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Original Article

Comprehensive Walkability Assessment of Urban Streets – Case of Tender S.U.R.E, Bengaluru

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Abstract *- Rapid urbanization and rising motorization have impacted pedestrian environments and walkability, especially in the Global South. To handle these challenges, many countries have initiated street redesign to prioritize pedestrianization. TenderSURE (Specifications for Urban Road Execution) is one such initiative adopted by Bengaluru under the Smart City Mission, with the key objective of creating world-class pedestrian-friendly streets. This study aims to evaluate the pedestrian walkability of seven streets of Bengaluru redesigned under the TenderSURE Phase 1 program through a mixed-methods approach, combining both field assessments using the Pedestrian Environment Data Scan (PEDS) tool, user perception surveys and qualitative feedback. Overall walkability scores across the study corridors are moderate. St. Marks Road emerged as the highest-rated street overall at 70.5%. St. Marks Road and Cunningham Road scored highest on objective physical measures (PEDS score 68.8%), and St. Marks Road is rated best on the perception survey (72.14%), particularly for safety and comfort. Although a clear improvement in footpath quality, paving, and street aesthetics can be seen through TenderSURE upgrades, several problems remain. Residency Road and St. Marks demonstrated a positive gap between objective scores and how people perceived the streets more favourably than their physical condition suggested. This could largely be attributed to the homogeneous, vibrant commercial character and lively atmosphere. Cunningham Road and Museum Road are perceived less favourably than the physical environment. Pedestrians emphasized the need for unobstructed footpaths, shaded resting spaces, safer crossings and improved maintenance. The study shows that for street design to be truly successful, both improvement in physical infrastructure and comfort, convenience, everyday usability, lived experience of people on the street, and continued maintenance are equally important.*

Keywords *- Accessibility, Bengaluru, Pedestrian infrastructure, TenderSURE, Walkability assessment.*

1. Introduction

Rapid urbanization and increasing motorization have significantly reshaped cities across the Global South, often reducing the importance given to pedestrians. In India, streets are largely dominated by vehicles, making walking environments unsafe, uncomfortable, and discontinuous in many areas. Yet, walking is one of the most accessible, sustainable, and healthy modes of transport as it eases congestion, reduces CO2 emissions, and improves local economic activity [1-4] Despite the clear benefits, pedestrian infrastructure in most Indian cities is very poor, with narrow footpaths, broken surfaces, unsafe crossings, vendor and vehicular encroachment and a glaring absence of basic amenities.[5, 6]

A large body of international research highlights the wide-ranging benefits of high-quality pedestrian environments. Streets designed with the objective to improve walkability encourage physical activity, help reduce obesity and chronic diseases, and support mental well-being. Beyond health gains, they help lower carbon emissions, build stronger social and community environments and support local economies by attracting more people to shops and businesses. [2, 7] It creates inclusive public spaces that work well for everyone - including women, children, older people, and persons with disabilities alike. [4, 8, 9]

To handle these issues, several Indian cities have initiated street redesign under the Smart Cities Mission and various other state-level programs. Bangalore City Connect Foundation (BCCF), in partnership with Jana Urban Space Foundation (JUSF) and government agencies, initiated TenderSURE with the objective of prioritizing pedestrianization and upgrading urban infrastructure. [10, 11] This program brought in comprehensive, standardized design specifications and guidelines by incorporating uniform high-quality granite footpaths, organized underground utilities, street furniture, landscaping, and improved traffic management. TenderSURE program is executed in three phases, covering about 50 roads in Bengaluru. Phase 1 was introduced to demonstrate the effectiveness of the design standards. Seven important commercial and institutional corridors in the central business district: St. Marks Road, Richmond Road, Residency Road, Museum Road, Vittal Mallya Road, Cunningham Road and Commissariat Road were redesigned and upgraded as part of Phase 1 [11].

The TenderSURE program has been widely appreciated for its design and engineering standards and improved street aesthetics, it has received criticism for the high cost of construction, damaging the roots of several trees, resulting in their death, and inadequate public consultations. Most of the existing assessments of TenderSURE's success are from the reviews conducted by implementing agencies themselves and focus on compliance checks. Very few independent academic evaluations of how the program actually affects the pedestrian experience have been carried out. [6] Not many studies have adopted a mixed-methods approach combining internationally validated walkability assessment tools like PEDS, along with user perception surveys and qualitative feedback. It is still not clear whether these interventions have genuinely improved everyday walking experiences in the Indian urban context.

Research on walkability has advanced considerably over the past two decades. Early studies show walkability as a multidimensional construct shaped at both the macro and micro scales. Urban form factors such as street connectivity, land-use mix and density influence at the macro level, whereas street-level details, including sidewalk quality, traffic buffers, crossing facilities, street furniture, shade, aesthetics, and perceived safety influence at the micro level. [1, 12, 13] One of the most useful tools from this work is the Pedestrian Environment Data Scan (PEDS), developed by [12], has become one of the most widely used and respected tools for evaluating micro-scale attributes of the pedestrian environment.

However, the vast majority of empirical research still comes from Global North cities, whose contexts differ substantially from those in India. More recent studies from the Global South have begun to highlight distinct local challenges, such as widespread informal encroachments, extreme climatic conditions, and high socio-economic diversity among pedestrians. [5, 14, 15]

To address the identified research gap, this study adopts a comprehensive mixed-methods evaluation to assess the walkability of seven streets in Bengaluru redesigned under TenderSURE Phase 1. Combining objective on-field assessments based on the Pedestrian Environment Data Scan (PEDS) tool with structured user perception surveys and qualitative responses, the research looks at both the physical upgrades delivered by the program and pedestrians' lived experience of these streets. In doing so, it seeks to generate data-driven, evidence-based insights into the real effectiveness of large-scale pedestrian-oriented street redesign initiatives in the Indian urban context. Most earlier assessments of the TenderSURE corridors are internal compliance audits, and none of them combine an internationally validated field assessment instrument like PEDS with a perception survey like NEWS across the entire Phase 1 after many years of completion of the project. Without a triangulated study, it remains unclear whether the physical upgrade has been consistent with maintenance years after completion and whether it has resulted in a measurable everyday walking experience.

Intending to close this gap, this study applies the PEDS audit across all seven corridors simultaneously rather than to a single subset or a single street. This allows cross-comparison across corridors several years after implementation. This study adopted a granular ground-level evaluation based on physical audits rather than secondary or model-derived data. It introduces an objective and subjective gap analysis for each street and triangulates these with inductively coded qualitative themes. This extends beyond the focus of earlier assessments conducted by implementing agencies.

2. Literature Review

Walkability has become a central concern across urban planning, transportation engineering, public health, and environmental sustainability. It is generally understood as the degree to which the built environment supports and encourages walking through safe, comfortable, convenient, accessible, aesthetically pleasing, and socially engaging conditions. [1, 8, 16] In his influential book Cities for People, Jan Gehl (2013) argued that successful pedestrian environments must be designed at a human scale - offering protection from traffic, physical comfort through thoughtful amenities, and opportunities for meaningful social interaction [8]. These ideas have shaped street redesign efforts in many parts of the world. However, their application and effectiveness in the rapidly urbanizing contexts of the Global South have received far less rigorous attention [5, 6].

2.1. Conceptual Foundations and Multidimensional Nature of Walkability

Early scholarly works on walkability largely concentrated on macro-scale urban form factors such as residential density, land-use mix, and street connectivity [1, 4]. While these elements undoubtedly shape walking behaviour, more recent research has equally stressed the importance of micro-scale street-level factors as well. These include sidewalk width and continuity, surface quality, buffers from traffic, crossing facilities, street furniture, shade, lighting, and overall aesthetic appeal. [5, 12, 13] In the Indian context, where the streets are characterized by dense, mixed-use, such micro-scale features often make a difference to how the streets are perceived, whether as one that feels walkable and one that feels hostile. [6]

Walkability is now widely looked at as a multidimensional construct that includes safety, comfort and convenience, connectivity and accessibility, aesthetics and environmental quality, and social and community environment. [2, 12, 16] This complexity calls for comprehensive assessment frameworks that combine both objective measures of the physical environment and subjective measures of pedestrians' lived experiences [14].

2.2. Health and Environmental Impact Evaluation

Walking is considered one of the most sustainable means of transport and helps lower carbon emissions associated with short motorized trips. [2, 7] High-quality pedestrian environments encourage walking, physical activity and mental wellbeing while reducing obesity and other chronic diseases related to inactivity. [7] Frameworks focusing on health reaffirm the relationship between walkability, physical activity, environmental sustainability and argue for health-integrated assessment frameworks alongside physical infrastructure. [17] In hot and humid and hot and dry contexts, inadequate shade and thermal discomfort may discourage walking altogether and offset health benefits. [3] This suggests that future street assessments should integrate pedestrian volumes and self-reported activity level along with physical audit scores for future street redesign evaluations.

