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THE USE OF THE "*HARRIS MATRIX*" IN FIRE SCENE DOCUMENTATION

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ABSTRACT
A properly documented delayering process at fire scenes is essential in understanding the progress of a fire, especially during death investigations where the position of the body and other relevant evidence is often buried under layers of fire debris. This paper examines and proposes the adoption of the ***Harris Matrix***, a worldwide standardized archaeological approach for recording excavations: it is used already in documenting the delayering and temporal succession of evidence found at ancient fire scenes. Presented in this paper are the key concepts of this approach along with several examples of the ***Harris Matrix*** in both modern and ancient fire scene investigations.

INTRODUCTION
The standard of care when conducting forensic fire science investigations and reconstruction is the National Fire Protection Association's ***NFPA 921 – Guide for Fire and Explosion Investigations***.[1] The acceptance of *NFPA 921* in the forensic community is largely based upon its strict reliance on the "scientific method" as its principle form of inquiry, guaranteeing that the fundamentals of science and engineering are used during the investigative process.

In the collection and interpretation of empirical data during this analytical process, *NFPA 921* recommends many careful and professional recovery techniques during scene investigations. In addition to *NFPA 921*, several expert treatises in the fire investigation field recommend "***grid-based***" searches. For example, ***Kirk's Fire Investigation***[2] recommends the use of the quadrant method in vehicle fire investigations where sections of a vehicle under examination are successively divided and subdivided. Recently, the grid-bases searches have expanded as a systematic methodology using matrices for origin determination in compartment fires.[3,4]

However, the science of grid and matrix-based examinations of fire scenes is based upon scientifically grounded approaches commonly used in the field of archaeology, which is the study of ancient human activity through the recovery and analysis of artifacts and architecture left behind. Physical evidence created during fire events has been known to survive the ravages of time, whether it is hours, days, years, or centuries.

THE HARRIS MATRIX

The excavation and analysis methods utilized by archaeologists is not new, with a comparison of the approaches made with fire investigators decades ago in England[5] to the present.[6,7] Both disciplines bring together common technical tools to determine the nature of the ash and char remains,[8,9] fuel load,[10] area of fire origin, and ultimately the cause of the fire. Fire modeling and testing have also found their way into the analysis of fires centuries ago in developing and evaluating the veracity of hypotheses for a fire's potential origin, cause, and motive in a historical framework.[11]

Presently at structural fire scenes where there has been significant destruction and collapse of furniture, walls, or ceilings, investigators would be well-advised to process at least the most critical portions in ***layers***. Most evidence of the critical early stages of a fire will be buried beneath the debris–of the collapsed ceiling and roof.

Regarding the process of removing the layers of debris, archaeologists use a systematic approach of coordinate systems that account for not only the location but also the depth of where an object is found. Their excavations are carried out layer by layer, so the depth of each is known. This approach can be helpful when layering debris at fire scenes that has fallen onto the area of fire origin. Such cases include multistory buildings, where collapsed floors bury important evidence. In some cases fallen debris often preserves evidence on lower floors.

In placing these layers spatially in the documentation process, if forensic evidence collection and documentation are viewed as a scientific endeavor, the use of archaeological techniques will only enhance this effort. With both fire scene investigations and archaeological excavations, it is important to document the physical structures, three dimensional layers of stratified debris, and the location of critical evidence that is preserved, altered, or destroyed by the excavation process. These surfaces are known as units of stratification.

Figure 1. An example of typical fire debris found on interior wall in archeological excavations at Mesa Portales (LA145165). (Source: Photo by Joe Lally)

Subsequently, what is lacking in the fire investigation community's present documentation procedures and standards is a temporal and three-dimensional approach to the delayering and excavation of fire debris. For example, the peer-reviewed textbook ***Forensic Fire Scene Reconstruction***[12] in 2013 first recommended this approach, recording the debris using documentation tools from our fellow archaeological scientists, including the ***Harris Matrix***, which is the standard of care in the archaeological community for scene excavations.

