Research Paper

Enhancing Street Life in Bengaluru's Transit Oriented Development by Improving Pedestrian and Bike Infrastructure

Case of Kanakapura Main Road

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Abstract

Pedestrian infrastructure, which plays an important role in determining the quality of life in cities, is one of the most neglected features in the global south where city development is seen as a profit-making opportunity instead of a social and cultural catalyst. While tier 1 and some tier 2 cities are investing in public transport infrastructure, pedestrian infrastructure connecting the transit modes is highly underdeveloped. Walking, cycling or even simply spending quality time on streets is becoming more dangerous with every passing day. The research aims to investigate the quality of pedestrian infrastructure in one of the Transit Oriented Development of Bengaluru, India. Using a mixed – methods approach involving detailed field studies, public interviews, literature studies and GIS and Google Earth mapping, this research highlights issues and concerns raised with the development of non-motorised transport infrastructure and public perception towards street life and safety. Using the findings of the research, the paper proposes design solutions for Bengaluru's TOD regions to improve walkability and cyclability, enhance street life and encourage people to use streets as vibrant public spaces, changing their perception of street usage.

Keywords

Pedestrian Infrastructure, Cycle Infrastructure, Street Life, People-Friendly Design, Quality of Life, Community Health and Well - Being

1. Introduction

Since 2015, under the Smart City Initiative, India has been rapidly developing 100 of its major cities and towns, focusing on road expansion for cars and two-wheelers. Traffic congestion is the most pressing issue that Indian cities wish to resolve to build liveable and breathable cities. Solutions adopted are mainly limited to expanding roads to accommodate more private vehicles. In a society, where people are wary of walking and cycling in their daily commutes, the absence of cycle networks and functional footpaths

encourage more vehicular usage, worsening the traffic situation. Meanwhile, cities in the West are actively working on developing well-functioning pedestrian and cycle transit systems, connected by metro and bus transits, diverse cultural and economic activities, and blue-green infrastructure to improve quality of life. However, developing efficient, functional, and attractive pedestrian and cycle infrastructure is usually the last priority in Indian cities. This research aims to investigate the quality of pedestrian infrastructure and street life in an important Transit Oriented Development (TOD) region of Bengaluru. The region includes a 1.1 km long stretch of TOD region on Kanakapura Main Road (connecting two important metro stations) and 1.4 km long stretch of Vasanthapura Main Road connecting the TOD, forming a T-junction. Being mixed-use developments, connecting all daily necessities within a 15 min walking distance, developing pedestrian infrastructure efficiently can help the region function perfectly as a 15 min low-carbon neighbourhood .

1.1. Research Methodology

Using a mixed method approach, I studied the selected road stretch to understand the existing condition of pedestrian infrastructure. A small stretch of Bengaluru's TOD region was selected where direct observation, visual analysis and site mapping were carried out to analyse the existing condition of non - motorised transport systems and quality of street life. 75 people of varied age groups and professions from two housing complexes namely Century Central and Falcon City were interviewed to understand how residents relate to their streets. The research further studied land use, building functional usage and public transit infrastructure using GIS and Google Earth to understand the area at a neighbourhood level. Literature studies were carried out to understand how quality pedestrian infrastructure can help enhance social relationships, boost local economy, strengthen communal integrity, enrich cultural identity, and improve public health and well-being, giving a unique character to the streets.

1.2. Issues and Concerns for Pedestrian and Bike Movements in Bangalore

Bengaluru, with a decadal growth rate (2001 – 2011) of 49.4%, is one of the fastest growing metropolises in the country (Infrastructure Development Corporation (Karnataka) Limited, 2020). Since India gained its Independence in 1947, the city emerged as a state capital of Karnataka, with army cantonment areas merging into the city and with the development of public sectors, academic institutions, and textile, IT and Biotech based industries (Infrastructure Development Corporation (Karnataka) Limited, 2020; Verma, Chatterjee and Mandal, 2017). Rapid population growth in the last decades has put immense pressure on the city's infrastructure and land use conversion. With only 7.28% of land use allocated for the transportation for a population of 8.5 million, serious concerns over the efficiency of transit infrastructure have grown recently (Infrastructure Development Corporation (Karnataka) Limited, 2020).

