

Martin O'Malley
Governor

Anthony G. Brown
Lt. Governor



Alvin C. Collins
Secretary

MARYLAND DEPARTMENT OF GENERAL SERVICES
OFFICE OF THE SECRETARY

January 15, 2009

Mr. Edward C. Papenfuse, Ph.D.
State Archivist and Commissioner of Land Patents
Maryland State Archives
350 Rowe Boulevard
Annapolis, Maryland 21401

Dear Mr. Papenfuse:

Enclosed is the Historical Consultant Report on Structural Floor Penetrations which was prepared by the Keast and Hood Company. They were asked by the Department of General Services to perform a structural investigation on the existing conditions that were exposed during the construction of our recent HVAC and interior piping renovations project.

If you have any questions, please contact me at 410-767-4960 or Mr. Thomas Genetti, Assistant Secretary for Facilities Planning at 410-767-4214.

Sincerely,

A handwritten signature in black ink, appearing to read 'Alvin C. Collins'.

Alvin C. Collins
Secretary

Enclosure

c: Thomas V. Mike Miller, Jr.
Michael E. Busch
Howard S. Freedlander
Jerry Klasmeier
J. Rodney Little
Drew Vetter



Historical Consultant Report on Structural Floor Penetrations

Prepared by Keast & Hood Company



State of Maryland Department of General Services HVAC and Interior Piping Renovations Maryland State House

**Department of General Services
Alvin C. Collins, Secretary
301 West Preston Street
Baltimore, Maryland 21201**

**Board of Public Works
Martin O'Malley, Governor
Peter Franchot, Comptroller
Nancy K. Kopp, Treasurer**

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1.0 Introduction - Background & Purpose of Investigation

Keast & Hood Co. (K&H Co.) was asked by the Maryland Department of General Services (DGS) to perform a structural investigation/ review and comment on existing conditions exposed during the construction of the 2008 mechanical renovations to the 18th century State House as well as the 20th century Annex. This review has been informed by our ongoing but sporadic involvement over the past decade advising DGS on the affect of mechanical renovations on structural conditions in the State House. In February 2000, K&H issued an in-depth structural assessment report on the State House Annex. This report documented the structural damage to the fragile tile decks in the Annex, primarily caused by years of accumulated mechanical penetrations. Generic details and guidelines for future mechanical penetrations were included in that report. In 2004, K&H Co. issued several letters and a site visit memorandum commenting on the design for the State House mechanical renovations then in progress by SMDA Architects/ Johnson-Berman Joint Venture.(see Attachments 1-3). Our primary concern was the potential damage from un-engineered mechanical penetrations. We understand that this design by SMDA Architects/ Johnson-Berman Joint Venture was never actually built. In the intervening years, another A/E team led by Davis Bowen & Friedel Inc. prepared the design documents that are currently being implemented by Coakley Williams Construction. The objective of the current report is to review and comment on the actual construction implementation of the mechanical renovations in process. The survey work was performed during a site visit on October 22, 2008. The design drawings for the current renovations were not made available to us until after the site visit. We have not attempted to determine the extent to which the current design documents may depart from those previously reviewed.

2.0 General Building Description

The structural systems of the Maryland State House exemplify a wide variety of late 19th and early 20th century fireproof construction assemblies, ranging from the obsolete (the wrought iron beams) to the standard (the flat arch tile floors) to the original and daring (the reinforced tile decks in the attic and roof). The attic floor, in particular, appears to be an exceptional design for its time; however, the attic floor reinforced tile deck lacks the thickness, sophistication, and detail refinements of later reinforced concrete designs. We concluded in our 2000 report that the attic floor was not intended to carry significant live loads and advised that future direct loading of the attic terra cotta tile deck should be avoided at all costs; new equipment loads and hangers should be placed directly on steel beams.

While we have not had the opportunity to closely study existing conditions in the 18th century Statehouse, we are aware that it contains both older wood floor joists as well as 19th and 20th century tile decks.

The performance of these floor systems has been generally sound over the years. However, significant damage has accumulated from unplanned holes and un-engineered penetrations in

the tile decks, which require compression continuity for optimal structural function. Therefore, the larger holes and penetrations in the tile floor systems require repairs in order to function safely. Beyond structural concerns, penetrations also compromise the intended fireproofing qualities of the terra cotta tile arch system.