The Harris Matrix is named after the Bermudian archaeologist Dr. Edward Cecil Harris, who invented the systematic technique in 1973.[13] This matrix documentation technique, which shows the chronological relationships (temporal sequences) among these stratified sequence of layers excavated at a site in logically presented and abstracted form, lends itself well to modern-day forensic fire scene examinations, and complies with the scientific method.

The Harris Matrix has gained wide acceptance in the archaeological community and widely considered to be the industry standard for stratigraphic archaeology. For example, in Belgium the Harris Matrix has been added to a set of universal requirements which are to be fulfilled during the processing of every archaeological site excavation, and will soon be required by law.[14]

EXAMPLE APPLICATION

The following Figure 2 is a hypothetical application of the Harris Matrix in a fire scene examination. In the formal process, ***layers*** and ***surfaces*** define the major elements of the schematic drawing and resulting matrix. In terms of fire scenes, the layers are dimensionally thick while the surfaces represent thinner physical items for example such as flooring materials.

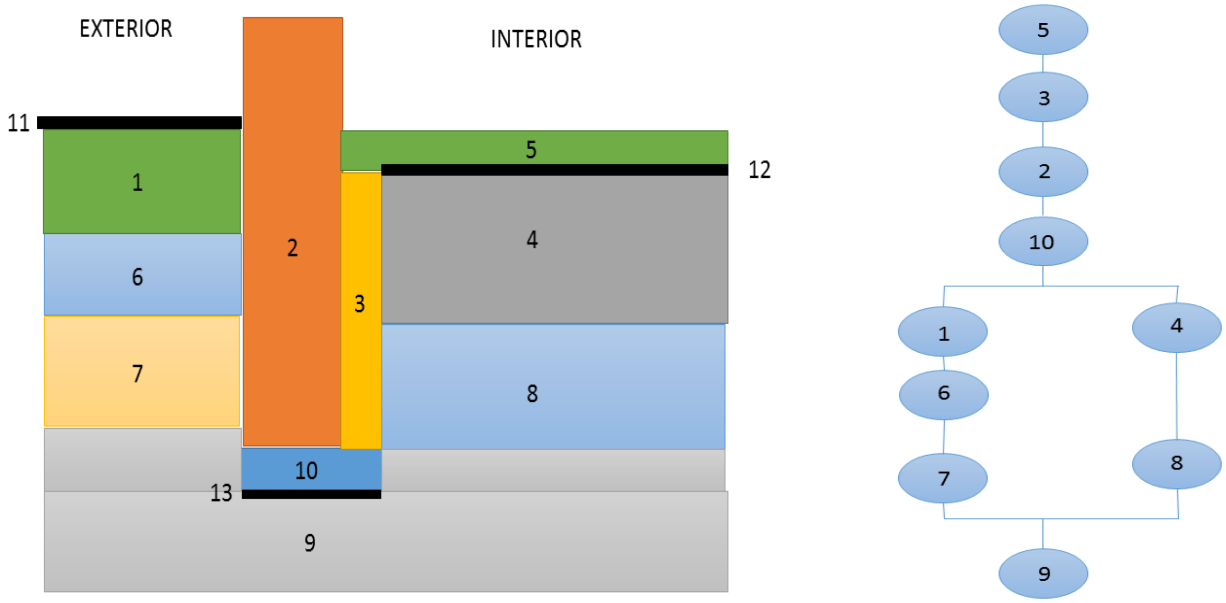

Figure 2. Physical cross sectional view of the debris Layers 1-10 and Surfaces 11-13 (left) and a simplified schematic Harris Matrix representation of the debris layers (right).

