



3D Modelling of Jerusalem's Maghrebi Quarter

RESEARCH PAPER

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ABSTRACT

Although Jerusalem is one of the most photographed places in the world, few works have focused on the existence of its former 800-year-old Maghrebi Quarter, located in the shadow of the Western Wall. Founded in 1193 by Saladin's son, al-Afdal 'Ali to house Muslim pilgrims from North Africa (today Morocco, Algeria, Tunisia, and Libya), the Quarter was razed by Israeli bulldozers on the night of 10–11 June 1967. Its 1,000 or so inhabitants were forced to flee within hours. Silenced by the occupation of East Jerusalem as part of the Six-Day War, the existence of the Maghrebi Quarter faded behind the walls of history. This research paper describes how 55 years after its razing, the selection of a corpus of archives, combined with 3D technology and Interprofessional collaborations between historians and 3D designers enable making a forgotten history accessible again. Beyond a discussion on methods and technical process, this research paper aims to highlight the potential applications of the data set and the 3D model not only for scholarly research but also for pedagogical purposes, for instance.

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(1) INTRODUCTION

(1.2) FOUNDATION AND ERASURE OF AN 800-YEARS OLD JERUSALEM NEIGHBOURHOOD

The Maghrebi Quarter was founded in Jerusalem in 1193 by Saladin's son, al-Afdal 'Ali, with the aim of welcoming, housing and caring for pilgrims of Maghrebi origins (today Morocco, Algeria, Tunisia, and Libya) on their way to Mecca. The religious endowments established in the Quarter were continuously sustained and maintained by the Maghrebi populations living there or passing through for the pilgrimage until the 1960s. The 10th and 11th of June 1967 indeed marked the end of the Quarter and its destruction by Israeli bulldozers driven by the enthusiasm generated by the Israelis taking of Jerusalem during the Six-Day War.

The disappearance of almost 800 years of history was accompanied by the destruction of 135 houses¹ and the expropriation of their inhabitants without notice and with very little compensation to make way for a vast square in front of the Western Wall. As the neighbourhood is a waqf (inalienable religious endowment) (Tamari, 2018), its residents did not own their homes. However, the compensation paid for damage caused by the expulsion, or for furniture, was done only on a modest scale. Two documents provide information about this issue: the list of personal property belonging to three former residents² and the accounts of the operation.³

The physical disappearance of the Quarter – which was not complete if we consider the archaeological remains that still exist under the present-day esplanade of the Western Wall – has also been followed by an almost total historiographic disappearance. Only fragments of clues remain that are elusive to the uninformed, such as the toponymy of places (Bab al-Maghariba (North Africans Gate), also known as the “Dung Gate” or the “Tanners’ Gate”, depending on the sources, the Maghrebi Mosque (North Africans Mosque), Zawiya⁴ al-Maghariba (the North Africans Zawiya) or the curious presence of the gateway giving non-Muslims access to the Haram al-Sharif, also known as the Temple Mount or esplanade of the Mosques. Its simple presence testifies to the existence of a structure here, originally providing access to the door several metres above the ground. A Moroccan flag still flies discreetly in front of the Western Wall on the roof of the Zawiya al-Maghariba, reflecting Morocco's ambition to monopolise⁵ the representation of the inhabitants of the Maghrebi Quarter since its destruction, and as an ultimate testimony of the existence of the neighbourhood (Figure 1).



Figure 1 External view of the central courtyard (partially covered) and the roof of the Zawiya al-Maghariba, pictured from west to east, 2023.

© Vincent Lemire (2023).

1 List of the 135 houses destroyed in the mughrabi quarter (1969). Retrieved from <http://www.archives.openjerusalem.org/index.php/list-of-the-135-houses-destroyed-in-the-mughrabi-quarter> (last accessed: 6 November 2023).

2 Letter from Attorney Gideon Japhet to the Department of Defence regarding compensation for personal property (1968). Retrieved from <http://www.openjerusalem.org/ark:/58142/3KDST#?c=0&m=0&s=0&cv=0&xywh=-1198%2C20%2C4302%2C2882> (last accessed: 6 November 2023).

3 Letter from Fares Ayub to Meron Benvenisti regarding the accounting balance of the compensation procedure (1969). Retrieved from <http://www.openjerusalem.org/ark:/58142/35DKm> (Last accessed: 6 November 2023).

4 Place for pious visitation associated with pilgrimage.

5 Tunisia and Algeria took part in this representation for a long time before progressively withdrawing from the issue, especially after their independence. The Moroccan monopolisation of the representation of the neighbourhood's residents has had an impact on the toponymy of the Quarter, which is frequently referred to as the “Moroccan quarter” in publications about it.

(1.3) FROM OPEN JERUSALEM TO ARCHIVAL CITY

The ambition to digitally reconstruct the Maghrebi Quarter was therefore born from this double void, both material and immaterial, condemning the history of the district to oblivion. Following the publication of a book on the subject (Lemire, 2023), the aim of the 3D reconstruction was to go a step further by offering wider visibility. This project is part of a larger research programme conducted by a team of scholars and digital developers-*Archival City* programme, funded by the I-SITE FUTURE of Gustave Eiffel University (2019–2023). The project builds on and expands the methodological and epistemological achievements of the *Open Jerusalem* ERC-funded project (2014–2019). Led by Vincent Lemire (Gustave Eiffel University), this project aimed at developing a connected history of *citadiné* in Jerusalem based on the identification, description and connections of available archives pertaining to the history of Jerusalem from 1840 to 1940.⁶

The 3D reconstruction of the Maghrebi Quarter therefore acts as a bridge between the two abovementioned research programmes highlighting the importance of decompartmentalising the archives and furthering the historiographical rehabilitation of the Quarter initiated by Vincent Lemire in his recent monograph (Lemire, 2023). The work of the *Archival City* Jerusalem (ACJ) team therefore aimed to retrace the erased past of a neighbourhood, its political, social, architectural and, more broadly, urban history. Against this background, the 3D modelling intended to reassert its historic value as part of the global heritage of the holy city. It is noteworthy that this work takes place in a complex scientific environment due to the current political context. Jerusalem is still an area disputed between Israelis and Palestinians. Its eastern part – which includes the Old City and thus the late Maghrebi Quarter – is considered by the international community as an Israeli occupied territory. The annexation was condemned by the UN Security Council (resolutions 476 and 478 of 30th June and 20th August 1980) although the Knesset has recognised Jerusalem as the “reunified” capital of Israel since 1980.

After describing the archival corpus that the ACJ team has collected as well as the selection of 11 valuable buildings to be modelled, this research paper will present the technical processing of the 3D research carried out in collaboration with ACJ’s researchers and resulting in the 3D model. The last section will be dedicated to the perspectives of improvements and the potential for re-using the data and the 3D modelling methodology in other contexts.