2.3. Equity and Accessibility Analysis

Studies have increasingly recognized that infrastructure upgrades do not benefit all pedestrians equally. Recent literature has identified that persons with disabilities face multiple recurring barriers on urban roads, including insufficient kerb ramps, uneven surfaces, and poorly marked crossings. This disproportionately restricts the mobility and independence of certain categories of pedestrians, like older people, children and persons with disabilities [5, 9]. Universal accessibility and inclusivity have been emphasized by international standards to make accessibility a mandated design and not incidental [4, 8]. These findings indicate equity-focused evaluation should be a distinct analytical dimension using both physical audits and perceived experience rather than aggregating into a walkability score.

2.4. Participatory and Qualitative Assessment

Pure infrastructure audits can miss context-specific pedestrian experience insights. Open-ended qualitative responses help develop thematic analysis to gain a better understanding of the recurring lived user experience. Physical audit tools do not directly capture experiences like perceived safety, encroachment, or maintenance neglect. Under Walkable Bengaluru and Walkable Malleshwaram, citizen-led pilot initiatives, trained volunteer teams carried out walkability audits. [18] Similar initiatives have been taken by Bengaluru City Corporation. [18] Combining structured qualitative coding with participatory citizen experience can generate continuous community-sourced monitoring data over more segments and time periods, and can complement periodic professional audits. This creates a continuous feedback channel between implementing agencies and the residents, increasing the success of pedestrian infrastructure projects.

2.5. Policy Implementation and Governance Review

Independent evaluations report visible construction-stage improvements but are undermined by fragmented administration across municipal bodies, traffic police, and multiple road-owning agencies. This points towards a governance bottleneck rather than a design failure. Despite high technical specifications, TenderSURE itself has faced constant criticism given the limited public consultation and the high cost of construction. Similar specification-driven programs, including Chennai's NMTP, Pune's Street Design Guidelines, Bengaluru's Namma Raste and Nagpur's "Streets for People," depend on continuous institutional coordination beyond the construction phase [19, 20, 21]. Audit-index studies reinforce that without post-handover governance, the physical upgrade alone cannot guarantee lasting outcomes.

2.6. Smart Tools and Technology in Walkability

Walkability assessment has moved beyond manual field audits to employing advanced methods that are data-intensive and technology-assisted. Many researchers embed street-level indicators, network accessibility measures, and safety and comfort directly into GIS to develop route planning tools. [22, 23] Many studies have employed machine learning techniques to automate scoring of large-scale studies across entire cities. This substantially reduces the time and cost involved in manual audits. [24] In parallel, Internet of Things (IoT) sensor networks are employed to count pedestrians and to monitor real-time ambient conditions. This offers continuous, low-cost data streams that complement periodic manual audits. [25] This can be a natural extension to established audit instruments such as PEDS.

2.7. Street Redesign Programs in the Global South

In response to declining walkability, many cities in the Global South have launched several ambitious, large-scale street redesign programs. Bogotá's well-known Ciclovía and TransMilenio corridors. Mexico City's major street transformations and many other initiatives under India's Smart Cities Mission are some such examples. [1, 26] While many of these projects have managed to increase pedestrian volumes and improve the visual aesthetics of the street, rigorous evaluations after implementation using standardized walkability tools remain quite limited. [6]

2.8. Pedestrian Infrastructure Initiatives in India

In India, street improvement programs have picked up considerable pace over the past decade, driven by the Smart Cities Mission, AMRUT, and various state-level initiatives. Cities such as Delhi, Ahmedabad, Pune, Hyderabad, Chennai, and Surat have carried out pedestrian improvements such as wider footpaths, improved paving, better street lighting, and landscaping. Independent assessments indicated that although post-construction physical upgrades were clearly seen, numerous inadequacies like long-term maintenance, encroachments by vendors and parked vehicles, lack of seating and shade, unsafe crossings, and limited accessibility continued to exist. The overall effectiveness of these projects was diminished by the persisting challenges. [6, 27]

Many initiatives still focus more on engineering standards and visual appeal than user comfort and long-term usability. Problems like broken and discontinuous footpaths, lack of basic amenities like seating, shade, drinking water, and public toilets, and poor control over encroachments have often resulted in lower usage, particularly among women, the old people, and persons with disabilities. [5, 14]

2.9. The TenderSURE Program in Bengaluru

The TenderSURE program in Bengaluru is one of India's most systematic and ambitious street redesign initiatives so far. The program was launched in 2014 by the Bruhat Bengaluru Mahanagara Palike (BBMP) in collaboration with Janaagraha to tackle the long-standing problems of poor road quality and inadequate pedestrian infrastructure in the city. It brought in standardized design guidelines and specifications for streets with pedestrianization, usage of high-quality materials and integrated streetscaping being the priority.

Unlike most of the earlier road-widening projects that primarily focused on vehicular traffic, TenderSURE prioritized pedestrian comfort and safety. The key features of TenderSURE street redesign included high-quality uniform granite paving, consistent width of footpaths, designated utility corridors, improved street lighting, integrated landscaping with shade-giving trees, street furniture, and better-managed intersections. Phase 1 included redesign and development of seven important commercial and institutional corridors in the central business district of Bengaluru: St. Marks Road, Richmond Road, Residency Road, Museum Road, Vittal Mallya Road, Cunningham Road and Commissariat Road. [11] The street selection was based on the strategic location in the central business district.

2.10. Walkability Assessment Methods

Walkability assessment methodologies can generally be divided into objective and subjective. Objective methods look at systematic field audits and direct physical measurements. The objective assessment tool Pedestrian Environment Data Scan (PEDS) developed by Clifton et al. (2007) is regarded as the most comprehensive and widely respected tool internationally. It assesses four key categories - environment, pedestrian facility, road attributes and crossings, and walking/cycling environment with 31 micro-scale elements using a consistent 0-5 scoring system. [12] The tool is particularly valued for its strong intra- and inter-rater reliability, replicability, and ability to capture detailed street-level features that influence walking behaviour. [12, 28]

Subjective assessments capture pedestrians' lived experiences through surveys and interviews. The Neighbourhood Environment Walkability Scale (NEWS), originally developed by Saelens et al. (2003), is one of the most established and widely adopted instruments globally. [14, 16] In Global South contexts, subjective measures uncover critical insights such as gender-specific safety concerns, the impact of informal vending, climatic discomfort, and the importance of social vibrancy in encouraging walking that objective tools tend to miss. [5, 14, 15] Recent studies suggest that a comprehensive approach combining both aspects is imperative, as objective audits alone frequently fail to capture the fine context-specific factors that influence the actual walking behaviour in diverse urban settings. [13, 29]

2.11. Divergence between Objective and Subjective Measures

Research shows that there is a consistent gap between objective and subjective assessments of walkability. In a study by Shatu et al. (2019), they found that perceived safety and comfort often have a stronger influence on walking behaviour than just the quality of the physical infrastructure.[29] Other studies carried out around Asian cities have made similar observations, where it was noted that even the streets that have scored average on objective assessment have been perceived as highly walkable streets given their busy commercial and social activities, familiarity, and lively atmosphere.[14, 15] This gap seems especially wide in Global South cities. In these cities, informal street economies, extreme climatic conditions, and wide socio-economic differences play an important role in shaping pedestrian experiences [5].

Depending completely on a single assessment method may create a gap and limit the study. Objective tools like PEDS can be very effective in assessing and measuring the physical environment, but do not cover the cultural and perceptual aspects. Subjective surveys measure the lived experience of the people, but this can be influenced by their familiarity and personal biases. Overall, the evidence points to the fact that adopting mixed-methods approaches combining both objective and subjective measures gives a more comprehensive and relevant understanding of walkability. [13, 29]

2.12. Research Gaps and Study Contribution

In spite of increasing academic interest, critical gaps remain in walkability research, especially in the Global South. Very few studies have employed internationally validated assessment tools like PEDS in the Indian context. Studies that have adopted mixed-methods designs and systematically compared and combined objective field audits with user perception and qualitative insights into pedestrians' actual experiences remain limited. The influence of social, cultural, economic and climatic factors on the link between physical upgrades and perceived walkability is not fully understood [5, 15].

Earlier assessments carried out by the implementing agencies and NGOs show visible improvement in surface quality, pedestrian movement and street aesthetics. [11] These evaluations have mostly been internal, with a focus on project outputs rather than long-term outcomes or pedestrians actual experience of the streets. Very few independent academic studies have adopted internationally validated tools like PEDS in combination with perception surveys and qualitative insights. Understanding both strengths and limitations of the program is essential if the pedestrian-focused street redesign efforts are to be successfully implemented in other Indian cities.

This study attempts to address these gaps by adopting a comprehensive mixed-methods evaluation of all seven streets redesigned under Bengaluru's TenderSURE Phase 1. By combining objective assessment using the PEDS tool with structured user perception surveys along with qualitative responses, it aims to advance methods in walkability research and provide practical policy insights for effective redesign of pedestrian-friendly streets in rapidly urbanizing cities. The present study's PEDS and Excel-based methodology could extend into GIS and other technology-intensive methods for further phases.

