchard Lake Road/Auburn Avenue. A Pedestrian Bridge extends over Orchard Lake Road/Auburn Avenue on Level 3 connecting the south half and north half of the garage to one another. The garage has a total of 6 stair towers and four elevator towers – two of the elevator towers are located adjacent to stair towers. The garage has four vehicular entrances/exits located around the perimeter of the garage – **Photo #3.03** is the entrance/exit location on the north side of the garage. Additional entrances/exits are also located along Orchard Lake Road/Auburn Avenue. At the time of our survey a majority of the entrance/exit locations were closed – the entrance/exit areas on the north and south sides of the garage were open and primarily being utilized by the patrons.

Photo #3.03

The structurally supported floors consist of a two-way, cast-in-place, un-bonded post-tensioned concrete slab with drop panels at the columns. The slabs are supported by conventionally reinforced concrete columns. At limited locations, primarily at expansion

joints, the slab is supported by cast-in-place, un-bonded post-tensioned concrete beams. The façade consists of precast concrete. The slab-on-grade surface is a bituminous asphalt. See Appendix A of this report for a typical floor plan of the garage.

Based on the available information, conversations with The City, and DESMAN's walk-thru of the garage, repairs and maintenance have been performed in the past but not within the last four to five years The Plaza was renovated approximately 10 to 12 years ago, which included repairs to the structural slab, waterproofing, miscellaneous repairs, and new pavers. Also, evidence of repairs throughout the garage are visible and primarily consist of concrete floor slab repairs and the installation of a thin traffic bearing waterproofing membrane. Based on our observations and the available information, it is estimated that the traffic bearing waterproofing membrane was installed approximately 10 to 12 years ago.

The following table is a list of general information regarding this facility:

GENERAL INFORMATION

1	Total Area of Garage	874,000 s.f. +/-
2	Total Area of Plaza	292,000 s.f. +/-
3	Footprint of Structure	672’-0” x 680’-0” +/-
4	Typical Floor Plate Size	672’-0” x 680’-0” +/-
5	Typical Bay Size	34’-0” (N-S) x 32’-0” (E-W)
6	Maximum Dimensions	672’-0” x 680’-0” +/-
7	Architectural Shape	Irregular
8	Age Of Garage	32 years
9	Year Built	1980
10	Number of Levels	3 structurally supported and 1 slab-on-grade
11	Total Number of Spaces In Garage	2,500 ±
12	Parking On-Grade	Yes
13	Retail Space Within Garage	No
14	Basement Parking	NA
15	Construction Type	Post-tensioned cast-in-place
16	Floor Thickness Parking Garage	9”
17	Floor Thickness Plaza	14”
18	Floor-to-Floor Height	10’-0”
19	Lighting Type	Primarily High Pressure Sodium; Some LED & Fluor.
20	Helix Ramp	No
21	Overall Condition of Garage	Fair
22	DESMAN Estimate of Repairs	See Section 5
23	Budget Recommendations	See Section 5

4. FINDINGS AND RECOMMENDATIONS

For a summary of factors that influence the deterioration of concrete please refer to Appendix B.

4.1 Observations

As outlined in the proposal, a visual examination was made of various components of the Phoenix Plaza & Parking Garage. Deteriorated locations were quantified and recorded for the visible elements. Photographs were also used to document the deteriorated conditions and distressed areas observed in the facility.

A limited sounding evaluation (chain drag) was conducted on the top surface of the structurally supported floor slabs of the parking garage to detect concrete delaminations. DESMAN estimates that approximately 25% of the garage was chain dragged. The floor slabs of the parking garage and the underside of the Plaza structural slab was visually examined for concrete spalling, exposed reinforcing, cracking, and surface scaling. A visual survey was also performed on the beams, columns, soffits, walls, stairs, and façade. Limited sounding (hand held hammer) was also utilized on the beams, columns, soffits, walls, stairs, and façade to aid in identification and quantification of concrete deterioration.

During the survey, the following items were identified as areas of structural and non-structural deterioration.

Floor Slabs

Floor slab deterioration was identified during both the visual survey and our sounding evaluation. The top surface of the Plaza was not observed due to the overburden. A majority of the top surface deterioration occurred around columns and at column strips and a majority of the bottom surface (soffit) deterioration occurred near the mid-span of the middle strip – see **Figure #4.01** for the location of a column strip and middle strip in a two-way flat slab system. The location of the deterioration is primarily due to the mild reinforcing steel of the floor slab being located close to the top surface in these areas, which is more susceptible to corrosion due to chloride exposure. Concrete is a very hard but brittle material that is very strong in compression but relatively weak in tension. Steel is a ductile material that is strong in tension. Therefore, steel reinforcing bars are placed in concrete structures at expected locations of high tension. In two-way floor slabs, those areas tend to be near the top surface of the slab along column strips and near the bottom surface, or soffit of the slab at mid-span of the middle strips.

