Proposed Urban Designs for the Streets Leading to the Holy Shrines in Karbala City

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Abstract

The research aims to prepare proposed urban designs for the streets leading to the two holy shrines in the city of Karbala, considering them as religious, service, and movement axes with intensive daily and seasonal use. The study was based on an analytical-applied methodology, including field visits, direct measurements, photographic documentation, and personal interviews with relevant authorities, as well as analyzing the current state of the streets and their design and environmental issues. The analysis results were converted into two-dimensional and three-dimensional plans using AutoCAD software, to clearly and practically illustrate the distribution of landscaping elements, water features, sidewalks, urban furniture, and services. The proposed designs included Imam Abbas Street, Imam Hussein Street, and Bab Baghdad, incorporating appropriate vegetative, water, and ground treatments to improve thermal comfort and the quality of the urban landscape. The results showed that the lack of vegetation cover and the high surface temperatures are among the most prominent existing problems, and that introducing organized planting, water elements, rooftop gardens, and light-colored materials contributes to improving the local climate and regulating movement. The study recommends adopting these designs as practical and implementable solutions that consider the identity of the place and the comfort of the visitors.

Keywords: Urban design, Proposed designs, Shrine streets, Streetscape design.

Introduction

Urban streets are considered public spaces that significantly affect the quality of the urban environment, users' health, and their thermal comfort; they are no longer viewed merely as paths for movement and transit. Consequently, their improvement has become closely associated with increasing vegetation cover, developing open spaces, and reducing thermal exposure, especially in hot cities suffering from high temperatures and declining green areas. Studies confirm that green spaces contribute to supporting physical and mental health, and that thermal comfort has become one of the fundamental issues in contemporary urban planning and design [1,2,3]. At the regional level, the importance of these treatments becomes even greater in cities located within hot and dry climatic contexts, where urban streets are exposed to intense solar radiation, high surface temperatures, and limited shading opportunities. In such environments, improving streets requires comprehensive design solutions that go beyond conventional beautification measures and include vegetation, shading systems, water elements, cool paving materials, and efficient service organization in order to enhance environmental performance and urban livability [4].

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At the local level, this importance increases in the streets leading to the two holy shrines in Karbala because of their functional, religious, service, and symbolic roles, especially during the million-visitor events. These streets accommodate intense pedestrian movement and represent major urban axes within the holy city. Therefore, their development requires comprehensive design solutions that go beyond merely planting trees, and instead incorporate rooftop gardens, cool materials, low-thermal-mass pavements, water elements, and service spaces, in a way that achieves both thermal comfort and urban scene quality [4]. According to [5], stakeholder involvement is a critical factor in developing realistic and implementable urban design solutions.

Despite the growing importance of thermal comfort and sustainable urban street design, previous studies have mainly focused on general environmental treatments, theoretical recommendations, or partial proposals related to greening and urban enhancement, without sufficiently transforming these directions into clear and implementable urban design plans for the streets leading to the two holy shrines in Karbala. In other words, what remains insufficiently addressed in previous studies is the translation of environmental and functional needs into integrated two-dimensional and three-dimensional urban design proposals that clearly organize movement, services, planting, pavements, water features, and urban furniture in a practical and readable manner.

Accordingly, the research problem lies in the fact that the streets leading to the two holy shrines in the city of Karbala, despite their great importance and high usage, still need more clear and comprehensive urban designs in terms of organization, environment, and aesthetics. Many of the proposed solutions remained within the realm of general ideas and did not transform into clear design plans that could be understood and practically utilized. Hence, there is a need to prepare proposed urban designs for these streets using AutoCAD, which helps to display the elements of urban space accurately, systematically, and practically. The research gap stems from the limited number of applied scientific studies that deal with the streets leading to the two holy shrines in Karbala as integrated urban spaces requiring analytical diagnosis and practical design output. There is also a lack of studies that connect thermal comfort improvement, crowd management, urban planning, and environmental sustainability in the holy city through detailed and implementable design proposals.

The importance of the research lies in its contribution to supporting crowd management, improving urban planning efficiency, and promoting environmental sustainability in a sacred city characterized by high pedestrian density and seasonal pressure. It also seeks to enhance the functional, environmental, and aesthetic performance of the streets leading to the holy shrines, while taking into account the identity of the place and the comfort of visitors. In this sense, the study does not only address the visual improvement of streets, but also contributes to proposing practical solutions for regulating movement, reducing thermal stress, and improving the urban environment in one of the most important religious urban centers.

The research aims to prepare proposed urban designs for the streets leading to the two holy shrines in Karbala using AutoCAD, by producing clear design plans that reflect the organization of movement, landscaping, water elements, pavements, and urban

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furniture. This contributes to improving the streets' efficiency functionally, environmentally, and aesthetically, making them more suitable for daily and seasonal use.

Materials and Methods

Design Standards for Streets Leading to the Holy Shrines

The proposed urban designs for the streets leading to the two holy shrines should be based on clear and recognized design standards in order to demonstrate that they are grounded in accepted planning and engineering principles rather than in purely artistic vision. In this study, these standards can be grouped into three main categories: functional standards, environmental standards, and visual-aesthetic standards. Together, these standards help define the street not only as a path for movement, but also as a space of movement, service, and crowd accommodation.