Highly compact city cores and drastic increase in demand for infrastructure has forced the city to sprawl into the fringes, developing public sectors, educational institutions, and multinational companies (MNCs) in the city periphery (Verma, Chatterjee and Mandal, 2017). With the residential population mostly concentrated in the city core (Infrastructure Development Corporation (Karnataka) Limited, 2020), daily commute distances and travel times have largely increased (Directorate of Urban Land Transport Bangalore, 2008). Considering vehicles as the biggest technological boon of the 21st century, the local authorities have emphasised the development of road infrastructure over public transit and non – motorised transport systems (Kumar and Kumar, 2008). As a result, today motorised vehicles dominate the city streets, with the number of registered vehicles crossing 8,000,000, causing high traffic congestion and severe vehicular pollution (Infrastructure Development Corporation (Karnataka) Limited, 2020; Kumar and Kumar, 2008). With non – motorised transit infrastructure being functionally non -

existent, lack of efficient first/ last mile connectivity and poor public transit coverage, people tend to use cars or two – wheelers even for very small distances (Directorate of Urban Land Transport Bangalore, 2008; Kumar and Kumar, 2008).

Streets of Bengaluru, like any other Indian cities, are designed to cater to vehicles instead of people. With the lack of efficient pedestrian facilities and absence of cycle friendly infrastructure, street life has been reduced to just a means of transit, making it an unpleasant and dangerous experience to spend time solely for leisure/ health benefits. Despite having specific planning codes in place for designing pedestrian infrastructure, the absence of footpaths/ presence of extremely narrow and discontinuous sidewalks is a very common scenario in Bengaluru, placing the city at a very low score on the Walkability Index (MV, 2014). Pedestrians and cyclists constantly need to compete for space with heavy vehicular traffic, street vendors and street utility infrastructure, creating unsafe conditions for walking and cycling (Indian Roads Congress, 2012; Infrastructure Development Corporation (Karnataka) Limited, 2020).

With an aim to encourage people to adopt walking as a mode of commute, Indian Roads Congress (IRC) clearly states that the footpaths should at least be 1.8m wide facilitating universal access or 1.2m wide with a separate passing passage for wheelchair access, on either sides of the roads. They should be continuous and free of cracks, obstructions, and encroachments. The edges of the sidewalks should have kerbs at a maximum height of 150mm, preventing vehicular encroachments while maintaining the comfort of the pedestrians (Indian Roads Congress, 2012, (Infrastructure Development Corporation (Karnataka) Limited, 2020; Indian Roads Congress, 2020). Unfortunately, these codes have been largely neglected across the city (Directorate of Urban Land Transport Bangalore, 2008; Kumar and Kumar, 2008; Indian Roads Congress, 2012). Priority to vehicles has led to city wide road widenings which have led to extremely narrow footpaths of 0.3 – 0.6m (Directorate of Urban Land Transport Bangalore, 2008), causing pedestrian spillovers onto the carriageways. Underground utilities like telecom cables, waterpower, sever lines, etc., which are buried under the sidewalks, require regular maintenance, resulting in potholes which are rarely filled up once the work is completed (Kumar and Kumar, 2008). Further, absence of strict traffic regulations has led to a wide usage of sidewalks as vehicular parking or as an exit route by 2-wheelers to escape traffic congestions, creating a nuisance to pedestrian activities. Absence of dead widths in mixed use and commercial areas have resulted in footpath encroachments by local shops and hawkers displaying their wares (Directorate of Urban Land Transport Bangalore, 2008). Having one-way roads with speed limits over 65kmph along with on street parking on narrow by lanes, sidewalks occupied with illegal parking and absence of pedestrian crossings (footbridge, subways, etc) on most of the roads (Directorate of Urban Land Transport Bangalore, 2008), has made crossing roads a living nightmare for the pedestrians.

While some pedestrian facilities are present in the city, however inefficient they may be, absence of cycle infrastructure is glaringly obvious in Bengaluru. In a city where cycling was once a traditional means of commute, today the vehicle – oriented planning approach has forced people to use cycling merely as a means of leisure (Directorate of Urban Land Transport Bangalore, 2008). The Public Bike Sharing (PBS) scheme started by the Bengaluru Government in 2018, despite the lack of cycle tracks and parking facilities has become popular in areas where people can access their workplaces within 3Km (Infrastructure Development Corporation (Karnataka) Limited, 2020; Menezes, 2017). People in the CBD areas are widely using PBS schemes to commute to work, for first/ last mile connectivity and for leisure purposes. But the quality of cycle infrastructure across the city has prevented the initiative from spreading on a larger scale. Today, dedicated cycle lanes covering a stretch of 20Km only are available in the entire metropolis, most of which are highly elevated and lack proper cycle parking systems, making

them largely inaccessible (Infrastructure Development Corporation (Karnataka) Limited, 2020; LBB, 2022).

