Getty
Conservation
Institute

Alessandra Sprega
Benjamin Marcus
Elena Macchioni
Claudia Cancino

Advancing Earthen Heritage Conservation

A Survey on Challenges and Research Priorities in the Field

Research Report

Advancing Earthen Heritage Conservation

A Survey on Challenges and Research Priorities in the Field

Research Report

Alessandra Sprega
Benjamin Marcus
Elena Macchioni
Claudia Cancino

Getty Conservation Institute
Los Angeles

The Getty Conservation Institute works internationally to advance conservation practice in the visual arts—broadly interpreted to include objects, collections, architecture, and sites. The Institute serves the conservation community through scientific research, education and training, field projects, and the dissemination of information. In all its endeavors, the Institute creates and delivers knowledge that contributes to the conservation of the world's cultural heritage.

Getty Conservation Institute
1200 Getty Center Drive, Suite 700
Los Angeles, California 90049-1684
United States
Telephone: (001) 310 440-7325
www.getty.edu/conservation

ISBN: 978-1-957939-28-5 (print)
ISBN: 978-1-957939-27-8 (online resource, PDF)
ISBN: 978-1-957939-29-2 (online resource, EPUB)

Front cover: View of Oman's Al Harma oasis and historic town with traditional earthen buildings. Photograph by Alessandra Sprega. Copyright 2022 J. Paul Getty Trust.

Getty

CONTENTS

INTRODUCTION

In 2023, the Earthen Architecture Initiative (EAI) of the Getty Conservation Institute (GCI) conducted a Survey on Earthen Heritage Conservation to gather insights on the state of earthen architecture conservation from professionals working in the field around the world. The primary goals of the survey were to identify key threats to earthen architecture and challenges to its conservation, assess needs in the field, and prioritize potential research directions to guide the GCI's future activities. Importantly, the results of the survey presented in this report are shared with the broader community of specialists in earthen heritage conservation. It is hoped that this will foster knowledge exchange and collaboration among institutions and individuals and support collective efforts toward conserving and safeguarding earthen heritage worldwide.

Over the past four decades, the GCI has been dedicated to advancing the conservation and study of earthen architecture, collaborating with an international array of institutions and professionals. Initially driven by scientific research in the 1980s at Fort Selden in New Mexico, the GCI began investigating interventions for the preservation of earthen walls through collaboration with New Mexico State Monuments (NMSM) and the US National Park Service (NPS) Southwest Region. The project, structured in two phases, aimed to research the treatment of earthen archaeological structures through various interventions like chemical consolidation, capping, and protective coatings.[1] The findings of this investigation were presented at the 6th International Conference on the Conservation of Earthen Architecture, known as Adobe 90, held in 1990 in Las Cruces, New Mexico. Sponsored by the GCI in collaboration with the Museum of New Mexico State Monuments, ICCROM (the International Centre for the Study of the Preservation and Restoration of Cultural Property), CRAterre–ENSAG (the International Center for Earthen Construction at the Grenoble National Higher School of Architecture), and the National Park Service, Adobe 90 not only signified a notable increase in international participation and engagement in this series of conferences but also played a pivotal role in shaping the subsequent trajectory of investigations and partnerships among institutions in this field.

Also in 1990, the GCI, in partnership with Stanford University, established the Getty Seismic Adobe Project (GSAP) to develop minimally invasive and easily implemented techniques for retrofitting historic adobe structures in earthquake-prone regions.[2] This extensive initiative involved surveying historic adobe buildings in California, developing planning guidelines for their retrofitting, conducting model adobe building tests on an earthquake simulator, surveying damage following the 1994 Northridge earthquake, and formulating engineering guidelines for the retrofit of historic adobe buildings.

Between 1996 and 1999, the GCI organized the PAT courses (Pan-American courses on the Conservation and Management of Earthen Architectural and Archaeological Heritage) in Peru in collaboration with ICCROM and CRAterre–ENSAG. These courses focused on training Latin American heritage professionals in the management and conservation of earthen buildings and archaeological sites. This collaboration among the three organizations led to the creation of Project Terra (1998–2005), a joint effort to study and conserve earthen architecture. Project Terra consisted of four components, namely education, research, planning and implementation, and advocacy. One of the research component outcomes was the development and dissemination of the Earthen Architecture Research Survey, conducted in 1998. The survey aimed to define the current state of earthen conservation and to pinpoint critical research directions within the field. The results of the survey, which are discussed further in the introduction to chapter 4 of this report, highlighted the necessity for further investigation into the physical, mechanical, and chemical properties of earthen construction materials. Building on the findings of the 1998 survey and the activities of Project Terra, an experts meeting was organized in conjunction with the 8th International Conference on the Study and Conservation of Earthen Architecture (Terra 2000). On the experts meeting's recommendation, the GCI conducted the comprehensive Terra Bibliography, which looked beyond the Terra conference proceedings to encompass a wide array of studies relevant to earthen architecture conservation.[3] This bibliography aimed to highlight areas where additional research was needed and support the creation of educational resources.

Upon the conclusion of Project Terra, the EAI was established within the GCI in 2006, carrying forward the same long-term goals of the previous project through international partnerships, research, and field activities identified as part of the Terra 2000 experts meeting. Within this framework, the GCI organized a colloquium on the conservation of decorated earthen surfaces in Mesa Verde, Colorado; carried out a Terra international conference in Africa for the first time (Mali, 2008); started the Seismic Retrofitting Project (SRP) in Peru to design, test, and implement techniques for the seismic strengthening of historic earthen structures using local materials and expertise; and developed a Conservation and Rehabilitation Plan for Kasbah Taourirt in Morocco, which addressed complex issues typical of the conservation and adaptive reuse of earthen settlements. Furthermore, in collaboration with the Department of Tourism and Culture of Abu Dhabi and Ministry of Heritage and Tourism of Oman, the EAI organized the International Course on the Conservation of Earthen Architecture (EAC)—conducted in 2018, 2022, and 2025—to build regional capacity and promote the conservation of earthen heritage in the Middle East.

Through these activities and others, the field of earthen heritage conservation has witnessed significant growth, leading to an increase in the involvement of professionals and organizations on an international scale. This is evidenced by the increasing participation and diverse representation of countries and institutions at the Terra international conferences dedicated to the conservation of earthen architecture. These conferences began with the inaugural event in Iran in 1972 and have continued through the Terra World Congress in Santa Fe in 2022, which was organized by the GCI in collaboration with the US National Park Service's Vanishing Treasures Program and the University of Pennsylvania's Weitzman School of Design and convened more than 350 experts and practitioners from 52 countries, both onsite and virtually. At the same time, the scope of earthen heritage conservation has broadened significantly, encompassing not only matters related to material characteristics, site analysis, and archaeological preservation, but also strategies

for adapting historic structures, sustaining living heritage traditions, fostering community involvement, and building capacity.

Coinciding with this increase in interest and activity, threats to earthen sites have also grown, mainly in the form of environmental changes and natural disasters. In addition, the progressive loss of traditional earthen settlements due to urban development has resulted in significant negative impacts on tangible earthen heritage and traditional knowledge. The survey presented here aims to assess these challenges and threats to earthen heritage and use the insights gained to identify priority research areas that can inform future strategic initiatives aimed at safeguarding earthen heritage. The survey recipients were carefully chosen to encompass a diverse range of perspectives from around the world, including various levels of expertise and fields of specialization. This selection was made with the understanding that the conservation of earthen heritage has evolved into a broader and more complex practice requiring a global and interdisciplinary perspective.

The survey, which was sent to 495 individuals, received responses from 260 participants (a 53% response rate) and has shed light on several key themes and provided valuable lessons and recommendations for the future of earthen heritage conservation. We hope that the results presented in this report will form the basis for continued discussions and serve as a source of inspiration for future collaboration and strategic planning.

Following an overview of the survey design and methodology in chapter 1, this report moves on to a detailed examination of the survey findings in chapter 2. This chapter addresses current threats and challenges facing the conservation of earthen heritage, followed by the ranking of research and work priorities grouped within broader themes related to the conservation of earthen sites. These themes were identified through an analysis of recurring research topics presented at Terra international conferences and in related proceedings. Additionally, the GCI's work in the field and discussions with partners and colleagues played a significant role in shaping the selection of these themes. This chapter also includes a summary of research and training needs reported by respondents.

Chapter 3 analyzes the survey responses and draws out significant themes and trends. Finally, chapter 4 offers lessons learned and recommendations drawn from this survey that may guide future strategic initiatives.

References

1. A. Oliver, Getty Adobe Project, Getty Conservation Institute, and Museum of New Mexico. *Adobe Test Wall Project: Phase I: Final Report*. Getty Conservation Institute, 2000. https://www.getty.edu/conservation/publications_resources/pdf_publications/fort_selden_project.html.
2. E. Leroy Tolles, Edna E. Kimbro, Frederick A. Webster, and William S. Ginell. *Seismic Stabilization of Historic Adobe Structures: Final Report of the Getty Seismic Adobe Project*. Getty Conservation Institute, 2000.
3. Getty Conservation Institute. *Terra: Sorted by General Category*. GCI Project Bibliographies Series. Getty Conservation Institute, 2002. https://www.getty.edu/conservation/publications_resources/pdf_publications/terra_bibliography_category.html.

CHAPTER 1

SURVEY METHODOLOGY

1.1. Data collection

The questionnaire was divided into four sections:

- Survey participant identification
- Current threats to earthen heritage and challenges to its conservation
- Priority areas for further research and/or project development
- Resource and training needs

The use of rating-scale questions facilitated the clear prioritization of specific themes and enabled concise visual data analysis. At the same time, the inclusion of open-ended questions allowed the gathering of in-depth perspectives regarding the resources needed for earthen heritage conservation. The appendix contains a copy of the questionnaire sent to recipients.

1.2. Survey structure

Survey participant identification. The first part of the survey aimed to gather general information on the participants, focusing on the following aspects:

(Q1) Geographic region of work
(Q2) Area of expertise
(Q3) Institutional affiliation

Threats to earthen heritage and challenges to its preservation. The next part of the survey focused on quantifying the significance of different threats to the physical fabric of earthen heritage (Q4) and challenges faced by conservation practitioners and stakeholders involved in the conservation of earthen sites (Q5). Participants were asked to rank the significance of proposed threats and challenges and provide comments where necessary to clarify or supplement their responses.

Work and research priorities. This section of the survey sought feedback on the most urgent needs in terms of field projects and research to determine areas that will require more focused investigation and attention. As mentioned in the introduction, to clarify all the work and research needed, a set of themes was identified by the GCI, its partners, and colleagues, drawing on their experience and analysis of recurring topics discussed at Terra conference proceedings from 1972 to 2022. The choice of themes was also influenced by the work conducted by the GCI in the field since 2006, particularly through the development of various field projects and international courses and workshops on earthen conservation in different regions of the world. The themes selected for the survey were:

(Q6) Understanding earthen building materials
(Q7) Documentation and assessment of earthen heritage
(Q8) Conservation of earthen settlements
(Q9) Conservation and management of earthen archaeological sites
(Q10) Preventive conservation of earthen heritage
(Q11) Education and capacity building
(Q12) Climate change and earthen heritage
(Q13) Disaster risk management for earthen heritage
(Q14) Rehabilitation and adaptive reuse of earthen buildings

In this report, each theme is introduced with a description, followed by a presentation of the survey results and a summary of any additional comments received to explain the respondents' choices. First, participants were asked to rank the topics within each theme based on their perceived importance. Then, participants were asked to prioritize the themes by importance and provide explanations for their choices (Q15 and Q16).

Resource and training needs. In the final section of the survey, participants were encouraged to provide their perspectives on resource and training needs for future initiatives by answering the following open-ended questions:

(Q17) What resources, in your opinion, should be developed to advance earthen heritage conservation? *(for example, conservation project reports, guidelines, conservation policies, climate change impact assessment, adaptive reuse case studies, etc.)*
(Q18) What training is needed, and for which target audience working in the field of earthen heritage conservation?

