

A GRAPHIC RECONSTRUCTION METHODOLOGY FOR THE CONSERVATION OF CULTURAL HERITAGE

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Abstract. Virtual modelling enables the testing of conceptual, constructional and environmental aspects, prior to embarking on the in situ construction process. This is being gradually implemented in architectural heritage, particularly with monuments that are at risk. Various international heritage conventions have emphasised the great role that virtual reconstruction plays in building a comprehensive repository of the selected case studies. This repository would be used for educational and professional purposes as well as raising community awareness of heritage values and conservation. On the other hand, only few genuine attempts have been made to develop a virtual reconstruction approach in a conservation project to integrate concept, materiality or spatial quality of the conservation proposal into the perception of the heritage cultural values.

This paper presents a conservation framework with a virtual reconstruction approach that allows the conservation strategy and proposed architectural interventions to be tested via remodelling them together with the original fabric in the virtual environment. The study is intended to apply the conservation framework on the Public Plaza, Residential Quarter of Ugarit and its associated structures in order to examine how this proposal affects the spatial and architectural settings of the fabric and enhances the perception of its cultural significance. A 3D model of the original fabric and proposed conservation strategy is built using CAD modelling techniques and, consequently, high-quality realistic photos and virtual tours are produced. These outputs will be analysed in order to highlight the contribution of the conservation framework to the original fabric and its cultural values.

1. Introduction

By the end of 20th century, increasing attempts have sought to extend the application of virtual reality (VR) technologies into multidisciplinary areas (e.g. archaeology, architecture and cultural heritage). The main aim has been to involve these technologies in more educational activities and create a vehicle that approaches public perceptions and response. The use of VR in the heritage sector constitutes an evolutionary endeavor that places more focus on the documentation and representation of the people's past and cultural aspects. The outcome of these technologies facilitates a broad-based public acceptance of using computer-based approaches in heritage studies, despite the challenges (e.g. costs and inaccessibility) involved (Addison, 2000). The concept of virtual archaeology that came to light by the beginning of 21st century (Roussou, 2002) aims to establish a virtual interface between historic structures and the public. It offers an interactive environment where people can experience spatial and architectural settings and also learn about their past and the skills of their ancestors. These technologies are sometimes very expensive, which limits their application outside the academic domain.

Therefore, this paper sheds a useful light on the use of CAD modeling in order to enhance the decision-making process in the preservation and presentation of cultural heritage and create temporary educational activities that promote engagement with and understanding of heritage cultural significance. The paper explores how the conservation strategy and proposed architectural interventions of the Public Plaza in Ugarit can be tested via a graphic reconstruction approach, VR, before proceeding to the in situ implementation of the proposal.

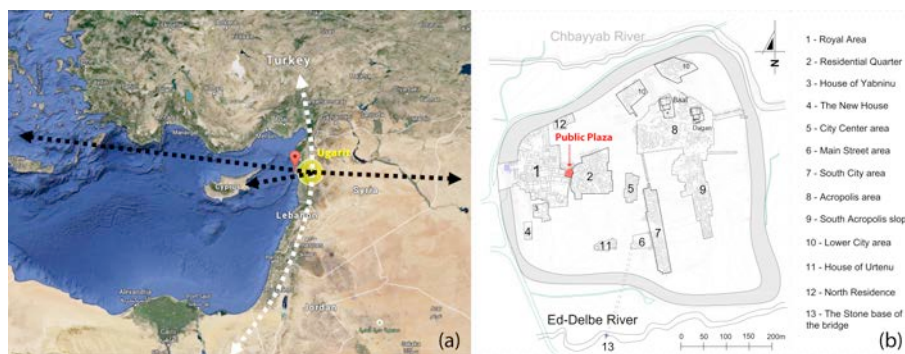


Figure 1. (a) Google map of Ugarit's location,
(b) Schematic plan of the City of Ugarit

The City of Ugarit is a Bronze Age site, located in northwest Syria, Figure 1a. Its strategic location that dominated the city trade routes (Malbran-Labat,

1999; 2000; Yon, 2000; 2006) promoted the city's importance and enabled Ugaritic people to establish a unique homogeneity with surrounding cultures and develop advanced architectural principles and techniques. The Public Plaza, Figure 1b, connected the Royal Area to the rest of the city. It was formed by a set of structures that were devoted to public functions.

