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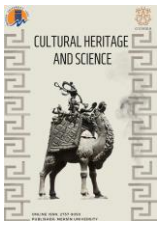

Cultural Heritage and Science (CUHES) is an interdisciplinary academic, refereed journal for scholars and practitioners with a common interest in heritage.

Aims and scope

Provide a multidisciplinary scientific overview of existing resources and modern technologies useful for the study and repair of cultural heritage and other structures. The journal will include information on history, methodology, materials, survey, inspection, non-destructive testing, analysis, diagnosis, remedial measures, and strengthening techniques.

Preservation of the architectural heritage is considered a fundamental issue in the life of modern societies. In addition to their historical interest, cultural heritage buildings are valuable because they contribute significantly to the economy by providing key attractions in a context where tourism and leisure are major industries in the 3rd millennium. The need for preserving historical constructions is thus not only a cultural requirement, but also an economic and developmental demand.

Therefore, Cultural Heritage and Science (CUHES) cover the main aspects related to the study and repair of an existing historical artifact, including:

- ✓ Issues on the history of construction and architectural technology
- ✓ General criteria and methodology for study and intervention
- ✓ Historical and traditional building techniques
- ✓ Survey techniques
- ✓ Non-destructive testing, inspection, and monitoring
- ✓ Experimental results and laboratory testing
- ✓ Analytical and numerical approaches
- ✓ Innovative and traditional materials for repair and restoration
- ✓ Innovative strategies and techniques for repair and restoration
- ✓ General remedial measures
- ✓ Repair and strengthening of structures
- ✓ Seismic behavior and retrofitting
- ✓ Detailed and state-of-the-art case studies, including truly novel developments
- ✓ Cultural Heritage and Tourism
- ✓ Close-range photogrammetry applications for cultural heritage,
- ✓ Laser scanning applications for cultural heritage,
- ✓ 3D modeling applications for cultural heritage,
- ✓ UAV photogrammetry applications for cultural heritage
- ✓ Underwater photogrammetry applications for cultural heritage
- ✓ Virtual Reality and Augmented Reality applications for cultural heritage
- ✓ Remote Sensing applications for cultural heritage
- ✓ Archeologic studies
- ✓ Architecture studies
- ✓ History of Art studies
- ✓ Description of novel technologies that can assist in the understanding of cultural heritage.
- ✓ Development and application of statistical methods and algorithms for data analysis to further understanding of culturally significant objects.
- ✓ Computer sciences in cultural heritage

The main objective is to provide an overview of existing resources useful for the rigorous and scientifically based study of the state of ancient structures and to present state-of-the-art novel research in the field. The journal will publish review papers, research papers, and detailed case studies. Interdisciplinary contributions will be highly appreciated.

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Articles

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Unlocking urban regeneration projects: A case study of Royal Railway Station in Phnom Penh, Cambodia

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Abstract

Drawing on theories that encourage compact urban patterns and propose walkable and transit-oriented developments, the article argues that the creation of calibrated pilot projects embedded in the neighborhood grain have the potential to stimulate cultural changes and promote practices that encourage the conceptualization of more sustainable and equitable cities in Southeast Asia. In this context, the article presents the case of the renovation of the old railway station terminal in Phnom Penh (the capital of Cambodia). The building is located in an area that forms a central node in the overall urban structure and could serve as a driving force for the activities of the emerging Central Business District, insisting on the western edge of the historic European quarter designed during the French Protectorate period in the early 20th century. Although small in scale, this initial regeneration and conversion of the building into a place capable of hosting more diverse activities can be seen as the first phase of a larger multimodal hub that, combined with a public park, would provide the city with the vital green infrastructure needed to support recent transformations, taking into account not only public interests but also the various private stakeholders.

1. Introduction

This paper examines literature from the past 25 years, comparing prior research on the urban development of Phnom Penh and reinterpreting it by analyzing the socio-economic mechanisms that have molded the city's current form. Existing publications and reports are reviewed in light of the most recent theories and practices of urban regeneration, including Landscape Urbanism and the "second wave" of New Urbanism. Assumptions surrounding these theories, which may not originate from a local perspective, are reassessed.

The paper highlights the lack of implementation of current urban planning instruments, primarily introduced through the aid of global agencies and consultants. It explores potential scenarios by examining emerging phenomena. It supplements these observations with interviews, notes, and photographs taken in the field, capturing the design experience forged in collaboration with local professionals and key decision makers.

It examines the insights gained by Cambodian practitioners who have returned to the country and draws its conclusions from the necessity of unleashing the potential of a green infrastructure network located amidst the city's firm urban fabric grid. The analysis has been carried out over the past four years with the help of architecture students from the Urban Lab at the American University of Phnom Penh.

2. Method

2.1. Historical overview

In the 1800s, the French colonial expansion introduced railways into Indochina region, with the aim of exploiting the region along Mekong River. This initiative aimed to connect the current territories of Laos, Thailand, Vietnam and Cambodia [1]. In Cambodia, two railway lines were constructed during this period (Figure 1). The initial line linked Phnom Penh to Poipet on the Thai border, while the second connected the capital to the port city of Sihanoukville [2].

In 1865, Phnom Penh was a small port on the banks of the Tonle Sap, Mekong, and Bassac rivers when it became the official capital of the country under the French Protectorate. The city's image, which had been dominated by wooden and thatched architecture, was completely transformed. The French administration

implemented customary land laws where public and private properties were separated [3]. The original rural settlement underwent reconfiguration with the introduction of an organized grid road system and the construction of administrative buildings [4].

Figure 1. Railway lines built during the period of the French protectorate, superimposed on the current morphology of Cambodia, courtesy of AUPP Urban Lab (2023).

Between the 1920s and 1930s, Ernest Hébrard, who led the Architecture and Urban Planning Service in Indochina, redeveloped the entire city encompassing the boundaries of the initial French Protectorate settlement. Right on the southern border, in the heart of the so-called Chinese quarter, Hébrard designed a new central market (Phsar Thmey). The market acted as a trading hub and was encircled by multiple rows of commercial shop-houses [5].

Ernest Hébrard's proposal for the expansion of Phnom Penh introduced a contemporary transportation system. The roads were converted into a broad and unified grid that radiated from the central districts, allowing for fast traffic flow. In addition, the city implemented measures of self-sufficiency, like establishing railway stations and ports. As more roads were constructed, official linear parks were introduced across the city's central stretches of major boulevards.

The city was partitioned into districts including the Chinese quarter, European quarter, Vietnamese quarter, and Cambodian quarter (Figure 2). Each district had distinctive traits and served a specific purpose for the city and its residents. The European quarter was comprised of administrative and government establishments. The Chinese quarter was acknowledged in the business area encircling the central marketplaces. The Cambodian district was identified by the Royal Palace, National Museum, pagodas, and other Khmer religious landmarks. The eastern peninsula was designated as a New European district for industrial purposes.

In 1932, the railway station was built as a representation of modernization for the Kingdom. Together with the Central Market and Phnom Penh Cathedral, the station created the city's Art Deco architectural 'triangle'. The station had a direct connection to the Tunle Sap River through the Verneville Canal. This canal was regarded as an arm of the river that extended below the Pont de Verneville. Afterwards, in 1932, the canal was converted into a landscape garden. The garden became widely recognized as the 'Station Garden' [6].

As suggested by Chheng and Asano [6], the rationale behind Ernest Hébrard's plan to transform the canal into a boulevard was to bridge the social divide between the north bank, which was occupied by the French, and the south, which was inhabited by the Chinese and Cambodian populations.

Figure 2. Boundaries of the ethnic districts in the 1930s, superimposed on the current urban fabric of Phnom Penh, courtesy of AUPP Urban Lab (2023).

The railway station in Phnom Penh was among the initial projects to bring early European modernist architecture to Indochina (Figure 3). The terminal building, which is a mere two floors tall, possesses a reinforced concrete structure whereas the exterior design reflects tropical style that shows clear inspiration from Art Deco, with ornamental latticework and wooden windows for lighting and ventilation regulation. It was created by French architect Jean Debios, who also played a role in the development of the central market project alongside Victor Chauchon and, together with Ernest Hébrard, in the Raffles Hotel Le Royal. The main hall features six parabolic arches that support a high ceiling. According to Osborne [7], Jean Debios played a crucial role in designing the structures of the railway station and new central market. It's possible that Jean Debois took inspiration from modern structures of his time, such as the Wroclaw Market Hall, which Richard Pluddemann designed between 1906 and 1908. This market hall also had parabolic reinforced-concrete arches. Above the arches, an extra office floor is situated which is connected to the ground floor by a staircase on the shorter side of the edifice. Additional service pavilions and train sheds were installed in the areas surrounding the tracks. The railway station began operation in 1932 and the terminal building has remained relatively unchanged since then. After Cambodia gained independence in 1953, the railway system reached its peak along with significant economic growth. Several railway lines received support from French, West German, and Chinese investments. However, operations ceased in 1970 due to the outbreak of civil war, and the railway was then restricted solely for military usage [2].

In 1975, after assuming power, the Communist Party of Kampuchea reconvened at the venue to deliberate on the obligatory exodus of the population from the capital to dispersed rural cooperatives and work camps nationwide [8]. In 2009, the Australian company Toll Holdings was awarded an exclusive 30-year concession for the railway, resulting in its outsourcing, and renaming as Royal Railway Station [9].

When AusAID and ADB began the restoration of the station's terminal building in 2010, the facade's colors had already been altered. The initial white walls were painted a pale yellow, while the windows and lattice-works were changed to red and white respectively. The new works presented a façade in lighter straw yellow, with green paint embellishing the windows and some cornices. Around 2017, the building's facade was restored to its original white color. The colors of the fixtures and windows from previous interventions were kept, except for the upper floor windows and the cornice of the front canopy, which were painted blue. The interior has undergone considerable changes, such as the replacement of the original wooden box office with different arrangements and materials on several occasions. A bar was added to the main hall in 2019.

2.2. Entering the New Era of Globalization

In 2001, property ownership regulations were amended by the National Assembly with the Land Law's

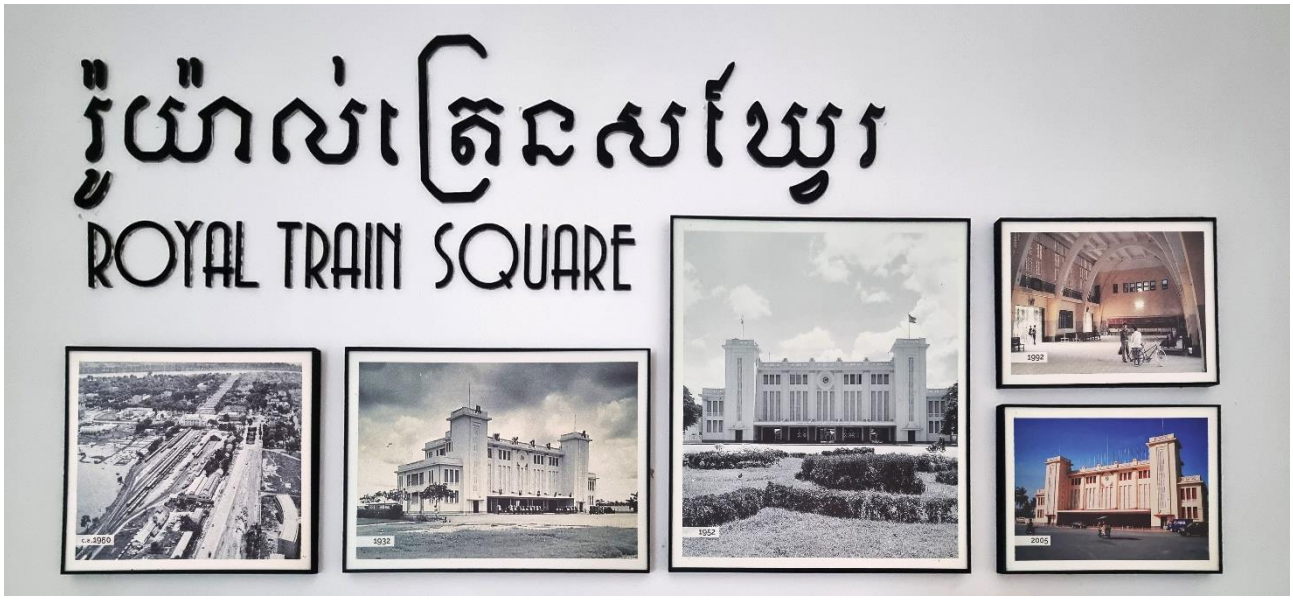

Figure 3. Railway station and deport from 1932 to 2005 – Exhibition at Royal Train Square, courtesy of Train Square Company Ltd.

approval, causing an influx of capital into the country. Large-scale interventions followed models borrowed from industrialized countries and major Asian cities. The modernization of infrastructure, supported by international experts, and Cambodia's entry into the WTO in 2004, led to an increase in property speculation and a rise in land value [10]. The filling of Boeung Kak reservoir in 2008 by Shukaku Inc was driven by fierce competition, limited land availability in the central districts, and insufficient government funding. As part of a 99-year lease to develop 130 hectares, the company relocated approximately 4,250 households [10]. In addition, the disappearance of traditional activities in the city center and the demolition of historic buildings has been documented by Khmero since 2000 [11].

Changes in land use have led to an increase in the urban density of the area and the construction of high-rise buildings [12]. The OCIC Tower, situated amidst the railway station and new central market, was finalized in 2009, followed by Exchange Square and Vattanac Capital in 2018. These ventures constitute the nucleus of Phnom Penh's nascent Central Business District (CBD) (Figure 4).

Figure 4. The emerging CBD of Phnom Penh, 2023.

3. Phnom Penh urban structure

As stated earlier, towards the end of the 19th century, the city's development took a compact form along the riverbanks' axis due to significant changes introduced during the French Protectorate (Figure 5). The riverbanks were stabilized to create a linear arrangement of buildings, the principal dam, and the river port.

A technique foreign to Khmer architectural customs, 'polderisation', helped to reclaim land for construction purposes. The landscape was converted into dense

European Quarter, situated in the north of the city and partially surrounded by a canal. Phnom Penh underwent a transformation into a divided city with two urban hubs: the royal palace and the 'white' administrative center following a Western colonial model. A third zone emerged between these two centers, known as the market area [13]. After achieving independence, the Cambodian planning called for a flexible and open approach. However, Vann Molyvann, the leading architect and planner in the post-independence period, unsuccessfully pursued to develop an alternative urban infrastructure in Phnom Penh [14]. Nonetheless, under the patronage of King Sihanouk, the influential architects of New Khmer Architecture thrived, turning an unknown city into a modern capital in the heart of Southeast Asia [15].

Vann Molyvann served as the state architect from 1957 to 1971. He aimed to blend Cambodian tradition with his knowledge of French architecture in both vernacular and monumental architecture. However, there were limited materials available in Cambodia, and there was a shortage of civil engineers, surveyors, and other professionals required at various stages, from design to completion [16]. A group comprising of Gerald Hanning, Vladimir Bodiansky, Vladimir Kandarouff, Um Samuth, and Khoun Khun-Neay designed a collection of practical and stylish public structures that fulfilled the demands of a developing, autonomous Cambodia [17].

The French introduced a linear street and block layout that was extended towards the south-west of the city. The initial alignments along the riverfront to the east resulted in an irregular street network, due to legal ownership issues and the high cost of building on marshland. Over the following decades, Phnom Penh's formal and informal areas grew in parallel [13].

Figure 5 offers a basis for visually examining the trends of urban expansion in Phnom Penh. According to the investigation carried out by Mialhe et al. [18], the city's enlargement occurred in multiple directions from the initial urban center, particularly towards the rivers and west of Chaktomuk.

Figure 5. Maps of urban expansion from 1922 to the present day, courtesy of AUPP Urban Lab (2023).

Investment in regional transportation systems began in the 1980s. The movement of people and goods in ASEAN cities, driven mainly by manufacturing and exports, is highly dependent on public and private transportation. Consequently, mega-urban regions tend to develop along transport corridors [19].

As recorded by Asian Development Bank [20], demand for light vehicles doubled in a 4-year period between 2013 and 2017 due to robust economic growth and rising per capita income. Due to this ongoing trend, the increase in urban traffic leads to congestion and increased air pollution. The transport infrastructure has been insufficient to accommodate the amplified demand. Even though feasibility studies are ongoing to suggest mass transit options for Phnom Penh, most public transport systems in Cambodian cities are still inadequate [21].

As is well known, Transit Oriented Development (TOD) was introduced in urban theory by Peter Calthorpe in the late 1980s and is generally defined as a mixed-use community that promotes living near transport services and reduces reliance on car travel

[22]. Therefore, studies conducted for the World Bank in 2017 [23], along with those prepared by the Japanese Cooperation Agency JICA in 2014, propose to revolutionize the infrastructure system by integrating a Transit Oriented Development (TOD) model into the city's master plan [24].

4. Prospects of further development: The role of the Railway Station area

The Royal Railway Station area is situated adjacent to the Boeung Kak reservoir, along Russian Boulevard towards the airport. It maintains continuity with several university campuses and the garden city of Toul Kork district. As mentioned, the events of the Civil War interrupted this form of expansion, which only resumed in the early 2000s, when the country finally achieved solid political stability. Today, however, the city tends to grow and develop in a polycentric manner towards its outer regions. This trend is driven by financial investments from private companies that primarily focus on constructing residential areas and new satellite towns [25].

The station acts as an urban node situated between the Old City and the forthcoming Central Business District, referred to as “Phnom Penh City Centre”, and which will be built on the reclaimed land of the Boeung Kak reservoir. In 2019, Train Square Company Ltd., began renovating the building and surrounding area to convert it into a commercial hub, capitalizing on the station's strategic location and ADB's previous refurbishment work between 2009 and 2010. The company planned to convert the railway into a 3,000 square meter retail and commercial area named 'Royal Train Square'. The proposal included shops, cafes, restaurants, banks, office, and exhibition space.

The management and consultants held an initial meeting in early 2019 to discuss the refurbishment of the station. Archetype Cambodia was hired as the lead designer to conduct a feasibility study and propose a conceptual design. The discussions were facilitated by a Dutch consultant who focused on beautifying the building's exterior through the use of luminous signage on the façade. The Archetype team suggested minimizing the use of signage and instead incorporating LED lighting strips concealed along the building's existing decorative frames (Figure 6). This approach was intended to enhance the original character of the Art Deco facade. The project then sought to reorganize the interior spaces by removing most of the partitions. It proposed to expose the modernist reinforced concrete structural elements to create a new perception of the interior. This would add greater depth and permit more flexible use of the space. The functional program thus remained open, and the ticket office was relocated to one of the temporary stands intended to occupy the main foyer and offer bars, bistros, and shopping arcades (Figure 7).

The two wings of the mezzanine were allocated for a small restaurant and a wine bar. The floor above the foyer and below the roof was intended to be wired and used as offices and art galleries (Figure 8). In addition, the columns and floors underwent structural consolidation while preserving the original floor tiles. Furthermore, the stairwells were fitted with two panoramic lifts. Externally, glass structures have been incorporated into the building to accommodate shops and bars. Two garden areas were planned, along with commuter parking for up to 200 cars and 400 motorcycles and the integration of a bus terminal. The anticipated expense of the project was at least 3 million USD.

The project experienced delays in its initiation due to the relocation of the airport to the southern part of the city, as well as setbacks in the development of the New Phnom Penh City Centre. Additionally, the uncertainty caused by the COVID-19 pandemic led to some reluctance in investment.

The refurbishment of the mezzanine and upper floors was postponed, while the ground floor foyer was transformed into an art gallery and multifunctional venue. Amid the pandemic lockdown, the station was deemed an essential service and remained operational, with the inaugural exhibition launching in 2021. In a controlled manner, events were organized primarily to advance Cambodia's nascent NFT market, the Cambodian Children Fund's student workshops, and Metaestetica Lab's digital and participatory art experiments (Figure 9). The station currently operates as a provisional events center. Undoubtedly, the opportunities arising from these first modifications pave the way for broader proposals. The area can be used for socializing and promoting culture now that it has been returned to the city.

The space behind the refurbished station, presently serving as a car park, and the vacant areas along the platforms, hold the potential for establishing an urban linear park, thereby offering the city much-needed green infrastructure to bolster the developments made in recent years.

The project put forth by the Urban Lab at the American University of Phnom Penh goes beyond, visualizing the formation of a new combined commuter hub, expanding on the idea proposed by the Archetype Cambodia team for the old station (Figure 10). The objective is to revitalize the area, generate funds for the construction of a public park, and provide sports facilities.

It may seem idealistic to propose prioritizing landscape infrastructure as a means of stimulating investment. However, as stated by the director of Train Square Company Ltd. during our interview, it is crucial to seek out investors and tenants who are receptive to an alternative vision, thereby preventing the fragmentation of Phnom Penh's historical town center. This method can guarantee not only immediate returns on investment but also long-term profitability.

It is clear from the words of the director that he envisions the Railway Station as a lively destination, integrating business and leisure areas in the heart of Phnom Penh's CBD. The venue should enable people to “have a good time”, dine, and enliven the neighborhood life, particularly in the evenings after work has ended. Moreover, it appears that the director has taken inspiration from similar, successful examples in other cities worldwide, such as Washington Union Station and Amsterdam Central Station.

He recognizes that one actor alone cannot change the face of the area. The construction project needs to be coordinated with the proposed activities of the Royal Railway of Cambodia to establish a high-tech and logistics hub beside high-rise mixed-use buildings. The potential reinstatement of the city's central park, lost due to the infilling of Boeung Kak reservoir and not yet included in the riverside's development, brings utopia within sight.

Figure 6. Royal Railway Station, Façade, courtesy of Vincentiis B. (2021).

Figure 7. Royal Railway Station, Ground Floor Hall, courtesy of Vincentiis B. (2021).

Figure 8. Royal Railway Station, First Floor, 2022.

Figure 9. Royal Railway Station, Event, 2022.

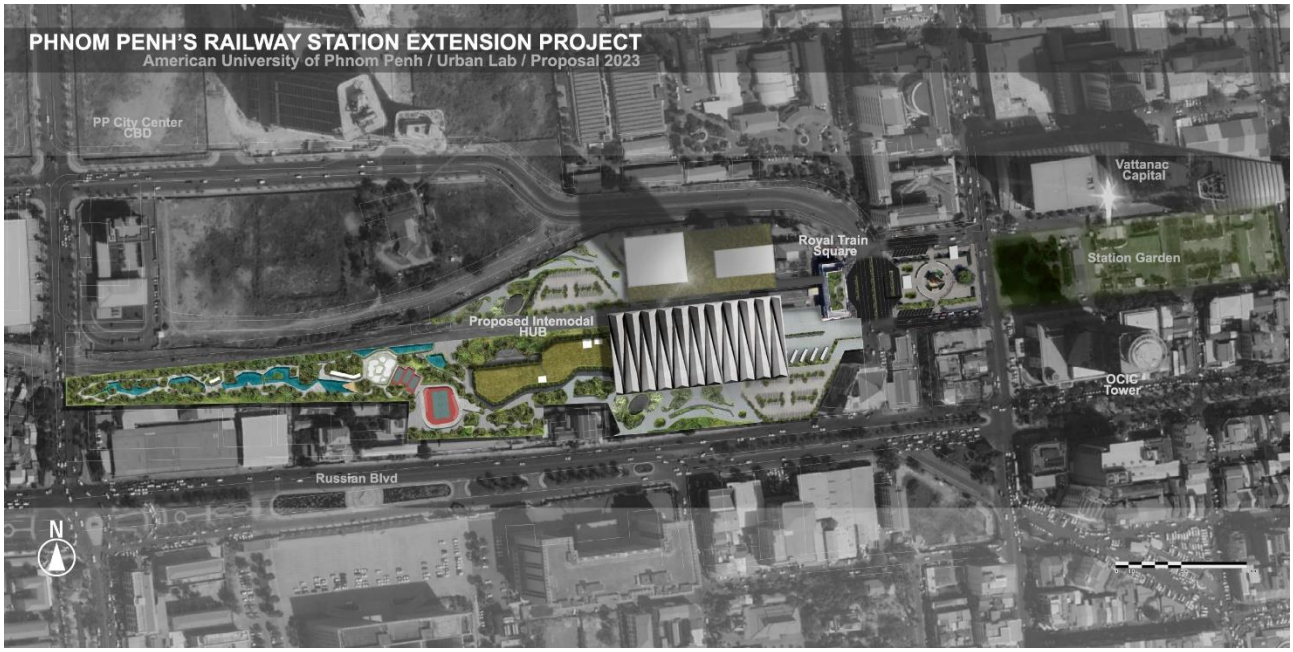

Figure 10. Phnom Penh's Railway Station extension project, courtesy of AUPP Urban Lab (2023).

Synergies to construct an intermodal station could also be developed with the city's public administration, drawing inspiration from European examples like the Logroño Transport Hub and Park in Spain. According to its designers, "abalos + sentkiewicz", this form of urban operations for developing a substantial public green area that balances historical centrality has the potential to create pole of attractions.

After all, in 2014, the Japan International Cooperation Agency (JICA) predicted that the intersection of Monivong and Russian Boulevard, where the railway station is situated, could serve as a central hub for the surface public transport network [23]. Additionally, the National Strategic Development Plan for 2019-2023 strives to advance the country's economy through the enhancement of transport infrastructure and connectivity. Furthermore, a study conducted by Yat Y., Wang. G. et al. [26] revealed that most young citizens in Phnom Penh acknowledge the environmental advantages of urban green spaces. The latest Country Planning Framework 2021-2025, produced by GGGI [21], highlights the transport industry as a fundamental element of Cambodia's national strategies. Lastly, in 2018, Phun reported that Phnom Penh authorities were considering alternative mass transit systems to alleviate traffic problems and accommodate increasing traffic flows. The Phnom Penh government, with foreign technical assistance, is evaluating other transit systems, including bus rapid transit, light rail transit, SkyTrain, tramways, and even motodop paratransit [27].

5. Conclusions

As explained earlier, the station area is situated in a large, mostly undeveloped location at the heart of the transportation network, not only in the city but also in the entire region. This area has been significant since the inception of the modern city, which emerged during the French colonial period and grew in the initial 15 years after the attainment of national independence. As illustrated by diagrams created by the Urban Lab at the American University in Phnom Penh, the area comprises the southern boundary of the former Boeung Kak reservoir.

In 2008, the entire reservoir was reclaimed and now this location acts as a vital junction point for the east-

west axis of the linear park in the Old City (Figure 11). It stretches from the city's riverbank to Russian Boulevard, where several of the most significant high-rise structures have recently been erected (Figure 12), facilitating the formation of the initial Central Business District (CBD).

It is widely acknowledged that a well-connected network of green infrastructure is essential for promoting compact development [28]. It aids in the reduction of air pollution and efficiently facilitates drainage [29]. It can support the creation of 'third places' that offset the increasing global trend towards the privatization of home life [30], which also had an impact on Phnom Penh. Above all in Southeast Asia, this approach cannot be limited to suburban areas alone, but can serve to regenerate historic centers. Indeed, the rethinking of this infrastructure has the potential to introduce an alternative identity into an urban fabric that still carries symbolic connotations associated with the colonial past.

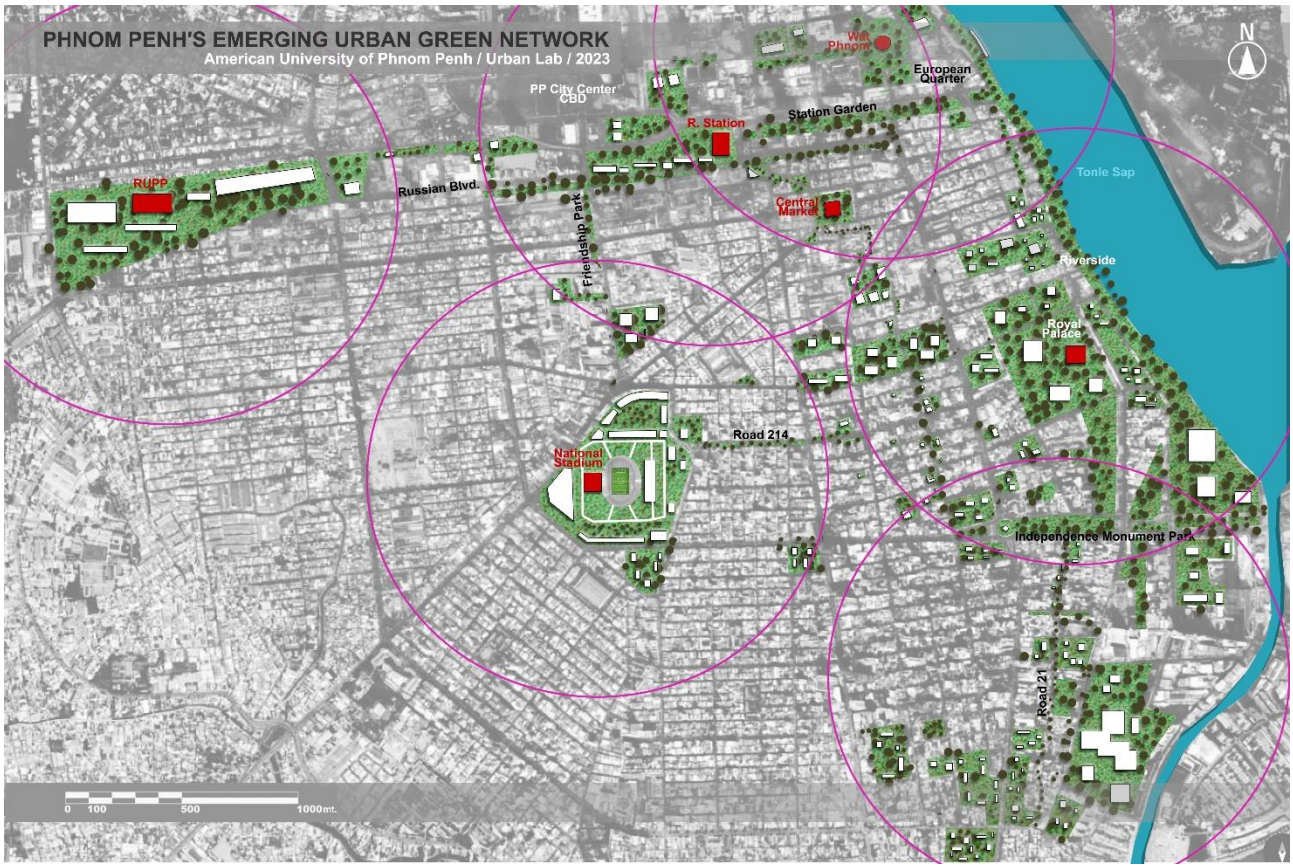

Figure 11. Phnom Penh's emerging urban green network.

Figure 12. Phnom Penh's railway station area on southern boundary of the former Boeung Kak reservoir, 2023.

Furthermore, the attention to local practices of spatial production that have already been adopted but not yet formalized in Cambodia might suggest a shift from controlling the transformation of the city through a

statutory master planning to a framework approach that guides the negotiation of pilot projects among multiple stakeholders. Finally, the emergence of a public open space in the form of urban parks can compensate for the exploitation of the increasingly dense urban fabric, promoting a concerted public-private partnership, typical of Southeast Asia, from which Cambodia has drawn its development models and which is now generally investing in Europe, as demonstrated by the use of project finance instruments in Italy and projects managed by originally semi-public companies, such as Lyon Confluence in France [31].

Several studies and proposals have been conducted based on the primary research thanks to the collaboration between the Phnom Penh and Paris Municipalities. Moreover, consultants from the Global Green Growth Institute (funded by Korean cooperation) have reiterated the importance of public-private partnerships in the latest comprehensive proposal of priority actions outlined in the Phnom Penh Sustainable City Plan 2018-2030 [32]. However, it is yet to be clarified whether there is a real intention on the part of the stackholders involved to implement the plan and provide the necessary financial resources.

In addition, the Build4People group, helmed by German academics and consultants from the University of Hamburg, primarily concentrates on sustainable development's behavioral shift, as well as sustainable building practices, neighborhoods, urban greening, urban climate, sustainable urban transformation and transdisciplinary transformation. The group puts forth multidisciplinary research that is implementation-oriented and inclusive of participation from government, businesses, and civil society. In their vision, objective transdisciplinary research can be accomplished through designing collaborative activities and products to support the transformative shift of Phnom Penh's urban development trajectory towards higher levels of sustainability and livability [33]. The first attempt to implement this strategy is still under discussion for an area to the south of the capital controlled by one of Cambodia's largest property groups, Peng Huoth. This area is situated on the outskirts of the city, and the proposal is still at a preliminary stage.

The railway station project, initiated in 2019 with the support of the Train Square Company Ltd, presents tangible opportunities. Located in a densely populated area, it serves both private stakeholders and the public administration due to its crucial transportation service to the population. The conservative restoration has engaged in a dialogue with the city's historical heritage whilst offering the potential to convert a small building into a significant commercial hub within the Central Business District. Currently, the intervention is restricted, but should be considered as the core of a far-reaching expansion plan on a principal axis that has structured the growth and transformation of Phnom Penh for almost a century.