Thus, narrow, discontinuous, and highly elevated sidewalks, absence of cycle lanes, lack of efficient parking systems, hawkers and utility encroachments on sidewalks, absence of pedestrian crossings, lack of climate resilient elements (like shading structures, water features, etc.) on streets and current land use patterns, have forced the people of Bengaluru to adopt unsustainable mobility habits, affecting the quality of street life in the metropolis.

2. Enhancing Pedestrian and Bike Infrastructure in Bengaluru's Transit Oriented Development (TOD) Region

2.1. Quality of Street Infrastructure in TOD Region of Bengaluru – Case of Kanakapura Main Road

Despite having fully – functioning green and purple metro lines serving 41 stations and covering 42.3km by 2011 (Mudde, 2017), Bengaluru did not have TOD policies until very recently (Ramulu, Sankar and Randhawa, 2021). While the current master plan largely makes provisions for land use changes (CEPT, 2017), most areas along the metro routes are not able to expand their FSI leading to low density, zonal development (BMRCL, 2019). With the absence of efficient pedestrian and cycle infrastructure, the TODs lack first/ last mile connectivity (CEPT, 2017). In 2019, Bengaluru's TOD policies were revised to promote high-density mixed-use developments, with mass transit stations and other daily necessities with 5 to 10 mins of walking distance and supported by well-integrated pedestrian, bicycle, feeder, and public transit networks. But the city did not just fail to create a compact and functionally diverse neighbourhood, but because of the negligence towards the development of non – motorised transport systems, the TODs have largely failed to achieve their goal of 70% modal share of public transit systems, making the transit infrastructure highly unsustainable (BMRCL, 2019).

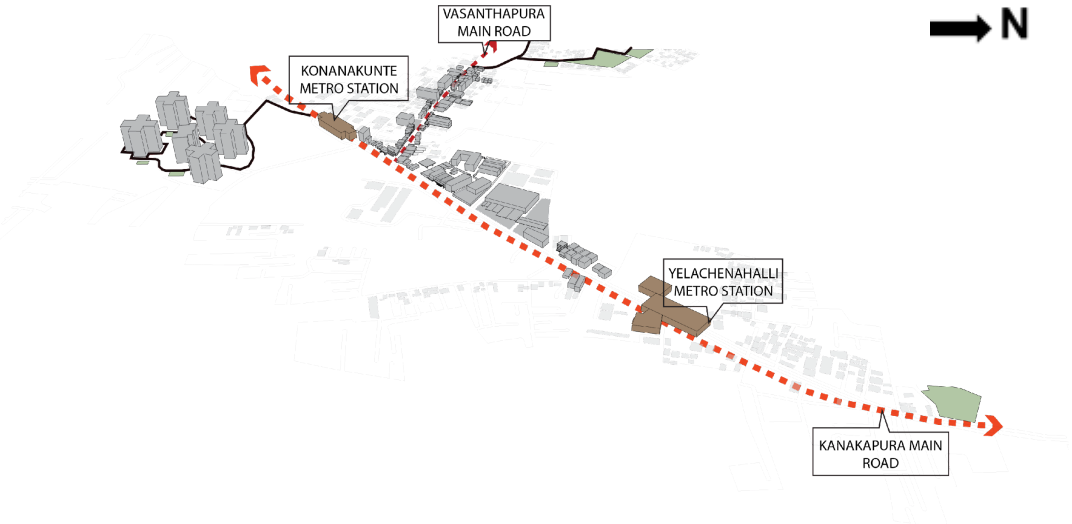

Figure 1. Location of Site Selected. Source: Based on Google Maps

The research studies one of the busiest TOD regions of the city located in Mango Garden Layout, Bikasipura. The site in focus includes two green line metro stations: Yelachenahalli Metro Station and Konanakunte Cross Metro Station, connected by Kanakapura Main Road. The Road forms a T-junction between the two metro stations by Vasanthapura Main Road, a mixed-use street dominated by commercial activities (Figure 1). Detailed fieldwork was carried out for the selected site to understand the quality of pedestrian and bike infrastructure and its impact on street life, involving street usages mapping activities during site surveys, land use and functional analysis using Google Earth, visual analysis, direct observations, and public interviews.

