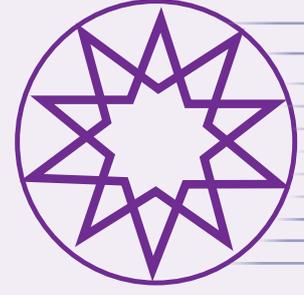


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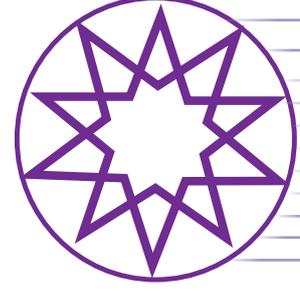
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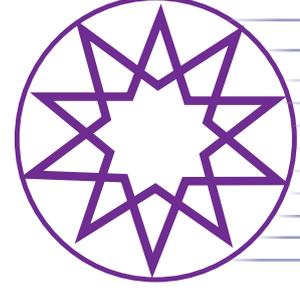
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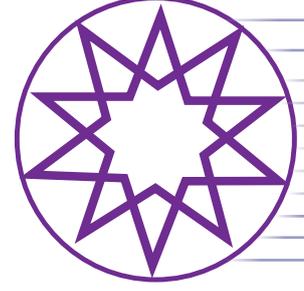
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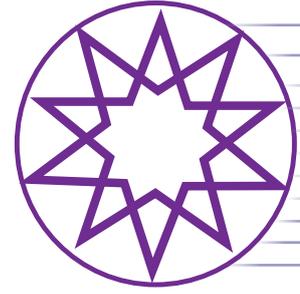
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Article

Representing the field of architectural representation: A Kraussian approach / A reproduction of semiotic square

Melek KILINÇ^{*}, Ahmet TERCAN

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ABSTRACT

Architectural projection could be the most decisive kulturtechnik in modern architectural processes, from the Renaissance and the Enlightenment to the present. Indeed, it is the technique that makes architectural practice modern by grounding it on the medial field of intellectual-corporeal distinction and constituting an operational field that is parallel to the modern notion of projection (Heideggerian Entwurf) that causes the dissolution of the ontology defined by a transcendental context. Architecture becomes a practice based on mediation (subject-agent-object), in which all its techniques (agents) are employed to project all mundane actions into the future. This text draws attention to the in-between area as an operational field where the kulturtechnik – a term employed by German media theory, particularly after the 1990s, as the fundamental element of the mediation – mediates and thus creates the differences, tries to represent the field itself as an operational ground for comprehensive interpretation of architectural representation, by following a Kraussian approach that allows us the hybrid conceptualization that the mediations require, reproducing the semiotic square. By reproducing the Kraussian diagram in the context of two categories, which are fundamental for the dissolution of classical ontology and therefore all the heterogeneous modern practices, such as architecture, it is aimed at mapping the expanded field of architectural representation to evaluate its mediations. In other words, this text aims to contribute to the literature by proposing a highly hybrid performative guide to evaluate architectural history and theory by mapping the mediations of architectural representation (its pragmatic, semantic, and syntactic hybridizations) in modern processes.

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FROM ONTOLOGY TO OPERATIVE ONTOLOGIES

There is no truth that doesn't "falsify" establish ideas. To say that "truth is created" implies that the production of truth involves a series of operations that amount to

working on a material –strictly speaking, a series of falsifications. [...] These capacities of falsify to produce truth, that's what mediators are about.

Gilles Deleuze, 1995

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The decisive moment of the drawing that turns into a disegno is made up of techniques of projection and project-making. [...] To describe design as a cultural technique means to distance oneself from the Florentine reading as disegno and instead conceive of it as project, projection, or projecting. In "The Age of the World Picture" (1938), Martin Heidegger defined "projection" (Entwurf) as the basic procedure of modern scientific research. [...] This "procedure" is not merely to be understood as a method, but also, and quite literally, as moving forward (Vorwärtsgen), a setting-out into the unknown, a voyage of discovery, conquest, and research eager to seize and apprehend the unknown in the shape of a picture.

Bernhard Siegert, 2015a

The assertion that the modernization processes, which took place mainly from the second half of the 19th century, are marked by a break from the regimes of representation is perhaps the most intense emphasis in modern literature¹. As often mentioned, the word "representation" implies the reproduction of a represented original; it is the media that makes it possible to establish a relation with the original represented. But also, – in Gadamer's words – "what is represented is itself present in the only way available to it" (Vesely, 2004). Therefore, while the word inevitably refers to a re-creation/translation/mediation, the separation of the concept from transcendent totalities centralizes the emphasis on the operability of the mediation: It is no longer a re-presentation of the given transcendent unity, but both the medium and the product of the procedure operating in the expression of the not-yet present. So that the truth, which is no longer given, is created by a series of operations of the subject on material, by falsification, and by the mediation between humans and their mediators. In other words, while before the modern secularization processes, the mediality in question had – in the classical sense – an ontological character by referring to the relation of humans with the transcendent, under the influence of the modern paradigm shift, it acquires an operative ontological character by referring to the medium and materiality of mundane projections of humans' thoughts and objects. Thus, it can be said that the ontological turn in representation comes along with the interest in mediation (subject-agent-object), and this turn is central for architecture as a modern practice based on representation/mediation.

In modern architectural theory and practice, the operative ontological character is formed in relation to the development of mediation/representation techniques that enable its realization at a temporal and spatial distance. Architecture, by becoming a modern practice based on mediation, projects actions into the future, thereby creating *truth* through a series of operations. In order to understand the role of architectural representation in the processes of modernization and to reveal whether architectural

representation techniques have the potential to adapt to the conditions that have brought it into crisis based on the controversy between architectural representation systems – which is based on prediction in temporal and spatial distance and the current context exposed to the unexpected and unpredictable created by the high relational demand of increasing, accelerating, complex, ever-changing information and non-stability (especially since the 1960s) – it seems to be essential to understand the operative ontologies of architectural representation for any discussion on it.

This paper attempts to explain the modern architectural representation in the context of its mediations and relations with the concepts of time and space, which are defined as the fundamental categories of modernization processes by various theorists². The main characteristic of the modernizing processes, which led to a fundamental ontological shift by affecting the nature of knowledge, perception, and representation, is explained in terms of the concepts of time and space, which can no longer be defined as absolute, singular, and separate from each other, but which integrate to form a new spatio-temporal space (Kwinter, 2001). These categories are also significant because their changing understanding leads to an awareness of the milieu/Umwelt, which makes visible the interaction between humans and non-humans (subjects and agents) in the studies of philosophy and science (Leibniz, Einstein, Uexküll, Nietzsche, Heidegger, Ebeling, etc.). Asserting an axonometric conception, a view that will make visible that modern practices are formed in the hybridization of pragmatic (subject), syntactic (agent), and semantic (object) tendencies that are connected to the basic mediating elements (subject-agent-object), this paper aims to address the architectural representation as a mediation with the guidance of kulturtechniken studies that address the material and external conditions of ontologies that operate without historical, geographical, or disciplinary limitations. For this reason, another purpose of the paper is to provide a relational mapping suitable for assessing architectural representation's mediations (pragmatic, semantic, and syntactic hybridizations) in modern processes. Since the kulturtechniken studies allow the architectural representation techniques to be considered as media-events that operate between the acts of building and envisioning, emphasize the unity of the difference they distinguish, and keep both the possibilities of being conceived and being constructed in themselves virtually current, it provides a theoretical background for the expanded field of architectural representation, which extends through various mediations signified by its own usages. In this paper, parallel to the theoretical background, the expanding field of architectural representation is mapped with the semiotic square³ to make visible a relation that could respond to the diversifications created by mediations by following

Krauss, who mapped the sculpture's expanded field with the semiotic square to evaluate new unclassifiable sculpture art of her time. The Kraussian diagram is reproduced for an expanded field of architectural representation that is formed by the decisive categories of modernity, which are time and space because the dissolution of the two categories implies human-technique hybridization and the emergence of operative ontologies in modern mediation processes. The diagram suggests a performative reading of architectural representation because instead of categorizing the mediations according to only historical processes, it refers to the mediations that it employs in differentiated contexts shaped by the hybridizations of perceptuality-conceptuality, contextuality-experientiality, concreteness-abstractness, stability-temporality, and the primary dichotomies of modern architectural representation. It has been developed as an interpretation-oriented alternative to the fixed readings of sharp categorizations by suggesting a ground on which increasing or decreasing tendencies of dichotomies can always be apprehended in relation to one another, which implies a highly hybrid environment for the systematic evaluation of the field of architectural representation.

In this context, the flow of the text is as follows: Firstly, it is explained why representation is considered a mediation and why the field of mediation it creates is mapped through a Kraussian diagram (semiotic square); then outlines a few of the performative readings which are respectively axial, prismatic, and spherical reading of the diagram. Initially, a reading along the axis of the pragmatic and the non-pragmatic is exemplified by the theoretical frame. Secondly, because it is considered the most generative field in the history of modern architecture, the hybridizations of the semantic prism and the diagrammatic's expansion of the diagram are evaluated. Lastly, referring to Gausa's conceptual framework of the epistemological transformation (from the Enlightenment to the early twenty-first century), another performative reading of the diagram is made from the outer periphery to the centre of it. Thus, it is asserted that the Kraussian way of representing the expanded field of architectural representation opens new mediations with a very high variety and different emphasis each time.

Representation/Projection as Mediation

The factors that trigger this interest in human-technic mediation, especially after the Industrial Revolution, are certainly based on the dissolution of the absolute concepts of time and space. Leibniz's introduction of the notion of relational space versus Newtonian absolute space as the thing in which objects are situated (Deleuze, 2007); Nietzsche's assertion of space as a field of forces experienced through the movement of the opposition of Apollonian intellectual pleasures and Dionysian bodily instincts (Forty, 2012); Einstein's theory of relativity, describing time and space in

a four-dimensional multiplicity that cannot be separated into its components (Barnett, 2005); and Siegfried Ebeling's space as a membrane that a field of subjective, organic, and biological forces, where the subject's mediations with the external world take place (Forty, 2012); are among the early philosophical arguments regarding the dissolution of time and space. In Kwinter's words (2001):

...space and time no longer carried with them their fixed categories of intelligibility, nor did they distribute their contents in quite the same ordered way. What is more (...) they would no longer remain separate from one another, but had merged to create a new field, one that would characterize the rest of our century, yet for which a properly solid map never emerged and will certainly never exist.

With the dissolution of time and space, the focus is now on the milieu/Umwelt and the relations between humans and technics as the creators of the milieu, that is, operational ontologies that lead to new philosophical discussions based on the concepts of "technical system", "technical tendency", and "process of concretization" (Stiegler, 1998). The early traces of operative ontologies can be found in the subjects who consider non-given time and space as a milieu created through mediations based on their technical extensions and bodily experiences: Nietzsche's *Übermensch* creates the self in the space formed by the coexistence of intellectual and bodily instincts; Heidegger's *Dasein* constitutes a non-metaphysical humanism by forming himself and the meaning of his world by being with other beings (mit sein) in the world he is in, with its technical extensions; and the Neo-Kantian Uexküllian subject, which, in terms of his emphasis on the inseparability of each term of the pairs of subject-object, perception-reality, and schema-sense, from the other (Kwinter, 2010), is defined by its own environmental world, its *Umwelt*, etc. Although they have differences with each other, each is the generator of their own ontologization through bodily experience in time and space, and thus they can be defined as the subjects who act in a series of operations with their mediators in the milieu they create. This is one of the points that German media theory, which centrally evaluates the media as media-event or, in its current extensions, "kulturtechniken" (Siegert, 2015b)⁴, finds the Heideggerian techno-ontological subject significant for conceptualizing the operative ontologies (Vogl, 2008):

Media events are events in a particular, double sense: the events are communicated through media, but the very act of communication simultaneously communicates the specific event-character of media themselves. Media make things readable, audible, visible, perceptible, but in doing so they also tend to erase themselves and their constitutive sensory function, making themselves imperceptible and 'anesthetic.' This double becoming-media cannot be predetermined with any certainty because it is in each case differently constituted

as an assemblage, a “dispositive” (in Foucault’s sense) of heterogeneous conditions and elements.

If we consider media as the event that, in each case it is employed, constitutes a different assemblage and so enables creative processes, it is significant to consider projection as Heideggerian *entwurf* (projection), which functions as the ground plan for the procedure, for the setting-out into the unknown. In other words, Heideggerian projection, as a procedure for the search for the unknown, is operational and therefore techno-ontological, which implies a break from classical ontology. So, the fundamental relation between Heidegger’s notions of *Entwurf* (projection) and *Dasein* (being in the world), who was thrown into the world and came into existence by being in the world, is signified by the act of coping with the thrownness (*wurf*) into the World (Oosterling, 2009). Projection/design (*Entwurf*) is the act of *Dasein* to situate his existence, and this is why it is fundamental to the modern ontological turn that took place with the break of representational regimes.

The break with regimes of representation brings with it an interest in the creative processes of human interaction with non-humans; those are the mediators operating in the mediated field. Although awareness of mediation is not a situation that only belongs to the processes following modernization processes, the acceleration in the movement of time-space-information makes the mediation more visible, either in order to control it or through the necessity of making it creative in the process. In Sprenger (2016)’s terms “fantasy of immediacy” has been employed for different prospects of reward, such as sublating the uncertainties and contingencies that lie in the separation between elements, the prospect of an undivided community, an origin from which everything can be derived in a metaphysical manner, and an always-already transmitted transmission in which delay or loss plays no role. The processes of modernism, which are built on the dichotomies (culture-nature, intellectual-corporeal, subject-object, human-non-human, private-public, spirit-body, universal-local, black-white, etc.)⁵ come along with the emphasis on mediality in the context of either the affirmation of mediation – hence of the differentiations/transformations – or the fantasy of immediacy, due to the emphasis on the poles themselves.

Without a doubt, especially in the early modernist processes, this procedure is built on resistance to the dissolution of the concepts of time and space, to mundane singularities⁶. Kwinter explains these singularities with two primary axes which correspond to the “time axis” and the “space axis”. Kwinter’s third axis, which is indeed not an axis, but the field of immanence, is the force axis that absorbs both time and space. The three axes (time, space, and force) that Kwinter put forward depending on time and space can be read as the space of inherent mediation (field of force) in the field of modern heterogeneous

practices and the fantasies of immediacy on them (time axis and space axis) (Kwinter 2001). So, in Latourian terms, representation is now not a “re-presentation” as if it were a first, but a model corresponding to what is not yet present in the context of the fantasies of immediacy (Bolt, 2004). At the same time, with the withdrawal of representation into secular immanence, the fact that there is nothing accessible but representations penetrates the operations of all kinds of modern practices, especially within idealized modernist fictions, at the level of idealism that everything can be represented at a temporal and spatial distance. However, it is possible to say that the lines of flight, which are separated from these worldly transcendental constructions and seek to stay in resonance with modern immanence, in other words folding on the field of force, are drawn simultaneously. In modern immanence, surrounded by unpredictability, the comprehensive destruction of the notion that the representation of what does not yet exist can be realized at a temporal and spatial distance, again in the awareness that everything inevitably consists of representation series, brings the problematic of representation to the agenda for the question of how to represent the unpredictable; the ones that cannot be defined anyway. More precisely, more than a model, projection as pro-injection acquires significance as a multi-layered process (Gausa, 2003), as the ground plan of a procedure that includes gaps where the unpredictable can leak. In this context, projection cannot be limited to a static, immutable representation of what does not yet exist. On the contrary, it points to the dynamic in-between that occurs depending on the temporal-spatial distance between intellectual and bodily activities and in which man creates his own ontologization by constantly switching with the non-human through their capacity for mediation and operativeness. Particularly in theories after the medial turn of the 1960s and in contemporary posthumanist studies (one of them is German media theory’s posthumanist second phase after the 1990s, namely kulturtechniken studies), mediation has been considered a core issue for all the practices. If we say it in the words of Kittler, “only that which is switchable is at all”⁷.

In brief, the dissolution of subject-object unity increases the visibility of the mediator in the mediation of subject-mediator/agent-object, and it makes the mediators’ capacity to falsify a core problematic for all worldly creative activities and future projections, namely, for the creations of truth. Thus, falsification refers to reproduction, the difference-making capacity of mediation, and this is why “mediators are fundamental”, “creation’s all about mediators”, and “without them nothing happens” (Deleuze, 1995). And this is why the focus should shift from the representation of meaning to the conditions of representation, which is the way that is offered by German media theory (Siegert, 2015b). In cases where creation is not given, it is not the question of meaning, but the conditions of meaning. To

understand the mediation that constitutes the creation, it is necessary to analyze the mediator, – in a media-theoretical term, *kulturtechnik* – as the third that precedes a time-spatial series of operations/the poles of the mediation. This is one of the main characteristics of a *kulturtechnik* that Siegert asserted (2015b) "Essentially, cultural techniques are conceived of as operative chains that precede the media concepts they generate".

Framing as a Fundamental Operative Ontology of Architectural Projection

The modern turn in architectural practice takes place, again with the involvement of an agent, when the architectural drawing acquires the decisive quality that allows architecture to be realized at a temporal and spatial distance from the construction site. Evans⁸ says that "architectural drawings are projections, which means that organized arrays of imaginary straight lines pass through the drawing to corresponding parts of the thing represented by the drawing," and points out that the technical invention that makes the drawing architectural is the triple orthographic set (Evans, 1989). Architectural projection is obtained through the extension of an intellectual operativeness in which the imagination of the subject is involved. In this context, as Siegert implies, projection as a voyage to discovery, as a setting put into the unknown as the basic Heideggerian procedure of modern design research, corresponds literally with the architectural projection (both as an object and a verb).

The operativeness of architectural drawing originated in Alberti's perspective formulation, which is based on framings that open up to the exploratory field rather than to the reality of the outside world. Through two framings (window and *velo*), Alberti opens a way of intellectual construction at a temporal and spatial distance from the bodily activity. The transformation of perspective formulation's projection rays and framings, which are converged at a single point, into three-dimensional orthographic expansion in the Cartesian space of the Enlightenment (Panofsky, 1997), makes it possible to identify framing as the media-technical trace, the primary operative ontology of the projective quality of architectural drawing⁹. This operational field played a crucial role in the ontological turn of representational regimes to an extent sufficient to shift design (*disegno*) to a human-centered position in the mid-16th century (Siegert, 2015a). That is to say, this is not only because Alberti's window and *velo* open to the mundane external reality, but also because they operate in a procedure that assigns a data space quality (Damisch) to the projection/drawing plane for envisioning the mundane but not yet present (Siegert, 2015c). On the other hand, while the effective use of the orthographic set enables the idea of the creative ego, whose knowledge is inaccessible in the context of Renaissance humanism, to

be expressed with high precision, it causes the mediation to be erased through the fantasy of immediacy and the high domination of the subject over the process and the final product¹⁰. However, mediation is elaborated quite extensively and differently in the theory and history of architecture. But what should be noted is that the possibility of such a wide range of elaboration is largely dependent on the high operational ability of architectural projection, which is based primarily on the framing and its employment by different subject mediations. Architectural projection, with its involvement in the field of architecture, comes to the fore as perhaps the most important *kulturtechnik* forming modern architectural activity in the context of its intellectual-corporeal distinction and its ability to mediate between envisioning/imaging and constructing. This is why it emerges as the primary reference to trace its extensively differentiated qualities of mediation throughout the modern secularization processes.

HOW CAN THE FIELD OF ARCHITECTURAL REPRESENTATION BE REPRESENTED?

Modern architecture is a heterogeneous practice that is formed mainly depending on architectural drawing (*media/kulturtechnik*) since the modern paradigm shift is based on the dissolution of the concepts of time and space. Thus, mapping the subject-agent(drawing)-object mediation in the context of time and space will provide the necessary basis for interpreting architectural theory and practice in any modern context¹¹. It is required to map its mediation in relation to the concepts of time and space and to adopt a performative attitude while reading it – as in all kinds of mediation. Architectural drawings are more than recordings of the construction of an imaginative object to be translated into constructional reality, and only because they are open constructions of the mediation that oscillates between dualities such as perceptual-conceptual, stable-temporary, concrete-abstract, contextual-experiential, they are the lines of flight in action that frame the will-to-be and include what does not yet exist. The field that makes architectural mediation visible is important for understanding its limitations and possibilities for creative design processes, as well as discovering the potentials of its operative features by pushing and expanding the limits of architectural representation in the context of the question of how we can represent *Dinge* (that exist in the relation between *Dasein* and object) – not the object/*gegestand* – in the unpredictability of life. Latour draws attention to the impossibility of drawing *Dinge*, which is inseparable from the object's experience, from the subject-object relationality, connectivity, and continuity, and reveals that the architectural representation that is realized at a temporal and spatial distance cannot go beyond the representation of the object (Latour, 2009):

[...] we [...] may insist that objects are always assemblies, "gatherings" in Heidegger's meaning of the word, or things and Dinge (...) We know how to draw, to simulate, to materialize, to zoom in and out on objects; we know how to make them move in 3-D space, to have them sail through the computerized virtual *res extensa*, to mark them with a great number of data points, etc. Yet we are perfectly aware that the space in which those objects seem to move so effortlessly is the most utopian (or rather atopic) of spaces (...) To use some more German: we know how to draw *Gegenstand* but we have no clue what it is to draw *Ding*.

In the crisis that emerged from *Dinge*'s unrepresentability and from the impossibility of overcoming the time-spatial distance in design practice, it is necessary to excavate architectural *kulturtechnik* as a creative mediativity that is neither subjective nor objective but reveals both the subject and the object in the moment of experience. Architectural projection as a special cultural technique/*kulturtechnik* that bridges the gap between envisioning and building highlights how this technique both separates and connects these concepts, keeping the potential for both design and construction inherently present, even if only virtually. This paper, considering architectural representation as a mediation issue (that is, in the connection of subject-agent-object), points out the necessity of reading the Kraussian diagram/semiotic square in an axonometric view, namely, with an irreducible relationality to mediation's elements/relatas. Before explaining why the Kraussian approach is referred to, it will be effective to explain the tendencies pointed out by the subject-agent-object mediation that guides its configuration.

Mediation is Already in Axonometric View

Morris (1938), in his text "Foundations of The Theory of Signs," refers to 'pragmatics' as an examination of the relations between 'signs' and their 'interpreters'; 'semantics' as the study of the relations between 'signs' and 'the objects' to which they can be applied; and 'syntactics' as the study of the formal relations among the 'signs'; that is, respectively, as the fields that examine the relationship between sign-subject, sign-object, and sign-sign. In his 1964 text, he mentions the precariousness of considering these three parts of semiotics as types of signs and warns that it may make unreadable the distinction between signs designed according to different ways of expressing the meaning, and particular signs that are involved in the fields of pragmatic, semantic, and syntactic, designed as the three parts of semiotics (Morris, 2014). In this context, considering that Morris's early definitions of the field of study offered a valid terminology for later semiotic studies and that connect the signs respectively to the subject; the agent; and the object, it is necessary to map the field of architectural drawing dependent on the mediation of subject-agent-object, to reach the expanded conditions it has been employed in.

Also, it will be appropriate that it should aim to reveal an axonometric view that will make visible the mediation of the fields detailed in the hybridizations of pragmatic, semantic, and syntactic tendencies (Figure 1).

To represent the field of architectural representation requires a transitional classification that will make visible the hybridization of the pragmatic-syntactic-semantic tendencies formed by the mediation, in relation to the concepts of time and space. In this context, inspired by Rosalind Krauss's reference to the Klein diagram/semiotic square to analyze sculpture that is neither architecture nor landscape and cannot be classified by the classifications that are already known, the field of architectural representation is represented with this Kraussian approach, which seeks the possibility of hybrid conceptualizations. In this way, considering that modern processes cannot be defined only by the relation between the concepts of time and space but rather by hybrid paths of their non-'s (non-time, non-space), the reproduction of the Kraussian diagram might be expected to make possible highly plural and hybrid conceptualizations. Furthermore, it is possible to say that since this field was produced with reference to the fundamental categories of modernity, it also has the ability to map the field of activity of other modern practices.

Reproduction of Klein-Four Diagram

The Klein four-group is a four-element group in mathematics in which each element is self-inverse (composing it with itself produces the identity) and in which composing any two of the three non-identity elements produces the third one" (Klein, 2003). Even before Krauss, structuralist thinkers and art theorists

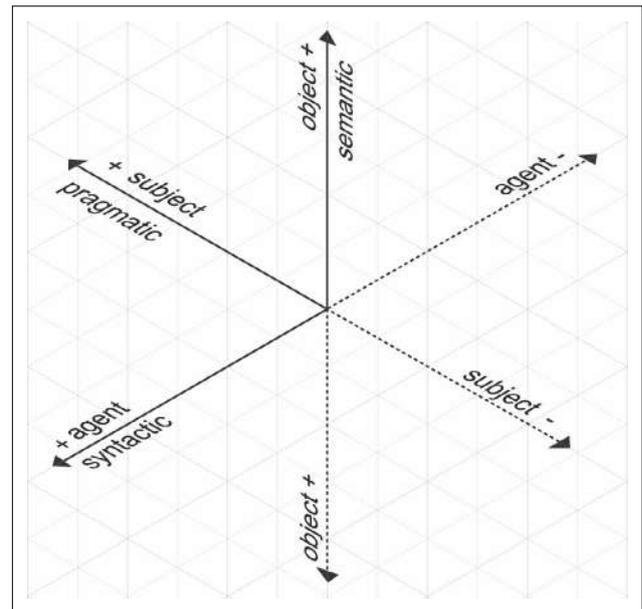


Figure 1. Axonometric relation between signs and the relatas of the mediation.

had been interested in the Klein diagram, which opens to multiple fields with the relations between the four elements. The semiotic square, a structuralist method of analysis that was put forward in the linguistics studies of Greimas in 1966, consisting of the expression of opposition, contradiction, and complementary relationship vectors between signs, is a diagram that many semiologists refer to. By referring again to the Klein diagram, art theorist Burnham reveals the structural matrix of logic modes of art-making based on “a quaternary structure where two terms are analogously equal to two other terms”. Burnham (1971) points out that though it is far from proven, Klein Group mathematics is so universal, at the level that leads one to suspect that the human brain possesses an innate faculty for partitioning meaningful relationships into groups of four:

The consistency of such a structure is always the result of permutations derived from one or two operations on a single function. [...] (Briefly, this implies that the preferred cultural mode in sentence structure or works of art consists of multiple propositions, or propositions which have more than a single idea).

Thus, Burnham refers to the Klein diagram to express a system of thought based on the five indistinguishable elements of alchemy (Air, Water, Earth, Fire, Aether) dominated by the relational vectors that cannot be identified with any particular function, concept, or process: “WATER implies FIRE, but not the reverse. Similarly, AIR implies EARTH, but not the reverse”. While Earth and Water contain Air and Fire, although they are not visible, the fifth element, Aether, is in the middle of everything, acting as a mediator between the body and the soul (Burnham, 1971) (Figure 2).

Krauss expresses the structuralists' and her own interest in the Klein Group as the possibility of rewriting (Krauss 1996):

For Levi-Strauss, for Greimas, for the structuralist generally, the interest of the Klein Group was precisely in this quality of rewriting, so that what might seem the random details of cultural practice [...] emerge as a set of ordered transformations, the logical restatements of a single, generating pair of oppositions. What the rewriting made clear to them is that for every social absolute [...] there is its more flexible, shadow correlate: the kind of maybe, maybe of the not-not axis; [...] The structuralist call the top axis of yes/not he 'complex axis', using the term 'neutral axis' for the maybes.

The diagram that she reproduced for "Sculpture in the Expanded Field" makes the ambiguity of the works of avant-gardes (such as Richard Serra, Robert Smithson, and Donald Judd) visible through the vectors of the relations between the terms defined by what they are not (pure contradiction), what they are the opposite of (contradiction as involution), or what they are the complements of (relationships of implication/deixis) (Krauss, 1979). While sculpture finds its expression as an artistic work that is revealed by referring to what it is and what it is not, and it seeps into blurred fields, the rewriting provides a contemporary conceptual expansion to the field of art (Figure 3). Krauss also reproduces the Klein diagram through the notions of *figure* and *ground*, which are the basic elements of perception in “modernist logic” –in her words, “visual logic” (Figure 4). She performs a relational reading of inside and outside, frame and deframe in the context of the art of painting. Thus, she aims to reach the expression of the dualistic nature of the modernist avant-garde in a dynamic logic that will be derived from exploring modernism as a topography rather than following it as a narrative.

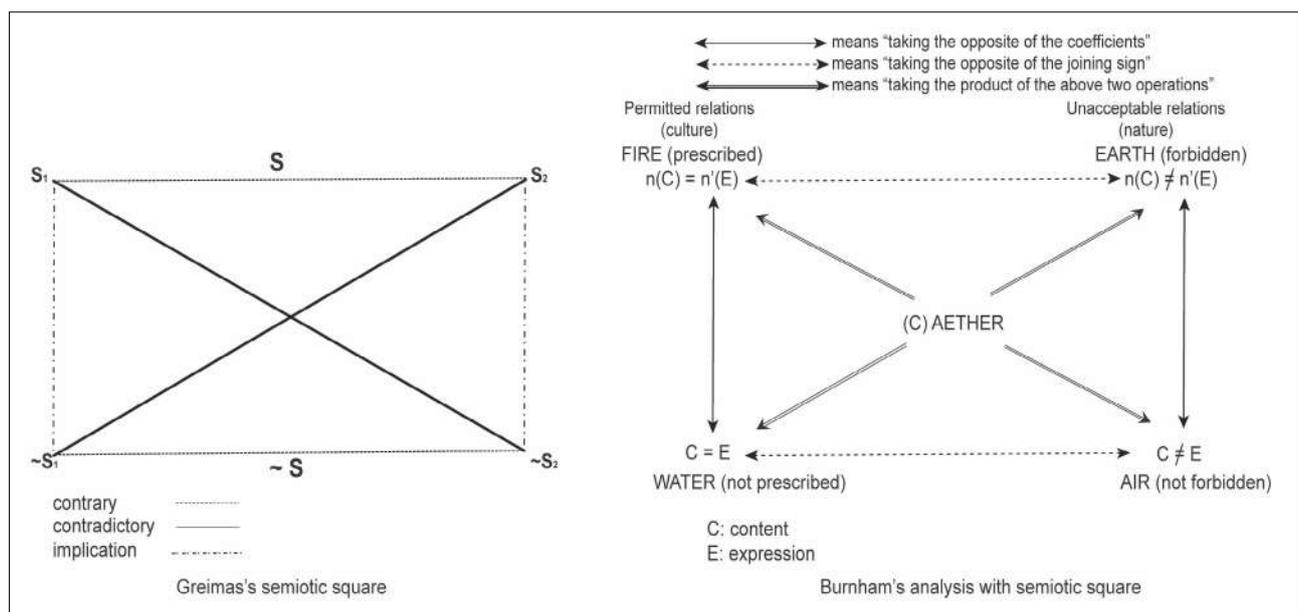


Figure 2. Greimas's Semiotic Square and Burnham's Alchemy Analysis with Semiotic Square.

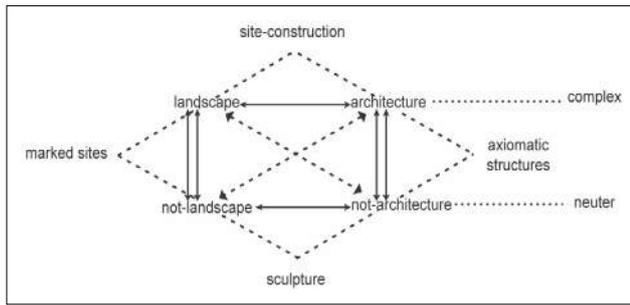


Figure 3. Sculpture in the expanded field.

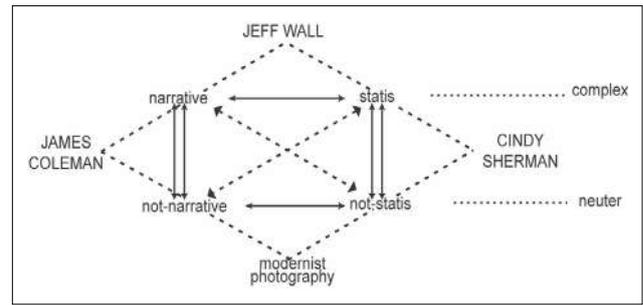


Figure 5. A reproduction of Klein Square for the art of photography by George Baker (Baker, 2005).

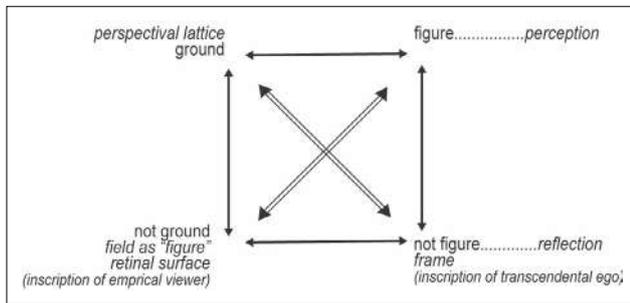


Figure 4. Krauss' analysis for modern painting.

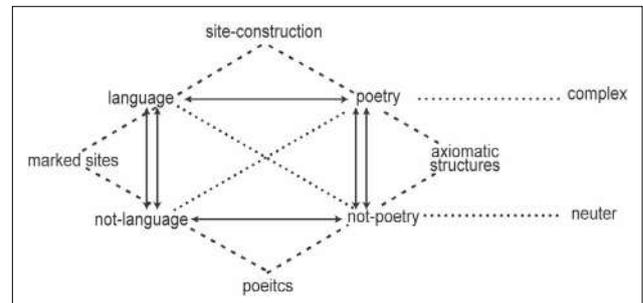


Figure 6. A reproduction of Klein Square for poetics by Barrett Watten (Watten, 2009).

This apophatic approach, which allows us to draw the framework of the inexplicable directly by saying what it is not, later finds its response in the field of architecture. Architectural historian and theorist Vidler instrumentalizes the diagram for architectural theory in his text titled "Architecture's Expanded Field". Although Vidler (2004) does not draw the diagram, he considers the whole text in the expanded field of the concept quartet consisting of architecture, landscape, program and biology and points out that architecture, since the involvement of digital techniques in the practice, is now about non-architecture. While in 2005, art critic and theorist Baker (2005), mapped the art of photography, which cannot be classified with previous photographic concepts because of the discovery of video, as an expanded field based on the relation between the terms fixed and non-fixed, narrative and non-narrative (Figure 5); in 2006, Watten (2009) referred to the Klein diagram, which offers a transitive conceptual infrastructure to be able to evaluate poetics as neither language nor non-poetry (Figure 6).

In 2011, Bernham and Burnham employed the Klein diagram, which has the ability to reveal the blurring boundaries, for the installation –titled "The Way Beyond Art" as part of the *Wattis Institute of Contemporary Arts'* series– that they designed to reveal the current context of installation art that is neither architecture nor art, to arrange the conceptual as well as the spatial configuration of it. The diagram, as a reproduction of the Kraussian diagram both in form and content, makes the continuum that tracks movements from one disciplinary domain to another, which is described by the vectors that connect each of the four terms (architecture,

sculpture, interior and landscape) to the other three, visible (cf. Figure 7) (Berman & Burnham, 2016).

Although there are more examples that reproduce the Klein diagram/semiotic square, the thrust that led to its employment is fundamentally based on its capacity for multiplicity, which opens the situation to the plurality of the definition "it is not" contrary to the singularity of the "it is": While 'what a thing is' is one, 'what a thing is not'– reveals a multiple potential. Therefore, while the Klein diagram was frequently employed in structuralist semiology research after Krauss, especially in parallel with the context of modern immanence that contradicts idealized concepts, codes, and situations, the diagram is frequently rewritten to express transitions that have occurred or have just occurred and cannot be known what they are but can be known what they are not by referring to existing notions. The Kraussian diagram maintains its currency by providing suitable plural grounds for mapping the conditions, such as the all kinds of conceptual and inter-scalar transitions that involve the metastabilities, hybridizations, and heterogeneities of the post-modern situation that emerge from modern immanence, that is, by its post-modern conceptualization ability. Indeed, some of the advantages that Krauss noted for the Klein Group support this view. These advantages can be listed as follows: allowing to grasp the inner logic of modernist art –in Krauss's analysis– by enabling dispensing with narrative; offering the possibilities of and therefore thrill of its manipulation through the inner logic; being a graph in stasis for its own inner dynamism in the multiple but

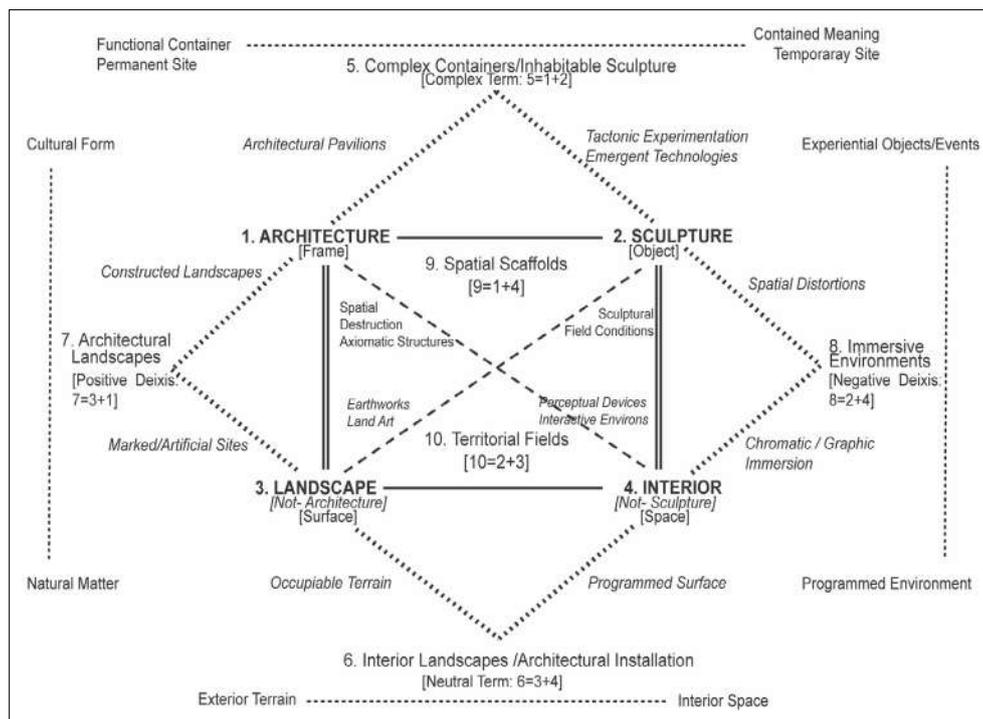


Figure 7. Installation Art: Architecture in the Expanded Field by Berman & Burnham (Berman & Burnham, 2016).

limited transcoding possibility; and having the opportunity to show the system whole (Krauss 1996)¹². Thus, despite all its complexity, by creating a fuzzy mapping that is appropriate for any study, enables us to focus on the inner logic of the operations instead of idealized situations, to produce manipulations on it, and to dispense with the narratives that are often built on the undefinable features of the creative ego by revealing a system that can be expanded.

The Expanded Field of Architectural Representation

The Kraussian diagram in Figure 8 expands the field of architectural representation. This expanded field is shaped by the decisive concepts of modern processes: time and space. Within this field, other related concepts are seen as references that guide us through its various, in-between states. This approach aims to reveal the main tensions present in architectural representation in modern processes and implies that these tensions include the blurring of lines between perceptuality - conceptuality, contextuality - experimentality, concreteness - abstractness, and stability - temporality.

The different levels of hybridization of the peripheral concepts in the diagram indicate the conditions mentioned together with the crisis of architectural representation, which often occurs as a disconnection between the intellectual and corporeal, non-material and material characteristics of modern architectural theory and practice. At the same time, it allows the evaluation of architectural projection through its immaterial qualities, which are associated with its materiality.

As seen in the diagram, these characteristics are always found as hybrids, but sometimes the level of hybridity varies as a requirement of idealized practices. Therefore, keeping in mind that the diagram includes hybridity in each context it points out, and any polarity hint indicates an effort to purify, to idealize. Another point to be noted in the diagram is related to the complex axis (yes/no axis) and the neutral axis (axis for maybes). The ‘non-time’ and ‘non-space’ points on the neutral axis used by the structuralists for maybes and their extensions are not a conceptualization at the level of the idealized certainties of the complex axis on which ‘time’ and ‘space’ take place. The neutral axis opens up to plurality only by being the axis of non-’s (non-time and non-space).

The framework of the diagram can be read as follows: while the expansion of space and time towards ‘concreteness’ and ‘perceptuality’ maps the construction of ‘the pragmatic’ such as models, procedures, and methods; the expansion of non-space and non-time towards abstractness and conceptuality maps the construction of ‘the non-pragmatic’ as critical architectural representations. On the other hand, the constructions of space and non-space with relatively high ‘stable’ and ‘experiential’ characteristics focus on the own spatiality of architectural representation and make visible ‘the syntactic’ tendencies of constructions that reckon with the modernist ideal of space. The outer expansion of time and non-time maps ‘the non-syntactic’ constructions that come to terms with the historiography and the historicist tendencies that are formed mainly around the concept of

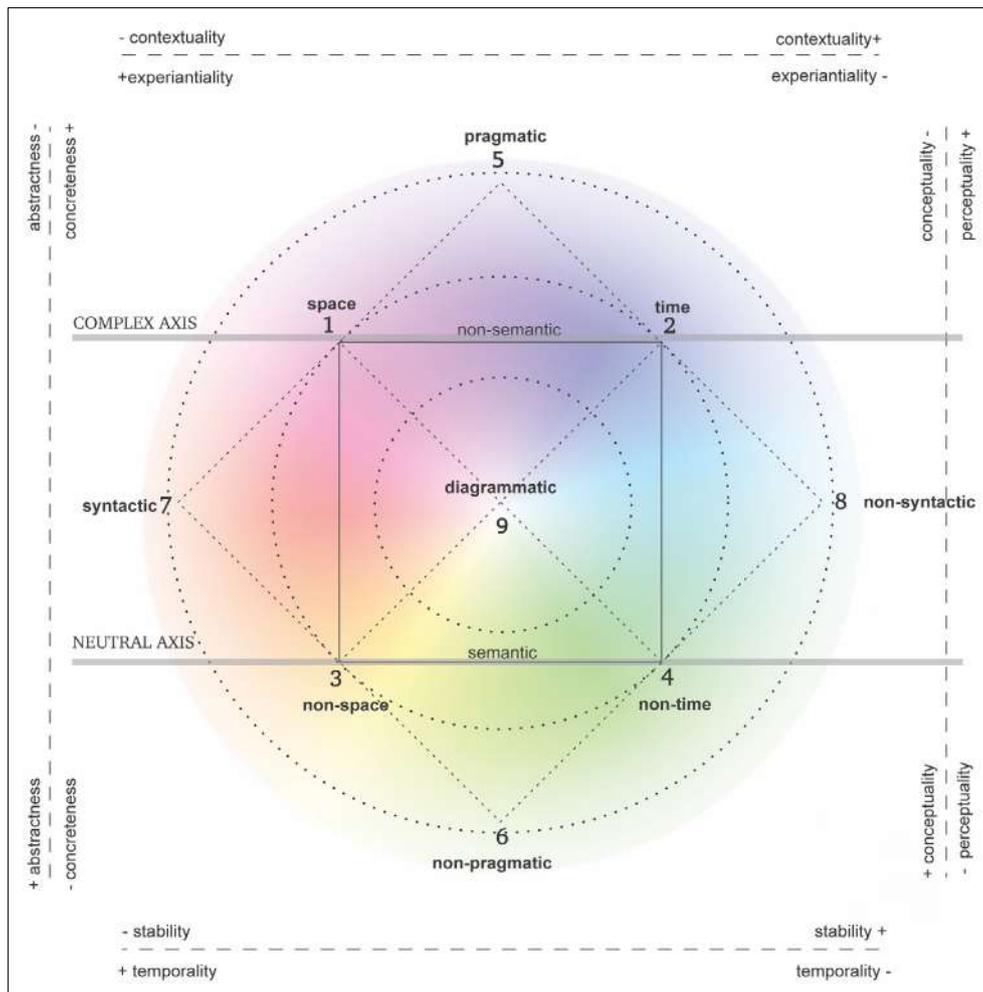


Figure 8. The expanded field of time and space / The expanded field of architectural representation.

type, by looking for the timeless in the temporal. On the other hand, by mapping the diagrammatic inclination of syntactic, pragmatic, and semantic axialities, the expansion of 'the diagrammatic' as the emanation of both time and space, non-time and non-space, points to an inherent theory-practice hybridity of the architectural practice itself, which is not separate from the criticality – in the sense of being related to the conceptual – of the contexts in question. At this point, since 'the diagrammatic' is positioned at the center of Kraussian mapping in relation between "it is" and its "non-"; since it involves simultaneously its construction and destruction as virtualities, it expresses its non-'s inherently: the expression of the diagrammatic corresponds to a black hole that absorbs (inner expansion) and penetrates (outer expansion) everything. Thus, the diagram, expanded field of time and space/expanded field of architectural representation maps a history of modern architectural representation, from the analytical characteristics of Enlightenment epistemology to its current dissolution, on a conceptual framework based on fundamental categories of

modernity, consisting of hybrid tendencies in the expansion of the points (syntactic, non-syntactic, pragmatic, non-pragmatic, time, non-time, space, and non-space) indicated in the processes of modernization. At this point, it should be noted that the modernization processes correspond to the hybridizations of the pragmatic, syntactic, and semantic tendencies, through which the elements of the mediation are linked to the outer expansion of the diagram by themselves. The diagram is formed as a topography of information in which mediation is made visible through the various layers of operative ontologies. While in subject-agent-object mediation, architectural projection, respectively connected to 'the subject' through 'the pragmatic' and 'non-pragmatic' tendencies, to 'the agent' through 'the syntactic' and 'non-syntactic' tendencies, and to 'the object' through 'the semantic' and 'non-semantic' tendencies. The kulturtechnik characteristics of architectural projection are determined by the hybridizations of the syntactic-pragmatic prism [the expansions of the pragmatic (5), non-pragmatic (6), syntactic (7), non-syntactic (8)] and the semantic prism

[the expansion of space (1), time (2), non-space (3), non-time (4)] on the diagram (Figure 9).

The diagram, can be read in a variety of ways and emphasizes. Considering the hybridity of the diagram, it is clear that there are no areas that can be restricted by the purely pragmatic or non-pragmatic, semantic or non-semantic, syntactic or non-syntactic. Because any construction is always inevitably positioned in-between the reference points of the diagram in Figure 10 (1, 2,

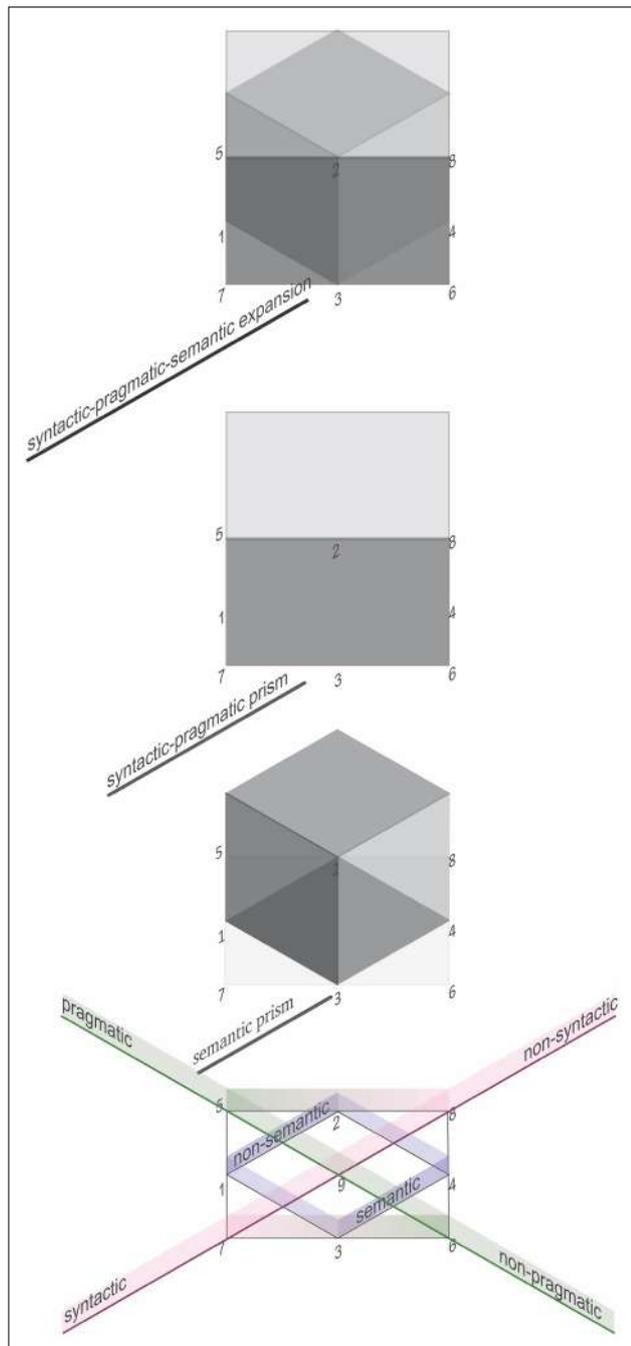


Figure 9. The expanded field that unfolds the triple-axis mediation by itself.

3, 4, 5, 6, 7, 8, 9), it involves the mediation of all three tendencies at different levels, and is always a hybridization. For example, the hybridization of the pragmatic with the non-semantic formed in the expansion of time and space is intense, while the hybridization fields of the non-semantic with both syntactic and non-syntactic are at a level that is distinguishable. It can be said that the semantic tendencies that acquired crucial roles in the expansion of non-time and non-space are intensely hybridized with syntactic, non-syntactic and non-pragmatic. Therefore, the diagram should be interpreted within the framework of in-between, hybrid identifications (which are indeed not pure identities) rather than with the singular themes (Figure 10).

As one of the performative readings of the expanded field which is guided by the conceptual mapping¹³ in the context of architectural projection (Figure 11), the axial expansion of the pragmatic and the non-pragmatic is below: While, architectural projection expands the field of architectural projection from the production of catalogue and regulation to the map depending on the shift in the tendency for immediacy of the pragmatic in the subject-agent relation towards the diagrammatic; on the other hand, through its employment in the intellectual tendencies of the non-pragmatic, the field expands from the past and future projections to the ones qualified as different-generator. In the graph, the fundamental differences depending on the syntactic capacity of the architectural projection become visible in the expansion of syntactic and non-syntactic axis. Furthermore, the expansion of the syntactic to the diagrammatic reveals the expansion from representation as a sign in the principle of analogy, and program as an expression of spatial association, to the sign which is employed to determine the performance of the creative process. Because the transition from non-syntactic to diagrammatic represents the hybridizations in tension primarily between time and non-time, it includes relatively more syntactic expansions of the concept of type, implying the expansion from contextual tendencies to the experientiality of the space of representation itself (Figure 11).

Another performative reading guided by the hybridizations of the semantic prism and the diagrammatic's expansion would make visible the most generative field in the history of modern architecture. While the semantic prism highlights the purest (expansion of the yes/no axis) and most ambiguous (expansion of the maybes axis) expansion of architectural projection, its hybridizations with the outer expansion of the diagrammatic in both the early and late 20th century have mapped the most elaborated field that was realized through architectural projection. Here, it will be explanatory to read the diagram in the context of the tendencies that have come to the fore in the historical process, which also explain the interrelation of the prisms.

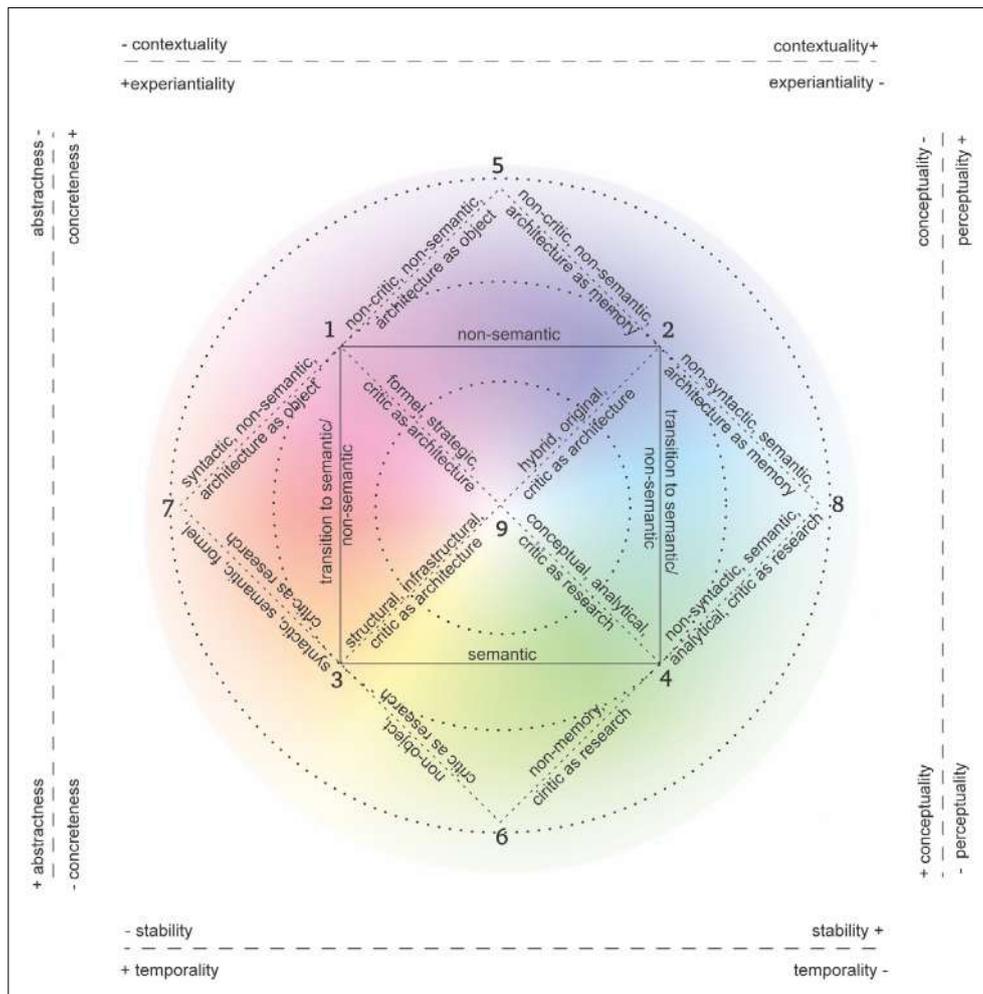


Figure 10. Hybrid identifications of the expanded field of time and space.

Gausa creates the conceptual framework of the epistemological transformation that has taken place from the Enlightenment to the present, depending on the differentiations and extensions of time and space¹⁴. Accordingly, 'classic' corresponds to 'time and space', 'modern' to 'time-space', and 'contemporary' to 'time-space-information' (Gausa, 2003). Following Gausa's framework, the search for the dominant rational science-based utility of the classical (time and space) epistemology of the Enlightenment (18th and 19th centuries) predominantly places in the first external ring. While in the first ring, the visibility of pragmatic and non-pragmatic tendencies increases, the subject is equipped with a quality on which the understanding of meaning and the world is built as the constituent element of these tendencies. The field of the pragmatic has expanded with the dominance of instrumental pragmatism in modern processes since the end of the 19th century by defining the object based on the logic of repetition, which constitutes the planning processes such as the standardization and modular arrangement of the industrial norm that is established on the appearance of

it. The expansion of the non-pragmatic, on the other hand, occurs in a context in which drawing/representation is made autonomous from being the signifier of the object. While the subject transforms the representational reality itself into his/her object, the drawing becomes a determinant in the media-technical establishment of architecture as an intellectual activity, in which the subject is also mentally independent of the construction activity¹⁵.

The elaboration of the modern (time-space) in the context of efficiency based on technological production in the early 20th century – again, predominantly – is in the expansion of the second ring. Architectural projection is employed in the response of semantic and non-semantic tendencies to the modern crisis of meaning, considering the architectural object as the basis on which meaning will be built. Hybridizations of non-semantic in the early 20th century were decisive in the formation of the architectural discipline (as a technical, discursive, and institutional practice), with the extensive employment of architectural drawing extending from architectural education to material production technologies, while the expansion of semantics in architecture was

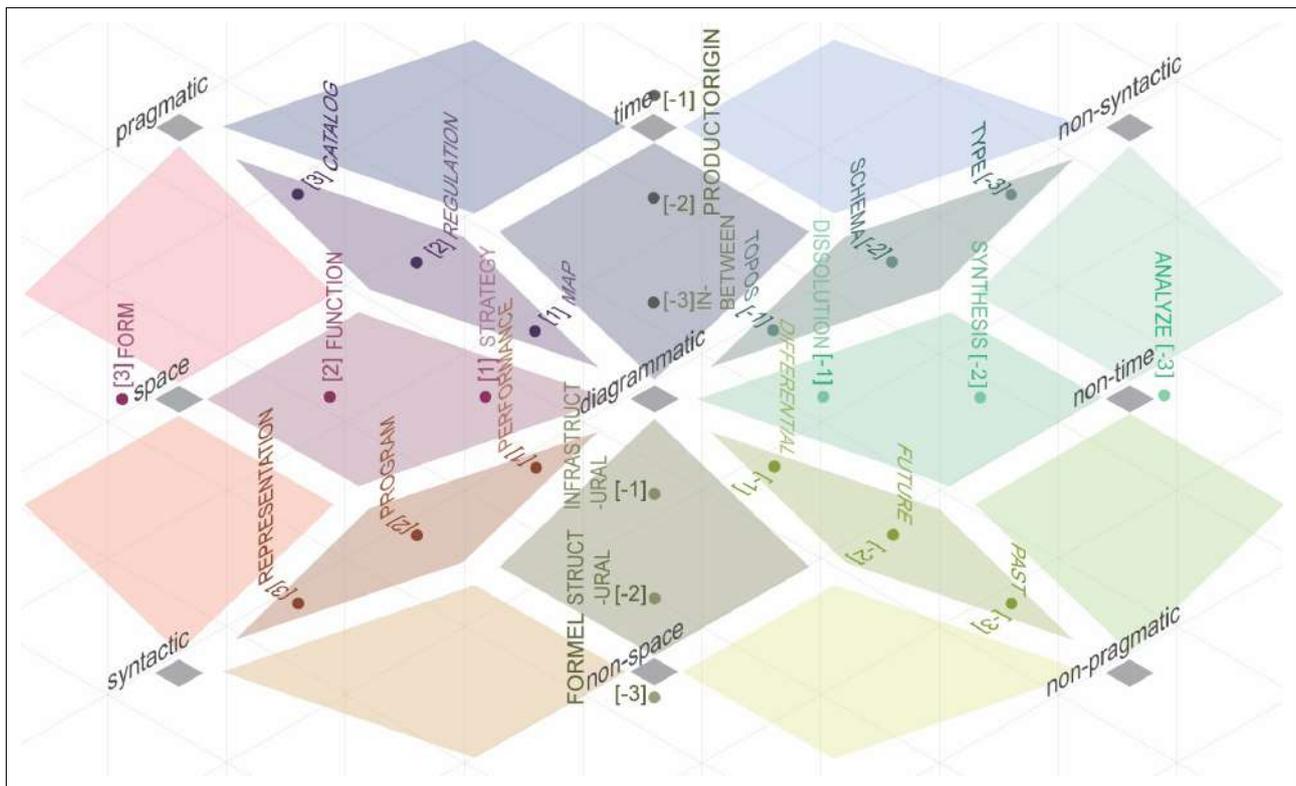


Figure 11. The conceptual mapping of the expanded field of time and space.

associated with relatively limited construction. Also, while in the Enlightenment, the semantic tendencies were decisive for the media-technical configuration of the designer subject and therefore of the architectural autonomy, at the beginning of the century, the tendencies' focus shifted to the conception of the object as a social construction and thus can be mapped to the hybridizations of the non-pragmatic¹⁶. The semantic tendencies after WWII, on the other hand, can be mapped to the pursuits that intensify not only in the hybridization of the non-pragmatic but also in the transition zones of time and space, on the expansion of the syntactic axis (on the diagram of Figure 11, vectors of 1-3 and 2-4). After the 1960s, the architectural autonomy, which is emphasized in scientific and non-abstract pursuits through the city, images, and formal memory of the city, has been extensively elaborated based on the meaning-producing capacity of the formation processes or the syntactic capacity of the architectural drawing itself.

This is the transition where the constructions in which all the complexity, contradiction, plurality, and hybridity of the contemporary (time-space-information) are detailed with a medial interest are intensely reflected in the last ring expanding to the center of the diagram. So, the third ring is formed by the expansion of syntactic and non-syntactic tendencies with the privilege given to the medium/media itself¹⁷. It is seen that with the syntactic inclination towards the medium/mediator/kulturtechnik itself – neither the subject nor the object – the agency of the agent/mediator/

kulturtechnik is emphasized, and sometimes this emphasis increases at the level of transcendence. However, the diagrammatic tendency expands to a context in which the agent itself is hybridized in the mediation of subject-agent-object in the historical process, and away from any privilege attribution. In this context, the last ring in question is formed intensely by the not of all kinds of tendencies (that is “it is”, and “not-it is”); and this is why it can be identified as diagrammatic.

IN PLACE OF THE CONCLUSION: MEDIATING THROUGH THE EXPANDED FIELD OF ARCHITECTURAL REPRESENTATION

The paper is primarily concerned with the issue of architectural representation as an issue of mediation, with a cultural technical interest and draws attention to the deterministic qualities of the mediators employed in the process of mediation. It is suggested to sustain any theoretical discussion on architectural theory and practice, representing the field of architectural representation in the form that allows revealing its mediations is necessary. For this purpose, following Krauss's semiotic approach, which proposes a relational reading ground, it is argued that a relational ground determined by the fundamental categories of modernization processes, which are time and space, can be mapped, and this mapping can reveal the hybridizations

of pragmatic, syntactic, and semantic tendencies. The paper, with reference to basic semiotic studies, the pragmatic, syntactic and semantic interrelationships in which the elements of the subject-agent-object mediation are respectively connected are made visible. So, while the diagram is based on the idea that representation is an issue of time and space and that the ground that will enable its evaluation can be mapped with a Kraussian approach depending on the concepts of time and space, it also has the ability to refer to the qualities of mediation simultaneously. This is the significant point that makes the diagram privileged: it is the ability to map the architectural projection's activity, which is regarded as mediation based on two fundamental categories of modernity and of its representational crisis. It is a flat, unfolding of triple-axis mediation/axonometric of subject-agent-object. On its flat surface, it opens the subject, agent, and object, and therefore the pragmatic, syntactic, and semantic mediations to new mediations.

In the paper, by reading the diagram in three contexts (the section titled as “The Expanded Field of Architectural Representation”), the validity of the diagram is validated by historical references, while at the same time utilizing the ability of a relational reading to in-between spaces (e.g., it is able to show simultaneously and relationally that early 20th century pragmatism can appear in both concrete object production and visionary architecture). The axial (the expansion of the pragmatic and non-pragmatic), prismatic (the expansion of the hybridization of the semantic prism and the diagrammatic), and spherical (outer periphery to the centre) readings of the diagram show us that it is open to reading in all directions, subjecting it to a translation with a very high variety and different emphasis each time. In the axial reading, while the interdependence of the relations between the two poles is exemplified through the pragmatic and the non-pragmatic, it is revealed that the evolution of the architect subject from the anonymous subject of instrumental pragmatism to the competent subject engaged in intellectual production depends on a conceptual vocabulary that expands from efficiency to criticality. The second, prismatic reading reveals the intense dualities involved in the semantic diffusion of architectural practice and provides a theoretical framework for the meaning-representation relationship of both constructive and non-constructive architectural practice. The last reading (spherical) maps the field of production, which intensifies in parallel with the process of dissolution of the concepts of time and space. It makes visible the conceptual correlation of the transformation of the subject, the agent, and the object depending on the tendencies intensified in historical processes and provides a theoretical guide for evaluating its reflection on architectural theory and practice. It is seen that, instead of a clear background with clear presuppositions and inferences, the diagram allows us

to focus on the inner logic of the operations on its fuzzy ground, always with a focus on mediation.

The diagram is a good illustration of the employment of a structuralist construction in a non-structuralist interpretation. It is an operational ground that enables the constant reproduction of information by mapping it on a flat surface in a relational way. It manifests the flat surface's ability to layer by making the dualities of the context in which the diagram is produced visible and how they are inextricably related. It has highly diversified performance potential as it consists of in-between fields that have indefinable precision and ambiguity at the appropriate level to examine. Rather than representing the mediation of architectural projection, it offers a performative ground to be reproduced in the reading of each subject. It is thus a media-event that maps a media-event (architectural projection). It is another kulturtechnik drawn for the analysis of a kulturtechnik, folding on itself and expanding. It makes visible the medial field of intellectual-corporeal distinction of modern architectural practice by both keeping the dualities and at the same time blurring the field through their relational paths. It is the third that precedes the polars of the dualities. On the one hand, while it makes the dualities of architectural projection visible, on the other, it erases the constructions of these dualities. So it is both a code-generating and de-coding interface. This is the essential quality that makes the field operational, and therefore, every point of the diagram expresses the erasure of identification and affirms hybridization. The field itself becomes the place where falsifications for truth are realized, while trying to make visible the falsifications of architectural projections. It stimulates the subject to generate constantly operative ontologies.

Since the diagram itself provides a conceptual map of the subject-agent-object relationship, it is capable of providing a relational conceptual basis for the mediation of any drawing/representation that is positioned in accordance with the conceptual guide on the diagram. In this respect, the diagram not only provides a conceptual basis for mapping a history of different representational techniques, such as axonometric/oblique projection or perspective, but also offers the appropriate conceptual infrastructure for the evaluation of a single drawing/representation. While making visible the inseparable relationality of the subject, the agent, and the object, it offers a theoretical guide to evaluate their effectiveness in the process. Thus, the diagram provides a relational and conceptual ground for studies that can be capillarised from the study of a specific geography and period to a singular drawing/representation by giving an idea about the mediation of any approach to be positioned in any relevant region. It is thought that it is applicable for further cross-readings between architecture, art, different geographies, or historical processes (for example, a comparative reading between the geography of Turkey and Europe), which will

be made in different layers on such a ground and can serve relational and fruitful theoretical openings that move away from "it is or it is not" logic.

NOTES

¹For two significant references on the subject from the history and theory of architecture, see: Eisenman (2000), Kwinter (2001).

²Kwinter's book titled "Architectures of Time: Toward a Theory of the Event in Modernist Culture" is considered a fundamental reference because it evaluates modern processes in the context of conceptions of time and space, and the epistemological repercussions of their extension. Also, Manuel Gausa's, Peter Eisenman's, and Bülent Tanju's works, which are mentioned later in the text, are significant because they refer to the conceptions of space and time as fundamental categories for their discussions.

³The semiotic square, a method of structural analysis proposed in 1966 in the linguistic work of Algirdas J. Greimas, which consists of the expression of vectors of opposition, contradiction and complementary relations between signs, is a diagram that many semiologists also refer to. It is based on the Klein Four-Group (dated 1884) by the mathematician Felix Klein (Klein, 2003).

⁴Although the term Kulturtechniken (cultural techniques) was introduced to German media theory by Friedrich A. Kittler (1943-2011), who was "a genealogist in the Nietzschean sense" to reproduce its new implications by depending on its original definitions, it defines a comprehensive field of study in the second phase of German media theory (Siegert, 2018). At the end of the 1990s, it developed as an alternative research field that was referred to with the term 'kulturtechniken' in the works of pioneering figures such as Siegert and Engell, which extended the implications of the term, 'media' to the technologies, techniques, signs, and practices that are active in the formation of cultural forms, that is, all kinds of relations between the agents of human and non-human. This is the end of the war for "the throne of the transcendental" between 'culture' and 'media'; the end of the media as a fixed, stable notion through the reproduction of the old agricultural engineering concept of kulturtechniken (Siegert, 2015b). The focus shifted to medial fields as a result of media criticism, which the German media theory presented as an alternative to the critique of reason being replaced by the critique of culture (Cassirer), and expanded the limits of the field to a wide variety of medialities. Kulturtechniken studies differ as a phase in which the media and technology no longer produce anxiety, and the domination of discourse analysis and hermeneutics are no longer highly effective as a result of the ontological dissolution of the subject. Instead,

mediations (media-events) in all kinds of fields, operations and operative ontologies, and the archeology of media-technological configurations are in play and decisive.

⁵For some remarks on modernist dichotomies, see: (Connor, 1997; Hardt & Negri, 2000).

⁶Also, Peter Eisenman, in his reading of architecture, reminiscent of the Kwinterian axes of space and time, points out that since the early 20th century, Western architecture has never been modern contrary to what is claimed, but rather it continues to be a 'classic' employing the 'fictions' that are 'representation' for 'meaning', 'reason' for 'truth', and 'timelessness' for 'history'. And he asserts that, even though divine transcendental totalities are denied, mundane transcendental totalities are built: the modern world produces illusions (Eisenman, 2000). In considering that all kinds of pursuits for totality demand immediacy as a requirement of the attempt to stabilize slippery slopes such as difference, plurality, and heterogeneity, it is possible to regard the fictions for modern worldly transcendent constructions in question (representation, reason, and history) as extensions of the fantasy of immediacy.

⁷The German phrase "Nur was schaltbar ist, ist überhaupt" by Friedrich Kittler was translated into English as "Only that which is switchable is at all" by Krämer, Siegert, and Winthrop-Young (Krämer, 2006; Siegert, 2018; Kittler, 2017). Mersch, on the other hand, refers to a simplified translation of "[...] there is nothing that is not switchable" (Mersch, 2016).

⁸Evans is one of the pioneers who pointed out that architectural drawing is not a neutral tool/vehicle but an active mediator that activates in translation/mediation. Some of his related works are: Evans, 1989; Evans, 1995; Evans, 1997.

⁹Although beyond the scope of this text, it is possible to determine that framing is an operational ontology inherent in architectural projection, because of its reference to other operations frequently used in architectural theory and practice, such as superimposition, rotation, replacement, layering, repetition, copying and of its visibility in the historical process with its continuity that refers to a variety of actualizations. See about operative ontologies: Operative Ontologies (IKKM, n.d.).

¹⁰It should be added here that because of the convention's reference to constructional reality was very limited relatively, the illusion of erasing was inevitably more convincing and influential.

¹¹It is also possible to assert that this mapping will offer a suitable ground for the evaluation of all the other heterogeneous modern practices, too, considering that everything is modernized through the media and the

modern resolution takes place depending on time and space.

¹²Although Krauss focuses on the five advantages, the fifth one she mentions is based on an overlap between Lacan's L-schema and her own diagram, which she reproduces for modernist art analysis. Considering the fifth advantage is a special case, it is not regarded as a valid quality for the other Kraussian diagrams referenced in this text (Krauss, 1996).

¹³The mapping expressed in Figure 11 is based on Ceylan's table, which expresses the use and the historical development of modern architectural diagram in the fields of architectural design and representation. Ceylan, rewrites Gausa's table that is based on the concepts of time, space and information –which was mentioned later– and Vidler's three typologies by overlapping them (Ceylan, 2010; Gausa, 2003).

¹⁴“Metapolis –The Dictionary of Advanced Architecture – City, Technology And Society in The Information Age” co-authored by Gausa, is an original dictionary and a comprehensive reference book on contemporary problematics and concepts in architectural theory. Gausa's inference is considered valuable as it allows for a conceptual and relational evaluation of modern processes (Gausa, 2003).

¹⁵In this regard, while in France at the Enlightenment, the drawings of J. N. L. Durand's can be considered as agents for the construction of 'controller architect' (subject) at the pragmatic expansion, the drawings of E. L. Boullée's –such as Newton Cenotaph– can be evaluated as agents for the construction of 'designer architect' (subject) at the non-pragmatic expansion.

¹⁶For instance, in the early 20th century Germany, the drawings of Walter Gropius and Bruno Taut can be considered, respectively, as the constructions of 'the object as idealized and industrial' and of 'the object as imaginative social construction' (especially City Crown and Alpine Architecture drawings) in non-semantic and semantic tendencies.

¹⁷For instance, after the 1960s, in Italy, in the drawings of Aldo Rossi and Superstudio, respectively, the configurations of 'the object of influence' and 'the image-object' are no longer absolute, idealized objects, but objects that are interrelated with subject and agent.

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REFERENCES

- Barnett, L. (2005). *The Universe and Dr. Einstein*. Dover Publications.
- Baker, G. (2005). *Photograph Expanded Field*. October, 114, 120–140.
- Berman, I. L., & Burnham, D. (2016). *Expanded field – architectural installation beyond art*. Applied Research + Design Publishing.
- Bolt, B. (2004). *Art beyond representation: The performative power of the image*. I. B. Tauris.
- Burnham, J. (1971). *The structure of art*. George Braziller.
- Ceylan, E. (2010). *Modern Bir Mimari Temsil ve Performans Aracı ya da Mimarlıkta Diyagram* [Unpublished Doctoral dissertation]. Mimar Sinan Fine Arts University.
- Connor, S. (1997). *Postmodernist Culture – An Introduction to Theories of The Contemporary*. Willey Blackwell.
- Deleuze, G. (1995). *Mediators*. In, *Negotiations* (pp. 121-134). Columbia University Press.
- Deleuze, G. (2007). *Leibniz Üzerine beş ders* (U. Baker, Trans.). Kabcacı Yayınevi.
- Eisenman, P. (2000). *The end of the classical: The end of the beginning, the end of the end*. In Michael Hays (ed.), *Architecture - Theory - Since 1968* (pp. 522-538). MIT Press.
- Evans, R. (1989). *Architectural projection*. In E. Blau & E. Kaufman (eds.), *Architecture and Its Image - Four Centuries of Architectural Representation* (pp. 19-35). MIT Press.
- Evans, R. (1995). *The Projective Cast - Architecture and Its Three Geometries*. MIT Press.
- Evans, R. (1997). *Mies van der Rohe's Paradoxical Symmetries*. In R. Evans, *Translations from Drawing to Buildings and Other Essays* (pp. 233.-277). Architectural Association Publications.
- Forty, A. (2012). *Space*. In *Words and Buildings - A Vocabulary of Modern Architecture* (pp. 256-275). Thames & Hudson.
- Gausa, M. (2003). *Projective*. In M. Gausa, V. Gaullart, W. Muller, Fr. Soriano, F. Porras, & J. Morales (eds.), *Metapolis / The Dictionary of Advanced Architecture – City, Technology and Society in The Information Age*. ACTAR.
- Hardt, M., & Negri, A. (2000). *Empire*. Harvard University Press.
- Krämer, S. (2006). *The cultural techniques of time axis manipulation on Friedrich Kittler's conception of media*. *Theory Culture Soc*, 23(7-8), 93-109.
- Kittler, A. F. (2017). *Real time analysis - time axis manipulation*. *Cultural Pol*, (13.1), 1–18.
- Klein, F. (2003). *Lectures on The Icosahedron and The Solution of Equations of The Fifth Degree*. Dover Publications.

- Krauss, R. E. (1979). Sculpture in the expanded field. *October*, 8, 30–44.
- Krauss, R. E. (1996). *The optical unconscious*. MIT Press.
- Kwinter, S. (2001). Modernist space and the fragment. In *Architectures of Time - Toward A Theory of The Event in Modernist Culture* (pp. 32-50). MIT Press.
- Kwinter, S. (2010). The Hammer and Song. In M. Garcia (ed.), *The Diagrams of Architecture - AD Reader* (pp. 122-127). John Wiley and Sons.
- Latour, B. (2009). A cautious Prometheus? - A few steps toward a philosophy of design. In *Networks of Design*. Universal Publishers.
- Mersch, D. (2016). Meta/dia two different approaches to the medial. *Cultural Studies*, 30 (4), 650-679.
- Morris, C. W. (1938). *Foundations of the theory of signs*. International Encyclopedia of Unified Science. University of Chicago Press.
- Morris, C. W. (2014). Göstergeler, dil ve davranış. M. Rifat ve S. Rifat (eds.), *XX.yüzyılda Dilbilim ve Göstergibilim Kuramları - 2. Temel Metinler* (pp. 237-239). Yapı Kredi Yayınları.
- Oosterling, H. (2009). Dasein as design or: Must design save the world? *Melintas*, 25 (1), 1–22.
- Panofsky, E. (1997). *Perspective as a Symbolic Form*. Princeton University Press.
- Siegert, B. (2015a). White spots and hearts of darkness drafting, projecting, and designing as cultural techniques. In *Cultural Techniques - Grids, Filters, Doors, and Other Articulations of The Real* (pp. 121-146). Forham University Press.
- Siegert, B. (2015b). Introduction: Cultural techniques: or the end of the intellectual postwar era in german media theory. In *Cultural Techniques - Grids, Filters, Doors, and Other Articulations of The Real* (pp. 1-17). Fordham University Press.
- Siegert, B. (2015c). (Not) in place - The grid, or, cultural techniques of ruling spaces. In *Cultural Techniques - Grids, Filters, Doors, and Other Articulations of The Real* (pp. 97-120). Forham University Press.
- Siegert, B. (2018). Coding as cultural technique: On the emergence of the digital from writing AC. *Grey Room*, 70(3), 6–23.
- Sprenger, F. (2016). The metaphysics of media: Descartes' sticks, naked communication, and immediacy. *Cultural Stud*, 30 (4), 630–649.
- Stiegler, B. (1998). *Technics and Time 1 - The fault of Epimetheus*. Stanford University Press.
- Vesely, D. (2004). *Architecture in The Age of Divided Representation - The Question of Creativity in The Shadow of Production*. MIT Press.
- Vidler, A. (2004). Architecture's expanded field. *Artforum*, (42.8), 142–147.
- Vogl, J. (2008). *Becoming-Media: Galileo's telescope*. Grey Room, 29, 14–25.
- Watten, B. (2009). Poetics in the expanded field: Textual, visual, digital. In, A. Morris and T. Swiss (eds.) *New Media Poetics – Contexts, Technotexts, and Theories* (pp. 335-370.) MIT Press.
- IKKM. (n.d.). *Operative Ontologies*. <https://www.ikkm-weimar.de/en/research/annual-topics/operative-ontologies/>



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M M G A R O N

Article

The impact of the February 6th, 2023, Kahramanmaraş epi-centered earthquakes on traditional underground water systems: Gaziantep case

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ABSTRACT

This article aims to compare the findings of an ongoing original doctoral study on the conservation of "traditional underground water systems" in Gaziantep and its vicinity, listed on the World Heritage Tentative List, with the significant damage to the built environment following the February 6th earthquakes and the resulting new situation, in order to define new conservation dynamics accordingly. The study seeks to initiate a discussion on the impact of changing environmental dynamics due to the earthquake on the conservation of these systems, focusing on the fundamental inputs of "resilience" and "vulnerability" in disaster risk management. The study utilized pre-earthquake documentation, such as system status, post-earthquake observations, damage assessments, expert reports, and satellite images, as primary inputs. Considering the earthquakes, the triggered secondary damages, and the scale of the disaster's impact, the comparative study of similar examples has been identified as a limitation. Hence, the article examined the 2003 Iran Bam earthquake's impact on Iranian Qanat Systems, a comparable example listed as a World Heritage Site since 2016. Despite the difficulties related to the accessibility of underground canals and traditional water structures such as kastel and livas, the study obtained significant findings for rapid post-disaster assessment and resilience capacity. The examinations reveal that traditional construction systems in the region are not always human-made, and karstic cave formations beneath historical structures should be evaluated separately, especially after earthquakes. The findings indicate that these water systems being constructed underground increases the resilience and reduces vulnerability of both the source and the users in the face of disasters such as earthquakes. Furthermore, the results support the study's hypothesis on how conservation efforts contribute to water security in the twenty-first century.

