ADDENDUM 1

to the

BIDDING DOCUMENTS

for

Jim Whelan Boardwalk Hall
Boardwalk Façade Renovation – Pilot Project
Atlantic City, MJ

October 25, 2019

To Prospective Bidders:

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents and previously issued Addenda, as noted below. All unmodified portions remain in full force and effect. Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject Bidder to disqualification.

1.1 GENERAL

1) Summary of Drawings Attached

NONE

2) Summary of Project Manual Documents Attached: The following documents are attached to, and are part of, this Addendum:

a. SECTION 00 10 00 – ADVERTISEMENT FOR BID
b. SECTION 00 11 53 - REQUEST FOR QUALIFICATIONS

3) Supplemental Information

a. Pre-bid meeting attendees sign-in sheet
b. Second walk-through sign-in sheet
c. Guidelines distributed at 10/17/2019 pre-bid meeting
d. Non-destructive evaluation report – for information only

1.2 SUMMARY CHANGES TO DRAWINGS

NONE

1.3 SUMMARY CHANGES TO PROCUREMENT AND CONTRACTING REQUIREMENTS

1) Section 00 10 00 – ADVERTISEMENT FOR BID
   a. Revised Dates for:
      a. Bid Questions due date
      b. Bid Submission time

1.4 SUMMARY CHANGES TO SPECIFICATIONS

1) Section 00 11 53 - REQUEST FOR QUALIFICATIONS
   a. Edits to Statement of General Notice, §B
   b. Edits to Statement of General Notice, §D.1, and §D.2
   c. Criteria for Evaluating Bidder Qualification on Historic Preservation Projects, §A, §A.1 and §A.2
   d. Edits to Bidder Qualification Statement, §2 - General Contractor
   e. Edits to Bidder Qualification Statement, §4 – Restoration Skills Qualification Form list of trades requiring Qualification Forms

1.5 QUESTIONS

1) General Note #3 on the plans calls for the contractor to remove and restore all plumbing, electrical, and alarm wiring; however, noting is shown on the drawings for these tasks. Can an allowance for this work be included?
   a. Scope of work includes removal of electrical wiring related to lanterns.

b. **Base bid to include disassembling any electrical system components at the roof to remain, as required to complete lantern removal, and reinstalling the systems when lantern removal is complete.**

2) Can an allowance for permit fees and plan review be established?
   a. **Contractor to contact appropriate authorities and determine building permit fees to be included in base bid.**
   b. **Plan review fees will be paid by Owner**

3) Typically, in public work, the GC must list the (prime) Mechanical, Plumbing, Electrical, and Steel subcontractors and provide their prequalification documents. Is this a requirement for this project?
   a. **Provide all documentations noted in Section 00 10 00 - Advertisement for Bid and Notice to Bidders, including, but not limited to, Section 3.2 – *Required Bid Submittals and Compliance Information*.**
   b. **Comply with requirements of Section 00 11 53 - REQUEST FOR QUALIFICATIONS**

4) Are DPMC documents required by the bidder and their prime subcontractors?
   a. **Provide all documentations noted in Section 00 10 00 - Advertisement for Bid and Notice to Bidders, including, but not limited to, Section 3.2 – Required Bid Submittals and Compliance Information.**

5) Can you clarify the alternate vs the base bid in terms of scope? The only reference is the dashed area on A-02.
   a. **Refer to attached Appendix A**

6) On drawings AD2.4 and A2.4, there is a note boxed out on the page that reads" Not In Project I Scope of Work". Does this include all work shown on these pages?
   a. **The scope of work on Sheets AD2.4 and A2.4 is NOT included in the Pilot Project scope of work, except for the Lantern removal and related roofing repairs.**

7) Can the bid time get pushed back to later in the day? Perhaps 2pm. Putting together subcontractor documents and vetting scopes the day of is time consuming when most prices don't hit the street until the day of the bid.
   a. **See attached revised Bid Advertisement Cover Page**

8) The schedule of 16 weeks is very aggressive considering the submittal and approval process, compounded by the lead time for stone. Stone cannot be released until after the scaffolding is in place and demo is underway.
   a. **Revised Section 3.1 - *Contract Schedule* will be issued in Addendum 2, reflecting a change of Contract duration from sixteen to twenty (20) work weeks.**

9) When is a NTP expected to be issued?
   a. **Anticipated Spring 2020.**

10) Please confirm that a "Preliminary Progress Schedule" is required with the bid submission per 3.1 of the Information for Bidders.
   a. **A preliminary schedule must be included in the bid submission.**

11) Please provide "Quantities" associated with Exhibit "G" as was discussed at the Prebid Meeting.

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a. **Question will be addressed in Addendum 2**

12) Please confirm that the quantities listed as "Key to Condition Survey Code" is not a basis of the scope of work.
   a. **Quantities listed in the Vertical Access Report Key to Condition Survey Code and Summary of Condition Quantities are not the basis for the scope of work.**

13) Please clarify the "Acknowledgement of Allowances"? What information is to be provided and what is the basis of the quantities?
   a. **Acknowledgement of Allowances form to be included in bid submission.**
   b. **Quantities and definition of allowances to be included in Addendum 2.**

14) Will "windy" condition be considered as part of the "Extreme Weather Conditions" when granting additional time?
   a. **Extreme Weather Conditions to be reviewed/discussed on as-need basis per event.**

15) Please provide the bidders with an "Event Schedule" and advise us how this will be factored into the schedule completion date. Will the contractors be given consideration for lost time due to early clean up days and disruptions in the schedule for unforeseen events?
   a. **Event schedule will be provided to successful bidder. It is not anticipated that such events will significantly impact the schedule completion date as they mostly occur during the weekend.**
   b. **Lost time due to early clean up days and disruptions in the schedule for unforeseen events will be taken into consideration on an as-needed basis, per event.**

16) Are there limitations on the days or hours that can be worked at the site?
   a. **Standard work hours apply, Monday through Friday, 7:00 am – 3:30 pm.**

17) What are the barricade requirements along the boardwalk? Will barricades have to be finished painted?
   a. **Contact Offices of City Engineer to review requirements for barricades on Boardwalk and vehicular access**
      a. **City Engineer's Office – Main line: 609-347-5360**
      b. **Gene Kirby – 609-464-0732 – gkirby@cityofatlanticcity.org**
   b. **Barricade finish requirements will be confirmed in Addendum 2**

18) Is there any "Project" signage required?
   a. **Question will be addressed in Addendum 2**

19) What is the structural limits of the boardwalk?
   a. **See Appendix B. letter report dated December 2017, summarizing the inspection and subsequent load rating of the boardwalk members to provide calculations showing that a Teupen model: TL92SJ could be utilized on the Boardwalk for selective investigative probes. <u>This report is provided for background information only</u>.**
   b. **Contractor to confirm load capacity for proposed shoring and scaffolding as part of design of engineered system, per specification section 01 52 50.**

20) What area will be provided to the contractor for staging, storage, dumpsters, and equipment? Can you show the area designated for the contractors on a plan?

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a. **Contractor will be provided staging area in the West Hall as noted during the pre-bid meeting walk through. Storage on the Boardwalk area should be kept to a minimum.**

21) Will parking for the workers be provided?
   a. **Contractor parking will be provided in the Wet Hall as noted during the pre-bid meeting walk-through**

22) Where is the water source for the contractor to use?
   a. **Location of connection to Boardwalk Hall's water supply will be provided to successful bidder**

23) Three phase 220v/30amp power will be needed. Where is the electrical source? Can you show it on a plan?
   a. **Location of connection will be provided to successful bidder**

24) Please confirm the permitting agencies involved with this project.
   a. **New Jersey Division of Community Affairs**
   b. **City of Atlantic City Licensing and Inspections Department**
   c. **New Jersey Historic Preservation Office**

25) Per 013300 / 2.8 a Mortar Analysis Report is required within 21 days of the NTP. This is vey aggressive. 60 days is more reasonable.
   a. **Question will be addressed in Addendum 2**

26) Please provide a roofing specification.
   a. **Roofing repair at lantern to be coordinated with existing roofing manufacturer. Reference specification will be provided in Addendum 2.**

27) Please confirm that all hazardous material removal / abatement (ie.: Asbestos caulk and or glazing compound, etc.) is NIC and will be performed by the owner.
   a. **Hazardous materials testing and remediation to be conducted under separate contract.**
   b. **Successful bidder will coordinate with Owner and hazardous materials remediation subcontractors under separate contract as needed to ensure timely scheduling of work.**

28) Will an additional period for Q&A be allowed after the addenda are issued?
   a. **See attached revised Bid Advertisement Cover Page**

29) The pilot window appears to be clad in copper. If this is the case can an in situ repair be priced as an alternate? The concern is that if it is in fact copper clad, more damage to the window could occur trying to remove the window and transport it to the restoration shop.
   a. **Repairing window in situ may be provided as alternate.**
   b. **Alternate will be added to revised bid form to be issued in Addendum 2**

30) Will there be a roofing spec section issued for the roofing below the lantern and any required flashings?
   a. **Roofing repair at lantern to be coordinated with existing roofing manufacturer. Reference specification will be provided in Addendum 2**

31) Will there be a load capacity provided for the Boardwalk from the City of Atlantic City?
   a. **See Appendix B. letter report dated December 2017, summarizing the inspection and subsequent load rating of the boardwalk members to provide calculations showing that**

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a Teupen model: TL92SJ could be utilized on the Boardwalk for selective investigative probes. This report is provided for background information only.

b. **Contractor to confirm load capacity for proposed shoring and scaffolding as part of design of engineered system, per specification section 01 52 50.**

32) Are we disposing of the lantern after it is removed? If so please confirm that there are no hazardous or regulated materials such as heavy metals and/or lead on the lantern?

a. **Lantern is to be disassembled, removed, and disposed of.**

b. **Hazardous materials testing and remediation to be conducted under separate contract. Successful bidder will coordinate with Owner and hazardous materials remediation subcontractors under separate contract as needed to ensure timely scheduling of work.**

33) Some of the trades are requesting a bid extension of one week in order to have enough time to prepare their bids. Can an extension be provided?

a. **No – bid due date to remain November 14, 2019.**

34) On detail 1/A2.1 there are certain shaded areas (Main body of the pylon and the section on top of the base bid arch at the loggia) that appear as though they should be designated with the A1 construction key note. Please advise.

a. **Construction key notes A1 will be added to drawing to be reissued in Addendum 2**

35) On detail 2/A2.2 please clarify if we are only restoring the window or if we are perming all work top to bottom from the pylon over to the left first window jamb? If the later, please designate the repairs required in the shaded area above the window with the proper construction key notes as there are none associated with that area.

a. **Refer to attached Appendix A**

b. **Repairs required in shaded area above window: construction key notes A1, A5, A10 will be added to drawing to be reissued in Addendum 2**

36) Reinforcement member size

- Column 1-2 Elevation 48'-0" missing reinforcement member size.
- Column 1-2 Elevation 60'-10" missing reinforcement member size.
- Column 1-2 Elevation 67'-6" missing reinforcement member size and bearing type detail.
- Column 3-4 Elevation 36'-0" missing bearing type detail.
- Column 4-5 Elevation 47'-8" missing reinforcement member size.
- Column 14-15 Elevation 47'-8" missing reinforcement member size.
- Column 15-16 Elevation 35'-8" missing bearing type detail.
- Column 16-17 Elevation 35'-8" missing bearing type detail.
- Column 17-18 Elevation 35'-8" missing bearing type detail.
- Column 40-40A Elevation 90'-8" missing bearing type detail.
- Column 74-74A Elevation 80'-1½" missing bearing type detail.

a. **Question will be addressed in Addendum 2**

37) Who is responsible for lead testing and abatement for welding purposes? Does all lead need to be removed or only what is necessary to perform work?

a. **Hazardous materials testing and remediation to be conducted under separate contract. Successful bidder will coordinate with Owner and hazardous materials remediation subcontractors to confirm extant of lead removal.**

38) Will all Quantities be provided for Phase 1 Pilot ?

a. **Yes - Question will be addressed in Addendum 2**

39) Please Clarify how the ICCP is to be priced for Phase 1 Pilot (add Alternate) ?
   a. **Question will be addressed in Addendum 2**

40) Please clarify if Window repair is to be performed by - Contractor or Conservator
   a. **Window repair to be conducted by subcontractor meeting qualification skills criteria of work similar to proposed work in scope and materials.**

41) Please clarify If Window repair is performed by a Conservator will apprenticeship program requirement apply?
   a. **Question will be addressed in Addendum 2**

42) Pre-qual's & documents will " see Attached'' be acceptable language on provided documents ?
   a. **Yes, but all forms requiring signature must be executed as noted, and requested information included in attachments.**

43) Please Clarify the project references dollar amount 1+ million - 10 million ?
   a. **See attached Specification Section 00 11 53**

44) The warranty required by spec 08 10 20-4 (metal window and door restoration, but insulating window glass) is limited to a manufacturer's warranty? The standard is 1 year, however that section includes a 5 year warranty on "failure of every kind".
   a. **Question will be addressed in Addendum 2**

45) Project References is mentioned on multiple pages pg17-107-110-111-114-120, is the owner/ A/E looking to see different projects for each ? And will "see attached" case studies be acceptable ?
   a. ***See attached case studies* is acceptable if all relevant information requested, including reference contacts, is included.**
   b. **Refer to question 42 above.**

46) Please confirm owner will remove all hazardous material regarding the windows i.e. asbestos, lead paint
   a. **Hazardous materials testing and remediation to be conducted under separate contract. Successful bidder will coordinate with Owner and hazardous materials remediation subcontractors under separate contract as needed to ensure timely scheduling of work.**

47) What is the load capacity of the boardwalk?
   a. **See Appendix B. letter report dated December 2017, summarizing the inspection and subsequent load rating of the boardwalk members to provide calculations showing that a Teupen model: TL92SJ could be utilized on the Boardwalk for selective investigative probes. <u>This report is provided for background information only</u>.**
   b. **Contractor to confirm load capacity for proposed shoring and scaffolding as part of design of engineered system, per specification section 01 52 50.**

48) How much of the boardwalk can be occupied by the contractor?
   a. **Contractor to occupy as minimal area of Boardwalk as possible.**
   b. **Coordinate with City Engineer Office. Refer to Question 17 for contact information.**

49) Where is the boardwalk to be accessed by equipment?

a. **Coordinate with City Engineer Office. Refer to Question 17 for contact information.**

50) If the boardwalk needs to have sections removed in order to provide a platform for contractor work or the crane, what are the requirements associated with it?
   a. **Contractor to remedy any areas of Boardwalk disturbed to accommodate work. Coordinate with City Engineer Office. Refer to Question 17 for contact information.**

51) Are there any fees associated with use of the boardwalk?
   a. **Coordinate with City Engineer Office. Refer to Question 17 for contact information.**

52) Where will the salvaged materials be stored or delivered to?
   a. **West Hall – or area in building designated by Owner for salvaged materials to be stored on site but not reinstalled.**

53) Where is contractor staging for parking and materials to be?
   a. **West Hall per pre-bid walk through.**

54) Can we utilize the roof space at the West side of the tower?
   a. **Roof area may be use for access and minimal staging – no storage or concentrated loads will be allowed.**

55) What are the temporary protection requirements at the window when components are removed?
   a. **Question will be addressed in Addendum 2**

56) Will the Starbucks location below the window work area be closed during construction or will pedestrian access need to be maintained?
   a. **Access to Starbucks and ticketing office to be maintained for contract duration.**

57) Given that this work is exterior and that it can be impacted by both temperature and humidity conditions, is there a potential extension of the proposed 16 week schedule into the summer?
   a. **Revised Section 3.1 - Contract Schedule will be issued in Addendum 2, reflecting a change of Contract duration from sixteen to twenty (20) work weeks.**

58) Where are the connection points to the owner's electric and water for contractor use per section 015000?
   a. **Location of connection to Boardwalk Hall's water supply will be provided to successful bidder**

END OF ADDENDUM 1

JIM WHELAN BOARDWALK HALL - FAÇADE REMEDIATION

DATE: THURSDAY, 10/17/19

TIME: 10:00 AM (1000 Hours)

PRE-BID

Clark Hughes:

COMPANY NAME	CONTACT	PHONE	TIME	EMAIL	BID
PULLMAN SST	DAN ORGAN	484 3902227	9:30	DORGAN@PULLMAN-SERVICES.com	
PULLMAN SST	NINO AVERSA	609685-6350	9:30	aaversa@pullman-services.com	
KHSHS CONTRACTORS	JOE GURDGIEL JR	609-569-9970	9:30	Joeg@KHSS.COM	
AP CONSTRUCTION	BOB CONSALVO	856-227-2033	9:35	BCONSALVO@APCONSTRUCTION.COM	
DAN LEPORE & SONS	Tony LEPORE	610 996 5432	9:35	SONUSTRERO@GMAIL.COM	
WU & ASSOCIATES	JAMES SIA	856 857 1639	9:35	estimating@wuassociates.com	
Accent	David Weber	609-517-1185	9:47	dweber@accentmetal.net	
IRONWORKERS LOCAL 399 RAY PHILLIPS	RAY PHILLIPS	609517-7148	9:50	raymondphillips350@gmail.com	
Lynn Canfield	Bricklayers	609-234-0413	9:50	l.canfield@bacnj.com	
Walls Restoration Inc	Kevin M Walls	267-784-3638	9:50	KWalls@WallsRestoration.com	
JOSEPH DUGAN INC.	COLTON HIEMER BOB FISCHER	215-233-2150	9:50	info@josephduganinc.com	
Michael Thomas Jr Thomas Co	Michael Thomas Jr	609-383-1400	9:55	MThomasJr@ThomasCoInc.com	

JIM WHELAN BOARDWALK HALL - FAÇADE REMEDIATION

DATE: THURSDAY, 10/17/19

TIME: 10:00 AM
(1000 Hours)

PRE-BID

Clark Hughes:

COMPANY NAME	CONTACT	PHONE	TIME	EMAIL	BID
SPECTRA	Clayton Salmon		9:45	Clayton, Salmon @ Spectratp.com	
MASSETT BUILDING	CHRIS WALSH	609-517-5741	9:55	WALSHC@MASSETT BUILDING.COM	
" "	DALE JACKSON	609-226 9283	"	JACKSONDC MASSETT BUILDING.COM	
HALL CONST.	JAKE SULLIVAN	732-938-4255	9:55	jsullivan e hallgc.com	
CRDA	Liz Daley	609 344 8338		edaley e njcrda.com	
Duall Bldg. Restoration	BOB ATKINSON	856-273-8200	9:45	bob.duall@comcast.net	
Past Forward Architecture	Leila Hamroun	302.276.5828	9:43	lhamroun@pastforwardarchitecture.com	

JIM WHELAN BOARDWALK HALL - FAÇADE REMEDIATION PROJECT

DATE: THURSDAY 11/17/19 **TIME: 10:00 AM (1000 HOURS)** **Project #**

PREBID/WALKTHROUGH: Clark Hughes:

COMPANY NAME	CONTACT	PHONE	TIME	EMAIL	BID
MPG	Jason Berghaier	609 238-1246	10:00 am	jberghaier@mpgnj.com	
MPG	Chuck Rector	856 287-0464	10.	crector@mpgnj.com	
Culbertson	Bill Chessick	610 716559		bchessick@ccrlpa.com	
Quinn Construction	Jack Duke	610-908-2492	10:00am	jduke@quinnconstruction.com	
Dandrea Const.	Chris Nugent	856 767 7750		chrisn@dandreaconst.com	
Masonry Preservation Group Inc MPG	Jay Happold	856 287-0469	10:00Am	jhappold@mpgnj.com	

CLARK HUGHES
Capital Project Procurement Manager
Atlantic City Convention Center
Historic Boardwalk Hall
2301 Boardwalk, Atlantic City, NJ 08401
O: 609.348-7026 c: 609 226-3069
clark_hughes@comcastspectacor.com

TO: Bid Responders

FROM: Clark Hughes

DATE: October 11, 2019

SUBJECT: **JIM WHELAN BOARDWALK HALL – BOARDWALK FAÇADE RENOVATION - GUIDELINES**

Bidders should be aware that all submitted **sealed** bids are carefully reviewed for compliance, and non-compliant bids are rejected. Please carefully review your bid submissions for compliance. The following information is required but not limited to.

Documents that must be submitted at the time of the bid.

1. Bid Bond (sect 1.15), Payment and Performance Bond (sect 1.16), Consent of Surety (sect 1.17)
2. Bidder to provide documentation evidencing that the firm meets the minimum requirements, (sect 1.18). **Bidders must complete and submit with their bids, the Request for Qualifications Section 00 11 53-4, the statement must be filled out completely, do not substitute this form.**
3. **Documentation of the bidders DOL Apprenticeship program and graduation information must be provided with the bid submission.**
4. Bidder and subcontractors must provide copies of the Business Registration Certificate, New Jersey Department of Labor & Workforce Development Certificate, and Public Works Contractor Registration Certificate.
5. Bidder's Insurance certificate showing evidence of coverage limits, and declaration pages for current policies.

The following Exhibits provided in the bid package must be completed and executed and provided with the bid.

Exhibit A	Signatory Page
Exhibit B	Disclosure of Investigations
Exhibit C	Notice of Intent to Subcontract
Exhibit D	Subcontractor Utilization Form
Exhibit E	*Affirmative Action, required after notification of award*
Exhibit F	Political Contribution Disclosure Part 3: Certification – One of the four options must be marked (i, ii, (C) (D)) off.
Exhibit G	All information on FEE Schedule is required for compliance.
Exhibit H	Affidavit of Non-Collusion
Exhibit I	Contract and Specification (the executed documents must be included with the bid) Contract must be signed with the submitted bid.

JAMES WHELAN BOARDWALK HALL - FAÇADE REMEDIATION

DATE: MONDAY 10/21/19 TIME: 10:00 AM (1000 HOURS) **Project #**

PREBID/2ND WALKTHROUGH: Clark Hughes: Clark H

COMPANY NAME	CONTACT	PHONE	TIME	EMAIL	BID
KHS+S CONTRACTORS	Joe Gurvaciel	609-569-9970	10:00	Joeg@khss.com	
ACCENT	DAVID WEBER	609-517-1185	10:00	dweber@accentmetal.net	
MASSETT	DAVID JACKSON	609-226-9283	10:00	Jacksond@massettbuilding.com	
Wu & Associates	James Sia	8568571639	10:00	estimating@wuassociates.com	
WallsRestoration INC	Kevin M Walls	267-784-3638	10:00	KWalls@WallsRestoration.com	
PULLMAN SST	DAN ORGAN	484-390-2227	10:00	DORGAN@PULLMAN-SERVICES.COM	

SPECTRA VENUE MANAGEMENT.

BID FOR GENERAL CONSTRUCTION – JIM WHELAN BOARDWALK HALL AND ATLANTIC CITY CONVENTION CENTER

For:	GENERAL CONSTRUCTION
	JIM WHELAN BOARDWALK HALL BOARDWALK FAÇADE REMEDIATION PILOT PROJECT

Event	Date	Time
Bidder's Question Due Date (Refer to BID Section 1.5 for more information.)	TUESDAY **OCTOBER 29, 2019**	12:00 pm 1200 Hours
Bidder's Questions Responses	TUESDAY **NOVEMBER 05, 2019**	**05:00 pm 1700 Hours**
Pre-bid Conference (Refer to BID Section 1.8 for more information.)	THURSDAY **OCTOBER 17, 2019**	10:00 am 1000 Hours
Site Visit (Refer to BID Section 1.9 for more information.)	THURSDAY **OCTOBER 17, 2019**	After Pre-bid Conference
Bid Submission Due Date (Refer to BID Section 1.3 for more information.)	THURSDAY **NOVEMBER 14, 2019**	**02:00 pm 1400 Hours**

Dates are subject to change. All changes will be reflected in Addenda to the bid posted on the Boardwalk Hall/Convention Center website at http://www.boardwalkhall.com/business-opportunities/rfps

Issued By
Spectra Venue Management ., as operator of Historic Boardwalk Hall and the Atlantic City Convention Center, as managing agent for Casino Reinvestment Development Authority
2301 Boardwalk
Atlantic city, New Jersey 08401
Phone: 609-348-7026

Date Issued: October 22, 2019 – ISSUED FOR ADDENDUM 1

SECTION 00 11 53
REQUEST FOR QUALIFICATIONS

STATEMENT OF GENERAL NOTICE

A. The Jim Whelan Boardwalk Hall in Atlantic City, Atlantic County, New Jersey, is listed as a National Historic Landmark on the New Jersey and National Registers of Historic Places.

