Lakefront Building Structural Evaluation

Fontana, Wisconsin

Community Development Authority and Lakefront Committee

Village of Fontana-on-Geneva Lake

May 2009

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Prepared for: Village Community Development Authority and Lakefront Committee
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Village of Fontana
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PDI GRAEF

Executive Summary

The Lakefront Building overall is in fair condition. The roof structure is in good condition and the walls are in fair condition. The roofing and floor slab are in poor condition.

With relatively minor repairs and typical maintenance, the building can be expected to continue to perform as it has been for years to come. These repairs include addressing the cracking in the walls and re-roofing the building. Some selective removal of ceilings should be performed to determine whether the roof framing in the south addition was damaged by roof leaks. For a longer life of the building, the roof framing members could be cleaned and painted. Finally, the building would be more user-friendly if the floor slab was replaced.

Alterations to the building are likely to require structural strengthening in the area affected by the alterations. Such strengthening is often significant and expensive.

Most changes in use of the building that have been discussed would require upgrading the building's lateral system and might require upgrading the gravity system. Both of these systems are typically expensive to upgrade. In addition to structural upgrades, it is likely that architectural, mechanical, electrical and plumbing aspects of the building would also require significant updating in order to meet the code requirements involved with a change in occupancy. These types of changes can be very expensive, and in some cases, it may be more cost effective to rebuild the building rather than perform the alterations required.

Reusing the building's foundation for a new building may be possible. More information would be needed to determine the capacity of the existing foundation. Also, the building footprint and loading characteristics would need to remain the same as the existing building. These requirements significantly limit the flexibility of the design of the new building.

Introduction & Background

Photo 1: East Elevation

Introduction

As requested, we performed a walk-through visual evaluation of the structural components of the Lakefront Building located at 454 Lake Street in Fontana, Wisconsin on April 23, 2009. The purpose of our visit was to evaluate the condition of the building in regards to the feasibility of renovating the building and possibly changing the use of the building. This report presents the findings and conclusions reached as a result of our evaluation.

Photo 2: West Elevation

Background

The Lakefront Building consists of a 75 foot x 75 foot original building and a triangular shaped addition on the south side (Photos 1 & 2). For the purposes of directional references in this report, the lake is on the east side of the building. The building previously had extended farther to the north and west, but these portions of the building were demolished. Another building had previously been built south of this building. It is thought that the triangular shaped addition was originally built to fill the space between the Lakefront Building and this previously demolished building to the south. Photo 3 is a historic photo of the building.

Photo 3: Historic Image

The original building was constructed in the early 1930's. It is a single story structure with concrete masonry (CMU) walls and a steel roof system. Given the age of the building, the walls are likely unreinforced, although this was not verified. The roof structure is comprised of metal deck, steel joists, steel beams and steel columns. The metal deck was replaced in 1991. At the exterior walls, the roof structure is not supported on the CMU walls, but rather on steel columns placed within the walls.

Background

The construction date of the south addition is unknown. It is also a single story structure with CMU walls. The roof structure is unknown at this time. This portion of the building has two ceilings. The lower ceiling is drop tiles and the upper ceiling is an older acoustical tile attached to either drywall or plaster.

The exterior finish of the building is metal paneling on the north, west and south elevations. The east elevation of the south addition has a stone façade; the complete construction of this wall is unknown. The east elevation of the original building is finished with vinyl siding which covers a brick veneer.

Both buildings are currently occupied by the Lake Geneva Marine Company. The north third of the original building is being used as a showroom for boat sales and also includes a small storage area and a single restroom. The south two thirds of the original building are being used for boat repairs and temporary storage. The south addition houses office space, storage, employee space and additional employee restrooms.

It is our understanding that the original building has always been used for boat building, repair and maintenance, and sales. It is thought that the south addition may have been previously used as a restaurant or concession sales.


