WALTER P MOORE

September 29, 2016

Mr. Stephen Kitterman
McKissak & McKissack
901 K Street, NW
6th Floor
Washington, DC 20001

Re: Phase I Building Enclosure Investigation
Stuart-Hobson Middle School
Washington, DC
Walter P Moore Project No. D01.16016.00

Dear Mr. Kitterman:

We have completed our Phase I Building Enclosure Investigation of the auditorium at the Stuart-Hobson Middle School located at 401 E St NE, Washington, DC. The work has been done in accordance with our proposal 15-2529 with a revision date of April 21, 2016.

Included in our report are our visual observations of distress conditions, a description of field testing performed and a discussion of our findings. Phase II of the investigation which consists of long-term monitoring of temperature and relative humidity inside the auditorium is in-progress. At the conclusion of the monitoring phase, Walter P Moore will provide an update to this report that includes a summary of the findings of the monitoring efforts and general recommendations for repair.

We very much appreciate this opportunity to provide these services to you. Please do not hesitate to contact us if you have any questions about our assessment.

Sincerely,

WALTER P. MOORE AND ASSOCIATES, INC.

E. Webb Wright, P.E., RRO (FL)
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STUART-HOBSON MIDDLE SCHOOL PHASE I BUILDING ENCLOSURE INVESTIGATION

401 E St NE
Washington, DC 20002

Report Date	September 29, 2016
Façade System (Auditorium)	Brick Mass Wall
WPM Project No.	D01.16016.00

EXECUTIVE SUMMARY

Walter P. Moore and Associates, Inc. has completed a Phase I assessment of moisture-related distress inside the auditorium at the Stuart-Hobson Middle School in Washington, DC. Specifically, the assessment focused on the west exterior wall of the auditorium where distress was most prevalent. The assessment work included visual observations, infrared thermography, moisture meter testing and installation of dataloggers. Our assessment consisted of a visual survey of the building enclosure in the vicinity of the observed interior damage to identify potential enclosure deficiencies that could lead to moisture infiltration. No exploratory openings or destructive testing were conducted as part of this assessment. The following are key observations of our assessment:

1. Cracks/voids in mortar joints.
2. Deteriorated mortar joints.
3. Past mortar joint repairs.
4. Cracks through bricks.
5. Brick spalling.
6. Water leakage out of glass-to-metal joints of new windows.

Based on our observations and field testing, it appears likely that there are multiple factors that have contributed to the moisture-related distress at the west wall. This includes moisture infiltration through the wall due to poor quality, deteriorated brick mortar joints and cracked brick. In addition, it appears likely that evaporative drying to the interior during the cooling season has contributed to interior distress. Vapor drive and evaporative drying to the interior is expected to be more substantial at the west wall of the auditorium than the east wall. Another factor that has likely contributed to the increased interior distress observed at the west wall of the auditorium is the recent addition of a new wing onto the building on the west side of the auditorium that shields the auditorium from the late afternoon sun. It also appears that condensation within and detailing at the new windows is another factor that may be contributing to the distress. Modifications to heating, ventilation, and air-conditioning (HVAC) systems during the recent renovations have also likely contributed to the recently observed interior distress.

These are preliminary conclusions regarding the cause(s) of the observed interior distress. Temperature and humidity data collected by the dataloggers during the 4-month monitoring period will be evaluated and these preliminary conclusions re-assessed based on the findings.

INTRODUCTION

It is our understanding that the auditorium of the Stuart-Hobson Middle School has experienced ongoing moisture damage in the past which has become more prevalent since the recent renovation of the facility. During our December 22, 2015 walk-through, we were directed to moisture-related damage to wall finishes inside the auditorium and efflorescence on the interior face of sections of the north and west exterior walls inside the attic. Walter P Moore was retained to assess the cause(s) of the moisture-related problems and provide general recommendations for repairs required to correct the identified issues.

BACKGROUND

The Stuart-Hobson Middle School was first constructed in 1927. It appears that the facility was originally constructed with three primary sections: classrooms and offices at the south end, the auditorium in the middle and a boiler room at the north end. The four-level facility has a basement, first floor, second floor and third floor.

