DCF Engineering, Inc.

February 13, 2006 06019

Peggy D. Smith
Bath High School Preservation (BHSP)
PO Box 149
Bath, NC 27808

Re: Preliminary Structural Evaluation and
Condition Assessment
Bath High School
Beaufort County
Bath, North Carolina

Dear Ms. Smith:

The purpose of this report is to relate our observations, analysis, and recommendations relating to the structural portion of the proposed work to renovate and restore or adaptively reuse Bath High School. This report is based on our visit and walk through inspection on February 2, 2006 with you and David Sayer.

DESCRIPTION

The existing Bath High School building, built in 1921, consists of two story building with load bearing exterior walls composed of brick masonry. It is a contributing structure to the Bath Historic District listed in the National Register of Historic Places. The overall dimensions of the building are 158'-0" in length and 142'-0" in width, with approximately 16,000 square feet of area on the first floor and 14,000 square feet on the second floor. The interior supports consist of load bearing stud walls with wood lath and plaster and steel pipe columns.

There are eight 2 3/8 inch diameter pipe columns and six 2 inch diameter pipe columns supporting four runs of dropped beams in the Cafeteria which support the second floor. Many areas of the Cafeteria floor have been patched. The Kitchen is framed with steel bar joists supporting a bulb tee and gypsum plank roof. The floor of the Cafeteria and the Auditorium are framed with full dimension 2x10s spaced at 16 inches on center. The Classroom floors are framed with 2 1/4" x 12" deep joists spaced at 14 inches on center. The three stairs in the building are wood framed.

The Auditorium is located on the first floor of one of the two story wings with a stage at the back of the building. The second floor is supported by eight pipe columns and two lines of dropped beams. These lines of support do not align with the second floor corridor walls above. The first floor joists of the Auditorium are supported by 4" x 6" girders which rest on 8 inch square brick masonry piers spaced approximately 8'-0" on center. The proscenium opening above the stage is probably framed with a steel beam based on the location of two 6 inch wide flange steel columns which can be observed in the crawl space. These columns are approximately 28'-0" on center. The crawl space under the Auditorium stage contains considerable debris.

The full dimension 2x6 roof rafters and second floor ceiling joists of the Classroom wings are

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trussed with 1x4 and 1x6 members. These built-up trusses are approximately 24 inches on center. They span the twenty one foot width of the Classrooms and the 8'-7" hall width in the double loaded corridor layout. In general, the Classroom ceilings consist of wood bead board while the ceilings of the halls are plaster.

CONDITION

The condition of the structural system of a building plays a large part in determining whether or not a building can be renovated. The structural system should be the least likely system requiring upgrading. In this case, the structural system consisting of timber floor and roof framing with load bearing exterior masonry walls is in fair condition.

The building was well maintained with little or no cracked masonry or plaster prior to being abandoned. Several roof leaks have caused damage to roof sheathing, trussed roofs, ceiling boards, floor sheathing and floor joists. There are roof leaks in the front of the Auditorium in the Kitchen, in the Second Floor Hall, and in several Classrooms. The steel bar joists of the Kitchen support bulb tees and a gypsum roof which is badly deteriorated in one location. Sheathing, joists, flooring, and ceiling boards have varying amounts of deterioration due to water, ranging from simple swelling and buckling to moderate fungal decay. The masonry walls contain few diagonal cracks due to settlement or vertical cracks due to temperature induced stresses. Some plaster in the building is cracked or missing.

DISCUSSION

As structural engineers, we are expected to limit comments to the structural aspects of the project. But as consultants to architects, familiar with many aspects of building construction, we do a disservice if we do not provide advice in other areas. There is a tendency to use structural deficiencies as the primary reason for demolition or for removing a building from service. Other issues such as fire safety or inadequate mechanical systems or programming inefficiencies may be more critical from an overall cost standpoint.

In some cases, the school planners, town officials, consulting architects or the public may not like the look, or style, of the existing building. Throughout North Carolina, facilities similar to Bath High School are removed from service as schools. They are often successfully renovated for adaptive re-use, indicating the general soundness of these buildings.

Demolition costs include demolition, disposal, and site rehabilitation. Selective demolition, the process of retaining some portions of the existing building prior to renovation, entails additional costs for stabilization, protection, and temporary bracing.

REHABILITATION GUIDELINES

As a possible a certified tax act project, The Secretary of the Interior's Standards for Rehabilitation contains some information worth considering.