1. Functional Standards

Functional standards focus on the operational efficiency of the street in terms of movement and service. These include providing pedestrian path widths that correspond to the density of human flow, organizing longitudinal and transverse movement, reducing conflicts between pedestrian circulation and service spaces, distributing rest areas and urban services appropriately, and ensuring spatial flexibility under both normal conditions and during million-visitor events. In this context, pedestrian capacity becomes a critical design consideration, particularly in streets that experience high seasonal crowd pressure. The proposed sidewalk organization improved pedestrian capacity, particularly during million-visitor events, by reducing spatial conflicts, maintaining clearer movement corridors, and enabling safer accommodation of high pedestrian densities.

2. Environmental Standards

Environmental standards are especially important in this study because they are directly related to improving thermal comfort and reducing heat stress in the hot urban environment of Karbala. These standards include achieving suitable shading ratios along pedestrian routes, using trees and other vegetation to reduce solar radiation and temperature, selecting paving materials with low heat absorption, incorporating water elements and visual cooling techniques, making use of rooftop gardens, and reducing thermal stress in order to improve the overall visitor thermal experience. Such measures play a major role in enhancing the microclimatic performance of the streets and supporting the comfort of visitors during both daily use and peak pilgrimage periods.

3. Visual and Aesthetic Standards

Visual and aesthetic standards are essential in the streets leading to the holy shrines because of their symbolic and spiritual value. These standards include preserving the visual axes leading toward the minarets and domes, avoiding elements that obstruct the symbolic view of the sacred urban scene, integrating planting, water elements, and urban furniture in a way that is consistent with the identity of the place, ensuring the clarity of entrances, nodes, and stopping points, and achieving a balance between visual attraction and visual order without creating unnecessary visual disturbance[3] .

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The research adopted an analytical-applied methodology. It relied on the base plans of the selected streets, field visits, photographic documentation, direct measurements, and information related to the existing conditions and uses of the streets, in addition to observations obtained through personal interviews with the authorities concerned with the development of these axes. The work began with diagnosing the spatial, functional, and environmental reality of the selected streets and identifying their main design problems. This was followed by the adoption of a set of design principles related to movement organization, landscaping, water elements, services, pavements, and urban furniture. The resulting data were then transformed into proposed urban designs using AutoCAD software through the preparation of two-dimensional and three-dimensional plans that clearly illustrate the spatial distribution of the proposed elements, making them readable, analyzable, and practically applicable [6].

The study area is located in Karbala City, which lies at an elevation of approximately 32 m above sea level and is characterized by a hot desert climate, with very high summer temperatures that may exceed 45–50°C, mild winters, and limited rainfall. Geographically, the city is located at approximately 32.6164° N latitude and 44.0324° E longitude. These climatic and urban conditions increase the importance of green spaces and environmental design treatments in improving thermal comfort and the quality of urban life for both residents and visitors.

The study focused on three main streets leading to the two holy shrines in Karbala: Bab Baghdad Street, Imam Hussein Street, and Imam Abbas Street. These streets were selected because of their historical, religious, service, and movement roles, as well as their intensive daily and seasonal use, especially during pilgrimage periods. Field observations indicated that pedestrian density in the study streets generally ranges from about 1–2 persons per square meter under normal daily conditions, while it may rise to approximately 4–5 persons per square meter during major million-visitor pilgrimage events.

To enhance the applied dimension of the study, coordination was carried out with the engineering departments of both the Imam Hussein Holy Shrine and the Imam Abbas Holy Shrine, according to the location of each street within the study area. Initial design proposals were presented to these authorities, and their technical observations were considered in order to improve the realism, efficiency, and practical applicability of the proposed designs, Figure (1 & 2).

Field observations also showed that the planting policy in the selected streets is limited and unbalanced, with weak vegetation continuity, irregular distribution, and low plant diversity. In Bab Baghdad Street in particular, planting was largely confined to a single irregular line of heavily pruned *Conocarpus erectus* trees, which reduced shading continuity and limited the environmental effectiveness of the planting along the pedestrian path. This reflects the absence of an integrated design vision capable of improving the local microclimate and enhancing thermal comfort, particularly during periods of high visitor density.

In addition, the study benefited from climatic and spatial data representing the main environmental conditions of the area. These included temperature, relative humidity, rainfall, and evaporation data, as well as satellite imagery from Landsat sources to support the understanding of

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environmental and vegetation changes over time. Such data helped provide a broader spatial and climatic background for evaluating the streets and guiding the proposed design treatments, Figure (3) and Table (2).

Personal Interviews

To strengthen the applied dimension of the study, the researcher maintained direct communication with the engineering departments of both the Imam Hussein Holy Shrine and the Imam Abbas Holy Shrine at several stages of the research. This communication constituted an essential part of developing the design proposals and linking them to the implementation reality. Table (1). It was not limited to a single interview or a specific phase; rather, it included a series of formal and informal meetings and field visits, exceeding ten interviews throughout the research period. These meetings enabled the gradual discussion and refinement of the design ideas with the concerned authorities.

