CITY OF STAUNTON
DEPARTMENT OF FINANCE-
PURCHASING

P.O. BOX 58
STAUNTON, VA 24402

540.332.3809 (TEL)
540.851.4011 (FAX)

WWW.STAUNTON.VA.US

CAMERON S. MCCORMICK, CPA
ASSISTANT DIRECTOR OF FINANCE
540-332-3948

BONNIE S. STEPHENSON
PURCHASING & RISK MANAGER
540-332-3819

REQUEST FOR QUALIFICATIONS
CONSTRUCTION PHASE SERVICES
JOHNSON STREET PARKING GARAGE
and
NEW STREET PARKING GARAGE

CITY OF STAUNTON, VIRGINIA

November 20, 2017

GENERAL INFORMATION

PROPOSAL:
The City of Staunton, a Virginia municipal corporation located in the Shenandoah Valley, is seeking sealed qualification proposals from qualified construction firms (the Applicant) that may wish to bid on remedial repairs to the Johnson Street Parking Garage, located at 101 W. Johnson Street, and the New Street Parking Garage located at 35 South New Street, Staunton, VA. Those firms found to be qualified may competitively bid on the construction work under a separate invitation to bid to be issued at a later date.

All proposals must be delivered to:

Bonnie S. Stephenson, Purchasing and Risk Manager
City of Staunton
Finance Department, Third Floor
116 W. Beverley Street (24401)
or
P.O. Box 58
Staunton, VA 24402-0058
540.332.3819
stephensonbs@ci.staunton.va.us

ALL PROPOSALS MUST BE SUBMITTED BY 4:00 PM THURSDAY, DECEMBER 28, 2017.

The City of Staunton is not responsible for delays in the delivery of the mail by the U.S. Postal Service, private couriers, or the inter-office mail system. It is the sole responsibility of the Applicant to ensure that its proposal reaches the Purchasing and Risk Manager by the designated date and hour. All Applicants shall abide by all applicable State and Federal laws. This public body does not discriminate against faith-based organizations in accordance with the Code of Virginia, § 2.2-4343.1 or against a Bidder or Offeror because of race, religion, color, sex, national origin, age, disability, or any other basis prohibited by state law relating to discrimination in employment.

Only the names of firms responding in accordance with the RFQ proposal due date will be available for announcement. Proposals received after the stated due date and time shall not be considered. Submit proposals in a sealed, opaque envelope, and put the RFQ title, due date and time on the lower left front.

PRE-PROPOSAL CONFERENCE

A non-mandatory pre-proposal conference to include a tour of both garages will be held on **Monday, December 11, 2017, at 10:00 a.m**., at City Hall, Council Chambers, first floor, 116 W. Beverley Street, Staunton, VA. Contractors will register attendance and then a tour of the garage facilities will be conducted.

Inquiries Concerning the RFQ:
Any questions or comments concerning this Request for Qualifications should be submitted in writing to:

Scott M. Francis, PE, Project Manager
Wiley|Wilson
127 Nationwide Drive
Lynchburg, VA 24502
434.455.3255
sfrancis@wileywilson.com

Addenda

Responses to questions or requests for information submitted will be shared with competing firms so that the same information is disseminated to all parties through addenda, to be posted on the City website.

All Applicants are responsible for obtaining issued addenda from the City's website: https://www.ci.staunton.va.us/departments/finance/procurement

Acknowledge receipt of addenda here: No.___ Date: _____

No.___ Date: _____

Proprietary Information
Information on requirements for submitting proprietary information is stated in section 2.2 below.

This RFQ proposal does contain proprietary information from the Applicant: YES_____ NO_____

Authorization
In compliance with this Request for Proposals and all the conditions imposed therein, the undersigned offers and agrees to furnish the information and qualifications in accordance with the attached proposal or as mutually agreed by subsequent negotiations. By my signature below, I certify that I am authorized to bind the Applicant in any and all negotiations and/or contractual matters relating to this Request for Qualifications Proposal. Sign in ink and type or print requested information.

Full Legal Name of Applicant: _____

Fed ID OR SOC. SEC. NO.: _____ Date: _____

Address: _____ Phone: _____

_____ Fax: _____

Email: _____

Signature: _____

Typed or Printed Name, Title: _____

1. PROJECT DESCRIPTIONS

The purpose of this Request for Qualifications (RFQ) is to solicit responses from qualified firms that may wish to bid on remedial repairs to the Johnson Street Parking Garage and the New Street Parking Garage. Those firms found to be qualified may competitively bid on the construction work under a separate Invitation to Bid to be issued at a later date. The estimated construction value of this project is in the range of $2.0M – $2.75M.

1.1. Johnson Street Parking Garage

The Johnson Street Parking Garage was constructed circa 1976 and is a three-story structure consisting of approximately 90,000 square feet. The structure consists of precast concrete single tees supported by precast concrete beams and/or precast concrete columns bearing on shallow spread footings. The perimeter of the parking garage is partially enclosed with sections of full height masonry walls. The masonry walls generally consist of 8" CMU with 4" brick veneer.

The City employed the professional services of the engineering consulting firm of Wiley|Wilson to perform an initial assessment and preliminary evaluation of the structure. They noted areas of distress to the precast concrete single tees, precast concrete columns, concrete topping slabs, joints, storm water inlet boxes, and masonry walls of the structure. To assist the potential RFQ respondents in understanding the scope of the remedial repairs, a copy of the structural assessment done by Wiley|Wilson is attached. Wiley|Wilson is currently developing full remedial repair construction drawings and specifications based on their findings during their structural assessment and subsequent field investigations. Construction drawings and specifications are expected to be completed in December 2017.

Johnson Street Parking Garage located at 101 West Johnson Street, Staunton, VA.

1.2. Project Scope: Johnson Street Parking Garage

Distress to the structure was observed during the initial evaluation phase of this project. Distress included damage to precast concrete single tees, precast concrete columns, cast-in-place concrete beams and topping slabs, joints between precast elements, guardrails, masonry walls, steel stair framing, storm water drainage piping, and lighting. Construction documents detailing the repair of these systems are being developed. These repairs can be broken down into the major work tasks described below.

1.3. Major Work Tasks: Johnson Street Parking Garage

Precast Concrete Repairs:

- Repair bearing ends of precast concrete single tees
- Repair spalls to flanges of precast concrete single tees
- Replace bearing pads for precast concrete single tees
- Replace precast concrete single tee to precast concrete single tee connections.
- Repair cracks in precast concrete columns
- Repair spalls in precast concrete columns at beam bearings

Cast-In-Place Concrete Repairs:

- Remove and replace spalled concrete
- Install anodes throughout cast-in-place concrete beams
- Repair cracks in cast-in-place concrete
- Remove and replace spalled and/or delaminated sections of topping slab

Guardrail Repairs:

- Clean and Paint guardrails
- Coat bottom of guardrail posts and sleeves with asphaltic mastic

Joints Repairs:

- Remove and replace existing joints between adjacent precast concrete single tees

Sealant Repairs:

- Seal concrete top surfaces with penetrating sealer w/corrosion inhibitor

Masonry Wall Repairs:

- Repair damaged mortar joints
- Remove and replace damaged bricks or CMU
- Tie multi-story vertical walls back to building at each floor level
- Sawcut and install expansion joints in brick veneer

Stair Framing Repairs:

- Remove and replace existing steel and concrete pan metal stairs.

Lighting Repairs:

- Remove and replace existing lights, conduit and wiring back to panelboard

Storm water Drain Repairs:

- Replace existing metal drain basins and horizontal piping back to vertical piping

1.4. New Street Parking Garage

The New Street Garage was constructed in 2000 and is a four-story structure consisting of approximately 84,600 square feet. The structure consists of precast concrete double tees supported by precast concrete beams and/or precast concrete columns with a brick veneer finish.

Wiley|Wilson is preparing bid specifications for the repair and preventive maintenance work for this structure. Scope of work includes joint sealing/repairs, waterproofing, miscellaneous repairs of spalled concrete, exterior painting on metal grates, and pressure washing.

New Street Parking Garage located at the corner of New Street and Greenville Avenue, physical address of 35 South New Street, Staunton, VA.

New Street View

Greenville Avenue View

1.5. Major Work Tasks: New Street Parking Garage

Spalled Concrete Repairs

- Repair miscellaneous spalled concrete areas

Sealant Repairs:

- Seal concrete top surfaces with penetrating sealer w/corrosion inhibitor

Painting:

- Paint exterior metal grates

Pressure Washing:

- Pressure wash the complete exterior and interior garage structure

2. RFQ Submission of Proposals Instructions

2.1. An original, marked and identified, and 4 copies, for a total of (5) of your proposal document are required. In addition, submit one (1) copy of proposal in an electronic format, either floppy disk or CD in Microsoft Word format or PDF file format must also accompany your proposal. The City will not assume responsibility for reproduction where an insufficient number of copies have been supplied. In any such case, the City will notify the Applicant of the deficiency and request that the appropriate number of copies be delivered within 24 hours. Failure to comply with this or other requirements of this Request for Proposal shall be grounds for the City to reject such proposals. Telegraphic or facsimile submission of proposals is not acceptable and any such proposals will not be considered. Nothing herein is intended to exclude any responsible Applicant or in any way restrain or restrict competition. All responsible Applicants are encouraged to submit proposals.

2.2. Submission of Proprietary Information

Trade secrets or proprietary information submitted in connection with this procurement transaction shall not be subject to public disclosure under the Virginia Freedom of Information Act; however, the Applicant must invoke the protection of this section prior to or upon submission of the data or the materials, and must identify the data or other materials to be protected and state the reason why protection is necessary (Section 2.2-4342 F. of the Code of Virginia). **Applicants shall submit, in a separate section of the proposal, any information considered proprietary and any copyrighted material and clearly identify the information as proprietary and/or copyrighted information. Applicants may not declare their entire proposal proprietary nor may they declare any proposed pricing to be proprietary.** References may be made within the body of the proposal to proprietary information; however, all information contained within the body of the proposal not in the separate section labeled proprietary shall be considered Public Information.

2.3. Proposals having any erasures or corrections must be initialed by the Applicant in ink.

2.4. By submitting a proposal response, the Applicant certifies that it has not combined conspired or agreed to intentionally rig, alter or otherwise manipulate, or to cause to be rigged, altered or otherwise manipulated its proposal response for the purpose of allocating purchases or sales to or among persons, raising or otherwise fixing the prices of the goods or services, or excluding other persons from dealing with the City of Staunton.

2.5. By submitting a proposal response, the Applicant certifies that its proposal is made without collusion or fraud and that it has not offered or received any kickbacks or inducements from any other Applicant, supplier, manufacturer or subcontracting firm in connection with its proposal; and that it has not conferred on any public employee having official responsibility for this procurement transaction any payment, loan, subscription, advance, deposit of money, services or anything of more than nominal value, present or promised.

2.6. The City of Staunton will not be responsible for any expense incurred by any Applicant in preparing and submitting a proposal response. All proposals submitted will become the property of the City of Staunton.

2.7. The proposal response must address the items included in the Scope of Work and the Criteria for Proposal Evaluation. Proposals should be prepared simply, providing straightforward and concise responses to requests for information and descriptions of qualifications and capabilities. Each copy of the proposal must be bound with all documentation in a single volume where practical. Failure to do so will result in a lowered

evaluation. Incomplete proposals may be determined nonresponsive.

3. Prequalification Process

3.1. The Applicant shall submit qualification information in accordance with the requirements identified herein. The City may contact the Applicant during the evaluation process for clarification of any information submitted by the Applicant, and may request additional information.

3.2. The City may deny prequalification to any contractor if it finds any one of the following:

a. Sufficient Financial Ability- The contractor does not have sufficient financial ability to perform the contract. The contractor will be required to obtain various surety bonds, such as a performance bond and a payment bond.

b. Minimum Experience- The Contractor does not have appropriate experience to perform the project as determined by the City.

c. Judgements- The contractor or any officer, director, or owner thereof has had judgements entered against him/her within the past (10) ten years for the breach of contracts for governmental or non-governmental construction projects, including, but not limited to, design-build or construction management.

d. Noncompliance- The contractor has been in substantial noncompliance, as determined by the City, with the terms and conditions of prior construction contracts with a public body without good cause.

e. Crime- The contractor or any officer, director, owner, member, project manager, procurement manager or chief financial official thereof has been convicted within the past ten years of a crime related to governmental or nongovernmental construction or contracting, including, but not limited to, a violation of (I) Article 6 (§ 2.2-4367 et seq.) of the Virginia Public Procurement Act, (ii) the Virginia Governmental Frauds Act (§ 18.2-498.1 et seq.), (iii) Chapter 4.2 (§ 59.1-68.6 et seq.) of Title 59.1, or (iv) any substantially similar law of the United States or another state;

f. Debarment- The contractor or any officer, director or owner or member thereof is currently debarred pursuant to an established debarment procedure from bidding or contracting by any public body, agency of another state or agency of the federal government; or

g. Failure to Provide Information- The contractor failed to provide in a timely manner any information requested relevant to subdivisions 1 through 6 of this section.

4. Evaluation Factors

In evaluating each Application for Prequalification, the City will consider the following criteria:

Sufficient Financial Ability:

a. The Applicant shall provide evidence that the contractor can acquire a surety bond from a corporation included on the United States Treasury list of acceptable surety corporations for a performance and payment bond.

b. The Applicant shall provide evidence of a valid Class A Virginia Contractor's license.

Minimum Experience:

c. The Applicant shall provide evidence of similar prior construction projects completed within the last five (5) years. The contractor shall have been established as a full time general construction contractor for a minimum of eight (8) years.

d. The Applicant shall also provide contact information of the local government official, or owner of the project, for each project submitted.

e. Performance on past and current projects within the past five (5) years. The City will review all construction projects completed in the last five (5) years, specifically on projects of a similar size and nature, including the ability to meet scheduled completion dates. The Applicant must show history of contract completion dates, including the original and final completion dates.

f. If the Applicant, contractor or its principals operated under another name or entity within the past five (5) years, a complete descriptive statement and audited financial statement for a minimum of the previous two (2) years will be required.

g. Experience of key personnel proposed for this project. The designated project manager and site superintendent must have a minimum of eight (8) years' experience in similar size and type of project.

Judgements:

h. The Applicant shall certify that no judgements have been entered against the contractor or any officer, director, or owner thereof has had judgements entered against him/her within the past (10) ten years for the breach of contracts for governmental or non-governmental construction projects, including, but not limited to, design-build or construction management.

Noncompliance:

i. The City has determined the Applicant has been in substantial noncompliance with the terms and conditions of prior construction contracts with a public body without good cause.

j. The Applicant shall certify that the contractor or any officer, director, owner, member, project manager, procurement manager or chief financial official thereof has been convicted within the past ten years of a crime related to governmental or nongovernmental construction or contracting.

Debarment:

k. The Applicant shall certify that the contractor or any officer, director or owner or member thereof is currently not debarred pursuant to an established debarment procedure from bidding or contracting by any public body, agency of another state or agency of the federal government.

Failure to Provide Information:

l. The City may deny prequalification to any Applicant who fails to provide any information requested from the Applicant in a timely manner.

The Applicant shall provide the information required on the form attached, Attachment A.