Under these standards, rehabilitation means "the process of returning a property to a state of utility, through repair or alteration, which makes possible and efficient contemporary use while preserving those portions and features of the property which are significant to its historic, architectural, and cultural value." Minimum alteration of the building, its environment and its distinguishing architectural qualities are required for a project to qualify as "certified rehabilitation" benefitting from the provisions of the tax act. Archeological resources must be protected as well as significant historical, architectural or cultural material. An understanding of the historical significance of a building must be obtained to enable the planners to provide an acceptable solution to a particular design problem while following the "secretary's standards".

The guidelines for applying the Secretary of the Interior's Standards for Rehabilitation recommend that the "special problems inherent in the structural system of historic buildings, especially where there are visible signs of cracking, deflection of failure" be recognized. "Stabilization and repair of weakened structural members and systems when damaged or inadequate" are also recommended. "Historically important structural members" are to be replaced "only when necessary".

Structural deficiencies in Bath High School are minimal. The major costs for rehabilitation will consist of upgrading the mechanical, electrical and plumbing systems and ensuring safe egress in accordance with the North Carolina Building Code. Other costs to consider are selective demolition, roof and floor repairs, drainage improvements, and finishes such as plaster, paint and flooring. Re-roofing and the reworking of gutters and downspouts should be included in the planning.

A thorough rehabilitation plan should address critical program needs, code issues, and construction costs.

CODE COMPLIANCE

The North Carolina State Building Code, which is the International Building Code with North Carolina amendments, includes several provisions for historic structures.

As a historic building, the Bath High School can be excused from some building code requirements by the building official.

> **3406.1 Historic Buildings**. The provisions of this code relating to the construction, repair, alteration, addition, restoration and movement of structures, and change of occupancy shall not be mandatory for historic buildings where such buildings are judged by the building official to not constitute a distinct life safety hazard. *See the North Carolina Accessibility Code.* 2000 International Building Code® /NC 2002.

To obtain tax credits for historic preservation, it is important for the Bath High School to qualify as a historic property.

QUALIFIED HISTORIC BUILDING OR FACILITY
A building or facility that is listed, or eligible for listing:

(1) In the National Register of Historic Places; or

(2) By the State Historic Preservation Officer, Division of Archives and History, North Carolina Department of Cultural Resources, acting on behalf of the North Carolina Historical Commission in compliance with G.S. 121-8 and N.C.A.C 4R.0600; or

(3) Under appropriate local law.

North Carolina Building Code 2002, Vol. 1-C

The intent of the code was to give special consideration , at the discretion of the local authorities when adherence to Volume 1-C of the code would require destructive alteration or demolition of building features as contributing to the building's significance.

The existing wood bead board ceilings can be retained depending on architectural and acoustical treatments. In some cases, suspended ceilings may be simply hung beneath the existing ceilings. If this is done, then the design of the new suspension system should be made to ensure the integrity of the existing plaster or wood ceilings.

Mechanical, electrical, plumbing, and other systems should be replaced. The Americans with Disabilities Act will require changes providing accessibility to all areas. This will affect the toilets which will vary greatly in number based on requirements for the new or modified occupancy.

Close coordination between the Beaufort County Building Inspector, County Planner, the designers, and the Department of Insurance will ensure the code compliance of the adaptively re-used commercial building. Input from the local Fire Marshall is also encouraged in reviewing fire protection issues.

STRUCTURAL ANALYSIS

Several adaptive reuse plans have ben discussed which would possibly convert Bath High School to commercial space, medical or other professional office space, or to an educational center devoted to museum exhibits, science, archeology. Portions of the building would possibly be used for public concerts and receptions.

The minimum uniformly distributed live loads for various occupancy or use are listed in the 2002 North Carolina Building Code. Most occupancy types can be easily accommodated within a school building except for retail, dining halls and restaurants, library stacks, public space, and some museum exhibits. In these cases, the existing floor system may have to be reinforced or supplemented. The minimum uniformly distributed live loads for school occupancy or use are as follows:

LOCATION	REQUIRED
Classrooms	40 psf
Corridors	80 psf
Ground Floor Corridors	100 psf
Offices	80 psf
Auditorium Aisles	100 psf
Auditorium Seating	60 psf
Stage	150 psf

Our preliminary analysis indicates that the floor joist system is adequate to support these code mandated floor live loads in most areas. The existing floors have adequate capacity in areas without deterioration.

