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Pázmány Péter Catholic University

Doctoral School of History – Program of Archaeology

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Digital Reconstruction of The Urban Morphology of The Old City of Aleppo: Between the Mamluk and the Post-War City, the case of "*al-Jallūm* and *al-ʿAqaba* Districts.

-A Parametric Study-

Doctoral (PhD) Dissertation

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DECLARATION

This thesis was submitted towards the fulfillment of the requirements for the award of a PhD degree in history and archaeology from Pázmány Péter Catholic University. It is the product of my own original work, unless otherwise mentioned through references, notes, or other statements.

SIGNATURE

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Arabic Letters Transliteration Table

أ	a	ط	ṭ
ب	b	ظ	ẓ
ت	t	ع	ʿ
ث	th	غ	gh
ج	j	ف	f
ح	ḥ	ق	q
خ	kh	ك	k
د	d	ل	l
ذ	dz	م	m
ر	r	ن	n
ز	z	ه	h
س	s	و	w
ش	sh	ي	y
ص	ṣ	ء	ʾ
ض	ḍ	ة	a

Long vowels are indicated with a dash line.

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Abstract

Aleppo, an urban settlement that dates to the Bronze Age, is also a renowned world heritage site. The Old City of Aleppo suffered extensive urban damage during the war that started in Syria in 2011. This dissertation presents a pioneer study for the implementation of digital technology in visualization and studying the history and development of two districts in the Old City of Aleppo, *al-Jallūm* and *al-ʿAqaba*.

This dissertation designs a process for a parametric time machine for Mamluk Aleppo. The historical reconstruction of the Mamluk Era (16th Century) is based on both cartographical and historical inputs. However, the study attempts to transcend the concept of a mere time machine. It links the past and the present by tracking the development of the studied area between the historical reconstruction of the Mamluk period and the post-war city. This is achieved through an extensive digital field survey using laser scanning and areal photogrammetry. The goal of this study is to compare both digital models and track the changes in the morphology of the city through the study of the changes in the heights of individual buildings and the general silhouette of the city, in addition to a comparison between the mass and void ratio between the two time periods.

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i. Introduction

Over the past decade, technological advances allowed architects and archeologists to achieve higher levels of finesse and precision in virtual reconstruction. Reality-capturing workflows such as laser scanning and photogrammetry paved the way for technology as a tool for the reconstruction of historical sites, monuments, and artifacts, as well as an informant to the urban decisions within a historic fabric.

As a result, digital models have enabled historians and architects to pay a 3D virtual visit to our past. A concept often referred to in scholarly literature as the "urban time machine". It aims to create an accurate architectural visualization of monuments or cities in different ears and track their development during different historical periods. Those models are not only tools of simulations of a time long gone, but they hold the potential to influence the decision process of the modern city and offer deeper knowledge of the morphological evolution of historic centers.

The idea of urban time machines relied on topographical maps, cartographic data, and historical pictures and paintings for the reconstruction of historic cities in different historical periods. Historical accounts from each period then help to examine previous inputs. Such projects gained momentum in the 1990s, especially for capitals of vast empires, such as Rome or Athens. Most recently, the European "Time Machine Project"[1] has been gaining a lot of popularity; and many cities in Europe have created their own urban time machines.

The 21st Century encompassed a gigantic leap for the field of historical reconstruction, represented in the several applications of photogrammetry and terrestrial laser scanning. These technologies not only help fabricate the past but hold the potential to aid the preservation and reconstruction of heritage under risk of conflict, climate change, and natural disasters. For example, the digital analysis of a post-war city can offer different levels of information for the city, its history, development, story, while being a tool of relief and recovery. Today, while the cultural heritage in the Middle East is facing deliberate destruction by wars and extremism, the same technology can play an important role in documenting damages and reconstructing the morphological development of cities before, during, and post-conflict.

Aleppo, a world heritage site since 1986, enjoyed an advantageous location on ancient trade routes. This location contributed to the prosperity and wealth of the city. The oldest

[1] https://www.timemachine.eu/project-scouting-service/

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mention of Aleppo dates to the 25th Century BCE. Making Aleppo a stronghold for several rulers throughout history: from Hittites, Assyrians, Akkadians, Greeks, Romans, Umayyads, Ayyubids, Mamluks to the Ottomans.

Old Aleppo stands as a fortified city encircled by a wall reinforced with defensive towers, with a centered citadel surrounded with covered markets bedesten (*bazars*), residential quarters, *madrassas*[2], *khans*[3], and religious buildings that used to be ancient temples; in addition to churches, synagogues and mosques, the most important of which is the Great *Umayyad Mosque.* These mixed-use buildings suggest a religious and social diversity that supported the important role of Aleppo as a commercial city on trade routes. As a result, the city developed a complex and mixed urban fabric that was subject to several destruction attempts and reconstruction processes, most significantly during the 12th to the 16th Century because of the constant invasions at the hands of the Mongols and Tatars as well as political instability. The most recent destruction the city has witnessed was during the conflict in Syria (2012-2015. Many of the buildings within the old city have suffered different amounts of damage, varying from mild to severe to complete demolition. Therefore, Aleppo was inscribed on the List of World Heritage in Danger in 2013.

The dissertation is based on field digital survey to document two districts in the Old City of Aleppo using laser scanning and aerial photogrammetry to create a model of the war damages across the studied area. Furthermore, the study will apply an analog/digital approach to the Old City of Aleppo to create an urban time machine for the city in the 16th Century and use that historical replica to study the morphological changes by comparing the historical reconstruction with the digital model of the post-war city.

ii. **Scope**

1. **Time Frame**: The study focuses on the 16th Century and the 21st Century (2018) when the field survey took place.
2. **Boundary**: The study identifies the old city of Aleppo as an intra-muros city and does not discuss the expansion of the city beyond the historical walls.
3. **Choice of Case Study:** The "*al-Jallūm Quarter*" was chosen because of its proximity to "*Tall al-'Aqaba*", "*Tallat al-Sawda*" and "*al-Kallāsa*" which are considered by

[2] A type of inn once found in the Middle East and parts of North Africa and Central Asia that effectively functioned as a trading center and hostel (https://www.britannica.com/technology/khan-architecture)

[3] An institution of higher education in the Islamic sciences (https://www.britannica.com/topic/madrasah)

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scholars to be (independently or collectively) as the earliest settlement' nuclei of Aleppo, in addition to the distinctness of the Hellenistic plan grid in the quarter, and the availability of previous 2D studies, upon which this study is based.

iii. Problem and research questions

Various historical studies and papers have been published about Aleppo, owing to its prestigious status. Travelers such as De Bruyn, orientalists such Michael Meinecke, and Jean Sauvaget, and artists such as Matrakçı Nasuh mentioned and represented the old city of Aleppo within their written of painted work. However, the drawings have remained flat or two dimensional, unable to fully express and describe the urban fabric and development of the morphology of the city through a comprehensive 3D model for the urban change and growth of Aleppo. Therefore, this work seeks to answer an urban and architectural question with the help of 3D modeling and by relying on an accurate hybrid digital survey. But the main question of this study is: **How did the 3D urban fabric of Aleppo change between the late Mamluk period (16th Century) and the post-war city?**

Another layer of this study considers the tragic destruction of the city's fabric, which created a need to document the phase of destruction to preserve it for future studies, analysis, and restoration projects. Small projects have been initiated by international organizations in individual buildings such as *Beit Ajaq-Bash* at *Beit Ghazala*. Nonetheless, the bulk of the documentation carried out was by Unmanned Aerial Vehicle (UAVs)[4] that is not easily available for scientific quality evaluation. However, the "Aga Khan Trust for Culture" has carried out scientific 3D documentation[5] in multiple historical bazars as a part of the project for the rehabilitation of the commercial center of the Old City of Aleppo. This thesis will expand the limits to the two of the (mostly) residential quarters (*al-Jallūm* and *al-'Aqaba*). But more importantly, it will explore **what is the optimum pipeline for implementing analog data with digital datasets?**

iv. OBJECTIVES

This dissertation investigates to what extent digital documentation methods can help in creating models of the past, especially when supplemented with analog spatial data and historical accounts, and how can these models be reflected and compared to the post-war city.

[4] (The Aga Khan Trust for Culture, 2018, p. 5)
[5] ibid.

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It will focus on investigating the political, economic, social, and religious aspects that shaped the urban structure of the city and will use the historical data to guide the historical modeling process. It will visualize the old city of Aleppo between the 16th Century to the post-war condition of the city, as it was surveyed through laser scanning and drone imagery in 2018. Thus, the main objectives of the study can be summarized as follows:

1. Study the 3D spatial development of the city through 3D models based on thorough architectural reading of the historical sources backed with available cartographic data such as maps, surveys, orthophotos and analog photos.
2. Create a parametric modeling and visualization workflow capable of interpolating the historically documented urban and architectural changes and their extent and context. Which will enable the creating of 3D digital models of the historical urban fabric changes of the old city of Aleppo.
3. Design a digital pipeline to superimpose historical-topographical data and combine them with the digital data.
4. Investigate the city in the Mamluk period as a selected historical anchor point and evaluate the magnitude of the social, political, economic, and religious events representing turning points for the morphology of the city.
5. Compare the 3D Mamluk time-machine to the 3D model of the post-war city to determine the key morphological changes to the urban fabric of the city.

v. IMPORTANCE AND CONTRIBUTION

The dissertation at its core bridges history, architecture, and technology. The importance and novelty of the study lies in combining historic and cartographic sources, digital documentation techniques. It also combines parametric design for visualizing, studying, and comparing the city in two different periods.

It provides the first post-war digital survey conducted in Aleppo on an urban scale. It relies on a scientific approach through utilizing laser scanning combined with aerial photogrammetry in the documentation, analysis, and reconstruction of a section of the urban fabric in Aleppo. The digital survey covers an area of 1 km^2 that is considered one of the oldest neighborhoods in Aleppo.

It contributes to the study of history from an urban and architectural point of view by creating an urban time machine of the city and investigating the three-dimensional changes of

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the city that were not sufficiently covered in the previous scientific studies; all is expressed in a parametric environment.

vi. METHODOLOGY

The dissertation adopts a bidirectional strategy, merging both bottom-up and top-down approaches. - In the top-down approach, the 3D models obtained from the survey are utilized as the foundation for visualizing the development of the urban fabric. A bottom-up approach is employed to construct a parametric model. By drawing on theoretical city studies and previous research, this model serves as a time machine for the 16th Century city. Mixing the two approaches generates a more realistic depiction. It produces a two-directional channel transmitting from the past to the present and vice versa. During this process, the study employs multiple methodologies in investigating the urban changes that affected the city. The methods used for extracting the parameters for the parametric model are, naturally, different from the ones used to conduct and process the post-war field survey:

a. Descriptive and Comparative Methods

By merging historical, archaeological, and spatial sources, this method creates guiding metadata and an analog base, which are indispensable to provide the parameters for the digital models of the fabric's development. This technique is also employed to contrast and track the morphological alterations to ascertain the pivotal influence of the social, political, religious, and economic factors in the city's evolution.

b. Quantitative Methods

Using the latest laser scanning and aerial photogrammetry methods, an accurate survey of the post-war condition of the studied area can be performed. Varying the acquisition resolution based on the level of detail to produce an efficient representation that offers satisfactory detail at reduced file sizes.

c. Content Analysis Methods

This method pertains to the second objective of the research, which seeks to create 3D parametric model for the late Mamluk period. It involves the following steps:

- Collect the most important topographic resources of the city. Use AutoCAD to trace them with a unified scale. Geo-reference and superimpose the maps on

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the postwar survey using GIS. The workflow will facilitate the identification of the urban changes, then using them as a base map for the 3D reconstruction.

- Analyze the spatial data from the fieldwork in Aleppo and compare them with the built 3D models, spatial and interpolated textual data. This permits the assessment and quantification of the impact of various factors, including the economy, politics, war, and natural calamities, on the historical urban fabric of Aleppo.

vii. **WORKFLOW**

The work was divided into three stages:

- Data Acquisition: The field survey using photogrammetry and laser scanning techniques to create the base model of the parametric modeling process.
- Data Processing and Parameterization: Creating a parametric model of the city in the Mamluk period by combining field survey data and historical research.
- Data Analysis: Comparative study between the post-war survey and the parametric model of the Mamluk city to track the urban changes.

The **parametrization** of the data uses the following workflow:

The process includes recognizing and extracting urban and architectural patterns associated with each historical period. Then translating it to digital parameters. This is achieved by examining the historic and cartography data as the following:

- Examine the city as a complex.
- Examine the surviving city quarters.
- Examine the quarters in terms of individual buildings.
- Develop a computational pipeline to model important buildings according to their accurate floor plans and height.
- Develop a computational pipeline to model the generic fabric according to their plan but with randomized heights.

The 3D parametric model of Aleppo provides valuable insights as to how the historical visualization of the city compares to the current post-conflict situation.

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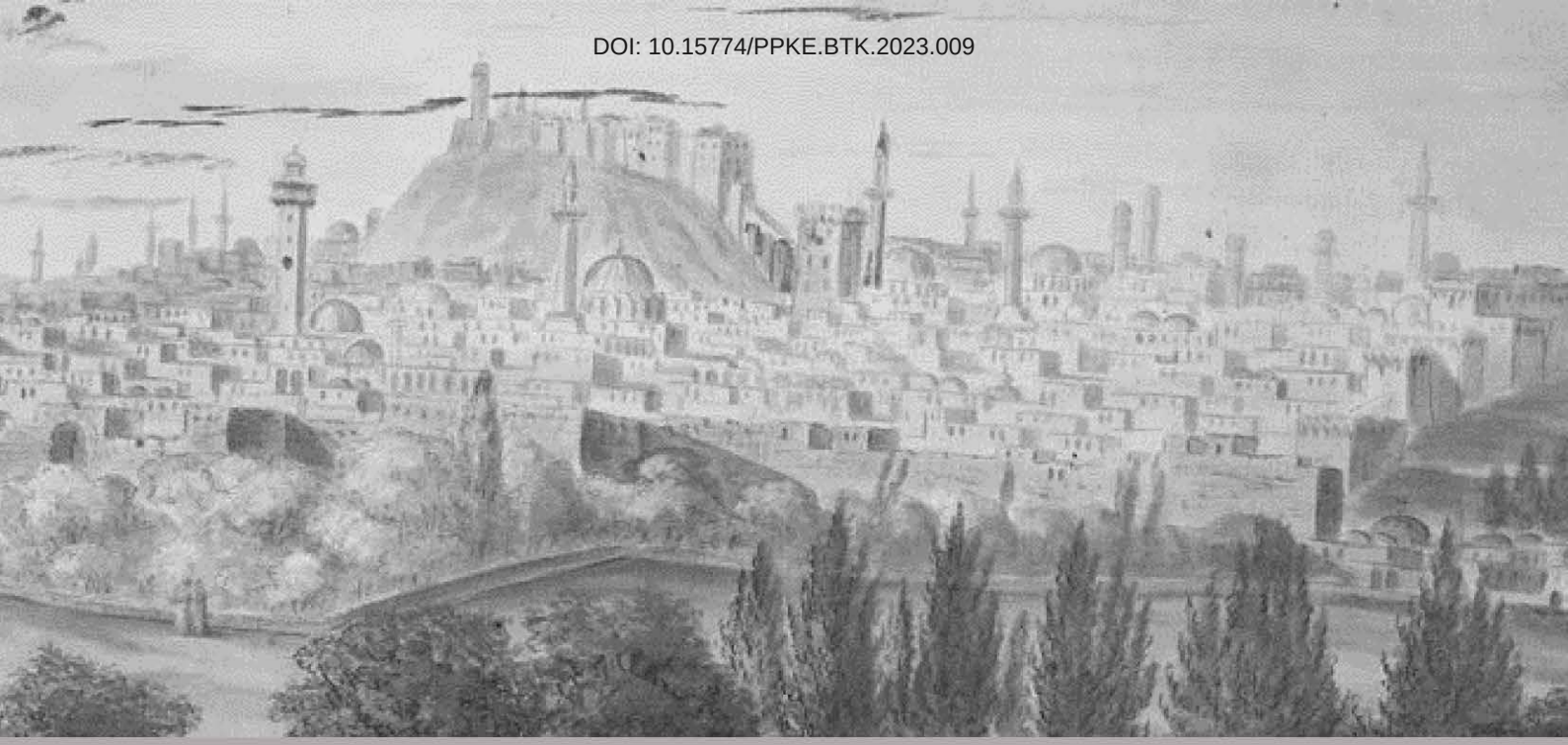

CHAPTER ONE

A BRIEF HISTORY OF ALEPPO

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I.1 Geographical Context

A desirable geographic location with accessible resources is a "must" for the formation of urban settlements. The ultimate preferable site should be easily defensible, as in being protected by mountains or hills. In addition to the availability of water and agricultural land that enables the city to have secure food sources. Additionally, being located on a crossroads adds more income to the city and the possibility of becoming a trade hub, thus contributing to the wealth and the status of any city.

Aleppo is located in northern Syria, at 400 m above the sea level. Yet, its location does not offer much in terms of resources. The only water source for the city was the Quwayq River, which arises from Aintab plateau and flows to the north of Syria passing by the west side of the old city of Aleppo, then by the city of *Qinnasrīn*. That river irrigated a thin grain cultivation field along its 130 km stream.[6] Therefore, in terms of the needed water supply, the river did not constitute an adequate source of the foundation of a city; still, Aleppo was established and relied heavily on bringing water from the nearby fountains of *Ḥaylān*[7] and the design of a canalization network for irrigation.

Many researchers suggest that it was mainly because of its location, that the residents not only endured the shortage of water but found creative ways to overcome it, such as digging wells and building complex networks of rain collecting reservoirs dug into the bedrock of the city, especially in the elevated western edge of the city called "*al-ʿAqaba*".

For example, according to Ross Burns, the advantage of the location of Aleppo is its proximity to the road from Persia and Mesopotamia to the Mediterranean or the so called "Royal Road" and to the basin of the Euphrates and Tigris. Located on the upward road-turn from Antioch to the Royal road (Fig.1)[8], it also lies at an equal distance of approximately 100 km from both the Mediterranean and the Euphrates and allows easy access through flat lands from the port of Antioch to Mesopotamia.[9] This argument is also supported by Heinz Gaube and Eugen Wirth, who considered Aleppo as a location connecting the Mediterranean Western world with the Islamic Middle East.[10] On the other hand, Jean Claude David argues that the

[6] Burns, 2017, p. 1
[7] al-Ghazzī, Vol 1, p. 61
[8] Burns, 2017, p. 3
[9] ibid. p. 4
[10] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 13

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location of Aleppo played no role in its establishments as a village or district, but supported its rise as an urban center capable of replacing the city of Ebla.[11]

The city itself is surrounded by a circle of semi-elevated plateaus, with little spring water[12], while, the old city and its suburbs lie on eight small hills with different heights interspersed with valleys.[13] Aleppo will keep taking the advantage of that intermediary location especially under the Mamluks and Ottomans, where Aleppo utilizes the port cities of Latakia, Tripoli and İskenderun for the export of their products.[14] This trade prosperity declined with the collapse of the Ottoman Empire and the discovery of alternative maritime travel routes.

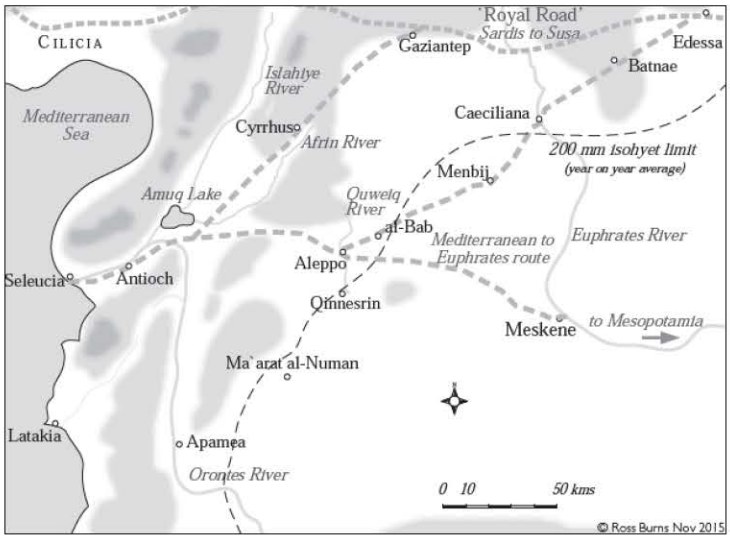

Fig. 1 Routes from Antioch to Edessa with staging posts after Burns, 2017, p. 3

I.2 A Short History of Aleppo

Aleppo was never the capital of a widespread empire like Damascus, Baghdad, or Istanbul, nor did it have the religious importance of Jerusalem or Mecca, yet it is its unique location that enabled it to be a prosperous commercial center.[15] On the other hand, many cities of antiquity overshadowed Aleppo commercially like Qinnsarīn, Cyrrhus and Antioch. Untill the Islamic period, it was Qinnsarīn that resided atop the trade route as an urban center. It was only after the beginning of decline of Qinnsarīn in 10th Century[16] that Aleppo started to build its commercial role in the region roughly for thousand years between the starting of the Crusades

[11] David & Ḥūraytānī, 2011, p. 17
[12] Russel, 1794, pp. 24-25
[13] ibid. p. 26
[14] David & Ḥūraytānī, 2011, p. 17
[15] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 45
[16] (Elisséeff, 2012)

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until the decline of the Ottoman Empire.[17] Hereinafter, I list the most important events of conquest, destruction, natural disasters and revival, while investigating the manner through which they shaped the political, religious, social and economic atmospheres in Aleppo. The following historical section will deal exclusively with historical periods that are relevant to the subsequent study. Therefore, some periods will be skipped to keep the historical information consistent with the urban development study that will be introduced in the second chapter.

I.2.1 Foundation and Early History

The lack of excavations in the city of Aleppo does not allow for an accurate determination of the earliest settlement in Aleppo. Although in the suburbs of Aleppo, specifically in the site of al-Daydariya, prehistoric settlements were excavated.[18] Nonetheless, ancient historical texts mentioned the existence of Aleppo. The oldest reference to the city was in the 25th Century BCE, in a cuneiform tablet from the era of "Rimush", the son of Sargon of Akkad between 2530-2515 BCE, when he first sacked the city and destroyed it.[19] Subsequently, Aleppo was mentioned as a major city in 1750 BCE, [20] until it was destroyed by the Hittites in 1650 BCE. Moreover, the archive of Mari gives information about Aleppo as the capital of Yamhad between 1800 and 1650 BCE, making Aleppo doubtlessly one of the oldest surviving urban centers in the Levant.

Lorenzo Nigro suggested a map of the city during the Amorite period of Yamhad (1800 - 1650 BCE) (Fig.2). He postulated, based on an archaeological and topographical survey, that the pre-classical settlement – opposed to what Sauvaget stated –was not confined to the banks of the river *Quwayq*, but it spread on a larger area.[21] The map he drew indicates possible locations of the gates that might coincide with the existing network of roads to other major cities of that period such as Antioch, Ebla, and the Euphrates region. He also explained the political status of the city that was derived from being the hometown of the god "Adda/ Haddad".[22] He also referenced pottery which remain unearthed in the market complex of the city that date to the period between 2700- 2200 BCE.[23]

[17] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 45
[18] http://dederiyeh.akazawa-project.jp/arabic/1.html
[19] *al-* Ṣawaf, 1952, p. 14
[20] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 24
[21] Nigro, 1997-1999, p. 49
[22] ibid. p. 46
[23] ibid. p. 49

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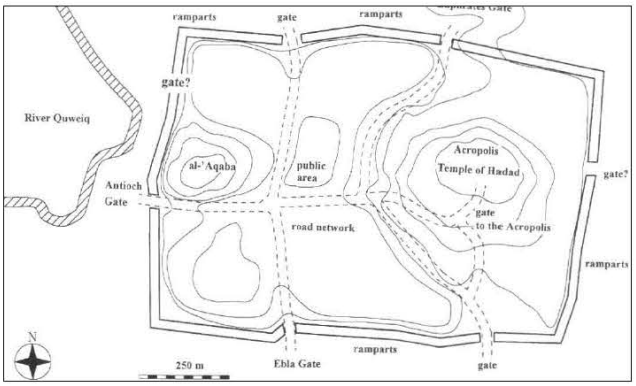

Fig. 2 Reconstructed plan of the town of Aleppo during the middle bronze age (ca. 2000-1600 BCE.) after Nigro, 1997-1999, p. 52.

I.2.2 Hellenistic Period (333 BCE- 64 BCE)

We start to have more data on the layout of the city from the Hellenistic period. The Seleucids took over the city from the Persians in 333 BCE. According to Burns, not much was changed in the city and that they rebranded it–as they have done previously–only by changing its name to Beroia.[24] On The other hand, Sauvaget discussed the introduction of new elements of architecture to Aleppo, such as the *agora* and grid plan streets, which will be discussed in length in the next chapter. .In a proximity to Aleppo, Seleucus I Nicator established a new capital in northern Syria 300 BCE, one of the great-to-be city: Antioch[25], a city which will imperil the fame and prosperity of Aleppo.[26] Seleucus is recorded as the new founder of Beroia; however, Burns argued that for the first decade Seleucid rulers were preoccupied with securing the land they have conquered and did not turn into urban projects before 198 BCE.[27]

Around 100 BCE, the Seleucid Empire began to crumble, simultaneously, with the rise of the power of the Roman Empire.[28] In 96 BCE, Aleppo was ruled as a separate principality by Grypos, and remained so even after 88 BCE during the rule of the Armenian king Tigranes.[29]

[24] Burns, 2017, p. 28
[25] ibid. p. 31
[26] ibid.
[27] ibid. 2017, p. 33
[28] ibid. p. 36
[29] ibid. p. 28

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I.2.2.1 Political, Social, Economic and Religious Environments

- *Politically*: The Greeks were tolerant of the pre-existing political systems.[27] However, in cities founded or developed by the Greeks in Syria, records of a city-state structure (*polis*) that is expressed in a city council and the magistrates were reported.[30]
- *Socially*: The population was expanded by supporting the migration of people from Beroea (Macedonia) to (Beroia) Aleppo. Therefore, it is logical to assume that relocation helped to transfer the Greek lifestyle and language. Moreover, Aleppo owes nucleus of its plan to the Hellenics, and according to many Arabic chronicles, they built a ring of fortifications in this period as mentioned by Ibn Shaddād [31] and Ibn al-ʿAdīm.[32]
- *Economically*: During this period, Aleppo was not a major city despite its proximity to transportation routes. Other cities of the Hellenistic establishment outshined Aleppo, such as Cyrrhus, Hierapolis, Chalcis and Apamea, which were closer to the routes of communication and to agricultural lands, [33] which contributed to their wealth and prosperity, especially due to one of the most important trade routes connecting the Indian Ocean with the Mediterranean through the Gulf Region.[34]
- *Religiously*: During their early rule, Greeks were also tolerant of the pre-existing religions. They attempted to assimilate indigenous gods to the Greek Pantheon, later upon a revolting attempt they launched a strict plan of Hellenization that including the implant of a Hellenistic settlement in every town and city in Syria.[35]

I.2.3 The First Islamic Era (637 CE-1050)

The Muslim armies entered the city upon a peace treaty between the Byzantine and the Muslim forces.[36] Its terms included the evacuation of the Byzantine armies from the city upon the surrender of their weapons.[37]

During the early Islamic period, the city did not get much prominence. That first period of the Islamic rule includes the rule of the Rightly Guided Caliphs (640-660) to Umayyads between (661-760), and to the Abbasids Between (760-947). The period of the Abbasids decline

[30] De Jong, 2007, p. 3
[31] Ibn Shadād, p. 7
[32] Ibn, al- ʿAdīm Būghīat al-Ṭalab fī Tarīkh Ḥalab, Vol 1, p. 51
[33] Burns, 2017, p. 32
[34] David & Ḥūraytānī, 2011, p. 38
[35] De Jong, 2007, p. 3
[36] David & Ḥūraytānī, 2011, p. 51
[37] Burns, 2017, p. 74

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is characterized by inner political instability expressed in the frequent transfer of power among princes.[38] The weak grasp of the Abbasids on their territory resulted in many autonomous Imarets that were only subjected to the Abbasids by name.[39]

Due to the distance between Aleppo and Baghdad, the city fell outside the control of the dying empire. Subsequently, in the period from 877 to 936 the city fell under the Tulunids, the Qarmatians and the Ikhshidids, respectively; [40] later on, the Ikhshidids were overthrown by the Ĺamdanids.

I.2.3.1 Social, Economic and Religious Environments

- *Politically*: First, Aleppo became an administrative vassal of "Ĺoms" then "Qinnasrīn"; it was chosen due to its accessibility to the surrounding steppe, easement of encampments and relative remoteness to the Byzantine-Arab frontier drawn around Aleppo. Asas a result, it was in a dead zone between the two empires.[41] Later, in the Umayyad period, it was outshined by the capital Damascus. That situation of subjugation and marginalizing continued to the Abbasids Rule.[42]
- *Socially*: After the Islamic conquest, the city suffered an earthquake. Arabic chronicles mention the Arabic leader Abū Ubayda Ibn al-Jarrāḥ rebuilding the walls of the city without care for solidity.[43]

  An Islamization of the population of Aleppo was encouraged and the numbers of Muslims grew. The growth in numbers was expressed in the building of new mosques.[44] The main social aspect of the Islamic community remained around the main congregational mosque (the Umayyad Mosque), and the souks that started to form around it in what used to be the Roman Decumanus. The Muslims also introduced the tribute system, where non-Muslim inhabitants had to submit a tax payment for their protection. ʿAbd al-Malik bin Marwān implemented procedures to enforce Arabic as a language of the state.[45]
- *Economically*: The decline of Antioch after the Muslim conquest created a vacuum in the crop-market.[41 above] The Khalīfa center was moved to Iraq causing Aleppo to

[38] ibid. p. 88
[39] David & Ḥūraytānī, 2011, pp. 56-57
[40] Burns, pp. 89-90
[41] ibid. p. 77
[42] ibid. p. 85
[43] ibid. pp. 89-90
[44] David & Ḥūraytānī, 2011, p. 53
[45] ibid. p. 54

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lose more of the commercial privileges that it used to have when the Khalīfa was centered in Syria. It is assumed that the population had drastically fallen in and around Aleppo as the agricultural market declined.[42]

- *Religiously*: The shift in religion was slowly converting the population to Islam. Nonetheless, for the first hundred years of Islam, a major push for converts was not applied.[46] Still, the first act of the conquerors was to build a mosque on the spot they first prayed in (al-Shūaybiyya Mosque), while Burns suggested that this memorial act was constructed in the Zengid reign by Nūr al-Dīn Zankī. According to Sauvaget, the second mosque of the city to be commissioned was the Umayyad Mosque, while the third was an open-air mosque at the foot of the citadel that was called al-Mouṣalla.[47] The second religious change was the growing power of the Faṭimids who followed the Shiʿa faith.[48]

I.2.4 The Seljuks (1071-1117 CE)

The Turkic power started to solidify under the Abbasid umbrella in the form Turkic mercenary raised by the Abbasids from infancy as trained soldiers. Led by Alp Arslan[49] and swinging the Abbasid sword, they place the Mirdasid and Aleppo under their dominion.

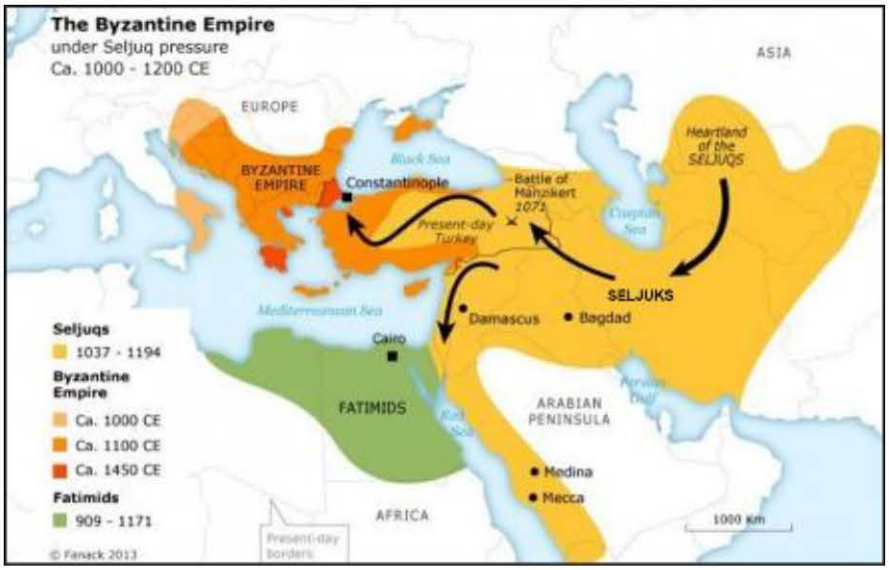

Fig. 3 A map showing the land-control among the Byzantines, Seljuks and the Fatimids; (1037 to 1450). (Source: https://istanbulclues.com/battle-of-manzikert-seljuks-byzantines/ 15/06/2018)

[46] Burns, 2017, p. 94
[47] Sauvaget, 1941, pp. 78-80
[48] David & Ḥūraytānī, 2011, pp. 56- 57
[49] Ḍamin, 1990, p. 92

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They were also a formidable opponent for the Byzantine forces as they had beaten them in the battle of Manzikert in 1071. Before that fight, they have repeated clashes with the Byzantine to assert their dominance and gain their neutrality regarding the Seljuk fights against the Fatimid.[50] The Seljuk took direct power in Aleppo in 1086. The end of their dynasty at the hands of the rival family members coincided with the arrival of the Crusaders to the east, an event that would later put Aleppo in the center of the defensive wars against the Crusaders.

I.2.4.1 Social, Economic and Religious Environments

- *Politically*: In the beginning of the direct control of the Seljuk in Aleppo, political stability was achieved. The presence of the Turks balanced the scale among the fighting empires Byzantine, Fatimid and Abbasid[51], until the inter-dynasty rivalry brought the dynastic rule to an end.[52] The main change to the political system manifested in the decline of the tribal systems under the Turks' growing power.[53]
- *Socially*: The social fabric in Aleppo in the 11th Century was constituted of Arabs, Armenians, Kurds and later the Turks, who assumed positions in the military and the government.[54] The new rulers encouraged arts in the form of poetry, as well as education as they introduced the *Madrassa* buildings as a place to spread religious (basically *Sunni* oriented) education. But due to the Shʿia majority population, and their opposition to the new *Sunni* educational institutions, the first *madrassa* (al- *Madrassa al-Zajjajiyya*) was not built until 1122 CE under the Artuqids.[55]
- *Economically*: The short period of their rule does not allow for an estimation of economic policies, impact and prosperity.
- *Religiously*: They showed interest in the religious building; the famous *minaret* of the *Umayyad Mosque* was built under the Seljuk rule in 1090.[56] They also supported buildings associated with mystic Islam (Sufism) and introduced the function of "*khanqah*" designated for the followers of Sufism.[57]

[50] Ḍamin, 1990, pp. 72-74
[51] Burns, 2017, p. 105
[52] Bosworth, 2007, p. 8
[53] Ḍamin, 1990, p. 267
[54] ibid. p. 281
[55] Ibn Shadād, p. 241
[56] Burns, 2017, p. 104
[57] ibid. p. 105

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I.2.5 The Zengids (1127-1174 CE)

Imād al-Dīn Zankī, the son of a former Seljuk ruler of Aleppo who had been raised in the Turkic court in Mosul, took power as the Atabeg of the Seljuk Sultan in Mosul and later in 1128 in Aleppo upon the request peace-desperate community of Aleppo.[58] After his death in 1146, his son Nūr al-Dīn ascended to power and managed to unite the Islamic world under his rule from Aleppo to Cairo with the help of the young Saladin. Under Nūr al-Dīn, Aleppo was the capital of a well-governed and powerful state. Upon his death in 1174, the throne was transferred to his 11 years-old son al-Malik al-Ṣāliḥ Ismāʿīl.[59]

I.2.5.1 Social, Economic and Religious Environments

- *Politically*: Imād al-Dīn Zankī led his battles on two fronts: the first with the neighboring princedom to enlarge his control, in order to help with his second battle to fend off the Crusader threat.[60] The central location of Aleppo between Antioch and Edessa helped his endeavors.[61] Aleppo finally became a major player on the political field not only capable of fending of the attacker, but served as a military base for launching military missions against the Crusaders or any Muslim leader who stood in the face of the ambitions of Imād al-Dīn.[62]

  Nūr al-Dīn, unlike his father, took a more diplomatic approach in uniting the Arab princedoms against the Crusaders which is demonstrated in his peaceful takeover of Damascus in 1153. Damascus then was a closer base for the battles against the Crusaders [63] as he was keen on displaying himself as the savior of *Sunni* Islam against the surrounding threats of the Shīʿa, the Byzantines, and the Crusaders.
- *Socially*: Aleppo was worn-out by interior struggles and sectarian rivalry, his firm grasp over the city, managed to overturn the situation.[64] Zankī's fruitful efforts were manifested in the form of architecture. Influenced by the Seljuk-Iran, "*the architecture was characterized by simplicity and symmetry, and channeling water into the building to create an environment of harmony*".[65] Nūr al-Dīn was an enthusiastic builder. He increased the number of religious *madrassas* and initiated vital urban projects in Aleppo[66], one of which

[58] ibid. pp. 122- 124
[59] Jammūl, 2006, pp. 129- 132
[60] ibid pp. 72- 74
[61] ibid. p. 76
[62] Burns, 2017, pp. 128- 129
[63] ibid. pp. 128- 129
[64] ibid. pp. 124- 125
[65] Burns, 2017, p. 126
[66] ibid. p. 130

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is the water channelization system that supplied the city, its mosques, and the public fountains "*qaṣṭals*" with running water. Another project was the rebuilding of the damaged city after the major earthquakes of 1157 and 1170. Furthermore, he ordered the previous four churches which were transformed into mosques to be rebuilt as *madrassas*, in addition to two mosques on the hill of the Citadel. [67] His interest in religious institutions in general and educational institutions such as *madrassas* in particular, is part of the image of the savior leader which he attempted to build around himself. He also commissioned the building of hospitals or *bīmāristāns*, the most famous of them are *al-Bīmāristān al-Nūrī* in Aleppo, Damascus, and Hama.[68] Travelers' accounts notes that at the end of the Zengid rule, Aleppo had a mixed ethnic and religious population, and finally, Aleppo enjoyed a long overdue security, justice, and civic order reforms.[69]

- *Economically*: Since the highlight of the period is military campaigns against the Crusaders, not much information was given about the economic situation. Yet, the unification of the Syrian land gave the Zengid access to fertile land to keep the armies and cities under his control well-fed.[70] Finally, Aleppo had become a prosperous trading hub for the region, in addition to its religious position that bestowed upon it a further fame. Its wealth is expressed in the flourished architecture and urban projects which reflect further a solid economic state.
- *Religiously*: The Zengids were *Sunni*'s enthusiasts, standing in the face of the Crusaders, Shīʿa and Ismāʿīlis at the same time.[71] Following the footsteps of the Seljuks continued establishing *Madrassas*, which again received the objections of the Shīʿa community. As a result, during the rule of Nūr al-Dīn, Aleppo transformed into a base of the *Sunni* breeching. In an attempt to demonstrate and solidify that position, he ordered the crafting of a wooden "*minbar*"[72] to be transferred to the Aqsa Mosque upon its retaking from the Crusaders. That *Minbar* was temporarily housed in the *Umayyad Mosque* in Aleppo. [73]

  Additionally, Christian population was inclined towards conversion to Islam under social pressure, especially after the Crusaders' attitude towards Muslim shrines.[74]

[67] ibid pp. 133, 136
[68] Moaz, 2009, p. 45
[69] Burns, 2017, p. 140
[70] Moaz, 2009, p. 45
[71] David & Ḥūraytānī, 2011, p. 70
[72] A pulpit in a mosque where the imam stands to deliver sermons. (https://en.wikipedia.org/wiki/Minbar)
[73] Burns, 2017, p. 131
[74] ibid. P. 140

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I.2.6 The Ayyubids (1174-1260)

Saladin kept the *khutba*[75] for the Zengid ruler al-Malik al-Ṣāliḥ until a political opportunity invited him to Damascus from Egypt in 1174. He kept reclaiming cities, from Homs, to Hama and finally Aleppo in 1183, which marked the end of the Zengid rule of Aleppo in leading the battles against the Crusaders.[76] In 1187, Saladin resumed his campaigns against the Crusaders in Palestine, where he won the battle of Hattin setting the war with the Crusaders in motion again.[77]

Saladin's son al-Ẓāhīr Ghāzī, was dispatched to Aleppo as governor in 1186 at the age of 14. Therefore, after Saladin's passing in 1193, the transition of power in Aleppo was minor, unlike the rest of his kingdom.[78] Although the official capital for the Ayyubid dynasty was Damascus, Aleppo enjoyed a state of autonomy under al-Ẓāhir Ghāzī.[79] He was able to solidify the power of Aleppo and expand it between Hama in the south to Taurus Mountains in the north to Latakia and the Euphrates to the west and east respectively.[80]

Ghāzī's wife Ḍayfa Khātūn was a prominent figure in the history of the city and acted as regent for her grandson al-Nāṣir Yūsif between (1236-1242). He was the last Ayyubid ruler; during his reign Aleppo was destroyed at the hands of Mongols in 1260.[81] There is not much information relating to the urban and architectural destruction caused by the Mongols, however, sources mention that the walls of the city and the walls of the citadel were heavily damaged.[82]

I.2.6.1 Social, Economic and Religious Environments

- *Politically*: The outstanding military campaigns against the Crusaders set the political scene in the Ayyubid period, while at home, in Aleppo, their practices in the city are also military-oriented, focusing on the expansion of the city's fortifications and military buildings such as the castle and defensive towers. Under Ghāzī, the city enjoyed more stability than any other city under the Ayyubid governance.[83]
- *Socially*: Once again, the *madrassas* played an important role in shaping the cultural, religious and urban development during this period due to the charitable endowment

[75] It serves as the primary formal occasion for public preaching in the Islamic tradition. (https://en.wikipedia.org/wiki/Khutbah)
[76] Jammūl, 2006, pp. 133- 139
[77] David & Ḥūraytānī, 2011, p. 74
[78] Burns, 2017, pp. 145, 146
[79] ibid.
[80] David & Ḥūraytānī, 2011, p. 74
[81] Burns, 2017, p. 169
[82] al-Ghazzī, 1922-1926, Vol 2, p. 9
[83] al-Ghazzī, 1922-1926, Vol 2, pp. 145, 146

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system.[84] Regarding the architecture and the urban development of the city, Ghāzī commissioned countless buildings and projects in Aleppo hence he was considered by many Arabic writers as the second builder of Aleppo after the Seleucids. Ḍayfa Khātūn also commissioned buildings mostly related to the Sufi practice such *Khānqa al-Farāfra.* [85]

In the Ayyubid period, literacy rates were high.[86] The Ayyubid court constituted a supportive milieu where science and artistic work were encouraged.[87]

- *Economically*: The control over Latakia enabled Ghāzī to sign the first trade with the Venetians in the same year.[88] The trade routes in the region were protected during military campaigns to ensure the prosperity of the dynasty.[89] The caravan-connections between Aleppo and other inland cities reached as far as Tabriz.[90]

  The military leaders were able to acquire revenue through an Islamic system of Feudalism called "iqtāʿ" that aimed to provide military officials with "a steady income in return of equipping and training a specific number of horsemen".[91]

  Markets flourished and special attention to the shoppers was stressed by the latrines project built close to the *Umayyad Mosque*.[92]

  To express the economic prosperity, Ghāzī minted Ayyubid coins in Aleppo to be in two values "*dirham*" and "*fils*"; and the minting of coins in Aleppo continued with his Ayyubid successors.

- *Religiously*: After the relief of the Crusaders' tension, religious minorities enjoyed a tension-free environment. *Sunni*s were the dominating faction, supported by the educational systems of *madrassas*, decrees to protect Christians, and their properties were issued by Saladin and al-Ẓāhir Ghāzī.[93]

[84] Moaz, 2009, p. 50
[85] Burns, 2017, p. 162
[86] Moaz, 2009, p. 50
[87] David & Ḥūraytānī, 2011, p. 77
[88] ibid. P. 74
[89] Moaz, 2009, p. 50
[90] Burns, 2017, p. 149
[91] Moaz, 2009, p. 50
[92] Burns, 2017, p. 194
[93] Burns, 2017, p. 149

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Fig. 4 The Ayyubid Control vs the Zengid Control in the beginning of the Ayyubid period. Source: *(Moaz, Tabbaa, & Takieddine, The Ayyubid Era, Art and Architecture In Medieval Syria, 2009, p. 14)*

I.2.7 The Mamluks (1260-1516)

An army of Mamluks defeated the Mongol troops in Ayn Jālūt in 1260.[94] They claimed Syria from the already scattered Ayyubids, and after their defeat, the Mongols returned to Aleppo seeking revenge for their lost battle and held the city for four months; then they were driven out again by the Mamluks.[95]

The fight against the Crusaders was left in the hands of the Mamluk forces led by al-Ẓāhir Baybars. He managed to achieve multiple victories in recapturing the main Crusader strongholds. As a result, Aleppo was safe from the Crusaders in its region, and a Mamluk governor was appointed there for further protection from the Mongols.[96] The first line of the Mamluks were the Bahri Mamluks who ruled between 1260-1382. [97] During this period, the Mongols returned to Aleppo repeatedly in 1262, 1280, 1299 and1312; yet the attacks were swift, aimed only at pillaging.[98]

The second line were the Burjī Mamluks who reigned between 1382-1516.[99] During that period two major threats took place, the first one being the less permanent is another Turkic invasion by Timur Lenk in 1400, he remained in Aleppo for one month just to come back two years later. The damaged inflicted on the city remains less severe than that of the Mongols.[100] The second threat was where Mamluks took their last breath at the battle of Marj Dābiq in 1516.[101] Qansūh al-Ghūrī led the Mamluk armies to combat the Ottomans of Selim I; most of

[94] David & Ḥūraytānī, 2011, p. 87
[95] Burns, 2017, pp. 172- 173
[96] ibid. pp. 174- 176
[97] ibid. pp. 189-190
[98] David & Ḥūraytānī, 2011, p. 88
[99] Burns, 2017, pp. 172- 173
[100] ibid. pp. 189-190
[101] ibid. pp. 198-199

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the Mamluk leaders fled, while al-Ghūrī had a stroke during the battle after realizing that their cause was lost.[102]

I.2.7.1 Social, Economic and Religious Environments

- *Politically*: After the chaos of the Mongol invasion, Baybars abolished the old autonomous Ayyubid system into a family appointee system and kept the administrative issues at a close to his eyes. [103] This system set by him was later eroded due to the inner rivalry among the Mamluks. [104] Nonetheless, Aleppo became an important province, and its rulers ranked second in political hierarchy among governors.[105] A large garrison unit was stationed in Aleppo, mainly due to its remote location in the Mamluk Sultanate and its military exposed fronts.[106]
- *Socially*: The Mamluk took the city in rubble: defenses and major buildings were destroyed and plundered. [107] A significant percentage of the inhabitants was either dead or on the run. Modern estimation by Anne-Marie Eddé put the numbers of deaths upon the two Mongols campaigns at 30000 out of the estimated population of 85,000. [108]

  The Mamluks worked on repairing the damages to the walls, the citadel, and the great mosque. They filled the gap between the old city wall and the Ayyubid addition with new neighborhoods, especially, the Christian neighborhoods.[109] They also endowed the city with mosques, *madrassas*[110] and mausoleums.[111] Assimilation-wise, unlike their Turkic predecessors, the Mamluks were not Arabized; in fact, many of them spoke little to no Arabic at all.
- *Economically*: Despite political rivalry, trade was the highlight of this period, which incited the commissioned of a wave of commercial buildings ranging from *khans* to *souks* to *qaysariyyas* (a small-scale khan). [112] European's representatives started taking residence in the khans of the city to facilitate their business. The first residence of the Venetian consul

[102] ibid.
[103] ibid. p. 174- 176
[104] ibid. p. 194
[105] David & Ḥūraytānī, 2011, p. 89
[106] David & Ḥūraytānī, 2011, p. 89
[107] Burns, 2017, p. 178
[108] ibid. p. 178
[109] David & Ḥūraytānī, 2011, p. 95
[110] Burns, 2017, p. 185
[111] ibid. p. 183
[112] Burns, 2017, p. 195

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in Aleppo was located from Damascus to Aleppo in 1548.[113] The number of commercial facilities increased exponentially. Raw cotton was one of the most prominent exports to Europe, in addition to precious stones, Indian spices, and Persian silk. [114] Genova and Venice were among the cities that had regular two-way trade traffic with Aleppo; there was a saying about the commercial traffic in Aleppo: "*Carry a hundred load of silk to Aleppo, they will sell in one day and in cash. While ten loads arrive to Cairo, the largest of cities, they are sold with a month*".[115]

The Mamluks finally managed to convert Aleppo to one of the major trade centers in the Middle East. As a sign of prosperity, various Sultans minted their own coins in Aleppo. Another sign might be the opening of lavish baths; the largest bath of Aleppo was situated southeast of the Citadel.[116]

- *Religiously*: The majority remained of *Sunni* Muslims. Minorities included Shīʿa, Christians and Jews. Even Jews from Andalusia migrated to Aleppo in 1492 CE to participate in the commercial activities in the city.[117] Historians mention that the Mamluk period witnessed a progressive religious activity, possibly in an attempt of the foreign rulers to shield their differences from the inhabitants; therefore, they established mosques, *Zāwiyas* and *Khānqas*[118].[119] The Mamluks also built the first congregational mosque called *al-Ṭunbūgha Mosque*, within the new ring of fortification in 1323 CE and commissioned by Yalbuga al-Nāṣirī.[120]

  The development of new Christian neighborhoods can be viewed in different lights. On one hand, it can be a signal of religious recognition, acceptance and accommodation by the ruler.[121] On the other hand, it can be viewed as casting aside religious minorities, or it might be due to the desire of Christians to live together or separate from the rest of the community.[122]

[113] ibid.
[114] ibid.
[115] David & Ḥūraytānī, 2011, p. 90
[116] Burns, 2017, p. 187
[117] Ḥamza, 2000, pp. 226-227
[118] *al-Khanqah* and *al-Zāwīya* are establishments designed to host and support the Sufi *darāwīsh*.
[119] Ḥamza, 2000, p. 245
[120] David & Ḥūraytānī, 2011, p. 94
[121] David & Ḥūraytānī, 2011, p. 90
[122] ibid. p. 95

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I.2.8 The Ottomans (1516-1916)

Selīm I led the Ottomans forces that occupied Aleppo. The city was taken without a fend off, owing to the treachery of the Mamluk governor Kayr Bayk.[123] It became the capital of the Wilayat of Ḥalab.[124] After 1750 the imperial system of the Ottomans started to crumble[125], the vast empire was dismembered in 1916, and Syria was placed under the French mandate until 1946.

I.2.8.1 Social, Economic and Religious Environments

- *Politically*: There was a balance between rivalry forces: the Mamluks, the Ottomans and the Safavids in Persia. Therefore, Aleppo was no longer in the crossroad of that struggle.[126] Due to the vast stretch of the empire, the Turkish system was "decentralized". [127] Yet, they had to report to the governmental hierarchy, expressed in ministers (*Wazirs*) and, ultimately, the Sultan (*Padishah*).[128]

  The Ottoman appointed governors during the first 200 years were unable to speak Arabic and with few ties to the locals. Another official appointed by the Ottomans was the qāḍī who answered directly to Istanbul.129 The second half of the Ottoman rule witnessed the breakup of the centralized administrative system empire-wide, meanwhile a valid local substitute was not provided.130 By the 19th Century, foreign governors of the city did not maintain their passion for a long time, which led to the appointment of local governors of the city.
- *Socially*: The Ottoman Empire incorporated people from many ethnicities, religions, languages, and cultures, all centered on the Turkic core. This heterogeneous mixture often faced some tensions; still, this paved not the way of urban development. Architecturally, the famous architect Sinan Basha (Mimar Sinan) executed many projects, one of them is the *al-Khasrawaiyya Mosque.*[131] Nonetheless, Sauvaget states that in Aleppo "the essence of the Aleppine Architecture deeply rooted in the site and Aleppo was less affected than

[123] ibid. p. 110
[124] Bosworth, 2007, p. 25
[125] Burns, 2017, p. 247
[126] ibid. 2017 p. 204
[127] ibid. pp. 205- 206
[128] David & Ḥūraytānī, 2011, p. 116
[129] Burns, 2017, pp. 205-206
[130] ibid. p. 247
[131] David & Ḥūraytānī, 2011, p. 116

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Damascus with Ottoman building ideas. The balconies, luxurious suspended stairs and large illuminated suits were added by European consuls and merchants who modified the *Khan*s according to their needs and therefore it ended up resembling the courtyards of palaces and gigantic public buildings in northern Italy".[132]

In the 18th Century, the Aleppian society included three main categories: notables, janissaries and lords.[133] Notables were prominent figures of the community who played an intermediary role between the authority and the public.[134] The janissaries were much like Mamluks; they were trained from childhood in the arts of military to solely erve the Padishah, they enjoyed legal and financial privileges that encouraged youth to join their ranks.[135] Yet, they turned into civilian groups refusing military profession and participated in commerce, crafts and trade.[136]

- *Economically*: During the Ottoman era, Aleppo was no longer a peripheral border town subjected to constant attacks. It was now located in the heart of the Empire, at the crossroads of the Euphrates and the Mediterranean, Anatolia and the Arab provinces.[137] Aleppo stood as a land-station along the roads connecting Istanbul with Cairo, Baghdad and the religious pilgrim's road to Mecca. Therefore, Aleppo became a distinguished commercial center between Asia and Europe in addition to the roads connecting India and Europe, prior to the discovery of the maritime route.[138] Moreover, in the Ottoman time, the city received an outstanding position of the empire as the third most important city after Istanbul and Cairo. The number of commercial buildings such as k*hans* and *qaysariyyas*[139] grew exponentially. It also gained unprecedented access to a vast empire stretched from the Balkans to the Gulf.[140] The number of European consuls and tourists were increasing in the city which partly led to the production of touristic guidebooks to Aleppo, one of which will be discussed in the next chapter.

[132] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 44
[133] David & Ḥūraytānī, 2011, p. 117
[134] ibid.
[135] David & Ḥūraytānī, 2011, p. 118
[136] ibid.
[137] ibid. p. 111
[138] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 13
[139] A small-scale Khan
[140] Burns, 2017, p. 207

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- *Religiously*: Aleppo´s urban development in the Ottoman time was mainly based on the system of *Waqf*[141] or religious endowment.[142] The Ottomans focused on building religious institutions in their style. Churches were commissioned in the newly formed Christian neighborhoods. [143] Christian merchants also oversaw some trade routes to the east and Persia to cities such as Isfahan.[144] The old Jewish quarter witnessed migration from Italy, Spain, Portugal and Salonica.[145] Catholic religious missions arrived under the protection of counsels especially from France, although they encountered disagreement of the official Ottoman authorities in the 19th and 20th centuries, in addition to refusal from the existing Orthodox denominations.[146] Soon after, Aleppo turned into a major center from spreading Catholicism in the east due to the existence of consulates and religious institutions.[147]

I.3 Major Earthquakes

Throughout history Aleppo suffered severe natural disasters in the form of disease outbreaks and earthquakes due to the direct effects of earthquakes on the urban fabric, and their varying intensity. The latest occurred in February 2023 which damaged the already fragile war-torn fabric.

