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Structural Site Visit Assessment Report for Trenton Central High School Trenton, NJ

Final Report – Revision 0

Report Prepared for: New Jersey School Development Authority

Trenton Central High School
400 Chambers Street Trenton, NJ 08609

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1.0 EXECUTIVE SUMMARY

CB&I was contracted by the New Jersey School Development Authority (SDA) to provide a structural assessment for the partial demolition of Trenton Central High School located at 400 Chambers Street in Trenton, NJ. This work is provided in conjunction with CB&I's Subtask order with NJSDA for Site Environmental Consultant and Civil & Structural Engineering Services, Trenton Central High School. This document summarizes the findings and provides recommendations for the partial demolition option activities.

CB&I structural engineers made an initial site visit in May 2014 as part of a pre-demolition survey effort in order to investigate the feasibility of the proposed design approach for the Trenton Central High School project. The design approach presented to CB&I involved retaining several areas of Building "A" as well as an option to retain the existing swimming pool within Building "D" (see Figure 1 for existing school orientation and building names). The specific areas proposed to be retained within Building "A" were the existing auditorium, entrance portico, the three story main entry corridor as well as the clock tower (see Cut Line Concept A, Appendix 1). All other areas within the existing school structure were proposed to be demolished.

As a result of that initial investigation, CB&I raised concerns regarding the proposed design approach which included:

- Concerns regarding the observed deviations in construction from what is shown on the available original design drawings.
- Concerns regarding both the temporary and permanent stabilization/support of the structure to remain as well as the potential conflict between the two.
- Concerns regarding the applicable code requirements for the portions of the structure to remain.

Based upon discussions with SDA regarding our concerns from the initial site visit, SDA requested CB&I perform a second onsite structural investigation in July 2014 which is the subject of this report. This second visit included a more detailed and invasive investigation which involved selected demolition activities so additional observations could be made. Furthermore, the second investigation also included consideration for an alternate design approach which proposed for all of Building "A" to remain (see Cut Line Concept B, Appendix 1). This alternate design concept was presented to CB&I by SDA in order to significantly reduce stabilization concerns related to the Concept A proposal.

The second structural investigation assessment revealed the following:

- The actual construction of the existing structure which could be observed varies significantly from the original available design drawings.
- Deterioration of the structure was noted in a number of areas.
- Several structural members are in need of repair/replacement throughout the structure.
- Despite invasive investigations, some elements of the existing structural design remain unclear.
- Some existing construction practices are inexplicable and/or questionable.
- Partial demolition activities required for both design Concepts A and B involve risks to the existing building components to remain.

- Stabilization/support requirements for design Concept A are more complex than originally realized and involve risk to both interior and exterior finishes.
- Design Concept A will most likely require a totally new lateral resisting system involving new columns, beams, foundations, and roof system as well as possible replacement of the existing roof and floor framing elements based on a preliminary review of the structural code requirements (Reference [3]). This would involve demolition of existing finishes throughout the building for installation of new structural elements and involves risk of cracking both interior and exterior existing finishes to remain.
- If triggered by the structural code requirements to substantiate current code mandated live loadings for either proposed design concept, extensive testing and demolition will be required which may or may not provide the required information for analysis.
- Observation of the pool area option to be retained revealed a four foot step down on the east and west sides. The exterior walls to be retained for the pool option are supported above the basement level on beams and do not extend down to the foundation level. Structural elements which resist lateral loads for the pool area are not located within the proposed pool area to remain.

As a result of these observations, CB&I recommends discarding both proposed design concept options as well as retaining the pool area based on the following factors:

- All of the structural concerns which require repair or replacement occur within the footprints of both proposed design concepts. Most notably, the auditorium floor slab exhibits many areas of concern. It appears the cracking which had previously been addressed in 2013 has continued to migrate even after shoring was installed. Additionally, other cracks very similar to the ones addressed in 2013 were observed in our site visit one bay west of the shoring location. Since these cracks were not mentioned in the original report, (Reference 2), we assume these cracks have formed since the installation of the shoring in 2013. The existence of this additional cracking gives rise to concerns regarding the structural integrity and stability of the existing auditorium floor structure.
- The lack of original design information as well as numerous construction deviations poses significant obstacles to obtaining sufficient information to undertake any required structural analysis.
- In the event such necessary information were obtained, the likelihood that such an analysis would confirm that the existing structure meets required code standards is very remote.
- Demolition efforts, let alone stabilization activities, pose substantial risk of cracking within the interior and exterior finishes of the portions of the structure to remain.
- The original structural design layout is not conducive for design Concept A or the pool option. The extent of building to remain does not align with existing columns/foundations, hence existing structural elements would need to be sheared off, i.e., beams and concrete slabs, and new columns and foundations would be required. Installation of these new elements, especially foundations, would require excavation adjacent to existing foundations which could cause settlement and/or destabilization within the existing structure.

2.0 STRUCTURAL SYSTEM DESCRIPTION

2.1 GENERAL BUILDING LAYOUT

The existing structure of Trenton Central High School (TCHS) is composed of six buildings and a separate boiler house building. The original construction, completed in 1932, contains Buildings “A” through “D” as well as the boiler house building. Buildings “E” and “F” were added later in 1956 to be utilized as vocational classrooms. Original design drawings, partial architectural and structural sets dated April 30, 1929 of Building “A” only were provided by NJSDA and compared against existing conditions observed at the site. No original design drawings were available for the remaining wings. The site visit observations centered around Buildings “A” and “D” due to the fact these are the only two wings which are proposed to remain, or in some part remain, within the scope of this report. See Figure 1 for Building locations and designations.

