Media Borough - Baltimore Avenue Parking Garage

S Olive St.

Media, PA 19063

February 2019 Condition Assesment

Engineering + Restoration + Preventive Maintenance + Training

www.structurecareus.com 717.735.1060 info@structurecareus.com

March 26, 2019

Jeff Smith
Borough Manager – Media Borough
301 N Jackson Street
Media, PA 19063

Re: Baltimore Avenue Parking Garage

Dear Mr. Smith:

The StructureCare group is pleased to present two copies of the condition assessment report for the referenced parking garage. The assessment was performed per your request in order to document recommendations and probable costs for repairs.

The report presents the results of our field visit completed in February of 2019 and our analysis and recommendations relating to the various findings.

Please contact the undersigned with any questions.

Sincerely,

StructureCare
Mathew E. Birney
Mathew E. Birney, P.E.
Field Engineer

Attachment as noted

TABLE OF CONTENTS

INTRODUCTION

Authorization – This inspection report is being provided by the StructureCare® division of the High Concrete Group LLC (High) at the request of Borough of Media involving a condition assessment of the Baltimore Avenue Parking Garage located in Media, Pennsylvania.

Purpose – The purpose of the inspection was to survey the conditions of the structural, waterproofing, and other related systems of the parking garage and in order to identify and evaluate repair and maintenance needs and to provide short and long term recommendations for the same.

Description of Structure – The parking garage was dedicated in 1987. It is composed of a precast/prestressed concrete building system made up of three bays across by seven bays deep, with two supported levels and a grade level, each with their own entrances/exit. Each level can only be accessed through these entrances (no ramps between levels). The roof and second level can be accessed at the northeast corner with the roof entrance featuring a cast-in-place access ramp from grade. The ground floor is accessed along the west elevation. There is a stair tower at the southwest and northeast corners of the garage. Structural elements include: columns, beams, slabs, walls, and field-topped double-tees. The exterior of the structure is composed of architectural precast panels, columns, and spandrels with inset brick masonry. The ground level floor is bituminous pavement. The overall size of the garage is approximately 192’x148’.

Historical Documentation – High was not involved with the initial component design, fabrication, and installation of the garage. Previous floor plans created for garage inspections were utilized during this assessment. A fair amount of concrete and waterproofing repairs was conducted in the mid-to-late 2000s. These include full depth repairs to multiple double-tee flange edges on the roof level, roof level waterproofing, and second level overhead

concrete repairs. In 2011, a condition assessment was conducted by StructureCare® as well.

About the Report – This report is intended to serve as a historical reference document outlining the condition of the garage at a specific moment in time. Observations, analysis, and recommendations are included in order to identify root conditions and prioritize appropriate repairs and preventive maintenance for the structure. The report should be used to guide future inspections as well as repair and maintenance activities and will become an integral part of the overall condition history of the structure.

The body of the report contains the following:

- General Summary - briefly identifies any major findings as well as provides a brief overview of the condition of the garage.
- Observations - identifies specific findings of the inspection.
- Analysis - evaluates findings outlined in the observations section for root cause.
- Recommendations - provides action items for repairs and ongoing maintenance. Probable costs are provided for these recommendations.
- Appendices - provides all of the reference data forming the foundation of the inspection document as well as other information.

GENERAL SUMMARY

Generally, the garage has signs of progressive deterioration. Water infiltration, cyclical freeze thaw cycles, aggressive winter maintenance activities, deferred maintenance, and other external factors appear to be the root cause for most of the conditions observed during the inspection.

The field inspection completed in February 2019 identified areas of deterioration, developing hazards, and other conditions. In general, the following key observations were noted:

- Floor level concrete delaminations and spalling, particularly on roof
- Significant amount of lower level overhead concrete delaminations and spalling, particularly on the second level below the roof
- Localized spalled pointing of exterior masonry
- Elevated chloride content floor level concrete on roof and second level
- Roof level floor joint sealants and routed cracks beyond service life
- Second level floor joint sealant localized failures (water infiltration)
- Interior architectural sealants on roof level beyond service life
- Missing bolt at lateral connection on roof level east elevation
- One double-tee joint on the roof and second level with broken connections
- Lower level rust at overhead drain bodies
- 10 ponding conditions on roof level and two on second level
- Faded line striping on roof level
- Missing/damaged overhead signage on lower two levels

Considering the age of the structure, many of the observed conditions are not unusual. However, given the apparent lack of ongoing maintenance, repairs, and consideration towards snow removal activities the garage has continued to deteriorate at an accelerated rate. Moderate restoration will need to take place in order to reverse the deterioration trend and to ensure a long service

life. Once restored, improvement in preventive maintenance will be equally important in order to prevent future damage and provide for a controlled and predictable operating life. Fortunately, with the use of the findings of this report, a restoration program can be implemented in which a maintenance program should follow.

OBSERVATIONS

(Additional Photographs are located in Appendix B)

During the inspection, various conditions were noted. Observations began with the roof level. The following was noted:

- Floor concrete delaminations, tee-edge spalling, and random cracks
- Scaling floor concrete throughout entire floor level
- Developing wall panel blowout along north wall
- Floor level sealants beyond useful service life
- Entry ramp routed cracks beyond useful service life
- Interior architectural sealants beyond useful service life
- Spandrel lateral connection missing hardware along east wall
- Double-tee joint with broken connections in south bay
- Approximately 10 ponding conditions
- Faded line striping

Photo #4: Tee-edge Spalling

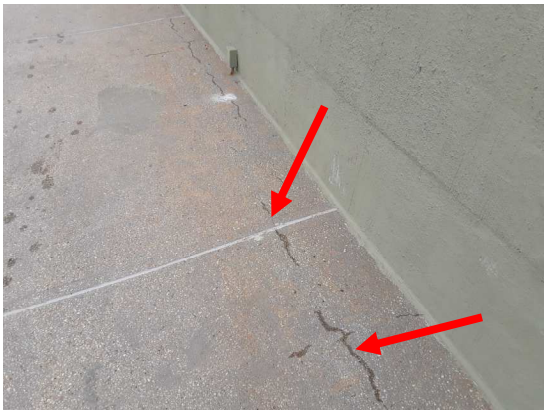


Photo #7: Floor Level Random Cracks

Photo #11: Floor Sealant Failure

Photo #22: Developing Wall Blowout

Photo #31: Scaling Concrete

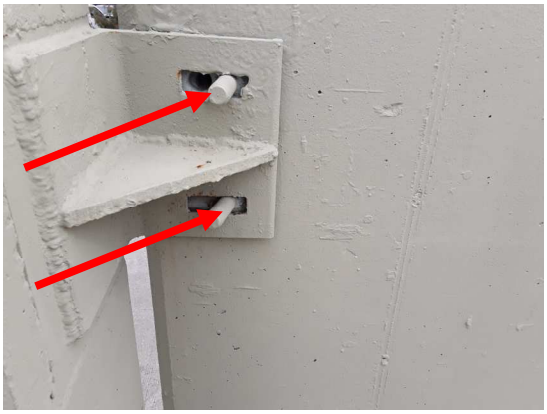


Photo #44: Missing Hardware Lateral Connection

The above photographs are representative of the conditions observed on the roof level. Additional photographs can be viewed in Appendix B of this report.