1.3. Survey recipients

The recipient list was designed to ensure a diverse representative sample of professionals with expertise in earthen heritage conservation, operating in different regions and with diverse specialties. The list comprised individuals from various fields, including the public and private sectors and non-profit organizations actively involved in the preservation of earthen heritage. This includes active members of prominent earthen heritage associations such as the International Scientific Committee on Earthen Architectural Heritage (ICOMOS-ISCEAH) and PROTERRA (Red Iberoamericana de Arquitectura y Construcción con Tierra). Scientific research groups, such as the International Union of Laboratories and Experts in Construction Materials, Systems and Structures (RILEM, from the name in French), and key institutions like CRAterre–ENSAG and ICCROM were also represented in the recipient list. Additionally, the survey was extended to individual professionals and students with relevant experience working with earthen structures and sites, such as past participants, instructors, consultants, and partner organizations who have collaborated with the GCI through various initiatives. These initiatives include the International Course on the Conservation of Earthen Architecture (EAC), the Seismic Retrofitting Project (SRP), Project Terra, and the PAT courses. This approach aimed to involve emerging professionals and other voices in the field. To promote accessibility, the survey was made available in English, Spanish, and French. (Responses provided in Spanish or French have been translated by the survey authors into English when included in this report.) Figure 1.1 illustrates the countries where the survey recipients were contacted.

TABLE 1.1

Summary of the number of individuals contacted by geographical area.

Geographical area	Number of individuals contacted	Percentage of overall number of individuals
Africa	38	8%
Asia	68	14%
Central and South America	104	21%
Europe	155	31%
North America	77	16%
Middle East	50	10%
Oceania	3	1%
Total of contacts	**495**	

Note: 260 of the 495 individuals contacted (53%) responded to the survey from April to May 2023.

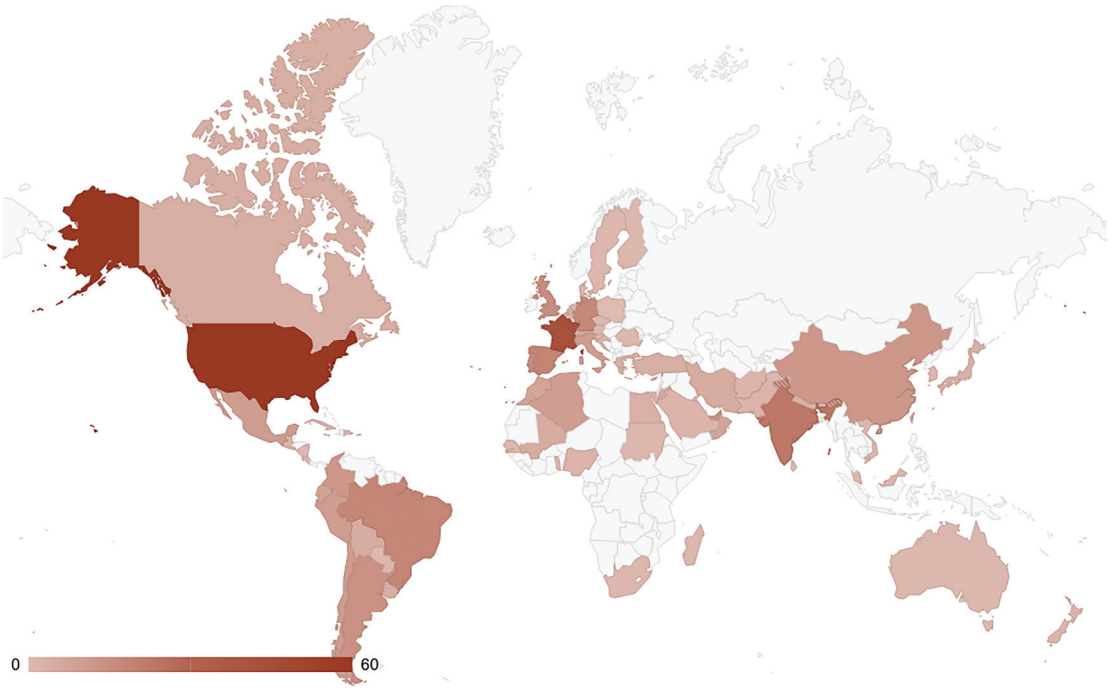

FIGURE 1.1

The survey reached out to a total of 495 recipients across various regions, especially North America, Europe, and Asia.

1.4. Challenges and limitations to survey design and methodology

The survey was widely distributed across various regions thanks to the involvement of international associations dedicated to earthen heritage conservation, such as ICOMOS-ISCEAH, and GCI projects in the Middle East, North Africa, and North and South America. However, as figure 1.1 shows, there were relatively few participants from Sub-Saharan Africa and Central Asia, regions where earthen heritage is especially prominent. To address this gap, future surveys should aim to broaden and diversify the participant network, actively engaging professionals and organizations in these underrepresented areas to gain a more comprehensive understanding of global earthen heritage conservation practices and challenges.

Another limitation of the survey is that, as participants underline in their comments, earthen heritage conservation varies across geographical regions due to factors such as climate, material availability, cultural practices, and economic resources. Consequently, responses to the survey reflect these regional nuances rather than a cohesive global perspective. This variation introduces complexity when interpreting the data and poses challenges for drawing universally applicable conclusions. Furthermore, the varying levels of expertise among the participants regarding specific topics in earthen conservation also influenced their responses to certain survey questions. Some participants possessed extensive knowledge in particular areas, resulting in more in-depth and specialized comments, while others might have had limited exposure to certain aspects of earthen heritage preservation, leading to potentially varying degrees of insight. Additionally, the survey included mostly mandatory questions, which compelled participants to provide responses even if they felt they lacked sufficient knowledge on the topic.

Despite the effort to maintain objectivity, another limitation of the survey design arose from the unavoidable influence of the GCI's own work in formulating the questions and pre-selecting areas of research to consider. However, the survey included an open-ended section for comments and suggestions, which complemented the analysis of the data and provided additional perspectives.

Furthermore, resource and time constraints restricted the survey's language options to English, French, and Spanish, potentially hindering accessibility for individuals who are not proficient in any of those languages.

Regarding the structure of the survey, the main limitations that emerged in the analysis of the survey results are grouped into the following categories:

Question type. The use of a rating scale in the survey to determine research and work priorities in earthen heritage conservation had certain limitations in accurately assessing the significance or importance of each factor. While the rating scale provided a broad overview, it could not adequately capture the interconnected nature of the factors. Participants found it challenging to isolate and prioritize individual research areas, given the interdependent and consequential relationships among various aspects of earthen heritage conservation. Despite this limitation, the survey results are structured to allow for straightforward comparisons between different areas, highlighting those that may require further study and development.

Insufficient space for explanations. One of the survey's limitations was the small amount of space given to definitions and explanations of terminology or the structure of the survey's themes. In

fact, the survey required concise wording to accommodate the limited response space and maintain respondent engagement. As a result, certain terms or concepts may not have been explicitly defined, potentially leading to varying interpretations among participants. Furthermore, each theme included several topics to choose from and comment on, and while the survey strove to be comprehensive, there was neither space nor time to represent all possible topics within each theme. Nonetheless, a space for additional comment was provided to enable participants to introduce topics where necessary and to provide further explanations of their choices.

CHAPTER 2

SURVEY RESULTS

2.1. Response rate

The survey, launched in April 2023, was sent via email to 495 contacts and remained accessible for a month. The response rate was significant, with 260 individuals (53% of recipients) providing answers. This high response rate reflects the strong interest and engagement from the international community regarding the issues connected to earthen heritage conservation covered in the survey. However, while 260 respondents participated in the survey, only 210 completed it. As a result, certain questions were answered by different numbers of participants, as some exited the survey before reaching its conclusion. This variability in response rates may slightly impact the overall data analysis and interpretation.

2.1.1. Participants by region and area of expertise

Figure 2.1 presents a summary of the geographical regions where the survey participants work. The distribution of responses is proportionate to the geographical distribution of survey recipients. Notably, most participants work in Europe, accounting for 36.2% of the total, while Central and South America closely follows with 32.3% of respondents. Meanwhile, participants working in Asia represent 22.7%, and those in the Middle East follow with 21.9%. Respondents in Africa account for 16.5% of the total, and those in North America for 13.5%. Oceania has the smallest share of respondents at just 1.9%.

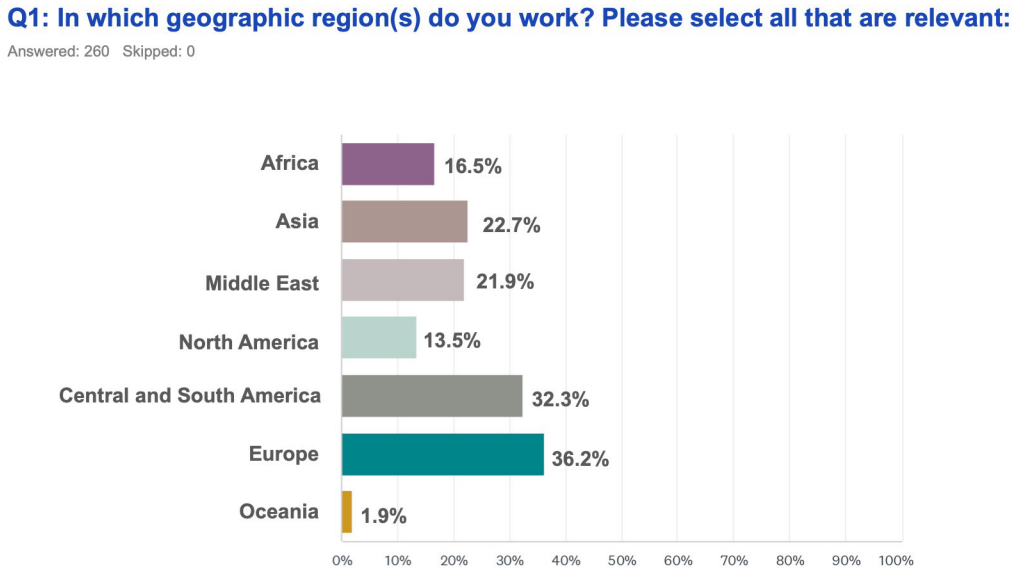

FIGURE 2.1
Distribution of survey participants working in different regions. Answers: 260, Skipped: 0.

The survey results indicate that a significant number of participants are primarily involved in building conservation (64.2%), education (49.6%), and scientific research (47.7%) (see figure 2.2). It should be noted that there is a small number of survey recipients engaged in other areas of work (10.3%), such as cooperation initiatives or contemporary social housing constructed with earth, which are not mentioned explicitly in this survey.

Furthermore, the survey findings indicate that a significant portion of participants are affiliated with universities (51.5%) (see figure 2.3). The remaining participants are more evenly distributed

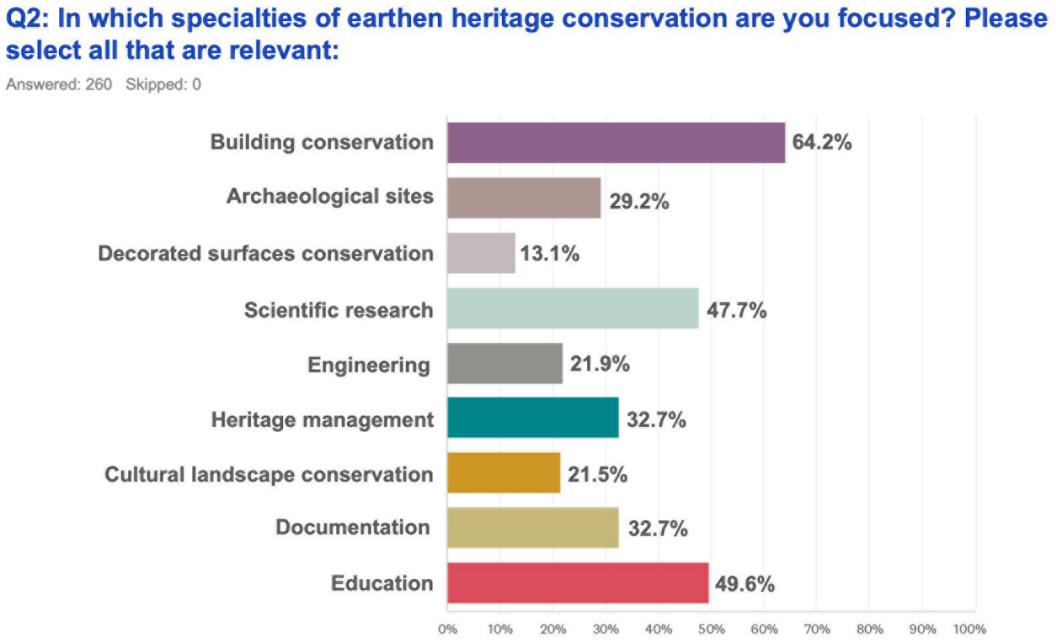

FIGURE 2.2
Distribution of type of specialization of participants. Answers: 260, Skipped: 0.

