Investigating the Attributes Influencing Pedestrian Behaviour of Commuters for Enhancing Accessibility of Metro Stations:

A Case Study of Delhi,



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Background



- India had a three-fold growth in the number of cities between 1961 and 2011, a five-fold increase in population, and a 200-fold increase in the number of vehicles (CSE, 2013). Delhi had the highest percentage of people who drove vehicles among any Indian city.
- In India, the share of urban trips via public transportation is directly related to the size of a city.
 In larger cities, the average share of commuting by public transportation will be higher. A strong correlation is seen between urbanization & increased demand for public transportation.
- □ A good public transportation system allows commuters to take multiple trips and cover larger distances in a day, thus increasing the load of this system. An integrated and multi-dimensional approach needs to be prepared and implemented to make the metro system more efficient and utilize its full potential.
- □ The present study focuses on understanding the pedestrian behaviour of commuters to improve the overall accessibility of metro station areas.





Existing modal split in Indian cities as a % of total trips (Source: MoUT, Gol, 2010)



Chandni Chowk Redevelopment Project (Source: images.newindianexpress.com, 2021)





Introduction



Need of the Study

- 1) Metro stations in Indian cities are primarily navigated by foot. Access area planning ensures improved accessibility to metro stations, eventually increasing public transport ridership and mitigating pollution.
- 2) Metro station areas being developed are largely unplanned and having inadequate infrastructure due to lack of focus areas, public funding, and inter-departmental coordination in station area development
- 3) The need arises to study various attributes which the commuters perceive to be important in enhancing the overall accessibility of metro station areas by walking
- 4) The study focuses on addressing the issues of first and last mile connectivity to achieve an ease of walking through spatial planning

Objectives

- 1) To identify attributes influencing walkability in station access area through a field survey
- 2) To assess the existing condition of pedestrian infrastructure and facilities within the study area in terms of users' satisfaction
- 3) To evaluate the performance of pedestrian infrastructure for the two selected stations (Saket and Vishwavidyalaya metro stations) of Delhi Metro Rail Transit System
- 4) To investigate the importance of attributes in enhancing the overall accessibility of metro stations with similar land use and urban conditions in Indian cities

Scope

- 1) The scope of this study includes pedestrian infrastructure and facilities
- 2) It will encompass metro stations on the Yellow line of Delhi Metro with a single line passing through them
- Delineation of the station access area involves a buffer zone of 500m around the selected metro stations



(Source: bsmedia.business-standard.com)



Share of cyclists and pedestrians in road accidents







Methodology





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Literature Review



- □ In order to understand the nature of travel characteristics of a daily commuter, certain key indicators help to understand access-egress of the users (Goel and Tiwari).
- □ Station area design, connectivity, and platform accessibility play crucial roles (Saygaonkar, Swami and Parida).
- □ For commuters accessing the metro station on foot, understanding the condition of footpaths and associated pedestrian facilities would be taken up for consideration (Mandal).
- Policy plays a critical role in enhancing access environment (Gupta, Bivina and Parida). Land cover change pattern in context of development of MRTS shall serve as critical indicators for planning metro expansions (Ahmad, Avtar, Sethi and Surjan).
- Transit Oriented Development (TOD) could encourage people to live and consume near transit station areas through walking and cycling; giving way to more sustainable mobility (Pengjun and Shengxiao). A scientific approach influencing commuter's decision may assist in understanding user perception better (Panchala, Majumdara, Rama and Basu).
- □ Shared Automated Vehicles may be an attractive way to experience first-mile last-mile (FMLM) connections (Huang, Kockelman, Garikapati, Zhu and Young).
- □ The physical imposition of the metro edifice on Delhi's landscape has led to creation of a new cultural geography. Spatial imaginaries experienced by individual riders will play an important role in metro expansion eventually (Sadana).
- □ The literature review suggests some crucial research gaps which need to be addressed through further research. Most of the authors have selected the same interchange stations with multiple lines passing, possibly due to the availability of data.







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Study Area



- □ Candidate station areas lie within the administrative boundary of NCT of Delhi; have varied land use distribution; high ridership and development potential; and have distinct quality and identity
- □ Vishwavidyalaya Predominantly institutional area due to Delhi University
- □ Saket Predominantly residential area with unique characteristics of having planned and unplanned areas, along with the upcoming mixed use and commercial streets



Delhi Metro Rail Network (Source: DMRC)



Delhi metro stations with buffer zones (Source: MPD 2041)



Vishwavidyalaya Metro Station Area







Station Area Profile



Existing Shared travel mode services and Road amenities in the influence area of the selected metro stations













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Issues related to Accessibility of Delhi Metro Stations

Reconnaissance survey of the station area was conducted to identify gaps in the existing pedestrian facilities



1. Stray animals causing public health concern

2. Manhole obstructing tactile paving



3. Transformers, vehicles, street vendors as barriers

4. Street vendor encroaching pathway



Footpath with many obstructions

6. Informal establishments encroaching pathways







Saket station area 1. Discontinuous



3. Encroach pedestrian pathways; Absence of tactile paving

4. Encroached footpaths creating conflicts



6. Dead building frontages and visually poor urban edge







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Data Analysis - Demography









Data Analysis - Travel Behaviour







Data Analysis - Accessibility





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Analysis of Importance and Satisfaction Attributes