Observations were then taken on the lower two levels of the garage. Conditions noted include:

- Localized floor level concrete delaminations and limited random cracks
- Significant overhead concrete deterioration at tee flange edges, tee stems, girder ledges, columns, wall below roof level ramp, and other locations

- Rust bleeding and water infiltration from roof level
- Localized floor sealant failure
- One double-tee joint with broken connections in middle bay
- Light rust in overhead drain bodies
- Two ponding conditions on the second level
- Overhead signage either loose, damaged, or missing on both levels

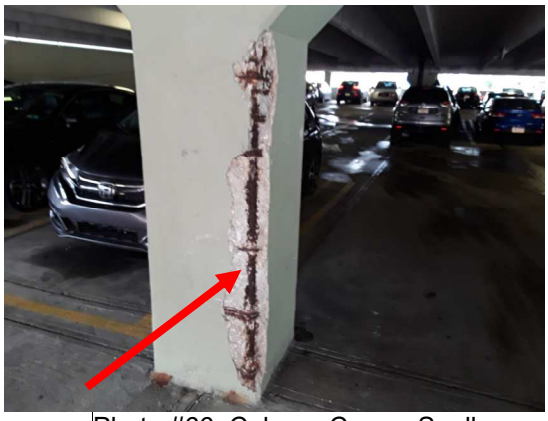


Photo #66: Column Corner Spall

Photo #86: Tee Edge Spalling/Rust Bleeding

Photo #108: Concrete Delam at Wall Under Ramp

Photo #131: Shored Tee Stem

Photo #132: Close-up Shored Tee Stem

Photo #149: Overhead Drain Body Rust

The above photographs are representative of the conditions observed on the lower levels. Additional photographs can be viewed in Appendix B of this report.

Observations then continued in the stair towers. Conditions include the following:

- Localized overhead concrete delaminations
- Localized rust bleeding and concrete leaching
- Localized floor level concrete spalls and delaminations
- Perimeter floor sealants beyond service life
- Worn wall paint
- Loose stair treads
- Mapped-cracking and scaling at stair landings

Photo #164: Overhead Concrete Delamination

Photo #166: Landing Concrete Delamination

Photo #170: Overhead Beam Spalling

Photo #173: Loosening Stair Treads

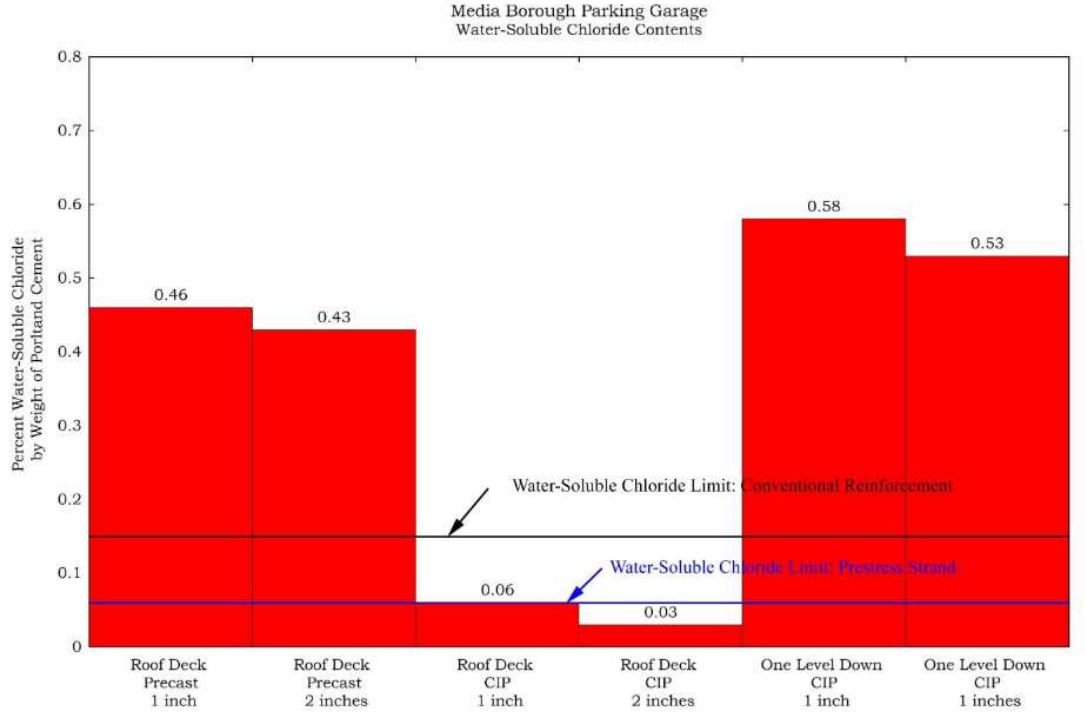
Finally, the inspection concluded with observations to the exterior of the garage. The following observations were taken:

- Dirt build-up on façade
- Localized efflorescence
- Localized masonry pointing deterioration

Photo #176: Localized Pointing Deterioration

Photo #177: Localized Efflorescence

In addition to the above observations, floor level concrete samples were taken from the roof and level below in the garage. These samples were tested for chloride content in order to gauge corrosion within the concrete. Below are the results of each location:



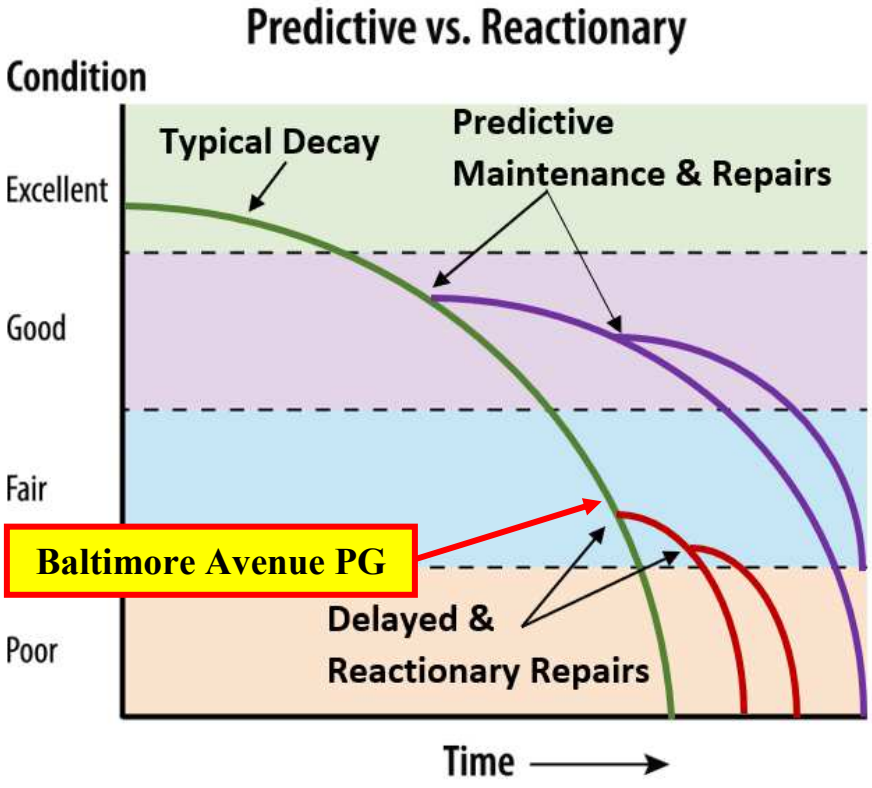
ANALYSIS

After consideration of the field observations and reviewing the chloride test results, it was determined that the apparent deferred maintenance and aggressive winter maintenance activities are the primary causes of the structure's current condition.

Garages by nature experience significant exposure over time from vehicular usage and winter cycles in the northeast. Roof level urethane floor sealants and architectural urethane sealants typically last about seven years and lower level urethane floor sealants up to fifteen years. After their respective service lives have been reached, cohesion and adhesion failures begin to develop and water can infiltrate. As localized deterioration naturally occurs, deicing chemicals carried by water infiltrate and further instigate corrosion by contaminating the concrete. In addition, cyclic freeze-thaw action of the saturated concrete promotes further deterioration. Exposed steel such as drains and connections along with embedded steel within the concrete corrode as well. This process, in conjunction with limited maintenance has allowed deterioration to progress unchecked since the garage has been in service.

The scaling floor level double-tees and amount of overhead corrosion identified on the level below the roof indicate moderate to advanced deterioration within the supported concrete members at multiple locations. During exploratory repairs conducted in early February, it was discovered that large amounts of concrete delamination exist at structurally-sensitive locations such as tee bearings to girder ledges, girder bearings to column corbels, structural walls, columns, and other elements. Some locations were shored in the interim until proper repairs can be implemented. It is believed that much of this corrosion is attributed to unchecked conditions and deferred maintenance as explained above.

In general, deterioration occurs naturally in all structures. However, this process is accelerated in the case of this garage. At some point, deterioration will become so advanced the structure will no longer function and will need to be demolished, usually when the cost of repair exceeds the cost of rebuilding. If nothing is done, the structure will require functional restrictions and will eventually experience more significant failures. A typical deterioration progression curve is shown below, which graphically shows the approximate stage of the garage with respect to its expected life cycle. Ideally, for maximum benefit and economic control, maintenance and repairs should occur at early stages, indicated by A1 and A2. Delayed, reactionary repairs often occur too late to provide long term, cost effective benefit, indicated by B1 and B2. Restoration of this structure can reverse this trend.



RECOMMENDATIONS

REPAIR – In order to return this structure to a maintainable condition, restoration of the progressively deteriorated systems within the garage will be required. This generally includes floor level concrete on the roof and second level, lower level vertical and overhead concrete, exterior masonry, roof and second level floor sealants, interior architectural sealants on the roof level, broken double-tee connections on the roof and second level, rusted overhead drain bodies on the lower levels, ponding conditions on the roof and second level, faded line striping on the roof level, lower level missing/damaged overhead signage, and both stair towers.

Concrete repairs within the garage structure should consist of routing/sealing cracks and removal/replacement of spalled/delaminated concrete with a structural grade repair material or epoxy and appropriate application of a corrosion inhibiting treatment and sealer over the entire finished floor of the roof and second level. Most of this work is focused towards the floor level concrete on the roof and second level and vertical/overhead concrete on the second level. In several cases on the second level, shoring may be required to temporarily stabilize precast members while repairs are implemented. Such cases include select double-tee stems and overhead girder ledges.

The exterior façade should be washed with pressurized water and localized masonry pointing re-tucked afterwards.

Waterproofing repairs/replacement should consist of removal of failed material and replacement with a two-part, traffic grade urethane sealant for the floor level joints. The roof level should have all floor level sealants replaced and localized repairs conducted on the second level. The architectural joints on the interior of the roof level should also be replaced, but traffic grade is not required since these sealants are a vertical application.

Exposed steel and connections should be cleaned and recoated. All embedded connections should be further inspected during concrete and sealant removal and appropriately cleaned and coated as necessary. The broken double-tee connections at the roof level tee joint along column line six in the south bay and second level along column line four in the middle bay should also be repaired by either reestablishing the connections or supplementing with additional hardware. Additionally, the lateral connection hardware at the roof level east wall missing nuts/washers should be replaced.

The drainage system in the garage should be cleaned and coated like the exposed steel and connections. This is primarily required on the second level overhead drain bodies. Additionally, the ten ponding conditions on the roof level and two ponding conditions on the second level should be remediated by installing supplemental drainage or altering grade of the finished floor.

Directional striping on the roof level should be restriped following any floor level repairs and lower level missing/damaged signage repaired or replaced.

Lastly, the stair towers should have localized repairs conducted in the form of: floor level and overhead concrete repairs, perimeter floor level sealant replacement, localized re-painting of walls, replacement of loosening stair treads, and application of a corrosion-inhibiting treatment to the exposed concrete surfaces.

MAINTENANCE - Beyond the recommended repairs, general maintenance is highly encouraged as emphasized before. General upkeep of the garage will allow for a controlled and predictable operating life, as well as an extended service life.

For this structure, the following items should be considered yearly operations:

- Annual inspection (including leak survey)
- Periodic housekeeping (removal of debris)
- Periodic training on winter snow removal activities
- Repair/replacement of service life failures (i.e. waterproofing)
- Annual spring chloride wash downs (pressure wash)

All repairs should be implemented under the supervision of a structural engineer with a background in precast garages. Additionally, qualified tradesman will be required to ensure overall quality of work performed.

The following are tables of prioritized probable costs associated with the above repair recommendations.

