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Date: May 20, 2022
Project Number: 19-009
Subject: 301 Mission Retrofit Monitoring Report 054: Results as of May 17, 2022

CONTEXT
This memorandum summarizes results from the monitoring plan implemented at the 301 Mission property. Instrumentation to monitor the structure prior to, during and after the retrofit was installed in January 2021, including piezometers and extensometers. Settlement markers installed in April 2009 and January 2017, survey prisms mounted on the exterior of the structure in December 2016, and crack gauges installed in April 2009 have also been monitored. This memorandum is for review only. It only contains ongoing monitoring information. This memorandum does not contain recommendations based upon the ongoing monitoring information.

PRESENTATION OF DATA
Figure 01 presents the instrument locations as referenced in later figures.

Figure 02 presents the historical settlement data interpreted from settlement markers installed on the B-1 Level of 301 Mission Tower. In addition, data from surveys performed during the retrofit are included. Figure 03A presents settlement data since the start of production pile installation (May 12, 2021; baseline readings on May 10, 2021) through May 16, 2022. Figure 03B presents settlement data since January 11, 2021, through May 16, 2022. Figure 04 presents current settlement contours (in inches) on May 16, 2022.

Figure 05 presents historical lateral roof deflections in the project north-south and project east-west directions interpreted from survey prisms mounted on the exterior of the Tower, from InSAR data, and from a planar fit of the settlement marker data. In addition, data from surveys performed during the retrofit are included. Figure 06A presents lateral roof deflection data from a planar fit of the settlement marker data and from survey prisms mounted on the exterior of the Tower since the start of production pile installation (May 12, 2021; baseline readings on May 10 and 13, 2021, respectively) through May 16, 2022. Figure 06B presents lateral roof deflection data from a planar fit of the settlement marker data and from survey prisms mounted on the exterior of the Tower since January 11, 2021, through May 16, 2022.

Figure 07 presents the historical groundwater elevation interpreted from piezometer readings at locations near 301 Mission. In addition, data from piezometers installed to monitor groundwater elevation during the retrofit are included. Figures 08 and 09 present groundwater elevation interpreted from piezometer readings in the Marine/Colma Sand and the Old Bay Clay, respectively, for the time period prior to the start of production pile installation (January 1, 2021) through May 17, 2022.
Figure 10 presents extensometer data from within the Tower basement since the start of production pile installation (May 12, 2021) through May 17, 2022. Figure 11 presents extensometer data from Fremont Street since the start of production pile installation (May 12, 2021) through May 17, 2022. Figure 12 presents extensometer data from Mission Street since the start of production pile installation (May 12, 2021) through May 17, 2022.

CLOSING

Please contact us if you have any comments or questions, or if you would like to discuss the results presented in this memorandum.

FIGURES

Figure 01A – Instrument Location Map: Settlement Markers, Piezometers, Extensometers
Figure 01B – Tower Survey Prism Location Schematic
Figure 02 – Historical Settlement Marker Data
Figure 03A – Settlement Marker Data since 05/10/2021 through 05/16/2022
Figure 03B – Settlement Marker Data since 01/11/2021 through 05/16/2022
Figure 04 – Settlement Contours since 05/10/2021 through 05/16/2022
Figure 05 – Historical Lateral Roof Deflection Data
Figure 06A – Lateral Roof Deflection Data since 05/10/2021 through 05/16/2022
Figure 06B – Lateral Roof Deflection Data since 01/11/2021 through 05/16/2022
Figure 07 – Historical Groundwater Elevation Measurements at Locations Near 301 Mission
Figure 08A – Groundwater Elevation Measurements in Marine and Colma Sand since 01/01/2021 through 05/17/2022
Figure 08B – Groundwater Elevation Measurements in Marine and Colma Sand since 05/10/2021 through 05/17/2022
Figure 09A – Groundwater Elevation Measurements in Old Bay Clay since 01/01/2021 through 05/17/2022
Figure 09B – Groundwater Elevation Measurements in Old Bay Clay since 01/01/2021 through 05/17/2022
Figure 10A – Extensometer Data from within Tower Basement since 01/01/2021 through 05/17/2022
Figure 10B – Extensometer Data from within Tower Basement since 05/10/2021 through 05/17/2022
Figure 11A – Extensometer Data from Fremont Street since 01/01/2021 through 05/17/2022
Figure 11B – Extensometer Data from Fremont Street since 05/10/2021 through 05/17/2022
Figure 12A – Extensometer Data from Mission Street since 01/01/2021 through 05/17/2022
Figure 12B – Extensometer Data from Mission Street since 05/10/2021 through 05/17/2022