Photo 4: CMU cracking at column location


Photo 5: CMU cracking at window opening

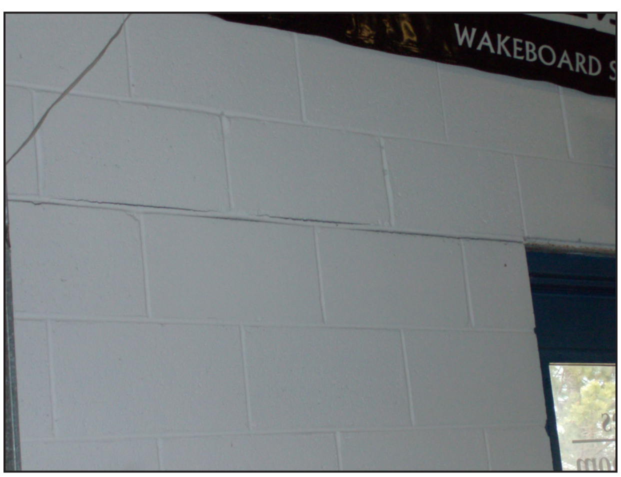

Photo 6: Horizontal CMU crack at window infill

This section provides information gathered during our on-site evaluation of the building. Interpretations of these items as well as recommendations based on these items are found in later sections of the report.

Original Building

a. Walls

The 10 inch CMU walls were originally built with three window or door openings on each elevation. Many of these openings have since been infilled with 8 inch CMU, wood framing and plywood, or smaller windows surrounded with wood framing. The interior face of the walls is exposed CMU.

The CMU walls are in fair to poor condition. The walls are generally plumb, but many cracks were noted in each of the walls.

Some of the cracks are located at the columns which is a normal and expected location for the wall to crack (Photo 4). Most of the wall cracks are diagonal stair-step cracks located near the window openings (Photo 5). These cracks do not appear to have formed recently; however, it is unknown whether they are actively moving or if they are stagnant.   The source of this cracking is not obvious at this time. Some of the cracks are consistent with foundation settlement. Others are consistent with lateral drift of the building.

A relatively large horizontal crack was noted in the infill CMU at the east end of the north wall (Photo 6). This crack is consistent with an inward horizontal load against the wall.

One half-height course of CMU below the south window on the east elevation of the original building has moved inward (Photo 7). The reason for this movement is unknown, although we suspect that it may be related to the installation of the new window or the siding. Invasive investigation would be required to determine the source of the movement.

b. Roof Structure

The roof structure is composed of 1 ½ inch metal deck spanning between 14 inch deep steel joists (Photo 8). The steel joists are supported on 14” deep steel I-shape beams which bear on 6 inch I-shape columns. The framing layout is a 3 bay x 3 bay pattern with 25 foot bays in each direction. Some additional framing for a small crane is located in the center bay (Photo 9). The roof heights near the center of the building are approximately 14 feet in the north and south bays and 16 feet in the center bay. These measurements are approximate and were taken from the top of the slab to the bottom of the deck.

The roof structure is in fair to good condition. Some surface rust was noted on the joists, beams and columns, however none of the rust is structural significant at this time (Photo 10). The roof framing appears to be performing as intended without significant deflection, deterioration or damage.

Some additional loading has been placed on the roof which would not have been originally intended during the design. In particular, the pulley system that raises the interior wall places a point load on the joist that would not have originally be designed for. However, given the nature of this building, it is likely that this pulley, and similar other sources of roof loading, would be used during the summer when the roof is not

Photo 7: CMU window jamb displacement

Photo 8: Steel roof framing

Photo 9: Crane support framing at high bay


Photo 10: Surface deterioration of steel joists and beams


Photo 11: Concrete slab on grade condition


Photo 12: Asphalt parking lot extends into building

supporting snow load. This would provide some additional capacity for such loading during the summer months. An analysis of the roof joists would be required to definitively determine whether the capacity of the joists is exceeded by the additional loading.

c. Floor Slab

The floor of the building is a concrete slab on grade and is in poor condition. The slab has substantial cracking and is extremely uneven (Photo 11). The floor elevation is lower than, or even with, much of the surrounding exterior grade. The asphalt from the parking lot is higher than the floor slab at the rear overhead door entrance (Photo 12).

d. Roofing

Although the roofing is not a structural component of the building, we did observe issues with the roofing during our evaluation including deterioration and improper installation.