From Google Earth and Direct observation during field work, it was observed that despite having a well-functioning metro and bus network, both the roads are dominated by private vehicles, with peak traffic hours between 9am – 8pm. People can be seen walking to the metro stations (especially students or young professionals) and on Vasanthapura Main Road for shopping daily necessities like groceries, fruits and vegetables, medicines or for accessing nearby health clinics. Land use study shows that the area is functionally diverse, consisting of small- and large-scale housing units, commercial units, hospitals, indoor recreation centre, educational institutions, and public transit stations, but lacks office/ workspaces (Figure 2). As a result, people need to commute to other parts of the city for work, increasing traffic load on the streets due to poor pedestrian infrastructure.

Figure 2. Functional Proximity. Source: Based on Data Collected during Site Survey

Findings from visual analysis showed the quality of non-motorised transit infrastructure in the area. With almost 85% of the street area being dedicated to vehicular traffic, the neighbourhood is plagued with extremely narrow footpaths with widths ranging from 0.6 – 1.5m. These narrow footpaths are not only discontinuous and lack proper levelling, but they are also designed at a height of 0.3 – 0.45m from the

ground level, making them inconvenient and dangerous for the pedestrians and inaccessible for wheelchair users, senior citizens, and people with respiratory issues. Further the footpaths are encroached by parked vehicles, ground floor shops, street vendors, electric poles, advertisement boards, fruits and vegetable markets and outdoor spaces for food joints.

Absence of dead widths abutting the commercial spaces have resulted in loading and unloading processes to happen on the sidewalks, entirely blocking the pedestrian movement. Since street utilities are generally placed below the footpaths, manholes opened for maintenance are rarely fixed, making it dangerous to walk on the footpaths. Free on-street parking system has resulted in people recklessly using streets and even sidewalks as parking spaces. Automobile garages are present on Vasanthapura Main Road with no provision of dead widths, forcing the mechanics to use sidewalk space for repair works and parking vehicles. Despite high footpath designs, some two – wheeler riders were also found to be using the sidewalks to escape the tedious traffic congestions during peak hours.

Apart from a dysfunctional pedestrian system, the area lacks cycle infrastructure. Cycle tracks, cycle parking spaces and public bike sharing schemes are absent in the area despite proposals being made in the recent masterplans. The streets also miss quality street furniture like benches, dustbins, streetlights in certain streets, water features, sunshades and green spaces promoting community interaction. While some shopkeepers have taken a personal initiative to add greenery outside their shops, overall, the streets lack trees and other forms of natural environments.

To understand how people perceive their streets and their expectations regarding pedestrian and bike infrastructure, detailed surveys were carried out. 75 people of varied age groups and professions from two housing complexes namely Century Central and Falcon City were interviewed in the process. Findings of the surveys show that a majority proportion (54.4%) of residents travel using motor vehicles, either by cars or two – wheelers, because of large workplace commute distances. Despite residents living in a TOD region with metro/ bus stations located within 1 Km distance from their place of residence, only 27.3% people travel by metro and 4.5% use buses as a means of daily commute. We found that people perceive walking to be very dangerous even for the first/ last mile connectivity due to inefficient pedestrian infrastructure. Absence of footpaths in certain areas of the neighbourhood, discontinuous, unlevelled, broken and extremely narrow sidewalks where they are present, and encroachments by shops, street vendors, parked vehicles, and street utilities force people to walk on roads amidst heavy traffic. The survey also showed the public dissatisfaction towards the absence of bike infrastructure. Almost 61.4% own at least one cycle, but not a single owner uses it for first/ last mile connectivity or even for accessing daily necessities. Due to heavy vehicular traffic, absence of cycle tracks and safe cycle parking, absence of protection from extreme heat on the streets and workplaces located far away from their residences, majority of the cycle owners consider it dangerous and impractical to use cycles as a means of daily commute and only use it for leisure in areas where traffic volume is low. The proportion of motor vehicular ownership was very high in the area. On an average, households used 1 vehicle/ 2 persons or in certain cases even every person in a household owns either a car or a two-wheeler. 88.6% residents own at least one car and 45.4% own one or more 2 wheelers. The lack of pedestrian and bike safety for first/ last mile connectivity along with higher percentage of motor vehicular ownership, has resulted in people avoiding the use of public transport altogether.