1.1. METHODOLOGY

This paper establishes a conservation framework for the Public Plaza, which uses critical conservation approaches and a graphic reconstruction methodology to materialise the theoretical discussion and map the proposed architectural and conservation approaches onto the original fabric. The conservation discussion is based on a detailed reading of archaeology and in situ architectural analyses of the plaza and its structures. Proposed interventions will be constructed onto the original fabric in virtual reality. 3D models, which show the new settings of the area after applying the conservation strategy, will be created using ArchiCAD, an architectural computer program from Graphisoft. Analysing the outputs of the virtual models aims to evaluate the contribution of the conservation strategy to the perception of the plaza's intimacy, cultural values and original architectural and spatial settings and its impact on the original fabric.

Henceforward, the present paper will be divided into three main sections which respectively draw on the literature relevant to this topic and discuss the conservation proposal and the outcomes. The following section presents a brief account of using computer based approaches in heritage studies.

2. Literature Review: the Use of VR in Heritage Studies

Moving the application of VR to public context has brought high recognition of and hope to cultural heritage studies. VR has been considered to be a unique potential for achieving public engagement and appreciation as well as a realistic and non-destructive representation of the past. These applications have initially started with applying a photorealistic approach to virtually reconstruct ancient sites (e.g. Pompeii, Luxor and Stonehenge) (Barceló *et al.*, 2000). The low-quality output did not meet the hopes of conservators, historians and the public and was a good criticising material for anti-technology groups (Addison, 2000). Therefore, a second wave of applications has started in order to confirm the efficiency of VR for documenting and preserving historic buildings and enhancing public engagement and entertainment. The new wave included 3D documentation projects which were based on digitising existing data of architectural (the Colosseum) or natural (Yosemite Valley) heritage. Also, 3D representation

attempts, that range from historic reconstruction to visualisation (e.g. the virtual model of Loire Valley and the fully navigable model of Notre Dame Cathedral, Figure 2a), have been carried out. The key introduced aspects were the visual presentation and dissemination and the in situ augmented reality using Computer-Aided Virtual Environment to reconstruct and project buildings' past and/or diverse interpretation onto the actual ruins (e.g. the live video that represents the archaeological site and its history on available ruins at Ename Center in Belgium, Figure 2b) (Addison, 2000).

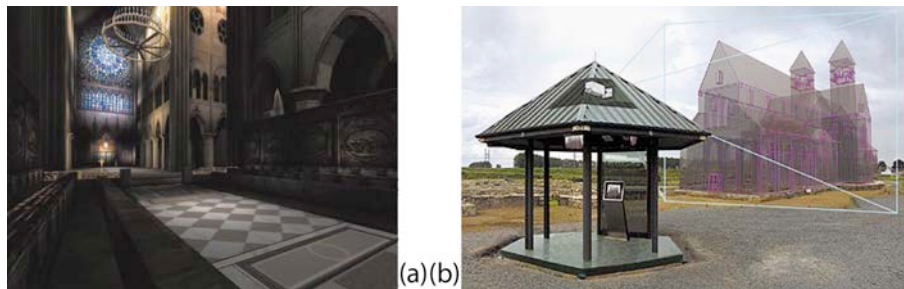


Figure 2. (a) Notre Dame Cathedral, (b) Virtual representation at Ename Center in Belgium.

Later developments have sought to establish a rich repository of digitised heritage environment and enhance public participation and experience (Thomas and Mintz, 1998). Thus, Visitors are not only viewers; they become learners and participants through identifying their values, actions and engagement mode (Roussou, 2002). VR started to be an educative, entertaining and sparkling method, allowing visitors to travel in space and time (Roussou and Efraimoglou, 1999). As a result, people are able to access sites that are at risk and experience diverse interpretations and representations. Thus, VR established an informal educational environment in which interaction, response and collaboration are key elements that engage the public, particularly the young generation (Roussou, 2002).