The roof is a built up roof. It is our understanding that the roof was last replaced in 1991. The roofing has reached the end of its expected life. The top layer of tar has worn away and the layer of felt below is exposed in many areas (Photo 13).

In addition to the normal deterioration observed, there also are two areas of concern relating to water flow and drainage paths. A strip of roll roofing has been placed along the edge of the built up roof adjacent to the gutters (Photo 14). The lap between the two roofing materials is directed such that water can get below the roofing and into the building. The second area of concern is at the east parapet. When the vinyl siding was installed on the front of the building, the top angle of the siding was placed on the parapet without a metal cap flashing over the parapet (Photo 15). This can allow water to get behind the siding rather than directing water to the exterior face of the siding.

South Addition

Much of the south addition building structure was not visible due to wall, floor and ceiling finishes. One crack was noted in the south wall (Photo 16). The crack did not appear to be structurally concerning. The roof structure was not visible. Roof leaks along the south wall may have caused deterioration of the structure depending on the construction type. There are two levels of ceiling in the south addition. The upper ceiling tiles have the appearance of tiles which may contain asbestos.

Photo 13: Roofing deterioration

Photo 14: Lap with roll roofing at roof edge

Photo 15: No cap flashing at front parapet

Photo 16: CMU crack in south addition wall

Continued Use

The Lakefront Building is performing adequately for its current use. It will likely continue to perform adequately for this use or a similar use with regular maintenance and upkeep. Addressing a few of the minor issues noted above by either repairing or monitoring the conditions should be considered. The recommendations for repairs and monitoring are discussed in the next section.

Alterations to Structure

The Lakefront Building has little room for alterations without requiring significant strengthening of the altered members or areas.

The International Existing Building Code (IEBC) has been adopted as part of the Wisconsin Commercial Building Code. The IEBC allows for continued use of a building under its current conditions as long as alterations to the building do not increase the loads to the structural elements by more than 5%. Once the loading is increased by more than 5%, the affected portions of the building must be strengthened to meet the current code for new buildings.

Based on the age and construction type of this building, it is highly unlikely that the building has reserve capacity in the structure. The structural elements would not likely even meet the strength requirements of today's code. Only alterations that would minimally affect the structure should be considered for this building if the Village wishes to avoid significant upgrades to the structure. These types of alterations would generally be limited to changes in the finishes within the building, changes in the exterior cladding of the building, or replacing windows and doors in their current locations.

Creating new openings through the exterior walls will require strengthening of the walls at the openings. The CMU walls are unreinforced, non-bearing walls. These types of walls generally do not have the capacity to resist the wind loads required by the current building code. Therefore, new openings through the walls would likely require "strongbacks" to be placed against the wall. "Strongbacks" are steel members placed on the interior or exterior face of the wall, in this case surrounding the new opening, which help to support the wall. Although strongbacking is the option most often used in these situations, there also are other ways of reinforcing these openings.

Re-establishing the previously existing window openings in the walls may also require strengthening. Some openings have been infilled with wood framing or have been modified with wood framing to accommodate smaller window. In these cases, the full original opening would likely be able to be reestablished without strengthening the wall. In the cases where the openings have been infilled with CMU, a structural analysis and a code review would need to be performed to determine whether strengthening of the wall would be required. Depending on the specifics of the results of these analyses, it may be possible to re-establish the original openings without strengthening; however, it is more likely that strongbacks or other reinforcing would be required to do so.

