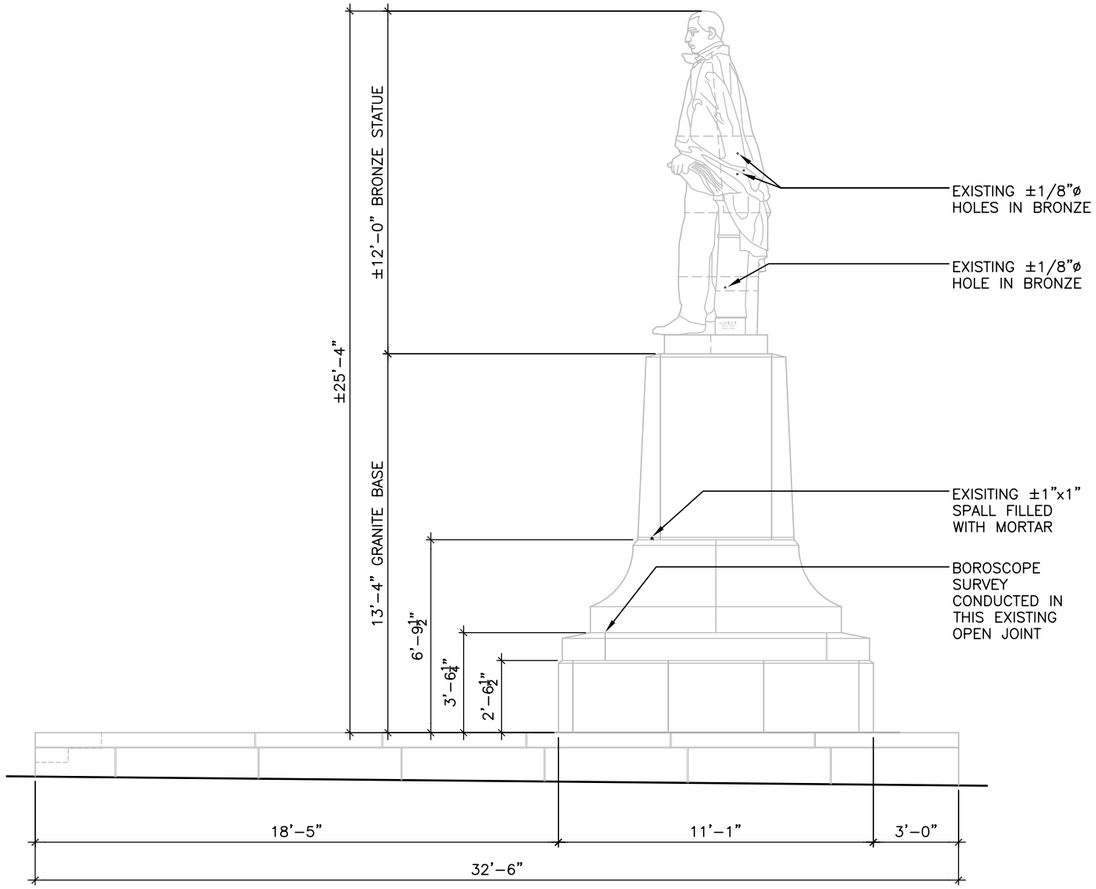
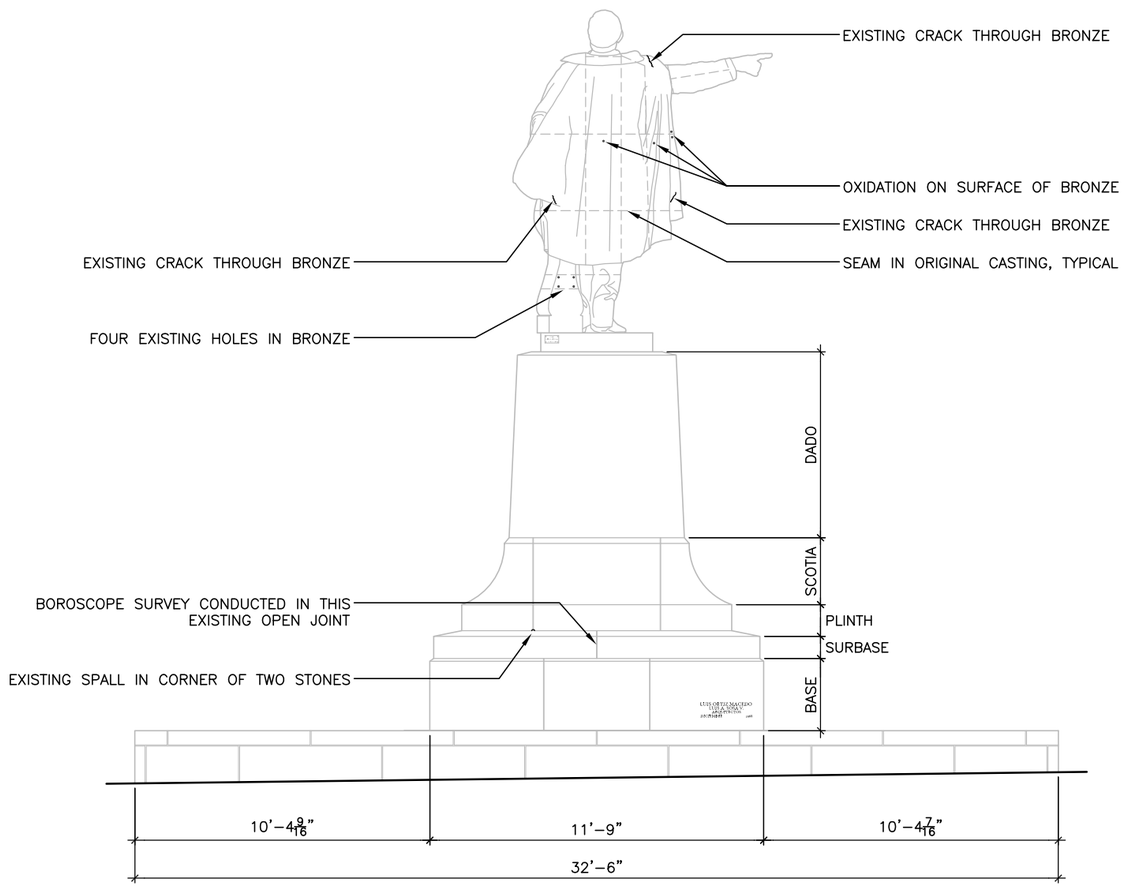


A/A2.2 SOUTH ELEVATION



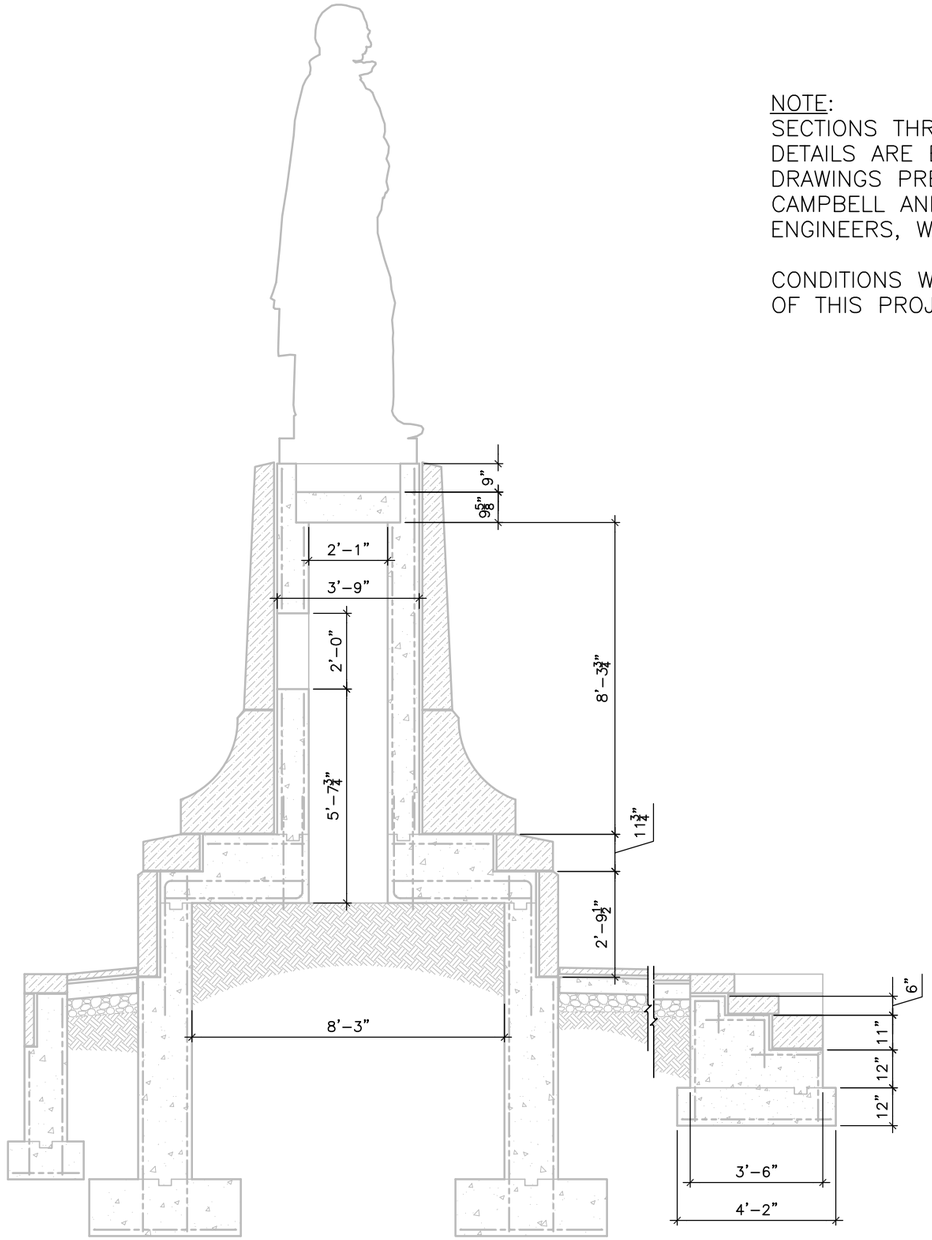
B/A2.2 EAST ELEVATION

2 0 2 4 6
SCALE OF FEET

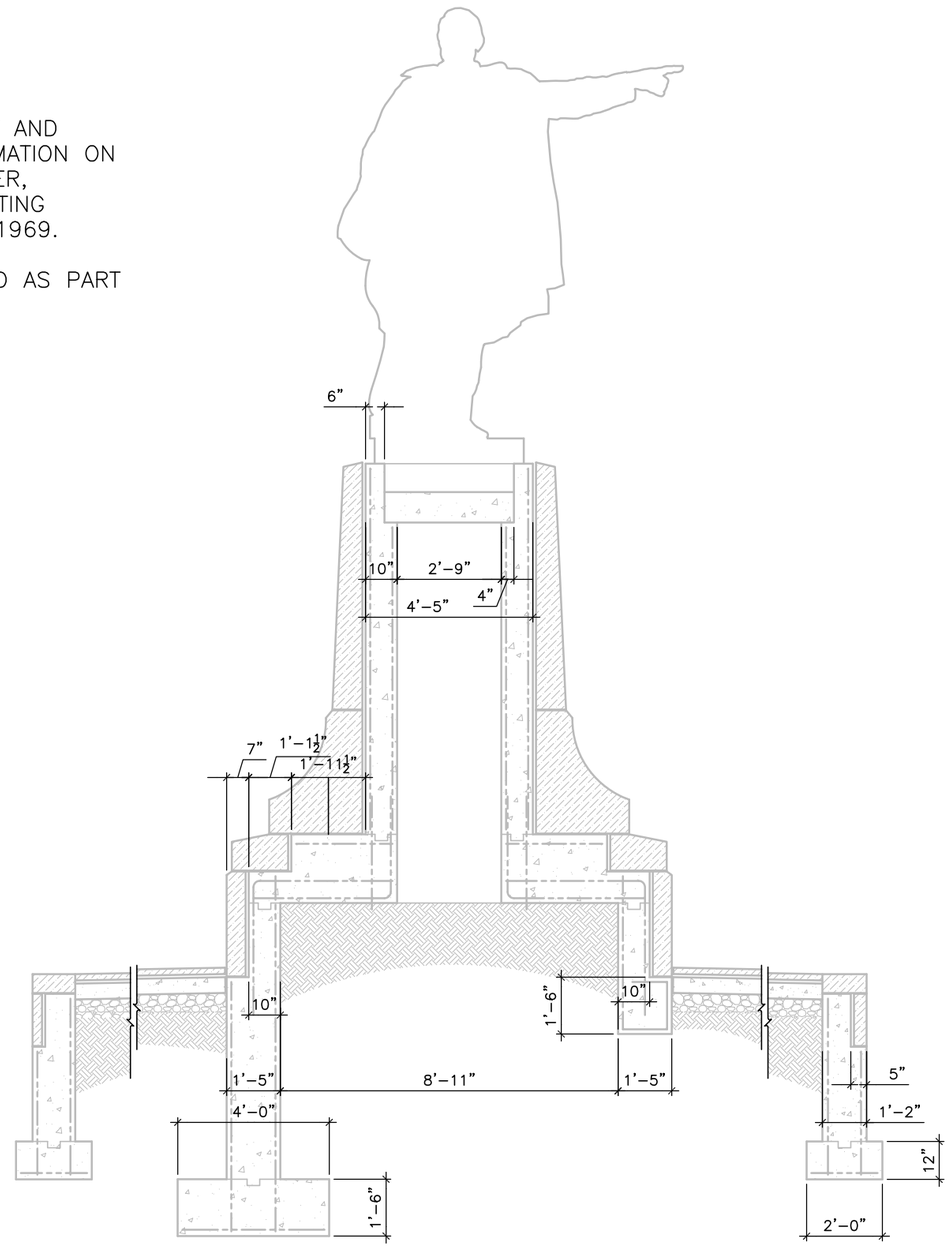
A/E FIRM ARCHITECT: OEHRLEIN & ASSOCIATES ARCHITECTS 1350 CONNECTICUT AVE. NW SUITE 402 WASHINGTON, DC 20036 202-785-7338 202-785-7334 (FAX)	Mark	Sheet	REVISION	Date	Initial	A2.2 SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION	DESIGNED MJH/BDR DRAWN MJH/BDR CHECKED MJH/BDR
							INVESTIGATIVE CONDITION ASSESSMENT AND REPORT FOR BENITO PABLO JUAREZ MONUMENT AND PLAZA	DWG. NO. 875 83420 DATE 01/25/10
			SOUTH & EAST ELEVATIONS TITLE OF DRAWING				TITLE OF PROJECT NATIONAL MALL AND MEMORIAL PARKS NAME OF PARK	SHEET 6 OF 8

NOTE:
SECTIONS THROUGH MONUMENT AND DETAILS ARE BASED ON INFORMATION ON DRAWINGS PREPARED BY PALMER, CAMPBELL AND REESE CONSULTING ENGINEERS, WASHINGTON, DC, 1969.

CONDITIONS WERE NOT VERIFIED AS PART OF THIS PROJECT.



