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Evaluating Walkability Condition of Footpath based on Obstruction:

A Case Study of Pulchowk - Lagankhel Road Section

by

Dhurba Pokhrel

A THESIS

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The undersigned certify that they have read, and recommended to the Institute of Engineering for acceptance, a thesis entitled **"Evaluating Walkability Condition of Footpath based on Obstruction: A Case Study of Pulchowk -Lagankhel Road Section"** submitted by **Dhurba Pokhrel** in partial fulfillment of the requirements for the degree of Master of Science in Transportation Engineering.

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ABSTRACT

Footpaths in Nepal have been found to be obstructed by a variety of obstacles. Obstacles on footpaths are objects that block or make it difficult to use a path. Such an obstacle needs to be removed in order to improve the pedestrian walking environment. While some of them need intricate removal techniques, others are simpler to remove. A scoring system called the Footpath Score based on Types of Obstructions (FOSTO) has been developed using the analytical hierarchy process (AHP). This system assigns a score between 0 and 100 to assess the condition of footpaths by considering the number and various types of obstacles present, along with their effects on pedestrian movement. Data were collected by continuously chaining the footpath along Pulchowk Lagankhel road section and data about existing obstructions were extracted for each meter length to provide a detailed footpath inventory. The research indicates that specific factors significantly influence the walkability score. These factors include the percentage of road length designated as footpath, the percentage of footpath meeting acceptable height criteria, the extent of rise and drop along the footpath, the presence of different obstruction groups (like garbage, tree leaves, potholes, personal gardening in Group 1; parked vehicles, hawkers in Group 2; constructed urinals, trees, poles in Group 3) as a percentage of the footpath length. These factors collectively contribute significantly to determining the overall walkability score.

To calculate an index (known as FOSTO - Footpath Score based on Types of Obstructions), this study has successfully integrated AHP and field values. The analysis confirmed that FOSTO score of analyzed footpath was found below 50. The result further showed that overall, there was no great difference between the FOSTO score of weekdays of the footpath and FOSTO score of weekends. Therefore, obstruction of permanent nature seems to have more effect on footpath walkability than obstruction of temporary nature on the footpath we have analyzed.

Keywords*:* Walkability, Obstruction, Pedestrianization, AHP, FOSTO

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LIST OF ABBREVIATIONS

AHP	Analytical Hierarchy Process
DoR	Department of Roads
MCA	Multi-criteria analysis
FOSTO	Footpath Score based on Types of Obstructions
SCBA	Social Cost Benefit analysis
CEA	Cost effectiveness analysis
CBA	Cost Benefit analysis
RECPHEC	Resource Centre for Primary Health Care
RWM	Relative Weight Matrix
CR	Consistency ratio
CI	Consistency Index

CHAPTER 1. INTRODUCTION

1.1.Background

The Kathmandu Valley is one of the fastest- growing cities in South Asia (Aparicio, 2013). A significant portion of the population walks in most developing country cities on a regular basis for social, recreational, and economic purposes (clean air network nepal, 2010). Walkability serves a major factor for making the city pedestrian friendly and sustainable transport development. The built environment's suitability for walking on a street or in a community is determined by its walkability. Any community will become more walkable when pedestrians have access to a secure, comfortable, and convenient infrastructure. The traditional method in transport planning focuses on expanding road infrastructure to handle increasing transportation needs. However, this approach, centered around automobiles, not only falls short in meeting mobility requirements but also leads to issues like air pollution, climate change, excessive noise, and the deterioration of urban landscapes. To mitigate these impacts, modern transport planning proposes a shift away from private cars towards more sustainable modes of transportation, such as walking. Experts consider walking as one of the quickest and most reliable means of travel for short distances, especially within city centers. Walking is one of the easiest and least expensive forms of physical activity and essential for maintaining good health.

Walking also encourages social engagement, which in turn can enhance people's wellbeing and mental health. Additionally, it is one of the most environment friendly modes of transportation and lowers air pollution by minimizing the usage of personal vehicles. Precise and effective planning, designing, and implementation of non-motorized transportation systems is crucial. So, a key prerequisite for modern planning is a thorough review of the walking terrain and an extensive assessment of the pedestrian infrastructure. To obtain more precise insights into walking infrastructure, the evaluation process must encompass a thorough examination of all obstacles present along the walking paths.

1.2.Problem Statement

While numerous studies have explored the walkability of footpaths in Nepal, none have conducted a quantitative assessment based on obstructions. While the Global Walking Index developed for the World Bank offered a valuable qualitative analysis of walking conditions, it lacked a quantitative assessment of pedestrian facilities, leaving a gap in its comprehensiveness. This omission limits the index's ability to fully inform decision-making around improving pedestrian infrastructure. Various types of obstacles exist along these paths, each causing different levels of inconvenience to pedestrians. There's a need to develop an approach that considers all these obstacles, their difficulty in removal, and their impact on walkability. Additionally, evaluating the elevation changes pedestrians encounter (per unit length of sidewalk) due to these obstacles is crucial from the users' perspective and should be taken into account during the evaluation process.

1.3.Objectives of study

The main objective of this study is to assess the walkability condition of existing footpath based on obstruction type and their frequency. The specific objectives of the study are:

- To identify the obstruction type having greater impact on walkability.
- To check the variation in FOSTO score on weekdays and weekends.

1.4.Organization of the report

The report contains five chapters. The first chapter deals with the general introduction, statement of problem and objectives associated with this research. Chapter two briefly provides the literature review regarding theories and research works. Chapter three deals with the overview of six stage framework methodology and chapter four describes results and discussions, whereas chapter five deals with the conclusions and recommendations. After that, references and annexes are provided.

1.5.Scope and Limitations

This study aims to assess the walkability condition of footpath based on obstruction type and their frequency by integrating AHP and field values. The scope encompasses a comprehensive examination of obstructions. Additionally, the amount of rise and drop that pedestrian must negotiate (per unit length of sidewalk), height of the footpath above top of the carriageway with the aim of providing valuable insights into quantitative rating of footpath.

Some limitations of this study are listed below:

- This study was carried out on a specific site.
- Not more than 10 number of parameters was considered as it would be complex to deal with large numbers of factors during pairwise comparison.
- Expert judgments were discarded if inconsistencies exceeded 0.10, leading to a reduction in the sample size for the AHP analysis.

CHAPTER 2. LITERATURE REVIEW

2.1. Walkability assessment Approaches

Three broad techniques (predicting walkability, 2005) are available to assess the performance of the built environment, these are:

1. Reviewing: Examines existing situations, utilizing tools like audits or ratings to assess and enhance walkability qualitatively by exploring various possibilities.
2. Auditing: Evaluates both existing and proposed designs, identifying deficiencies concerning established standards and offering recommendations for improvement.
3. Rating: Scores the walkability of an environment or facility, allowing for quantitative comparison between different walking environments, applicable to both existing and proposed designs.

Previous research indicated the need for a consumer-style audit that integrates with a rating system. This combined approach aims to encompass both qualitative and quantitative aspects in assessing walking environments. This differs from methodologies used to assess provisions for motorized vehicles, which typically prioritize efficiency and safety and are often reported as quality of service (or level of service).

2.2. Overview of Decision Making & Criteria Analysis Approach

When dealing with numerous variables, their interactions, potential solutions, and diverse project objectives, making a rational decision becomes incredibly challenging, if not impossible. To navigate this complexity, a strategic approach is essential to organize, classify, and evaluate this wealth of information (Bhushan, 2007).

Multi-Criteria Analysis (MCA) works by comparing options based on specific objectives identified by the decision-making body. These objectives are supported by measurable criteria used to gauge how effectively they're achieved. MCA provides diverse methods to combine data from individual criteria, offering indicators for overall option performance.

What distinguishes MCA is its reliance on the decision-making team's judgment in establishing objectives and criteria, determining the relative importance of these criteria, and to some extent, assessing each option's contribution to meeting the performance criteria. This emphasis on subjective judgment is a fundamental aspect of MCA (Dodgson, 2009).

A prioritization matrix offers a simple way to rank various items based on their importance, assigning numerical values to determine their relative significance. It enables the ordering of projects or requests based on predefined criteria, allowing organizations to identify the most critical projects for immediate attention and those that could potentially be postponed or discontinued.

Social Cost Benefit Analysis (SCBA) holds significant usage in countries like the US, New Zealand, England, Australia, Singapore, Chile, and Ireland, especially in evaluating and prioritizing infrastructure projects that require substantial investments. However, in recent years, the UK, Australia, and several US states have also released guidance notes on employing multi-criteria decision analysis for similar purposes (Marcelo, 2016).

Multi-criteria decision analysis has become increasingly popular for structuring investment decisions that involve balancing multiple aspects associated with proposed investments. These approaches enable the systematic consideration of non-monetary and qualitative factors in decision-making, offering a formalized method to incorporate diverse considerations into the analysis. They prove particularly valuable in situations where there are limitations in available information or analytical resources (Marcelo, 2016).

Dodgson's manual on Multi-criteria Analysis outlines key insights into various decision-making techniques, particularly focusing on monetary-based methods:

1. Cost Effectiveness Analysis (CEA): Commonly used in government, CEA compares costs among different ways of achieving similar outputs. It focuses on monetary costs without explicitly assigning value to non-monetary outputs.
2. Cost Benefit Analysis (CBA): While less common in government, CBA, prevalent in transport and health and safety sectors, explicitly assigns monetary value to important non-market outputs. It evaluates all costs and benefits associated with alternative options.

Monetary-based techniques for decision-making highlighted in the manual include:

- Financial Analysis**:** Assesses an option's impact on the organization's financial costs and revenues, necessitating the discounting of future impacts to their present value, applicable to both cost-effectiveness and cost-benefit analysis.
- Cost-Effectiveness Analysis**:** Compares the costs of various solutions serving the same objective, not limited to monetary costs.
- Cost-Benefit Analysis**:** Assesses all costs and benefits of alternative options. However, CBA faces criticism on political or philosophical grounds, as it requires government judgments that might not align with current preferences. Moreover, some impacts might be challenging to quantify in monetary terms

2.3. Different Types of Multi Criteria Analysis Techniques

Different Multi-Criteria Analysis (MCA) methodologies share a common goal of simplifying options and their contributions to various criteria while requiring discretionary judgment. However, their differentiation lies in how they combine data. Their fundamental purpose is to address the challenges faced by human decision-makers when handling complex information consistently.

The presence of various MCA techniques arises due to the diverse circumstances where MCA is applicable. Factors contributing to these differences include the time available for analysis, the quantity and nature of available data, the expertise of individuals supporting the decision-making process, and the administrative culture and requirements of organizations.

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2.3.1. Multi attribute utility theory

There isn't a universally accepted normative model for making multi-criteria choices without facing criticism. However, the multi-attribute utility theory comes closest to gaining widespread acceptance. Despite offering valuable theoretical perspectives, this approach doesn't directly assist decision-makers in handling complex multi-criteria tasks.

A significant breakthrough in addressing this challenge occurred with the work of Keeney and Raiffa in 1976. They developed practical procedures, aligning with earlier normative foundations, to aid decision-makers in evaluating multi-criteria options. Their methodology relies on three key elements:

1. Performance Matrix**:** A structured table outlining the performance of various options across different criteria.
2. Assessment of Criteria Independence**:** Procedures to determine whether criteria are independent of each other.
3. Parameter Estimation Techniques**:** Methods to estimate the parameters of a mathematical function. This enables the calculation of a single numerical index, summarizing decision-makers overall evaluation of an option based on its performance across multiple criteria.

These methods devised by Keeney and Raiffa provide a practical framework for decision-makers to evaluate complex options involving multiple criteria, aiding in a more structured decision-making process (Dodgson, 2009).

2.3.2 Linear additive models

The Simple Linear Additive Evaluation Model is suitable under specific conditions: when it's evident or inferred that criteria preferences are independent of each other and when uncertainty isn't explicitly factored into the Multi-Criteria Analysis (MCA) model.

This model illustrates how an option's performance across different criteria can be amalgamated into a single overall score. It involves multiplying the value score of each criterion by its weight and summing up these weighted values. However, this arithmetic is only accurate when the criteria don't influence each other's preferences.

Despite this requirement, many MCA approaches utilize this additive model. These models have a strong track record, providing reliable and effective support to decision-makers dealing with diverse problems in various contexts (Dodgson, 2009).

2.3.3 Outranking methods

The concept of outranking suggests that one option ranks higher than another if it performs better across a sufficient number of significant criteria (as indicated by the sum of criteria weights) without significantly underperforming on any single criterion. However, this idea indirectly reflects some political aspects of decision-making. It tends to devalue options that fare poorly on specific criteria, potentially causing challenges in implementing such options and leading to considerable lobbying from vested interests.

While outranking can effectively explore how preferences between options evolve, its applicability for widespread public use appears limited when considering its potential biases and the challenges it poses in implementation due to its tendency to downgrade options based on single-criterion performance (Dodgson, 2009).

2.3.4 Procedure that use qualitative data inputs

Using numerical weights and scores on a cardinal scale is often deemed the most effective method to offer dependable and transparent support for decision-making. However, government decision-makers frequently encounter situations where the data within the performance matrix or preference weights relies on qualitative judgments rather than numerical values (Dodgson, 2009).

2.3.5 MCA methods based on fuzzy sets

Fuzzy sets aim to accommodate the inherent imprecision in our language when discussing various issues. Instead of strictly defining options as "attractive" or "expensive," they acknowledge the nuanced nature of our perspectives, where options might be considered "fairly attractive" or "rather expensive."

The concept of a membership function is central to fuzzy mathematics. It allows an option to possess a degree of membership within a set like "attractive" alternatives, represented by a value between 0 and 1. This membership value signifies the extent to which an option aligns with the defined characteristics, capturing the nuanced and qualified judgments inherent in decision-making (Dodgson, 2009).

2.3.6. Analytical Hierarchy Process

Thomas Saaty introduced the Analytic Hierarchy Process (AHP), an invaluable method for tackling complex decisions. The AHP aids decision-makers in establishing priorities and navigating toward optimal solutions by breaking down intricate problems into more manageable parts. This structured approach assists in evaluating and comparing various criteria and alternatives, facilitating a more informed and effective decision-making process (Saaty, 1992).

2.3.6.1. How the AHP works

The Analytic Hierarchy Process (AHP) considers multiple evaluation criteria and alternative possibilities to identify the best option. It's crucial to note that due to potential conflicts among criteria, the optimal choice doesn't always maximize each individual criterion. Instead, it aims for the best balance or trade-off between these various criteria.

Using the decision maker's pairwise comparisons of assessment criteria, the AHP assigns a weight to each criterion. The higher the weight, the greater the importance of that criterion. For every fixed criterion, the AHP determines each option's score based on the decision-makers' pairwise assessments. A higher score signifies better performance concerning that criterion.