There is some evidence based on historic photographs that the north wall of the original building was originally built as an interior wall. This presents an additional concern with any changes to this wall as it was not originally intended to resist wind load. Given the age of the construction, it is not likely that this wall was built with significantly different construction than the other exterior walls, but it still would be a consideration when evaluating changes to the wall.

Changing features of the building that would increase the weight of the roof or wall systems would likely require significant strengthening of the structure. The most likely example of such a change would be installing a roof with a higher weight that what is currently in place, including installation of a green roof.

Adding height to the parapet wall, building an addition adjacent to the building, or anything else that would cause snow to drift on the roof would also require structural strengthening.

Change of Use/Occupancy

A change in the use of a building is referred to as “Change of Occupancy” in the building code. Examples of a change of occupancy would be changing this building from its current use to an assembly space, to a restaurant or to a store or market. If a change of occupancy is considered for this building, the structural systems may be required to be upgraded for gravity loads (snow load) or lateral loads (wind and seismic loads) depending on the change of occupancy proposed.

A change in occupancy could have a significant impact on a renovation project as it may require substantial upgrades to the structural systems. The most likely and possibly most significant of these upgrades would be renovating the lateral system of the building to meet the International Building Code’s (IBC) seismic requirements. The IBC is the code to which new buildings are designed.

The IEBC provides a hazard classification system for buildings. Category 1 is the most hazardous and category 5 is the least hazardous. If a building is changed from a lower hazard category (such as 4) to a higher hazard category (such as 3), the seismic system of the building must meet the requirements of the IBC. If a building remains in the same hazard category or is changed to a lower hazard category, the seismic system is not required to conform to the IBC. The current use of the building is a Moderate Hazard Factory Industrial (F-1) occupancy which is in relative hazard category 4. Many of the possible alternate uses of the building are in relative hazard category 3, which is a higher hazard category. These category 3 uses would require significant upgrading of the structure’s lateral system.

Occupancies that are in relative hazard category 4 are Business (offices), Factory Industrial Moderate Hazard (uses such as the current use of the building), certain types of Residential, and Moderate Hazard Storage. Occupancies that are in relative hazard category 5 are Low Hazard Factory Industrial, Low Hazard Storage, and Utility and Miscellaneous.

The possible future uses for this building that have been discussed are typically in relative hazard category 3.

Examples of category 3 uses are:

- Assembly – such as community halls, restaurants, libraries and museums
- Mercantile – such as stores and markets
- Other uses not likely at this site including Educational, Institutional and Residential.

It should be noted that the portion of the existing building that is being used as a sales floor is being used as a Group M occupancy. This makes the building a mixed use occupancy. The IEBC does not specifically address how to apply the seismic upgrade provisions to a building with a mixed use occupancy. For the purposes of this study, we have classified the entire building as the lower occupancy given that the majority of the floor area of the building is being used as a Group F-1 occupancy. An interpretation by the building official would be recommended to clarify this issue.

Additional code studies and a structural analysis would be required to determine the extent of the strengthening that would be required to upgrade the lateral system of the building.

In addition, the gravity loads on the building would increase if the occupancy classification is changed in a way which results in the building moving to higher occupancy category. The "occupancy category" is different than the "occupancy classification" and "hazard category" discussed above. The occupancy category affects the snow, wind and seismic loads on a building. There are a variety of factors that are involved with this occupancy category, but only one that appears likely to affect this building. That is, if the building was changed to an assembly space with an occupant load of more than 300 people, the snow, wind and seismic loads would be increased and the structure would need to be upgraded to meet these additional loads. Examples of such uses that might create such an assembly space include community halls, restaurants, libraries, and museums.

In addition to the items discussed above, it is possible, and in some cases likely, that architectural, mechanical, electrical and plumbing aspects of the building would also require significant updating in order to meet the code requirements involved with a change in occupancy. Such updating may include meeting ADA requirements, meeting a new fire rating for the building, adding egress, updating the HVAC and electrical systems, adding restrooms or other items.

