

Cross-section Paint Microscopy Report

Jefferson County Courthouse Exterior Paints Charles Town, West Virginia

For: Bill Polk
Director of Maintenance
Jefferson County Commission
128 Industrial Boulevard
Kearneysville, West Virginia 25430

Conservator: Susan L. Buck, Ph.D.
303 Griffin Avenue
Williamsburg, VA 23185

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Jefferson County Courthouse South and West Elevations



Purpose:

The goal of this project is to use cross-section microscopy paint analysis techniques to analyze and identify the paints remaining on the exterior of the original 1837 Courthouse building. If earliest (original) coatings on the 1837 building and the 1910 addition remain *in situ* they will be color-matched for documentation and replication with a colorimeter/microscope.

Procedures:

Susan L. Buck met with Bill Polk on September 19, 2012 to review the areas where the painted surfaces are flaking and damaged, and to look at the paints on the north wall of the original building that were trapped when the 1910 addition was constructed. The brick and wood trim painted surfaces were first examined at 30X magnification with a monocular microscope, then samples (about 300 microns in size) were removed with a microscalpel and placed in labeled polyethylene baggies for transport. At the lab these samples were first examined at 45X magnification with a binocular microscope and the best samples were selected for analysis. This group was cast into polyester resin cubes for permanent mounting. The cubes were ground and polished for cross-section microscopy analysis and photography. The sample preparation methods and analytical procedures are described in the reference section of this report.

The cast samples were analyzed with a Nikon Eclipse 80i epi-fluorescence microscope equipped with an EXFO X-Cite 120 Fluorescence Illumination System fiberoptic halogen light source and a polarizing light base using SPOT Advanced software (v. 4.6) for digital image capture and Adobe Photoshop CS for digital image management. Digital images of the best representative cross-sections are included in this report. Please note that the colors in the digital images are affected by the variability of image capture and color printing and do not accurately represent the actual colors.

Paint Analysis Results

The original building and the 1910 addition are now painted with an opaque, deep red, oil-based paint and the wood trim elements and columns are coated with a bright white oil-based paint. An easel painting mounted on the east wall of the stair hall of the Courthouse depicts the building with deep red trim elements and tannish or cream-colored brick body. The painting does not show the north addition, but the inscription is not dated so it may be a modern interpretation of the appearance of the original building (see below). It is interesting to note that there are early yellowish limewashes in the cross-section samples that might relate to the brick color shown in the painting and several early red and red-brown paints were found on the windows.

“COURT HOUSE WHERE JOHN BROWN WAS TRIED AND SENTANCED
STUART”



Black and white images from the Historic American Buildings Survey (HABS) collection on the Library of Congress website of the exterior of the building after 1933 show the brick body as a solid dark color and the wood trim as a very light color. In these images the bases and capitals of the columns on the south elevation are not as dark as the body color, so the bases were likely painted with a color similar to the current green. The capitals are now white.

HABS WVA-19-CHART,3-2



HABS WVA-19-CHART,3-4



The cross-section paint evidence will be described and illustrated based on location and type of element, beginning with the brick and wood trim samples taken from the 1837 building. This also includes a discussion of the evidence found on the trapped north wall of the second story of the 1837 building which presumably dates to 1871-72 when the “walls of the Courthouse were built higher to accommodate larger second-story windows, equal to those on the first floor”.¹ After this restoration the exterior painting of the Courthouse was described in an article in *The Virginia Free Press*: “The painting by Wm. Kimes is a very marvel of beauty and skill”.²

The evidence found in the two window trim samples from the 1837 building will then be presented, and then this section ends with a discussion of the evidence in one sample taken from the well-adhered red paint on the one-story 2007 addition to the east for comparison.

Sample Locations

South Elevation

1. Brick left of door, about 3-feet up, at peeling area, recent paint is thick and flexible.
3. Relatively intact painted brick above bronze plaque left of door.
4. Relatively intact painted mortar above bronze plaque, mortar is quite soft.
5. West window, west architrave, 5-feet up at loss, for trim paints.
6. Stable paint on brick of one-story east addition, about 5-feet up, near join with original building.

North Elevation

2. Trapped brick just below gable level, enclosed by north addition, coating is red paint with joints picked out in black.

West Elevation

7. Brick below north window, about 5-feet up, area of incipient paint failure.
8. Brick below north window, about 6-feet up, area where the paints are well-adhered to the brick.
9. North window, trim paint on underside of stone sill, right corner.

East Elevation

10. Stable paint on top of mortar joint below north window.
11. Cleaving paint on top of mortar joint below north window.

¹ David A. Kamnitzer, “Jefferson County, WV, Courthouse, Historic Structure Report”, August 31, 2010, 1-2.

² Ibid.

South Elevation



South Elevation

Brick Wall Detail



South Elevation Window Trim



2007 Addition



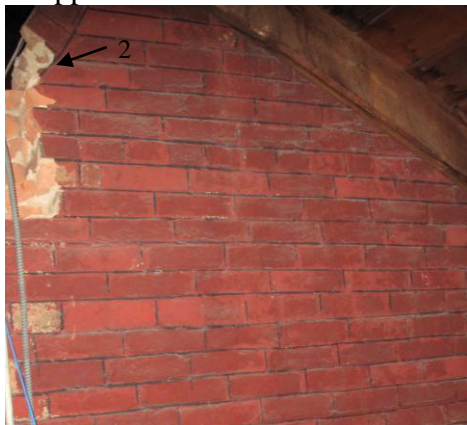
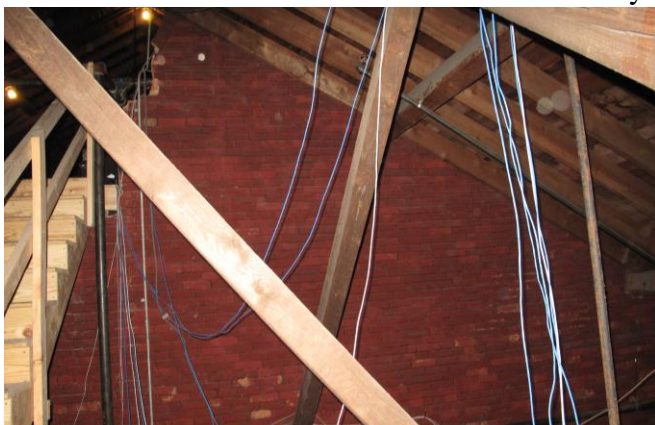
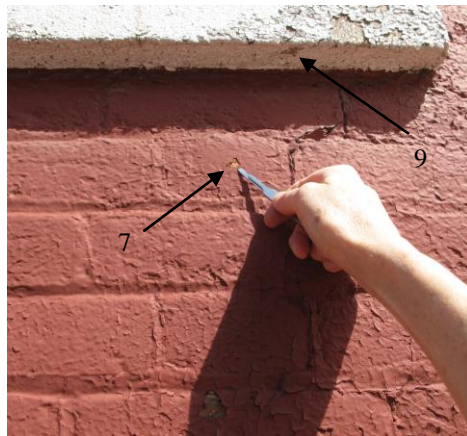
West Elevation North Window



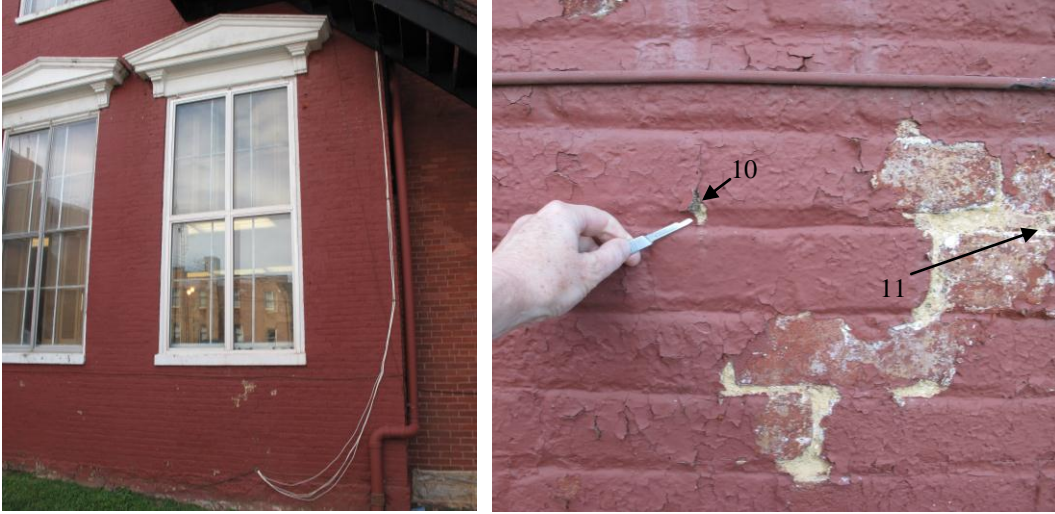
Detail



Painted Bricks and Mortar Joints on Second Story of Trapped North Elevation



East Elevation



Paints on Brick and Mortar of the 1837 Courthouse:

Samples were taken from areas of the brick and mortar where the paints are still relatively intact and from areas where there is active cleaving and damage, some of which may be due to rising moisture and salt applied to the paving during the winter.³ Two samples were also taken from different areas of window trim to see if it is possible to relate the early brick paints to the early trim paints using comparative cross-section microscopy analysis.