Acknowledgement

I am grateful to the design team of Archetype Cambodia, which assisted me as the Lead Concept Designer, for the 2019 renovation of Royal Train Square. I would like to commend Train Square Company Ltd. and its Director, Mr. Scott Ball, as well as the Event Project Manager, Mr. Li Pin, for their exceptional bravery in converting their project into a space for public art events and exhibitions during the pandemic. For over a year, these events have been among the few safe opportunities for public art exhibitions and social gatherings in the city through collaboration with Krama NFT Marketplace, Cambodian Children's Fund, and Metaestetica Lab.

As responsible for the research conducted by the AUPP Urban Lab at the American University of Phnom Penh, I express gratitude to all the students who participated. Specifically, Sean Pichara's contribution was integral to the elaboration of this article and the included diagrams, while Kakada Lyhor's thesis significantly contributed to the design of the station extension proposal.

Conflicts of interest

The authors declare no conflicts of interest.

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Is all the UNESCO´s Qhapaq Ñan really Inca? Problems with the incorporation of sections and sites from San Juan (Argentina)

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Abstract

The nomination and acceptance of the Qhapaq Ñan as World Heritage took more than a decade of work in the six countries involved. In Argentina, a centralized coordination system in charge of articulating the proposals of the provinces that were part of the national program was implemented. Some people expressed certain inconveniences in the program's development, mainly related to the participation of native communities. Furthermore, the presentation approved by UNESCO shows some shortcomings associated with the identification of some of the proposed elements. In this sense, and in order to provide relevant information to better understand the Argentinean nomination process and its outcome, this article shows the divergences between the Inca Road system known in San Juan and the one accepted in the project, the nomination of a section and associated sites without the corresponding evidence of their Inca character and a failed previous proposal to incorporate historical sites to the project. Also, to help explain this situation, some aspects related to the actions of different agents and the possible incidence of political power are discussed.

1. Introduction

In June 2014, at the session of the World Heritage Committee held in Doha (Qatar), the inclusion of the Qhapaq Ñan on the UNESCO World Heritage List was approved [1]. Before and after this event, numerous criticisms were raised towards the project, which fundamentally pointed out:

(a) its management by modern states, which would thus impose a vision distant from those of the indigenous communities [2];

b) the scarce or null participation of local communities in the elaboration and discussion of the proposal [3-5];

c) the exclusion of local stories and the promotion of a homogenizing discourse on very diverse territories [6];

d) the economic contribution of large mining companies to the project, as a means to legitimize their activities [6];

e) centralized decision making and lack of information to local communities and authorities [7];

f) the absence of prior archaeological research to responsibly define the components to be incorporated into the project [7];

g) the lack of understanding between the different organizations involved [3].

However, there have been no adverse criticisms linked to the validity of the archaeological data presented there. These were not questioned, as was to be expected in a program of this importance, which brought together the specialists on the subject in the six countries involved. But this does not mean that in reality there were no problems.

In this respect, the information referred to the Qhapaq Ñan in the province of San Juan (one of the seven provinces crossed by the state road in the Argentine territory) presents some important errors and inconsistencies. Added to this is the apparent choice of sectors that were not the most representative or the most convenient from the point of view of the objectives of the project, which among other aspects sought the development of the local communities linked to the road. Equally striking is the existence of serious drawbacks in the first part of the selection process of sites and road sections, which should have implied a more rigorous control over the final proposal. This information is relevant not only to make transparent some aspects of the development of the project but also to contribute to

avoiding the repetition of similar cases or actions and to reflect on the need to improve the structural conditions that serve as a basis for its implementation. In view of the above, this article describes the San Juan sectors that were part of that declaration and its selection and application process, analyzes its relationship with the current knowledge on regional Inca roads and exposes the resulting divergences.

2. Method and Antecedents

All available documents related to the development of the project in Argentina and the selection and application of sites in the province of San Juan were gathered and analyzed. Likewise, oral sources were sought that would contribute to establishing the origin and function of some of the proposed sections. Part of the information comes from the author's direct participation in some of the academic meetings which dealt with the topic. In the same sense, the analysis and interpretation of the data was facilitated by the in-situ knowledge of the sites described in the text and that acquired through more than three decades of research linked to Inca domination in the central west of Argentina. The quality of the images coming from the UNESCO nomination document has been improved through the use of Adobe Photoshop and Microsoft Office Picture Manager.

2.1. National and international meetings

The initiative to declare the Qhapaq Ñan as World Cultural Heritage arose in May 2001, when Peru proposed to include it on the tentative list of Unesco World Heritage [8]. These authors review the international meetings related to the project. The World Heritage Center in Montevideo reportedly made a commitment at a meeting in March 2002 to prepare the first meeting of experts to initiate the procedures for the presentation of the candidacy. Shortly thereafter, on May 23, 2002, the presidents of Argentina, Bolivia, Chile, Colombia, Ecuador and Peru signed the commitment to promote the nomination process. In 2003, significant progress was made with several meetings in Jujuy (February), Lima (April) and Cusco (May and October). In 2004, agreements were signed between Unesco, the IDB and the government of Peru for the implementation of the "Action Plan for the Development of the Qhapaq Ñan or Main Andean Road", a non-reimbursable technical cooperation project from the IDB. On January 21, 2013, the complete dossier was submitted to Unesco and on June 21, 2014, the Qhapaq Ñan was declared a World Heritage Site in Doha.

In Argentina, in the first stage of work, each of the seven provinces involved in the project (Jujuy, Salta, Tucumán, Catamarca, La Rioja, San Juan and Mendoza) had to identify the sections of the Qhapaq Ñan to be submitted to UNESCO. Once this task was completed, further work would be done on the ethnographic, cultural and local development components, issues on which the provinces had already begun to work before July 2005 [9]. According to the action plan submitted by Argentina, the main components of the project were a) cultural heritage; b) natural heritage and territory; c) community development; d) sustainable tourism; and e) crosscutting lines. This makes clear not only the relevant role of local communities but also the interest in sustainable use through tourism. It should be noted that in each province the choice of the specialists involved in the project depended exclusively on the local authorities in charge of applying National Law No. 25,743 on the protection of archaeological and paleontological heritage, i.e., these decisions were political.

In the following years, several meetings were held at the national and binational level (with Chile) to advance in the characterization of the declared sites, in the summary of cartographic information, the integration of information, etc. [10-11]. After the declaration, this dynamic of meetings continued and intensified from 2020 onwards at the national level and in the other participating countries [12-18].

2.2. The failed initial proposal and the problem of the submission deadline

The first national meeting related to the project was held in Tilcara (Jujuy) in 2003, with the presence of the author of the article as representative of the province of San Juan. A few months later, after José Luis Gioja took office as governor of the province, there were changes in the area of Culture, which resulted in the official appointment of Dr. Catalina Teresa Michieli as the new representative to the project.

In a very short time, the sites that San Juan would propose for incorporation to the project were selected. The core of the proposal consisted of a group of sites and stretches of Inca Road located in the proximal sector of the Conconta ravine, in the northwest of the province. The public presentation of these sites in an academic environment took place in September 2004, on the occasion of the XV National Congress of Argentine Archaeology. There, at the West Central Communications Table, the representative of San Juan presented the work entitled "Investigaciones arqueológicas y protección de las instalaciones incaicas de la Quebrada de Conconta (San Juan, Argentina)", carried out together with two visual arts professors. Michieli and her collaborators were then warned about the risks of considering the proposed sited as Inca. The response to these observations was the hasty publication of the work in a local magazine [19]. An abstract with the same title appeared in 2010 in the conference proceedings [20].

As a result of these events, in October 2007 the paper "¿Ocupación incaica en la quebrada de Conconta? Una propuesta alternativa" (Inca occupation in the Conconta ravine? An alternative proposal) was presented at the XVI National Congress of Argentine Archaeology, held in San Salvador de Jujuy [21]. In that article, the Inca affiliation of the Conconta sites was seriously questioned. Diana Rolandi, the National Technical Secretary of the Qhapaq Ñan/Main Andean Road Project, expressed to the author her total perplexity and concern for the information presented, mainly because shortly before she had met with Chilean specialists to coordinate actions that would allow the articulation of the Conconta sites with the nearby sites on the trans-Andean side through the Tórtolas pass. Indeed, in a "Regional Action

Plan for an integration and cooperation process" on the Qhapaq Ñan [22], the section proposed by San Juan appears as "Toconta (sic) - Tórtolas (potentially binational)". According to this plan, the identification and registration of the sections of the Qhapaq Ñan should have been completed by January 2007, although at a meeting held in Nariño this deadline was extended to April 30, 2007 [23]. Based on this timeline, it is understood that at the International Meeting concerning the process of preparation of the nomination process for the inscription of the Qhapaq Ñan - Main Andean Road, in the framework of the process of preparation of the nomination of this property to the UNESCO World Heritage List [24], held in Paris between November 19 and 21, 2007, the Conconta ravina appeared as the only section proposed by the province of San Juan, with 90% of the work carried out in terms of road sections and associated Inca sites. At that time, the list of sites for the entire international program was already defined, and the representatives of the National Committees of Argentina, Bolivia, Chile, Colombia, Ecuador and Peru committed themselves to finalize the registry with all its components: road, archaeological sites, environmental, geological, ethnographic-oral and photographic record of the Qhapaq Ñan property by June 1, 2008, in order to comply with a schedule that will allow the property's nomination to be submitted to the World Heritage Center for a first formal examination in August 2009 [24].

In the weeks following the Jujuy congress, the doubts about the Inca affiliation of the sites proposed by the province of San Juan for the Qhapaq Ñan project were spread by the print media. When they learned of the news through a regional newspaper, the officials of the Culture Secretariat of San Juan had an exaggerated response: on November 7, the Undersecretary of Culture of San Juan, the Director of Heritage and the provincial representative of the project gave a press conference to express the full support of the Government to the latter. In the following days, in various newspapers and radio and television channels of the province, a strong official attack was organized in order to "clarify the situation". In summary, the local officials expressed their defense and endorsement of the official advisor's research, and strangely maintained that in reality the underlying problem was a confrontation between researchers, between the provinces of Mendoza and San Juan and between the national universities of Cuyo and San Juan. The attitude of the government of San Juan, although unjustifiable and at odds with advisable academic and ethical practices, is understandable in the context of the progress of the overall project and what it meant to have to change the proposed site and give the relevant explanations, both for the time delay and for the damage to the prestige of the province and of the local agents involved.

But apparently the San Juan authorities were not aware of Rolandi's concern about the issue. As a result, in February 2008, without being reported in the local media, the national responsible for the Qhapaq Ñan project arrived in San Juan to visit and evaluate the sites under discussion. The consequence of this trip was the early withdrawal of the Conconta sites from the San Juan proposal, although this action and the reasons for it were never communicated to the press nor publicly transmitted by the National Technical Secretariat. It is evident the disruption that this meant not only for San Juan's participation in the project but also for the overall Argentine proposal, which seems to be referred to in a newspaper article that, while celebrating the 2014 declaration, was however titled "Inka Road: a journey full of difficulties that almost made the project fall" [25].

After the incidents of the "Conconta case" the local activities linked to the project adopted a total secrecy, probably to avoid controls and similar unwanted interventions, so that only in 2014, when the proposal was approved in Doha, it was possible to know the details of the sites involved. At the same time, academics continued to defend the Inca affiliation of the Conconta sites [26-27], although all the evidence showed a completely different reality [28].

2.3. Conconta: The "confusion" between inca sites and 20th Century constructions

The Conconta ravine connects the eastern foothills (2,900 m a.s.l.) with the Cura Valley (3,900 m a.s.l.) in northwestern San Juan. The supposedly Inca sites are located in the upper section of the ravine. There are five groups of structures named A35, A34, A27, A18-19 and A13, and three road sections (A15-14, A11-5 and A100). Michieli and her collaborators carried out excavations in several of these sites and proposed that they were lodging tambos, intermediate constructions and sections of imperial road.

The only argument put forward by the authors was the presence of "the most characteristic architectural features (...) present in almost all Inca installations" [19], among which stand out the construction of groups of connected rooms of rectangular shape combined with rooms of circular shape, the trapezoidal shape of hornacinas or niches, entrances and openings, the entrances closed with lintel of a single piece of stone or the entrances open up to the ceiling without lintel, the presence of stone jambs in the entrances and the presence of artificial platforms of different sizes. Other proposed features are less justifiable than the previous ones, largely because of their wide spatial and chronological use in multiple construction systems, even in Hispanic times: the selection of stones for construction, the care in the foundation, the union of the stones of the walls with mud mortar, the double course stone wall with constant thickness and the constant width of the openings.

However, the biggest problem is not that the Inca affiliation is based on architectural elements or that some of them (such as the miradors or the niches or trapezoidal openings) are not actually observed in these sites. Neither is the location of some of these structures in the middle of a steep slope, with the subsequent problems of great investment of work in the previous conditioning and maintenance of the site. The major archaeological drawback is that the only cultural component detected in the excavations presented exclusively very recent materials (empty shells of shutguns of different caliber, bones of guanaco and domestic animals cut with saws, remains of old footwear

repaired with a saw, and remains of old shoes repaired with a saw, remains of old shoes repaired with pieces of automobile tires, tin cans, glass and plastic containers, bottle caps, remains of goggles, fragments of canvas and other fabrics, wires and nails, pieces of sheet metal, batteries, a fork, a detonator, metallized papers, etc.) and that in none of these sites were indigenous elements discovered (nor Inca, obviously). The explanation put forward by the authors is frankly unusual and unsustainable: these sites were being built when the news of the fall of Cuzco arrived, so they would have been abandoned suddenly (see more extensive analysis in [28]). And if there was still any doubt of the legitimacy of the sites, there is a conclusive documentary proof: the existence of a report indicating that the sites were erected between 1955 and 1956, during the construction of the road that runs along the Conconta ravine and allows access to the Cura Valley. In this case, the author of the report declared having participated in these works and narrated some problems they had in these sites due to the inclement weather [29]. Given this panorama, it is evident that the supposed stretches of Inca Road (which in no case show any associated indigenous archaeological record) were in fact old sectors of a modern road that were abandoned as the road was altered by the floods of the stream on whose bed and banks it ran and the corresponding repairs and corrections of the layout were carried out.

As already mentioned, the forcefulness of the arguments put forward did not prevent the Inca character of the Conconta sites from continuing to be proclaimed and reaffirmed, although without empirical support. Thus, to prove its connection with Cerro Tórtolas (where members of the High Mountain Group of the Chilean Andean Club had found remains of a capacocha [30-32], the discovery of a site called Quebrada de las Máquinas-Confluencia was presented. This is located in "the lowest and most sheltered place of the Conconta-Tórtolas route (...) and approximately halfway (15 to 20 km)", and its "fragments [ceramics], especially one with decorated interior and exterior engobed in red, refer to the stage of Inca presence in the region" [26]. However, shortly afterwards this author admitted that the site actually "is contemporary with the first moment of the installations of the late pre-Inca agricultural stage between both *portezuelos*" [27] and that its pottery would be similar to the pre-Inca known as initial Diaguita and the Ánimas of central Chile, and a dating of 790±50 BP (LP-2851) was presented for it [27].

It is worth mentioning the existence of a precedent on the subject of mistakenly considering a site as Inca, taking its architecture as a fundamental criterion. In central Chile, near Los Andes, Coros and Coros [33] proposed the existence of the Tambo del Salto del Soldado, a group of quadrangular enclosures that they associated with a possible section of the Inca Trail. Although only elements apparently corresponding to its use by the workers of the Trans-Andean Railroad (nails, nuts, cans, etc.) were found at the site, the authors considered that the absence of indigenous or Inca archaeological record was not an obstacle to attribute these constructions to the Tawantinsuyu. However, later archaeological and documentary studies by Stehberg, Niemeyer and Coros [34], which included excavations in all the enclosures, indicated that the site would date from the late 19th century and would have been an auxiliary camp for the workers who built a pair of tunnels for the passage of the railroad.

The above is enough to note the unfounded nature of the postulation of these modern sites and the impossibility of maintaining them in the Argentine proposal, even when their change was made in a framework of extreme urgency that ended up giving rise to other slightly less obvious errors.

2.4. The Inca Road System of San Juan in the UNESCO Declaration

After withdrawing the Conconta proposal, it was urgent to find a replacement, for which two sections located in the northwest of the province were selected. The northernmost one was called Segmento Llano de los Leones (Figure 1); in the declaration it carries the code AR-LLL-16/CS-2011. It is a straight section, 228 m long and an average width of 2.5 m, which joins Tambo Pircas Blancas with the Morro Negro site. This one does not present architectural structures, but there is an accumulation of Inca pottery, which also appeared associated with the trail [35]. In addition, according to the proposal, this section is located in an area rich in minerals and vicuñas, and Morro Negro could have been part of the Cerro del Toro trail (where a capacocha has been found).

Figure 1. View of the segment Llano de los Leones. Modified from [36].

The other section is called Angualasto-Colangüil (Figure 2). It is 3,314 or 3,109 meters long (according to [35]) and an average width of 2.3 m. Two archaeological sites have been associated with this stretch: Punta del Barro, located 7,310 m to the SE and Angualasto, 8,440 m to the SE [37].

Figure 2. View of the Angualasto-Colangüil stretch.

This section's central area was at a lower ground level than its edges, which would have been produced by the transit of cattle [35]. The arguments for considering this stretch Inca [35] were:

(a) its similarity with others that in Chile are attributed to the Incas.

b) Its linearity.

c) Its width of 2.35 m, "ideal for a double row of llamas".

d) That would join the Angualasto and Punta del Barro sites with another one called Las Casitas, located at the northwest end of the trail. In Las Casitas there would exist what the informant Augusto Vega calls "chozas de barro" (mud huts), apparently similar to those that exist in the Angualasto site. Therefore, that site would also be ascribed (like the latter) to the Late Period and its "use by Incas must not be ruled out", not because Inca architecture or materials have appeared, but "because they were good at integrating technologies and systematically annexed regions" [35].

e) Some people (whose references are not provided) call it "Colangüil Inca Road".

f) Previously, it had already been considered Inca by a local andinist and a geologist (Beorchia Nigris, 2001; Miolano, 2004) (the bibliography corresponding to these references does not appear in the relevant document published by UNESCO on the Internet).

g) Fragments (supposedly ceramic) found by the park ranger Alejandro Carrizo "were ascribed by Michieli to the Tawantinsuyu" [37].

With respect to the associated sites, the nomination makes it clear that in the case of Punta del Barro "Inca presence in this mine is up to now an assumption" [35]. For Angualasto, the presence of a mixed Inca ceramic piece in the site museum is mentioned, and it is simply noted that "as for the case of Punta del Barro archaeological site, we suggest there was contact with Incas" [35]. In addition to these sections, the final UNESCO statement shows a map with the location of Inca roads in San Juan. This map shows several entry roads of the Inca Road from the north of San Juan, and several sections that in general do not follow the route of the main longitudinal and transversal ravines (Figure 3).

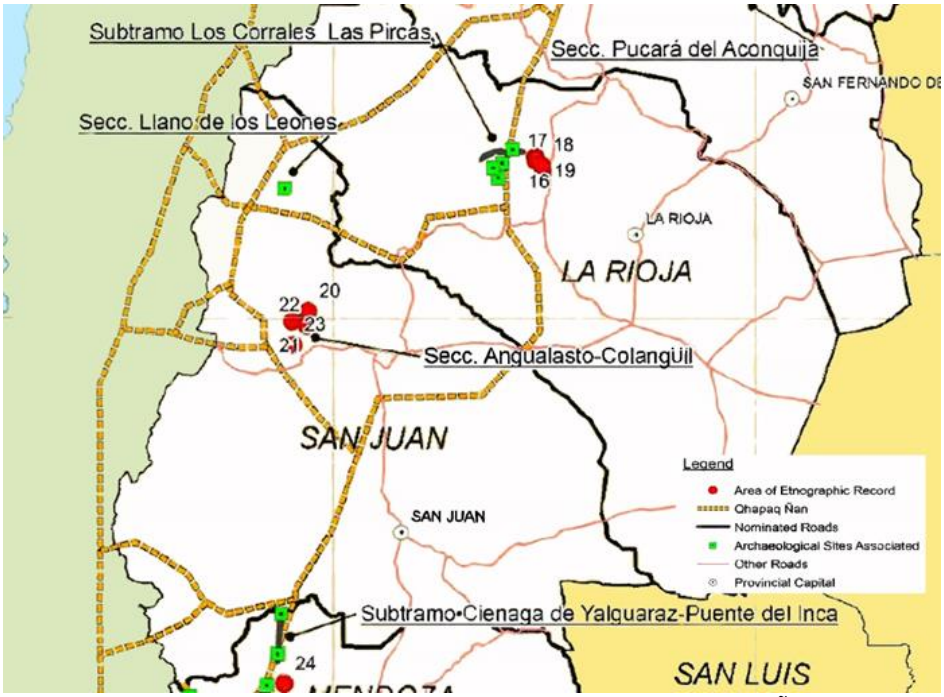

Figure 3. Detail of the map of the final Nomination showing the route of the Qhapaq Ñan in the province of San Juan [35].

In the extreme NW, a first axis with an approximate N-S direction runs approximately 110 km through the San Guillermo Reserve and after being crossed by a branch that directly connects the sites Cerro El Toro and Paso del Lámar, it goes through the Valle del Cura ravine to end up forking into two routes that head towards Chile

(near Cerro Tórtolas) and towards the center of San Juan (apparently through the Conconta ravine). This second section follows an approximate NW-SE direction and at the height of the locality of Rodeo a road opens towards Chile, apparently through the ravine of Agua Blanca. Later it ends in a longitudinal branch that has an approximate NNE-SSW course, although about 50 km to the north of the meeting point it turns to the E and then to the NE, towards La Rioja, without crossing Inca sites in all that sector. To the south, the branch passes through the foothills towards the San Juan River and then turns to the SW. Once it reaches the current border with Mendoza, a section of it branches off to the west, which then forks into two roads that enter Chile through SW San Juan.

3. Results and Discussion

3.1. Differences between the local archaeological knowledge and the declaration

3.1.1. The map of the Qhapaq Ñan

In the section corresponding to San Juan, the Nomination map showing the location of the Inca Road [35] exhibits notable differences with the known and published information for the region (Figure 4).

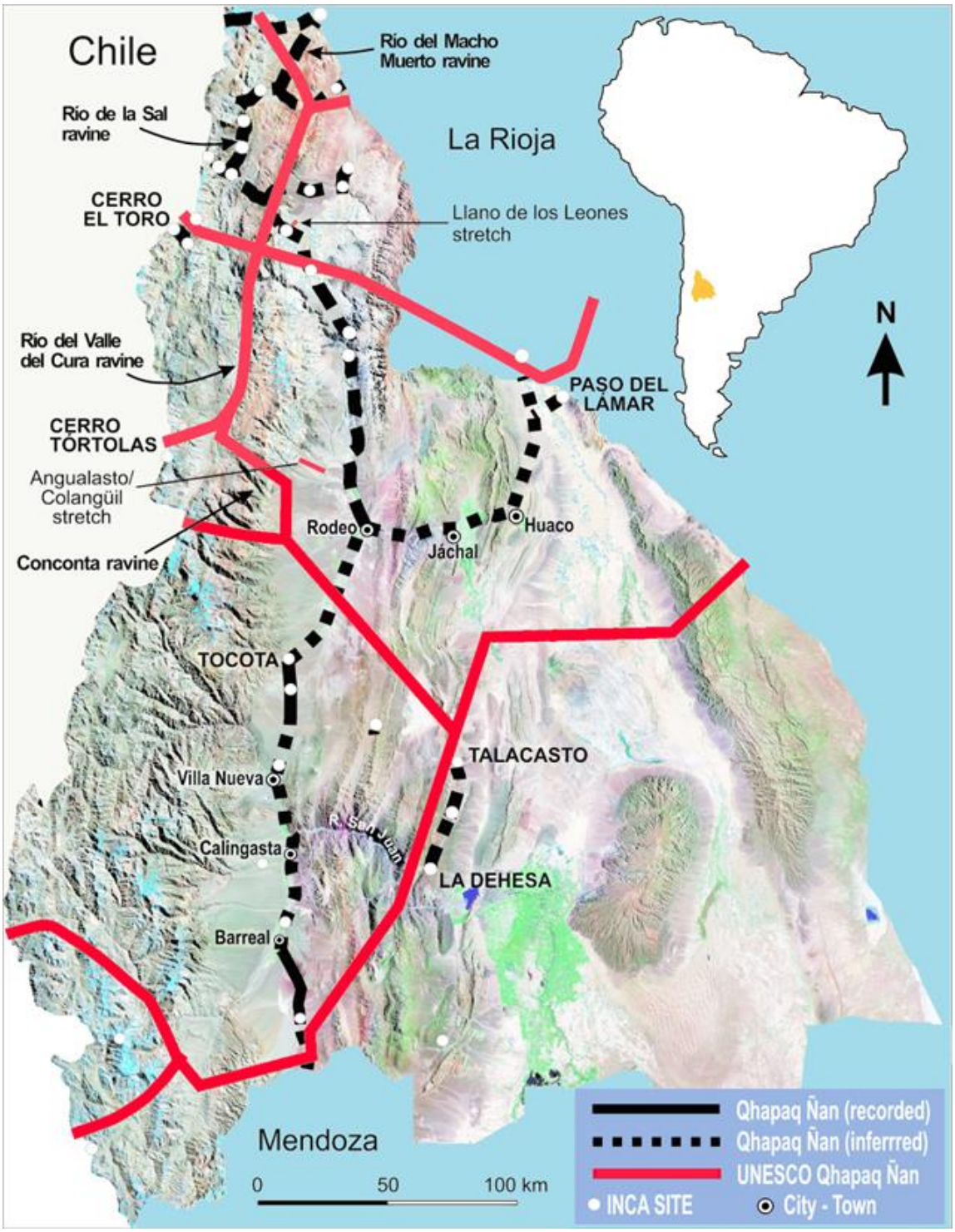

Figure 4. Comparison between San Juan's proposal and that resulting from current archaeological knowledge.

As can be seen, the proposed network of Inca roads does not match the distribution of Inca sites or of the stretches of Qhapaq Ñan known in San Juan. Let us look at some of the divergences:

(a) in the extreme NW, instead of joining the known Inca sites on the axis of the Macho Muerto ravine [37], the road is drawn to the east of it, probably to bring it closer to the sites closer to the Llano de los Leones section.

b) As a result, to the south, instead of passing through the Sal ravine (natural continuation of the Macho Muerto ravine around which several Inca sites have been found [38], the road coincides with the Río del Valle del Cura ravine, where there is no Inca evidence.

c) The section that branches off from the previous one to the SW passes through the Conconta ravine, whose lack of Inca evidence has already been analyzed [28].

d) From Conconta, the broken section that heads towards the center of the province does not fit the archaeological evidence and was simply created to obtain a link with the locality of Talacasto, through which a pre-Cordilleran Inca trail would have passed, linking two known Inca sites (La Dehesa and Matagusanos) and a third that would have existed in Talacasto [39].

e) To the north of Talacasto, there is no known Inca evidence nearby to justify the route described, and the same happens in the sector through which the supposed Qhapaq Ñan is crossed towards the east, in the direction of La Rioja.

f) To the south of the La Dehesa dairy farm, the road crosses obliquely through various foothills, with a layout far removed from any that could actually be realized in reality.

g) At the southern end of this longitudinal section there is a detachment to the west, which then opens into two sections that would point to the Portillo and Valle Hermoso passes. There are no published data to verify the use of these trails in the Inca period [37].

h) Even if the inferred routes along which the Qhapaq Ñan would have run according to Raffino [40] and Levillier [41], approximately north and east of the town of Rodeo, were not taken into account, the presence of the main road in the pre-Andean valleys of Iglesia and Calingasta, at least from Tocota to the border with Mendoza, is indisputable [42-43], and this route differs significantly from the one approved by UNESCO.

i) In short, it should be noted that in no case were the stretches that appear in the map of the Nomination based on identifications produced by direct surveys that would allow the detection and identification of the supposed sectors of the Inca roadway included therein.

3.1.2. Sections and associated sites

Most of the sections and associated sites in San Juan declared as part of the Qhapaq Ñan do not present a situation very different from that of the map analyzed. The Llano de los Leones section seems undoubtedly Inca: it joins sites of evident state character and presents ceramic material corresponding to that period. In this sense, the most ostensible criticisms that can be made are linked to superfluous and poorly used information to support the insertion of the section, fundamentally the fact that it is located in an area rich in minerals and vicuñas, since it is not these circumstances but the aforementioned elements that support the Inca character of the path. In addition, no study has provided elements that allow us to relate the functionality of the Tambo Pircas Blancas or any other in the region with the exploitation of vicuñas, despite their repeated affirmation [38-39, 26, 44].

On the other hand, there are peculiar drawbacks to the postulation of the Angualasto-Colangüil section. This section is particularly strange, since it consists of some trail segments located in the upper part of some hills, with no direct link to archaeological sites.

Firstly, the introduction in such a large-scale project of a section with an Inca attribution which was not only unproven but also completely unsustainable due to the weak arguments used in its presentation (see below) is inexplicable and academically inadmissible. Another curious element is that Argentina's defense of the Angualasto-Colangüil section against an objection from the International Council on Monuments and Sites (ICOMOS) was based on the fact that said segment "relates directly to the economic practices that financed the institutional apparatus of Tawantinsuyu and, specifically, to the extraction of vicuña (Vicugna vicugna) fiber" [35], which is by no means researched or proven and simply constitutes a hypothesis to explain the presence of Inca sites in the San Guillermo area [38].

With respect to the arguments (already mentioned above), the first three (the similarity with Chilean cases, the linearity and its "ideal" width) do not withstand the slightest analysis. Something similar happens with the fourth one: the trail does not link Inca sites but pre-Inca settlements, assigned to the Late Period, one of which (Las Casitas) does not appear in any previous publication. But according to the authors of the proposal, the Incas "were good" at integrating systematically annexed technologies and regions, so it cannot be ruled out that they used this path. An interesting fact is that it is mentioned that the informant Vega "discovered mud huts" near Las Casitas [35], which suggests that the author of the report only took this information but did not verify it personally, which also does not seem to have been done by those responsible for the project at the national level.

Equally incomprehensible are the following two arguments: that some people called the path “Colangüil Inca Road” and that an andinist and a geologist regarded the path as being Inca. In fact, in the province of San Juan itself there are studied examples of errors in the oral tradition that consigned the Inca character of an irrigation system [45] and in the already commented evaluation of the Conconta sites [19]. In the case of Beorchia Nigris, in a volume on high mountain archaeology, he mentions having traveled the Colangüil section, about which he states that the opinion of the baqueano Aníbal Vega was that "it must have linked the *toldería* of Angualasto with the *tambos* of the Frío river” (a toldería was a residential camp formed by portable conical tents similar to the teppes) and that "it could have had some relation with the Osorio tills [mines] (...) and with the current gold mines existing in Chilean territory” [46]. This author simply thinks that this idea of the baqueano "is an acceptable assumption", but he does not

affirm that it is an Inca road nor that he knows evidence of it. In view of the above, to use as a proof the simple opinion of several non-experts in the matter is as risky and striking as it is scientifically improper.

This set of non-evidentiary elements includes the finding of non-georeferenced and unpublished ceramic fragments, made outside the framework of the project. In this regard, it is interesting to note that there is no mention of the Inca character of the sherds but rather "their ascription to the Tawantinsuyu by Michieli" [35], which suggests that the author of the report did not have the opportunity to see and analyze the pottery of reference.

Finally, another unclear aspect is the linkage of the proposed section with the associated sites, which are approximately 7-8 km away from the currently visible trail segment. According to the corresponding illustration (Figure 5; [35]) this spatial linkage was not ascertained but merely inferred. More serious is the non-Inca character of these sites. According to the Nomination, with respect to Punta del Barro "the Inca presence at this site is so far an assumption" [35], while for Angualasto "we suggest that there was contact with the Incas" [35].

This self-condemnatory confession contrasts directly with what is stated in the Nomination with respect to the authenticity of the nominated properties, an essential element frequently reiterated in the document. Thus, it states that "authenticity is the essential qualifying factor concerning values" and that "the archaeological evidence registered in the road's sections and associated archaeological sites proposed for nomination are supported by a significant quantity of scientific and technical studies carried out in the last fifty years" [35]. But, in fact, in the Angualasto-Colangüil section, no previous studies had been carried out and, even worse, those developed in Punta del Barro and Angualasto did not support its Inca status. The document then points out that "from an archaeological perspective, this evidence allows the establishment of the authenticity of the archaeological sites and their context" [35]. Certainly, it can be accepted that the sites and even the analyzed section are authentically archaeological, which in no way means that they are Inca.