B. All work done on this project must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties (1995), be performed by contractors and craftsmen with demonstrated successful experience in working with older buildings and construction materials, and is subject to review by the New Jersey Historic Preservation Office. The scope of work consists of ~~multiple contracts~~ **of a single contract** for all of the work for Boardwalk Hall Façade Remediation Pilot Project according to the Project Manual, plans and specifications.

C. The project consists of stone masonry repairs, concealed structural steel repairs, and a sample restoration of a metal-clad historic window. The building retains a high degree of integrity and the project will emphasize the historic aspects of the work, and will require careful engineered access, rigging and temporary shoring to maintain the structural integrity of the façade for project duration.

D. The principal activities requiring Bidder and bidder Subcontractor qualification in this project include:

1. **Supervision and Administration of Projects of Similar Scale and Complexity**
2. **Site** Supervision and Administration of Historic Preservation Projects;
3. Masonry Restoration;
4. Metal-Clad Window Restoration.

BIDDER QUALIFICATION

A. Bidders for the General Contract must submit a completed Bidder’s Qualifications Statement and bidder Subcontractor Restoration Skills Qualification Statements as set forth herein as a part of the Bid Submission Documents. Failure to complete and submit the Bidder’s Qualification Statement as a part of the Bid Submission Documents shall result in disqualification of the Bidder.

B. The Bidders’ Qualification Statements received from Bidders will be reviewed according to the Evaluation Criteria set forth herein.

C. The Bidders must submit with the bid the name or names of all subcontractors to whom the bidder will subcontract. The Bidder must also submit Qualification Statements as set forth herein for Subcontractors performing the work identified for qualification above.

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1. Bidder must submit separate Restoration Skills Qualifications Forms for each trade as specified herein.

2. Subcontractors whose Qualification Statements are determined to be acceptable will be identified as Qualified Subcontractors. Only Qualified Subcontractors will be allowed to perform the Work.

CRITERIA FOR EVALUATING BIDDER QUALIFICATION ON HISTORIC PRESERVATION PROJECTS

The following four (4) criteria will be used for evaluating the qualifications and experience of Bidders on Historic Preservation Projects. The evaluation will be based on information in the Qualifications Statement provided by Bidders as well as information supplied by the Bidders' references.

A. The Bidder will be required to demonstrate verifiable, successful experience in Project Supervision and Administration of ~~Historic Preservation~~ **Large, Complex** Projects. This experience shall meet the following requirements:

1. At least two (2) projects involving separate significant historic buildings or sites, or buildings comparable to the Jim Whelan Boardwalk Hall Boardwalk Facade in size and complexity. The two projects must have involved similar activities~~,~~ ~~scope of work~~ and coordination as the subject project.

2. All projects shall be completed ~~in compliance with the Secretary of the Interior's Standards for the Treatment of Historic Properties~~ within the past ten (10) years preceding the date of the execution of this pre-qualification form. ~~The listed projects must have been reviewed by one of the following: National Park Service, a State Historic Preservation Office or the historic review body of a county or local municipal authority.~~ The aggregate construction cost of each project must be at least $1,000,000.

B. The Bidder's proposed project supervisor will be required to demonstrate verifiable, successful experience in Project Supervision and Administration ~~of Historic Preservation Projects.~~ This experience shall meet the following requirements:

1. At least two (2) projects involving separate significant historic buildings or sites, or buildings comparable to the Jim Whelan Boardwalk Hall Boardwalk Facade in size and complexity. The two projects must have involved similar activities, scope of work and coordination as the subject project.

~~2. All projects shall be completed in compliance with the Secretary of the Interior's Standards for the Treatment of Historic Properties within the past ten (10) years preceding the date of the execution of this pre-qualification form. The listed projects must have been reviewed by one of the following: National Park Service, a State Historic Preservation Office or the historic review body of a county or local municipal authority. The aggregate construction cost of each project must be at least $1,000,000.~~

C. The Bidder's Subcontractors Restoration Skills Qualification Statements as set forth herein must be determined to be acceptable and Subcontractors identified as Qualified Subcontractors. Only Qualified Subcontractors will be allowed to perform the Work.

D. The Bidder must demonstrate satisfactory performance on all current projects in progress.

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BIDDER QUALIFICATION STATEMENT

This statement must be completed and submitted by Prospective Bidders who wish to be considered for this work. **THIS STATEMENT MUST BE FILLED OUT COMPLETELY. Do not substitute another format for this STATEMENT.**

1. GENERAL CONTRACTOR:

Provide information regarding firm.

Name and address of firm: ____

____

Under what other name(s) has your business operated?

____

____

Business form (corporation, partnership, etc.): ____

Date of formation: ____

Principal location: ____

Names of Officers of Corporation, or Partners: ______________________________________

____

____

Has your firm or any predecessor firm defaulted on a contract or had work terminated for non-performance within the past five (5) years? If so, on a separate sheet describe the project, owner, date and circumstances/reasons.

NO ☐ YES ☐

Has your firm or any predecessor firm been denied a consent of surety, a bid bond, or a performance bond within the past twelve (12) months? If so, on a separate sheet describe the circumstances/reasons.

NO ☐ YES ☐

2. GENERAL CONTRACTOR

Provide evidence of successful experience on the following:

a. at least two (2) projects involving separate ~~historic~~ buildings or sites, and similar activities and scope of work as the subject project.

b. All projects shall be completed ~~in compliance with the Secretary of the Interior's Standards for the Treatment of Historic Properties~~ within the past ten (10) years preceding the date of the execution of this pre-qualification form. ~~The listed projects must have been reviewed by one of the following:- the National Park Service, a State Historic Preservation Office or the historic review body of a county or local municipal authority.~~ The aggregate construction cost of each project must be at least $1,000,000.

PROJECT #1:

Project Name: ____

Location: ____

Approximate Construction Date of the ~~Historic~~ Building or Site: ____________________

Construction Cost: ____________ Completion Date: ____________________

On-Site Project Supervisor: ____

Scope of Work and Nature of Project: ________________________________

____

____

Owner: ____

Owner's Contact Person: ____________ Phone: __________ Fax: ____________

Architect: ____

Architect's Contact Person: ____________ Phone: __________ Fax:

~~Reviewed by (name of Historic Review Body): ____________________~~

PROJECT #2:

Project Name: ____

Location: ____

Approximate Construction Date of the ~~Historic~~ Building or Site: ______________________________

Construction Cost: ____________________ Completion Date: ______________________________

On-Site Project Supervisor: ____

Scope of Work and Nature of Project: ____

____

____

Owner: ____

Owner's Contact Person: __________________ Phone: ______________Fax: _________________

Architect: ____

Architect's Contact Person: __________________ Phone: ______________Fax:

~~Reviewed by (name of Historic Review Body): ____~~

3. PROPOSED ON-SITE PROJECT SUPERVISOR:

Provide evidence of successful **on-site supervision** experience on the following:

c. at least two (2) projects involving separate historic buildings or sites, **or buildings comparable to the Jim Whelan Boardwalk Hall** and similar activities ~~and scope of work~~ as the subject project.

~~All projects shall be completed in compliance with the Secretary of the Interior's Standards for the Treatment of Historic Properties within the past ten (10) years preceding the date of the execution of this pre-qualification form. The listed projects must have been reviewed by one of the following: the National Park Service, a State Historic Preservation Office or the historic review body of a county or local municipal authority.~~ The aggregate construction cost of each project must be at least $1,000,000.

Name of Proposed On-Site Project Supervisor: ____

Address of Proposed On-Site Project Supervisor: ____

____

PROJECT #1:

Project Name: ____

Location: ____

Approximate Construction Date of the Historic Building or Site: ________________________________

Construction Cost: _____________________ Completion Date: __________________________________

On-Site Project Supervisor: ____

Scope of Work and Nature of Project: ____

____

____

Owner: ____

Owner's Contact Person: ___________________ Phone: _______________Fax: __________________

Architect: ____

Architect's Contact Person: ___________________ Phone: _______________Fax:

~~Reviewed by (name of Historic Review Body): ____~~

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PROJECT #2:

Project Name: ____

Location: ____

Approximate Construction Date of the Historic Building or Site: ______________________________

Construction Cost: ____________________ Completion Date: ______________________________

On-Site Project Supervisor: ____

Scope of Work and Nature of Project: ____

____

____

Owner: ____

Owner's Contact Person: __________________ Phone: ______________Fax: _________________

Architect: ____

Architect's Contact Person: __________________ Phone: ______________Fax:

~~Reviewed by (name of Historic Review Body): ____~~

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4. RESTORATION SKILLS QUALIFICATIONS FORM

This form must be completed by proposers for the following trades, and submitted along with Bid Form, as evidence of subcontractor/installer qualifications to complete restoration work included in this Project. To be considered for qualification, all questions contained in this form must be completed. If a proposer is submitting bids including work in more than one of the following trades a separate Qualifications Form must be completed for each trade.

~~SELECTIVE DEMOLITION (Section 02 41 19).~~

STONE MASONRY RESTORATION (Division 04)

METAL WINDOW RESTORATION (Sections 05 54 00 and 08 10 20)

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RESTORATIONS SKILLS QUALIFICATION FORM

Trade:

Specification Section: ____________________

QUALIFICATIONS FOR:

____

(Name of Company)

____

(Address)

____________________, ____________________ ____________________

(City) (State) (Zip Code)

____

(Telephone Number)

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RESTORATIONS SKILLS QUALIFICATION FORM

List five (5) Projects involving the installation of system similar to this project completed within the previous eight years. Select projects that best demonstrate completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.

a. at least two (2) projects involving separate historic buildings or sites, and similar activities and scope of work as the subject project.

b. All projects shall be completed in compliance with the Secretary of the Interior's Standards for the Treatment of Historic Properties within the past ten (10) years preceding the date of the execution of this pre-qualification form. The listed projects must have been reviewed by one of the following: the National Park Service, a State Historic Preservation Office or the historic review body of a county or local municipal authority. The aggregate construction cost of each project must be at least $1,000,000.

PROJECT ONE

____
(Name of Project)

______________________, ____________ ____________
(City) (State) (Date of Completion)

____
(Contact Person) (Title)

____
(Address)

______________________, ____________ ____________
(City) (State) (Zip Code)

____
(Telephone Number)

Description of Work Completed by Your Firm:

____

____

____

____

____

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____

____

(Value of Contract or subcontract)

____

(Labor Force Employed at Project, Skilled / Unskilled)

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RESTORATIONS SKILLS QUALIFICATION FORM

List five (5) Projects involving the installation of system similar to this project completed within the previous eight years. Select projects that best demonstrate completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.

PROJECT TWO

____

(Name of Project)

____________________, ____________ ____________

(City) (State) (Date of Completion)

____

(Contact Person) (Title)

____

(Address)

____________________, ____________ ____________

(City) (State) (Zip Code)

____

(Telephone Number)

Description of Work Completed by Your Firm:

____

____

____

____

____

____

____

(Value of Contract or subcontract)

____

(Labor Force Employed at Project, Skilled / Unskilled)

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RESTORATIONS SKILLS QUALIFICATION FORM

List five (5) Projects involving the installation of system similar to this project completed within the previous eight years. Select projects that best demonstrate completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.

PROJECT THREE

____
(Name of Project)

______________________, ____________ ______________
(City) (State) (Date of Completion)

____
(Contact Person) (Title)

____
(Address)

______________________, ____________ ______________
(City) (State) (Zip Code)

____
(Telephone Number)

Description of Work Completed by Your Firm:

____
____
____
____
____
____

____
(Value of Contract or subcontract)

____
(Labor Force Employed at Project, Skilled / Unskilled)

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RESTORATIONS SKILLS QUALIFICATION FORM

List five (5) Projects involving the installation of system similar to this project completed within the previous eight years. Select projects that best demonstrate completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.

PROJECT FOUR

____
(Name of Project)

______________________, __________ ______________
(City) (State) (Date of Completion)

____
(Contact Person) (Title)

____
(Address)

______________________, __________ ______________
(City) (State) (Zip Code)

____
(Telephone Number)

Description of Work Completed by Your Firm:

____

____

____

____

____

____

____
(Value of Contract or subcontract)

____
(Labor Force Employed at Project, Skilled / Unskilled)

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RESTORATIONS SKILLS QUALIFICATION FORM

List five (5) Projects involving the installation of system similar to this project completed within the previous eight years. Select projects that best demonstrate completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.

PROJECT FIVE

____

(Name of Project)

____________________, __________ ______________

(City) (State) (Date of Completion)

____

(Contact Person) (Title)

____

(Address)

____________________, __________ ______________

(City) (State) (Zip Code)

____

(Telephone Number)

Description of Work Completed by Your Firm:

____

____

____

____

____

____

____

(Value of Contract or subcontract)

____

(Labor Force Employed at Project, Skilled / Unskilled)

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RESTORATIONS SKILLS QUALIFICATION FORM

Qualifications and experience of fulltime personnel who will be assigned to this project:

Job Site Foreman:

____

(Name)

______________________ ______________________

(Title) (Years with your company)

Experience

____

____

____

____

____

Senior Craftsperson:

____

(Name)

______________________ ______________________

(Title) (Years with your company)

Experience

____

____

____

____

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Senior Craftsperson:

(Name)

(Title) (Years with your company)

Experience

Senior Craftsperson:

(Name)

(Title) (Years with your company)

Experience

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RESTORATIONS SKILLS QUALIFICATION FORM

List any additional pertinent comments regarding your restoration skills qualifications:

(Signature) (Date)

Note: Attach additional sheets, if required, to describe qualifications. Do not include a company brochure or list of projects.

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CERTIFICATION

I (we) the undersigned certify the truth and correctness of all statements and answers contained herein.

DATE: ____

NAME OF BIDDER: ____

ADDRESS OF BIDDER ____

____

____

TELEPHONE AND FAX ____

BY (signature, no stamp) ____________________________________

(Print/type name and title) ____________________________________

WITNESSED: (If a Corporation, by the Secretary of the Corporation)

BY (signature, no stamp) ____________________________________

(Print/type name and title) ____________________________________

Subscribed and sworn to before meNotary Public of the State of _________________________

My commission expires

This __________day of ___________, 20___.

(Signature and Seal)

END OF SECTION 00 11 53

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APPENDIX A

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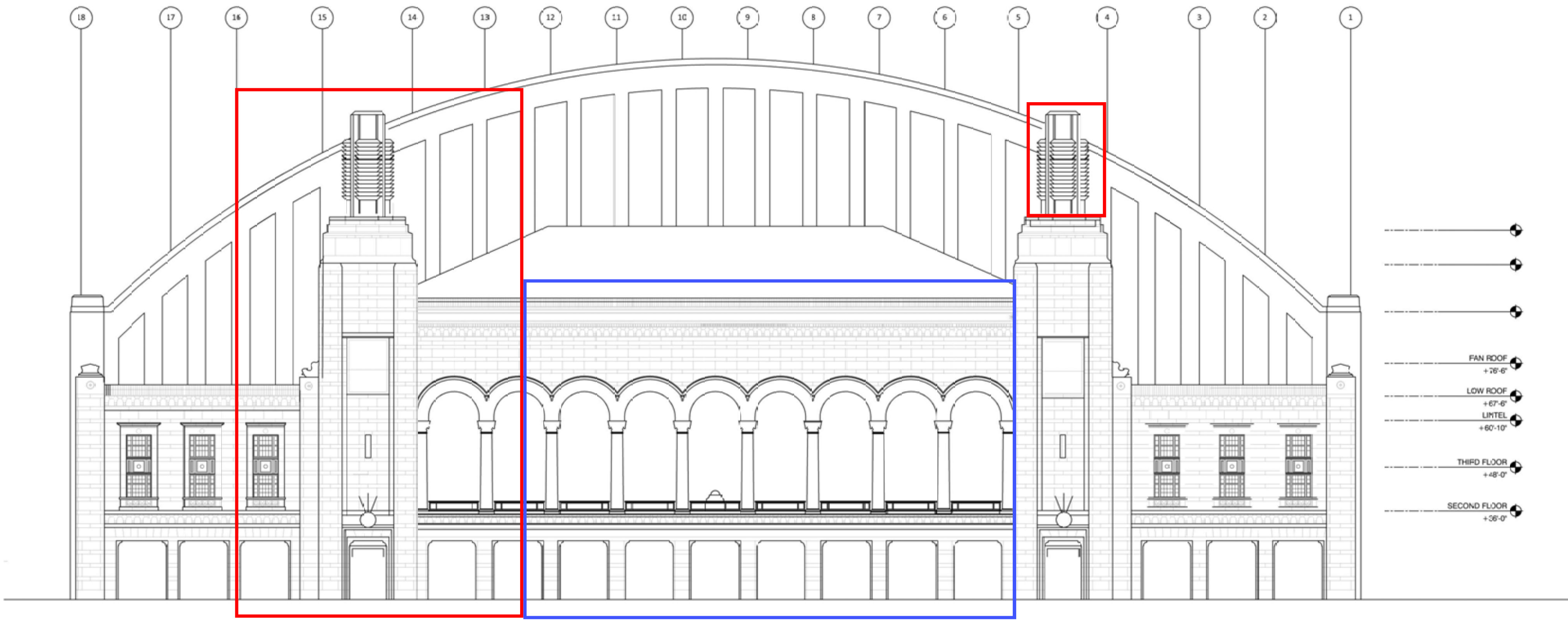
PHASE 1 - PILOT PROJECT
BASE BID

PHASE 1 - PILOT PROJECT
ADD-ALTERNATE 1



OVERALL BUILDING ELEVATION - SOUTH (1 / A0.6)
SCALE: 1/16"=1'-0"

APPENDIX B

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Newark, DE 19713
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www.pastforwardarchitecture.com

Work Order #2:

Professional Design Services

Boardwalk Hall – Façade Remediation
Atlantic City, NJ

5 December 2017

Clark Hughes, Capital Projects Manager
SPECTRA
2301 Boardwalk Hall
Atlantic City, NJ 08401

Dear Mr. Hughes,

This letter summarizes the inspection and subsequent load rating of the boardwalk members that were covered by our Agreement to provide calculations showing that the anticipated lift equipment (a Teupen model: TL92SJ) can be utilized to access Boardwalk Hall's outside faces during this Façade Remediation project. We determined that this equipment's total weight (9480 pounds) results in a contact pressure below the allowable contact pressure acting on the boardwalk while using timbers under the vehicle's tracks (during moving operation) and is, therefore, acceptable. Our analysis also determined that the 14"x 4" timber joists are capable of carrying the maximum weight (5845 pounds) under an outrigger for both the shear and bending moment anticipated to be on the timber joists. The minor damage noted during the inspection and selected for the rating has little to no effect on boardwalk's ability to carry the live load of the proposed inspection vehicle (see page 11 of 22 in Attachment 1).

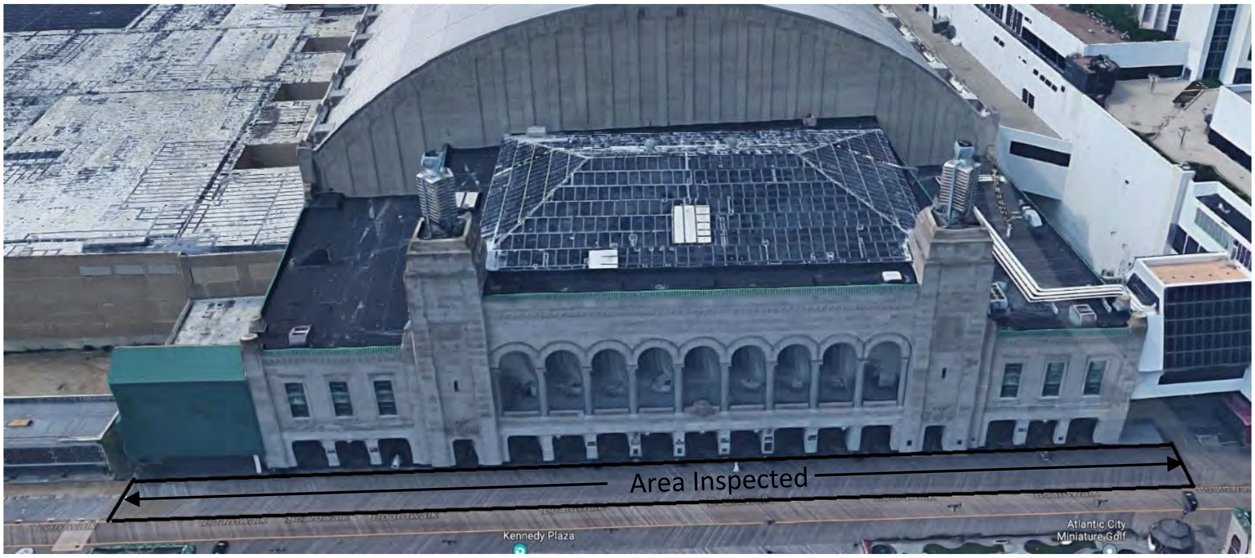
During our inspection, one area of concern was located (as shown in Attachment 2). The damaged area needed to be repaired prior to setting the lift equipment within this span. These repairs appear to be satisfactorily completed and, therefore, no inspection observations limit the use of a Teupen model TL92SJ from moving within the area identified in the introduction of Attachment 1 (page 1 of 22). Good judgment must be utilized while operating lift equipment on the boardwalk. Note: Not all timbers were visible from the underside of the boardwalk and, as such, we strongly recommend using caution while the equipment is in operation to avoid any localized damage that may result. Timber mat placement is a good practice for distribution of load under the outriggers while operating the inspection equipment. We recommend testing the seating of all outrigger/timber matting used during operations prior to placing additional loads on the lift equipment. Feel free to call me if you have questions regarding this report at 717-460-8911.

Kind regards,

Kenneth S. Jones, P.E. - Project Engineer at N & W

Introduction

This report is based on a visual inspection of the Boardwalk members immediately in front of Boardwalk Hall as indicated in the following image.



Preliminary Findings

The timber joists supporting the boardwalk deck boards are damaged to the extent that a repair is needed before using any portion of the damaged span during the inspection operation. This damage is visible in the following 2 photographs:

The only other area of concern from the underside inspection is shown in the following photograph:

This damage has only a minor effect on the structural capacity of the joists and is not as critical as the maximum moment capacity at midspan. It is an isolated joist and the damage occurs approximately 4 feet away from the support in a 13’-2” span. The reason this is not important is that the live load bending moment at this location is only about 85% of the midspan moment and, therefore, the overall stresses are less than those at midspan.

The most significant damage to the top surface of the timber decking is near the edge of the boardwalk as it transitions onto the concrete pavement at the access point to S. Mississippi Avenue, as shown in the following photograph:

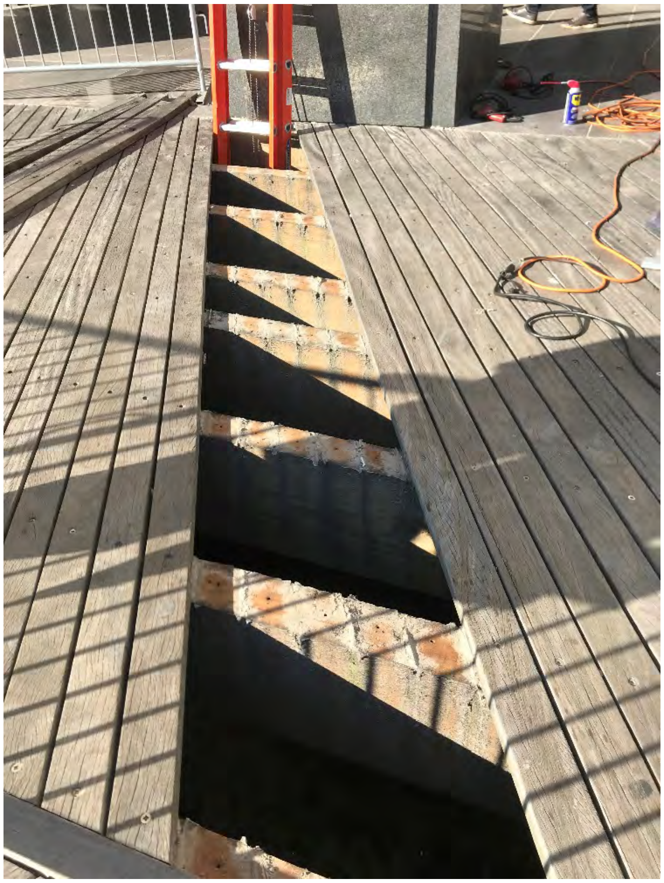
The inspection of the top side of the Boardwalk indicates that the timbers are in fair to good condition. As long as the contractor protects the boards from damage using planks and timber mats between the manlift surfaces and the top surface of the boardwalk, we do not anticipate any problems during the façade inspection operations. One cautionary note is that not all of the timbers were visible from below (for instance those above the concrete tunnels were not exposed). These may have some deterioration, but the equipment should not have any issues associated with a subsequent deflection for these timber boards.