3. Materials and Methods

3.1. Study Area

Bengaluru, widely known as the "Silicon Valley" is one of the fastest-growing metropolitan cities in India. It has a population of 13 million. It has witnessed rapid expansion and urbanization, largely driven by the booming IT sector and manufacturing sectors. Along with significant economic opportunities, the growth has increased urban problems significantly, including severe traffic congestion, poor air quality, inadequate public transport and declining pedestrian infrastructure. [5, 6]

Due to rapid urbanization, the streets are mainly designed to handle growing vehicular traffic. The character of the street as a social space is lost in Bengaluru. The footpaths are usually narrow, broken or undulating in places, poorly maintained or frequently blocked by street vendors and parked vehicles. They lack basic amenities like seating, shade and universal accessibility features. These factors have made walking difficult, unsafe and unpleasant, especially for women, older people, children and people with disabilities.

To address these issues, Bruhat Bengaluru Mahanagara Palike (BBMP), in partnership with the civic society organization Janaagraha, launched the TenderSURE program in 2014. TenderSURE put the pedestrians first and drafted clear, standardized design guidelines for urban roads with better accessibility, proper utility management and aesthetic streetscaping. This demonstrated an obvious shift away from the conventional vehicle-focused approach towards a more holistic, pedestrian-friendly approach.

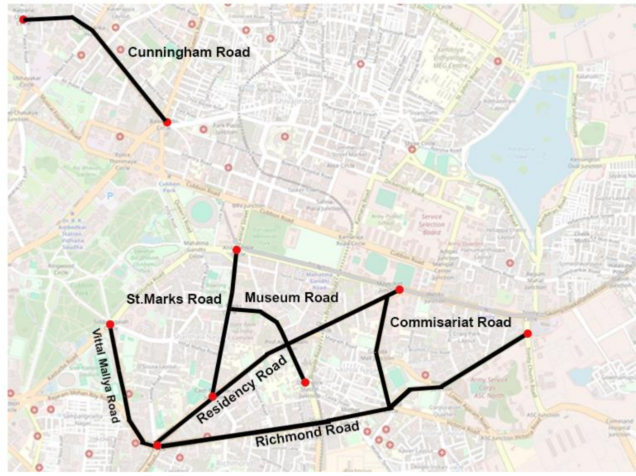

Fig. 2 Map showing the roads redeveloped under TenderSURE phase 1 (Source: janausp)

Phase 1 of the program (2014-2018) focused on seven major commercial and institutional corridors in the city centre: St. Marks Road, Richmond Road, Residency Road, Museum Road, Vittal Mallya Road, Cunningham Road and Commissariat Road. [11] These streets were selected for their prime location, heavy pedestrian footfall, and importance as commercial centres in central Bengaluru. Subsequent phases have expanded the program to other parts of the city, with more than 50 kilometres of roads developed or under implementation as of 2025. This research focuses on the seven corridors redesigned under Phase 1 of TenderSURE, providing an ideal opportunity to evaluate the long-term results several years after their completion.

3.2. Research Design

A convergent mixed-methods design was adopted for this study. Pedestrian environment data were collected primarily through field assessments supplemented by Google Street View imagery for cross-validation. Subjective user perception surveys were carried out in parallel during the same period. Initially, the two datasets were analyzed separately and then brought together for interpretation. The convergent parallel approach was selected as it allows for a comprehensive understanding of walkability by triangulating objective physical measurements with subjective human experiences. Instead of relying on a single method, this design brings together complementary components of evidence. The overall research was based on a pragmatic approach with emphasis on practical utility and the use of multiple methods to answer research questions effectively.

This approach allowed examination of both the physical condition of the streets ("what is there"), along with the lived experience of the pedestrians ("how it feels"). These two datasets were first compared side-by-side through tables, radar charts and gap analysis; and second, by using qualitative themes to explain and deepen the qualitative results. This approach works especially well for walkability research as it captures both the objective physical features of the street and the real-time walking experience on the streets.

3.3. Objective Walkability Assessment

Systematic field evaluation was carried out using the Pedestrian Environment Data Scan (PEDS), a walkability assessment tool originally developed by Clifton et al. (2007) and published in Landscape and Urban Planning. PEDS is a well-validated tool for auditing the pedestrian environment at street level through detailed, observable, and measurable indicators. The tool has been widely applied in both developed and developing countries because of its thoroughness, good reliability between different raters and ability to pick up detailed street-level features that affect how people walk. [12, 28]

Selection of 25 indicators for the audit was through a two-stage process. First, all 31 original PEDS indicators were reviewed for relevance and measurability within the study corridors. Pilot walkthrough excluded the low-variance indicators revolving around suburban and low-density housing forms were excluded as they are not present in this central business district. Second, the remaining indicators were mapped into four categories in fixed proportions according to their original weightings. This ensured that no single category's achievable score was altered relative to the original instrument. This was independently cross-checked by both researchers to ensure representation of all categories rather than being skewed by a single dimension.

The 25 indicators that were selected covered both macro- and micro-level factors known to influence walking behaviour. The parameters such as obstructions, continuity, buffer from traffic, encroachments, shade, and accessibility are more relevant to the Indian context as they are the common challenges in cities like Bengaluru.

These clear, observable, and measurable indicators gave the PEDS assessment tool a solid, reliable, and repeatable basis to evaluate the physical improvements delivered by the TenderSURE program.

The PEDS tool assesses the streets across four main categories with a total maximum score of 125 points:

- Category A: Environment (Maximum 15 points) examines the broader contextual support for walking and assesses land use, slope, and connectivity land use mix, slope, and connectivity.
- Category B: Pedestrian Facility (Maximum 40 points) is the most weighted category and assesses facility type and width, surface material condition, obstructions, buffer from traffic, curb ramps, continuity and connectivity to crossings.
- Category C: Road Attributes & Crossings (Maximum 35 points) evaluates road condition, number of lanes to cross, posted speed limits, on-street parking, driveways, crosswalk quality and traffic control devices.
- Category D: Walking/Cycling Environment (Maximum 35 points) assesses pedestrian-scale amenities like lighting, trees and shading, street furniture, cleanliness and maintenance, building enclosure and interest, bicycle facilities and bus stop quality.

A 5-Point scoring system, similar to a Likert scale, was adopted for each parameter according to clearly defined criteria. This allowed for consistent and comparable assessments.

Field audits were carried out by two researchers between October and December 2025. Each street was assessed both during the non-peak and peak hours on weekdays and weekends to gain a realistic insight into how the streets are actually used by pedestrians. Data collection was based on direct observation, physical measurements and photographic documentation. In order to minimize observer bias, each street was assessed by the researchers independently. Cohen's Kappa was used to check the inter-rater reliability, and a score of 0.87 was achieved. Minor disagreements were resolved, and a common consensus was reached through discussion and joint re-examination of the segments.

The systematic application of the PEDS tool gave a clear objective baseline for assessing the TenderSURE Phase 1 streets and allowed detailed comparisons of the streets.

3.4. Subjective User Perception Survey

A structured questionnaire was developed to understand pedestrians' lived experience and subjective perceptions of the seven TenderSURE streets being evaluated. This questionnaire was an adaptation of the Neighbourhood Environment Walkability Scale (NEWS), originally developed by Saelens et al. (2003), a widely validated and globally recognized tool to assess perceived walkability. [16] Similar to the PEDS tool modification to suit the Indian context, the perception assessment framework was carefully modified, considering local culture, climatic conditions, and common challenges such as encroachments and informal economies.

The final questionnaire comprised 24 indicators organized into five key dimensions:

- Safety, the first dimension with 5 indicators, looked at perceived safety from traffic and crime, adequacy of crossings and street lighting.
- Comfort and Convenience, the second dimension, with 6 indicators assessed footpath width, surface quality, shade, cleanliness, continuity, and availability of seating.
- Connectivity & Accessibility, the third dimension, with 5 indicators evaluated ease of access to destinations, street connectivity, universal accessibility for persons with disabilities and strollers and wayfinding.

- Aesthetics & Environmental, the fourth dimension, with 5 indicators examined street appearance, greenery, air quality, noise levels and visual appeal of buildings and shopfronts.
- Social & Community Environment, the fifth dimension, with 3 indicators, looked at feelings of liveliness, opportunities for social interaction and inclusivity of diverse user groups.

All the 24 indicators under five dimensions were rated using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).

3.4.1. Qualitative Data

The qualitative feedback was collected through two open-ended questions with the objective of understanding primary challenges faced by pedestrians while walking on the streets and the changes they recommend to improve their walking experience. The qualitative components provided context-specific insights and complemented the quantitative data.

3.4.2. Sampling and Data Collection

Convenience sampling and systematic intercept methods were adopted for sample collection. Pedestrians who had walked at least 100 meters along the streets were approached to participate in the survey. Surveys were carried out both on weekdays and weekends. Various types of users were approached for the survey, such that the sample included a good mix of different age groups, men and women and pedestrians with varied trip purposes such as recreation, shopping, and commuting.