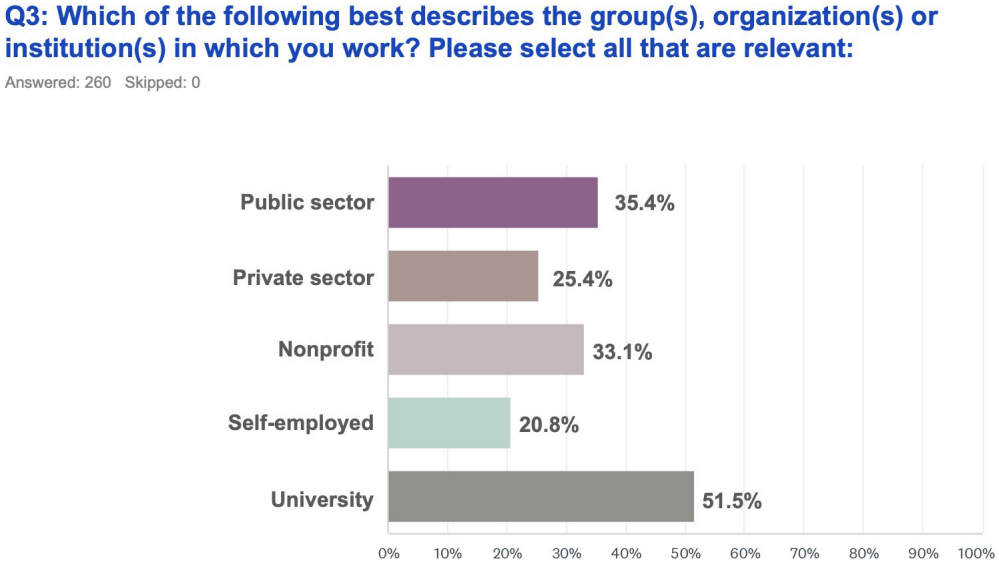

FIGURE 2.3
Affiliation of participants across groups, institutions, and organizations. Answers: 260, Skipped: 0.

across the other categories, including the public and private sectors, non-profit organizations, and self-employed professionals. Additionally, 7.6% of participants identify themselves as members of other categories, including retirees, volunteers, and independent researchers.

2.2. Overview of the current threats to earthen heritage and challenges to its preservation

2.2.1. Threats to earthen heritage

In the context of this survey, "threats" refer to external factors that pose risks to the physical fabric of earthen heritage and its surrounding environment. These threats include deterioration caused by weathering and erosion, extreme environmental conditions resulting from climate change, and natural disasters. Moreover, threats encompass human activities that impact heritage sites' structural integrity and cultural significance, such as inappropriate interventions, urban development, mass tourism, and material defects.

Figure 2.4 breaks down the survey participants' understanding of various threats to earthen heritage by perceived significance. In the survey, inappropriate interventions (48.8%), urban development leading to the loss of earthen heritage (46.7%), and natural disasters (45.1%) are most often identified as Very Significant threats.

Environmental decay (43.4%), disuse and/or abandonment (38.9%), and climate change (34.8%) are also considered Very Significant threats to the physical fabric of earthen heritage, though at lower rates. Among the 45 comments received for this question, one respondent points out that climate change plays a crucial role in accelerating decay, primarily through environmental factors

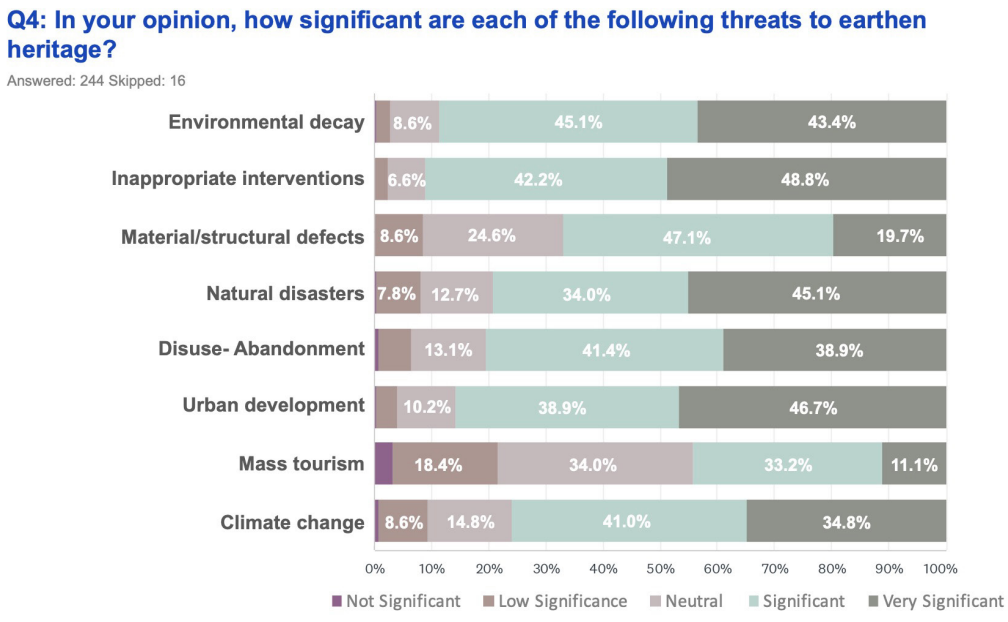

FIGURE 2.4
Significance of threats to earthen heritage as reported by participants (%). Answers: 244, Skipped: 16.

such as precipitation, floods, storms, etc. Participants also highlight that disuse and abandonment of earthen structures are driven by a complex interplay of factors. For example, the absence of norms or building regulations, coupled with limited awareness of the value and performance of earthen structures, contributes to their neglect. This neglect is further exacerbated by migration from rural to urban areas, which reduces the population in regions where earthen heritage sites are concentrated.

Material and structural defects are regarded as a Very Significant threat by only 19.7% of participants, but an additional 47.1% consider them a Significant threat. Some suggest that this threat is linked to diminishing traditional maintenance practices and the loss of construction knowledge, both of which undermine the preservation of historic structures. Mass tourism is not seen as a significant threat; it is indicated as Very Significant by only 11.1% of participants. Some justify this perspective with the belief that well-managed mass tourism can benefit earthen heritage by encouraging people and governments to invest in preservation.

2.2.2. Challenges to earthen heritage conservation

For the purposes of this survey, "challenges" are defined as obstacles or difficulties encountered by professionals and communities involved in the preservation of earthen heritage and sites. These challenges stem from various factors, including limited funding for conservation efforts, inadequate heritage protection policies (such as the absence of comprehensive building codes and guidelines specific to earthen architecture), and a scarcity of professional expertise in earthen heritage conservation due to the lack of specialized curricula and training offered at universities. In addition, the difficulty of preserving intangible practices associated with earthen heritage and the perception of earth as a poor and unsafe building material were also identified as significant challenges.

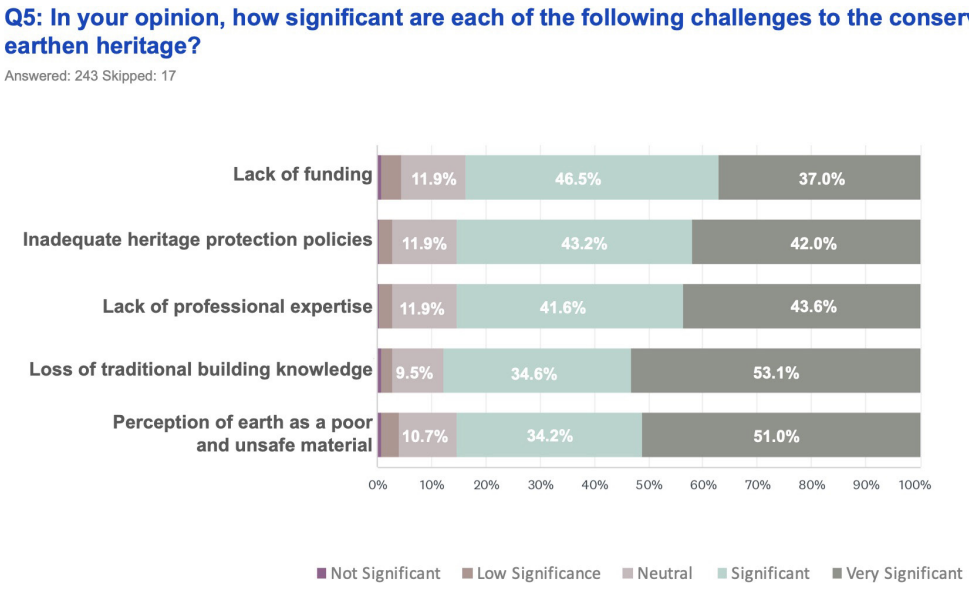

FIGURE 2.5
Significance of challenges to earthen heritage as reported by participants (%). Answers: 243, Skipped: 17.

According to a majority of survey participants, the loss of traditional building knowledge (53.1%) and the perception of earth as a poor and unsafe material (51.0%) are Very Significant challenges to the conservation of earthen heritage (see figure 2.5).

This question received a total of 39 comments. While most comments attribute the loss of traditional building skills to a lack of training and formal education, one respondent highlights that it is also connected to challenges in sourcing traditional materials used in earthen constructions. Factors such as aggressive resource extraction and deforestation have made these materials increasingly scarce, further hindering efforts to maintain and transmit traditional construction practices. In addition, the comments suggest that overcoming the perception that earth is a poor and unsafe building material can be achieved through raising awareness and knowledge. Participants also emphasize the importance of educational courses and engagement with a wide range of stakeholders as effective means to achieve this goal, as in the comment below:

> L'insuffisance des programmes et projets d'information et de sensibilisation du grand public est une des dépréciations des constructions en terre pourtant perçues par la grande majorité des populations rurales comme étant bioclimatiques et adaptées pour atténuer les effets de la crise climatique.
>
> —
>
> The lack of information and public awareness programs and projects is one of the factors contributing to the undervaluation of earthen constructions. These structures are, however, widely perceived by rural populations as being bioclimatic and suitable for mitigating the effects of the climate crisis.

However, participants suggest that perceptions of earth as a building material vary depending on the context. Several point out that in wealthier countries, such as France and Germany, there is growing awareness of the benefits of the thermal properties of earthen materials. As one respondent notes, there is an increasing trend of using earthen materials for both new construction and the preservation of existing structures. This comment suggests that the use of earth in contemporary architecture will enhance the overall perception of earthen materials and the value of heritage places made of earth.

When discussing the challenge to earthen heritage conservation posed by a lack of professional expertise (considered Very Significant by 43.6% of participants), one respondent emphasizes the absence of a scientific approach in the conservation process. According to this comment, this deficiency is reflected in the dearth of essential scientific activities like investigation campaigns, documentation collection, desk research, and structural assessment, all of which are crucial for preserving earthen structures. The participant adds that there is not sufficient specialization in the engineering sector to support the preservation of earthen structures effectively.

Finally, inadequate heritage protection policies (42.0%) and lack of funding (37.0%) are considered Very Significant challenges encountered by professionals working on the conservation of earthen structures at somewhat lower rates than the others. According to the comments, these challenges can lead to the abandonment of earthen structures due to the absence of proper maintenance and contribute to the perception of them as unsafe and in poor condition.

2.3. Identifying research and work priorities in earthen heritage conservation

In the second section of the survey, participants were asked to rank research priorities or "topics" according to their level of importance (ranging from Very Important to Not Important) within nine different themes related to earthen heritage conservation. Each of the following subsections summarizes one theme.

2.3.1. Understanding earthen building materials

This survey theme encompasses a holistic understanding of earthen building materials from the micro to the macro level. On the micro level, it involves laboratory activities and in situ testing to assess the granulometric composition and behavior of earth, as well as studies to improve its durability and performance. On the macro level, it involves construction techniques employed in earthen architecture and the study of their decay over time.

Of the 238 respondents, 52.9% identified construction methods and typologies studies as a Very Important research and work priority in the field, while 50.0% emphasized the need to understand decay mechanisms in earthen heritage conservation (see figure 2.6). Other areas were deemed less urgent priorities; 50.0% of respondents indicated that the behavior of consolidants was an Important research area, followed closely by additives at 48.7%.