The interviews were based on oral questions and direct discussions conducted by the researcher during the meetings. They addressed several issues, including the presentation of preliminary design proposals, movement organization, planting distribution, the selection of tree and shrub species, the possibility of implementing rooftop gardens, and the suitability of the proposed environmental and climatic solutions to the reality of the streets surrounding the two holy shrines. These meetings also provided the researcher with the opportunity to receive comments from the implementing authorities and to discuss administrative, service, and movement-related aspects of the site. This contributed to the gradual revision and improvement of the proposals, making them more consistent with the actual needs of the site and the practical possibilities of implementation. Therefore, the personal interviews helped connect the academic aspect with the practical one and enhanced the realism and applicability of the proposed designs.

Table1 . Meetings and personal interviews with the engineering departments of the two holy shrines

No.	Interview Date	Authority / Person	Subject of Interview
1	25/9/2025	Haj Abu Dharr Al-Husseini / Imam Hussein Holy Shrine / Administration; Haj Mohammed Barakat / Imam Abbas Holy Shrine / Administration	Collecting information and identifying the shrines' development directions
2	3/11/2025	Eng. Baqir Jaafar / Imam Hussein Holy Shrine / Engineering Department; Eng. Ahmed Al-Zuwaini / Imam Abbas Holy Shrine / Planting Department	Discussing the development of the study streets
3	24/11/2025	Eng. Hussein Sabah / Imam Abbas Holy Shrine / Planting Department; Eng. Ali Najm Al-Hilli / Imam Hussein Holy Shrine / Engineering Department	Discussing the proposed planting distribution
4	14/1/2026	Eng. Hussein Sabah; Eng. Ahmed Al-Zuwaini /	Presenting and discussing

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No.	Interview Date	Authority / Person	Subject of Interview
		Both Holy Shrines	the proposals
5	12/4/2026	Eng. Ali Najm Al-Hilli / Imam Hussein Holy Shrine	Presenting the proposed urban designs

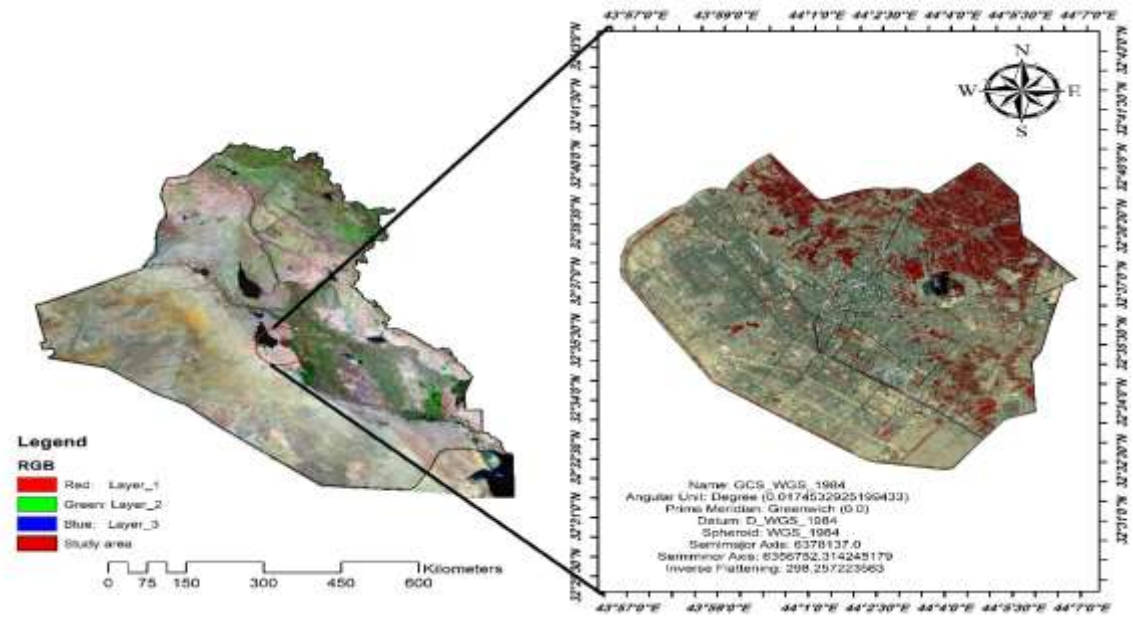

Figure.1 The geographical location of the study area (the streets) (Source: prepared by the researcher using Google Earth).

Table 2. Information on the satellite images used in the study

No.	Satellite	Sensor	Date	Resolution
1	Landsat 5	TM	21/03/2000	30 m
2	Landsat 7	ETM+	23/03/2015	30 m

