Evolving Urban Transport in Visakhapatnam: A Smart City Case Study on Mobility Planning

L.Venkata Pavan Kumar[1], T. Jaswanth Kumar[2]
[1]Assistant Professor, Department of Civil Engineering,
[2]M. Tech Scholar, Department of Civil Engineering,
St. Ann's College of engineering & Technology, Chirala, Andhra Pradesh

Abstract- **As Visakhapatnam continues to grow as a coastal industrial hub, rapid motorization and fragmented urban planning have stressed its transportation systems, prompting the need for sustainable solutions under the Smart City Mission. This study explores how the city responded through measures such as junction redesign, structured parking policies, and the promotion of non-motorized transport (NMT). Results show that while private vehicle ownership surged, public transport usage fell to below 20%, leading to congestion and safety challenges, especially at high-demand locations like Beach Road and Gajuwaka Junction. In response, the city implemented Adaptive Traffic Management Systems, pilot NMT corridors, and parking reforms—steps that, although still in early stages, reflect a shift toward integrated mobility planning. The study concludes that Visakhapatnam's progress offers a replicable model for mid-sized Indian cities aiming to transform urban mobility while balancing local needs, environmental goals, and economic growth.**

Index Terms- **Visakhapatnam, smart city, Mobility planning, urban transport.**

I. INTRODUCTION

Urban transportation in India has reached a critical juncture, with cities struggling to accommodate increasing travel demand, rising vehicle ownership, and growing environmental concerns. Visakhapatnam, a key port city in Andhra Pradesh, reflects this nationwide challenge. As the largest city in the state with a population exceeding 2 million and a projected rise to 7.56 million by 2030, the urban sprawl and motorization rate have significantly outpaced transport infrastructure development (ICLEI South Asia, 2019).

The Government of India launched the Smart City Mission in 2015, aiming to enhance the quality of urban life through improved services and infrastructure, particularly focusing on sustainable transport (MoUD, 2015). Visakhapatnam was selected among the first batch of Smart Cities and began implementing various projects to address its growing mobility issues. The initiatives include the promotion of non-motorized transport (NMT), development of smart streets, structured parking systems, and adaptive traffic management solutions (ICLEI South Asia, 2019).

One of the core issues identified in the city was the sharp decline in public transport usage, which dropped below 20% of total trips, while private vehicles and intermediate public transport modes like auto-rickshaws rapidly expanded. The city currently experiences high congestion at major junctions such as Diamond Park and Gajuwaka, in addition to poorly regulated parking along key corridors like Beach Road (ICLEI South Asia, 2019). Without an integrated and inclusive transport strategy, these trends could worsen, leading to lower air quality, longer commutes, and reduced urban livability.

Through its Smart City engagement, Visakhapatnam has begun rethinking its transport network to create a more inclusive, safe, and environmentally sound system. This study reviews and analyzes the outcomes of these planning efforts, using official documentation and assessments conducted under the smart city program to reflect on the city's transportation evolution and offer insights for replication in other urban areas.

Study area:

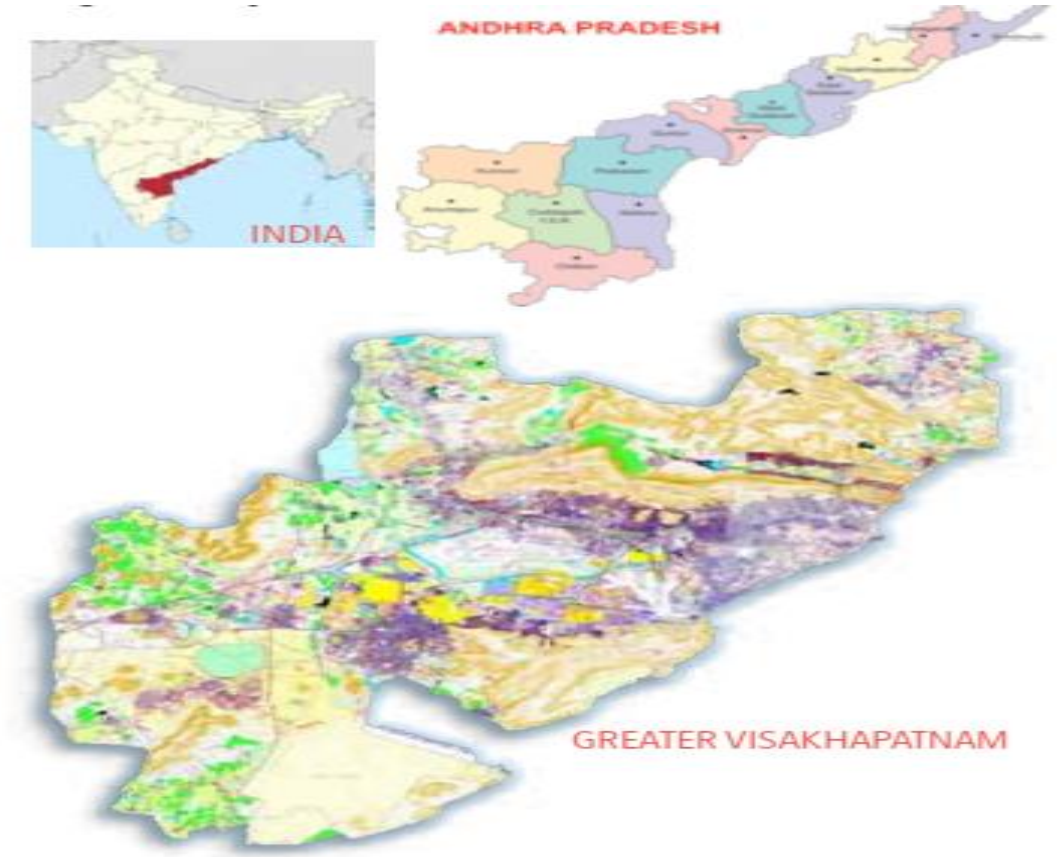

Fig:1 Study area

Visakhapatnam, commonly referred to as Vizag, is the largest city in Andhra Pradesh in terms of both population and economic activity. Situated along the southeastern coast of India, it spans approximately 515 square kilometers and serves a population of around 1.7 million. The city is geographically well-positioned, offering access to multiple modes of transportation, including the East Coast Railway, national highways, a domestic airport, and Visakhapatnam Port—the only natural harbor on India's east coast and one of the largest in the country. This strategic location, along with industrial and financial infrastructure, has made Vizag a significant urban and economic center. However, the city faces challenges typical of rapidly urbanizing Indian metros: inadequate public transport supply has not kept pace with population growth, while rising income levels have led to a surge in private vehicle ownership, contributing to congestion and pollution (ICLEI South Asia, 2019). Historically, the Visakhapatnam Municipality was established in 1858 and became a Municipal Corporation in 1979. Later, with the inclusion of Gajuwaka Municipality and 32 surrounding villages, the Greater Visakhapatnam Municipal Corporation (GVMC) was officially formed in 2005 through a government order issued by the Andhra Pradesh state government. The GVMC area includes major industries such as the Visakhapatnam Steel Plant and Bharat Heavy Plate and Vessels, further adding to the region's urban density and mobility pressures. The city experiences a tropical savanna climate with minimal variation in temperature throughout the year; the average maximum temperature peaks at around 36 °C in May and dips to 29 °C in January. The distinctive geography—marked by the "Dolphin Nose" promontory—also affects local climatic conditions and makes the city vulnerable to weather-related hazards (ICLEI South Asia, 2019).

II. METHODOLOGY

This study adopts a case study approach to evaluate the evolution of transport planning in Visakhapatnam under the Smart City Mission. The methodology involves secondary data analysis, infrastructure mapping, and trend interpretation using data provided in the City Report prepared by ICLEI South Asia (2019). The overall workflow involves three key steps: (1) transport system profiling, (2) infrastructure assessment, and (3) evaluation of outcomes of planning interventions. This study adopts a comprehensive case study methodology to evaluate transport trends and planning efforts in Visakhapatnam under the Smart City Mission. It includes secondary data analysis, traffic and infrastructure assessment, and vehicle growth projections. Data was primarily sourced from the *City Report: Visakhapatnam* prepared by ICLEI South Asia (2019), supplemented by forward-looking estimations for vehicle registrations using past trends.

2.1 Projected Vehicular Growth (2020–2024)

To understand ongoing stress on urban transport infrastructure, we projected vehicle registrations from 2020 to 2024 using historical growth rates from 2002 to 2005. The **Average Annual Growth Rate (AAGR)** was calculated for each vehicle type using:

$$\text{AAGR} = \left(\left(\frac{V_{\text{end}}}{V_{\text{start}}} \right)^{\frac{1}{n}} - 1 \right) \times 100$$

Where:

- V_{start} and V_{end} are vehicle counts in 2002 and 2005 respectively
- n=3 years

Using this AAGR, we forecasted vehicle counts from 2020 to 2024 based on assumed baseline values in 2020.

