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Prospects of Urban Design in Commercial Areas: A Case Study in Chennai, Tamil Nadu, India

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Abstract: *Due to present day significant increase in population and consequently in traffic congestion in most of the metropolitan cities in India, designing of streets in order to maintain active traffic flow, parking of vehicles and the safety of cyclist and pedestrian has become important aspects for consideration. This paper addresses various problems faced by pedestrians, cyclists as well as motorists in the concerned area due to improper and ineffective designs of carriage way, footpaths and even the lighting and storm water drainage facilities in the streets. This paper presents the proposed design of the concerned area, in Chennai, Tamil Nadu, India. It covers the design of every aspect of street starting from carriage way to pedestrian friendly footpaths, street furniture, street lighting, table top crossings as well as the storm water drainage facilities. Various studies of topography, traffic volume, pedestrian and cyclist count, right of way overlay, parking were carried out multiple times in order to conclude the proposed design.*

Keywords: *Traffic Congestion, Pedestrian Safety, Carriage Way and Footpath Design, Traffic Volume Study, Parking Study*

1. Introduction

With the invention of wheeled transport, streets are no more exclusive, habitual realms of pedestrians. For the first time in India, street shape, width, intersection, pavement lighting and drainage have become important for pedestrians, cyclists and motorists. The fast rate of urban growth has always shown a series of serious challenges to road user in growing cities like Chennai. Unless attention is immediately directed for designing and implementing an optimal system and efforts are made on a continuous basis to build up adequate carrying capacity to avoid congestion. Street Design plays an important role to support adequate movement of motorists, cyclists and pedestrians. The absence of proper footpath, tabletop, pavement, insufficient parking area results in many problems on streets.

Urban Street Designing is very important for the development of urban cities. Nowadays, the smart city design suggests street design. It is about making connections between people and places, movement and urban form, nature and the built fabric. Urban design draws together the many strands of place-making, environmental stewardship, social equity and economic viability into the creation of places with distinct beauty and identity. Urban street design draws these and other strands together creating a vision for an area and then deploying the resources and skills needed to bring the vision to life. Streets rank amongst the most valuable assets in any city. They not only ensure residents' mobility, allowing them to travel from one place to meet, interact, do business and have fun, but they make a city livable. They foster social and economic bonds, bringing people together. Decisions about how to allocate and design street space have a tremendous impact on quality of life.

1.1 Scenario of Indian Streets

Indian cities struggle to reconcile the competing needs of mobility and liveability. As private motor vehicle ownership grows and governments attempt to accommodate the additional vehicles, it is becoming more and more difficult to retain adequate space for the social and economic activities that traditionally have taken place in our streets. One of the key problems of Indian streets is that they are designed from the centreline outwards, without taking the needs of all users into account. After parking eats away a significant share of this area, pedestrians, trees, utilities, street vending and social activities jostle for whatever space remains. It is no surprise that in most cases the leftover space is not sufficient to safely and comfortably accommodate these essential functions of the street.

1.2 Review of Literature

Any pedestrian includes any person walking, sitting, running, standing, or a person in a toy vehicle, or devices which are not capable of exceeding 10 km/h. Walking is one of the most important travel modes in every country but pedestrians are always neglected in transportation planning and management. Akash Jain et al. (2014) [1] explained that in India, pedestrian related fatalities accounted for about 8.4% of all motor vehicle related deaths in the year 2006 and around 8906 pedestrians died in accidents. 72% of all pedestrian fatalities in 2003 occurred in urban areas,

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the elderly have the highest fatality rate because of the lower probability of their recovery from injuries.

