YODER + TIDWELL, Ltd.
Architects and Engineers

February 16, 2012

Ashley Prester
Durkee, Brown, Viveiros & Werenfels Architects
111 Chestnut Street
Providence, RI 02903

Re: Gates Middle School – Scituate, MA
Structural Observations on 1-13-2012

Dear Mr. Prester,

At your request, I met with you on January 13, 2012 to make a structural assessment of the existing building located on First Parish Road in Scituate, Massachusetts. The building currently serves as the Middle School for the Scituate School Department. The focus of this structural assessment is on the three central portions of the building. This includes the original building constructed in 1917, the adjacent east classroom wing constructed in 1931, and the west gymnasium/auditorium wing also built in 1931. This west wing was renovated in 1974 and the gymnasium was converted to the current Resource Center and a second floor added to create the current Learning Center and additional classrooms. My assessment consisted of a walkthrough of the building, including attic and basement spaces, and visual observation of any exposed structural conditions. I have also reviewed the construction drawings from the 1931 additions as well as the 1974 renovation. No drawing information was available for the original 1917 building. The following report summarizes the results of my observations, identifies the primary structural deficiencies that were observed, and provides a general recommended course of action.

1.0 General Building Observations

1.1 Original Building (1917)

The original building constructed in 1917 is a three story structure. The lowest level is partially below grade (referred to as the ground level) leaving just two and a half stories of building exposed above grade. Nearly all of the structural framing is concealed behind finish materials. However, from my site visit and review of available drawings, it is clear that the structural framing consists of wood framed joists that span in the north/south direction. The joists are supported at the exterior walls and by the two interior bearing walls between the corridor and classrooms. The exterior walls appear to be 12" solid brick masonry and the interior bearing walls are a combination of wood stud in some locations, and solid brick masonry in others. The interior walls that are of brick masonry appear to occur at the locations of the original brick chases, probably for heating and ventilation.

The typical floor joists appear to be approximately 2"x12" and clear span from the corridor wall to the exterior wall. The exception to this is at the first floor level where an additional beam line was added in the boiler room/storage room to reduce the span of the joists. This was probably done to support the loads of the Library which was originally located directly above.

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Subsequently, the Library was moved and this location is the area of the current administration offices.

The roof of the original 1917 building was a flat roof which still remains and can be seen from the attic. The original roof framing was similar to the floors consisting of 2x12 joists spanning from the north and south exterior walls to the same two interior bearing lines. In the 1931 renovation, a gable roof was placed over a portion of the original flat roof. The gable roof extends from the front north wall to the second interior bearing wall on the south side of the corridor. The original flat roof and rafters remain from this wall over to the south exterior wall.

1.2 East Classroom Wing (1931)

This wing of the building was constructed in 1931 and is a three story structure similar to the original building. Nearly all of the structural framing is concealed behind finish materials. However, from my review of the 1930 drawings, the structural framing consists of structural wood decking spanning between 4x12 wood joists spaced at approximately four feet on center. The joists are supported by the exterior masonry walls and by two interior masonry bearing walls. In some areas the joists are supported by steel beams that clear span the classroom spaces. The steel beams are also supported by the exterior and interior masonry bearing walls therefore there are no steel columns in this wing of the building. The exterior walls, along with the interior bearing walls appear to be 12” solid masonry. The type of backup masonry for the face brick (brick, block, or hollow clay tile) is not indicated on the drawings.

1.3 West Wing (1931 Gymnasium/Auditorium)

This wing of the building was constructed in 1931 with the east classroom wing and originally was a two story structure with a Kitchen/Cafeteria on the ground floor and a Gymnasium/Auditorium on the first floor. In 1974, this wing was renovated and the first floor gymnasium/auditorium was changed to the current Resource Center. The balconies and stage were removed and another floor was added to create the current second floor classrooms and Learning Center. Nearly all of the existing structural framing is concealed behind finish materials. However, from my review of the 1930 and 1974 drawings, the structural framing consists of structural wood decking spanning between 4x12 wood joists spaced at approximately 3’-6” on center. The joists are supported by the exterior masonry walls and interior steel beams. The steel beams are also supported at the exterior by masonry bearing walls and at the interior by several steel columns. The first floor originally had only four interior columns and the roof beams clear spanned over the gymnasium/auditorium space. When the second floor Learning Center was added, additional columns were added on the first floor to support the new second floor. The roof continues to clear span as before allowing the Learning Center to be mostly column free. The exterior walls, along with the interior bearing walls appear to be 12” solid masonry, except for the original two story auditorium/gymnasium space which has 16” thick walls. The type of backup masonry for the face brick (brick, block, or hollow clay tile) is not indicated on the drawings.