3.0 Description of Investigation Methods

Staff from K&H completed a general floor by floor walkabout of the Maryland State House in which ceilings, walls, visible beams, columns, joists, mechanical systems, etc. were observed. Photos were taken with a digital camera to record areas of concern, and descriptive information was recorded in field notes for each floor level to document the condition of the structural members.

4.0 Existing Documentation

The following sets of drawings were referenced during the current investigation:

“Addendum to Maryland State House” dated 1985/1986; Historic American Building Survey, National Park Service, U.S. Department of the Interior.

Additionally, K&H reviewed the following reports:

“Interim Report: Old Senate Chamber Architectural Evidence Investigation,” John Greenwalt Lee Company, February 4, 2008. Available on www.mdstatehouse.net

“Interim Report on Archival and Architectural Evidence: Old Senate Chamber at the Maryland State House,” John Greenwalt Lee Company, September 17, 2008. Available on www.mdstatehouse.net

“Comprehensive investigation of the Old Senate Chamber and Old Treasury Building History of Alteration,” John Greenwalt Lee Company, June 7, 2007. Available on www.mdstatehouse.net

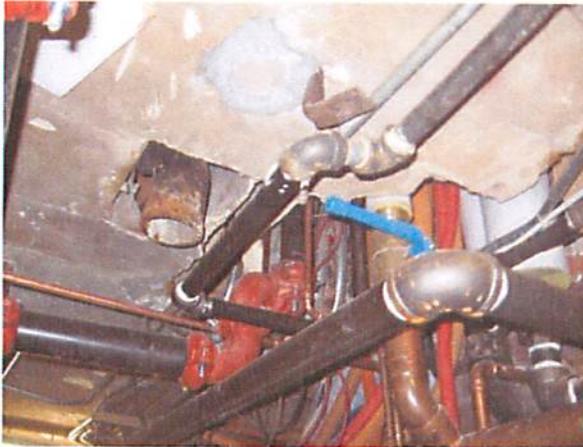
“Preliminary Masonry and Finishes Failure Assessment: Old Senate Chamber, Old Treasury Building & Shaw House,” John Greenwalt Lee Company, December 12, 2006. Available on www.mdstatehouse.net

“Project Report: Conditions Survey, Maryland State Capitol and Shaw House,” Atkinson-Noland & Associates and Masonry Solutions, August 3, 2006. Available on www.mdstatehouse.net

5.0 Observations and Recommendations

K&H deemed the following structural observations of greatest concern during our visit with respect to the current building conditions:

5.01 Abundant Ceiling Penetrations:



Below men's first floor restroom, 1902 basement floor assembly.

Many holes have been cut over the years without consideration of the structural consequences. Although most of the holes that we viewed date from prior renovations, some existing holes may have been enlarged or exacerbated during the current work. Such penetrations destroy the compression continuity of the flat tile arch system, as well as jeopardize the intended fireproofing functionality. Areas below the restrooms on each floor have been especially subjected to an accumulation of penetrations, causing significant damage.

Recommendation: All existing floor penetrations larger than 12"x12" should be reinforced with shotcrete.

5.02 Plywood Patchwork to Ceilings:



Located below attic floor assembly, 1902 building

We observed several plywood patches under the attic floor in the Annex. It is not clear whether these represent new holes cut in the Attic floor, or new repairs to old holes, or old repairs to old holes. Such penetrations compromise the structural integrity of the entire framework, as well as fireproofing functionality. This particular patch is especially significant because it is part of the attic floor system. The attic floor is constructed in a completely different manner than the lower floors. The attic floor system more closely resembles a one-way slab of reinforced concrete,

with terra cotta tiles providing the compression area and the reinforcing rods resisting the tension stress. The floor deck of the attic spans from beam to beam (or between bearing walls) and is comprised of 4" deep three (3)-cell terra cotta tiles. The relatively shallow nature of the 4" attic floor system renders it extremely fragile in comparison to the other floors. Therefore, any additional penetrations to the existing terra cotta attic floor assemblies can seriously diminish or destroy their structural stability.