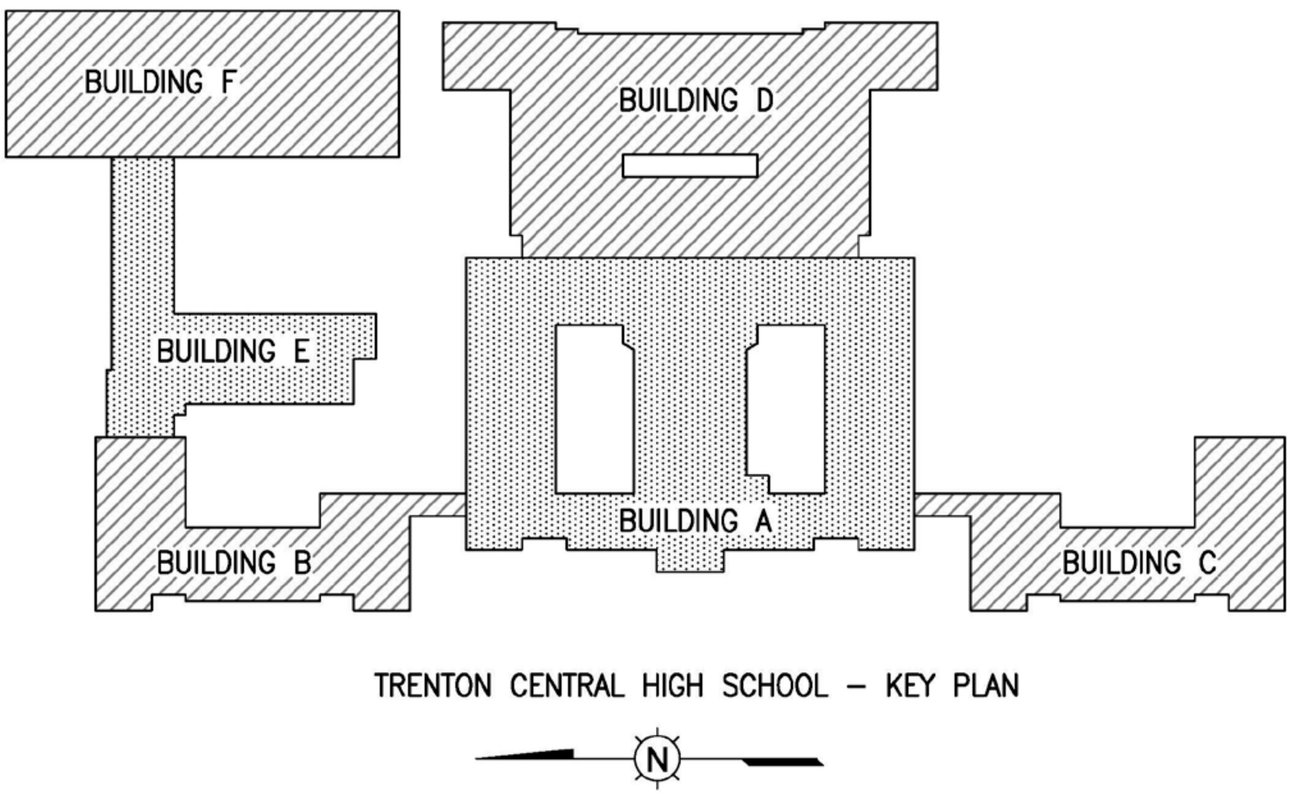


Figure 1

2.2 BUILDING "A" CONSTRUCTION

Building "A" is a four story structure composed of approximately 178,000 square feet of floor area (Reference [1]) with a basement level and three stories above grade as well as a series of service tunnels below the basement level. In addition, Building "A" has a multi-story clock tower located directly over the entry lobby as well as intakes, ventilators and skylights scattered atop the main building roof area. The existing design drawings for Building "A" denote both gabled and flat roof areas utilizing slate and built-up roofing, respectively. The roofing encountered on our site visit was a combination of asphalt shingles for the gable areas with a rubber membrane system utilized for the flat roof areas.

A. Building "A" Roof Framing

The existing structural drawings denote the roof framing to be structural steel comprised of fabricated trusses in the clock tower, auditorium, and balcony areas. These fabricated trusses bear on structural wide flange columns located within the exterior walls. Structural steel wide flange beams and channel sections were utilized as purlin members spanning between the trusses.

The gabled and flat roof sections of Building "A" were shown to be framed with steel wide flange sections for girder, rafter, and purlin members. All interior roof framing members shown on the design drawings are supported by either beams or columns while all members terminating along an exterior perimeter wall are shown to bear on the multi-wythe brick walls. Rolled and straight steel angle sections hung from the main roof framing members supported both rolled and flat plaster ceiling areas throughout the building.

B. Building "A" Floor Framing

The existing structural drawings show the floor framing for the auditorium floor to be a cast-in-place concrete beam system laid out in square grids between concrete columns. The concrete floor system between the concrete beams appears to be a two way concrete flat slab system, however no sections or details are provided on the existing drawings. Other than the auditorium floor framing, all other floor framing appears to be a composite masonry/concrete floor system cast within a grid of structural steel beams encased in concrete. Similar to the roof framing system above, no columns are shown in the exterior perimeter walls, therefore all concrete floor systems as well as the structural steel beams appear to bear on the exterior multi-wythe brick walls.

C. Building "A" Foundation System

The foundation system, according to the existing drawings, is a combination of isolated concrete spread footings supporting the columns and continuous concrete footings supporting the interior and exterior walls. Additionally, portions of the basement area are slab-on-grade while others areas are on a crawl space.

D. Building "A" Lateral Force Resisting System

The existing drawings do not show any vertical bracing or beam to column rigid connections to resist lateral loadings. Additionally, the foundation schedule shows only bottom reinforcing for the footings, hence it appears the foundations were designed for gravity loading only. Based on the proceeding information, the lateral loads imparted to the structure are being resisted by the multi-wythe brick walls which are serving as a shear/bearing wall system for the structure.

2.3 BUILDING "D" CONSTRUCTION

Building "D" is a three story structure composed of approximately 82,500 square feet of floor area (Reference [1]) with a partial basement level and two stories above grade as well as a series of service tunnels at the basement level. In addition, Building "D" has a multi-classroom appendage located directly over the pool roof attaching to the back wall of Building "A" as well as intakes, ventilators and skylights scattered atop the main building roof area. No original design drawings of Building "D" could be located; therefore roof and floor framing systems were identified via visual observation during our site visit either in areas which had no ceilings or through access holes which had been cut prior to our visit. The roofing encountered during our visit consisted solely of a rubber membrane system for both the shaped and flat roof areas of Building "D".