How, then, can the presence of a section of trail at this site be explained? The answer, as in the case of Conconta, comes from direct witnesses of the formation of the trail. On this occasion, according to the statement of a local baqueano, his father and grandfather, as well as other local settlers, went to the fields to look for firewood. The demarcation of the trail was done by the action of the "rastras de leña que traían con los burros", that is, the bundles of firewood that were dragged by these animals and were clearing the path (Juan Díaz, personal communication, 21/4/2023).

In conclusion, the Angualasto-Colangüil section would correspond to a recent path, which does not present attributes that allow defining it as Inca nor links Inca sites; therefore, there is no evidence to support its integration to the Inca Road system.

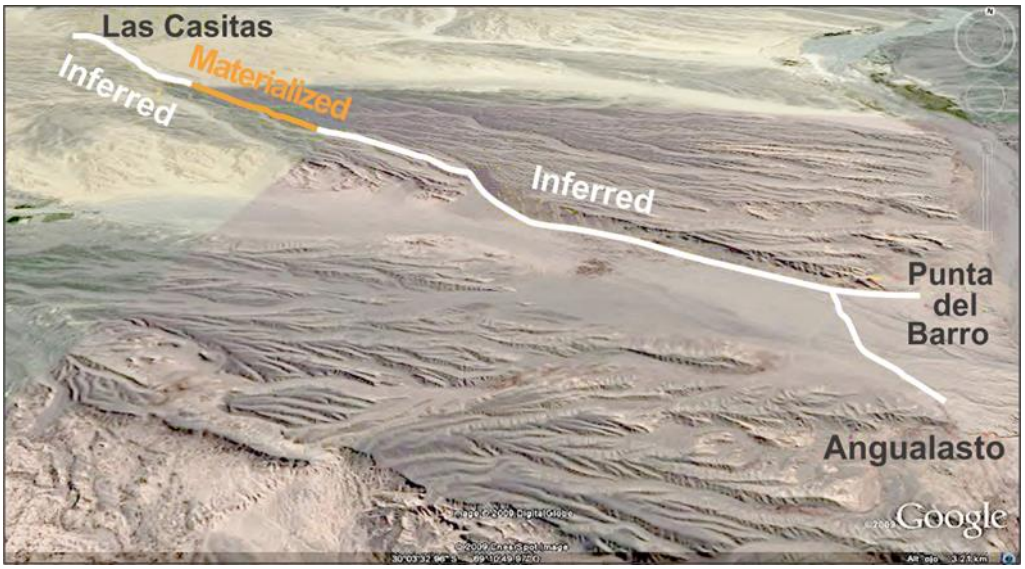

Figure 5. Location of the Angualasto-Colangüil section according to the UNESCO Nomination [35].

4. Discussion

It is very difficult to explain the errors previously pointed out. In order to warn the seriousness of the case, it is worth reiterating that the final Nomination was very close to proposing as Inca several constructions that in fact dated from the middle of the XX century. On the one hand, it is clearly observed that the basic criteria commonly accepted to consider when a road or trail is Inca were not respected. Hyslop [47] defined the Inca Trail as "any route (...) which was used at the time of the empire and which was continually associated with structures and/or settlements whose functions were related to the operation of the Inka state". Therefore, the Inca character of the different sections of the road is given by its association with Inca or local constructions modified, expanded or used in function of the operation of the Tawantinsuyu [21, 48-51] and by the evidence of its state use, for example diagnostic ceramics from that period [21, 51, 53]. Additionally, in some sectors, other useful criteria can be added at a local or regional level, such as place names, constructive characteristics, the presence of road architecture and the straightness of the road [48-49]. As previously seen, the basic identification

criteria were not considered neither in the previous case of the Conconta sites, nor in Punta del Barro, Angualasto or the Angualasto-Colangüil section, but were completely replaced by the subjectivity of the agents involved.

On the other hand, when trying to understand this remarkable mismatch, it is striking that the stretches postulated by San Juan are adapted to the assumptions previously published by the advisor of the Government of San Juan on archaeological issues [52]. In that work, unlike what was pointed out by other authors [42, 44, 53-55], Michieli proposed that the Qhapaq Ñan did not run through the pre-Andean valleys of Iglesia and Calingasta, but through the precordillera, further east. However, the best section that San Juan could postulate for this project was undoubtedly the one recorded south of Tocota; alternatively, the one starting from the town of Barreal could have been presented. In the same sense, the sites postulated previously (Conconta) and in the final document (Punta del Barro and Angualasto) had also been studied by this researcher [19-20, 26, 56-58]. As Díaz [59] suggests, "it is inevitable to think that the fluctuation in the selection of sites must have been related to the interests of the professionals who had participated in the project".

Why did the Government of San Juan insist on supporting the actions of its representative, even when the mistakes made were obvious? Why did the Argentine project managers agree to support those mistakes? It is very difficult to answer these questions, especially if we take into account that after what happened with Conconta, the issue should have been handled with much more care. Just as the supposed Inca sites had not been inspected and evaluated by the National Technical Secretariat and the Technical Coordinator of the Qhapaq Ñan program, it is very difficult to admit that these authorities had analyzed the Angualasto-Colangüil section before accepting it, without noticing the serious inconveniences described in this work. Among the factors to be considered to explain this situation are the already mentioned delay that the San Juan case caused to the international project, and possible official pressures (from the government of San Juan and/or the Argentinean government) to solve the problem as soon as possible.

Equally serious is the fact that the situation described above was not noticed by the inspection carried out by ICOMOS. This problem adds to other serious shortcomings of the UNESCO World Heritage Program previously noted [60]. At least one ICOMOS technical evaluation mission visited the sites nominated by Argentina, between September 25 and October 6, 2013 [61]. There is no detailed information available about this evaluation (number of evaluators, names, time spent visiting each site, local host, etc.), so it is impossible to go deeper into the subject. However, it is likely that it was a group of technicians not specifically specialized in the subject, more interested in verifying compliance with the basic criteria to justify the nomination of the sections and sites than in verifying their Inca character (since this was an obvious factor to be handled by local specialists).

5. Conclusion

The Qhapaq Ñan program required the identification and incorporation of unquestionably Inca roads and sites that were of special significance for the understanding of their role and cultural value within the framework of the practices and ideology of the Inca state, and that would contribute to the development of local communities and the implementation of tourism activities. On the contrary, it did not constitute a testing laboratory for the detection of sites that could eventually or remotely be proven to belong to the Tawantinsuyu.

These premises were not fulfilled when first the sites of Conconta and later those of Punta del Barro and Angualasto were postulated in association with the (supposedly Inca) Angualasto-Colangüil road segment, nor was the principle of authenticity, one of UNESCO's essential bases for its declarations of cultural heritage properties.

The fact that mistakes have been made and that progress is still being made based on those mistakes (in fact, activities related to the program continue with work meetings and specific actions at the sites involved) implies the responsibility of various agents, mainly officials and researchers, and a damage to the public image of the province of San Juan. As has been analyzed, it is relatively easy to note the absence or presence of actions or omissions that contributed to the situation discussed here (for example, the lack of verification in due time and form by the authorities of the national program and by UNESCO inspectors of the sites nominated by San Juan, the wrong choice of the specialists in charge of identifying the sites, or the insistence of the San Juan government in defending the Conconta sites to the last consequences). On the contrary, it is very difficult to understand the political decisions that supported these mistakes. It seems that the preeminence of political-partisan interests over academic ones cannot be ruled out.

Two main consequences can be drawn from the above. At a local level (provincial and national, in Argentina), a major problem is the probable persistence of conditions that in matters of a fundamentally academic nature allow the making and imposition of political decisions, sometimes (as in the present case) based on opinions that do not reflect a careful handling of scientific information and that could be aimed at satisfying other interests. These conditions are linked both to the lack of institutional or informal controls and to the absence of administrative or academic sanctions, i.e., of procedures that make the healthy concern for correct performance prevail and encourage the abandonment of arbitrary practices.

On the other hand, at an international level, the approval of a project that contained markedly erroneous information supports the doubts raised about the performance of UNESCO's World Heritage Program [60] and should serve as a serious wake-up call to be taken into account in future evaluations of cases involving the participation of multiple nations that present heterogeneity of procedures and internal controls.

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Conflicts of interest

The authors declare no conflicts of interest.

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3D printing for the reinterpretation of architectural heritage: Proposal of a model

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Abstract

3D printing for the reinterpretation of architectural heritage stands out as one of the most efficient ways of using contemporary printing technologies in terms of architecture. The aim of the study is to present a comprehensive methodology on how to use 3D printing techniques for reinterpretation of architectural heritage. In this context, the scope of the study consists of pioneering information obtained from literature studies focusing on the details of the use of three-dimensional printing techniques in the promotion, preservation and remodeling of cultural heritage and architectural heritage components. The method of the study was determined as identifying leading themes through literature research and presenting a method proposal by grouping conceptually related themes. The unique value of the study is important in that the model to be created offers a potential to affect mass production tools, offices and local governments by incorporating contemporary architectural heritage products into a modeling process that can produce more innovative and faster solutions. The findings of the study show that the different techniques used can respond to different detail scales and different contextual challenges. Each modeling method and strategy creates different feedback mechanisms, mediating the recognition of the architectural heritage element by larger user groups or the more effective protection of the architectural heritage element. In the model presented as a result of the study, which mediates the gathering of the techniques used in different sample projects on a common working ground with a series of successive strategies, a comprehensive basis for which 3D printing solution will be used for which problem is presented and solution suggestions are offered for a case-oriented 3D printing strategy.

1. Introduction

By past and present heritage conservation studies' evaluation, it is understood that some basic steps need to be taken to develop strategies for differences and similarities. In this context, the purpose of the study is to present a comprehensive methodology on how to use 3D printing techniques for reinterpretation of architectural heritage. The scope of the study consists of pioneering information obtained from literature studies focusing on the details of the use of three-dimensional printing techniques in the promotion, preservation and remodeling of cultural heritage and architectural heritage components. While cultural and architectural heritage is evaluated as a part of the past, the differences and similarities between abstract and concrete concepts should be examined in detail. The fact that standardization consisting of definitive criteria has not yet been achieved for determining the value of architectural and cultural heritage works creates certain uncertainties in the sector. However, although there is no official working method based on a scorecard in this context, two basic situations can be mentioned in which the specific prominent values of each work are determined by evaluating it in the context of its relationship with the past and are included in the development processes [1]. Related to this issue, it is understood that 3D printing techniques offer indispensable potential for architecture and cities. A possible standardization would facilitate the integration of cities into modeling strategies. Expansion of cities can sometimes lead to the deterioration of some structures directly due to new urban planning. Instead of demolishing these structures due to updating the urban design, carrying out an evolutionary research process to determine the current situation and define the extension of the design is important both in terms of urban identity and in terms of preserving the current identity of the building and making it known to a wider audience. In the context of more sustainable cities and the integration of sustainability strategies that help make the structure more usable, not only cultural diversity but also tourism and education should support strategies to highlight national treasures. Lack of authority and organizational

problems in this regard basically lead to some impulsive interventions lacking expert knowledge and an increase in the margin of error due to the direct use of traditional professional groups such as carpenters in restoring the building. In order to understand this, it is necessary to investigate architectural evolution in detail and make academic and strategic planning accordingly [2]. With the help of digital technological developments, where special equipment and expertise are needed less and less, the ability to copy many cultural heritage outputs, especially monuments and basic works, has become commonplace, despite various difficulties, in virtual screenings and motivational studies for the dissemination of restoration practices. In addition, an atmosphere in which concerns about the preservation of objects are less prominent with the help of technological modeling facilities dominates cultural heritage conservation strategies [3]. A detailed laser scanning is required to vectorize the structures. In addition, the fact that the teams are multidisciplinary means that the team is not limited to just architects and modelers, but also includes historians and archaeologists. Examining the textures of historical buildings and, in this context, discussing a complex with a rich character in terms of restoration and improvement requires a comprehensive research process. Taking three-dimensional prints of building parts of cultural heritage can be only a part of the holistic steps. Contemporary modeling to be carried out with the aim of restoring an existing monumental structure and reintroducing the value of this structure to the masses should be supported with updates at different detail scales and should be made more comprehensive with more inferences on how a photogrammetric examination can be improved in terms of material typology [4]. In the study, potential work areas and holistic solution suggestions regarding how 3D printing techniques can be used for architectural heritage will be presented, respectively. The extracts that mediate the creation of a contemporary context on this subject can be listed as follows (Figure 1).

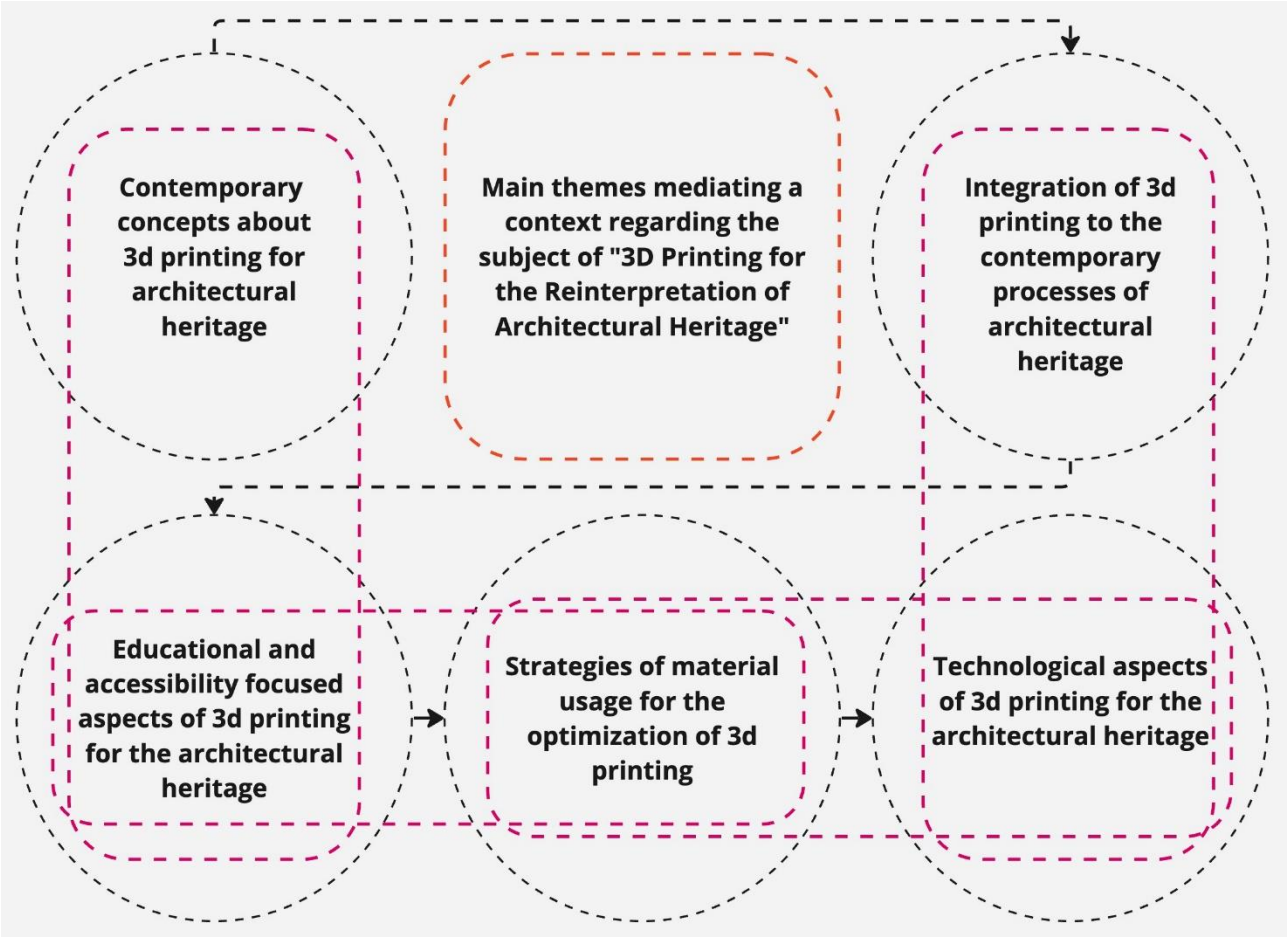

Figure 1. Main themes mediating a context regarding the subject of "3D Printing for the reinterpretation of architectural heritage". Related themes are evaluated together.

2. Method

In the study, basic approaches about the integration of 3D printing to the contemporary processes of architectural heritage were determined, and in line with these approaches, important details about the application examples of three-dimensional modeling and printing processes in the context of leading cases, technology, education, accessibility and materials. has been associated. In this context, the scope of the study consists of pioneering information obtained from literature studies focusing on the details of the use of three-dimensional printing techniques in the promotion, preservation and remodeling of cultural heritage and architectural heritage components. The method of the study was determined as identifying leading themes through literature research and presenting a method proposal by grouping conceptually related themes.

3. Integration of 3D printing to the contemporary processes of architectural heritage

3D modeling stands out as a mandatory support rather than an option, not only in terms of paying attention to performance criteria, but also in solution-oriented approaches directly related to the function. The conveniences provided through digital archiving will trigger different, more technological archiving methods that will be developed with the help of three-dimensional scanning methods in the following stages. The start of preserving cultural heritage items through three-dimensional digitalization will take its place among current studies as a very comprehensive and detailed archiving method, and it will also mediate the reduction of basic risks such as damage to the monument when working with historical buildings. Preliminary studies on the structure can be carried out primarily through models, instead of studies based on close contact that will cause possible damage to the structure, and in the next step, processes based on direct contact with the structure can thus be reduced [5]. Relatedly, as an applied example, professors John Lin and Lidia Ratoi from the University of Hong Kong, blended tradition and 3D printing for adaptive architecture (Figure 2).

Figure 2. Blended tradition and 3D printing for adaptive architecture, Lin, J., Ratoi, L., University of Hong Kong [6].

As an example to the concrete advantages of 3D modeling, in addition to the now well-known utilities of BIM, in terms of operational practice of building conservation, this sample generates agile solutions for complex combinations. It is important to archive 3D models so that they can be used both in analysis and visualization studies and in original studies containing geometric and historical features. As all the steps towards developing a new approach to rationalize the reconstruction process of unbuilt architectures have been tested over the years in architectural drawing courses, it is seen that higher efficiency can be achieved in this regard. It should be taken into consideration that the main motivation for digital reconstructions designed to be used in different scenarios is that they are products that can be adapted to many different solutions and developed as a result of trials and calibration processes. Archiving 3D models so that they can be used both in analysis and visualization studies and in original studies containing geometric and historical features is one of the most concrete achievements in this regard [7]. However, it should not be forgotten that discussing the limitations of three-dimensional modeling is at least as important as discussing its benefits and what it can do. It is known that virtual graphics offer more efficient solutions in both animation creation and infographic solutions, if the basic inputs regarding the limitations of three-dimensional printing are taken into account in the processes of representing textures and color features [8]. In this context, Barry Wark uses sand to create an intricate 3D-printed wall which include sequences represents dramatic phases (Figure 3).

When all these are evaluated together, it becomes clear that all situations in which architectural heritage becomes more accessible to the public can directly affect the rate of use of three-dimensional modeling in future scenarios. It is understood that new additive techniques in printing technologies and the integration of special software into modern topographic solutions can accelerate this process [9]. The frequent repetition of some architectural themes and the failure to directly address the new problems arising from the current era through original solution scenarios constitute a major obstacle to supporting design-construction processes. While the design theory of three-dimensional printing and its role in determining the living spaces of tomorrow are analyzed through case studies, it is important to evaluate the subject of home for everyone and additive home production in terms of the integration of a series of mass production methods through different paradigms

[10]. The potentials of the basic integration scheme regarding this subject are shown in the image below (Figure 4).

It seems that contemporary studies on this subject have achieved success after many trials and prototyping steps. As one of the most successful examples of producing strategies that will provide solutions to specific scenarios, another prominent example related to this subject is the 3D print work produced for the Notre-Dame de Paris Cathedral in situ in the CRIACIV wind tunnel (Figure 5).

Figure 3. 3D-printed Wall, Wark, B., Photo Credits: Wark, B., [11].

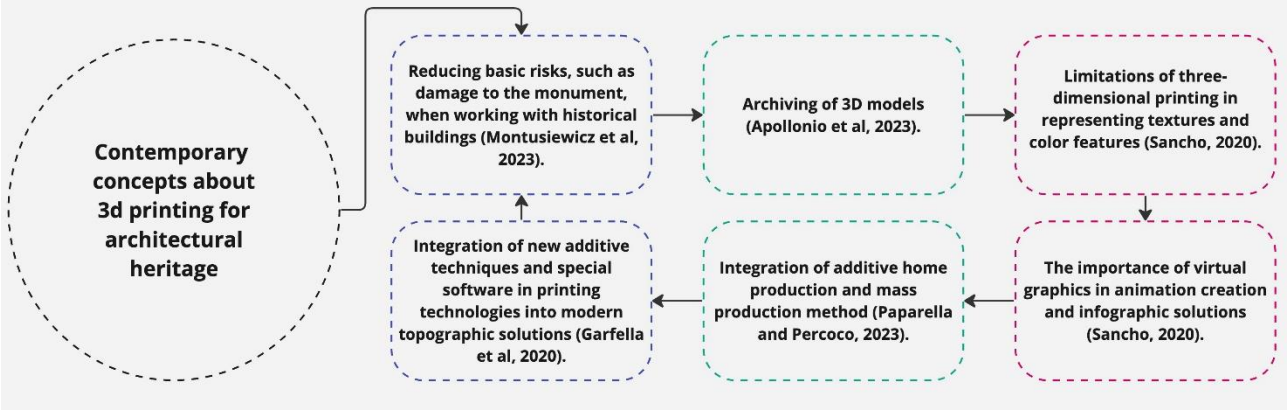

Figure 4. Contemporary concepts about 3D printing for architectural heritage.

Figure 5. Notre-Dame de Paris Cathedral in situ in the CRIACIV wind tunnel, Lynxter, Photo Credits: Lynxter., [12].

3.1. Developing strategies via cases in terms of potentials and necessities

Pereira et al. [13] emphasizes that the glaze via different cases are evaluated together, leading conclusions are reached. In this context, it becomes important to revitalize the basic complex planning in design in a contemporary style while also developing it in parallel with the interests of the manufacturers. In order to include basic planning for future residences in a strategy aimed at increasing functional performance, the importance of using digital preservation and production technologies becomes evident in cases where the restoration and reproduction of architectural structures is required. Market share studies related to 3D modeling concerning the Gulf countries indicate that this technology can be used at much more affordable prices in the near future [14]. In the case of THK in Singapore, a series of applications that include the definition of new coordination steps based on eye movement and hand movement of breakthroughs in perceptual interaction technology can be included in the working processes for modeling architectural cultural heritage. Utilizing three-dimensional modeling and output techniques for the protection of architectural and cultural heritage has also become a digital trend, so it finds its place in the industry, and support is received from virtual reality and augmented reality technologies by incorporating the interaction mode into the process to disseminate this approach to protecting cultural heritage [15]. Similarly, the results of research by a team that developed a workflow to create a virtual replica of the Acropolis for 3D printing are striking. It is seen that three-dimensional modeling provides a great efficiency in experiencing huge ancient structures such as the Acropolis, which has its own details and positioning style, as visitors have a more holistic experience and the three-dimensional copy can be experienced more easily than the believer. Including students in the listening process with an active program and updating both students' programs and travel routes accordingly provides significant added value. Such studies also provide original contributions in terms of documenting the architectural complex with digital research techniques [16].

In addition, in the example of post-fire reconstruction, the striking gains of three-dimensional modeling can be seen more clearly. The flexible opportunities offered by wooden structures to present and re-evaluate documents belonging to historical heritage in a way that contributes to the experimental method also produce unique solutions in terms of three-dimensional modeling offering flexibility solutions specific to each building material [17]. Similarly, if a residential building has modern features, developing a strategy on how to improve the algorithm that creates it by analyzing the basic elements and the dominant system can provide important clues about how the housing units that make up the urban environment may change in the future. Details that can be reflected in the external form require going beyond the conceptual foundations of architectural design, not only in terms of urban planning and building architecture, but also in terms of ecology and building design [18].

Findings regarding the importance of artificial intelligence in the three-dimensional printing process require a systematic analysis including the application processes of artificial intelligence techniques. In this context, the use of artificial intelligence in the optimization of the process in the context of the difficulties that arise for the standardization of the details of building manufacturing, not only the basic stages such as print quality control, but also more complex steps for changing the printing parameters, improving the printing and output process, and therefore errors in the modeling process. It provides clues that correction may be possible [19]. It is clear that technologies such as Building Information Modeling, 3D printing and 3D scanners, through the development of complex answers, offer some unique fundamental variables not only in the context of producing effective solutions for the protection and preservation of traditional buildings, but also in terms of re-investigating and improving conservation processes in terms of deficiencies and errors. can be seen. Gathering and storing architectural heritage and cultural heritage in a digital archive through three-dimensional modeling is no longer considered an extraordinary action as it used to be, and is considered one of the cornerstones of contemporary museology. It is known that photogrammetry offers very practical solutions to create models of old buildings in technologically lagging countries such as Pakistan. Photogrammetry is also meaningful because it resolves old structures without damaging them [20]. In addition, unlike other studies, in order to achieve a healthy result in modeling, a high-resolution reticulated structure was first created, and with the help of this reticulated structure, a geometric compatibility was achieved in which high-depth internal and external details that make important details and basic folds visible in non-typical solutions can be accurately represented. It is possible. The Porta del Drac example in Pavelló Güell is one of the important examples in the sense that it contains a lot of detail that three-dimensional modeling steps that offer a comprehensive combining approach can be considered technically more successful than other competitors [21]. When a comprehensive and relational inference is made regarding this issue, the following conclusions are reached (Figure 6).

3.2. Technological aspects of 3d printing for the architectural heritage

Developing strategies via technological aspects of 3d printing for the architectural heritage works as a balancing tool for reorganizing existing buildings' preservation processes. In this context, it becomes clear that virtual promoters should be included in traditional heritage-oriented conservation practices. The importance of collecting 3D geometric documentation of historical buildings in addition to 2D geographical data is supported by the creation of a 3D environment based on webGL, in addition to the use of a webGIS viewer, when large data files can be examined as three-dimensional contents through any web browser without downloading. and it becomes possible to experience it. In this context, it can be seen that cultural and architectural

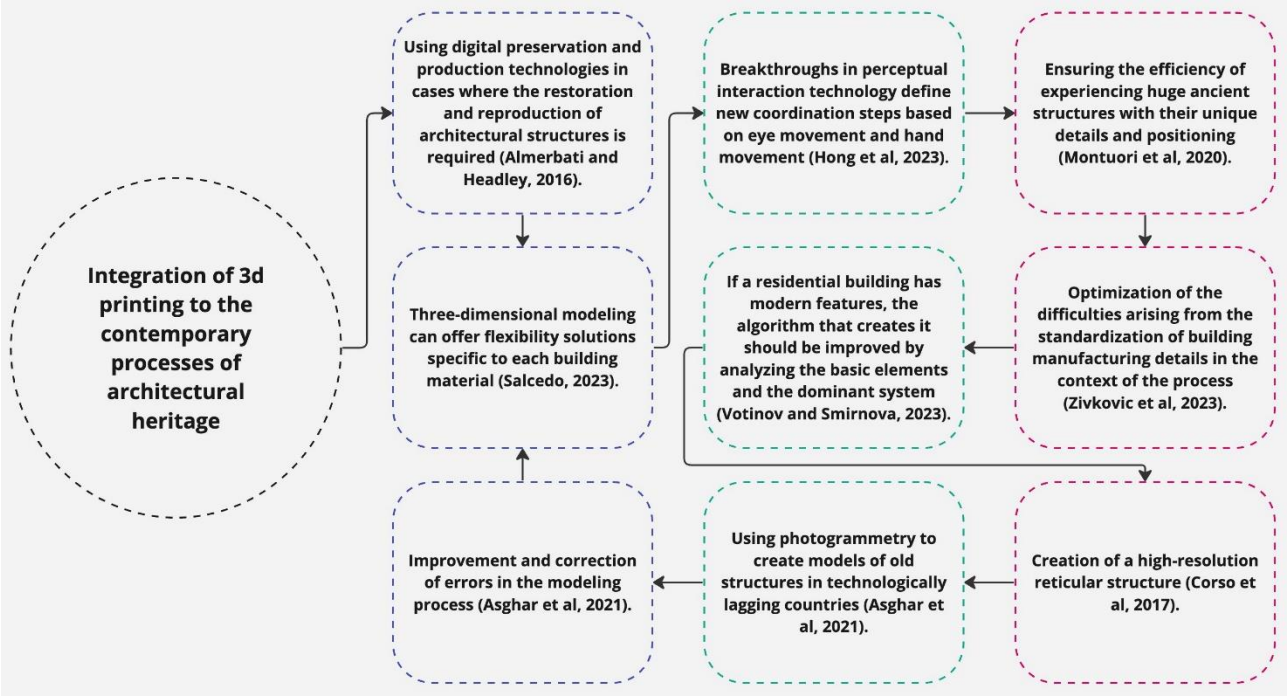

Figure 6. Integration of 3d printing to the contemporary processes of architectural heritage.

heritage inventories can be included in a seamless flow in terms of cartographic archiving, presentation and representation [22]. One of the most important details in creating a digital model using photogrammetry technology is related to the opportunities offered by photogrammetry, helping to clearly document even the finest details of the existing architectural and cultural heritage. The importance of a detailed representation not only in wooden walls and ceilings, but also in contemporary modeling techniques for masonry, carved images and inscriptions on stone, points to the importance of taking advantage of the opportunities offered by photogrammetry. Modeling of cultural heritage objects of federal importance with contemporary approaches without causing any information or representation errors is achieved by using polygonal 3D modeling and FFF 3D printing technologies, in addition to photogrammetry [23]. Many cases that aim to develop a solution that will benefit the socio-economic structure of the country while investigating the reasonableness of the means will be considered successful to the extent that they can suggest guidelines for the development of strategies for the virtual retrieval of cultural heritage. In this regard, any approach that details how architecture plays an important role in designing the metadatabase with optimal user experience and the relationship of sustainable development plans with the architectural scope in the metadatabase will be of great importance. Additionally, an approach that combines holographic elements with physical architectural elements, as well as using Midjourney to present detailed representations of virtual reality (VR) and augmented reality (AR) systems, is considered efficient in many respects. This issue can be mentioned in all cases where rediscovering a heritage or examining the discovered heritage in detail chronologically has special meaning, as in the case of Egypt [24]. Related to this issue, it is seen that the inclusion of three-dimensional scanning data in the process by evaluating it together with the data obtained from BIM, in addition to presenting research reports, also has a critical role in the more meaningful evaluation of data sets that have a direct meaning in the creation of digital cities. In this context, the wooden architectural heritage of cities such as Korea can be re-evaluated and developed [25]. Similarly, the infrared thermography (IRT) technique may open new horizons in terms of thermal imaging through the potential of developing thermal cameras. Diagnostics of architectural heritage can present a complex approach in terms of additional data integration and in the context of temporal analysis of historic buildings. The development of the possibilities of renewal and modeling of historical information will, in this context, point to new horizons in terms of adaptability to future challenges. In line with these gains, the overlap value of the results of infrared thermography in energy efficiency is different from each other [26]. In addition to the criteria mentioned above, it is known that a textured modeling is one of the most fundamental deficiencies in basic three-dimensional modeling techniques. In the decision-making processes, the development of key criteria such as deep excavations and imaging technologies using a combination of multiple imaging strategies, the efficiency of UAV photogrammetry and the definition of the SfM workflow, not only the traditional plan and section-based modeling solutions, but also the multi-layered models developed to complement the facades and interiors of the work. It participates in the workflow by bringing opinion-based solutions to the fore. It is clearly understood that some deep excavations do not have legal basis and three-dimensional modeling is essential for data collection, and the potential of UAV and CV should be used mostly in study, documentation, diagnosis, intervention planning, monitoring and decision-making processes [27]. In another example where a three-dimensional model was

developed using a stereogram miniature of a collapsed cathedral, image parallax was used to provide a comprehensive configuration. In this context, it should not be forgotten that a matching and optimization process is carried out with the help of human hands and minds in the use of old photographs and sketches. On the other hand, it is understood that creating and printing three-dimensional models that can be used to graphically redesign and edit old architectural pieces can only be completed by incorporating digital technologies into the system [28]. As a related issue, one of the main initiatives that will completely change the perspective of the sector by occupying one of the most important points in the finding of three-dimensional modeling in the construction sector is to take an approach that focuses on extrusion printing in concrete to eliminate the need for formwork. Innovations in concrete production methods based on 3D printed molds not only offer some basic strategies to reduce the corrosive effect on polymer shells, but also help produce an alternative to the inefficiency of traditional flat panel molds. Optimizing polymer shells for the development of polymer shells also offers a solution to reduce carbon emissions from concrete [29].