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INTRODUCTION

Traditional underground water systems have produced complex technical solutions developed under the influence of different cultures to access and protect water in

different geographical regions of the world for centuries. These systems, which have been a critical element in the development of civilizations, have served both the daily drinking water and agricultural production needs of communities in their regions by conveying water

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underground to prevent evaporation. Although some of these systems have not survived to the present day, there are many examples that are still in active use. As envisioned in this study, these systems also have a positive impact on providing water security resilience to local users in their geographical locations.

In the UNESCO World Heritage List, which provides important sanctions for the protection of cultural assets and guarantees the efforts of the State Parties to protect these cultural assets, 10 of the 140 underground structures registered to date are water-related structures (Özdemir, 2020). These systems, which are still in active use, have been inscribed on the UNESCO World Heritage List as being of outstanding universal value.

However, intense population growth, unplanned urbanization, and major disasters in the last century put these systems at risk of extinction. Therefore, the protection and sustainability of these systems are critical for both the continuation of cultural heritage and water security. Understanding the impact of the risks to which these systems are exposed requires specialized studies due to their underground location.

This paper examines the impact of the category 4 earthquake that struck Gaziantep and ten other provinces in its vicinity on 6th February 2023 on traditional underground water systems such as kastels and livas. It aims to determine the conservation dynamics of these systems in the context of resilience and vulnerability parameters after the earthquake. As part of the study, the investigation of the earthquake's impact on the traditional underground water systems in Gaziantep will be supported by an evaluation of the "Persian Qanats" of Iran, which have previously experienced similar disasters and are on the World Heritage List. As a result a new framework for the protection of traditional underground water systems in the face of rapidly evolving disasters will be proposed.

Gaziantep Kastels and Livas: A Traditional Underground System for Water Management

The traditional underground water systems of Gaziantep, "Kastels and Livas," which are the focus of the study, were developed based on a necessity, as in all similar systems.

- Insufficient quantity of water in the Alleben stream in the region,
- That the Gaziantep plateau is unsuitable for lakes,
- Due to the geological structure, a significant proportion of rainfall seeps into the ground, forming groundwater,
- The need to prevent evaporation due to high temperatures,
- The area has geological formations of soft limestone, marly limestone, and chalk that are suitable for the construction of underground water tunnels (UNESCO, 2018).

The 'livas' system in Gaziantep has a different arrangement from the pipe or aqueduct transport systems found in Anatolia. The main feature of the water system is creating a continuous water source and using this water throughout the settlement (Uçar, 2016). A "Kastel," which has various functions, is a public underground water structure with a regional character. Kastels are underground complexes that include lavatories, open spaces, laundry areas, resting places, and mosques (Altın, 2017). The historic water structures of Gaziantep serve as significant evidence of cross-cultural interaction on a global scale, as well as reflecting socio-cultural life and local technical knowledge.

Studies on the impact of earthquakes on historical water systems in the literature are generally addressed under the broader topic of the effects of disasters on cultural heritage. The preservation of cultural heritage is essentially risk management. Therefore, analyzing the hazards involved in risk management, assessing the potential risks arising from these hazards, and conducting vulnerability analysis, which affects manageability, are fundamental steps in analyzing the risks to cultural heritage (Ünal & Ünal, 2019). Managing the risks that affect these systems is a fundamental necessity for preserving cultural heritage. Currently, the main factors threatening water heritage include population growth and urbanization, as well as disasters such as earthquakes and the floods and droughts brought on by climate change. In disaster situations, the connection with cultural heritage is viewed in two contexts. The first context is the role of traditional systems in enhancing resilience and reducing disaster risks. The second context is the role of actions aimed at mitigating disaster effects and supporting post-disaster recovery (Jigyasu et al., 2013). An understanding of the risks to these systems and their impact on urban resilience is critical to the creation of resilient cities.

There are many studies showing that traditional underground water distribution networks are affected by earthquakes in areas with high seismicity. The study by Pellet et al. (2005) examines the geotechnical performance of Iran's Qanat systems following the 2003 Bam earthquake. This study addresses the subsidence and cracks caused by the earthquake in the Qanat systems. Ambraseys & Melville (2005), in their study evaluating the impact of historical earthquakes on Iran's Qanat systems, highlight the vulnerabilities of these systems in the face of seismic activities. Smerzini et al. (2009), in their study investigating the effects of underground voids on surface earthquake waves, explain how underground water systems are affected during earthquakes. These sources provide critical data to understand the impact of earthquakes on underground water systems and how to protect these systems from seismic events.

Jigyasu (2015) emphasizes the role of traditional water systems in increasing societal resilience during natural

disasters and illustrates how historical water tanks and wells in Nepal meet water needs during emergencies. Molden (2019) examines the connection between water heritage and urban development in the Kathmandu Valley of Nepal, highlighting the resilience of traditional water systems. These sources address strategies for preserving traditional water systems and risk management, while also exploring the impact of these systems on societal resilience.

AFAD, in its preliminary assessment report on the Kahramanmaraş earthquakes published in 2023, addresses the impacts of the earthquakes and the subsequent measures taken. Aldemir et al. (2023) present a detailed examination of the Kahramanmaraş earthquakes, assessing their effects on Gaziantep and its surroundings. These sources discuss the impacts of earthquakes on water systems and the measures taken to mitigate these impacts.

The Iranian Persian Qanats World Heritage Site is the most notable example in the literature review. The existence of previous research on post-earthquake effects on traditional groundwater systems (Pellet et al., 2005 and Amini et al., 2004) will be useful for comparison. The inclusion of Gaziantep's traditional underground water systems on the Tentative World Heritage List for their outstanding universal value provides an opportunity for assessment in a common context. The Persian Qanat World Heritage Site Risk Management Plan, published by UNESCO in 2019, details the risk management plan for Iran's Qanat systems. This report encompasses measures that need to be taken against natural and human-induced hazards for underground water heritage in Iran.

The literature review shows that this study will provide new data for conservation strategies by analyzing the effects of large-scale disasters such as earthquakes on these systems under changing conditions. This research is one of the first studies to be carried out on the status of traditional underground water systems in the aftermath of the 6 February earthquake in Gaziantep. It fills a significant gap in the literature on the conservation of these systems.

METHOD OF THE STUDY

This study employs a qualitative research methodology to investigate the post-earthquake conditions and the potential use of traditional underground water systems in the city center of Gaziantep and its vicinity, which were affected by the earthquakes on February 6th, 2023. The research was conducted in two stages, with field visits being the most critical component of the study (Figure 1).

Post-earthquake field research was carried out in the city center of Gaziantep on February 7th, 2023, and in Sam Village, Gaziantep between March 28-30th. Field visits were undertaken to assess both the resilience and vulnerability parameters of the affected areas. These visits involved direct observations and evaluations on-site, which provided a comprehensive understanding of the extent of the damages and the condition of existing infrastructure. The field observations were structured to examine:

- **Physical Condition of Damages:** Detailed inspections of the damages sustained by various structures, focusing on the types and severity of the damages.

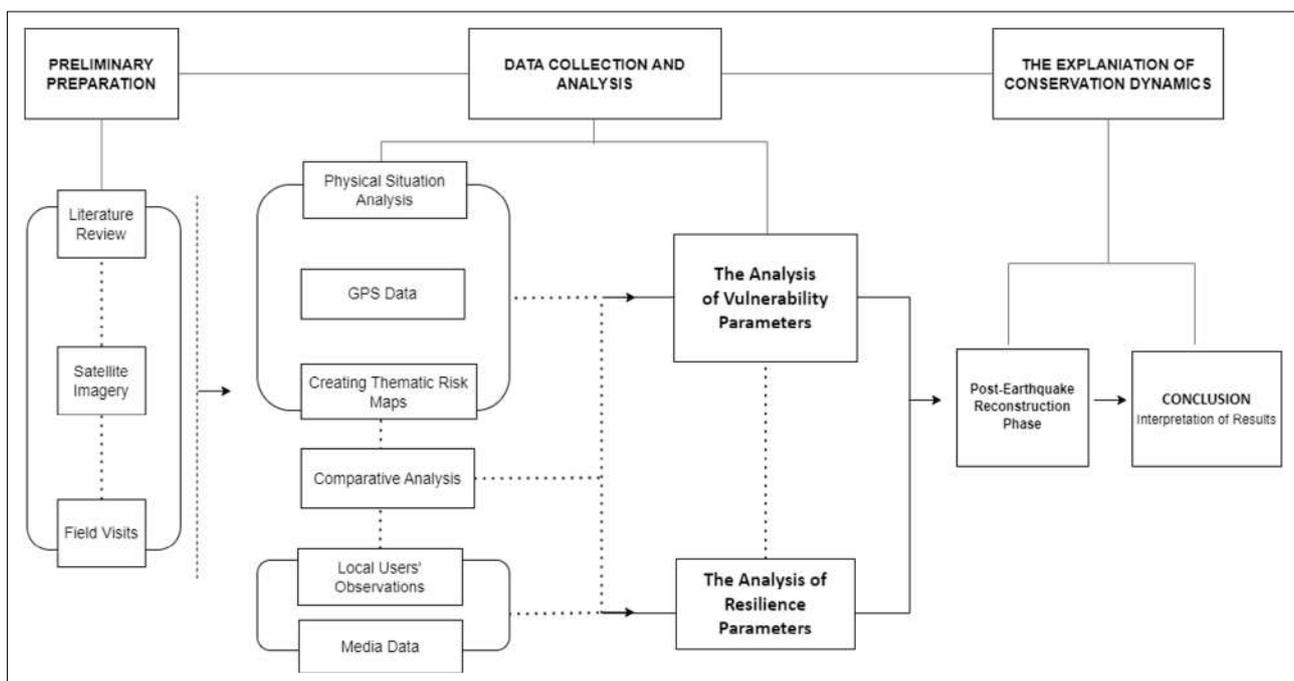


Figure 1. Method flow chart of the research.

This information was analyzed specifically within the 'vulnerability' parameter to understand how different structures fared during the earthquakes.

- **Usability of Traditional Underground Water Systems:** Investigations were carried out to evaluate the potential use of traditional underground water systems in the aftermath of the earthquakes. This included field observation of the physical conditions and operational status of the water systems in question. It also utilized information gathered from reports on the subject, local records, local authorities, residents, and open sources.

Data Analysis

During the post-earthquake field examination, observed damages were photographed and documented, while GPS (Global Positioning System) data were recorded to mark the locations of the structures. The qualitative data collected from field observations were complemented by a thorough literature review. This review aimed to contextualize the field data within broader research on earthquake resilience and traditional water systems. The analysis was divided into two main parameters:

Analysis of Vulnerability Parameters: This involved a detailed examination of the types of structural damages observed during the field visits. The analysis focused on identifying common patterns of vulnerability in the affected structures, considering factors such as construction materials, design, and age of the buildings. Additionally, the comparable structural and technical characteristics of the Iranian qanat systems and the Gaziantep *kastels* and *livas* have enabled their comparative examination, as they represent important formations and expressions of cultural richness. Furthermore, the importance of this comparative analysis is underlined by the availability of data on the impact of the 2003 Bam earthquake on the qanat system in Iran. Similarly, assessing the disaster risk to traditional underground water structures in Gaziantep provides crucial information to help manage disaster risk. The last section of the article presented the results of a study conducted in Gaziantep on the conservation of traditional underground water systems during the post-earthquake reconstruction phase. The studies conducted after the earthquake in Iran, which was selected as a case study for measures to be taken during the reconstruction phase after the earthquake, have been examined. Access to the data was facilitated through the "Persian Qanats World Heritage Site Risk Management Plan" prepared in 2019. The nomination file defines the areas designated as "Buffer Zone" as areas designated to protect the qanat and its water supply system from possible natural, environmental, cultural, and landscape hazards. This delineation of boundaries prioritizes protecting the system against the effects of earthquakes (UNESCO, 2019). Therefore, in this study, thematic maps were utilized for assessing ground-

based risks, similar to the approach used in the Persian Qanats case. This allowed the assessment of disaster preparedness for existing traditional underground water systems in Gaziantep.

Analysis of Resilience Parameters: The usability of traditional underground water systems was analyzed in terms of their operational status post-earthquake and their potential role in providing water in emergency situations. The field observations and information from open sources were cross-referenced with existing literature to evaluate the resilience of these systems. The literature review included studies on the historical and technical aspects of these water systems, their performance in previous earthquake scenarios, and their adaptability to current needs. This methodology allowed for a comprehensive understanding of both the immediate impacts of the earthquakes and the potential long-term benefits of utilizing traditional underground water systems in enhancing the resilience of the affected communities.

EFFECTS OF THE FEBRUARY 6TH EARTHQUAKE ON TRADITIONAL UNDERGROUND WATER SYSTEMS

The initial earthquakes on February 6th, with magnitudes of 7.7 and 7.6, respectively, were followed by over 1300 smaller aftershocks within the next 72 hours (AFAD, 2023). Given the presence of various traditional underground water systems in the area affected by this devastating disaster, it is necessary to investigate the impact of the earthquake on these traditional underground water systems. Furthermore, as water systems play a critical role in the post-disaster reconstruction phase, examining the potential use cases of these systems is deemed essential. The impact zone of the earthquake includes cities directly affected by the disaster, such as Kahramanmaraş, Gaziantep, Hatay, Osmaniye, Adıyaman, Malatya, Adana, Kilis, Diyarbakır, Elazığ, and Şanlıurfa, which have been declared disaster areas (Resmi Gazete, 2023). An examination of the earthquake history of these regions reveals significant earthquakes in the area from the 19th century to the present, with the least intense of these major earthquakes having a magnitude of 6.8 (Mimarlar Odası, 2023) (Figure 2).

In addition to the loss of life and injuries, the earthquake of 6 February 2023 caused irreversible damage to the built environment. An important feature of these areas is their historical identity, and the historic environment of these cities suffered significant damage from the earthquake. The two magnitude 7 earthquakes caused widespread rural and urban destruction, numerous deaths, environmental damage, and, according to studies, millions of tonnes of construction and demolition waste, including hazardous waste (Doğdu & Alkan, 2023).

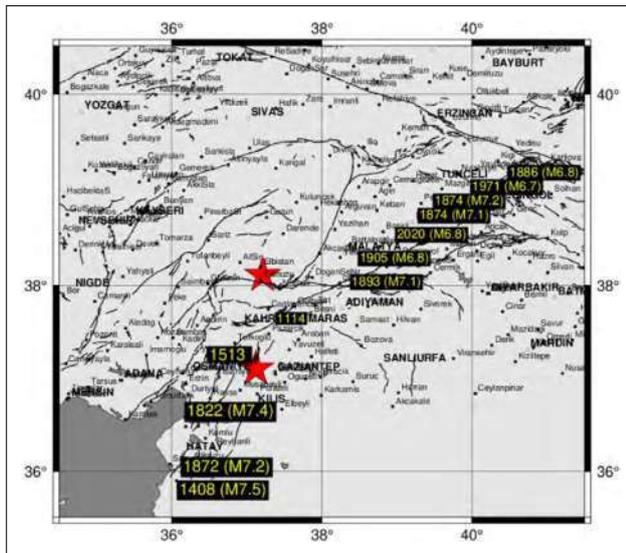


Figure 2. Significant earthquakes in the East Anatolian Fault Zone (Mimarlar Odası, 2023).

The field study conducted to investigate how the underground water heritage in urban areas was affected by the disaster revealed that the extent of destruction was lower in the city center of Gaziantep. For example, in the city center of Hatay Antakya, the estimated archaeological aqueduct and kastel structure were damaged by collapsing rubble piles. Gaziantep's underground water structures, known as kastels, were damaged by the secondary effects of the earthquake. The kastel in the village of Sam, outside

the center of Gaziantep, was affected by debris from surrounding structures after the earthquake. This can be attributed to the fact that previous planning decisions for the preservation of the historical environment in the city center were more organized compared to those in village settlements. Examples of historic water structures were not immediately destroyed by the earthquake; only partial damage occurred to kastel structures where their presence above ground could be observed due to the secondary effects of the earthquake. This section describes the effects of the earthquake on kastels, based on field observations and existing assessment forms.

In Gaziantep, there are six known kastels and their associated livas in the city centre. The names of the kastels are Pişirici, Kozluca, İmam-ı Gazali, Şeyh Fethullah, İhsan Bey, and Ahmet Çelebi (Figure 3).

The construction of the kastels is based on the geographical features of Gaziantep. The deep underground water level and the inadequacy of the existing rivers at low altitudes forced the craftsmen of Gaziantep to find a solution. This solution was to carve the limestone found underground. This allowed water to flow from the source to the city center and create a specific slope. The kastel structures were designed to allow public access to the water via steps (Çam, 1984). According to Altuğ (2013), the kastels not only provided access to water but also served as natural cooling areas for the local community in the days before modern cooling technology. These structures provided a comfortable environment that satisfied the worship needs

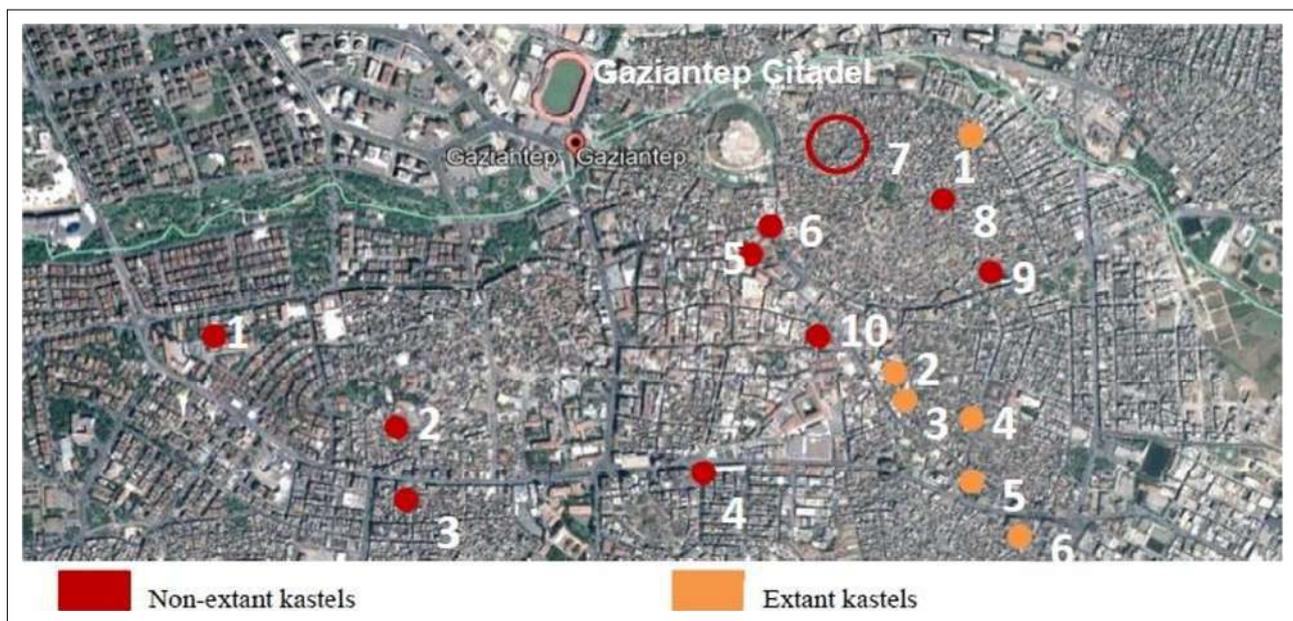


Figure 3. The non-extant and extant Kastels located in Gaziantep, Non-extant kastels: 1. Kastel of Eşraf, 2. Kastel of Şahveli, 3. Kastel of Ayşe Bacı, 4. Kastel of Şeyhcan, 5. Kastel of Kabainek, 6. Kastel of Sultan Gavri, 7. Kastel of Mehak, 8. Kastel of Kanalıcı, 9.10. Unknown; Extant kastels: 1. Kastel of İmam Gazali, 2. Kastel of Kozluca, 3. Kastel of Pişirici, 4. Kastel of Şeyh Fethullah, 5. Kastel of İhsan Bey, 6. Kastel of Ahmet Çelebi (Uçar et al, 2018).

of the people in the region. The plan schemes also reveal the forms of the structures and how they are integrated into the bedrock (Figure 4). The water mains, known locally as 'livas,' are historic systems designed to bring water from the Pancarlı and Esenbek sources outside the city centre to the regional population by gravity.

The latest findings regarding the livas and kastels in the city have not yet been disseminated to NGOs such as the OBRUK Cave Team and the ÇEKÜL Foundation/Gaziantep, as well as governmental agencies like the Ministry of Culture, the Cultural Heritage Protection Board, and the Gaziantep Cultural Heritage Protection Board. According to the assessment forms received from Gaziantep Conservation Board and Monuments Directorate after the 6 February earthquake, the Ahmet Çelebi Mosque and its kastel and the İhsanbey Mosque and its kastel were moderately damaged. The Mosque of Şeyh Fethullah and its kastel sustained minor damage, while the İmam Gazali and Kozluca kastels were reported undamaged. Since the last visits on 23.11.2023, the Kozluca and İhsanbey kastels in the region

are open to the public again. However, the Pişirici, Şeyh Fethullah, and Ahmet Çelebi kastels are not accessible. The İmam Gazali kastel remains partially open for visits, similar to its previous condition (Figure 5)¹.

Except for the kastels indicated as "no damage" in the Ministry reports, the condition of other kastels has been summarized during the fieldwork conducted. Furthermore, information regarding the post-earthquake condition of a kastel located outside the city has also been provided as a result of the fieldwork conducted in the area. This example is one of the instances that suffered physical damage following the earthquake. In spite of the identification studies conducted in the area being sufficient for a quick assessment, detailed studies by different disciplines are required to fully determine the damage.

The Kastel of Pişirici (Number 3)

This kastel building is the oldest of them. It was built in 1283. At the entrance to the structure, which is about 30 steps below ground level, there is a pool and a vault

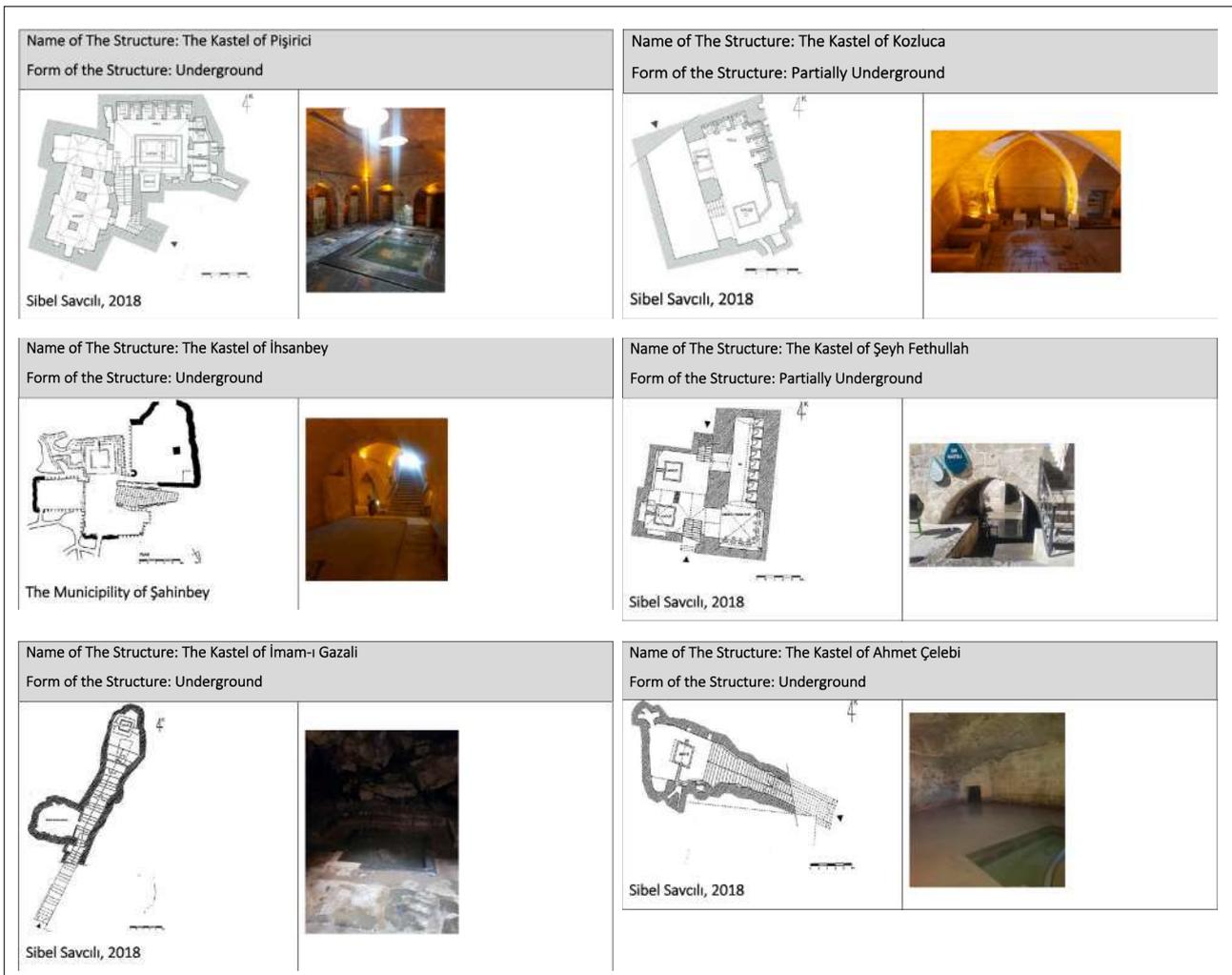


Figure 4. The Kastels in Gaziantep (Savcılı, 2018; Uçar et al., 2018).



Figure 5. According to reports, the post-earthquake situation of the Kastels in Gaziantep City Center.

covering the pool. The building also has toilets and laundry facilities (Çam, 1984). During the fieldwork, no entrance was provided into the Kastel of Pişirici because access to the site was closed post-earthquake. Only the surrounding area of the structure could be examined. However, discussions with the ÇEKÜL Foundation and the OBRUK Cave Team revealed that the Kastel of Pişirici was accessed and inspected through a special authorized study, and no damage was observed.

The Kastel of Şeyh Fethullah and The Kastel of Ahmet Çelebi (Number 4 and Number 6)

The Kastel of Şeyh Fethullah was built in the 16th century and was made of hewn stone. It is used as part of the ablution center in the courtyard of the Şeyh Fethullah Mosque. On the southwest wall, there is a livas connection (Çam, 2006). It has been temporarily closed due to a fragment detachment from the minaret of the mosque in the courtyard where the kastel is located. While the structural cracks and the falling stones of the minaret did not cause any damage to the kastel structure, effects such as collapse and fragment loss in the tall buildings surrounding the kastels can increase their vulnerability in the event of an earthquake. Similarly, the Kastel of Ahmet Çelebi is also temporarily closed, with ongoing restoration work focusing on strengthening the minaret. During the site visit, no visible physical damage was observed at the entrance of the kastel.

The Kastel of Büyük Pınar in the Sam Village

While the primary or secondary effects of the earthquake did not cause destruction to the kastel structures in the city center, a kastel structure located outside the city center suffered secondary damage due to the impact of surrounding buildings. The kastel, locally known as "Büyük Pınar" (37.151771, 37.304160), is located in the village square of Sam. There was a seven-story apartment building approximately 1 meter south of this open kastel structure before the earthquake. During the intentional demolition of the apartment building due to the damage it sustained after the earthquake, part of the building collapsed towards the historic water structure (Figure 6). The kastel's structural integrity was compromised when debris from the collapsing apartment building struck its walls. The impact caused significant cracking along the lower portion of the wall and displaced several stones from the structure's base, leading to instability. This incident can be cited as an example of damage and destruction due to the secondary effect of the earthquake.

Historic Underground Water Cistern of The Gaziantep Castle

Another traditional underground water structure in Gaziantep, commonly referred to as "sweet water-bitter water" by the local population, is the ancient cistern located at the lowest level of the Gaziantep Castle, known

to be connected to livas lines (Beyazlar, 2003). Experts conducting damage assessments for the castle have stated that, in addition to the clearly visible damage observed on the surface, no definitive assessment has yet been made regarding the condition of the sweet water-bitter water source and the well inside the castle³ (Figure 7).

There are no post-disaster reports available for the livas connected to the kastels in Gaziantep. According to a report by Hacettepe University Department of Civil Engineering related to the earthquake, "due to the earthquakes, there are cave collapses, slope movements, and rock falls in and around the city center of Gaziantep." This risk could also be considered for livas formations intersecting with caves. Even if collapses occur in the lines in the city center, their effects may not be immediately noticeable. This situation is one of the most significant challenges encountered with underground water systems. Field studies carried out on these kastels after the earthquake did not reveal any deterioration in their physical condition. The main reason for this is that the structures are generally carved into the rock. However, to cite this as a reason, there is a need for comparison with similar examples.

The Impact of Earthquakes on Traditional Underground Water Systems: The Case of Persian qanats and The Bam Earthquake

Numerous studies have shown that earthquakes in regions with high seismic activity affect traditional underground water supply networks. For example, it has been found that traditional underground water systems, such as "qanat," lead to collapses and cracks in the underlying soil layers due to disruptions in their geotechnical structure (Pellet et al., 2005; Smerzini et al., 2009; Ebrahimi et al., 2019). These damages can sometimes directly affect the traditional underground water heritage or indirectly impact nearby structures, leading to collapses and damages caused by falling rock fragments on the heritage.

Examining World Heritage Sites with livas and similar underground water distribution systems in affected areas would be beneficial for better understanding the earthquake impacts on traditional underground water systems. Before the destructive Bam earthquake on December 26, 2003, it was already known that qanat systems are sensitive to seismic events. The most significant observed impact was the collapse of qanats and damage to water transmission lines. Additionally, the secondary effect of the earthquake caused the collapse of hidden qanats under living corridors, thereby damaging roads and buildings on the surface (Ambraseys & Melville, 2005). The impact of the Bam earthquake on qanat systems extended beyond surface collapses, also causing pits in the deep layers where qanats are located (Figure 8). These collapses disrupted water flow to palm groves in Bam, affecting a significant part of the cultural landscape connected to the traditional underground water system and



Figure 6. The condition of a structure near the Kastel of Büyük Pınar in Gaziantep/Sam Village during its controlled demolition after the earthquake (Kashgil Archive²).

causing economic losses for the country. Pits under main roads complicated the efforts of emergency response teams trying to reach the affected area in the first 48 hours after the disaster (Amini et al., 2004).

A study in Tehran province reported a series of collapse events in horizontal tunnels near areas where Kariz tunnels had collapsed due to long-term gravitational effects (Rayhani & El Naggar, 2007). According to post-earthquake reports, the collapse of garden walls or other structures onto the surface distribution channels of qanat systems led to these channels being covered with debris. Consequently, the vital water sources for local communities in villages near fault lines were obstructed (Nadim et al., 2004). The relationship between fault lines and qanat routes offers important lessons

for local administrators, especially in urban planning. The Persian Qanat World Heritage Site Risk Management Plan indicates that significant damage did not occur during earthquakes (UNESCO, 2019). However, the nomination file prepared in 2015 shows an increase in restoration activities, especially after 2003, and new decisions in management mechanisms. The report also states that areas designated as "Buffer Zones" are defined to protect the qanat and water supply system against possible natural, environmental, cultural, and landscape hazards. This definition aims to prioritize the protection of the system against earthquake effects. Therefore, the most critical section where the qanat route passes through dense urban and settlement areas has been designated as a buffer zone extending 50 meters on

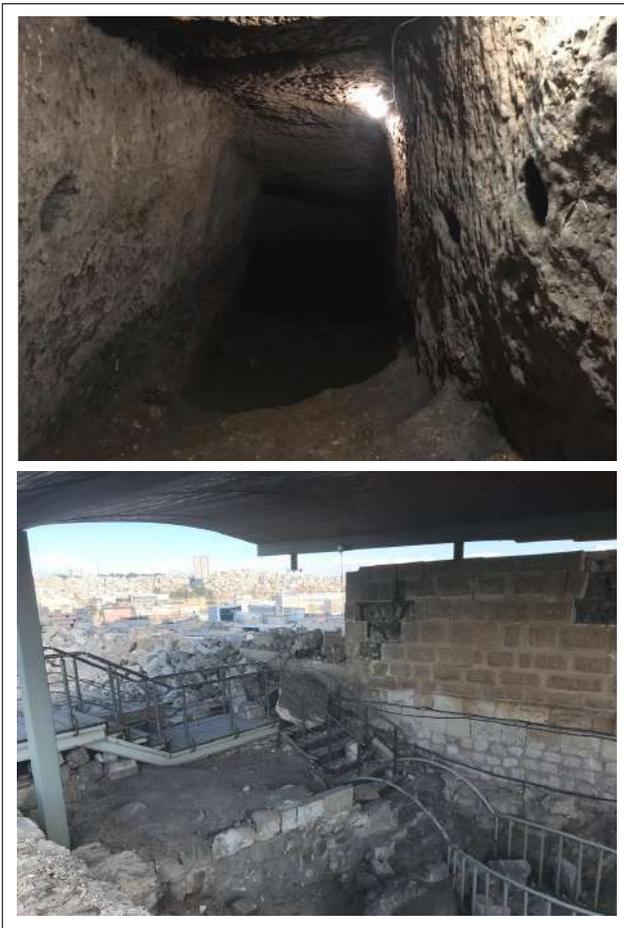


Figure 7. Gaziantep Castle tunnels lead to the bitter water-freshwater junction, and on the right, the view of the hill leading to the castle corridors after the earthquake (Umut Almaç³).

either side of the route. Approvals for urban developments in these areas are granted by ICHHTO, the central institution responsible for matters related to qanats, based on detailed zoning plans (UNESCO, 2015).

Reports based on observations in the affected regions indicate:

- Changes in the water regimes of some qanats were observed,
- The north-south orientation of fault lines and the east-west orientation of qanat routes reduced the level of collapse in qanats,
- Collapses in qanats occurred at intersections of fault lines,
- Qanats passing over wide alluvial deposits suffered more damage during the earthquake.

Regarding measures taken for earthquakes and qanat systems:

- After the earthquake, cracks in qanats were filled with

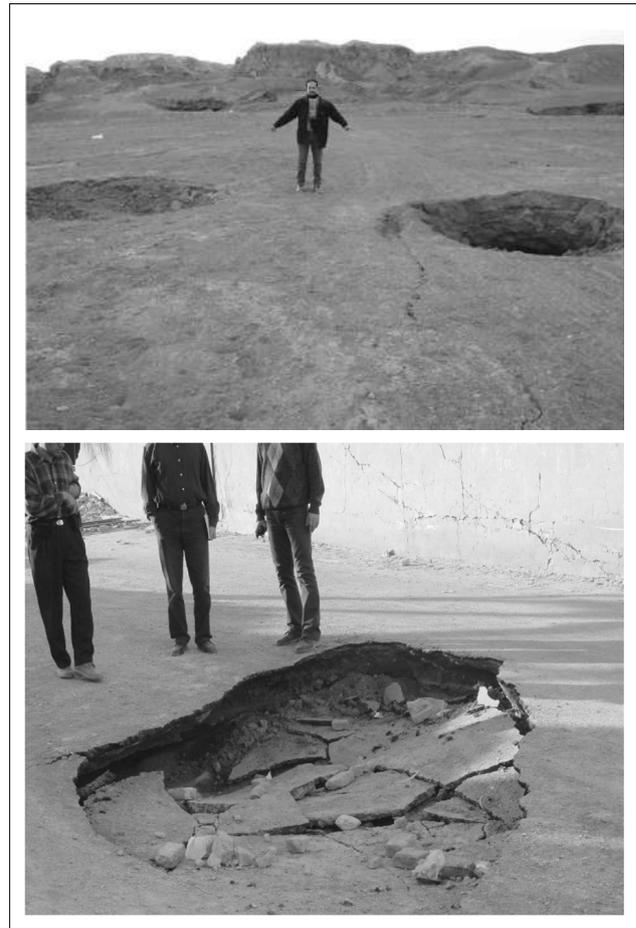


Figure 8. Ground voids and tension cracks formed after the collapse of a shallow qanat in Iran after the earthquake (Pellet et al., 2005).

a soft clay and water mixture according to traditional methods by experts,

- Well entrances passing through urban areas were sealed with stone materials to prevent foreign objects from falling into the channels,
- The Bam Cultural Heritage Rescue Project (RPBCH) was implemented after the earthquake. This project aimed to map the routes of qanat main wells and exit points to gather all information about qanats.

Compared to the Gaziantep case, the primary damage observed in the qanat system can be attributed to the lines directly passing over fault lines, even though the systems were created using similar techniques under similar geographical conditions. Since there is no definitive report on the condition of the livas systems in Gaziantep, it is unknown whether collapses occurred. Identifying risky points of lines, particularly those related to soil structure, can help prevent similar incidents to the qanat example from happening in the future and contribute to the existing literature.

CONTRIBUTION OF TRADITIONAL UNDERGROUND WATER SYSTEMS TO RESILIENCE CAPACITY IN TIMES OF DISASTER

Globally faced earthquakes, climate crises, and related disasters such as floods, landslides, and fires emphasize the importance of "resilience." Traditional underground water systems, as man-made structures and systems throughout history, stand out not only for their cultural, historical, and archaeological values but also for their contributions to building resilient communities and cities. For instance, challenges related to water supply are encountered both instantly and after earthquakes. In regions with modern water distribution networks, water supply is intentionally cut off during earthquakes. This is because water leaking from damaged or broken pipes can cause trapped individuals under debris to drown. Moreover, leaking water coming into contact with already weakened structural elements of buildings can accelerate the collapse of damaged structures (Yıldız, 2019). This water cutoff complicates disaster victims' access to clean water, jeopardizes hygiene conditions, and increases the risk of epidemics threatening public health in the disaster area. This raises questions about potential water supplies in settlements during disaster scenarios and whether the relationship between traditional underground water heritage and disasters is significant. These questions are aimed at exploring whether traditional underground water systems can serve as potential water sources for vulnerable communities in emergencies.

The earthquakes experienced on February 6th, 2023, in Kahramanmaraş underline the challenges faced in accessing basic needs such as clean drinking water and water for personal hygiene during and after the event, further emphasizing the importance of this topic. After the earthquakes, it was observed that local people, especially those living in rural areas, experienced water shortages and used water for drinking and cleaning purposes from the Kastel of 'Küçük Pınar' in the village center (Figure 9).

Another example regarding the potential use of traditional underground water systems after the earthquake is the Historic Bath of Naib, which is connected to livas and is still actively used today. According to information provided by the hamam's operator, the hamam did not suffer damage after the earthquake, and it is mentioned that it could accommodate around 50-60 people from nearby residences for approximately 10 days (NTV, 2023). The strongest evidence of the contribution of traditional groundwater systems to water security is that in the critical first three days after the earthquake disaster, which affected some 11 provinces, water supply was actively provided by historic water systems in both urban and village centers.

As seen, water, which is a basic necessity in daily life, becomes even more crucial during disasters, especially earthquakes. To support this research in defining the resistance parameter,



Figure 9. The post-earthquake situation in Sam Village, Gaziantep and the reference to "Küçük Pınar".

studies of the use of traditional groundwater systems after earthquakes are also being evaluated.

Contribution of Traditional Underground Water Heritage to Resilience in Disaster Situations: International Cases

Molden (2019) argues that underground water heritage extends beyond being merely a temporary alternative, a water museum, or a universal solution for modern problems (UNESCO, 2015). Traditional underground water systems should be considered not only as cultural assets but also as systems that have served numerous purposes. They may be used as temporary options, can remain functional, and should not be considered obsolete until their potential is fully understood. They may not be completely compatible with modern needs due to their physical condition but can be somewhat stable (Molden, 2019). Disasters worldwide have shown the need to analyze water structures within vulnerability and resilience parameters, integrating this aspect into disaster management as a fundamental input. The connection between various types of disasters and traditional underground water structures in different

regions worldwide has been examined in numerous studies. For example, in Rome, which has traditional aqueducts, historical water aqueducts like Acqua Vergine and Acqua Paola have been identified as having the water capacity to support firefighters due to the dense building concentration and fire risk in the historical city center, indicating they could be used during or after disasters (Okubo, 2016).

A similar situation is observed in Japan. Studies have shown that underground water wells provided significant benefits during earthquakes in Japan. For instance, fires following the 1995 Hanshin-Awaji earthquake damaged many wooden cultural heritages. Considering the high risk of continuing earthquakes, the benefits of traditional water management inherited from the Shirakawa-go and Gujyo-Hachiman communities began to be researched. The traditional water system consisting of urban canals and reservoirs provided clean drinking water and met the necessary water requirements, especially for extinguishing fires in emergencies (Kobayashi, 2003).

An older example of this system is found in the case of San Francisco, which experienced a major earthquake disaster in the spring of 1906. Following the earthquakes, the city was completely destroyed by fire disasters. As a solution, it was suggested to build cisterns based on traditional knowledge at certain points underground in city centers. Today, 175 underground cisterns lined with circular red bricks are kept ready in the city center for use in case of earthquakes and subsequent fire disasters (Atlas Obscura, n.d.) (Figure 10). After surviving the 7.8 magnitude earthquake in San Francisco, interviews with survivors brought up another significant issue related to water heritage. Immediately after the event, the meeting place for people to gather was known as Lotta's Fountain, "Lotta's Foundation." Since then, it has become a memorial space where people gather annually to remember the 1906 disaster and the lost lives. Today, the fountain is preserved for its place in the city's image and its ritual value (ABC7 News, 2023).

In Japan, a "national emergency underground water well registration system program" was launched in 2015. This law introduced regulations on the efficient use of underground water for emergency water supply during disasters (Table 1).

Jigyasu (2015), in his example on the role of traditional water systems in natural disaster situations using the case of Nepal, emphasized their contribution to forming resilient communities (Figure 11). Water tank systems or wells in the historical urban fabric of the Kathmandu Valley met the city's water needs in emergencies. Jigyasu (2015) mentioned that these systems are currently facing pressure from intense urbanization. This not only accelerates the disappearance of cultural resources but also increases the fragility of communities against natural disasters by disrupting the local ecological balance (Jigyasu, 2015).

The stages that follow a disaster can be identified as,

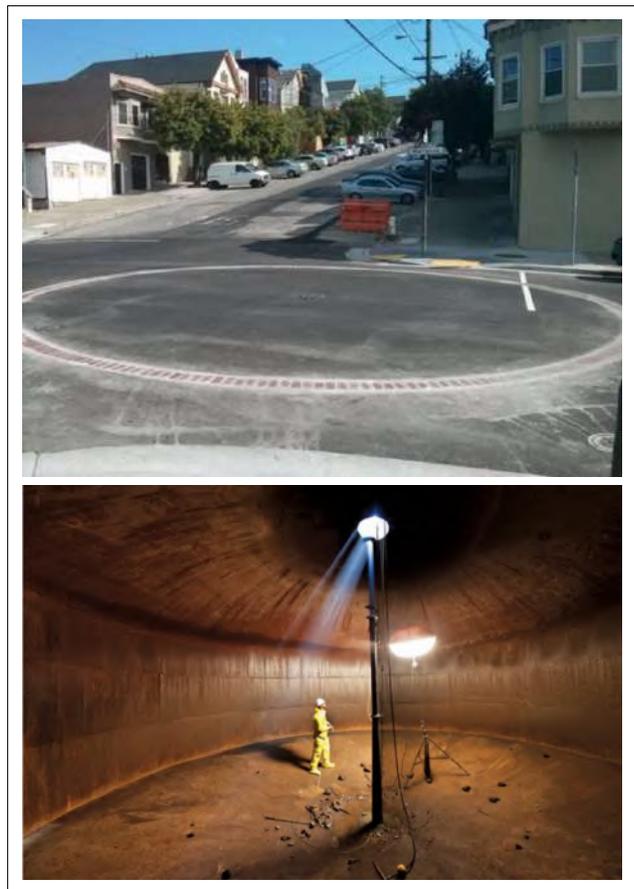


Figure 10. An example from the underground cistern on Sanchez Street (Atlas Obscura, n.d.).



Figure 11. The traditional water supply system in the Kathmandu Valley is utilized for both daily needs and emergencies (Jigyasu, 2015).

- Emergency aid,
- Rehabilitation, and
- Reconstruction phase (Limoncu, 2004; Yıldız, 2019).

A review of examples from around the world and from Turkey can provide a general framework for the potential use of traditional groundwater systems during disasters (Table 2).

Table 1. Different amounts and qualities of water were used depending on the location after the Tohoku earthquake in Japan. (Tanaka, 2016).

Water Source	Quantity	Quality	Remarks
River, lake and pond water	Large amount	Different depending on water source	Transportation is necessary
Sea water	Large amount	Treatment is necessary for freshwater usage	Transportation is necessary
Groundwater	Amount will be affected place to place	Pollution of shallow groundwater is a factor	Need and supply locations can coincide; Water table decline is possible; water pollution is possible, set of hand pumps is needed
Rainwater	A water tank set is necessary to provide 0.22-2,000 m ³	Possibly clean but treatment is necessary sometimes	Need and any supply locations can coincide

Table 2. Traditional Underground Water Systems' Potential for Use During Earthquakes

Method of Use	Rural Area	City Center
Drinking Water	Emergency Response and Recovery Phase	Emergency Response and Recovery Phase
In Preventing Secondary Disasters	-	First 24 Hours (Emergency Assistance)
Sanitation	Emergency Response and Recovery Phase	-
Assembly Point	At the Moment	At the Moment

According to the United Nations Office for Disaster Risk Reduction (UNDRR), resilience is "the ability of a system, community or society exposed to hazards to withstand, absorb, accommodate, adapt to, transform and recover from the effects of hazards in a timely and efficient manner, including through the maintenance and recovery of its essential basic structures and functions" (UNDRR, n.d.). Literature-based research has demonstrated the potential use of traditional underground water systems in disaster situations, contributing positively to resilient cities and communities. They have provided protection against secondary disasters that can occur in both rural and urban centers, met the urgent need for drinking water, served hygiene needs in the first 3 days when water was cut off, and in some cases, because of their place in the memory of the city, have acted directly as assembly points.

PRESERVATION AND PLANNING OF TRADITIONAL UNDERGROUND WATER SYSTEMS IN THE POST-EARTHQUAKE RECONSTRUCTION PHASE

It is important to study and monitor the impact of the 6 February earthquakes on cultural heritage. This section of the study explains the parameters to be considered in urban planning decisions and the measures to be implemented during the post-earthquake reconstruction phase. Any disruption in the underground water transmission lines

can cause water to seep into the soil and soften it, if it still carries water. This condition can lead to vertical deflection in the buildings, affecting their foundation settlement (Arun, 2019).

In considering the impact of the Iran-Bam earthquake on qanats, it is noted that qanats are generally buried in the ground and are sufficiently stable during earthquakes and ground shaking. However, it is emphasized that the characteristics of the ground should be taken into account during the post-earthquake reconstruction phase (UNESCO, 2019). Similarly, in the case of Gaziantep, the potential impact of the earthquake on livas and kastels was investigated based on the soil characteristics.

Risk Assessment for Kastels and Livas Based on Soil Properties

In the initial phase of damage assessment studies following the 6 February earthquakes, observational assessments were carried out on the Gaziantep kastels and livas, which are part of the UNESCO World Tentative Heritage Site. During the preparation phase of these initial assessments, damage assessment studies carried out at the Iran Bam World Heritage Site, which suffered significant earthquake damage to its historic settlement and has a similar traditional system, served as a guiding reference. The damage assessment conducted after the Iran Bam earthquake identified breaks and collapses in the lines of the traditional underground water systems (Rayhani & El Naggar, 2007; UNESCO,

2015). These findings indicate the need to assess similar damage risks for Gaziantep's traditional underground water systems, which have a similar structure. The fact that both historical systems are part of the Outstanding Universal Value emphasizes the importance of not only assessing the physical damage but also the potential loss of value due to this damage.

In order to preserve this heritage and prepare for future risks, it is essential to understand the long-term effects of the earthquake on underground water structures and to identify which parts may be affected. In contrast to the Iranian example, the impact of the earthquake on Gaziantep's traditional groundwater heritage was felt differently, as fault lines do not cross the city center and its surroundings. Therefore, identifying areas with high sensitivity to earthquake effects due to soil properties is an important step in the long term¹.

Underground water structures located within the soil can develop different responses in the absence of any earthquake threat and during an earthquake. In areas with alluvial soil properties, liquefaction or soil softening can be observed under the impact of an earthquake (Gaziantep IRAP, 2021). Soil liquefaction is defined as the significant reduction in shear strength and stiffness of cohesionless or low-cohesion soils below the groundwater level up to a depth of 20 m under earthquake shaking, parallel to the increase in pore water pressure (Türkiye Bina Deprem Yönetmeliği, 2018). The risk of liquefaction, being predictable beforehand, is an important input that should be considered in design decisions

and urban planning parameters. Liquefaction also damages the stability of underground structures (Mian et al., 2013) (Figure 12). Liquefaction areas generally manifest themselves in coastal regions, river surroundings, lake/swamp areas, and their surroundings (Bulut Üstün et al., 2023).

It is known that the "kastels" part of the traditional underground water system in the Gaziantep sample area and the nearby livas lines connected to these kastels are located in the layer 20 meters deep from the surface (Altan & Arun, 2019). The depths of the structures from north to south are as follows: İmam Gazali 13.75 meters, Kozluca 2.65 meters, Şeyh Fethullah 3 meters, Pişirici 5.80 meters, İhsanbey 5.5 meters, and Ahmet Çelebi 8.75 meters. The depths of the livas lines reaching from the source point to the city center vary, with some depths identified as deep as 50 meters (e.g., under the American Hospital) and others as shallow as 1 meter from the surface (e.g., around the Pancarlı source point). Another parameter affecting liquefaction is the soil PGA (Peak Ground Acceleration) value. According to the Turkey Earthquake Hazard Map, when the PGA 475 value is greater than 0.1, the risk increases, and liquefaction is expected to intensify (JMO, 2021). PGA values for Gaziantep were examined based on coordinates entered on the AFAD Earthquake Hazard Map. Three different points in the region were researched: firstly, the area where the urban "kastels" are clustered, secondly, the Pancarlı region mentioned as the starting point of the livas line in sources, and lastly, Sam Village, which was damaged during the earthquake. Accordingly, the lowest PGA 475 value of 0.165 was recorded in the

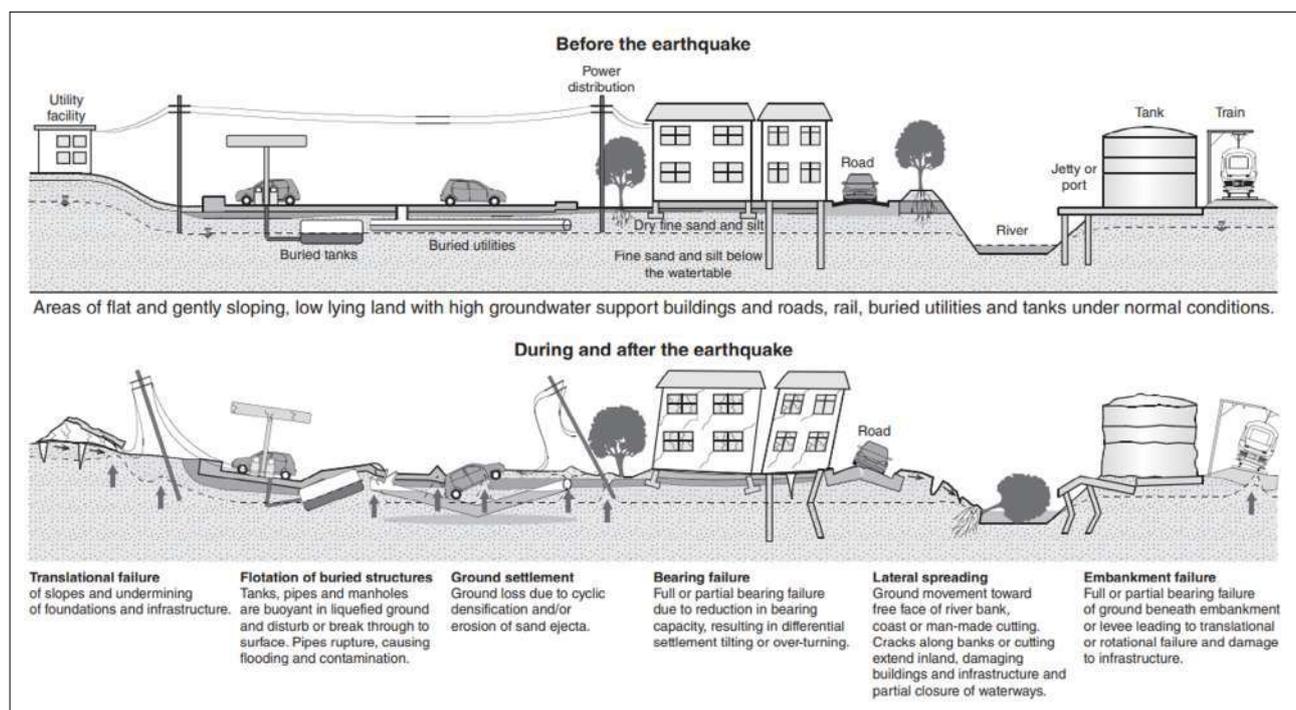


Figure 12. Soil liquefaction and its impact on underground structures (Mian et al., 2013).

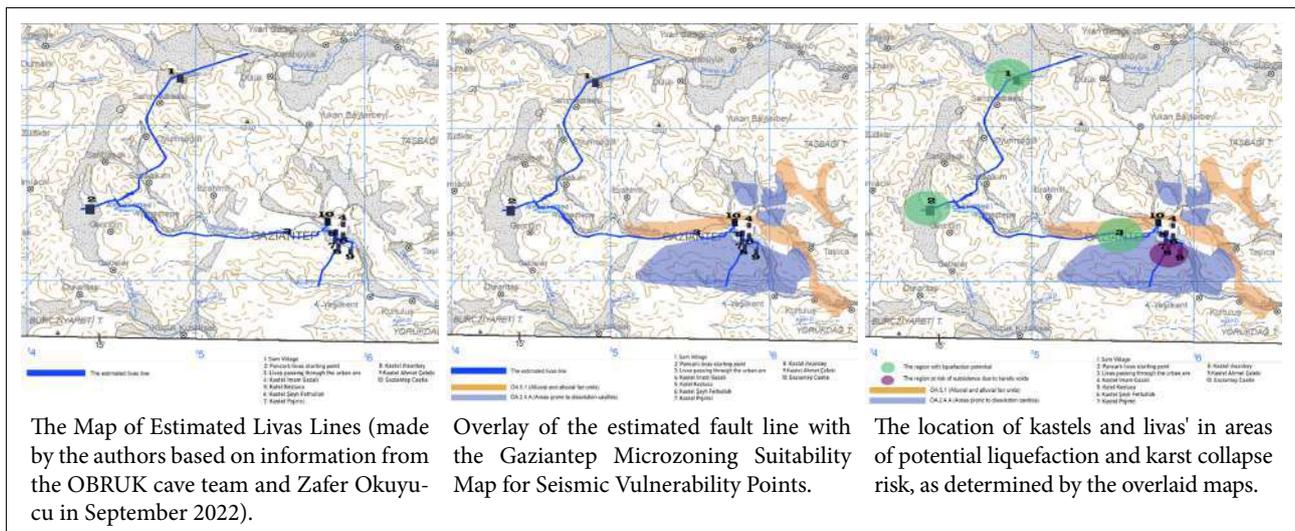


Figure 14. Traditional underground water structures located in areas with high earthquake damage risk (The estimated livas line map was created using the 2023 MTA (General Directorate of Mineral Research and Exploration) data generated by the authors and interviews conducted with the OBRUK Cave Team and Zafer Okuyucu).

CONCLUSION

This study was prepared to understand the status of traditional underground water systems after the February 6, 2023, Kahramanmaraş earthquakes. According to the evaluations, the traditional underground water systems in the affected city of Gaziantep were exposed to the secondary effects of the earthquake, suffering damage from surrounding debris rather than the direct impact of the earthquake itself. Furthermore, in the case of Gaziantep examined under the resilience parameter, in addition to the potential use of the systems during disasters, the likelihood of direct damage from disasters is generally low. It is concluded that the historical endurance of the systems and their function in preserving water sources have increased the level of resilience for the source and users and decreased the degree of vulnerability.

When evaluated in the context of resilience and protection parameters, better preservation of traditional underground water systems has been identified as an output that contributes to resilience in disaster situations. Therefore:

- Priority should be given to mapping historic groundwater pipes. Missing points should be completed as soon as possible.
- High-rise construction where the groundwater system comes to the surface and in its vicinity should be avoided.
- A detailed assessment of the collapse risk of buildings should be made where water pipelines cross areas of high seismic vulnerability, particularly in residential areas. This factor should be taken into account in land-use planning and development decisions.

- Historic underground water systems in rural areas should be re-established and made available to the local community. Local action can revitalize the system.
- Preparations of these systems should be made for use by disaster victims in case of emergency, especially in areas with a dense stock of wooden buildings in historic city centers, which increases resistance to fire risk.
- Preserving the intangible values of these historic systems is important. Especially the local communities living in the region should be educated and informed about the system.
- It is important to protect the technical knowledge of craftsmen familiar with the system and to teach them how to maintain these systems.

The field study revealed that historical underground water structures were not directly affected by earthquakes. However, significant risks are posed by the urban layer near the points where historic underground water structures emerge. The collapse of substandard structures near traditional underground water systems due to the earthquake's effect shows secondary effective damage to these historic water structures. Therefore, in future conservation and urban planning decisions, it is crucial to prevent multi-story constructions around the points where these structures emerge to protect these cultural assets. This provides important data in defining the conservation criteria for the Gaziantep Kastels and Livas in the UNESCO Tentative Heritage List and in determining the buffer zone.

Traditional systems have demonstrated their potential for emergency use during disasters, increasing urban resilience, providing drinking water, meeting sanitation needs, and mitigating secondary effects. Although not

regularly recommended, their benefits in rural emergencies are supported by international examples (Hein et al., 2020; Celia López-Bravo et al., 2022; Blanco et al., 2019). The example of Küçük Pınar studied in Gaziantep could be an important case to address this issue. Therefore, the critical importance of Gaziantep's kastels and livas is not limited to their heritage value; their contribution to water security in the 21st century is also significant.

Examining the impact of earthquakes on qanats in Bam, Iran, has yielded valuable data for understanding the impact of the February 6 earthquake on traditional underground water systems. The collapse of qanat lines where fault lines passed and damage to main road lines due to breaks and collapses in underground qanats in Bam had widespread effects on the city. Main fault lines bypassing Gaziantep's livas prevented direct damage to the city center. In rural areas, the earthquake spared traditional underground water systems, except for the collapse of buildings on kastels. However, future secondary effects remain a concern. A soil-based risk map for Gaziantep pinpoints vulnerable areas for underground water systems post-earthquake. These areas signal collapse risks, both seismic and non-seismic. Further scrutiny is needed to prioritize action in these zones. To preserve these systems, collaborative efforts by expert hydrogeologists, geologists, civil engineers, environmental engineers, urban planners, archaeologists, and architects are needed to determine the long-term impact of risks.

In conclusion, the study confirms that traditional groundwater systems increase resilience and reduce vulnerability during disasters, contributing to 21st-century water security. It also suggests conservation strategies based on post-earthquake observations in the Kastels and Livas of Gaziantep.

NOTES

¹The information provided is based on the interview conducted with Zafer Okuyucu on July 14, 2023.

²The information is provided by the personal archive of Sibel Karşılıgil on May 03, 2024.

³The information provided is based on the interviews conducted with Assoc. Prof. Dr. Umut Almaç on May 18, 2023, and Architect Zafer Okuyucu on July 17, 2023.

⁴The discussions with Murat Ergenekon Selçuk, an Assistant Professor in the Department of Civil Engineering at YTU, have been utilized in the investigation of the earthquake's impact on underground structures based on soil properties.

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REFERENCES

- ABC7 News. (2023). 110th anniversary of 1906 earthquake in San Francisco. <https://abc7news.com/110th-anniversary-of-1906-earthquake-in-san-francisco/1297723/>
- AFAD. (2023). Kahramanmaraş depremleri: Ön değerlendirme raporu. https://depem.afad.gov.tr/assets/pdf/Kahramanmaraş%20Depremleri_%20On%20Değerlendirme%20Raporu.pdf
- AFAD. (n.d.). Türkiye deprem tehlike haritası. Türkiye Afet ve Acil Durum Yönetimi Başkanlığı. <https://tdth.afad.gov.tr/TDTH/main.xhtml>
- Aldemir, A., Unutmaz, B., Koçkar, M. K., Erkal, G., Şahin, U., Sandıkkaya, A., Şahmaran, M., Öztürk, B., Küçükali, S., Çiçek, E., Aktepe, R., Akduman, Ş., İçen, A., Demir, C., Kocaer, Ö., Kul, A., Şahin, G., İlcan, H., Sönmez, M., ..., & Kaya, Y. E. (2023). 06 Şubat 2023 – Kahramanmaraş Pazarcık (Mw=7,7) ve Kahramanmaraş Elbistan (Mw=7,6) depremleri inceleme raporu. Hacettepe University.
- Altan, H. M., & Arun, G. (2019). Damage assessment of livas and kastels in Gaziantep, Turkey. In *Structural analysis of historical constructions: An interdisciplinary approach* (pp. 1789–1797). Springer International Publishing.
- Altın, A. (2017). Gaziantep kanavâtları (yer altı su yolları, kehrizleri) ve kastelleri. In S. M. Topçu & R. Aydın (Eds.), *Sanat Tarihi Yazıları. Çizgi Kitabevi*.
- Altuğ, K. (2013). İstanbul'da Bizans dönemi sarnıçlarının mimari özellikleri ve kentin tarihsel topografyasındaki dağılımı (Doctoral dissertation, İstanbul Teknik Üniversitesi).
- Ambraseys, N. N., & Melville, C. P. (2005). *A history of Persian earthquakes*. Cambridge University Press.
- Amini, K., Hoseyni, A., Visseh, Y., Rakhshandeh, M., & Farzipour Saein, A. (2004). Urban planning of Southern Tehran in order to reduce seismic vulnerability. https://www.researchgate.net/publication/285819707_Urban_planning_of_Southern_Tehran_in_order_to_reduce_seismic_vulnerability_Supported_by_International_Institute_of_Earthquake_Engineering_and_Seismology_of_IRAN
- Arun, G. (2019). Deprem risklerini azaltan geleneksel yapım teknikleri. ICORP Türkiye. <https://icorp-turkiye.org/Makaleler/K%C3%BClt%C3%BCr%20Varl%C4%B1klar%C4%B1na%20Y%C3%B6nelik>

- lik%20Afet%20Risklerinin%20Y%C3%B6netimi.pdf
- Atlas Obscura. (n.d.). 1908 Cistern Circles. <https://www.atlasobscura.com/places/1908-cistern-circles>
- Beyazlar, A. (2003). 2003 yılı Gaziantep kalesi kazısı. https://www.academia.edu/19665273/Gaziantep_Kalesi
- Bulut Üstün, A., Altuntaş, G., Demirörs, U., & Karayazı, O. (2023). 6 Şubat 2023 Kahramanmaraş depremleri ve 20 Şubat 2023 Defne (Hatay) depremi sonucu gelişen sivilaşma yapıları saha gözlemleri ve değerlendirmeler. Jeoloji Etütleri Dairesi Başkanlığı, Ankara.
- Çam, N. (1984). Gaziantep'te kastel adı verilen su tesisleri. *Vakıflar Derg.*, 18: 165–174.
- Çam, N. (2006). Türk kültür varlıkları envanteri: Gaziantep 27 (Vol. 10). Türk Tarih Kurumu Yayınları.
- Doğdu, G., & Alkan, S. N. (2023). Deprem Sonrası Oluşan İnşaat ve Yıkıntı Atıklarının Değerlendirilmesi: 6 Şubat 2023 Kahramanmaraş Depremleri. *Artvin Çoruh Üniversitesi Mühendislik ve Fen Bilimleri Dergisi*, 1(1), 38-50.
- Ebrahimi, E., Abdollahzadeh, G., & Jahani, E. (2019). Assessment of axial load effect on nonlinear modeling and seismic response of reinforced concrete structures based on fuzzy set theory using genetic algorithm. *Struct Concr*, 20(2), 614–627.
- Gaziantep İl Afet ve Acil Durum Müdürlüğü. (2021). Gaziantep IRAP raporu. <https://gaziantep.afad.gov.tr/kurumlar/gaziantep.afad/E-Kutuphane/Il-Planlari/Gaziantep-IRAP.pdf>
- Gaziantep Metropolitan Municipality. (2023). Gaziantep merkez mikro bölgeleme etüt raporu. <https://www.gaziantep.bel.tr/uploads/2023/09/plan-aciklama-raporu-11.pdf>
- Hein, C., Schaik, H. V., Six, D., Mager, T., Kolen, J. J., Ertsen, M., Nijhuis, S. & Verschuure-Stuip, G. (2020). Introduction: Connecting water and heritage for the future. In *Adaptive strategies for water heritage* (pp. 1–18). Springer.
- Jigyasu, R., Sharma, A., & Dhar, A. (2013). Disaster management and heritage preservation. In P. F. Wilkinson & W. T. Easterling (Eds.), *Disaster Risk Reduction for Heritage Places: A Strategic Approach* (pp. 55–68). Getty Publications.
- Jigyasu, R. (2015). Reinforcing the link between water and heritage in order to build disaster resilient societies. In Willem J.H. & Henk P.J. van Schaik, *Water & Heritage*. Sidestone Press Academics.
- JMO. (2021). Ulusal kılavuz. Türk Jinekoloji ve Obstetrik Derneği. https://www.jmo.org.tr/resimler/ekler/cafb473706e58e6_ek.pdf
- Kobayashi, M. (2003, March 16-23). Traditional practice of water management for fire prevention in Shirakawa-go and Gujo-hachiman in Gifu, Japan. Third World Water Forum, Kyoto, Japan.
- Limoncu, S. (2004). Türkiye'de afet sonrası sürdürülebilir sistem yaklaşımı [Unpublished Thesis, Yıldız Technical University].
- Mian, J. F., Kontoe, S., & Free, M. (2013). Assessing and managing the risk of earthquake-induced liquefaction to civil infrastructure. In *Handbook of Seismic Risk Analysis And Management Of Civil Infrastructure Systems* (pp. 113–138). Woodhead Publishing.
- Mimarlar Odası. (2023). 6 Şubat 2023 depremleri raporu - 2. <https://www.arkitera.com/haber/mimarlar-odasi-6-subat-2023-depremleri-raporu-2-yayimlandi/>
- Molden, O. (2019). Water heritage and urban development: Lessons from Nepal's Kathmandu Valley. *J Heritage Manag*, 4(2), 176–191.
- Nadim, F., Moghtaderi-Zadeh, M., Lindholm, C., Andresen, A., Remseth, S., Bolourchi, M. J., Bolourchi, M. J., Mokhtari, M., & Tvedt, E. (2004). The Bam earthquake of 26 december 2003. *Bull Earthquake Eng*, 2, 119–153.
- NTV. (2023). Gaziantep'te 600 yıllık tarihi hamam depreme meydan okudu. <https://www.ntv.com.tr/n-life/gezi/gaziantep-te-600-yillik-tarihi-hamam-depreme-meydan-okudu,auYVPgpxy0iB-NI-uUKPRCg>
- Okubo, T. (2016). Traditional wisdom for disaster mitigation in history of Japanese architectures and historic cities. *J Cult Heritage*, 20, 715–724.
- Özdemir, C. (2020). UNESCO Dünya Miras Alanları bağlamında Süleymaniye bölgesi yer altı envanterinin değerlendirilmesi [Doctoral thesis, Fatih Sultan Mehmet Vakıf University].
- Pellet, F., Hosseini, K. A., Jafari, M. K., Zerfa, F. Z., Mahdavi, M. R., & Bakh-shayesh, M. K. (2005). Geotechnical performance of qanats during the 2003 Bam, Iran, earthquake. *Earthq Spectra*, 21(S1), 137–164.
- Rayhani, M. H. T., & El Naggar, M. H. (2007). Centrifuge modeling of seismic response of layered soft clay. *Bull Earthquake Eng*, 5, 571–589.
- Resmi Gazete. (2023, February 8). [32098 ve 08.02.2023]. Yürütme ve İdare Bölümü Cumhurbaşkanı Kararı. <https://www.resmigazete.gov.tr/eskiler/2023/02/20230208.pdf>
- Savcılı, S. (2018). The Kastels in Gaziantep. *Personel archive*. Gaziantep.
- Smerzini, C., Aviles, J., Paolucci, R., & Sánchez-Sesma, F. J. (2009). Effect of underground cavities on surface earthquake ground motion under SH wave propagation. *Earthq Eng Struct Dyn*, 38(12), 1441–1460.
- Tanaka, T. (2016). Measures for groundwater security during and after the Hanshin-Awaji earthquake (1995) and the Great East Japan earthquake (2011), Japan. *Hydrogeol J*, 24(2), 277–286.
- Türkiye Bina Deprem Yönetmeliği. (2018). Türkiye bina de-

- prem yönetmeliği: Deprem etkisi altında binaların tasarımı için esaslar. Türkiye Cumhuriyeti, Ankara.
- Uçar, M. (2016). Gaziantep tarihi su sistemi ve su yapıları. METU JFA, 33(2), 73–100.
- Uçar, M., Okuducu, A. Z., & Yamaç, A. (2018). Gaziantep tarihi su yapıları. In M. Uçar (Ed.), Gaziantep livasları, kastelleri ve yer altı su yapıları (pp. 59–164). Gazi Kültür A.Ş.
- UNDRR. (n.d.). Resilience. <https://www.undrr.org/terminology/resilience>
- UNESCO. (2015). Nomination of the Persian Qanat for inscription on the World Heritage List. Tehran, Iran: UNESCO.
- UNESCO. (2018). The underground water structures in Gaziantep: Livas' and kastels. <https://whc.unesco.org/en/tentativelists/6345/>
- UNESCO. (2019). Risk management plan of the Persian Qanat World Heritage Site. <https://whc.unesco.org/en/soc/4084/>
- Ünal, Z. G., & Ünal, M. (2019). Kültür varlıklarına yönelik bütünlük afet risklerinin yönetiminde acil müdahale evresi. In Z. G., Ünal & N., Ertürk (Eds), Kültür Varlıklarına Yönelik Afet Risklerinin Yönetimi, 13–27. Maviy Ofset Etkilet.
- Yıldız, D. (2019). Deprem ve su raporu. Su Politikaları Derneği. https://www.academia.edu/40772881/DEPREM_VE_SU_RAPORU_Su_Politikalar%C4%B1_Derne%C4%9Fi



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M M G A R O N

Article

A cross-domain systematic review on guest speakers in higher education: Reconsidering the role of “outsiders” in architecture education

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ABSTRACT

Guest speaker events, as a form of instructional strategy in higher education settings, has long been recognized as a valid pedagogical method, whereas the factors that either promote or hinder the efficacy of this strategy in architecture education has not been extensively investigated. Accordingly, this paper presents a cross-domain literature review on the topic. The findings of the review have led to a discussion on guest speakers in design studios as an effective manifestation of inquiry-based learning (IBL). By searching 8 databases using the PICO framework, a systematic literature review was conducted to an in-depth examination of 35 articles across 25 domains in higher education, followed by a thematic analysis considering Braun and Clarke’s approach. The interpretive analysis yielded six themes: (1) bridging academia and practice, (2) speaker selection, (3) event planning, (4) content and format, (5) interaction mode, and (6) students’ preferences. While incorporating guest speakers can enhance student engagement, critical thinking, and networking, successful implementation hinges on addressing several factors such as the role of instructors’ guidance and tailoring topics and guest speakers’ selection with students’ levels. Students’ engagement with guest speakers in exploring content, issues, real-world perspectives and questions aligns with experiential learning and IBL principles. The study underscores the need for additional research in architecture education to understand students’ and instructors’ perceptions, concerning the role of guest speakers particularly on issues like contributions to learning, influence on design approaches and the implications for developing collaborative pedagogical practices.

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INTRODUCTION

Scholars emphasize the importance of connecting design studios with the professional world to provide architecture students with the best preparation and to create relevant and dynamic learning experiences (Utuberta

et al., 2012; Hejazi, 2020; Mamdouh et al., 2022). This involves transferring knowledge from academia to real-world practice and integrating practical insights into academic outcomes. There is a belief that graduates from architecture programs often lack practical experience and struggle to connect with real-life experiences (Mari

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et al., 2019). By immersing students in real-life projects, skills like teamwork, communication, and engagement can be enhanced. Therefore, educational institutions are encouraged to align their design studio teachings with industry standards to better prepare architecture students for their careers (Mari et al., 2019). The ongoing effort to link academia with practice calls for approaches to enrich students' educational journeys, such as fostering collaborative learning environments (Utaberta et al., 2012; Hejazi, 2020), establishing connections between faculties and industry firms (Hejazi, 2020), and involving clients and users in design studio activities (Utaberta et al., 2012).

In higher education, it is common for instructors to invite guest speakers from varied backgrounds, including experts, scholars, and practitioners, which has been extensively studied across various fields. For instance, Sage (2013) found that guest speakers effectively enhanced student learning outcomes within the domain of social work. According to Lee and Joung (2017), in the field of hospitality and tourism, guest speakers have the potential to enhance teaching methods, increase students' self-confidence, and add value to students' development. Design instructors often involve guest speakers, which, according to McLaughlan and Chatterjee (2020), not only gives students knowledge and real-world experiences but also provides them with theoretical insights that enhance their education. Featuring experts from different fields in design studios ensures the instructors' role and gives students a wide

range of resources and practical knowledge to build a "kit of parts" for their projects (McLaughlan & Chatterjee, 2020). While the use of guest speakers within design education is common, the literature lacks empirical investigations and extended descriptions of how "outsiders" contribute within the context of architecture schools. Through a systematic review of the literature, this study aims to examine the effectiveness of this pedagogical tool in higher education and to identify research routes in architecture design education by exploring how guest speakers can support inquiry-based learning in design studios.

METHODS

By adopting the procedure of the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2008), a systematic literature review was undertaken to study the role of guest speakers in different domains in higher education settings, as shown in Figure 1.

Search Strategy

The methodology and presentation of the findings adhered to the guidelines outlined in the PRISMA 2020 statement. An initial search was carried out in April 2023 on eight prominent databases, including Google Scholar, Elsevier, Emerald, Taylor & Francis (T&F), Wiley, SAGE, The Education Resources Information Center (ERIC), ProQuest, and JSTOR, to guarantee and optimize the retrieval of the most relevant research.

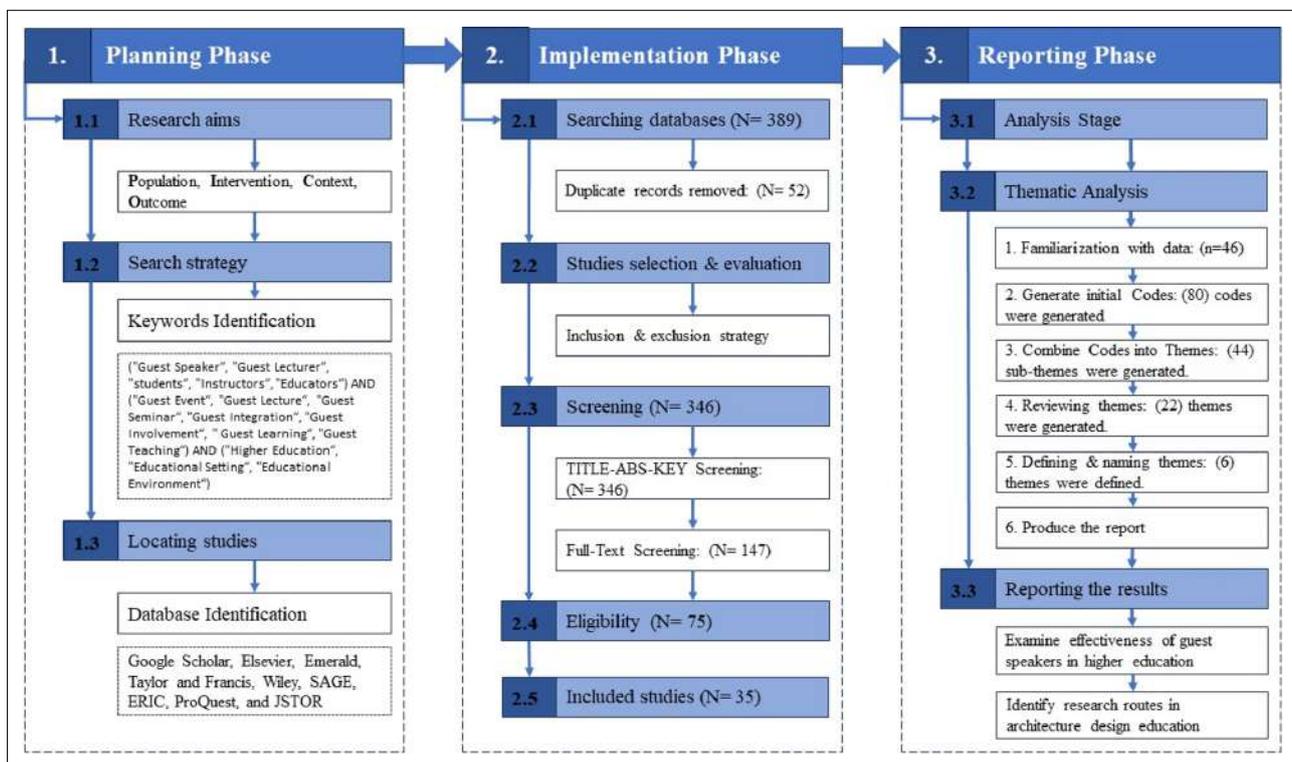


Figure 1. Study stages.