The “Magic Screen” project is a key attempt through which the Foundation of Hellenic World actively promoted understanding of Hellenic cultural values and encouraged scholars to use advanced technologies for representing their ideas and work on this cultural heritage. The foundation is recognised for its contribution to the virtual reconstruction of the city of Miletus and “Kivotos” exhibition (Roussou, 2002). Thus, for educational and entertainment purposes, building 3D reconstructions and journeys on heritage sites has dominated the use of virtual reality in heritage studies. For example, a journey through Ancient Miletus takes visitors 2000 years back through history and enables them to experience iconic buildings, the architectural and landscape settings and their evolution over time. Other

successful examples of this approach are the virtual reconstruction of the Temple of Zeus at Olympia, the Byzantine costumes and the traditional olive oil press in the Mediterranean culture (Roussou, 2002).

The former 25th Ephorate of Byzantine Antiquities in Greece has also used graphic reconstruction method to enhance the digital representation of sites of castles (e.g. Argolid Arcadia and Corinthia castles) and create a digital repository that facilitates easy communication with researchers and the public (Athanasoulis *et al.*, 2015). The development of VR approach has not stopped; virtual reconstruction started to use automated distance measurements, together with photographs, in order to produce 3D textured realistic models. This method was used in modelling the Salon Delacroix at the French National Assembly, Paris, and the Sala dello Scrutinio at the Doges' Palace, Venice (Gonçalves and Sequeira, 2001).

International charters have also regarded VR as a method for the communication and preservation of cultural heritage. The London Charter for the computer-based visualisation of cultural heritage encourages the use of computer-based technologies believed to develop interpretation, preservation, and communication strategies for heritage assets (Denard, 2009). Also, the Seville Charter introduced the definition of virtual archaeology and virtual restoration, anastylosis, reconstruction and recreation to frame the anticipated outcomes of using VR methods in heritage conservation. The charter focuses more on setting up criteria and guidelines that ensure the effectiveness of virtual methods, and encourages the use of new technologies for better conservation, management and dissemination of cultural values. Enhancing public appreciation and engagement is a main focus as well (Lopez-Menchero and Grande, 2011).

In the UK, the use of VR technologies to enhance public engagement was explored through collaboration between the University of York and Heritage Technology Limited. The project aimed to test public engagement and appreciation of historic churches through VR. Exterior and interior virtual reconstructions of Trinity parish church in York and Guild Chapel in Stratford-upon-Avon were created (Figure 3). The project could encourage visitors, academics and professionals to look beyond the church experience and explore the cultural significance of this heritage (Giles *et al.*, 2010).



Figure 3. (a) Trinity parish church in York, (b) Guild Chapel in Stratford-upon-Avon

3. The Public Plaza of Ugarit: Analysis and Proposal

The Public Plaza constitutes a significant urban element that connects the Royal Palace to the Residential Quarter and, subsequently, the rest of the city to the east (Figure 4). Excavated structures around this plaza are of a public nature, which further promoted its importance.

The Oven House (3) to the north is characterised by its findings (e.g. ovens, jars, drainage, pit and stone vat) and attached to the owner's private house (2) to the east. A lightweight structure (5) attached to the Royal Palace and looking over the plaza occupies the western side. Moreover, a direct street, Palace Street, connects the plaza to the New Royal Zone to the west through a simple check point. The eastern side accommodates a well-preserved structure, the Tavern (4), around which an agglomeration of shops (1), bazaar, flanks the eastern and southern sides of the Public Plaza.

The principal building material is sandstone which varies in size and condition. The buildings were constructed using big keystones both at the access and in the corners and large flagged stones in between. The Royal Palace to the west and the Tavern to the east are exceptional structures which were built with large cut stones. In addition to the tangible evidence it provides, the plaza offers valuable insights into Ugaritic people's urban experience and public social life during the Bronze Age.