The fact that 3DP and 3D scanning can be combined with photogrammetry and laser scanning techniques makes it important to determine the role of some important opportunities in the process flow in many basic areas such as the rehabilitation of building elements. Important real-life solutions that require the evaluation of the information summarized in the rehabilitation of cultural heritage and the development of new mixtures such as lime trees compatible with the existing surface are also important indicators that digital modeling technologies play a direct role [30]. However, of course, three-dimensional modeling can be positioned at a disadvantage compared to manual markets due to some uncertainties in digital processes and the incompleteness of manual solution processes. One of the main advantages that compensate for these disadvantages is the elimination of basic errors based on human movements and basic variables such as the flawless operation of CNC machines in matters requiring technical details such as scaling. On the other hand, it can be observed that while rapid prototyping technology provides an easier printing and analysis process among students in basic tools such as parametric modeling, there are cases where it is inadequate in more multi-layered solutions [31]. The fact that basic information obtained through building information modeling technology and which has the potential to be used for restoration can be used to contribute to the evaluation process of architectural heritage in the context of historical buildings shows that both two-dimensional and three-dimensional drawings can initiate an integration process that can directly contribute to buildings in the repair steps. It is observed that in order to make urbanization more sustainable, multidimensional information should be optimized in layers, as in the Chinese example, and included in urban renewal strategies in the sustainable urbanization process, and included in work areas as a whole of complex systems where three-dimensional modeling is used together with building information modeling technologies [32]. In a holistic conclusion regarding this issue, the details of a technological staging scheme that can contribute to the holistic model in the next step can be seen (Figure 7).

Figure 7. Technological aspects of 3d printing for the architectural heritage.

3.3. Educational and accessibility focused aspects of 3D printing for the architectural heritage

Prioritizing the use of museums and architecture schools is of critical importance in terms of three-dimensional modeling of cultural heritage. The complexity of the 3D printing process related to many variables such as budget, time, size, labor, material, purpose and the direct relationship of modeling for 3D printing with the teaching analysis and design, file formats, software, integration and development of 3D printing equipment, cultural development by modeling with 3D printing. These emerge as fundamental problems and leading variables in the representation of heritage. In this context, it should also be mentioned that representing the differences and similarities between the three-dimensional model, which is one of the least mentioned topics in the representation of cultural heritage, and the original version of the design, has an important place in the process [33].

While some strategies are being developed for the development of architectural project courses in architecture schools, it is understood that the use of three-dimensional modeling and its output in studio courses has some basic advantages. These advantages have many different features and basically provide flexibility between the steps regarding the difference in the way of thinking in the design process, parametric modeling's concept thinking. It offers some important gains, such as reorganizing the steps of associating with models more frequently and developing competencies among students regarding the use of technology in the design process more gradually [34]. Some basic steps that support and improve students' conceptual learning during architectural education are directly related to the issues of how correspondence theory can be used in education together with three-dimensional printing methodologies. The shortcomings and changeable aspects of three-dimensional printing research regarding technology and construction applications provide a detailed study area, especially through the use of concrete material, in order to explain architectural design to students in three-dimensional printing methodologies in architecture schools [35].

Although accessibility represents a wide field of study, it is known that today, the most fundamental field in which architectural products, as cultural heritage objects through three-dimensional outputs, mediate connections with users who have accessibility problems, is provided through strategies developed for the visually impaired. All changes that can be made in contemporary museums to provide visually impaired people with more advanced opportunities can be made more effective with the help of three-dimensional scanning and digitalization technologies. The conveniences this situation provides in creating virtual museums can be explained through a powerful example, with the experiment of making prototypes of museum objects to be updated for the use of blind people in the Silk Road region available to large audiences through the use of scanning, modeling and 3D printing. It is clearly understood that new technologies to be developed in this regard must be compatible with the Braille alphabet. An advanced technology in terms of interchangeability and smoothness will mediate the faster and more effective use of the Braille alphabet in contemporary museum techniques [36]. Another detail that can be related to this issue is that the way visually impaired people perceive and experience the world is completely different. Here, kinesthetic recognition of the architectural element and its ability to be included in the work will be considered an important added value. Since the act of seeing is a title that should be evaluated directly within the cognitive context, three-dimensional modeling stands out as an added value for the constraints of the cognitive field in terms of museum studies and history teaching. In an exemplary study that presents a modified procedure for creating scalable copies of architectural objects using additive technology to obtain digital 3D models with the use of Autodesk Inventor 2021 version, findings are presented that diversified scaling of elements facilitates kinesthetic recognition of the relevant architectural object for participants and their near future potential. its importance is understood [37]. Education and accessibility are diversified as cornerstones of a similar motivation, and the related overarching and gradual scheme forms an important pillar of the subsequent holistic scheme (Figure 8).

3.4. Strategies of material usage for the optimization of 3D printing

Developing autonomous techniques regarding the use of materials contains important information that each architectural structure and the context of this structure differ. In this context, in addition to normal filament use, innovative concrete casting techniques and composite material use also point to areas that can be improved in the sector. The use of recycled clay in three-dimensional printing technologies, as an effective answer and alternative to the constraints of three-dimensional modeling with the use of traditional filament and the adaptation to new natural materials of the near future, is suitable for many technological situations where environmental impact is directly related to material waste. It can produce natural answers. Using recyclable clay for a circular economy means that recycled clay obtained from energy-intensive production processes, construction and demolition waste or other sources can contribute to sustainable architecture in different aspects. In this approach, clay waste is first collected, then processed and finally converted into printable material [38].

The production method that stands out as additive manufacturing, which mediates the creation of intricate objects by using many materials such as plastic, metal, concrete and sand, offers strong clues about how the technology can develop. It is understood that three-dimensional solutions developed by using different materials together, instead of the restrictions in the use of conventional filaments, will provide much more efficient results. It is seen that the solutions to be provided in this context can be found not only in construction technology, but also in many areas such as human body parts and new technological clothing [39]. In contemporary studies on the subject, light-sensitive resin, nylon and stainless steel as three-dimensional

printing materials are evaluated in terms of their advantages and disadvantages, and material science tests are carried out according to the material performance index, triggering some basic solutions to meet the need for cultural and creative products in historical buildings. By integrating and evaluating the advantages of the materials to be used in three-dimensional modeling, the most suitable product in terms of three-dimensional modeling can be used. The integration of material performance index composition, cultural heritage, product design, quality system and material science literature will be decisive at this point [40].

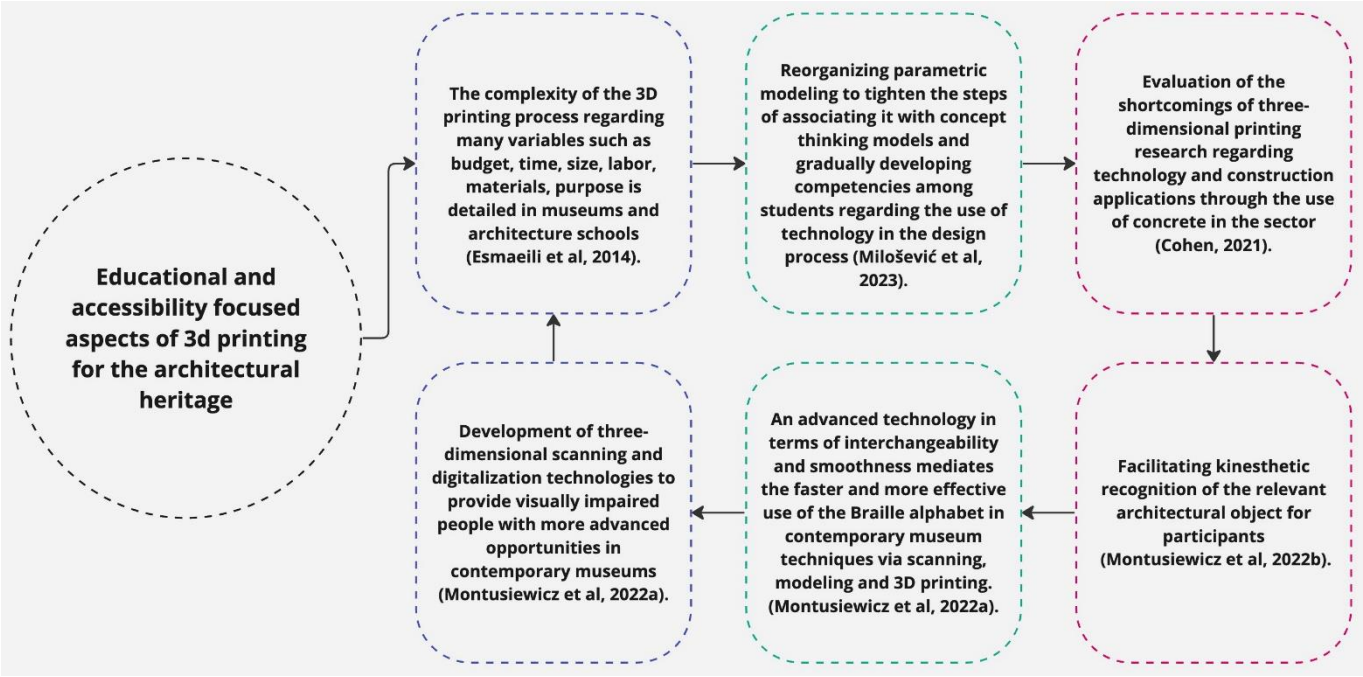

Figure 8. Educational and accessibility focused aspects of 3d printing for the architectural heritage.

One of the most common problems experienced in three-dimensional modeling in areas of use related to architecture is that the bridging steps that occur during printing are too few and weak, preventing the creation of a strong enough model. For example, in order to successfully model an architectural brick prototype, these bridging mechanisms must be handled with a solution-oriented approach, where the properties of the filament materials are evaluated through a multi-stage development process. It is understood that the methods that can be used for filament-reinforced three-dimensional printing of the material also require a comprehensive testing phase for the composite material as an extrusion step. In this context, it is seen that basic criteria such as lightness, reticulated structure, tensile strength or pressure resistance can be improved with filament-reinforced prints and modeling techniques with increased bridging ability [41]. In this context, it is extremely important that the strategies developed for material use match the right software selection. An example of modeling a Roman sarcophagus and tomb stele in the Aksaray Museum using two different software can provide a comparison matrix to ensure maximum efficiency in the 3D context of the historical environment by choosing the right software [42]. All related strategies that enable the assessment of the damage status of the building, in order to support the use of digital technologies that facilitate the storage, sharing and management of existing data, are decisive in this context [43]. Holistic and sequential approaches to material use represent a field of study directly related to innovative solutions in modeling architectural heritage through three-dimensional printing processes in the context of technology, education and accessibility (Figure 9).

4. Discussion and Conclusion

In this context, bringing together the data obtained through the prominent cases and interpreting them in the context of technological possibilities stands out as the first step. The data obtained here is developed for use in the field of education to help children, young people and those with accessibility problems easily access cultural and architectural heritage elements. Finally, a process similar to the development studies carried out in the field of education functions as a laboratory of processing the results of the cases with the help of technology. Respectively, the data obtained from the cases, technology and training steps are combined with the innovations that will be made and are being made in the field of materials in order to model the cultural heritage and architectural heritage elements more easily and more realistically and in accordance with the experience, and a final product is aimed to be achieved. The most common references to addressing today's problems in this order are the basic concerns about reducing basic risks such as damage to monuments when working with historical buildings, strategies for archiving 3D models, identifying the limitations of three-dimensional printing in the representation of textures and color features, creating animations and infographic solutions, It is seen that the understanding of the importance of virtual graphics, the integration of new additive techniques in

printing technologies into modern topographic solutions, and the integration of additive house production and mass production method. In this regard, the holistic model is presented below, and then the basic determinations that will mediate the development of this model for 3D printing for the reinterpretation of architectural heritage are listed (Figure 10).

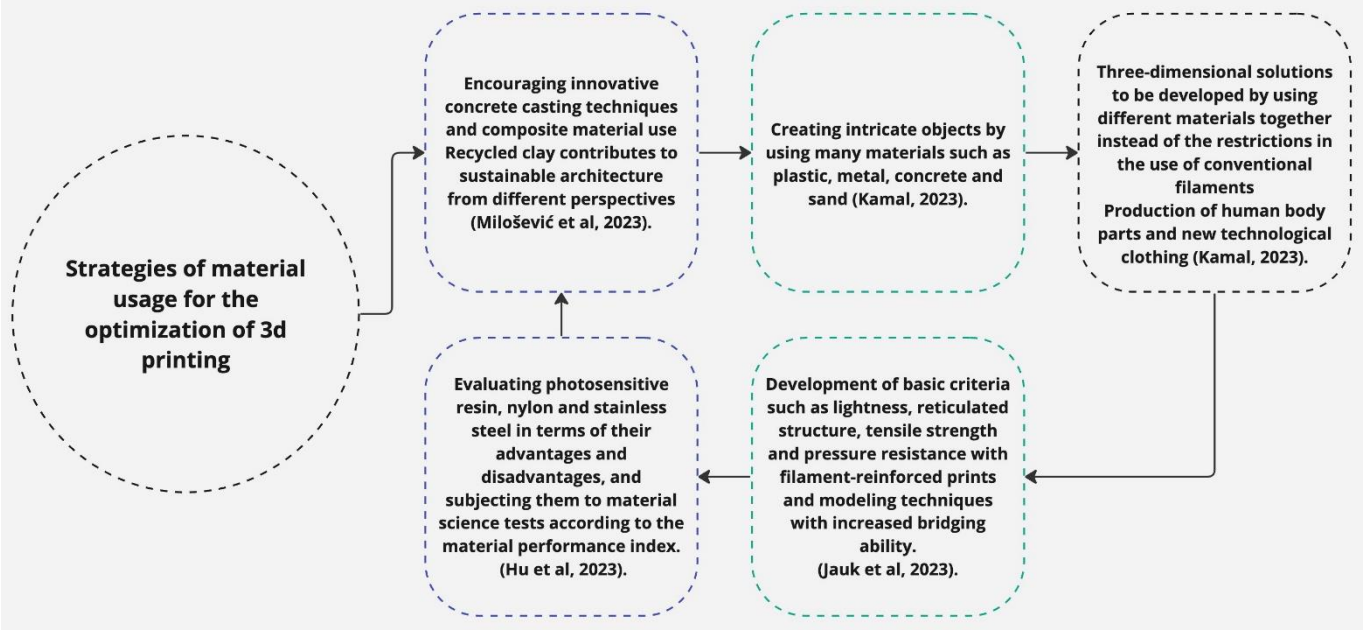

Figure 9. Strategies of material usage for the optimization of 3d printing.

The basic determinations that will mediate the development of this model for 3D printing for the reinterpretation of architectural heritage are as follows:

• In cases where restoration and reproduction of architectural structures are required, the use of digital preservation and production technologies stands out as a necessity, not an option.

• In order to ensure the efficiency of experiencing huge ancient architectural structures with their unique details and positioning style, new coordination steps based on eye movement and hand movement of breakthroughs in perceptual interaction technology should be defined.

• Optimization of the difficulties that arise in the standardization of building manufacturing details in the context of the architectural heritage focused process can be possible by determining a strategy to improve and correct errors in the modeling process.

• If the collection of 3D geometric documentation in addition to 2D geographical data is achieved by creating a 3D environment based on WebGL, offices can include and benefit from holistic databases for modeling of architectural heritage into their systems.

• In addition to photogrammetry, the use of polygonal 3D modeling and FFF 3D printing technologies mediates the modeling of architectural heritage in accordance with contemporary scenarios. The use of photogrammetry and different workflow diagrams in documentation, diagnosis, intervention planning, monitoring and decision-making processes is the clearest example of this.

• Using Midjourney to present detailed representations of virtual reality (VR) and augmented reality (AR) systems and contributing to the creation of research reports by evaluating three-dimensional scanning data together with data obtained from BIM, not as two separate topics, but a common working area. They should be evaluated and operated as serving components.

• Evaluating the infrared thermography (IRT) technique in terms of thermal imaging imaging and utilizing image parallax to provide a comprehensive configuration will enable the technology to be used in a wider area in the future as alternative solutions in remodeling the architectural heritage.

• In extrusion printing on concrete, reducing the corrosive effect on polymer shells and sector-based development and rapid prototyping in CNC machines should be connected to a common line of work. Incorporating BIM-based information into urban renewal and architectural heritage strategies in the process of sustainable urbanization should also support this process.

• The complexity of the 3D printing process regarding many variables such as budget, time, size, labor, material, purpose should be detailed in museums and architecture schools, and parametric modeling should be reorganized to increase the frequency of association steps with concept thinking models, and the proficiency in the use of technology in the design process should be gradually increased among students. Its development will play a direct impetus for the development of contemporary museology techniques in the field of education.

• Evaluation of the shortcomings of three-dimensional printing research in architectural heritage regarding technology and construction applications through the use of concrete in the sector and the ability to deliver prototypes of museum objects to large masses through the use of scanning, modeling and 3D printing can also be integrated into mass production processes as an accessibility problem.

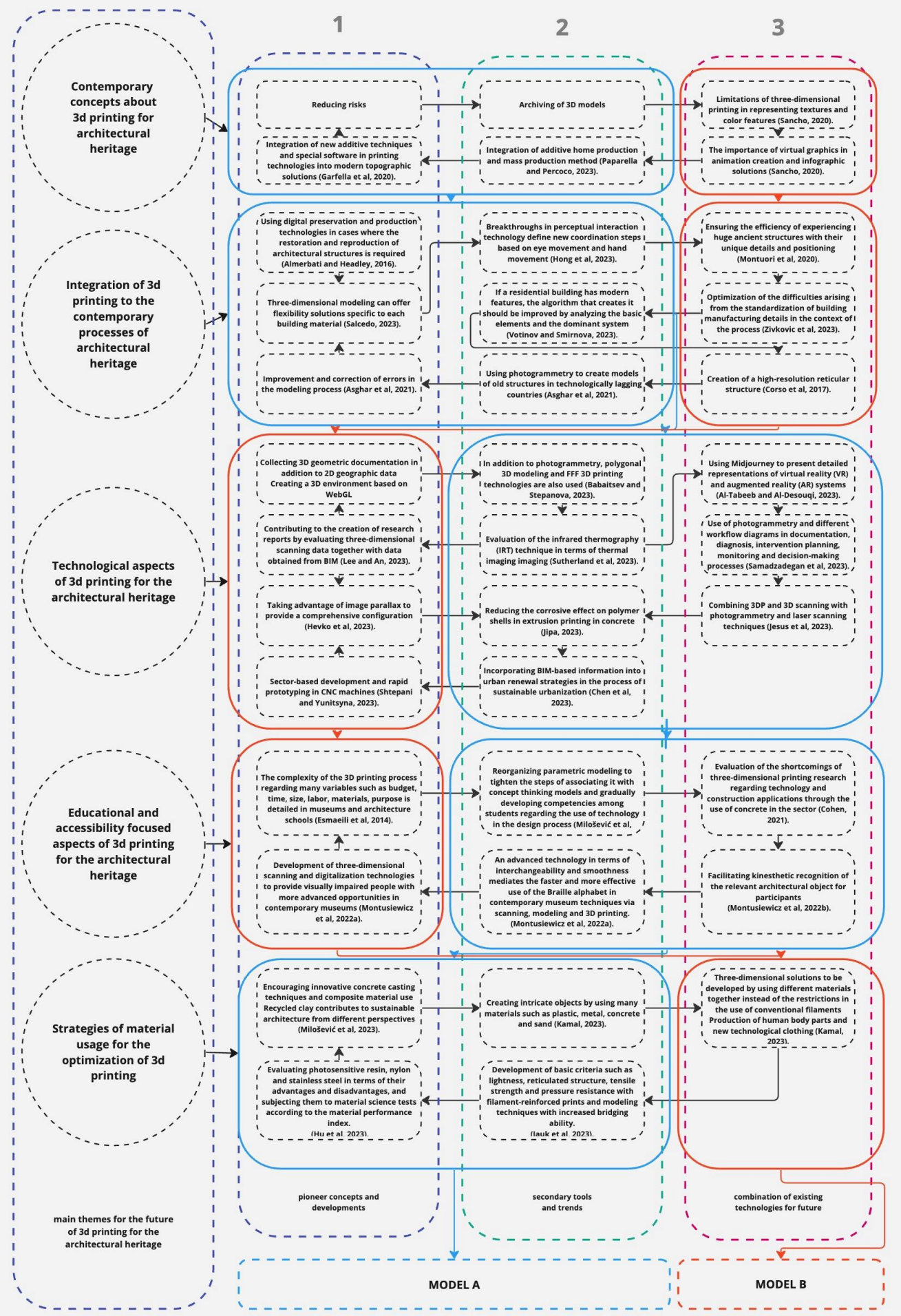

Figure 10. Model A and Model B, including main themes for the future of 3d printing for the architectural heritage, pioneer concepts and developments, secondary tools and trends and combination of existing technologies for future.

• In addition to the development of three-dimensional scanning and digitization technologies to provide visually impaired people with more advanced opportunities in contemporary museums, the advantages to be gained through the faster and more effective use of the Braille alphabet in contemporary museology techniques in terms of changeability and smoothness will enable the three-dimensional output system to be widely used. transfers it to the fields. In this way, facilitating the kinesthetic recognition of the relevant architectural object for the innovators is also achieved as a lateral gain.

• The easiest way to introduce and implement the promotion of innovative concrete casting techniques and the use of composite materials is seen in the contribution of recycled clay to sustainable architecture from different perspectives.

• The impact of architecture will be felt more in work areas that create intersections through the production of human body parts and new technological clothing, with three-dimensional solutions to be developed by using different materials together instead of the restrictions in the use of conventional filament.

Conflicts of interest

The authors declare no conflicts of interest.

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Stone deterioratins in Mardin Madrasas: The case of Şehidiye and Kasımiye Madrasas

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Abstract

Stone is a widely used building material in cultural heritage buildings due to its petrographic properties. However, changes occur on the stone surfaces of the buildings due to exposure to environmental and climatic factors. Therefore, it is of great importance to detect these changes and take measures for the long-term preservation of these structures. The aim of this study is to identify and classify the stone changes observed in Şehidiye and Kasımiye madrasahs in Mardin. In addition, the similarities and differences of the changes and the causes of the changes will be determined. The study includes the identification and classification of stone alterations based on a general literature review, visual inspection of the alterations and mapping methodology. Observed changes were identified through visual inspection, categorized as physical, chemical, biological or anthropogenic, and photographed for documentation. A mapping method was used to determine the extent of change, which involved calculating the ratio of observed changes to total façade area. The changes on each façade were then analyzed to determine their causes. The impact of the same changes on the various structures and their proportions in relation to the façade were compared.

1. Introduction

Due to its geographical location and its location on the Silk Road, one of the most important trade routes, Mardin has welcomed many civilizations. Communities belonging to different civilizations, cultures and religions have lived together [1, 2]. These communities, who lived in Mardin at different times, played an important role in the development of the city by leaving artifacts from their own periods [3]. The high number of cultural heritage buildings in the city is important in terms of reflecting the experiences of different cultures in the past and present. One of the building types built in different periods and times is madrasah buildings. Madrasa buildings are the structures where the cultural and educational activities of the period were carried out [4]. While some of these structures have survived to the present day, some of them have not survived to the present day. Some of the madrasah buildings that have survived to the present day have changed their functions and some of them are used for the same functions [5, 6]. The easy accessibility of stone material specific to the region has played an important role in the use of stone as the main construction material of cultural heritage buildings [7]. Under natural factors and atmospheric conditions, degradation is observed on the surfaces of stone materials [8]. Surface degradation is observed physically, chemically and biologically. In addition to these degradations, anthropogenic degradations caused by human impacts are also observed and cause the destruction of structures over time [9-11]. These damages on stone surfaces cause weakening in the strength and durability of the stone and also pave the way for the formation of other degradations [12, 13]. Taking precautions against the degradation seen in the structures is important in terms of transferring the structures to future generations [14].

As a result of the on-site observations, physical, chemical, biological and anthropogenic degradation and their causes were examined in two different madrasas, Şehidiye and Kasımiye madrasas in Mardin. It is important to identify and classify the stone deterioration in historical buildings that are cultural heritage, and to take the right precautions to transfer the buildings to future generations [15, 16]. For this reason, the measures to be taken against the deterioration of historical buildings that have the characteristics of cultural heritage are important in terms of people's awareness of

history and appropriate protection procedures by authorized persons or institutions.

2. Method

Stone material has been preferred more than other main construction materials. This process covers the period from the settlement of people to the present day. In addition, stone material has been frequently used in historical buildings since it can be used without the need for additional binding materials and its high workability [17]. The stone used in historical buildings deteriorates on the surface of the stone as a result of factors such as humidity, air pollution and salt accumulation under climatic conditions [18-20]. In this study, stone deterioration in Şehidiye and Kasımiye madrasahs in Mardin was identified, classified and analyzed. In the study, the deterioration was visually analyzed by photography and the proportions of the deterioration to the façade were determined by mapping method. The types, rates, types and causes of deterioration in the two madrasahs were analyzed by comparing two different structures and it was aimed to determine the similarities and differences of the deterioration.

The degradation of Şehidiye and Kasımiye madrasas were classified as physical, chemical, biological and anthropogenic degradation by visual analysis method. Autocad 2018 and Adobe Photoshop CS6 were used in the mapping method. After determining the deterioration seen on the facades and inner courtyards of the buildings, the deterioration was applied to the facades with the mapping method. The area covered by the deterioration type on the entire facade was determined and written as a percentage ratio. While calculating the areas covered by the deterioration on the facades, it was determined by the ratio of the total area of the surface where the deterioration occurred to the entire facade surface area. The study aims to support the studies to be carried out in the following years as a basis.

2.1. Study Area

The city of Mardin was founded in the region called "Fertile Crescent" on Mesopotamia. As it was home to different cultures, different names such as "Maride", "Mâridin" and "Mârdê" were used [21, 22].

In terms of historical development, historical artifacts dating back to 3000 BC are found in the first settlements of Mardin [23]. When the later years are examined, artifacts belonging to different civilizations are found [24]. Although the Artuqid state has a great influence on the formation of the city's identity, the works belonging to the Karakoyunlu, Akkoyunlu, Safavid and Ottoman states are also located in the city [25]. Only some of these artifacts have survived to the present day.

Madrasa buildings, which were used as educational and cultural buildings in the society, were also used as basic educational institutions within the complexes during the Ottoman Empire [26]. The city of Mardin was also located on the historical road, which influenced the construction of a large number of madrasah buildings in the city. There are eleven madrasas in the city: Kasımiye, Şehidiye, Zinciriye, Altunboğa, Şah Sultan, Muzafferiye, Savur Kapı, Melik Mansur, Hatuniye, Marufiye and Hüsamiye.

Şehidiye Madrasah, the subject of this study, was built between 1239-1260 [27, 28]. However, it is not known exactly when the Kasımiye Madrasa was built. Since it is similar to Zinciriye Madrasah in terms of architectural style, it is thought to have been built during the same period (the last years of the Artuqid State) [22, 24]. Both buildings are among the madrasas that have survived to the present day and are still frequented by visitors. The locations of Şehidiye and Kasımiye madrasas are shown in Figure 1 by processing Google Earth map.

Figure 1. Geographical locations of Şehidiye and Kasımiye madrasas (processed on Google Earth)

Mardin is located in the Southeast Region of Türkiye in terms of geographical characteristics. It has 36° 54' and 37° 47' north latitudes and 39° 55' and 42° 41' east longitudes. It has an altitude of 1100 meters and a surface area of 8891 km^2. Due to its sloping terrain, access to the buildings is provided by steep ramps and stairs [29, 30]. Şanlıurfa borders Syria in addition to the provinces of Diyarbakır, Batman, Şırnak and Siirt (Figure 2).

The city has a continental climate in the center and a Mediterranean climate in the districts. Due to the characteristics of the climate, the winter months are cold and the summer months are dry and hot. July is the month with the highest average temperature (29.8 °C) and January is the month with the lowest average temperature (3.0 °C). Table 1 shows the average temperature values between 1942 and 2022. In light of

the data obtained, it was observed that the maximum sunshine duration was in July (12.4 hours) and the minimum in December (4.4 hours). Due to the climatic characteristics of Mardin, stone deterioration is common [31, 32].

Figure 2. Location map of Mardin in Türkiye [7].

Table 1. According to meteorological data, average temperature and precipitation values of Mardin province.

Mardin	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annually
Average Temperature (°C)	3,0	4,2	7,9	13,5	19,5	25,6	29,8	29,6	25,3	18,6	11,1	5,4	16,1
Average Highest Temperature (°C)	5,8	7,4	11,6	17,4	24,0	30,6	35,0	34,7	30,1	22,9	14,5	8,2	20,2
Average Lowest Temperature (°C)	0,6	1,4	4,6	9,8	15,1	20,3	24,6	24,7	20,8	14,7	8,1	2,9	12,3
Average Sunshine Time (Hours)	4,5	5,1	5,9	7,3	9,7	12,1	12,4	11,4	10,3	7,7	5,9	4,4	8,1
Average Number Of Rainy Days	12,11	10,61	11,70	10,28	7,35	1,54	0,48	0,24	0,70	5,12	7,66	10,80	78,60
Total Monthly Rainfall	115,9	103,2	97,7	81,1	47,3	6,5	3,2	2,3	4,0	33,8	71,9	108,7	675,6

2.2. Architectural features of Şehidiye and Kasımiye Madrasas

Şehidiye Madrasah is located in Şehidiye Neighborhood. It is not known exactly by whom the madrasah structure was built. It has survived to the present day but has lost its originality due to restoration works carried out at different times. After the construction of the building was started, the building was named Şehidiye Madrasa as a result of the martyrs' graves around the building [24]. The entrance to the building is through the main portal and the passage to the courtyard is through the corridor covered with a barrel vault. The cells located opposite each other in the building were used as education centers (Figure 3). The building has a total of 5 facades, including four facades facing the courtyard and the facade on which the main portal is located. The madrasah structure changed its function after the restoration and is now used as a mosque [33]. Limestone was used as the main construction material of the building. In addition to limestone, cut stone and kabayonu stone were also observed in some parts of the building.

Kasımiye Madrasah is a two-story madrasah with a single courtyard in Mardin. The building consists of a square space with a dome over the mosque and rooms covered with barrel vaults. There are also madrasah rooms at the back of the courtyard. The ground floor of the building has a mausoleum, Hanafi masjid, Shafii masjid and 11 cells, while the first floor has 12 cells (Figure 4).

To the left of the main entrance is the onion-sliced masjid and to the right is the tomb with a sliced dome. When you enter the courtyard, there is an iwan with selsebil and cells with sliced domes located around the courtyard. The iwan in the courtyard is covered with a

pointed vault. With the 2007 repair, the portico vaults on the ground floor were made of cut stone, but after the repair, they were plastered and turned into barrel vaults [25, 34, 35]. Kasımiye Madrasah has a total of seven facades, including four facades facing the inner courtyard, the south facade, which is the front facade, and the east and west facades, which are the side facades. Limestone was used as the main material of the building. In addition to limestone, there are kabayonu stone and cut stone.

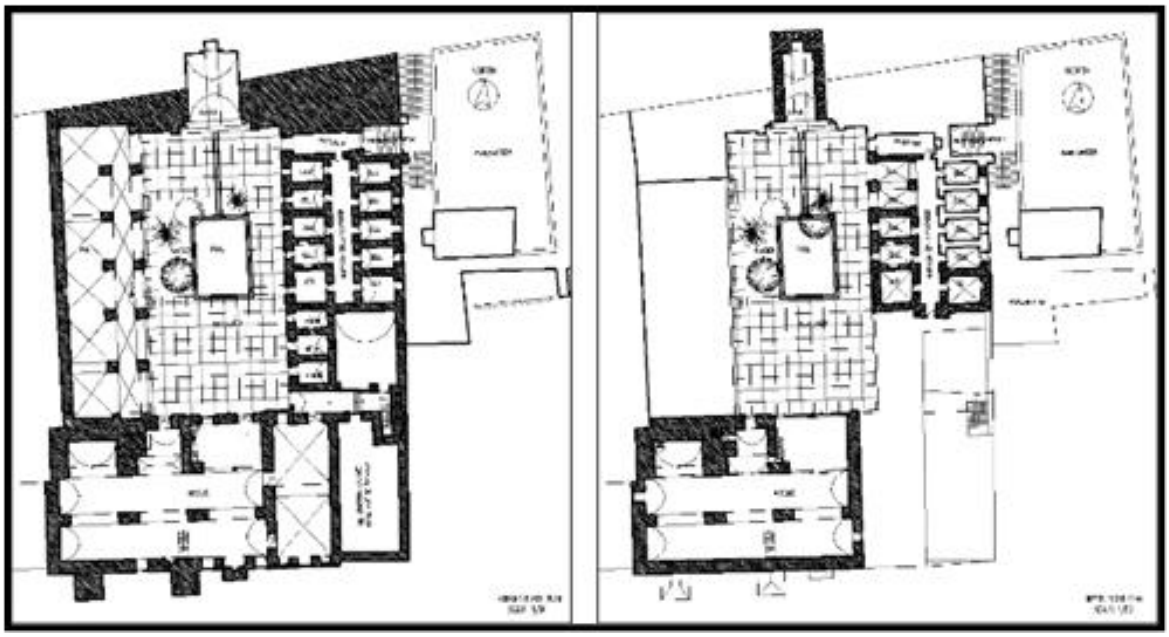


Figure 3. Plan of Mardin Şehidiye Madrasa.

