Final Structural Condition Assessment
Fire District No. 1
West Sand Lake, New York

Submitted to:

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1.0 Introduction

Holzmacher, McLendon and Murrell, P.C. (H2M) conducted a structural condition assessment of four structures on the property including a firehouse, a museum, dining hall attached to the museum and a rental residence. The buildings are located at the intersection of Fire House Lane and NY Highway 43 in West Sand Lake, NY as shown in the aerial view shown in Appendix A, Photo No. 1.0.1. A site inspection was performed on December 9th of 2011 to observe conditions of the buildings. An additional site visit was completed on August 24, 2012 to review the condition of wall and floor components within the firehouse mezzanine and community hall that were previously concealed and exposed by the Fire Department to be included within this investigation. The purpose of the assessment is to review the physical condition of the structure, identify apparent structural deficiencies and severity, complete various representative structural calculations and provide our opinions and recommendations based on our investigation results. Specific objectives include sharing opinions regarding the expected remaining life of each structure as well as the feasibility and costs of recommended repair measures and/or other building modifications.

In addition to providing our recommendations in response to the observed condition of specific structural components, H2M also provides opinions regarding building code compliance, as requested by the District. Existing buildings are governed by the “Existing Building Code of New York State, 2010.” According to this code, structural components are required to meet the minimum code requirements in effect during the time of construction. Buildings are not required to be upgraded to meet code requirements for new construction unless significant alterations to existing structural systems are proposed or changes in use are proposed which may increase the importance of the structure or load intensity. Although upgrades may not be required in certain instances, it may be desired by the District to increase probability of proper performance during significant loading conditions such as seismic or hurricane events because each new edition of code improves upon the historic codes. The issues related to code compliance for each structure are further discussed within the body of this report pending the configuration, capacities and expected uses of each of the buildings.

2.0 Structure Descriptions

2.1 Firehouse

The building is believed to have been built in 1976 and consists of one-story with no basement and a small mezzanine. The construction is a pre-fabricated steel building with corrugated metal wall and roof panels, steel load carrying components, portions of concrete masonry walls and brick veneer along the front facade. The floor is a slab on grade with steel diamond plate components used for slip resistance.

The building contains five overhead doors, four of which are located along the front façade and one of which is at the rear of the building. Various man doors and windows are also positioned along the rear and two side walls. The first floor is used as apparatus bays with an office in the rear corner and a portion of the rear of the building containing a small mezzanine used for storage. Restrooms are located below the mezzanine.

A floor plan of the firehouse is found in Appendix B, Figure 2.1.1. Overall photographs of the firehouse are found in Appendix A, Photo No.'s 2.1.1 through 2.1.21. Photo No.'s 2.1.22 and 2.1.23 indicate the framing for the mezzanine, which was exposed by the District during the August site visit,

2.2 Museum

The building consists of two stories and a basement constructed with a combination of wood, steel and concrete masonry components. It is believed that the museum was constructed in 1913 as a barn and subsequently used to house vehicles for fire suppression. It is also believed an expansion occurred around 1945 when the hayloft was converted to an office and the basement was converted to a recreation room with boiler and storage. The first floor is used for the museum with the basement used for storage and mechanical spaces. At some point, the community building was constructed to the south of the museum and is adjoined through the basement and first floor.

Floor plans for the museum are found in Appendix B, Figure 2.2.1. Overall photographs of the museum are found in Appendix A, Photo No.'s 2.2.1 through 2.2.12.

2.3 Dining Hall (attached to Museum)

The dining hall consists of one story with a basement constructed with a combination of wood stud walls, wood truss roof framing, wood floor joists, steel girders and concrete masonry components. The date of construction is unknown; however, it is apparent that roof truss framing has been reconstructed in the recent past. Tie rods within the ceiling space remain in place from what appears to be a previous remediation technique. The first floor is used as a community hall for various social functions and the basement level is used as a recreation room for firefighters.

Floor plans for the dining hall are found in Appendix B, Figure 2.3.1. Overall photographs of the dining hall are found in Appendix A, Photo No.'s 2.3.1 through 2.3.19. Photo No.'s 2.3.20 through 2.3.23 illustrate the results of the destructive testing performed by the District along a section of the wall exposing portions of both a door and a window.

2.4 Rental Property

The rental property consists of an unoccupied one-story residence with attic and basement constructed with wood framing and concrete masonry foundation walls. The exterior of the structure is sheathed with aluminum siding and the roof is covered with 3-tab asphalt shingles. According to Rensselaer County, New York tax parcel information, the residence was constructed in 1949.

Floor plans for the rental property are found in Appendix B, Figure 2.4.1. Overall photographs of the rental property are found in Appendix A, Photo No.'s 2.4.1 through 2.4.17.

3.0 Referenced Documentation

The documents referenced within this report include the following:

3.1 "Feasibility Study for The West Sand Lake Fire District #1," by Hueber Breuer Construction Co.

