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Title	Assessing the Accessibility of Footpaths at the Core of Old Indian Cities : The Universal Mobility Perspective [an abstract of dissertation and a summary of dissertation review]
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Degree Grantor	北海道大学
Degree Name	博士(工学)
Dissertation Number	甲第15626号
Issue Date	2023-09-25
Doc URL	https://hdl.handle.net/2115/90884
Rights(URL)	https://creativecommons.org/licenses/by/4.0/
Type	doctoral thesis
File Information	Das_Mahapatra_Gaurab_abstract.pdf, 論文内容の要旨



学 位 論 文 内 容 の 要 旨

博士の専攻分野の名称 博士（工学） 氏名 Das Mahapatra Gaurab

学 位 論 文 題 名

Assessing the Accessibility of Footpaths at the Core of Old Indian Cities: The Universal Mobility Perspective
(インド古都における歩道のアクセシビリティ評価に基づくユニバーサル・モビリティに関する研究)

As per the data of the Census of India from the last 100 years (1911- 2011), the percentage of specially-abled people has phenomenally increased by 737.2% (from 0.26% in 1911 to 2.21% in 2011) in comparison to 284.21% increase in population (from 833,644 in 1911 to 26,814,994 in 2011). Similarly, the percentage of elderly (people aged 60 and above) has increased significantly by 105.25% (4.18% in 1911 to 8.58% in 2011). Indicators 11.2.1 and 11.7.1 within targets 11.2 and 11.7 of the UN-SDG emphasize making the public spaces and transportation system accessible to all (specially-abled and able-bodied), with additional focus on the needs of (a) those in vulnerable situations, (b) women, (c) children, (d) persons with disabilities, and (e) older persons. Additionally, the UN member nations (like India) are also instructed to improve road safety, especially by expanding accessible public transport. In contrast to international guidelines, most of the Indian documents related to Universal Design/accessible design are mere guidelines and not mandatory rules; thus, their implementation for accomplishing ‘barrier-free’ or ‘inclusive’ built environments at the societal and/or urban level has not happened. Especially, pedestrian-level infrastructures in old Indian cities are often affected by poor infrastructure and pose a threat to able-bodied and users with wheelchairs or walking assistance alike.

The aim of this research is to find out strategies to improve the quality of life in congested urban cores by making the footpaths accessible to all under the broader paradigm of urban reforms in India. The dissertation hypothesizes that the strengths of the organically planned old settlements might improve the livability standards if the accessibility component is inserted into its pedestrian paradigm through architectural planning. The four primary objectives of the research are mentioned: (a) To define the role of Architectural Planning in an ‘accessibility planning’ proposal, (b) To determine the degree of accessibility possible in the footpaths of core areas of an old Indian city by proposing an ideal accessibility audit checklist, (c) To improve cognition at the footpath level in old cities, especially for the specially-abled, and (d) Policy-level recommendations to increase the quality of life in cities by improving the footpaths. The four key research questions are mentioned: (a) What is the role of accessibility under the broader domain of Universal Design in improving the quality of life? (b) What is the degree of accessibility that can be achieved in the public domain of old cities? (c) Can core Indian cities be made inclusive in terms of Universal Mobility? and (d) What degree of cognition can be achieved in the footpaths of old cities? The 2 major domains of research scope are: (a) To explore the potential of inclusiveness in footpaths of congested cores where the density is more concerning the rest of the city, and (b) To furnish a process-oriented approach in the realm of accessibility where the approach is still product oriented. The 3 principal limitations of this research are: (a) Restrict the design intervention to a delineated part of Central Kolkata, (b) Some disabilities shall be prioritized, preferably, Mobility and Physical Impairments, and (c) ‘Transportation System Accessibility’ involving (vehicular and walkability) will be dealt upon with greater focus.

This dissertation consists of 7 chapters as follows:

Chapter 01: This chapter titled ‘Introduction’ elaborates on the research background, research outline, key terms used in this research, research methodology, a summary of dissertation chapters, and interpretation of the dissertation chapters.

Chapter 02: In this chapter, users’ perception towards Universal Mobility in old core cities of India has been critically analysed. Despite Universal Design guidelines from the United Nations and the Union Government of India, old cities in India seldom have Universal Mobility, in effect endangering the lifestyle of senior citizens and specially-abled people. The core of Kolkata Municipal Corporation in Kolkata, India, has been considered a case example for this section. This section has considered three types of datasets for analysis. First, the authors interviewed 310 respondents from the Indian design fraternity, to understand their opinions on the concept of Universal Design. The next investigative study of 125 respondents from different wards of Kolkata Municipal Corporation aimed to comprehend people’s perceptions regarding walkability and mobility in an old Indian city. In the last visual survey of a stretch in Central Kolkata, the focus was on identifying hindrances in Universal Mobility in an old city core of Indian origin. Significant dissatisfaction was found regarding walkability amongst all user groups, which is linked to poor infrastructural conditions. Furthermore, accessing public transportation is difficult due to improper waiting facilities. However, the design fraternity in India suggests the need for separate accessibility guidelines for old and new cities in India. The design fraternity also recommends a customized rating system for accessing Universal Design. The result of this study indicates a need of recognizing the difficulty in imparting Universal Mobility in old core cities in India. The findings of this chapter can be used for preparing an access audit checklist through Architectural Planning, which is the first step in proposing a framework for Universal Mobility in old core cities in India.

