MADSEN CONSULTING ENGINEERING, PLLC
26 BROADWAY, NEW YORK, NY 10004
ERIK MADSEN 646.645.7346
erik@madsenengineering.com
CRISTIAN VIMER 917.705.5537
vimer@madsenengineering.com

November 15, 2022

John Weiss
Deputy Counsel
Landmarks Preservation Commission
1 Centre Street
New York, NY 10007

Dear Mr. Weiss,

This Reconstruction Feasibility report was written following a site visit to 112 2nd Avenue, the site of Middle Collegiate Church (MCC) by Erik Madsen from Madsen Consulting Engineering, PLLC, on October 24, 2022. The visit was also attended by John Weiss of the Landmarks Preservation Commission (LPC), Stephen Lampard of Ancora Engineering, Anthony Johnson of Anthony Johnson Architects and Tim Vetrero, the Owner's Representative for MCC. A follow-up visit was performed from the sidewalk on November 14, 2022. The report also had the resources of a Conditions Assessment Report prepared by Ancora Engineering, dated August 10, 2022, as well as an Architectural presentation and LPC drawing set from Anthony Johnson Architect, dated August 11, 2022, and other available information from public resources. This report is intended to provide information to assist the LPC in determining the potential feasibility for reuse of the remaining elements of the Church.

According to LPC documents, the Middle Collegiate Church was constructed in 1891-1892. The structure has rubble foundation walls with brick structural bearing walls above grade. The front façade is covered in Indiana Limestone and the original roof was made from wood trusses with wood purlins and sheathing. Two bell towers flank the sides of the front façade, one of which housed a historical bell.

In 2020, a devastating fire damaged the church such that the only remaining parts of the structure are the east (rear) wall, the south wall adjacent to a shelter, and the west (front) façade and bell towers facing the street. The stairs leading up to the towers are damaged or demolished, the roof is gone, and debris is piled against the inside of the front rubble foundation wall. The adjacent property to the north at the corner of 2nd Avenue and 7th Street was destroyed and demolished from the fire. Damage was also seen against the brick face of the four-story brick shelter building to the south of the MCC due to fire. The stabilization work in the immediate aftermath of the fire was guided by Tim Lynch at the DOB in collaboration with the filing design engineer Howard Shapiro & Associates.

Summary

At this point, there is insufficient evidence to state that the structure is other than globally stable and able to be further stabilized through an investigation and remediation.

The reports provided indicate damage but they did not yet provide enough information to support the conclusion that the remaining structure is too damaged to investigate more thoroughly. Further analysis and/or investigation is needed to identify and address local issues and to provide safe access for workers. It would be helpful if the reports went a step further to rationally discuss what would be the methods of restoration and clarify whether or why they are or are not feasible for this building.

I. Global Structural Stability of the remaining structure

During our walkthrough, all parties agreed that the base structure as it stands now is globally stable. No deterioration to the new members or failure of that stability design was evident.

The side, rear and front masonry walls that currently remain appear to be generally stable. The front wall is the tallest and is braced by the two bell towers on the sides and by a shoring girder placed during the stabilization design up high to replace the roof bracing out of plane. In its original condition, the front wall seems like it carried very little gravity load beyond its own weight other than a 5-to-10-foot span of the front bay of the wood roof. The first truss would likely have set back and rested on the inside edge of the bell towers according to the Owner's team. This means that while the top of the wall is braced by the added steel frame, the wall loading remains mostly as it was originally.

On the north or south interior faces of the bell towers, the brick transfers out onto steel beams about twenty feet above grade. While the steel appears to be in serviceable condition and has functioned since the fire, it should be reviewed prior to any repair work to confirm its adequacy. A couple samples on the interior face may be helpful in determining its current state for reuse.

For a quick check of gravity loads, the formula P/A of load divided by area can be used. The weakest of the masonry materials (limestone, bluestone rubble and brick) is the brick. At 60 feet of height (a high point for the front façade wall), brick weighs 120 pounds per cubic foot, giving 7200 lbs of weight. Divide that by 144 square inches and the stress is 50 lbs per square inch. Assuming a conservative value of 500 psi for the masonry modulus, f'm, and taking 0.25 f'm for the capacity of the brick, we have 125 psi. 50 psi of load is considerably less than 125 psi capacity. While the limestone could be as much as 75% heavier, the stone capacities are typically proportionately higher.