The facility has undergone several renovation projects. We do not have the complete history of improvements to the building but some improvements of which we are aware include the following.

- The boiler room was later converted to boys and girls gymnasiums and locker rooms.
- An east wing with a media center and classrooms was also later added.
- Window and door replacement projects were done circa 1990.
- Mechanical, electrical, plumbing, interior finish repairs and window re-glazing were done circa 2007.
- Widespread renovations to the facility were performed circa 2012 as part of a modernization project.
- Building additions on the west side of the auditorium were recently completed.

BRIEF DESCRIPTION OF BUILDING ENCLOSURE

Scanned images of limited original design documents for the building were provided by the client. The architectural and structural drawings were reviewed for information pertaining to the original design and construction of the exterior wall systems at the auditorium. Unfortunately, the drawings provided did not contain wall sections showing the cross-section of the exterior wall assemblies.

Based on our field observations and the age of the structure, we understand that the exterior walls of the auditorium are most likely multi-wythe brick masonry mass walls. The thickness of an exterior wall was measured at a window opening and found to be approximately 19 inches. The interior surfaces of the brick walls are finished with a cement plaster.

Both the east and west walls of the auditorium have three new large windows with insulated glass units. The auditorium roof has a new white single-ply roofing membrane.

OBSERVATIONS

Walter P Moore conducted a visual survey of the auditorium to document moisture-related interior damage, signs of past water infiltration and potential sources of moisture infiltration on July 20, 2016 and July 27, 2016. The east and west exterior walls of the auditorium were the focus of our field assessment as moisture-related damage was prevalent at the interior face of the west wall. The exterior surfaces of the east and west auditorium walls were reviewed from the adjoining low roofs (Photos 1 and 2). The interior surfaces of the walls were reviewed from the floor of the auditorium and at select locations from an eight-foot ladder. We also reviewed a section of the attic space near the northwest corner of the auditorium and accessed the roof to observe the roofing membrane. Observations made during our visual survey are listed below.

Exterior

The following observations were made at both the east and west exterior walls of the auditorium unless the description specifically refers to only one of the walls.

1. Cracks/voids in mortar joints (Photos 3 and 4). **Note:** Crack widths of up to 1/16" measured.
2. Deteriorated mortar joints.
3. Past mortar joint repairs (Photo 5).
4. Variable mortar joint widths. **Note:** Joint widths of 1/8" (min.) up to ½" (max.) measured.
5. Cracks through bricks (Photo 6). **Note:** Crack widths of up to 1/32" measured.
6. Localized stair-step cracks.
7. Localized brick spalls (Photo 7). **Note:** Spalls appear to be the result of freeze-thaw damage.
8. Corrosion at head of windows on west exterior wall (Photo 8).
9. Sealant applied at the joint between the soldier course brick and steel lintel at the head of windows on the west exterior wall (Photo 9).
10. Black staining on brick in certain areas of both the east and west walls (Photo 10).
11. Water leaking out of glass-to-metal gasketed joints in new windows (Photos 11 and 12).

Interior

The interior finishes on both the east and west exterior walls (Photos 13 and 14) of the auditorium were observed. In general, moisture-related distress that was widespread on the west wall as absent from the east wall. Accordingly, the observations below pertain to the west wall.

- Cracked paint.
- Blistering/bubbling/peeling paint (Photo 15).
- Deteriorated plaster (Photos 16 – 18).
- Deteriorated decorative gypsum shapes (Photo 19).

It is important to note that the distress conditions above were most evident at the wall sections located between the windows. Distress was observed over the full-height of these wall sections from the window sills to the heads.

Attic

Access to the attic space above the ceiling of the auditorium was limited. Observations were made near the northwest corner of the auditorium.

- Efflorescence on interior surfaces of both the north and west exterior walls of the auditorium (Photo 20).

Roof

Limited review of the roof of the auditorium was performed.

- Distressed brick at exterior wall of adjoining section of building to the south.
- Deteriorated sealants at parapet coping joints.
- Condensate line at rooftop HVAC unit directs water onto roof and toward gutter at west side of roof. Joint in gutter possible source of leaking down west wall of auditorium.

