

Combination of standardised methods to create a detailed source-based reconstruction of the Tepidarium at L'Alcudia de Elche, Alicante, Spain

Cristina Gonzalez-Esteban^{1*}

¹ Department of Archaeology, University of Southampton.

*Correspondence: cristina.ge14@gmail.com

Presented at the ARCHEO.FOSS XV 2021: Open software, hardware, processes, data, and format in archaeological research; online; November 23rd-26th, 2021.

Abstract: This study proposes a combined method for Virtual Archaeological Reconstructions (Extended Matrix, Reconstructive Units and Evidence Graphic Scale) to ease understanding, recording and display of archaeology. It aims to create new questions and challenges to increase knowledge. The *Tepidarium* project at L'Alcudia de Elche, Spain, showed the need to reduce duplicity and quicken the workflow; however, it increases the possibility of comparative studies due to similar results in other projects.

Keywords: FLOS Software; Archaeology; Source-based Virtual Reconstructions [V-R]; L'Alcudia de Elche; Roman *Tepidarium*;

FOSS software used and license:

1. Blender, GNU Public License (GPL) Version 2.83 and 2.90;
2. yEd, Freeware Version 3.20.1;
3. LibreOffice, MPLv2.0 Version 7.1.5;
4. Inkscape, GNU Public License (GPL) Version 1.0.1.

Introduction

This project started as a MA Virtual Heritage study (2019) when Prof. Molina and Prof. Muñoz (University of Alicante) shared data from the site of L'Alcudia de Elche, Spain, to create a source-based Virtual Reconstruction [V-R] of the Eastern *Thermae Tepidarium*, testing different techniques of metadata and paradata standardisation (fig. 1).

The main objective was to create an exhaustive and easy-to-read 3D archive of the site and its reconstruction process. This would boost Virtual Archaeology [VA] as a scientific discipline and promote V-R as new tools characterised by historical rigour and scientific transparency. They could help further archaeological research and bring accurate and interactive narratives of the past to the public.

This article innovates through the combinations of three standardisation techniques: Extended Matrix [EM] by Dr Demetrescu (CNR); Reconstructive Units [RU] from Prof. Molina and Prof. Muñoz; and Graphic Scale of Historic-Archaeological Evidence [GS] by Aparicio and Figueiredo. Diverse projects have used these techniques, as can be seen in Table 1.

