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DESIGNING INCLUSIVE RESIDENTIAL LANDSCAPES: A SPACE–BEHAVIOR–PERCEPTION APPROACH

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Rapid urbanization and demographic diversification are reshaping the structure and functioning of residential environments. In high-density cities, inclusive landscape design faces increasing challenges related to spatial inequality and differentiated user needs. This study proposes a Space–Behavior–Perception (SBP) framework together with a Community Needs Mapping toolkit to support inclusive residential landscape design. The findings demonstrate that spatial accessibility, behavioral support, and perceptual inclusivity interact to determine overall inclusivity, while mobility-limited residents continue to experience spatial inequities. The results highlight the importance of integrated design approaches that address spatial, behavioral, and perceptual dimensions.

Key words: Inclusive landscape design, residential landscape design, Space–Behavior–Perception framework, community-centered design, spatial accessibility, perceptual inclusivity

INTRODUCTION

Contemporary urban development is characterized by increasing demographic diversity, population aging, and growing socio-spatial disparities. Within this context, residential landscapes function not only as aesthetic components but as everyday environments that structure social interaction, regulate movement, and shape perceptions of belonging [1–2]. Spatial organization directly influences patterns of access, participation, and inclusion. From the perspective of spatial justice, space acts as a medium that distributes opportunities unevenly among different social groups [3].

Global policy frameworks have increasingly emphasized inclusive urban development. The United Nations' New Urban Agenda calls for equitable access to public space and urban services [4]. Yet inclusion in practice often remains narrowly interpreted as compliance with accessibility standards. While barrier-free infrastructure has expanded, experiential exclusion persists. Research in environmental behavior suggests that physical accessibility alone does not guarantee meaningful participation [5]. The ability to use space, interact within it, and perceive it as welcoming is equally important. This disconnect between normative aspirations and lived experience is especially visible in high-density urban contexts, where limited land resources intensify competition for spatial access and amplify the



consequences of design decisions. All data and conclusions in this paper are derived from the author's independent empirical research on three high-density residential communities in eastern China using mixed research methods.

PURPOSE

This study aims to develop and validate a Space–Behavior–Perception (SBP) framework and a Community Needs Mapping toolkit for inclusive residential landscape design in high-density urban contexts. The research focuses on revealing the interaction between spatial configuration, behavioral engagement, and perceptual experience, as well as identifying their role in enhancing inclusivity and spatial equity.

RESULTS AND DISCUSSION

Inclusive landscape design in high-density residential areas offers a practical path to advance spatial justice and equitable urban planning. This study develops and validates the SBP framework (fig. 1), defining inclusivity as a dynamic process instead of a static state, and uncovering the mechanism converting spatial configuration into real experiential inclusion. The framework is developed and verified based on empirical data: 612 valid questionnaires, 48,372 behavioral trajectory records, 1,284 spatial segments and 18 semi-structured expert interviews.

First, spatial accessibility is the structural basis of inclusive landscapes, with its effect strongly mediated by behavioral engagement. Spatial accessibility significantly boosts behavioral support ($\beta = 0.48$, $p < 0.001$), explaining 23% of usage variation. Behavioral heatmap analysis of trajectory data shows that pocket parks and communal courtyards with seating, greenery and social functions support longer stays and higher interaction, while pure circulation corridors see low engagement. Physical accessibility alone is insufficient; behavioral activation is necessary.

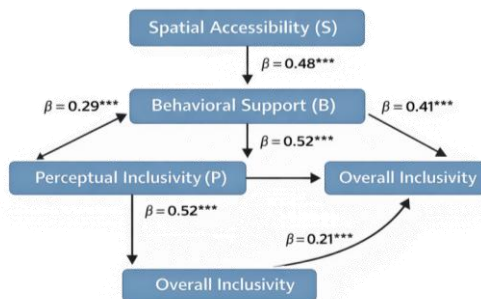


Fig. 1. Structural Equation Model of the SBP Framework

Second, perceptual inclusivity is the core mediator and strongest predictor of overall inclusivity ($\beta = 0.52$, $p < 0.001$). Spatial and behavioral factors jointly explain 41% of perceptual inclusivity variance, and the full model explains 56% of total inclusivity variance. Subjective experiences such as perceived safety, fairness and



belonging are critical to holistic inclusion. ANOVA analysis of survey data shows significant gaps across mobility groups ($F = 24.37$, $p < 0.001$), with inclusivity scores dropping from 4.18 (no limitation) to 3.21 (severe limitation), proving experiential inequality persists despite accessibility compliance.

