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Public Transport Accessibility Analysis in Ahmedabad Metro

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Abstract - This paper presents a rigorous analysis of the realized accessibility of the Ahmedabad Metro Rail System (Phase I & II, covering over 40 km operational network) against its strategic goal of substantially increasing public transport mode share. Employing a framework that assesses both Objective Accessibility (time, frequency) and the operational efficiency of Multi-Modal Integration (MMI), the research identifies a critical accessibility-ridership paradox.

Quantifiable data reveals a significant failure to meet core operational standards: current realized headways of approximately 15 minutes across the main corridors fall drastically short of the planned Detailed Project Report (DPR) targets (2.5–5 minutes), severely eroding the system's time-based competitive advantage. This deficiency is compounded by systemic failures in MMI implementation. Key barriers include critical infrastructure deficits (lack of secure park-and-ride facilities) and structural planning errors, such as the remote location of the GIFT City terminal station, which requires costly correctional projects. Crucially, the unreliability of the last-mile network, particularly the slow and frequently diverted AMTS feeder services, introduces high uncertainty and friction for daily commuters.

These constraints result in low daily ridership (averaging 1.18 lakh passengers) and establish a negative feedback loop: low realized accessibility justifies conservative, low-frequency service, preventing the system from attaining its strategic mobility and congestion relief goals. The paper concludes by urging the Unified Metropolitan Transport Authority (UMTA) to prioritize immediate operational scaling (increasing peak frequency to a minimum of seven minutes) and to enforce seamless integration through the immediate implementation of a common ticket slab and a mandate for guaranteed feeder service reliability.

1.INTRODUCTION - Context, Definition, and Objectives

The Ahmedabad Metro Rail Project (Phase I & II, total 68 km planned) is a strategic investment intended to address urban mobility, aiming to increase the public transport mode share from 15% to 40%. This analysis evaluates the system's **realized accessibility**, which is defined by a dual framework: **Objective Accessibility** (quantifiable metrics like time and frequency) and **Perceived Accessibility** (user subjective experiences, including convenience and reliability) . The success of this high-capacity rail backbone depends fundamentally on seamless Multi-Modal Integration (MMI) and efficient last-mile connectivity.

The primary objective is to rigorously analyze the critical constraints hindering the system's operational and integration potential, which serves high-density residential zones (East: 234 pph) and key employment corridors (West and Gandhinagar).[4] Methodologies like the Public Transport Accessibility Level (PTAL) and the Two-Step Floating Catchment Area (2SFCA) [6] are the standard for quantifying spatial access in multi-modal Indian city contexts.

2. Network Status and Operational Accessibility Gaps

The Ahmedabad Metro network, overseen by GMRC, comprises substantially operational East–West and North–South lines (Phase I: 40.03 km) and partially operational regional extensions (Phase II: 22.7 km operational 11). Despite connecting high-demand zones such as major universities and the financial hub of GIFT City , the system faces major operational deficiencies that erode time-based accessibility.

2.1 Frequency and Time-of-Day Constraints

The system's engineered capacity is significantly underutilized. The Detailed Project Report (DPR) projected peak headways of 2.5–5 minutes for the core lines.12 However, the current realized operational frequency across the main

corridors is approximately 15 minutes.14 This substantial difference imposes a high waiting time penalty (average 7.5 minutes), sharply diminishing the metro's competitive advantage over private vehicles.

Time-of-day accessibility is severely restricted on the Phase II extension linking Ahmedabad to Gandhinagar. This regional line operates on a narrow schedule, with the first train departing Motera at 8:11 AM and the last train departing Sachivalaya at 7:46 PM, offering only 28 daily trips . This limited service window compromises the metro's role as a regional connector for workers outside traditional office hours.

2.2 Economic Accessibility

Economic accessibility is well-managed: the fare structure is affordable (Rs 5 to Rs 40), and technological measures, including the adoption of the National Common Mobility Card (NCMC) , enhance convenience. Both the GMRC Smart Card (CSC) and the NCMC offer a 10% discount upon completion of the journey.

Table 4.1: Ahmedabad Metro Operational Service Parameters and Accessibility Constraints

Corridor	Operational Length (km)	DPR Peak Headway Target (min)	Current Operational Headway (min)	Operating Hours (Core)	Accessibility Constraint
East–West Line (Phase I)	~21.16	2.5–5 [12]	~15 [14]	06:20 AM – 10:05 PM	Low operational frequency erodes time efficiency.
North–South Line (Phase I)	~18.87	2.5–5 [12]	~15 [14]	06:20 AM – 10:09 PM	Low frequency fails to meet projected capacity needs.
Phase II (Regional Extension)	22.7 [11]	N/A	Highly Restricted	8:11 AM – 7:46 PM	Limited service window restricts regional utility.