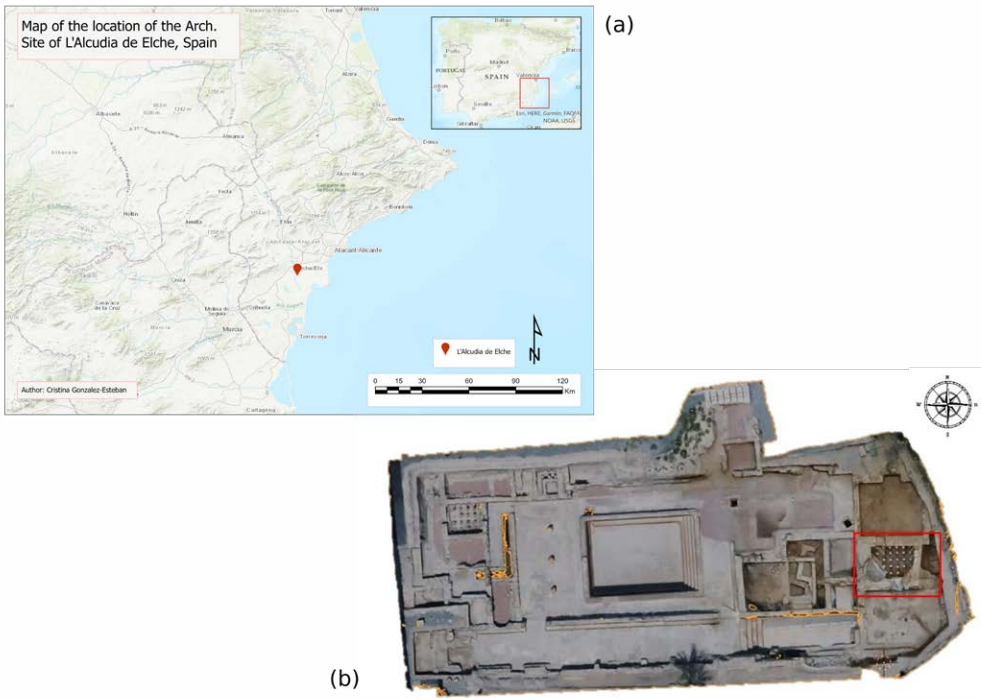


Figure 1. Location of the study site: (a) Map of Eastern Spain showing the location of the site of L'Alcudia of Elche; (b) Zoomed view of the Eastern Thermae of the site of L'Alcudia of Elche with a square over the Tepidarium. (Images: Cristina Gonzalez-Esteban)

Nevertheless, no one had combined the three of them. This unification is the main significance of this project, pushing to combine styles of virtual standardisation to cover different needs and show how important it is to integrate upcoming perspectives. This avoids diversifying standards for virtual reconstructions, which would hinder the core purpose of creating a standardisation system: comparable, compatible and reproducible data.

Standardisation techniques for Virtual Archaeological Reconstructions

The 20th century came with advances in technology coupled with increasing usage of computers and data management, which helped boost growth in recordings and displays of archaeological remains (reality-based models/Digital Twins). These new tools gave birth to the new subdisciplines of Virtual Archaeology (Reilly 1990) and the later CyberArchaeology (Forte 2010) to encompass the possibilities and potential of new technologies for historic and archaeological studies. However, the purpose of archaeology is to interpret and learn of past societies through their material culture, which does not get fully covered by these digital documentations, hence the need of promoting representations of archaeological interpretative components (i.e. Virtual Reconstructions [V-R]).

Nonetheless, these models are developing much slower, especially hindered by the fact that hypotheses are based on the researcher's analysis (subjective). Therefore, the accuracy of reconstructions cannot be objectively measured, as is the case of reality-based models,

A SOURCE-BASED RECONSTRUCTION OF THE TEPIDARIUM AT L'ALCUDIA DE ELCHE

Table 1: Examples of published or conference-presented projects that have reported the usage of some kind of metadata recording methodology for their reconstructions. Note that this is a partial list of projects, just some examples. Table: Cristina Gonzalez-Esteban.

Project	Reconstructive Units (Molina Vidal and Muñoz Ojeda 2015)	Graphic Scale (Aparicio Resco and Figueiredo 2016)	Extended Matrix (Demetrescu and Ferdani 2021)	References
Tepidarium of the Eastern Thermae of L'Alcudia de Elche	YES	YES	YES	Gonzalez-Esteban 2019
Roman Villa of Aiano (San Gimignano, Italy)			YES	Demetrescu and Ferdani 2021
Roman Villa at L'Albir (Alicante, Spain)	YES		YES	<i>In prep</i>
Roman Villa out of Porta Marina (Ostia, Italy)			YES	Demetrescu and Ferdani 2021
Temple A of Illeta dels Banyets (El Campello, Alicante, Spain)		YES		Aparicio Resco and Figueiredo 2016
Imperial Forum of Augustus (Rome, Italy)			YES	Demetrescu and Ferdani 2021
German WW2 bunker H669 (<i>no location</i>)	YES	YES		Aparicio Resco and Figueiredo 2016
Onde Marine, Necropolis of Banditaccia (Cerveteri, Italy)			YES	Demetrescu and Ferdani 2021
1st Phase of the Santiago Domus (Bracara Augusta, Braga, Portugal)		YES		Aparicio Resco and Figueiredo 2016
Amba Aradam (Rome, Italy)			YES	Demetrescu <i>et al.</i> 2021
Door-Tower of Bejanque (Guadalajara, Spain)	YES	YES		Aparicio Resco and Figueiredo 2016
Great Temple (Sarmizegetusa, Romania)			YES	Demetrescu and Ferdani 2021
Craft Building (Montebelluna, Italy)			YES	Demetrescu and Ferdani 2021
Amphitheatre of Cartagena (Murcia, Spain)			YES	Garcia 2021

whose level of detail is represented by a metric value. This brought the issue of downgrading virtual reconstructions to graphic design products since their historical rigour and scientific background could not be checked.