Hereinafter is a list of the most devastating ones in the history of the city and some of their effects on the city and the population:

- The earthquake After **638**: The date of the earthquake is not certain; it can be placed after the Muslim conquest of the city in 638. It caused damages to the walls and the citadel. [148]
- October of **1138**: It is recorded as one of the deadliest earthquakes in history. It was named after Aleppo because there were the most recorded casualties. [149]"*The ramparts of the city buckled, and the walls of the citadel were shattered…., stones detached themselves from the walls and fell into the streets, houses were destroyed,*

[141] (Arabic for endowment) is a special kind of philanthropic deed in perpetuity. It involves donating a fixed asset which can produce a financial return or provide a benefit.(https://islamic-relief.org/waqf-endowment/)
[142] Burns, 2017, p. 219
[143] David & Ḥūraytānī, 2011, p. 120
[144] ibid.
[145] ibid.
[146] ibid. p. 120
[147] David & Ḥūraytānī, 2011, p. 121
[148] Ambraseys, 2009, p. 220
[149] ibid. p. 295

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some house walls collapsed, and the two parts of the walls, east and west of the citadel, were breached". [150]

- December **1156**: Aleppo was heavily damaged; houses collapsed, and many people died.[151]
- August **1157**: Damages were varied across the city, some fortification and towers collapsed along with some houses, and the wall between *Bāb al-Jinān* and *Bāb Qinnasrīn* also collapsed.[152]
- June **1170**: Some sources exaggerate the damages and claim the whole city collapsed, and that is obviously not true.[153] The city, however, suffered different degrees of damages to public buildings and residences. [154]
- February **1181**: The earthquake caused extensive damage to the city and surrounding villages. [155]
- January **1344**: The ripples of an earthquake centered in Aintab, reached Aleppo causing the residents to evacuate the city. [156]
- April **1484**: Six earthquakes hit the city over the period of a month with no recorded damage.[157]
- March **1719**: Damage was reported to three unidentified mosques and 200 houses in Aleppo.[158]
- August **1822**: Another devastating earthquake occurred; the casualties of this event are normally overstated. The walls of the citadel were destroyed in addition to many *Khans* and markets. A series of aftershocks and damage persisted until October of the same year. Therefore, many people left the city and settled elsewhere.[159]

[150] Ambraseys, 2009, p. 295
[151] ibid p. 301
[152] ibid. p. 305
[153] ibid. p. 318
[154] ibid.
[155] ibid. p. 326
[156] ibid. p. 370
[157] ibid. p. 405
[158] ibid. p. 405
[159] ibid. p. 633

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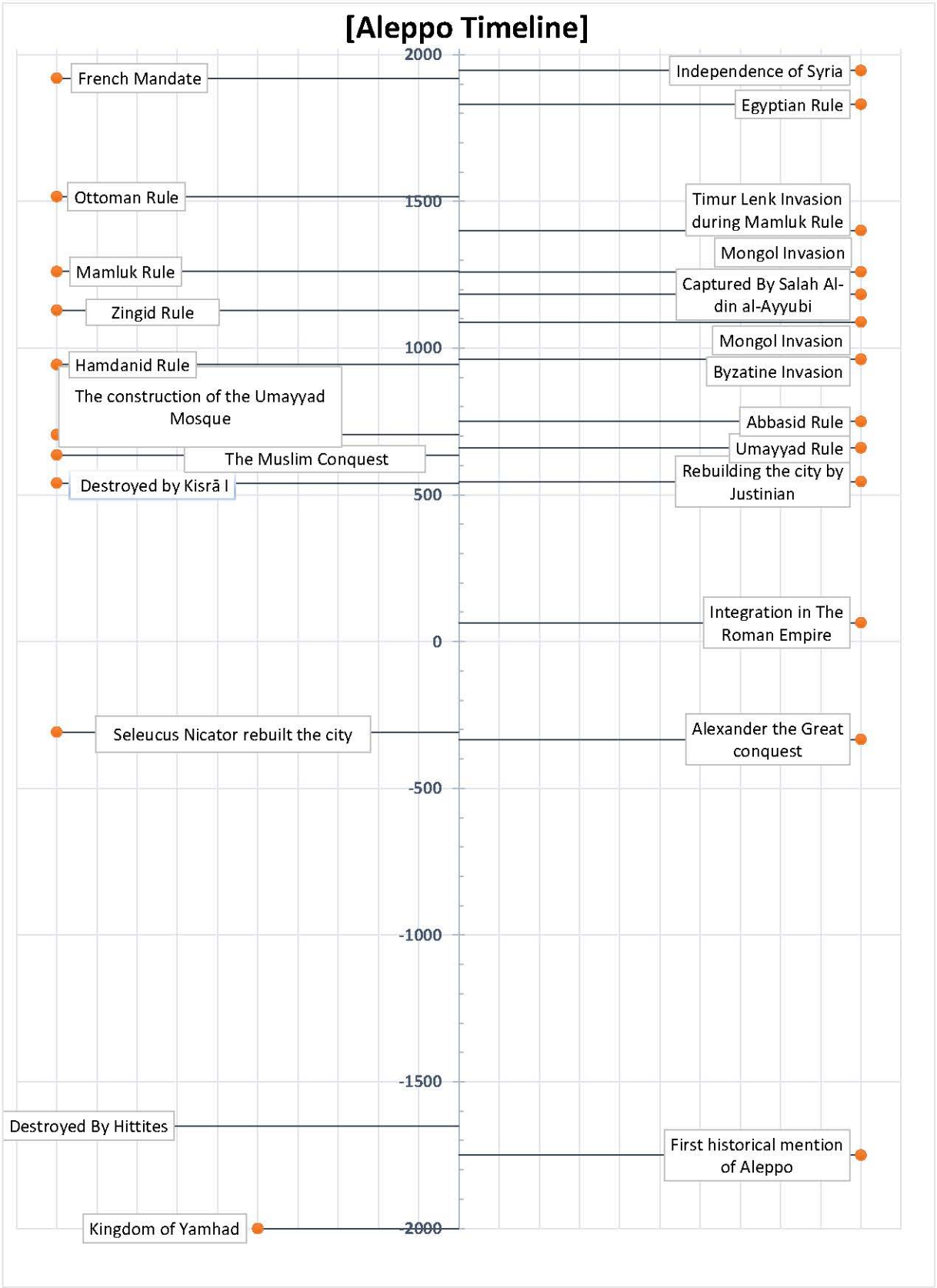

Fig. 5 A timeline of the most important events of Aleppo, compiled by Orabi, 2023.

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I.4 Literature Review

Aleppo is one the most discussed and studied cities of Syria. Hence, ample previous studies exist, some of which, of course, are more focused and orientated than others. They fall under different categories such as historical chronicles which will be discussed extensively in the third chapter and travelers' accounts, which will be analyzed in the second chapter.

Some of the sources of lesser relevance to the scoop of the study will be examined in this section. Those generally belong to two periods, historical sources and contemporary sources from the 19th and 20th Century. The studies are listed according to the date of the publication and author, respectively:

1- Historical Sources

This section will list the less important historical sources about Aleppo as the most important ones will be discussed and analyzed in length in the third chapter.

1- Abū al-Fidaʾ, *al-Yawāqīt wa al-Ḍurab fī Taʾrīkh Ḥalab*

Abū al-Fidāʾ Ismāʿil ibn ʿAli ibn Mahmūd ibn Muhammad ibn ʿUmar ibn Shahanshah ibn Ayyūb (1273- 1331 CE). A historian and geographer born and raised in Damascus, later, he moved to Egypt where he became close to Saladin and was assigned as a governor of Hama.[160] He authored many books, two of which addressed the history of Aleppo. The first one is "*al-Mukhtaṣar fī Akhbār al-Bashar*", widely known as *Tārīkh Abū al-Fidaʾ*. The other is "*al-Yawāqīt wa al-Ḍurab fī Taʿrīkh Ḥalab*" which was more concentrated on Aleppo. However, it addresses a short historical period from the pre-Islamic city to the arrival of Sayf al-Dawla. It also does not include new urban or architectural information other than the ones to be mentioned in chapter three.

2- *al-*Shuʿayfī: *Twārīkh min Ḥalab wa ma Biha min al-ʿImārāt al-Latīfa wa al-ʿĀdāt al-Gharība*

Zayn al-Dīn Aḥmad ibn ʿAli ibn al-Ḥussayn bin ʿAli known as al-Shuʿayfī, not much information can be found about him, apart from the fact that he created a summary of the book of Ibn al-Shūḥna "*al-Durr al-Muntakhab fī Tārīkh Mamlakat Ḥalab*". He followed the same structure and relied on Ibn Shadād as well. [161] Only a digital copy of the unedited

[160] https://al-maktaba.org/author/734
[161] https://gallica.bnf.fr/ark:/12148/btv1b11000916d/f6.item.zoom

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original manuscript was found on the website of the National Library of France "Gallica".[162]

3- Ibn al-ʿAdīm: *Būghīat al-Ṭalab fi Tārīkh Ḥalab*

ʿUmar ibn Aḥmad bin Hibat al-llah bin Aby Jarāda al-ʿAqīlī, Kamāl al-Dīn ibn al-ʿAdīm (1192-1262) was a historian and orator. His work will be extensively discussed in the third chapter that is dedicated to the historical accounts of Aleppo.

4- Ibn Shaddād: *al-Aʿlāq al-Khatīra fī Dzikr Umarāʾ al-Shām wa al-Jazīra*

Muḥammad ibn ʿAli ibn Ibrāhīm, ʿIzz al-Dīn ibn Shaddād al-Anṣārī al-Ḥalabī (1217-1285 CE) was an Aleppian historian who served under Saladin. in the third chapter, his work will be extensively discussed to track the architectural and urban information about the city.

- **Contemporary studies**

1- Alex Russell, 1756 The Natural History of Aleppo, and Parts Adjacent, translated by Khalid al-Jubaylī: It is considered as one of the earliest manuscripts about Aleppo authored by a foreign writer. The two-volume book discussed different geographic, religious, political and demographic aspects of the city with a chapter dedicated for women, in addition to elements of intangible heritage such as folk-songs and Shadow play[163].
2- Georges ploix de Rotrou, 1930, Ḥalab ʿAbra al-ʿusūr: The original text was French, but the consulted book was translated to Arabic by Zubayda al-Qāḍī. It examines the events that took place in Aleppo chronologically and year by year, when available. The author offers interesting information that is not easily available in other sources, yet the sources he used are often not reliable, making it hard to vet the historical information that he presents. The second section of the book includes a detailed study of the citadel by Ṣubḥī al-Ṣawāf.
3- Khayr al-Dīn al-Asadī: A prominent scholar of Aleppo, born in *al-Jalūm* in 1900, was an Arabic teacher.[164] He authored many books in Arabic linguistics but also three

[162] https://gallica.bnf.fr/ark:/12148/btv1b11000916d/f6.item.zoom
[163] A traditional art consisting of handmade puppets moving behind a thin translucent curtain or screen inside a dark theatre. (https://ich.unesco.org/en/USL/shadow-play-01368)
[164] al-Asadī, 1984, p. 8

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major books concerning the city of Aleppo with its tangible and intangible heritage. These books are:

- 1951, Ḥalab al-Jānib al-Lughawī [165] min al-Kalima, in which he analyses the name, archaeology of the city, the theories of the establishment of Aleppo and the theories behind its name.
- 1960, Aḥyāʾ Ḥalab wa Aswāquhā[166]: as the most relied on in this study, it lists the name and description of prominent buildings, streets, neighborhoods, and public figures of the city in alphabetical order. The consulted copy was edited and expanded by Abul Fatḥ Rawās, Qalʿajī.
- 1981, Mawsūʿat Ḥalab al-Muqārana[167]: the biggest of his book contains around 8000 pages, in which he created an encyclopedia of the Aleppian accent, in addition to many of the intangible stories, sayings, folkloric tales, songs, poetry, food, tribes, idioms, figures, streets and neighborhoods. [168]

4- Ṣubḥī al-Ṣawāf:
   a. 1952, Aqdam ma ʿUrifa ʿn Tārīkh Ḥalab, min al-ʾAlf al-Thālitha Ḥatta al-ʿAhd al-Salūqī: The book outlines the only ancient historic events of Aleppo and its region, from the Stone Age to the Assyrian period, including religious, political administrations and archaeological finds of each period.
   b. 1972, Tārīkh Ḥalab Qabla al-Islām: The book is overlapping with its predecessor, yet it covers an extended period of history that includes the Seleucid, Roman and Byzantine periods. Including the development of the religion, the inhabitants, and the city.
5- Ernst Herzfeld, 1954, Matériaux pour un-Corpus inscriptionum arabicarum, Inscriptions et monuments d'Alep, Syrie du Nord: This book is dedicated to the study and analysis of the inscription of the city. During his studies, he connects the historic accords with the architectural remains. Yet, on multiple occasions, his connections often overlook information that is easily available from the inhabitants.
6- 1980, The Conservation of the Old City of Aleppo by Stefano A. Bianca, Jean-Claude David, Giovanni Rizzardi, Yves Beton and Bruno Chauffert-Yvart: It is one of the

[165] al-Asadī, 1984, p. 9
[166] ibid p. 10
[167] ibid. p. 11
[168] Ibid. 1984, p. 8

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most referenced conservation reports submitted to the UNESCO. It discusses the traditional architecture and the effects of the "western planning ideologies" on the structure and urban growth of Aleppo.

7- Shawqī Shaʿth:

- 1981, Ḥalab Tārīkhuha wa Maʿālimuha: the book briefly discusses the historic event between the Stone Age period until the Ottoman era, in addition to listing of the most important monuments according to function and dedicated a separate chapter to discuss the museum of Aleppo.
- 1995, Ḥalab fī Kutub al-Būldāniyyn al-ʿArab: Co-authored by Bakūr, Faliḥ, the book investigated the mentions of Aleppo in the books of famous Arab and foreign travelers, in addition to the books only designated to the city of Aleppo. It covers the books that were written in the period between the 10th Century and the 19th Century.

8- Fayz al-Ḥomṣī, 1983, Ḥalab al-Qadīma: The book provides a historical overview of Aleppo and lists the most important monuments based on their function.

9- Terry Allen, 1986: A Classical Revival in Architecture: Allen studied a prominent change in the style on the medieval Islamic architecture manifesting as classical features incorporated into new buildings as spolia or newly designed elements. He studied buildings commissioned in the Zengid period commissioned or transformed by Nūr al-Dīn al-Zankī. His study focuses on *al-Madrassa al-Ḥalāwiyya*, *al-Madrassa al-Shuʿaybiyya*, *al-Madrassa Muqaddamiyya* and *al-Bīmāristān* al-Nūrī to identify elements of what he specified as a classical revival.

10- Muḥammad, Ḍamin, 1990, Imārat Ḥalab fī Ẓil al-Ḥukm al-Suljūqī: This study examines the political, social, and economic circumstances before, during and shortly after the Seljuk rule.

11- Maḥmūd Ḥuraytānī:

- 1991, Ḥalab Aswāq "al-Madīna", Taṭawūr al-Mulkiyya al-ʿAqāriyya wa al-Faʿʿāliyyāt al-Iqtiṣādiyya wa al-Ijtimāʿiyya: The study investigates the markets of the city; it relies on field research more than historic sources, tracking the development of the souks through the change of ownership and function.

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- 2011, a translation of a book by Jean-Claude David titled Ḥalab Madīnat al-Tārīkh. The book briefly discusses the historical events of the city and its urban, social, and economic manifestations.

12- Yasser Tabbaa, 1991 Construction of Power and Piety in Medieval Aleppo: One of the most important books that discusses the city in the Ayyubid period, the author addresses architectural patronage as a manifestation of the religious, social and political atmospheres and also its usage as a tool to create an impression of power and poetry of the rulers in the minds of the ruled.

13- GTZ, 1998, Rehabilitation of the Old City of Aleppo, Development Plan for the Old City of Aleppo: One of the few manuscripts that is dedicated to the study and development of the urban planning of the city. It discussed the historic evolution and the principles of planning of the city from the Islamic period until the inscription of Aleppo on the world heritage list. It recommends a master plan of the city taking into consideration sustainability, population, growth, land use, infrastructure, transportation, economy, social infrastructure and historic conservation.

14- Jean-Claude David

- 1998, La Sūwayqat ʿAli A Alep, translated by Maḥmūd Ḥuraytānī: The book concentrates on the study of Sūwayqat ʿAli, located north to the *Umayyad Mosque*, by analyzing the built spaces of the neighborhood and the continuity of and the functions within the neighborhood.
- 2014, Alep et ses Territoires: The book was edited by David and Thierry Boissière and included chapters by different authors discussing the region of Aleppo in terms of the economic and business growth and the formation of Aleppo as a metropolis.

15- ʿAdil ʿAbd al-Ḥafīẓ Ḥamza, 2000, Niyābat Ḥalab fī ʿAṣr Ṣalāṭīn al-Mamālīk (1250-1517): The book discusses the political struggle during the Mamluk period among Muslim and not-Muslim forces in the region of Aleppo, in addition to religious, judicial, and economic settings.

16- 2004, The Ottoman Empire and its Heritage, Politics, Society and Economy: The articles concerning Aleppo are mostly addressing the *Waqf* system for both Christian and Muslim communities during the Ottoman period.

17- Jamīl Jammūl, 2006, Ḥalab wa al-Ḥūrūb al-Ṣalībiyya (1098-1183): The book details the response of the Levant in general and Aleppo specifically to the Crusades, relying

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on historical sources (Arabic, Latin and Greek). It covers the period of the first crusade until Aleppo was taken by Saladin.

18- 2009, The Ayyubid Era, Art and Architecture in Medieval Syria: The book discusses Syria in the Zengid, Ayyubid and Mamluk period, with articles dedicated to the commercial life, to patronage and political atmosphere.

19- ʿAbdullah Ḥajār, 2010: Maʿālim Ḥalab al-ʾAthariyya: The book provides a concise introduction of the city, from its historic development to an overview of the most important buildings in each district of the city in a form of tours in each of those neighborhoods.

However, the most relevant sources are reviewed in length in the following section, the study shall identify and focus on main categories of the available resources for the scope of this study:

I. Precedent studies regarding the historical development of the Old city of Aleppo.
II. Precedent studies in the field of 3D Urban Morphological Reconstruction.

I.4.1 Precedent studies regarding the historical development of the Old City of Aleppo.

After reviewing the literature of Aleppo regarding the development of the old city, four studies stand out:

- The study of Jean Sauvaget in 1941 titled : *Alep Essai Sur le développement d'une grande ville syrienne, des origines au milieu du XIX siècle*. One of the first and the most important and comprehensive studies regarding the development of the old city of Aleppo. He discussed the development of the city chronologically and according to historical period. Sauvaget started by outlining major events of the period and information of the dynasty or political power, later he discussed important buildings of the period and the prominent urban changes. Based on his deductive reasoning, historical sources, and the modern layout of the city he suggested a number of maps to express the urban development of the city. Those maps will be examined and discussed in length in the second chapter of the thesis.
- The study of Heinz Gaube and Eugen Wirth in 1984 titled: *Aleppo: Historische und Geographische Beiträge zur baulichen Gestaltung, zur sozialen Organisation und zur wirtschaftlichen Dynamik einer vorderasiatischen Fernhandelsmetropole, Karten.* The authors conducted a historical study backed with a field survey between the years

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of 1979 and 1984 and created the most recent survey of the city. They consulted historic and travelers accounts and previous maps of the city in order to express the development of the city during the 13th Century (with a focus on both the intramural and extramural quarters) and the 15th Century (especially the development of the street networks, congregational mosques and neighborhoods). Gaube and Wirth discussed Aleppo during the Ottoman rule and in the 19th Century, in addition to the development of the components of the city, especially the defensive, commercial facilities, infrastructure and water supply projects.

- The study of Giulia Annalinda Neglia in 2009 titled: *The Process of Formation of the Medieval Islamic City in Aleppo.* Unlike Gaube and Wirth, Neglia did not draw a complete map of Aleppo; instead, she tried to read the underlying evidence of the ancient city through the remaining modern fabric, in addition to archaeological and historical material. She investigated and 2D-reconstructed the *forma urbis* of Aleppo between the Byzantine period and the 13th Century, tracing the orientation of the main axes in the Byzantine, Roman and Islamic period in the light of the spontaneous development during the latest period.
- The study of Ross Burns in 2017, "Cities of The Ancient World, Aleppo, A History": There is no main highlight in the book in terms of urban planning or architectural design. It takes a broader approach connecting the historic sources and accounts to outline and explore the history of the city divided according to the ruling dynasty. He discussed the political rivalry, anarchy, and peace from the early history of the city to the 21st Century. It also discussed religious transformation and its political and social implications, economic development, its extents and incentives, as well as the urban and architectural development and the occasional study of the iconic buildings of each period.

Finally, it is worth noting that none of the mentioned studies envisioned or even referred to the development of the city in the third dimension, which will be the focus in this study.
Relying on parametric reconstruction, this research will take a step further to compute different possibilities of the urban fabric and comparing them to determine the key architectural changes, reflect them on the political and historical events and on the social and economic situations. It will also contribute to the research regarding the methods of historical reconstruction of built cultural heritage.

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I.4.2 Precedent studies in the field of Urban Morphological Reconstruction

There is no previous study addressing the 3D representation of the different historical periods in Aleppo. But similar approaches are famous and can be considered related. Although much of the work was not automated parametrically but rather remodeled manually. Some of the examples are:

1- Rome Reborn Project [169]:

The project was initiated in the 1990s by UCLA (Cultural Virtual Reality Laboratory). The aim of the project was to model digitally the urban development of the city of Rome. The first aim was to reconstruct the city as the first settlement in ca 1500 BCE, 550 CE and 320 CE. Later, the city in 320 CE was chosen as the beginning of the reconstruction process as it represents Rome´s glorious period. The work is mainly aimed as an application for Virtual Reality (VR) technology.

Fig. 6 An overview of the city. (Source https://www.romereborn.org/content/aboutcontact)

The reconstruction included multiple monuments such as the Roman Forum, the Basilica of Maxentius, the Pantheon, the Colosseum District, the Imperial Fora, and the Imperial Palace.

Although, the work process is not clear, and the material used to produce the historical reconstruction is not explained. The project's leaders assert that it is historically accurate,

[169] https://www.romereborn.org/content/aboutcontact

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possibly based on maps and paintings of Rome. Therefore, the result might be comparable with that of this study, albeit this study takes on a smaller section of Aleppo.

2- Urban Time Maps Project [170,171]:

The project aims to facilitate digital time-travel in order to visualize the spatial and architectural development of four European historic city-centers during different periods of history. The 3d product is referred to as a "Time Map". The participating cities are Edinburgh, Lublin, Budapest, and Granada. Another aim of the project is to compare when and how each city developed in the specific historic period. A wide range of historic sources were consulted in the process of the project such as maps, paintings, drawings, photos, and texts.

For example, in the case of Budapest, the city was reconstructed in 350 CE, 1541, 1848, 1918 and 2015. Those specific points in time are backed by historical events that shaped the development of the city such as the period of the Ottoman occupation, and the revolution against the Habsburgs in 1849.

The researchers also outline the process of reconstruction and provide a tutorial of the steps used to replicate their results.

Fig. 7 A snapshot of the reconstruction of Pest in 1848. Source: http://urbantimemaps.com/.

Many other small-scale projects provide methodological guidance regarding the extraction of architectural information from historical texts and excerpts, and the parametrization of the components of the city in addition to their historical data. Some of these studies are:

[170] http://urbantimemaps.com/

[171] Urban Timemaps, Applicable Representation of City Centres with Heritage importance, 2018

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1- A parametric-assisted method to 3d generation of as-built BIM models for the built heritage by Naboni, Zheliazkova, & Paoletti, 2015
2- A New Approach for Interactive Procedural Modeling in Cultural Heritage by Zmugg, et al., 2012
3- 3D-Model as a Basis for the Discussion on the Reconstruction of the Aleppo Bazaar by Mollenhauer & Topal, 2019.

The first section of chapter 1 investigated the city through historical periods relevant to the study and tracked its development on four main axes: politically, socially, economically, and religiously, during the foundation, Hellenistic, Islamic rule until the decline of the Ottoman Empire. A special attention was given to the religious, social, and political changes to the atmosphere of Aleppo after the arrival of the Turks. It also explored the reported earthquakes that affected the city and the extent of the damage caused by each natural disaster.

The second section of chapter 1 focused on the precedent studies about Aleppo and similar projects of 3D reconstruction of historic cities. The following chapters will rely on most of the methodology of the Urban Time Maps and the work of Gaube, Wirth and Sauvaget, in addition to the historical accounts. The next chapter will discuss the development of the urban fabric of Aleppo through the available spatial data mainly as maps and paintings.

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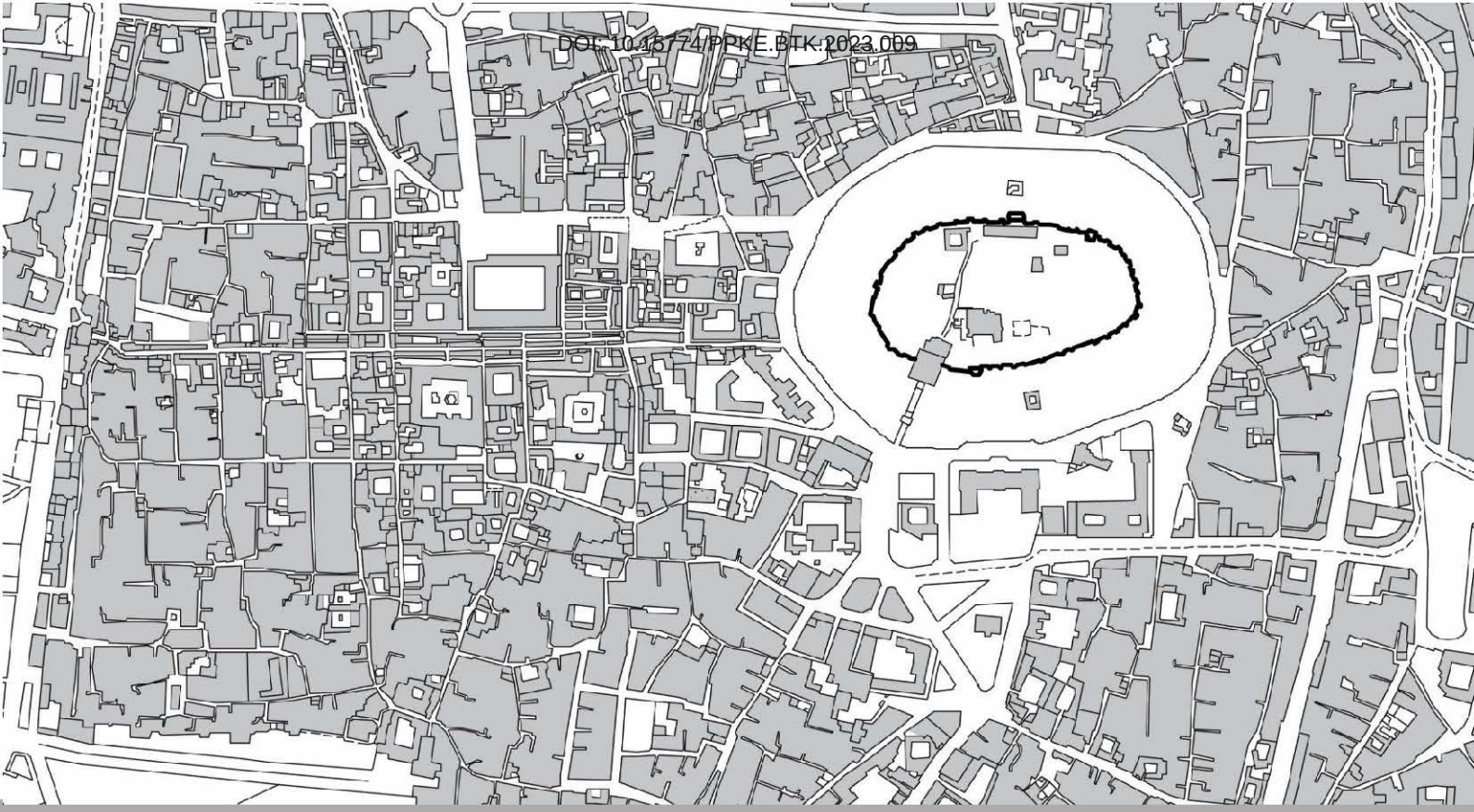

CHAPTER TWO

THE URBAN DEVELOPMENT OF THE CITY THROUGH HISTORICAL SPATIAL DATA

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Two main sources can be utilized in the process of visualizing a city. The first one is graphic sources such as photos, paintings, cartographer maps, plans, sketches, and other drawings, whether in 2D or 3D; while the other is the written information, travelers' accounts, historic accords, statistics, and written description of urban and architectural features.

This chapter will explore the development of the city from the available graphic sources in the form of paintings, travelers' maps, cartographic maps (cadasters), while the photos will be left out from the discussion but will be used in Chapter 4 in the process of 3D reconstruction of the Mamluk city.

II.1 Tracing the Development of the Urban Fabric of the Old City of Aleppo: Historical Sources with Spatial Data

Due to the strategic location of Aleppo, it was a stopping point for many Arabic and foreign travelers. This unique location puts it in the frame of the paintings of traveling artists and the books of historians. The most produced paintings were during the Ottoman period, when the city hosted many European consulates, merchants, and tourists. Fascinated by the city and its unique urban setting, some of them drew plans and paintings of Aleppo and even prepared touristic guides addressed to foreign travelers. One of the most famous tourists' guidebooks is the publication prepared by Karl Baedeker in 1912.

Subsequently, we examine the development of the city using the available sources with spatial information, mainly artistic painting, scaled and unscaled maps.

II.1.1 Drawings

Historically, the reliability of drawings is questionable, because they are subjected to the interpretations and imagination of the artists. Especially if they are to be included in 3D reconstruction of the historic fabric, the accuracy of the spatial data offered by the paintings becomes highly debatable. Nonetheless, the drawings grow to be of increasing value when confirmed by photos, historical descriptions, or cartographical information. Therefore, for every discussed painting, the factual spatial data will be identified based on other available sources of information, coupled with the added features or characteristics as a product of the artist´s imagination.

Aleppo, featured in many paintings, albeit not all, is noteworthy; hereinafter, some of the most important ones are listed chronologically as follows:

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- Matrakçı Nasuh, 1537

Matrakçı Nasuh or Nasuh al-Silaḥī was a famous Ottoman statesman, historical cartographer and Mathematician of a Bosnian origin. He authored illustrated books that offered an improved vision of the city during the Ottoman period.[172] He had a valuable contribution in documenting the geographical description of Anatolia and Mesopotamia by drawing of cities from the Ottoman Empire[173] like Baghdad, Eskışehir, Tabriz, Aleppo and other cities. The date of his painting of Aleppo is not clear but it can be associated with the first published work of Matrakçı "The Ottoman city views" in 1537[174] which makes it the oldest drawn document of the city. We see the emphasis on portraying the separation of intra-mural and extra-mural neighborhoods.

While examining the details of the painting, we can discern the following:

1- In terms of the general plan, the square plans assumed for the city are rather the artist's signature that can be observed in most of his paintings.
2- The walls include many defensive towers, while the represented number of gates (4) and their placement in the middle of the walls is not accurate.
3- In the citadel the artist captured the filled moat, the bridge, the entrance tower, and the northern and southern defensive bastions located on the slope outside the walls, as well as the residential buildings within the walls of the citadel. Moreover, the proportions between the citadel and the rest of the city are exaggerated, possibly due to the fact that he intended to capture iconic monuments and natural elements at the expense of less impressive features.
4- Notably, Matrakçı captured a limited section of the extra-mural city, only until to the river *Quwayq* and its bridges while leaving the *Khandaq* of the city out of the painting.

[172] Ebel , 2008, p. 4
[173] Somel, 2003, p. 81
[174] Ebel , 2008, p. 5

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Fig. 8 Aleppo in 16th Century painting by Matrakçı Nasuh (Source: Istanbul University Library, T. 5964.)

It was more than 100 years until the city was depicted on canvas again. However, this time the period between 16th and the 17th Century marked the zenith in the numbers of paintings drawn of Aleppo, which reflected further the influx of the number of foreigners visiting Aleppo or passing it through, possibly as an indication of the flourishing trade of the city.

- **Olfert Dapper, 1677**

Olfert Dapper is a Dutch physician, geographer, and writer. His painting's original title is "Aleppo een vermaerde stad in Syriën"[175] which translates to "Aleppo a lost city in Syria", (Fig. 9). The urban features in this painting are not well defined, as it only fills the background landscape of the painting. The only features that are discernable are the city's walls and the citadel, despite the amplified proportions between the heights of the citadel in comparison with the city, as was the height of the *minarets*. Nonetheless, the elevation of the left side of the image could reflect the high elevation of *al-'Aqaba* neighborhood to the west of the Old City.

[175] Dapper, 1677

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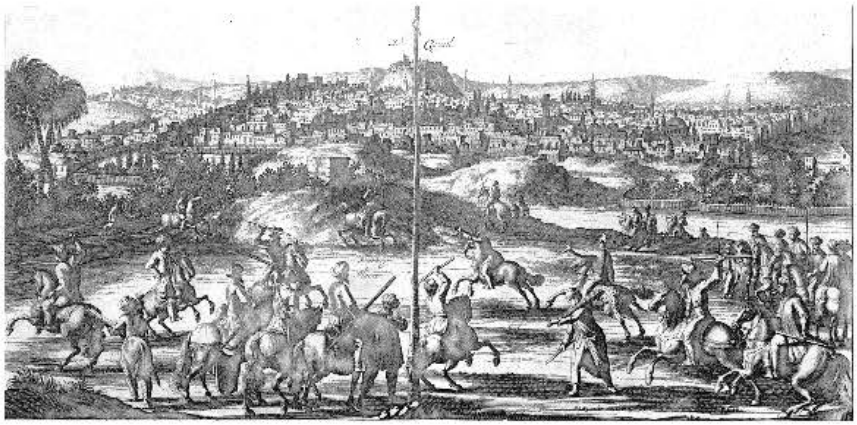

Fig. 9 Aleppo een vermaerde stad in Syriën by Dapper (Source: Dapper, 1677, p. 205).

- A painting in al-Aẓm Palace in Hama from the 17th Century

This painting is rarely mentioned in the scholarly work about Aleppo. It is analyzed in the work of Annalinda Neglia (2009) as a fresco depicting the citadel of Aleppo in the *al-Aẓm Palace* in Hama photographed by Ecochard. It is a clear mixture of the two cities displaying the *Aẓm Palace* in the lower corner of the city merged with the urban fabric of Aleppo, where the height of the *minarets* is the most exaggerated and distributed with landscapes from both cities.

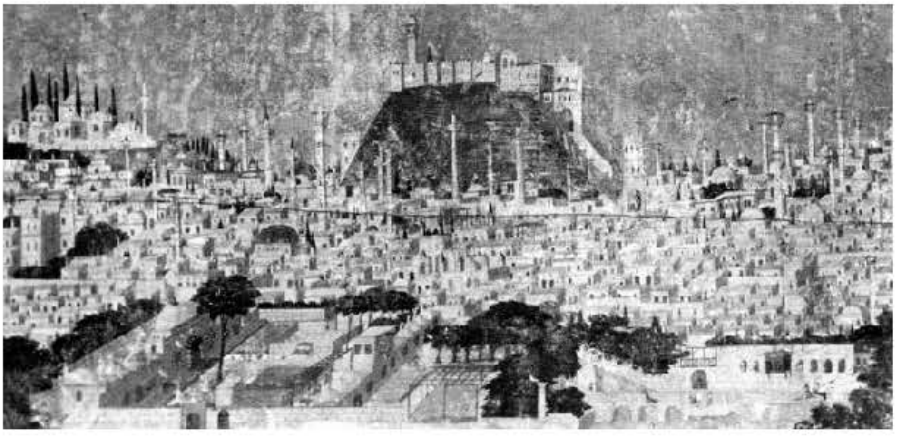

Fig. 10 A painting of Aleppo in al-Aẓm Palace in *Hama* photographed by Ecochard from the 17th Century. (Source: Neglia, 2000-2001, p. 27,http://archnet.org/authorities/33/media_contents/91316)

- Henry Maundrell, 1703

Henry Maundrell was an English academic who served as a chaplain in Syria.[176] The map was published in his book "A journey from Aleppo to Jerusalem" documenting his journey between the two cities in 1699 [177] (Fig. 11). While a hasty look at the drawn city might make

[176] https://en.wikipedia.org/wiki/Henry_Maundrell
[177] Maundrell, 1703, p. 131

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as if it is full of details, in reality, it is rather the opposite: it was created by repeating the same stair-shaped silhouette.

Despite the exaggerated heights of the citadel, the hills of Aleppo and the *minarets*, in this painting we can see the city extending further outside the walls, while the walls themselves incorporate several defensive towers, which do not resemble the surviving remains.

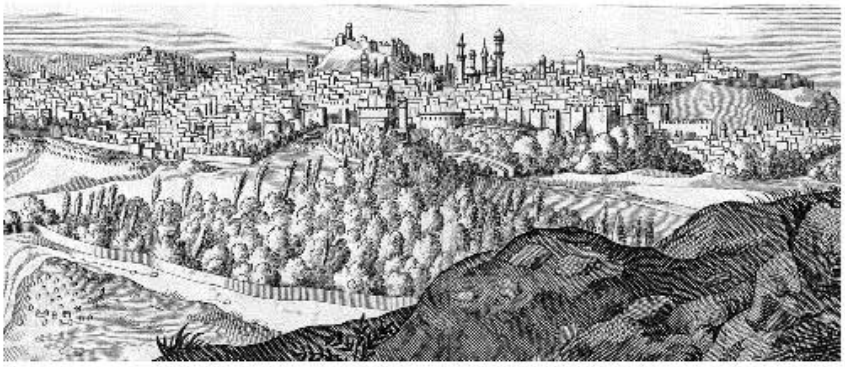

Fig. 11 The prospect of Aleppo by Maundrell (Soeuce: Maundrell, 1703, p. 1).

- **Cornelis de Bruyn, 1718**

Cornelis de Bruyn a Dutch artists and traveler.[178] He made a journey through the Levant (1674 to 1693) and published his book in 1725.[179] This panorama of the city (Fig. 12), depicted from a far point of observation, also captures the extra-mural neighborhoods, the towers located on the slope, *minarets* of different styles and increased in height, along with the horizontal sprawl of the city. However, the hill of the citadel seems more appropriately scaled than in other paintings.

Fig. 12 De Bruyn painting (http://eng.travelogues.gr/collection.php?view=50)

- **Alexander Drummond, 1754**

Alexander Drummond was a Scottish consul. He travelled to Syria between 1750 and 1751, served as the British consul in Aleppo (1751-1758)[180] and wrote his journals in the form of

[178] https://en.wikipedia.org/wiki/Cornelis_de_Bruijn
[179] https://eng.travelogues.gr/collection.php?view=50
[180] https://en.wikipedia.org/wiki/Alexander_Drummond_(consul)

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letters to his brother.[181] His work is one of the most famous paintings of the old city of Aleppo. It is focused on the area around the citadel. We see the details of the walls of the citadel, its bridge, the details of the *minaret* of the mosque in the citadel and the domes covering the throne room. In addition to important buildings such as *al-Khusrūwiyya Mosque* and its unique dome, *al-'Adiliyya Mosuque* and the *minaret* of the *Umayyad Mosque* are identifiable.

Fig. 13. The area around the citadel by Drummond (eng.travelogues.gr/item.php?view=49179)

- **François-Marie Rosset, 1790**

François-Marie Rosset was a French painter and sculptor.[182] He produced the second colored paining of Aleppo after Matrakçi, captured from a far vantage point. Like all the previous paintings, the elevations of the citadel and the height of the *minarets* were exaggerated (Fig. 14). The entire city was depicted within walls, several bastions are present along those walls. But what is specific about the elements of the city in the drawing is the smaller second wall that is separated from the actual walls of the city. He also sketched a section of one of the covered souks in the city (Fig. 15).

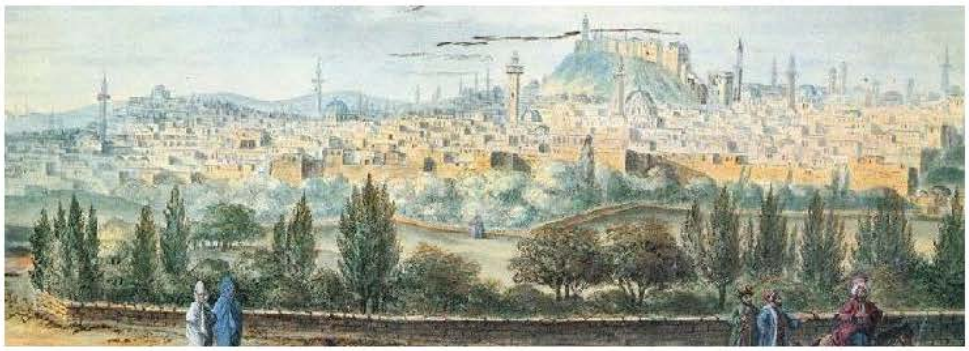

Fig. 14 A panoramic view of Aleppo by Rosset (https://gallica.bnf.fr/ark:/12148/btv1b8528996b)

[181] https://eng.travelogues.gr/collection.php?view=185
[182] https://data.bnf.fr/fr/14526350/francois_rosset/

DOI: 10.15774/PPKE.BTK.2023.009

Fig. 15 A bazar in the city by Rosset 1790.
(https://gallica.bnf.fr/ark:/12148/btv1b8528992p/f1.item)

- The Aftermath of the 1822 Earthquake

As mentioned in chapter 1, Aleppo suffered multiple earthquakes. This unique painting by an unknown artist represents the condition of the city after the devastating earthquake of 1822. We can recognize the damage in *Bāb Qinnasrīn*, its towers and the walls of the city. Some of the important features visible in the painting are the *minarets* of the *Umayyad Mosque*, the mosque of the Citadel and *al-Rūmī* Mosque, as well as the domes and *minarets* of *al-Bahramiyya Mosque* and *al-Shuaybiyya Mosque*, and the detailed entrance of the citadel and its bridge. Moreover, this painting bears an undeniable similarity to a picture of Aleppo in 1907, especially *al-Rūmī Mosque* and *al-ʿAdīliyya Mosque* (Fig. 17). A newly published work by (Darawcheh, Abdul-Wahed, & Hasan, 2022) studied the effects of the eartquake of this earthquake on the region and especially Aleppo. They tracked historical sources that mention the accounts of four survivors of the eartqauke. Some of the damaged districts were: the quarters of *Baḥsītā al-ʿAqaba, al-Farāfira, Souk al- ʿAṭṭārīn,* the towers of the Citadel and most of the houses surrounding it, the defensive towers and walls as well as several mosques were severely damaged or destroyed. [183]

[183] (Darawcheh, Abdul-Wahed, & Hasan, 2022, p. 210)

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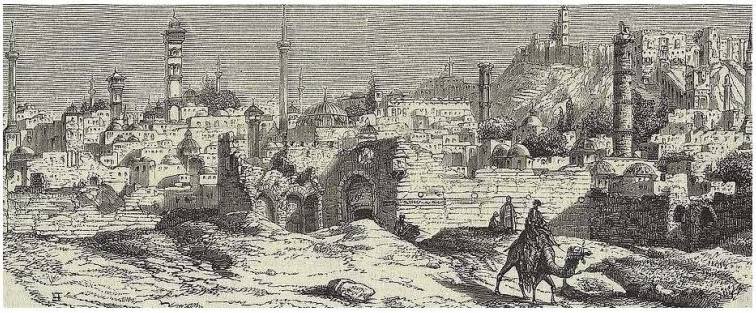

Fig. 16 Aleppo after the earthquake of 1822, unknown artist, 1857.

Fig. 17 A picture of Aleppo, 1907 (Ḥajār, 2010, p. 188)

- Sydney Carline, 1919

Sydney Carline, a British artist was famous for painting aerial combat,[184] sketched Aleppo in 1919 during World War 1 (Fig. 18). However, this painting appeared to be drawn from within the walls of the city and perhaps from the north side, because the location of the citadel seems peripheral rather than central. We see the *minaret* of the *Umayyad Mosque* depicted as the highest and only rectangular *minaret* among cylindrical ones. Unlike previous paintings, the general scale of the painting is more coherent.

[184] https://en.wikipedia.org/wiki/Sydney_Carline

DOI: 10.15774/PPKE.BTK.2023.009

Fig. 18 Aleppo by Sydney Carline (Source: IWM (Art.IWM ART 2686)

A. Maps

In the beginning of the twentieth Century, with the rise of urban development projects and the traffic of tourism, producing maps became very crucial. Many maps of Aleppo were prepared. In terms of conveying factual data maps are more reliable than paintings, where artists manipulate the landscape and the architectural details for aesthetics and proportions. Nonetheless, the maps need to be surveyed and scaled properly for reliability to apply.

The maps prepared of the old city of Aleppo can be classified under various categories, each category is characterized by a different degree of accuracy in term of the precision of survey and scaling. Within the published literature, the following categories can be identified:

- Researchers' drawings: prepared for scientific studies, based on deductive reasoning and extrapolation such as the maps of Sauvaget, the field survey of Gaube and Wirth between 1975 and 1982 and the maps of Neglia 2009. They can either be based on a field survey or a representation of descriptive information. Therefore, the degree of accuracy is highly case-dependent.
- Travelers and orientalists' maps: presented in the form of touristic guide maps. Normally prepared with little field survey and an approximate scale, resulting in minimum accuracy for small and less touristic neighborhoods.
- Plans prepared during the French Mandate: like any maps prepared by the authorities, these works are produced by specialists with topographical drawing and measuring equipment. Therefore, the results are very accurate and depended upon projects of urban development, such as the French Cadaster of Aleppo in 1930.
- Military maps: these documents usually have the highest accuracy and reliability.

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- Public service maps and tourist maps: They are also case dependent, based on the authority that prepared the maps and its intended usage, such as the survey by the electricity company, the Directorate General of Antiquities and Museums and the Ministry of Tourism.
- Master Plans: prepared in the aim for urban interventions, they are based on an accurate survey of the city but do not exclusively include the surveyed urban fabric. These plans normally include new alteration to the existing fabric by removing and/ or adding buildings, streets, or complete neighborhoods, with different goals that range from facilitating traffic, expanding the infrastructure to modernizing the building typologies. An example of those plans are the Master plans worked out by Banshoya and Gutton.[185]

The maps are discussed as: maps of estimated scale and maps of accurate scale. The establishment, urban development and expansion of Aleppo will be examined through the analysis of the maps in chronological order.

II.1.2 Guide Maps of Estimated Scale in Chronological Order

This section investigates researcher's maps of Aleppo prepared by Sauvaget, public officials such as Niebuhr (1778), Rousseau (1818) and travelers such as Karl Baedeker (1912). In the case of the plans of Sauvaget, they are based on an informed intuition, and they cannot precisely portrait the layout of the city, its expansion nor its extents. However, the other maps are based on site visits by the cartographers, although they are as unreliable as the previous maps of Sauvaget in terms of scale, orientation and outlining the layout, shapes, and number of parcels in each block; hence, they are here referred to as "Guide Maps".

II.1.2.1 The Hellenistic Settlement in the Sauvaget Maps

These maps were published by Sauvaget in 1941. He estimates that the first settlement in Aleppo emerged on "*Tallet al-'Aqaba*". However, archaeological evidence was unearthed in "*Tallet al-Sawda*" and in "*al-Kalāsa*" dating to 3rd millennium B.C[186]. al-Asadī, on the other hand, suggests that the first settlement was founded on "*Tallet al-Sawda*", then expanded to the west, reaching "*Tallet al-'Aqaba*" and "*Kalāsa*". Therefore, either of these tells or all of them could have been the first settlement of Aleppo. Eventually, these three tells grew until they

[185] (David & Boissière, 2014)
[186] al-Asadī, 1984, p. 19

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merged together, taking advantage of their proximity to the main water source (*Quwayq River*) and the religious center (the temple of Haddad) in *Tell al-Qal'a*.[187]

In his publication, Sauvaget studied the urban growth of Aleppo, supporting his theories and readings of the historic sources with approximate maps of the city during different historical periods, starting from the Hellenistic period until the 19th Century which is expected to be more accurate in terms of survey techniques and scale. Those maps were based on the theories of the traceable historic layout of the city, further on the location of the *agora*, temples, churches, and fortifications.

As discussed in chapter 1, the city of Aleppo was prosperous in pre-Classical Periods, yet, except for the German excavations in the citadel and the emergency excavations in the *Umayyad Mosque*, little archaeological evidence was unearthed around or under the old city. It is however more common to find descriptions of the city in the Classical Periods, as well as archaeological evidence such as in *al-Madrassa al-Ḥalāwiyya* and under the *Umayyad Mosque* which consolidates the prevalent theory, ascribing the second establishment of Aleppo to the Hellenistic period after the conquest of Alexander the Great in 333 BCE. [188]

Nonetheless, Burns suggests that due to control assertive battles, in which the Seleucids engaged, any construction work could not have taken place before the second half of the 2nd Century BCE.[189]

Regardless of the uncertain date of construction, the Hellenistic settlement was characterized by the buildings of new residential quarters and a defensive wall[190] which was emphasized by multiple Arab historians. *Bāb Anṭākiya* stand on the location of a Hellenistic gate that leads to the citadel, passing by the *agora* and the temple of the city and ultimately to the Acropolis (the citadel).

The planning followed the Hellenistic grid plan[191] and its palimpsest could be traced in the modern city especially in studied area in the southern and western quarters of *al-Jallūm* and *al-'Aqaba*. The main urban character of the period is the Hippodamian plan, with the West-East Street stretching from the west edge of the defensive wall to the religious center (Acropolis) in

[187] al-Asadī, 1984, p. 20
[188] Sauvaget, 1941, pp. 38- 39
[189] Burns, 2017, p. 33
[190] Sauvaget, 1941, p. 42
[191] ibid. p. 40

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Tall al-Qal'a[192]. Sauvaget depended on this layout to envision the layout of the city during this period. He suggests that the first establishment of the settlement was found as a military base because of the high hills suitable for fortification[193]; this fact is possible due to the Persian threat and to the vast extent of the boundaries of the empire pushed by Alexander the Great.[194]

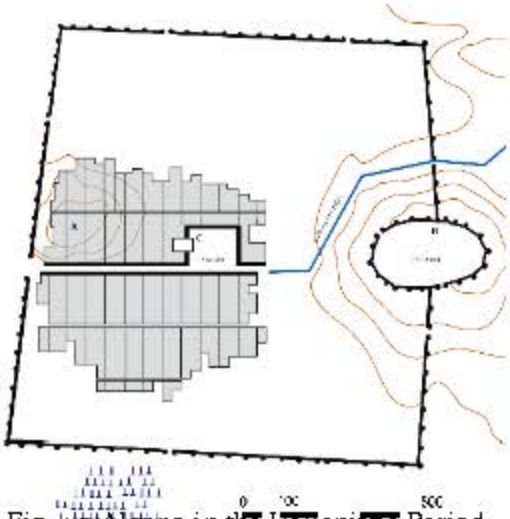

Fig. 19 Aleppo in the Hellenistic Period (Sauvaget, 1941, p. Pl.LII), redrawn by Orabi, 2023.

Bearing in mind that there was an urban nucleus in Aleppo before the classical periods, according to Nigro, it might have been inspired by the Babylonian planning, based on the rectangular shape fortifications, and the central Acropolis. This morphology was preserved during the following Classical Periods.[195]

In the map of Sauvaget of the Hellenistic Period (Fig. 19), he outlined the city blocks ("*insulae*"), defined by the network of perpendicular streets forming the city's quarters. Each of these streets measured around 3 meters in width.[196]

On either side of the west-east city-dividing road "*via recta*", there are no more than two rows of *insulae* that measure 114 m for the east-west axis and 47.2 m for the north-west axis. Those dimensions are calculated from the Greek foot system, where every *insula* measured 160*420 Greek foot which is more precise than the previous analysis of Sauvaget. Neglia calculates the north-south streets to measure 2.36 and the west-east street to measure 4.72 m, with the exception of the *via recta*, that was continuously being adjusted and reshaped and which is still expressed in the modern layout.[197]

The *agora* was formed by combining 2 or 3 *insulae* and in direct connection with the temple of the city (see Fig. 19, letter A). The dimensions of the new city were 550 meters north-south and 780 meters east-west.[198] As a result, the city maintained the humanistic-scale and the East-West axe from *Bāb Anṭākiya* or the "Gate of Antioch " to *Tall al-Qal'a* measured 800 meter.[199]

[192] *al*-Asadī, 1984
[193] Sauvaget, 1941, pp. 42, 46
[194] David & Ḥūraytānī, 2011, p. 28
[195] Nigro, 1997-1999, p. 55
[196] Sauvaget, 1941, pp. 42, 46
[197] Neglia, 2010, p. 88
[198] Burns, 2017, pp. 32, 34, 41
[199] Gaube, Wirth, & Trans: 'Ulabī, 2007, p. 18

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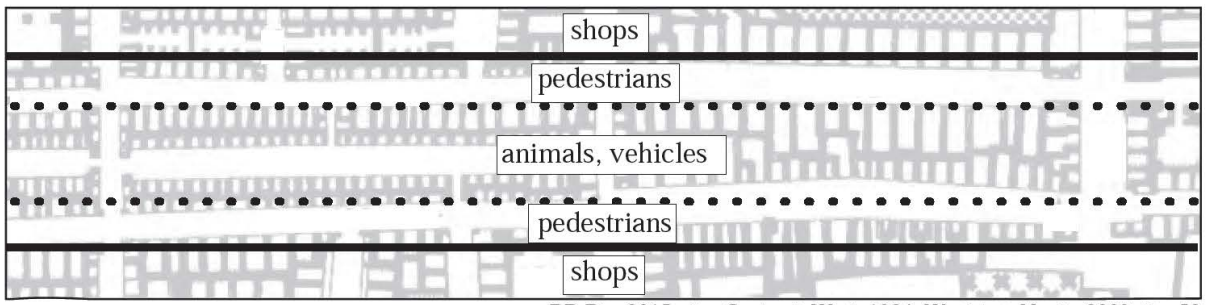
However, the defensive wall should have been smaller than the suggested one, given the extents of the neighborhoods.