The most complete paint sequence for the 1837 bricks was found in sample 3 from an intact painted area of brick on the south elevation. There are approximately fifteen generations of coatings, beginning with remnants of a chalky, slightly translucent, yellow-pigmented limewash directly on top of the brick. This is followed by two more unpigmented limewashes, and then a grayish pigmented limewash in generation 4. Generation 5 is a yellowish pigmented limewash, and generation 6 is a greenish-gray pigmented limewash. Generation 7, a tannish-gray paint, is the first opaque, oil-based paint in the paint stratigraphy. All the subsequent coatings are opaque oil-based paints that are similar shades of red. A comparable sequence of coatings was found in sample 4 from a mortar joint in an intact area of paint on the south elevation.

It is not surprising to find that the building was originally coated with limewash. In its simplest form limewash is essentially slaked lime and water mixed to the consistency of milk or cream, with pigments added to change the color from white to a range of grays, yellows, oranges or reds. Limewashes are completely compatible with brick, stucco and mortar as they do not trap moisture and they are easily renewed. The comparative evidence shows the building was recoated with limewashes until just before the 1910 addition. The first generation of red oil paint with picked-out black mortar joints was the last paint on the building before the addition was constructed.

³ Bill Polk, September 19, 2012.

When the paint history in sample 2, taken from the upper section of the trapped wall at the north end of the 1837 building, is compared to the evidence in samples 3 and 4, it is apparent that the first coating is a grayish pigmented limewash that can be aligned with generation 4 in the samples from the south elevation. The paints found on the trapped north wall consist only of generations 4 through 8. Generation 8 is the red oil-based paint with black mortar joints that can still be seen on the trapped north wall of the original building. This is consistent with this upper section of north wall being constructed as part of the 1871-72 restoration and then trapped by the addition in 1910.

The evidence in other cross-sections shows that in some areas the earliest paints are quite fragmentary. Sample 1, from an area of peeling paint on the south elevation, is missing generations 1 through 5, and retains remnants of the grayish-green limewash found in generation 6, followed by seven generations of dark red oil-based paints.

Sample 7, from a badly peeling area of brick on the west elevation, retains only remnants of the early limewashes, followed by the most two most recent oil-based paints. By comparison, the coatings in sample 8, from a stable area of painted brick on the west elevation, consist only of the most recent seven generations of oil-based deep red paint. There are no limewashes in this cross-section, which may be one reason that the oil-based paints are so well-adhered in this area.

The brick and mortar surfaces on the east elevation (samples 10 and 11) retain a few of the early limewashes. But in sample 11, taken from a mortar joint where the paints are actively flaking, the later red paints have flowed into cracks between the damaged layers of the generation 6 and 7 limewashes. The absence of the earliest limewashes suggests that this area has had flaking problems for many years. The stratigraphy of coatings found on the most intact areas of brick and mortar is shown in the chart below.

Reconstructed Brick Paint Stratigraphy

<u>Generation/Layer</u>	<u>Observations</u>
15. Oilbound red paint	
14. Oilbound red paint	
13. Oilbound red paint	
12. Oilbound red paint	
11. Oilbound red paint	
10. Oilbound red paint	
9. Oilbound red paint	First layer on the 1910 addition
8. Oilbound red paint with black mortar joints	Black mortar joint found in samples 2, 4 and 11
7. Oilbound tannish-gray paint	
6. Gray limewash	
5. Yellowish limewash	
4. Greenish-gray limewash	First layer on 1871 trapped north wall
3. Unpigmented limewash	
2. Unpigmented limewash	
1. Yellowish limewash	Earliest coating found on 1837 building
Brick and mortar substrates	

Binding media characterization with biological fluorochrome stains shows that there are strong reactions for oils in all the opaque red paints found in generations 8 through 15 with the fluorochrome Rhodamine B (RHOB). There is also an uneven positive reaction for oils in the tannish-gray paint in generation 7. Positive reactions for carbohydrates with triphenyl tetrazolium chloride (TTC) were also observed in all the deep red paints, which may relate to modern cellulosic bulking agents in these coatings.

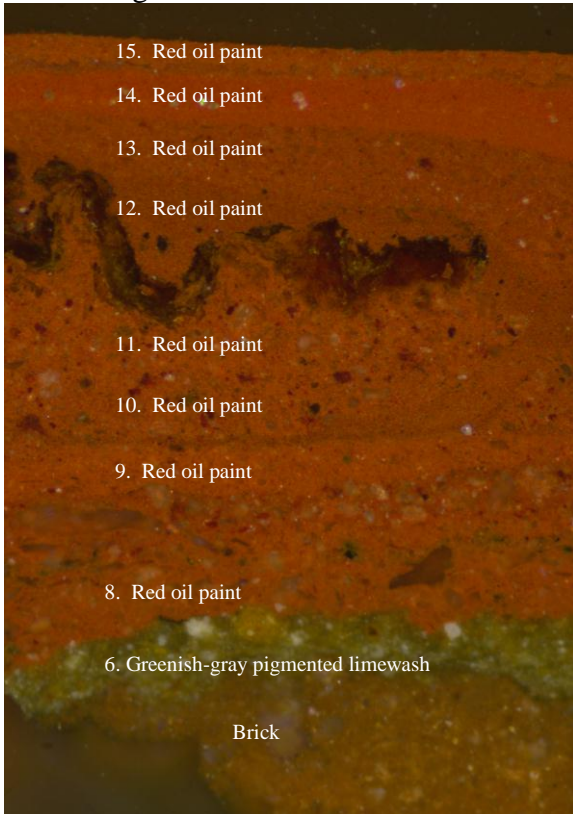
Weak positive reactions for proteins with fluorescein isothiocyanate (FITC) were observed in the limewash layers in generations 1 through 4. Some traditional limewash recipes list proteinaceous additives like milk, casein and hide glue which were likely intended to increase the durability of exterior limewashes.

Sample 1. South elevation. Brick left of door, about 3-feet up, at peeling area, recent paint is thick and flexible.

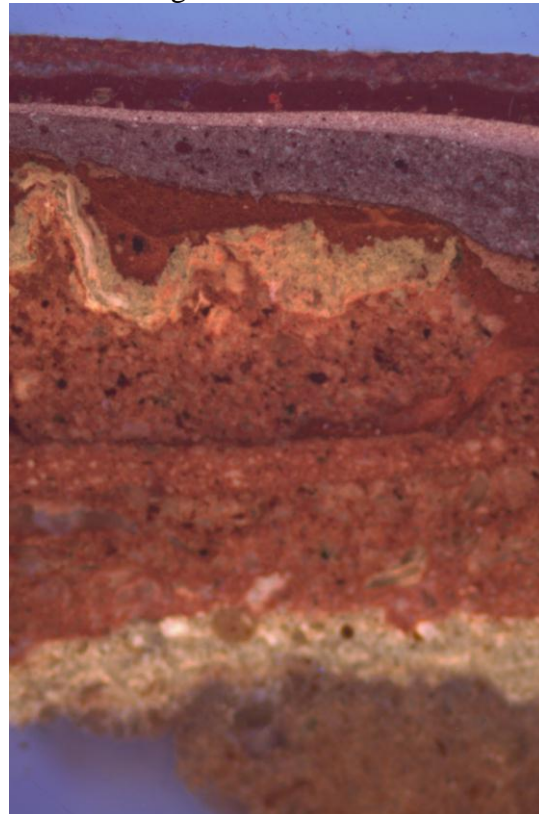
Visible Light 40X



Visible Light 100X



Ultraviolet Light 100X

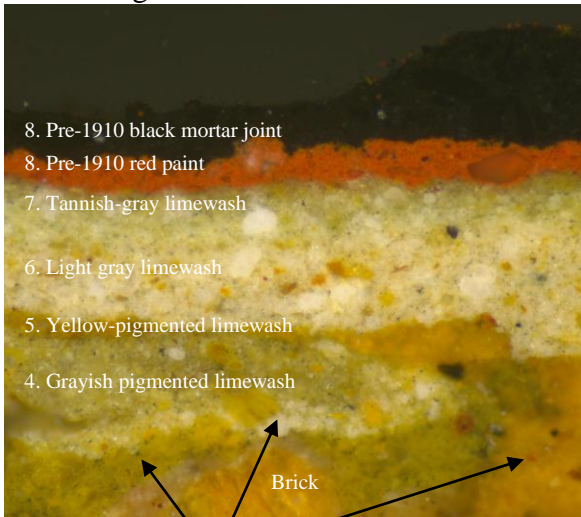


Sample 2. North elevation. Trapped brick just below gable level, enclosed by north addition, coating is red paint with joints picked out in black.