LOCATION	ACTUAL
Second Floor Classrooms, Wing Classroom	47 psf
Corridors	at least 100 psf
Cafeteria	60 psf
Auditorium	45 psf
Stage	150 psf
Classrooms above the Auditorium and Cafeteria	varies, but more than 50 psf

The roof structure appears to be adequate to support a 20 psf live load. The capacity of the roofs depends on nailed connections in built-up trusses which cannot be easily observed. The capacities of floor joists or beams, in areas of the building where framing changes direction or is headed off to form openings, are subject to additional review. The capacity of the Auditorium floor is governed by the 4"x6" girders. The size of the dropped girders which support the floors above the Auditorium and Cafeteria are unknown at this time.

SEISMIC ANALYSIS

Obviously Bath High School was not designed anticipating the changes in the building and construction codes since 1921. Present structural code requirements should not be an issue if the existing structure is adequate to carry code mandated floor loads, and has in fact performed very satisfactorily for over eighty-five years.

Horizontal loads are assumed to travel through the floor and roof structure, into the masonry walls. It can be demonstrated that brick masonry from 1921 has a sufficiently high shear capacity to enable horizontal forces generated by seismic activity to be resolved in the wall system.

To determine the actual capacity of the existing building to resist lateral loads due to seismic will require analysis and testing. Shear strength of brick and the diaphragm strength of existing wood framed floors can be determined through a materials testing program and analysis. The load testing of brick wall panels or sections of floor can be used to determine the capacity of such elements to resist lateral loads. If necessary, seismic capacity can be enhanced through a "bolts plus" program where additional ties are installed between floor and roof structures and surrounding walls. Alternately, a seismic frame or frames can be installed if, through analysis, the existing building is found deficient. Both of these solutions are nominal in cost.

Our preliminary analysis indicates that this building is not deficient in its overall capacity, in areas without deterioration, to resist seismic forces as mandated by the North Carolina Building Code.

MASONRY

Few areas of the masonry walls will require repointing. The brick units appear to be generally hard and in good condition. This project will require masonry restoration techniques based on the characteristics of the existing masonry. These techniques are well known and in use everyday.

Mortar for face brick should match the original mortar in color, texture, density, and porosity. It should have the same or less strength than the original mortar. New mortar should have the same or less hardness than the original brick as determined by testing. The color of mortar used for repointing should be matched to the original by matching the color of original aggregates and mortar components as closely as possible.

A complete, up-close survey of the exterior walls can easily establish the extent of masonry restoration and repair quantities accurately sufficient for estimating purposes. Minimal repointing appears to be required at this time on the exterior face of the building. Masonry cracks primarily run through mortar joints with very few bricks cracked through.

TIMBER REPAIRS

The contractor undertaking restoration repairs at Bath High School should make an effort to match the thickness, width, species, grade, and shape of wood elements to be replaced. Replacement material including flooring, sub-floor sheathing, roof sheathing, floor joists, trussed roof top and bottom chords and braces, ceiling boards, and millwork should match the original material. The existing trussed roof rafters and ceiling joists can be reinforced if necessary and their connection to the support of walls can be enhanced to resist the wind load

requirements of today's building code.

ENERGY

Conformance to the energy code will impact the cost of rehabilitation. If the original existing amount of glass area is retained, then thermal glazing and insulated frames will be a budget item. As an alternate, the existing windows can be rehabilitated and storm window units can be added which will not detract from the appearance of the existing windows. Insulation will have to be added to the roof above heated spaces. The existing walls are uninsulated.

STABILIZATION

Deterioration in the building should be stabilized by placing a New Orleans type "blue tarp" temporary roof covering over large portions of the roof containing leaks. Where there is standing water on floors, the water should be removed or made to drain through. Similar to the Palmer-Marsh House, forced ventilation such as electric fans can be used to dry the areas which are not wet. When the roof of the Palmer-Marsh House burned, a tarpaulin was installed and two industrial size electric fans were installed. These ran for 24 hours a day until wood and plaster elements were dried to their normal moisture content. Wood materials must be dried to 20% moisture content or less for deterioration due to fungal attach to cease. The normal equilibrium moisture content of wood components in a building such as Bath High School is probably 7 to 10%.

The OSB temporary window coverings could be removed in some places so that some windows can be opened to provide additional ventilation. Of course, temporary screening should be installed to prevent insects and birds from entering the building. The existing temporary window covering is good for protecting windows from breakage, but the vents are too small to be effective if the roof is allowed to leak. Some of the damage to ceilings and flooring can be reversed by reducing the moisture content.