II.1.2.2 The Roman and Byzantine City

II.1.2.2.1 The Roman and Byzantine city in the maps of Sauvaget

As in numerous cities in Syria, according to many researchers, the Hellenistic settlement provided the core layout for the Roman settlement; the *insula* that was the agora remained the focal point of the civic institutions and was later possibly transformed into a Roman Forum. However, Neglia suggested that a second grid with the same orientation was followed in order to expand the city to the north, south and east; in addition to expanding the east-west street to reach the citadel, widening it from 5 meter to 25 meter, and converting it to a colonnaded street.[200] Sauvaget identified the remains of that Roman colonnaded street within the central *Bazar* to the south-west of the *Umayyad Mosque*.[201] It was known in the Middle Ages as "*al-Balāṭ*" meaning the pavement.[202] This colonnaded street was also traced in the study of Gaube&Wirth and the study of Neglia. In (Fig. 20) we see the estimated location of the lanes of the colonnaded street overlayed on top of the modern plan of the souks, which stressed the minor changes to the original dimensions and usage of the lanes.



RB Dec 2015 after Gaube & Wirth 1984: Westblatt; Neglia 2009: fig. 53

Fig. 20 The remains of the triple passage colonnaded street reflected on the patterns of the souks southwest of the *Umayyad Mosque* Burns, 2017.

With the adoption of Christianity in Aleppo, the building of churches begun. The Emperor Justinian reportedly ordered the restoration of the walls of the city, in addition to some

[200] Burns, 2017, pp. 32, 34, 41
[201] Sauvaget, 1941, pp. 42, 46
[202] ibid.

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restoration work in the citadel, including the building of two water cisterns following the style of Constantinople.[203]

Sauvaget also noted the most important buildings from the Byzantine period:

1. In the location of the temple next to the *agora*, we find the Church of Saint Helena (Fig. 21, letter A), the mother of Constantine the Great, which was built as early as the second half of the 6th Century. The church was the main Cathedral of Aleppo and might have been rebuilt after the invasion of the Persians in 540 CE. The church spread over a large territory that incorporated the Roman forum as its forecourt.[204]
2. Two synagogues, the most important of them is the Great synagogue of Aleppo located in *al-Bandara* (Fig. 21, letter C). Sauvaget believed that it dates to the 6th Century, and parts of the masonry in west and north walls date back to the Byzantine period, while other Byzantine elements inside of the building are merely *spolia*.[205]
3. Spontaneous new neighborhoods emerged to meet the needs of the city expansion, with little regard to the principles of urban planning which is visible from the winding streets of uneven width.[206] Yet, despite the claims of Sauvaget, during the Byzantine period, the city was developed according to urban policies documented in various inscription commemorating buildings commissioned by the Emperor.[207] It is very possible that what Sauvaget referred to as a lack of urban planning only signals the urban and architectural manifestation of a new political and religious system not centered on worshipping the Emperor. [208] In addition to the diminished usage of the chariot in favor of animals, the rendering of the wide paved street was an unnecessary expenditure.[209] The new neighborhoods carried Syrian names such as *Baḥsītā*, *al-Farāfra*. and *al-Asfarīs*; therefore, Sauvaget suggested a high percentage of non-Muslim inhabitants within those districts.[210]

[203] Sauvaget, 1941, pp. 44- 45
[204] Ibid. pp. 58- 59
[205] ibid. p. 60
[206] David & Ḥūraytānī, 2011, p. 45
[207] ibid. p. 45
[208] ibid. pp. 46- 47
[209] ibid.
[210] Sauvaget, 1941, p. 61

DOI: 10.15774/PPKE.BTK.2023.009

Fig. 21 Aleppo in the Byzantine Period (Sauvaget, 1941, p. P1.LIII), redrawn by Orabi, 2023

From the map of the Byzantine period (Fig. 21), we notice that the city grew significantly to the north, and less growth happened to western and southern areas of the city. The districts on the map are listed as follows: *al-'Aqaba*, *al-Qasīla* (a), *Baḥsītā* (b), *al-Jallūm* (d), *al-Farāfra* (f). However, both the maps of the Roman and Byzantine periods do not reference the *Cardos* of the city or attempt to identify its palimpsests.

II.1.2.2.2 The Roman and Byzantine city in the maps of Neglia

Neglia refused the theory of the continuation of Hellenistic urban planning system in the Roman and Byzantine periods. Thus, she followed a unique method in tracking the changes of the urban fabric of the city from the pre-Islamic period to the Mamluk city. The method relies on reading the persisting elements of the city such as the building parcels, channels, routes and even vegetation, with little focus on the archaeological remains.[211] In an attempt to separate the planned phases of the urban development from the spontaneous ones[212], her study confirmed the suggestion of Sauvaget about the morphology of the city during the Hellenistic period, just with a smaller fortification parameter (Fig. 22.a). At the same time the work identified similar patterns of planning outside of those established parameters, which is attributed to the first Roman expansion of the city. Also, two traditional routes were identified; one entered the city

[211] Neglia, The Forma Urbis of Aleppo (Syria) During The Middle Ages, 2010, p. 115
[212] ibid. p. 116

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from *Bāb al-Naṣr* and exists until today around *Bāb al-Nayrab*, while the other entered the city from *Bāb al-Maqām* and exists through *Bāb al-Qanāt* (*Bāb al-Ḥadīd*).

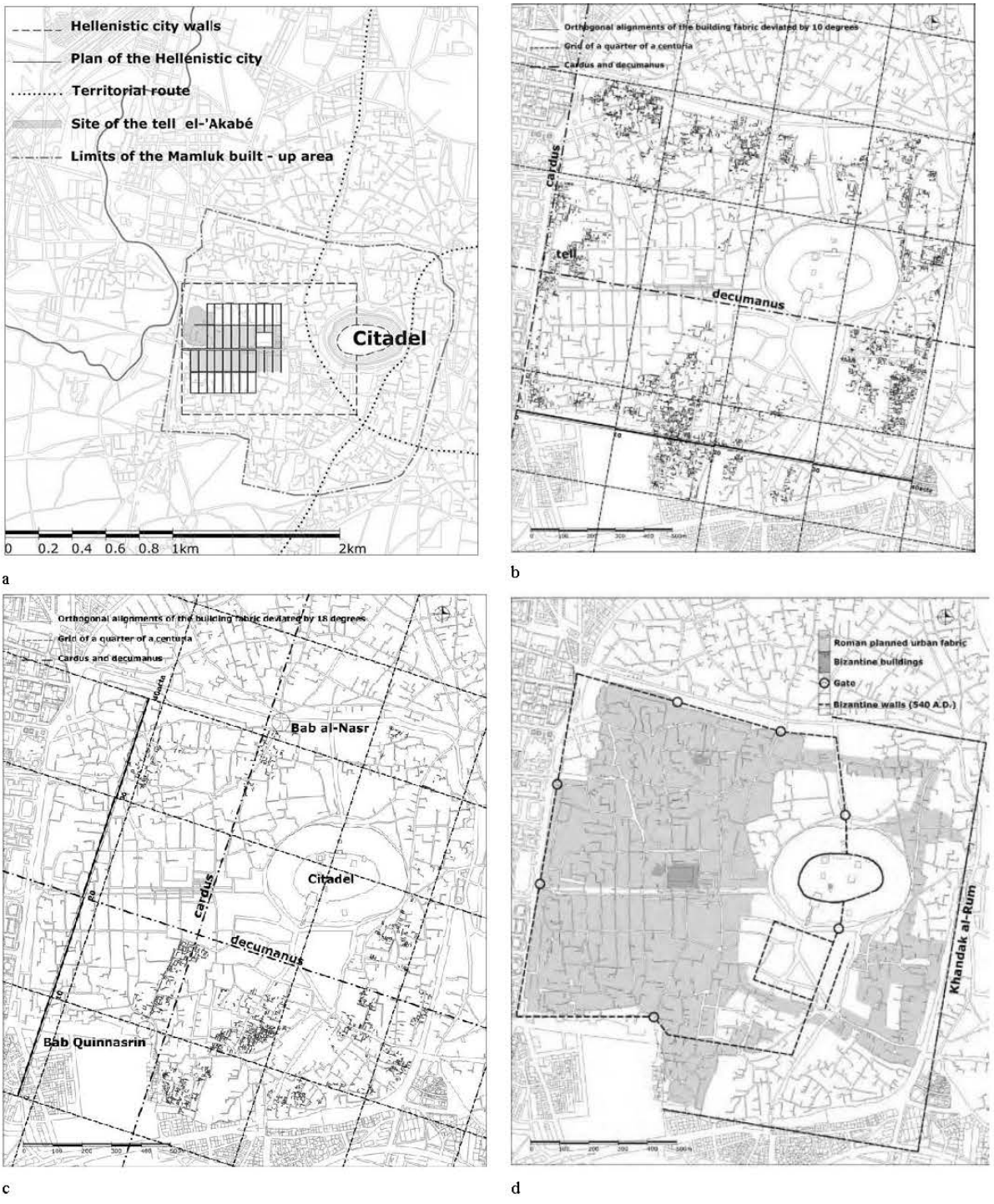

Fig. 22.a The Hellenistic Plan (Neglia, The Forma Urbis of Aleppo (Syria) During the Middle Ages, 2010, p. 119). b. The first Roman plan. Neglia, An interpretation of the urban fabric: the structure of pre–Islamic Aleppo, 2007, p. 53.c. The second Roman plan. Neglia, An interpretation of the urban fabric: the structure of pre–Islamic Aleppo, 2007, p. 50. d. Byzantine fortification and urban Fabric (Neglia, The Forma Urbis of Aleppo (Syria) During the Middle Ages, 2010, p. 128)

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As for the Roman period, three planning phases were identified. Firstly, the Romans preserved the traces of the Hippodamian plan but secondly expanded the city further as evidenced by the growth of structure of the areas east of the city beyond the boundaries of the Hellenistic settlement. This was thirdly concluded based on an analysis of the routes system and the dimensions of the *insulae*, usually 20*20 *acta*[213](71*71 m).[214] Moreover, the *Cardos* was developed, east to the *agora* and perpendicular to the d*ecumanus* as shown in (Fig. 22.b). Three major deviations of axis are discerned:

1- The first one is the axis of *Bāb Qinnasrīn*, *Bāb al-Naṣr* and the axis south and east of the citadel, deviate by 18° on the north-south axis. [215]
2- A deviation of 10° from the north-south axis along the walls of the city, coinciding with the second Roman plan.[216]
3- The third is a deviation of 10° from the west- east axis, which coincides with the last plan of the Roman city (Fig. 22.c).[217]

The Byzantine city was characterized by a new set of fortifications of double walls, which were built over the traces of the Roman fortifications. The main axis of the city was superimposed on the *Decumanus* of the second Roman phase[218] (Fig. 22.d); moreover, the Jewish neighborhood was built[219].

II.1.2.3 The Early Islamic City (637-1128)

When the Muslims arrived at the gates of the city in 637 CE, the walls were in no shape to withstand a siege. Therefore, the city negotiated the surrender and evacuation of the Byzantine army.[220] Muslims entered from *Bāb Anṭākiya*[221], which supports the theory that the fortifications of the city were built during the Classical Periods.[222]

The first mosque of the city, now known as *al-Shu'aybiyya Mosque*, was commissioned right after the conquest. Sauvaget erroneously suggested that it was built by walling up the bays of a

[213] A Roman measuring unit that measures between 35.1 to 35.6 m.
[214] Neglia, The Forma Urbis of Aleppo (Syria) During The Middle Ages, 2010, pp. 119, 131
[215] ibid. p. 121
[216] ibid. p. 126
[217] ibid.
[218] ibid. p. 127
[219] ibid. p. 129
[220] Burns, 2017, pp. 74, 81
[221] Ibn Shadād, p. 19
[222] ibid. p. 7

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former monumental arch built in the beginning of the *Decumanus Maximus* Street.[223] Yet, none of the surviving structure incorporated any Roman remains nor was it included in the Arabic sources mentioning the first prayer at site where the mosque was to be built.

In 715, during the Umayyad period, the Great Mosque of Aleppo was completed by Sulaymān, the brother of the Caliph al-Walīd Ibn ʿAbd al-Malik. It was originally intended as a replica of the *Umayyad Mosque* in Damascus. The mosque was situated in the forecourt and gardens of the Church of St. Helen. Therefore, it possessed a central location. Sauvaget also mentioned an open-air praying space being constructed east of the city at the foot of the citadel; it was named *al-Muṣallā*.[224]

The theory of Sauvaget about the development of the *souk*s was based on two new constructions:

1- The first is the *Umayyad Mosque* that occupied the area of the *agora* making its commercial function obsolete.
2- While the second is the *al-Shu'aybiyya Mosque* that interrupted the usage of the East-West Street as the main artery of city. This newly vacant space adapted the usage of a new *agora*.

Only one market sustained its location in the old *agora*, which was the textile and clothes market.[225] That *souk* formed enclaved in the *Umayyad Mosque*, this was inevitable due to the inherit relationship between the congregational mosque and the commercial activities in an Islamic city[226], given the role of the mosque in the life of the early Muslim community as a political, congregational and religious center surrounded by commercial activities.[227]

Sauvaget also noted a similarity between the plan of the *Qaysāriyya* of Gold and Silver smith and the layout of a basilica, and suggests that the Umayyads repurposed the basilica, as they did with many previously existing buildings.[228] Like what was mentioned earlier regarding the West-East street providing the best location for relocating commercial activities due to its

[223] Sauvaget, 1941, pp. 75, 80
[224] ibid.
[225] ibid. pp. 78- 79
[226] ibid.
[227] David & Ḥūraytānī, 2011, pp. 54- 55
[228] Sauvaget, 1941, pp. 75, 80

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proximity to the mosque, eventually, the Roman/ Byzantine streetscape was broken up by the arbitrarily established shops.[229]

In Fig. 23 Sauvaget demonstrated the process of conversion from the colonnaded street to the covered markets, from 200 CE to the 21st Century, with slight changes that eventually led to the deformation and loss of ordinance of the axis. The central lane was completely taken over by shops, and elements of the columns were reused.[230] This drawing is also supported by the occasional discovery of the remaining columns and capitals in that section of the *souks*.[231]

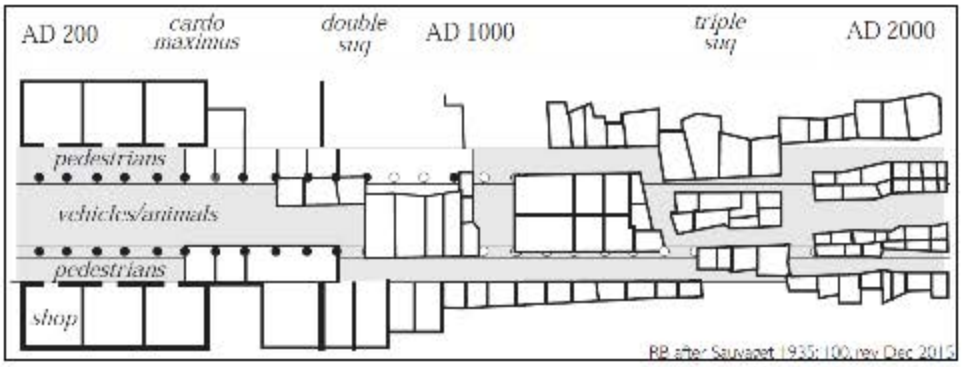

Fig. 23 Evolution of a colonnaded street (Burns, 2017, p. 81)

Yet, during the Islamic period, even the newly established *souks* were regulated to follow the Roman module, as stated in the guidelines of *al-Ḥisba*[232] system that "*souks should be established according to the previous Roman organization, a middle street surrounded by peripheral porticos, with warehouses behind them.*"[233]

Neglia, on the other hand, postulates that any true alteration of the urban fabric did not take place until the 10th Century.[234] The arguments here are: firstly, because the Umayyads were already accustomed to the Byzantine and Roman planning in several of their cities including their capital Damascus. They rather commissioned changes on an architectural level, such as building mosques and reorganizing the *souks*. Secondly, because the city did play an important role in the political and administrative atmospheres of the Umayyad period as well as in the Abbasid period, where not only Aleppo, but Syria in general was marginalized.

[229] Burns, 2017, pp. 74, 81
[230] Sauvaget, 1941, pp. 104, 105
[231] ibid.
[232] An Islamic system of market supervision executed by a state worker called al- Muḥtasib.
[233] David & Ḥūraytānī, 2011, p. 54
[234] Neglia, The Forma Urbis of Aleppo (Syria) During The Middle Ages, 2010, p. 186

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The Byzantine siege of Aleppo in 962 CE led by Nicephore Phokas damaged the walls of the city especially in the south-east sides of the fortification[235], due to the ditch that was dug by the besiegers, which was later called *Khandaq al-Rūm*. Phokas' army also burned the *Umayyad Mosque* and the souks upon sacking the city.[236] After the Muslims retook the city, the fortifications were repaired later by Sayf al-Dawla. Sauvaget argued that those repairs were poorly patched and only provided illusory security for the city.

II.1.2.3.1 The City between (1075-1260)

This period includes the Zinkis and Ayyubid rule of Aleppo, who were renowned warriors and led the Muslim resistance against the Crusaders and the *Shi'te* influence and battled to spread their control over Syria, Iraq, Egypt, and other regions of the Arab land.[237] As a result, this period is famous for the increased interest in fortifications and military architecture. The same militarized architectural style influenced civil and religious buildings. Nasser Rabbat expands the argument for the militarized style outside the environment of war to the arrival of the Turkic dynasties to the region. Therefore, the city witnessed a wide scale of urban expansion, infrastructure projects and the introduction of new architectural functions such as the *Khānqa* and the *madrassa*. The *Umayyad Mosque* was also reconstructed, and by 1090 it received its iconic *minaret*.[238]

As a result of 300 years of political instability, the city suffered from accumulating neglect. Even when and where works were carried out, it was individual and unplanned.[239] That state of political instability was demonstrated further in the commissioning of *Qal'at Sharīf* for the personal protection for Sharīf abū al-Ḥasan al-Ḥītītī. The castle was not connected with the city defenses and had an enclosure of its own. It was improvised, almost as if this location was a reflection of the

Fig. 24 Aleppo in the end of the 11th century (Sauvaget, 1941, p. Pl.LIIV), redrawn by Orabi,

[235] Ibn al- 'Adīm, 1996, p. 80
[236] Ibn al- 'Ajamī, Vol 1, p.552
[237] David & Ḥūraytānī, 2011, p. 71
[238] Sauvaget, 1941, pp. 100, 101
[239] ibid. p. 105

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city's planned layout falling into chaos and the beginning of the individual patronage.[240] Another outcome of the political instability was the emerging of cul-de-sac streets and gated neighborhoods.[239]

In Fig. 24 Sauvaget portrayed Aleppo in the end of the 11th Century; the city hardly grew beyond the boundaries of the Byzantine settlement. However, the grid plan system began to meander, the once connected streets converted to cul-de-sac. It is from this point forward that Aleppo was set to develop like any Eastern Arab city.

In terms of architectural changes, we can also notice the addition of *al-Shu'aybiyya* Mosque referred to as the first mosque (Fig. 24, letter A), the *Umayyad Mosque* (Letter B), *al-Mūṣalla* (Fig. 24, Letter C), and the transformation of the colonnaded street into the commercial artery connecting the edges of the city. Moreover, changes to the walls of the city became clear, especially on the south-east frontier. The gates that are listed on this map are:

1- *Bāb al-Ṣaghīr.*
2- *Bāb al-'Irāq.*
3- *Bāb Qinnasrīn.*
4- *Bāb Anṭākiya.*
5- *Bāb al-Jinān.*
6- *Bāb al-Yahūd.*
7- *Bāb al-Arba'īn.*

In the Zengid period, the city walls were restored, rebuilt, and expanded on the orders of Nūr al-Dīn after the earthquake of 1157.[241] The reign of Nūr al-Dīn was characterized by the rigorous building strategies that also involved the improvement and expansion of infrastructure by the canalization project aiming to bring water to the *Umayyad Mosque* and the newly developed quarters.[242] This project will be discussed extensively in chapter 3.

The newly commissioned buildings spread across a variety of functions, from *al-Bīmāristān* al-Nūrī (Fig. 25 number 9), and the new soon to be famous courthouse (*Dār al-'Adl*), in addition to palaces (*Qaṣr al-Dzahab* in the Citadel and The Palace of Mujaddid al-Dīn ibn al-Raya[243]), *Madrassas* (*al-Madrassa al-Ḥalāwiyya*), *Hammams* (*Hammam Nūr al-Dīn* in the Citadel), mosques and water fountains (*Qaṣṭals*)[244].

[240] Sauvaget, 1941, pp. 103- 104
[241] ibid. pp. 116- 118
[242] ibid.
[243] David & Ḥūraytānī, 2011, p. 78
[244] ibid. p. 72

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The *Umayyad Mosque* was burnt down in 1169 and rebuilt to incorporate parts of the *souks* into its prayer hall. The new markets stretched to the east, west and south of the Mosque. [245] Likewise, the city grew to the south[246]; new quarters emerged such as *al-Tūrkmān* (Fig. 25, letter T). This district, as the name suggest, accommodated the Tūrkmān troops that constituted the bulk of the army of the rulers.[247] On the other side of the walls, new extra-mural quarters started to form such as *al-Sha''ār*. [248]

The architectural character of this period was heavily influenced by the Persian arts and architecture that was imported to the region by the Seljuks. Some new decorative and functional elements such as the Iwan were introduced to the city and since it became an essential element of the Syrian architecture in general and Aleppian architecture specifically.[249] A more characteristic element of the architecture of Aleppo is the exclusive use of carved white ashlars[250] opposed to the combination of mud, wood and stones used in other Syrian cities such as Damascus, or basalt stone as it is processed in southern Syria.

After only 50 years of Zengid rule, Aleppo recovered from its previous state of neglect and was provided with infrastructure and amenities necessary for it to function; however, there has been a split in society between the Turkic leaders and the Arab subjects.[251]

The Ayyubids were also keen on transforming the fortifications. They renovated the citadel, built a new palace, mosque with a high *minaret*, garden, *hammams* and cisterns; they excavated the moat and prepared to be filled in case of an attack, dressed the glacis with stones, and connected the citadel with a secret passage leading to the hall of Justice.[252]

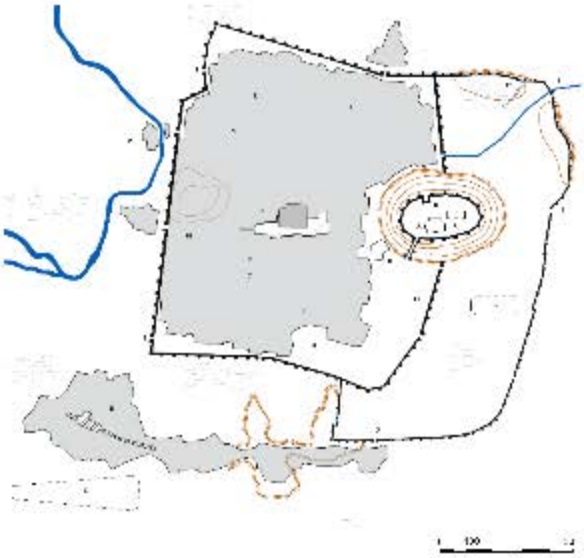

Fig. 25 Aleppo in the middle of the 13th century (Sauvaget, 1941, p Pl.LVIII), redrawn by Orabi, 2023.

[245] Sauvaget, 1941, pp. 116- 118
[246] David & Ḥūraytānī, 2011, p. 72
[247] Sauvaget, 1941, pp. 116- 118
[248] ibid.
[249] David & Ḥūraytānī, 2011, p. 78
[250] ibid. p. 73
[251] Sauvaget, 1941, pp. 127, 128
[252] ibid.

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Moreover, the north, west and south sides of the walls were rebuilt. However, to the east side another wall has been added following the footprint of the *Khandaq al-Rūm* dug by the Byzantine during their siege of Aleppo.[253] As a result, the citadel gained its central location; the new fortifications included new gates as well. Thus far, the area between the two rings of fortification was not yet subjected to the urban sprawl which will peak in during the Mamluk period. The new gates within the new fortification are listed in Fig. 25 as follows:

1- *Bāb al-Faraj.*
2- *Bāb al-Sa'āda.*
3- *Bāb al-Maqām.*
4- *Bāb al-Nayrab.*
5- *Bāb Khandaq Yālouj (Bāloj).*
6- *Bāb al-Qanāt (Bāb al-Ḥadīd).*

The map also notes the most important *Madrassas* such as *al-Madrassa al-Ḥalawiyya*, which occupied the spaces of the church of St. Helen (Fig. 25, number 8) and *al-Madrassa al-Shū'aybiyya* (Fig. 25, number 10). The number of *hammams* began to increase following the example of the Sultan al-Ẓāhir Ghāzī royal *hammam* near the citadel. They also constructed their *Madrassas* such as the funerary *Madrassa* of Ghāzī (*al-Sultāniyya Mosque*) (Fig. 25, number 11).

The Ayyubids supported the role Aleppo played in trade and resumed trade relation with Europe, Mesopotamia and Anatolia, leading to the expansion and building of souks such as silk and copper *Qaysariyyas*, soap factories, *khans* and tanners shops, around which a new neighborhood was formed named as *al-Dabāghah* (tanners) quarter (Fig. 25, letter D). There was even a district for stone masons called *Sūwayqat al-Ḥajārīn* (letter S), supposedly supplying Aleppo with the necessary craftsmen to facilitate the construction project of that period. The same neighborhood was also known for its big number of soap factories, and nowadays it is referred to as *al-Maṣābin*.[254] A study of the masons' marks on the southern fortification of the city renovated in the Zengid, Ayyubid and Mamluk periods suggest the existence of off-site production workshop to supply the demand for new constructions.[255] At the end of the Ayyubid rule, the city was reborn as an economic and trade center with mainly the patronage of the son of Saladin al-Ẓāhir Ghāzī, his son al-Nasir Yūsuf and Queen Regent Ḍayfa Khātūn.

[253] Sauvaget, 1941, pp. 141-146
[254] ibid. pp. 151- 154
[255] Orabi, 2020

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The Ayyubid and Zengid architecture, whether civil or military, was characterized by the harmony of propositions, composed of circles and square carefully designed to achieve a coherent space, in terms of the distribution of architectural elements within the space. The essence of their system was much similar to that applied by Byzantines previously and the Ottomans subsequently.[256] Researchers argue that interest in mathematics, numeric and engineering in the Islamic society spurred from a religious path to understand God and his creations and expressed the ideal relation among the elements of the universe of God, and most importantly, "Heaven".[257]

This hypothesis was also supported by Yasser Tabbaa who discussed the origin of the Muqarnas as an expression of philosophical and physical theories[258] that were not proved scientifically until the 19th and 20th Century. These mathematical rules and relations will be an important parameter in the parametric construction of the urban fabric discussed in chapter 4.

Tabbaa also reasoned that despite the hard assimilation efforts put forward by the Ayyubids, through generous architectural patronage, urban development projects and the commissioning of many *madrassas* and public buildings, they remained estranged from the population who perceived their attempts as a sign for asserting their power and dominion over the city.[259]

The Ayyubid rule came to an end in 1260 after the Mongol invasion of Aleppo. The city suffered damages from fires and demolition, as Hulagu ordered the demolition of the walls of the city and the citadel; only few places received his promise of safety.[260] Afterwards, the power transferred to the last powerful Islamic rulers, "the Mamluks" who were able to fend off the invaders.

II.1.2.4 The city between 1260-1516

After the destruction of the city walls by the Mongols, the walls remained in a state of disrepair for almost 130 years.[261] The restoration work started in 1390 through the collaboration of the local population[262], just for it to be sacked again by Timur Lenk in 1417. Once again terror was at the gates and the city suffered extensive damages to the buildings and walls [263]

[256] David & Ḥūraytānī, 2011, p. 81
[257] ibid. p. 82
[258] Tabbaa, 1985, pp. 67- 68
[259] Tabbaa, 1993, pp. 187- 188
[260] al-Qalqashandī, , 1985, Vol 2, p. 104
[261] Sauvaget, 1941, pp. 164-165
[262] David & Ḥūraytānī, 2011, p. 91
[263] al-Ghazzī, Vol 2, p. 9

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through demolition and burning in addition to the slaughtering of a substantial part of the population.[264]

After the departure of Timur Lenk, the walls were restored section by section until the arrival of the Mamluk Sultan Mu'ayyad Shaykh, who ordered the complete rebuild of the walls. Based on his commands many towers were constructed along the walls. [265] Moreover, the Palace of Justice was rebuilt, it expanded with a slight change to the original location and was renamed to be the palace of government[266]. The Synagogue next to the citadel was transformed into a mosque[267]. While, under the last Mamluks, the Citadel received the barbican of the entrance and later, many doors were rebuilt to accommodate canon power, and other modern infrastructures such as fire hydrants.[268]

Arguably there are two different architectural and urban strategies followed by the Mamluk during their rule, which was both necessitated and affected by the social and political situation in the city. The first period was a period of war that manifested in creation of fortification, and focus on military architecture, while the other was characterized by the expansion of *souks* and commissioning of new commercial establishments focusing on wholesale and accommodation like the *khans*, the first being *Khan al-Qaḍi*, commissioned in 1450. Arabic historians report the comments of Selim I during his stay in Cairo after the defeat of the Mamluks regarding the differences in style between *Madrassat of al-Sultan Ḥasan* (1357-62) and *Madrassat al-Sultan al-Ghūri*, where he referred to the first as a citadel and to the second as a hall of a merchant.[269]

The same transformation can be observed in Aleppo. Firstly, we see the Mamluks using the space in front of the Citadel as a training field or a "*Maydān*" with bow and an arrow shooting range.[270] After the Mongol invasion, the horse market was relocated from outside the walls in *al-Ḥaḍir* to the intra-mural city, at the foot of the citadel, making it more feasible to serve the cavalry army training in the *Maydān*. The shops of the bow and arrow blacksmiths replaced the offices of notaries.[271] These war-oriented rulers literally transformed the city center into a training ring estranged from the locals who were cautious of them.[272]

[264] al-Ghazzī, Vol 3, p. 167- 168
[265] Sauvaget, 1941, pp. 151- 154
[266] ibid. p. 169
[267] ibid. p. 174
[268] ibid. pp. 164-165
[269] Rabbat, 2005, p. 105
[270] Sauvaget, 1941, p. 170
[271] Sauvaget, 1941, p. 170
[272] David & Ḥūraytānī, 2011, p. 92

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The expansion of markets left a very limited unbuilt space around the citadel. New neighborhoods emerged filling the space between the old walls and the Ayyubid extension corresponding to new needs, and demographics. Moreover, an extensive urban expansion started to take place outside the walls. [273]

Later in the Mamluk period, the souks were majorly transformed at the expense of the residences; promoted by the commercial position of Aleppo. New commercial functions were introduced such as the souk of soap, silk, and fur. The central *Khan*s took a portion of the commercial traffic, moreover, foreign merchants started to take residence in those *Khan*s, and much of the Aleppian merchandize traffic was directed to and from Europe. [274] The dates of the establishment of the grand commercial facilities overlap around the second half of the 15th Century.[275] New bathhouses were also built such as *Hammam Yalbughā al-Naṣirī* at the hill foot of the citadel, while older *Hammam*s were restored as well[276], which is the more indicator of wealth and prosperity of the city.

The increase in appetite for patronage during the Mamluk period is also visible in the chronology of Mamluks in Egypt and Syria by Michael Meinecke, in which he identifies architectural patronage of each Mamluk Sultan. We can find periods of expensive architectural work such as under al-Naṣir Muḥammad (1299, 1309-10), where the first restoration of the canalization of the city was conducted.[277] A bigger wave of patronage was under al-Ashraf Shaʿbān (1362-1377). In that period Ishqtamur al-Mardīnī al-Ashrafī commissioned several buildings (a *madrassa*, a khan and a hammam) to serve as an endowment for his mosque and mausoleum Jāmiʿ Ishqtamur or Jami, known today as *Jāmiʿ al-Sakakīnī* next to *Bāb al-Maqām*.

Some researchers suggest that the interest in building the conventional Madrassa decreased. Instead, The Mamluks focused on building of mosques. Nonetheless, according to the chronology of Michael Meinecke, an almost equal number of new *madrassas* and mosques – around 20 – were commissioned in Aleppo during the entire Mamluk period.

A mosque was built in each new district; also, a new *minaret* topology has been introduced, with high polygonal and cylindrical forms replacing the moderately elevated square Ayyubid

[273] Sauvaget, 1941, p. 173
[274] ibid. pp. 164-165
[275] ibid.
[276] David & Ḥūraytānī, 2011, p. 95
[277] Meinecke, Die mamlukische Architektur in Ägypten und Syrien (648/1250 bis 923/1517), Chronologische Liste der mamlukischen Baumassnahmen, 1992

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minarets. The highest concentration of the new mosques was around the citadel.[278] Some of the new mosques are presented by Sauvaget on his map of Aleppo in the 16th Century in Fig. 26, consisting of *al-Mihmeindār Mosque* (2), *Baktamūr al-Qarnṣī Mosque* (3), *al-Sha'rāwī Mosque* (4), *Ibn Ūghūl-beg Mosque* (5), a*l-Tūnbūgha Mosque* (6), the Mosque of *Akbūgha al-Aṭrash* (7), *Jawhar the eunuch Mosque* (8), *Taghri Vermich Mosque* (9), in addition to the converted Synagogue (1). However, we can never identify the famous Mamluk *mosque-madrassa* complex dedicated for the four *madzhabs* as in Cairo. The *madrassa* in Aleppo generally remained dedicated to one *madzhab* per building, occasionally combined with a tomb of the patron but not combined with a congregational mosque. That is mainly the case because in many instances there was a neighboring mosque and possibly a tomb commissioned by the same patron at the same time; there is also the instance where the *madrassa* was converted to a mosque and vice versa such as *al-Madrassa al-Naṣiriyya*, also known as *Jāmi' al-Ḥayyāt* that was originally a synagogue and later converted to a *madrassa* in 1326-1327 and finally to a mosque by adding a *minaret*.[279]

The newly formed quarters in the east and north rearranged the ethnic and religious demographic distribution of the residents of the city, the most notable of which is the development of the Christian quarters, dominated by Armenians and Maronites, [280] in addition to the migrant quarters who were of Kurdish or Turkic origin.[281] As a result of the Mamluks urban strategies, the urban life became decentralized, and each neighborhood could function as a separate cell. Hence, the once central commercial activity spread across the entire city.[282] In (Fig. 26) we see the expansion of the markets to the edge of the citadel, in addition to the new quarters that started to form outside the city walls. The places listed on the map noted with letters are:

A. The Palace in the Citadel.
B. The Palace of Happiness.
C. The *Qāḍī* Court.
D. The Horse Market.
E. The *Khan* of the Venetians.
F. The Palace of *Bazza*.

As for the city quarters, they were listed in the map according to the profession of the neighborhood as follows: The awls makers (A), the bleachers (*al-Bayyaḍa*) (B), the lime-Burners (*al-Kalasseh*) (C) and the Spinning Market (F). Neighborhoods named according to

[278] David & Ḥūraytānī, 2011, p. 93
[279] al-Jāsir, 1998, pp. 268-277
[280] David & Ḥūraytānī, 2011, p. 95
[281] Sauvaget, 1941, pp. 174- 175
[282] ibid. p. 177

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the origin of the inhabitants are al-*Ḥauranis* (H), the Jewish Quarter (J), The Kurds (K), *al-Mar'ashi* (M), the Orientalists (O) and The Persians (P).

Sauvaget also prepared a map of Aleppo in the middle of the 19th Century (Fig. 27). However, this period of the history of Aleppo is covered with better detailed and precise maps that will be discussed later in this chapter.

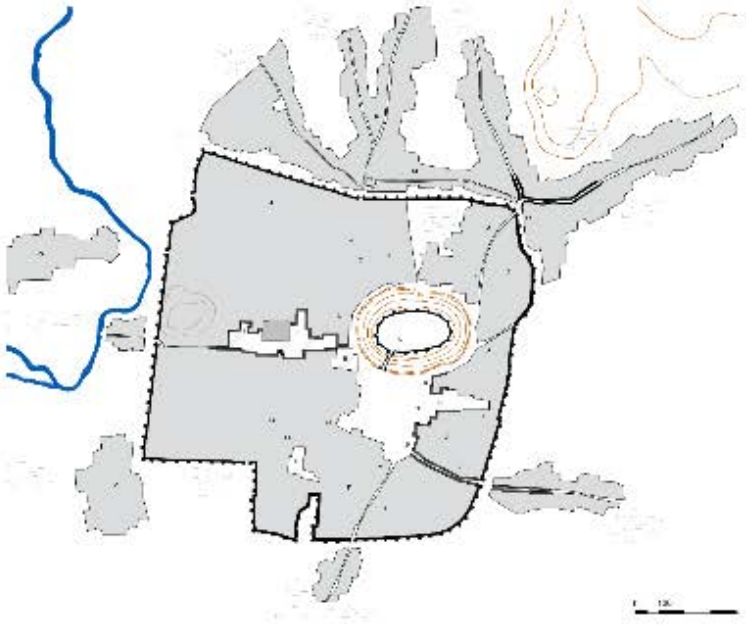

Fig. 26 Aleppo in the beginning of the 16th Century (Sauvaget, 1941, p. Pl. LXII), redrawn by Orabi, 2023.

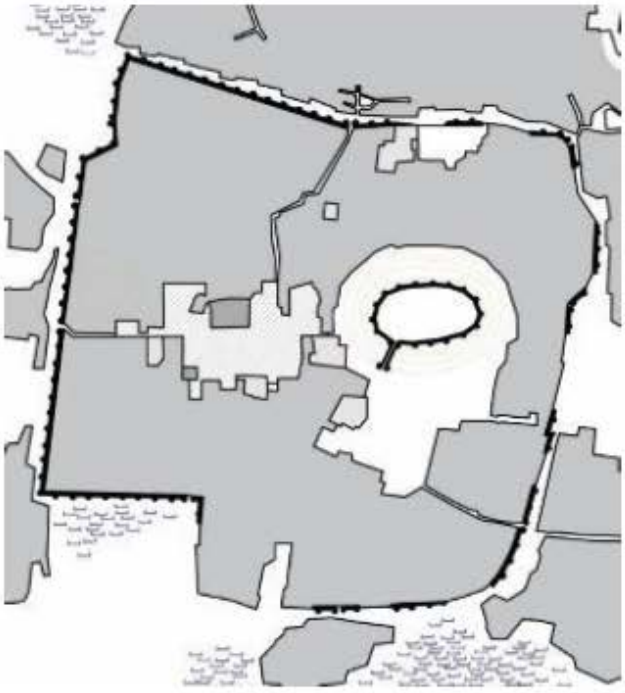

Fig. 27 Aleppo in the middle of the 19th Century (Sauvaget, 1941, p. Pl. LXX) redrawn by Orabi, 2023.

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II.1.2.5 Carsten Niebuhr Map, 1778

This plan is drawn by the German explorer Carsten Niebuhr and published in his book *Travels through Arabia and other countries in the East*. The map was published also in the "Natural History of Aleppo in the 18th Century" but with modification made by Russel, such as including the hills of the city: *Baḥṣītā*, *Tallet al-Yāsamān*, *al-'Aqaba*, *al-Jallūm*, *Qal'at Sharīf* and *Tallet al-Qal'a*. The importance of this map stems from the fact that the first cartographic map prepared for Aleppo outlining the street network, built blocks and the most important urban elements of the city consisting of gates, neighborhoods, bridges and *Qaṣṭals*. Niebuhr documented nine gates on the walls of the city and 3 outside those walls. The gates are[283]:

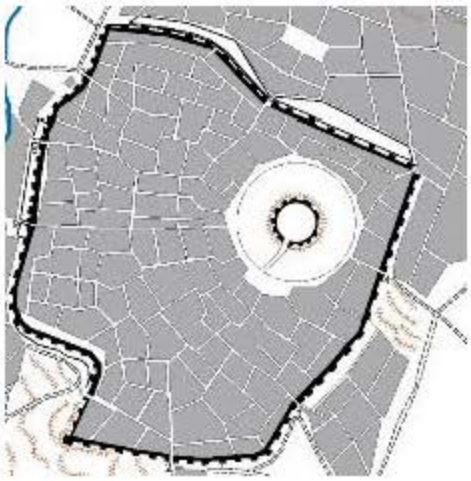

Fig. 28 Aleppo plan drawn by Niebuhr (rotated) (Raymond, 2010, p. 500), redrawn by Orabi, 2023.

1- *Bāb Qinnarīn*
2- *Bāb al-Maqām*
3- *Bāb al-Nayrab*
4- *Bāb al-Aḥmar*
5- *Bāb al-Ḥadīd*
6- *Bāb al-Naṣr*
7- *Bāb al-Faraj*
8- *Bāb al-Jinain (al-Jinān)*
9- *Bāb Anṭākiya*
10- *Bāb al-Jadayda*
11- *Bāb al-'Urbān*
12- *Bāb al-Akrād*

The last three gates were never mentioned in historical texts about Aleppo, especially in the books of al-Ghazzī. Therefore, they could be only common names given to the entrances of the new neighborhoods based on the name of the district such as in *al-Jadayda*, with the dominant Christian population; that name was mostly based on the profession, ethnicity, or religion such as *Ḥayy al-Akrād*, *al-'Urbān*.

Fig. 29 Aleppo by Alexander and Patrick Russel (Russel, 1794, p. 1)

[283] Russel, 1794, p. 31

DOI: 10.15774/PPKE.BTK.2023.009

Niebuhr also recorded another 38 buildings, location and neighborhoods within and outside the walls of the city.[284] Despite the obvious wrong ratios, orientations and divisions, the map describes the main features of the extra and intra-mural city and gives support to the information provided in written historical sources.[285] For example, we can see the *Decumanus* connecting *Bāb Anṭākiya* with the Citadel. The gates are in relative positions within the city.

II.1.2.6 Rousseau Map, 1818

Drawn by Vincent Germain, the work followed the request of the French Consul in Syria in 1811, Jean-Baptiste Rousseau, who completed the map by 1818 and published it in "*Société de Géographie de Paris*" in 1825.[286] This map documented the situation in the city before the earthquake of 1822. It recorded the same previous nine doors (as Niebuhr), and an improved number of 25 neighborhoods within the walls. Outside the walls the map noted 69 districts with 26 gates and 175 various buildings, public utilities, squares, gardens, and cemeteries. Interestingly, it also marked the remaining parts of the walls of the city. Despite the error in orientation of the form of the boundary of the city and the citadel, it preserved the general shape of the streets' network. We can identify the most important streets and neighborhoods; it also portrayed the central market complex relatively accurately.

Fig. 30 Aleppo by Jean-Baptiste Rousseau Raymond, 2010, p. 505, redrawn by Orabi, 2023.

II.1.2.7 Karl Baedeker Map, 1912

Conducted as a tourist map by Karl Baedeker, and published in his book "*Palestine and Syria, With Routes Through Mesopotamia and Babylonia And the Island of Cyprus, Handbook for Travelers*". The degree of accuracy that this map exhibits suggests that the author used another map as a base document. Most likely it was the map prepared by the Ottomans in 1900, which is discussed in the following section. However, the importance of this map lies in the

[284] Russel, 1794, p. 31
[285] Gaube, Wirth, & Trans: ʿUlabī, 2007
[286] Raymond, 2010, pp. 499-503

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expressing of the degree of city's prosperity and its seat on the touristic and commercial destination.

The commercial prospect of his books was illustrated by listing the foreign consulates that were in operation in Aleppo (American, British, Austrian, French, Italian, Russian and German)[287] which is more likely to serve as an advertisement rather than a touristic destination.

For tourists likewise, it also recorded the doors of the city, 22 buildings, gates, and the districts of the city. We also see the formation of *Jadet al-khandaq* to the north of the city.

Fig. 31 Aleppo by Karl Baedeker Mansel, 2016, p. xv, redrawn by Orabi, 2023.

II.1.3 The Population of Aleppo

Not many sources provide data on the population of Aleppo during different historical periods. One of the few manuscripts is the work of al-Ghazzī that provides an insight to the population of the city and the "Provenance of Aleppo". An Ottoman census that was concluded between 1892 and 1893 suggested that the population in the city of Aleppo (Intra and extra-muros) was 101031 inhabitants, while the provenance population was 128000 inhabitants. [288]. In contrast to the population before the 1822 earthquake that was estimated around 400000 inhabitants for the "Province of Aleppo".[289] The earliest estimation of the population of Aleppo is from the 17th Century. The French traveler "Laurent d'Arvieux" mentioned the population to be between 285000 and 295000 inhabitants. [290] For an earlier estimation of the population between the 12th and the 13th Century. al-Ghazzī uses the number of *hammams* to estimate the population of Aleppo to be around 666680 inhabitants excluding the ones that have a *hammam* inside their home. The suggested number is exaggerated, however, no other information is available regarding the population during that period.The growth graph (Fig. 32) shows a decline in the population that can be attributed to the plague of the 13th Century[291] and the earthquake of 1822. However, these numbers cannot be fully trusted because of the inherent

[287] Mansel, 2016, p. xv
[288] al-Ghazzī, Vol 1, p. 258
[289] ibid, p.257
[290] ibid.
[291] al-Ghazzī, Vol 1, p. 258

DOI: 10.15774/PPKE.BTK.2023.009

error of estimation and the fact that many did not participate in the Ottoman census according to al-Ghazzī.

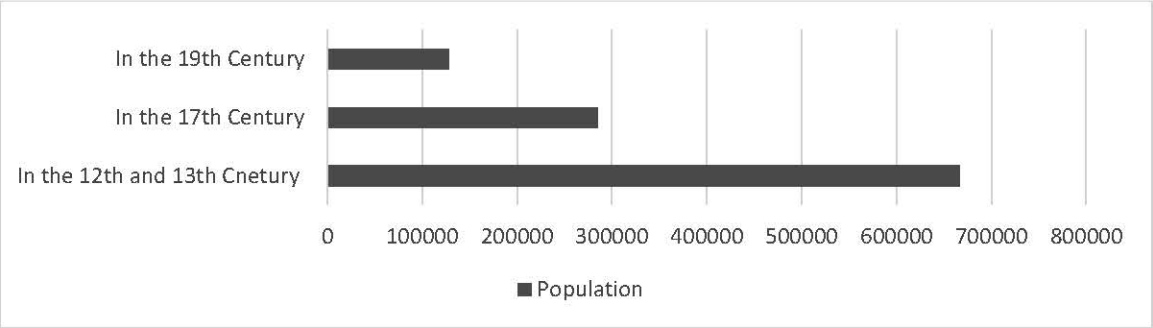

Fig. 32 An estimation graph of the change of population in Aleppo after al-Ghazzī.

II.1.4 Maps of True Scale

By the late 18th Century, the use of accurate topographical survey was a necessity, mainly to facilitate the planning of infrastructure projects, recording and organizing of ownership rights and to oversee the urban growth of any agglomeration. Many maps were prepared of Aleppo by governmental agencies starting from the Ottomans period to the French Mandate and continuing in the 19th and 20th Century, in addition to maps prepared by the military and researchers preparing studies about the city. In the following, I will examine the most important maps of true scale of Aleppo.

II.1.4.1 The Ottoman Map of 1900

The Ottomans took the city in 1516. During the first years of their rule, Mamluk architectural and urban forms remained in practice.[292] In that period the machines of warfare were reinvented. As a result, the importance of walls was severely reduced after the use of heavy artillery. Therefore, dwellings started to take over the obsolete wall of the city and its bastions; the citadel also suffered a similar fate, and the state of degradation was catalyzed by the earthquake of 1822.[293]

However, Sauvaget would argue that this negligence was enacted only to the outdated function i.e., old defensive systems, while the other sector of the city witnessed an increase in the construction projects. The Ottomans also encouraged the endowment system (*Waqf*) to support the religious buildings. The use of *Waqfs* dated back to the 9th Century and it is based on the patron buying revenue-generating businesses holding the name (*Waqf*) which are

[292] Watenpaugh, 2004, p. 50
[293] Sauvaget, 1941, p. 211

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exempted from taxes, in order to support religious buildings[294] such as mosques, *madrassas*, *zawāyās*, etc.[295] The *Waqf* system was also heavily used in the Ayyubid and Mamluk period, yet again, this regulation played a pivotal role in reshaping the ottoman city in addition to official patronage. Most of the *Waqf*s were located in the vicinity of the central markets[296], as many of them were *khan*s, *hammam*s or even entire *souk*s.[297]

The commercial heart of the city underwent the biggest transformation to accommodate the trade traffic. This translated to buildings of more commercial facilities (*souk*s, *khan*s, *qaysāriyyas*); they were covered with masonry vaults as a fire precaution. Grand-scale *khans* were built to accommodate the foreign travelers and some of the khans had shops overlooking the souks to generate additional revenue.[298] *Souk*s became specialized, and goods that were not interesting for the foreign traders were eventually relocated outside the heart of the commercial zone as a result.[299] Starting from the beginning of the 19th Century, the Medina exclusively dealt with merchandise related to the trade with Europe such as clothes, gold, soap, ropes and silk.[300]

As for the administrative buildings, the courthouse transformed to the accommodation of the Pasha and his courtroom. That building later burnt down during the revolt of 1818.[301] The buildings of mosques also continued. The Ottoman mosques were famous for their distinctive features, with multiples domes, semi-domes and pencil-shaped *minarets* that shapes the skyline of the city until today.[302]

To turn the wheel of urban development and to satisfy the need for a railroad network, the Ottomans commissioned the first master plan of the city. This master plan is one of the most important maps of Aleppo, because it was the first map based on an accurate survey with a reliable scaling system. It was prepared in 1900 by Ottoman Road and Bridges engineers, with a scale of 1/5000[303] (Fig. 34). This map depicted buildings with the earliest drawing of the contour lines, which makes it one of the most valuable topographical resources of the city. However, there is a clear deformation in the map causing the central section of the city to appear

[294] David & Ḥūraytānī, 2011, p. 125
[295] Sauvaget, 1941, p. 213
[296] David & Ḥūraytānī, 2011, p. 126
[297] ibid. p. 127
[298] Sauvaget, 1941, pp. 214-215
[299] ibid. p. 220
[300] ibid. p 220
[301] ibid. p. 232
[302] David & Ḥūraytānī, 2011, p. 128
[303] Gaube, Wirth, & Trans: ʿUlabī, 2007, pp. 91, 92

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curved. This was probably caused by the fact of using early surveying techniques and is unlikely due to the digitization process.

Fig. 33 The General Plan of Aleppo, Source: National Library for France, gallica.bnf.fr/ark:/12148/btv1b52507324h/f3.item, redrawn by Orabi, 2023.

It portrays the cul-de-sac streets and the final development of the city quarters within the walls before the destructive urban projects of the 19th Century. Nonetheless, only a few of the buildings are drawn with the interior courtyard. The extraction of a mass and void plan is not completely possible while the biggest void space remains in front of the citadel. We can also identify the newly constructed *Jādat al-Khadaq* where the northern section of the city moat was filled up. They also purchased buildings on the opposite side of the northern old walls and demolished a section of them in order to expand the street. As a result, it is now characterized by wooden Ottoman façades executed with construction of the streets.

Based on the location of the surviving bastions, we can detect more of the defensive towers located on the city walls, especially in the northern, western, and southern segments of the walls. As for the studied neighborhoods, hereinafter, a description of the visible changes in this map will now be presented.

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II.1.4.1.1 *al-Jallūm* Quarter

The map recorded the main streets of the quarter. As for the courtyards, some of them were included in the map especially the ones of important buildings such as *Khan al-Jumruk* and *al-Bahramiyya Mosque*. It also suggested the presence of multiple defensive bastions spread along the walls of the city. We also recognize that *the* fabric around *Bāb al-Sa'āda* and the building adjacent to the northern entrance of the *Umayyad Mosque* are unaltered.

II.1.4.1.2 *al-'Aqaba* Quarter

The same applies to the *al-'Aqaba* Quarter. The recorded streets are accurate to the level of the cul-de-sac streets, especially behind the walls of the city. However, we notice two of the major differences with the modern map; the first are the two streets that fork away from each other at *al-Shū'aybiyya Mosque*, while the second is the representation of *Ṣibāṭ Sūdān* in *Darb al-Khirāf* (the street preceding the one with *al-Bīmāristān al-Nūrī*). The map also expressed the elevation difference of this quarter from the surrounding neighborhoods.

Fig. 34 The parade of the General Gouraud in *Jādat al-Khandaq* in 1930

II.1.4.2 The French Bureau of Topography Map, 1919

The French Bureau of Topography of the French troops in the Levant prepared this map of the city of Aleppo in 1919 during the early period of the French Mandate of Syria, (

Fig. 35). But this copy was of minor quality in comparison with the previous Ottoman map and with multiple mistakes.[304] It overlooked many details such as the contour lines, the details of the wall and the interior courtyards. Nonetheless, in this map we can notice that the fabric around the walls has started to be altered, from the disappearing of the defensive bastions to the destruction of the wall near *Bāb al-Sa'āda*.

[304] Gaube, Wirth, & Trans: 'Ulabī, 2007, p. 92

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Fig. 35 The Map of Bureau of Topography, http://historic-cities.huji.ac/syria/aleppo/maps/tfl_1929_aleppo.html, redrawn by Orabi, 2023.

II.1.4.3 The French Cadaster Map, 1930

The French Cadaster Map was the most detailed map of Aleppo (Fig. 36). It was prepared by a team headed by C. Duraffourd; the team conducted a concise survey of the old city between 1926 and 1928. For a better representation of the details, the city was divided into 12 real estate districts [305] (Fig. 37). The intra-mural city covered 4 cadastral regions by 28 plans scaled 1/500, while the central markets maps were scaled 1/200 with detailed construction plans for multiple buildings. Each map was named and ordered according to these three consecutive numbers[306]:

- A constituency, which is the number of the region, ordered from VII to X.
- A section number between 1 and 6.
- The number of the sheet.

Its importance lies in the fact that it was the last detailed map before the master plans of 1954 and 1974 which reformed the nucleus of the old city of Aleppo. Therefore, it provided a picture of the authentic historic fabric and individual buildings, with information regarding the parcels, the open spaces, and details of the plans.

[305] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 92
[306] The Aleppo Archive, A place for the Memory of Urban History, 2012, p. 34

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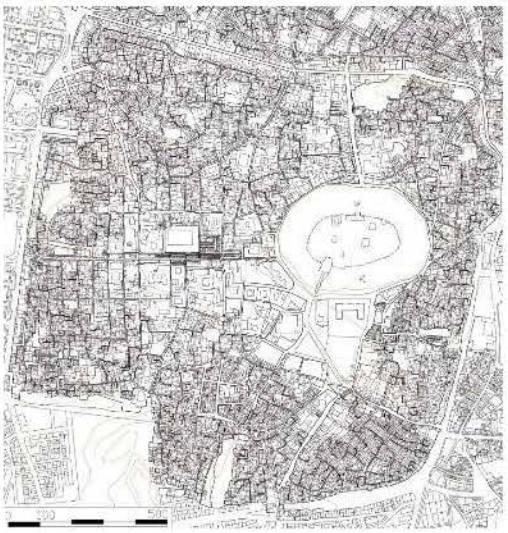

Fig. 36 The Cadaster plan of Aleppo, Neglia, 2000-2001, p. 150, redrawn by Orabi, 2023.

Fig. 37 The cadastral regions of Aleppo (The Aleppo Archive, 2012, p.34)

II.1.4.3.1 *al-Jallūm* and *al-ʿAqaba* Quarters

Both districts were not subject to changes compared with the previous maps of 1900, possibly because the first alterations were carried out on the walls of the city, the first being the disappearance of *Bāb al-Jinān* and the expansion of the adjacent street, while the second were the modern buildings filling up the concavity next to *Bāb al-Faraj* in addition to the rest of the Mamluk *Mydān*.