4.0 Method of Assessment

The condition assessment relies upon visual observation collected during a walk-through of the structures. Various deficiencies were documented and categorized in accordance with the rating system described herein. General dimensions were collected to help quantify the extent of damage and probable associated costs of repair. The scope of work did not include field or laboratory testing. No design drawings were available nor probing through existing finishes performed for preparation of this assessment.

Excellent	New or Like-new condition - No deficiencies observed
Good Condition	Limited minor deficiencies observed
Fair Condition	Structural capacity of primary member not significantly affected by minor deterioration, section loss, spalling, crackings, decay or other deficiency
Poor Condition	Structural capacity of primary element is affected or jeopardized by advanced deterioration, section loss, spalling, cracking, decay or other deficiency
Serious Condition	Local failures are possible. Primary structural elements are seriously affected by advanced deterioration, section loss, spalling, cracking, decay or other deficiency
Failed Condition	Element is out of service and condition is beyond corrective action.

5.0 Field Observations / Findings

5.1 Firehouse

5.1.1 Structure

The building is a pre-fabricated "Butler" style steel building consisting of z-shaped roof purlins, rigid moment frames, exterior gravity columns, steel wall girts and steel rod cross bracing within the roof and wall panels. The front / north façade contains concrete masonry unit (CMU) walls to support overhead door components. The rear/south façade contains an overhead door supported by pre-fabricated steel components. (Refer to Photo No.'s 2.1.1 through 2.1.4)

The lateral force resisting system for wind and seismic forces consists of rigid frames spanning in the east west direction with tension rod cross bracing in the north-south direction. The interior girder of the rigid frame has a member depth ranging from 4'-0" at the column support to 2'-4"± within its length. The flanges are typically 0.36" thick and 8-7/8" wide. The column is constructed similar to the girder, but with depth of member ranging from 12" at the base to 4'-0" at the connection to the girder. The height of the structure at the eave is approximately 16'-4" and slopes at ½" per foot towards the ridge, which is at a height of approximately 17'-7" (Refer to Photo No.'s 2.1.10 through 2.1.16)

The gravity force resisting system consists of purlins spanning approximately 20 feet between rigid frames and exterior spandrels and spaced at 5'-0" on center. The z shaped roof purlins are 9 ½" deep with 3 ¼" wide flanges at 1/8" thick. (Refer to Photo No. 2.1.14)

The components appear in good condition as little to no deterioration and/or excessive deflections were observed. It appears roof leaks have occurred in the past or may continue to occur based on limited staining of the insulation. The concrete masonry unit walls along three sides of the buildings appear in good condition with no major cracks observed. Minor deterioration of bottom of metal wall panels was observed, but does not appear to significantly affect structural performance at this time. (Refer to Photo No. 2.1.5) Damage to a wall panel was observed at the rear of the building, but does not appear to be a critical structural issue. (Refer to Photo No. 2.1.9)

Each component of a typical pre-fabricated structure is designed as economically as possible, which usually results in little to no residual capacity in components and/or limited flexibility to modify the use or arrangement of such components. For example, the existing building code required resistance for 45 psf snow load. The capacity of the purlins assuming continuity over the supporting girders is 48.9 psf. Since the dead load is approximately 3 to 4 psf, the purlins are stressed 98% to 100% of their capacity. The gravity load is the controlling design loading for the frame based on our analysis of a simplified two dimensional frame of this geometry under historic building code lateral pressures of 15 psf.

The primary building structure appears to be in compliance with the Existing Building Code based on our cursory analysis with little to no residual capacity.

The historic code did not contain provisions for seismic. The building code for new construction specifies resistance to seismic loads as well as specific roof, wall and beam attachment requirements along the load path. Our analysis shows that the seismic force delivered to the system using equivalent lateral force procedures equates to the same force resulting from about a 4 to 5 psf lateral wind pressure, which is 1/3 of the design wind load. It is our opinion that the primary building components are capable of resisting the imposed seismic forces; however, there may be localized attachments that may or may not comply with the newest provisions. If the building was properly designed to carry the wind force, which appears appropriate based on visual observations, there is no apparent reason to conclude that it is not capable of resisting seismic forces specified in the code for new construction in its current configuration, based on our professional opinion.

5.1.2 Foundation / First Floor Slab

The floor consists of a slab on grade. The surface appears relatively slick and steel diamond plate coverings are installed at wheel locations for additional traction. (Refer to Photo No. 2.1.18) A trench drain and single drainage inlet were located within the floor slab footprint. (Refer to Photo No. 2.1.20 and 2.1.17)

The slab contained a few cracks with no significant differential movement. The cracks are likely due to initial settlement or shrinkage during curing. Their presence is more of a visual nuisance than a structural concern at this time. (Refer to Photo No. 2.1.19) The exterior concrete driveway apron at the overhead doors contains damage from freeze thaw cycles, but does not appear to require repair at this time. (Refer to Photo No. 2.1.6)

The most obvious deficiency in the slab is the slip hazard associated with the sealed concrete. The surface is not ideal for emergency related activities due to this hazard and resurfacing is recommended to increase the coefficient of friction of the concrete surface to suitable limits. This risk is increased due to wet conditions that occur as result of vehicle washing performed within the structure. The installation of a polymer coating with an epoxy base to reduce this risk is further discussed within section 6.1.2 of this report.