Next, the AHP combines these choice scores with the weighted criteria scores, generating a final score and ranking for each option. The overall score for a particular choice is a weighted average of the ratings received for each criterion. This process enables a comprehensive evaluation, considering both the importance of each criterion and the performance of each option across those criteria.

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2.3.6.2. Features of AHP

The Analytic Hierarchy Process (AHP) proves highly adaptable and efficient because it derives scores and final rankings from the user's relative pairwise evaluations of both criteria and options. It functions as a tool translating the decision maker's assessments, whether qualitative or quantitative, into a multi-criteria ranking, relying on the decision maker's expertise as the basis for calculations. Unlike complex expert systems, the AHP simplifies this process.

However, employing the AHP might demand numerous evaluations from the user, especially for problems encompassing many criteria and options. Although each evaluation is relatively straightforward merely indicating how two options or criteria compare the cumulative workload of evaluations might become overwhelming. Notably, the number of pairwise comparisons grows exponentially with the number of criteria and options.

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2.3.6.3. Implementation of AHP

Implementation of the Analytic Hierarchy Process (AHP) involves three key steps:

1. Determining the Vector of Criteria Weights**:** This step involves assessing the relative importance or weights of the criteria. Decision-makers assign these weights based on pairwise comparisons, establishing the criteria's priority order.
2. Determining the Matrix of Option Scores**:** Here, decision-makers compare options against each criterion, providing scores or values based on their relative performance for each criterion.
3. Ranking the Options**:** Using the weighted criteria and the scores assigned to options for each criterion, the AHP calculates an overall ranking for the options, aiding in identifying the most favorable choice.

In the methodology chapter, these processes will be elaborated upon in greater detail, outlining the specific procedures and methodologies used to perform each step within the framework of the AHP.

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2.4. Analytical Hierarchy Process Applications

Thomas L. Saaty introduced the Analytical Hierarchy Process (AHP) as a method to derive relative priorities in decision-making through pairwise comparisons. This methodology has found extensive application in various road safety research studies, particularly in identifying accident-prone locations.

For example, Agarwal & Habibian (2011) proposed methodologies using AHP to rank black spots based on Safety Hazardous Index and Safety Index. Sadeghpour (2018) evaluated traffic risk indexes in Iran's rural roads using AHP, focusing on accident severity and accident numbers to establish Risk Index scores.

Keymanesh (2017) utilized AHP without accident data, employing Expert Choice Software to identify and prioritize black spots in Baluchistan, Iran. Jakimavičius (2018) combined AHP and GIS technology to assess Lithuanian road accidents, using spatial analysis to rank accident sections based on accident density.

Additionally, Hajeeh (2012) employed AHP in Kuwait to analyze traffic accidents. The primary objective was to determine strategic policies for Kuwaiti authorities to minimize the severe impact of traffic accidents on both humans and property. These studies showcase the versatility of the AHP methodology in assessing and prioritizing road safety concerns across different regions and context

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2.5. Copeland Method

The Copeland method, a ranked voting approach, operates on a system of "wins," "losses," and "ties" in pairwise comparisons. It holds a significant historical background, also known as "Llull's method" due to its initial definition by Ramon Llull in 1299. This method was further developed by Arthur Herbert Copeland, leading to its widespread reference as "Copeland's method" (Ermatita, 2013).

In this method, each pair of candidates undergoes comparison to determine the preferred choice according to all preferences. The candidate perceived more favorably earns 1 point, while in the case of a tie, both candidates receive 1/2 point each. Following completion of all pairwise comparisons, the candidate accumulating the most points, representing the highest number of pairwise wins, is declared the overall winner (Al-Sharrah, 2010).

2.6. Summary of Literature Review

There are various methodologies utilized to assess walkability, each differing in the parameters considered for evaluation. For instance, the Ministry of Urban Development in India uses a walkability index based on walkway availability and pedestrian amenity quality. Another study by Patricia A. Collins calculates walkability based on residents' proximity to amenities, using a scoring system that rewards closer amenities with higher points.

Meanwhile, the Global Walking Index developed for the World Bank provides a qualitative analysis of walking conditions, considering inhibitions, cleanliness, safety, and convenience of pedestrian facilities. In New Zealand, the Walkability Prediction Model factors in pathway conditions, greenery, comfort elements, path deviation, and vehicle speed to determine walkability.

Greece investigated urban mobility along sidewalks, offering solutions to improve pedestrian conditions in Serres' city center. Surveys by the Resource Centre for Primary Health Care in Thasikhel Lalitpur highlighted that 33% of available footpaths were in poor condition. Mukti Advani in India evaluated walkability using the Analytical Hierarchy Process (AHP) and the Footpath Score based on Types of Obstructions (FOSTO), identifying parked vehicles and hawkers as significant impediments in the study region. These various methodologies showcase the diverse approaches employed globally to assess and address walkability concerns in different urban settings.

CHAPTER 3. METHODOLOGY

3.1. General

In the first chapter, the objectives of the present study have been discussed. In order to fulfill those objectives, a methodology needs to be formulated to achieve the required results. This chapter describes the details of the site considered in the study, the overall method adopted for evaluating walkability condition of footpath based on obstruction in Pulchowk-Lagankhel road section. The chosen area for this study was a 2 km road segment (Pulchowk-lagankhel) located within the Lalitpur Metropolitan City of the Kathmandu valley as shown in Figure 3.1. This particular road plays a crucial role as a primary arterial route within the Kathmandu valley. Furthermore, this road segment experiences substantial pedestrian traffic, making it an ideal location for assessing various parameters that contribute to walkability.

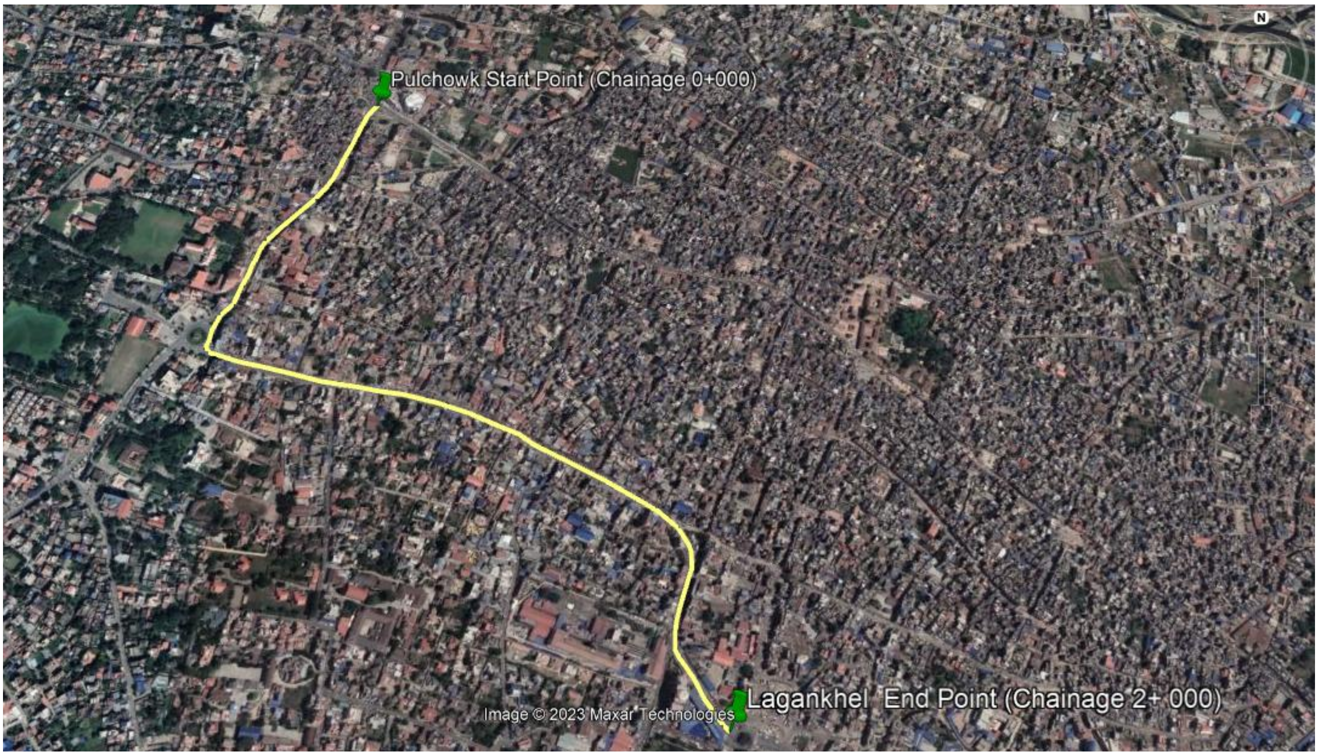

Figure 3.1 Location of study area

Obstructions are a big problem on segments surveyed. Most of the roads were found with obstructions. Pillars and trees were found to be blocking the footpaths in all segments, which highlights mismanaged development. Some percent of street segments had cars/motorbikes blocking the way and shop goods were found to cause obstruction a similar number of street segments. Construction rubbish and car entry/exits were contributing to obstructing surveyed segments. Other more minor sources of obstruction including trashcans and vendors. In addition to understand the type of obstructions, we also wanted to understand whether those obstructions caused problems for pedestrians. We found that surveyors could not walk on the footpath due to the obstructions on approximately 20 percent of all segments. They had to leave the footpath because of presence of various type of obstruction.

3.2 Methodology

The proposed framework for “Determination of FOSTO index” is divided into six stages as shown in Figure 3.2.

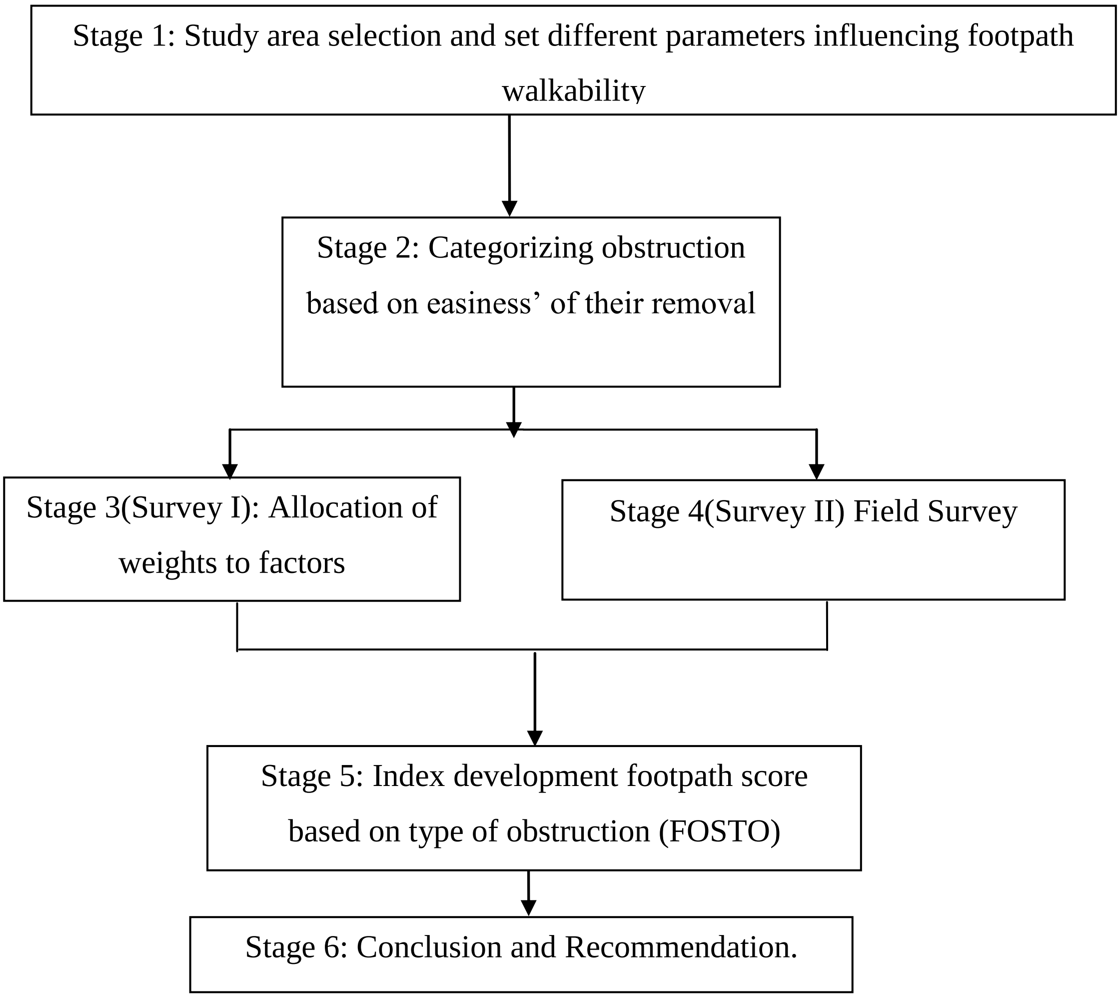

Figure 3.2 Methodology flow chart

3.2.1. Study area selection, set different parameters and categorizing obstruction.

The left and the right footpaths of road section from Pulchowk (CH.0+000) to Lagan Khel (CH.2+000) was chosen as study area due to road section with sidewalk and considering presence of various obstruction on footpath, it's influence on footpath walkability. On the basis of literature review related to Analytic Hierarchy Process (AHP) and walkability study, field visit and experiences, six parameters influencing the walkability were identified (Table 3.1) for this study.

Table 3.1 Factors influencing footpath walkability

SN	Parameter
1	Percentage of road length with footpaths (%)
2	Percentage of footpath sections with adequate height (%)
3	Percentage of footpath length with inclines and declines (%)
4	Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)
5	Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)
6	Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)

In accordance with how simple or difficult it is to remove them; various obstruction has been divided into three groups.

• Group 1: This classification takes into account obstructions such as trash, tree leaves, potholes, and personal gardening. These obstructions are relatively simple to clear and don't require an extensive amount of time for removal.

• Group 2: These obstructions, such as hawkers and parked vehicles, might seem straightforward to remove from sidewalks. However, they stem from long-term planning policies encompassing town planning, transportation planning, and prior engineering decisions. The parked vehicles often belong to residents or visitors in the vicinity, perhaps for shopping purposes. If alternative modes were provided for their trips, these vehicles might have parked at their residences or designated parking areas, thus avoiding encroachment on pedestrian pathways. The lack of designated spaces contributes to their intrusion onto footpaths.

. • Group 3: This includes constructed restrooms, trees, and poles. All these elements are established to ensure utility services for society and maintain cleanliness and greenery in the area. Removing these obstructions from pedestrian pathways would require a comprehensive overhaul of these services. Such a transformation can only be achieved through long-term planning decisions.