Chapter 03: Old Indian cities are often less accessible due to temporal restrictions and ever-rising pedestrian volume. In this research, the accessibility of the footpath-level walkability condition of old core cities has been assessed through Architectural Planning Research, considering 32 footpath stretches in Central Kolkata, India as a case. The research has considered 3 data sets, (a) 257 experts' opinions about universal mobility, (b) 18 variables for assessing accessibility conditions, and (c) peak hour pedestrian volume. IBM® SPSS® Statistics 26.0 version has been used to validate the findings of the research. It was found that mixed-use buildings demarcate the edge of the footpaths in old cities. 50.6% of Indian experts have prioritized the "dimension of the footpath" while assessing universal mobility for pedestrians in the old cities of India. The average accessibility percentage for the entire surveyed stretch is negative which highlights the poor accessibility of the stretch. Pearson's correlation between footpath width and infrastructure score of 0.535 signifies the width of a footpath plays a significant role in determining the level of footpath infrastructure. Thus, the findings of this chapter can be used while preparing accessibility development plans for the study area and other areas of a similar genre.

Chapter 04: In this chapter, the condition of Universal Mobility in the core of old Indian cities has been critically analysed. Implementing Universal Design guidelines (especially Universal Mobility standards) in the core of old Indian cities is comparatively challenging due to the high-density, ever-increasing population, and organic urban development. The rising number of elderly and specially-abled also adds a demographic challenge to the aspect of Universal Mobility. This research focuses on understanding the extent to which Universal Mobility guidelines can be implemented in the core of old Indian cities. The dataset for this research is derived from the field survey of sixty-nine footpath stretches from the core of five old cities in India, namely Jaipur, Jodhpur, Nagpur, Hyderabad, and Chennai. Footpath stretches in the core of these old cities was evaluated based on several factors in the domain of universally designed infrastructure and Universal Mobility features. Such comprehensive research on Universal Mobility in footpaths of old Indian cities has not been conducted. The findings of this chapter indicate the poor condition of Universal Mobility in the study areas. Furthermore, the results can be useful for assessing the extent of implementation of Universal Mobility in the core of old Indian cities.

Chapter 05: In this chapter, expert opinion on Universal Mobility in the footpaths of urban India has been critically appraised. Universal Mobility (as a component of Universal Design) is still a largely ignored urban parameter in India despite an increase of 732.20% in the specially-abled and 105.25% in the elderly, between 1911 and 2011. 257 experts from the field of architecture and planning hailing from 66 cities in India were interviewed for this section. It was found that despite nationally implemented Universal Design guidelines, footpaths in 42.8% of the cities do not have Universal Mobility. 74.7% of the respondents identify the dimension of the footpath as the most important factor for implementing Universal Mobility. The findings of this chapter indicate the importance of Universal Design in improving the quality of life in Indian cities and urban local bodies can play a significant role in the process using Public Private Partnership models and a new accessibility audit checklist.

Chapter 6: In this chapter, the role of cognition in Universal Mobility at the pedestrian-level has been investigated. A stretch of approximately 850 m in the core of Kolkata Municipal Corporation (in India) has been delineated as the case area for this research. The 02 data sets considered for this research are: (a) Physical data: Pedestrian Count and Vehicular Traffic Volume, and (b) Cognitive data: Light Intensity, Noise, and Thermal Comfort. The authors collected the data from the case area in the years 2020 and 2021. This section initially involves determining the pedestrian "Level of Service" (LOS) based on the pedestrian count. Furthermore, the authors co-relate (Pearson's Correlation with a 95% confidence interval) the LOS data with the light intensity, sound intensity, and temperature data; to establish a relationship between them. This chapter's findings indicate a gap in realizing the potential of walkability in the case area. The authors conclude that the improvement of cognition in pedestrian-level Universal Mobility can lead to a better physical environment for the specially-abled and elderly.

Chapter 07: This chapter titled 'Conclusions and Recommendations' consists of the summary of the research, a compilation of global best practices in relation to the dissertation, a critical appraisal of the global researchers in the context of the dissertation, and the scope of future research.