A total of 50 valid responses were collected across the seven streets of TenderSURE Phase 1. Informed verbal consent was obtained from all respondents before the survey was conducted, and all responses were recorded anonymously. Out of the 50 valid responses from the subjective user perception survey, 30 participants responded to the open-ended questions.

This subjective assessment is necessary to complement the objective assessment. The pure objective tools like PEDS cannot fully capture how the streets are designed on paper and how the people actually experience them in their day-to-day lives.

3.5. Data Analysis

Microsoft Excel (Version 365) was chosen as the primary analytical platform for all quantitative data processing, statistical calculations, visualizations and data integration. The primary intention of choosing Excel was to ensure high transparency, ease of reproducibility, and practical accessibility. Though there has been an increase in the usage of newer analytical tools and specialized statistical software in recent times, Excel remains strongly relevant in urban studies as the planning and municipal agencies in India still rely on Excel and spreadsheet-based tools instead of advanced statistical software.

3.5.1. Objective PEDS Data Analysis

The field data collected using PEDS tools was organized for each street. This data was carefully entered into the structured spreadsheets with a separate tab for each street. Data were cleaned and cross-verified with field notes and photographs to reduce errors. Scores were aggregated at four levels for each street. These levels included individual parameters, the four major categories (A-D), the overall total and the normalized score. The normalized scores were calculated out of 100 using the formula.

$$\left(Achieved\ Score — Maximum\ Possible\ Score\right) x\ 100$$

These normalized scores made it easier to compare categories with different maximum scores, helped create radar charts, rank the streets and carry out gap analysis. Microsoft Excel’s built-in functions were used to calculate descriptive statistics, including mean, median, standard deviation, range, minimum, and maximum.

3.5.2. Subjective User Perception Survey Analysis

Valid responses from all 50 participants in the perception survey were rated as per the Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) and entered into a master Excel database. Data were cleaned and checked for incomplete responses and logical inconsistencies. Scores were calculated for the 24 indicators, the five major dimensions and overall perception.

3.5.3. Qualitative Data Analysis

Given the small number, theme frequencies were not compared at the individual street level, as the difference of one or two responses may swing the percentage considerably and may incorrectly imply the precision. Hence, the qualitative responses were analyzed collectively across the entire sample to contextualize the patterns in objective audits and perception surveys. This approach reflects the exploratory role of the qualitative component.

3.5.4. Overall Walkability Analysis

Ministry of Urban Development (MoUD) developed a walkability index specially to address urban challenges specific to Indian conditions. [30] According to this method, the walkability index evaluates the physical environment and user perception using the formula

Walkability Index = W1 x Presence of Footpath + W2 x Pedestrian Ratings [31]

Where W1 and W2 stand for equal weights of 50% each

Based on the MoUD method of equal weights, the overall walkability performance of each street was calculated by combining the normalized PEDS score (objective assessment) and normalized perception score (subjective assessment). The equal weighting also reflects the idea that pedestrians' lived experience is as critical as physical infrastructure.

PivotTables and PivotCharts were used to generate frequency distributions, percentage responses, and cross-tabulations (by street, gender, age group and trip purpose). In order to compare objective and subjective measures, the same normalization formula applied to PEDS was used to compute normalized perception scores as well.

3.5.5. Reliability Analysis

Cronbach’s Alpha was used to assess the internal consistency of the survey instrument. The overall questionnaire returned a Cronbach’s Alpha of 0.912, indicating excellent reliability. Dimension-wise reliability coefficients ranged between 0.792 (Social and Community Environment) and 0.889 (Comfort & Convenience), all scores well above the widely acceptable threshold of 0.70 (Nunnally, 1978; Hair et al., 2019). Item-total correlations were examined to ensure no indicator overly reduced scale reliability.

3.5.6. Integrated and Advanced Analysis

Multiple analytical techniques were used to combine the objective dataset from the field audit and the subjective dataset from the perception survey. Gap analysis was performed by calculating the difference between the normalized PEDS score and the normalized perception score for each street. A positive gap indicated that the users perceived the street more favourably than its measured physical condition suggested. Streets were ranked using their PEDS scores, perception scores and overall weighted composite index.

Radar charts and bar charts were used to visualize and compare overall scores across multiple dimensions and to identify gaps. Qualitative data from the open-ended responses were manually categorized into themes following Braun and Clarke (2006). [32] Responses were coded inductively, grouped into themes, and frequency was quantified and cross-verified independently by two researchers to check for consistency. Verbal informed consent was obtained from all participants. The respondents were briefed on the purpose of the study. They were also made aware of the voluntary nature of participation, their right to withdraw at any time and the anonymity of the responses. Surveys were conducted in public spaces during the daytime, and no incentives were offered to any of the participants. The study adopted the required ethical standards. Measures were taken to ensure participants’ comfort.

4. Results and Discussion

4.1. Objective Walkability Assessment (PEDS)

The Pedestrian Environment Data Scan (PEDS) provided a detailed, standardized evaluation of the physical quality of the pedestrian environment across the seven TenderSURE Phase 1 streets.

4.1.1. On-Field Observations

Field observations carried out across the seven TenderSURE Phase 1 streets revealed that the program has successfully improved physical infrastructure like uniform footpath width, good quality paving, dedicated non-motorized vehicle lanes, kerb ramps, below-grade utilities, signage, improved street lighting, on-street parking, police chowkies, road markings, uniform and well-defined kerb height of 150 mm. However, several issues and challenges continue to affect everyday walkability. While most streets had good quality paving material, undulating pathways can be commonly seen either due to root lifting, regular wear and tear or utility servicing.

This was particularly seen on Residency Road, Richmond Road, Museum Road and Commissariat Road, while St. Marks Road and Commissariat Road had relatively better surface continuity. Mature trees provide decent canopy cover along Vittal Mallya Road and most stretches of Commissariat Road. All other streets face poor, inconsistent shade.

The vegetation planted under the program to act as a barrier between pedestrian pathways and the travel lane has largely withered or dried in many stretches due to a lack of care and maintenance. Encroachment from parked vehicles, shop frontages extending onto the footpath, informal vendors and hawkers and parked vehicles. Though this boosted the local economy, it reduced usable footpath width. Residency Road and Richmond Road faced the highest level of footpath encroachments.

Construction spillover, leaf litter, and occasional garbage dumps could be seen on St. Marks Road, Commissariat Road and Museum Road. Overall, limiting the objective of universal accessibility. Crosswalks are either faded or sometimes poorly aligned, especially on Commissariat Road and Richmond Road. Fast-moving traffic on several streets makes crossing difficult at the intersections.

Undulations in the pathway and slippery surfaces during rain add to discomfort. Street furniture like bollards, dustbins and lighting is present, but there are hardly any seating spaces along these corridors. Even if present, they are not well shaded.

The streets lack spaces for socializing. Poor drainage and waterlogging after rains caused by undulating pavement could be noticed on St. Marks Road. A network of crisscrossing overhead cables creates visual clutter, undermining an improved landscape, as seen at the Cash Pharmacy junction between St. Marks Road and Residency Road.

Fig. 3 Pedestrian pathway condition in Cunningham Road (Source: Author)

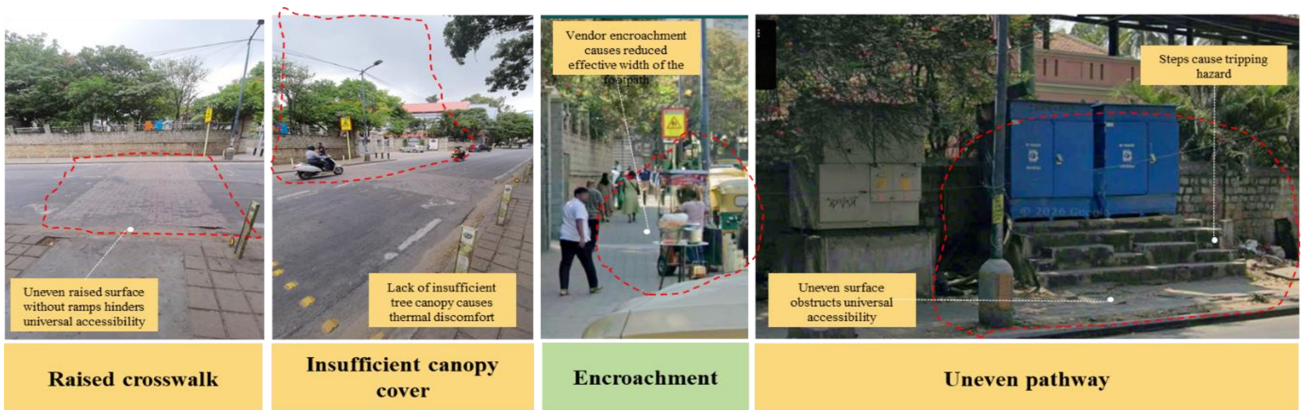

Fig. 4 Pedestrian pathway condition in Museum Road (Source: Author)