Study Selection

A commonly used strategy to determine the inclusion criteria is the PICO model (Population, Intervention, Control, and Outcomes) (Eriksen & Frandsen, 2018). The PICO model can be used as a tool for developing search terms deemed to be relevant (Considine et al., 2017). The search encompassed a variety of search phrases employed in various combinations and search strings, constructed from the combination of the keywords identified in Table 1 (see Appendix 1 for the detailed search strategy). The various combinations and search strings will manage to find similar terms in titles, abstracts, and keywords (TITLE-ABS-KEY) in relevant research.

The PICO and the eligibility criteria guided the review process to ensure the relevance and representativeness of the reviewed papers, as summarized in Table 2. The review focused on peer-reviewed articles in academic journals and international conference proceedings to ensure the reliability of the findings. Given the scarcity of literature on this subject, the review encompassed papers published from any year up to the present to ensure a comprehensive analysis.

Description of Included Studies

A total of 398 citations were first identified and collected in one folder. The study selection process is illustrated in the PRISMA flow diagram (see Figure 2). After duplicates were removed, the authors conducted initial manual checks on the titles and abstracts to eliminate duplicate research

papers and to ensure accuracy and completeness, with 199 articles excluded. Then, full-text records (147) were screened for all studies against the inclusion and exclusion criteria, with 72 studies excluded. A total of 75 articles were screened for eligibility, and 40 articles were excluded for the reasons shown in Figure 2. Conflicts and disagreements were solved by consensus through discussion with the second author. The key information from the 35 included studies was then represented in a table (see Appendix 2).

The study examined 35 papers in full-text, 16 of which were published before 2012 and 19 were published after 2012. The reviewed papers addressed a variety of topics related to guest speakers in higher education, with the majority of papers (34.3%) focusing on guest speakers in general. A significant number of papers (28.9%) focused on online guest speakers, guest speakers' roles in bridging theory and practice (25.7%), and students' perceptions (20%). Although these papers covered a wide range of topics, there is a significant gap in exploring the perspectives of instructors and guest speakers. The majority of emphasis on the topic is evident in the research originating from the United States, with a significant representation of 29 papers (82.9%), underscoring its notable focus and contribution to this area of study. The reviewed papers utilized a variety of methodological approaches, with a large number of studies formulated as qualitative (22.9%), experimental case studies (22.9%), and expert opinion methods (22.9%) (see Table

Table 1. PICO framework for guest speakers' integration in higher education

Element	Definition	Search strings scenarios
P (Population)	Students, instructors, and guest speakers	"Guest Speaker" OR "Guest Lecturer" OR "Undergraduate students" OR "students" OR "Instructors"
I (Intervention)	Guest speakers' integration	"Guest Event" OR "Guest Lecture" OR "Guest Seminar" OR "Guest Involvement" OR "Guest Learning" OR "Guest Teaching" OR "Teaching" OR "Learning"
C (Control)	Higher Education and Architecture Design Education	"Higher Education" OR "Educational Environment" OR "Design Studio" OR "Architecture Education" OR "Architecture pedagogy"
O (Outcome)	Outcome identification	-

Table 2. PICO, inclusion and exclusion criteria

Element	Inclusion criteria	Exclusion criteria
P (Population)	Students and instructors at higher education, guest speakers invited to higher education	Articles with participants other than college students such as elementary schools, No study population
I (Intervention)	Focus on the use of guest speakers in education	No study intervention
C (Control)	Higher educational and vocational settings are included	
Study design	Only looking at articles published in English, All geographic locations, All dates of publication	Hard-copy or electronic articles without full-text accessibility, Articles other than those published in English, Articles that are not peer-reviewed, Articles with missing citation information

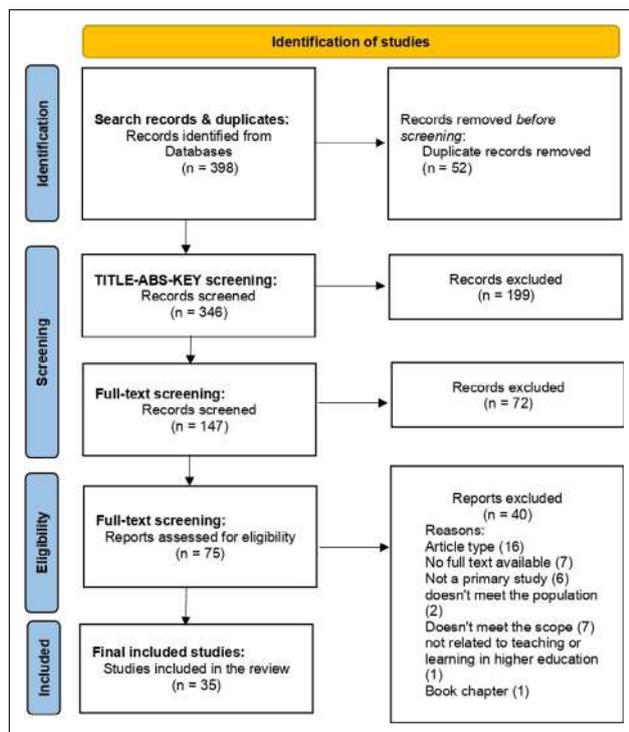


Figure 2. PRISMA flow diagram.

3). Although expert opinion studies offer flexibility and the ability to incorporate subjective knowledge, there is also a risk of potential bias and a lack of objectivity.

The research conducted in this study identified a total of 25 areas of investigation, which were categorized into 11 groups. These categories encompass fields such as computer science, hospitality and tourism, education, and marketing, among others. Refer to Table 4 for an overview. One specific paper examined the role of guest speakers in design studios within the spatial design domain (Vicentini & Camocini, 2021). Since there is a growing number of domains, the distinction implies that while some findings may directly apply to design-based education, further investigation and scholarly examination are required for others.

Data Analysis

To explore the main themes regarding the included articles, the authors conducted a thematic analysis following Braun and Clarke's (2006) six-step approach, which is: collecting data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and writing the report. Data analysis was carried out without imposing any pre-existing categories or theories, enabling the emergence of themes naturally. The first author conducted the first review process on the dataset to become familiar with it and then coded the entire dataset. The authors then revisited the dataset and initial codes to identify potentially missed information. Then, the authors searched, identified, defined, and named the themes. The results of this stage revealed

Table 3. Description of the included articles

Characteristic	Number of articles (n=35)
Publication year	
Before 2012	16 (45.7%)
After 2012	19 (54.3%)
Distribution by database	
Elsevier	1 (02.9%)
Emerald	3 (08.6%)
T&F	7 (20.0%)
Google Scholar	13 (37.1%)
Sage	4 (11.4%)
Wiley	2 (05.7%)
JSTOR	2 (05.7%)
ERIC	3 (08.6%)
Topics	
Guest speakers	12 (34.3%)
Online (Virtual) Guest speakers	10 (28.9%)
Guest speaker and students' perception	7 (20.0%)
Guest speaker to bridge the gap between practice and industry	9 (25.7%)
Guest speaker and event preparation	2 (05.7%)
Research methods approach	
Quantitative Research	4 (11.4%)
Literature review	1 (02.9%)
Mixed approach research	3 (08.6%)
Qualitative Research	8 (22.9%)
Exploratory study	3 (08.6%)
Experimental study – case study approach	8 (22.9%)
Expert opinion	8 (22.9%)
Distribution by the Country of the Corresponding Author	
United States	29 (82.9%)
Canada	1 (02.9%)
UAE	1 (02.9%)
Saudi Arabia	1 (02.9%)
Ireland	1 (02.9%)
Italy	1 (02.9%)
Qatar	1 (02.9%)

six themes presented below that served as the foundation for the following discussion and helped acquire a deeper understanding of key concepts, trends, and patterns. (For details, check Appendix 3a and 3b).

Table 4. Disciplines of the included articles

Domain	Article	Domain	Article
Education (3)		Business (5)	
Education	2	Business & Economics	2
		Supply-Chain Management	1
Entrepreneurship Education	1	Marketing	1
		Accounting	1
Health Sciences (3)		Communication (5)	
Nursing	1	Strategic Communication	1
		Advertising	1
Pharmaceutical Sciences	1	Information & Communication Studies	1
Pharmacy	1	Journalism	2
Social Sciences (5)		Science and Technology (5)	
Women's Studies	1	Science, Technology, Engineering & Math (STEM)	1
Sociology	1	Technology/Telecommunication	1
Criminal Justice	1	Computer Science	3
Social Science	1		
Social Work	1	Tourism (4)	
		Hospitality & Tourism	4
Real Estate (1)		Design (1)	
Real Estate	1	Interior & Spatial Design	1
Fashion (2)		Interdisciplinary (1)	
Fashion Industry	2	Research	1

EMERGING THEMES

Theme 1. Bridging the Gap Between Academia and Practice

Students greatly appreciate the chance to learn from professionals, such as industry experts and alumni who bring real-world examples into the classroom (Craig et al., 2020). Having guest speakers helps students see how theoretical concepts can be put into practice (Craig et al., 2020; Metrejean et al., 2002; Payne et al., 2003; van Hoek et al., 2011; Vicentini & Camocini, 2021; Agha-Jaffar, 2000; Ostorga & Farruggio, 2013; Merle & Craig, 2017; Abdallah, 2016; Lee & Joung, 2017; Robert & Hanton, 2021) and is vital for their overall development (Butler & Wielligh, 2012; Kamoun & Selim, 2007; Abdallah, 2016). By presenting real-life cases, guest speakers make students feel that the course content is more relevant and comprehensive (Baki & Peeters, 2019; van Hoek et al., 2011; Ostorga & Farruggio, 2013). This also assists students in improving their skills and reaching their goals (Jablon-Roberts & McCracken, 2022; Merle & Craig, 2017; Robert & Hanton, 2021; Payne et al., 2003).

According to Merle and Craig (2017), there are distinct roles for instructors and professionals in the classroom. Instructors focus on providing a theoretical understanding, while guest speakers bring an understanding concerning professional implications. However, finding a professional who also has the skills to properly deliver information to students is challenging (Kang et al., 2005). Robert and Hanton (2021) argued that students perceive feedback from guest speakers as more valuable than feedback from instructors. This is because industry experts provide insights into real-world applications that reflect the realities of the industry and highlight job opportunities. Therefore, instead of relying on academic feedback based on grading, incorporating input from industry guest speakers can greatly enrich targeted academic assignments, such as capstone projects and final presentations, and ultimately benefit students in their future careers (Robert & Hanton, 2021). Guest speakers come into play as role models who inspire students to acquire necessary skills (Nourse, 1995; Agha-Jaffar, 2000) and significantly boost students' confidence (Lee & Joung, 2017). Consequently, guest lectures enrich students' professional lives by providing insights from experts in the field (Alebaikan, 2016; Jablon-Roberts & McCracken, 2022; Jablon-Roberts & McCracken,

2023; Ji et al., 2021; Kang et al., 2005; Lee & Joung, 2017; Merle & Craig, 2017).

Theme 2. Guest Speaker Event Planning and Practices

Proper preparation is important to maximize the benefits of having guest speakers (Zou et al., 2019; Craig et al., 2020). Without preparation, the shared content and information may lack relevance or designated impact (McCleary & Weaver, 2009). To ensure the guest speaker events' success, researchers recommend sending timely invitations (Cloud & Sweeney, 1987; Metrejean et al., 2002) and incorporating the guest speakers' background into the course material (Kamoun & Selim, 2007; Dalakas, 2016). It is also important to communicate expectations from guest speakers' engagement and discuss goals and tasks with students (Fulton, 2020; Kamoun & Selim, 2007; McCleary & Weaver, 2009; Dalakas, 2016; Payne et al., 2003).

To foster student engagement and participation, instructors can employ strategies such as inviting multiple speakers within the same session (Metrejean et al., 2002), facilitating question-and-answer sessions, incorporating post-speaker activities (Jablon-Roberts & McCracken, 2023), and organizing follow-up meetings to gather feedback and address key points (Kamoun & Selim, 2007). Moreover, encouraging students to conduct research and prepare questions beforehand can further enhance their engagement (Dalakas, 2016; Kamoun & Selim, 2007; McCleary & Weaver, 2009; Metrejean et al., 2002). For example, Dalakas (2016) suggests that sharing students' questions in advance with guest speakers can enhance student involvement and learning; however, this may require additional instructional effort. Researchers also discussed the importance of asking students to write their reflections on what the guest speakers have discussed and relate these discussions to the scope of the course to make these engagements more beneficial (Eveleth & Baker-Eveleth, 2009; Zorek et al., 2011).

In addition, active moderation during discussions can help maintain students' engagement and ensure that the content aligns with the learning objectives (Kamoun & Selim, 2007). By having a plan in place, instructors can maintain control and prevent off-topic discussions, harmonizing the learning objectives with the presentation. It's important to note that this does not imply instructors' control over guest speakers; rather, it aims to provide guidance and facilitate focused discussions while still allowing flexibility for guest speakers in how they deliver their presentations (Kamoun & Selim, 2007). A concrete example of incorporating industry guest speakers into design courses is Goldberg et al.'s (2014) capstone design course in engineering education. In this course, industry professionals, who delivered half of the lectures, were provided with comprehensive guidelines to ensure relevance and coherence in their presentations. These guidelines include a summary of their chosen topics and practical examples of their application.

Theme 3. Content and Format of the Presentation

Guest speakers can introduce different topics, which may enhance student engagement in subjects that students may lack interest in and boost the effectiveness of guest speakers' integration in education (Butler & Wielligh, 2012; Hess, 2004; Robert & Hanton, 2021; van Hoek et al., 2011; Abdallah, 2016). Moreover, several studies have highlighted the insights shared by guest speakers regarding workplace guidance, job interview preparation, and internships and employment opportunities (McCleary & Weaver, 2009; Metrejean et al., 2002; Zorek et al., 2011). By exposing students to diverse career paths and helping them plan for their careers, guest speakers can effectively enhance career awareness (Baki & Peeters, 2019; Ji et al., 2021; Belser et al., 2018; Kang et al., 2005), which is preferred by students (Ji et al., 2021; Craig et al., 2020) and aligns with industry expectations (Belser et al., 2018).

Additionally, guest speakers may introduce their personal stories, which can validate the material and make the conversation more interesting (Agha-Jaffar, 2000). They may also address topics such as local practice issues, social and political tensions, and controversial subjects (Farruggio, 2011; McCleary & Weaver, 2009). To maximize the benefits of guest speaker events, it is necessary for guest speakers to acquire more information about the course material before the lecture (Payne et al., 2003). This is the reason why presentations facilitated by guest speakers that are structured around course objectives receive higher approval ratings (Agha-Jaffar, 2000; McCleary & Weaver, 2009; Payne et al., 2003).

Moreover, the delivery method is essential for the success of a guest lecture (McCleary & Weaver, 2009; Payne et al., 2003). Instructors can guide the guest speakers' delivery method and preparation work by asking reflection questions to the guest speakers that may also stimulate their interactions with students (Zorek et al., 2011). While the lecture/presentation format is commonly used for guest speaker events (Zou et al., 2019), it was found that students prefer conversations and interactive question-and-answer sessions over slide-based lectures (Jablon-Roberts & McCracken, 2023; Merle & Craig, 2017). This can also be traced in the architectural education domain, where Aston et al. (2020) present a case involving "Feminisms conversations," in which students from different years discuss feminist agendas, architecture possibilities, and technologies within the guest speakers' involvement. As a result, these conversations allowed students to investigate and develop theoretical positions and facilitated peer-to-peer learning (Aston et al., 2020).

Theme 4. Selection of the Guest Speaker

According to literature, many factors contribute to making guest speaker events and lectures more successful. These factors include considering guest speakers' credibility

(Kamoun & Selim, 2007), communication skills (Alebaikan, 2016; Fulton, 2020; Lee & Joung, 2017), and practical experience (Alebaikan, 2016; Cloud & Sweeney, 1987; Eveleth & Baker-Eveleth, 2009; Fulton, 2020; Lee & Joung, 2017). Regarding their experience and backgrounds, guest speakers can be categorized into diverse types, such as experts, faculty members, graduate students, and authors (Payne et al., 2003). The diversity of guest speakers' backgrounds can enhance students' critical thinking, spark new areas of interest, and promote active learning (Hess, 2004; Payne et al., 2003; Robert & Hanton, 2021). Also, this diversity can reduce gender bias, improve students' outcomes, and foster inclusivity and community (Sage, 2013). The literature emphasized the importance of using a guest speaker database, which helps save time and resources (Kamoun & Selim, 2007; Metrejean et al., 2002). Also, these databases help in tracking guest speakers' performance and feedback (Cloud & Sweeney, 1987) and foster a network of professionals who are willing to participate (Metrejean et al., 2002; Zou et al., 2019). Different stakeholders and individuals, with different motivations, like institutions, instructors, or students, can invite guest speakers (Metrejean et al., 2002; Nourse, 1995). While guest speakers are traditionally invited by the instructors or the department (Craig et al., 2020), engaging students in the selection process of guest speakers enhances learning, engagement, ownership, and accountability (Eveleth & Baker-Eveleth, 2009). It ensures varied perspectives and encourages inclusivity (Zorek et al., 2011).

Theme 5: Face-to-face and Online Modes of Interaction

Through distance learning, students have opportunities to connect with a wide range of guest speakers, enabling them to gain diverse perspectives (Vicenti & Camocini, 2021; Baki & Peeters, 2019; Flynn & Birrell, 2021; Ostorga & Farruggio, 2013). Utilizing online guest speakers promotes accessibility and inclusivity, as students from different programs and geographical locations can participate in discussions and contribute diverse perspectives. Considering these advantages, it becomes crucial to plan the integration of online guest speakers and allow enough time for reflection and discussions that can enhance student understanding and attitudes (Eveleth & Baker-Eveleth, 2009). The literature mentions tools used to facilitate engagement with online guest speakers, including video chats (Sage, 2013), live streaming on YouTube (Flynn & Birrell, 2021), discussion platforms (Eveleth & Baker-Eveleth, 2009; Hemphill & Hemphill, 2006), audio recordings (Schumann, 2019), and Eventbrite (Flynn & Birrell, 2021). These tools are employed both asynchronously and synchronously. Researchers suggest that utilizing asynchronous online discussion boards can be effective (Hemphill & Hemphill, 2006; Jablon-Roberts & McCracken, 2023). Additionally, to enhance interactivity

during these engagements, it is advised to combine these discussion platforms with elements like question-and-answer sessions or post-reading discussions (Hemphill & Hemphill, 2006). Schumann (2019) also found that when using recorded videos of guest speakers, students could connect with more role models and mentors compared to traditional learning methods. Students in the class were given access to a database of recordings featuring guest speakers' presentations. They were then asked to visualize these recordings as a way to understand and connect with the content. This exercise required them to listen to the recordings multiple times, which resulted in a deeper connection with the guest speakers compared to experiencing presentations (Schumann, 2019). Having guest speakers in class forums offers benefits, including promoting deep learning, encouraging active participation, expanding knowledge, and fostering critical thinking (Farruggio, 2011; Ostorga & Farruggio, 2013). Conversely, synchronous engagements with guest speakers allow for real-time interactions online and provide access to expertise (Sage, 2013), thereby enhancing student engagement and learning (Fulton, 2020; Tenenberg, 2009). Nevertheless, virtual events provide a platform for researchers, guest speakers, and archivists to share their work with an audience, although creating a sense of community within these spaces presents a challenge (Flynn & Birrell, 2021).

Researchers discussed the effectiveness of the two modes of guest speaker engagements, face-to-face or online. Merle and Craig (2017) reported that students generally prefer interacting with guest speakers in person. However, other researchers argue that virtual guest speakers have higher attendance rates compared to face-to-face engagements (Flynn & Birrell, 2021). Moreover, Hemphill & Hemphill, (2006) found that online guest speaker engagements led to increased real-time interactivity with students. This helps create a feeling of connection with the guest speaker by allowing them to inquire, express their ideas, and receive feedback. On the other hand, other researchers argued that both modes have benefits. In this vein, Alebaikan (2016) suggests that face-to-face guest speakers allow for physical interaction and effective discussion, while online guest speaker engagements offer flexibility and accessibility. This aligns with students' perceptions of viewing both face-to-face and online guest lectures as equally valuable for enriching their understanding and guiding their future careers (Jablon-Roberts & McCracken, 2023; Baki & Peeters, 2019).

Theme 6: Students' Preferences of Learning Activities

Guest speakers' success is affected by the students themselves, as the diversity of student profiles can be a challenge. Students have different levels of willingness, motivation, and interest in the subject matter (i.e.,

Hemphill & Hemphill, 2006; Metrejean et al., 2002; Mooney, 1998). Understanding the students' different learning styles is important to facilitate mutual comprehension among diverse student groups (Robert & Hanton, 2021). This will aid in avoiding students viewing such sessions as pure entertainment (Abdallah, 2016) or as downtime while waiting for the session to end, especially if the students are uninterested in the speaker's work or place of employment (Dalakas, 2016). Students' interest and learning outcomes can be improved by a well-done guest lecture (Mooney, 1998), effective communication, and active participation (Fulton, 2020). It is important to incorporate multiple teaching approaches and guest speakers who cater to various learning styles (McCarthy, 1996). In this regard, Karns (2005) categorized students into four learning groups: (1) sensate learners, (2) visual learners, (3) sequential learners, and (4) active learners. Earlier in the literature, McCarthy (1996) identified them as (1) innovative learners, (2) analytic learners, (3) common-sense learners, and (4) dynamic learners. Figure 3 below offers a detailed overview, bringing together the potential benefits of guest speakers discussed earlier in the literature and how they can align with students' preferred learning activities, as Karns (2005) and McCarthy (1996) discussed. This alignment has revealed the power of guest speakers to enhance the learning experience among students with different learning styles, fostering their motivation. For sensate learners and common-sense learners, practical strategies, valuable information, and industry contacts are beneficial. Visual and innovative learners benefit from new perspectives and stimulating presentations. Sequential and analytic learners appreciate clear explanations, specific facts, and effective application. Active and dynamic learners thrive with engaging

presentations and Q&A sessions to better understand current issues. In other words, guest speaker integration can benefit these diverse groups of learners.

The advantages of incorporating guest speakers into education extend to instructors (Tenenberg, 2009; Zou et al., 2019), guest speakers (Zou et al., 2019; van Hoek et al., 2011), and faculty (van Hoek et al., 2011). For instructors, Tenenberg (2009) found it valuable to have a colleague to discuss choices such as the order of topics, assigned readings, class assignments, and student practice sessions. Additionally, this interaction can enhance credibility within learning environments (Eveleth & Baker-Eveleth, 2009; McCleary & Weaver, 2009). It was also reported that guest speakers can help educational institutions meet the intended learning outcomes in an engaging way (van Hoek et al., 2011). Moreover, this integration can create opportunities for funding, internships, and job prospects for students (Metrejean et al., 2002; McCleary & Weaver, 2009; Zou et al., 2019). Baki and Peeters (2019) found that guest speakers can facilitate relationships with organizations and networking experiences for students. In addition, guest speakers themselves can benefit from delivering lectures in educational environments through the opportunity to mentor students and receive feedback on their presentations and work, which in turn can contribute to their growth (McCleary & Weaver, 2009). Moreover, this allows guest speakers to get in touch with the academic environment (Zou et al., 2019). Additionally, this collaboration with the university can positively impact employer branding and serve as a means to promote the company and its career opportunities (van Hoek et al., 2011; Zou et al., 2019).

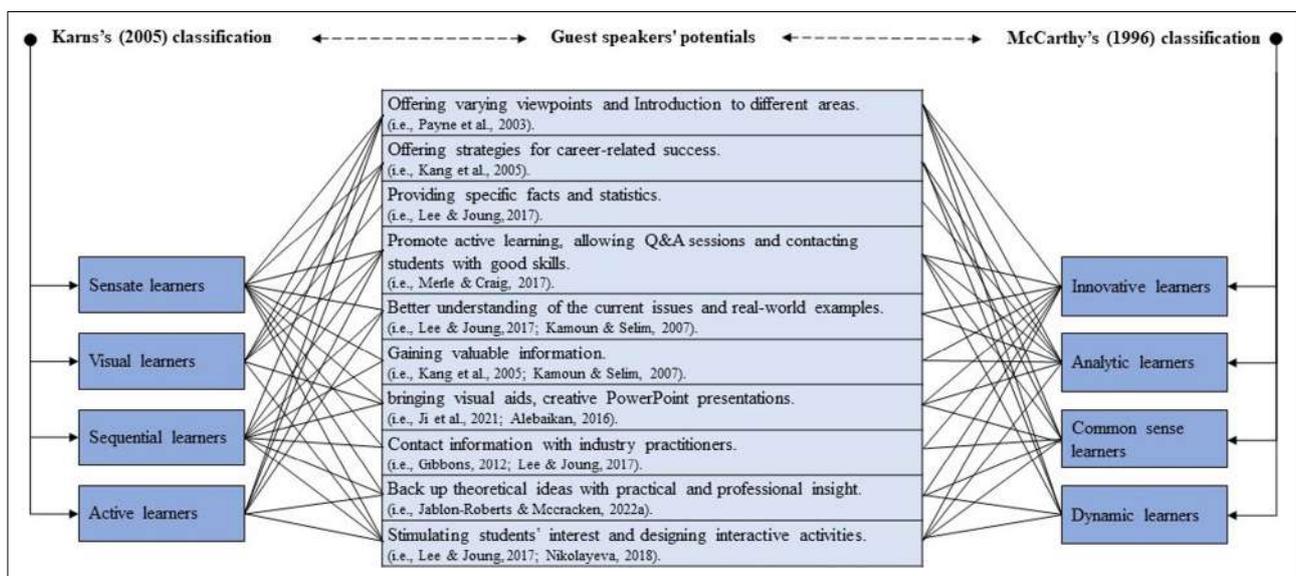


Figure 3. Guest speakers' potential and students' preferences.

DISCUSSION: GUEST SPEAKERS IN ARCHITECTURE DESIGN EDUCATION

Building upon the identified themes and insights from the 25 domains, the discussion delves deeper into the implications of integrating guest speakers in architecture design education through the lens of inquiry-based learning (IBL). This instructional method, rooted in the 1960s, continues to characterize current interests in higher education (Ackoff, 1974; Salama, 2009). It was developed in response to the perceived failure of traditional forms of instruction, in which students were required simply to memorize and reproduce instructional materials (Salama, 2012). Our findings underscore the various benefits guest speakers bring to design studios, impacting students, instructors, curriculum developers, and the guest speakers themselves. This discussion, grounded in the results, reaffirms the value of guest speakers in advancing the goals of IBL and preparing students for the challenges of the architectural profession.

Factors Associated with Guest Speakers in Design Studios

1. The Guest Speaker as Self

Instructors in design studios commonly utilize guest speakers, site visits, and assigned readings to cater to the diverse needs and interests of students and provide diverse perspectives (McLaughlan & Chatterjee, 2020; Orhan, 2020; Erkin & Soygeniş, 2014). Effective guest speakers align their presentations with their expertise, the course content, and the hosts' particular needs. For instance, in a theoretical foundations course, speakers might focus on theory-driven design, while in a course emphasizing material and technical issues, speakers might highlight practical aspects of building construction. This alignment has the potential to ensure the speaker's enthusiasm and proper communication of expertise, making the sessions more engaging and impactful. This alignment may also enhance guest speakers' confidence and teaching skills as they engage with students and academic environments, fostering a connection to the academic community and keeping them abreast of current trends and student needs.

Guest speakers, chosen for their expertise or unique perspectives, employ varied delivery strategies such as anecdotes and case studies to frame experiences differently, capturing attention, eliciting emotions, and making communication memorable (Casper & Balgopal, 2020). In the context of IBL, students are empowered to connect real-world scenarios by asking questions, exploring, and conducting research (Mieg, 2019). This approach empowers students to define the design problem at hand and find appropriate solutions, which helps them gain an understanding of the complexities involved in architectural design. In a design studio, students develop knowledge through inquiry, action, reflection, and conversation,

provoking new thinking and refining old thinking (Kolko, 2012). Effective guest speakers provide real examples and can answer students' follow-up questions about applied theory (Casper & Balgopal, 2020). They stimulate intellectual curiosity, encourage exploration beyond the classroom, and challenge stereotypes and preconceptions, inspiring students to undertake interdisciplinary explorations and sparking self-directed inquiry that aligns with IBL principles.

The phrase "guest speaker as self" refers to the concept of guest speakers finding a deep, personal connection and identity within their role in the academic environment. Guest lecturing becomes an aspect of a speaker's identity and self-expression. By presenting with genuine passion and personal insights, guest speakers establish a unique connection with students, enhancing the learning environment and reflecting their true identity and passion. Engaging with students and sharing their expertise can be revitalizing, helping speakers reconnect with the academic environment. This interaction often leads to a sense of renewal, sparking new ideas and rejuvenating their enthusiasm. Additionally, guest speakers benefit from engaging in discussions with faculty and students, further enriching the overall educational experience. They bring excitement to the studio, inspiring and energizing students with dynamic explorations rather than mere knowledge transfers. Many guest speakers are active professionals whose real-world experience adds urgency and reality to their talks, making their contributions more impactful and credible. When guest speakers tailor their content to their strengths and align it with course objectives, they foster deeper engagement and a more fulfilling educational experience. Thus, "guest speaker as self" emphasizes personal authenticity and relevance in guest lectures, enhancing educational impact and encouraging a meaningful exchange of ideas.

2. For Instructors

Understanding the differences between first-year and senior students in terms of design expertise (Cross et al., 1994) and the design process (Atman et al., 1999; Avsec & Jagiełło-Kowalczyk, 2021) is crucial for tailoring topics and guest speaker selection. The needs and expectations of first-year students, who are laying the foundation for their architectural understanding, differ significantly from those of senior students, who are preparing for practice life and its challenges. First-year learning lays the foundation for students' development and understanding of architecture. At this stage, students begin to observe, visualize, perceive, and represent in new ways (Sıkıçakar et al., 2006), shaping their understanding and concepts about architecture. First-year students need orientation, as they are unfamiliar with design tools and have not yet formed design habits (Orbey & Sarıoğlu, 2021). First-year students benefit from guest

speakers who can introduce them to basic design principles and motivate them to navigate their educational path with confidence. According to Dunlap (2011), most instructors tend to invite guest speakers in novice design studios who are in the same profession as their corresponding program, such as architects and interior architects. Senior students, on the other hand, are more capable of developing a greater number of alternative solutions and producing higher-quality designs due to their extensive experience and transitions between design steps, as highlighted by Atman et al. (1999). This advanced knowledge gives them more confidence to express their ideas and communicate effectively, shaping their readiness for the architectural profession. Thus, senior students, with their advanced knowledge, require industry professionals who can prepare them for practical challenges and align with their career development.

Instructors play a crucial role in selecting guest speakers who can effectively engage students at different levels, steering discussions, and coaching speakers on effective engagement strategies (Casper & Balgopal, 2020). Considering pedagogical objectives, the instructors have the responsibility to guide students through the integration of guest speakers in design studios. First-year students, lacking confidence and experience, may lean too heavily on guest speakers' ideas, but instructors can transform this into a valuable learning opportunity by providing careful guidance and structured assignments, fostering independence and creativity. Conversely, senior students, with more experience, may have preconceived notions about guest speakers, necessitating instructors to clarify the learning aims and ensure students approach these experiences with openness and readiness to extract insights. While first-year students may struggle to actively participate in choosing guest speakers or suggesting topics due to limited exposure, senior students, with their heightened awareness and experiences, are better positioned to contribute meaningfully.

3. For Curriculum Developers

The integration of industry professionals as guest speakers not only clarifies studio content and goals (Vicenti & Camocini, 2021), but also requires careful planning to align with course objectives. This coordination involves ensuring that the timing and content of guest speaker sessions complement the curriculum and cater to the specific needs and interests of students. Timing is crucial, influenced by the desired goals at different stages of the design studio. Integrating guest speakers throughout the semester enhances students' practical educational experience and contributes to a vibrant learning atmosphere. While some guest speakers may also serve as jurors, their primary focus is to provide various perspectives and inspire students through workshops, panel discussions, and online interactive sessions (Fleming, 2021).

4. For Students

The IBL approach suggests an environment where students work independently or in groups on tasks, projects, and fieldwork aimed at exploring different issues. Paszkowski and Gołębiowski (2020) assert that integrating design workshops into studios helps students understand spatial, aesthetic, functional, and policy issues. Guest speakers from different disciplines, like urban planning, art, structural design, and landscape architecture, have the potential to enrich the learning experience and foster a sense of community among students. Feedback from guest speakers during these workshops brings diversity into the studio environment, breaking the monotony, facilitating international connections, and enhancing language proficiency (Paszkowski & Gołębiowski, 2020). Organizing expert-led site visits can further enhance students' skills, motivation, and engagement levels (Erktin & Soygeniş, 2014; McLaughlan & Chatterjee, 2020). Through workshops and field trips, guest speakers share their experiences, prompting students to learn and critically analyze how architectural concepts are applied in real-world scenarios. This approach goes beyond memorization-based teaching methods by encouraging students to apply their knowledge to real-world situations, aligning with the experiential learning aspect of IBL.

Experiential learning opportunities, such as field trips and guest lectures, enhance students' learning experiences by connecting theoretical knowledge with practical applications (Park et al., 2024). Guest speakers play a vital role in linking theoretical knowledge to practical applications, scaffolding students to understand the intricacies of architectural design and preparing them for the challenges they will face in professional practice (Vicenti & Camocini, 2021). To bridge the gap between theory and industry application, researchers advocate for the inclusion of industry-related case studies, practical projects, and guest speakers (Desouki & Awad, 2023). Drawing on their personal experiences and professional journeys, guest speakers provide valuable context and relatability, humanizing the profession by offering tangible examples of career paths, obstacles, and achievements, which can be highly motivating for students. This approach not only deepens students' comprehension of the importance of considering needs and well-being in design solutions but also provides them with real-world perspectives and practical insights (Vicenti & Camocini, 2021), contributing to the inquiry-based learning (IBL) goal of active exploration within the discipline. This enables students to connect theory with real-world use, cultivating qualities such as curiosity, resilience, and self-confidence. This aligns with the learning methods inherent in architectural design studios, rooted in experiential learning or learning by doing (Utaberta et al., 2012), which is further promoted with IBL (Salama, 2012). While problem-based learning involves solving real-life design problems as a means of

learning, experiential learning immerses learners directly in touch with the realities being studied (Keeton & Tate, 1978). In this context, students' progress is evaluated based on their development of critical thinking skills and analytical abilities, rather than merely acquiring knowledge (Salama, 2012). By incorporating guest speakers, architectural design education enriches the learning experience with real-world insights, supporting IBL and experiential learning, and fostering critical thinking and problem-solving skills.

By examining factors associated with guest speakers in design studios and the roles they play for different stakeholders, the discussion elucidates the intricate dynamics involved in optimizing the use of guest speakers to enrich the educational experience.

CONCLUSION AND RECOMMENDATIONS

The body of literature reviewed in this paper evidently suggests that the integration of guest speakers in higher education provides exposure to real-world challenges and experiences, connects students with industry professionals, keeps faculty in pace with industry trends, and enhances students' skills and motivation. Online guest speaker sessions have expanded opportunities for interaction with more professionals regardless of location. The discussion in the previous section highlights guest speakers' key role in enriching the learning experience for students in architecture design education. Accordingly, the discussion and results also emphasized particular benefits for instructors in higher education settings.

The review reveals several key dimensions to be considered to enrich the learning experience while implementing guest speakers as a pedagogical tool, including instructors' pivotal role in maximizing benefits concerning topics within and beyond curricula. The instructors need to carefully select speakers whose expertise aligns with course objectives and student needs. Introducing guest speakers to the course goals and student learning preferences is crucial for a successful integration. Additionally, guest speaker events have the potential to contribute to the content within existing curricula by providing diverse perspectives and industry insights. This requires careful planning to ensure that guest speaker sessions are well-timed and complement the course content. Integrating guest speakers throughout the semester can enhance the overall educational experience.

By connecting theoretical concepts with practical applications, guest speakers encourage students to explore, inquire, and think critically. This promotes active learning and engagement. Guest speakers provide insights into current trends and issues in design, leading to a more detailed and focused approach to their projects and preparing students for their future professions. Typically, students perceive guest speakers as experts who can

connect them with real-world scenarios, which aligns with the experiential learning approach, fostering a deeper understanding of architectural practice. For guest speakers, engaging with students and faculty provides an opportunity to reconnect with the academic environment, stay updated with current trends, and contribute to the development of future professionals. This interaction often leads to a sense of renewal and inspiration for the speakers themselves.

These outcomes yield shared benefits which align with various domains in higher education. When applied wisely, the integration of guest speakers in architecture education complements the goals of inquiry-based learning (IBL). Through engagement with guest speakers, students can develop critical thinking, analytical skills, and a deeper understanding of the complexities of architectural practice beyond theoretical concepts.

This study provides a foundation for further research and underscores the importance of optimizing guest speaker integration to maximize its educational impact. Despite the valuable insights gained from this study, certain constraints, including the limited research on guest speakers in architectural design education, are acknowledged. To fill the existing research gap, it is recommended to study the best practices for selecting and integrating guest speakers into architecture design education in general, and into design studios in particular, considering factors like student levels, interests, and course objectives. Future research should also examine the long-term impact of guest speakers on student engagement, career development, and professional growth, as well as explore the effects of soliciting student feedback on guest speaker sessions and how it influences future invitations and event planning. Additionally, investigating the benefits of involving students in the selection process of guest speakers to ensure that their interests and learning needs are addressed is crucial.

Appendices: <https://tinyurl.com/4np3f2dw>

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REFERENCES

- Abdallah, A. (2016). Guest speakers and internationalization in higher education: A critical reflection of guest speakers in tourism programmes. *Turističko Poslovanje*, 17, 61–70.

- Ackoff, R. (1974). *Redesigning the future: A systems approach to societal problems*. John Wiley.
- Agha-Jaffar, T. (2000). From theory to praxis in women's studies: Guest speakers and service-learning as pedagogy. *Fem Teach*, 13(1), 1–11.
- Alebaikan, R. A. (2016). Online and face-to-face guest lectures: Graduate students' perceptions. *Learn Teach Higher Educ Gulf Perspect*, 13(2), 53–65.
- Aston, H., Crompton, E., Renshaw, S., & Timmins, K. (2020). Praxis: Always personal, always political, always pedagogical. *J Archit Educ*, 74(2), 280–287.
- Atman, C. J., Chimka, J. R., Bursic, K. M., & Nachtmann, H. L. (1999). A comparison of freshman and senior engineering design processes. *Des Stud*, 20(2), 131–152.
- Avsec, S., & Jagiełło-Kowalczyk, M. (2021). Developing a framework to predict factors significant for creative architectural design performance of freshmen and senior architecture students, by adopting and validating the CEDA. *Int J Eng Educ*, 37, 594–607.
- Baki, G., & Peeters, M. J. (2019). Exploring the impact of technology use with cosmetic science guest-speakers: A qualitative study. *INNOV Pharm*, 10(2), 13.
- Belser, C. T., Prescod, D. J., Daire, A. P., Cushey, K. F., Karaki, R., Young, C. Y., & Dagley, M. A. (2018). The role of faculty guest speakers and research lab visits in STEM major selection: A qualitative inquiry. *J Career Tech Educ*, 33(1), 8–26.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qual Res Psychol*, 3(2), 77–101.
- Butler, R., & Von Wielligh, S. P. J. (2012). Using guest lecturers to address the gap between theory and practice in auditing studies at a South African university - a case study. *South Afr J Account Audit Res*, 13(1), 47–56.
- Casper, A. M. A., & Balgopal, M. M. (2020). How guest experts tell stories about environmental socio-scientific issues in an undergraduate class. *Int J Sci Educ*, 42(9), 1568–1584.
- Cloud, B., & Sweeney, J. (1987). Effective guest speakers require thought and care. *J Educ*, 42(4), 30–31.
- Considine, J., Shaban, R. Z., Fry, M., & Curtis, K. (2017). Evidence based emergency nursing: Designing a research question and searching the literature. *Int Emerg Nurs*, 32, 78–82.
- Craig, C. M., Bergstrom, A. M., & Buschhorn, J. (2020). All guest speakers are not created equal: Diverse students require diverse speakers. *J Advert Educ*, 24(2), 150–167.
- Cross, N., Christiaans, H., & Dorst, K. (1994). Design expertise amongst student designers. *J Art Des Educ*, 13(1), 39–56.
- Dalakas, V. (2016). Turning guest speakers' visits into active learning opportunities. *Atl Mark J*, 5(2), 93–100.
- Desouki, M., & Awad, H. (2023). Integrating environmental control and architectural design: A coordinated teaching framework that uses multiple strategies to enhance student skills. *J Eng Res*, 7(3), 272–283.
- Dunlap, D. R. (2011). Teaching evidence-based design to the beginning design student: Educator perceptions about incorporating research in beginning design education [Thesis, University of Nebraska].
- Eriksen, M. B., & Frandsen, T. F. (2018). The impact of patient, intervention, comparison, outcome (PICO) as a search strategy tool on literature search quality: A systematic review. *J Med Libr Assoc*, 106(4), 420.
- Erktin, E., & Soygeniş, S. (2014). Learning by experiencing the space: Informal learning environments in architecture education. *Boğaz Univ Educ Derg*, 31(1), 81–92.
- Eveleth, D. M., & Baker-Eveleth, L. J. (2009). Student dialogue with online guest speakers. *Decis Sci J Innov Educ*, 7(2), 417–421.
- Farruggio, P. (2011). The effect of a virtual guest speaker in expanding the consciousness of bilingual education teachers preservice during an online discussion. *Int J Instr Media*, 38(2), 169–176.
- Fleming, B. (2021). Frames and fictions: Designing a green new deal studio sequence. *J Archit Educ*, 75(2), 192–201.
- Flynn, K., & Birrell, L. (2021). Fostering graduate student research: Launching a speaker series. *RBM*, 22(2), 71.
- Fulton, C. (2020). Collaborating in online teaching: Inviting e-guests to facilitate learning in the digital environment. *Inf Learn Sci*, 121(7/8), 579–585.
- Goldberg, J. R., Cariapa, V., Corliss, G., & Kaiser, K. (2014). Benefits of industry involvement in multidisciplinary capstone design courses. *Int J Eng Educ*, 30(1), 6–13.
- Hejazi, S. (2020). The gap between architecture education and architectural profession in Iran. *J Archit Res Educ*, 2(2), 121–133.
- Hemphill, L. S., & Hemphill, H. H. (2006). Evaluating the impact of guest speaker postings in online discussions. *Br J Educ Technol*, 38(2), 287–293.
- Hess, D. (2004). Beyond guest speakers: This inaugural column about democracy education explains how to involve politicians, political activists, and candidates in interactive lessons to maximize student engagement and learning. *Soc Educ*, 68(5), 347–349.
- Higgins, J. P., & Green, S. (2008). *Cochrane handbook for systematic reviews of interventions*. Wiley.
- Jablon-Roberts, S., & McCracken, A. (2022). Undergraduate student perceptions of industry guest speakers in the college classroom. *J Scholarsh Teach Learn*, 22(3), 76–88.
- Jablon-Roberts, S., & McCracken, A. (2023). Virtual guest

- speakers in textile and apparel courses: Student experiences and expectations. *Cloth Text Res J*, 41(1), 43–56.
- Ji, H., Jain, P., & Axinn, C. (2021). Student perceptions of guest speakers in strategic communication courses. *J Public Relat Educ*, 7(1), 40–79.
- Kamoun, F., & Selim, S. (2007). A framework towards assessing the merits of inviting IT professionals to the classroom. *J Inf Technol Educ Res*, 6(1), 81–103.
- Kang, S. K., Wu, C., & Gould, R. (2005). An exploratory study: Students' perceptions of academic faculty and industry practitioner instructions. *J Hosp Leis Sport Tour Educ*, 4(2), 44–53.
- Karns, G. L. (2005). An update of marketing student perceptions of learning activities: Structure, preferences, and effectiveness. *J Mark Educ*, 27(2), 163–171.
- Keeton, M., & Tate, P. (1978). *Learning by experience*. JosseyBass.
- Kolko, J. (2012). Transformative learning in the design studio. *Interactions*, 19(6), 82–83.
- Lee, K. W., & Joung, H. W. (2017). An examination of students' perceptions for guest speakers in hospitality and tourism programs. *J Teach Travel Tour*, 17(4), 300–312.
- Mamdouh, A., Abdelkader, M., & Samir, T. (2022). Analysis of the gap in architects' skills of lifelong learning. *Ain Shams Eng J*, 13(6), 101805.
- Mari, T. S., Srirangam, S., Gunasagaran, S., Kuppusamy, S., & Ang, F. L. (2019). Architecture graduate work readiness: The gap between learning and employability. *IOP Conf Ser Mater Sci Eng*, 636(1), 012010.
- McCarthy, B. (1996). *About learning*. Excel Publishing.
- McCleary, K. W., & Weaver, P. A. (2009). The effective use of guest speakers in the hospitality and tourism curriculum. *J Teach Travel Tour*, 8(4), 401–414.
- McLaughlan, R., & Chatterjee, I. (2020). What works in the architecture studio? Five strategies for optimising student learning. *Int J Art Des Educ*, 39(3), 550–564.
- Merle, P. F., & Craig, C. (2017). Be my guest: A survey of mass communication students' perception of guest speakers. *Coll Teach*, 65(2), 41–49.
- Metrejean, C., Pittman, J., & Zarzeski, M. T. (2002). Guest speakers: Reflections on the role of accountants in the classroom. *Account Educ*, 11(4), 347–364.
- Mieg, H. A. (2019). *Inquiry-based learning-undergraduate research: The German multidisciplinary experience*. Springer Nature.
- Mooney, L. A. (1998). Pitching the profession: Faculty guest speakers in the classroom. *Teach Sociol*, 26(3), 157–165.
- Nourse, M. E. (1995). Tapping campus talent for the collegiate business communication course: A guide to guest speakers. *Bus Commun Q*, 58(2), 25–27.
- Orbey, B., & Sarioğlu Erdoğdu, G. P. (2021). Design process re-visited in the first year design studio: Between intuition and reasoning. *Int J Technol Des Educ*, 31(4), 771–795.
- Orhan, M. (2020). The place and importance of informal education in the freshman year experience of architectural education. *Cypriot J Educ Sci*, 15(6), 1707–1719.
- Ostorga, A. N., & Farruggio, P. (2013). The use of a virtual guest speaker as a catalyst for deep learning. *Procedia Soc Behav Sci*, 93, 2144–2151.
- Park, H. Y., Licon, C. V., Givens, J., & Sleipness, O. R. (2024). Implementation of sustainability principles in landscape architecture education: An examination of faculty attitudes and course syllabi. *Int J Sustain High Educ*. <https://www.emerald.com/insight/content/doi/10.1108/IJSHE-02-2023-0060/full/html>
- Paszkowski, Z. W., & Gołębiowski, J. I. (2020). International design workshops as an intensive form of architectural education. *World Trans Eng Technol Educ*, 18(1), 51–56.
- Payne, B. K., Sumter, M., & Sun, I. (2003). Bringing the field into the criminal justice classroom: Field trips, ride-alongs, and guest speakers. *J Crim Justice Educ*, 14(2), 327–344.
- Robert, J. G., & Hanton, L. (2021). Collaborating with industry to improve undergraduate real estate education: Recommendations to enhance guest speaking activities. *J Real Estate Pract Educ*, 23(1), 10–19.
- Sage, M. (2013). Distance guest speakers in online synchronous classrooms: Practical and legal considerations. *J Teach Soc Work*, 33(4–5), 385–392.
- Salama, A. M. (2009). Transformative pedagogy in architecture and urbanism. *Umbau Verlag*.
- Salama, A. M. (2012). Evaluation research as a mechanism for critical inquiry and knowledge construction in architectural and urban education. *FORMakademisk*, 5(2), 1–12.
- Schumann, H. O. (2019). The use of student-copresented virtual guest speakers in entrepreneurial education. *J Educ Bus*, 94(6), 418–422.
- Sıkıçakar, A., Yıldız, D., Dursun, P., Kürtüncü, B., Omer, E., Şener, E., & Avcı, O. (2006). A first year architectural design studio experience. *Archit Educ Forum III Glob Archit Educ Area*, 15(17), 1–5.
- Tenenberg, J. (2009). The ultimate guest speaker: A model for educator/practitioner collaboration. *J Comput Sci Coll*, 25(1), 123–129.
- Utaberta, N., Hassanpour, B., Surat, M., Ani, A. C., & Tawil, N. M. (2012). Architecture from teaching to learning to practice: Authentic learning tasks in developing professional competencies. *Int J Educ Pedagog Sci*, 6(7), 1809–1812.

- van Hoek, R., Godsell, J., & Harrison, A. (2011). Embedding “insights from industry” in supply chain programmes: The role of guest lecturers. *Supply Chain Manag Int J*, 16(2), 142–147.
- Vicentini, M., & Camocini, B. (2021). Human well-being and design of office space. The impact of guest speaking from business companies into the design studio activity. In *EDULEARN21 Proceedings* (pp. 7786–7790). Spain.
- Zorek, J. A., Katz, N. L., & Popovich, N. G. (2011). Guest speakers in a professional development seminar series. *Am J Pharm Educ*, 75(2), 28.
- Zou, P., Sun, W., Hallowell, S. G., Luo, Y., Lee, C., & Ge, L. (2019). Use of guest speakers in nursing education: An integrative review of multidisciplinary literature. *Adv Med Educ Pract*, 10, 175–189.



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Article

A cultural route proposal for historical baths on the Kırkçeşme water system

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ABSTRACT

In recent years, studies on water-related values have intensified on international platforms. İstanbul is one of the world's important water cities with its historical water structures that are part of a complex system. This study focuses on the evaluation of the public baths located in the Kırkçeşme Water System largest water system in İstanbul. Aiming for the cultural, environmental, and economic continuity of water-related historical assets, an integrated preservation approach for the existing traces of the historical water system is examined focusing on public baths. An increasing number of public baths are used in their original function with their full authenticity. They are also re-used for contemporary art and cultural activities regarding to their spatial opportunities. Cultural routes provide a versatile preservation methodology, also offering innovative solutions for the integration of historic assets into contemporary life. The study contains an evaluation of several texts, charters, and recommendations clarifying the systematics of cultural routes and their criteria. Evaluating the data, regarding their historical values and also current conditions, public baths redefined as a cultural route element of water systems have the opportunity to be an effective method in the holistic preservation approach.

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INTRODUCTION

Throughout history, supplying clean water has been one of the main problems people have had to solve. Freshwater resources are quite limited in İstanbul, especially in the Historical Peninsula known as old İstanbul. The settlements in the region needed the constructions to access clean water. İstanbul is one of the important cities in the world with its historical water structures that are part of a wide system developed starting from the city's foundation. The water systems were developed during the period of the

empires ruled the city, either separately or by adding to or completing the previous system. During the Roman, Byzantine, and Ottoman periods, new constructions were needed to provide water to the increasing population. The first important water facilities were built during the reign of the Roman emperors. Then the water systems built during the Roman period were used and developed in the following periods.

The theme of 2011 Monuments and Sites Day by ICOMOS has been determined as 'Cultural Heritage of Water' as a

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part of that water heritage has come to the fore in the field of conservation in recent years. It is thought that technologies developed for purposes such as using, consuming, managing, and traveling on water will guide the problems that humanity will experience in the future (ICOMOS, 2011). In the 'Cultural Heritage of Water' thematic study prepared for ICOMOS in 2017, the importance of the Kırkçeşme Water System was included in the Turkey section (Cotte et al, 2017). In the study titled 'The Water Industry as World Heritage' prepared by James Douet in 2018 for TICCIH (The International Committee for the Conservation of the Industrial Heritage), it is mentioned that Rome, Carthage, and Istanbul had better water systems than those achieved in the modern cities until the 19th century (Douet, 2018). In this study, the water heritage is examined according to the criteria of the World Heritage List, and the feature of having extraordinary universal value is also discussed. Thus, the importance of Istanbul's water systems, which have a centuries-long history, is more clearly understood.

Water supply systems and structures played a direct role in the historical development of Istanbul. Old water supply systems spread throughout the city with lines that branch off at some points and join together by completing each other at some points. In this context, each line of the water supply system of Istanbul constitutes a historical route representing the city's centuries-old history. Public baths or fountains kept a water-related culture alive as the old water structures in Istanbul. The fact that bath rituals are interesting for local people and tourists ensures that their original function has been maintained in many baths for centuries.

However, old water structures like baths, fountains, e.g., are exposed to threats due the change of their environment physically and socially. Their abandonment, lack of maintenance, change of function, and lack of awareness of historical values have been causing many conservation problems. These facts also affect the continuity of the entire historical water system in today's social and economic system. The transfer of Istanbul's historical water systems to the future generations needs to be addressed using a holistic approach and considering the framework of the contemporary conservation discipline.

The study aims to discuss the continuity of existing assets and the values related to water supply systems and water structures in Istanbul, and focuses on the historical baths, especially. The old baths of Istanbul are evaluated as the living elements of the Kırkçeşme Water System using the cultural route concept. Suggestions are presented to ensure the centuries-old cultural, social, and economic continuity of the bath culture, to preserve their existing traces, and to integrate them into contemporary life.

Cultural routes offer approaches for preserving and presenting existing values and are also bringing innovative solutions for their conservation. In the study, first of all, these approaches were examined in detail in the documents of various institutions and organizations, and a table was created for the evaluation of cultural routes in a systematic way. In addition, the effects of historical water systems on urban development and daily life in Istanbul were tried to be understood by conducting literature research on the historical water systems of Istanbul, including the Kırkçeşme Water System. In order to see the positioning of the system in urban space, current aerial photographs as well as old maps were used. A cultural route proposal has been developed for the baths located within the boundaries of the study area determined on the Kırkçeşme Water System. As a result of aerial photographs and on-site examinations, the current status of the bath structures within the study area was determined. Taking into account the data obtained as a result of the research on the current situation, the potential use and conservation conditions of the proposed new route were evaluated in line with the prominent features in the table created regarding the cultural route evaluation criteria.

THE CONCEPT OF CULTURAL ROUTE IN THE CURRENT CONSERVATION APPROACH

Many international and local institutions and organizations examined within the scope of the study, such as UNESCO, ICOMOS, World Roads Network, United Nations World Tourism Organization, European Ramblers Association, and Turkish Cultural Routes Association, carry out studies for the protection of cultural and natural heritage. Creating a cultural route is among the prominent methods within the scope of current studies. There are four types of definitions for an international cultural route. These are the Council of Europe Cultural Route, the ERA-pan European E-trail, the routes defined by The World Trails Network, and the UNESCO Approved World Heritage Route. Especially within the scope of European Cultural Routes, there are routes directly related to water-based cultures, such as the 'Viking Route' (Cultural Routes, n.d.). Although there are no direct water-related routes within the scope of UNESCO Approved World Heritage Routes, there are world heritage sites on the World Heritage List for water structures (such as Pont du Gard Roman Aqueduct) and holistic historical water systems (Water Management System do Augsburg) (UNESCO, n.d.).

Cultural and natural properties are distinct representations of the settings where they originate. In the globalizing world, the importance of studies aimed at the protection of cultural and natural heritage is increasing. The concept of cultural route emerged as a result of the ideas developed

within the framework of conservation science. In 1964, at the European Council meeting called 'L'Europe Continue', consisting of experts; a report¹ was introduced to raise collective awareness about Europe's key cultural sites and how they intersect with entertainment culture via cultural expeditions. This report can be considered the beginning of the emergence of the concept of cultural route, and it has been developed through various meetings held and bylaws prepared over time.

Cultural route is defined in the Charter on Cultural Routes of ICOMOS, published in 2008, as any means of communication physically separated by land, water, or otherwise, serving a specific and well-defined purpose, characterized by its historical functionality and its specific dynamics (ICOMOS, 2008). The effects of new cultures arising from the communication between different cultures include cultural routes into a dynamic historical system. While creating cultural routes, it is possible to use, in whole or in part, historical lines that were previously used for different purposes (religion, trade, etc.) in a certain period. In addition, new ways are being used today to ensure the flow of people to serve a special purpose. Apart from being the means of communication or transportation, the existence and importance of lines as cultural routes is explained by the fact that they have been used for a special purpose throughout a long history and thus create heritage values and cultural assets (ICOMOS, 2008).

Evaluation Criteria Applied in Creating Cultural Routes

Although the ICOMOS Charter on Cultural Routes dated 2008 provides a basic perspective, the evaluation criteria that should be considered when creating a cultural route diversify with the institutions and organizations that produce studies in this field. These organizations have both common and unique evaluation criteria. Within the scope of the study;

About the cultural route and water-related heritage; the documents listed below have been reviewed. In this context, it has been seen that the documents have common purposes and evaluation criteria, as well as their evaluation criteria in line with specific purposes.

About the cultural route;

- I. Cultural Routes of the Council of Europe certification criteria (Council of Europe, 2013)
- II. ICOMOS International Report on Expert Meeting on Routes as Part of Our Cultural Heritage (ICOMOS, 1994)
- III. ICOMOS International Committee on Cultural Routes (CIIC ICOMOS., n.d.)
- IV. ICOMOS Charter on Cultural Routes (ICOMOS, 2008)

V. ERIH European Route of Industrial Heritage, which adopts the Council of Europe criteria (European Route of Industrial Heritage, n.d.)

VI. UNESCO Approved World Cultural Heritage Route and UNESCO World Heritage List Criteria (UNESCO, 2004)

About walking-oriented routes;

VII. ERA Walking Commission; European Walking Code, European Code of Good Walking (European Ramblers Association, 2002)

VIII. The World Trails Network definitions (WTN) (World Trails Network, 2010)

IX. The European Long-Distance Paths, E-Paths (European Ramblers Association, n.d.)

About tourism-oriented routes;

X. The United Nations World Tourism Organisation, The UNWTO Silk Route Programme (UN Tourism, n.d.)

About local cultural routes;

XI. Turkish Cultural Routes Association Charter (Culture Route Society. n.d.) About studies focused on the concept of water;

XII. 'Water Industry as World Heritage' ICOMOS – TICCIH joint report (Douet, 2018)

XIII. Cultural Heritage of Water ICOMOS thematic study (Cotte et al, 2017)

As a result of the investigations, an evaluation table was prepared for creating a cultural route (Table 1). As can be seen in Table 1, the evaluation process in all these documents and studies is grouped under two main headings. Some characteristics of the area to be suggested as a route are questioned. In addition, it is evaluated whether the route is suitable for a purpose determined for the present or the future. The cultural and natural elements of the proposed route are considered holistically.

In the documents examined regarding the routes, evaluation criteria such as historical importance, intercultural dialogue, and cultural diversity are found in the majority of the documents. However, it appears that some of the evaluation criteria contained in the table are specific to a document.² The fact that scientific studies on the routes to be suggested have been carried out and are available to be carried out is also a common issue in the documents. Suitability for projects to be developed for education and culture-art activities and suitability in terms of cultural, economic, and environmental sustainability are also important in the evaluation. Next to each of the evaluation criteria in the table, the document in which they are mentioned is noted.

Table 1. Evaluation criteria for creating a cultural route

1) DOES THE ROUTE HAVE THESE FEATURES?	
Cultural Heritage	<ul style="list-style-type: none"> Outstanding Universal Value (VI) Historical Significance (I, II, III, IV, V, VI, X, XI, XII, XIII) <ul style="list-style-type: none"> Religious Commercial Military Sport Person/Event Technological Development Phase Transfer of Technical Knowledge Becoming a Symbol of Creative Genius Diversity (Diversity of Samples) (I, IV, V, XII, XIII) Cultural Diversity (Representation of Different Cultures) (I, II, IV, V, VIII, XIII) Intercultural Dialogue (I, II, IV) <ul style="list-style-type: none"> Indigenous-Immigrant Communities Urban-Rural Communities Developed-Disadvantaged Regions Different Regions (North, South, East, West) Cross-Border Mutual Exchange (I, II, IV) <ul style="list-style-type: none"> Culture Substance/Product Conceptual Framework (Scientifically Based) (I, IV, XIII) Maintaining Originality (II, IV, VI, XIII) Maintaining Integrity (IV, VI, XIII) Unique or Exceptional Value in Representation of Cultures and Civilizations (VI) Ethnic and Social Minority Heritage (I, II, IV, XII, XIII) Extraordinary Example of Environment-Human Interaction (VI, XIII) Relationship with Artistic and Literary Works (IV, VI) Scientific Studies/Research/Committees (I, IV, V, VIII) Physical/Spatial Features <ul style="list-style-type: none"> Route Components (II, IV) <ul style="list-style-type: none"> Concentration Points (Departure/Arrival) Accommodation Points Water Supply Points (Human, Animal) Mandatory Crossing Points (Bridge, Passage, Port, etc.) Length (VIII, IX) <ul style="list-style-type: none"> Long distance Short distance Territorial Scope (I, II, IV, IX, XIII) <ul style="list-style-type: none"> Local National Regional Continental Intercontinental

Table 1. Evaluation criteria for creating a cultural route (Cont.)**1) DOES THE ROUTE HAVE THESE FEATURES?**

Accessibility (IV, VIII)
On foot
Road Transportation
Sea Transportation
Railway Transportation
Public Transport
Disabled Transportation
Part of a System/Network (IV, XIII)
Natural Environment (IV, XIII)
Land
Shoreline
Sea
Structural Configuration (IV)
Linear
Circular
Cruciform
Radial
Network
Physical Values Contained (III, IV, XII, XIII)
Specialized Building Types
Monuments
Sites
Temporal Features (II, IV, XIII)
Time Range (Start-End)
Usage Time
Seasonal
Yearly
Current Historical Route
Tracking Physical Traces
Out of use
Still in Use
Tracking Footprints or Ideas
Out of Use
Still in Use
New Route to be Created
Usage Intensity
Used 1 time
Continuous use
Original State/Spirit/Local Meaning of the Movement (VII)
In groups
Individual
Many Items/Heavy Bags
Fewer Items
On a Certain Line
In Scattered Rural Area

Table 1. Evaluation criteria for creating a cultural route (Cont.)

1) DOES THE ROUTE HAVE THESE FEATURES?	
Natural Heritage	Intangible Heritage Values (Rituals, Beliefs, etc.) (I, VI, VII, XIII)
	Extraordinary Natural Beauty/Aesthetics, Superior Natural Phenomenon (VI)
	Representation of an Important Phase in Earth History (Geological, Geomorphic, Physiographic) (VI)
	Having an Important Place in Plant and Animal Evolution (VI)
	Impact on Settlement History (V, VI, XII, XIII)
	Flora (VI, VII)
	Unique Plant Species
	Endangered Plant Species
	Animals (VI, VII)
	Unique Animal Species
	Endangered Animal Species
	Landscapes (IV, XII, XIII)
	Natural Resources (I, XIII)
	Natural Water Resources
	Available/Still in Use
	Available/Not Used
	In danger
Extinct	
2) IS THE ROUTE SUITABLE FOR THIS PURPOSE?	
	Eligibility for Research and Development (I, IV, VIII, X)
	Multidisciplinary Committee
	Have
	Can Be Created
	Expert Research/Academic Studies
	Combining Disorganized Information
	Compliance with Regulations and Agreements
	Cooperation with Educational Institutions
	Does it have legal status? (Association etc.) (I, IV)
	Education (I, III, IV, V, VIII, X)
	Youth Education
	Concept of Citizenship
	Emphasizing the Value of Personal Experience (Seeing Different Places/Contacts)
	Integration of Individuals with Different Social Backgrounds
	Cooperation with Educational Institutions
	Cultural Tourism and Art Activities (I, IV, V)
	Conservation Development in Rural Destinations
	Artistic Projects Investigating the Connection Between Contemporary Culture + Cultural Heritage
	Highlighting Innovative and Creative Practices
	Artistic Projects That Promote Multidisciplinary and Intercultural Discussion

Table 1. Evaluation criteria for creating a cultural route (Cont.)

2) IS THE ROUTE SUITABLE FOR THIS PURPOSE?
Collaboration Between Amateurs and Professionals
Creative Contemporary Practices and Skill History Relationship (Performing Arts, Visual Arts, Architecture, etc.)
Diversification, Development, and Presentation of Cultural Products/Services/Events
Sustainability (I, III, IV, V, VIII, X, XI, XIII)
Cultural Sustainability
Tangible
Intangible
Environmental Sustainability
Sustainability of Resources
Light Footprint
Compliance with Environmental Campaigns
Economic Sustainability
Increasing the Number of Visitors
Providing Economic Contribution to Local People
National Financial Sustainability
Brand/Promotion (Logo etc.) (I, IV, V, VIII)
Introduction of the System of which it is a Member
Introduction of the Route
Determining Target Audience (IV, V)
Local people
Tourist
Researchers and Experts
Students
Children

HISTORICAL WATER SYSTEMS OF ISTANBUL

The water systems that have been created since the beginning of urban history in Istanbul have survived to the present day by adding them together, improving the existing system, or establishing new water supply lines in different periods (Figure 1). In addition to the construction of new water structures in different periods, there are also structures containing many interventions from different periods.

During the early Byzantium period, water needs were met by some underground sources and wells (Çeçen, 1997). With the expanding borders and increasing population during the Roman period, water supply became a major problem to be solved. It is seen that the first important water facilities were built during the time of the Roman emperors (Tabakoğlu, 2017). Roman-period buildings were repaired and used for a long time during the Byzantine period (Aysel, 2008).

At the beginning of the 2nd century, Emperor Hadrian (117-138) provided financial support for the construction of an aqueduct that carried the waters of the springs in the Belgrad Forests to Byzantium (Crow, 2015).³ This region, where the water resources in the Belgrad Forests are located, was also used during the Byzantine and Ottoman periods.

Bozdoğan (Valens) Aqueduct⁴ brings the water channel to a fountain and pool in today's Beyazıt Square (Figure 2). The water collected in this area was distributed to higher parts of the city, such as the Forum of Constantine (Çemberlitaş) (Crow, 2015).

In an order dated approximately 440-441 from the period of Theodosius II (408-450), information is given about the waters brought by the Hadrian Aqueduct (Crow, 2015). According to this, the water brought by the aqueduct will be used only in the public baths and the imperial palace. According to texts from later periods, it is known that the water coming from

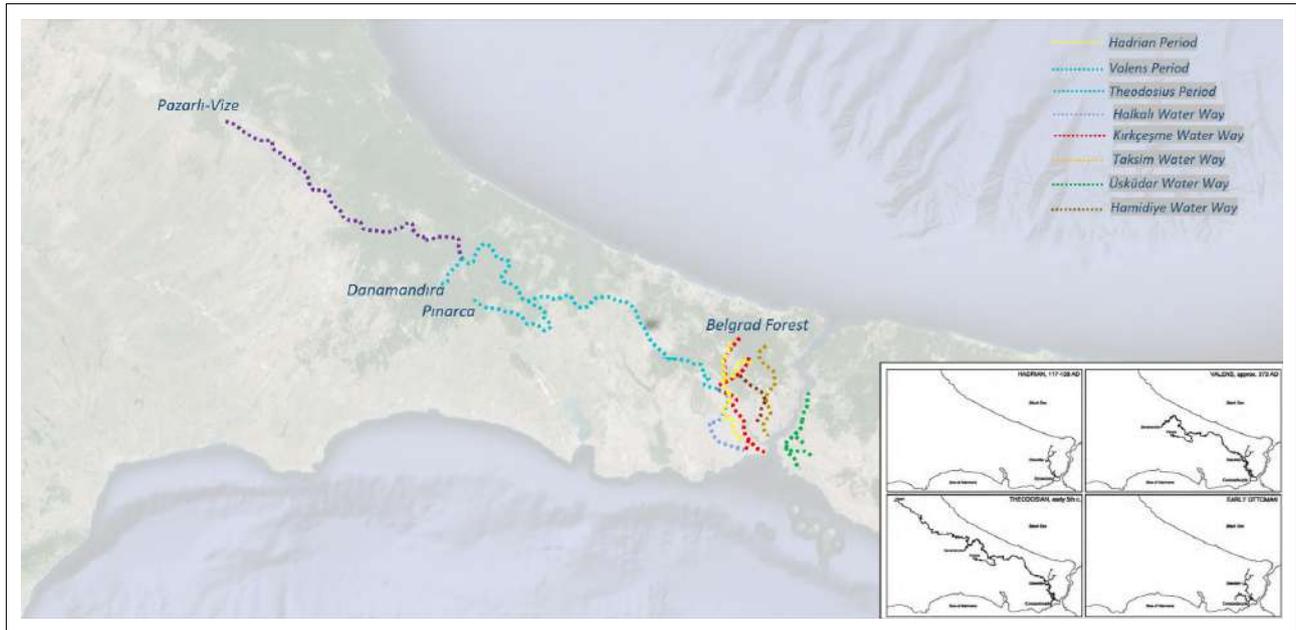


Figure 1. Historical water lines of Istanbul (Drawn by the authors using different historical maps on current aerial photography. Crow's drawings were used for the Byzantine period lines (Crow, 2015).

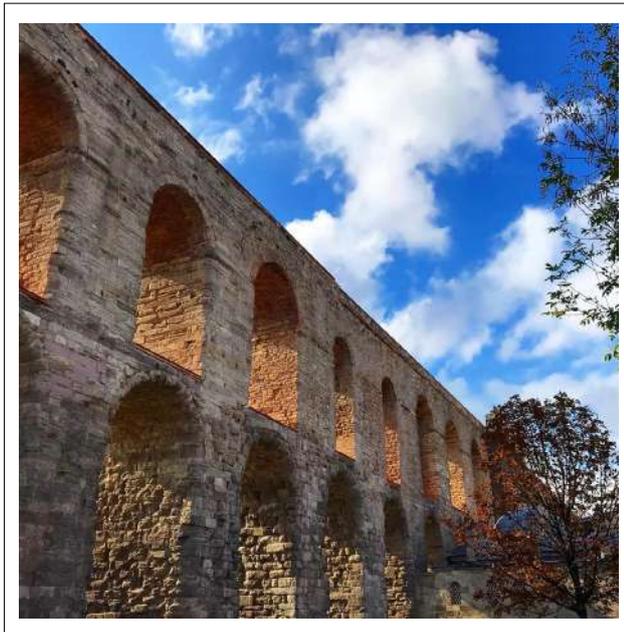


Figure 2. Bozdoğan (Valens) Aqueduct.

the aqueduct met the water needs of families, private baths, public baths, and some cisterns (Crow, 2015).

Since the 7th century, the parts of the transmission lines that supplied water to the city, especially those outside the city walls, were destroyed during various sieges (Altuğ, 2014).⁵ The fact that the city's waterways can be easily destroyed has created insecurity. Therefore, the Byzantine Empire developed a cistern system to address these problems.⁶

In the Ottoman period the main water supply systems were the Halkalı Water System, Kırkçeşme Water System, Taksim Water System, Üsküdar Water System, Hamidiye Water System, and Terkos Water System.⁷

The structures belonging to the water systems created over the centuries in Istanbul can be grouped under four main headings;⁸ water collection structures, water transportation structures, water distribution structures, and water use structures (Figure 3).

The cisterns in Istanbul, especially in the historical peninsula, date back to the Roman and Byzantine periods (Figure 3). The open cisterns dated to the Byzantine period were not used with their original function during the Ottoman period. The construction of pools and wells has existed since the Byzantium period. Their use and construction continued during the Roman, Byzantine, and Ottoman periods. Although the use of the city's cistern system was not preferred during the Ottoman period, there are also cisterns dating back to that period.⁹ Waterways and aqueducts have continued their existence since the beginning of building the water supply system in Istanbul. However, over time, they have undergone some transformations as a result of technological developments or changes in the construction system. For instance, water towers started to emerge in Istanbul's water system during the Ottoman period. *Maksem*, *Maslak*, and water-pumping buildings serve the same function. *Maksem* and *maslaks*, built since the Roman period, were replaced by water-pumping buildings in the 19th century with the technological change. Fountains which are water-use structures began to be seen in the city

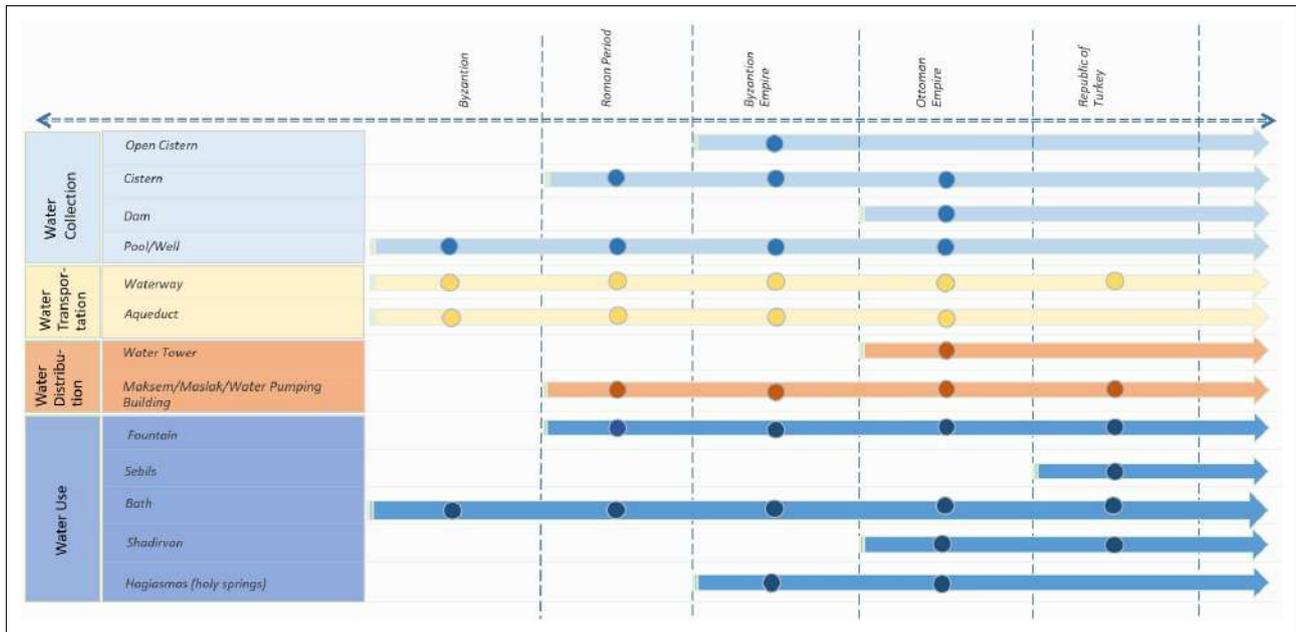


Figure 3. Structures and period analysis of water systems (note: the dots in the table indicate the periods in which the construction of the structures continued, and the arrows indicate the periods in which they continued their existence.)

during the Roman period. The construction of the baths in the city started from the ancient times. However, the baths and fountains used today are dated to the Ottoman period. Over time, there have been changes in construction systems or typologies due to reasons such as technological developments and the change of empires. *Shadirvans* (water-tank with a fountain for ablution in mosques) in the courtyards of mosques began to appear in the city during the Ottoman period. Its use continues today. *Hagiasmas* (holy springs) from the Byzantine period that are integrated with churches generally continue to function.

KIRKÇEŞME WATER SYSTEM AND STRUCTURES

During the reign of Sultan Süleyman (1520-1566), the water problem in Istanbul was significantly solved. The waterways built by Sinan the Architect (1489-1588) in Istanbul and Edirne created the most important water facilities and the largest water system of the Ottoman period (Karakuş, 2019).¹⁰ The distribution of water was made through corridors and vaulted waterways (Tabakoğlu, 2017).

The waters of the Kırkçeşme Water System¹¹ come from two regions north of Istanbul. The waters coming from Kağıthane in the northeast and Ayvat region in the northwest meet in Başhavuz and reach Topkapı Palace via Eğrikapı Maksem (Karakuş, 2019).¹²

The buildings built by Sinan the Architect (1489-1588) to transport water to the city on the Kırkçeşme Water System are Bend Aqueduct, Uzun Aqueduct, Mağlova Aqueduct, Güzelce Aqueduct and Müderris Köyü Aqueduct (Tabakoğlu, 2017) (Figure 4).¹³



Figure 4. Mağlova Aqueduct (Kültür Envanteri, n.d.)

After the construction of the water system was completed, the water brought according to the measurements made by Sinan the Architect (1489-1588) in 1568; is known to have fed 94 fountains, 19 wells, 15 *maslaks*, 13 baths, seven palaces, four fountains, two water closets, two basements, a palace garden and a palace aviary (İSKİ, 1983).

There were no dams on the waterway when it was first built. To increase the efficiency of water over time, four dams called Kırkçeşme Dams were built in the Belgrad Forest. These are the Topuz Dam built in 1620, the Büyük Dam built in 1723-24 (the second time in 1748 due to its collapse), the Ayvat Dam built in 1765, and the Kirazlı Dam built in 1818 (İSKİ, 1983) (Figure 5).



Figure 5. Ayvat Dam (Eyüp Sultan Belediyesi, n.d.).

Current Situation: Evaluation of Kırkçeşme Water System and Structures

Kırkçeşme Water System was evaluated through current aerial photographs and by observing the urban physical development of the structures by the authors.¹⁴ In this context, it is seen that the structures of the line have changed in the context of the environmental conditions from the period when they were built until today (Figure 6). Areas that were considered out of town in the past have now turned into residential areas that can be considered city centers. In this context, it is seen that the elements of the Kırkçeşme Water System mostly remain in settled areas. Especially the parts of the water system towards the north of the city, up to the Sultangazi City Forest, remain within densely populated areas. The part of the Belgrad Forest up to the valley of the dams is partially located in the natural environment and in residential areas.

When today's aerial photographs are examined, it is thought that the water system, which dates back centuries and creates a huge building stock, does not physically affect the development of residential areas. On the other hand, the historical water system and its facilities is not taken into consideration even in the planning process of newly developed residential areas. In addition to their physical existence, issues such as integration into social life, current usage status, and protection problems have also been ignored.

Historical fountains, as the most numerous structures of the system, are mostly out of use. Though there have been various studies on the revitalization of fountains in recent years, most of the historical fountains in residential areas are mostly in neglected or abandoned states. Bath structures, like fountains, continue to exist in residential areas today. It is seen that the large baths continue their existence with their original functions due to their use for touristic purposes. Shadirvans that continue to exist together with a religious structure have generally preserved their original function. Various re-functions such as cafes can be seen in the use of *sebils* (public fountains for free distribution of water).

Structures such as *maksem* and *maslak*, which are part of the system, generally continue their physical existence in today's conditions. The physical existence of historical water pipes, which constitute the hidden part of the water system, partially continues. Aqueducts, which are the largest structures of the water system in size, are not used due to technological reasons. However, it is seen that both the aqueducts in residential areas and the aqueducts in the natural environment continue to exist physically. The aqueducts within the residential areas constitute a very dominant mark on the urban space. Despite this, they were not handled in a planned manner in the development of the settlements. Although its structural integrity appears to be preserved, there are areas where it has been damaged due to uncontrolled contact with the aqueduct. For example, it is observed that the walls of the structure located in the middle of the city, such as the Bozdoğan (Valens) Aqueduct, were used in many ways (Figure 7). At some points, it has been observed that cafes and schools use the walls of the aqueduct directly. Despite the proximity of people to the aqueduct, their lack of awareness about it persists as a social and conservation issue.