In addition to these three categories, the height of the footpath (measured above the level of the carriageway) has also been considered in formulating the index for assessment. According to NRS 2070, the footpath must be 15 cm higher than the top of the carriageway. Further, percentage of length of ups/down along the footpath length is also considered as a parameter of evaluation.

3.2.2. Allocation of weights to factors using AHP

Relative weights to these criteria at each level of hierarchy becomes crucial. To establish these weights, a scale needs to be set. Several studies have explored various measurement scales, with the 1-to-9 scale often preferred due to its alignment with our innate ability to distinguish between strengths of dominance or preferences among items. Saaty's Intensity of 1-to-9 Importance Scale.

Following the selection of the measurement scale, pair-wise comparisons are conducted with expert assistance. This method involves evaluating different criteria by comparing them in pairs, streamlining the evaluation by focusing solely on two alternatives at a time.

Consequently, pair-wise comparisons must encompass all combinations of criteria. Equation 3.1 outlines the number of pair-wise comparisons needed for n criteria or alternatives. For instance, with 10 criteria, the evaluator would conduct 45 pair-wise comparisons. Throughout this process, the evaluator assesses their preference intensity between two criteria, one pair at a time, disregarding other criteria temporarily. This iterative approach ensures consistent evaluations and culminates in a ranking of all criteria based on pair-wise comparisons.

$$\text{. No. of pairwise comparisons} = n \times (n - 1)/2 \qquad (3.1)$$

Where,

n = Number of criteria. Also, represents size of square matrix.

After completing pairwise comparison, the relative weight matrixes (RWM) are constructed and the matrixes would be:

	C_1	C_2	…..	C_n
C_1	1	w_1/w_2	…..	w_1/w_n
C_2	w_2/w_1	1	…..	w_2/w_n
:	:	:	:	:
C_n	w_n/w_1	w_n/w_2	…..	1

In the above matrix w_1, w_2,…..,w_n are the relative importance given by the expert to the parameter C_1, C_2,……, C_n respectively. Certainly, the subsequent step involves computing the matrix eigenvector, A_{ij}, along with conducting the Consistency Index test (CI) for the criteria. To derive the matrix eigenvector A_{ij}, the process involves multiplying the n elements in each row, taking the nth root, and forming a new column with the resulting values to ascertain the value of X_{ij}. This calculation is typically represented by equation 3.2 in the process.

$$X_{ij.=} \sum_{i=1}^{n} \left(\frac{w_i}{w_1} \times \frac{w_i}{w_2} \times \ldots\ldots\ldots\ldots \frac{w_i}{w_n}\right) \wedge \left(\frac{1}{n}\right) \qquad (3.2)$$

Following the computation of the values in the new column as determined by equation 3.2, the subsequent step involves dividing each number in this column by the sum of the resulting values. This division process is depicted by equation 3.3.

$$\text{Eigen vector, } A_{ij}(W_j) = \frac{\sum_{i=1}^{n} \left(\frac{w_i}{w_1} \times \frac{w_i}{w_2} \times \ldots\ldots\ldots\ldots \frac{w_i}{w_n}\right) \wedge \left(\frac{1}{n}\right)}{\sum \sum_{i=1}^{n} \left(\frac{w_i}{w_1} \times \frac{w_i}{w_2} \times \ldots\ldots\ldots\ldots \frac{w_i}{w_n}\right) \wedge \left(\frac{1}{n}\right)} \qquad (3.3)$$

Eigen value, ƛi is determined by summing the product of each row element of RWM with corresponding column element of eigenvector and dividing it by eigenvector in corresponding row. Which can be shown in equation 3.4.

$$\text{Eigen value, } ƛi = \frac{\sum_{j=1}^{n} \left(\sum_{i=1}^{n} A_{ij}\right) W_j}{A_{ij}} \qquad (3.4)$$

The Consistency Index (CI) provides a measure of deviation from consistency as shown in equation 3.5

Consistency index, CI $= \frac{\lambda max - n}{n-1}$ (3.5)

Subsequently, the consistency index obtained is compared with the random index (RI), outlined in Table 3.2. This comparison generates the Consistency Ratio (CR), derived by dividing the consistency index by the random index. If the CR exceeds 10%, it indicates an inconsistency in judgment, suggesting the need for exclusion or repetition of the evaluation process.

Consistency ratio, CR $= \frac{CI}{RI}$ (3.6)

Table 3.2 Random Index for different dimensions of RWM (Saaty and Wong 1983)

Dimension	1	2	3	4	5	6	7	8	9
RI	NA	NA	0.58	0.90	1.12	1.24	1.32	1.41	1.45

3.2.3. Field Survey

Parameters to be studied were optimally found within the length of about 500m. Thus, entire route of survey was divided into parts of 500m such that measurement of each field parameter was made separately. The section of road analyzed (Pulchowk – Lagankhel) contained different 4 segments. The sections were analyzed individually as the severity of the problem varies across each of them. This was carried out in following steps:

- Reconnaissance Survey
- Facilities Check
- Field Measurement

Reconnaissance Survey

Entire section of road was observed thoroughly by walking. This was carried out to identify the parameter which makes influence on walkability of footpath in predefined section of analysis. This survey provides the basis for planning of entire field survey.

Facilities Check

After completion of first phase of survey, this survey was carried out to note every footpath facility throughout the section. Every footpath obstruction, intersections and public/private entrance were thoroughly observed in every 500m facilities of road section were aggregated. Survey of left side and right side footpath was carried out separately.

Field measurement

To create an index for assessing walking amenities in a specific area, a comprehensive inventory of footpaths was compiled. This involved conducting continuous measurements along the entire length of each footpath. This was done for footpath in both directions covered in study area. Study area includes the overall footpath section of 4km. This field survey was done twice. Once on a weekend (3rd April 2021, 10th April 2021) and once on a weekday (7th April 2021, 8th April 2021). Different days were chosen to capture data on both short-term and long-term obstructions found on footpaths. Separate footpath inventories were compiled for each of these days. The information collected for the footpath inventory encompassed chainage, footpath presence, footpath width (if available), obstruction type, and other relevant details. Observations were recorded for every meter of footpath length, detailing various aspects.

Footpath availability: The determination of footpath availability was based on its visibility, irrespective of its condition. If a footpath was deemed available, further observations were recorded as follows:

- Width: Measured on-ground in meters.
- Parked vehicles: Noted if any vehicle(s) were parked per meter length of footpath.
- Trees/poles: Observed for the presence of trees or poles along each meter of footpath.
- Gate openings: Recorded if any residential gates opened onto the footpath within each meter.
- Personal gardening: Noted if there were instances of personal gardening, typically fenced off, along the footpath.
- Potholes: Any observed potholes on the footpath were recorded.
- Garbage/mud: Presence of garbage or mud obstructing pedestrian paths was documented.
- Tree leaves/branches reaching lower height (below 1.65m above the footpath): Noted if tree leaves/branches obstructed pedestrian paths by hanging at a height less than 1.65 meters above the footpath.
- Hawkers: Hawkers sitting on footpath were observed and noted.

3.2.4. Index development footpath score based on type of obstruction (FOSTO)

All types of obstructions, in addition to other contributing factors like footpath height above the top of the carriageway and the percentage of rise and drop along the footpath length, were considered for assessment. An index was created to allocate score values to different footpath conditions based on these criteria. This index was formulated utilizing the Analytic Hierarchy Process (AHP). The method involved calculating the weights for various parameters using inputs from a selected panel of experts. These experts provided their weightage for different parameters, which were then used to compute an aggregate weightage termed as the consistency measure in AHP. Six parameters and their respective importance levels were gathered. Using the acquired consistency measure values and field data, an index known as the Footpath Score based on Types of Obstructions (FOSTO) was developed. Equation 3.7 was employed to calculate this index.

FOSTO score = $(X_1 \times P_1 + X_2 \times P_2 + ... + X_n \times P_n) - (Y_1 \times N_1 + Y_2 \times N_2 + … + Y_n \times N_n)$ ………(3.7) (Mukti Advani 2017)

Where,

$X_1, X_2, ….., X_n$ are the parameter having Positive impact on walkability and $P_1, P_2, ….., P_n$ are their weightage respectively.

Similarly, $Y_1, Y_2, ….., Y_n$ are the parameter having adverse impact on walkability and $N_1, N_2, ….., N_n$ are their weightage respectively.

3.2.5. Conclusion and Recommendation

At this stage, conclusions can be derived from the obtained results. Based on the assessment of the walkability conditions of footpaths across the study area, necessary countermeasures or preventive actions should be recommended. These recommendations need to align with the available budget and prioritize the identified countermeasures effectively.

CHAPTER 4. RESULTS AND DISCUSSION

4.1.Primary Data Collection:

4.1.1. Expert Questionnaire Survey

Expert Questionnaire Survey Form was prepared, and then distributed to 16 experts from various transportation related sectors. The list of experts filling the questionnaire format is provided in **Appendix A**. The relative weight given by the experts during filling the format is tabulated in **Appendix B**.

4.1.2. Preparation of footpath inventory

For preparation of footpath inventory of each road segment, field survey of site conditions and footpath facilities of Pulchowk-Lagankhel road section was performed. While moving from Pulchowk to Lagankhel, the left hand side of footpath is referred as left footpath and similarly, right hand side footpath is referred as right footpath.

4.1.2.1.Field survey at left footpath section (weekday)

Different type of temporary and permanent obstruction, The percentage of road length having footpath and length of footpath meeting the acceptable height criterion (15cm above the top of the carriageway), percentage of ups and down along the footpath are the key indicators used in this study. field survey in this section has been done on 7thapril 2021. Footpath on study area was divided into four section each of 500m length and survey of each individual parameter was done. The detail field condition data is tabulated in **Appendix D**. Condition of footpath in this section is as shown in Figure 4.1, Figure 4.2, Figure 4.3 and Figure 4.4.

Figure 4.1 footpath section at chainage 0+200 to chainage 0+300 (left side)

Figure 4.2 Footpath section at chainage 0+400 to chainage 0+500 (left side)

Figure 4.3 footpath section at chainage 1+600 to chainage 1+700 (left side)

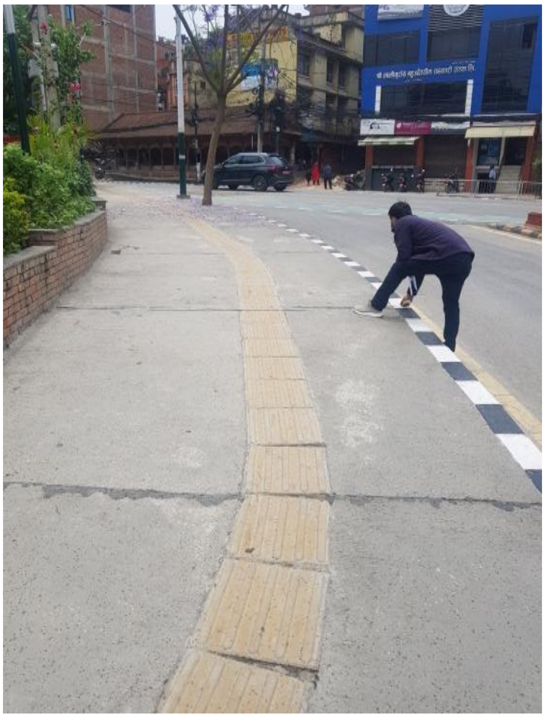

Figure 4.4 Footpath section at chainage 0+000 to chainage 0+800 (left side)

4.1.2.2.Field survey at right footpath section (weekday)

Field survey in this section was done on 8th April 2021.There were few significant changes in parameter along the route than that of left footpath section. Different type of temporary and permanent obstruction, percentage of road length having footpath and the length of footpath meeting the acceptable height criterion (15cm above the top of the carriageway), percentage of ups and down along the footpath are the key indicators used in this study. Footpath availability, group 1 type and group 3 type obstruction are found to be slightly more than left section and footpath having acceptable height above carriageway, length of ups and down, group 2 type obstruction are found lesser during the field survey. The detail field condition data is tabulated in **Appendix D**. Condition of footpath in this section is as shown in Figure 4.5 and Figure 4.6.

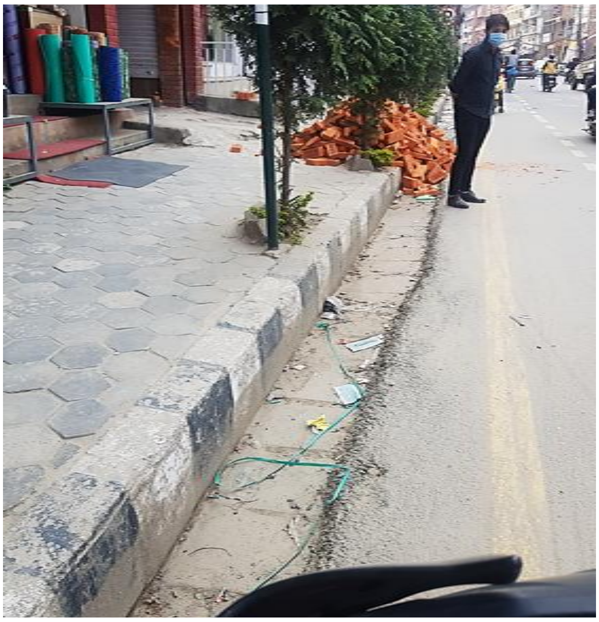

Figure 4.5 Footpath section at chainage 0+500 to chainage 0+600 (right side)

Figure 4.6 Footpath section at chainage 1+500 to chainage 1+550 (right side)

4.1.2.3.Field survey at left footpath section(weekend)

field survey in this section was done on 3rd April 2021.The key indicators used in survey were same as in weekdays. Obstruction of temporary natures such as parked vehicles, hawker etc. (group 1 and group 2 type) were found lesser on this observation. The detail field condition data is tabulated in **Appendix D**. Condition of footpath in this section is as shown in Figure 4.7.

Figure 4.7 Footpath section at chainage 1+300 to chainage 1+400 (left side)

4.1.2.4.Field survey at right footpath section(weekend)

Field survey in this section was done on 10th April 2021.The key indicators used in survey were same as in weekdays. Obstruction of temporary natures such as parked vehicles, hawker etc. (group 1 and group 2 type) are found lesser on this observation. The detail field condition data is tabulated in **Appendix D**. Condition of footpath in this section is as shown in Figure 4.8.