Therefore, it is our opinion that the remaining walls are currently able to support the loads and that a very large amount of degradation at the base of the walls would have to occur to reduce the load bearing capacity. Barring an unusual or unforeseen event, we would not expect the structure to become globally unstable.

II. Securing the Site

Even though the remaining structure is globally stable, before starting any restoration work, the following items must be addressed to ensure a safe workplace. Workers' safety must remain a priority.

1. The local façade stability.
2. The access to the inside of the bell towers.
3. The stability of the remaining masonry.

1. Local Façade Stability – Investigation and Remediation

In order for work to occur on site, even though the structure is globally stable, local façade stability issues must be identified and addressed. the tops of the walls, the limestone and the bell towers must be assessed to identify any loose pieces of masonry. Any masonry that is loose should be removed. Any areas that are vulnerable should be secured and sealed to prevent dislodging. Overhead protection should be installed where necessary, in addition to the sidewalk shed in front.

To accomplish this work, the structure must be accessed by either a boom lift from 2nd Ave or pipe scaffolding placed around the remaining façade for access. The boom lift is likely required to document the bell tower stone. The boom lift company is expected to charge approximately $10k / day. This does not account for DOT permitting, design team costs, etc. If there is unstable structure on the north side adjacent to the empty lot to the north, pipe scaffolding must be installed there to access and secure that structure. NYC DOB often requires access from a neighboring property be extended to remediate imminently hazard conditions.

A New York City certified Qualified Exterior Wall Inspection (QEWI) must be retained by the Owner to perform this work. Inspection of the brick and mortar can be done by testing or sounding. This work will likely be minimally invasive and minimally destructive during the investigative phase. This will be discussed more in the masonry section below. Access to perform these tests on the exterior façade will be safely performed from the boom lift via the 2nd Avenue sidewalk or by installing pipe scaffolding. Due to the height and angles, the boom lift company will need to be heavily involved to provide adequate access for all areas.

During the site visit, Mr. Johnson and Mr. Lampard pointed out some of the cracking, also mentioned in Ancora's report. During the initial visit, it did not look like a large percentage of visible façade damage exists, but during the second visit, on a clear day, the façade areas that appear damaged by the fire were more clearly observed. The exterior peak of the limestone window arch above the front door suffered a fair amount of surface damage with some damage extending above the top of the arch. The limestone of the bell tower roofs and corners near the top facing east to the interior of the site experienced damage as well. Some of the expressive pieces sticking out from the tower were missing. The stone around the dormer windows on each interior face were heavily damaged. The other sides of the bell tower as they moved away from the fire appeared to suffer less to no damage. A closer inspection of the limestone façade is necessary.

A plumbness survey of the walls should also be undertaken as part of the investigative work. A brick wall can bow in a fire, therefore the plumbness should be confirmed by an optical survey. While no deviation was noticed on site, an official report is far more valuable. If the brick wall is plumb without excessive cracking, replacing the distressed mortar and repointing the brick wall can likely restore its capacity. The limestone walls are supported by the brick; therefore, they will likely follow the brick. The plumbness survey can confirm.

If the façade is assessed by the wall inspection and considered safe, the next step in order to repair the masonry would be to install pipe scaffolding along the front façade of 2nd Avenue and along the interior faces to access the tops of the walls. The interior grade must be carefully leveled and stabilized sufficiently to allow for the installation of the pipe scaffold. This can likely occur with hand tools and using a buggy to deliver concrete through the front facade. The current scaffold interior system must be upgraded to support these construction loads as well.

Parging and weatherproofing of the adjacent shelter wall to the south that extends above the church's remaining south wall should also be considered with any work that occurs. That wall can be seen from the ground to have spalled brick faces and needs inspection and maintenance. The weatherproofing installed on the church brick was not extended beyond the church's walls and the shelter walls remain exposed to the elements.

2. Access to the Inside of the Bell Towers

Access was not available during the site visit to view the inside of the bell towers. While difficult, there are ways to access the inside. The access to the interior of the bell tower is a dangerous and complicated situation. By being creative it may be possible to safely access the interior and document the conditions. A human need not necessarily go in on the first pass, machinery and equipment can be utilized where advantageous. This process could include creating scaffolding on the outside to access through the dormer windows of the bell tower or create a new window through the structure after the roof and exteriors have been inspected and remediated. Either method will allow a visual inspection for loose debris using cameras or other direct visual means. If the structure needs remediation, that should be targeted, and access discussed by possibly opening up a portion of the wall to provide access. If the interior appears safe in its current condition, then a more hands on inspection for local damage can be performed by installing pipe scaffolding on the interior. Installing overhead protection at the top may be helpful through the use of needle beams from the outside if needed. If the tower is then able to be inspected and is in stable condition, work can proceed to reinstall the stairs.