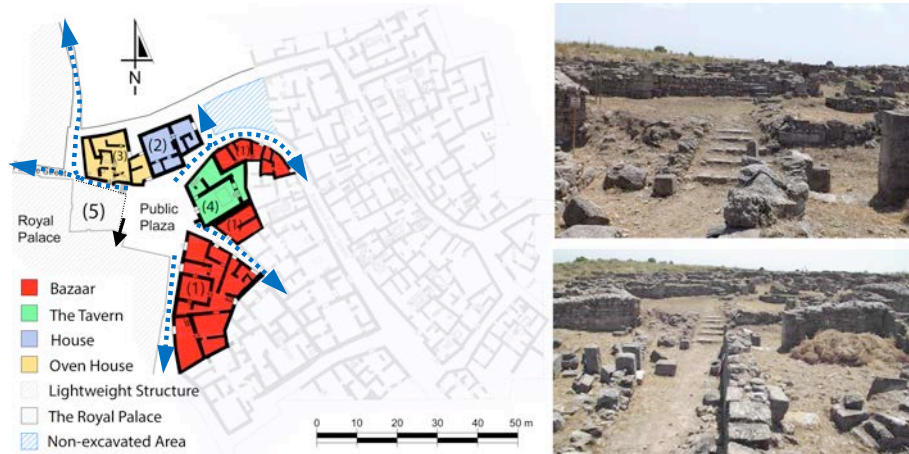


Figure 4. The Public Plaza of Ugarit: plan and in situ observation May 2013.

3.1 THE ANALYSIS

Considering its location, the Public Plaza is a very important urban element where public and private lives meet in the city. The street network that connects the plaza to the surrounding areas confirms the significance it holds to the overall urban circulation. Also, public, social and entertainment

buildings constructed around this plaza emphasise its importance not only to the city's planning but also to the people's social life. The lightweight structure (5), attached to the palace, Figure 4, was most probably used by the royal family, keen to engage with their people. The northeastern secondary access to the palace is located beside this structure, which most likely facilitated the connection between the palace and the plaza.

On an architectural scale, Ugaritic people had dedicated a public function to all buildings surrounding this urban element; this clearly shows their intention to highlight the meaning of this plaza to their life. The people of Ugarit developed similar concepts in the city: the Public Plaza in the South City and The Royal Plaza (Yon, 2006); however, in both cases, one type of structure, domestic or royal, formed the plaza. This plaza is unique especially in terms of its diverse surrounding activities (public, private, commercial and entertainment). A detailed analysis of surrounding structures will promote the understanding of the Public Plaza and its cultural values.

The entrance to the Oven House, for instance, shows monumental characteristics; very large cut stones formed this entrance (Figure 5). Having a monumental entrance to a simple building confirms Ugaritic people's intention to monumentalise the periphery of this plaza.



Figure 5. The ruins of the Oven House, Ugarit, May 2013.

Another important building overlooking the plaza is the Tavern, also known as the Building with the Stone Vase, which was built in high architectural and structural quality (Yon and Arnaud, 2001: pp. 65–82); it was built with cut stones almost the same size of the Royal Palace's (Figure 6). The monumental entrance to this building, which rises three steps above the plaza's level, highlights its importance to the community. The existence of the big hall and the big vase strongly advocates the assumption of its function as a tavern. This building was likely the place where the community met and enjoyed good social relationships. The architectural analysis of the building and discovered foundations has pointed out that the main hall had a high interior space, while the rest of the building was built in two storeys.



Figure 6. The ruins of the Building with the Stone Vase, the Tavern, Ugarit, May 2013.

Consequently, the Plaza's cultural values are as follows: (a) the plaza is an important urban element in the city; (b) it reflects the unique social life of Ugarit: strong relationships both among Ugaritic people themselves and between the people and their royal family; (c) the Plaza and surrounding structures are evidence of the advanced architectural and urban experience that Ugaritic people had had during the Bronze Age.

3.2 CONSERVATION PROPOSAL AND VIRTUAL MODELS

The cultural values assigned to the Public Plaza need to be treated as fundamental aspects in the conservation plan. Therefore, architectural interventions and their materials should be critically chosen in order to avoid compromising the plaza's originality and authenticity. Thus, the critical conservation approach which advocates reversibility and compatibility is essential. This dynamic approach upholds contemporary design principles and materials with full appreciation of the original fabric; it recognises architecture's ability to express the aspirations and values of a society in their spatial resolution and cultural context. The authentic fabric, the faithful representative of the past, has the ability to control the design and reconstruction processes, and the architect has a responsibility to prioritise the cultural values and critically operate their preservation with full engagement with and understanding of all associations and meanings.