In order to overcome this obstacle, a series of Charters were written defining new concepts and requisites of these new Archaeological tools: the 2009 London Charter (Denard 2009) and the 2011 Seville Principles (IFAV 2012). From their principles, the most important ones for this research are “Documentation”, “Authenticity”, “Scientific Transparency”, and “Historical rigour”. The above-mentioned experts have attempted to fulfil these obstacles of Archaeological Virtual Reconstructions, leading to the creation of source-based V-R to include metadata (sources) and paradata (thoughts) needed for creating interpretive models from reality-based ones possible to validate and reuse.

This is the line of research that this article follows, focused on making the model’s information accessible to read, enjoy and reuse through standardisation techniques that guide the creation of source-based models and help the user understand its content. Many techniques have been developed along the years, but this paper focuses on three: the Reconstructive Units [RU] (Molina Vidal and Muñoz Ojeda 2015), the Extended Matrix [EM] (Demetrescu 2015), and the Graphic Scale of Historic-Archaeological Evidence [GS] (Aparicio Resco and Figueiredo 2016) (fig. 2).

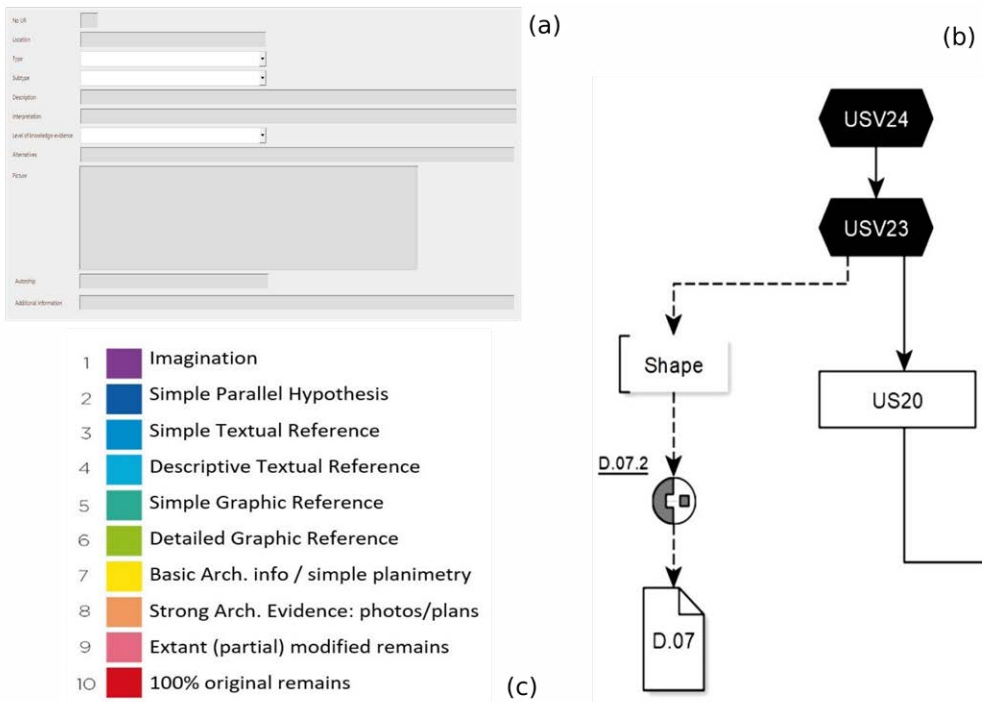


Figure 2. Examples of the three standardisation techniques applied in this study to record the metadata and paradata of V-Rs: (a) clean RU template in English; (b) Example of the combination of “found” nodes (HM) and reconstructed nodes to create an EM; (c) Fixed colour ramp of the GS together with its relation to a type of source. (Images: Cristina Gonzalez-Esteban)

Reconstructive Units [RU]

The RUs (fig. 2a) are context sheets whose template was designed in Access by Prof. Molina Vidal and Prof. Muñoz Ojeda in 2015 but which is easily transferable to a FLOS software such as LibreOffice. The files use the same parameters to record the metadata and descriptions of the archaeological units found on the field and the ones reconstructed in labs, making it easy to complete, publish, share and access them.