DRAINAGE

It is important that the roof drainage system be tied into an underground system to transport water away from the building. This system may include yard drains and catch basins.

PORTICO

The original front entrance portico can be reconstructed based on photographic evidence if original plans can not be located.

RECOMMENDATIONS

We have several recommendations with regard to the existing conditions and the possible rehabilitation of this building for re-use:

- The conditions leading to the deterioration at Bath High School should be stabilized by placing a tarpaulin on the roof to protect the building from further damage. Standing water should be removed from wood floors and the building should be dried to a moisture content of 20% or less.

- A complete code review should be made to ensure that the adaptively re-used building meets the current North Carolina Building Code for its new occupancy category.

- The building should be re-roofed. This will provide an opportunity to inspect roof sheathing from above and replace in kind any that is deteriorated.

- Flashing and counter flashing should be reworked at all areas with special attention to chimneys and roof/wall intersections. Counter flashing should be installed in the traditional manner, turned into horizontal mortar joints. This will require a coordinated effort between restoration mason and roofer.

- All new metal flashing, gutters and downspouts should be copper if possible.

- An underground drainage system should be designed and installed to conduct downspout water away from the building. This system may include yard drains and catch basins.

- Based on testing and mockups of repointed areas of the wall, a suitable mortar match should be found.

- Interior spaces within classrooms can be partitioned with metal studs and sheetrock. Double staggered stud partitions with sheetrock provide excellent sound separation between rooms.

- The HVAC and plumbing systems should be replaced, as well as, the electrical system with an emphasis on lighting, communications and fire detection.

- We recommend that the existing structural system remain as is. Through analysis, the ability of the existing structures to resist lateral forces such as wind and seismic and to support additional weight on the roof consisting of insulation and new roofing can be verified.

- Paint should be removed from wood surfaces that require renewing by the gentlest means possible. Heat guns, certain chemical strippers, scraping, and light water blasting are better methods than sand blasting. Specifications should require that test samples or mockups be made in each case.

- The existing wood stairs should be reviewed for compliance with the building code for the new occupancy. These stairs should be replaced with non-combustible steel and concrete construction, supplemented with another set, or sets of stairs, or protected with

a sprinkler system and fire rated doors.

- An interior elevator consisting of a 4 foot deep cast-in-place concrete pit and 8 inch concrete masonry shaft should be constructed. A properly protected elevator lobby at each level and fire rated corridors will be required.

- Debris located in the crawl space below the auditorium stage should be removed.

Repairs to the building can be made on the basis of proposals obtained from qualified contractors. The work can be solicited informally or by bidding on the basis of plans and specifications produced by an architect and consultants with historic preservation experience. The addition of an elevator is a task complicated enough to require the services of an architect to coordinate the efforts of the elevator builder, modify the building to accommodate the elevator, and verify the related code issues governing access and fire protection. The exterior repairs should include the services of a masonry restoration specialist and a good roofing contractor as subcontractors to a general contractor. The general contractor should be engaged by the owner utilizing an architect experienced in this type of work as the owner's representative.

CONCLUSION

In general, the existing Bath High School is still sound structurally, although active roof leaks are causing continuing deterioration in several areas. Based on observation and analysis, we will be able to certify the structural portion of Bath High School as adequate in meeting the structural requirements of the North Carolina Building Code once repairs are made to areas which are now deteriorated. It is important to undertake a stabilization program to halt ongoing deterioration due to roof leaks.

Based upon our experience in the rehabilitation of such projects, it is our conclusion that this project is an excellent opportunity to rehabilitate a significant facility, by upgrading major systems.

ACKNOWLEDGMENT

This report has been prepared for the exclusive use of Bath High School Preservation, and your assignees for specific application to the referenced property in accordance with generally accepted engineering practice. Our inspection consisted of visual observation only, made solely to determine the structural integrity of the described building. Neither the inspection nor the report covers plumbing, mechanical, electrical, hydrological or geotechnical features.

No other warranty, expressed or implied, is made. These conclusions and recommendations may not reflect variations in conditions which could exist intermediate of the observed locations or in unexplored areas of the building. Should such variations become apparent during design or construction, it may be necessary to re-evaluate our conclusions and recommendations based upon an on-site observation of the conditions.

We very much appreciate this opportunity to be of service. If you have comments or questions regarding this report, please do not hesitate to contact us.

Sincerely,
DCF Engineering, Inc.

David C. Fischetti, P.E.
President