Figure 4.8 Footpath section at chainage 1+200 to chainage 1+300 and chainage 1+880 to chainage 1+980 (right side)

4.2.Determination of Weightage of Safety Factors

The Relative Weight Matrices (RWM) or comparison matrices were prepared based on expert questionnaire survey form as shown in Table 4.1. The process involved creating a comparison matrix and computing the priority vector, which represents the normalized Eigen vector of the matrix. This priority vector delineates the relative weights among the factors compared by the experts. In addition to determining the relative weights, the consistency of the experts' assessments was verified. If the Consistency Ratio value was equal to or smaller than 10%, the inconsistencies in the assessments were deemed acceptable. Weightage of parameters and consistency ratio was determined by AHP priority calculator (Goepel, 2018).The calculation of relative weight of each parameters and its consistency ratio from one of the expert’s questionnaire survey is presented as below.

Table 4.1 Sample of Filled Questionnaire Survey Form

Factors	Expert rating
A over B	5
A over C	5
A over D	6
A over E	6
A over F	7
B over C	3
B over D	3
B over E	3
B over F	4
C over D	1
C over E	2
C over F	4
D over E	1
D over F	4
E over F	1

The above mentioned Letters A, B, C, D, E, F indicates following parameters

A=Percentage of road length having foot path (%).

B=Percentage of road length having acceptable height (15 cm or more above the top of carriageway). As per NRS 2070 which is stipulated to be 15cm.

C=percentage of rise and drop along footpath length or discontinuities along the linear path due to private, public entrances, topography etc.

D=Percentage of road length obstructed by Group 1 elements, which may include garbage, fallen leaves, potholes, and personal gardening (%).

E=Percentage of road length obstructed by Group 2 elements, such as parked vehicles and street vendors (%).

F=Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%).

The corresponding RWM was developed as tabulated below as shown in Table 4.2.

Table 4.2 Development of RWM

	A	B	C	D	E	F
A	1.00	5.00	5.00	6.00	6.00	7.00
B	0.2	1.00	3.00	3.00	3.00	4.00
C	0.2	0.33	1.00	1.00	2.00	4.00
D	0.17	0.33	1.00	1.00	1.00	4.00
E	0.17	0.33	0.5	1.00	1.00	4.00
F	0.14	0.25	0.25	0.25	0.25	1.00

In the process, the subsequent step involves computing the matrix eigenvector, denoted as A_{ij}, and conducting the consistency index test (CI) for the criterion. To derive the matrix eigenvector, the process entails multiplying the n elements in each row, obtaining the nth root, and then creating a new column for the resulting values to establish the value of X_{ij}. This calculation can be represented using equation 4.1.

$$X_{ij.} = \sum_{i=1}^{n} \left(\frac{w_i}{w_1} \times \frac{w_i}{w_2} \times \ldots\ldots\ldots\ldots \frac{w_i}{w_n}\right)^\wedge\left(\frac{1}{n}\right) \quad (4.1)$$

In the above matrix w_1, w_2,…..,w_n are the relative importance given by the expert to the parameter C_1, C_2,……, C_n respectively. Calculation of Eigen vector, A_{ij}:is shown in equation 4.2.

$$\text{Eigen vector, } A_{ij}\,(W_j) = \frac{\text{Xij}}{\sum \text{Xij}} \quad (4.2)$$

$$= 4.29/8.53$$

$$= 0.503$$

The eigenvector of each factor was computed as the example given in Table 4.3.

Table 4.3 Eigen vector or Priority vector

	A	B	C	D	E	F	Xij	$A_{ij}(W_j)$
A	1.00	5.00	5.00	6.00	6.00	7.00	4.29	0.503
B	0.2	1.00	3.00	3.00	3.00	4.00	1.66	0.19
C	0.2	0.33	1.00	1.00	2.00	4.00	0.90	0.10
D	0.17	0.33	1.00	1.00	1.00	4.00	0.77	0.09
E	0.17	0.33	0.5	1.00	1.00	4.00	0.69	0.08
F	0.14	0.25	0.25	0.25	0.25	1.00	0.28	0.03
					Sum		**8.53**	**1.00**

To obtain the consistency ratio (CR), the calculation of Eigen-value was needed which is shownin Table 4.4 and Calculation of Eigen value, λ_i:is shown in equation 4.3.

Table 4.4 Eigen Value or Consistency measure

	A	B	C	D	E	F	Xij	$A_{ij}(w_j)$	λ_i
A	1.00	5.00	5.00	6.00	6.00	7.00	4.29	0.503	6.492
B	0.2	1.00	3.00	3.00	3.00	4.00	1.66	0.194	6.447
C	0.2	0.33	1.00	1.00	2.00	4.00	0.90	0.10	6.221
D	0.17	0.33	1.00	1.00	1.00	4.00	0.77	0.09	6.223
E	0.17	0.33	0.5	1.00	1.00	4.00	0.69	0.08	6.224
F	0.14	0.25	0.25	0.25	0.25	1.00	0.28	0.033	6.631
						Sum	**8.53**	**1.00**	**38.28**

$$\text{Eigen value, } \lambda i = \frac{\sum_{j=1}^{n}(\sum_{i=1}^{n} A_{ij}) W_j}{A_{ij}} \qquad (4.3)$$

Eigen value, λ_i = (1x0.503+5x0.194+5*0.10+6x0.09+6x0.08+7x0.033)/ 0.503

= 6.492

Next, the consistency index (CI) was calculated using equation 4.4 below.

$$\text{Consistency index, CI} = \frac{\lambda \max - n}{n-1} \qquad (4.4)$$

= 0.076

Finally, the consistency ratio was calculated using equation 4.5 below.

$$\text{Consistency ratio} = \frac{CI}{RI} \qquad (4.5)$$

$$= \frac{0.076}{1.24}$$

= 0.0612

Thus, the judgment was acceptable since CR < 0.1. The process was repeated for all the experts. Then, the final weightage for safety factors was calculated by averaging the weight of priority vectors of experts whose judgements were approved by consistency test as shown in **Appendix C**

The average weight developed for each element is summarized in tabular form in Table 4.5.

Table 4.5 Average Weight for each element

Parameter	Average Wt.
Percentage of road length having foot path	0.499
Percentage of road length having acceptable height (15 cm or more above the top of carriageway)	0.123
percentage of ups/downs along footpath length or discontinuities along the linear path due to private , public entrances , topography etc.	0.118
Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)	0.072
Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)	0.073
Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)	0.111

4.3.Development of FOSTO index

Combining the calculated average weight of each parameter & field measurement data as shown in **APPENDIX E** for each factor, FOSTO Index for all section was determined.

In our study A and B are the parameter having Positive impact on walkability and W_1 and W_2 are their corresponding weightage. Similarly, C, D, E and F are parameter having adverse impact on walkability and W_3, W_4, W_5 and W_6 are their weightage respectively.

Where,

A = Percentage of road length having foot path

B= Percentage of road length having acceptable height (15 cm or more above the top of carriageway)

C = percentage of rise and drop along footpath length or discontinuities along the linear path due to private, public entrances, topography etc.

D = Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)

E = Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)

F = Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)

Now,

FOSTO score = ($A \times W_1 + B \times W_2 - C \times W_3 - D \times W_4 - E \times W_5 - F \times W_6$)

$$=(A\times0.499+B\times0.123-C\times0.118-D\times0.072-E\times0.073-F\times0.111)$$

FOSTO score for all footpath section was calculated as shown in Table 4.6, Table 4.7, Table 4.8, Table 4.9, Table 4.10, Table 4.11Table 4.12 and Table 4.13.

Table 4.6 FOSTO index for left footpath section (0+ 000 to 0+500)

		Weight assigned	weekend	weekday
Section 1	Percentage of road length having footpath	0.499	81	81
	Percentage of road length having acceptable height.	0.123	59.6	59.6
	percentage of rise and drop along footpath length	0.118	5	5
	Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)	0.072	1	1
	Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)	0.073	0	19.2
	Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)	0.111	4	4
	FOSTO Score		**46.64**	**45.24**

Table 4.7 FOSTO index for left footpath section (0+ 500 to 1+000)

		Weight assigned	weekend	weekday
Section 2	Percentage of road length having footpath	0.499	84	84
	Percentage of road length having acceptable height	0.123	57.6	57.6
	percentage of rise and drop along footpath length	0.118	9	9
	Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)	0.072	0	1
	Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)	0.073	0	22.3
	Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)	0.111	6	6
	FOSTO Score		**47.272**	**45.644**

Table 4.8 FOSTO index for left footpath section (1+ 000 to 1+500)

		Weight assigned	weekend	weekday
Section 3	Percentage of road length having footpath	0.499	79	79
	Percentage of road length having acceptable height	0.123	51.6	51.6
	percentage of rise and drop along footpath length	0.118	6	6
	Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)	0.072	1	1
	Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)	0.073	1	17.7
	Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)	0.111	8	8
	FOSTO Score		**44.026**	**42.879**

Table 4.9 FOSTO index for left footpath section (1+ 500 to 2+000)

		Weight assigned	weekend	weekday
Section 4	Percentage of road length having footpath	0.499	58	58
	Percentage of road length having acceptable height	0.123	21	21
	percentage of rise and drop along footpath length	0.118	8	8
	Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)	0.072	1	1
	Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)	0.073	1	27.7
	Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)	0.111	5	5
	FOSTO Score		**29.881**	**28.004**

Table 4.10 FOSTO index for right footpath section (0+ 000 to 0+500)

		Weight assigned	weekend	weekday
Section 1	Percentage of road length having footpath	0.499	81	81
	Percentage of road length having acceptable height	0.123	59	59
	percentage of rise and drop along footpath length	0.118	9	9
	Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)	0.072	2	4
	Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)	0.073	1	20.8
	Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)	0.111	3	3
	FOSTO Score		**46.1936**	**44.7626**

Table 4.11 FOSTO index for right footpath section (0+ 500 to 1+000)

		Weight assigned	weekend	weekday
Section 2	Percentage of road length having footpath	0.499	66	66
	Percentage of road length having acceptable height	0.123	38	38
	percentage of rise and drop along footpath length	0.118	6	6
	Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)	0.072	1	1
	Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)	0.073	0	15.6
	Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)	0.111	6	6
	FOSTO Score		**36.162**	**35.095**

Table 4.12 FOSTO index for right footpath section (1+ 000 to 1+500)

		Weight assigned	weekend	Weekday
Section 3	Percentage of road length having footpath	0.499	91	91
	Percentage of road length having acceptable height	0.123	45	45
	percentage of rise and drop along footpath length	0.118	7	7
	Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)	0.072	1	2
	Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)	0.073	1	18.9
	Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)	0.111	7	7
	FOSTO Score		**49.196**	**47.961**

Table 4.13 FOSTO index for right footpath section (1+ 500 to 2+000)

		Weight assigned	weekend	Weekday
Section 4	Percentage of road length having footpath	0.499	65	65
	Percentage of road length having acceptable height	0.123	57	57
	percentage of rise and drop along footpath length	0.118	7	7
	Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)	0.072	1	1
	Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)	0.073	0	32
	Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)	0.111	4	4
	FOSTO Score		**38.104**	**35.84**

Further, FOSTO index for entire footpath section of 2km was obtained by considering field data of all parameter obtained in whole footpath section. This was performed for every 2 km road segments both side of Pulchowk Lagankhel Ch.0+000 to Ch. 2+000 km. This survey was carried out to note every footpath facility throughout the section. Every footpath obstruction, intersections and public/private entrance were thoroughly observed in every 500m facilities of road section were aggregated. Survey of left side and right side footpath was carried out separately. FOSTO index was determined based on field survey data and weightage of each walkability parameter as shown in Table 4.14 and Table 4.15 below.

Table 4.14 FOSTO Index for each 2km footpath (left section)

		Weight assigned	weekend	Weekday
Left Section	Percentage of road length having footpath	0.499	75.6	75.6
	Percentage of road length having acceptable height	0.123	47.4	47.4
	percentage of rise and drop along footpath length	0.118	7	7
	Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)	0.072	1	1
	Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)	0.073	1	21.7
	Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)	0.111	5	5
	FOSTO Score		**42.028**	**40.589**

Table 4.15 FOSTO Index for each 2km footpath (Right section)

		Weight assigned	weekend	weekday
Right Section	Percentage of road length having footpath	0.499	76	76
	Percentage of road length having acceptable height	0.123	49.8	49.8
	percentage of rise and drop along footpath length	0.118	7	7
	Percentage of road length obstructed by Group 1 elements (e.g., garbage's, fallen leaves, potholes, personal gardening) (%)	0.072	1	1
	Percentage of road length obstructed by Group 2 elements (e.g., parked vehicles, street vendors) (%)	0.073	5	16.8
	Percentage of road length obstructed by Group 3 elements (e.g., constructed restrooms, trees, poles) (%)	0.111	5	5
	FOSTO Score		**43.149**	**41.442**

4.4.Results

The average weight developed for each element was summarized in graphical form as shown in Figure 4.9.

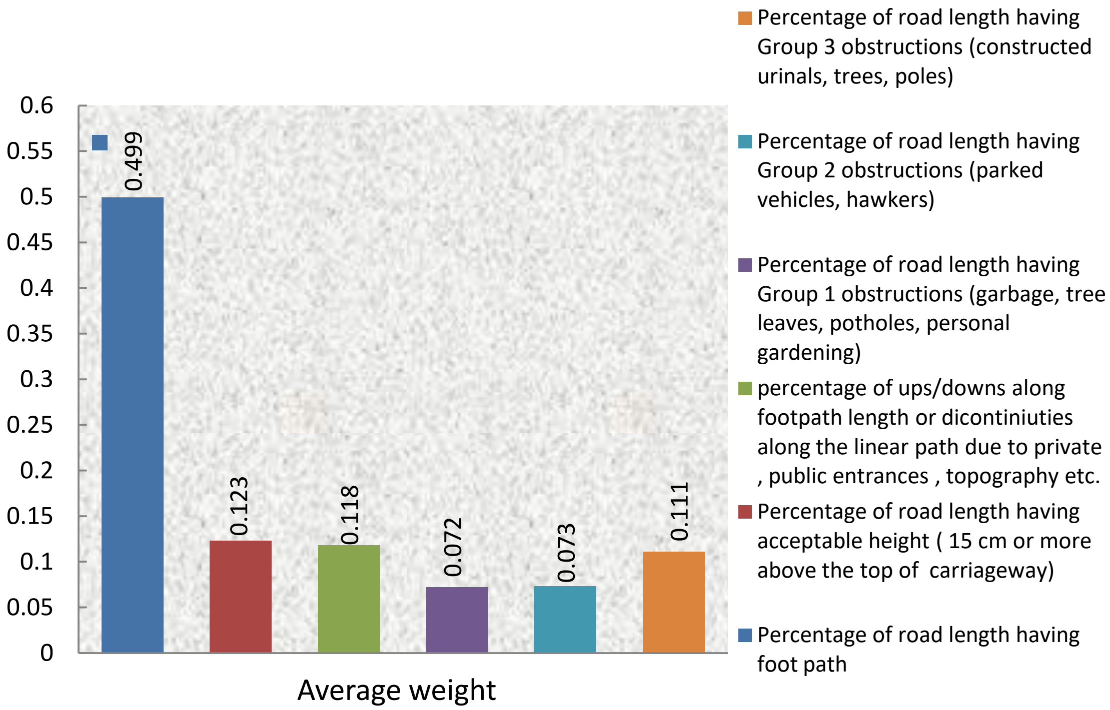

Figure 4.9 Average weight of parameters

Figure 4.9 shows that experts have given more importance to the parameter ‘Percentage of road length having foot path (49.9%)’, ‘Percentage of road length having acceptable height (12.3%)’, ‘percentage of ups/downs along footpath length (11.8%)’ and ‘Percentage of road length having Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) (7.2%)’ and so on.