The foundation was partially observed from the exterior where grade is lower than the top of wall. There are no indications of significant settlement such as stepped cracking in masonry walls. It appears that the foundation is functioning properly and is in good condition.

5.1.3 Vehicular Door Openings

The overhead doors are approximately 12 feet wide and 12 feet tall with a door jamb consisting of a four foot wide strip of CMU and centrally located steel column. At the north façade, the overhead CMU is supported by a steel lintel which appears to span between columns. The CMU portion of the jamb and infill above the lintel is not load bearing.

At the south/rear opening, prefabricated steel components support the door frame and winch system.

For both types of doors, the width and height can be modified to accommodate a larger door if modifications are performed on the structure and slab within the opening limits. The work required for widening each type of door is explained further within Section 6.1.3 of this report. The doors can be increased to 14’-0” width based on this discussion since the load bearing CMU can be removed without major structural modifications.

5.1.4 Mezzanine Framing

The mezzanine framing consists of 2x12 members (1.5” x 11.0” actual size) with a clear span of 12’-4” between CMU walls and contains plywood floor sheathing above. The space above appears to be used as storage and also supports typical miscellaneous loading from pipes, lighting and gypsum.

Complying with the existing building code, the framing is capable of supporting a total load of 157 psf. With dead load usually approximated at 5 to 10 psf, the mezzanine is structurally capable of supporting loads such as light storage, office space, bunk-in facilities and other normal firehouse uses.

5.2 Museum

5.2.1 Roof Structure

The roof framing appears to consist of wood roof rafters and ceiling joists spanning from exterior load bearing walls to an interior steel header. The framing was not visible due to the ceiling tile installation; however limited observations within a closet indicate wood plank sheathing, wood roof rafters and ceiling joists are utilized for construction. A portion of the structure to the north-east consists of a flat roof with ceiling joists spanning approximately 13'-3". A cupola is situated above the gable portion of the roof. (Refer to Photo No.'s 2.2.1 through 2.2.3)

There are no apparent deficiencies observed within the roof framing. There are no indications of excessive sag or water infiltration, which suggests the rafters are performing acceptably. (Refer to Photo No.'s 2.2.1 through 2.2.3 and Photo No. 2.2.11)

The design snow pressure on the flat roof portion for new construction is 31 psf including balanced snow and sliding snow from the adjacent gable roof. The design snow pressure using the existing building code (1973 building code) is 45 psf. With the absence of noticeable deflections or other indication of non-performance in combination with the fact that the design snow pressure has reduced in recent codes for new construction, it is our opinion that the roof framing does not require modification to accommodate potential new uses for the interior.

5.2.2 Second Floor Structure

The second floor framing consists of 2x8 (nominal size) wood joists spanning between exterior walls to an interior centrally located steel girder, which is supported by an interior column. The girder was enclosed in gypsum for fire protection and not visible for measurement. The sizes of joist differed on each side of the interior girder. The actual size of the west bay was 1 ½" x 7" spanning 15'-0" while the east bay contained 2 ¾" x 7 ½" members spanning approximately 12'-0". (Refer to Photo No.'s 2.2.8 through 2.2.10)

The specified live load for office use in both the existing and new construction building codes is 50 psf. The larger members in the east bay adequately support the live load in combination with the dead load; however those in the west bay are overstressed by approximately 32% using the existing building code. These wood members on the west bay will require reinforcing to meet building code requirements for supporting office use above. The steel member was not visible; however, based on the configuration of the soffit, it appears an 8" deep steel beam is installed and can support the office live load based on conservatively assumed minimum section properties of a steel beam.

5.2.3 First Floor Structure

The first floor framing consists of steel girders encased in cementitious fireproofing. Infill framing and flooring were not visible, and it is probable that the visible concrete acts as a deck and spans between the visible beams.

The steel section remains in fair condition as limited deterioration near the support at the foundation wall was observed. (Refer to Photo No. 2.2.7) The beams should be monitored for ongoing corrosion and budgets for scraping and painting scheduled in the next 5 to 10 years.

It is our opinion that the use of the museum above be assigned a live load value of 100 psf as it acts as an access way to the offices above as well as providing a place for people to assemble. With the smallest wide flange shape in the historic AISC manual available with the 5 ¾," it is conservatively estimated that the minimum size of the beam would be W5 section, which has a capacity greater than the required 100 psf. This infers that the beams are in compliance with both the existing and new construction building codes.

5.2.4 Foundation / Basement Slab

The foundation wall consists of concrete masonry unit construction. The basement floor consists of a slab on grade. The foundation below the basement slab was not visible for this assessment. Portions of the exposed foundation above grade are parged with a cementitious material. An exposed portion of the foundation wall is found in the storage room of the basement. There are no apparent indications of significant settlement or foundation deficiencies other than water infiltration. (Refer to Photo No. 2.2.4 through 2.2.6)

Portions of the foundation walls, especially along the east façade, show indications of water seepage through the wall into the basement. (Refer to Photo No.'s 2.2.4 through 2.2.6) The steel beams show indications of corrosion at their support location at the wall and cracking with discolored paint is found over the entire wall surface. There are no apparent major structural deficiencies at this time; however, two improvements should be considered in the next 5 to 10 years. This includes scraping and painting of steel at support locations as discussed in section 5.2.3 of this report as well as installing a waterproofing system as described below.