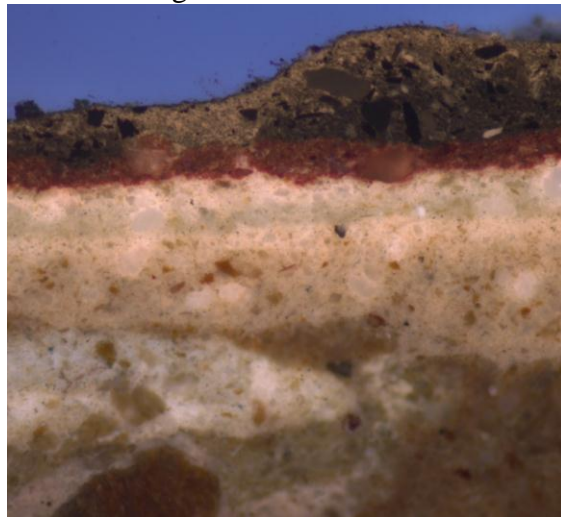
Visible Light 100X



Visible Light 200X



Ultraviolet Light 200X



Later limewashes flowed into cracks in earlier coatings

Sample 3. South elevation. Relatively intact painted brick above bronze plaque left of door.

Visible Light 40X

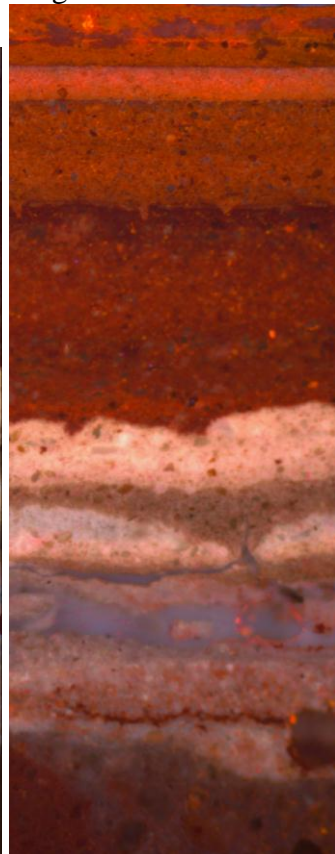
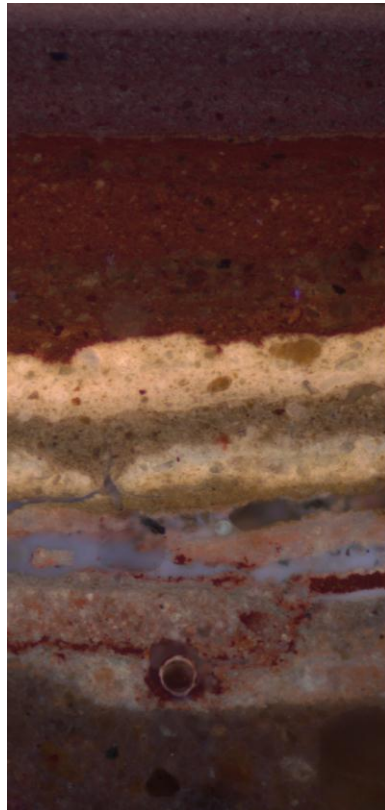
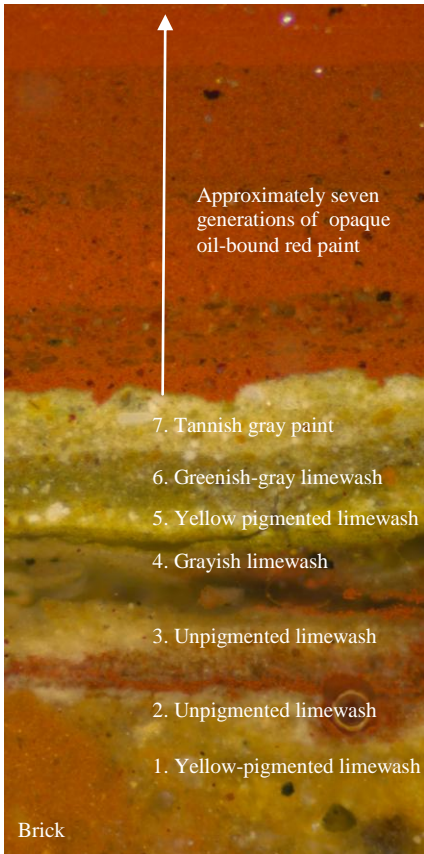


Later red paint flowed into cracks in early limewashes

Visible Light 100X

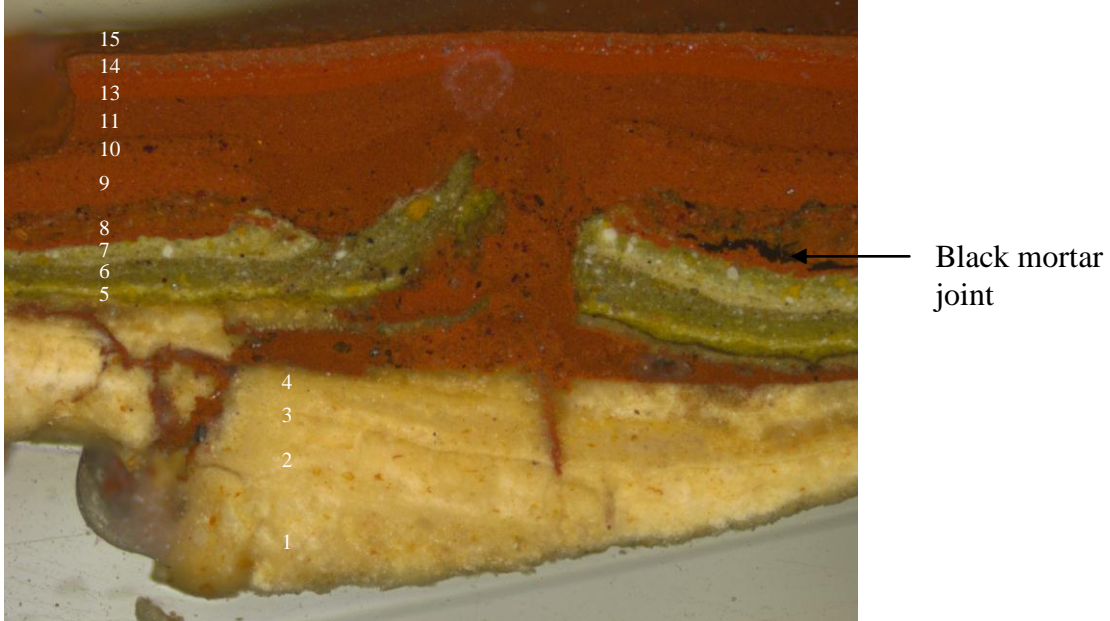
Ultraviolet Light 100X

UV Light & RHOB + for oils in generations 7-14



Sample 4. South elevation. Relatively intact painted mortar above bronze plaque, mortar is quite soft.