People were also interviewed to understand their perception regarding street safety in the area. Due to heavy and disorganised vehicular traffic, potholes, and open drains frequently emerging in the already narrow pedestrian zones, lack of security surveillance (like CCTV, continuous human footfall, police patrolling, etc.) and poor street lighting, residents consider the streets to be merely a means of vehicular

commute. Majority of residents find streets dangerous for walking, cycling, or spending leisure time, especially after dark.

The findings of the field work activities and the analysis of existing land use and building use patterns, existing public transit infrastructure and street usage patterns show that the TOD region require immediate action towards people-friendly street planning with the focus on developing pedestrian and bike infrastructure, complimented by natural based solutions facilitating community interaction and public well-being. The survey clearly shows the public dissatisfaction towards the non-motorised transit systems and their demand for the development of low carbon transit systems.

2.2. Proposed Guidelines

Guideline 1 – Pedestrian Infrastructure –

- At least 30% street space should be allocated for pedestrian use and should be divided into 3 zones – utility zone, walking zone and activity zone.
- Walking zone – Clear width of the walking zone should be at least 1.5m for streets up to 18m wide, to facilitate easy wheelchair mobility, while for streets greater than 18m, a 1.8m wide walking zone should be provided. Sidewalks should be continuous, slip resistant, smooth, and free of potholes and encroachments of any kind and should be present on each side of the carriageway.
- Activity Zone – All kinds of street activities like street vendors, spaces for community interactions, seating spaces, outdoor spaces for restaurants, kid's play activities and fruits and vegetable markets should be placed in the activity zone. The zone should be at least 1.2m wide, provided on each side of the road, abutting the setbacks of the built spaces.
- Utility Zone – All utilities should be planned in the utility zone, at least 0.5m wide on either side of the street, separating the walking and activity zones, incorporating electric poles, underground drainage systems, advertisement boards, etc. The utility zones might be a landscaped stretch, planted with a series of trees for beautification and paved at frequent intervals providing an easy connection between the walking and activity zone.
- The pedestrian way should be at a level higher than the carriageway but not more than 150mm high, to restrict the vehicular entry while providing a comfortable experience for walking. The connections to the carriageways shall be through well designed ramps with barriers to restrict vehicular entry.
- Inner roads connecting the Kanakapura Main Road (TOD route) must be developed as shared spaces, prioritising pedestrian, and cycle transit. These routes must be open for vehicular traffic only during restricted hours as per the local demand. These streets must be developed with temporal activities free of traffic for the residents during the off -peak traffic hours.
- The pedestrian way shall be surrounded by trees and shading structures for protection from heat, providing a clear height of 2.2m.

