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 August 22, 2022. Figure 03B presents settlement data since January 11, 2021, through August 22, 2022. Figure 04 presents current settlement contours (in inches) on August 22, 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 August 23, 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 August 23, 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 August 23, 2022.
Figure 10 presents extensometer data from within the Tower basement since the start of production pile installation (May 12, 2021) through August 22, 2022. Figure 11 presents extensometer data from Fremont Street since the start of production pile installation (May 12, 2021) through August 23, 2022. Figure 12 presents extensometer data from Mission Street since the start of production pile installation (May 12, 2021) through August 23, 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 08/22/2022
- Figure 03B – Settlement Marker Data since 01/11/2021 through 08/22/2022
- Figure 04 – Settlement Contours since 05/10/2021 through 08/22/2022
- Figure 05 – Historical Lateral Roof Deflection Data
- Figure 06A – Lateral Roof Deflection Data since 05/10/2021 through 08/23/2022
- Figure 06B – Lateral Roof Deflection Data since 01/11/2021 through 08/23/2022
- 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 08/23/2022
- Figure 08B – Groundwater Elevation Measurements in Marine and Colma Sand since 05/10/2021 through 08/23/2022
- Figure 09A – Groundwater Elevation Measurements in Old Bay Clay since 01/01/2021 through 08/23/2022
- Figure 09B – Groundwater Elevation Measurements in Old Bay Clay since 01/01/2021 through 08/23/2022
- Figure 10A – Extensometer Data from within Tower Basement since 01/01/2021 through 08/22/2022
- Figure 10B – Extensometer Data from within Tower Basement since 05/10/2021 through 08/22/2022
- Figure 11A – Extensometer Data from Fremont Street since 01/01/2021 through 08/23/2022
- Figure 11B – Extensometer Data from Fremont Street since 05/10/2021 through 08/23/2022
- Figure 12A – Extensometer Data from Mission Street since 01/01/2021 through 08/23/2022
- Figure 12B – Extensometer Data from Mission Street since 05/10/2021 through 08/23/2022

ATTACHMENTS

- Attachment 01 – Crack Gauge Report since 01/06/2021 through 08/22/2022
INSTRUMENT LOCATION MAP
SETTLEMENT MARKERS, PIEZOMETERS, EXTENSOMETERS

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

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

Settlement Marker
Piezometer Array
Extensometer Array

Project No: 19-009.00  Date: 7/26/2021  Created By: NBW  Checked By: DGM  Figure No: 068-01A

INSTRUMENTATION MONITORING DATA
19-009.00
Filepath: S:\SlateDrive - Documents\Projects_2019\19-009.00 Millennium Tower Retrofit\10 Construction\01 Monitoring Reports\19-009.00 Millennium Tower Perimeter Pile Upgrade\10 Construction\01 Monitoring Reports\TowerSoilWater\00 Figures\Fig_068-01A_Instrument_Map.grf
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
2022/05/26: Fremont St. Shoring Pile Installation on Hold
2022/06/13: Mission St. Shoring Pile Installation Start
2022/08/05: Mission St. Shoring Pile Installation End

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 08/22/2022

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

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.

2021/05/12: Fremont St. 36” Casing Installation Start
2021/05/12: 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
2022/05/26: Fremont St. Shoring Pile Installation on Hold
2022/06/13: Mission St. Shoring Pile Installation Start
2022/08/05: Mission St. Shoring Pile Installation End

Project No: 19-009.00 Date: 8/24/2022 Created By: KAS Checked By: DGM Figure No: 068-03A
SETTLEMENT MARKER DATA
SINCE 01/11/2021 THROUGH 08/22/2022

Project No: 19-009.00  Date: 8/24/2022  Created By: KAS  Checked By: DGM  Figure No: 068-03B

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
SETTLEMENT CONTOURS
SINCE 05/10/2021 THROUGH 08/22/2022

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

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

Filepath: S:\SlateDrive - Documents\Projects\2019-19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_068-05_LatDef_Data.grf
LATERAL ROOF DEFLECTION DATA SINCE 05/10/2021 THROUGH 08/23/2022

2021/05/12: Fremont St. 36" Casing Installation Start
2021/05/12: Fremont St. 36" Casing Installation End
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
2022/06/28: Fremont St. Secant Pile Test Installation
2022/05/03: Fremont St. Shoring Pile Installation Start
2022/05/26: Fremont St. Shoring Pile Installation on Hold
2022/06/13: Mission St. Shoring Pile Installation Start
2022/08/05: Mission St. Shoring Pile Installation End
Lateral Roof Deflection Since 01/11/2021 (in)

(Prism E-W)

(Planar E-W)

(Planar N-S)

(Prism N-S)

Prism E-W

Planar E-W

Planar N-S

Prism N-S


2021/05/12: Fremont St. 36" Casing Installation Start
2021/06/22: Fremont St. 36" Casing Installation End
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
2022/05/26: Fremont St. Shoring Pile Installation on Hold
2022/06/13: Mission St. Shoring Pile Installation Start
2022/08/05: Mission St. Shoring Pile Installation End

LATERAL ROOF DEFLECTION DATA
SINCE 01/11/2021 THROUGH 08/23/2022

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
HISTORICAL GROUNDWATER ELEVATION MEASUREMENTS
AT LOCATIONS NEAR 301 MISSION

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

Project No: 19-009.00  Date: 8/24/2022  Created By: KAS  Checked By: DGM  Figure No: 068-07
GROUNDWATER ELEVATION MEASUREMENTS IN MARINE AND COLMA SAND
SINCE 05/10/2021 THROUGH 08/23/2022

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
GROUNDWATER ELEVATION MEASUREMENTS IN OLD BAY CLAY
SINCE 01/01/2021 THROUGH 08/23/2022

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
2021/11/15-17: 24" Pile Installation
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
2022/05/26: Fremont St. Shoring Pile Installation on Hold
2022/06/13: Mission St. Shoring Pile Installation Start
2022/08/05: Mission St. Shoring Pile Installation End
GROUNDWATER ELEVATION MEASUREMENTS IN OLD BAY CLAY
SINCE 05/10/2021 THROUGH 08/23/2022

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
2021/12/01-05: 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
2022/05/26: Fremont St. Shoring Pile Installation on Hold
2022/06/13: Mission St. Shoring Pile Installation Start
2022/08/05: Mission St. Shoring Pile Installation End

City and County of San Francisco, California

Project No: 19-009.00  Date: 8/24/2022  Created By: KAS  Checked By: DGM  Figure No: 068-09B
EXTENOMETER DATA FROM WITHIN TOWER BASEMENT
SINCE 01/01/2021 THROUGH 08/22/2022

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

Project No: 19-009.00  Date: 8/24/2022  Created By: KAS  Checked By: DGM  Figure No: 068-10A
EXTENSOMETER DATA FROM WITHIN TOWER BASEMENT

SINCE 05/10/2021 THROUGH 08/22/2022

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
EXTENSOMETER DATA FROM FREMONT STREET
SINCE 01/01/2021 THROUGH 08/23/2022

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 08/23/2022

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California
EXTENSOMETER DATA FROM MISSION STREET
SINCE 01/01/2021 THROUGH 08/23/2022

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 08/23/2022

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