Table 1: Projected Vehicular Growth in Visakhapatnam (2020–2024)

Year	2-Wheelers	4-Wheelers (Cars)	Auto-rickshaws	APSRTC Buses
2020	1,000,000	120,000	75,000	1,500
2021	1,109,087	138,100	85,434	1,518
2022	1,230,073	158,930	97,320	1,536
2023	1,364,258	182,903	110,860	1,554
2024	1,513,080	210,490	126,284	1,572

This projection reveals that two-wheelers are likely to exceed 1.5 million by 2024, while cars could grow by 75% from the 2020 baseline. The modest increase in APSRTC buses, by contrast, highlights insufficient investment in formal public transport. These figures emphasize the need for demand-side management, fleet expansion, and modal integration policies.

Table 1 illustrates the projected vehicular growth in Visakhapatnam from 2020 to 2024, based on historic growth trends observed between 2002 and 2005. The data shows an exponential rise in private vehicle ownership, with two-wheelers expected to increase from 1 million in 2020 to over 1.5 million by 2024, and four-wheelers nearly doubling in the same period. Auto-rickshaws, a key component of intermediate public transport, also show significant growth. In contrast, the number of APSRTC buses increases only marginally, highlighting the lack of investment in public transport relative to private mobility (ICLEI South Asia, 2019). This imbalance indicates a future where congestion and emissions could intensify if corrective planning measures are not adopted.

Modal Share Assessment

The transport mode share in Visakhapatnam shows a high dependence on non-motorized transport (NMT), yet formal public transport accounts for only 19% of all trips, far below the desired benchmark.

Table 2: Modal Share in Visakhapatnam

Transport Mode	Trips (%)
Non-Motorized Transport	55
Public Transport (APSRTC)	19
Private Transport	17
Intermediate Public Transport	9

Table 2 presents the existing modal share of daily trips in the city, where 55% of trips are made via non-motorized modes (walking and cycling), yet only 19% by formal public transport. This modal split emphasizes that while active mobility is high, the city is failing to support it adequately with safe, continuous infrastructure.

2.3 Footpath and Pedestrian Infrastructure Inventory

The city's footpath network, though spanning 77 km, lacks continuity and accessibility. Field surveys show that most footpaths are either narrow or obstructed.

Table 3: Footpath Infrastructure in Visakhapatnam

Footpath Width (m)	Length (km)	% of Total Footpath
1.5	67	87.0%
2.0	6	7.8%
3.0	4	5.2%

Table 3 confirms this gap, showing that approximately 87% of footpaths in Visakhapatnam are only 1.5 meters wide, which is significantly below recommended standards for urban footpaths that support inclusive, high-volume pedestrian movement. According to urban street design guidelines, a minimum clear width of 1.8 to 2.5 meters is typically required to accommodate two-way pedestrian flows, especially in commercial or institutional zones. Narrow footpaths in Visakhapatnam are often obstructed by electric poles, shop extensions, and parked vehicles, leaving little usable space for walking (ICLEI South Asia, 2019). This creates daily hazards for vulnerable groups such as children, senior citizens, and persons with disabilities, who require barrier-free and continuous paths for safe mobility. Moreover, these inadequacies severely limit the city's ability to capitalize on its high share of non-motorized trips (55%), as seen in Table 2, thereby discouraging walking and pushing more commuters toward private or intermediate transport options. Improving footpath width and quality is essential not only for pedestrian safety but also for achieving larger sustainability goals under the Smart City Mission.

2.4 Parking Demand on Beach Road

The study also evaluated parking demand using PCU (Passenger Car Unit) counts at high-footfall locations along Beach Road. These numbers highlight the potential for congestion and the urgent need for structured parking.

