



BENEATH THE SURFACE: A SYNTHESIS OF FORENSIC ARCHAEOLOGICAL INVESTIGATIONS

CHAITANYA BHOSALE¹, GANESH KOLLU², GOWTHAM PENUMARTHI³

1. Under Graduate, Giet Degree College, Rajahmundry, Andhra Pradesh
2. Under graduate, Giet Degree College, Rajahmundry, Andhra Pradesh
3. Assistant Professor, Giet Degree College, Rajahmundry, Andhra Pradesh

ABSTRACT

An interdisciplinary field that combines forensic science and archaeology, forensic archaeology is essential to crime scene investigations, person identification, and reconstructing historical contexts. This overview explores the diverse field of forensic archaeology, emphasizing its developing approaches, technical advancements, and significant roles in the criminal justice system. “The study commences by delineating the chronological progression of forensic archaeology, underscoring its metamorphosis from a specialized field to an indispensable element of contemporary forensic inquiries. It scrutinizes diverse excavation methodologies, spanning from antiquated manual approaches to state-of-the-art technologies such as ground-penetrating radar (GPR) and three-dimensional laser scanning, exhibiting their uses in detecting and excavating covert graves and archaeological sites. “This paper provides a deeper understanding of the interdisciplinary nature of forensic investigations and archaeology by combining historical perspectives, methodological innovations, ethical considerations, and future prospects. This paper delves into the ethical considerations and obstacles faced by forensic archaeologists, encompassing the preservation of ancient sites, sensitivity to cultural differences, and the incorporation of indigenous knowledge in investigations, in addition to methodological developments. The present thorough review highlights the crucial role that forensic archaeology plays in the field of forensic science and offers a nuanced understanding of its advancements.

Keywords: archaeology, stratigraphy, ground penetrating radar, excavation techniques, clandestine graves, taphonomy,

INTRODUCTION

ARCHAEOLOGY:

A fascinating exploration of our past, archaeology is the scientific study of human history and prehistory through the excavation and examination of artifacts, structures, and other physical remains. Archaeology, in contrast to other historical fields, is based on concrete evidence, which helps us piece together the stories of vanished civilizations, historical periods, and our ancestors' lives.

Fundamentally, archaeology aims to provide answers to questions concerning the existence of humans. And who were our ancestors? How did they interact, survive, and change over time? Which technologies were created by them? Archaeologists utilize meticulous excavation, documentation, and analysis to piece together the narratives of bygone societies, providing insight into their values, practices, and accomplishments.

A thorough and complex process goes into archaeology. Archaeology, Eco fact analysis, and landscape surveying are all part of it. With the use of dating methods like stratigraphy and radiocarbon dating, archaeologists can create exact timelines and situate discoveries within the larger historical context.

There are no geographical or historical boundaries for archaeology. From classical archaeology, which focuses on ancient Greece and Rome, to underwater archaeology, which investigates sunken civilizations, it covers a wide range of specializations. Within the field of archaeology, cultural anthropology, history, geology, and chemistry come together, making it an interdisciplinary field that is always changing in response to advances in technology. Scott, D. D., & Connor, M. (2001).

Evolution in History:

It is necessary to look back at the history of forensic archaeology in order to understand its significance. From early attempts to use archaeological techniques in crime scene investigations, the field has developed. Founded by persons aiming to combine the accuracy of archaeology excavation with the requirements of recovering criminal evidence, forensic archaeology has gradually become recognized as a specialty discipline with unique techniques designed for judicial settings. (Buckley, M. (2019).)

Goals and Extent:

Fundamentally, the goal of forensic archaeology is to piece together the circumstances behind crimes by methodically examining tangible evidence buried beneath the surface of the ground. Finding concealed evidence, revealing secret graves, or clarifying burial customs are just a few of the ways this field adds vital information to support conventional forensic methods. (Schultz, J. J., & Dupras, T. L. (2008).)

