Directorate of Urban Land Transport
Government of Karnataka

Connought Place, New Delhi

GUIDELINES FOR PLANNING & IMPLEMENTATION OF PEDESTRIAN INFRASTRUCTURE (Version 1.0, January 2014)

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Preface:

These guidelines are targeted for use by all local bodies and municipalities in Karnataka dealing with pedestrian or roadway infrastructure. It is recommended that the municipalities follow these guidelines, when planning for new infrastructure or improving the existing roadway/pedestrian infrastructure.

Distribution:

Available online @ http://urbantransport.kar.gov.in

1.0 INTRODUCTION

"Walking is a mode of making the world as well as being in it" ~ Rebecca Solnit, Wanderlust: A History of Walking

Historically, walking was the primary mode of mobility to get from one place to another, either for work, or for social interaction, within short distances (since cities/ towns were smaller during those times), until the discovery of the wheel.

With technological advancements and industrialization, work places moved farther from homes, and faster and mechanized forms of transportation gained prominence.

Walking creates a connection between an individual and his physical surroundings-one is more aware of places, people and things in one's environment when one is walking. The feeling of being part of a community is accentuated when one is walking. As other modes like automobiles became more predominant, people walked less and this in many ways has reflected on the way infrastructure for pedestrians is designed in urban areas and more importantly, on the way communities bonded.[1]

[1] Wanderlust: A History of Walking; Rebecca Solnit

Why is walking an important mode of mobility?

Innumerable advantages of walking can be enlisted, since it is the cheapest, easiest and a common mode of transport. Some of the most common ones have been discussed below.

Healthy and thriving cities

Healthy cities don't just happen. They result from creative visions; strategic decision-making and thoughtful implementation that respect the needs and challenges of all residents.[2] Walking is one of the healthiest ways to get around cities, providing valuable physical activity, missing in most people's lives in present day. The health benefits of walking are too many and too obvious, thus, creating walk-able neighborhoods is a very important aspect of creating healthy cities. Walking also generates indirect public health benefits by reducing the use of cars and two wheelers and hence diminishing air, water, and noise pollution and increasing the overall level of safety on the streets. Walkability is important for building social capital and hence for a vibrant and healthy city. Those living in walk-able neighborhoods are more likely to be active in the community.

[2] A Healthy By Design Report, Road to Health: Improving Walking and Cycling in Toronto, April 2012;
Web source: http://www.toronto.ca/health/hphe/pdf/roadtohealth.pdf

Last mile connectivity

Well-connected footpaths/ sidewalks have been one of the major building blocks of a strong pedestrian network in urban design. All trips, at least in part involve walking. Walking is a mode that everybody knows how to use. A person making a trip by bus walks to the bus stop and then after alighting the bus walks to their final destination. Even a person using a car has to walk to his destination after parking his vehicle in the parking lot. Hence, creating a good walking infrastructure is a must as it benefits everybody.

Main mode of travel for certain groups of people

For older adults who no longer drive, and for children who cannot drive, footpaths/ sidewalks form a crucial public resource to remain active and also a space to interact with others of their own age or as a connector to public spaces where they can do the same. A World Bank report on "Demand, Constraints and Measurement of the Urban Pedestrian Environment" in 2008 states that the urban poor make up a city's 'captive walkers'. Thus then the footpaths/ sidewalks also become the most important resource for those who cannot afford to take the public transit, let alone driving a car.

"If you design communities for automobiles, you get more automobiles. If you design them for people, you get walk able, livable communities." ~ Parris Glendening

Although walking is such a fundamental and important mode of travel, pedestrians have been largely ignored in planning transportation systems in our cities, where personal vehicles have become a dominant mode of mobility.

Livable communities are those, where the pedestrians come at the top of the pyramid, followed by cyclists and users of public transportation. The rest of the modes of travel are placed much below on the ladder of livability.

Figure 1: Pyramid of Livability

Factors influencing walkability include the ***presence or absence and quality of footpaths/ sidewalks or other pedestrian rights-of-way***, ***traffic and road conditions, land use patterns, accessibility, and safety***, among others.

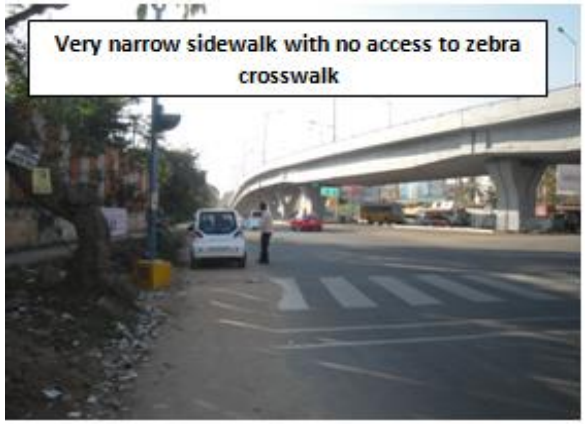
Poor pedestrian infrastructure and amenities plague all cities all over the world. Even the most urbanized and forward-looking cities have less than desirable pedestrian facilities. For example, the city of Bangalore, which is renowned as the IT hub of India, has a low Walkability Index ranging from 0.18 to 0.58 across the different localities of the city[3].

This guidance document is an effort to fill the above-identified gap and an aide/tool to make our cities pedestrian friendly and Livable. It provides guidance for planning and design of pedestrian facilities along roadways in urban areas and is intended for all decision makers, planners, traffic engineers, and infrastructure project implementing agencies, so that each is aware of the needs of the pedestrians and incorporates the same in the planning process.

The document contains the following information or guidance:

- Summary of some policies that relate to pedestrians.
- General guidance on planning for pedestrian facilities, such as understanding pedestrian types and their needs, components that constitute a pedestrian facility, attributes of a good pedestrian facility, and planning considerations of some important components of a pedestrian facility.
- Design guidelines on specific components of a pedestrian facility such as sidewalk, crosswalk, foot-over bridges and subways etc.

[3] Bangalore Mobility Indicators, Directorate of Urban Land Transport



PEDESTRIAN WOES

- Obstructions on Footpaths/ Sidewalks (Utility devices, occupied by hawkers and other construction materials)
- Discontinuous and Disjointed Routes
- Non-existent Footpaths/ Sidewalks in some communities
- Motorists using the pedestrian right-of-way
- Footpaths/ Sidewalks used for parking
- Lack of maintenance of footpaths (Uneven surfaces, broken pavements, dug up footpaths)
- Difficulty in crossing streets
- Unsafe Grade separated crossings like subways and foot over bridges
- Footpaths/ Sidewalks used to dump trash and used by people to relieve themselves
- Lack of ideal infrastructure for handicapped pedestrians
- Increasing Road Accidents due to unsafe pedestrian infrastructure
- Lack of personal safety due to poor design and lighting

1.1 Background

1.1.1 Context

The total population of Karnataka has witnessed a decadal growth of 15.7 percent from Year 2001 to 2011. In the same period, the state urban population has seen a decadal growth of 31.3 percent, whereas the rural population has grown at 7.6 percent over the last decade.[4] The number of registered vehicles in Karnataka stands at 9.93 million in 2011, with a 150 percent increase from year 2001 to 2011.[5]

As such the growth of vehicles has increased at the rate of 10 times the population growth, which could be attributed to the aspirations of growing middle class to own a vehicle, and lack of accessible and good-quality public transport.

Lack of land use and transport integration has led to urban sprawl in many cities; as distances became greater, the dependence on personal vehicles for mobility has increased.

The ever-compelling need to provide more road space for growing number of vehicles meant that newer infrastructure investments are more focused on personal vehicles than the need for allocating space for other modes like walking, cycling and public transport. A result of which, has been diminishing sidewalks, neglected and ill-maintained pedestrian facilities.

While the need to strengthen non-motorized modes of transport has been stressed at the central, state and local levels, there is little indication that sufficient investments are being made to promote non-motorized transport.

Pedestrians are most vulnerable in a traffic accident. Currently in Bangalore, more than 50% of the fatalities on the road involve pedestrians.[6] Hence improving conditions for the safety of the pedestrians should be of utmost concern for local urban planners, engineers, municipal administrators etc.

[4] *Census of India 2011, Urban Development Policy for Karnataka*

[5] *Government of Karnataka, Transport Department (RTO)*

[6] Bangalore Traffic Police

1.1.2 Existing Policies Related To Pedestrian Facilities

It is always useful to know the existing policies and laws that are in place, so that the guidelines can use that as the yardstick and build upon them. Existing policies also makes it easier to justify the need for such a document.

This section lists national, state and regional policies, regulatory and legal frameworks that are related to pedestrians and the city. Most policies related to pedestrians seem to advocate for making the cities more walk able and pedestrian friendly**.** There is little doubt that cities have to be walk able and pedestrian- friendly. As on today, there is a policy framework that advocates the above view and it would be of use and interest to highlight the salient features of such.

The National Urban Transport Policy (Ministry of Urban Development – MoUD) has amongst its objectives -

- Bringing about a more equitable allocation of road space with people, rather than vehicles, as its main focus.
- Encourage greater use of public transport and non-motorized modes by offering Central financial assistance for this purpose.