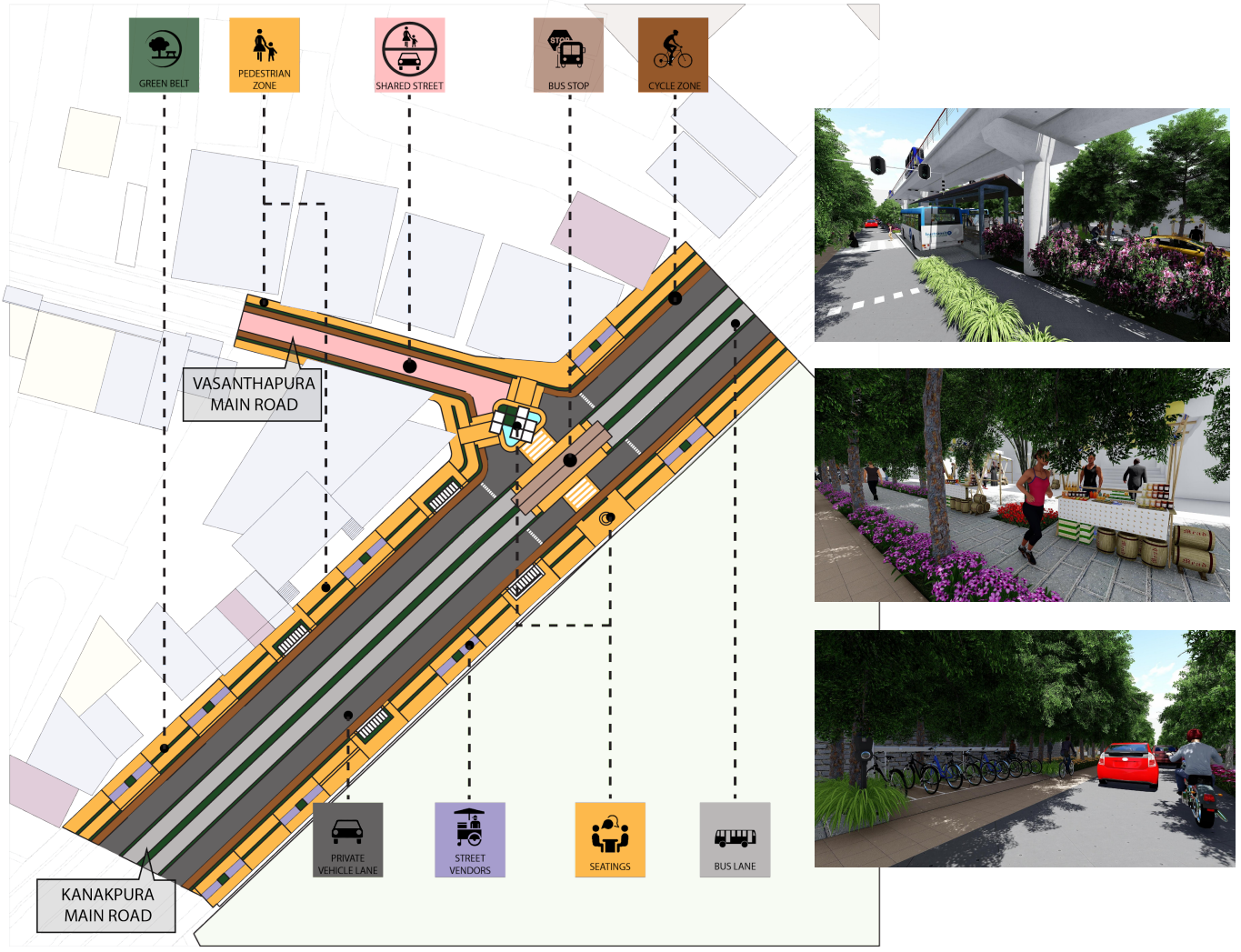

Figure 3. Design Proposal for Kanakapura Main Road and Vasanthapura Main Road. Source: Original Work

Guideline 2 – Cycle Infrastructure

- At least 10% of the street space should be allocated for cycle infrastructure.
- Cycle tracks of 1.2m widths on either side of the walking zone should be provided.
- Cycle tracks should be on the same level as the carriage way, but clearly separated by a row of trees, to avoid the vehicles using the cycle tracks to escape the road traffic.
- The cycle tracks should be in a different colour thus making it distinct for the street users.

Guideline 3 – Carriageway Design

- Carriageways on the TOD route should be divided into two zones: Private vehicle lanes and Bus Lanes.
- Private Vehicle Lanes – Not more than 30% of the total street space should be dedicated to private vehicle lanes on the metro transit route. This should

preferably be a 2- lane about 8m wide including the median for streets up to 18m wide. For streets with widths greater than 18m, must have a separate bus lane in addition to the 2-lane carriageway.

- Bus Lanes – At least 20% of the total street space must be dedicated to bus lanes. Bus lanes of minimum width of 6m may occur in the middle of the carriageway complemented by safe pedestrian crossings connecting the walking zone on both ends.
- Safe vehicular crossings must be provided on all junctions, especially on the junction connecting the Kanakapura Main Road and Vasanthapura Main Road.