(2) DESCRIPTION OF THE DATA SET

The data set described in this research paper includes the archival corpus that has served for the 3D reconstruction of the Jerusalem Maghrebi Quarter. It consists of different written and visual sources such as maps, aerial photographs and contemporary photographs, as well as architectural plans of the streets and buildings that were part of the former Maghrebi Quarter. These archives are all described on the AtoM platform of the Open Jerusalem project website.⁷ Eleven buildings were selected as valuable buildings for the 3D modelling of the quarter. For these reasons short texts describing these buildings from a historical and architectural point of view were produced on the basis of the aforementioned heterogeneous corpus of archives. These have been included in the 3D modelling as written explanatory texts. The aim was to reconstruct the pre-1967 Maghrebi Quarter. However, not all the sources collected agree in time. Thus, the reconstruction does not represent the Quarter at a given moment, but rather brings together what is known about it between the years 1930–1967, the aim being to get as close as possible to a realistic reproduction of what the Maghrebi Quarter looked like in the last years of its long existence.

The data set also includes samples of PBR Textures and materials used in the reconstruction of the Maghreb quarter, and three samples of the modelled valuable buildings. The data set is available on the Nakala (Huma-Num) under the alphanumeric code ACJ01_RB3D, where AC stands for *Archival City* project, J01 refers to the first data set of the Jerusalem study field and RB3D refers to the authors of this research paper. The various elements of the dataset are detailed in the finding aid document ACJ01_FA_01_RB3D available on Nakala both in CSV and Excel formats. This dataset contains personal data and photographic archives subject to copyright restrictions. Users wishing to view “embargoed” images must make a formal request

⁶ The catalogue of available archives is still being regularly updated <http://www.openjerusalem.org/database> (last accessed: 6 November 2023).

⁷ <http://www.openjerusalem.org/solr-search?q=Maghrebi+quarter>.

to the dataset creators (Vincent Lemire lemire.vincent@gmail.com and Raphaël Banc-Lévêque raphael-banc@outlook.fr).

Data set name – 3D modelling Jerusalem Maghrebi quarter (ACJ01_RB3D)

DOI: <https://nakala.fr/10.34847/nkl.a813b098>

Format names and versions – FBX, PDF, CSV, JPEG, Excel

Creation dates – 2022–2023

Language – English

License – Creative Commons Attribution Non-Commercial Share Alike 4.0 International (CC-BY-NC-SA-4.0)

Repository name – Nakala, Huma-Num, Archival City Collection, Archival City Jerusalem Collection

Publication date – October 2023

(3) METHOD

(3.1) CONSTITUTION OF THE ARCHIVAL CORPUS

(3.1.1) 11 “valuable buildings”: selection and descriptive notes

It might seem paradoxical to speak of “3D reconstruction” insofar as eight⁸ of the 11 buildings chosen as “valuable buildings” still exist. Although most of them were not destroyed, the disappearance of the heart of the Quarter has peripheralized most of the buildings that formed a homogeneous urban whole before 1967. The 3D modelling thus brings back to life this whole: a once connected neighbourhood now spatially disassociated by the physical destruction of most of it as well as its destruction as an urban entity.

The selection of the valuable buildings followed several criteria. The idea was to first use toponymic homogeneity to remind people of the Maghrebian aspect of the Quarter, which was the reason for its establishment and its durability. We therefore turned our attention to the Bab al-Maghariba,⁹ opening the city walls to the south and giving direct access to the Maghrebi Quarter. We have based our work on Jean-Michel Tarragon’s work on the door and its history (2022). In the same vein, we have also focused our interest on the Zawiya al-Maghariba.¹⁰ This Zawiya has long held our attention regarding the existence or not of a second one (Zawiya Abu Madyan) as both had been the subject of different indications. However, our readings of the sources have converged on the existence of a single Zawiya which is the Maghariba one, built on an aggregation process. The relevance of the Zawiya also stemmed from its function which is closely linked to the very existence of the Maghrebi Quarter itself, as it welcomed the Maghrebi populations passing through Jerusalem during their pilgrimage to Mecca.

The inclusion of the Maghrebi Mosque and the adjoining Madrasa al-Fakhriyya in the project was both for toponymic reasons and because of the importance of the closeness of the Maghrebi Quarter to the Haram al-Sharif (Islam’s third holiest site, due to the night journey that the prophet Muhammad is said to have made between Mecca and Jerusalem (*al-isra*) around the year 620). The same applies to the Maghrebi ramp, initially part of the Dar Abu Saud¹¹ and then split off from it after the destruction of the latter. The Maghrebi Quarter was indeed directly connected to the Haram al-Sharif through the Bab al-Maghariba (door allowing access to the Haram al-Sharif to the south of its western façade, facing the Maghrebi Quarter, not to be confused with the eponymous door mentioned above, also known as the “Dung Gate” or “Tanners’ Gate”, which provides access to the Old City from the south through the city walls). The originality of Dar Abu Saud and the Maghrebi ramp also stems from the later destruction of the former on 15th June 1969 and the collapse of the latter in 2004. Both events in fact

⁸ Bab al-Maghariba; Madrasa al-Tashamuriyya; Bab al-Silsileh; Khalidi Library/Turba Barka Khan; Madrasa al-Tankiziyya; Maghrebi Mosque and Madrasa al-Fakhriyya; Zawiya al-Maghariba; Western Wall/al-Buraq.

⁹ See the image ACJ01_HP_072_RB3D stored on Nakala.

¹⁰ See documents ACJ01_CP_045_RB3D to ACJ01_CP_093_RB3D on Nakala.

¹¹ Housing complex located in the south-western part of the Haram al-Sharif giving access to it through the Maghrebi ramp and the Bab al-Maghariba. See ACJ01_HP_040_RB3D; ACJ01_HP_041_RB3D; ACJ01_HP_038_RB3D on Nakala.

pointed to other political and heritage rationales concerning the more global destruction of the Maghrebi Quarter (Abu Saud, 2004/2005).

Furthermore, the choice of valuable buildings for the 3D modelling was made both because of their architectural significance and their existence as places of gathering and exchange characteristic of neighbourhood life. These include Madrasa al-Afdaliyya,¹² Madrasa al-Tashtamuriyya¹³ and Madrasa al-Tankiziya¹⁴ (a Madrasa referring to any kind of educational institution, whether secular or religious). Because the history of these places is closely linked to the history of the people who lived in them, the very existence of these buildings bears witness to the special character of the Maghrebi Quarter. For example, the Madrasa al-Afdaliyya takes its name from the founder of the neighbourhood who was Saladin's eldest son, al-Afdal'Ali. The Madrasa contained a Maliki law school,¹⁵ the dominant school of jurisprudence in the Maghreb (Kedar, Weskler-Bdolah and Da'adli, 2012).