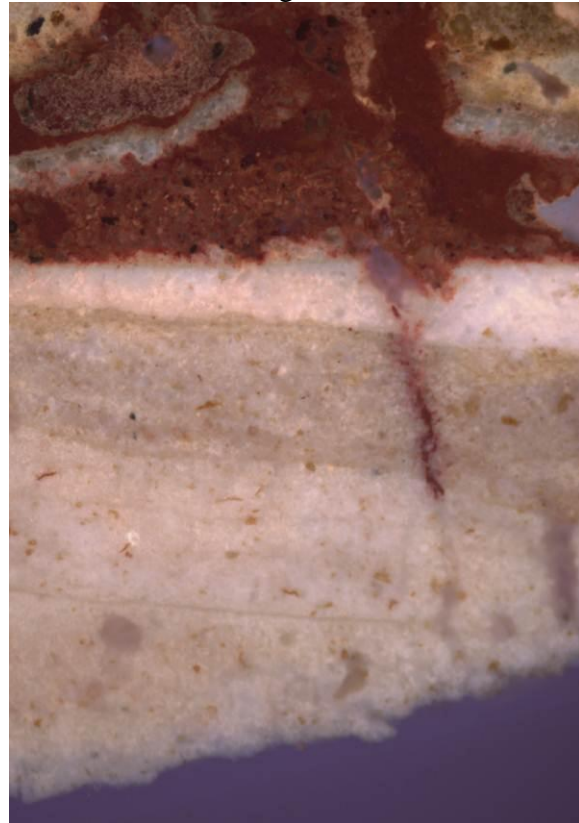
Visible Light 40X



Visible Light 100X

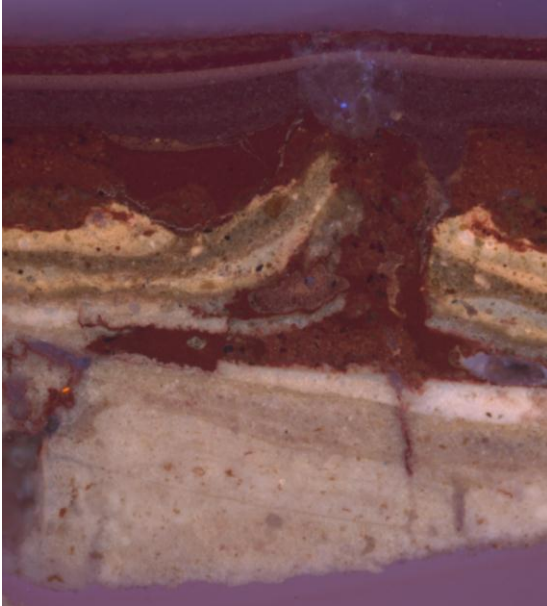


Ultraviolet Light 100X

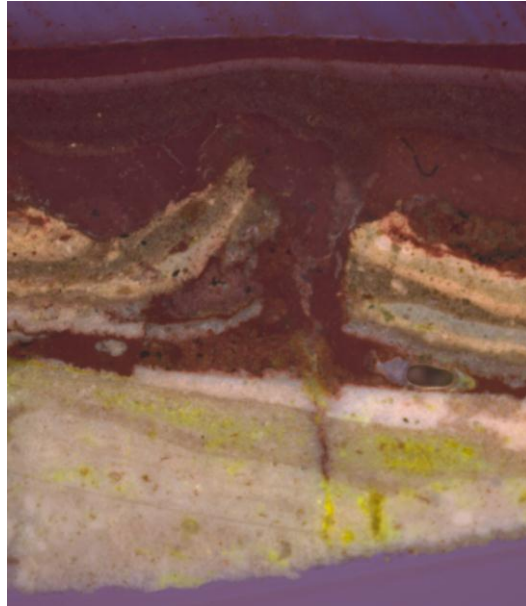


Sample 4. South elevation. Relatively intact painted mortar above bronze plaque, mortar is quite soft.

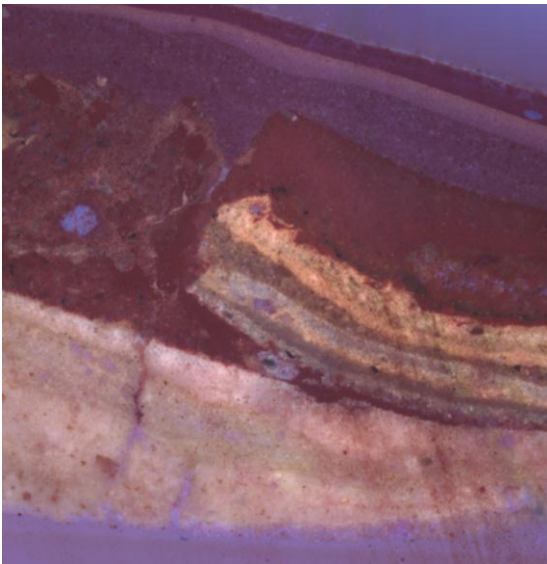
Ultraviolet Light 40X



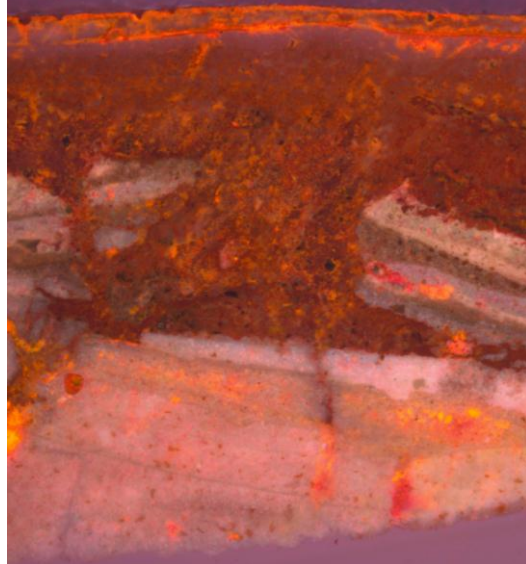
UV Light & FITC for proteins 40X
Weak + reactions for proteins in generations 1-4



UV Light & TTC for carbohydrates 40X
Weak+ reactions for carbohydrates in generations 8-15

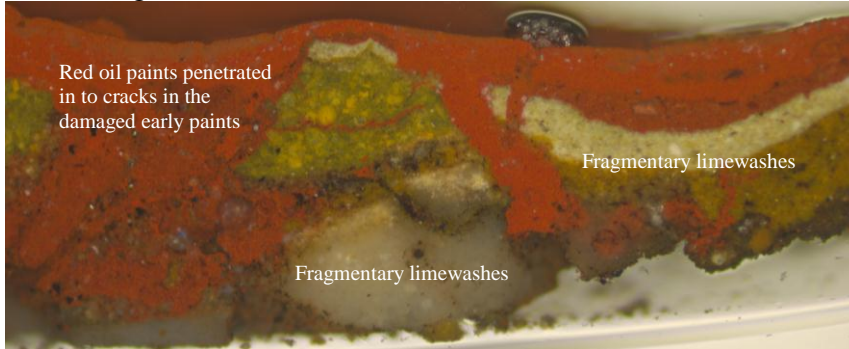


UV Light & RHOB for oils 40X
Strong + reactions for oils in generations 8-15

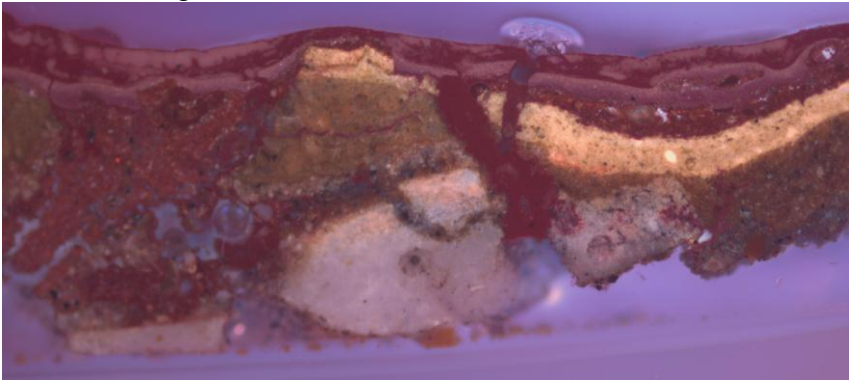


Sample 7. West elevation. Brick below north window, about 5-feet up, area of incipient paint failure.