Manuj Darbari et al. (2008) [2] said that Traffic accidents involving pedestrians have become a major safety problem all over the world, particularly in developing countries, due to high population density, rapid urbanization, and lack of adherence to traffic regulations by both drivers and pedestrians. Sachin Dass et al. (2015) [3] said that in India, pedestrians account for 65% of the accident deaths and out of these, 35% are pedestrian children. Hence, there is a special need to analyze the crossing behavior of pedestrians to ensure their safety on roads. Bijit Kumar Banik et al. (2009) [4] said that there are different methods for data collection, direct observation methods, Video observation methods, Time Lapse Photography, Pedestrian opinion surveys. Amudapuram Mohan Rao et al. (2012) [5] explained that traffic congestion has been one of major issues that most metropolises are facing and thus, many measures have been taken in order to mitigate congestion. There are two principal categories of causes of congestion, and they are; (a) micro-level factors (e.g. relate to traffic on the road) and macro-level factors that relate to overall demand for road use. Congestion can be defined as the situation when traffic is moving at speeds below the designed capacity of a roadway (Ann Forsyth et al., 2011 [6]).

Congestion may be defined as state of traffic flow on a transportation facility characterized by high densities and low speeds, relative to some chosen reference state (with low densities and high speeds).Fanis Grammenos et al. (2008) [7], said that the recent addition of motor power to wheeled transport brought back the need for balance with renewed urgency. Early in the 20th century planners began to propose abatement as a way to limit the speed and volume of traffic and separation as a way to segregate vehicular and pedestrian movement. Behind these proposals stand the grim statistics of pedestrian and motorist fatalities and injuries and their economic and social costs as well as the attested degradation of the street's social environment in proportion to the traffic volume. Sponsored car-free days in cities transiently recapture the pleasure of unhampered cycling and walking in the streets.

Brian E Saelens et al. (2003) [8] studied that pedestrian's crossing out of crosswalks (unmarked roadway) contributed to many traffic accidents, but existing pedestrian studies mainly focus on crosswalk crossing in developed countries specifically. Field observation of 254 pedestrians at unmarked roadway in America showed that 65.7% of them did not look for vehicles after arriving at the curb.

2. Study Stretch

Chennai, the capital city of Tamil Nadu is sited on the Coromandel Coast of the Bay of Bengal with 6.40 million populations played a crucial role in the traditional, historical and academic growth of the country, representing the different elements of the highest variety of the Dravidian civilization. Today, Chennai is the Fourth Largest city of India and is also the leading commercial centre of South India. The credit of the booming Economy of the city goes to the leading industries including automobile, software services, petrochemicals, services, textiles and hardware manufacturing. Due to heavy development of industries, software companies, educational institutions etc., vehicular traffic and also movements of pedestrians are increased abnormally in the last one decade. The situation possesses a very tough challenge and warrants the existing infrastructure facilities to facilitate free flow of traffic and safe walk of pedestrians.

The study stretch is in Thyagaraya Nagar, commonly known as T. Nagar, which is the hub for commercial, social and traditional activities of Chennai. A Stretch of 723 m has been considered for our study. This stretch is divided into three reaches namely Reach 1, 2 and 3. These three reaches are further divided into two parts A and B from its median for each reach to make the survey of traffic volume, pedestrians, cyclist, parking study and obstruction study and presented in Fig. 1, 2 and 3.

Figure 1: *Reach 1*

Figure 2: *Reach 2*

Figure 3: *Reach 3*

2.1 Objective and Scope of the Study

Following are the objectives of the concerned study:

- Proposal of Uniformity in carriage way width.
- Proposal of Pedestrian Accessibility through Pedestrian Friendly Footpaths and Table Top Crossing.
- Proposal of Mobility Zone (Segregated Cycle Track).
- Creation of Liveability in the street's slow zone.
- Proposal of creative use of street space.
- Creation of sensitivity to local context. Increasing awareness of NMT (Non-Motorized Transport) and Road Safety.

The 8 developments for better streets & cities are as follows:

- WALK - Develop neighbourhoods that promote walking
- CYCLE - Prioritize non-motorized transport networks
- CONNECT - Create dense networks of streets and paths
- TRANSIT - Locate development near high-quality public transport
- MIX - Plan for mixed use
- DENSIFY - Optimize density and transit capacity
- COMPACT - Create regions with short commutes
- SHIFT -Increase mobility by regulating parking and road

3. Methodology

During the whole study, a procedural methodology was followed for optimum results. The methodology is followed to keep track of the progress of the work done and generate a systemized report. The methodology followed is in sequential order and checked and performed multiple times in order to come to a near accurate conclusion about our research.