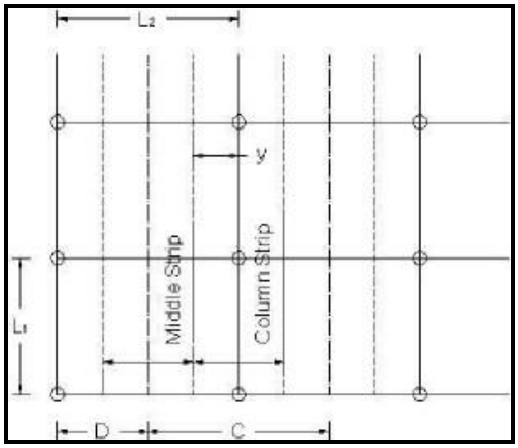


Figure #4.01

The floor slab deterioration primarily consisted of delaminations and spalling, which is believed to be due corrosion of the mild reinforcing steel as a result of chloride exposure. **Photo #4.01** displays typical top surface floor slab deterioration in the form of concrete delaminations – note the heaving in the top surface of the concrete slab near the column. **Photo #4.02** displays typical

Photo #4.01

soffit floor slab deterioration in the form of concrete spalling – note the corroded reinforcing steel at the location of the spall. In order for corrosion of the reinforcing to occur the chloride levels within the slab at the level of the mild reinforcing steel must be at or above the threshold limit to initiate corrosion. The chloride levels to initiate corrosion are either obtained by chloride migration through the slab or by chloride migration through cracks, with the former being most likely the case in top bar corrosion and the later being the case in bottom bar corrosion.

Photo #4.02

As mentioned, in a post-tensioned structure such as this, mild reinforcing bars, or rebar, are placed to supplement the post-tensioning system. The reinforcing bars being placed close to the top surface at column strips, which provides less concrete protection for the bars, usually about 1 ½". The concrete protects against water and chlorides from de-icing salts from penetrating to the depth of the reinforcing steel. Even though, concrete is somewhat porous and will allow water and chlorides to penetrate it to some degree, the more concrete provided as protection the better.

Once exposed to water and chlorides, corrosion of steel is imminent. When steel corrodes, it expands to several times its original size, pushing outward on its surroundings. In the case of reinforcing steel embedded in concrete, the concrete is "pushed" by the corrosion process inducing tensile stress within the concrete. The concrete, being relatively weak in tension, is unable to resist this force and breaks loose from the surrounding concrete and creating a delamination. Eventually the delaminated concrete will completely dislodge from the surrounding concrete and become a spall.

The post tensioning system may also be affected by the deterioration of the concrete. The main reinforcing system consists of high strength post-tensioning cables running both ways in a two-way slab and spaced at approximately every two-to-two and half foot centers. Additionally, banded, or bundled, post-tensioning cables are utilized at column strips to create beam-like conditions.

The main post-tensioning cables are placed near the top surface of the slab over column strips and allowed to drape near the bottom surface of the slab at the middle strips. The cables are encased in a protective plastic sheathing in part to protect them against corrosion. The plastic sheathing can be breached by exposure to traffic or pinched by concrete delaminations adjacent to the cables. The steel cables would then be exposed to the corrosive elements that affect the mild reinforcing steel with more immediate consequences. The post-tensioning system is the main reinforcing system in the slabs and any loss would result in diminished structural integrity of the slab. During the survey a number of broken and/or de-tensioned post-tensioned cables were observed – see **Photo #4.03**.

Photo #4.03

The post-tensioned cables are typically stressed between 25,000 lbs to 30,000 lbs and, as a result, when they de-tension a significant amount of force is released. Due to the amount of force that is released, sections of the de-tensioned cable can protrude from the slab (see **Photo #4.03**) and/or the anchor assemblies become horizontally displaced – the displacement can range from several inches to a few hundred feet.

Overall, the deterioration of the structurally supported floor slabs was widespread throughout all of the supported levels of the garage, with a slightly higher quantity

observed in the south half of the garage. The amount of deterioration observed on the soffit of the Plaza slab was approximately a third of what was identified on the soffit of the structurally supported slabs for the parking garage.

