

1010 LAKE STREET

HOPKINS, MINNESOTA

PARKING GARAGE CONDITION ASSESSMENT



PREPARED BY:



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Project Number 23028.00
April 23, 2023



April 23, 2023

Christopher P. Kearney
City of Hopkins
1010 First Street South
Hopkins, M 55343

Re: 1010 Lake Street Parking Garage - Condition Assessment
CDG Project #23028.00

Dear Chris:

We have completed the Structural Condition Assessment for this parking garage. This report summarizes our evaluation procedures along with our observations, conclusions regarding structural integrity, and recommendations for repairs and maintenance.

The services performed in evaluating the structure and in preparing this report have been in accordance with the level of skill and care normally used in engineering practice. The conclusions and recommendations discussed in this report are our best professional opinions based on our knowledge of current design and repair of parking structures. No warranties are expressed or implied. Although some safety issues may be identified, this report is not to be viewed as a comprehensive safety evaluation of this facility. Maintenance and safety are the responsibility of the owner.

It has been a pleasure to perform this service for you. If you have any questions, or if we can be of further assistance, please feel free to call.

Very truly yours,
Collaborative Design Group, Inc.


Craig Milkert, PE
Principal

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota.

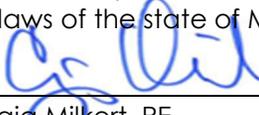
Signature: 
Name: Craig Milkert, PE
Date: 04/23/2023 License Number: 18360

Table of Contents

1010 LAKE STREET PARKING GARAGE

REPORT SUMMARY	1
INTRODUCTION	2
SCOPE OF WORK	2
Review of Documents	2
Observations	3
Precast Double Tees/Slabs	3
Beams	9
Walls	10
Waterproof Coatings	11
DISCUSSION	12
Precast Double Tees / Slabs	12
Beams	13
Walls	13
Waterproof Coatings	13
CONCLUSION AND RECOMMENDATIONS	13
Precast Double Tees / Slabs	14
Beams	14
Walls	14
Waterproof Coatings	14

REPORT SUMMARY

Observations of the 1010 Lake Street Parking Garage were performed in April 2023 to determine its current structural condition. The intent of this summary is to provide an overview of the following report. The report must be reviewed in its entirety for a complete understanding of our conclusions and recommendations.

The recommendations made in this report are not inclusive of all items to be repaired; as such, this report is not intended to be used as a construction document. Because of the extent of recommended repairs, complete documentation of all items to be repaired should be made on a set of construction drawings, along with appropriate details and specifications to ensure that the work is completed correctly.

Overall, the 1010 Lake Street Parking Garage is in good structural condition at this time, but in need of maintenance. The structural systems discussed in this report are capable of supporting the loads required by the Minnesota Building Code for parking garages. While there is deterioration throughout the garage, the defects noted in this report do not appear to be detrimental to the load carrying capacity at this time.

The double tee slab system is performing well, but in need of maintenance. The areas of the double tees with significant concrete spalling, such as the currently barricaded areas, should not have vehicle traffic until repairs are made. All other areas of the garage are safe for occupancy.

The issue of highest structural priority at this time is deterioration of the double tee flange connector plates throughout the garage. These connector plates are critical to the performance of the double tee joints, but do not affect the structural integrity of the individual double tees. The connector plates create a continuous diaphragm and ensure that adjacent double tees deflect together. If they do not deflect together, excessive stress will be placed on sealant joints, and they will fail prematurely.

INTRODUCTION

The 1010 Lake Street Parking Garage is located adjacent to the Knollwood West Apartments. This garage has two levels of parking. There is no direct vehicular connection between the two levels.

The lower level is a concrete slab on grade. The upper-level slab is constructed with precast concrete double tees spanning east-west. Concrete masonry unit (CMU) walls support the double tees at the exterior and center walls.

SCOPE OF WORK

The following is a summary of the work performed:

Review of Documents

Existing plans, construction documents, maintenance records, and previous inspection records are typically reviewed to determine any previous findings or modifications to the structure. Review of the drawings will indicate the method of construction used and design assumptions. Review of inspection reports will indicate what has been observed in the past, and what repairs have been recommended. No original design drawings were available.