TESTING

Relative moisture readings were taken on the interior finished surfaces of the east and west walls of the auditorium. Non-destructive readings were taken using a GE Protimeter MMS2 moisture meter which measures moisture on a scale of 0 to 999. Readings were taken over the wall sections located under the windows. Readings taken at the east wall ranged from 129 to 256. Readings taken at the west wall ranged from 139 to 999 (Photo 21). Refer to Exhibits A and B.

We also used an FLIR infrared camera to take infrared images of both the interior and exterior surfaces of the east and west walls. Infrared thermography measures infrared radiation and generates thermal images that show thermal patterns of objects under observation. With an understanding of typical temperature signatures, engineers can detect problem areas as they typically show up as thermal anomalies in the acquired image. Infrared thermography uses a device called an infrared thermal camera to acquire and analyze thermal signatures. This camera can detect, measure and analyze the infrared light and generate thermal images of the objects being viewed. Thermal images can reveal hidden problems within the building envelope, making the camera an extremely useful forensic tool.

Images were taken approximately two hours after sundown. Images at windows indicate that the brick at the perimeter of the windows had a lower surface temperature than brick in the field of the wall (Photo 20). Possible reasons for this thermal difference are a lack of a thermal break between the window frames and the brick and interior air leakage at the window perimeter. Thermal anomalies were detected at specific locations approximately ten feet below the top of the walls where the surface temperature was lower than the remainder of the wall (Photo 23). These locations were later identified as bearing points for steel roof trusses during our attic observations.

Photo 23 shows large areas of the wall in a magenta color and other areas in a white color. The white color indicates the highest surface temperature detected. The magenta color indicates wall areas with a slightly lower surface temperature. It is feasible that the white color indicates that these areas of the wall are retaining more moisture relative to the areas in the magenta color. Water has a high heat capacity, which is defined as the ratio of the heat added to (or removed from) a material to the resulting temperature change of the material. Accordingly, wet brick will not change in temperature as much as dry brick when heat is added to or removed from the material. With the drop in air temperature and lack of radiant heat at the time the infrared image was taken, heat was being removed from the brick wall. The resulting temperature change of the brick would have been less in areas of the wall with higher moisture content.

Thermal images also indicated that the surface temperature of the section of the east wall adjacent to the attic was lower than the surface temperature of the lower section of the wall. Infrared images of the west wall indicate that the surface temperature was less variable across the wall surface.

Walter P Moore set twelve data loggers at the east and west walls inside the auditorium (Photo 24). Data logger probes were set at the following typical locations. Refer to the referenced data logger images in Exhibits C and D for representative installations.

- Inside decorative gypsum finishes located between windows (Data Logger 26).
- Recessed in cement plaster finishes (Data Logger 25).
- At metal grilles located below windows (Data Logger 29).
- Exposed on window sills (Data Logger 28).

Data loggers were programmed to take temperature and relative humidity readings every hour. Data loggers will be retrieved at the end of the 4-month monitoring period.

DISCUSSION

Mortar joint repairs and brick spalling due to freeze-thaw damage indicate that moisture infiltration through the west exterior wall of the auditorium has been a problem in the past. However, we understand that interior distress at the west wall has become more apparent since completion of recent building renovations. The east wall of the auditorium does not exhibit moisture-related distress to interior finishes even though exterior distress conditions are similar to the distress observed at the exterior of the west well (i.e., cracked/deteriorated mortar joints, cracked bricks).

Based on our observations and field testing, it appears likely that there are multiple factors that have contributed to the moisture-related distress at the west wall. This includes moisture infiltration through the wall due to poor quality, deteriorated brick mortar joints and cracked brick. In addition, it appears likely that evaporative drying to the interior during the cooling season has contributed to interior distress. Vapor drive and evaporative drying to the interior is expected to be more substantial at the west wall of the auditorium than the east wall. This is because of the higher surface temperature at the exterior of the west wall during the afternoon hours. Accordingly, a greater temperature gradient (between the exterior and interior) will exist at the west wall which results in greater vapor drive. Another factor that may have contributed to the increased interior distress observed at the west wall of the auditorium is the recent addition of a new wing onto the building on the west side of the auditorium. This addition shields the west exterior wall of the auditorium from the late afternoon sun and reduces the ability of the wall to dry out.