II.1.4.4 Master Plans of Aleppo

In the 19th Century the city underwent drastic urban changes in the name of modernization. This development resulted in extensive damage of the historic fabric of the old city in terms of

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population density, vehicular traffic, the void to mass ratio, and building heights. Some of the reshaping projects concerning the old city were[307]:

1. The master plan of Gutton in 1954.
2. The master plan of Banshoya in 1974.

Notably, Dangeit and Ecochard also prepared suggestive master plans of Aleppo in 1932 and 1935 respectively. Both plans remained theoretical and were not implemented.

Fig. 38 The street of *Khan al-Wazīr* from the citadel in 1950 (unknown source).

II.1.4.4.1 The Master Plan of Gutton, 1954

In 1954, a masterplan of the city was worked out by the French architect André Gutton. It had a serious negative impact on the development of Aleppo. Gutton had the idea to bring car traffic into the heart of the old city in an attempt to provide fast transportation of goods. He labeled his idea "from sea to desert", with an additional goal of facilitating construction on the vacant land of the old city [308], mainly in the previous *Mydān*.

The plan suggested dissecting the city from east to west, by creating a ring road around the markets and the *Umayyad Mosque*, separating this region from the rest of the historic fabric; another ring road should be constructed around the historic districts justified by displaying historic monuments on the side of the roads. Another vertical axis would start from the *Umayyad Mosque* to the north of the city. Closer to the mosque itself, the buildings adjacent to its northern façade were destroyed to create a square in front of the mosque entrance.[309]

Only part of this plan was executed from the *Umayyad Mosque* to the north of the city and to the citadel, in addition to the street leading from the north of the citadel and westward to the

[307] Stürzbecher, Windelberg, & AbdulAzizHallaj, 1998
[308] David & Boissière, 2014, p. 519
[309] Stürzbecher, Windelberg, & AbdulAzizHallaj, 1998, p. 7

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street of *Bāb al-Jinān*. This fact led to an estimated loss of 10 % of the original fabric of the city within the wall in addition to the isolation of *Bāb al-Faraj* district, setting the first step in the development project yet to be proposed and completed. Moreover, four-story buildings started to emerge along the newly built wide streets, which caused further damage to the homogeneity of the city.

Fig. 39 The Plan of Gutton, 1954, David & Boissière, 2014, p. 519, redrawn by Orabi, 2023.

II.1.4.4.1.1 al-Jallūm and *al-ʿAqaba* Quarters

The circular road around the *Madina* suggested the creation of multiple plazas at the expense of the historic fabric in both *al-ʿAqaba* and *al-Jallūm*. The most destructive of which would have been the one extending westward from the southern side of the Government building (*The Saray*) and forking into two streets that convert the heart of the old city to islands separated by vehicular streets. It is fortunate that this section of the plan was not executed.

II.1.4.4.2 The Master Plan of Banshoya,1974

The next masterplan was prepared by Japanese architect Gioji Banshoya and the French urbanist Jean-Claude David in 1974. The objective of the plan was to preserve "the heritage and its traditional values".[310]

To prevent further damage to the city, several dead-end streets (cul-de-sac) were suggested instead of the previous ring road, although sections of it had been executed. Additionally, a parking space was suggested to serve the residential and commercial quarters. Although, the planning document aimed to preserve the connection between the markets and the gates. It led to the destruction of many buildings of the inner city and – if completed – it would have led to the separation of the extra-mural city into a northern and southern section. These damages

[310] David & Boissière, 2014, p. 519

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caused by the initiated project led to a wave of protest that culminated in the inscription of the city as a historic area[311] and later to the registration on the world heritage list.

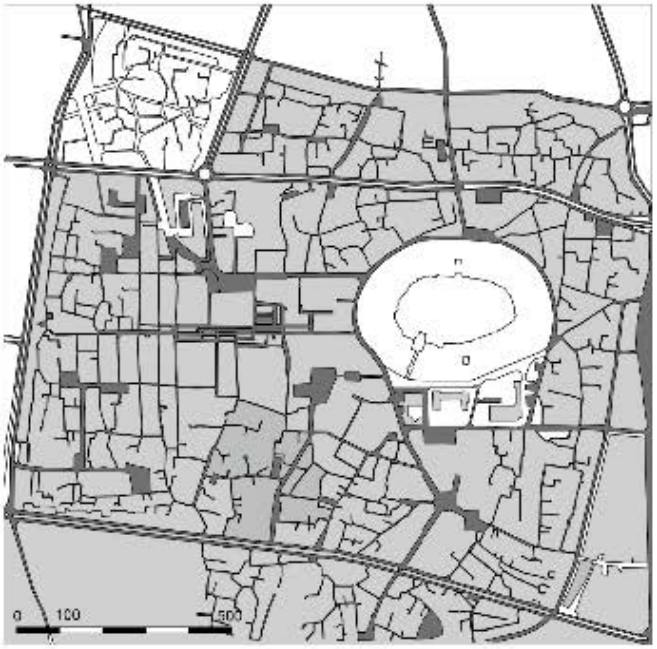

Fig. 40 The master plan of Banshoya, 1974, cited in: David & Boissière, 2014, p. 520, redrawn by Orabi, 2023.

II.1.4.4.2.1 al-Jallūm and al-'Aqaba Quarters

This plan carried out even more destruction to both neighborhoods. Especially regarding the wide streets and the parking squares, seven new open spaces can be counted. Although not all of them were carried out to completion, they introduced a more severe problem with new high-rise buildings within the historic fabric.

The high-rise concrete buildings were an indirect outcome of both referred masterplans, and from this point onward, the foreign style started invading the old city, changing its image and negatively affected the remaining buildings due to overcrowding, pollution, noise from vehicles, and invasion of privacy. The relative height of those alien buildings stripped the privacy element from the low-rise courtyard houses, making them exposed to their neighborhoods, which led to the abandonment of the old houses, and to the erection of more high-rise buildings.

[311] Stürzbecher, Windelberg, & AbdulAzizHallaj, 1998, p. 7

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II.1.4.4.3 Gaube and Wirth

The work of Heinz Gaube and Eugen Wirth took place between 1975-1984, where many surveyed plans of the city were reviewed and improved. Commercial buildings and vital centers outside the central commercial area were also documented in detail.[312] Its importance comes from the fact that it is the last complete survey of the city within the 20th Century.

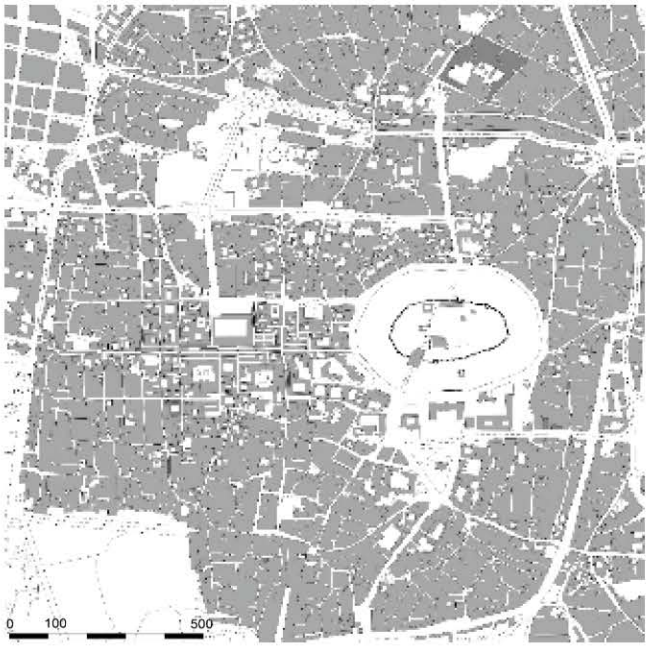

Fig. 41 A plan of Aleppo by Gaube, Gaube & Wirth, 1984, p. Karte 4, redrawn by Orabi, 2023.

Using these surveys, Gaube and Wirth prepared a series of maps that represent the historic development of the city mainly in the 13th Century, the Ottoman period, and the 19th Century. Relying on historical information, the maps mark the street networks, water supply networks, neighborhoods and buildings belonging to those different periods. The 19th Century offers the most working data, therefore, the number of maps concerning this period exceeds any other time periods and it includes population density, religion, function of buildings, services and commercial establishments in each district (Fig. 41).

II.1.4.4.3.1 .al-Jallūm and al-ʿAqaba Qaurters

These maps record all the effects of the combination of the two previously discussed master plans, in addition to the illegal construction carried out by the residential or commercial properties at the expense of the coherence of the elements of the city. We witness the illegal modifications to residences and business spreading around the walls of the city, in addition to

[312] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 101

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the destruction of sections of the walls around *Bāb al-Jinān*. In addition to an increase in the erection of high-rise building that goes hand in hand with the widened streets and the state of neglect of the city.

II.1.4.4.4 **The "Aleppo Archive in Exile"-plan**

It was prepared by the Brandenburg University of Technology (BTU), Cottbus, in 2014. The map uses the cadastral plans of the city in addition to around 400 ground-plans of significant buildings, combining different studies of many researchers such as Sauvaget, Gaube and Wirth and Neglia. Yet, no field survey was carried out, and consequently no new information was introduced.

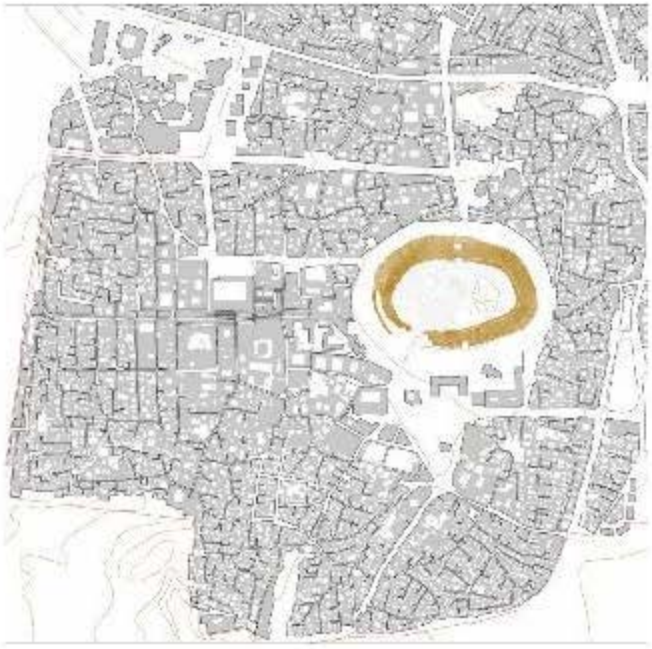

Fig. 42 A plan of the Old city of Aleppo, source: (https://www.b-tu.de/middle-east-cooperation/research/research-projects/aleppo-archive-in-exile), redrawn by Orabi, 2023, scale 1/10000.

Nonetheless, the BTU-team prepared a version of the maps that portrayed the city before the urban projects of 1954 and 1974. The only missing feature from the published map was the contour lines. When this map was used in the study, contour lines were imported from the original French Cadaster of 1930 (Fig. 36). In the process of redrawing, different maps were prepared to illustrate the fabric of the city before and after the previously mentioned urban transformation projects. The importance of this map lies in the fact that it combines a big section of the visual information prepared for Aleppo, such as the parcels, courtyards, and the function of buildings (Fig. 42).

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II.1.5 Selection of Study Maps

The study will utilize some of the maps mentioned in this chapter serving as a base map for the 3D reconstruction of the urban fabric. Each map was selected to represent an important historic point in the city. In order to identify the periods of interest and their corresponding base maps, a selection of leading questions should be addressed:

- What are the most important dates that reflect not only important historical events but also a vital urban transformation to the fabric of the city?
- What are the available relevant cartographic and architectural information that will allow an acceptable level of accuracy in the resulting models, and to which period do they belong?
- To what extent can textual information supplement the modeling process?

The architectural and urban description of the city in historical documents actively began with the Zengid period and steadily increased from that point. Unfortunately, reliable cartographic information is not available for both periods, but the process is slightly easier for the Mamluk period, especially towards the end of their rule, since, by that time, the intra-mural city was comparable to the one of the Ottomans and the differences can be easily extrapolated from textual data. Therefore, the first chosen date is at the end of the Mamluk rule in 1516.

The second date represents the city after the war and at the time of the field survey in 2018. Hereinafter is a list of the selected plans and explains the reasons behind their selection as a base map for the historic model:

- The Ottoman map 1900: This map was chosen because it is the earliest accurate map of the city that incorporates details of the walls, important buildings, and the elevation information. The map offers important information about the expansion of the city, and it is used to model the city at the end of the Mamluk Era and as a base map to represent the city at the end of the Ottoman period.
- The Cadastral map of 1930 offers an accurate survey of the city before the 20th Century changes to the urban fabric to along with the Ottoman map as a second base map to model the city after 1946.
- The "Aleppo Archive in Exile"-map: It was chosen due to the bulk of information and metadata incorporated in the maps, from courtyards, the parcels and their numbers to

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the most important buildings and their details. It will be used to represent the city before the war that started in 2011.

- The map of Gaube and Wirth is also used to complement the creation of the three chosen points in time.

The third and final model will be compared with the digital survey in order to check the fidelity and accuracy of the molding when compared to a realistic model, also to identify the changes and estimate damages after the war.

II.1.6 Aligning, geo-referencing and superimposing the scaled maps

The first step of preparing the base maps is visualizing and aligning them in the same datum and in accordance with the current layout of the city. Given most of the maps do not offer information about the used geo-reference system, they had to be aligned and geo-referenced manually in QGIS that bases and relies on the geo-referenced orthographic photo that resulted from the survey conducted for this study.

In addition to the selected base maps, several aerial photographs were aligned in the same file such as the aerial photograph taken by Michel Ecochard in 1936 and images from the archive of the spy-satellite "Corona" taken between 1968-1970. The alignment process allowed to accurately track the spread of the high-rise buildings, division of courtyards, and new commercial and residential constructions. Moreover, the result represents the most complete layered map of the city encompassing all the cartographic data of Aleppo, where each layer complements different missing elements of other maps. But more importantly, we can identify the errors in each map and correct them in the parametric model. The maps were added to QGIS and sorted from the newest to the oldest.

The first comparison is through the alignment of the map of Aleppo archive in exile with orthophoto from the field survey (Fig. 43). Five reference points were selected from different areas on both maps; then a linear transformation was applied.

First, we notice the remarkable accuracy and fitting between the map and the orthophotos. Nonetheless, several discrepancies are recognizable, mainly concerning the orientation, size, and number of courtyards. Moreover, it is evident that the number and size of courtyards had decreased, while the width and orientation of the street network were mostly conserved.

Adding another old layer (the cadaster map of 1930) reveals additional information compared to the survey results regarding the changes in the size, distribution of open spaces and

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courtyards. Courtyards marked with red rectangles have been subject to alteration, division and covering. On the other hand, there are courtyards that are not recorded in both the cadaster of 1930 and the map of the Aleppo Archive in Exile (AAE) (marked in red).

From the density and distribution of the red rectangles, the photo suggests a medium level alteration, in terms of the 2D plans. Those changes will be examined in the third dimension in the context of the fourth chapter.

Still the most challenging alignment process is for the Ottoman map of 1900 because of the curved distortion in the center of the map and the tilting distortion around the main *souk*, as well as fortifications. A testing protocol was developed to allow for an accurate placement along with the newer maps. The process revolves around the testing of different points on the maps of 1900 that are more likely to have remained unchanged. Different combinations of points were tested to achieve the most accuracy with the least distortion. Despite multiple attempts, using over 70 reference points and applying a thin plate spline transformation, a significant distortion remains.

Nonetheless, the comparison provides information about the urban changes. Firstly, we recognize that the street behind the walls of the city in the *'Aqaba* quarter was actually a cul-des-sac (Fig. 45, 1). Additionally, the wide street leading to *Jāmi' al-Kizwānī* (Fig. 45, 2) is not visible, however, it seems unlikely that it did not exist due to different elevation around its sides and the fact that it borders an open space. The same cannot be said about the street perpendicular to it (3), where only a small section of it existed as a cul-des sac- and was extended later. *Darb Ibn Qays* was also extended (4) until the street parallel to the wall (1), new streets emerged separating the fabric further (5, 6). The new streets and the cracked cul-des-sac resulted in the separating of the section of *Tallet al-'Aqaba* behind the wall to six distinct blocks that also started to accommodate high rise buildings despite its initial advantageous elevation.

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Fig. 43 The orthophoto from the survey overlayed with the AAE map, exported from QGIS, compiled by Orabi, 2023.

Fig. 44 The orthophoto from the survey overlayed with the AAE map and the map of 1930, exported from QGIS, created and designed by Orabi, 2023.

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Fig. 45 The geo-referenced maps of 1900 the AAE map overlaid, exported from QGIS, created by Orabi, 2023.

Chapter 2 discussed the urban development of the city through the available topographical, cartographic, and painted sources. During that overview, we conclude that until the second half of the Ottoman period, the city preserved its initial urban features. All the new buildings that were accommodated by the successive rulers had been added to the puzzle without altering the core of its fabric. Throughout history, different development principles were applied to create an organically grown organism against a planned artificial built environment. The most transformative period regarding the fabric of the intra-mural city is represented by the Ayyubid and Mamluk periods. The late Ottoman period introduced urban planning systems, with the decline of the importance of fortification and the new requirements for wide roads to accommodate vehicular traffic. Despite the political change, invasion, economic instability, and natural disasters, the intra-mural city did not undergo a drastic urban intervention until the major master urban projects implemented in the 1990s, albeit the studied area remains the least affected by both Gutton's and Banshoyas' master plans.

Moreover, the most informative maps of the city were identified and aligned in the same datum of the results of the survey conducted during this study. This clearly revealed the changes to the urban fabric in terms of the division of urban blocks and the degradation of green spaces and courtyards. This analysis will play a pivotal role in the parametrization workflow to be designed within the scope of the study. In this workflow, the information of different levels such as urban and architectural surveys and different types such as historical text, images and

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paintings could be combined together as the metadata of the 3D visualization of Aleppo as the parametric layers of the digital model.

The following chapter 3 will examine the historical sources that wrote about Aleppo, in search for architectural information to guide and support the creation of the 3D model based on the 2D maps presented in chapter 2.

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CHAPTER THREE

AN ARCHITECTURAL READING OF THE WRITTEN HISTORICAL SOURCES

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Chapter 3 will discuss the historical text that describes the old city of Aleppo, with special focus on the architectural and urban development, patronage, change of function, infrastructure expansion, and on the form of an architectural translation of the historic text. However, this chapter does not include sources that mention Aleppo as a part of the province as it lacks the details, scrutiny, background, and perspective that local historians provide (see below). The information discussed in this chapter will provide the basis for the process of extracting parameters from the historical information and the implementation in the three-dimensional mainframe.

III.1 An Architectural Reading of History

Among the numerous manuscripts prepared about Aleppo, the ones written by Aleppian historians or ones who lived in Aleppo paint the most vivid picture of the city. They are listed in this chapter according to the date of the manuscript as:

1. The medieval sources: Starting from the book of Ibn al-ʿAdīm named "*Bughiyat al-Ṭalab fī Tārīkh Ḥalab*", its concise version of "*Zubdat al-Ṭalab fī Tārīkh Ḥalab*", in addition to the most famous and valuable manuscript about Aleppo "*al-Aʿlāq al-Khatīra fī Dzikr Umarāʾ al-Shām wa al-Jazīra*" by Ibn Shaddād, to the book of Abū al-Fidaʾ "*al-Yawāqīt wa al-Ḍurab fī Tārīkh Ḥalab*", and finally the most architecturally informative manuscript titled "*Kunūz al-Dzahab fī Tārīkh Ḥalab" by Ibn al-ʿAjamī.*
2. The modern sources include "*Nahr al-Dzahab fī Tārīkh Ḥalab"* by Kamāl al-Ghazzī.

It is simpler to track the text-recorded changes of the fabric of the city by tracing the times and locations these changes took place. In other words, tracking the timeline can be achieved by following the patronage, which will eventually yield patterns and parameters of construction depending on the patron and the period in which the specific work was commissioned. As for the location, the city will be examined according to three main urban elements and districts:

- The walls and gates of the city.
- Changes in the *al-Jallūm* District.
- Changes in *al-ʿAqaba* District.

The focus is not on the dates or the patrons, rather than on the architectural information that can be interpolated from that information and the possibility to express it in a three-dimensional

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context. However, as previously mentioned, discussing the periods of restoration and construction allows the establishment of a timeline of the works in order to facilitate the modeling process for each period of that particular timeline.

III.1.1 Aleppo in Medieval Sources

III.1.1.1 ***Ibn al-ʿAdīm: Bughiyat al-Ṭalab fī Tārīkh Ḥalab and Zubdat al-Ṭalab fī Tārīkh Ḥalab***

The author's work was introduced in the literature review section. His book consists of three volumes, the first of which addresses the city and its elements, while the subsequent volumes focus on public figures related to the history of the city. He later shortened the book and renamed as "*Zubdat al-Ṭalab fī Tārīkh Ḥalab*". It consists of 30 sections organized according to historical chronology starting from the pre-Islamic history of the city. Although he does not mention architectural nor urban description, we can recognize the existing monuments and elements of the city in his lifetime.

III.1.1.1.1 The walls and the gates of the city

Ibn al-ʿAdīm mentions that most of the walls of Aleppo were built by the "Rūm", a name Arab historian often describe the Byzantines. He also records the restoration they carried out on the walls after the attack of the Persians using big mud bricks which he refers to as "*the big wall of the city*" that is visible between *Bāb al-Jinān* and *Bāb al-Yahūd*.[313] Upon the conquest of the Muslims, they entered the city through *Bāb Anṭākiya*.[314]

In "*Bughīyt al-Ṭalab fī Tārīkh Ḥalab*", Ibn al-ʿAdīm mentions the presence of many bastions along the walls that were restored by the Muslim rulers, a detail that was also visible on the Ottoman map of 1900. The first to begin the restoration works of the walls was Nūr al-Dīn, who built a short wall outside of the walls stretching between *Bāb al-Ṣagir*, *Bāb al-ʿIrāq*, and *Qalʿat Sharīf*, followed by *Bāb al-Yahūd* to *Bāb al-Jinān*, and from *Bāb al-ʾArbaʿīn* to *Bāb al-Yahūd*.[315]

al-Zāhir Ghāzī built the outer ring for fortification along (*Khandaq al-Rūm*) by elevating the short walls of Nūr al-Dīn.[316] His projects also included the renovation of the defensive walls

[313] Zubdat al- Ḥalab fī Tarīkh Ḥalab, p. 12
[314] ibid. p. 16
[315] Bughiat al-Ṭalab fī Tarīkh Ḥalab, p. 51
[316] Zubdat al- Ḥalab fī Tarīkh Ḥalab, p. 452

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between *Bāb al-Jinān* to *Burj al-Thaʿābīn*. In addition to renovating the bastions on the main wall [317] and commissioning a new gate called *Bāb al-Farādīs*, that would have had a bridge over the northern section of the trench of the city; al-Zāhir Ghāzī died before completion.[318] He also deepened the trench (*Khandaq al-Rūm*) stretching from *Qalʿat Sharīf* to (*Bāb al-Maqām*), (*Bāb al-Nayrab*) and (*Bāb al-Qanāt*) until it connects to the moat of the city [319]. Moreover, he remodeled and changed the name of *Bāb al-Yahūd* to *Bāb al-Naṣr* and replaced the original gate with a gate consisting of four doors, flanked by high bastions.[320] The active patronage of al-Ẓāhir Ghazi awarded him the name "the builder of Aleppo".

Tughril Beg constructed another bastion between *Bāb al-Naṣr* and *Burj al-Thaʿābīn* in front of the lime kilns and the Jewish cemeteries and ordered the stones to be cut from *Khandaq al-Rūm* to further increase its width and depth.[321]

al-Nāṣir Yūsuf renovated the bastions from *Bāb al-ʾArbaʿīn* to the new *Burj of Tughri*; he ordered the addition of other bastions between *Bāb al-Jinān* and *Bāb Qinnasrīn*.[322] He also renovated, expanded and commissioned new flanking towers around *Bāb Qinnasrīn*.[323] Similarly, he completed *Bāb al-Farādīs*[324] and commissioned a gate between *Burj al-Ghanam* and *Bāb Anṭākiya*, called "*Bāb al-Saʿāda*" which was flanked by two towers.[325]

What we can interpolate of that information that the following gates were present before the arrival of Muslims to Aleppo:

1. *Bāb al-Jinān.*
2. *Bāb al-Yahūd (Bāb al-Naṣr).*
3. *Bāb Anṭākiya.*
4. *Bāb al-Qanāt (Bāb al-Ḥadīd).*[326]
5. *Bāb Qinnasrīn.*

Other doors such as *Bāb al-ʾArbaʿīn*, *Bāb al-ʿRāq*, *Bāb al-Ṣagīr*, and *Bāb al-Faraj* might also be pre-Islamic, because they are mentioned as existing in the Ḥamdanīd period without any reference to their patron princes, which is unusual for Arabic chronicles.[327] After Muslims

[317] Bughiat al-Ṭalab fī Tarīkh Ḥalab, pp. 51-52
[318] ibid. p. 56
[319] ibid. p. 54
[320] ibid. p. 55
[321] ibid. PP. 51-52
[322] ibid. p. 51
[323] ibid.55
[324] ibid. p. 56
[325] ibid.
[326] ibid. p. 54
[327] Zubdat al- Ḥalab fī Tarīkh Ḥalab, p. 87

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renovated the walls, they added bastions and new gates. At his time, he records them as the following, starting from the north-east of the inner ring and moving counterclockwise to the exterior ring:

1- *Bāb al-ʾArbaʿīn*, which was closed for a prolonged period of time.[328]

2-*Bāb al-ʿIrāq*, on the interior ring of fortifications, mirrored along a tilted axis by another door on the exterior ring of fortification which was closed after the death of al-Zāhir Ghāzī.[329]

3-*Bāb al-Ṣagīr*, on the interior ring of fortifications, mirrored along a tilted axis by "*Bāb al-Nayrab*" on the exterior ring of fortification.

4-*Bāb Qinnasrīn*.

5-*Bāb al-Saʿāda*.

6-*Bāb Anṭākiya*; however, there was another door outside the walls of the city on the bridge of "*Anṭākiya*" on the *Qūayq River* named "*Bāb al-Salāma*".[330]

7-*Bāb al-Jinān*.

8-*Bāb al-Faraj*.[331]

9-*Bāb al-Farādīs* (*Bāb al-Faraj* 2).

10- *Bāb al-Naṣr* (*Bāb al-Yahūd*).

11- *Bāb al-Ḥadīd* (*Bāb al-Qanāt*).[332]

12- *Bāb al-Nayrab*.

13- *Bāb al-Maqām* that leads to the shrine of Ibrahīm.

14- *Bāb al-Rabiya*, located on (*Khandaq al-Rūm*), between the (*Bāb Qinnasrīn*) and the outer ring of fortifications.[333]

Only *Bāb al-Aḥmar* (*Bāb Yaloj*) was not mentioned in both manuscripts. While the sole bastions mentioned by name are (*Burj al-Ghanam*) on the southern section of the walls and (*Burj al-Thaʿābīn*) on the western section. But more importantly, we note that the use of flanking towers was an important parameter and indicator for renovated gates and an established element of the newly commissioned gates.

[328] Bughiat al-Ṭalab fī Tarīkh Ḥalab, pp. 55
[329] ibid. p. 56
[330] ibid. p. 57
[331] ibid.
[332] ibid. p. 54
[333] ibid. p. 57

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III.1.1.1.2 *al-ʿAqaba* and *al-Jallūm* Districts

Not much information is mentioned in the literature regarding the urban organization of the districts except for the following:

1- *Qal'at Sharīf* was not yet built, and the walls of the city were continuous along the hill that the citadel later occupied.[334]
2- The residents of *al-ʿAqaba* and *Qal'at Sharīf* had rainwater-collection cisterns. [335]
3- The Jewish residents brought the area known today as *Qal'at Sharīf*. [336]

III.1.1.2 ***Ibn Shaddād: al-A'lāq al-Khatīra fī Dzikr Umarāʾ al-Shām wa al-Jazīra***

Muḥammad ibn ʿAlī ibn Ibrāhīm, ʿIzz al-Dīn ibn Shaddād al-Anṣarī al-Ḥalabī (1217-1285 CE) was an Aleppian historian who served under Saladin [337] and continued serving the Ayyubid Sultan until 1259. When he moved to Egypt after the Mongol invasion of Aleppo [338]. He was received and appreciated by al-Malik al-Ẓāhir Baybars and authored his biography under the title "al-Rawḍ al-Zāhir fī Sīrat al-Malik al-Ẓāhir". He remained in the service of Mamluks until his death. [339] In this section, we explore the architectural description of the city in his book "*al-A'lāq al-Khaṭīra fī Dzikr Umarāʾ al-Shām wa al-Jazīra*". The book was written in three volumes: The first one discusses the history of Aleppo, its monuments and notables, while the other two address Damascus and al-Jazīra respectively. For the purpose of this thesis only the first manuscript was consulted.

III.1.1.2.1 The Walls and the gates of the city

Like Ibn al-ʿAdīm, Ibn Shaddād references the building of the wall to the Byzantines, however, unlike the previous architect, he mentions the bastions being renovated by the Umayyads[340], then he lists the patrons who commissioned the restoration works and discusses each door separately. At times, he reported similar information of that of Ibn al-ʿAdīm, yet with more clarity and consistency. For instance, the followingly the discussed description of the gates and towers of the city and their locations and patrons is by far superior to that of Ibn al-

334 Bughiat al-Ṭalab fī Tarīkh Ḥalab, pp. 54
335 ibid. p. 58.
336 Zubdat al- Ḥalab fī Tarīkh Ḥalab, p. 54.
337 Ibn Shadād, Vol 2, p. 20
338 https://al-maktaba.org/author/778
339 Ibn Shadād, Vol 2, p. 22.
340 Ibn Shadād, Vol 1, p. 59.

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ʿAdīm. Hereinafter, he listed the newly presented information, firstly in terms of patronage of the fortifications, secondly in terms of each of the gates.

After the Byzantine invasion, Sayf al-Dawla restored the walls in 964 CE and bastions, including one bastion to the west of (*Bāb Qinnasrīn*), yet he does not mention its name, other sources however, refer to it as (*Burj al-Ghanam*).[341] His son Saʿd al-Dawla ibn Ḥamdān also carried another restoration project in 977 CE. During the Mirdasid rule, Sāliḥ bin ʿAlī built new bastions in 1029, which remained until they were destroyed by the Mongols.[342]

In his description of the work of al-Zāhir Ghāzī, he specifies 1196 CE as the date for digging the ditches and extending the small wall to form the exterior ring of fortification. Ghāzī also renovated the bastions and made them equal in height with the interior ring, in addition to towers between (*Bāb al-Jinān*) and (*Bāb al-Naṣr*).[343] The princes appointed by him were ordered to carry out the completion of those bastions, with each prince assigned a tower and were branded by his name.[344]

Ghāzī commissioned (*Bāb al-Ṣaghīr*) next to his new courthouse (*Dār al-ʿAdl*) which construction work started in 1189 CE. Adjacent to it he commissioned a gate for his personal use that takes its name from the building (*Bāb Dār al-ʿAdl*).[345]

al-Nāṣir Yūsuf prepared the defenses of the city by building citadel-looking-bastions on the wall in 1244, upon unfruitful attacks of the Mongols. Those towers were more than 20 and distributed between (*Bāb al-ʾArbaʿīn*) and (*Bāb Qinnasrīn*).[346] Followingly, he describes the towers' dimensions and style as follows:

1- The height is more than 40 cubits [347] (19.3 m to 27 m).
2- The width between 40 (19.3 m to 27 m) to 50 cubits (24.1 m to 33.8 m).
3- Each had two porches (possibly arrow loopholes) to protect the warriors from arrows and the missiles of catapult.[348]

341 Ibn Shadād,Vol 1, p. 60
342 ibid. p. 61
343 ibid. p. 62
344 ibid.
345 ibid.
346 ibid. pp. 65-66
347 The Cubit being between 48.25 to 67.7 (cloth cubit in Aleppo).
348 Ibn Shadād,Vol 1, pp. 65-66

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The overall number of the fortification mounted to 128 for both towers and curtain walls connecting those towers, while the circumference of the exterior ring of walls measured 6825 Cubit (3293 m to 4620.5 m).[349]

In another estimation for the lengths of the cubit, we can examine the height of the Minaret of Aleppo. It was mentioned that its length is around 97 cubits [350] which allows us to calculate the cubit used during that period as ~0.464 m since the *minaret* measures 45m., while al-Gahzzī mentioned that the cubit of the builder is 76 cm during the Ottoman period[351].

These measurements provide the first step to recreate the defensive parameter of the studied area and contribute to the creation of plans of mass and void for and the following comparison with the earliest available survey from the year 1900. Unfortunately, no further data is available on the conversion of the Cubit to modern measurement units. Therefore, the entire workflow of the study was designed to address this issue. The parametric nature of the model allow for the alteration of the value of cubit and the model with be changed with the value in real-time.

As for the examination of each of the gates independently, he begins with *Bāb Qinnasrīn.* His description does not mention the old palimpsest of the gate, but rather associates it with Sayf al-Dawla. The next mention is for al-Nāṣir Yūsuf, and the project that took place in 1256, allegedly using stone transported from a town near Aleppo called (al-Nāʿūra) from a palace built by the Umayyad prince (Maslama bin ʿAbd al-Malik). It incorporated castle-like towers, mills, furnaces, water and oil cisterns.[352] It was the first gate to be destroyed at the time of the Mongol invasion, later al-Zāhir Baybars supposedly transported the iron and nails of this door to Egypt and Damascus.[353] What we understand from this that the gate might have been in a bad shape and that using it as a query of raw material was more profitable than restoring it.

Moving eastward along the interior ring of fortification, the next door is (*Bāb al-ʿIrāq*). It is an old gate with flanking towers; somewhere on them they bear the inscriptions Ṣālih bin Mirdās. To its east lies (*Bāb al-Ṣagīr*), outside of it Ghāzī renovated two other gates a second (*Bāb al-Ṣagīr*) and (*al-ʿIrāq*).[354]

349 Ibn Shadād,Vol 1, pp. 65-66
350 Ibn al- Shuḥna, p. 67
351 al-Ghazzī, Vol 1, p. 90
352 Ibn Shadād, Vol 1, p. 69
353 ibid. p. 70
354 Ibn Shadād, Vol 1. p. 71

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The rest of the details are mostly repeated from Ibn al-ʿAdīm, except for the following:

1- *Bāb al-ʾArbaʿīn* had two gates.[355]
2- *Bāb al-Maqām* was known as *Bāb Nafīs*.[356]
3- *Bāb al-Qanāt* is the location of the water canal entering Aleppo drawn from the fountain of *Ḥaylān*.[357]
4- *Bāb al-Naṣr* was modified by Ghāzī to encompass four doors, each two of them have a vaulted curtainwall that enables movement from one to the other. A bridge over the moat was built, in addition to flanking towers. [358]
5- *Bāb al-Farādīs*, built by Ghāzī and closed after his death, until it was re-opened by his son al-Nāṣir Yūsuf.[359]
6- *Bāb Anṭākiya* was destroyed by Nikephoros in 962 CE, restored by Sayf al-Dawla, and later demolished and rebuilt by al-Nāṣir Yūsuf between (1245-1247). It is constituted of two flanking towers with two doors, a porch and vaulted curtainwalls that facilitate movement.[360]
7- *Bāb al-Saʿāda*, was equipped with flanking towers, two door and a porch.[361]
8- *Bāb al-Faraj* was destroyed by al-Ẓāhir.
9- *Bāb* al-Salāma was destroyed by Nikephoros.[362]

III.1.1.2.2 *al-Jallūm* District and *al-ʿAqaba* District

There is no specific information about the neighborhoods themselves, instead the text focuses on individual buildings -mostly religious- that will be discussed in the following sections. However, the text also reported important information regarding open spaces in the city along with their dimensions. Although some of the mentioned locations are outside the studied area, yet together they compose of an unbreakable cluster of open spaces that is important to understand the void-to-mass ratio within the city. They were reported as follows[363]:

355 Ibn Shadād, Vol 1. p. 72
356 ibid. p. 73
357 ibid.
358 ibid. p. 74
359 ibid.
360 ibid. p. 75
361 ibid.
362 ibid. p. 76
363 ibid. pp. 65-66

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1- al-*Midān al-Akhḍar*, built by ʿMād al-Dīn Zankī[364]. It measured 50 (24.1 m to 33.8 m) cubits on the southern side and 70 cubits (31.67 m to 47.3 m) on the northern side.
2- *Midān Bāb Qinnasrīn*: Outside of its namesake gate, measuring 1150 cubits (554.9 m to 778.5 m) in length with no mention of the other dimension.
3- *Midān Bāb al-ʿIrāq*: It was commissioned by Nūr al-Dīn Zankī in 1158 CE and is reported to have two gates, one of them is (*Bāb al-Ṣagīr*), while the other one is closed (after the death of Ghāzī) [365]. It measures 520 cubits (250 m to 352 m) in length, 85 cubits (41 m to 57.5 m) in width on the southern side and 150 cubits (72.4 m to 101.5 m) to the northern side.
4- Another *Midān* was mentioned in the text outside the list of open spaces that is *Midān al-Ḥaṣa*, located outside of *Bāb al-Saʿāda*, without any reference to its dimensions.[366]

III.1.1.2.3 Important buildings within the two neighborhoods

The following discussed book of Ibn al-ʿAjamī and ibn al-Shuḥna adopts much of the text of Ibn Shaddād and supplements it with further architectural and urban information. Therefore, in order to prevent repetitiveness and incomplete information, it is wise to discuss this section for all of the historians combined.

III.1.1.3 ***Ibn al-Shuḥna: al-Durr al-Muntakhab fī Tārīkh Mamlakat Ḥalab***

Muḥammad ibn Muḥammad ibn Muḥammad ibn Maḥmūd ibn Ghāzī al-Thaqafī al-Ḥalabī. known as Abū al-Faḍl ibn al-Shuḥna al-Ṣaghīr (1402-1485 CE), [367] born and raised in Aleppo, served as a teacher of the *Ḥanafī* madhab in many of the schools in Aleppo.[368] His books are mostly of a religious category, except the book of *"al-Durr al-Muntakhab fī Tārīkh Mamlakat Ḥalab"*. Like his predecessors, he discussed the history of Aleppo, the change of its name and added a description of its architecture, walls, palaces, public and religious buildings. In addition to what Ibn Shaddād forgot to mention in his preceding book, as well as the buildings were commissioned after his time.

[364] Ibn Shadād, Vol 1. p. 81. No mention of its precise location but other sources put that space in or around the citadel.
[365] ibid. p. 71
[366] ibid. p. 75
[367] Ibn al- Shuḥna, p. 15
[368] ibid. p. 19

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III.1.1.3.1 The walls and the gates of the city

His information regarding the walls and the gates of the city are basically a combination of what Ibn Shaddād and Ibn al-Khaṭīb had already described previously. Nonetheless, he provides new information of his own accord that sometimes either adds to the previous sources or contradicts them. Hereinafter, a discussion of the newly mentioned information could be:

The gate that al-Ẓāhir Ghāzī commissioned between *Bāb al-Jinān* and *Burj al-Tha'ābīn* was known as *Bāb al-'Abāra*[369]. Later it was to be called *Bāb al-Faraj*[370] which contradicts previous accounts that the gate was known as *Bāb al-Farādīs* while *Bāb al-Faraj* belonged to an older period. Moreover, he mentioned that Aleppo did have a gate with the name "*Bāb al-Faraj*" located under the citadel next to another gate called *Bāb al-'Āfîya* and was demolished by Ghāzī.[371] The father of Ibn al-Shuḥna was one of the princes entrusted by Ghāzī, which was a customary request during that period, to carry out the construction of the towers across the walls of the city.[372] However, it is unclear whether *Bāb al-'Āfîya* is another name for *Bāb al-'Irāq* since it is in the vicinity of the described area.

Another gate between *Qal'at Sharīf* and *Bāb al-Nayrab* is mentioned as *Bāb al-Nafîs*, which is mentioned later as *Bāb al-Maqām*. Another door is located westwards, and the gate was mentioned as *Bāb al-Rabīya*, however destroyed during the rule of Ilghazī bin Artaq.[373]

According to Ibn al-Khatīb, the walls renovated by al-Nāṣir Yūsuf were drastically destroyed by Hulagu; they remained in the state of demolition until the reign of Sayf al-Dīn al-Ḥamwī.[374]

The walls were again destroyed by Timur Lenk. Some of the defenses were consecutively loosely patched. But no major work was commissioned until the reign of Mūayyad Shaykh, when he ordered the walls and the towers to be restored according to their previous design, including the rebuilding of *Bāb al-'Irāq* and *Bāb al-'Arba'īn*.[375] Mūayyad Shaykh died before complaining the work on the interior ring of fortification. While the exterior ring was later completed by Sultan Ashraf Birsbay as well as the demolished section of the walls built on the side of *Jāmi' al-Ṭawāshī* and the *Bizza* neighborhood.[376] As a result, the inner ring of

[369] Ibn al- Shuḥna, p. 36
[370] ibid. p. 33
[371] ibid. p. 36
[372] ibid. p. 33
[373] ibid. p. 36
[374] ibid. pp. 37- 38
[375] ibid. p. 37-38
[376] ibid. pp. 37-38

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fortification was completely renovated, allowing to more fluid movement within the intra-mural city.

Bāb al-ʿIrāq bared the inscription of the name Thumāl bin Sāliḥ bin Mirdāsh (1029 CE). Ibn al-Khatīb mentioned that it is located north to *Jāmiʿ al-Ṭawāshī* and *Hammam al-Dzahab*.[377]

While *Bāb al-ʾArbaʿīn* was renovated at the time of al-Ẓāhir Ghāzī, it has reached a state of disrepair by the reign of Ashraf Birsbay, who ordered the remaining of its stone to be used in the reconstruction work of the exterior ring of walls.[378]

Bāb al-Maqām was also named *Bāb Nafīs* during the times of Ibn al-Shuḥna.[379] He brings up the first mention of *Bāb* Khandaq *Yāloj (Bāloj)* or *Bāb al-Aḥmar*, possibly during the reign of al-Malik al-ʿAzīz.[380]

Ibn al-Shuḥna assumed that *Bāb al-Jinān* is the identical name as *Bāb al-Farādīs* because they are synonyms in the Arabic language.[381] Yet, previously discussed historical descriptions put them in two different locations, which was also abruptly noted by Ibn al-Shuḥna himself and assumes that *Bāb al-Farādīs* is another name for *Bāb al-Faraj*, which is more likely the case.[382] On this argument, Herzfeld based his estimation of the location of some of the extant gates and tower, which will be discuss later in the course of this chapter.

III.1.1.3.2 Important Buildings within the two neighborhoods

Regarding the open spaces of the city, another *Midān* is mentioned outside *Bāb al-Saʿāda* named "*Midān al-Ḥuṣa*".[383], in addition to a reference to an earthquake in 1179 that destroyed most of the houses in Aleppo,[384] without indicating which neighborhoods were affected. As for the rest of the important buildings, they were sorted according to their function. These examples are discussed in the following section along with the ones mentioned by Ibn Shaddād and Ibn al-ʿAjamī in order to avoid repetition and incomplete description of individual monuments.

377 Ibn al- Shuḥna, p. 41
378 ibid. pp. 42-43
379 ibid. p. 43
380 ibid. p. 44
381 ibid. p. 45
382 ibid. p. 46
383 ibid.
384 ibid. pp. 67-68

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III.1.1.4 ***Ibn al-ʿAjamī: Kunūz al-Dzahab fī Tārīkh Ḥalab***

Abū al-Dzurr, Mūafaq al-Dīn, Aḥmad Ibn Ibrahīm, known by Ṣabt Ibn al-ʿAjamī (1415-1480), although he is from Tripoli, he was born in Aleppo and lived there until his death. He authored 12 books [385]; the one concerning this study titled "*Kunūz al-Dzahab fī Tārīkh Ḥalab*". It is published in two volumes. The first one discusses Aleppo from its historical, urban and architectural aspects, while the other lists important figures and notables in history in general and those of the city in alphabetical order. Therefore, for the purpose of the study only the first volume will be consulted.

Ibn al-ʿAjamī relied in his text on the book of Ibn Shaddād. Nonetheless, he included more detailed information regarding the location, architecture, and urban characteristics of the city.

Like his contemporary colleague, Ibn al-Shuḥna, he included the architectural and urban changes that were made after the time of Ibn Shaddād. Yet, his work stands out among the historical text because it included a much-detailed description of the plan of the city in term of street names and buildings names, location, and brief descriptions of their architecture.

III.1.1.4.1 The walls and the gates of the city

His description of the walls of Aleppo relies heavily on Ibn Shaddād. The latter information is provided regarding the restoration work at the time of Sultan Mūʾayyad Shaykh and the renovation of bastions from *Bāb al-Jinān* to *Bāb Qinnasrīn*, in addition to the later work carried out by al-Ashraf Birsbay.[386]

The only new information that he provides is the following (the remaining and lost gates and towers are represented in Fig. 46)

1- The presence of a tower next to *Qal'at Sharīf*.[387]
2- Another mention of *Bāb Khandaq Bāloj*.[388]
3- Notes the fact that *Bāb al-Farādīs* is being named as *Bāb al-Faraj*, [389] as previously suspected by Ibn al-Shūḥna.
4- The older *Bāb al-Faraj* was located next to the *Hammam al-Qasīr* by the citadel.[390]

[385] Ibn al- ʿAjamī, Vol 1, p. 34
[386] ibid. p. 555
[387] Ibn al- ʿAjamī, Vol 1, p. 557
[388] ibid. p. 558
[389] ibid. p. 559
[390] ibid. p. 560

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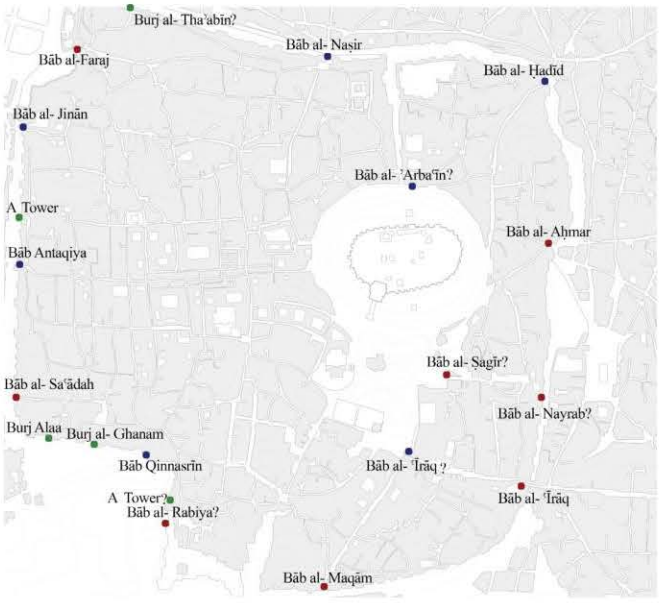

Fig. 46 The recorded gates and towers of the city in the time of Ibn al-ʿAdīm. Pre-Islamic gates are in blue, Islamic gates are in red and towers are in green. Redrawn by Orabi, 2023.

III.1.1.4.2 *al-Jallūm* and *al-ʿAqaba* District

III.1.1.4.2.1 The Grid of Streets.

Prior to the work of Ibn al-ʿAjamī, the historical text was limited to the mentioning of the names of the streets or *souks*. However, he took a more detailed yet limited approach by including the location of these streets and the most important buildings in some of them. For the limits of the research, only the list of the streets of *al-ʿAqaba* district and sections of *al-Jallūm* district are mentioned here. It is crucial to identify those names in order to better understand the orientation and descriptions available in the historic text and facilitate their identification in the cartographic data and their implementation in the urban reconstruction.

The first attempt to connect the old names of the streets with their modern counterparts was undertaken by al-Gazzī and later by the scholars Gaube and Wirth. Combining the information provided by Ibn Shadād, Ibn al-ʿAjamī, al-Ghazzī and Gaube and Wirth, we can list the street located in the studied area in addition to the most important monuments within them, from east to west as the following:

1- *al-Qaṣaba* is the street the stretches west to east from *Bāb Anṭākiya* to the citadel.[391]
2- *Darb al-Bazādra* (*Jadat al-Barqa*[392]) was the first street after *Bāb Anṭākiya* running south along the wall of the city [393] to *al-Jallūm*.

[391] Ibn al- ʿAjamī, -, p. 451
[392] (*al*-Ghazzī, Vol 2, p. 62)
[393] Ibn al- ʿAjamī, -, p. 451

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3- *Darb al-Zaydiyya*, to the east of the previous street. There is a mosque and a *Ṣibāṭ*[394] in its beginning[395], and a school of the same name.[396]

4- *Darb Ibn Kazlak*, located to the east of *Darb al-Zaydiyya*, includes a mosque built in 1375 CE (*Masjid al-Sayid Hū*).[397]

5- *Darb al-Ḥaṭṭābīn* (*Darb bin Salār*) or (*Zuqāq* al-*Madār* [398]), within is located *al-Madrassa al-Muqadamiyya* and a *Khānqa* commissioned by ʿAbd al-Malik bin al-Muqaddam, as well as a suspended (Muʿallaq) mosque at the southern end – modernly named as *Masjid Muḥarm* [399] commissioned by Jaʿfar bin Muzāḥim. [400] Another mosque is located at the extension of this street to the south.[401]

6- *Darb al-Khirāf*, in the time of Ibn Shadād, there was a mosque in the beginning[402] of the street commissioned by Amīn al-Dīn al-Isḥaqī.

7- *Darb al-Subayʿī* (*Darb* al-Ṭayr al-ʿatīq[403]) to the east of *al-Bīmāristān al-Nūrī* also we can find *Masjid* ibn Zurayq[404] (*Masjid al-Shaykh Abudllah*[405]).

8- *Darb Hammam ʿItāb* is the next street to the east. In this street, traces of the *Hammam* are still visible. [406]

9- *Darb al-Dahānīn*, where Dār al-Zakāt, a *Hammam* and *Khan al-Dahhān* (*Khan* ibn al-Jalī)[407] are located. The area was also known as *Tall Fayrūz*. Later, *Khan al-Jumruk* was built closing this street. [408]

10- *Darb al-Ḥaṣṣārīn*, within it, there was a public toilet and a mosque commissioned by Abū al-Fatiḥ Masʿūd bin Sabiq al-Dīn ʿUthāmn in 1209 CE, and the remains of a suspended mosque known as "al-*Masjid al-Muʿallaq*".[409]

11- *Darb* "*Hammam al-Sit* "; it was not officially referred to by that name, but it contained two bath houses, one non-working. [410] Both baths were known as *Hammam* al-Sit. The working bath house got renamed modernly as (*Hammam al-Naḥḥāsīn*). [411] In addition

394 A vault-covered section of the street.
395 Ibn al- ʿAjamī, -, p. 451
396 Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 214
397 ibid.
398 al-Ghazzī, pp. Vol 2, 57
399 Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 214
400 Ibn al- ʿAjamī, Vol 1, p. 452
401 Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 214
402 The orientation the mentioned streets are north to south.
403 Ibn Shadād, Vol 1, p. 147
404 Ibn al- ʿAjamī, Vol 1, p. 453
405 Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 215
406 ibid.
407 Ibn al- ʿAjamī, Vol 1, p. 454
408 Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 215
409 Ibn al- ʿAjamī, Vol 1, p. 454
410 ibid. p. 454
411 Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 215

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to the hotel of ʿAīsha, we can find the remains of a mosque, a working mosque to its south and *Khan al-Qaūasīn.*[412]

12- *Darb al-Dilba* to the east, within it, there were a jail, a bath house (*Hammam al-ʿAfīf*) and a mosque at its northern side, later, two bath houses were commissioned by ʿAlam al-Dīn bin al-Kuayz and a suspended mosque.[413]

Concluding the vertical north-to-south streets between *Bāb Anṭākiya* and eastern limit of the studied area, moving south to the streets that lead to *Bāb Qinnasrīn*, we encounter the following streets:

13- *Darb Banī al-Saffāḥ*, east to west oriented (however, according to Heinz Gaube, the modern orientation could have been different[414]), within it there is *al-Madrassa* and Mosque of al-Safāḥiyya, while to the west, there is a non-working mosque, in addition to the house of al-Shayikh Zayn al-Dīn bin al-Wardī.[415]

14- *Darb Banī Sawāda*, oriented slightly off the north-south orientation and leading to *al-Bīmāristān* al-Kamilī [416](*al-Bīmāristān al-Aragūnī*). Within this street, there is also Masjid Tugril (probably *Masjid* Mīrū [417]), *Masjid Muntakhab al-Dīn Aḥmad al-Iskafī* (*Masjid al-Shayikh Ḥammūd*) and *Masjid al-Muḥaṣṣab* (*Jāmiʿ al-Karīmiyya* [418]).[419]

15- *Darb al-Banāt*, a winding path forked from the previous street, and directed west-east in front of *Khan al-Qāḍī*. It included a mosque built by *Banī* Shanqash and a *Khānqa*.[420] According to Gaube, and due to the fact that *Qnāq Raghib* Aghā was constructed at a later period, this street was most likely connected to the vertical *Darb al-Isfarīs* to the east.[421] This is supported by the fact that Ibn al-ʿAjamī rarely mentioned cul-de-sac streets and adhered only to main streets, and even when he referred to them, , he identified them as such.

16- *Darb al-Raḥba* constitutes the continuity of *Darb Banī Sawāda* to the direction of *Bāb Qinnasrīn*; within it there is *al-Madrassa al-Asadiyya* and *Masjid al-Ṭarṭūsī*.[422]

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[412] Ibn al-ʿAjamī, Vol 1, p. 455
[413] ibid.
[414] Gaube, Wirth, & Trans: ʿUlabī, 2007
[415] Ibn al-ʿAjamī, Vol 1, p. 460
[416] ibid. 462
[417] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 218
[418] ibid.
[419] Ibn al-ʿAjamī, Vol 1, p. 467
[420] Ibn al-ʿAjamī, Vol 1, p. 486
[421] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 218
[422] Ibn al-ʿAjamī, Vol 1, p. 487

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17- The street leading to *Mankalī Baghā* and branched from *Darb al-Isfarīs*. It had an old mosque in addition to the mosque of *Mankalī Bagha* [423](*Jāmiʿ al-Rūmī*[424]) and according to Gaube this street might had a different orientation at those time. It also enclosed a *Hammam* and a hospice.[425]

18- *Qaṣabat Bāb Qinnasrin* is located within the gate in a location where the old soap manufacturing workshops were established before they were relocated to the district of soap manufacturing (*al-Maṣabin*).[426]

To the northwest of *Bāb Qinnasrīn*, we can identify the following streets:

19- The street leading to *Hammam al-Mālḥa*[427] orientated from *Qaṣabat Qinnasrīn* to the west and north-west.

