**Civil Engineering and Applied Solutions**

*Research Article*

journal homepage: ceas.journals.umz.ac.ir

CEAS Civil Engineering and Applied Solutions

# An Overview of Strategic Mistakes in Alteration of Urban Development Plans in Iran and Their Implications for Transportation Planning

Fatemeh Mousavi Ghadikolaei [a], Mehdi Zarrinmehr [b], Reza Mohammad Hasany [c*]

[a] *Urban Planning, Iran University of Science and Technology, Senior Urban Development Expert, Sari, Mazandaran, Iran*
[b] *Department of Civil Engineering, Shahrood University of Technology, Shahrood, Iran*
[c] *Department of Railway Engineering, Iran University of Science and Technology, Tehran, Iran*

ARTICLE INFO

*Keywords:*
Urban development plans
Land use
Growing demand
Trip concentration

*Article history:*
Received 23 July 2025
Accepted 02 August 2025
Available online 01 September 2025

ABSTRACT

Master and detailed plans, as core components of urban development plans (UDPs), play a fundamental role in urban planning in Iran. While these plans may be modified when necessary, such changes must be approached with great caution. This is because gradual land-use changes can significantly alter travel demand patterns, leading to substantial transportation costs. This paper investigates the long-term impacts of strategic decisions in urban development on transportation costs within an urban network. To this end, the paper first identifies key risks associated with modifying urban development plans, particularly at the detailed planning level. One potential outcome, trip concentration, is then examined, wherein long-term travel demand growth becomes concentrated in one or a few attractor zones within the network. A computational example is presented to illustrate the cost implications of such concentration. In this example, the Sioux Falls transportation network is analyzed under two scenarios of increasing demand: uniform growth and concentrated growth. The findings indicate that with a 50% increase in trip demand, the transportation costs in the concentrated growth scenario rise significantly. Moreover, under a 100% demand increase, even the implementation of over 20 infrastructure projects fails to mitigate the costs, which remain three times higher than those under the uniform growth scenario.

## 1. Introduction

Urban development is a complex and dynamic process that demands coherent, long-term planning across multiple spatial and infrastructural dimensions. This need becomes even more critical in rapidly urbanizing countries like Iran, where accelerating growth places mounting pressure on cities to adopt integrated and forward-thinking urban policies. In the Iranian context, two primary planning instruments, Master Plans and Detailed Plans, serve as the foundational frameworks for shaping urban growth. These comprehensive documents determine land allocation for various functions, guide spatial development, and influence the configuration of transportation systems. Beyond land use, they play a critical role in shaping transportation networks, housing strategies, and the provision of public services. Adopting a strategic and future-oriented approach to the formulation, implementation, and revision of these plans is therefore essential to addressing existing urban challenges, promoting sustainable [1, 2].

Despite the strategic importance of Master and Detailed Plans in guiding urban development, a major concern in the Iranian context is the frequent and often fragmented revisions made at the Detailed Plan level. These modifications, typically involving land-use conversions, increased building densities, and alterations to the street network, are frequently implemented without a thorough assessment of their long-term implications, particularly concerning transportation systems. While such changes may

* Corresponding author.
*E-mail addresses:* rmhasany@iust.ac.ir (R. Mohammad Hasany).

https://doi.org/10.22080/ceas.2025.29716.1030

How to cite this article: Mousavi Ghadikolaei, F., Zarrinmehr, M., Hasany, M. R. An Overview of Strategic Mistakes in Alteration of Urban Development Plans in Iran and Their Implications for Transportation Planning. Civil Engineering and Applied Solutions. 2025; 1(4): 49–55. doi:10.22080/ceas.2025.29716.1030.

address short-term economic or administrative pressures, they often disrupt the critical balance between land development and mobility needs. This can result in increased traffic congestion, spatial inequality, and reduced efficiency in public service delivery [3, 4]. A particularly troubling trend is the dominance of short-term priorities, such as speculative real estate profits or localized political motivations, over long-term public interests, ultimately undermining the objectives of sustainable urban development [2, 5].