It is essential, first of all, to highlight the relationship between the plaza and surrounding structures. Therefore, the first procedure will be to restore a sense of space and orientation by bringing the demolished walls back up to some height and clarifying the original layout. An anastylosis approach will be applied to the fragmented fabric using only the original stones. Rectified

stone walls should be repointed using the original lime mortar (soil, water and lime). Also, the original level of the plaza will be restored using a stones and compact soil pavement as a reference to a public and open space.

The Public Plaza promotes evidence of an evolution in Ugaritic people's appreciation of their public spaces and gives a clue of a high urban advancement in Ugaritic architecture. It is a strong representation of the people's attempts to involve new urban concepts that reflect the requirements of their social life in the city. Also, the concept of Public Plaza in Ugarit constitutes a historical anchor linking modern Syrian communities with their ancestors in terms of the use of public plaza with public facilities around it, which is a common urban aspect in 19th and early 20th century AD cities in Syria. Therefore, reconstructing all facades around the Public Plaza will, above all, give the real volumetric impression of this urban element and highlight the public nature of the buildings around it. Differentiating the added fabric is very important. The new facades should be reconstructed with light and flexible materials. Steel framework and timber cladding are sufficient materials for the reconstruction work (Figures 7 and 8); they are easily manufactured offsite and, simultaneously, distinguished from the original fabric. The reconstructed part, although light, should have its own separate foundations and apply no further loads on the original structures. However, when it is necessary, some loads can be transferred to the wall intersection points or corners as these key points of the buildings were built in ashlars and are in a very good condition (Callot, 1994: pp. 115–147).

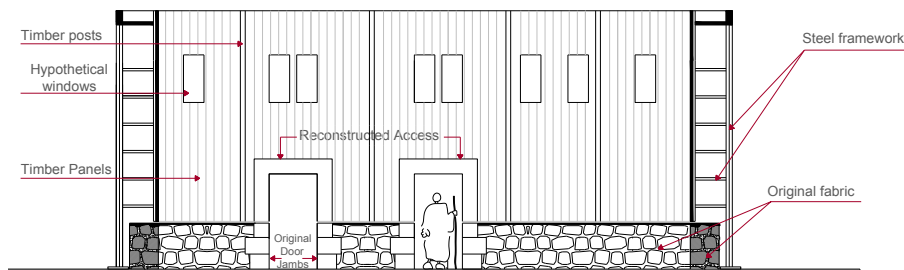


Figure 7. Proposed reconstruction of the surrounding facades.

The main access to the buildings around the plaza will be reconstructed in a U-shape timber profile in order to highlight the entrance and point out the different structure and material quality of these accesses. Also, a timber platform will be installed on the ground of the lightweight structure attached to the palace aiming to emphasise the unique relationship between Ugaritic people and their king. The pavement of the public structures around the plaza will be restored in different textures or colours and differentiated from the surrounding residential spaces; this approach has been successfully

applied to enhance the reading of many archaeological sites (e.g. Saint-Romain-en-Gal Museum in France and Roman ruins of Empuries in Spain).



Figure 8. Restoring the volumetric sense of the plaza: Virtual model.

Special intervention will be dedicated to the Tavern structure in the hope of highlighting its importance and reconstruct its interior public and entertainment environment. An enveloping box, made of timber, will be added on top of the building ruins, Figure 9, 10. Since some original artefacts are still there, especially the original stone vase, most probably used as a wine container, the original interior environment of the building will be reconstructed using natural light. Therefore, some perforations will be added to the new timber box in order to control the natural light coming into the building interior; this principle has been successfully applied in Badalona Roman Museum in Spain and Kolumba Museum in Germany. The added timber structure should be an abstract and conceptual choice, without restoring any anticipated architectural details from the Bronze Age. The location of structural supports of the new addition will be identified based on a detailed archaeological and architectural analysis. This intervention will allow visitors to explore the original environment of the interior spaces of an entertainment public building from the Bronze Age. It will also enhance visitors' appreciation of the Public Plaza as a focal point that hosted everyday public, social and entertainment activities.