The following documents were reviewed:

- Braun Intertec Structural Evaluation and Testing Report dated November 17, 2020: This report identified that the parking slabs are constructed with precast concrete double tees supported by CMU walls. The flanges of the double tees are deteriorated at the locations of the flange connectors. The steel lintels over the openings in the center wall are constructed with a W16x50 steel beam with a bottom plate. Pack rust is evident on the bottom plate. Minor cracking and spalling were identified at the bearing ends of the precast tees. The recommendations included repair of the double tee flanges, replacement of the steel lintels, repairing deteriorated CMU, and a waterproofing system installed.
- Braun Intertec Repair Options for Precast Double Tees dated December 1, 2020: This report outlined four recommended options for the repair of the double tee flanges.
- Braun Intertec Observation Report dated February 2, 2023: This report indicated that the deterioration of the concrete on the flanges of the double tees is continuing to worsen, the cracking of the CMU walls has not worsened, and that water seepage and ponding is evident. The recommendation was that no parking be allowed on the upper level due to the deterioration and lack of repairs
- Palanisami Structural Condition report dated April 6, 2023: This report identified that the garage has been closed since March 15, 2023 due to structural safety concerns. The observations listed in this report includes that the underside of the joints between double tees is covered with a nylon fabric to prevent falling concrete, deterioration of the concrete at the flange connectors is evident, and the flanges and tee stems are in good condition. The recommendation is that traffic should not be permitted on the barricaded area on the upper level until repairs are completed, and that the remainder of the garage can be opened for occupancy with monitoring every two weeks until the repairs are completed.

Observations

Visual observations of the slabs, beams, and walls are recorded below. These observations include noting the condition of the double tee joints, indications of movement of the structural elements, location and extent of deteriorated concrete including cracks and spalls, and corrosion of the steel connector plates.

The following rating system was used in assessing the building condition:

- **Excellent:** The building component is new, with no apparent defects.
- **Good:** The building component is able to perform its originally intended function in its current condition. Any defects are minor and do not affect the performance of the building component.
- **Poor:** The building component is unable to perform its originally intended function in its current condition. The component has major defects, but is repairable.
- **Unacceptable:** The building component is unable to perform its originally intended function in its current condition, and cannot be economically repaired. Replacement of the building component is required.

OBSERVATION	REFERENCE PHOTO
<p>Precast Double Tees/Slabs</p> <p>1. Precast concrete double tees clear span the width of the east and west sides of the garage, and are in overall good condition, with isolated areas of deterioration.</p>	 A photograph showing the interior of a parking garage. The view is looking down a long, straight aisle. The ceiling consists of multiple levels of precast concrete double tees and slabs. The floor is a smooth, light-colored concrete surface with some faint markings. The walls are also made of concrete. The lighting is provided by several recessed ceiling lights, creating a bright, well-lit environment. The overall condition of the structure appears to be good, with no significant signs of deterioration or damage visible.

OBSERVATION	REFERENCE PHOTO
2. The double tees bear on CMU walls at the center and exterior walls.	 A photograph of an underground parking ramp. The ceiling consists of concrete double tees supported by a wall of concrete masonry units (CMU). The wall has three sections labeled '3X', '2X', and '1X' from left to right. The floor is concrete with yellow painted lines and some water stains.
3. Fabric was installed beneath the joints between the double tees. Note that fallen concrete is evident in the bulged fabric, along with water seepage.	 A close-up photograph of the space between two concrete double tees. A black plastic fabric is installed to seal the joint. The fabric is bulging in the center, and there is visible water seepage and some concrete debris on the fabric.

OBSERVATION	REFERENCE PHOTO
4. The observed flange connectors on the upper level double tees are in poor condition, with corrosion and spalling concrete evident.	
5. Spalling concrete is evident at the flange connectors on the upper level.	

OBSERVATION	REFERENCE PHOTO
6. Spalling is evident on the upper level double tee flanges in isolated locations, exposing the steel wire mesh. This is a poor condition.	
7. Minor spalling is evident at the bearing ends of some double tees.	

OBSERVATION	REFERENCE PHOTO
8. Minor spalling is evident at the bearing ends of some double tees.	
9. Stains from water infiltration is evident on the double tees of the roof, but no deterioration was observed.	