20- *Darb al-Khānqa*, an extension of the previous street in the direction of *al-Jirn al-Aṣfar*. It had a *Khānqa* (trench) and in its southern end, we can find a mosque commissioned by Abū al-Ḥassan Muḥammad ibn al-Khashshāb next to *al-Jirn al-Aṣfar*.[428]

21- *Darb Banī al-Khashshāb*[429] leads from the district of *Bāb Qinnasrin* to the north in the direction of *Darb al-Zajjāgīn*. It accommodated the houses of *Banī* al-Khashshab and an office for orphaned children, in addition to a non-working basin of water (possibly a *Qasṭal*) and a small door called *Bāb Khūkha* in the direction of *al-Jallūm*.[430] There was also *al-Jawharī* hall and Ibn Mashūr Mosque which was later converted to a jail.[431]

22- *Darb al-Zajjāgīn* leads from the previous street to the east. Within it, *al-Madrassa* al-Zujjajiyya was located, as well as *Hammam al-Zajjāgīn* commissioned by al-Malik al-ʿAdil and supervised by Aḥmad bin ʿAbdullah al-Shafiʿī in 1156 CE.[432]

23- *Darb ibn al-Ḥakam*, despite what Gaube explained about its location. Ibn al-ʿAjamī never mentioned that *Darb ibn al-Ḥakam* was in the same street of *Hammam al-Khawājā* [433]. But he was rather referencing and identifying Ibn al-Ḥakam as a merchant and included some of the construction work that he commissioned in the vicinity. According to Ibn al-ʿAjamī, there was a mosque in the beginning of this street and two additional mosques within. Taking into account that Ibn al-ʿAjamī lists the streets from

[423] ibid. p. 459
[424] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 217
[425] ibid.
[426] ibid. p. 232
[427] Ibn al- ʿAjamī, Vol 1, p. 522
[428] ibid. p. 489
[429] ibid.
[430] Ibn al- ʿAjamī, Vol 1, p. 489
[431] ibid.
[432] ibid. p. 488
[433] ibid. p. 492

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west to east, and the fact that *Darb al-Ṭayr* is mentioned as the extension of the street of *al-Bīmāristān*[434], we can fix this location and move to the east. By this logic, *Darb Ibn al-Ḥakam* would be the second street from *Bāb Anṭākiya* next to *Hammam Bazdār* (Fig. 47). It has a mosque in its beginning, possibly at the location of *al-Kamalīya Mosque* which was situated on the remains of an older mosque.[435]

24- Following the same logic, the next street to the east is possibly *Darb Masjid al-Jūra.* According to Ibn al-ʿAjamī, it included *Masjid al-Jūra* which entrance was not originally from this street but was converted to it after the level of the previous street rose and the original entrance of the mosque became inaccessible.[436]

25- *Darb al-Shaḥām* (*Darb al-Khawāja*[437]), it included a bath (*Hammam al-Khawāja*) and a great hall of *Banī Zuhra.* This street was wrongly identified by Gaube. The Arabic translator of the book "Sakhir ʿUlabī" attempted to correct the location of this street. He suggested that the link between *Darb al-Kiraf* is the street that included the houses of *Banī Zuhra* and *Darb al-Shaḥām*[438] where their hall is located. Gaube erroneously identified it as *Darb Ibn al-Ḥakam* due to the presence of *Hammam* and *Masjid al-Khawāja*, which influenced the second name of the street as *Darb al-Khawāja.*

26- *Darb* al-Ṭayr can be the next street to the east number (26). Since Ibn al-ʿAjamī mentioned it as the street with the Bīmārīstān in reference to *al-Bīmāristān* al-Nūrī.[439]

26-1 Another location for *Darb* al-Ṭayr is the street number (26-1). ʿUlabī suggested that it was the same as *Zuqāq* al-Mīkhanāt next to *Khan al-Qaṣābiyya.*[440]

27- *Darb al-Ḥalāwiyya*[441] (*Souk al-Silāḥ*), not much reference is given to this street since its location is obvious, containing *al-Madrassa al-Ḥalāwiyya*, leading to the west of the *Umayyad Mosque.*

28- *Dar al-Khābūrī*, was named after a famous orator of the *Umayyad Mosque.* It was a cul-de-sac at the northern entrance of the *Umayyad Mosque.*[442] Gaube suggested this street location to the left of its current suggested location. Possibly because he did not have access to a good quality version of the Ottoman map of Aleppo 1900. Moreover, there

434 ibid. p. 494
435 ibid. p. 493
436 ibid.
437 al-Ghazzī, Vol 2, p. 71
438 Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 223
439 Ibn al- ʿAjamī, Vol 494
440 Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 223
441 Ibn al- ʿAjamī, Vol 1, p. 495
442 ibid. p. 504

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is an error (also referred to by ʿUlabī[443]) of mixing it with *Darb al-Zahrāwī*, that stretches from the north gate of the mosque northward outside of the studied area.

29- *Darb al-Daylam,* leading from the eastern gate of the *Umayyad Mosque* to *ʿAqaba*t *al-Yāsamīn* to the north, within there is *al-Madrassa al-Shrafiyya* and *Masjid al-Shaykh al-Shahīd ibn al-ʿAjamī*, *Masjid ibn al-Zarrād*, in addition to a close-by water basin and a cul-des-sac.[444]

30- *a- Saḥliyya* and a street leading to *al-ʿAqaba. al-Saḥliyya* street, also known as (*Sūwayqat Ḥatim*), includes two bath houses belonging to *Banī* ʿAṣrūn. While the street leading from it to *al-ʿAqaba* includes two mosques – one at the beginning next to the market, whereas the second which close to the boundaries of *al-ʿAqaba* dates to the time of al-Ẓāhir Ghāzī.[445]

31- A street from *Qaṭiʿat al-Sadla* leading to *al-ʿAqaba* at its northern border; it includes a mosque and *Khānqa al-Tibniyya*.[446] Gaube wrongly identified it as *Darb al-Sammānīn* as he considered *Darb al-Sammānīn* and *Darb al-Shaḥām* as one street due to the similar nature of their merchandise.[447]

32- *Darb Ibn Qays* to the west of the previous street; it includes a mosque. [448]

33- A street from *Qaṣabat al-Jinān* to *al-ʿAqaba* along the western wall of the city, which included two mosques next to the walls. [449]

34- *Souk al-Ḥawa*; this street is not clearly mentioned in the listing of Gaube or in Ibn al-ʿAjamī, but it was mentioned elsewhere in his text. The main street spans from *al-Qaṣaba* to until al-*Bahramiyya Mosque.* [450]

[443] Gaube, Wirth, & Trans: ʿUlabī, 2007, p. 225
[444] Ibn al-ʿAjamī, Vol 1, p. 505
[445] ibid. p. 495
[446] ibid. p. 494
[447] Gaube, Wirth, & Trans: ʿUlabī, 2007, pp. 221-222
[448] Ibn al-ʿAjamī, Vol 1, p. 494
[449] Ibn al-ʿAjamī, Vol 1, p. 494
[450] ibid. pp. 333, 585

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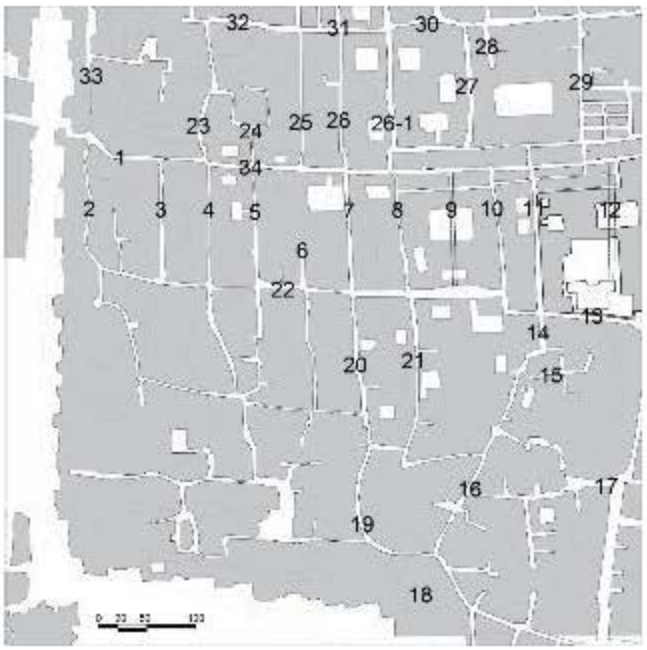

Fig. 47 The street network with their historic names following Ibn al-'Ajamī, al-Ghazzī and (Gaube & Wirth, Tran: 'Ulabī). Adjusted, redrawn and corrected by Orabi, 2023.

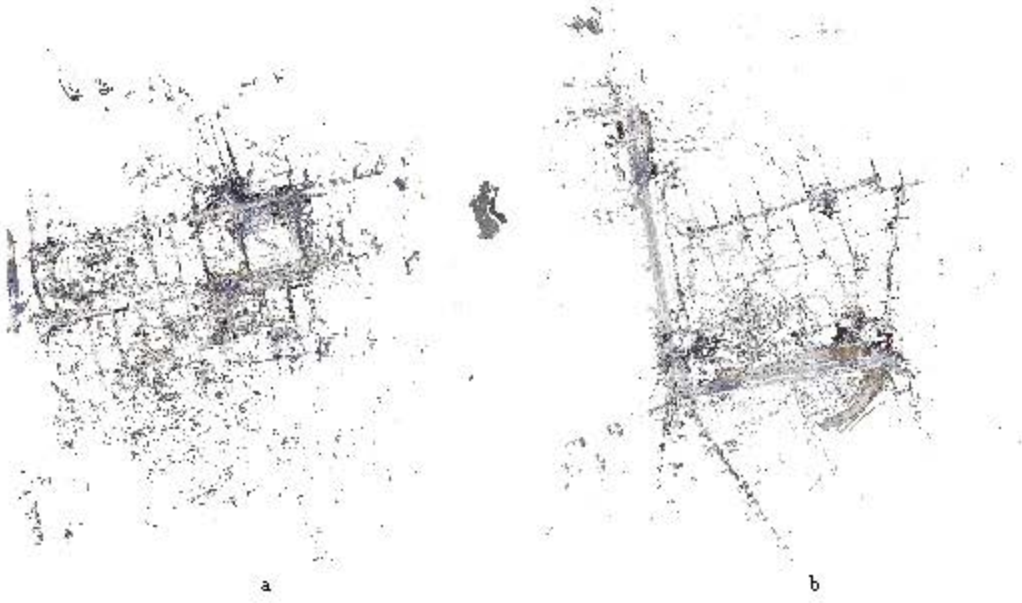

Fig. 48a. The street network in *al-'Aqaba* from TLS data. b. The street network in al-*Jallūm*

III.1.1.4.3 Important buildings within the two neighborhoods

The identification of the buildings mentioned in the previous sub-chapter supports tracking the changes of the historic fabric by identifying the changed and surviving buildings, their patrons, and the year of construction.

As previously mentioned, this section will discuss the works of Ibn Shaddād, Ibn al-Shuḥna and Ibn al-'Ajamī.

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Ibn Shaddād and the following authors specified the buildings according to their functions and divided them to particular categories as Mosques, congregational mosques, *Khānqas*, *Madrassas*, houses, Mausoleums and *Hammams*. Hereinafter, the following list of the ones included in the studied area can be concluded.

1- Mosques

Given the holy nature of this religious institution, mosques maintained their permanence in the urban fabric. Yet, the changes in their layout likely affected other elements of the urban fabric such as souks and houses. Where they were annexed to expand the religious buildings and mosques, like the case of the *Umayyad Mosque* that will be discussed subsequently. Although it is mentioned that 204 mosques existed in Aleppo during the time of Ibn Shaddād, they were listed only by name without adequate information, geographical indication nor an architectural description. Except for high-profile mosques which mostly dominated the text combined with the reference to the order of succession of their orators. The detailed description is either from the accounts of Ibn al-Shūḥna or Ibn al-ʿAjamī.

The mosques were mentioned as follows:

a. *al-Ghaḍā'rī Mosque*[451], modernly known as *al-Shu'aybiyya Mosque*, is located inside of *Bāb Anṭākiya*; it was the first mosque to be built at the location of the first Muslim prayer that took place after the conquest of Aleppo in 637.
b. For the *Umayyad Mosque*, Ibn al-ʿAjamī mentions that it was built in the garden of the previous Church of St. Helen; also, the cemetery of the church was located to the north side of the mosque. Later, it was destroyed by Nikephoros, and partially restored by Sayf al-Dawla.[452] In the reign of Nūr al-Dīn, it was burnt along with the neighboring markets. During the restoration work, they enlarged the mosque by adding to it a section of the adjacent markets.[453] The text also mentions a cistern dug in the courtyard of the mosque.[454] The *minaret* was built in 1089 CE, using stone from an old "fire" temple in the city that had been converted into a furnace of a *Hammam*.[455] During the invasion of the Mongols, the ruler of "Sis" in Armenia

[451] Ibn Shadād, Vol 1, pp. 137-138
[452] Ibn Shadād, p. 103
[453] ibid. pp. 106, 107
[454] ibid. pp. 108-109
[455] ibid. p. 111

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burnt the southern wall of the mosque.[456] Finally, the gable roof was added during the rule of al-Ẓāhir Baybars.[457]

c. *Jāmi' Idmir* in the end of *'Aqabt ibn al-Munthir* next to *Hammam al-Khawājā*[458], which makes it located within *Darb al-Shaḥāmīn.*

d. *al-Qiqān Mosque* (*Qāqān mosque*) on the western side of the walls of the city.[459]

e. *al-Mankalī Baghā* Mosque, built in 1385 CE, located in the vicinity of *Bāb Qinnasrīn* in the street number 17 (Fig. 47).[460]

f. *Masjid al-Muḥaṣṣab*[461] in *Darb al-Raḥba.* [462]

g. *Masjid Ẓubiyān* in al-*Jallūm.*[463]

2- Churches

The epoch of the building of churches was in the Byzantine period. Still, due to the lack of chronicles from this period that document the churches of Aleppo, the identification process relies heavily on Islamic sources. Which in their turn did not pay as much attention to them as they did to the other elements of the Muslim city. As a result, only limited information is available. Ibn Shaddād reported that there were 72 churches in Aleppo, four of which were ordered to be converted to *Madrassas* by the judge Ibn al-Khashāb in 1124 CE upon the ruthless incursions of the Crusaders, of which the following were located in the study boundaries:

1- The church of St. Helen, which later became *Masjid al-Sarājīn*, then it was renamed as *al-Madrassa al-Ḥalāwiyya.*[464] Ibn Shaddād also explores that there was an altar of this church in the same location of *Dār al-Zakāt* which was connected to the church of St. Helen by an underground vaulted tunnel. *Hammam Mūgān* was also belonging to the church.

2- A church was located in *Darb al-Ḥaṭṭābīn* (in *al-'Aqaba* quarter) that was converted later to a *madrassa* for the *Ḥanafī Madhhab* by ʿAbd al-Malik ibn al-Muqaddam.

3- A church located in *al-'Aqaba* quarter close to the church of St. Helen and connected to it thorough a vaulted underground tunnel. Yet, it started as a temple,

[456] ibid. p. 116
[457] ibid. p. 117
[458] Ibn al- ʿAjamī, Vol 1, p. 257
[459] ibid. p. 82
[460] Ibn al- Shuḥna, p. 73
[461] ibid. p. 74
[462] Ibn al- ʿAjamī, Vol 1, p. 256
[463] ibid.
[464] Ibn Shadād, Vol 1, p. 264

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then a synagogue before it was converted to a church and finally to a mosque. Located next to this building is "*Dār al-Zakāt*" and *Hammam Mūgān* (*Hammam al-Baylūnī*[465]); they were built by Dzukāʾ al-Dīn in 904 CE. The bath served as a bath for the church and contained a room for the bishop.[466]

Yet, his text apparently leaves out the church that was located in *al-Jallūm* district that is now known as the "*Shībānī*" church/school.

3- Shrines (*Mashhads*)

Most of the *Mashhads* were located outside the walls of the city. But when intercrossing the entire list of names with the studied area, we can identify only one building that is Mashhad al-Nūr next to *Bāb Qinnasrīn* in one of the towers on the southern section of the city wall.[467] This building has since kept its location and even named as "*al-Nūr Mosque*".

4- Madrassas

"al-Madrassa is a state institution aimed at the education of generations of political, legal and religious magistrates in the Orthodox (Sunni) spirit. Their founding is the most important step taken by Sunnism."[468]

According to Herzfeld, the construction of *Madrassas* was a *Sunni* response to the *Shi'te* power in Iraq and Iran from the East, coupled with the attacks of the Crusaders from the west.[469]

The religious schools in Aleppo were divided according to the four madhabs of the Islamic *Sunni* faith. However, the city is dominated by *madrassa*s designated for the *Shafi'ī* and the *Ḥanafī* Madhabs, with only few schools designated for the remaining two.

The beginning is with *Madrassas* following *al-Shafi'ī madhab* as listed chronologically below:

- *al-Madrassa al-Zajājiyya* (also known as *al-Sharafiyya*); it is the first *madrassa* to be built in Aleppo in 1122 CE[470], commissioned by Sulaymān bin ʿAbd al-Jabbār ibn Artaq. It is named after the street in which it is located.[471] Notably, despite other

[465] Ibn al- Shuḥna, p. 83
[466] Ibn Shadād, Vol1, p. 141
[467] ibid. p. 133
[468] Herzfeld, 1954, p. 215
[469] ibid.
[470] Ibn Shadād, Vol 1, p. 241
[471] Ibn al- ʿAjamī, Vol 1, p. 270

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sources reporting otherwise, in this text, this location is not mentioned as one of the previous four churches that were converted into *madrassas*. al-Ghazzī gave one possible location for this school next to *Masjid abī al-Darājīn*, in *al-Jalūm al-Kubra*.[472]

- *al-Madrassa al-Shu'aybiyya*, located at the site of the first prayer of the Muslim conquerors also known as *al-Ghaḍāirī Mosque*. It was rebuilt as *madrassa* by Nūr al-Dīn [473] in 1150.
- *al-Madrassa al-'Aṣrūniyya*, located to the north of the *Umayyad Mosque*. It was a residence for a Mirdasid Wazir, and later converted to a *madrassa* by Nūr al-Dīn in 1155 CE.[474] This building was demolished while completing the plaza in front of the *Umayyad Mosque*.
- *al-Madrassa* al-Asadiyya, commissioned by Asad al-Dīn Shirkūh [in 1167].[475] It is located in *al-Jallūm* in *Maḥalat al-Raḥba*[476].
- *al-Madrassa* al-ZZaydiyya, also known as al-Alwaḥiyya[477], commissioned by Zayd al-Kayyal al-Ḥalabī in 1266 CE. [478] It was located within *Bāb Anṭākiya* next to *al-Madrassa al-Shū'aybiyya*.
- *al-Madrassa al-Ruwaḥiyya* next to *Khan al-Shamsiyya* and *al-Sahliyya* (known as *Sūiakat Ḥatim*), commissioned by Zakī al-Dīn bin Rawaḥa al-Ḥamwī.[479]

While the *Ḥanafī madrassas* were listed as the following:

1- *al-Madrassa al-Ḥalāwiyya* (previously known as *Masjid al-Sarajīn*[480]), designated as *madrassa* during the reign of Nūr al-Dīn in 1149 CE [481] when its Iwan was added.[482]

2- *al-Madrassa al-Muqaddamiyya*, one the four converted churches. It was commissioned in 1150 [483] as a Madrassa by 'IZz al-Dīn ibn al-Muqaddam and expanded it by adding a neighboring house.[484]

[472] al-Ghazzī, Vol 2, p. 67
[473] Ibn Shadād, Vol 1, p. 257
[474] ibid. p. 248
[475] ibid, p. 253
[476] Ibn al- 'Ajamī, Vol 1, p. 301
[477] ibid. p. 315
[478] Ibn Shadād, Vol 1, p. 259
[479] Ibn al- 'Ajamī, Vol 1, p. 304
[480] Ibn al- 'Ajamī, Vol 1, p. 340
[481] All the mentioned dates are for the date of completion of the works unless otherwise specified.
[482] Ibn Shadād, Vol 1, p. 264
[483] The date of the commissioning of the works
[484] Ibn Shadād, Vol 1, p. 276

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3- *al-Madrassa al-Jawīliyya* located in *al-Sahliyya* (*Sūaykat Ḥatim*), commissioned by ʿAfīf al-Dīn al-Jawilī al-Nūrī.[485]

5- *Khānqas*

The word *Khānqa* is derived from Persian, and it means "house", in reference to the beginning of "Sufism" from private houses and shops.[486] It was designed as mosque-houses to accommodate the needs of the followers of the Mystic Islam "Sufism".[487] The *Khānqas* recorded in the studied area are the following:

- *Khānqa al-Balāṭ*, the first of its function to be built in Aleppo in 1115, commissioned by Shamsī Lūlū al-Khādim.[488] It is located in *Souk al-Balāṭ* (known as *Souk* al-*Ṣabūn*).
- *Khānqa* al-Malik al-Muʿaẓẓam Muẓaffar al-Dīn Kūk, also known as *Khānqa al-Zayttiyya* [489], located in *Sūaykat Ḥatim*.[490]
- A *Khānqa*, commissioned by Faṭima Khātūn, daughter for al-Malik al-Kamil in *al-Qat'iyya* in 1258 CE.[491] It is located next to *al-Bīmāristān al-Nūrī*.[492]
- *Khānqa*, commissioned by ʿAbd al-Malik bin al-Muqaddam in *Darb al-Ḥaṭṭābīn*in 1169 CE.
- *Khānqa* in *Darb al-Banāt*.[493] It is commissioned by Zumurrud Khātūn, the daughter of Ḥusam lajīn, in 1178 CE.[494]
- *Khānqa al-Kāmliyya*, next to *Dār Banī al-Khashshāb*. [495]
- *Khānqa al-Tanbīh*, in the end of *al-'Aqaba* neighborhood in the street leading to *Jub al-Sudla*.[496]
- *Khānqa al-Shamsiyya*, in the beginning of *Darb al-Bāzyār*, commissioned by Shams al-Dīn abū Bakir.[497] To its north, another lost *Khānqa* is located, known as *al-Khānqa al-Qadīm*. [498]

6- *Ribāṭs*

[485] Ibn al- ʿAjamī, Vol 1, p. 354
[486] Schimmel, 2011, pp. 231-232
[487] Hillenbrand, Islamic Art and Architecture, 1999, p. 113.
[488] Ibn al- ʿAjamī, Vol 1, p. 106
[489] ibid. p. 392
[490] ibid. p. 106
[491] ibid. p. 108
[492] ibid. p. 402
[493] Ibn al- ʿAjamī, Vol , p. 108
[494] ibid. p. 403
[495] Ibn al- ʿAjamī, Vol, p. 108
[496] ibid. p. 399
[497] ibid. p. 397
[498] ibid. p. 398

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The usage of *Ribāṭ* started as a military fortress [499] as the Arabic name suggests. Later, it was transformed to a religious institution very similar to the *Khānqa*, but it is designed to receive individuals interested in the Sufi life.[500] Not many *Ribāṭs* were commissioned in Aleppo, and only one is located in the studied area in *al-Raḥba al-Kabīra*, in *Bāb Qinnasrīn*, commissioned by Sayf al-Dīn bin Jandar.[501]

7- *Bīmāristāns*

The building of *bīmāristāns* was common practice to highlight the power [502] and care of the rulers to provide treatment for patients and practical education for doctors. It also fulfills the Islamic obligation to care for the sick. The first documented health establishment commissioned by Muslims dates to the 7th Century, located in Damascus under the patronage of the Umayyad Khalif al-Walid as an asylum for leprosy patients [503], while the first generalized Bimaristan was recorded in Baghdad in 786 under Harun al-Rashid.[504]

There were not many *bīmāristāns* in Aleppo, very possibly that at most two *bīmāristāns* co-existed in the same period such as:

1 *Bīmāristān Banī al-Daqāq*, located next to *al-Madrassa al-Ḥalāwiyya*. Later, it was merged within the house of Sūdūn al-Dūdārī.[505]
2 A non-working bīmāristān at the entrance of the *Umayyad Mosque* that can be attributed to Ibn Khakhāz [506] or KharKhan.[507]
3 *al-Bīmāristān al-Nūrī* (*al-Bīmāristān* al-ʿAtīq), attributed to the doctor al-Mukhtār bin Buṭlān, al-Ḥasan al-Baghdadī. It was later renovated by Nūr al-Dīn.[508]
4 *Bīmāristāns al-Aragūnī al-Kāmilī* (*al-Bīmāristān al-Jadīd*), commissioned by Argūn al-Kamilī in *Bāb Qinnasrīn* in 1354.[509]

8- *Souk*s

499 Hillenbrand, Islamic Art and Architecture, 1999, p. 113.
500 Fernandes, 1987, p. 26
501 Ibn al- ʿAjamī, Vol 1, p. 426
502 McClary, 2021, p. 101
503 Mahfoud, 2010, p. 44
504 Issa bek, 1981, p. 178
505 Ibn al- ʿAjamī, p. 448
506 Ibn al- ʿAjamī, p. 448
507 al-Ghazzī, 1922-1926, pp. vol 2, 54
508 Ibn al- ʿAjamī, Vol 1, p. 445
509 ibid. p. 448

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As for public and commercial establishments, Ibn al-ʿAjamī lists some of the *souk*s of the city, their merchandise and location. The rest of the souks are discussed by al-Gazzī in the next section. Hereinafter a list of the ones mentioned by Ibn al-ʿAjamī located in the studies area:

- *Souk al-Ṣāgha al-Jadīd* (*Souk al-Naṭṭāʿīn* [510]): East to the *Umayyad Mosque*, the function changed from binding books to selling gold.[511]
- *Souk al-Ṣāgha al-Qadīm*: Next to *Hammam al-Sit* (*Khan al-Naḥāsīn*). The area used to be called *Tall Fayrūz*; its merchandise shifted from gold to linen.[512]
- *Souk al-Ḥibāl* (*Souk al-Bazz al-Khālīʿ*): Located to the west of the *Umayyad Mosque*; its merchandise shifted from linen (*Bazz*) to ropes.[513]

Moreover, Ibn Shādād noted that al-Nāṣir Yūsuf commissioned the building of two souks east of the *Umayyad Mosque*, one for silk and the other for coppersmiths (*al-Naḥḥāsīn*).[514]

9- *Hammam*s

Much like many other buildings in the chronicles, the *hammam*s were only mentioned by name and occasionally referenced without any reference to the patron nor date of construction. Therefore, further sources will be consulted in the following chapters to aid in the reconstruction process. As for the books at hand, the list was divided into in-house *hammam*s and public *hammam*s, since access to private in-house baths was a luxury of the wealthy elites. In-house baths are not considered as a separate part of the study as they form an element of the house rather than the city; therefore, only public *hammam*s will be discussed here.

Interestingly, Ibn al-ʿAjamī mentioned that despite the high number of *hammam*s, they were barely enough for the people of Aleppo. [515] That speaks for the dense population, in addition to the strong hygiene practices that were popular within the city. The baths mentioned with a referenced location are:

1- In *al-ʿAqaba* District there was (*Hammam al-Ṣaffī*).

2- In *al-Jallūm* District there was *(Hammam al-Wālī and Hammam al-Zajjājīn).*

10- The Canalization

[510] al-Naṭṭāʿīn professional practice book binding.
[511] Ibn al-ʿAjamī, Vol 1, p. 523
[512] ibid.
[513] ibid.
[514] Ibn Shadād, Vol 1, p. 50
[515] Ibn al- ʿAjamī, p. 133

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Since Aleppo was not located at an abundance of water, providing adequate irrigation to the city was imperative from the first establishment of Aleppo. The chronicles report that the king who first commissioned the irrigation system, ordered a canalization to be built from the spring fountains in the city of *Ḥaylān*. The ancient canalization entered from *Bāb al-Qanāt* and continued underground to reach *Bāb al-Arba'īn*. Then spread from there to the rest of the city.[516] Sections of the canal are likely of Byzantine origin that was mainly directed to the Church of St. Helen[517], later restored by ʿAbd al-malik bin Marwān.[518] During the rule of Nūr al-Dīn, he made a special project dedicated to expanding and spreading those canals to the following locations:

- The public toilet establishment in the weapons market, west of the *Umayyad Mosque*.[519]
- *R's al –Shu'aybīn*, a location that is debated but often wrongly confused with the *Qaṣṭal* at the entrance of the *Shu'aybiyya Mosque*.
- *al-Khashshābīn* street.[520]

The canal was supposed to reach *al-Raḥba* inside *Bāb Qinnasrīn*, but Nūr al-Din died before it was realized. The project was picked up, improved and expanded by al-Ẓāhir Ghāzī as he intended to deliver water to each building in the city. He also commissioned the building of *Qaṣṭal*s in big numbers, the first one being at *Bāb al-Arba'īn*.[521]

The section that lies in the studied area starts in the beginning of the souks' complex. Its water was diverted form the direction of the citadel into a water distribution hub that branches to the *Umayyad Mosque*.[522] The canal enters the study area at *Souk Souk al-Naṭṭā'īn* (which is the current market of goldsmiths) [523] east of the *Umayyad Mosque*, from there the water is taken through three canals; one of which heads to the neighborhood of *Qinnasrīn* and its neighboring areas, as distributed in Fig. 49 and Fig. 50.

Gaube and Wirth created an estimated map of the canalization system based on the Arabic chronicles. However, they were some mistakes in the drawing and the estimated location of

[516] Ibn Shadād, Vol 1, p. 339
[517] ibid. p. 340
[518] ibid.
[519] ibid. p. 340
[520] ibid. p. 341
[521] Ibn Shadād, Vol 1, p. 341
[522] ibid. p. 345
[523] al-Ghazzī, Vol 1, p. 523)

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some of the *Qaṣṭals*. Some were pointed out by ʿUlabī in the Arabic translation. The errors were corrected in (Fig. 50). After comparison with the historic text, the map of the names and locations of the streets, we can track the section located within the studied area and adjust the correction on the drawing according to the translator guidelines[524]:

1- The Q7 [525] and Q7 b are misplaced on the map. They do not belong to the study area. This was due to the conflicting name of the *al-ʿAqaba* districts and the *al-Balāṭ* Street. Gaube ignored the existence of the other *ʿAqaba* named *ʿAqaba*t *al-Yāsamīn*, as discussed previously, to the north of the *Umayyad Mosque*. To mend the issue, the pattern of the *Qaṣṭal*'s distribution suggests that it is in the intersection of *Souk al-Hawa* and *Darb Hammam ʿItāb* in the location specified as Q7 "in red" in (Fig. 50).

2- *Qaṣṭal* Q24 is also misplaced. The alternatively suggested location based on the basics of Hydraulics would be at the beginning of the old *Souk al-Ṣāgha,* referred to in the previous figure as 24a in the adjusted drawing.[526]

3- The next *Qaṣṭal* is at *Souk al-Naṭṭāʿīn*; yet the diagram of Gaube puts it at the end of *Souk al-ʿAṭṭārīn*, located south of the *Umayyad Mosque*. Despite the fact that Ibn Shaddād clearly records its location east to the mosque in *Souk al-Naṭṭāʿīn*, therefore, it is replaced in (Fig. 50) with Q24b.[527]

4- Q25 is the *Qaṣṭal* at *Umayyad Mosque*. Q25 b supplies its cisterns, while Q25 Z continues to the western public WC-establishment.[528]

5- Q26 is *Qaṣṭal Souk al-Ṭayr*; Q27 is *Qaṣṭal Darb al-Khirāf*; Q28 is *Qaṣṭal Darb* al-Ṣabaghīn; Q29 is *Qaṣṭal* al-Shuʿaybiyya.[529]

6- Q30 is the *Qaṣṭal* in *Khan al-Jumruk* [530] (*Dār al-Zakkāt*); its fountain is B31.[531]

7- Q32 is at *Raʾs Souk al-Khashshābīn*, while Q33 is at *Raʾs Darb Asad al-Dīn*.[532]

8- *Qaṣṭal* Q34 is also misplaced; even that it was recorded next to *Masjid al-Mijjan* or *Masjid Khan al-Ṭāf*, which is located next to the khan that is known by the same name in around the middle of *Darb al-Ḥaṣṣādīn*. The adjusted location is referred to as Q34a.[533]

9- *Qaṣṭal* Q35 is at *Raʾs Darb al-Bīmarīstān*; Q36 is at *Raʾs Darb al-Ḥaṭṭābīn*.[534]

[524] Gaube & Wirth, Translated by Sakhir ʿUlabī, 2007, pp. 473-476
[525] Q stands for Qaṣṭal, and the numbering system is identical to the ones used in the study of Gaube and Wirth to enable accurate comparison.
[526] Ibn Shadād, Vol 1, p. 345
[527] Ibn Shadād, Vol 1, p. 345
[528] ibid. p. 346
[529] ibid.
[530] Gaube & Wirth, Translated by Sakhir ʿUlabī, 2007, pp. 474
[531] ibid. p. 346
[532] ibid. p. 347
[533] ibid. p. 347
[534] ibid.

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10- *Qaṣṭal* Q37 is at *Ra's Darb Banī* al-Aswad; Q38 is at *Masjid* Ibn al-Iskāfī; Q39 is at *Masjid al-Mukhaṣṣab* at *al-Raḥba*; Q45 is at the beginning of the *Bāb Qinnasrīn*; Q46 is to the exterior side of the gate. [535]

11- *Qaṣṭal* Q41 is at Dar Gars al-Dīn Qulaylī; Q42 is at *al-Jurn al-Aṣfar*; Q43 is at *al-Raḥba al-Ṣagī*ra; Q44 is at *Darb Banī Bakrān* at the furnace of *Hammam al-Sharīf*.[536]

12- *Qaṣṭals* Q 53 and 54 arrive to *Darb al-Banāt* from a separate canalization system that starts from the water collection cistern to *Kuttā al-Aswad*.[537]

However, due to the elevation of the *al-'Aqaba* district, the transportation of water of *Ḥaylān* to that location was not possible. Therefore, residents often constructed water collecting cisterns and wells.[538]

The exploration of the route of the water channelization offered an unexpected advantage, which lead to the identification of more locations and monuments of the city in reference to the location of *Qaṣṭals*.

[535] ibid. p. 348
[536] ibid.
[537] ibid. p. 349
[538] Gaube & Wirth, Translated by Sakhir ʿUlabī, 2007, pp. 474

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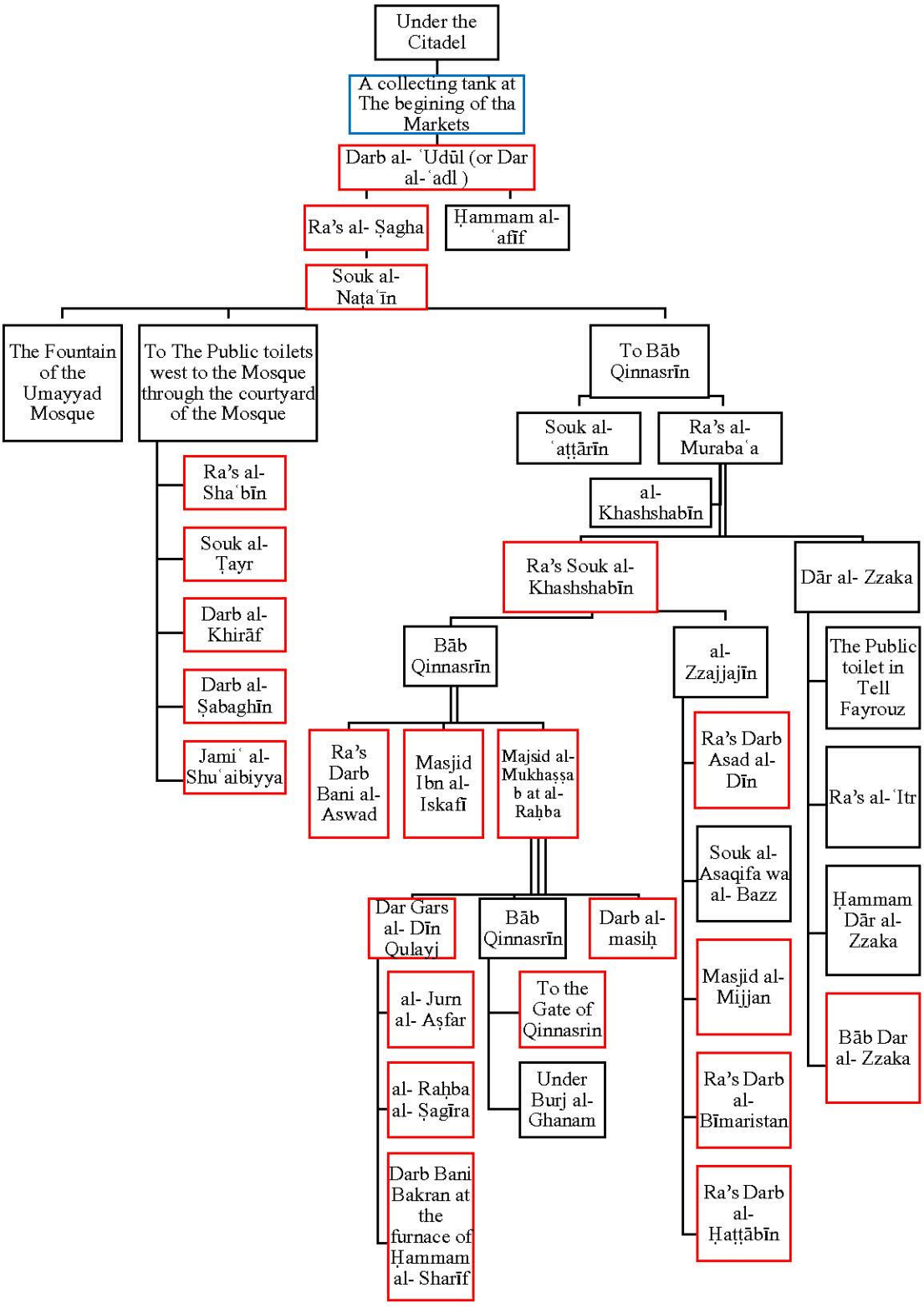

Fig. 49 Diagram tracking the flow of the canalization of Aleppo following Ibn Shadād, Ibn al-ʿAjamī and al-Ghazzī. Red Outline indicates a *Qaṣṭal*. Designed and compiled by Orabi, 2023.

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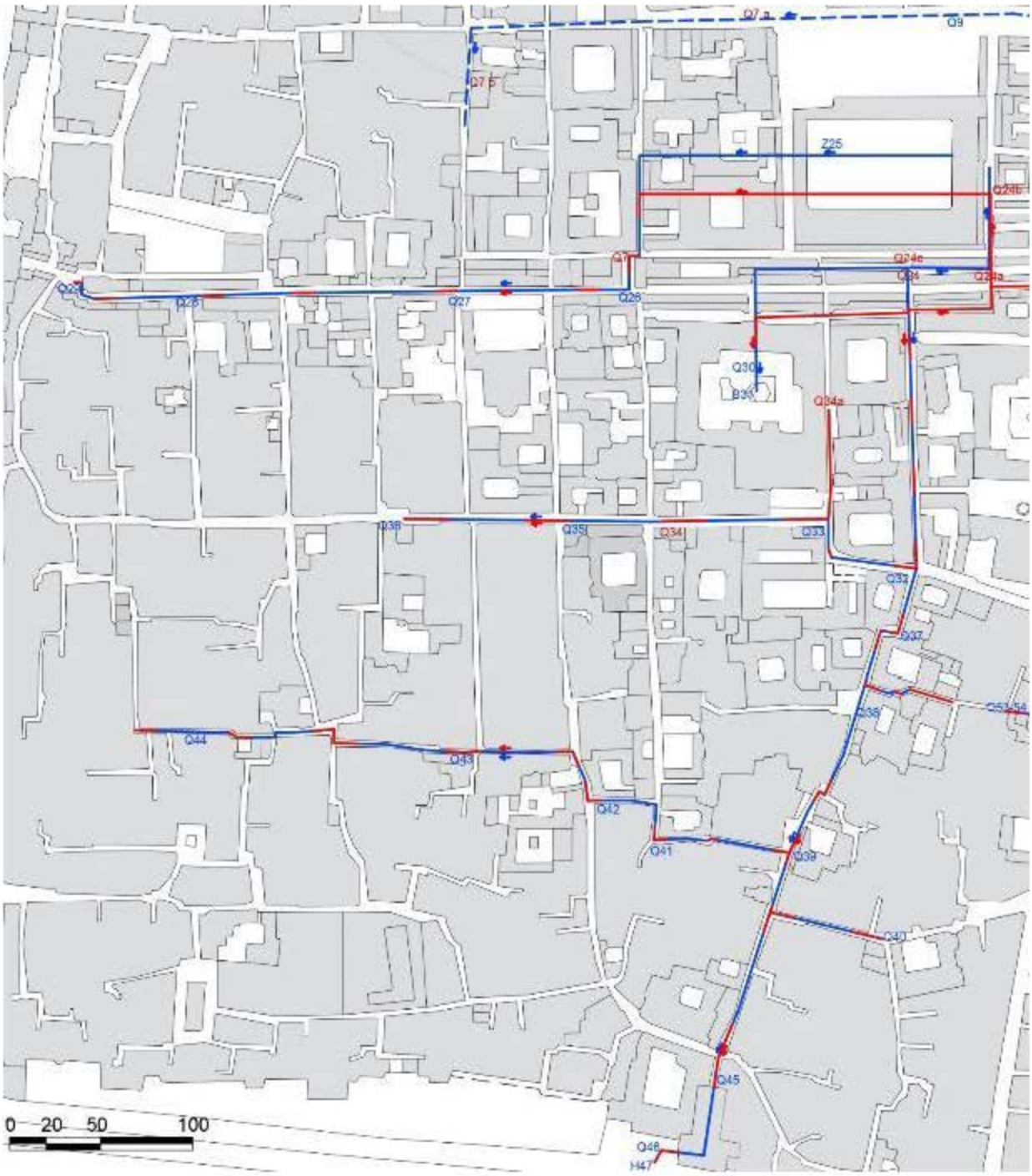

Fig. 50. An estimated map of the 12th Century channelization. In blue the plan of the canalization Gaube & Wirth, 1984, p. 181. In red, the plan of the canalization adjusted according to the reading of Ibn Shaddād, Ibn al-'Ajam and the notes of Sakhir 'Ulabī, redrawn by Orabi, 2023. In dark red the marks the *Qaṣṭal* which their location has been changed in the second examination of the historic texts.

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III.2 Assertion of power social influence through religious patronage

"The major expression of royal patronage was religious architecture. In this respect the ruling class was conforming to an ancient Islamic ideal which dictated that the ruler should build widely for the public good. Thus, it was standard practice for Amirs to build Madrassas, usually with their own tombs attached, as soon as they had the means to do so – and it was this custom above all, more than any government-sponsored building program, that ensured the rapid spread of these institutions of learning throughout the Near East in the twelfth and thirteenth centuries."[539]

Robert Hillenbrand draws a relation between the religious teaching and sacred wars based one of the *Hadiths* of the prophet Muhammad. "Whoever enters our mosque to learn well or to teach, he is like a warrior in the way of God".[540] In that narrative, learning is equal to fighting in status and vice versa. This provided a two-sided plot with fighting against the enemy, in this case, the Crusaders, and in pursuing an education in law and religion. Nūr al-Dīn not only instigated both ends of that narrative; on one hand, he labeled his entire rule under the umbrella of the holy war against the Crusaders. On the other hand, he commissioned religious teaching institutions that acted to put all aspects of civil, political, martial, and religious actions in service of branding him as the defender of faith and land. This marked the architectural patronage, especially for religious buildings, as one of the most prominent characters of his reign.

In addition to commissioning new religious complexes and commercial establishments, Ottoman rulers often invested in conducting reconstruction and renovation work mainly in religious buildings. Especially in two main periods towards the beginning and the end of the Ottoman rule over Bilad al-Sham in what can be explained as a tool to gain favor with the locals right before the Arab revolt, in addition to the highly valued Sufism beliefs in the Turkish culture. Moreover, some researchers argue that the interest in the building stems from its dedication to the *Ḥanafī madzhab*, which was the preferred *madzhab* of the state.

III.3 Aleppo in Modern Sources

Two major authors arise from this period. The first to be named here is Khayr al-Dīn al-Asadī. One of his famous books is the comparative encyclopedia of Aleppo "*Mawsū'at Ḥalab al-Muqārana*" which was discussed among the previous literature about the city. The second

[539] Hillenbrand, 1999, p. 116
[540] ibid. p. 173

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historian to refer to is Kamil al-Ghazzī; his book is titled "*Nahr al-Dzahab fī Tārīkh Ḥalab*", which will be analyzed in the next section.

III.3.1.1 ***al-Ghazzī: Nahr al-Dzahab fī Tārīkh Ḥalab***

Kāmil bin Ḥusayn al-Balī al-Ḥalabī, famous by al-Ghazzī (1853-1933). An Aleppian historian, born and died in his city, he was the head of the Committee of Antiquity in Aleppo and the editor of its newspaper.[541] His book "*Nahr al-Dzahab fī Tārīkh Ḥalab*" constitutes of four volumes, only three of which are published. The first volume describes the geographical, ecological, social, demographic, and economic context of the city including the vegetation, the weights and measures used in Aleppo. The second volume, which intersects the most with the boundaries of this thesis, discussed the urban situation of the city. It listed the names of the districts and their demographic, religious and ethnic components. The third volume addressed the history of Aleppo and lists historical events, famous figures, and incidents until the period of the French Mandate.

He offered an insight from the early 19th Century, which provides a bridge between the information mentioned in the medieval accounts and the city during his time before the big-scale urban modifications.

III.3.1.1.1 The walls and the gates of the city

In the second volume, he included a similar recording of the previous accounts regarding the situation of the walls of the city, then tried to link that information with the state of conservation of Aleppo in the 1900s.

He discussed his interpretation of that information provided in earlier historical texts, which contributed to the creation of Fig. 46. He starts with describing the walls of the city during the time of Sayf al-Dawla. al-Ghazzī says:

"*The wall starts from Bāb Qinnasrīn covering a portion of the district of Qala'at Sharif, then it cuts since this area is already elevated and is not in need for a protective wall. Then, it continues east until the Saḥit Bizza, then continues northward (tilted slightly to the east) until the north of al-Ṭawāshī Mosque next to Hammam al-Dzahab, where Bāb al-'Irāq is located. It continues straight upwards and curves toward Hammam al-Naṣiriyya (Hammam al-Labbābīdī) south to the citadel at the edge of its moat, where Bāb al-Ṣaghīr is located. Then it moves to the east to al-Tūn-Būgha district, continuing to*

[541] https://al-maktaba.org/author/1945

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the north to al-Ḥamwī district and al-Bayaḍa. Then it curves west until Qarqlar hospice north of the citadel and east of Dār al-Ḥukūma, where Bāb al-Arba'īn is located. From there it curves north until the end of Khandaq al-Rūm behind the building of 'Uthmān bashā, there, it slightly turns left where Bāb al-Yahūd is located it continues for a short while until Bāb al-'Abārra [Bab al-Faraj]. It curves back until it is in line with the citadel, Bāb Anṭākiya is located and then curves back to Bāb Qinnasrīn."[542]

He provides information about the remains of the walls and their state of conservation in 1900s. Here we list the additional information not mentioned previously about the defensive parameter (listed clockwise):

1- *Bāb Qinnasrīn*, on its southern tower and eastern tower walls, there were inscriptions with the name of Mūayyad Shaykh in 1415 CE. Yet al-Ghazzī suggests that the architectural style is not consisted with that of the reign of Mūayyad Shaykh.[543] On the western tower wall, there is another inscription with the name of Qansūh al-Ghūrī in 1501 CE.[544]
2- *Bāb al-Sa'āda* disappeared by his time; yet in its vicinity, the street there is known as *al-Khrāq* [545] or (*Khrāq al-Jallūm*).
3- *Bāb Anṭākiya* was restored under the orders of Mūayyad Shaykh by Duqmāq al-Naṣirī.[546] Yet, al-Ghazzī notes a difference in the architectural style between the exterior and the interior of the gate.[547]
4- *Bāb al-Jinān*, a single door without a vestibule; al-Ghazzī reported an inscription of Qansūh al-Ghūrī in 1503 CE in a nearby located mosque that was possibly integrated into one of the gate towers. This gate was demolished in the year 1892 in order to widen the street.[548]
5- *Bāb al-Faraj* or *Bāb al-'Abārra*, located in the concave section in the west-north side of the walls, consists of a single door without a vestibule. There were inscriptions of the name of al-Ashraf Birsbay, while on the western bastion there is another inscription with the name of Abū al-Naṣir Qaytbay in 1468 CE.[549]

[542] al-Ghazzī, Vol 2, p. 13
[543] ibid. p. 19
[544] ibid.
[545] ibid.
[546] ibid.
[547] ibid. p. 20
[548] ibid.
[549] ibid.

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6- *Bāb al-Naṣir*, consisted of three doors; each has its own vestibule. In 1885, the government demolished the first door in order to expand the street; the remaining middle door has an inscription of al-Ẓāhir Ghāzī.[550]

7- *Bāb al-Qanāt*, which is also called *Bāb al-Ḥadīd/ Bāb* Banqūsa, constituted of two doors connected by a vestibule with a bastion on top of them. There is an inscription commemorating Qansūh al-Ghūrī in 1514 CE.[551] Behind al-Tūn-Bugha (*Saḥit al-Miliḥ*), there is an inscription attributing the construction of this section of the wall to Ashraf Qaytbay.[552]

8- *Bāb Bālūj/Yalūj*, named after a Rūmī mason (possibly Seljuk or Byzantine) who took part in its construction.[553] On the gate, there was an inscription of Qansūh al-Ghūrī in 1514 CE. It was destroyed in 1885. [554]

9- *Bāb* al-Nayrab, it includes two inscriptions of Ashraf Birsbay; one is on the entrance and the other on the eastern bastion in addition to an inscription of the Ottoman Sultan Maḥmūd *Khan*.[555]

10- *Bāb al-Maqām*, the construction began during the reign of Birsbay and was completed during the reign of Abū al-Naṣir Qaytbay. There is an inscription of him in 1465 CE. Its towers were in poor condition. [556]

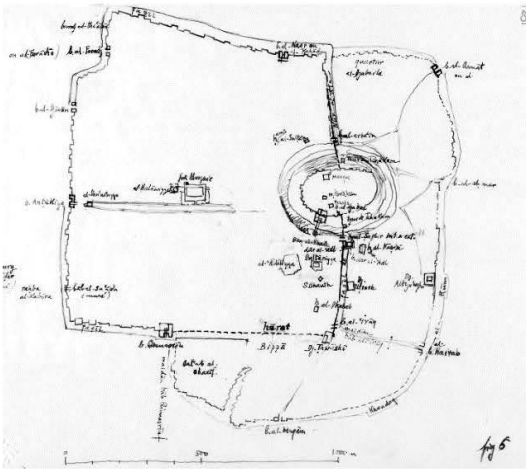

Fig. 51 The map of Herzfeld estimating the location of *Burj al—Tha'ābīn*, The Ernst Herzfeld papers. Freer Gallery of Art and Arthur M. Sackler Gallery Archives. Smithsonian Institution, Washington, D.C

[550] al-Ghazzī, Vol 2, p. 21
[551] ibid.
[552] ibid.
[553] ibid. p. 11
[554] ibid. p. 21
[555] ibid. p. 22
[556] ibid.

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There is also a mention of a gate named *Bāb al-Faraj* next to the citadel during the time of Nūr al-Dīn[557] which supports the theory that *Bāb al-Farādīs* is identical with *Bāb al-Faraj*. Nonetheless, there are many sources that mention them separately and with different construction dates. Herzfeld relied on this theory when estimating the location of the gates of the exterior walls (Fig. 51).

After the demolition of the walls of the city by Timur Link, al-Malik al-Ashraf Birsbay ordered the outer ring of the walls to be built without *Bāb al-Farādīs*, and *Bāb al-Sa'āda* and al-*Midān*.[558] The specific name of the *Midān* is not mentioned, however, it is most likely *Midān al-Ḥaṣa* was located outside *Bāb al-Sa'āda* while leaving the inner ring without restoration to preserve the buildings constructed around its boundaries.[559]

Regarding the towers on the walls, they are mentioned as follows:

1- The famous tower of the southern section of the walls is mentioned, but not its name "*Burj al-Ghanam*", it is reported to be in a state of disrepair. [560]
2- A tower after *al-Ṭunbūgha Mosuqe* bears the name of Qansūh al-Ghūrī. [561]
3- *Burj al-Tha'ābīn* was subject to misinformation, while Ibn Shaddād mentions it in the vicinity of *Bāb al-Jinān*. al-Ghazzi describes it close to *Baūabāt al-Qaṣab* and *Mazzār al-Saharwardī* [562] at the entrance of *al-Jadīda* neighborhood (Fig. 46). At the time of its demolition, a mosque was found in the tower and destroyed along with the gate. Herzfeld attempted to estimate the location of *Burj al-Tha'ābīn* and the extant gates (Fig. 51); yet he mis-located *Burj al-Tha'ābīn* on the western section of the wall instead of the northern section.

   On top of the towers, houses were built; some of the towers got absorbed into those houses, yet most of them were demolished.

The text also provided compiled information on the moat of the city and spent effort tracing its palimpsests. Although most of it was either filled, built over or transformed into orchards, such as the sections between *Bāb al-Naṣr* and *Burj al-Tha'ābīn*, near Banqūsa, behind *Bāb*

[557] al-Ghazzī, Vol 2, p. 15
[558] ibid.
[559] ibid. p. 17
[560] ibid. p. 19
[561] ibid. p. 21
[562] ibid. p. 20

DOI: 10.15774/PPKE.BTK.2023.009

Balūj, after *Bāb Qinnasrīn*, it was leveled and converted to a street within which high-rise buildings started to emerge especially between *Burj al-Tha'ābīn* to *Bāb al-Ḥadīd*.[563]

III.3.1.1.2 *al-Jallūm* District

The distinctive importance of the text of al-Ghazzī is that he included an approximate census of the neighborhoods in Aleppo, divided by religions, sects, and foreigner residents, in addition to the numbers of houses in each quarter which provides information about the population of the city. According to al-Ghazzī, al-*Jallūm* is divided into two districts:

1- al-*Jallūm al-Kubra*: It stretches from the southern edges of *al-'Aqaba* until al-Safaḥiyya in the east. While to the south it is bordered by al-*Jallūm* al-*Ṣughra* around the street of *Jāmi' al-Kawākibī* until *Bāb Qinnasrīn*. According to al-Ghazzī, it included 477 houses and 3543 inhabitants. The residents were of Muslim majority, in addition to Christians of different denominations and a number of foreigners that mounted up to 350 inhabitants.[564] However, it is noteworthy that he has not identified what criteria he used to classify foreigners and whether he meant Europeans, Arabs, and Syrians from different cities, or a combination of them.
2- *al-Jallūm al-Ṣughra*: Bordered by the southern and western walls of the city until al-*Jallūm al-Kubra* to the north and *Bāb Qinnasrīn* to the east.[565] It included 164 houses and 1327 residents only of the Muslim faith.[566]

III.3.1.1.3 *al-'Aqaba* District

This district is also known as *'Aqabat Banī* al-Mundzir. It stretches from the western walls of the city to *al-Jallūm al-Kubra* in the south, *Zuqāq al-Mīkhanāt* in the east, and *Darb Ibn Qays* in the north. It includes 110 houses, with 969 residents distributed among Christians of different denomination, who constitute the majority in this quarter, in addition to Muslims and Jews, with small number of foreigners.[567] It remains unclear whether the foreigners are included in the religious counting.