They are simple and integral, collecting the fundamental information to reproduce the reconstruction using limited options; but at the same time, having an open space in case the author needs to add extra information.

Extended Matrix [EM]

The EM (fig. 2b) was first published in 2015 by its founder Dr Demetrescu. This method was born from the necessities and complexities of the archaeological discipline and it has been defined as “a visual node-based formal language grounded on a stratigraphic approach designed for virtual archaeology and on the theory of knowledge graphs” (Demetrescu and Ferdani 2021, 2).

Even though it is still in development, its core uses the semantic tools applied for recording reality-based models together with the stratigraphic principles of the Harris Matrix to create a new language able to document and validate Archaeological 3D Reconstructions. These “extra” nodes (Demetrescu and Ferdani 2021, 29) represent the “not found” parts of Virtual Reconstructions and allow to easily connect the archaeological field finds with its lab reconstruction.

Furthermore, the visual differentiation of the nodes makes it not dependent on any language (i.e. universally understandable) and its synoptic (all the elements and their relationships are in the same file) and synchronic (all chronological phases are in one file) characteristic eases the reading of archaeological data. (A detailed use of the EM and its tool can be read in Demetrescu and Ferdani 2021)

Graphic Scale of Historic-Archaeological Evidence [GS]

The idea of using a colour ramp to display data granularity, authenticity and reliability of a V-R was first presented during the project “Byzantium 1200” (Ihsan-Tunay and Berger 1994, <http://www.byzantium1200.com/>). However, it would be in 2016 when the concept was published (Aparicio Resco and Figueiredo) establishing the currently most popular colour ramp for Archaeological V-R (fig. 2c). Establishing a series of fixed colours to present source type and reliability helped eliminate the “Black Box” effect of V-R: warm colours represent high levels of authenticity (being the highest reserved to context found on the field), while cold show lower reliability (leaving the coolest colours to the imaginative additions).

Even though assigning the colours to each reconstructed unit is still a manual job, creating subjectivity on the interpretation, the use of this fix GS has proven to have positive results to boost the importance of the transparency principle. It is not dependent on language (it is

visual), and it can be adapted to different audiences, reaching benefits beyond the academic world into the public engagement scenarios as new tools to bring the public to understand the reconstruction process and evidence support of the models.

***Tepidarium* of L'Alcudia de Elche, Spain**

The site is located outside Elche, Alicante, on an elevated platform; hence its Arabic name, “L'Alcudia”. Human settlement date back to the 4th millennium BC, through the Iberian, Roman and Visigoth/Byzantine periods, until the founding of the current city during the Muslim Era (8th century AD). Afterwards, this land was farmed and looted, as rich remains were unburied. Archaeological excavations started in 1933, but it would not be until the 21st century when the University of Alicante buys the land and, together with local authorities, establishes the archaeological site.

The reconstructed room (Ambient 28) is part of the Roman Eastern *Thermae* complex of the site (1st to 3rd century AD) (see fig. 1b). The presence of different construction styles indicates at least two phases and a series of targeted repairs. During the 4th century AD, the site lost its function and split into different rooms for habitation. During the 7th century AD, the Visigoth Era, most structures were semi-ruined, and the area became a dumpsite (Tendero Porras *et al.* 2014).

Ambient 28 was initially catalogued as the *Calidarium* due to its small size. However, further excavation revealed that the heating ovens were separated by another room, probably making the water arrive lukewarm. Therefore, it was renamed *Tepidarium*. The room shows its history of repairs, reuse, and abandonment/looting until becoming a dumpsite c. 7th century AD.

Methodology

The project methodology was developed in 8 steps:

Documentation and historical study of the site, building or object. This stage included a *detailed* study of reports, grey literature, comparative examples (e.g. *Thermae* of Pompey, Herculano, Carranque, Olmeda, etc.) and complementary subjects (architectonic studies, talks and debates of the area, etc.). A collection of the final sources used for the V-R was done using a table that can be found in Appendix1.

