February 4, 2020

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To: Matthew Mendisco  
Town of Hayden  
Hayden, CO

Re: Structural, Electrical, and Mechanical Engineering Report on Recommendations  
for Reusing the Existing Hayden High School  
495 Jefferson Street  
Hayden, CO

I. Introduction
Per your request we have prepared this engineering report regarding the structural, electrical, and mechanical issues for salvaging and reusing the existing Hayden High School. It is our understanding that the Town of Hayden has purchased this building with intent to serve multiple uses. These include gymnasium recreational facilities, a children’s day use program, theater, community meetings, and office space. A portion of the existing building consisting of the middle and grade schools will be demolished. The remainder of the building which includes the high school classrooms, gymnasium, library and theater will remain. The existing mechanical and electrical rooms will also remain.

II. Background
This report addresses the recommended modifications and the adequacy of the existing systems to continue in service with deferred maintenance. Our initial assumptions for this contract were that no system upgrades or design drawings would be required from our Office. The building was assumed to be structurally adequate and only demolition would be required. The existing mechanical and electrical systems were assumed to be adequate; the partial demolition would result in a reduction in the square footage that these systems would serve and the parts servicing the demolished areas would simply be blanked off or removed. All installation, testing and service requirements would be provided through shop drawings and service documents which would be provided by the Contractor and approved by an engineer. These assumptions are still valid and form the basis for the material presented in this report.
Two site visits were performed prior to our work on this report. In addition to our site observations the deficiencies noted in the CDE School Assessment Report dated 3/9/2015 are also addressed.

III. Structural Recommendations
This section outlines the recommended repairs to the building structure, with the exception our recommendations for the ceiling and roof. The ceiling and roof are addressed in Section V.

We do not expect the demolition of the middle and grade schools to affect the existing structure that is to remain. We recommend that the existing electrical and mechanical rooms remain in place. The proposed demolition would occur just beyond these rooms. No bearing walls will be impacted. The severed hallway will need a closure wall which may require a doorway. Metal stud construction would likely be the most economical solution for the closure wall due to its strength and longevity.

The cracked masonry block walls in the main building should be repaired. This deficiency is identified in the CDE report. A standard injection product may be used to fill in the cracks. Any blocks that are found to be damaged should be replaced with new blocks that are dowelled into the existing wall with the cells fully grouted. A fill hole and weep hole will likely be required to do this.

We do not recommend any other structural work at this time with the exception of the roof and ceiling repairs which are covered in Section III. In general the structural system is functioning adequately and most of the components have a service life of 100 years. We recommend that the Town monitor the structure for any changes in the future. To accomplish this all of the structural components that are currently exposed as well as those uncovered in the future should be photographed. An archive should then be created so that any changes in the structure can be identified and addressed. It is possible that while performing other work on the building that additional deficiencies will be discovered. Our Office should be notified of any additional deficiencies that are discovered now or that might be discovered in the future.

A Building Code analysis will likely be needed to assess any egress requirements, fire walls, or fire prevention systems that might be required. These are outside the scope of our structural, electrical, and mechanical engineering contract. We are working with an architectural subcontractor that can address these items if needed.

IV. Electrical Recommendations

A. Option 1
The electrical distribution system is functioning adequately but is beyond its service life. We believe that it is feasible to remove the disconnect levers and wiring from the main panel and blank off the open spaces that remain, and then remove all of the electrical
components that service the portions of the system that are being demolished. The resulting load demand on the system would be lower than the current condition and there would be additional capacity should it be desirable to add equipment in the future. All obsolete wiring and components would be removed and all openings capped, blanked, or otherwise sealed off. Additionally we would recommend that an electrician inspect and test all of the lighting, wiring, subpanels, circuit breakers, and other components in the system. Anything found to be deficient or defective should be repaired or replaced.

B. Option 2
While Option 1 is feasible, our preferred recommendation is to replace the main electrical service, main panel and the feed wiring due to their age. We also recommend replacing all of the circuit breakers in the subpanels. The CDE report indicates that the portion of the system in the main building has a 30 year service life which expired in 1988. The gymnasium addition was done later but we believe that it makes sense to replace all of the circuit breakers at this time. We make this recommendation based on:

1) General Safety - The electrical service and main panel are the primary protection elements against short circuits that may occur at the feed lines, subpanels, and other components located downstream.

2) Deferred Maintenance or Replacement - At some point parts of the system will fail and will need to be replaced. This could occur at a time that is disruptive to scheduled events. At some point these components will need to be replaced completely.