Similarly, FOSTO score of different footpath section can be represented in bar chart in figure 4.10

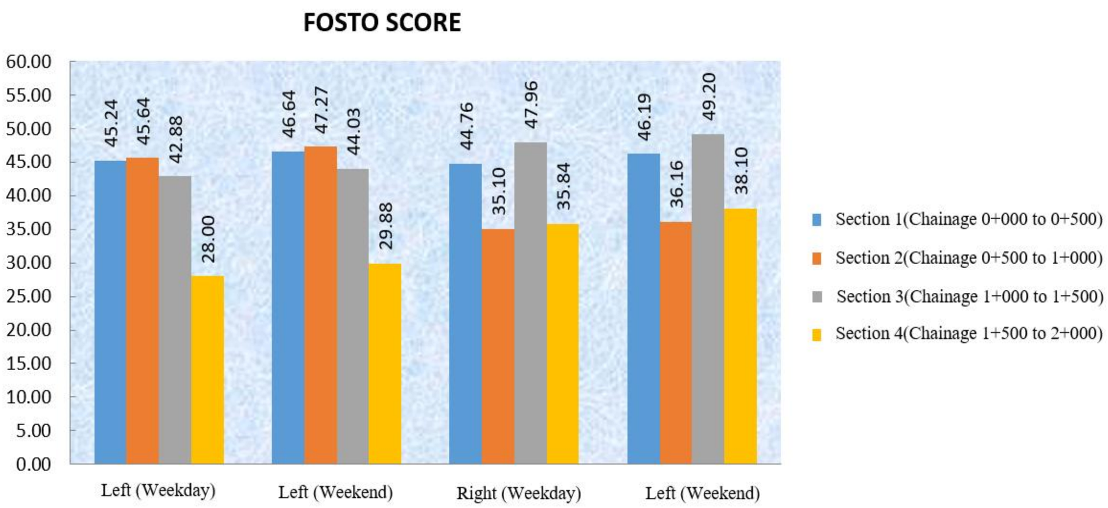

Figure 4.10 FOSTO score of different footpath sections

Figure 4.10 shows that third section of right footpath (1+000 to 1+500) have highest FOSTO score (49.9%) during weekend and 4th section of left footpath (1+500 to 2+000) have lowest FOSTO score (28.00%) during weekday.

Finally, FOSTO index for entire footpath section of 2km in both directions can be expressed in bar chart shown in figure 4.11.

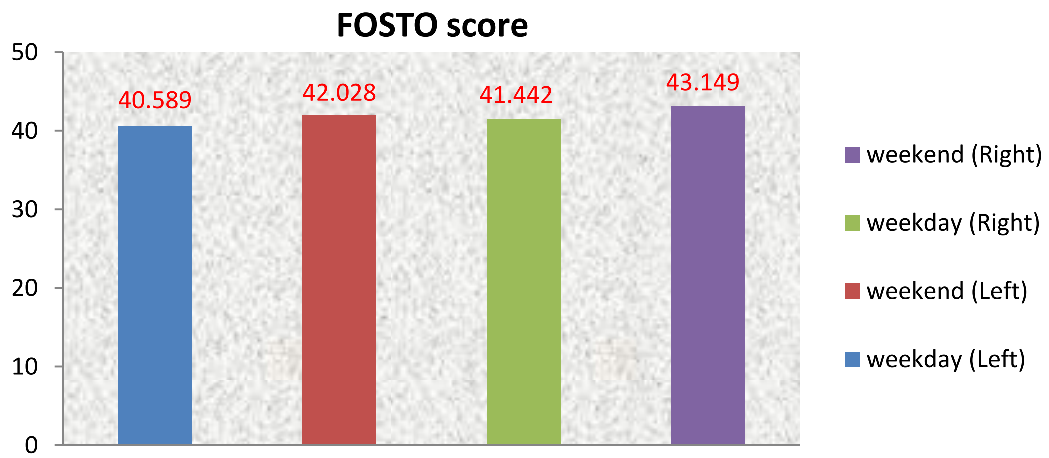

Figure 4.11 FOSTO score of overall 2 km road section

Here, Right footpath section was found to have highest FOSTO value of 43.149 during weekend as shown in Figure 4.11, This particular road section is deemed the most walkable concerning walkability parameters, whereas the left footpath section is observed to be slightly less walkable compared to the right section.. FOSTO score of footpaths during weekend was found more than weekday at both section.

4.5 Validation of Result obtained from AHP

Validation of result obtained from AHP was done by Copeland method. Copeland method is a voting theory based on scoring parameters by pairwise comparisons. Each respondent is asked to which parameter is more significant for influencing footpath walkability in a given road section. The respondent should be local resident, pedestrian and traffic Police working on a given Road section. The result obtained from Copeland method was compared with weightage of parameter obtained from AHP result. The correlation between Relative weight of each parameter obtained from AHP and Copeland method was developed on the basis of rank of each parameter. Correlation coefficient and probable error was determined. For the Test become significant the Probable error should be within permissible limit.

The rankings obtained by AHP weightage as shown in **APPENDIX C** and weightage of parameter from Copeland method as shown in **APPENDIX I** were then compared. Spearman's rank correlation was employed to determine the degree of concurrence between the rankings acquired through the two methods. The outcomes of the correlation analysis validated the methodology utilized in the study, demonstrating a correlation coefficient of 1 and a probable error of 0, as depicted in table 4.16.

Table 4.16 Correlation between AHP weightage and Copeland weightage

S N	parameter	Rank, R1 and R2		d= R1-R2	d^2	Correlation coefficient, r	Probable Error, P.E.(r)	Result, 6*P.E(r)
		AHP(R1)	Copeland (R2)					
1	Percentage of road length having footpath	0.499 (1)	0.305 (1)	0	0	1	0	0
2	Percentage of road length having acceptable height	0.123 (2)	0.167 (2)	0	0			
3	percentage of rise and drop along footpath length	0.118 (3)	0.165 (3)	0	0			< r= 1
4	Percentage of length having Group 1 obstructions (garbage, tree Parameter leaves, potholes, personal gardening)	0.072 (6)	0.112 (6)	0	0			Hence, test is significant
5	Percentage of length having Group 2 obstructions (parked vehicles, hawkers)	0.073 (5)	0.123 (5)	0	0			
6	Percentage of length having Group 3 obstructions (constructed urinals, trees, poles)	0.111 (4)	0.128 (4)	0	0			
	N=	6	6		0			

Where, calculation of correlation coefficient is shown in equation 4.6 and probable error is shown in equation 4.7.

$$R = 1 - \frac{6*\Sigma(d^2)}{N*(N^2-1)} \qquad (4.6)$$

$$= 1$$

$$P.E.(r) = \frac{0.6745*(1-r^2)}{N^{0.5}} \qquad (4.7)$$

$$= 0$$

CHAPTER 5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusions

From the result obtained, FOSTO score of weekdays of the footpath and FOSTO score of weekends on each side was found below 50. Group 3 obstructions (constructed urinals, trees, poles) impact on the footpath walkability was found highest (11.1%) whereas Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) impact on the footpath walkability was found lowest (7.2%). Overall, there was no great difference between the FOSTO score of weekdays of the footpath and FOSTO score of weekends on both sides. Therefore, obstruction of permanent nature seems to have more effect on footpath walkability than obstruction of temporary nature on the area we have studied.

5.2. Recommendations

Based on our findings, we recommend the following policy and infrastructure improvements to improve the situation for pedestrians:

- Provide necessary supports for law enforcement to ensure footpaths are free of obstructions and clean.
- Ensure footpaths have acceptable height (15 cm or more above the top of carriageway).
- Create designated hawker zones as a part of the pedestrian network.

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APPENDIX A: List of experts filling the questionnaire format

	Name of Expert	Designation, Organization	Remarks
E1	Pramila Devi Shakya Bajracharya	Secretary, Nepal Government	Highway Engineer
E2	Krishna Raj Adhikari	Senior Divisional Engineer, Department of Roads	Highway Engineer
E3	Anil Marsani	Coordinator, MSc in Transportation Engineering, Pulchowk Campus	TOT on Road Safety, Delft Road Safety Course
E4	Subhash Dhungel	Independent Road Safety Expert	Road Safety Expert
E5	Prof. Dr. Padma Bahadur Shahi	Chairman, Society of Transportation Engineer Nepal (SOTEN)	Road Safety Expert
E6	Hemant Tiwari	Chairman, Safe & Sustainable Travel Nepal	TOT on Road Safety; Delft Road Safety course
E7	Mahesh Chandra Neupane	SDE, Planning section DOLI	Former TID chief of province 3
E8	Dr. Partha Mani Parajuli	Transport Safety Expert	
E9	Dr. Pradeep Kumar shrestha	Assistant Professor,IOE Pulchowk	Road Safety Expert
E10	Dr.Hareram Shrestha	Executive Director,SIDEF	Past President NEA
E11	Prativa Bhandari	Civil Engineer at DOLI	General Engineer
E12	Jagat Prajapati	Project Head at BNSBD project	Highway Engineer
E13	Saroj Kumar Pradhan	Joint Secretary, Ministry of Physical Infrastructure & Transport	Highway Engineer
E14	Dr. Sahadev Bdr Bhandari	TID Chief Province 3	General Engineer
E15	Shreeram Dhakal	Srcretaary at SOTEN	Transport Policy Analyst/ researcher
E16	Himal Kafle	Engineer at mid Hill Highway	Highway Engineer

APPENDIX B: Relative weight given by experts for each parameter

Factors			E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16
A	over	B	5	0.143	0.111	0.11	9	9	6	6	6	6	6	6	1	5	5	8
A	over	C	5	0.250	0.20	0.167	6	6	6	6	6	6	6	6	2	5	6	5
A	over	D	6	0.200	0.143	0.143	7	6	7	5	7	5	5	5	3	7	7	0.33
A	over	E	6	0.250	0.25	0.125	8	7	8	5	8	5	6	5	2	3	8	0.25
A	over	F	7	0.111	1	0.167	4	4	7	6	7	6	6	7	2	5	9	0.20
B	over	C	3	2	2	7	0.14	0.14	1	1	1	1	1	1	7	0.33	6	0.50
B	over	D	3	0.50	2	4	0.25	0.25	2	2	2	2	2	2	4	3	7	0.33
B	over	E	3	0.33	2	2	0.20	0.20	2	2	2	2	2	2	9	3	8	0.25
B	over	F	4	0.20	7	7	0.14	0.14	2	2	2	2	2	2	4	5	9	0.20
C	over	D	1	0.50	1	0.33	3	3	2	2	2	2	2	2	0.17	3	7	1
C	over	E	2	0.33	2	0.20	5	5	2	2	2	2	2	2	0.25	0.33	8	1
C	over	F	4	0.20	7	1	1	1	2	2	2	2	2	2	0.33	0.33	9	1
D	over	E	1	2	5	0.5	4	4	1	1	1	1	1	1	1	0.20	2	1
D	over	F	4	0.20	8	3	0.33	0.33	1	1	1	1	1	1	1	0.33	1	1
E	over	F	1	0.33	6	5	0.20	0.20	1	1	1	1	1	1	1	0.33	2	1

APPENDIX C: Average weight calculation for consistent judgements

Experts	A	B	C	D	E	F	CR
1	0.504	0.194	0.102	0.087	0.079	0.035	0.062
2	0.489	0.134	0.176	0.081	0.087	0.029	0.073
3	0.346	0.039	0.058	0.048	0.111	0.395	0.043
4	0.547	0.026	0.150	0.069	0.040	0.157	0.060
5	0.509	0.024	0.163	0.08	0.050	0.170	0.097
6	0.497	0.024	0.167	0.09	0.050	0.173	0.099
7	0.490	0.264	0.093	0.064	0.053	0.033	0.056
8	0.475	0.281	0.025	0.069	0.117	0.031	0.086
9	0.566	0.119	0.119	0.065	0.063	0.065	0.0068
10	0.533	0.126	0.126	0.073	0.070	0.070	0.015
11	0.533	0.126	0.126	0.073	0.073	0.068	0.017
12	0.240	0.413	0.036	0.111	0.097	0.100	0.059
Average wt.	**0.499**	**0.123**	**0.118**	**0.072**	**0.073**	**0.111**	

APPENDIX D: Field survey data

Location: Pulchowk Lagankhel Road section. (left side/week Day)
Survey Date: 2077/12/25
length of footpath surveyed: 2KM
0+000 chainage @ footpath just in front of Shankhadhar Shakhwa Salik
Section 1 (chainage 0+000 to 0+500)
Total length of road having footpath = 403m
Total length of footpath having acceptable height above top of carriageway= 298m
Total length of rise and drop along footpath= 27m

SN	Chainage		width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group 2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	0+000	0+020	3			
2	0+020	0+040	2.25			0.6
3	0+040	0+060	2	2	9	0.7
4	0+060	0+080	2	0.8	8	1.2
5	0+080	0+100				
6	0+100	0+120				
7	0+120	0+140	2			1.6
8	0+140	0+160	2		3	0.35
9	0+160	0+180	2		8	0.4
10	0+180	0+200	2		8	0.5
11	0+200	0+220	2		4.5	0.65
12	0+220	0+240	2			0.7
13	0+240	0+260	2			0.4
14	0+260	0+280	2		9	0.9
15	0+280	0+300	2		7	0.4
16	0+300	0+320			7	
17	0+320	0+340	2			0.5
18	0+340	0+360	2			0.43
19	0+360	0+380	2		6.5	0.4
20	0+380	0+400	2	0.9		1.6
21	0+400	0+420	2	0.5	7	1.6
22	0+420	0+440	2	0.6	6	2.4
23	0+440	0+460	1.5		6	1.5
24	0+460	0+480	2	1.2	17	1.2
25	0+480	0+500	1.95			0.9
Total				**6**	**96**	**18.93**

section 2 (chainage 0+500 to 1+000)