Visible Light 40X



Ultraviolet Light 40X

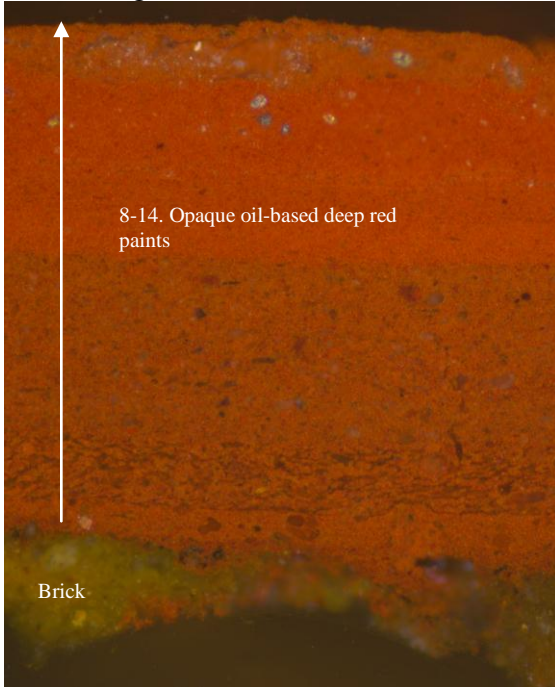


Sample 8. West elevation. Brick below north window, about 6-feet up, area where the paints are well-adhered to the brick.

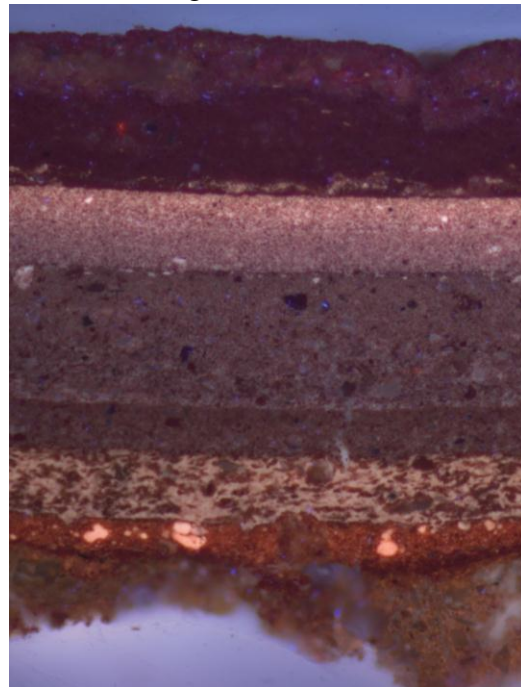
Visible Light 100X



Visible Light 200X

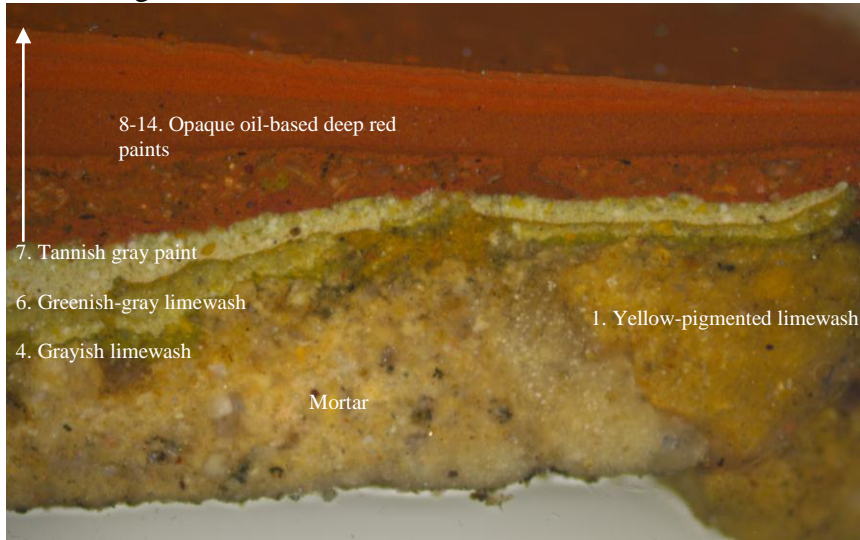


Ultraviolet Light 200X



Sample 10. East elevation. Stable paint on top of mortar joint below north window.

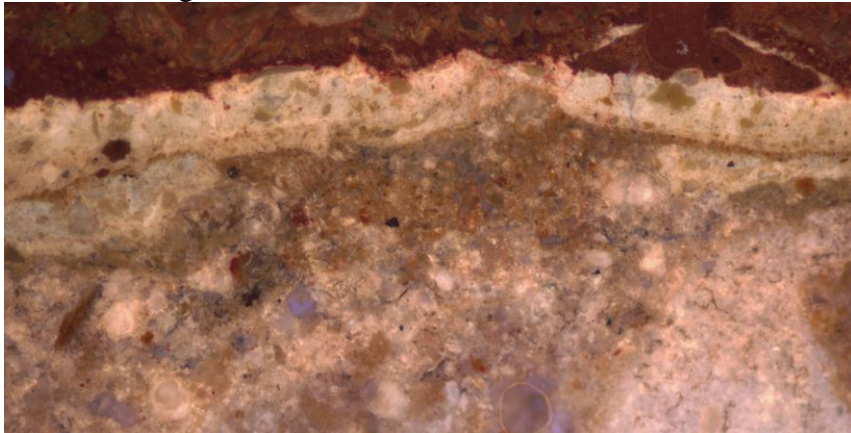
Visible Light 40X



Visible Light 100X



Ultraviolet Light 100X

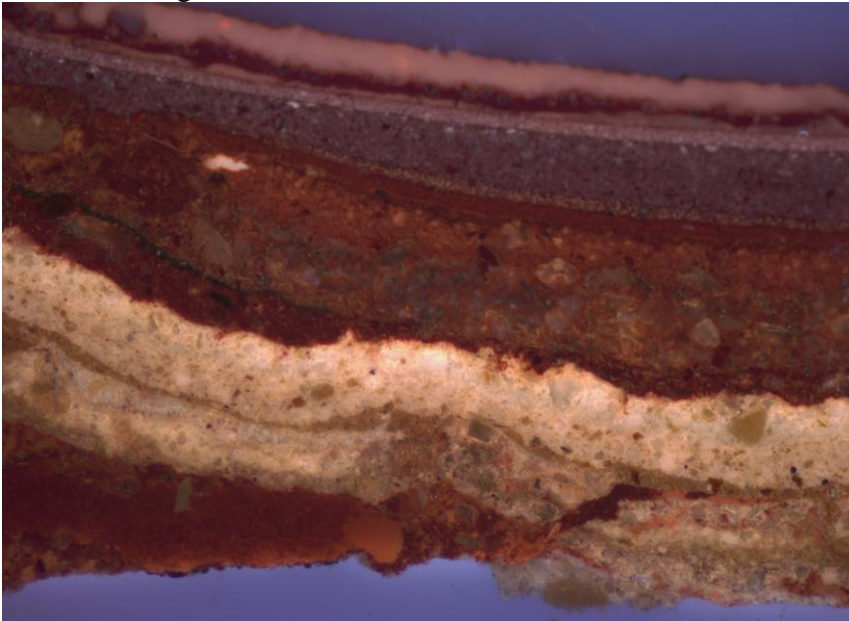


Sample 11. East elevation. Cleaving paint on top of mortar joint below north window.

Visible Light 100X



Ultraviolet Light 100X



Paints on the Window Trim of the 1837 Courthouse:

The window trim was not the focus of this investigation, but two samples were taken from two different areas of window trim to understand the early coatings, and to try to relate the window trim colors to the brick body colors. Sample 5 from a window architrave on the south elevation contains approximately 16 generations of paint that can be loosely correlated with the brick paints.

In this cross-section there are remnants of off-white paint remaining on top of the wood substrate, which may date to 1837. Generations 2 and 3 are tan paints with resinous components which would have made them glossier and more durable than traditional white lead-based oilbound paints. Generation 4 is off-white, followed by two red-brown paints in generations 5 and 6. All the subsequent paint layers are variations of cream color and off-white. The most recent bright white paints are considerably brighter and cooler in color than the earliest off-white coatings.