As discussed in our scope of work, N & W did not evaluate any of the members below the floor joists, and hidden deterioration, like rot in the Timber Piles, would not have been uncovered during this investigation.

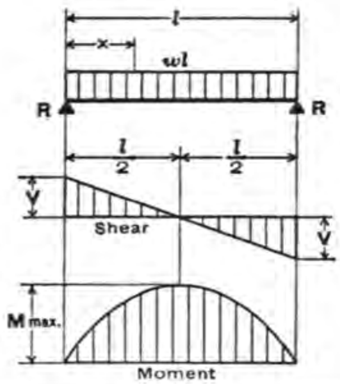
Based on information provided to us regarding the repairs for the area of deterioration, we believe that the repairs are sufficient to hold the original design loads. The steps presented below are illustrated in the following photographs as well:

1. Drilled holes from top to bottom of every split beam.
2. Installed galvanized bolts and nuts through entire beam.
3. Installed anchor bolts through header beam into concrete wall.
4. Shored up the bottom beam.
5. Shimmed all beams/joists as needed.

The following pages show our backup calculations demonstrating that the Boardwalk's floor joists appear to have adequate capacity for the 5845-pound outrigger load for the proposed manlift. Although this does not account for all areas of the boardwalk, it is believed to cover those areas visible from the underside during our inspection where we accessed those areas by removing the decking timbers as shown in the following photographs:



1. SIMPLE BEAM—UNIFORMLY DISTRIBUTED LOAD



Total Equiv. Uniform Load . . . . $= wl$

R = V . . . . $= \frac{wl}{2}$

V_x . . . . $= w\left(\frac{l}{2} - x\right)$

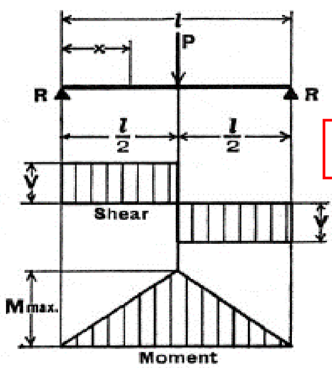
M max. (at center) . . . . . $= \frac{wl^2}{8}$

M_x . . . . $= \frac{wx}{2}(l - x)$

Δmax. (at center) . . . . . $= \frac{5wl^4}{384EI}$

Δx . . . . $= \frac{wx}{24EI}(l^3 - 2lx^2 + x^3)$

7. SIMPLE BEAM—CONCENTRATED LOAD AT CENTER



Total Equiv. Uniform Load . . . . . . $= 2P$

R = V . . . . $= \frac{P}{2}$

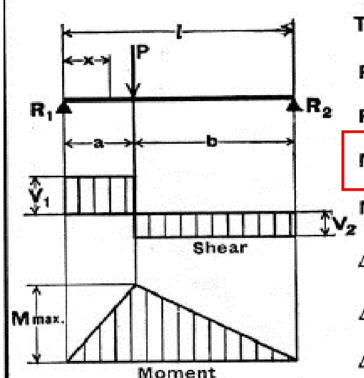
M max. (at point of load) . . . . . . $= \frac{Pl}{4}$

M_x (when $x < \frac{l}{2}$) . . . . . . $= \frac{Px}{2}$

Δmax. (at point of load) . . . . . . $= \frac{Pl^3}{48EI}$

Δx (when $x < \frac{l}{2}$) . . . . . . $= \frac{Px}{48EI}(3l^2 - 4x^2)$

8. SIMPLE BEAM—CONCENTRATED LOAD AT ANY POINT



Total Equiv. Uniform Load . . . . . . $= \frac{8Pab}{l^2}$

$R_1 = V_1$ (max. when $a < b$) . . . . . $= \frac{Pb}{l}$

$R_2 = V_2$ (max. when $a > b$) . . . . . $= \frac{Pa}{l}$

M max. (at point of load) . . . . . $= \frac{Pab}{l}$

M_x (when $x < a$) . . . . . $= \frac{Pbx}{l}$

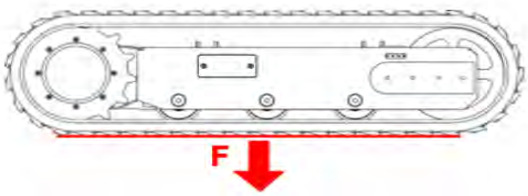
Δmax. $\left(\text{at } x = \sqrt{\frac{a(a+2b)}{3}} \text{ when } a > b\right)$ $= \frac{Pab(a+2b)\sqrt{3a(a+2b)}}{27EIl}$

Δa (at point of load) . . . . . $= \frac{Pa^2b^2}{3EIl}$

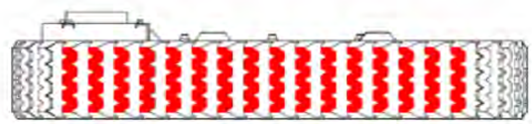
Δx (when $x < a$) . . . . . $= \frac{Pbx}{6EIl}(l^2 - b^2 - x^2)$

Given information: Load is from Manufacturer

2. Machine Effect on Floor Surface Material – Tracks		
Max. load under one track (machine weight / 2) (4300kg / 2)	21.1 kN	4743 lb force
Crawler area in contact with surface	735 cm2*	114 sq in
Max. ground pressure	28.7 N/cm2*	41.6 psi



41.6 psi



Assume the track width application of load is 10" wide as shown below:

TEUPEN®
...access redefined

Specifications

MEASUREMENTS	US	Metric
Platform height, max.	91 ft 10 in	28,00 m
Horizontal outreach with 176 lbs	51 ft 6 in	15,70 m
Horizontal outreach with 441 lbs	45 ft 11 in	14,00 m
Platform height **(A)**	3 ft 7 in	1,10 m
Platform length **(B)**	2 ft 8 in	0,80 m
Platform width **(C)**	3 ft 11 in	1,20 m
Length, overall **(D)**	23 ft 8 in	7,20 m
Height, travelling position **(E)**	6 ft 6 in	1,98 m
Width, min. **(F)**	5 ft 3 in	1,58 m

Ref: AASHTO Standard Spec. (Attached)

Assumptions:

1) Timber Decking is 2" thick (See original Plans)

2) Timber = HEM-FIR No. 2 (AASHTO Table 13.5.1A → $F_b = 675$ PSI)

3) Dist. Factor = S/4.0 (See AASHTO Table 3.23.1)
where S = joist spacing in feet = 20"/12 = 1.67'

∴ DF = 1.67/4 = 0.417 wheels (or Outrigger)

④ Maximum Load = 5.845 kips (See Teupon Document)

⑤ Maximum Moment (In a sign Joist)

Assume simple span

$$M_{LL} = \frac{PL}{4}$$

where P = concentrated Load
L = span length = 13'-2"

P = 5.84 kips

$$M_{LL} = \frac{5.84(13.17')}{4} = 19.2 \text{ ft·kips}$$

↑ For one outrigger

⑥ Bending Stress (BS)

$$BS = DF \frac{\text{Bending Moment}}{\text{Section Modulus}} = 0.417 \frac{19.2'^k \times 12''/ft}{130.7 \text{ in}^3} = 0.735 \text{ ksi}$$

Live load stress

$$\frac{bh^2}{6} = \frac{4''(14)^2}{6} = 130.7 \text{ in}^3$$

Section Modulus

Dead Load Calculation (Timber = 50 PCF AASHTO Section 3.3.6)

Dead Load moment = $\frac{wl^2}{8}$ = 0.033 (13.17)^2/8 =0.723 ft-kips

Dead Load Moment

Where $w = (14 \times 4" + 20 \times 2")/144 \frac{(50\ PCF)}{1000}$ = 0.033 KLf

1000 ← 1000#/Kip

∴ The maximum pressure/load caused by the outrigger causes an overload of the timbers if it is placed at midspan. The load should be limited to about 19.2/3.61 or 5.32 times the area of the existing contact area between the outrigger and the underlying material.

∴ Minimum contact area = 105.7 × 5.32 = 562

say 600 SI or 15" × 40" for a pad under the out riggers.

Project Name:	Boardwalk Façade Remediation & Rating	Computed by:	KSJ
Date:	12/1/2017	Checked by:	HLW
Project No.:	1604TD037	Sht.	5 of 7

NAVARRO & WRIGHT CONSULTING ENGINEERS, INC.

Allowable Stress $F'_b = F_b C_m C_D C_L C_r$

$F'_b = 675\text{ PSI}(1.0)1.25(1.0)1.15 = 970\text{ PSI}$

(1.25: 7 days or less)

< 1,150 ∴ $C_m = 1.0$

AASHTO page 324

Dead Load and Live Load Stress

Dead Load moment = 0.723 ft.-kips see sheet 4

Section Modulus, Sx = 130.7

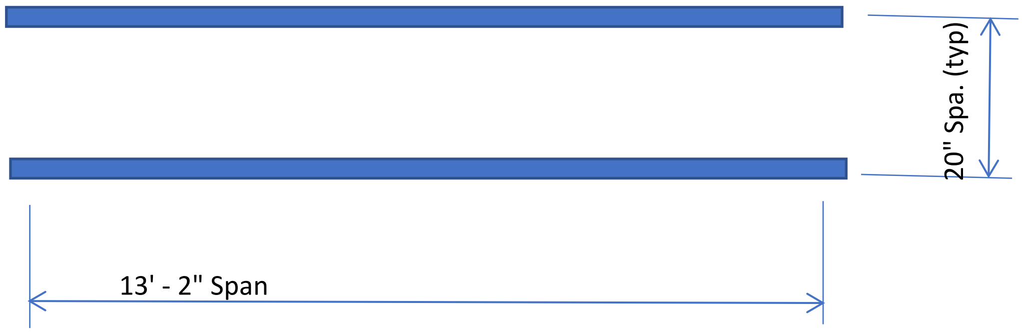
(in inches to the 3rd - See Sheet 3)

Dead Load Stress 0.006 in ksi

Live Load Stress 0.735 in ksi

Total Stress = 0.743 in ksi

Changed duration factor



Plan View of Joists (NTS)

Assume Point load is placed 4' from support to maximize the moment

Moment = Pab/L, where a, b, and L are measured in feet

a = 4
b = 9.17
L = 13.17
P = 5.845 kips

LL Moment = 16.28 Ft-kips

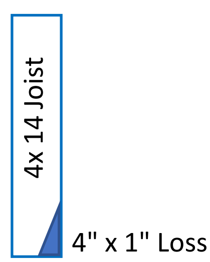
DL Moment = 0.092

Triangle Section Equation Used

Description	Equation
Area Moment of Inertia Section Properties I_x (in^4, mm^4) =	$bh^3 / 36$
Area Moment of Inertia Section Properties $I_{x'}$ (in^4, mm^4) =	$bh^3 / 12$
Area Moment of Inertia Section Properties I_y (in^4, mm^4) =	$hb^3 / 36$
Area Moment of Inertia Section Properties= $I_{y'}$ (in^4, mm^4) =	$hb^3 / 12$

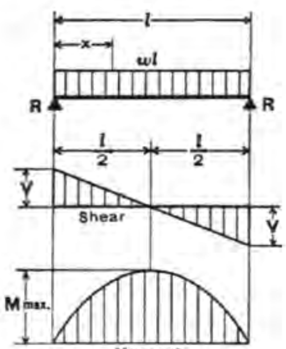
Section Modulus at Deterioration

Original I, BH^3/12
I (in inches^4)= 915
I lost (in inches^4)= 1.78
I lost (in inches^4)= 64.2
New I = 848.67
New S = 121.24
LL Stress 0.672 ksi
DL Stress 0.001



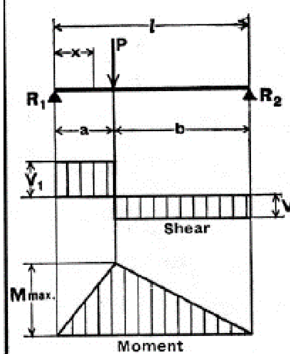
Stress Total 0.673 KSI < 0.970 KSI Capacity (therefore OK)

1. SIMPLE BEAM—UNIFORMLY DISTRIBUTED LOAD



Total Equiv. Uniform Load	$= wl$
R = V	$= \frac{wl}{2}$
V_x	$= w\left(\frac{l}{2} - x\right)$
M max. (at center)	$= \frac{wl^2}{8}$
M_x	$= \frac{wx}{2}(l - x)$
Δmax. (at center)	$= \frac{5wl^4}{384EI}$
Δx	$= \frac{wx}{24EI}(l^3 - 2lx^2 + x^3)$

8. SIMPLE BEAM—CONCENTRATED LOAD AT ANY POINT



Total Equiv. Uniform Load	$= \frac{8Pab}{l^2}$
$R_1 = V_1$ (max. when a < b)	$= \frac{Pb}{l}$
$R_2 = V_2$ (max. when a > b)	$= \frac{Pa}{l}$
M max. (at point of load)	$= \frac{Pab}{l}$
M_x (when x < a)	$= \frac{Pbx}{l}$
Δmax. $\left(\text{at } x = \sqrt{\frac{a(a+2b)}{3}} \text{ when } a > b\right)$	$= \frac{Pab(a+2b)\sqrt{3a(a+2b)}}{27EIl}$
Δa (at point of load)	$= \frac{Pa^2b^2}{3EIl}$
Δx (when x < a)	$= \frac{Pbx}{6EIl}(l^2 - b^2 - x^2)$

Determine DL Shear at a distance = D from support (14")

V, Shear = w(L/2-x) = 0.179

Determine LL Shear at a distance = 3D from support or L/4

P = 5845 lb force (see literature)

3D = 3.5
L/4 = 3.29
Distr. Factor = 0.417

V, Shear = P b/L = 1.828

Total Shear (reduced for duration factor)

Total V = LL/1.25 + DL/0.9 = 1.661

Allowable Shear, Fv = 70 PSI

Allowable Shear reduced by Cm = 0.97
fv = 67.9

Equation 13-9

Stress =3V/2/b/d = 44.5

TABLE 3.23.1 Distribution of Wheel Loads in Longitudinal Beams

Kind of Floor	Bridge Designed for One Traffic Lane	Bridge Designed for Two or more Traffic Lanes
Timber:[a]		
Plank[b]	S/4.0	S/3.75
Nail laminated[c] 4" thick or multiple layer[d] floors over 5" thick	S/4.5	S/4.0
Nail laminated[c] 6" or more thick	S/5.0 If S exceeds 5′ use footnote f.	S/4.25 If S exceeds 6.5′ use footnote f.
Glued laminated[e] Panels on glued laminated stringers		
4" thick	S/4.5	S/4.0
6" or more thick	S/6.0 If S exceeds 6′ use footnote f.	S/5.0 If S exceeds 7.5′ use footnote f.
On steel stringers		
4" thick	S/4.5	S/4.0
6" or more thick	S/5.25 If S exceeds 5.5′ use footnote f.	S/4.5, If S exceeds 7′ use footnote f.
Concrete:		
On steel I-Beam stringers[g] and prestressed concrete girders	S/7.0 If S exceeds 10′ use footnote f.	S/5.5 If S exceeds 14′ use footnote f.
On concrete T-Beams	S/6.5 If S exceeds 6′ use footnote f.	S/6.0 If S exceeds 10′ use footnote f.
On timber stringers	S/6.0 If S exceeds 6′ use footnote f.	S/5.0 If S exceeds 10′ use footnote f.
Concrete box girders[h]	S/8.0 If S exceeds 12′ use footnote f.	S/7.0 If S exceeds 16′ use footnote f.
On steel box girders	See Article 10.39.2.	
On prestressed concrete spread box Beams	See Article 3.28.	
Steel grid:		
(Less than 4" thick)	S/4.5	S/4.0
(4" or more)	S/6.0 If S exceeds 6′ use footnote f.	S/5.0 If S exceeds 10.5′ use footnote f.
Steel bridge Corrugated plank[i] (2" min. depth)	S/5.5	S/4.5

wheels

S = average stringer spacing in feet.

[a]Timber dimensions shown are for nominal thickness.

[b]Plank floors consist of pieces of lumber laid edge to edge with the wide faces bearing on the supports (see Article 20.17—Division II).

[c]Nail laminated floors consist of pieces of lumber laid face to face with the narrow edges bearing on the supports, each piece being nailed to the preceding piece (see Article 20.18—Division II).

[d]Multiple layer floors consist of two or more layers of planks, each layer being laid at an angle to the other (see Article 20.17—Division II).

[e]Glued laminated panel floors consist of vertically glued laminated members with the narrow edges of the laminations bearing on the supports (see Article 20.1.1—Division II).

[f]In this case the load on each stringer shall be the reaction of the wheel loads, assuming the flooring between the stringers to act as a simple beam.

[g]"Design of I-Beam Bridges" by N. M. Newmark—Proceedings, ASCE, March 1948.

[h]The sidewalk live load (see Article 3.15) shall be omitted for interior and exterior box girders designed in accordance with the wheel load distribution indicated herein.

[i]Distribution factors for Steel Bridge Corrugated Plank set forth above are based substantially on the following reference:

Journal of Washington Academy of Sciences, Vol. 67, No. 2, 1977 "Wheel Load Distribution of Steel Bridge Plank," by Conrad P. Heins, Professor of Civil Engineering, University of Maryland.

These distribution factors were developed based on studies using 6" × 2" steel corrugated plank. The factors should yield safe results for other corrugated configurations provided primary bending stiffness is the same as or greater than the 6" × 2" corrugated plank used in the studies.

3.22.4 When long span structures are being designed by load factor design, the gamma and beta factors specified for Load Factor Design represent general conditions and should be increased if, in the Engineer's judgment, expected loads, service conditions, or materials of construction are different from those anticipated by the specifications.

3.22.5 Structures may be analyzed for an overload that is selected by the operating agency. Size and configuration of the overload, loading combinations, and load distribution will be consistent with procedures defined in permit policy of that agency. The load shall be applied in Group IB as defined in Table 3.22.1A. For all loadings less than H 20, Group IA loading combination shall be used (see Article 3.5).

Part C
DISTRIBUTION OF LOADS

3.23 DISTRIBUTION OF LOADS TO STRINGERS, LONGITUDINAL BEAMS, AND FLOOR BEAMS*

3.23.1 Position of Loads for Shear

3.23.1.1 In calculating end shears and end reactions in transverse floor beams and longitudinal beams and stringers, no longitudinal distribution of the wheel load shall be assumed for the wheel or axle load adjacent to the transverse floor beam or the end of the longitudinal beam or stringer at which the stress is being determined.

3.23.1.2 Lateral distribution of the wheel loads at ends of the beams or stringers shall be that produced by

*Provisions in this Article shall not apply to orthotropic deck bridges.

3.3.5 Where the abrasion of concrete is not expected, the traffic may bear directly on the concrete slab. If considered desirable, ¼ inch or more may be added to the slab for a wearing surface.

3.3.6 The following weights are to be used in computing the dead load:

	#/cu.ft.
Steel or cast steel	490
Cast iron	450
Aluminum alloys	175
Timber (treated or untreated)	50
Concrete, plain or reinforced	150
Compacted sand, earth, gravel, or ballast	120
Loose sand, earth, and gravel	100
Macadam or gravel, rolled	140
Cinder filling	60
Pavement, other than wood block	150
Railway rails, guardrails, and fastenings (per linear foot of track)	200
Stone masonry	170
Asphalt plank, 1 in. thick	9 lb. sq. ft.

3.4 LIVE LOAD

The live load shall consist of the weight of the applied moving load of vehicles, cars, and pedestrians.

3.5 OVERLOAD PROVISIONS

3.5.1 For all loadings less than H 20, provision shall be made for an infrequent heavy load by applying Loading Combination IA (see Article 3.22), with the live load assumed to be H or HS truck and to occupy a single lane without concurrent loading in any other lane. The overload shall apply to all parts of the structure affected, except the roadway deck, or roadway deck plates and stiffening ribs in the case of orthotropic bridge superstructures.

3.5.2 Structures may be analyzed for an overload that is selected by the operating agency in accordance with Loading Combination Group IB in Article 3.22.

3.6 TRAFFIC LANES

3.6.1 The lane loading or standard truck shall be assumed to occupy a width of 10 feet.

3.6.2 These loads shall be placed in 12-foot wide design traffic lanes, spaced across the entire bridge roadway width measured between curbs.

3.6.3 Fractional parts of design lanes shall not be used, but roadway widths from 20 to 24 feet shall have two design lanes each equal to one-half the roadway width.

3.6.4 The traffic lanes shall be placed in such numbers and positions on the roadway, and the loads shall be placed in such positions within their individual traffic lanes, so as to produce the maximum stress in the member under consideration.

3.7 HIGHWAY LOADS

3.7.1 Standard Truck and Lane Loads*

3.7.1.1 The highway live loadings on the roadways of bridges or incidental structures shall consist of standard trucks or lane loads that are equivalent to truck trains. Two systems of loading are provided, the H loadings and the HS loadings—the HS loadings being heavier than the corresponding H loadings.

3.7.1.2 Each lane load shall consist of a uniform load per linear foot of traffic lane combined with a single concentrated load (or two concentrated loads in the case of continuous spans—see Article 3.11.3), so placed on the span as to produce maximum stress. The concentrated load and uniform load shall be considered as uniformly distributed over a 10-foot width on a line normal to the center line of the lane.

3.7.1.3 For the computation of moments and shears, different concentrated loads shall be used as indicated in Figure 3.7.6B. The lighter concentrated loads shall be used when the stresses are primarily bending stresses, and the heavier concentrated loads shall be used when the stresses are primarily shearing stresses.

*Note: The system of lane loads defined here (and illustrated in Figure 3.7.6.B) was developed in order to give a simpler method of calculating moments and shears than that based on wheel loads of the truck.

Appendix B shows the truck train loadings of the 1935 Specifications of AASHO and the corresponding lane loadings.

In 1944, the HS series of trucks was developed. These approximate the effect of the corresponding 1935 truck preceded and followed by a train of trucks weighing three-fourths as much as the basic truck.

TABLE 13.5.1A Tabulated Design Values for Visually Graded Lumber and Timbers (Continued)

		Design Values in Pounds per Square Inch (psi)						
Species and Commercial Grade	Size Classification	Bending F_b	Tension Parallel to Grain F_t	Shear Parallel to Grain F_v	Compression Perpendicular to Grain $F_{c\perp}$	Compression Parallel to Grain F_c	Modulus of Elasticity E	Grading Rules Agency
HEM-FIR								
Select Structural		1400	900	75	405	1500	1,600,000	
No. 1 & Btr	2″–4″ thick	1060	700	75	405	1350	1,500,000	WWPA
No. 1		950	600	75	405	1300	1,500,000	
No. 2	2″ & wider	850	500	75	405	1250	1,300,000	WCLIB
Select Structural	Beams and Stringers	1300	750	70	405	925	1,300,000	
No. 1		1050	525	70	405	750	1,300,000	
No. 2		675	350	70	405	500	1,100,000	WCLIB
Select Structural	Posts and Timbers	1200	800	70	405	975	1,300,000	
No. 1		975	650	70	405	850	1,300,000	
No. 2		575	375	70	405	575	1,100,000	
Select Structural	Beams and Stringers	1250	725	70	405	925	1,300,000	
No. 1		1050	525	70	405	775	1,300,000	
No. 2		675	325	70	405	475	1,100,000	WWPA
Select Structural	Posts and Timbers	1200	800	70	405	975	1,300,000	
No. 1		950	650	70	405	850	1,300,000	
No. 2		525	350	70	405	375	1,100,000	
MIXED SOUTHERN PINE								
Select Structural		2050	1200	100	565	1800	1,600,000	
No. 1	2″–4″ thick	1450	875	100	565	1650	1,500,000	
No. 2	2″–4″ wide	1300	775	90	565	1650	1,400,000	
Select Structural		1850	1100	90	565	1700	1,600,000	
No. 1	2″–4″ thick	1300	750	90	565	1550	1,500,000	
No. 2	5″–6″ wide	1150	675	90	565	1550	1,400,000	SPIB
Select Structural	2″–4″ thick	1750	1000	90	565	1600	1,600,000	
No. 1		1200	700	90	565	1450	1,500,000	
No. 2	8″ wide	1050	625	90	565	1450	1,400,000	
Select Structural	2″–4″ thick	1500	875	90	565	1600	1,600,000	
No. 1		1050	600	90	565	1450	1,500,000	
No. 2	10″ wide	925	550	90	565	1450	1,400,000	

TABLE 13.5.1A Tabulated Design Values for Visually Graded Lumber and Timbers (Continued)

1. Design values are taken from the 1991 Edition of the NDS® and are for a 10-year load duration and dry service conditions. Refer to the 1991 NDS® for additional species and grades and for a summary of grading rules agencies and commercial species classifications.

