CYPRESS
BUILDING CONSERVATION

Preliminary Thermographic Survey of Madame John's Legacy, New Orleans, LA

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PROJECT SUMMARY

This report describes the preliminary thermographic survey results of the brick first floor walls of Madame John's Legacy located in the French Quarter of New Orleans, LA. This work was completed by Cypress Building Conservation over a period of three days from Monday, August 5 to Wednesday, August 7, 2013. The thermographic survey was completed in conjunction with the installation of 3 temperature and relative humidity sensors in the wall core and a soil moisture sensor at the base of wall 281-NE4. The readings from these sensors will be used to determine the effectiveness of infrared thermography to map the internal moisture content of the brick walls using surface temperatures.

The results of this survey show temperature patterns occurring on each of the five wall surfaces in room 281. Cooler areas are represented by violets and blues while warmer areas are indicated by yellows and reds. The temperatures represented in all of the images are scaled to between 81° and 87° Fahrenheit. Areas near the bottom of the walls where there is no color have surface temperatures below 81° Fahrenheit.

PURPOSE

The moisture mapping methods in this report provide the Louisiana State Museum with a non-destructive testing procedure to locate moisture infiltration through the surface of the brick walls. Thermal cameras measure the amount of emitted thermal energy from a material surface. The camera software the generates a temperature map based on the amount of emitted thermal energy that reaches the camera sensor. Wall surfaces with large thermal differences between two connected elements or areas are an indication moisture content variances. Surfaces with areas of increasing moisture content appear as cooler areas in the infrared images due to the effects of evaporation (surface cooling). After moisture infiltrates the wall, it evaporates leaving efflorescence or salt crystallization on the brick surface. Salt crystallization, on the interior and exterior of the porous brick and original mortars, has caused accelerated damage. Determining the patterns of moisture infiltration across wall surfaces will provide the Louisiana State Museum with a method to develop conservation treatments to stop further efflorescence from occurring. Additionally, scaled infrared images captured of the wall surfaces under different environmental conditions will provide the Louisiana State Museum with a nondestructive method to test how changes in the exterior and interior environment affect moisture infiltration and salt deposition on the brick surface.

INFRARED CAMERA SPECIFICATIONS

The camera used for all infrared imaging was the FLUKE Ti32 Thermal Imager. This camera has a 320 x 240 uncooled micobolometer focal plane array and the temperature measurement range for this camera is -20°C - 600°C with an accuracy of +/- 2° C at 25° C. The thermal sensitivity of the camera allows for 76,800 individual temperature measurements and the detection of temperature variations of .004° C on a sample surface. This camera has a field of view of 23' x 17' and a minimum focus distance of 18". The Fluke Ti32 camera captures both an infrared thermogram of emitted thermal energy between 7.5 µm to 14 µm wavelengths and also a visible light image of the same field of view. FLUKE cameras have a patented IR Fusion technology that allows for the storing of a full visual image which can be displayed, blended and stored with each IR image. Thermal and visual images can be presented simultaneously as a full infrared image or as a Picture-In-Picture (PIP) image in various blend modes. This feature greatly enhances the ability to depict both real time and computer enhanced thermographic images allowing for the isolation of thermal anomalies on a sample surface.

Figure 1: A digital photograph and infrared image of wall 281-NE4 showing sensor locations. The sections of the wall in violet and blue indicate areas of higher moisture content of the wall.

RESULTS

Initial testing results show that infrared thermography is capable of mapping the moisture content of brick walls by mapping the surface temperature of the test wall.

In order to create a high resolution infrared image of the test wall, a series of infrared images was taken of each wall surface and scaled to show temperatures between 81° and 87° Fahrenheit. These images were then tiled over a high resolution digital photograph of the wall surface to create a single infrared image of each wall.

The infrared image in Figure 1 shows surface temperatures of wall 281-NE4 as well as the core locations where temperature and relative humidity sensors were installed inside the wall cavity. Figure 2 shows the installed sensors in wall 281-NE4 as well as the soil moisture sensor installed at the base of the wall.

Figure 2: Photograph showing the testing assembly and installed temperature, relative humidity and a soil moisture sensors.

SENSOR LOCATION

Initial sensor readings taken at the time of the thermographic survey on August 7, 2013 gives the following results: Sensor 1 @ 11" above the finished floor 74.95° F/ 99.8% RH; Sensor 2 @ 35" above the finished floor 75.92° F/ 99.8% RH; Sensor 3 @ 61" above the finished floor 76.78° F/ 67.8% RH. The temperatures measured on the interior of the wall are lower than those at the wall surface as indicated by the infrared image. However, the gradient of temperatures follows the same pattern of lower temperatures at the base of the wall with rising temperatures moving up the surface of the wall.