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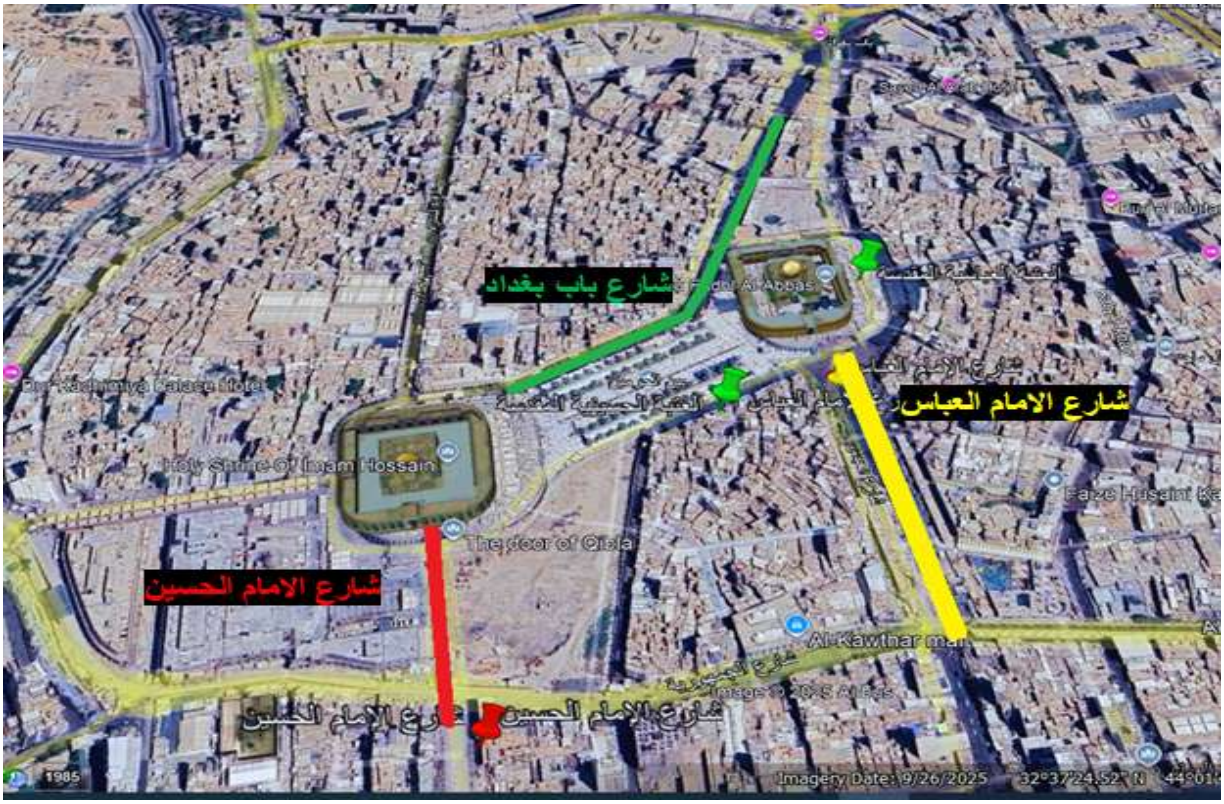

Figure.2 The geographical location of Karbala Governorate center (Source: prepared by the researcher using GIS).

Street Design Standards

Within the theoretical framework, it is necessary to define the design standards that guide the proposed urban interventions in order to demonstrate that they are based on recognized planning and engineering principles rather than on purely visual or artistic preferences. In the present study, the proposed street designs were developed according to three interrelated groups of standards: functional standards, environmental standards, and visual-aesthetic standards, with special emphasis on thermal comfort and visitor experience.

The functional standards concern the capacity and organization of pedestrian movement within streets that experience intensive daily and seasonal use. These standards include providing sufficient pedestrian path widths to accommodate human flow, organizing circulation in a clear and efficient manner, reducing conflicts between movement corridors and service spaces, and ensuring flexibility in use during periods of high crowd density, especially during million-visitor events.

The environmental standards focus on improving the microclimatic performance of the streets and reducing thermal stress on users. These include the selection of vegetation capable of providing effective shading, with the aim of covering no less than 60% of pedestrian paths where possible, the use of light-colored and low-thermal-mass materials, the incorporation of

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water features when suitable, and the enhancement of local climatic conditions through planting and surface treatment strategies. Such measures directly contribute to improving thermal comfort and the environmental quality of the urban space.

The visual and aesthetic standards relate to the preservation of the symbolic identity and spatial character of the streets leading to the holy shrines. These standards include maintaining clear sightlines toward the minarets and the sacred landmarks, avoiding visual obstructions, and arranging planting, pavements, urban furniture, and water elements in a coherent and balanced composition that strengthens the identity of place and improves the overall visitor experience. Accordingly, the proposed designs for the streets leading to the two holy shrines in Karbala were formulated on the basis of these standards in order to achieve functional efficiency, environmental improvement, thermal comfort, and a more coherent and meaningful urban experience within the sacred context of the city.

Figure.3 Imam Abbas Street (Bab Al-Qibla). Imam Hussein Street (Bab Al-Qibla) in 2018 before the latest expansion process (Source: researcher)

Results and Discussion

Imam Abbas Street

The existing condition of Imam Abbas Street indicates weak shading continuity, high surface heat gain, and limited environmental integration between pedestrian movement, service spaces, and landscape treatment. The proposed design addressed these deficiencies through a more structured spatial organization combining

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fixed and movable vegetation, rooftop gardens, and lighter surface treatments. In this proposal, deciduous shade trees such as *Delonix regia* and *Albizia julibrissin*, together with movable units of *Acacia* spp. and *Fraxinus angustifolia*, were used to improve shading while preserving visual openness and operational flexibility during pilgrimage peaks. Rooftop planting with *Myrtus communis* and *Duranta erecta* further strengthened the environmental role of the street figure (4&5).