3. Multi-Modal Integration (MMI) and Last-Mile Deficiencies

The true barrier to high ridership lies in the failure of MMI implementation, which introduces significant friction into the door-to-door journey.

3.1 Structural and Physical Failures

- **Last-Mile Walkability Failure (GIFT City):** The original GIFT City terminal station was built physically remote from the core office district, requiring extensive shuttle services.[17] This structural misalignment confirms a critical lapse in planning for **walkable accessibility** and necessitates the construction of two new stations inside the central business district to correct the flaw.[17]

- **Infrastructure Deficit:** Despite policy mandates to prioritize Non-Motorized Transport (NMT) and parking management [18], officials acknowledge the lack of adequate and secure parking slots near stations actively deters potential commuters.

3.2 Operational and Technological Lag

- **Feeder System Unreliability:** Feeder services provided by the AMTS network are inherently inefficient, characterized by low average speeds (15 km/hr) and high waiting times (15 minutes average).[22] Critically, this unreliability is compounded by the frequent, unauthorized diversion of over 5,700 AMTS buses for non-commuter government programs over a seven-month period [23], creating systemic uncertainty for daily, low-income commuters.[23]
- **Technological Lag:** While the Unified Metropolitan Transport Authority (UMTA) was notified in mid-2025 to centralize governance , the lack of a **common ticket slab** across Metro, BRTS, and AMTS remains a significant barrier, imposing logistical and financial friction for multimodal users.

Table 5.1: Status of Multi-Modal Integration and Last-Mile Constraints (2025)

Integration Dimension	Status/Implementation Detail	Accessibility Impact Level	Contradiction/Constraint
Fare (Technological)	Common Ticket Slab across modes is "in the works"	Low/Future	Logistical friction and increased cost for multi-modal passengers.
Operational (Feeder)	AMTS Feeder services launched , but are low reliability and subject to mass external diversion [23]	High Negative	Unreliability shrinks the *realized catchment area* of stations.[3]
Physical (NMT/Egress)	Insufficient parking/NMT facilities at major stations [21]	High Negative	Deterrence of park-and-ride users and failure to support NMT.[18]
Structural Planning	GIFT City station failure requires major correction (new stations planned inside CBD) [17]	Critically Low Realized Access	Failure to prioritize end-user walkability and destination integration.

4. Governance and Financial Sustainability

4.1 Administrative Decentralization

Surat employs a unique administrative structure divided into **7 Zones and 52 Sanitary Wards**. This "Pin Point" responsibility system allows the administration to trace sanitation lapses to specific field staff. Zonal Commissioners hold significant financial autonomy, enabling rapid response to local issues without bureaucratic bottlenecks.

4.2 Financial Innovation: Municipal Green Bonds

Unlike most Indian municipalities dependent on state grants, SMC has accessed capital markets to fund its infrastructure.

- **The Instrument:** SMC issued **Municipal Green Bonds** to fund sustainable projects.
- **Deployment:** The proceeds are specifically earmarked for **"Project IV: Construction of Centralized Dry and Wet Waste processing plant at Umber"**.
- **Impact:** This ensures financial transparency and enforces strict project timelines due to market compliance requirements.

4.3 Public-Private Partnerships (PPP)

SMC leverages PPPs to reduce Operational Expenditure (OPEX). For instance, the plastic waste plant operates on a royalty-free basis, where the private partner's profit motive (selling recyclables) aligns with the public goal (removing plastic from the city).

6. Conclusion and Strategic Recommendations

The Ahmedabad Metro faces a ridership paradox: high geographical potential but modest daily ridership (around 1.18 lakh in Ahmedabad). This is due to a negative feedback loop where low objective frequency (15 minutes) and poor MMI (unreliable feeder buses and parking deficits) lead to low ridership, which, in turn, justifies conservative, low-frequency service. The following strategic priorities are necessary to improve realized accessibility:

1. Operational Scaling: The UMTA must immediately commit resources to increase peak-hour frequency to a minimum of seven minutes, targeting the DPR goal of 2.5–5 minutes. Phase II operational hours must be extended to align with core Phase I service windows .
2. Expedited Fare Integration: The common ticket slab across Metro, BRTS, and AMTS must be implemented immediately to eliminate transfer friction and enhance economic accessibility .
3. Last-Mile Infrastructure: GMRC and AMC must aggressively address the physical deficits by providing structured, secure park-and-ride facilities and robust NMT infrastructure within station precincts.
4. Future planning must mandate walkability, avoiding the GIFT City structural planning failure.
5. Feeder Service Reliability: The UMTA must enforce protective measures to prevent the unauthorized diversion of AMTS buses, ensuring the guaranteed reliability of the last-mile link, particularly for socially vulnerable populations.

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