3.0 SITE VISIT OBSERVATIONS

3.1 GENERAL SITE VISIT INFORMATION

The purpose and scope of the site visit was to provide a cursory visual assessment of the current structural conditions of the building as they relate to the portions of the school which are proposed to remain, verify existing drawing information, gather information relating to the structure in areas where no drawings exist, and to determine the feasibility of the proposed design concept options presented in Appendix 1 from a structural and demolition standpoint only.

Prior to the site visit, engineers provided locations along the proposed cut line options so small, selective areas of demolition could occur in order to allow visual observations of both floor and roof framing systems in various locations throughout Buildings "A" and "D". Additional areas were also accessed during the site visit at the engineer's request.

3.2 BUILDING "A" OBSERVATIONS

A. Current Structural Conditions

The following current structural conditions assessment is based upon a cursory visual review conducted in areas where the existing framing was either open to observation or in areas which had been accessed by the selective demolition conducted specifically for the site visit. The assessment is not inclusive of the entire structure due to limits of both time and access of the framing components. An additional constraint which limited the assessment was the concrete encasement of all structural steel columns and beams below the attic level.

Several areas of concern were observed during the time of our visit relating to the structural system of Building "A". These items within Building "A" are summarized below.

General Structural Concerns

- As shown in photograph [1], piping had been originally cast into the bottom of the forms adjacent to the tension reinforcement in two concrete joists supporting the main office room on the first floor. At some point the piping has dropped below the concrete in places along the joist and exposed the reinforcing. The reinforcing has experienced moderate corrosion and does not have bond with the concrete along almost the entire middle third of the span. Additionally, as shown in photograph [2], additional concrete has broken away from the floor joists and exposed the reinforcing for several joists located underneath the principal's office. Although we did not see signs of structural distress in the floor above at the time of our visit, we recommend these areas be repaired to their original capacity or permanently shored if the building is to be reoccupied.
- At two separate locations under the first floor main corridor of Building "A" which runs north and south, access holes in the bearing wall were observed at the junction of the concrete pan and joist system (photograph [3]). It appears the concrete joist do not have a bearing connection to this corridor wall, instead it is believed the reinforcing from the concrete joists penetrate the multi-wythe brick wall and provide a shear connection only to this wall. The reinforcing steel cannot bond with the multi-wythe brick wall and must act as a physical "seat" to support the load from the concrete joist. This reinforcing which is assumed to penetrate into the multi-wythe wall must also serve as a connection for the floor diaphragm to distribute all lateral loads into this wall as well. This particular method of construction causes specific concern due to the past water infiltration problems and possible corrosion of the reinforcing steel. Since the floor construction does not appear to interrupt the multi-wythe brick bearing walls, the only means of support is the aforementioned reinforcing which is assumed to exist at these locations. It is highly unlikely that any type of analysis would reveal the assumed reinforcing to be adequate to resist dead and live loadings, much less transfer lateral loads to these walls.
- Deviations from the original design drawings were noted in various places throughout the structure. The original floor system design shown on drawing S-A-3 indicates a masonry/concrete composite floor system (Figure 2); however a concrete pan and joist system was utilized almost exclusively throughout the structure (photographs [4] and [5]). A concern noted with the pan and joist system is the joists do not appear to bear directly on the concrete encased steel beams. It seems likely that reinforcing steel from the floor system may extend over top of the steel beams, which similar to the condition noted previously, is very unlikely to reveal an adequate analysis conclusion for support of dead and live loadings. A few areas utilized a one way slab with beams such as the auditorium floor and adjacent first floor level rooms to the south (photograph [6]), but the original floor system shown on the design drawings was not observed in any place during our site visit. Furthermore, several steel beams shown on the original design drawings were not installed in lieu of the concrete pan and joist system which runs parallel to the direction of the missing steel beams. This deviation from steel beams to concrete is troubling as it again brings into question the validity of the steel beam locations for the entire building.
- During our site visit we observed several areas where the wall construction was composed of a combination of brick and concrete for no apparent reason. Sometimes

this transition was a horizontal transition while other times it was a vertical transition. This too, served as a deviation from the original design drawings and could pose structural problems.