A limited amount of deterioration was identified on the slab-on-grade, or Level 1, of the parking garage. As mentioned, the slab-on-grade consists of a bituminous asphalt pavement. The most significant observed deterioration was a large heaved area on the south half of the garage. **Photo #4.04** displays cracks in the asphalt due to heaving. This is most likely due to the use of an unstable fill material or a contaminated fill material at this location.

Photo #4.04

Concrete Beams

During the survey limited locations were identified with a moderate amount of deterioration in the form of delaminations and spalls. The deterioration is most likely due to exposure to chloride-laden moisture/water. The exposure to chloride-laden moisture is most likely the result of a failed/leaking expansion joint seal. The corrosion usually occurs to the mild reinforcing, or rebar, embedded in the beams that supplement the PT system rather than the actual PT strands themselves, which make up the main reinforcing for PT beams.

Concrete Columns/Walls

During the survey concrete deterioration in the form of concrete delaminations and spalling were observed on both the columns and walls. The deterioration is believed to be due to corrosion of the mild reinforcing steel as a result of exposure to chloride-laden moisture. The column deterioration was primarily located at the base, or near the drive surface – see **Photo #4.05**. The concrete at this location is in a "splash zone" and, therefore, is exposed to higher chloride concentrations.

Photo #4.05

A majority of the wall deterioration observed occurred to the spandrel wall sections. The deterioration at these locations typically occurred at the bottom of the wall section and was in the form on concrete cracking, delaminations, and spalling – See **Photo #4.06**. The deterioration is believed to be due to corrosion of the mild reinforcing steel due to exposure to chloride-laden moisture. The exposure, particularly for the spandrel wall sections, is most likely due to a failed flexible cove joint sealant, which permitted chloride-laden water to leak through the joint and expose the underlying concrete.

Photo #4.06

Expansion Joints

The garage primarily contains one type of expansion joint system, which is referred to as

a premolded expansion joint system. However, at one particular location where the joint seal had failed/was missing it appeared that a compression joint seal was installed in the throat of the expansion joint. It is believed that the original joint seal was left in place and a new (premolded joint seal) seal was installed over top of the existing seal.

Premolded expansion systems consist of a premolded urethane seal adhered in place with a urethane nosing compound. There is usually a steel or aluminum plate below the premolded seal to allow it to span the joint opening. At numerous locations throughout the garage the joint seal is in a deteriorated state, which consists of missing sections, splits, and tears in the seal – see **Photo #4.07**. The deterioration is most likely to due to normal wear.

A failed expansion joint typically does not provide a water-tight seal. The American Concrete Institute (ACI) provides designers with concrete coverage requirements for embedded reinforcing steel based on types of exposure. Typically, ACI requires less concrete coverage of the embedded reinforcing steel that is near the soffit or free edge of an element, such as a slab, than for reinforcing steel located near the top surface of the slab. The more concrete cover that is provided to the reinforcing steel the longer it will take for chlorides to migrate to the level of the embedded reinforcing steel. Therefore, when areas are exposed to chlorides (due to a failed expansion joint seal) with limited concrete cover premature deterioration can occur.

Photo #4.07

<u>Waterproofing Membrane</u>

The structurally supported levels of the parking garage are covered by what appears to be

a cold applied thin elastomeric traffic bearing waterproofing membrane. Based on the available information, the Plaza is waterproofed with a hot-applied rubber membrane. The condition of the waterproofing membrane for the Plaza slab was not observed due to the overburden. However, there was no visible indication that the Plaza slab waterproofing membrane was experiencing any significant leaking based on observations made from the underside.

The waterproofing membrane utilized in the parking garage consists of a multi-layer system, which consists of a primer, base coat, and wear course. The base coat provides the waterproofing characteristics. The wear course, which typically incorporates a sand aggregate for skid resistance, protects the underlying base coat. The waterproofing membrane on the south half of the garage displayed visible signs of wear, particularly in high traffic areas and turning locations. At these locations the wear course and skid resistance of the membrane were completely missing and the basecoat exposed to direct vehicular traffic. The waterproofing membrane on the north half of the garage displayed little to no wear. Under normal vehicular exposure, these types of systems typically have a lifespan of five to ten years.

Stair Towers

The stair towers were surveyed and areas with evidence of deterioration were recorded.