Compared with the current situation, the proposed design is expected to increase the effective shading of pedestrian movement zones from approximately 18–22% in the existing condition to about 55–65% in the proposed condition during peak daytime hours. It is also expected to reduce near-ground air temperature by around (4-5)°C, while surface temperatures may decline by approximately 6–9°C, particularly in zones benefiting from tree shade and light-colored paving. These changes indicate that the proposed design improves not only the visual quality of the street but also its thermal performance and visitor experience. The integration of rooftop gardens and organized planting supports a more sustainable microclimatic response in a corridor that accommodates intense pedestrian density.

[7] Table .(2)

Table 2. Proposed plants for cultivation in the study streets Source: Author, based on [8].

No.	English Name	Scientific Name	Plant Type	Foliage Habit
1	Flamboyant / Royal Poinciana	*Delonix regia*	Tree	Deciduous
2	Albizia	*Albizia julibrissin*	Tree	Deciduous
3	Acacia	*Acacia spp.*	Tree	Evergreen
4	Narrow-leaved Ash	*Fraxinus angustifolia*	Tree	Deciduous
5	Common Myrtle	*Myrtus communis*	Shrub	Evergreen
6	Golden Dewdrop	*Duranta erecta*	Shrub	Evergreen
7	Texas Sage	*Leucophyllum frutescens*	Shrub	Evergreen
8	Jacaranda	*Jacaranda mimosifolia*	Tree	Deciduous
9	Red Silk Cotton Tree	*Bombax ceiba*	Tree	Deciduous
10	Toothbrush Tree / Arak	*Salvadora persica*	Tree	Evergreen
11	Pink Trumpet Tree	*Tabebuia rosea*	Tree	Deciduous
12	Natal Plum	*Carissa macrocarpa*	Shrub	Evergreen
13	Gardenia	*Gardenia jasminoides*	Shrub	Evergreen

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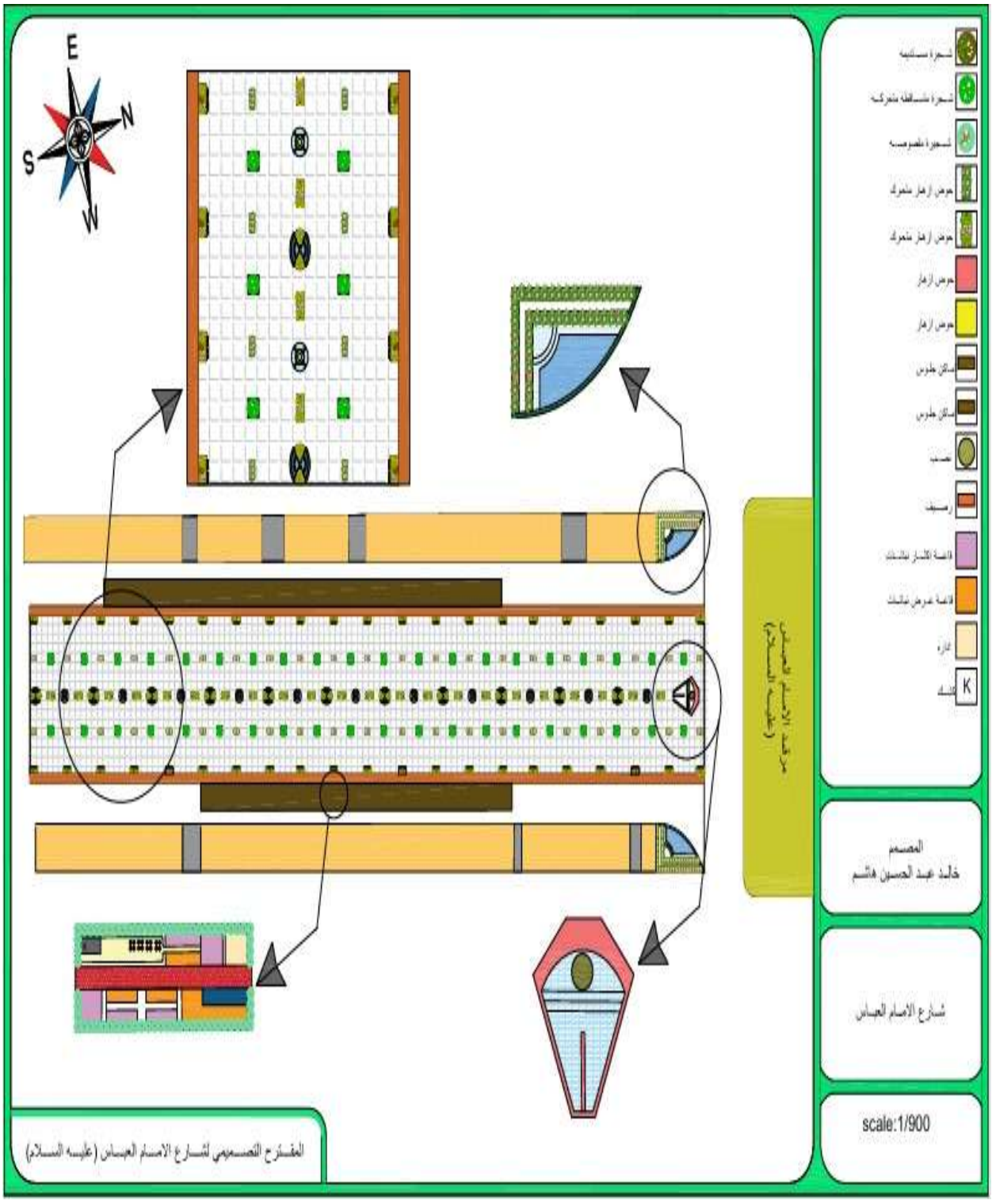