In this context, it is essential to recognize that transportation systems are not passive infrastructures, but dynamic elements that evolve in close interaction with land use and urban form. Urban planning decisions that overlook this interdependence risk reinforcing car dependency, accelerating environmental degradation, and diminishing urban livability. To promote resilience and social equity, cities must move beyond car-oriented development models and instead prioritize public transit and active transportation, underpinned by integrated and consistent land-use strategies [6, 7]. Realizing this vision demands more than technical proficiency and data-driven planning; it also requires strong institutional commitment to protecting the long-term public interest in urban development policy.

This study examines the primary categories of modifications made to Detailed Plans in Iran and emphasizes the critical role of transportation foresight in such planning decisions. To this end, Section 2 provides an overview of the urban development planning framework in Iran, with a focus on the types of modifications commonly introduced at the detailed planning level and their connection to land use and transportation systems. Section 3 analyzes the specific risks associated with three main types of changes: land-use conversions, increases in building density, and alterations to the street network. To illustrate the long-term implications of these modifications, Section 4 presents a numerical case study based on the Sioux Falls transportation network, comparing transportation costs under two demand growth scenarios: uniform and concentrated growth. Finally, Section 5 summarizes the key findings and offers practical recommendations for more sustainable urban development planning

## 2. Background of the study

The emergence of urban planning and the formulation of structured urban development plans can be traced to the global response to rapid urbanization [8]. In Iran, the formal development of such plans began in the mid-1960s and has remained an integral part of urban governance ever since [9]. This section provides a concise overview of Iran's urban development planning framework, introduces the Article 5 Commission as the primary authority responsible for approving modifications to these plans, and concludes with a brief discussion on the interrelationship between land-use changes and transportation planning.

### *2.1. Urban development plans in Iran*

Urban development planning in Iran is carried out through a range of formal plans, including: the Comprehensive Plan, the Detailed Plan, renovation and revitalization plans for deteriorated urban areas, development plans for new urban extensions, urban design plans, thematic or site-specific detailed plans, urban master plans, new town development plans, residential town plans, and various other types such as industrial or recreational settlement plans. Structural-strategic plans have also been introduced more recently [10].

According to national legislation, a Comprehensive Plan is defined as: "A long-term plan that outlines the land-use framework and zoning regulations for residential, industrial, commercial, administrative, and agricultural areas; public service facilities and amenities; major transportation and communication corridors; terminals, airports, and ports; the required space for infrastructure and public facilities; strategies for urban renewal and revitalization; and the rules governing all of the above, including the preservation of historical buildings, façades, and natural landscapes. The Comprehensive Plan may be revised as necessary [11]".

A Detailed Plan, on the other hand, is defined as: "A plan that, based on the general principles outlined in the Comprehensive Plan, specifies land use at the neighborhood level, the exact location and size of land parcels, detailed street network configurations, population and building density, priorities for revitalization and development, and urban problem-solving strategies. It also includes maps and property information based on official cadastral records [11] ".

Although the use of comprehensive and detailed urban plans has been phased out in many countries, these planning instruments remain widely practiced in Iran. Generally, the Comprehensive Plan establishes the overarching framework for urban development, while more technical and spatial analyses are addressed through the Detailed Plan. The Detailed Plan serves as the principal operational document for municipalities, guiding land-use designations, building density regulations, and zoning codes at the parcel level. As such, these plans, particularly the Detailed Plan, play a central role in shaping the spatial and physical development of cities and act as foundational references in various urban planning processes, including transportation planning. Further technical information regarding the components and specifications of these plans can be found in [12].

### *2.2. The Article 5 Commission and modifications to urban development plans*

In Iran, the final authority for approving Comprehensive Plans and their associated documentation is the Supreme Council of Urban Planning and Architecture. In contrast, the responsibility for approving Detailed Plans lies with a separate entity known as the Article 5 Commission, which was formally established under the Law on the Establishment of the Supreme Council. Hereafter, this body is referred to as the Article 5 Commission. In addition to approving Detailed Plans, the Commission also holds the primary authority to authorize modifications to them, including changes in land use, building density, and the street network [13].