The new windows at the west wall of the auditorium may have also likely contributed to the interior moisture-related distress. Sealants have been installed at metal-to-metal joints/seams in the window frames. These sealants were not installed at the time of window fabrication but were rather installed in the field. Based on our observations of water leaking out of glass-to-metal gasketed joints, it is possible that the drainage system for the windows has been blocked by the field-applied sealants. Window units are typically designed to permit drainage of incidental water and condensation from the assembly. The observed leakage out of the gasketed joints indicates that the drainage system for these windows is not functioning properly. It is also possible that under certain conditions water vapor condenses on the window frame and enters the brick wall, adding to the moisture that has entered the wall due to ingress of mass water through distressed/deteriorated mortar joint and brick units.

Another factor that may have contributed to the recently observed interior distress are modifications to heating, ventilation, and air-conditioning (HVAC) systems made during the recent renovations.

These are preliminary conclusions regarding the cause(s) of the observed interior distress. Temperature and humidity data collected during the 4-month monitoring period will be evaluated and these preliminary conclusions re-assessed based on the findings.

PHOTOGRAPHS

Photo 1: Overall view of north and west exterior walls of auditorium.

Photo 2: General view of west exterior wall of auditorium.

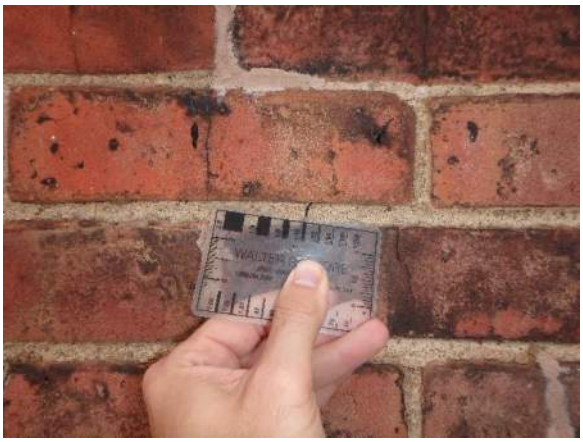


Photo 3: Mortar joint crack.

Photo 4: Mortar joint void.

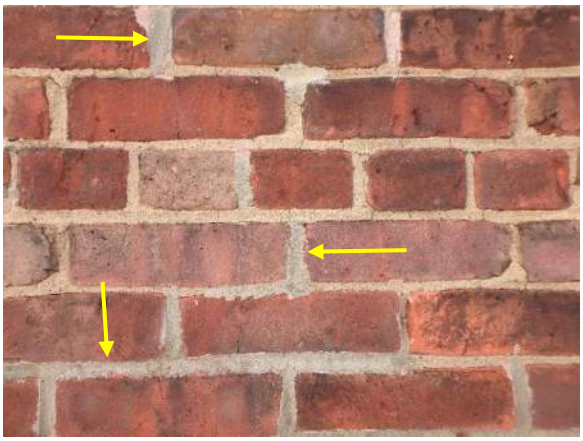


Photo 5: Mortar joint repairs.

Photo 6: Crack through brick.

PHOTOGRAPHS

Photo 7: Brick spall above window.

Photo 8: Corrosion at window head.

Photo 9: Sealant installed between soldier brick and steel lintel.

Photo 10: Partial view of west exterior wall of auditorium. Note varying color and staining of brick.

Photo 11: Sill of new window at auditorium. Arrows highlight field installed sealants at metal-to-metal joints/seams.

Photo 12: Close-up view of sill/jamb interface. Arrows denote water on sill framing.

PHOTOGRAPHS

Photo 13: General interior view of west exterior wall of auditorium.

Photo 14: Closer view of windows on west wall. Areas of most prominent moisture-related distress are highlighted.

Photo 15: Peeling paint at east wall at balcony.

Photo 16: Plaster deterioration between windows.