Continued and consistent use of thermal imagery is necessary in order to detect changes in moisture content in wall 281-NE4. Additional infrared images correlated to wall sensor data will allow for comparisons between wall sensor and infrared data over time and under changing conditions. Following future testing that shows a correlation between wall sensor and infrared data, the Louisiana State Museum can use this technique to determine the potential cases of moisture infiltration and also test proposed conservation interventions to slow salt crystallization and deterioration of the brick walls.

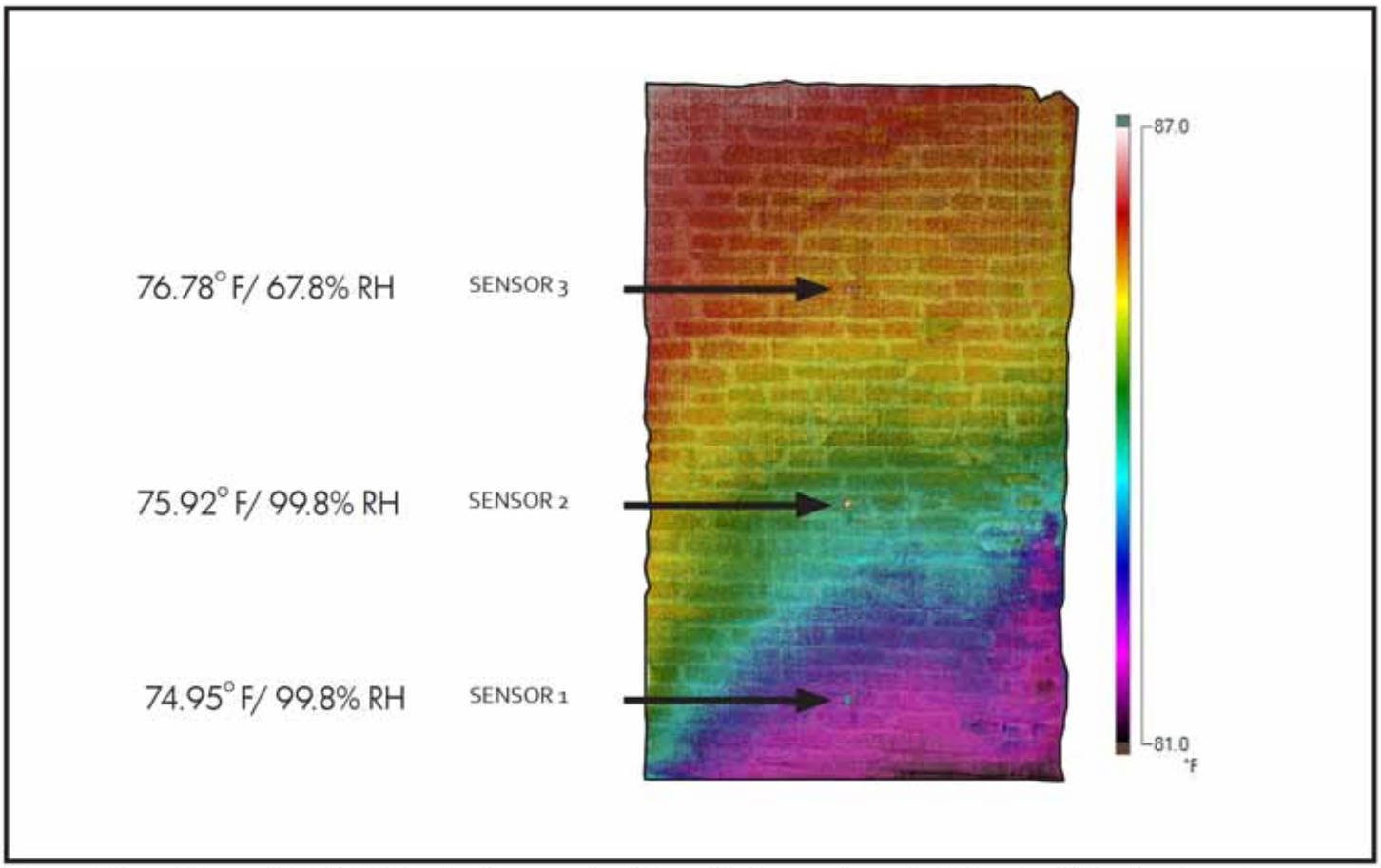


Figure 3: Infrared image of wall 281-NE4 showing sensor locations with temperature and relative humidity values for each sensor on August 7, 2013. The core of the wall is cooler than the exterior surface, however, there appears to be a correlation between surface temperature and moisture content.