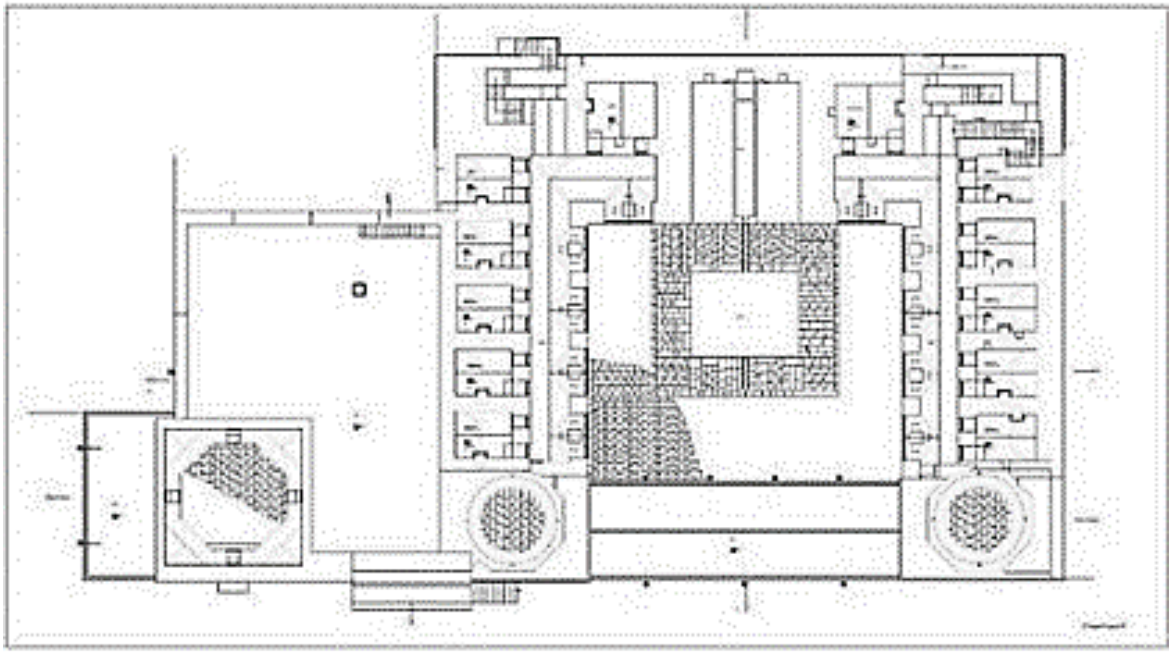


Figure 4. Plans of Mardin Kasımiye Madrasa.

3. Results

Stone, which is the main construction material of stone structures that have the characteristics of cultural heritage, degrades over time due to climatic reasons such as pressure, temperature, wind and precipitation [36-39]. These degradations on stone surfaces cause the durability of the stone to decrease over time and cause the formation of other degradations. In addition, in some cases, it causes the acceleration of the degradation process that has already occurred. Taking precautions against the deterioration of the structures and correct interventions prevent serious damage to the structures [40-43].

In this study, the deterioration observed on the stone surfaces of the Şehidiye and Kasımiye madrasas in Mardin was identified, classified and documented by photography. The deterioration of the buildings was classified as physical, chemical, biological and anthropogenic deterioration [44, 45]. With the data obtained, deterioration was analyzed by visual analysis method and mapping method. In the mapping method, the types of deterioration occurring on the facades were

recorded on the facade and the entire rate of deterioration was determined.

Physical degradation occurs due to mechanical effects and atmospheric conditions. These are the formations such as fracture, joint discharge, crack formation and abrasion that occur on stone surfaces due to the breakage of bonds as a result of the weakening of the minerals in the stone [46-48].

Chemical degradation is the changes that occur on stone surfaces as a result of atmospheric events. Effects such as color changes, salinization, and crusting on stone surfaces are examples of chemical degradation [49, 50].

Biological degradation is the type of degradation caused by organic substances on surfaces. Moss, plant and lichen formations are examples of biological degradation [51, 52].

Anthropogenic degradation is the changes that occur as a result of conscious or unconscious destruction of stone surfaces by humans [53]. Misuse, periodic wear and tear, and lack of maintenance occur as a result of anthropogenic degradation.

In this study, the stone deterioration seen in Şehidiye and Kasımiye madrasas were examined under two headings visual analysis and mapping method.

3.1. Investigation of stone deterioration in Şehidiye and Kasımiye Madrasas by visual analysis method

With the visual analysis method, stone deterioration in Şehidiye and Kasımiye madrasas were identified and analyzed by classification. As a result of the classification, the deteriorations were classified as physical, chemical, biological and anthropogenic and documented by photography.

In both Şehidiye and Kasımiye madrasahs, joint discharges, hairline crack formation, fragment loss and surface abrasion are observed as physical deterioration types. Due to the climatic conditions prevailing in the city and the effect of time, the mortars binding the stone structures together have lost their effectiveness and the joints between the stones have become empty. Due to the climatic conditions of the city of Mardin, capillary cracks are frequently observed in historical stone structures, which are cultural heritage, as a result of exposure to thermal shock, and crack formation due to weather events such as precipitation and the properties of the stone. Surface abrasions on stone structures are observed as a result of the wind-carrying dust particles. It can be said that the natural conditions and the orientation parameters of the buildings are also effective in the similar types of physical deterioration seen in Şehidiye and Hatuniye madrasas. The physical deterioration observed in the structures is shown in Figure 5. Capillary cracks (Figure 5a), joint discharges (Figure 5b and 5c), fragment losses (Figure 5d) and surface abrasions (Figure 5e and 5f) are observed.

The limestone used as the main construction material in the Şehidiye and Kasımiye madrasas has been subjected to chemical deterioration as a result of internal and external factors over time. Changes such as discoloration, salinization and bacterial growth observed on the stone surfaces are examples of chemical degradation. The chemical deterioration of the Şehidiye and Kasımiye madrasas is shown in Figure 6. Color changes (Figure 6a), salinization (Figure 6b) and bacterial growth (Figure 6c).

The biodegradation observed in Şehidiye and Kasımiye madrasas are shown in Figure 7. Plant, algae and bacterial growths were observed as biodegradation in Şehidiye and Kasımiye madrasas. The growth of roots due to plant growth in the structures causes the formation of joint gaps, widening of cracks and fragmentation on the stone surfaces. Plant growth, which is a type of biological degradation, accelerates the processes of physical degradation such as joint voiding, crack formation and surface detachment [54]. In addition to plant growth, moss and bacterial growths are found in Şehidiye and Kasımiye madrasas. Moss formations are more common in areas where stone surfaces come into contact with water [55]. Plant growth (Figure 7a), moss growth (Figure 7b) and bacterial growth (Figure 7c) observed in the madrasas are shown.

Anthropogenic degradation, which occurs as a result of the damage and harm caused by people consciously or unconsciously to cultural heritage buildings, was observed in Şehidiye and Kasımiye madrasas. In both buildings, anthropogenic deterioration is observed on the stone surfaces as a result of the use of sharp tools. Figure 8 shows the deterioration caused by the use of sharp tools.

3.2. Investigation of stone deterioration in Şehidiye and Kasımiye Madrasas by mapping method

The stone deterioration observed in Şehidiye and Kasımiye madrasas were analyzed by mapping method in addition to visual analysis. The deteriorations observed in the buildings were classified and the ratio of the deterioration type to the entire façade was determined. In the study, the eastern façade, south-facing façade, north-facing façade and east-facing courtyard façade of Şehidiye Madrasah and the southern façade, eastern façade, western façade, south-facing courtyard façade and west-facing courtyard façades of Kasımiye Madrasah were analyzed.

As a result of the examinations, capillary cracks, joint discharges, surface abrasion and fragmentation were observed as physical alterations. Surface abrasion was the most common physical alteration while fragmentation was the least common. The analysis of the physical alterations observed in Şehidiye Madrasah by mapping method is shown in Table 2, and the analysis of the physical alterations in Kasımiye Madrasah by mapping method is shown in Table 3.

According to the analysis by mapping method, discoloration, salinization and bacterial formation were observed as chemical alterations. While discoloration and salinization were the most common types of alteration, bacterial formation was less common than the other two types. The analysis of the chemical alterations observed in Şehidiye Madrasah by mapping method is shown in Table 4 and the analysis of the chemical alterations in Kasımiye Madrasah by mapping method is shown in Table 5.

As a result of the analysis of the biological alterations observed in Şehidiye and Kasımiye Madrasas by mapping method, plant formation and moss formation were observed in Şehidiye Madrasah; plant formation, moss formation and bacterial formation were observed in Kasımiye Madrasah. The plant and moss formations observed in Şehidiye Madrasah are shown in Table 6, while the plant, moss and bacterial formations in Kasımiye Madrasah are shown in Table 7.

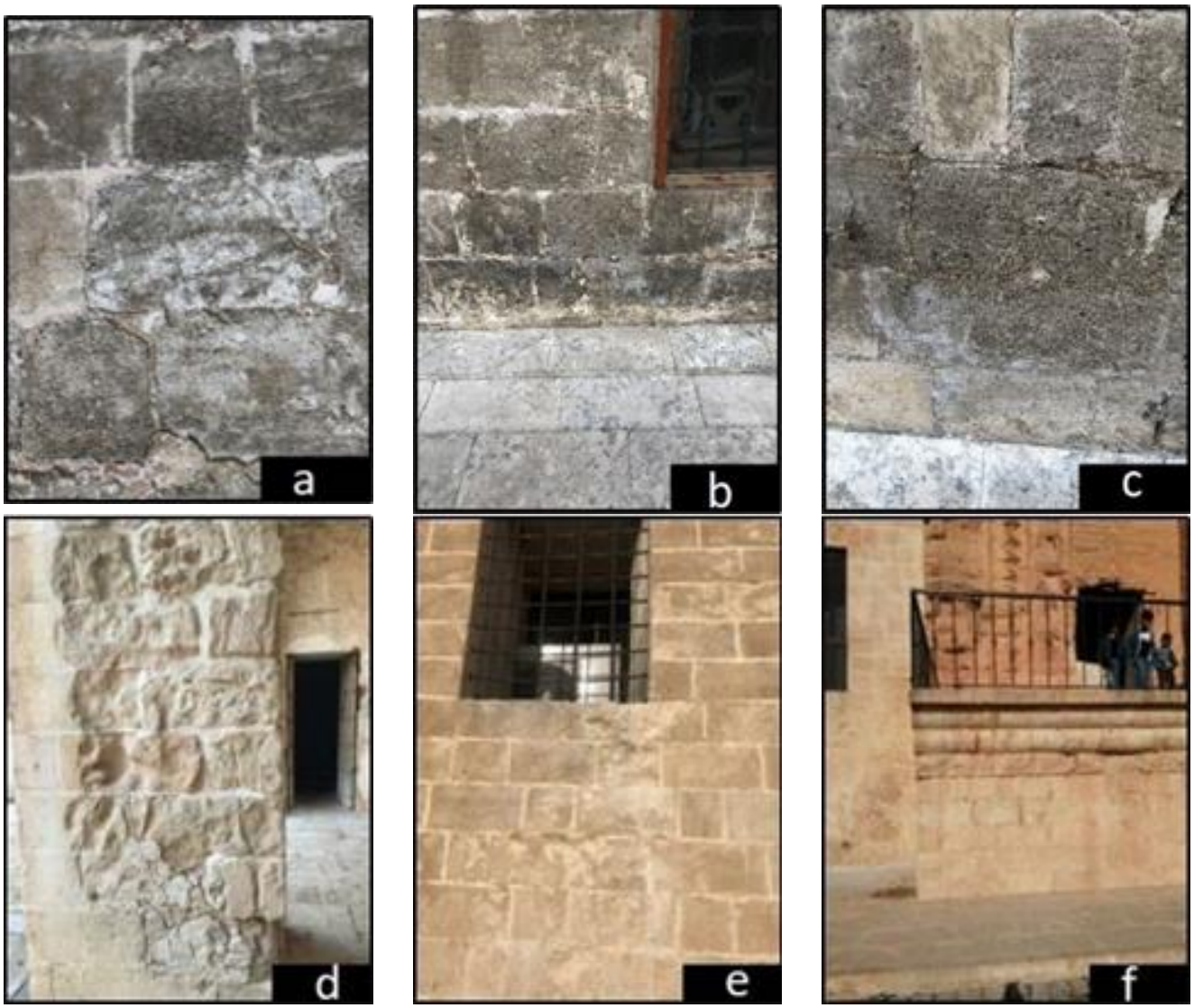


Figure 5. Physical deterioration observed in Şehidiye and Kasımiye madrasas.

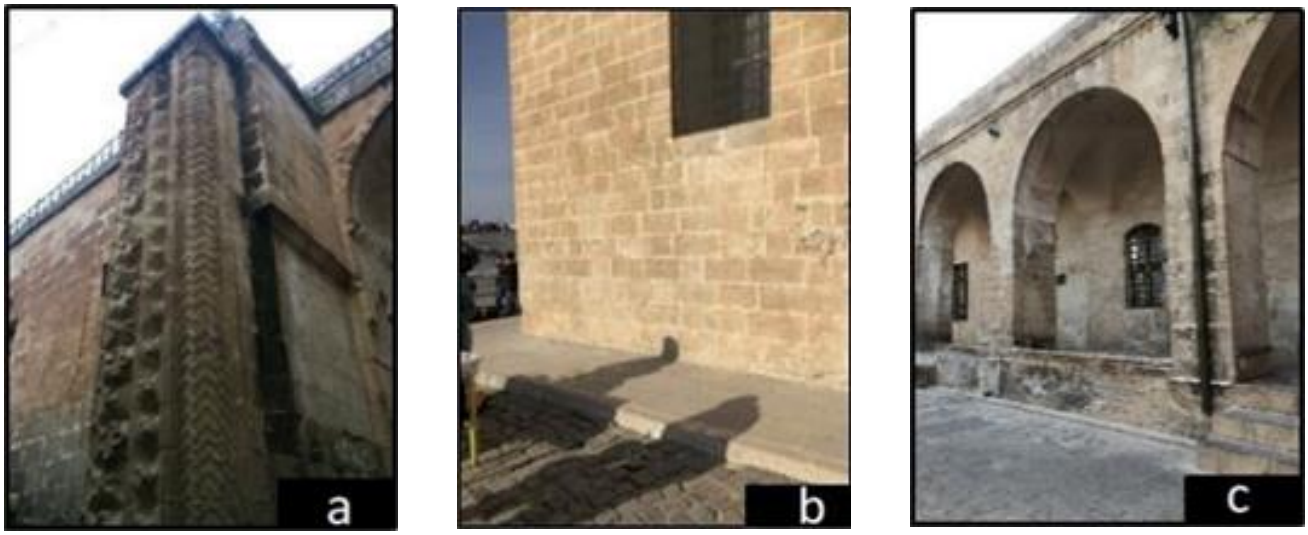


Figure 6. Chemical deterioration observed in Şehidiye and Kasımiye madrasas.

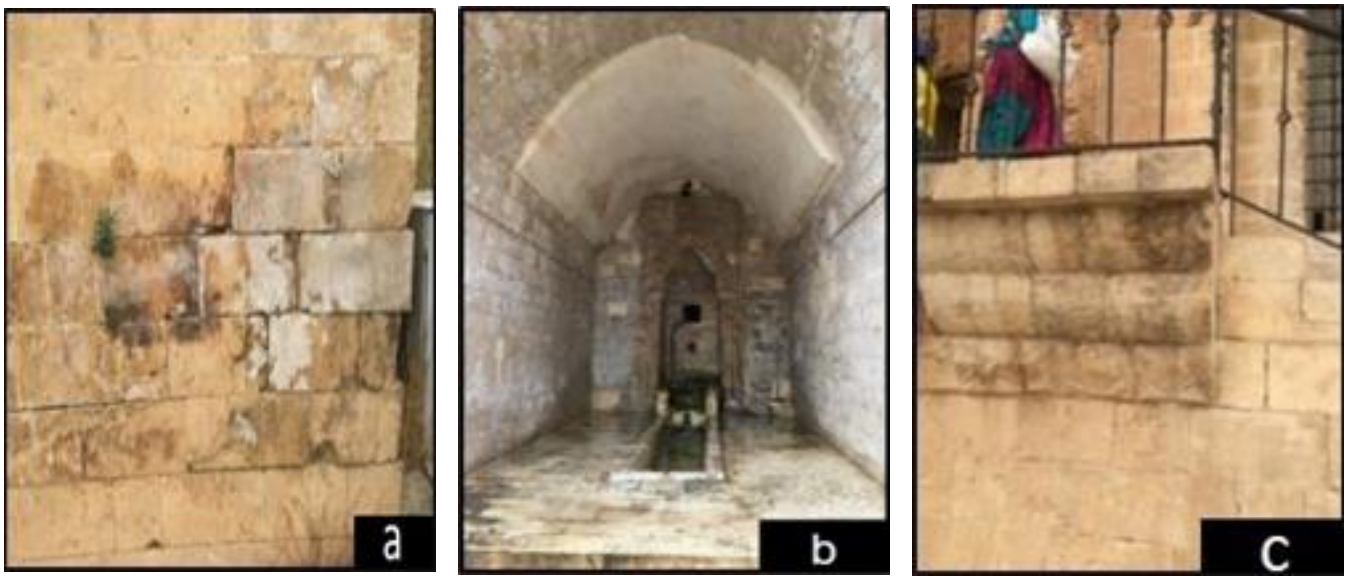


Figure 7. Biological deterioration observed in Şehidiye and Kasımiye madrasas.

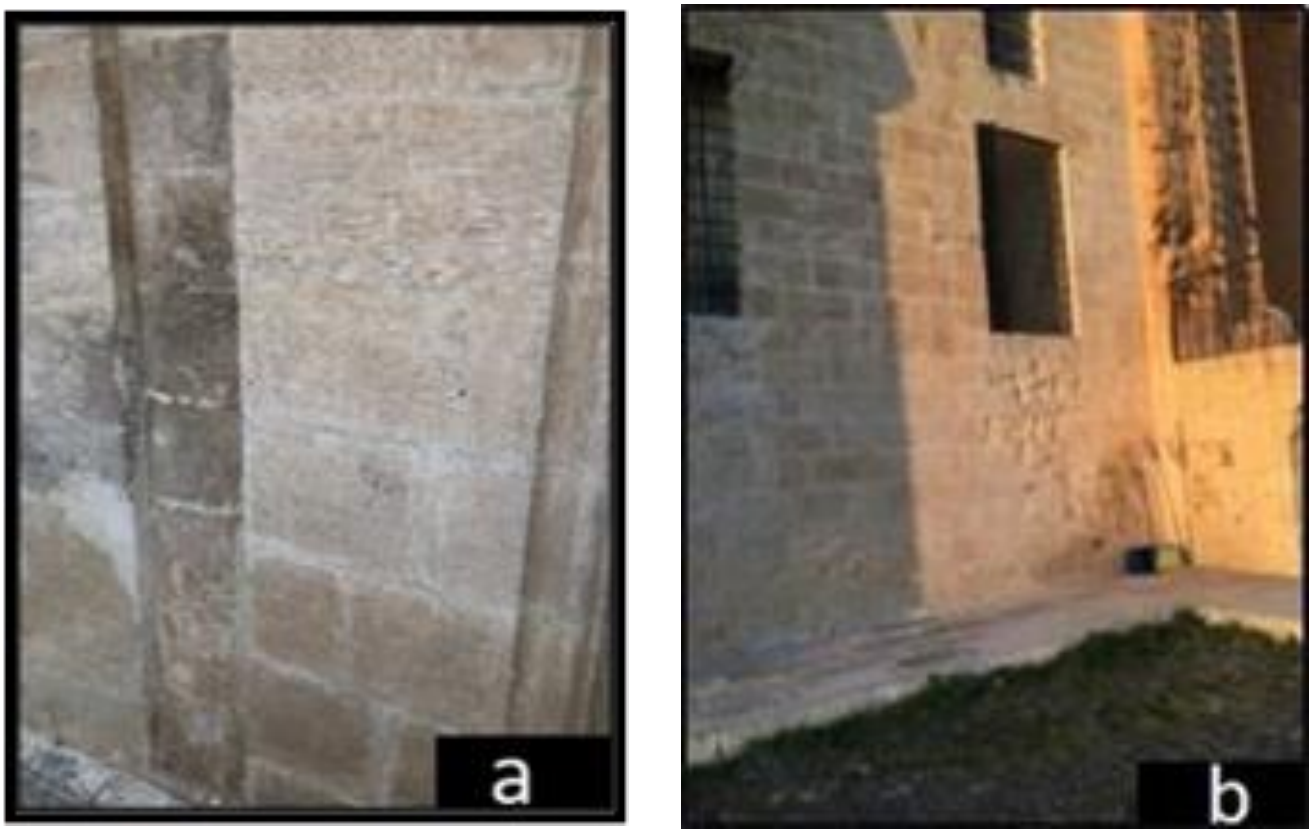


Figure 8. Anthropogenic deterioration observed in Şehidiye and Kasımiye madrasas.

As a result of the analysis of the anthropogenic alterations observed in Şehidiye and Kasımiye madrasas by mapping method, alterations were observed due to the use of sharp tools. The use of sharp tools in Şehidiye Madrasah is shown in Table 8, while the use of sharp tools in Kasımiye Madrasah is shown in Table 9.

4. Conclusion

Stone, one of the main construction materials of cultural heritage historical buildings, has been used for different purposes in different areas of human life. The limestone, which is the main construction material of Şehidiye and Kasımiye madrasas, which are located in Mardin and are cultural heritage, has been subjected to changes on the stone surfaces due to exposure to climate and external factors and the petrographic properties of the stone. In this study, the stone deterioration observed in the Şehidiye and Kasımiye madrasas was analyzed. In the study, the stone deterioration seen on the exterior facades and courtyard facades of the buildings were analyzed by classification. After the classification, the deterioration was analyzed by visual analysis method and mapping method by photographing the deterioration.

Table 2. Analysis of physical deterioration in Şehidiye Madrasah by mapping method.

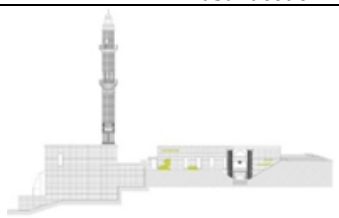
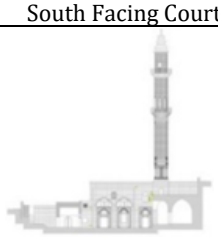
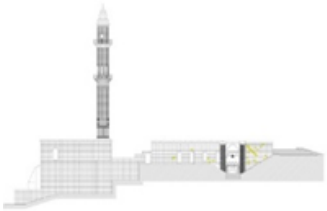
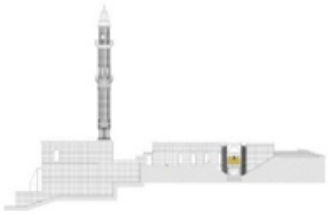
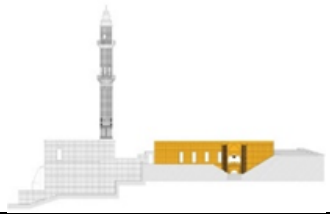
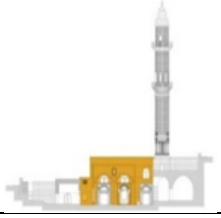
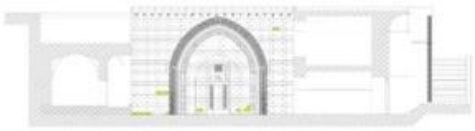
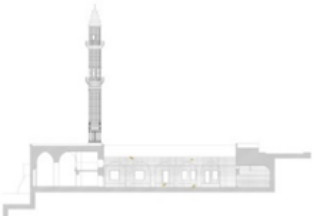
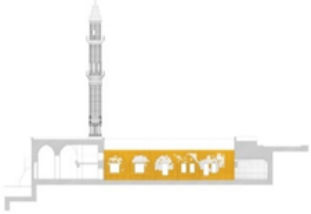
Physical Degradation Type	Facade Deterioration Ratio	Ratio (%)	Facade Deterioration Ratio	Ratio (%)
	East Facede		South Facing Courtyard Facade	
Joint Discharge		8		1.2
Capillary Crack		6		1.4
Fragment Breakage		5		0.3
Surface Abrasion		93		90
	North Facing Courtyard Facade		East Facing Courtyard Facade	
Joint Discharge		1.5		10
Capillary Crack		2.3		12
Fragment Breakage		0.8		1
Surface Abrasion		21		87

Table 3. Analysis of physical deterioration in Kasımiye Madrasah by mapping method.

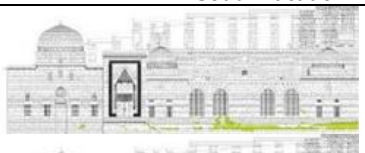
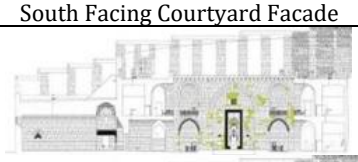
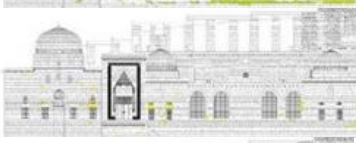
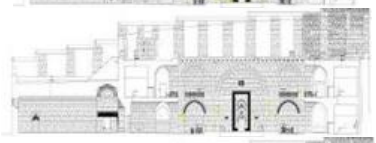
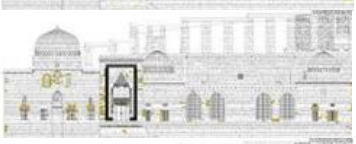
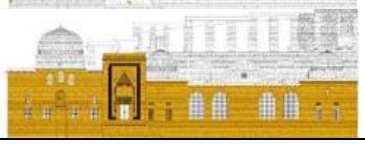
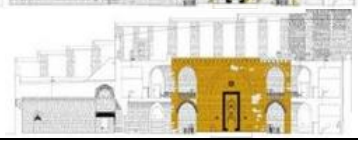
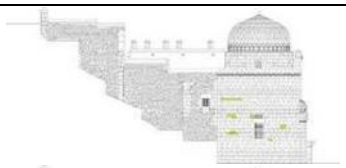
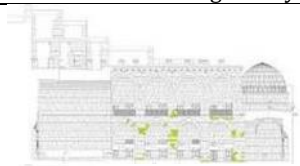
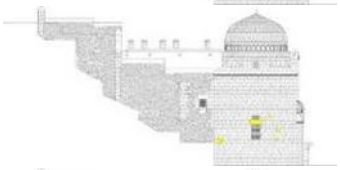
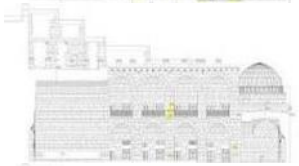
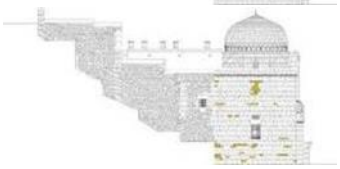
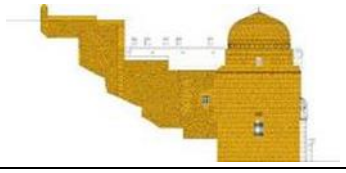
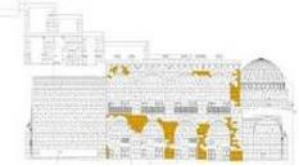
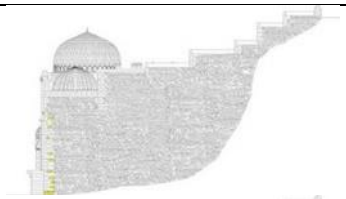
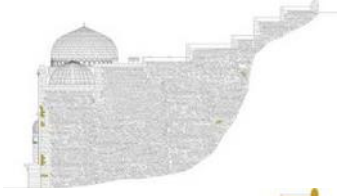
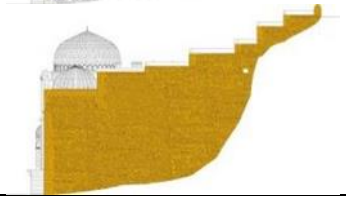
Physical Deterioration Type	Facade Deterioration Ratio	Ratio (%)	Facade Deterioration Ratio	Ratio (%)
	South Facade		South Facing Courtyard Facade	
Joint Discharge		6.6		11
Capillary Crack		1.9		1.2
Fragment Breakage		8		10
Surface Abrasion		100		83
	West Facade		West Facing Courtyard Facade	
Joint Discharge		0.9		8.1
Capillary Crack		0.6		1.2
Fragment Breakage		2.5		13
Surface Abrasion		100		20
	East Facade			
Joint Discharge		0.5		
Fragment Breakage		0.7		
Surface Abrasion		100		

Table 4. Analysis of chemical deterioration in Şehidiye Madrasah by mapping method.

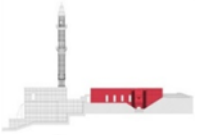
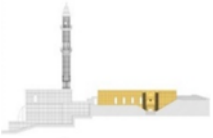
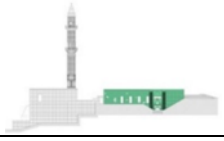
Chemical Deterioration Type	Facade Deterioration Ratio	Ratio (%)	Facade Deterioration Ratio	Ratio (%)
	East Facede		South Facing Courtyard Facade	
Color Variation		100		100
Salinization		100		100
Bacteria Formation		98		43
	North Facing Courtyard Facade		East Facing Courtyard Facade	
Color Variation		88		94
Salinization		100		100
Bacteria Formation		42		82

Table 5. Analysis of chemical deterioration in Kasımiye Madrasah by mapping method.

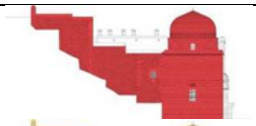
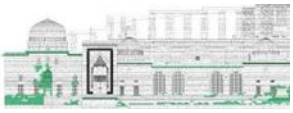
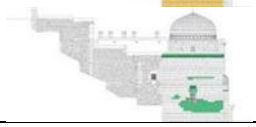
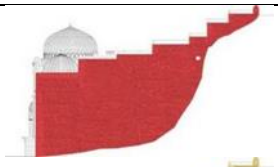
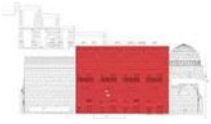
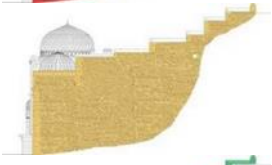
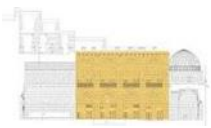
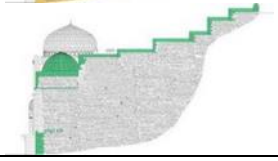
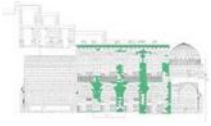
Chemical Deterioration Type	Facade Deterioration Ratio	Ratio (%)	Facade Deterioration Ratio	Ratio (%)
	South Facade		West Facade	
Colour Variation		100		100
Salitisation		100		100
Bacteria Formation		5.6		7.9
	East Facade		West Facing Courtyard	
Colour Variation		100		100
Salitisation		100		100
Bacteria Formation		18		47

Table 6. Analysis of biological deterioration in Şehidiye Madrasah by mapping method.

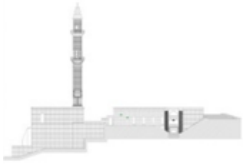
Biological Deterioration Type	Facade Deterioration Ratio	Ratio (%)	Facade Deterioration Ratio	Ratio (%)
	North Facing Courtyard Facade		East Facade	
Plant Formation		0.1		0.2
Moss Formation		1.3		

Table 7. Analysis of biological deterioration in Kasımiye Madrasah by mapping method.

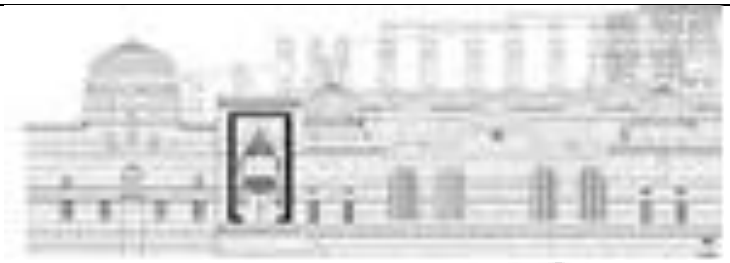
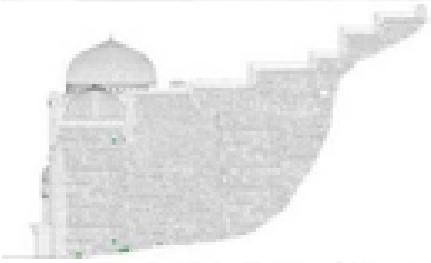
Biological Deterioration Type		Facade Deterioration Ratio	Ratio (%)
South Facade	Plant Formation		0.2
East Facade	Plant Formation		0.1
South Facing Courtyard Facade	Moss Formation		1.8

Table 8. Analysis of anthropogenic deterioration in Şehidiye Madrasah by mapping method.