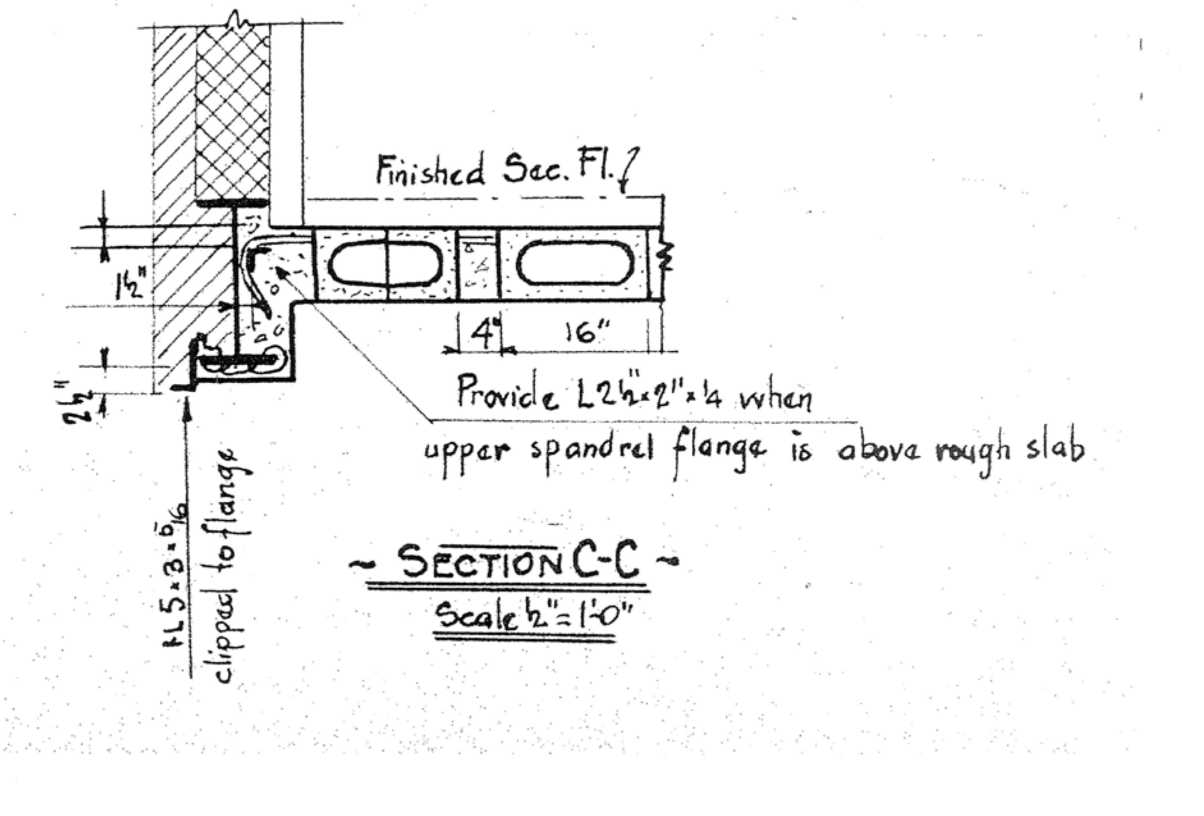


Figure 2

Auditorium Area Concerns

- Underneath the Auditorium floor, we observed the additional steel beams and columns prescribed in the letter by Leonard Busch Associates, PC dated August 26, 2013 and associated drawing, S1, (Reference 2) which was recommended as shoring to stop any further cracking which had occurred in the slab floor (photograph [7]). The crack, viewed from the underside of the slab, initiates on the north side of the auditorium and runs mainly north to south. The crack crosses from one side to the other of the installed shoring and extends down approximately one half of the depth of the joists in several instances (photograph [8]). We only have an approximate location or length of the original crack noted in the letter, however it appears the crack has migrated slightly farther south at the time of our visit. We also observed another crack; very similar in appearance and in location to the beam supports a few bays west of the one which was shored. This particular crack was not identified in the aforementioned letter and we believe it to be a new crack as we observed it as a hairline crack in the floor covering above which was placed after the shoring was installed. The existence of this additional cracking gives rise to concerns regarding the structural integrity and stability of the existing auditorium floor structure.
- A rain water leader along the north wall underneath the auditorium was either clogged or had burst and allowed water to collect on top of the slab-on-grade (photographs [9] and [10]). If the rainwater is allowed to wash underneath the existing foundations, localized settlement can occur. We recommend replacing the rain water leader and clearing of any subgrade clogging which may have occurred should the building be reoccupied.
- One of the concrete joists supporting the auditorium floor just west of the stage area has had a significant portion of concrete spall off of the side and bottom of the joist beam exposing the tension reinforcement as shown in photograph [11]. We recommend this joist be repaired and restored to its original dimensions should the building be reoccupied.
- Spandrel beams running parallel to the south wall of the exterior auditorium wall have exposed reinforcing bars with moderate corrosion in several locations (photograph [12]). At one location along the spandrel beam near a concrete encased steel column, a rainwater leader enters the interior space interrupting the spandrel beam at its connection point to the column (photograph [13]). Although we did not view any structural distress along the spandrel beam at the time of our visit, the original design strength of the spandrel beam has been compromised and will continue to decline as the corrosion of the reinforcing steel increases over time. We recommend relocation of the existing piping and a permanent shoring system be installed underneath this spandrel beam.

- A spandrel beam along the north side wall of the exterior auditorium wall was cut in two by a rain water leader most likely during the initial construction of the building. A crack was observed in the bottom of the concrete floor pan which initiates at the rain water leader interruption (photograph [14]). No apparent distress was noted at the time of our visit; however the crack has migrated from the spandrel beam south through one joist and into the next pan section. We recommend this area be monitored and any further migration of cracking be reviewed for repairs or retrofits.
- Interior water damage was observed in both rear corners of the balcony with the worst damage noted in the northwest corner (photograph [15]). We could not access the structure behind the damaged plaster at the time of our visit; however each area should be investigated for any potential structural damage due to corrosion.

<u>Concept A Structural Concerns</u>

In addition to the “General Structural Concerns” and the “Auditorium Area Concerns”, the proposed Concept A presents the following issues.

- The cut line to keep the Concept A option would involve cutting directly through two 8” steel beams supporting the vault room located on the first floor immediately adjacent to the main office. These beams would need to be supported through the installation of permanent shoring as well as installation of foundations in the unfinished area below the vault space.
- According to the original design drawings, there are no columns located at the Concept A section option high roof area proposed cut lines along the east side at both the north and south ends. The structural steel beams spanning in the east-west direction supporting adjacent roof framing and walls frame into perpendicular steel beams which connect into columns outside of this high roof area. This presents a very difficult situation for support at this cut line location due to the existing wall foundations below as well as the complexity of installing a new column and cutting of the existing beam. Holes would be cut in both the roof and floors in order to allow installation of the new columns. Additionally, installation of new foundations to support new columns in these areas could very well cause instabilities of the existing wall foundations. Any instabilities in these areas could cause cracking of both the interior finishes and the exterior brick façade.
- The two extensions on either side of the Concept A option adjacent to the stage area on the north and south sides which serve as corridors connecting the auditorium floor to the corridors behind the stage area do not align over the existing column grid lines. The line of support for this floor as well as the exterior wall is supported by beams at the level of the cafeteria roof and is ultimately supported by columns outside of the proposed cut lines for the Concept A option. In order to support the structure at this cut line, new columns would need to be installed, existing beams sheared at these columns, as well as the installation of new foundations to support the columns. The existing structure in these areas would need to be temporarily shored prior to performing all of these retrofits before demolition efforts begin. Additionally water damage was observed in the first floor flooring on the south side at the time of our visit (photograph [16]), most likely due to lack of maintenance for the gutter and downspout system (photograph [17]). We did not access the structure in this area however additional investigation should be conducted if these areas are to remain.