Photo #4.08

The interior stairs of the parking garage are comprised of metal pan risers with concrete in-filled treads that is supported by a structural steel frame. A majority of the stair tower deterioration observed consisted of cracking, delaminations, and spalling of the concrete in the landings, which can be seen in **Photo #4.08.** Cracked CMU block, which is utilized in the construction of the walls for these

stair towers, was also observed.

The open stair towers located adjacent to the bisecting road are also comprised on metal pan risers with concrete in-filled treads that is supported by a structural steel frame. Deterioration in these stairs was also observed and it was primarily in the form on spalled/delaminated treads and failure associated with the paint system that covers the metal pan stairs.

The stair towers around the perimeter of the structure that provide access to the Plaza consist of conventionally reinforced cast-in-place concrete. Deterioration was observed on these stairs, which was primarily in the form of concrete delaminations and spalling.

Facade

A visual inspection of the façade was performed from the street level and from strategic locations within the garage.

Pedestrian Bridge

A visual inspection of the Pedestrian Bridge was performed from within the pedestrian bridge, from street level, and from strategic locations within the garage – see **Photo #4.09.** At several locations the wall panels were missing/damaged and the lighting was very poor.

Photo #4.09

Plaza

The top surface of the Plaza was visually observed, with the exception of the structural steel frame and canopy assembly – see **Photo #4.10**. The pavers, which appear to consist of concrete, displayed little to no deterioration. The walls/curbs that comprise the landscaped areas all appeared to be in "Very Good" condition. Two sections of the plaza are covered by what appears to be an elastomeric traffic bearing waterproofing membrane – similar to the garage. The membrane is displaying some wear. The top surface of the structural slab was not observed due to the overburden. The flower beds and landscaped areas were overgrown and not in a maintained state.

Photo #4.10

Drainage System

At numerous locations the drains appeared to be clogged, the grating missing/broken or it was highly corroded, and/or the drain body corroded. The branch piping, which primarily consisted of cast iron pipe, was cracked at numerous locations throughout the garage. Cracked pipes usually occur when the pipe becomes clogged, water then fills the pipe, freezes and expands, which causes the pipe to crack – see **Photo #4.11**. Portions of the branch piping appear to be heat traced but it is not certain whether or not this system is currently operational.

Photo #4.11

Lighting

The lighting for the parking garage primarily consists of high pressure sodium light fixtures. At numerous locations the light fixture is either missing completely, not functioning, and/or missing a lens. Also, at several locations the conduit is corroded due to exposure to chloride-laden moisture that migrated from above through a crack, failed joint seal, etc. **Photo #4.12** displays a section of highly corroded conduit.

Photo #4.12

Elevators

Our scope of services did not include an assessment of the elevators. However, during our site visit it was noticed that none of the elevators were operational. It is not known that whether this was due to mechanical/electrical problems or that there was no current need and the elevators were shut-down.

4.2 Recommendations

The following section is the repair recommendations, listed in order of priority. The specific repairs, and a time period in which the repairs should take place will be described within each section.

It must be noted that items listed within each of Priority Repair categories primarily address structural and durability items. At this time only a small percentage of the garage is being utilized and the Plaza has only been utilized on a very limited basis in the recent past. In order for the extent of this facility to be safely utilized by the public, it is strongly recommended that items not directly part of our scope will need to be reviewed, addressed, or need to be operational, which include, but may not be limited to, the elevators, revenue control system, security system, fire alarm & suppression system, lighting (both non-emergency and emergency), signage (both vehicular and pedestrian), and structural steel framing for canopy.

Short Term Priority Repairs (Repairs within eighteen months)

The repairs considered "Short Term" should be implemented to address current structural deficiencies and maintenance items. These repairs should be performed prior to the full extent of this facility being utilized by the public. The "Short Term" repairs will prevent a more costly future repair program, maintain the structural integrity of the facility, and extend the useful life of the facility.

Structurally Supported Floor Slabs

The concrete deterioration in the form of delamination and spalling on the top surface of the floor slabs needs to be repaired. The repairs would involve removing the deteriorated concrete, cleaning the steel reinforcement, and patching the areas with a ready-mix concrete material. The concrete spalls located on the soffit of the floor slabs should be repaired in the same manner, except that a pre-packaged engineered repair material

would be utilized. During this time all broken post-tensioning tendons would need to be spliced or replaced and re-stressed. This would involve removing concrete from around the PT strands and/or anchors, splicing new strand to the old strands, installing new hardware as required, re-stressing the strands, and patching the areas with a ready-mix concrete material.