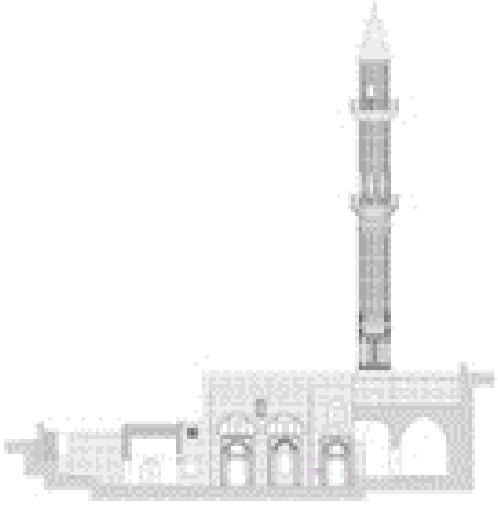
Anthropogenic Deterioration Type		Facade Deterioration Ratio	Ratio (%)
North Facing Courtyard Facade	Sharp Instrument Use		0.1

Table 9. Analysis of anthropogenic deterioration in Kasımiye Madrasah by mapping method.

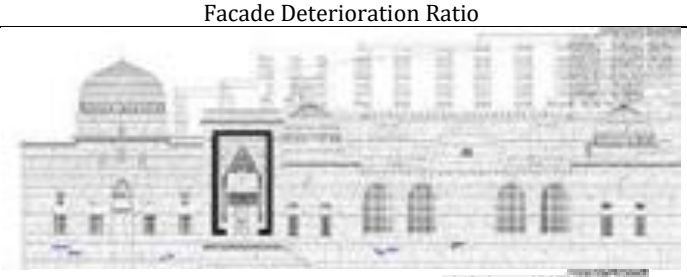
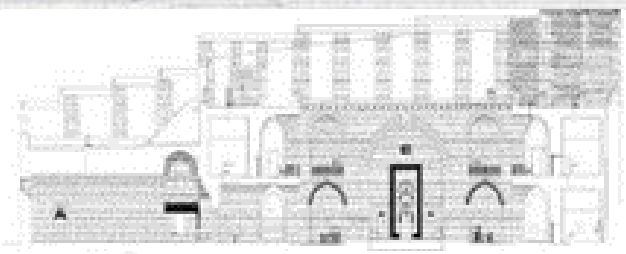
Anthropogenic Deterioration Type		Facade Deterioration Ratio	Ratio (%)
South Facade	Sharp Instrument Use		0.4
South Facing Courtyard Facade	Sharp Instrument Use		0.9
West Facıng Courtyard Facade	Sharp Instrument Use		1.6

Table 10. Deterioration of the facades of the Şehidiye and Kasımiye madrasas.

		Abrasion	Capillary Crack	Joint Emptying	Fragment Breakage	Colour Variation	Salinization	Bacteria Formation	Plant Formation	Moss Formation	Sharp Instrument Use
Şehidiye Madrasa	East Facade	✓	✓	✓	✓	✓	✓	✓	✓	x	x
	North Facing Courtyard Facade	✓	✓	✓	✓	✓	✓	✓	x	x	x
	South Facing Courtyard Facade	✓	✓	✓	✓	✓	✓	✓	✓	✓	x
	East Facing Courtyard Facade	✓	✓	✓	✓	✓	✓	✓	✓	x	✓
Kasımiye Madrasa	South Facade	✓	✓	✓	✓	✓	✓	✓	✓	x	✓
	East Facade	✓	✓	✓	✓	✓	✓	✓	✓	x	x
	West Facade	✓	✓	✓	✓	✓	✓	✓	x	x	x
	South Facing Courtyard Facade	✓	✓	✓	✓	✓	✓	✓	x	✓	✓
	West Facing Courtyard Facade	✓	✓	✓	✓	✓	✓	✓	x	x	✓

According to the visual and mapping method analyses, it was determined that the most common type of deterioration in both Şehidiye and Kasımiye madrasas was chemical deterioration and the least common type of deterioration was anthropogenic deterioration. In terms of physical deterioration, fragment breakage was the least common type of physical deterioration, while surface abrasion was the most common type. In chemical Deterioration, discoloration and salinization, and in biological Deterioration, plant growth was the most common type of Deterioration observed on the facades. It is possible to observe the use of sharp tools in both buildings as anthropogenic deterioration. Table 10 shows the deterioration observed on the facades of both Şehidiye and Kasımiye madrasas together.

As a result of the study, the stone deterioration in the Şehidiye and Kasımiye madrasahs was analyzed comparatively. The distribution of deterioration on the façades and their causes were explained. It is expected that the data obtained at the end of the study will provide solutions for the renovation works to be carried out in the coming years. To minimize these deteriorations in the buildings, necessary studies should be carried out and solution proposals should be presented.

Author contributions

Ayşe Biçen Çelik: Conceptualization, Methodology, Field study; **İlhami Ay:** Conceptualization, Methodology, Writing-Original draft preparation, Validation; **Şefika Ergin:** Investigation, Writing-Reviewing and Editing; **Murat Dal:** Investigation, Writing-Reviewing and Editing

Conflicts of interest

The authors declare no conflicts of interest.

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Tarsus historic city center, identification of problem and potentials as base for strategic guideline

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Abstract

Tarsus historic city center is a continuous settlement from the Neolithic Age to the present day. Archaeological heritage is integrated with traditional historic quarters, historic city center, Early Republican buildings and industrial heritage. Social practices, cultural production processes, legends and religious events transferred from generation to generation constitute the intangible cultural heritage elements and also the symbols of the city. In 2013, conservation area boundaries were revised and Tarsus historic city center, was declared as 3rd Grade Archaeological Site by the Regional Conservation Council. In defined context, the Conservation-Strategy Guideline was prepared with the contract signed between Mersin Metropolitan Municipality and Mersin University, Faculty of Architecture in 2022. Within the scope of document, a guideline containing urban conservation strategies for the historic city center of Tarsus has been prepared. Within the scope of this article, findings and evaluations regarding current situation based on field surveys and questionnaires that form the basis for the guideline are presented. The study aims to document the physical and socio-cultural situation of the historic center in 2022 to guide further studies concerning cultural heritage in Tarsus.

1. Introduction

There is a continuous settlement from the Neolithic Age to the present day, according to the results of archaeological research in Tarsus. Archaeological heritage within the built-up area of the city is integrated with built environment elements such as traditional housing pattern, historic city center, Early Republican Period buildings [1, 2] and industrial heritage [3]. In addition to social and cultural features located at different points within historic city center, there are also intangible heritage items those are symbols of the city [4].

In 2013, Tarsus historic city center, was declared as 3rd Grade Archaeological Site by the Adana Regional Council for the Conservation of Cultural Properties Current conservation plan was approved in 1989. Studies on revision and provision of conservation plan studies have not been finalized yet.

In defined context, the Conservation-Strategy Guideline was prepared with the contract signed between Mersin Metropolitan Municipality and Mersin University, Faculty of Architecture in 2022. Within the scope of document, a guideline containing urban conservation strategies for the historic city center of Tarsus has been prepared. Within the scope of this article, findings and evaluations regarding the current situation based on field studies and questionnaires that form the basis for the guideline are presented, as the first phase of the project. In the second phase of the project, short-medium-long term conservation strategies and sub-project areas were developed, taking into account the problems and potentials identified specifically for the sub-regions within the project area. Implementation phase of conservation strategies and sub-project continue in line with these suggestions.

1.1. Brief history of conservation activities in Tarsus

The first conservation work for the historic city center of Tarsus was the registration of 40 buildings by the Supreme Council of Real Estate Antiquities and Monuments (GEEAYK) in 1977 [5]. During this period,

two areas of approximately 13 and 4.6 hectares within the city were designated as urban protected areas, while an area of 7.6 hectares around Gözlükule Mound and an area of 11.7 hectares around Donuktaş were designated as 1st Grade Archaeological Site.

In 1989, the Tarsus Municipality Council approved the Conservation Plan prepared by Istanbul Technical University to cover the designated conservation areas [6]. In the Master Plan, it is seen that in addition to the historic quarters, plan decisions were taken for the archaeological sites of Donuktaş and Gözlükule Mound (Figure 1). When we examine conservation plan and its annexes, it is seen that detailed assessments and analyzes had been made at the building scale. The registered buildings and street texture were preserved. In addition, historical axes were envisaged to be preserved as pedestrian roads. However, proposed buildings or infill development predominantly altered to be transformed into 2-3-storey pattern.

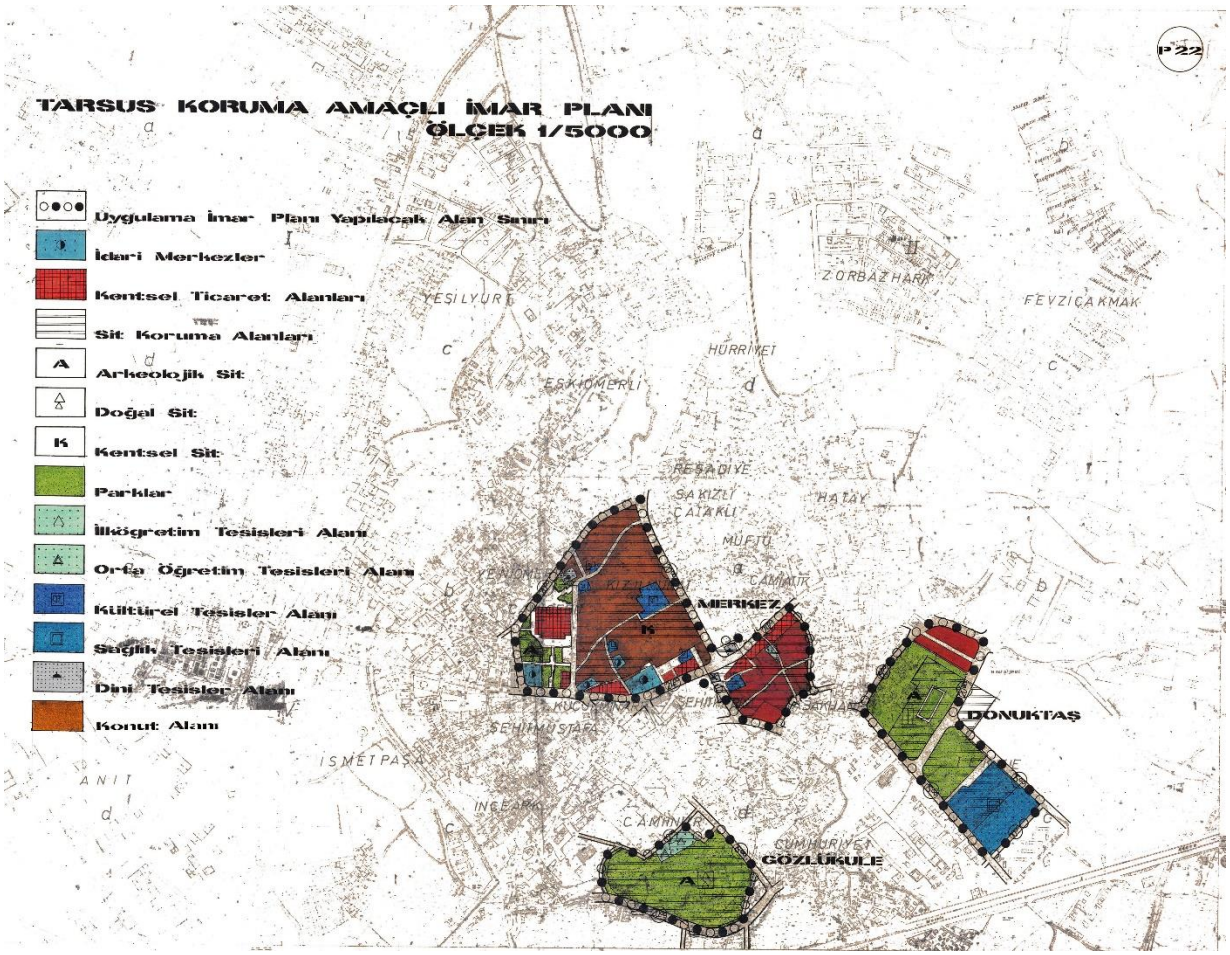

Figure 1. 1989 ITU Conservation Zoning Plan - 1/5000 (Tarsus Municipality Archive).

In the process that has continued until today, expect archaeological excavations, no site management intervention has been made in the archaeological sites despite the fact that a period of approximately 35 years has passed after the approval of the Conservation Plan. During this period, there has been development pressure outside the boundaries of conservation zones in the historic city center of Tarsus.

Development Plan approved by the Tarsus Municipality Council in 2013 enabled demolish-and-build processes in those areas. After Adana Regional Council for the Conservation of Cultural Properties declared Tarsus historic city center as 3rd Grade Archaeological Site, development plans in force in the entire city center are no longer valid. The transition period regulations in line with the decision were first approved in 2014. When we examine those regulations, it is seen that in addition to the Museum-controlled development processes, there were regulations to decrease planning rights in terms of the number of floors. However, due to the decisions regarding the decreasing of density and number of floors, the transitional period regulations were partially canceled by the Higher Council for the Conservation of Cultural Properties. In 2015, the regulations were revised and the current ones were approved in 2018 due to the expiration of the three-year period specified in the relevant legislation. During this process, a recommendation we prepared by the Regional Conservation Council to enlarge conservation boundaries including historic fabric around Ulucami, the Historic Trade Center and Altından Geçme. According to current legislation, conservation zoning plans should be prepared within 3 years after the declaration of conservation sites, but the Conservation Plan has not been prepared since 2013.

Tarsus, as a multi-layered settlement [7] structures, sites and archaeological remains should be integrated into daily life as a historical identity. The city has been a settlement of cultural and economic importance throughout its history [8-10]. The cultural and economic

life of the city in different periods is reflected in the built environment and socio-cultural life. Within this framework, the monumental and traditional structures that have survived to the present day and those that have disappeared but whose existence is known and still in the memory of locals; industrial heritage buildings and areas; archaeological heritage above and below ground; narratives and meanings related to beliefs and legends; and the food and beverage culture blended by the citizens within this rich diversity constitute tangible and intangible heritage values of the city. The strategic guideline is prior requirement for the conservation and management of these cultural heritage values. In this context, as mentioned above, a field study and a questionnaire were conducted to form the basis of the guideline. In the next section, firstly the research methodology and then the findings will be explained.

2. Method

In the preparation of a strategy guide for the historic city center of Tarsus, in addition to the historical-spatial evaluation and literature review of the area, the current situation of the city center was determined. The field study started in mid-June 2022 and at the end of approximately one month, the observations made during the field study were organized in a table to be associated with Geographical Information Systems. Prior to the determinations made in the field study, all of the buildings were coded by unique identification numbers. Based on these identification numbers, the buildings were examined from the street, an inventory sheet (Table 1) was filled out for each building and the building was photographed from the street from the appropriate facades. Due to the constraints of the work schedule and the project team, the identification/documentation work could only be carried out from the street/outside of the buildings. In the process of developing sub-scale project design and conservation strategies, it is recommended to carry out building-specific identification and analysis where necessary.

First, the functions of the buildings were documented in the inventory sheet. In addition to land use study, secondary data was also collected with open-ended texts in order to understand commercial and accommodation uses and possible traditional ones. In addition, data on the structural condition and construction system of the buildings were recorded. In terms of building type, not only registered buildings but also authentic buildings were identified through traces of different periods and constructions. Determinations were also made regarding the compatibility and harmony of new buildings with the historic environment in terms of massing and facade features. Findings regarding the current situation are presented in detail in the following sections.

Table 1. Inventory Sheet / Form.

Tarsus Project Identification Sheet					
Inventory No.		Expert Name		Door No:	
Date		Neighbourhood		Block / Parcel	
Function	Residential Education Health Unit	Residen.+Comme Administrative Religious	Commercial Bank Vacant	Type Accommodation: Other:	
Floor	High One Floor	Floor Basement	Half-Basement	Cihannüma / Belvedere	Winter
Building-Street Relationship	Street-Building	St.-Buil.-Garden St.-Buil-.Court.	St.-Gar.-Building St.-Court.-Buil.	St.-Buil+Garden St.-Buil+Court.	
Construction System	Reinforced Concrete Stone Masonry	Steel Mas.+Timber Frame	Timber Frame		
Structural Condition	Good	Moderate	Moderately Damaged	Heavy Damaged	Ruin
Building Type	Traditional New	Transition Period Mass: Compatible	Early Republic Incompatible	Modern Facade: Compatible	Incompatible
Spolia / Reused Material	present / absent				

In addition to the field study, a questionnaire was applied to evaluate the opinions of locals. 490 surveys were conducted in all neighborhoods in the study area; 82 Evler, Caminur, Cumhuriyet, Duatepe, Eski Ömerli, Fatih, İsmetpaşa, Kızılmurat, Reşadiye, Şehit Mustafa, Şehit Kerim, Tekke, Yeni Ömerli neighborhoods. With the survey questions, it was aimed to obtain information from the users about their personal profile, use of historical buildings, use of the historical city center, perception-consciousness level of historical texture and problems-demands.

3. Results

3.1. The Field Practice / Observations

3.1.1. Number of floors and traditional features

Traditional residential buildings in the historic city center of Tarsus have 1-3 storey. The height of monumental buildings depends on the type of building. When the study area is evaluated; 32.4% of the area is composed of single-storey; 50.9% is composed of two-

storey; 9.6% is composed of three-storey; 2.8% is composed of 4-storey; 2.3% is composed of 5-storey buildings; and 1.8% is composed of buildings above 5 floors. It is seen that single and two-storey buildings constitute the majority in the area. Buildings with 5 or more storeys are concentrated in the south east of the historical trade center and on the periphery of 3rd Grade Archaeological Site (Figure 2).

Considering that the traditional residential buildings in Tarsus have different forms according to social, economic and construction technique information, the ground floor height, the presence of a basement floor, the presence of a *cihannüma* (belvedere) and the presence of an intermediate floor called the winter floor (*kışlık*) constitute important data in the evaluation of the floor height. 88 buildings in the project area have basement floors; 16 buildings have semi-basement floors; 6 buildings have cihannüma; and 35 buildings have winter floors. While the presence of winter floors is concentrated in Kızılmurat Neighborhood, a small number of cihannüma are located in different neighborhoods in the study area (Figure 3).

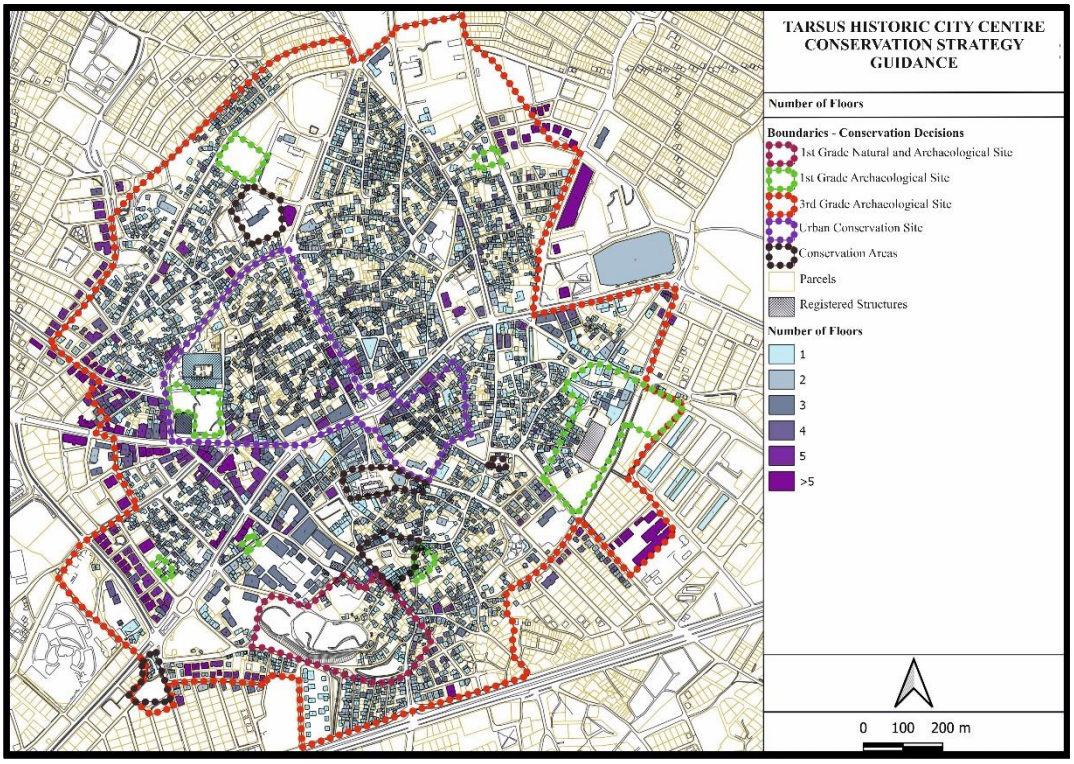

Figure 2. Number of floors.

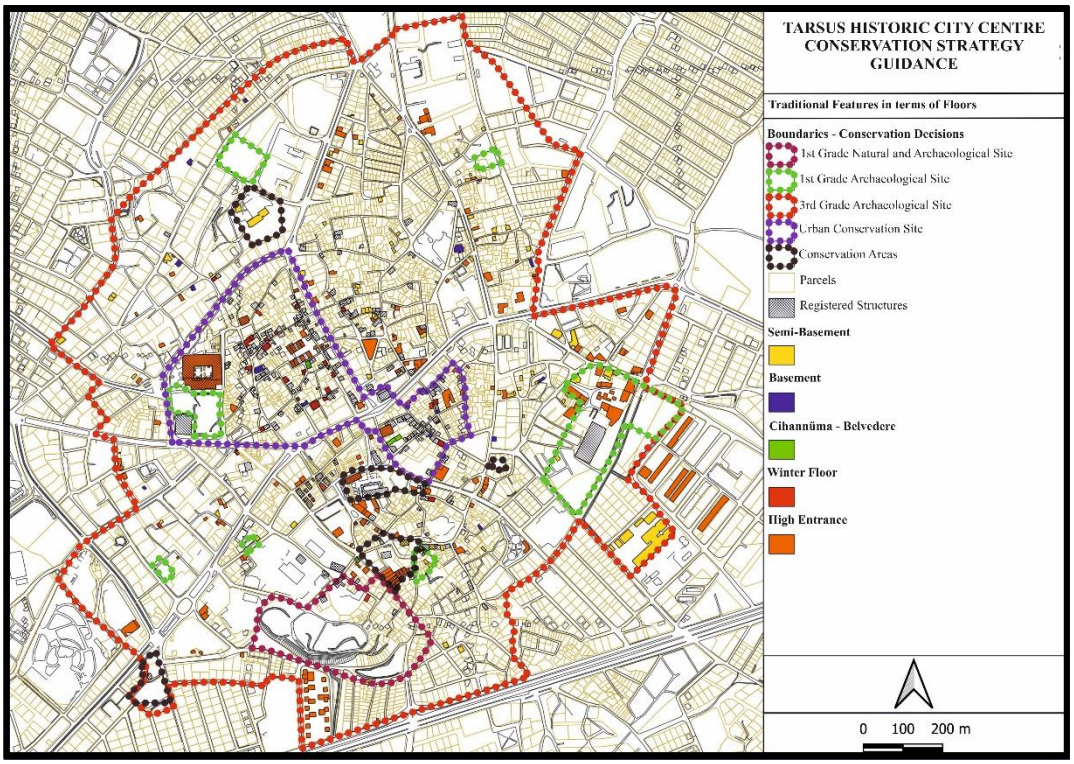

Figure 3. Traditional features in terms of floors.

3.1.2. Construction system

It is seen that the mixed construction system consisting of stone masonry and ground floor stone masonry with timber frame infill system is widely used in the traditional residential buildings in the historic quarters of Tarsus. The buildings constructed in the Republican period have a mixed construction system in which stone material and reinforced concrete beam-column system are applied together. The use of reinforced concrete system is common in multi-storey buildings built after the Republic.

In the project area, the following construction systems were found: timber frame with a rate of 2%; stone masonry with a rate of 21%; mixed system where stone masonry and timber frame are used together with a rate of 14.8%; mixed system where stone masonry and reinforced concrete are used together with a rate of 3.1%; reinforced concrete with a rate of 56%; steel with a rate of 0.4%; prefabricated with a rate of 0.1%; and brick masonry with a rate of 0.05% (Figure 4). Although some of the buildings built in reinforced concrete system are cultural assets that need to be preserved, it can be observed that they are not in compliance with current construction legislation. In historic quarters, there are traditional construction systems. New reinforced concrete buildings are concentrated in the south-east of the historical commercial center, where high-rise buildings are observed.

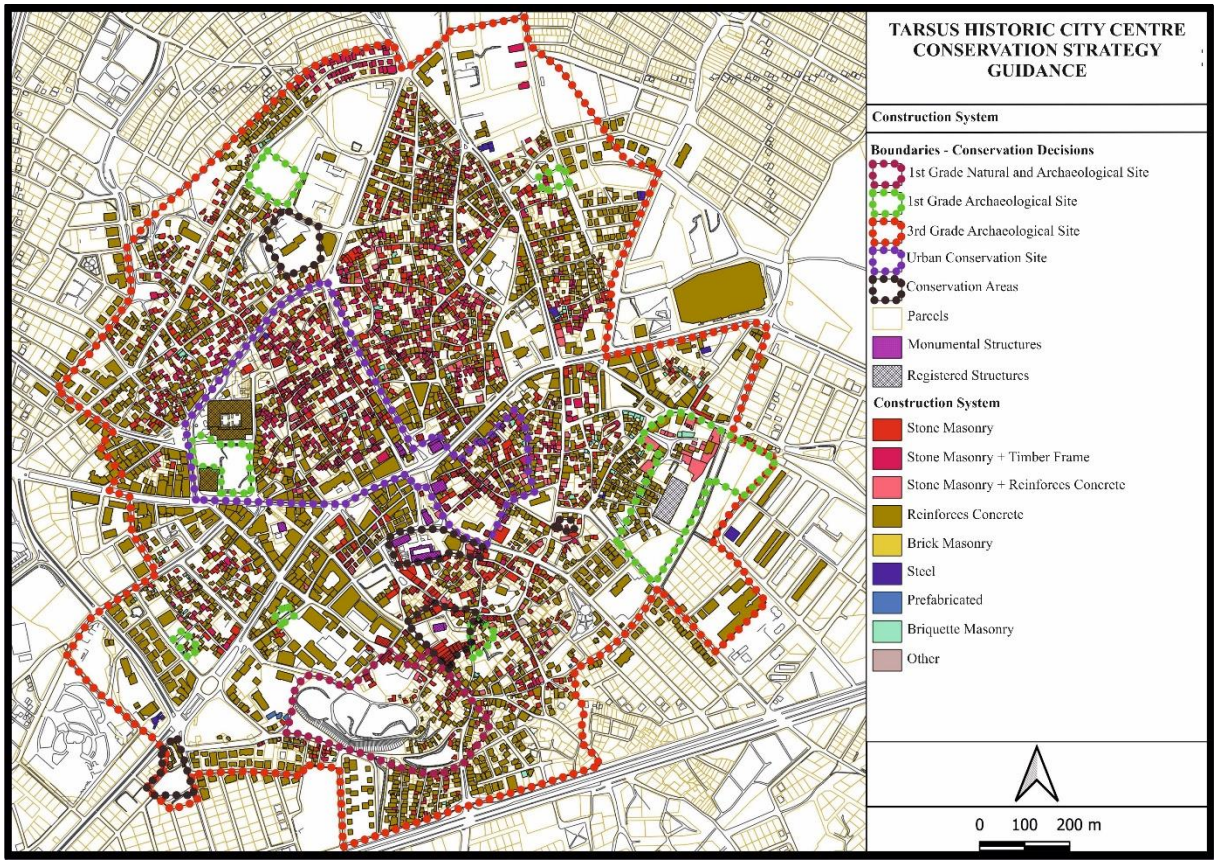

Figure 4. Construction system.

3.1.3. Building Type - Typology

Within the historic city centre of Tarsus, there are a significant number and variety of buildings that are examples of traditional architecture from the Ottoman period, monumental buildings from the pre-Ottoman period and archaeological finds, as well as a significant number and variety of buildings built after the Republic of Turkey that are cultural assets that need to be protected. As of 2021, there are 448 registered parcels within the project area, including 261 within the urban conservation area, 8 within the 1st degree archaeological conservation area, 157 within the 3rd degree archaeological conservation area and 22 within the protection areas [3]. As a result of field studies, 1438 traditional buildings, 147 buildings built after the Republic, which has traditional design and construction principles, 48 buildings built after the Republic reflecting the design approach of the period, and 8 buildings built in modern design approach were identified (Figure 5).

Traditional buildings are also concentrated outside the boundaries of the urban conservation site. Traditional houses are located towards the northwest, east and southeast of the historic commercial center.

According to the field study, there are unique unregistered structures that should be listed by a special study. In addition to the buildings built after the Republic, where traditional design and construction principles used, there are also buildings built after the Republic reflecting its period. By the way, historic city center is a unique characteristic of ongoing multi-layeredness. Modern buildings concentrated on Atatürk Street and Hilmi Seçkin Boulevard leading to Tarsus Station from the core of administrative buildings in the

historic city center towards the west. Both of these axes were opened after the Republic.

It is seen that multi-storey and adjacent buildings are concentrated on the boulevards and streets within the project area. These buildings are largely incompatible with the historic environment in terms of mass and façade. However, while the buildings in the area where the traditional street texture is preserved within the project area are partially incompatible with the historic environment in terms of façade features, they are compatible with the historic environment in terms of mass, more precisely, the building-parcel-street relationship and the number of floors (Figure 6).

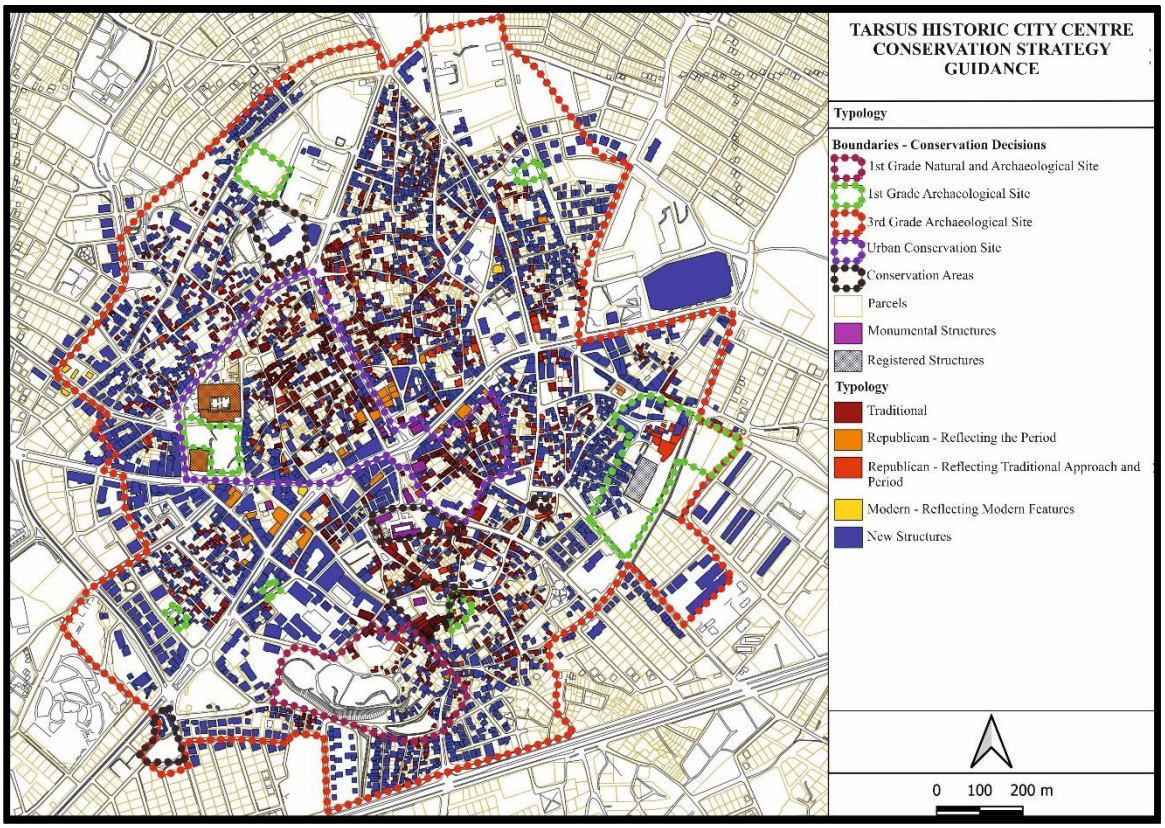

Figure 5. Building type – Typology.