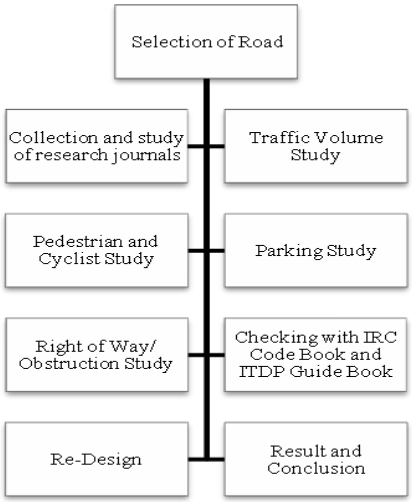

Figure 4: *Flow Chart showing the various stages of the study*

3.1 Existing Condition of the Road

- The width of the carriage way is not uniform throughout the road stretch. The existing carriage width of the road varies from 30-31m in Reach 1 and 2, and 6-8 m on both sides in Reach 3.
- Existing footpath is in different height, width, raised/lowered manhole cover, lower level of the gate entrance opening and branching small streets.
- The vehicles are also as they want parked on the carriage obstructing regular vehicular traffic in absence of proper parking space provided.
- Irregular arrangement of street lighting in the road.
- Trees, Dustbins, Electric Boards and Poles are obstructing the footpath as well as the parking areas.

Figure 5: *Raised Manhole Cover in Reach 1 B*

Figure 6: *Car parked in the footpath obstructing pedestrian movement in Reach 1A*

Figure 7: *Vehicles parked in the Carriageway creating congestion in Reach 3B*

Figure 8: *Trees obstructing the parking area in Reach 2B*

Figure 9: *Electric Board obstructing the Footpath in Reach 2A*

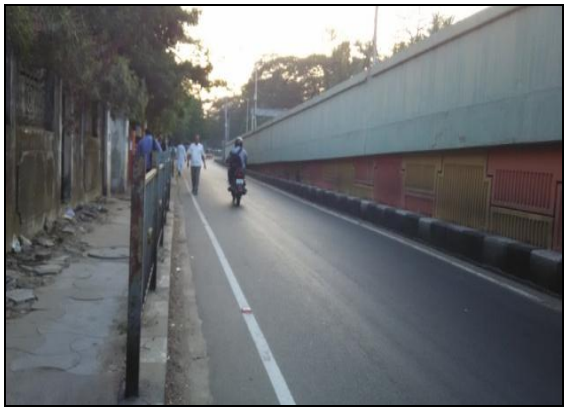

Figure 10: *Damaged condition of the footpath in Reach 3A*

3.2 Traffic Studies

The most important data are generated through the modern survey techniques like traffic volume count at different links and intersections. The extent of variation of traffic flow was ascertained by carrying out thirty minutes interval counts in peak hour at three intersections of the three reaches multiple times. By analyzing the peak hour traffic volumes, the period of peak flows are assessed. The traffic volume is expressed as passenger car unit per hour (PCU/h). These theoretical traffic volumes are compared with the actual traffic volume and the ratio of volume to capacity is assessed.

Table 1: *Traffic Volume Study*

Stretch	Pedestrian	Bicycle	Auto	Two Wheeler	Car	LCV	HCV
1A	43	12	128	500	180	14	3
1B	60	26	89	700	237	20	0
2A	76	20	142	478	230	11	11
2B	82	33	86	663	254	24	1
3A	148	32	90	271	140	7	2
3B	207	40	44	367	168	17	