Fig. 5 Pedestrian pathway condition in St. Marks Road (Source: Author)

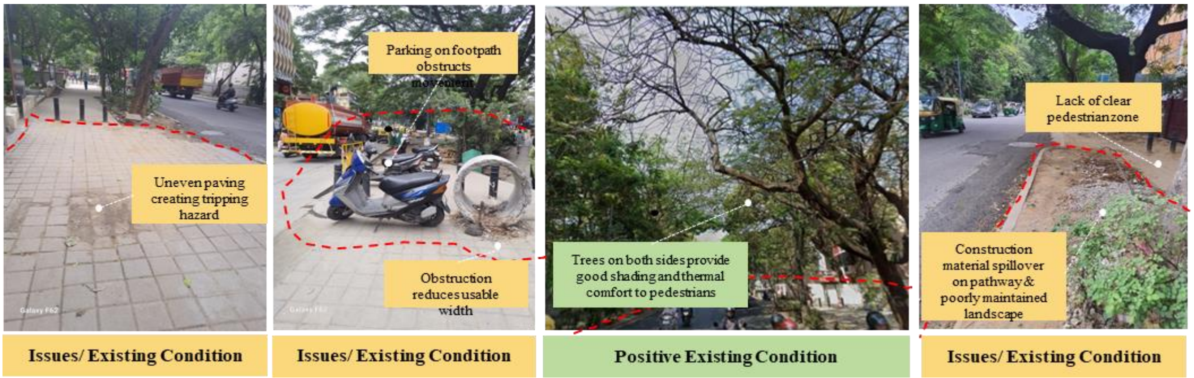

Fig. 6 Pedestrian pathway condition in Commissariat Road (Source: Author)

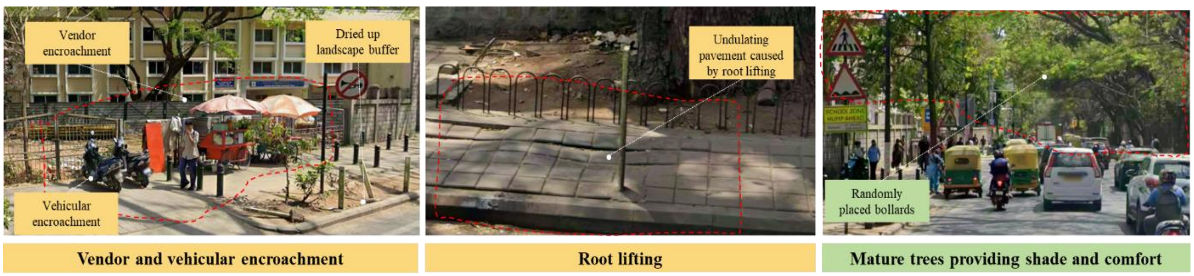

Fig. 7 Pedestrian pathway condition in Vittal Mallya Road (Source: Author)

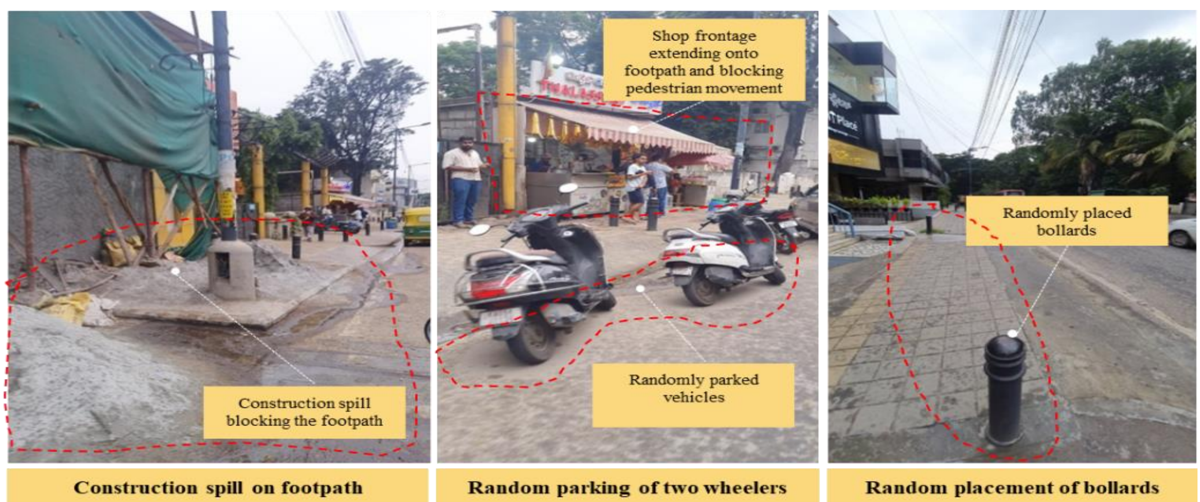

Fig. 8 Pedestrian pathway condition in Richmond Road (Source: Author)

Fig. 9 Pedestrian pathway condition in Residency Road (Source: Author)

Table 1. Normalized category-wise PEDS scores for each street

Street	A. Environment	B. Pedestrian Facility	C. Road Attributes & Crossings	D. Walking / Cycling Environment
Vittal Mallya Road	80.00	67.50	77.14	45.71
St. Marks Road	73.33	77.50	71.43	54.29
Residency Road	73.33	65.00	65.71	54.29
Commissariat	73.33	80.00	68.57	45.71
Museum Road	73.33	72.50	65.71	48.57
Cunningham Road	80.00	70.00	80.00	51.43
Richmond Road	80.00	65.00	68.57	48.57

4.1.2. Category-wise Walkability Assessment (PEDS)

Normalized scores were calculated for each dimension using the formula.

$$Normalized\ Category\ Score\ (\%) = \left(\frac{Achieved\ Score}{Maximum\ Possible\ Score}\right) x\ 100$$

This enabled easier comparison across categories that have different maximum possible scores. Radar charts were generated across four PEDS categories to easily compare the performance of each street.

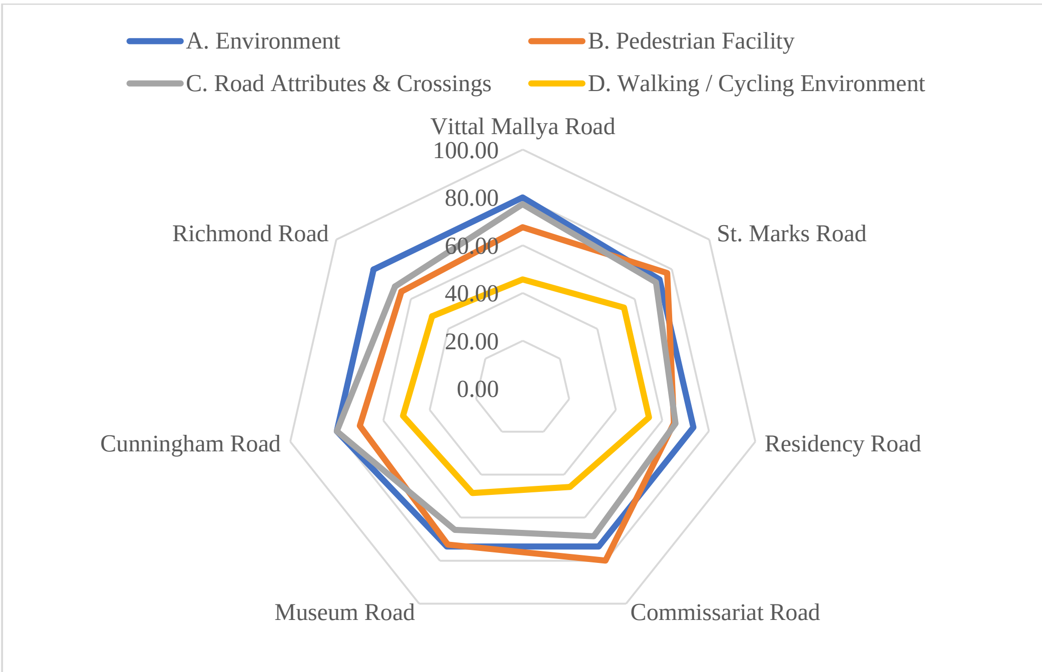

Fig. 10 Radar chart illustrating normalized category-wise PEDS scores for each street. Source (Author)

The normalized scores (see Table 1) reveal a clear and consistent pattern across the seven TenderSURE streets. All streets performed relatively well in Category A: Environment (73–80%), indicating good contextual support for walking. Under Category B: Pedestrian Facility, especially on Commissariat Road (80%) and St. Marks Road (77.5%), performance was strongest, reflecting the program's success in delivering wider and better-quality footpaths.