Table 4: Weekend Parking Demand along Beach Road (in PCU)

Location	Weekend PCU Demand
NTR Statue – CCD	135.0
Aqua Sports Complex – Submarine	134.5
Park Hotel – Bell Park	107.0
CCD – Aqua Sports Complex	92.5
Submarine – Park Hotel	75.5
Hawahmahal – Novotel	67.0
Coastal Battery – Hawahmahal	35.0
Kurpam Circle – Pedha Waltair	33.5
Bell Park – Kurpam Circle	8.0

Table 4 quantifies the parking demand along the high-traffic Beach Road corridor, using weekend Peak Car Unit (PCU) counts to highlight usage intensity. Segments such as NTR Statue to CCD (135 PCU) and Aqua Sports Complex to Submarine Museum (134.5 PCU) exhibit particularly high demand, indicating acute pressure on both on-street and off-street parking infrastructure. These areas are key recreational and tourist hotspots, drawing large numbers of visitors who often resort to informal parking practices that spill over into carriageways, obstruct pedestrian movement, and reduce road efficiency. The presence of autos and two-wheelers occupying over 70% of road space at junctions further complicates the traffic environment (ICLEI South Asia, 2019). This scenario emphasizes the need for a comprehensive parking policy, integrating measures such as dynamic pricing, multi-level parking structures, para-transit zones, and enforcement mechanisms, all while ensuring that redesign efforts do not compromise pedestrian access or the visual appeal of one of the city's most iconic public spaces.

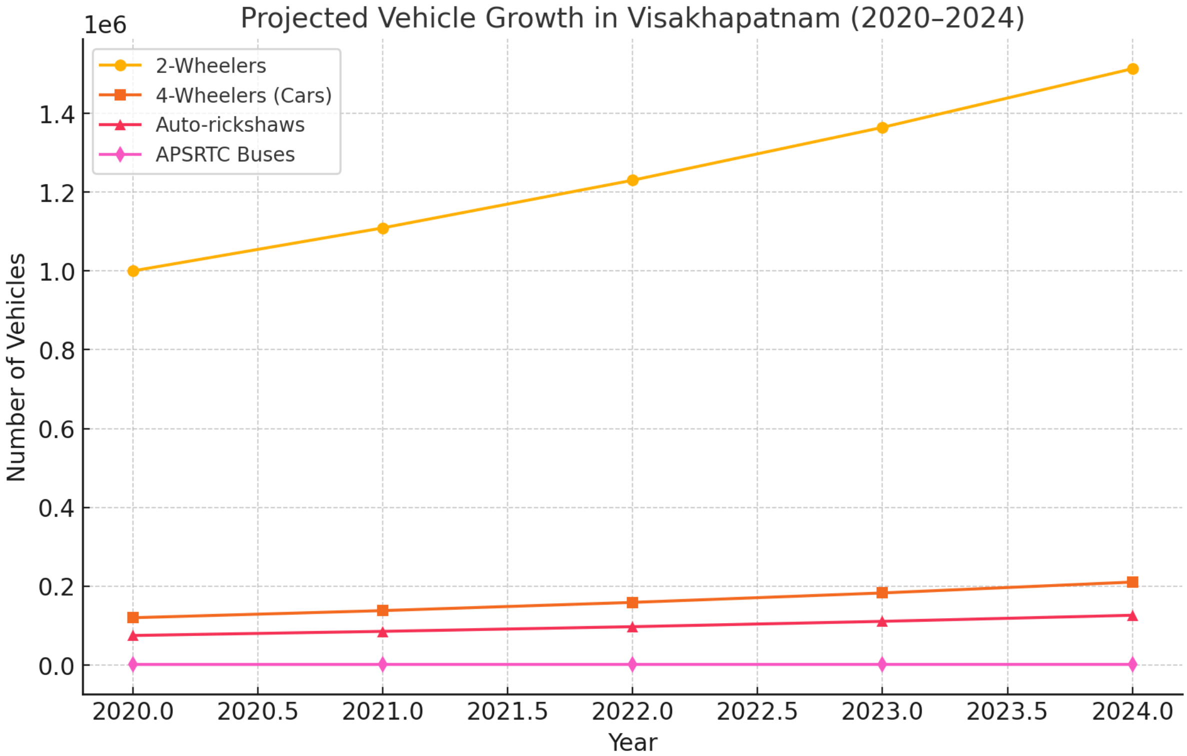

Fig 2. Projected Vehicle Growth in Visakhapatnam (2020 – 2024)

This graph shows the forecasted growth of different vehicle types over a five-year period. The most striking trend is the steep rise in two-wheeler ownership, which grows from 1 million in 2020 to over 1.5 million by 2024. This 51.3% increase represents not just a growing demand for personalized mobility but also a likely consequence of limited public transport alternatives. Four-wheelers show an even sharper rise of approximately 75.4% over the same period, indicating rising disposable incomes and changing mobility preferences toward comfort and convenience. Auto-rickshaws also show substantial growth, from 75,000 in 2020 to 126,284 in 2024—a 68.4% increase, suggesting their continuing role in last-mile and intermediate public transport.