[563] al-Ghazzī, Vol 2, p. 23
[564] ibid. p. 39
[565] ibid. p. 71
[566] ibid. p. 39
[567] ibid. p. 70

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III.3.1.1.4 Important buildings in both neighborhoods

Although important buildings are discussed previously, this chapter offers architectural description of each important monument in addition to painting a picture closer to untampered condition of the city. al-Ghazzī lists what he believes to be an important monument of the district. Therefore, the mentioned monuments intersect with the previously mentioned monuments and elaborate further on them. Nonetheless, it does not provide information about all the monuments extracted from the previously discussed historic accounts. However, some street names remain unidentifiable.

The information is organized in tables listing the name of the building, its location, previous constructions on the same location (where applicable), patrons, and architectural description. An additional description of typologies of the different architectural functions is also included after each section. The monuments are listed according to their order of mention in the original text.

Moreover, in the preparation of the next chapter, the buildings are categorized according to typology into two main categories.

1- Type 1: Buildings with no courtayrds and with domes roof (*souks*)
2- Type 2: Buildings with courtyard, domes and a minaret such as mosques.
3- Type 3: Buildings with courtyard and domes such as (*Khans, hammams, zāwīyas, Khānqās, madrassas, Bīmāristāns, mausoleums and churches*)

1- *Type 1: Souk*s

The market complex of the city has not witnessed drastic urban nor architectural changes after the Ottoman period. Yet the change in the names makes it harder to trace other urban or architectural changes linked to this central nucleus. Therefore, in an attempt to ease and guide the 2D and 3D-orientation, the old and modern names of the souks and their location are coupled within one coherent map (Fig. 52). To cover all the souks in the studied area, the book of ʿAbd allah Ḥajjar and Muḥammad Ḥurrayttānī was consulted. Hereinafter a list of the names of souks in the text of al-Ghazzī and Ḥurrayttānī:

Table 1 *Souk*s after al-Ghazzī, pp. Vol 2, 41- 75, Vol.2 and Ḥūraytanī, 1990, compiled by Orabi, 2023

Name	Location	Old Name	Old Merchandise	New Merchandise
Souk al-Naḥḥāsīn	South of the *Umayyad Mosque*	*Souka al-Bayraq, Souk Khan al-Naḥḥāsīn, Souk al-Ṣāgha*	Coppersmiths, gold.	Shoes

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Name	Location	Old Name	Old Merchandise	New Merchandise
Souk al-Ṣirmāyattiyya[568]	To the right of southern gate of the *Umqyad Mosque*	*Souk al-Qawāfīn, souk al-Murawbiṭīn, al-Ṭaqaqīn*	Shoes	Shoes
Souk al-Ḥibāl[568]	To the left of southern gate of the *Umqyad Mosque*	*Souk al-Ḥibāl*	Hemp ropes	Hemp ropes
Souk Istanbul al-Jadīd[568]	Adjacent to the eastern gate of the *Umqyad Mosque*.	*Souk al-Ṭqybiyya* [568]	Thread and fabric	Female textile and thread
Sūwayqat *Ḥatim*[568]	Adjacent to the north gate of the *Umqyad Mosque*	Sūwayqat *Ḥatim*	Various products	Various products
Souk al-Ḥalawiyya	Adjacent to the west gate of the *Umqyad Mosque*	*Souk al-Ḥaddadīn*, souk al-Silah, souk al-Mut'a[568]	Blacksmiths	-
Souk Khan al-Ḥarīr	The street west of *souk al-Ḥalāwiyya*, adkancet to the entrance of *Khan al-Ḥarīr*	*Souk al-Bazz*	Silk	Textile
Souk al-Jirfās (al-Khqysh)	Connecting souk *Khan al-Ḥarīr* and souk al-Ḥalawiyya from the southern side	*Souk al-Qutun*	Textile	Textile
Souk al-Ḥūr	Between souk *al-Jirfās* to the north and *Souk al-Saqṭiyya to* the south	-	-	Wood
Souk al-Saqṭiyya		*Souk al-Saqṭiyya*	Food	Food
Souk Khan al-Jumruk	Adjacent to the main entrance of *Khan al-Jumruk*	-	-	-
Souk al-Shām	The eastward extension of	-	-	-
al-Souk al-`Atiq	South of *Souk al-Ḥibāl*	*Souk al-`Atiqa*	Raw leather	Used clothes
Souk Bāb Anṭākiya	From *Bāb Anṭākiya* to the beginning of *Souk al-Bahramiyya*	*Souk al-Ḥawa', Souk al-Ṣabbaghīn*	-	Various products
Souk Khan al-Tutun	A eastward extension of souk *Bāb Anṭākiya*	*Souk al-Ḥawa'*	-	-
Souk al-Waqif[569]	Adjacent to *al-Bahramiyya Mosque*, and extension of *Souk* al-*Hawa'*	*Souk al-Bahramiyya*	-	Food
Souk al-Qaṣābiyya	North of *Souk al-Bahramiyya*	-	-	Food
al-Sūwayqa al-Aḥmadiyya	Adjacent to al-*Madrassa al-Aḥmadiyya*	-	-	Food
Sūwqyqat `Abrak	The vertical street between *Souk al-Bahramiyya and al-Sūwayqa al-Aḥmadiyya*	-	-	Spices

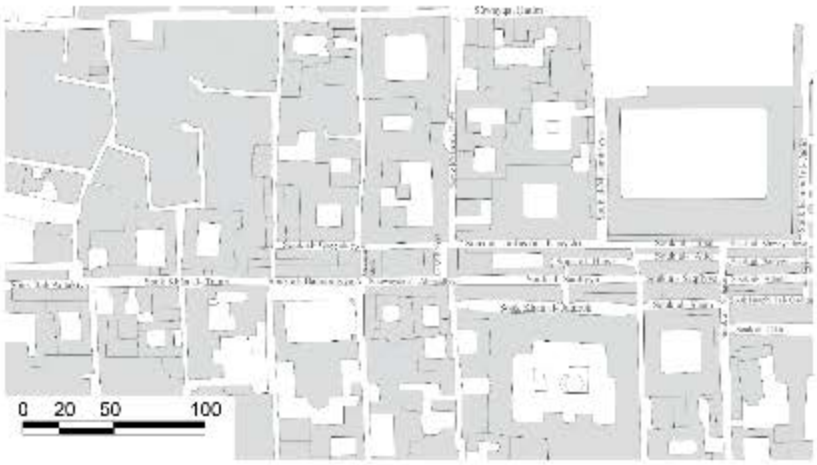

Fig. 52 A map of the old modern names of the *Souks* of Aleppo, after Ibn al-'Ajamī (Gaube & Wirth, Translated by Sakhir 'Ulabī) and Ḥūraytanī, 1990. Drawn and compiled by Orabi, 2023, based on the map of Gaube and Wirth.

[568] al-Ghazzī, Vol 2, p.182
[569] ibid. p. 42

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2- Type 2: Mosques

Mosques were undoubtedly the most popular choice for architectural patronage in the Old City of Aleppo. The typology of mosques in all over the Islamic world can be viewed under three categories: first is the hypostyle mosques, widely used by the Umayyads and the Abbasids. It is also the most common form of mosques in the studied area. The *Umayyad Mosque* in Aleppo is a vivid example of such typology. Second is the Four-iwan Mosque, an imported form widely used in medieval Islamic architecture. This form was not solely used for the design of mosques but also implemented in other religious functions such as *madrassas* and *bīmārīstans*. This form was rarely used for mosques in the studied area and only *al-Bahramiyya Mosque* is documented to have two Iwans but following a centralized form. Finally, there is the centralized form that is most common in Ottoman architecture and has its origins in Ecclesiastical Byzantine Architecture.

Table 2 The mosques in the districts of *al-'Aqaba* and al-*Jallūm*, after al-Ghazzī, Vol 2, pp. 41- 75

Name	Location	Date and Patron	Architectural Description
Masjid Abū Yaḥya al-Kawakibī	*al-Jallūm* al-*Ṣughra*	Expanded by Muḥammad al-Kawakibī	It is built around a courtyard, with a *minaret* next to the entrance. Tombs are located to its western side, and they roofed with a doom.
Jāmi' al-Bahramiyya	*al-Jallūm al-Kubra*	Bahām Basha	Built around a courtyard (19[57]m 50 cubits). Supplied by the canalization of the city. It is characterized by an arched praying hall, preceded by an arcade, and ending with Iwans on both sides. Its unique tall *minaret* is located to the west.
Masjid al-Shaykh 'Abd al-Llah	Next to *al-Bīmāristān* al-Nūrī	-	Its eastern and western walls are suspended onto adjacent houses, hence granting it the name al-Mu'allaq. It includes a mausoleum; at the time of al-Ghzaaī, it was inoperable.
Jāmi' al-Aṣfar	*al-Jallūm al-Kubra*	Muḥammad bin Yaḥya bin al-Khashshāb	Located in connection with the houses of *Banī* Sayyaf.
Masjid Khan al-Ṭāf	On the main street close to the *Khan* with the same name.	1156, *al*-malik al-'Àdil	It is a courtyard with a praying hall in the eastern side.
Masjid Souk al-Ghazil	In front of *Souk al-'Afis*, next to *Qaysarīyat al-Jalabī*	-	Only a praying hall.
Masjid Banī al-Ḥalfā	*Zuqāq* Yabraq (*Zuqāq al-Shakhākh, oriented* east)	-	Known as Jāmi' Yabraq, it has a big courtyard and a praying hall to its eastern side, it used to have rooms on the southern side of the courtyard as well.
Masjid Zuqāq al-Shaykh Na'sān	*Zuqāq al-Shaykh* Na'sān,	-	South of the street leading to Bab Antaqīya in the direction of the street leading al-Kīzwānī mosque.
Masjid al-Ḥarām	South to the main street directed from *Khan al-Ṭāf*	-	-
A Masjid under Báb Anṭākiya	East of the door of the entrance	Muḥammad Badr al-Dīn	Only a prayer hall without a courtyard and it includes a mausoleum.
al-Masjid al-Qamarī	*Zuqāq Arabī kātbī*	Renovated in 1582, Shams al-Dīn	-
al-Masjid al-Umarī	*Bawabat al-Ṣafṣāf*	-	-
Masjid Jadet al-Barqa	*Jadat al-Barqa*	-	A small mosque with a courtyard and a praying hall.
Masjid al-Zaytūna1	*Zuqāq al-Ṣulayba*	-	It includes a courtyard and a praying hall.

[57] The length of the north-east side

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Name	Location	Date and Patron	Architectural Description
Masjid al-Zaytūna2	*Zuqāq al-Zaytūna*	-	It includes a small courtyard and a praying hall.
Jāmi' al-Kumaynī	The end of *Souk* al-*Saqtiyya*	-	A small courtyard with a praying hall.
Jāmi' al-'Shu'ybiyya	In *Qaṣabat Bāb Anṭākiya*	1150, Nùr al-Dīn Zankī	A courtyard with a praying hall, in includes a tomb in its eastern corner.
Jāmi' al-Qīqān	On the edge of the western defensive wall	-	A small courtyard with a praying hall in its center.
Jāmi' al-Kīzwānī	*Zuqāq al-Kīzwanī*	-	A large courtyard and a praying hall, with an incomplete *minaret*.

3- Type 3:

1- Churches

The lack of surviving churches in the studied area makes it very difficult to estimate the typology of the churches of Aleppo. However, some studies have been conducted on the former Great Cathedral of Aleppo (*al-Madrassa al-Ḥalāwiyya*) by Guyer who suggests that it followed a basilica plan [571] and Ecochard who suggests that it followed the Tetraconch style.[572] This theory is corroborated by many other researchers such as Tabbaa[573] and Kleinbauer.[574]

Name	Location	Date and Patron	Architectural Description
Kanisat al-Rahbana al-Fransīskāniyya	Adjacent to *Khan al-Ṭāf* from the east	1853, The Franciscan monks	The biggest Church in Aleppo. To the north it is separated by a street from a monastery and connected by an arch vault above the street. It was expanded by annexing an older *hammam* named *Hammam al-Banāt*.

Table 3 The churches of the studies area after al-Ghazzī, Vol 2, pp. 41- 75

2- Madrassas

Although the function of *madrassas* was first introduced by the Artuqids, the zenith of their construction was only reached during the Zengid period. The number of *Madrassas* multiplied by four-fold under the rule of Nūr al-Dīn; there were 59 *madrassas* in his kingdom stretching from Damascus to Mosul. Ayyubids also paid close attention to the *madrassa*, however, they did not commission as many as in the Zengid period. Female patronage was common as evidence from the religious buildings commissioned by Dayfa Khātūn in Aleppo and Shajarat al-Durr in Egypt. Nonetheless, this period witnessed a shift toward militarized architecture instead of the previous balance between urban, religious, and military construction projects in the Zengid period.

571 Guyer, 1911
572 Écochard, 1950
573 Tabbaa, 1986
574 Kleinbauer, 1973

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While the arrival of Mamluks carried an increase of the then established militarized taste, Nasser Rabbat argues that there is a link between that increase of military taste and the arrival of the Turks to Bilad al-Sham.[575] Yet, the construction of *madrassas* persisted as they were a mean for the Mamluk rulers to control and supervise the literal elite who were to assume positions in the management of the state and the judicial system.

There are two types of *Madrassas* in Aleppo: *madrassas* converted from churches such as most of the *madrassas* in the studied areas and newly commissioned *madrassas*, such as *Madrasat al-Firdaws* and *al-Madrassa al-Zajjājjiyya*. The first type does not necessarily follow a typological form, but it results from the transformation process with an emphasis on adding an *Iwan*, a prayer hall and teaching rooms. While the other type, like *Madrasat al-Firdaws* which follows the proportions of the *four-iwan* plan but altered to include a single main *Iwan*.

Table 4 The *Madrassas* of the studies area after al-Ghazzī, pp. Vol 2, 41- 75

Name	Location	Previous buildings	Date and Patron	Architectural Description
Madrasat al-Kawakibī	*al-Jallūm al-Ṣughra*	-	-	It includes two main rooms, a praying space, and a courtyard.
al-Madrassa al-Aḥmadiyya	*Darb al-Subay'ī*	-	Aḥmad ibn Ṭaha ibn Muṣṭafa, 1751.	Designed around a courtyard surrounded by a peristyle covered with domes. It includes the mausoleum of the patron and his family, a mosque, and a *madrassa*.
al-Madrassa al-Muqqadamiyya	*Darb al-Ḥaṭṭābīn*	A church	'Zz al-Dīn ibn al-Muqaddam, 1150.	It has a praying hall and a courtyard with rooms to the west. The courtyard and the praying hall measure 43 cubits from north to south and 33 cubits east to west.
Madrassa al-Zajjājiyya	Possibly close to the mosque of Abī al-Darājīn	-	Abū al-Rabī' bin 'Abd al-Jabbār bin Artaq, 1122.	-
al-Madrassa al-Ḥalāwiyya	*Souk al-Silaḥ*	A church	St. Helen, Nūr al-Dīn al-Zengi, 1150.	Accessed through the East, organized around a courtyard with an Iwan added during the reign of Nūr al-Dīn, in addition to a portico to the south. The domed Byzantine remains are converted to the prayer hall.

3- *Khānqas* and *Zwāyās*

al-Khānqa and *al-Zāwiya* are establishments designed to host and support the Sufi *Darāwīsh*. The only discernable architectural difference between *al-Khānqa* and *al-Zawiyā*, is that *al-Zawiyā* includes a small prayer hall.[576] Nūr al-Dīn was famous for supporting Sufi monuments and many were commissioned during his reign.[577] Many researchers have attempted to investigate different manifestation of his ideology, through patronage of literature, poetry, architecture, inscriptions, and urban development. Under Nūr al-Dīn Sufi convents were

[575] Rabbat, The Militarization of Taste in Medieval Bilad al-Sham, 2005
[576] Rizq, 1997, p. 70
[577] Elisséeff, 1967

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commissioned; many shrines were restored. Some Arabic sources suggest another secondary function as *al-Madrassa al-Khānqa*, *al-Jāmi ' al-Khānqa*, and *al-Qubba* (shrine) *al-Khānqa*.[578]

Their popularity continued in the Mamluk period as well, while in the Ottoman period the Tekke function was also introduced as an expanded concept of both al-*Khānqa* and al-*Zāwiya* that is sometimes combined with the function of *al-Bīmāristān*.

Just like *madrassas*, the typology of the Sufi establishments (*Khānqa- Zāwiya*) often follows the four-iwān plan. In the studied area, they are organized around a central courtyard, some of them included a tomb as in al-*Zawiyā al-Bazzaziyya* or a *minaret* like al-*Zawiyā al-Kamāliyya,* attesting to the said secondary function.

Table 5 The Sufi buildings (*Khānqa* and Zawāya) of the studies area after al-Ghazzī, pp. Vol 2, 41- 75

Name	Location	Previous buildings	Date and Patron	Architectural Description
Masjid Abū al-Darrājīn (Zāwiya)	In *Zuqāq al-Darajīn*	-	Yaḥya Mousa al-Riḥawī in 1543	It has stairs leading to two levels. The lower is a mausoleum of the patron. While the upper is a courtyard and a domed praying hall.
Khānqa al-Kamiliyya	In the same street as *Madfan al-Jalabī*	-	-	In despair and encroach upon by the neighbors.
al-Zawiyā al-Ḥilāliyya	*al-Jallūm al-Kubra*, in the street bearing its name.	A mosque	-	Includes a courtyard and praying hall, was expanded by annexing a neighboring house to it.
al-Zawiyā al-Bazzaziyya	*Zuqāq al-Bayḍ*	-	1387, Ḥassan bin Zayn al-Dīn Aūrān	There are two praying halls in the eastern and southern sides. While in the northern side of the courtyard, there is a tomb.
al-Zawiyā al-Kamaliyya	East to *al-Kīzwānī Mosque*	-	-	A medium sized courtyard with a proportional praying hall, and a *minaret*.
A Khānqa (Extant)	Next to *al-Bīmārītān al-Nūrī*	-	Faṭima Khaūn	-
Khānqa al-Tanbīh (lost)	-	-	1241, Jamal al-Dīn bin ʿIsa	-

4- Mausoleums

Mausoleums follow a typology similar to that of the *zawāyās*. Domed burial chambers were organized around a courtyard, and they sometimes incorporate a prayer hall. Nūr al-Dīn al-Zengi sets a new practice of establishing burial champers in *madrassas*, a practice that developed into what was later known as "Funerary *Madrassas*". He transformed the remains of his father "Aq- Sunqur" to *al-Madrassa al-Zajjajiyya* in Aleppo, and he himself was buried in a *madrassa* that he commissioned in Damascus known as *al-Madrassa al-Nūriyya*.[579]

Table 6 The Mausoleums of the studies area al-Ghazzī, pp. Vol 2, 41- 75

Name	Location	Date and Patron	Architectural Description
al-Tūrba al-Khassabiyya	Next to the mosque of Abī al-*Dār*aāJīn	Muḥammad bin Yaḥya al-Khashshāb	It is a courtyard with a portico to the east leading to the tombs and a praying hall
Madfan al-Jalabī	In the direction of the street of al-Shaykh ʿAbd al-Llah, separated from it by the main street.	1728- Ṭaha bin ʿUmar ibn Muṣṭafa	A family mausoleum, it includes a prayer hall, and it was used as a mosque.

[578] Rizq, 1997, p. 69
[579] Elisséeff, 1967

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Madfan Aḥmad Bashā Maṭāf	East to *Khan al-Ṭāf* and adjacent to the Franciscan church, on the main street.	Aḥmad Bāshā Mūtiyab bin Maḥmūd al-Jindī	-

5- *Bīmāristāns*

Many *Bīmāristāns* strictly follow the four Iwan plan. Famous examples include *al-Bīmāristān al-Nūrī, al-Bīmāristān al-Qaymarī* in Damascus, and 'Izz al-Din Kay Qāwūs Bīmāristān in Sivas. Although this applies to many places in Syria, Iraq, Turkey, and Iran especially during the 12th and 13 centuries, it does not seem to be valid in Aleppo. Both surviving examples *al-Bīmāristān al-Nūrī* and *al-Bīmāristān al-Aragūnī* do not follow the four-iwān plan. A possible explanation is that the former building was renovated from an older structure, while the latter constituted an innovative typology for the design of such monuments.

Table 7 The *Bīmāristāns* tof the studies area al-Ghazzī, pp. Vol 2, 41- 75

Name	Location	Date and Patron	Architectural Description
al-Bīmāristān al-Nūrī	*Darb* al-Subayʿī	Nūr al-Dīn Zankī	In the time of al-Ghazzī the building was dilapidated.
Bīmārīstān a- Dadāq (lost)	West to *al-Madrassa al-Ḥalāwiyya*	-	-
al-Bīmāristān by the Ummayyad Mosque (lost)	At the northern gate of the *Umayyad Mosque*.	Ibn KharKhan	Non- working and inhabited by some poor people.

6- *Hammam*s

The origin of bathing houses can be traced back to the Hellenistic and Roman period in Aleppo. In that period, the *Hammam*s followed the famous Roman typology of the Frigidarium, Tepidarium and Caldarium.[580] The baths were on a lower level than the rest of the city to facilitate the flow of water.[581] This tripartite typology was preserved in the 2D plans but was transformed into domed structures in the Islamic periods.

The baths in the studied area according to al-Ghazzī were:

1- *Hammam 'Itāb*, located in the street bearing the same name.

2- *Hammam Bazdār*, located in the southern end of *al-'Aqaba*.[582]

3- *Hammam al-Khawājā* (Extant), located in *Zuqāq al-Khawājā*.[583]

7- *Khan*s

*Khan*s were introduced to Aleppo by the Mamluks, the oldest one being *Khan al-Qāḍī*. In this period, they were characterized by simple architectural typology: a central courtyard

[580] Muʿawaḍ, 2013, p. 21
[581] Muʿawaḍ, 2013, p. 69
[582] al-Ghazzī,, Vol 2, p. 74
[583] ibid.

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surrounded by two story rooms, the ground rooms for storage while the upper floor was used for accommodation. Sometimes they include a prayer hall (*Khan al-Jumruk*).

Table 8 The *Khans* of the studies area after al-Ghazzī, pp. Vol 2, 41- 75

Name	Location	Date and Patron	Architectural Description
Khan al-Shibānī	In the direction of *Hammam* 'Itāb.	*Banī* al-Ḥasbī	-
Khan al-Jumruk (Bashā al-Shaḥīd)	Its entrance is between *Souk* al-'Afis and *Souk* al-Hawa'	Ibrahīm *Khan* Zādah	On the outside, it measures 100 by 100 cubits. In its courtyard, there is a mosque. There are rooms surrounding the courtyard, and rooms for Europeans on the second floor.
Khan al-Ṭāf	Next to the Franciscan church	Mūtiīyab Aḥmad Bāshā	-
Khan al-Markūblī (al-Bayka)	Next to al-Bŏmārīstān al-Nūrī	*Banī* al-Markūblī	-
Khan Banī Ṣūlā (al-Jalabī)	In the southern side from the main street heading to the church.	1892, *Banī* Ṣūlā	-
Khan al-Shaykh Ibrāhīm	*Zuqāaq al-Makhāzin*	-	Used as a stable.
Khan al-Jūra 1	*Souk al-Ḥawā'*	-	Known as *Souk* Báb *Anṭākiya*.
Khan al-Tutun al-Qadīm	*Souk al-Ḥawā'*	-	-
Khan al-Tutun al-Jadīd	*Souk al-Ḥawā'*	-	-
Qasariyya in Zuqāq al-Arba'īn	*Zuqāq al-Arba'īn*	-	-

Finally, although many of the sources conveyed overlapping information, they still paint a vivid picture of the architectural and urban development of the city. As each of the chronicles contributed a piece of the puzzle that are the elements of the fabric of Aleppo, we see an extensive density of religious buildings justifying the nickname of the city as "*The city of endowments*", in reference to the substantial *Waqf*s required to support the abundance of religious buildings. Luckily, there are many souks and public service buildings that picked up that mantel to form the most sophisticated symbiotic relationships among the buildings of the city.

One of the most important steps achieved in this chapter was to identify the location, old and modern names of streets and monuments referenced in historic text making it feasible to navigate in the textual description of the historic city. This represents a first step in recreating those elements in 3D-dimensions. Nonetheless, the extraction of architectural information from the historic text alone can be challenging. Appreciatively, we can visually identify some patterns from the previous data without resorting to computer-assisted identification.

This chapter discussed the most informative and descriptive records about the urban planning of the city of Aleppo, using both medieval and modern sources, as well as famous architectural typologies popular in the city during different historical periods. Fig. 53

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summarizes the discussed information with particular focus on the knowledge transfer through the historical account, both Medieval and Modern.

The following chapter 4 also discusses the process of the digital field survey, processing of data, data post processing, and the implementation of the survey within the parametric models, the Grasshopper script, and the process of extracting the parameters that guided the urban development of the city.

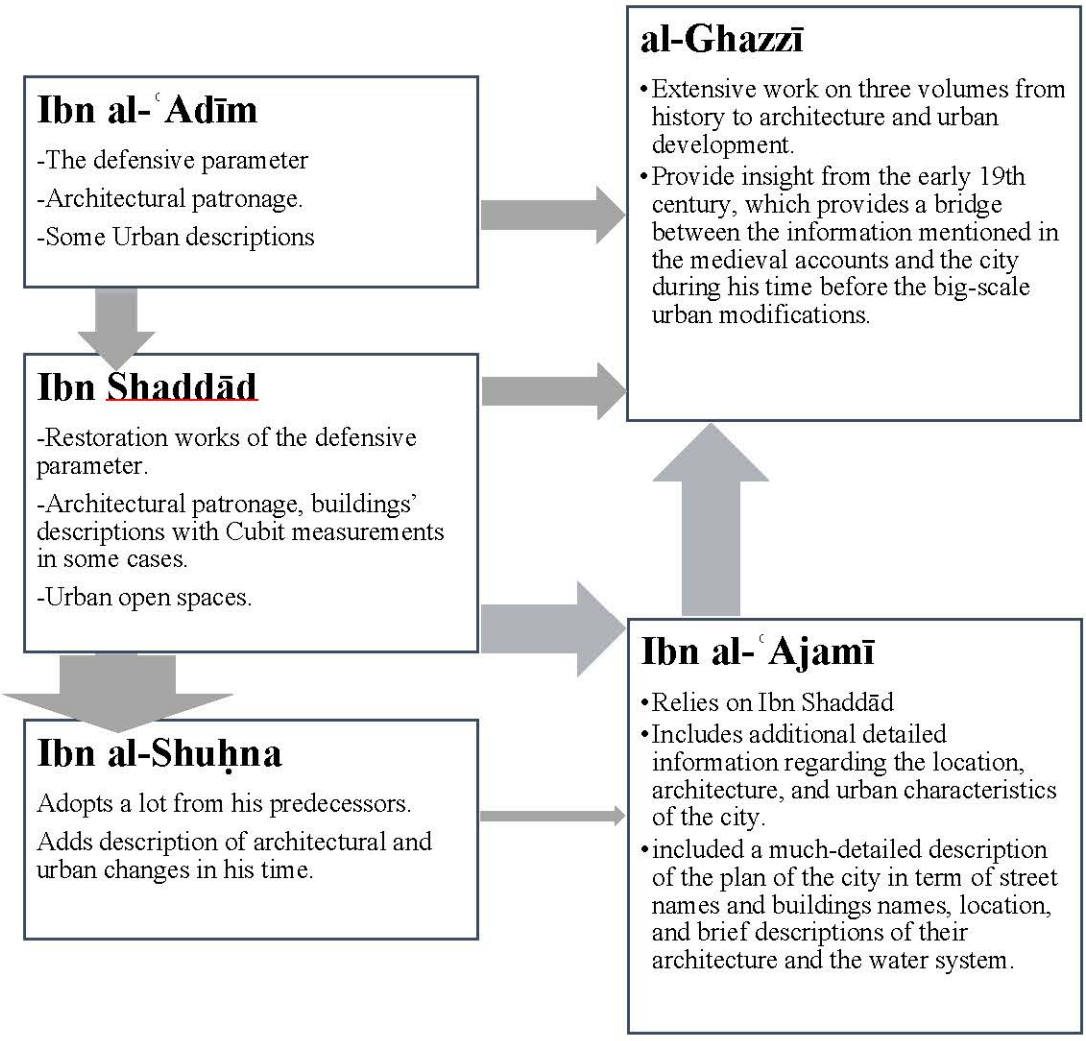

Fig. 53 The process of knowledge transfer through the historical accounts (The arrows represent how much the authors took from their predecessors) by Orabi, 2023.

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CHAPTER FOUR

DIGITAL FIELD SURVEY AND THE PARAMETRIC MODELING OF ALEPPO

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The first section of chapter 4discusses the laser scanning and the photogrammetry field survey of two districts of the old city of Aleppo and the following processing and post-processing procedures. While the second section addresses the parametric modeling of the historic fabric based on the previously recognized parameters. The final section combines both data in order to compare the multiple models and compute the spatial changes that took place in different time periods.

The survey covers 1 km^2, stretching from *Bāb Anṭākiya* in the west to the *Umayyad Mosque* in the east, and from *Bāb Qinnasrīn* in the south to the *Umayyad Mosque* in the north. The area was chosen because it incorporates many elements that encapsulate the character of the city. The area exhibits the remains of the Hellenistic planning of Aleppo, in addition to two of the four surviving gates of the city, three surviving defensive bastions; all are connected by the remains of the defensive parameter. Moreover, it encloses an important section of the central markets, at least one example of important commercial, public, and religious buildings, and a significant number of houses, some of which are encroaching on the walls of the city.

Not to forget that the area was one of the least affected by the urban development projects which makes it the perfect location to investigate the effects of time, climate, culture, religion, the political atmospheres on the urban development and growth of a Middle Eastern city such as Aleppo.

During the crisis monuments of Aleppo suffered extensive damages to some areas, which makes basing the study in this region the more imperative, since it will provide a digital documentation of the damages, which is likely to be of use during the reconstruction projects.

The field work started in April 2018 and continued until August 2018. During that period, a total of 1.823 terrestrial laser scans were recorded using the instrument FARO focus 330X while the Aerial Photogrammetry of the region was done in February 2018. Some terrestrial photogrammetry data was recorded as well, especially for the high-profile feature, yet, this data was not included in the final model, since the data collected from the laser scanning and aerial photogrammetry proved to be sufficient for the purpose of the study. There was no reason to increase the resolution accuracy further.

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The first section of this chapter explains the method used for the data acquisition and processing for both laser and photogrammetry data.

IV.1 Data Acquisition Process

As previously mentioned, there are two types of the collected data; one is acquired using an UAV and the other was acquired through a laser scanning instrument. Each process encompassed different steps of data capturing, processing, and post-processing, not to mention that they both faced different types of obstacles that will be discussed subsequently.

IV.1.1 Terrestrial Laser Scanning

The area was divided into two sections: the first is from *Bāb Qinnasrīn* until al-*Shībānī* church in the north and *Bāb Anṭākiya* in the west constituting the district of al-*Jallūm*, while the other started from the borders of the first section until the street of *Ibn Qays* which marks the northern edge of *al-ʿAqaba*, until souk *al-Naḥḥāsīn* in the east and the *Umayyad Mosque* in the north. Only the *Souk al-Ṣirmāyatiyya* and *Souk Istabnūl al-Jadīd* were included from outside the studied are, in order to fully capture the southern and eastern façades of the *Umayyad Mosque*.

To effectively cover the wide extent of the studied area, multiple scanning resolutions were used: The highest being 1.5 mm per 10 m, the average resolutions is maintained between 10 mm per 10 m and 7 mm per 10 m, and the lowest quality was around 50 mm per 10 m. The resolution of choice was based on the following factors:

- Level of details visible in each scan: The more complex the details, the higher the chosen resolution was to facilitate the capturing of small details such as inscriptions, carvings and mason's marks.
- The possibility of overlapping the scans: Normally it is crucial to have overlapping scans of recorded features in order to increase the fidelity of registration and increase the overall accuracy and resolution. However, during the field survey there were situations where rubble prevented the possibility of overlapping scans. As a result, higher resolution was chosen to facilitate the recording of most of the scenes at hand – of course, provided that a clear line of sight for the scanner is maintained.
- The speed of the machine for different resolutions: This was a determining and crucial factor especially in invigorated streets that had a lot of car and pedestrian traffic. In that situation, given there were a limited number of details in the scene, the resolutions were

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reduced to facilitate faster capturing and minimize laser shadows of cars and people in the resulting scans.

- Whether the RGB data (colors) was acquired from the scanner or not: Given the moderate resolution of the camera imbedded in the laser scanner, this factor was heavily depended on the location of the scan in addition to the condition of lighting (indoor/ outdoor). For example, if the work was being carried out indoors with no source of lighting, it was not very important to acquire RGB data since it will be black inevitably; otherwise, data was always collected indoors. However, if the work was carried outdoors, the RGB data was collected during cloudy weather because it provided an even lighting of the subject to weather and lighting conditions, while the sunny and extremely hot weather was mostly opted out especially in scans with few important details. The uneven lighting would compromise the quality of the lighting in the photos and by extension the usability; it would also extend the time of recording extensively putting the machine in the risk of overheating.

IV.1.1.1 Challenges of the Terrestrial Laser Survey

The field survey faced multiple challenges. The most severe ones of them were:

- The excessive heat and the repeated overheating of the device sometimes let to freezing and malfunctioning of the machine until it was turned off to cool down. This resulted in shaking photos and point clouds that rendered the scans unusable. Sometimes under extensive heat, a section of up to 20 % percent of the scenes was not recorded by the device.
- The difficulty of restricting the movement of cars and pedestrians in the narrow and twisting streets-network resulted in a number of laser shadows that required additional scans to be taken and lengthy post-processing measures to remove cars and people from the point cloud.
- The bulks of rubbles that restricted movement and the possible positioning points for the device and inevitably the workflow of data-capturing and registration. This created a number of gaps in the recorded data that was compensated for through the use of drone footage.
- The destruction of numerous stairs in some buildings made it hard to place the device on the stairs to connect the floors of such buildings. As a result, some roofs were accessed through moving from the neighboring roof. This can also include unstable

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structural elements such as roofs that made it dangerous to position the scanner in certain locations (such as on the roof of the *al-Shībānī Church*).

- The mass vegetation that grew in the buildings and over the rubble after the years of neglect and abandonment of the buildings; this fact resulted in mass laser shadows.

In the picture below, we see an example of an intensity preview of one of the laser scans. The device was positioned on top of the covered markets behind the *Umayyad Mosque*.

Fig. 54 A laser scan preview of the top of the city's main market, by Orabi, 2023.

IV.1.2 Aerial Photogrammetry

The photos were acquired prior to the laser scan survey and were purchased from the drone pilot, due to the lengthy permission process to get the approval for flying an UAV over the old city of Aleppo. Notably, the distribution of the photos is not homogenous due to the manual flight mode of the UAV. It was captured in a manner giving priority to important features of the city such as the *Umayyad Mosque*, the Citadel, and the main souks; on the other hand, other areas were less covered and even had missing photos especially in the southern east side of the city. As a solution, and despite the resolution decrease, videos taken by the same machine will be used in an attempt to patch the missing photos from the pictures with ones of lesser resolution from the videos. The photos were processed with Adobe Lightroom to unify the lighting conditions, while the videos were first converted to photos before they were subject to the same pre-processing.

IV.2 Data Processing

The data from the photos and the scans were processed separately by different software. The laser scans were registered using Autodesk Recap, while the UAV footage (pictures and videos) were processed by using Agisoft Photoscan.

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IV.2.1 Terrestrial Laser Scanning

The processing of the laser scans themselves was done in two stages. The first one was the-on-site preliminary registration. During that stage, and to facilitate file handling, the registration file was separated into two Autodesk Recap Projects. The main aim was to ensure that the scans were balanced, complete, and usable and that they completely covered the required area homogenously. The results are shown in (Fig. 48 a and b).

Fig. 55 A view from the laser point cloud from the west above the *Souks*1, by Orabi, 2023.

The second stage of scan processing took place in the university labs. All 1.823 scans were reimported to Autodesk Recap and re-registered within the same file; the result registration is shown in (Fig. 56). The huge number of scans made the file harder to handle, because the software exceeded the quota of scans that can be registered together, which is set around 500 scans. Therefore, processing took longer, and the accuracy of the registered scans was affected negatively. Still, the final accuracy of the registration of the 1.823 scans was acceptable; for details less than 10 cm the accuracy was 93 %, overlap was 45% and balance was 30%, and the cloud contained "10, 898,985,641" points.

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Fig. 56 The entire set of laser scans combined in Autodesk Recap.

Nevertheless, in order to use the laser point cloud in other software such as Cloud Compare and Grasshopper), the cloud was spatially subsampled, where the minimum space between two points was set to 5 cm, the resulted cloud contained "280,170,937" points with a file size of 6 GB.

The subsampled point cloud, much like the original one, was missing many inaccessible roof data, which is to be remedied by merging it with the data from the drone flights, while some roof data was acquired with the laser scanner from accessible roofs such as the roof of the main souks of the Medina, as shown in Fig. 55.

IV.2.2 Aerial Photogrammetry

The data set of aerial photos includes 3,600 geo-referenced photos taken by DJI Phantom 4 Drones. The processing of the photos was also done in two stages. First, they were imported and tested in Agisoft Photoscan; the test included alignment, dense point cloud generation and meshing, the result is shown in (Fig. 57 and Fig. 58). Then they were imported and tested in Agisoft Metashape. This process demonstrated better alignment algorithm and a high-resolution point cloud generation result.

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The configurations for the photo alignment in Agisoft Metashape were as follows:

1- Accuracy: Ultra High.
2- Key Point Limit: 100,000.
3- Tie Point Limit: 4,000.
4- The resulted Tie Points: 2,613,260 points.

For the point-cloud (Fig. 57) the following configurations were used:

5- Quality: Ultra High.
6- Depth Filtration: Aggressive.
7- The resulting depth map count: 2,162 maps.
8- The resulted dense point cloud count: 1,604,917,351 points.

In addition to photos and due to the military restriction on flying UMVs in Syria, photos from a video recorded by the same vehicle were used to bridge the gap caused by the low percentage of the photo-overlap at the south-western side of the studied area (Fig. 57). Therefore, a separate file was created for the photos extracted from the videos to be combined with the rest of the data using Cloud Compare.

The video was converted to 1,297 non-geo-referenced photos that were preprocessed in Adobe Lightroom to unify lighting conditions. The configurations used to generate the Tie Point were as follows:

9- Accuracy: Ultra High.
10- Key Point limit: 80,000.
11- Tie Point Limit: 4,000.
12- The resulted Tie Points: 213,463 points.

Next, a dense point cloud was generated using the following configurations:

13- Quality: Ultra High.
14- Depth Filtration: Moderate.
15- The resulted depth map count: 727 maps.
16- The resulted dense point cloud count: 46,917,608 points.

Point clouds (Fig. 58) from both files were exported as an E57 file in preparation for combining it with the data from the laser scanner.

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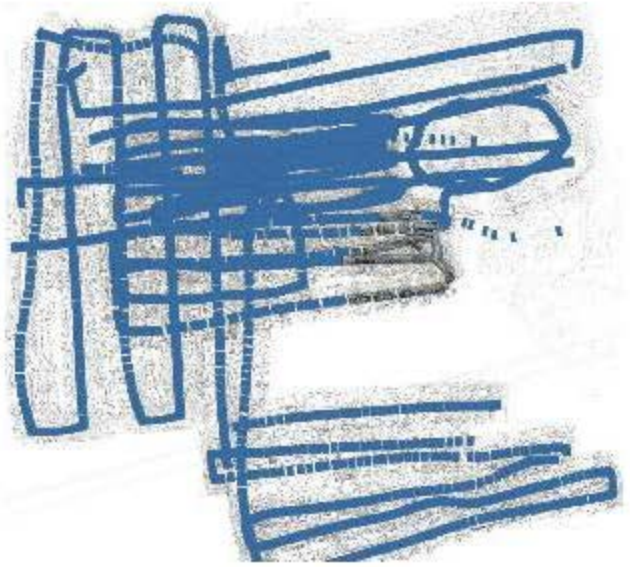

Fig. 57 Drone flight path, the studied area is marked within a rectangle, by Orabi, 2023.

Fig. 58 A section of the resulted high-resolution point cloud in Agisoft Photoscan, by Orabi, 2023.

IV.2.3 Combining the Data

The vast number of high-resolution scans resulted in bulky files that were challenging for postprocessing, let alone export to other point cloud manipulation software – in this case Cloud Compare – and later to 3d modeling programs, in this case Rhino 6. In order to combine the laser data with the photos and videos, the resolution had to be reduced to decrease the files' size and to facilitate computation. As previously discussed, the point cloud resolution was reduced to a homogenous 50 mm, as a result the size of the cloud was subsampled from 400 GB to 6 GB (Fig. 60); then, the point cloud was exported in E57 format. Results are shown in (Fig. 59). Since the aim was to investigate the urban planning of the city, the new resolution proved to be adequate. Three separate E57 files – laser scans, photos, and videos – were imported in Cloud Compare in the preparation for aligning them using point pair picking (where three or more

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pairs of corresponding points are chosen). However, there was a need to adjust the reference system before continuing with the alignment of different datasets.

Fig. 59 The laser scan and the aerial photogrammetry (Photos and Video) combined in Cloud Compare, by Orabi, 2023.

Fig. 60 The Subsampled point cloud to be imported in Grasshopper/ Rhino. Subsampling distance is 200 mm. Rendered in Cloud Compare, by Orabi, 2023.

IV.2.3.1 Adjusting the reference system

Importing the geo-referenced aerial point cloud proved to be challenging since it was referenced in WGS 84 system. In this system the value for X and Y are in degrees, while the Z value or the altitude is in meters. This caused CloudCompare to read it as a seemingly infinite 2d line; therefore, it was necessary to express the degrees in linear units. As a result, the reference system had to be converted in Agisoft Metashape from WGS 84 to WGS 72/ UTM

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zone 37N. This zone was selected specifically because the zone 37N is the UTM zone that includes Syria.

IV.2.4 Aligning the point clouds

Upon importing the geo-referenced drone point cloud, it was automatically shifted to fit within cloud compare workspace, because the units were larger than the available workspace. The shifting parameters are shown in (Fig. 61). This translation is to be reversed upon exporting the point clouds.

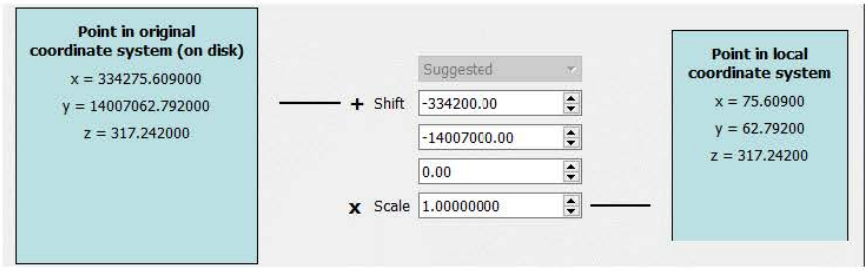

Fig. 61 Geo-referenced translation in Cloud Compare, compiled by Orabi, 2023.

The base cloud for alignment is intuitively the geo-referenced drone cloud, in order to set the reference system according to which both of the remaining cloud will be combined, since the programs allows only two clouds to be paired together at a time (a target cloud and an aligned cloud). The target was to create a geo-referenced drone cloud, to maintain the scale and the reference system, while the aligned cloud was the laser point cloud. They were aligned using "point pair picking"; the resulting cloud to cloud registration RMS is 1.97 [584].

The alignment matrix is shown in (Fig. 62). We can detect only a 27 mm difference between the two scales of the clouds, which attests to the accuracy of the photo georeferencing. This difference was adjusted through the alignment matrix.

Next, the video point cloud was to be aligned with either the photos point cloud or the laser scan point cloud. The latter was selected because it includes a lot more distinctive details than the cloud of the photos. They were aligned using the same "point pair picking" which resulted in the matrix shown in (Fig. 63) with an RMS of 0.28. The resulting combination of all three clouds amassed "599,382,545" points with a total file size of 15 GB. As the aim was to post-process the data in Grasshopper/ Rhino, the clouds had to be subsampled again.

[584] The standard deviation of the relative distances between the two clouds

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Final RMS: 1.97994

Transformation matrix
1.002 0.042 0.003 -7.181
-0.042 1.002 -0.004 -9.575
-0.003 0.003 1.003 -1.704
0.000 0.000 0.000 1.000

Scale: 1.00273 (already integrated in above matrix!)

Fig. 62 The alignment matrix of the georeferenced drone and laser scan point clouds in Cloud Compare, compiled by Orabi, 2023.

Final RMS: 0.228782

Transformation matrix
0.959 0.032 0.046 127.211
0.033 0.960 0.017 444.738
0.046 0.019 0.959 326.323
0.000 0.000 0.000 1.000

Scale: 0.960639 (already integrated in above matrix!)

Fig. 63 The alignment matrix of the video and laser scan point clouds in Cloud Compare, compiled by Orabi, 2023.

Fig. 64 A view from the resulted combined point cloud showing *al-Bahramiyya Mosque*, by Orabi, 2023.

Fig. 65 A view in the reduced and combined point cloud, by Orabi, 2023.

The laser scan was already subsampled in Recap with point spacing of 50 mm. To match the same level of details, the two drone clouds were subsampled in Cloud Compare at 50 mm each. Then the three clouds were subsampled a second time at 90 mm, afterwards at 200 mm. Both files will be used in Grasshopper, the smaller one will be the working file used to design the script, while the bigger one will be substituted at the end of the design process to secure better results while enabling a smooth workflow in Grasshopper.

The resulting combination of the clouds included "133,622,519" points for the 90 mm-spaced cloud and "25,963,019," with a file size of 4 GB. Points for the 200 m-spaced cloud and

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the final file size were reduced to 780 MB. Fig. 65 represents a view from the final 200 m-spaced point cloud.

IV.2.5 Missing Data

As previously discussed, the drone photos were not distributed homogeneously, as shows the number of photos taking in each section of the flight. Moreover, the black line represents the flight path of the drone, and it is clearly leaving a blank area. This lack is to be compensated by the laser scans and the point cloud from the video, compare (Fig. 67) and (Fig. 68). Although it will not completely be patched; the missing data set is compromised solely because of roofs that can be annexed to the available data set at any moment. More importantly, for the scoop of the urban study, it does not affect the accuracy of the urban modeling.

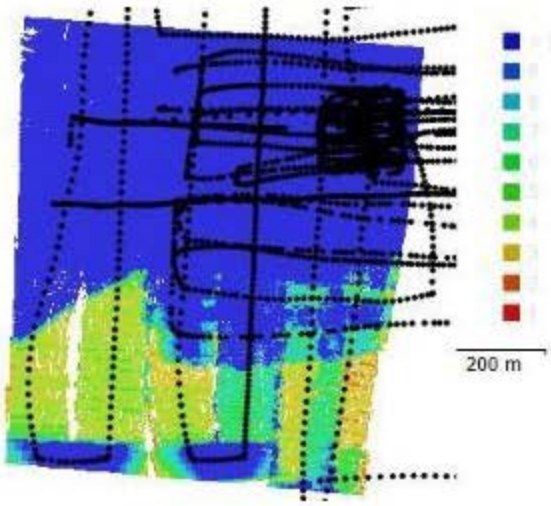

Fig. 66 Camera Overlap Diagram showing the low overlap on the southern and the south-western sides of the survey. Exported from Metashape 1.6.2, by Orabi, 2023

Fig. 67 The Drone-Point-Cloud data before adding any supplementary data set, rendered in Cloud Compare, by Orabi, 2023.

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Fig. 68 The Drone-Point-Cloud after adding the data from the video, saved from Cloud. Compare, by Orabi, 2023.

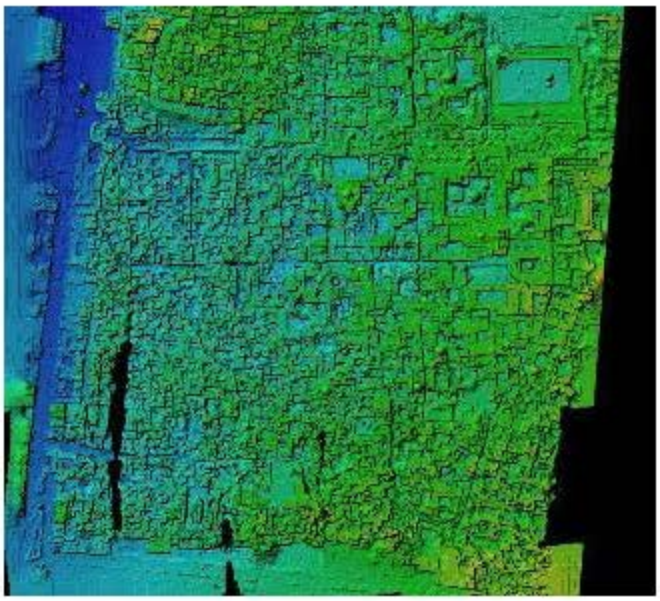

Fig. 69 A DEM model of the Photogrammetry Point Cloud. Rendered from Metashape, by Orabi, 2023.

IV.2.6 Export of Data and Post-Processing Preparations

After the successful merge of the point clouds, a final E57-file was exported spaced at 90 mm, in preparation to be imported in Grasshopper for further development and analysis. However, a lower resolution file (the previously mentioned cloud spaced at 200 mm) was

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created to facilitate the file-handling after importing the file into Rhino and the process of creating the Grasshopper definition.

IV.3 Post-Processing

The post-processing consists of four main steps:

1- Creating the terrain of the old City of Aleppo.

2-Geo-referencing the E57 point cloud onto that terrain using the geolocation recorded from the drones.

3- Importing the 2D drawing of the city (chosen in chapter 2) on top of the model to serve as the base for the modeling of the city in the Mamluk period.

4- Comparative analysis of the different models and the survey data using various parameters that will be discussed later in this chapter.

IV.3.1 Superimposing the Historical Spatial Data

The next process was to overlay the historical map with the modern city layout. The base of the alignment was the combined geo-referenced file in Cloud Compare; however, the program does not provide this possibility in a straightforward manner. Therefore, the combined cloud compare E57 file was imported again to Metashape to export a complete geo-referenced Digital Elevation Model (DEM).

IV.3.2 Creating Topography and Geo-referencing

The workspace now moves to Grasshopper running within Rhino 6. For the creation of the topography, the Rhino plugin "Land Design" was used. This plugin allows for importing terrain data from Google Maps and imports it as an image, terrain, and/or a mesh. The resolution set for the import is 2498* 1518 (Fig. 70). Upon the import, the terrain will be positioned according to the coordinates available in the database of Google Maps.

To make sure that the E57-model will be imported correctly and with the optimum fit above the imported terrain, 5 spatially distributed points were selected from the geolocation data set. Their corresponding ones were identified from the terrain and shifted to fit on top of them, since the coordinates acquired by the drone are generally more accurate than the ones from Google Maps. Therefore, when the E57 file was imported it fit correctly over the terrain without any need of adjusting it further (Fig. 71 and Fig. 72). This method ensures that the coordinates are imported correctly into a 3D manipulation software that is originally not designed to perform correctly with geo-referenced data. Upon merging the file, we notice that

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the contours of the terrain-mesh are not precise as they include the heights of the building in their original elevation. Nonetheless, this will not affect the accuracy of the final elevation-model as it will be generated from the dense cloud.

Then, the harder task lies in combining historical and spatial information in one parametric model of the city in different periods. The following section will discuss the used survey data and the maps of Aleppo, guided by historical information as a base for the 3D-modeling of the city with Grasshopper.

Fig. 70 The imported terrain textured with the layout of the city imported from Land Design, by Orabi, 2023.

Fig. 71 The low-resolution point clouds after importing to Grasshopper, by Orabi, 2023.

Fig. 72 Elevation of the model, by Orabi, 2023.

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IV.4 Identifying the Workflow

The workflow is based on the combination of analog parameters with computational ones to be able to interpolate urban and architectural features from historical cartography and text information (see chapters 1 and 3). In the following section, the most important analog parameters will be discussed.

IV.4.1 Analog Parameters

- The first analog parameter is the *anchor point*s during which the models are built. This selection is based on important historic events that are thought to have shaped the future of the city and perhaps its urban fabric as well, in accordance with the available maps, photographs, and historic texts. The chosen period is the Late Mamluk Period. The second anchor point is in 2018 in the time of the survey, after the liberation of Aleppo, which documents the state of conservation of the city after the war.
- Secondly, there are the urban and architectural characters, which are considered to be the *pivotal aspects,* identified from written sources of each historical period corresponding to the chosen dates. The city underwent religious, political, sociological and commercial fluctuations; in each chosen period a subset of these factors prevailed over the others and possibly left a unique impact on the architecture and planning of the city which will be used later for defining computational parameters specific to each period. For example, the Mamluk period constituted the zenith of *urban grandeur* triggered by the expansion of commercial operations.
- Thirdly, using the cartography data, photos, and texts as a base for the modeling, where appropriate.

IV.4.2 Computational Parameters

1- While defining computational parameters, the challenge relies in extracting architectural features from historical texts and expressing them as dimensions, mathematical and logical expressions. This is achieved by examining the city as whole, then breaking down the components to their basic elements: walls and roofs. Later, these basic elements can be expressed parametrically in terms of height, length, width, and elevation to reconstruct the building-blocs of the models. One assumption is that every period is characterized by distinctive urban and architectural

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styles and units that makes it possible to create distinctive sets of parameters for each period. For example, if we de-construct a mosque into the basic modeling blocs, we will identify a *minaret*, a courtyard, and a dome (or domes), while a *madrassa* is characterized by a dome (or domes) and a courtyard. On the other hand, the gates are characterized by the flanking towers and vestibules.

2- Another key parameter is the city layout and building material: The main elements that define the spatial layout of the city are the heights of buildings, width and shape of the streets, roofing system and the allocation of mass and void; all of which were, to some extent, subject to the available building material. Most buildings in Aleppo are made of stone which dictated unique features defensive walls and roads. Not to mention that mainly because of the building material, the major street network and terrain have remained unchanged from what was reported by the historical accounts as far as the Ayyubid period. Moreover, the endowment system played an essential role in preserving many key buildings which were subjected to only minimal changes until today.
3- The type of the elements and the specific parameters require to identify and recreate it digitally.
4- The date of construction influences the shape and architectural style of the element.

IV.4.3 Parameterization of the Historic Information

Parameterization involves visualization of the hidden logic of the city, whereas the mathematical function governs the growth and development of elements and create a unit-dependent fabric; changing one parameter in the definition affects the entire model.