Collection of reality-based data: photogrammetry/ 3D scanner. In this case, a photogrammetric survey of the whole Eastern *Thermae* had already been done by the University of Alicante (see fig. 1b). Therefore, my task was only to crop and re-mesh the *Tepidarium* area to be used as a base for the next steps.

Designing the hypothesis. The design was possible thanks to the information gathered and the site plan developed using the photogrammetry model. The hypothesis was discussed and reviewed by the archaeologists in charge of the excavation of the *Thermae* before continuing the process of creating the source-base V-R.

3D modelling. The modelling was done using Blender 2.83 and 2.90.

6. and 7. These steps encompass the **creation of the metadata and paradata** of the model to make it accessible, validated and reusable data. In the beginning, these steps were thought of as independent; however, as the project went on, it was clear that the production of one set of data helped to better understand and quicken the writing of the rest. Therefore, it was decided to group them in the article. A total of 36 RU were written for this V-R (fig. 3a), each one associated with one GS colour (fig. 3c). These sheets also match the 36 nodes (including field and reconstructed) that ended up creating the EM (fig. 3b), which was organised using “Virtual Activities” to ease its reading.

Creating the outcomes. The resulting model opened the possibility of developing a wide range of outcomes for academics and the public. In this project, the visualisations were limited to rendering and images displaying the different elements of the reconstruction, both showing the metadata and paradata recorded (see fig. 3), but also through a photorealistic texturing of the 3D (fig. 4).

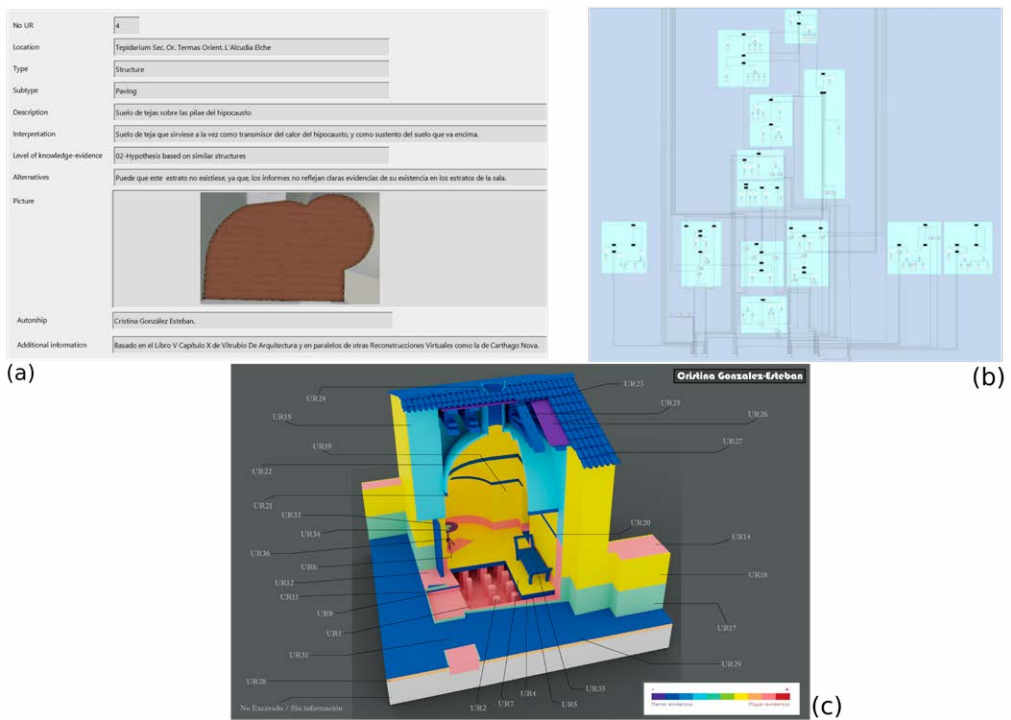


Figure 3. Standardisation techniques applied to the Case Study of the Tepidarium of the Eastern Thermae at L'Alcudia: (a) original RU 4, tiled floor level of the hypocaust, written in Spanish, showing a clear language barrier when using RUs; (b) EM of the Tepidarium during its usage as a Roman Thermae, separated into Virtual Activities to organise and ease the understanding of the graph; (c) 3D model of the Source-based V-R of the Tepidarium textured using the GS colours and completed by linking the RUs to each modelled element. (Images: Cristina Gonzalez-Esteban)

Discussion

The results reached the main objective, achieving a deep understanding of the room, its construction and usage thanks to a detailed study of the remains, comparative examples and other sources. Due to limited space and thanks to the visual impact of this project, the architectonic and historic results are visible in fig. 4.