The last buildings chosen represent elements that are inextricably linked to the social and cultural life of the Maghrebi Quarter. These include the Khalidi / Turba Barka Khan Library¹⁶ (Khalidi, 2021) on the one hand and Bab al-Silsileh¹⁷ with its emblematic 16th century fountain on the other. The latter still form the second access to the Haram al-Sharif from the Maghrebi Quarter. Finally, it was unthinkable not to include in the selection the Western Wall / al-Buraq¹⁸ (Ben-Dov, Naor and Avner, 1983; Saposnik, 2008) which was central in the last decades of the life of the Maghrebi Quarter. Indeed, this was the main reason why Jews wanted to buy the Maghrebi Quarter in the 1910s,¹⁹ before polarising tensions in the 1920s with the 1927 bombing²⁰ and the Wall riots of 1929.²¹

The drafting of the descriptive notes for these 11 buildings²² was based on Vincent Lemire's work (2023) and on that directed by Michael H. Burgoyne (1987) (mainly for the architectural description of the site and the building plans). We also relied on the work of Nazmi Jubeh (2019; 2021) as well as on an interview conducted with him at the Chateaubriand French Institute of Jerusalem.²³ His accounts were very helpful as he had lived in the neighbourhood during his childhood. The short notices were written with the same objective as the 3D reconstruction itself, which is to address both specialists and the general public. It was therefore important to highlight the historical and patrimonial value of the buildings as well as their religious, social and symbolic functions, without overloading the reader with too much specific information (such as the many architectural details available for most of the buildings). We have therefore chosen to maintain a text length (about 300–400 words) accessible to a wider audience and that will not discourage newcomers, while aiming for the greatest possible scientific accuracy and precision. Finally, we weaved links between the different buildings in order to remind people that they were initially a whole (intersecting narratives, similar or complementary function, etc.).

(3.1.2) Frederick John Salmon's plan of 1936 as the main cartographic source

The major cartographic source used for the reconstruction is the 1936 cadastral plan of the Old City of Jerusalem compiled under the direction of the British surveyor Frederick John Salmon

¹² ACJ01_HP_071_RB3D.

¹³ From ACJ01_CP_011_RB3D to ACJ01_CP_044_RB3D and ACJ01_HP_084_RB3D to ACJ01_HP_090_RB3D.

¹⁴ From ACJ01_HP_079_RB3D to ACJ01_HP_083_RB3D.

¹⁵ The Maliki law school is one of the four main schools of Islamic jurisprudence within Sunni Islam.

¹⁶ From ACJ01_CP_001_RB3D to ACJ01_CP_010_RB3D and ACJ01_HP_091_RB3D to ACJ01_HP_094_RB3D.

¹⁷ From ACJ01_HP_073_RB3D to ACJ01_HP_078_RB3D.

¹⁸ ACJ01_HP_009_RB3D; ACJ01_HP_014_RB3D; ACJ01_HP_016_RB3D; ACJ01_HP_017_RB3D; ACJ01_HP_022_RB3D; ACJ01_HP_035_RB3D to ACJ01_HP_037_RB3D; ACJ01_HP_048_RB3D; ACJ01_HP_049_RB3D; ACJ01_HP_054_RB3D; ACJ01_HP_070_RB3D.

¹⁹ Proposal by Djemal Pasha to sell the place in front of the Western Wall to the Jews (1915–1917). Retrieved from <http://www.archives.openjerusalem.org/index.php/proposal-by-Djemal-pasha-to-sell-the-place-in-front-of-the-western-wall-to-the-jews> (Last accessed: 6 November 2023).

²⁰ Explosion by the Western Wall (1927). Retrieved from <http://www.archives.openjerusalem.org/index.php/e7kp-28pa-wa6h>. (Last accessed: 6 November 2023).

²¹ Palestine Riots. Dossier for Chief Secretary (1929). Retrieved from <http://www.archives.openjerusalem.org/index.php/e7kp-28pa-wa6h>. (Last accessed: 6 November 2023).

²² See ACJ01_VB_001_RB3D on Nakala.

²³ 21/03/2023.

and revised in 1945 and 1947.^{24,25} Frederick John Salmon was the director of the Palestine Survey between 1933 and 1938, during which time he launched an initiative to produce a modern topographical map of Palestine. His map provides valuable information about the urban organisation of the Maghrebi Quarter. At the same time, it shows the location of most of the buildings that we wanted to highlight in the 3D model. In the first step, the 11 valuable buildings were located on the map (Figure 2) to visualise the overall space that had to be processed and digitally reproduced (Figure 3).

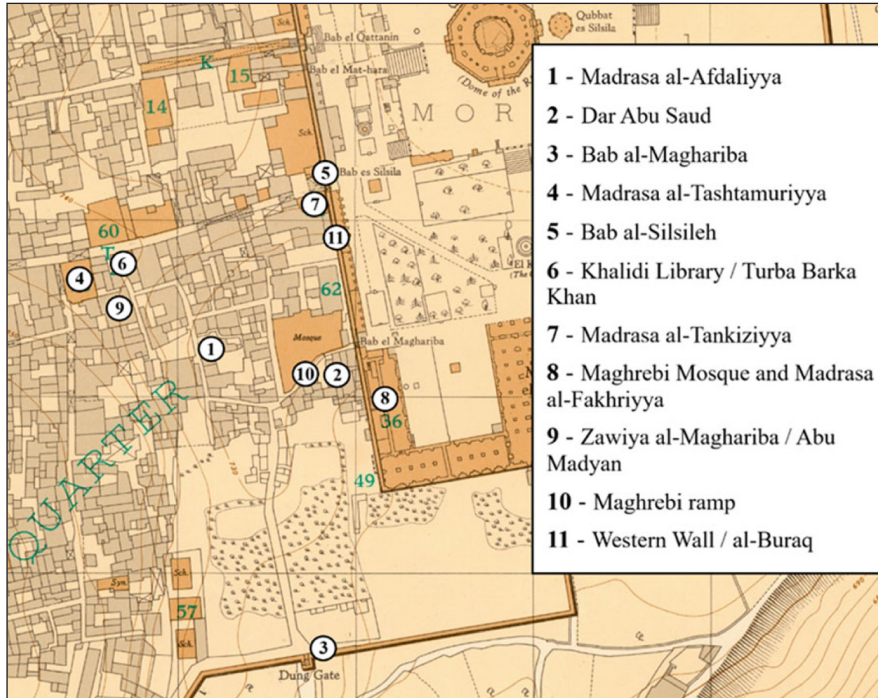


Figure 2 Location of the 11 valuable buildings highlighted in the 3D reconstruction.²⁶

© map by F. J. Salmon.



Figure 3 First version of the 3D reconstruction of the Maghrebi Quarter built on the cadastral map of Frederick John Salmon.

© 3D Research srl, 2023.