The dams, other significant elements of the Kırkçeşme Water System, remain within the area called the dams region of the Belgrad Forest today. The physical preservation of the buildings is good as they are not in residential areas. It is a common practice today to organize daily trips to the Bent region and include them in natural and cultural activities. In addition, the wells within the old water supply system still exist but are no longer functional.

THE HISTORICAL BATHS AS A CULTURAL ROUTE

The Kırkçeşme Water System defines a linear historical cultural route. A new thematic route can be proposed for a section of the system or a specific type of structure within the system. In this regard, an assessment was conducted on the baths supplied water by the Kırkçeşme Water System, utilizing the criteria outlined in Table 1 for cultural routes, to serve as a model for preserving historical water systems and structures. The distinctive features of the baths that qualify them as a cultural route are elaborated upon.

Establishing the boundaries of the study area: A defined area has been outlined for the creation of a cultural route for the historical baths supplied by the water system. The area between Eğrikapı Maksemi and Sarayburnu, where the Kırkçeşme Water System enters the Walled City of Istanbul, is dominated by the Bozdoğan (Valens) Aqueduct, the most prominent and recognizable structure of the system. Together with the baths and other water structures in its vicinity, the aqueduct forms a suitable area for comprehending the historical water system (Figure 8). Additionally, this study area is an attractive tourist destination within the Historical Peninsula. For this reason,

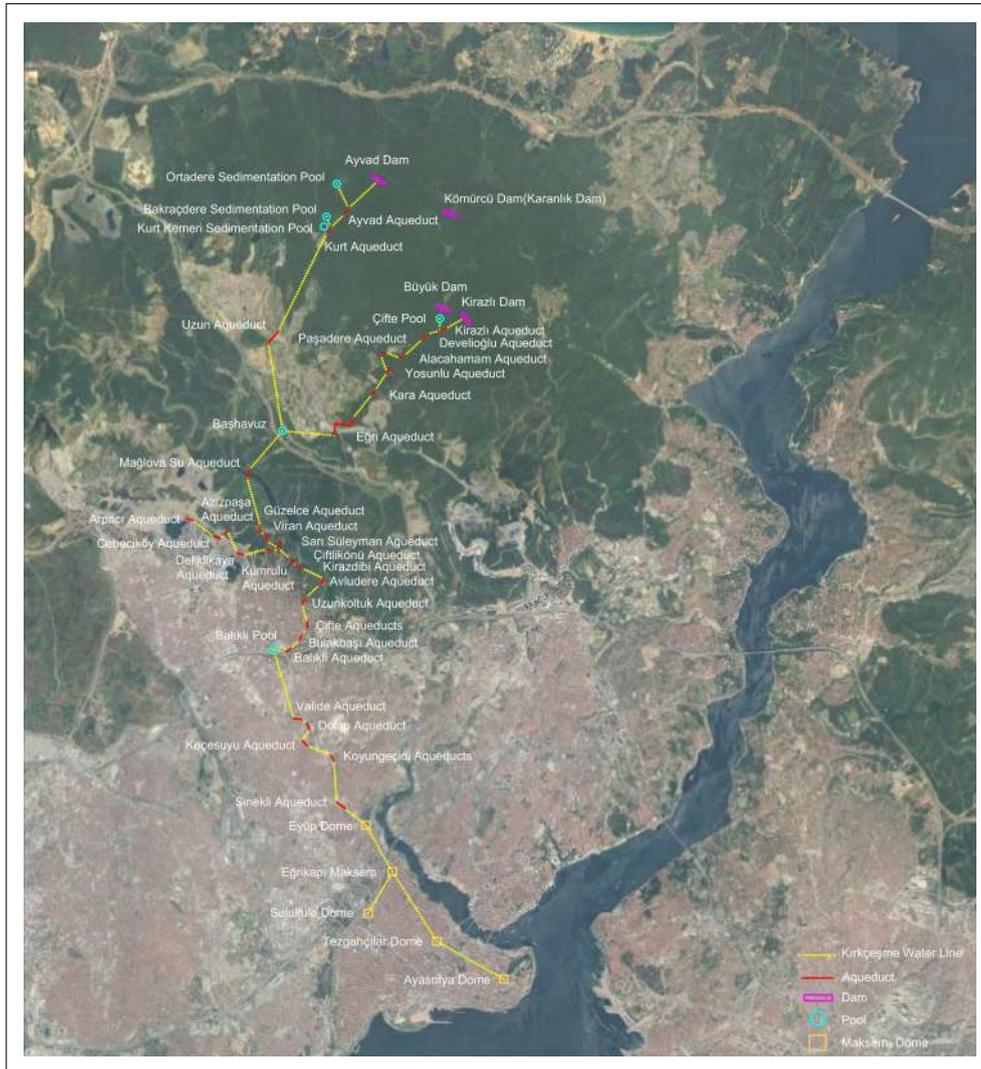


Figure 6. Historical Kırkçeşme Water Line structures on the current map (Prepared by the authors using Kazım Çeçen's drawings and the 'Kültür Envanteri' Map)¹⁵



Figure 7. Use of Bozdoğan (Valens) Aqueduct in current urbanization.

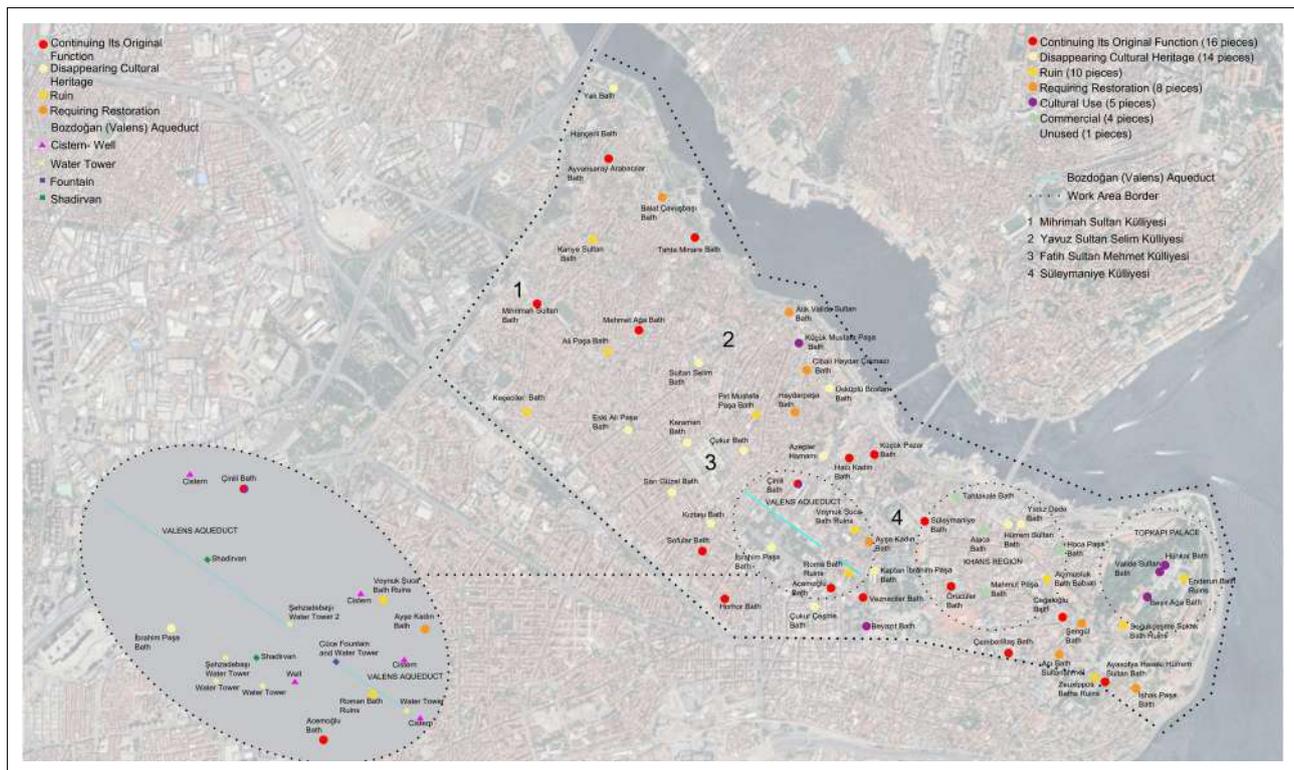


Figure 8. Evaluation of the Bath Route in the Northern Part of the Historical Peninsula.

it is seen that the bath structures mostly maintain their original function and/or are used for cultural purposes (Figure 8).

Historical importance: A line utilized for a specific purpose in a particular historical period holds significance as a cultural route. As indicated in Table 1, the criterion of historical importance, prevalent in the majority of the analyzed documents, significantly influences the recommendation of an area as a cultural route. Despite the Kırkçeşme Water System no longer serving its original purpose today, it remains a significant historical feature in the urban landscape with its physical components. Thus, due to its structure, the system serves as a model for cultural routes that were once utilized for specific purposes in history. The enduring structures within this system, existing for centuries, represent various stages of technological advancement within urban settings. As noted in the historical significance section of Table 1, while baths may share similarities due to cultural interactions, they exhibit a diverse range of architectural characteristics that evolve across different periods and technological progressions. In this context, they hold significant historical value in cultural and social aspects. The baths constructed by Sinan the Architect, such as the Çinili Hamam, carry additional historical importance due to their association with the specific period and style.

Kırkçeşme Water System extends to the Hagia Sophia,

utilizing Roman and Byzantine era constructions. It facilitates water distribution to significant social complexes, edifices, and neighborhoods via multiple branches across the peninsula (Tabakoğlu, 2017). Among these, baths are the prominent structures. Kırkçeşme Water System was developed according to new needs and was built as the largest waterway of the Ottoman period, providing water to all baths in Istanbul (Tabakoğlu, 2017).

Historically, water brought to the city in the Byzantine period was predominantly utilized in public baths. It is also noted that during the Ottoman era, baths consumed the most water, leading to caution on water usage (Ertuğrul, 2015).

Bath as a social structure: When assessing cultural pathways, the importance of incorporating social life rituals and intangible values into the route's development is evident in Table 1. Baths hold a significant role in public life within this context. Furthermore, structures like baths, serving the same purpose in both Roman and Ottoman times but with distinct social customs, highlight the system's intangible heritage values.

Baths have not only served for cleaning purposes but have also become integral to social life (Eyice, 1997). They have been utilized for entertainment, relaxation, socializing, and even activities like sports and reading (Ertuğrul, 2015). In the Roman and Byzantine eras, baths were hubs for entertainment, relaxation, social and political

discourse, dining, and personal hygiene (Necipoglu, 1999). Particularly during the Ottoman period, they held significant importance as social spaces where women could partake in various life rituals (Boyar & Fleet, 2012). Richard Tappin Claridge, in his guidebook about Istanbul, highlights that the women had dedicated bathhouses for their relaxation on specific days of the week, frequented by many individuals (Claridge, 1837). Baths still maintain their characteristics of experiencing some rituals as a part of social life.

Maintaining originality and sustainability: The preservation of the original function of the values that make up cultural routes is crucial for cultural, economic, and environmental sustainability, as well as for enhancing the historical and temporal characteristics of the route (Table 1). While the entire Kırkçeşme Water System may not be utilized in its original function, it comprises structures like baths, fountains, hagiomas, and shadirvans that continue to serve their original purposes today. Among these structures, baths are particularly noteworthy for retaining their original functions. Despite a decline in construction due to water supply to residential buildings in the 19th century, baths still hold significance, especially in terms of tourism. The extensive tourist activity also offers benefits in terms of cultural and economic sustainability. The fact that it has maintained its original function as a water-use structure for centuries is commendable. Therefore, its continued use in its original function is feasible in the future.

Climate and water crises are among the most critical issues on the agenda of this century. In this context, ensuring environmental, cultural, and economic sustainability plays a vital role in the development of cultural routes. The Kırkçeşme Water System boasts a rich inventory of physical buildings. This not only holds cultural significance but also offers opportunities for heritage-based sustainable solutions to climate and water challenges. Reviving traditional infrastructures also serves to preserve culture and natural resources. Implementing rainwater collection systems in the cistern structures supplied by the Kırkçeşme Water System, which hold a significant position in the global framework, is feasible. The harvested water can be utilized in bath structures that typically consume large amounts of water. This way, the potential of baths to contribute to environmental sustainability can be evaluated.

Cultural tourism and art events: As seen in Table 1, when assessing cultural routes, an essential consideration, besides the features of the route, is its suitability for future purposes. Particularly, integrating individuals from diverse backgrounds and raising awareness about cultural heritage through educating children and young people are key aspects in planning the route's future. Connecting cultural and artistic activities, contemporary culture, and cultural heritage, as well as promoting creative practices, are also encouraged for route design. Today, historical baths as parts

of the Kırkçeşme Water System are utilized for tourism, cultural events, and artistic activities, alongside their original functions and some unique rituals.¹⁶ These baths are being reconsidered as alternative venues for exhibitions, performing arts, and visual arts as well as for purposes like museums and libraries. Developing comprehensive cultural practices for baths within framework of the cultural route is achievable.

Relationship with artistic and literary works: The incorporation of the values in cultural routes into artistic and literary works enhances the route culturally. As seen in Table 1, the connection between the route's elements and artistic and literary works is a significant evaluation criterion in the Cultural Routes Regulation and the World Heritage List Criteria. The structural and natural attributes of the Kırkçeşme Water System have often been depicted in various works across different fields.

Baths, a significant part of the system, have been a subject of artistic expressions like literature and painting within the culture they belong to, attracting attention from foreign cultures as well. The baths in Istanbul were portrayed from an orientalist viewpoint, particularly by travelers, statesmen, and writers from European nations. Helmunt Van Moltke, who visited Istanbul in 1835, elaborated on his bath experience here, detailing everything from the entrance to the washing area (Moltke, 2017). He provided thorough information on the preparation and washing process. Additionally, he described in detail the enjoyment phase of the Turks, which consists of lying down and drinking sherbet, coffee, and sticks after bathing. Similarly, in his guidebook from 1837, Claridge recounted his bath experience in Istanbul (Claridge, 1837).

Evaluation: Historical baths as cultural route elements to be created

The current status of the bath structures in the study area was assessed (Figure 8). A total of fifty-eight bath structures were evaluated in the study area. Fourteen of the bath structures were lost their cultural assets. Lost bath structures are mainly concentrated in the vicinity between the Sultan Selim Complex and the Fatih Complex. The original site of the Halil İbrahim Pasha Bath, one of the lost baths, is located on Atatürk Boulevard, which also perpendicular to the Bozdoğan (Valens) Aqueduct. Azepler Bath, existed in the city before the era of Sultan Mehmet II underwent repairs, and was demolished during the construction of Atatürk Boulevard (Köseoğlu, 1952).

Ten baths (10/58) are in ruins and have only the basic structure or some walls. Among them, there are baths from both the Roman and Ottoman periods. For instance, the ruins of a Roman bath next to the Bozdoğan Aqueduct in the garden of the Kalenderhane Mosque are visible at the ground (Figure 9).



Figure 9. Roman bath ruins in the garden of Kalenderhane Mosque.

There are eight (8/58) bath structures whose superstructure maintain the integrity but are neglected and requires restoration because they are out of use. These baths are not concentrated in a certain region but rather spread. Through maintenance and repair efforts, revitalization is possible for baths requiring restoration. Ayşe Kadın Bath, which is an example of a typical bath with its small scale, is one of the baths that can be used after restoration in the city. Balat Çavuşbaşı Bath, one of the oldest baths in Istanbul, shares similar potential for use as other baths in need of restoration. However, Hançerli Bath (1/57) is not in use, though it is in a good and relatively well-maintained condition.

The baths in the Istanbul Hanlar District, which exist with the dominant trade activities, are utilized for commercial purposes. Although Tahtakale Bath, Alaca Bath, Mahmut Pasha Bath, and Hoca Pasha Bath are structurally sound, they are primarily used for commerce rather than their original function. Mahmut Pasha Bath, situated in a bustling commercial area of Istanbul, underwent extensive restoration in 1989; the '*soyunmalık*' (changing room, known as the *camekân*) section now serves as a shop, '*ılıklık*' (the warm room) section functions as a tea house, and '*sıcaklık*' (the hot room) section is used as a carpet sales store (Kuruçay, 2010).

Five baths (5/58) serve cultural purposes such as exhibition areas, museums, event spaces, and performance venues. Hünkar Bath, Valide Sultan Bath, and Beşir Ağa Bath are located within the Topkapı Palace Complex, making them accessible as part of the palace complex museum. Following the restoration of the historical Çinili Bath (Zeyrek)¹⁷ to its original function, it was utilized as a special performance space during the 17th Istanbul Biennial in 2022 (Figure 10). This allowed visitors to explore the baths' structure. Currently, apart from hosting exhibitions and special performances on occasion, it also houses a permanent museum. Beyazıt Bath is also one of the bath structures utilized as a museum.

Sixteen baths (16/58) still maintain their original function. These baths are distributed across the study area, with a notable concentration between Fatih Complex and Sarayburnu, now a popular tourist spot. The interest from both local and foreign visitors has played a significant role in preserving the original function of the baths. Among the baths in the Historical Peninsula, Haseki Bath which is located between Hagia Sophia and Sultan Ahmet Mosque, and designed by Sinan the Architect, stands out as a particularly intriguing attraction for tourists. Additionally, Acemoğlu Bath, one of the baths that continues its original function today, holds historical significance as the sole remaining example of the *Yeniçeri* quarters baths (Kuruçay, 2010).

Which of the bath's users want to see within the study area, used for cultural purposes, commercial purposes, in ruins, needing restoration, or still functioning, will personalize the route experience for users (Figure 11). The Bozdoğan (Valens) Aqueduct stands out as a focal point in the study area due to its physical dominance. This focal point, created by the aqueduct, offers insights into the historical water systems' interaction with their surroundings and the role of baths in urban spaces (Figure 8). In this area, visitors can explore the ruins of a Roman bath, one of the oldest baths in the city, located near the aqueduct in the garden of the Kalenderhane Mosque, as well as various surviving baths from the Ottoman era. The Çinili Bath in this area serves as a prime example, used for both cultural purposes and its original function, hosting a museum, performance arts, and exhibitions at specific times. Besides its primary function, it also promotes awareness and sustainability through contemporary art events. The region encapsulates the entire water system, from water collecting in cisterns and wells, water transportation through aqueducts, water distribution via water with water towers, to water utilization in structures like fountains, baths, and shadirvans.



Figure 10. Çinili Bath, an image from the Healing Ruins Exhibition in 2023 (Çinili Hamam, n.d.).

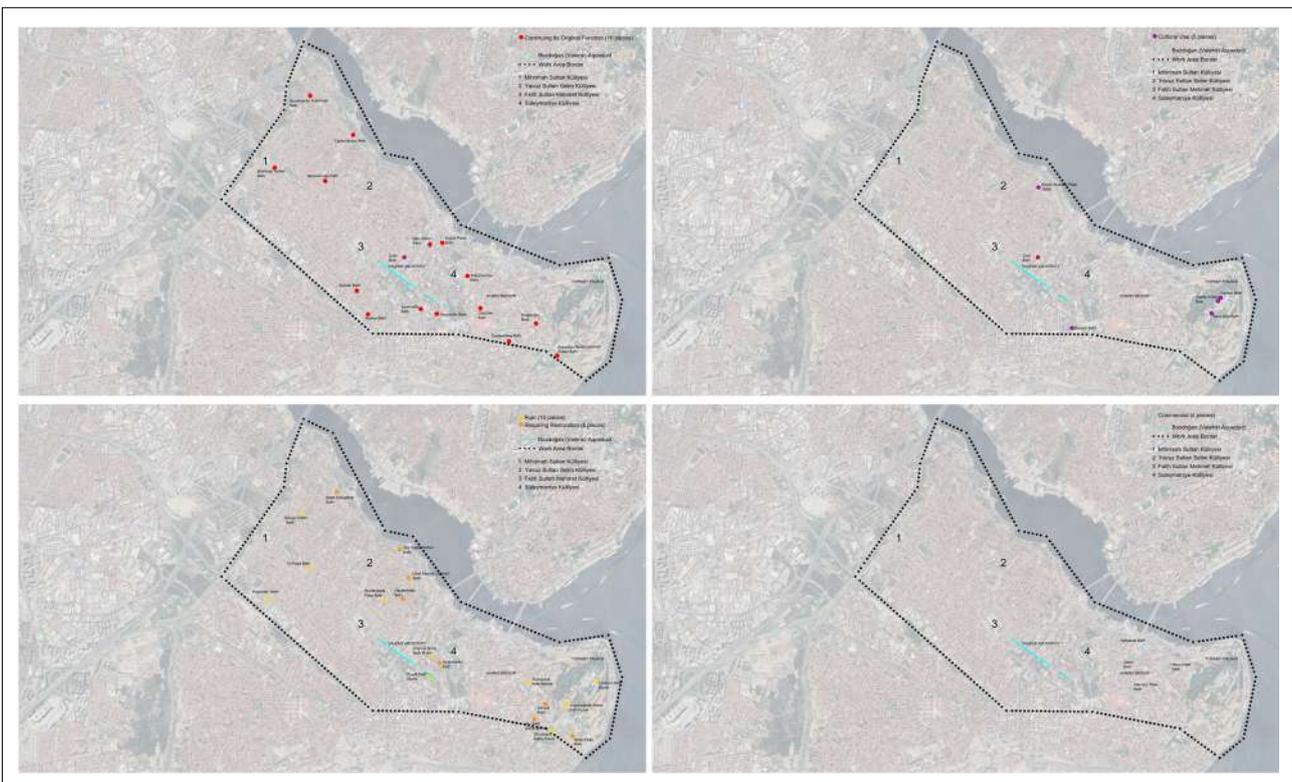


Figure 11. Alternative route contents: baths that maintain their original functions, baths for cultural use, ruins and baths requiring restoration, commercial use baths.

CONCLUSION

The historical baths situated along the historical line of Kırkçeşme Water System encompass a diverse range of historical and cultural assets. These structures, as part of

a proposed new cultural route, allow for comprehensive planning that incorporates supportive functions and intangible components. Recommendations have been put forth for the route, considering the cultural route evaluation criteria in Table 1 and the current state of the baths.

In this context, the proposed cultural route for the baths, whose values are explained in the article, is defined in line with the temporal characteristics' subheading in the first part of the table. In line with the second part of the table, where the aims of conservation and participation in contemporary life are conveyed, the baths in the study area stand out in terms of their functional features such as maintaining their original function and use within the scope of cultural and artistic activities, contributing to economic and environmental sustainability, and brand and promotion potential. Consequently, suggestions and evaluations have been made under the following headings. In this regard,

Defining the cultural route:

- Kırkçeşme water system and structures such as the baths constitute an example of existing historical lines whose physical traces can be followed today, as seen in the temporal characteristics subheading in the first part of Table 1.
- It is possible to experience the system in its entire or partial elements. A concept can be developed to cover the entire line or focus on a specific segment or type of structure within the system, such as the historical baths highlighted in this study.

Recommendations for function; original function, cultural and/or artistic activities:

- It can be seen in Table 1 that in the evaluation of cultural assets, the preservation of their structural originality and integrity, as well as the continuation of their original function, are important for holistic conservation. Ensuring the integration of the activities and cultural functions discussed under the 'Cultural Tourism and Art Activities' subheading in the second part of the table into the cultural route supports the aims of transferring heritage elements to the future and integrating them into contemporary life. Function recommendations and evaluations have been developed in this context.
- Revitalization of the original function of structures that are possible to maintain their original function (for example, bath structures that require restoration can be restored and used with their original function); For those unable to continue their original function, functions that include cultural activities such as exhibition areas and museums can be recommended. The Atik Valide Sultan Bath (Ayakapı Bath), constructed by Sinan the Architect, and situated in the study area, is an example of a bath that can be used with its original function after restoration.
- As we see in the example of the Çinili Bath, a comprehensive planning approach can be carried out by combining creative contemporary applications with traditional uses in possible structures such as cisterns, maksems, and *sebils* belonging to water systems, as well as baths.

- By combining the use with contemporary arts and cultural events, the working principle of the water system can be explained to the target audience in a suitable section of the route. For example; Bozdoğan (Valens) Aqueduct has a fountain at one end, a cistern structure at the other, and many baths in the vicinity. Therefore, it is possible to show the relationship between storage, transportation, and usage structures.
- Different interpretation and presentation techniques and educational activities for different target groups should be supported to explain the importance of water and historical water systems and structures in the development of the city.¹⁸

Recommendations for economic, and environmental sustainability:

- The cultural, environmental, and economic sustainability characteristics of cultural routes and their elements are evaluated under the subheading 'Sustainability' in the second section of Table 1. The baths evaluated within the scope of the study have potential in this context.
- The baths, which still mostly maintain their original functions, have shown cultural, social, and economic continuity for centuries. It has the potential to contribute to environmental sustainability by encouraging its use with other structures of the historical water system, such as the cistern structures used to store water, especially those around the baths.¹⁹

Brand and promotion suggestions:

- As seen in the 'Brand and Promotion' subheading in the second section of the 'Evaluation Criteria for Creating a Cultural Route' table, the promotion of the system of which cultural routes are members and the route itself provides an advantage in terms of the awareness of the route.
- European Thermal Heritage Day is annually celebrated as part of the European Historical Thermal Cities Route, a cultural route of the Council of Europe that also highlights Turkish thermal spa areas like those in Bursa and Afyonkarahisar.²⁰ This helps to increase the visibility of the tangible and intangible cultural heritage of these structures. Similar to international cultural routes, route-specific festivals can be organized for Istanbul baths to integrate these structures into social and cultural life.

NOTES

¹⁸“L'Europe continue” report, Strasbourg, 13 and 14 October 1964. In the early 1960s, the Council of Europe aimed to make the fundamental principles of the European Cultural Convention clear and visible to all Europeans. The Council of Europe brought together a group of experts to consider what to do to "improve collective awareness". They were

in favor of the idea of evaluating Europe's leading cultural venues, incorporating them into entertainment culture, and discovery through travel. The working party considered that it would be advisable to place greater importance on cultural journeys, which are one of the best uses of leisure time. Quoted in 'Impact of European Cultural Routes on SMEs' Innovation and Competitiveness', The Council of Europe, 2010.

²For example, the form of the original movement that took place in the proposed route in the past and the local meaning of the spirit of the movement is questioned in the European Good Walking Code document prepared by the ERA commission in 2002. It is recommended that the walk be done by the original version of the route.

³In the first half of the 2nd century, the city's water needs were met by canals built by Hadrian (117-138). Water channels convey the waters of Kağıthane Stream and Alibey Stream to the neighborhoods around the Golden Horn (Aysel, 2008).

⁴The aqueduct, considered one of the longest arches in the Roman world, is 971 m long (Crow, 2015).

⁵During the reign of Heraclius (610-641), in 626, the Avars seriously damaged the Bozdoğan (Valens) Aqueduct (Tabakoğlu, 2017). In the period before the Avar attacks, when Theodoric Strabon revolted against Emperor Zeno (474-491) in 487, the aqueduct was damaged for a short time, until it was repaired, the aqueduct lost its functionality (Crow, 2022).

⁶Basilica (Basilica Cistern Museum, 2023) Cistern and Binbirdirek Cistern, the two largest known closed cisterns of the Ancient World, dating back to the periods of Anastasios and Justinian, meet the large water reservoir needs of a crowded urban area (Crow, 2015).

⁷After the conquest of Istanbul (1453), Fatih Sultan Mehmet preferred to repair old transmission lines rather than using cisterns as the main element of the water system (Karakuş, 2019). With the addition of new springs to the old lines, plenty of clean water was brought to the city. Fatih and Turunçlu waterways emerged by rehabilitating the old line (Tabakoğlu, 2017).

⁸In the thematic study titled 'The Water Industry as World Heritage' prepared by James Douet in 2018 as a joint publication of ICOMOS - TICCIH; structures required for the acquisition, management, and control of water for human use; It is classified as water collection, water storage, water distribution and wastewater filtering (Douet, 2018). In his master's thesis titled İstanbul'daki Tarihi Su Sistemleri ve Kumrulukemer (Akyar Kemeri) Örneğinde Bozulma Nedenleri, Çözüm Önerileri ', structures belonging to water systems; are classified as water collection, water

transportation, water distribution, and water use structures (Akova, 2012). Within the scope of this study, structures belonging to historical water systems were classified according to their construction purposes, taking reference from the above-mentioned and similar studies.

⁹During the studies carried out, 25 cisterns were found within the borders of Sur-1 Sultani. One of these cisterns dates back to the Ottoman period (Altuğ, 2014).

¹⁰The waterway, whose construction started in 1554, was completed in 1564 (Karakuş, 2019).

¹¹Since forty fountains were built during the construction of the Kırkçeşme system, this system is called 'Kırkçeşme Waters'.

¹²With this line, water was provided to places below 34 m elevation in the city (Salman, 2008).

¹³Uzun Kemer is the largest structure of the Kırkçeşme Water System. There are Roman ruins in the arch. There are documents showing that the part that was destroyed in the flood in 1563 was repaired by Sinan the Architect (Kolay, 2022). Eğri Kemer, which dates back to the Roman period, was also completely ruined and was later repaired by Sinan the Architect by opening it to its foundation (Kolay, 2022).

¹⁴For detailed information about water system structures, you can also refer to the master's thesis titled 'The Documentation and Suggested Protective Methods of the Monumental Structures That Belong to the Kırkçeşme and Taksim Historical Water Supply Systems' prepared by Ahmet Aygün at Mimar Sinan Fine Arts University in 2018.

¹⁵For detailed information; <https://kulturenvanteri.com/tr/harita/#10.96/41.116/28.9309>

¹⁶The bath hosted a variety of traditional rituals in Ottoman society. These included the postnatal bath, held on the fortieth day after a baby's birth, where a ceremonial procession entered the hammam. Red sugar syrup was poured, and a prayer was recited for protection. Bridal baths were customary for girls before their weddings, while henna baths were observed in some parts of Anatolia. Additionally, there was the fifteenth-day bath for brides and their relatives, circumcision baths for boys about to undergo the procedure, groom's baths for the groom and his entourage before a wedding, and soldier's baths for prospective military recruits.

¹⁷For detailed information about bath usage times and cultural events; <https://zeyrekcinilihamam.com/en>

¹⁸The 'Istanbul in Pursuit of Water' Project of the Culture Civic Culture and Arts Support Program financed by the European Union is a work that invites children aged 5 and above and

everyone to think about the concept of urban heritage with a focus on 'water'. In this context, various cultural events are organized. For detailed information; <https://www.culture-civic.org/projeler/suyun-pesinde-istanbul>

¹⁹The freshwater required for baths was obtained from natural water sources or structures such as wells and cisterns. In addition, there is information that some baths benefit from the snow and rain falling on their roofs (Önge, 1981).

²⁰For detailed information; <https://historichermaltowns.eu/>

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REFERENCES

- Akova, E. (2012). İstanbul'daki Tarihi Su Sistemleri ve Kumrulukemer (Akyar Kemeri) Örneğinde Bozulma Nedenleri, Çözüm Önerileri [Yüksek Lisans Tezi, Mimar Sinan Güzel Sanatlar Üniversitesi].
- Altuğ, K. (2014). Tarihi yarımada'da Bizans dönemi sarnıçları envanteri ışığında topografik gözlemler. İstanbul Araştırmaları Yıllığı, 3, 23–38.
- Aysel, N. R. (2008). İstanbul'un Tarihi Su Sistemleri: Kırkçeşme Tesisleri. Tarihi Su Yapıları Konferansı Bildiriler Kitabı. T.C. Çevre ve Orman Bakanlığı.
- Basilica Cistern Museum. (2023). Basilica Cistern gallery. <https://yerebatan.com/galeri/>
- Boyar, E., & Fleet, K. (2012). A Social History of Ottoman Istanbul. Cambridge University Press.
- CIIC ICOMOS. (n.d.). What is CIIC? <https://ciicicomos.org/>
- Claridge, R. T. (1837). A Guide Along the Danube from Vienna to Constantinople. Howlett and Son Printers.
- Cotte, M., AI, S. M., & Durighello, R. (2017). Cultural Heritage of Water: The Cultural Heritage of Water in the Middle East and Maghreb. ICOMOS.
- Council of Europe. (2013). Enlarged Partial Agreement on Cultural Routes (EPA). https://search.coe.int/cm/Pages/result_details.aspx?ObjectId=09000016805c69ac
- Crow, J. (2015). Bizans Konstantinopolis'inin Su Tedarik Sistemleri. In C. Yılmaz, (Ed.), Antik Çağ'dan XXI. Yüzyıla Büyük İstanbul Tarihi (Vol. 6, pp. 44–53). Büyükşehir Belediyesi Kültür A. Ş.
- Crow, J. (2022). Waters for a Capital: Hydraulic Infrastructure and Use in Byzantine Constantinople. In S. Bassett (Ed.), The Cambridge Companion to Constanti-
- nople (pp. 67–86). Cambridge University Press.
- Culture Route Society (n.d.). About the Culture Routes Society. <https://cultureroutesinturkey.com/tr/dernek-hakkinda>
- Culture Routes. (n.d.) Explore all cultural routes by theme. <https://www.coe.int/en/web/cultural-routes/by-theme>
- Çeçen, K. (1997). II. Bayezid Suyolu Haritaları. İSKİ.
- Çinili Hamam. (n.d.). Healing Ruins. <https://zeyreckinilihamam.com/en/healing-ruins>
- Douet, J. (2018). The Water Industry as World Heritage. ICOMOS.
- Ertuğrul, A. (2015). İstanbul Hamamları ve Mimarisi. In C. Yılmaz (Ed.), Antik Çağ'dan XXI. Yüzyıla Büyük İstanbul Tarihi (Vol. 8., pp. 450–467), İstanbul Büyükşehir Belediyesi Kültür A. Ş.
- European Ramblers Association. (2002). European Walking Code. <https://www.era-ewv-ferp.org/tr/internal/basics-for-walking/european-walking-code/>
- European Ramblers Association. (n.d.) Walking: E-Paths. <https://www.era-ewv-ferp.org/e-paths/>
- European Route of Industrial Heritage. (n.d.). The milestones of European Industrial Heritage: Anchor Points. Selection criteria and procedure. <https://www.erih.net/about-erih/route-system/anchor-points-selection-criteria-and-procedure>
- Eyice, S. (1997). İslam Ansiklopedisi: Hamam. <https://islamansiklopedisi.org.tr/hamam>
- Eyüp Sultan Belediyesi. (n.d.). Foto Galeri. <https://www.eyupsultan.bel.tr/tr/main/foto/ayvad-bendi-kurtkemer-sosyal-tesis-alani/12224>
- ICOMOS. (1994). Routes as a Part of Our Cultural Heritage. <https://www.icomos.org/en/about-the-centre/publicationsdoc/other-publications-3/116-english-categories/resources/publications/317-routes-as-a-part-of-our-cultural-heritage>
- ICOMOS. (2008). The ICOMOS Charter on Cultural Routes. ICOMOS.
- ICOMOS. (2011). 18 April 2011: The Cultural Heritage of Water. <https://www.icomos.org/18thapril/2011/index.html>
- İSKİ. (1983). İstanbul Waters Throughout History and Istanbul Water and Sewerage Problem. İSKİ Publishing.
- Karakuş, F. (2019). İstanbul'daki Osmanlı dönemi tarihi su sistemlerinin incelenmesi. Türk Hidrolik Derg, 3(1), 14–30.
- Kolay, C. (2022). Urban water supply in historic İstanbul: The aqueducts of İstanbul. In NIT Urban Heritage Lab: Water Heritage for Sustainable Cities Online Seminars (September 23, December 16). İstanbul: The Netherlands Institute in Türkiye (NIT).
- Köseoğlu, N. (1952). İstanbul Hamamları. <https://core.ac.uk/download/pdf/38304521.pdf>.

- Kültür Envanteri. (n.d.). Mağlova Kemer. <https://kulturenvanteri.com/tr/yer/maglova-kemeri/#17.1/41.135971/28.893354>
- Kuruçay, A. (2010). İstanbul'un 100 Hamamı. İstanbul Büyükşehir Belediyesi Kültür A.Ş. Yayınları.
- Moltke, H. V. (2017). Moltke'nin Türkiye Mektupları. Remzi Kitabevi.
- Necipoglu, N. (1999). Bizans İstanbul'u. In F. Türe (Ed.), İstanbul'un Dört Çağı (pp. 24). Yapı Kredi Yayınları.
- Önge, Y. (1981). Eski Türk Hamamlarında Su Tesisatı İle İlgili Bazı Detaylar. I. Uluslararası Türk İslam Bilim ve Teknoloji Tarihi Kongresi (pp. 213-223). İstanbul Teknik Üniversitesi.
- Salman, M. Ç. (2008). Avasköy Kemer Restorasyon Projesi [Yüksek Lisans Tezi]. İstanbul Teknik Üniversitesi.
- Tabakoğlu, A. (2017). Osmanlı Dönemi İstanbul Su Tarihi. Marmara Belediyeler Birliği Kültür Yayınları.
- UN Turizm. (n.d.). Silk Road. <https://www.unwto.org/silk-road>
- UNESCO. (2004). The Criteria for Selection. <https://whc.unesco.org/en/criteria/>
- UNESCO. (n.d.). UNESCO World Heritage List. <https://whc.unesco.org/en/list/>
- World Trails Network. (2010). World Trails Networks: Priorities. <https://worldtrailsnetwork.org/about/>



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Article

Assessing the driving forces for future housing design

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ABSTRACT

The COVID-19 pandemic has underscored the imperative for housing to adapt to various factors, such as spatial, functional, climatic, and aesthetic considerations. The pandemic has transformed the dynamics between occupants and their living environments, influencing how different age groups interact with dwelling spaces, as well as impacting work, learning, healthcare access, and services. Urban life dynamics, especially in metropolitan areas, have undergone significant shifts due to social, cultural, technological, environmental, and economic factors. These changes, propelled by urbanization, demographic changes, evolving social structures, challenges in housing accessibility, and the rapid advancement of communication technologies, demand innovative approaches to housing design and programming. This study aims to identify future housing design trends and tendencies within this evolving context. Using a systematic literature review methodology, the study analyzed 87 articles published between 2010 and 2023, selected from digital databases according to predetermined criteria. Through meta-synthesis, STEEP analysis, and Shannon entropy assessments, the study identified 21 megatrends and 72 driving forces across the social, technological, environmental, economic, and political dimensions of housing design. The findings lay the groundwork for future housing innovations and sustainability, contributing to a wider discourse and enabling the generation of foresight model scenarios for housing design. Identifying these trends is crucial for creating functional, flexible, and sustainable living spaces that are suitable for the changing lifestyles and needs of individuals.

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INTRODUCTION

Metropolitan systems, covering only 3% of the Earth's surface, accommodate 55% of the human population (Guida & Natale, 2021). By 2050, it is projected that approximately 70% of the population will reside in urban

areas, with the number of megacities—each housing 10 million or more individuals—expected to increase rapidly (United Nations, 2018). Additionally, cities are responsible for about 60% of greenhouse gas emissions and 70% of solid waste, consuming roughly 70% of the global energy supply (Guida & Natale, 2021).

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The livability and urban quality of cities face significant challenges due to the impacts of climate change and environmental degradation, migration patterns, demographic shifts, global pandemics, and health risks. Despite these challenges, cities continue to be pivotal as financial, technological, and cultural centers of communities. For the majority of the world's population, the definition of cities as spaces for living, working, and leisure is being reimagined. This redefinition process is transforming aspects such as livability, connectivity, sustainability, health, and well-being from mere targets into fundamental expectations among occupants regarding urban amenities.

Particularly, the rapid population growth and densification faced by cities are making multi-unit housing a common form of accommodation worldwide. In this context, urban housing is directly linked to emerging problems for the future of cities and plays a crucial role in their capacity to cope with this new reality. However, the inability of existing structures to fully meet even today's needs heightens the uncertainty of their capacity to adapt to future lifestyles.

Housing is a broad term used to describe any kind of dwelling, residence, or shelter intended for living (Chey, 2018). Fundamentally, housing responds to the human need for shelter and establishes deep, meaningful relationships with the individuals living within it and the surrounding built environment. Besides serving as a private living space, housing also functions as a center in the social and cultural context, reflecting the social structure of the community. The characteristics that make housing the starting and ending point of people's everyday lives distinguish it from other architectural structures. Dwellings are directly affected by various changes in daily life, and these changes, in turn, trigger social and physical transformations in housing. Therefore, researching the future and identifying parameters that could significantly influence the design of both cities and housing emerges as a critical solution in this field.

Environmental indicators, known as "megatrends," support design processes and their relationship with the built environment through innovative approaches. Megatrends are broad changes that slowly emerge and have long-lasting effects, covering society, economics, politics, and technology. These changes are influential in the emergence of specific trends and behavioral patterns. Recognizing megatrends is important for understanding the directions of change and developing strategies for the future. While megatrends have a global impact over decades, the trends influenced by megatrends are observed in shorter durations and specific regions (Kalaitzi et al., 2021). Trends are expansive, slow-moving forces and patterns that typically impact society globally over several years, encompassing phenomena observable in the present, such as population aging, the shift towards digital technology, and the trend towards mobile living (Saritas & Smith, 2011). Trends are

shaped by driving forces—forces, uncertainties, and factors capable of instigating or directing change. A defining feature of driving forces is their inherent level of uncertainty, which significantly influences the future adaptation capabilities and outcomes for individuals or organizations. Whether a driving force is deemed positive or negative can engender divergent futures, fostering change patterns in opposite directions (Saritas & Smith, 2011).

This study aims to identify megatrends and trends that will shape the future of housing design. The main goal of the research is to raise awareness of the topic by identifying the driving forces capable of yielding innovative and progressive solutions. Furthermore, it contributes theoretically to the literature by providing a comprehensive list of megatrends and drivers that will impact design.

Housing studies are a pivotal research domain within the architecture discipline. Yet, these studies often focus on the present or current situation and examine the historical context. The lack of a comprehensive field of study addressing the future dynamics and trends shaping housing is notable. To enable work in such a field, this study identifies the guiding concepts most frequently encountered in the literature as "driving forces" through systematic literature review, meta-synthesis methods, and STEEP analysis themes. The findings have been statistically assessed using the SPSS program. This analysis has culminated in a list of trends related to the social, technological, environmental, economic, and political dimensions of housing.

This paper promotes interdisciplinary knowledge production. The findings enable professionals and researchers working in housing to deeply explore the implications of the identified drivers and develop alternative scenarios. The outcomes of the study lay the groundwork for a future-oriented foresight model, presenting alternative projections for the future of housing design and planning when considered together with ongoing studies.

BACKGROUND

In today's world, a paradigmatic transformation process has begun, triggered by the convergence of four fundamental trends in the social, technological, and environmental fields. The effects of changes in social structure, demographic shifts, digital transformation, and global environmental challenges are becoming increasingly visible in urban development and housing trends.

Changes in social structure involve the evolution of social norms, roles, and interactions. They characterize a shift towards more fluid, inclusive, and interconnected social paradigms. Traditional boundaries that define social hierarchies and classifications are becoming increasingly permeable, leading to the emergence of a more egalitarian and network-based society. At the same time, expansions in

demographic structure are reshaping the global population. This trend includes a wide range, from aging populations in certain countries to the contrast of younger demographics in others, urbanization, and migration patterns. The integration of digital technology into all areas of social and economic life, along with the widespread adoption of digital technologies such as artificial intelligence, the Internet of Things, and blockchain, is creating opportunities for innovation, efficiency, and connectivity. At the same time, it also presents challenges related to privacy, cybersecurity, and the digital divide.

Environmental challenges threaten the sustainability of life, requiring urgent and globally coordinated solutions. The “Earth Overshoot Day,” marking when humanity’s demand exceeds Earth’s capacity to regenerate resources within a year, fell on August 2, 2023 (Global Footprint Network, 2023). This indicates humanity used the year’s supply of resources 151 days early, exceeding what the planet can regenerate in a year. The need to provide a livable planet for future generations has become more evident than ever. Sustainability has expanded to encompass not only environmental protection but also all innovative approaches that will reduce human impact.

In understanding and guiding the ongoing transformations, three fundamental concepts emerge as crucial: Society 5.0 and Human-Centric Design, Industry 5.0 and Innovability, and Sustainability and Ecological Transition.

Society 5.0 and Human-Centric Design

Society 5.0 is a societal transformation model defined as a “Smart Society” or “Super Smart Society,” which is more human-oriented than our current information society, shaped by the accumulation of past eras and approved by Japan’s Science, Technology, and Innovation Council in 2016 (Keidanren, 2018). It aims at a societal structure where technological innovations contribute not only to economic growth but also to social welfare and sustainability. The model aims to create new values where technology will eliminate social inequalities regardless of age, gender, language, or geographical location, and provide personalized products and services that focus on individual needs (Fukuyama, 2018). Society 5.0 focuses on using new technologies to support personal development and remove physical, administrative, and social barriers, anticipating developments in technological fields such as innovative strategies for an aging population, integration of cyber and physical worlds, effective solutions to environmental problems, and the Internet of Things, which will benefit society (Keidanren, 2018).

Human-centered design complements Society 5.0 with solutions to ensure that technological progress serves to enhance human well-being and social resilience. It follows an iterative process to respond to user needs, understand behaviors and experiences, and ensure user satisfaction. The synergy of these two concepts expects technology integration

into architecture to contribute not only to functionality but also to the creation of environments that are comfortable, intuitive, inclusive, accessible, and personalized through technology. It represents a transformation towards a smarter architecture that enhances the human experience, promoting efficiency and sustainability.

Industry 5.0 and Innovability

Today marks a new era defined by the rapid development of digital technologies such as artificial intelligence, the Internet of Things, cloud computing, big data, robotics, and 3D printing. Advances in information and communication technologies have sparked a fully digitized industrial revolution known as Industry 4.0 since 2011, initially in Germany. This revolution has made production processes smart by connecting machines and devices, minimizing human intervention, and maximizing automation. Big data and machine learning have increased production efficiency. This transformation has enabled autonomous decision-making processes based on information and facilitated the flow of intelligence between devices (Lu, 2017; Maddikunta et al., 2022).

Industry 5.0 is a global concept that integrates human creativity and critical thinking skills with technology, extending the automation-oriented approach of Industry 4.0. It supports a symbiotic relationship between humans and machines. While monotonous and repetitive tasks are automated through robots and machines, tasks requiring planning and strategy development are left to human control. This new relationship transforms production processes into a more personalized, environmentally sensitive, socially centered, and flexible structure (Maddikunta et al., 2022; Nahavandi, 2019).

The vulnerability of advancing technologies to the environment and initiatives aimed at developing the built environment reveal a contradictory relationship in efforts to protect the planet. “Innovability” refers to this delicate balance between innovation and sustainability. The concept emphasizes the practice of creating new ideas, products, or methods that enable change to be sustainable in the long term. In this era dominated by environmental, social, and economic emergencies, humanity must continue to shape its future by consciously using resources taken from nature (innovation) while being aware of these resources’ limitations (sustainability) (Sposito & Scalisi, 2023).

Sustainability and Ecological Transition

Human activities have increasingly exerted pressure on the structure and functioning of nature, transforming the once resilient and robust natural environment into a delicate and vulnerable state. Global developments such as wars, migrations, and pandemics have brought the complex relationship between the development of the built environment and the desire to protect the planet back onto the agenda. It has revealed that sustainable development practices require not only protective

measures but also broader, more inclusive, and innovative strategies (Sposito & Scalisi, 2023).

Focusing on the efficient use of resources under sustainability practices simplifies the complexity of the wider ecological crisis. This simplification leads to underestimating the seriousness of environmental emergencies and the comprehensive strategies needed to address them. Fundamental changes and comprehensive transformations are needed to increase the resilience of society in the face of ecological crises, climate change, and depleting resources. The concept of “transition” as a new dimension of sustainability has come up for discussion. Transition refers to the movement of initiatives that seek to increase the resilience of communities. This resilience is defined as the capacity of a community to maintain its functions in the face of challenges such as economic crises and ecological disasters (Pour La Solidarité, 2023).

Ecological transition refers to the comprehensive process of moving towards sustainable and environmentally friendly ways of living, working, and organizing communities. EU Member States often define a new sustainable development under the concept of “Ecological Transition,” especially concerning 2030 Agenda targets.

The ecological transition theme is clearly defined in the European Green Deal, approved in 2020 by the European Commission, which targets making the EU climate-neutral by 2050. The ecological transition is also the basic model of Italy’s National Recovery and Resilience Plan (Errante, 2022). In the context of the European Green Deal and Italy’s National Recovery and Resilience Plan, the ecological transition aims to align economic growth and environmental sustainability by promoting energy transition (energy efficiency, preference for renewable energies), industrial transition (local production of recyclable goods within a circular economy perspective), and agricultural-food transition (replacement of industrial agriculture with organic farming) (Pour La Solidarité, 2023). The ecological transition process requires a global paradigm shift towards circular economies and the use of renewable energy, supporting a more resilient and equitable global society.

MATERIAL AND METHODS

This study employs a quantitative methodology combining systematic literature review, meta-synthesis, and Shannon entropy to objectively assess current and emerging trends in residential design. By minimizing subjective bias and grounding the analysis in statistical rigor, this approach ensures the scalability and replicability of the findings, thereby enhancing the credibility and trustworthiness of the research. However, it is important to recognize that findings from quantitative data run the risk of overgeneralization and may not accurately reflect emerging trends. Nevertheless, this study

presents a balanced view that highlights both the strengths and potential limitations of the quantitative approach, aiming to standardize the process of gathering information from the literature and make knowledge extraction efficient.

This study begins with a literature review to identify possible future trends in the built environment. The review allows for the selection of keywords that frame the study. Based on the chosen keywords, a systematic approach relying on content analysis is employed to thoroughly investigate the relevant literature and establish conceptual relationships. The steps of the methodologies are presented in Figure 1.

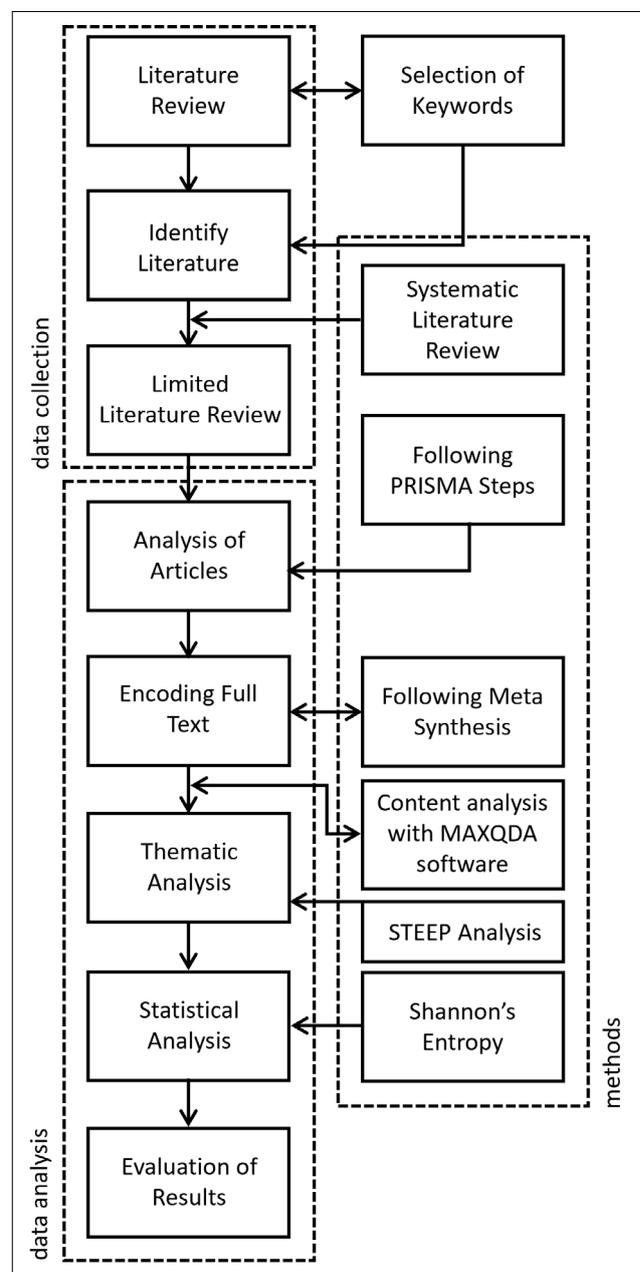


Figure 1. The structure of the research methodology.

Systematic literature review is a rigorous, verifiable, and repeatable research method that summarizes large datasets by following predetermined review steps (Petticrew & Roberts, 2006). The review process defined by Denyer & Tranfield (2009) consists of five steps: (1) identifying the research question, (2) identifying relevant literature, (3) selecting and evaluating studies, (4) analyzing and synthesizing, and finally, (5) reporting and utilizing the findings. The in-depth analysis after the systematic review is conducted through the meta-synthesis method. This method involves integrating and evaluating the findings obtained from the systematic review using qualitative analysis techniques (Yilmaz, 2021).

This paper follows the PRISMA (Preferred Reporting Items for Systematic Reviews) guidelines to increase the reliability and validity of the research. PRISMA is a research protocol that provides a 27-item checklist and evaluation flowchart (Moher et al., 2015; Yilmaz, 2021). The quality and reliability of the selected articles as a result of the systematic review have been examined through a critical appraisal using the Critical Appraisal Skills Programme. The CASP guideline guides researchers through the quality assessment process based on a predetermined set of 10 criteria (CASP, 2018).

The full texts of the selected articles were coded using Maxqda software. The coding was converted into statistical data using the frequency distribution technique

and then categorized using predetermined thematic analysis techniques. For thematic analysis, the “STEEP” framework is utilized to identify the social, technological, environmental, economic, and political dimensions of the research (Fahey & Narayanan, 1986; Szigeti et al., 2011) (Figure 2). Frequency distribution is the main technique used in evaluating the findings obtained through systematic review and meta-synthesis steps. However, within the scope of this research, frequency distribution alone is not sufficient to determine the importance of each trend and its impact on the study. Therefore, the Shannon entropy technique is employed to enable a more comprehensive assessment in the formation of the set of driving forces. Statistical data were analyzed using SPSS and Excel programs.

Defining the Research Question

The research was conducted to identify new developments and controversial concepts in the field of architecture and housing design. In this context, it seeks to answer the following questions to uncover the dynamics and potential trends that will shape the future of housing design:

Q1: What are the megatrends shaping the future of housing design?

Q2: What are the trends shaping the future of housing design?



Figure 2. STEEP dimensions.

Defining the Relevant Literature

The literature review focused on current studies conducted between 2010 and 2023. Searches were made in the Scopus and Web of Science digital databases, covering the "title/abstract/keywords" fields. Keywords were selected in pairs to closely relate to the research topic. Since the concepts of "housing" and "dwelling" were the main research subjects of the study, they formed the first group of words. The second group of keywords, identified as a result of the literature review, includes "driving forces, driving factor, and indicator"; "forecasting, foresight, backcasting, and scenario"; "ecology, ecological transition, sustainable transition, and environmental transition"; "society 5.0, human-centered, future society, next generations, and smart society"; "innovation, innovability, sustainability, sustainable innovation, and sustainable creativity." The Boolean Logic technique was used to determine the relationship between keyword groups, combining words with "OR" and "AND" connectors to narrow down the search (Figure 3).

Publications to be examined in the systematic review were limited to those related to the field of architecture and housing, published in peer-reviewed journals, in English, and compatible with at least one of the STEEP headings. These criteria define the scope of the subject areas the research will focus on and enhance the scientific validity of the study.

Study Selection and Evaluation

The PRISMA flowchart process is delineated in Figure 4. A total of 5304 articles were found in the initial database

search. After the removal of 803 duplicates, the remaining articles underwent keyword-based scrutiny. Publications irrelevant to the discipline of architecture were excluded due to keyword limitations. Subsequently, title and abstract assessments were conducted on the remaining 3444 articles. The elimination of articles was based on certain criteria: (1) articles that contain keywords in the title or abstract but do not examine the concept of housing; (2) studies that use the keyword "housing" due to the examined case study but are not related to the discipline of architecture; (3) detailed studies that address the subject from a specific/single perspective, despite being related to the keywords; (4) studies related to the keywords and the field of architecture but are limited by geographical restrictions. Thus, 49 out of the remaining 282 articles were inaccessible, culminating in 233 articles progressing to the full-text review phase. Upon comprehensive text evaluation, 98 articles evidencing a linkage between the future and housing, and fulfilling the thematic research criteria were identified. Based on CASP's 10-step criteria, 87 articles scoring higher than 6/10 were selected for full reading and conceptual coding in the meta-synthesis.

RESULTS

Analysis of Resources

Figure 5 shows the distribution of 87 articles by years. There has been an increase in the number of studies since 2019. The most significant increase occurred in 2021, which

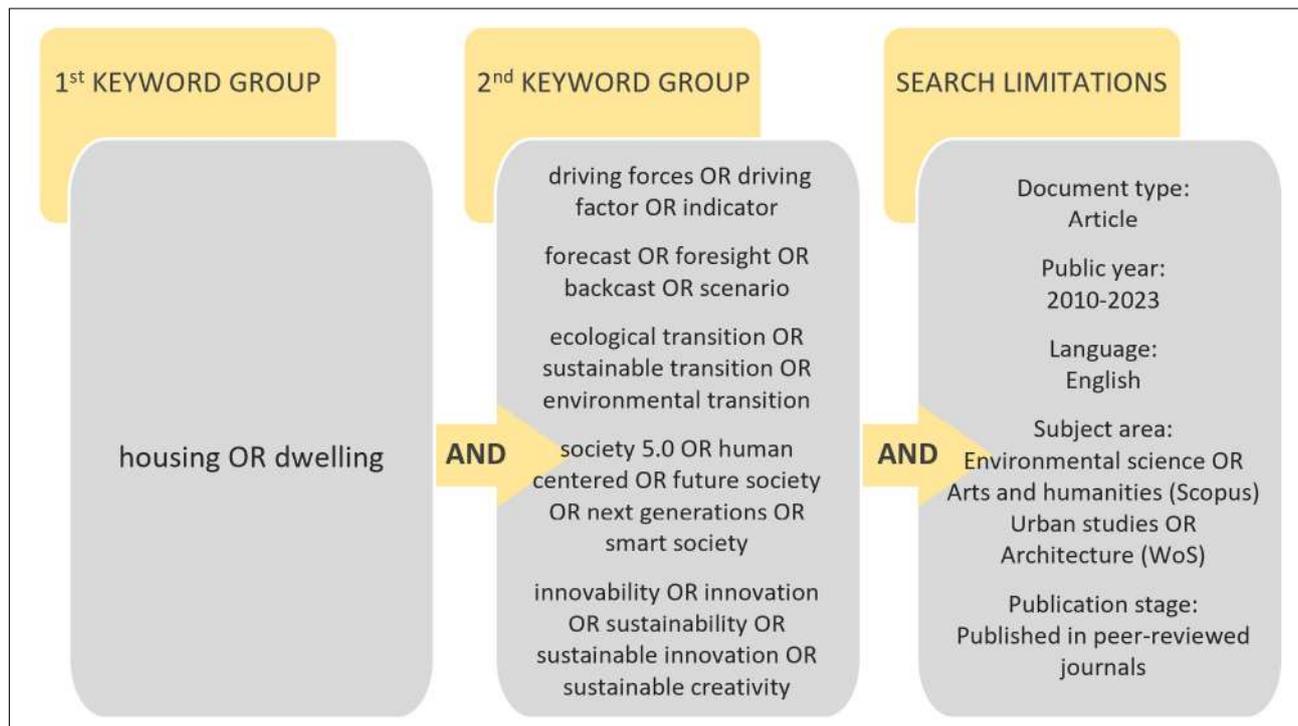


Figure 3. Keyword combination and search limitations for data collection.

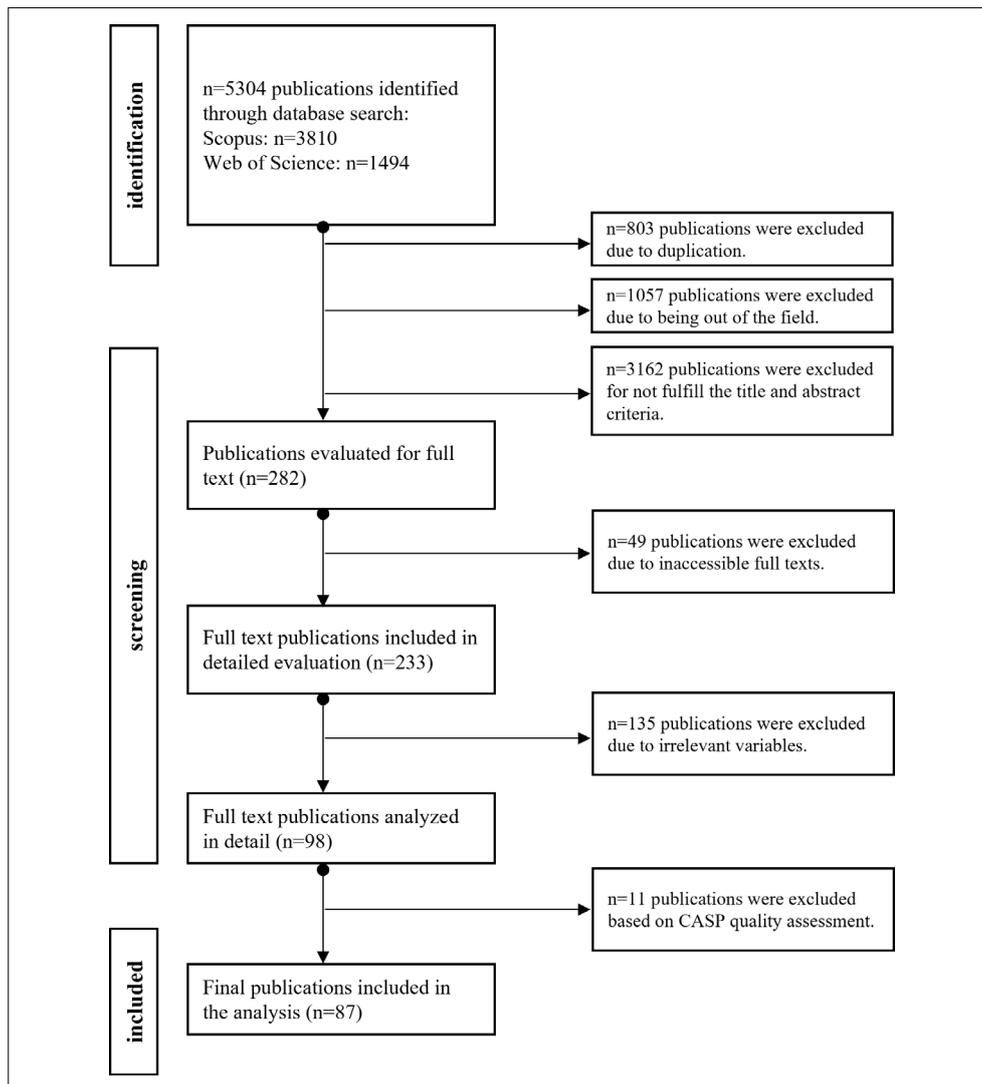


Figure 4. PRISMA flowchart.

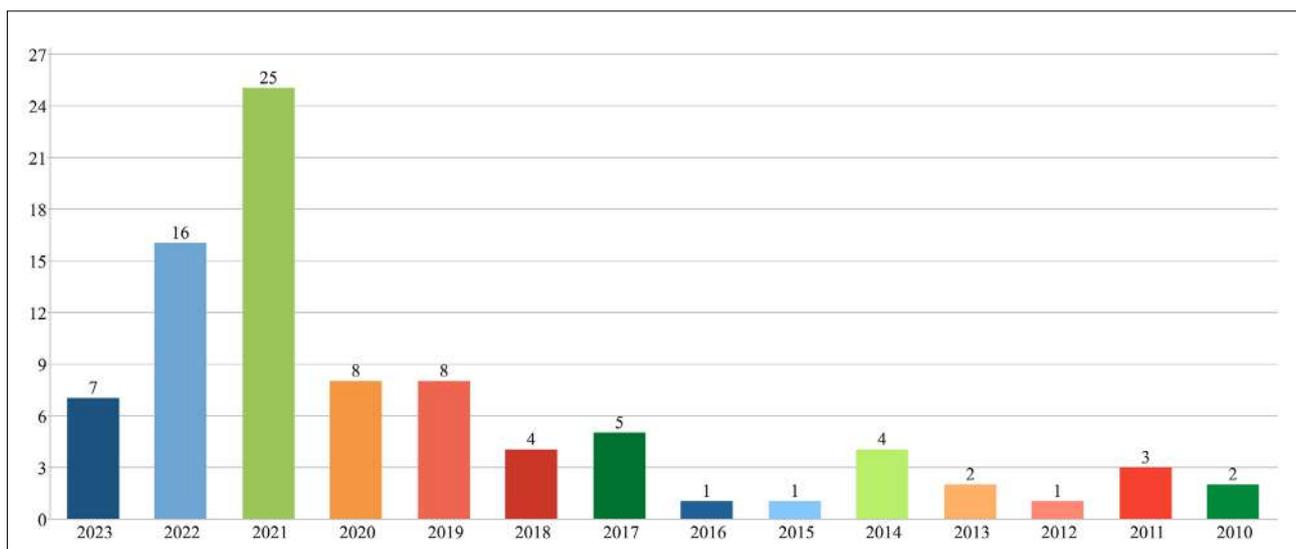


Figure 5. Number of articles based on year.

accounted for 28.74% of the total publications, followed by the year 2022 with 18.39%. Articles published in the first two months of 2023 were included in the study, and their relatively high rate of 8.05% indicates that research in the field will continue throughout the year.

The analyzed studies indicate that sustainability was a prominent theme before the year 2015. Between 2015 and 2019, there was a shift in focus towards technological subjects such as artificial intelligence, big data, and augmented reality. The increase in the number of articles in 2021 could be attributed to the COVID-19 pandemic. During the pandemic, mandatory lockdowns necessitated a reevaluation of the functionality and design of living spaces. Research revealed a growing interest in alternative uses of residential areas, indicating the increasing importance of flexible and multifunctional living spaces as homes and workplaces become more interconnected. The recent surge in publication numbers suggests extensive discussions on innovative concepts in housing design.

Analysis of Data

In the 87 articles examined, parameters that could affect the future of housing design and trends that can be classified as “driving forces” whose effects can be observed today were extracted as conceptual codes. These codes were determined through an inductive approach without a predefined categorization or framework. Driving forces reflecting the same or similar trends were consolidated under a single code to optimize the number of codes. The classification of driving forces followed a two-stage grouping process: (1) grouping under five main factors - social, technological, environmental, economic, and political - within the framework of STEEP analysis, (2) driving forces with similar themes and impacts were further divided into more detailed categories as megatrends under these factors. Frequency analysis was applied to the driving forces according to their thematic distribution based on the frequency of occurrence in the articles. As a result of the analysis, 5 factors, 21 megatrends, and 72 driving forces were identified with a frequency of 933 in total (Table 1).

Table 1. Frequency distribution of factors.

Factors	Megatrends	D.Forces	Frequency
Social	5	21	378
Technological	5	17	163
Environmental	5	16	224
Economic	3	10	103
Political	3	8	65
Sum.	21	72	933

Synthesis of Data

The megatrends and driving forces related to the social factor reveal the needs associated with modern society's urban lifestyles (Figure 6). The megatrend of Changes in Social Awareness (*f*:95) encompasses main themes such as environmental awareness, social interaction, and participation. Spatial Demand-Driven Changes (*f*:90) and Demographic and Cultural Changes (*f*:80) megatrends highlight the balance between individuals' spatial needs and privacy expectations and the changes in social structure and culture, drawing attention to shifts in family structures and the increasing importance of individual rights. The megatrend of Changes in Consumer Behavior (*f*:63) describes multidimensional changes experienced by society through driving forces like shared consumption habits and digitalization. Collective Living Changes (*f*:50) focus on the trends related to the need to create community and the dynamics of living together. This analysis comprehensively examines the wide spectrum of social factors that will shape the future of housing design and their detailed impacts on society.

Technology is creating important paradigm shifts in today's architectural field. The megatrend of Data and Sensor-Based Communication Technologies (*f*:50) enriches interactions and experiences by establishing data-driven and interactive bridges between daily life and the physical environment. Digital Fabrication and Automation (*f*:36) and Smart Living Technologies (*f*:32) megatrends focus respectively on the digitalization of architectural production and the increase in automation within homes, while Integrated Digital Experiences Technologies (*f*:32) highlight the digital transformation in life and work processes. Despite its lower frequency distribution, the Green Technologies (*f*:13) megatrend stands out due to its emphasis on sustainability and eco-friendly innovations (Figure 7).

The environmental factor determines current design parameters and trends through themes such as climate change and adaptation, energy and resource management, urban planning, and land use. The megatrend of Climate Change and Adaptation (*f*:66) refers to global environmental challenges, while Energy and Resource Management (*f*:47) and Urban Planning and Land Use (*f*:47) megatrends focus on the efficient management of natural resources, urban area densification strategies, optimal land use, and the valuation of green and open space demands for the sustainability of living spaces. Although the frequency distribution of Efficiency and Sustainability (*f*:37) and Environmental Impact and Pollution (*f*:27) megatrends are relatively low, their impact is significant due to their focus on energy and resource efficiency and the built environment's effects on the natural habitat. Environmental megatrends highlight strategies for enhancing sustainability, reducing carbon footprint, and conserving natural resources. The close frequency distribution of the megatrends indicates the

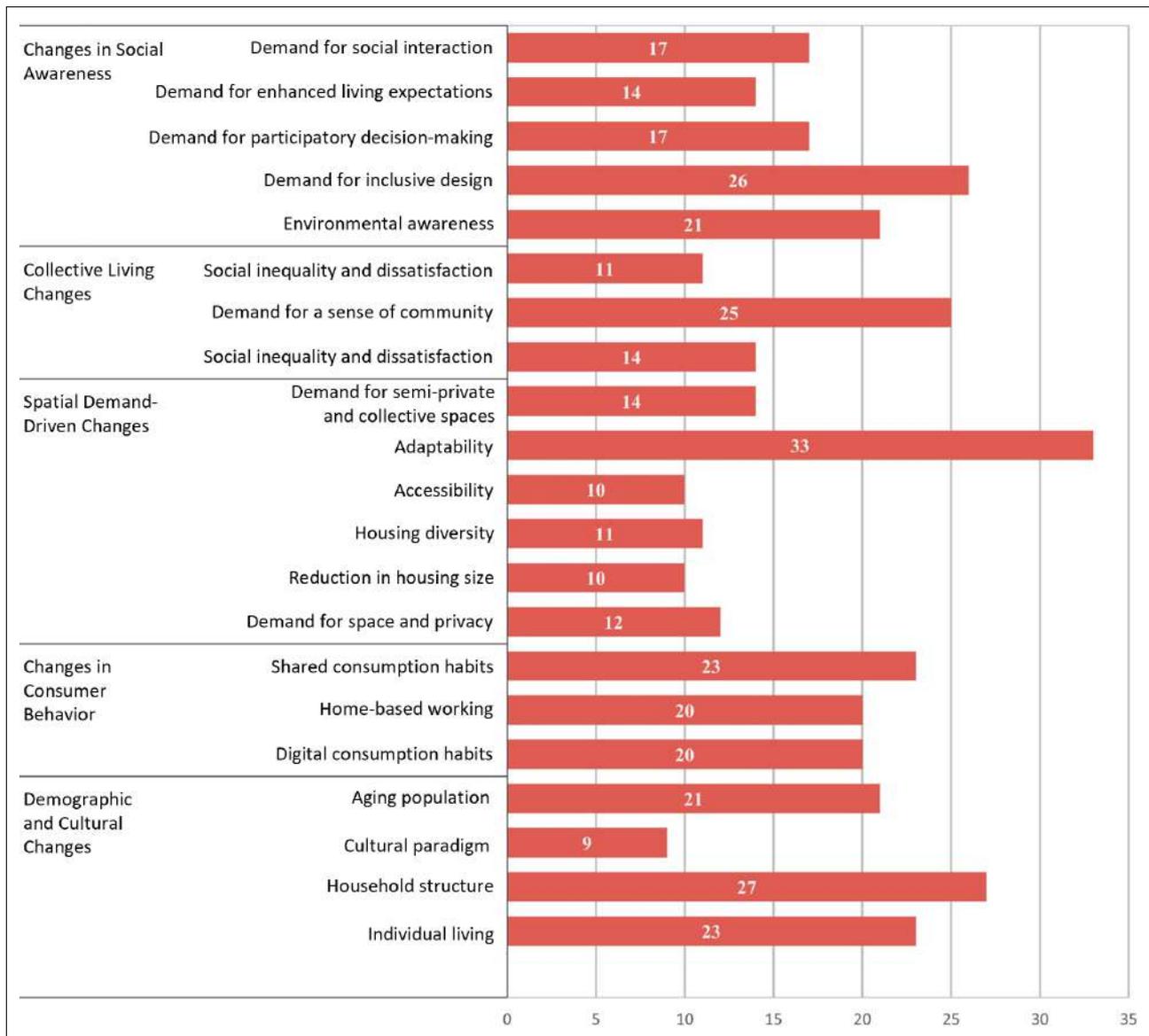


Figure 6. The frequency of each driving forces of social factors.

necessity of considering and integrating parameters to form a comprehensive strategy (Figure 8).

The economic factor focuses on the affordability and financial sustainability of living spaces. The megatrend of Housing Finance and Market Dynamics (*f*:58) highlights the transition to more flexible housing acquisition models over traditional purchasing methods, focusing on the capacity to meet users' needs. The Innovative Economic Models (*f*:24) megatrend emphasizes the rise of contemporary economic strategies, while Macroeconomic Indicators (*f*:21) focus on the effects of growth rates and general economic indicators on development trends. The findings reveal the significance of the economic factor's connection to the disciplines of architecture and urban planning at both macro and micro scales (Figure 9).

Under the heading of political factor, three megatrends have been identified: Urban Quality of Life Policies (*f*:24), Environmental and Sustainability Policies (*f*:24), and Economic and Social Policies (*f*:17). Urban Quality of Life Policies focus on policies aimed at enhancing residents' capacity to live within a community, Environmental and Sustainability Policies on the development of policies that preserve ecological balance and support sustainable development, and Economic and Social Policies on strategies to increase economic accessibility and social welfare. These megatrends demonstrate how political dimensions can create strategic changes in urban life, sustainability, and socio-economic development, and how they can shape advancements (Figure 10).

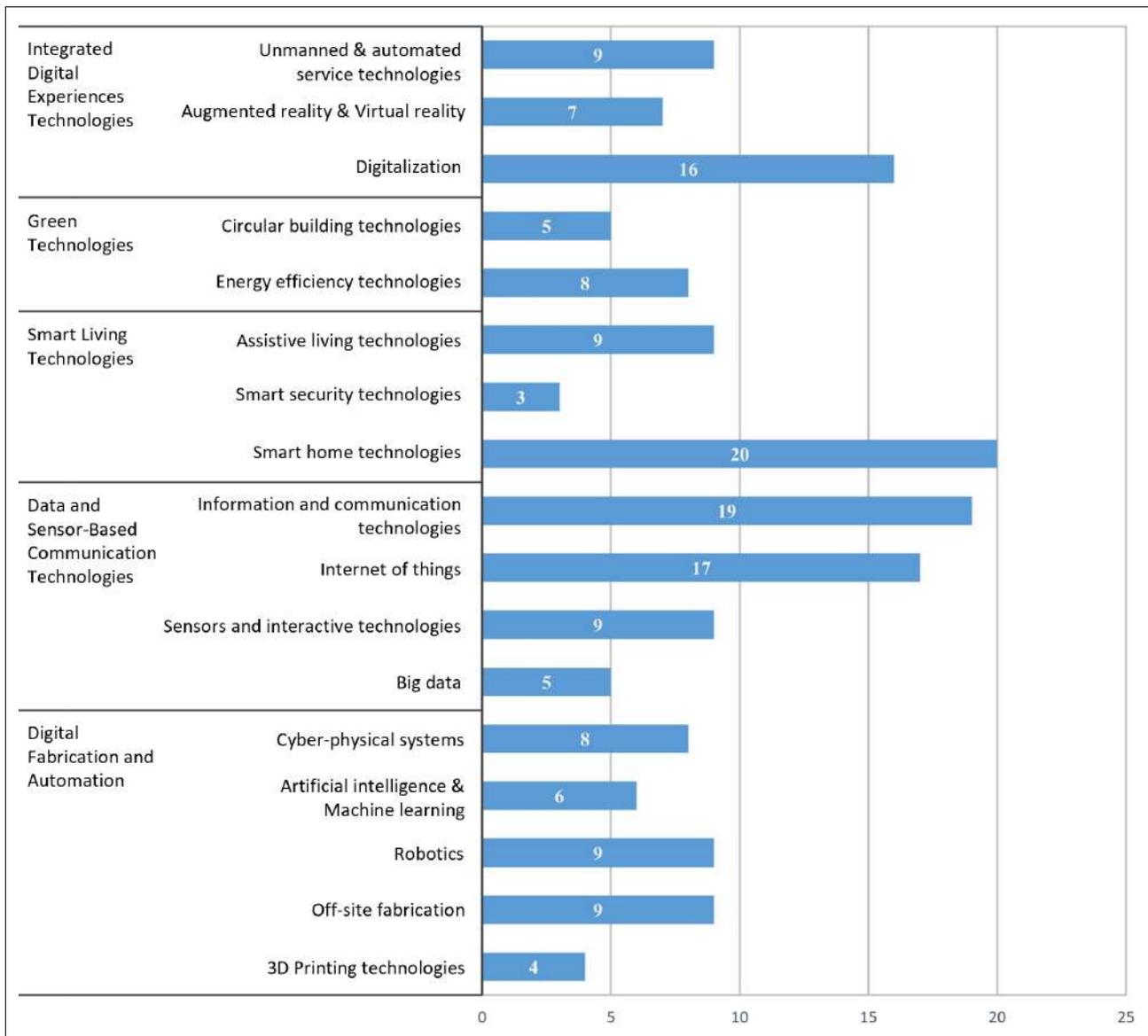


Figure 7. The frequency of each of the driving forces of the technological factors.