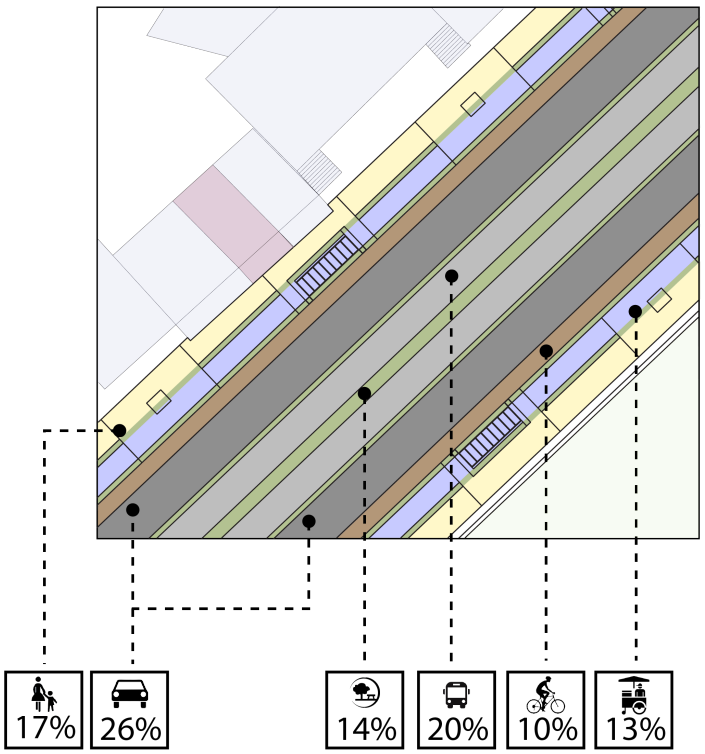

Figure 4. Proposed Street Space Distribution. Source: Original work based on above guidelines

Guideline 4 – Land Use Pattern

- Small scale commercial spaces should be planned within 10 mins of walking distance from the residential units, while at least one big supermarket must be planned within 20 mins of walking distance
- Small scale local food joints should be planned within 10 mins of walking distance from the residential units, while at least one medium scale restaurant may be planned within 15 mins of walking distance.
- A primary health care centre and local medicine shops should be planned within 5-10 mins of walking distance from the residential units, while at least one multi -specialty hospital must occur within 15 mins of walking distance.

- Offices and schools must be planned within 15 mins of walking distance from the residential units.
- Play areas for children should be planned within 5-10 mins of walking distance from the residential units and must be easy to access with a safe and vehicle free approach.

Guideline 5 – Climate Resilient Urban Design

- The pedestrian and cycle zones must have ample shaded areas, created using trees, tensile structures or building roof extensions, providing a comfortable experience for pedestrians and cyclists during peak summers.
- Seating spaces should be provided at strategic locations complimented by water fountains, trees, and creative shading structures, providing therapeutic outdoor meeting and working spaces for the residents.
- Shared streets should allow traffic only during morning and evening hours, opening the entire street for communal activities during the day.

Figure 5. Proposed Climate Resilient Street Infrastructure. Source: Original work based on above guidelines

3. Conclusion

Non-motorised transit systems in Bengaluru are highly underdeveloped and usually the last priority while designing streets. As a result, despite a well-established public transit system, pedestrian and cycle movements have become very dangerous, forcing people to depend heavily on private vehicles. This has caused streets to become merely a means of transit, rather than a place of community interaction and social well - being. The research, using a mixed method approach, identifies serious issues with non-motorised transit infrastructure responsible for the degrading quality of street life in the city's TOD regions. This research analysed Kanakapura Main Road TOD route connecting Yelachenahalli Metro Station and Konanakunte Cross Metro Station and Vasanthapura Main Road, an important commercial street which forms a T-junction at Kanakapura Main Road. Findings of the site survey shows the lack of efficient pedestrian and cycle infrastructure on Kanakapura Main Road, affecting the first/ last mile connectivity to the metro stations. The sidewalks, although present on either side of the streets, were found to be narrow, discontinuous, extremely high, and full of encroachments with potholes appearing at regular intervals. The area lacks dedicated cycle tracks and safe cycle parking. Climate resilient infrastructure required to protect walkers and cyclists from harsh weather, is absent on the streets. Thus, the existing state of Bengaluru's streets present unfavourable conditions for the residents to walk or cycle

daily, forcing them to use private vehicles even for very small distances. The research further interviewed residents in the neighbourhood regarding their views on the quality of streets, their preferred mode of transport and their expectations for the quality of street life. Majority of the residents believed they preferred walking or cycling in general but were forced to resort to motor vehicular use due to unsafe and unpleasant experience the existing non-motorised transport infrastructure offered and also due to the larger commute distances their workplaces demanded. It was observed that the residents desired wide walking and cycling lanes, pedestrian-friendly infrastructure, diversity in land use, more green and open spaces for spending time with loved ones, play areas for children, climate resilient infrastructure, car free/ car restricted zones and banning of free on-street parking. Using the findings of the research, the paper proposes design solutions for Kanakapura Main Road and Vasanthapura Main Road to improve walkability and cyclability,to enhance street life and encourage people to use streets as vibrant public spaces thus changing their perception of street usage. The proposals are further used to form street design guidelines addressing walkability, cyclability, climate resilience and land use changes, a flexible framework that architects and urban planners can adapt to design pedestrian friendly streets in Global South.

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