Prioritized Probable Costs (Priority 1)	
Scope	Cost
Concrete Repairs	
• Roof Level Floor Repairs	$123,300
• Roof Level and Second Level Vertical & OVH Repairs	$282,500
• Roof Level CIT Application to Supported Finished Floor	$62,700
• Pressure Wash All Floor Surfaces	$6,300
Waterproofing Repairs	
• Roof Level Floor Sealant Replacement	$83,500
Steel/Connection Repairs	
• Roof and Second Level Double-Tee Conn. Repairs	$18,000
Drainage System Repairs	
• Remediate 10 Ponding Conditions on Roof Level	$64,200
Line Striping/Signage	
• Roof Level Striping Following Floor Repairs	$2,150
Total	**$642,650**

*Probable costs include all required design and engineering support

Prioritized Probable Costs (Priority 2)	
Scope	Cost
Concrete Repairs	
• Second Level Floor Repairs	$80,900
• Ground Level OVH Repairs	$32,350
• Second Lvl CIT Application to Supported Finished Floor	$65,800
• Pressure Wash All Floor Surfaces	$6,600
Waterproofing Repairs	
• Second Level Localized Floor Sealant Repairs	$32,400
Drainage System Repairs	
• Second Level OVH Rusted Drain Bodies	$2,700
• Remediate Two Ponding Conditions on the Second Lvl	$13,500
Total	**$234,250**

*Probable costs include all required design and engineering support

Prioritized Probable Costs (Priority 3)	
Scope	Cost
Concrete Repairs	
• Stair Tower Repairs (Includes Perimeter Waterproofing, Miscellaneous Paint, and Application of CIT to Exposed Surfaces)	$51,000
• Exterior Pressure Wash and Masonry Tuckpointing	$15,250
• Pressure Wash All Floor Surfaces	$6,900
Waterproofing Repairs	
• Roof Level Interior Architectural Sealant Replacement	$11,350
Line Striping/Signage	
• Repair/Replace Lower Level OVH Signage	$5,450
Total	**$89,950**

*Probable costs include all required design and engineering support

LIMITATIONS

The inspection was primarily limited to the structural elements of the garage. However, related systems including waterproofing and miscellaneous metals were also reviewed. The inspection was primarily visual based on observed deficiencies and deterioration.

Given the limitations of this type of condition survey, certain assumptions were required relative to usage, service, and condition of the garage. The recommendations made are based on current best practices in consideration of the observations and assumptions made. The costs of recommended repairs are ‘order of magnitude’ in nature and not based on firm pricing. We do not guarantee that the inspection discovered or disclosed all possible latent conditions.

No effort was made to certify compliance with current codes or standards. No other representation and no warranty or guarantee, expressed or implied, is offered or intended as a result of this inspection and report. This report is for the use of the Owner and not intended for use by or publication to others without the written permission of High. High’s inspection and report are intended solely and exclusively for the benefit and use of the Owner. No party may claim hereunder as a third party beneficiary.

Appendix A
Definitions and Terminology

Appendix A: Definitions and Terminology

Adhesion failure – a waterproofing failure where joint sealants have lost their bond to the adjacent material

Camber Clip – a welded structural connection between adjacent floor members

Cast-in-Place Concrete - field poured concrete, which is usually produced and delivered from a ready-mix supplier. This material is used in precast garages to create positive drainage, cover exposed connections, augment the structural building system and serve as the foundation for the precast elements. Cracks or deterioration of these systems can lead to long term maintenance conditions.

Critical – critical conditions or findings usually imply a significant concern that should be addressed as soon as possible. A knowledgeable engineer should evaluate the condition and determine an appropriate course of action.

Chain Drag Survey – a diagnostic tool to determine the location and extent of delaminations in concrete by dragging a metal chain or chains over the surface. Delaminated areas emit a lower frequency sound than sound areas.

Cohesion Failure – a waterproofing failure where joint sealants fail within the body of the sealant

Condition – general condition assessment classifications:

> **Poor** – little to no maintenance, significant deterioration, long-term repair and maintenance strategy required to sustain structure beyond 2-4 years
>
> **Fair** – inadequate or incomplete routine maintenance, advanced local or general deterioration, corrective repairs required

Appendix A: Definitions and Terminology

Good – minor to moderate deterioration, some improvements needed in maintenance, and corrective and/or preventative repairs required to arrest or prevent further damage

Excellent – Minor to no deterioration, well maintained, routine repairs and maintenance required only

Cracks – splits, or openings that develop in concrete from various causes including stress, curing, impact, etc. Cracks can serve as pathways for water infiltration, exposing steel to corrosive forces.

Double Threaded Helix – defines the traffic flow configuration through a garage. A double threaded helix rises two floors with every 360 degrees of revolution.

Efflorescence - mineral salts appearing on the surface of concrete or masonry, usually white in color. This is usually a sign of water penetration.

Expansion Joint – similar to sealants in purpose, but usually constructed of pre-formed materials capable of a range of movements. In traffic areas a protective covering is often applied. Damage to these elements by snow removal operations or from other causes can shorten their service life and allow harmful water infiltration.

Joint damage – occurs when something tears or punctures waterproofing sealants. This can be caused by snow removal operations or pressure from built up debris such as stones or other hard materials.

Joint failure – occurs when sealants fail to perform as designed as a result of any of the following; placement errors, material quality, age, damage, etc.

Appendix A: Definitions and Terminology

Precast Connections – a connection that ties one piece of precast to another element. Connections are an important part of structural integrity. Signs of deterioration should be monitored and, if necessary, addressed.

Precast Bearings – a support for precast members, usually in the form of a haunch or ledge or directly on another member. Usually bearing conditions involve the use of bearing pads that distribute the applied load and allow for some minor movement. Signs of deterioration around bearing conditions might indicate excessive movement.

Reinforcing Steel – a rigid steel rod used as primary or secondary reinforcing within cast-in-place concrete. This steel helps add tensile strength and crack control to concrete.

Sealants – flexible material installed in joints to prevent the infiltration of water, wind, etc.

Single Threaded Helix - defines the traffic flow configuration through a garage. A single threaded helix rises one floor with every 360 degrees of revolution and has two-way traffic.

Spalls – dish shaped break out of concrete caused by internal or external pressure or impact. Spalls could be a sign of corrosion of internal reinforcing steel or hardware or water infiltration. The area should be sounded to locate loose or deteriorated concrete. All such material should be removed and exposed steel should be cleaned, coated and re-patched.

Topping/Wash/Pour Strip – A cast-in-place concrete field applied overlay used to create drainage swales, ADA access ramps or a transitional riding surface over precast concrete floor members.