The strategy in converting the historic information to computer data lies in two main steps:

- The extraction of the set of parameters that guides and defines each historical period. In search of this goal, the following steps were identified:
    1- Establishing the timeline when changes took place by tracing the patronage and periods of restoration and/or reconstruction.
    2- Identifying the changes and their attributes, where possible.
    3- Characterization of the changes, depending on dimensions, typology, and architectural style.

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The previous extracted information was collected and organized within a Microsoft Access Database.

- The database is later consulted during the parametric modeling with Grasshopper in the form of mathematical and logical relations within grasshopper definition that will create the basis for the modeling process and later the representation, emphasizing the role of the databases in exploring the process of 3D modeling and whether it will yield recognizable urban patterns.

IV.4.3.1 Advantages of the Parameterization of the Historic Information

1- The process accommodates and accounts for the range of uncertainty within every unit of measurement – in this case, the cubit.
2- Enables recognizing urban and architectural patterns, such as a pattern of mosque at the corners of streets, possibly to allow more accessibility to a greater number of worshipers. Another explanation can be spiritual giving and blessing to the neighborhoods in which they are established.
3- Parametric modeling provides extended flexibility in terms of the numerical and physical boundaries of the modeling blocs and the city by extension. It also facilitates implementing changes to the urban fabric with minimum modeling since the entire fabric is mathematically and geometrically connected and/or dependent. Later, the process of parameterization of the historic information will be discussed in detail later in this chapter.
4- But more importantly, a unified definition constitutes a basic code that can be applied to any city similar to Aleppo in terms of urban fabric and architectural styles. Just by changing the input geometry such as the outline of the *insulae*, the courtyards, the domes and the *minarets*, the model is instantaneously created. Therefore, reducing the time necessary to model other similar post-war cities. Highlighting the most practical feature of parametric modeling which is that each definition can be implemented in all the buildings within their respective category. Furthermore, it can be applied in any scenario that shares similar modeling blocs and parameters; thus, saving time and standardizing the process of digitally visualizing and reconstructing the urban fabric.

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IV.4.4 Workflow

Mimicking all computer algorithms, the workflow depends on three main stages: the input, the process, and the output.

1- **INPUT**: It involves collecting all the available data in the same software platform. For this thesis, Grasshopper was chosen because it enables parametric modeling in addition to importing the code directly from different programming languages such as C++ and Python; furthermore, it is possible to link it to Cloud Compare, Microsoft Excel and different package software.

The data to be combined in Grasshopper included the laser scan survey, the historical base maps (1900, 1930 and the "Aleppo Archive in Exile" by BTU Cottbus-Senftenberg), important buildings layout and information from the buildings Microsoft Access Database.

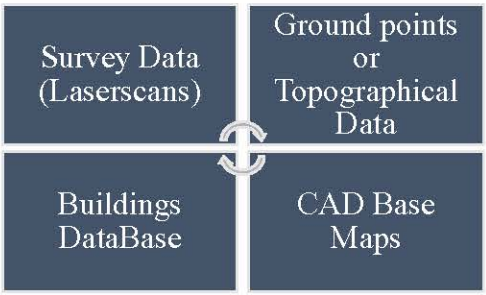

Fig. 73 The Grasshopper INPUT Diagram, by Orabi, 2023.

2- **PROCESS**: The second step is creating the model based on the CAD base maps for each period. During this step, parameters of each period are identified and modeling blocs for different building usages are created; those usages are religious (mosques, khanqas, churches), commercial (souks and khans) and public (hammams).

3- **OUTPUT**: The final step results heavily dependent on the previous ones. The output are the historical models that represent different periods. However, only the latest model of the year 1930 is selected to be analyzed and compared with the field survey. This comparison is based on several criteria dependent on basic dimensions such as street width, building heights and void and mass ratio. These criteria can be increased or altered by simple mathematical functions.

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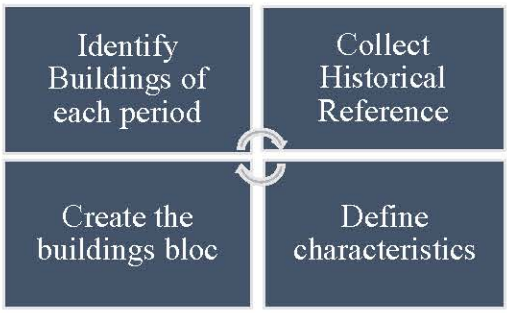

Fig. 74 The Grasshopper PROCESS Diagram, by Orabi, 2023.

Fig. 75 The Grasshopper OUTPUT (Criteria) Diagram, by Orabi, 2023.

IV.4.5 The Grasshopper Definition

After the low-resolution E57 file was referenced into Grasshopper using "Volvex" component (Fig. 79), the maps of the city (the Ottoman map, The French cadaster, the map of Gaube&Wirth and the map of the BTU-Aleppo Archive in Exile) were layered on top of each other, and adjusted to the height of the point cloud.

The next step was referencing the outline boundaries of the *insulae* from the most complete map of the Aleppo Archive in Exile. Each *insula* was modeled separately in order to convert all of them into surfaces. Later the courtyards in each *insulae* were referenced as well so they can be subtracted from the area of the *insulae*. The remaining spatial difference is then extruded to the historical height. However, this definition will be slightly altered after importing the terrain. But it is easier to apply the original heights from the flat surfaces rather than the terrain-projected ones.

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Heights were mainly acquired from historical documents or from the available plans of the key buildings. However, not all of the heights were explicitly mentioned in the historical records, nonetheless all the recorded heights range between 5-7 m depending on the function of the building in each *insulae*; in some unique buildings such as the *Umayyad Mosque* the height is around 8.5 m. Therefore, when information about dimension was lacking, the laser scan model was observed for the needed measurements.

Each *insulae* was then examined for important buildings to be modeled parametrically according to historical records, photographs, maps and laser scan data.

IV.4.5.1 Creating the Terrain

Modeling the terrain involves two main steps. The first is classifying the ground points from the laser data of the field survey and then mapping the buildings onto the terrain.

1- **Classifying Ground Point**: Cloud Compare offers a wide range of effective filters for classifying point clouds. One of them is "CFS Filter" which is used to classify and group the ground points. In order to perform the classification, the overall terrain form – or the style of the slope – should be selected. Then, in the advanced settings tab, the resolution of the terrain, the number of calculations and the height threshold are tested until the desired result is achieved. The smaller the resolution of the cloud gets, the more accurate the classification will be. On the other hand, increasing the resolution will increase the complexity of the mesh and will make the modeling process hard. Therefore, an ultimate result has sufficient points to accurately represent the terrain without adding unnecessary details to it. The settings chosen for the purpose of this study after thorough experimentation are demonstrated in (Fig. 76). The next step is meshing the surface using Delaunay 2.5 D (best fitting plane) to create the surface from the point cloud. The final step in Cloud Compare is exporting the resulted mesh as an OBJ file to be imported to Grasshopper for the following process.

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Fig. 76 The parameters applied when classifying the ground points in Cloud Compare, by Orabi, 2023.

2- **Extruding the Generic Fabric:** two workflows were tested to create a randomized height of generic fabric:

   a. **Mapping the 2D polylines to ground surface**: This step takes place in both Rhino and Grasshopper. The OBJ model is imported to Rhino and then referenced in Grasshopper. Using the Mesh+ plugin and "Map Curves to Surfaces" command, the outline of the *insulae* and the courtyard are mapped to the extracted topography (Fig. 79) and (Fig. 77). Again, the geometrical difference between the projected *insulae* and courtyards is calculated and then extruded to the reported heights (Fig. 80). However, one problem arises that the non-flat extruded polylines are not solid and therefore are not capped. In order to solve that problem, a flat non-projected surface is moved to the desired extrusion height and a Boolean operation is executed to cap the extruded surfaces (Fig. 78).

Fig. 77 The result of projecting outlines on the terrain in Grasshopper, by Orabi, 2023.

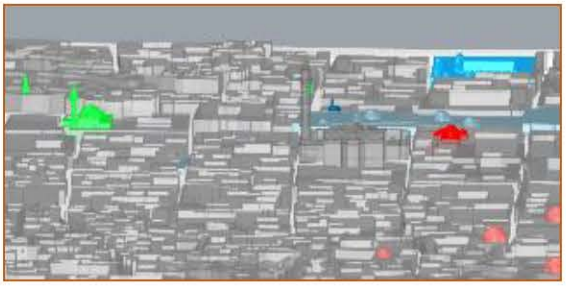

Fig. 78 A section of the historical reconstruction showing the randomized heights in Grasshopper, by Orabi, 2023.

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b. **Moving the 3D masses to the ground surface**: The first workflow had a notable shortcoming related to randomization. This workflow introduced "Supervised" randomization. Each generic *insula* was extruded with a number between 8 and 12 m, which corresponds to a height of two or three floors, then the mesh was moved to the ground surface that also acted as a trim surface to the bottom section of the meshes. This workflow ensures that the roof of each insulae remains within the assumed heigh. The workflow is also capable of incorporating the heights in Cubit if available.

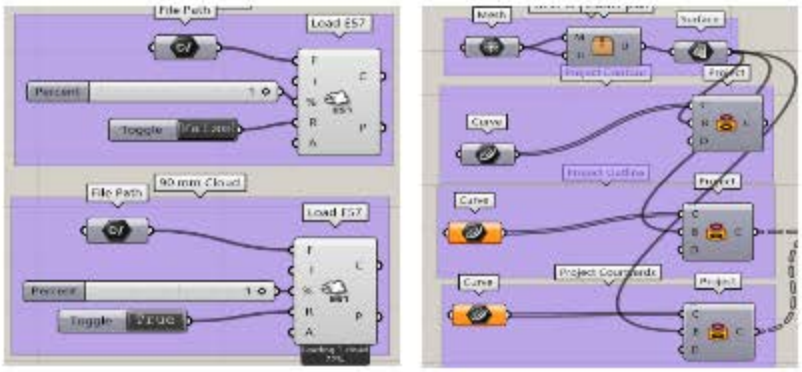

Fig. 79 To the left is the definition for importing the point Cloud to Grasshopper using the Volvex plugin by creating a link with Cloud Compare. To the right the definition for importing the ground points and projecting the outline onto the terrain is given, by Orabi, 2023.

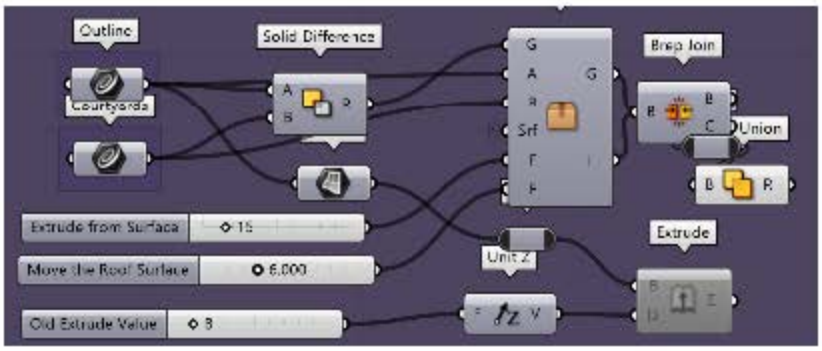

Fig. 80 Projecting the insulae with the courtyards on the terrain and extruding the remaining Surface, by Orabi, 2023.

IV.5 Modeling the Urban Blocs

After identifying important buildings in each *insulae*, the process of modeling these buildings commences. Depending on their period of construction, they are broken down into their basic elements or – as they are referred to in this study – into "the modeling blocs". Several adjacent buildings and covered adjacent streets are also referred to as "the urban blocs".

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The recreation of the urban blocs heavily depends on the modeling blocs, since urban blocs are mainly an arrangement of the modeling blocs within their respective spatial position. Therefore, it is inevitable for patterns to start emerging within the urban fabric of the city.

IV.5.1 Buildings' Modeling Blocs

Each building is comprised of essential architectural elements, such as walls, windows, domes, *minarets*, gates, courtyards, etc. Each building can be expressed as a certain array of a combination of the previous essential elements of a "Modeling Blocs". As previously discussed, each of these elements has different architectural styles based on the period during which it was built and in dependence of the patron who commissioned it. By combing these basic elements one by one, entire monuments can be parameterized and reconstructed according to the mathematical and construction properties that govern the initial blocks, such as height, width, shape, legally binding plan and building material. The building blocs can be divided into two main categories:

I. **The general bloc**: Their presence does not depend on the function of the building such as courtyards, windows, and roofs.
II. **The function-dependent bloc**: Their presence is essential for the function; they are even defining aspects for and of the building such as the *minaret*, the dome for religious buildings, the chimney and the "elephant-eye domes" of the *Hammam*s. These blocs can overlap across the different functions of buildings.

Subsequently, each building function is examined separately to decipher their respective modeling blocs and the manner through which they were implemented in the parametric model.

IV.5.1.1 Infrastructure

It can be challenging to discuss the infrastructure during times that pre-date the adaptation of the term. Yet, the only aspect that can be classified under the modern term of infrastructure is the water management project of Nūr al-Dīn. Although the project helped to shape and further the urban expansion of the city, the main elements that facilitated that expansion are mostly hidden or identified as very small when viewed in the urban context, and which are mainly constituted of the water fountains or *Sabīls* scattered across the city of Aleppo. Not to mention that they do not stand alone in the fabric of the city, rather they are imbedded within buildings, and sometimes slightly protruding. Thus, in the case of Aleppo, these elements of infrastructure are not reconstructed during the modeling process.

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IV.5.1.2 The Defensive Parameter and Military Buildings

Defensive parameters were an essential element of the Middle Eastern cities from the dawn of their existence on. These barriers were not subjected to drastic changes across the centuries, and their components remained quite comparable regardless of the historical period. We find the double or single city walls with flanking towers, gates, and moats, which makes the process of parametric modeling flexible and applicable during multiple historical periods.

For the case of Aleppo, the defensive parameters were composed of the following elements:

I. **The Gates**: This thesis created a standardized gate with two flanking towers as most of the gates of the city followed this typology according to historical sources mentioned in the previous chapter. The historical dimensions were used when they were available.

   One important question arises regarding the architectural differences of each period and the previously discussed process of parameterization of each element. It is easier to extrapolate data from surviving gates and reflect them of the missing gates of the city in accordance with the timeline and patronage of each gate within the limits of the study. They can be divided into the surviving gates and towers within the studied area which are *Bāb Anṭākiya* and *Bāb Qinnasrīn*; the missing gates that were interpolated from the surviving ones and their historical descriptions in the studied area is only *Bāb al-Sa'āda*.

II. **The Towers**: According to historical sources, the walls of the old city of Aleppo incorporated several bastions. The remaining ones in the studied area are *Burj Alā'*, *Burj al-Ghanam* and the bastion north to *Bāb Anṭākiya*. Those are modeled according to their current situation. However, not all bastions are traceable since their exact location was not disclosed in historical sources; only the span across which they stretched was described. Still, the Ottoman map of 1900 offers tangible information regarding the location of those lost bastions. We can discern one on the southern side of the wall and two on the western walls where new high-rise buildings are now erected.

III. **The Wall**: It is the stretch of stones connecting the gates and towers. In the parametric modeling process, the walls result automatically after modeling the *insulae* bordering it.

The modeling blocs of the elements of the defensive parameters are as follows:

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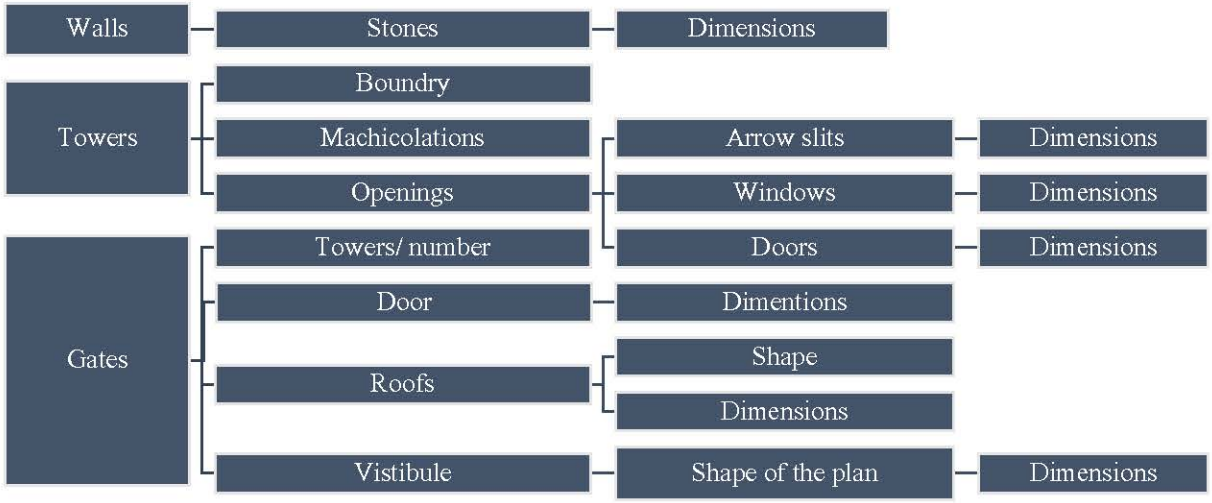

Fig. 81 The architectural elements of the defensive walls and their parameters, by Orabi, 2023

Fig. 81 describes the process of parameterization of the defensive tower and the parameters that were deemed essential for the reconstruction of those architecture structures. It details each key part of them and converts it to a mathematical expression (mainly as dimensions). For example, to model a gate we need to determine its flanking towers –location and dimensions– the location of the door within the gate, and the presence or lack of a vestibule. Each of those elements is also subject to further parametrization in terms of their shape, plan, and dimensions.

For the purpose of modeling the urban fabric of the city, the architectural elements were not modeled in the aforementioned details. Only the exterior shape is maintained. Nonetheless, the flexibility of parametric modeling allows for the addition and implementation of further architectural details during further research into the topic or when adapting the definition for another urban center.

IV.5.2 Religious Buildings

Aleppo is famous for being the city of endowments. Almost each *insulae* is bordered by a mosque at each end. The different religious buildings include *zawāyās* and *khanqahs*, mosques and churches.

IV.5.2.1 Mosques, Zawāyās, Khānqas and Madrassas

The modeling of the religious buildings followed a straightforward workflow focusing on the three main modeling blocs of the mosque:

- The main building and courtyard (*al-Ṣaḥn*) (Fig. 86.b): Firstly, the exterior boundaries of the building are referenced and converted to surfaces, and then all the interior courtyards are subtracted from the surface. The difference is then extruded into the height mentioned in the

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text. The main variable is expressed through the numerical slider that controls the height of the building, where the modeling is separate for each different height. All the height sliders are designed in a manner that allows the changes in the value of the cubit to better fit the historical information (Fig. 82).

- The Minaret/church tower *(al-Mi'zzana)* (Fig. 86.a): Firstly, the boundaries were referenced and extruded to the historically recorded height. Secondly, the workflow can slightly differ according to the number of different profiles of the *minaret* which are observed in the modeling process and constitute the second important parameter after the height of the *minaret*. Finally, the ornament of the *minaret* is modeled from the top of the *minaret*.

- The Dome/Domes (*al-Qubba*) (Fig. 86.a, b): They were addressed in mainly two workflows. The first one is by referencing the outline of the dome, creating the profile, and revolving it around a central axe. While the second scenario is when the dome is a simple semi-sphere, then it is created by slicing a sphere. The parameters here are the radius of the dome and the revolving axis in addition to the elevation of the dome from the ground.

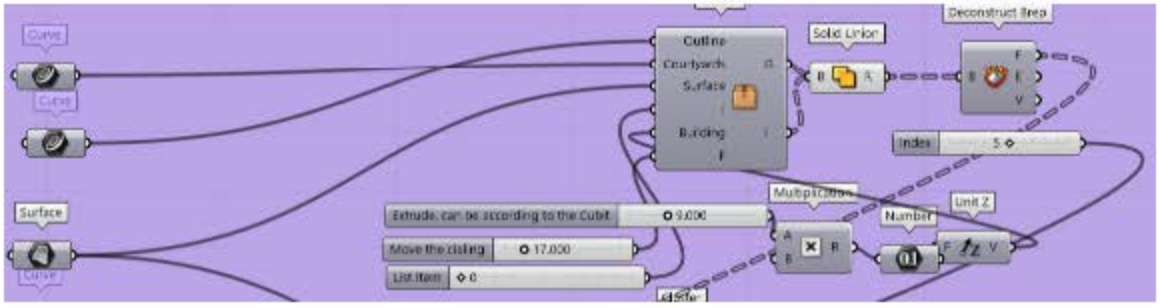

Fig. 82 The definition for the parametric modeling of the main building and the courtyard of the *Umayyad Mosque*. (Some of the code is clustered to simplify the presentation) by Orabi, 2023.

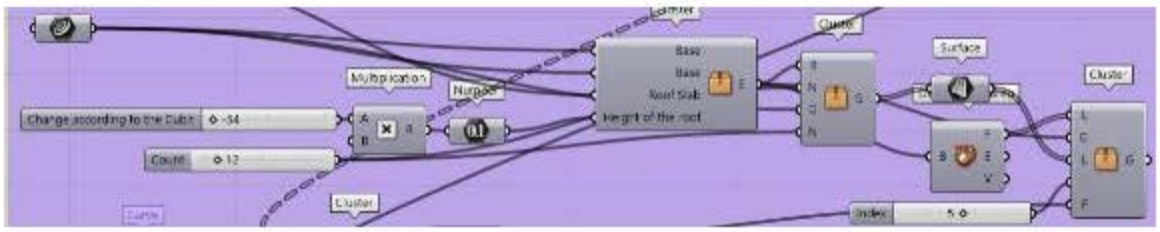

Fig. 83 The definition for the parametric modeling of the *minaret* of the *Umayyad Mosque*. (Some of the code is clustered to simplify the presentation) by Orabi, 2023.

Fig. 84 The definition for the parametric modeling of the dome of the *Umayyad Mosque*. (Some of the code is clustered to simplify the presentation) by Orabi, 2023.

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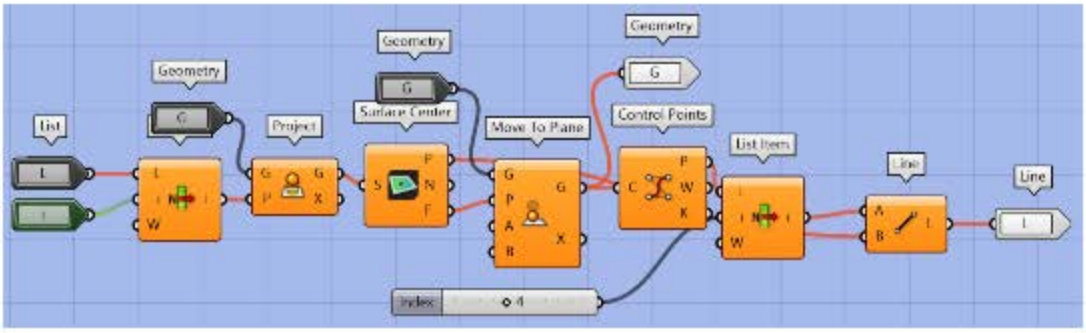

Fig. 85 The clustered data from the previous figure. The process of referencing the outline of the dome and creating the revolving axis by Orabi, 2023.

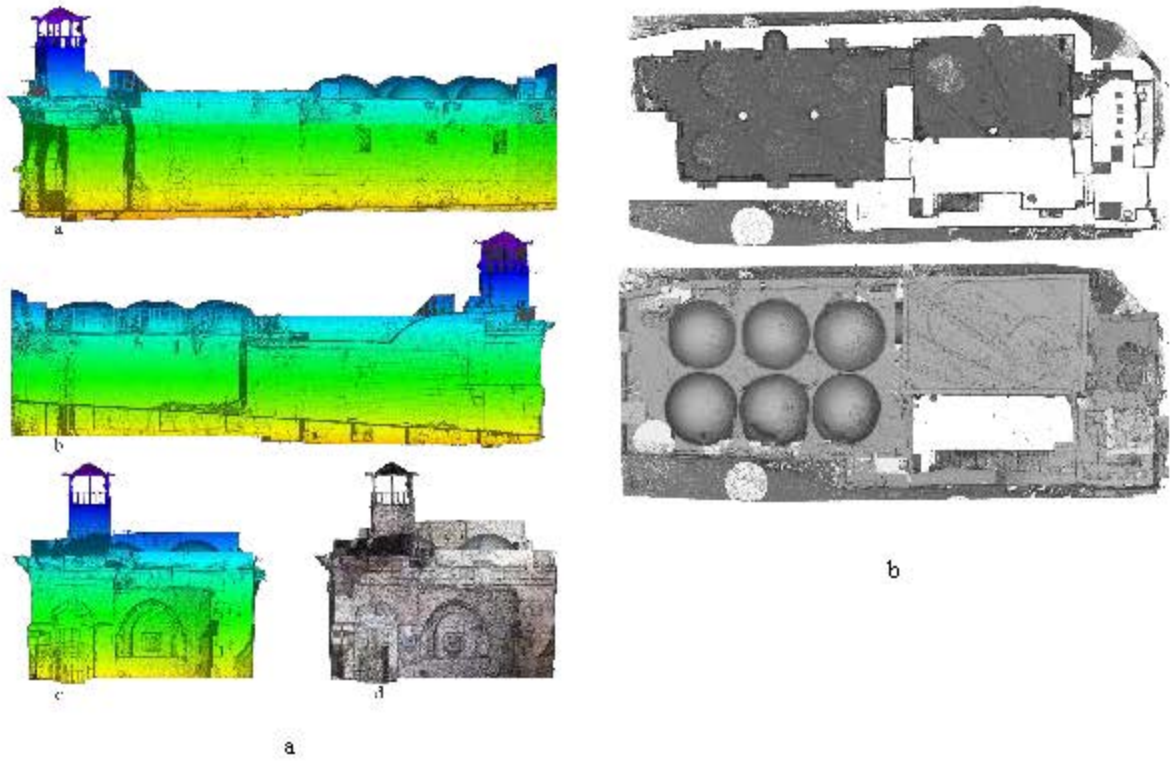

Fig. 86.a An example of the layout of religious building from the facades of *al-Shu'aybiyya* Mosque and Madrassa. b. The plans and the top view of the building from the field survey data and rendered from Autodesk Recap, by *(Orabi, 2021)*

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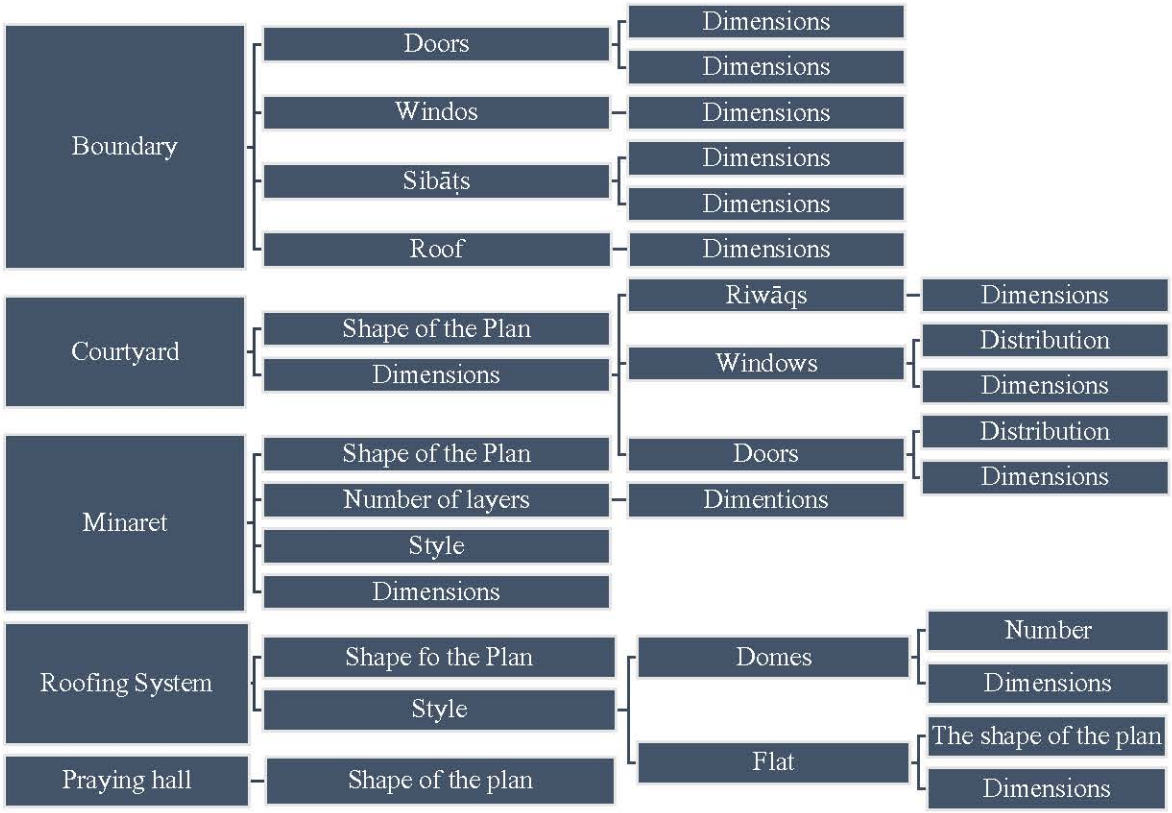

Fig. 87 The architectural elements of religious buildings and their parameters, by Orabi, 2023.

Fig. 87 illustrates the process of transforming the religious structure to their main modeling blocs, represented in the boundary (or the main structure), the courtyard, the *minaret* or bell tower in case of a mosque or a church, the roofing system, and the praying hall in case it incorporated especial elements or if it was of different height.

The architectural style of the religious buildings was dependent on the period of construction, and the patron of the building to define the style, form, morphology and number of the *minaret(s)* and dome(s). It also provided guidelines to the roofing system of the porticos. For example, we can discern several dome and *minaret* styles.

IV.5.2.1.1 The main dome's types.

Islamic architecture is famous for using domes in its buildings, to the point that some artists depend out-of-place usage of dome and *minarets* to express an eastern city or to fill the urban gaps between key monuments in the painting. In chapter 2 of the thesis, many examples supporting this practice were highlighted.

The domes in general constitute of the following elements, some of which are either special to Islamic domes such as muqarnases or the polygonal drums:

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1- The Squinches/Pendentives/Muqarnases: The transitional elements facilitating the square to circle transformation. The squinch being the first element used in this context, especially in Iran and Anatolia. While in the Byzantine empire, the pendentive was the widespread transitional element. In Islamic architecture, squinches were the base geometrical element for the development of the muqarnas[585] that was also applied as a transitional element all over the Muslim world.
2- The Base: The initial shape that the dome covers. Common shapes include squares, hexagons, and octagons.
3- The Drum and the Windows: It distinguishes the main dome of the monument. The drum is often used to emphasize and elevate the dome, as well as to allow natural light into the space. Unlike the Byzantine cylindrical drums, in Islamic buildings, drums are often polygonal, and octagonal drums being the most common shape. The sides can be either plain or incorporating a window, or more.[586]
4- The Body: Can follow different profiles (pointed, spherical, segmented, etc.), even within the same building. Common construction materials include wood, brick and stone. However, the latter is more common in the City of Aleppo.
5- The Lantern: Only occasionally present, and it is used to allow natural light through the apex of the dome.

There are some simplified studies on the geometric proportions of domes in some of Islamic monuments in Egypt, especially those belonging to the Fatimid, Ayyubid and Mamluk periods.[587] Yet, generalizing those proportions to the region of Aleppo requires further studies and verification.

[585] Creswell, 1969, pp. 101-102
[586] al- Ḥaddād, 1993, pp. 137-138
[587] ibid. pp. 70, 75

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Fig. 88 A sample of the dome typologies in and around the covered markets. Rendered from Autodesk Recap by Orabi, 2023.

In the City of Aleppo, the modeling process revealed several typologies of domes in the studied area; they are classified as follows:

1- Hemispherical dome resting directly on the roof.

2- Hemispherical dome resting on a transitional horizontal square drum such as the dome of *Khan al-Jumruk*.

3- Hemispherical dome resting on two square drums; one of them is rotated 45 degrees (example: the dome of *al-Madrassa al-Ḥalāwiyya*). In the case of *al-Madrassa al-Ḥalāwiyya*, both the dome and the supporting structure belong to the Byzantine period, and it is very likely that only the drum is adopted into a polygonal shape.

4- Segmental dome resting on a cylindrical drum (example: *al-Madrassa al-Aḥmadiyya*).

5- Hemispherical dome resting on a polygonal drum (example: *al-Bahramiyya Mosque*).

IV.5.2.1.2 The Main Minarets' Types.

Minarets are without doubt the most famous element of Islamic architecture. Jonathan Bloom traces the origin of the *minaret* in early mosques to a small structure on the roof. It was not until the Umayyads and early Abbasids, when *minarets* were first incorporated into the mosque structure.[588] The fully developed elements of the *minaret* include:

6- The Pulpit (Base): Determined by the shape of the plan of the *minaret*. It is often used in free-standing *minarets*, but sometimes in structure-embedded ones such as the dome in *al-Kizwanī Mosque*.

[588] Bloom, 1990

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7- The Transitional Segments: facilitating the shape transformation if the plan of the pulpit is different from the body. This element does not exist in *minarets* with consistent shapes across the height.
8- The Body: The main element of the *minaret* which is used to adjust the height.
9- The Balcony: A space designated for the *Muazzin*. The balcony transformation between the balcony and body is often decorated with muqarnases, especially in the Mamluk and Ottoman periods.
10- The Upper Part of the Body: This element also does not exist in *minarets* with consistent shape across the height; but when it does, the shape, the size of the body, or both changes.
11- The Spire: The utmost part of the *minaret*, mostly it takes either a conical, spherical or semi-spherical shape.

The Minaret typology changes depending on the historical period. However, there is some overlap in styles especially in the Mamluk period. Famously, Umayyad, Seljuk and Zengid *minarets* are square-shaped; Mamluk Minarets are polygonal and sometimes circular, and Ottoman *minarets* are thin and tall (always referred to as pencil-shaped). Several examples of each *minaret* typologies exist in the studied area:

1- The small balcony over the roof as in the *al-Qīqān Mosque*.
2- The square plan of the Seljuk and Zengid periods (examples: *al-Shu'aybiyya Mosque* and the *Umayyad Mosque*)
3- The Octagonal Plan of the Mamluk period such as the *minarets* of *al-Karamiyya Mosque* and *al-Kizqanī Mosque*.
4- The Circular Mamluk and Ottoman Plan: With different elevation and diameters depending on the period of construction. There are the short and wide circular *minaret* of *al-Kīzwānī Mosque*, and the taller and wider circular *minaret* of *al-Rūmī Mosque*, in addition to the thin and tall *minarets* following the Ottoman style such as the *minaret* of *al-Bahramiyya Mosque*.

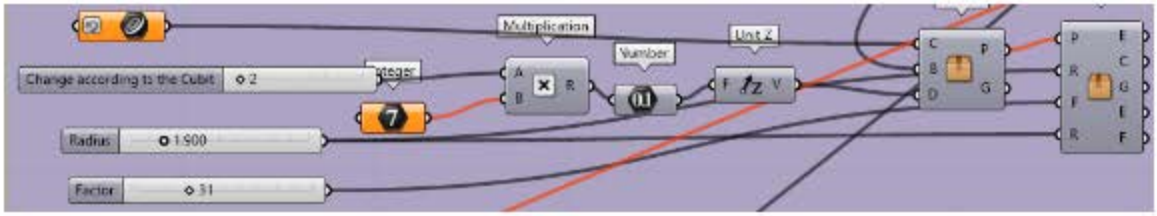

Fig. 89 The script of modeling a *minaret*, rendered from Rhino/Grasshopper, by Orabi, 2023.

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IV.5.3 Public and Educational Buildings

IV.5.3.1 Hammams

In the same manner of parametrization, a similar workflow is followed to model the *Hammams* in the studied area. The focus in modeling the *Hammams* lies on the pattern and distribution of the domes and chimneys. Therefore, they were modeled from their plans and profiles and then moved to the desired height.

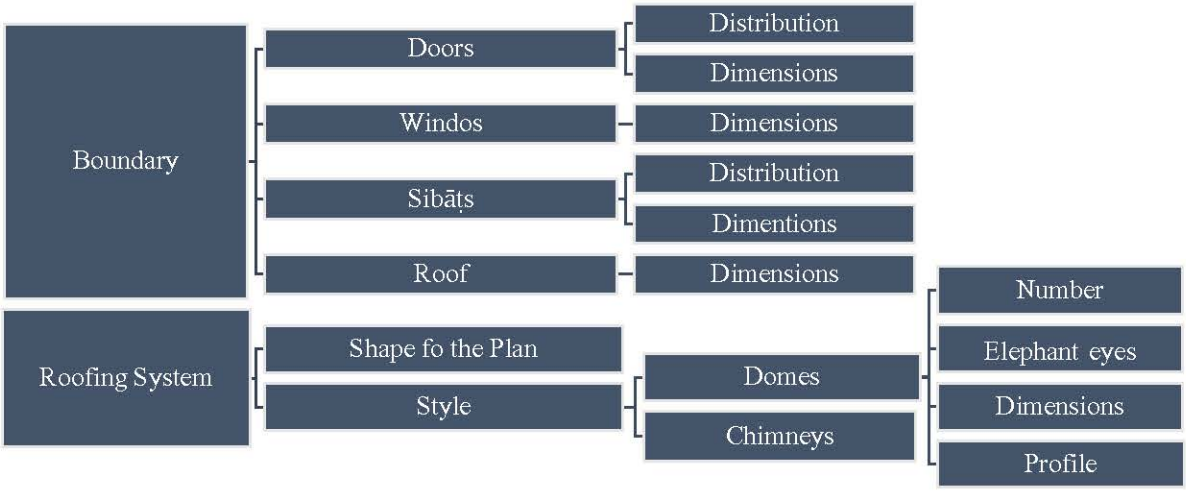

Fig. 90 The architectural elements of religious buildings and their parameters, by Orabi, 2023.

IV.5.3.2 The Khans, Souks, Qaysāriyyas

There are three important factors when modeling commercial buildings. First, there is the distribution, location, and profile of the domes; second, the proportion of void and mass between the building and the courtyard is of importance. Finally, the roofing system of the linear souks and the connection profiles with the rest of the urban fabric, especially, in *Souk al-Hawa* when the roofing system shifts from light metal structure to the stone vaulted and dome roofing system.

IV.5.4 Residential Neighborhoods

The modeling of residential neighborhoods relies on holistic modeling approaches. Further studies are required in order to identify the parameters that governed the residential growth and development in the area. The holistic modeling approach uses the void and mass plans for the residential buildings and applies a randomized height between one and two stories (which was the common height for residential buildings). However, the script also takes into account the error of the unit conversion from cubits to meters; therefore, the script also integrates flexible values.

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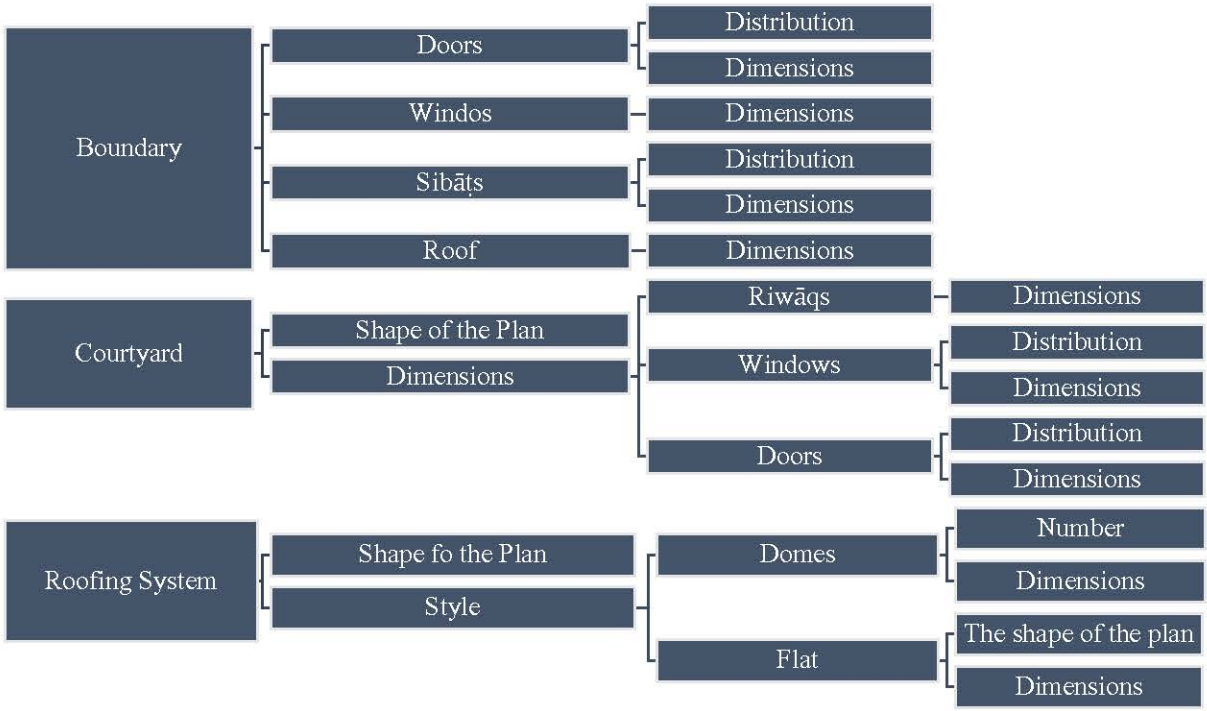

Fig. 91 The architectural elements of *Khan*s and *Qaysariyyas* buildings and their parameters, by Orabi, 2023.

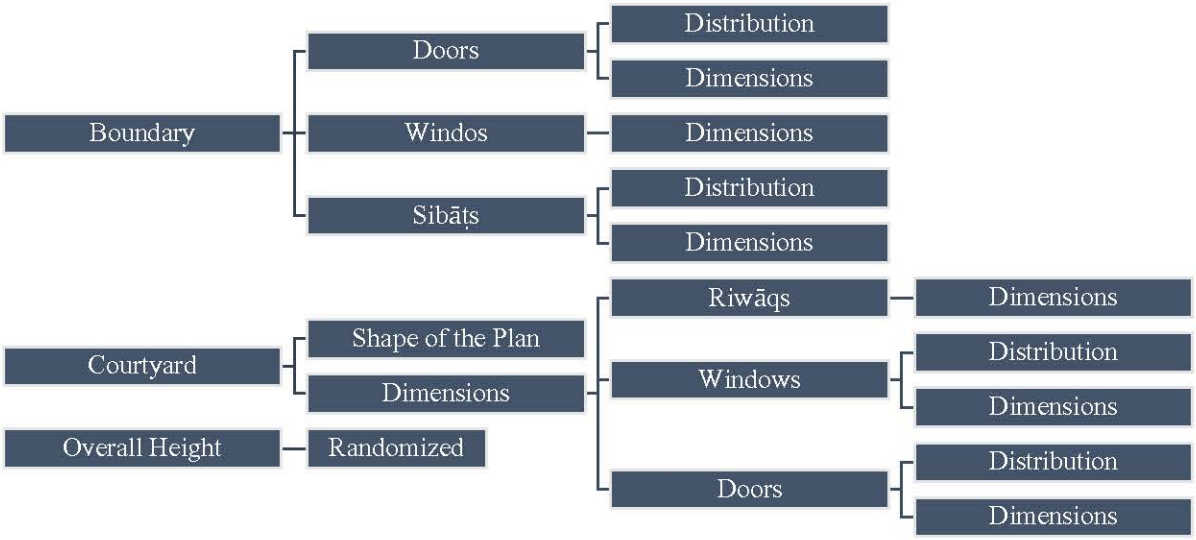

Fig. 92 The architectural elements of residential buildings and their parameters, by Orabi, 2023.

IV.6 Modeling the City

The 3D workflow is separated into two steps:

1- The parametric modeling of each building is separately based on modeling blocs that are discussed previously. It includes:

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- Assign the function of the plot of land with the basic location of the rooms.
- Assign style or type of the buildings based on the available historic in formation and/or date of construction and patron (e.g., Byzantine domes, Ottoman Minarets).

2- The parametric modeling of each period which examines the effects of multiple factors on the urban form such as:
   a. The changes of the architectural style.
   b. The changes of the building measurement units.

The maps of the city were rescaled according to the survey before commencing the reconstruction since they are only drawn in 2D, they were projected in QGIS.

Many variations were spotted in the maps when compared to the field survey which is mainly related to multiple reasons, such as the accumulative margin of error of the manual survey and the deviation of retracing paper maps and converting them to computer drawings.

The start is from the most recent map (in this case the Aleppo in Exile map) and move downwards on chronology. This method makes it easier to fully benefit from accurate maps and adjust the less accurate ones accordingly. The process includes orientation and straightness of streets but considers the different addition to each building and *insulae*. The main base map is the post war survey, and it is adjusted to fit the other maps coinciding with different periods in order to maintain the referencing system in Grasshopper.

The beginning is from the French mandate period based on the cadaster map of 1930, followingly adjustments that are incorporated from the map of 1900 to reach the visualization of the late Ottoman period. Adjustments to the base maps were made in a manner that gives more credibility to the cadaster plans and consults the plans of Gaube and Wirth for more further information, but which relies on the maps of 1930 in case of a difference.

Not many building heights are recorded from the Mamluk and Ayyubid period; therefore, the heights are randomized within the range of 4.5 to 7 multiplied by different values of the cubit except for location with documented dimension. This height correlates to building heights between one and two stories and it is applied in residential quarters.

It is important to note that the modeling process differentiates between key monuments that were modeled according to either their reported or current height and the generic fabric, where random heights are applied to the rest of the fabric of the studied area. The randomized heights

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are crucial to achieve notion of the patterns of the old city´s fabric. However, for the scientific comparison and since the heights are already assumptive, it is possible to use a standardized height of two stories; a median number of six is suggested for those models.

IV.6.1 At the End of the Mamluk Period in 1516

IV.6.1.1 The Endowment System

The religious buildings – in general – were sustained through the endowment system (the *Waqf* system), where the operational costs of those buildings are secured through dedicated revenue-generating buildings such as *hammams*, *khans*, markets, farms, etc. The statute of a building is often measured by the size and number of estates dedicated for its sustenance. In Medieval Islamic periods, as well as the Ottoman period, the waqf system played a major social and religious role in shaping the urban development of the cities. In the case of the Old City of Aleppo, and due to the scarcity of un-built plots of land in that area, many constructions were endowed as a second and a third story.

Nimrud Liz argues in her book "*The Mamluk City in the Middle East*" that "*The contribution of waqfs to the development of cities attests to the existence of an inchoate urban policy, which was formulated and implemented by members of the Mamluk bureaucracy and aristocracy.*"[589] However, the debate remains whether the waqf system was part of a defined general plan of urban generation or was just at the will of the endower to further personal, political, social and religious agendas.

IV.6.1.2 Characteristics of the Ayyubid Period

The Ayyubid architecture was characterized by big carved and dressed ashlars.[590] Repetition, order and harmony were dominant in the Ayyubid buildings.[591]

Abstract geometric shape (squares, parallelograms, and circles) dominated most of the plans. Those shapes were essential to maintain the followed construction practice, such as the spaces' heights, dimension of buttresses, arches, vaults, and the rest of structural elements. [592] The fact that the Ayyubid architecture was created based on underlying mathematical relations eases the process of extracting those formulas for parametric modeling.

[589] Luz, 2014, p. 108
[590] David & Ḥūraytānī, 2011, pp. 72- 73
[591] ibid. pp. 78, 81
[592] ibid

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Madrassas were characterized by a square or rectangular courtyard, with a rectangular domed prayer hall on its southern side. The plan may also accommodate an *Iwan* in the north and students' rooms in the east and or west, connected with the other section of the building with porticos.[593]

IV.6.1.3 Characteristics of the Mamluk Architecture and its Parameters

Many researchers agree that the architecture in the Mamluk period declined. Logically, this statement cannot be generalized to cover all the dominion of the Mamluk Sultanate. Major urban centers such as Cairo, the Mamluk capital, Aleppo and Jerusalem have countless extraordinary architectural monuments and infrastructure projects that demonstrate the techniques and abilities of the Mamluk builders. To that regard, Michael Meinecke argues that the Mamluk builders from Syria were a major influence on the development of early Ottoman architecture.[594]

Mamluk architecture was defined by unique characteristics such as the massive scale hypostyle mosques with cylindrical, polygonal, and rarely square *minarets*, new two-story khans, and souks.[595, 596] In Aleppo, traditional Aleppian elements such as the vaulted porticos were not only maintained but extensively used during the Mamluk Period. The implementation of alternating colored-courses of stones or "*Ablaq*" arose in that period as well.

Vernacular architecture in general and historical architecture in particular, Ottoman and Mamluk architecture were a rich subject for many studies to extract urban and architectural patterns suitable for the climate in the Middle East, in terms of ventilation, proportions and building materials. Still, very few studies analyzed them for pure morphological and formative purposes; many apply their studies to the formation of *madrassas*. One of the pioneer studies examines the morphological grammar of *madrassas* in Cairo during the Mamluk period in terms of pure geometry.[597] Yousef's research sheds light on the hidden mathematics in the Mamluk buildings in general and in Madrassas more specifically. She underlines the ratios and proportions that governed the design of *madrassas* in the Mamluk period in Cairo (Fig. 93) whichcan logically be extended to other cities under the influence of the Mamluks like Aleppo.

[593] ibid p. 84
[594] Meinecke, Patterns of Stylistic Changes in Islamic Architecture Local Traditions Versus Migrating Artists, 1996
[595] David & Ḥūraytānī, 2011, p. 97
[596] Meinecke,1992, p. 208
[597] Yousef, 2020, p. 8

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Although Aleppo does not enjoy the importance of Cairo during the Mamluk period, yet, as Doris Behrens-Abouseif suggests, the building supervisors especially during the Bahri period (1250-1382) "*were members of the ruling Mamluks, or the powerful administrative classes*"[598]. In the Burji period (1382-1516) new trained builders and artisans were also involved, along with the previous group, albeit with rough architectural, structural, and decorative planning.[599] Therefore, it is logical to assume that basic geometrical rules and planning applies both in Aleppo and Cairo. Moreover, it is the aim of the author to conduct further parametric studies to investigate this issue. However, for the time being, the study will rely on the previous body of work to generate the model of the Mamluk city of Aleppo.

It is also possible to extend and extrapolate the limited research of the building of the same period, given the similarities of typologies and structure of the building across the territory of the Mamluks. It is also reasonable to assume that the same parametric and mathematical rules apply to Syria and Egypt because there is no evidence against that. Future research will entail extracting computational parameters of the buildings in the study area.

The first example is from the work of Yousef, "*Morphological indicators for Courtyard and Durqa'a of Mamluks Madrassa in Cairo*" (2020) which investigates the different parameters between the open courtyard and the closed courtyard (*Durq'a*) during the Mamluk period. We can see from the following figure that the courtyards were mostly square-shaped or very close to one, where the parameter of the courtyard is 3 to 5 times greater than the height.

Building Code	Type	W	L	H	A	P	PAR	ERA1	ERA2	RPH	AR
SMQ	Court	16.70	20.38	16.00	340.3	74.16	0.82	1.04	1.27	4.64	1.33
SIJ	Court	16.40	19.78	13.95	324.3	72.36	0.83	1.18	1.42	5.19	1.67
SNM	Court	14.40	23.30	13.23	335.5	75.40	0.62	1.09	1.76	5.70	1.92
KTH	Court	8.65	7.55	10.32	65.3	32.40	1.15	0.84	0.73	3.14	0.81
ASR	Court	17.25	21.18	14.52	365.3	76.86	0.81	1.19	1.46	5.29	1.73
SNH	Court	31.70	35.50	32.70	1125.	134.4	0.89	0.97	1.09	4.11	1.06
USS	Court	11.20	14.30	16.80	160.2	51.00	0.78	0.67	0.85	3.04	0.57
SZB	Court	17.90	22.00	13.80	393.8	79.80	0.81	1.30	1.59	5.78	2.07
AJU	Court	18.20	8.75	11.96	159.2	53.90	2.08	1.52	0.74	4.51	1.11
AGF	Court	10.94	13.50	13.00	147.7	48.88	0.81	0.84	1.04	3.76	0.87
QAB	Court	10.40	10.87	11.90	113.	42.54	0.96	0.87	0.91	3.57	0.80
SAB	Court	16.00	16.30	16.60	260.8	64.60	0.98	0.96	0.98	3.89	0.95

PAR = Plan aspect ratio Courtyard plan ratio (W:L).
EAR1 = Elevation aspect ratio of width to Height.
EAR2 = Elevation aspect ratio of Length to Height.
RPH = The ratio of Court Yard perimeter to height P/H.
AR = Aspect Ratio Courtyard floor Area/Average Height^2.

Fig. 93 Results of geometric properties and proportions of the courtyards (unit: m). (Yousef, 2020, p. 6).

The second example is from the work of Amer & Gaber, 2018, titled "*A* Generative Technique for Mamluk Madrasa Buildings Design". They classified elements in Mamluk *madrassas* to core elements (entrance, courtyard, *iwan*, mausoleum) and attached functions

[598] Behrens-Abouseif, 2011, Rabbat, 2010, p. 34
[599] ibid.

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(student cells, *mairstan*,… etc). [600] This can be expanded to include other functions if we remove the mausoleum form and the courtyard in case of *Hammams* from the core spaces to the auxiliary functions. Those core elements are governed by generative relationships (*the Qibla wall is oriented in the Qibla direction*, the *entrance is perpendicular to the street and to the courtyard as well*). [601]

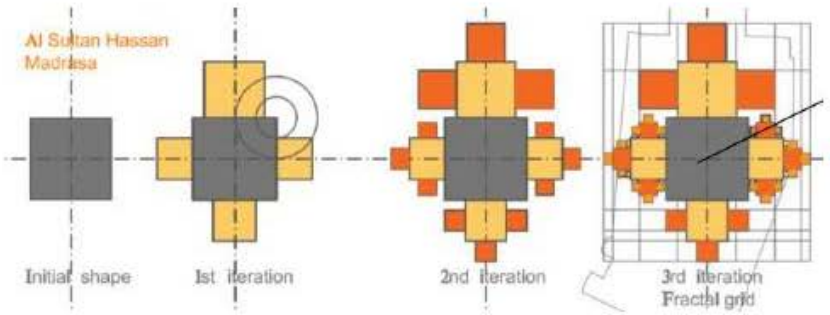

Fig. 94 A generic diagram for *al*-sultan Hassan fractal geometry iteration process (Abdelsalam & Ibrahim, 2018, p. 32).

Other researchers suggest fractal mathematics governing the evolution of the Mamluk architectural work, such as the work of Abdelsalam & Ibrahim, 2018, titled "Fractal Dimension of Islamic Architecture: The case of the Mamluk Madrassas: al-Sultan Hassan Madrasa". The authors argue that there is an imbedded modular system that can also be expressed through fractal geometries (Fig. 94).

IV.6.1.4 Street Network of the Mamluk City

The map of 1900 was traced onto the map of the Aleppo Archive in Exile after recognizing the key changes in the urban fabric in QGIS. Those changes were implemented in the map of 2014 accordingly. This method creates more coherent results and facilitates the 3D reconstruction and comparison. The process was also necessary as a counter measure for the low accuracy and preliminary survey methods and techniques of the 1900s. It is also justified by the fact that many streets were intact, and they were utilized to guide and implement the tracing process.