3. Stability of the Remaining Masonry

a) Brick Masonry

Brick masonry is created in a kiln. When buildings like this were built, literature states that the bricks closest to the fire were exterior bricks and those furthest were interior bricks. Bricks are not particularly vulnerable to fire and unless large cracking was seen, which it was not during our site visit, the brick is likely in serviceable condition.

The mortar can be vulnerable at the surface and would have been damaged in a fire like this. According to reports, temperatures above 575 degrees Fahrenheit can cause loss in strength, but mortar is typically not affected for strength beyond ¾" of depth. Mortar can be tested to confirm the quality. Testing can include a pulse-velocity, impact-echo, lab analysis of samples, or other testing. Specialty engineering and testing companies can perform this work and advise on the testing needed.

b) Limestone

Regarding the limestone, damage can occur at lower temperatures. Limestone will begin to change color at temperatures as low as 400 degrees Fahrenheit and go through multiple color changes with increasing temperatures. A pinkish red is usually the first color change. This should not be relied on alone, but typically indicates the level of temperature experienced and may correlate to some degree to the damage. The stone can and will break under the temperature of the fire and experience surface damage and spalling. Strength loss begins to occur beyond 10% with more sustained exposure at temperatures above 600-800 degrees Fahrenheit.

At the site, the front façade limestone above the main arch and at the inside face of the bell towers appeared to be damaged by discoloration and flaking of the surface. The dormer windows and some of the interior faces and edges of the limestone at the bell tower were heavily damaged. The arch experienced some damage, but less than the bell towers. The stones remained in place and did not exhibit full depth cracking like a few of the interior bell tower stones. While the fire was intense inside the building, it would also burst out through the windows. In general, the remainder of the front façade does not appear particularly affected for the most part, but the areas at the apex of the window arches and directly above should be reviewed more closely as these are the most likely to need repair or replacement. The arches are also more sensitive areas of the structure to replace and the only limestone that is bearing more than its own self-weight.

Replacement of the front façade limestone is made more difficult because based on the methods of construction at the time it was constructed the limestone was possibly weaved into the brick backup as bonded masonry. This can be removed and replaced by chopping out a section fully through the wall and reinstalling it. A challenging part to this is creating an alternate load path for the masonry or to reestablish gravity. The current system is gravity based and the reinstallation of the stones will not reestablish gravity unless actuated by a construction method, such as designed locations of steel wedges or an alternate method.

Cracking was noted in the Ancora report. Some of these cracks were visible on the site and should be remediated with the Step 1 Local Façade Stability repair. The cracks from the sidewalk did not appear as bad as the report indicated, but that could be due to the viewpoint down low.

c) Rubble Foundation Wall

The bluestone rubble foundation wall is not particularly vulnerable to the fire. Prior to the fire, the owner said on site the wall was already leaking and sand was seen at the base of the foundation wall. In order to repair this, the sidewalk side of the wall must be weatherproofed and then the wall can be injection grouted to restore stability with the mortar. In order to weatherproof the exterior, dig boxes can be created along the sidewalk and a membrane can be installed in a sequence similar to underpinning. This will need to be carefully coordinated with the sidewalk shed above and additional temporary shoring likely necessary during this portion.

III. Future Construction

The investigation and assessment of the existing structure's remaining elements of the original Middle Collegiate Church was discussed above:

1. Performing a façade analysis and stabilization of all the remaining structure, similar to Local Law 11.
2. Reviewing and stabilizing the interior of the bell towers
3. Assessing the stability of remaining masonry including Restoring and weatherproofing the front foundation wall

The following are the challenges for the new construction, including:

4. Staging construction equipment
5. Designing the structure for new code requirements

4. Delivering and Staging Construction Equipment

Access to the interior for mechanical equipment and material deliveries must be provided. Remediation of the foundation wall and the securing of the site is necessary first. Once remediated, the foundation wall will still likely need to be shored during construction as it was originally braced by the ground floor on the interior. The light scaffold rig in existence will need to be replaced by a sturdier platform if it had not been already as part of the remediation plan. If the foundation wall is stabilized, equipment can be brought onto the site.