Appendix A: Definitions and Terminology

Typical Precast Garage Diagram –

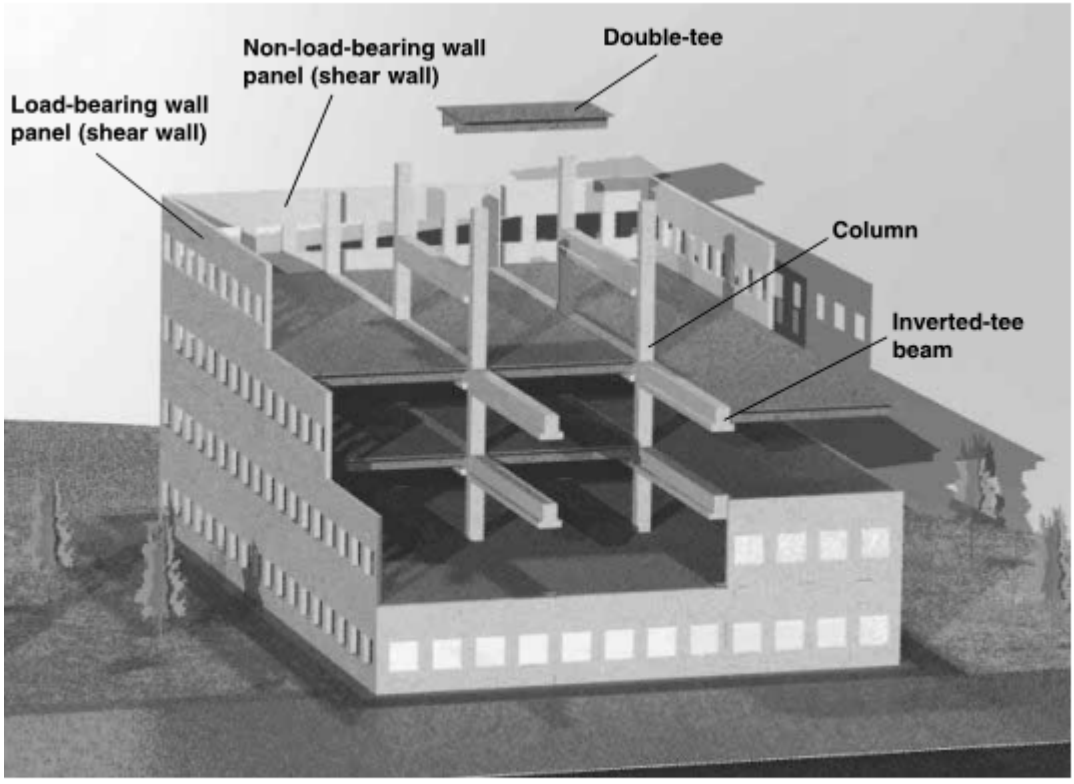


Fig. 3.2.6 Exterior shear wall system.
In general, the exterior shear wall system permits greater design flexibility than an interior shear wall system because it eliminates the need for a structural core. By combining gravity load-bearing function with lateral-force resistance, the exterior shear wall system is, in general, more economical.

Appendix B
Photographs

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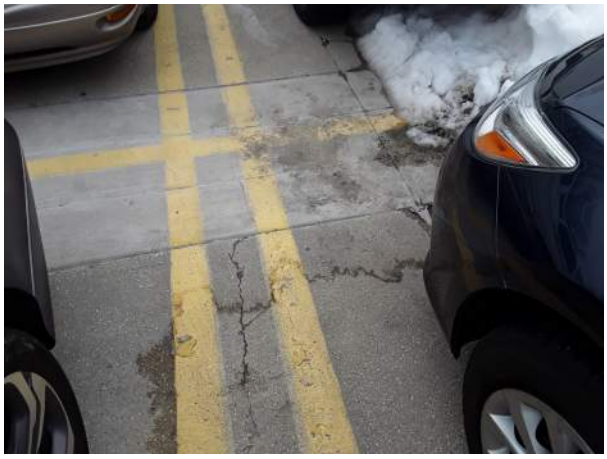

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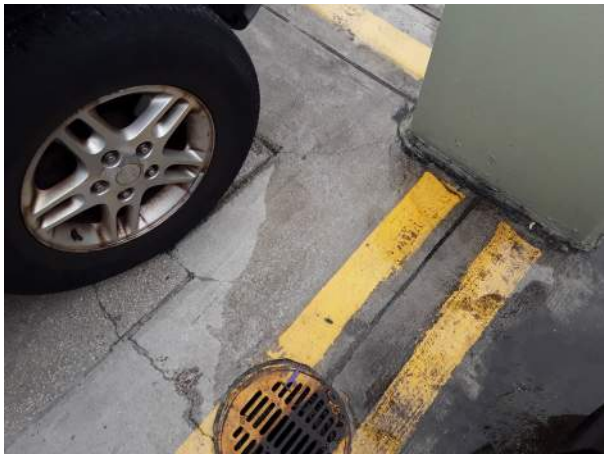

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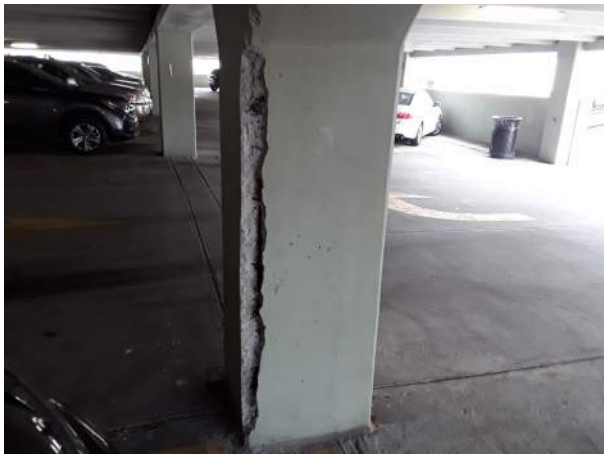

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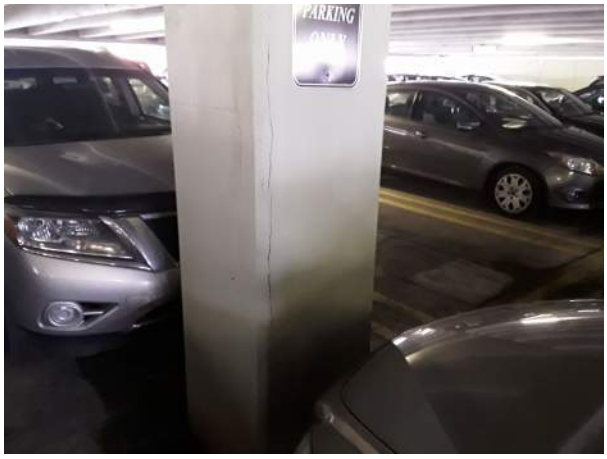