APPLICATION FOR PREQUALIFICATION AND QUESTIONNAIRE
JOHNSON STREET PARKING GARAGE PROJECT
NEW STREET PARKING GARAGE PROJECT
CITY OF STAUNTON, VIRIGNIA
ATTACHMENT A

ALL RESPONSES SHALL BE TYPED

Submitted to:	City of Staunton Finance Department-Procurement 116 W. Beverley Street Staunton, VA 24401	
Applicant's Name:	Parent Organization:	Office to Perform Work: (If different from parent organization)
Street Address:		
Mailing Address:		
Telephone Number:		
Facsimile Number:		
Website:		
Name of Contact:		
Title:		
Email:		

Check one of the following, as applicable:

Corporation__	Partnership __	Individual__	Joint Venture__	Other__
Affiliate__				

BUSINESS ORGANIZATION:

How many years has the office to perform the work been in business as a contractor?	
How many years has the office to perform the work been in business under its present business name?	
List any other or former names the office to perform the work has operated under in the past.	
If the office to perform the work is a **corporation**, answer the following:	
Date of incorporation:	
State of incorporation:	
President's name and contact information:	
Length of time of president in this position:	
Vice-President's name and contact information:	
Length of time of Vice-President in this position:	
Treasurer's name and contact information:	
Length of time of treasurer in this position:	
If the office to perform the work is a **partnership**, answer the following:	
Date of organization:	
Type of partnership (if applicable):	
Name(s) of general partner(s), contact information, and length of time in this position:	
If the office to perform the work is **individually owned**, answer the following:	
Name:	
Date of organization:	

MINIMUM EXPERIENCE:

The Applicant shall provide evidence of similar prior construction projects completed within the last five (5) years. The contractor shall have been established as a full time general construction contractor for a minimum of eight (8) years.	Has the Applicant or contractor been a general construction contractor for a minimum of eight (8) years? Yes _____ No _____ Did the Applicant or contractor complete similar construction projects in the past five (5) years? Yes _____ No_____
List all construction projects that the specific office to perform the work has in progress. Do not include current projects being performed by a home office or branch office.	
List the owner's name, address, project location, and contact information for each project.	
List the total construction contract amount for each project.	Original Contract: $ Change Orders: $
List the architect/engineer's firm name and contact information for the project.	
Name of the Project Manager and Site Superintendent who had direct responsibility for these projects.	
List any projects not completed on time under the contract terms	Project Name: Address:

JUDGEMENTS AND CRIME:

If you answer 'yes' to any of the following, provide the name, phone number, persons to contact, and circumstances related to the question on a separate attachment.

Has the Applicant, Contractor or any officer, director, or owner thereof, had judgements entered against him within the last ten years for the breach of contracts for governmental o non-governmental construction, including, but not limited to, design-build or construction management?	Yes_____ No _____
Has the Applicant, Contractor, or any officer, director, owner, project manager, procurement manager or chief financial officer thereof, been convicted within the past ten years of a crime related to governmental or non-governmental construction or contracting, including, but not limited to, a violation of (I) Article 6 (§ 2.2-4367 et seq.) of the Virginia Public Procurement Act, (ii) the Virginia Governmental Frauds Act (§ 18.2-498.1 et seq.), (iii) Chapter 4.2 (§ 59.1-68.6 et seq.) of Title 59.1, or (iv) any substantially similar law of the United States or another state?	Yes_____ No_____
Is the Applicant, Contractor, or any officer, director, or owner thereof, currently debarred pursuant to an established debarment procedure from bidding or contracting by any public body?	Yes_____ No _____

LICENSING:

Does the Applicant, or contractor have a Class A Contractor's License?	Yes _____ No _____
List the jurisdictions in which the office to perform the work is legally qualified to do business and indicate registration or license numbers	Jurisdiction: _____ License Number: _____

DEBARMENT / CLAIMS / NONCOMPLIANCE:

If the answer to any of the questions provided below is yes, provide the name of the Project, Owner, and Architect/Engineer, including the Company name, address and phone number related to the event.

Has the office to perform the work ever failed to complete any work awarded?	Yes _____ No _____
Have there been any judgements, claims, arbitration proceedings or suits pending or outstanding against the office to perform the work or its officers within the last five years?	Yes _____ No _____
Has the office to perform the work filed any lawsuits or requested arbitration with regard to construction contracts with the last five years?	Yes _____ No _____
List any federal, state, or local government agencies, which have excluded the office to perform the work or any of its members, from bidding on construction projects.	
Has the Applicant or contractor ever been denied Prequalification by any public body in Virginia in the last five years? If so, provide the date, the name and address of the entity, the reason for denial, and attach a copy of the notice of denial.	Yes _____ No _____
Has the Applicant or contractor ever been alleged to have been in substantial noncompliance with the terms and conditions of a prior construction contract with a public body? If so, provide the name of the Project Owner and Architect/Engineer, including company name, address and phone, associated with the contract, and an explanation of the allegations and any resolution or current status of such allegations.	Yes _____ No _____
Any additional information relevant to this requirement?	

SUFFICIENT FINANCIAL ABILITY

Has the Applicant or contractor ever had a Bankruptcy Petition filed in its name, voluntarily or involuntarily?	Yes _____ No _____
Is the Applicant or contractor currently in default on any loan agreement or financing agreement with any bank, financial institution, surety, or other entity?	Yes _____ No _____
Certify that the Applicant or contractor will have sufficient financial ability to perform the contract that would result from such procurement and the Applicant or contractor can acquire a surety bond from a corporation included in the United State Treasury list of acceptable surety corporations in the amount and type (100% Performance and Payment Bond) required by the City of Staunton.	Yes _____ No _____
Name of surety/ bonding company.	
Current bonding capacity with a contract surety/bonding company.	$
Name, address, contact information of surety/bonding company agent.	
Have Performance and Payment Bond claims been filed to a surety company for this Applicant or contractor on any project within the past eight (8) years?	Yes _____ No _____
Has any company refused to bond the Applicant or contractor on any project in the last eight (8) years?	Yes _____ No _____

Applicants not providing all the required information will be negatively evaluated. Applicants may be required to provide additional information if deemed necessary by the City of Staunton to determine the Applicant's qualifications.

Evaluating an Applicant's past performance and experience may include information provided directly by the Applicant, customer inquiries, and other publicly available sources. Failure to provide any requested data, inaccessible points of contact, invalid phone numbers or email addresses may result in a firm being considered less qualified. Verbal agreements will not be considered during the RFQ process.

The City of Staunton expects that any and all services that are required to complete the project shall be included in the Applicant's proposal, whether specifically stated in the RFQ or not.

Confidentiality

Information submitted by any Applicant will be considered confidential and will not be used for any other purpose than evaluating the Applicant's response to the RFQ.

Disclaimer

The City of Staunton will select the applicants or contractors solely based on what it perceives as the highest quality proposals. However, this RFQ does not commit the City of Staunton to any specific course of action. In addition, the City of Staunton reserves the right not to select any firm responding to this RFQ based solely on its subjective opinion.

AFFIDAVIT OF ACCURACY

The undersigned Applicant is/will be a Class A Contractor under Title 54.1-1100 of the Code of Virginia, as amended. The Applicant agrees to comply with and be bound by this Prequalification Procedure. The undersigned hereby agrees that the Prequalification Procedure does not constitute or give rise to any contract with the City of Staunton.

The undersigned certifies under oath that the information contained in the Application, Qualification Statement, and Questionnaire and attachments thereto, and any other information submitted with this Application is complete, true, and correct so as not to be misleading or untruthful.

Firm Name

Address

City, State, Zip Code

Signature

Date

Title

Seal if Corporation:

NOTARY:

STATE of _____, County/ City of _____,

Subscribed and sworn to before me this _____day of _____, 2017.

Notary Public Signature_____

My commission expires_____

Notary Seal:

January 19, 2017 ***Amended May 30, 2017***

Mr. Tom Sliwoski
Public Works Director
City of Staunton
P.O. Box 58
Staunton, VA 24402-0058

Re: Structural Assessment of Parking Garage
Wiley|Wilson Comm. No. 216184/217031

Dear Mr. Sliwoski:

Wiley|Wilson is pleased to submit this report detailing our findings, remedial repair recommendations, order of magnitude cost estimate, and estimated life of repairs for the City owned parking garage located on West Johnson Street between South Lewis Street and North Central Avenue in Staunton, Virginia.

On Thursday October 20, 2016, Wiley|Wilson conducted a site visit to the parking garage located on West Johnson Street between South Lewis Street and North Central Avenue in Staunton, Virginia. The purpose of our site visit was to visually observe the conditions of the precast concrete parking garage.

DESCRIPTION OF STRUCTURE
The parking garage along West Johnson Street was designed in July of 1974 by Neal S. Goodloe, Architect of Staunton, Virginia. In addition to the construction drawings, copies of the precast concrete shop drawings for the structure were provided by your office. We noted that the shop drawings were prepared by Shockey Brothers, Inc. of Winchester, Virginia and were dated October, 1974. We note that the structure consists of precast concrete single tees supported by precast concrete beams and or precast concrete columns bearing on a shallow spread footing foundation. The non-load bearing walls for the parking garage consist of CMU with brick veneer.

FIELD OBSERVATIONS
We have included distress plans, photo location plans, and representative photos in the appendices located at the end of this report. For your convenience, we have grouped our field observations by building component below:

A. Precast Concrete Structure
Typical Observations

- At numerous locations, the bearing end of the precast concrete single tees had spalled, partially exposing the steel reinforcement.
- The repaired bearing ends of the precast concrete single tees were noted to be cracked, spalled, and/or delaminated at multiple locations throughout the parking garage.
- At multiple locations, spalls were observed at the edge of the precast concrete columns where the precast concrete single tees bear on them.
- At multiple locations there was exposed reinforcement on the underside of the precast concrete single tee flanges near the edges.
- The tee to tee connections were noted to be corroded, and the welds broken at multiple locations.

- The bearing pads were flattened and deformed at multiple locations throughout the parking garage structure.
- The joint material filling the gaps between adjacent precast concrete single tee flange edges was noted to have separated allowing water to infiltrate the structure at many joint locations.

Location Specific Observations

- The flanges of two adjacent precast concrete single tees at the upper level of the parking garage were vertically offset approximately 1 1/2 inches from each other. We also noted a spall in the precast concrete at the corner of the rightmost panel near the edge (See Photo 1).
- A previous repair to the bearing end of a precast concrete single tee located at the upper level of the parking garage, near the east end, had spalled partially exposing the steel reinforcement (See Photo 2).
- There were several spalls in the precast concrete beam spanning above the drive lane at the upper level of the east end of the parking garage. We noted that the spalls partially exposed the steel reinforcing stirrups of the beam (See Photo 3).
- The bearing pad beneath the bearing of a precast concrete single tee at the upper level on the east end of the parking garage was flattened and deformed. We also noted a spall in the precast concrete column at the edge of the bearing (See Photo 4).
- The bearing end of the precast concrete single tee at the north end of the upper level of the parking garage had been previously repaired. New cracks have formed along the edge of the repair (See Photo 5).
- The tee to tee connection between adjacent tees consisted of a piece of steel reinforcement welded to a partially exposed piece of reinforcement embedded into the edge of the flange of each of the adjacent precast concrete tees (See Photo 6).
- The bearing end of the precast concrete single tee located at the north end of the upper level, towards the west side of the parking garage, had been previously repaired. Subsequent cracking and spalling of the repair had partially exposed the reinforcement (See Photo 7).
- There is a vertical crack in the precast concrete column at the north end of the parking garage, extending down from the bearing end of the precast concrete single tee. We also noted a spall on the far side of the precast concrete single tee which partially exposed the steel reinforcement at the bearing end (See Photo 8).
- Spalled concrete has exposed the steel reinforcement at the north bearing end of the precast concrete single tee located at the middle level of the parking garage, towards the northwest end of the garage. We also noted that the exposed steel reinforcement showed signs of corrosion (See Photo 9).
- Spalled concrete was noted on the underside of the flanges of two adjacent precast concrete single tees located at the middle level of the parking garage, at the north end of the tees. The concrete spall partially exposed the steel reinforcement in the flanges of the precast concrete tees near the end (See Photo 10).

B. Topping Slab

Typical Observations

- The topping slab generally appeared to be in poor condition with loss of cement paste exposing aggregate, cracking, spalling, and delamination detected throughout the parking garage.

Location Specific Observations

- The topping slab at the upper level of the parking garage showed signs of loss of cement paste at the surface partially exposing the aggregate. Several cracks and spalls were present in the topping slab (See Photo 11).
- At a number of locations, spalled concrete topping slab and/or cracks in the concrete topping slab existed approximately 7'-0" from the end of the precast concrete single tees (See Photo 12).
- Close-up view of the joint in the topping slabs between two adjacent precast concrete single tees. We noted a spall that extended the full depth of the topping slab, exposing a gap between the adjacent precast concrete single tees on the ramp leading up to the upper level of the parking garage to the south of the center row of columns of the parking garage (See Photo 13).

C. Cast-in-place Concrete

Typical Observations

- At multiple locations, the cast-in-place concrete edge beams were cracked, spalled, and/or delaminated, exposing steel reinforcement that also showed signs of corrosion.
- Cracks in the cast-in-place concrete edge beams were observed at many guardrail post sleeve locations.
- At multiple locations, concrete debris was observed on the deck of the parking garage beneath spalled sections of the cast-in-place concrete beams above.

Location Specific Observations

- A vertical crack extending out from the embedded guardrail post and continuing down both sides of the cast-in-place concrete curb, at the curb separating the upper level from the middle level of the parking garage near the east end (See Photo 14).
- A steel guardrail post embedded in the cast-in-place concrete curb separating two levels of the parking garage. The face of the concrete curb had spalled at the location of the sleeve embedded into the concrete for the guardrail post (See Photo 15).
- The cast-in-place concrete edge beam was cracked and spalled along the north side of the parking garage at the middle level (See Photo 16).
- The underside of the cast-in-place concrete beam along the north side of the parking garage at the upper level had spalled, partially exposing the steel reinforcement. Additionally, the exposed steel reinforcement showed signs of corrosion (See Photo 17).
- The cast-in-place concrete beam at the upper level along the south side of the parking garage showed signs of cracking and spalling of the concrete, which partially exposed the steel reinforcement. Additionally, several rusted steel brackets anchoring the wall to the cast-in-place concrete beam were observed. Loose and/or missing anchor rods and nuts were observed at several of the holes in the steel brackets (See Photo 18).

D. Masonry Walls

Typical Observations

- Significant distress to the masonry walls, in the form of cracks and loose or missing mortar, broken CMU and brick veneer, and displaced sections of brick veneer, were observed at multiple locations throughout the masonry walls.
- The walls at the southeast corner of the parking garage appeared to be bowed outward at the intermediate parking garage levels. We also noted bent straps spanning between the precast

concrete elements and the masonry walls at each of the above grade parking garage levels for the full height wall segments located at the southeast corner of the parking garage.