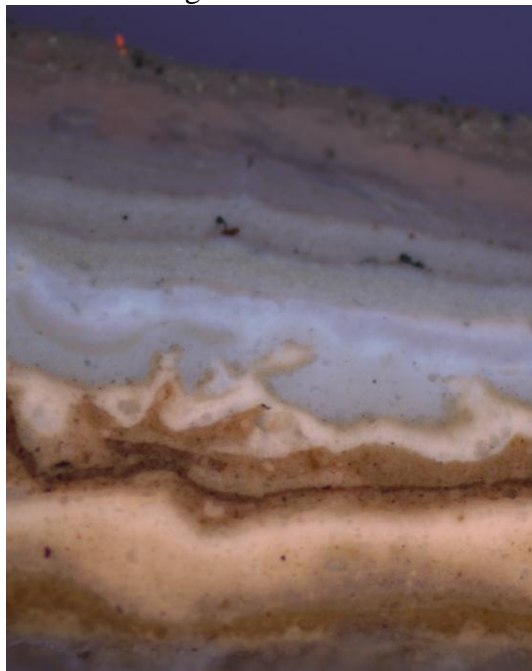
When the paints in sample 9 from the underside of the stone window sill are compared to sample 5, it appears that the first paint on the sill is a deep red that may be an overlap from the brick body color. This is followed by off-white and white paints that can be aligned with generations 9 through 16. The comparative evidence suggests that there is a long history of cream-colored or off-white paint on the window trim, and certainly by the 1910 addition the window trim was consistently painted off-white.

Sample 5. South elevation. West window, west architrave, 5-feet up at loss, for trim paints.

Visible Light 100X

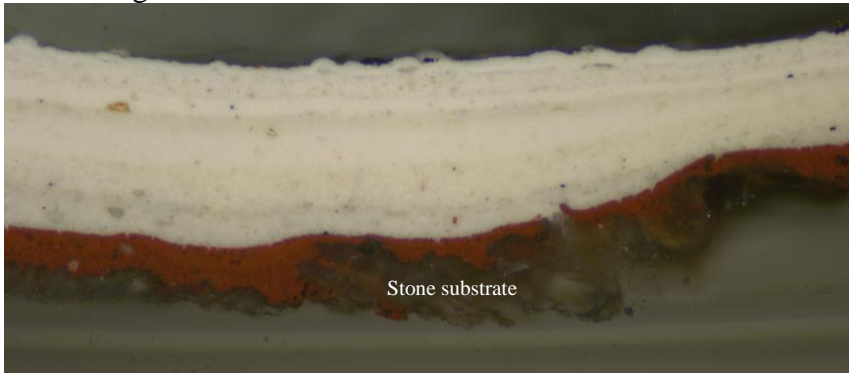


Ultraviolet Light 100X

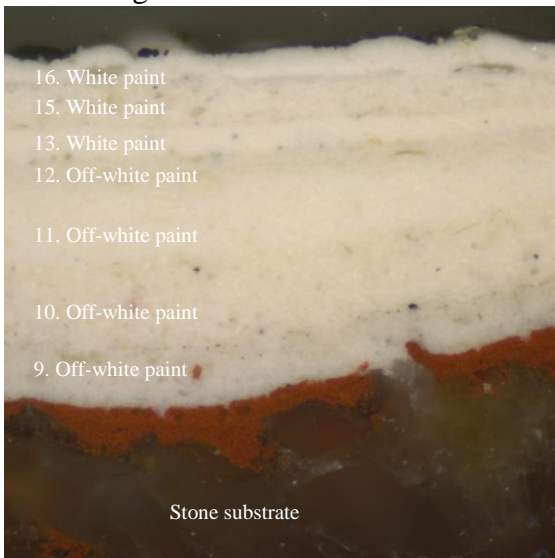


Sample 9. West elevation. North window, trim paint on underside of stone sill, right corner.

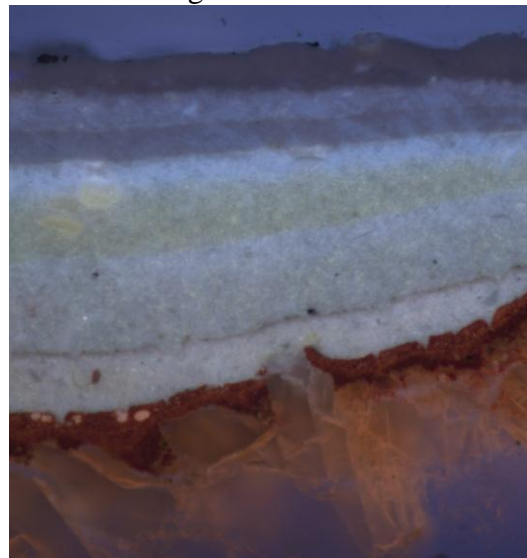
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Visible Light 200X



Ultraviolet Light 200X



Paints on the 2007 Addition:

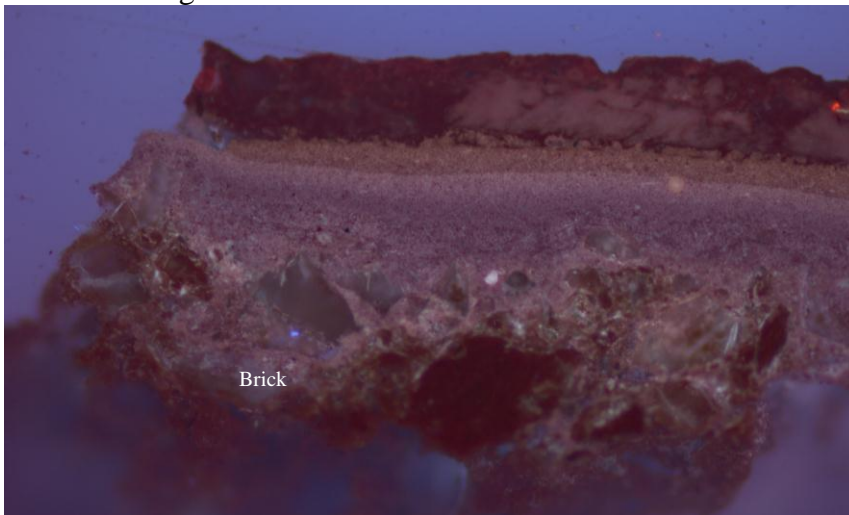
One area of painted brick on the most recent addition to the east of the Courthouse was sampled for comparison with the historic painted surfaces. This cross-section shows that one reason the red paint is so well-adhered and stable is that the first paint layer penetrated deeply into the uneven surface of the brick, creating a strong mechanical bond. The next two red paints are smooth and unweathered finish coats. There are no priming layers in this cross-section.

Sample 6. South elevation. Stable paint on brick of one-story east addition, about 5-feet up, near join with original building.

Visible Light 100X



Ultraviolet Light 100X



Conclusion:

The evidence in this group of samples shows that there is a considerable amount of variation in the surviving paint histories from area to area. In general, the areas where the paints are still well-adhered do not retain as many early limewash coatings. The most intact painted surfaces are those where the red oil-based paints are in direct contact with the brick and mortar substrates. However, these early limewashes remain as important evidence of how the bricks were painted before the 1863 battle which badly damaged the Courthouse.

It is quite remarkable that these early coatings survive as a contemporary description suggests that the building was terribly damaged: “. . . The only ruined parts of the town are the Courthouse and the Jail. The former maintains its walls and outlines, and the four brick and plaster Doric columns before it are still standing, but the roof is reduced to a few beams, the whole interior is torn out, and the edifice has only one floor . . .”⁴

The paint evidence and the HABS photographs indicate that the Courthouse was painted dark red just before the 1910 addition, and then continued to be painted in similar colors up to the present, suggesting that it would not be appropriate to return to an early limewash coating as these lime-based pigmented washes were only applied to the building before the 1910 addition. The 1910 addition was never limewashed, and the Courthouse and the addition are now painted to match each other. So, if the Courthouse is to be repainted based on its current form, the appropriate palette would be the colors applied just after the addition was completed. Color matches have been made for the 1910 deep red body color and off-white trim color. A color match has also been made for the original dull yellow limewash color, for documentation and to better understand the original appearance of this Courthouse. The window trim paints are too damaged and degraded to allow accurate color measurement of the 1837 or 1910 white lead and linseed oil-based trim paints, but a color match for a traditional hand-ground off-white oil-bound paint is included for reference.

The following chart shows how the paint stratigraphies can be aligned in all the cross-section samples from the Courthouse brick.

⁴ HSR, 1-1.