- Demolition of the cafeteria is a concern due to the roof framing bears on the north wall of the auditorium. It is recommended to shore the entire roof framing system of the cafeteria near the auditorium wall and carefully cut the framing north of the shoring point. Once the cut has been made, the remainder of this roof framing should be carefully removed from the auditorium wall. The first concern of this three story wall is the possibility of out of plane movement during demolition could cause partial or total collapse of the auditorium wall that is to remain. Secondly, once the cafeteria roof framing is removed, brick will need to be replaced within the pockets where the roof framing had been in order to prevent local areas of collapse in this wall.
- The fan room roofs located on both the north and south sides of the stage area are not supported along column lines. It is unclear as to whether these rooms are proposed to be kept for the Concept A option; however new columns, connections, and foundations would need to be installed for support of these areas if they are to remain. The same complexity of shoring and installation would exist similar to the previous two bulleted areas. Additionally, risks to the interior finishes and exterior façade exist in this area as well throughout the shoring, installation, and demolition phases of the project.

Concept B Structural Concerns

In addition to the “General Structural Concerns” and the “Auditorium Area Concerns”, the proposed Concept A presents the following issues.

- Demolition of the pool area is a concern due to the roof framing bears on the east rear wall of the Building “A”. It is recommended to shore the entire roof framing system of the pool near the rear wall and carefully cut the framing east of the shoring point. Once the cut has been made, the remainder of this roof framing should be carefully removed from the rear wall. The first concern of this three story wall is the possibility of out of plane movement during demolition that could cause partial or total collapse of the rear wall that is to remain. Secondly, once the pool roof framing is removed, brick will need to be replaced within the pockets where the roof framing had been in order to prevent in local areas of collapse in this wall.
- Should renovation of any area in Building “A” trigger requirements to substantiate current code mandated live loadings, extensive testing and demolition will be required which may or may not provide the required information for analysis.

3.3 BUILDING "D" OBSERVATIONS

A. Current Structural Conditions

The following current structural conditions assessment is based upon a cursory visual review conducted in areas where the existing framing was either open to observation (areas without ceilings) or in areas which had been accessed by the selected areas of demolition conducted specifically for the site visit. The assessment is not inclusive of the entire structure due to limits of both time and access of the framing components. An additional constraint which limited the assessment was the concrete encasement of all structural steel columns and beams below the attic level. Furthermore, no original design drawings were available for Building "D", therefore the level of knowledge available for the structural systems utilized was substantially decreased from that of Building "A". It should be noted that while we did perform cursory visual reviews for most of Building "D", our efforts centered around the pool area due to the scope of our report.

Several areas of concern were observed during the time of our visit relating to the structural system of Building "D". These items within Building "D" are summarized below.

<u>General Structural Concerns</u>

- The partial basement level in Building "D" contains the pool walls bearing at approximately 12'-0" below finished grade as well as another level to the north and south of the pool at approximately 16'-0" below finished grade. These two basement areas adjacent to the pool area house pool equipment, large fan equipment, and piping which extends into the tunnel structure below Building "A". The exterior walls on the north and south ends of the proposed pool cut lines do not extend down to foundations. These walls are supported on beams (which we assume are structural steel encased with concrete) which are connected to structural steel columns that are located at the 4'-0" step down in the partial basement area (photographs [18] and [19]). The four foot step down on each side of the pool basement provides a very complex and costly solution for the proposed cut line. The existing walls and wall foundations would need to be removed in order to build a new foundation and shear wall which would meet current code standards. The existing basement walls currently retain fill which may be compromised upon removal of these walls. If sufficient amounts of this fill are compromised during demolition, the existing pool walls could also be compromised.
- Two structural steel columns on the north side partial basement were not encased in concrete and severe corrosion was observed at the junction of the column to the concrete floor (photograph [20]). Although no structural distress was observed at the time of our visit, the load capacity of these columns has been seriously degraded by the corrosion and we recommend either a repair or replacement of these columns should this area of the structure remain.
- We observed several concrete joists to the south of the pool with spalled concrete and exposed reinforcing ranging from light to moderate corrosion (photograph [21]). We recommend these joists be repaired if this portion of the structure is to be retained.

- Several diagonal to horizontal cracks were observed to have been patched along the east wall at the pool itself (photograph [22]). It appears these cracks follow the break in between two subsequent concrete pours when the wall was originally constructed. While we do not have information regarding when the patching took place, some cracks have extended beyond the extent of the patchwork. We recommend additional patching/repair and a monitoring program should the pool remain.
- As we stated previously, no design drawings are available for this wing of the school, however in the south side of the partial basement three different floor framing systems were utilized immediately adjacent to one another. One was the predominant concrete pan and joist system, one was a two way concrete slab, and the third was a waffle slab type construction (photograph [23]). It appears that, similar to Building "A", many deviations were taken from the design drawings during construction of the structure.

4.0 REFERENCES

1. *Final Existing Conditions Assessment Report Building Envelope* for Trenton Central High School by STV Architects, Inc. dated 12/11/2013.
2. Leonard Busch Associates, PC Consulting Engineers Letter to Everett Collins concerning *Crack in Auditorium Floor Slab – Trenton Central High School* dated 26 August, 2013 and associated structural drawing S1 dated 9-19-13.
3. *Uniform Construction Code* – part of the New Jersey Administrative Code, Chapter 23, subchapter 6, 2014 edition.