The Persons with Disabilities (Equal Opportunities, protection Of Rights and Full Participation) Act, 1995 also lays down provisions to help ensure that people with disabilities can have easy access to the streets. The Act, among other things mentions that the appropriate Governments and the local authorities shall, within the limits of their economic capacity and development, provide for:

- Installation of auditory signals at red lights in the public roads for the benefit of persons with visual handicap;
- Causing curb cuts and slopes to be made in pavements for the easy access of wheel chair users;
- Engraving on the surface of the zebra crossing for the blind or for persons with low vision;
- Engraving on the edges of railway platforms for the blind or for persons with low vision.

The municipal authorities follow the **Indian Roads Congress** (IRC-103 1988). Design and engineering guidelines by IRC are currently being revised and updated.

Link to NUTP document:
http://urbanindia.nic.in/policies/TransportPolicy.pdf

1.2 Goals and Objectives

The goal of this document is to provide guidelines that form as a framework for agencies to plan, design and implement well connected, safe, comfortable and sustainable pedestrian facilities that will encourage and inspire increasing number of people to choose walking as their preferred mode of travel for shorter trips (trips less than 2-3 km) in cities.

It is important to lay the framework in the form of goals and objectives at the beginning of the pedestrian planning process, so that any projects and decisions taken on pedestrian infrastructure are directed towards achieving these common goals.

Goals are the generic actions and purposes towards which any pedestrian infrastructure improvement projects and studies are directed.
Objectives are specific measurable actions that support the attainment of the associated goals.

These goals and objectives are described as *Attributes of Good Pedestrian Facility* in *Section 2.2*.

2.0 PRINCIPLES FOR PLANNING PEDESTRIAN FACILITIES

2.1 Defining a Pedestrian and Pedestrian Facility

A pedestrian is defined as a person making a trip on foot or on a wheel chair. Pedestrian trip can be for various purposes such as commuting to work, connecting to a different mode of travel, walking for leisure, walking to shop, walking a dog and others.

Pedestrian facilities can consists of various components such as:

- Footpath/ Sidewalk;
- Pedestrian crossing (crosswalk);
    - At-grade crosswalk
    - Grade separated crosswalk
        - Subways
        - Humped subways
        - Foot Over Bridges (FOB)
- Street corners;
- Median refuge;
- Pedestrian-only-streets.

Figure 2: Pictures depicting the various pedestrian facilties to make streets more livable

2.2 Attributes of a Good Pedestrian Facility

Some common attributes of good pedestrian facility is described below:

Accessibility – pedestrian facilities should be accessible to all pedestrian, irrespective of their abilities.

Connectivity – pedestrian facilities should be well networked for pedestrians to choose the most convenient path.

Safety – pedestrian facilities should provide a sense of safety to the pedestrians and pedestrians should not be threatened or overwhelmed by vehicles.

Comfort – pedestrian facilities should be comfortable to use for people of all ages and abilities.

Ambience – Pedestrian facilities should have good ambience to make the facilities seem inviting for pedestrians to use.

Place making – Pedestrian facilities should provide space for people to gather and socialize.

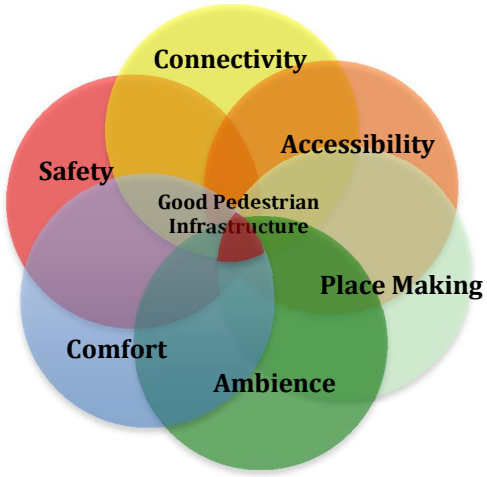


Figure 3: Venn diagram demonstrating how the goals of good pedestrian infrastructure are interrelated.

GOOD PEDESTRIAN FACILITY ATTRIBUTES

- Accessibility
- Connectivity
- Safety
- Comfort
- Ambience
- Place-making

2.3 Understanding Pedestrian Groups

Before planning and designing any pedestrian facilities, it is important to understand the different groups of pedestrians and their specific needs. Pedestrians can be classified on the basis of their capabilities to use pedestrian facilities as:

- Children;
- Elderly people;
- Disabled people;
- The Rest/Others.

Children use pedestrian facilities to commute to school and to access recreational facilities either accompanied by adults or by themselves. Children tend to be impulsive in making crossing decisions. Young children, due to their low height are likely to be less noticed by speeding motorists as compared to adults.

Elderly people noticeably travel as pedestrians in higher proportions than other groups of people. Elderly people are generally slow to react, walk at a slower pace compared to other groups; visual acuity can be compromised and may have decreased stability to walk. Some elders may also use assistance for walking. (Such as handholding, walk stick, etc.)

Disabled people can be people with different restricted abilities such as visually impaired, walking disabilities (people on wheel chairs or crutches), etc. Disabled people as any others, having their "right to movement", should be able to use any pedestrian facility.

The rest comprise of average adults whose ability to walk safely is not compromised. Such people have an average walking speed of 4 ft. /sec (or 1.22 m/s or 4 km/hr.) and are expected to exercise safe judgment when walking on pedestrian facilities. While this group of people forms the majority of the pedestrians, the needs of every other group of people should always be carefully considered in the planning and design of all pedestrian facilities.

2.4 Accessibility of Pedestrian Facilities

All pedestrian facilities and amenities within the pedestrian facility should be universally accessible to people of all abilities such as people on wheel chair, visually impaired, etc. Some specific aspects of accessibility to be considered while planning pedestrian facilities are listed below.

Accessibility of Footpaths

- Footpath should have convenient height such that it is easily accessible by aged people and children.
- Footpath should be accessible to people on wheel chair by provision of ramps with suitable gradients.
- At the ingress and egress to a footpath, special surface such as tactile pavement should be provided for guidance of visually impaired.

Accessibility of Pedestrian Crossing

- Pedestrian crossing should be at the same level as the footpath for easy access for all.
- Ramps should be provided at the transition between footpath and pedestrian crossing, when the pedestrian crossing cannot be at the same level as the footpath.
- Handrails should have opening leading to the crosswalk, and should have a width at least the width of the crosswalk.
- At signalized pedestrian crossing with pedestrian push buttons, the push buttons should be aligned in such a way that it is comfortably accessible to people on wheel chair.

Accessibility of Subways and Foot-Over-Bridges

- All subways and FOBs should have elevators in addition to stairs. Elevators are essential at all grade-separated pedestrian crossings for mobility of disabled on wheel chair.
- Escalators may be provided along with stairs to increase comfort, but it cannot be a replacement to elevators, as escalators cannot safely accommodate pedestrians on wheel chair.
- Elevators should have enough space to accommodate at least one wheel chair and a pedestrian to stand.
- Opening to subways and FOBs should have sufficient width at least to allow two people to comfortably cross each other.

- Railings should be provided along the stairs for safety of aged and young pedestrians.

Accessibility of Median Pedestrian Refuge

- Pedestrian refuge area should be at the same level as the pedestrian crossing.
- Pedestrian refuge area should be accessible by a ramp when a level difference exists between the refuge area and the pedestrian crossing.

Design Parameters for Accessibility

- Curb height
- Ramp gradient
- Width of handrail opening at pedestrian crossing
- Tactile paving at ingress and egress of a footpath or median refuge
- Subway/FOB entrance opening
- Stair case gradient

Examples of Pedestrian Facilities with Bad Accessibility

1. Footpath too high for elderly and disabled pedestrians to access.
2. No opening in the railing provided for accessing footpath.
3. Median interrupting pedestrian crossing.

Examples of Pedestrian Facilities with Good Accessibility

4. Clear pedestrian crossing with bold markings for visibility.
5. No physical obstructions on the other side of the crossing.
6. Median Refuge for safety of people.
7. Bold Road markings for good visibility.

2.5 Connectivity of Pedestrian Facility

Pedestrians should be able to access any destination by foot in the shortest path safely without getting into conflict with vehicular traffic. Some specific aspects of connectivity of pedestrian facilities are listed below.

Connectivity of footpaths

- Footpath should be provided on either side of a roadway.
- Footpath should be continuous without obstructions.
- Footpath of intersecting streets should be connected, with what is termed as ***street corner.***
- Footpath on opposite sides of a street should be connected by ***pedestrian crossings.***
- Pedestrian crossing should connect all arms of a junction.

Access to pedestrian subways and FOBs should be seamless, such that pedestrians can use them without getting on to a busy road.