Third, this study develops the Community Needs Mapping toolkit, integrating spatial syntax, behavioral tracking, perceptual surveys and structural equation modeling for measurable, replicable inclusive planning. This toolkit quantifies the shift from spatial potential to behavioral and perceptual inclusion, supporting equity diagnosis and design simulation, unlike traditional accessibility audits.

Application of the SBP framework (fig. 2) is limited by site context, population structure and management rules, requiring adaptive adjustments and community participation for better local fit. Digital tools like spatial syntax analysis, behavioral mapping and A-BIM used in the framework were verified and applied in empirical research, with effects tested via actual data, improving design precision and efficiency.

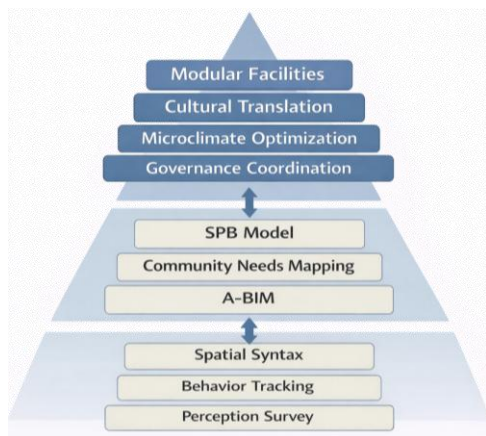


Fig. 2. Operational Framework for Inclusive Residential Landscape Planning

This study proves the process-based SBP framework effectively connects spatial configuration, behavioral practice and perceptual experience. Integrating quantitative analysis, behavioral feedback and equity-focused strategies, it supports the design of more inclusive, equitable and people-centered residential landscapes in high-density cities.

CONCLUSIONS

This study confirms that residential landscape inclusivity is a dynamic process driven by the interaction of space, behavior and perception, not a static



result of physical design. Spatial accessibility forms the structural foundation, behavioral engagement acts as a key mediator, and perceptual inclusivity determines final inclusive outcomes. Mobility-limited groups still face severe experiential inequality, meaning physical accessibility cannot resolve spatial injustice.

The proposed SBP framework and Community Needs Mapping toolkit offer a measurable, replicable method to translate spatial justice theory into design practice. Integrating multiple analytical methods, this research provides a systematic tool for equity diagnosis and inclusive planning in high-density residential areas.

Findings suggest future inclusive landscape design should discard single accessibility standards, prioritize behavioral activation and perceptual experience, and adopt adaptive, community-participatory strategies. This study provides theoretical support and practical routes for building equitable, inclusive and sustainable urban residential environments.

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ПРОЄКТУВАННЯ ІНКЛЮЗИВНИХ ЖИТЛОВИХ ЛАНДШАФТІВ: ПІДХІД НА ОСНОВІ ВЗАЄМОДІЇ ПРОСТОРУ, ПОВЕДІНКИ ТА СПРИЙНЯТТЯ

Швидка урбанізація та демографічна диверсифікація змінюють структуру та функціонування житлового середовища. У містах із високою щільністю забудови інклюзивний ландшафтний дизайн стикається зі зростаючими викликами, пов'язаними з просторовою нерівністю та різноманітністю потреб користувачів. У дослідженні запропоновано модель Space–Behavior–Perception (SBP) та інструментарій Community Needs Mapping для підтримки проєктування інклюзивного житлового середовища. Результати показують, що просторова доступність, поведінкова підтримка та перцептивна інклюзивність взаємодіють, визначаючи загальний рівень інклюзивності, тоді як маломобільні групи населення продовжують стикатися з просторовою нерівністю. Отримані результати підкреслюють важливість інтегрованих дизайнерських підходів, що враховують просторові, поведінкові та перцептивні аспекти.

Ключові слова: інклюзивний ландшафтний дизайн, дизайн житлового середовища, модель Space–Behavior–Perception, дизайн, орієнтований на користувача, просторова доступність, перцептивна інклюзивність.