

To:	Wade Johns	From:	Najib A. Kalas, P.E. Brett A. Shipton, P.E., G.E.
Company:	Alamo Manhattan Properties, LLC	Date:	December 17, 2019
Address:	3012 Fairmount Street, Suite 100 Dallas, TX 75201		
cc:	Kim Lan, Alamo Manhattan Properties, LLC (via email only)		
GDI Project:	AlamoMan-6-12		
RE:	Ground Improvement Buttress Preliminary Recommendations Alamo Manhattan Blocks Portland, Oregon		

This memorandum summarizes our preliminary recommendations for the ground improvement buttress for the proposed Alamo Manhattan Blocks development located in the South Waterfront of Portland, Oregon. The purpose of the buttress is to mitigate lateral spreading between the proposed Alamo Manhattan Blocks development and the Willamette River. Such a buttress is present at all of the developments adjacent to the river at the South Waterfront. The buttress will be constructed of cement deep soil mix (CDSM) columns.

CDSM ground improvement uses a specialized mixing tool to blend the existing soil with cement slurry. The soil and cement slurry are mixed together using paddles along the hollow shaft, which is also used as a conduit to pump the cement slurry to the tip of the mixing tool. The soil and cement slurry are mixed until a relatively uniform column of soil and cement is formed. The resulting columns have relatively low compressibility and high stiffness compared to the original soil. The columns have higher shear strength than the surrounding soil. We estimate the CDSM columns are typically 4 feet in diameter. Spoils will be generated by the CDSM installation process as the cement slurry is injected into the ground and mixed with soil. Typically, CDSM spoils will be on the order of 20 to 30 percent of the volume of the injected cement slurry. The CDSM spoils can likely be used on site as structural fill or will need to be removed from the site. We estimate the CDSM columns will be installed in three rows spaced 8 feet on-center in a triangular pattern as shown on Figures 1 and 2. The CDSM columns will have a tip elevation of approximately -40 feet and a top elevation of approximately 20 feet. The ordinary high water elevation of the Willamette River is approximately 18 feet. To avoid cement contaminating the root zone in landscaping areas, it is recommended that the columns be installed from a bench that is at an elevation at the base of the root zone. As such, the proposed ground improvement buttress will not impact the proposed landscaping and will not be visible at the ground surface. We have attached drawings that show the preliminary layout of the ground improvement and a cross section.





# Memorandum

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We appreciate the opportunity to be of continued service to you on this project. Please call if you have questions concerning the information provided.

NAK:BAS:kt

Attachments

One copy submitted (via email only)

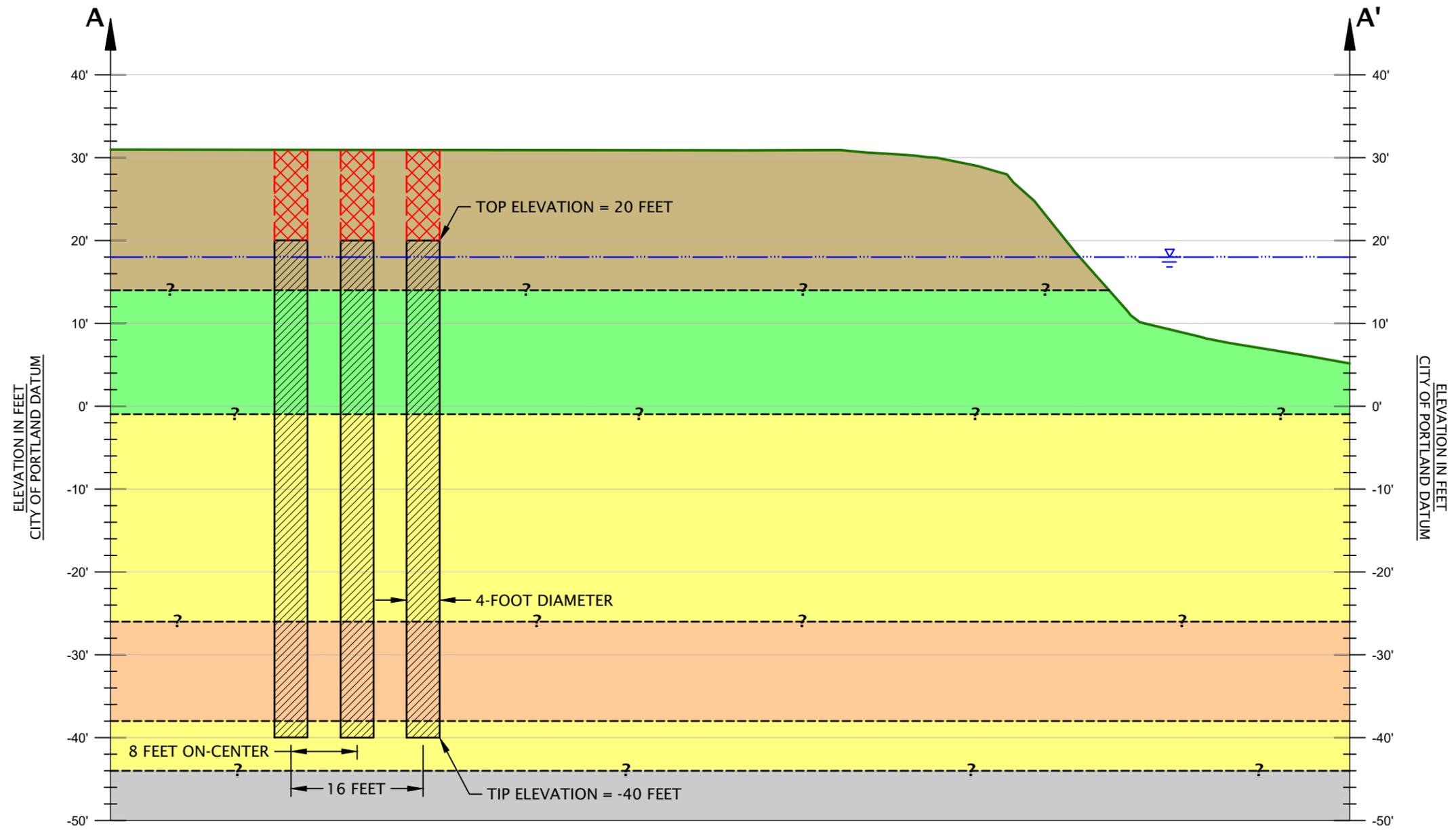
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## FIGURES



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 File Name: J:\A-D\AlamoMan\AlamoMan-6\AlamoMan-6-12\Figures\CAD\AlamoMan-6-12-CS01.dwg | Layout: FIGURE 2



**LEGEND:**

- EXISTING TOPOGRAPHY
- INTERPRETED CONTACT
- ORDINARY HIGH WATER
- CDSM COLUMN
- DISTURBED SOIL OR LIGHTLY TREATED SOIL
- FILL: MOSTLY GRAVEL AND SAND (LOOSE TO DENSE) AND SANDY SILT (VERY SOFT TO MEDIUM STIFF)

- ALLUVIAL SILTY SAND (VERY LOOSE TO LOOSE) TO SANDY SILT (VERY SOFT TO MEDIUM STIFF)
- ALLUVIAL SILT (VERY SOFT TO VERY STIFF)
- ALLUVIAL GRAVEL
- ALLUVIAL GRAVEL (DENSE TO VERY DENSE)



**CROSS SECTION A-A'**

ALAMO MANHATTAN BLOCKS  
 PORTLAND, OR

ALAMOMAN-6-12

DECEMBER 2019



**FIGURE 2**