Comparison of Paint Histories Found in Brick Cross-section Samples

Generation	1	2	3	4	6	7	8	10	11	Observations
15. Red paint	x				x	x			x	
14. Red paint	x		x	x	x	x	x	x	x	
13. Red paint	x		x	x	x		x	x	x	First paint on 2007 addition
12. Red paint	x		x	x			x	x	x	
11. Red paint	x		x	x			x	x	x	
10. Red paint	x		x	x			x	x	x	
9. Red paint	x		x	x		x	x	x	x	First paint on 1910 addition
8. Red paint with black mortar joints	x	x	x	x		x	x	x	x	Pre-1910 addition
7. Tannish-gray paint		x	x	x		x		x	x	
6. Gray limewash	x	x	x	x		x		x	x	
5. Yellowish limewash		x	x	x						
4. Greenish-gray limewash		x	x	x				x		First paint on 1871-72 restoration
3. Unpigmented limewash			x	x						
2. Unpigmented limewash			x	x		x				
1. Yellowish pigmented limewash			x	x				x		First paint found on 1837 building

Recommendations:

Some of the paint flaking problems observed on the building may relate to the presence of the early limewashes which are chalky and damaged, and have poor adhesion to the brick compared to the later oil-based paints. The worst areas of flaking are likely related to rising damp as they are located at the bases of the Courthouse walls. Other areas are very well-adhered, even where early limewashes remain. The comparative cross-section sequences graphically show the wide variations in surviving coating histories.

Preservation efforts related to historic buildings encourage retaining as much historic material, including paint finishes, as possible. As this small paint study demonstrates, the important early limewashes which predate the 1870-72 restoration still remain in some areas, providing insights into the appearance of the early building that would not be possible if all the exterior paints were removed.

Large historic sites like Colonial Williamsburg, Monticello, and Mount Vernon and small historic sites like Clermont Farm in Berryville, VA and Battersea in Fredericksburg, VA recognize the need to save historic paint evidence for future research. They also acknowledge that thoroughly stripping a building exterior for repainting completely removes evidence of aging over time, resulting in surfaces that appear incongruously new.

Generally, the recommended practice for exterior repainting of historic structures is to scrape off the paints that are actively flaking, and then hand-sand the edges of these areas to feather them into the surviving well-adhered paints. This provides intact surfaces for repainting and retains the historic materials.

If this conservative preservation approach is followed for the Courthouse then the paint chosen for repainting will have to stick well to the existing coatings and be porous enough to allow vapor penetration. A Keim potassium silicate paint was recommended by the National Park Service.⁵ So the next phase of work should be to test the appropriate Keim product, and possibly other paint products, on several areas of the exterior to see if what type of coating is most suitable on top of the paints that remain on the brick.

⁵ Bill Polk, September 19, 2012.

COLOR MATCHING PROCEDURES

Uncast portions of the most intact samples taken from samples containing the earliest pigmented limewash on the 1837 building and the red oil- based paint applied after the construction of the 1910 addition were used for matching with the Minolta Chroma Meter CR-241, a tristimulus color analyzer/microscope with color measurement area of 0.3mm. This instrument has an internal, 360-degree pulsed xenon arc lamp and provides an accurate color measurement in a choice of five different three-coordinate color systems.

The target layers for color matching were exposed with a scalpel to provide clean areas for color measurement and matching. The exposed layers were measured three times in three different areas of the exposed target layers to establish the color coordinates. The measurements were first generated in the Munsell color system (a color standard used in the Architectural Preservation field), and after the measurements were taken the closest Munsell color swatches from a standard Munsell Book of Color (gloss paint standards) was compared under 30X magnification to the actual samples. The measurements were also generated in the CIE L*a*b* color space system, which is currently one of the most widely accepted industry color space measuring systems.

However, when the Munsell matches generated through color measurement were compared to the actual limewash samples it became obvious that the paints were too darkened and degraded to allow accurate color measurement. So, a second round of color matching was done by eye comparing the Munsell swatches to the samples under 30-45X magnifications and a color-corrected light source. The best visual matches for the Munsell swatches were then used to generate close commercial paint matches.

The best commercial swatches are provided for color references only, not as recommendations for a particular paint manufacturer.

Generation 1 on the 1837 brick building. Original dull yellow pigmented limewash.

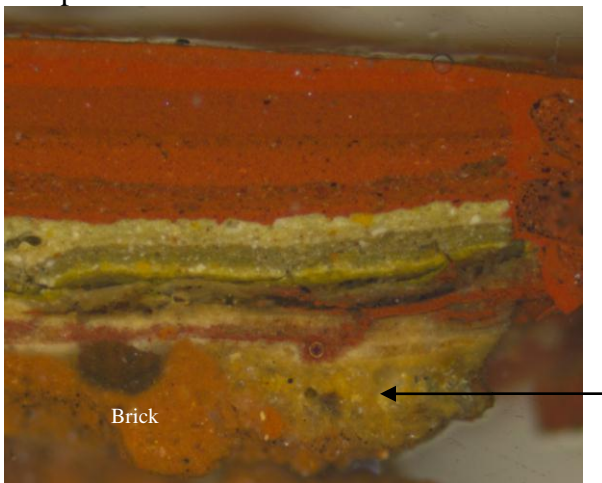
Samples 3, 4, 10

Color-matched October 11, 1012

Benjamin Moore #2165-10 “Dark Beige”

<u>Color System*</u>	<u>Coordinates</u>		
Munsell	Hue	Value	Chroma
	0.1Y	7.4	4.6
CIE L*a*b*	Black to White	Green to Red	Blue to Yellow
	L74.70	a+5.06	b+29.73

Sample 3



The degraded dull yellow-pigmented limewash was matched by eye at 30X magnification under a color-corrected light source to the Munsell Book of standards and it was measured with a Minolta CR 241 colorimeter/microscope. The swatch for 2165-10 is an excellent visual match to the best surviving areas of this original pigmented limewash. The evidence in the cross-section and the uncast samples suggest this paint was originally chalky and could be reproduced in a flat gloss level.

Generation 9. Deep red paint on brick related to 1910 addition.

Samples 1, 3, 4,

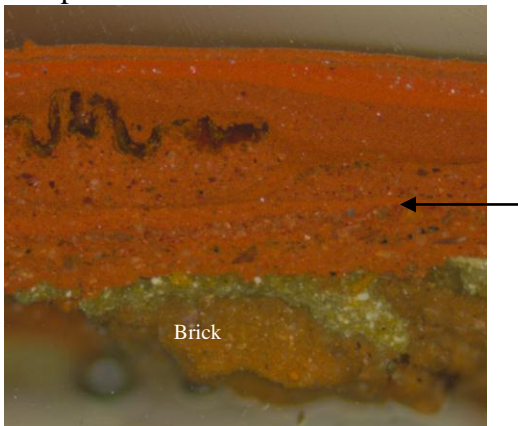
Color-matched October 12, 2012

Color System*		Coordinates	
Munsell	Hue	Value	Chroma
	9.6R	3.4	4.9
CIE L*a*b*	Black to White	Green to Red	Blue to Yellow
	L35.27	a+19.82	b+17.52

Benjamin Moore #2084-10 “Brick Red”

Color System*		Coordinates	
Munsell	Hue	Value	Chroma
	8.6R	3.3	5.8
CIE L*a*b*	Black to White	Green to Red	Blue to Yellow
	L33.92	a+23.84	b+17.61

Sample 1



The deep red layer was matched by eye at 30X magnification under a color-corrected light source to the Munsell Book of standards and it was measured with a Minolta CR 241 colorimeter/microscope. The commercial swatch is just slightly darker (the L value) and slightly redder (the a value) than the best preserved areas of the aged deep red paint applied to the 1910 addition. The swatch for 2084-10 is an excellent visual match to the best surviving areas of this deep red exterior paint. The evidence in the cross-section and the uncast samples suggest this paint was originally not particularly glossy and could be reproduced in eggshell gloss level coating.

Exterior Trim Paint: Typical off-white, lead white-based oil paint color for the 1910 palette.