These types of changes can be very expensive, and in some cases, it may be more cost effective to rebuild the building rather than perform the alterations required.

Reuse of Existing Foundations

During our site visit, there was discussion regarding reusing existing foundations for a new building. This may be possible; however it typically limits the functionality of the new building. The footprint of the new building must match that of the existing building. The loads and their locations must match the capacity of the existing foundation.

If this option is entertained, we would need to excavate inspection holes at a few places around the building to determine the size and geometry of the foundation. In addition to the geometry of the foundation, we would also need to perform testing to determine the reinforcing in the foundation and the soil capacity at the site. These items would begin to provide the information needed to determine the capacity of the foundation.

Often reusing an existing foundation does not end up being cost effective; however depending on the plan that is developed for the building, it is possible that it would be cost effective in this case.

If the grade around the building is raised, the foundation would need to be extended. If the existing foundation meets the layout and structural needs of the new building, it may be cost effective compared to demolition of the existing foundation and construction of a new foundation.

This section provides actions that are recommended for continued use of the building as its current use. The upgrades to the structural system that were discussed in the previous section are not addressed here. Specific requirements of such upgrades would require a more in depth code review based on the specific use being evaluated, gathering of additional information regarding the existing structure and a structural analysis.

Diagonal Wall Cracks

The diagonal wall cracks should be monitored to determine whether they are active cracks. This can be accomplished by measuring the cracks at specific locations and periodically checking the measurements to determine whether they have moved. Alternately, crack monitors could be installed across the cracks and periodically checked for movement. The crack monitors would give a better idea of the magnitude and direction of movement. Both of these methods will allow tracking of long term movements.

There is a possibility that the cracks have formed due to structure drift (lateral deflection of the roof). If this is the source of the cracking, then periodic checking of the cracks is not likely to provide any information. The most cost effective way to check for these movements would be to repair the cracks by repointing the cracked joints. If the cracks reappear, they are active cracks and may be related to structure drift. It may take a significant period of time for the cracks to reappear. This option would be preferable also because it will strengthen the building walls providing more resistance to wind against the building.

A final option for monitoring these cracks is to install crack monitors with data capturing abilities. These crack monitors automatically read and record the movements of the wall and digitally record the information. This information is then periodically downloaded and analyzed to determine the movements of the walls. This technique is relatively expensive and is probably not warranted in this situation.

Horizontal Wall Crack

The horizontal crack in the CMU infill at the east end of the north wall should be repaired. We recommend that some additional exploratory investigation be performed in this location to determine the source of the cracking. The repair for this condition would likely be replacing the infill with new CMU or providing strongbacks along the wall at this location.

Floor Slab

The concrete floor slab is in very poor condition. We recommend replacing the slab with a new concrete slab on grade. This is not a structural component and is not required to be replaced, but is recommended for usability of the building.

Roof Structure

Portions of the ceiling in the south addition should be removed to determine whether the roof structure sustained damage during the roof leaks. We recommend testing the upper ceiling tiles for asbestos prior to performing demolition or other work which could disturb this ceiling.

For the longest life of the building, we recommend cleaning and painting the steel elements of the roof system in the original building to protect the steel from further corrosion. This is not required for structural capacity, but will provide protection that will extend the life of the building.

Roofing

An additional layer of built up roofing should be applied to the building. At that time, the built up roof can be placed on top of the roll roofing at the edge of the building to allow proper water flow. Also, metal cap flashing should be installed at the parapet wall.

Limitations

This report is based on conditions of structural elements that were readily observable at the time of our evaluation. No testing or inspections were performed. PDI/GRAEF does not accept responsibility for structural deficiencies not evident during an evaluation of this type. The report is intended to inventory existing conditions of the observed areas of the building. Conditions observed on the date of evaluation may change if noted deficiencies are not corrected. Repair recommendations provided in this report are conceptual in nature and are not intended for construction.