In our hypothetical case, careful excavation reveals evidence is discovered over and under the deceased victim who is trapped in fire debris within Layer 8 of the interior of a building. The victim is within the interior wall (Layers 2 and 3) under debris (Layer 4), including the roof (Layer 5). Beneath the victim is the earthen floor (Layer 9). The exterior debris consists of exterior (Layer 1), construction materials (Layers 6 and 7), and the earthen layer (Layer 9). The stone wall (Layer 2) and backfill (Layer 3) both rest on the footer (Layer 10) beneath the wall.

The Harris Matrix can also address surfaces discovered during excavation. In this case, a surface number for the interface between Layers 2, 3, and 10 defines the relationship to Layers 1 and 4. A surface appears under Layer 10 and over Layers 1 and 4. For the sake of preventing confusion, Figure 2 illustrates the layers but they are not reflected in the Matrix diagram.

This is only a simplified generic case and does not relate to an actual incident. The integrity of an investigation may be called into question without this form of documentation.

ADVANTAGES OF THE MATRIX APPROACH

There are several advantages for using the Harris Matrix approach in the forensic processing of fire scenes. These advantages underscore the importance of adhearance to methodologies borrowed from an allied field of archaeology.

- ***Preserves the Chronology of the Excavation*** – The methodology records the order in which these events occurred and the reverse order they should have been excavated.
- ***Three-Dimensional Documentation*** – Previous fire scene excavation techniques used simple gridded zones of the debris from the top to bottom of the surface. This layered approach preserves the three-dimensional representation of evidence with regards to their stratigraphic relationships.
- ***Time-Proven Methodology*** – The method is already accepted and proven to be reliable within the scientific community and has wide acceptance.
- ***Maintains the Integrity of the Process*** – The method assists in maintaining the integrity of the forensic fire scene investigation by documenting the layering process. Photographic documentation of the process can also deter any concerns.
- ***Produces a Visual Record*** – The method provides a graphical record to document and compare. The use of multiple investigators at the scene can maintain the same context of structural materials, soils, debris, and evidence.
- ***Universal Training*** – Wherever a fire investigator lives or works, there are competent archaeology schools and programs that can provide systematic training on the use and implementation of the Harris Matrix approach.

EVIDENCE AND THE FORENSIC SCIENTIST

Standards promulgated by both *NFPA 921* and *ASTM International*'s *ASTM E860*[15] point out the importance of identifying its location, safely collecting without altering, and preserving evidence that is of forensic value.

The loss of critical evidence is defined by *NFPA 921* (2014 Edition, pt. 3.3.167) as ***spoliation***, which is the "Loss, destruction, or material alteration of an object or document that is evidence or potential evidence in a legal proceeding by one who has the responsibility for its preservation." Clearly, the use of the Harris Matrix in documenting evidence can do much to ensure that spoliation is minimized, preserving the integrity of the investigation.

COMPUTER PROGRAMS USING THE HARRIS MATRIX

Numerous computer packages exist, developed for both the Windows and Mac OSX operating systems that can assist in the documentation and construction of a Harris Matrix. One package is called the ***Harris Matrix Composer*** (HMC), a computer program that builds and administers a representation of an archaeological three-dimensional stratification in form of a Harris Matrix.

Researchers are continuously exploring the complex relationships for Harris Matrices. The science of graph theories continue to explore the application of this approach.[16]

SUMMARY

A properly documented delayering process at fire scenes is essential in understanding the progress of a fire, especially during death investigations where the position of the body and other relevant evidence is often buried under layers of fire debris. The authors recommend the adoption of the *Harris Matrix* approach by forensic fire investigators, since it is already a worldwide standardized archaeological approach employed in documenting the delayering and temporal succession of evidence found at both present-day and ancient fire scenes, and on archaeologist sites in general. Its use in documenting evidence can do much to ensure that spoliation is minimized, preserving the integrity of the investigation.

For a download of the English and translations of the textbook, ***Principles of Archaeological Stratigraphy*** by Dr. Harris, see: http://www.harrismatrix.com/harrisbook.html

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