Figure (4): The proposed two-dimensional (2D) urban design for Imam Abbas Street Source: (Author with AutoCAD).

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Figure (5): The proposed 3D urban model for Imam Abbas Street Source: (Author with AutoCAD).

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Imam Hussein Street

The proposed urban design for Imam Hussein The diagnosed reality of Imam Hussein Street revealed environmental and functional limitations despite its strong religious and symbolic role. The street suffers from insufficient shading, high thermal exposure, and limited integration between movement needs and climatic treatment. The proposed design responded by combining linear planting, structured shrub edges, and water features in order to improve both thermal comfort and visitor experience. The proposal used *Myrtus communis* and *Leucophyllum frutescens* as shrub edges, *Jacaranda mimosifolia* as fixed sidewalk trees, and movable units of *Bombax ceiba* in the more flexible central areas.

This integrated treatment is expected to improve shading coverage from around 20–25% in the existing street to approximately 60–70% in the proposed design, especially along the main pedestrian corridor. Because of the combined effect of shade and water features, the expected reduction in near-ground air temperature may range between 2.5 and 3.5°C, while the decrease in surface temperature may reach 7–10°C in the most exposed sections. In thermal-comfort terms, the proposal may contribute to a noticeable reduction in heat stress during the hottest daytime periods. This indicates that the proposed street design functions as an environmental and spatial intervention rather than a purely formal one, especially in a street that carries major pedestrian flows during religious visitation periods.
Figure (6)& (7).

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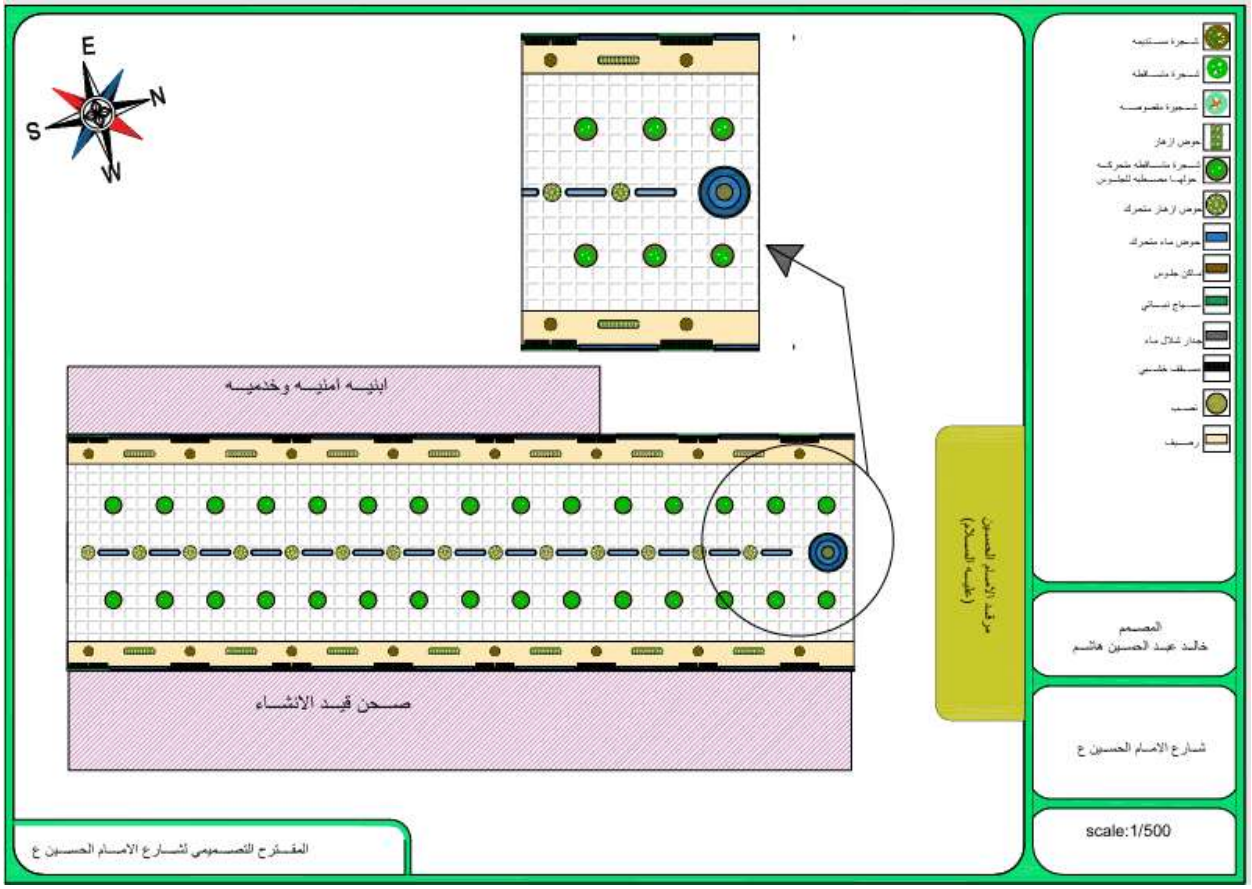