(3.1.3) Archive photographs and architectural plans

The technical reconstruction of the Maghrebi Quarter benefited from background information and research on the buildings (floors, number of rooms, recognisable architectural elements), as well as from architectural plans (mainly from the book *Mamluk Jerusalem: An Architectural Study*)²⁷ and images.²⁸ One of the main challenges concerning the photographic documents and plans was to gather and mix a heterogeneous corpus covering several decades of the Quarter's existence. The choice was therefore made to use similar sources for all the buildings, as far as possible and when they existed, in order to harmonise and homogenise the result. The plans included in the (Figures 4, 5, 6, 7) corpus are thus all taken from the book *Mamluk Jerusalem. An Architectural Study* and were used as a second main source along with the 1936 cadastral map to accurately reconstruct the buildings described in the notices.

²⁴ Jerusalem the Old City (1945). Retrieved from <http://www.archives.openjerusalem.org/index.php/jerusalem-the-old-city-1945>. (Last accessed: 6 November 2023).

²⁵ See ACJ01_MA_001_RB3D on Nakala.

²⁶ See ACJ01_MA_003_RB3D on Nakala.

²⁷ See images From ACJ01_PL_001_RB3D to ACJ01_PL_015_RB3D on Nakala

²⁸ See images From ACJ01_CP_001_RB3D to ACJ01_CP_114_RB3D and ACJ01_HP_001_RB3D to ACJ01_HP_095_RB3D on Nakala.

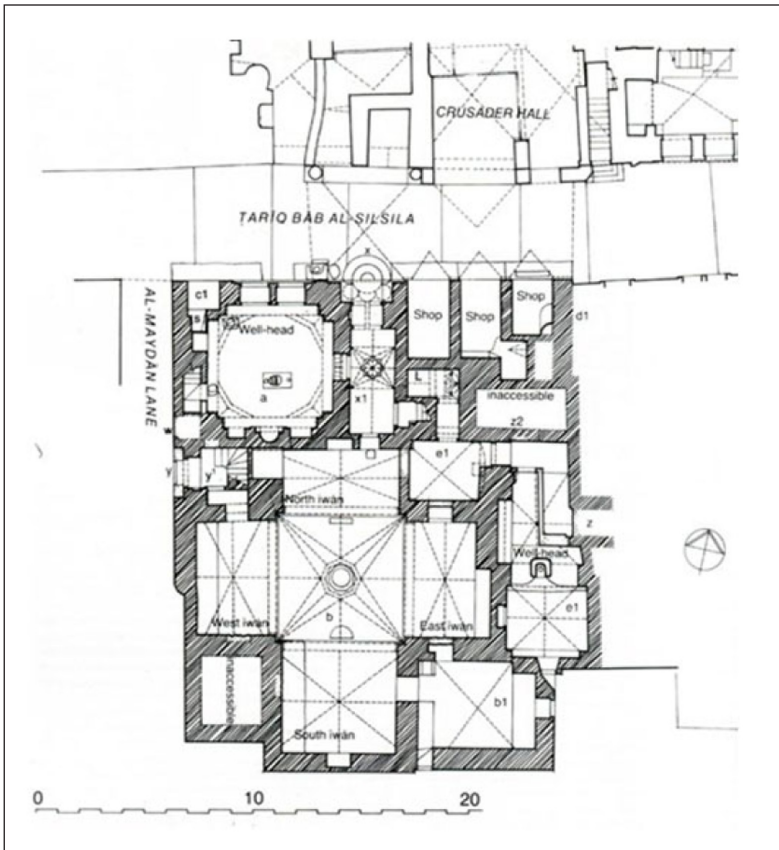


Figure 4 Ground floor plan of the madrasa al-Tashtamuriyya.

Source: Burgoyne & Richards 1987.

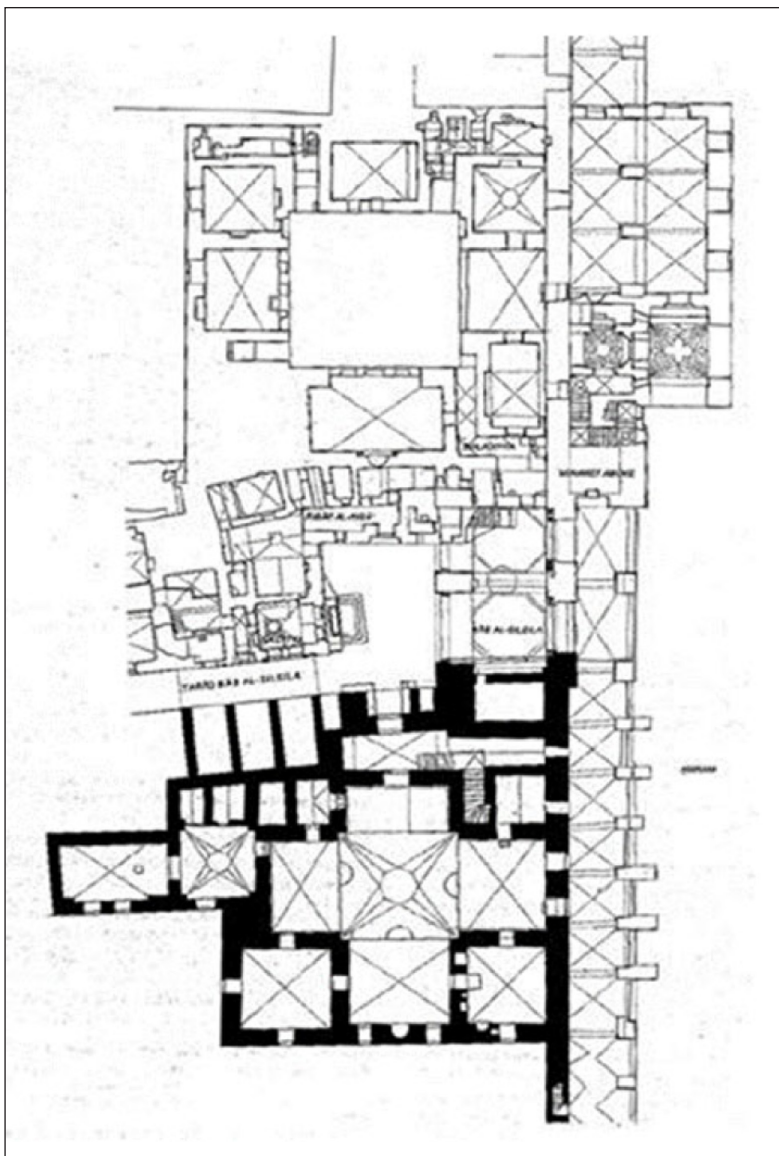


Figure 5 Ground floor plan of the Madrasa al-Tankiziyya.

Source: Burgoyne & Richards 1987.