Design Parameters for Connectivity

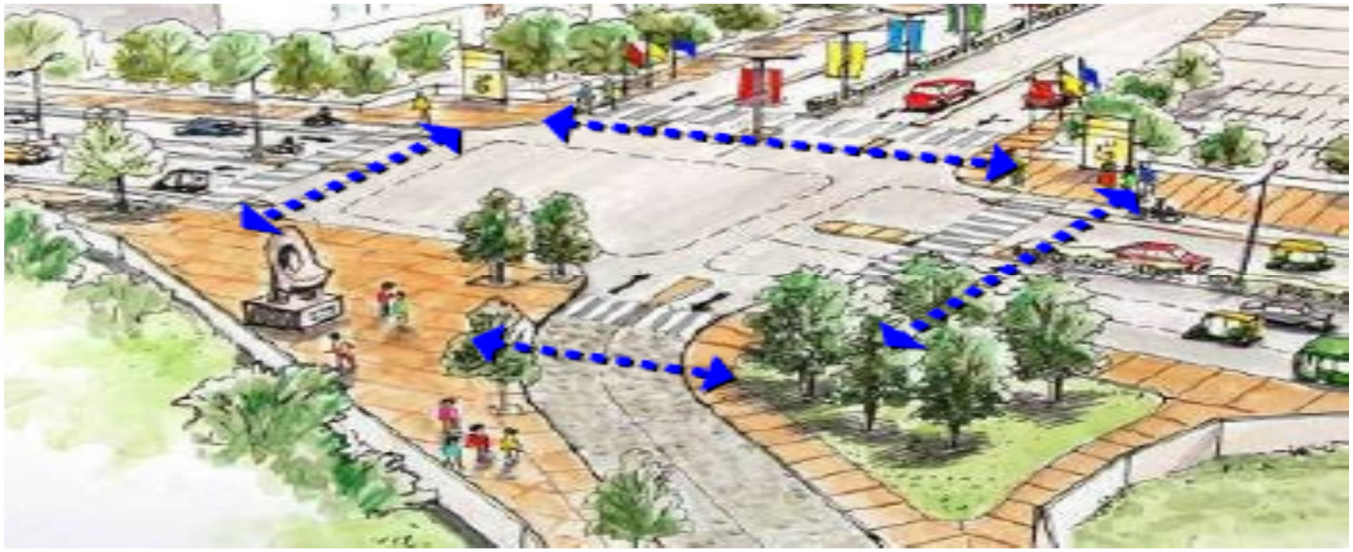
- Design of street corners
- Location of pedestrian crossing
- Alignment of footpath
- Location of pedestrian subway/FOB access

Examples of Pedestrian Facilities with Bad Connectivity

1. No footpath available for pedestrians to walk in the direction of the arrow.

2. Trees and electrical utilities occupying whole of the footpath width resulting in disconnected footpath.

Illustration of a Pedestrian Facility with Good Connectivity



2.6 Safety of Pedestrian Facility

Pedestrian facilities should be perceived to be safe for use by pedestrians of all types including disabled, women, children and elderly people. Pedestrian facilities should be designed to also reduce the conflict between pedestrians and vehicles.

Safety of Footpath

- Footpath should be well lit with direct lighting on footpath.
- Footpath should have an even surface free from obstacles that could create any safety concern for elderly people.
- When footpaths (or ramps) have a gradient unsafe for elderly people to walk, then handrails should be provided at such locations.
- Tactile pavement should be provided at all locations on a pedestrian facility where there is a potential safety concern for visually impaired pedestrians (such as just before a ramp that leads to pedestrian crossing, around an obstruction, before the stairs to a subway access).
- Access to footpaths and medians should be provided to only pedestrians. Railings and bollards should be used to restrict access for motorists.

Safety of At-Grade Pedestrian Crossing

- At grade pedestrian crossing should be well demarcated with retro reflective Zebra marking and/or Retro Reflective Pavement Marker's.
- Stop line should be provided before the pedestrian crossing area such that the stopped vehicles do not intrude into the pedestrian crossing area.
- Tabletop crossings can be used to improve the visibility of pedestrians, especially where children are expected to cross.
- Traffic calming measures should be taken upstream of a pedestrian crossing to slow the vehicular traffic.
- At signalized intersections with high pedestrian volume on all approaches, signal phasing should include all red phase for vehicles so that pedestrians could cross safely in all directions.
- Pedestrian signals should be used at mid-block sections and at non-signalized intersections where gaps between vehicles are insufficient or infrequent for pedestrians to cross safely.

- Audible signals such as those fitted on pelican crossings should be used with all pedestrian signals for safety of visually impaired people.
- Pedestrian crossing should be well lit so that pedestrians crossing are visible to the turning vehicles at the intersections.

Safety of Pedestrian Subways and FOBs

- Grade separated crossing (subways, FOBs) should be designed in a way that is safe for vulnerable group of pedestrians such as women, children and others who may be targeted by miscreants.
- Subways and FOBs should be well lit all throughout the day for safety of women and other pedestrians.
- FOBs should have protective railing bearing in mind the safety of children.
- However FOBs should not be fully enclosed in a manner that the pedestrians on the FOBs are not visible from the road (by opaque design, advertising or for other reasons), as enclosed FOBs can be claustrophobic for some potential users and may also encourage miscreant activities.
- Hawking space should be assigned and permitted in the grade separated crossing to improve the safety for pedestrians.
- Automated surveillance cameras can be utilized for stricter enforcement against miscreant activities and misuse of grade separated crossing.

Design Parameters for Enhanced Safety

- Lighting of footpath, street corners and pedestrian crossings
- Gradients for footpaths and ramps
- Zebra markings
- Table tops
- Access management – placement of bollards and railings
- Traffic/pedestrian signals
- Hawking space

Examples of Unsafe Pedestrian Facility

1. Uncovered drainage hole in close proximity to bus stop can be hazardous for pedestrians, especially unsafe for visually impaired.

2. Large gap between the edge of the tabletop crossing and footpath is unsafe for elderly pedestrians, visually impaired and people on wheel chair.

3. Uneven and unpaved footpath surface will be unsafe for elderly and handicapped pedestrians and footpath may become unusable during and after rainstorms.

Examples of Safe Pedestrian Facility

Continuous stretch of unbroken footpath separated from the carriageway with the help of a planting zone

Footpath made accessible to physically handicapped using ramps.

2.7 Comfort of Pedestrian Facility

Pedestrians use their own power to move and are more exposed to any adverse environmental conditions compared to motorists. As such pedestrian facility should be designed to provide as much comfort as possible to all pedestrians. Comfort will be a value addition to pedestrians and encourage people to walk rather than using other modes of travel. Some specific aspects that enhance the comfort of pedestrians are listed here.

- Footpath should be wide enough for pedestrians to walk without feeling too congested.
- Footpath gradient if provided should be comfortable for elderly and disabled people to maneuver.
- Trees should be planted along the footpath to provide shelter to the pedestrians without obstructing free pedestrian movement.
- An offset should be provided between building line adjacent to a footpath and the clear walking space along the footpath for the comfort of pedestrians.
- Benches should be provided at frequent intervals for elderly people to rest en-route their journey.

Elevators should be provided at FOBs and Subways for the comfort of elderly and disabled people.

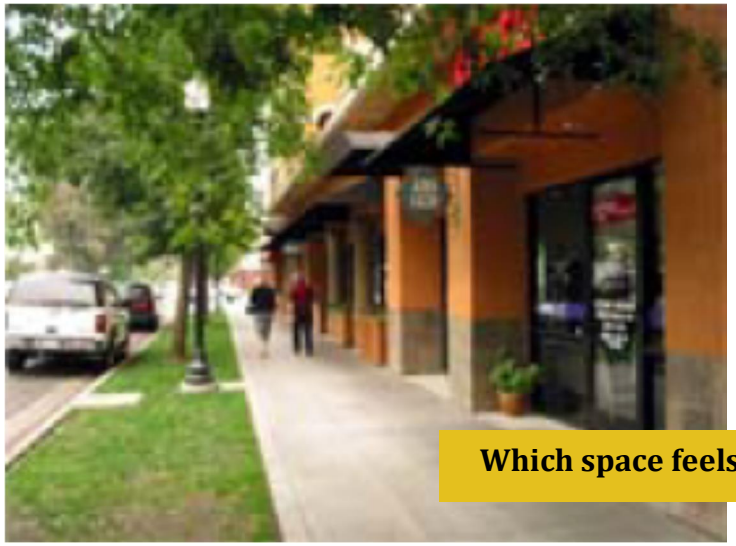
- Allocation of footpath width for walking, plantations and offset.
- Provision of pedestrian utilities, street furniture like benches etc. along the footpath.

2.8 Ambiance Around Pedestrian Facilities

Pedestrians are human, who feel, and have emotions unlike vehicles. Feelings and emotions of pedestrians are affected by their surroundings; ambience of the space around them and they respond accordingly to make decisions whether to use a facility or not. For a motorist (vehicle user), travel cost and time bear more impact on their decisions to travel than the ambience. But for pedestrians, ambience, perceived comfort and safety of their surroundings matter the most. This is a key differentiation that the planners and designers have to bear in mind while designing pedestrian facilities.

Pedestrian Facility for Place making

Historically streets have not only been used as a means to commute, but also a place for people to gather and socialize. Pedestrian footpath and street corners can be used at select places for people to congregate. Place making encourages more people to use pedestrian facilities, which in-turn makes our streets livelier and safer.



Which space feels more inviting to walk?