S NO	ATTRIBUTES	IMPORTANCE		SATISFACTION		
5.NO.		MEAN	SD	MEAN	SD	QUADRANT
1	INFRASTRUCTURE	3.66	1.519	2.93	1.396	Quadrant-A
1.1	Wide footpaths	3.79	1.381	2.80	1.332	Quadrant-A
1.2	Continuity of footpaths	3.58	1.518	2.70	1.289	Quadrant-A
1.3	Good surface quality of footpaths	3.77	1.490	2.80	1.332	Quadrant-A
1.4	Universal design and accessibility	3.50	1.684	3.42	1.629	Quadrant-B
2	PUBLIC AMENITIES	3.22	1.469	2.73	1.241	Quadrant-A
2.1	Street furniture	2.46	1.336	2.49	1.090	Quadrant-D
2.2	Toilet facilities	3.27	1.448	2.43	1.306	Quadrant-A
2.3	Food & Beverage shops	2.22	1.271	2.90	1.078	Quadrant-D
2.4	Encroachment-free footpaths	3.42	1.629	2.47	1.318	Quadrant-A
2.5	Footpaths free from stray animals	3.86	1.688	2.29	1.326	Quadrant-A
2.6	Proximity to nearest metro station	4.07	1.443	3.81	1.329	Quadrant-B
3	SAFETY AND SECURITY	3.95	1.538	2.62	1.272	Quadrant-A
3.1	Adequate street lighting	4.26	1.402	2.86	1.379	Quadrant-A
3.2	Wayfinding/ signages	3.63	1.641	2.79	1.399	Quadrant-A
3.3	Crossing facilities on roads	4.11	1.448	2.93	1.165	Quadrant-A
3.4	Slow speed of motorized vehicles	3.81	1.587	2.13	1.068	Quadrant-A
3.5	Street surveillance	3.96	1.612	2.41	1.352	Quadrant-A
4	COMFORTABLE ENVIRONMENT	3.59	1.461	2.27	1.147	Quadrant-A
4.1	Shaded pathways	3.25	1.418	2.49	1.280	Quadrant-A
4.2	Cleanliness	3.95	1.418	2.36	1.157	Quadrant-A
4.3	Good air quality	3.83	1.458	1.86	0.936	Quadrant-A
4.4	Less noise	3.41	1.433	2.19	1.126	Quadrant-A
4.5	Good ambience	3.53	1.577	2.45	1.239	Quadrant-A
5	BUILT ENVIRONMENT	2.43	1.268	2.92	0.852	Quadrant-D
5.1	Building frontage and aesthetics	2.06	1.116	2.83	0.881	Quadrant-D
5.2	Building height	2.35	1.259	3.05	0.781	Quadrant-C
5.3	Building setback	2.87	1.429	2.89	0.893	Quadrant-D

Means for Importance and Satisfaction Attributes

S.NO.	ATTRIBUTES	IMPOR	TANCE	SATISFACTION	
		MEAN	RANK	MEAN	RANK
1	Infrastructure	3.66	2	2.93	1
2	Public Amenities	3.22	4	2.73	2
3	Safety and Security	3.95	1	2.62	3
4	Comfortable Environment	3.59	3	2.27	4
5	Built Environment	2.43	5	2.92	1

Mean for attributes of importance is higher than satisfaction. Overall importance and satisfaction values show that commuters are dissatisfied with existing pedestrian facilities.







Locating each attribute of Walking in Importance-Satisfaction Analysis (ISA) Matrix







Station Area Inventory Data



- □ Attributes requiring more concentration (high importance rate but less satisfaction rate) Physical infrastructure, public amenities, safety and security, and comfortable environment
- □ Attributes lying in low priority zone (less importance rate and less satisfaction rate) Built environment

S.NO.	ATTRIBUTES	MEAN		
		IMPORTANCE	SATISFACTION	QUADRANT
1	Infrastructure	3.66	2.93	A
2	Public Amenities	3.22	2.73	A
3	Safety and Security	3.95	2.62	A
4	Comfortable Environment	3.59	2.27	A
5	Built Environment	2.43	2.92	D



SUB - ATTRIBUTES					
CONTINUITY	FRONTAGE	STREETLIGH			
	FREE SURVEI				
Y UNA	CROSSING	H SETBACK OF			
	PATH WISTH				
G STREET S FURNITURE	CLEANLINES				
TOILETS AIR OUA	BUILDING T. THEYGHT				
v·		Y N			

S.NO.	STATION NAME	SAKET	VISHWAVIDYALAYA				
GENERAL ATTRIBUTES							
1	Platform Accessibility	Satisfied	Good				
2	Access Routes Facilities	Poor	Satisfied				
3	Feeder Connectivity	Satisfied	Good				
4	Parking Facilities	Satisfied	Satisfied				
5	City Connectivity	Good	Good				
PEDESTRIAN ATTRIBUTES							
1	Physical Infrastructure	Satisfied	Good				
2	Public Amenities	Satisfied	Satisfied				
3	Safety and Security	Poor	Good				
4	Comfort and Ambience	Poor	Good				
5	Built Environment	Satisfied	Good				





Conclusion









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Thank you!

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