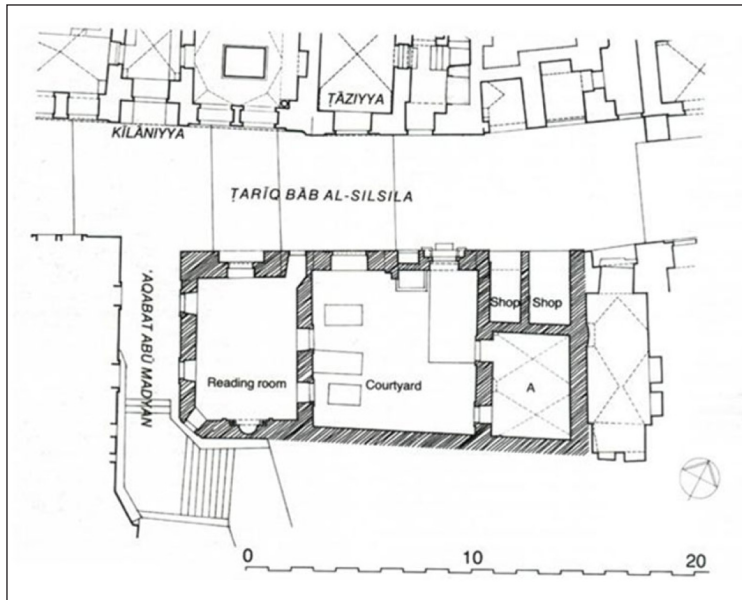


Figure 6 Ground floor plan of the Khalidi Library.

Source: Burgoyne & Richards 1987.

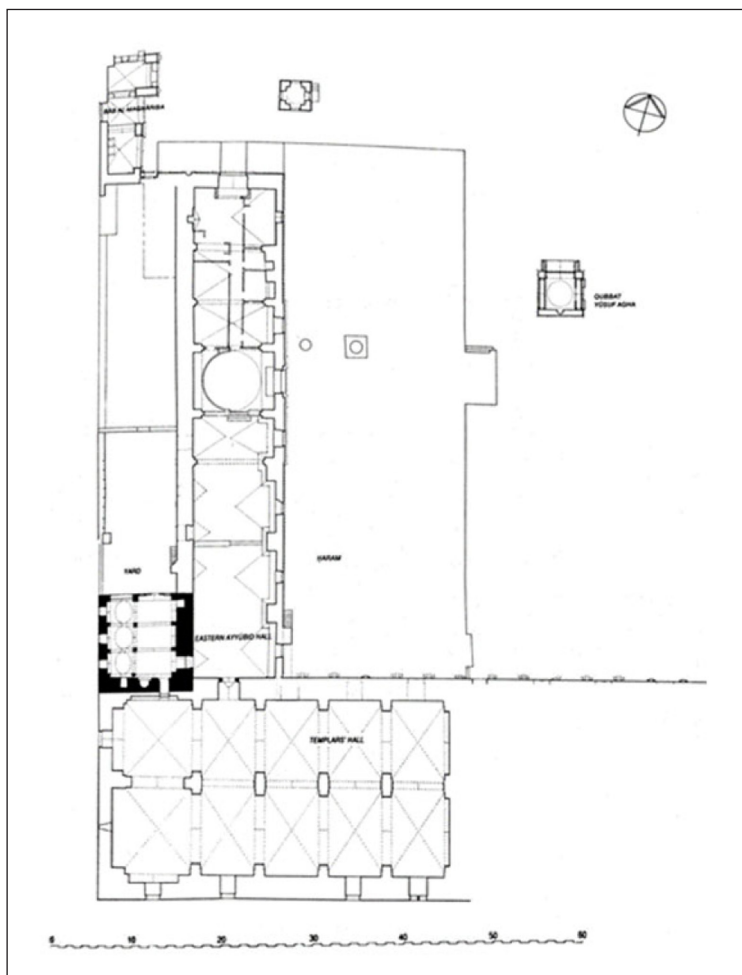


Figure 7 Ground floor plan of the Maghrebi Mosque with the Madrasa al-Fakhriyya inside (in black).

Source: Burgoyne & Richards 1987.

Once the basis for the reconstruction had been established on the plans, we collected photographic documents likely to provide additional information. We used wide-angle photographs of the Quarter in order to clarify and correct the location of certain buildings and streets,²⁹ but also photographs of specific elements such as the gate of the Madrasa al-Fadaliyya (now disappeared) (Figure 8).

²⁹ Mosque & Jew's wailing place (1930–1935). Retrieved from <http://www.archives.openjerusalem.org/index.php/mosque-jews-wailing-place> (Last accessed: 7 November 2023); Temple area, Mosque of Omar (i.e. Dome of the Rock) and Jerusalem (1930–1935). Retrieved from: <http://www.archives.openjerusalem.org/index.php/temple-area-mosque-of-omar-i-e-dome-of-the-rock-and-jerusalem> (Last accessed: 7 November 2023); The temple area. Jerusalem. The Dome of the Rock and the western Temple wall (1920–1925). Retrieved from <http://www.archives.openjerusalem.org/index.php/the-temple-area-jerusalem-the-dome-of-the-rock-and-the-western-temple-wall>. (Last accessed: 7 November 2023).



Figure 8 The scalloped arch (Ayyubid period)³⁰ above the entrance to the Madrasa Afdaliyya, pictured from north-west to south-east, 1930s.³¹
© EBAF.

One of the main photographic sources used was a 1931 Zeppelin photograph taken from the sky, showing most of the Maghrebi Quarter (Figure 9). The importance of this document led us to look for other photographs from the same series, ideally from a new angle. We therefore contacted the archives of the Zeppelin Museum Friedrichshafen where the first photograph is archived, with no success due to the lack of similar photographs.



Figure 9 Aerial picture taken from a Zeppelin on April 11, 1931, from north to south, with the Maghrebi ramp (S-shape, center) and a part of the Maghrebi Quarter (lower-right).^{32,33}
Source: Archiv der Luftschiffbau Zeppelin GmbH, Friedrichshafen.

We also used many photographs from the archive of the Fine Arts Library of Harvard College Library, collected and displayed on the Archnet website,³⁴ especially for the following buildings: Madrasa al-Tashtamuriyya³⁵; Bab al-Silsileh³⁶; Khalidi Library / Turba Barka Khan³⁷ and Madrasa al-Tankiziyya.³⁸ All these photographs allowed the reconstruction of additional details such as

³⁰ Photograph of a scalloped arc (Ayyubid era) above the madrasa entrance, in the 1930's. Retrieved from <http://www.archives.openjerusalem.org/index.php/hgyk-qgqg-d5z2>. (Last accessed: 7 November 2023).

³¹ See ACJ01_HP_071_RB3D on Nakala.

³² See ACJ01_HP_002_RB3D on Nakala.

³³ Aerial photograph of the Maghreb district taken by the Zeppelin (1931). Retrieved from <http://www.archives.openjerusalem.org/index.php/aerial-photograph-of-the-maghreb-district-taken-by-the-zeppelin>. (Last accessed: 7 November 2023).