Location Specific Observations

- Bent steel strap anchors are bolted into the masonry wall at the southeast corner of the parking garage at the upper level. Note the large caulk joint between the wall and the cast-in-place concrete curb. Additionally, a crack in the cast-in-place concrete curb adjacent to the end of the masonry wall was observed (See Photo 19).
- Horizontal cracks in the mortar joints were noted on the interior face of the masonry wall near the top at the east side of the parking garage. Additionally, missing and loose mortar was observed (See Photo 20).
- Cracked and loose or missing mortar was noted in the brick veneer joints in the exterior face of the masonry wall along the east side of the parking garage (See Photo 21).
- Vertical, horizontal, and stair step cracks were noted in the brick and mortar joints of the masonry wall at the entrance to the 2B level of the parking garage, at the northeast corner of the parking garage. Additionally loose and missing mortar in the joints of the brick veneer were noted. Further, the steel angles forming the lintel above the opening were rusted (See Photo 22).
- Horizontal and stair step cracks were noted in the brick and mortar joints of the brick veneer below where the steel plate for the cantilevered end of the equipment room of the elevator shaft is supported by the elevator shaft below (See Photo 23).
- Stair step and vertical cracks were noted in the bricks and mortar joints in the brick veneer of the exterior face of the masonry wall located below the pedestrian ramp leading to South Lewis Street, at the northwest corner of the parking garage. Additionally, the bricks above the crack were displaced from those below the crack (See Photo 24).
- Stair step and horizontal cracks were noted in the mortar joints of the interior face of the masonry wall for the elevator enclosure at level 2B. Additionally, the flanges of the interior and end single tee precast concrete planks were vertically offset approximately 1" from each other (See Photo 25).
- Horizontal and stair step cracks were noted in the bricks and mortar joints of the brick veneer of the exterior face of the masonry wall to the west of the main entrance to the parking garage, off of West Johnson Street. The cracks were a maximum of approximately ¾" wide at some locations (See Photo 26).

E. Steel Stair

Typical Observations

- Corrosion was observed in the stringers, support bars, metal stair pans, and structural framing members of the painted metal stair located towards the north end of the east side of the parking garage.

Location Specific Observations

- The metal stair pans of the exterior stair along the east side of the parking garage were supported by steel bars welded to the stair stringers. Corrosion of the stringer, support bars, and metal stair pans were observed (See Photo 27).
- Corrosion of the metal stair pan and supporting steel framing of the underside of the exterior steel stair along the east elevation of the parking garage (See Photo 28).

DISCUSSION

Concrete is a durable material capable of supporting significant loads. However, concrete structures are susceptible to damage through long-term exposure to harsh climates. Three of the most common types of damage to concrete are discussed below.

Corrosion of Steel Reinforcement

Corrosion of steel reinforcement is an electrochemical reaction that occurs when the steel rebar is exposed to at least two metals of differing energy levels, an electrolyte, and a metallic connection. In reinforcing, the rebar itself may have differing levels of energy in separate areas throughout the structure. The electrolyte in this system is the concrete itself, and the metallic connection is achieved by wire ties, chair supports, or the rebar itself. In addition to the loss of strength of the steel reinforcing with corresponding section loss from corrosion, we note that the rebar will undergo expansion up to seven times the original thickness of the metal. This expansion produces significant stresses on the surrounding concrete which can lead to cracking, spalling, and delamination.

When steel reinforcing is contained within a concrete matrix, a passive layer of high alkalinity develops around the steel reinforcing through the hydration of the cement. This passive layer acts to protect the steel from corroding. The next two processes affect this passive layer.

Carbonization of Concrete

Carbonization is a type of acid attack on concrete. It involves reaction of atmospheric carbon dioxide with hydrated constituents in portland cement paste. Carbon dioxide combines with humidity in the air to form a weak, carbonic acid. The carbonic acid permeates the concrete and reacts with the cement paste, neutralizing the natural alkalinity of the concrete by converting hydroxides to carbonates. Carbonization occurs to some extent on all concrete surfaces exposed to weather. The rate of carbonization depends on the permeability of the concrete, relative humidity, and temperature. The neutralizing of the alkalinity of the concrete reduces the passive corrosion protection of the steel reinforcing, which in turn allows the reinforcing to corrode in the presence of water and oxygen.

Chlorides

The presence of chloride ions in concrete can lead to the premature corrosion of steel reinforcement. Chlorides are present in deicing salts, which are often brought into parking garages on the vehicles that park within it, or are used to melt/deice portions of the parking garage structure that are exposed to the elements. Chlorides dissolved in water can permeate through concrete and reach steel reinforcement. If moisture and oxygen are present they can lead to corrosion of the steel reinforcement. The risk of corrosion increases as the chloride content of the concrete increases.

ADDITIONAL TESTING PROGRAM

At multiple locations throughout the parking garage, the cast-in-place concrete beams were observed to have cracks, spalls, delaminations, and corroded steel reinforcement. We feel that the extent of distress observed in the cast-in-place concrete edge beams is the result of corrosion of the steel reinforcement which has been accelerated by the loss of the passive film of high pH oxides and hydroxides on the surface of the steel. This passive film protected the steel reinforcement from corrosion even when exposed to moisture and air. As discussed in the section above, over time the pH of the concrete can be

reduced, thereby eliminating the passive layer protection to the steel reinforcement. This can occur through exposure to carbon dioxide (carbonation) or chloride ions (chlorides) brought in by vehicles during the winter when deicing salts are applied to the roads.

While the cast-in-place concrete edge beams are not part of the primary structural system of the building, which consists of the precast concrete single tees and columns, the cast-in-place concrete beams support the guardrails and serve as locations to tie the masonry walls back to the structure.

Additionally, at a number of locations, there were spalls in the underside of the precast concrete single tee members. Since the spalling of the precast concrete single tee members was much less prevalent, we feel that the denser concrete typically seen in precast concrete members, as well as the presence of a topping slab on the top side of the precast concrete tees, has limited the distress observed in the precast concrete single tees. However, we note that while the topping slab does protect the top surface of the precast concrete single tees, it also prevents visual observation of the condition of the top surface of the tees potentially hiding distress.

Therefore, we recommended that both the carbonation and chloride levels for the cast-in-place concrete edge beams and the precast-concrete single tees and columns be investigated prior to proceeding with the remedial repair recommendations, in order to determine the extent to which either will affect the long-term integrity of the cast-in-place and precast concrete elements.

Subsequent to the January submittal of this letter report, a sampling program was completed in March 2017 by Froehling & Robertson, Inc. (F&R). Samples were collected from various elements and locations throughout the parking garage structure. For convenience, we placed a copy of the testing results in Appendix C. The results provided by F&R contain three columns associated with the chloride ion testing and one column associated with the carbonation testing. Both elevated levels of chlorides and carbonation of concrete result in a lowering of the pH of the concrete. The pH of freshly placed concrete is strongly basic and generally in the range of 12 to 13. The passivation threshold of steel reinforcement is 11.5. When the pH level of the concrete exceeds this passivation threshold, corrosion of the steel reinforcement will not occur. When concrete is exposed to high levels of chloride ions, or carbonation at the depth of the steel reinforcement, the pH of the concrete can be lowered to as low as 7. When the pH of the concrete is below the passivation threshold of the steel, corrosion of the steel can occur provided both moisture and oxygen are present.

Corrosion of steel reinforcing can be initiated with chloride ion contents in the range of 0.20% to 0.30% chloride ions by weight of cement (1.0 to 1.5 lbs chloride ions/yd^3 of concrete) with accelerated corrosion starting at 0.60% chloride ions by weight of cement (3 lbs/yd^3).

A review of the chloride testing results revealed the following:

- Cast-in-place concrete beams had an average chloride content of 0.46% chloride ions by weight of cement with approximately 85% of the samples being above the chloride ion content required to initiate corrosion of the steel and 15% of the samples being above the accelerated corrosion rate.
- Chloride ion contamination does not appear to be a problem in the precast concrete columns with only one sample being above the chloride ion content required to initiate corrosion of the steel.
- Flanges of the precast concrete single tees had an average chloride content of 1.10% chloride ions by weight of cement with approximately 75% of the samples being above the chloride ion content

required to initiate corrosion of the steel and 37.5% of the samples being above the accelerated corrosion rate.
- Stems of the precast concrete single tees had an average chloride content of 0.01% chloride ions by weight of cement with none of the samples being above the chloride ion content required to initiate corrosion of the steel.

Carbonation likewise allows steel reinforcing to undergo corrosion by reducing the pH of the concrete around the reinforcement. In order for this to happen, the carbonation has to penetrate to the depth of the reinforcing steel. Carbonation is estimated to proceed at a rate of 0.04 inches per year but this rate is dependent on the quality of the concrete as well as environmental conditions including humidity. Based on the estimated rate and with normal concrete cover of 1 ½" for cast in place concrete elements, the number of years before the carbonation has reached the depth of the steel reinforcement would be approximately 37 years.

A review of the carbonation testing results revealed the following:
- Cast-in-place concrete beams had an average depth of carbonation of 0.45" with approximately 23% of the samples containing carbonation to a depth of more than 7/8".
- Precast concrete columns had an average depth of carbonation of 0.44" with none of the samples containing carbonation to a depth of more than 7/8".
- Flanges of the precast concrete single tees had an average depth of carbonation of 0.53" with approximately 25% of the samples containing carbonation to a depth of more than 7/8".
- Stem of the precast concrete single tees had an average depth of carbonation of 0.68" with none of the samples containing carbonation to a depth of more than 7/8".

Based on these results, it appears that the parking garage structure has issues related to excessive chloride ion concentrations throughout many components of the structure. Further, there also appears to be some limited areas of the structure where the depth of carbonation is sufficient to affect the reinforcement.

OPTIONS FOR ADDRESSING CHLORIDE ION/CARBONATION CONTAMINATION

For your convenience, we have compiled a list of remedial repair treatments to address chloride ion/carbonation contamination. This list contains a brief description of each of the options along with the pros/cons.

Penetrating Sealants – Penetrating sealants are liquid applied sealants that typically are hydrophobic and produce a barrier to prevent water penetration into the member. Silanes and siloxanes fall into this category. These sealants are spray or brush applied to the surface of the concrete and form a coating that prevents water intrusion while still allowing vapor transmission out of the concrete. Penetrating sealants reduce the availability of water from within the concrete thereby reducing the rate of corrosion of the steel reinforcement.

Pros/Cons:
- Pros – Low cost method to reduce water intrusion into concrete
- Cons – Does not restore passivity to steel reinforcement; needs to be re-applied every 3 to 5 years; will not bridge across cracks.

Traffic Bearing Membranes – Traffic bearing membranes are elastomeric coatings that form a barrier locking out moisture and chlorides.

Pros/Cons:

- Pros – Will bridge small to moderate cracks
- Cons – Pliability of elastomeric coatings makes them susceptible to abrasion damage; tend to separate from concrete at joints; does not restore passivity to steel reinforcement

Surface Applied Corrosion Inhibitor – Corrosion inhibitors are proprietary products that are spray or brush applied to the concrete surface penetrating into the concrete down to the steel reinforcement as a liquid or diffusing as a vapor where it inhibits corrosion. Corrosion inhibitors can be combined with silane/siloxane sealers and can also be added as an admixture to concrete during the batching process.

Pros/Cons:

- Pros- Chemically inhibits corrosive action of chlorides reducing the rate of corrosion; when combined with silane/siloxane will reduce water intrusion into concrete
- Cons- Reduces the rate but does not stop corrosion; needs to be re-applied every 3 to 5 years; will not bridge across cracks.

Passive Galvanic Anode – Passive galvanic anodes protect steel from corrosion by connecting the reinforcement to a sacrificial anode. The sacrificial metal will corrode preferentially protecting the steel reinforcement from corrosion. The galvanic anode is consumed in this process.

Pros/Cons:

- Pros- Stops corrosion process in steel reinforcement within area of influence of anode; no auxiliary power source is required.
- Cons- Anode is eventually consumed in the chemical reaction and would need to be replaced; no active control over the current produced by the anode; areas of the structure will likely fall outside of the area of influence and will therefore be in danger of continued corrosion.

Impressed Current Cathodic Protection – Impressed current cathodic protection involves the installation of an anode system, rectifier (power supply/converter to DC), DC wiring and conduit, and monitoring probes. In an impressed current cathodic protection system, anodes are installed to distribute protective current to the reinforcing steel and provide locations for anodic reactions to take place.

Pros/Cons:

- Pros- Stops corrosion process in steel reinforcement; active controls over the current produced by the system.
- Cons- Require constant power source and its associated power costs; requires periodic inspection and observation to ensure that it is operating correctly.

Based on the City of Staunton's desire to extend the life cycle of the parking garage another 20 years, we recommend that the following remedial steps be taken in addition to the remedial repairs described below to address the chloride ion and carbonation contamination:

- Apply corrosion inhibitor with a silane/siloxane sealant on the top surface of all slabs, sidewalks, curb areas.
- Install passive galvanic anodes throughout the cast-in-place concrete perimeter beams/curbs.

- Install passive galvanic anodes within the area of the concrete that has been removed and replaced at spalls or delaminations.

REMEDIAL REPAIR RECOMMENDATIONS

We observed distress and deterioration at a number of locations throughout the structure. For clarity, we have grouped our observations based on the affected structural members and provided our remedial repair recommendations for each.

A. Precast Concrete Elements

1. Precast Concrete Single Tees

At numerous locations throughout the parking garage structure, we observed distress at the bearing ends of the precast concrete single tees. This distress consisted primarily of cracking, spalling, and delamination of concrete confining the structural steel reinforcement attached to the steel bearing plates of the precast concrete single tees. We recommend that the loose/delaminated concrete at these locations be removed down to sound concrete. We also recommend that any exposed reinforcement be cleaned by sand-blasting and then coated with a corrosion inhibitor such as Sika Armatec 110 Epocem. Following the repair to the reinforcement, we recommend that the surface be repaired using a cementitious repair mortar with penetrating corrosion inhibitor such as SikaTop 123 Plus. Further, we recommend that the cracks in the precast concrete tees be repaired by sealing the surface of the crack with an epoxy paste product such as Sikadur 33, installing injection ports, and injecting epoxy such as Sikadur 35 Hi-Mod LV into the injection ports. Following this repair, we recommend that the tips of the grout ports that protrude out from the precast concrete tees be cut off and that the sealer epoxy be ground down flush with the adjacent concrete surface.

As we noted that the previous repairs to the precast concrete single tees have experienced failure at a number of locations due to the exposure to the environment and the high stresses adjacent to the bearing seats, we recommend that these new repairs be confined by installing carbon fiber reinforced polymer (CFRP) fabric overtop of the repaired areas. We recommend that the CFRP fabric be installed starting at the bearing seat and extending a minimum of 7'-0" from the end of the tee on all repaired precast concrete single tee stems. The CFRP fabric will run from the underside of one flange of the tee, down and around the stem, and up to the underside of the flange on the other side of the stem. In order to install the CFRP, the surface of the precast concrete single tee will need to be roughened by spraying the concrete with a high pressure water jet to provide an open roughened texture. The CFRP fabric is then installed using either a wet or dry lay-up procedure using epoxy adhesives to bond the CFRP fabric to the concrete.

We also observed at multiple locations the presence of spalls and or exposed reinforcement on the underside of the flanges of the precast concrete tees, typically near the ends of the precast concrete single tees. We recommend that the loose/delaminated concrete at these locations be removed down to sound concrete. We also recommend that any exposed reinforcement be cleaned by sand-blasting and then coated with a corrosion inhibitor such as Sika Armatec 110 Epocem. Following the repair to the reinforcement, we recommend that the surface be repaired using a cementitious repair mortar with penetrating corrosion inhibitor such as SikaTop 123 Plus.

2. Precast Concrete Single Tee Bearing Pads

At numerous locations throughout the parking garage structure, we observed distress to the bearing pads at the bearing ends of the precast concrete single tees. The purpose of the bearing pads is to distribute load between two structural elements and allow horizontal and rotational movements to occur through deformation of the pad. The bearing pads observed in the parking garage were crushed and distorted such that the edges of the bearing pads were often turned up and no longer distributing the loads between the two elements. At some locations, the bearing pads were "walking off" from underneath of the bearing end of precast concrete single tees. "Walking off" is a term used to describe the relative movement of the bearing pad over time.