*Figure 4. Photorealistic texturing of the Source-based V-R representing the interpretation of the Tepidarium of the Eastern Thermae complex of L'Alcudia of Elche, Spain during the Roman Period (1st - 3rd century AD).
(Image: Cristina Gonzalez-Esteban)*

Nevertheless, a series of limitations evidence the need to polish the process in future works:

Lack of versatility. The method separates each step and suggests finishing them before moving on. In reality, the workflow could be simplified (Demetrescu and Ferdiani 2021; Gonzalez-Esteban 2021) and should be more fluid and understandable of changes and new interpretations, as they are widespread in Archaeology (e.g. the *Caldarium* switched into a *Tepidarium*).

Novelty. Despite the techniques being from the mid-2010s, their application has not expanded yet, meaning that there are not many source-based models for comparative studies.

Incipient discipline. There are still not many experts on the techniques, hindering cross-referencing the use of the process.

Despite these obstacles, the outcomes are very favourable towards the advantage of using standardisation techniques in virtual archaeological projects to validate them and reinforce their scientific base. The main aspects benefited are:

Time/Effort invested in the source-based reconstruction compared to “traditional” undocumented 3D models of heritage sites.

Potential of sourced models as interactive, transparent and historically accurate tools for public engagement and as references themselves to further academic research.

Furthermore, it would be possible to add the stratigraphic layer of the site, recreating the history of the area (4D model).

Range of outcomes, including both the academic/research environment and as a public engagement tool, thanks to being a great asset to easily display the sources and processes developed in order to reach the resulting V-R.

Conclusions

This project was helpful in understanding that the techniques are compatible, not comparable and that their joining would highly benefit the recording and also the possible outcomes of these source-based models.

Even though this is just one case example, and it would be necessary to test the limits and possibilities of each technique in more case studies (e.g. Gonzalez-Esteban 2021) to consolidate the process in a discipline as heterogeneous as Archaeology, this study has reinforced the value of source-based models for both research and public engagement purposes. Reconstruction models can be scientific and be validated and repeated thanks to the recording of their sources (metadata) and chain of thoughts (paradata) that developed the hypothesis. This makes a new way of creating archaeological assets accessible, comparable and contrastable in an easy and user-friendly manner. It creates a new baseline to start rejuvenating archaeological documentation and bringing it into the increasingly international and virtual world.

Funding: The project that gave rise to these results received the support of a fellowship from “La Mutua Madrileña” Foundation.

Acknowledgements: I would like to thank my supervisor, P. Aparicio Resco, from PAR and the University of Alicante, especially Prof. Muñoz Ojeda, for sharing the data of the site of L’Alcudia with me, making this project possible.

Appendix A

This Appendix presents the table developed to collect all the sources used in the reconstruction study of the *Tepidarium* of the Eastern Roman *Thermae* at L’Alcudia of Elche, Spain. It is based on an initial template of the “Dossier Comparatif” proposed by Dr. Demetrescu in 2018 (tab. A1).

Table A1: Sources used in the Tepidarium source-based model detailing: its related EM node, the type of document, its descriptions and its reference. This table contains images that have had to be erased due to limits on the current publication; however, they have always been substituted with a website reference to an online copy of the image. (Table: Cristina Gonzalez-Esteban).