Such modifications should be applied selectively and only in response to genuine needs, with careful consideration of technical

standards and professional planning criteria [14].

Given that Detailed Plans are currently the most operational and legally enforceable documents within Iran's urban planning system, any modifications to these plans carry considerable significance and can profoundly influence the future structure and functionality of cities.

To the best of the authors' knowledge, the existing transportation and urban planning literature lacks comprehensive studies that specifically examine the consequences of Detailed Plan modifications approved by Article 5 Commissions. The available data is typically limited to annual statistics, such as the number of reviewed cases, the thematic categorization of proposals, and the frequency of commission meetings.

### *2.3. Land-use planning and its relationship with transportation*

Land-use planning is the science of allocating land and space to various human activities to optimize land efficiency and achieve spatial order [15]. There is a well-established and deeply interrelated connection between land use and travel generation in transportation planning, an idea long recognized in both urban and transportation planning theories.

Urban planners have consistently emphasized the relationship between land use and transportation. Pakzad [16], citing major urban theories, highlights the role of land-use planning in achieving coordinated spatial organization, whereby all urban activities are functionally integrated and logically linked with transportation systems. Likewise, transportation planning scholars recognize land use as a key determinant in travel demand, and have proposed various models to represent this relationship, such as the Garin-Lowry model and models based on game theory frameworks [17-19].

The collective insight from these studies underscores the need for sensitivity to transportation implications in any urban development decision, particularly in land-use planning, so that long-term costs can be minimized or avoided.

Due to the broad and well-developed literature in this field, interested readers are referred to the review papers and its referenced sources for further details [1-3].

## 3. Risks associated with modifications to urban development plans

As discussed in previous sections, the Detailed Plan of a city serves as the principal legal reference for municipalities, and the Article 5 Commission is the primary authority responsible for approving its modifications. analyzing the resolutions of Article 5 Commissions in various Iranian cities reveals that changes to detailed plans generally fall into three main categories: land-use changes, increases in building density, and modifications to the street network. Each of these has the potential to fundamentally alter long-term travel demand patterns and impose significant implications on urban transportation planning and associated costs. This section briefly reviews the risks inherent to each of these three categories.

### *3.1. Land-use changes*

Land-use changes often involve the conversion of service-oriented areas, such as educational, recreational, cultural, or green spaces, into residential, commercial, or administrative uses. Several factors contribute to this trend, including the limited financial capacity of public agencies to acquire land for public purposes, the reluctance of landowners to develop properties per designated service uses, and the relatively lower market value of such lands compared to residential or commercial parcels. These challenges frequently result in stalled development and lead property owners to request land-use reclassification.

Although such conversions allow landowners to obtain building permits and capitalize on significant increases in land value, they gradually undermine the original service-oriented functions envisioned in the development plans. Over time, areas designated for public services are replaced by residential, administrative, or commercial developments, altering the intended structural hierarchy of the city. As a result, land uses originally planned to support the urban population through a distributed, tiered service network are transformed into attractor zones for population settlement or high-intensity, trip-generating commercial activities.

For instance, changes often involve the conversion of neighborhood-level green spaces, educational facilities, or cultural centers into high-rise residential towers or mixed-use commercial-office complexes, contrary to the initial spatial allocation principles.

### *3.2. Increased building density*

Building density is a fundamental tool in detailed plans used to achieve balanced urban development, control population distribution, and fulfill broader urban planning goals. Typically, these plans specify both a base density and a maximum allowable density, with the latter subject to "adjustment fees" that municipalities may collect to finance public services. However, review of Article 5 Commission decisions across various cities shows that granting density levels above the officially defined maximum has become a widespread practice.

This trend is primarily driven by property owners aiming to maximize economic returns, especially in high-value urban areas. Consequently, excessive residential density contributes to the emergence of new population centers, while increased commercial or office density leads to elevated levels of travel demand and attraction. These shifts diverge from the city's intended growth trajectory, reflecting market-driven interests rather than the structured and balanced development approach originally outlined in the planning documents.