A A2.3 SECTION LOOKING SOUTH



B A2.3 SECTION LOOKING WEST

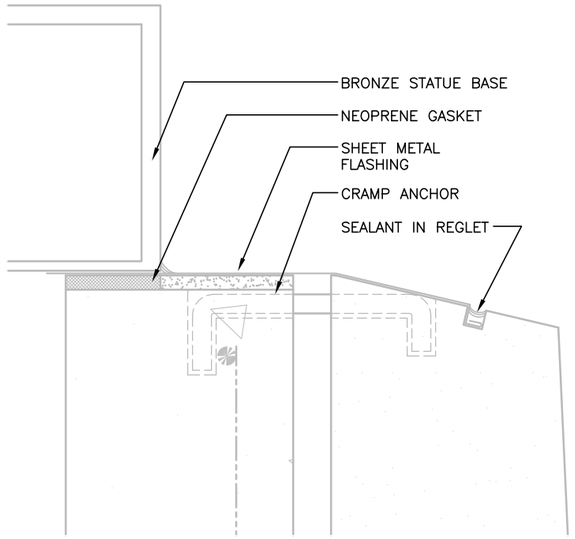
2 0 2 4
SCALE OF FEET

A/E FIRM ARCHITECT: OEHRLEIN & ASSOCIATES ARCHITECTS 1350 CONNECTICUT AVE. NW SUITE 412 WASHINGTON, DC 20036 202-785-7336 202-785-7334 (FAX)	Mark	Sheet	REVISION	Date	Initial	A2.3 SUB SHEET NUMBER
						SECTIONS TITLE OF DRAWING

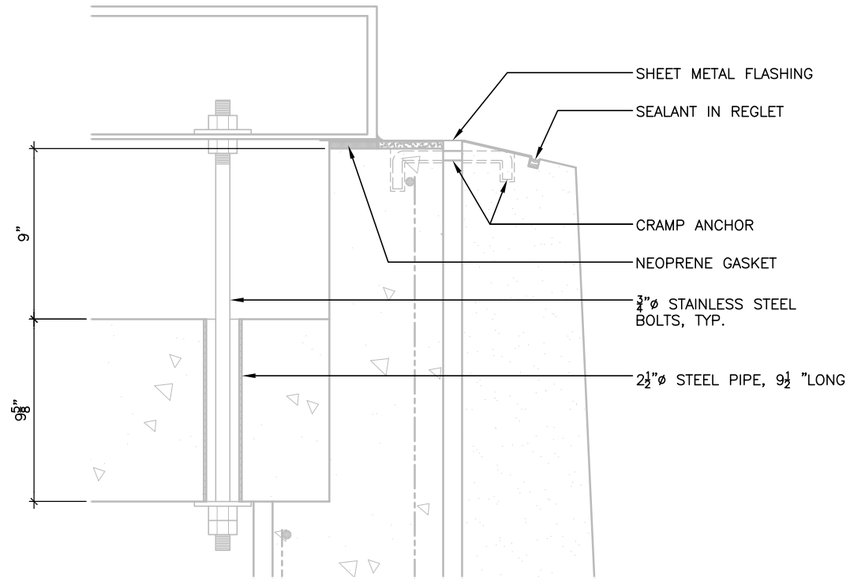
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

INVESTIGATIVE CONDITION ASSESSMENT AND REPORT FOR BENITO PABLO JUAREZ MONUMENT AND PLAZA
TITLE OF PROJECT
NATIONAL MALL AND MEMORIAL PARKS
NAME OF PARK

DESIGNED	MJH/BDR
DRAWN	MJH/BDR
CHECKED	MJH/BDR
DWG. NO.	875
	83420
DATE	01/25/10
SHEET	7 OF 8



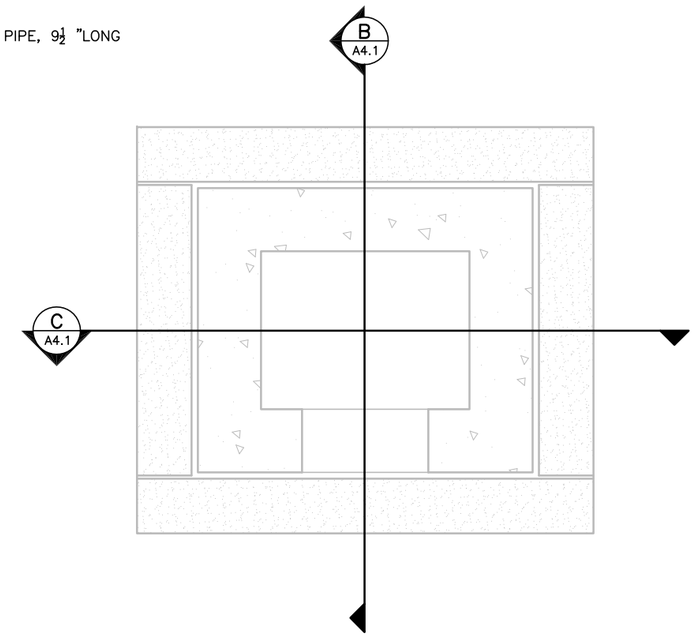
E A4.1 FLASHING DETAIL AT STATUE BASE
SCALE C



D A4.1 FLASHING DETAIL AT STATUE BASE
SCALE B

NOTE:
SECTIONS THROUGH MONUMENT AND DETAILS ARE BASED ON INFORMATION ON DRAWINGS PREPARED BY PALMER, CAMPBELL AND REESE CONSULTING ENGINEERS, WASHINGTON, DC, 1969.

INTERIOR CONDITIONS WERE NOT VERIFIED AS PART OF THIS PROJECT.



SCALE (A)

A A4.1 PLAN AT PEDESTAL
SCALE A

C A4.1 DETAIL SECTION LOOKING SOUTH
SCALE A

B A4.1 DETAIL SECTION LOOKING WEST
SCALE A

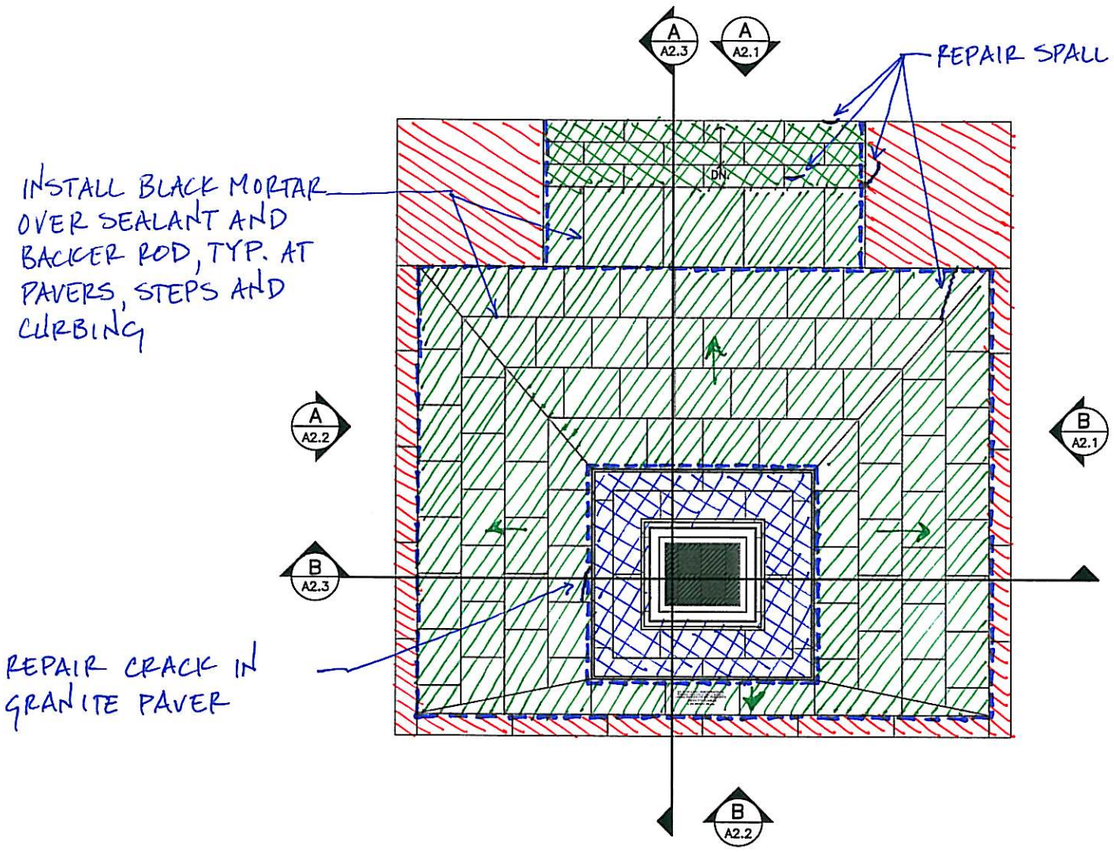
SCALE (C) 2 0 2 4
SCALE OF INCHES

SCALE (B) 6 3 0 6
SCALE OF INCHES

SCALE (A) 1 0 1 2
SCALE OF FEET

A/E FIRM ARCHITECT: OEHRLEIN & ASSOCIATES ARCHITECTS 1350 CONNECTICUT AVE. NW SUITE 412 WASHINGTON, DC 20036 202-785-7338 202-785-7334 (FAX)	Mark	Sheet	REVISION	Date	Initial	A4.1 SUB SHEET NUMBER
						UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
						INVESTIGATIVE CONDITION ASSESSMENT AND REPORT FOR BENITO PABLO JUAREZ MONUMENT AND PLAZA TITLE OF PROJECT NATIONAL MALL AND MEMORIAL PARKS NAME OF PARK
						DESIGNED MJH/BDR DRAWN MJH/BDR CHECKED MJH/BDR DWG. NO. 875 83420 DATE 01/25/10 SHEET 8 of 8
			DETAILS TITLE OF DRAWING			

NOTE: CLEAN GRANITE OF SOILING, ANIMAL DEPOSITS, AND BIOLOGICAL GROWTH, TYP.



A A1.1 PLAZA PLAN

LEGEND

- REMOVE AND RESET GRANITE CLADDING AT STATUE PEDESTAL IN NEW MORTAR BED. FACE POINT JOINTS WITH MORTAR
- REMOVE AND RESET GRANITE CURBING IN NEW MORTAR BED.
- REMOVE AND RESET PLAZA PAVERS AT CORRECT SLOPE IN NEW SAND SETTING BED.
- REMOVE AND RESET GRANITE STEPS IN NEW MORTAR BED.
- --- INSTALL SEALANT AND BACKER ROD

NOTE: FOR CLARITY, THE BRONZE STATUE IS NOT SHOWN IN PLAN VIEW

4 0 4 8
SCALE OF FEET

A/E FIRM
ARCHITECT:
OEHRLEIN & ASSOCIATES ARCHITECTS
1320 CONNECTICUT AVE. NW SUITE 412 WASHINGTON, DC 20036 202-785-7328 202-785-7334 (FAX)

Mark	Sheet	REVISION	Date	Initial

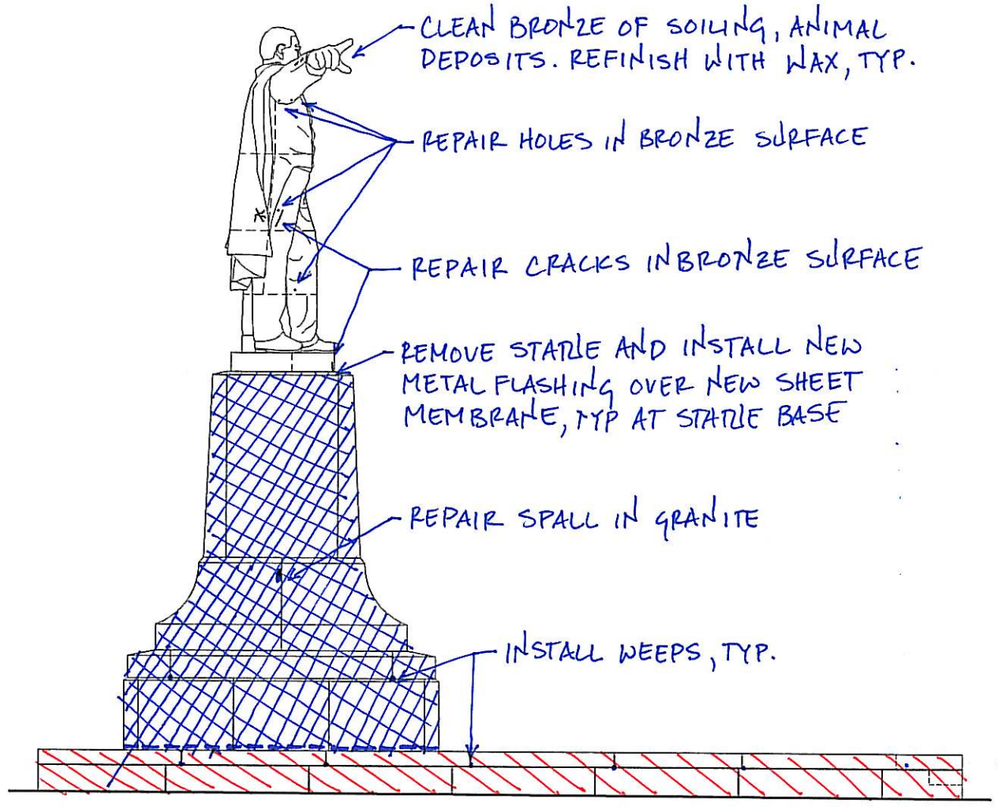
REPAIR PLAN
PLAZA PLAN
TITLE OF DRAWING

A1.1
SUB SHEET NUMBER

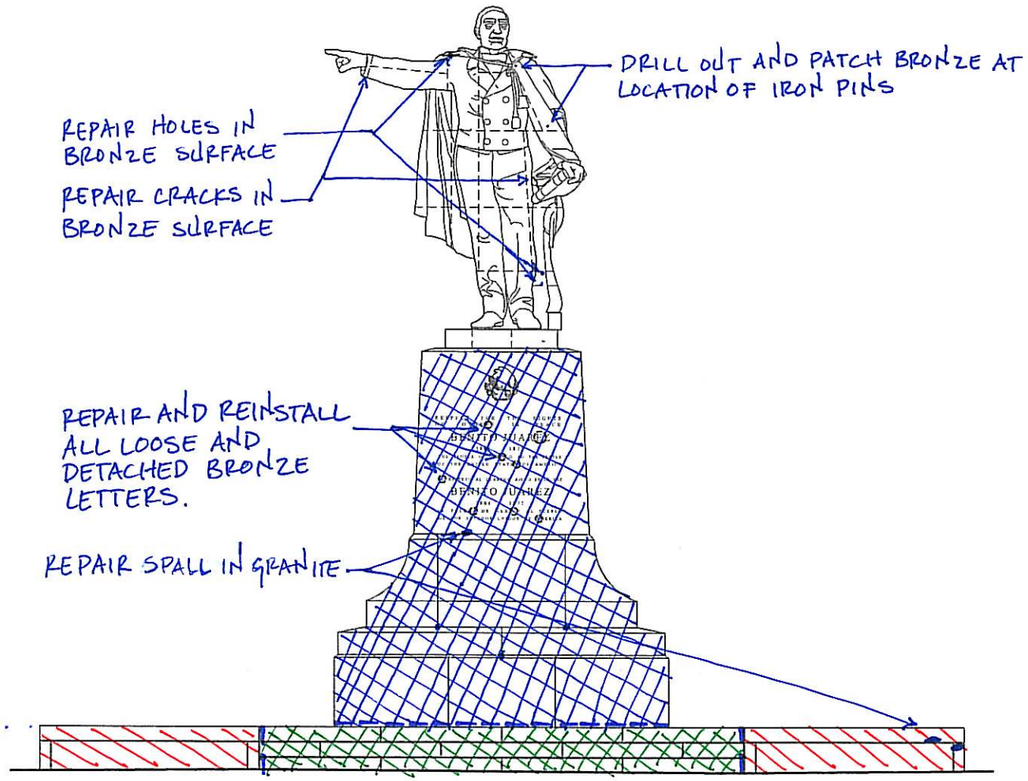
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

INVESTIGATIVE CONDITION ASSESSMENT AND REPORT FOR BENITO PABLO JUAREZ MONUMENT AND PLAZA
TITLE OF PROJECT
NATIONAL MALL AND MEMORIAL PARKS
NAME OF PARK