Figure 4

3.0 PLANNING & DESIGN OF PEDESTRIAN FACILITIES

3.1 Planning a Pedestrian Footpath/ Sidewalk

Footpaths/ Sidewalks should be provided on both sides on all categories of street. Sidewalks can be on one side of a street only under special circumstances where people do not need to access the other side of the street. For example, on a street running adjacent to a railway line with establishments/residences only on the side opposite to railway line, with on-street parking restrictions adjacent to railway line and restricted right-of-way, footpath/sidewalk may be provided on one side only.

Suggested cross-section of different categories of roadway, viz. arterial, sub-arterial, collector and local roads is provided in the Roadway Hierarchy Guidelines document developed by the Directorate of Urban Land Transport, Government of Karnataka, and the same is enclosed in the annexure.

More detailed guidance on the exact widths to be provided for footpaths/ sidewalks, on zoning of footpaths/ sidewalks for various purposes is provided in the following section of this document.

3.1.1 Footpath/ Sidewalk Design

Footpath/ Sidewalk should be divided into three zones:

- **Walking/Pedestrian zone:** This zone is primarily dedicated for pedestrians to walk without any obstruction.

- **Frontage/Dead zone:** This zone functions as a transition zone between building line and the walking zone of a public footpath/ sidewalk. As pedestrians tend to shy away walking next to a building wall or a fence, the effective width for pedestrians to walk freely is reduced. Hence providing frontage zone creates added comfort for the pedestrians to walk freely.

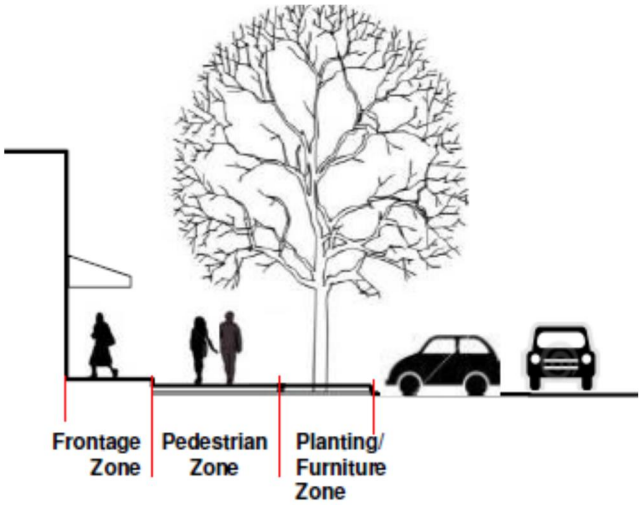


Figure 5: Picture showing the division of Footpath/ Sidewalk into 3 zones

This zone can also be used as a place maker so that pedestrians can stop for socializing, window-shopping at commercial areas and also can be effectively used by hawkers.

- **Footpath Furnishing zone:** This zone can consists of plants/trees, utilities (fire hydrants, light poles, parking meters, etc.), roadside furniture (benches, maps, etc.), bus shelters, etc.

The purpose of dividing the sidewalk into the above zones is to ensure that pedestrians get a comfortable width to walk without any obstructions by organizing all other utilities and obstructions into separate zones. The following sections provide guidelines pertaining to these zones.

3.1.1.1 Footpath/ Sidewalk width

Walk zone shall have a minimum clear width of 1.8 meters (36 + 36 inches), which is the width required for two wheel chairs to comfortably cross each other. In case of footpaths/ sidewalks with high pedestrian activity, such as commercial areas, the minimum walk zone width of 4 meters (~13.2ft) shall be provided. The following table gives the minimum clear width that shall be provided on the basis of land use adjacent to the sidewalks.

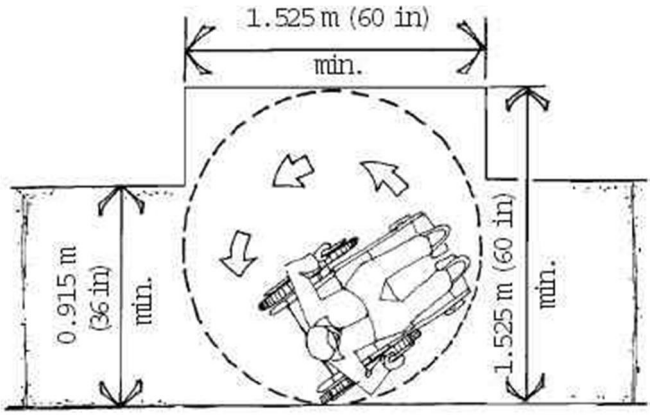


Figure 6: Diagram showing clear turning radius required for a wheelchair.

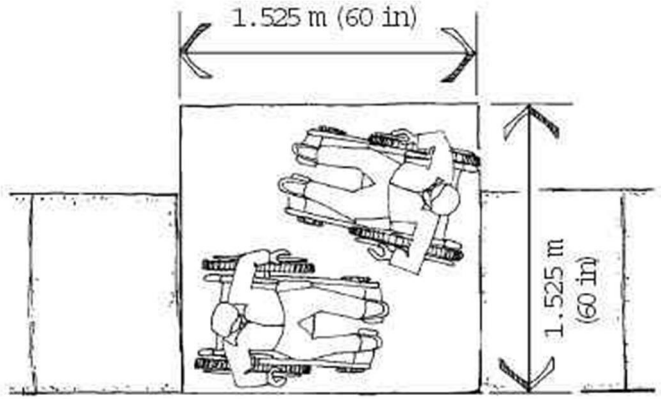


Figure 7: Diagram showing clear distance required for two wheelchairs to move simultaneously.

LANDUSE	WIDTH (IN METERS)
RESIDENTIAL AREAS	1.8
MIXED USE AREAS	3.0
COMMERCIAL AREAS	4.0

Table 1: Walk Zone width guide

The width of the walk zone necessary, above the minimum specified width, should be determined based on pedestrian flow rate at peak periods. Pedestrian flow rate is defined as the number of people crossing a section (imaginary line) in both directions in a given period. For a peak hour flow rate of 800 pedestrians, the minimum widths should be provided as per land use. For every increase of 800 pedestrians in the peak hour flow rates, 0.5-meter (~1.6ft) width should be added to the minimum clear width.

Frontage zone shall have a minimum width of 0.5 m (1.6 ft.). However when buildings along the footpath/ sidewalk have an offset of 0.5 m (1.6 ft.) or more without fencing, then frontage zone need not be provided. Appropriate frontage zone width above the minimum width should be provided when frontage zone is intended for place making, or hawking or other such activities where people need to stand along the sidewalk.

Footpath Furnishing zone minimum width is dependent upon the type of roadway adjacent to the footpath/ sidewalk. Arterial streets which carry high volume of vehicles and are designed for high speeds, needs a larger separation between vehicles and pedestrians with trees and street furniture for pedestrian safety and comfort as compared to local streets.

Hence arterial roads need wider planting zones to provide the necessary separation. Table 2 shows minimum widths of planting zone to be provided for sidewalk based on the classification of adjacent roadway.

Additional width can be provided for planting zone at commercial and recreational locations, where more roadside furniture would be necessary for pedestrian comfort.

When transformer, bus shelter, etc. are located on the sidewalk, sufficient planting zone width should be provided to accommodate these safely such that the clear walking zone capacity is not compromised.

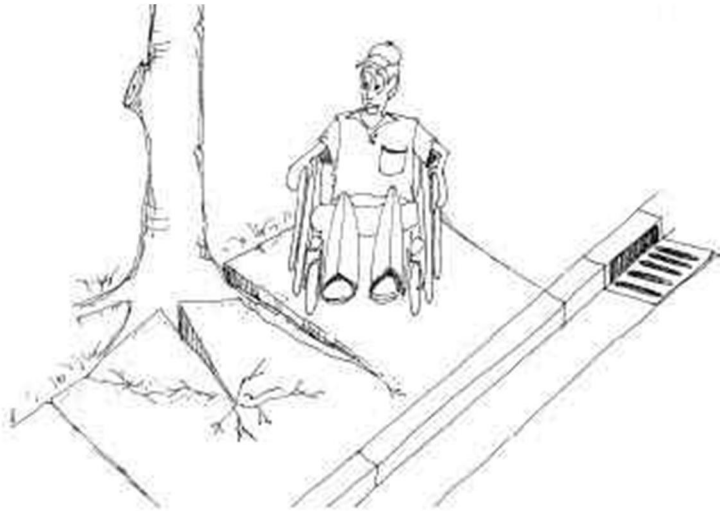


Figure 8: Trees obstructing the clear walking space, hence the need for a planting zone and a planting plan for streets.

3.1.1.2 Footpath/ Sidewalk vertical clearance

Walk zone shall have a minimum vertical clearance of 2.4 meters (~8 ft.). Any obstructions to the vertical clearance such as protruding tree branches, hanging cables, display boards, protruding building shelters (building shelters provide shade, and can be allowable) from adjacent zones should be cleared. Tree branches should be trimmed periodically to ensure that they do not encroach the clear walk zone.

3.1.1.3 Footpath/ Sidewalk gradient

Sidewalks need to be safe for disabled users and elderly people. Sidewalks shall have gentle grades, no steeper than the adjacent road. If longer steeper grades are to be provided, due to topographical constraints then landings at every 125 m (~420 ft.) should be provided where people can rest.