In stark contrast, APSRTC buses—the city's primary public transport fleet—only increase from 1,500 to 1,572 vehicles over five years, marking a negligible 4.8% rise. This minimal investment highlights the systemic neglect of formal public transport infrastructure. If this trajectory continues, the road network will likely face extreme saturation. The imbalance between public and private modes, when viewed with the modal share and pedestrian infrastructure conditions, indicates a potential shift toward vehicle-dependent urban development, contrary to the goals of sustainable and inclusive urban mobility (ICLEI South Asia, 2019).

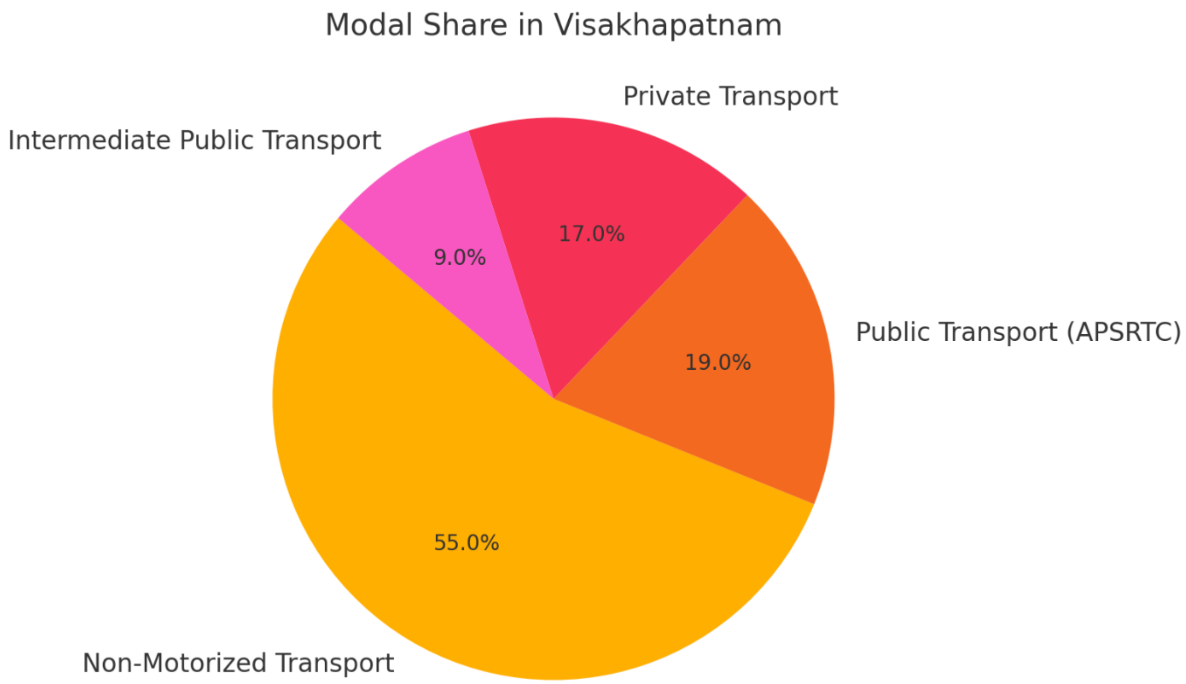

Fig 3. Model share in Visakhapatnam

This pie chart presents a snapshot of daily mobility choices among residents. The most encouraging feature is the 55% share of non-motorized transport (walking and cycling), which is unusually high for a rapidly urbanizing Indian city. This reflects short trip distances, compact neighborhood layouts, and economic conditions that favor active mobility. However, such a high share is not necessarily a marker of well-developed infrastructure. As seen in subsequent analyses, many of these trips occur under unsafe or inadequate conditions.