Concrete Beams

The concrete deterioration in the form of delamination and spalling of the concrete beams needs to be repaired. The repairs would involve removing the deteriorated concrete, cleaning the steel reinforcement, and patching the areas with a pre-packaged engineered repair material.

Concrete Columns/Walls

The concrete deterioration in the form of delamination and spalling of the concrete columns and walls needs to be repaired. The repairs would involve removing the deteriorated concrete, cleaning the steel reinforcement, and patching the areas with a pre-packaged engineered repair material.

Stair Towers

The deterioration in the stair towers will require repair. The concrete deterioration in the landing and treads will need to be removed and replaced with either a ready mix concrete or a pre-packaged repair material. The cracks in the landings would be repaired by routing the existing cracks and then installing a polyurethane sealant. The cracked/broken CMU units should be removed and replaced in-kind.

Drainage

The deterioration associated with the drains and branch piping will be addressed. Repairs would consist of installation of new drains, drain grating, and removal and replacement of cracked branch piping in-kind.

Lighting

The deterioration associated with the lighting and electrical conduit should be addressed. All broken and non-functioning light fixtures would be removed and replaced in-kind and sections of corroded conduit would be replaced in-kind. The intent upon completion of this program would be to have all light fixtures operational.

Intermediate Term Priority Repairs (Repairs within two to five years)

These repairs will extend the useful life of the facility and minimize future maintenance costs. These types of repairs are considered preventative in nature and primarily consist of surface treatments and/or waterproofing membranes. Also, anticipated structural repairs are included in this period.

Structurally Supported Floor Slabs

It is anticipated that floor slab deterioration will continue within the facility over this period. Therefore, we estimate that a minimum amount of slab repairs will be required in years two thru five, both on the floor and soffit. The repairs that will be performed will be similar to those listed in the "Short Term Repair" section of this report.

Concrete Columns/Walls

Similar to the "*Structurally Supported Floor Slab*" of this section, we estimate that a minimum amount of column and wall repairs will be required in years two thru five. The repairs that will be performed will be similar to those listed in the "Short Term Repair" section of this report.

Concrete Beams

Similar to the "*Structurally Supported Floor Slab*" of this section, we estimate that a minimum amount of beam repairs will be required in years two thru five. The repairs that will be performed will be similar to those listed in the "Short Term Repair" section of this report.

Stair Towers

Similar to the "*Structurally Supported Floor Slab*" of this section, we estimate that a minimum amount of stair tower repairs will be required in years two thru five. The repairs that will be performed will be similar to those listed in the "Short Term Repair" section of this report.

Traffic Bearing Waterproofing Membrane

In order to reduce future maintenance and repair costs, we recommend that the existing traffic bearing waterproofing membrane on the south half of the garage receive a new topcoat. This is primarily recommended due to the widespread wear of the waterproofing membrane at this location of the garage and to provide on-going protection to the basecoat and underlying concrete slab. In addition to the application of the waterproofing membrane topcoat, the construction joint sealants would be removed and replaced corresponding to the area that is being topcoated.

Expansion Joints

As mentioned, the expansion joint seals are considered to be in a deteriorated state. Therefore, we are recommending that the existing joint seals be removed at all locations and replaced with a new thermoplastic prefabricated, elastomeric winged seal that is secured with an elastomeric concrete header material.

Drainage

Based on the age of these components continued deterioration is expected. The proper removal of water is critical in minimizing future structural repairs and the long-term durability of the structure. Therefore, it is recommended that a majority of the drains and branch piping be replaced in-kind during this period.

Long Term Priority Repairs (Repairs within five to ten years)

These repairs will extend the useful life of the facility and minimize future maintenance costs. These types of repairs are considered preventative in nature and primarily consist of surface treatments and/or waterproofing membranes. Also, anticipated structural repairs are included in this period.

Structurally Supported Floor Slabs

Again, it is anticipated that floor slab deterioration will continue within the facility over this period. Therefore, we estimate that a minimum amount of slab repairs will be required in years five thru ten, both on the floor and soffit. The repairs that will be performed will be similar to those listed in the "Short Term Repair" section of this report.

Concrete Columns/Walls

Similar to the "*Structurally Supported Floor Slab*" of this section, we estimate that a minimum amount of column and wall repairs will be required in years five thru ten. The repairs that will be performed will be similar to those listed in the "Short Term Repair" section of this report.

Concrete Beams

Similar to the "*Structurally Supported Floor Slab*" of this section, we estimate that a minimum amount of beam repairs will be required in years five thru ten. The repairs that will be performed will be similar to those listed in the "Short Term Repair" section of this report.