We recommend that the bearing pads be replaced with new elastomeric bearing pads of sufficient density to adequately distribute the loads from the precast concrete single tees into the precast concrete columns. Prior to lifting the single tee and replacing its bearing pads on each end, any structural repairs to the precast concrete single tee should be performed as described herein. Additionally, just prior to lifting the tee, the tee to tee connections to the adjacent tees should be temporarily saw-cut to allow the tee to be lifted independently of the adjacent tees. We recommend that shoring be provided to distribute the weight of the tee and the lifting equipment loads down to the slab-on-grade. We also recommend that each precast concrete single tee be lifted by means of a hydraulic jack in order to lift the tee enough to allow the existing bearing pad to be removed, the bearing seat cleaned, and the new elastomeric bearing pad epoxied into place.

3. Precast Concrete Columns

At a number of locations throughout the structure, spalling of the edge of the precast concrete columns was observed where the stem of the precast concrete single tee bears on the column corbel. We feel that these generally small spalls are the result of the deterioration of the bearing pads between the tees and the columns over time. We recommend that these spalls be repaired by removing any loose concrete down to sound concrete. We also recommend that any exposed reinforcement be cleaned by sand-blasting and then coated with a corrosion inhibitor such as Sika Armatec 110 Epocem. Following the repair to the reinforcement, we recommend that the surface be repaired using a cementitious repair mortar with penetrating corrosion inhibitor such as SikaTop 123 Plus. Please note that these repairs should be completed prior to replacing the bearing pads.

Additionally, at the northwest corner of the parking garage, we observed a vertical crack in the precast concrete column extending from the bearing of the end precast concrete single tee. We recommend that any loose/delaminated concrete be removed down to sound concrete. We also recommend that any exposed reinforcement be cleaned by sand-blasting and then coated with a corrosion inhibitor such as Sika Armatec 110 Epocem. Following the repair of any exposed reinforcement, we recommend that the removed loose/delaminated concrete be replaced by using a cementitious repair mortar with penetrating corrosion inhibitor such as SikaTop 123 Plus. Following this repair, we recommend that the crack in the precast concrete column be repaired by sealing the surface of the crack with an epoxy paste product such as Sikadur 33, installing injection ports, and injecting epoxy such as Sikadur 35 Hi-Mod LV into the injection ports. Following the injection of the crack with epoxy, we recommend that the tips of the grout ports that protrude out from the precast concrete column be cut off and that the sealer epoxy be ground down flush with the adjacent concrete surface.

4. Joints between Adjacent Precast Concrete Single Tees

At multiple locations throughout the parking garage, we observed water staining running down through the joints between the flanges of adjacent precast concrete single tees. The presence of water staining signals the failure of the joint sealing system. Additionally, we noted that the condition of the tee to tee connectors visible from below the panels showed signs of corrosion and some have failed. The tee to tee connectors consist of steel plates embedded into the vertical edges of the flanges of the precast concrete single tees that are then connected in the field by welding a piece of reinforcing steel to both plates. The failure of the tee to tee connections between adjacent panels allows excessive movement between adjacent panels as vehicles traverse across the panels. This excessive movement leads to the failure of the sealed joint system which allows more water to infiltrate into the interior of the parking garage structure where it causes further damage to the structure. We recommend that the tee to tee connectors between the precast concrete single tees be cleaned by sandblasting the exposed portion of the connector to bear metal, in order to inspect both the weld and the reinforcement bar welded to both sides of the joint. Any broken welds or loss of section in the reinforcement bar should be repaired.

If any of the tee to tee connectors are damaged to the point that they cannot be repaired, we recommend that V2 CFRP Tee Biscuits be installed in place of the original tee to tee connectors. The CFRP Tee Biscuits are installed by cutting a vertical slot in the top of the tee across the joint between adjacent tees with a 14" diameter sawblade, cleaning the slot out with high pressure water, inserting epoxy paste into the slot and on the CFRP Tee Biscuit, and then inserting the CFRP Tee Biscuit into the slot.

Once the tee to tee connectors have been repaired, we recommend that the existing sealant be removed and replaced with new backer rods and an elastomeric sealant meeting the requirements of ASTM C920 Type M, Grade NS, Use T, M such as Sikaflex-2c NS TG, in order to seal the joints between the precast concrete tees and prevent further water infiltration into the structure through the joint system.

5. Rotation of Precast Concrete Single Tee Edge Units

It was observed at several locations that the precast concrete single tee edge units had rotated such that the flange of the end unit was lower at the edge than the adjacent unit. The shape of the edge precast concrete units is asymmetric forming an L-shape. This shape is inherently unstable and relies on the connection between the flange of the edge precast unit and the flange of the adjacent tee to resist the rotational forces that it experiences. As the tee rotated, the bottom edge of the stem moved outwards and in some cases closed the gap between the masonry wall and the precast L-shape and pushed outward on the masonry wall. We noted the absence of distress in the topping slab above these end units and the adjacent units. Based on this absence, we feel that the majority of the rotation of the end units occurred during the erection of the precast concrete garage structure. However, since the tee to tee connection between the end tees and the adjacent tees is critical to stabilize the L-shaped end units, we recommend that a V2 CFRP Tee Biscuits be installed adjacent to each existing tee to tee connection. For the end units, we recommend that the CFRP Tee Biscuits be installed by cutting a vertical slot in the top of the tee across the joint between adjacent tees and L-shapes with a 14" diameter sawblade, cleaning the slot out with high pressure water, inserting epoxy paste into the slot and on the CFRP Tee Biscuit, and then inserting the CFRP Tee Biscuit into the slot.

B. Cast-In-Place Concrete Elements

1. Concrete Edge Beams

At multiple locations throughout the parking garage, the cast-in-place concrete beams were observed to have cracks, spalls, delaminations, and corroded steel reinforcement. We feel that the extent of distress observed in the cast-in-place concrete edge beams is the result of corrosion of the steel reinforcement which has been accelerated by the loss of the passive film of high pH oxides and hydroxides on the surface of the steel, which protected the steel reinforcement from corrosion even when exposed to moisture and air. As discussed in the section above, over time the pH of the concrete can be reduced, thereby eliminating the passive layer protection to the steel reinforcement. This can occur through exposure to carbon dioxide (carbonation) or chloride ions (chlorides) brought in by vehicles during the winter when deicing salts are applied to the roads.

We recommend that the cracks be repaired by sealing the surface of the crack with an epoxy paste product such as Sikadur 33, installing injection ports, and injecting epoxy such as Sikadur 35 Hi-Mod LV into the injection ports. We also recommend that any spalled, loose, or delaminated concrete be removed down to sound concrete. Then we recommend that any exposed reinforcement be cleaned by sand-blasting and then coated with a corrosion inhibitor such as Sika Armatec 110 Epocem. Following the repair of any exposed reinforcement, we recommend that the removed loose/delaminated concrete be replaced by using a cementitious repair mortar with penetrating corrosion inhibitor such as SikaTop 123 Plus.

C. Guardrail Embedment Sleeves

At many of the guardrail posts where the steel pipe sleeves are embedded into the cast-in-place concrete curb, we observed cracking and or spalling of the concrete. As discussed above, when steel corrodes, it can expand up to seven times its original volume. We feel that the cracks and/or spalling of the concrete are the result of stresses in the concrete as the result of corrosion of the embedded steel sleeve. We recommend that any loose concrete be removed and replaced by using a cementitious repair mortar with penetrating corrosion inhibitor such as SikaTop 123 Plus. We also recommend that the cracks in the cast-in-place concrete be repaired by sealing the surface of the crack with an epoxy paste product such as Sikadur 33, installing injection ports, and injecting epoxy such as Sikadur 35 Hi-Mod LV into the injection ports. Following the injection of the crack with epoxy, we recommend that the tips of the grout ports that protrude out from the precast concrete column be cut off and that the sealer epoxy be ground down flush with the adjacent concrete surface. To reduce the amount of moisture present in and around the embedded sleeve, we also recommend that the bottom 1'-0" of the guard rail post as well as the top of the sleeve and concrete within 6" of the sleeve be coated with an asphaltic mastic.

D. Guardrails

The guardrails throughout the structure consisted of painted steel pipe members. During our site visit, we noted that the paint system protecting the steel guardrails from exposure to moisture were not in good condition with areas of the steel piping exposed. Therefore, we recommend that the guardrails be cleaned by wire brushing and repainted with an appropriate exterior paint system.

E. Topping Slab

The topping slab consists of a series of individual slabs, the extent of which matches that of the precast concrete single tees below. The surface of the topping slab appeared to be in poor

condition with loss of cement paste exposing the aggregate at the surface over large areas of the slab. Additionally, cracking, spalling, and delamination were observed at multiple locations throughout the parking garage. At some of the spalled areas, the welded wire fabric reinforcement for the topping slab was visible. However, we note that the extent of the cracks, spalls, and delaminated areas were relatively small in comparison to the overall extent of the topping slab. Therefore, we recommend that at this time the cracks in the topping be sealed by routing a V-notch into the cracks and sealing them with a semi rigid epoxy or two-part polyurethane sealant. We also recommend that in the areas of delaminated topping slab, the topping slab be sawcut around the delaminated concrete, the delaminated portion removed, a bonding agent applied and new concrete topping slab that includes a corrosion inhibiting admixture be installed. While the delaminated portion of the topping slab has been removed and prior to the installation of the new topping slab, we recommend that the structural engineer of record observe the exposed top surface of the precast concrete single tee members at a representative number of locations to determine the extent of damage, if any, that has occurred to the tops of the precast concrete single tees as a result of exposure to water, chlorides, or carbonation.

Once these repairs have been completed, we recommend that a penetrating sealer such as a silane/siloxane penetrating sealer with corrosion inhibitor be applied to the topping to reduce the permeability of the concrete topping slab thereby reducing the damage from cyclical freeze-thaw, and the rate of chloride-ion penetration into the topping slab and down to the precast concrete single tees. Please note that the application of a penetrating sealer to prolong the life of the topping slab will become an ongoing maintenance item requiring re-application every 3 to 5 years.

F. Masonry Walls

We noted that in general the masonry walls around the perimeter of the parking garage structure were in poor condition. We observed cracked, loose, or missing mortar in both the brick veneer and CMU at multiple locations. We also observed vertical, horizontal, and stair step cracks in the masonry walls at multiple locations. Additionally, there were signs of previous attempts to anchor the masonry walls back to the parking garage structure at the south-east corner of the building. It is our opinion that there are several causes to the distress observed in the masonry walls. The first is the lack of expansion/contraction joints around the parking structure. While many of the masonry wall sections were not long enough to require expansion/contraction joints, there are several sections, including at the main entrance on West Johnson Street, that exceed the recommended lengths between masonry expansion/contraction joints. We note that brick veneer undergoes expansion as a result of changes in moisture and temperature. For a brick wall that is 24 feet long, the expected change in length of the wall is approximately ¼" due to this expansion. Likewise, we also note that CMU contracts due primarily to drying shrinkage of the units. For a CMU wall that is 24 feet long, the expected change in length of the wall is approximately 1/16" due to contraction. The combined differential movement between these two materials is 5/16" for every 24 foot length of wall. Therefore, we recommend installing expansion joints in the brick veneer for wall segments that exceed 24 feet in width to allow expansion and contraction of the brick veneer. The expansion joints can be saw cut into the existing wall and sealed with a backer rod and an elastomeric sealant.

A second cause of distress to the masonry walls is the constant exposure of the walls to changing atmospheric conditions exposing the walls to differing temperatures and moisture levels. Freeze-

thaw cracking can occur when moisture penetrates into the wall and then freezes. Over time the cycles of freeze-thaw can damage the mortar joints leading to cracking, loose, and/or missing mortar joints. Further insufficient mortar cover between the horizontal joint reinforcement and the exterior of the wall can lead to damage to the mortar joints as well. We recommend that cracked/loose mortar joints be repaired by removing any loose mortar, raking the mortar joint to a depth of ¾", and replacing the mortar with a matching mortar. Likewise for locations where the mortar is missing, we recommend that the missing mortar be replaced with a matching mortar.

We also noted damaged CMUs and bricks at some of the stair step and vertical cracks observed in the masonry walls. As part of the remedial repairs, we recommend that broken CMUs and bricks be removed and replaced.

We also noted that the elevator equipment room located above the elevator in the north east corner of the garage cantilevers approximately 3'-4" over the elevator shaft below. The cantilever appeared to be constructed of W6 beams with bottom plates that were embedded into the front and rear elevator shaft walls. We noted that the bottom plate extended approximately 20" into the shaft wall where it terminated. There was significant vertical cracking of the bricks and mortar below the steel bottom plate as well as a horizontal crack in the brick mortar joint within which the bottom plate was embedded. A review of the original construction drawings indicate that the frame supporting the equipment room was designed to be W8 beams around the perimeter of the equipment room with L4x4x5/16 angles attached to the bottom flange of the W8 beams to support the brick veneer above the cantilevered portion of the wall. The construction drawings indicate that the equipment room was designed to be 17'-0" out to out over top of a 10'-4" elevator shaft. As indicated above, the overhang was only approximately 3'-4". Therefore it appeared that the field conditions differed significantly from the construction drawings. We recommend that an in-depth review of the framing for the floor of the elevator equipment room be performed to both determine its adequacy and condition. In order to do this, access will need to be provided to the elevator shaft so that the underside of the equipment room can be observed from within the elevator shaft. Following the review of the existing framing and its condition, if the existing conditions are found to be adequate, we recommend that the brick veneer and mortar joints below the bottom plate of the W6 beam be repaired as described above. If the existing conditions are found to be inadequate, additional repairs to the shaft and structure may be required.

Additionally, we noted that the walls along the southeast side of the garage appeared to bow out at the intermediate levels. We feel that this displacement is the result both the rotation noted in the asymmetrical edge precast concrete L-shapes and a lack of adequate structural ties between the masonry wall and the precast parking garage structure. We note that previous attempts to tie the masonry wall back to the precast concrete parking garage structure appeared to consist of plates and/or brackets that were through bolted through the existing masonry wall and anchored back to the precast concrete structure. We noted that many of these brackets were either partially removed or in poor condition. Further at several locations where the cavity between the brick veneer and the masonry backup could be observed, we noted the lack of adequate ties between the wythes of the masonry wall. We recommend that the brick veneer be adequately tied to the CMU by installing retrofit brick anchors such as Helifix DryFix Ties, such that at least one existing tie or new helical tie anchor is provided for each 2.67 ft^2 of wall. We also recommend that the CMU be anchored back to the precast concrete structure at each level by either drilling and installing Helifix DryFix Ties through both wythes of the masonry wall and into the cast-in-

place concrete edge beams at 16" on center, or installing new steel brackets between the masonry wall and the precast concrete structure

G. Steel Stairs

During our site visit, we observed the presence of corrosion of the structural steel framing members of the exterior painted steel stair structure. Corrosion of the steel framing was observed at the metal stair pans, the bars supporting the metal stair pans, the structural steel stringers, and other structural steel framing members. Due to the observed extent of distress, we feel that it is likely that significant portions of the steel stair framing will need to be replaced. However, if the City would like to take a more incremental approach, we recommend that the structural steel framing be sandblasted to bear metal, inspected for section loss, and if no appreciable section loss is observed the structural steel framing be repainted with an exterior paint system. We also recommend that at any locations were the structural steel framing has appreciable section loss, that these members be replaced prior to repainting.