Synthesis of Results

The high frequency (f) values of the megatrends listed under the factors show that the driving forces are concentrated around certain themes and how deeply and comprehensively the analysis covers the subject under examination. However, this technique may be insufficient to evaluate the importance of driving forces. To overcome this deficiency, the Shannon entropy technique, one of the Multi-Attribute Decision Making methods, can be applied. Shannon entropy is widely used in information theory to measure uncertainty or complexity and is seen as an important alternative among objective weighting methods in MADM techniques. It is a useful metric for making informed inferences in situations of data insufficiency or uncertainty (Lotfi & Fallahnejad, 2010). The first step in Shannon entropy is to identify the examined data

categories. The amount of insignificance of each driving force is calculated using Formula 1.

$$E_j = -k \sum_{i=1}^m P_{ij} \ln(P_{ij}); \forall_j \tag{Formula 1}$$

In the second stage, the importance weights of the driving forces are calculated using Formula 2.

$$W_j = \frac{E_j}{\sum_{i=1}^m E_j}; \forall_j \tag{Formula 2}$$

The column of importance weight (Wj) in the Shannon entropy technique quantitatively expresses the relative impact of each trend on the analyzed case or system. Driving forces with high entropy values indicate areas that should be prioritized in design processes, while those of medium and low importance offer ideas about specific strategies and innovative solutions that can be applied in housing designs.

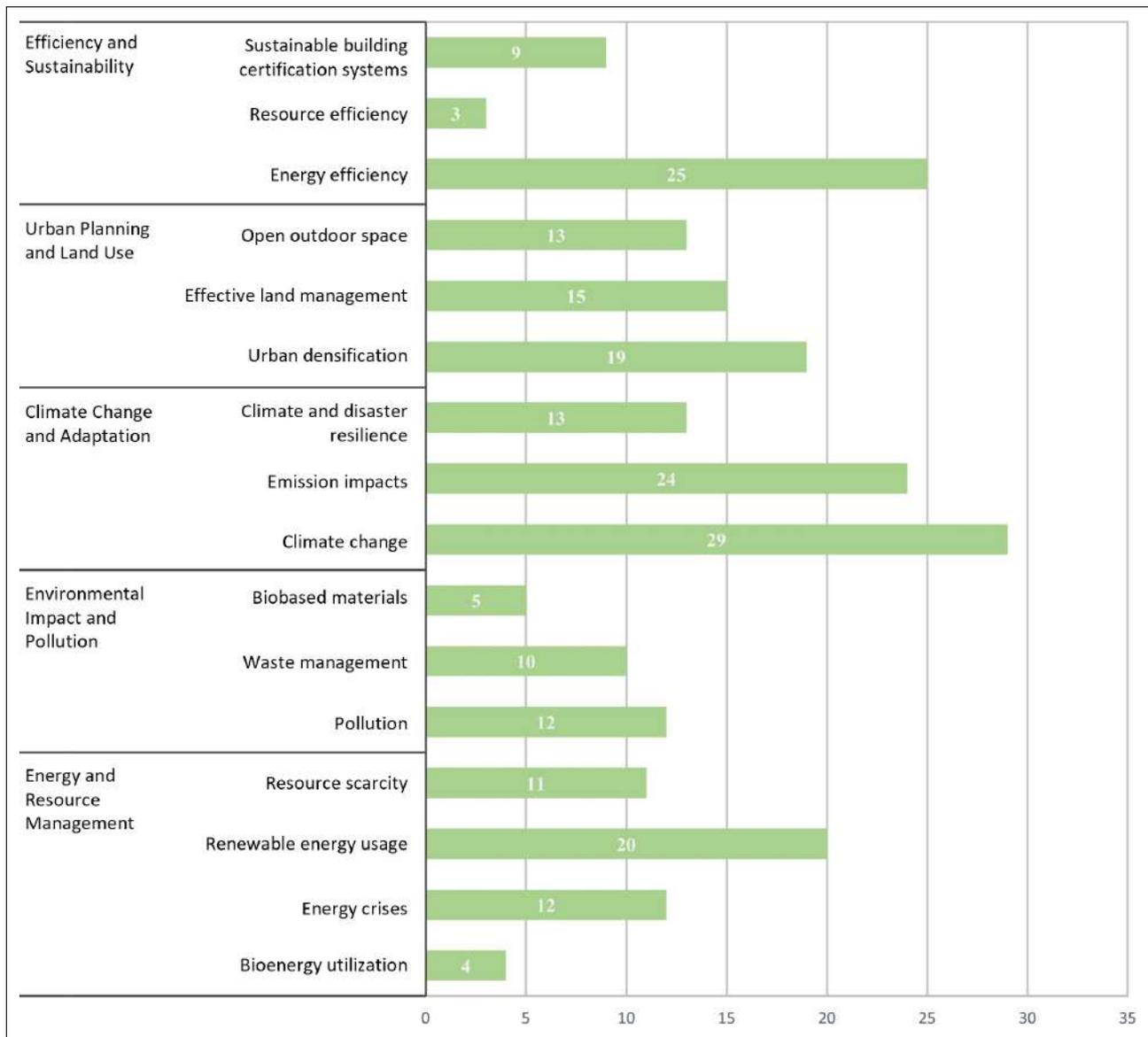


Figure 8. The frequency of each of the driving forces of the environmental factors.

Table 2 presents the importance weights calculated using the Shannon entropy technique for the driving forces associated with social factors. The analysis identifies adaptability, household structures, and the demand for inclusive design as the most significant driving forces. These are closely followed by the demand for a sense of community, individual living, and aging population. Especially, the megatrend of demographic and cultural changes highlights transformations in family structures and household dynamics, the place of the individual in society, the growing importance of individual rights and freedoms, and the diversity in forms of self-expression, drawing attention to changes in social values, norms, and beliefs.

Table 3 presents the importance weights calculated using the Shannon entropy technique for the driving forces under

technological factors. The analysis reveals that interactive technology developments such as smart home technologies, information and communication technologies, and the Internet of Things are the most significant driving forces in the future of housing design. Digitalization and subsequent innovative trends highlight technologies that transform traditional lifestyles into ones compatible with modern needs, making living spaces smarter, more connected, and more efficient.

Table 4 presents the importance weights calculated using the Shannon entropy technique for the driving forces associated with environmental factors. The analysis highlights that discussions on climate change, energy efficiency, emission impacts, environmental sustainability, and reducing carbon footprints remain pertinent. Additionally, subsequent key

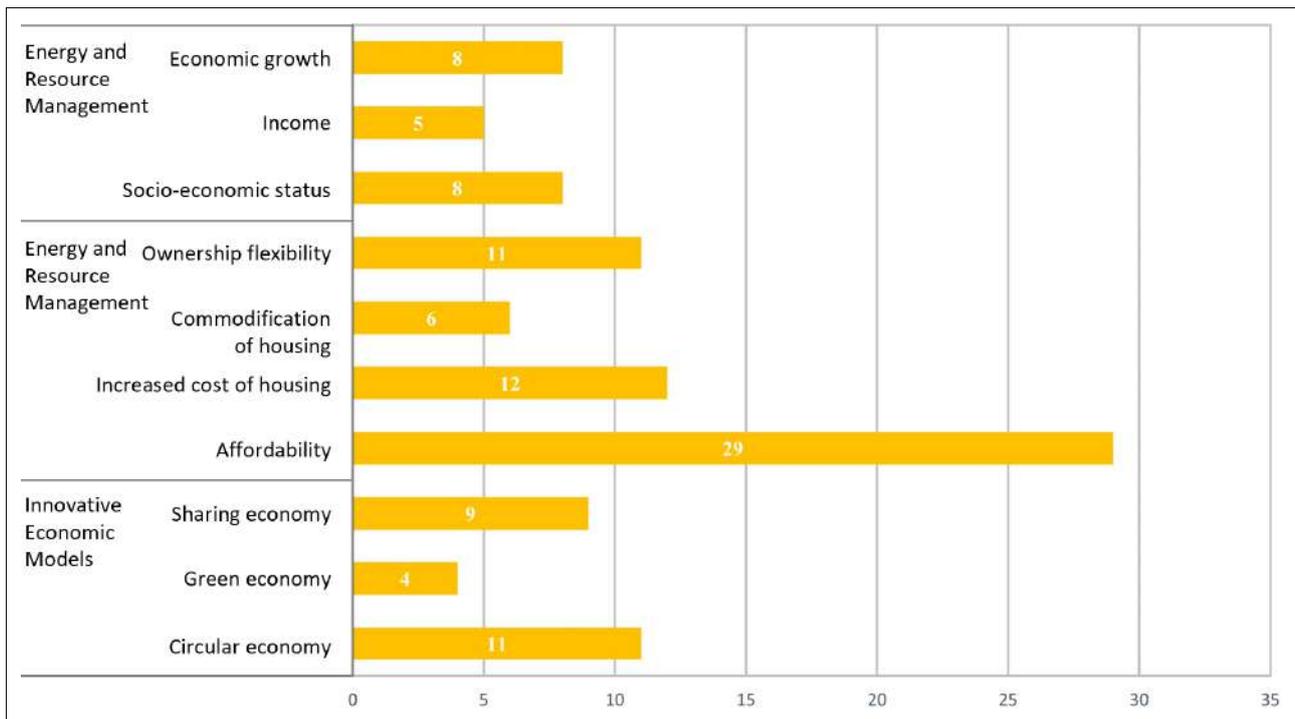


Figure 9. The frequency of each of the driving forces of the economic factors.



Figure 10. The frequency of each driving forces of political factors.

drivers such as the use of renewable energy usage, urban densification, and effective land management demonstrate that the quest for solutions to environmental challenges occupies a significant place in current debates.

Table 5 presents the importance weights calculated using the Shannon entropy technique for the driving forces

associated with economic factors. The driving forces such as affordability and the increased costs of housing are high importance. Subsequent drivers such as ownership flexibility and the circular economy point to alternative methods of acquiring and utilizing housing, offering new perspectives on the current housing market dynamics. Findings indicate that economic factors have impacts on

Table 2. The calculated importance weights of social factors

Factors	Megatrends	Driving Forces	<i>f</i>	<i>E_j</i>	<i>W_j</i>	Rank
Social	Demographic and Cultural Changes	Individual living	23	-0.702	0,053	5
		Household structure	27	-0.738	0.056	2
		Cultural paradigm	9	-0.492	0.037	13
		Aging population	21	-0.682	0.051	6
	Changes in Consumer Behavior	Digital consumption habits	20	-0.671	0.051	7
		Home-based working	20	-0.671	0.051	7
		Shared consumption habits	23	-0.702	0.053	5
	Spatial Demand-Driven Changes	Demand for space and privacy	12	-0.556	0.042	10
		Reduction in housing size	10	-0.516	0.039	12
		Housing diversity	11	-0.537	0.040	11
		Accessibility	10	-0.516	0.039	12
		Adaptability	33	-0.783	0.059	1
	Collective Living Changes	Demand for semi-private and collective spaces	14	-0.591	0.045	9
		Social inequality and dissatisfaction	14	-0.591	0.045	9
		Demand for a sense of community	25	-0.721	0.054	4
	Changes in Social Awareness	Support for community well-being	11	-0.537	0.040	11
		Environmental awareness	21	-0.682	0.051	6
		Demand for inclusive design	26	-0.730	0.055	3
		Demand for participatory decision-making	17	-0.634	0.048	8
			Demand for enhanced living expectations	14	-0.591	0.045
		Demand for social interaction	17	-0.634	0.048	8
		Sum.		- 13.276		

Table 3. The calculated importance weights of technological factors.

Factors	Megatrends	Driving Forces	<i>f</i>	<i>E_j</i>	<i>W_j</i>	Rank
Technological	Digital Fabrication and Automation	3D Printing technologies	4	-0.310	0.038	10
		Off-site fabrication	9	-0.492	0.061	5
		Robotics	9	-0.492	0.061	5
		Artificial intelligence & Machine learning	6	-0.401	0.050	8
		Cyber-physical systems	8	-0.466	0.058	6
	Data and Sensor-Based Communication Technologies	Big data	5	-0.360	0.045	9
		Sensors and interactive technologies	9	-0.492	0.061	5
		Internet of things	17	-0.634	0.078	3
	Smart Living Technologies	Information and communication technologies	19	-0.659	0.081	2
		Smart home technologies	20	-0.671	0.083	1
		Smart security technologies	3	-0.246	0.030	11
	Green Technologies	Assistive living technologies	9	-0.492	0.061	5
		Energy efficiency technologies	8	-0.466	0.058	6
	Integrated Digital Experiences Technologies	Circular building technologies	5	-0.360	0.045	9
		Digitalization	16	-0.621	0.077	4
		Augmented reality & Virtual reality	7	-0.436	0.054	7
		Unmanned & automated service technologies	9	-0.492	0.061	5
		Sum.		-8.091		

Table 4. The calculated importance weights of environmental factors.

Factors	Megatrends	Driving Forces	<i>f</i>	<i>E_j</i>	<i>W_j</i>	Rank
Environmental	Energy and Resource Management	Bioenergy utilization	4	-0.310	0.035	13
		Energy crises	12	-0.556	0.063	8
		Renewable energy usage	20	-0.671	0.076	4
		Resource scarcity	11	-0.537	0.061	9
	Environmental Impact and Pollution	Pollution	12	-0.556	0.063	8
		Waste management	10	-0.516	0.058	10
		Biobased materials	5	-0.360	0.041	12
	Climate Change and Adaptation	Climate change	29	-0.754	0.085	1
		Emission impacts	24	-0.712	0.080	3
		Climate and disaster resilience	13	-0.574	0.065	7
	Urban Planning and Land Use	Urban densification	19	-0.659	0.075	5
		Effective land management	15	-0.606	0.069	6
		Open outdoor space	13	-0.574	0.065	7
	Efficiency and Sustainability	Energy efficiency	25	-0.721	0.081	2
		Resource efficiency	3	-0.246	0.028	14
Sustainable building certification systems		9	-0.492	0.056	11	
Sum.				-8.846		

Table 5. The calculated importance weights of economic factors.

Factors	Megatrends	Driving Forces	<i>f</i>	<i>E_j</i>	<i>W_j</i>	Rank
Economic	Innovative Economic Models	Circular economy	11	-0.537	0.110	3
		Green economy	4	-0.310	0.064	8
		Sharing economy	9	-0.492	0.101	4
	Housing Finance and Market Dynamics	Affordability	29	-0.754	0.155	1
		Increased cost of housing	12	-0.556	0.114	2
		Commodification of housing	6	-0.401	0.082	6
		Ownership flexibility	11	-0.537	0.110	3
	Macroeconomic Indicators	Economic growth	8	-0.466	0.095	5
		Income	5	-0.360	0.074	7
		Socio-economic status	8	-0.466	0.095	5
Sum.				-4.880		

Table 6. The calculated importance weights of political factors.

Factors	Megatrends	Driving Forces	<i>f</i>	<i>E_j</i>	<i>W_j</i>	Rank
Political	Economic and Social Policies	Affordable housing policies	8	-0.466	0.131	3
		Private-sector housing development policies	6	-0.401	0.113	5
		Social housing policies	3	-0.246	0.069	7
	Environmental and Sustainability Policies	Energy efficiency policies	12	-0.556	0.157	2
		Sustainability policies	12	-0.556	0.157	2
	Urban Quality of Life Policies	Urban security and health policies	4	-0.310	0.088	6
		Multidisciplinary collaboration policies	7	-0.436	0.123	4
		Aging-in-place policies	13	-0.574	0.162	1
	Sum.				-3.546	

housing accessibility and sustainability, underscoring the need for the development of innovative approaches.

Table 6 presents the importance weights calculated using the Shannon entropy technique for the driving forces associated with political factors. Aging-in-place policies emerged as the most significant driving force in the last dimension analyzed. Subsequently, energy efficiency and sustainability policies were identified, providing strategic directions for minimizing environmental impacts and optimizing energy usage. Additionally, affordable housing policies underscore the urgent need to develop housing solutions that are both accessible and sustainable.

DISCUSSION

Digital transformation, human-centered development, and environmental awareness are reshaping cities, spaces, and people's lifestyles. Public and collective spaces, particularly housing, play a prominent role in these transformation processes by reinforcing the interaction between the social fabric and the built environment. The built environment is continuously evolving, extending beyond tangible and visible elements to include abstract components that provide social and environmental benefits (Sposito, 2022). These changes underscore the importance of adapting to spatial transformations and discovering effective new approaches and driving forces in housing design.

As discussed in this paper, housing is shaped by the combination of five dimensions: social, technological, economic, environmental, and political. Current studies often address only certain aspects of this complex structure and are generally limited to a narrow perspective (Bitterman & Shach-Pinsly, 2015; Colistra, 2019; Höjer et al., 2011; Iuorio et al., 2019; Jaouhari et al., 2019; Lojanica et al., 2018; Ma et al., 2022; Mete, 2022; Nikezić et al., 2021; Oorschot & Asselbergs, 2021; Wright et al., 2014; Xhelili et al., 2020; Zvěřinová et al., 2020). This paper aims to identify the driving forces effective in housing design, to provide a comprehensive overview of research gaps in the field, and to evaluate the current literature within a conceptual framework. A systematic literature review and meta-synthesis resulted in the identification of 21 megatrends and 72 driving forces, with a frequency distribution of 933, in the 87 articles examined.

A high frequency value (f) indicates that the examined concepts are focused on specific subjects, demonstrating substantial interest in these topics within the field. The findings of the article reveal that social, technological, and environmental dimensions have impacts on the future of housing design. Despite having fewer trends and frequencies compared to other factors, economic and political dimensions cannot be overlooked in a holistic analysis, as they can create significant driving forces. This situation shows that current studies are insufficient in understanding

the effects of economic and political factors on housing design and that more comprehensive research is needed in these areas. In addition, existing housing studies mostly focus on statistical analysis based on quantitative data, highlighting the need for multidimensional discussions and conceptual and theoretical research.

Shannon's entropy was utilized in this study to measure the variability and unpredictability of different factors affecting housing design. High entropy values suggest areas with significant diversity in opinions or projections, indicating either evolving fields with no consensus or emerging trends that are not yet fully understood or agreed upon. The study identified several key trends, such as the increasing integration of smart home technologies and the growing importance of sustainability in housing design. These trends are not isolated phenomena; they reflect broader societal shifts towards a more interconnected and environmentally conscious world. For example, the emphasis on sustainability mirrors a global movement towards reducing carbon footprints and enhancing energy efficiency in response to climate change concerns. Similarly, the rise of smart technologies in housing underscores a societal tilt towards convenience, security, and connectivity.

The study's findings demonstrate that social factors will trigger significant changes not only in the built environment but also in the dynamics of social structure due to demands arising from changing lifestyles and intergenerational differences. The difficulties associated with individual living and the necessity of increasing the capacity to meet the needs of shrinking household sizes have been emphasized in the studies examined. In particular, the increase in the aging population and single-person households notably strengthens the need for new lifestyles (Lavikka & Paiho, 2023). The juxtaposition of concepts such as a sense of community and individualization, combined with the emergence of demands for inclusive design, underscores the need to prioritize diversity and accessibility, aiming to create livable and flexible spaces for everyone.

The driving forces in the context of technological factors point to innovations aimed at enriching everyday life interactions and experiences by creating data-driven and interactive spaces between the physical environment and the digital world. Innovative technologies have the potential to transform design processes, production techniques of the built environment, and end-user experiences. For instance, modular technologies offer off-site production opportunities to accelerate construction processes, reduce costs, and enhance building quality. The Internet of Things, sensors, and advanced communication technologies increase the intelligence of living spaces, making homes more connected and interactive. These technologies allow users to interact with their environment in smarter and more responsive ways, accelerating the functional

evolution of housing while enhancing the mobility capacity of residents. Such transformations are leading to the widespread adoption of smart homes, which offer new models and methods of working that extend beyond mere technological progress and are oriented towards enhancing the daily life practices of users. This suggests that future housing designs will need to be highly adaptable to integrate new technologies that may not currently be at the forefront of design considerations. Therefore, technological advancements have the potential not only to reshape housing design but also to redefine building operations, alter how individuals interact with their living spaces, and influence how communities evolve.

The findings on environmental factors highlight the increasing importance of sustainable environmental management strategies and innovative solutions, which should play a role in housing design and urban planning practices. Articles show that unresolved issues, such as the environmental and energy crisis, biodiversity loss, natural resource depletion, global warming, and climate change, are persisting and intensifying. While the findings emphasize the effects of global climate change and the necessity of reducing carbon footprints, they also reveal the importance of prioritizing energy efficiency and sustainability principles in housing design. Design decisions that save energy and increase environmental awareness are expected to become foundational features of future housing. These approaches can support economic accessibility and ownership flexibility, adaptable to various socio-economic conditions, and contribute to the promotion of social equity for a broad range of users.

On the other hand, the growth of economies and the increase in income, along with changing consumption habits, could lead to a rise in demand for higher quality and technologically advanced housing that meets the lifestyles, desires, and demands of individuals and families. This situation can encourage an increase in housing diversity, leading to the emergence of various housing options that reflect cultural, social, and individual identities. However, viewing housing as an investment tool and economic value may lead to treating homes as goods or commodities in market conditions. This may lead to an increase in inequalities in housing access. In this context, adopting inclusive and participatory approaches in housing design and policies that center on environmental sustainability and social justice could form an effective response to both today's and future challenges.

Finally, this study has identified that political factors provide a guiding framework for housing design and planning, capable of implementing the trends mentioned above, as a significant finding. Political trends establish standards and regulations on strategic issues such as energy efficiency, sustainability, accessibility, and affordability. These political factors, directly related to economic, social, technological,

and environmental dimensions, facilitate the holistic integration of factors through the creation of regulations and the support of social development. The political and economic dimensions possess complementary driving forces. These two factors need to be considered together for effective design and sustainable social development. The findings of this study indicate that the trends obtained through the analysis of STEEP factors support each other and should be evaluated by adopting a broader and more holistic approach that considers the dynamic interactions between factors in housing design and policies.

CONCLUSION

This research, based on megatrends and driving forces collected through a systematic literature review, constitutes the starting point for a comprehensive study to develop future scenarios specifically for the multi-family housing typology. At the same time, it also brings into question the opportunities and challenges that researchers and practitioners may encounter in terms of spatial and functional transformation in the future of housing design. By focusing on trends within a broad conceptual framework, the study offers the possibility to be prepared for the future in areas such as social unraveling, ecological degradation, economic imbalances, and digital transformation, to mitigate potential adverse effects, create a strategic roadmap, and produce effective solutions to changes. The results of the research aim to raise awareness in architectural research about adapting to major changes.

In the future of housing typology, developing fair and inclusive living spaces that can meet user expectations should be considered a priority research area. Designing affordable housing for diverse social groups and adopting an approach that supports social, economic, and technological equality can be effective in re-establishing social balance. Otherwise, the addition of technological inequality to existing economic inequalities may deepen social segmentation and widen the gap between countries and regions. Therefore, it is recommended that future research should detail flexible and versatile housing design parameters by considering user diversity and socio-economic factors.

A more holistic and in-depth analysis of environmental sustainability, economic justice, and technological opportunity equality is recommended. These three fundamental dimensions have direct impacts on social norms and the built environment. The discipline of architecture plays a critical role in maintaining social balances and optimizing user-space interactions, extending beyond physical spaces. In this context, it may be important to take strategic steps in housing design to meet the housing needs of every person, eliminate inequality, and promote housing diversity.

For future studies, it is recommended to analyze the identified megatrends and driving forces at more detailed geographic levels. Focused analyses, by revealing specialized needs and trends, can contribute to the development of regional and comprehensive future scenarios. Such an approach allows for the evaluation of alternatives and the discussion of desired futures. These analyses can be useful in determining the decisions to be made today and the policy steps to be taken to achieve desired futures.

In conclusion, this paper provides a comprehensive assessment of the megatrends and driving forces that will shape the future of housing design, offering theoretical and practical contributions to the discipline of architecture. Understanding and supporting these multilayered and dynamic trends require interdisciplinary collaboration and the prioritization of innovative regulation development by relevant policymakers. Architectural practice must adopt a holistic approach that encompasses the three dimensions of sustainability, including social and economic aspects, beyond just technological and environmental dimensions. With such an approach, architectural, urban planning, and policy development processes will gain the potential to create sustainable, livable, and resilient living spaces for future generations by developing accessible, flexible, and inclusive housing design strategies.

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REFERENCES

- Bitterman, N., & Shach-Pinsly, D. (2015). Smart home – A challenge for architects and designers. *Archit Sci Rev*, 58(3), 266–274.
- CASP. (2018). Critical Appraisal Skills Programme. <https://casp-uk.net/casp-tools-checklists/>
- Chey, K. (2018). *Multi-unit housing in urban cities*. Taylor & Francis.
- Colistra, J. (2019). Innovations in housing for smart cities. *J Archit Eng*, 25(4), 06019001.
- Denyer, D., & Tranfield, D. (2009). Producing a systematic review. In D. Buchanan & A. Bryman (Eds.), *The Sage Handbook of Organizational Research Methods* (1st ed), pp. 671–689. Sage Publications.
- Errante, L. (2022). Design opportunities towards the ecological transition of villages, cities, buildings and dwellings. In F. Calabrò, L. Della Spina, & M. J. P. Mantiñán (Eds.), *New metropolitan perspectives*, pp. 120–135). Springer.
- Fahey, L., & Narayanan, V. K. (1986). *Macroenvironmental analysis for strategic management*. West Publishing Company.
- Fukuyama, M. (2018). Society 5.0: Aiming for a new human-centered society. *Japon Spotlight*. https://www.jef.or.jp/journal/pdf/220th_Special_Article_02.pdf
- Global Footprint Network. (2023). Earth overshoot day 2023 fell on August 2. <https://overshoot.footprint-network.org/>
- Guida, C., & Natale, F. (2021). Ecological transition: Which transactions? *TeMA J Land Use Mobil Environ*, 14(1), 93–98.
- Höjer, M., Gullberg, A., & Pettersson, R. (2011). Backcasting images of the future city – Time and space for sustainable development in Stockholm. *Technol Forecast Soc Change*, 78(5), 819–834.
- Iuorio, O., Wallace, A., & Simpson, K. (2019). Prefabs in the North of England: Technological, environmental and social innovations. *Sustainability*, 11(14), 3884.
- Jaouhari, S., Palacios-Garcia, E., Anvari-Moghaddam, A., & Bouabdallah, A. (2019). Integrated management of energy, wellbeing, and health in the next generation of smart homes. *Sensors*, 19(3), 481.
- Kalaitzi, D., Matopoulos, A., Fornasiero, R., Sardesai, S., Barros, A. C., Balech, S., & Muerza, V. (2021). Megatrends and trends shaping supply chain innovation: A roadmap for research and innovation. In R. Fornasiero, S. Sardesai, A. C. Barros, & A. Matopoulos (Eds.), *Next Generation Supply Chains*, pp. 3–34. Springer.
- Keidanren. (2018). Society 5.0: Co-creating the future. *Japan Business Federation*. <https://www.keidanren.or.jp/en/policy/2018/095.html>
- Lavikka, R., & Paiho, S. (2023). Motivations and market solutions for flexible housing in Finland. *J Housing Built Environ*, 38(3), 1789–1818.
- Lojanica, V., Colic-Damjanovic, V. M., & Jankovic, N. (2018). Housing of the future: Housing design of the Fourth Industrial Revolution. *5th International Symposium on Environment-Friendly Energies and Applications (EFEA)*, 2018, 1–4.
- Lotfi, F. H., & Fallahnejad, R. (2010). Imprecise Shannon's entropy and multi attribute decision making. *Entropy*, 12(1), 53–62.
- Lu, Y. (2017). Industry 4.0: A survey on technologies, applications and open research issues. *J Ind Inf Integr*, 6, 1–10.
- Ma, C., Guerra-Santin, O., & Mohammadi, M. (2022). Smart home modification design strategies for aging in place: A systematic review. *J Housing Built Envi-*

- ron, 37(2), 625–651.
- Maddikunta, P. K. R., Pham, Q. V., Prabadevi, B., Deepa, N., Dev, K., Gadekallu, T. R., Ruby, R., & Liyanage, M. (2022). Industry 5.0: A survey on enabling technologies and potential applications. *J Ind Inf Integr*, 26, 100257.
- Mete, S. (2022). Towards degrowth housing development? Lessons from a scenario-based gaming session in the Oslo region. *Local Environ*, 27(4), 517–536.
- Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., Stewart, L. A., & PRISMA-P Group. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews*, 4(1), 1–9.
- Nahavandi, S. (2019). Industry 5.0 — A human-centric solution. *Sustainability*, 11(16), 4371.
- Nikezić, A., Ristić Trajković, J., & Milovanović, A. (2021). Future housing identities: Designing in line with the contemporary sustainable urban lifestyle. *Buildings*, 11(1), 18.
- Oorschot, L., & Asselbergs, T. (2021). New housing concepts: Modular, circular, biobased, reproducible, and affordable. *Sustainability*, 13(24), 13772.
- Petticrew, M., & Roberts, H. (2006). *Systematic reviews in the social sciences: A practical guide*. Blackwell Publishing Ltd.
- Pour La Solidarité. (2023). European observatory of transition: Definitions. <https://www.transition-europe.eu/en>
- Saritas, O., & Smith, J. E. (2011). The big picture – Trends, drivers, wild cards, discontinuities and weak signals. *Futures*, 43(3), 292–312.
- Sposito, C. (2022). Reflections and trajectories for interdisciplinary research on the digital transition. *Agathón Int J Archit Art Des*, 12, 2–13.
- Sposito, C., & Scalisi, F. (2023). Reflections and trajectories for interdisciplinary research on the ecological transition. *Agathón Int J Archit Art Des*, 13, 3–18.
- Szigeti, H., Messaadia, M., Majumdar, A., & Eynard, B. (2011). STEEP analysis as a tool for building technology roadmaps. In *Internationale Challenges E-2011 Conference*, Florence, Italy.
- United Nations. (2018). World urbanization prospects: The 2018 revision. <https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf>
- Wright, D., Buys, L., Vine, D., Xia, B., Skitmore, M., Droge-muller, R., Kennedy, R., & Li, M. (2014). EUTOPIA 75+: Exploratory futures scenarios for baby boomers' preferred living spaces. *J Futures Stud*, 19(2), 41–60.
- Xhelili, A., Strube, R., Grossi, F., Zvěřinová, I., Taylor, T., Martinez-Juarez, P., Quiroga, S., Suárez, C., & Gjorgjev, D. (2020). A technological scenario for a healthier, more equitable and sustainable Europe in 2040: Citizen perceptions and policy implications. In *J Environ Res Public Health*, 17(1), 231.
- Yılmaz, K. (2021). Sosyal bilimlerde ve eğitim bilimlerinde sistematik derleme, meta değerlendirme ve bibliyometrik analizler. *MANAS Sosyal Araştırmalar Dergisi*, 10(2), 1457–1490.
- Zvěřinová, I., Máca, V., Ščasný, M., Strube, R., Marques, S., Dubová, D., Kryl, M., Craveiro, D., Taylor, T., Chiabai, A., & García de Jalón, S. (2020). How to achieve a healthier and more sustainable Europe by 2040 according to the public? Results of a five-country questionnaire survey. *Int J Environ Res Public Health*, 17(17), 6071.



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Article

Exploring Zipf's Law and population density patterns in metropolitan Istanbul's neighborhoods: A spatial insight

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ABSTRACT

Most studies on size distributions focus on examining rank-size distributions at urban or regional scale, but they often overlook their spatial dependencies, distributions, and neighboring relationships. This study aims to test Zipf's Law at the neighborhood scale of Metropolitan Istanbul, analyze its spatial dependencies, and investigate their spatial behavioral patterns in urban areas over the past decade. Initially, we found that Zipf's Law is not valid at the neighborhood scale of Istanbul. Secondly, we identified significant spatial dependencies in neighborhood population densities, observed clustering of high- and low-density neighborhoods in different locations, and detected their influences from adjacent neighborhood densities. Thirdly, we observed that population dynamics are directly affected by urban policies. Based on these findings, when spatial dependencies are considered as essential factors and analyzed in detail at lower scales, population density can provide preliminary insight into the social, economic, and political processes occurring in the city.

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INTRODUCTION

With the faster spread of neoliberal urban policies due to globalization, production outputs, capital, labor, and assets can move more easily and quickly. As a result, with the removal of physical boundaries between different geographies, social and economic interactions have developed, leading to faster and more intense urban development. Therefore, capital-oriented policies have affected spatial distribution in urban systems. In the face of all these factors, urban systems, as noted by Dicken & Lloyd (1990), may exhibit regular distributions in terms of density and size. One of the theories concerned with the regular

distribution of population sizes in settlements is Zipf's Law, also known as the rank-size rule (Gabaix, 1999).

Zipf's Law was developed by linguist George Kingsley Zipf in 1949 (Zipf, 1949). The law posits an inverse relationship between the frequency of values subjected to ranking and their rankings (Nitsch, 2005; Zipf, 1949). Although Zipf developed his theory in the field of linguistics, it has been tested in various fields, from economics to the arts, such as company sizes, income distribution, industrial sectors, web pages, book analyses, and song lyrics. It has also been applied and tested in the field of urban planning to analyze the population distributions of cities. According to urban

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researchers (Arshad et al., 2018), a city's optimal distribution should adhere to Zipf's Law. In other words, the hierarchy between cities should exhibit an inverse proportionality between their population rankings and frequencies.

In the 1950s, Zipf's Law began to be discussed in the field of urban and regional planning. Academic studies testing the law between cities and regions showed its validity (Corominas-Murtra & Solé, 2010; Dicken & Lloyd, 1990) and provided some preliminary insights into analyzing the socio-economic levels of cities (Córdoba, 2008). The impact of globalization, which began in the 1970s, has led to differences in studies on Zipf's Law. Studies conducted by urban scholars such as Akseki et al. (2014), Behrens et al. (2014), Black & Henderson (2003), and Casetti (1972) found the loss of validity of Zipf's Law in cities and regions with rapid urbanization rates.

With metropolitan cities becoming the central hubs of knowledge flow in the 2000s (Mukherji & Silberman, 2018), Zipf's Law started to vary according to cities and regions. Hackmann & Klarl (2020) found that the relevant law is more valid among medium-sized cities than megacities, while Giesen & Südekum (2011) analyzed its validity among cities in developed regions. Sun et al. (2021) observed a more unequal population distribution in cities with advanced industrial structures, whereas Luckstead & Devadoss (2014) found the law to be invalid even among the world's largest cities. A study testing Zipf's Law at the neighborhood scale of 12 global cities found that neighborhood sizes conform to the law (Sahasranaman & Jensen, 2020). Therefore, although population distributions vary according to scale, there is a direct relationship between the urbanization rate of cities and the consistency of the law (Kundak & Dökmeci, 2018).

Istanbul is the most rapidly urbanizing metropolitan city in Türkiye. Especially in the last 50 years, it has been the city with the highest population density due to irregular domestic and international migration rates (Bayartan, 2003). However, according to the data from the Turkish Statistical Institute (TSI), the increasing migration rate started to decline after 2015 (TSI, 2024). The decline in migration rates has also led to a decrease in population size. Istanbul, the fastest-urbanizing city in Türkiye, was chosen as the case study to examine population changes over the past decade in detail. To access reliable results, both the spatial and numerical distributions of irregular population movements have been examined for annual changes.

Based on the aforementioned reasons, this study aims to test the validity of Zipf's Law through Istanbul's neighborhood settlements, examine spatial dependencies, and identify the neighborhoods where population density varies locationally. In line with the stated objectives, the following research questions will be addressed:

- Is Zipf's Law valid at the neighborhood scale in Istanbul? If so, how do neighborhood population densities exhibit spatial distribution patterns?
- Is there spatial dependence in the distribution of neighborhood population densities in Istanbul? If so, how strong of a factor might this be?

This research provides answers to the above questions through the Istanbul case, contributing to the literature both methodologically and theoretically. Methodologically, in addition to Zipf's Law, physical distance has been used as an indicator. This indicator has been tested using spatial econometric methods, leading to the development of a multiple hybrid approach model. Theoretically, it has been demonstrated that the law can be tested through the distribution of population density, which is rarely used in the literature. It also emphasizes the need to include spatiality in population analysis studies.

This article is structured as follows: Section 2 covers the development of Zipf's Law, its use in urban studies, and the findings obtained. Sections 3 and 4 provide detailed information on the study area, the dataset, and the methods used in the research. Section 5 analyzes the findings of the study, while Section 6 contains a general evaluation of the findings.

Literature Review

Studies on the size distributions of cities are based on two main theories: Central Place Theory and Zipf's Law. Central Place Theory conceptualizes the relationships between settlements and focuses on the gradual organization of settlements. Developed by Christaller (Brush, 1966; Christaller, 1966) and Lösch (1954), Central Place Theory predicts that urban systems will develop in a functional hierarchical structure based on the goods and services they provide. According to this theory, there is a close relationship between the quantity of goods and services provided by a city at certain intervals, its spatial market influence, population density, and the demand rate of this population (LeSage, 1999). Therefore, settlements in a country are expected to be distributed in certain sizes and geographical distributions depending on these factors.

According to Beckmann (1999), urban systems are also shaped by political decisions. In this context, if cities are divided into size groups, the distributions of their numbers and the areas they cover can be predicted or ranked in a regular manner. Over time, researchers such as Lösch (1954), Beckmann (1999), and many others have developed the thesis that Central Place Theory and Zipf's Law are compatible or shaped by the same phenomena, but as noted by Parr (1985), no definitive and widely accepted reconciliation has been reached between the two models.

Unlike the hierarchical organization of central places, Zipf's Law focuses on the growth of cities at national, regional, or urban scales (Zipf, 1949). Zipf's Law states that there is an inverse relationship between the ranking of population sizes of settlements (regions, cities, towns, neighborhoods, etc.) and the populations of these settlements at defined time intervals (Parr & Suzuki, 1973). The rank-size rule is also described as a negative relationship between the logarithms of urban populations and the logarithms of the ranks of population sizes. In this case, the slope of the curve that represents the relationship between the logarithm of population size and the logarithm of rank size is equal to -1 (Knudsen, 2001). This idea is based on the assumption of a regular relationship between the populations and rankings of settlements.

Zipf's Law, one of the settlement hierarchy theories, was first proposed by Auerbach in 1913 (Auerbach, 1913). The law was shaped by Auerbach's Pareto coefficient (Ioannides & Overman, 2003; Nitsch, 2005). The Pareto coefficient indicates how evenly the population is distributed among cities. When the Pareto coefficient is greater than 1, small settlements have relatively high proportions of the population, and population distribution is concentrated in these areas. When it is less than 1, the population is more concentrated in large cities (Marin, 2007). Over time, changes in intercity relationships occur with the rapid growth of large cities and the stagnation of small cities. Casetti (1972), who developed the extended rank-size rule, aimed to test changes in coefficients over time, so he reformulated Zipf's model by adding a time coefficient (Dokmeci & Turk, 2001).

Research on Zipf's Law has been reformulated and developed over time. However, the relationship between spatial dependence and the law in rank-size distribution studies has been discussed for the past three years (Bergs, 2021). The theory of spatial dependence stems from the First Law of Geography. According to Tobler, "*everything is related to everything else, but near things are more related than distant things*" (Tobler, 1970:3). Building upon this law, spatial dependence is defined as the degree of spatial autocorrelation between independently measured values in a geographical area (Kitchin & Thrift, 2009). For example, it assumes that there is autocorrelation, or a relationship, between a measured value in a geographic unit and the same type of value in its neighboring unit (Anselin, 1985). Therefore, while Zipf's rank-size distribution hierarchy is measured by population sizes, these population sizes are not spatially independent; they functionally exhibit autocorrelation. Hence, when measuring rank-size distributions, the level of functional relationship between the values' physical locations also needs to be tested.

When examining studies on the distribution of city sizes in Türkiye, the linearity of the city size distribution is generally assumed in the literature as it stands. However, there is no common consensus among the results obtained from these studies. Dokmeci (1986) applied the rank-size rule both at the national and regional levels in Türkiye between 1945 and 1975. She found the rank-size rule to be invalid due to the shaping of the size distribution of regions in parallel with their economic development since 1945.

Between 1975 and 1982, the distribution of city sizes in Türkiye showed a better fit to the rank-size rule. Marin (2007) examined the population changes between cities in 1985, 1990, and 2000 by using econometric methods. It was found that the Pareto coefficient was below -1, indicating a departure from Zipf's Law in urban population distribution in Türkiye after 1985 (Marin, 2007). In a study conducted by Deliktaş et al. (2013), it was found that the Pareto exponent of 81 provinces in Türkiye varied between 0.87 and 0.97 during the period of 1980-1997, indicating a more linear spread of sizes.

In the 2000s, studies revealed imbalances in rank-size distribution. A study in 2015 concluded that Zipf's Law failed among cities in Türkiye (Duran & Özkan, 2015). In another detailed study, data obtained from 973 districts in Türkiye were used, and it was found that the sizes of districts were unevenly distributed in 2019, indicating the invalidity of the rank-size rule. (Duran & Cieślík, 2021).

In conclusion, Zipf's Law, subjected to testing through examples from Türkiye and around the world, has not found its full counterpart in urban systems. There are three main reasons for this. Firstly, research has been extensively conducted at the national, regional, and city scales, but rare studies have been encountered at the district and neighborhood scales. Secondly, the level of development in many countries, regions, and cities has led to differences in size distribution. Thirdly, when testing Zipf's Law, the locations with high population densities have been neglected. Therefore, this study, which is distinct from other studies, evaluates Zipf's Law at the neighborhood scale. It questions the validity of the law through population density distribution. While elucidating Zipf's Law with a spatial interaction, the research also provides an opportunity to measure the level of spatial impact in detail through spatial econometrics.

MATERIALS: STUDY AREA

According to the Turkish Statistical Institute (TSI, 2021), Istanbul, with its approximately 16 million population, is the most populous city in Türkiye and the largest metropolitan area in the country, offering various urban services such as

economic, social, cultural, historical, and transportation services. When examined in terms of population density, the city receives an average of around 29% internal and 7% external migration annually (TSI, 2021). Despite Istanbul's high population density, uneven population growth rates and migration rates have been observed in the past decade. For this reason, it has been selected as the study area to examine the changes in density distribution at the neighborhood scale over the years.

As a preliminary data analysis of the study, the spatial sizes of districts and neighborhoods in Istanbul are shown in Figure 1. Istanbul, which has 39 districts, consists of 963 neighborhoods as of the year 2020. Şile, located in the easternmost part of the city on the Anatolian side, has the highest number of neighborhoods with 62, while Adalar, located in the south of the city, has the lowest number of neighborhoods with 5 (TSI, 2021).

Figure 2 illustrates the spatial distribution of neighborhood population densities in Istanbul for the years 2010 and 2020. The neighborhoods with the highest population density are concentrated in the southern districts of the city. In 2010, a total of 12 neighborhoods in Esenler, Bağcılar, Kağıthane, and Esenyurt districts, and in 2020, a total of 21 neighborhoods in Bağcılar, Güngören, Kağıthane, Esenyurt, and Zeytinburnu districts had the highest population density with 347 people per hectare.

The neighborhoods with the lowest population density are

located on the peripheries on both sides of the city. Şile and Çatalca districts have the lowest population density with 3 people per hectare in a total of 23 neighborhoods. Medium-sized neighborhoods with population densities ranging from 141 to 280 people per hectare are distributed around high-density neighborhoods. Neighborhoods with population densities ranging from 71 to 140 people per hectare are distributed around low-density neighborhoods. Additionally, when compared between the two years, the scattered population density of neighborhoods in 2010 exhibited a more concentric spatial distribution in the districts and neighborhoods with the highest population density in 2020.

Table 1 displays the summary of changing population data in Istanbul from 2010 to 2020. Clearly, the average neighborhood size decreased from 16,750 in 2010 to 16,056 in 2020. The largest neighborhood's size expanded from 84,560 in 2010 to 101,660 in 2020. Moreover, the number of neighborhoods with a population of 15,000 or more increased from 364 in 2010 to 417 in 2020. At first glance, there appeared to be a balanced distribution among neighborhood sizes and numbers. However, upon closer examination of minimum and maximum sizes at any given time, there is not a consistent and stable distribution among neighborhoods. Additionally, it is observed that the minimum and maximum neighborhood size distributions began to change in 2015 and 2016.

When the population data in Table 1 is examined in

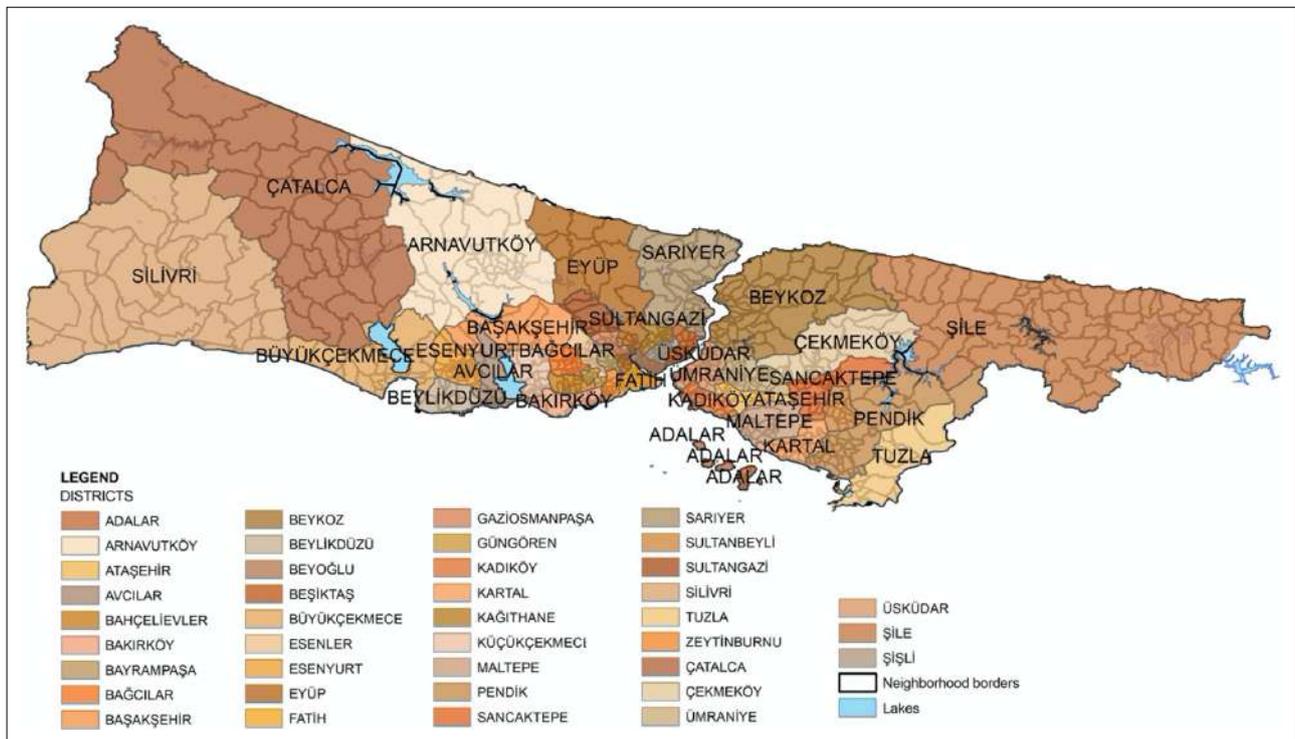


Figure 1. Study Area.

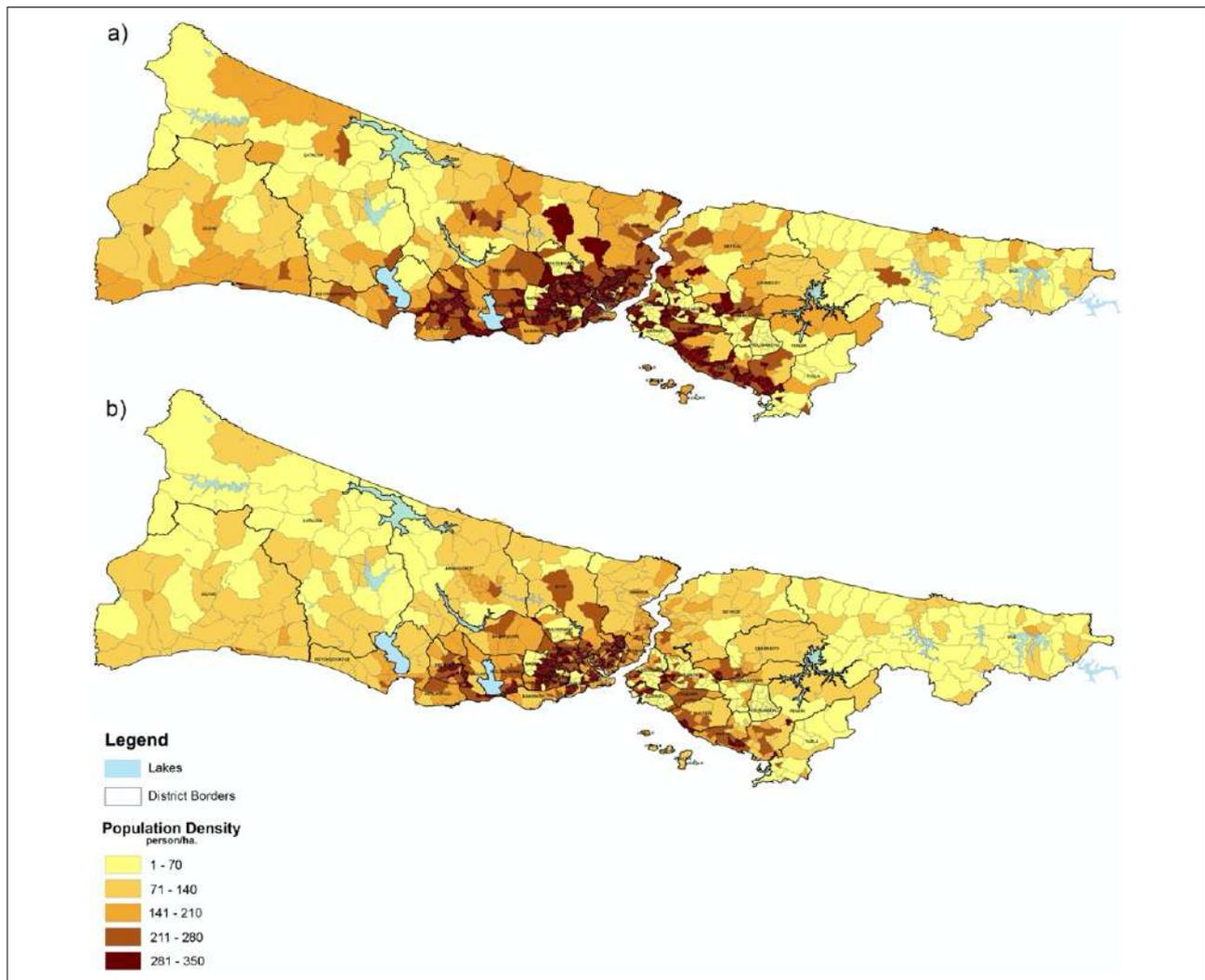


Figure 2. (a) Population density distributions of neighborhoods in Istanbul in 2010, (b) Population density distributions of neighborhoods in Istanbul in 2020.

detail, two significant years affecting population change stand out: 2013 and 2020. The first population change was driven by the population increase rates, migration rates, and the number of neighborhoods in 2013 and 2020. The reason for the initial population change was the transformation of villages into neighborhoods under metropolitan municipalities through Law No. 6360 issued in the last month of 2012 (TC Resmi Gazete, 2012), coupled with the influx of Syrian refugees into the country starting at the end of 2011. This law introduced a different dimension to the urbanization process in the country, leading to a rapid increase in the urban population. The population of Istanbul, which was 13,710,512 in 2012, reached 14,160,467 in 2013 with a population growth rate of 3.28% (TSI, 2024). With the opening of doors to Syrian refugees, the foreign population, which was 85,360 in 2012, increased by

approximately 50,000 people in 2013, reaching 135,018 (TSI, 2024). Consequently, 2013 had the highest population growth rate within the study period.

The second population change occurred in 2019 due to the global pandemic outbreak. Istanbul was negatively affected by the COVID-19 pandemic, which claimed the lives of approximately 10,000 people worldwide per month (WHO, 2024). The population growth rate and migration rates, which had been increasing until 2019, decreased significantly in 2020 for the first time. While the population growth rate decreased by 3.35% and the migration rate decreased by 5.5%, the population density remained constant. In summary, population changes, as observed in the Istanbul case, can be influenced by economic, social, and political decisions (Sun et al., 2021).

Table 1. Descriptive Summary Statistics of Neighborhoods

Year	2010	2011	2012	2013	2014	
Avg. neighborhood size (1000 people)	16.75	17.21	17.48	15.12	15.34	
Median neighborhood size (1000 people)	13.93	14.17	14.58	11.79	11.93	
Minimum neighborhood size (1000 people)	0.018	0.015	0.014	0.022	0.013	
The neighborhood and its district with the smallest size	Sarıdemir Neigh. (Fatih)	Sarıdemir Neigh. (Fatih)	Sarıdemir Neigh. (Fatih)	Sarıdemir Neigh. (Fatih)	Sarıdemir Neigh. (Fatih)	
Maximum neighborhood size (1000 people)	84.56	86.43	85.65	86.63	85.75	
Neighborhood and district with the largest size	Zafer Neigh. (B.evler)	Zafer Neigh. (B.evler)	Zafer Neigh. (B.evler)	Zafer Neigh. (B.evler)	Zafer Neigh. (B.evler)	
Population density (person/ha)	25	26	26	27	28	
Population growth rate (%)	2.64	2.76	1.68	3.28	1.52	
Net migration rate (%)	16.53	16.68	13.92	15.49	15.39	
Total number of neighborhoods	783	783	783	936	937	
Number of Neighborhoods> 15,000	364	370	376	382	389	
Year	2015	2016	2017	2018	2019	2020
Avg. neighborhood size (1000 people)	15.26	15.42	15.65	15.64	16.11	16.05
Median neighborhood size (1000 people)	12.18	15.15	12.18	12.17	12.48	12.39
Minimum neighborhood size (1000 people)	0.011	0.013	0.012	0.019	0.014	0.013
The neighborhood and its district with the smallest size	OSB Neigh. (İkitelli)	Sarıdemir Neigh. (Fatih)	Sarıdemir Neigh. (Fatih)	OSB Neigh. (Dudullu)	OSB Neigh. (Dudullu)	OSB Neigh. (Dudullu)
Maximum neighborhood size (1000 people)	86.44	88.95	93.22	95.63	98.80	101.66
Neighborhood and district with the largest size	Zafer Neigh. (B.evler)	Atakent Neigh. (Halkalı)	Atakent Neigh. (Halkalı)	Atakent Neigh. (Halkalı)	Atakent Neigh. (Halkalı)	Adnan Kahveci Neigh. (Beylikdüzü)
Population density (person/ha)	28	28	29	28	29	29
Population growth rate (%)	1.95	1.00	1.52	0.25	2.99	-0.36
Total migration rate (%)	15.72	12.62	13.96	12.98	15.98	10.48
Total number of neighborhoods	960	960	960	963	963	963
Number of Neighborhoods> 15,000	402	412	418	412	421	417

Data Set and Methodology

The study encompasses all neighborhoods in Istanbul for the years 2010 and 2020. The neighborhood population data were obtained from the Turkish Statistical Institute in 2021 (TSI, 2021). The population densities of neighborhoods in 2010 and 2020 were comparatively analyzed using established methods.

After reviewing the literature, it is evident that Zipf's Law examines the rank-size relationships of cities and regions, Exploratory Spatial Data Analysis (ESDA) evaluates their spatial relationships, and Spatial Autoregressive (SAR)

and Spatial Error (SEM) test spatial dependency. Typically, researchers have tested size distributions at the city or regional scale using general assumptions. However, there are a few studies that investigate density distributions, examine relationships between densities from the part to the whole scale (neighborhood to city), and assess their spatial interdependence. Therefore, this study presents a comprehensive hybrid model.

The research methodology consists of three parts. In the first stage, the hierarchy of neighborhood population densities was measured using Zipf's Law. In the second

stage, the measurement results were tested for spatial dependence using the Spatial Error Model (SEM) and Spatial Autoregressive Model (SAR) and were compared with the findings of Zipf's Law. In the third stage, spatial autocorrelation between neighborhood locations and population densities was tested using Global Moran's I, and neighborhood adjacency relationships were analyzed using LISA analysis.

Zipf's Law

Zipf's Law, developed by George K. Zipf (1949), is a practical method that has been used for many years to test the growth patterns of cities, thereby analyzing the acceptability of social and economic growth theories (Brakman et al., 1999). Zipf's Law assumes that the distribution of neighborhoods should be linear according to the rank-size relationship. If a city's Zipf distribution is valid, it implies that its growth is sequential, orderly, and controlled. Formula 1 illustrates Zipf's Law. In the formula, N represents the sample size, A represents the constant empirically obtained from the data, x denotes the rank of population density in a neighborhood, $\text{Prob}(x)$ represents the probability of population density in a neighborhood at rank x , and $\text{Freq}(x)$ denotes the frequency of the neighborhood at rank x (Gabaix & Ioannides, 2004).

$$\log(\chi) * \log(\text{freq}(\chi)) = A * N \quad \text{Formula (1)}$$

If we rank neighborhoods according to population density, we observe $\log(x)$ on the x -axis and $\text{freq}(x)$ on the y -axis (Knudsen, 2001). If the slope is greater than 1, it indicates that neighborhoods are dispersed. If it is smaller than 1, it suggests that they are more concentrically clustered. If a straight line with a slope of -1 is observed, it indicates the validity of Zipf's Law, demonstrating that neighborhood densities exhibit equal or similar distributions. However, when testing neighborhood densities, the law does not account for the relationships between neighborhoods.

Spatial Error Model (SEM) and Spatial Autoregressive Model (SAR)

In a multiple linear regression model ($y = \chi\beta + \varepsilon$), where y is the dependent variable, x is the explanatory variable, β is the regression coefficient, and ε is the error term (Fischer & Wang, 2011). The model assumes that the error terms are independent of each other, have a zero mean, and have a constant variance with a normal distribution. However, if the errors contain spatial autocorrelation, this assumption loses its validity (Anselin & Rey, 1991).

According to Anselin (1988), spatial dependence refers to the existence of a functional relationship between events occurring at specific points in space and those in other regions. In other words, the value of a variable at locations a and b is explained by both internal values (the internal conditions of a and b) and external values (the influence of a on b , and the influence of b on a) (Zeren, 2010). Ignoring spatial dependence can lead to underestimated true variance and problems in the estimation and interpretation of results.

Spatial regression models are determined based on the cause of spatial autocorrelation in two ways (SEM and/or SAR). SEM assumes that spatial autocorrelation exists among the error terms (Zeren, 2010; Anselin, 1988). SAR, on the other hand, assumes that the variables in neighboring locations also affect the dependent variable of observations in that location (Fischer & Wang, 2011). In other words, the model expresses the relationship between the dependent variable measured in one location and another. In the SAR method, spatial autocorrelation exists among the dependent variables.

$$\gamma = \chi\beta + \varepsilon, \varepsilon = \lambda W_2 e + u, u \sim N(0, \sigma^2 I_n) \quad \text{Formula (2)}$$

Formula 2 represents the spatial error model. Here, γ represents the dependent variable of size $n \times 1$, X denotes the independent variable matrix of size $k \times k$, β is the coefficient vector of size $k \times 1$, and ε represents the vector of independently and identically distributed error terms of size $n \times 1$. The spatial error coefficient, λ , measures the degree of spatial dependence among the error terms, and this coefficient takes values less than 1 (Zeren, 2010). A significant spatial coefficient indicates spatial dependence among the error terms.

$$\gamma = \rho W\gamma + \beta x + u \text{ and } u \sim N(0, \sigma^2 I_n) \quad \text{Formula (3)}$$

The spatial lag model is shown in Formula 3. Here, γ represents the dependent variable of size $n \times 1$, X denotes the explanatory variable matrix of size $n \times k$, β is the coefficient vector of size $k \times 1$, and u represents the error term. The coefficient ρ , which is the dependent variable of the spatial lag model, measures the effect of the γ 's in neighboring locations on the γ in the respective location. Generally, $|\rho| < 1$ is assumed (Fischer & Wang, 2011). A significant ρ value indicates the presence of spatial lag dependence and implies that the use of the classical regression model is not appropriate (Çetin & Sevüktekin, 2016).

Exploratory Spatial Data Analysis (ESDA)

Exploratory Spatial Data Analysis is one of the most used methods to test the presence of spatial autocorrelation in cities and regions. This method conducts two different spatial measurements: global (Global Moran's I) and local spatial autocorrelation (Local Moran's I). Global Moran's I assumes that all observations within the studied city are connected, and a change in one neighbor affects all neighbors (Anselin, 1995). The Global Moran's I statistic is expressed as follows (Rey & Montouri, 1999):

$$I_t = \left(\frac{n}{S_o} \right) \frac{\sum_{i=1}^n \sum_{j=1}^n W_{i,j} X_{i,t} X_{j,t}}{\sum_{i=1}^n \sum_{j=1}^n X_{i,t} X_{j,t}} \quad \text{Formula (4)}$$

Formula 4 represents i and j as neighbors, n as the number of neighbors, $X_{i,t}$ as the density of a neighborhood in year t , W_{ij} as the standardized spatial weight matrix, and S_o as the sum of all W_{ij} values. If i and j share a spatial neighborhood, W_{ij} takes the value of 1; otherwise, it takes the value of 0 (Rey & Montouri, 1999). Although the Global Moran's I test provides

a general discourse on the change in neighborhood densities, it does not analyze the locational information of the change.

To test the locational change in neighborhood densities, the Local Moran's I method (LISA) is used. The Local Moran's I (LISA) evaluates whether neighborhood densities differ from surrounding neighborhoods using location data. Additionally, it provides an opportunity to analyze densities in detail according to their spatial relationships. The Local Moran's I is shown as follows:

$$I_i = \left(\frac{X_i}{S_o} \right) \sum_{j=1}^n \sum_{t=1}^n W_{i,j,t} X_{i,t} \text{ with } m_0 = \sum_i X_{i,t}^2$$

Formula (5)

In contrast to Global Moran's I, this method includes the m_0 value. m_0 represents the sum of the weighted spatial matrix, i.e., the sum of the W_{ij} elements (Rey & Montouri, 1999).

RESULTS AND DISCUSSION

a. Zipf's Law and Spatial Dependency Test Results

Zipf's Law was applied to examine the population density distributions in neighborhoods. While Zipf's Law provides insight into the rank-size relationship, it does not offer an explanatory method for the spatial dependency and locations of the ranks. Therefore, spatial lag and spatial error models were utilized to test the validity of Zipf's Law and spatial dependency.

Table 2 represents the results of Zipf's Law and spatial dependency tests for the years 2010 and 2020. In terms of neighborhood population densities, Zipf's Law is not valid

for both years. When evaluating the spatial dependencies of population densities, it was found that their distributions are statistically positive, indicating that neighborhoods of similar sizes tend to cluster in certain urban areas. In other words, over the decade, although the rank-size distribution of Istanbul may not be valid, the population densities within each year tend to cluster in different sizes within specific regions.

Figure 3 displays the graphs of Zipf's Law, where the straight line represents the logarithm of neighborhood rankings on the y-axis to the logarithm of neighborhood population densities on the x-axis. According to the graph for 2010, the distribution in neighborhoods with high densities tends towards linearity, whereas it deviates from linearity towards neighborhoods with lower densities. The graph for 2020 exhibits a similar trend to that of 2010. However, unlike the previous measurement, in 2020, the population increase has concentrated between $\ln(3)$ and $\ln(5)$, and also at $\ln(12)$. In summary, it can be stated that Zipf's Law is not valid for both graphs, and the distributions among neighborhoods are significantly far from linear due to differences in density. Additionally, the requirements of the law explain the impact of the dependent variable on the independent variable by 54% in 2010 and 41% in 2020. The explanatory rate of the variables and the resulting numerical values (-0.0098 and -0.0039) indicate that neighborhoods in Istanbul will not be distributed in accordance with the rank-size relationship and will continue to grow through clustering.

Zipf's Law and spatial dependency tests are useful in testing rank-size relationships and spatial dependencies among

Table 2. Results of Zipf's Law and Spatial Dependency Tests in Istanbul

	Model 1 (2010)		Model 2 (2020)	
	Coefficient	p	Coefficient	p
Constant	646.589	0.0000	315.435	0.0000
Pop_Density	-0.0098	0.0000	-0.0039	0.0000
R-Squared	0.54		0.41	
Spatial Error Model				
Constant	602.869	0.0000	312.545	0.0000
Pop_Density	-0.0074	0.0000	-0.0038	0.0000
LAMBDA	0.5942	0.0000	0.1201	0.0155
R-Squared	0.66		0.42	
Spatial Lag Model				
Constant	375.488	0.0000	275.583	0.0000
Pop_Density	-0.0068	0.0000	-0.0037	0.0000
W_Rank	0.452635	0.0000	0.1400	0.0026
R-Squared	0.66	0.42		
N	783		963	

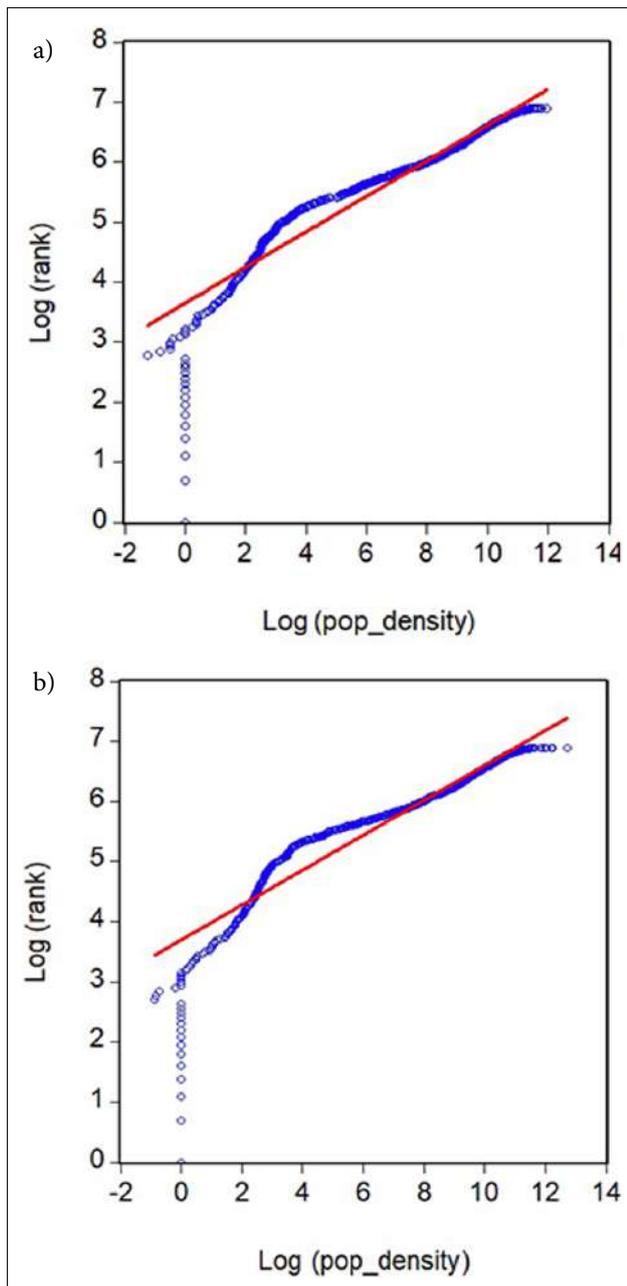


Figure 3. (a) Graph of Zipf distribution in 2010, (b) Graph of Zipf distribution in 2020.

neighborhood population densities but do not provide detailed information about their locations and neighborhood relationships. Therefore, Global Moran's I and LISA analyses were conducted to examine the correlation between neighborhood locations and population densities in detail.

b. Global Moran's I

To determine the relationships between neighborhood population densities and their locations, the Global Moran's I test was conducted. Global Moran's I explains a relationship or clustering between neighborhood density

values and their locations within the range of -1 and 1. As shown in Formula 4, if the result is close to 1, it indicates positive autocorrelation, and if it is close to -1, it indicates negative autocorrelation.

Figure 4 illustrates the Global Moran's I scatter plots of neighborhood population densities for the years 2010 and 2020. The plots indicate that the density values are not randomly distributed. The Moran's I value, calculated as 0.506 in 2010, decreased to 0.364 in 2020. These values indicate that neighborhood population densities exhibit positive spatial autocorrelation. In other words, there is a positive relationship between neighborhood locations and their densities in both years. However, the positive autocorrelation value of the spatial pattern for Istanbul in 2010 is higher compared to 2020. Therefore, although neighborhood population densities have positive autocorrelation in recent years, the relationship between neighborhood locations and their densities appears to be decreasing.

c. Local Moran's I

To examine the spatial behavior between neighborhood population densities and their neighborhood relationships, Local Moran's I (LISA) analysis was utilized. As shown in Formula 5, Local Moran's I analysis tests local-scale spatial neighborhood relationships of the Global Moran's I test in four different types. HH and LL regions represent neighborhoods with positive clustering, while HL and LH regions represent neighborhoods with negative clustering (spatial outliers).

Figure 5 illustrates the local distributions of neighborhood population densities for the years 2010 and 2020. Neighborhoods located in the HH region exhibit positive clustering relationships in the southern part of the European side of the city, with their population densities higher than the Istanbul average. In 2010, the positive clustering pattern of neighborhoods with high densities extended to influence 11 neighborhoods in 2020, thereby increasing the level of spatial autocorrelation. Neighborhoods in the LL region demonstrate positive clustering along the east-west axis on both sides of the city. These neighborhoods have significantly lower population densities than the Istanbul average and are also in proximity to neighborhoods with low densities. Comparing the LL regions of the two years, the number of neighborhoods exhibiting positive clustering patterns increased in 2020, including 9 additional neighborhoods. This increase, in 2010, encompassed neighborhoods previously exhibiting negative autocorrelation, clustering in the inner areas of both sides of the city.

Neighborhoods in the HL region exhibit negative autocorrelation. The population densities of neighborhoods in these regions are above the Istanbul average. However, most neighborhoods in the HL region are adjacent to those

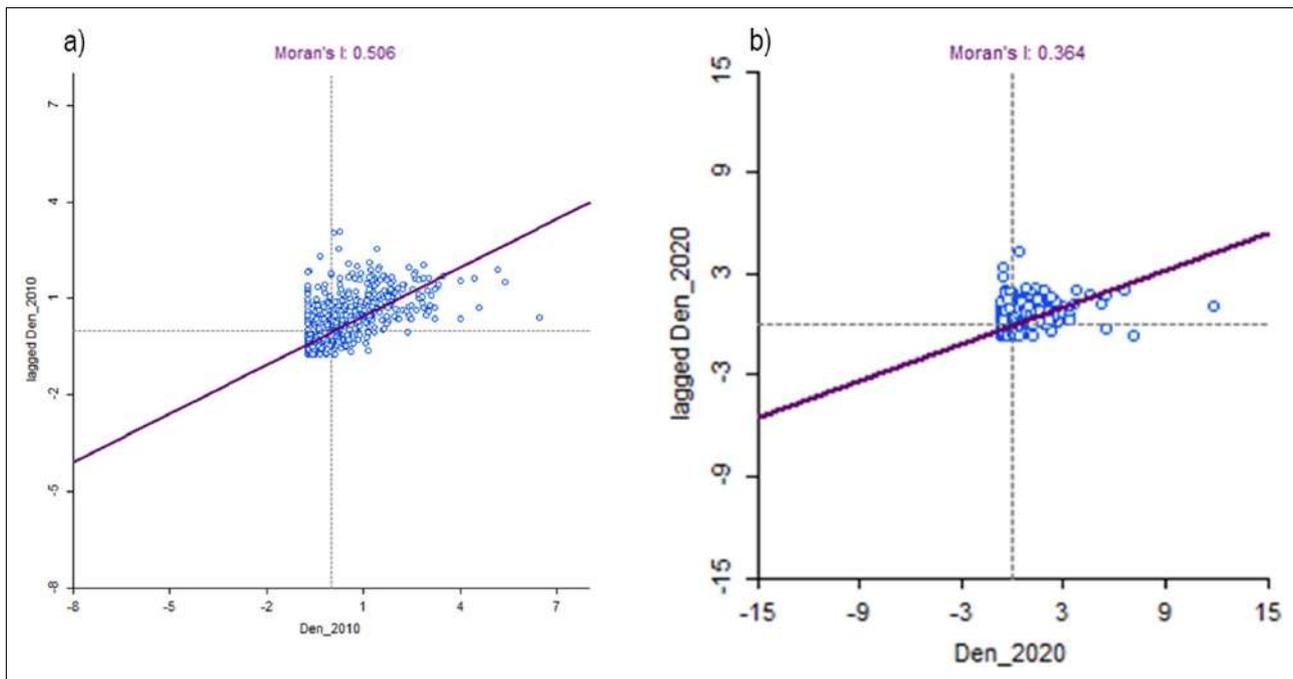


Figure 4. (a) Global Moran's I Distribution in 2010, (b) Global Moran's I Distribution in 2020.

in the LL region. Neighborhoods in the LH region represent a negative clustering pattern, with population densities lower than those in Istanbul on average. Additionally, these neighborhoods are related to those with denser populations than the Istanbul average. The number of LH regions decreased from 2010 to 2020, reducing the level of negative autocorrelation. As expected, these are observed on the European side of the city, where the HH region clusters densely.

The study examines the spatial behavior of urban growth in Istanbul, Türkiye's fastest-growing city in the last decade, both through spatial econometric tests and Zipf's Law at the neighborhood level. To conclude, Zipf's Law was invalid in both years, and there were significant differences in neighborhood population density distributions. Additionally, neighborhood densities exhibited noteworthy spatial dependence, positive spatial autocorrelation, and physical neighborhood relationships. In a general evaluation, although Zipf's Law was found to be invalid in Istanbul's density distribution, as Anselin (1995) pointed out, the spatial relationships of neighborhoods were found to be significantly affected by internal and external factors.

EVALUATION AND CONCLUSION

The aim of the study was to test the distribution of neighborhood densities using Zipf's Law and to examine their spatial dependence, clustering patterns, and neighborhood relationships in Istanbul. To achieve this goal, a multifaceted methodological approach was adopted,

and both population density distributions and their spatial relationships were tested with different methods, and the validity of the acquired knowledge was verified.

Firstly, the validity of Zipf's Law and spatial dependence were measured across the city. In Istanbul, Zipf's Law proved invalid, yet it showed positive spatial autocorrelation. The dependency tests received statistically significant findings, demonstrating that neighborhood population densities were influenced by the densities of adjacent neighborhoods. It was observed that political decisions led to the invalidation of Zipf's Law in Istanbul. The "Metropolitan Law" enacted in 2012 and the influx of Syrian refugees in 2013 introduced a different perspective to urbanization in Istanbul. As mentioned in the literature, uncontrolled urbanization has had a negative impact on the maintenance of Zipf's scientific law (Dittmar, 2009). The findings regarding Zipf's distribution in Istanbul align with research conducted by Akseki et al. (2014), Behrens et al. (2014), Black & Henderson (2003), and Casetti (1972).

Secondly, the spatial behavior of density distributions was examined using Global Moran's I and Local Moran's I analyses. According to the Global Moran's I test, neighborhood population densities in Istanbul exhibited positive spatial autocorrelation. Local Moran's I analysis revealed that neighborhood population densities in Istanbul had a heterogeneous distribution. High-density neighborhoods clustered in the inner areas of both sides of Istanbul, while low-density neighborhoods were observed to have neighborhood relationships on the eastern and

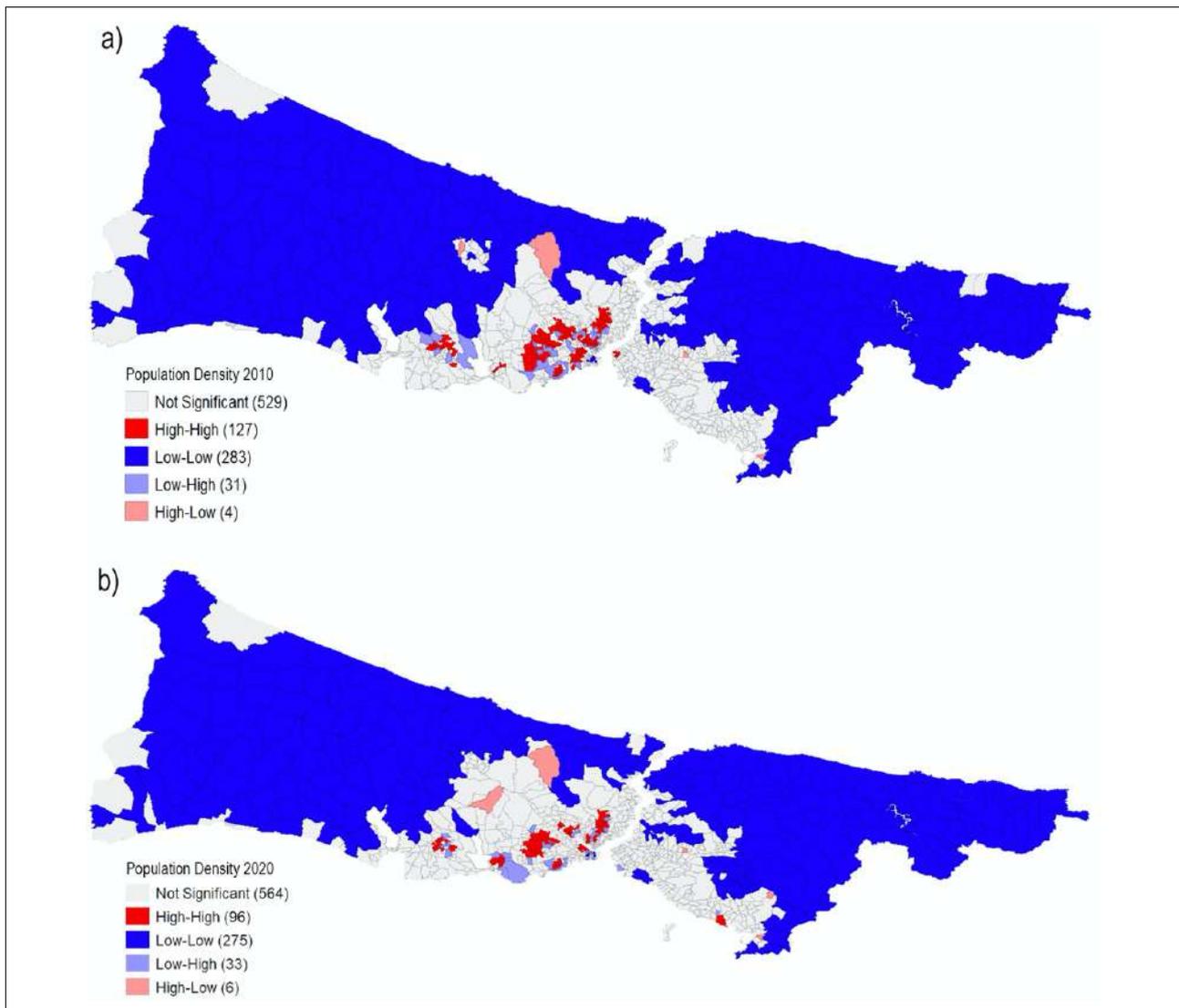


Figure 5. (a) Local Moran's I Distribution in 2010, (b) Local Moran's I Distribution in 2020.

western peripheries of the city.