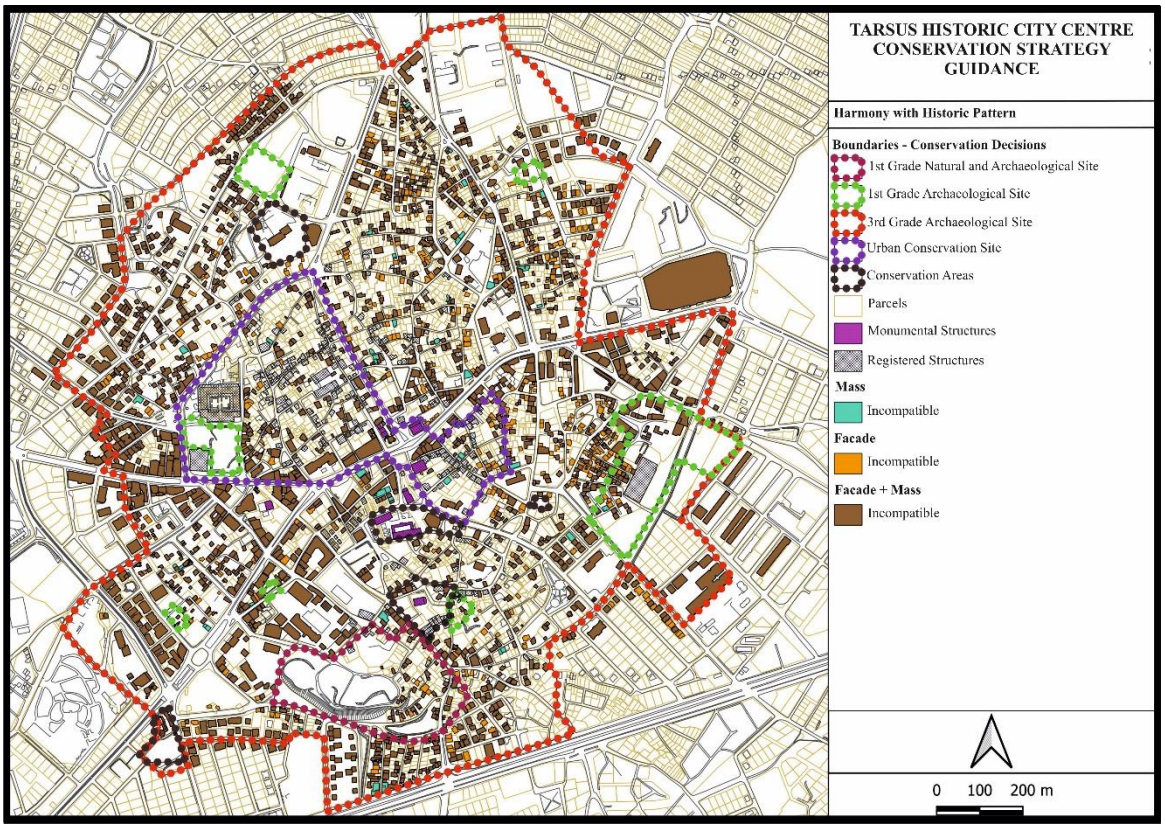

Figure 6. Harmony with historic pattern.

3.1.4. Structural condition

According to the visual surveys, 2.2% of the buildings in the area were determined as ruins, 2.7% as heavily damaged, 23.5% as damaged, 50.2% as in fair condition and 19.1% as in good condition. The percentage of buildings identified as heavily damaged and damaged according to the deterioration of the construction system and materials, and the percentage of buildings identified as ruins according to the state of collapse is 28.4%. The fact that 50.2% of the remaining buildings are in moderate condition indicates that physical deterioration in the building stock is intensive throughout the area. The number of damaged buildings is also high within the urban conservation site. In the area between 2722 Street and Turkmenistan Street and 3410 Street, the density of damaged buildings increases. Buildings in good condition are concentrated in the south-east of the historic commercial center and on the periphery of the Grade 3 Archaeological Site.

3.1.5. Land-use

Within the 3rd degree archaeological area designated as the project area, it has been observed that the vast majority of the buildings (approx. 61%) are used as residential buildings. There are also buildings used as Commercial + Residential. Commercial activities in the area are mostly concentrated on Atatürk Street and İsmet İnönü Boulevard to the west of the traditional historic commercial center (Figure 7). Among the commercial functions, food and beverage uses and accommodation areas that may preserve the vitality of the city center are also located on the main street axes starting from the traditional - historic trade center towards the west.

One of the important issues in terms of land use is that more than 5% of the buildings in the project area are vacant. These buildings mainly cover the traditional housing texture in Kızılmurat Neighborhood, the areas east of Ali Menteşoğlu Boulevard, Şehitkerim Neighborhood and the areas to the south. In Kızılmurat Neighborhood, especially the buildings in the areas north of the District Governorship are not occupied. Similarly, there are vacant buildings in the residential areas north of Siptili Bazaar. There are idle buildings in Şehitkerim Neighborhood and especially in the south of Ulucami. In this context, it is revealed that the buildings in the area, which are listed, cannot be actively utilized due to financial and/or management issues.

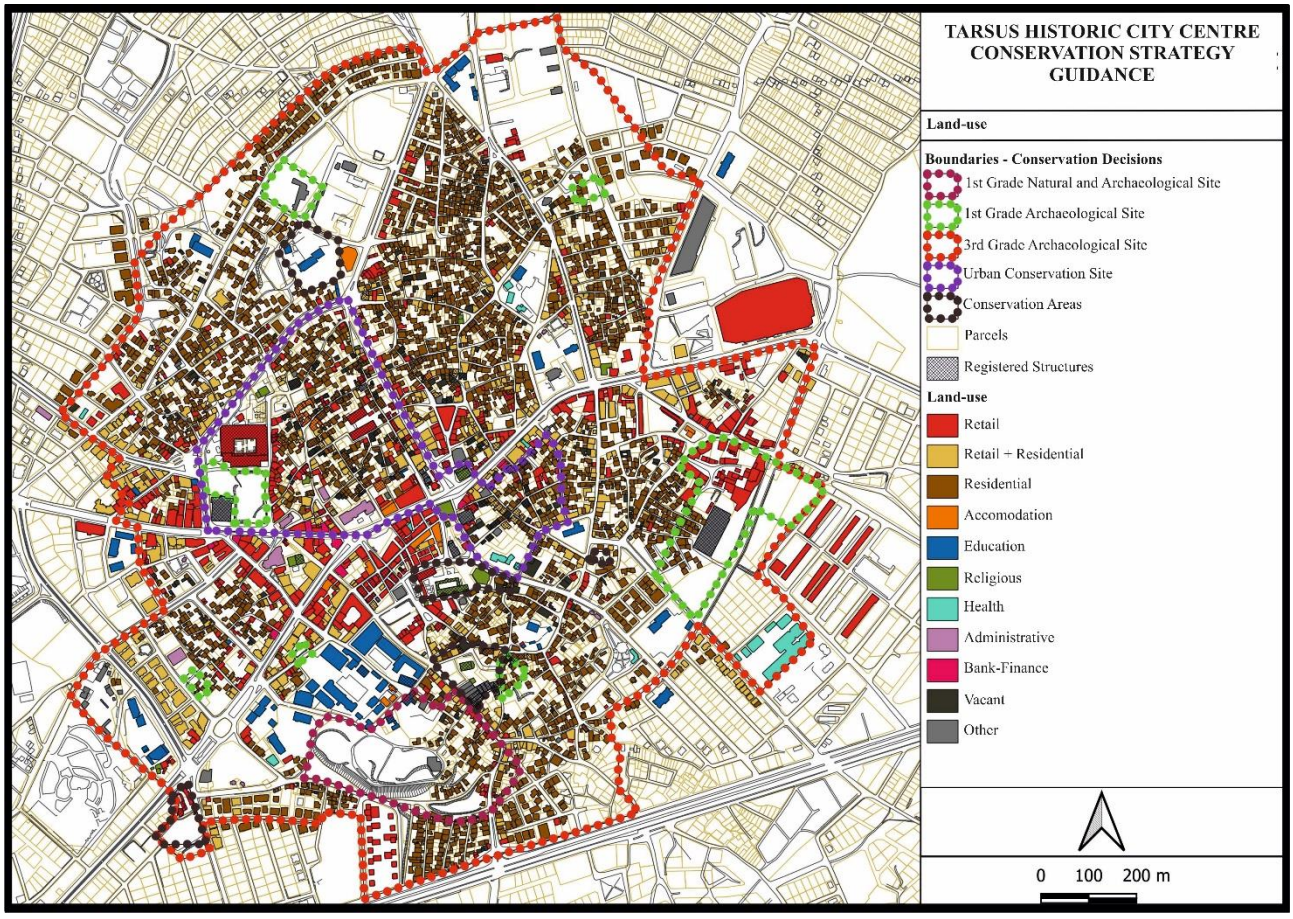

Figure 7. Land-use.

3.2. Questionnaire

Within the scope of Tarsus Historic City Center Conservation Strategy Guide, a questionnaire was applied to evaluate the opinions of the locals about the area. Of the 490 people who participated in the questionnaire, 40% were women and 60% were men. 32% of the participants were between the ages of 18-34, 45.3% were between 35-59 and 19.4% were 60 years and older. Of the respondents, 3% were literate, 26% were primary school graduates, 15% were middle school graduates, 33% were high school graduates, 6% were

associate degree graduates, 14% were university graduates and 2% were master's degree graduates. Of the respondents, 33.1% were artisans, 10.2% were retired, 10.2% were students, 9.4% were housewives and 3.3% were teachers. They are followed by farmers, workers, etc. There is 1.4% unemployed in the study area.

When we examine the income status in the historic city center, it is seen that the majority of the users have incomes below the minimum wage both in the historic trade center and in the traditional quarters. The survey questions consisted of open and closed-ended questions. According to the answers of closed-ended questions, descriptive, cross and frequency tables were prepared in SPSS program and graphs were prepared with MS Excel software. Closed-ended survey questions were evaluated in the order of "agree", "partially agree", "disagree" and "no opinion". The answers to open-ended questions were analyzed with qualitative techniques (discourse analysis). The survey aimed to measure the user profile, the perception and knowledge of locals about the use of the area and the historical texture, their awareness of the area, the priority area they identified and the priority action they expect for the area.

3.2.1. Use of historic entities

In order to measure the use of historic buildings in the area, the participants were asked the following questions: "Do you own a property that is a listed structure?" and "Are you a tenant in a building that is listed structure?"2.4% (12 people) of the users stated that they have a house and 0.4% (2 people) a workplace; 0.2% (1 person) at home and 0.8% (4 people) as tenants. Of these users, 6% were very satisfied, 9% were satisfied and 3% were not satisfied with the historic building they own. As deficiencies and problems, the users stated that the plaster of the building is falling off, the building is worn out, the roof is leaking and that they cannot easily perform maintenance and repair in the face of these deficiencies. For the problems and deficiencies, the users stated that maintenance and repair of gardens and open spaces, reinforcement of balconies, roof repairs, and strengthening of buildings are necessary.

3.2.2. Use of historic city center

The question "How often do you come to Tarsus Historic City Center?" was asked to the users regarding the use of the area. Of the respondents, 27.3% stated that they use the area 1-2 times a month, 22.4% every weekday, 10.6% 1-2 times a week, 7.8% 3-4 times a week, 7.3% every day and 5.3% every weekend. The fact that about one third of the users come 1-2 times a month shows that shopping is done from the city center on a monthly basis, and that about one third come every weekday (22.4%) and every day (7.3%) shows that the area is a historical business area. On the other hand, weekend use is low at 5.3%.

The other question asked about the use of Tarsus Historic City Center is about how much time they spend in the area. In response to the question "How long do you spend when you visit?", 35.9% of the users stated that they spend 1-2 hours, 19% less than 1 hour, 13.7% 3-4 hours, and 9.4% 2-3 hours. Approximately 42% of the participants use the area for sightseeing and visiting, 21% use the area because their workplaces are located in the Historic City Center, 16% of the users come for individual needs, 5% for eating and drinking, and 4.3% for shopping for groceries. When this situation is evaluated, it is seen that more than half of the users use the area for sightseeing, walking around and eating and drinking.

Approximately 36% of the users come to the Historic City Center by bus or minibus, 31.6% on foot, and about a quarter (24.5%) by private car. This is followed by bicycles (3.7%) and motorcycles (3%). In this area, access by public transportation and on foot is quite popular in the Historic City Center. Bicycle use and access is low.

3.2.3. Perception of historic environment

In order to evaluate the perceptions of the historic environment of Tarsus Historic City Center, questions related to the historical fabric were asked. In this context, participants were asked whether "historic structures are sufficiently conserved in Tarsus". Approximately 60% of the users stated that they are not conserved, 19% stated that they are conserved and 19% stated that they are partially conserved. Another question asked in relation to the subject is related to "what kind of attitude should be taken towards historic entities". In response to this question, the majority of the users (93.5%) stated that all of the historic buildings should be conserved, 5% stated that there is no need to conserve all of them and that it is sufficient to conserve enough to set an example.

In order to evaluate the participants' views on the area and what the Historic City Center means to them, the question "What importance and meaning do historic buildings and areas carry for you?" was asked. 37% of the users stated that its reflect the past and culture of the society and are important documents in this respect. Approximately 37% of the users stated that they are important and meaningful because they are touristic places, approximately 10% because they provide job opportunities and economic gains, 9% because they help us understand the lifestyles and technologies of ancient people, 3% because they provide visual richness to cities, approximately 3% because they are the heritage left to us by our ancestors and 1% because they create visual materials to teach children about the past.

In relation to the area, participants were asked the question "What are the most important historic entities and sites in Tarsus?". According to the users, Cleopatra's Gate (28%), Eshabı Kehf Cave (18%), St. Paul's Well (16%), Makam Mosque, St. Paul's Church, Roman Road, Donuktaş Temple, Great Mosque, Historic Tarsus Houses, Gözlükule Mound, Kırkkaşık Bedesteni, Gözlükule Mound and Historic Tarsus Houses are the most important historical buildings and sites (Figure 8).

Another question asked to the participants is where there is a structure or place that can be used to describe Tarsus and be a symbol of Tarsus. In this context, approximately 34% of the users stated that Eshabı Kehf Cave and 28% of the users stated that Cleopatra's Gate

describes Tarsus very well and can be a symbol of Tarsus. In addition, Tarsus Waterfall, Şahmeran, Tarsus houses, Yarenlik, and St. Paul's Well were also mentioned as places that could be symbols of Tarsus. Another question asked to the users is where improvements should be made in Tarsus Historic City Center. In this context, 17% of the users suggest that the Ancient Roman Road, 16% suggest the Historic Tarsus houses, and 9% suggest Cleopatra's Gate.

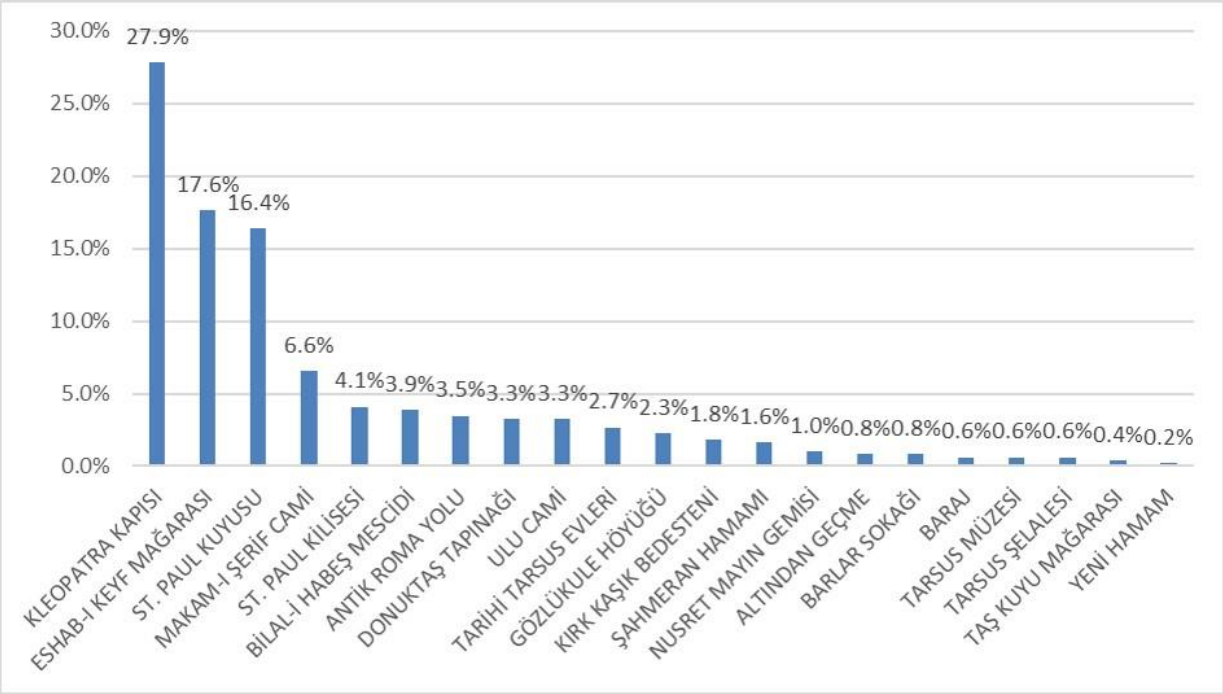

Figure 8. Perception of historic environment.

4. Discussion

In order to assess the adequacy of open space uses, walkability, safety and accessibility in Tarsus Historic City Center, closed-ended questions were asked on a graded scale (agree-somewhat agree-disagree-no opinion).

With this evaluation, about half of the users stated that the open spaces and parks in the area are sufficient, benches and resting areas are sufficient, but the arrangements such as ramps and special flooring for disadvantaged groups are insufficient and they cannot walk comfortably in the area. They stated that there are not enough cultural and artistic activities in the area and that the variety of uses and activities in this area is not sufficient. They stated that the density of vehicle traffic in the area is a deterrent factor for pedestrians to use the city center. It was also stated that there is not enough parking space in the area.

The majority of the users stated that there is a lot of noise caused by traffic. Approximately half of the users stated that the lighting of the area at night is good, but the area is not safe at night; open shops and residential areas to be located in the area can provide security to a certain extent.

Tarsus Historic City Center has largely survived its unique characteristics. Within the urban pattern of the Ottoman period, there are archaeological sites belonging to the historical periods of the city, monumental buildings of the Principalities period and qualified buildings built after the Republic. In addition, industrial buildings mostly based on cotton production, constitute the industrial heritage of the city. With these qualities, the city is a multi-layered city that hosts buildings, areas and sociocultural aspects belonging to the cultures it has hosted throughout its history. Although residential buildings have started to be abandoned and adapted to new functions in recent years, most of the monumental buildings and residences continue their original functions in the city as a whole.

However, there is significant physical deterioration especially in residential buildings. Some of the qualified buildings built during the Republican period have been demolished and destroyed, and the buildings that have survived to the present day continue to be damaged due to interventions that disrupt the original structure.

5. Conclusion

Tarsus is a legendary city that has many priorities and importance in all religions. It also has intangible heritage values with these features and the fact that it still contains behavioral patterns and information belonging to its cultural past. In this framework, it is important to protect all tangible and intangible values with a holistic approach.

The basic assumption in contemporary conservation approaches is to conserve cultural assets in their original form and function. The fact that the historic city center, which has multicultural and multi-layered cultural values, is still included in the daily life of the inhabitants of Tarsus, as seen in the survey results, supports the approach of preserving the area with its original use.

Tarsus is an important destination due to its historical and cultural values. In recent years, with the establishment and opening of hotels in the historic fabric,

the city is becoming a tourism area with accommodation rather than a day visit. There is a potential for an increase in tourism demand for the city. On the other hand, as identified in questionnaire evaluations, the citizens still use historic area in their daily life and want to continue their cultural way of life while demanding the arrangements required by contemporary life.

Within this framework, the basic approach of the conservation strategy of Tarsus Historic City Center is determined to conserve and sustain the historic buildings and areas with their original use, the primary target group is determined as the residents in Tarsus and the type of tourism is decided to be a controlled cultural tourism, in a way to provide visitors to experience cultural daily life of the city.

For the buildings that have lost their original function, functions that will provide social and economic benefits to the citizens and support the buildings to remain in the daily life of the city have been proposed. Within the scope of the project, alternative sightseeing routes have been determined and presentation proposals have been developed for heritage buildings and sites, taking into account tourism use and visitor demands. Within the framework of guidance map created within the scope of this strategy document, conservation projects continue to be designed.

The experiences to be gained after the implementation of the stated conservation approach, which is based on the sustaining the continuity of original use with local residents, will set an example for similar multi-cultural and multi- layered areas.

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This article presents basic information and field studies regarding the research project titled as "Tarsus Historic City Center Conservation Strategy Document - Guideline" prepared with the contract signed between Mersin Metropolitan Municipality and Mersin University.

Author contributions

Züleyha Sara Belge: Conceptualization, Methodology, Field study, Discussions, Writing-Reviewing and Editing
Burak Belge: Conceptualization, Methodology, Field study, Discussions, Writing-Reviewing and Editing
Meltem Uçar: Conceptualization, Methodology, Field study, Discussions, Writing-Reviewing and Editing
Ümit Aydınoğlu: Conceptualization, Methodology, Field study, Discussions, Writing-Reviewing and Editing.

Conflicts of interest

The authors declare no conflicts of interest.

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Culture and arts management: A bibliometric analysis using software

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Abstract

This article aims to make a comparative analysis of academic publications on cultural management and art management in the field of architecture through software programs. The bibliometric analysis method was used as a method in the research. This method is an effective analysis method to show the trend of existing publications from an objective and quantitative point of view and to create visual maps. The data of the study were collected between February 29, 2024, and March 15, 2024. The analysis of the research data was carried out with the VOSviewer software program. An evaluation was made according to the findings of these analyses. As a result of the research, it was concluded that the number of publications in the field of culture and arts management is low and more research should be done in the field. In addition, this publication aims to examine and reveal the visibility of academic publications in the field of culture and arts management and to contribute to future research by evaluating existing publications through software programs.

1. Introduction

"Culture is the transfer of material and spiritual values such as eating, drinking, dressing, handicrafts, language, religion, literature, traditional folk dances, traditions, and customs produced by one or more societies in the historical process from generation to generation in a complete manner." [1]. The concept of culture is also a dynamic concept that shapes human behavior and the development of the social environment as an indispensable part of social life. In the social sciences, culture refers to the interactions of individuals and communities in areas such as thought, art, education, and philosophy, and the reflections of these interactions on social heritage and traditions. In the historical process, the structure and scope of the concept of culture have been handled by different disciplines with various definitions, and these definitions have led to the view of culture as the development of the intellectual structure in society and how individuals adapt to the environment [2]. Culture management refers to the process of creating, sharing, sustaining, and developing cultural values in organizations. This concept includes a set of strategies, practices, and methods that shape the cultural identity of businesses and organizations. When the literature on Cultural Management is reviewed, the current publications that can be accessed are [3-5]. Cultural Management in the context of local governments [3]. Comparatively examined arts and cultural management education in Turkey and the world [4], examined, street music and street musicians in the context of cultural management [5]. Art is an aesthetic reflection of natural and social realities. This aesthetic dimension gives people pleasure and joy, gives new perspectives, distances them from single truths, destroys prejudices, leads people to behave like human beings, enlightens brains, and sensitizes hearts [6].

Arts management: is the direction of art and artists in a scientific sense. It aims to acquire the knowledge and experience necessary for the management of art forms such as courses, workshops, galleries, theaters, and concerts. It also includes business creation, investment, capital raising, price calculation, promotion, and protection. An art management is also is under the influence of the political, economic, social and ideological conditions of the environment; it is also closely linked to the personalities of the managers [7].

Table 1. Main references on culture and arts management.

Author (s). Year	Reference	Publication Titles	Publisher
Dewey, P. (2004).	[8]	From arts management to cultural administration.	International Journal of Arts Management
DeVereaux, C. (2018).	[9]	Arts and Cultural management.	Routledge.
Hua, F. (2018).	[10]	Arts and Cultural Management. Arts and Cultural Management: Sense and Sensibilities in the State of the Field.	Routledge.
Mandel, B. (2017).	[11]	Arts/cultural management in international contexts.	Georg Olms Verlag AG.
Ebewo, P., & Sirayi, M. (2009).	[12]	The concept of arts/cultural management: A critical reflection.	The Journal of Arts Management, Law, and Society
Jung, Y., Vakharia, N., & Vecco, M. (Eds.). (2024).	[13]	The Oxford Handbook of Arts and Cultural Management.	Oxford University Press.
Paquette, J., & Redaelli, E. (2015).	[14]	Arts management and cultural policy research.	Springer.
Paquette, J., Redaelli, E., Paquette, J., & Redaelli, E. (2015).	[15]	Academic beginnings: Arts management training and cultural policy studies.	Arts management and cultural policy research,
Evard, Y., & Colbert, F. 2000.	[16]	"Arts Management: A New Discipline Entering the Millennium?"	International Journal of Arts Management,
Chong, D. 2000.	[17]	"Re-readings in Arts Management."	The Journal of Arts Management, Law, and Society,
Chong, D. (2009).	[18]	Arts management.	Routledge.
Byrnes, W. J. 1999.	[19]	Management and the Arts, 2nd edition.	Boston: Focal Press
Pick, J. & Anderton, M. 1996.	[20]	Arts Administration, 2nd edition. .	New York: E & FN SPON
Radbourne, J. 1996.	[21]	Arts Management: A Practical Guide.	Sydney, Australia: Allen & Unwin.
Wroblewski, L. 2017.	[22]	Culture Management: Strategy and marketing aspects.	Logos Verlag Berlin.

A review of the literature on arts management reveals that recent publications [7, 23, 24], discussed the subject in the context of art management and the roles, functions, and importance of art managers [7]. For comprehensive main references on arts and culture management (Table 1). The roles and functions of arts management and arts administrators and their impact on society are discussed in this article [23], examined that arts management should be addressed in different contexts within the arts and the role of the curator in arts management [24]. The pyramid in Figure 1 shows a conceptual map of theoretical use in arts management research.

In this research, the concepts of culture and arts management will be examined through bibliometric analysis management through studies conducted in the field of architecture. The current publications of the research will contribute to the categorization of past publications. In this research, the concepts of culture and arts management will be examined by examining the bibliometric analysis of management through the studies conducted in the field of architecture. This research will contribute to the existing publications, categorizing the past years and revealing effective studies.

Figure 1. Conceptual map of theoretical use in art management research [25].

2. Method

Bibliometric analysis is a quantitative method used to systematically examine and describe published articles from past to present. It helps researchers evaluate academic studies in the field they focus on [26, 27]. Bibliometric analysis examines secondary data obtained in a digital database using secondary data from a quantitative and objective point of view [28]; therefore, it can offer a systematic, transparent, and reproducible review process and subsequently improve the reliability and quality of the review [29]. In this study, bibliometric analysis, which is a quantitative research method, was used as a method [30-33]. In addition, bibliometric analysis is a technique used to quantify the factors that determine the quality of research. Bibliometric analysis is based on the indicators that it depends on the methodology based on the reliability related to the research topic and requires data sets obtained from relevant databases on the subject [34-36].

In the literature, there is a bibliometric analysis method in culture and arts management research. Examples of these are arts and culture [36], arts-based management [37], cultural and creative industries [38], cultural heritage [39], art therapy [40], and organizational culture [41].

This research is a systematic literature review and scientific mapping method. A systematic literature review was conducted between February 29, 2024, and March 15, 2024, using Web of Science Core Collection databases. In the data collection phase of the research, publications between 2020-2024 were included in the research, while publications from other years were excluded from the Web of Science Core Collection database [16]. In the Web of Science Core Collection database, the research words "Cultural Management" (Topic) or "Arts Management" (Topic) or "Cultural Management" and "Arts Management" (Topic) or "Culture and Arts Management" (Topic) or "Arts" (Topic) or "Culture" (Topic) or "Arts" (Topic) or "Culture" (Topic) were searched in six separate lines in the Topic words. Architecture was selected as a category in the database. The data were collected between February 29, 2024, and March 15, 2024. In the second step of the research, network visualization was performed by analyzing the data accessed from the Web of Science Core Collection database through VOSviewer software. In this analysis, the relationship networks between authors, citations, countries and most used words were visualized [42].

3. Results

This section describes the findings obtained from the data collected between February 29, 2024, and March 15, 2024. The data accessed from the Web of Science Core Collection database were analyzed through VOSviewer software and network visualization was performed.

3.1. Co-authorship of authors

According to the co-authorship analysis of the authors, a network map was created by determining at least 1 publication and at least 1 citation criteria to identify the most connected and collaborating authors. According to the analysis conducted among the names with the highest number of connections between them, it was determined that there were 14 names combined in 2 clusters and 63 connections in total. Each of the 3 most connected authors in the cluster had a total of 39 connections. The figures show in detail network visualization (Figure 2) and density visualization (Figure 3).

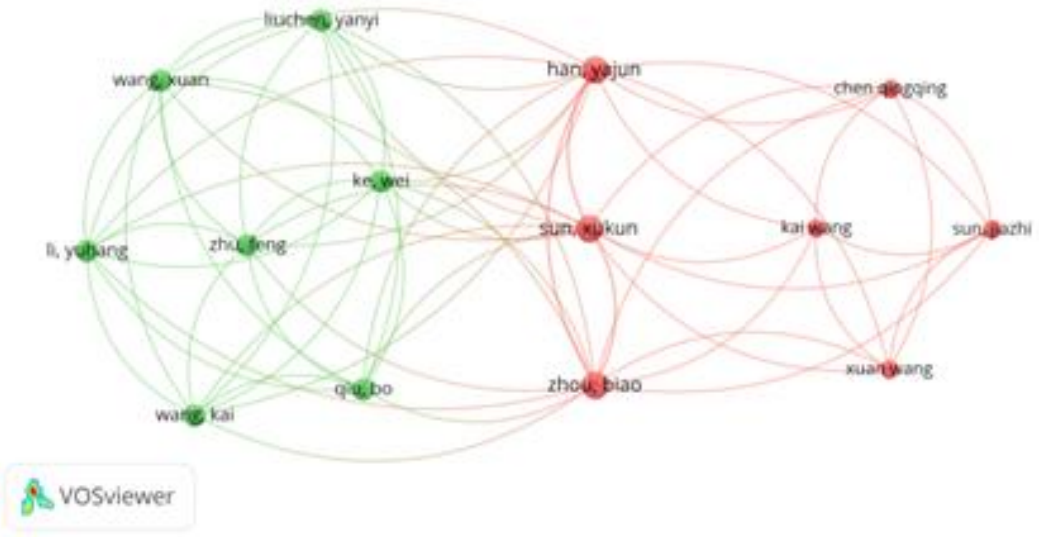

Figure 2. Co-author links demonstrating collaboration between authors (Network visualization).

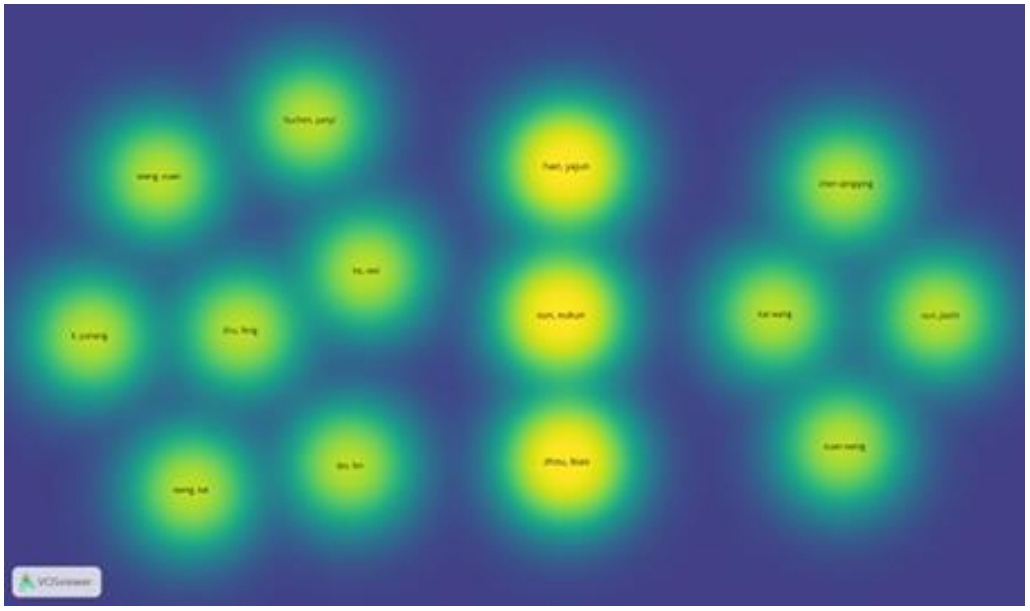

Figure 3. Co-author links indicating collaboration between authors (Density visualization).