OBSERVATION

REFERENCE PHOTO

10. The concrete slab on grade on the entrance ramps is cracked and in poor condition. This is not a structural concern.



11. The concrete slab on grade on the lower level is cracked and in poor condition. This is not a structural concern.



OBSERVATION

REFERENCE PHOTO

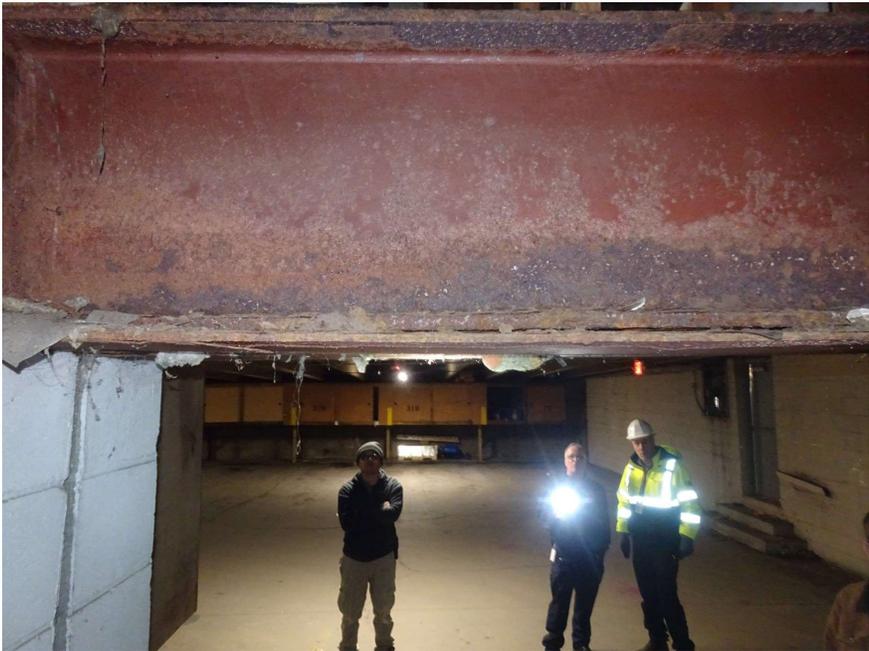
12. Ponding water is evident on the lower level, likely due to clogged drains.



Beams

13. Steel beams are used to support the double tees at the openings of the center wall. The steel beams have some corrosion, but are performing well and in overall good condition.



OBSERVATION	REFERENCE PHOTO
<p>14. The bottom plate on the steel beams is buckled due to corrosion. This is not a structural concern, as the bottom plate is not required for the integrity of the beam. The bottom flange of the beam is in good condition, with minor corrosion.</p>	
<p>Walls</p>	
<p>15. The CMU walls are in overall good condition, with some minor cracking evident.</p>	

OBSERVATION	REFERENCE PHOTO
<p>16. Some deterioration of the CMU walls is evident on the exterior walls.</p>	 A photograph showing a section of a concrete masonry unit (CMU) wall. The wall is heavily deteriorated, with significant crumbling and loss of material, particularly in the center. The surface is uneven and appears to be covered in a layer of dust or debris. The lighting is dim, highlighting the texture and damage of the masonry.
<p>Waterproof Coatings</p> <p>17. Waterproof coating has been applied over the joints between double tees, and is in overall poor condition.</p>	 A photograph showing a corner where two concrete double tee beams meet. The joints between the beams are covered with a dark, textured waterproof coating. The coating appears uneven and possibly peeling or cracked in some areas, indicating poor condition. The surrounding concrete is light-colored, and the floor is visible in the foreground.

DISCUSSION

Overall, the 1010 Lake Street Parking Garage is in good structural condition at this time. The structural systems discussed in this report are capable of supporting the loads required by the Minnesota Building Code for parking garages. While there is some deterioration throughout the garage, the defects noted in this report do not appear to be detrimental to the load carrying capacity at this time.

The double tees and beams in this structure are constructed with precast prestressed concrete. Prestressing is a method of adding strength to the concrete, allowing for long spans. The basic theory is that since concrete is strong in compression and weak in tension, the concrete can be strengthened by applying compressive stresses to counteract the tension stresses. Prior to casting the concrete double tees and beams, high strength steel cables are carefully placed in the formwork at precise locations as determined by the structural engineer, and are stretched with approximately 27,000 pounds of force. After the concrete has cured to the required strength, the cables are cut, thereby releasing the full force into the concrete member. This force provides uplift to the concrete members to counteract the gravity loads on the structure, as well as applies compression to the concrete to counteract tension stresses.