DRAWN MJH/BDR
CHECKED MJH/BDR
APPROVED MJH/BDR
DWG. NO. 875 83420
DATE 01/25/10
SHEET 1 of 4



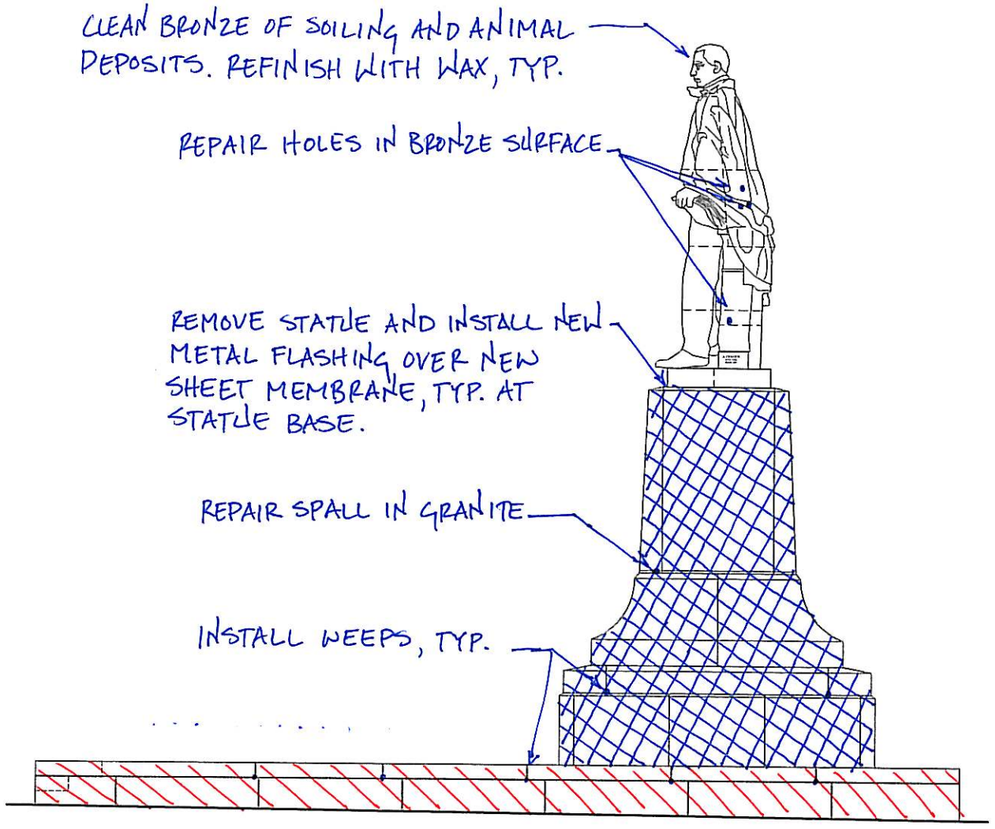
A A2.1 NORTH ELEVATION



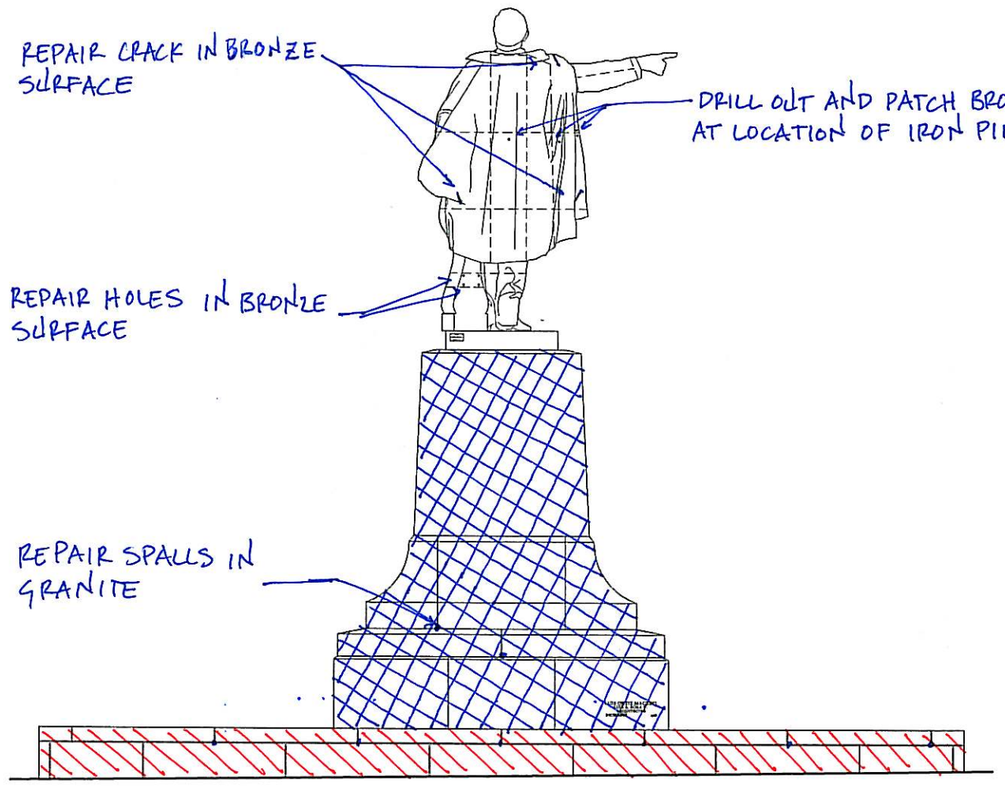
B A2.1 WEST ELEVATION

2 0 2 4 6
SCALE OF FEET

A/E FIRM: OEHRLEIN & ASSOCIATES ARCHITECTS, 1300 CONNECTICUT AVE. NW SUITE 412 WASHINGTON, DC 20036 202-785-7330 202-785-7334 (FAX)	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
						MJH/BDR DESIGNED MJH/BDR DRAWN MJH/BDR CHECKED
REPAIR PLAN NORTH & WEST ELEVATIONS TITLE OF DRAWING						DSAL NO. 875 83420 DATE 01/25/10 SHEET 2 of 4
A2.1 SUB SHEET NUMBER						INVESTIGATIVE CONDITION ASSESSMENT AND REPORT FOR BENITO PABLO JUAREZ MONUMENT AND PLAZA TITLE OF PROJECT NATIONAL MALL AND MEMORIAL PARKS NAME OF PARK



A A2.2 SOUTH ELEVATION



B A2.2 EAST ELEVATION

2 0 2 4 6
SCALE OF FEET

A/E FIRM
ARCHITECT:
OEHRLEIN & ASSOCIATES ARCHITECTS
1300 CONNECTICUT AVE. NW SUITE 412 WASHINGTON, DC 20036 202-785-7338 202-785-7334 (FAX)

Mark	Sheet	REVISION	Date	Initial

REPAIR PLAN
SOUTH & EAST ELEVATIONS
TITLE OF DRAWING

A2.2
SUB SHEET NUMBER

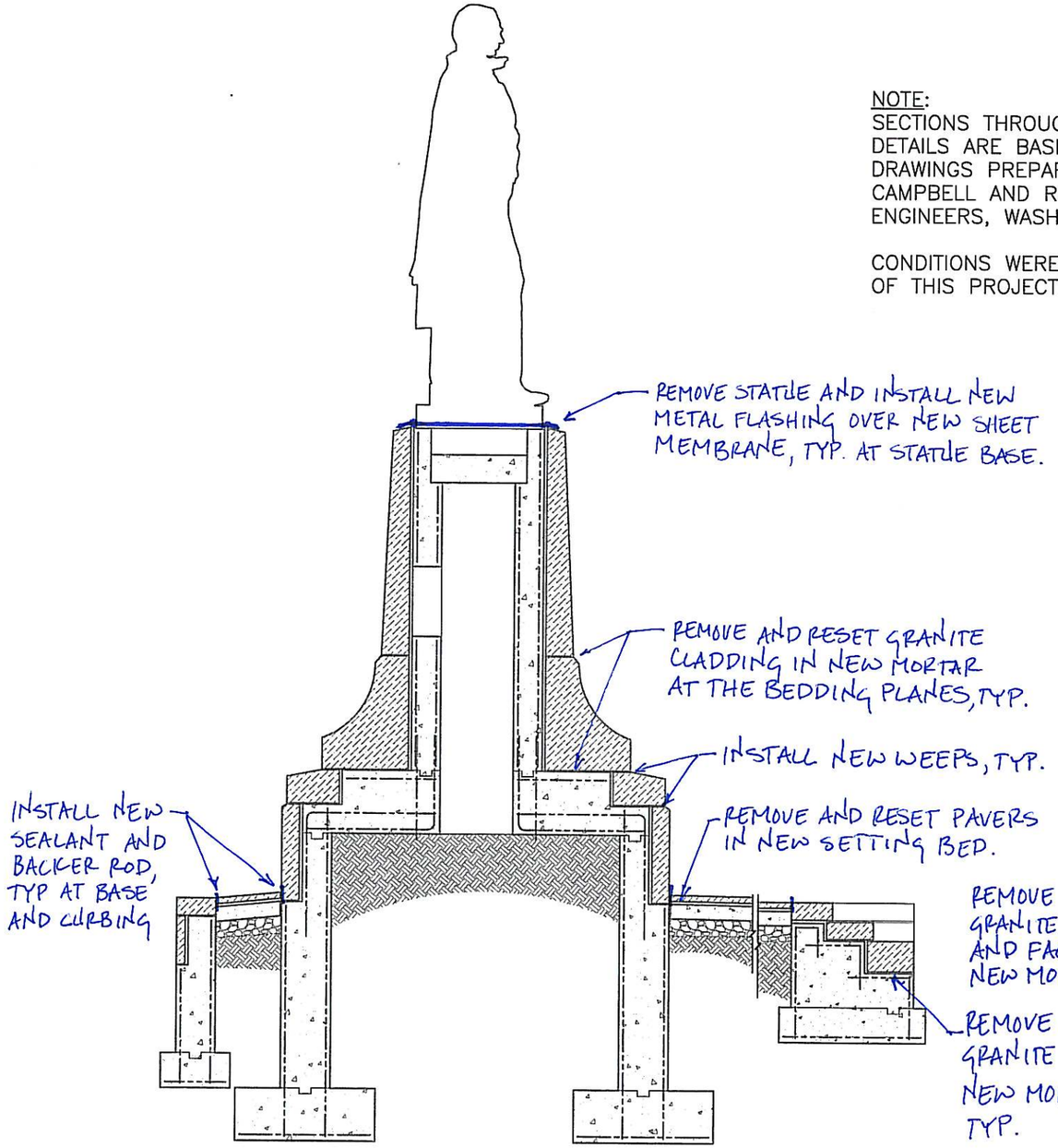
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

INVESTIGATIVE CONDITION ASSESSMENT AND REPORT FOR BENITO PABLO JUAREZ MONUMENT AND PLAZA
TITLE OF PROJECT
NATIONAL MALL AND MEMORIAL PARKS
NAME OF PARK

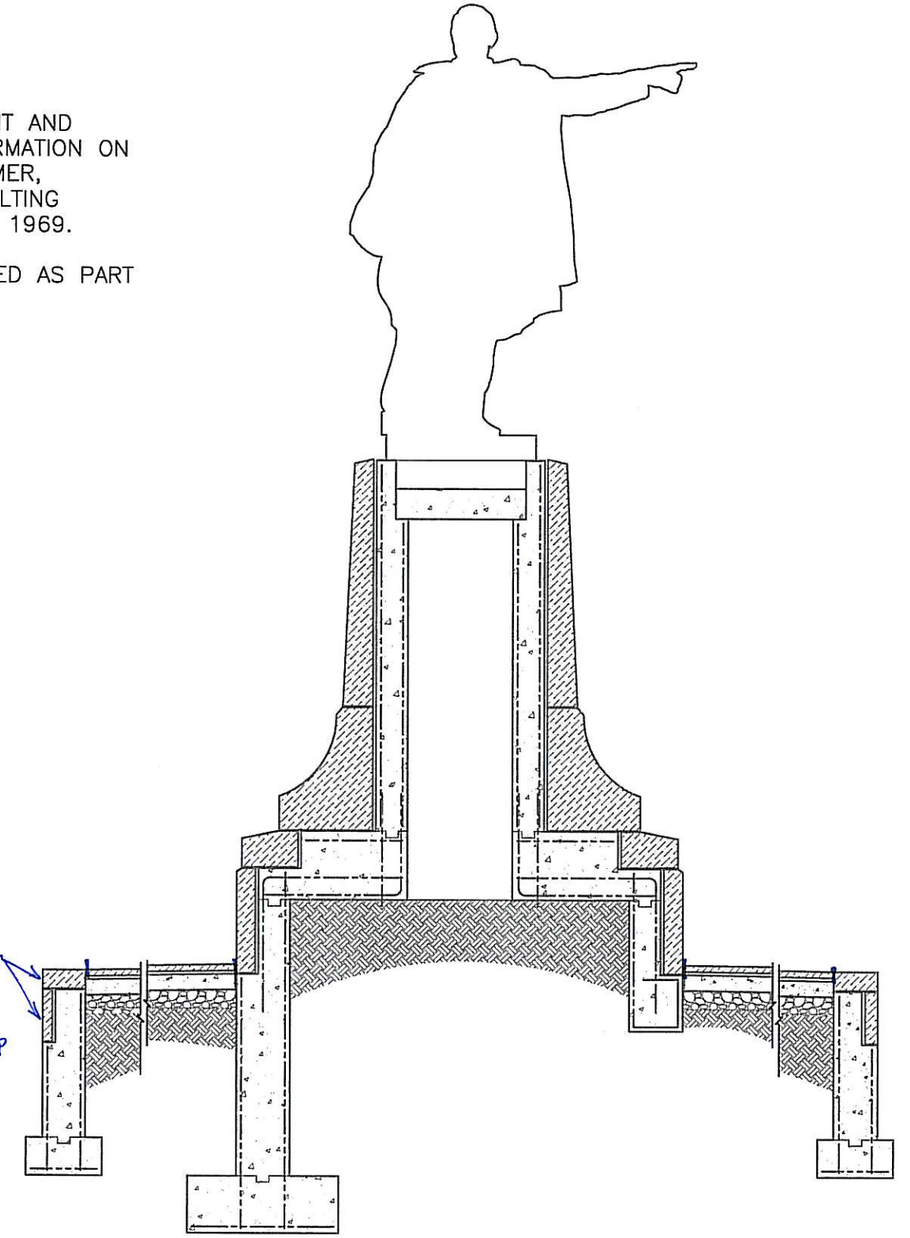
DESIGNED	MJH/BDR
DRAWN	MJH/BDR
CHECKED	MJH/BDR
PROJ. NO.	875
	83420
DATE	01/25/10
SHEET	3 of 4

NOTE:
SECTIONS THROUGH MONUMENT AND DETAILS ARE BASED ON INFORMATION ON DRAWINGS PREPARED BY PALMER, CAMPBELL AND REESE CONSULTING ENGINEERS, WASHINGTON, DC, 1969.

CONDITIONS WERE NOT VERIFIED AS PART OF THIS PROJECT.



A A2.3 SECTION LOOKING SOUTH



B A2.3 SECTION LOOKING WEST

2 0 2 4
SCALE OF FEET

A/E FIRM: OEHRLEIN & ASSOCIATES ARCHITECTS, 1300 CONNECTICUT AVE. NW SUITE 412 WASHINGTON, DC 20036 202-785-7220 202-785-7224 (FAX)	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE - NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION
						INVESTIGATIVE CONDITION ASSESSMENT AND REPORT FOR BENITO PABLO JUAREZ MONUMENT AND PLAZA
REPAIR PLAN SECTIONS (TITLE OF DRAWING)	A2.3 (SUB SHEET NUMBER)					TITLE OF PROJECT: NATIONAL MALL AND MEMORIAL PARKS (NAME OF PARK)

DESIGNED	MJH/BDR
DRAWN	MJH/BDR
CHECKED	MJH/BDR
PROJ. NO.	875 83420
DATE	01/25/10
SHEET	4 of 4

APPENDIX D – VIBRATION MONITORING REPORT

FACILITY ENGINEERING ASSOCIATES, P.C.
11001 LEE HIGHWAY, SUITE D
FAIRFAX, VIRGINIA 22030

703.591.4855
703.591.4857 FAX

December 2, 2009

Oehrlein and Associates, Architects
1350 Connecticut Avenue, N.W.
Washington, DC 20036

ATTN: Martin Howell, AIA
Architect

SUBJECT: **Report of Vibration Monitoring**
The General Juarez Memorial
Washington, DC
FEA Project No. R01.2009.006314

Dear Mr. Howell:

Facility Engineering Associates, P.C. (FEA) is pleased to provide the following report concerning our vibration monitoring at the General Juarez memorial in Washington, DC. Our services were authorized by your acceptance of our proposal (FEA Proposal No. P01.2009.006314, dated October 20, 2009). The following summarizes our scope of work, observations, and recommendations.

1.0 PROJECT INFORMATION/BACKGROUND

The General Juarez Memorial is located in northwest Washington D.C. at a traffic circle on Virginia Avenue near the Watergate Hotel. The statue was erected in 1969. The pedestal for the statue was constructed with stone panels attached to a concrete base. An underground roadway tunnel was constructed just north of the memorial plaza running under Virginia Avenue.

Since the statue was constructed, the stone panels have displaced from their original position, causing separation of the panels. In some locations, lateral movement of over one inch has been observed. At the time of the vibration monitoring, the stone panels were secured with straps to prevent further movement. The displacement of the stone panels had reportedly been occurring for many years. The purpose of the monitoring was to determine the level of vibration from the tunnel traffic and whether the magnitudes were such that structural integrity was a concern.

Documentation used in establishing a threshold value was taken from the United States Department of Interior Bureau of Mines (USBM) report number 8507 titled, “Structure Response and Damage Produced by Ground Vibration From Surface Mine Blasting.” FEA’s scope of work included installing vibration monitoring equipment for the purpose of documenting the duration, magnitude, and frequency of the vibration events in the building. The threshold value established based on the USBM report was 0.5 in./sec.

2.0 SCOPE OF SERVICES

FEA placed two vibration monitors on the statue pedestal. Equipment used consisted of a Minimate Plus instrument with an external geophone to measure wave amplitude in the form of Peak Particle Velocity (PPV). One vibration monitor was placed on top of the stone panel pedestal at the foot of the statue and the other on top of the shelf at the base of the statue. Both vibration monitors were placed on the stone panels and secured in place. These locations were monitored for vibration events above an established threshold for a total of four weeks. The memorial was monitored from November 2, 2009 to November 30, 2009.

The two sensors were monitoring for vibrations continuously during the monitoring period, recording a PPV for each one-minute time period. At the end of each day, a histogram was created to document the readings measured through the day. In the event that the threshold vibration level was exceeded, a waveform would activate to provide additional detail to a specific event. The waveform would be activated if an event occurred greater than 0.3 in./sec.

