Northeast Metropolitan Regional Vocational High School

Wakefield, Massachusetts

Structural Assessment

March 2, 2020

STRUCTURAL ASSESSMENT

The purpose of this report is to describe, in broad terms, the structure of the existing building; to comment on the condition of the existing building; and on the feasibility of renovation and expansion of the existing building.

Scope

1. Description of existing structure.
2. Comments on the existing condition.
3. Comments on the feasibility of renovation and expansion.

Basis of the Report

This report is based on our visual observations during our site visits on February 18 and 21, 2020 and drawings of the original construction prepared by Korslund, LeNormand & Quann, Inc. dated November 25, 1967; Pre-Feasibility Study Report prepared by Dore & Whittier Architects, Inc. dated February 1, 2016.

During our site visit, we did not remove any finishes or take measurements; so, our understanding of the structure is limited to the observations of the exposed structure and the exterior facade.

School Building Description

The school is located on Hemlock Road in Wakefield, Massachusetts. The school is essentially a single story rectangular structure with two interior courtyards and a partial basement. The portion of the structure between the two interior courtyards houses a two story classroom wing. The building is divided into seven parts separated by way of expansions joints. No major renovations or additions were constructed since the original construction. The pool structure was added as an alternate to the main building, but it is not clear whether the pool was constructed at the same time as the school or was added on at a later date. The pool structure is located on the southwest of the school and is separated from the school structure by way of an expansion joint.

The lowest level floor is a concrete slab-on-grade. The portion of the first floor above the basement is a 12-inch thick reinforced concrete flat slab supported on wide flange steel columns.

The primary roof structure throughout the building consists of bulb-tees spanning between steel bar joists supported on interior and exterior masonry bearing walls. The typical roof construction is 2-inch poured gypsum deck supported on steel bulb tees spanning between steel bar joists. The bar joists are supported on interior and exterior masonry walls.

The Cafetorium roof consists of 2-inches of poured gypsum deck supported on steel bulb-tees spanning between steel trusses supported on reinforced concrete columns. The kitchen roof consists of 2-inches of poured gypsum deck supported on steel bulb-tees spanning between steel joists supported on wide flange structural steel beams and structural steel columns. The Gymnasium roof consists of pre-cast concrete tees supported on pre-cast concrete beams on masonry bearing walls. The typical second floor framing is a 2 ½-inch concrete slab on form deck supported on steel bar joists spanning between interior and exterior masonry walls. The lateral load of the structure is resisted by masonry shear walls.

The carpentry shop is used as a storage area and is currently not in use due to a fire that occurred in January 2013. The fire started in the dust collection system which was located inside the shop and destroyed the inner structural bay of the roof. The school replaced the old roof structure with new open web steel joists, corrugated metal deck and a membrane roofing system soon after the fire. Documents related to the design and construction of the roof replacement as well as inspection reports related to the remaining structure should be reviewed prior to any improvements being made in this space.

The pool structure is currently not in use. The pool deck is a concrete slab on metal deck supported on reinforced concrete pool walls and exterior walls. The roof is framed with precast concrete tees supported on precast concrete beams and exterior masonry walls.

Bleacher Structure Description

The bleachers are located in the football filed. The bleacher structure is steel framed structure supporting aluminum seating, walkway and treads, it also supports a wood framed press box at the top of the bleachers.

The structure is framed with wide flange columns, bents and beams with vertical and horizontal cross bracing composed of structural steel angles. The sub frame supporting the walkways and seating are galvanized “Z” shaped purlins. The structure is supported on sono tube concrete foundations. The aluminum framing for the treads, seating and walkway are supported directly on the steel frame. The pressbox is wood framed supported on the steel frame.

Existing Conditions

School Building

Based on our observations the original (main) school structure is functioning adequately. We observed signs of minor and major active water leaks at various locations. The interior masonry walls appeared

to be in good condition with the exception of some minor cracking in a few local areas. We did not observe any excessive vibrations due to footfall on the framed floors. The roof and floor framing also appeared in good condition.

We observed the pool deck structure from the underside in the utility tunnel around the pool tub, we observed significant corrosion of the metal floor deck. It was not apparent from our review of the existing drawings whether or not this metal deck was an integral part of the floor system or was used as a form deck. We observed a significant amount of effervescence on the concrete walls of the pool.