Cross slope may be necessary sometimes for drainage purposes, so that storm water do not stand on the sidewalk surface. However steeper cross slopes can cause inconvenience to wheel chair users and elderly people to walk steadily. Hence a maximum cross slope of two percent is recommended.

3.1.1.4 Footpath/ Sidewalk Curb Ramps

Curb ramps provide the critical access between Footpath/ Sidewalk and the street, for senior citizens, kids, and people with impairments. It is a very important element to get on and off the Footpath/ Sidewalk. Curb ramps should generally be designed at intersections, but when required these can also be designed at mid-blocks.

Curb ramp designs are site condition specific, but in general they consist of the following elements as shown in the figure 8.

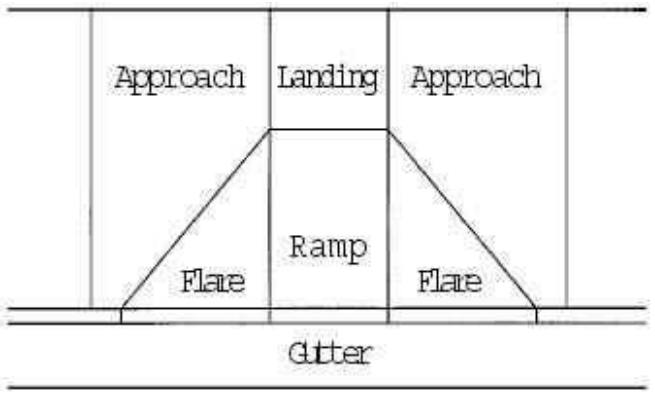


Figure 9: Components of curb ramp

- Landing: Level area of footpath/ sidewalk at the top of a curb ramp facing the ramp path.
- Approach: Section of the Footpath/ Sidewalk adjacent to the landing and flaring out into the ramp.
- Flare: Sloped transition between the curb ramp and the footpath/sidewalk. They are generally steeper than the ramp and hence not used as a direct accessible path to the street.
- Ramp: Sloped transition between the street and footpath/sidewalk where the gradient is constant and the cross slope is at a minimum (preferably less than 2 percent).
- Gutter: Trough or dip used for drainage purposes that runs along the edge of the street and the curb or curb ramp.

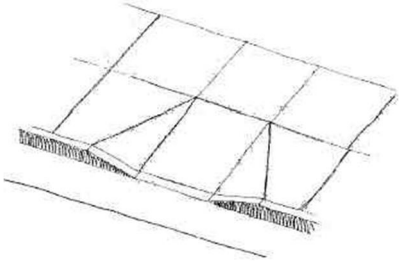


Figure 10: Flares provide a sloped transition between the ramp and the surrounding sidewalk and are designed to prevent ambulatory pedestrians from tripping.

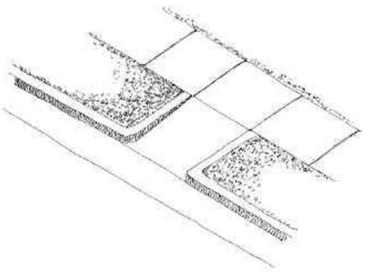


Figure 11: Returned curbs may be used when the curb ramp is located outside the pedestrian walkway, such as in a planting strip.

Figure 12: Components of curb ramp as seen in Seattle, USA.

There are different kinds of curb ramps patterns, depending on the location, type of street, and existing design constraints, and are categorized based on their position relative to the curb line. [7]The 4 basic types are:

1. Perpendicular Curb Ramps (Without level landings, perpendicular curb ramps are problematic for wheelchair users and others to travel across as shown in the picture below),
2. Parallel Curb Ramps,
3. Diagonal Curb Ramps (Diagonal curb ramps are single curb ramps installed at the apex of a corner (Figure 4-23). Diagonal curb ramps force pedestrians descending the ramp to proceed into the intersection before turning to the left or right to cross the street.),
4. Built-Up Curb Ramps.

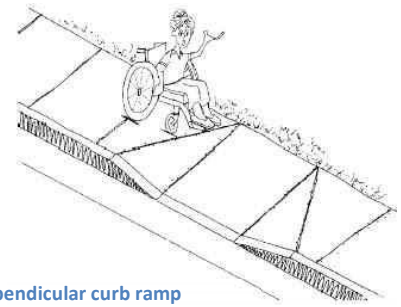


Figure 13: Perpendicular curb ramp

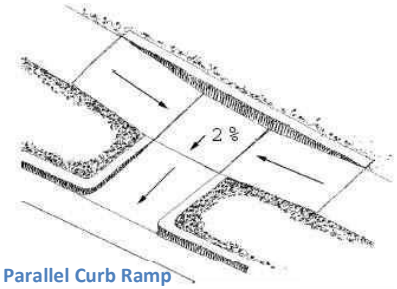


Figure 14: Parallel Curb Ramp

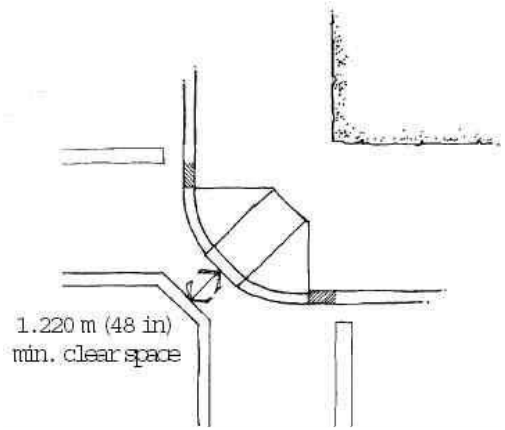


Figure 15: Diagonal Curb Ramp

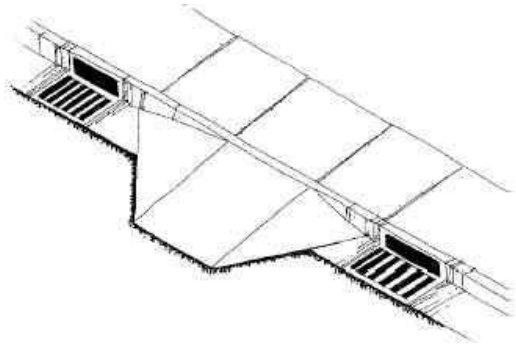


Figure 16: Built-up Curb Ramp

[7] Designing Sidewalks and trails for access, Best Practices Design Guide, U.S. Department of Transportation, Federal Highway Administration

3.1.1.5 Surface quality

Evenness of surface, slip resistance, and permeability are three important qualities of a pavement surface.

3.1.1.5.1 Evenness

Sidewalk should have an even surface along its length such that it is safe for kids and elderly people, and provides a smooth ride for wheel chair users. Specifically at driveways, height difference is noticed along most sidewalks. In such instances driveway height should be raised to make an even surface along the sidewalk. When minor differences exist between the sidewalk and the driveway due to topological constraints, the ramps with slope not exceeding 2% should be provided for ease of disabled people to maneuver in wheel chairs.

3.1.1.5.2 Slip resistance

The sidewalk surface should be slip resistant for safety of the pedestrians. Textured or matt finished even surface should be provided for sidewalks.

3.1.1.5.3 Permeability

The sidewalk surface should be permeable to allow some rainwater runoff to percolate and add to the ground water. Also permeable sidewalks will result in less pockets of standing water on the sidewalk surface.

3.1.1.6 Constraints for provision of good footpath/ sidewalk (potential solutions for these constraints)

3.1.1.6.1 Trees/utilities restricting width

Sometimes existing trees that are decades old are hard to deal with while providing pedestrian infrastructure. Such trees can be dealt with by either designing these sections of the ROW in a manner that one can maneuver around it or should be made sure to replace these trees along with their roots elsewhere such that they provide no obstruction.

3.1.1.6.2 Hawkers restricting width

Hawking zones can be an integral part of the Indian streets, as they encourage walkability, increase street activity and provide safety. These however, encroach upon the available clear width for pedestrians and hence become a nuisance in the Indian context where streets are narrow. Thus while designing new streets; one should keep some space as hawking zones so as to make streets vibrant and also provide a living for these hawkers.

3.1.1.6.3 Driveways obstructing surface evenness

Driveways should be designed in such a way that they do not hamper pedestrian right of ways, especially since these infrastructures are being used by physically handicapped as well. Property owners need to design their entrance/exit driveways such that the pedestrian walkways are not obstructed as shown in the designs below. These show three ways of designing the ramps at the intersection of an entry/exit of the driveways with the pedestrian infrastructure.