Recommendation: As the attic floor is extremely fragile with basically a zero live load capacity, new penetrations through this floor should be consistently avoided. Additionally, we also recommend that a thorough survey of all attic penetrations be conducted. Full documentation of these areas is necessary, and all penetrations should be promptly addressed on this level. Developing an outline of contractor guidelines specifically for the attic space is also recommended.

5.03 Penetrations below fan coil units



Fan coil unit adjacent to historic vertical shaft in pilaster.

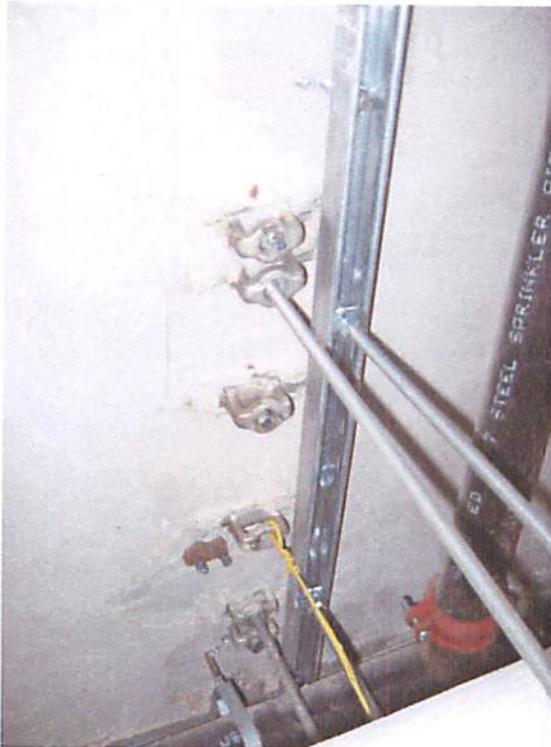


Damage to tile deck typical below fan coil units

Another typical location of structural damage to the tile decks is the holes that were historically cut to feed the fan coil units installed around the perimeter of the first and ground floors. These holes have been reused, although perhaps enlarged and/or altered, during the current renovations. It is unfortunate that alternative locations for vertical distribution of utilities could not be found during the design phase. Fortunately, it is not too late to repair the damage caused by the mechanical penetrations. Subsequent to our 2000 report, in which we recommended removing the tile entirely from beam to beam at large penetrations, we have had success retrofitting damaged tile decks with shotcrete. This is, however, a very messy operation.

Recommendation: Repair tile decks below fan coil units.

5.04 Hanging HVAC and Plumbing Hardware Directly from Ceiling Tiles:

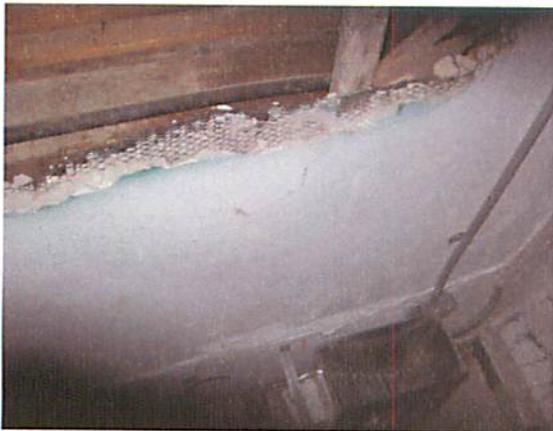


Found near southeast corner of 1902 basement floor assembly

While this photograph actually depicts an appropriate historic ceiling hanger (left row of hangers) attached directly to a beam flange above, there are many locations in the basement ceiling where mechanical equipment is not supported from a beam, hanging directly from the ceiling tiles instead (right row of fasteners). Historic structural systems, such as the terra cotta tile arch system, are brittle and weakened by installing fasteners directly into the tile.

Recommendation: All attachments should have been directly hung from the bottom flanges of steel beams. K&H Co. recommends that the steel anchor manufacturers be required to perform pull-out tests to qualify the existing installations.

5.05 Loss of Plaster Ceiling:



Looking up, northwest corner of 1772 basement

Plaster was frequently an integral component of the fireproofing system. Large plaster losses such as shown could reduce fire separation protection between floors. Moreover, any additional loss of plaster may affect the building's overall fire rating.

Recommendation: The Architect and state Fire Marshal should advise on existing rated fire assemblies.

