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July 29, 2019

Marathon Acquisition & Development, Inc.
Attention: Aaron Wigod
30050 SW Town Center Loop W. Suite 200
Wilsonville, OR 97070

Re: Providence Academy Smokestack Investigation
400 Evergreen Blvd, Vancouver, Washington
Project Number: 18322.01

Dear Aaron:

As requested, we have reviewed the investigations by Carlson Testing and Olson Engineering, and have compared this information with the current standard (ASCE41) to seismically evaluate the existing Providence Academy smokestack. Based on this evaluation, it is our opinion that the unreinforced masonry smokestack is seismically unsafe, it presents a life safety risk even in a low to moderate seismic event, and complete collapse is very likely during a significant seismic event. Based on the findings to date, it is our opinion however, that measures can be taken to repair and seismically retrofit the smokestack that will reduce the collapse and life safety risks. The specific performance criteria and level of retrofit will need to be determined if that option is pursued. The information in the following paragraphs summarizes the reviewed/evaluated items.

The Carlson Testing Inc report, dated June 19, 2019, describes the overall condition of the mortar joints throughout the height of the smokestack. Based on their assessment it appears multiple locations will require repair and re-pointing if a retrofit is pursued. Carlson Testing should be consulted to see if they can give a rough percentage of surface area that will need repair. A general guideline for this exercise can be that repointing is required if more than 1/2 inch of mortar loss from the face of brick has occurred. Based on the brick shear testing report it should be assumed that the entire upper 30' of the stack will require re-pointing.

The Carlson Testing Inc brick shear tests, dated May 23, 2019, generally show the lower 60' of the stack has adequate in-plane shear strength to use proprietary anchors and to use ASCE41 guidelines to seismically retrofit the smokestack. The upper 30' will need to be repointed and proprietary anchors used in this region will need to be field tested to develop their allowable capacities.

The Olson Engineering survey describes the overall height of the smokestack, it's geometry, and specifies the "lean" or plumbness of the smokestack throughout its height. Generally, it appears the smokestack is relatively plumb with little to no foundation settlement which would indicate the smokestack is stable under its own gravity loading.

The main ASCE41 items that raise concerns are noted and commented on below:

- a) The smokestack is located in a high seismic zone and the height to width ratio is roughly five times the allowable limit noted in this standard. This would suggest that toppling or complete collapse is very likely during a moderate seismic event.
- b) The structure lacks redundancy which means if a small to moderate region fails it is likely that most of the smokestack above this region will collapse.
- c) The in-plane shear tests are deficient in the upper 30' which means additional repairs and testing will be required in this region if a retrofit is pursued.
- d) The masonry layup or mortar loss is problematic in some regions. These regions will need to be repaired and re-pointed if a retrofit is pursued.
- e) The opening around the base and where the old boiler flue enters the smokestack will greatly reduce the strength of the masonry in these regions. These areas will need to be infilled if a retrofit is pursued.

The smokestack in question abuts a brick building that houses a boiler. The wood framed roof structure of this building has collapsed and no longer braces or ties into the surrounding brick walls. The walls of the building extend up roughly 21' above grade. The south brick wall of this building ties into the northwest and northeast corner of the smokestack. There is significant cracking between this wall and one corner of the smokestack while the other intersection appears to be undamaged. Due to the collapsed roof structure we feel the adjacent building wall currently is providing negligible bracing for the smokestack in the north/south direction. In the east/west direction, although one intersection is cracked, we feel it is acting as a buttress to the smokestack. It is our understanding that removing the adjacent building is being considered. Removing this building will laterally weaken the smokestack in the east/west direction, but we feel a seismic retrofit can effectively compensate for the removal.

This seismic evaluation is based on field observations of exposed structural components only and the review of reports prepared by other firms. Although certain problem areas may be noted, it is expressly understood that an exhaustive review of the smokestack has not been performed and that other concealed problems may exist. We have not performed any significant numeric structural calculations relating to the feasibility of retrofitting the smokestack.

If you have any further questions or require additional information, please do not hesitate to call.

Sincerely,



Timothy Agnew, P.E.
Project Manager