³⁴ Archnet is a digital library dedicated to architecture, urban planning and the built environment in Muslim societies. Launched in 2002, this open-access resource is the result of a partnership between the Aga Khan Documentation Center at MIT (AKDC@MIT) and the Aga Khan Trust for Culture (AKTC), with support from the Aga Khan Program for Islamic Architecture at Harvard and MIT. <https://www.archnet.org/>.

³⁵ Al-Tashtamuriyya. Retrieved from <https://www.archnet.org/sites/1793>. (Last accessed: 7 November 2023).

³⁶ Sabil Bab al-Silsila. Retrieved from <https://www.archnet.org/sites/3058>. (Last accessed: 7 November 2023).

³⁷ Turba Baraka Khan. Retrieved from <https://www.archnet.org/sites/3727>. (Last accessed: 7 November 2023).

³⁸ Madrasa al-Tanzikiyya. Retrieved from <https://www.archnet.org/sites/1792>. (Last accessed: 7 November 2023).

the gardens, the pavements of the streets³⁹ (Figure 10), the colour of the roofs, the colour contrasts between the stones of the walls and the joints, the diversity of the domes⁴⁰ and the presence of “cornices”⁴¹ on some roofs. For the colour and shape of the stones that cover all the buildings, we also used the rest of the old city as a reference and the similar architecture that remains there.

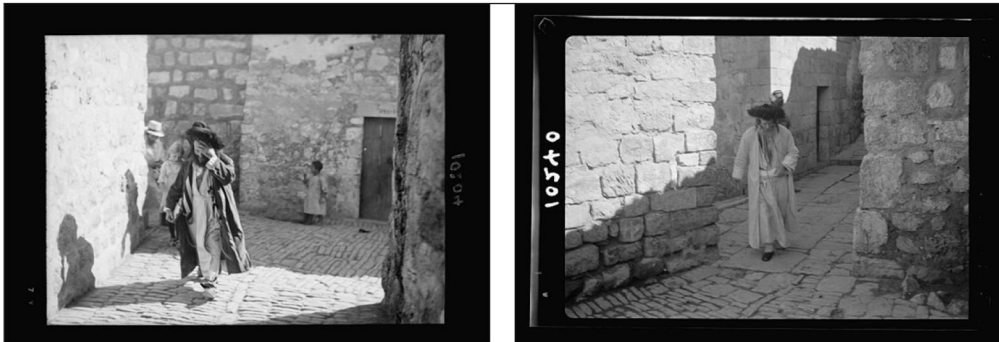


Figure 10 Orthodox Jews near the Wailing Wall between 1934 and 1939.^{42,43}

© Matson Photograph Collection, Library of Congress.

(3.1.4) Contemporary photographs

Our reliance on pre-1967 sources sometimes limited the material needed for the technical reconstruction. We have therefore used contemporary photographs⁴⁴ for the buildings that still exist, while taking into account the possible transformations that took place between the 1960s and the 2020s, such as façade renovations or additions of floors. These recent sources have provided more detail and allowed the recovery of little-known information, particularly concerning the boundary of the Zawiya al-Maghariba (of which we have no plans) and its still visible foundation stone (Figure 11).



Figure 11 Foundation stone of the Zawiya al-Maghariba located above the eastern door of the Zawiya.⁴⁵

© Lemire, 2023.

³⁹ From ACJ01_HP_060_RB3D to ACJ01_HP_065_RB3D and ACJ01_HP_053_RB3D to ACJ01_HP_048_RB3D on Nakala.

⁴⁰ From ACJ01_CP_105_RB3D ; IMG_1946 ; ACJ01_HP_056_RB3D on Nakala.

⁴¹ From ACJ01_CP_112_RB3D to ACJ01_CP_114_RB3D on Nakala.

⁴² Orthodox Jew near Jews' wailing place (between 1934 and 1939). Retrieved from <https://www.loc.gov/pictures/collection/matpc/item/2019709801/> (Last accessed: 7 November 2023).

⁴³ Orthodox Jews on their usual Sabbath walk to the Wailing Wall (man with fur cap) (between 1934 and 1939). <https://www.loc.gov/pictures/item/2019709832/> (Last accessed: 7 November 2023).

⁴⁴ From ACJ01_CP_001_RB3D to ACJ01_CP_114_RB3D on Nakala.

⁴⁵ From ACJ01_CP_059_RB3D to ACJ01_CP_062_RB3D on Nakala.

3.2. 3D MODELLING PROCESS

The three-dimensional reconstruction of the Maghrebi Quarter required regular meetings between the ACJ historians and 3D research specialists, highlighting both the challenges and the potential of inter-professional collaborations. The methodology followed for the 3D modelling is described below.

(3.2.1) Technical data processing

3D Research Srl carried out the reconstructive workflow by considering the results of the theoretical and methodological discussion built around the definition of Virtual archaeology (Munster & Kohler, 2016). The main steps of the followed methodology are shown in Figure 12.

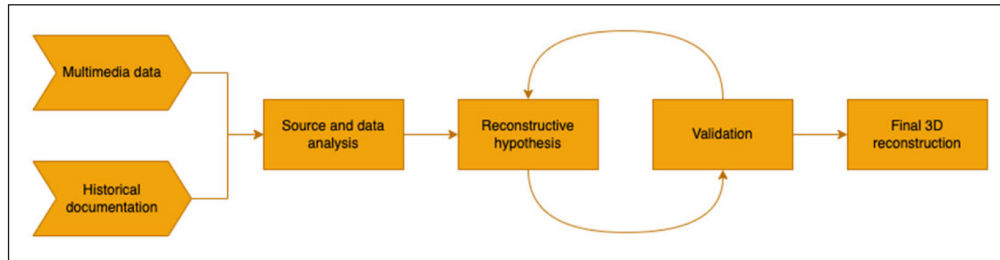


Figure 12 Iterative feedback reconstruction process.

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(3.2.2) Source and data analysis

The three-dimensional reconstruction of the Maghrebi Quarter was produced through an iterative feedback process that integrated 3D data with previously acquired historical sources. Alongside old photos and current on-site pictures, as mentioned before, Google Street View resources were used to gather more references of the best-preserved areas, such as Madrasa al Tashtamuriyya, Bab al-Silsila, and Turba Baraka Khan. These resources, combined with maps of ancient Jerusalem⁴⁶ (the 1936 map in particular), facilitated an initial analysis to identify the spatial layout, building and street configurations, and architectural patterns, while also taking into account slopes and vegetation. The modern images and Google Street View proved to be particularly valuable for replicating local materials and surfaces, as the old photos were in black and white, lacking colour information and having lower resolution. This provided a more accurate and detailed representation of the materials and textures found in the Maghrebi Quarter.

This comprehensive analysis, incorporating both historical and modern references, played an important role in creating a faithful representation considering the historical context and the intricacies of the local environment. In addition, recognized patterns served as a basis for imagining the likely appearance of undocumented sections, which often consist of structures partially or completely covered by other buildings, where references were unavailable. After selecting and processing all the necessary information about the Quarter, the modelling phase started. Each stage of the modelling process involved several technical reconstruction steps, interspersed with regular review meetings with numerous experts to generate a feedback process resulting in the most faithful reproduction of the Quarter.