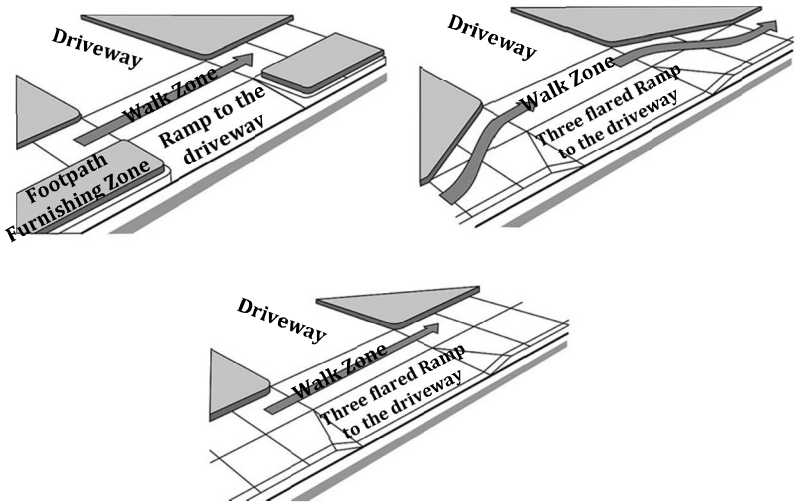


Figure 17: Preferred accessible designs for driveways. Web Source: http://www.ite.org/css/online/DWUT08.html

3.2 Planning the Street Corners

Street corners form an important part of the sidewalk network, where sidewalk of two streets meet. Crosswalk (like Zebra crossing, etc.) usually meets the sidewalk at the street corners (except at midblock crossings). It is a refuge for pedestrians, waiting for their turn to cross the road. Street corners also tend to be a place maker for people to stand and interact. In addition street corners host various utilities like traffic signal poles, traffic signal cabinets, light poles, street name signs etc. Hence street corners should be designed to accommodate all these activities.

Street corners should be sloped down to the road level for provision of crossing of the old and the differently abled people.

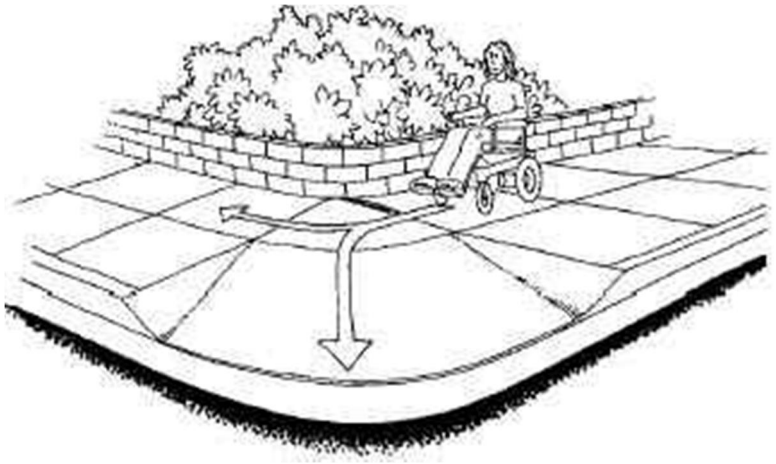


Figure 18: This wheelchair user is maneuvering successfully a curb ramp because a level landing is provided.

3.2.1 Accessibility to crosswalks

The following elements will help improve accessibility to crosswalk:

- Opening of the sidewalk railing should correspond with the crosswalk width.
- Ramp should be provided that leads directly to the crosswalk.
- The ramp landing should be surfaced with Tactile Pavement for guidance of disabled people with vision impairment to cross.
- Street corners can have a bulb projection to help reduce the length of crosswalk for pedestrians to cross the road, thereby requiring pedestrians to spend less time on carriageway.

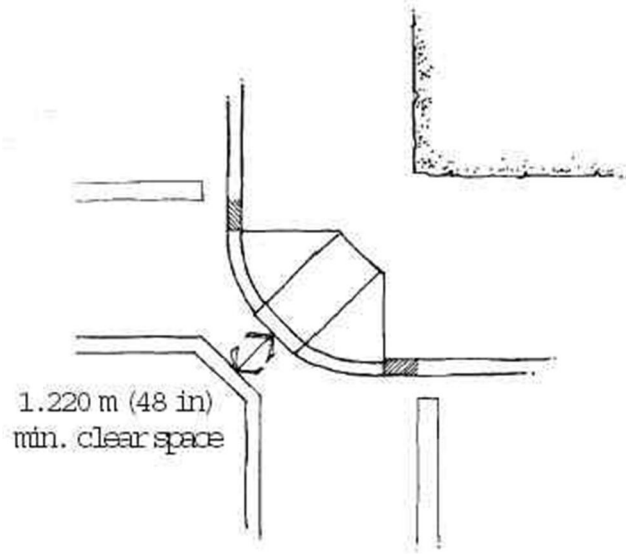


Figure 19: If diagonal curb ramps are installed, a 1.220-m (48-in) clear space should be provided to allow wheelchair users enough room to maneuver into the crosswalk.

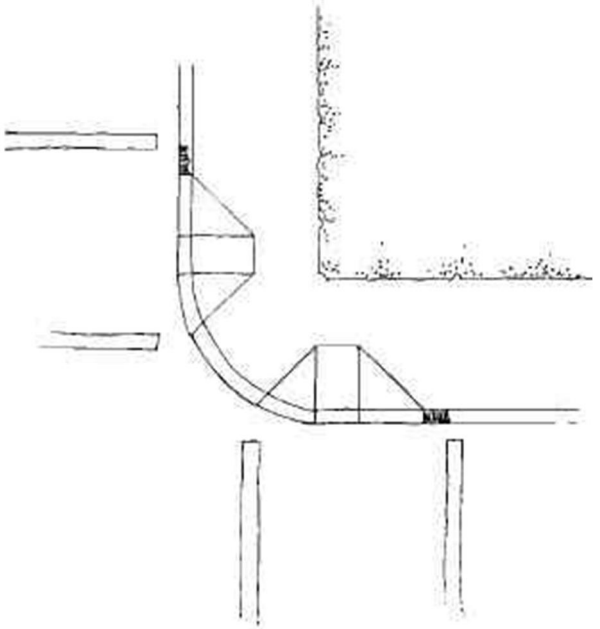


Figure 20: Two perpendicular curb ramps with level landings maximize access for pedestrians at intersections.

3.2.2 Street Corner waiting area

The designer needs to ensure that there is enough space to accommodate pedestrians waiting to cross the road, such that there is no obstruction to other pedestrians walking across the street corner. Additional space at cross street for accommodating pedestrians and utilities can be attained by:

- Use of bulb projection at street corners.
- Acquiring additional right of way where available.

The designer also needs to ensure that the street corners are safe in terms of visibility requirements and encroachment issues. Specifically that:

- Pedestrians have good visibility of the vehicles on all approaches before they cross.
- The motorists approaching the crosswalk have visibility of the pedestrians waiting to cross as well as the vehicles entering the intersection from the cross street.
- The turning vehicles do not encroach the cross street waiting area by the use of sidewalk railing or increased curb height.

Attributes of a good Street Corner[8]

- UNOBSTRUCTED SPACE: Corners should be unobstructed and have space to accommodate people waiting to cross.
- VISIBILITY: Corners should have good visibility of the travel lanes, and the motorists in the travel lanes should be able to see pedestrians at the corner easily.
- LEGIBILITY: Signages, road markings and symbols used at corners should clearly indicate actions to be taken by pedestrians waiting at the corner.
- ACCESSIBILITY: All the features on street corners, such as curb ramps, landings, pelican signal call buttons, signage, symbols, marking, etc. must meet accessibility standards.
- SEPERATION FROM TRAFFIC: A Street corner design and construction must be effective in discouraging turning vehicles from driving over the pedestrian area.

[8] Portland Pedestrian Design Guide, June 1998; Web Source: http://www.portlandonline.com/index.cfm?a=437808&c=61813

3.3 Planning Pedestrian Crossings/ Crosswalks

A crossing/ crosswalk is usually provided at an intersection or at the midblock section of a roadway where pedestrians intend to cross. The crosswalk can be at-grade or with a grade separation (such as subways and foot over bridges). At all intersections, crosswalk should be at-grade.

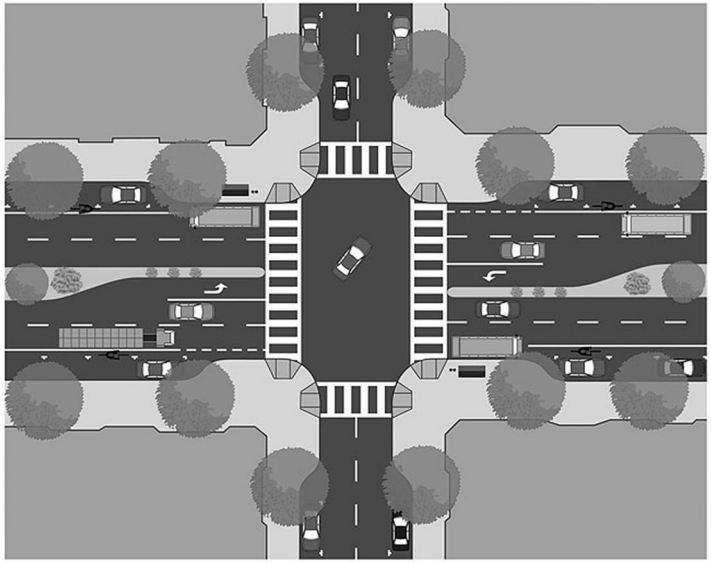


Figure 21: Example of a typical intersection crossings and accessible ramps.