3) Cost Savings - There would be expenses associated with removing and blanking off the components servicing the portions of the system that are being removed and also for inspection and testing the portions that are to remain. There would also be expenses for any future repairs or maintenance. At some point the components will need to be replaced either due to failure or unavailability of the old parts. The money spent in deferring the replacement is a lost investment; it only buys time. Additionally there is likely to be cost inflation. Wiring prices, panels and metal enclosures continue to rise as metals become more expensive. We expect that it will never be less expensive to do than it is now.

4) Additional Capacity - The replacement system could be designed to accommodate additional power for window air conditioning, office refrigerators, etc.

5) Affordability – The CDE report estimated the replacement of the service and main distribution at $154,812. The estimated cost does not seem excessive for these gains. We note that the report was prepared in 2015. The cost has likely increased since then and will continue to do so in the future.

The CDE report recommended replacement of the entire electrical system in the main building at a 2015 estimated cost of $912,952. However we feel that simply replacing the old circuit breakers and having the electrician inspect and test all of the existing lighting, wiring, panels, and components and then replacing only those necessary would be a cost effective alternative. With the new circuit breakers installed there would be a
safety mechanism in place to protect against any short circuit in the lighting, branch wiring or components downstream of the individual circuit breakers and subpanels. The proposed new main panel will have new disconnects protecting the individual subpanels and the feed wiring to them. The existing lighting, wiring, panels, and other components should all be inspected and tested by an electrician. Anything found to be deficient or defective should be replaced or repaired.

C. Option 2 Additional Item to be Considered
Replacement of the existing lighting to LED should also be considered due to

1) Cost savings in utilities.

2) Maintenance of the old lighting such as ballasts and bulbs.

3) Increased safety and reliability as noted below.

D. Option 2 Benefits
We feel this proposal (Option 2) is an acceptable compromise between the CDE recommendations of full system replacement and simply removing the components serving the areas that are to be demolished (Option 1) because:

1) Greater Safety than Option 1 – There would be adequate safety mechanisms to provide short circuit protection between both the main panel and the individual subpanels and between the subpanels and components downstream.

2) Increased Reliability over Option 1 – The replacement of the main panel and circuit breakers in the subpanels will result in greater reliability and lower the chance of failure.

3) More Cost Effective than CDE Recommendation – The electrician would inspect and test the wiring and components and only those found deficient or defective would be replaced. Based on the complete replacement recommendation from the CDE estimate which done in 2015, this proposal could save in excess of $1,000,000.

3) Less Chance of Disruption for Failure or Maintenance – If the main panel were to fail this might require shutting down the entire system at an inopportune time. By replacing the main panel we would not expect a failure there for the duration of its service life. The new main panel will have disconnects for the individual subpanels so that they can be isolated without affecting the rest of the system. The new circuit breakers will protect all of the branch wiring and provide isolation of each individual branch circuits so that work can be performed without shutting down an entire subpanel.

4) New LED Lighting (if implemented): Safety, Reliability, Disruption Concerns – Short circuits and burnout are more likely to occur in the old lighting fixtures than in new ones. Replacement of the existing lighting with LED lighting would improve safety, reliability, and reduce potential disruptions. There will also be cost savings in operation and maintenance.
V. Mechanical System & Roof Insulation Including Roof and Ceiling Repairs

A. Mechanical System, Roof Insulation and Ceiling Tiles
The existing heating system utilizes two boilers located in the mechanical room. Hot water is supplied to the individual radiators that are located in each room and there is a cold water return system to the boilers. There are seven air handlers in the main building and four air handlers in the gymnasium area. (Additionally there are three air handlers in the middle and grade schools that will be removed.) There is no air conditioning system.

The supply air is accomplished through a system of supply ducts that run through the space between the dropped ceiling tiles and the roof deck. The supply ducts feed vents located in the ceiling of each room. There is no duct system for the return air. The space between the dropped ceiling tiles and the roof deck acts as a plenum for the return. There are vents in the ceiling of each room feeding the return plenum. The air handlers draw air from the plenum creating negative air pressure in this area. This in turn draws air from the ceiling vents in each room into the plenum.

The main building has no roof insulation. The only insulation is in the dropped ceiling tiles which are 2” – 3” thick. These are the existing white ceiling tiles that are visible throughout the building. This means that the space above these tiles which functions as the return air plenum and also has the supply air ducts running through is not tempered. In the winter this area is colder than the room below; then in the summer it is hotter than the room below. This tempers the circulating air in the opposite direction than is desired. In flowing through this un-insulated area both the return air and supply air are cooled to below room temperature in the winter so that cold air is blown into the room below. In the summer the circulating air is heated to above room temperature and hot air is blown in.