2.0 Observed Structural Deficiencies

Because almost all of the structural elements are concealed by finish materials, the number of structural deficiencies that were observed during my site visit is very limited. The deficiencies listed below do not include those items that may be required for any potential future renovation or change of use to the building. Those structural issues will be identified in a separate study and report. The deficiencies listed below are those items that in my opinion will eventually require repair for the continued use of the building regardless of any major renovation or change of use.

2.1 Snow Drifting on Existing 1917 Roof Joists

When the gable roof was constructed over the existing flat roof in 1931, it created a significant potential increase for drifting snow load on the adjacent existing flat roof joists on the south side of the building. Along the west edge of this roof there is also a vertical projection created by the elevator mechanical room that was added with the 1974 renovation (See Photo 2.1). This vertical wall also creates the potential for significant localized drifting snow. Based on my observation of existing conditions and my review of the structural drawings for the 1931 and 1974 renovations, the additional drifting caused by these two conditions does not appear to have been addressed. In many cases, older codes did not address drifting conditions at all. Based on the current code, the additional drift potential is approximately 50 pounds per square foot above and beyond the base design snow load requirement of 35 pounds per square foot. This creates an increase in stress on the existing flat roof rafters of nearly twice the allowable in the area immediately adjacent to the mechanical room projection.

This condition is very significant structurally and so it is my recommendation that this portion of the roof framing be reinforced by sistering each of the existing rafters with 2x12 LVL’s. This work should be done regardless of any future renovation to the building. Until this work has been completed, the snow should be removed from the lower roof during the winter so that the depth of snow on the existing flat roof never exceeds 12 inches.

2.2 Cracks in Southwest Stair Walls of West Wing

Several significant cracks were observed in the interior masonry walls of the southwest stair. The cracks varied in thickness from hairline to approximately ¼” in thickness. In some areas, there has been out of plane movement on opposite sides of the crack (See photos 2.2a and 2.2b). There are a couple of possible causes for these types of cracks. The diagonal cracking could be the sign of differential settlement. However, there do not appear to be any other typical indicators that settlement is a problem in the building. Also, settlement typically occurs early in the life of the building and these cracks appear to be much more recent. Settlement cracks also are not typically out of plane. Based on this, it is my opinion that the more likely cause of these cracks is that they are result of water infiltration into the wall. With this type of solid masonry wall, water infiltration can cause severe damage. If the water gets trapped and freezes, it causes the walls to crack and push out resulting in out of plane movement. It appears that the most likely entry point for water getting into the walls was with the original belt course detail near the top of the wall. This was removed and replaced during the most recent façade renovation and so it is likely that previously deteriorated belt course was allowing water into the wall. The cracks above the entry door are most likely related to failure of the flashing over the entry canopy roof which was also repaired during the 2006 façade renovation.

It is my recommendation that the masonry walls in this stair be repaired by removing localized portions of the cracked interior face and reconstructing. These existing conditions do not represent a severe structural deficiency, but something that should be addressed within the next couple of years.

2.3 Deteriorating Lintels

During the 2006 exterior renovations that were made to the building, many of the original exterior lintels over windows were replaced with new galvanized lintels. However, it was noted during my site visit that there were many existing lintels that were not replaced as part of this work. The original lintels are not galvanized nor painted (See photo 2.3). The lintels over these windows are currently exposed bare steel and will deteriorate over time if left unattended.

It is my recommendation that these lintels at the very least be cleaned and painted. Eventually, they will need to be replaced with galvanized steel angles. The existing lintel conditions do not represent an immediate structural deficiency, but something that should be addressed within the next couple of years.

3.0 Existing Floor Loading

As part of my assessment, I have performed a very general structural load analysis of the existing framing for the building. My analysis was based on observation of the limited visible areas of the structural framing as well as the information available on the construction drawings. Since most of the framing is not visible, my load evaluation is based on typical framing conditions. It is also based on members and connections that are assumed to be in sound condition and does not consider deterioration or damaged members. Based on my observations, review of the original drawings, and subsequent analysis, the following are the approximate live load capacities of the typical structural elements. See the attached analysis sheet at the end of this report.

3.1 Floor Live Load Capacity Summary

Original Building (1917)
- Classroom Floor = 40 psf
- Corridor = 80 psf
- Original Library Floor = 150 psf
- Flat Roof = 35 psf

East Classroom Wing (1931)
- Classroom Floor = 40 psf
- Corridor = 80 psf
- Flat Roof = 40 psf

West Wing
- First and Second Floor (including corridors) = 60 psf
- Roof = 40 psf

4.0 Recommendations

Based on my observations, the general overall structural condition of the building is satisfactory with the exception of the structural deficiencies noted in Section 2.0, and therefore is reasonable for the building to continue to serve its current use. The structural deficient items should be addressed as recommended in this report. It should be noted that future renovations and repairs (for example putting a new roof on the entire building) could also trigger other code required improvements that are not part of this report.