In summary, it was analyzed that neighborhoods are not independent of their neighbors and are influenced by their density distributions, and spatiality is an important and statistically accountable factor. Although there were no significant changes in density distributions and spatial dependencies when comparing data from both years, it was evidenced that population movements exhibited a more heterogeneous distribution over time in the urban space. The increase in spatial heterogeneity in 2020 was triggered not only by population movements but also by an increase in mortality rates and significant migration outflows due to the global pandemic in 2019 (Baser, 2021).

The study's usefulness lies in its requirement to examine spatiality as an effective indicator in research on density distribution in metropolitan areas such as Istanbul. Future studies could add new methods to the proposed hybrid

approach to test the validity of the results. The study provides fundamental knowledge for future policy implementations regarding sustainable urban growth, as well as important insights into understanding the spatial distribution and socioeconomic dynamics of the city. Researchers can test the same methods and datasets in other metropolitan cities and compare them to our study. Additionally, they can contribute to the literature by introducing new indicators.

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REFERENCES

- Akseki, U., Gök, B., & Deliktaş, E. (2014). City size distributions in Central Asian republics: ZIPF'S Law. *Ege Academic Review*, 14(2), 295–304.
- Anselin, L. (1988). Lagrange multiplier test diagnostics for spatial dependence and spatial heterogeneity. *Geogr Anal*, 20(1), 1–17.
- Anselin, L. (1995). Local indicators of spatial association - LISA. *Geogr Anal*, 27(2), 93–115.
- Anselin, L., & Rey, S. (1991). Properties of tests for spatial dependence in linear regression models. *Geogr Anal*, 23(2), 112–131.
- Arshad, S., Hu, S., & Ashraf, B. N. (2018). Zipf's law and city size distribution: A survey of the literature and future research agenda. *Physica A Stat Mech Appl*, 492, 75–92.
- Auerbach, F. (1913). Das gesetz der bevölkerungskonzentration. *Petermanns Geogr Mittheil*, 59, 74–76.
- Baser, O. (2021). Population density index and its use for distribution of Covid-19: A case study using Turkish data. *Health Policy*, 125(2), 148–154.
- Bayartan, H. (2003). Geçmişten günümüze İstanbul'da nüfus. *Coğrafya Derg*, 11, 5–20.
- Beckmann, M. J. (1999). Assignment. In *Lectures on Location Theory* (pp.113-120). Springer.
- Behrens, K., Duranton, G., & Robert-Nicoud, F. (2014). Productive cities: Sorting, selection, and agglomeration. *J Pol Econ*, 122(3), 507–553.
- Bergs, R. (2021). Spatial dependence in the rank-size distribution of cities—weak but not negligible. *Plos One*, 16(2), e0246796.
- Black, D., & Henderson, V. (2003). Urban evolution in the USA. *J Econ Geogr*, 3(4), 343–372.
- Brakman, S., Garretsen, H., Van Marrewijk, C., & Van Den Berg, M. (1999). The return of Zipf: Towards a further understanding of the rank-size distribution. *J Reg Sci*, 39(1), 183–213.
- Brush, J. E. (1966). Walter Christaller. In *Central Places in Southern Germany* (pp. 230). Englewood Cliffs.
- Casetti, E. (1972). Generating models by the expansion method: Applications to geographical research. *Geogr Anal*, 4(1), 81–91.
- Christaller, W. (1966). *Central Places in Southern Germany*. Prentice-Hall.
- Córdoba, J. C. (2008). A generalized Gibrat's law. *Int Econ Rev*, 49(4), 1463–1468.
- Corominas-Murtra, B., & Solé, R. V. (2010). Universality of Zipf's law. *Phys Rev E Stat Nonlin Soft Matter Phys*, 82(1), 011102.
- Çetin, I., & Sevüktekin, M. (2016). Türkiye'de gelişmişlik düzeyi farklılıklarının analizi. *Uluslararası Ekonomik Araştırmalar Derg*, 2(2), 39–61.
- Deliktaş, E., Önder, A. Ö., & Karadağ, M. (2013). The size distribution of cities and determinants of city growth in Turkey. *Eur Plan Stud*, 21(2), 251–263.
- Dicken, P., & Lloyd, P. E. (1990). *Location in space: Theoretical Perspectives in Economic Geography*. Harper Collins Publishers.
- Dittmar, J. (2009). *Cities, Institutions, and Growth: The Emergence of Zipf's Law*. University of California.
- Dokmeci, V. (1986). Turkey: Distribution of cities and change over time. *Ekistics*, 53, 13–17.
- Dokmeci, V., & Türk, S. S. (2001). The application of expanded rank-size model in Turkish urban settlements. In *41st Congress of the European Regional Science Association*, Zagreb, Croatia.
- Duran, H. E., & Cieřlik, A. (2021). The distribution of city sizes in Turkey: A failure of Zipf's law due to concavity. *Reg Sci Policy Pract*, 13(5), 1702–1719.
- Duran, H. E., & Özkan, S. P. (2015). Trade openness, urban concentration and city-size growth in Turkey. *Reg Sci Inq*, 7(1), 35–46.
- Fischer, M. M., & Wang, J. (2011). *Spatial data analysis: Models, methods and techniques*. Springer Science & Business Media.
- Gabaix, X. (1999). Zipf's Law and the growth of cities. *Am Econ Rev*, 89(2), 129–132.
- Gabaix, X., & Ioannides, Y. M. (2004). The evolution of city size distributions. In *Handbook of regional and urban economics* (Vol. 4, pp. 2341–2378). Elsevier.
- Giesen, K., & Südekum, J. (2011). Zipf's law for cities in the regions and the country. *J Econ Geogr*, 11(4), 667–686.
- Hackmann, A., & Klarl, T. (2020). The evolution of Zipf's Law for US cities. *Pap Reg Sci*, 99(3), 841–852.
- Ioannides, Y. M., & Overman, H. G. (2003). Zipf's law for cities: An empirical examination. *Reg Sci Urban Econ*, 33(2), 127–137.
- Kitchin, R., & Thrift, N. (2009). *International encyclopedia of human geography*. Elsevier.
- Knudsen, T. (2001). Zipf's law for cities and beyond: The case of Denmark. *Am J Econ Sociol*, 60(1), 123–146.
- Kundak, S., & Dökmeçi, V. (2018). A rank-size rule analysis of the city system at the country and province level in Turkey. *ICONARP Int J Archit Plan*, 6(1), 77–98.
- LeSage, J. P. (1999). The theory and practice of spatial econometrics. *Univ Toledo*, 28(11), 1–39.
- Lösch, A. (1954). *The economics of location*. Yale University Press.
- Luckstead, J., & Devadoss, S. (2014). Do the world's largest cities follow Zipf's and Gibrat's laws? *Econ Lett*, 125(2), 182–186.
- Marin, M. C. (2007). 1985 sonrası Türkiye'deki kentsel sistemin dönüşümü: Zipf Yasası'nın bir testi. *Gazi Univ Muh Fak Derg*, 22(1), 33–38.
- Mukherji, N., & Silberman, J. (2018). Knowledge flows among US metro areas: Innovative activity, proximity, and the border effect. *Rev Reg Stud*, 48(2), 193–216.

- Nitsch, V. (2005). Zipf zipped. *J Urban Econ*, 57(1), 86–100.
- Parr, J. B. (1985). A note on the size distribution of cities over time. *J Urban Econ*, 18(2), 199–212.
- Parr, J. B., & Suzuki, K. (1973). Settlement populations and the lognormal distribution. *Urban Stud*, 10(3), 335–352.
- Rey, S. J., & Montouri, B. D. (1999). US regional income convergence: a spatial econometric perspective. *Reg Stud*, 33(2), 143–156.
- Sahasranaman, A., & Jensen, H. J. (2020). Distribution of neighborhood size in cities. arXiv preprint arXiv:2010.06946.
- Sun, X., Yuan, O., Xu, Z., Yin, Y., Liu, Q., & Wu, L. (2021). Did Zipf's Law hold for Chinese cities and why? Evidence from multi-source data. *Land Use Policy*, 106, 105460.
- TC Resmi Gazete. (2012, November 12). Kanun no.6360: Establishment of a metropolitan municipality and the determination of its borders. *TC Resmi Gazete*, 28489, p. 1–3. <https://www.resmigazete.gov.tr/eskiler/2012/12/20121206-1.htm>
- Tobler, W. R. (1970). A computer movie simulating urban growth in the Detroit region. *Econ Geogr*, 46(sup1), 234–240.
- TSI. (2021, April 3). Population statistics of İstanbul by neighborhood. www.tuik.com.tr.
- TSI. (2024, January 21). Statistics of foreign population in İstanbul. www.tuik.com.tr.
- Zeren, F. (2010). Mekansal etkileşim analizi. *İstanbul Univ Ekon Ekonometri İstat e-Dergi*, 12, 18–39.
- Zipf, G. K. (1949). Human behaviour and the principle of least-effort. Addison-Wesley.
- WHO. (2024). Death rates due to COVID-19. <https://data.who.int/dashboards/covid19/cases?n=c>



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Article

Understanding the Multi-faceted Barriers to Residents' Adoption of Green Infrastructure: The case of Villakent, Izmir

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ABSTRACT

Impermeable surfaces have increased due to urbanization, leading to environmental problems in urban areas. To address these challenges, more municipalities are turning to green infrastructure strategies. Municipalities need to implement green infrastructure on public land and encourage residents to adopt it on their private properties. While previous research has explored factors influencing residents' willingness to install green infrastructure, little attention has been given to the combined barriers to implementation, particularly social barriers. This study aims to develop a comprehensive understanding of the factors affecting residents' willingness. An online survey was created utilizing a previously employed scale, and regression models were used for each green infrastructure strategy. The study area was selected as Villakent, Izmir, and the responses of 123 participants were analyzed. The findings suggest that municipalities can facilitate greater adoption of green infrastructure by organizing seminars and training sessions in addition to existing incentives.

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INTRODUCTION

The development and expansion of cities over the years have led to significant changes, notably the increase in impervious surfaces. Increased impervious surfaces within urban areas lead to stormwater runoff, which has negative effects on aquatic ecosystems and water quality (Walsh et al., 2005). To address this issue, municipalities are turning to green infrastructure (GI)—comprised of natural and semi-natural ecosystems constructed within urban areas—as a decentralized approach to managing stormwater runoff problems (Wise, 2008). Unlike conventional stormwater management methods that quickly move stormwater

runoff away via pipes and drains, these strategies called green infrastructure (GI) reduce the amount and volume of stormwater before it reaches water bodies (Adesoji & Pearce, 2024). Moreover, GI is an appealing solution for cities dealing with stormwater problems since it may be used on a smaller scale and offer multiple benefits in terms of ecological, social, and economic (Mell, 2019; Ekren, 2021).

Planners and practitioners are beginning to appreciate the advantages of green infrastructure for cities and local communities. Many countries, including Türkiye, are actively engaging in green infrastructure initiatives. In Türkiye, one notable project is the "Adaptation to Climate Change through Rain Harvest Project," which

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was completed in 2017. This project, led by the Landscape Research Society (PAD) in partnership with Çankaya Municipality and the Humanitarian World Association, aimed to raise awareness about rainwater retention through the development of a guide called "Introduction to Rain Harvesting Practices" (Adaptation, 2021). Additionally, Türkiye has implemented green infrastructure measures such as rain gardens and permeable concrete walkways as seen at the Ministry of Environment and Urbanization's central campus by the 2018 regulations (Adaptation, 2021). The Izmir Metropolitan Municipality is currently focusing on developing green infrastructure plans at the metropolitan level, particularly emphasizing river corridors that connect urban and peri-urban areas. However, these strategies have yet to be fully integrated into comprehensive plans (Hepcan, 2019). Unfortunately, the absence of comprehensive approaches to implementing green infrastructure prevents the development of a lasting solution to the issue.

However, there are major obstacles that need to be overcome to switch from conventional stormwater management systems to green infrastructure techniques. According to some research, green infrastructure methods need the involvement of a broader range of stakeholders than traditional stormwater infrastructure does (Turner et al., 2016). This collaborative approach can contribute to the development of sustainable communities, a primary objective of green infrastructure strategies. Private property owners and residential area inhabitants are among the many stakeholder groups that must be involved in municipal green infrastructure plans for them to be implemented successfully at the city or regional level (Keeley et al., 2013). Even in cases where free infrastructure or incentives are provided, local involvement in municipal green infrastructure projects has frequently been restricted.

While numerous authors have examined barriers to implementing green infrastructure strategies, some focus on government-level obstacles while others investigate challenges at the public level. However, relatively few studies have examined the involvement of residents in green infrastructure initiatives as well as the obstacles preventing homeowners

from participating. This research aims to address this gap in the literature by analyzing the variables influencing residents' desire to adopt green infrastructure strategies. Specifically, it explores how environmental values, perceptions, and attitudes affect the adoption of green infrastructure. For these purposes, the Villakent neighborhood in Izmir was selected as a study area and an online survey was distributed to residents in the area to measure the factors influencing the implementation of green infrastructure.

Integrating Green Infrastructure into Urban Planning

The objective of stormwater management is to safeguard urban infrastructure and aquatic ecosystems by effectively managing the flow of runoff, aiming to slow it down and store it (Parker & Zingoni de Baro, 2019). Urban areas with impervious surfaces generate stormwater runoff, leading to issues like flooding, erosion, and a decline in water quality in both urban environments and neighboring ecosystems (Young et al., 2014). The prevalence of impervious surfaces in urban settings leads to an increase in stormwater runoff, exacerbating issues such as flooding, erosion, and deterioration of water quality within cities and neighboring ecosystems. GI offers an environmentally friendly strategy for managing urban growth, minimizing land consumption, and enhancing the resilience of urban environments (Liotta et al., 2020). Figure 1 illustrates examples of green infrastructure components integrated into urban areas.

Within the European Commission framework, the implementation of GI is viewed as a top priority for urban adaptation. The main component of European institutions' plan to achieve a climate-resilient Europe and protect natural habitats for the sake of ecosystems is GI, and they are completely dedicated to putting this policy into action (Adaptation, 2021). A policy encouraging investments in ecosystem services to mitigate the increasing risk of climate change and improve GI in urban spatial planning was adopted by the European Commission in 2013. Over the past two decades, there has also been significant interest in green infrastructure in the United States, in part due to

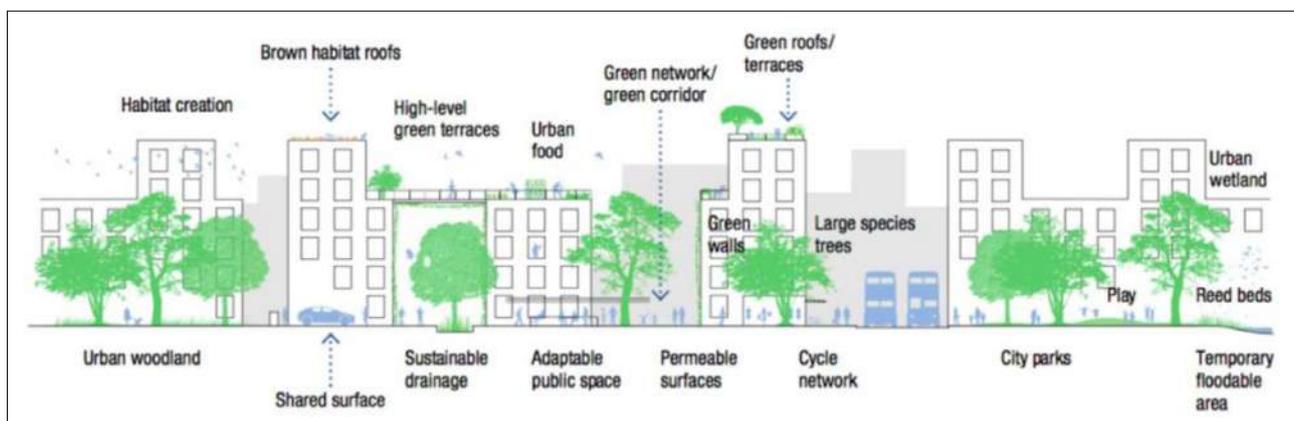


Figure 1. Urban-integrated Green Infrastructure System (Hepcan, 2019).

changes in federal legislation (Wise, 2008). Large US cities have implemented policies aimed at incorporating GI into urban planning to solve issues related to stormwater runoff and meet the requirements of the Clean Water Act (Turner et al., 2016). Prince George County in Maryland was among the pioneers in implementing Green Infrastructure (GI) policies, allocating \$1.2 billion for retrofitting 4,000 acres of impervious surfaces during the 1990s. In recent years, cities like Seattle and Philadelphia have also launched GI programs to address stormwater issues, particularly related to combined sewer overflow issues. Seattle aims to manage 700 million gallons of stormwater annually through GI measures, while Philadelphia aims to reduce stormwater entering waterways by 85% (Seattle Public Utilities, 2016; Philadelphia Water Department, 2016). Though they go by different names, interest in green infrastructure approaches is growing in other regions of the world as well.

Türkiye is one of the countries implementing national and local strategies to construct green infrastructure networks and enhance nature-based design solutions. For instance, since 2019, Izmir Metropolitan Municipality has participated in the Green Cities Programme initiated by the European Bank for Reconstruction and Development (EBRD) and initiated preparatory efforts for the "Izmir Green City Action Plan." This initiative aims to build a climate-resilient metropolitan region by utilizing green infrastructure across Izmir Province. For instance, the government requires buildings over 60,000 square meters to implement green roof systems. Another significant project undertaken by the central government is the Impact of Climate Change on Water Resources in Türkiye Project, which was completed by the Ministry of Forestry and Water Affairs in 2016. The consequences of climate change on surface and underground water resources were investigated. There were also additional recommendations for climate change adaptation in the

agriculture and industrial sectors (GCAP, 2020). Moreover, The Ministry of Environment and Urbanization executed a project involving the application of permeable concrete on the central campus and the establishment of a rain garden alongside the roadside (Figure 2). The aim was to redirect rainwater to green areas and the rain garden. The Ministry suggests implementing similar initiatives in the gardens of other public institutions and remains committed to advancing such practices (Hepcan, 2019).

The Significance of Stakeholders in Green Infrastructure Projects

Implementing green infrastructure is an expensive and long-term endeavor that requires collaboration among multiple stakeholders (Alves et al., 2018). While the primary responsibility for managing green infrastructure typically falls on local and central government entities, the involvement of non-governmental organizations, residents, and volunteers in management processes enhances the adaptation. Furthermore, by raising awareness and creating solutions, users can play a pivotal role in adopting and preserving green infrastructure strategies.

Initially, green infrastructure planning in urban areas primarily targeted open spaces or public parks (Dreher, 2009). As cities expand, the reduction of open spaces presents difficulties in handling stormwater following intense rainfall. In suburban settings, most impermeable areas are linked to stormwater infrastructure, and lawns may not provide adequate stormwater absorption during intense rainfall events (Thurston et al., 2010). Consequently, implementing small-scale green infrastructure solutions has become vital in both urban and suburban areas to improve the effectiveness of green infrastructure and strengthen stormwater retention capabilities (Turner et al., 2016; Sutunc & Corbaci, 2020).



Figure 2. The implementation of permeable concrete and rain garden.

Private property owners are essential participants in green infrastructure projects. Only depending on public property to develop green infrastructure measures wouldn't suffice to meet cities' stormwater management objectives (Gundlach, 2017). For instance, New York City faces significant water pollution from stormwater runoff and sewer overflows, with billions of gallons of untreated sewage entering waterways annually (Gundlach, 2017). To address this, the City introduced a hybrid plan in 2012 combining gray and green infrastructure to capture storm runoff prior to its discharge into waterways (Gundlach, 2017). While DEP has primarily focused on implementing green infrastructure on public property like streets and sidewalks over the past six years, more than half of the targeted land area for green infrastructure projects is privately owned (Gundlach, 2017). Achieving their goals requires substantial support from private landowners.

Some cities provide incentives to increase participation in green infrastructure practices. The İzmir Metropolitan Municipality is the pioneering local government in Türkiye to adopt the designation of a sponge city. The Sponge City initiative commenced last year and encompasses the implementation of rain gardens, water retention ponds, permeable landscaping materials, and rainwater management systems within designated basins. With the Sponge City Izmir project, an incentive system for rainwater harvesting is being implemented along with the distribution of 5,000 rainwater tanks to 5,000 buildings and a campaign to establish 10,000 rain gardens in Izmir. The project aims to transform Izmir into a sponge city within five years with plans to reduce rainwater runoff in urban areas by 70% within that timeframe. Moreover, in the UK, regulations specify the pavement size and the type of paving material permissible for use in private properties, particularly residential gardens, with detailed guidelines provided. Permission is typically required for using impervious pavement exceeding five square meters in these areas. Moreover, there are incentives such as tax reductions aimed at promoting the increased utilization of pervious surfaces (DCLG, 2008; Interpave, 2013). Likewise, in cities like Portland (OR), Seattle (WA), and Philadelphia (PA), residents receive tax reductions for utilizing permeable pavements.

Overall, coordination between the many stakeholder groups that own and manage land in urban areas—including inhabitants and property owners in residential areas—is necessary for the success of both municipal and regional green infrastructure projects. Increased rates of involvement enable the disconnection of a greater number of impermeable surfaces, which may lead to more significant changes in the hydrology and biological function of the headwater streams receiving stormwater runoff (Green et al., 2012; Mayer et al., 2012; Bos & Brown, 2015). Residents depend on their surrounding environment for various

aspects of their lives. Both built and natural environments should be planned and designed to facilitate these functions and enhance their overall quality of life.

Factors Influencing Residents' Willingness to Implement Green Infrastructure

The involvement of residents in municipal green infrastructure projects has remained low despite the availability of incentives or free infrastructure. This lack of participation is likely influenced by various institutional and sociocultural factors affecting residents' desire to adopt and maintain green infrastructure on their property (Baptiste et al., 2015). Municipalities need to assess residents' environmental knowledge and consider strategies to enhance it if necessary. Studies indicate that many residents are unaware of the environmental benefits of green infrastructure and its connection to stormwater management (Barnhill & Smardon, 2012; Mayer et al., 2012). However, once informed, residents are often more willing to embrace change.

Educational programs aimed at increasing residents' understanding of stormwater management and green infrastructure have shown promise in increasing willingness to adopt these strategies. While some studies suggest that education alone may not always motivate participation, others highlight its potential impact, particularly when residents share knowledge with their communities. Multiple research findings have indicated a favorable correlation between enhanced environmental awareness, a positive attitude, and behavioral shifts (Coyle, 2005). Increasing residents' awareness of stormwater management and green infrastructure techniques could influence the implementation of green infrastructure in residential environments (Faehnle et al., 2014; Dogmusoz et al., 2020). In conclusion, while knowledge is frequently cited as a significant obstacle to residents' willingness to implement green infrastructure (Baptiste, 2014; Baptiste et al., 2015; Barnhill & Smardon, 2012), other research has found no correlation (Turner et al., 2016; Robinson et al., 2008). Moreover, socio-cultural constraints such as social position and subjective norms were also discussed in the literature as a limitation factor to individuals' decision-making abilities and influence individuals towards particular choices. For instance, a study conducted by Sinasas (2017) revealed that subjective norms significantly influenced residents' willingness to engage. However, Dogmusoz et al. (2020) found out that subjective norms had no substantial influence on residents' intentions to implement green infrastructure. There is little knowledge of how socio-cognitive factors influence residents' willingness to adopt green infrastructure strategies. While attitudes toward green infrastructure didn't significantly affect residents' intentions to implement these strategies, social pressure played a crucial role (Sinasas, 2017). Turner et

al. (2016), however, showed that attitudes and perceptions had a significant influence on participation in green infrastructure projects.

Additionally, the appearance of green infrastructure has been identified as an obstacle to their implementation at the resident level. According to this research, individuals are more ready to adopt visually appealing landscapes than those that are less aesthetically pleasing (Baptiste, 2014; Dogmusoz et al., 2020). Cost is recognized as a significant obstacle to the adoption of green infrastructure among residents. A study conducted by Barnhill and Smardon (2012) revealed that participants perceived the initial cost as a primary obstacle to their desire to install green infrastructure strategies. Furthermore, since the future costs and required time of green infrastructure maintenance are comparatively unclear, maintenance requirements are also identified as an obstacle to the adoption of these strategies (Hammit, 2010; Foley, 2012; Dogmusoz et al., 2020). Health concerns, perceived control over property, and site suitability are also identified as potential obstacles to implementation (Barnhill & Smardon, 2012). Finally, socio-demographic factors such as age, gender, and income can also influence residents' willingness to implement green infrastructure, with older individuals and those in higher-income areas showing more interest (Baptiste, 2014; Locke & Grove, 2016; Dogmusoz et al., 2020).

The literature on green infrastructure implementation can be broadly categorized into two main groups: cognitive factors such as attitudes, beliefs, etc., and other influencing factors such as initial cost, required time to maintain, etc. While some research has focused on cognitive variables impacting green infrastructure adoption, others have examined the influence of other factors. However, very few studies have explored these factors together. Moreover, some studies have found weak or no association between these variables and willingness to adopt green infrastructure. These conflicting findings highlight the need for further investigation into the factors influencing property owners' and residents' desire to install green infrastructure strategies. This research aims to enrich this topic by examining these aspects comprehensively and addressing the existing gap in research by investigating them collectively.

METHODOLOGY

Study Area

The Villakent neighborhood, situated between Karşıyaka and Menemen in the Seyrek District of Izmir, was selected as a study area (Figure 3). Covering approximately 2.5 million square meters, it comprises 1,000 villas with various projects implemented on individual plots since 2003. These villas, ranging from 210 to 390 square meters in size, boast garden areas spanning 175 to 650 square meters (EgeKoop,



Figure 3. Villakent neighborhood.

2008). As of 2023, Villakent's population stands at 2,137, with 49.3% male and 50.7% female residents. Around 59.6% of the population is married, and approximately 56% hold a bachelor's degree or higher. Izmir is a pioneering city in green infrastructure practices and, as mentioned above, has been providing incentives for rain gardens and rain barrel implementations in recent years. The reason for selecting Villakent as the study area is that residents here have the necessary spaces for green infrastructure practices, and there are opportunities for implementation if barriers are overcome.

Sample

This study targeted the residents who live in the district of Villakent. Power analysis was used to estimate the minimum sample size. A power analysis is the method used to determine the minimum sample size required for an experiment based on a specified significance level, statistical power, and effect size. After entering the required information into the system, the minimum sample size was determined to be 116 to conduct the survey. To facilitate this endeavor, we reached out to the head of the Villakent community and requested them to distribute the survey through their official channels. Additionally, volunteers took the initiative to disseminate the survey among their neighbors. The primary target for the survey is the head of each household, although responses from their spouses are also welcome. For the purposes of this poll, only independent households are included. Adults who still live with their parents are not represented in the research in terms of housing preferences. In all, 262 people responded to the poll. A total of 123 surveys were prepared for analysis after non-replies were removed in order to reduce inaccuracy.

Survey

The web-based survey was created and distributed using the "Qualtrics" program. The survey questions were derived from Dogmusoz et al.'s (2020) study conducted

in Raleigh, USA, in 2019. This study discussed the factors influencing residents' implementation of green infrastructure on their properties in Raleigh. Similarly, in this study, we examined the same factors. In both Raleigh and Izmir, incentives were provided to the public to encourage participation and adoption of green infrastructure. The current research employed the "Theory of Planned Behavior (TPB)" as the theoretical framework for developing the questionnaire. This choice was made because TPB is recognized for its ability to elucidate the essential processes underlying individuals' intentions and behaviors (Ajzen & Driver, 1992). According to TPB, attitudes, subjective norms, and perceived behavioral control collectively influence behavioral intention, subsequently impacting actual behavior. This theory has a strong empirical basis and has been successfully applied in various social behavior studies. The questionnaire employed closed-ended questions and was structured into various sections to evaluate respondents' knowledge, TPB constructs (attitudes, self-efficacy, subjective norms), factors influencing the willingness to adopt green infrastructure strategies, and respondents' demographic characteristics. The questionnaire comprised seven distinct parts. The survey questions were included in the Appendix section. The Izmir Katip Celebi University Institutional Review Board (IRB) examined and authorized the survey.

Analysis

Descriptive statistics were utilized to summarize the sample data by quantifying information briefly. Frequencies, mean values, and percentages were calculated to outline the characteristics of our data. Additionally, chi-square tests were employed to explore the association between willingness and other factors.

Confirmatory factor analysis was conducted in this study because a previously validated scale (from Dogmusoz et al., 2020's study) was utilized. Confirmatory factor analysis is a statistical technique that assesses the degree to which observed variables accurately reflect underlying constructs. The participants' responses were evaluated using a 5-point Likert scale, with 1 indicating strong disagreement and 5 indicating strong agreement. Factors were extracted based on the criterion that eigenvalues exceeded 1. In this instance, three eigenvalues collectively represented 63.03% of the variance. Factor 1 accounted for 31.6% of the total variance, Factor 2 for 18.9%, and Factor 3 for 12.4%. The rotated component matrix (Table 1) displays the factor loadings of each variable on each factor. A rotated component matrix is a table used in factor analysis, a statistical technique often used in the field of psychology, social sciences, and marketing research. The matrix displays the loadings of each variable on the different factors (or components) after rotation.

Cronbach's alpha reliability coefficients were calculated

Table 1. Rotated Component Matrix for Confirmatory Factor Analysis

	Component		
	1	2	3
Item 1. If my neighbors were to install green infrastructure on their property, I would be more likely to install it on my property.	0.563		
Item 2. When considering whether to install green infrastructure, I consider what my friends may be thinking.	0.632		
Item 3. If the people in my life whose opinions I value agreed that I should install green infrastructure on my property, I would be more likely to install.	0.777		
Item 4. I am confident that I could learn the skills required to install or maintain GI on my property.		0.542	
Item 5. I feel that the expense related to maintaining green infrastructure on my property would not be a burden.		0.569	
Item 6. I feel that the amount of time required to maintaining green infrastructure on my property would not be a burden.		0.563	
Item 7. I support the adoption/implementation of green infrastructure on my property.		0.570	
Item 8. I believe that green infrastructure strategies are easy to learn and implement.		0.550	
Item 9. I believe that installing green infrastructure on my property would not reduce the amount of polluted runoff going into local streams and rivers.			0.786
Item 10. I believe that green infrastructure at the resident level does not help improve the quality of water bodies.			0.731

for each component to determine the items' internal consistency. Cronbach's alpha coefficient was 0.70 for Factor 1 (subjective norm) and 0.71 for Factor 2 (self-efficacy). Both values demonstrated strong internal consistency. Compared to these two factors, Factor 3 (Attitudes) has a low Cronbach's alpha (0.51). Additionally, item-total correlations ranged from 0.51 to 0.72 for the subjective norm variable, ranged from 0.65 to 0.74 for self-efficacy, and ranged from 0.62 to 0.68 for attitudes, meaning that the items were consistent and assessed the same construct.

The mean score for the subjective norm influence factor ($M = 3.33$, $SD = 1.14$) revealed that respondents had moderate levels of subjective norm on implementing GI techniques. Furthermore, the mean value indicated that the participants on average would consider others' opinions about green infrastructure. The mean score for self-efficacy ($M = 3.77$, $SD = .79$) presented that respondents had a high perceived ability to install and maintain green infrastructure on their property. The mean score for attitudes ($M = 3.12$, $SD = 1.01$) indicated that respondents had moderately positive attitudes toward the effectiveness of green infrastructure.

Finally, logistic regression analysis was conducted to explore the factors that might influence participants' willingness to adopt green infrastructure on their properties. Participants were asked to indicate their likelihood of installing green infrastructure strategies on their property over the next five years using a 5-point Likert scale (1 = extremely unlikely and 5 = extremely likely), with higher scores indicating greater willingness to implement. The outcome variable (willingness) was recoded as a binary variable: 0 = not willing to implement and 1 = willing to implement. Given the three types of green infrastructure strategies (rain barrels, rain gardens, and porous pavement) examined in the study, separate models were created for each type of technique. The independent variables that remained significant in logistic regression models were included in a hierarchical logistic regression model (final complete model). Hierarchical regression combines many regression models in one step. This method determines if factors explain considerable variance in the dependent variable after controlling for other variables. The goal is to see if new variables significantly enhance model fit. Classification percentages were reported to evaluate the adequacy of predictors in predicting the likelihood of the outcome. Additionally, regression coefficients and odds ratios were interpreted. Statistical analysis was conducted using IBM SPSS Statistics for Windows version 25 with a specified significance threshold of $\alpha = 0.05$.

RESULTS

Sample Demographics

This study looked at the demographics of 123 respondents, with more women (62.6%) than men (37.4%). Table 2 displays demographic data for the participants. The results showed that 51.2% of the participants were in their late middle years (50-64). The sample's youngest age group, 18-29 years, accounted for a modest share (0.8%). 39.8% of participants completed a four-year program. The demographic statistics suggest that the majority of respondents (33.4%) reported a household income of more than \$90K per year. Approximately 31% of respondents said that the market value of their home was between 20,000 TL and 40,000 TL. In terms of residency time, the biggest group consisted of 51 (41.5%) individuals who had resided in Villakent for 0-4 years, and approximately 86.2 percent of the participants were homeowners.

Logistic Regression Results for the Rain Barrels

The chi-square test of independence was performed to assess the relationship between willingness to implement rain barrels and other categorical variables. The results of the chi-square tests showed that there was a significant association between willingness to implement rain barrels and required time for maintenance ($\chi^2 = 3.902$, $p = 0.030$), visual appearance ($\chi^2 = 4.669$, $p = 0.020$), existing rain barrels ($\chi^2 = 3.032$, $p = 0.031$), age ($\chi^2 = 6.164$, $p = 0.024$), education ($\chi^2 = 3.716$, $p = 0.049$), income level ($\chi^2 = 3.037$, $p = 0.045$), general knowledge ($\chi^2 = 5.133$, $p = 0.014$). Each of these variables was examined in binary logistic regression models within their domains, and the significant ones were then included in the final full model in order by the theoretical framework of this study. The hierarchical logistic regression model contained three blocks of variables. The first block included gender and education; the second block had visual appearance and existing rain barrels, which were significant in preliminary regression analysis. Lastly, the third block contained all TPB measures as independent variables. The first levels of all categorical variables were specified as the "reference level" for ease of understanding and interpreting odds ratios.

The results are summarized in Table 3. The Hosmer-Lemeshow (H-L) test was used to assess the adequacy of the model to predict the category of participants based on the predictor variables. The test result ($\chi^2 = 3.578$, $p = 0.841$) for the final model revealed a good fit to the data. The overall correct percentage prediction rate was 78.6%. A "good fit" refers to how well a statistical model describes or approximates the observed data. In the final full model, the level of general stormwater knowledge had a significant effect ($\beta = 0.910$, $p = 0.011$) on predicting the likelihood of willingness to implement rain barrels. The odds ratio

Table 2. Demographics of participants

	Count (n)	Percentage (%)
Gender		
Male	46	37.4
Female	77	62.6
Age		
18-29 years	1	0.8
30-49 years	43	35.0
50-64 years	63	51.2
Over 65 years	16	13.0
Education		
Less than high school	2	1.6
High school graduate	15	12.2
Some college	24	19.5
2-year	6	4.9
4-year	49	39.8
Master degree/Ph.D.	27	22.0
Income		
<10000 TL	8	3.4
10001-20000 TL	34	27.6
20001-40000 TL	41	33.4
>40001 TL	33	26.8
Marital Status		
Married	113	91.9
Single	10	8.1
Number of children		
None	13	10.6
1	50	40.7
2	53	43.1
3 or more	7	5.7
Number of people in household		
1	4	3.3
2	47	38.2
3	46	37.4
4	15	12.2
5 or more	10	8.1
Length of residency (in years)		
0-4	51	41.5
5-10	38	30.9
11-15	23	18.7
16 or more	11	8.9
Number of cars		
None	10	8.1
1	72	58.5
2	34	27.6
3 or more	6	4.9
Home ownership		
Rent	16	13.0
Owner	106	86.2

*Sample size (N)= 123.

for general knowledge indicated that participants falling in the high-knowledge group were 3.19 times more likely to implement rain barrels than participants in the high-knowledge group. Additionally, the required maintenance time ($p = 0.037$) was a significant variable. Specifically, participants who feel the required maintenance time for rain barrels as a burden were 1.58 times less likely to install rain barrels on their property. Finally, attitudes ($\beta = 0.800$, $p = 0.031$) were positively associated with willingness. The participants who had a higher positive attitude toward rain barrels were 1.56 times more likely to implement rain barrels on their properties.

Logistic Regression Results for Rain Gardens

The chi-square test of independence was performed to assess the relationship between willingness to implement rain gardens and other categorical variables. The results of the chi-square tests showed that there was a significant association between willingness to implement rain gardens and required time for maintenance ($\chi^2 = 3.795$, $p = 0.049$), adequate space ($\chi^2 = 1.795$, $p = 0.018$), age ($\chi^2 = 3.626$, $p = 0.0305$), education ($\chi^2 = 5.330$, $p = 0.037$), and general knowledge ($\chi^2 = 8.708$, $p = 0.018$). Each of these variables was examined in binary logistic regression models within their domains, and the significant ones were then included in the final full model in order by the theoretical framework of this study. The hierarchical logistic regression model contained three blocks of variables. The first block included gender and education; the second block had visual appearance and existing rain barrels, which were significant in the preliminary regression analysis. Lastly, the third block contained all TPB measures as independent variables. The first levels of all categorical variables were specified as the “reference level” for ease of understanding and interpreting odds ratios.

Based on the results shown in Table 4, the final model's Hosmer-Lemeshow test ($\chi^2=19.869$, $p=0.424$) revealed a satisfactory fit to the data. Required time to maintain ($p=0.046$) was a significant variable to predict respondents' willingness to implement rain gardens while holding other variables in the model constant. Participants who believed that the installation time for rain gardens had a high influence on their decisions were less likely to implement than those considering time was not an issue at all ($OR=0.19$). Additionally, the effect of adequate space ($p = 0.022$) was a significant variable. Primarily, participants who believed that the adequate space for rain gardens had a high amount of influence on their decisions were 7.35 times less likely to implement rain gardens on their property. Attitudes ($\beta = -2.439$, $p = 0.017$) also significantly affected participants' willingness to implement. For example, the odds ratio ($OR = 0.87$) was less than 1, meaning that the participants who had low levels of attitudes were less willing to implement.

Table 3. Hierarchical binary logistic regression for rain barrels

	Block 1			Block 2			Block 3			OR
	β	Std. Error	p	β	Std. Error	p	β	Std. Error	p	
(Constant)	-0.963	0.422	0.000	0.029	0.489	0.051	-0.038	0.392	0.923	
Age		0.846			0.960			0.974		
Age (1)	0.853	0.512	0.515	0.570	0.422	0.981	0.799	0.420	0.987	
Age (2)	1.208	0.504	0.483	0.516	0.539	0.981	0.938	0.420	0.987	
Age (3)	1.230	0.401	0.855	0.505	0.422	0.981	0.946	0.420	0.987	
General Knowledge				0.556	0.468	0.235	0.910	0.327	0.011*	3.19
Time to maintain						0.302			0.304	
Time to maintain (2)				-1.065	0.510	0.042*	-0.350	0.436	0.037*	1.58
Time to maintain (3)				-1.726	0.597	0.183	-0.843	0.347	0.171	
Time to maintain (4)				-1.352	0.586	0.724	-0.758	0.822	0.477	
Self-efficacy							0.458	0.928	0.621	
Subjective norm							-0.278	0.585	0.316	
Attitudes							0.800	0.798	0.031*	2.25
H-L		1.025			6.658			8.965		
p		0.795			0.773			0.578		

*p < 0.05.

Table 4. Hierarchical binary logistic regression for rain gardens

	Block 1			Block 2			OR
	β	Std. Error	p	β	Std. Error	p	
(Constant)	-1.153	0.853	0.000*	-0.153	1.877	0.007*	
Time			0.260			0.403	
Time (1)	-1.480	2.221	0.036*	-2.264	0.870	0.460	
Time (2)	-1.878	1.579	0.065	-2.830	0.808	0.088	
Time (3)	-1.352	1.920	0.481	-2.357	0.821	0.288	
Time (4)	-1.797	1.724	0.297	-1.944	0.821	0.035*	0.19
Space			0.304			0.392	
Space (1)	-2.203	2.238	0.325	-1.455	2.195	0.508	
Space (2)	-2.031	2.006	0.311	-3.100	2.437	0.203	
Space (3)	-2.268	1.789	0.205	-2.595	2.133	0.022*	7.35
Space (4)	-1.282	1.467	0.382	-1.995	1.617	0.217	
General knowledge	3.032	1.194	0.011*	2.979	1.578	0.049*	19.6
Self-efficacy				0.120	1.783	0.946	
Subjective norm				1.110	1.321	0.401	
Attitudes				-2.439	1.808	0.017*	0.87
H-L		17.070			19.869		
p		0.448			0.424		

*p < 0.05.

Logistic Regression Results for Porous Pavements

The chi-square test of independence was performed to assess the relationship between willingness to implement porous pavements and other categorical variables. The results of the chi-square tests showed that there was a significant association between willingness to implement porous pavements and visual appearance ($\chi^2 = 2.066$, $p = 0.015$), maintenance cost ($\chi^2 = 3.112$, $p = 0.048$), installation cost ($\chi^2 = 1.725$, $p = 0.046$), gender ($\chi^2 = 3.678$, $p = 0.045$), age ($\chi^2 = 1.609$, $p = 0.045$), the garden area ($\chi^2 = 9.692$, $p = 0.042$), education ($\chi^2 = 4.158$, $p = 0.042$), income ($\chi^2 = 4.372$, $p = 0.035$), and general knowledge ($\chi^2 = 1.646$, $p = 0.020$). Each of these variables was examined in binary logistic regression models within their domains, and the significant ones were then included in the final full model in order by the theoretical framework of this study. The hierarchical logistic regression model contained three blocks of variables. The first block included gender and education; the second block had visual appearance and existing rain barrels, which were significant in the preliminary regression analysis. Lastly, the third block contained all TPB measures as independent variables. The first levels of all categorical variables were specified as the “reference level” for ease of understanding and interpreting odds ratios.

Based on the results shown in Table 5, the final model’s Hosmer-Lemeshow test ($\chi^2=21.677$, $p=0.460$) revealed a satisfactory fit to the data. Gender ($\beta=-2.584$, $p=0.021$) also significantly affected participants’ willingness to implement porous pavement. For example, the odds ratio (OR=0.33) was less than 1, meaning that the male participants were less willing to implement porous pavement on their properties. The effect of maintenance cost of porous pavement also had an essential role in predicting the class of the outcome ($p=0.039$). The coefficient for the third level (professional) of education was positive ($\beta=1.342$, $p=0.015$), indicating that the higher concern related to the maintenance cost, the less likely they were willing to implement porous pavement on their properties. For instance, if a person had a higher concern of maintenance cost, they were 16.195 times less likely to implement porous pavement. Additionally, the effect of visual appearance ($p=0.019$) was significant. The coefficient for the last level (great influence) of visual appearance was negative ($\beta=-4.649$, $p=0.019$), indicating that the higher levels of concern about the visual appearance of porous pavement were related to a decreasing likelihood of willingness to implement. The odds ratio for this category (OR=0.207) was less than 1. This result indicated that participants who thought the visual appearance greatly influenced the adoption of porous pavements were less likely to be willing to implement them. Additionally,

Table 5. Hierarchical binary logistic regression for porous pavement

	Block 1			Block 2			Block 3			OR
	β	Std. Error	p	β	Std. Error	p	β	Std. Error	p	
(Constant)	1.609	0.658	0.003	2.993	1.352	0.027	5.335	2.245	0.017	
Gender	-1.099	0.658	0.95	-1.992	0.935	0.033*	-2.584	1.119	0.021*	0.75
Maintenance cost				-0.641	1.421	0.652				0.771
Maintenance cost (1)				-0.641	1.421	0.652	-2.200	1.336	0.100	
Maintenance cost (2)				-2.564	1.245	0.040*	-2.200	1.336	0.100	
Maintenance cost (3)				-2.274	1.351	0.092	-2.852	1.580	0.071	16.195
Maintenance cost (4)				-2.067	1.165	0.076	-2.785	1.406	0.048*	
Visual appearance						0.162				0.175
Visual appearance (1)				-3.397	1.528	0.026*	-3.407	1.658	0.040*	0.33
Visual appearance (2)				-2.040	1.421	0.151	-2.877	1.596	0.071	
Visual appearance (3)				-3.017	1.470	0.040*	-3.971	1.744	0.023*	0.19
Visual appearance (4)				3.705	1.664	0.026*	-4.649	1.975	0.019*	0.10
Self-efficacy							-0.524	1.329	0.693	
Subjective norm							1.226	1.064	0.249	
Attitudes							-2.322	1.307	0.046*	0.10
H-L		3.039			17.046			21.677		
p		0.765			0.376			0.460		

* $p < 0.05$.

attitudes ($\beta = -1.072$, $p = 0.003$) were significantly linked to participants' willingness. Attitudes ($\beta = -2.439$, $p = 0.017$) also significantly affected participants' willingness to implement. For example, the odds ratio (OR = 0.87) was less than 1, meaning that the participants who had low levels of attitudes were less willing to implement.

DISCUSSION

The study examined the role of factors that have been discussed in the literature to predict willingness to implement green infrastructure (GI) strategies. Studies in academic literature suggest that attitude plays a role in shaping actual behavior (Guagnano et al., 1995; Rauwald & Moore, 2002). This study supports these findings for all three different green infrastructure strategies. The results of this study align with Turner et al. (2016)'s research indicating that attitudes had an influence on residents' overall intentions to implement green infrastructure on their properties. Essentially, participants' perceptions of the effectiveness of green infrastructure impacted their decision to adopt it. Conversely, our findings are inconsistent with Sinasas's (2017) and Dogmusoz et al.'s (2020) study, which proposed that attitudes did not have the greatest influence on residents' involvement. It is significant to remember that the scale measuring a particular environmental activity (like GI implementation) frequently differs from the scale used to measure general environmental attitudes. The different results might be because of the different measures used. However, the difference in results despite using the same scale as Dogmusoz et al. (2020)'s study can be explained as follows: (1) the location of the study or (2) low variance between participants. If respondents' opinions varied much from one another, the impact of attitudes on behavioral intention may be more obvious.

In the current study, the subjective norm was not a significant predictor for all three green infrastructure strategies. These results contradict other studies (Sinasas, 2017; Dogmusoz et al., 2020). In Sinasas's (2017) study, green infrastructure was examined holistically rather than focusing on specific types. This might be the reason for the different results. However, Dogmusoz et al.'s (2020) study also examined the relationship between subjective norm and willingness separately, similar to the current study, and employed the same scale. Nevertheless, the reason for the different outcomes could be explained by people in different cultures feeling varying degrees of societal pressure. Moreover, self-efficacy was not the strongest predictor of the willingness to adopt these three green infrastructure strategies. Actually, based on the strong self-efficacy scores, I predict relatively high levels of green infrastructure adoption. These findings contradict some prior research (Baptiste et al., 2015; Dogmusoz et al., 2020; Moan & Rise, 2011; Mullan et al., 2013). In other words, participants' perceptions of their

ability to engage in a certain action had no impact on their willingness to install green infrastructure. This could be attributed to variations in the measurement scales used to assess self-efficacy. However, despite using the same scale, the current study and Dogmusoz et al. (2020)'s study yielded different results. This could be because of the study being conducted in different locations as well as differences in the number of participants and demographics.

Knowledge was also regarded as an independent predictor of willingness to install green infrastructure. In this study, it was observed that residents' stormwater management knowledge significantly predicted the desire to install rain barrels and rain gardens but not the installation of porous pavement. While these results support studies (Baptiste et al., 2015; Foley, 2012) which suggest that participants who had a high level of knowledge of environmental issues show more willingness to participate in those issues, they also conflict with other research (Dogmusoz et al., 2020; Turner et al., 2016; Heimlich & Ardoin, 2008). The differences might be because of: (1) different measures used or (2) the measure might determine not the level of knowledge but instead the level of awareness. The current study and Dogmusoz et al. (2020) also conflict in terms of porous pavement. While the level of knowledge was not a predictor for porous pavement in the current study, it was significant for porous pavement in Dogmusoz et al. (2020)'s study. The reason might be the different locations of the study areas. For instance, in Izmir, there are no incentives provided for porous pavement, whereas incentives are offered for rain gardens and rain barrels. Since then, people might be more familiar with other types of green infrastructure strategies instead of porous pavement.

In this study, specific knowledge regarding green infrastructure strategies did not emerge as a predictor of willingness to implement, which contradicts findings from other studies in the field but aligns with Dogmusoz et al. (2020)'s study. For example, Foley (2012) identified specific green infrastructure knowledge as a significant predictor of implementation. However, Foley's approach to measuring knowledge involved using only one statement for each type of green infrastructure. The variance in results between this study and others in the green infrastructure domain may be attributed to differences in the scales used to assess knowledge levels.

The visual appearance was identified as a potential obstacle to green infrastructure implementation. However, our findings suggest that while visual appearance doesn't predict the implementation of rain gardens or rain barrels, it does predict the implementation of porous pavement. This could be because participants generally prefer the appearance of rain gardens or rain barrels over porous pavement. The conflicting results could be attributed to variations in the aesthetic scales used across studies. Furthermore,

differences in the images depicting green infrastructure strategies, including factors like background and color, might influence participants' aesthetic evaluations of the same types of green infrastructure. Studies on aesthetics have demonstrated that cultural factors influence our aesthetic preferences. Therefore, even if the same scale is used, research conducted in different locations may yield differences due to cultural influences.

The cost of installation was viewed as a possible obstacle to implementing green infrastructure. Surprisingly, in the current study, installation cost did not emerge as a significant predictor for any of the three types of green infrastructure. This might be because of two possible reasons: firstly, respondents in this study may have higher incomes, thus not perceiving cost as a barrier; or secondly, the City of Izmir's reimbursement program might be well-known among participants, mitigating concerns about installation expenses. The current study examined both installation and maintenance costs, whereas most literature focuses solely on installation costs, neglecting maintenance expenses. However, in our findings, maintenance costs were not significant for rain barrels and rain gardens but for porous pavement. This aligns with Foley's (2012) research, which also found that maintenance costs did not affect respondents' decisions to implement green infrastructure. The lack of significance regarding maintenance costs in the current study may be due to two potential reasons: firstly, respondents in our study may have higher incomes, diminishing the perceived barrier of cost; or secondly, participants might perceive that The City of Izmir's initiatives effectively cover maintenance costs for the rain garden and rain barrel but not for porous pavement.

Rain gardens and rain barrels showed a significant relationship with necessary maintenance time in the current investigation; porous pavement did not show a meaningful correlation. The participant's employment situation may be the cause of the discrepancy in the literature. Surveys commonly inquire about whether individuals perceive "required time" as a barrier without considering their employment status (employed or retired). Those in the workforce might have limited time available for maintaining green infrastructure. Participants could also believe that maintaining porous pavement will need expert assistance, and this might save them time.

Furthermore, health concerns about green infrastructure have been recognized as a barrier to implementing such measures in earlier research (Hammit, 2010; Foley, 2012). However, issues related to health did not emerge as predictors for installing green infrastructure in the current study. This finding aligns with Baptiste's (2014) and Dogmusoz et al.'s (2020) research, which similarly found that health concerns did not influence the implementation of green infrastructure strategies. The lack of space was significantly

associated with the desire to install rain gardens but not for rain barrels and porous pavement. Another explanation could be that participants may perceive rain gardens to occupy more space compared to porous pavement and rain barrels.

Finally, socio-demographic factors have been considered as barriers to the adoption of these strategies. This study supports the research indicating the relationship between socio-demographics and the willingness to implement green infrastructure in this field (Ando & Freitas, 2011; Baptiste, 2014; Pincetl, 2009). In the current study, gender emerged as a significant predictor only for porous pavement. The findings indicate that females are more inclined to install porous pavement compared to males. The lack of significant results for rain gardens and rain barrels may be due to minimal variance among respondents who primarily have high income and education levels. Using a different sample could provide more accurate insights into how socio-demographic factors related to the adoption of green infrastructure.

CONCLUSION

This study addresses a gap in the growing literature on green infrastructure by examining factors influencing residents' willingness to install specific types of green infrastructure on their property. The findings indicate that attitudes have a significant influence on residents' intentions to adopt all three types of green infrastructure strategies. While visual appearance and maintenance cost are significant predictors for porous pavement, required maintenance time has an influence on residents' desire to install rain barrels and rain gardens. Additionally, general stormwater knowledge affects residents' intentions to implement rain gardens and rain barrels, not porous pavement. Encouragement from municipalities is crucial to help residents overcome perceived barriers to implementing green infrastructure. This research can guide municipal policymakers in targeting social constructs to promote residential green infrastructure adoption.

This study emphasizes the importance of attitudes, suggesting that a person's feeling about the effectiveness of green infrastructure can increase their willingness to adopt it. Municipalities can effectively communicate the benefits of green infrastructure to the community and the environment based on scientific research conducted in this field. Since general knowledge about stormwater management is a significant predictor, municipalities can also organize seminars and workshops to increase public awareness about stormwater management, which is the main cause of the issue and why green infrastructure is needed.

Furthermore, required maintenance time for rain barrels

and rain gardens and maintenance cost for porous pavement emerge as significant predictors, suggesting a need for municipalities to consider providing reimbursement for maintenance costs in addition to installation costs.

In this study, factors influencing the feasibility of green infrastructure adoption among participants have been investigated. For future research, further analysis of the significant factors identified in this study could provide insights and recommendations for green infrastructure designs. For example, it has been determined within the scope of this study that visual appearance is significant. However, factors such as color, texture, material, etc., which influence this appearance, could be addressed in future research.

Overall, green infrastructure strategies offer sustainable solutions to various environmental challenges, including water quality, flooding, urban heat islands, and climate change. To achieve these goals, it is essential to implement green infrastructure strategies at all scales. Studies conducted in different regions are all valuable and contribute to the literature.

Appendices: [https://jag.journalagent.com/megaron/abs_files/MEGARON-10734/MEGARON-10734_\(5\)_MEGARON-10734_Appendix.pdf](https://jag.journalagent.com/megaron/abs_files/MEGARON-10734/MEGARON-10734_(5)_MEGARON-10734_Appendix.pdf)

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REFERENCES

- Adaptation. (2021). Enhancing adaptation action in Turkey project. https://iklimeuyum.org/documents/Climate_Change_Adaptation_Works_In_Turkey.pdf
- Adesoji, T., & Pearce, A. (2024). Interdisciplinary perspectives on green infrastructure: A systematic exploration of definitions and their origins. *Environments*, 11(1), 8.
- Ajzen, I., & Driver, B. L. (1992). Application of the theory of planned behavior to leisure choice. *J Leisure Res*, 24, 207–224.
- Alves, A., Patiño Gómez, J., Vojinovic, Z., Sánchez, A., & Weesakul, S. (2018). Combining co-benefits and stakeholders' perceptions into green infrastructure selection for flood risk reduction. *Environments*, 5(2), 29.
- Ando, A. W., & Freitas, L. P. C. (2011). Consumer demand for green stormwater management technology in an urban setting: The case of Chicago rain barrels. *Water Resour Res*, 47(12), W12501.
- Baptiste, A. K. (2014). “Experience is a great teacher”: Citizens’ reception of a proposal for the implementation of green infrastructure as stormwater management technology. *Community Dev*, 45, 337–352.
- Baptiste, A. K., Foley, C., & Smardon, R. (2015). Understanding urban neighborhood differences in willingness to implement green infrastructure measures: A case study of Syracuse, NY. *Landscape Urban Plann*, 136, 1–12.
- Barnhill, K., & Smardon, R. (2012). Gaining ground: Green infrastructure attitudes and perceptions from stakeholders in Syracuse, New York. *Environ Pract*, 14(1), 6–16.
- Bos, D. G., & Brown, H. L. (2015). Overcoming barriers to community participation in a catchment-scale experiment: Building trust and changing behavior. *Freshw Sci*, 34(3), 1169–1175.
- Coyle, K. (2005). Environmental literacy in America: What ten years of NEETF/Roper research and related studies say about environmental literacy in the U.S. The National Environmental Education & Training Foundation. <https://files.eric.ed.gov/fulltext/ED522820.pdf>
- DCLG (2008). Department for Communities and Local Government. Guidance on the permeable surfacing of front gardens. <http://www.communities.gov.uk/documents/planningandbuilding/pdf/pavingfrontgardens.pdf>
- Dreher, D. (2009). Chicago wilderness green infrastructure vision: Challenges and opportunities for the built environment. *J Green Build*, 4(3), 72–88.
- Dogmusoz, B. B., Tekbudak, M. Y., & Rice, A. (2020). The factors affecting residents’ willingness to implement green infrastructure strategies on their property. *J Green Build*, 18(1), 17–35.
- EgeKoop. (2008) 24th Ordinary General Assembly Working Report. <http://egekoop.org.tr>
- Ekren, E. (2021). Planning sustainable cities: A green infrastructure-based approach. In Ş. Ertaş Beşir, M. B. Bingül Bulut & İ. Bekar (Eds.), *Architectural Sciences and Sustainability Volume 2* (pp. 1–28). Iksad Publications.
- Faehnle, M., Backlund, P., Tyrvaiven, L., Niemela, J., & Yli-Pelkonen, V. (2014). How can residents’ experiences inform planning of urban green infrastructure? Case Finland. *Landscape Urban Plann*, 130, 171–183.
- Foley, C. M. (2012). How socio-demographic factors and the physical environment shape resident attitudes towards green infrastructure in Syracuse, NY [Final Thesis, State University of New York].

- GCAP. (2020). Green City Action Plan. Izmir green city action plan. https://ebrdgreencities.com/assets/Uploads/PDF/GCAP-EN_Optimized.pdf
- Green, O. O., Shuster, W. D., Rhea, L. K., Garmestani, A. S., & Thurston, H. W. (2012). Identification and induction of human, social, and cultural capitals through an experimental approach to stormwater management. *Sustainability*, 4, 1669–1682.
- Guagnano, G. A., Stern, P. C., & Dietz, T. (1995). Influences on attitude-behavior relationships in a natural experiment with curbside recycling. *Environ Behav*, 27(5), 699–718.
- Gundlach, J. (2017). Putting green infrastructure on private property in New York City. Sabin Center for Climate Change Law. <http://columbiaclimatelaw.com/files/2017/06/Gundlach-2017-05-GI-in-NYC.pdf>
- Hammit, S. A. (2010). Toward sustainable stormwater management: Overcoming barriers to green infrastructure [Graduate Thesis, Massachusetts Institute of Technology].
- Hepcan, C. C. (2019). Green infrastructure solutions as part of climate change adaptation in cities. Climate Change Training Module Series 12. https://www.iklimin.org/wp-content/uploads/2020/03/modul_12_en.pdf
- Heimlich, J. E., & Ardoin, N. M. (2008). Understanding behavior to understand behavior change: A literature review. *Environ Educ Res*, 14, 215–237.
- Interpave. (2013). Planning rules for retrofitting paving on domestic & commercial premises—guidance for professionals. https://www.paving.org.uk/documents/professional_guide.pdf
- Keeley, M., Koburger, A., Dolowitz, D. P., Medearis, D., Nickel, D., & Shuster, W. (2013). Perspectives on the use of green infrastructure for stormwater management in Cleveland and Milwaukee. *Environ Manage*, 51, 1093–1108.
- Liotta, C., Kervinio, Y., Levrel, H., & Tardieul, L. (2020). Planning for environmental justice - Reducing well-being inequalities through urban greening. *Environ Sci Policy*, 112, 47–60.
- Locke, D. H., & Grove, J. M. (2016). Doing the hard work where it's easiest? Examining the relationships between urban greening programs and social and ecological characteristics. *Appl Spat Anal Policy*, 9, 77–96.
- Mayer, A. L., Shuster, W. D., Beaulieu, J. J., Hopton, M. E., Rhea, L. K., Roy, A. H., & Thurston, H. W. (2012). Building green infrastructure via citizen participation: A six-year study in the Shepherd Creek (Ohio). *Environ Pract*, 14, 57–67.
- Mell, I. (2019). Green infrastructure planning: Reintegrating landscape in urban planning. *Lund Humphries*.
- Moan, I. S., & Rise, J. (2011). Predicting intentions not to “drink and drive” using an extended version of the theory of planned behavior. *Accident Anal Prev*, 43(4), 1378–1384.
- Mullan, B., Wong, C., & Kothe, E. J. (2013). Predicting adolescents' safe food handling using an extended theory of planned behavior. *Food Control*, 31(2), 454–460.
- Parker, J., & Zingoni de Baro, M. E. (2019). Green infrastructure in the urban environment: A systematic quantitative review. *Sustainability*, 11, 3182.
- Philadelphia Water Department. (2016). Green city, clean waters. http://www.phillywatersheds.org/what_were_doing/documents_and_data/cso_long_term_control_plan
- Pincetl, S. (2009). Implementing municipal tree planting: Los Angeles million-tree initiative. *Environ Manage*, 45(2), 227–238.
- Rauwald, S. R., & Moore, C. F. (2002). Environmental attitudes as predictors of policy support across three countries. *Environ Behav*, 34(6), 709–739.
- Robinson, T. L., Lazor, N., & Bixler, R. D. (2008). Evaluation of the potential for a park neighbor program to increase environmental integrity of Cleveland Metroparks: Phase II. Prepared for the George Fund Foundation.
- Seattle Public Utilities. (2016). Green stormwater infrastructure: Managing stormwater with natural drainage. <https://www.seattle.gov/utilities/your-services/sewer-and-drainage/green-stormwater-infrastructure>
- Sinasas, S. (2017). A use of theory of planned behavior to determine the social barriers to the implementation of stormwater green infrastructure on private properties in Dundas, Hamilton, Ontario [Graduate Thesis, University of Waterloo].
- Sutunc, H., & Corbaci, O. L. (2020). Building urban green infrastructure systems using ecological planning principles. *J For*, 16(2), 70–88.
- Thurston, H. W., Taylor, M. A., Shuster, W. D., Roy, A. H., & Morrison, M. A. (2010). Using a reverse auction to promote household level stormwater control. *Environ Sci Policy*, 13, 405–414.
- Turner, V. K., Jarden, K., & Jefferson, A. (2016). Residents' perspectives on green infrastructure in an experimental suburban stormwater management program. *Cities Environ*, 9(1), 1–32.
- Walsh, C. J., Fletcher, T. D., & Ladson, A. R. (2005). Stream restoration in urban catchments through redesigning stormwater systems: Looking to the catchment to save the stream. *J North Am Benthol Soc*, 24, 690–705.
- Wise, S. (2008). Green infrastructure rising. *Planning*, 74, 14–19.
- Young, R., Zanders, J., Lieberknecht, K., & Fassman-Beck, E. (2014). A comprehensive typology for mainstreaming urban green infrastructure. *J Hydrol*, 519, 2571–2583.



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Article

Regional development, institutions and policies in Türkiye: Dynamic shift-share analysis (2004-2023)

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ABSTRACT

Inequalities between regions tend to increase worldwide. In Türkiye, where inter-regional inequalities are quite high, regional inequalities and regional policies came to the fore along with the EU harmonization principles and the candidacy process, following the approval of EU candidacy in 1999. In the early 2000s, new regions were created in Türkiye in parallel with the EU regional classification, and Development Agencies (DAs) were established in these regions to accelerate regional development. In this research, the effects of the new regional development policies in Türkiye post-2000 and the DAs, which are the prominent actors of regional development, on the economic growth and competitive performances of the regions were examined. As the research method, regional policies after 2000 and regional economic growth performances in the 2004-2009 period and the 2013-2018 period, based on the year 2010 when DAs were established, were examined with dynamic shift-share analyses. In parallel with the changes in public administration, the period after 2018 was analyzed separately as the 2019-2023 period. According to the analysis results obtained, compared to the performance of the pre-2010 period, the regional competitiveness effect has increased in some middle-low-income and low-income regions in the periods after the establishment of DAs, especially in sub-regions in the Southeastern Anatolia Region, where the Southeastern Anatolia Project is being implemented. On the other hand, negative regional competitiveness effects were observed in the economic growth performances of nine regions from different income groups after 2010. Additionally, a positive medium-low level correlation was determined between the financial support of DAs and the regional growth performances.

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INTRODUCTION

Regional inequalities arising from the uneven distribution of economic growth in space or its concentration in certain regions become deeper over time with the accumulation of the population and the increase in infrastructure and some

other investment opportunities. Interregional disparities and related discontent are increasing both in developed and developing countries, especially in the USA and England (McCann, 2020). Inequalities, unfair distribution of wealth, neglected regions and people, and regional discontent are

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considered threats to the EU's economic and social cohesion goals and future, causing negative consequences for countries in the Global North and South (Iammarino et al., 2019; Pike, 2020). The relevant literature on the globalization of the economy, the mobility of production factors, the negative effects of global economic crises on regions, and regional development traps for left-behind regions draw attention to existing economic, social, and political risks, showing that new and effective measures should be taken for regional development and resilience of local economies (Dicken, 2015; Pike, 2020; Diemer et al., 2022; Dijkstra et al., 2015).

The OECD (2023) points out that after 2000, there was income convergence between countries, but divergence occurred between regions. Regional inequalities increased in high-income countries and Eastern European countries, but decreased in high-income countries such as Germany, Finland, Norway, and New Zealand, as well as low-growth countries like Spain, Greece, Portugal, and New Zealand. These different paths across countries show that longstanding inequalities can be reduced with the right policies (OECD, 2023). Among OECD countries, Türkiye stands out in terms of high income differences and regional development imbalances between the east and west of the country, with the highest ratio of the richest region to the poorest region. As for the Gini coefficient, Türkiye ranks third among OECD countries after Mexico and Chile, where income is most unequally distributed. On the other hand, Türkiye's four lowest-income regions (TRC2, TRC3, TRB2, TRA2 NUTS II Regions) are among the 20 poorest regions of 285 OECD regions, according to OECD data (OECD, 2019). It has been stated in the related literature that, despite exceptional disparities between regions in Türkiye (Tekeli, 2009), regional development policies have been discussed since the 1960s, but negligible progress was made in reducing the persistent regional differences until the 2000s (Gezici & Hewings, 2003; Yıldırım et al., 2004). When evaluating development policies, changes in economic and political trajectories are also important. After the decisions of January 24, 1980, Türkiye followed neoliberal economic policies, integration into the global economy, public restructuring policies, and economic integration with Europe. With the announcement of Türkiye's candidacy to the EU in 1999, a wave of reforms was triggered, transforming Türkiye's political and legal system, including regional policies based on a new regionalism approach that corresponds to the liberalization process of the economy. At the beginning of the 2000s, having high income differences with both the EU countries and among its regions, Türkiye defined this as a challenge in national strategies and emphasized the necessity and possible structure of regional development institutions in EC National Progress Reports 2000, 2001, 2003, and 2004 (Sezgin & Erkut, 2020).

RDAs, which spread rapidly in Europe in the 1990s and with the increasing political influence of the EU, were established in Türkiye as of 2010 to improve regional competitiveness

based on internal dynamics, enhance the investment (Sezgin & Erkut, 2017) environment, and accelerate local economic development. DAs existing in Europe have played important roles in the globalization era, changing economic conditions, bottom-up development in localization processes, the success of local initiatives, and the positive effects of good governance on regional and local development (Danson et al., 2017). Regional policies and relevant institutions evolve according to the characteristics and needs of localities. In the example of England, RDAs have been transformed into more localized and specialized local enterprise partnership organizations. Nevertheless, there are many successful DAs in European countries, working at the networks and governance levels, that remain indispensable actors of regional development (Pike et al., 2017; Tomaney, 2010).

Local and regional development organizations are shaped by states from the “developmentalism” era to the current “globalism” era, according to the different conditions, needs, and aims of countries and regions, and they definitely play governing roles in legal and institutional changes (McMichael, 2012). Regional development policies and related institutions have been affected by changes in the public administration of Türkiye within the last two decades. DAs in Türkiye were established based on Law No. 5449 (T.C. Resmi Gazete, 2006) and operated under the coordination of the State Planning Organization, a supra-ministerial planning authority, until 2011 when SPO transformed into the Ministry of Development. Afterwards, with Presidential Decree No. 4 (T.C. Resmi Gazete, 2018), DAs started working under the coordination of the Ministry of Industry and Technology with the closure of the Ministry of Development in 2018. According to audit reports of DAs in Türkiye (Devlet Denetleme Kurulu, 2014; Sayıştay Başkanlığı, 2018), especially low-income regions need DAs as a governance mechanism for development, but due to the inadequacy of resources, the contribution of DAs to development is limited. Despite the positive effects of varied activities of DAs on their regions (Aydoğdu & Sezer, 2018; Bakır & Bahtiyar, 2019; Şahin & Kabayel, 2017; Pektaş & Demirkol, 2018), the weakness of multi-level governance functions reduces the effectiveness of DAs in their regions (Ertugal, 2017).

According to Yücel's (2024) research on development traps and regions of Türkiye, six regions are already in the development trap, and seven regions are at risk of entering the development trap. The capacity to adapt to changing conditions, local development, the creation of good jobs, and the role of strong development agencies are quite important in these regions. Over the last two decades, there have been some interruptions in the functioning of governance and a loss of capacity in some respects (Yücel, 2024). According to the findings of the authors on the performance of DAs in conjunction with the socio-economic development levels of the 26 regions of Türkiye from 2010-2018, the performance of DAs is highly dependent on local stakeholders, with key

factors being the adequacy of financial and human resources. Besides the discussions on the structure and effects of DAs, the roles of DAs in Türkiye require more detailed study and evaluations with the experience gained (Halkier, 2007). Considering the relationship of DAs with the state, the business world, and other social actors in Türkiye, the effectiveness of DAs in supporting regional economies is also among the main questions (Lagendijk et al., 2009) and needs to be evaluated. Iammarino et al. (2019) propose a new "place-sensitive" approach against increasing inequalities in Europe, instead of people-based and as a complement to place-based policies. Having a very special geography, Türkiye's regions are diversified from each other by their development and income levels. They also have genuine characteristics depending on historical, cultural, economic, social, and ecological aspects. In this research, the effects of the policies and DAs followed in Türkiye after 2000 on the growth performances and internal competitiveness potentials of the regions are examined. The aim is to contribute to the development of new policies that are sensitive to the uniqueness of the regions in Türkiye, which have noteworthy inequalities in Europe.

Literature Review

Inter-regional development differences, causing unequal income distribution and inequality of opportunity in different parts of a country, are attributed to initial advantages or disadvantages, institutional factors, or the inability of lagging regions to adapt to critical change processes (Cörvers & Mayhew, 2021). On the other hand, it has been stated that inter-regional inequalities are resistant and persist for generations (Rice & Venables, 2021). Moreover, the convergence expectation due to labor and capital mobility in the post-2000 globalization processes is quite insufficient. Many studies conducted in the first years of the millennium showed that the problem of income inequality tended to increase as globalization processes increased investments in metropolises, especially with the rapid growth of developing countries in the 2000s (Pernia & Quising, 2003; Brenner, 2003; Farole, 2013). Pike (2020) argues that the geographical political economy approach, as a new perspective for underdeveloped regions and people focusing on differentiated pathways and institutions, stimulates engagement, dialogue, and cross-national learning for development. Diemer et al. (2022) identified some regions that face structural challenges in increasing income, employment, and welfare as regions either in a development trap or at significant near-term risk of falling into it within the EU geography. They suggest interventions and approaches that go beyond traditional concerns for these less-developed regions and urge policymakers to take preventive measures (Diemer et al., 2022). In their research on inequality increases in Europe, Iammarino et al. (2019) propose that a new "place-sensitive" approach is needed, instead of people-based policies, as a complement to place-based policies.

With the influence of the new regionalism movement, local and regional development around the world over the last

30 years has been shaped by multi-actor and decentralized systems of government and good governance at all levels, spanning multiple geographic scales and relational networks (Pike et al., 2017). The institutional capacity of regions has been cited by the OECD as the implicit reason why some of its member countries' regions tend to grow steadily, based on advanced human capital and innovation (OECD, 2012). In this direction, many states have tended to give more authority and decentralization to regional and local governments and governance institutions in support of regional development (Rodríguez-Pose, 2013). Research on the future of RDAs, governance mechanisms playing important roles in development, shows that supra-regional scale and urban scale are on the rise globally, with specialization in certain fields coming to the fore (Bellini et al., 2012). The success of DAs in the near future depends on their highly qualified and knowledge-based structures (Bellini et al., 2012).

At the beginning of the 2000s, Türkiye changed its regional policy under the direction of EU policies, so NUTS level regions were created. Development Agencies (DAs) were established in these regions to initiate planning studies and strengthen the institutional capacity responsible for regional development (Kayasü & Yaşar, 2006). DAs have not been included in the central-local hierarchy in the administrative structure of Türkiye but have been institutionalized as a scale for planning and development at the regional level. According to Ertugal (2017), DAs in Türkiye differ from eastern EU counterparts by representing policy instruments, implementation, and governance functions rather than decentralization.

According to EURADA, DAs in Türkiye operate on the principles of regionalization and good governance, aiming to use resources efficiently and reduce exceptional disparities. Tekeli (2009) points out that since Türkiye's high-income regions are behind the EU average, for real progress in Türkiye, DAs should be differentiated according to the various qualities and capacities of the regions rather than being uniform. Ertugal (2017) stated that the problems in the governance functions of DAs in Türkiye and the deficiencies in their processes significantly reduce DA effectiveness. Some studies investigated the effects of DA activities in their regions (Çetinkaya & Akkurt, 2016; Özkan et al., 2014; Kayasü & Eldeniz, 2013; Günaydın, 2012; Aydoğdu & Sezer, 2018; Pehlivan, 2013; Bakır & Bahtiyar, 2019; Türkoğlu, 2016; Pektaş & Demirkol, 2018; Şahin & Kabayel, 2017) and concluded that DA financial supports have positive effects in their regions. However, some studies (Tarı et al., 2017; Kırankabeş, 2013; Şimşek, 2013) measuring the effectiveness of the DAs in Türkiye concluded that most of the DAs are not financially effective. Current studies investigating the change in income distribution in Türkiye post-2000 note a convergence for the 2004-2017 period, but others point out that there was no convergence or there was club convergence, especially after 2018 (Sakarya et al., 2024; Karahasan, 2020; Doğan & Kındap, 2019; Öztürk & Gültekin, 2021; Gündem, 2017; Kartal & Karşıyakalı, 2023). According to a current inter-regional performance assessment analysis of DAs

in Türkiye, the performance of DAs also depends on the participation of regional stakeholders in DA activities, and half of the six high-performing DAs are in low-income regions (Celebi Deniz & Erkut, 2022). According to the results of research in which the performances of DAs were analyzed, financial resources and the adequacy of expert staff are key factors. Agencies responsible for four or more provinces have difficulty in regional adaptation and coordination, reducing the success of DAs, especially in low-income and medium-low-income regions (Celebi Deniz, Z. & Erkut, G. 2022).

Yücel (2024), in his research on development traps in Türkiye for the 2014-2022 period, found that TR51 and TR41 regions representing the high-income group, TR61 and TR22 regions representing the middle-income group, and TR90, TR83, and TRC2 regions representing the low-income group are in the development trap. Additionally, TR10, TR32, TR72, TR82, TRA1, TRB1, and TRB2 regions are at risk of falling into the development trap. It emphasizes that DAs and regional/local development mechanisms in these regions should be strengthened and restructured (Yucel, 2024).

METHODOLOGY AND DATA

This research aims to examine the effects of post-2000 policies on the economic performance of regions in Türkiye and to contribute to the development of genuine approaches for the success of regional and local development policies. In this context, this research analyzes the effects of post-2000 regional policies and Development Agencies on the 26 NUTS 2 regions using dynamic shift-share analyses (DSSA) in Türkiye within the periods of 2004-2009 (before DAs) and 2013-2018 (after DAs), in parallel with regional data. Afterwards, the 2019-2023 period was analyzed separately in accordance with the changed public administrative system of the country.

The variation shift-share analysis method, developed by Dunn, 1960; was presented as a statistical and analytical method to understand and interpret the reasons for sectoral growth in a particular region of a country. Traditional, dynamic, spatial, and sectoral versions of the methods are used in a wide variety of fields such as production, industry, international trade, tourism, and regional policy, and demographic changes have been studied as referred to in academic literature (Haynes & Dinç, 1997; Knudsen, 2000; Shi & Yang, 2008). Barff & Knight (1988) developed the DSSA method using annual growth performances to measure employment growth from 1939 to 1984 in New England, using data from the U.S. Bureau of Labor Statistics.

The analysis is the decomposition of regional growth into three components, as follows (Wieland, 2019):

- **National Growth Effect (NGE):** This gives the expected value of the national growth effect of growth in certain sectors of the region, in other words, the national growth rate.

- **Industrial Mix Effect (IME):** This is the growth effect resulting from the effect of the total growth in the sectors of the region, the contribution of specialized sectors, or the low growth of weak sectors.
- **Regional Competitiveness Effect (CE):** This gives the amount of growth realized due to the internal competitive advantages of the region. The competitiveness effect component, which is the most important and key component of the analysis, shows the growth or decline in the examined sector depending on spatial advantages and disadvantages.

In this study, the dynamic variation analysis method (Barff & Knight, 1988) was used to include the growth changes and components in the analysis in all the years examined in detail. The model used in the analyses made within the scope of the research is shown below.

$$e_i^{t+n} - e_i^t = NGE_i + IME_i + CE_i$$

$$NGE_i = \sum_{k=t+1}^{t+n} [e_i^{k-1} (G^k)]$$

$$IME_i = \sum_{k=t+1}^{t+n} [e_i^{k-1} (G_i^k - G^k)]$$

$$CE_i = \sum_{k=t+1}^{t+n} [e_i^{k-1} (g_i^k - G_i^k)]$$

In the above model, e represents employment, $t+n$ represents the end of the period, and i represents a certain region.

Andrikopoulos et al. (1990), Huaxiong & Fang (2011), Sobczak (2012), Otsuka, (2016), and Márquez et al. (2009) examined different aspects of regional growth performances, competitiveness of selected different sectors from manufacturing to energy demands in selected periods, and the effects of public development policies and demographic changes by using the DSSA method in different contexts. Akıncı & Yılmaz (2014) and Şahin et al. (2015) applied the traditional shift-share analysis method, and Akıncı & Yılmaz (2014) concluded that the competitiveness of NUTS 2 regions in the Marmara and Aegean Regions and the Central and Southeast Anatolian regions increased, while the North and East Anatolian regions showed negative performance in 2004-2011. Elburz & Korten (2018) used DSSA to explore the relationship between the specialization/diversification patterns of regions in Türkiye between 2009 and 2014.