In order to limit water infiltration into the basement and minimize further wall deterioration, two courses of action are recommended: 1) Leaders discharging to grade should be directed away from the foundation and 2) A waterproofing system should be installed along the east wall. These recommendations are further discussed in Section 6.2.4 of this report.

5.2.5 Lateral Force Resisting System and Walls

The lateral force resisting system consists of wood shear walls with wood sheathing. The exact type and size of sheathing and wall studs were not observed. Only three sides of the building appear to have shear walls as the north face of the building contains large openings for two garage doors and a man door. The shear wall at the east façade contains many openings as well. There is no indication of raking or significant wall out-of plumbness.

Calculation of lateral force capacity of a shear wall arrangement involves significant destructive testing to determine wood fastening patters, chord and collector attachments and hold down locations and depths at ends of each wall segment. Based on our previous experience, it is highly unlikely that the current shear wall arrangement and fastening scheme was built in a manner that will comply with the building code requirements for new construction. However, employing empirical methods of design from the Existing Building Code applicable during construction, the museum structure appears to meet code requirements. Under the existing building code, the wall is salvageable; however, if the occupancy classification is changed or significant structural modifications proposed, the provisions of the new code for lateral force resisting systems and wind uplift become applicable and retrofitting is required. Reinforcing, sheathing replacement, uplift strapping and anchorages to foundations will be required.

5.3 Dining Hall (attached to Museum)

5.3.1 Roof Structure

The roof framing consists of wood trusses spaced at 24 inches on center and spanning between exterior load bearing walls approximately 32 feet. The pitch is approximately 8 on 12. The top and bottom chords consist of 2x6 lumber while web members consist of 2x4 lumber. The framing appears to be in good to new condition based on visual observations. Truss tie downs and uplift connectors are installed and materials appear new. (Refer to Photo No.'s 2.3.15 through 2.3.17)

Based on visual observations, cables appear to remain from a previous rehabilitation method. They are 1/2" diameter and are spaced at 10'-0" on center. They are attached to what appears to be wood rakers installed to the exterior of the top wall plate. With the new roof construction, it does not appear that the cables are necessary for structural stability. (Refer to Photo No. 2.3.18) There does not appear to be ongoing movement of supporting walls based on gypsum condition and ease of opening windows. (Refer to Photo No. 2.3.19)

Based on the referenced feasibility report and our visual observations, it appears that the trusses have been installed within the last five years. Based on our cursory analysis, the trusses in their current configuration are overstressed by approximately 27% under the full code defined balanced snow loading of 20.7 psf for existing structures. The roof framing does not meet building code requirements for snow load capacity and should be reinforced as discussed in Section 6.3.1 of this report.

5.3.2 First Floor Structure

The first floor framing consists of wood joists spanning between a grid of steel beams and girders. The joists are 3x8 wood members at 24” on center spanning continuously over wide flange steel beams spaced at 7’-6” on center. The wide flange shape is 5-7/8” deep with 3 ¼” x 1/8” thick flanges and they span between steel girders. Steel girders are located at 9’-0” and consist of wide flanges with depth of 15-1/16” and 5.45” wide x .45” thick flange. (Refer to Photo No. 2.3.12)

A majority of the framing is visible behind ceiling grids and various portions were observed to be in good condition with little to no excessive deflection or deterioration observed.

The floor framing members were analyzed according to new and existing code and it is determined that the framing system is capable of supporting loads imposed of 100 psf for use as a dining room / restaurant.

5.3.3 Foundation / Basement Slab

The foundation wall consists of concrete masonry unit construction. The basement walls are primarily covered by wood paneling and other finishes within the recreation room; however, walls are exposed in the boiler room and a storage area. (Refer to Photo No.’s 2.3.13 and 2.3.14) The floor consists of a slab on grade. The foundation below the basement slab was not visible for this assessment. Portions of the exposed foundation above grade are visible, especially at raised planters, and minor typical cracking is visible at various locations. (Refer to Photo No. 2.2.5 through 2.2.9) The cracking appears at typical locations susceptible to cracking from minor settlement such as window corners. Visible portions of the foundation of a small shed indicate poor material finishing; however, there does not appear to be a significant structural condition as result since limited to no cracking or building movement was observed. There are no apparent indications of significant settlement or foundation deficiencies elsewhere.

5.3.4 Lateral Force Resisting System and Walls

The lateral force resisting system consists of wood shear walls with wood sheathing. All four side walls act as shear walls.