This question received 27 comments in total. Here, a strong consensus emerges that topics such as the behavior of consolidants, additives, and material characterization have been extensively studied and researched. One participant underlines that there are numerous educational institutions in the fields of conservation, engineering, and architecture that offer instruction and conduct research on earthen building materials. The deficiency of knowledge in diagnosing building

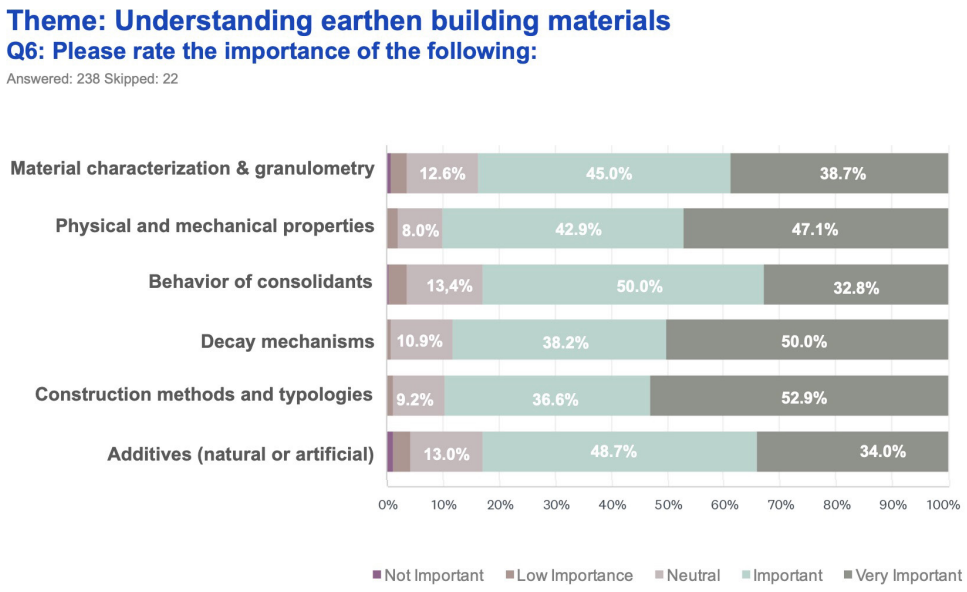

FIGURE 2.6
Importance of topics within the theme "Understanding earthen building materials" as reported by participants (%). Answers: 238, Skipped: 22.

conditions, selecting suitable conservation methods, executing appropriate interventions, and addressing preventive conservation measures are highlighted as primary issues in some comments. Other participants express the view that greater emphasis should be placed on practical applications, such as the construction of mock-ups and long-term monitoring of earthen materials through changes in climatic conditions.

2.3.2. Documentation and assessment of earthen heritage

In the EAI survey, this theme encompasses different methods of documenting and assessing tangible and intangible heritage. These include surveying and mapping, developing heritage and environmental impact assessments, recording oral history and traditions, and conducting historic and archival research.

Figure 2.7 illustrates that among the research areas related to the documentation and assessment of earthen heritage, documentation (48.9%)—which, for the purposes of this survey, includes metric survey, photogrammetry, laser scanning, aerial survey, and remote sensing—and mapping and inventory (48.1%) are most frequently perceived as Very Important areas for further research. A substantial number of participants consider historical and archival research for earthen structures (38.7%) Very Important. Similarly, 36.6% of participants recognize the recording of oral history as Very Important, particularly in the face of increasing displacement of local communities living in earthen sites and the loss of knowledge resulting from changing demographics. A near-majority consider data acquisition for environmental monitoring an Important area of research (49.8%). One participant highlights its value as a tool for understanding and tracking environmental changes and their effects on the physical integrity of earthen structures.

Across the 20 comments that this question received, it is observed that documentation reports of earthen heritage often fail to provide scientific analyses of materials. At the same time, several

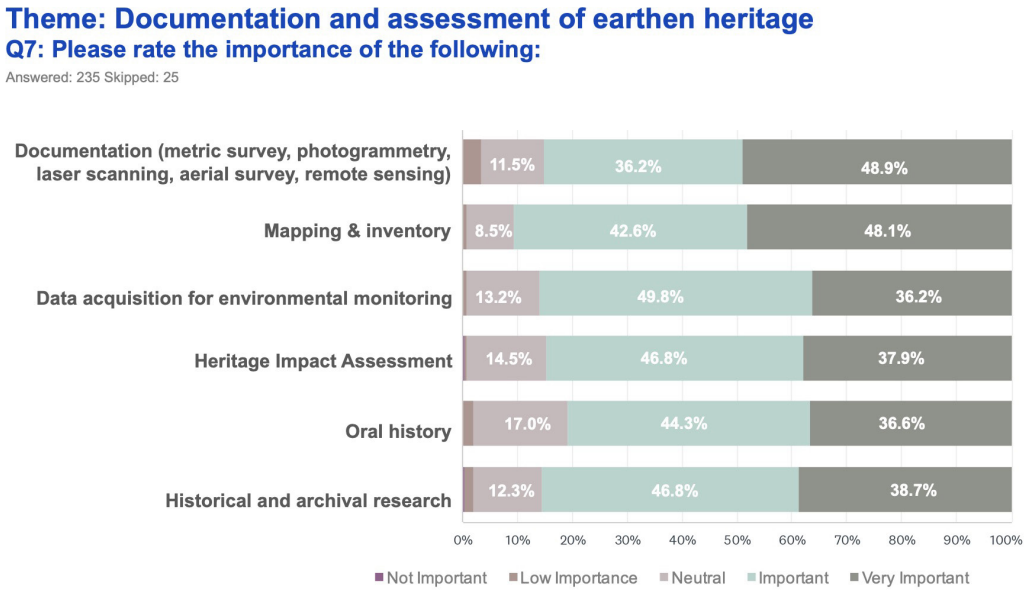

FIGURE 2.7

Importance of topics within the theme "Documentation and assessment of earthen heritage" as reported by participants (%). Answers: 235, Skipped: 25.

comments emphasize the critical need for comprehensive documentation extending beyond the conditions of the physical fabric. These comments also underscore the importance of capturing social aspects connected with earthen sites. This broader perspective acknowledges that heritage documentation encompasses more than just the recording of materials; it includes the survey of intangible dimensions that contribute to the cultural significance and historical value of these sites.

2.3.3. Conservation of earthen settlements

In this survey, the theme "Conservation of earthen settlements" encompasses various topics related to the conservation and management of groups of buildings constructed with earth. These include the adoption of urban conservation approaches such as the Recommendation on the Historic Urban Landscape (HUL) promoted by UNESCO in 2011,[1] the implementation of design guidelines, the construction of new construction within a historic context, and strategies aimed at supporting local communities residing in earthen settlements. Among these topics, support for local communities living in earthen settlements was identified as Very Important for further work and research by most participants (64.8%) (see figure 2.8).

In the 20 comments this question received, participants agree that participatory methods for community engagement in conservation and maintenance, as well as the creation of financial tools to facilitate the adaptive reuse of earthen structures, are effective strategies to support the conservation of earthen sites. However, one participant highlights that at some sites in Morocco, poorly managed or biased participatory activities led the local communities to disengage from the sites, which were subsequently abandoned or transformed into tourist attractions.

The topic of design and operational guidelines is recognized as an Important area for further research by 53.0% of participants. Nonetheless, one participant argues that design guidelines

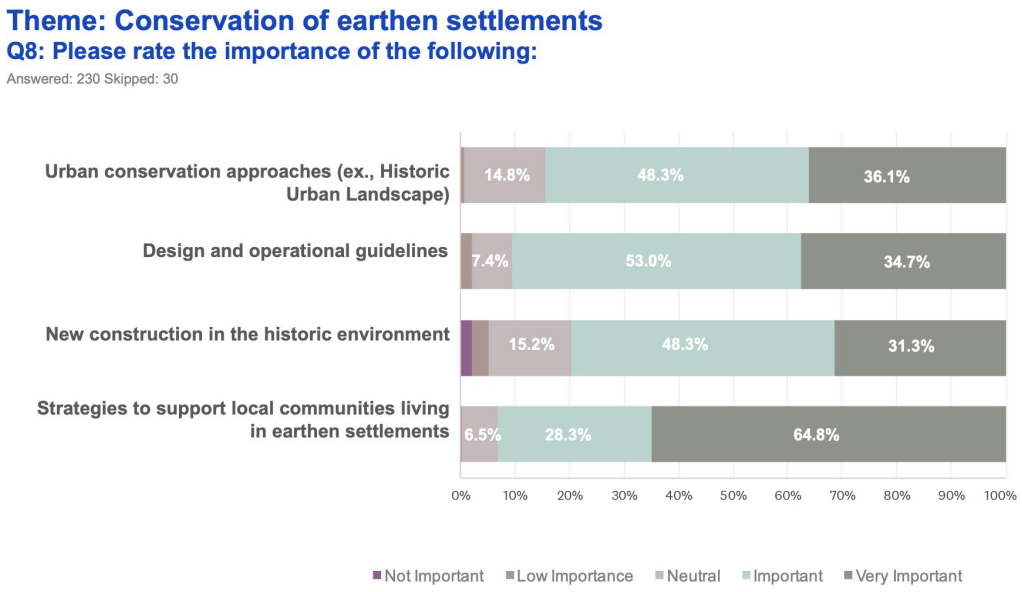

FIGURE 2.8
Importance of topics within the theme "Conservation of earthen settlements" as reported by participants (%). Answers: 235, Skipped: 25.

should be tailored to each specific case, as there is no universally applicable approach. They suggest that a comprehensive assessment, considering multiple aspects related to the value and significance of each site, is essential prior to intervention. Furthermore, survey participants highlight the challenges faced by earthen architecture in rural settings as opposed to urban ones, particularly in regions of the world where such sites lack specific policies for their preservation and management.

2.3.4. Conservation and management of earthen archaeological sites

For the purposes of this survey, this theme encompasses conservation strategies dedicated to preserving the physical integrity of archaeological earthen heritage sites, including material conservation and structural and non-structural interventions, alongside other approaches like shelter design, reburial, and drainage. Additionally, it encompasses methods to enhance the management and comprehension of archaeological sites through effective planning and interpretation.

Figure 2.9 shows that 53.0% of respondents consider material interventions a Very Important area of research. This topic is closely followed in importance by site management planning (50.0%) and heritage interpretation and presentation (44.8%). Additionally, the design of shelters (44.3%) and reburial and drainage (43.0%) are considered Important aspects of the conservation of archeological heritage sites.

Out of the total 20 comments received, one participant highlights the challenges faced by earthen archeological sites compared to those constructed with stone, particularly concerning material durability and resistance to erosion. For this reason, the participant suggests that site management planning and a careful interpretation of the site are necessary to determine the most appropriate conservation strategies. Another suggestion drawn from the comments is the need for additional research that compares various conservation approaches for archaeological sites, such

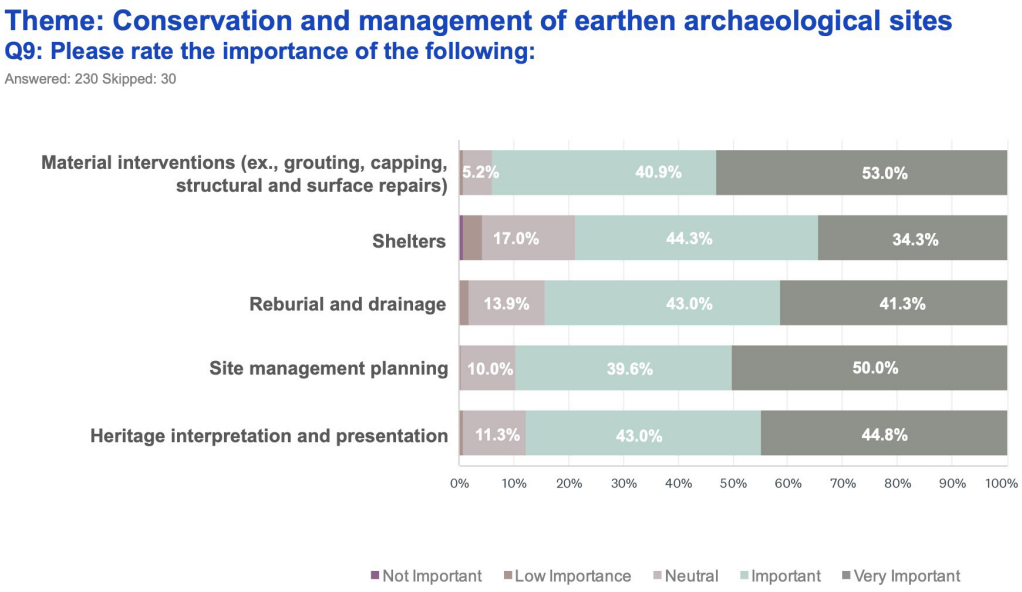

FIGURE 2.9

Importance of topics within the theme "Conservation and management of earthen archaeological sites" as reported by participants (%). Answers: 230, Skipped: 30.

as sacrificial layers, shelters, and reburial. This kind of research could compare the advantages and disadvantages of each approach, including their associated costs and benefits.