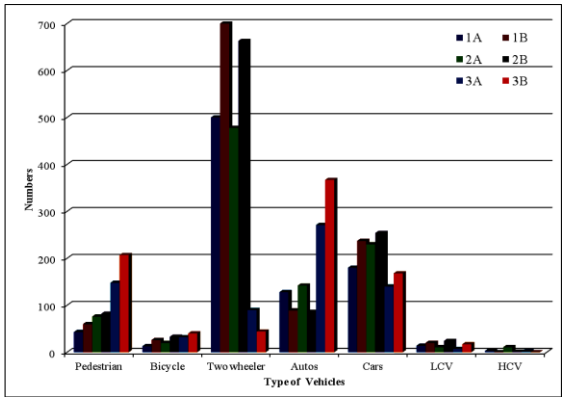

Figure 11: *Graph of Traffic Volume Study*

3.3 Pedestrian and Cyclist Studies

Huge number of pedestrians may aggravate the traffic congestion if sufficient footpaths are not provided for the movement of pedestrians. Considering the importance of the pedestrian activities, pedestrian counts were conducted at three intersections of the three reaches in the peak period. In the same manner, numbers of cyclists were counted during the peak hour as they form the integral part of street space and consume considerable amount of street space in their activities.

Both the counts were done for 30 minutes interval multiple times. Ways of conducting pedestrian survey,

- Manual counting method
- Mechanical approach

Out of the following, we used Manual counting method.

Table 2: *Pedestrian and Cyclist Count*

Sl.No	Reach	Pedestrian Survey				Cyclist Passengers	
		Off Street		On Street		Off Street	On Street
		Female	Male	Female	Male		
1	1A	16	44	7	62	16	2
2	1B	29	45	3	0	21	1
3	2A	7	25	17	52	9	0
4	2B	15	50	9	17	16	2
5	3A	37	72	0	0	33	0
6	3B	30	55	24	60	41	0

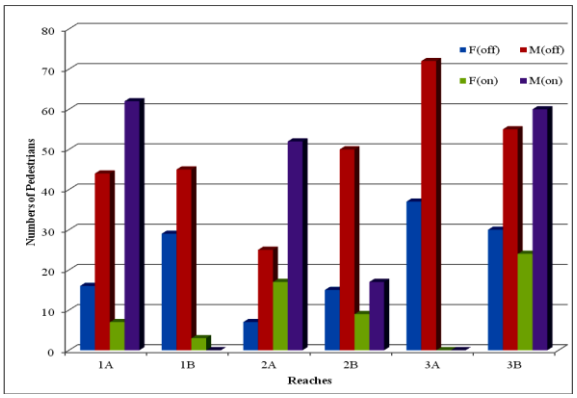

Figure 12: *Graph of Pedestrian Count*

3.4 Parking Studies

Parking is one of the major problems that are created by the increasing road traffic. It is an impact of transport development. The availability of less space in urban areas has increased the demand for parking space especially in areas like Central business district. This affects the mode choice also.

This has a great economic impact. Most parking activities in the study area occur in the peak hour, mostly near commercial lands on Reach 1 and 2. Angular type of parking is used as a consequence of which traffic congestion occurs during taking out of vehicles from parking area during peak hours. However, in Reach 3, parking is only provided under the flyover. Waiting auto rickshaws at the outgoing eastbound arm of the Reach 1 and 2 forms a second row of parked vehicles on the carriageway at the end of the free left turn pocket.

Figure 13: *Angular Parking in Reach 2 B*

Table 3: *Parking Study (30 minutes Interval Result)*

Stretch	Bicycle		Two Wheeler		Auto		Car		LCV		HCV		Others	
	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off
1A	5	0	10	0	6	0	0	0	0	0	0	0	0	0
1B	2	3	24	7	8	0	14	4	1	0	0	0	0	0
2A	3	11	19	55	6	0	0	0	0	0	0	0	3	0
2B	1	9	15	6	8	0	36	1	5	0	0	0	18	0
3A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3B	-	-	-	-	-	-	-	-	-	-	-	-	-	-

3.5 Right Of Way/ Obstruction Studies

Municipal authorities can provide right of way widths but generally do not have maps showing precise, decoded locations of public of right of way. Therefore, a right of way must be defined using municipal authorities can provide right of way widths but generally do not from the topographic survey. The right of way is typically determined based on building and compound wall locations. Therefore, few private properties were found to be encroaching on the right of way. The obstructions were found in the form of manholes, electric boards, electric poles, extended property line, off-street parking in footpaths which were resisting the pedestrian movement in the footpaths in Reach 1, 2 and 3.