Public transport usage is worryingly low, at just 19%, while private transport and intermediate modes (autos) account for a combined 26%. The low public transit share is likely tied to issues such as poor frequency, limited route coverage, and an aging bus fleet. If investments and policy support are not urgently realigned to enhance APSRTC's capacity, the rising motorization trend (as seen in Graph 1) will shift even more users from shared to private modes. The city must focus on making walking, cycling, and transit more attractive and safe to preserve the existing sustainable travel pattern and reverse the shift toward private vehicles (ICLEI South Asia, 2019).

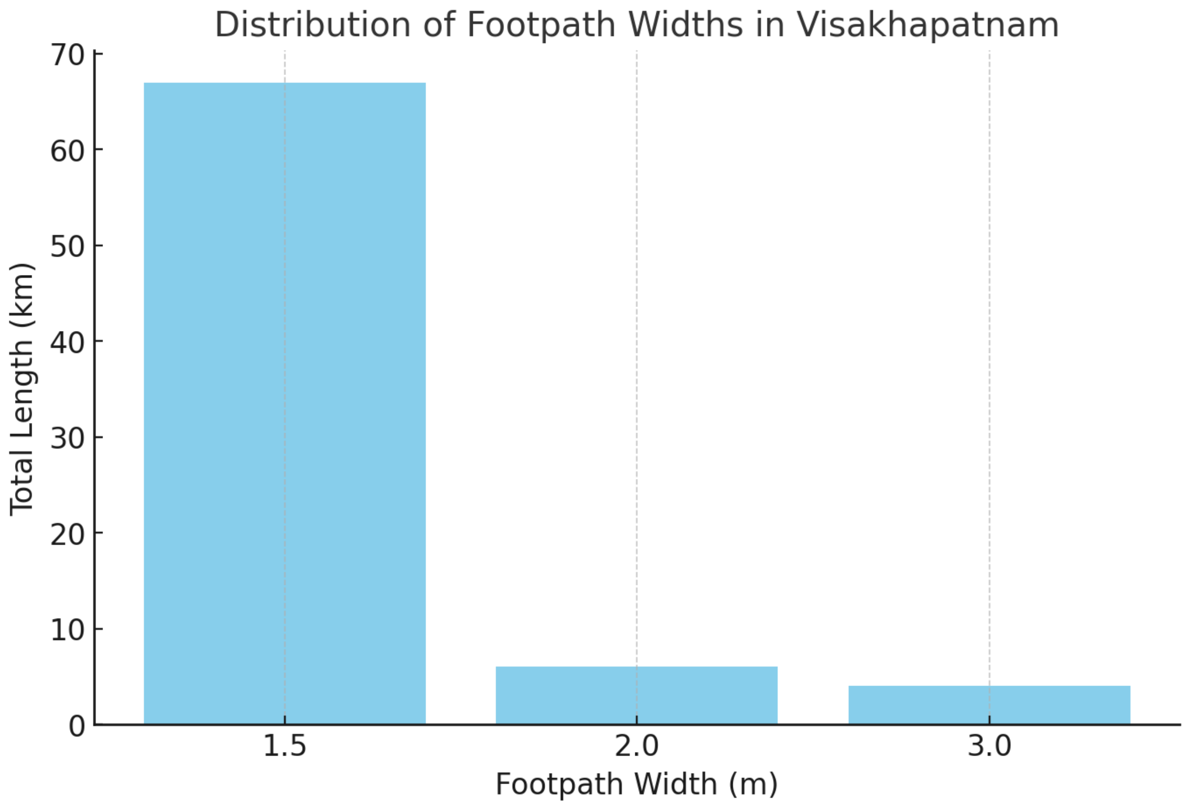

Fig 4. Distribution of Footpath widths in Visakhapatnam

This bar chart shows the breakdown of footpath widths across the city, highlighting a severe infrastructure deficit. Nearly 87% of the documented footpaths are just 1.5 meters wide, which is below the Urban Street Design Guidelines recommended width of 1.8–2.5 meters for urban areas with two-way pedestrian flow. Only 6 km and 4 km of footpaths exist in the 2.0 m and 3.0 m categories respectively, together comprising just 13% of the total pedestrian network. Such narrow and fragmented pathways are typically encroached upon by parked vehicles, vendors, or utility poles, making them unusable for the elderly, disabled, and children.