2.3.5. Preventive conservation of earthen heritage

In this survey, "Preventive conservation" encompasses the development of maintenance programs and the adoption of monitoring tools and protocols to facilitate continuous assessment and data collection for site conservation. The theme's topics include engaging stakeholders, like local authorities and communities, to ensure the implementation of maintenance and monitoring programs.

Seventy percent of the survey participants consider the need for further research on the involvement of local communities in maintenance and monitoring Very Important, one of the highest percentages recorded in the survey. This is followed closely by developing maintenance programs, which 158 participants (68.7%) rank as Very Important. One participant highlights the central role of local communities as the original builders of the heritage, noting that they can effectively maintain their heritage. On the other hand, monitoring tools and protocols are considered Very Important by only 43.9% of the participants (see figure 2.10).

This theme received 17 comments in total. In the comment below, one participant stresses the significance of co-designing engagement activities for the maintenance of earthen structures, acknowledging the value of mutual learning among diverse stakeholders, including experts, community members, and others:

> This should not be seen as a linear process with "experts" trying to engage others. Instead, there is a need for more co-learning and co-production of knowledge to bring forth innovation and make the most of existing knowledge.

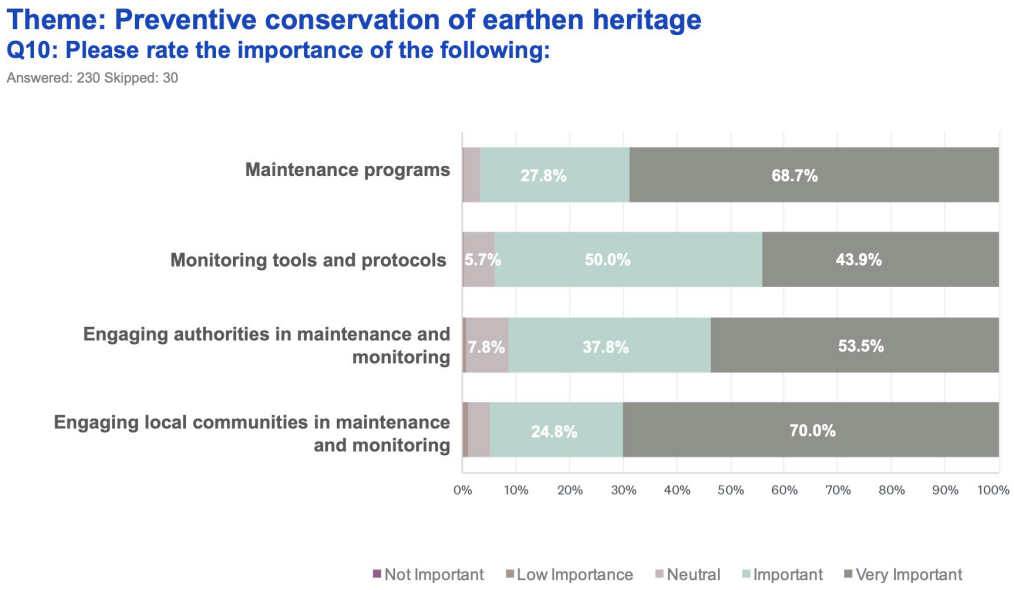

FIGURE 2.10

Importance of topics within the theme "Preventive conservation of earthen heritage" as reported by participants (%). Answers: 230, Skipped: 30.

This comment underscores the indispensable role of both experts (meaning heritage professionals including specialized masons) and the community that is connected to the heritage in the ongoing maintenance of earthen structures, emphasizing the fact that both groups can learn from each other to advance the maintenance of earthen historic sites.

Engaging authorities in the maintenance and monitoring of earthen heritage is considered Very Important by 53.5% of respondents. One comment suggests that involving government authorities is essential because specific governmental interventions can inadvertently contribute to the deterioration of sites. This may occur due to profit-seeking motives, lack of awareness, or complete disregard for both the architectural heritage and the communities residing in these areas.

2.3.6. Education and capacity building

In the context of "Education and capacity building," various forms of teaching and learning were selected to gauge which ones need further research. These include practical and theoretical initiatives offered through degree programs, university training, hands-on workshops, and seminars. This theme also incorporates community engagement in the conservation process and the dissemination of knowledge through international conferences and expert meetings.

As shown in figure 2.11, 70.0% of participants consider community participation in workshops and training activities Very Important. This coincides with the level of support for further research on engagement with the local community mentioned in the previous theme (Preventive conservation) and is the highest percentage of selection in this survey. Workshops and seminars including hands-on courses were also identified as a Very Important topic of further study by most participants (66.5%).

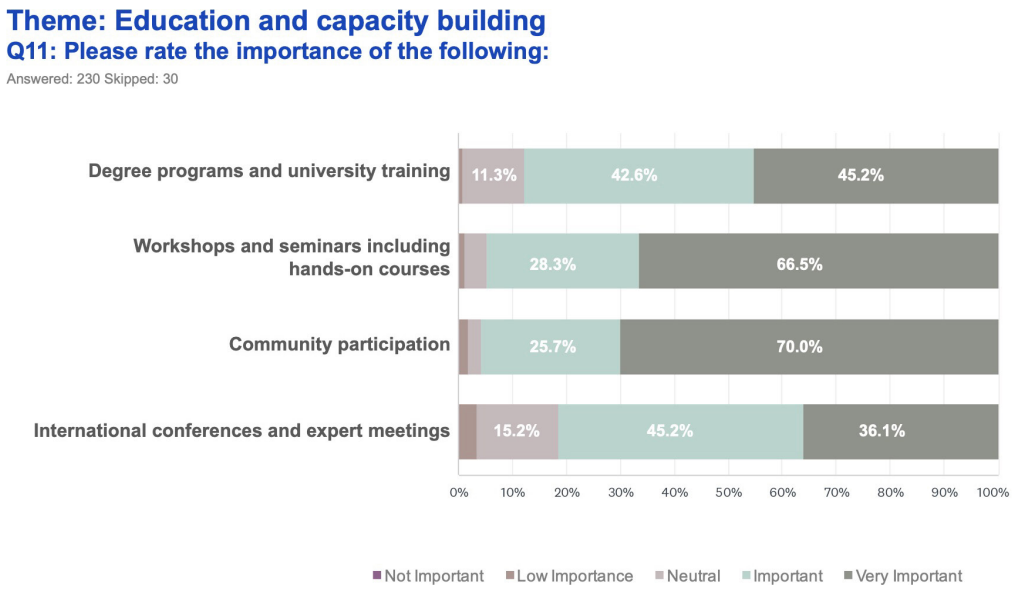

FIGURE 2.11

Importance of topics within the theme "Education and capacity building" as reported by participants (%). Answers: 230, Skipped: 30.

Most of the 20 comments received for this theme emphasize the significance of practical training involving local communities and craftspeople for the conservation of earthen heritage. One participant states:

> Es ultra necesario capacitar a los artesanos. Empezamos a tener técnicos con conocimientos, pero si no hay mano de obra y si la gente común no entiende la necesidad de preservar el patrimonio, la batalla está perdida.
>
> —
>
> It's extremely necessary to train artisans. We're starting to have technicians with knowledge, but if there's no workforce, and if ordinary people don't understand the need to preserve heritage, the battle is lost.

Regarding university courses, some participants acknowledge that conservation and material analysis of earthen structures should be included in the curricula for architecture schools. Nonetheless, one participant mentions the challenges associated with implementing practical and long-term courses on earthen conservation at the university level. In fact, these courses demand infrastructure like materials testing laboratories and open spaces for hands-on experimentation with earth as a construction material.

Finally, international conferences and experts meetings were considered Very Important by 36.1% of respondents. The comments emphasized the necessity of increasing access to these events and proposed adopting hybrid formats of participation, as well as recording and disseminating the proceedings through the web, for example, via YouTube.

2.3.7. Climate change and earthen heritage

In this survey, further research and work priorities in the context of climate change are focused on two categories: comprehending the impacts of climate change on both earthen sites and their inhabitants and developing methods for risk mitigation and thermal performance assessment in response to these challenges.

The Very Important responses are evenly distributed across the following areas of work and research: methods to mitigate climate change impacts on earthen sites (51.5%), identifying and assessing climate change impacts on populations living in earthen buildings (49.8%), and identifying and assessing climate change impacts on earthen sites (48.0%) (see figure 2.12). Only 26.2% of participants consider assessing thermal performance, meaning studies to understand how buildings perform in extreme weather conditions, Very Important. However, 49.3% deem this area Important.

Across the 14 comments on this topic, there is a general agreement on the importance of integrating traditional knowledge into strategies aimed at mitigating the impacts of climate change by enhancing the resilience of historic earthen buildings. For instance, one suggestion is to adapt traditional calendar-based maintenance practices in response to changing seasonal weather patterns.

Regarding the assessment of the thermal performance of earthen structures, one participant comments on the importance of studying moisture management, particularly in regions susceptible to high humidity and flooding. According to the participant, this should include a comprehensive examination of the entire moisture cycle to prevent the decay of earthen materials.

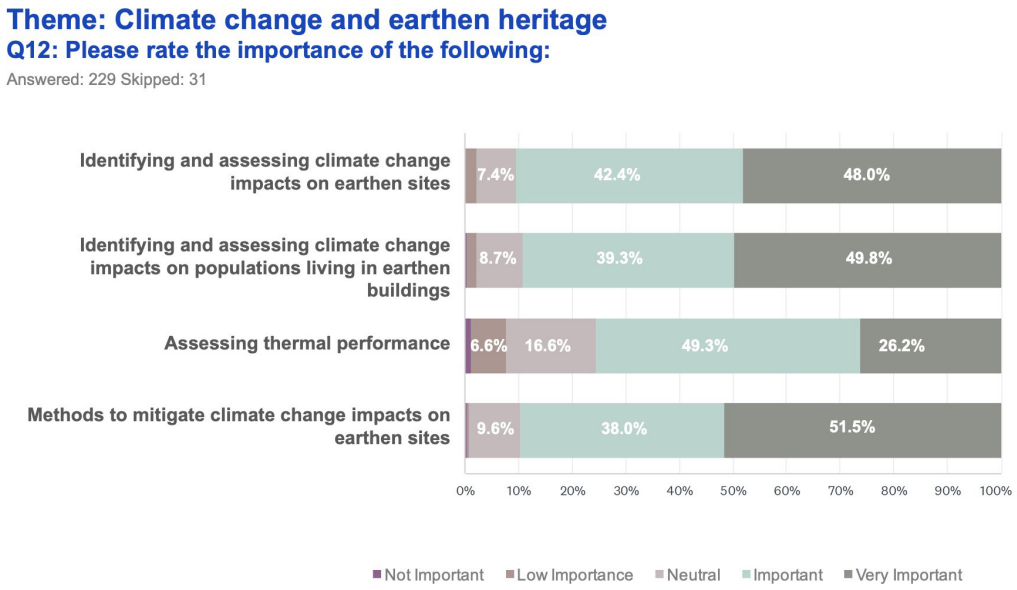

FIGURE 2.12
Importance of topics within the theme "Climate change and earthen heritage" as reported by participants (%). Answers: 229, Skipped: 31.

2.3.8. Disaster risk management for earthen heritage

This theme encompasses a range of research areas focused on both preventing and responding to various types of disasters. These include mitigation measures and responses to the effects of natural disasters (like earthquakes and flooding) and man-made disasters (like those resulting from war). Additionally, the theme involves the development of risk plans, risk-mapping strategies, and community-awareness programs, all of which serve as preventive measures to address potential impacts effectively.