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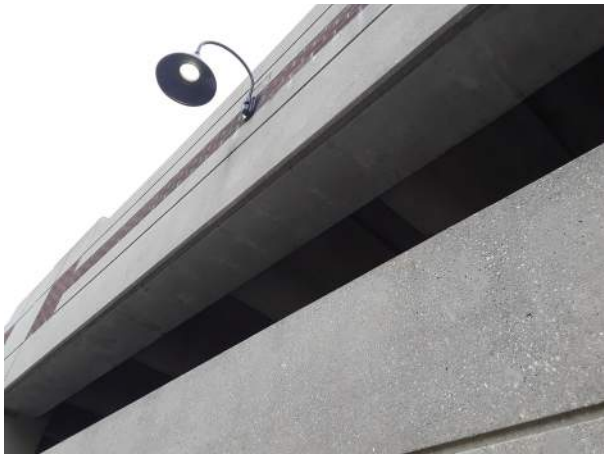

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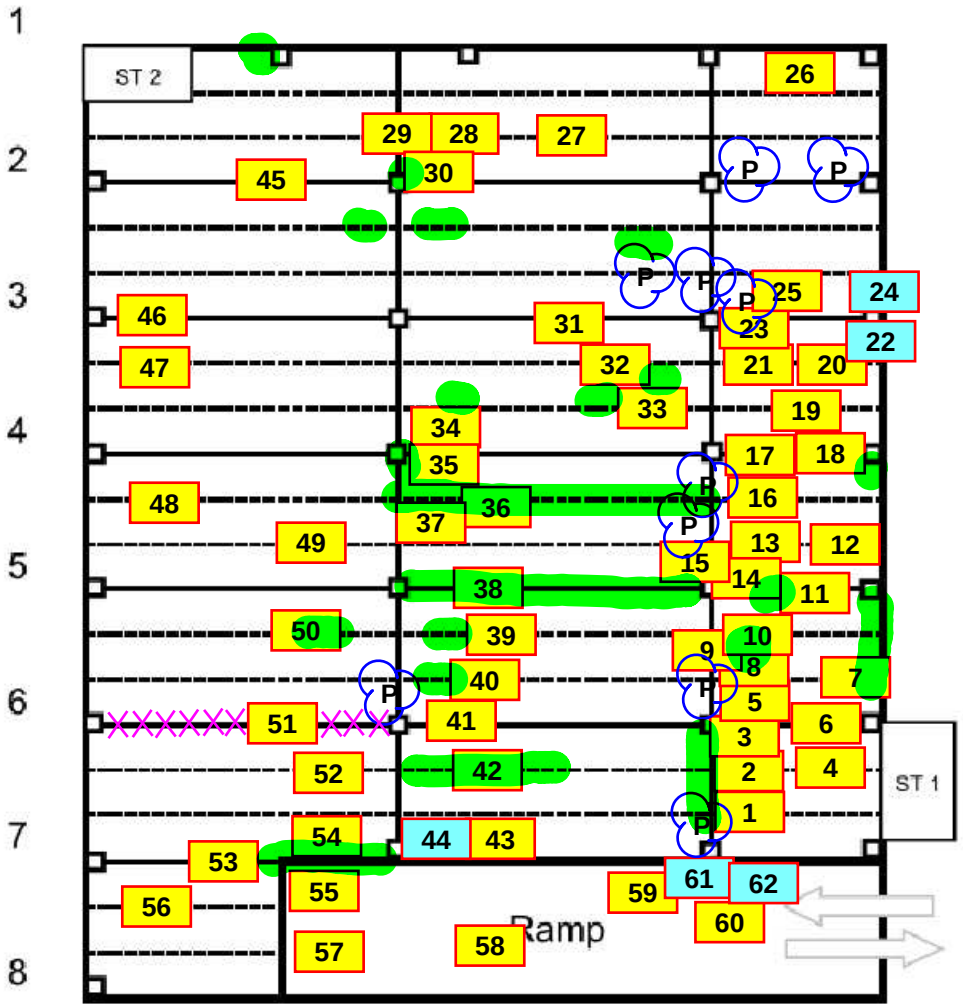
MEDIA MUNICIPAL PARKING GARAGE
MUNICIPAL
PARKING
DO NOT ENTER
CLEARANCE
ENTRANCE

181.

Appendix C
Reference Drawings & Field Notes

KEY

- Floor Level Observations
- Overhead Observations
- Ponding
- Concrete Delamination
- X Broken Tee-Tee Conn.



Roof Level

NORTH

StructureCare
1850 William Penn Way
Suite 101
Lancaster, PA 17601

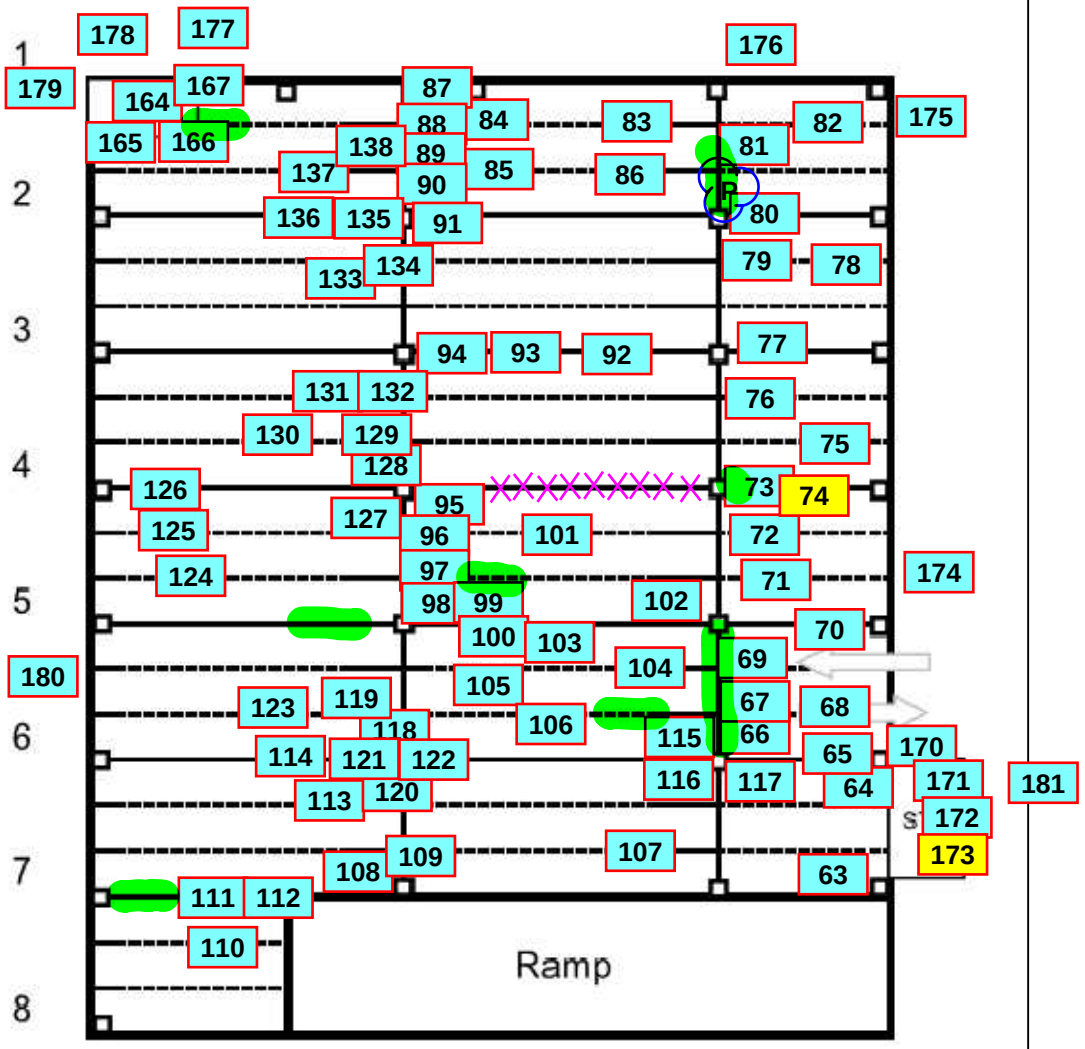
NOTES:
DRAWINGS COMPLETED BY HIGH CONCRETE GROUP D/B/A STRUCTURECARE.