Methodological Strategies:

The methodological rigor of forensic archaeology is one of its main features. This field uses a variety of methods drawn from archaeology, including as stratigraphic analysis and geophysical surveys, to find and record evidence. This review will clarify the useful uses of these approaches by a methodical analysis of case studies, highlighting their effectiveness in various forensic settings. (Dupras, T. L. (2005))

Collaboration Across Multidisciplinary Fields:

Collaboration between forensic archaeology and other scientific fields is essential to its success. Collaborations with geology, chemistry, forensic anthropology, and other disciplines enhance the breadth and precision of investigation findings. The review aims to investigate the areas of overlap and collaboration between forensic archaeology and related fields, emphasizing the multidisciplinary aspect that enhances its influence on criminal investigations.

Ethical Considerations:

Forensic archaeologists face moral conundrums relating to the preservation of cultural legacy and honoring the dead as they explore the riddles of the past. The ethical issues that are fundamental to forensic archaeology will be discussed in this presentation, highlighting the necessity of striking a careful balance between ethical obligation and scientific investigation.

Our goal as we begin this methodical investigation is to offer a thorough grasp of forensic archaeology, clarifying its disciplinary collaborations, historical development, methodological nuances, and moral obligations. We hope to highlight in this assessment the vital role that forensic archaeology plays in revealing the past in order to further justice in the present.

DIFFERENT TYPES OF TECHNIQUES USED IN FORENSIC ARCHAEOLOGY:

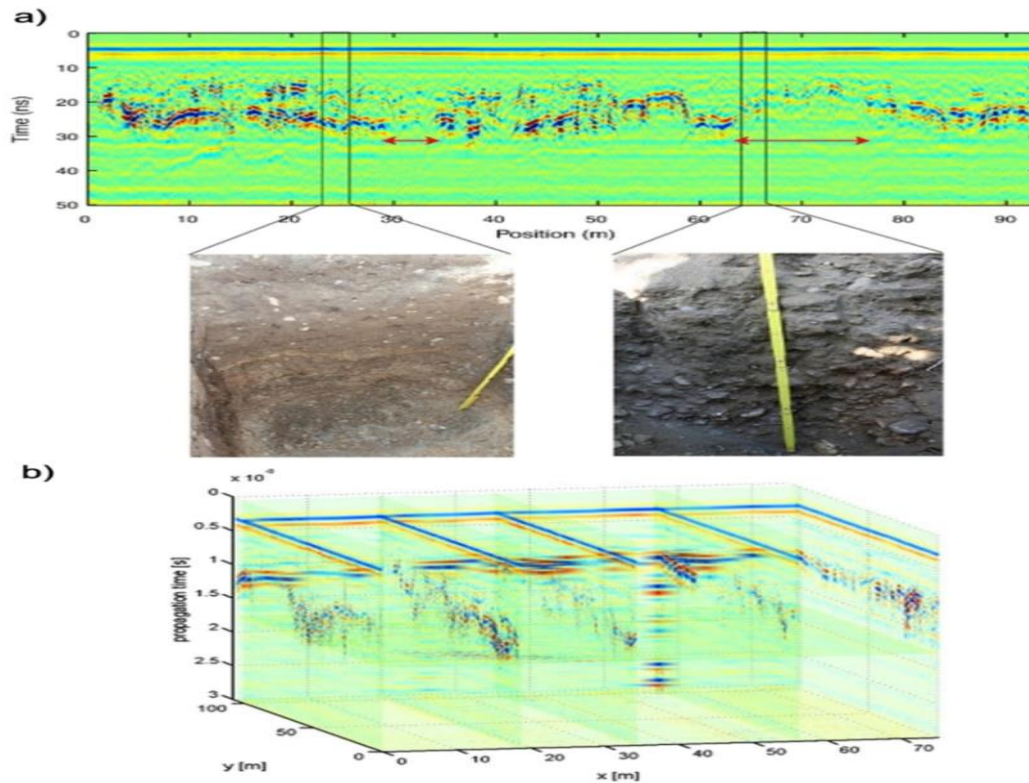
GEOPHYSICAL SURVEY: The geophysical survey is a technique used in forensic archaeology to locate and analyze buried structures. It involves the use of various geophysical instruments, such as ground-penetrating radar and magnetometers, to detect anomalies and patterns in the ground that may indicate the presence of buried objects or buried features. By taking data from these surveys, forensic archaeologists can develop hypotheses about the location and nature of buried structures and then test their hypotheses using traditional, excavation-based methods.