5.06 Diffuser Grill Notched into Floor Joist:

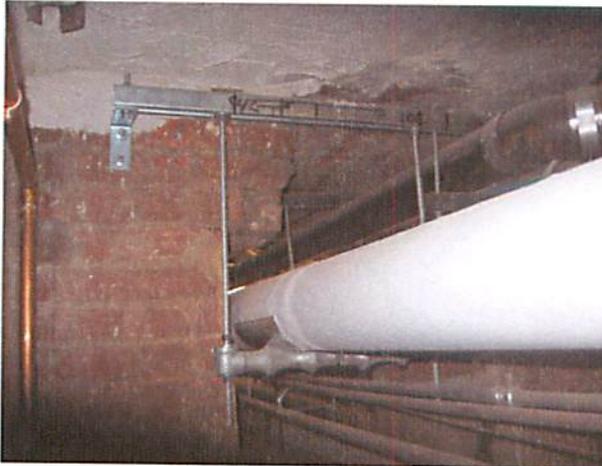


Located below the former visitor's center, in 1772 basement

Here, ductwork cuts into the original wooden floor joists. Such intrusive additions weaken joist live load capacities.

Recommendation: Mechanical system work should avoid joist penetrations, unless the penetrations are compensated for with remedial structural details.

5.07 Masonry Wall Penetrations:



Located near southeast corner of 1902 sub basement

In addition to the floor/ceiling assemblies on all levels being subjected to adverse penetrations, large holes have been cut through foundation walls. Here, there are no lintels or sleeves in place to support this hole and provide structural and fire-separation continuity.

Recommendation: Coring is acceptable under certain conditions. Otherwise, install lintels or sleeve details to sufficiently support all existing masonry wall penetrations, and maintain fire separations where appropriate.

5.08a Deep Shafts not Underpinned:



These photographs depict raw earth exposed below foundation walls in two separate areas.

Recommendation: These areas need to be properly underpinned immediately.

Found in the 1772 basement, immediately to the right of the doorway to the 1902 sub basement

5.08b



Found along the northeast wall, 1772 basement.

5.09 Cracked Walls:



All three photographs:
Old Senate Chamber room.

As a direct result of the lack of foundation shaft underpinning, additional building settlement and separation has occurred. Significant cracks were observed in both the interior and exterior walls of the Old Senate Chamber on the second floor, as well as the second floor wall bordering on the brick-vaulted room. The cracked wall areas correspond with the locations of the undermined foundations shown in 5.08b and 5.10.

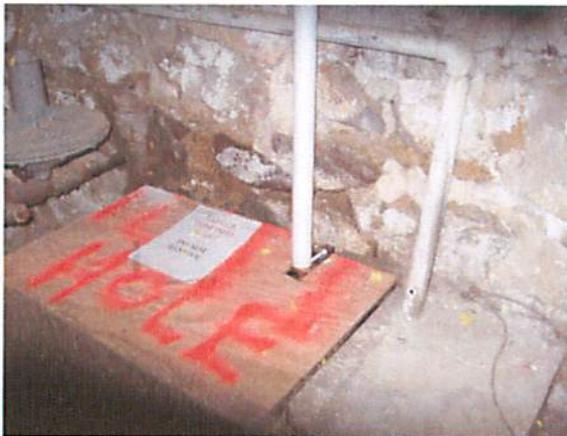
Recommendation: Fill cracks in these walls and address moisture intrusion issues before replastering in Old Senate Chamber occurs; concurrently, address underpinning needs of foundation walls.

Additionally, we were asked to comment on the safety and feasibility of restoring the plaster ceiling of the Old Senate Chamber. We understand an outside consultant has recommended removal and replacement of both the wall and ceiling plaster. On the basis of our preliminary observations, we are strongly disposed to question these recommendations, and to recommend that any action be postponed until a more extensive analysis could be performed.

The wall plaster had already been removed at the time of our site visit. The ceiling plaster was however intact and showed no evidence of penetrations, buckling, peeling, or moisture damages. We do not perceive any cause to remove the existing ceiling plaster which is directly adhered to the tile deck. The adhesion seems to have performed adequately and there is no reason to believe that this ceiling will fail.