Total length of road having footpath = 422m

Total length of footpath having acceptable height above carriageway= 288m

Total length of rise and drop along footpath= 43m

SN	Chainage		Width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	0+500	0+520	1.5			0.7
2	0+520	0+540	1.5		13	0.6
3	0+540	0+560	1.5	2	15	0.35
4	0+560	0+580	1.5			0.25
5	0+580	0+600	1.5	2.5		0.46
6	0+600	0+620	1.5		6.5	0.9
7	0+620	0+640	1.5			1.4
8	0+640	0+660	1.5			1.6
9	0+660	0+680	1.5		7	2.4
10	0+680	0+700	1.5		19	2.7
11	0+700	0+720	1.5	1.3		2.3
12	0+720	0+740	1.55		2.7	1.7
13	0+740	0+760	1.55			2.1
14	0+760	0+780				
15	0+780	0+800	1.6		17	1.9
16	0+800	0+820	1.45			1.45
17	0+820	0+840	0.9			1.6
18	0+840	0+860	1.5			1.45
19	0+860	0+880				
20	0+880	0+900	1.55		3.5	1.35
21	0+900	0+920	1.55			1.25
22	0+920	0+940	1.55		12	1.55
23	0+940	0+960	1.55		16	0.9
24	0+960	0+980	1.5			0.55
25	0+980	1+000	1.5			0.6
Total				**5.8**	**111.7**	**30.06**

Section 3 (chainage 1+000 to 1+500)
Total length of road having footpath = 397m

Total length of footpath having acceptable height above carriageway= 258m
Total length of rise and drop along footpath= 32m

SN	Chainage		width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	1+000	1+020	1.45			0.9
2	1+020	1+040	1.4		16	0.5
3	1+040	1+060	1.5		7.8	0.8
4	1+060	1+080				
5	1+080	1+100	1.5			1.5
6	1+100	1+120	1.5			1.6
7	1+120	1+140	1.5			1.7
8	1+140	1+160	1.5		12	1.6
9	1+160	1+180	1.5		15	3.2
10	1+180	1+200	1.5			4.4
11	1+200	1+220	1.5			5
12	1+220	1+240	1.55	2.7		3
13	1+240	1+260	1.55		11	1.2
14	1+260	1+280				
15	1+280	1+300	1.6		18	2.3
16	1+300	1+320	1.45			0.9
17	1+320	1+340	0.9		5.6	0.6
18	1+340	1+360	1.5			0.8
19	1+360	1+380				
20	1+380	1+400	1.55			0.9
21	1+400	1+420	1.55	3.3		1.2
22	1+420	1+440	1.55	1.2		1.3
23	1+440	1+460	1.55		3.5	1.2
24	1+460	1+480	1.5			1.4
25	1+480	1+500	1.5			1.6
Total				**7.2**	**88.9**	**37.6**

Section 4 (chainage 1+500 to 2+000)
Total length of road having footpath = 291m
Total length of footpath having acceptable height above carriageway= 105m
Total length of rise and drop along footpath= 39m

SN	Chainage		width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group.2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	1+500	1+520	1.5	0.3		0.6
2	1+520	1+540	1.4		14	0.4
3	1+540	1+560	1.5	0.9	12	0.55
4	1+560	1+580	1.5			0.4
5	1+580	1+600	1.5		7	0.6
6	1+600	1+620	1.5	1.7		1.2
7	1+620	1+640	1.5			
8	1+640	1+660	1.5			
9	1+660	1+680	1.5		18	0.9
10	1+680	1+700	1.5		12	2.2
11	1+700	1+720	1.5		11	1.3
12	1+720	1+740	1.55			1.4
13	1+740	1+760	1.55			1.6
14	1+760	1+780				
15	1+780	1+800	1.6			0.75
16	1+800	1+820	1.45		3.8	2.4
17	1+820	1+840	0.9			2.4
18	1+840	1+860	1.5			1.6
19	1+860	1+880			19	
20	1+880	1+900	1.55		4.9	1.2
21	1+900	1+920	1.55	0.55	6	1.4
22	1+920	1+940	1.55			0.8
23	1+940	1+960				
24	1+960	1+980			13	
25	1+980	2+000	1.5		18	0.9
Total				**3.45**	**138.7**	**22.6**

Location: Pulchowk Lagankhel Road section. (right side/week Day))
Survey Date: 2077/12/26

Section 1 (chainage 0+000 to 0+500)

Total length of road having footpath = 407m
Total length of footpath having acceptable height above top of carriageway= 295m
Total length of rise and drop along footpath= 47m

S N	Chainage		width of footpath (m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group.2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	0+000	0+020	1.5			0.25
2	0+020	0+040	1.5			0.7
3	0+040	0+060	2	0.7	12	0.4
4	0+060	0+080	2		11	1.3
5	0+080	0+100	2			0.7
6	0+100	0+120	2.2		4.6	1,2
7	0+120	0+140	2			0.35
8	0+140	0+160	2			0.35
9	0+160	0+180	2			0.6
10	0+180	0+200	2			0.5
11	0+200	0+220	2		4.3	0.65
12	0+220	0+240				
13	0+240	0+260	2	0.56		0.4
14	0+260	0+280	2		9	0.9
15	0+280	0+300	2		13	0.2
16	0+300	0+320	2			0.5
17	0+320	0+340	2			1.5
18	0+340	0+360	2		14	0.43
19	0+360	0+380				
20	0+380	0+400	2		7.2	0.8
21	0+400	0+420	2			0.8
22	0+420	0+440	2			2.4
23	0+440	0+460	1.5		17	1.5
24	0+460	0+480	2	0.85	12	1.2
25	0+480	0+500	1.75			0.75
Total				**2.11**	**104.1**	**17.18**

Section 2 (chainage 0+500 to 1+000)

Total length of road having footpath = 331m

Total length of footpath having acceptable height above carriageway= 190m

Total length of rise and drop along footpath= 28.5m

SN	Chainage		Width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group 2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	0+500	0+520	1.6	1		0.45
2	0+520	0+540	1.6			0.65
3	0+540	0+560	1.5			0.35
4	0+560	0+580	1.5		19	0.25
5	0+580	0+600	1.5			0.46
6	0+600	0+620	1.5			0.9
7	0+620	0+640	1.5			1.4
8	0+640	0+660	1.5	1.3	2	1.6
9	0+660	0+680	1.5			2.4
10	0+680	0+700	1.5			2.1
11	0+700	0+720	1.5		6.8	2.3
12	0+720	0+740	1.55			1.3
13	0+740	0+760	1.55			2.1
14	0+760	0+780				
15	0+780	0+800	1.6			1.9
16	0+800	0+820	1.45			1.45
17	0+820	0+840	0.9		17	1.6
18	0+840	0+860	1.5			1.45
19	0+860	0+880				
20	0+880	0+900	1.55			1.35
21	0+900	0+920	1.55		3.9	1.25
22	0+920	0+940	1.55		4.3	1.35
23	0+940	0+960	0.9	1.7	13	0.9
24	0+960	0+980	1.5		12	0.45
25	0+980	1+000	1.3			0.4
Total				**4**	**78**	**28.36**

Section 3 (chainage 1+000 to 1+500)

Total length of road having footpath = 457m

Total length of footpath having acceptable height above carriageway= 226m
Total length of rise and drop along footpath= 33m

SN	Chainage		Width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group 2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	1+000	1+020	1.5			0.6
2	1+020	1+040	1.4			0.5
3	1+040	1+060	1.5			0.8
4	1+060	1+080	1.5		14	0.2
5	1+080	1+100	1.5			1.5
6	1+100	1+120	1.5		3.7	1.6
7	1+120	1+140	1.5	3.2		1.7
8	1+140	1+160	1.5			1.6
9	1+160	1+180	1.5			3.2
10	1+180	1+200	1.5			4.4
11	1+200	1+220	1.5		15	5
12	1+220	1+240	1.55		12	3
13	1+240	1+260	1.55		17	1.2
14	1+260	1+280	1.5			
15	1+280	1+300	1.6			2.3
16	1+300	1+320	1.45			0.9
17	1+320	1+340	0.9		4.6	0.6
18	1+340	1+360	1.5	4.7		0.8
19	1+360	1+380	1.53			
20	1+380	1+400	1.55		19	0.9
21	1+400	1+420	1.55		9.3	1.2
22	1+420	1+440	1.55			1.3
23	1+440	1+460				
24	1+460	1+480	1.5			1.2
25	1+480	1+500	1.52			1.45
Total				7.9	94.6	35.95

Section 4 (chainage 1+500 to 2+000)

Total length of road having footpath = 325m

Total length of footpath having acceptable height above carriageway= 285m
Total length of rise and drop along footpath= 34m

SN	Chainage		Width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group.2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	1+500	1+520	1.4			0.35
2	1+520	1+540	1.4		8.2	0.8
3	1+540	1+560	1.35			0.55
4	1+560	1+580	1.5			0.4
5	1+580	1+600	1.5	2.1	7.3	0.6
6	1+600	1+620	1.5			1.2
7	1+620	1+640	1.5	3.7	16	0.3
8	1+640	1+660	1.5			0.35
9	1+660	1+680				
10	1+680	1+700	1.5			2.2
11	1+700	1+720	1.5			1.3
12	1+720	1+740	1.55			1.4
13	1+740	1+760	1.55		14	1.6
14	1+760	1+780	0.9		11	0.6
15	1+780	1+800	1.6			0.75
16	1+800	1+820	1.45			2.4
17	1+820	1+840	0.9			2.4
18	1+840	1+860	1.5			1.6
19	1+860	1+880	1.2			0.2
20	1+880	1+900	1.55		3.9	1.2
21	1+900	1+920				
22	1+920	1+940				
23	1+940	1+960				
24	1+960	1+980	1.2			0.8
25	1+980	2+000	1.5			0.9
Total				**5.8**	**60.4**	**21.9**

location: Pulchowk Lagankhel road section. (left side/ weekend)
length of footpath surveyed: 2KM
Section 1 (chainage 0+000 To 0+500)
Total length of road having footpath = 403m
Total length of footpath having acceptable height above top of carriageway= 298m
Total length of rise and drop along footpath= 27m

SN	Chainage		width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	0+000	0+020	3			
2	0+020	0+040	2.25			0.6
3	0+040	0+060	2	2		0.7
4	0+060	0+080	2	0.8		1.2
5	0+080	0+100				
6	0+100	0+120				
7	0+120	0+140	2			1.6
8	0+140	0+160	2			0.35
9	0+160	0+180	2			0.4
10	0+180	0+200	2			0.5
11	0+200	0+220	2			0.65
12	0+220	0+240	2			0.7
13	0+240	0+260	2			0.4
14	0+260	0+280	2			0.9
15	0+280	0+300	2			0.4
16	0+300	0+320				
17	0+320	0+340	2			0.5
18	0+340	0+360	2			0.43
19	0+360	0+380	2			0.4
20	0+380	0+400	2	0.9		1.6
21	0+400	0+420	2			1.6
22	0+420	0+440	2		2	2.4
23	0+440	0+460	1.5			1.5
24	0+460	0+480	2			1.2
25	0+480	0+500	1.95			0.9
Total				**3.7**	**2**	**18.93**

Section 2 (chainage 0+500 to 1+000)
Total length of road having footpath = 422m
Total length of footpath having acceptable height above carriageway= 288m
Total length of rise and drop along footpath= 28.5m

SN	Chainage		Width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group.2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	0+500	0+520	1.6			0.45
2	0+520	0+540	1.6			0.65
3	0+540	0+560	1.5			0.35
4	0+560	0+580	1.5			0.25
5	0+580	0+600	1.5			0.46
6	0+600	0+620	1.5			0.9
7	0+620	0+640	1.5			1.4
8	0+640	0+660	1.5	1.3		1.6
9	0+660	0+680	1.5			2.4
10	0+680	0+700	1.5			2.1
11	0+700	0+720	1.5			2.3
12	0+720	0+740	1.55			1.3
13	0+740	0+760	1.55			2.1
14	0+760	0+780				
15	0+780	0+800	1.6			1.9
16	0+800	0+820	1.45			1.45
17	0+820	0+840	0.9			1.6
18	0+840	0+860	1.5			1.45
19	0+860	0+880				
20	0+880	0+900	1.55			1.35
21	0+900	0+920	1.55			1.25
22	0+920	0+940	1.55			1.35
23	0+940	0+960	0.9	1.7		0.9
24	0+960	0+980	1.5			0.45
25	0+980	1+000	1.3			0.4
Total				**3**	**0**	**28.36**

Section 3 (chainage 1+000 to 1+500)
Total length of road having footpath = 397m
Total length of footpath having acceptable height above carriageway= 258m
Total length of rise and drop along footpath= 32m

SN	Chainage		Width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group.2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	1+000	1+020	1.45			0.9
2	1+020	1+040	1.4			0.5
3	1+040	1+060	1.5			0.8
4	1+060	1+080				
5	1+080	1+100	1.5			1.5
6	1+100	1+120	1.5			1.6
7	1+120	1+140	1.5			1.7
8	1+140	1+160	1.5			1.6
9	1+160	1+180	1.5			3.2
10	1+180	1+200	1.5			4.4
11	1+200	1+220	1.5		3.4	5
12	1+220	1+240	1.55	2.7		3
13	1+240	1+260	1.55			1.2
14	1+260	1+280				
15	1+280	1+300	1.6		2.3	2.3
16	1+300	1+320	1.45			0.9
17	1+320	1+340	0.9			0.6
18	1+340	1+360	1.5			0.8
19	1+360	1+380				
20	1+380	1+400	1.55			0.9
21	1+400	1+420	1.55	3.3		1.2
22	1+420	1+440	1.55	1.2		1.3
23	1+440	1+460	1.55			1.2
24	1+460	1+480	1.5			1.4
25	1+480	1+500	1.5			1.6
Total				**7.2**	**5.7**	**37.6**

Section 4 (chainage 1+500 to 2+000)
Total length of road having footpath = 291m
Total length of footpath having acceptable height above carriageway= 105m
Total length of rise and drop along footpath= 39m

SN	Chainage		Width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group.2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	1+500	1+520	1.5	0.3		0.6
2	1+520	1+540	1.4			0.4
3	1+540	1+560	1.5	0.9		0.55
4	1+560	1+580	1.5			0.4
5	1+580	1+600	1.5			0.6
6	1+600	1+620	1.5	1.7	6.3	1.2
7	1+620	1+640	1.5			
8	1+640	1+660	1.5			
9	1+660	1+680	1.5			0.9
10	1+680	1+700	1.5			2.2
11	1+700	1+720	1.5			1.3
12	1+720	1+740	1.55			1.4
13	1+740	1+760	1.55			1.6
14	1+760	1+780				
15	1+780	1+800	1.6			0.75
16	1+800	1+820	1.45			2.4
17	1+820	1+840	0.9			2.4
18	1+840	1+860	1.5			1.6
19	1+860	1+880				
20	1+880	1+900	1.55			1.2
21	1+900	1+920	1.55	0.55		1.4
22	1+920	1+940	1.55			0.8
23	1+940	1+960				
24	1+960	1+980				
25	1+980	2+000	1.5			0.9
Total				**3.45**	**6.3**	**22.6**

location: Pulchowk lagankhel Road section. (right side/weekend)
Survey Date: 2077/12/28
length of footpath surveyed: 2KM
Section 1 (chainage 0+000 to 0+500)
Total length of road having footpath = 407m
Total length of footpath having acceptable height above top of carriageway= 295m
Total length of rise and drop along footpath= 47