Photo 17: Deterioration of plaster at window jamb.

Photo 18: Deterioration of plaster at window jamb.

PHOTOGRAPHS

Photo 19: Deterioration of decorative gypsum shape near window sill.

Photo 20: Efflorescence observed inside attic.

Photo 21: Moisture meter reading at west wall.

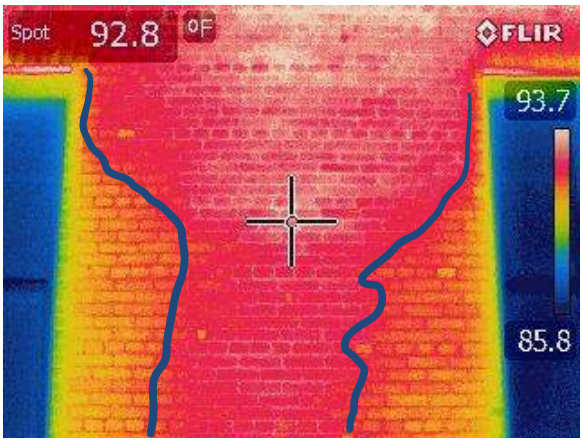


Photo 22: Infrared image of location of west exterior wall. Areas in yellow along window jambs have lower surface temperature than other (red) areas.

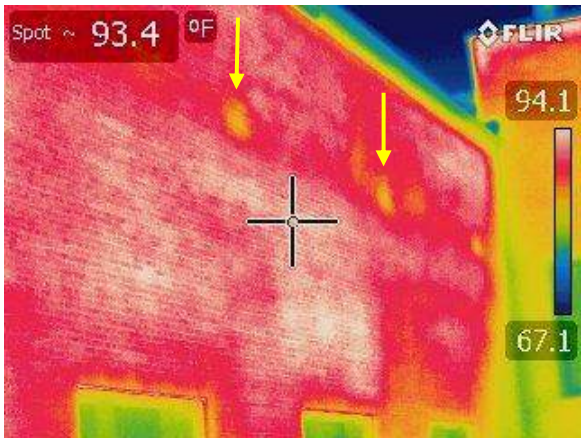


Photo 23: Thermal anomalies at west wall.

Photo 24: Datalogger set at window sill.

LIMITATIONS

This report has been prepared to assist McKissak & McKissack and their client in understanding the nature and type of distress investigated in this study and determine a future course of action. Walter P Moore assessed specific issues relevant to the distress inside the auditorium of the Stuart-Hobson Middle School in Washington, DC.

Walter P Moore has no direct knowledge of, and offers no warranty regarding the condition of concealed construction or subsurface conditions beyond what was revealed in our review. Any comments regarding concealed construction or subsurface conditions are our professional opinion, based on engineering experience and judgment, and derived in accordance with current standard of care and professional practice.

Various other non-structural, cosmetic and structural damage unrelated to this assessment may have been observed throughout the structure, some of which are discussed in general in this report. However, a detailed inventory of all cosmetic, nonstructural and structural damage was beyond the scope of our assessment. Comments in this report are not intended to be comprehensive but are representative of observed conditions. In this study we did not include review of the design, review of concealed conditions, or detailed analysis to verify adequacy of the structure to carry the imposed loads and to check conformance to the applicable codes. Repair recommendations discussed herein are conceptual and will require additional engineering design for implementation.

We have made every effort to reasonably present the various areas of concern identified during our site visits. If there are perceived omissions or misstatements in this report regarding the observations made, we ask that they be brought to our attention as soon as possible so that we have the opportunity to fully address them in a timely manner.