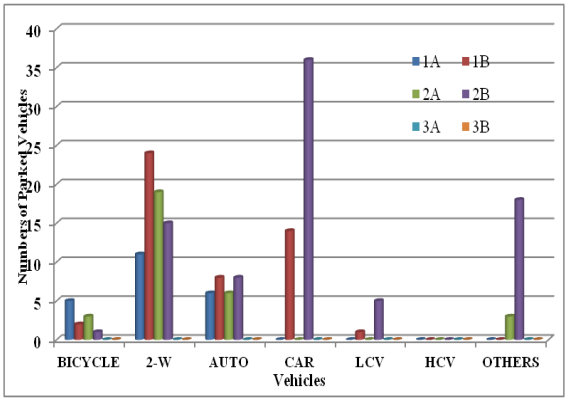

Figure 14: *Graph of Parking Study*

Figure 15: *Obstruction in the form of Electric Board (EB) in Reach 1 B*

Figure 16: *Extended property line obstructing the pedestrian movement in footpath*

4. Proposed Design of the Road

A complete street that caters to all users can take on a variety of forms depending on factors such as the available right-of-way, traffic volumes, street-side activities, and adjacent land uses. In general, smaller right-of-ways can function as slow shared spaces used by both pedestrians and vehicles. Street vending and social activities can also take place in the shared space.

A) Principles of Street Design

- Safety: Streets must be safe for all users. This implies that every street needs to have a slow zone where pedestrians have priority.
- Mobility: Larger roads can include a mobility zone for vehicle movement. This mobility zone—for private vehicles and public transport—is physically separated from the slow zone.
- Pedestrian Accessibility: All streets need to have continuous footpaths or safe shared space with minimal grade differences and adequate clear width for pedestrian through movement.
- Creative use of Street Space: For example, the width occupied by a parking lane can become multifunctional if it includes occasional bulb-outs for street vending or street furniture.
- Liveability: Elements such as tree lines, landscaping, and furniture enhance a street's slow zone, creating space for relaxation, interaction, vending, and other activities.

B) Street Design Elements: Street design elements demand detailed planning and need to be customized to fit the local context. Getting the elements in the right proportion and location is challenging because all elements interact with one another. The street design elements includes footpaths, cycle tracks, Carriage-way, service lanes , median and pedestrian refuges, pedestrian crossings, street furniture's, on-street parking, traffic calming elements, street lighting, storm water drainage, landscaping and other underground utilities.

C) Proposals: Detailed proposals have been made following the data collected from the above studies and based on the recommendations of IRC (Indian Road Congress) and ITDP (Institute for Transportation and Development Policy):

- The carriage way width has been made uniform throughout the road of width 7 m on side A of Reach 1 and 2, and width 10.5 m on side B of Reach 1 and 2. On th other hand, Reach 3A has been provided with uniform width of 5.5 m and Reach 3B with 4.8 m.
- The new proposed footpath width extends along the side of the carriage way, which is varying from 3.5 m to 4.8 m.
- The height of the footpath has been maintained as 150 mm throughout the road to facilitate pedestrian walker comfort, especially old peoples and children.
- Raised table top intersection for regulating the traffic of both pedestrians and motorist for steady flow.
- Parallel car parking has been provided with 15 m length and 2m width.
- Raised table top pedestrian crossing acts as speed breakers and makes pedestrians to cross the footpath at same levels.
- Electric Poles, Junction Boxes and Telephone Boxes have been shifted to appropriate places.
- 8 m height dual sided LED Lamp Posts have been provided at 20 m interval in the centre median of the road.

- 6 m height single sided LED Lamp Posts have been provided at 20 m interval in the pedestrian footpath.

The level of the manhole cover is proposed to be kept in the level of the footpath.