Portions of the framing were exposed by the District at a location where both door and window framing components could be observed as shown in Photo No.'s 2.3.20 through 2.3.22. The walls construction consists of two layers of gypsum over wood paneling and wainscoting, which are attached to 2x4 wood studs. The door header consists of two 2x4 boards on the flat. The header bisects what appears to be a previous jack stud, which is intended to transfer lateral loads from wind by spanning from floor to roof. The header actually extends beyond the opening and attaches to a stud that is butt spliced at the connection point, causing a structural hinge. This is likely why movement was observed when the door was shut firmly.

The 2x4 headers were analyzed and found only capable of supporting the roof load of approximately 11 psf, which is about 1/3 of the actual code defined life load.

Additionally, the window frame was found to be located inches away from the closest stud and typical frame fasteners were screwed directly into air without attachment to the structure. Refer to Photo No. 2.3.22. A crack was observed within a window on the adjacent side of the building nearly two inches away from the window as shown in Photo No. 2.3.19.

5.4 Rental Residence

5.4.1 Roof Structure

The roof framing consists of 2x6 rafters spaced at 16 inches on center and spanning between a ridge board and an exterior load bearing wall as well as an interior knee wall. (Refer to Photo No.'s 2.4.11 and 2.4.12) The rafters span approximately 11' either side of the ridge board and provide a 7:12 roof pitch. Ceiling joists consist of 2x8 lumber spaced 16" on center, and they support an approximately 15-foot wide wooden attic access/storage deck. The framing appears to be in good condition based on visual observations. Limited mold was observed in the sheathing from below, suggesting some material deterioration may have occurred where framing is not visible. Truss tie downs and uplift connectors are not installed.

Based on our cursory analysis, the rafters in their current configuration are capable of supporting loads defined in the existing building code. If the occupancy category of the building changes or if significant modifications are performed such as converting the space to an office, the code requires retrofitting the rafters and joists by installing new uplift straps at all framing ends and connection points. The straps must be installed at the floor level also to anchor the building to the foundation appropriately. If no modifications are proposed, the roof structure can remain in its current condition as it complies with criteria for the Existing Building Code (Residential). Minor structural modifications to deteriorated joists above bathrooms where mold was observed may require reinforcing in the future.

5.4.2 First Floor Structure

The first floor framing consists of 2x8 wood joists spaced at 16 inches on center. The floor sheathing consists of 1x10 wood planks installed at a 45-degree angle over the joists. A triple 2x8 header spans the length of the structure with a few interior columns and bearing locations. (Refer to Photo No.'s 2.4.14 and 2.4.15)

Under building codes for both existing and new construction, the joists are stressed approximately 99%, which is in compliance with strength requirements. If no modifications are proposed, the floor framing can remain in its current condition as it complies with criteria for the Existing Building Code (Residential). If the use of the building changes or significant modifications is performed such as converting the space to an office, the framing will require retrofitting. The code defined live load magnitude for office spaces on the first floor range from 50 psf to 100 psf pending use as corridor or office. Compared to code defined residential live loading values of 40 psf for living areas, it is apparent that reinforcing is necessary to accommodate the new use, especially as the joists are stressed just shy of capacity in the residential use.

5.4.3 Foundation / Basement Slab

The foundation consists of a concrete masonry unit (CMU) block foundation. Indications of ongoing water seepage were observed in the CMU construction with limits extending from the basement floor to approximately 24" below exterior grade. (Refer to Photo No. 2.4.15 and 2.4.16) Where masonry units were not damp proofed and efflorescence was observed, which is a condition indicative of long term water seepage through the foundation. The windows do not contain window wells, a few masonry blocks are dislodged and deterioration of mortar was also observed from the exterior.

Based on the condition of the walls, we recommend damp proofing and repointing of the masonry from the exterior in order to maintain proper performance. This involves excavation of exterior soils to expose the entire wall in order to repoint and damp proof the wall.

6.0 Recommended Repair / Maintenance Plan and Cost Estimates

The deficiencies itemized in Section 5.0 of this Assessment have been reviewed in order to determine the criticality of each distressed condition in relation to the overall performance of the structure. Figure 6.1 included herein further illustrates our opinions in regards to which deficiencies should be corrected in the near future verses those where delay will not significantly affect the cost of repair in our opinion. Approximate quantities gathered during the walk-through site visit were used for estimating purposes although no complete survey of every component's condition has been documented within the Assessment. A description of each recommendation follows the summarizing figure.

Figure 6.0
Itemized Deficiencies Observed with Associated Costs and Recommended Repair Terms