3.0 OBSERVATIONS

FEA representatives Mr. Lee Gabriel and Mr. Erick Mercado visited the site on October 28, 2009 and met with Martin Howell to perform a reconnaissance of the site and coordinate the installation of the monitoring equipment. During this visit, FEA was introduced to employees of the park service who assisted in recommendations for installation materials and locations to prevent damage to the stone pedestal of the statue. No apparent construction activities were observed near the statue during the time of the vibration monitoring.

4.0 FINDINGS

Vibration data reviewed for the vibration monitors typically had PPV's ranging from 0.015 in/sec to 0.050 in/sec. When events occurred, the vibration monitors showed PPV's ranging from 0.055 in/sec to 0.375 in/sec. Two types of events were observed during the monitoring period; long-duration events and short-duration events. The long-duration events that were recorded ranged in duration from a few hours to two days. The long-duration events were only observed when it rained and the vibration was most notably observed in the vertical direction. The vibration levels were also greater in the sensor at the foot of the statue, which was less protected from the weather. These events appear to be caused from the weather and not from the adjacent underground tunnel traffic.

The short-duration events were also only observed when it rained, but the vibration levels were greater in all directions during these events. Each event was only recorded for a one-minute period, showing a spike in the readings. The short-duration events were greater in the sensor at the base of the pedestal, which is the opposite of what was observed during long-term events. These events may be caused from the weather; however, this cannot be determined as a certainty as no personnel were on-site at the time of these events. However, all PPV values recorded during the monitoring period were less than the generally acceptable threshold for vibrations affecting structural integrity.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the vibration levels observed, vibration was not related to the adjacent underground tunnel. Vibration from the tunnel would generally be larger during the high-volume traffic hours. Vibration would also show a pattern of being repeated from day to day from typical traffic patterns. Vibrations that were observed did not occur at high-volume traffic hours and did not show a pattern of vibration from day to day.

Based on vibration data gathered at the memorial, the vibration levels observed were within a safe level for vibrations for the statue and do not appear to be of a structural concern. Vibrations that were recorded occurred

when it rained, which appears to be the cause of the vibration events observed. Based on levels of vibrations recorded, FEA does not recommend additional outside vibration monitoring of the statue at this time. However, if future adjacent construction projects occur, monitoring would be recommended to ensure that vibrations are not causing further displacement of the panels.

6.0 CLOSING

Thank you for the opportunity to provide our services to you for this project. Please contact us if you have questions regarding this report.

Very truly yours,
FACILITY ENGINEERING ASSOCIATES, P.C.

Lee Gabriel, E.I.T.
Project Engineer

Paul G. Swanson, P.E.
Principal

Attachments: Appendix A – Sample Vibration Data with Explanation

APPENDIX A – SAMPLE DATA WITH EXPLANATION

The data reports identified below have been included in this appendix. The data provided is a representation of the vibration data and events recorded during the monitoring period. An explanation for each report is included below.

Daily PPV Readings
Typical Daily Histogram
Histogram Showing Long-Duration and Short-Duration Events
Waveform Triggered from Vibration Event

Daily PPV Readings

This table shows the maximum PPV for each direction recorded over each day. The maximum value reported is for both sensors, not for the individual sensors. PPV are reported in ins/sec.

Typical Daily Histogram

This report shows a graphical presentation showing the typical readings observed during the monitoring period. The graph displays the PPV on the vertical axis over time on the horizontal axis. The scale for each axis is indicated at the bottom of each graph. Above each graph, the time and frequency of the maximum PPV for the day is presented for all directions. The top of the report shows general notes and setup information for the sensors. A graph is prepared for each sensor. The sensor is identified with a 1 or 2 at the end of each monitoring direction (i.e.- Vert2 would indicated the vertical direction for Sensor 2).

Histogram Showing Long-Duration and Short-Duration Events

This report shows a graphical presentation showing the typical long- and short-duration events observed during the monitoring period. This report is the same setup as the daily histogram.

Histogram Showing Long-Duration and Short-Duration Events

This report shows a graphical presentation showing the waveform from a vibration event. The report consists of two pages per sensor. One page shows a graph of the amplitude versus frequency of the waveform in each direction. The second page shows the PPV's observed during the recorded event. The data is presented in two graphical formats. One graph shows the amplitude of the PPV observed in each direction over time. The second graph shows a plot of the data observed during the event. A data point is presented for each velocity and frequency observed during the event for all directions. Points that fall below the line on the graph are below the threshold value of 0.5 in./sec. indicated in the report.

Average Daily Peak Particle Velocities

	Peak Particle Velocity (PPV)		
	Transverse	Vertical	Longitudinal
2-Nov	0.025	0.020	0.030
3-Nov	0.025	0.020	0.035
4-Nov	0.025	0.020	0.015
5-Nov	0.025	0.030	0.035
6-Nov	0.025	0.020	0.015
7-Nov	0.020	0.020	0.015
8-Nov	0.030	0.020	0.015
9-Nov	0.025	0.020	0.015
10-Nov	0.025	0.020	0.015
11-Nov	0.030	0.090	0.035
12-Nov	0.095	0.375	0.115
13-Nov	0.025	0.120	0.040
14-Nov	0.020	0.025	0.015
15-Nov	0.020	0.020	0.015
16-Nov	0.020	0.020	0.015
17-Nov	0.025	0.020	0.015
18-Nov	0.025	0.025	0.015
19-Nov	0.055	0.075	0.070
20-Nov	0.045	0.045	0.020
21-Nov	0.025	0.020	0.015
22-Nov	0.025	0.045	0.015
23-Nov	0.025	0.050	0.025
24-Nov	0.215	0.360	0.220
25-Nov	0.025	0.170	0.020
26-Nov	0.025	0.115	0.045
27-Nov	0.025	0.035	0.025
28-Nov	0.020	0.025	0.015
29-Nov	0.020	0.025	0.015
30-Nov	0.020	0.025	0.015

* All Readings are in inches per second.

** The above PPV's are the maximum recorded value during a 24-hour period for both sensors.

Event Report

Histogram Start Time	00:00:22 November 5, 2009	**Serial Number**	BE12089 V 8.12-8.0 MiniMate Plus/8
Histogram Finish Time	23:59:00 November 5, 2009	**Battery Level**	7.0 Volts
Number of Intervals	1438 at 1 minute	**Calibration**	October 8, 2009 by Instantel Inc.
Range	Geo :10.00 in/s	**File Name**	N089CYRP.CM0
Sample Rate	1024sps		

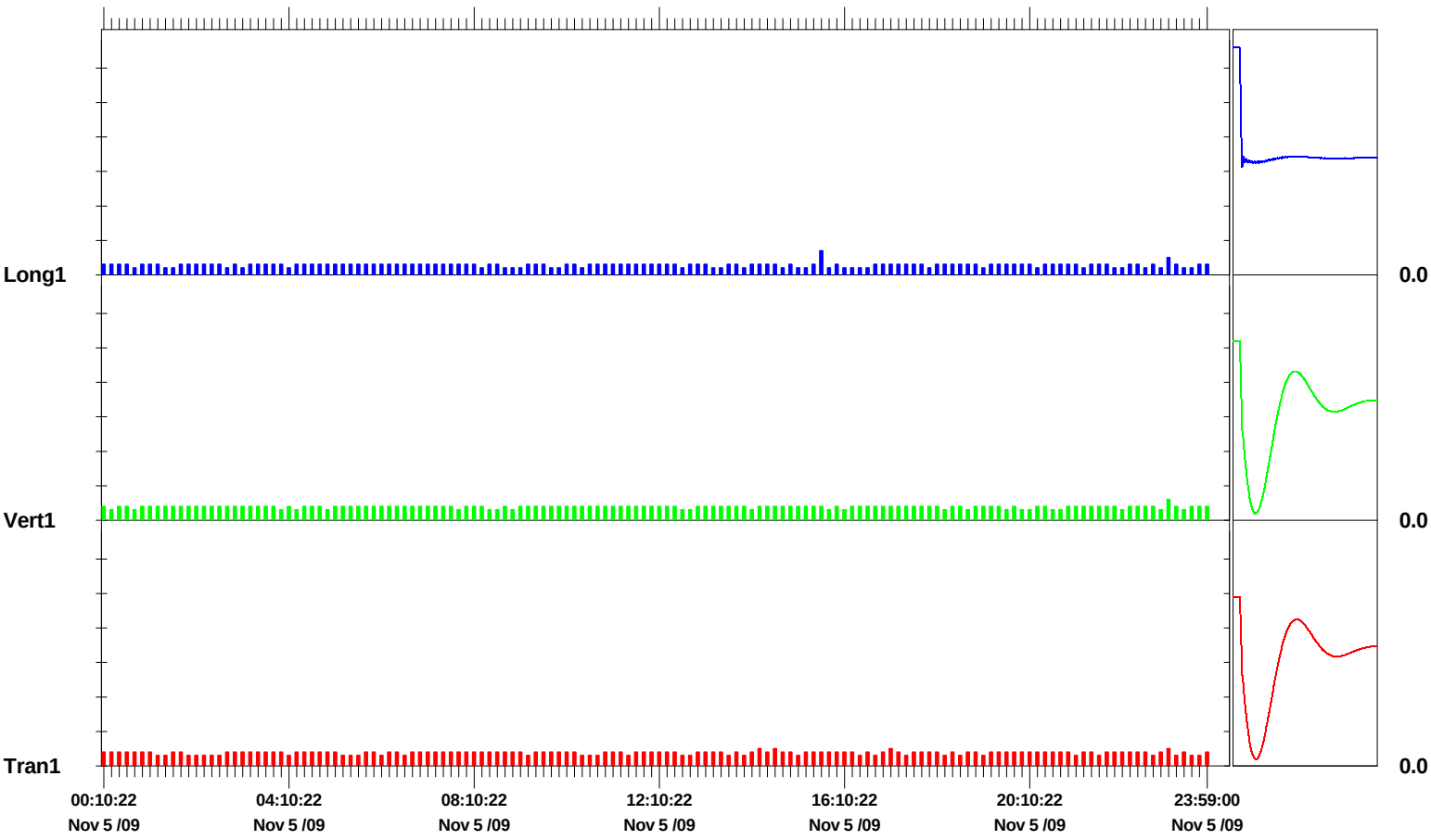
Notes
Location: Juarez Memorial, Washington, DC
Client: Oehrlein and Associates
User Name: FEA
General:

Sensor Location
Sensor 1 - Top of Statue
Sensor 2 - Bottom of Statue

Post Event Notes

	Tran1	Vert1	Long1	
PPV	0.0250	0.0300	0.0350	in/s
ZC Freq	37	57	>100	Hz
Date	Nov 5 /09	Nov 5 /09	Nov 5 /09	
Time	14:12:22	23:09:22	15:31:22	
Sensorcheck	Passed	Passed	Check	
Frequency	7.3	7.6	8.1	Hz
Overswing Ratio	3.8	3.5	5.0	

Peak Vector Sum 0.0464 in/s on November 5, 2009 at 23:09:22



Time Scale: 10 minutes /div **Amplitude Scale:** Geo: 0.0500 in/s/div Sensorcheck

Event Report

Histogram Start Time	00:00:22 November 5, 2009	**Serial Number**	BE12089 V 8.12-8.0 MiniMate Plus/8
Histogram Finish Time	23:59:00 November 5, 2009	**Battery Level**	7.0 Volts
Number of Intervals	1438 at 1 minute	**Calibration**	October 8, 2009 by Instantel Inc.
Range	Geo :10.00 in/s	**File Name**	N089CYRP.CM0
Sample Rate	1024sps		

Notes

Location: Juarez Memorial, Washington, DC
Client: Oehrlein and Associates
User Name: FEA
General:

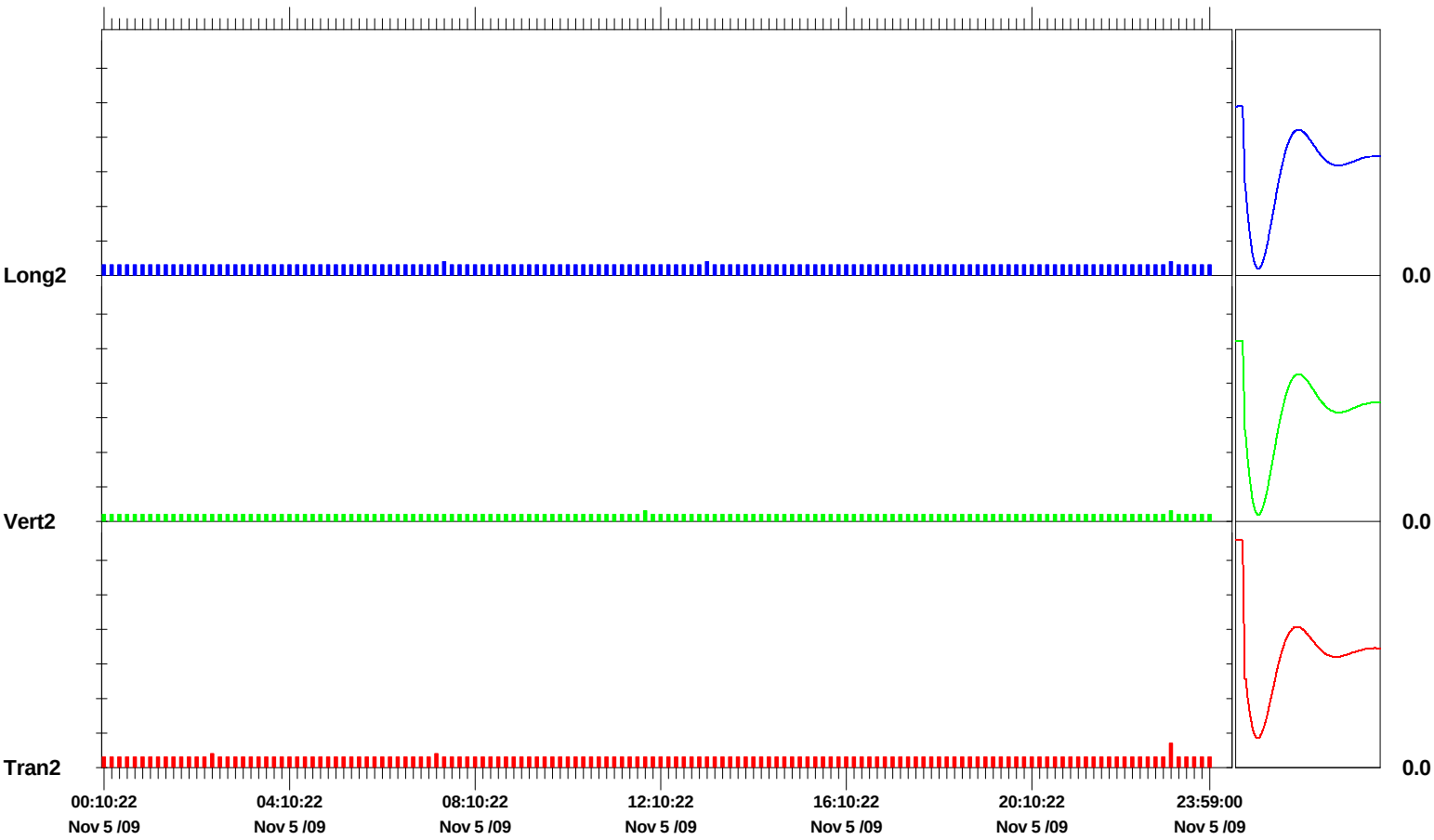
Sensor Location

Sensor 1 - Top of Statue
Sensor 2 - Bottom of Statue

Post Event Notes

	Tran2	Vert2	Long2	
PPV	0.0350	0.0150	0.0200	in/s
ZC Freq	>100	>100	>100	Hz
Date	Nov 5 /09	Nov 5 /09	Nov 5 /09	
Time	23:09:22	11:41:22	07:30:22	
Sensorcheck	Check	Passed	Passed	
Frequency	7.7	7.4	7.4	Hz
Overswing Ratio	3.8	3.8	3.9	

Peak Vector Sum 0.0409 in/s on November 5, 2009 at 23:09:22



Time Scale: 10 minutes /div **Amplitude Scale:** Geo: 0.0500 in/s/div Sensorcheck

Event Report

Histogram Start Time	00:00:22 November 12, 2009	**Serial Number**	BE12089 V 8.12-8.0 MiniMate Plus/8
Histogram Finish Time	23:59:00 November 12, 2009	**Battery Level**	6.9 Volts
Number of Intervals	1438 at 1 minute	**Calibration**	October 8, 2009 by Instantel Inc.
Range	Geo :10.00 in/s	**File Name**	N089CZ4O.0M0
Sample Rate	1024sps		

Notes
Location: Juarez Memorial, Washington, DC
Client: Oehrlein and Associates
User Name: FEA
General:

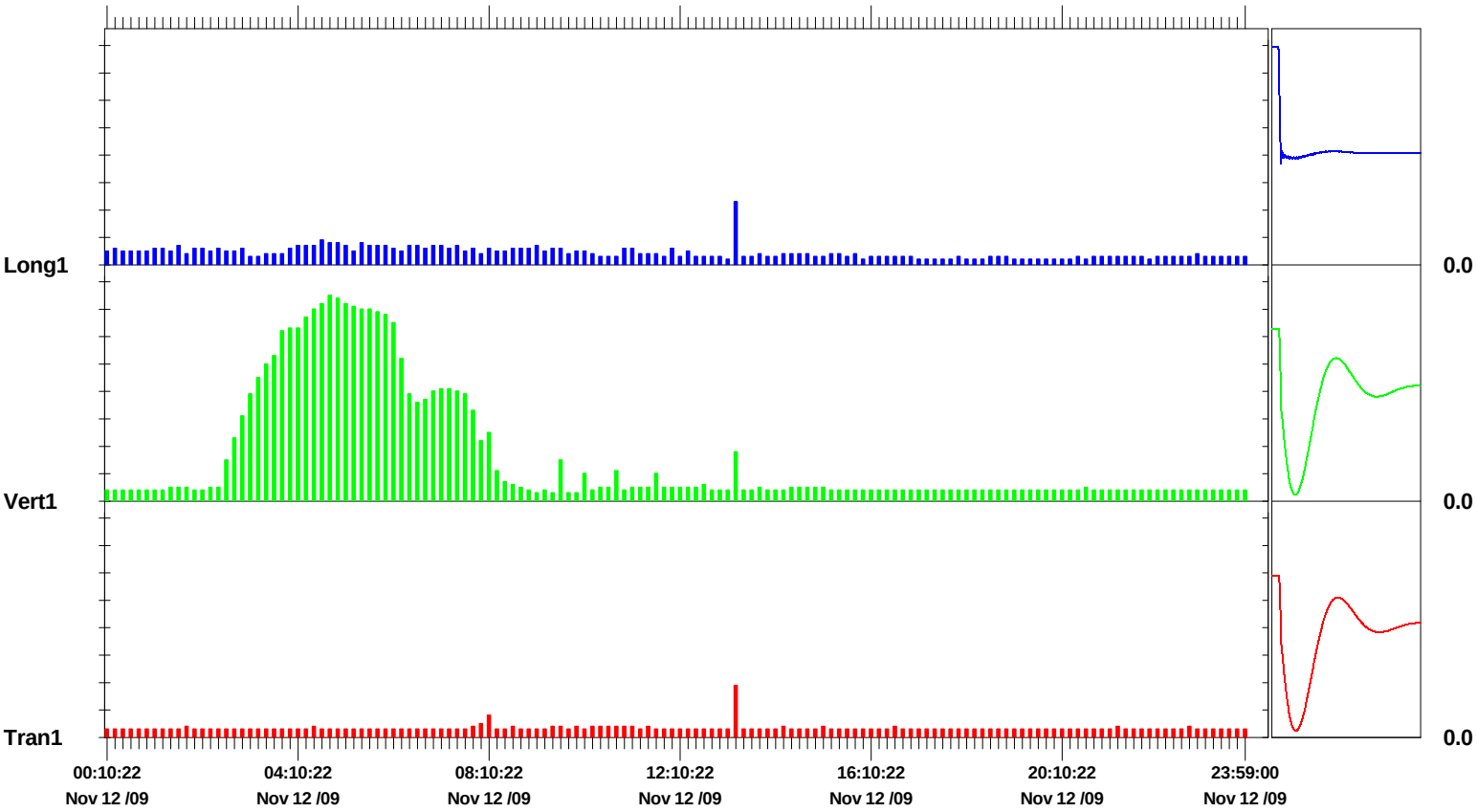
Sensor Location
Sensor 1 - Top of Statue
Sensor 2 - Bottom of Statue

Post Event Notes

	Tran1	Vert1	Long1	
PPV	0.0950	0.375	0.115	in/s
ZC Freq	64	N/A	>100	Hz
Date	Nov 12 /09	Nov 12 /09	Nov 12 /09	
Time	13:12:22	04:45:22	13:12:22	
Sensorcheck	Passed	Passed	Check	
Frequency	7.2	7.5	8.1	Hz
Overswing Ratio	3.9	3.5	6.0	

Peak Vector Sum 0.376 in/s on November 12, 2009 at 04:45:22

N/A: Not Applicable



Time Scale: 10 minutes /div **Amplitude Scale:** Geo: 0.0500 in/s/div Sensorcheck

Event Report

Histogram Start Time	00:00:22 November 12, 2009	**Serial Number**	BE12089 V 8.12-8.0 MiniMate Plus/8
Histogram Finish Time	23:59:00 November 12, 2009	**Battery Level**	6.9 Volts
Number of Intervals	1438 at 1 minute	**Calibration**	October 8, 2009 by Instantel Inc.
Range	Geo :10.00 in/s	**File Name**	N089CZ4O.0M0
Sample Rate	1024sps		

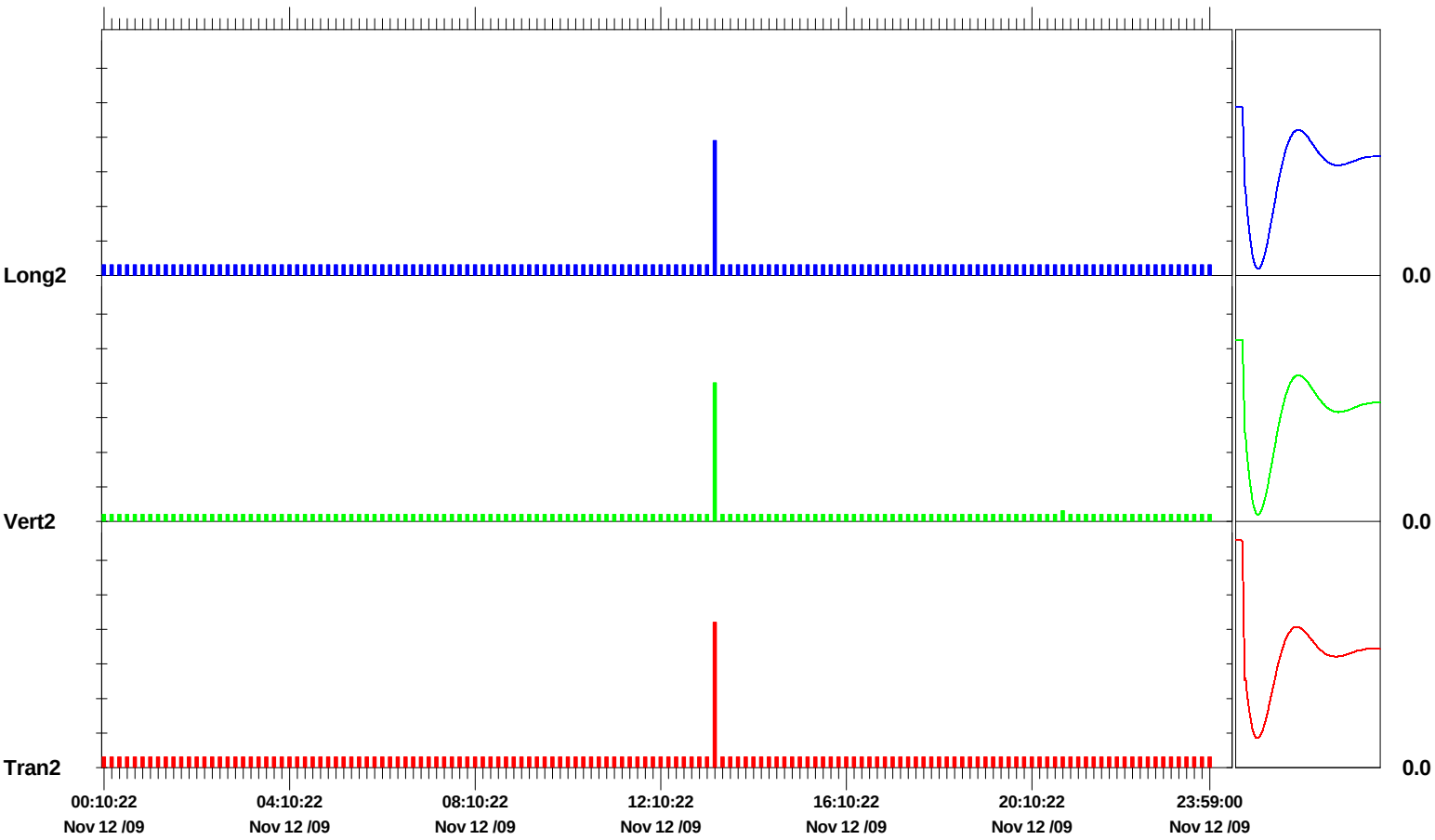
Notes
Location: Juarez Memorial, Washington, DC
Client: Oehrlein and Associates
User Name: FEA
General:

Sensor Location
Sensor 1 - Top of Statue
Sensor 2 - Bottom of Statue

Post Event Notes

	Tran2	Vert2	Long2	
PPV	0.210	0.200	0.195	in/s
ZC Freq	>100	>100	>100	Hz
Date	Nov 12 /09	Nov 12 /09	Nov 12 /09	
Time	13:12:22	13:12:22	13:12:22	
Sensorcheck	Check	Passed	Passed	
Frequency	7.7	7.4	7.4	Hz
Overswing Ratio	3.8	3.9	4.0	

Peak Vector Sum 0.316 in/s on November 12, 2009 at 13:12:22



Time Scale: 10 minutes /div **Amplitude Scale:** Geo: 0.0500 in/s/div Sensorcheck

FFT Report

Date/Time	Vert1 at 23:33:33 November 24, 2009	**Serial Number**	BE12089 V 8.12-8.0 MiniMate Plus/8
Trigger Source	Geo: 0.200 in/s	**Battery Level**	6.9 Volts
Range	Geo :10.00 in/s	**Calibration**	October 8, 2009 by Instantel Inc.
Record Time	9.622 sec at 1024 sps	**File Name**	N089CZSP.FX0

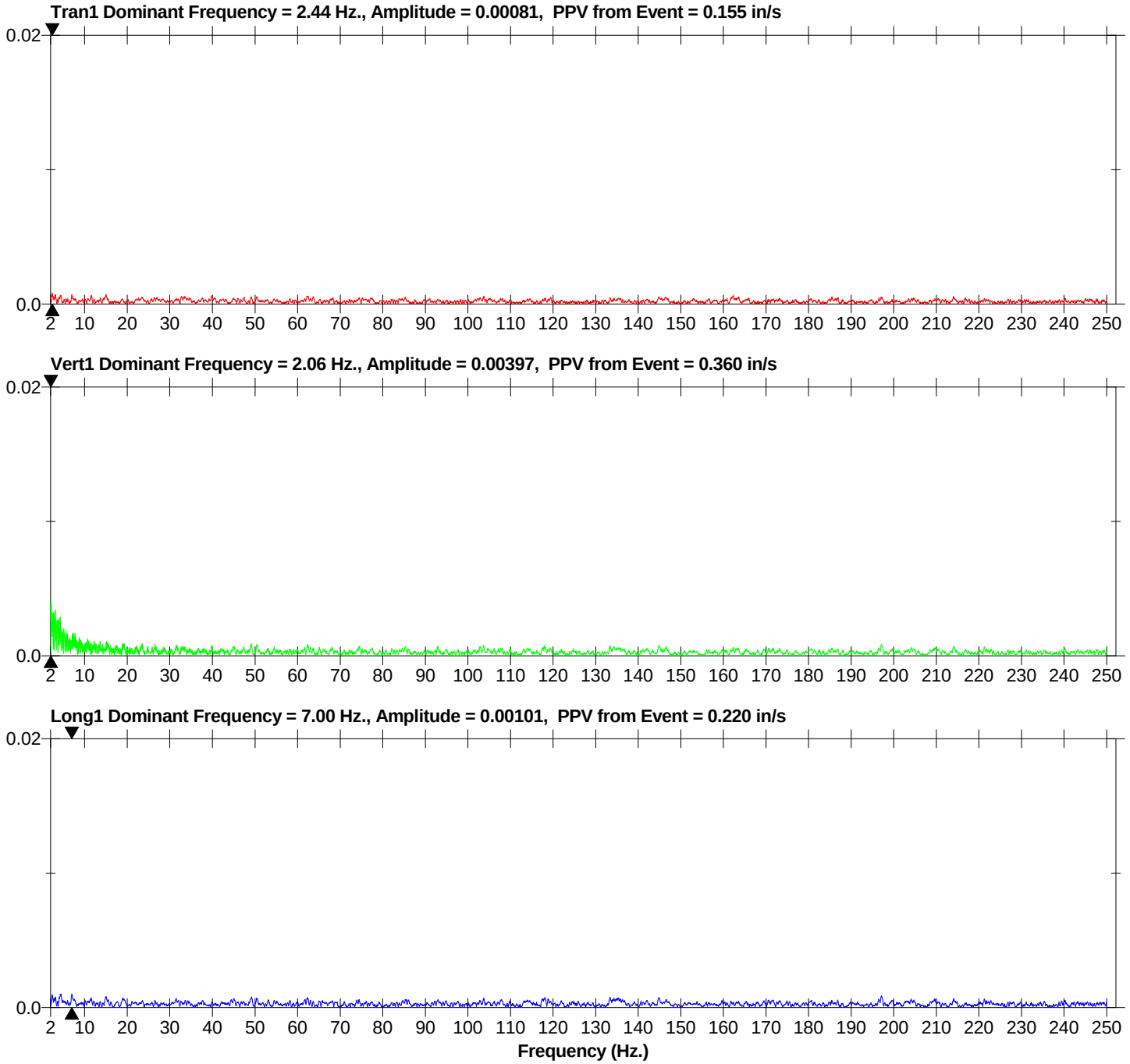
Notes

Location: Juarez Memorial, Washington, DC
Client: Oehrlein and Associates
User Name: FEA
General:

Sensor Location

Combo Mode November 24, 2009 00:00:22
Sensor 1 - Top of Statue
Sensor 2 - Bottom of Statue

Post Event Notes



Event Report

Date/Time	Vert1 at 23:33:33 November 24, 2009	**Serial Number**	BE12089 V 8.12-8.0 MiniMate Plus/8
Trigger Source	Geo: 0.200 in/s	**Battery Level**	6.9 Volts
Range	Geo :10.00 in/s	**Calibration**	October 8, 2009 by Instantel Inc.
Record Time	9.622 sec at 1024 sps	**File Name**	N089CZSP.FX0

Notes
Location: Juarez Memorial, Washington, DC
Client: Oehrlein and Associates
User Name: FEA
General:

Sensor Location
Combo Mode November 24, 2009 00:00:22
Sensor 1 - Top of Statue
Sensor 2 - Bottom of Statue

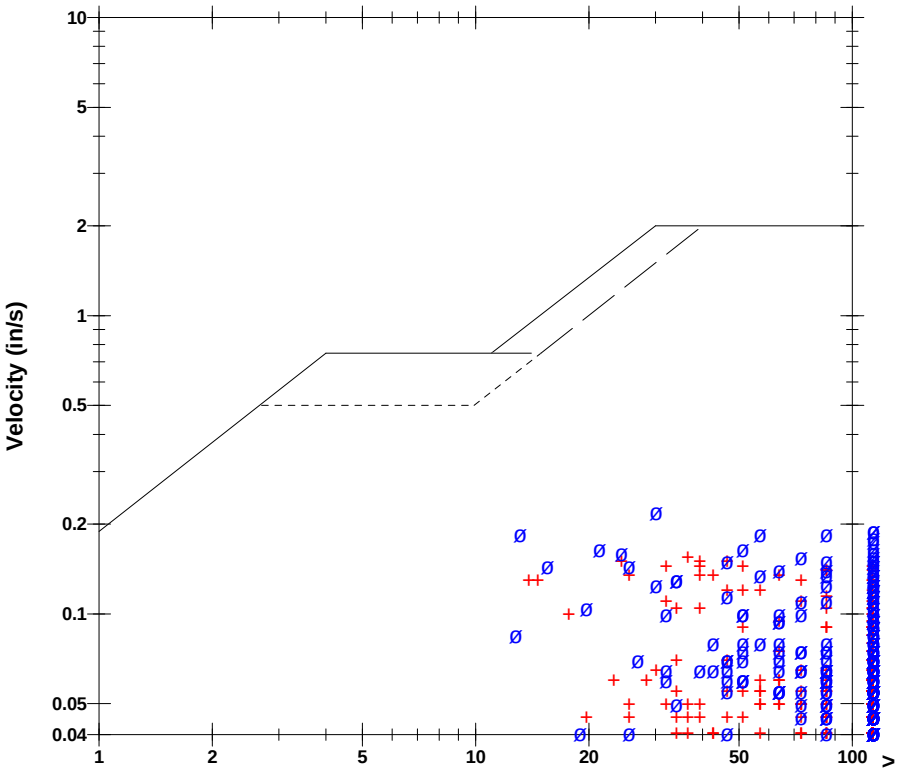
Post Event Notes

	Tran1	Vert1	Long1	
PPV	0.155	0.360	0.220	in/s
ZC Freq	37	N/A	30	Hz
Time (Rel. to Trig)	0.208	0.235	0.235	sec
Peak Acceleration	0.371	0.557	0.557	g
Peak Displacement	0.00110	0.0	0.00135	in
Sensorcheck	Passed	Passed	Check	
Frequency	7.3	7.6	8.1	Hz
Overswing Ratio	3.8	3.4	5.0	