Within this theme, community awareness and preparedness for disasters was selected as Very Important topic in need of research by 62.3% of respondents (see figure 2.13). The comments underscore the necessity of developing additional research programs that empower communities to enhance their preparedness for disasters by increasing awareness and preserving the memory of past disasters. Similarly, some comments suggest integrating traditional knowledge into disaster risk management strategies.

Regarding the distribution of the other responses, all are regarded as Very Important to similar degrees. These include seismic retrofitting (53.1%), flood mitigation (49.6%), development of risk plans and maps (49.6%), and post-conflict response and recovery (45.2%).

This theme received 18 comments in total. Some of the comments suggest that while there is already a substantial body of research on seismic retrofitting, the main challenge lies in the integration of this research into building codes for historic earthen structures. Some participants mentioned that in North African countries like Morocco, building regulations often require the use of concrete for repairs, and that this actually weakens the earthen structures, potentially exacerbating their vulnerability to seismic damage.

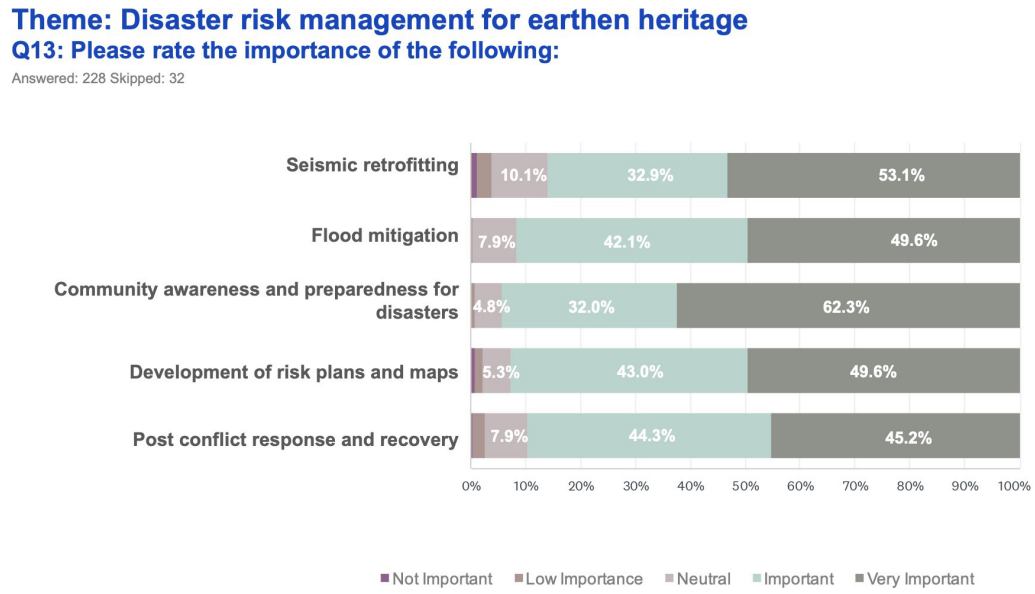

FIGURE 2.13
Importance of topics within the theme "Disaster risk management for earthen heritage" as reported by participants (%). Answers: 228, Skipped: 32.

2.3.9. Rehabilitation and adaptive reuse of earthen buildings

The final theme addresses physical interventions for earthen heritage conservation, including rehabilitation planning and methods and the development of innovative solutions for adaptive reuse. Additionally, it delves into the perspectives of stakeholders, examining the need for financial tools and strategies to encourage their effective management and engagement.

Figure 2.14 shows that the only topic and ranking combination chosen by the majority of respondents is stakeholder management strategies, with 54.4% selecting it as Important. Respondents rank the topics of rehabilitation planning and methods (49.1%), financial tools and regulatory systems (40.8%), and technological advances and innovations for adaptive reuse (40.4%) Very Important less often.

Many of the 10 comments received for this theme emphasize the importance of stakeholder management strategies for the successful implementation of adaptive reuse of earthen buildings. One participant underlines the need for collecting examples of rehabilitation practices, regulations, and financial supports, such as social development microfinancing, tax incentives, and changes to land-use and heritage policies to favor historic earthen architecture. However, a common challenge in the adaptation process identified by the survey participants is the presence of conflicting interests among various stakeholders associated with the site, along with insufficient financial resources for adapting historic buildings.

2.3.10. Priority areas of research and work in earthen heritage conservation

After prioritizing specific areas of research and work within the nine selected themes, participants were asked to choose the themes that were the highest priorities to further advance the field of earthen heritage conservation. Respondents could choose more than one theme and selected three to four on average.

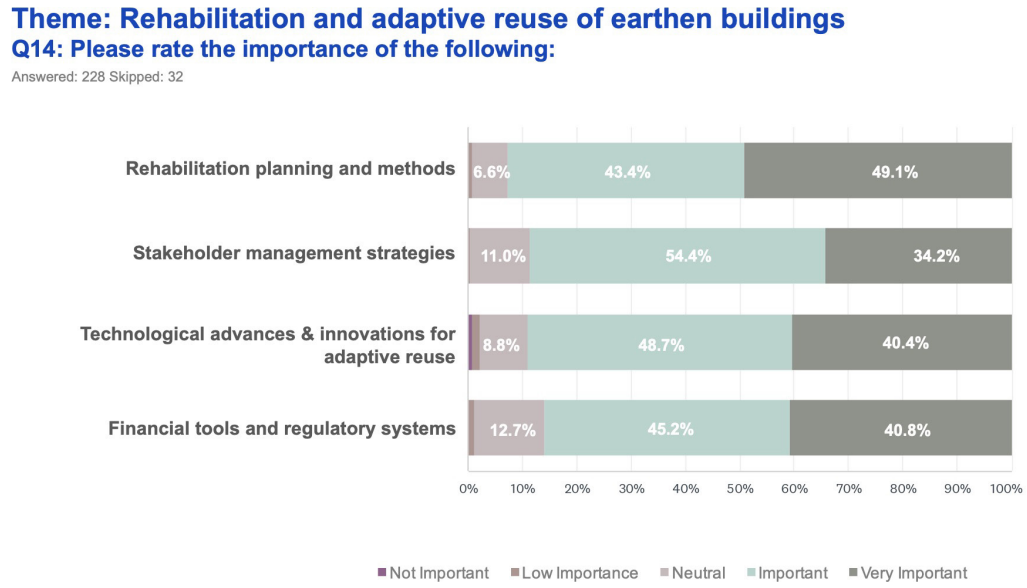

FIGURE 2.14
Importance of topics within the theme "Rehabilitation and adaptive reuse of earthen buildings" as reported by participants (%). Answers: 228, Skipped: 32.

Of the 260 survey participants, 210 responded to this question (see figure 2.15). "Education and capacity building" was the theme chosen most often, by 65.7% of respondents. This was followed by "rehabilitation and adaptive reuse of earthen buildings" (60.0%) and "preventive conservation of earthen heritage" (57.6%). The next results were as follows: "understanding earthen building materials" (54.3%), "climate change and earthen heritage" (45.7%), and "conservation of earthen settlements" (45.2%). At the bottom of the list, there are "documentation and assessment of earthen heritage" (41.4%), "disaster risk management for earthen heritage" (41.0%), and "conservation and management of earthen archaeological sites" (30.5%).

Of the participants who answered this question, 168 provided additional comments to justify their selections regarding the highest-priority themes in earthen heritage conservation. These comments have been grouped and summarized to provide a deeper understanding of the issues identified as most urgent in the field. The highest-ranked theme is "education and capacity building," which is considered crucial for the conservation of earthen heritage. This includes hands-on training, integrating earthen conservation into university curricula, capacity-building initiatives, and involving local communities in preservation efforts. Twenty-six comments emphasize the importance of engaging diverse stakeholders in the conservation, use, and management of earthen structures, as well as educating young members of local communities to preserve their significance. One respondent states:

> En mi opinión, la educación, la atención y el cuidado de la conservación son esenciales, pero solo a través del compromiso, la concienciación y la participación de las comunidades, gestores, empresas y otros actores, se logra fomentar que la comunidad permanezca en su lugar de residencia, se fortalezca y modele su propio futuro.
>
> —

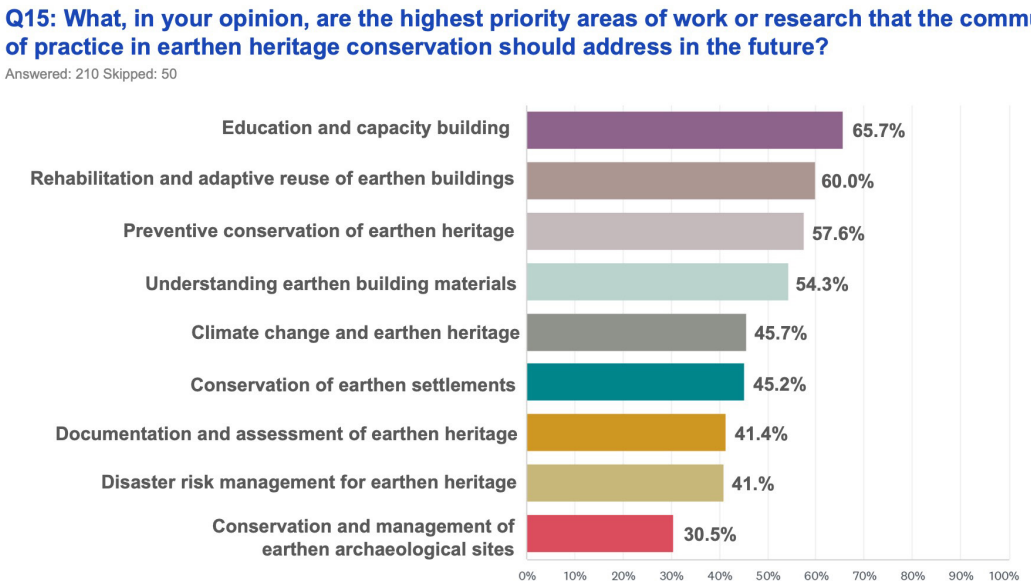

FIGURE 2.15
Importance of priority areas of research and work ranked by participants (%). Answers: 210, Skipped: 50.

> In my view, education, attention, and conservation care are fundamental. However, it is only through the involvement, awareness, and participation of communities, managers, businesses, and others that we encourage the community to stay where they live, strengthen themselves, and shape their own future.

Participants also point out deficiencies in the education system concerning traditional methods of construction and conservation of earthen materials and stress the need for more opportunities to train professionals working in this field.

The second most-chosen theme, "rehabilitation and adaptive reuse of earthen buildings" (60.0%) is perceived by the participants as an important conservation approach. The comment below highlights that rehabilitation of historic earthen buildings will ensure continuity and use of the buildings while avoiding deterioration and abandonment:

> I believe that using buildings, through their rehabilitation, is one of the most powerful actions since non-use leads to abandonment and deterioration of earthen heritage.

The emphasis placed on this theme in the comments also reflects the recognition that adaptation can contribute to addressing the challenges posed by climate change. This involves adopting adaptive measures to ensure the long-term viability and resilience of earthen structures.

The third most-selected theme is "preventive conservation" (57.6%). Survey participants underline its significance in safeguarding earthen heritage from potential threats and changing environmental conditions. Among the comments, four participants stress that earth is a fragile material, highly susceptible to environmental conditions and decay, and underscore the vital importance of preventive conservation. Like the theme "rehabilitation and adaptive reuse of earthen buildings," in the view of the survey participants, "preventive conservation" is also closely connected to addressing climate change impacts and increasing the resilience of earthen sites. This is highlighted in the following comment:

> For this reason, I think protection from the effects of climate change is the primary issue to investigate in order of priority. The first way to address this problem is to enhance the resilience of earthen structures through techniques of preventive conservation.

Moreover, there is wide recognition of the need for effective preventive measures, such as monitoring tools and maintenance programs, to ensure the long-term preservation and sustainability of earthen structures. Comments highlighted the importance of proactive conservation strategies to preserve earthen heritage involving not only professionals but also local communities as an aid to a people-centered approach.

The theme "understanding earthen building materials" received substantial attention (54.3%), with participants recognizing the need for in-depth research and analysis of earthen materials to develop effective conservation interventions. As expressed by one participant, a significant priority is to acquire knowledge that can challenge the perception of earth as an unsafe and inferior material. According to the participants, understanding earth's properties, demonstrating its preservability, and sharing this knowledge with others are essential for the conservation of earthen heritage. Equally essential is showcasing earth's capacity for reuse and adaptation to new purposes, which is as vital as effectively managing and conserving heritage, as stated by a participant:

> The highest priority is to understand the material, to prove that it can be preserved, and teach others. To prove its capacity for reuse and adaptation to new uses is as essential as the management of heritage.