Stair Towers

Similar to the "*Structurally Supported Floor Slab*" of this section, we estimate that a minimum amount of stair tower repairs will be required in years five thru ten. The repairs that will be performed will be similar to those listed in the "Short Term Repair" section of this report.

Traffic Bearing Waterproofing Membrane

In order to reduce future maintenance and repair costs, we recommend that the existing traffic bearing waterproofing membrane on the north half of the garage receive a new topcoat. Again, this is primarily recommended due to the widespread wear of the waterproofing membrane at this location of the garage and to provide on-going protection to the basecoat and underlying concrete slab. In addition to the application of the waterproofing membrane topcoat, the construction joint sealants would be removed and replaced corresponding to the area that is being topcoated.

Lighting

At this time it is recommended that the lights be replaced with a new energy efficient light fixture. Also, the existing conduit will be replaced in-kind at this time.

Summary of Repair Recommendations

Short Term Priority Repairs (within 18 months)

- Perform repairs to the structurally supported floor slabs including PT repairs.
- Perform repairs to concrete beams.
- Perform repairs to concrete columns and walls.
- Perform repairs to the stair towers
- Perform drainage repairs
- Perform lighting repairs

Intermediate Term Priority Repairs (from two to five years)

- Perform anticipated repairs to the structurally supported floor slabs.
- Perform anticipated repairs to concrete columns and walls.
- Perform anticipated repairs to concrete beams.
- Perform anticipated repairs to the stair towers
- Apply a topcoat to the existing waterproofing membrane on the south half of the garage.
- Remove and replace expansion joint seals throughout
- Replace a majority of the drainage system

Long Term Priority Repairs (from five to ten years)

- Perform anticipated repairs to the structurally supported floor slabs.
- Perform anticipated repairs to concrete columns and walls.
- Perform anticipated repairs to concrete beams.
- Perform anticipated repairs to the stair towers
- Apply a topcoat to the existing waterproofing membrane on the north half of the garage.
- Replace lighting system.

5. REPAIR PROGRAM AND COST ESTIMATE

5.1 Repair Program

Prior to implementing repairs, it is recommended that any loose or broken concrete be removed from the deteriorated areas. The proposed repair programs are intended to eliminate public safety hazards by repairing the structural deterioration, and extending the useful life of the facility.

In order to ensure the longevity of the repairs, a basic repair approach has been developed for implementing repairs throughout the ramp. The repair programs are recommended for all areas of deterioration identified during the survey. The repair approach will include performing all the structural and non-structural repairs to the ramp. The initial step of the repair program is addressing the Short Term Priority Repairs.

5.2 Phasing

It is recommended that all structural and non-structural repairs should be performed under one repair program. Repairs will need to be phased in order to maintain traffic flow and meet required available parking requirements. During the implementation of the repairs traffic flow will need to be maintained and access to each level must be provided.

5.3 Cost Estimates

Due to the preliminary nature of this study, the following estimates are presented for budget purposes only and are not guaranteed construction costs. Formal bids should be obtained from qualified contractors. The estimate is based on DESMAN's experience with similar parking garage rehabilitation projects and prices for similar repairs and preventive maintenance work in the Greater Detroit area. The estimates exclude engineering costs associated with the development of construction documents and construction administrative/management services.

PHOENIX PLAZA & PARKING GARAGE
Construction Cost Estimate
Pontiac, MI
May 2012

Item	Description	Short Term Repairs (within 18 months)	Intermediate Term Repairs (within 2 to 5 years)	Long Term Repairs (within 5 to 10 years)
1	General Conditions	$150,000	$130,000	$360,000
2	Floor Repairs	$417,000	$41,000	$47,000
3	PT System Repairs	$282,000	$28,000	$32,000
4	Vertical Repairs	$242,000	$24,000	$28,000
5	Overhead Repairs	$275,000	$28,000	$31,000
6	Masonry Repairs	$30,000	$3,000	$4,000
7	Expansion Joint Repairs	$0	$299,000	$0
8	Waterproofing	$0	$674,000	$783,000
9	Striping	$0	$25,000	$29,000
10	Drainage Repairs	$40,000	$120,000	$0
11	Lighting Repairs	$131,000	$0	$2,600,000
	Subtotal	$1,567,000	$1,372,000	$3,914,000
	15% Contingency	$235,000	$206,000	$587,000
	Total	$1,802,000	$1,578,000	$4,501,000

Notes:

1. The figures are exclusive of annual budgets for operational issues such as light bulb replacement, janitorial services, equipment maintenance contracts, etc.
2. Costs are expressed in 2012 dollars. Inflation and escalation have not been included in the cost estimates.
3. A premium cost of 10% to 15% over estimated costs is possible if a single work item is divided over multiple years due to budget constraints.
4. Figures are exclusive of any abatement of hazardous materials or revenue control system changes.
5. Engineering and other 'soft' costs are not included in the above and are typically 5-8% of the noted construction costs.