However, scores dropped noticeably in Category C: Road Attributes & Crossings and were weakest in Category D: Walking/Cycling Environment (ranging between 45% and 54%). Even the best-performing street in this category, Cunningham Road (51.43%), shows that elements such as seating, shade, street furniture, and overall street appeal are yet to be developed.

4.1.3. Overall Walkability Assessment (PEDS)

The PEDS evaluation (see Table 2) revealed moderate overall walkability across the seven TenderSURE Phase 1 streets, with total scores ranging from 79 to 86 out of 125. St. Marks Road and Cunningham Road came out on top, while Residency Road and Richmond Road recorded the lowest scores. TenderSURE's redesign and development have brought visible improvements compared to pre-upgrade conditions. However, substantial scope remains for further enhancement, especially in user comfort and safety-related elements. Category B assessed the Pedestrian Facility, including footpath width, surface quality, and paving, where the TenderSURE program made the biggest investment. This clearly emerged as the strongest area, demonstrating visible improvements in street infrastructure, and most streets performed well in this category. On the contrary, Category D, assessing Walking/Cycling Environment, was the weakest on every single street with consistently low scores. This was mainly because of the lack of seating and street furniture, insufficient shade and other amenities that make a street comfortable and inviting. Overall, the results demonstrated that while TenderSURE street redesign and upgrades have significantly improved the basic physical infrastructure, it has failed to create pleasant, people-friendly environments where pedestrians actually want to spend time.

Table 2. Overall Walkability Assessment (PEDS)

Street	A. Environment (15)	B. Pedestrian Facility (40)	C. Road Attributes & Crossings (35)	D. Walking / Cycling Environment (35)	Total PEDS (125)	Normalized (100)
St. Marks Road	11.0	31.0	25.0	19.0	86.0	68.8
Cunningham Road	12.0	28.0	28.0	18.0	86.0	68.8
Commissariat Road	11.0	32.0	24.0	16.0	83.0	66.4
Vittal Mallya Road	12.0	27.0	27.0	16.0	82.0	65.6
Museum Road	11.0	29.0	23.0	17.0	80.0	64.0
Residency Road	11.0	26.0	23.0	19.0	79.0	63.2
Richmond Road	12.0	26.0	24.0	17.0	79.0	63.2

4.2. Subjective User Perception

The user perception survey gave useful insight into pedestrians' lived experience of TenderSURE streets (see Table 3). From the 50 valid responses collected across seven streets, the perception scores range between 71.83 and 86.57 out of 120. This indicated moderate to good satisfaction with noticeable variation between streets.

St. Marks Road scored highest in the user perception survey, particularly in the dimensions of Safety (19.29/25) and Comfort & Convenience (21.14/30). Pedestrians showed appreciation towards wider footpaths, smooth surfaces and better-managed traffic. Museum Road scored the lowest (71.83/120 due to the concerns over footpath condition, shade and maintenance of the street. Residency Road scored second highest in perception score (83.88/120), though it scored moderately in objective score. They could be a result of street’s vibrant commercial character and lively atmosphere, which could positively enhance the user experience despite moderate scores on physical assessment.

The Comfort & Convenience dimension was rated highest across streets. This shows user’s appreciation for improved paving and footpath width. On the contrary, Social & Community Environment dimension scored low across all streets pointing towards the program’s partial success in creating socially engaging and lively public spaces.

Table 3. User perception scores by dimension

Street	Safety (25)	Comfort & Convenience (30)	Connectivity & Accessibility (25)	Aesthetics & Env. Quality (25)	Social & Community (15)	Overall (120)	Normalized (%)
St. Marks Road	19.29	21.14	17.86	17.29	11.00	86.57	72.14
Residency Road	18.50	19.13	17.50	17.00	11.75	83.88	69.90
Cunningham Road	16.50	19.88	15.63	17.50	10.50	80.00	66.67
Vittal Mallya Road	16.00	18.57	15.00	15.67	11.33	76.57	63.81
Richmond Road	15.71	17.71	17.43	15.57	9.14	75.57	62.98
Commissariat Road	16.29	17.60	16.14	15.00	10.14	75.17	62.64
Museum Road	15.83	16.33	15.33	15.00	9.33	71.83	59.86

Table 4. Descriptive statistics of walkability scores (N=7 streets)

Statistics	Normalized PEDS (%)	Normalized Perception (%)	Weighted Overall Index (%)	Best Performing Street
Mean	65.71	65.43	65.60	-
Median	65.60	63.81	64.90	-
Minimum	63.20	59.86	62.34	-
Maximum	68.80	72.14	70.47	St. Marks Road
Standard Deviation	2.32	4.35	2.68	-
Range	5.60	12.28	7.80	-

4.3. Descriptive Statistics of Walkability Scores

Descriptive statistics were calculated using Microsoft Excel. This provided a summary of walkability scores (see Table 4) across TenderSURE Phase 1 streets. The normalized PEDS scores showed relatively low variability (Mean = 65.71%, SD = 2.32). User perception showed higher variation (Mean = 65.43, SD = 4.35). The Weighted Overall Index averaged 65.6% with a standard deviation of 2.68.

The results show that the PEDS scores are consistent, but the perception scores vary across the streets. The moderate variation in PEDS scores highlight TenderSURE program's success in achieving relatively uniform improvement in basic infrastructure across all streets. However, the higher variation in user perception scores implies that the pedestrian's lived experience and satisfaction are more context-dependent and influenced by factors such as street vibrancy and commercial activity and not physical design alone.

4.4. Overall Walkability Performance of TenderSURE Phase 1 Streets

The overall Walkability Performance Index (see Table 5) for each street was calculated by averaging the respective streets normalized PEDS scores (objective and normalized perception scores (subjective). This combined metric provided a comprehensive, balanced evaluation of the street, taking both physical quality and user experience into account.

St. Marks Road ranked first the Weighted Overall Normalized Index of 70.47, and Cunningham Road trailed second with a score of 67.73. Although both St. Marks Road and Cunningham Road scored equally on Normalized PEDS score, Cunningham Road performed poorly on Normalized Perception score. Museum Road scored least at 62.97 due to a lack of shade, footpath condition and poor maintenance.

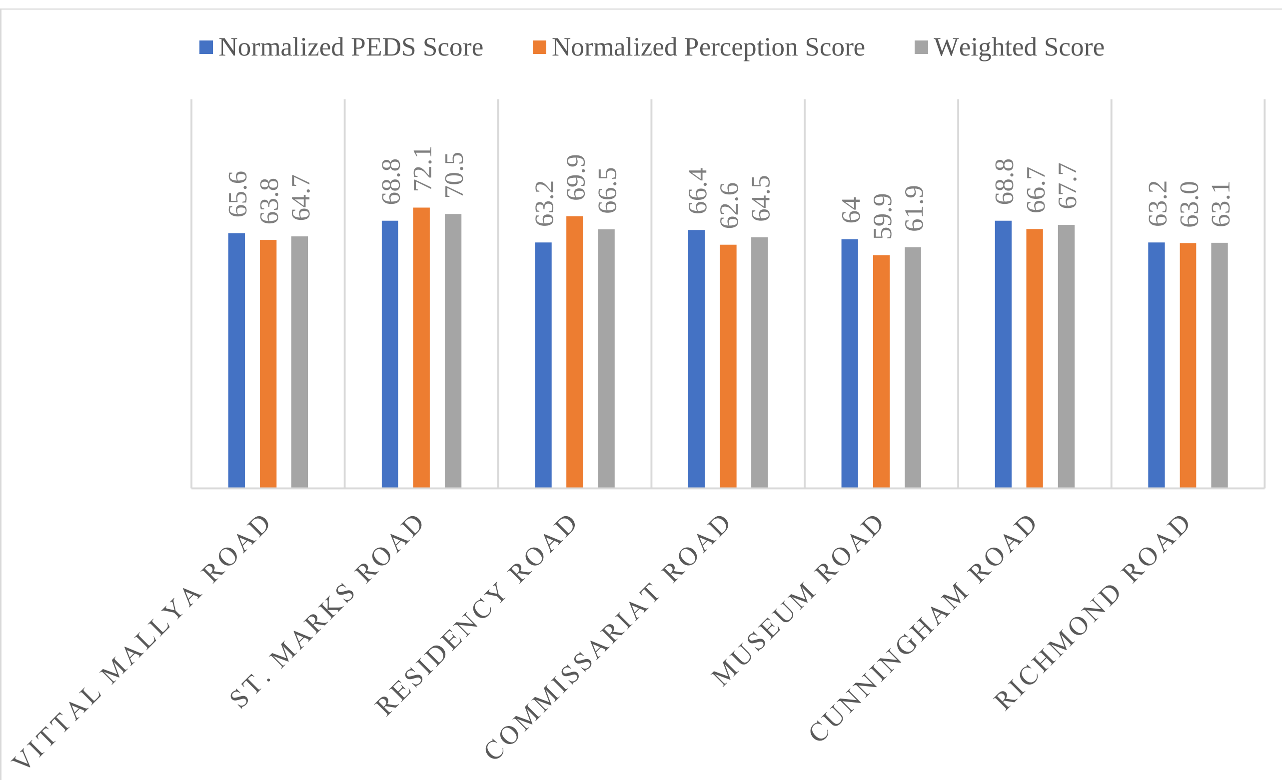

Fig. 11 Weighted overall walkability performance (Source: Author)