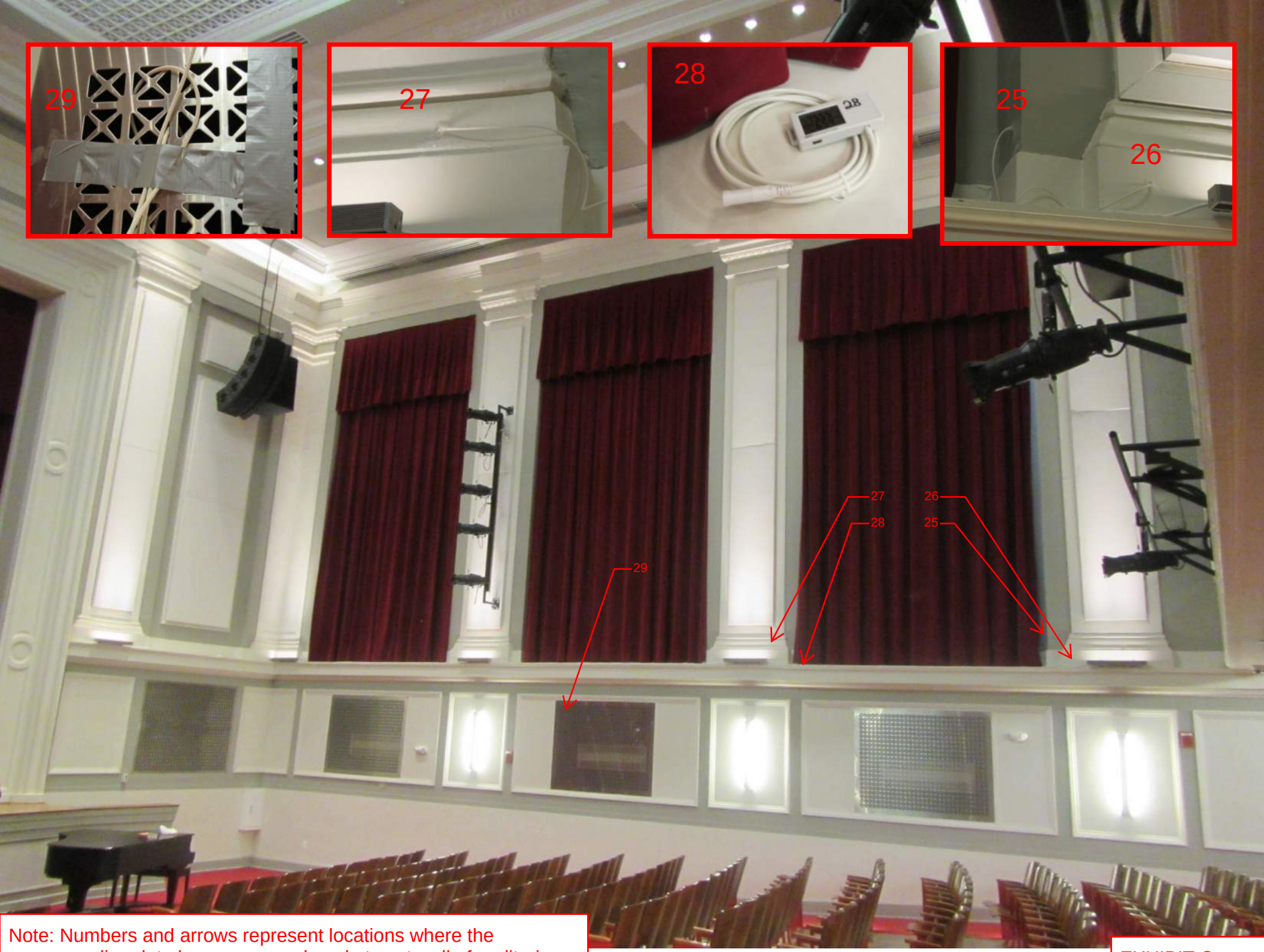
This report has been prepared on behalf of and for the exclusive use of McKissak & McKissack and their client. This report and the findings contained herein shall not, in whole or in part, be disseminated or conveyed to any other party or used or relied upon by any other party, in whole or in part, without prior written consent.

Note: Numbers represent moisture meter readings taken at east wall of auditorium.

EXHIBIT A

Note: Numbers represent moisture meter readings taken at west wall of auditorium.

EXHIBIT B



Note: Numbers and arrows represent locations where the corresponding data loggers were placed at east wall of auditorium.

EXHIBIT C

Note: Numbers and arrows represent locations where the corresponding data loggers were placed at west wall of auditorium.

EXHIBIT D