Peak Vector Sum 0.446 in/s at 0.235 sec

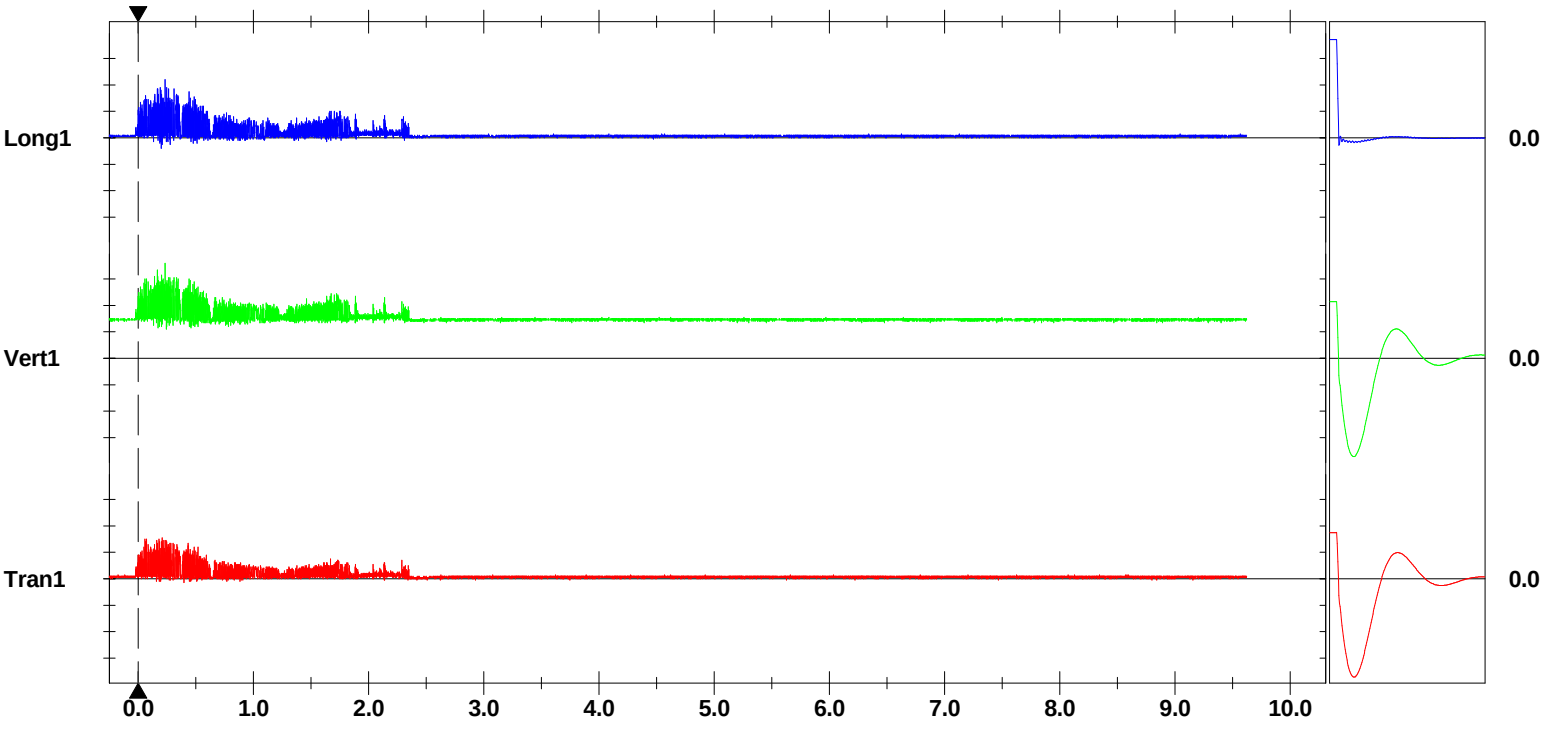
N/A: Not Applicable

USBM RI8507 And OSMRE



Tran1: + Vert1: x Long1: ø

Monitor Log
Nov 24 /09 23:33:33 Nov 24 /09 23:33:43 Event recorded. (Memory Full Exit)



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div Sensorcheck
Trigger = ▶—— —— ◀

FFT Report

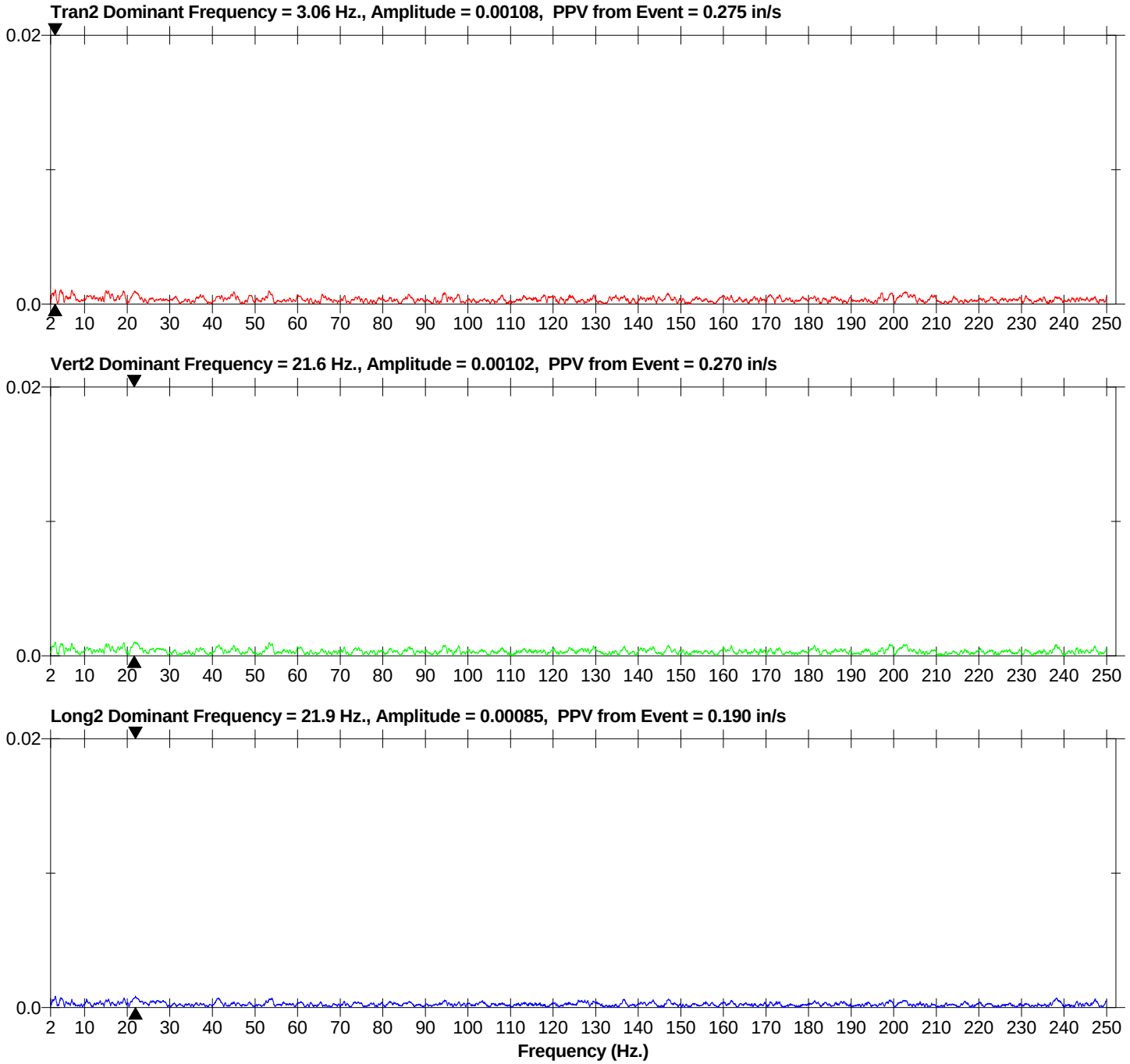
Date/Time Vert1 at 23:33:33 November 24, 2009
Range Geo :10.00 in/s
Record Time 9.622 sec at 1024 sps

Serial Number BE12089 V 8.12-8.0 MiniMate Plus/8
Battery Level 6.9 Volts
Calibration October 8, 2009 by Instantel Inc.
File Name N089CZSP.FX0

Notes
Location: Juarez Memorial, Washington, DC
Client: Oehrlein and Associates
User Name: FEA
General:

Sensor Location
Combo Mode November 24, 2009 00:00:22
Sensor 1 - Top of Statue
Sensor 2 - Bottom of Statue

Post Event Notes



Event Report

Date/Time Vert1 at 23:33:33 November 24, 2009
Range Geo :10.00 in/s
Record Time 9.622 sec at 1024 sps

Serial Number BE12089 V 8.12-8.0 MiniMate Plus/8
Battery Level 6.9 Volts
Calibration October 8, 2009 by Instantel Inc.
File Name N089CZSP.FX0

Notes
Location: Juarez Memorial, Washington, DC
Client: Oehrlein and Associates
User Name: FEA
General:

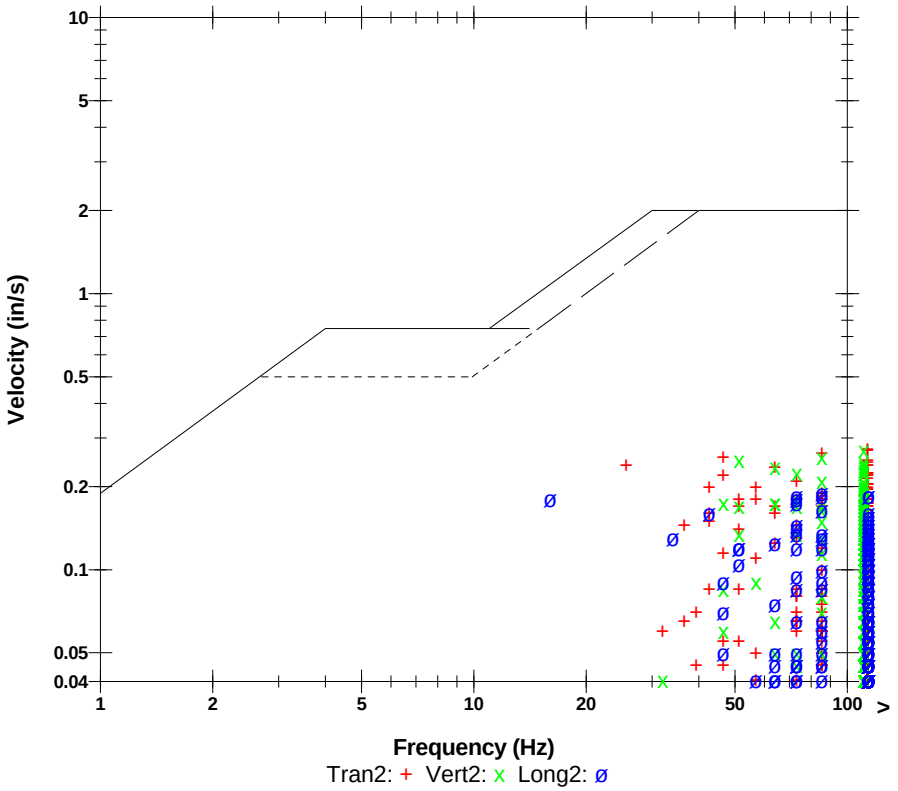
Sensor Location
Combo Mode November 24, 2009 00:00:22
Sensor 1 - Top of Statue
Sensor 2 - Bottom of Statue

Post Event Notes

	Tran2	Vert2	Long2	
PPV	0.275	0.270	0.190	in/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.221	0.407	0.439	sec
Peak Acceleration	0.716	0.703	0.530	g
Peak Displacement	0.00112	0.00072	0.00136	in
Sensorcheck	Check	Passed	Passed	
Frequency	7.7	7.4	7.4	Hz
Overswing Ratio	3.8	3.8	4.0	

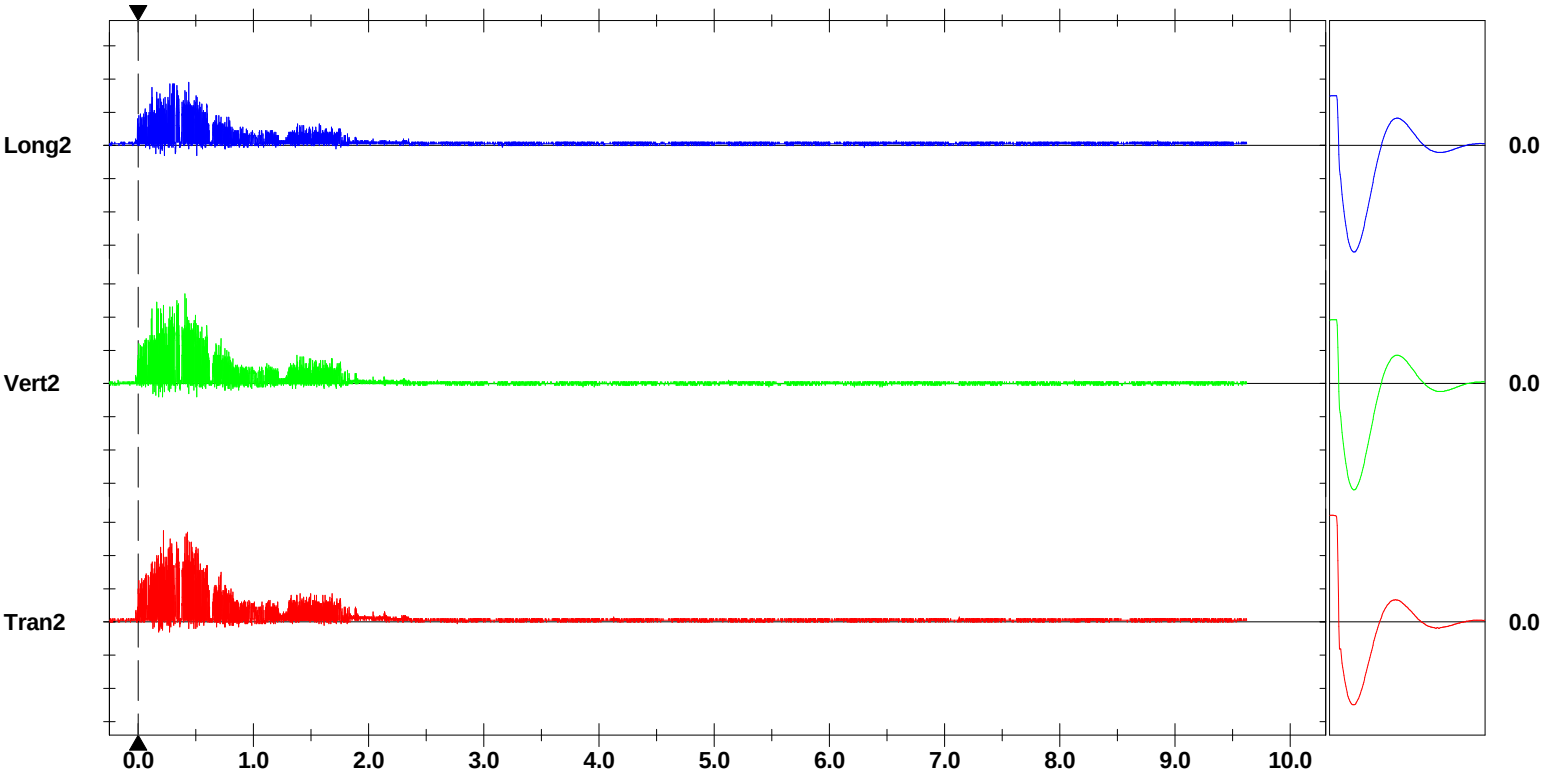
Peak Vector Sum 0.406 in/s at 0.407 sec

USBM RI8507 And OSMRE



Tran2: + Vert2: x Long2: ø

Monitor Log
Nov 24 /09 23:33:33 Nov 24 /09 23:33:43 Event recorded. (Memory Full Exit)



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div Sensorcheck
Trigger = ▶—— ——◀

APPENDIX E – MORTAR ANALYSIS REPORTS

BENITO JUAREZ MONUMENT
Petrographic and Chemical Studies of Mortar

Washington, DC

L. Brad Shotwell
Associate Principal

Final Report
January 22, 2010
WJE No. 2009.5347

Prepared for:
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Washington, DC 20036-1701

Prepared by:
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WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

BENITO JUAREZ MONUMENT
Petrographic and Chemical Studies of Mortar

Washington, DC

INTRODUCTION

At the request of Mr. Martin J. Howell of Oehrlein and Associates, studies of a mortar sample removed from the Benito Juarez Monument in Washington, D.C. were conducted. The studies were conducted to characterize the mortar prior to preparation of repairs to the monument. The current studies were requested to characterize the mortar and provide volume estimates of the raw material constituents which will be used in development of repair materials. It was also requested that the gradation of the sand aggregate contained in the mortar be determined.