At mid-block sections, at-grade crosswalk are recommended on all non-arterial streets, and, grade separated crosswalk is recommended on arterial streets and highways to reduce the exposure of pedestrians to vehicles travelling at high speeds.

Figure 22: Mid-Block section crossings; Source: Dan Burden, walklive.org

Although at grade is a preferred option, grade separation can be used where at grade solutions are found not feasible.

Figure 23: Midblock crosswalks provide opportunities to cross streets with long distances between intersection crossings. Claire Vlach, Bottomley Design & Planning.

Among the grade-separated crosswalks, foot over bridges and subways are the most common options available. To increase the perceived safety of subways is having public art, vendors/ street artists and other such activity inside such subways. Subways can be considered, when physical restrictions may exist to the construction of foot over bridges (example, when an elevated highway or an elevated BRTS lane exists).

On new arterial or when an arterial is reconstructed (or modified), provision of humped subways should be considered. A humped subway is a new concept where in the road elevates to height of 1.5 m (~5 ft.) and the subway is depreciated to a height of 1.2 m (~4 ft.) to provide enough clear height (2.7 m or ~9 ft.) for pedestrians and bicyclist to cross underneath the roadway, where in the distance pedestrians are required to climb down is significantly reduced as compared to traditional subways.

At-grade crosswalks should be provided at frequent intervals, at least at every 300 m (~985 ft.) on all sub-arterial roads, and connector roads. On non-arterial roads with high pedestrian activities such as around commercial or mixed land use, a crosswalk at every 100 m (~328 ft.) is preferred. Grade-separated crosswalk on arterial midblock sections should be provided at convenient locations where majority of pedestrians are expected to cross. However the spacing between crosswalks (at-grade or grade-separated) on an arterial should not be more than 500 m (~1650 ft.).

Details to be considered in designing a crosswalk are provided in the forthcoming section of this document.

3.3.1 Crosswalk Design

Designing an effective pedestrian crossing/crosswalk involves the correct layout of a variety of elements including[9]:

- Crosswalks and Crossing times;
- Curb Ramps;
- Medians, Refuge islands and slip lanes;
- Information/ signs, signals and markings;
- Turning radius and Sight lines;
- Traffic patterns; and
- Onset of Signal phases.

[9] Designing Sidewalks and trails for access, Best Practices Design Guide, U.S. Department of Transportation, Federal Highway Administration

3.3.1.1 At-grade Crosswalk

3.3.1.1.1 Delineation of crosswalk area

The crosswalk area can be delineated by either Zebra markings or by Raised crosswalks or by using themed crosswalks with different material to distinguish it from the regular asphalt of the road.

Zebra crossing should be used where pedestrian signalization or signalized intersections with pedestrian phase exists.

Raised crosswalks can be used at un-signalized intersections or at midblock section without a pedestrian signal so that the pedestrians are clearly visible forcing the motorists to slow down and thereby increasing the safety for the crossing pedestrians.

Figure 24: At grade crosswalk with a median refuge for pedestrians.

3.3.1.1.1.1 Zebra crossing

- The Zebra crossing should be no less than 3 m (~10 ft.) wide. Zebra crossings wider than 3m (~10 ft.) should be considered in locations with high pedestrian demand.
- A stop line shall be marked in advance of the Zebra crossing (1 to 1.5 m in advance) to prevent stopped vehicles from encroaching the Zebra crossing.
- Zebra crossing shall be in white color. But, when daytime visibility issues exist due to

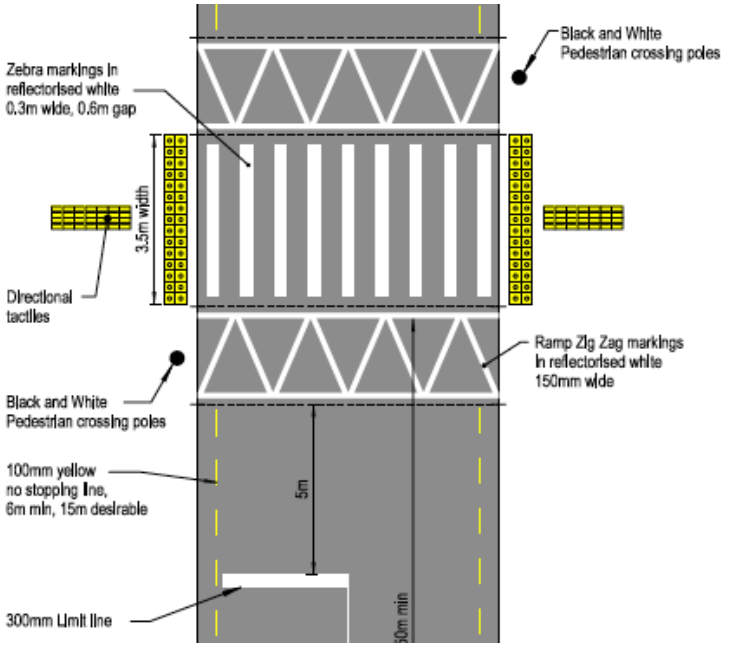


Figure 25: Zebra Crossing in white Retroreflective marker.

lack of contrast between the Zebra marking and the pavement color (eg. White Zebra marking on new concrete road has low contrast), then conspicuity of the Zebra marking can be increased by using a black bordering around the white Zebra marks. Retro-reflective paint shall be used for all Zebra markings to enhance the visibility of the crossing at night. Where sufficient overhead lighting is not available, Raised Retro-reflective Pavement Markers (RRPMS, also termed as Cat Eyes) can be used to improve the visibility of Zebra crossing at night.

- Zigzag markings: The zigzag lines are found on the approach to any form of pedestrian crossing. They denote an area where vehicles should not be parked because it causes a vision obstruction to do so, and where you should not pass the leading moving vehicle (overtaking a vehicle is not allowed in this zone), for pedestrian safety. These lines can be used at places where additional safety for pedestrians is required, such as outside of school entrances, and on residential intersections.

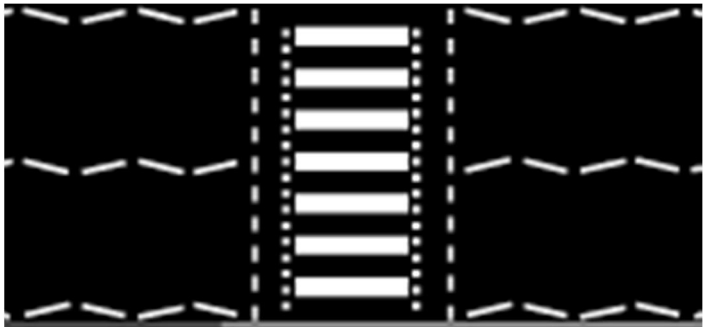


Figure 26: ZigZag markings approaching towards a crosswalk at a busy intersection.

3.3.1.1.1.2 Themed Crosswalks

- Themed crosswalks can be used on streets that are buzzing with pedestrian activities, like a shopping district or an important boulevard, where Crosswalks can be designed using different materials and colors of pavements. These themed crosswalks can serve as public art as well.

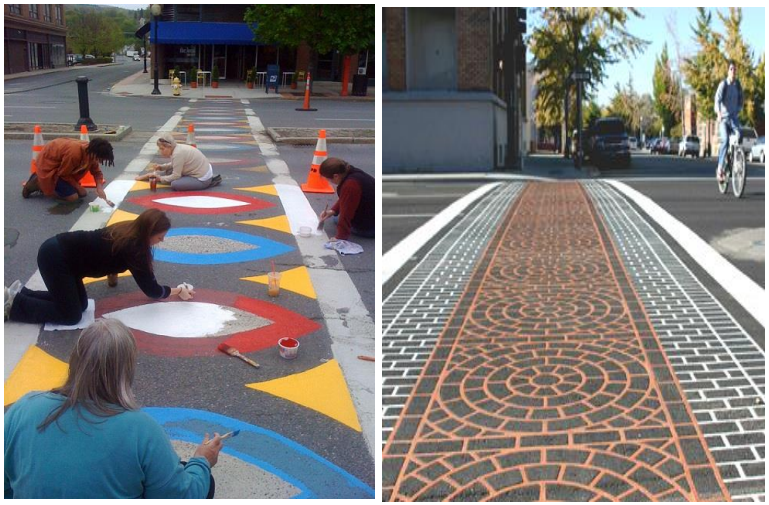


Figure 27: Public Art can be carried to the crosswalks in busy districts where they could be themed (using different colors or patterns of pavement. Web Source: www.mainstreetmail.com, www.contextsensitivesolutions.org

3.3.1.1.1.3 Raised crosswalks

- Raised crosswalk shall have a minimum width of 3m (~10 ft.). Increased width can be considered when high pedestrian activities exist or are anticipated.
- The surface level of the raised crosswalk should coincide with level of the sidewalk, so that the transition from sidewalk to the raised crosswalk is even and smooth.
- The surface of the raised crosswalk should be skid resistant.
- The climbing and descending edges of the raised crosswalk should have a slope of 1:8.
- The sloped edges of the raised crosswalk should be painted with retro reflective paint for night time visibility of the approaching motorists.