In this empirical analysis, the data specified for the following periods were used on the basis of the 26 NUTS 2 Regions of Türkiye. Regional employment data used for these years after 2000: 2004, 2005, 2006, 2007, 2008, and 2013, 2014, 2015, 2016, 2017, 2018. Furthermore, the 2019-2023 period was also analyzed within this research using the DSSA method with 2019, 2020, 2021, 2022, and 2023 regional employment data to evaluate the current situation of competitiveness

performance in the regions. Additionally, a correlation analysis was conducted to explore the relationship between regional growth and the financial support provided by DAs.

Changing Regional Development Policies in Türkiye after the 2000s

Türkiye has changed its regional development policy based on incentives for nearly 40 years and has switched to a new regional policy and approach aligned with the principles of harmonization with the EU. A Preliminary National Development Plan (PNDP) was prepared, setting the framework for economic and social cohesion programs as EU financial aid in 2003 (Devlet Planlama Teşkilatı, 2006). One of the four priorities of the PNDP is "Increasing the economic power of the regions, reducing regional disparities, and accelerating rural development" (Devlet Planlama Teşkilatı, 2003). The classification of statistical regional units in

accordance with the EU regional statistical system was made in three levels in 2002 as follows: 12 regions at the NUTS 1 level, 26 regions at the NUTS 2 level, and 81 (provincial) regions at the NUTS 3 level (Devlet Planlama Teşkilatı, 2006).

As an important turning point in terms of regional development policies, DAs were established in these NUTS 2 regions in Türkiye by 2010. DAs in Türkiye are not investor organizations, and the resources they use are not sufficient for regional development goals (Turkish Court of Accounts, 2015). However, through activities such as regional development planning, governance, financial support programs, technical support, and training programs, they have had positive effects in their regions. The financial support given by the DAs through their calls for project proposals in their regions for the period of 2010-2018 is presented in Table 1.

Table 1. Financial supports given by Development Agencies in the period of 2010-2018.

	Financial supports provided by development agencies in Türkiye via project calls for proposals (1000 TL)								
	2010	2011	2012	2013	2014	2015	2016	2018	Total
TR10 İSTKA		120.000	95.000	36.830	78.966	83.896	69.650	86.594	570.936
TR21 TRAKYAKA		13.500	20.000	12.035	10.886	14.053	10.538	5.718	86.730
TR22 GMKA		12.000	15.200	29.242	12.125	12.155	0	50.987	131.709
TR31 İZKA	31.600	18.000	14.000	24.401	49.864	14.642	18.332	24.544	195.384
TR32 GEKA		16.000	0	20.143	23.594	23.851	0	29.315	112.904
TR33 ZAFER		20.000	18.100	14.736	25.932	23.723	20.548	19.167	142.206
TR41 BEBKA		12.000	16.000	17.182	41.247	12.166	13.140	10.314	122.049
TR42 MARKA		15.000	16.000	11.960	18.395	12.713	14.225	22.899	111.192
TR51 ANKARAKA		25.000	0	10.292	23.381	17.012	20.443	10.814	106.942
TR52 MEVKA	10.000	35.000	0	17.374	14.977	13.677	0	21.534	112.561
TR61 BAKA		10.000	20.000	15.387	15.365	15.627	7.452	18.151	101.982
TR62 ÇUKUROVA	25.000	40.000	27.000	31.717	31.124	22.834	4.680	20.372	202.726
TR63 DOĞAKA		13.500	17.000	22.805	18.327	12.634	10.587	17.069	111.922
TR71 AHİKA		13.000	15.510	22.028	11.161	11.227	6.801	13.009	92.736
TR72 ORAN		18.000	16.800	16.415	21.707	16.582	31.984	14.354	135.842
TR81 BAKKA		11.000	14.500	11.159	13.707	10.712	6.904	14.827	82.809
TR82 KUZKA		16.000	0	10.068	20.684	20.176	0	4.774	71.701
TR83 OKA	14.500	18.000	18.000	6.945	23.878	0	0	26.162	107.484
TR90 DOKA		14.500	15.000	16.303	8.130	15.940	0	17.728	87.601
TRA1 KUDAKA	15.000	0	16.000	14.551	8.860	10.273	9.833	15.994	90.510
TRA2 SERKA		16.500	12.000	8.175	12.820	13.348	13.483	0	76.326
TRB1 FIRAT		22.500	14.700	11.072	16.790	8.200	14.270	17.900	105.433
TRB2 DAKA	14.100	18.500	9.000	20.879	16.782	25.229	0	15.582	120.072
TRC1 İKA		29.500	6.500	37.438	15.592	9.021	2.613	19.559	120.223
TRC2 KARACADAĞ	22.900	19.200	0	19.615	22.058	29.005	4.896	27.321	144.995
TRC3 DİKA	18.000	17.000	0	19.984	13.912	23.290	2.466	39.606	134.258

Prepared by using data from annual DAs activity reports published by Ministry of Development and and Ministry of Industry and Technology between 2010-2018 period. (Ministry of Industry and Technology, 2018).

New regional development administrations were established as EAP (Eastern Anatolia Project), the Eastern Black Sea Project (DOKAP) and the Konya Plain Project (KOP) (Ministry of Development, 2013) during the 10th Development Plan period. Regional Development National Strategy 2014-2023 was prepared at the same period. The regional classification according to these income levels included in the

regional development national strategy (Ministry of Development, 2014) is shown in the Table 2.

The incentive system of Türkiye renewed in 2011 according to the results of the socio-economic development index of regions and provinces, the provinces were divided into 6 regions and incentives were put into practice according to these groups (Figure 1).

Table 2. Regional classification by income (Ministry of Development, 2014).

Code of the region	Regions	GDP per capita (\$)	Income Levels
TR10	Istanbul	17 827	High Income Regions
TR51	Ankara	14 253	
TR42	Kocaeli, Sakarya, Düzce, Bolu, Yalova	13 911	Middle-High Income Regions
TR31	Izmir	12 344	
TR41	Bursa, Eskisehir, Bilecik	11 793	
TR21	Tekirdag, Edirne, Kırklareli	11 512	
TR61	Antalya, Isparta, Burdur	12735	
TR	Türkiye's average	10 602	
TR22	Balikesir, Çanakkale	10 034	
TR32	Aydin, Denizli, Mugla	9 320	
TR33	Manisa, Afyon, Kütahya, Usak	9 194	
TR52	Konya, Karaman	8 595	
TR72	Kayseri, Sivas, Yozgat	8 486	Middle-Low Income Regions
TR62	Adana, Mersin	8 132	
TR81	Zonguldak, Karabük, Bartın	7 598	
TR71	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir	7 454	
TR82	Kastamonu, Çankırı, Sinop	7 319	
TR90	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane	7 257	
TRC1	Gaziantep, Adiyaman, Kilis	7 011	
TR83	Samsun, Tokat, Çorum, Amasya	6 944	
TRA1	Erzurum, Erzincan, Bayburt	6 814	
TR63	Hatay, Kahramanmaraş, Osmaniye	6 716	
TRB1	Malatya, Elazığ, Bingöl, Tunceli	6 350	Low Income Regions
TRC3	Mardin, Batman, Şırnak, Siirt	5 031	
TRA2	Ağrı, Kars, Iğdır, Ardahan	4 727	
TRC2	Şanlıurfa, Diyarbakır	4 403	
TRB2	Van, Muş, Bitlis, Hakkari	4 162	

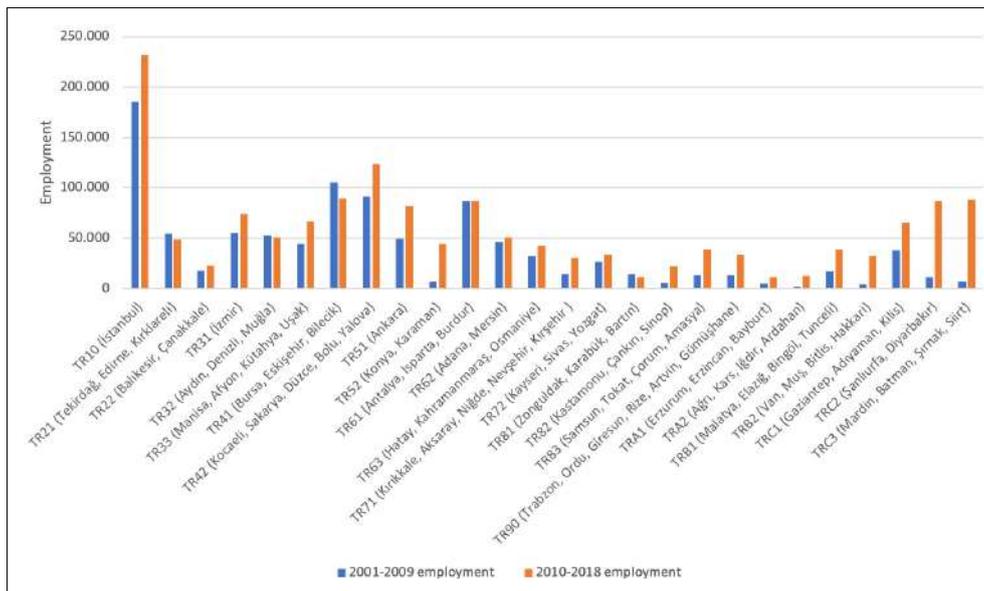


Figure 3. Employment created in NUTS2 Regions with investment incentives in 2001-2009 and 2010-2018 periods.

Istanbul, TR42 Kocaeli, TR41 Bursa, TRC3 Mardin, and TRC2 Diyarbakır-Şanlıurfa regions. This shows that after 2010, Southeast Anatolian Regions with low income levels showed progress in this regard.

With the EU harmonization processes, to support local development initiatives and reduce regional income gaps, the Regional Development Program and Türkiye-Bulgaria Cross-Border Cooperation Program implementations started in 12 low-income NUTS 2 Regions (TRB1, TRB2, TRC1, TRC2, TRC3, TR82, TR83, TRA1, TR72, TR52 regions) (Ministry of Development, 2013). Türkiye benefited from EU financial support to make legal and institutional arrangements during the candidacy process in the 2002-2006 period (AB Başkanlığı, 2020). According to EU Presidency data, 30% of these funds were used for institutional restructuring, 35% for harmonization with the EU acquis, and 35% for economic and social cohesion purposes. During the 2007-2013 IPA I period, 37% of the financial aid was used for regional development, 35% for institutional development, 18% for rural development, 10% for human resources development, and 1% for cross-border cooperation purposes. Financial assistance under the 2014-2020 IPA II amounted to EUR 11.7 billion, and its components were "Political reforms," "Economic, social, and regional development," "Strengthening capacity regarding common rights and obligations," and "Regional integration and regional cooperation."

Effects of Post-2000 Regional Policies and Development Agencies on Regional Economic Growth Performances: Comparative Dynamic Shift-Share Analysis

High unemployment is among the main problems for both Türkiye and most of its regions. Accordingly, new

job creation and employment are targets both in national policies and in the regional development plans of all NUTS 2 regions, prepared by DAs with the participation of regional actors in Türkiye. The table below shows the results of DSSA for the 2004-2009 and 2013-2018 periods of employment growth, which is crucial for regional development in Türkiye and all its regions (Table 3).

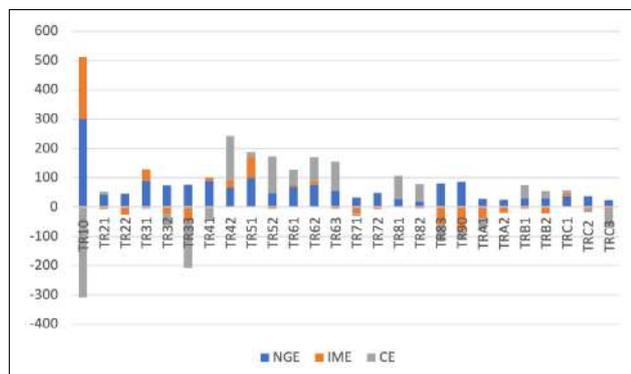
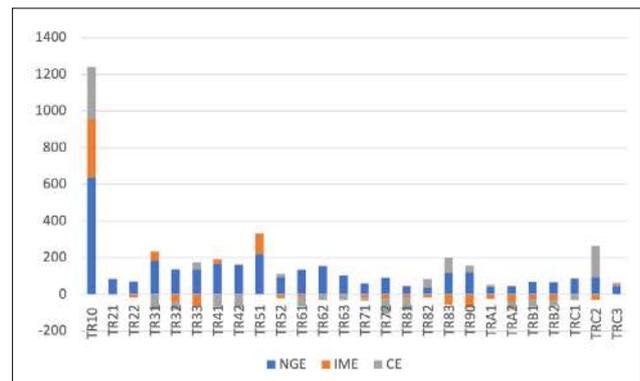
While the employment change in Türkiye was 1.6 million in 2004-2009 period, it was 3.2 million in 2013-2018 period. Considering the change in employment of regions in 2013-2018, with their rapid growth TR10 İstanbul, TRC2 Diyarbakır-Şanlıurfa Region and TR83 Samsun Region stands out. One of the lowest-income region of the country TRC2 Diyarbakır-Şanlıurfa Region, has risen to the 3rd rank in the 2013-2018 period and while TR83 Samsun Region was in the last place in the 2004-2009 period, took place in the top 5 of the employment growth in the 2013-2018 period. As a result of the comparison of the analyzed periods; regions that have increased their employment growth based on the regional competitive factors in 2013-2018 period are respectively; TR10 İstanbul, TRC2 Diyarbakır-Şanlıurfa Region, TR83 Samsun Region, TR33 Manisa Region, TR90 Trabzon Region, TRA1 Erzurum Region and TRC3 Mardin Region.

The contribution of dynamic shift share components to regional employment growth during the analysis periods is shown in the charts Figure 4.

It has been observed that the national growth effect is high in regional employment growth in this period, and the regional competitiveness effects are relatively low in regions where unemployment is higher. The Figure 5 shows the components DSSA for the 2013-2018 period.

Table 3. DSSA Results for 2004-2009 and 2013-2018 Periods

TR Türkiye	2004-2009 Dynamic Shift Share Analysis Results (Thousand)				2013-2018 Dynamic Shift Share Analysis Results (Thousand)			
	Total Change	NGE	IME	CE	Total Change	NGE	IME	CE
TR10 (İstanbul)	205	303	210	-307	1.241	638	319	284
TR21 (Tekirdağ, Edirne, Kırklareli)	45	43	-7	10	80	84	1	-4
TR22 (Balıkesir, Çanakkale)	19	45	-25	-2	53	73	-19	0
TR31 (İzmir)	125	90	40	-5	149	185	49	-85
TR32 (Aydın, Denizli, Muğla)	10	73	-23	-40	55	139	-42	-42
TR33 (Manisa, Afyon, Kütahya, Uşak)	-130	77	-48	-160	109	139	-64	35
TR41 (Bursa, Eskişehir, Bilecik)	59	90	11	-43	126	166	27	-67
TR42 (Kocaeli, Sakarya, Düzce, Bolu, Yalova)	242	67	24	152	90	160	2	-72
TR51 (Ankara)	187	101	71	16	332	221	110	2
TR52 (Konya, Karaman)	168	48	-6	125	91	95	-20	16
TR61 (Antalya, Isparta, Burdur)	129	70	9	48	70	135	-11	-54
TR62 (Adana, Mersin)	169	77	13	80	124	154	1	-33
TR63 (Hatay, Kahramanmaraş, Osmaniye)	149	55	-5	100	72	102	-6	-25
TR71 (Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir)	3	33	-22	-8	24	61	-18	-17
TR72 (Kayseri, Sivas, Yozgat)	43	46	-8	5	-13	93	-23	-84
TR81 (Zonguldak, Karabük, Bartın)	108	28	0	80	-42	46	-18	-69
TR82 (Kastamonu, Çankırı, Sinop)	76	19	-3	60	64	36	-19	47
TR83 (Samsun, Tokat, Çorum, Amasya)	-36	81	-59	-57	145	117	-56	85
TR90 (Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane)	-21	86	-79	-28	87	122	-71	35
TRA1 (Erzurum, Erzincan, Bayburt)	-45	28	-36	-39	29	42	-24	12
TRA2 (Ağrı, Kars, Iğdır, Ardahan)	5	25	-20	0	-36	46	-40	-42
TRB1 (Malatya, Elazığ, Bingöl, Tunceli)	70	31	-5	45	3	69	-25	-41
TRB2 (Van, Muş, Bitlis, Hakkari)	33	30	-22	24	6	66	-35	-26
TRC1 (Gaziantep, Adıyaman, Kilis)	59	38	8	12	57	85	3	-31
TRC2 (Şanlıurfa, Diyarbakır)	20	38	-8	-10	236	96	-30	169
TRC3 (Mardin, Batman, Şırnak, Siirt)	-48	23	-8	-63	63	45	10	7

**Figure 4.** Contribution of the DSSA components to growth in 2004-2009 period.**Figure 5.** Contribution of the DSSA components to growth in 2013-2018 period.

It is noteworthy that Istanbul significantly increased its competitiveness effects in regional employment growth in the 2013-2018 period. Unlike other high-income regions, the dominant competitive power of TR10 Istanbul increases.

On the other hand, it has been seen that the internal potentials of some low-income and underdeveloped regions also increased in this period and regional share effected growth performance more.

According to the results DSSA, the contribution of the competitiveness component of the regions to the increase in employment in the 2004-2009 period before the DAs and the increase in employment in the 2013-2018 period when DAs were active can be seen comparatively in the chart below (Figure 6).

According to the findings; the effects of regional development policies and implementations on regions with different income levels are evaluated for 2004-2009 and 2013-2018 periods and shown on the Table 4.

Accordingly, TRC2 and TRC3 Regions from low-income regions and TR83, TR90 and TRA1 regions from middle-low-income regions increased their regional

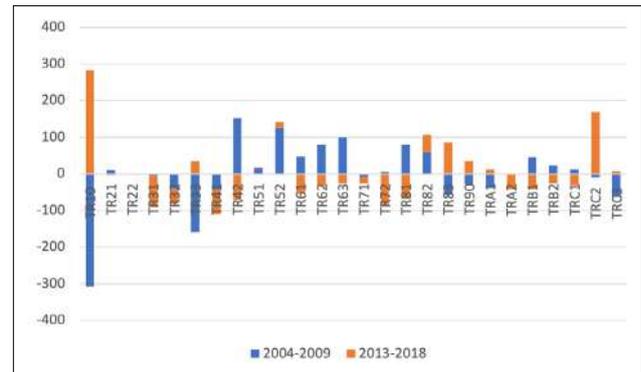


Figure 6. Comparison of the regional competitiveness effect component on employment growth.

Table 4. Income levels of regions that improved competitive performance after DAs

High-income Regions	Middle-high income Regions	Middle-low income Regions	Low-income Regions
TR10 İstanbul	TR33 (Manisa, Afyon, Kütahya, Uşak)	TR83 (Samsun, Tokat, Çorum, Amasya)	TRC2 (Şanlıurfa, Diyarbakır)
		TR90 (Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane)	TRC3 (Mardin, Batman, Şırnak, Siirt)
		TRA1 (Erzurum, Erzincan, Bayburt)	

Table 5. DSSA Results for the period of 2019-2023

NUTSII Regions	Total Change	NGE	IME	CE
TR10 (İstanbul)	791	708	239	-155
TR21 (Tekirdağ, Edirne, Kırklareli)	82	97	6	-19
TR22 (Balıkesir, Çanakkale)	111	83	-13	41
TR31 (İzmir)	139	194	38	-94
TR32 (Aydın, Denizli, Muğla)	56	148	-19	-73
TR33 (Manisa, Afyon, Kütahya, Uşak)	139	147	-35	27
TR41 (Bursa, Eskişehir, Bilecik)	276	197	42	35
TR42 (Kocaeli, Sakarya, Düzce, Bolu, Yalova)	330	183	22	125
TR51 (Ankara)	280	250	57	-28
TR52 (Konya, Karaman)	95	106	-16	3
TR61 (Antalya, Isparta, Burdur)	288	159	-14	142
TR62 (Adana, Mersin)	137	167	-9	-22
TR63 (Hatay, Kahramanmaraş, Osmaniye)	50	120	-6	-63
TR71 (Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir)	23	65	-15	-26
TR72 (Kayseri, Sivas, Yozgat)	132	99	-6	41
TR81 (Zonguldak, Karabük, Bartın)	9	44	-7	-28
TR82 (Kastamonu, Çankırı, Sinop)	17	38	-16	-5
TR83 (Samsun, Tokat, Çorum, Amasya)	57	133	-55	-21
TR90 (Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane)	47	128	-64	-15
TRA1 (Erzurum, Erzincan, Bayburt)	51	43	-17	26
TRA2 (Ağrı, Kars, Iğdır, Ardahan)	29	40	-27	18
TRB1 (Malatya, Elazığ, Bingöl, Tunceli)	-21	70	-20	-73
TRB2 (Van, Muş, Bitlis, Hakkari)	43	68	-28	3
TRC1 (Gaziantep, Adıyaman, Kilis)	122	109	0	13
TRC2 (Şanlıurfa, Diyarbakır)	134	102	-35	68
TRC3 (Mardin, Batman, Şırnak, Siirt)	134	55	-1	81

competitiveness in employment growth performance. In other words, it has been observed that the internal advantages of the region on economic growth have increased in these regions.

The subsequent years following the comparative analysis periods, 2019-2023 were analyzed using regional employment data for 2019, 2020, 2021, 2022 and 2023. Current period DSSA results can be evaluated together with the socio-economic changes, and crisis periods during the period (Covid-19 pandemic, Kahramanmaraş centered earthquakes). The results of DSSA for the 2019-2023 period are presented in the table 5.

In the 2019-2023 period, the total employment change at the national level is 3.5 million. During this period, the largest growth occurred in Istanbul, and the second largest employment growth occurred in the Antalya region. In the 2019-2023 period, the region with the highest regional competitiveness factor is TR61 Antalya Region, followed by TR42 Kocaeli Region, TRC3 Mardin Region and TRC2 Diyarbakır-Şanlıurfa Region, respectively. In current period TRC3 Mardin Region and TRC2 Diyarbakır-Şanlıurfa Regions, the two of the four lowest income regions of the country, stand out with their CE performance. This is seen as a positive situation in terms of regional development policies and points to the existing potential. According to findings of the DSSA, from different income groups TR62 Adana, TR63 Hatay, TRB1 Malatya, TR71 Kırıkkale, TR81 Zonguldak, TRB2 Van, also TR51 Ankara, TR31 İzmir, TR32 Aydın regions have negative CE within 2013-2018 and 2019-2023 periods.

The contribution of dynamic shift share components to regional employment growth during the 2019-2023 period is shown in the Figure 7.

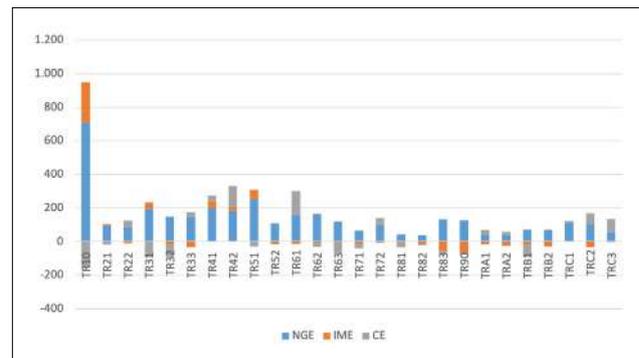


Figure 7. Contribution of the DSSA components to growth in 2019-2023 period.

The CE components of TRC1, TRC2 and TRC3 regions are positive as Southeastern Anatolian Region’s sub-regions. This situation observed after 2010, thus it can be evaluated that activities of DAs with the existence of GAP Project has affected the competitive potential of the region positively.

The growth performances of the NUTS2 regions in the mentioned periods were examined with the correlation analysis with the financial supports given by the DAs, taking into account both GDP and employment growth. The statistical analysis results obtained are shown in the Table 6.

The results of the statistical correlation analysis indicate that there is a middle-low positive linear correlation between the financial support of DAs and the GDP growth and employment growth of the regions.

Table 6. Correlation Analysis Results

			GDP	Employment	Agency Support
Spearman’s rho	GDP	Correlation Coefficient	1.000	0.693**	0.503**
		Sig. (2-tailed)	.	p=0.000	p=0.009
		N	N=26	N=26	N=26
	Employment	Correlation Coefficient	0.693**	1.000	0.458*
		Sig. (2-tailed)	p=0.000	.	p=0.018
		N	N=26	N=26	N=26
	Agency Support	Correlation Coefficient	0.503**	0.458*	1.000
		Sig. (2-tailed)	p=0.009	p=0.018	.
		N	N=26	N=26	N=26

** correlation is significant at the 0.01 level (2-tailed); * correlation is significant at the 0.05 level (2-tailed).

CONCLUSION

In Türkiye, where interregional inequalities are high, new regional development policies began to be implemented during the EU harmonization process after 2000, and DAs were established to accelerate regional development. Within the scope of this research, the effects of Türkiye's post-2000 regional development policies were analyzed comparatively for separate periods, both before and after the establishment of DAs. According to the economic growth performances of the regions, during the period before 2010, the effects of rapid national economic growth were significant on regional economies. On the other hand, with the decrease in national growth rates in the 2013-2018 period, the sectoral composition effect and especially the regional competitiveness effect were seen to be the determinants of regional growth. According to DSSA results, while the highest employment growth occurred in high-income regions during the 2004-2009 period, the TRC2 Diyarbakır-Şanlıurfa and TR83 Samsun regions ranked 3rd and 5th, respectively, among the 26 NUTS II regions during the 2013-2018 period. In the 2013-2018 period, the regions with the highest regional competitiveness effect were TR10 Istanbul, TRC2 Diyarbakır-Şanlıurfa, TR83 Samsun, TR33 Manisa, TR90 Trabzon, TRA1 Erzurum, and TRC3 Mardin. As for the 2019-2023 period, the highest employment growth was again realized in high-income and metropolitan regions. However, the highest competitiveness effect was seen in the TR61 Antalya, TR42 Kocaeli, TRC3 Mardin, and TRC2 Diyarbakır-Şanlıurfa regions during 2019-2023. The results show that the internal competitiveness advantages of sub-regions in the Southeast Anatolian Region, where the GAP project is being implemented, increased relatively compared to other regions after 2010, when DAs began to operate. On the other hand, regions from different income groups, including TR62 Adana, TR63 Hatay, TRB1 Malatya, TR71 Kırıkkale, TR81 Zonguldak, TRB2 Van, as well as TR51 Ankara, TR31 Izmir, and TR32 Aydın, experienced negative CE within the 2013-2018 and 2019-2023 periods.

Türkiye has a special geography in terms of historical, economic, social, and cultural aspects, as it is located near the continents of Asia, Europe, and Africa and has been a main transit route throughout history. Due to these characteristics, it has been affected by historical turning points, significant changes, and transformations. As a result, the country consists of regions that are quite different from each other in terms of income, development levels, and structural characteristics. As Iammarino et al. (2019), Diemer et al. (2022), and Pike (2020) argued, and as Tekeli (2009) suggested, it is clear that approaches based on genuineness and place-sensitive strategies are needed to address the challenges of increasing inequalities and discontent. The research findings indicate the necessity of good governance at all levels and strengthened institutional capacity in all regions. It has been observed that strengthened institutions, in terms of governance processes, the financial resources they use, qualified expert staff, and close relations and coordination with the central and local governments, are important for the success of regional

development policies. It is recommended that, based on the different structures and needs of regions, rather than relying on uniform institutions, supra-regional DAs and localized, urban-scaled DAs should be established in low-income regions. Additionally, urban-scaled DAs focusing on specific fields in higher-income regions are necessary for regional development and real progress in Türkiye.

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REFERENCES

- Akıncı, M. & Yılmaz, Ö. (2014). Türkiye'de sektörel istihdam ve bölgesel kalkınma ilişkisi: Shift – Share (değişim payı) analizi. *İstanbul Üniversitesi İktisat Fakültesi Mecmuası*, 63(2), 25–51.
- Andrikopoulos, A., Brox, J., and Carvalho, E. (1990). Shift-share analysis and the potential for predicting regional growth patterns: Some evidence for the Region of Quebec, Canada. *Growth and Change*, 21, 1–10.
- Aydoğdu, A. & Sezer, M. (2018). Kalkınma ajanslarının turizmin gelişmesine etkileri: Kuzey Anadolu Kalkınma Ajansı-Kastamonu örneği. *International Journal of Social Humanities Sciences Research*, 19, 584–601.
- Bakır, H. & Bahtiyar, G. (2019). Sustainable development and its applicability through regional development agencies. *Yönetim ve Ekonomi Araştırmaları Dergisi*, 17(1), 1–21.
- Bachtler, J. (2001). Where is regional policy going? Changing concepts of regional policy. 22nd meeting of the Sponsors of the European Policies Research Center. University of Strathclyde.
- Bachtler J. & Yuill, D. (2001). Policies and strategies for regional development: A shift in paradigm?. (Regional and Industrial Policy Research Paper:46). Glasgow: European Policies Research Center.
- Barff, R. ve Knight, P. L. (1988). Dynamic shift-share analysis. *Growth and Change*, 19(2), 1–10.
- Bellini, N., Danson, M., & Halkier, H. (2012). *Regional Development Agencies: The Next Generation? Networking, Knowledge and Regional Policies*. Routledge Taylor & Francis Group.
- Brenner, N. (2003). Metropolitan institutional reform and the rescaling of state space in contemporary Western Europe. *European Urban and Regional Studies*, 10(4), 297–324.
- Cörvers, F. & Mayhew, K. (2021). Regional inequalities:

- Causes and cures. *Oxford Rev Econ Pol*, 37(1), 1–16.
- Çetinkaya, Ş., & Akkurt, İ. M. (2016). Türkiye’de kalkınma ajanslarının istihdam üzerindeki etkisi: Zafer kalkınma ajansı örneği. *Uşak Üniv Sos Bilim Derg*, 9(3), 254–277.
- Çelebi Deniz, Z., & Erkut, G. (2022). Development agencies in Turkey: an inter-regional performance assessment. *Innovation: Innovation: The European Journal of Social Science Research*, 1–29.
- Danson, M., Halkier H., & Damborg, C. (2017). *Regional Development Agencies in Europe*. Routledge.
- Devlet Denetleme Kurulu. (2014). Türkiye’nin Kalkınma Ajansları Uygulamasının Değerlendirilmesi Araştırma ve İnceleme Raporu.
- Çelebi Deniz, Z. (2023). Türkiye’de bölgesel gelişme ve kalkınma ajansları: Bölgeler arası performans değerlendirme modeli [PhD Thesis], Istanbul Technical University.
- Dicken, P. (2015) *Global Shift: Reshaping the Global Economic Map in the 21st Century* (7th Ed). Thousand Oaks.
- Diemer, A., Iammarino, S., Rodríguez-Pose, A., & Storper, M. (2022). The regional development trap in Europe. *Economic Geography*, 98(5), 487–509.
- Dijkstra, L., Garcilazo, E., & McCann, P. (2015). The effects of the global financial crisis on european regions and cities. *Journal of Economic Geography*, 15 (5), 935–949.
- Doğan, T., & Kındap, A. (2019). Regional economic convergence and spatial spillovers in Turkey. *International Econometric Review*, 11(1), 1–23.
- Devlet Planlama Teşkilatı. (2003). *Ön Ulusal Kalkınma Planı (2004-2006)*. Devlet Planlama Teşkilatı Yayını.
- Devlet Planlama Teşkilatı. (2006). *Dokuzuncu Kalkınma Planı (2007-2013)*. Devlet Planlama Teşkilatı Yayını.
- Dunn, E.S. (1960). A statistical and analytical technique for regional analysis. *Papers of the Regional Science Association*, 6, 97–112.
- Elburz, Z., & Korten, F. G. (2018) Looking for diversified specialization in the regions of Türkiye, *MEGARON*, 13(4), 623–635.
- Ertugal, E. (2017). Challenges for regional governance in Türkiye: The role of development agencies. *METU J Fac Archit*, 34 (2), 203–224.
- Erkut, G. & Sezgin, E. (2017). Bölgesel politikalar için Etkin İş Birliği Projesi, Değerlendirme Raporu ve Politika Önerileri. Diyarbakır: T.C. Karacadağ Kalkınma Ajansı Yayını.
- Farole, T. (2013). *The Internal Geography of Trade: Lagging Regions and Global Markets*. World Bank Publications.
- Gezici, F. & Hewings, G. J. D., (2003, August 27-30). Spatial Analysis of Regional Inequalities in Türkiye [Paper presentation]. 43rd Congress of European Regional Science, Jyväskylä, Finland.
- Günaydın, D. (2012), Türkiye’de bölgeler arası gelişmişlik farklarının giderilmesinde kalkınma ajansların yeri: İZKA mali destek programları örneği. *Dokuz Eylül Üniv Sos Bilim Enst Derg*, 15, 73–01.
- Gündem, F. (2017). Is there income convergence between nuts 2 territories in Turkey? A spatial statistical and spatial econometrics contribution. *Sosyoekonomi*, 25 (34), 145–160.
- Halkier, H. (2007). Regional development agencies and multilevel governance: European perspectives. In *Bölgesel Kalkınma ve Yönetişim Sempozyumu* (pp. 3-15). ODTÜ Mimarlık Fakültesi. https://www.tepav.org.tr/sempozyum/2006/bildiri/bolum1/1_1_halkier.pdf.
- Haynes, K. E., & Dinç, M. (1997). Productivity change in manufacturing regions: A multifactor Shift Share Approach. *Growth and Change*, 28, 201–221.
- Huaxiong, Z., & Fang, Y. (2011). Research on regional economic and industrial structure based on dynamic shift-share analysis: An empirical analysis of six provinces in Central China. <https://ieeexplore.ieee.org/document/6003827>.
- Iammarino, S., Rodríguez-Pose, A., & Storper, M. (2019). Regional inequality in Europe: Evidence, theory and policy implications. *Journal of Economic Geography*, 19(2), 273–298.
- Karahasan, B. C. (2020). Can neighbor regions shape club convergence? Spatial Markov chain analysis for Turkey. *Letters in Spatial and Resource Sciences*, 13(2), 117–131.
- Kartal, T., & Karşıyakalı, B. (2023). Türkiye’de bölgesel gelir eşitsizliği: Düzey-2 bölgeleri bazında yakınsama analizi. *Pamukkale Üniv Sos Bilim Enst Derg*, 59, 61–82.
- Kayasü, S., & Eldeniz, F. (2013). Institutional performance of İzmir Development Agency. *METU J Fac Archit*, 30(1), 57–78.
- Kayasü, S., & Yaşar, S. S. (2006, Eylül 7–8). Avrupa Birliği’ne üyelik sürecinde kalkınma politikaları. Yasal ve kurumsal dönüşümler. *TEPAV, Bölgesel Kalkınma ve Yönetişim Sempozyumu*, pp. 199–215, Türkiye.
- Kırankabeş, M. (2013). Yeni bölgesel kalkınma politikasının yerel aktörleri olarak kalkınma ajanslarının etkinliğinin değerlendirilmesi: Türkiye örneği. *Dumlupınar Üniv Sos Bilim Derg*, 35, 253–268.
- Knudsen, D. C. (2000). Shift-share analysis: Further examination of models for the description of economic change. *Socio-Economic Planning Sciences*, 34(3), 177–198.
- Lagendijk, A., Kayasu, S., & Yaşar, S. (2009). The role of regional development agencies in Türkiye: From implementing EU directives to supporting regional business communities? *European Urban and Regional Studies*, 16(4), 383–396.
- Márquez, M. A., Ramajo, J., & Hewings, G. J. D. (2009). Incorporating sectoral structure into shift-share analysis. *Growth and Change*, 40, 594–618.
- McCann, P. (2020). Perceptions of regional inequality and

- the geography of discontent: Insights from the UK. *Regional Studies*, 54(2), 256–267.
- McMichael, P. (2012). *Development and social change: A global perspective* (5th ed.). Thousand Oaks.
- Ministry of Development. (2013). *Development Agencies General Activity Reports for 2012*. <https://static.ka.gov.tr/files/11/FaaliyetRaporlari/KA2012Yili-GenelFaaliyetRaporu.pdf>
- Ministry of Development. (2014). *Development Agencies General Activity Reports for 2013*. https://static.ka.gov.tr/files/11/FaaliyetRaporlari/KA2014_Y%C4%B1%C4%B1_Genel_Faaliyet_Raporu.pdf
- Ministry of Industry and Technology. (2018). *Kalkınma Ajansları 2017 Yılı Genel Faaliyet Raporu*. <https://www.sanayi.gov.tr/assets/pdf/plan-program/Kalk%C4%B1nmaAjanslar%C4%B12017Y%C4%B1%C4%B1GenelFaaliyetRaporu.pdf>
- OECD. (2012). *Promoting growth in all regions*. https://www.oecd.org/en/publications/promoting-growth-in-all-regions_9789264174634-en.html
- OECD. (2019). *Regional outlook 2019*. Paris: https://www.oecd.org/en/publications/oecd-regional-outlook-2019_9789264312838-en.html
- OECD. (2023). *Regional development policy*. <https://www.oecd.org/en/topics/regional-development.html>
- Otsuka, A. (2016). Regional energy demand in Japan: Dynamic shift-share analysis. *Energy, Sustainability and Society*, 6, 10.
- Özkan, Ç., Saçılık, M., & Yeşiladağ, B. (2014). Kalkınma ajanslarının sürdürülebilir bölgesel turizmin gelişimine etkisi: GMKA örneği. *Karamanoğlu Mehmetbey Üniv Sos Ekon Araş Derg*, 2014(2), 34–44.
- Öztürk, A., & Gültekin, L. (2021). Türkiye’de iller arası ekonomik yakınsama: 2008 Küresel krizinin rolü. *Hacettepe Üniv J Fac Econ Admin Sci*, 39(2), 253–270.
- Pehlivan, P. (2013). Türkiye’de kalkınma ajanslarının yerel ekonomi üzerine etkileri: Zafer Kalkınma Ajansı örneği. *Manisa Celal Bayar Üniv Sos Bilim Derg*, 11(3), 412–438.
- Pektaş, E., & Demirkol, A. (2018). Kalkınma ajanslarının bölgesel kalkınma sürecindeki rolü ve etkileri: Zafer Kalkınma Ajansı örneği. *Celal Bayar Üniv Sos Bilim Derg*, 16(2), 77–98.
- Pernia, E. M., & Quising, P. F. (2003). Trade openness and regional development in a developing country. *The Annals of Regional Science*, 37, 391–406.
- Pike, A., Pose, A. R., & Tomaney, J. (2017). *Local and regional development*. Routledge Publishing.
- Pike, A. (2020). Coping with deindustrialization in the global North and South. *International Journal of Urban Sciences*, 26(1), 1–22.
- Rodríguez-Pose, A. (2013). Do institutions matter for regional development? *Reg Stud*, 47(7), 1034–1047.
- Sakarya, B., Baran, V., & İpek, M. (2024). Türkiye’de iller arasında gelir farklılıkları: Kulüp yakınsama analizi. *Bölgesel Kalkınma Derg*, 2(1), 9–27.
- Sayıştay Başkanlığı. (2018). 2017 Yılı Kalkınma Ajansları Genel Denetim. <https://www.sayistay.gov.tr/reports/OqY74r3oN1-2018-yili-kalkinma-ajanslari-genel-denetim-raporu>
- Sezgin, E., and G. Erkut. 2020. “Kalkınma Ajansları ve Türkiye’de Mekansal Planlama Sisteminin Dönüşümü [Development Agencies and Transformation of Spatial Planning System in Turkey],” in Dinçer İ, Enlil Z. (Ed) *Kent ve Planlama*. YEM yayın İstanbul 149–168
- Shi, C., & Yang, Y. (2008). A review of shift-share analysis and its application in tourism. *The International Journal of Management*, 1, 21–30.
- Sobczak, E. (2012). Smart specialization of workforce structure in the European Union countries – Dynamic analysis applying shift-share analysis method. *Comp Econ Res*, 15(4), 219–232.
- Şahin, İ. E. A., & Kabayel, M. (2017, September 21–24). Sürdürülebilir kalkınma sürecinde kalkınma ajanslarının rolü: İZKA örneği. *International Congress of the New Approaches and Technologies for Sustainable Development*, Isparta, Türkiye.
- Şahin, M., Uysal, Ö., & Kuru, E. (2015). Türkiye turizm politikasının shift-share analizi. *Marmara Univ J Econ Admin Sci*, 32(1), 95–122.
- Şimşek, A. (2013). Kalkınma Ajanslarının Performans Ölçümü. *Kalkınma Bakanlığı Yayını*.
- Tarı, R., Pehlivanoğlu, F., & Özbilgin, M. (2017). *Dokuz Eylül Üniv J Econ Admin Sci*, 32(2), 47–78.
- T.C. Resmi Gazete. (2006). 5449 sayılı Kalkınma Ajanslarının Kuruluşu, Koordinasyonu ve Görevleri Hakkında Kanun. <https://www.mevzuat.gov.tr/MevzuatMetin/1.5.5449-20110213.pdf>
- T.C. Resmi Gazete. (2018). 4 No’lu Cumhurbaşkanlığı Kararnamesi: Bakanlıklara Bağlı, İlgili, İlişkili Kurum ve Kuruluşlar ile Diğer Kurum ve Kuruluşların Teşkilatı Hakkında Cumhurbaşkanlığı Kararnamesi <https://www.mevzuat.gov.tr/MevzuatMetin/19.5.4.pdf>
- Tekeli, İ. (2009). Türkiye’de bölgesel eşitsizlik ve bölge planlama yazıları. *Tarih Vakfı Yurt Yayınları*.
- Tomaney, J. (2010). *Place-based approaches to regional development: Global trends and Australian implications*. Australian Business Foundation.
- Türkoğlu, M. (2016). Kalkınma ajanslarının bölgesel kalkınma açısından önemi: BAKA örneği. *Uluslararası Alanya İşletme Fak Derg*, 7(3), 183–198.
- Yıldırım, J., Özyıldırım, S., & Öcal, N. (2004). Regional income inequality and economic convergence in Türkiye: A spatial data analysis. *Int Reg Sci Rev*, 32(2), 221–254.
- Yücel, B. (2024). Türkiye’de hangi iller bölgesel kalkınma tuzağında? *Değerlendirme Notu*. Türkiye Ekonomi Politikaları Vakfı.
- Wieland, T. (2019). REAT: A regional economic analysis toolbox for R. *REGION, The Journal of ERS* 6(3), R1–57.



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Article

Barriers to ensuring continuity in urban facades identity, legal tools-based analysis: The case of Iran

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ABSTRACT

With the increase in construction activities under the effects of neo-liberal policies, especially in metropolitan cities, the urban management system faces the critical issue of striving for an urban identity. This study seeks to reveal the awareness of national urban laws and regulations regarding the urban identity concept in the scope of urban facades and silhouettes. On the other hand, the problems experienced and visible in urban silhouettes and identity are indicators of awareness regarding the legislation and the deficiencies and obstacles arising from its implementation. Iran, a developing country with different layers of identity such as culture and religion, is selected for this research. The research focuses on the case of Iran in two essential components. Firstly, it aims to demonstrate the awareness of legal tools in the scope of the necessity for the continuity of urban identity and silhouettes. Then, it reveals the real implementations in urban areas, which show the loss of identity and continuity in the urban facade and silhouette.

The most reliable way to reveal this is through urban silhouettes and facade visuals. In this case, the visuals of the buildings built during the Pahlavi period, the buildings from the first years of the revolution, and those being built today as city and architecture interfaces show the lack of identity and the loss of continuity of the facade in their most distinctive features.

Since architectural development and urban areas are always subject to social and political development, the era after the Islamic Revolution of Iran, as one of the most important political, social, and cultural events, was chosen to evaluate city facades and identity. In this study, a comprehensive literature review was conducted, in which the legislation, including legal sources, laws, and regulations, as well as historical periods, maps, and visual sources, were examined. The requirements of the legislation and real practices were compared with the support of visuals.

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INTRODUCTION

Urban landscape, as defined by Cullen (2003), is the structural and visual integrity of the series of buildings, streets, and places that form urban areas. Urban identity is created by the various elements that make up an

urban region, including streets, squares, public spaces, and buildings. Therefore, the urban landscape has been described as a space with a unique material composition, color, texture, and form. Stated differently, Norberg-Schulz believed that each area has its essence, the 'Genius Loci' (Vecco, 2020). On the other hand, the intangible factors

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that shape urban areas are urban policies and motivations, religious and cultural aspects, and inspirations from other civilizations (Kelly, 2019). Cities' unmeasured growth, combined with the effect and pressure of competitiveness and global urbanization, causes a loss of primary or acquired identity qualities. Identity is the distinct characteristic of a place and a way of representing natural, cultural, and man-made components of the city, as distinctive physical and visual features that shape the images of the place (Ziyadeh, 2018; Ujang, 2012; Carmona et al., 2010). A city's identity features, such as its aesthetics, are discernible in all urban settings, including streets.

On the other hand, interfaces exist between nature and the city, masses and voids, meaning and spaces, and shape and activity. Interfaces serve as the transitional areas between different architectural forms, influencing how we perceive the urban environment. Dovey & Wood (2015) define interfaces as assemblages that connect various elements at different scales, such as streets, buildings, and neighborhoods (Dovey & Wood, 2015). Urban interfaces exist in the transition between public and private spaces. For example, street interfaces are formed by aggregating masses and the spaces between buildings (Orhan, 2018).

Thus, the phenomenon known as the 'identity crisis' is one of the subjects that many cities are dealing with, as streets, landscapes, and mass constructions have not left any significant impact on the quality of today's modern cities (Kasravi et al., 2020; Majidi et al., 2021). On the other hand, urban identity should reflect the perception of society and individuals observing the city (Şahin, 2022). It means an effective and positive connection, in other words, a sense of belonging between the place and the individual (Altanlar, 2021). Recently, by presenting "themes" for residential environments, the identity and image of an ideal place to live have been artificially copied and shown to users (Garip & Garip, 2015).

After the Second World War, there was a shift towards prioritizing economic aspects in urban design and planning. This led to the formation of rational urban spaces and the adoption of a modernist approach, while ignoring social dimensions and natural environments (Madanipour, 2006; Bal, 2007). According to Mumford, the city of that era symbolized the strengths of modernity, in which every perspective of life had to be controlled (Imrie & Street, 2009; Mumford, 1961). Thus, bureaucracy became the outcome of this era, starting in the early 20th century. The interrelationship between bureaucracy, urbanism, and the regulation of daily life in the city are important subjects in urban governance literature (Imrie & Street, 2009). Since the 1980s, the implementation of large-scale urban projects began with the neoliberal policies followed by governments (Yollu, 2006). Different interventions by the state supported this process.

In the past century, the management of urban spaces has evolved significantly. Today, there are alternative development regulations, new types of organizations, and large management associations (Ben-Joseph, 2009) involved in global urban management, all of which differ from traditional approaches. In this regard, the urban environment is a collective endeavor affected by diverse stakeholders (Carmona, 2009) and decision-makers. This process was accompanied by the eclectic designs of post-modernism with different architectural styles. The identity crisis created by all these interventions in urban spaces, which affected both conceptual and physical areas (Amiri, 2017), is becoming visible in today's cities through inharmonious landscapes and architecture.

Urban identity can be lost due to the impact of new and dense constructions and the functional changes of buildings, even when they maintain their architectural character. Spatial and functional changes become vital determinants in the transformation of the urban spaces surrounding them, and the adaptation of new functions directly affects the identity of urban space (Seçmen & Süyük, 2021).

Therefore, the behavior of society is influenced by architectural and urban features in cities (Amiri, 2017). Thus, the urban facade/view, which serves as an urban interface and emerges as a socio-spatial assemblage, forms urban identity and the quality of urban spaces, playing a vital role in urban structure (Tavakoli, 2010). It is also the most important part of cities for this influence. In recent decades, the decision-making process in neoliberal cities has been under the authorization of urban elites and private agents. Cities are managed with the collaboration of the private sector through neoliberal urban policies, with the strategy of gaining a place in the global urban network (Miro, 2011). In this context, urban regulations by the government, as a specific type of rule, have played an important role in the design of the built environment (Baer, 1997). Despite the wide scope of urban management, here it refers to the general performance of the country's governments against endogenous and exogenous events and their sequences. This situation appears to be more common, especially in developing countries.

In European architecture, facade characteristics are closely related to the city and its urban spaces, as well as its cultural, social, and environmental aspects. Despite the diversity of shapes, the buildings were relatively harmonious, even in their attempts to provide the best quality in their main facades. On the one hand, the building faces the urban space and establishes a reciprocal relationship with the city with maximum architectural style in the facade's design (Alishah et al., 2016). Although identity and facade issues have been examined since the 1960s and '70s in the West (Kasravi et al., 2020), it has only recently become a subject in developing countries like Iran.

Iran settled some of the world's oldest civilizations and had cities such as Hegmataneh (Iran, Median Empire). Hence, urban management systems in the country can be traced back to the past. On the other hand, in the Middle East, Iran was among the states that first emerged and were recognized within the international political system (Soheili & Diba, 2011). The country's urban management systems changed significantly after the 1920s when the First Pahlavi era began. Modernity and nationalism replaced localism and ethnic identity during this period with an effective central government. Particularly, the architecture of this era was primarily influenced by the trend of ancient nationalism, where the bulk and volume designs were derived from historic structures without explicitly imitating the shapes or features of Achaemenid, Parthian, or Sassanid architecture (Figure 1). Figure 1 shows buildings whose facades were designed decisively using ancient elements and symbols in Iran during the First Pahlavi era (Figure 2) and buildings whose structures were designed based on ancient elements without direct imitation (Figure 2). In comparison, the identity crisis is apparent in the eclectic view of today's Iranian streets (Kasravi et al., 2020) (Figure 3).

The maintenance of continuity in urban identity, as a reposition of different experiences and cultures, has now become an unreachable parameter for metropolitan and historical cities. Various types of academic research debate the urban management, urban planning paradigm, and the government's stance on planning programs in the developing country of Iran (Charbgoog & Mareggi, 2020; Pilehvar & Kamali, 2010; Farhoodi et al., 2009; Rasoolimanesh & Jafar, 2013; Pilehvar, 2020). Against these studies, this research tries to reveal the differences between the awareness of urban legal sources and real implementation in Iranian cities. The research is structured into five sections to address the following questions: Which laws emphasize the necessity of continuity of facade identity in the scope of

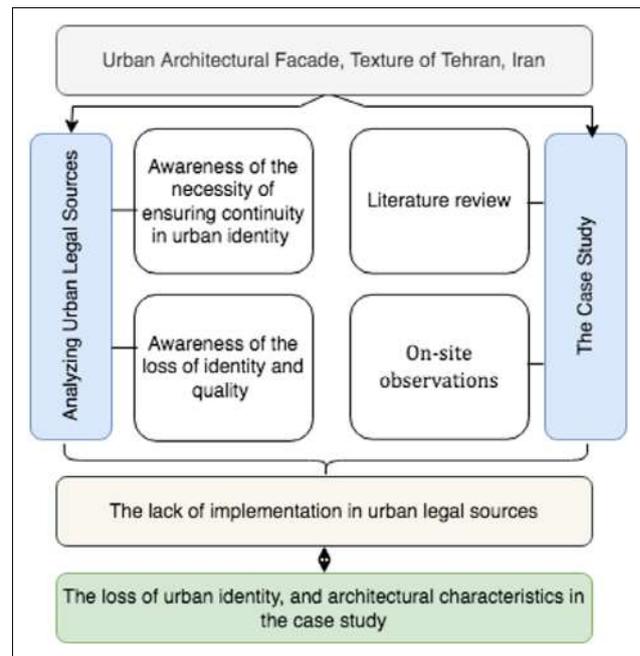


Figure 2. Research design.

the urban silhouette? In which laws is the awareness of the continuity of facade identity present? What are the barriers to ensuring continuity in Iran's facade identity/silhouettes despite the understanding of urban legal sources?

Literature Review

Given the rapid growth of urbanization and the increasing number of constructions in recent years, the heterogeneity and visual alteration in the "faces" of cities have become a supplementary part of visually polluting urban landscapes (Gjerde, 2010). Building facades, as one of the indicators of visual pollution in today's cities, are considered one of the urban features that provide essential information for citizens



Figure 1. (Left) Police Palace, Tehran (1936); (Right) Ministry of Foreign Affairs, by Gabriel Gorkian, Tehran (1933-1937) (Yousefi, 2019; Wikipedia, 2024; Hakim, 2001).



Figure 3. Facade/view, and city/ building interface of Tehran, Iran.

to establish a correct relationship with the environment. Architectural structures and the street interfaces in which they are situated are key elements that both create the city and give it its identity (Orhan, 2018). Unfortunately, this relationship between the building, architectural structures, facade, and atmosphere—briefly, city and architecture interfaces—is often neglected (Salingaros, 1999). Heterogeneous structures in form, color, and material are placed together so inconsistently that one might think "maybe it's intentional" (Hight & Chris, 2011; Amiri, 2017). Pedestrian-oriented environmental design is an issue that has been ignored in today's cities, causing them not to meet human aesthetic, emotional, identifiable, and cultural needs. The confusion and disorganization in the city's appearance show no strong connection between architecture and culture (Naghizadeh, 2000; Amiri, 2017). Modern architecture has altered the face of urban public spaces by inviting infrastructures, automobiles, and industrial buildings into cities. Subsequently, the constitution of so-called "industrial cultures" has undeniably changed our sense of urban spaces and their cultural landscapes.

As Ziyae (2018) mentioned, many of the current urban issues arise from industrialization and modernism that emerged in the 19th and 20th centuries, manifesting in many urban layers (Table 1). In particular, the two main trends of urbanization and globalization significantly influence urban settings. While identity and facade issues have been studied in the West since the 1960s and 1970s (Kasravi et al., 2020), developing nations such as Iran have only recently turned their attention to them. There are numerous studies analyzing the architectural characteristics, identity, and silhouette of urban areas. Examples from these studies are summarized in Table 1. However, research that discusses the influence of legal source awareness and the differences between this awareness and real implementation is very limited. This study is original due to its examination of urban legal sources connected to the historical periods of the country (specifically after the Islamic revolution) and the loss of continuity of facade identity and silhouette as reflected in reality.

Table 1. Urban facade and identity through urban research literature.

Author	Matter	Method	Scope
Rapoport, 1990	The meaning of the built environment.	Professor Rapoport explains a new framework for comprehending how the built environment develops to have significance for both individual people and entire civilizations through examples and vignettes derived from a variety of cultures, historical periods, and modern America.	Studying the relations between urban environments and the reactions of their users based on the meaning that the environment provides for users.
Bahrainy & Aminzadeh, 2007	Evaluation of Navab Regeneration project in central Tehran, Iran.	An analysis of the Navab Regeneration Project in central Tehran using a post-construction/post-occupancy evaluation.	Analysing place identity through Regeneration of a high way Project.
Shamsuddin & Ujan, 2008	The sense of a place for traditional streets.	Users of the streets were surveyed and interviewed in person to learn more about place attachment and how it affects place identity.	Highlighting place attachment concept and its significance in creating the sense of place.
Alishah et al., 2016	The role of building facade on the urban landscape.	The library approach and document analysis have been the techniques employed in the data collection process. The content was examined utilizing the inductive reasoning method to study building facade designs within the historically documented urban environments.	Revealing the dominant figure of the urban body as facade and urban landscape and its effect on the citizen's outlook, with the case of Sari.
Ziyadeh, 2018	Evaluation of urban identity through a pattern of cultural landscapes.	A paradigm for study that emphasizes the place's identity based on its cultural features.	The need for special notice of the cultural and social appearances of places transformed in the urban planning/design process.
Sadeghifar et al., 2019	The relationship between building facade and people preferences.	A total of 124 students enrolled in three faculties at Golestan University were given a photo-questionnaire survey.	Exploring the importance of urban building facade on visual quality of the city and the user's perception.
Montazer et al., 2019	The influence of 18 th and 19 th century Russian Neoclassical architecture on the architecture of Iranian managerial-service buildings.	Descriptive-analytical research methods have been employed, while historical-interpretive research methods have been utilized to gather historical theoretical foundations.	To examine the part of Russia in using European architecture and western architectural components in Iran, and to specify patterns of Russian neoclassical architecture and capture them in Iran's administrative-service buildings.
Askarizad and Jafari, 2019	The influence of Neoclassic facades on urban textures.	Using statistical analysis method.	The importance of designing buildings and their effect, with the case of Iran.
Kasravi et al., 2020	The principality of existence, approach to the identity of urban facades.	The qualitative study uses written materials to support its conclusions, which are reached by applying logical and philosophical reasonings.	This article aims to find the philosophical cause for the sense among urban experts and practitioners.
Jokar et al., 2021	Assessment of urban identity in newly built neighbourhoods.	The Pardis neighborhood's identity components are examined, and the neighborhood's status is evaluated and examined in light of the urban identity indicators examined in the literature.	Evaluating elements of identity in newly built neighborhoods raises the cognizance of researchers and city managers to find effective plans to solve their problems.
Farhad et al., 2021	Architectural identity and spatial belonging in historical neighborhoods.	A questionnaire survey was administered to a sample of 300 respondents as part of this quantitative study to evaluate the associations between the elements of architectural identity and place attachment.	Examining the relationship between architectural identity (supplementary tie pattern, symbol, and ornament) and the attachment of the space.

RESEARCH METHOD

The research focuses on the Iranian case in two essential components. First, it aims to demonstrate the awareness of legal tools in the scope of the necessity of the continuity of facade identity and silhouette. Then, it reveals the real implementations in urban areas, which show the loss of identity and continuity in the urban facade and silhouette. Since architectural development and urban areas are always subject to social and political development, the period after the Islamic Revolution of Iran, as one of the most important political, social, and cultural events, is selected for evaluating the place of urban facades, identity, and city and architectural interface development in the urban legal sources. A comprehensive literature review is used in this study to analyze the selected period, visual resources, and legal sources, including laws and regulations, supported by visuals to compare laws and real implementations.

The analysis is based on revealing the difference between the urban legal sources and the implementation in urban areas by considering the binding nature of the legal sources for everyone. It is a frequently mentioned subject in the literature that architecture and urbanism are affected by socio-political events. Therefore, the period after the revolution was chosen because it was the beginning of an important socio-political era in Iran. Islamism and anti-Westernization characterize the period after the 1979 Islamic revolution, which is the subject of the analysis in this research (Fazeli, 2005).

Case Study

As an ancient civilized country, Iran has a long history of modern urban planning. A country with a top-down planning framework has a highly centralized governance system (Shahab et al., 2021; Alvanchi et al., 2021). Although Iran is historically strong, its social, political, and economic fields have witnessed significant changes, especially from the Pahlavi period to the present day. Iran, with its strategic position (between the Persian Gulf and the Caspian Sea), has played the role of an East-West link (Golkarian, 2019). Sariolghalam (2007) defines identity in Iran as a kind of harmony between Iran, Islam, and Western liberalism (Figures 1 and 3). In this regard, Iran and Iranian culture are sources of territorial and historical identity, Islam is a source of spiritual identity, belief, and a broad socio-political worldview, and Western liberalism is a philosophical resource with economic, political, and cultural applications.

These processes and changes brought different institutional organizations as well as time-oriented policies, which implicitly affected urban management systems as well. Increasing power and state system concentration, the White Revolution (Enghelabe Sefid), the 28 August 1953 coup, the implementation of development programs,

and increased economic and cultural exchanges with the West are examples of these changes. The result was the emergence of scattered and uncoordinated urban planning and architectural rules in the country, which manifests in the appearance and facades of the cities (Figures 1 and 3).

The formation of urban governance has also been affected, resulting in spatial and identity consequences. The following analysis reveals contingent historical events and intersections or junctures that make up the Iranian cities and architecture interface. The main factors that played key roles in the development trajectories in the planning area of Iran fall under three main headings: (1) actors, (2) urban planning systems and regulations, and (3) other external events. In this study, the laws and regulations introduced—rather than the role of the actors—are discussed in different historical events, especially in the period after the Islamic Revolution.

The real feature of Iranian cities was presented by Dr. Abbas Akhondi, Iran's Transportation and Urban Development Minister (2013-2018), who stated: "...When you walk in the city, it is as if the buildings are slapping you, and they have ridiculed your whole identity and being..." (Setavin, 2020).

I would like to emphasize the UNDP (United Nations Development Programme) statement in contrast to this paragraph: "Iran has been home to organized urban settlements since at least 4000 BC, and even from those times, the history of Iran has been intertwined with the history of the region as a whole" (Arefian & Moeini, 2016). Iran, as a modern developing country with a complicated national system, faced different political periods and unfair capitalism growth and modernization throughout history, which have influenced Iranian restructuring (Valadbaygi, 2020; Ziyadee, 2018). The country has experienced modern aspects of life in traditionally developed cities (Ebrahimpour, 2011). Iran also experienced a rapid transition from a traditional civil society during the First Pahlavi¹ (Nationalism-Nativism) era and testimony to the Islamic Revolution (Islamism-Anti Westernization) and war (Iran-Iraq war) (Fazeli, 2005). These contingent historical events shaped and reorganized urban management and structure systems, causing a shift from path dependence to new path creation at a critical juncture of the era. In this context, the Pahlavi dynasty was one of the most complicated and revolutionary periods in Iranian political and social history. The First Pahlavi era monarch tried to destroy the traces of Islamic identity and characteristics in the national identity and highlight the identity of Iranian culture (Soheili & Diba, 2011) (Figure 1). With the social transformation and the construction of industrial and modern Western buildings and houses, neoclassical facades replaced the old buildings on the wide streets that were characteristic of the European model (Hashemi, 2019).

The legalization of these practices in the cities was through

the Street Widening Law of the period. The process of modernization accelerated after the 1960s with the White Revolution reforms during the second Pahlavi era. In this period, two factors contributed to changes in attitudes towards building materials and technology. First, the modernist view led architects to simplify exterior views and internal components. Second, there was a necessity for construction using fast and cheap instruments (Hasanpour & Soltanzadeh, 2016). Therefore, to manage the population crisis in urban centers, the resulting technology provided the basis for the emergence of a type of building characterized by a box-shaped volume with a vaulted roof, constructed with the help of iron beams and bricks. This process continued to evolve in the following years (Hasanpour & Soltanzadeh, 2016). The second Pahlavi period marked the development of modern architecture and the international style, which led Iranian architecture to move away from the old Iranian concept of extroversion and embrace high-rise construction, a new practice previously not possible in Iran.

These contingent historical events and external changes brought about new urban legal sources, institutional structures, and management systems. The period after the victory of the Islamic Revolution was marked by intensified changes. The values of the revolution, the influence of Western postmodern pluralist ideas, and the production of paradigms different from the traditional culture of society caused many transformations in architecture and the urban landscape (Habib & Hoseyni, 2010). In this context, Iranian cities' views, urban facades, architectural characteristics, identity, and quality became—and remain—the most important issues, similar to other developing countries.

These changes can be discussed using the example of introversion, an ancient feature of Iranian architecture that distinguishes it from other architectural styles (Figure 4) (Gharehgheshlaghi, 2019). The priority of constructing public and industrial buildings alongside social transformation was an indication of the westernization of

the country. The focus was on reconstructing the old core of Iranian cities. New westernized buildings and homes with neoclassical facades replaced old buildings, and wide avenues were introduced, following the characteristics of the European pattern. These projects were generally funded by the urban elite, which began the socioeconomic degradation of the urban environment (Hashemi, 2019). Tehran, the capital city during this era, was completely transformed into a modern and industrialized city. The source of these reforms was abundant oil income. As mentioned, the Street Widening Law, under the purview of the Ministries of Justice and Interior, legalized these implementations during the First Pahlavi era. Since then, city management and physical planning have become the focus of municipalities. The westernization of Iran can be interpreted in this way: it was an event that did not take the form of an invasion or attack but was accepted by the majority of people (Japalaghi et al., 2019; Farzaneh, 2011).

While the second Pahlavi government placed a strong focus on the preservation of cultural assets, it also began to restore and protect historical sites. Traditionalist and Islamic architectural approaches, Iranian archaism (national style), and modern architectural approaches were all reflected in the urban facade and architectural characteristics of Iranian cities during the First Pahlavi era. In contrast, the Islamic and traditionalist architectural approaches, modernism, and Iranian quasi-modernism were reflected in the urban facade and architectural characteristics of Iranian cities during the second Pahlavi era (Haghjou et al., 2019). These periods had spatial, visual, and aesthetic effects on urban facades and architectural areas, which gradually led to the loss of continuity in urban facade identity. Interestingly, this issue has frequently been mentioned by decision-makers and practitioners and is referenced in Iranian urban legal sources. Table 2 summarizes some of the legal sources of Iran that address the lack of urban quality and uniqueness in different forms.

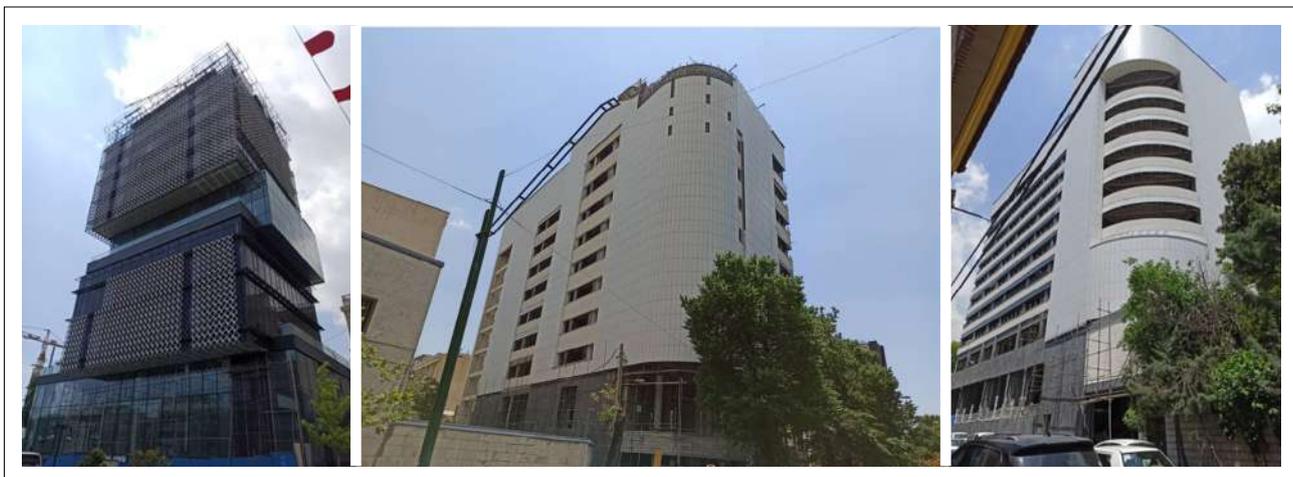


Figure 4. Today's facade of buildings under construction, Tehran, Iran.

Table 2. Emphasis on the loss of urban identity and continuity through laws analysis, the case of Iran (The Era after the Islamic Revolution).

Law/Legal Sources	Approval Year	Related Content/ sentence on the subject	Approval authority
Enactment on the Preventing the Increase of City Limits.	November, 1999	Increasing the area of cities causes the destruction of agricultural lands, scattering and ugliness of the appearance and landscape of the city.	High Council of Architecture and Urban Development
Enactment on the National Document of Architecture and Urban Planning of Islamic Iran	April, 2015	The need to improve the quality of the building and the landscape of cities and as a result to improve the architecture and urban planning of the country.	High Council of Architecture and Urban Development
Enactment on the Competitiveness Plan of Cities	March, 2017	Accelerated process of urbanization and urbanization of settlements.	High Council of Architecture and Urban Development
Enactment a New Approach to Preparing Comprehensive Urban Plans	June, 2018	The trend of quality reduction of cities during the last 2 decades.	High Council of Architecture and Urban Development
Enactment on Unauthorized Constructions in Urban Areas	August, 2018	Irregular and illegal development of cities.	High Council of Architecture and Urban Development
Enactment of the National Document of Architecture and Urban Planning of Islamic Iran	August, 2020	The need to recover the Iranian-Islamic identity, The importance of orderly and integrated organization of urban spaces at different scales; school mosque house interactions.	High Council of Architecture and Urban Development

In other words, it has been accepted that Iranian cities, especially megacities such as Tehran, lack urban identity and quality. Providing continuity in urban identity is possible through the definition of the framework and requirements in urban laws and regulations, which serve as sanction tools. In this context, many laws and regulations were enacted to ensure urban identity and continuity in Iran. Some of the most relevant laws are summarized in Table 3. As shown in Table 3, most of the laws enacted after the Islamic revolution emphasize the preservation of Iranian-Islamic architectural features and their reflection in urban designs.

Many features of Iranian architecture have decreased or disappeared in today's structures (Figure 4 and Figure 5). "Urban identity" and "architectural identity" are two interrelated issues because if the architectural process loses its connection to Iranian civilization and culture, it creates space for the supremacy of a type of disconnected, incompatible, and imported architecture (Ghorbaniyan, 2004; Amiri, 2017). Stuart Hall² believes: "Identity is a process of change that is a cause for certification and recognition. Some know identity as a communicative concept that gains meaning with similarities and differences with others." Iranian architecture and urbanism are testimonies to regaining their special status as they face a developing

society experiencing processes of industrialization, globalization, and networking.

The adaptation from the traditional to the modern city and from the modern city to networking is updating the whole world and creating both positive and negative effects on societies. For example, some hallmarks of Iranian urban design were simplicity, introversion, and anthropomorphism. Islamic ideology has changed the scale, patterns, and architectural morphology by combining building style and urban development with the Islamic ideology of privacy as intimacy (Farzaneh, 2011). Iranian cities also experienced rapid adaptation from conventional society to modern society without creating the necessary scientific, engineering, cultural, and artistic infrastructures. In such cases, a network society emerges in Iranian cities (Ghorbaniyan, 2004; Amiri, 2017). Many Iranian intellectuals understand Iran's current identity as a society comprising three layers: religion, national culture, and modern culture and civilization. These layers are inherent in each Iranian's essence, and the proper connection of these three layers, in proportion to the spirit of time and space, can be instrumental in completing the contemporary identity of Iranian society (Amiri, 2017). Urban planning and architectural rules in Iran are scattered and uncoordinated.

Table 3. Related laws for the necessity of ensuring the urban identity, the case of Iran, (The Era after the Islamic Revolution).

Law/Legal Sources	Approval Year	Related Content/sentence on the subject	Approval authority
Rules And Regulations of The City Facade	November, 1990	The need for aesthetically and harmoniously Building facades with displaying high-quality materials, in the passages.	High Council of Architecture and Urban Development
Rules and Regulations of Iranian-Islamic Architecture and Urban Planning	October, 1996	Consideration of the mosque as a central landmark of cities in all plans.	High Council of Architecture and Urban Development
Rules and Regulations for Increasing and Improving the Quality of Appearance and Urban Landscape	November, 2008	In cities with sloping cover, the color of the material and the slope limits should be in harmony with the appearance and urban landscape, In submitting the volumetric plan of buildings to obtain a building permit, coordination and harmony between volumes in terms of material and color of materials, morphology in neighborhood units is required.	High Council of Architecture and Urban Development
Enactment on Improving the Quality of Appearance and Urban Landscape	December, 2011	The need to consider the natural, historical, and cultural characteristics of the region in urban design and the characteristics of Iranian Islamic architecture.	High Council of Architecture and Urban Development
Enactment on the Competitiveness Plan of Cities	March, 2017	Improving the quality of life and economic and social development of cities and creating contextual differences in cities. Changing the approach in the urban management system, the importance of urban competitiveness.	High Council of Architecture and Urban Development
Enactment a New Approach to Preparing Comprehensive Urban Plans	June, 2018	Prioritize urban regeneration policy Paying attention to historical and cultural and natural capacities of the cities. Paying attention to the specific conditions of each city such as historical and culctural and economic.	High Council of Architecture and Urban Development
General Criteria for the Installation of Tall Buildings in Iranian Cities	August, 2019	It is necessary to build tall buildings in the city in terms of alignment with the landscape and the role defined for the city.	High Council of Architecture and Urban Development
Enactment of the National Document of Architecture and Urban Planning of Islamic Iran	August, 2020	Creating the grounds for the continuation of Iranian Islamic thought and culture in contemporary architecture city by compiling and approving the principles and indicators of Iranian-Islamic architecture and urban planning based on the common spiritual heritage of Islamic Iran based on rationality and using the techniques, skills, and methods in the periods of Iranian history and responding to the needs and requirements of the present era in line with the Iranian-Islamic model of progress. Preservation and revival of Iranian-Islamic urban architectural patterns.	High Council of Architecture and Urban Development

Table 3. Related laws for the necessity of ensuring the urban identity, the case of Iran, (The Era after the Islamic Revolution) (Cont.)

Law/Legal Sources	Approval Year	Related Content/sentence on the subject	Approval authority
Enactment Regarding the Design of Urban Passages	June, 2021	Improving the quality of urban sidewalk design.	High Council of Architecture and Urban Development
General Criteria for Designing Facades of Urban Buildings	March, 2024	Improving the quality of the urban appearance as a public right, creating grounds for the realization of Iranian-Islamic architectural indicators and native architecture, providing the context for the emergence and development of the identity of the place in the urban facades, the coordination of the facades of the buildings with the characteristics of the natural, historical and cultural background of the city, and reducing visual inconsistencies.	High Council of Architecture and Urban Development

**Figure 5.** Facade/view, and city/ building interface of Tehran, Iran.

DISCUSSIONS AND CONCLUSION

The 1973 legislation creating the Iranian High Council of Architecture and Urban Development is the most significant application in the field of architecture and urbanism (Rezafar, 2023; Asemanabi, 2020, Mejlis 96910, 2020). The goal of the law was to raise people's standard of living, support Iranian architecture as an art form, promote identity and traditional architectural styles, and showcase the distinctive qualities of that architecture by incorporating new scientific and technical advancements while also taking local needs, lifestyle preferences, and weather patterns into consideration. Thus, the emphasis on qualitative issues in urban contexts is reflected in the law's goals. The council is the primary body that considers urban design and qualitative concerns in the city's later comprehensive planning stages. The council first brought the need for "aesthetically and harmoniously building facades with high-quality materials in the passages" to the agenda in 1990.

Shortly after the rate of urbanization began to rise, the council (1999) criticized the "scattering and ugliness of the appearance and scenery of the city" and focused on stopping

the expansion of city borders. The most effective regulations in the field of ensuring urban identity were implemented in 2008 by the council. The regulation emphasizes the harmony of color, material, and slope limits with the appearance and urban landscape. The need to consider the area's natural, cultural, and historical features was consolidated into a comprehensive document by the council in 2011. In 2015, the council took the matter of bettering the nation's architecture and urban planning seriously and voiced its criticism. The loss of continuity in urban facade identity, along with the need to ensure identity, was highlighted in the legislation and regulations passed from 2017 to 2020 by the council. Laws and regulations have been passed specifically to protect urban identity beyond 2020. The most recent regulation, "General requirements for designing facades of urban buildings," was approved in March 2024. This regulation clearly emphasizes the need to reduce visual inconsistency (Tables 2 and 3). Compared to the preceding political regimes, more urban rules and regulations have been passed since 1978, demonstrating that there are complications, particularly with urban planning, facade design, continuity, and identity management.

Figure 4 reveals the current facade of the structures that are being built in Tehran. It can be said that these facades have little to do with the Islamic architecture of Iran, which is emphasized in the laws and regulations. This situation (Figure 4) demonstrates problems in implementing the laws and regulations and controlling facade designs in urban areas. Urban development during this time reflects the government's traditionalist attitude and preference for modernity, even in the face of the enforcement of Islamic laws and regulations in all areas of administration (Madanipour, 2006). The lack of specialized design policies in the field of urban planning, together with a lack of coordination and cross-sectoral cooperation among relevant institutions, can be highlighted as obstacles to ensuring the continuity of urban facades' identity in Iran.

Cultural, social, economic, technological, and political dynamics have caused growth, transformation, and even the loss of city identities. The loss of historical background, urban silhouette, facade, and context has affected the continuity of urban facade identity and the city and architecture interface. Iranian distinctive, traditional architecture with identity was influenced by architectural art, which was greatly affected by Iran's profound contact with the West. As a result, Iranian towns looked very different from those of earlier periods before the Pahlavi, and modernity was infused into Iranian architecture through the repurposing of Western art.

The phenomenon of urban identity plays an important role in today's urban planning and design agenda. While legal frameworks emphasize the importance of preserving historical continuity and ensuring urban identity, challenges persist in the effective implementation of these regulations. The most reliable way to reveal this is through urban silhouettes and facade visuals. In this study, the actors playing a role in urban planning were not considered. However, considering that the laws are mandatory for everyone, it reveals that the actors who implement urban regulations or control the implementation of these regulations should play a more effective role. Otherwise, as seen in the country, a board such as the High Council of Architecture and Urban Development may be the only institution that approves both the destruction and loss of urban facade identity and the need to ensure urban facade identity at the same time. This may mean that a single institution is insufficient to ensure the continuity of urban facade identity. To ensure the continuity of urban facade identity, conscious decision-makers, along with mandatory laws and regulations, are needed simultaneously.

NOTES

¹Pahlavi era: 1925–1941 is considered the First Pahlavi era, and 1941–1978 (The Islamic Revolution) is considered the Second Pahlavi era.

²Stuart Hall is one of the most influential theorists of British Cultural Studies. Stuart Hall is a Jamaican immigrant who focuses on ideological and cultural themes, but he also has important opinions and suggestions on these concepts in the field of communication (Gökgül, 2022).