3.2. Citation of authors

In order to identify citation networks, a network map of author citation analysis with at least 1 publication and at least 1 citation criterion was created. In the analysis made on 7 units that were found to be connected to each other, it was determined that there were 2 clusters and 14 connections in total. The most cited authors are 28 citations. These three authors are not in the top three in terms of total link strength (Figure 4) and density visualization (Figure 5).

3.3. Citation of countries

To create a network map of the citations of publications by country, 66 observation units with a relationship between them were analyzed within the scope of the criteria of publishing at least 1 work by a country and receiving 1 citation. 7 clusters, 23 links, and 29 total link strengths were identified. The countries with the highest number of citations were Italy (160 citations), the People's Republic of China (149 citations) and the UK (90 citations). In terms of total link strength, only the People's Republic of China is among the top three countries. In terms of the number of publications, Italy (246 publications), Spain (221 publications), and the United States of America (219 publications). The figures show in detail network visualization (Figure 6) and density visualization (Figure 7).

3.4. Citation of organizations

To create a network map of inter-institutional citations, an analysis was made on 502 observation units with a relationship between them within the criteria of publishing at least 1 work by an institution and receiving 1 citation. University of Polytechnic Madrid (44 publications), Polytechnic University of Milan (32 publications), and University of Valladolid (22 publications) were represented, while the address institutions of the most cited publications were Delft University of Technology (44 citations), University of L'Aquila (30 citations) and University of Florence (29 citations). In terms of total link strength, none of these institutions ranked in the top three. In total, 2 clusters, 5 links, and total link strength of 6 were identified. The figures show in detail network visualization (Figure 8) and density visualization (Figure 9).

3.5. Co-occurence of all keywords

When we look at the most frequently used minimum 5 criteria and keywords in publications on Culture and Arts Management, the words Architecture with 83 repetitions, London with 34 repetitions, Culture with 34 repetitions, Cultural Heritage with 31 repetitions, and Art with 30 repetitions are in the first place. In terms of total link strength, the strongest expressions were London (117), New York (102), and Architecture (90). As a result of the analysis conducted with 163 observation units that were seen at least 5 times and had a relationship between them, a total of 7 clusters, 1002 links, and 1435 total link strength were identified. The figures show in detail network visualization (Figure 10) and density visualization (Figure 11).

3.6. Bibliographic coupling of documents

Bibliographic matching analysis is used to understand important topics, key concepts, and relationships between these concepts in the scientific literature. According to the analysis conducted with 203 unit works selected with the criterion of having at least 1 citation and having links between them, 19 clusters, 476 links, and 576 total link strength were obtained. The publications with the highest number of bibliographic matches were [43] with 28 citations, [44] with 26 citations, and [45] with 22 citations. The works with the highest total link strength were [46-48]. The figures show in detail network visualization (Figure 12) and density visualization (Figure 13).

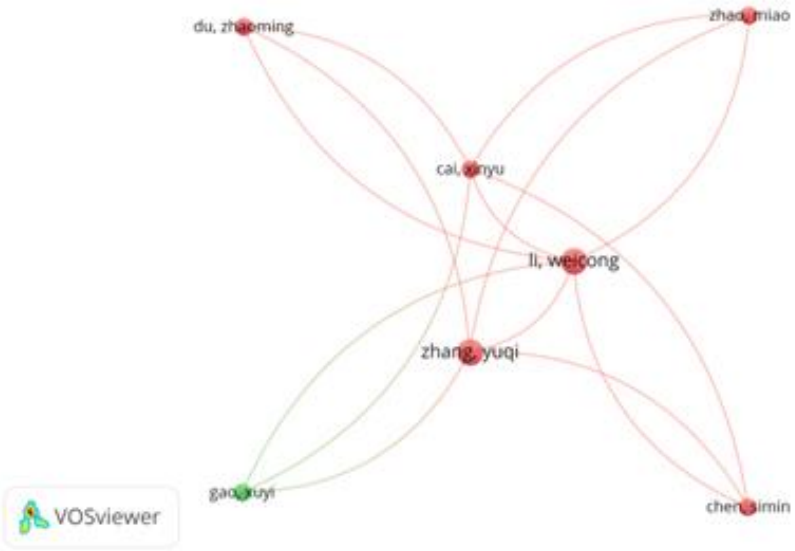

Figure 4 Author citation links (Network visualization).

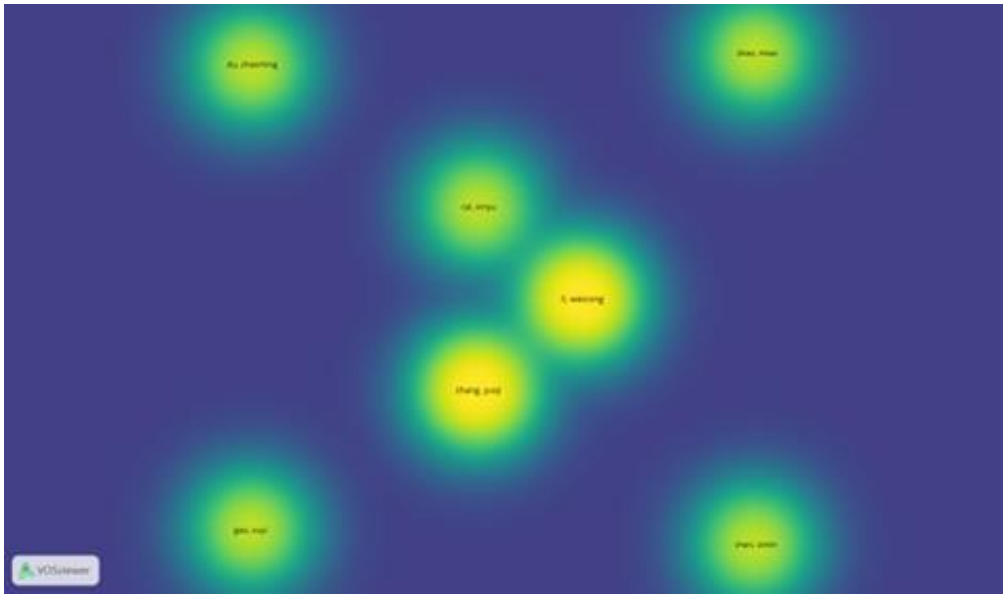

Figure 5. Author citation links (Density visualization).

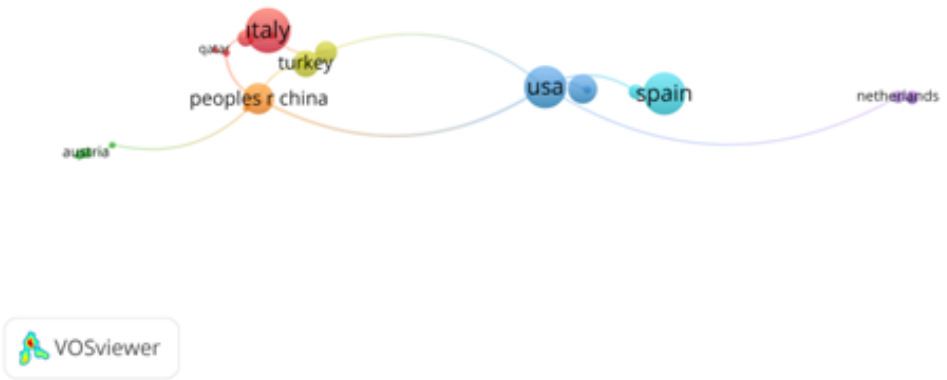

Figure 6. Country citation links (Network visualization).

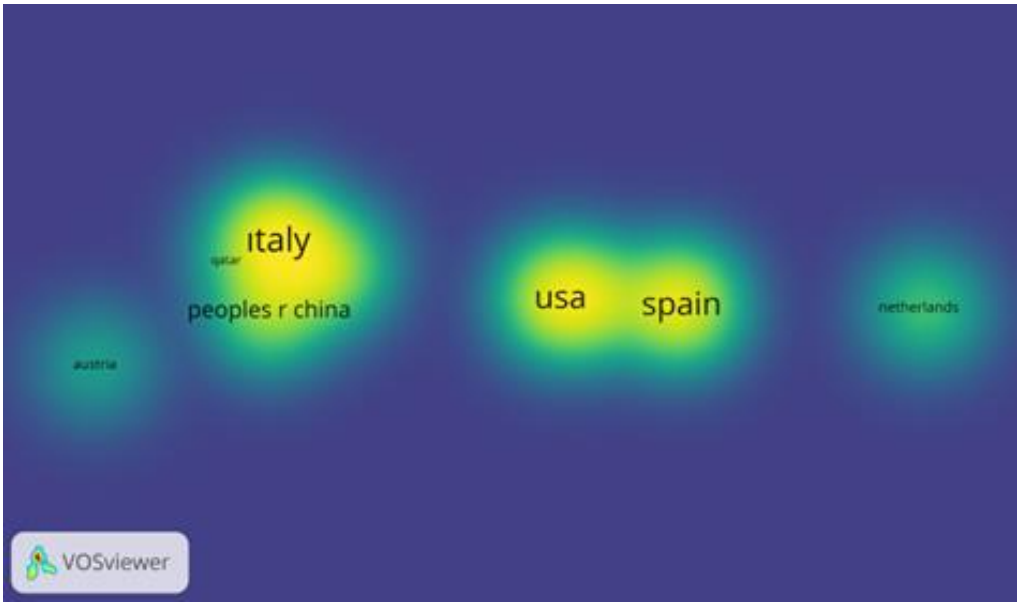

Figure 7. Country citation links (Density visualization).

Figure 8. Affiliation citation links (Network visualization).

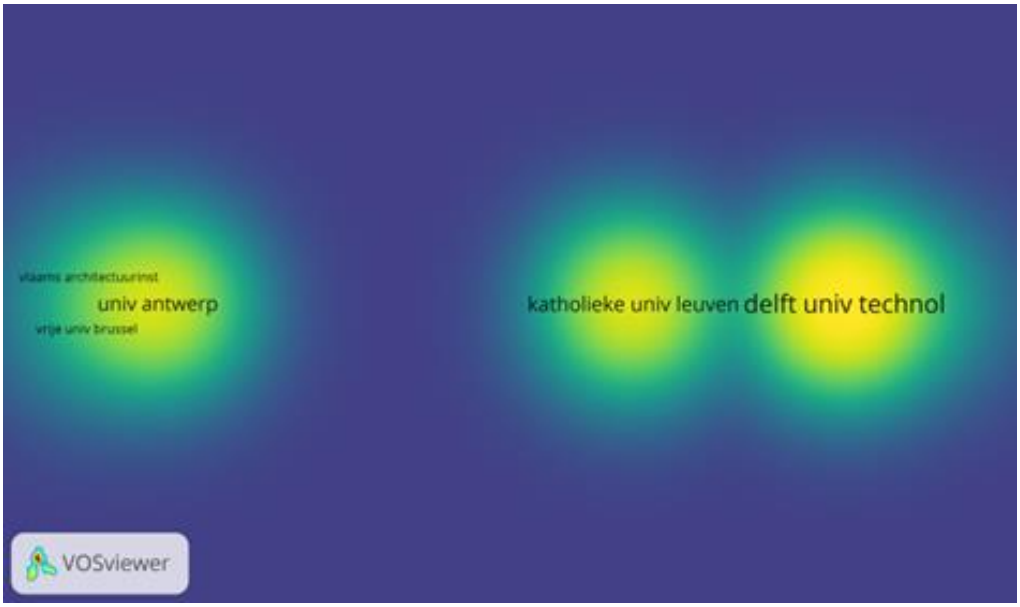

Figure 9. Affiliation citation links (Density visualization).

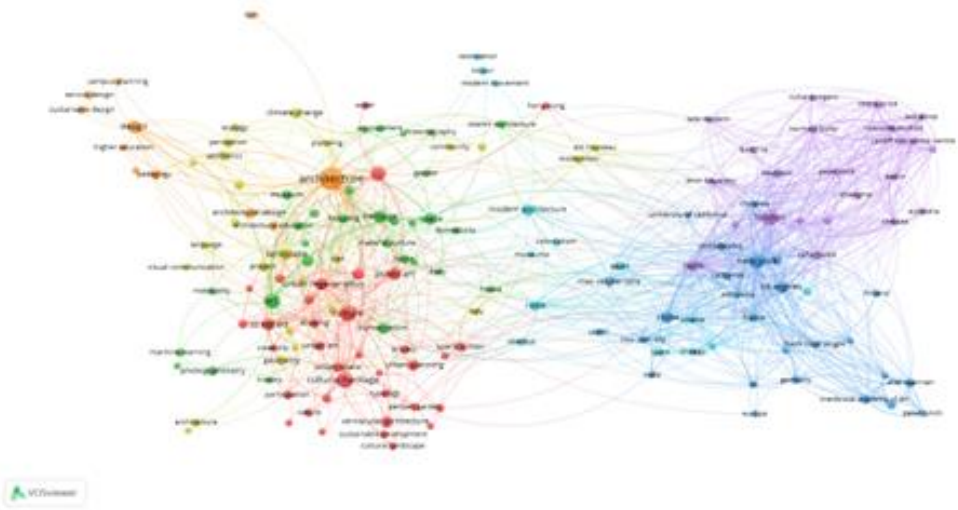

Figure 10. Keyword links (Network visualization).

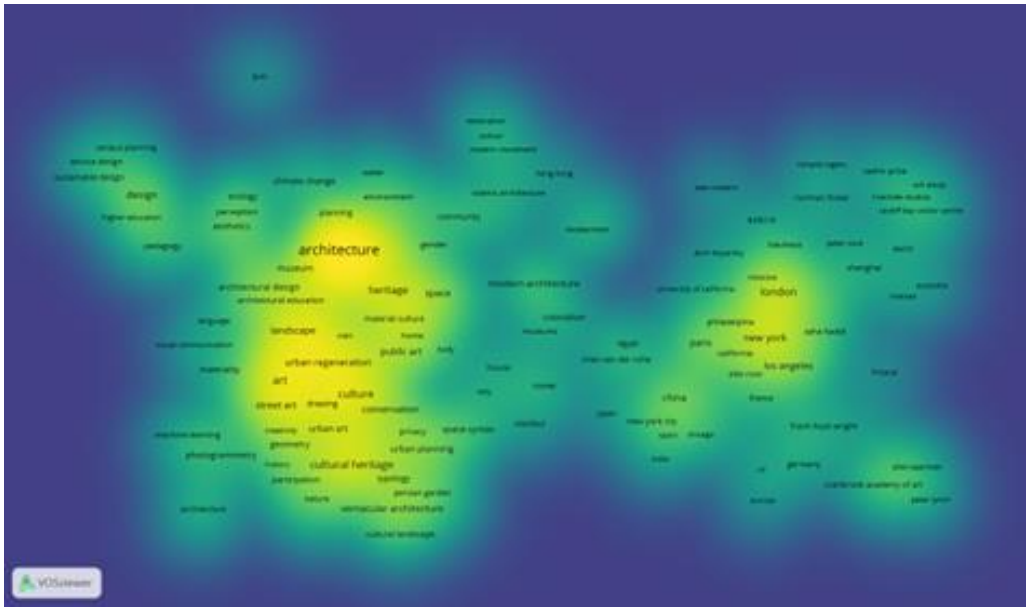

Figure 11. Keyword links (Density visualization).

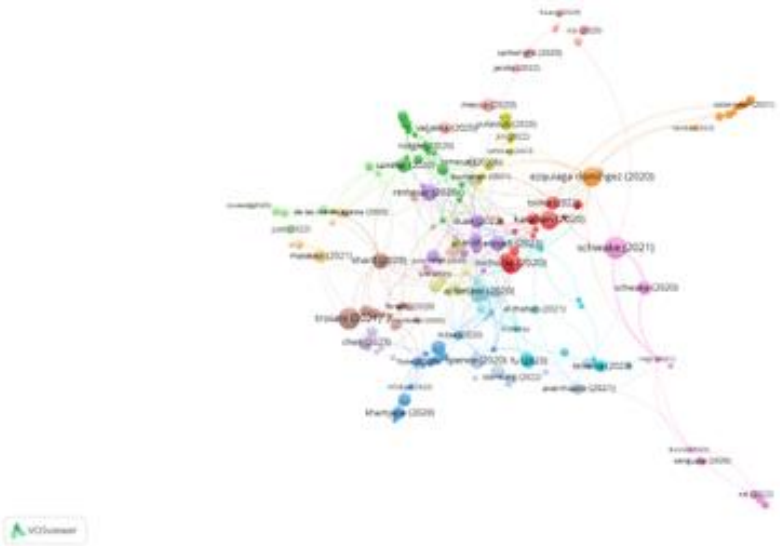

Figure 12. Bibliographic coupling links of texts (Network visualization).

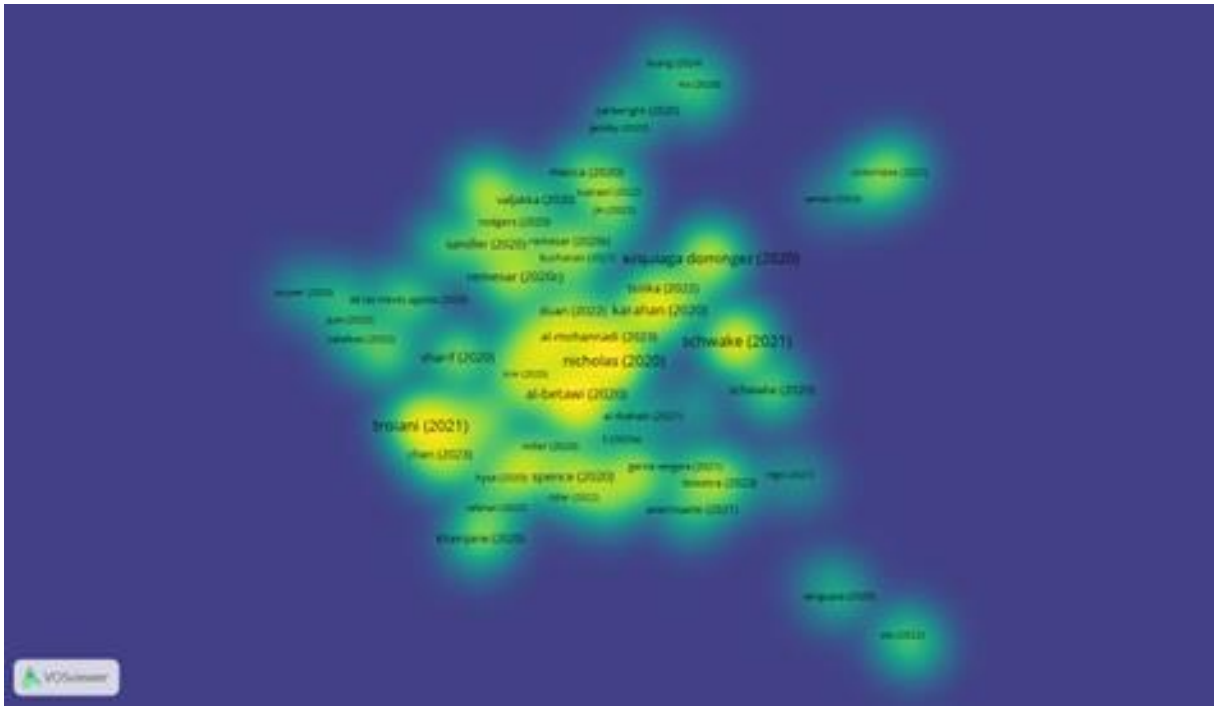

Figure 13. Bibliographic coupling links of texts (Density visualization).

3.7. Bibliographic coupling of authors

According to the analysis conducted with 452 units selected with the criteria of having at least 1 published work and 1 citation, 41 clusters, 2769 links, and 23698 total link strength were obtained. The authors with the highest number of bibliographic matches were [49] with 5 citations (697 link strength), [50] with 5 citations (697 link strength), [51] with 5 citations (697 link strength), and [52] with 5 citations (697 link strength). The figures show in detail network visualization (Figure 14) and density visualization (Figure 15).

3.8. Co-citation of cited-authors

Different sources cited in a publication are called co-citation. According to the analysis conducted over 48 units with a minimum number of 18 citations, 6 clusters, 466 links and 1894 total link strength were determined. The figures show in detail network visualization (Figure 16) and density visualization (Figure 17).

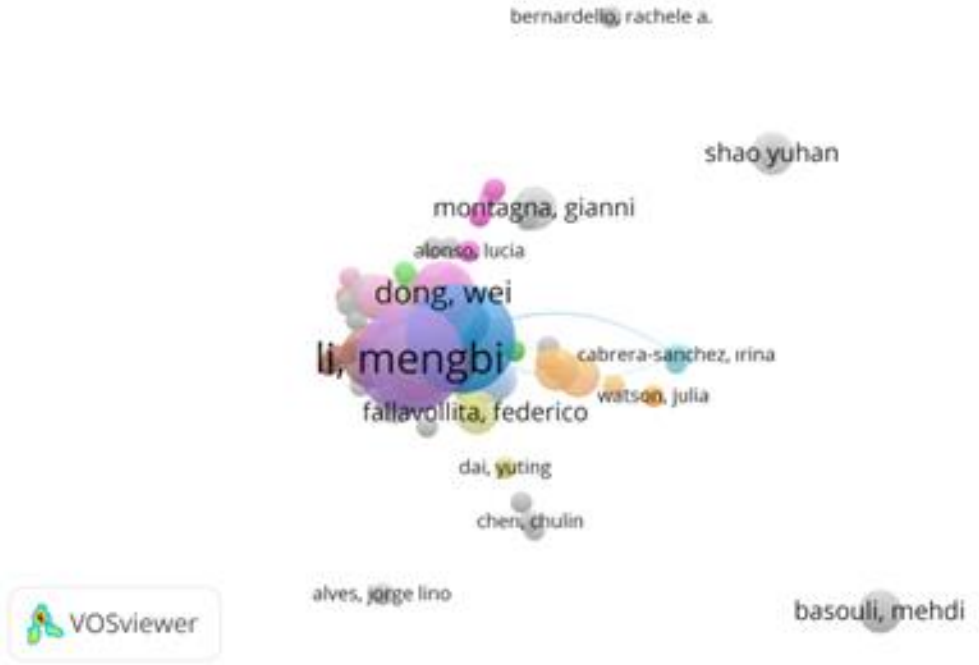

Figure 14. Bibliographic coupling links of authors (Network visualization).

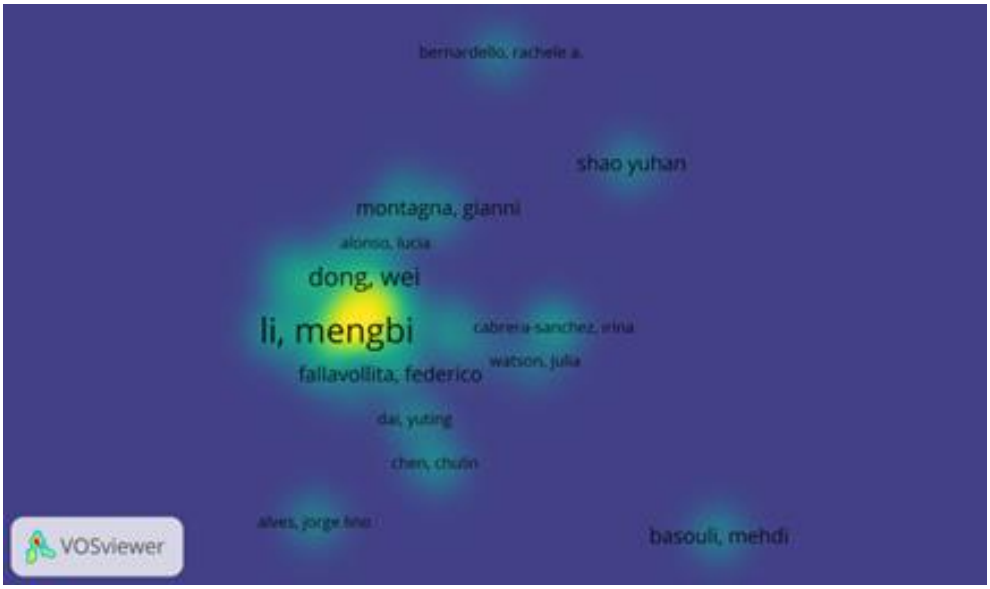

Figure 15. Bibliographic coupling links of authors (Density visualization).

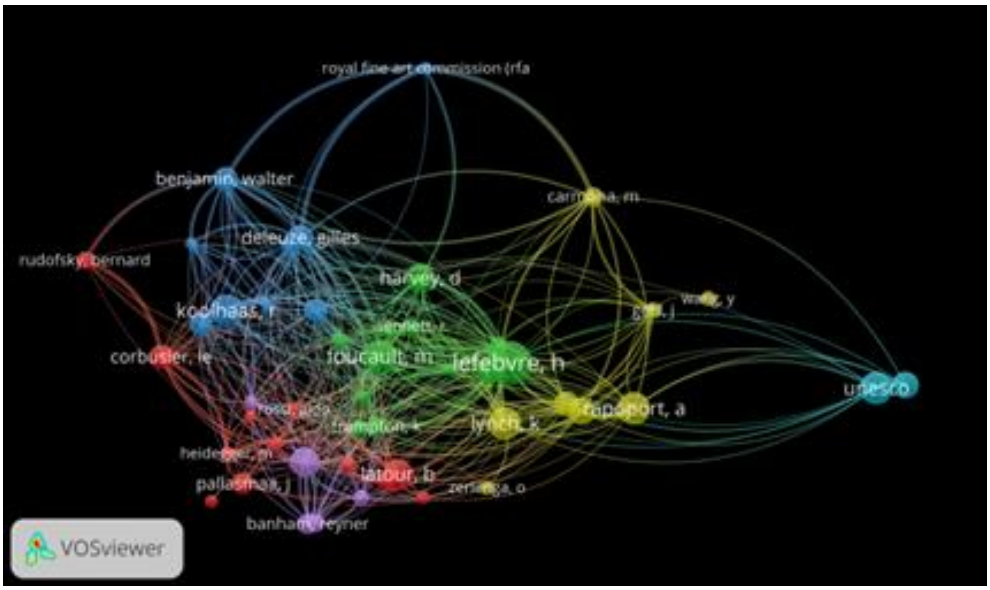

Figure 16. Co-citation of cited-authors Links (Network visualization).

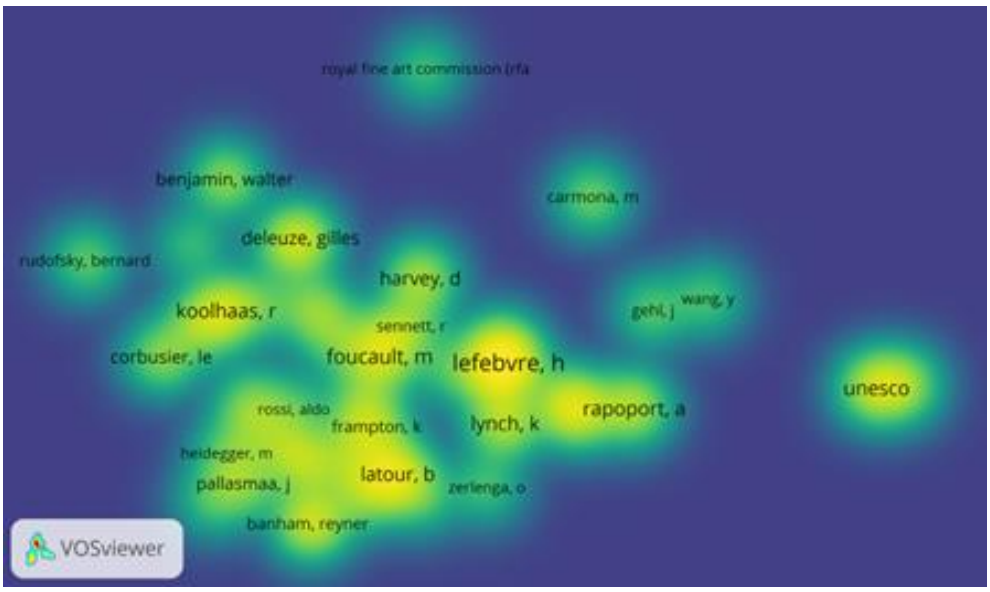

Figure 17. Co-citation of cited-authors links (Density visualization).

4. Discussion

According to the co-authorship analysis, it is seen that the most cited authors and the authors who produce the most works are not the same people. This reveals that the authors who produce the most works are not the most productive. When the citation analysis of the countries was analyzed, it was found that Italy was the country with the highest number of citations and the highest number of publications. According to this result, it is concluded that Italy has high publication productivity.

According to the keyword analysis, Architecture, which is the most recurring keyword, was found to be among the top three words with the highest link strength. Also, culture and arts management and most relevance publications are in Web of Science; choosing cultural management as a profession [53], mapping arts management graduate education [54], the concept of arts and cultural management [55], students' perceptions of arts and cultural management [56], the way academic programs for arts and sciences in Germany have changed cultural management curricula and teaching methods [57]. In additionally, cultural management students' expectations of internships in arts and sciences [58], a critical look at curricula in arts management [59], how arts and cultural management have changed historically in Brazil [60]. In addition, implications for arts management [61], critical issues for research in arts management [62], and research of arts management educators' teaching on diversity issues [63].

Comprehensively analyzing these publications, and comparing their aims, methods, and findings, provides important literature for future research and analysis of publications related to culture and arts management in the field of architecture [64]. The recent increase in research on arts and culture management is a positive development for the development of this field.

5. Conclusion

Culture management refers to the process of creating, sharing, sustaining, and developing cultural values in organizations. This concept includes a set of strategies, practices, and methods that shape the cultural identity of businesses and institutions.

Art Management, on the other hand, refers to the field of study of the people who manage and organize art from the creation of art until it reaches the end consumer. Arts management ensures coordination between artists, galleries, museums, theaters, concert halls, and other arts institutions. It also plays an active role in issues such as marketing, financing, organization, and promotion of art.

The relationship between these two fields places arts management and organization in a cultural context. While arts management provides the skills necessary for organizing and managing cultural events, cultural management takes a broader perspective on cultural policies, social interactions, and the functioning of the cultural industry. Working together, arts and cultural management professionals play an important role in enhancing the impact of the arts on society and preserving cultural heritage.

In this article, publications in the literature on culture and arts management in the category of architecture in the Web of Science database were analyzed [65]. In the WoS (Web of Science) database, 2102 publications published until March 15, 2024 were reached. These publications were analyzed by the bibliographic mapping method. Bibliographic analysis was performed in the VOSviewer program, including co-authorship of authors, citation of authors, citation of countries, citation of organizations, keyword analysis (co-occurrence of all keywords), bibliometric coupling of documents, bibliographic coupling of authors, bibliographic coupling of authors, and co-citation of co-authors. Network visualization and density visualization analyses of these analyses were performed in the VOSviewer program.

This article has some limitations. First of all, the data was accessed only from the WoS (Web of Science) database. The research area is limited to architecture. In addition, to provide a general perspective, studies from the last five years between 2020-2024 were analyzed. The studies examined in this study were subject to numerical research. The publications subject to the research were not critically analyzed in terms of quality, content, and originality. There are a few points that can be considered as suggestions for future research. In order to bring an up-to-date perspective, data from the last ten or twenty years can be analyzed with the same method. New research can be conducted by expanding the scope of the research on culture and arts management in the field of architecture or by using different keywords. In this way, a larger data set can be obtained and evaluations can be made in future studies. In addition, data sources such as Scopus, Google Scholar, and ProQuest Dissertations and Theses can be expanded to include more publications on architecture-culture management-arts management. Finally, this publication prepared using the scientific mapping technique can also be done using other bibliometric analysis programs. In summary, this study will provide a different perspective on culture and arts management issues analyzed under the category of architecture.

In conclusion, to summarize the importance of this research, the importance of culture and art, culture and art management for architecture; as a human subject, architecture has a cultural and artistic identity. In order to better understand the relationship between architecture and culture, some artifacts should be analyzed. There are references that examine the effects of culture on architecture and the relationship between culture and architecture [66-68] and art and architecture [69-71]. Moreover, the architect's mission is to regain the individual artistic heritage, cultural roots, and self-consciousness from the past, because only then can a lasting impact be created Architecture is part of the identity of each community and carries the message of the culture of that society. Therefore, architecture depends on the geography, cultures, traditions, manners, and knowledge of the community, as well as its history. Also, both arts and culture are important ways to maintain or strengthen a strong

sense of community, build a personal identity, and show creativity [72-75]. In recent years, many master's programs in the field of culture and arts management have started at universities. It is suggested that these master's students and curricula should be examined and a more comprehensive study and focus should be made on this subject.

Author contributions

Seçkin Tekin: Conceptualization, Methodology, Software, Field study **Emine Banu Burkut:** Data curation, Writing-Original draft preparation, Software, Validation, Field study **Murat Dal:** Visualization, Investigation, Writing-Reviewing and Editing.

Conflicts of interest

The authors declare no conflicts of interest.

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