THERMAL IMAGES OF ROOM 281

The following layouts depict surface temperatures on the five walls of room 281. All of the walls exhibit similar surface temperature patterns with the coolest portion of the wall surface being the base of each wall. The two long interior wall sections, 281-SE1 and 281-NW1, display the largest surface areas with temperatures below 81° F. Cooler temperatures are also found at the tops of these wall sections, possibly due to cool air falling from the climate controlled second level. The exterior wall in this room, wall section 281-SW1, has on average a higher surface temperature than the rest of the room. This is due to external heating of the exterior wall surface which has moved by conduction through the wall cavity to the interior wall surface. The highest surface temperatures are found on the test wall section 281- NE4. Continued monitoring of these wall sections using infrared thermography and sensor data will help to better understand the effect of the external environment on the location of moisture infiltration in the wall cavities under different environmental conditions.

DIGITAL PHOTOGRAPHS

INFRARED IMAGE OVER PHOTOGRAPHS

281-NE4 | 281-SE1 | 281-SW1 | 281-NW1 | 281-NE1

FIRST FLOOR

Drawing:	Comparison between rectified wall elevation and merged thermal images
Date:	August 26, 2014
Analysis:	Michael Shoriak Cypress Building Conservation

MADAME JOHN'S LEGACY

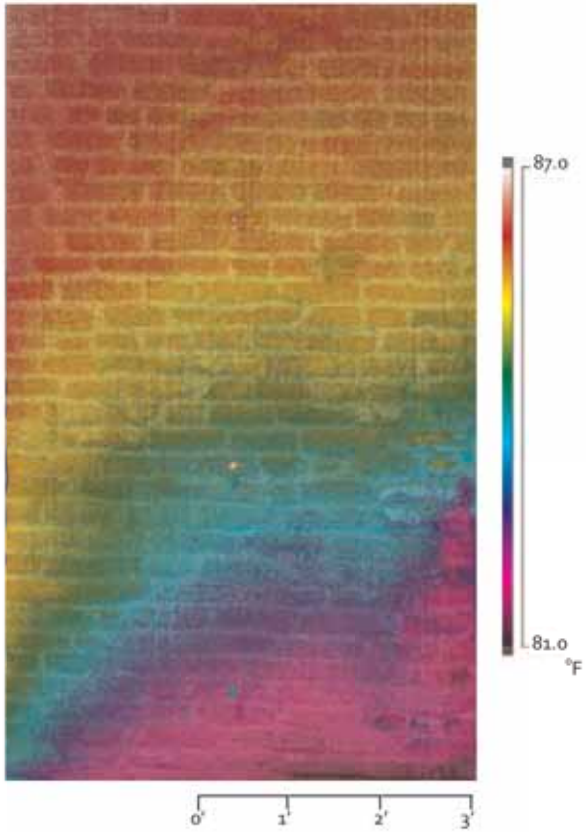
632 DUMAINE STREET, NEW ORLEANS, LA, 70116

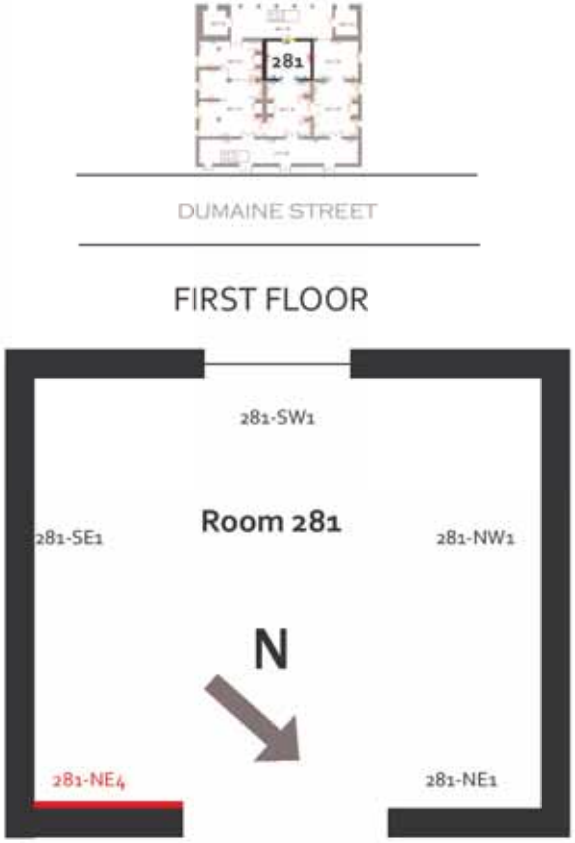
room #

281

DIGITAL PHOTOGRAPH

INFRARED IMAGE OVER PHOTOGRAPH





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MADAME JOHN'S LEGACY

632 DUMAINE STREET, NEW ORLEANS, LA, 70116

wall #

281-ne4

DIGITAL PHOTOGRAPH

0' 1' 2' 3'

INFRARED IMAGE OVER PHOTOGRAPH

0' 1' 2' 3'