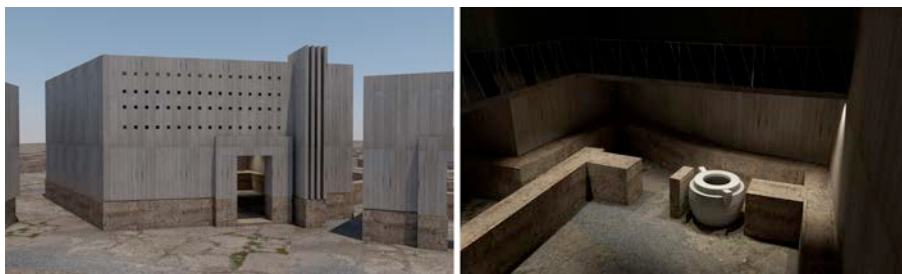


Figure 9. The Reconstruction of the Tavern structure: Virtual model.



Figure 10. The Reconstruction of the Tavern structure: Virtual model.

The presence of some shop agglomerations differentiates this area from other domestic areas in Ugarit. The professional workshops which are usually found in the Ugaritic house are replaced here with these shop agglomerations, similar to what is known as bazaar in Middle Eastern cities. Restoring these agglomerations as much as possible and differentiating them from the rest of the structures is very significant in that it serves to highlight the relationship between these compounds and the surrounding fabric. It would also give an idea about how these shops had worked together in each agglomeration and been linked to the assigned streets and residential blocks.

4. Discussion

The graphic reconstruction method has contributed to the understanding of the physical output of the conservation proposal. The virtual models have enabled the perception of a real implementation of the proposed interventions. These models show the new spatial, urban and material settings of the plaza after applying the conservation strategy. The new reconstructed facades and the original fabric are simulated together highlighting the reversible nature and minimal cons of this reconstruction on the plaza's authenticity. The rendered pictures and virtual tour (<https://goo.gl/RGLXkl>) mimic the real in situ experience that will be offered to the visitors as part of the conservation strategy. The virtual experience has confirmed the effectiveness of the proposed interventions in reconstructing the urban form of the Public Plaza and its relationship to the surrounding structures, and also showed the good communication between the original fabric and added materials (the timber facades).

The virtual model of the Tavern proposal actively recreates the original dim and cozy interior environment of the building. The output of the virtual model is presented in the virtual tour (<https://goo.gl/2PNIHp>) and rendered pictures inside the new complex, which demonstrates how proposed interventions have successfully reconstructed the interior environment and

established a simple and engaging public life museum on the site. The virtual output presents the sought-after experience that visitors would have in the new structure.

In addition, virtual tours create an opportunity for in situ screen display to be installed in the plaza and the Tavern for visitors before implementing the actual proposal on the site; they also constitute reliable evidence and basis for the second stage of the conservation proposal, the design stage.

5. Conclusion

Virtual reconstruction has become a predominant method in heritage and conservation studies. Using a graphic reconstruction approach in the conservation of the Public Plaza in Ugarit has introduced many practical, educational and entertaining dimensions for the visitors. By using CAD programs, commonly-used and cheap ones, the conservation proposal of the plaza has been tested and the reconstructed self-experience has been presented in a virtual tour format.

This output provides good materials for public engagement with the ruins and their conservation. The output of this paper (the conservation strategy and the virtual models) prepares a rich platform for the second stage of the conservation process where feedback on the conservation proposal from the public, academics and professionals will be sought in order to proceed to the design stage and finalise designs and details of the interventions.

The main limitation has been that there is no 3D documentation of the original fabric in Ugarit. Therefore, we had to build a virtual model of the Plaza's original fabric using ArchiCAD program, which does not provide a realistic perception of the ruins' materiality as much as other technologies (e.g. photography-based) would do. Thus, building a 3D virtual model of the excavated fabric in Ugarit would be a key future project that would enhance the site's engagement and communication as well as contribute to both its conservation and presentation.

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