2. Wet Service Factor, C_M. When dimension lumber, 2″ to 4″ thick is used where moisture content will exceed 19%, design values shall be multiplied by the following wet service factors:

WET SERVICE FACTORS, C_M

F_b	F_t	F_v	$F_{c\perp}$	F_c	E
0.85*	1.0	0.97	0.67	0.8**	0.9

* when $(F_b)(C_F) \leq 1{,}150$ psi, $C_M = 1.0$
** when $F_c \leq 750$ psi, $C_M = 1.0$

When timbers 5″ by 5″ and larger are used where moisture content will exceed 19%, design values shall be multiplied by the following wet service factors (for Southern Pine and Mixed Southern Pine, use tabulated values without further adjustment):

F_t	F_v	$F_{c\perp}$	F_c	E
1.00	1.00	0.67	0.91	1.00

3. Size Factor, C_F. For all species other than Southern Pine and Mixed Southern Pine, tabulated bending, tension, and compression parallel to grain design values for dimension lumber 2″ to 4″ thick shall be multiplied by the following size factors:

SIZE FACTORS, C_F

		F_b		F_t	F_c
		Thickness			
Grades	Width	2″ & 3″	4″		
	2″, 3″ & 4″	1.5	1.5	1.5	1.15
Select	5″	1.4	1.4	1.4	1.1
Structural,	6″	1.3	1.3	1.3	1.1
No. 1 & Btr.	8″	1.2	1.3	1.2	1.05
No. 1, No. 2,	10″	1.1	1.2	1.1	1.0
No. 3	12″	1.0	1.1	1.0	1.0
	14″ & wider	0.9	1.0	0.9	0.9

TABLE 13.5.1A Tabulated Design Values for Visually Graded Lumber and Timbers (Continued)

For Southern Pine and Mixed Southern Pine dimension lumber, 2″ to 4″ thick, appropriate size adjustment factors have been incorporated in tabulated values, with the following exceptions:

For dimension lumber 4″ thick, 8″ and wider, tabulated bending design values shall be multiplied by the size factor, $C_F = 1.1$.

For dimension lumber wider than 12″, tabulated bending, tension, and compression parallel to grain design values for 12″ wide lumber shall be multiplied by the size factor, $C_F = 0.9$.

4. Flat Use Factor, C_{fu}. Bending design values are based on edgewise use (load applied to narrow face). When dimension lumber 2″ to 4″ thick is used flatwise (load applied to wide face), the bending design value shall be multiplied by the following flat use factors:

FLAT USE FACTORS, C_{fu} ← NA

Width	Thickness 2″ & 3″	Thickness 4″
2″ & 3″	1.0	. . .
4″	1.1	1.0
5″	1.1	1.05
6″	1.15	1.05
8″	1.15	1.05
10″ & wider	1.2	1.1

5. Repetitive Member Factor, C_r. Bending design values for dimension lumber 2″ to 4″ thick shall be multiplied by the repetitive member factor $C_r = 1.15$, ← USE when such members are used as stringers, decking or similar members which are in contact or are spaced not more than 24″ on centers, are not less than 3 in number and are joined by load distributing elements adequate to support the design load.

6. Shear Stress Factor, C_H. Tabulated shear design values parallel to grain, F_V, have been reduced to allow for the occurrence of splits, checks, and shakes and may be multiplied by the shear stress factors given below when the length of split, or size of check or shake is known and no increase in them is anticipated. When the shear stress factor is applied to Southern Pine or Mixed Southern Pine, a tabulated design value of $F_V = 90$ lb/in.^{2} shall be used for all grades. Shear stress factors shall be linearly interpolated.

SHEAR STRESS FACTORS, C_H

Length of split on wide face of 2″ (nominal) lumber	C_H	Length of split on wide face of 3″ (nominal) and thicker lumber	C_H	Size of shake* in 2″ (nominal) and thicker lumber	C_H
no split	2.00	no split	2.00	no shake	2.00
1/2 × wide face	1.67	1/2 × narrow face	1.67	1/6 × narrow face	1.67
3/4 × wide face	1.50	3/4 × narrow face	1.50	1/4 narrow face	1.50
1 × wide face	1.33	1 × narrow face	1.33	1/3 × narrow face	1.33
1-1/2 × wide face or more	1.00	1-1/2 × narrow face or more	1.00	1/2 × narrow face or more	1.00

* Shake is measured at the end between lines enclosing the shake and perpendicular to the loaded face.

TABLE 13.5.5A Load Duration Factor, C_D

Load Duration	C_D
Permanent	0.90
2 months (vehicle live load)	1.15
7 days	1.25
1 day	1.33
5 minutes (railing only)	1.65

curved glued laminated timber members shall be as specified in the 1991 Edition of the NDS®.

13.6.1.2 For simple, continuous, and cantilevered bending members, the span shall be taken as the clear distance between supports plus one-half the required bearing length at each support.

13.6.1.3 Bending members shall be transversely braced to prevent lateral displacement and rotation and transmit lateral forces to the bearings. Transverse bracing shall be provided at the supports for all span lengths and at intermediate locations as required for lateral stability and load transfer (Article 13.6.4.4). The depth of transverse bracing shall not be less than ¾ the depth of the bending member.

13.6.1.4 Support attachments for bending members shall be of sufficient size and strength to transmit vertical, longitudinal and transverse loads from the superstructure to the substructure in accordance with the requirements of Section 3.

13.6.1.5 Glued laminated timber and structural composite lumber girders shall preferably be cambered a minimum 3 times the computed dead load deflection, but not less than ½ inch.

13.6.2 Notching

Notching of bending members can severely reduce member capacity and is not recommended. When notching is required for sawn lumber members, design limitations and requirements shall be in accordance with the NDS®, 1991 Edition. Design requirements and limitations for notching glued laminated timber members shall be as given in the "Timber Construction Manual," 1985 Edition by the American Institute of Timber Construction, published by John Wiley & Sons, New York, New York. Design requirements and limitations for notching structural composite lumber shall be as specified for glued laminated timber.

13.6.3 Modulus of Elasticity

The modulus of elasticity used for stiffness and stability computations shall be the tabulated modulus of elasticity adjusted by the applicable adjustment factor given in the following equation:

$$E' = EC_M \qquad (13\text{-}1)$$

where:

E' = allowable modulus of elasticity in psi;
E = tabulated modulus of elasticity in psi;
C_M = wet service factor from Article 13.5.5.1.

13.6.4 Bending

13.6.4.1 Allowable Stress

The allowable unit stress in bending shall be the tabulated stress adjusted by the applicable adjustment factors given in the following equation:

NA 1.0 1.0 1.15

$$F_b' = F_bC_MC_DC_FC_VC_LC_fC_{fu}C_r \qquad (13\text{-}2)$$

1.25 NA

where:

F_b' = allowable unit stress in bending in psi
F_b = tabulated unit stress in bending in psi
C_M = wet service factor from Article 13.5.5.1
C_D = load duration factor from Article 13.5.5.2
C_F = bending size factor for sawn lumber and structural composite lumber, and for glued laminated timber with loads applied parallel to the wide face of the laminations, from Article 13.6.4.2
C_v = volume factor for glued laminated timber with loads applied perpendicular to the wide face of the laminations, from Article 13.6.4.3
C_L = beam stability factor from Article 13.6.4.4.
C_f = form factor from Article 13.6.4.5
C_{fu} = flat use factor for sawn lumber from footnotes to Tables 13.5.1A and 13.5.1B
C_r = repetitive member factor for sawn lumber from footnotes to Table 13.5.1A.

The volume factor, C_v, shall not be applied simultaneously with the beam stability factor, C_L, and the lesser of the two factors shall apply in Equation 13-2.

13.6.4.2 Size Factor, C_F

13.6.4.2.1 The tabulated bending stress, for dimension lumber 2 inches to 4 inches thick shall be multiplied by the bending size factor, C_F, given in the footnotes to Table 13.5.1A.

13.6.4.2.2 For rectangular sawn lumber bending members 5 inches or thicker and greater than 12 inches in depth, and for glued laminated timber with loads applied parallel to the wide face of the laminations and greater than 12 inches in depth, the tabulated bending stress shall be multiplied by the size factor, C_F, determined from the following relationship:

$$C_F = \left(\frac{12}{d}\right)^{1/9} \qquad (13\text{-}3)$$

where d is the member depth in inches.

13.6.4.2.3 For structural composite lumber bending members of any width, the tabulated bending stress shall be reduced by the size factor, C_F, given by the following equation:

$$C_F = (21/L)^{1/m}(12/d)^{1/m} \qquad (13\text{-}4)$$

where:

L = length of bending member between points of zero moment in feet;
d = depth of bending member in inches;
m = parameter for the specific material determined in accordance with the requirements of ASTM D 5456.

13.6.4.3 Volume Factor, C_v

13.6.4.3.1 The tabulated bending stress for glued laminated timber bending members with loads applied perpendicular to the wide face of the laminations shall be adjusted by the volume factor, C_v, as determined by the following relationship:

$$C_V = (21/L)^{1/x}(12/d)^{1/x}(5.125/b)^{1/x} \leq 1.0 \qquad (13\text{-}5)$$

where:

L = length of bending member between points of zero moment in feet;
d = depth of bending member in inches;
b = width of bending member in inches;
x = 20 for Southern Pine;
x = 10 for all other species.

13.6.4.3.2 When multiple piece width layups are used, the width of the bending member used in Equation 13-4 shall be the width of the widest piece used in the layup.

13.6.4.4 Beam Stability Factor, C_L

13.6.4.4.1 Tabulated bending values are applicable to members which are adequately braced. When members are not adequately braced, the tabulated bending stress shall be modified by the beam stability factor, C_L.

13.6.4.4.2 When the depth of a bending member does not exceed its width, or when lateral movement of the compression zone is prevented by continuous support and points of bearing have lateral support to prevent rotation, there is no danger of lateral buckling and $C_L = 1.0$. For other conditions, the beam stability factor shall be determined in accordance with the following provisions.

13.6.4.4.3 The bending member effective length, l_e, shall be determined from the following relationships for any loading condition:

$$l_e = 2.06 l_u \quad \text{when } l_u/d < 7$$
$$l_e = 1.63 l_u + 3d \quad \text{when } 7 \leq l_u/d \leq 14.3$$
$$l_e = 1.84 l_u \quad \text{when } l_u/d > 14.3$$

where:

l_e = effective length in inches;
l_u = unsupported length in inches;
d = depth of bending member in inches.

If lateral support is provided to prevent rotation at the points of bearing, but no other lateral support is provided throughout the bending member length, the unsupported length, l_u, is the distance between points of bearing, or the length of a cantilever.

If lateral support is provided to prevent rotation and lateral displacement at intermediate points as well as at the bearings, the unsupported length, l_u, is the distance between such points of intermediate lateral support.

13.6.4.4.4 The slenderness ratio for bending members, R_B, is determined from the following equation:

$$R_B = \sqrt{\frac{l_e d}{b^2}} \leq 50 \qquad (13\text{-}6)$$

where:

R_B = bending member slenderness ratio;
d = depth of bending member in inches;
b = width of bending member in inches.

13.6.4.4.5 The beam stability factor, C_L, shall be computed as follows on the next page.

$$C_L = \frac{1+(F_{bE}/F_b^*)}{1.90} - \sqrt{\frac{[1+(F_{bE}/F_b^*)]^2}{3.61} - \frac{F_{bE}/F_b^*}{0.95}} \qquad (13\text{-}7)$$

$$F_{bE} = \frac{K_{bE}E'}{R_B^2} \qquad (13\text{-}8)$$

where:

F_b^* = tabulated bending stress adjusted by all applicable adjustment factors given in Equation 13-2 except the volume factor, C_v, the beam stability factor, C_L, and the flat-use factor, C_{fu};

K_{bE} = 0.438 for visually graded sawn lumber 0.609 for glued laminated timber, structural composite lumber, and machine stress rated lumber;

E' = allowable modulus of elasticity in psi as determined by Article 13.6.3.

13.6.4.5 Form Factor, C_f

For bending members with circular cross sections the tabulated bending stress shall be adjusted by the form factor, C_f = 1.18. A tapered circular section shall be considered as a bending member of variable cross section.

13.6.5 Shear Parallel to Grain

13.6.5.1 General

13.6.5.1.1 The provisions of this article apply to shear parallel to grain (horizontal shear) at or near the points of vertical support of solid bending members. Refer to the 1991 edition of the NDS® for additional design requirements for other member types.

13.6.5.1.2 The critical shear in wood bending members is shear parallel to grain. It is unnecessary to verify the strength of bending members in shear perpendicular to grain.

13.6.5.2 Actual Stress

The actual unit stress in shear parallel to grain due to applied loading on rectangular members shall be determined by the following equation:

$$f_v = \frac{3V}{2bd} \qquad (13\text{-}9)$$

where:

f_v = actual unit stress in shear parallel to grain in psi;
b = width of bending member in inches;
d = depth of bending member in inches;
V = vertical shear in pounds, as determined in accordance with the following provisions.

For uniformly distributed loads, such as dead load, the magnitude of vertical shear used in Equation 13-9 shall be the maximum shear occurring at a distance from the support equal to the bending member depth, d. When members are supported by full bearing on one surface, with loads applied to the opposite surface, all loads within a distance from the supports equal to the bending member depth shall be neglected.

For vehicle live loads, the loads shall be placed to produce the maximum vertical shear at a distance from the support equal to three times the bending member depth, 3d, or at the span quarter point, L/4, whichever is the lesser distance from the support. The distributed live load shear used in Equation 13-9 shall be determined by the following expression:

$$V_{LL} = 0.50\,[(0.60\,V_{LU}) + V_{LD}] \qquad (13\text{-}10)$$

where:

V_{LL} = distributed live load vertical shear in pounds;
V_{LU} = maximum vertical shear, in pounds, at 3d or L/4 due to undistributed wheel loads;
V_{LD} = maximum vertical shear, in pounds, at 3d or L/4 due to wheel loads distributed laterally as specified for moment in Article 3.23.

For undistributed wheel loads, one line of wheels is assumed to be carried by one bending member.

13.6.5.3 Allowable Stress

The allowable unit stress in shear parallel to grain shall be the tabulated stress adjusted by the applicable adjustment factors given in the following equation:

$$F_v' = F_v C_M C_D \qquad (13\text{-}11)$$

where:

F_v' = allowable unit stress in shear parallel to grain in psi;
F_v = tabulated unit stress in shear parallel to grain in psi;
C_M = wet service factor from Article 13.5.5.1;
C_D = load duration factor from Article 13.5.5.2.

For sawn lumber beams, further adjustment by the shear stress factor may be applicable as described in the footnotes to Table 13.5.1A.

For structural composite lumber, more restrictive adjustments to the tabulated shear stress parallel to grain shall be as recommended by the material manufacturer.

13.6.6 Compression Perpendicular to Grain

13.6.6.1 General

When calculating the bearing stress in compression perpendicular to grain at beam ends, a uniform stress distribution shall be assumed.

13.6.6.2 Allowable Stress

The allowable unit stress in compression perpen-337dicular to grain shall be the tabulated stress adjusted by the applicable adjustment factors given in the following equation:

$$F_{c\perp}' = F_{c\perp} C_M C_b \qquad (13\text{-}12)$$

where:

$F_{c\perp}'$ = allowable unit stress in compression perpendicular to grain, in psi;
$F_{c\perp}$ = tabulated unit stress in compression perpendicular to grain, in psi;
C_M = wet service factor from Article 13.5.5.1;
C_b = bearing area factor from Article 13.6.6.3.

13.6.6.3 Bearing Area Factor, C_b

Tabulated values in compression perpendicular to grain apply to bearings of any length at beam ends, and to all bearings 6 inches or more in length at any other location. For bearings less than 6 inches in length and not nearer than 3 inches to the end of a member, the tabulated value shall be adjusted by the bearing area factor, C_b, given by the following equation:

$$C_b = \frac{l_b + 0.375}{l_b} \qquad (13\text{-}13)$$

where l_b is the length of bearing in inches, measured parallel to the wood grain. For round washers, or other round bearing areas, the length of bearing shall be the diameter of the bearing area.

The multiplying factors for bearing lengths on small areas such as plates and washers are given in Table 13.6.1A.

TABLE 13.6.1A Values of the Bearing Area Factor, C_b, for Small Bearing Areas

Length of Bearing, l_b (in.)	1/2	1	1-1/2	2	3	4	6 or more
Bearing Area Factor, C_b	1.75	1.38	1.25	1.19	1.13	1.10	1.00

13.6.7 Bearing on Inclined Surfaces

For bearing on an inclined surface, the allowable unit stress in bearing shall be as given by the following equation:

$$F_\theta' = \frac{F_g' F_{c\perp}'}{F_g' \sin^2\theta + F_{c\perp}' \cos^2\theta} \qquad (13\text{-}14)$$

where:

F_θ' = allowable unit stress for bearing on an inclined surface, in psi;
F_g' = allowable unit stress in bearing parallel to grain from Article 13.7.4;
$F_{c\perp}$ = allowable unit stress in compression perpendicular to the grain from Article 13.6.6;
θ = angle in degrees between the direction of load and the direction of grain.

13.7 COMPRESSION MEMBERS

13.7.1 General

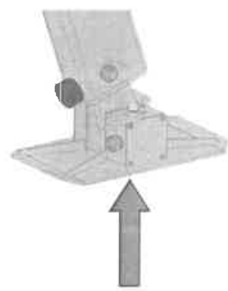
13.7.1.1 The provisions of this article apply to simple solid columns consisting of a single piece of sawn lumber, piling, structural composite lumber, or glued laminated timber. Refer to the 1991 Edition of the NDS® for design requirements for built-up columns, consisting of a number of solid members joined together with mechanical fasteners, and for spaced columns consisting of two or more individual members with their longitudinal axes parallel, separated and fastened at the ends and at one or more interior points by blocking.

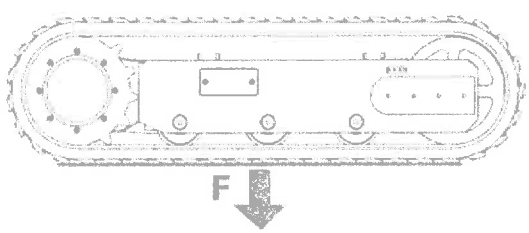
13.7.1.2 The term "column" refers to all types of compression members, including members forming part of a truss or other structural components.

13.7.1.3 Column bracing shall be provided where necessary to provide lateral stability and resist wind or other lateral forces.

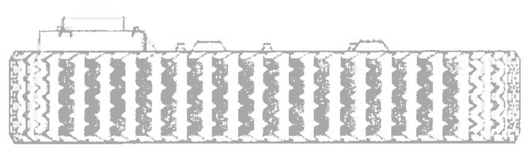
Teupen TL92SJ

Pressures and Force: Stable ground

I. Force Impact		
1. Machine Effect on Floor Surface Material - Outriggers		
Maximum Force on Floor Material under single outrigger (fully loaded machine with max basket load)	26 kN	5845 lb force
Total area of a single outrigger foot 9* (based on foot dimensions 22cm x 31cm)	682 cm^{2*} hard	105.7 sq in
Max. ground pressure (force / area of plate)	38.1 N/cm^{2*}	55.3 psi
		
Suggestion: Option / extra – synthetic underplate for outrigger		
30cm x 85cm (11.8x33.5in) , 2911 / 0241	10.2 N/cm^2	14.8 psi
2. Machine Effect on Floor Surface Material – Tracks		
Max. load under one track (machine weight / 2) (4300kg / 2)	21.1 kN	4743 lb force
Crawler area in contact with surface	735 cm^{2*}	114 sq in
Max. ground pressure	28.7 N/cm^{2*}	41.6 psi



41.6 psi



Track width = 10"
length = 6'-2"

N
Location of damaged/ repaired timbers (Joists)
MISSISSIPPI AVE.
PROPERTY LINE
BOARDWALK
SECTION 7-7
SECTION 17-17 (AS SHOWN)
SECTION 19-19 (OPP. HAND)
SECTION 18-18 (AS SHOWN)
SECTION 20-20 (OPP. HAND)
SECTION 14-14
SECTION 15-15 AS SHOWN
SECTION 16-16 OPP. HAND
SECTION 21-21
DETAIL 'A'
SECTION 23-23 (AS SHOWN)
SECTION 22-22 (OPP. HAND)
MATCH LINE
NOTE: USE THIS DRAWING IN CONNECTION WITH DRAWINGS S6 - S8 & S9
REVISIONS
CHECK
APPVD.
DATE
MODERNIZATION OF ATLANTIC CITY CONVENTION HALL
ATLANTIC CITY NEW JERSEY
CARROLL, GRISDALE & VAN ALEN
ARCHITECTS
PHILADELPHIA PENNSYLVANIA
TUNNEL CONCRETE PLAN - BASEMENT LEVEL
(MISSISSIPPI AVE.)
AS NOTED
DRAWING NUMBER
S-7
HARRY MARK PERKS

APPENDIX C

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CBZ CONSULTING

Understanding your Buildings & Structures

PROJECT: **Boardwalk Hall, 2301 Boardwalk, Atlantic City, NJ 08401**

TITLE: **Non-Destructive Evaluation: Façade Assessment**

CLIENT: **Past Forward Architecture (PFA)**

Report No: **BZ17010 – Visits 1 & 2**

Compiled **Charles Bransby-Zachary BSc MRICS**

Issued on: **February 15th 2018**

RICS

Address: 61B Bernards Ave, Bernardsville, NJ, 07924 **Tel:** (310) 990 8062
Email: cbz@cbzconsulting.com

Professional Building Surveyor's Declaration:

I am a Chartered Building Surveyor, Professional Member of RICS USA, Register No. 1271252. This survey report represents a survey made under my supervision. The testing processes, data analysis, and conclusions drawn from this survey have been approved for issue.

The findings presented in this report represent my best professional opinions based on experience gained from similar investigations carried out on other buildings and structures within New York State and elsewhere in the USA and the UK. These professional opinions are supported by the results of destructive methods of coring, drilling and probing carried out elsewhere on similar materials.

Charles Bransby-Zachary BSc MRICS
Principal / CBZ CONSULTING
15 February 2018

RICS
Professional Member, Register No. 1271252

1.0 INTRODUCTION

1.1 General

CBZ Consulting (CBZ) attended Boardwalk Hall at 2301 Boardwalk, Atlantic City, New Jersey to provide Past Forward Architecture (PFA) with critical information regarding the existing façade conditions using Non Destructive Evaluation (NDE) techniques.

We have completed analysis of the data and are pleased to provide a final report of the investigation.

1.2 Background & Purpose

This study represents a targeted façade evaluation including but not limited to testing stone conditions, water saturation damage in the masonry, and locating anchorages, cramps and dowels holding the various stone components together.

This report includes all investigation results from Visits 1 & 2. Following a thorough review of all information collected by the project team, PFA and the project's consulting engineer will provide recommendations for future repair and maintenance requirements for the building façade.