(Fenning et.al., 2004).

GROUND PENETRATING RADAR [GPR]: Ground-penetrating radar (GPR) is a geophysical technique used in archaeology to non-invasively investigate subsurface structures and features. It works by transmitting high-frequency electromagnetic pulses into the ground and then recording the reflection patterns of these pulses as they encounter buried objects or stratigraphic layers. The radar signal that bounces back to the surface is then analyzed to create a subsurface image, showing variations in soil composition, compactness, and the presence of buried objects or features.

In forensic archaeology, GPR is valuable for identifying buried foundations, walls, artifacts, and other subsurface structures. The principle behind its use is based on the fact that different materials have different electrical properties, causing variations in the reflection of the radar signal. By analyzing these reflections, archaeologists can map out and analyze the subsurface without the need for extensive excavation, making it

a key tool in the non-destructive investigation of potential archaeological sites. (Wai-Lok Lai, W., Dérobert, X., & Annan, P. (2018). (Berezowski, V., Mallett, X., Ellis, J., & Moffat, I. (2021))



Zajícová, K., & Chuman, T. (2019).

MAGNETOMETRY: Magnetometry is a non-destructive technique used in forensic archaeology to detect magnetic anomalies caused by buried metallic objects. It involves placing a magnetometer over the surface of the ground to detect the Earth's magnetic field, which is disturbed by the presence of ferromagnetic materials such as iron, nickel, and cobalt. By analyzing the deformation of the magnetic field, archaeologists can identify various features such as burial locations, miners' shafts and tunnels, and even artifacts. Magnetometry has been used extensively in archaeological investigations, particularly in areas with high metal content, and it can provide valuable insights into past human activity. (Deng, E. A., Doro, K. O., & Bank, C. G. (2020))

- i. **ARIAL PHOTOGRAPHY:** Aerial photography in forensic archaeology involves using drones to capture images of a site for analysis. This technique allows for a comprehensive survey of the entire site, including areas that are difficult to access or view from the ground. Aerial photography can also create detailed 3D models of the site, which can be helpful in identifying and tracking changes over time. Additionally, aerial photography can help archaeologists identify potential hazards, such as unstable terrain or hidden artifacts. (Hochrein, Michael J., and Special Agent. A, 2003.)
- ii. **MAPPING AND GRID SYSTEM:** Forensic archaeology often employs a mapping and grid system to aid in the recording and understanding of artifacts and other objects within a site. The system involves creating a precise plan of the site, including its boundaries and key features, such as graves, buildings, and structures. Its use ensures that all artifacts are correctly documented, making it easier to analyze and

interpret data later. Additionally, it can help identify patterns and trends within the site, critical for understanding historical events and cultural practices. Various mapping and grid systems are available for use in forensic archaeology. (To, Denise. (2017))