By previous reports, the wall plaster had been subject to moisture damage. We found evidence of a decayed wood nailer embedded in the brickwork. The fungal decay of the wood demonstrates that the brick wall has been subject to sustained high moisture content, a condition which does not exist in the tile decks. The presence of structural settlement cracks in the walls, likely due to the foundation undermining noted previously, is an obvious source of moisture penetration which must be addressed.

5.10 Potential Loss of Stone Above Foundation Tunnel Opening:



This plywood covering prevented us from fully investigating the condition of the undercut foundation wall.

Recommendation: This temporary plywood covering should be removed for further investigation of this location. All undercut stonework needs to be adequately supported.

Found along the northeast wall, 1772 basement.

6.0 Conclusion:

Unfortunately, numerous problems associated with the work in progress were anticipated in the two prior Keast & Hood Co. reports. Consequently, the situation at the State House has reached, or is imminently approaching, a critical point where new floor/ceiling penetrations cannot be structurally sustainable. Comprehensive coordination of new building services with existing structural assemblies is essential to prevent major compromises to, and failures of, the building structure.

To summarize and reiterate our previous recommendations – both in this contemporary report and our past reports, we strongly urge investment in a comprehensive survey to fully document and address all significant floor/ceiling penetrations, masonry wall penetrations and cracks, and unsupported foundation walls in need of immediate underpinning.

Attachment 1 – Maryland State House DGS Plan Review, 9 March 2004
March 9, 2004

Mr. Stephen Billings
Maryland Dept of General Services
State Office Building
301 W. Preston Street
Baltimore, MD 21201

Re: Maryland State House
HVAC Renovations Review
Keast & Hood Co. Project No. 04014

Dear Mr. Billings:

Per your request, Keast & Hood Co. has reviewed the Request for Bids document and the mechanical drawings, M1 through M25, for the Renovation to the Interior of the State House of Maryland in Annapolis, Maryland. In addition to those mechanical drawings we received from your office, we reviewed an old set of the 1999 Architectural drawings from the same design package, which we had in our files from our work on the State House Annex in 1999-2000.

We offer the following comments regarding the Request for Bids:

- Section B – Project Description: Add to the first sentence, “The Maryland State House, a **National Historic Landmark**, is located at the State Circle in Annapolis, Maryland.”
- Section B – Project Description: In the second paragraph, insert after the second sentence, “**The 1772 section has a combination of brick vaults, wood floor framing, and heavy-timber roof construction; the 1902 section has terracotta flat-tile floor construction and steel roof construction.**”
- Section C – Scope Documents: General Comment: Will the 50% CDs include either an outline or draft specification? If so, will this include a Division 1, provided or reviewed by the State, covering such topics as:
 1. “Cutting and Patching”, including requirements for architect/state approval before cutting historic fabric, as indicated on the drawings [see below], and identification of which trades are responsible for which aspects.
 2. “Definitions”, as appropriate to historic buildings.

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The Maryland State House, Annapolis, Maryland

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Mr. Stephen Billings
Maryland Dept of General Services
Re: Maryland State House
HVAC Renovations Review
Keast & Hood Co. Project No. 04014

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3. "Preservation Procedures", including requirements for submitting proposed means and methods, undisclosed conditions, artifacts, etc., etc. What are the requirements/ restrictions on field welding/ braising?
4. "Submittals", "Closeout Procedures", etc., with requirements for progress photography, record drawings, etc.?

To be meaningful, these requirements should be cross-referenced to the drawings, indicating the boundaries of preservation zones, which should be defined by the Maryland Historic Trust's Historic Structures Report [HSR].

- Section E, Part A.2, Highest Consideration: Insert as part of item 3, "The ideal example would be the re-construction / renovation of an historic landmark, **herein defined as a National Historic Landmark [NHL] or property with a Determination of Eligibility [DOE] from the Maryland Historic Trust [MHT] or other State Historic Preservation Office [SHPO], constructed between 1750 and 1920, multi-storied, wood framed, masonry structure within the last five years of 150,000 to 200,000 GSF.**"

From our review of the mechanical renovation drawings, all of the mechanical units are being replaced. The majority of the associated existing ductwork will be reused, while the majority of the associated piping will be replaced. However, there is some new ductwork which will require new floor penetrations.