ATTACHMENTS

Attachment 01 – Crack Gauge Report since 01/06/2021 through 05/16/2022
Settlement Marker
Piezometer Array
Extensometer Array

From 301 Mission Perimeter Pile Upgrade Bulletin 8 Set S 207 2021-06-15

INSTRUMENT LOCATION MAP
SETTLEMENT MARKERS, PIEZOMETERS, EXTENSOMETERS

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
HISTORICAL SETTLEMENT MARKER DATA

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
SETTLEMENT MARKER DATA
SINCE 05/10/2021 THROUGH 05/16/2022

Note: The red bilinear limiting line is intended to be for comparison with post-construction observations. The rate of settlement observations since the start of production pile installation (May 12) exceeds the post-construction limiting rates. As a result, action is being taken to modify the construction process to reduce the additional settlement through completion of construction.

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City and County of San Francisco, California
SETTLEMENT MARKER DATA
SINCE 01/11/2021 THROUGH 05/16/2022

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Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
SETTLEMENT CONTOURS
SINCE 05/10/2021 THROUGH 05/16/2022

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
HISTORICAL LATERAL ROOF DEFLECTION DATA

2021/05/12: Fremont St. 36" Casing Installation Start
2021/06/22: Fremont St. 36" Casing Installation End
2021/07/06: Mission St. 36" Casing Installation Start
2021/07/09: Fremont St. 24" Casing/Rock Socket Installation Start
2021/08/02: Mission St. 36" Casing Installation on Hold
2021/08/22: Fremont St. 24" Casing/Rock Socket Installation on Hold
2021/10/12-13: 36" Pile Installation / Vibration Test
2021/10/28: Mission St. 36" Casing Installation Restart
2021/11/15-19: 24" Pile Installation / Vibration Test
2021/12/01-05: 24" Pile Installation
2021/12/13-17: 24" Pile Installation
2022/01/10: 24" Pile Installation Restart
2022/02/23: 24" Pile Installation Restart
2022/03/12: 24" Pile Installation Completion
2022/04/26-28: Fremont St. Secant Pile Test Installation
2022/05/03: Fremont St. Shoring Pile Installation Start
LATERAL ROOF DEFLECTION DATA
SINCE 05/10/2021 THROUGH 05/16/2022

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
LATERAL ROOF DEFLECTION DATA
SINCE 01/11/2021 THROUGH 05/16/2022


-9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4

Lateral Roof Deflection Since 01/11/2021 (in)
(East and North Positive [+])

2021/05/12: Fremont St. 36" Casing Installation Start
2021/06/22: Fremont St. 36" Casing Installation End
2021/07/06: Mission St. 36" Casing Installation Start
2021/07/09: Fremont St. 24" Casing/Rock Socket Installation Start
2021/08/02: Mission St. 36" Casing Installation on Hold
2021/08/22: Fremont St. 24" Casing/Rock Socket Installation on Hold
2021/10/12-13: 36" Pile Installation / Vibration Test
2021/10/28: Mission St. 36" Casing Installation Restart
2021/11/15-19: 24" Pile Installation / Vibration Test
2021/12/01-05: 24" Pile Installation
2021/12/13-17: 24" Pile Installation
2022/01/10: 24" Pile Installation Restart
2022/02/23: 24" Pile Installation Restart
2022/03/12: 24" Pile Installation Completion
2022/04/26-28: Fremont St. Secant Pile Test Installation
2022/05/03: Fremont St. Shoring Pile Installation Start
HISTORICAL GROUNDWATER ELEVATION MEASUREMENTS
AT LOCATIONS NEAR 301 MISSION

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
GROUNDWATER ELEVATION MEASUREMENTS IN MARINE AND COLMA SAND
SINCE 01/01/2021 THROUGH 05/17/2022

- SB-1 @ 85'
- PB-1 @ 85'
- PB-2 @ 85'