The limited sidewalk width poses a direct threat to the safety and accessibility of the city's dominant NMT population, as seen in Graph 2. While the high modal share of walking suggests potential for a walkable city, the quality of footpaths undermines this advantage. Infrastructure constraints force pedestrians to share roads with motorized vehicles, increasing accident risk. Visakhapatnam's Smart Street program, focused initially on the Beach Road corridor, needs to be scaled up across key arterial and residential roads to create a continuous, safe pedestrian experience aligned with Smart City objectives (ICLEI South Asia, 2019).

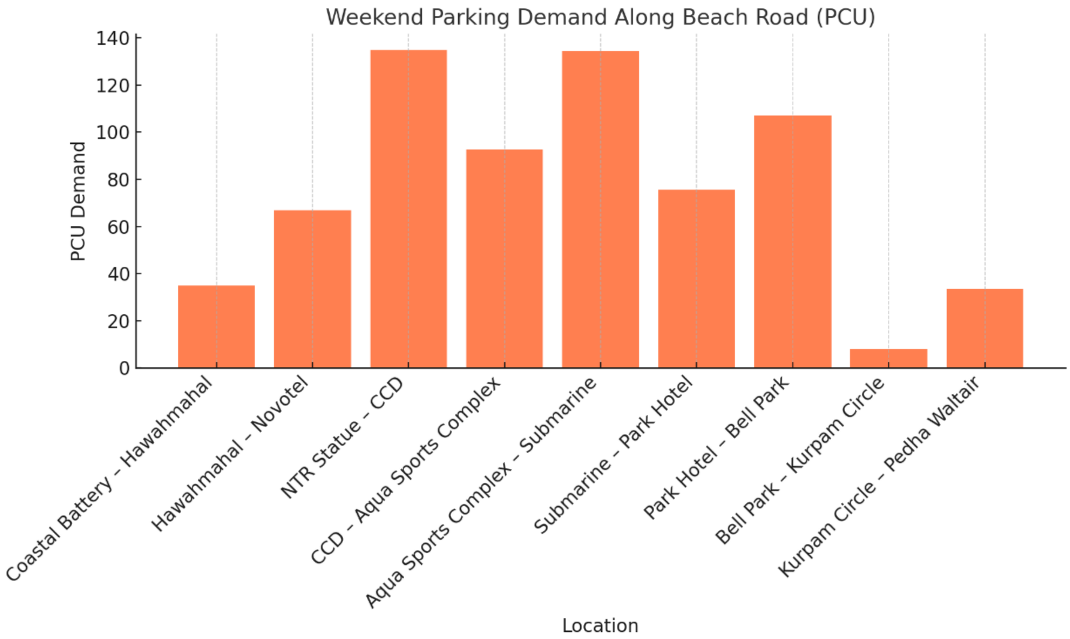

Fig 4. Weekend Parking Demand Along Beach road (PCU)

This graph illustrates peak weekend parking demand in PCU (Passenger Car Unit) along one of the city's busiest tourist and recreational corridors—Beach Road. Segments like NTR Statue to CCD (135 PCU) and Aqua Sports Complex to Submarine Museum (134.5 PCU) record the highest levels of parking saturation. The data reflects not only tourist influx but also the lack of formalized parking infrastructure such as multi-level or underground parking. Vehicles parked informally on carriageways reduce road capacity, disrupt traffic flow, and increase the risk of accidents—especially in pedestrian-dense areas like the promenade and park entrances.

The high parking demand also reveals a policy gap: most of the corridor lacks enforcement of parking regulations, designated parking zones, or dynamic pricing models. Furthermore, the demand is not limited to cars—two-wheelers and autos contribute significantly but occupy road space inefficiently. The city's draft parking policy, which proposes dynamic rates, digital parking maps, and MLCPs, must be prioritized for implementation. Without intervention, unregulated parking will continue to erode both traffic efficiency and pedestrian safety on one of Visakhapatnam's most prominent public corridors (ICLEI South Asia, 2019).

III. RESULTS AND DISCUSSION

3.1 Vehicular Growth Trends (2020–2024)

The projected vehicle growth analysis (Figure 1) shows a steep upward trend in all vehicle categories. Two-wheelers are expected to grow from 1 million in 2020 to over 1.5 million by 2024, registering a 51.3% increase over five years. Similarly, four-wheelers (cars) are projected to grow by 75.4%, while auto-rickshaws may rise by 68.4%. Public transport (APSRTC buses), however, shows minimal increase—from 1,500 to 1,572 vehicles—only a 4.8% growth, reflecting stagnation in fleet investment.