5.0 RECOMMENDATIONS AND CONCLUSIONS

5.1 GENERAL STRUCTURE CONDITIONS

Several areas and items of structural concern were identified on our site visit and listed within sections 3.2 and 3.3 of this report. Almost all of the items listed in Building "A" are located within the proposed Design Concept A, however they affect both conceptual Design Concept options A & B. One of the most complex areas involves the cracking within the auditorium floor slab which can be observed from both the top and bottom of the slab. As noted in the original report by Leonard Busch Associates, PC (Reference 2), the cracks in the mid span locations indicate tension along the top of the slab which would generally only be present over top of the concrete beam supports. Not only are the original cracks extending beyond their locations as noted in the initial report, similar cracks have formed in a mid span location farther back within the auditorium which needs to be addressed.

Other areas have noted concerns due to damage caused by water infiltration, original construction issues, and previous renovation activities.

The basement areas around the pool area showed moderate to severe corrosion of both concrete reinforcing steel as well as at the base of two structural steel columns. The advanced corrosion in this area may be due to the chemicals utilized for the pool as well as the fact it is a higher humidity area of the building.

Additionally, the concrete has spalled in several locations exposing reinforcing steel which has experienced varying levels of corrosion to date. Left unrepaired, the reinforcing steel will continue to corrode and structural capacity will be further reduced.

Several areas have experienced water damage in the past as evidenced along walls and floor coverings. A new roofing system has been installed; however the guttering system, downspouts, and surrounding soffit areas still appear to be in need of repair and/or replacement. We could not review the structural components surrounding these areas at the time of our visit; therefore we cannot determine the extent of possible corrosion/damage to any adjacent structural members.

In summary, the original building has performed very well structurally considering it has reached a service life of 82 years to date. Little to no visible settlement issues were observed at the time of our visit within Buildings “A” and “D”. With the exception of the auditorium floor and the pool walls, very little cracking throughout these wings were observed; however the structural items of concern noted within the report will only be exacerbated as the service life of the building is extended without proper repairs and attention to maintenance. As noted previously however, the auditorium floor system casts questions concerning its integrity due to the apparent continued cracking within this area. Although we do not know the original structural design parameters of the structural elements due to both deviations from the design drawings as well as a lack of a complete drawing package, several areas of the concrete floor system have experienced significant reductions to their original capacity as noted in this report. Finally, due to incomplete access to the structural elements of the building, other structural issues or concerns may exist which have not yet manifested themselves in terms of visible structural distress in finishes or coverings which still remain.

5.2 CODE REQUIREMENT CONSIDERATIONS FOR DESIGN CONCEPT OPTIONS

A meeting/teleconference was held on August 20, 2014 with the State of New Jersey Department of Community Affairs (DCA) in order to receive an official interpretation concerning our demolition efforts as they relate to the New Jersey Administrative Code, Subchapter 6 – Rehabilitation Subcode (Reference 3). The code reference given to us was cited from section 5:23-6.1(a)2 which states, “Buildings whose use was changed and buildings receiving rehabilitation costing more than 50 percent of the replacement cost of the building were required to comply with all the provisions of the Uniform Construction Code for new buildings.” DCA stated that due to the fact both of our demolition options exceed the 50% limit as stated with the UCC, the portion of the existing building proposed to remain must be brought up to current code provisions. Structurally this would have to be supported by calculations to be provided by the structural engineer.

However, a follow up call to Mr. Jim Strang with the DCA on August 26, 2014 resulted in an alternate final conclusion regarding the code requirements for our demolition options. Mr. Strang stated any portion of the existing building to remain would not be required to meet current code provisions for new buildings unless triggered by specific provisions in chapter 6 of the UCC Rehabilitation Code. All new elements to be designed for stabilization would however need to meet all current code provisions of the 2009 IBC NJ edition. Mr. Strang also clarified that existing elements would not be required to demonstrate their ability to transfer loadings to the new stabilizing elements unless again, those elements were specifically triggered by the UCC Rehabilitation Code to do so.

5.3 SPECIFIC DESIGN CONCEPT AND POOL DEMOLITION CONCLUSIONS & RECOMMENDATIONS

Our recommendation concerning the proposed design concept options for demolition is to discard both options as well as the pool area option based upon the following factors:

<u>Auditorium Floor Concerns</u>

All of the structural concerns which require repair or replacement occur within the footprints of both proposed design concepts. Most notably, the auditorium floor slab exhibits many areas of concern. It appears the cracking which had previously been addressed in 2013 has continued to migrate even after shoring was installed. Additionally, other cracks very similar to the ones addressed in 2013 were observed in our site visit one bay west of the shoring location. Since these cracks were not mentioned in the original report, (Reference 2), we assume these cracks have formed since the installation of the shoring in 2013. The existence of this additional cracking gives rise to concerns regarding the structural integrity and stability of the existing auditorium floor structure.

<u>Live Loading Determination</u>

It is our understanding that any portion of the existing structure to remain may need to comply with minimum code required live loads. Due to incomplete design drawings as well as many deviations observed while onsite, obtaining complete and accurate information required for this analysis appears to not only be infeasible, but maybe impossible in certain cases such as obtaining information pertaining to reinforcing sizes, lengths, and depths both above and below grade. Field investigation techniques such as x-ray analysis *may* provide sufficient information to make these structural analyses possible in many areas; however it is expected the amount of testing required to verify thicknesses and reinforcing throughout the portion of structure to remain would be extensive.

Another area of extreme complexity in obtaining information required for this analysis is the encasement of all the structural steel connections below the attic spaces. Connection plate/clip angle sizes and thickness as well as rivet number and sizes would need to be verified in order to determine adequate live load compliance. In order to obtain access to these encased members, existing finishes would need to be demolished for both the wall and ceiling areas for the entire portion of the structure to remain. Furthermore, if the testing proves sufficient to provide the required information to perform the analysis, there is no assurance the existing floor and/or roof system will meet minimum code parameters. If any structural members are identified which do not meet code minimum live loadings, reinforcement or replacement of these members and their connections would be required.

Lateral Loading Determination

Any new elements installed to stabilize the structure to remain, according to the DCA, would be required to meet current code parameters of the International Building code, 2009 New Jersey edition. These elements would most likely be shear walls to resist both wind and seismic loadings. The risk involved with installation of new foundations is that existing foundation stability could be compromised during the excavation and construction of the new foundations. Any undercuts near the existing foundation could cause settlements which in turn could initiate cracking within the existing walls and finishes.