We offer the following comments regarding the mechanical renovation drawings:

- The General Notes indicate "*Unless reused all openings created by removal of ductwork, piping, conduits, etc. shall be patched to match surrounding surfaces.*" How are the floor openings detailed to be infilled? What details would the contractor use to infill the floor openings?
- General Comment: Is any portion of the building being considered as a Museum, which would require special humidification requirements?
- The original design package included architectural, lighting, mechanical, and electrical drawings. There were no structural drawings included as part of the design package. How will the contractor know how to cut new openings through the existing floor systems or infill existing openings in a structurally sufficient method?

Mr. Stephen Billings
Maryland Dept of General Services
Re: Maryland State House
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- New Basement Mechanical Equipment: How are mechanical equipment pads, which are required in the basement to support the new equipment, detailed?
- Duct and Pipe Hangers: If the new piping and ductwork is being hung from the existing framing, how are the hangers being attached to the existing terra cotta, steel, and/or wood framing above?
- New Floor Penetrations: How are these new floor openings through the terra cotta flat arches detailed?
- Window Fan Coil Units: Our Structural Assessment report of the Annex dated February 1, 2000 indicated that there were large unreinforced openings for the existing FCU piping. Are the new FCU pipes reusing the existing holes or are new holes required? The drawings seem to indicate that the pipes are in different locations from the existing pipes. How are the new penetrations to be implemented and/or how will the existing terra cotta floor system be reinforced?
- Attic Mechanical Units: New mechanical units are being installed in the Annex attic. Some units will be located in the same locations where existing units are being removed. However, a new unit is shown between the skylight areas. Our 2000 Assessment report also indicated "*New equipment (in the attic) should be supported directly on the steel framing.*" How are the new units supported? Will any units interfere with the existing catwalk system installed in 2000? Will the units require inertia bases?
- Attic Floor Penetrations: New round openings are indicated to be cut through the attic floor system. How are these openings to be cut? How will the existing adjacent terra cotta tiles be reinforced to compensate for such an opening?
- Construction Phasing: How will the construction phasing be revised to accommodate the existing building occupants?

In general, the level of documentation required for historic structures is usually more extensive than that needed for new construction. Existing vs./ new construction, required protection, proposed demolition, extent of repairs, and required patching or replacement materials should be more fully described in associated specifications and architectural and structural drawings, which we have not yet had the opportunity to review. Has the design been coordinated with information in the Historic Structures Report on the State House being prepared by the Maryland Historic Trust?



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Mr. Stephen Billings
Maryland Dept of General Services
Re: Maryland State House
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We hope the above comments are helpful in assisting you in the review of the current mechanical renovation project. If we can provide any additional assistance, please give us a call.

Very truly yours,

KEAST & HOOD CO.

Suzanne M. Pentz

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Copy: Orlando Ridout V – Maryland Historic Trust
Brian D. Wentz, David G. Cornelius – Keast & Hood Co.

Attachment 2 –Additional Comments, 30 March 2004

March 30, 2004

Mr. Stephen Billings
Maryland Dept of General Services
State Office Building
301 W. Preston Street
Baltimore, MD 21201

Re: Maryland State House
HVAC Renovations Review Additional Comments
Keast & Hood Co. Project No. 04014

Dear Mr. Billings:

Per your request, Keast & Hood Co. had reviewed the Request for Bids document and the mechanical drawings, M1 through M25, for the Renovation to the Interior of the State House of Maryland in Annapolis, Maryland. Our initial comments were included in a letter dated March 9, 2004. We have subsequently visited the State House for a walk through with Mimi Calver of the Maryland State Archives on March 25, 2004.

We offer the following additional comments regarding the mechanical renovation drawings:

- Existing Plaster Crown Molding: A few areas of the 1772 State House currently have a drop ceiling, which is concealing the existing plaster crown molding. Any new ductwork or pipe penetrations through the existing wood floor framing will need to avoid the existing plaster crown molding at the perimeters of all the ceilings. This may require the penetrations to move further way from the walls which have a plaster crown molding.
- Existing Wood Floor Joists: Any new ductwork or pipe penetrations through any floor framing should avoid cutting any of the existing wood floor joists. If the ductwork cannot fit between the existing wood floor joists, this may require the ductwork to be split to go around the existing wood floor joists.
- Humidification: Since many items and the rooms themselves in the 1772 portion of the State House are considered museum pieces, humidification should be carefully reviewed for the protection and preservation of these items.
- Ceiling Return Registers: The new return registers shown on the mechanical drawings are square or round. Some of the existing return register shapes do not match what is indicated on the drawings. Any reconfigured return register should fit in the same locations as the existing locations. Also, if a revised return register shape, there may be some plaster removal required and/or some plaster repair work required.