1.3 Scope & Extent

CBZ CONSULTING was commissioned to a targeted facade investigation using a combination of NDE techniques, including Ground Penetrating Radar (GPR), Metal Detection and Infrared thermal imaging (IRT) in order to verify existing conditions.

GPR & Metal Detection

Five areas of façade (Areas 1-5) were selected by CBZ and PFA for detailed investigation using a combination of GPR and metal detection; the location of each area is shown on drawings provided as Appendix A (See Figure 1, Drawing D01). Each area is located on the Boardwalk (front) elevation and was accessible (by hand) using a scissor lift (Visit 1) and 90ft access platform (Visit 2) both provided by the building maintenance staff and PFA. Information capture was geared towards obtaining the following condition related information.

- Stone thicknesses and bonding patterns (bonding patterns into masonry or facing stone etc.)
- Embedment depth of anchorages (depth of embedment will help determine risk of future corrosion and spalling stone)
- Anchorage patters (does each stone contain an anchor, how many and where are they typically placed? etc.)
- Existence and depth to additional possibly post construction, steel (steel columns, angles etc.)

Infrared Thermal Imaging

All stone façades, including the Boardwalk, Mississippi Avenue and Georgia Avenue were also assessed using infrared thermal imaging, both from street level and also from the adjacent roof of the Trump Plaza building. Information capture was geared towards verifying the extent of condition related issues identified in the detailed survey Areas 1-5.

- Areas of moisture retention in stonework
- Areas of incipient spalling
- Stone thickness patterns
- Open jointing, stone displacement

The above information will provide PFA with valuable information that would build confidence in the repair designs, estimates and procedures presented. The NDE will also be compared (by PFA) with the detailed visual information collected by Vertical Access (via drone) that will help calibrate the NDE data collected.

Data Calibration – Verification of the NDE data collected through the limestone façade was achieved through mapping of known stone block thicknesses at street level; this confirmed the average dielectric constant to be 10. Calibration of the GPR data was used to provide accurate stone thickness and embedded metal depth measurements for the remainder of the assessment.

2.0 THE ASSESSMENT

2.1 General

Visit 1 was conducted by CBZ CONSULTING over a 10 hour survey session on December 7th 2017; Visit 2 was conducted on Feb 8th 2018. The Boardwalk Hall Facilities staff and PFA arranged for permission for CBZ to access all areas requiring investigation from 9am onwards.

Note: Building Facilities staff accompanied CBZ at all times.

2.2 Investigation Methodologies

On site, the investigation was carried out using non-invasive methods, Ground Penetrating Radar (GPR), Metal Detection and Infrared Thermal Imaging (IRT). A brief explanation of each investigative technique is given below.

2.2.1 Ground Penetrating Radar (GPR)

Ground Penetrating Radar (GPR) - Induces an electro-magnetic pulse of energy into the materials under investigation and measures the changes in wave velocity as the pulse passes from one material type to another. This change causes energy to be reflected at boundaries between material types or individual features thus giving a record of the interfaces and mapping conditions such as masonry thickness, anchorage / framing locations, depths and spacing.

Fig 1: GPR Data Collection – From Scissor Lift

GPR uses the principle that radio waves travel at different velocities through different materials: the velocity being dependent on the electrical characteristics of the material being scanned through. GPR records the change in that electrical difference and this can be used to map the subsurface conditions.

2.2.2 Metal Detectors

Metal Detectors - measure currents induced in ferromagnetic objects to determine their location to a depth over a maximum range of approximately 8" (dependant on size of embedded metal being mapped).

Metal detection was used to map the existence and relative depth of embedded metal (framing, anchors etc.) and as a complement to the GPR data collected.

2.2.3 Infrared Thermal Imaging (IRT)

Infrared Thermal Imaging (IRT) - Operating in the long-wave to far infrared region, thermal imaging cameras allow an assessment to be made of the low temperature thermal radiation of an object, thereby allowing the collection of responses of objects subjected to environmental changes.

CBZ CONSULTING utilized IRT to map variations in temperature across the façade that relate to heat transfer through the wall and diurnal surface temperature fluctuations; these variations highlight conditions such as retained moisture, voiding, spalling and masonry thickness variations (See Fig 2 below).

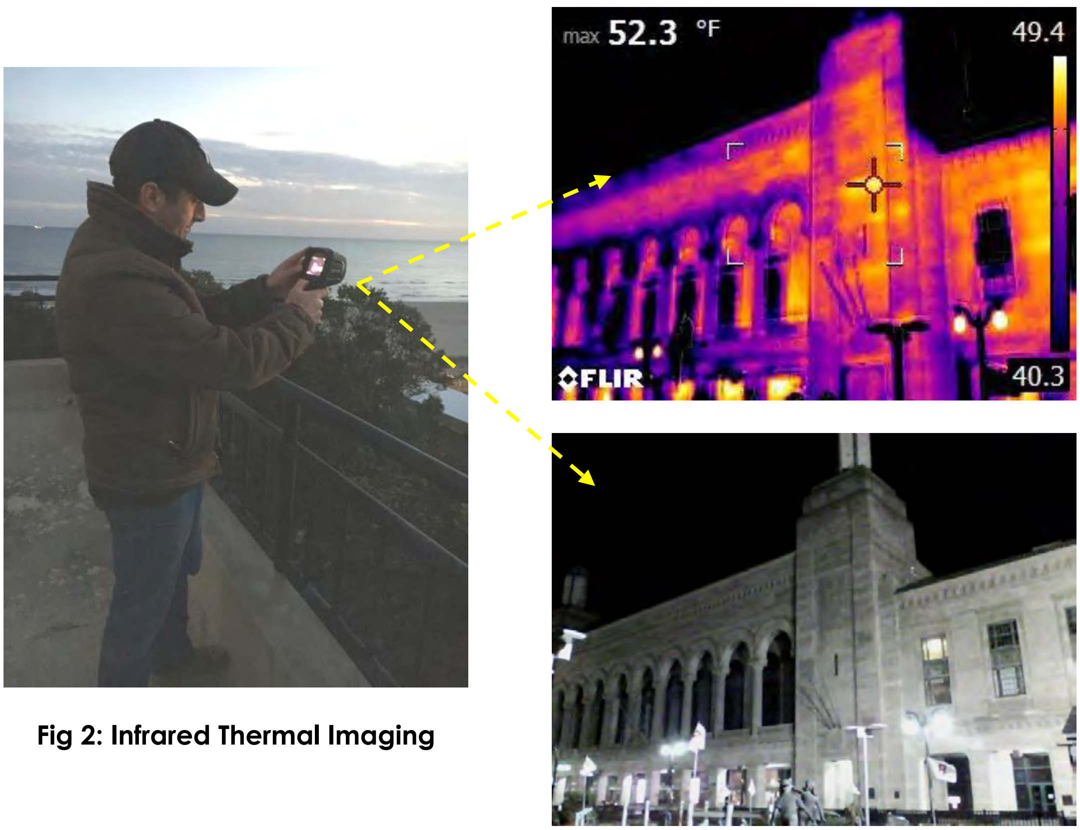


Fig 2: Infrared Thermal Imaging

3.0 RESULTS

3.1 Overview

The assessment findings are derived from the analysis of GPR data, Metal Detection and Infrared thermography as described above. The GPR / metal Detection results recovered at Areas 1-5 and also the results of the IRT survey are presented as schematic drawings, sections and images in the Appendix (Figures 2-7, Drawings D02-D08); these should be read in conjunction with this report. The results are also summarized below.

3.2 Construction Arrangement

The construction arrangement of the exterior walls is generally consistent with sections observed in available design drawings and comprises a brick masonry back up and limestone facing exterior wall. The facing stone typically alternates in thickness for each horizontal course, which helps to bond the stone with the back-up masonry. Typical stone thicknesses are 3½" (thinner larger panels) and 6-7" (thicker, narrow blocks); however some stones are >10" thick. Additionally the stone is tied back into the brickwork using steel anchors, which are notched into the top of many stones and into Lewis (lifting) holes.

A cut out from an original drawing section and a cut out of the schematic section created by CBZ (Figure 3, See Also Appendix A) are shown below and highlight how closely the as-built construction resembles the original drawing designs.

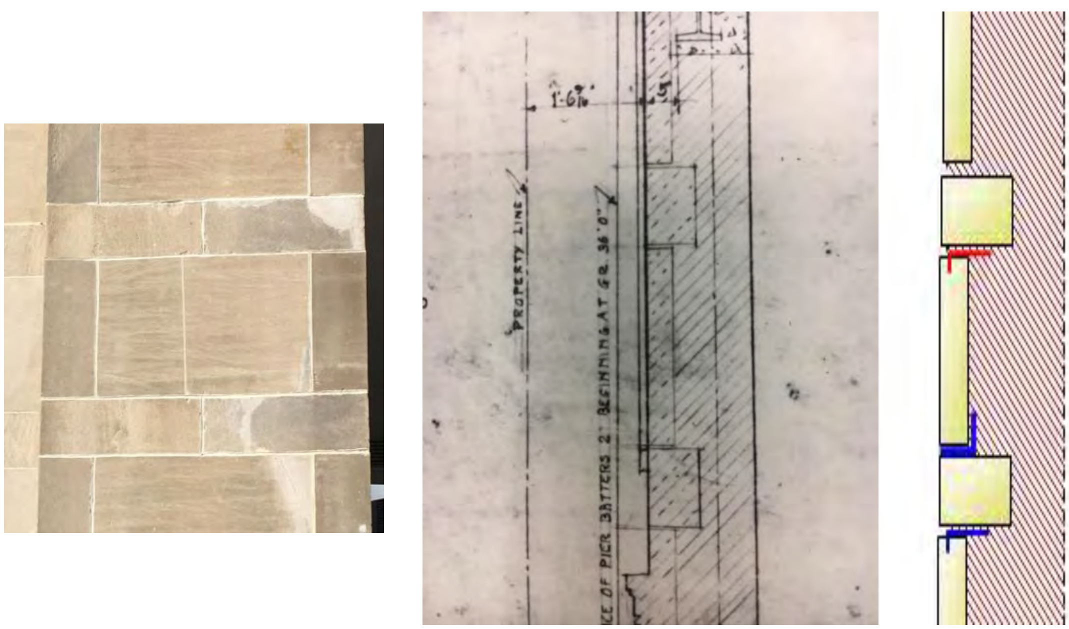


Fig 3: Left: Image showing block coursing / **Middle:** Original drawing section through façade / **Right:** CBZ part section through façade created through NDE data analysis

3.2.1 Anchors

Review of the original drawings revealed evidence of embedded anchorages being used to tie the façade into the backup masonry; however the frequency of anchors, typical cover depths and position in each stone was not clearly set out in the drawings and was not therefore confirmed until this phase of NDE.

A significant number of stone panels contain anchors. The precise design of the anchors used cannot be confirmed without targeted exposure into the back up masonry; however they are notched into the top of the stones and extend back into the backup brick masonry, where the rear of the anchor may or may not be bent up into the brickwork.

For a building of this construction period (1929) and design, it is common to use Lewis or Lifting holes (holes drilled into the top of stones to help hoist them in place during construction) to embed anchors. This has been confirmed in places, such as in Area 5 where a corroded anchor has spalled the surrounding stone revealing its position in a Lewis hole (See Figure 4 below); however this is not always the design as numerous scanned stones contained empty Lewis holes and also adjacent anchors, presumably chased directly into the top of the stone.

Fig 4: Left: Corroded anchor set in Lewis (Lifting hole) **/ Right:** Close up view of corroded anchor

Appendix Figures 2-6 shows the construction arrangement in combinations of plan, section and elevation for each area investigated; this includes in places the typical placement of anchors. Typical design appears to be two anchors placed roughly at ¼ and ¾ intervals in the top of each of the thinner, taller stone panels. Anchors were also identified in the top of some the thicker coursed stones; however these were less frequent; placement depth from the exterior ranges from <1½" to 3+". The typical placement depth is 1½" from the exterior face.

3.2.2 Steel Framing

Evidence of embedded steel framing was also resolved in the data, which again is consistent with the original design drawings. The framing identified at each area investigated is discussed separately below:

- **Areas 1 & 2 Framing**

  The steel framing resolved at Areas 1 and 2 is shown in the drawings provided (See Appendix Figures 2 and 3).

  Vertical columns (6" wide flanges resolved) were identified in the corners of Areas 1 and 2 at a depth of approximately 8" from the exterior stone face. Additional horizontal metallic responses in the NDE data are likely to represent steel shelf angles that provide additional support to the stone; they do not appear to be continuous, which is consistent with historical photographs of the façade during construction.

- **Area 3 Framing**

  The embedded metal (plinth beneath column and vertical dowels) resolved at Area 3 is shown in the drawings provided (See Appendix Figure 4).

  GPR data collected through the 10" thick stone course beneath the column (beneath solid square plinth stone) identified a section of stone cut away (cover depth from exterior face 5"). The cut away section appears to incorporate steel, which may comprise steel 'I' section beams or reinforced concrete and is assumed (by CBZ) to provide bearing support to the columns above. The plinth design, steel conditions and materials used at this location (assumed beneath each loggia column) position would require verification through probing.

  Vertical metallic responses were also resolved in the stone course beneath (5" thick); these are assumed to be anchors that extend vertically close to the rear face of the stone course (verification required).

- **Area 4 Framing**

  Area 4 (See Appendix Figure 1B for location and 5 for detailing) focused on an area of damaged stone towards the top of the façade adjacent to a window on a side elevation (Georgia Street side).

  The general construction arrangement identified was consistent with other areas investigated; however one variation was that a narrow (typically thicker course at 6-7") of stone above the window level was cut to the same thickness as the thinner main stone panels above and below (3" thick) to accommodate a large spandrel beam behind.

  Area 4 also confirmed the existence of 6" wide steel 'I' section columns positioned centrally between windows.

- **Area 5 Framing**
  Area 5 (See Appendix Figure 1B for location and 6 for detailing) focused on an area where the shorter side elevations connect to the adjacent taller Pylon (tower) structures.

  The general construction arrangement identified was consistent with other areas investigated, with alternating stone course thicknesses, anchorages, columns, beams and shelf angles.

  The approximate position of the various stone, steel anchorages and framing is shown in section and elevation.

3.2.3 Time Capsule

GPR scanning of the Boardwalk elevation cornerstone identified evidence of an embedded metal box using both GPR and Metal Detection. The box measures approximately 12" wide, 7" tall and is embedded approx. 3½" from the front face of the stone. The corner stone inscribed with the building date (1929) is approximately 12" thick and the depth of the box cannot be confirmed without exposure (See Fig 5 below).

The 'box' is assumed to be a time capsule and was an unexpected find during this investigation (See also Appendix, Drawing D02, Figures 2C and 2D)

Fig 5: NDE equipment identified embedded metal box thought to be a time capsule in the corner stone

3.3 Condition Assessment

In addition to the assessment to verify the as-built construction arrangement of the façade NDE data was also analyzed and combined with visual observations to assess the condition of the stone, embedded metal components and the reasons behind any failures that are visible at the surface.

3.3.1 General Condition

General observations of the façade suggest that the stonework is mostly in good condition considering the building's age (approx. 90 years) and also considering the design, which incorporates a significant amount of unprotected steel components. It also appears that the façade has undergone relatively recent (dates not known to CBZ) stone repairs, mortar repointing and cleaning work, which has helped to protect the stonework and has avoided significant additional moisture infiltration from accelerating corrosion issues to embedded metal components.

Close visual inspection however does reveal active cracking and spalling, which has occurred since the repair work and is the result of ongoing corrosion of embedded anchors and framing. It should be noted that this is not unexpected for a façade of this age and design; however it will require remedial attention and consideration for regular future monitoring, maintenance and repair.

3.3.2 Corrosion of Anchors and Framing

The facing stone across all elevations contains cracks, spalls and stone displacement; all of which relate to corrosion of embedded steel anchors and framing. Moisture infiltration through the mortar joints over significant periods of time causes the embedded steel to corrode expansively, which overstresses the immediately surrounding stone, causing cracking, spalling and ultimately failure; this further exacerbates the problem by allowing increased moisture infiltration and accelerated corrosion to occur.

The facing stone currently contains conditions ranging from spalling stone and fine cracks to incipient spalling, which has not yet revealed itself at the surface but will do so in time as corrosion continues.

Anchors - Cracking and spalling associated with corroding anchors appears to relate significantly to embedment depth; again this is typical for a façade of this design. Based on GPR data collected anchors placed <1½" from the outer face represent the most imminent risk of corrosion and spalling; at these locations evidence of hairline cracking and rusting is sometimes visible at the surface (not observable from ground level) and in some cases corrosion has not yet initiated any visible cracking. Examples of cracking and spalling associated with corrosion of anchors placed are shown on Page 12 as Fig 6.

Note: In some cases corrosion of anchors will also be due to poorly pointed mortar joints between stones and not always shallow embedment depth.

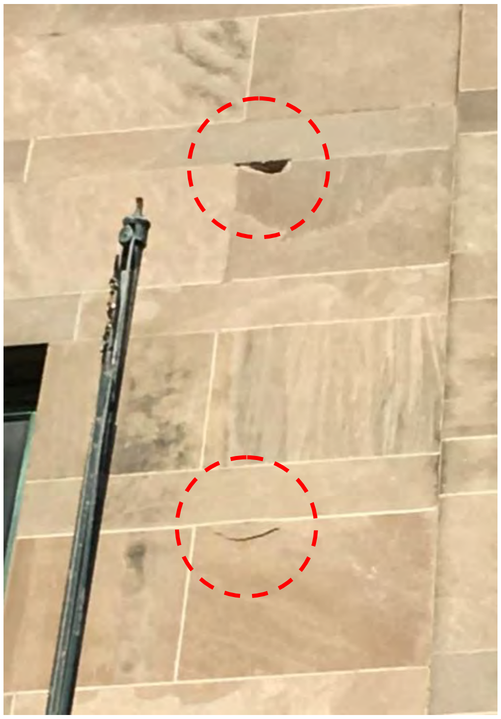
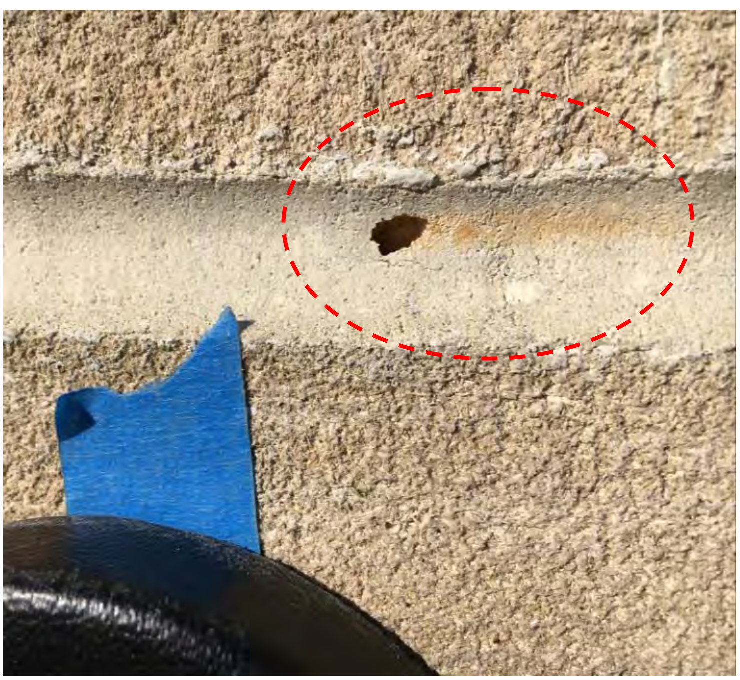


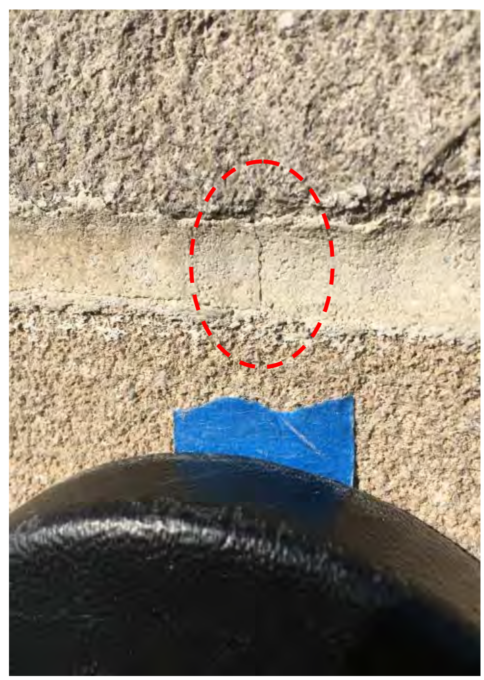
Fig 6:

Top Left: Spalled stone (top) and spalling stone (bottom) due to anchor corrosion

Bottom Left: Close inspection of mortar joint reveals rust staining and gaps in mortar pointing at near surface embedded anchor

Bottom Right: Close inspection of mortar joint reveals Hairline cracking through mortar joint at near surface embedded anchor





Note: Spalling and cracking associated with corroding anchors is more significant at the upper levels due to increased exposure to wind driven rain conditions.

- ***Area 1 –*** Of the sixteen (16) anchors resolved in Area 1 a total of five (5) or 31% appear to be placed <1" from the exterior face. These have been colored red on the Appendix drawings Figure 2A.

- ***Area 2 –*** Of the seven (7) anchors resolved in Area 2 a total of three (3) or 42% appear to be placed <1" from the exterior face. These have been colored red on the Appendix drawings Figure 3A.

- ***Area 3 –*** No near surface anchors were resolved in Area 3, which is also likely to explain the lack of any spalling and cracking in the top of the various stone courses.

- ***Area 4 –*** Area 4 investigation focused on understanding embedded framing and not on the anchorages; however based on review of the GPR data, metal detector readings and some exposed, corroded anchors, they are typically placed at 1½" from the exterior face across all thinner stone panels and deeper (3-4") for all thicker stones.

  Note: the deeper embedment of anchors in thicker stones likely accounts for the lack of corrosion evidence and associated surface cracking for all thicker stone courses.

- ***Area 5 –*** Area 5 investigation focused on understanding embedded framing and not on the anchorages; however based on review of the GPR data, metal detector readings and some exposed, corroded anchors, they are typically placed at 1½" from the exterior face across all thinner stone panels and deeper (3-4") for all thicker stones.

Steel Framing – Significant cracking and stone displacement was also noted in areas not associated with the existence of anchors, specifically at the building corners. This additional damage is coincident with the placement of embedded steel framing.

Columns (Areas 1, 2, 4 & 5) - Damage to the stone corners, most significant at the Pylon corners are coincident with embedded steel columns, which are likely corroding expansively, overstressing the surrounding masonry and causing the observed damage.

NDE data collected at the corners suggests the columns are located behind the thicker courses of stone at a depth of approximately 9-10" from the exterior surface. This significant embedment depth should normally protect the steel from exposure to significant moisture infiltration; however the building corners are significantly displaced and contain cracking throughout, in particular at upper levels of the façade (See Figure 7 on following page).

These conditions suggest that the corner columns are likely packed tightly with mortar and masonry and that even a small amount of corrosion would overstress the surrounding masonry and cause the observed damage.

Note: Columns identified at Areas 4 and 5 have damaged the stonework mainly at the corners of elevations and not between windows. This is likely due to the detailing, which may leave columns between protected at the central spans.