Consequently, new urban centers and corridors emerge not as a result of integrated planning but due to market-driven shifts in high-value parcels, often creating spatial imbalance and further complications for long-term transportation planning.

### *3.3. Street network modifications*

Most changes to the street network involve changing the right-of-way of vehicles, relocating streets, or reconfiguring routes. These modifications are typically driven by municipalities' limited financial capacity to acquire land or implement street widening projects. In response, municipalities often request Article 5 commissions to rezone adjacent properties and approve higher building densities. This rezoning creates added value for landowners along the corridor, which in turn facilitates land acquisition for public street expansion through land value compensation (land swaps).

However, such interventions often disregard the original rationale behind street design in urban development plans, where road dimensions, alignments, and functional roles were carefully determined based on adjacent land uses and their position within the broader transportation network. As a result, uncoordinated modifications can undermine the intended performance of the urban circulation system, leading to long-term inefficiencies and reduced network effectiveness.

## 4. Numerical example

As discussed in the previous section, land-use and density modifications can lead to spatial imbalances and concentrated urban development, especially toward high-value areas, thereby undermining the original goals of urban development plans. This section aims to provide a quantitative illustration of the consequences of such concentrated urban growth through a numerical example.

To this end, the transportation network of Sioux Falls, located in the state of South Dakota, USA, is employed [20]. The network configuration is presented in Fig. 1, along with its associated details, which will be described below.

In this example, two long-term travel demand growth scenarios are considered:

- Uniform growth: demand increases proportionally across all origin-destination (OD) pairs based on existing demand levels.
- Concentrated growth: demand growth is exclusively focused on a small number of destination nodes, specifically, nodes 4 and 5 of the Sioux Falls network (as shown in Fig. 1), representing travel attractors.

These nodes are assumed to have been developed with high-density and high-attraction land uses, reflecting the potential impact of unbalanced urban planning decisions, such as changes in land-use designations and increased density in a few select zones.

For both scenarios, a traffic assignment algorithm is used to model traffic distribution, and the total system travel time is used as the key performance metric. Since total travel time is widely accepted as a comprehensive proxy for several transportation-related costs, as in the network design problems, it is referred to hereafter as the transportation cost [21, 22].

### *4.1. Comparison of uniform vs. concentrated demand growth scenarios*

This experiment examines a gradual increase in travel demand ranging from 0% to 50% above the baseline level. In the uniform growth scenario, demand increases proportionally across all origin-destination (OD) pairs, thereby preserving the spatial balance of the original network. In contrast, the concentrated growth scenario channels all additional demand exclusively toward nodes 4 and 5, simulating the long-term effects of concentrated urban development patterns resulting from suboptimal planning decisions.

To assess the progressive impact of demand growth, travel demand was incrementally increased in 2% steps. Although detailed numerical outputs are not included in this paper, the aggregated results are illustrated in Fig. 2, which depicts the percentage increase in total travel cost under both the uniform and concentrated growth scenarios.

As illustrated in Fig. 2, total travel costs rise in both scenarios as demand increases, which is consistent with expectations. However, the rate of increase is markedly steeper in the concentrated growth scenario, underscoring the inefficiencies associated with spatial imbalance and the accumulation of travel demand in a limited number of urban centers. Notably, when demand exceeds a 30% increase, transportation costs in the concentrated scenario escalate sharply, indicating a significant decline in network performance under such imbalanced conditions[1].

### *4.2. Mitigating costs of concentrated growth through infrastructure development*

An inefficient approach in urban planning involves allowing land-use changes and the resulting growth in travel demand to proceed without adequate regulation, and then attempting to address the ensuing congestion through the construction and expansion of urban roadways. This reactive strategy not only imposes a substantial financial burden during implementation [23], but also promotes increased reliance on private vehicles. As a result, it fails to align with the principles of sustainable urban development.

[1] Increases in total travel time beyond 50% have not been applied or reported, as the severe cost escalation observed under the concentrated growth scenario may induce phenomena such as population migration and changes in trip destinations over the long term factors that warrant cautious interpretation of any further results.