The pool has not been in use for several years as the cracks in the pool structure have not been repaired. Since the pool space is not currently in use, the temperature of this space has not been maintained. We observed vertical cracks regularly spaced on the inside face of the exterior walls of the pool, the cracks may have been formed due to Cracking in the masonry walls was observed running vertically at regular intervals and propagating from the corners of windows and the heads of the doors. Most likely this cracking is due to the temperature fluctuations that this portion of the building has seen and may also be due to the lack of control joints in the wall.

We did not observe any major deterioration of the structure in the carpentry shop due to the fire. There appears to have been superficial damage to the floor and wall finishes. The structure appears to be functioning adequately.

We observed settlement of the slab on grade in corridor D-116 near stairwell C, this was apparent as the joint between the floor finishes and the wall base has opened up but did not observe any cracking in the terrazzo floor finish at the joint between the flooring and wall finishes. The settlement is the slab appears to be local and may be the result of improper compaction of the grade at time of the original construction. This settlement is not a structural concern.

We did not observe any evidence of foundation settlement.

Bleacher Structure

The bleacher structure is showing wear and tear due to its age and exposure to the elements. The structure seems to be performing adequately. We noted surface rust on most of the structural steel framing members. The base of the columns and column base plates have started to delaminate from the rust and have lost some of the sectional area and require to be reinforced and repaired. The top of the sono tube foundations appear to be in fair condition. The aluminum seating and treads are in fair condition. The pressbox structure is in fair condition but is need of general maintenance repairs.

Feasibility of Renovation and Expansion of the Structure

Depending on the scope of the renovations to the school, it may be feasible to make modifications to the existing structure without requiring full compliance with the code requirements for new construction. We would recommend that any additions, if planned, be separated from the existing structure by way of expansion joints.

GENERAL CODE CONSIDERATIONS

Primary Structural Code Issues Related To the Existing Structure

If any repairs, renovations, additions or change of occupancy or use are made to the existing structure, a check for compliance with 780 CMR, Chapter 34 "Existing Building Code" (Massachusetts Amendments to The International Existing Building Code 2015) of the Massachusetts Amendments to the International Building Code 2015 (IBC 2015) and reference code "International Existing Building Code 2015" (IEBC 2015) is required. The intent of the IEBC and the related Massachusetts Amendments to IEBC is to provide alternative approaches to alterations, repairs, additions and/or a change of occupancy or use without requiring full compliance with the code requirements for new construction.

The IEBC provides three compliance methods for the repair, alteration, change of use or additions to an existing structure. Compliance is required with only one of the three compliance alternatives. Once the compliance alternative is selected, the project will have to comply with all requirements of that particular method. The requirements from the three compliance alternatives cannot be applied in combination with each other.

The three compliance methods are as follows:

1. Prescription Compliance Method.
2. Work Area Compliance Method.
3. Performance Compliance Method.

Comment

The approach is to evaluate the compliance requirements for each of the three methods and select the method that would yield the most cost effective solution for the structural scope of the project. The selection of the compliance method may have to be re-evaluated after the impact of the selected method is understood and after analyzing the compliance requirements of the other disciplines, Architectural, Mechanical, Fire Protection, Electrical and Plumbing.

Prescriptive Compliance Method

In this method, compliance with Chapter 4 of the IEBC is required. As part of the scope of this report, the extent of the compliance requirements identified are limited to the structural requirements of this chapter.

<u>Additions</u>

Based on the project scope, the following structural issues have to be addressed:

- All additions should comply with the code requirements for new construction in the IBC.
- For additions that are not structurally independent of an existing structure, the existing structure and its addition, acting as a single structure, shall meet the requirements of the Code

for New Construction for resisting lateral loads, except for the existing lateral load carrying structural elements whose demand-capacity ratio is not increased by more than 10 percent, these elements can remain unaltered.

- Any existing gravity, load-carrying structural element for which an addition or its related alterations causes an increase in the design gravity load of more than 5 percent shall be strengthened, supplemented or replaced.

Alterations

- Any existing gravity, load-carrying structural element for which an addition or its related alterations causes an increase in the design gravity load of more than 5 percent shall be strengthened, supplemented or replaced.
- For alterations that would increase the design lateral loads or cause a structural irregularity or decrease the capacity of any lateral load carrying structural element, the structure of the altered building shall meet the requirements of the Code for New Construction, except for the existing lateral load carrying structural elements whose demand-capacity ratio is not increased by more than 10 percent, these elements can remain unaltered.

Work Area Compliance Method

In this method, compliance with Chapter 5 through 13 of the IEBC is required. As part of the scope of this report, the extent of the compliance requirements identified are limited to the structural requirements of these chapters.