PRIORITIZED REPAIR LIST AND ESTIMATED LIFE OF REPAIRS

For your convenience, we have grouped our remedial repairs described above into three categories to assist the City of Staunton with determining the urgency of the repairs. Additionally, we have also provided an estimated repair life for each of the repairs. The three prioritized categories and their definitions are:

Immediate	0 – 1 years	Intended for repairs/replacements that represent a public safety hazard, or need to be completed to prevent further damage from occurring within the garage.
Short Term	1 – 2 years	Repairs that need to be completed as soon as possible to prevent further damage within the garage.
Mid Term	2 – 5 years	Repairs that are necessary, but do not present a current hazard to the garage performance.

Component/ Building System	Description of Distress	Repair Timeframe	Estimated Life of Repair
Precast Concrete Single Tee	Cracking, spalling, delamination of concrete at bearing ends of tees	Immediate	10-20 years
Precast Concrete Single Tee	Spalling of concrete flanges	Immediate	5-10 years
Precast Concrete Column	Cracks in precast concrete column	Immediate	10-20 years
Masonry Walls	Anchorage of CMU to structure	Immediate	10-20 years
Stair Framing	Corrosion of Steel Framing	Immediate	10-20 years
Precast Concrete Single Tee	Repair of Tee to Tee Connections	Short Term	5-10 years

Precast Concrete Single Tee	Joint sealant between adjacent precast concrete single tees	Short Term	5-10 years
Cast-in-place Concrete	Cracking, spalling, delamination, and exposed reinforcement in cast-in-place concrete beams and curbs	Short Term	5-10 years
Cast-in-place Concrete	Cracks, delamination, and surface deterioration in topping slab	Short Term	5-10 years
Cast-in-place Concrete	Topping slab sealant	Short Term	2 - 5 years
Masonry Walls	Cracked, Loose, or Missing Mortar	Short Term	5-10 years
Masonry Walls	Anchorage of Veneer back to CMU	Short Term	10-20 years
Masonry Walls	Expansion/Contraction Joints	Short Term	10-20 years
Guardrails	Repaint	Short Term	2 – 5 years
Precast Concrete Column	Spalls at edge of tee bearing	Mid Term	5-10 years
Precast Concrete Single Tee	Crushed and Distorted bearing pads	Mid Term	10-20 years
Cast-in-place Concrete	Cracks and spalls in concrete curbs at guardrail embeds	Mid Term	5-10 years

Please note that all of the estimated repair life values provided above assume that regular periodic maintenance is performed on these items as necessary. The estimated repair life can be significantly reduced if periodic maintenance is not followed.

ORDER OF MAGNITUDE CONSTRUCTION COST ESTIMATE

We have included an order of magnitude construction cost estimate in the appendices to this report. The following summary has been broken down based on the priority of the repairs.

Repair Priority	Order of Magnitude Cost
Immediate Repairs	
Short Term Repairs	
Mid Term Repairs	
Periodic Resealing (Every 3-5 years)	

Please note that the estimated repair costs do not include engineering fees to develop construction drawings, nor do they include the contractor's overhead and profit markups or any permit fees or contingencies. Additionally, please note that there may be additional cost premiums if the project is broken into multiple smaller projects.

CONCLUSION

We feel that the majority of the distress noted in the parking garage structure is the result of water infiltration into the structure through the failed joint system between the precast concrete single tees. The water infiltration has allowed a pathway for moisture and de-icing salts to reach much of the structure leading to corrosion of reinforcing members, as well as the spalling and delamination of both cast-in-place and precast concrete members.

Despite the widespread distress observed in the structure, we feel that the structure can be repaired to extend the life of the structure. We feel that if the repairs described herein are performed and continued periodic maintenance is performed on the structure, the life of the facility may be extended up to 20 years. If the structural repairs are not performed, the distress to the structure will likely render it unusable within the next 2 to 5 years.

An order of magnitude cost estimate for the repairs described above has been included in an appendix to this report. Additionally, for comparison purposes, we note the construction of a brand new above-grade precast concrete parking structure on an empty site (i.e. no site costs except those required to install the new foundations) and excluding soft costs such as engineering and architectural fees, land acquisition, etc. should cost approximately per square foot or per parking space.

With approximately 270 parking spaces in the current garage, the replacement-in-kind cost for this structure including demolition of the current parking garage and soft costs associated with the design and construction markups and fees for the new parking garage would be approximately Million (see Option 1 Construction Cost Estimate below). Conversely if the City of Staunton proceeds with the full remedial repair of the existing garage, the cost for these repairs including design fees and contractor markups and fees would be approximately Million (see Option 2 Construction Cost Estimate below) or of the cost of replacement-in-kind.

Option 1 Construction Cost Estimate		
Demolition		
Demolition Contingency		
Construction Costs		
Construction Contingency		
	Subtotal	
Contractor Overhead & Profit		
	Subtotal	
Design Fees		
	Subtotal	
Design Bid Services		
A/E Construction Admin		
Design Construction Contingency		
Special Inspection/Quality Assurance Testing Services	% of Construction Costs	
	Total	

Notes:

[a] Based on parking spaces @ per space.

[b] Based on construction duration of 12 months and having on site representation 2 days a week.

[c] Based on % of construction costs. We do not have a proposal from a special inspection testing agency.

Option 1 Estimated Construction Schedule	
Notice to Proceed	1 month
Design Phase	8 months
Bid Phase	2 months
Award & Mobilization	2 months
Construction	18 months
Total	31 months

Option 2 Construction Cost Estimate		
Construction Costs		
	Immediate - Structural	
	Immediate - Drain inlets & piping	
	Short Term - Structural	
	Mid Term - Structural	
	Mid Term - Elec fixtures, wire, and conduit	
	Subtotal	
Construction Contingency		
	Subtotal	
Contractor Overhead & Profit		
	Subtotal	
Design Fees		
	Subtotal	
Design Bid Services		
A/E Construction Admin		
Design Construction Contingency		
Special Inspection/Quality Assurance Testing Services	% of Construction Costs	
	Total	
Recurring Maintenance Cost		

Notes:

[a] % Contingency based on increased uncertainty in remedial repair projects versus new construction.

[b] Based on construction duration of 6 months and having on site representation 2 days a week.

[c] Based on % of construction costs. We do not have a proposal from a special inspection testing agency.

[d] Every 2 to 5 years for resealing.

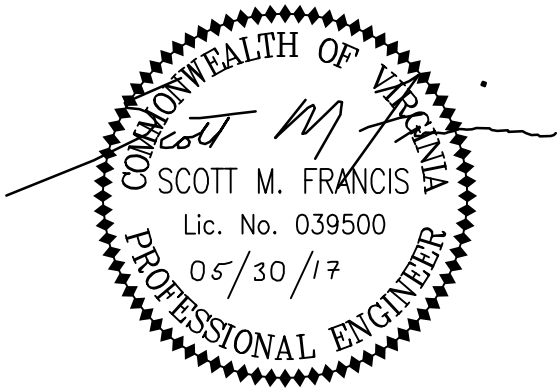
Option 2 Estimated Construction Schedule	
Notice to Proceed	1 month
Design Phase	3 months
Bid Phase	2 months
Award & Mobilization	2 months
Construction	6 months
Total	14 months

Please note that with Option 2, some of the remedial repairs can be completed with only portions of the parking garage being closed. While it is difficult to quantify how long the entire garage would be closed to traffic, we feel that the entire garage would be closed for approximately one and a half months of the six month construction time. This will ultimately be up to the contractor's means and methods and the schedule and price may be affected by how limited the contractor is in their access to the parking garage structure.

LIMITATIONS

Our report has been based on our observations of distress noted during our site visit. Please note that the report is limited to a structural assessment of the parking garage and includes only limited mechanical systems (consisting of the grates, inlet boxes and horizontal piping from the inlets to the vertical downspouts for the stormwater runoff system) as well as the electrical systems (consisting of the lights, wiring, and conduit back to the existing panelboard). A review of the electrical, mechanical, and plumbing systems associated with the elevator, bathrooms, parking garage booth and access system were beyond the scope of this report. A civil survey of the parking garage has also not been included in this scope of work.

Scott M. Francis, P.E.
Senior Engineer, Structural Department



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APPENDIX A
DISTRESS LOCATION PLANS

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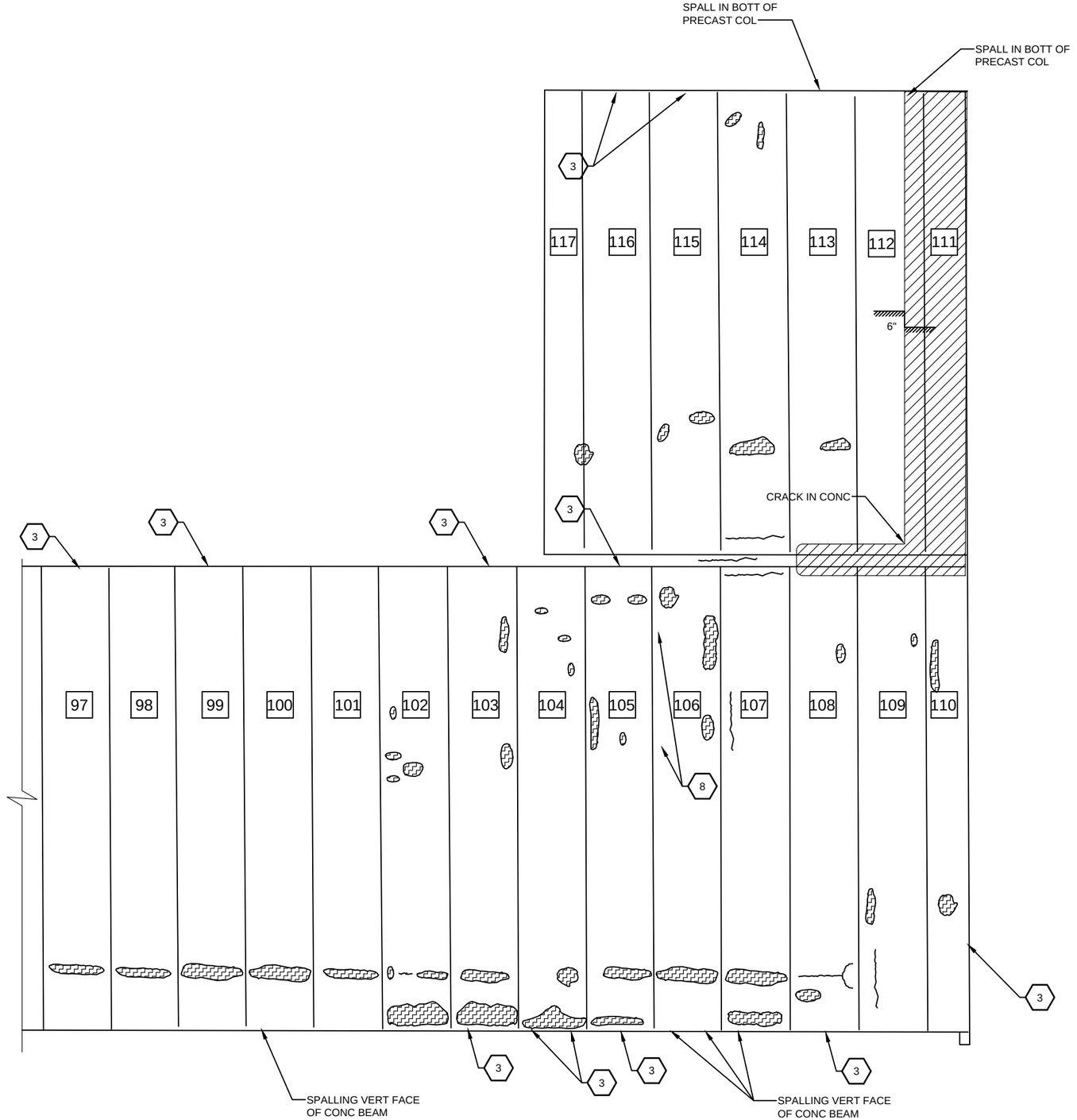