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REFERENCES

- Alishah, M., Ebrahimi, A., & Ghaffari, F. (2016). The role of buildings facades on urban landscape, case study: Old context of Sari. *TOJDAC*, 6, 1347–1356.
- Altanlar, A. (2021). The impact of place attachment of historical neighborhood residents on tourism support. *MEGARON*, 16(2), 325–335.
- Alvanchi, A., Jafari, M. A., Shabanlou, M., & Meghdadi, Z. (2021). A novel public-private people partnership framework in regenerating old urban neighborhoods in Iran. *Land Use Policy*, 109, 1–11.
- Amiri, N. (2017). Investigation of the factors affecting the identity crisis in contemporary designs and architectural styles of Iran. *J Hist Cult Art Res*, 6(3), 1104–1117.
- Arefian, F., & Moeini, H. (2016). Urban change in Iran, proceedings of the international conference, 8–9 November 2012, University College London, UCL, 16–73.
- Asemanabi. (2020). Date Conversion. <https://www.asemanabi.net/DateConvert>.
- Askarizad, R., & Jafari, B. (2019). The influence of neo-classical facades on urban textures of Iran. *J Hist Cult Art Res*, 8(2), 188–200.
- Baer, W. C. (1997). Toward design of regulations for the built environment. *Environ Plann B Plann Des*, 24, 37–57.
- Bahrainy, H., & Aminzadeh, B. (2007). Autocratic urban design the case of the navab regeneration project in Central Tehran. *IDPR*, 29(2), 241–270.
- Bal, U. (2007). Utilization of urban design principles in designing the urban space – case studies on the Netherlands and Turkey [Master's thesis, Izmir Institute of Technology].
- Ben-Joseph, E. (2009). Commentary: Designing codes: Trends in cities, planning and development. *Urban Stud*, 46(12), 2691–2702.
- Carmona, M. (2009). Designing coding and the creative, market, and regulatory tyrannies of practice. *Urban*

- Stud, 46(12), 2643–2667.
- Carmona, M., Tiesdell, S., Heath, T., & Oc, T. (2010). *Public places urban spaces: The dimensions of urban design*. Architectural Press.
- Charbgoon, N., & Mareggi, M. (2020). A framework for time studies in urban planning: Assessment of comprehensive planning in the case of Tehran. *Environ Plann B Urban Anal City Sci*, 47(6), 1098–1114.
- Cullen, G. (2003). *A selection of urban facade*. Tehran University Press.
- Dovey, K., & Wood, S. (2015). Public/private urban interfaces: Type, adaptation, assemblage. *J Urbanism Int Res Placemaking Urban Sustain*, 8(1), 1–16.
- Ebrahimpour, H. M. (2011). *A new approach to the Iranian urban planning, using neo-traditional development* [Doctoral dissertation, Technical University of Dortmund].
- Farhad, S., Maghsoodi Tilaki, M. J. & Hedayati Marzbali, M. (2021). Architectural identity and place attachment in historic neighborhoods: an empirical study in Sanandaj, Iran. *J Place Manag Dev*, 14(2), 148–162.
- Farhoodi, R., Gharakhlou, M., Ghadami, M., & Panahandeh Khah, M. (2009). A critique of the prevailing comprehensive urban planning paradigm in Iran: The need for strategic planning. *Plann Theory*, 8, 335–361.
- Farzaneh, M. (2011). *Urban development planning, regeneration and public participation: A comparison between the UK and Iran* [Unpublished doctoral dissertation, Newcastle University].
- Fazeli, N. (2005). Gençler ve Iran Islam devrimi sonrası yaşam tarzı. *Sosyol Sos Bilim Derg*, 56, 24–28.
- Garip, S. B., & Garip, E. (2015). Copying urban identity and pasting it on residential architecture: Themes for gated settlements in Istanbul. *MEGARON*, 10(4), 470–478.
- Gharehgheshlaghi, S. Z. (2019). *Public art in public space: Tracking graffiti and mural art practices in contemporary Tehran* [Master's thesis, Middle East Technical University].
- Ghorbaniyan, V. (2004). Principles and concepts in the contemporary architecture of the West. *Cultural Research Bureau*.
- Gjerde, M. (2010). Visual aesthetic perception and judgement of urban streetscapes. In *Building a Better World: CIB World Congress*. Salford, UK.
- Golkarian, G. (2019). Globalization and its impacts on Iranian culture. *Univ J Hist Cult*, 1(1), 1–11.
- Gökgül, A. N. (2022). Stuart Hall's contributions to cultural theory. *Boyut J Media Cult Stud*, 21, 55–70.
- Habib, F., & Hoseyni, A. (2010). An analysis of contemporary Iranian architecture in facing the phenomenon of globalization. *Hoviyate Shahr J*, 6, 29–38.
- Haghjou, A., Soltanzadeh, H., Tehrani, F., & Ayvazian, S. (2019). Tendencies and theoretical approaches of the architecture of government and governmental buildings of the first and second Pahlavi periods. *Sci Res J Islam Stud*, 15(34), 154–170.
- Hasanpour, N., & Soltanzadeh, H. (2016). The background factors of the evolution of contemporary Iranian architecture during the second Pahlavi period and its comparative comparison with Turkey. *Bagh-Nazar*, 44, 39–52.
- Hashemi, M. (2019). Embedded enclaves: Cultural mimicry and urban social exclusion in Iran. *Int J Urban Reg Res*, 43(5), 914–929.
- Hight, C., & Chris, P. (2011). Collective intelligence in design. *AD Mag*, 76(5), 5–9.
- Hakim, N. (2001). Gabriel Gurkian's Architectural Style of Public Buildings and Attributing the Design of the Buildings of the Ministry of Foreign Affairs and Justice to him. *Memar Journal*, 2001, 85-76.
- Imrie, R., & Street, E. (2009). Regulating design: The practices of architecture, governance, and control. *Urban Stud*, 46(12), 2507–2518.
- Japalaghi, G., Moradi, A. M., Memarian, G. H., & Hosseini, M. (2019). Consequences and the process of creating a historical disconnection in the last six decades of architecture and urbanism of Iran. *Int J Architect Eng Urban Plan*, 29(2), 183–193.
- Jokar, S., Hajilou, M., Meshkini, A. & Esmaeili, A., (2021). Assessment of urban identity in newly built neighborhoods; Case of Pardis Neighborhood in Ahvaz City, Iran. *GeoJournal*, 87, 4531–4546.
- Kasravi, R., Mansouri, S. A., & Barati, N. (2020). The "principality of existence" approach to the identity of urban facades. *Manzar*, 12(52), 38–45.
- Kelly, T. (2019). What are the factors behind the distinct character of mosques in Turkey and Iran? *Earth Environ Sci*, 385(012023), 1–12.
- Madanipour, A. (2006). Urban planning and development in Tehran. *Cities*, 23(6), 433–438.
- Majidi, M., Mansouri, S. A., Saber Nejad, J., & Barati, N. (2021). Landscape capacities in realizing the concept of participation in urban projects. *Manzar*, 13(54), 18–27.
- Mejlis 96910. (2020). Law on the establishment of the Supreme Council of Urban Planning and Architecture of Iran. <https://rc.majlis.ir/fa/law/show/96910>
- Miro, S. V. (2011). Producing a "successful city": Neoliberal urbanism and gentrification in the tourist city case of Palma (Majorca). *Urban Stud Res*, 2011, 1–13.
- Montazer, B., Soltanzadeh, H. & Hosseini, S., B., (2019). The effect of 18th and 19th centuries Russian neo-classical architecture on the architecture of Iranian administrative-service buildings (During Qajar and First Pahlavi Eras). *Bagh-e Nazar*, 16(70), 85-100.
- Mumford, L. (1961). *The city in history: Its origins, its*

- transformations, and its prospects. Penguin.
- Naghizadeh, M. (2000). The relationship of identity, tradition, and modernity in Iranian architecture with modernism. *Fine Arts*, 7, 63–64.
- Orhan, M. (2018). The impacts of the building and street interface relationship on urban space quality. In 4th International Conference on New Trends in Architecture and Interior Design. St. Petersburg, Russia.
- Pilehvar, A. A. (2020). Urban unsustainability engineering in metropolises of Iran. *Iran J Sci Technol Trans Civ Eng*, 44(3), 775–785.
- Pilehvar, A. A., & Kamali, N. (2010). The government and urban structure unsustainability in Iran. *Sustain City*, 6, 41–51.
- Rapoport, A. (1990). *The meaning of the built environment: A nonverbal communication approach*. University of Arizona Press.
- Rasoolimanesh, S. M., & Jaafar, M. (2013). Urban planning and management system in Iran: A review and assessment. *Middle East J Sci Res*, 18(2), 220–229.
- Rezafar, A. (2023). The effect of politics on the formation of urban aesthetics: The case of Iran. *Cities*, 132(104095), 1–20.
- Sadeghifar, M., Pazhouhanfar, M. & Farrokhzad, M., (2019). An exploration of the relationships between urban building facade visual elements and people's preferences in the city of Gorgan, Iran. *Architect Eng Des Manag*, 15(6), 445–458.
- Salingaros, N. A. (1999). Urban space and its information field. *J Urban Des*, 4(1), 29–49.
- Sariolghalam, M. (2007). The confrontation of liberalism and Islam in identity in Iran. *Jihad Daneshgahi Publications*.
- Seçmen, S., & Süyük, E. M. (2021). The urban and architectural characteristics of Voyvoda Street from past to present. *ICONARP Int J Architect Plan*, 9(1), 1–10.
- Setavin. (2020). Iran Shar – Islamic Iranian identity in architecture and urban planning. <https://www.setavin.com/529-Iran-city-Iranian-Islamic-identity-in-architecture-and-urban-planning>
- Shahab, S., Bagheri, B., & Potts, R. (2021). Barriers to employing e-participation in the Iranian planning system. *Cities*, 116, 1–9.
- Shamsuddina, S. & Ujan, N. (2008). Making places: The role of attachment in creating the sense of place for traditional streets in Malaysia. *Habitat Int*, 32, 399–409.
- Soheili, J., & Diba, D. (2011). How government systems have influenced the emergence of nationalist architectural movements in Iran and Turkey. *Bagh-e Nazar*, 4, 27–44.
- Şahin, Y. D. (2022). A spatial reading on environmental urban identity: The place of stamps as cultural heritage in urban memory. *MEGARON*, 17(3), 461–485.
- Tavakoli, N. (2010, July 12-15). The role of physical identity of city in urban sustainability. The case study: Yazd, Iran. In 14th International Planning History Society Conference, Istanbul, Türkiye.
- Ujang, N. (2012). Place attachment and continuity of urban place identity. *Procedia Soc Behav Sci*, 49, 156–167.
- Valadbaygi, K. (2020). Hybrid neoliberalism: Capitalist development in contemporary Iran. *New Political Econ*, 26(3), 1–15.
- Vecco, M. (2020). Genius loci as a meta-concept. *J Cult Heritage*, 41, 225–231.
- Wikipedia. (2024). FreeBSD. <https://en.wikipedia.org/wiki/FreeBSD>.
- Yollu, D. (2006). Mekân organizasyonu ve biçim kavramlarının tarihi yarımada örneğinde incelenmesi (Master's thesis, Yıldız Technical University).
- Yousefi, M., (2019). A comparative study of the influence of political thoughts on the architecture of Iran and Turkey in the years 1946-1956, *Shabak J Sci*, 6, 58–61.
- Ziyae, M. (2018). Assessment of urban identity through a matrix of cultural landscapes. *Cities*, 74, 21–31.



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Article

Diagnosis of an historical layer from urban context to building scale: The case of Istanbul, Levent Farm and Barracks

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ABSTRACT

This paper presents a methodological approach to the process of identifying the traces of Levent Farm and Barracks in the urban landscape of late 18th- and early 19th-century Istanbul, contextualizing and recording these structures as part of a settlement complex. The research methodology includes the preparation of a prediction map, inter-scale evaluations based on cross-referencing with written sources, and the correlation of the findings with historical geography and the contemporary urban context. In this way, the building traces determined by the exploratory field surveys have been holistically identified as part of the Levent Farm and Barracks and registered as tangible cultural heritage values. The research outputs offer a new perspective on the spatial development of 18th-century Istanbul in the context of urban history and urban archaeology, while revealing the potential of evaluating current planning and design processes together with the cultural heritage of the modern period and the potential of valuing different cultural layers as a whole.

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INTRODUCTION

The aim of this paper is to identify the context of the late 18th- and early 19th-century Levent Farm and Barracks settlement complex, the traces of which have been lost due to rapid urbanization in Istanbul, within the historical urban landscape and to provide an overview of the process of developing the prediction map required for exploratory field surveys. In this context, an analytical process was followed for the holistic evaluation of a potential urban archaeological site that reveals an important cultural heritage value in the urban development process of Istanbul. The Levent Region, which is the subject of the research, is

currently under the pressure of rapid urban transformation. In the process of demolition and reconstruction, the spatial qualities of the urban area, as well as traces of cultural heritage values within the urban fabric that have not yet been identified, are under the threat of losing their structural integrity. It is necessary to identify the widespread area in the urban landscape where this potential can be located and to identify the structural traces in relation to the existing urban context.

Based on these concerns and following the general definitions provided by the research project (Birik, 2022), this paper focuses on the development of a dataset for the diagnosis of spatial traces through exploratory fieldwork.

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HISTORICAL BACKGROUND

Today's Levent Region became an important part of the defense of the Bosphorus with the allocation of Levent Farm to Cezayirli Hasan Pasha in 1793, in the process of innovative breakthroughs and modernization of the army during the reign of Selim III (Ahmet Fâiz Efendi, 1993). During this period, the Bosphorus was a strategic waterway connecting the Black Sea to the Mediterranean, and thus had strategic importance in terms of eliminating threats to the capital of the Ottoman Empire from the north. As the first spatial organization of the Barracks within the framework of the regulations dated 1794 declared the New Order for military organization within the scope of "Nizam-ı Cedid," a modern settlement model was created in the farm area (Shaw & Ezel, 2002). Although the settlement was burnt and destroyed during the Janissary Revolt in 1808, it continued to be partially used, with repairs made in the following periods (Beydilli & Şahin, 2001). Levent Farm and Barracks is seen as the first modern settlement of the New Order period (Beydilli, 1995). The official records of the Ottoman Archives of the Prime Ministry of Türkiye (hereinafter referred to as BOA), dated 1805, indicate that this successful development was seen as a model and an example for new military settlements (BOA, 1805). The settlement consisted of two hospitals, schools, workshops, administrative buildings, two large barracks, and various social and technical infrastructure units, as well as agricultural facilities associated with the complex. In addition to military personnel, many foreign technical advisors and trainers were also accommodated. These inhabitants exceeded ten thousand at its peak (Beydilli, 1995). However, after the late 19th century, there are no records of this settlement complex, except for a few agricultural farms, dairies, and a few military outposts.

From the 1950s, in parallel with the modern urbanization process and new housing policies in Istanbul, residential constructions started to develop in the area, and the traces of the Levent Farm and Barracks were lost under the modern urban fabric. Until 2021, neither the location nor any structural traces of the old settlement were precisely identified, except for the Sultan Pavilion. Despite this significant cultural heritage potential, the Levent Region is best known for the Levent Neighborhoods, which were developed in the 1950s in accordance with new housing policies, and are now recognized as a leading cultural heritage site of the modern period of Istanbul. During this period, offering a new lifestyle and change with a better urban environment for the neglected city center, Levent was defined as the area where the city meets modernity (Karabey, 2011). As one of the first modern neighborhoods in Istanbul, the first phases of the Levent Housing Projects were designed with the garden city approach in 1947. The 4th Section, the last phase of the Levent Neighborhoods

completed in 1957, was developed in accordance with the legislation on multi-storey construction and the principle of progression of public and private spaces (Arú, 1992). With its public spaces, residences of different typologies, wide avenues, social areas, facades with decorative modern art, and shopping spaces with large car parks, the Levent 4th Section Housing Project attracted public attention (Arú, 1956). In movies and magazine reports from the 1960s and 1970s, the city's elite, traveling by "automobile" on "proper roads" between "housing blocks" and "villas with gardens" in the Levent Neighborhood, were offering an attractive lifestyle. Meanwhile, in terms of the contemporary daily life of the period, the Levent Region offered ideal opportunities to workers, artists, writers, middle-income civil servants, and those who wanted to build a new life a little far from the city center, yet close to it. In short, the modern life of Istanbul was being shaped here.

This spatial configuration and the lifestyle that the Levent Region presented spread to a wider area, providing connections to the housing projects that developed in the 1970s. This situation extended to Nispetiye and Büyükdere Avenues, on the upper level of the Bosphorus, which Prost defined as the "Corniche Superieure" in his 1944 plan. The region was seen as a potential site for large housing projects due to its characteristic wide property pattern resulting from its former military lands and farms. Through new transportation strategies and the decentralization of industry, the revival of the peripheries as an alternative to the tired urban fabric in the center was defined as a step towards creating the modern city (Bilsel, 2010). The foundations of integrated, permeable neighborhoods starting from Levent and extending to Akatlar, Etiler, and Uçaksavar Neighborhoods through Baltalimanı Valley were established in recognition of this potential (Birik, Aksoyak ve Çalışkan, 2022). This situation reveals that the residential areas that developed in the region until the 1980s were a continuation of the period that began with modern housing projects and the expansion of housing cooperatives, while at the same time continuing the modern culture described above.

Two different perspectives emerged from the planning approach that developed in historic cities between 1950 and 1970: the development of new settlements outside the center, which allowed for spatial expansion, or urban renewal practices that did not yet include holistic conservation strategies and damaged the historic fabric (Dinçer, 2011). Similarly, the modernization of cities in Turkey, which started in the mid-20th century, was based on the demolition and reconstruction method in historical centers. It can be said that this practice allowed the traces of cultural heritage to disappear and damaged the identity of the place (Tekeli, 1998). Today, the need for a holistic approach to urban identity in a broad geographical context within the scope of the historical urban landscape has been recognized (UNESCO, 2012). With this contemporary

approach, it is suggested that potential areas outside the historic core should be mapped and identified, their vulnerability to rapid urban development should be diagnosed, and they should be integrated into planning and design processes, bringing them together with daily life (UNESCO, 2012).

Accordingly, the Levent Region, which is located today in the central urban area of Istanbul, has faced the risk of losing the spatial qualities it accumulated throughout the modern period. The transformation of permeable neighborhoods into gated communities has accelerated, and the spatial identity of the Levent Region has changed as a result of new and fast transportation connections, rising rent values, and increasing non-residential use of the area. Although Levent Neighborhoods were declared an Urban Conservation Area based on their modern settlement characteristics in 2017, plan decisions such as the connection roads proposed to pass between neighborhood units and "special construction conditions" continued to change the existing urban characteristics. Therefore, it can be said that potential traces of cultural heritage from the 18th century are also under threat of destruction, as are the modern neighborhood heritage elements, which have been visible since 1950.

Based on this issue, the primary objective of the research was to identify, document, and record the surviving building traces of Levent Farm and Barracks to increase their visibility. It is also aimed to determine how urban layers shape each other by revealing the spatial interaction of modern architectural heritage with these potential archaeological sites in Levent, starting from the 18th century.

METHODOLOGY AND TOOLS FOR THE DIAGNOSIS

The methodological approach is based on the historical landscape approach (UNESCO, 2012) to define the overlapping of different layers of urban geography over time through the synthesis of information collected from archival documents, literature, and cross-referencing of spatial information from superimposed historical maps, plans, and projects.

Spatial data were evaluated with a holistic approach in part-whole interaction by considering inter-scale network relations in the urban landscape (Favory et al., 2012). In this approach, as in urban history and urban archaeology studies aiming to understand the processes of change and transformation of space, relational evaluations were made to understand and define the urban context in the historical process, including the location of the area within the urban geography, its functional connections, and the qualities of the buildings in this context (Butzer, 1980). A holistic approach is needed to conceptualize how the study area was established, developed, fragmented, and reconfigured over a series of periods. Therefore, spatial analyses are elaborated

in relation to each other from the urban scale to spatial sub-scales to understand change and transformation. These analytical approaches reveal not only the knowledge of a retrospective reading of space, but also clues to the transmission of memory by recognizing the interactions and connections between spaces that developed in different periods.

The historical maps, site plans, and aerial photographs were superimposed on the geographical coordinate system to provide a platform for mutual spatial evaluations. The findings obtained from written archival sources, such as BOA and Mihrişah Valide Sultan Foundation Records (hereinafter referred to as MVSV), were cross-examined with the spatial data. The unique topographical features of the Bosphorus were considered as important reference points for correlating different large-scale historical thematic maps and spatializing written documents. Considering similar characteristics and the current coordinate system, site plans of housing projects developed in the focus area between 1950 and 1960 obtained from the archive of Beşiktaş Municipality and aerial photographs from 1946 and onwards obtained from the General Directorate of Mapping of the Ministry of National Defense were used to create a common platform for spatial analysis.

The varying media noted above were superposed on the current coordinate system by geo-referencing (Benavides & Koster, 2006). This method can be described as overlapping the control points determined on maps prepared with different techniques to the common coordinate system using GIS tools. In urban archaeology studies, superimposing historical maps through the geo-referencing method is used for the detection of spatial traces in comparative analyses (Bitelli et al., 2009). Depending on the nature of each map, different geometric transformation methods can be applied based on the control points to transform historical maps with appropriate interpolation and position them on the current coordinate system (Balletti, 2006).

The concept of in-depth reading is discussed in the context of drawing technique, prominent geographical representations, semantic content, theme, and the relationship of the map with the geopolitical situation of the period. Among the 23 maps dated between the mid-18th century and the beginning of the 20th century, repeating maps were eliminated, and the maps that are the main source were selected. Geometric transformations were applied for in-depth reading to ensure the optimum level of alignments while preserving their semantic content. Each map was associated with the current coordinate plane based on the north direction, and at least three control points were kept constant by overlapping them to the coordinate system, and basic geometric transformations (trilateration and warping on the grid plane) were applied to ensure a minimum level of surface deformation.

HOLISTIC EVALUATION PROCESS

The discussion of the urban context in which the Levent Farm and Barracks interact is analyzed at three complementary scales to define the historical urban landscape as follows (Figure 1):

- Urban Area: Location within the urban structure through historical maps.
- Immediate Vicinity: Interactions with the immediate vicinity and definition of character zones.
- Focus Study Area: Structural elements and traces of the compound.

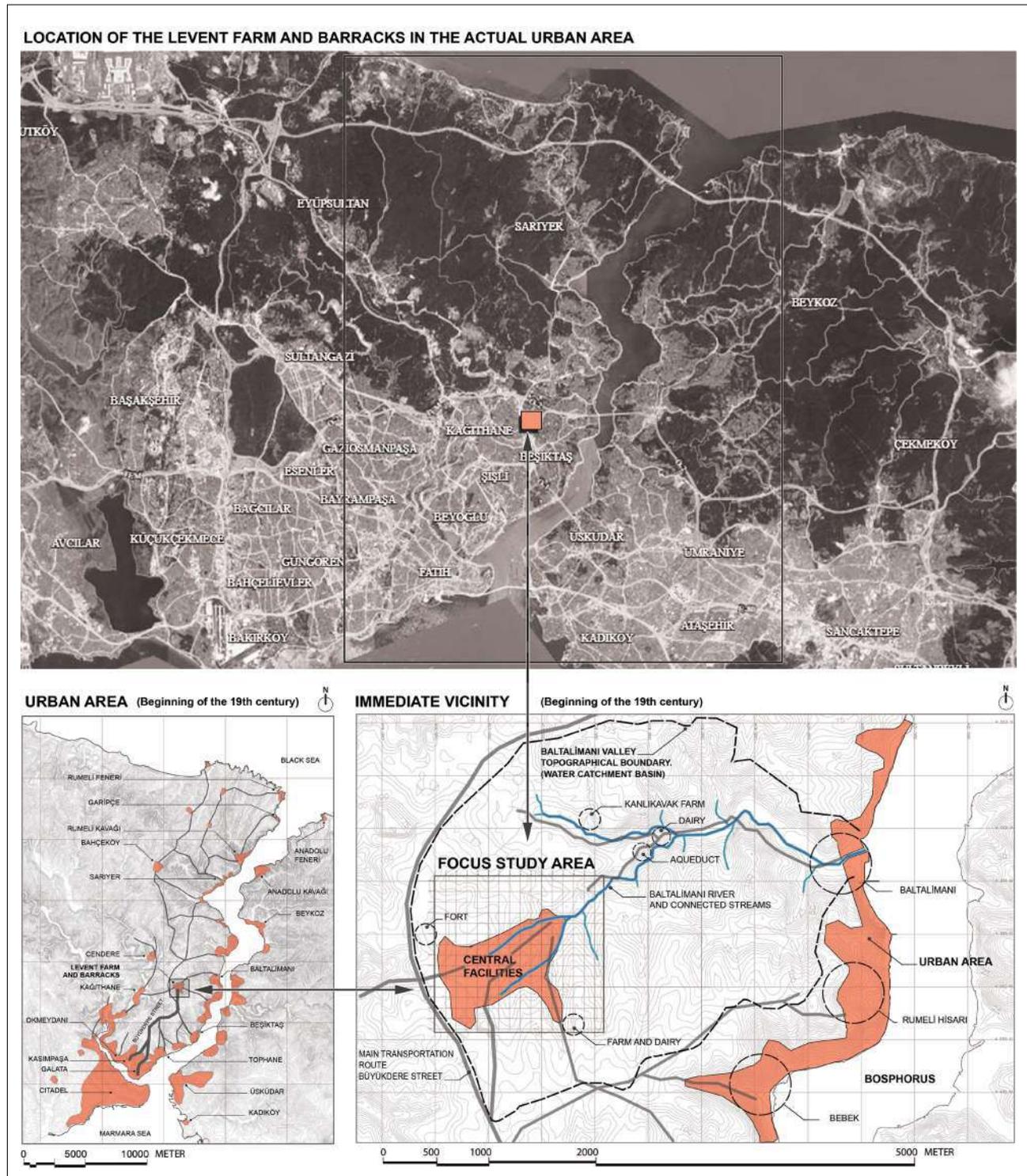


Figure 1. Three complementary scales for Levent Farm and Barracks to define its place in the historical urban context: Urban area, immediate vicinity and focus study area. (The maps were developed by the author using topographic maps obtained from the Istanbul Metropolitan Municipality database).

Urban Area: Location Within the Urban Structure Through Historical Maps

Four historical maps were selected to discuss the location of Levent Farm and Barracks within the spatial networks at the urban scale and its relationship with the city center. These maps stand out in terms of the number and representational quality of the control points and provide detailed spatial information for in-depth reading with reference to written sources.

From the beginning of the 18th century until the establishment of the Barracks in 1794, maps emphasized the strategic importance of the Bosphorus and showed the natural harbors and water resources. In this context, the map of Andelfinger (1703) is an important document that reveals the strategic value of the Bosphorus for the city center, which is also considered the first map that expresses the location of the farm before the Barracks and its relationship with other central nodes.

Guillaume Antoine Olivier's map (Olivier, 1801) stands out with its details describing the geological features of the Bosphorus (Lom et al., 2016). Levent Farm and Barracks is located within a strong transportation network with other military nodes built during the New Order and the city center (Şenyurt, 2016). Olivier's map provides information to support these evaluations. The farm, indicated on the map as the last central node in the north, is connected to Pera by land. From there, it reaches the Golden Horn shore where the shipyard is located via Okmeydanı and connects to Divanhâne, the military headquarters, and the armory in Kasımpaşa. Considering that the Kalyoncu Barracks and Mühendishâne, the Engineering School, where modern techniques were taught, are also located in Kasımpaşa, the importance of the Barracks' connection with military centers for the defense of the city is emphasized.

François Kauffer, who served the Ottoman Empire during the New Order movement, produced maps in accordance with the modern standards of the period by using new techniques and tools in terms of cartography (Pedley, 2012). The map (Kauffer, 1819), published after his death, was improved by Barbié du Bocage's additions, providing a comprehensive description of the entire Bosphorus shortly after the Janissary revolt (Pedley, 2012). The "Great Levent Farm," defined on this map, consists of different building clusters between the Baltalimanı Valley and Büyükdere Road. It is located on a plateau between two branches of the riverbed without any structural boundaries. The fact that the "Great Levent Farm" is connected to the "Cargo Port" on the shore of the Bosphorus via the road running parallel to the Baltalimanı River reveals its important relationship to the sea.

Despite Kauffer's detailed illustration, Franz Fried's map of Istanbul (Fried, 1821) illustrates the settlement as a single structure. It emphasizes the strong connection of the road passing through the Barracks with Baltalimanı and the Büyükdere Road and presents a connection of the Barracks with Kağıthane, where one of the important military nodes is located.

Helmuth Moltke's map (Moltke, 1849) provides detailed information on the identification of geographic references in comparison with contemporary maps. The expression "Ruins of Great Levent Farm Barracks" on this map describes the period 40 years after the Janissary revolt, indicating the buildings were abandoned. Unlike the Kauffer Map, the functions or names of the buildings are not noted, but the location of the two barracks and the Sultan Pavilion are indicated in a way that corresponds to their current locations.

The maps above and the records describing the characteristics of Levent Farm and Barracks demonstrate the central role and strategic position of the settlement complex in the defense of the Bosphorus line. In the late 18th century, with the allocation of Levent Farm and its immediate vicinity to Cezayirli Hasan Paşa, Levent Farm and Barracks became an important point of attraction for the central military hub in Kasımpaşa. Connections with the Shipyard and the Engineering School in Kasımpaşa reveal its strong relationship with the political, administrative, technological, and cultural breakthroughs of the New Order period in the urban context. In addition to strong road connections to the city center, there was also a strong connection by sea to the central port at Tophane, indicating that Baltalimanı was used as the port of this settlement. Considering the transportation networks and the echelon of functions within the urban geography, Levent Farm and Barracks was an important settlement in proximity to the center.

From the 19th century to the mid-20th century, there was no large-scale development in the region, and except for the old settlements along the Bosphorus coastline, the boundaries of the existing city did not yet reach Levent on the upper levels. As described in the historical background section, the Levent Region has developed and become a center of attraction since the 1950s with new housing policies, the development of nearby industrial areas, and new transportation plans.

Interaction with the Immediate Vicinity and Character Zones

The immediate vicinity of the study area was analyzed by dividing it into character zones, as the widespread settlement and unbounded structural form of Levent Farm and Barracks make it difficult to identify potential archaeological sites and building traces. The term "character zone" is used in urban morphological studies to describe the unique regions that result from the interaction of building, street, and property fabric with the surrounding physical environment and topography (Larkham & Morton, 2011). As a contribution to this background, and with reference to characteristics of place defined at general assemblies of the International Council on Monuments and Sites (ICOMOS, 1987; ICOMOS, 2011), the term "Potential Character Zones," as used in this paper, refers to areas of potential archaeological value as well as clusters of interrelated groups of building traces and natural features

under pressure from rapid urbanization.

Through the evaluation of the research project outputs, four potential character zones were identified that define the possible locations of structural traces within 500 meters of the focus study area and their relationship with the existing urban structure (Figure 2). Nodes such as the water reservoir in Kanlıkavak Farm and Baltalimani harbor are not evaluated in this study as they define the peripheral fifth zone.

- **Character Zone 1** is the plateau where the new and

old barracks, two hospitals, mosques, baths, kitchens, shops, stables, arsenal, fountains, water reservoirs, ponds, training grounds, squares, roads, and the Sultan Pavilion identified in archival documents from the early 19th century (BOA, 1800; BOA, 1803) overlap with the clusters of buildings indicated on historical maps.

- **Character Zone 2** can be considered a natural boundary surrounding Zone 1. In addition to the riverbeds, gardens, and agricultural areas, the roads connecting the plateau to the city center and the bridges that serve as gateways were in this threshold area.

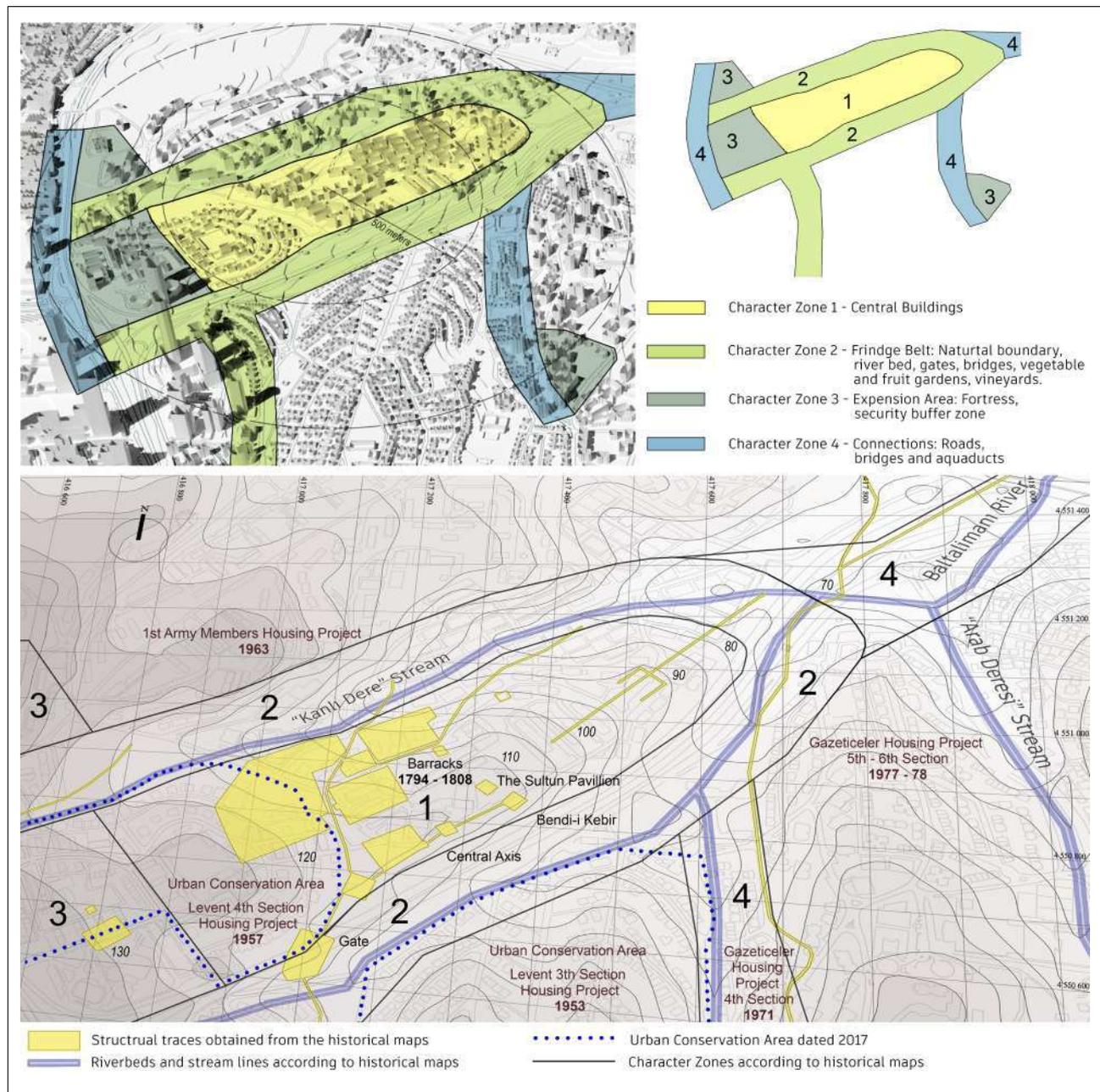


Figure 2. Structural traces according to historical maps referencing the character zones and topographical features within the existing urban structure.

- **Character Zone 3** is defined as the improvement area where new functions were added over time, including agricultural fields, farm buildings, infrastructures such as sewage drains and clean water ducts, and defense structures in fragmented sub-areas.
- **Character Zone 4** consists of natural corridors that provide connections and passages between built-up areas within the fragmented identity zones. It includes bridges and water supply structures following historical waterways and riverbeds.

Focus Study Area and Definition of Spatial Traces

The focus study area is the central cluster of building traces within Character Zone 1 selected for the exploratory field survey. This area is located within the boundaries of the Konaklar Neighborhood of Beşiktaş District and has been subjected to residential development since 1957.

At this stage, detailed maps, plans, and aerial photographs conveying building-scale information were added to the GIS environment, creating a prediction map showing the focus study area for exploratory field surveys. In addition to the spatial data located in the coordinate system, the gravure from Mahmut Raif Efendi's book dated 1798 (Beydilli & Şahin, 2001) and the drawing titled "The Plan Showing the Boundaries of the Area Around Baltalimanı and Kanlıkavak" dated 1873 (BOA, 1873) provide important spatial clues. While the gravure describes the building composition of Levent Farm and Barracks during the period when it was in active use, the 1873 plan, which presents the abandonment of the settlement, shows the prestige buildings and their descriptions on a central axis and pattern of central buildings (Figure 3).

Aerial photographs reveal that all the buildings associated with Levent Farm and Barracks in the focus study area were



Figure 3. Spatial change 1798-1966.

abandoned, in ruins, with only a few structural traces legible (Figure 3). The aerial photographs present the trace of two large rectangular buildings with courtyards and a cluster of building traces to the west. These traces complement each other when evaluated together with the traces of a group of buildings lined up on the central axis, which is also coherent with the 1873 plan. The location of the rectangular building traces and other structural clusters can be determined within the coordinate system, and necessary connections can also be made with reference to the Sultan Pavilion and the riverbeds, as their locations are known today. The photograph shows that the central buildings, whose exact location is not specified in the written sources, are located to the west of the rectangular building traces corresponding to the Barracks.

Through the superimposition of the spatial information and synthesis of findings described above, a prediction map was developed to locate potential central structures and identify their interaction with the existing urban pattern (Figure 4). As a result of the comparative analysis of the findings of the past periods with the current maps, it was revealed that four building traces in the present structural context could be identified on the prediction map, and the exploratory

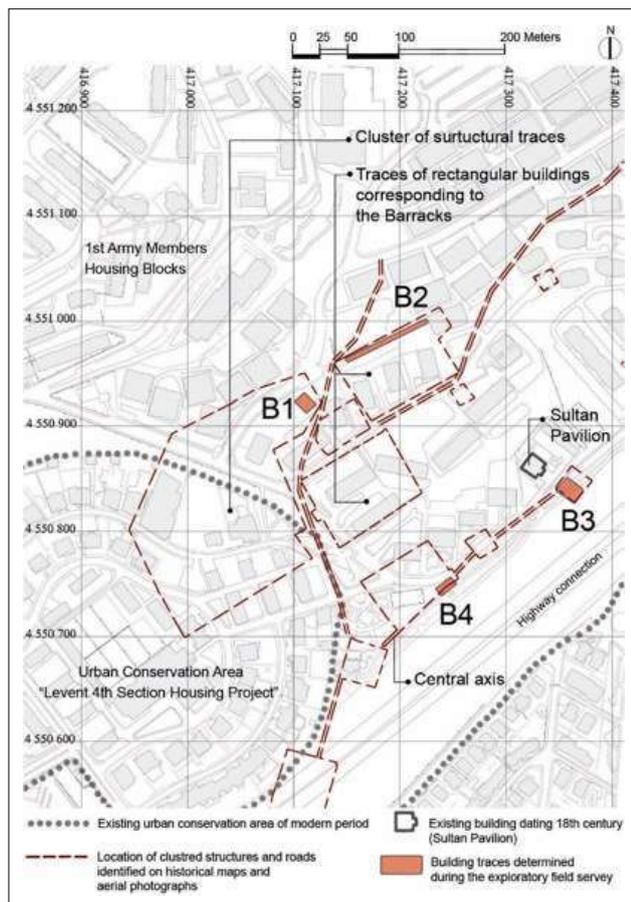


Figure 4. Prediction Map. Location of potential structures and building traces.

fieldwork phase was initiated. In this way, the conceptual framework for the location of the potential single structures to be identified was determined by establishing their relationship with the urban context.

The Building Trace 1: Bathhouse (Hamam) of Levent Barracks

The Building Trace 1 (B1 in Figure 4 and 5) is located between the proposed Barracks and the clustered building traces. Today, it is in the public area and is located 40 meters south of the road covering the branch of the riverbed visible in the 1946 aerial photograph.

A part of the arced wall element above the soil surface was observed during the exploratory field survey (Figure 6).

The building with a dome and skylight shown in the gravure dated 1798, located between the riverbed and the Barracks, is a bathhouse. This building also corresponds with the remains of the square-shaped building presented in the site plan of the 1st Army Members Housing Project dated 1963 (Figure 7).

It is notable that Mihrişah Sultan, the mother of Selim III, supported the construction of mosques, bathhouses, and fountains, especially for the newly developed military complexes (Uğurlu, 2016). Detailed information about the Bathhouse of Levent Barracks is obtained from the foundation records established by Mihrişah Sultan. The records dated July 1795 indicate that the building consisted of 2 small rooms (halvet), 3 large rooms (sofa), a passage (dehliz), an entrance hall (camekân), a staff room (tellak room), stables, and various storerooms, and its surface area was approximately 500 square meters (Kala & Akarçeşme, 2019). This dimension approximately corresponds to the area of the identified building trace.

The information about the bathhouse in the written sources and the location determined on the prediction map corresponds to the remains of the building observed during the exploratory field survey. Therefore, the arched wall element of B1 located on the prediction map is considered to belong to the Levent Farm and Barracks Bathhouse.

The Building Trace 2: Barracks Embankment Wall

The Building Trace 2 (B2 in Figure 4 and 8) is located northwest of the central cluster of buildings. The part observed on the surface belongs to an embankment wall, approximately 4 meters high and 25 meters long. This stone masonry wall is located along the northern edge of the Barracks traces close to the riverbed. At present, the wall is within the public area. However, the trace of the Barracks, of which this wall was a part, is now covered with housing blocks (Figure 9).

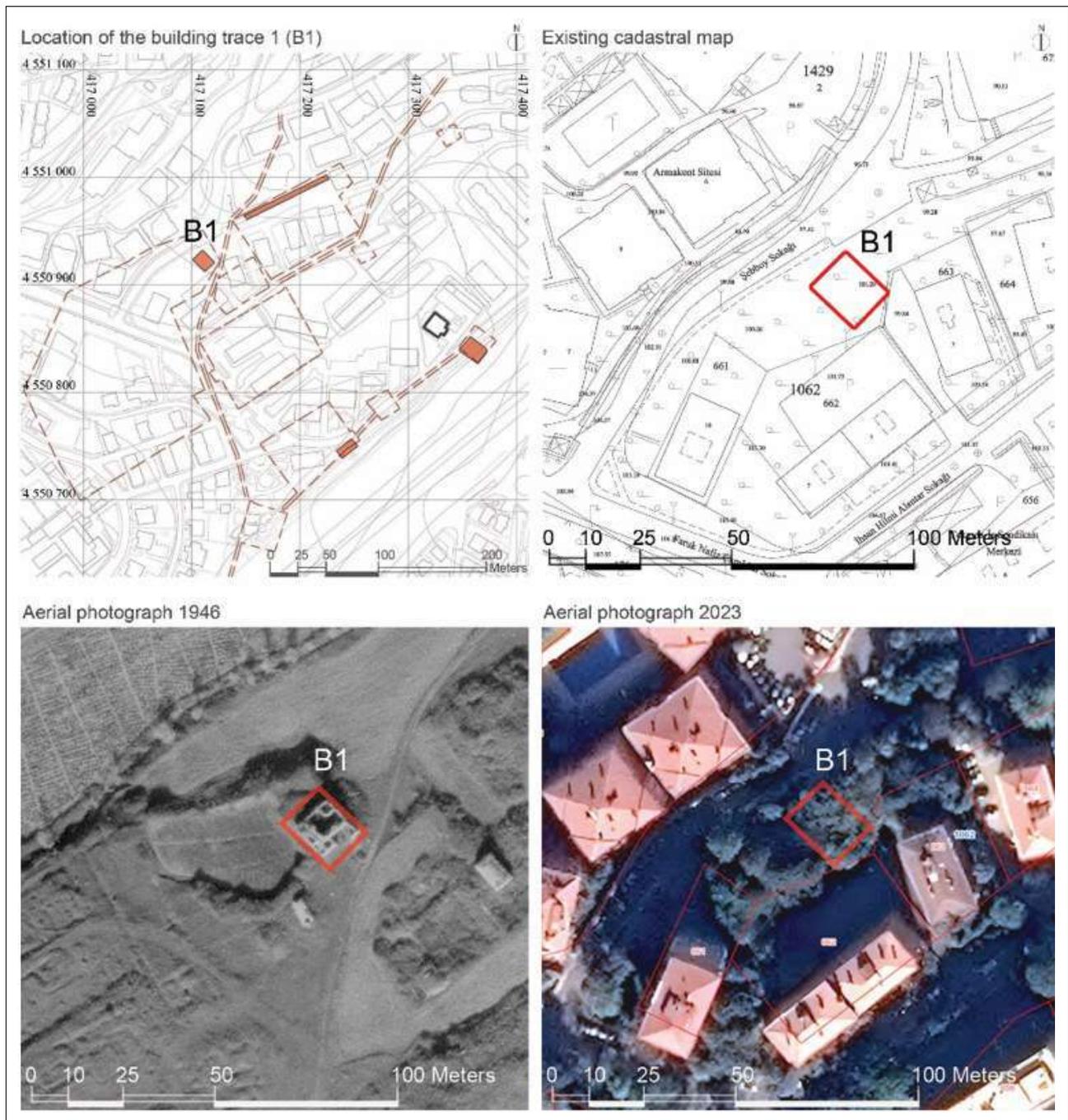


Figure 5. Location of the Building Trace 1 (B1).

The perimeter of the Old Barracks (Atık), dating back to 1797, is approximately 230 meters long and 13.5 meters wide (BOA, 1797). The BOA document dated 1803 mentions both the Old and New (Cedid) Barracks. The perimeter length of the New Barracks, related to the roof repair, is approximately 238 meters, and its width is 12 meters. This document also mentions the construction of a masonry embankment wall on the riverside to support the New Barracks built on a slope (BOA, 1803). This

statement suggests that the rectangular building closer to Kanlıdere, which appears to the north of the site in the aerial photographs, is the New Barracks remains. In addition, the dimensions of the traces of the rectangular building, which can be seen close to the riverbed in the 1946 aerial photograph, correspond to the dimensions of the New Barracks described in BOA documents dated 1803.



Figure 6. Arched wall element observed during the exploratory filed survey.

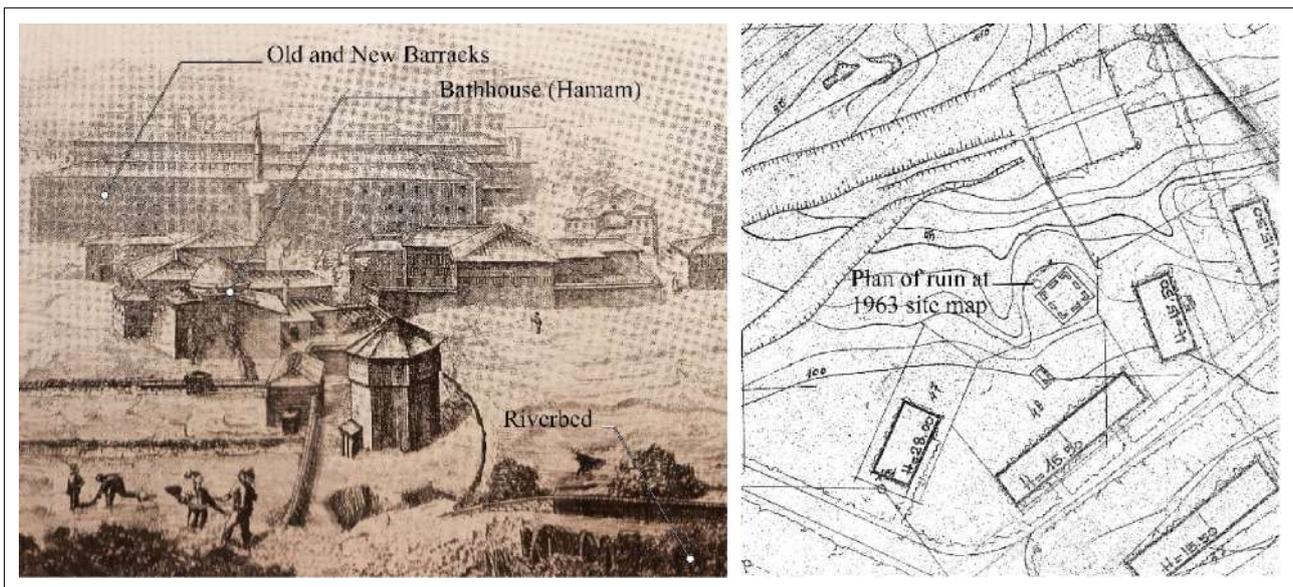


Figure 7. Gravure dated 1798 (Left). The Building Trace 1 in the Site Plan of the 1st Army Members Housing Project dated 1963 (Right).

The Building Trace 3: Great Dam Wall in Front of the Sultan Pavilion, Bend-i Kebir

Based on the prediction map, the location of the Building Trace 3 (B3 in Figure 4 and 10) lies between the neighborhood road passing in front of the Pavilion and the highway connection. Although not recognized as part of Levent Farm and Barracks, the only registered cultural heritage in the focal study area is the Sultan Pavilion.

The 1873 Plan shows a road connecting the settlement complex to the city center. The Sultan Pavilion is located at the end of this linear road axis, which offers a ceremonial route, and the name Bend-i Kebir is indicated next to the building symbol in front of the Pavilion (Figure 11).

"Kebir" in Turkish refers to "Great," and the term "Bend" is used to describe retaining walls built to collect water. Therefore, from this expression, which can be translated as "Great Dam," it is expected that the structure supported the

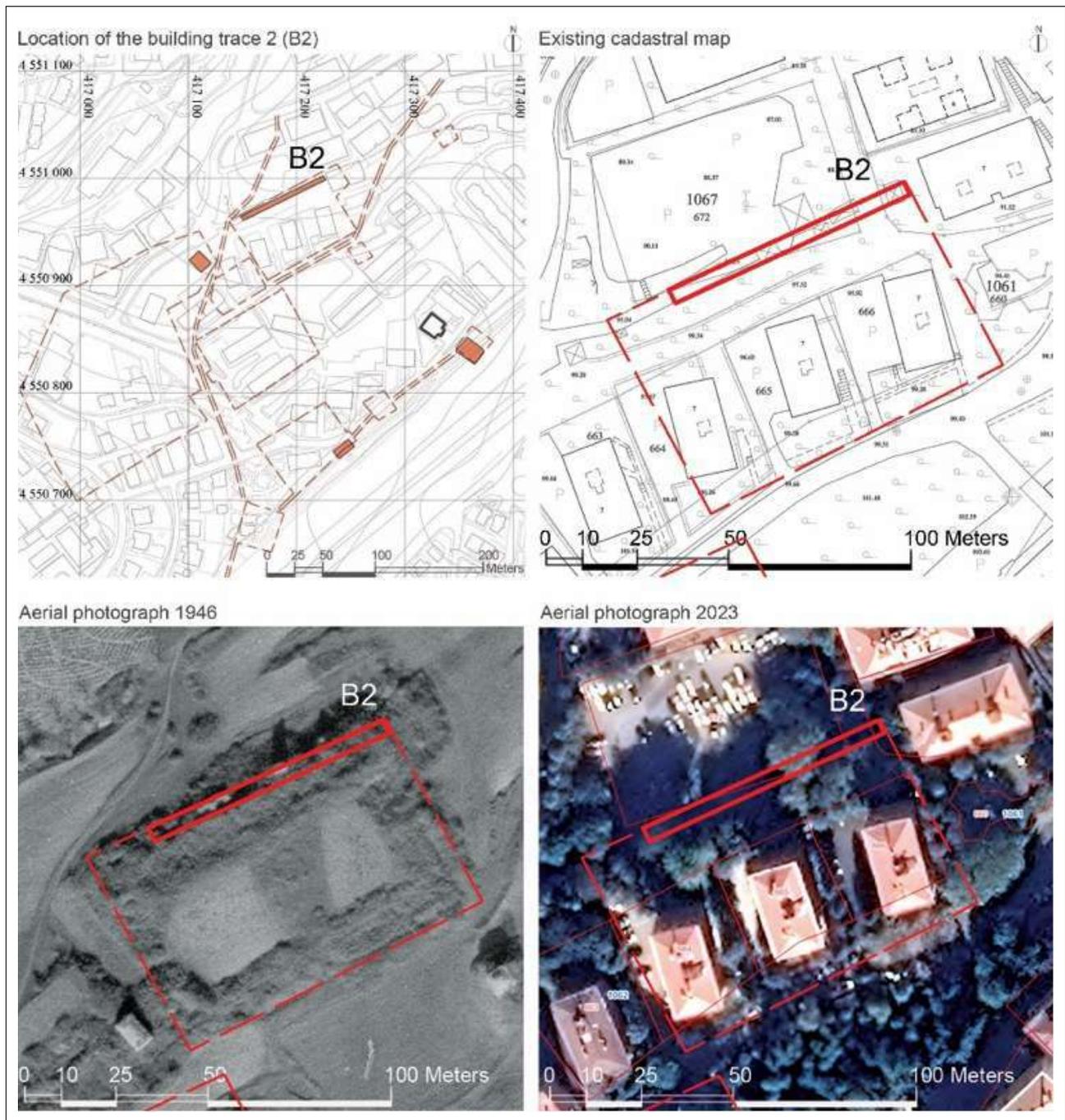


Figure 8. Location of the Building Trace 2 (B2).

platform built on the sloping land in front of the Pavilion overlooking the view and that a water element such as a pond was located on it. The corresponding information for Building Trace 3 was also found in the records of the Mihrişah Valide Sultan Foundation archive. The archive document D.1452 p. 28b–29a defines the 9-hectare area where the Pavilion is located as agricultural land and a large garden. There was a pond and a kitchen in this area, together

with the Pavilion (Kala & Akarçesme, 2019). BOA records dated 1803, which provide information on the maintenance of the central buildings, mention the Havuz-ı Kebir (Great Pond) in this area and the retaining wall in front of it.

When the 1946 aerial photograph is analyzed, traces of a structure built perpendicular to the slope can be seen on the entrance axis of the Pavilion. It is approximately 15 meters and parallel to the slope with a length of 22 meters (Figure 11).



Figure 9. The embankment wall detected during the exploratory field survey.

Based on the above-mentioned findings, it is considered that Building Trace 3 was built on the sloping terrain in front of the Pavilion, supporting a platform overlooking the landscape, and that there was potentially a pond on it.

The exploratory field surveys revealed two groups of wall remains on the sloping terrain at the entrance axis of the Pavilion, corresponding to B3 (Figure 12). It was also observed that the structure in question was damaged and partially covered with soil fill due to the highway connection road completed in 1988 and the neighborhood road passing in front of the Pavilion.

The Building Trace 4: Potentially a Service or Storage Structure

The location of Building Trace 4 (B4 in Figure 4 and 13) was identified on the prediction map and on the same sloping terrain in a park approximately 120 meters from B3. The 1946 aerial photograph shows that the building is approximately 12 meters by 6 meters (Figure 13).

B4 is one of the structures on the linear axis extending from the entrance of Levent Farm to the Pavilion and is visible in the 1946 aerial photograph. The aerial photograph shows that the northern part of the building, leaning on the upper level of the land, is covered with soil

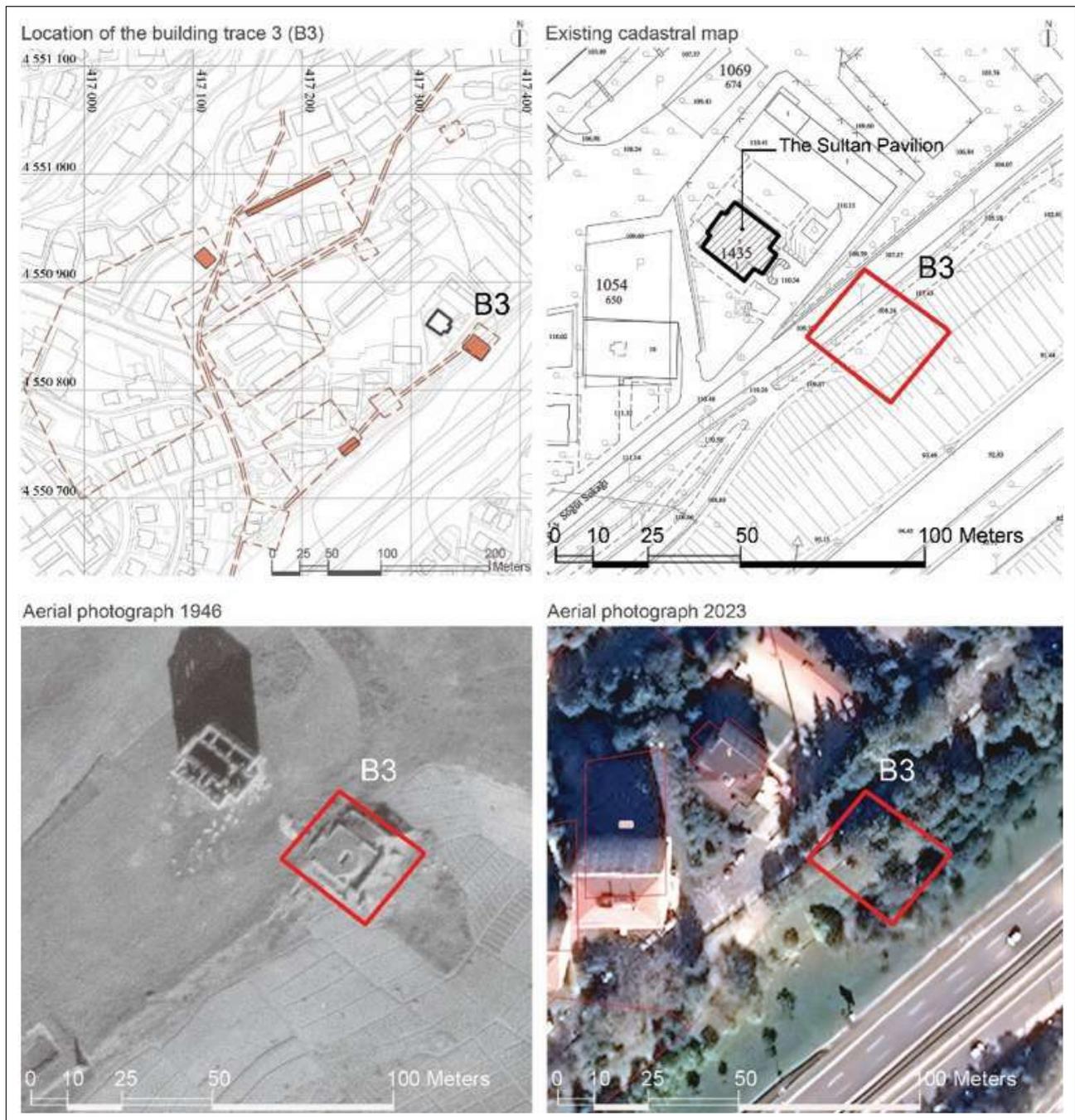


Figure 10. Location of the Building Trace 3 (B3).

and partially buried. No detailed information matching this building was found in written sources. On the other hand, it is expected that the linear axis extending from the entrance gate of the Farm to the Pavilion was used during the visits of the Sultan and members of the dynasty to the Barracks (Uğurlu, 2016). There are ponds, vineyards, and gardens in this area, therefore it is considered to be a prestige axis. For this reason, there is a perception that

the building in question is a service or storage structure associated with this axis.

B4 is preserved and has been repaired and re-functionalized but not recognized as a cultural asset. The 10-meter-long entrance façade facing southeast and located on the opposite side of the road is exposed from the soil surface, while the rear façade below the road level is buried.

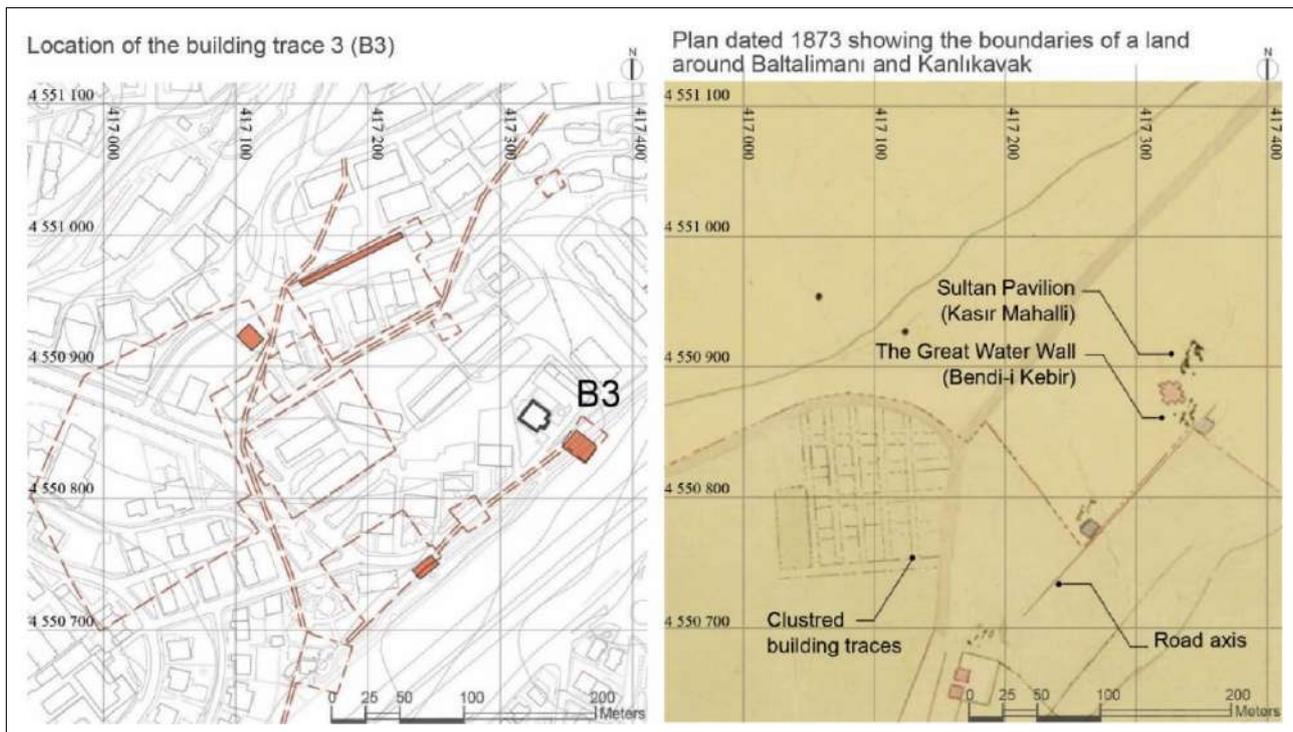


Figure 11. Location of Bend-i Kebir.

Although it was observed that the façade of the building has been renovated with recent materials and the roof cover has been added, the building preserves its structural qualities. Today, it is used as a social center and workshop by the local municipality (Figure 14).

FINDING AND CONCLUSION

The Levent Neighborhoods, developed in the early 1950s, were important for offering living spaces suitable for the modern lifestyle of the period, compared to the city center of Istanbul, which was inadequate for the rapidly growing population and the need for contemporary housing units. From the point of view of the historic landscape, the construction of these new neighborhoods can be considered to have mitigated the pressure of urban renewal based on demolition and reconstruction, and thus the destruction of the central area. Contrary to this approach from a dialectical point of view, in the 1950s and 60s, when Levent Farm and Barracks were not yet accepted as part of the holistic cultural landscape, and its location and impact area had not yet been determined, the construction of projects representing the modern period brought about a new spatial destruction, and thus traces of the 18th-century cultural landscape were lost. Despite these contradictory situations, this research determined

that there is still potential for the traces of the 18th-century settlement to be revealed in open public spaces, and that the continuity of urban memory can be ensured by evaluating them within the current urban fabric. This situation gives important clues for the evaluation of modern-period tangible urban heritage values and the 18th-century settlement layer together in planning and design processes.

The challenge to utilizing this high potential lies in the fact that these traces of cultural heritage are not yet addressed in the current development plan (Figure 15). In addition, infrastructure projects such as highway connections and urban transformation implementations with more extensive reconstruction conditions introduce significant risks. Among these risks, allowing basement floors that cover the entire parcel area threatens the traces of cultural heritage potential within private properties. For this reason, there is a need to protect potential cultural values by adding temporary provisions to the existing development plan and to make comprehensive regulations as soon as possible.

Through this research, a prediction map covering the focus study area was produced in relation to the urban context, and the findings superimposed through different media were transferred holistically to the building scale. The building traces indicated on the



Figure 12. The traces of walls detected during the exploratory field survey.

prediction map were confirmed during the exploratory field surveys, and four building traces were determined to be within the context of Levent Farm and Barracks. Thus, the necessary database was created for the official submission for registration of these traces as tangible cultural values.

As a result of the submitted proposal in May 2023, four building traces identified within the historical and spatial context described in the article were evaluated by the Istanbul Regional Board for the Protection of Cultural Assets. In August 2023, upon the Board's assessment, these four building traces were identified as part of the Levent Farm and Barracks and registered as Grade 2 tangible cultural assets (Turkish Ministry of Culture and Tourism, 2023). The registration of these four buildings as cultural assets, with reference to the findings presented in this paper, has revealed the existence of an

urban archaeological layer belonging to the late 18th-century Levent Farm and Barracks settlement complex. Revealing the interaction of this urban layer with the modern layer that developed between the 1950s and mid-1970s increases the current value of the building traces. Considering the rapid urban change and transformation in the region today, the dynamic structure of Istanbul, and the vibrant urban life, the issue of how the different layers of urban heritage can be carried into the future in interaction with each other gains importance. It is necessary to define policies and administrative and management decisions that will support planning and design tools to preserve and transmit historical heritage values. Research findings can guide and constitute data for new studies to be developed in the fields of urban archaeology and history, urban design, and planning. Therefore, the identification of this potential

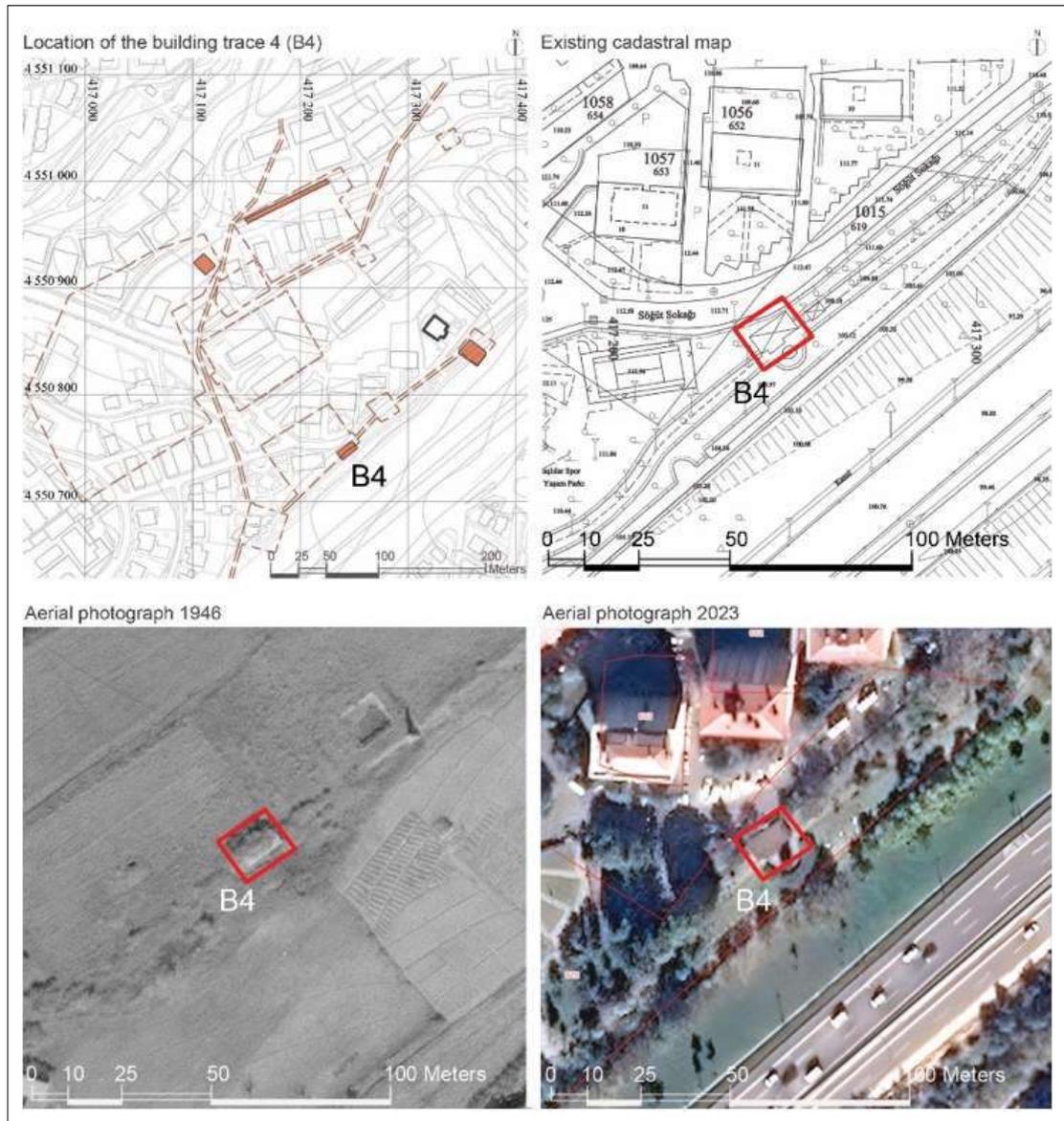


Figure 13. Location of the Building Trace 4 (B4).



Figure 14. The existing structure of B4.

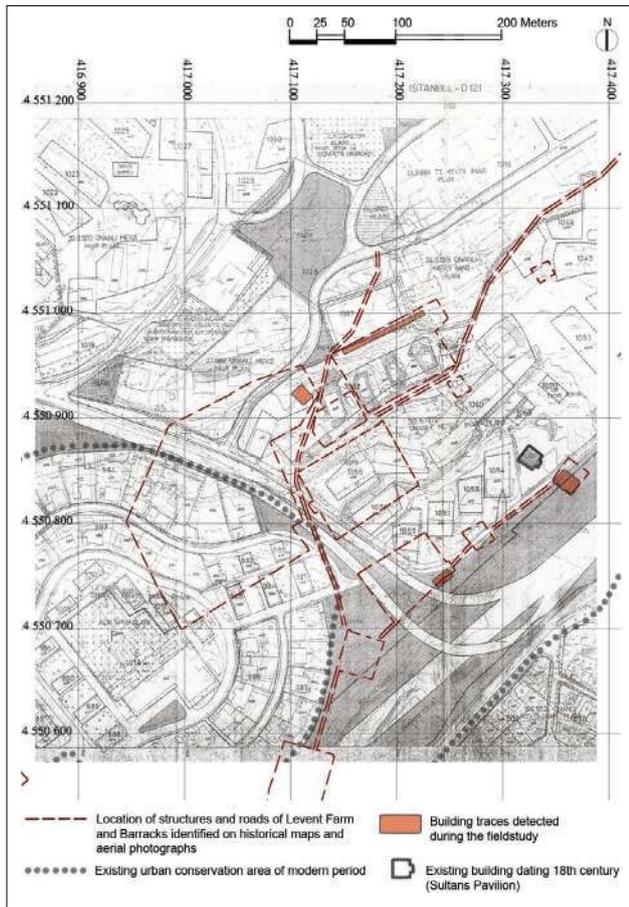


Figure 15. Potential location of spatial layer of Levent Farm and Barracks in the actual urban development plan (Bosphorus Urban Development Plan dated 10.12.1993).

archaeological layer is important not only for the spatial identity of the Levent Region, but also for providing a new perspective on the spatial development of Istanbul in the context of historical geography.

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REFERENCES

- Ahmet Fâiz Efendi. (1993). *Rûznâme* (S. V. Arıkan, Ed.). Turkish History Institution Publication [Original work published, 1807].
- Andelfinger, J. J. (1703). *Plan de Constantinople, de son port, canal et environs* [Map]. Aug. Vindel: I. F. Leopold Exc. Gallica the digital library of the Bibliothèque nationale de France. <https://gallica.bnf.fr/ark:/12148/btv1b8444112z.r=Andelfinger?rk=42918;4>
- Arû, K. A. (1956). 4. Levent Mahallesi. *Arkitekt*, 3(285), 140–153.
- Arû, K. A. (1992). *Anılarda Mimarlık. Yapı*, 127, 45–46.
- Balletti, C. (2006). Georeference in the analysis of the geometric content of early maps. *E-Perimetron*, 1(1), 32–39.
- Benavides, J., & Koster, E. (2006). Identifying surviving landmarks on historical maps. *E-Perimetron*, 1(3), 194–208.
- Beydilli, K. (1995). *Türk Bilim ve Matbaacılık Tarihinde Mühendishâne, Mühendishâne Matbaası ve Kütüphanesi (1176–1826)*. Eren Yayıncılık.
- Beydilli, K., & Şahin, I. (2001). *Mahmud Raif Efendi ve Nizam-ı Cedid'e Dâir Eseri (1798)*. Turkish History Institution Publication.
- Bilsel, F. C. (2010). Henri Prost's working Istanbul 1936–1951: Transforming the structure of a city through master plans and urban operations. In F. C. Bilsel & P. Pinon (Eds.), *From The Imperial Capital to The Republican Modern City: Henri Prost's planning of Istanbul 1936–1951* (pp. 101–165). Suna and İnan Kıraç Foundation Istanbul Research Institute.
- Bitelli, G., Cremonini, S., & Gatta, G. (2009). Ancient map comparisons and georeferencing techniques: A case study from the Po River Delta (Italy). *E-Perimetron*, 4(4), 221–233.
- Birik, M. (2022). Tarihi haritalar üzerinden kayıp kentsel mekânın izini sürmek: Levent Çiftliği ve Kışlası'nın 18. ve 20. yüzyıllar arasında kentsel bağlamla etkileşiminin belirlenmesi. *Tasarım Kuram*, 18(37), 70–79. <https://doi.org/10.14744/tasarimkuram.2022.04934>
- Birik, M., Aksoyak, Ö.D. ve Çalışkan, Ö. (2022). Açık geçiş mahalle kavramı ve Levent Bölgesi'nde açık geçiş mahalle sisteminin geliştirilmesine yönelik tasarım kriterlerinin tanımlanması. *Planlama*, 32(2), 280–297.
- BOA. (1797, May 20). *Cevdet Askeriye (C.A.S.)*, 964/41956. Istanbul: Turkish Republic Presidency State Archives, Ottoman Archives.
- BOA. (1800, December 2). *Bâb-ı Defterî Başmuhasebe Bina Eminliği*, 6834. Istanbul: Turkish Republic Presidency State Archives, Ottoman Archives.
- BOA. (1803, May 17). *Bâb-ı Defterî Başmuhasebe Bina Eminliği*, 7102. Istanbul: Turkish Republic Presiden-

- cy State Archives, Ottoman Archives.
- BOA. (1805, February 14). Cevdet Askeriye (C.AS.), 187/8095. Istanbul: Turkish Republic Presidency State Archives, Ottoman Archives.
- BOA. (1873, February 2). Plan, Proje ve Krokiler (PLK.p.), no. 121. Istanbul: Turkish Republic Presidency State Archives, Ottoman Archives.
- Butzer, K. W. (1980). Context in archaeology: An alternative perspective. *J Field Archaeol*, 7(4), 417–422.
- Dinçer, İ. (2011). The impact of neoliberal policies on historic urban space: Areas of urban renewal in Istanbul. *Int Plan Stud*, 16(1), 43–60.
- Favory, F., Nuninger, L., & Sanders, L. (2012). Intégration de concepts de géographie et d'archéologie spatiale pour l'étude des systèmes de peuplement. *L'Espace Géogr.*, 41(4), 295–309.
- Fried, F. (1821). Plan de Constantinople: du Bosphore & du Canal de la Mer Noire. Harvard Map Collection, Harvard University.
- ICOMOS. (1987). Charter for the conservation of historic towns and urban areas. General Assembly, Washington DC. https://www.icomos.org/images/DOCUMENTS/Charters/towns_e.pdf
- ICOMOS. (2011). The Valletta principles for the safeguarding and management of historic cities, towns and urban areas. 17th General Assembly, Paris, France. https://civvih.icomos.org/wp-content/uploads/2022/03/Valletta-Principles-GA-_EN_FR_28_11_2011.pdf
- Kala, E. S., & Akarçesme, İ. (2019). Bölüm 3.22. Ticarethane / Hamam. In M. Kurtoğlu (Ed.), *Mihrişah Valide Sultan Vakfı* (pp. 99–100). Vakıflar Genel Müdürlüğü.
- Karabey, H. (2011). Planlanıp gerçekleştirilmesinden 60 yıl sonra, değişen koşullar ve kullanıcı talepleri doğrultusunda Levent Mahallesi'nin geleceği. *Mimarist*, 39, 61–66.
- Kauffer, F. (1819). Plan topographique du Bosphore, de Thrace ou Canal de Constantinople et de ses environs [Map]. Gallica the digital library of the Bibliothèque nationale de France. <https://gallica.bnf.fr/ark:/12148/btv1b10100957j>
- Larkham, P. J., & Morton, N. (2011). Drawing lines on maps: Morphological regions and planning practices. *Urban Morphol*, 15(2), 133–151.
- Lom, N., Ülgen, S. C., Sakiç, M., & Şengör, A. M. C. (2016). Geology and stratigraphy of Istanbul region. *Geodiversitas*, 38(2), 175–195.
- Moltke, H. (1849). Karte des nördlichen befestigten Theils des Bosphorus: von den Hissaren bis zu den Leuchthürmen am Schwarzen Meer: im Auftrage Sr. Hoheit Sultan Mahmud II mit dem Messtisch. Harvard Map Collection, Harvard Library. <https://hgl.harvard.edu/catalog/harvard-g7432-b6-1849-m6>
- Olivier, G. A. (1801). Bosphore de Thrace ou Canal de la Mer Noire [Map]. In *Atlas pour servir au Voyage dans Empire Othoman, L'egypte Et La Perse*. H. Agasse.
- Pedley, M. (2012). Enlightenment cartography at the Sublime Porte: François Kauffer and the survey of Constantinople. *J Ottoman Stud*, 39, 28–53.
- Shaw, S. J., & Ezel, K. S. (2002). History of the Ottoman Empire and modern Turkey: Reform, revolution and republic. Rise of modern Turkey (Vol. 2, 1808–1975). The Press Syndicate of University of Cambridge.
- Şenyurt, O. (2016). Arşiv belgeleri ışığında III. Selim'in askeri alandaki kararlarının İstanbul'da kent mekânının kullanımına etkileri. *Bilig*, 78, 199–229.
- Tekeli, İ. (1998). Türkiye'de Cumhuriyet döneminde kentsel gelişme ve kent planlaması. In Y. Sey (Ed.), *75 yılda değişen kent ve mimarlık* (pp. 1–24). Tarih Vakfı.
- Turkish Ministry of Culture and Tourism. (2023). Board no. 3, Report no. 8431, no. 8432, no. 8433, no. 8434. Istanbul Regional Board for the Protection of Cultural Assets.
- Uğurlu, H. (2016). Siyâsî bir projenin izinde bânilik: Mihrişah Vâlide Sultan'ın îmar faaliyetlerini yeniden okumak. *Bellekten*, 80(287), 85–101.
- UNESCO. (2012). Recommendation on the historic urban landscape, including a glossary of definitions (Report No. 36). <https://www.unesco.org/en/legal-affairs/recommendation-historic-urban-landscape-including-glossary-definitions#item-0>