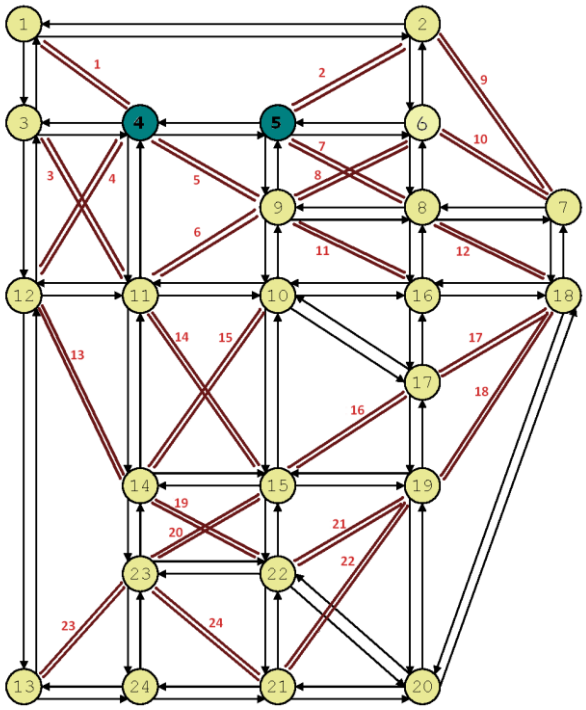


**Fig. 1. Sioux Falls transportation network with 24 additional highway links to be constructed.**

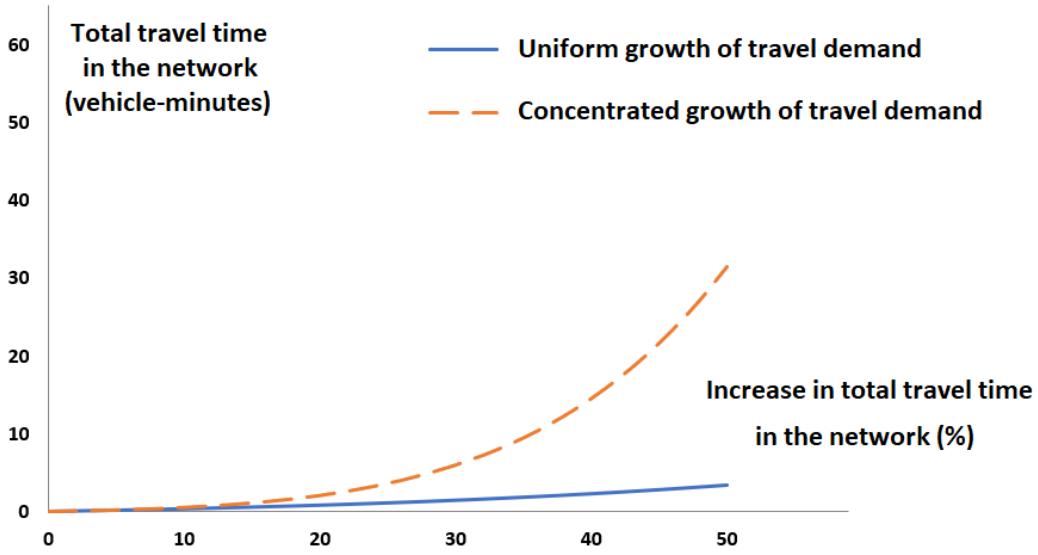


**Fig. 2. Increase in total travel cost (travel time) over the network.**

This section examines a 100% increase in travel demand under two contrasting scenarios: one involving uniform growth across the network, and the other featuring concentrated growth combined with the implementation of 24 new infrastructure projects, as illustrated in Fig. 1. These projects consist of newly constructed dual-carriageway arterial roads, each designed to accommodate an average practical capacity of 5,000 vehicles per hour per direction. A summary of the comparative results is presented in Table 1.

