CIRRUS
STRUCTURAL ENGINEERING

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Franklin Square Preservation Society, Inc.
33 Kensington Road
Kensington, CT 06037

Reference: Saint Peter Church - Review of Structural Assessment

To Whom It May Concern:

Due to my expertise in evaluating historic masonry worship structures, including the post-collapse investigation of First Congregational Church, New London, I was engaged to review and provide an opinion of the Redfern Engineering, LLC report entitled "Review of Earthquake Damage to [..] Saint Peter's Church" dated July 16, 2024.

After careful review, it is my professional opinion that the scope of the assessment, as documented by the report, was not of sufficient depth to substantiate the definitive conclusion that the building has sustained "substantial structural damage." This building code-defined categorization was triggered by the author's determination that "the lateral load-carrying capacity of the tower has been reduced by more than 33% from its pre-damage condition." Based on this conclusion, the author recommends retrofit of a new steel skeleton, bracing and foundations for the tower and the rest of the building.

I arrived at my opinion by making the following observations:

- The report noted in its initial paragraph that its purpose was to "investigate suspected earthquake damage [from the April 5, 2024 magnitude 4.8 earthquake 124 miles away in Tewksbury Township, New Jersey] and form a professional opinion on the condition of the structure and possible structural repairs." A few paragraphs later, the report definitively states that "the earthquake event caused several noticeable areas of damage." *The report does not state how the author arrived at the conclusion that the observed damage was caused by the earthquake.* The only suggestion of their forensic analysis is in the last paragraph where the author states that they have no knowledge of the structure prior to their visit, and that some observed cracks were at prior repairs and others appeared "new". In my experience, a thorough investigation of a structure includes the dimension of time. In many cases, it is critical to understand the behavior of the building throughout its life (as best we can) to effectively determine the root cause of damage. This is often done by interviewing stewards of the building and reviewing past photos, reports and repair history. *The report does not include an evaluation of the past repairs, which would provide important data to determine if cracks may be due to unfixed chronic problems caused by something other than seismic activity.* In addition, damage from the April 2024 NJ earthquake to other historic unreinforced masonry worship structures like Saint Peter has been minimal in Connecticut, making the report's claim an exception rather than the norm.

- In the fourth paragraph of the report the author lists the observed areas of cracking damage including:
  - diagonal cracking on the walls above the lancet windows on each side of the nave;
  - in the ornamental capitals for the columns along the side aisles of the nave;
  - horizontal cracking around the sanctuary;
  - "heavy" cracking at the ground level of the tower as well as second floor level behind the choir loft.

  In the final paragraph, the author notes that the observed cracking is in the finish plaster and that it was removed in several areas to view the brick behind the cracks (2 photos were included of the areas). The author concludes that the brick behind the openings "appeared to show some hairline cracking and some loss of bond between brick and mortar in some of the joints." *The plaster finish system appears to be mounted on horizontal wood lathe and vertical studs or strapping against the brick. It is not clear how the wood studs / strapping are connected to the brick masonry behind, if at all. In my experience, there are many reasons why plaster can crack, and they are not always indicative of a structural issue. If there is a structural issue, the cracking pattern in the structure behind usually presents differently than that of the plaster, depending on how the finishes are supported. The author does not provide their analysis of how the cracking in the plaster translates to the observations of "some hairline cracking and loss of bond" in the brick wall behind the two openings. It seems that a direct correlation about how the observations on the plaster and brick tie together would be necessary to confirm a pattern and extrapolate the likely condition behind other areas of damaged plaster. Because the report did not provide such an argument, it seems that additional investigation of the brick is needed to support a holistic assumption about the condition of the structure.*