# EM Node	Type of Document	Description	Reference
D00	Wildcard	Represents the absence of archaeological finds	Absence
D1	Text	Vitruvio, Book V Chapter X, <i>De Architecture</i>	Vitruvio Polion, Marco. <i>Ten books on Architecture</i> . Ediciones Akal, 1992.
D2	V-R	San Juan de Maliaño	Balawat: https://zonacachonera.wordpress.com/2014/02/06/asi-serian-las-termas-romanas-de-san-juan-de-maliano/
D3	V-R	Villa de la Olmeda	Balawat: https://www.balawat.com/reconstruccionesvirtuales/#&gid=1&pid=1
D4	V-R	Carranque	http://www.lacerca.com/noticias/reportajes/parquearqueologico-carranque-anos-126559-1.html
D5	V-R	Eastern <i>Thermae</i> of L’Alcudia of Elche	Digital Report of Elche 2014 and 2015: http://www.elche.me/video/las-termasorientales-de-la-alcudia-29-de-junio-de-2014 http://www.elche.me/video/virtualizacion-de-las-termas-orientales-de-la-alcudia-23-de-septiembre-de-2014 http://www.elche.me/video/fotogrametriaaerea-y-reconstruccion-virtual-en-arqueologia-la-alcudia-24-de-marzo-de-2015
D6	V-R	V-R of the site of Carthago Nova	Madrid, Maria Jose, Noquera Celdran, Jose Miguel and Pavia, Marta “Las termas del Puerto de’ Carthago Nova’: un complejo augusteo de larga perduración”. <i>Tarraco Biennal: actes, 2on Congrés Internacional d’Arqueologia i Món Antic: August i les províncies occidentals, 2000 aniversari de la mort d’August: Tarragona, 26-29 de novembre de 2014</i> (2015): 15-22.

A SOURCE-BASED RECONSTRUCTION OF THE TEPIDARIUM AT L'ALCUDIA DE ELCHE

D7	Text	Detail description, including measurements, of the Alhange Thermae	Alvarez Martinez, Jose Maria “Las termas romanas de Alange”, Habis 3 (1972): 267-290.
D8	Image	Alexandre de Laborde 1811: Baños de Alhange. It shows a room with a lantern, exedras and a circular dome.	https://commons.wikimedia.org/wiki/File:1806-1820,_Voyage_pittoresque_et_historique_de_l%27Espagne,_tomo_I,_Ba%C3%B1os_de_Alhange_(cropped).jpg
D9	Image	Painting by L. Alma-Tadema 1881: The Tepidarium	https://commons.wikimedia.org/wiki/File:Tepidarium_Lawrence_Alma-Tadema_(1836-1912).jpg
D10	Paint	Painting by L. Alma-Tadema 1879: Strigils and Sponges. Typical objects in the Thermae	https://commons.wikimedia.org/wiki/File:Tepidarium_Lawrence_Alma-Tadema_(1836-1912).jpg
D11	Arch. Remains	Remains of the Thermae at Pompeii	https://commons.wikimedia.org/wiki/File:Frigidarium._Termas_del_foro._01.JPG
D12	Arch. Remains	Remains of the Thermae at Pompeii: Caldarium	https://commons.wikimedia.org/wiki/File:Forum_Baths,_the_apse_of_the_caldarium_(hot_bath_room)_containing_a_labrum_or_(marble_basin),_Pompeii_(14832295629).jpg
D13	Image	Example of a Roman Caldarium at a public forum of Pompeii, crown by a ¼ dome.	https://commons.wikimedia.org/wiki/File:Caldarium_of_the_Old_Baths_at_Pompeii_by_Overbeck.png
D14	Arch. Object Catalogued	Wooden double doors found in the 2 nd floor of the Decumanus Maximus house at Herculaneum.	Digital Report of Elche 2014: http://www.elche.me/video/virtualizacion-de-las-termas-orientales-de-la-alcudia-23-de-septiembre-de-2014
D15	V-R	V-R of the Thermae at Herculaneum.	MAV (Museo Archeologico Virtuale de Erconalo) 2014: https://www.youtube.com/watch?v=klre-67UI1Q
D16	Image	Polychrome mosaic of reddish and ochre tones, located on the wall, creating garland diamond shapes. Provenance: Villa del Romeral (Albesa, Lleida).	Museu d'Arqueologia de Catalunya