While "climate change" and "disaster risk management" scored below 50.0%, they have been identified in the comments as urgent themes for research. According to participants' comments, the changing climate patterns and the rising frequency of natural disasters are widely recognized as significant threats to earthen heritage conservation in various regions. For instance, one respondent mentions that many earthen heritage sites in Northern China, which typically experiences a dry climate, suffered significant damage during heavy rainfall in 2021. Similarly, another respondent underlines that "disaster risk management" for both natural and man-made disasters is a significant topic in areas such as the Middle East and North Africa.

Two comments highlight the importance of the theme "conservation of earthen settlements" for safeguarding living heritage, which encompasses traditional practices and local culture. Different comments highlight the relevance of the theme "documentation and assessment of earthen heritage" in relation to the effects of rapid change in climate patterns and the use of traditional earthen settlements. According to most of the comments, documentation is considered an effective tool for the conservation of earthen sites, but it is also important to document the inevitable and ongoing loss of heritage. A perceived lack of documentation and understanding of earthen building techniques emerged in certain regions, such as Asia, as stated in the following comment:

> Our understanding of historic earthen building techniques in Asia, is still limited and needs to be well documented. Given the increased pace of deterioration or willful destruction, documentation is critical.

Finally, the last theme considered as a research priority, with 30.5% of responses, is the 'conservation and management of earthen archaeological sites,' perhaps due to the ample knowledge and publications already available in this field.

2.4. Resources needed in the field

The last section of the questionnaire included two open-ended questions. The first question (Q17) aimed at gathering insights on the resources required to advance the field of earthen heritage conservation. 210 participants responded to each of these questions. These responses were analyzed and grouped based on common suggestions and recurring key themes. These groups are outlined below.

Guidelines: 60 comments mention the need for guidelines designed for practitioners and local communities who reside in earthen structures. Moreover, there is a clear consensus among participants in favor of promoting guidelines on the adaptive reuse of earthen buildings, showcasing case studies, and disseminating best practices. Due to the growing risk posed by extreme weather conditions, climate change assessments and multi-hazard risk management guidelines are also suggested. Survey participants recommend that assessments of climate change impacts should include both earthen structures and their users, providing strategies and tools to enhance resilience in the face of potential risks.

Conservation policies: 49 survey participants indicate that conservation policies for historic earthen buildings are the most-needed resources to advance earthen heritage conservation. For example, some participants suggest creating an international charter for earthen buildings, as well as building codes for historic earthen structures.

One participant, while recognizing the importance of better policies, also proposes creating an international fund to support and finance earthen heritage conservation efforts and research in South America and Africa.

Dissemination: The significance of disseminating the resources mentioned above is strongly emphasized by the participants. This dissemination could take various forms, such as making existing studies more accessible, publishing new didactic materials, developing manuals and hands-on courses, and producing accessible conservation reports and studies. Additionally, creating a comprehensive digital database and online inventories covering various aspects of earthen heritage conservation is proposed. Furthermore, the establishment of international networks to foster collaboration and knowledge exchange is highlighted. Participants also suggest utilizing different mediums to raise awareness about the advantages of earthen structures, including the creation of informative videos and booklets addressed to a wider audience. Several participants point out the importance of co-designing certain resources in collaboration with the users of earthen buildings. This approach ensures that the needs and perspectives of different stakeholders are included, favoring a bottom-up approach to the dissemination of best practices for the conservation and maintenance of historic buildings.

2.5. Education and training needs

The second open-ended question (Q18) delved into training needs and aimed to identify the specific audience interested in education for earthen heritage conservation. In total, 210 responses were received. The comments are summarized below.

Training topics: Participants emphasize the importance of tailoring training programs to meet each country's specific needs. Practical and hands-on courses focused on understanding earthen materials, pathologies, and construction techniques were strongly recommended. Trainings on risk assessment, climate change adaptation, and building performance analysis are also suggested. Other themes, such as preventive conservation and documentation, are also recognized, albeit to a lesser extent.

Training recipients: The target audience for training is perceived to be a multidisciplinary group including architects, engineers, archaeologists, and conservators, as well as site managers and government officials engaged in the heritage sector. Notably, significant attention is placed on providing training for masons and craftspeople to preserve traditional construction techniques. Integrating earthen architecture conservation training into university curricula is also highlighted as crucial.

Moreover, community involvement and raising awareness through participatory activities are widely acknowledged as essential. Engaging local stakeholders and authorities in the education and capacity development process is considered vital for fostering a sense of ownership and ensuring the sustainability of conservation efforts. Collaborating directly with communities involved in earthen heritage conservation is identified as an effective training approach for the long-term preservation of earthen heritage.

Reference

UNESCO. *Recommendation on the Historic Urban Landscape*, 2011. https://whc.unesco.org/document/160163.

CHAPTER 3

OBSERVATIONS

Upon analyzing the EAI survey responses, several significant themes and trends emerged, highlighting urgent needs and priorities within the field. First, it is important to note the active participation of countries with well-established traditions in earthen construction and conservation practices, particularly in Central and South America and Europe. This engagement has been encouraged by the presence of conservation groups like ICOMOS-ISCEAH and PROTERRA and research centers such as CRAterre, but also by training courses promoted by the GCI and its partners such as PAT96 and PAT99. These initiatives actively promote conservation practices and maintenance of earthen structures through conferences, studies, and hands-on training.

First, there is an evident correlation between the threats to earthen heritage and the challenges to its preservation identified by respondents and their research and work priorities. Most survey participants suggest that the challenges arising from inappropriate interventions, the loss of traditional knowledge, and the perception of earthen materials as poor and unsafe can be effectively addressed by increasing understanding of earthen materials, education, and adaptive reuse case studies.

In total, 66.5% of survey participants propose implementing education programs like workshops and seminars including hands-on courses (see section 2.3.6). A significant majority of the participants are affiliated with university institutions (see section 1.3), which could explain their emphasis on the importance of education. Participants typically suggest that educational initiatives should be addressed to both specialists, including masons and craftspeople, and to the local community, which plays a vital role in the maintenance of earthen historic buildings. Notably, in the themes of "preventive conservation" and "education and capacity building," community engagement and participation was ranked Very Important by 70% of respondents, the highest-ranked topic in the survey (see sections 2.3.5 and 2.3.6). Furthermore, when discussing the challenges to earthen sites, participants highlighted a significant gap in education regarding the conservation of earthen structures within engineering schools. There is a need to establish the necessary facilities and infrastructure to assist the development of academic courses related to this field.

A recurring concern for educational activities is the need to bridge the gap between experts and non-experts by disseminating scientific and technical knowledge to diverse audiences, for example, younger generations residing in earthen buildings. Additionally, participants emphasize the increasing demand to improve the interpretation of earthen archaeological sites, thereby expanding public understanding and appreciation of their significance. To address this challenge, proposed solutions include leveraging technologies like video, artificial intelligence, and the development of open-source toolkits for communities with examples of best practices. Additionally, participants mention the creation of networks and platforms dedicated to the promotion of best practices for earthen heritage conservation, use, and adaptation of earthen buildings as possible solutions.

These initiatives aim to facilitate effective knowledge sharing and foster a stronger connection between heritage experts and the wider public.

Another significant theme selected by the participants, which is closely connected to the identified "threats" and "challenges" (see section 2.2), is the adaptation and reuse of earthen buildings, alongside the implementation of preventive conservation methods. It is increasingly evident that rapid shifts in environmental and economic conditions have contributed to the widespread abandonment and deterioration of earthen structures. There is a prevailing consensus that adaptation strategies can help maintain the continued functionality and use of earthen buildings while mitigating potential risks and preserving their cultural significance. In addition to adaptive use, the survey highlights the pressing need for preventive measures to safeguard earthen heritage against the adverse impacts of climate change.

Understanding earthen materials and local traditions emerged as another significant theme, highlighting how this area of research can guide appropriate interventions and play a crucial role in raising awareness about earthen heritage within the community. Participants show a particular interest in further research into the topics of construction techniques and decay mechanisms. They recognize the significance of such understanding in guiding appropriate methods of intervention for conservation efforts.

Participants also express the need for tailored guidelines that can better direct specialists and communities to manage, adapt, and preserve their earthen heritage, including climate change assessments and multi-hazard risk management. Local authorities and governmental bodies should integrate these guidelines for the development of policies to support and regulate conservation efforts.

Overall, the survey highlights the importance of considering the social aspect of the different themes relevant to earthen heritage conservation and management. Participants recognized that engaging and involving communities in conservation efforts will ensure the long-term sustainability of any project through the development of ongoing maintenance programs and will also foster a communal sense of pride and ownership. Participants stressed the importance of favoring methods of co-production and design to promote mutual learning among different stakeholders.

CHAPTER 4

LESSONS LEARNED AND RECOMMENDATIONS

Before introducing the lessons learned and recommendations drawn from this survey, it is valuable to reflect on the evolution of earthen heritage conservation over recent decades. To that end, this chapter will compare the findings of the current survey with the previous results gathered from the Earthen Architecture Research Survey launched by the GCI, ICCROM, and CRAterre-ENSAG in 1998 as part of the Project Terra framework.

While the scope of the EAI survey differs from that of its predecessor, it is possible to compare some specific results. First, increased participation and engagement in defining and addressing the field's evolving needs and priorities by the earthen heritage conservation community can be observed. In the Project Terra survey, 233 questionnaires were distributed to individuals and institutions involved in earthen architecture conservation, and 52 responses were received (a 23% response rate). Nevertheless, it is important to note that, unlike this survey, the Project Terra survey was distributed through traditional mail, which placed limits on accessibility and response rates.

Second, the Project Terra survey specifically targeted scientists and conservation practitioners, whereas this survey included those with diverse specializations such as education, urban conservation, engineering, and cultural landscape studies, as well as other practitioners working with communities in the field. This reflects the evolution of the field, emphasizing the multidisciplinary approach needed for the conservation of earthen sites.

Both surveys aimed to explore the perceived research needs of participants. In the Project Terra survey, 44.0% of participants identified conservation intervention as a priority for research, making it the highest-rated topic. It was followed by studies on the relationships between composition, properties, environmental and contextual factors, decay mechanisms, and the use of earth as a building material. Notably, the Project Terra survey focused predominantly on material conservation, whereas the results of this survey reflect a more holistic view of conservation practice. The highest-rated priorities for future work and research in Question 15 of this survey are education (65.7%), adaptability of buildings to diverse uses (60.0%), and preventive conservation (57.6%). Responses suggest that the research to be developed under these themes should address issues posed by changes in climate and the rehabilitation of earthen structures. This represents a paradigmatic shift that underscores the evolving landscape of conservation priorities and the widening scope of the field.

The results of the new EAI survey on earthen heritage conservation yield several important lessons that will assist the field and Getty in developing a strategic 10-year plan and informing future activities.

4.1. Lessons learned

The importance of education and capacity building. The high percentage of participants prioritizing education and capacity building highlights the crucial role of skill development and knowledge dissemination. This emphasizes the need for continuous learning and training programs to equip stakeholders, including professionals and local communities, with the necessary tools to conserve and manage earthen structures effectively.

Addressing climate change, disaster management, and adaptation. The interest in the rehabilitation and adaptive reuse of earthen buildings is closely linked to their continuous use, as well as efforts to improve their standard and living conditions. This also highlights the urgency of addressing the impacts of climate change, including natural disasters, on earthen heritage. There is a demand for developing environmental assessments as well as guidelines to support the management, adaptation, and conservation of earthen heritage. This may involve the collection and dissemination of valuable case studies, showcasing successful approaches to address the challenges posed by climate change and disaster management.

Emphasizing preventive conservation. The recognition of preventive conservation as a priority area of further research emphasizes the importance of proactive measures to safeguard earthen heritage from potential threats and deterioration. This underscores the need for monitoring, maintenance programs and protocols, as well as involving local stakeholders and authorities.

Collaborative and participatory approach. The survey results suggest that involving various stakeholders, including local communities, in the conservation process is crucial for success and the sustainability of the outcomes. This lesson emphasizes the value of a collaborative, participatory, and co-designing approach to heritage conservation, ensuring that diverse perspectives are considered, and a sense of ownership is fostered among all stakeholders.