PROJECT: MEDIA BOROUGH PG
LOCATION: MEDIA, PA
CONTRACTOR: HCG D/B/A STRUCTURECARE
DRAWING TITLE: ROOF LEVEL

DRAWN	CHECKED	ENGINEER
MEB		MEB

PROJECT NUMBER

DRAWING NUMBER
E01



StructureCare
1850 William Penn Way
Suite 101
Lancaster, PA 17601

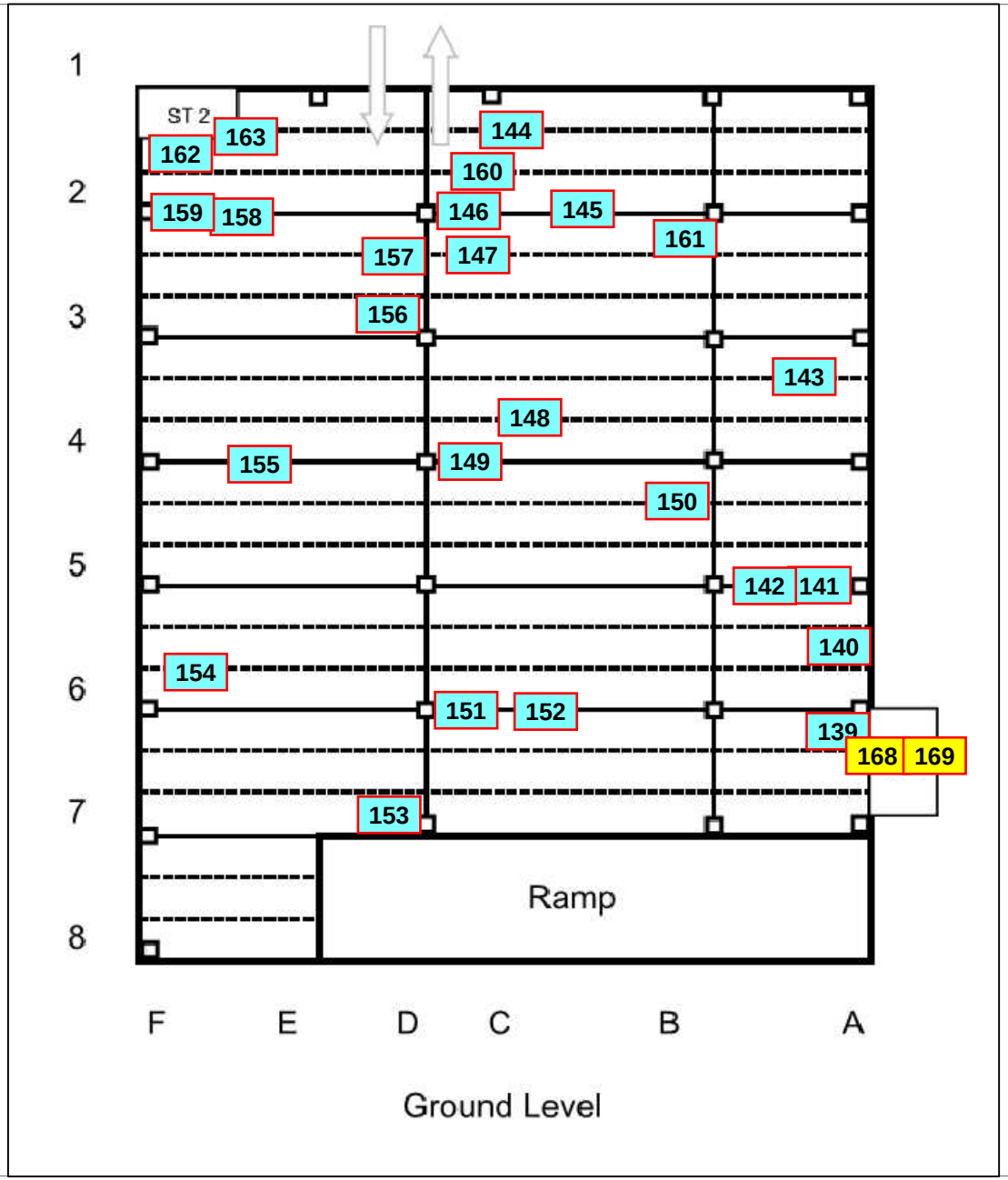
NOTES:
DRAWINGS COMPLETED BY HIGH CONCRETE GROUP D/B/A STRUCTURECARE.

PROJECT: MEDIA BOROUGH PG
LOCATION: MEDIA, PA
CONTRACTOR: HCG D/B/A STRUCTURECARE
DRAWING TITLE: SECOND LEVEL

DRAWN	CHECKED	ENGINEER
MEB		MEB

PROJECT NUMBER

DRAWING NUMBER
E02



StructureCare

1850 William Penn Way
Suite 101
Lancaster, PA 17601

NOTES:
DRAWINGS COMPLETED BY HIGH CONCRETE GROUP D/B/A STRUCTURECARE.

PROJECT: MEDIA BOROUGH PG
LOCATION: MEDIA, PA
CONTRACTOR: HCG D/B/A STRUCTURECARE
DRAWING TITLE: GROUND LEVEL

DRAWN	CHECKED	ENGINEER
MEB		MEB

PROJECT NUMBER

DRAWING NUMBER
E03

Appendix D
Diagnostic Test Results

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March 21, 2019
MP1903996

Mr. Robert Grasser
Project Manager
StructureCare
1850 William Penn Way
Lancaster, PA 17601

RE: Water-soluble chloride studies of powder samples from Media Borough P/G, Media, PA 19063.