BACKGROUND DRAWING BY
SHOCKEY BROS., INC.
SHEET # S-2 DATED 9/24/1974

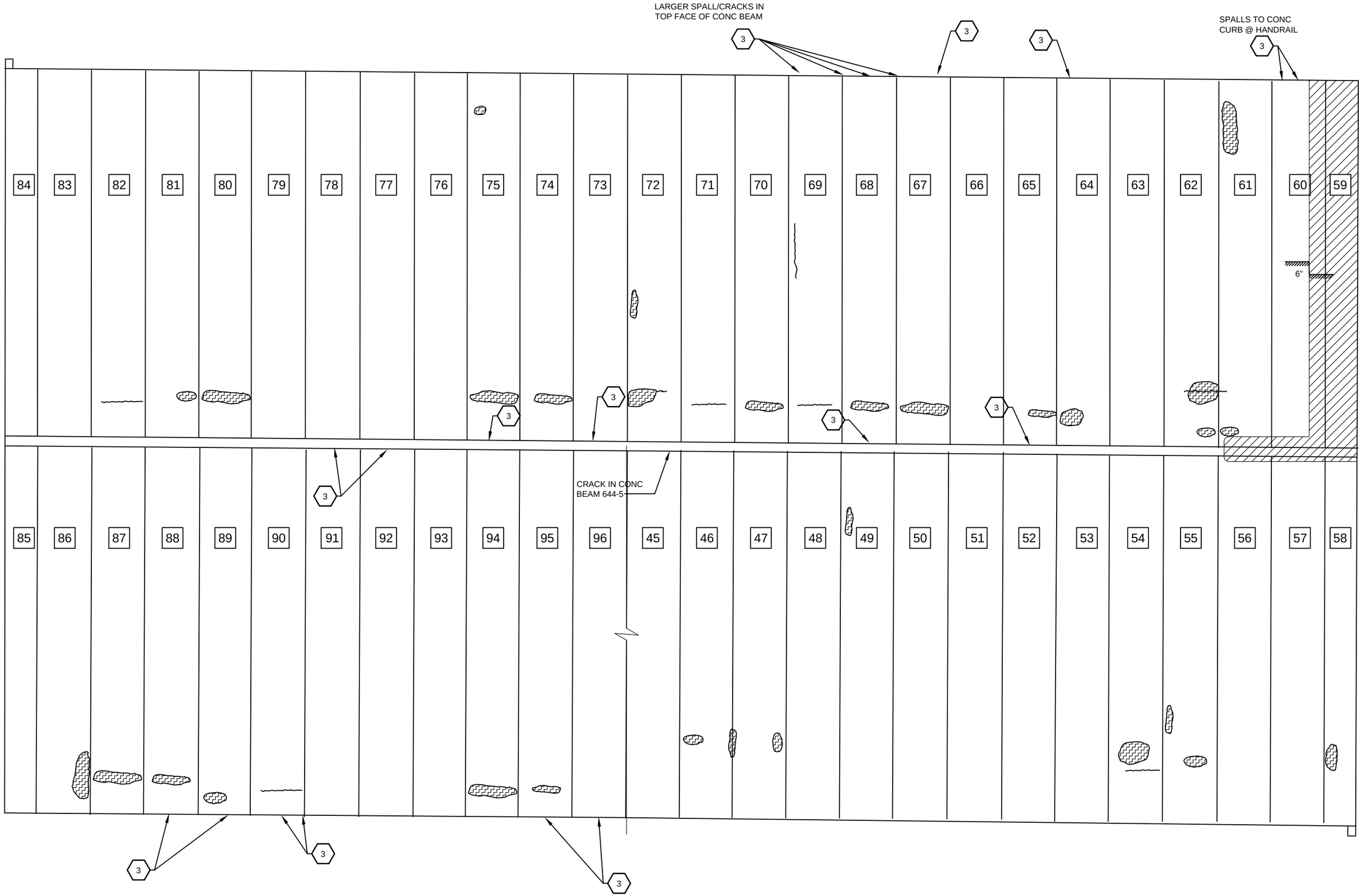
KEYNOTES

1 SPALLED CONCRETE

2 DELAMINATED SLAB

3 LARGER SPALL IN TOP OF CONCRETE BEAM

SHEET: SSK-1.1
TITLE: 1ST LEVEL, TOP SURFACE OF SLAB FIELD NOTES



BACKGROUND DRAWING BY
SHOCKEY BROS., INC.
SHEET # S-3 DATED 9/24/1974

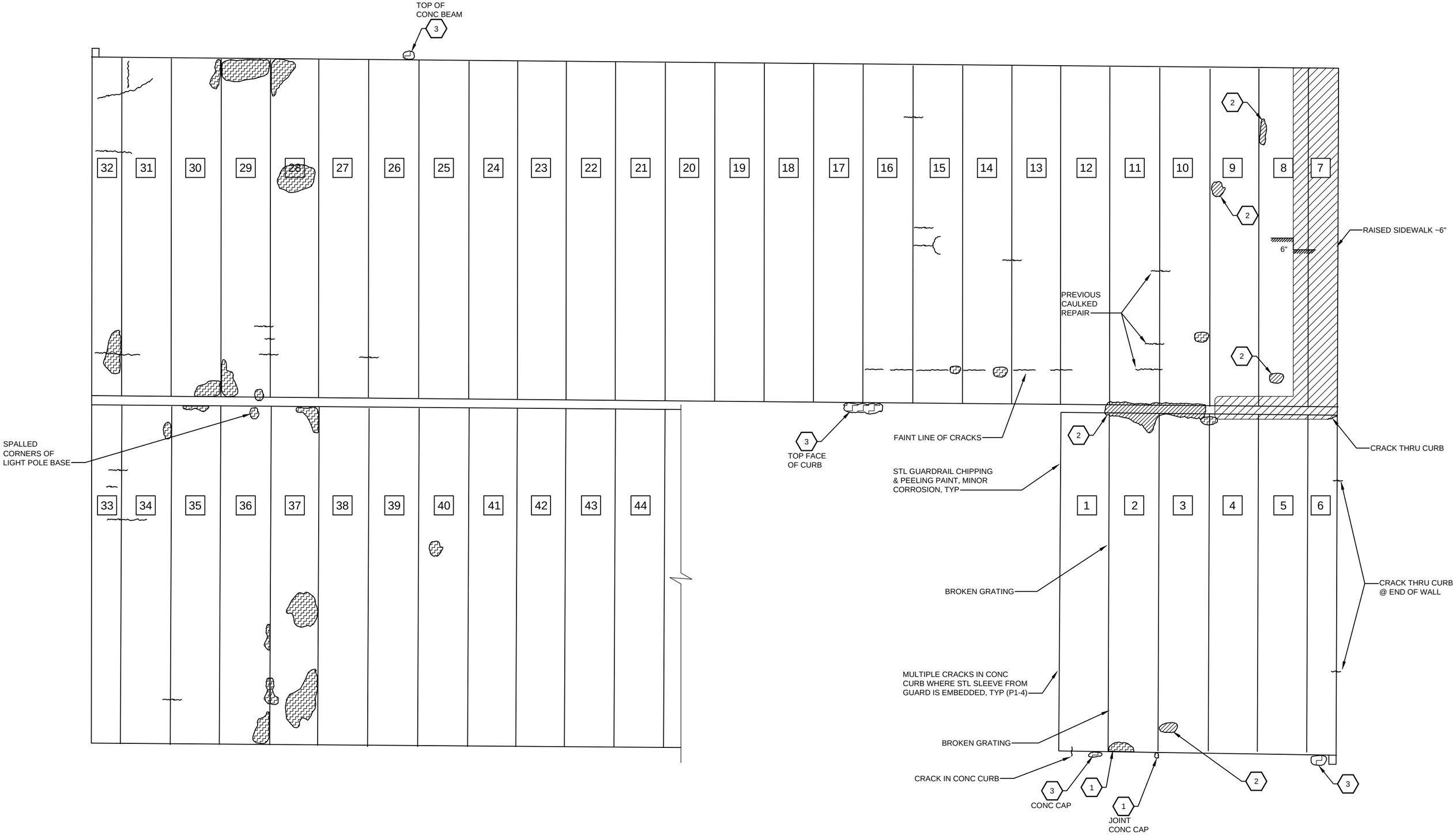
KEYNOTES

1 SPALLED CONCRETE

2 DELAMINATED SLAB

3 LARGER SPALL IN TOP OF CONCRETE BEAM

SHEET: SSK-1.2
TITLE: 2ND LEVEL, TOP SURFACE OF SLAB FIELD NOTES

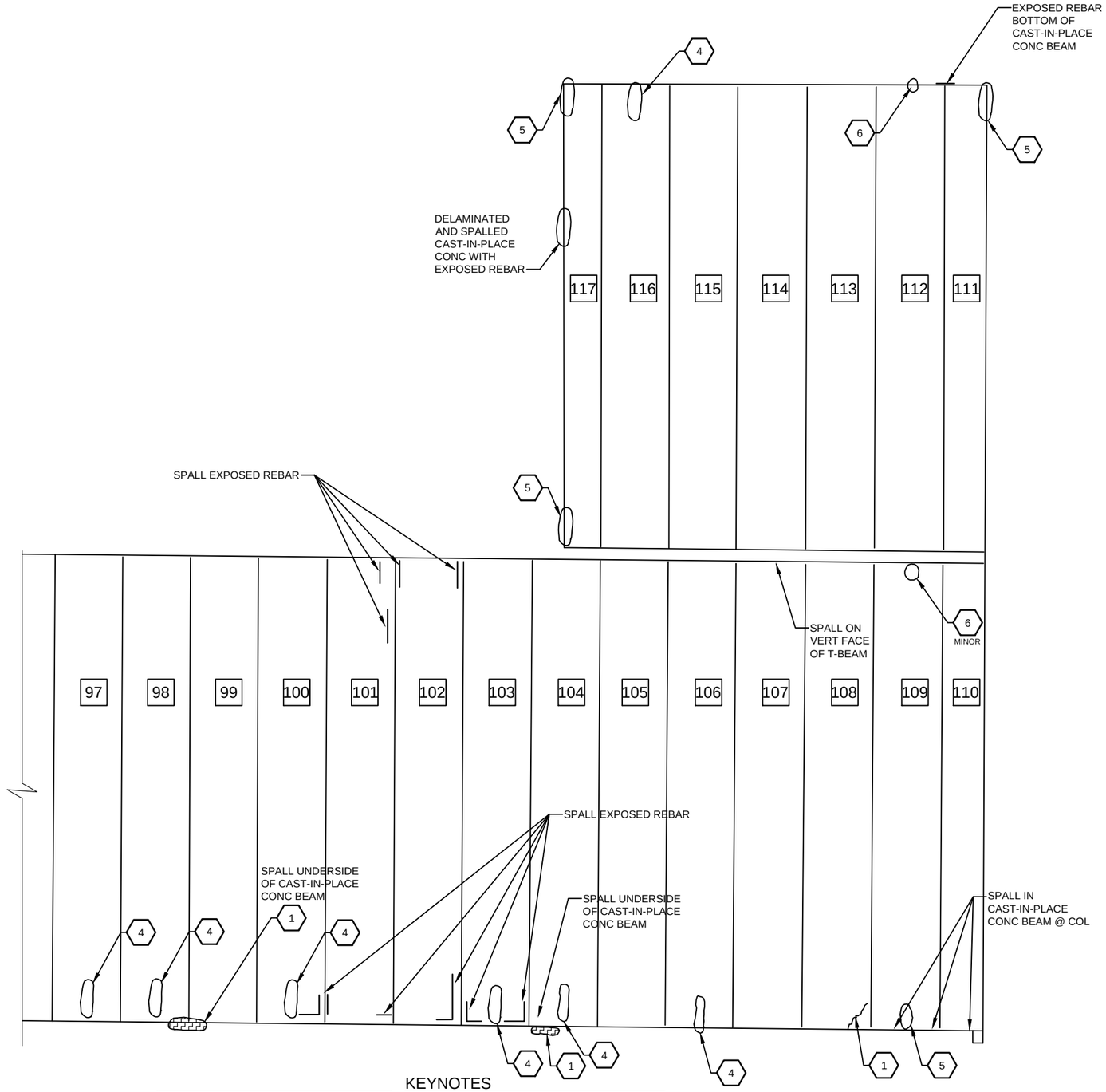


BACKGROUND DRAWING BY SHOCKEY BROS., INC. SHEET # S-4 DATED 9/24/1974

KEYNOTES

1. SPALLED CONCRETE
2. DELAMINATED SLAB
3. LARGER SPALL IN TOP OF CONCRETE BEAM

SHEET: SSK-1.3
TITLE: 3RD LEVEL, TOP SURFACE OF SLAB FIELD NOTES



BACKGROUND DRAWING BY
SHOCKEY BROS., INC.
SHEET # S-2 DATED 9/24/1974

KEYNOTES

1 SPALLED CONCRETE

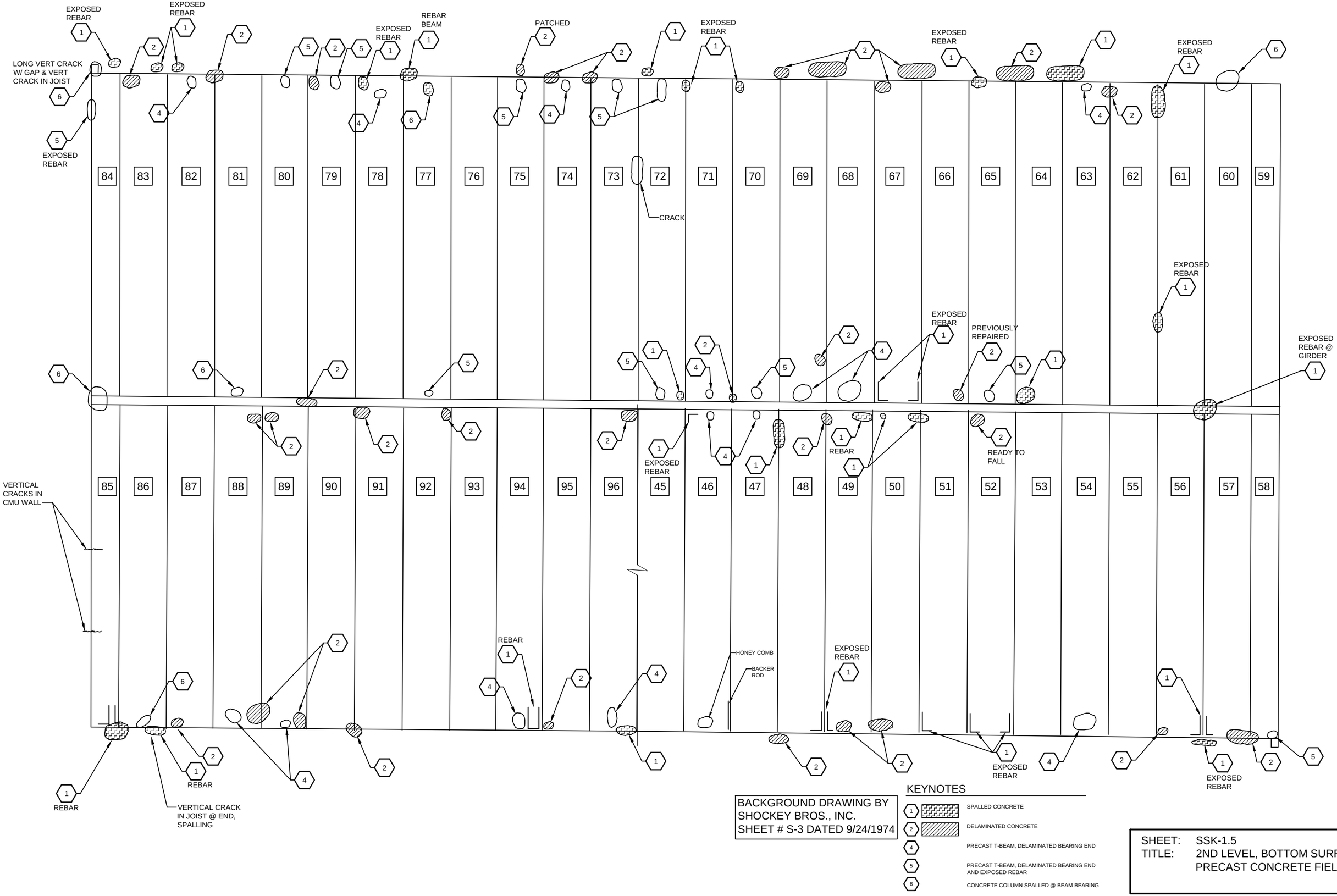
2 DELAMINATED CONCRETE

4 PRECAST T-BEAM, DELAMINATED BEARING END

5 PRECAST T-BEAM, DELAMINATED BEARING END AND EXPOSED REBAR

6 CONCRETE COLUMN SPALLED @ BEAM BEARING

SHEET: SSK-1.4
TITLE: 1ST LEVEL, BOTTOM SURFACE OF PRECAST CONCRETE FIELD NOTES

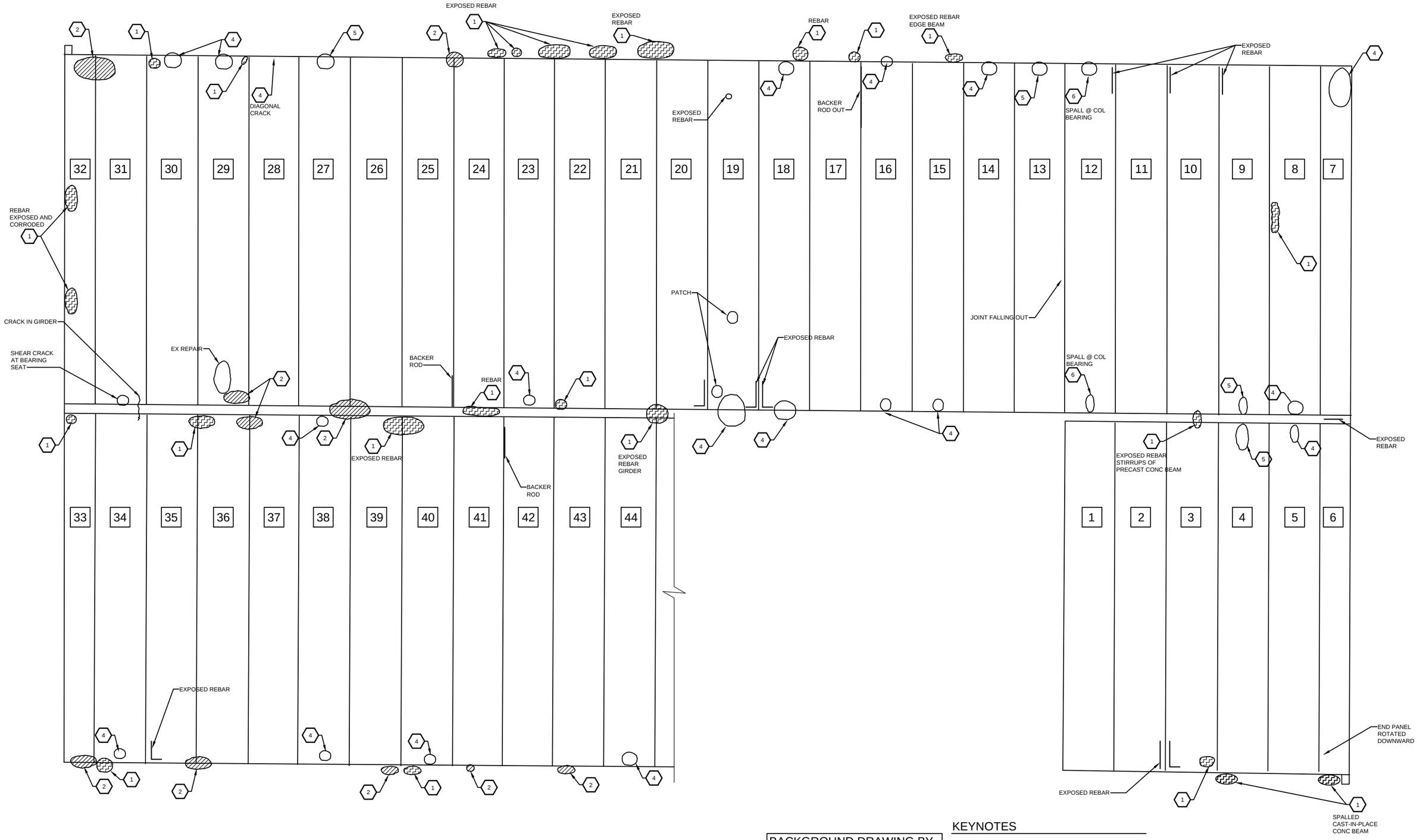


BACKGROUND DRAWING BY SHOCKEY BROS., INC.
SHEET # S-3 DATED 9/24/1974

KEYNOTES

1. SPALLED CONCRETE
2. DELAMINATED CONCRETE
4. PRECAST T-BEAM, DELAMINATED BEARING END
5. PRECAST T-BEAM, DELAMINATED BEARING END AND EXPOSED REBAR
6. CONCRETE COLUMN SPALLED @ BEAM BEARING