Understanding earthen building materials. The acknowledgment of the need to understand earthen materials reflects the significance of research and analysis in developing effective conservation methods. Participants indicate that studies on earthen pathologies and traditional construction methods are necessary. This highlights the importance of bridging gaps in knowledge and challenging preconceptions about earthen materials to promote their sustainable use and preservation.

Policy. Advances in conservation implementations solutions (i.e., methodologies, tools, techniques, etc.) should be integrated into policies that offer financial support and regulate the conservation of earthen heritage.

4.2. Recommendations

Regarding education and training opportunities, the comments were grouped under the following recommendations:

Promoting hands-on courses. Prioritize hands-on courses that bring together a multidisciplinary team, featuring instructors from academia and practitioners. The use of laboratories and learning

facilities can support university courses. While countries in Europe and South America have a strong tradition of offering such courses, it could be beneficial to target regions that are underrepresented in this survey.

Co-designed teaching materials. Develop co-designed teaching materials, toolkits, and training programs, involving input from various stakeholders. The content should be tailored to specific regional needs and ensure the representation of local perspectives.

Targeting diverse audiences. Disseminate educational resources targeting different audiences, including professionals, academics, and the general public. Additionally, focus on engaging young individuals through different media to foster a sense of appreciation and responsibility for earthen heritage conservation among the next generation.

The team identified the following areas for future work and research:

Adaptive reuse of earthen buildings. Develop case studies and guidelines in response to various threats such as adapting abandoned earthen buildings to new uses; respond to changing environmental conditions and/or disasters through mitigation and preventive strategies; formulate urban design and use policies for earthen heritage under threat of urban development; and promote seismic retrofitting guidelines.

Preventive conservation. Create methods and approaches for maintenance and monitoring programs in collaboration with local stakeholders. This could include the use audiovisual technology and documentaries for the dissemination of maintenance practices and case studies.

Professional networking and knowledge-sharing. Create networks of specialists and institutions involved in heritage conservation that can use an online platform for dissemination of best practices to different publics.

Encouraging continuous learning. Promote grant opportunities for training and specialization.

ACKNOWLEDGMENTS

We appreciate the time and effort of all the respondents worldwide who participated in this survey. Your insights have been invaluable in identifying the challenges and research priorities in earthen heritage conservation, making a significant contribution to this project.

We are also grateful to those who helped disseminate the survey, including ICOMOS-ISCEAH, PROTERRA, and scientific research groups such as RILEM. Key institutions, including CRAterre–ENSAG, ICCROM, and the Department of Culture and Tourism of Abu Dhabi, played a crucial role in broadening our reach.

This initiative was led by Benjamin Marcus, Project Specialist at the GCI, with the oversight of Senior Project Specialist Claudia Cancino. The development, distribution, data collection, and analysis of the questionnaire were managed by Benjamin Marcus and Alessandra Sprega, Associate Project Specialist at the GCI, with input from Claudia Cancino and Elena Macchioni, GCI Project Specialist. We also extend our thanks to the Conserving Modern Architecture Initiative team at the GCI for sharing their expertise in survey design and providing valuable contributions.

Our appreciation also goes to Susan Macdonald, Head of the Buildings and Sites department, for her guidance, as well as Davide Gulotta, Scientist in the GCI Science department, for his assistance in compiling contact lists and his valuable suggestions.

Additionally, we acknowledge the support of Martin Coleman, GCI Publications Manager, and Kate Mendoza, Associate Editor, for their role in preparing this publication, as well as the efforts of the copy editor, Mary Huber.

Our deepest gratitude goes to everyone who contributed to the survey.

APPENDIX

Earthen Architecture Initiative Survey on Earthen Heritage Conservation

The EAI team developed an online questionnaire consisting of 19 questions aimed at gathering a wide range of information related to the current threats and challenges faced by earthen heritage, as well as the urgent research and work priorities in the field.

The following is the questionnaire sent to the recipients.

Earthen Architecture Initiative (EAI)

Survey on earthen heritage conservation

Thank you for taking this survey sponsored by the Getty Conservation Institute's Earthen Architecture Initiative. This survey aims to solicit feedback from the community of professionals working on earthen heritage conservation, to identify current significant themes and research priorities in the field, and to inform the GCI's future activities.

Earthen Architecture Initiative (EAI)

Personal information

1. In which geographic region(s) do you work? *Please select all that are relevant:*

- ☐ Africa
- ☐ Asia
- ☐ Middle East
- ☐ North America
- ☐ Central and South America
- ☐ Europe
- ☐ Oceania

2. In which specialties of earthen heritage conservation are you focused? *Please select all that are relevant:*

- ☐ Building conservation
- ☐ Archaeological site conservation
- ☐ Decorated surfaces conservation
- ☐ Scientific research
- ☐ Engineering
- ☐ Heritage management
- ☐ Cultural landscape conservation
- ☐ Documentation
- ☐ Education

Other (please specify)

3. Which of the following best describes the group(s), organization(s) or institution(s) in which you work? *Please select all that are relevant:*

- ☐ Public sector
- ☐ Private sector
- ☐ Nonprofit
- ☐ Self-employed
- ☐ University

Other (please specify)

Earthen Architecture Initiative (EAI)

Identifying current threats to earthen architectural heritage

4. In your opinion, how significant are each of the following threats to earthen heritage?

	Not Significant	Low Significance	Neutral	Significant	Very Significant
Environmental decay (wind, water)	○	○	○	○	○
Inappropriate interventions	○	○	○	○	○
Material/structural defects	○	○	○	○	○
Natural disasters (earthquake, flood, fire)	○	○	○	○	○
Disuse-Abandonment	○	○	○	○	○
Urban development leading to the loss of earthen heritage	○	○	○	○	○
Mass tourism	○	○	○	○	○
Climate change	○	○	○	○	○

Do you have additional suggestions or comments on the above?

Earthen Architecture Initiative (EAI)

Identifying current challenges to the conservation of earthen heritage

5. In your opinion, how significant are each of the following challenges to the conservation of earthen heritage?

	Not Significant	Low Significance	Neutral	Significant	Very Significant
Lack of funding	○	○	○	○	○
Inadequate heritage protection policies	○	○	○	○	○
Lack of professional expertise	○	○	○	○	○
Loss of traditional building knowledge	○	○	○	○	○
Perception of earth as a poor and unsafe material	○	○	○	○	○

Do you have additional suggestions or comments on the above?

Earthen Architecture Initiative (EAI)

Identifying research and work priorities in earthen heritage conservation

Theme: Understanding earthen building materials

6. *Please rate the importance of the following:*

	Not Important	Low Importance	Neutral	Important	Very Important
Material characterization & granulometry	○	○	○	○	○
Physical and mechanical properties	○	○	○	○	○
Behavior of consolidants	○	○	○	○	○
Decay mechanisms	○	○	○	○	○
Construction methods and typhologies	○	○	○	○	○
Additives (natural or artificial)	○	○	○	○	○

Do you have additional suggestions or comments on the above?

Earthen Architecture Initiative (EAI)

Identifying research and work priorities in earthen heritage conservation

Theme: Documentation and assessment of earthen heritage

7. *Please rate the importance of the following:*

	Not Important	Low Importance	Neutral	Important	Very Important
Documentation (metric survey, photogrammetry, laser scanning, aerial survey, remote sensing)	○	○	○	○	○
Mapping & inventory	○	○	○	○	○
Data acquisition for environmental monitoring	○	○	○	○	○
Heritage Impact Assessment	○	○	○	○	○
Oral history	○	○	○	○	○
Historical and archival research	○	○	○	○	○

Do you suggest any other priorities or have further comments on the above?

Earthen Architecture Initiative (EAI)

Identifying research and work priorities in earthen heritage conservation

Theme: Documentation and assessment of earthen heritage

8. *Please rate the importance of the following:*

	Not Important	Low Importance	Neutral	Important	Very Important
Urban conservation approaches (ex., Historic Urban Landscape)	○	○	○	○	○
Design and operational guidelines	○	○	○	○	○
New construction in the historic environment	○	○	○	○	○
Strategies to support local communities living in earthen settlements	○	○	○	○	○

Do you have additional suggestions or comments on the above?

Earthen Architecture Initiative (EAI)

Identifying research and work priorities in earthen heritage conservation

Theme: Conservation and management of earthen archaeological sites

9. *Please rate the importance of the following:*

	Not Important	Low Importance	Neutral	Important	Very Important
Material interventions (ex., grouting, capping, structural and surface repairs)	○	○	○	○	○
Shelters	○	○	○	○	○
Reburial and drainage	○	○	○	○	○
Site management planning	○	○	○	○	○
Heritage interpretation and presentation	○	○	○	○	○

Do you have additional suggestions or comments on the above?

Earthen Architecture Initiative (EAI)

Identifying research and work priorities in earthen heritage conservation

Theme: Preventive conservation of earthen heritage

10. *Please rate the importance of the following:*

	Not Important	Low Importance	Neutral	Important	Very Important
Maintenance programs	○	○	○	○	○
Monitoring tools and protocols	○	○	○	○	○
Engaging authorities in maintenance and monitoring	○	○	○	○	○
Engaging local communities in maintenance and monitoring	○	○	○	○	○

Do you have additional suggestions or comments on the above?

Earthen Architecture Initiative (EAI)

Identifying research and work priorities in earthen heritage conservation

Theme: Education and capacity building

11. *Please rate the importance of the following:*

	Not Important	Low Importance	Neutral	Important	Very Important
Degree programs and university training	○	○	○	○	○
Workshops and seminars including hands-on courses	○	○	○	○	○
Community participation	○	○	○	○	○
International conferences and expert meetings	○	○	○	○	○

Do you have additional suggestions or comments on the above?

Earthen Architecture Initiative (EAI)

Identifying research and work priorities in earthen heritage conservation

Theme: Climate change and earthen heritage

12. *Please rate the importance of the following:*

	Not Important	Low Importance	Neutral	Important	Very Important
Identifying and assessing climate change impacts on earthen sites	○	○	○	○	○
Identifying and assessing climate change impacts on populations living in earthen buildings	○	○	○	○	○
Assessing thermal performance	○	○	○	○	○
Methods to mitigate climate change impacts on earthen sites	○	○	○	○	○

Do you have additional suggestions or comments on the above?

Earthen Architecture Initiative (EAI)

Identifying research and work priorities in earthen heritage conservation

Theme: Disaster risk management for earthen heritage

13. *Please rate the importance of the following:*

	Not Important	Low Importance	Neutral	Important	Very Important
Seismic retrofitting	○	○	○	○	○
Flood mitigation	○	○	○	○	○
Community awareness and preparedness for disasters	○	○	○	○	○
Development of risk plans and maps	○	○	○	○	○
Post conflict response and recovery	○	○	○	○	○

Do you have additional suggestions or comments on the above?

Earthen Architecture Initiative (EAI)

Identifying research and work priorities in earthen heritage conservation

Theme: Rehabilitation and adaptive reuse of earthen buildings

14. *Please rate the importance of the following:*

	Not Important	Low Importance	Neutral	Important	Very Important
Rehabilitation planning and methods	○	○	○	○	○
Stakeholder management strategies	○	○	○	○	○
Technological advances & innovations for adaptive reuse	○	○	○	○	○
Financial tools and regulatory systems	○	○	○	○	○

Do you have additional suggestions or comments on the above?

Earthen Architecture Initiative (EAI)

Dissemination and next steps

15. What, in your opinion, are the highest priority areas of work or research that the community of practice in earthen heritage conservation should address in the future? ***Please check the ones that are the most important to you.***

- ☐ Understanding earthen building materials
- ☐ Documentation and assessment of earthen heritage
- ☐ Conservation of earthen settlements
- ☐ Conservation and management of earthen archaeological sites
- ☐ Preventive conservation of earthen heritage
- ☐ Education and capacity building
- ☐ Climate change and earthen heritage
- ☐ Disaster risk management for earthen heritage
- ☐ Rehabilitation and adaptive reuse of earthen buildings

Other (please specify)

16. Please help us understand why you selected your answers above:

17. What resources, in your opinion, should be developed to advance earthen heritage conservation? *(for example conservation project reports, guidelines, conservation policies, climate change impact assessment, adaptive reuse case studies, etc.)*

18. What training is needed, and for which target audience working in the field of earthen heritage conservation?

19. Thank you for your participation in this survey. Before you submit your responses, is there anything you haven't mentioned that you would like to add?

Getty
Conservation
Institute

getty.edu/conservation