SN	Chainage		Width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group 2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	0+000	0+020	1.5			0.25
2	0+020	0+040	1.5			0.7
3	0+040	0+060	2			0.4
4	0+060	0+080	2		1.9	1.3
5	0+080	0+100	2			0.7
6	0+100	0+120	2.2			1,2
7	0+120	0+140	2			0.35
8	0+140	0+160	2			0.35
9	0+160	0+180	2			0.6
10	0+180	0+200	2		2.6	0.5
11	0+200	0+220	2			0.65
12	0+220	0+240				
13	0+240	0+260	2			0.4
14	0+260	0+280	2			0.9
15	0+280	0+300	2			0.2
16	0+300	0+320	2			0.5
17	0+320	0+340	2			1.5
18	0+340	0+360	2			0.43
19	0+360	0+380				
20	0+380	0+400	2			0.8
21	0+400	0+420	2			0.8
22	0+420	0+440	2			2.4
23	0+440	0+460	1.5			1.5
24	0+460	0+480	2	0.85		1.2
25	0+480	0+500	1.75			0.75
				0.85	**4.5**	**17.18**

Section 2 (chainage 0+500 to 1+000)

Total length of road having footpath = 331m

Total length of footpath having acceptable height above carriageway= 190m

Total length of rise and drop along footpath= 28.5m

SN	Chainage		Width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group.2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	0+500	0+520	1.6			0.45
2	0+520	0+540	1.6			0.65
3	0+540	0+560	1.5			0.35
4	0+560	0+580	1.5			0.25
5	0+580	0+600	1.5			0.46
6	0+600	0+620	1.5			0.9
7	0+620	0+640	1.5			1.4
8	0+640	0+660	1.5	1.3		1.6
9	0+660	0+680	1.5			2.4
10	0+680	0+700	1.5			2.1
11	0+700	0+720	1.5			2.3
12	0+720	0+740	1.55			1.3
13	0+740	0+760	1.55			2.1
14	0+760	0+780				
15	0+780	0+800	1.6			1.9
16	0+800	0+820	1.45			1.45
17	0+820	0+840	0.9			1.6
18	0+840	0+860	1.5			1.45
19	0+860	0+880				
20	0+880	0+900	1.55			1.35
21	0+900	0+920	1.55			1.25
22	0+920	0+940	1.55			1.35
23	0+940	0+960	0.9	1.7		0.9
24	0+960	0+980	1.5			0.45
25	0+980	1+000	1.3			0.4
Total				**3**	**0**	**28.36**

Section 3 (chainage 1+000 to 1+500)

Total length of road having footpath = 457m

Total length of footpath having acceptable height above carriageway= 226m

Total length of rise and drop along footpath= 34m

SN	Chainage		Width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	1+000	1+020	1.5			0.6
2	1+020	1+040	1.4			0.5
3	1+040	1+060	1.5			0.8
4	1+060	1+080	1.5			0.2
5	1+080	1+100	1.5			1.5
6	1+100	1+120	1.5			1.6
7	1+120	1+140	1.5	3.2		1.7
8	1+140	1+160	1.5			1.6
9	1+160	1+180	1.5			3.2
10	1+180	1+200	1.5			4.4
11	1+200	1+220	1.5			5
12	1+220	1+240	1.55			3
13	1+240	1+260	1.55			1.2
14	1+260	1+280	1.5	1.5		
15	1+280	1+300	1.6			2.3
16	1+300	1+320	1.45			0.9
17	1+320	1+340	0.9		4.6	0.6
18	1+340	1+360	1.5			0.8
19	1+360	1+380	1.53			
20	1+380	1+400	1.55			0.9
21	1+400	1+420	1.55			1.2
22	1+420	1+440	1.55			1.3
23	1+440	1+460				
24	1+460	1+480	1.5			1.2
25	1+480	1+500	1.52			1.45
Total				**4.7**	**4.6**	**35.95**

Section 4 (chainage 1+500 to 2+000)

Total length of road having footpath = 325m

Total length of footpath having acceptable height above carriageway= 285m

Total length of rise and drop along footpath= 34m

SN	Chainage		Width of footpath(m)	Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) length in(m)	Group.2 obstructions (parked vehicles, hawkers) Length in(m)	Group 3 obstructions (constructed urinals, trees, poles) Length in (m)
	From	To				
1	1+500	1+520	1.4			0.35
2	1+520	1+540	1.4			0.8
3	1+540	1+560	1.35			0.55
4	1+560	1+580	1.5			0.4
5	1+580	1+600	1.5	2.1		0.6
6	1+600	1+620	1.5			1.2
7	1+620	1+640	1.5	3.7		0.3
8	1+640	1+660	1.5			0.35
9	1+660	1+680				
10	1+680	1+700	1.5			2.2
11	1+700	1+720	1.5			1.3
12	1+720	1+740	1.55			1.4
13	1+740	1+760	1.55			1.6
14	1+760	1+780	0.9			0.6
15	1+780	1+800	1.6			0.75
16	1+800	1+820	1.45			2.4
17	1+820	1+840	0.9			2.4
18	1+840	1+860	1.5			1.6
19	1+860	1+880	1.2			0.2
20	1+880	1+900	1.55			1.2
21	1+900	1+920				
22	1+920	1+940				
23	1+940	1+960				
24	1+960	1+980	1.2			0.8
25	1+980	2+000	1.5			0.9
Total				**5.8**	**0**	**21.9**

APPENDIX E: Section wise summary of field survey data

Parameter	section 1 (0+000 to 0+500)		section 2 (0+500 to 1+000)		section 3 (1+000 to 1+500)		section 4 (1+500 To 2+000)	
	length(m)	proportion	length	proportion	length	proportion	length	Proportion
Road having footpath	403	0.81	422	0.84	397	0.79	291	0.58
Footpath having acceptable height above carriageway	298	0.596	288	0.576	258	0.516	105	0.21
Rise and drop along footpath	27	0.05	43	0.09	32	0.06	39	0.08
Group 1 obstructions (garbage, tree leaves, potholes, personal gardening)	6	0.01	5.8	0.01	7.2	0.01	3.45	0.01
Group 2 obstructions (parked vehicles, hawkers)	96	0.192	111.7	0.223	88.9	0.177	138.7	0.277
Group 3 obstructions (constructed urinals, trees, poles)	18.9	0.04	30.06	0.06	37.6	0.08	22.6	0.05

Left side (weekday)

Parameter	section 1 (0+000 t0 0+500)		section 2 (0+500 to 1+000)		section 3 (1+000 to 1+500)		section 4 (1+500 To 2+000)	
	length(m)	proportion	length	proportion	length	proportion	length	Proportion
Road having footpath	407	0.81	331	0.66	457	0.91	325	0.65
Footpath having acceptable height above carriageway	295	0.59	190	0.38	226	0.45	285	0.57
Rise and drop along footpath	47	0.09	28.5	0.06	33	0.07	34	0.07
Group 1 obstructions (garbage, tree leaves, potholes, personal gardening)	2.11	0.004	4	0.01	7.9	0.02	5.8	0.01
Group 2 obstructions (parked vehicles, hawkers)	104.1	0.208	78	0.156	94.6	0.189	160.4	0.320
Group 3 obstructions (constructed urinals, trees, poles)	17.18	0.03	28.36	0.06	35.95	0.07	21.9	0.04

Right side (weekday)

Parameter	section 1 (0+000 t0 0+500)		section 2 (0+500 to 1+000)		section 3 (1+000 to 1+500)		section 4 (1+500 To 2+000)	
	length(m)	proportion	length	proportion	length	proportion	length	Proportion
Road having footpath	403	0.81	422	0.84	397	0.79	291	0.58
Footpath having acceptable height above carriageway	298	0.596	288	0.576	258	0.516	105	0.21
Rise and drop along footpath	27	0.05	43	0.09	32	0.06	39	0.08
Group1 obstructions (garbage, tree leaves, potholes, personal gardening)	3.7	0.01	2	0	7.2	0.01	3.45	0.01
Group2 obstructions (parked vehicles, hawkers)	2	0	1.8	0	5.7	0.01	6.3	0.01
Group3 obstructions (constructed urinals, trees, poles)	18.9	0.04	30.06	0.06	37.6	0.08	22.6	0.05

Left side (weekend)

Parameter	section 1 (0+000 to 0+500)		section 2 (0+500 to 1+000)		section 3 (1+000 to 1+500)		section 4 (1+500 To 2+000)	
	length(m)	proportion	length	proportion	length	proportion	length	Proportion
Road having footpath	407	0.81	331	0.66	457	0.91	325	0.65
Footpath having acceptable height above carriageway	295	0.59	190	0.38	226	0.45	285	0.57
Rise and drop along footpath	47	0.09	28.5	0.06	33	0.07	34	0.07
Group 1 obstructions (garbage, tree leaves, potholes, personal gardening)	0.85	0.002	3	0.01	4.7	0.01	5.8	0.01
Group 2 obstructions (parked vehicles, hawkers)	4.5	0.01	0	0	4.6	0.01	0	0.00
Group 3 obstructions (constructed urinals, trees, poles)	17.18	0.03	28.36	0.06	35.95	0.07	21.9	0.04

Right side (weekend)

APPENDIX F: Summary of field survey data for whole length 2km

Parameter	Left side (week Day)		Right side (week Day)		Left side (weekend)		Right side (weekend)	
	length(m)	proportion	length	proportion	length	proportion	length	proportion
Road having footpath	1513	0.756	1520	0.76	1513	0.756	1520	0.76
Footpath having acceptable height above carriageway	949	0.474	996	0.498	949	0.474	996	0.498
Rise and drop along footpath	141	0.07	142.5	0.07	141	0.07	142.5	0.07
Group 1 obstructions (garbage, tree, leaves, potholes, personal gardening)	22.45	0.01	19.81	0.01	16.35	0.01	14.35	0.01
Group2 obstructions (parked vehicles, hawkers)	435.3	0.217	337.1	0.168	15.8	0.01	9.1	0.005
Group 3 obstructions (constructed urinals, trees, poles)	109.2	0.05	103.39	0.05	109.2	0.05	103.4	0.05

APPENDIX G: Sample questionnaire

Sample of Filled Questionnaire Survey Form

Factors	More	Less	Equal
A over B			
A over C			
A over D			
A over E			
A over F			
B over C			
B over D			
B over E			
B over F			
C over D			
C over E			
C over F			
D over E			
D over F			
E over F			

The above mentioned Letters A, B, C, D, E, F indicates following parameters

Letter	Parameter
A	Percentage of road length having foot path (%)
B	Percentage of road length having acceptable height (15 cm or more above the top of carriageway)
C	percentage of rise and drop along footpath length or discontinuities along the linear path due to private , public entrances , topography etc.
D	Percentage of road length having Group 1 obstructions (garbage, tree leaves, potholes, personal gardening) (%)
E	Percentage of road length having Group 2 obstructions (parked vehicles, hawkers) (%)
F	Percentage of road length having Group 3 obstructions (constructed urinals, trees, poles) (%)

APPENDIX H: Score of all parameter for single respondent

Factors	More	Less	Equal	Parameter score
A over B	1			A= 5 B= 3 C=3 D=0.5 E=0.5 F= 3
A over C	1			
A over D	1			
A over E	1			
A over F	1			
B over C			0.5	
B over D	1			
B over E	1			
B over F			0.5	
C over D	1			
C over E	1			
C over F			0.5	
D over E			0.5	
D over F		1		
E over F		1		

APPENDIX I: Weightage of each parameter from questionnaire data

Respondent No	Score					
	A	**B**	**C**	**D**	**E**	**F**
1	5	3	3	0.5	0.5	3
2	4	4	3	2	1	1
3	4	2	2	2	3	2
4	4	3	4	1	2	1
5	5	0.5	0.5	3	3	3
6	4	4	3	0.5	1	2.5
7	5	3	3	2	1	1
8	5	2	1	2	3	2
9	5	4	2	1	2	1
10	4	5	2	2	1	1
11	4	2	2	2	3	2
12	4	4	3	1	2	1
13	5	0.5	0.5	3	3	3
14	4	4	3	0.5	1	2.5
15	5	3	3	2	1	1
16	5	1	2	2	3	2
17	5	2	4	1	2	1
18	5	0.5	0.5	3	3	3
19	4	3	4	0.5	1	2.5
20	5	3	3	2	1	1
21	5	2	1	2	3	2
22	5	3	3	0.5	0.5	3
23	4	4	3	2	1	1
24	4	2	2	2	3	2
25	4	3	4	1	2	1
26	5	0.5	0.5	3	3	3
27	4	4	3	0.5	1	2.5

Respondent No	Score					
	A	B	C	D	E	F
28	5	3	3	2	1	1
29	5	1	2	2	3	2
30	5	2	4	1	2	1
31	4	4	3	2	1	1
32	4	2	2	2	3	2
33	4	3	4	1	2	1
34	5	0.5	0.5	3	3	3
35	4	4	3	0.5	1	2.5
36	5	3	3	2	1	1
37	5	1	2	2	3	2
38	5	2	4	1	2	1
39	5	0.5	0.5	3	3	3
40	4	4	3	0.5	1	2.5
41	5	3	3	2	1	1
42	5	1	2	2	3	2
43	5	3	3	0.5	0.5	3
44	4	4	3	2	1	1
45	4	2	2	2	3	2
46	4	3	4	1	2	1
47	5	0.5	0.5	3	3	3
48	4	4	3	0.5	1	2.5
49	5	3	3	2	1	1
50	5	1	2	2	3	2
51	5	2	4	1	2	1
52	4	4	3	2	1	1
53	4	2	2	2	3	2
54	4	3	4	1	2	1
55	5	0.5	0.5	3	3	3
56	4	4	3	0.5	1	2.5
57	5	3	3	2	1	1
58	5	1	2	2	3	2