The building directly to the north was destroyed by the fire. Were that site allowed to be used for access for the reconstruction, the rebuilding would be much easier. As access from the north site is not allowed per the Owner, access is available only from 2nd Avenue. In this case, the entry door is too small to drive significant equipment through. It is possible this would need to be altered and widened to allow for the passage of new construction machinery and equipment. If the door is widened, heavier materials can be brought in. Installation of a new slab on grade and foundation where needed would be the first step. Hand digging would be laborious, and a smaller excavator at least would be necessary to begin work. The front wall would need to be opened enough to allow for the entry of this equipment. Smaller pile rigs should be able to fit through a similar sized opening, though they would be less efficient compared to larger rigs.

Once the foundations are installed, the superstructure will need to be carefully installed. If a crane is installed, it would need to be brought in piece by piece through the front door and assembled on the site or positioned on 2nd Avenue. If placed on 2nd Avenue, the foundation would likely be best on piles to avoid surcharging the foundation walls and loading any adjacent piping under 2nd Avenue. This would require temporary access from 2nd Avenue for the duration of the full structural superstructure phase and until a hoist can be installed on the interior. Once the interior hoist is installed, construction may resume by bringing materials in like any project and bringing them up. The crane would be removed as soon as the hoist is completed.

If the structure is concrete. A pump would be required for the pours on 2nd Avenue.

5. Designing for New Code Requirements

If the new 2022 NYC Building code must be applied to this structure, special care would need to be applied to determine what items may be waived by LPC and DOB for the historic structure to create compliance with the new Code. The existing brick façade will have a large seismic weight that must be attended to if a new structure is designed, however, if exempted, it would and obviously has performed well under hurricane wind loading.

Egress requirements must be reviewed and studied. Some of these may be required for equipment access anyway and can be addressed then.

IV. Ancora Report Conclusions Review

(Ancora report text written in italics and abbreviated where necessary)

1. *All the remaining structure is currently locally unstable at various points throughout the entire façade and back-up structure; it is in a state of disrepair and has deteriorated beyond its usable life.*

   While the limestone in areas has exhibited fire damage, the overall basis for this statement is not yet met. A closer inspection of the façade must be performed in order to better confirm and determine local instabilities. The deterioration in the past two years does not appear to be of significance to state that it is no longer usable. As previously mentioned, all parties agreed the remaining structure is globally stable.

2. *Based on the structure's varying height of over 53' in height, the collapse zone (Structure height x 1.5) would be an approximate 80' perimeter around the remaining façade.*

   All parties on site agreed the remaining structure was globally stable. The collapse zone would be a problem if the building were to be demolished rather than repaired.

3. *The two remaining towers present a high risk to safety of workers.*

   The interior of the two remaining towers presents a higher risk to investigate. Ingenuity of the investigative team is required to access these spaces as discussed above. This must be carefully done and we agree that the risk in these areas due to difficulty of access is higher than normal and must be considered.

4. *The remaining gables main window lintel presents a high risk to safety of workers.*

   There are no confirmed stability issues of the remaining gables as of yet. The limestone shows discoloration and damage by spalling, but enough structure remains that the loss of strength does not guarantee failure. It is possible the structure has not lost more capacity than needed to perform its job. Investigation and calculations must be performed to determine the actual status.

5. *[W]e believe that the remaining structures present such a high risk of safety to workers that none of these investigations [geotechnical investigations, material investigations, destructive probing, rigging] would be safe.*

   It is not correct to state that no investigation can be done at this time. Limited investigation can be done and is necessary prior to demolition or new construction to determine loose elements. As discussed above, a façade investigation would be the first step to determine stability. Once the exterior façade is investigated and any immediate stability issues are remediated, the other investigations may begin depending on the initial results.

6. *Due to the structure's instability, it is unsafe for workers to approach the remaining structures.*

   This is true if work were to begin without proper investigations utilizing pipe scaffolding and/or a lift. Most of these arguments state the difficulty of demolition. It is possible that demolishing the structure may be difficult and might not be easier than maintaining it. This topic needs to be given more consideration by the Owner's team.

