

## PROJECT

181<sup>st</sup> St Station, MTA Line 1  
New York, New York

## CLIENT

di Domenico + Partners  
Long Island City, New York

## PROJECT DESCRIPTION

A partial collapse of the interior wythe of the brick masonry barrel vault at MTA's 181st Station on Line 1 in New York City occurred in 2009. A series of tests were conducted to evaluate the existing masonry construction, provide engineering properties for analysis of the barrel vault, and establish viable repair options.



*ANA Engineer conducting flatjack test to determine compressive deformability of the brick masonry vault.*

## SERVICES PROVIDED BY ATKINSON-NOLAND

Preliminary investigations focused on verifying the condition of existing masonry.

The following techniques were used:

- Use of microwave radar to detect voids within the vault
- Use of infrared thermography to map delaminations and moisture
- Fiber-optic videoscope to evaluate internal construction and view anomalies detected with microwave radar

In situ masonry tests were performed to quantify the following material properties:

- Masonry compression response with flatjacks and Goodman Jack borehole dilatometer
- Masonry compressive state of stress
- Mortar bed joint shear strength

Laboratory testing included:

- Brick absorption in cold and boiling water, saturation coefficient, and IRA
- Brick compressive strength
- Core specimen moisture content
- Compressive strength of portions of the masonry cores



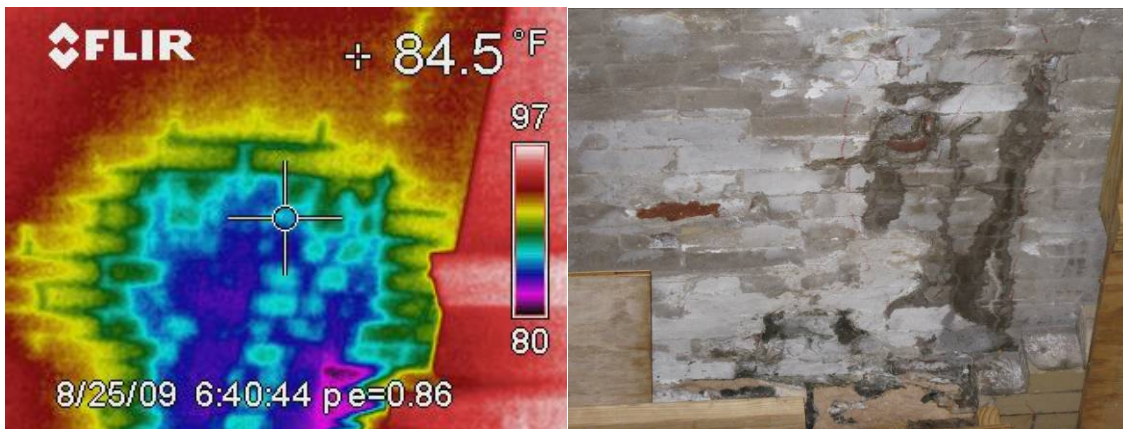
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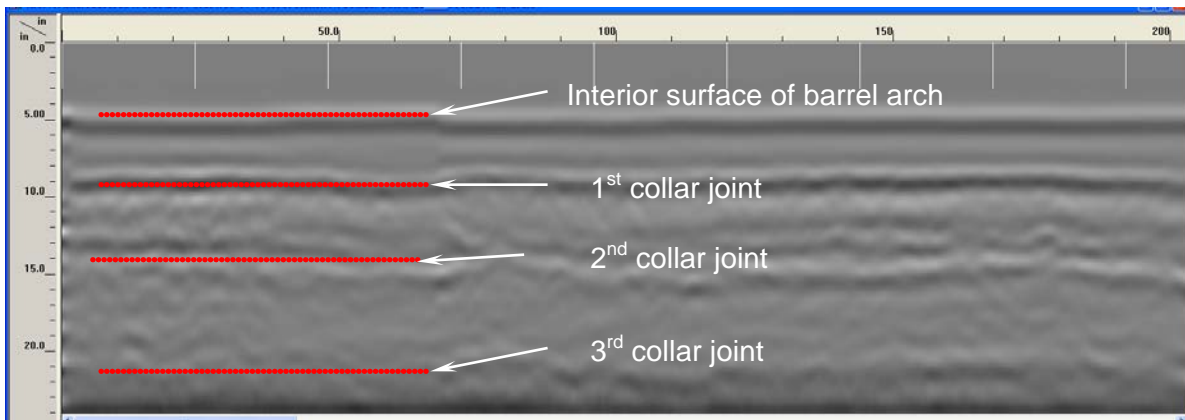
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*Goodman jack testing to measure the stiffness of the masonry at various depths within a 4-inch core hole (photograph on right courtesy of Durham Geo Slope Indicator).*

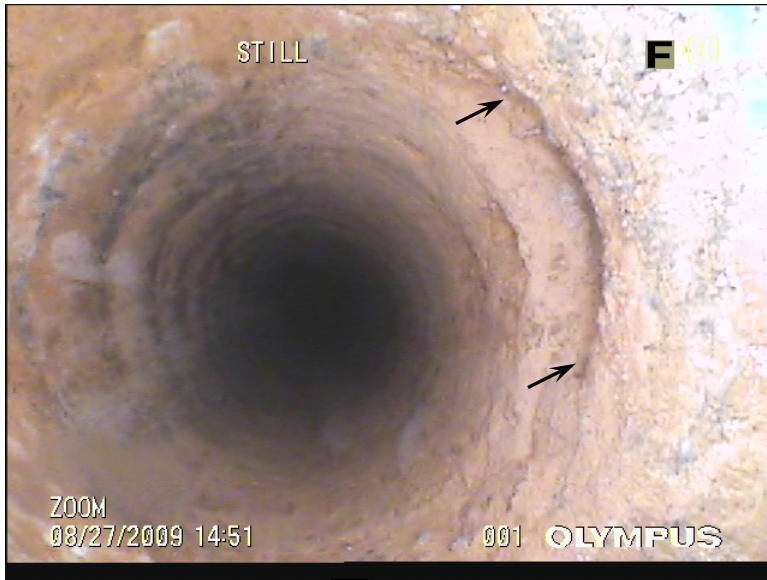


*Thermal image (left) indicates larger moisture extent in masonry than visible light image would suggest (right).*



*Impulse radar image from interior of vault indicating generally solid construction.*





*Minor void detected with microwave radar and investigated using  $3/8$  inch diameter drilled hole and fiber-optic videoscope.*



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