Computer imaging analyses of brick patterns in paintings by Jan van der Heyden (1637-1712)

Left: *The Keizergracht and the Westerkerk in Amsterdam*, ca. 1667-1670, panel, 54 x 63 cm (Private Collection, USA). Right: *The Oudezijds Voorburgwal and the Oude Kerk in Amsterdam* (Royal Picture Gallery Mauritshuis, inv no 868), ca. 1670, panel, 41.4 x 52.3 cm.

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Introduction

Jan van der Heyden (1637-1712), engineer, inventor and preeminent painter of city scenes and country estates, is known for his extraordinary rendering of architecture, specifically his minute depiction of bricks. It remains unclear whether the tiny brick patterns were laboriously painted by hand or instead were printed using some form of template, for example by pressing a wet print face down against the painting (1). This unique feature appears throughout his entire oeuvre. It has been speculated, as early as 1712, that the artist had a special trick or technique that allowed him to do things that were impossible with traditional painting techniques. "...He painted every little stone in the buildings so minutely that one could clearly see the mortar in the grooves in the foreground, as well as the background... In truth, it is still believed that he had a special trick, or had invented a means whereby, to all who understand the use of the brush, he could accomplish things that seem impossible with the customary ways of painting..." (2).

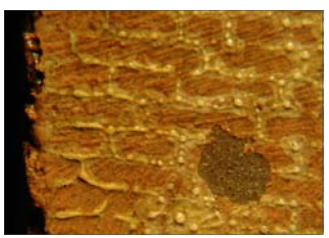
An unusual phenomena

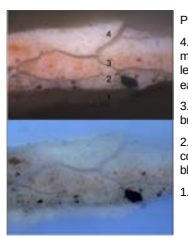
Detail of brick patterns in *The Keizergracht and the Westerkerk in Amsterdam, ca. 1667-1670.*

Detail of brick patterns in a painting from another artist (Gerrit Berckheyde, 1638-1698) where the bricks are clearly painted with a brush.

Detail of brick patterns in *The Oudezijds Voorburgwal and the Oude Kerk, ca. 1670*.

Closer detail showing the contrast between the bricks of the window arch (clearly painted with a brush) and the unusual texture of the brickwork section between the arches.





Paint build-up:

4. Pale yellow paint of the mortar lines, containing lead white and fine yellow earth
3. Orange brown of the bricks
2. Light brown priming containing lead white, black and earth pigments
1. Chalk-glue ground

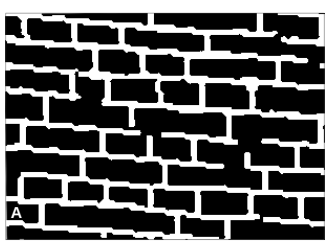
Microscope detail (8x) showing the peculiar raised texture of the brickwork in *The Oudezijds Voorburgwal and the Oude Kerk* and cross-section (right) of a paint sample taken from this area (400x, DF (top) and UV (below). The width of the mortar lines vary between 0.5 -1 mm.

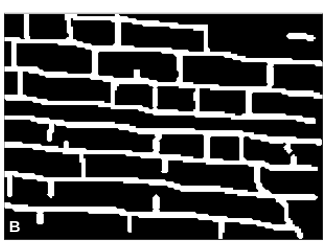
Computer imaging analyses

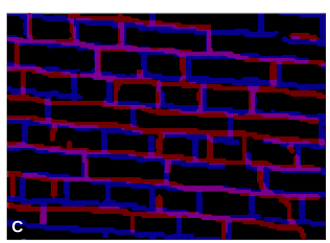
If, indeed a template was used to create the brick patterns we might expect to find identical patterns in different parts of the painting, or in different paintings, as the template was shifted from place to place, or painting to painting. Here, a standard tool in forensic image analyses - **digital cross-correlation** - has been applied (3).

Method:

Step 1: The areas of brick patterns were hand-segmented in a high-resolution image of the painting.
Step 2: Edge enhancement was used to make the mortar lines of the brick patterns of equal thickness.
Step 3: The vertical mortar lines provided the most relevant information since the horizontal mortar lines were found to be strikingly consistent throughout the painting. Therefore a morphological filter was used to eliminate the horizontal lines in the brick patterns.
Step 4: Cross-correlation analysis of two images was performed by plotting correlation as a function of spatial shift in order to search for significant matches.
Step 5: Statistical analysis was applied to determine significance of correlation.







The mortar patterns for the two areas in *The Oudezijds Voorburgwal and the Oude Kerk* that demonstrate the strongest correlation are a section of the brickwork in the building at far left (A, and C given in blue) and a section of the brickwork in the canal wall (B, and C given in red). It is clear from the overlay of these images (C) that these are not a perfect match. The consistency of the horizontal lines is striking while the vertical segments show much variation.

Conclusions

The horizontal lines of the brick patterns were found to be very consistent throughout the painting suggesting the use of a guide, such as a ruler. In addition, cross-sectional analyses of the mortar lines demonstrate a conventional paint build-up and appearance. No significant regions of cross-correlation or subtle breaks in the pattern were revealed with image analysis that would indicate multiple pressings of a template. A few small regions of moderate cross-correlation are not considered significantly higher than that which would occur by chance if executed by hand. This does not rule out the possible use of a single impression. Preliminary inter cross-correlation analysis with the similar brick patterns in *The Keizergracht and the Westerkerk in Amsterdam,* painted a few years earlier, has not revealed significant correlation ruling out the idea that the same template was used to render the brick patterns in both pictures. It is anticipated that the application of computer-vision, image-analyses, and pattern recognition will provide new ways to look at how pictures are constructed.

Selected references

1. Arie Wallert, “Refined technique or special tricks? Painting methods of Jan van der Heyden,” in *Jan van der Heyden: 1637–1712*, P. C. Sutton, ed., pp. 91–103, Yale University Press, New Haven, CT, 2006.
2. Arnold Houbraken, *De groote schouburgh der Nederlandtsche konstschilders en schilderessen,*1753, 2nd ed., Vol. 3, p. 81.
3. David G. Stork, Sean Meador and Petria Noble, "Painted or printed? Correlation analysis of the brickwork in Jan van der Heyden's *View of Oudezijds Voorburgwal with the Oude Kerk in Amsterdam*," *SPIE Electronic Imaging: Human vision and electronic imaging XIV*, Bernice E. Rogowitz and Thrasyvoulos N. Pappas (eds.), vol. 7240, pp. 7240xx1-xx, 2009. For this and other publications by Stork see http://diatrope.com/stork/FAQs.html

Acknowledgement

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