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The Maryland State House, Annapolis, Maryland

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Mr. Stephen Billings
Maryland Dept of General Services
Re: Maryland State House
HVAC Renovations Review Additional Comments
Keast & Hood Co. Project No. 04014

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We hope the above additional comments are helpful in assisting you in the review of the current mechanical renovation project. If we can provide any additional assistance, please give us a call.

Very truly yours,

KEAST & HOOD CO.

Brian D. Wentz

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Copy: Orlando Ridout V – Maryland Historic Trust
Suzanne M. Pentz, David G. Cornelius – Keast & Hood Co.

Attachment 3 – Maryland State House DGS Plan Review, 5 April 2004

Site Visit Memorandum No. 1

Project: Maryland State House HVAC Renovations Review	Date of Issue: April 5, 2004
Project No: 04014	Date of Visit: March 25, 2004
Client: Maryland Dept. of General Services	Weather: Sunny, warm
Visit by: Suzanne Pentz Brian Wentz	Met With: M. Calver R. Skeirik
Distribution: Steve Billings – MD DGS M. Calver – Maryland State Archives R. Skeirik – Maryland Historical Trust	

Purpose of Visit:

To walk through the 1772 portion of the Maryland State House and review the current HVAC/ Piping Mechanical Renovation drawings.

Observations:

The following observations were made during our visit with respect to the current HVAC/Piping Mechanical Renovation drawings which will be implemented in the near future.

1. Existing Plaster Crown Molding: A few areas of the 1772 State House currently have drop ceilings which conceal the existing plaster crown moldings. Any new ductwork or pipe penetrations through the existing wood floor/ ceiling assemblies should be moved as required to avoid the existing plaster crown moldings.
2. Existing Wood Floor Joists: Our review disclosed that many areas of the 1772 State House retain the original wood floor framing. Any new ductwork or pipe penetrations through the floor framing should avoid cutting any of the existing wood floor joists. If the ductwork cannot fit between the existing wood floor joists, it may be necessary to split the ducts to go around the existing wood floor joists.
3. Environmental Criteria: There are many artifacts and furnishings in the State House that are considered museum pieces. Environmental criteria for museum collections are generally stated as average 70 degree F (+ or - 2 degree swing) and 50% relative humidity, but should be adjusted for specific objects (paper, furnishings, etc.) as directed by the curatorial staff. There is often an inherent conflict between the needs of the collections and the preservation of the building fabric, particularly if winter humidification is desired for the objects. What are the environmental criteria for the current HVAC renovation?
4. Ceiling Return Registers: The new return registers shown on the mechanical drawings are square or round. Some of the existing return register shapes do not match what is indicated on the drawings. Ideally any reconfigured return registers should fit in the same locations as the existing locations. Installation of incompatible register shapes may necessitate the removal of historic plaster.
5. Fireproof Vaults: The northwest and southwest rooms on the first floor of the 1772 building were renovated early in the 19th century to house the state archives. These rooms were rebuilt in groin vaulted masonry in order to be fireproof. The early fireproof construction is considered historically significant. New penetrations into the monumental vaults should be carefully considered, detailed, and executed.
6. Existing Chases into Masonry Piers: In the past, vertical chases were cut into the load-bearing brick piers between windows in order to bring supply air to the first floor. Fortunately, the structurally diminished piers are not showing major distress, although we did note a few cracked bricks on the exterior.
7. Column Encasements at East Entry: There are large rectangular non-historic shaft enclosures around the existing historic wood columns at the east entry. These enclosures

appear to have been built to hide the vertical distribution of ductwork. They apparently also hide the historic wood columns. Have any other locations for vertical distribution of ductwork been considered?

8. Data Wiring in Duct: An air duct in the southwest part of the first floor has been used as an expedient location to run temporary data wiring. This condition should be evaluated and a more permanent solution should be considered.