



## Engineering Sciences Section - 2016

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### D29 Forensic Engineering Examination of Stucco on a Concrete Masonry Unit (CMU) Wall, Paint Layer Evidence, and Crack Propagation

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After attending this presentation, attendees will be informed of a basic method of determining the ordering and timing of paint layer application on a stucco surface applied to a CMU wall structure.

This presentation will impact the forensic science community by explaining how this method of examining the time-related ordering of paint deposition was critical to understanding the sequence of paint material application and subsequent fracture propagation through the structure.

Two basic methods have been used for centuries in the scientific and engineering examination of materials — surface examination and cross-section inspection.

Cross sections are commonly used in many disciplines, including engineering, material science, and medicine. For example, sections through welds or fractures are a primary means of metallurgical analysis. Similarly, Computed Axial Tomography (CAT) scans and Magnetic Resonance Imaging (MRI) techniques are now everyday terms and are, in effect, sophisticated cross-section methods to analyze the human body.

In this case, sections of stucco were removed, sectioned, polished, and magnified. A clear sequence of events was developed based on the physical evidence, namely identification of individual paint layers, the sequence of application, and the intrusion of paint into pre-existing fractures.

In spite of disproportionately vigorous and impassioned objections and motions *in limine* from opposing attorneys, this cross-section method was in fact grudgingly admitted at trial by the judge, and is described in this presentation, along with the illustrative exhibits and related graphics. Since the opposing attorney stridently objected to this method as being novel and unpublished, it is being presented through this presentation.

The underlying case concerned a substantial CMU structure that was originally built in September of 2001, and coated with a white primer paint approximately 30 days later. Subsequently, in the following months a brown pigment paint layer was applied. In the following years, an additional coat of a similar brown pigment paint was applied. In 2012, municipal road improvement construction along the wall was alleged to have created a network of fractures and cracks in the CMU wall. Furthermore, numerous learned reports were submitted by various experts alleging that the fractures could be explained by engineering formulations and other arguments. None of the reports effectively refuted the physical evidence that the fractures were in fact evident well before the date of the municipal construction, time stamped by the order of paint application; this evidence will be presented.

NACE International (formerly National Association of Corrosion Engineers) identifies tools and methods to examine paint thickness, but these methods are not applicable to this type of investigation. The method described in this investigation may be useful in similar future investigations.

Briefly described, the method was to adhere a 3"x3"x $\frac{1}{8}$ " (75mm x 3mm) Fiberglass Reinforced Plastic (FRP) laminate with a generous layer of epoxy over a fracture line of interest. The FRP laminate was taped in place and allowed to cure for 24 hours. A diamond blade on a portable grinder was used to cut a 4" coupon from the stucco wall, removing the FRP laminate and the attached stucco layer (this also exposed the underlying prior fracture in the CMU). The FRP laminate preserved the geometric relationship in the stucco section and preserved the fracture features. The FRP surface was marked, photographed, then the entire sample was sectioned on a masonry diamond blade wet cutter. The sections were  $\frac{3}{4}$ " (20mm) thick, resulting in four sectioned samples per location.

Each cut section was then polished on a wet diamond lapidary surface. The resulting finished samples were then photographed and measured using both optical and digital microscopes. The resulting inspection and analysis clearly revealed the individual paint layers, allowed dimensional measurements, and illustrated the intrusion of paint into the pre-existing fractures long before the construction began near the CMU wall in question. This data will be presented.

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#### CMU, Stucco, Paint Layer