VERDANT
Structural Engineers

March 31, 2022

SUBJECT: Structural Analysis of Engineering Judgment by NTA-ICC OF MONO-DENSITY COB WALL ASSEMBLY tested 12/07/2021

The purpose of this analysis is to support a load bearing rating for an assembly, based on an ASTM E119 test where a 5.5x higher load was applied after the heat exposure and hose stream, rather than during the heat exposure and hose stream as originally intended and specified in the standard protocol.

This letter shall stand as a follow-up and structural justification for the analysis described and conclusion in the letter dated 1/10/2022 and titled RE: ENGINEERING EVALUATION OF ASTM E119 TESTING OF MONO-DENSITY COB WALL ASSEMBLY (PROJECT NO. QS032921-80) by Luke R. Snyder, PE and Michael E. Luna of ICC-NTA.

During the 2-hour first test, the outer 2”-3” of the cob wall’s clay vitrified. During the 2.5-minute hose stream portion of ASTM E119 test, much of this verified layer was blown off. This left a minimum, average wall thickness of 8” at the thinnest points of the wall. Since the loading in ASTM E119 and the subsequent ultimate load test is uniform and distributed, there are no eccentric effects of the loss of material like this at any point of the firing or post firing compression test.

The 5° temperature rise of the non-exposed is more likely attributable to the rise in temperature of the air on the cool side, rather than a result of the firing. The cob material behind the blown off vitrified clay showed no signs of fire effects following the test and the straw appeared to be fresh and yellow. There is no structural engineering president to expect fatigue- or time-associated decreases in strength on a 2-hour time span for a compression based material like cob, therefore, considering compressive strength alone, an ultimate load test should exhibit the same or very similar properties as a 2-hour compressive test if loaded in the same way.

The center of the wall deflected out-of-plane between 1.5”-1.75” by the end of the two-hour firing, due to the temperature and expansion differential between the inside and outside faces. The deflection was significantly less toward the top, bottom and sides of the wall. The 2”-3” vitrified portion of the material was still fully attached through this point of the test. It is assumed that the most extreme out-of-plane deflection was resolved prior to the removal of the vitrified portion of clay.

A structural analysis comparing the ultimate load test results of 6,682 plf or 66,820 lbs and the proposed allowable superimposed load of 1,200 plf. The following factors were applied based on testing results and discussion above:

- The 2-hour ASTM E119 equivalent with the proposed allowable superimposed load
    - Conservatively considering 2” of eccentricity due to out-of-plane deflection uniformly across the center of the wall.
    - 10” average wall width.
    - Modulus of Elasticity= 40,000 psi
- The ultimate load test:
    - 8” average wall width.

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- No eccentricity.
- Modulus of Elasticity= 40,000 psi

The compressive strength (f'c) of the mix indicated by the ultimate testing value of 6,682 plf or 66,820 lbs is f'c=325psi. The compressive strength (f'c) of the mix required for the proposed allowable superimposed load of 1,200 plf is f'c=80 psi. Temperature effects are the only variable not accounted for in this calculation because there is no engineering standard for that type of analysis for a cob-like material. Other than that variable, these f'c values should equal each other in a real-life scenario. Therefore, the factor of safety to accommodate temperature affects is a factor of 4 between 80 psi and 325 psi.

The ultimate testing load is also 5.5 times greater than the proposed allowable superimposed load of 1,200 plf.

It is our conclusion that the proposed allowable superimposed load of 1,200 plf is a conservative and appropriate allowable load for the 2-hour fire rating of the Mono Density Wall Assembly.

Very truly yours,

Anthony Dente, P.E.

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