References

- Alvarez Martinez, Jose Maria. 1972. "Las termas romanas de Alange", *Habis* 3 : 267-290.
- Aparicio Resco, Pablo, and Cesar Figueiredo. 2016. "El grado de evidencia histórico-arqueológica de las reconstrucciones virtuales: hacia una escala de representación gráfica." *Otarq* 1 : 235-247. <http://dx.doi.org/10.23914/otarq.v0i1.96>.
- Demetrescu, Emanuel. 2015. "Archaeological stratigraphy as a formal language for virtual reconstruction. Theory and practice." *Journal of Archaeological Science* 57: 42-55. <https://doi.org/10.1016/j.jas.2015.02.004>.
- Demetrescu, Emanuel. 2018. "Virtual Reconstruction as a Scientific Tool". In *Digital Research and Education in Architectural Heritage*, edited by Sander Münster, Kristina Friedrichs, Florian Niebling and Agnieszka Seidel-Grzesińska, 102-116. Cham: Springer. ISBN: 9783319769912.
- Demetrescu, Emanuel, and Daniele Ferdani. 2021. "From Field Archaeology to Virtual Reconstruction: A Five Steps Method Using the Extended Matrix." *Applied Sciences* 11, no. 11 : 5206. <https://doi.org/10.3390/app11115206>.
- Denard, Hugh. (ed.). 2009. *The London Chapter for the computer-based visualisation of cultural heritage*. London: King's College London.
- Forte, Maurizio. (ed.). 2010. *Cyber-archaeology*. Oxford: Archaeopress.
- Garcia, Juan Simon. 2021. "Extended Matrix aplicada al Anfiteatro de Cartagena". MA Diss. *Unpublished*. University of Alicante.
- Gonzalez-Esteban, Cristina. 2019. "Estandarización metodológica Internacional de la Reconstrucción Virtual en Arqueología. Caso práctico del Tepidarium de la Alcudia de Elche". MA Diss., *Unpublished*. University of Alicante.
- Gonzalez-Esteban, Cristina. 2021. "Testing the archaeological importance of metadata-orientated Virtual Reconstructions. Case Study of a Roman Wreck from the Black Sea". MSc Diss. *Unpublished*. University of Southampton.
- IFAV (International Forum of Virtual Archaeology). Principles of Seville. International Principles of Virtual Archaeology. Accessed Feb. 20, 2022. <https://icomos.es/wp-content/uploads/2020/06/Seville-Principles-IN-ES-FR.pdf>
- Ihsan-Tunay, M., and Albrecht Berger. 1994. *Proyect Byzantium 1200*. Accessed Feb. 20, 2022. <https://www.byzantium1200.com/>
- Madrid, Maria Jose, Jose Miguel Noquera Celdran, and Marta Pavia. 2015. "Las termas del Puerto de' Carthago Nova': un complejo augusteo de larga perduración". *Tarraco Biennial: actes, 2on Congrés Internacional d'Arqueologia i Món Antic: August i les províncies occidentals, 2000 aniversari de la mort d'August: Tarragona, 26-29 de novembre de 2014* : 15-22.
- Molina Vidal, Jaime, and Francisco J. Muñoz Ojeda. "Ficha UR, 2015". Accessed Feb. 14, 2022. <http://rua.ua.es/dspace/handle/10045/46205>.
- Reilly, Paul. 1990. Towards a virtual archaeology. In *CAA90: Computer Applications and Quantitative Methods in Archaeology 1990*, edited by Kris Lockyear and Sebastian Rahtz (eds.), 133-139. Oxford: BAR International Series, 565.
- Tendero Porras, Mercedes, Ana M. Ronda Femenia, Rafael Ramos Fernández, Alejandro Ramos Molina, Diego Peña Domínguez, and Lorenzo Abad Casal. 2014. "Ciudades Romanas Valencianas. Ilici". In *Ciudades Romanas Valencianas. Actas de las Jornadas sobre Cuidades Romanas Valencianas. Actualidad de la investigación historicoarqueológica, celebradas en el MARQ los días 3 y 4 de diciembre 2013*, edited by Manuel H. Olcina Doménech, 225-249. Alicante: MARQ, Dip. Alicante,, ISBN 978-84-15327-47-9.
- Vitruvio Polion, Marco. *Ten books on Architecture*. Ediciones Akal, 1992.