As observed in Table 1, under the concentrated demand growth scenario in the long term (100% demand increase), even the construction of numerous infrastructure projects with substantial costs fails to effectively mitigate congestion. The incurred costs remain more than three times higher compared to the uniform demand growth scenario.

**Table 1. Comparison of the costs of 100% demand growth under two scenarios: uniform growth vs. concentrated growth with new road construction.**

| | Total travel time in the network (vehicle-minutes) | Increase in total travel time in the network (%) |
|---|---|---|
| Uniform growth | 122814899 | 15.4 |
| Concentrated growth accompanied by the construction of 24 new two-way arterial | 375875051 | 49.3 |

## 5. Conclusions

This study explored the implications of modifications to urban development plans at the Detailed Plan level. Specifically, it examined three primary categories of change, land-use conversions, increases in building density, and alterations to the road network, alongside a discussion of the associated risks each poses to urban and transportation systems.

To evaluate the transportation impacts of these planning decisions, a numerical case study was conducted using the Sioux Falls transportation network. Two long-term travel demand growth scenarios were analyzed. The first scenario, termed uniform growth, assumed a proportional increase in travel demand across all areas of the network. The second, referred to as concentrated growth, directed the additional demand exclusively toward two designated nodes representing high-attraction zones. These nodes reflect areas that, as a result of misguided planning policies, have been transformed into high-density, high-value land-use zones that generate disproportionate travel demand.

The analysis of demand increases from 0% to 50% revealed that total travel costs in the concentrated growth scenario were significantly higher than in the uniform growth scenario. Furthermore, even under a 100% increase in demand, the concentrated growth scenario—despite incorporating the construction of 24 transportation infrastructure projects, each with an average practical capacity of 5,000 vehicles per hour per direction remained inefficient. In this case, total travel costs exceeded those of the uniform growth scenario by more than threefold.

The findings of this study highlight the critical need to prioritize long-term strategic outcomes over short-term gains when modifying urban development plans, particularly at the Detailed Plan level. Without adequate foresight, such changes can lead to severe transportation inefficiencies and escalating costs, challenges that even large-scale infrastructure investments may fail to resolve. Effective urban planning must therefore strike a careful balance between immediate pressures and sustainable, long-term objectives, especially in terms of how policy decisions affect land use patterns and travel demand growth. While this research employed a simplified model based on the Sioux Falls transportation network in North America, it offers a valuable framework for analyzing the consequences of spatially imbalanced urban growth. Future research should build on this foundation by applying the methodology to real-world case studies in Iran, incorporating long-term behavioral factors such as residential relocation and shifts in trip destinations to enhance the contextual relevance and policy applicability of the results.

## Statements & declarations

*Author contributions*

**Fatemeh Mousavi Ghadikolaei:** Conceptualization, Formal analysis, Methodology, Investigation.

**Mehdi Zarrinmehr:** Methodology, Investigation, Writing - Review & Editing.

**Reza Mohammad Hasany:** Conceptualization, Supervision.

*Funding*

The authors received no financial support for the research, authorship, and/or publication of this article.

*Data availability*

The data presented in this study will be available on interested request from the corresponding author.

*Declarations*

The authors declare no conflict of interes.

## References

[1] Acheampong, R. A., Silva, E. A. Land use-transport interaction modeling: A review of the literature and future research directions. Journal of Transport and Land Use, 2015; 8: 11-38. doi:10.5198/jtlu.2015.806.

[2] Raimbault, J. A systematic review and meta-analysis of interaction models between transportation networks and territories. arXiv preprint, 2020; doi:10.48550/arXiv.2012.13367.

[3] Geurs, K. T., van Wee, B. Land-use/transport Interaction Models as Tools for Sustainability Impact Assessment of Transport Investments: Review and Research Perspectives. European Journal of Transport and Infrastructure Research, 2004; 4: doi:10.18757/ejtir.2004.4.3.4272.

[4] Zarrinmehr, A., Saffarzadeh, M., Seyedabrishami, S. A local search algorithm for finding optimal transit routes configuration with elastic demand. International Transactions in Operational Research, 2018; 25: 1491-1514. doi:https://doi.org/10.1111/itor.12359.