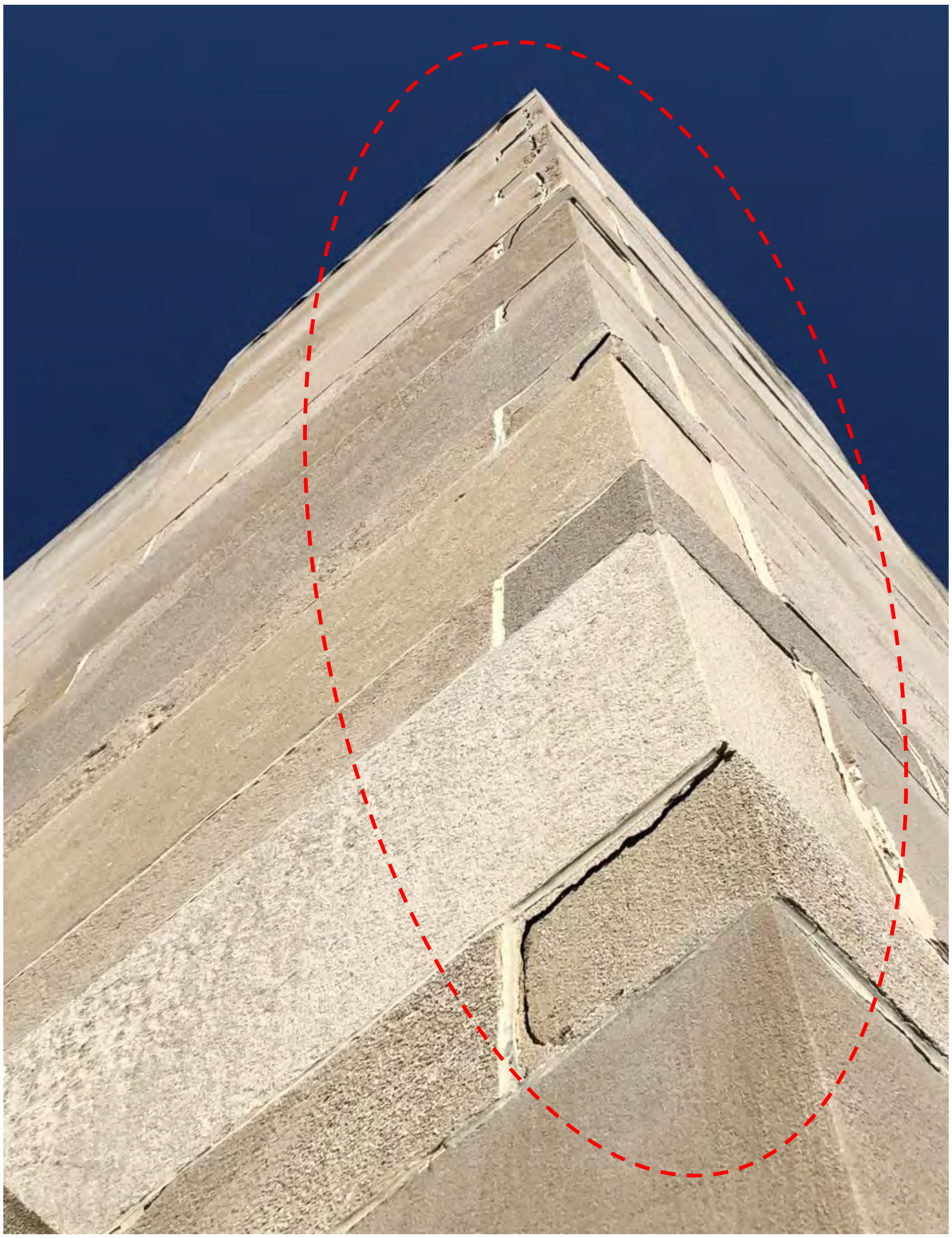


Fig 7: Significant stone displacement and cracking at the corners (especially at high level) associated with corroding embedded columns

Shelf Angles (Areas 1, 2, 4 & 5) – In addition to the identified columns, horizontal metallic responses in the stone joints highlight the existence of steel shelf angles. The steel angles provide support to the facing stone and the outer 'toe' of the angles are placed close to the surface (1½" approx.) in the mortar joint. Steel angles were resolved in Areas 1, 2, 4 & 5 (See Appendix Figures 2, 3, 5 & 6) and at each location they have caused additional damage to the stonework; this is observable as horizontal cracking and lifting of mortar joints containing the steel.

The example below (See Fig 8 below - left) was exposed during a recent probing campaign (organized by PFA) and revealed that the steel shelf angle had undergone previous repair work; this explained the visible mortar repairs to the surrounding joints.

It should also be noted that between Visit 1 and 2, PFA located a historic photograph of the building during construction. The photograph confirmed the existence of the shelf angles which (in the exposed upper section of the Pylon) are welded or bolted to spandrel beams behind (See also Fig 8 below - right).


Fig 8: Left: Significant repairs and also cracking through thinner stone course below the shelf angle confirms active corrosion to the steel (See also Appendix Figure 2 for likely angle position in stone) / **Right:** Historic construction photograph (provided by PFA) revealing existence of shelf angles attached to spandrel beams

Spandrel beams (Areas 4 & 5) – Investigations at Areas 4 and 5 (during Visit 2) identified spandrel beams. The placement of the spandrels in the areas investigated is approximately consistent with original drawings available that show the position of the beams in relation to the stone in front.

Area 4 revealed that in places the alternating facing stone thickness sometimes varies to accommodate spandrel beams behind (See also Appendix Figure 5, Area 4).

Note: As the spandrel beams are positioned behind the stone and appear to be embedded in combinations of terra cotta tile and brick masonry back up they are reasonably well protected from wind driven rain. As a result, damage to the stone from corroding spandrels appears relatively minor and any damage that has occurred appears to be limited to connections and corners (See Figure 9 below).

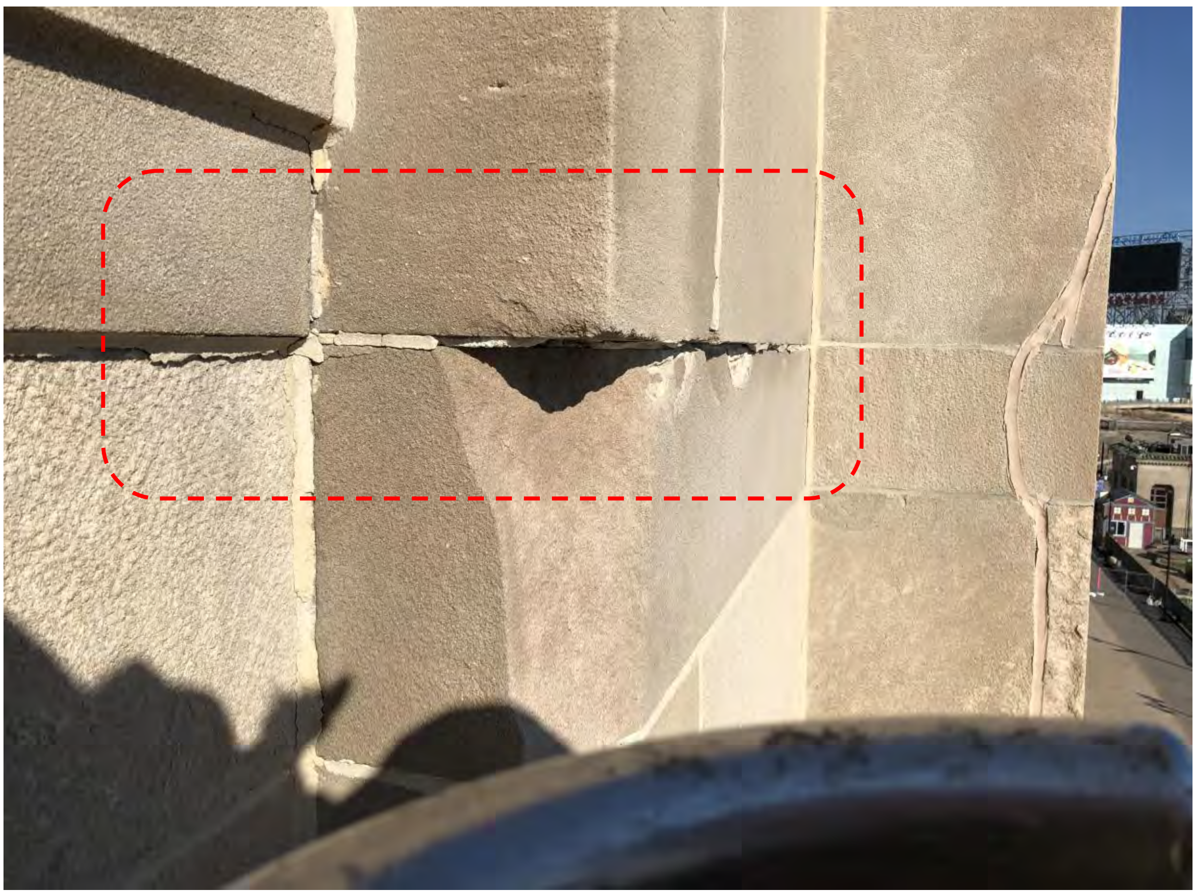


Fig 9: Area 5: Significant cracking, open jointing and stone movement occurring at corner, likely as a result of spandrel beam and column corrosion behind pier

Dowels and Plinth (Area 3) – NDE data analysis in Area 3 resolved vertical metallic features assumed to be dowels and also large metallic features assumed to be supporting plinths to the large stone columns to the Loggia above.

The steel dowels have not caused any significant visible failures along the course of arches in Area 3, which is likely result of their embedment depth of approximately 4" from the outer face and the fact the stone above projects out from the arched course of stone, providing a drip edge and preventing significant moisture from entering the joint during wet weather conditions.

The plinth however, containing metal (steel 'I' sections or reinforced concrete or similar) are coincident with significant displacement to the surrounding stone, beneath each column and suggests that expansive corrosion of the embedded steel is actively pushing out the stone, causing bulging of the stone course that extends horizontally from each column (See Figure 10 below).

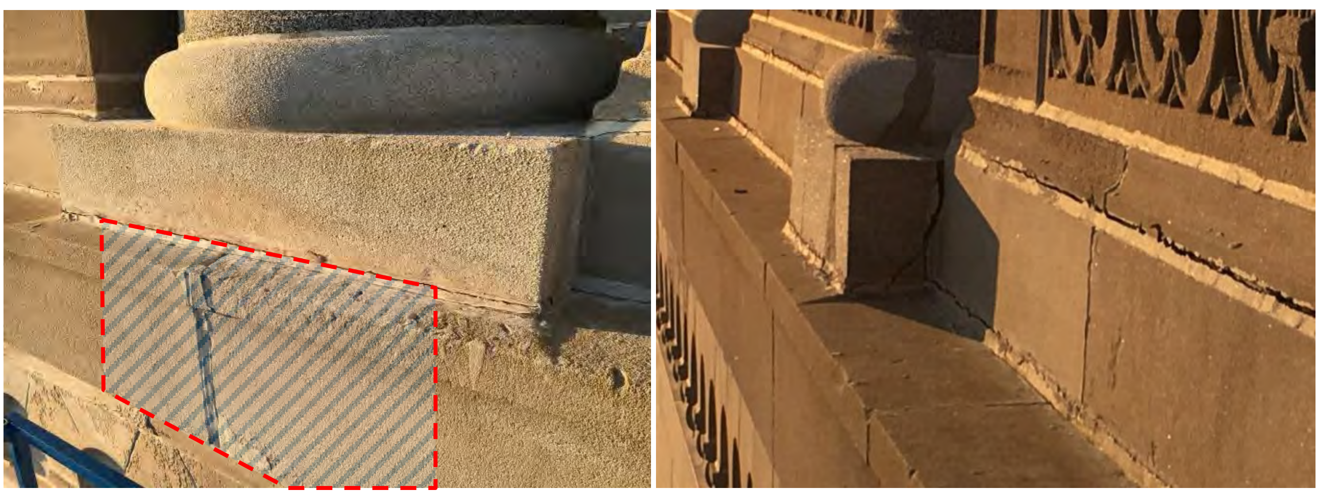


Fig 10: Cracking and pushing out / displacement of stone in front of and extending away from the Loggia stone column locations is indicative of active expansive corrosion to embedded metalwork in plinth (Area hatched blue highlights the approximate extent of stone containing steel – embedment depth 5")

In order to fully appreciate the extent of corrosion to the embedded steel beneath the columns, targeted exposures through the stone will be necessary.

3.3.3 Infrared Thermal Imaging Results

Infrared thermal imaging was conducted from street level and from an adjacent roof top at trump Plaza. The review highlighted a number of results which are explained in more detail below. The thermal imaging results are presented in the Appendix, as Figure 7. A description of the thermal imaging analysis procedures and what types of conditions are resolvable in the data collected is provided below.

Stone Thickness Mapping

Assessment of the surface temperature is able to provide relative information regarding stone thickness. Thicker stones hold heat for longer periods and also lose heat more slowly than for thinner stones. These temperature patterns can be mapped and used to understand general thickness related information (See Figure 11 below).

Note: Thermal images confirmed results from the detailed survey areas that confirm that block courses of alternating thicknesses exist across all elevations.

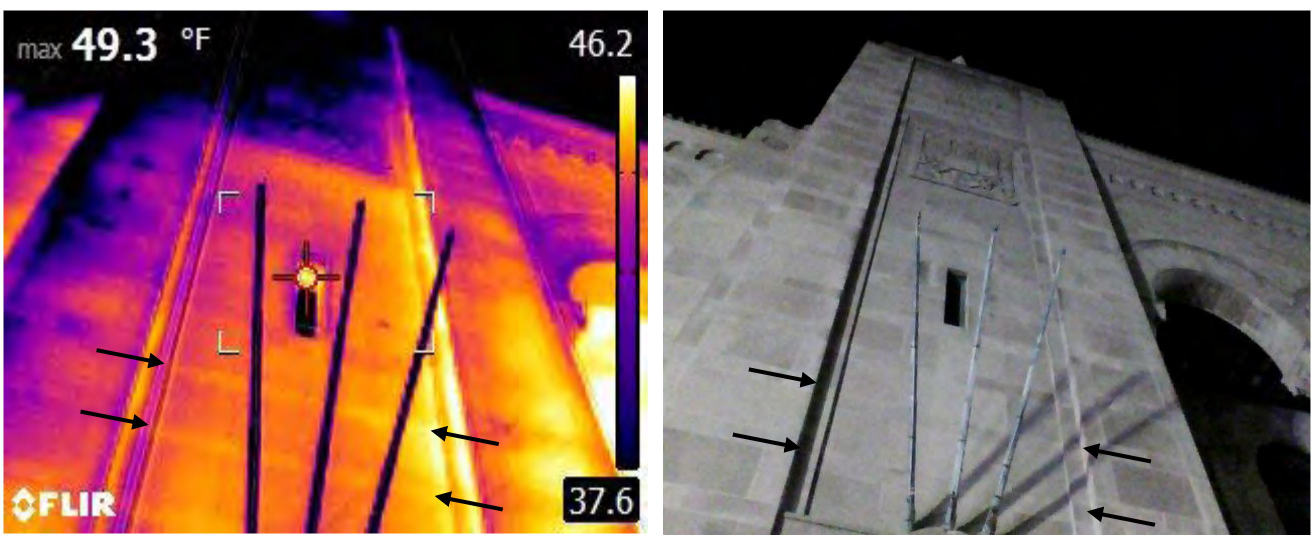


Fig 11: Horizontal hotter (lighter) stone courses highlight thicker stones as a result of increased heat retention

Spalling stonework

Assessment of the surface temperature is able to provide information regarding stone spalling. As this assessment was conducted at the end of the day and in cold conditions thinner sections of stone cooled more rapidly than the larger mass of the stone bocks they were detaching from; therefore they provided localized cooler responses (See Figure 12 on the following page).

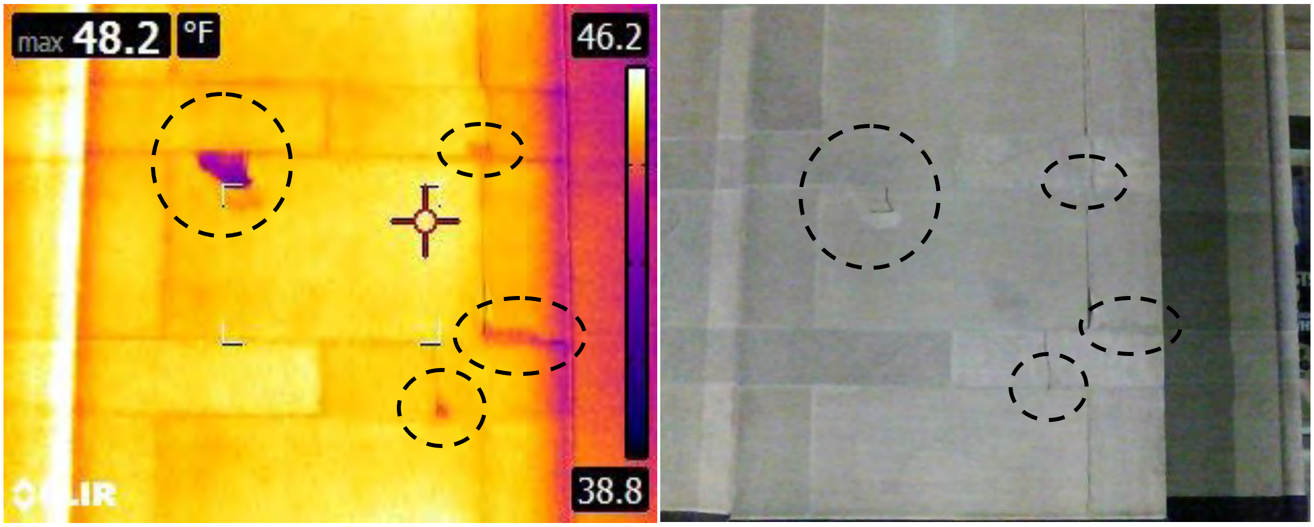


Fig 12: Localized cooler (darker) responses highlight areas of spalling stone, already detaching from the façade

Moisture Retention

Assessment of the surface temperature is able to provide relative information regarding moisture retention and also stone displacement / open jointing, which can provide useful indicators in terms of areas most at risk from accelerated stone deterioration and corrosion of embedded anchors and framing.

Moisture close to the surface is typically mapped as a cooler response, which can be further verified through the use of a moisture meter (See Figure 13 below).

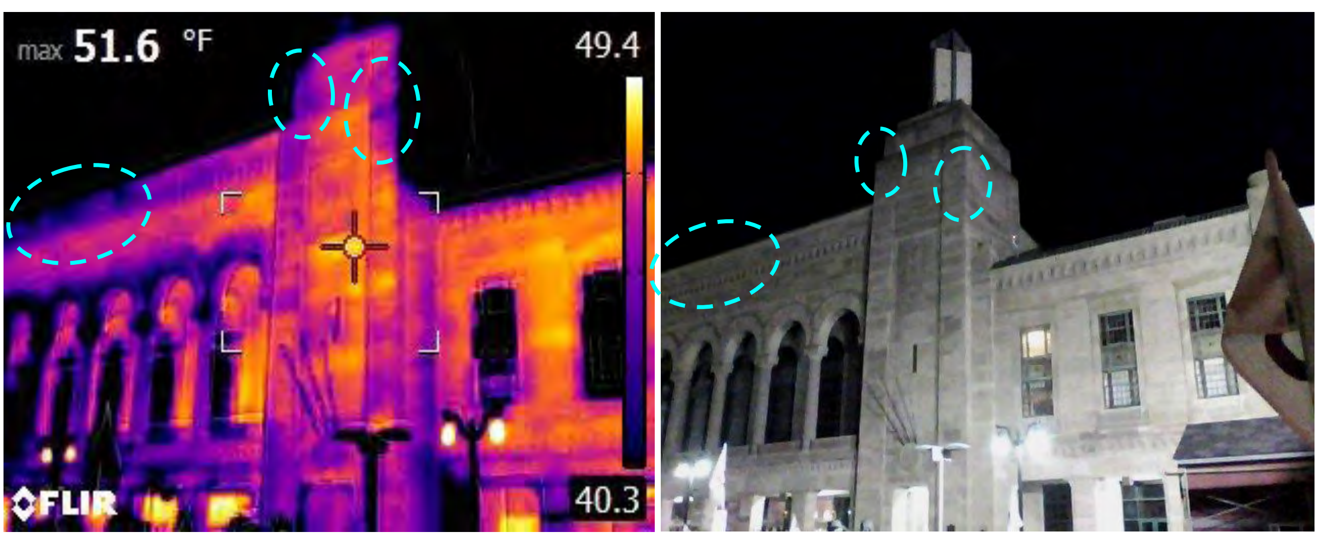


Fig 13: Cooler (darker) responses in thermal images can highlight areas of moisture retention and open jointing / stone displacement due to increased flow of cool air through mortar joints.

4.0 CONCUSIONS & RECOMMENDATIONS

4.1 Conclusions

Based on NDE data collected during Visits 1 & 2 much of the main central spans of stone, in particular the upper and lower side elevations appears visually to be in fair condition with relatively few cracks, spalls and displacement for a building of this age. The corners however, in particular the upper areas of façade, do display significant cracking and stone displacement, which is the result of corrosion to embedded steel anchorage and framing, the extent of which will need to be established through probing, and potentially additional NDE. Numerous examples of this stone deterioration and displacement have been provided as part of this assessment.

In addition to the corners the stone courses beneath the Boardwalk façade loggia columns are also cracking and displaced (pushing out / bulging) as a result of corrosion to embedded steel behind, the extent of which will need to be established through future probing and visual inspection (See Appendix Figure 4 for more information).

Smaller areas of localized spalling are actively occurring as a result of embedded corroding steel anchors. Although only a relatively small number of these spalls are currently visible from street level and only a small number have actually failed and fallen, close up inspections by CBZ has revealed numerous hairline cracks, rust stains and early stage spalls, which will continue to worsen and detach from the façade during cold weather conditions as a result of freeze thaw cycles. One spall during Visit 2 was actually removed from the façade by CBZ as it was loose and represented a health and safety risk to pedestrians below (See images in Appendix Figure 6).

NDE data analysis has revealed that shallow embedded anchors (placed <1½" from the exterior stone face) may represent up to 30-40% of anchors across all façades. Anchors placed this close to the surface are at greatest risk of corrosion and subsequent spalling to the surrounding stone and will require careful consideration in terms of future façade reviews, maintenance plans and repair procedures. It should be noted that most corrosion and subsequent spalling occurs in the larger (thinner) panels, where anchors are placed centrally within 3" panels; these are anchors are therefore embedded no greater than 1½" from the exterior face.

4.2 Recommendations

The following items should be considered as additional inspections for the future:

1. ***Mapping corroding anchors and incipient / future spalls*** - In addition to close visual inspection Infrared thermal imaging has identified additional insipient spalls, which are either barely visible as hairline cracks or have not yet caused any surface damage.

Although thermal imaging results are presented as Figure 7 in the Appendix, the results are generalized and highlight that the problem of open jointing and spalling stone extends well beyond the targeted five (5) areas investigated using GPR and Metal detection.

In order to fully understand the extent of incipient spalls and thus future hazardous conditions and repair needs, a more thorough investigation of all façades using a combination of techniques to include close visual inspection, metal detection, infrared thermography, GPR and sounding is strongly recommended.

2. ***Mapping Steel Structure*** – Although Visits 1 & 2 allowed for assessment of the embedded steel framing at five (5) locations, additional inspections could allow for more accurate mapping of the embedded framing (columns, spandrels and shelf angles etc.); this would be of benefit when estimating construction repair work

   It is important to note however, that this investigation has revealed that the historic drawings available are relatively accurate and thus can be used to a good degree for estimating purposes.