Sample 5

Color-matched October 12, 2012

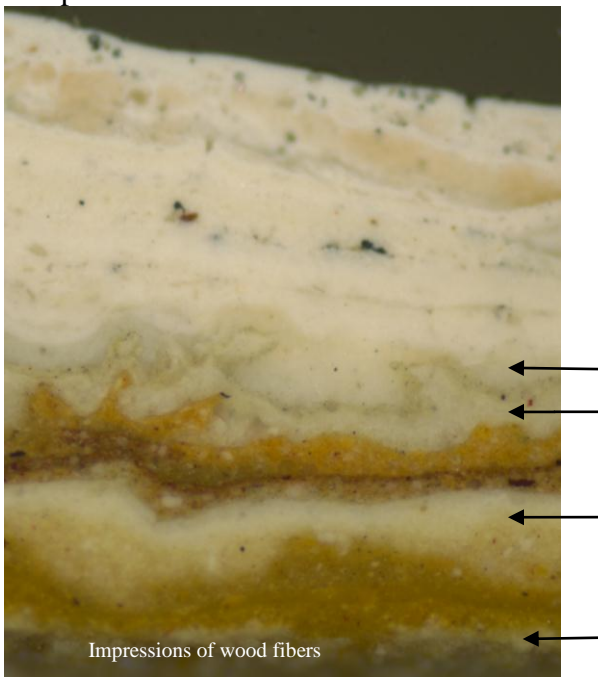
Benjamin Moore #OC-40 “Albescent”

Color System*

Coordinates

Munsell	Hue	Value	Chroma
	3.6Y	8.8	1.4
CIE L*a*b*	Black to White	Green to Red	Blue to Yellow
	L89.02	a-0.72	b+10.24

Sample 5



There are at least four generations of paint on the window trim that are good visual matches with this traditional white lead and linseed oil-based paint color. The swatch for OC-40 is a good reference color for this type of traditional exterior trim paint. The evidence in the cross-section and the uncast samples suggest this paint was originally moderately glossy and could be reproduced in a semi-gloss level coating.

*** COLOR SYSTEMS** Derived from the Minolta CR-241 Instruction Manual and Minolta Precise Color Communication

Chroma Meter CR-241 offers five different color systems for measuring absolute chromaticity: CIE Y_{xy} (1931), $L^*a^*b^*$ (1976), and $L^*C^*H^*$ (1976) colorimetric densities $D_xD_yD_z$; Munsell notation and four systems for measuring color differences.

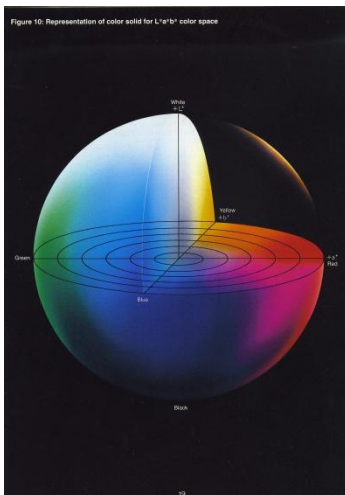
For two colors to match, three quantities defining color must be identical. These three quantities are called tristimulus values X, Y, and Z as determined by CIE (Commission Internationale de l'Eclairage) in 1931.

Color as perceived has three dimensions: hue, chroma and lightness. Chromaticity includes hue and chroma (saturation), specified by two chromaticity coordinates. Since these two coordinates cannot describe a color completely, a lightness factor must also be included to identify a specimen color precisely.

Munsell Color System: The Munsell color system consists of a series of color charts which are intended to be used for visual comparison with the specimen. Colors are defined in terms of the Munsell Hues (H; indicates hue), Munsell Value (V; indicates lightness), and Munsell Chroma (C; indicates saturation) and written as H V/C.

CIE Y_{xy} (CIE 1931): In the Y_{xy} (CIE 1931) color system, Y is a lightness factor expressed as a percentage based on a perfect reflectance of 100%, x and y are the chromaticity coordinates of the CIE x, y Chromaticity Diagram.

CIE $L^*a^*b^*$: Equal distances in the CIE x,y Chromaticity Diagram do not represent equal differences in color as perceived. The CIE $L^*a^*b^*$ color system, however, more closely represents human sensitivity to color. Equal distances in this system approximately equal perceived color differences. L^* is the lightness variable; a^* and b^* are the chromaticity coordinates.



ΔE : ΔE (Delta E) is the industry measure used to determine how closely two colors match in the CIE $L^*a^*b^*$. The symbol Δ means “the change in”. It is based on calculating the sum of the differences between each measure. The calculation is: $\Delta E = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$, or, the color difference equals the square root of the squared sums of the differences between each of the three $L^* a^* b^*$ tristimulus values. Industry color standards indicate a ΔE of 1 is barely perceptible to the human eye, and ΔE of 6 to 7 is acceptable for color matches in the printing industry.

REFERENCES

Cross-section Preparation Procedures:

The samples were cast into mini-cubes of polyester resin (Excel Technologies, Inc., Enfield, CT). The resin was allowed to cure for 24 hours at room temperature and under ambient light. The cubes were then ground to expose the cross-sections, and dry polished with 400 and 600 grit wet-dry papers and Micro-Mesh polishing cloths, with grits from 1500 to 12,000.

Cross-section microscopy analysis was conducted with a Nikon Eclipse 80i epi-fluorescence microscope equipped with an EXFO X-Cite 120 Fluorescence Illumination System fiberoptic halogen light source and a polarizing light base using SPOT Advanced software (v. 4.6) for digital image capture and Adobe Photoshop CS for digital image management. Photographs and digital images of the best representative cross-sections are included in this report. UV photographs were taken with the UV-2A filter in place (330-380 nanometers excitation with a 400 nm dichroic mirror and a 420 nm. barrier filter). Please note that the colors in the printed photomicrographs may not accurately reflect the actual color of the samples because the colors in the digital images are affected by the variability of color printing.

The following fluorescent stains were used for examination of the samples:

Triphenyl tetrazolium chloride (TTC) 4.0% in ethanol to identify the presence of carbohydrates (starches, gums, sugars). Positive reaction color is dark red or brown.

Alexafluor 488 (ALEXA) 0.02% in water, pH 9.0, 0,05M borate and 5% DMF. Positive reaction for proteins is bright yellow-green.

Eosin isothiocyanate (EITC) 0.2% in anhydrous acetone to identify the presence of proteins. A yellow or yellowish-green colors indicates a positive reaction.

2, 7 Dichlorofluorescein (DCF) 0.2% in ethanol to identify the presence of saturated and unsaturated lipids (oils). Positive reaction for saturated lipids is pink and unsaturated lipids is yellow.

Rhodamine B (RHOB) 0.06% in ethanol to identify the presence of oils. Positive reaction color is bright orange.

The best cross-section images for each area are included in this report. Photographs were taken at 40X, 100X, 200X and 400X magnifications.

Information Provided by Ultraviolet Light Microscopy:

When viewed under visible light, cross-sections which contain ground, paint and varnish may often be difficult to interpret, particularly because clear finish layers look uniformly brown or tan. It may be impossible using only visible light to distinguish between multiple varnish layers. Illumination with ultraviolet light provides considerably more information about the layers present in a sample because different organic, and some inorganic, materials autofluoresce (or glow) with characteristic colors.

There are certain fluorescence colors which indicate the presence of specific types of materials. For example: shellac fluoresces orange (or yellow-orange) when exposed to ultraviolet light, while plant resin varnishes (typically amber, copal, sandarac and mastic) fluoresce bright white. Wax does not usually fluoresce; in fact, in the ultraviolet it tends to appear almost the same color as the polyester casting resin. In visible light wax appears as a somewhat translucent white layer. Paints and glaze layers which contain resins as part of the binding medium will also fluoresce under ultraviolet light at high magnifications. Other materials such as lead white, titanium white and hide glue also have a whitish autofluorescence.

There are other indicators which show that a surface has aged, such as cracks which extend through finish layers, accumulations of dirt between layers, and sometimes diminished fluorescence intensity, especially along the top edge of a surface which has been exposed to light and air for a long period of time.

**Jefferson County Courthouse
Charles Town, West Virginia**

Exterior Paint Samples Removed September 19, 2012

South Elevation

1. Brick left of door, about 3-feet up, at peeling area, recent paint is thick and flexible.
3. Relatively intact painted brick above bronze plaque left of door.
4. Relatively intact painted mortar above bronze plaque, mortar is quite soft.
5. West window, west architrave, 5-feet up at loss, for trim paints.
6. Stable paint on brick of one-story east addition, about 5-feet up, near join with original building.

North Elevation

2. Trapped brick just below gable level, enclosed by north addition, coating is red paint with joints picked out in black.

West Elevation

7. Brick below north window, about 5-feet up, area of incipient paint failure.
8. Brick below north window, about 6-feet up, area where the paints are well-adhered to the brick.
9. North window, trim paint on underside of stone sill, right corner.

East Elevation

10. Stable paint on top of mortar joint below north window.
11. Cleaving paint on top of mortar joint below north window.