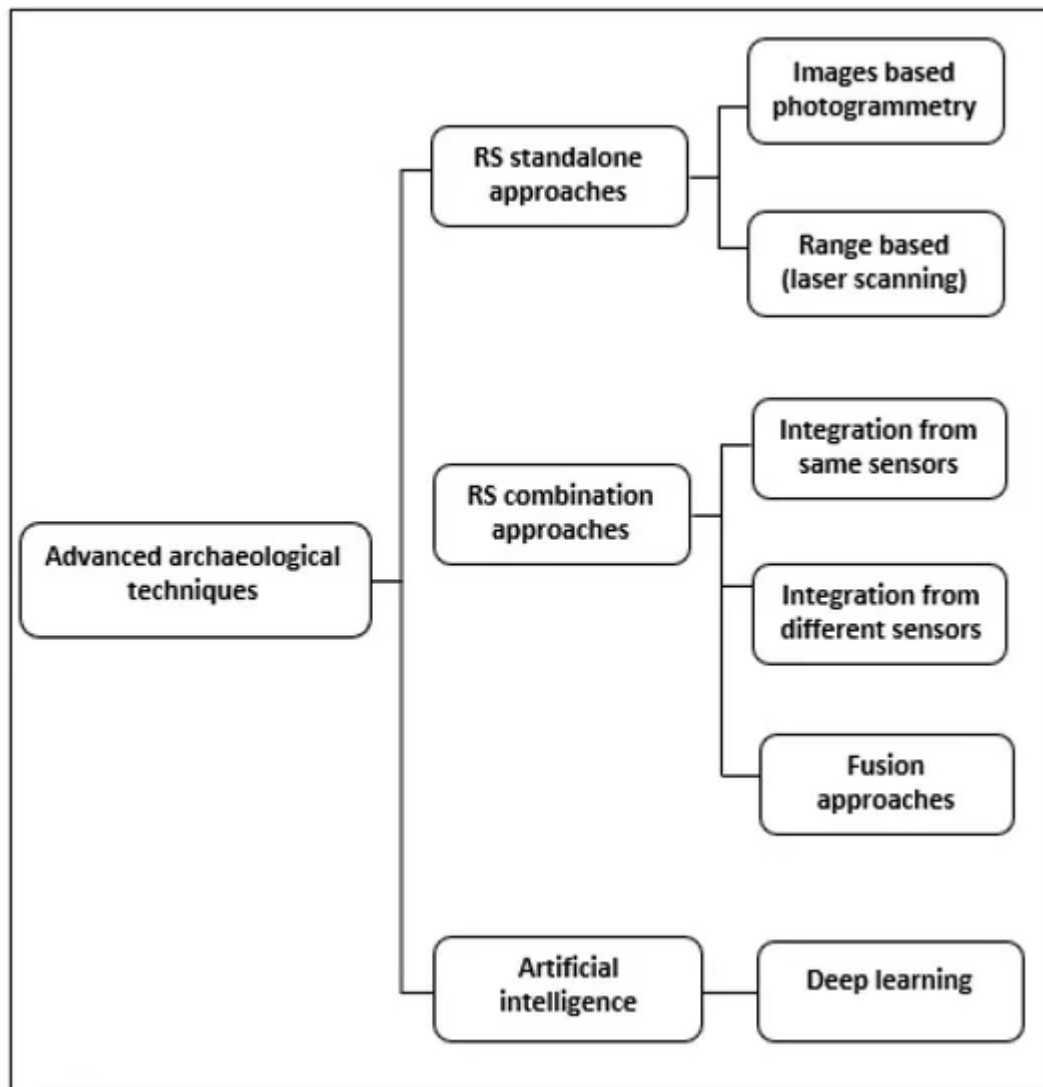


Figure . Advanced archaeological techniques. There is a research gap in assessing these approaches together to detect archaeological remains. These approaches are discussed in this review based on previous studies. (Kadhim, I., & Abed, F. M. (2023).)

FIELD WORK PROCEDURES:

EXCAVATION TECHNIQUES: Excavation techniques in forensic archaeology involve the careful and systematic removal of soil and other materials to reveal and preserve evidence of past activities. Common techniques include the use of trowels, brushes, and specialized tools such as sieves and screens to analyze and categorize artifacts. Forensic archaeologists also use remote sensing technologies such as ground-penetrating radar and magnetometers to locate potential burial or archaeological sites before excavation begins. (EVIS, Laura. 2016.)

a) **STRATIGRAPHY:** Stratigraphy is a scientific discipline that studies the structure of rock formations and their properties. In forensic archaeology, stratigraphy is used to create an understanding of the depositional environment and dating of excavated artifacts. It aids in identifying changes in the sedimentary record

over time and can help reconstruct historical events or periods of occupation that have left traces in the Earth's record. It can also be used as an independent dating method, complementing radiocarbon dating. (Hanson, I. D. (2004).)