It is our understanding that there have been problems in the past regarding the temperature during the cold and hot times of the year. This corresponds with the lack of roof insulation which creates a non-tempered area in which the air circulation system passes through. As such we have examined the possibility of insulating the roof so as to temper this space. The intent is to keep the temperature in this area closer to the temperature of the rooms below and further from the exterior temperature at the roof surface. This would make the air supplied into the room warmer in the winter and cooler in the summer, which is the desired effect.

In addition to acting as the return air plenum and housing the supply air ducts, the space between the ceiling and roof decking is also where the structural trusses supporting the roof are located. Therefore insulation cannot be placed along the top of this area. The only realistic option is to install the insulation over the existing roof.

The current Commercial Energy Code requires a minimum R-35 insulation at the roof deck. A heat calculation was performed using the HVAC-CALC software analysis program. Based on this analysis it was our determination that with the addition of R-35 insulation at the roof the existing heating system can maintain an indoor temperature of
68° F when the outdoor temperature is -10° F. If R-48 insulation were installed this would allow an indoor temperature of 70° F to be maintained. It was also determined that the room temperature will be 5° F cooler in the summer with the R-35 insulation, and 7° F cooler with R-48 than in the current condition.

These results assume removing the portion of the heating and circulating air systems that serve the area that is to be demolished, leaving the remainder of these systems as-is, adding only insulation at the roof. Additionally any damage in the dropped ceiling would need to be repaired in order to maintain integrity of the return air plenum. Testing and balance of the final system would also be required.

The absolute temperature in the summer could not be precisely determined as it depends on a large part of the actual operation and usage. The air in the rooms and in the plenum space will be cooler at night but will heat up throughout the day. Keeping the cool air inside for as long as possible and limiting its warming may involve closing the windows and adding shades to the windows. The effect of these variables could not be predicted exactly. However it is certain that insulating the roof will keep the area above each room significantly cooler than in the current condition, and as a result the air blown into the rooms will also be much cooler.

With this work we believe that the room temperature in winter will be acceptable and the temperature in the summer will be greatly improved. If additional cooling is desired we would recommend adding windows or window air conditioning units. In our opinion this would be the most cost effective option. It is noted that the building was not intended for summer use and that adding central air conditioning is thought to be cost prohibitive.

To summarize, we believe that the existing mechanical system is adequate for heating the proposed building which will be reduced in size due from the partial demolition; however roof insulation and repair of the damaged ceiling tiles are needed to make this work. If the ceiling tiles are to be removed then a system of return air ducts will need to be added. Testing and balance of the final system should be performed to provide optimal performance.

B. Additional Issues that will be Addressed
The existing roof and ceiling have other problems as well. There are reported leaks, ice dams, and drainage issues in the roof and damaged tiles in the ceiling. In conjunction with adding insulation for heating and cooling, the rework done on the roof and ceiling would provide opportunity to address these other issues as well. These would include:

1) The roof coverings are beyond their service life which expired in 1978.

2) The roof openings are beyond their service life which expired 1988.

3) The ceiling finishes are beyond their service which life expired 1978.
4) There is inadequate drainage for the water that accumulates on the roof and there are ice dam buildups at the roof edge.

5) Testing and balance of the mechanical system needs to be done.

C. Recommended Actions
Based on these considerations our recommendation is to remove the portion of the existing mechanical system that serve the areas that are to be demolished and leave the remainder of the existing system in place. Work should be performed on the roof and ceiling to provide insulation and to address the other related issues.

A detail of the proposed roof insulation that is to be added on top of the existing roof is shown in Figures 1 and 2. The work needed for this would be as follows:

1) Remove the existing gravel ballast as best as possible, leaving the built up roofing membrane in good shape. This will serve as a moisture barrier in the system.

2) Mechanically fasten 2 or 3 layers of R17.2 polyisocyanurate insulation (5.6” total or 8.4”) and a 1/2” layer of DensDeck protection board to the existing wood roof deck. Two layers of insulation are required for R-35 and three layers are required for R-38 as discussed in Section V.A. above.

3) Adhere 60 mil gray color TPO to the protection board, to be fully adhered.

4) Adhere snow retention devices to the sloped roof areas.

5) Install gutters and downspout to prevent dripping and ice formation. Scuppers may also be used.

6) Any damage to the ceiling tiles should be repaired as well.

7) Testing and balance of the final system should be performed.