Dear Mr. Grasser:

This letter presents the results of the water-soluble chloride content determinations done on powder samples of concrete from the parking structure identified as Media Borough Parking Garage located in Media, Pennsylvania. The results are presented in the attached Table and Figure. The analyses were done using methods of ASTM C1218, "Water-Soluble Chloride in Mortar and Concrete."

In the test, the results are measured as percent by weight of concrete. The threshold limit for the water-soluble chloride content at which corrosion of conventional reinforcement is initiated in new non-carbonated concrete is established by the American Concrete Institute (ACI) as 0.15 percent by weight of portland cement. For initiation of corrosion in prestress strand the limit is established as 0.06 percent by weight of portland cement. If mix proportions of the concrete are known, then the measured values can be converted to percent by weight of portland cement. In this project the unit weights and portland cement contents of the precast and cast-in-place concretes are not known and are estimated for the conversion calculation. The unit weights of the precast and cast-in-place concretes are estimated to be 4,000 pounds per cubic yard; the respective portland cement contents for

the precast and cast-in-place concretes are assumed to be 600 and 564 pounds per cubic yard.

The chloride profiles demonstrate that the concrete slabs have been exposed to external chlorides (chloride-based deicing agents) from the top surface. Except in the CIP samples from the Roof Deck, water-soluble chloride contents at all sample locations (Precast on the Roof Deck and CIP, One Level Down) exceed the threshold levels for initiation of corrosion in new concrete established for both prestress strand and conventional reinforcement to depths of at least 2 inches. The results of the analyses are summarized in the Table and Figure.

Submitted,

Mark E. Patton, PhD, PE

Table – Results of the water-soluble chloride content analyses of the powder samples.

Media Borough Parking Garage Samples	Water-Soluble Chloride (percent by weight of)	
	Concrete	Portland Cement (1)
Roof Deck, Precast; 1 inch	0.069	0.46
Roof Deck, Precast; 2 inches	0.064	0.43
Roof Deck, CIP; 1 inch	0.009	0.06
Roof Deck, CIP; 2 inches	0.003	0.02
One level down, CIP, 1 inch	0.082	0.58
One level down, CIP, 2 inches	0.075	0.53
Established Threshold Limit for Nucleation of Corrosion in New Non-Carbonated Concrete - Conventional Reinforcement	--	**0.15**
Established Threshold Limit for Nucleation of Corrosion in New Non-Carbonated Concrete – Prestressing Strands	--	**0.06**

(1) Calculated assuming a unit weight of concrete of 4,000 lbs. for the precast and CIP and respective portland cement contents of 600 and 564 pcy.

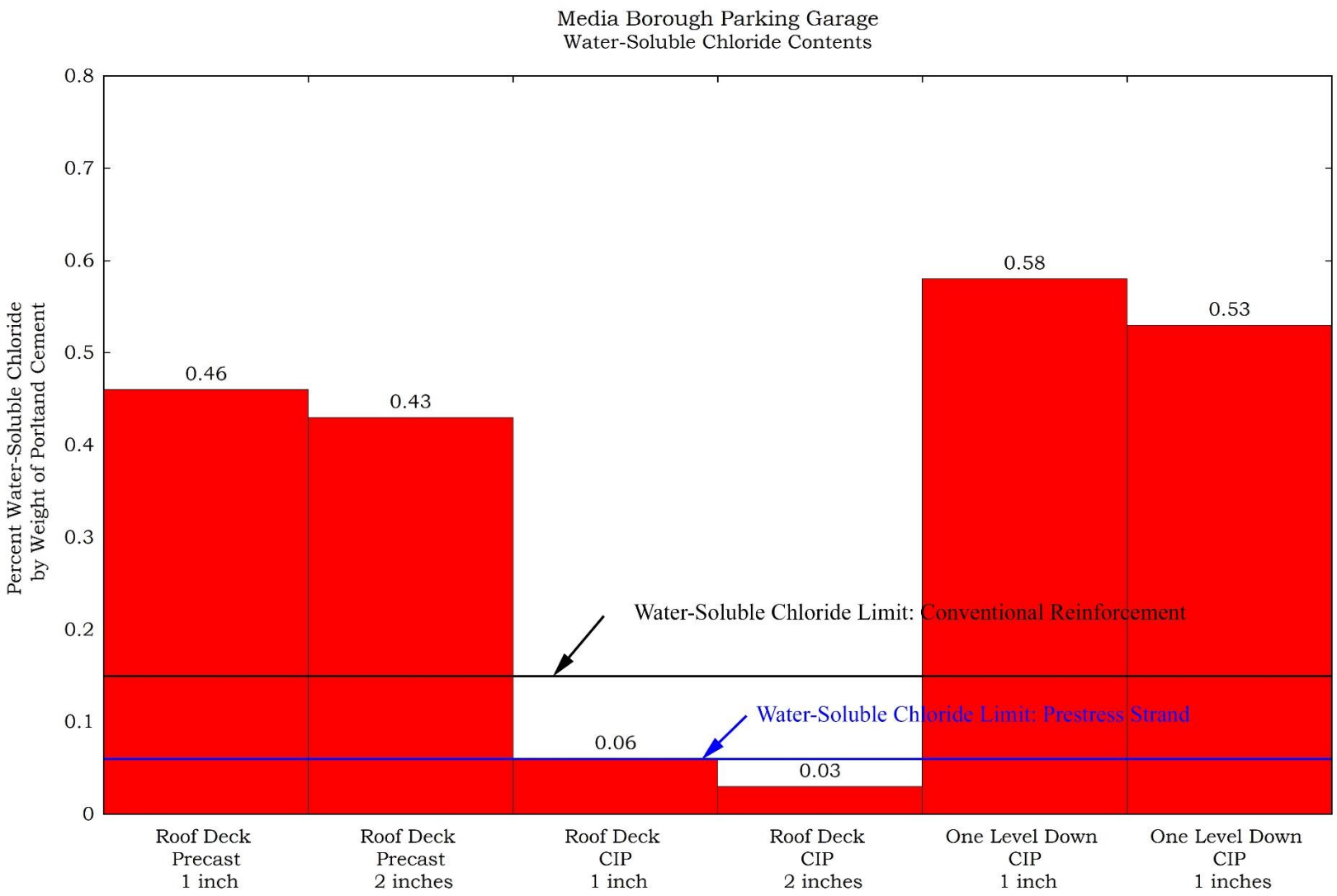

Figure – Chart of water-soluble chloride contents for the samples assuming unit weights and portland cement contents of the precast and cast-in-place concretes.