- b) FINE SCREENING:** Fine screening in forensic archaeology refers to the process of using fine mesh or wire screens to separate small artifacts such as bones, teeth, and small pieces of pottery from larger and more robust materials. This technique is particularly useful for identifying and analyzing tiny biological remains that might be missed if the larger materials were processed first. Fine screening helps to increase the precision and accuracy of forensic archaeological analysis, allowing researchers to make more informed decisions about human activity, time periods, and cultural identities. This method is an essential tool for archaeologists and forensic specialists working on time-consuming projects in archaeology and forensic medicine.

THREE PHASES IN FORENSIC ARCHAEOLOGICAL FIELD INVESTIGATIONS

PHASE I: SYSTEMATIC AND COMPREHENSIVE SEARCH/INVESTIGATION (RECONNAISSANCE)

In order to find human remains, forensic archaeologists employ a range of methods, including visual or pedestrian searches, technological tools like GPS, aerial photography, thermal imagery, and geophysical methods, and the use of decomposition (cadaver) dogs in the right climate. Forensic archaeologists can recreate the events at crime sites and offer crucial evidence for investigating teams by using specialized skills and archaeological methodologies including stratigraphy and context recording. For complicated settings, it is advised to apply modern technologies, such as LiDAR and Total Stations, to improve the evidence's interpretation. The effectiveness of forensic archaeology and the precise reconstruction of historical events ultimately depend on the thorough and methodical search for human remains.

PHASE II: DETERMINATION OF FORENSIC SIGNIFICANCE

When searching for human remains in forensic archaeology, a comprehensive scene assessment is necessary, along with the application of visual or pedestrian searches, technological tools like GPS, aerial photography, thermal imagery, and geophysical methods, and the support of decomposition (cadaver) dogs in the right climate. Upon discovering human remains, forensic archaeologists have to verify the identification of the remains and determine their age by examining preservation, dental or medical care records, and related artifacts. Law enforcement organizations and medical examiners must be alerted if the remains are forensically significant and if they are historic or prehistoric. It is advised to employ cutting-edge technologies for precise identification, such as DNA analysis and radiocarbon testing. The effectiveness of forensic archaeology and the precise reconstruction of historical events ultimately depend on the thorough and methodical search for human remains. (Sorg, M. H., & Haglund, W. D. (Eds.). (1996).)

PHASE III: RECOVERY; EXCAVATION:

In order to locate and record human remains, forensic archaeologists employ a range of methods, including visual or pedestrian searches, technological tools like GPS, aerial photography, thermal imagery, and geophysical techniques, as well as the use of decomposition (cadaver) dogs in the right climate. Forensic archaeologists must identify the remains, estimate their age, and establish if they are in situ, disturbed, or scattered after they are discovered. When searching for buried remains, forensic archaeologists need to mark the grave's perimeter, excavate horizontally with caution, and filter the dirt that has been removed. It is advised to employ cutting-edge technologies for precise identification, such as DNA analysis and radiocarbon testing. Ultimately, the effectiveness of forensic archaeology ultimately depends on the thorough and methodical search for human remains. (Cheetham, P. N., & Hanson, I. (2016)).

DOCUMENTATION AND RECORDING:

Thorough site recording is crucial to the preservation and interpretation of evidence in forensic archaeology. This entails drafting precise site plans and maps, taking copious amounts of photos and videos, and using aerial photography to get a thorough perspective of the property. Furthermore, thorough excavation records that document soil layers, context sheets, and specific discoveries are essential for upholding a transparent chain of custody and guaranteeing the safe handling, transportation, and preservation of evidence. Using specialized techniques like context recording and stratigraphy in conjunction with archaeological approaches, forensic archaeologists are able to recreate events at crime scenes and offer crucial evidence to investigating teams. For complicated settings, it is advised to employ cutting-edge technologies like LiDAR and Total Stations to improve the evidence's interpretation. In the end, thorough and methodical documentation of archaeological sites is essential to the accomplishment of forensic archaeology and the precise reconstruction of historical events. (Powers, N., & Sibun, L. (2016)), (Montoya, R. D., & Morrison, K. (2019)), (Powers, Natasha, and Lucy Sibun. (2013))

RECOVERY AND HANDLING OF EVIDENCE:

A methodical approach to the retrieval and examination of evidence from crime scenes or archeological sites is known as forensic archaeology. Some of the most important procedures in forensic archaeology include the initial scene assessment, grid system creation, photography and mapping, planning the excavation, documentation during the excavation, gathering artifacts and evidence, using specialized recovery techniques, documenting disturbances, backfilling and site preservation, chain of custody, and transportation to the laboratory. These procedures include working in tandem with other forensic disciplines, such forensic dentistry and forensic anthropology, and need for specific knowledge, abilities, and tools. Despite the difficulties forensic archaeologists encounter—such as inadequate or fragmented remains, postmortem

modifications, and age estimation—forensic archaeology is essential to the investigation of crimes and the recovery of the missing. (Dirkmaat, D. C., & Cabo, L. L. (2016), (COX, Margaret; HUNTER, John. 2005.)

LABORATORY ANALYSIS:

To make it possible for forensic archaeologists to examine the evidence gathered from crime scenes or digs more thoroughly, laboratory analysis is essential. Among the most important elements of laboratory analysis in forensic archaeology are the examination of artifacts, human remains, soil, dating methods, stable isotope, DNA, and geophysical surveys. aid in the extraction of important information from a variety of materials by forensic archaeologists, which advances our knowledge of a crime scene or historical context. Additionally, this study makes it possible to employ cutting-edge technologies like X-ray fluorescence, magnetic susceptibility, and ground-penetrating radar, which improves the capacity to analyze and examine the evidence. In the end, thorough reporting and statistical analysis guarantee that the outcomes of laboratory analyses are appropriately reported and suitable for use in scientific or legal contexts. (Schultz, J. J., & Dupras, T. L. (2008).) (Latham, K. E., & Strand, R. (2018).)

LIMITATIONS AND CHALLENGES:

Numerous restrictions and difficulties confronting forensic archaeology may affect the caliber and precision of research. Natural and human-caused site disturbance can change or completely destroy archaeological settings. Other difficulties faced by forensic archaeologists include time constraints, resource limitations, legal and ethical issues, a lack of standards, complex contexts, technological constraints, post-excavation preservation, a lack of historical documentation, community engagement, and difficulties in the courtroom. These difficulties may make it more difficult to carry out in-depth investigations, maintain the integrity of the site, and produce reliable findings. However, forensic archaeology is becoming more and more important to law enforcement as a tool for investigating crimes and locating missing people, particularly in situations involving decayed, fragmented, or skeletonized remains. (Beckett, R. G. (2014).)

CONCLUSION

To sum up, this review article has examined the vital and diverse function of forensic archaeology in the context of criminal investigations and the fight for justice. It is clear from a thorough examination of several case studies and methodological stances that forensic archaeology is a crucial instrument for revealing concealed information and aiding in the settlement of challenging legal disputes.

The study emphasized the value of using archaeological methods to find, record, and examine human remains and related material. Forensic archaeologists are essential in reconstructing the events surrounding a crime, from the methodical excavation of burial sites to the utilization of state-of-the-art technologies. They

frequently offer vital information that conventional investigation techniques may miss. Furthermore, the review highlighted how forensic archaeology is an interdisciplinary field, highlighting its partnerships with forensic anthropology, geology, chemistry, and other scientific fields. This multidisciplinary approach improves the findings' dependability and correctness, which strengthens the evidence that is offered in court.

The study of forensic archaeology's inherent ethical issues was also conducted, recognizing the fine line that must be drawn between the pursuit of justice and the preservation of historical and cultural settings. Forensic archaeologists have a duty to handle their work with tact and care for the human tales entwined with the archaeological record, as stewards of the past. In the future, forensic archaeology's capabilities will probably be significantly enhanced by technological and methodological developments, allowing investigators to solve puzzles in even more difficult and complex cases. The field's continuous evolution emphasizes how crucial it is for specialists to collaborate, do research, and get training in order to improve current procedures and handle new problems.

This review has essentially shown that forensic archaeology is situated at the nexus of science, justice, and ethics, and that it plays a significant role in resolving legal disputes and establishing the truth. The lessons gleaned from the past by forensic archaeologists will surely continue to influence the direction of forensic science and criminal investigations going forward.

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