2021/05/12: Fremont St. 36'' Casing Installation Start
2021/06/22: Fremont St. 36'' Casing Installation End
2021/07/06: Mission St. 36'' Casing Installation Start
2021/07/09: Fremont St. 24'' Casing/Rock Socket Installation Start
2021/08/02: Mission St. 36'' Casing Installation on Hold
2021/08/22: Fremont St. 24'' Casing/Rock Socket Installation on Hold
2021/10/12-13: 36'' Pile Installation / Vibration Test
2021/10/28: Mission St. 36'' Casing Installation Restart
2021/11-15-19: 24'' Pile Installation / Vibration Test
2021/12/01-05: 24'' Pile Installation
2021/12/13-17: 24'' Pile Installation
2022/01/10: 24'' Pile Installation Restart
2022/02/23: 24'' Pile Installation Restart
2022/03/12: 24'' Pile Installation Completion
2022/04/26-28: Fremont St. Secant Pile Test Installation
2022/05/03: Fremont St. Shoring Pile Installation Start

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Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
GROUNDWATER ELEVATION MEASUREMENTS IN MARINE AND COLMA SAND
SINCE 05/10/2021 THROUGH 05/17/2022

2021/05/12: Fremont St. 36" Casing Installation Start
2021/06/22: Fremont St. 36" Casing Installation End
2021/07/06: Mission St. 36" Casing Installation Start
2021/07/09: Fremont St. 24" Casing/Rock Socket Installation Start
2021/08/02: Mission St. 36" Casing Installation on Hold
2021/08/22: Fremont St. 24" Casing/Rock Socket Installation on Hold
2021/10/12-13: 36" Pile Installation / Vibration Test
2021/10/28: Mission St. 36" Casing Installation Restart
2021/11-19: 24" Pile Installation / Vibration Test
2021/12-01-05: 24" Pile Installation
2021/12-13-17: 24" Pile Installation Restart
2022/01/10: 24" Pile Installation Restart
2022/02/23: 24" Pile Installation Restart
2022/03/12: 24" Pile Installation Completion
2022/04/26-28: Fremont St. Secant Pile Test Installation
2022/05/03: Fremont St. Shoring Pile Installation Start
GROUNDWATER ELEVATION MEASUREMENTS IN OLD BAY CLAY

SINCE 01/01/2021 THROUGH 05/17/2022

Project No: 19-009.00  Date: 5/18/2022  Created By: NBW  Checked By: DGM  Figure No: 054-09A

City and County of San Francisco, California
GROUNDWATER ELEVATION MEASUREMENTS IN OLD BAY CLAY
SINCE 05/10/2021 THROUGH 05/17/2022

2021/05/12: Fremont St. 36" Casing Installation Start
2021/06/22: Fremont St. 36" Casing Installation End
2021/07/06: Mission St. 36" Casing Installation Start
2021/07/09: Fremont St. 24" Casing/Rock Socket Installation Start
2021/08/02: Mission St. 36" Casing Installation on Hold
2021/08/22: Fremont St. 24" Casing/Rock Socket Installation on Hold
2021/10/12-13: 36" Pile Installation / Vibration Test
2021/10/28: Mission St. 36" Casing Installation Restart
2021/11/15-19: 24" Pile Installation / Vibration Test
2021/12/01-13: 24" Pile Installation
2021/12/13-17: 24" Pile Installation
2022/01/10: 24" Pile Installation Restart
2022/02/23: 24" Pile Installation Restart
2022/03/12: 24" Pile Installation Completion
2022/04/26-28: Fremont St. Secant Pile Test Installation
2022/05/03: Fremont St. Shoring Pile Installation Start
EXTENSOMETER DATA FROM WITHIN TOWER BASEMENT
SINCE 01/01/2021 THROUGH 05/17/2022

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California

Settlement Relative to Anchor (in)

- SB-2 @ 15'
- SB-2 @ 100'
- SB-2 @ 120'
- SB-2 @ 140'
- SB-2 @ 160'

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EXTENSOMETER DATA FROM WITHIN TOWER BASEMENT
SINCE 05/10/2021 THROUGH 05/17/2022

Settlement Relative to Anchor (in)

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City and County of San Francisco, California
EXTENSOMETER DATA FROM FREMONT STREET
SINCE 01/01/2021 THROUGH 05/17/2022

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
EXTENSOMETER DATA FROM FREMONT STREET
SINCE 05/10/2021 THROUGH 05/17/2022

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
EXTENSONOMETER DATA FROM MISSION STREET
SINCE 01/01/2021 THROUGH 05/17/2022

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
EXTENSOMETER DATA FROM MISSION STREET
SINCE 05/10/2021 THROUGH 05/17/2022

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California