87.0

81.0 °F

DUMAINE STREET

FIRST FLOOR

N

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MADAME JOHN'S LEGACY

632 DUMAINE STREET, NEW ORLEANS, LA, 70116

wall #

281-se1

DIGITAL PHOTOGRAPH

0' 1' 2' 3'

INFRARED IMAGE OVER PHOTOGRAPH

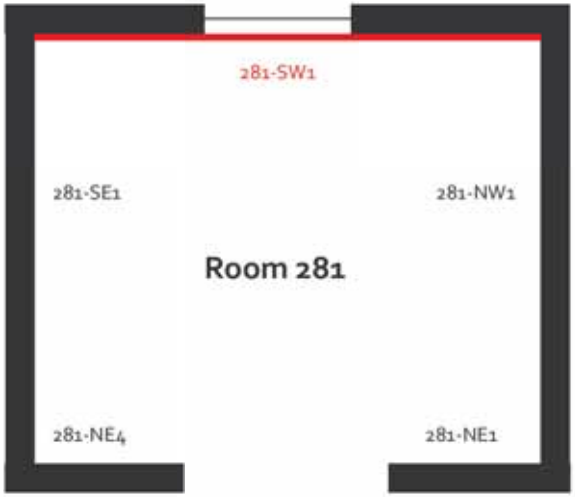
0' 1' 2' 3'

87.0

81.0 °F

DUMAINE STREET

FIRST FLOOR



N

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MADAME JOHN'S LEGACY

632 DUMAINE STREET, NEW ORLEANS, LA, 70116

wall #

281-SW1

DIGITAL PHOTOGRAPH

0' 1' 2' 3'

INFRARED IMAGE OVER PHOTOGRAPH

0' 1' 2' 3'

87.0

81.0 °F

DUMAINE STREET

FIRST FLOOR

N

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MADAME JOHN'S LEGACY

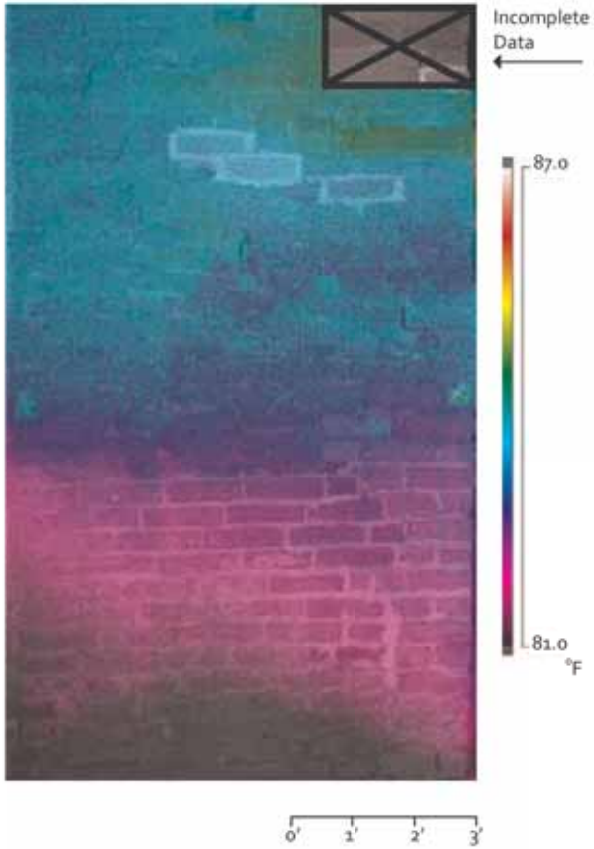
632 DUMAINE STREET, NEW ORLEANS, LA, 70116

wall #

281-nw1

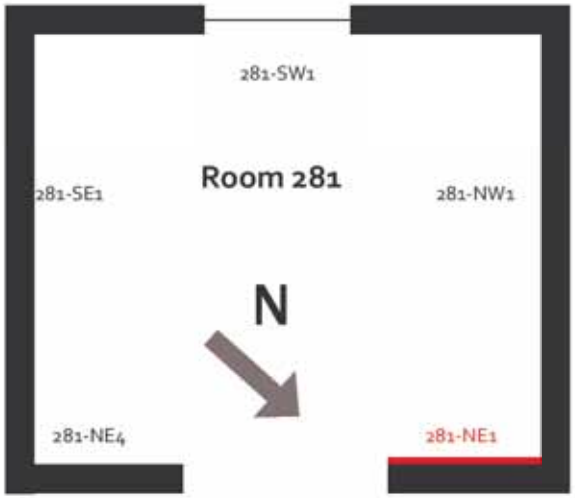
DIGITAL PHOTOGRAPH

INFRARED IMAGE OVER PHOTOGRAPH



DUMAINE STREET

FIRST FLOOR



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MADAME JOHN'S LEGACY

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wall #

281-ne1