In this method, the extent of alterations has to be classified into LEVELS OF WORK based on the scope and extent of the alterations to the existing structure. The LEVEL OF WORK can be classified into LEVEL 1, LEVEL 2 or LEVEL 3 Alterations. In addition, there are requirements that have to be satisfied for additions to the existing structure.

If the extent of the renovations (includes Architectural, FP and MEP renovations) for this project exceeds 50 percent of the aggregate area of the building, then, the LEVEL OF WORK for this project would be classified as LEVEL 3 Alterations. This would require compliance with provision of Chapter 7, 8 and 9 of the IEBC. If the scope of the project includes new additions to the existing structure; this would trigger compliance with provisions in Chapter 11 of the IEBC.

Level 3 Alterations

- Any existing gravity, load-carrying structural element for which an alteration causes an increase in the design gravity load of more than 5 percent shall be strengthened, supplemented or replaced.
- For alterations where more than 30 percent of the total floor area and roof areas of a building or structure have been or proposed to be involved in structural alterations within a 12 month period, the evaluation and analysis shall demonstrate that the altered building complies with

the full design wind loads as per the code requirements for new construction and with reduced IBC level seismic forces.

- For alterations where not more than 30 percent of the total floor and roof areas of a building are involved in structural alterations within a 12 month period, the evaluation and analysis shall demonstrate that the altered building or structure complies with the loads at the time of the original construction or the most recent substantial alteration (more than 30 percent of total floor and roof area). If these alterations increase the seismic demand-capacity ratio on any structural element by more than 10 percent, that particular structural element shall comply with reduced IBC level seismic forces.
- Existing anchorage of all unreinforced masonry walls to the structure have to be evaluated.

Additions

- All additions shall comply with the requirements for the Code for New Construction in the IBC.
- Any existing gravity, load-carrying structural element for which an addition or its related alterations cause an increase in design gravity load of more than 5 percent shall be strengthened, supplemented or replaced.
- For additions that are not structurally independent of any existing structures, the existing structure and its additions, acting as a single structure, shall meet the requirements of the Code for New Construction in the IBC for resisting wind loads and IBC Level Seismic Forces (may be lower than loads from the Code for New Construction in the IBC), except for small additions that would not increase the lateral force story shear in any story by more than 10 percent cumulative. In this case, the existing lateral load resisting system can remain unaltered.

Performance Compliance Method

Following the requirements of this method for the alterations and additions may be onerous on the project because this method requires that the altered existing structure and the additions meet the requirements for the Code for New Construction in the IBC.

PARTICULAR REQUIREMENTS OF COMPLIANCE METHODS

For our project, in order to meet compliance with one of the two compliance methods “Prescriptive Compliance Method” or the “Work Area Compliance Method”, we have to address the following:

Prescriptive Compliance Method

Additions

The proposed additions would be designed structurally independent of the existing structure, thus, would not impart any additional lateral loads on the existing structure.

If the proposed alterations are such that the alterations increase the design lateral loads on the existing building or cause any structural irregularity of decrease the lateral load carrying capacity of

the building, the structure of the altered building shall meet the requirements of the Code for New Construction in the IBC.

If the proposed additions increase the design gravity load on portions of the existing roof members, these members would have to be reinforced and this incidental structural alteration of the existing structure would have to be accounted for in the scope of the alterations to the existing structure and would trigger requirements for alterations.

Alterations

Alterations that would increase the design gravity loads by more than 5 percent on any structural members would have to be reinforced.

If the proposed alterations of the structure increases the demand-capacity ratio of any lateral load resisting element by more than 10 percent, the structure of the altered building or structure shall meet the requirements for the Code for New Construction.

Work Area Compliance Method

Level 3 Alterations

If the proposed structural alterations of an existing structure are less than 30 percent of the total floor and roof areas of the existing structure, we have to demonstrate that the altered structure complies with the loads applicable at the time of the original construction and that the seismic demand-capacity ratio is not increased by more than 10 percent on any existing structural element. Those structural elements whose seismic demand-capacity ratio is increased by more than 10 percent shall comply with reduced IBC level seismic forces.

If the proposed structural alterations of an existing structure exceed 30 percent of the total floor and roof areas of an existing structure, we have to demonstrate that the altered structure complies with the IBC for wind loading and with reduced IBC level seismic forces.

Existing anchorage of all unreinforced masonry walls to the structure have to be evaluated. If the existing anchorage of the walls to the structure is deficient, the tops of the masonry walls will require new connections to the structure.