The results are shown in (Fig. 95). The adjusted and traced map of 1900s is in blue, while the red and magenta colors are from the map of 2014 which depicts the current city in great detail and completely overlaps with the orthophoto from the survey, as discussed previously in chapter 2. In this comparison, we see a clear implementation of the cul-de-sac streets in the

[600] Amer & Gaber, 2018, p. 138
[601] ibid. p. 149

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southern and western quarters of the city which can be explained by the transformation of the defensive parameter to a residential function that required more accessibility. Furthermore, the street behind *al-Shuʿaybiyya Mosque* did not exist and the mosque was integrated with its surroundings. Additionally, a square was built into a public school (Fig. 45, open space number 19).

However, two major issues arise in this context: The first issue is the change of the outline in the street leading south from *Bāb Anṭākiya*. Historically and morphologically this transformation cannot be confirmed, especially that the entire western section of this area was destroyed. Nonetheless, given the contrasted concave and convex shapes of the street, it is highly unlikely that this was an error in survey; the current outline is a result of the new developed projected westward to the city walls, as it is the case in its extension paralleling the west defensive walls. The second issue is related to the size and span of the sloped open space to the northeast of *Bāb Anṭākiya* (Fig. 95 in yellow), as it was not detailed in the map of 1900s, while it details all other open spaces. Therefore, it is highly likely that this region was also built or otherwise developed.

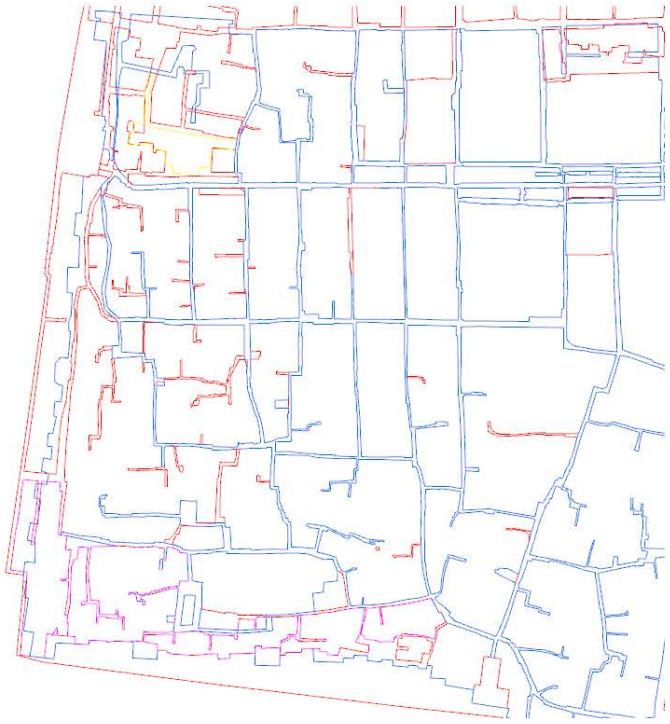

Fig. 95 The street network in the map of Aleppo archive in Exile (in red) and the traced map of 1900 (in blue), by Orabi, 2023.

The comparison also suggests narrower streets, or cul-de-sacs in front of the *Umayyad Mosque*, opposed to the "mini square" that is drawn in later maps. It also illustrates the process of formation of the current *insulae* of the modern city. The clearest example is the street parallel

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to the western defensive parameter; its addition was solely reliant on the new high-rise building designed on the western edge of the city.

The major changes are located in the *'Aqaba* quarter as it was subdivided, many foreign style elevated buildings were forced into its fabric altering the historical skyline of the city and adding more elevation to the highest "*Talls*" of the old city.

Finally, the increased number of cul-de -sac can be attributed to the division of the family houses and the need to create separate and semi-private access points for the divided properties.

IV.6.1.5 Reconstructing the Mamluk City

Two elements were crucial for the reconstruction of the Mamluk period in the studied area. First is the map of 1900 that provided an informative base map for the reconstruction. The second consists of the implementation of the discussed building blocs in accordance with the parameters of the Mamluk architecture.

The process of combining all the historical and cartographic information for the reconstruction of the Mamluk city rested on the following steps:

- **Open Spaces**:
    - The historically reported open spaces, as well as the ones already included in the map of 1900, were added to the plan. However, the existing open spaces that intersected the newly added or removed formations were deleted.
- **Defensive Parameter**
    - The wall of the city was added according to the map of 1900.
    - The extant gates and towers were added to the 3D model according to the historical records discussed in chapter 3, as well as the geo-referenced Ottoman Map. Not many references were needed to reconstruct the existing gates since no major changes were reported after the Mamluk period.
- **Street Networks**
    - It followed the discussion of the last section and mainly implemented the following:

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i. The streets network was modeled according to the combination of the Aleppo Archive in Exile-map and the geo-referenced Ottoman Map of 1900; street orientation was maintained according to the Aleppo in Exile map of 2017, while the open spaces and cul-de-sacs were adopted from the older one.

ii. The street that used to be in the middle of *Khan al-Jumruk* was restored for the reconstruction.

- **The Skyline**
  - The initial difference in elevation was the main method resulted in the variations of the skyline. A randomization of heights was arbitrarily assigned to the parcels of the residential use; the heights range was suggested between 5-16 m.
  - The division of the parcels was manually randomized and roughly based on the Cadaster map of 1930.
- **The Building Blocs**
  - The different building uses were modeled according to the parameters set for each use in the first section of chapter 4.
  - Buildings from an Ottoman origin that posed a challenge to the Mamluk reconstruction were retained in place in cases where no mention was found about the previous use of the building, as it is the case in *al-Bahramiyya Mosque*. In this historical reconstruction, it is modeled with transparent texture and with similar color as the general fabric in order not to create a visual attraction epically that it is the highest building in the model.
  - Prominent public and religious buildings such as *al-Madrassa al-Ḥalāwiyya*, *Khan al-Harīr* and *Hammam al-Naḥḥāsīn* were given separate colors according to their usage as follows: *Madrassas* in yellow, Mosques in green, *Hammams* in blue, *Khans* in cyan, Gates in dark red, walls and defensive towers in dark gray, covered alleys and markets in light blue, scattered domes in light red, while the rest of the fabric is in light gray.

The result of the parametric historical reconstruction can be seen in (Fig. 96)

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This 3D-model will be compared to the post-war 3D-survey in the following section of the study, in order to identify the changes in the urban fabric and its components. The changes will be discussed based on different aspects such as: The changes of the height increase, the void and mass ratio, the lost and preserved sections of the urban fabric, and finally, the illegal changes to the urban fabric. For this section of the study, the initial results or cartographic comparisons provided in Chapter 2 are used as a base to identify 3D changes and verify the comparison results between the virtual reconstruction of the Mamluk city and the digital survey.

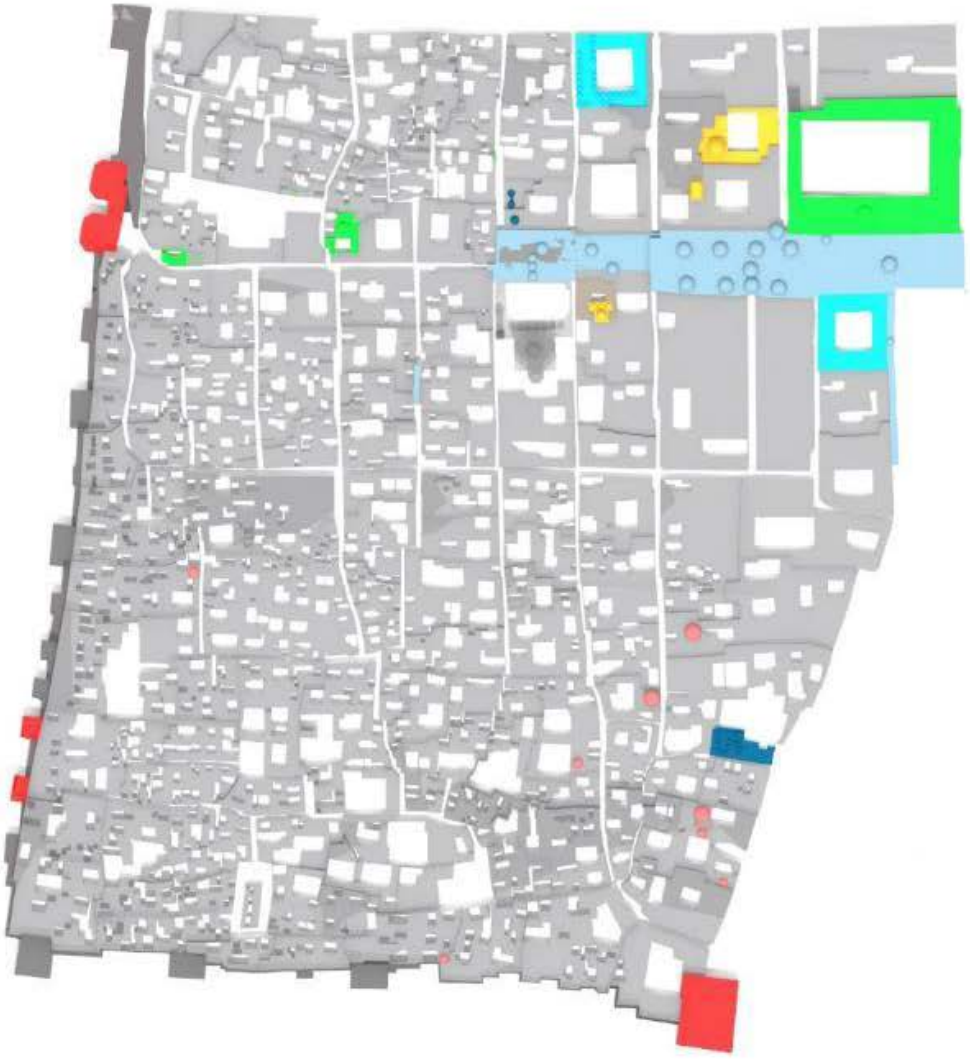

Fig. 96 The historical reconstruction of the *al-Jallūm* and *al-'Aqaba* quarters in the Mamluk period, by Orabi, 2023.

IV.6.2 The Post-War City

IV.6.2.1 Height Analysis

The earliest signs of the height increase in the Old city of Aleppo can be traced to the Mamluk period. New endowments were built as second and third stories for existing buildings. One example from the Ottoman period can be found in *al-Madrassa al-Halāwiyya*, where two

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stories were added as endowment to support the school through the rent. It is fair to assume that such practices took place in other locations of the city due to the limited open space plots within the Old City coupled with the high number of religious establishments.

Upon comparison with the map of 1900, and despite its lack of details, we can detect 4 new streets and one square that were added in the next 30 years. But the general 2D layout of the city was preserved. Regarding the height map, we clearly identify a spike in the elevation of the city. Many landowners have extensively modified and expanded their properties either to accommodate the expanding families or to generate revenue by renting or selling the newly developed areas.

The urban projects of the 20th Century were a major reason for the current height increase in *al-'Aqaba* and along selected main axis, especially around the western section of the ancient walls. In Fig. 97 we can clearly see the effects of those buildings on the homogenous fabric (shown in green). Despite the initial elevation difference between *al-'Aqaba* and *al-Jallum*, the high-rise building dominates the skyline of the Old City of Aleppo; only the *minaret* of the *al-Bahramiyya Mosque* can compare to visual effects of those massive concrete structures.

Although the 2D spatial organization of the city in the studied area preserved its general features and suffered minimal changes (up until the war), several additional changes can be observed on the third dimension. We notice the changes in the cross section of the city between the Mamluk period and the modern era.

Even though legal changes to the urban fabric – especially the residential neighborhoods –a direct contributor to all the previously discussed changes as part of the urban transformation of Aleppo. Illegal alterations to the residential neighborhoods contributed largely to the height increase and the alteration of the mass-void-ratio. But more importantly, they introduced more concrete into the city by replacing traditional material and construction techniques.

The comparison between the historical reconstruction and the point cloud revealed that *minaret* of *al-Bahramiyya Mosque* is tilted. This inclination might have been present since construction or it was a result of war damage, which will require further attention to stop any possible structural degradation of the *minaret*.

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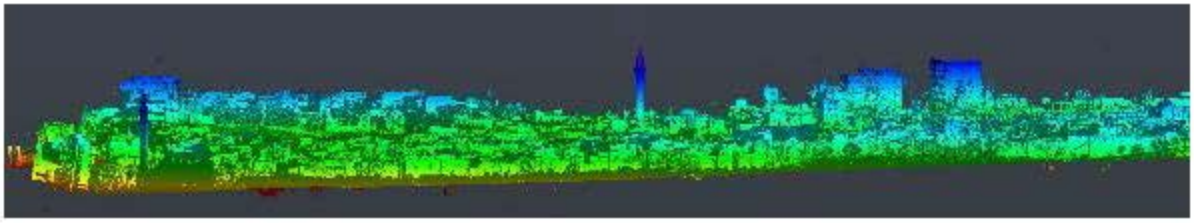

Fig. 97 A section of the southern façade that illustrates the height increase, by Orabi, 2023.

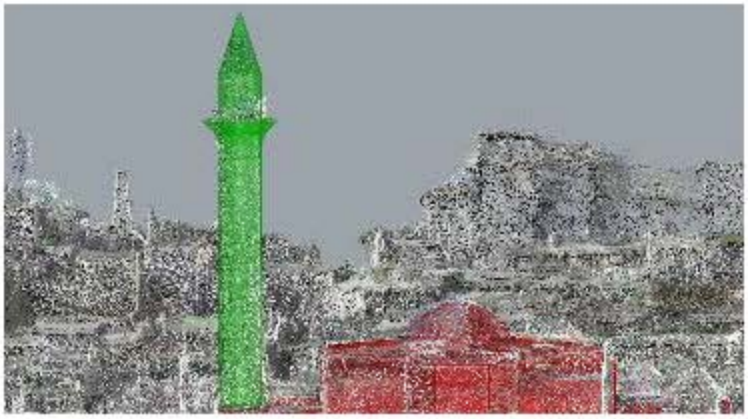

Fig. 98 The inclination of the minaret (in white) and the original direction (in green), rendered from Rhino 6, by Orabi, 2023.

IV.6.2.2 Mass and Void

As previously discussed, the loss of the open spaces as well as the repeated division of big courtyard-houses was only the beginning of the change in mass and void ratio. The high rise building soon followed expatiating an existing problem and causing more abandonment to the houses due to the loss of privacy. As houses were sold to commercial enterprises, or storage facilities, they had to be adapted to such a change of use. Those changes often include increasing the height of the building to accommodate additional storage space.

Even if the residential use continues, new floors had to be adopted to accommodate either the growth of the population, or the landowner's intention to increase leasing revenues. But more importantly, adding additional stories can also be viewed as an act to claim back the privacy of the residential building by elevating the height advantage of the new concrete buildings. However, it is crucial to keep in mind that concrete was emerging as a new revolutionary building material and, at some point, it is used to reflect the process of modernizing a city.

If we want to examine the studied area for surviving and lost neighborhoods, we can observe the most changes in the *al- 'Aqaba* region and around the western section of the city walls where concrete and higher building replaced the traditional urban fabric. Moreover, as

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previously discussed in chapter 2, the number and size of open spaces was altered and/or reduced. Notably, the biggest loss of neighborhoods occurred as a result of the master plan of Banshoya that created perpendicular vehicular streets and an open space in front of the *Umayyad Mosque*. The comparison between the combined cartographic maps with the 3D survey revealed additional courtyards that were not included in all the previous maps, all of which were added according to their plan from the point cloud.

IV.6.3 A comparison with the Mamluk Period

IV.6.3.1 Height Increase

The initial idea for the comparison between the field survey point cloud and the virtual reconstruction was to create an automated comparison process. However, the main factor that will have skewed such an automated process is the amount of rubble (in the streets or in destroyed buildings) that was recorded in the survey that changes the 3D features of the post-war city. The volume of the rubble will negatively affect the accuracy of computing the volume of the cloud of the post- war city. Therefore, the process was redesigned around manual comparison of the two models. The point cloud was subdivided with multiple "bounding box boundaries" into 8 blocks (Fig. 99) to enable the comparison with of each block of the city separately. The blocks were chosen based on street orientation and division and in a manner that will cause the least interruption to the fabric. Using the bounding box was the least computational consuming method, however it dictates that the bonding boxes intersect since the outline of the boxes does not resemble the layout of the street network or buildings outlines. Through the division of the city into smaller components, it is possible to identify little changes in the heights' profile as well as the alternation to the open spaces.

In the top view of section 1 (Fig. 100), it is easy to understand the changes to the heights by following the distribution of the red color that resembles the Mamluk city. In the south end of section 1, we see that the building preserved their heights, except the plot behind *al-Shū'aybiyya Mosque*, where a multistory building has been erected. As we move to the north of the section, we can see an increase in height that ranges between 1 to 8 meters. This increase is not only caused by high rise buildings, but we see that some traditional residential buildings have added an additional story.

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Fig. 99 The analysis zones, rendered from Rhino, by Orabi, 2023.

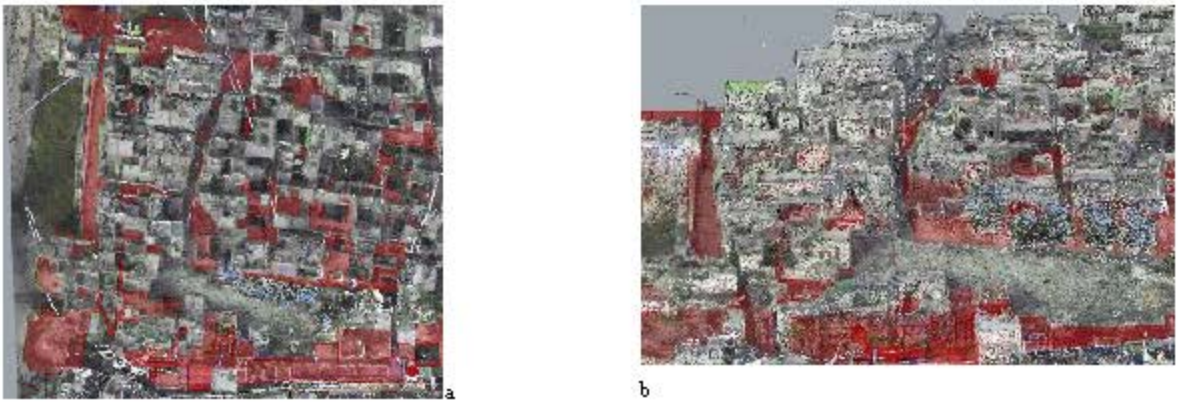

Fig. 100.a A top view comparing the model of the Mamluk City (in red) and the post-war city (as a colored point-cloud) in Section 1, rendered from Rhino 6. b. A perspective view of the two 3D models of the city showing the height's increase, by Orabi, 2023.

Fig. 101.a A top view comparing the model of the Mamluk City (in red) and the post-war city (as a colored point-cloud) in Section 2. b. A reconstruction of the fabric that was demolished to create the square in front of the *Umayyad Mosque* rendered from Rhino. c. The height increase in the area east to *Khan al-Harīr,* by Orabi, 2023.

In section 2 (Fig. 101.a) we notice general preservation in heights between the Mamluk and the post-war city. This can be explained by the concentration of roofed souks and domed

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buildings that contributed to stabilizing the vertical growth of this section of the city. Nonetheless, two major changes are observed. The first is the block in front of the *Umayyad Mosque* that was demolished to create the square (Fig. 101.b). The second is the area east to *Khan al-Ḥarīr*, we observe one additional floor between 3 and 4 meters high. An additional floor can also be observed in two plots west of the *Khan al-Ḥarīr*. Additional minor changes include the dome above the entrance of *Khan al-Jumruk* as the building itself dates to the early Ottoman period. Based on the Ottoman map of 1900, this section also included two defensive bastions that are no longer traceable in the post-war fabric. In section 3 (Fig. 102) there are several multistory buildings added across section 3, they can be estimated around 5-10 % of the area. Another major difference is the addition of *Khan al-Jumruk* in the Ottoman period sealing a street that existed in the Mamluk period, as confirmed by Arabic accounts. The one-story addition is very prominent in this section and is present in 20-30 % of the section. Comparing the fabric that preceded *al-Bahramiyya Mosque* was not possible as there was no mention for the use of the plot before the mosque was commissioned in the Ottoman period.

Fig. 102. A top view comparing the model of the Mamluk City (in red) and the post-war city (as a colored point-cloud) in Section 3, by Orabi, 2023.

a b

Fig. 103.a. A top view comparing the model of the Mamluk City (in red) and the post-war city (as a colored point-cloud) in Section 4. b. The multistory buildings concentrated to the west of section 4, by Orabi, 2023.

Therefore, the mosque was modeled with its Ottoman form in the Mamluk city, and the plot is excluded from this comparison. In section 4 (Fig. 103.a), the previously discussed missing

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data of the drone footage is concentrated. Therefore, until the time the missing data is acquired this region is excluded from comparison. As for the rest of the section, in the Mamluk period, the enclosure of this section used to incorporate *Bāb al-Sa'āda* as well as multiple bastions that no longer exists today. Instead, multistory buildings have dominated various locations across the area, with occasional multistory buildings that are often located to the west of the section (Fig. 103.b), another multi-story buildings can also be observed in the area, especially around the intersection of alleys. The least height increase can be seen in section 5 (Fig. 104.a), with only occasional addition of an extra story and no multistory building. Section 6 (Fig. 104.b) is also homogenous regarding the height increase, an extra story can be seen in al-*Shībānī* church at the north-eastern corner of section 6 as well as to north and west of the section. In section 7 (Fig. 104.c) between one and two stories are added in the south of the area, also along the main *Bāb Qinnasrīn* street.

Fig. 104.a. A top view comparing the model of the Mamluk City (in red) and the post-war city (as a colored point-cloud) in Section 5. b. A top view comparing the model of the Mamluk City (in red) and the post-war city (as a colored point-cloud) in Section 6. c. A top view comparing the model of the Mamluk City (in red) and the post-war city (as a colored point-cloud) in Section.

Another method to compare the height increase is by using Digital Elevation Models (DTMs). They offer additional information regarding the heights, terrain, and void and mass distribution that takes into account even smaller building elements such as *minarets* and their height in relation to the city as can be seen in (Fig. 105 and Fig. 106), where the *minarets*

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appear vividly on the map as red spots. Additionally, DEMs can be influential in identifying the illegal modification that encroached on the city over time. It is also possible to acquire the DTMs for the model of the Mamluk city and compare it with the post-war map. However, the process might be redundant since it will yield very similar results to the ones that have been previously mentioned.

Fig. 105 Mass and void interpreted according to heights, from the point cloud, generated in Cloud Compare, by Orabi, 2023.

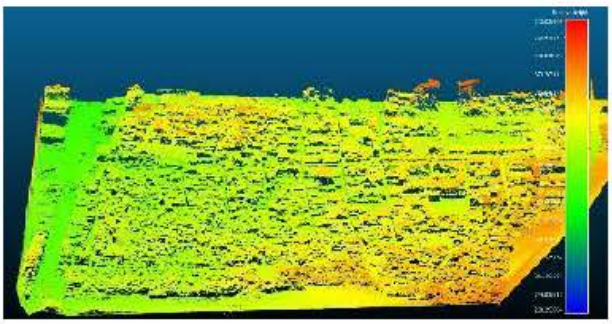

Fig. 106 A view form a height map generated from high values in Cloud Compare, by Orabi, 2023.

IV.6.3.2 Mass and Void

The general mass and void ratio has increased across the studied area. In comparison between (Fig. 107 and Fig. 108) we can identify regions with taller building and less open spaces in the northern west region (section 1 and 2, Fig. 100 and Fig. 101), the central section of the studied area (section 4) and along the southern wall (section 7 and 8).

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Fig. 107 Void and Mass diagram of the studied area in 1930, by Orabi, 2023.

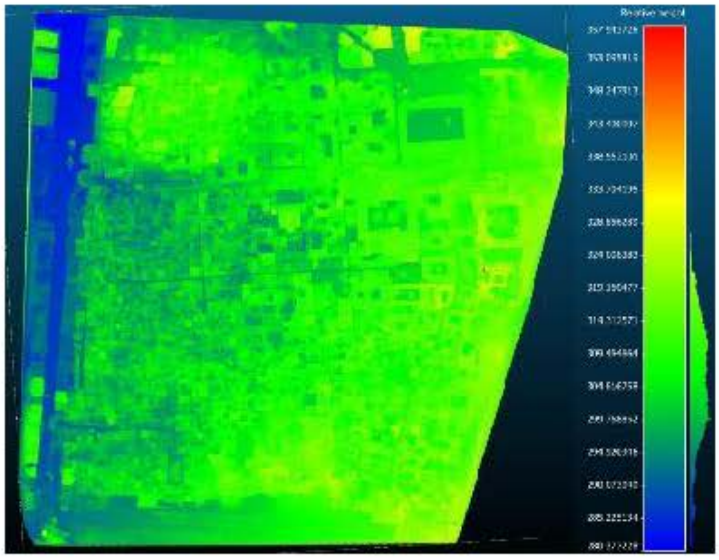

Fig. 108 The heights map generated in Cloud Compare for minimum values, by Orabi, 2023.

A grasshopper definition was implemented for the closer examination of sections, through which multiple cross sections are performed on the post-war cloud and the Mamluk model of each section. This method offers a close-up view to the changes of mass and void. For example, in section 1 we can observe the most changes to the mass and void ration within the studied region. Due to the high-rise buildings the void-mass ratio has significantly declined, especially that those buildings have also absorbed the open spaces of the previous plot, on which they were built (Fig. 109.a).

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Another notable morphological change is expressed through the vertical translation of the ground-floor courtyards into a roof courtyard as can be seen in (Fig. 109.b) In section 2 (Fig. 110) and section 3 (Fig. 111.a), we observe a decrease in void and mass ratio next to *Khan al-Ḥarīr* due to the additional floor. On the other hand, the opposite occurred to create the square in front of the mosque, as well as the addition of the courtyard in *Khan al-Jumruk* where there is an increase in the percentage on open space. In section 4, the increase in heigh has reduced the mass and void ratio. In some blocks the courtyard is starting to function as a shaft as shown in (Fig. 111.b). We can also see the same vertical translation from courtyard to the intermediate roof. Section 5 suffered heavy damages that resulted in the destruction of several parcels (Fig. 111.c). However, the remaining fabric reveals similar transformation from courtyards shafts. Several damaged buildings can also be observed in section 6. Nevertheless, the major change to the void and mass ratio is in *al-Shībānī* Church. The current building dates to the period of the French mandate. The comparison between the two models shows that the open space in front of the building was built in the Mamluk period. Moreover, many buildings have incorporated an extra story resulting in an increase in the mass ratio (Fig. 112.a).

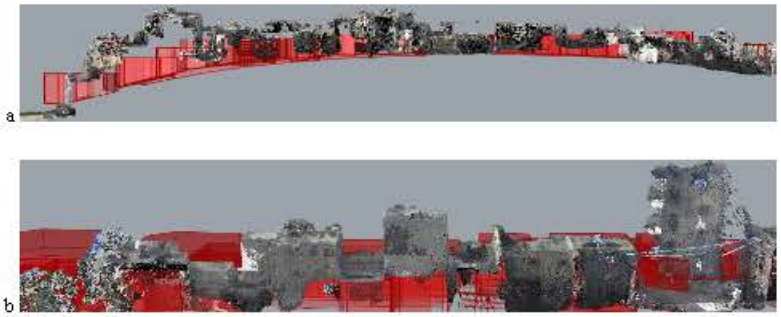

Fig. 109 A longitudinal cross section comparing the model of the Mamluk City (in red) and the post-war city (as a colored point-cloud) in Section 1. b. A cross section illustrating the vertical translation of courtyards, by Orabi, 2023.

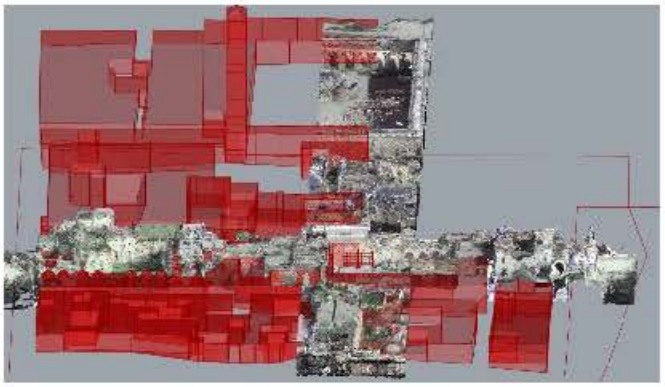

Fig. 110 Two perpendicular sections in the center of area 2, rendered from Rhino, by Orabi, 2023.

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Section 7 displays one of the major changes in mass and void ratio to south of the section, where buildings of increased heights are located (Fig. 112.b). Nonetheless, several parcels preserved their historical mass and void ratio. In section 8, the biggest change to mass and void ratio is observed in between *Bāb Qinnasrīn* and *Burj al-Ghanam*, the second one is in the plot of *Madrassat al-Kawākibī* (Fig. 112.c). The building of the school and its courtyard replaced the historical fabric in the area, so it increased the void ratio rather than mass ratio. The final region where changes are observed is behind *Burj Āala'* where a new two-story building was added in a previously open area (Fig. 112.c).

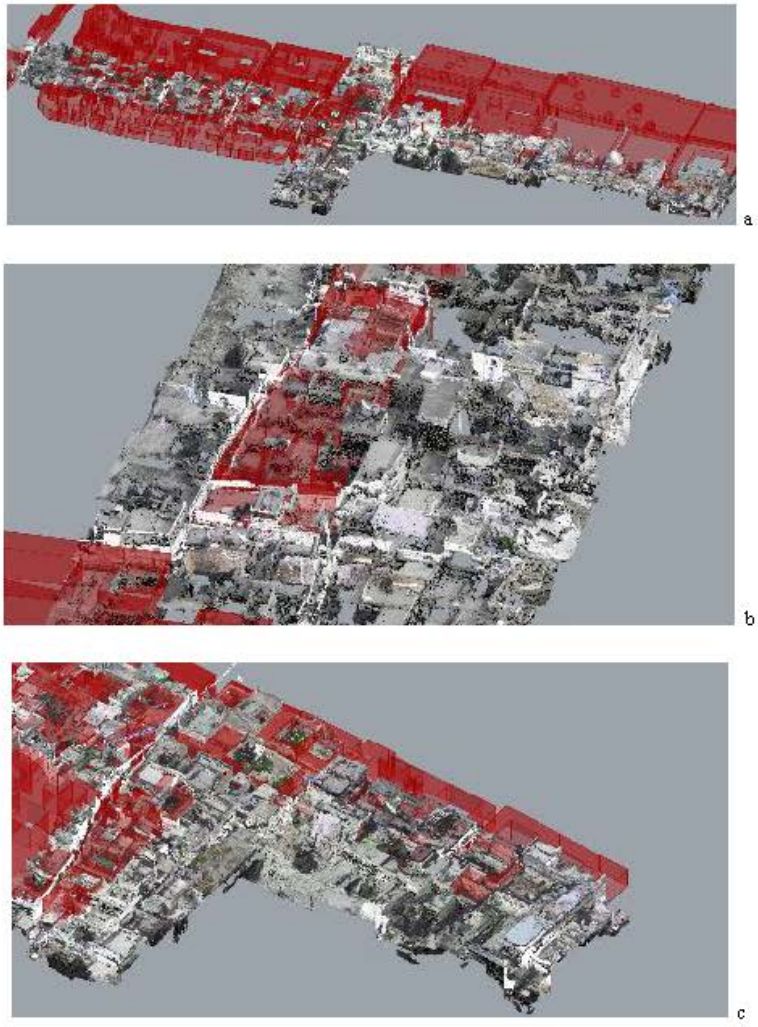

Fig. 111.a Two perpendicular sections in the center of area 3, rendered from Rhino. b.A view of the center of area 4 showing the decrease in mass and void ratio, rendered from Rhino. c. A view of the center of area 5 showing the destroyed parcels and the diminished courtyards, rendered from Rhino, by Orabi, 2023.

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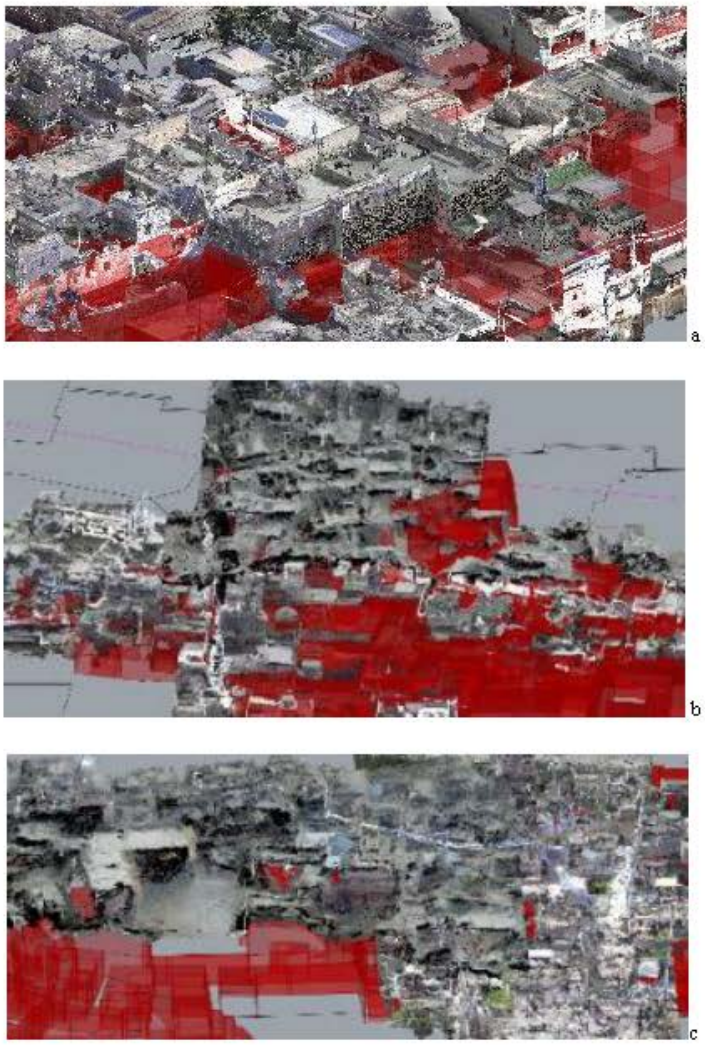

Fig. 112.a.A view showign the vertical growth of section 6 rendered from Rhino. b. Two perpendicular sections in the center of area 7 showing the buildings of increased height, rendered from Rhino. c. A sections in the center of area showing the area 8 with the major change in mass and void ratio, rendered from Rhino, by Orabi, 2023.

In conclusion, the suggested workflow combines reality capture models as well as parametric models based on historical, spatial, and cartographical inputs to imagine the studied area in the Mamluk period and compare it with the post-war city in terms of height increase and void and mass ratio.

As for the height increase, the changes range from the occasional addition of floors to the insertion of multistory buildings that disturb the distribution of courtyards as well. Finally, the expected drastic changes can be observed where master plans were implemented in the vicinity of the *Umayyad Mosque*, the western part of section 3, to the south of section 3, and occasionally around alleys' intersections in several sections.

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Determining the change in mass and void ratio proved to be more challenging. Due to the rubble and the destruction of the post-war fabric an estimation of that change was achieved. Two perpendicular sections (longitudinal and cross sections) were applied to one of the eight areas around prominent mass and void changes. The perpendicular sections were positioned in a manner that avoids the piles of rubble when possible.

Finally, the case study of *al-Jalūm* and *al-ʿAqaba* sets a proof of concept for the use of 3D-models in the analysis of the evolution of historic centers as well and the evaluation of the state of conservation of the city and the risks and threats that faces the historical fabric especially during and/or after the conflict.

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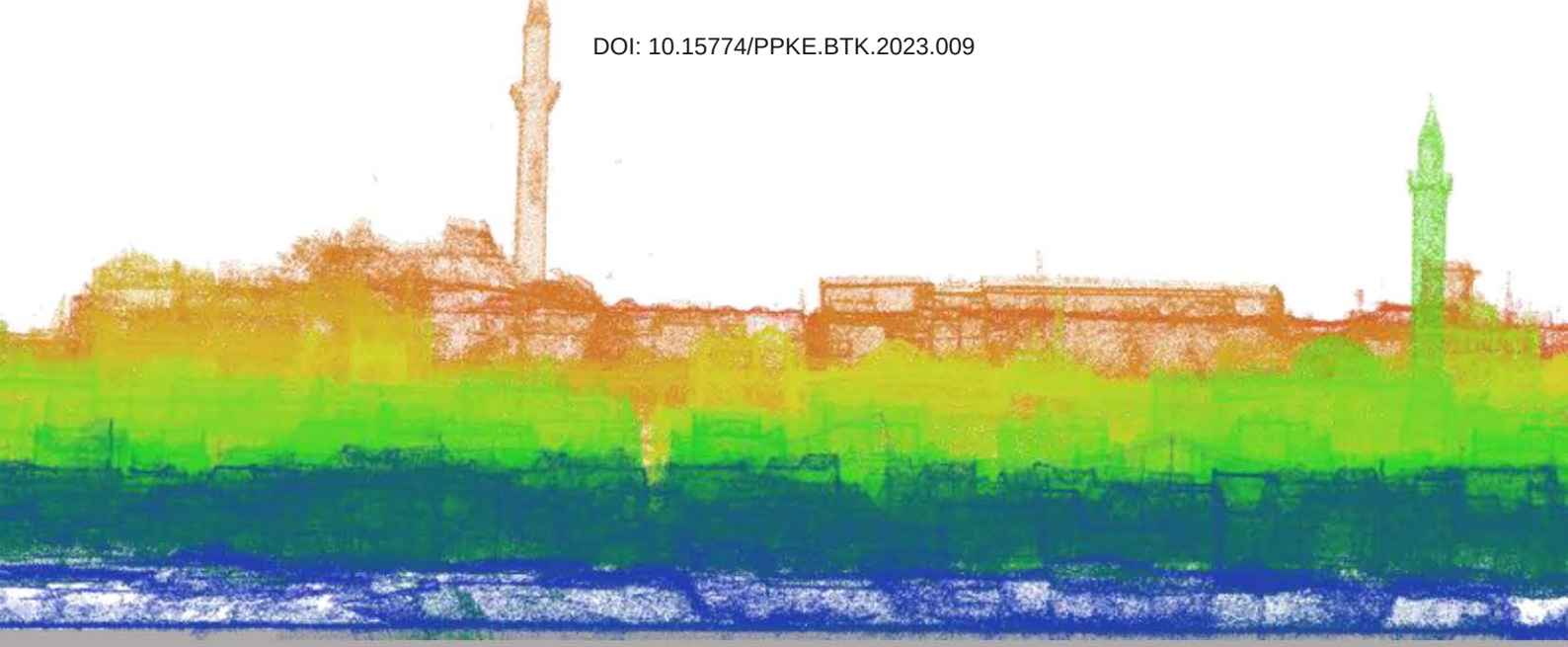

CHAPTER FIVE

CONCLUSIONS AND REMARKS

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The results of the dissertation can be divided into two main groups: The results from the historical and urban analysis and the results of the 3D-study.

V.1 The Results of the Historical and Urban Analysis

First Chapter

1. Although Aleppo was not a pivotal empire, it possessed a unique religious position to the indigenous and invader communities alike as the hometown of the God Haddad. This position continued during the Hellenic rule, yet politically Antioch seized the bigger share of political and commercial rule.
2. By the beginning of the Islamic rule, Antioch lost its control over the political and economic domain. Yet Aleppo was still neglected under shadows of the prominence of Damascus and later Baghdad. The only importance of the city and its suburbs at that time was the borderline between the Arabs and the Byzantines – a position that will remain a constant definer of the prosperity and stability of Aleppo. It is the same location that will later enable the commercial prosperity at the gates of numerous empires, place it in multiple crossfires, and add additional burden of defending it against motivated indefatigable neighbors.
3. The Seljuk and their Zengid vessels managed to stabilize the political chaos that dominated the city for a long period; they promoted the *Sunni* faith by paving the way for the establishment of *Madrassa* to spread the teaching of the four *Sunni Madhabs*. Zengids converted Aleppo into a military base for their counter Crusader's campaigns, in attempt of establishing themselves as the leaders of the Muslim resistance. Later, the Ayyubids expanded the city of Aleppo in terms of architecture and urban projects and identified it as a commercial hub; yet it lost its military position launching attacks on the Crusaders to the city of Damascus.
4. Overall, the Zengid and Ayyubid periods brought to Aleppo a long overdue peace, urban and economic prosperity. Moreover, it rose as a political-power center and an operation base against the Crusaders.
5. The growth of markets for commercial and tradable goods went hand in hand with the growth of religious buildings since the commercial activities were the main funding sources for the religious institutions in the *Waqf* system. The characteristic of the building practices

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was shaped by social, economic, and political events. We notice the peak of the commissioning of *madrassas*, *bīmāristāns* and *khanqahs* during the Zengid period as a crucial instrument in the holy war of Nur al-Din against the Crusaders. Similar practices persisted in the Ayyubid period regarding religious institutions, but with a more militarized orientation towards fortifications.

6. Nonetheless, the city reached its fullest glory during the Mamluk period as a commercial capital. Despite periods of internal rivalry, the Mamluks managed to facilitate trade with Genova and Venice by offering liberal trade policies.
7. The Ottoman period brought further prosperity, stance, and fame for the city, when it remained in the literal heart of the empire as the main center for trade in the east, circulating goods from the Gulf, Anatolia, Mesopotamia to Europe and vice versa, until the discovery of alternative maritime routes.
8. As a result of the lengthy history of the city, the social fabric in Aleppo incorporated a mixture of ethnicities and religious and sectorial factions. The historical city center was a manifestation of many civilizations and political, economic and urban policies.

Second Chapter

9. Viewing the city from the perspective of artists provides further light on the importance and fame of the city as an inspiration for travelers and orientalists. The prevailing style of amplifying the urban features such as the walls, the *minarets* and the citadel also indicate their perception of the city´s importance.
10. The ancient nucleus of the city grew according to Hellenistic and Roman planning strategies; the multi-phase-planning is still traceable within the modern structure.
11. The second deliberate planning of the city commenced in the Zengid period and continued to the Ayyubid period with special consideration and focus on the fortifications, infrastructure projects and new religious functions – which can be regarded as a period of militarized and ideological urban planning.
12. The third urban growth was in the Mamluk period, which can be viewed in two schemes: the first is also militarized, but the second is trade-oriented.

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13. The expansion of the *souks* remained linear until the *khans* and *Qaysariyyas* were introduced, marking the architectural and urban manifestation of trade especially after the second half of Mamluk period.

The famous Mamluk complexes did not appear in Aleppo as they did in Cairo, possibly due to limited vacant land parcels until the first complex was commissioned by Ḥusruf Basha in 1546.

14. Four major urban shaping events of the city intra-muros occurred: within the walls (The Mamluk Period, the Ottomans, the urban projects, and the war. The developments in between were minimal architectural projects with specific changes that overtime accumulated into an observable change on the urban scale.
15. Urban changes between 1900 and until 1930 were concentrated in the residential western and south-western section of both *al-Jallūm* and *al-ʿAqaba*.
16. We can recognize different driving factors for the development of the city in each period. For example, in the Zengid period, urban expansion was driven by political ambitions and military orientations combined with a religious agenda. While in the Mamluk period, a shift in the driving force is observed, in their early rule it had been military objectives that slowly shifted to economic interests during the second phase of the Mamluk period. The economy remained the main driving factor of the development of the city in the Ottoman period as well, and the *Waqf* system guaranteed that a handsome sum of which was spent on expanding the religious institutions. In a sense, Aleppo manifested the wealth acquired by trade as political and religious establishments.

However, in the period of the French Mandate, the ancient urban centers were considered outdated and unmodern, an idea that eventually resulted in the new master plans to equip the city with the elements that then represented the modern city, such as wide streets, tall buildings, parking lots and large squares. From that point onward, the colonial image of the city remained in the minds of the inhabitants, who in turn tried to modernize their old houses and build high buildings, and to accommodate the population within a limited area. Moreover, the resulting lack of privacy was a driving force for urban change; courtyards were roofed, and additional stories were added to prevent being observed by higher buildings. This resulted in social practices guiding the urban development such as privacy and marriage within the family home, especially in residential quarters.

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17. This process of adding vertical elements to the city started roughly around the Ottoman period, many of the *Waqf*s were created as second or third floors on top of the existing religious monument itself as it was the case in *al-Madrassa al-Ḥalāwiyya*.

Third Chapter

18. The Byzantine origin of the defensive parameter is well documented in Arabic sources. Some of them provide numeric values for the dimensions of the towers in *cubit*, which were later implemented in the grasshopper script in order to express the value range of the cubit unit in the metric system.
19. The same accounts provide a primitive architectural description that is concentrated on the defensive parameter, the street network, open spaces (mainly squares), the water distribution system, and individual monuments depending on the text. However, major bias exists among their writing which can be attributed to the family feuds they had among themselves. This description becomes more meaningful when coupled with the cartographic map of the year 1900. Moreover, it provides a general example of the vertical development of Aleppo by detailing the location of the *Waqf*s commissioned as a second and third storeys in the Mamluk and Ottoman period.
20. By tracing the patronage, it is clear that the last period of urbanization in the city was during the first 200 years of the Ottoman period, in terms of building of commercial and official establishments. Furthermore, on one hand, the walls still played some of their traditional role; they were reportedly restored during the reign of the Sultan Maḥmūd Khan. On the other hand, the following periods carried the loss of function of traditional fortification. As a result of the period between 1885 till 1892, three gates of the city were destroyed (*Bāb al-Aḥmar*, *Bāb al-Jinān* and *Bāb al-Faraj*) as the projects of the urban development in favor of housing and trade were initiated by the Ottomans.
21. Regarding the distribution of gates in the walls of Aleppo, we notice that they were mostly concentrated toward east of the southern edges of the city. This may be due to the fact that until the Mamluk period most of the neighborhoods were concentrated to the west, north and south of the citadel, and the area between the two walls was not fully urbanized until that period. Another reason would be related to the history of the siege and attacks on the city, as both the Byzantines and the Muslims attacked and entered the city from the

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west. While Alp Arslan attacked and entered the city from the south (next to *Bāb al-Ghanam*)[602], the Mongols (entered next *Qal'at Sharīf*)[603] attacked from the south. An attempt to even the numbers were made by the addition of *Bāb al-Farādīs* on the northern edge during the Ayyubid period and *Bāb al-Aḥmar* during the Mamluk period on the western edge.

22. As for the spatial setting, the huge religious buildings and their *minarets* dominate the 3D space as portrayed in the paintings mentioned in chapter 1. Yet, *minarets* were infrequently mentioned as such in the historic texts; possibly due to lack of interest and the irrelevance in describing the 3D environment in the context of a historical text.
23. As previously discussed, Aleppo has always been a commercial hub but also held a regional religious status. With the arrival of the Zengids and later the Ayyubids and Mamluks, it can be argued that they skilled Muslim traders with the aim of putting the commercial attributes and success of the city in service of their religious and political agendas and quarrels.
24. As a result, we can notice that after the Zengid period, the commissioning of such public buildings was not limited to the ruler of the city. It could have been casually initiated by governmental officials and esteemed members of society, as a trend of "individual patronage". This can be mainly related to the prolonged state of autonomy which Aleppo underwent. Some of the most individual religious architecture projects were mausoleums and mosques, since commanding a building at that period consolidated the status of the patron.
25. Some buildings did not follow widespread architectural forms and typologies, especially in the intra-mural city. Because most probably alterations were made to previous existing buildings as an act of commissioning or endowments. Theses renovation or replacement of functions often entailed the increase of height such as in *al-Madrassa al-Halāwiyya*, where three additional stories were endowed between the Mamluk and Ottoman period.
26. After the development of modern machines of warfare, we can start to witness the demise of the cities' fortification as we know it; the residential function started to take over what remains of those fortifications after the major urban projects.

[602] Ibn al- ʿAdīm, pp. Vol 4, 975
[603] al- Dzahabī, 1993, p. 50

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V.2 The Result of the 3D-Study

Fourth Chapter:

27. The digital technology in the documentation and analysis provides a new and insightful domain to examine the urban space and its historical development.
28. The importance of parameterization is to create a methodology and a digital workflow (Fig. 113) for mapping the historic layout in a parametric environment which saves modeling time and allows for new interpretation and editing of the models that accompany new excavation, discoveries, and results.
29. The changes to the silhouette of the city were a result of the new urban policies of the 19th and 20th Century combined with illegal construction which gradually led to the change of 3D-morphology of the city. The war damage, on the other hand, presented a drastic and sudden change of morphology.
30. The parametric script includes elements that are case-sensitive such as the process of the deformation of the base map of the 1900s of the Old City of Aleppo; in addition to elements that are not case-specific and can be applied to similar urban fabrics such as the 3D reconstruction script or Grasshopper definition.

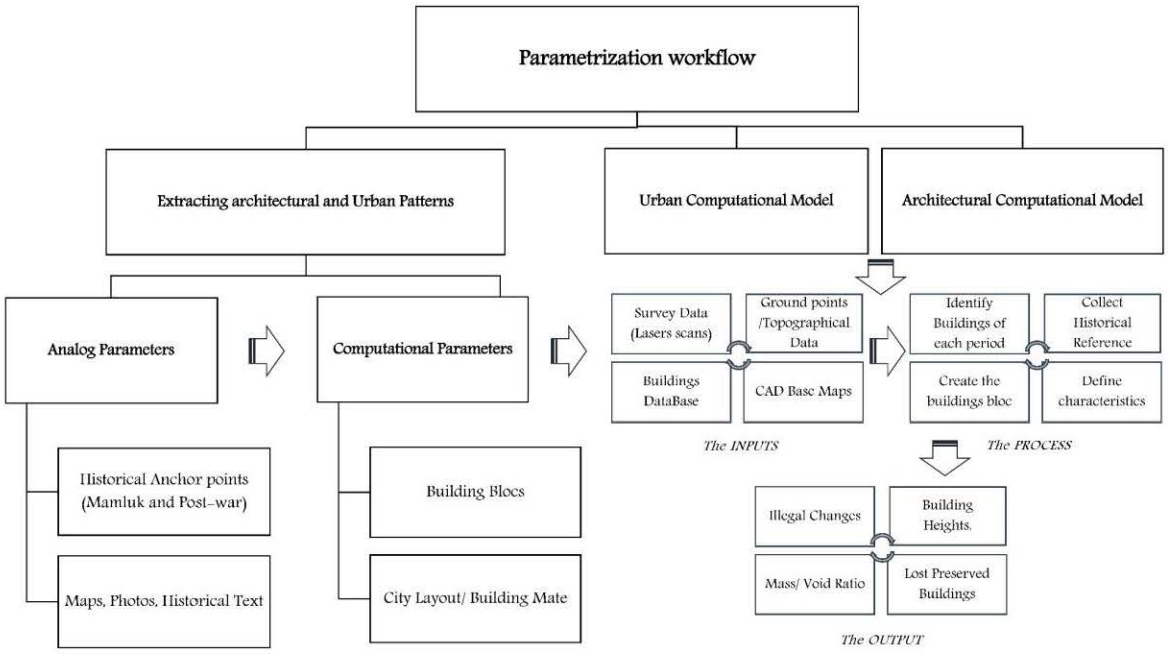

Fig. 113 The Parametric Workflow of the Study, designed by Orabi, 2023.

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31. Although historical events are the anchors to which this thesis is tied, the study shows that it is more applicable to associate the development of the city individually rather than a set-date. Because one day, one month or one year means so little in the life of a city; however, throughout the reign of dedicated rulers, the effects of the wheels of construction can have enough time to manifest.
32. While the law of the protection of cultural heritage somewhat succeeded in preserving the 2D layout of the city, it failed considerably in protecting the low-rise nature of the fabric. This process created a false permanence which is visible only in 2D-maps, while, in reality, the height-to-width-ratios doubled and even tripled in some quarters.
33. The importance of the Ottoman map revealed the urban details especially when they are aligned and superimposed on the digital survey. It allowed for the identification of large-scale transformation (such as loss of public space) as well as small scale transformation (the changes in cul-des-sac and occasionally of courtyards). In the third dimension the 3D-survey provided a baseline for the reconstruction of Mamluk Aleppo that eventually played a pivotal role in analyzing mass and void ratios.
34. The heights analysis of the Mamluk and post-war cities revealed the location in which the city vertically grew as well as the location where it maintained its skyscape. In general, an extra floor was adapted in several plots. However, domed structures and roofed souks did not experience such change and hence preserved their historical heights.
35. The void and mass analysis tracked areas where the ratio between mass and void changed (increased or decreased). In general, the decrease in the mass ratio corresponds to plots that were destroyed either to create a congregational space (such as the square in front of the *Umayyad Mosque*) or to provide a space for building with modern design such as the public schools as in the case of *Madrassat al-Kawākibī*. On the other hand, the increase in the mass ratio is associated with the spontaneous vertical growth of the city as in the extra floor on several parcels, or the designed vertical growth as is the case in the section 4, 7 and 8.

Finally, this study attempted to quantify the change in the urban scape of the city and provide percentage growth or decline in the mass and void respectively, which was enabled by connecting the historical cartography to modern technology and utilize that data

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individualization of the city in a selected period in time while at the same time compare and evaluate the growth and metamorphosis of the urban fabric.

V.3 Outlook: Further Continuation and Evolution of the Study

The future work on the topic will focus on expanding this research to include additional historical anchor points such as the Ottoman period, to which extensive theoretical and applicable grounds have been laid in this dissertation thesis. Moreover, future studies will focus on analyzing each monument that was part of the survey in detail regarding the war damages and a structural evaluation for the ones which are severely damaged.

Further applications can include the converting of those 3D models into what is being called the "Digital Twin". Digital twins are interactive replicas of physical elements, whether it is a room, building, or an entire city. In this case, the digital model is automatically (or sometimes manually) updated once new changes have been introduced to the original element. In this regard, interactive workflows such as the one presented in this dissertation not only hold the keys to unlocking the history of Aleppo and examining its status quo, but it enables monitoring the spatial and demographic developments and predict their effects on the growth of the city. But far more importantly, due to the parametric and flexible nature of the input data, this method can be easily adapted to study other historical cities with similar fabric.

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List of Transcriptions

Place Name	Arabic Transcription
al-Daydariya	al-Daydarīya
Aleppo	Ḥalab
al-Kallasih	al-Kallāsih
Aqsa	Aqṣa
Hama	Ḥama
Hattin	Ḥaṭṭīn
Homs	Ḥumṣ
Latakia	al- Lathīqiyya
Yamhad	Yamḥād

Building Type	Arabic Transcription
Bazar	Bazār
Hammam	Ḥammāms
Khan	Khān
Khānqa	Khanqāh
Qaysariya	Qaysāriyya
Ribat	Ribāṭ
Sunni	Sūnnī
Zawiya	Zāwiya

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