Structure		Deficiency and Repair Measure	Term Repairs and Approximate Cost				
			Immediate Less than 1 yr.	Short 0-2 yr.	Intermediate 2-5yrs.	Long 5-10yrs.	Future 10-50yrs.
6.1	Firehouse	6.1.1 Wall Panel Rehabilitation				$5,000	$80,000
		6.1.1 Bollard Installation		$7,500			
		6.1.2 Floor Slab Slip Resistant Coating		$75,000			
		6.1.3 Vehicular Door Opening Widening		$100,000			
		Roof Replacement / Coating System*					$120,000*
6.2	Museum	6.2.2 Second Floor Framing Reinforcing	$15,000				
		6.2.3 Steel Girder Scrape and Painting				$5,000	
		6.2.4 Foundation Waterproofing System			$25,000		
		Roof / Wall Covering Replacement *					$20,000*
6.3	Dining Hall	6.3.1 Roof Truss Retrofitting	$20,000				
		6.3.4 Wall Retrofitting**		$70,000 Option 1 $550,000 Option 2			
6.4	Rental Residence	6.4.1 Roof Maintenance at Mold Locations			$5,000		
		6.4.3 Foundation Maintenance		$20,000			
		Roof / Wall Covering Replacement *					$20,000*
			Immediate	Short	Intermediate	Long	Future
	Total (if Option 1 Selected for Dining Hall Wall Retrofitting)		$30,000 - $40,000	$270,000-$280,000	$30,000	$10,000	$300,000
	Total (if Option 2 Selected for Rebuilding Dining Hall above 1st floor)		$15,000***	$750,000-$850,000	$30,000	$10,000	$300,000

* Future Cost Considerations include typical maintenance such as roof replacement and exterior wall covering replacements.

** Wall Retrofitting is necessary be code, but two options are feasible. Option 1 includes reinforcing existing wall studs to remain. Option 2 includes rebuilding newwall studs and roof.

*** The estimated cost for truss retrofitting is removed from the total where Option 2 is selected to avoid double counting the cost of this item.

6.1 Firehouse

6.1.1 Structure

If the structure is to remain in its current condition, there are no recommended structural modifications recommended at this time based on apparent code compliance and condition of the structural elements.

Minor wall paneling deterioration may be rehabilitated within the next five years at a budgeted cost of $5,000.

Bollards are recommended to prevent vehicles from further damaging wall components. The estimated budge cost for providing new bollards is $7,500.

6.1.2 Foundation / First Floor Slab

The foundation is in good condition and does not require modification at this time.

The slab is sealed creating a slip hazard for firefighters and equipment and resurfacing with an epoxy based polymer coated finish is recommended over the entire apparatus bay. This estimated budge cost for an epoxy slab finish is $75,000.

6.1.3 Vehicular Door Openings

If vehicular doors are widened to accommodate larger fire trucks, structural modifications will be necessary for the slab and structure. The slab will need to be sawcut at each door opening and a new slab installed. Embedded steel closure angles shall be installed in the interior slab, which is raised relative to the exterior apron. The entire CMU wall and brick along the front façade will require removal and rebuilding since existing piers will be reduced from a width of 4’-0” to 2’-0,” and new reinforcing will be required. A column at the opening in the rear façade will require relocation due to proximity to the existing opening. This will require shoring for the existing structure as the work is performed. The budgeted cost for removing and replacing the front façade including new doors is estimated at $90,000. The budget cost for widening the door at the rear façade is estimated at $10,000. The work can be performed in phases to allow continued use of portions of the building as the work progresses.

6.1.4 Mezzanine Framing

No estimated budgetary cost is included for this structural system since the governing existing building code indicates structural adequacy for uses desired by the fire department such as bunk-in facilities, offices, light storage, radio rooms etc. The only other potential use suggested by the District that may exceed the capacity of the joists is an exercise room. The capability of the joists to support this use is highly dependent upon the weights of the proposed equipment and arrangement within the space. Localized reinforcing may be required if exercise use is proposed in this area and reinforcing should be designed at that time to adequately support the highly variable loading patterns produced by this type of use.

6.1.5 Structure Expansion Options

It is our understanding that future renovations to the structure are being considered to accommodate necessary spaces for turn out gear, storage, hazardous waste storage, office space, bunk space, fitness room, training spaces, etc. Based on the building's current configuration and our review of past feasibility reports supplied by the District, the building does not appear to have enough floor space to accommodate any of the proposed renovations without an addition or new building construction. There are three feasible options for accommodating proposed new uses: 1) constructing a stand-alone addition adjacent to the existing building, 2) modifying the existing building to create an integral addition and 3) install a new building to accommodate all uses.

Option 1

A stand along addition is probably the least expensive option for renovation. In this option, the existing building is not substantially modified since it is governed by the existing building code requirements. The addition will not be integral to the existing structure to remain and will not impose additional forces onto the existing frame elements. Localized non-critical components can be altered such as perimeter gravity columns, wall girts or openings in metal panels to allow access between the buildings. It is not advisable to attempt to move rigid frames or roof framing in this option since significant re-design and reinforcing will be necessary.

A budgetary cost for a 7,200 square foot stand-alone addition is approximately $*2.5 million*. The costs associated with the vehicular door modifications discussed in Section 6.1.3 of this report can be incorporated into this option for an additional cost of *$100,000*. Interior finish modifications are estimated at *$500,000* for this option, for a total estimated budgetary cost of $3.1 million.

Option 2

The second option includes modifying the structure to accommodate an integral addition. Depending on the level of structural changes required to meet the proposed architectural layout, significant reinforcing is probable in this option.