Figure 17: *Table Top Crossing and Cycle Track (in orange colour) at the Intersection at the starting of Reach 2*

Figure 18: *Proper Parking Facilities and Footpath in the proposed design in all Reaches*

Figure 19: *Proper Lighting Facility as per the proposed design in all Reaches*

5. Conclusions and Recommendations

The following conclusions were made from the study, as per IRC (Indian Road Congress) Code, ITDP (Institute for Transportation and Development Policy) Guide and Smart city requirements:

- The Road has been provided with uniform carriage width throughout the concerned stretch.
- Pedestrians can now access through pedestrian friendly footpaths and table top crossings.
- Height of the footpath has also been made uniform and as low as possible to support the elderly aged people and children.
- Mobility Zone (Segregated Cycle Track) has been proposed for the large no. of cyclists in Reach 1 and 2.
- Elements such as Street Furnitures, Tree Lining, Landscaping has been proposed in the street's slow zone to promote liveability in the stretch.
- Creative use of street space has been proposed by giving on-street parking in only the suitable required places instead of giving in the whole stretch.
- Sensitivity to local context has been promoted by improving the movement patterns of the pedestrians and of the motorists.
- It creates a safer environment for all users. Occurrence of traffic jam and accidents in Chennai Roads will be reduced as a result of the proposed design.
- Last but not the least, NMT (Non-Motorized Transport) awareness has been increased and utmost priority has been given to Road Safety.

Also, this project intends to meet all the norms followed by Government in economy, environment, society and public safety. It is keeping pace with Corporation of Chennai's NMT policy which aims to arrest the current decline in walking and cycling in city by creating safe and pleasant network of footpaths, cycle tracks, greenways and other NMT facilities. By rewriting the hierarchy—putting pedestrians, cyclists, at the top, where they always should have been—Chennai is showing the way for other cities.

Figure 20: *AUTOCADD Drawing of the Proposed Design*

References

[1] Akash Jain, Ankit Gupta, Rajat Rastogi ., "Pedestrian Crossing Behaviour Analysis at Intersection", *International Journal for Traffic and Transport Engineering*, 2014, 4(1): 103 - 116, 2014

[2] Manuj Darbari, Sanjay Medhavi and Abhay Kumar Srivastava,"Development of effective Urban Road Traffic Management using workflow Techniques for upcoming metro cities like Lucknow(India)", *International Journal of*

Security and its Applications ,Vol. 2, No. 2, April, 2008

[3] Sachin Dass , Dhirendra Singhal, Praveen Aggarwal., "Study of Pedestrian Flow / Behaviour on Indian Roads "*IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)* e-ISSN: 2278-1684, p-ISSN: 2320-334X. PP 38-42 2015 289-1305

[4] Bijit Kumar Banik, Md. Aktarul Islam Chowdhury and Md. Shahjahan Kaisar Alam Sarkar, "Study of Traffic Congestion in Sylhet city",Paper No.550,*Journal of the Indian Roads Congress*, January-March 2009 .

[5] Amudapuram Mohan Rao, Kalaga Ramachandra Rao "Measuring Urban Traffic Congestion" *International Journal for Traffic and Transport Engineering*, 2012, 2(4): 286 – 305, 2012.

[6] Ann Forsyth, Kevin Krizek, "Urban Design: Is there a distinctive view from the bicycle?" Journal *of Urban Design*, Vol. 16. No. 4, 531–549, November 2011

[7] Fanis Grammenos, Barry Craig, Douglas Pollard and Carla Guerrera "Hippodamus rides to Radburn: A New Model for the 21st Century**",** 2008

[8] Brian E. Saelens, James F. Sallis, Lawrence D. Frank, "Environmental Correlates of Walking, Cycling: Findings from the Transportation, Urban Design, and Planning Literatures", the Society of Behavioral Medicine, 2003

[9] ITDP Manual: "Better Streets, Better Cities: A guide to street design in Urban India", December 2007

[10] ITDP Manual: "Chennai Street Design Project" April, 2015

[11] IRC-81-1997 and IRC-84-2014