(3.2.3) Block out of the Maghrebi Quarter

Once the data were processed, a volumetric model representing the perimeter walls of the Quarter was created, to which the block-out representing the 2D grid of buildings in the Quarter was attached (Figure 13). Starting from F.J. Salmon's historical map, the perimeters of the structures within the Quarter were drawn iteratively to define the area of each structure.



Figure 13 2D block out of the building area in the Maghrebi Quarter.

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⁴⁶ See maps ACJ01_MA_001_RB3D ; ACJ01_MA_004_RB3D on Nakala.

(3.2.4) Procedural modelling of buildings

After completing the initial block-out phase, an overhead perspective of the area was created based on panoramic photos.⁴⁷ The blocks, which represented a sketch of the buildings in the Maghrebi Quarter, were extruded along the z-axis to give them an appropriate height (Figure 14).

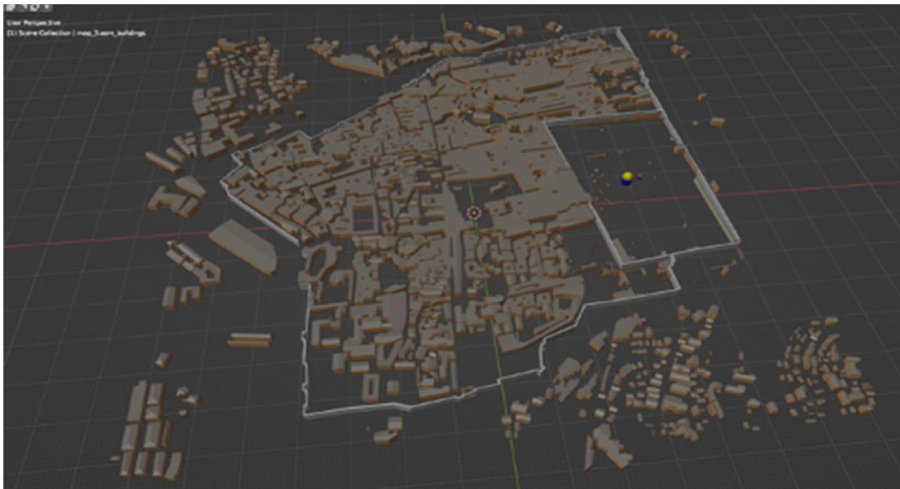


Figure 14 3D representation of the building area in the Maghrebi Quarter.

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Next, the details of the buildings were generated procedurally using Geometry Nodes, a tool available in Blender. This tool is used to modify the geometry of objects procedurally following a predefined structure based on modular assets (Figure 15). Through this process it was possible to create the building structures, the facades, and other architectural elements, such as windows, doors, and roofs. The use of Geometry Nodes enabled accurate and realistic texturing of the buildings, contributing to making the Maghrebi Quarter a visually authentic and immersive environment (Figures 16 and 17).

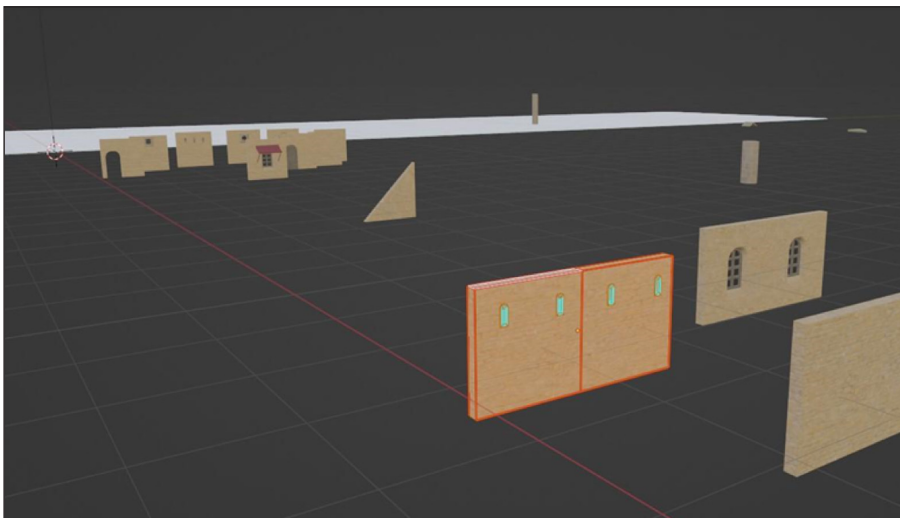


Figure 15 Modular assets.

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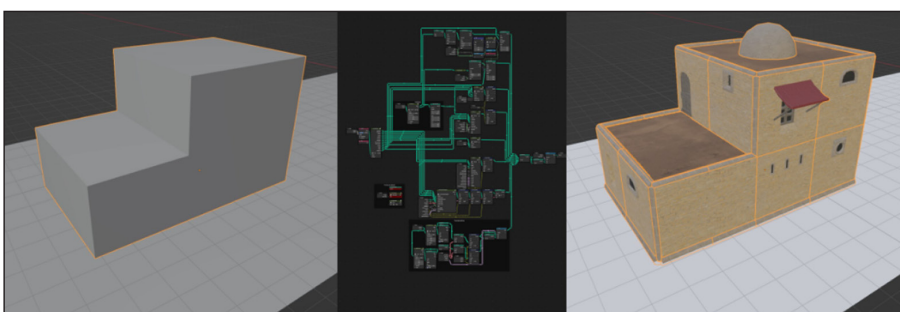


Figure 16 Block out of a building (on the left); Geometry Nodes for procedural generation (in the middle); final aspect of the building (on the right).

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⁴⁷ See on Nakala ACJ01_HP_002_RB3D; ACJ01_HP_006_RB3D; ACJ01_HP_007_RB3D; ACJ01_HP_010_RB3D; ACJ01_HP_012_RB3D; ACJ01_HP_013_RB3D; ACJ01_HP_018_RB3D; ACJ01_HP_020_RB3D; ACJ01_HP_021_RB3D; ACJ01_HP_023_RB3D; ACJ01_HP_024_RB3D to ACJ01_HP_034_RB3D; ACJ01_HP_039_RB3D; ACJ01_HP_042_RB3D to ACJ01_HP_046_RB3D; ACJ01_HP_055_RB3D; ACJ01_HP_059_RB3D; ACJ01_HP_066_RB3D to ACJ01_HP_069_RB3D.



Figure 17 The Maghrebi Quarter after applying Geometry Nodes.

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(3.2.5) Modelling the Valuable Buildings

The eleven buildings, identified as Valuable Buildings, underwent a process of individual remodelling and texturing, which differentiated them from the rest of the Quarter.⁴⁸ Following the above-mentioned in-depth research into historical sources and data, the block modelling process was launched to define the overall volume of the structures. Once the research team had confirmed the structure, specific details of the buildings were added. Finally, texturing was performed using the UV mapping technique (Flavell, 2010) (Figure 18).