Additions

Any proposed additions would be designed structurally independent of the existing structures, thus, they would not impart any additional lateral loads on the existing structures.

Comment

The compliance requirements of the two methods, in most respects, are very similar. The Prescriptive Compliance Method would require that the existing lateral load resisting systems meet the requirements of the Code for New Construction of the IBC, even for small increases of design lateral loads. The requirements of both methods will require anchorage of all existing masonry walls. Based on this, we would recommend the Work Area Compliance Method for the project.

SUMMARY

The existing school structure appears to be performing well. All of the structural components that are visible appear in sound condition.

We observed significant effervescence in the pool crawl space walls as well as severe corrosion of the metal deck which supports the slab around the pool. Further investigation will be required to verify the extents of the corrosion to the deck and to determine whether or not the deck is an integral component of the slab. An investigation will be required to determine whether the concrete slab and walls have been compromised by the chlorine from the pool water.

The settlement of the slab on grade in corridor D-116 is not a structural concern

Any proposed major renovations or additions would likely require that the structure be updated to meet the code for new construction. This may require the addition of some shear walls, connecting the floor and roof diaphragms to the existing masonry walls, clipping of non-structural masonry walls to the structure. All of the existing masonry walls would have to be adequately connected to the roof and floor structure.

The bleacher structure is in fair condition, the main structure needs to be wire brushed to remove all the surface rust and painted. The column bases have to be reinforced and repaired due to the delamination of the steel. The press box structure is in fair condition, the connection of the framing members and the floor need to be reinforced with supplemental connectors.

SCHEME 0 – Base Renovations
STRUCTURAL

PROPOSED SCHEME O – BASE RENOVATIONS

Structural: Designed in accordance with the 9th Edition of The Massachusetts State Building Code and incorporating IBC 2015 with Massachusetts amendments.

The proposed scheme will require repairs, renovations and upgrades to the existing school triggered by requirements for compliance with the International Existing Building Code. All of the proposed renovations will essentially be Architectural in nature and will require no major reconfiguration of the structure. The scheme calls for filling the existing pool structure, demolition of the concrete bleachers and reconfiguring the spaces in this area. The scheme also calls for reconfiguration of some of the demising walls in other parts of the school for expanding the classrooms. The proposed scheme requires replacement of all mechanical equipment, renovations related to ADA requirements and the addition of a vestibule.

PRIMARY STRUCTURAL CODE ISSUES RELATED TO THE EXISTING STRUCTURE

Based on the proposed scope, we would recommend following the compliance requirements of the Work Area Compliance Method since it will be the most cost effective method for this proposed scheme. Based on the reconfiguration of the existing partitions the work area for the proposed renovations is less than 50% of the aggregate floor area of the building thus there is no requirement for clipping for clipping the tops of the existing masonry walls to the structure.

No other structural upgrades will be triggered, since there are no planned structural modifications to the existing structure.

PROPOSED STRUCTURAL SCHEME

The proposed scheme does not call for any reconfiguration of the existing structure. The structural scope is essentially what is triggered by following the compliance requirements of the Work Area Compliance Method.

We would propose infilling the pool with Geofoam (https://www.geofoam.com/), lightweight fill material that is essentially like blocks of insulation so we can reduce the lateral pressures on sides of the existing pool walls and top it off with 5” thick concrete slab on grade reinforced with WWF, 6x6, W2.1xW2.1.

Demolishing the concrete bleachers would be trickier as the bleacher structure braces the top of the concrete wall at the interface with the masonry wall. We would propose constructing 12” thick reinforced concrete slab spanning between the exterior concrete slab and the interior tunnel wall (basement wall) at the deck level reinforced with #5 @12” on center each way, top and bottom. In addition allow for HSS 12x12 structural steel girts or cast in place concrete beams spanning along length of the wall at the interface of the existing concrete wall and the masonry wall at top of the existing bleacher structure.

SCHEME 0 – Base Renovations
STRUCTURAL

Based on the scope of the proposed scheme, no structural upgrades are triggered or required. Due to the limited proposed reconfiguration of spaces the work area for the proposed renovations will be less than 50% of the aggregate floor area of the building and there is no requirement to clip the tops of existing masonry walls. We would recommend that all existing masonry walls be clipped to the structure to mitigate this seismic hazard. The replacement mechanical units can be supported on the existing framing, if the proposed units are lighter in weight than the existing units. Some of the mechanical equipment may be required to be supported on dunnage platforms. Allow for costs for reinforcement of the roof structure as a percentage of the cost of the mechanical units.