Redevelopment Options

In-lieu of performing the recommending repairs, as identified above, the parking structure could be demolished and the land utilized for another use. At this time the cost associated with demolishing this facility is unknown.

This concludes our condition assessment report related to this facility. A formal meeting should be scheduled between the Owner and Engineer to discuss our findings and recommendations. In the meantime, if you should have any questions please do not hesitate to contact us.

Respectfully submitted,

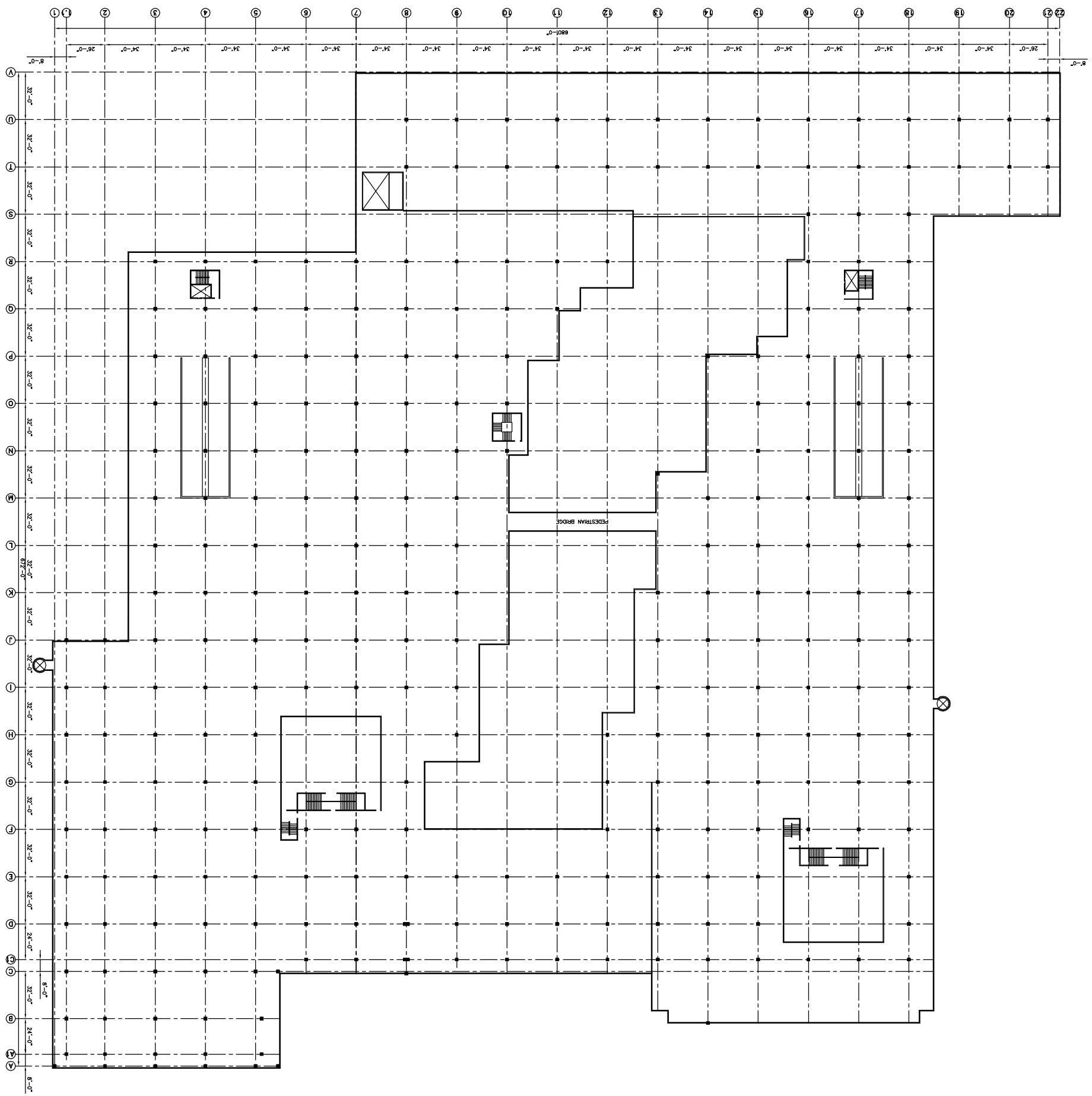
DESMAN Associates,
A Division of Desman, Inc.