Figure (6): Proposed two-dimensional (2D) urban design for Imam Hussein Street Source: (Author with AutoCAD).

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Figure (7): The proposed 3D urban model for Imam Hussein Street Source: (Author with AutoCAD).

Bab Baghdad Street

The existing condition of Bab Baghdad Street reflects the weakest planting structure among the three study streets. The current vegetation is largely confined to a single irregular line of heavily pruned *Conocarpus erectus*, resulting in weak shading continuity, poor spatial rhythm, and limited environmental effectiveness. This confirms the absence of an integrated planting strategy capable of improving the local microclimate or supporting pedestrian thermal comfort.

The proposed design introduced a more structured planting composition using *Salvadora persica*, *Fraxinus angustifolia*, *Tabebuia rosea*, and *Bombax ceiba* as fixed tree elements, supported by *Carissa macrocarpa* shrub groups and *Gardenia jasminoides* in central planted units. Flower beds should also be specified by actual species, such as *Rosa* spp., instead of being left as unnamed ornamental beds. In comparison with the present condition, the proposed design is expected to raise shading coverage from about 10–15% to nearly 45–55%, with an estimated reduction in near-ground air temperature of 1.5–2.5°C and a reduction in surface temperature of approximately 5–8°C. These values suggest a clear environmental improvement over the diagnosed reality, especially in a street where the main problem lies in the poor

continuity and low efficiency of the existing planting policy.

The discussion here demonstrates that the value of the proposal lies not in adding more vegetation for visual effect alone, but in replacing a fragmented and ineffective planting condition with a more structured environmental treatment that supports thermal moderation, spatial clarity, and pedestrian use.

Across the three study streets, the diagnosed urban reality consistently showed weak vegetation continuity, limited shade provision, and insufficient environmental response despite the high religious and movement importance of these corridors. The proposed designs therefore sought to correct these deficiencies through organized planting, selective water elements, rooftop greening, and surface treatments. Based on the indicative estimates proposed above, Imam Hussein Street appears to achieve the highest environmental improvement because of the combined effect of vegetation and water features, followed by Imam Abbas Street, while Bab Baghdad Street shows a lower but still meaningful improvement due to the weaker baseline condition and the limited width and planting continuity of the existing street figure (8&9).

From a research perspective, this comparison is important because it shifts the discussion from mere description of the proposed elements to an analytical reading of their expected impact. In other words, the design proposals can be discussed in terms of how much they improve thermal comfort and shading performance compared with the diagnosed existing condition, rather than only describing what was planted or arranged. This provides a stronger scientific basis for the study and makes the proposed designs more defensible as planning and environmental interventions.