SHEET: SSK-1.5
TITLE: 2ND LEVEL, BOTTOM SURFACE OF PRECAST CONCRETE FIELD NOTES



BACKGROUND DRAWING BY
SHOCKEY BROS., INC.
SHEET # S-4 DATED 9/24/1974

KEYNOTES

1. SPALLED CONCRETE
2. DELAMINATED CONCRETE
4. PRECAST T-BEAM, DELAMINATED BEARING END
5. PRECAST T-BEAM, DELAMINATED BEARING END AND EXPOSED REBAR
6. CONCRETE COLUMN SPALLED @ BEAM BEARING

SHEET: SSK-1.6
TITLE: 3RD LEVEL, BOTTOM SURFACE OF PRECAST CONCRETE FIELD NOTES

APPENDIX B
PHOTO LOCATION PLANS & PHOTOS

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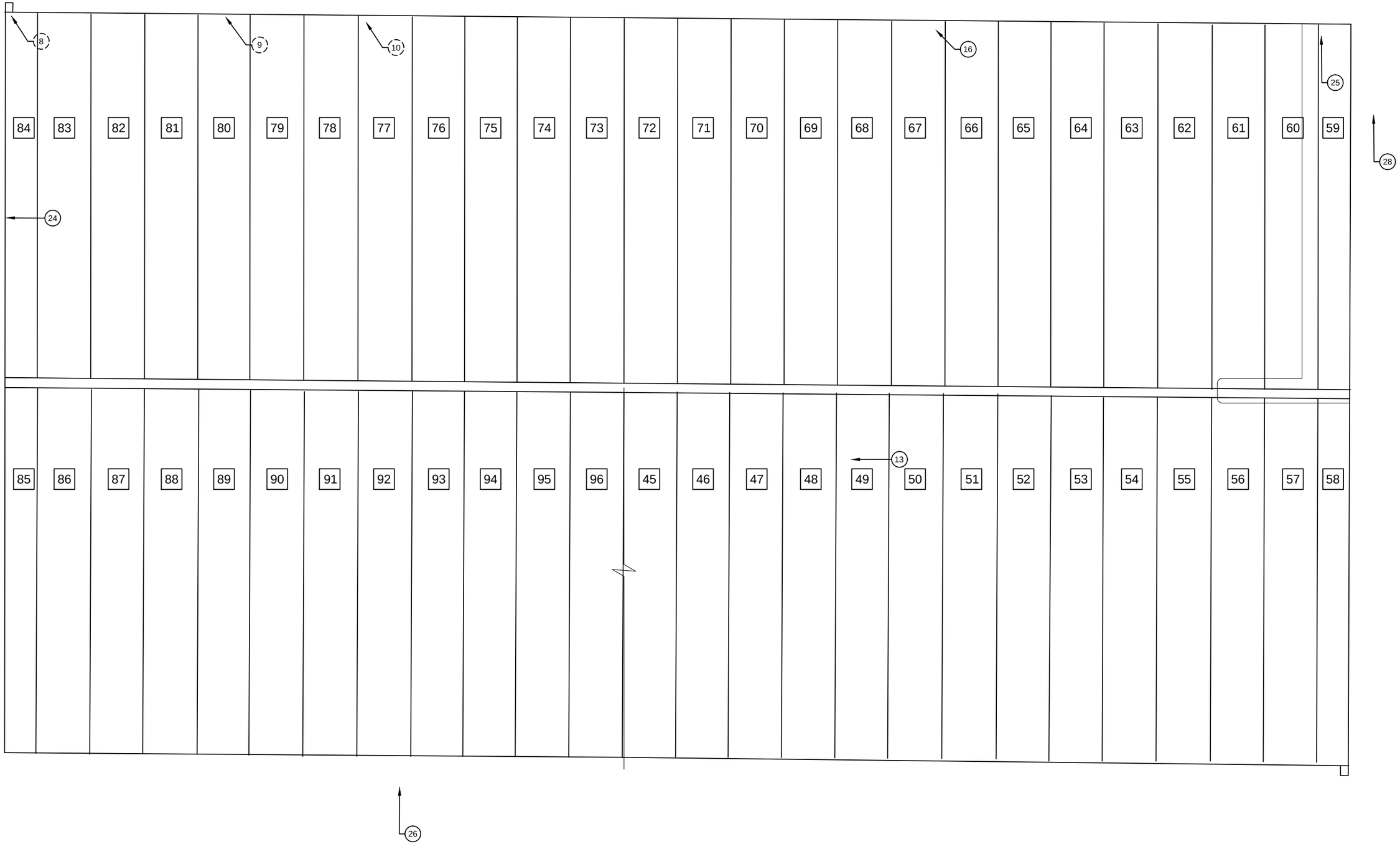


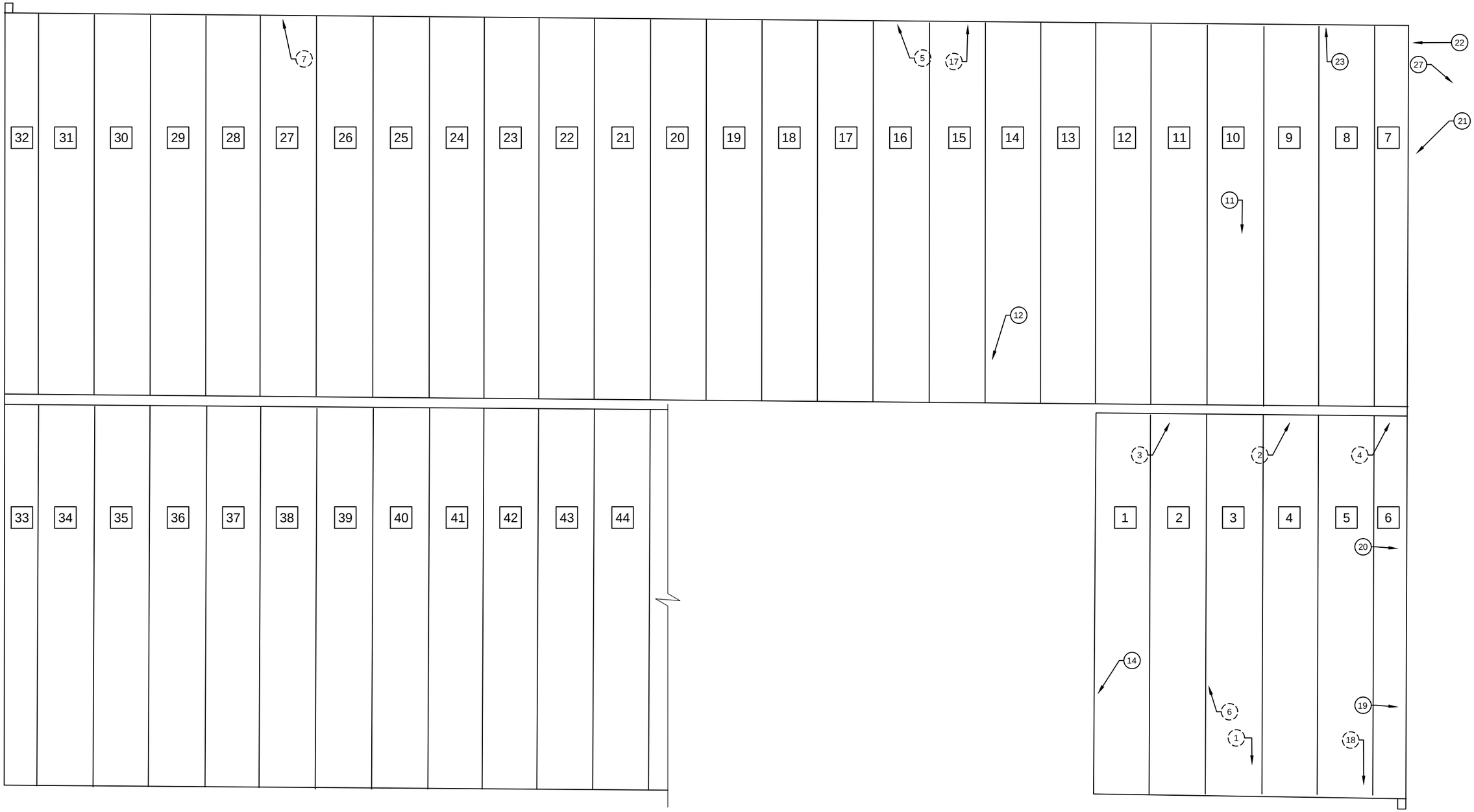
BACKGROUND DRAWING BY
SHOCKEY BROS., INC.
SHEET # S-3 DATED 9/24/1974

KEYNOTES

(XX) PHOTO # OF IMAGE OF TOP SURFACE OF STRUCTURE

(XX) PHOTO # OF IMAGE OF UNDERSIDE OF STRUCTURE

SHEET: SSK-1.2
TITLE: 2ND LEVEL, PHOTO LOCATION PLAN



BACKGROUND DRAWING BY SHOCKEY BROS., INC. SHEET # S-4 DATED 9/24/1974

KEYNOTES

XX

XX

SHEET: SSK-1.3

TITLE: 3RD LEVEL, PHOTO LOCATION PLAN

Photo 1 - View of the underside of two adjacent precast concrete single tees at the upper level of the parking garage. This photo was taken looking towards the south end of the parking garage. The flanges of the single tees were vertically offset approximately 1 1/2 inches from each other. We also noted a spall in the precast concrete at the corner of the rightmost panel near the edge.

Photo 2 - View of the bearing end of a precast concrete single tee. We noted that a previous repair in the vicinity of the end of the tee had spalled partially exposing the steel reinforcement.

Photo 3 - View of a precast concrete beam spanning above the drive lane at the east end of the parking garage. We noted the presence of several spalls in the precast concrete beam which partially exposed the steel reinforcing.

Photo 4 - Close-up view of the bearing of a precast concrete single tee on a precast concrete column. We noted that the bearing pad was flattened and deformed. We also noted a spall in the precast concrete column at the edge of the bearing.

Photo 5 - Close-up view of the bearing end of a precast concrete single tee. We noted that the bearing end of the tee had been previously repaired and that new cracks have formed along the edge of the repair.

Photo 6 - Close-up view of the joint between two adjacent precast concrete single tees. We noted the joint connecting the adjacent tees consisted of a piece of steel reinforcement welded to a partially exposed piece of reinforcement embedded into the edge of each of the adjacent tees.

Photo 7 - Close-up view of the bearing end of a precast concrete single tee. We noted that the bearing end of the tee had been previously repaired and that cracking and spalling of the repair had partially exposed the reinforcement.

Photo 8 - View of the precast column at the north end of the parking garage. We noted the presence of a vertical crack in the precast concrete column extending down from the bearing end of the precast concrete single tee. We also noted a spall on the far side of the precast concrete single tee which partially exposed the steel reinforcement at the bearing end.

Photo 9 - Close-up view of the bearing end of a precast concrete single tee. We noted spalled concrete exposing the steel reinforcement at the bearing end of the tee. We also noted that the exposed steel reinforcement showed signs of corrosion.

Photo 10 - View of the underside of two precast concrete single tees. We noted spalling of the concrete which partially exposed the steel reinforcement at the end of the two tees.

Photo 11 - View of the topping slab of the parking garage at the upper level of the garage. The topping slab showed signs of loss of cement paste at the surface partially exposing the aggregate. Several cracks and spalls were present in the topping slab.

Photo 12 - View of the topping slab of the parking garage along the ramp from the upper level down to the middle level. This picture was taken looking towards the southwest. We noted that at a number of locations spalled concrete topping slab and/or cracks in the concrete topping slab existed approximately 7'-0" from the end of the precast concrete single tee planks.

Photo 13 - Close-up view of the joint in the topping slabs between two adjacent precast concrete single tee planks. We noted a spall that extended the full depth of the topping slab exposing a gap between the adjacent single tee planks.

Photo 14 - Close-up view of a steel guardrail post embedded in the cast-in-place concrete curb separating two levels of the parking garage. We noted a vertical crack extending out from the embedded guardrail and continuing down both sides of the cast-in-place concrete curb.

Photo 15 - Close-up view of a steel guardrail post embedded in the cast-in-place concrete curb separating two levels of the parking garage. We noted the face of the concrete curb had spalled at the location of the sleeve embedded into the concrete for the guardrail post.

Photo 16 - Close-up view of the cast-in-place concrete edge beam along the north side of the parking garage. We noted that the concrete beam was cracked and spalled along this section of the parking garage.

Photo 17 - View of the underside of the cast-in-place concrete beam along the north side of the parking garage. We noted spalling of the concrete which partially exposed the steel reinforcement. Additionally, the exposed steel reinforcement showed signs of corrosion.

Photo 18 - View of the underside of the cast-in-place concrete beam along the south side of the parking garage. We noted cracking and spalling of the concrete which partially exposed the steel reinforcement. Additionally, several rusted steel brackets anchoring the wall to the cast-in-place concrete beam were observed. Loose and or missing anchor rods and nuts were observed at several of the holes in the steel brackets.

Photo 19 - Close-up view of bent steel strap anchor bolted into the masonry wall at the southeast corner of the parking garage at the upper level. Note the large caulk joint between the wall and the cast-in-place concrete curb. Additionally we noted a crack in the cast-in-place concrete curb adjacent to the end of the masonry wall.

Photo 20 - View of the interior face of the top of the masonry wall at the east side of the parking garage. We noted horizontal cracks in the mortar joints. Additionally, we also noted missing and loose mortar.

Photo 21 - View of the exterior face of the masonry wall along the east side of the parking garage. We noted cracked and loose or missing mortar in the joints in the brick veneer.