Appendix – Drawings D01 – D08 (Separate Attachment)

FIGURE 1 – GENERAL VIEW OF BOARDWALK (FRONT) ELEVATION HIGHLIGHTING SURVEY AREAS 1-5 (SEE ALSO FIGURES 2-6)

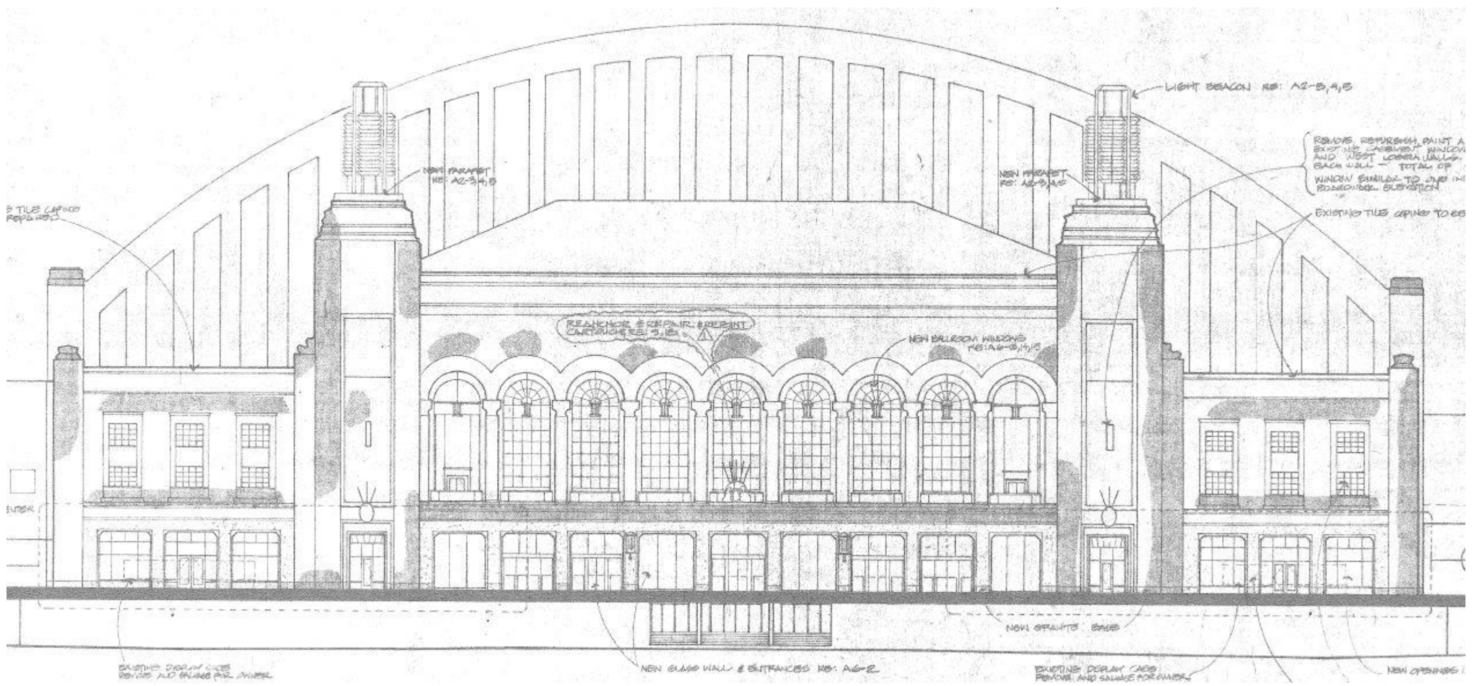


FIGURE 1A: BOARDWALK ELEVATION – NTS (PROVIDED BY PFA)

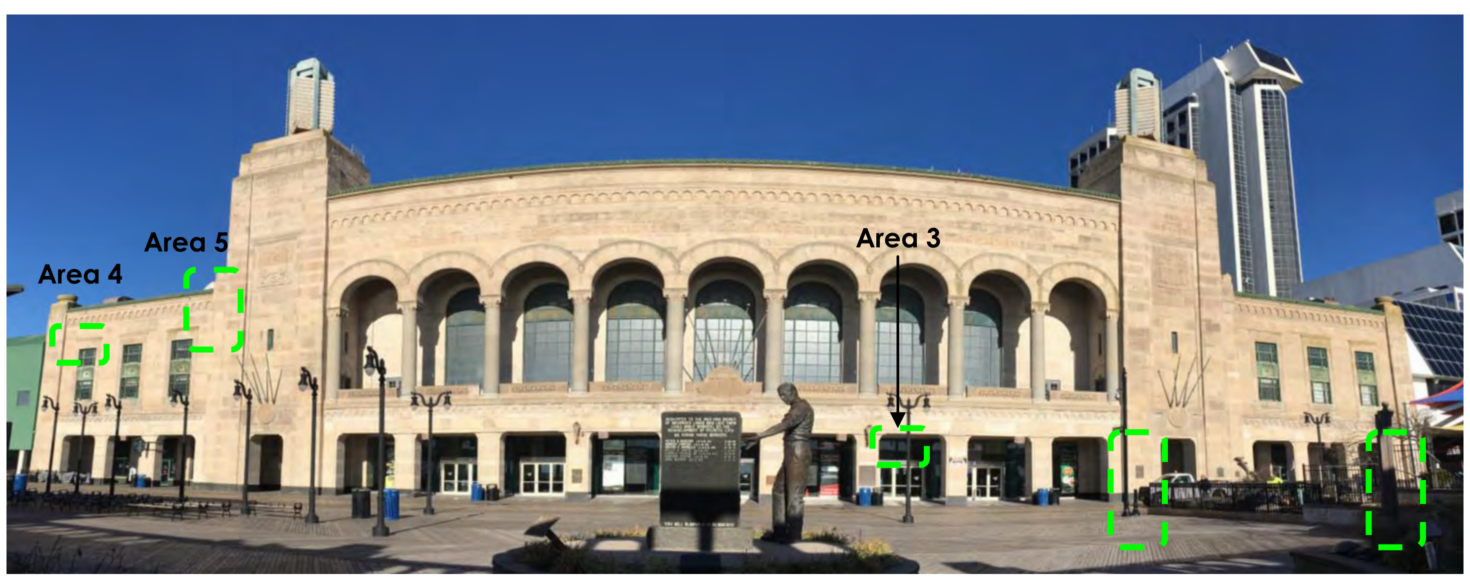


FIGURE 1B: BOARDWALK ELEVATION (PANORAMIC IMAGE) - IMAGE BY CBZ

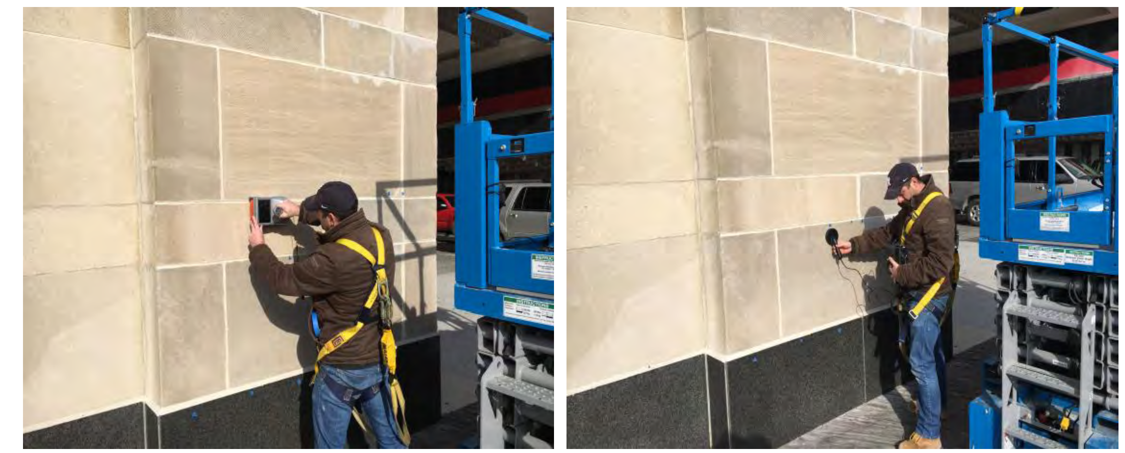


FIGURE 1C: LEFT: GPR DATA COLLECTION / RIGHT: METAL DETECTION DATA COLLECTION

Legend:

- Approximate extent of area scanned using GPR & Metal Detection
- Masonry Backup – assumed brick
- Limestone Block
- 3½" Limestone Block thickness (approximate)
- Embedded steel target – assumed anchor (cover depth ≥ 1")
- Embedded steel target – assumed anchor (cover depth < 1") (Corroding or at high risk of corroding)
- Steel 'I' Section Column / shelf angle
- Steel 'I' Section Column (Assumed or inferred location)

FIGURE 1D: DRAWING LEGEND (FOR ALL DRAWINGS PROVIDED)

Figure 2 – Area 1 (Not To Scale) – GPR & Metal Detection Results

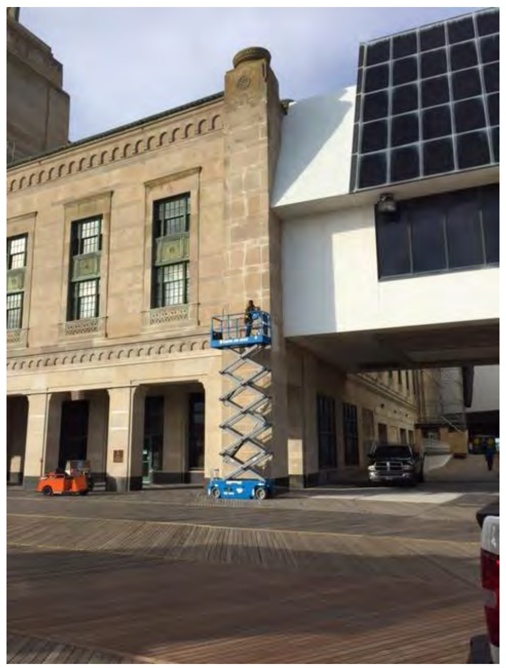


Figure 2A: General View of Area 1 Under Inspection

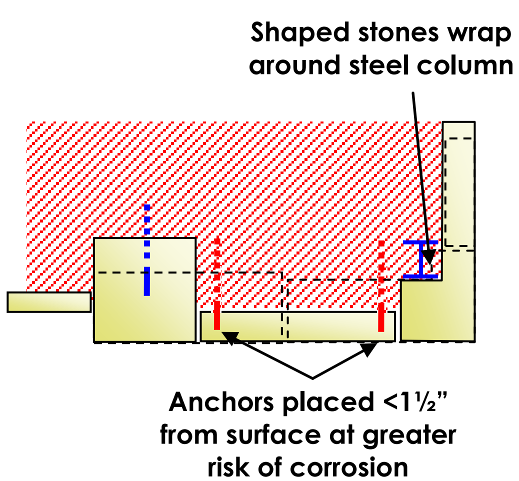


Figure 2B: Schematic Plan Section B-B

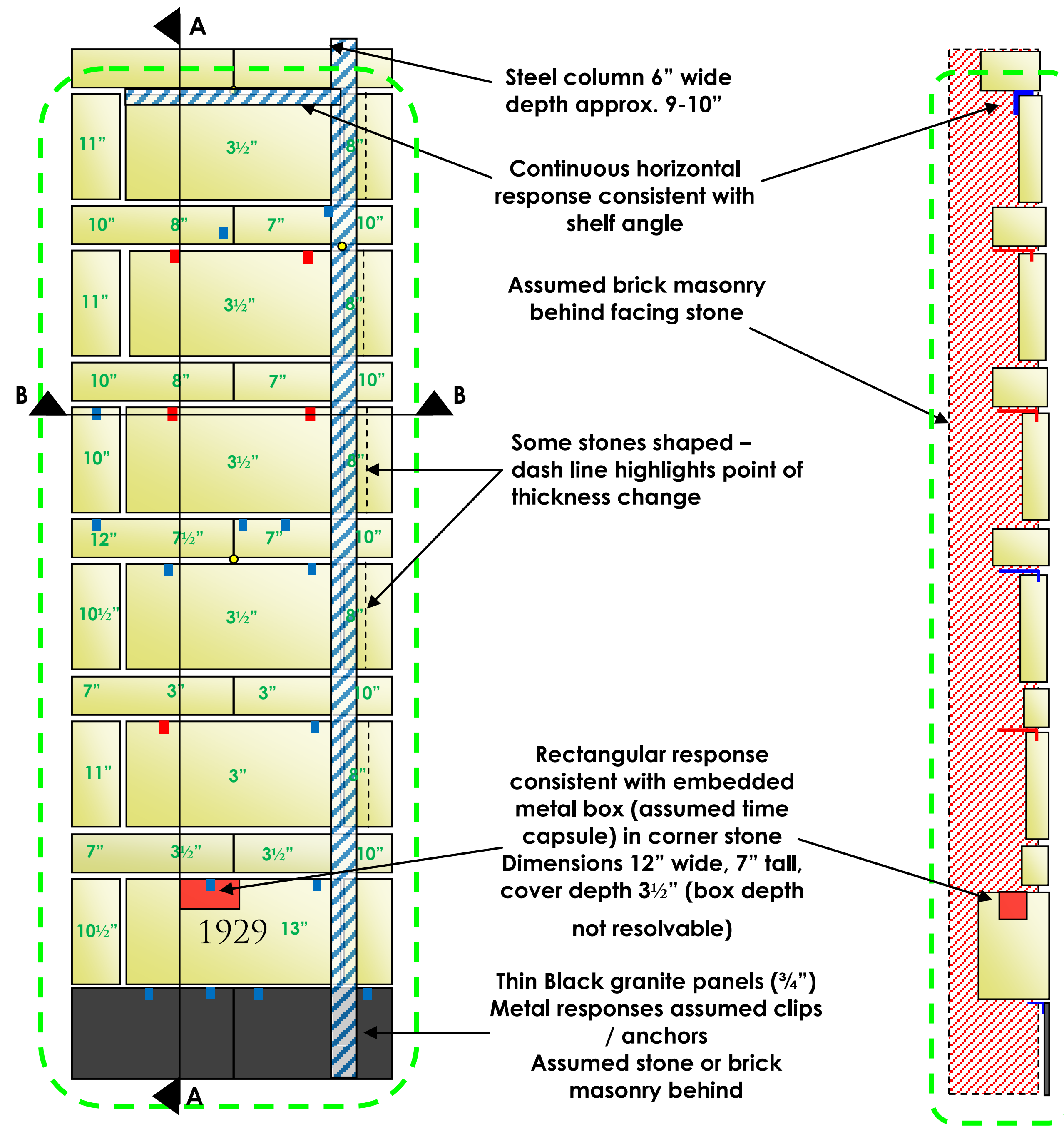


Figure 2C: Schematic elevation showing metallic inclusions (assumed anchors, column and angle) and stone thicknesses

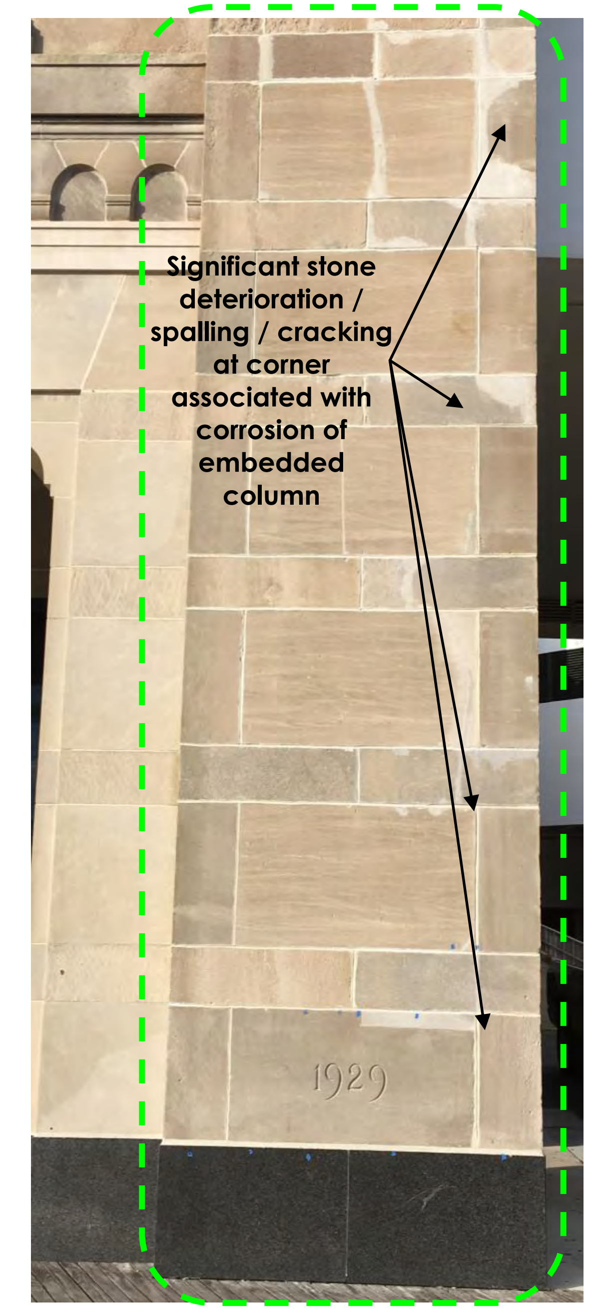


Figure 2D: Left: Schematic Section A-A / Right: Image showing Area 1 general conditions

Figure 3 – Area 2 (Not To Scale) – GPR & Metal Detection Results

Figure 3A: General View of Area 2 Under Inspection

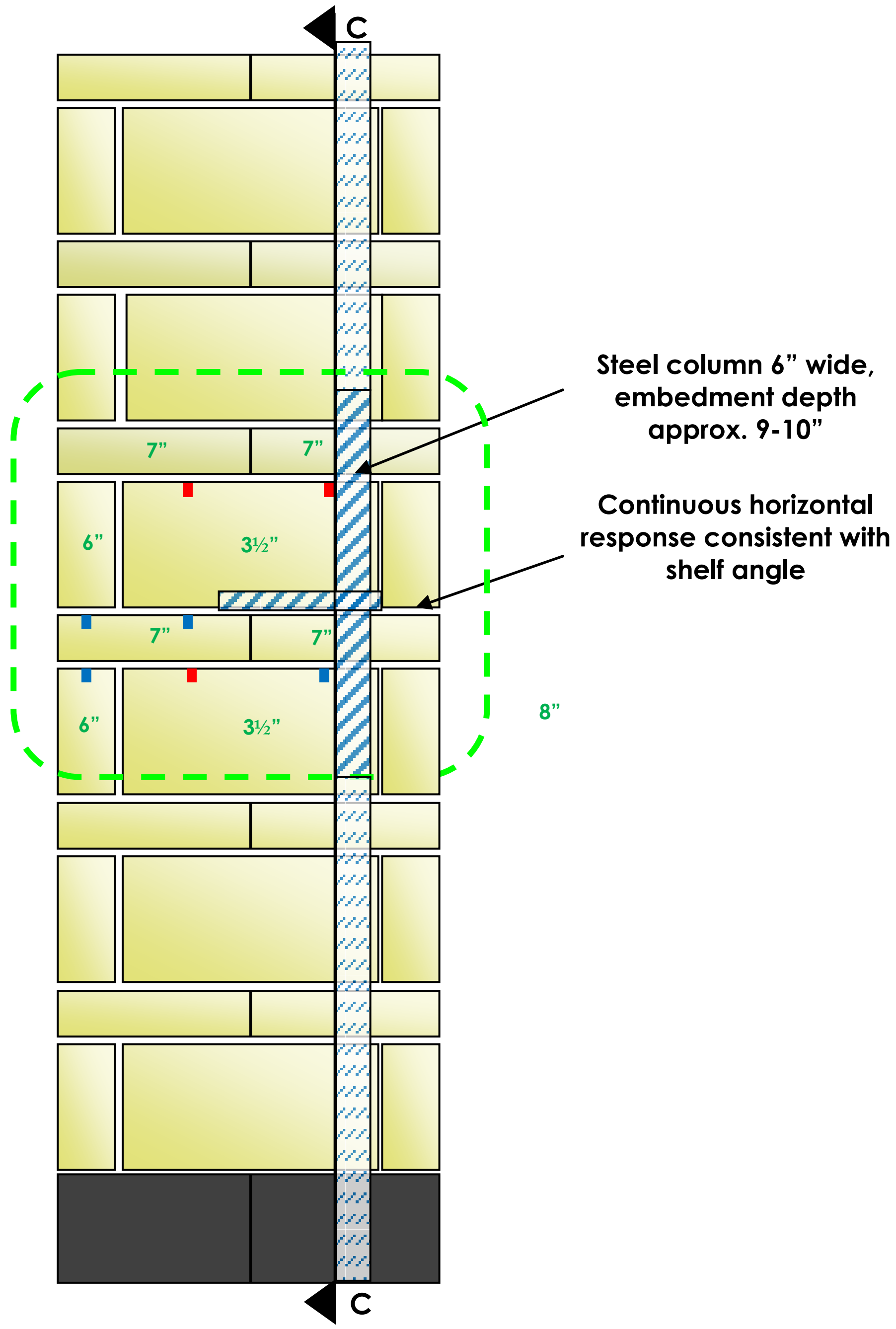


Figure 3B: Schematic elevation showing metallic inclusions (assumed anchors, column and angle) and stone thicknesses

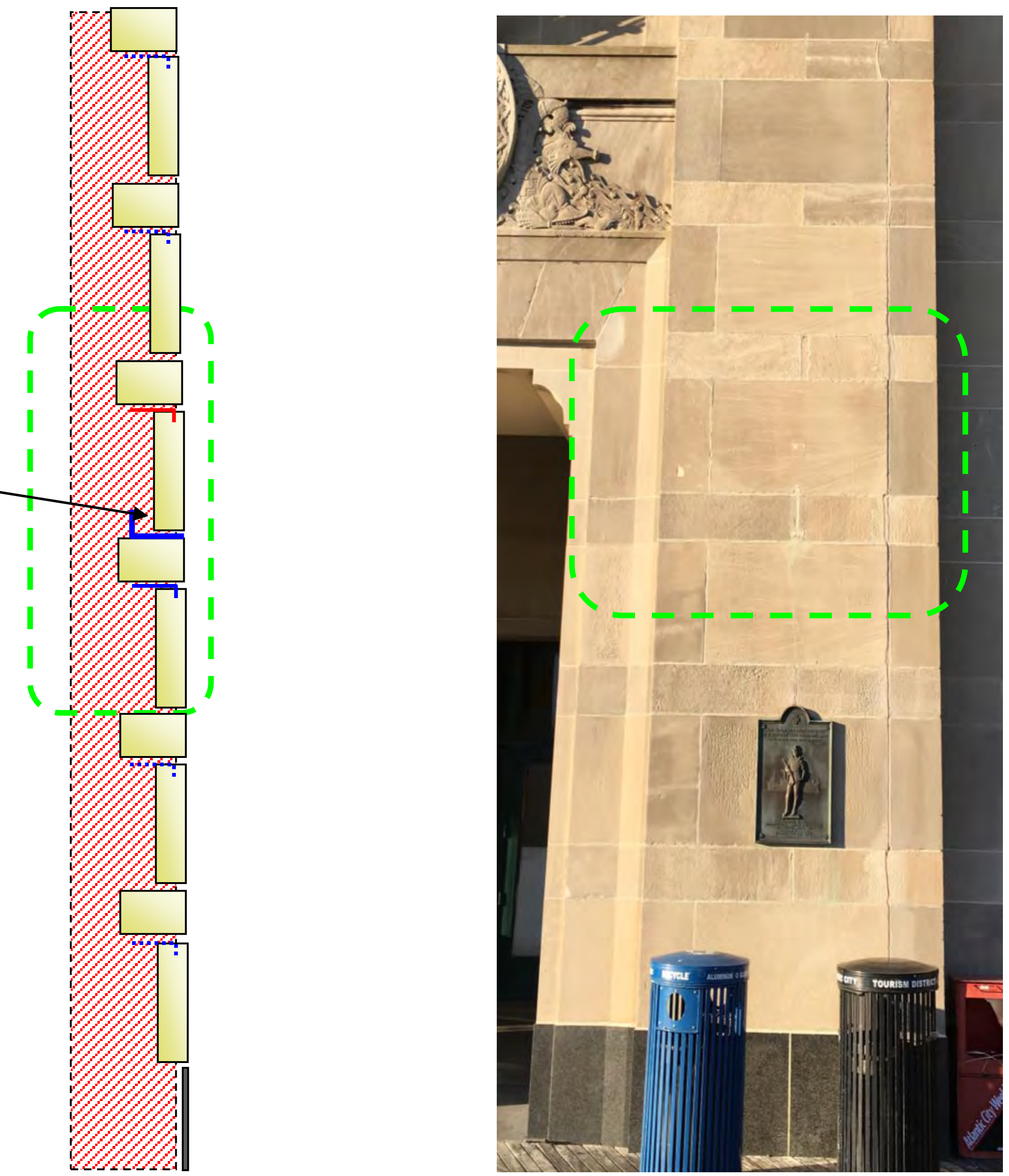


Figure 3C: Left: Schematic Section C-C / Right: Image showing Area 2 general conditions