[5] Chang, J. S. Models of the Relationship between Transport and Land-use: A Review. Transport Reviews, 2006; 26: 325-350. doi:10.1080/01441640500468432.

[6] Nayeb-Pashaei, K., Vahabzadeh, S., Hosseinian-Far, A., Ghoushchi, S. J. Sustainable Urban Transportation: Key Criteria for a Greener Future. Spectrum of Operational Research, 2025; 3: 103-127. doi:10.31181/sor31202634.

[7] Zarrinmehr, A., Saffarzadeh, M., Seyedabrishami, S., Nie, Y. M. A path-based greedy algorithm for multi-objective transit routes design with elastic demand. Public Transport, 2016; 8: 261-293. doi:10.1007/s12469-016-0131-1.

[8] Habibi, M. From Village to City (Az Shaar ta Shahr). 2nd ed. Tehran (IR): University of Tehran; 1999 (In Persian).

[9] Mirehai, M., Kalantari Khalilabadi, H. Introduction to Urban Development Plans. ed. Tehran (IR): Organization of Municipalities and Village Administrations; 2011 (In Persian).

[10] Ministry of Housing and Urban Development. Regulations on the Procedures for Reviewing and Approving Local, Regional, and National Development and Construction Plans, and Urban Planning and Architecture Rules of the Country, Article 1. Tehran (IR): 1999 (In Persian).

[11] Parliament of Iran. Law on Changing the Name of the Ministry of Development and Housing to the Ministry of Housing and Urban Development. Tehran (IR): 1974 (In Persian).

[12] Iranian Planning and Budget Organization, Strategic Planning Center of the Presidency of Iran. 2011 (In Persian). www.spac.ir.

[13] Parliament of Iran. Law Establishing the High Council of Urban Planning and Architecture of Iran. Tehran (IR): 1974 (In Persian).

[14] Ministry of Housing and Urban Development. Regulations on the Procedures for Reviewing and Approving Local, Regional, and National Development and Construction Plans, and Urban Planning and Architecture Rules of the Country, Article 49. Tehran (IR): 1999 (In Persian).

[15] Pourmohammadi, M. R. Urban Land Use Planning. 1st ed. Tehran (IR): Organization for the Study and Compilation of Humanities Books (SAMT); 2006 (In Persian).

[16] Pakzad, J. The History of Thoughts in Urban Planning. ed. Tehran (IR): Armanshahr Publication; 2010 (In Persian).

[17] Berechman, J., Small, K. A. Modeling Land Use and Transportation: An Interpretive Review for Growh Areas. University of California Transportation Center, 1988; doi:10.1068/a201285.

[18] Chang, J. S., Mackett, R. L. A bi-level model of the relationship between transport and residential location. Transportation Research Part B: Methodological, 2006; 40: 123-146. doi:10.1016/j.trb.2005.02.002.

[19] Siripanich, A., Ghasrikhouzani, M., Rashidi, T. H. Integrating the Garin-Lowry model with a Travel Demand Model. In: Transportation Research Board 98th Annual Meeting; 2019 Jan 13-17; Washington DC, United States. p.

[20] Bar-Gera, H. Transportation Network Test Problems. 2016. https://tzin.bgu.ac.il/~bargera/tntp/.

[21] Sheffi, Y. Urban Transportation Networks: Equilibrium Analysis with Mathematical Programming Methods. 1st ed. Saddle River (NJ): Prentice-Hall; 1984.

[22] Zarrinmehr, A., Shafahi, Y. Parallelization of the Branch-and-Bound Algorithm in Transportation Discrete Network Design. Scientia Iranica, 2016; 23: 407-419. doi:10.24200/sci.2016.2127.

[23] Jiang, F., Ma, L., Broyd, T., Li, J., Jia, J., Luo, H. Systematic framework for sustainable urban road alignment planning. Transportation Research Part D: Transport and Environment, 2023; 120: 103796. doi:10.1016/j.trd.2023.103796.