Respondent No	Score					
	A	B	C	D	E	F
59	5	2	4	1	2	1
60	5	0.5	0.5	3	3	3
61	4	4	3	0.5	1	2.5
62	5	3	3	2	1	1
63	5	1	2	2	3	2
64	5	3	3	0.5	0.5	3
65	4	4	3	2	1	1
66	4	2	2	2	3	2
67	4	3	4	1	2	1
68	5	0.5	0.5	3	3	3
69	4	4	3	0.5	1	2.5
70	5	3	3	2	1	1
71	5	1	2	2	3	2
72	5	2	4	1	2	1
73	4	4	3	2	1	1
74	4	2	2	2	3	2
75	4	3	4	1	2	1
76	5	0.5	0.5	3	3	3
77	4	4	3	0.5	1	2.5
78	5	3	3	2	1	1
79	5	1	2	2	3	2
80	5	2	4	1	2	1
81	5	0.5	0.5	3	3	3
82	4	4	3	0.5	1	2.5
83	5	3	3	2	1	1
84	5	1	2	2	3	2
85	5	3	3	0.5	0.5	3
86	4	4	3	2	1	1
87	4	2	2	2	3	2
88	4	3	4	1	2	1
89	5	0.5	0.5	3	3	3

Respondent No	Score					
	A	B	C	D	E	F
90	4	4	3	0.5	1	2.5
91	5	3	3	2	1	1
92	5	1	2	2	3	2
93	5	2	4	1	2	1
94	4	4	3	2	1	1
95	4	2	2	2	3	2
96	4	3	4	1	2	1
97	5	0.5	0.5	3	3	3
98	4	4	3	0.5	1	2.5
99	5	3	3	2	1	1
100	5	1	2	2	3	2
101	5	2	4	1	2	1
102	5	0.5	0.5	3	3	3
103	4	4	3	0.5	1	2.5
104	5	3	3	2	1	1
105	5	1	2	2	3	2
106	5	3	3	0.5	0.5	3
107	4	4	3	2	1	1
108	4	2	2	2	3	2
109	4	3	4	1	2	1
110	5	0.5	0.5	3	3	3
111	4	4	3	0.5	1	2.5
112	5	3	3	2	1	1
113	5	1	2	2	3	2
114	5	2	4	1	2	1
115	4	4	3	2	1	1
116	4	2	2	2	3	2
117	4	3	4	1	2	1
118	5	0.5	0.5	3	3	3
119	4	4	3	0.5	1	2.5
120	5	3	3	2	1	1

Respondent No	Score					
	A	B	C	D	E	F
121	5	1	2	2	3	2
122	5	2	4	1	2	1
123	5	0.5	0.5	3	3	3
124	4	4	3	0.5	1	2.5
125	5	3	3	2	1	1
126	5	1	2	2	3	2
127	5	3	3	0.5	0.5	3
128	4	4	3	2	1	1
129	4	2	2	2	3	2
130	4	3	4	1	2	1
131	5	0.5	0.5	3	3	3
132	4	4	3	0.5	1	2.5
133	5	3	3	2	1	1
134	5	1	2	2	3	2
135	5	2	4	1	2	1
136	4	4	3	2	1	1
137	4	2	2	2	3	2
138	4	3	4	1	2	1
139	5	0.5	0.5	3	3	3
140	4	4	3	0.5	1	2.5
141	5	3	3	2	1	1
142	5	1	2	2	3	2
143	5	2	4	1	2	1
144	5	0.5	0.5	3	3	3
145	4	4	3	0.5	1	2.5
146	5	3	3	2	1	1
147	5	1	2	2	3	2
148	5	3	3	0.5	0.5	3
149	4	4	3	2	1	1
150	4	2	2	2	3	2
151	4	3	4	1	2	1

Respondent No	Score					
	A	B	C	D	E	F
152	5	0.5	0.5	3	3	3
153	4	4	3	0.5	1	2.5
154	5	3	3	2	1	1
155	5	1	2	2	3	2
156	5	2	4	1	2	1
157	4	4	3	2	1	1
158	4	2	2	2	3	2
159	4	3	4	1	2	1
160	5	0.5	0.5	3	3	3
161	4	4	3	0.5	1	2.5
162	5	3	3	2	1	1
163	5	1	2	2	3	2
164	5	2	4	1	2	1
165	5	0.5	0.5	3	3	3
166	4	4	3	0.5	1	2.5
167	5	3	3	2	1	1
168	5	1	2	2	3	2
169	5	3	3	0.5	0.5	3
170	4	4	3	2	1	1
171	4	2	2	2	3	2
172	4	3	4	1	2	1
173	5	0.5	0.5	3	3	3
174	4	4	3	0.5	1	2.5
175	5	3	3	2	1	1
176	5	1	2	2	3	2
177	5	2	4	1	2	1
178	4	4	3	2	1	1
179	4	2	2	2	3	2
180	4	3	4	1	2	1
181	5	0.5	0.5	3	3	3
182	4	4	3	0.5	1	2.5

Respondent No	Score					
	A	B	C	D	E	F
183	5	3	3	2	1	1
184	5	1	2	2	3	2
185	5	2	4	1	2	1
186	5	0.5	0.5	3	3	3
187	4	4	3	0.5	1	2.5
188	5	3	3	2	1	1
189	5	1	2	2	3	2
190	5	3	3	0.5	0.5	3
191	4	4	3	2	1	1
192	4	2	2	2	3	2
193	4	3	4	1	2	1
194	5	0.5	0.5	3	3	3
195	4	4	3	0.5	1	2.5
196	5	3	3	2	1	1
197	5	1	2	2	3	2
198	5	2	4	1	2	1
199	4	4	3	2	1	1
200	4	2	2	2	3	2
201	4	3	4	1	2	1
202	5	0.5	0.5	3	3	3
203	4	4	3	0.5	1	2.5
204	5	3	3	2	1	1
205	5	1	2	2	3	2
206	5	2	4	1	2	1
207	5	0.5	0.5	3	3	3
208	4	4	3	0.5	1	2.5
209	5	3	3	2	1	1
210	5	1	2	2	3	2
211	5	3	3	0.5	0.5	3
212	4	4	3	2	1	1
213	4	2	2	2	3	2

Respondent No	Score					
	A	B	C	D	E	F
214	4	3	4	1	2	1
215	5	0.5	0.5	3	3	3
216	4	4	3	0.5	1	2.5
217	5	3	3	2	1	1
218	5	1	2	2	3	2
219	5	2	4	1	2	1
220	4	4	3	2	1	1
221	4	2	2	2	3	2
222	4	3	4	1	2	1
223	5	0.5	0.5	3	3	3
224	4	4	3	0.5	1	2.5
225	5	3	3	2	1	1
226	5	1	2	2	3	2
227	5	2	4	1	2	1
228	5	0.5	0.5	3	3	3
229	4	4	3	0.5	1	2.5
230	5	3	3	2	1	1
231	5	1	2	2	3	2
232	5	3	3	0.5	0.5	3
233	4	4	3	2	1	1
234	4	2	2	2	3	2
235	4	3	4	1	2	1
236	5	0.5	0.5	3	3	3
237	4	4	3	0.5	1	2.5
238	5	3	3	2	1	1
239	5	1	2	2	3	2
240	5	2	4	1	2	1
241	4	4	3	2	1	1
242	4	2	2	2	3	2
243	4	3	4	1	2	1
244	5	0.5	0.5	3	3	3

Respondent No	Score					
	A	B	C	D	E	F
245	4	4	3	0.5	1	2.5
246	5	3	3	2	1	1
247	5	1	2	2	3	2
248	5	2	4	1	2	1
249	5	0.5	0.5	3	3	3
250	4	4	3	0.5	1	2.5
251	5	3	3	2	1	1
252	5	1	2	2	3	2
253	5	3	3	0.5	0.5	3
254	4	4	3	2	1	1
255	4	2	2	2	3	2
256	4	3	4	1	2	1
257	5	0.5	0.5	3	3	3
258	4	4	3	0.5	1	2.5
259	5	3	3	2	1	1
260	5	1	2	2	3	2
261	5	2	4	1	2	1
262	4	4	3	2	1	1
263	4	2	2	2	3	2
264	4	3	4	1	2	1
265	5	0.5	0.5	3	3	3
266	4	4	3	0.5	1	2.5
267	5	4	1	2	0	3
268	5	4	1	2	0	3
269	5	4	1	2	0	3
270	5	4	1	2	0	3
271	5	4	1	2	0	3
272	5	4	1	2	0	3
273	5	4	1	2	0	3
274	5	4	1	2	0	3
275	5	4	1	2	0	3

Respondent No	Score					
	A	B	C	D	E	F
276	5	4	1	2	0	3
277	5	4	1	2	0	3
278	5	4	1	2	0	3
279	5	4	1	2	0	3
280	5	4	1	2	0	3
281	5	1	2	2	3	2
282	5	2	4	1	2	1
283	4	4	3	2	1	1
284	4	2	2	2	3	2
285	4	3	4	1	2	1
286	5	0.5	0.5	3	3	3
287	4	4	3	0.5	1	2.5
288	5	3	3	2	1	1
289	5	1	2	2	3	2
290	5	2	4	1	2	1
291	5	0.5	0.5	3	3	3
292	4	4	3	0.5	1	2.5
293	5	3	3	2	1	1
294	5	1	2	2	3	2
295	5	3	3	0.5	0.5	3
296	4	4	3	2	1	1
297	4	2	2	2	3	2
298	4	3	4	1	2	1
299	5	0.5	0.5	3	3	3
300	4	4	3	0.5	1	2.5
301	5	3	3	2	1	1
302	5	1	2	2	3	2
303	5	2	4	1	2	1
304	4	4	3	2	1	1
305	4	2	2	2	3	2
306	4	3	4	1	2	1

Respondent No	Score					
	A	**B**	**C**	**D**	**E**	**F**
307	5	0.5	0.5	3	3	3
308	4	4	3	0.5	1	2.5
309	5	3	3	2	1	1
310	5	1	2	2	3	2
311	5	2	4	1	2	1
312	5	0.5	0.5	3	3	3
313	4	4	3	0.5	1	2.5
314	5	3	3	2	1	1
315	5	1	2	2	3	2
316	5	3	3	0.5	0.5	3
317	4	4	3	2	1	1
318	4	2	2	2	3	2
319	4	3	4	1	2	1
320	5	0.5	0.5	3	3	3
321	4	4	3	0.5	1	2.5
322	5	3	3	2	1	1
323	5	1	2	2	3	2
324	5	2	4	1	2	1
325	4	4	3	2	1	1
326	4	2	2	2	3	2
327	4	3	4	1	2	1
328	5	0.5	0.5	3	3	3
329	4	4	3	0.5	1	2.5
330	5	3	3	2	1	1
331	5	1	2	2	3	2
332	5	2	4	1	2	1
333	5	0.5	0.5	3	3	3
334	4	4	3	0.5	1	2.5
335	5	3	3	2	1	1
336	5	1	2	2	3	2
337	5	3	3	0.5	0.5	3

Respondent No	Score					
	A	B	C	D	E	F
338	4	4	3	2	1	1
339	4	2	2	2	3	2
340	4	3	4	1	2	1
341	5	0.5	0.5	3	3	3
342	4	4	3	0.5	1	2.5
343	5	3	3	2	1	1
344	5	1	2	2	3	2
345	5	2	4	1	2	1
346	4	4	3	2	1	1
347	4	2	2	2	3	2
348	4	3	4	1	2	1
349	5	0.5	0.5	3	3	3
350	4	4	3	0.5	1	2.5
351	5	3	3	2	1	1
352	5	1	2	2	3	2
353	5	2	4	1	2	1
354	5	0.5	0.5	3	3	3
355	4	4	3	0.5	1	2.5
356	5	3	3	2	1	1
357	5	1	2	2	3	2
358	5	3	3	0.5	0.5	3
359	4	4	3	2	1	1
360	4	2	2	2	3	2
361	4	3	4	1	2	1
362	5	0.5	0.5	3	3	3
363	4	4	3	0.5	1	2.5
364	5	3	3	2	1	1
365	5	1	2	2	3	2
366	5	2	4	1	2	1
367	4	4	3	2	1	1
368	4	2	2	2	3	2
369	4	3	4	1	2	1

Respondent No	Score					
	A	B	C	D	E	F
370	5	0.5	0.5	3	3	3
371	4	4	3	0.5	1	2.5
372	5	3	3	2	1	1
373	5	1	2	2	3	2
374	5	2	4	1	2	1
375	5	0.5	0.5	3	3	3
376	4	5	1	0.5	1	3.5
377	5	3	0.5	2	1	3.5
378	5	1	1	2	3	3
379	5	3	0.5	1	1.5	4
380	4	4	1	2	1	3
381	4	2	0.5	2	3	3.5
382	4	3	4	1	2	1
383	5	1.5	0.5	3	1	4
384	4	4	3	0.5	1	2.5
385	5	4	1	2	0	3
386	5	4	1	2	0	3
387	5	4	1	2	0	3
388	4	2	2	2	3	2
389	4	5	2	2	1	1
390	4	3	1	2	3	2
391	4	3	4	1	2	1
392	5	0.5	0.5	3	3	3
393	4	4	3	0.5	1	2.5
394	5	3	3	2	0	2
395	5	1	2	2	3	2
396	5	2	4	1	2	1
397	4	3	1	2	0	3
398	4	4	3	1	2	1
Total	**1822**	**997**	**986.5**	**668.5**	**733**	**761**
Weigtage	**0.305**	**0.167**	**0.165**	**0.112**	**0.123**	**0.128**

APPENDIX J: Footpath condition Photograph

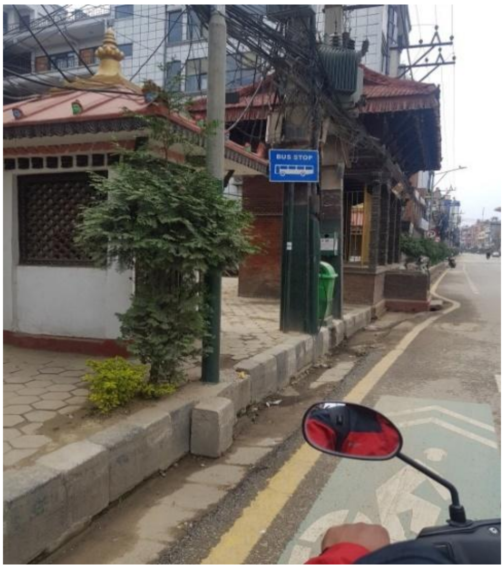
footpath section at chainage 0+200 to chainage 0+300 and chainage 0+400 to chainage 0+500 (left side)

footpath section at chainage 1+600 to chainage 1+700 and 0+000 to chainage 0+800

(left side)

Footpath section at chainage 0+500 to chainage 0+600 and chainage 1+500 to chainage 1+550 (right side)

Footpath section at chainage 1+300 to chainage 1+400 (left side)



Footpath section at chainage 1+200 to chainage 1+300 and chainage 1+880 to chainage 1+980 (right side)