Table 5. Overall walkability performance of TenderSURE Phase 1 streets

Rank	Street	Normalized PEDS	Normalized Perception	Weighted Overall Normalized Index	Grade
1	St. Marks Road	68.80	72.14	70.47	Good
2	Cunningham Road	68.80	66.67	67.73	Fair
3	Residency Road	63.20	69.90	66.55	Fair
4	Commissariat Road	66.40	64.90	65.46	Fair
5	Vittal Mallya Road	65.60	64.88	65.15	Fair
6	Richmond Road	63.20	63.11	63.14	Fair
7	Museum Road	64.00	62.34	62.97	Fair

Table 6. Gap analysis between objective (PEDS) and subjective (Perception) scores

Street	Norm. PEDS (%)	Norm. Perception (%)	Gap	Interpretation
Residency Road	63.20	69.90	+6.70	Strong positive gap due to vibrant commercial atmosphere
St. Marks Road	68.80	72.14	+3.34	Users perceive it better than physical condition suggests
Richmond Road	63.20	63.11	-0.09	Near perfect alignment between objective and perception
Vittal Mallya Road	65.60	64.88	-0.72	Slight underperformance in user perception
Commissariat Road	66.40	64.90	-1.50	Users are less satisfied than the physical score indicates
Museum Road	64.00	62.34	-1.66	Largest negative gap – users notably less satisfied
Cunningham Road	68.80	66.67	-2.13	Strong infrastructure but lower user perception

4.5. Gap Analysis between Objective and Subjective Measures

Mixed-methods approach provides a clear comparison between PEDS (objective) score and user perception score. The gap for each street was calculated by subtracting the normalized PEDS score from the normalized perception score. Positive gap between the scores indicated higher user satisfaction, and that the users perceived the streets more favourably than its physical condition suggested.

The gap analysis highlighted some interesting facts (see Table 6). Residency Road showed the largest positive gap of +6.70, indicating higher user satisfaction as against its physical condition. This could be due to the vibrant and lively commercial atmosphere. St. Marks Road showed a positive gap of +3.34. On the contrary, Cunningham Road showed the highest negative gap of -2.13, pointing that the pedestrians were relatively less satisfied than the objective score suggested. Most other streets recorded small negative gaps.

The positive gap points that social vibrancy, commercial activity, and a sense of belonging strongly influence the pedestrians' perception of walkability. These findings emphasize that purely objective assessment tools often fail to capture the intangible qualities and users' lived experience of the streets.

The future phases of TenderSURE and other similar initiatives could move beyond mere physical upgrades. They can deliberately enhance elements that foster positive user experiences, such as vibrant street life, adequate seating, and effective shade provision.

Table 7. Cross-tabulation of overall user perception scores by gender, age group, and trip purpose

Variable	Category	Count (n)	Safety	Comfort & Convenience	Connectivity & Accessibility	Aesthetics & Env Quality	Social & Community Environment	Normalized (100)
Age Group	<18 & >51	8	51	38	52	51	83	55
	18-30	29	56	44	53	55	99	62
	30-50	13	52	39	51	44	85	54
Gender	Female	35	52	40	51	50	91	57
	Male	15	59	44	57	57	98	63
Trip Purpose	Commuting	30	54	41	51	50	90	57
	Recreation	7	55	45	53	55	97	61
	Shopping	13	55	40	56	54	99	61

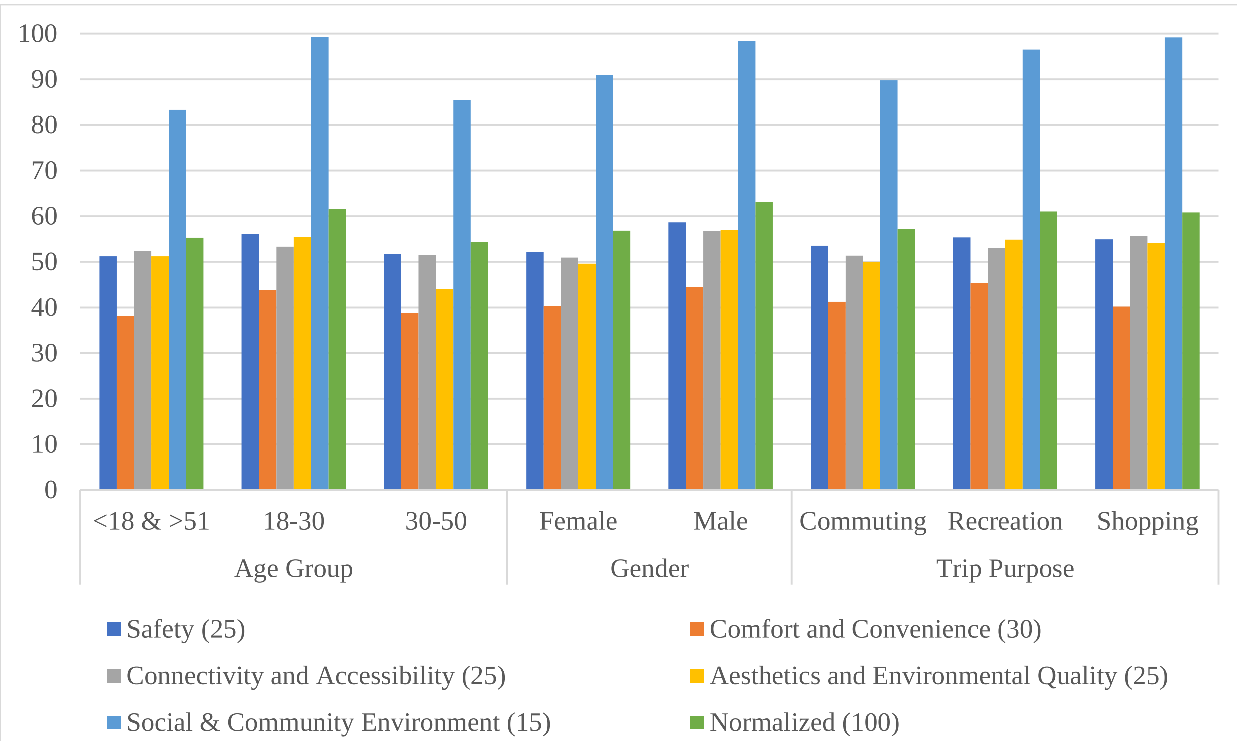

Fig. 12 Subgroup analysis of pedestrian perception scores: dimension-wise comparison by age group, gender, and trip purpose (Source: Author)

4.6. Subgroup Analysis

Raw data from user perception survey was cleaned and categorized into subgroups. The scores were normalized for easier comparison between various dimensions.

A notable pattern emerged in how different groups perceived the TendeSURE streets (see Table 7). In the age subgroup analysis, people in the 18-30 age group expressed highest satisfaction (62/100), while the other age groups rated similarly (54-55/100). An interesting finding was noted in the gender subgroup analysis. The overall perception scores by male respondents (63/100) were slightly higher than female respondents (58/100). The subgroup analysis of trip purpose revealed that pedestrians walking for recreation and shopping expressed the highest satisfaction (61/100) while commuters rated relatively low (57/100).

These subjective findings complement the objective PEDS scores and provide a comprehensive perspective of the street performance. While the objective audits measure physical infrastructure effectively, the perception survey data throws light on human experience dimension, which is essential in evaluating the true success of any user-oriented design program.

4.7. Qualitative Insights

Out of the 50 respondents who participated in the user survey, 30 responded to the open-ended questions. Using Braun and Clarke's (2006) thematic analysis framework, four themes – Comfort & Amenity Provision; Accessibility & Inclusive Design; Pedestrian Infrastructure and Maintenance; and Safety & Traffic Management emerged. PEDS results of the perception survey are strongly reinforced by these themes. The most frequently mentioned themes are Comfort & Amenity Provision (20 references). Participants repeatedly cited a lack of basic facilities like disrupted footpaths, insufficient shade and inadequate resting places or benches. Many also called for small public plazas, additional benches and more resting areas. Even though the TenderSURE program significantly improved footpath surfaces and width, it failed to adequately address essential comfort elements specific to Bengaluru's hot and humid climate. This has underscored the Comfort & Amenity Provision theme. Equal prominence was given for Accessibility & Inclusive Design (20 mentions). Some of the major areas of concern included lack of continuous footpaths, insufficient measures for ensuring universal accessibility and constant intrusions from vendors and hawkers. The recommendations included provision of wider footpaths, better ramps and provision for hawking zones. The people mainly affected by this were women with children, elderly people and those with disabilities.