If the stabilization efforts trigger the existing structure to meet current lateral loadings by the UCC, extensive renovation efforts in both design and construction are expected. The existing shear wall system consists of multi-wythe, unreinforced brick shear walls with no positive connection to the underlying foundations. The only tensile and shear capacity which can be realized from this system to meet current code loading is from the adhesion value between the existing mortar and brick. In order to offset this deficiency, a new lateral load resisting system would need to be installed throughout the structure to remain. This would allow the existing exterior walls to act only as a façade while requiring a new structural system to resist the lateral loadings of wind and seismic placed on the structure. This new system would most likely consist of new columns, beams, and foundations to be placed just inside the existing walls and integrated with and around existing windows and doors. Penetrations through roofs, floors, and walls would be required for installation. Not only would the installation of this system reduce the current available floor space within the building, it would involve installation of new foundations for this system. The installation of these foundations would necessitate demolition of existing portions of the slab-on-grade in the auditorium and cafeteria areas as well as construction of these new foundations in existing crawl space areas for most of the other remaining structure.

Furthermore, based on our visual observations to date and the amount of information we have from the existing design drawings, the existing roof diaphragm and supporting metal decking is not expected to meet current loading standards in transferring lateral loadings to either the current shear wall system or a new lateral force resisting system. This would most likely incur removal of the entire existing roofing system (roofing, concrete deck, and supporting metal deck).

Pool Area Option

As stated previously in section 3.3, the exterior walls at the proposed cut line of the pool do not extend down to the foundation level on the north and south sides. Presently the lateral stability of the pool area is resisted beyond the proposed cut lines and new elements would need to be designed and constructed in order for the pool area to remain. The difficulty with the construction of these new elements is the location of any new shear walls at the proposed cut lines occur at a step down in the existing structure. A four foot step down occurs on both the north and south sides terminating at a foundation wall which retains fill adjacent to the pool walls. It will be extremely difficult to remove these existing walls without compromising the fill underneath the slab adjacent to the existing pool walls. As mentioned previously, we observed cracks within the pool walls at the time of our visit and any movement created in this area could put these walls at risk. Additionally, construction of the new stabilizing walls involves construction of new foundations. The existing wall foundations are most likely tied together with the existing structural steel column foundations. Should these foundations which support an existing exterior wall be upset during the removal of the other foundations, cracking of these walls could result.

Furthermore, no existing drawings are available for Building “D”. No determinations can be made without extensive field verifications and testing on all structural members as to adequacy for minimum live loadings.

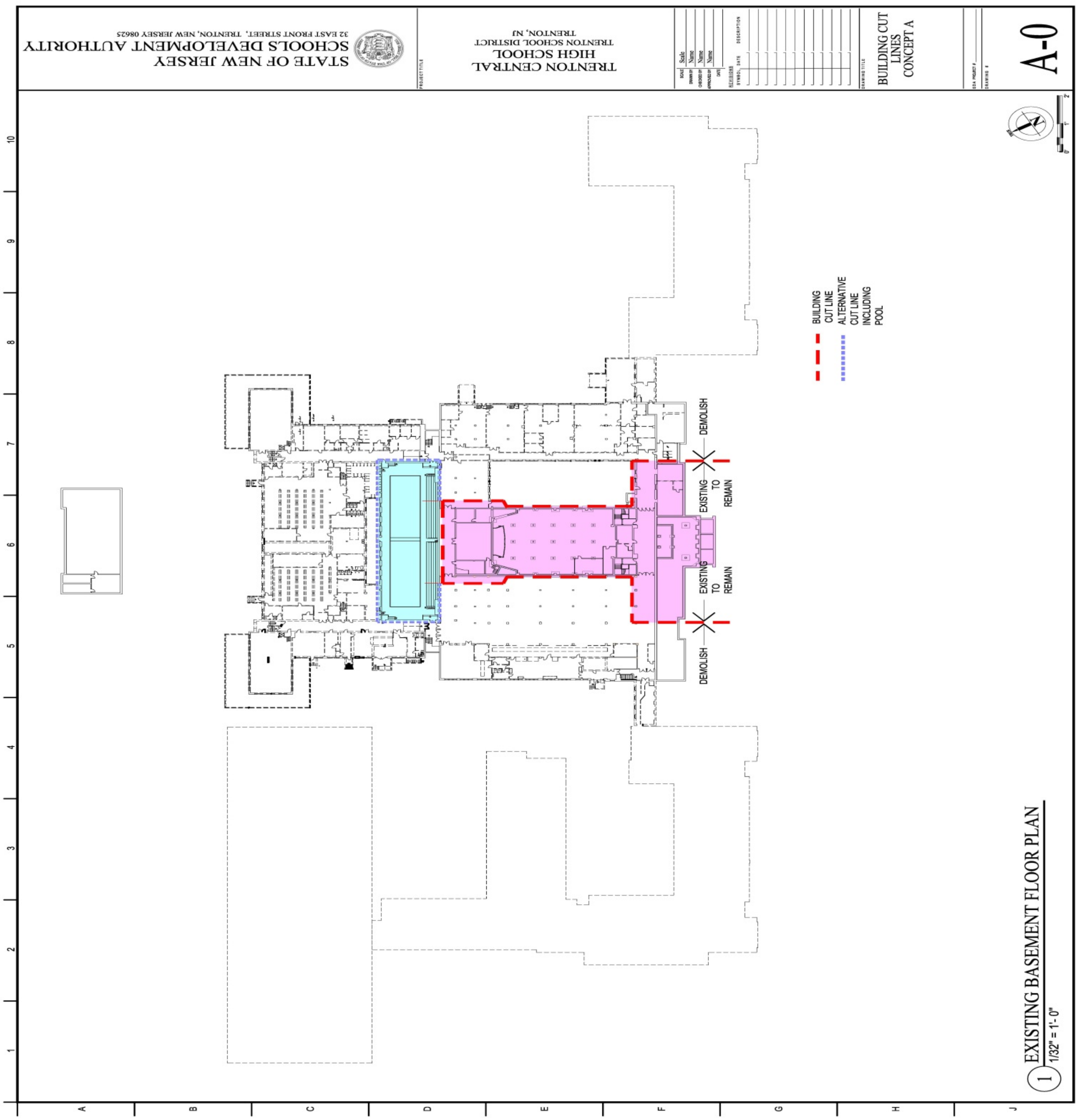
Demolition and Stabilization Risks to the Existing Structure