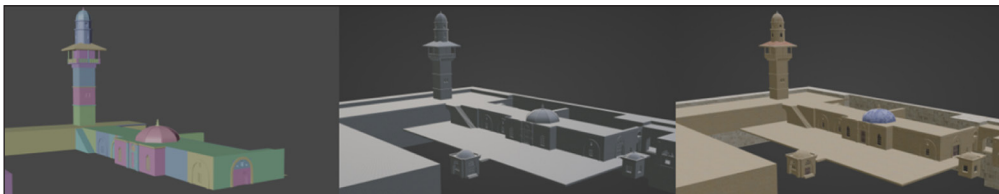


Figure 18 Madrasa al-Fahriyya: block out (on the left); detailed modelling (in the middle); texturing (on the right).

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(3.2.6) Block out of the surrounding area

The area of Jerusalem surrounding the Maghrebi Quarter was carefully modelled using OpenStreetMap, an add-on that allows the import of data from maps into Blender and the creation of the corresponding structures (Figure 19). Using this tool, it was also possible to faithfully scale the map of the Quarter. However, unlike the Maghrebi Quarter, Jerusalem was not enriched with textures and details, but was simply created as a series of block structures, providing a visual context for the Maghrebi Quarter. This approach allowed the Quarter to be placed within a context that is realistic and consistent with its surroundings.

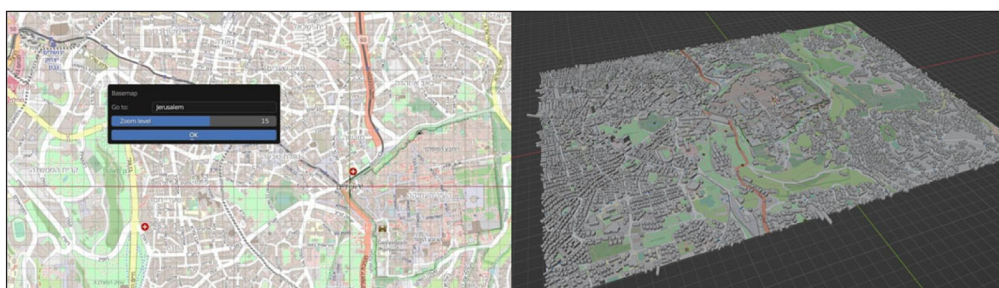


Figure 19 Selection of the area of interest from OpenStreetMap (on the left); creation of the buildings (on the right).

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(3.2.7) Virtual Scenario: Level design in Unity

The last phase of the process involved assembling the results of the steps described above (Figure 20) and importing them to Unity (Figure 21).

⁴⁸ See samples ACJ01_MO_001_RB3D to ACJ01_MO_003_RB3D on Nakala.



Figure 20 Integration of all the modelled buildings.
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Figure 21 Virtual scenario in Unity.
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Initially, the terrain was generated, faithfully reproducing the characteristics of the location, and the sky was rendered to add depth to the scene. Next, lights and visual effects were then added to create realistic lighting effects. We also know that the Quarter was relatively rich in vegetation, thanks to the historical photographs we have been able to gather. To make the scene even more authentic, this vegetation in the Maghrebi Quarter had to be created using a combination of reference images and modelling techniques. Numerous photos were used as a basis for creating plants and trees, carefully replicating their appearance and arrangement within the scene.

Furthermore, props were added to further enhance the atmosphere and liveliness of the scene. These additional elements, such as furniture, tools, and decorative objects, were strategically placed to help make the scene more realistic and provide additional visual details.

The combination of all these operations made it possible to create a complete and immersive scene in the Maghrebi Quarter, combining terrain, sky, vegetation, and props to provide a rich and realistic visual experience (Figure 22).



Figure 22 Some details from the scenario.
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(4) IMPLICATIONS/APPLICATIONS

(4.1) ENRICHING THE 3D MODEL

Our work is a work in progress. The aim of the reconstruction is also to add to it on a regular basis and to update it in proportion to the historical and memorial details that we will be able to provide. A Quarter is made up of both stone and life, so one of our main aims is to incorporate oral testimonies into the reconstruction in the near future, which will make our reconstruction more personal and livelier. We hope to use the first version of the reconstruction described in this research paper as a visual aid for oral testimonies as the images can help to bring back memories for those who knew the place. We would also like to add information about the archaeological excavations⁴⁹ conducted in the Maghrebi Quarter, as well as certain building interiors.⁵⁰ We also want to improve the tracing of the sources used by creating direct links between the application and our archival database.

(4.2) PERSPECTIVES, POTENTIAL FOR RE-USING DATA AND IMPACT

This 3D model opens several perspectives for the revaluation of the Maghrebi Quarter and also points towards widening the use of 3D technology within the framework of similar scientific works. Regarding the Maghrebi Quarter and the history of Jerusalem, the archival corpus we have collected and selected for 3D reconstruction might serve as a foundation for future research work, whether it concerns the architectural aspects (especially from the Mamluk period) or the social and religious history of the Holy city. The corpus we gathered also allows us to explore the links between tourism and heritage issues, considering their inclusion in a sometimes-contradictory national narrative.

The second main perspective concerns the methodology used in the 3D model as well as the articulation of the technical aspect with historical scholarly work. One of the objectives of our 3D reconstruction was indeed to incorporate the use of such technical tools (which are constantly being improved) in other similar projects concerning other cities and other contexts.

The current international environment encourages us to think about the reconstruction of cities destroyed in the framework of ongoing conflicts, such as in Ukraine. The methodology used in our 3D modelling might even serve as the basis for knowing what is necessary to reconstitute an urban area, which would make it possible to act upstream of a possible destruction during a conflict (such as knowing what data is most important to collect, or knowing how to proceed technically and very concretely).

Finally, the articulation between digital techniques and history on the one hand, and the general public and academic public on the other, deserves to be further developed insofar as it brings together dissemination, academic historical work, public history and the perpetuation of disappeared urban areas, within the same project. In addition to these advantages, 3D reconstruction could also be used as a pedagogical tool (not only in schools but also during workshops targeting young people and adults) to supplement other forms of science popularisation and raise awareness about the different historical layers of the Holy City. In our case, most visitors and pilgrims who now pass through the Western Wall / al-Buraq plaza and walk on the remains of the Maghrebi Quarter are unaware of its history or even its existence. 3D reconstruction can remedy this situation, as it allows us to address both an academic and a neophyte audience, making it a tool with huge potential and impact.

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⁴⁹ From ACJ01_CP_106_RB3D to ACJ01_CP_111_RB3D.

⁵⁰ From ACJ01_IP_001_RB3D to ACJ01_IP_022_RB3D.

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COMPETING INTERESTS

The authors have no competing interests to declare.

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