Prestressing tendons are comprised of seven, high strength steel wires, twisted together to produce a 1/2" diameter strand. The tendons are left uncoated, and bond with the concrete during the curing period. Because the tendons are stressed to such high levels, a small amount reduction of the cross-sectional area of the wires caused by corrosion will initiate failure of the tendon. When the tendons break, they lose their force and ability to reinforce the structure at that location. However, because the tendon is bonded to the concrete, compression is maintained in the concrete away from the break location. Eventually, as more of these local area failures occur, the structural integrity of the concrete member can be compromised. Because the prestressing provides the primary reinforcing for the concrete double tees and beams, and deterioration of the system is not always obvious, it is crucial that the structure is maintained properly to slow water and chloride infiltration.

The location where this type of precast system is most vulnerable to water seepage and deterioration is at the joints between the double tee slab flanges. Steel plates are installed in the edges of the slab flanges and are welded together to create a monolithic slab structure. These slab connections are important to reduce the likelihood of differential vertical movement between flanges at the joints due to vehicle wheel loads.

Water seeping through these joints can also run across the underside of slabs, down or across tee stems, and eventually to the beams and columns as water finds and follows the path of least resistance. Water seepage through these joints causes deterioration of the concrete and corrosion of the reinforcing steel. It is critical that these joints be protected from water seepage.

Precast Double Tees / Slabs

The supported slabs are formed using precast prestressed double tees. The double tees are performing well and are in overall good condition, with some spalling on the stems at the bearing ends in a few locations, and spalling of the concrete at the flange connector plates.

Typically, the main concern with the slabs in any garage is deterioration of the concrete due to corrosion of the reinforcing steel. This corrosion process can be accelerated due to the common use of de-icing salts on our roads. High chloride levels, combined with water and oxygen can cause corrosion of the steel reinforcing and subsequent deterioration of the concrete structure.

Most of the obvious deterioration in this garage appears in the failure of slab flange weld plates and sealant joints. Flange connector plates serve to connect adjacent double tees, ensuring that they act uniformly as one system. Without the plates, adjacent double tees deflect differently under loading, causing excessive wear and tear on the sealant joints. The connector plates also serve to provide a diaphragm to distribute lateral loads, such as wind, and ensure structural stability of the garage. Based on the observations indicated above, it is evident that a significant number of connector plates have deteriorated.

Even with repairs to the joints and flange plates, water infiltration will continue, along with continued corrosion of the reinforcing steel. In order to extend the useful life of the structure, the rate of corrosion must be slowed. Installing waterproof traffic coating over areas of known seepage will stop the flow of water through the concrete and slow deterioration. The strip of waterproof coating over the replaced sealant joints will greatly improve the effectiveness and lifespan of the joints.

The concrete slab on grade on the lower level is in overall good condition with some localized cracks and small spalls. This condition is not a structural issue, but should be repaired if a tripping hazard is created.

Beams

Although the steel beams have some corrosion, they remain in good structural condition and are able to support the intended loads. The water infiltration above the beams needs to be remediated prior to correcting the corrosion issue.

Walls

The CMU walls are in overall good condition, with some localized cracking and deterioration. The water infiltration issues should be corrected prior to repairs.

Waterproof Coatings

The joints between the double tees have been covered with some type of waterproof coating, which is in poor condition. This coating should be completely removed and replaced.

CONCLUSION AND RECOMMENDATIONS

Although there is some amount of deterioration throughout the garage, there is no evidence of present or impending structural failures at the time of this Assessment. The double tee slab system is performing well, but in need of maintenance. The areas of the double tees with significant concrete spalling, such as the currently barricaded areas, should not have vehicle traffic. All other areas of the garage are safe for occupancy.

The recommendations made in this report are not inclusive of all items to be repaired; as such, this report is not intended to be used as a construction document. Because of the extent of recommended repairs, complete documentation of all items to be repaired should be made on a set of construction drawings, along with appropriate details and specifications to ensure that the work is completed correctly.

The issue of highest structural priority at this time is deterioration of the double tee flange connector plates throughout the garage. These connector plates are critical to the performance of the double tee joints, but do not affect the structural integrity of the individual double tees. The connector plates create a continuous diaphragm and ensure that adjacent double tees deflect together. If they do not deflect together, excessive stress will be placed on sealant joints, and they will fail prematurely.

Precast Double Tees / Slabs

All spalls and delaminations on the top side of the double tee flanges should be identified and repaired. All deteriorated or failed connector plates should be repaired or replaced.

Beams

The corrosion on the steel beams should be removed and the beams repainted after the water seepage from above is corrected.

Walls

Any deteriorated CMU should be repaired after the water seepage is corrected.

Waterproof Coatings

The waterproof coating over the double tee joints should be replaced.