The demolition and stabilization efforts which must take place with either proposed design concept option as well as the pool option involve risk to the structure that is to remain. The existing multi-wythe brick walls and the interior plaster finishes are very brittle materials which do not tolerate movement well. Existing framing systems to be demolished are pocketed into these walls to remain and any excess movements created during the demolition portion of the framing elements may cause cracking. Additionally, stabilization efforts will involve installation of new foundations adjacent to existing foundation systems. Excavations required for placement of the new foundations could cause slight movements in the existing foundations, therefore potentially causing cracking of the existing exterior and interior finishes to remain.

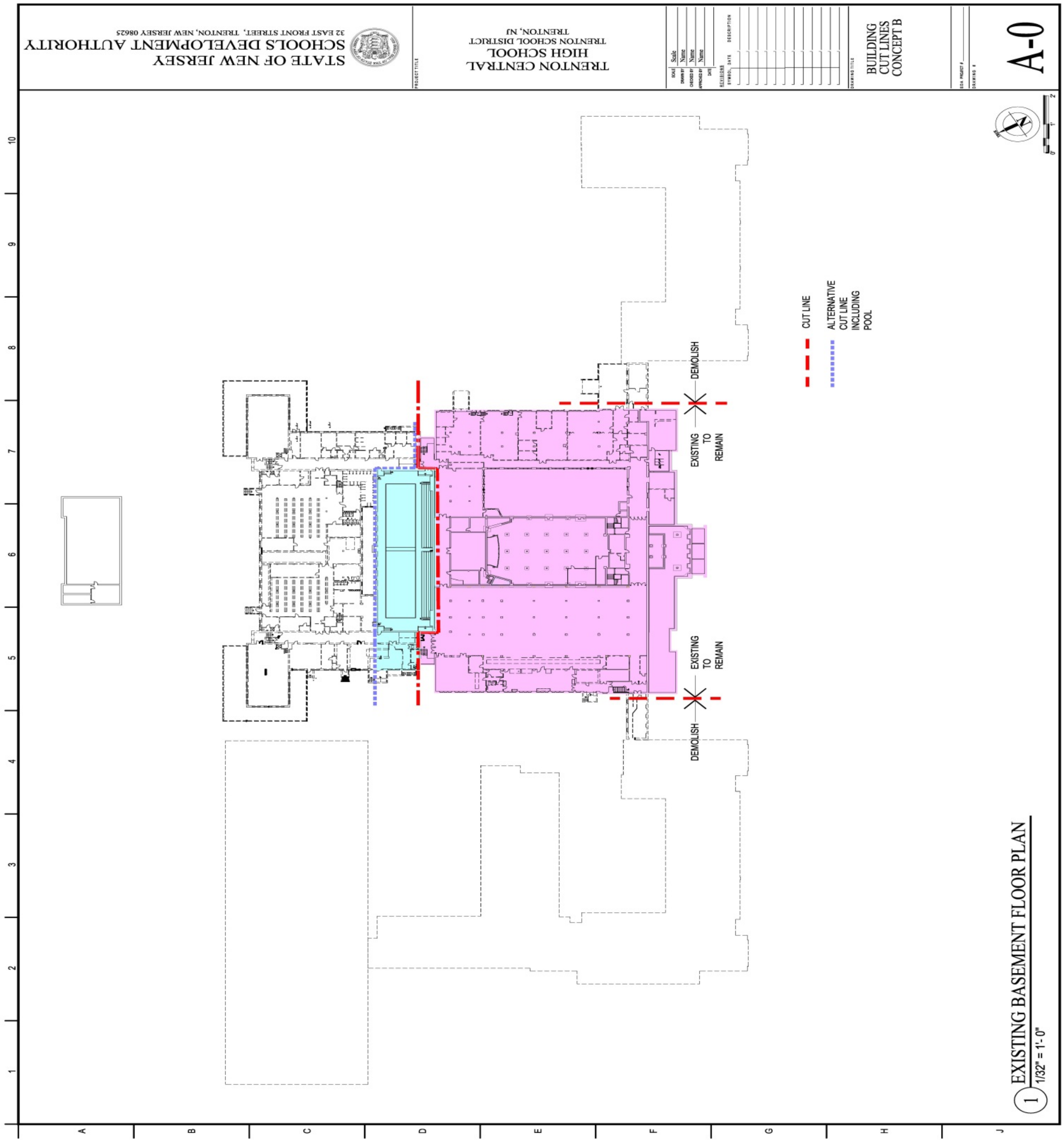
If, despite our recommendations to discard both design concept options as well as the pool option, it is decided to reoccupy the building in the future; all repairs, shoring efforts, and monitoring of the existing structure listed in the report should be addressed prior to re-occupancy. It should be noted, however, that additional elements within the structure may require repair or replacement but were not observed during our visit, and thus are not listed within this report. Lastly, an in-depth study of the auditorium floor should also be conducted to address the apparent on going cracking and adequacy of the existing floor system.

APPENDICES

APPENDIX 1 – Cut Line Concept Drawings



Cut Line – Concept A



Cut Line – Concept B

APPENDIX 2 – Site Visit Photographs

Photograph 1

Photograph 2

Photograph 3

Photograph 4

Photograph 5

Photograph 6

Photograph 7

Photograph 8

Photograph 9

Photograph 10

Photograph 11

Photograph 12

Photograph 13

Photograph 14

Photograph 15

Photograph 16

Photograph 17

Photograph 18

Photograph 19

Photograph 20

Photograph 21

Photograph 22

Photograph 23