This disparity is quantified using the Compound Annual Growth Rate (CAGR):

$$\mathrm{CAGR} = \left(\frac{\text{Final Value}}{\text{Initial Value}}\right)^{\frac{1}{n}} - 1$$

for four-wheelers:

$$\mathrm{CAGR}_{4w} = \left(\frac{210490}{120000}\right)^{\frac{1}{4}} - 1 = 15.0\%$$

Such high CAGR values for private modes suggest worsening urban congestion and higher carbon footprints, unless counteracted with policy intervention (ICLEI South Asia, 2019).

IV. CONCLUSION AND POLICY RECOMMENDATIONS

Visakhapatnam, as a fast-growing industrial and coastal hub, is currently navigating the complexities of rapid urbanization and motorization. This study shows that while the city maintains a high share of non-motorized transport (55%), infrastructure conditions—particularly footpath width and connectivity—remain far below acceptable standards. Meanwhile, the projected rise in private vehicles, particularly two-wheelers and four-wheelers, indicates increasing pressure on road space and public safety. The stagnation in APSRTC fleet growth is particularly alarming, suggesting an urgent need to revitalize public transport to prevent further mode shift toward private vehicles. Parking demand analysis, especially along Beach Road, further reveals the impact of unregulated vehicle storage on urban mobility and pedestrian environments (ICLEI South Asia, 2019).

To address these challenges, a multi-pronged policy strategy is essential. First, the city must expand and modernize its public transport network through the procurement of new buses, real-time transit tracking systems, and integrated ticketing. Second, it should prioritize the implementation of the proposed parking policy, including dynamic pricing, multi-level parking structures, and zone-based restrictions. Third, pedestrian and cycling infrastructure must be redesigned citywide using inclusive design principles—wider footpaths, tactile paving, barrier-free access, and continuous walkways. Lastly, inter-agency coordination among GVMC, APSRTC, traffic police, and planning authorities should be institutionalized to ensure integrated mobility planning. By adopting these targeted interventions, Visakhapatnam can transition toward a cleaner, safer, and more inclusive transportation ecosystem in line with Smart City goals and national sustainable mobility frameworks (ICLEI South Asia, 2019; MoUD, 2015).

REFERENCES

[1]. Basu, R., Maitra, B., & Mitra, S. (2015). "Evaluation of Pedestrian Facilities in Indian Context: A Case Study in Kolkata," *Transportation Research Procedia*, 10, 936–944.

[2]. Brakewood, C., Barbeau, S., & Watkins, K. (2014). "An experiment evaluating the impacts of real-time transit information on bus riders in Tampa, Florida," *Transportation Research Part A: Policy and Practice*, 69, 409–422.

[3]. Census of India. (2011). *Provisional Population Totals, Andhra Pradesh*.

[4]. ICLEI South Asia. (2019). *City Report: Visakhapatnam – Supporting Sustainable Mobility under Smart City Mission*. New Delhi: ICLEI–Local Governments for Sustainability, South Asia.

[5]. ITDP India. (2019). *Footpath Design: A Guide to Creating Walkable Streets in Indian Cities*.

[6]. JICA (Japan International Cooperation Agency). (2011). *Comprehensive Traffic and Transportation Study for Indian Cities*.

[7]. Litman, T. (2020). *Evaluating Public Transit Benefits and Costs: Best Practices Guidebook*. Victoria Transport Policy Institute.

[8]. Ministry of Urban Development (MoUD). (2015). *Smart Cities Mission Statement and Guidelines*. Government of India.

[9]. NITI Aayog & Rocky Mountain Institute. (2018). *India Leaps Ahead:*

[10]. Pucher, J., Dill, J., & Handy, S. (2010). "Infrastructure, programs, and policies to increase bicycling: An international review," *Preventive Medicine*, 50(1), S106–S125.

[11]. RITES Ltd. (2018). *Comprehensive Mobility Plan for Visakhapatnam Metropolitan Region*.

[12]. TERI. (2014). *Transforming Cities with Transit*. New Delhi: The Energy and

[13]. Wilbur Smith Associates. (2008). *Study on Traffic and Transportation Policies and*

[14]. World Bank. (2013). *Urban Transport for Development: Towards an Operationally*

[15]. Zhao, J., Deng, W., & Song, Y. (2013). "Ridership and Transit-Oriented Development in China: A Case Study of Beijing Subway Line 13," *Transport Policy*, 30, 232–239.