5.0 Limitations of Report

The conclusions and recommendations contained in this report are based on observation of those structural items that were visible at the time of my visit. It is also based on building conditions that existed at the time of my observation. This report is limited to that which could be reasonably assessed from visual observation alone. No detailed survey or probing was made of all structural joists, beams, and columns or all structural conditions. Due to finished ceilings in walls in most of the spaces, and limited access to some areas, many structural elements and conditions could not be observed.

If you have any questions or need any additional information in regards to this report, please contact this office.

Sincerely,

Loren Yoder, PE
President
Yoder + Tidwell Ltd.

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Photos of Deficiencies

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Photo 2.1 – Snow Drifting caused by Sloped Roof and Elevator Mechanical Room

Photo 2.2a – Out of Plane Crack in Southwest Stair Wall

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Photo 2.2b – Out of Plane Crack in Southwest Stair Wall

Photo 2.3 – Unpainted Lintel

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Analysis of Selected Members

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Gates Middle School
Scituate, MA
Typical Framing Member Capacities

	Typical Floor Joist (1917 Building) at North Classrooms	Typical Floor Joist (1917 Building) at South Classrooms	Typical Floor Joist (1917 Building) at Corridor	Typical Floor Joist (1917 Building) at Previous Library	Typical Roof Joist (1917 Building) at North Flat Roof	Typical Floor/Roof Joist (East Classroom Wing)	Typical Corridor Joist (East Classroom Wing)	Typical First Floor Joist (West Wing)	Typical Second Floor Joist (West Wing)	Typical Roof Joist (West Wing)
Joist Width (in)	2	2	2	2	2	3.5	2.5	3.5	1.5	3.5
Joist Depth (in)	11.5	11.5	11.5	11.5	11.5	11.5	9.5	11.5	11.5	11.5
Span (ft) =	22.50	24.50	14.00	12.25	24.50	16.00	9.75	18.00	18.00	18.00
Tributary Area (ft) =	1.33	1.33	1.33	1.33	1.33	3.75	3.75	3.00	1.33	3.50
Sx (in^3) =	44.08	44.08	44.08	44.08	44.08	77.15	37.60	77.15	33.06	77.15
Ix (in^4) =	253.48	253.48	253.48	253.48	253.48	443.59	178.62	443.59	190.11	443.59
E (psi) =	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000
Fb (psi) =	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450
Deflection ratio limit, L/	360	360	360	360	360	360	360	360	360	360
Deflection limit (in) =	0.75	0.82	0.47	0.41	0.82	0.53	0.33	0.60	0.60	0.60
Allowable Moment (ft-lbs) =	5,327	5,327	5,327	5,327	5,327	9,322	4,544	9,322	3,995	9,322
Stress										
Maximum Allowable Linear Load (plf) =	84	71	217	284	71	291	382	230	99	230
Maximum Allowable Uniform Load (psf) =	63.3	53.4	163.5	213.5	53.4	77.7	102.0	76.7	74.2	65.8
Deflection										
Maximum Allowable Linear Load (plf) =	56	43	233	347	43	273	485	192	82	192
Maximum Allowable Uniform Load (psf) =	42.1	32.6	174.9	261.1	32.6	72.7	129.4	63.9	61.7	54.7
Actual Forces										
DL (psf) =	15	15	15	20	15	15	15	15	15	15
LL (psf) =	40	40	100	50	35	40	80	60	60	35
TL (psf) =	55	55	115	70	50	55	95	75	75	50
Uniform Line Load (plf) =	73	73	153	93	67	206	356	225	100	175
Moment (ft-lb) =	4,629	5,489	3,747	1,746	4,990	6,600	4,233	9,113	4,040	7,088
Stress (psi) =	1,260	1,494	1,020	475	1,358	1,027	1,351	1,417	1,466	1,102
Stress Unity =	0.87	1.03	0.70	0.33	0.94	0.71	0.93	0.98	1.01	0.76
Deflection (in) =	0.979	1.376	0.307	0.109	1.251	0.403	0.239	0.705	0.729	0.548
Deflection Ratio L/	276	214	548	1343	235	476	490	306	296	394
Deflection Unity =	1.305	1.685	0.657	0.268	1.532	0.756	0.734	1.175	1.215	0.914
Reaction (pounds) =	823	896	1071	570	815	1650	1737	2025	898	1575

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