- In the fourth paragraph, the author comments on the downspouts being knocked off on the north side and some visible water damage on walls and around windows (not clear if water damage is on the interior or exterior). Notably absent are observations of cracking patterns or other observations of the condition of the exterior brick masonry. The exterior face of the brick masonry is in fact the outside of the structural wall and is not concealed behind finishes as it is on the interior. *An assessment of the cracking patterns, or absence of them, on the exterior is an essential element to determining their root cause. A rigorous analysis comparing interior to exterior cracking is another important component of the forensic work needed to draw probable conclusions about cause and extent of damage.*

- The author concludes the report stating that "based on the cracking around the tower, it is my professional opinion that the lateral load-carrying capacity of the tower has been reduced by more than 33% of the pre-damage condition." Earlier in the final paragraph, the author states that "estimating the percentage of damage that the existing lateral load resisting system has sustained is a difficult question." As noted above, except for two openings made in the plaster to review the condition of the brick wall, the extent of damage to the structural walls is generally unknown. *In my opinion, the degree of field assessment and desktop analysis described in this report is not enough to make a reasonably accurate assumption about the extent of damage; therefore, the report cannot make a credible case for the building having "substantial structural damage" as defined by the building code.*

- The author discusses their code analysis of the International Existing Building Code (IEBC) relative to design of remedial support in this situation. The report statement that "unreinforced masonry design as a lateral force resisting system... would not be allowed [per building code, for the remediation of the report's findings]" is an argument that could likely be refuted with a more rigorous code analysis. The IEBC provides extensive guidance on seismic evaluation and upgrades of unreinforced masonry structures. *Additionally, while the author recommends retrofit of the full building using a steel skeleton, there are other methods more compatible with the properties of historic masonry and that are less invasive, such as reinforcing walls with a fiber-reinforced cementitious matrix (FRCM), possibly in combination with grouted masonry sock anchors. Multiple systems should be evaluated for impact and cost in a comprehensive assessment if retrofit is found to be needed.*
- It has come to our attention that the building has been condemned in response to the subject report. *In my opinion, basing the conclusion of 'substantial structural damage' on hairline cracks in the brick masonry at only two discrete locations on the second floor in the tower, without consideration of the cracking patterns on the exterior or a more in-depth investigation to validate the limited observed structural damage, does not provide sufficient evidence to support a building condemnation.*

Typically, in a situation when such a significant finding is made following a seemingly cursory overview assessment as this, a recommendation is made for further study to confirm and support the initial findings. It is my professional opinion that a deeper, more comprehensive study should be undertaken, to address the following:

- Identify and itemize damage, including behind finishes, more holistically (possibly using non-destructive testing) and on the exterior; survey the building envelope (including areas not visible from the ground via drone) to identify deferred maintenance and potential incipient leaks.
- Collect data about past building performance and repair history.
- Perform root cause analysis by correlating cracking in the finishes and elsewhere with other data including orientation of cracks, condition of the building envelope, past repairs, etc to identify most probable causes of each crack type individually based on expected behaviors due to specific causation considered. Cracks may not all have the same root cause.
- Perform a rigorous forensic analysis that explains the behavior of adjacent materials to substantiate conclusions and allow the findings to be extrapolated to determine quantities.
- Include a deep code review to understand options for navigating repair and remediation; assess multiple repair strategies by evaluating material compatibilities, costs and impact on historic finishes and structure. Follow the IEBC's chapters on Historic Buildings and consider the Secretary of Interior's Standards for the Treatment of Historic Buildings (see paragraph below).

Because the building is a contributing resource within the Downtown New Britain National Historic District and therefore serves a defined role as part of the historic building fabric of the community, a deeper investigation to justify what could be adverse modifications to the building or historic district is important. Since the building is listed on the National Register of Historic Buildings, it may be necessary to show that a thorough study has been completed to evaluate all options and give reasoning behind the course of action chosen.

This report is based solely on information provided in the subject report. We reserve the right to amend our analysis and conclusions should new information be made available to us.

Please don't hesitate to reach out should you need further clarification.

Respectfully Yours,

Cirrus Structural Engineering, LLC

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Principal