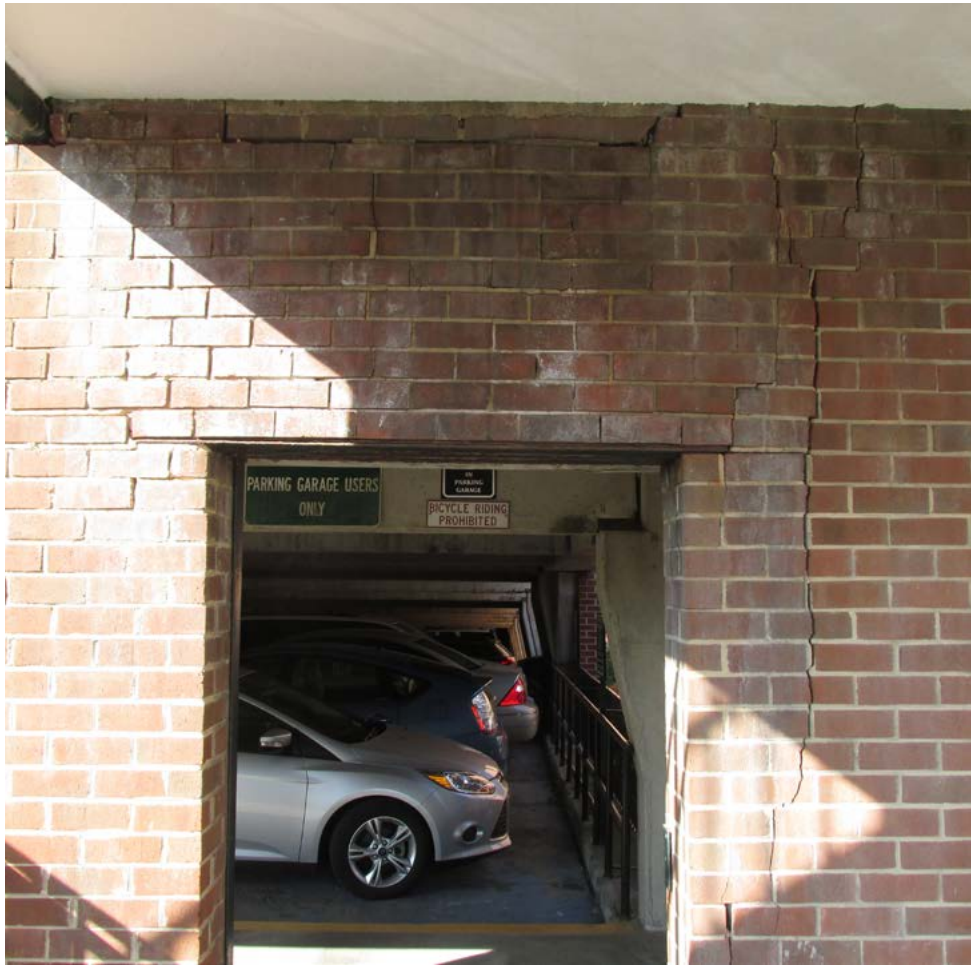


Photo 22 - View of the entrance to the 2B level of the parking garage at the northeast corner of the parking garage. We noted vertical, horizontal, and stairstep cracks in the brick and mortar joints of the masonry wall. We also noted loose and or missing mortar in the joints of the brick veneer. Additionally, we noted the steel angles forming the lintel above the opening were rusted.

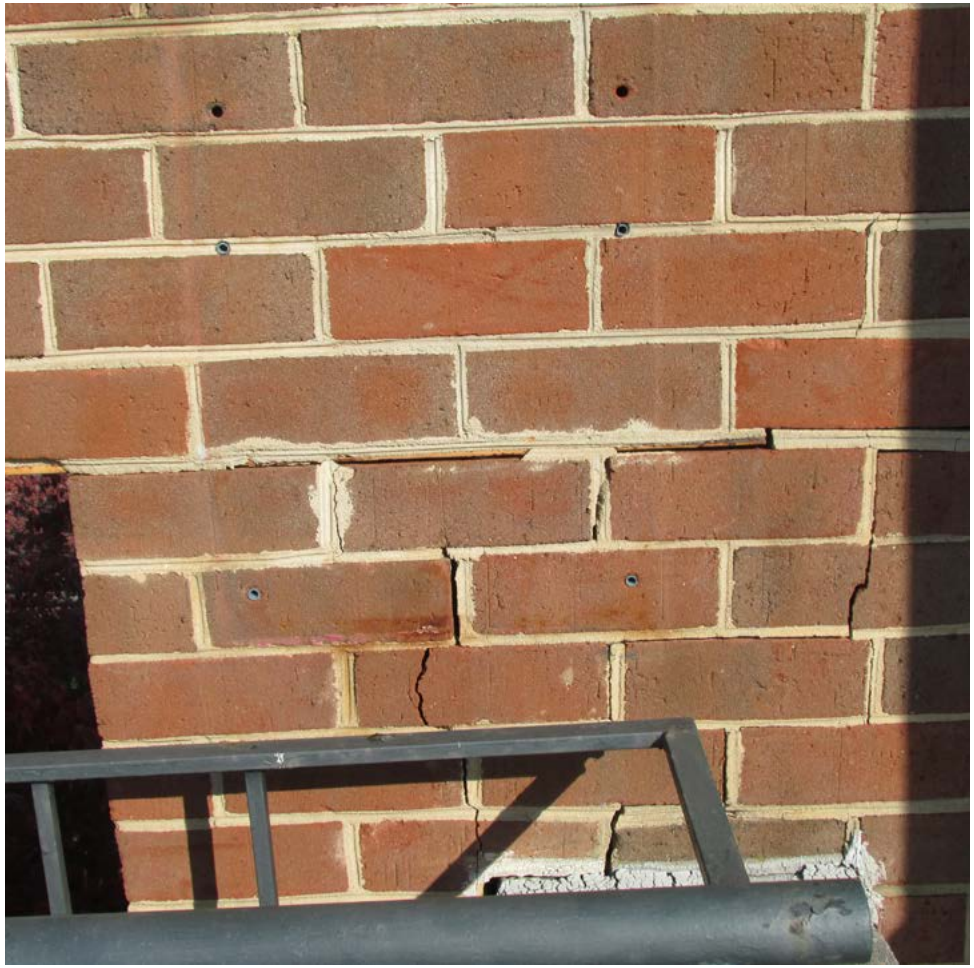


Photo 23 - Close-up view of the brick veneer at the top level of the elevator shaft. This photo was taking looking towards the north. We noted that a portion of masonry wall overhangs the lower section of the wall and is supported by a steel plate that is embedded approximately 24" into the wall. We noted horizontal and stairstep cracks in the brick and mortar joints of the brick veneer at this location.

Photo 24 - View looking down the exterior face of the masonry wall located below the pedestrian ramp leading to South Lewis Street at the northwest corner of the parking garage. We noted the presence of stairstep and vertical cracks in the bricks and mortar joints of the brick veneer. Additionally, we noted that the bricks above the crack were displaced from those below the crack.

Photo 25 - View of the interior face of the masonry wall for the elevator enclosure at level 2B. The photo is taken looking towards the north. We noted stairstep and horizontal cracks in the mortar joints of the CMU wall. Additionally, the flanges of the interior and end single tee precast concrete planks were vertically offset approximately 1 inch from each other.

Photo 26 - View of the exterior face of the masonry wall to the west of the main entrance to the parking garage off of Johnson Street. We noted the presence of horizontal and stairstep cracks in the bricks and mortar joints of the brick veneer. The cracks were a maximum of approximately 3/4" wide at some locations.

Photo 27 - Close-up of the underside of the steel stair stringers of the exterior stair along the east side of the parking garage. We noted that the metal stair pans were supported by steel bars welded to the stair stringer. Corrosion of the stringer, support bars, and metal stair pans were observed.

Photo 28 - View of the underside of the exterior steel stair along the east elevation of the parking garage. We noted corrosion of the metal stair pan and supporting steel framing.

APPENDIX C
CHLORIDE ION/CARBONATION TEST RESULTS

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SINCE 1881

FROEHLING & ROBERTSON, INC.

Engineering Stability Since 1881

3015 Dumbarton Road
Richmond, Virginia 23228-5831 I USA
T 804.264.2701 I F 804.264.1202

March 31, 2017

CHLORIDE ION AND CARBONATION TEST REPORT

PROJECT NO.: 71U-0270
CLIENT: Wiley|Wilson
127 Nationwide Drive
Lynchburg, Virginia 24502
PROJECT: Johnson Street Parking Garage
STANDARD: ASTM C1218-15, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete

Dear Sir,

Froehling & Robertson, Inc. (F&R) is pleased to submit the results of water-soluble chloride testing and depth of carbonation testing for the following samples. The test results are shown in the table below.

SAMPLE	PPM	LBS/YD^3	% BY WT. OF CEMENT	DEPTH OF CARBONATION (IN.)
B-1	998	3.79	0.58	0.20
B-4	1,510	5.74	0.87	0.10
B-5	179	0.68	0.10	0.19
B-6	1,780	6.76	1.03	0.92
B-7	744	2.83	0.43	1.49
B-8	382	1.45	0.22	0.17
B-9	944	3.59	0.55	0.14
B-10	971	3.69	0.56	0.31
B-11	811	3.08	0.47	0.19
B-12	7	0.03	<0.01	0.22
B-13	488	1.85	0.28	0.52
B-14	720	2.74	0.42	0.93
B-15	664	2.52	0.38	0.47
C-4	717	2.72	0.41	0.39
C-5	44	0.17	0.03	0.19
C-6	31	0.12	0.02	0.75
C-7	21	0.08	0.01	0.55
C-8	21	0.78	0.01	0.47
C-9	38	0.15	0.02	0.26
F-3	3,370	12.81	1.95	1.10

SAMPLE	PPM	LBS/YD^3	% BY WT. OF CEMENT	DEPTH OF CARBONATION (IN.)
F-4	7,170	27.2	4.14	0.87
F-5	1,860	7.07	1.07	0.28
F-6	151	0.57	0.09	0.66
F-7	636	2.42	0.37	0.59
F-8	994	3.78	0.57	0.27
F-9	155	0.59	0.09	0.35
F-10	865	3.29	0.50	0.13
T-1	20	0.08	0.01	0.80
T-2	9	0.03	0.00	0.70
T-3	24	0.09	0.01	0.65
T-4	10	0.04	0.01	0.64
T-5	13	0.05	0.01	0.61

Should you have any questions about these test results or require additional information or testing, please contact us at your convenience.

Respectfully Submitted,
FROEHLING& ROBERTSON, INC.

Robert A. Hill, III, P.E.
Branch Manager

RAH:jc

APPENDIX D
ORDER OF MAGNITUDE CONSTRUCTION COST ESTIMATE

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Component/ Building System	Description of Remedial Repair	Unit	Cost per Unit	Total
Precast Concrete Single Tee – Bearing Ends	• Remove loose/delaminated concrete be removed down to sound concrete. Clean exposed reinforcement be cleaned by sand-blasting and coat with a corrosion inhibitor. Repair the surface using a cementitious repair mortar. • Repair cracks by installing injection ports and injecting epoxy. • Install carbon fiber reinforced polymer (CFRP) fabric overtop of the repaired areas starting at the bearing seat and extending a minimum of 7'-0" from the end of the tee.	EA		
Precast Concrete Single Tee – Spalls on underside of flanges	• Remove loose/delaminated concrete down to sound concrete. • Clean exposed reinforcement and coat with a corrosion inhibitor. • Repair the surface using a cementitious repair mortar w/penetrating corrosion inhibitor.	EA		
Precast Concrete Single Tee – Bearing Pads	• Replace bearing pads with new elastomeric bearing pads. Includes temporary supports for jacking ends of precast panel.	EA		
Precast Concrete Single Tee – Failed tee to tee connections and caulk joints	• Clean the exposed portion of the tee to tee connector to bear metal in order to inspect both the weld and the reinforcement bar welded to both sides of the joint. Repair any broken welds and/or replace any reinforcement found to have suffered section loss. • If any of the tee to tee connectors are damaged to the point that they cannot be repaired, install V2 CFRP Tee Biscuits. • Remove and replace existing joints with new backer rods and an elastomeric sealant meeting the requirements of ASTM C920 Type M, Grade NS, Use T, M such as Sikaflex-2c NS TG	LF		
Precast Concrete Column – Cracks	• Repair cracks by sealing the surface of the crack with an epoxy paste product and install injection ports. • Inject epoxy into injection ports. • Cut the tips of the grout ports off and grind down the sealer epoxy flush with the adjacent concrete surface.	LF		

Precast Concrete Column – Spalls at beam bearing	• Remove any loose concrete down to sound concrete. • Clean exposed reinforcement and coat with a corrosion inhibitor. • Repair the surface using a cementitious repair mortar w/penetrating corrosion inhibitor.	EA		
Cast-in-place Concrete – Spalls/ Delaminations	• Remove loose/delaminated concrete down to sound concrete. • Clean exposed reinforcement and coat with a corrosion inhibitor. • Repair the surface using a cementitious repair mortar w/penetrating corrosion inhibitor.	LF		
Cast-in-place Concrete – Spalls/Delaminations Galvanic Protection	• Install anodes w/in each spalled concrete area. • Drill and install anodes periodically along length of beam.	EA		
Cast-in-place Concrete – Cracks & Spalls in concrete curbs at guardrail embeds	• Remove loose concrete down to sound concrete. • Patch spalls using a cementitious repair mortar. • Repair cracks by sealing the surface of the crack with an epoxy paste product and install injection ports. • Inject epoxy into injection ports. • Cut the tips of the grout ports off and grind down the sealer epoxy flush with the adjacent concrete surface. • Coat the bottom 1'-0" of the guard rail post as well as the top of the sleeve and concrete within 6" of the sleeve with an asphaltic mastic.	LF		
Cast-in-place Concrete – Topping Slab	• Sawcut and remove spalled and delaminated concrete topping slab. • Install new concrete topping slab	SF		
Cast-in-place Concrete - Sealant	• Install penetrating sealer w/corrosion inhibitor	SF		
Masonry Walls – Cracked, Loose or Missing Mortar	• Remove any loose mortar, rake the mortar joint to a depth of ¾", and replacing the mortar with a matching mortar.	LF		
Masonry Walls – Anchorage of brick veneer to CMU	• Install retrofit helical tie brick anchors such that at least one existing tie or new helical tie anchor is provided for each 2.67 ft^2 of wall	SF		

Masonry Walls – Anchorage of CMU to concrete structure	• Drill and install helical ties through both wythes of the masonry wall and into the cast-in-place concrete edge beams at 16" on center at each floor level	LF		
Masonry Walls – Expansion/Contraction Joints	• Install expansion joints in the brick veneer by saw cutting brick veneer and sealing with a backer rod and caulk	LF		
Stair Framing – Corrosion of Metal Framing	• Sandblast steel framing to bear metal and inspect for section loss. • If no appreciable section loss is observed, repaint with an exterior paint system. • At any locations were the structural steel framing has appreciable section loss, replace the affected members prior to repainting	RISER		
Guardrails	• Clean guardrails with wire brush and apply new paint system	LF		
Lighting	• Replace existing lights, conduit, and wiring back to existing panelboard	EA		
Stormwater Drains	• Replace existing metal drain basins and horizontal drainpipe back to Y in vertical stormwater piping	EA		

Abbreviations:

EA	Each
LF	Linear Foot
SF	Square Foot

Please note that the estimated repair costs do not include engineering fees to develop construction drawings, nor do they include the contractor's overhead and profit markups or any permit fees or contingencies.