A budgetary cost for a 7,200 square foot integral addition is approximately *2.5 million*. The costs associated with the vehicular door modifications discussed in Section 6.1.3 of this report can be incorporated into this option for an additional cost of *$100,000*. It is estimated that structural steel modifications and reinforcing may be near *$500,000* pending complexity. Interior finish modifications are estimated at *$500,000* for this option, for a total estimated budgetary cost of $3.6 million.

Option 3

The third option includes demolishing the existing facility and installing a new building with a larger footprint to accommodate most or all of the proposed new required spaces. This is likely the most expensive option, but will allow for the most flexibility in developing efficient floor plans for the new spaces. The building can also be designed to comply with the newest code requirements for 'essential facilities' to increase probability of proper performance during significant loading conditions such as seismic or hurricane events.

A budgetary cost for demolition and new construction of a 12,000 square foot firehouse is approximately $4.3 million based on typical square foot unit prices.

6.2 Museum

6.2.1 Roof Structure

The roof structure appears acceptable based on no indications of excessive deflection or deterioration. No action is recommended at this time.

6.2.2 Second Floor Structure

Portions of the second floor framing do not comply with existing and new building code requirements for use as office space. One bay of the second floor will require sistering with additional joists to provide appropriate capacity. A budgetary cost for this work is approximated at $15,000. (if second floor is office space)

If the occupancy category of the building changes or if significant structural modifications are scheduled, significant reinforcing of various shear walls, floor beams, and connections such as hold downs and foundation anchorage will be required. The estimated budgetary cost for this work is approximated at **$300,000.**

6.2.3 First Floor Structure

The structure appears in good to fair condition based on visual observations. Scraping and painting of steel components is recommended within the next 5 to 10 years. The estimated budgetary cost for this work is approximated at **$5,000.**

6.2.4 Foundation / Basement Slab

The foundation and basement slab appear to be performing acceptably; however, water infiltration through the foundation wall is observed. In order to limit water infiltration into the basement and minimize further wall/steel beam deterioration, two courses of action are recommended: 1) Leaders discharging to grade should be directed away from the foundation and 2) A waterproofing system should be installed along the east wall. The waterproofing system will consist of excavation to expose the wall from the exterior, application of a waterproofing membrane, backfill and painting of interior surfaces with water repellant. The estimated budgetary cost for this work is approximated at **$25,000.**

6.2.5 Lateral Force Resisting System and Walls

It is highly unlikely that the current shear wall arrangement and fastening scheme was built in a manner that will comply with the building code requirements for new construction. If no modification to the spaces is proposed, the lateral force resisting system can remain in its current configuration according to the existing building code. However, if the occupancy category of the space is changed portions of the structure will require upgrading including straps and anchorage to resist overturning, shear and uplift loads. The budgetary cost for this work is explained in Section 6.2.2 of this report.

6.3 Dining Hall (attached to Museum)

6.3.1 Roof Structure

The roof framing does not comply with existing and new building code requirements for snow loading. Reinforcing of each of the trusses with additional members is required to meet building code requirements for strength. The concept for retrofitting includes adequately attaching reinforcing to chords with steel studs or wood boards to overstressed components and extending them beyond critical section. Due to limited access, a ceiling opening will be required to fit material into the attic space. A budgetary cost for this work is approximated at $20,000. (An engineering design is also required to finalize reinforcing locations, sizes and extents)

6.3.2 First Floor Structure

The first floor structure appears acceptable based on no indications of excessive deflection or deterioration. No action is recommended at this time.

6.3.3 Foundation / Basement Slab

The foundation appears acceptable based on no indications of excessive settling or deterioration. No action is recommended at this time.

6.3.4 Lateral Force Resisting System and Walls

The destructive testing indicates that the wall framing does not comply with typical industry standards and violates code defined requirements for header strength, continuous load transfer paths at jack stud and proper attachments of the window frame to the structure. In addition, a crack observed within the gypsum on the adjacent wall is located inches away from the molding, which is consistent with the behavior that might be expected with framing found in the probe. (Refer to Photo No. 2.3.19. For this reason, it is our opinion that the walls be reinforced or re-built to retrofit the structural capacity and construction techniques discovered during the investigation. Two options are discussed below.

Option 1

A retrofitting scheme which involves removing interior finishes and installing new walls studs and headers at specific locations each side of windows, at all locations directly under roof trusses and at ends of all headers. New headers will be required to meet code defined strength requirements. New windows should be installed to restore proper functionality as the work progresses and shall be attached directly into new studs that span from floor to ceiling. In this option, exterior finishes remain and roof framing can be shored as the work progresses systematically. Electrical work and baseboard heating removal and replacement will also be required to accommodate the work. A budgetary cost for this work is approximated at $70,000.

Option 2

The second option for retrofitting the walls includes removal and replacement of the portion of the structure above the foundation. This option is also required if major modifications such as a second floor addition is considered as the lateral force resisting system will require removal and replacement in this instance. Portions of the foundation may be salvageable; however, hold downs and connections for shear may require modification to portions of the wall. A budgetary cost for this work to remove and replace structure above the foundation similar to existing is approximated at **$550,000**. This does not include costs for changing the configuration, use, or other expansion concepts.