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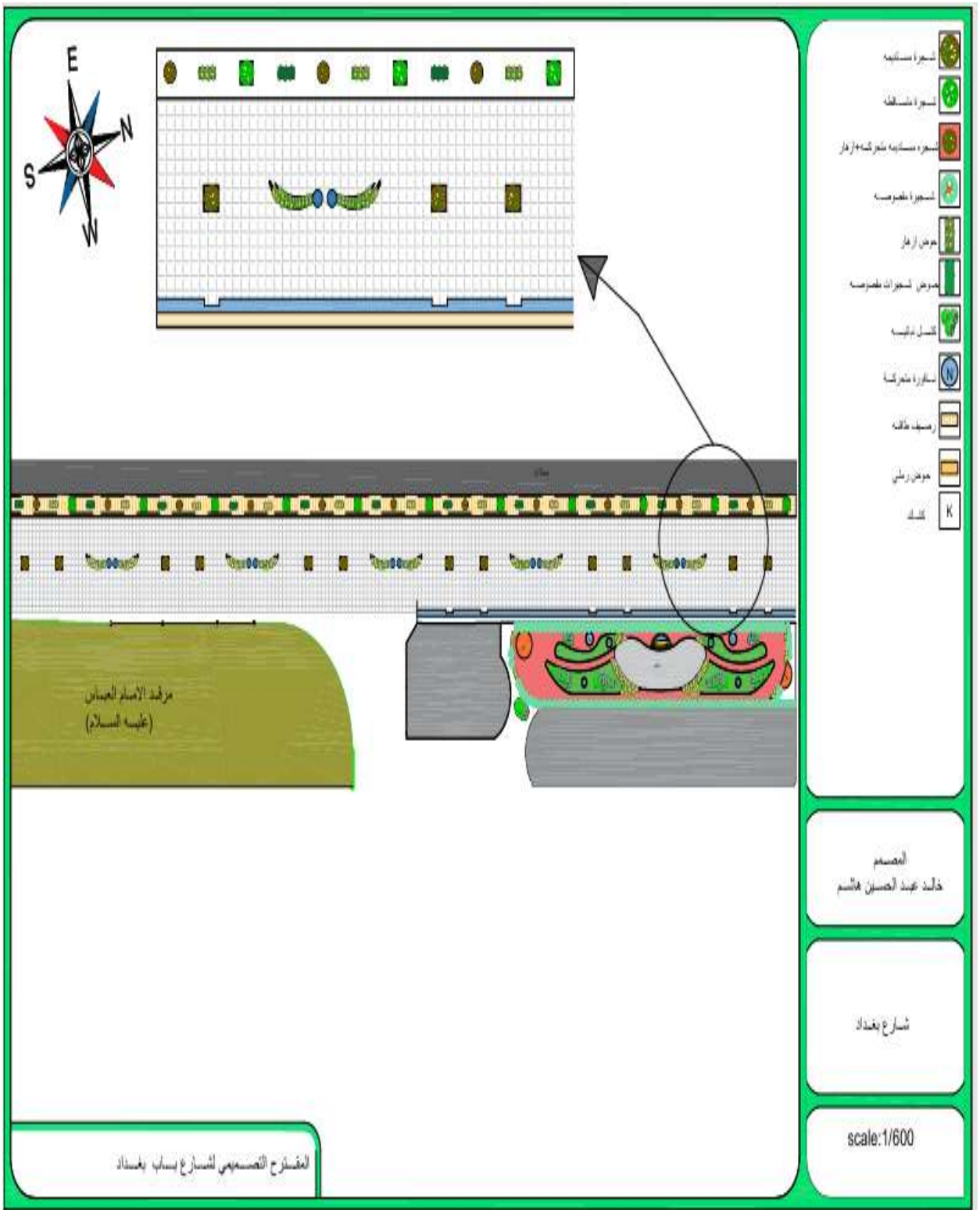

Figure (8): The proposed two-dimensional (2D) urban design for Bab Baghdad Street Source: (Author with AutoCAD).

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Figure (9): The proposed 3D urban model for Bab Baghdad Street Source: (Author with AutoCAD).

Conclusions

The study concluded that the current condition of the streets leading to the two holy shrines in Karbala suffers from clear deficiencies in vegetation continuity, shading efficiency, and environmental treatment, despite the high intensity of pedestrian use on both daily and seasonal levels. The proposed urban designs showed that organized planting based on clearly specified species, combined with surface treatments and selected water elements, can substantially improve the environmental performance of these streets and enhance both thermal comfort and visitor experience. The comparative assessment between the existing and proposed conditions indicates that shading coverage can increase from approximately 10–25% in the current situation to nearly 45–70% in the proposed alternatives, depending on the street and the type of intervention. The expected thermal improvement may reach about 1.5–3.5°C in near-ground air temperature and 5–10°C in surface temperature, which confirms that the proposed interventions have a measurable environmental value and are not limited to aesthetic enhancement alone. Among the

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three streets, Imam Hussein Street appears to have the greatest potential for thermal improvement because of the combined use of structured planting and water features, whereas Bab Baghdad Street represents the strongest corrective case in relation to its currently weak planting condition. Overall, the study confirms that the development of the streets leading to the holy shrines should be approached as an integrated issue involving crowd movement, environmental performance, place identity, and visitor comfort, rather than as a purely formal beautification exercise. It also concludes that the proposed designs provide a practical planning basis that can support future implementation, provided that the indicative values presented in the discussion are later verified through simulation outputs or field-based environmental measurements.

Recommendations

Based on the findings of the study, it is Based on the findings of the study, it is recommended that the proposed urban designs for the streets leading to the two holy shrines in Karbala be officially adopted and implemented in phases, as they have shown clear potential to improve movement efficiency, environmental performance, thermal comfort, and visitor experience. Priority should be given to increasing effective shading along pedestrian routes through organized planting based on clearly specified tree and shrub species rather than fragmented or irregular planting patterns.

The study also recommends adopting supportive design measures, including the use of light-colored paving materials, selective water features, and rooftop gardens in suitable locations, in order to reduce thermal stress and improve the quality of the urban scene. Special priority should be given to Bab Baghdad Street, since it represents the weakest existing condition in terms of vegetation continuity and shade provision, and therefore requires corrective design intervention as a first step. Imam Hussein Street and Imam Abbas Street should also be developed in ways that preserve their religious and symbolic importance while improving pedestrian flow and environmental quality during both ordinary days and peak pilgrimage periods.

In addition, future street development projects in Karbala should be based on clear functional, environmental, and visual design standards, particularly those related to pedestrian path capacity, shading performance, and the preservation of important sightlines toward the holy shrines and their minarets. Coordination with the engineering departments of the two holy shrines should continue during future implementation stages to ensure that the proposed designs remain realistic and compatible with site requirements and crowd management needs.

Finally, the study recommends that, after adoption and implementation, the proposed designs should be further evaluated through environmental simulation tools or field measurements in order to verify their actual impact on shading efficiency, thermal comfort, and visitor experience under extreme summer conditions

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