Pedestrian Infrastructure & Maintenance was referred to 11 times. The pedestrians appreciated the level of construction carried out under TenderSURE program. However, they also expressed that lack of maintenance, deteriorated walkways, exposed electric cables and poor drainage systems were some of the challenges they faced while walking.

Safety & Traffic Management was mentioned 9 times. The pedestrians faced problems such as unsafe pedestrian crossings, high speed cards, noise pollution and poor street lighting at night. Respondents suggested that with improved street lighting at night, safer pedestrian crossings and better traffic calming methods, the walking experience could be enhanced.

To summarize the survey, the qualitative findings aligned closely with the low-scoring dimensions that are identified in both the PEDS assessment and the perception survey. The pedestrians have consistently asked for basic livability elements such as adequate seating, wider unobstructed footpaths with no encroachments, sufficient shade and continued maintenance. These feedbacks and insights from pedestrians highlight that while the TendeSURE program has made notable progress in physical infrastructure, future efforts should be towards adopting a user-centric approach. It should go beyond initial construction and address real-world usability and provide long-term user comfort.

4.8. Discussion

The findings from the mixed-method evaluation gives an unbiased picture of TenderSURE phase 1 streets. While it is clear that the project has improved the essential pedestrian facilities, it is yet to achieve the larger aim of making these streets completely walkable.

St. Marks Road and Cunningham Road were rated highest, scoring 70.14% and 67.95% respectively. Good performance in the pedestrian facility quality, with wider and smoother footpaths and better surfaces have majorly contributed to their high ratings. This finding aligns with TenderSURE program's core strength and main objective of providing standardized footpath width, high-quality paving and construction.

Walking/Cycling Environment emerged as one of the low-scoring categories. The trend was uniform and represented most consistent weakness throughout the study area. Even the highest performing streets scored low in category D, mainly due to insufficient seating, shade and street amenities.

Gap analysis provided an important insight. Residency Road, which scored higher on perception and moderately on PEDS, had the highest positive gap (+6.70). It proved that a vibrant commercial environment, lively atmosphere and presence of people could improve the perceived walkability even in a street with moderate objective scores.

Cunningham Road had the highest negative gap (-2.63), indicating that the user satisfaction was low despite higher PEDS score. The higher gaps in user perception and objective scores highlight that, in real urban life, how the streets feel is as important as its physical condition.

Though TenderSURE followed same guidelines and specifications for all seven streets, people's experiences varied noticeably depending on the street character. This finding aligns with another international research. It shows that familiarity, social activity and sense of place play a significant role in shaping walkability. This is especially true in cities like Bengaluru and other Asian and Global South cities.

These findings point towards clear policy implications for future phases of TenderSURE. Though the program has been successful in providing physical infrastructure upgrades like high-quality paving; it should also pay attention to user comfort and livability elements. Another key concern is lack of maintenance post-implementation. This necessitates the inclusion of a systematic long-term management and maintenance plan into the future phases.

The qualitative insights strongly corroborate the quantitative findings. The pedestrians have consistently emphasized the need for providing wider unobstructed footpaths, sufficient resting places, better shade, safer crossing facilities and improved street lights at night. These details help differentiate the streets that users merely tolerate from those they actually want to use. The dimensions ‘Comfort & Amenity Provision’ and ‘Accessibility’ are the most commonly mentioned topics. This demonstrates that despite high investment on infrastructure, fundamental livability issues are yet to be addressed.

This study sheds light on both the strengths and weaknesses of large-scale street redesign programs in Indian cities. Engineering upgrades are essential, but do not address the needs of a walkable street on their own. To make a street truly walkable, attention needs to be shifted to softer elements like human comfort, perceived safety, social vibrancy and continued maintenance. The wary forward for future phases of TenderSURE and similar initiatives would be adopting an integrated user-centric approach with the right balance between engineering excellence and lived experience.

The findings of this study provide the larger picture of the TenderSURE phase 1 streets in Bengaluru. While the program has achieved moderate success in physical infrastructure upgrades, the outcomes are uneven across various dimensions. A comprehensive integrated assessment combining PEDS, user perception and qualitative insights reveals both notable achievements and persistent challenges offering important.

The findings of this study present the overall picture of the TenderSURE Phase 1 streets in Bengaluru. While the program has achieved moderate success in physical infrastructure upgrades, the outcomes are uneven across other dimensions of walkability. An integrated assessment combining objective PEDS assessments with user perception surveys and qualitative insights reveals both notable achievements and persistent challenges, offering important takeaways for future street designs in Indian urban context.

4.9. Comparative Analysis Indian and International Case Studies

Redesign of Jakarta’s Sudirman-Thamrin Central business district following a “road diet” similar to TenderSURE raised walkability by 38.98%.[33] A 13-city Asian Development Bank benchmark revealed a score of 44.4/100 for Kathmandu and 78.52/100 for Metro Manila, with a regional average of 56.99/100.[34] TenderSURE normalized PEDS score sits within the regional central business district range, above the Asian average but below Manila. A six-city national baseline survey found a median walkability score of 47/100 across Chennai, Pune, Rajkot, Haryana, Surat and Indore. Similar to TenderSURE, a study of Delhi Dwaraka sub-city and other footpath indices revealed that physical audit scores are in the moderate-to-good range; however, encroachment, gaps in comfort amenities, and lack of maintenance were the shortfalls.[30] The findings suggest a broader, measurable pattern across Global South pedestrian infrastructure programs.

4.10. Implementation and Governance

The gap between the construction stage and the present-day condition of TenderSURE streets, with undulating pavers, root lifting, withered planting buffers, and encroachment, points towards shortcomings in governance rather than a design problem. TenderSURE’s specifications were developed with technical rigour, but maintenance, encroachment, and vendor management sit outside the design mandate. Similar Indian pedestrian-infrastructure evaluations report a gap between construction quality and post-handover maintenance owing to jurisdiction lapses. [30] Barcelona’s Superblocks, Seoul’s Cheonggyecheon restoration and Addis Ababa’s phased NMT strategy indicate that for durable and successful redesign, sustained follow-through is as important as construction quality. [35, 36, 37] This suggests a policy need for future TenderSURE phases to clearly define a post-handover maintenance mandate to the relevant agency or to conduct periodic lighter-weight re-audits with GIS or citizen-sensing tools.

5. Conclusion

This mixed-methods study provides a more realistic assessment of the seven streets redesigned under Bengaluru’s TenderSURE Phase 1 program. The results show moderate overall walkability, with weighted scores ranging from 61.9 % (Museum Road) to 70.5% (St. Marks Road) and an average of 65.6%. Only St. Marks Road crossed the 70% mark to earn a “Good” rating, while the remaining six streets scored between 60-70% and fell in the “Fair” category.

The PEDS assessment confirmed that the program has relatively achieved consistent physical improvements with normalized objective scores averaging 65.71% (SD = 2.32). Category B (Pedestrian Facility) came out as the strongest dimension. This is an indication that the TenderSURE project has been able to deliver better footpaths. However, Category D (Walking/Cycling Environment) has scored between 45% and 54%. This is mainly due to the poor provision of shade, street facilities and seating.

User perception scores have shown greater variation with (Mean = 65.43%, SD =4.35). This depicts the difference in how the seven streets were experienced by pedestrians. Residency Road scored the second highest in user perception score, with the largest positive gap of +6.70. Even though the objective scores were moderate, the lively atmosphere and the vibrant commercial character enhanced the pedestrian experience. The largest negative gap (-2.13) was recorded in Cunningham Road, showing that the users were less satisfied than the physical environment alone would suggest.

To summarize, these findings suggest that physical infrastructure upgrades with wider footpaths and high-quality paving are important foundations, but they alone are not enough. Pedestrian suggestions of providing shade, increased seating, continuous footpaths, controlled encroachments and safer crossings should be incorporated into the design. The moderate overall scores and the persistent weakness in Comfort & Convenience strongly hint that future phases of TenderSURE should take livable elements into account, along with infrastructure upgrades. Greater emphasis should be given to people-centric designs so that streets become genuinely walkable social assets.

This study has certain limitations that qualify its findings. Given the scale of the study area, the user perception sample size and reliance on descriptive statistical analysis constrain the extent to which observations can be generalized for statistical significance. This is a practically actionable method for resource-light audits when GIS and large-scale survey resources are unavailable.

This study did not measure health, environmental or universal accessibility outcomes directly but inferred their relevance from qualitative and subgroup findings. Evaluation of future phases with larger samples, inferential statistical techniques, GIS-based spatial analysis with embedded assessment of health, environment and universal accessibility, along with physical and experiential outcomes, could be the priority directions for TenderSURE research. The TenderSURE program has made a visible effort to improve pedestrian spaces in Bengaluru. However, a balanced approach with equal importance to engineering quality and everyday lived walking experience could realize its full potential. Only then can the street redesign initiatives adopted by various Indian cities create streets that people use not just out of necessity but actually enjoy and choose to use every day.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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