Matthew W. Repasky, P.E.
Senior Associate

Appendix A

Typical Floor Plan

TYPICAL FLOOR PLAN N



Appendix B

Concrete Deterioration Overview

Parking Ramp Deterioration and Restoration Overview

Concrete is a stone-like material created by placing a carefully proportioned mixture of cement, sand, gravel or other aggregate, and water into forms shaped to the dimensions of the desired structure and allowing it to harden. Concrete has existed and been used in various ways for thousands of years, and is currently used as a building material worldwide. The advantages of this building material include its high fire and weather resistance, local availability at low costs, and high compressive strength. However, it is a relatively brittle material whose tensile strength is low compared to its compressive strength. Beginning in the late 19th century, and continuing throughout the 20th century, steel bars have been used to reinforce concrete members where the low tensile strength would otherwise limit load-carrying capacity. Under normal environmental conditions, steel reinforcing bars embedded in concrete do not corrode. A protective film of iron oxide forms on the surface of the steel when it is encased in concrete. The natural alkalinity (pH value of approximately 13.2 or higher) associated with hydration of the Portland cement in the concrete is usually sufficient to keep this protective film stable.

However, the service environment of parking structures is more similar to that of highway bridges than most other buildings. Often these structures are exposed to extreme seasonal and daily ambient temperature variations. The associated thermal volume changes can cause cracking of the slabs, beams, columns, and walls. Moisture and oxygen can enter the concrete through these cracks and initiate the corrosion process. With time, the volume increase associated with the corrosion formation will generate enough force to delaminate the concrete cover over the reinforcing steel.

With the widespread use of salt de-icing programs for our national highways, the conditions of our bridge decks, parking garages and other reinforced concrete structures directly exposed to these elements began to deteriorate. The relationship between the deterioration and the use of de-icing salts was most evident by the extent of deterioration found in the “snow belt” states. Due to

the development of this deterioration, programs were initiated to study the cause and effect of the problem so that repair programs and preventive maintenance procedures could be instituted.

Research during this period confirmed that corrosion of the embedded reinforcing steel is typically the primary cause of the structural deterioration. It was further determined that the presence of chloride ions in the concrete, from both external and internal sources, greatly accelerates the corrosion process. External sources of chloride ions primarily consist of de-icing salts that have been applied directly to the slabs or have been carried into the parking garage by vehicles. Internal sources are typically provided by calcium chloride admixtures to the concrete such as those used in winter months to speed the temperature sensitive curing of the concrete mix. According to the American Concrete Institute, chloride ion concentration of 0.2% by weight of cement, or chloride concentrations of approximately 1.1 lb/cy of concrete to 1.6 lb/cy of concrete, can initiate corrosion of the embedded reinforcing steel in concrete structures.

Repair programs began to consider that the only method to stop subsequent corrosion of reinforcing steel was one in which all concrete that contains threshold values of chloride ions was removed, and chloride ions and moisture were prevented from entering the new concrete. However, removal of all concrete containing significant amounts of chloride ions is seldom a practical solution.

A normal assumption made during a condition evaluation is that the structure was adequately designed, and was constructed in accordance with that design. Extensive destructive testing to confirm that existing conditions meet the original design criteria is typically beyond the scope of a condition assessment survey. As stated by the American Concrete Institute (ACI) Committee 362 in their State of the Art Report on Parking Structures, “Repairing an existing deteriorated structure involves many unknowns, uncertainties, and risks. Especially with regard to repair of deicer caused corrosion damage, the process is considered an extension of the useful life of the deteriorated structure. It is not equivalent to building a new structure with current technology.” Therefore, in the development of alternate repair programs, contingency funds must be

anticipated and included in the probable construction costs to account for concealed, unknown, or unexpected conditions that may be encountered.

The successful extension of the service life of a structure will also depend on upon the degree of continuing maintenance provided after a repair program is completed. Usually, some continuing deterioration can be expected to occur, and funds should be set aside to address this condition in future years.