7. *The conditions observed indicate excessive water infiltration and wet conditions throughout the entire structure over an extended period…The water intrusion, if left untreated, can result in structural degradation to the point of structural failure.*

   This damage was not visible during the walkthrough, however it is true that freeze / thaw can occur. A more in-depth inspection of the façade would indicate the level of damage and the team could work to seal the structure appropriately to prevent further damage. It does not yet appear that a sufficient level of damage has occurred to elements that were not previously in an exposed state such as the front façade and the tops and exterior sides of the bell towers due to freeze thaw. Where the foundation wall is buried on both sides, the soil on both sides will insulate the wall for the predominance of the site and prevent freeze/thaw there.

8. *The excessive water infiltration will also have led to the deterioration of the existing rubble stone foundation that has been exposed to the elements in the post-fire conditions.*

   The grout injection steps recommended above, while lengthy and difficult, would restore any strength degradation of the rubble foundation wall.

V. Conclusions

Further investigation and rational calculation should be undertaken to determine the status of the structure. The ability of the limestone to be reused and the possible repair methods or lack thereof should be considered. At present, there is not enough clear information either way to state if the structure is fully sound or safe to perform work. The limestone at the bell tower and along the front façade may be not possible to be easily replaced, but the methods and details of this need to be stated more clearly by the Owner's team. Understanding this could help LPC make a clearer and quicker decision.

The remaining structure of the building appears to be currently globally stable, and with further investigation and facade repair work to address immediate local stability issues, it may be stabilized to begin construction work. Investigation followed by stabilization would need to occur first and the site secured before starting the restoration work. DOB must be involved and review stability at the very beginning before any work occurs and be involved throughout.

In order to investigate the façade, good coordination with a lift company is required. Ingenuity will be required of the design team to investigate the interior of the bell towers, if this is possible. Safety must be kept as a priority. If the investigation confirms instabilities that are too difficult to repair, that information should then be brought forward.

Site logistics and construction operations will be difficult, not least of which is due to site access. Widening the doorways sufficiently to allow the passage of heavy equipment will alter the architecture and structure of the front façade and require additional shoring. The shoring must also be sequenced with any scaffolding and sidewalk sheds in place.

Remediation of the foundation wall will require significant coordination and time. Carefully excavating the front sidewalk areas in coordination with staging the sidewalk shed will be challenging.

The necessary steps to be taken prior to any new construction work beginning will add significantly more time than if the structure were to be built from new. At the same time, it is also quite possible that the efforts to restore the existing structure may actually not be as significant when compared with the effort required to demolish it, once both have been itemized and compared. The Ancora report raises questions about the ability to demolish the structure safely or easily but does not provide clarity as to the means and methods of demolition.

VI. Recommendations

Further investigation is strongly recommended to determine if the structure is able to be further stabilized through an investigation and remediation. It is possible the investigation may prove the remaining structure cannot be repaired reasonably. The reports provided indicate damage but it would be helpful if they went a step further to rationally discuss what would be the methods of restoration and clarify whether or why they are or are not feasible for this building.

The Architect's report indicates limestone damage around areas of the façade. A more detailed assessment of how the limestone can be repaired – can the surface damage be scraped, and the limestone be resurfaced with a poultice and reused in most places damaged by smoke or with light surface damage? Obviously in areas where the stone is burnt and deeply cracked it cannot receive that treatment. What is this repair procedure? What about the surface scaled stones being recrafted or what is the repair procedure? How much of the fabric of the original architecture will remain and can it be reasonably restored?

The Owner's Engineer can endeavor to perform calculations of the overall structure and/or assessments of the damage and repair. How stable is the window arch over the front door?

If there is not information at this time, an investigation from 2nd Ave of the facade and what structure can be safely observed using a boom lift can also occur. This would be helpful either for demolition or new construction to keep the workers safe.

Additionally, it is recommended that a broadstroke analysis demolition plan be prepared after the assessment phase and compared with the Owner's and/or an independent LPC remediation broadstroke analysis for new construction in order for LPC to better understand if one is safer or more feasible than the other.

Any work that occurs on site must be done hand in hand with NYC DOB Engineers. Until the NYC DOB has visited and assessed the site and begun discussions with the EOR on the methods of stabilization and repair, no work other than light investigative and non-destructive testing or light mortar testing in open areas should occur. A licensed professional must design and/or supervise preliminary site work in the investigation phase and maintain safety.

Sincerely,

Erik A. Madsen, P.E.
MADSEN CONSULTING ENGINEERING, PLLC