6.4 Rental Residence

6.4.1 Roof Structure

In its current configuration, the roof framing complies with the structural requirements of the existing building code. No reinforcing measures are recommended at this time unless the building use is scheduled to be modified. Minor structural modifications to deteriorated joists above bathrooms where mold was observed may require reinforcing in the future pending deterioration rate. A budgetary cost for this work is approximated at **$2,000** over the next 5 years.

In the event the building configuration or use is changed such as for office space or other use to accommodate the District's programming needs, retrofitting of the rafters and ceiling joists with uplift straps is recommended to meet building code requirements. A budgetary cost for this work is approximated at **$50,000**. (An engineering design is also required to finalize reinforcing locations, sizes, connections, etc.)

6.4.2 First Floor Structure

In its current configuration, the first floor framing complies with the structural requirements of the existing building code. No reinforcing measures are recommended unless the building use is scheduled to be modified.

In the event the building configuration or use is changed such as for office space or other use to accommodate the District's programming needs, reinforcing of the floor joists and headers or the installation of load bearing walls in the basement is recommended to meet building code requirements for strength. A budgetary cost for this work is approximated at **$100,000**. (The cost only includes structural reinforcing. Costs associated with Architectural, Mechanical, Electrical and Plumbing requirements may be the deciding factor regarding feasibility of Use modification to this structure. Also, an engineering design is required to finalize reinforcing locations, sizes, connections, etc.)

6.4.3 Foundation / Basement Slab

There are no apparent significant structural deficiencies observed in the foundation walls at this time other than continued deterioration in mortar over time due to water seepage. It is recommended that the foundation wall be exposed from the exterior in order to repoint masonry and apply a damp proofing system in order to limit water infiltration over time and maintain proper performance. The estimated budgetary cost for this work is approximated at $20,000.

7.0 Conclusion

Based on the findings of our assessment, it is apparent that components of the various structures have varying degrees of condition, code compliance and functionality as discussed in Section 6.0 of this assessment. In addition to recommending repair measures for structures on site in their existing configuration, we have also included some discussion within Section 6.0 regarding probable structure modifications that may or may not be necessary to accommodate the District's programming goals such as increased space for turn out gear, storage, hazardous waste storage, office space, bunk space, fitness room, training spaces, etc.

Any changes or modifications to the structures that may be necessary to meet the programing goals of the District as discussed in the Hueber Breuer Construction Co. feasibility report may require structural use changes, which triggers the necessity to comply with newer code requirements. These discussions from Section 6.0 are summarized below in Figure 7.0 for your use. The intention of the table is to be a useful tool while determining the best expansion programs to meet the District's needs for functionality while considering physical feasibility as well as economic impact.

Figure 7.0
Budgetary Costs for Potential Expansion / Structural Use Modifications

Structure		Expansion / Use Modification Assumption	Budgetary Construction Costs
6.1	Firehouse	**6.1.4 Structure Expansion Options**	
		Option 1 - 7,200 sq ft Stand Alone Addition	$3.1 million
		Option 2 - 7,200 sq ft Integral Addition with Structure Reinforcing	$3.6 million
		Option 3 -Exist'g Facility Demolition / New 12,000 sq ft. facility / Complete Code Upgrade	$4.3 million
6.2	Museum	**6.2.2 Structural Use Modification to Office Space or Similar**	
		Lateral Force Resisting System and Gravity Framing System Upgrades (Refer to 6.2.2 and 6.2.5)	$300,000*
6.3	Dining Hall	**6.3.4 No expansion options explored**	
6.4	Rental Residence	**6.4.2 Structural Use Modification to Office Space or Similar**	
		Gravity Framing System Upgrades (Refer to 6.4.2)	$150,000*

* Includes Structural Reinforcing Costs Only - Architectural and Mech/Elec/Plumbing Costs likely far exceed structural costs

8.0 Disclaimers

8.1 This report does not express or imply any warranty of the structure but only addresses the condition of the portion which was readily accessible and observable at the time of the inspection.

8.2 It should be noted that the above report is based on visual observations and that there is no claim, either stated or implied, that all c onditions were observed.

8.3 The opinion and recommendations contained in this report are based on the information provided by the Owner.

8.4 The opinions stated in this report are based on limited visual observations only. No physical testing was performed and no detailed calculations have been made unless specifically noted otherwise to determine the adequacy of the structural system or its compliance with accepted building code requirements.

8.5 The referenced buildings were visited for the purpose of observing the physical condition and state of repair of the major structural components to the extent reasonably ascertainable without disturbing the system or engaging services of testing agency, which is beyond the agreed upon scope of work.

8.6 The visit to the referenced structure does not constitute a design and the structural system for the building cannot be warranted. This report is limited to the observed conditions as much as site observations will allow.

8.7 The following services and responsibilities are specifically excluded from this report:

8.7.1 Discovery, testing, monitoring, clean-up, neutralization of pollutants and hazardous substances.

8.7.2 Determinations or advisement related to the existence of proportion of asbestos, modification, installation, abatement or removal of a product, material or process containing asbestos.