The lower portion of the Figure 1 shows the sloped roof which is typical for most of the building. For the flat roof areas a slope should be provided. This can be accomplished by tapering the insulation as shown in the upper portion of the detail. A detail of the roof edge is shown in Figure 2. We do not think that the roof work is required over the gymnasium. This was a later addition and the plans indicate that roof insulation was included. The gutters and downspouts should be added, however, to prevent drip and ice buildup from occurring.

D. Additional Item – Remove Existing Ceiling and Add Return Duct System
Based on discussions at the site trip there is interest in removing the existing dropped ceiling due to its age and appearance. However, because the dropped ceiling is used to create the return air plenum its removal would require the addition of a return air duct system. A return air duct system with no ceiling would be beneficial as this would better
temper both the supply and return air. Under this scenario both the supply and return ducts would be at room temperature, whereas in the configuration proposed the supply ducts and return air would be somewhere between room temperature and that of the roof surface. This is not as bad as it may sound though. Because the new roof insulation has a much greater R value than the existing ceiling tiles the temperature in the plenum will be much closer to room temperature than to that of the roof surface. We believe this idea is both feasible and would lead to better system performance but it would be an additional budgetary item. We recommend doing this if there is money available for it but it is not our top priority.

VI. Conclusion
This report presents our structural, electrical, and mechanical recommendations for salvaging and reusing the existing Hayden High School. Were there no budgetary considerations then ideally we would recommend repair or replacement of all of the issues presented in the CDE report and would add a few of our own. Clearly this is not the case. In recognizing the budgetary limitations we have prioritized our recommendations as follows:

1) **Existing Mechanical System requires Roof Insulation, Roof & Ceiling Repairs to Function Adequately** - Our top priority is the addition of roof insulation and repairs to the roof and ceiling in order to support mechanical system so the building is properly tempered as per Sections V.A, V.B & V.C. This includes addressing the other roof and ceiling issues in those sections including roof coverings, roof openings, roof drainage, ceiling repairs, and testing & balancing of the mechanical system. The system is not performing adequately. The mechanical equipment in place is sufficient in size if the roof was insulated properly and the damaged ceiling tiles were repaired. The roof insulation needs to be placed on top of the existing roof which logically leads to addressing the other roof issues at the same time, such as penetrations, drainage, and ice dams.

2) **Electrical Upgrades are Recommended for Safety and Reliability** – Our second priority is to replace the existing electrical service, main panel, and all of the circuit breakers in the system. Additionally all components should be inspected and tested by the electrician with remedial action taken as needed. This is detailed in Sections IV.B and IV.D.

3) **Structural Repairs are Recommended to Repair Damage to the Existing Block Walls** – Based on our observations we do not feel that these walls are in danger of structural failure so this is not our top priority. However we do recommend that these be repaired to prevent any cracking or damage that might occur. This is discussed in Section III.

4) **Remove Existing Dropped Ceiling and Add Return Duct System** – As discussed in Section V.D, removal of the existing ceiling would necessitate the installation of a return duct system and would bring the air circulation system to room temperature, thereby enhancing the system performance. Moreover the existing ceiling is old and unattractive. Its removal would eliminate any replacement or repair work and would result in a better appearance.
5) **Replacement of the Existing Lighting with LED**
If the existing ceiling is removed as discussed above it is likely that the lighting fixtures will need to be replaced as well. The advantages of replacing the existing lighting with LED are discussed in Section IV.D.

6) **Additional Notes** - Please note that the repairs noted in this section are in addition to those required to execute demolition of the existing building and to provide for closing off the existing systems and provide a complete enclosed structure conforming to the applicable Building Code requirements. These and other efforts are discussed in greater detail in the individual sections that are referenced.

Please contact me if you have any questions.

Michael Ehrlich, president
TYPICAL FLAT ROOF DETAIL

1 1/2" = 1'-0"

TYPICAL SLOPED ROOF DETAIL

1 1/2" = 1'-0"
EXISTING METAL FASCIA TO REMAIN

(2) 2X6 ROOF EDGE

2X6 ROUGH FASCIA

OPTIONAL GUTTER AND DOWNSPOUT SYSTEM

ROOF MEMBRANE WELDABLE SHEET METAL DRIP EDGE

1/2" DENS DECK

2 LAYERS R17.2 POLY ISOCYANURATE INSULATION - OFFSET ALL JOINTS 12" MIN

EXISTING CONDITIONS SHOWN SHADED

ROOF EDGE DETAIL

1 1/2" = 1'-0"

HAYDEN HIGHSCHOOL

Rev: 01/29/20

Scale: 1 1/2" = 1'-0"

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