SAMPLE

A representative portion of the as-received mortar specimen was used for petrographic studies (Figure 1). Four thin slabs were cut from the portion of the mortar specimen. Three of these slabs were embedded in epoxy and a thin section was prepared of the three slabs (Figure 2). The remaining portions of the mortar were submitted for chemical studies using the appropriate analytical methods outlined in ASTM C 1324, *Standard Test Method for Examination and Analysis of Hardened Masonry Mortar* and for studies to determine the gradation of the sand used in the mortar.

PETROGRAPHIC STUDIES

Inspection of the thin section (Figure 2) reveals that the sand aggregate contained in it had a maximum nominal dimension of about 0.8 mm. The sand is uniformly distributed. The lapped surface for the remainder of the epoxy-encased mortar used for the studies is pictured in Figure 3. Inspection of the lapped surface reveals the presence of a few sand-sized white lumps. When viewed at higher magnification some of the white lumps can be seen to have absorbed blue epoxy during sample preparation (Figure 4). Microfractures that are consistent with freeze-thaw distress were also detected in the mortar (Figure 4).

When viewed at higher magnification using the petrographic microscope, the angular nature of the quartz sand was apparent (Figure 5) and the cementitious matrix located adjacent to the original exposed face of the mortar is carbonated (Figure 6).

The white lumps in the mortar are composed of concentrations of portland cement (Figure 7). The mortar lumps contain portland cement particles that are surrounded by clear rims of cement hydrates. Similar particles are notable in the surrounding matrix of the mortar (Figure 8). This is consistent with the presence of dicalcium silicate and tricalcium silicate detected by X-dray diffraction (Table 1). Some of the cement lumps that had absorbed blue epoxy contain well-dispersed bladed crystals of calcium hydroxide that is now carbonated (Figures 9, 10, 11, 12 and 13).

The mortar was not air entrained. Extremely fine black opaque particles that may be pigment were detected at high magnification.

A layer of mortar behind the mortar layer that is the subject of the current studies was detected in the sample (Figures 9, 10 and 11).

Chemical Analyses and X-ray Diffraction Studies

The mortar was analyzed using the appropriate analytical methods outlined in ASTM C 1324, *Standard Test Method for* Examination *and Analysis of Hardened Masonry Mortar*.

Test Methods Used for Analysis of the Mortar

X-ray diffraction was used to determine the crystalline components of the mortar. The crystalline components detected are listed in

Table 1. The soluble silica, calcium, and magnesium oxide contents were determined by atomic absorption spectroscopy. The insoluble residue was determined by digestion in dilute hydrochloric acid. Losses on ignition were determined by heating and calculated as follows: from room temperature to 110° C, as a measure of free water, from 110° C to 550° C, as a measure of combined water, and from 550° C to 950° C, as a measure of carbonates and carbonation. The as-determined mortar composition is included in Table 2.

Methods of Calculation of the Mortar

Using the data obtained, the composition of the mortar specimen was calculated. The portland cement in the mortar was calculated from the calcium data assuming 63.5 percent calcium in the cement. The portland cement content is overestimated to the extent of the solubility of the calcareous components of the sand. The sand content was assumed to be the insoluble residue. Sand is underestimated to the extent of soluble components.

The volumetric ratio was calculated using unit weights of 94 and 80 pounds per cubic foot for portland cement and sand, respectively. The percent composition by mass, volumetric ratio, and the ASTM C 270, *Specification for Mortar for Unit Masonry* mortar type are included in Table 3.

Interpretation of the Chemical Studies

Based on the chemical, x-ray diffraction, and petrographic data, the mortar from the Benito Juarez Monument appears to be a non-air-entrained portland cement-sand mortar. The volumetric proportions of the mortar are one part portland cement to one part sand. These mortar proportions do not meet any of the proportion requirements for ASTM C 270 mortars of any type. The mortar has a much higher cement factor than an ASTM C270 mortar. It would be very strong and more prone to shrinkage than the various mortar formulations described in ASTM C 270.

The presence of lumps of cement that have a higher estimated water to cement ratio (w/c) than the surrounding body of the mortar suggests that the sample may contain several mixed batches of mortar that had different water to cement ratios at the time the mortar was freshly installed.

The presence of microfractures oriented parallel to the direction of bedding suggests that the mortar has suffered from deleterious expansion due to freezing and thawing.

Studies are currently in progress to determine the gradation of the sand contained in the mortar. Petrographic studies suggest that the sand is relatively fine and well-distributed. The sieve analysis of the sand aggregate contained in the mortar will be reported when it is available.

Storage: Thirty days after completion of our studies, samples will be discarded unless the client submits a written request for their return. Shipping and handling fees will be assessed for any samples returned to the client. Any hazardous materials that may have been submitted for study will be returned to the client and shipping and handling fees will apply. The client may request that WJE retain samples in storage in our warehouse. In that case, a yearly storage fee will apply.

Table 1. X-ray Diffraction

Mortar Sample	Crystalline Components Detected
Mortar	Major--Quartz (silicon dioxide) Minor--Portlandite (calcium hydroxide), calcite (calcium carbonate), ettringite ($3CaO{\cdot}Al_2O_3{\cdot}3CaSO_4{\cdot}32H_2O$), hatrurite (tricalcium silicate), larnite (dicalcium silicate)

Table 2. Analytical Data

Determined	Mortar
Soluble silica, %	10.64
Calcium oxide, %	29.84
Magnesium oxide, %	1.12
Insoluble residue, %	41.08
Losses on ignition, % from 0° C to 110° C from 110° C to 550° C from 550° C to 950° C	 4.20 6.33 4.37

Table 3. Calculated Mortar Proportions

Calculated	Mortar
Portland cement, % by mass	46.99
Sand, % by mass	41.08
Volumetric ratio, Portland cement : sand	1 : 1
ASTM C 270 Type	n/a
Sanding by ASTM C 270	n/a

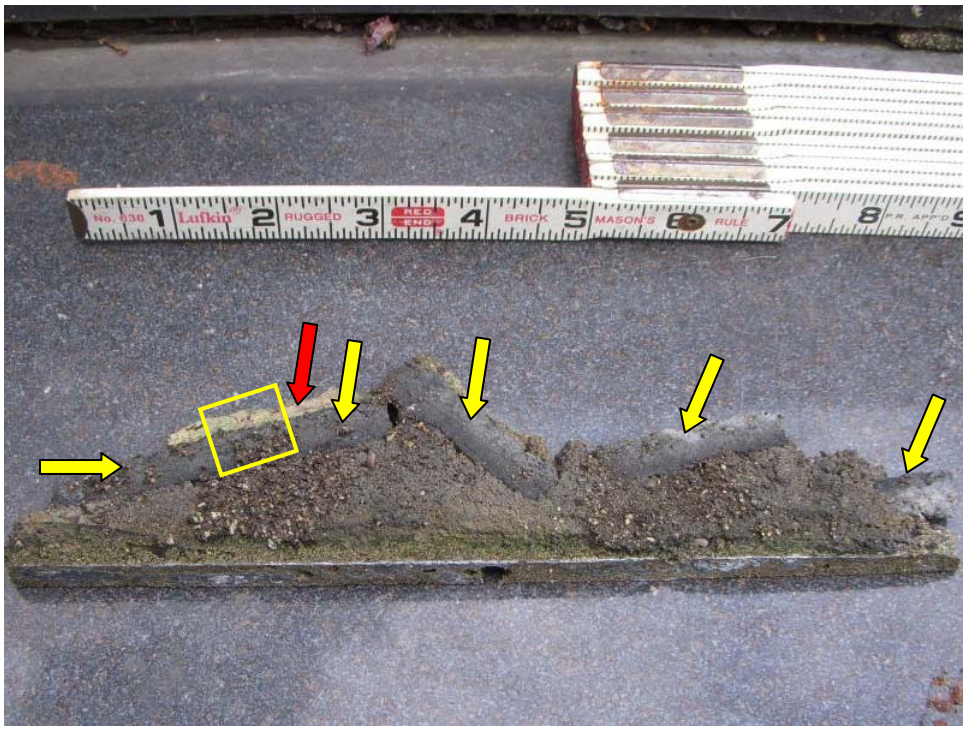

Figure 1. Photo supplied by Oehrlein & Associates. The yellow arrows mark the material of interest that was removed from the submitted sample for the current studies. The portion of the mortar outlined by the yellow box was used for preparation of a thin section and subsequent petrographic studies. The remainder of the material marked with the yellow arrows was used for the chemical composition studies and the sand gradation studies. The material of interest is medium to dark gray and appears to have shifted in the joint due to installation of additional pointing material. The red arrow marks some white colored mortar that appears to be located behind the medium dark gray mortar that is the subject of the current studies. This white mortar layer was also intersected by the thin section that was prepared as part of the current studies.

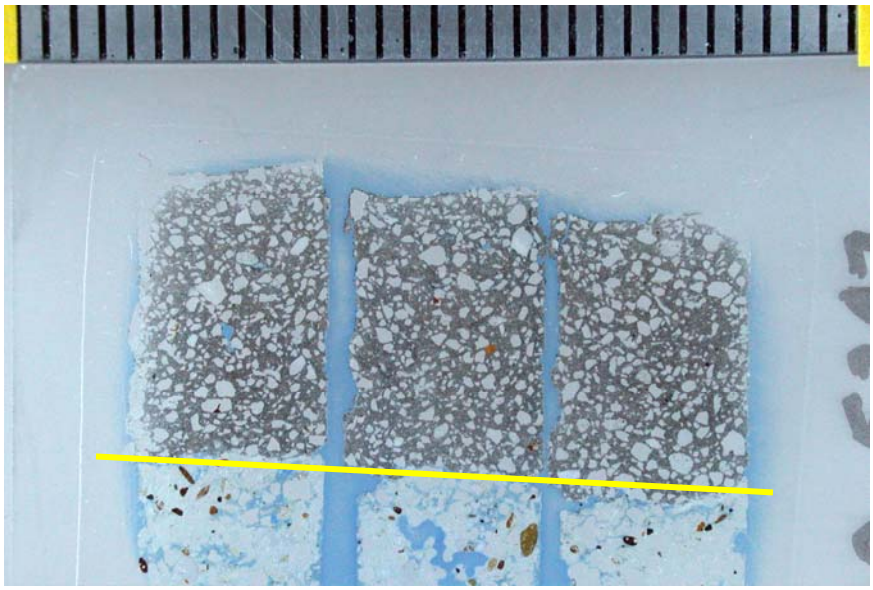

Figure 2. A photograph of the thin section that was prepared for the current studies is pictured. Three separate pieces of the mortar were mounted on the same thin section to increase the area of the mortar available for examination. The portion of the mortar located above the yellow line is the medium to dark gray mortar that is the subject of the current studies. The mortar below the yellow line is the white material marked with a red arrow in the previous figure. The width of the field of view is 3 cm. A millimeter scale is visible along the top of the figure.

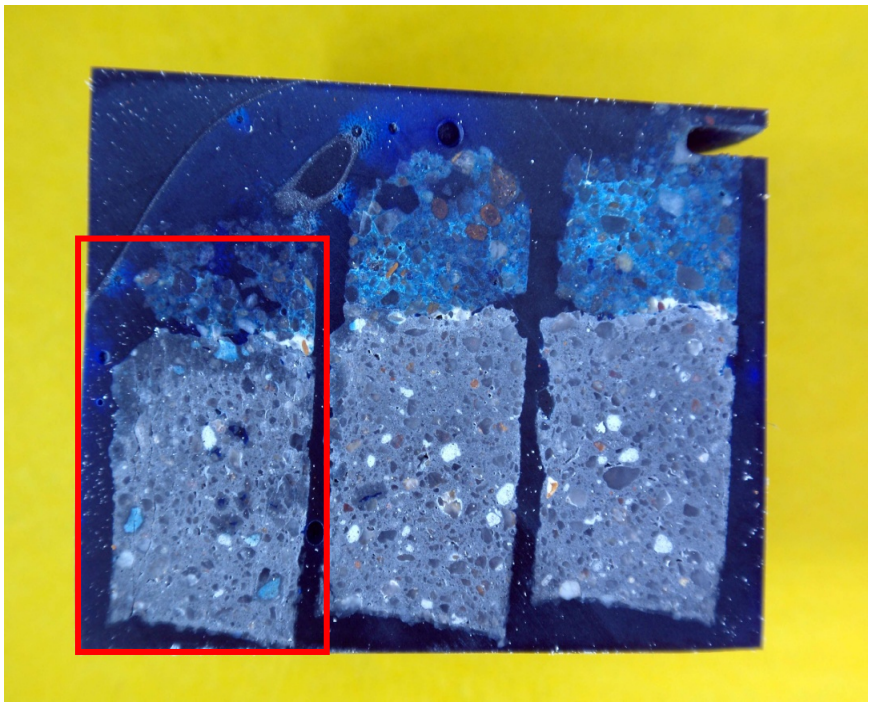

Figure 3. The lapped surface of the impregnated specimen that remained after the thin section had been cut is shown above. The sample was produced by embedding three thin slabs that had been cut from the sample perpendicular to the mortar bedding plane. The red box outlines the portion of the sample viewed at higher magnification in Figure 4. The width of the field of view is 3 centimeters.

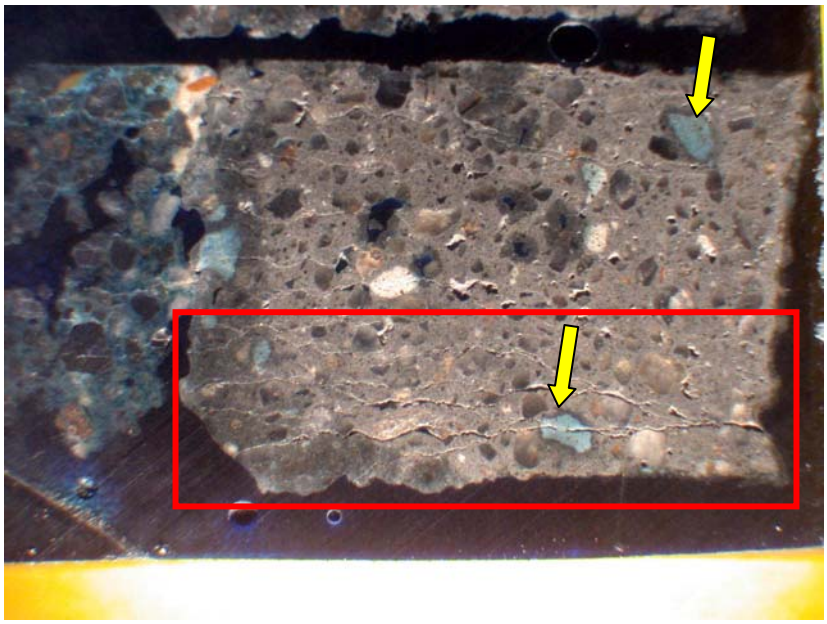

Figure 4. A close-up of the mortar fragment outlined by the red box in Figure 2 is shown above. Freeze-thaw cracks are visible in the area outlined by the red box. The white sand-sized particles marked with yellow arrows are cement lumps (not lime lumps) that were porous and preferentially absorbed blue epoxy during thin section preparation. Note non-air entrained nature of the mortar (although some irregularly-shaped voids are present). The width of the field of view is 0.5 inch.