FIGURE 4 – AREA 3 (NOT TO SCALE) – GPR & METAL DETECTION RESULTS

FIGURE 4A: GENERAL VIEW OF AREA 4 UNDER INSPECTION

FIGURE 4E: IMAGE SHOWING AREA 3

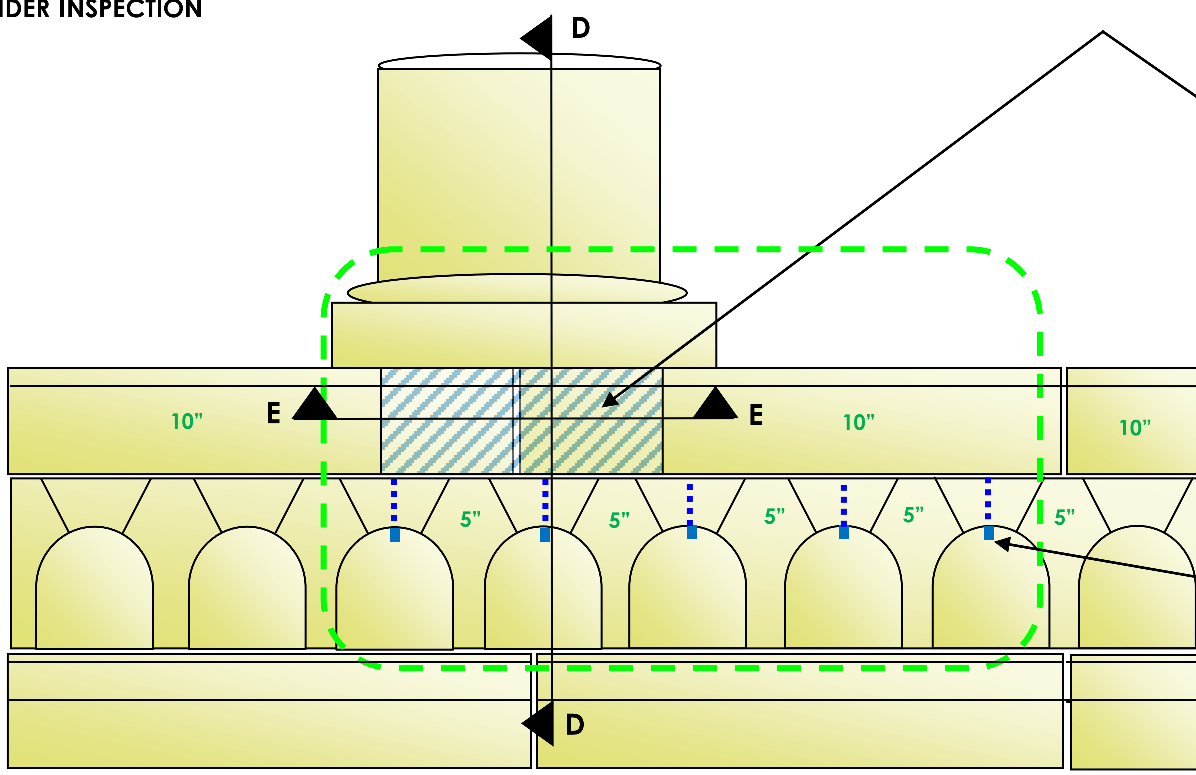


FIGURE 4B: SCHEMATIC ELEVATION SHOWING METALLIC INCLUSIONS (ASSUMED STEEL CONTAINING PLINTH AND DOWELS) AND STONE THICKNESSES

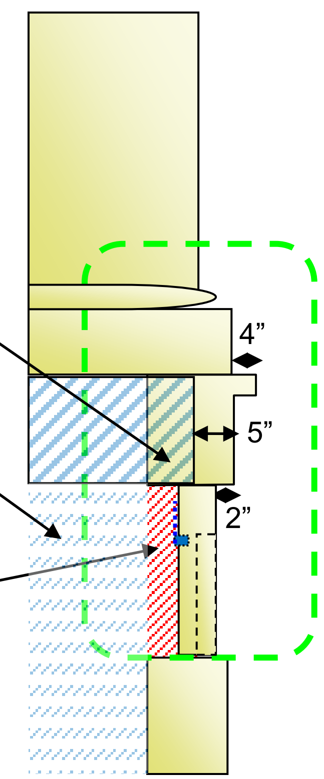


FIGURE 4C: LEFT: SCHEMATIC SECTION D-D

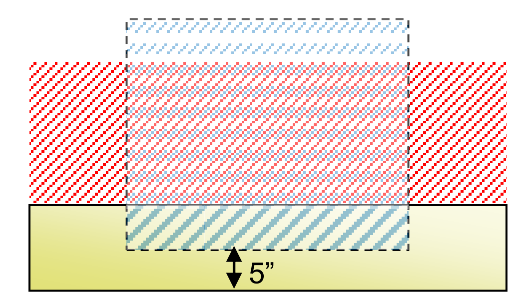


FIGURE 4D: SCHEMATIC PLAN SECTION E-E

FIGURE 5 – AREA 4 (NOT TO SCALE) – GPR & METAL DETECTION RESULTS

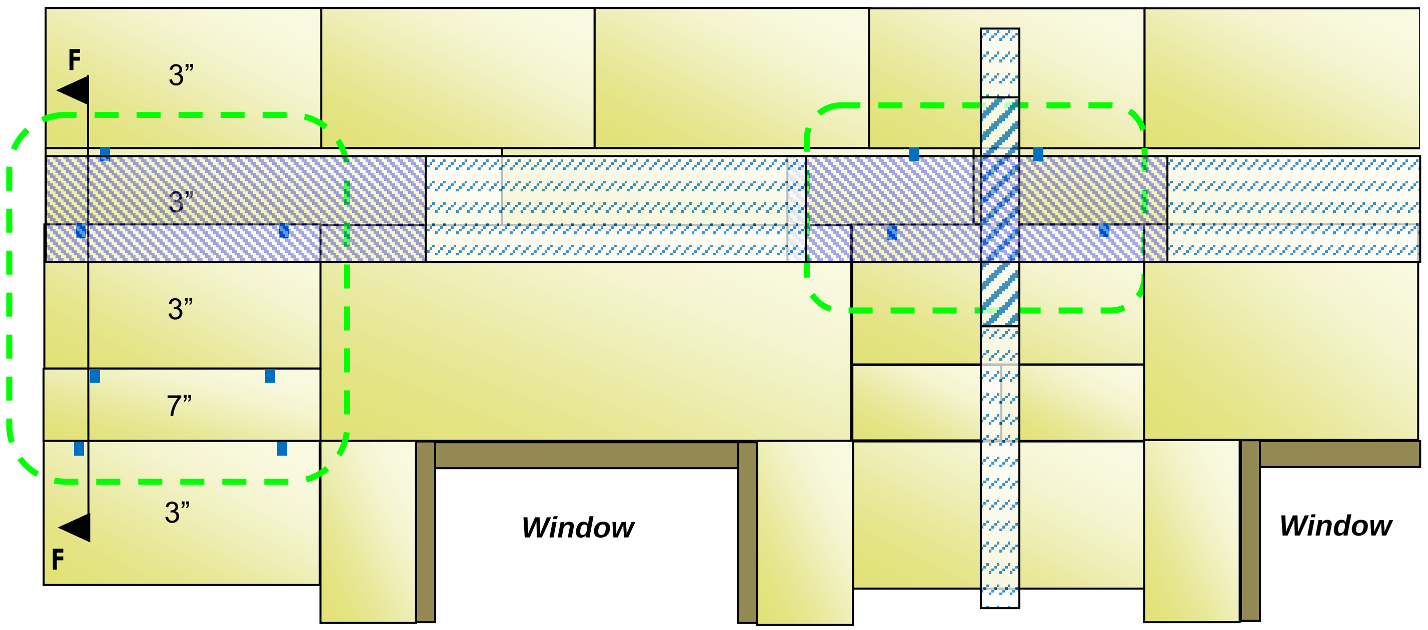


FIGURE 5A: SCHEMATIC ELEVATION SHOWING METALLIC INCLUSIONS, STONE BLOCK THICKNESSES AND STEEL FRAMING IDENTIFIED AT AREA 5

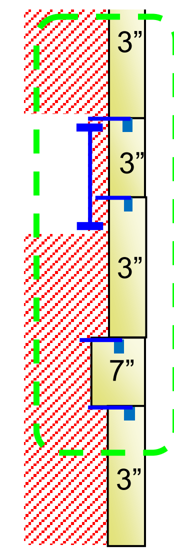


FIGURE 5B: LEFT: SCHEMATIC SECTION F-F

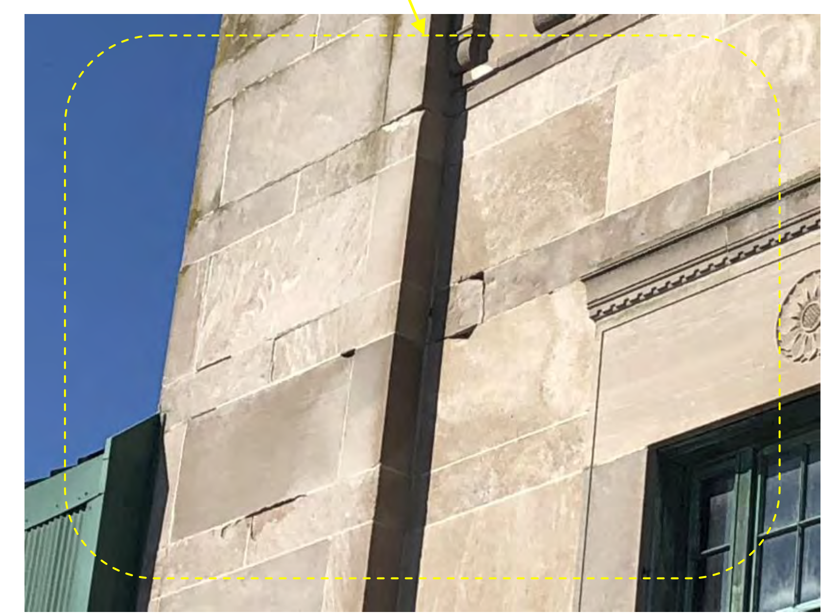


FIGURE 5C: SIGNIFICANT DAMAGE TO STONE IN FRONT OF SPANDREL BEAM

FIGURE 5D: CLOSE UP OF CORRODED ANCHOR – COVER DEPTH 1½"

FIGURE 5C: IMAGES SHOWING AREA 5

Figure 6 – Area 5 (Not To Scale) – GPR & Metal Detection Results

Figure 6E: Spalling / detached stone removed at corroded anchor

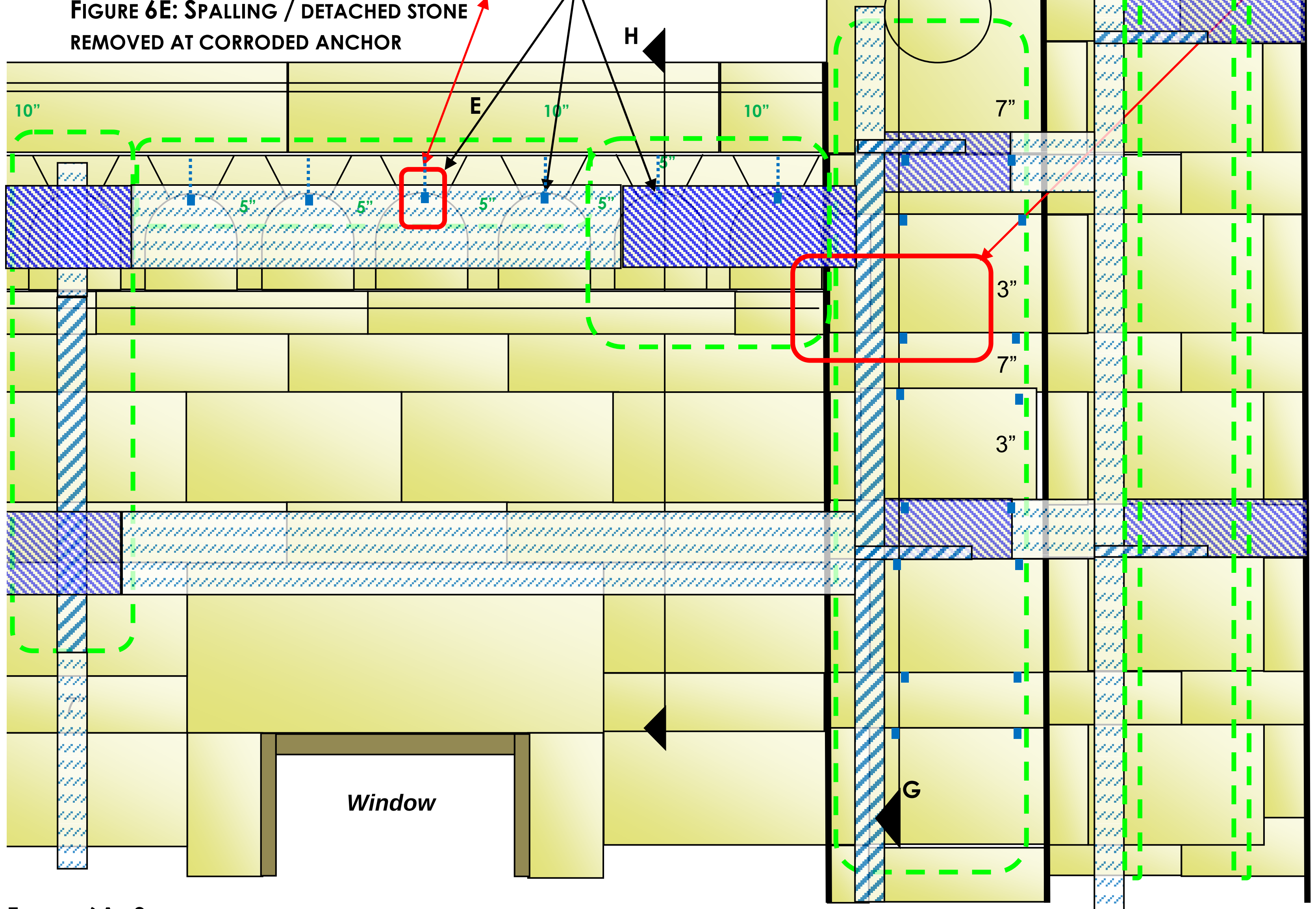


Figure 6A: Schematic elevation showing metallic inclusions, approximate stone block thicknesses and evidence of Steel Framing identified at Area 6

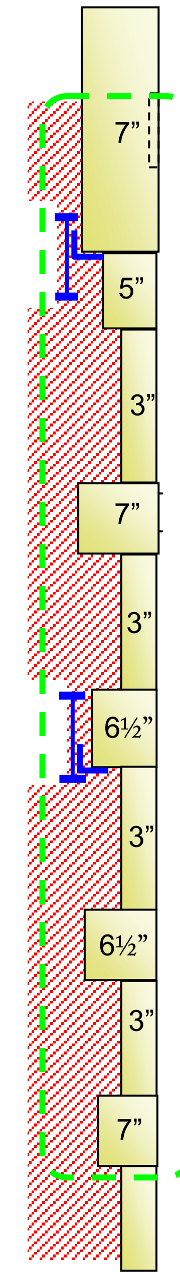


Figure 6B: Schematic Section G-G

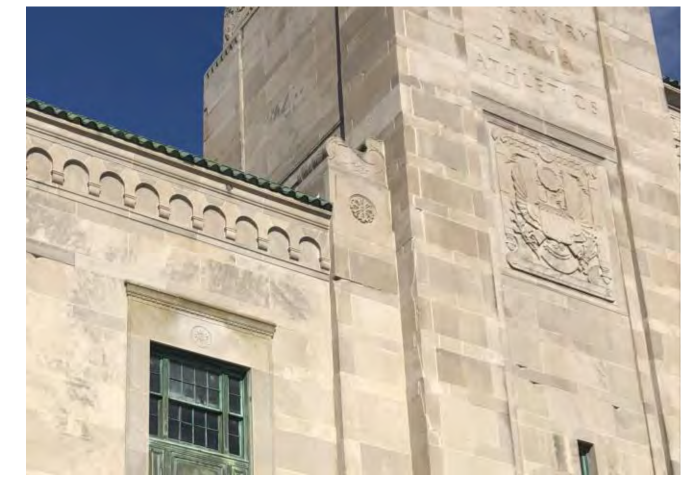


Figure 6D: Images showing Area 6

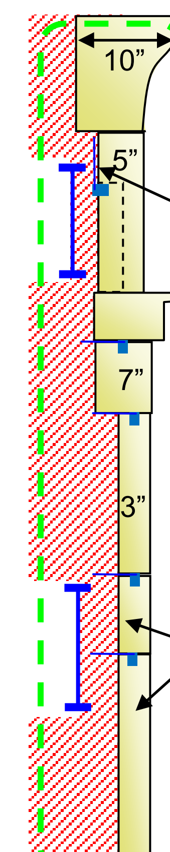


Figure 6C: Schematic Section H-H

FIGURE 7 – INFRARED THERMAL IMAGING RESULTS

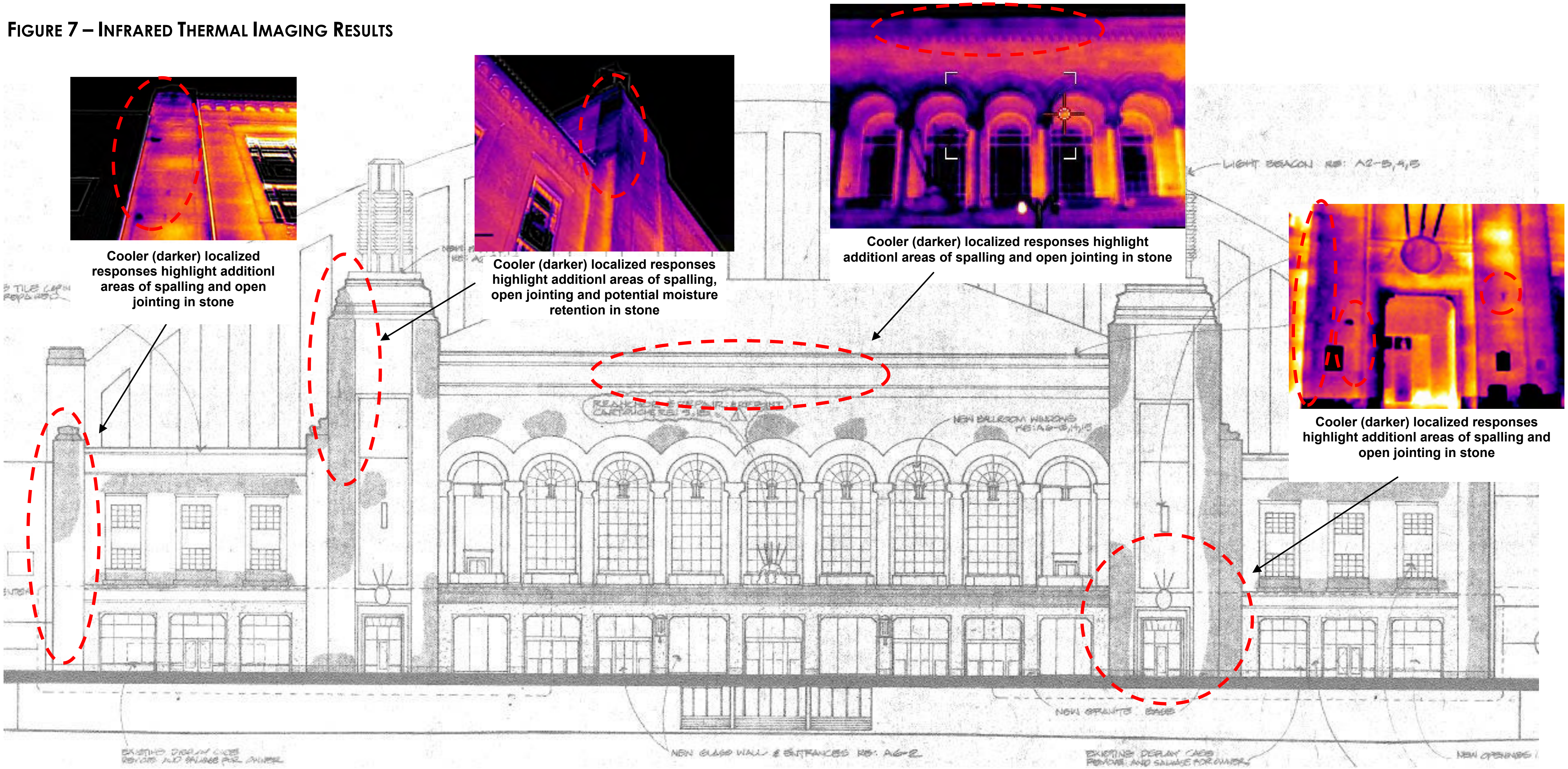


FIGURE 7A: BOARDWALK ELEVATION

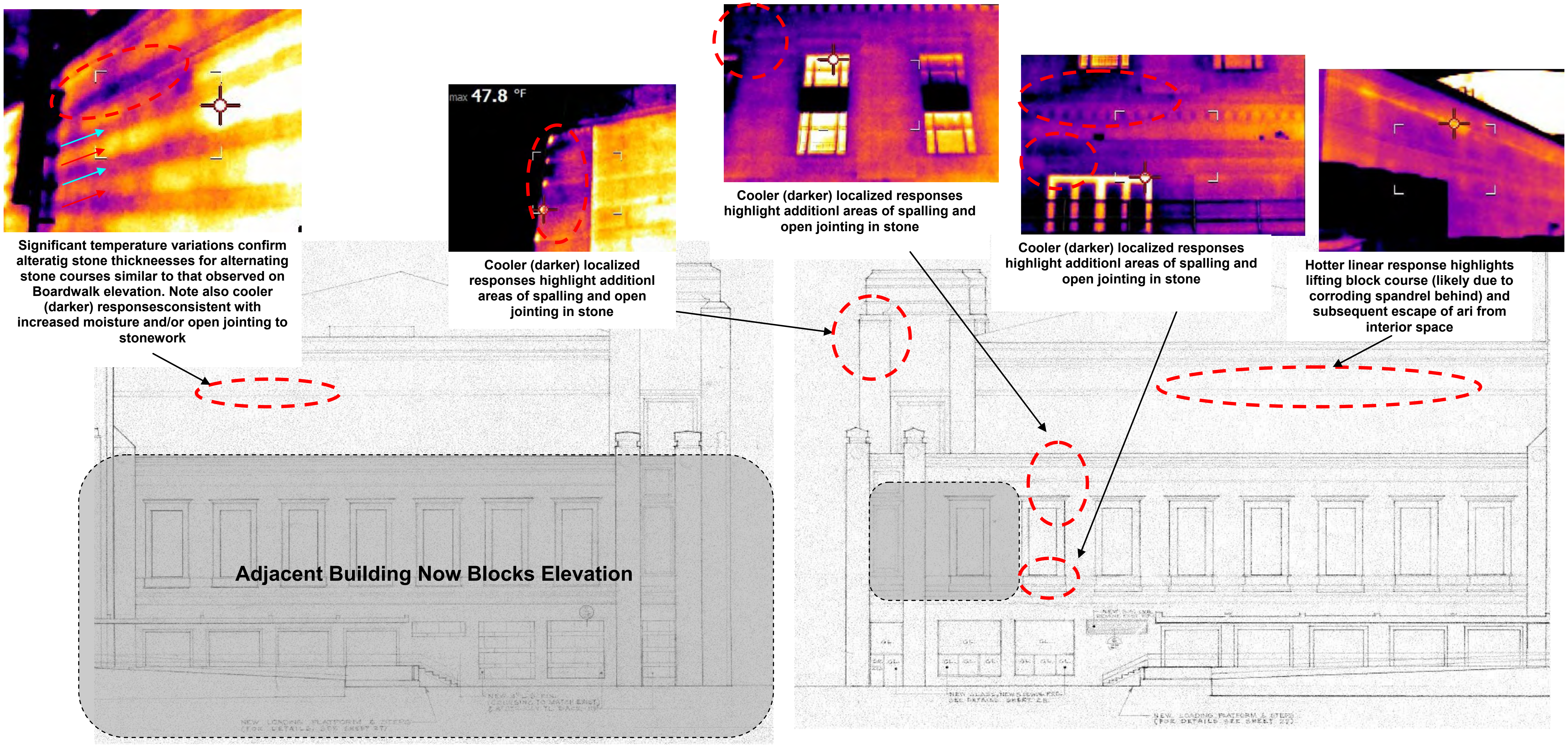


FIGURE 7B: GEORGIA AVENUE ELEVATION

FIGURE 7C: MISSISSIPPI AVENUE ELEVATION