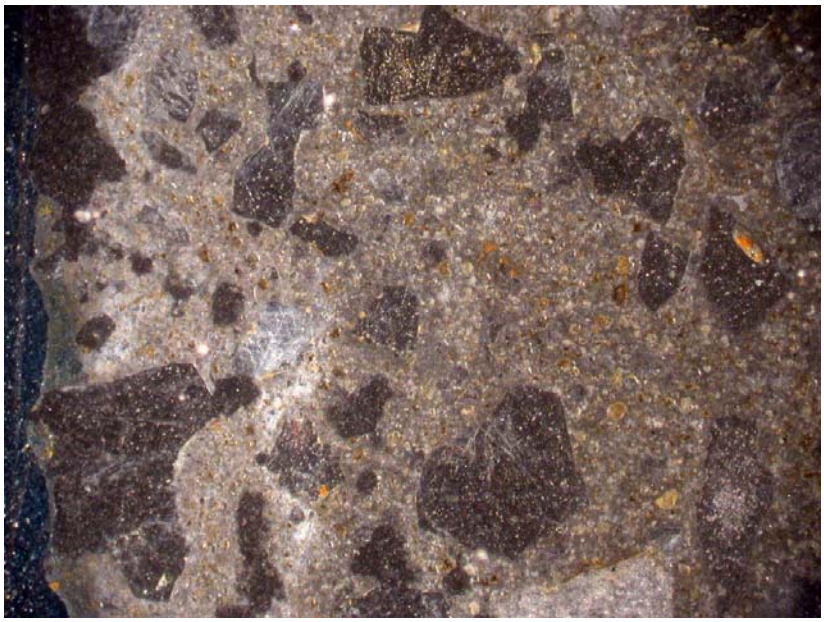

Figure 5. The near-surface region of the mortar as viewed in thin section using reflected light is shown above. The light brown to tan particles are composed of residual portland cement. The width of the field of view is 2.5 mm.

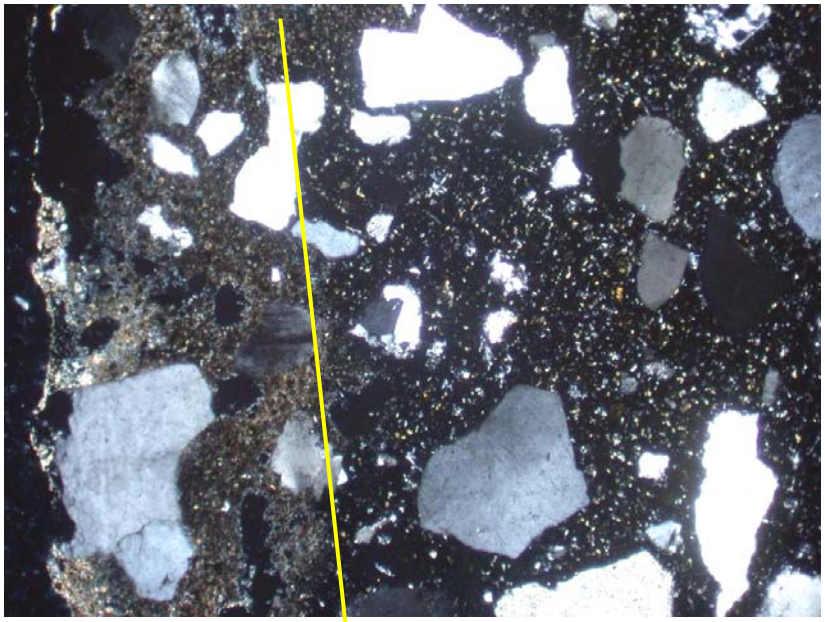

Figure 6. The same area shown in Figure 5 using polarized light is shown above. The bright region of the matrix to the left of the yellow line is carbonated. The width of the field of view is 2.5 mm.

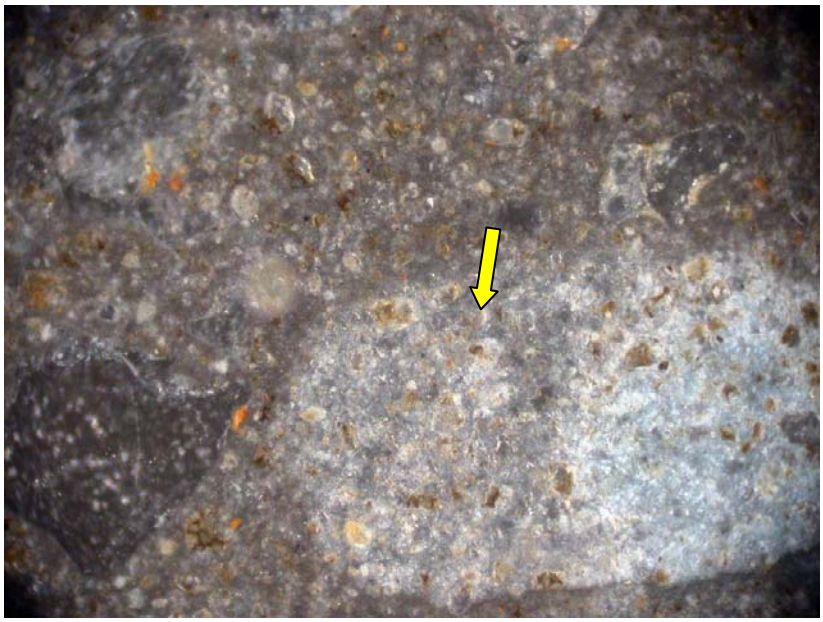

Figure 7. A cement lump in the mortar is marked with an arrow. Note the variable density in the lump, which may be related to internal differences in w/c. Note that the lump is lighter in color than the surrounding (probably pigmented) mortar. The photo was taken using reflected light. The width of the field of view is 1.0 mm.

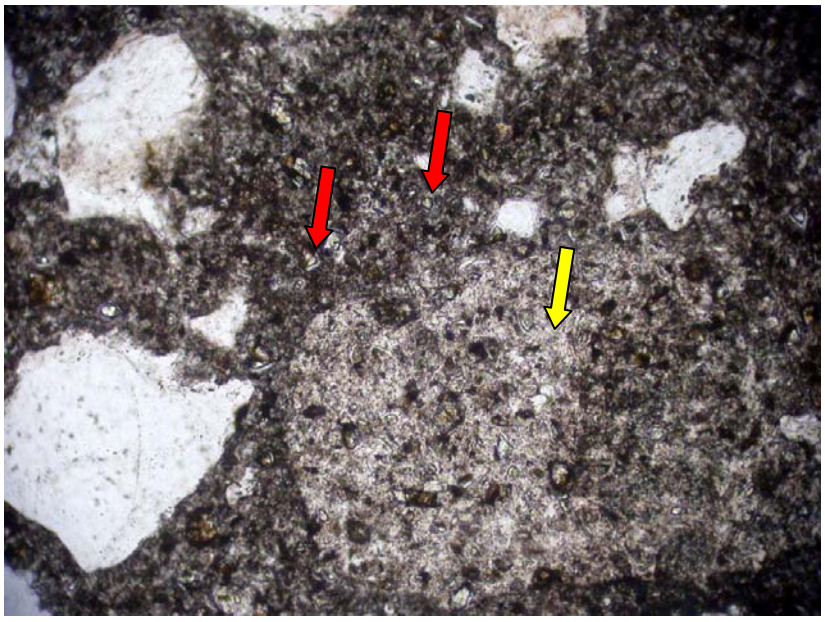

Figure 8. The same area shown in Figure 7 as viewed using transmitted light is pictured. Note the variation in opacity of the cement lump (marked with a yellow arrow). Cement particles that are surrounded with clear rims are also visible and two of them are marked with red arrows. The width of the field of view is 1.0 mm.

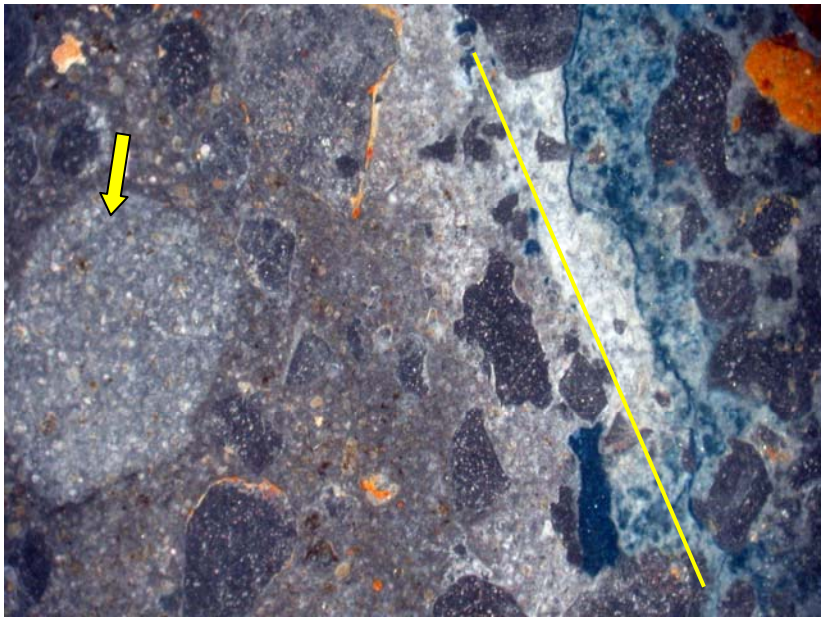

Figure 9. The interface between the mortar that is the subject of the current studies and the possible sand lime material located behind it is marked with a yellow line. The yellow arrow marks the location of another cement lump in the mortar. The photo was taken using reflected light. The width of the field of view is 2.5 mm.

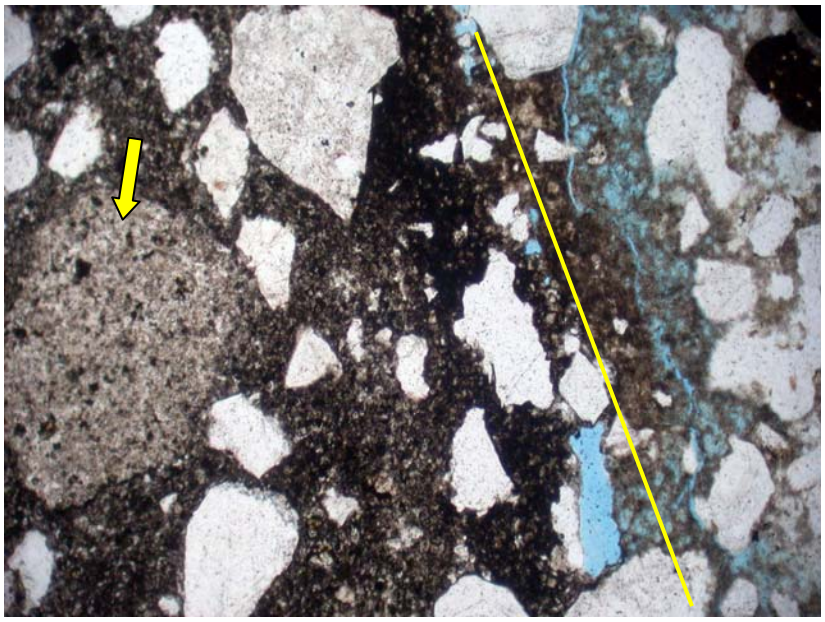

Figure 10. The same area shown in Figure 9 as viewed using transmitted light is shown above. The cement lump has reduced opacity to transmitted light relative to the bulk of the matrix. The width of the field of view is 2.5 mm.

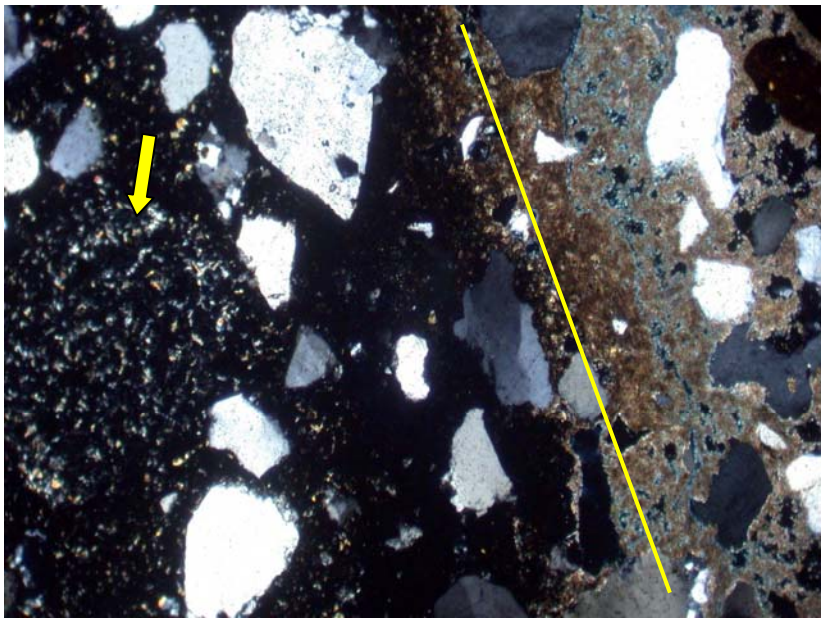

Figure 11. The same area shown in Figure 10 as viewed using polarized light is shown above. The cement lump contains discrete calcium hydroxide crystals that are uniformly dispersed, as would be expected if they formed due to hydration of the cement. The bright (highly birefringent) condition of the likely sand/lime mortar to the right of the yellow line is due to nearly complete carbonation of the matrix in this material. The width of the field of view is 2.5 mm.

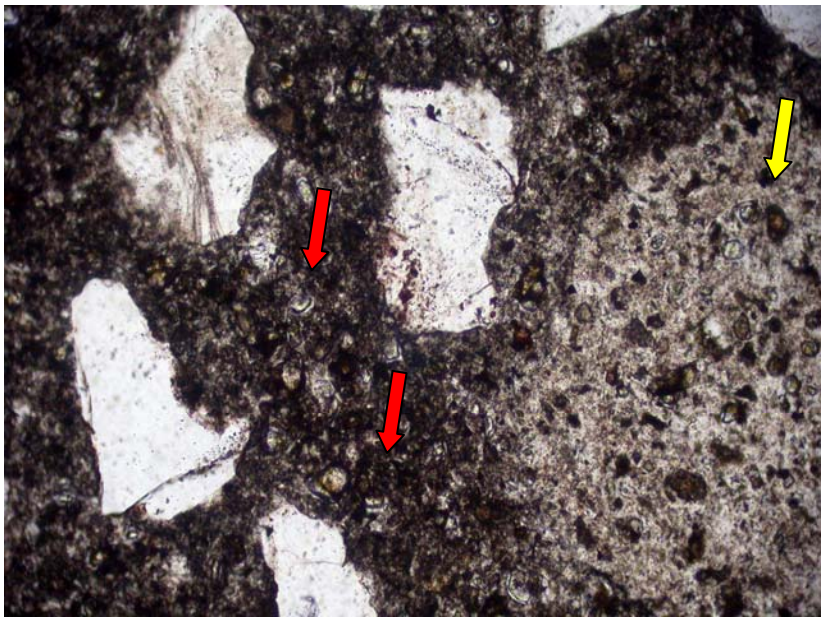

Figure 12. A close-up of a cement lump similar to that shown in Figure 8 as viewed at higher magnification is shown above. The lump is marked with a yellow arrow. Cement particles that are surrounded with clear rims are also visible and two of them are marked with red arrows. The width of the field of view is 1.0 mm.

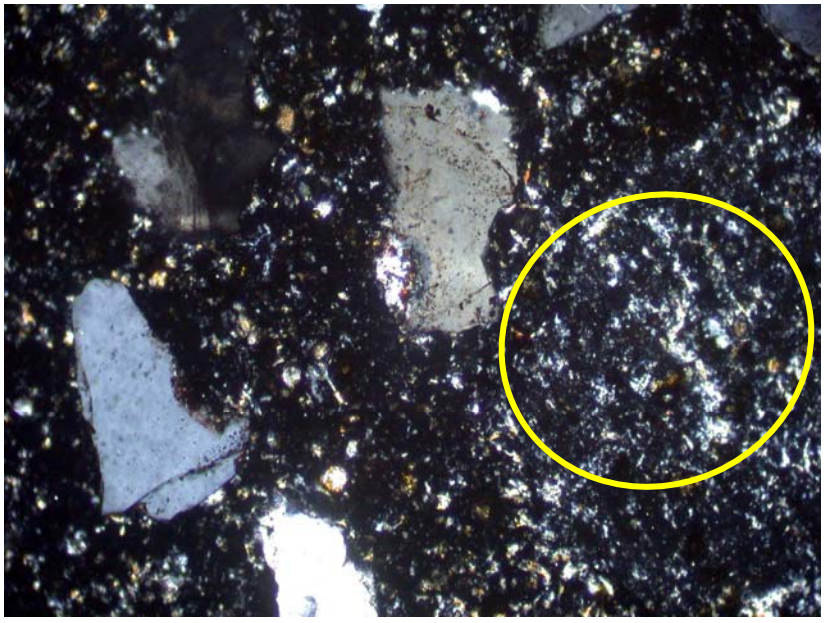

Figure 13. The same area shown in Figure 12 as viewed using polarized light is shown above. Note the higher concentration of calcium hydroxide within the cement lump (light gray to white regions in the area outlined by the ellipse). The width of the field of view is 1.0 mm.