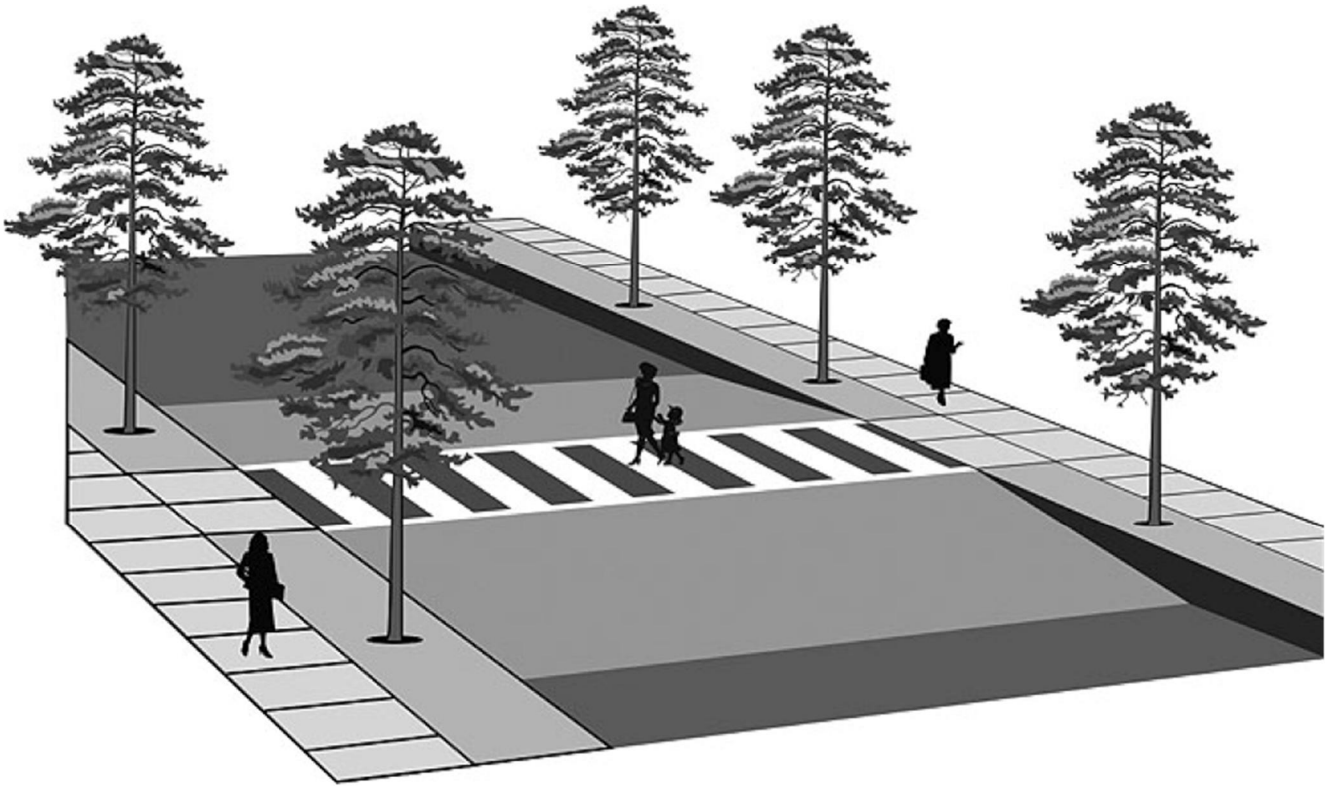


Figure 28: The raised roadway crosswalk concept combines midblock crosswalks with traffic calming devices. Kimley-Horn and Associates, Inc.

3.3.1.1.2 Pedestrian signals

- At all signalized intersections, pedestrian phase shall be incorporated in the signal-phasing plan. The designer should provide sufficient time for the pedestrian phase such that the people waiting to cross can safely clear the crosswalk.
- Audible signals (at Pelican crossings) should be provided for the benefit of pedestrians with low vision or vision impairment.
- The acoustic device should preferably be installed on both ends of the crosswalk for better audibility of pedestrians originating from either ends of the crosswalk.
- When signals are provided with push buttons, the push buttons should be accessible to people on wheel chairs.
- The height of the push button should be approximately 1.1m (3.5 ft.) and no more than 1.2m (4 ft.) from the footpath surface.
- Push buttons should be located parallel to the crosswalk and a proper sign explaining the purpose and use of push buttons should mounted on top of the push button in a way that the sign is clearly visible.
- Since a street corner can have more than one crosswalk, a sign on top the pushbutton should indicate which crosswalk is activated through that pushbutton.
- The crosswalk ramp should be easily accessible from the pole where the pushbutton is located.

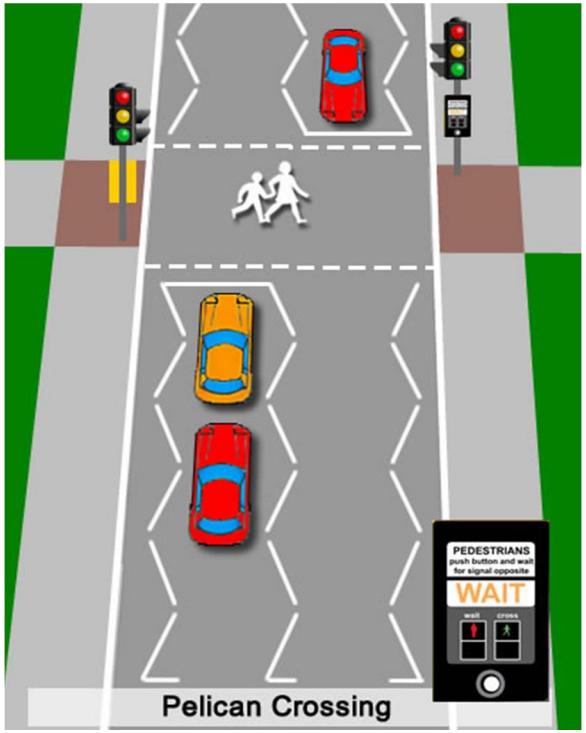


Figure 29: Diagram showing intersection with zigzag markings, where pelican signals have been installed.

3.3.1.2 Grade Separated Crosswalk

- All foot over bridges and subways should be universally accessible. (Staircase + Ramp or Staircase + Elevator for universal accessibility).
- Minimum size of the elevators provided for foot over bridge or subways should not be less than 1.4m x 1.4m.
- For ramps, a 5% slope with appropriate landings is preferable.
- Grade separated crosswalks should be well lit and pleasantly decorated to create an inviting atmosphere for pedestrians to use.
- The foot over bridge should be provided with roof covering and the sides of the FOB should not be fully covered as it hampers visibility.
- In Figure 29, shows a poorly designed Skywalk in Bangalore. The reason it is unused is because of the discomfort a pedestrian faces while using it. The skywalk consists of 2 flights of staircase and no ramps/ escalator/ elevator, rendering it unusable for physically disabled and senior citizens.

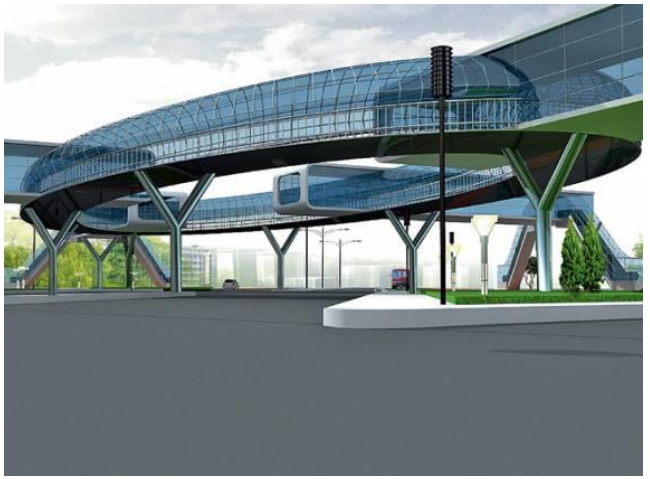


Figure 30a: Example of some well designed skywalks, which are accessibly by escalators and lifts. Proposed Skywalk at Kochi Metro, India.

Figure 30b: Example of well-designed pedestrian Bridge, HELIX Pedestrian Bridge, Seattle.

Figure 31: Example of poorly designed skywalks, at High Ground, Bangalore.

3.4 Planning Pedestrian Refuges

Medians are a part of the roadway that physically divides the two directions of traffic. Medians can also be used as a refuge for pedestrians crossing the road. Median pedestrian refuge area should have sufficient width to accommodate pedestrians. All the accessibility considerations described for the street corner (Section 3.2: Planning Street Corners, Page 30) will also imply to the median pedestrian refuge area. Bollards should be used at the median access such that vehicles are discouraged from using the refuge area for maneuvering 'U' turns. However the gap between the bollards should be sufficient (approximately 42 inches) for wheel chair users to maneuver comfortably.

Figure 32: This boulevard median serves as a pedestrian refuge, a community gateway and area for landscaping. Source: Kimley-Horn and Associates,Inc.

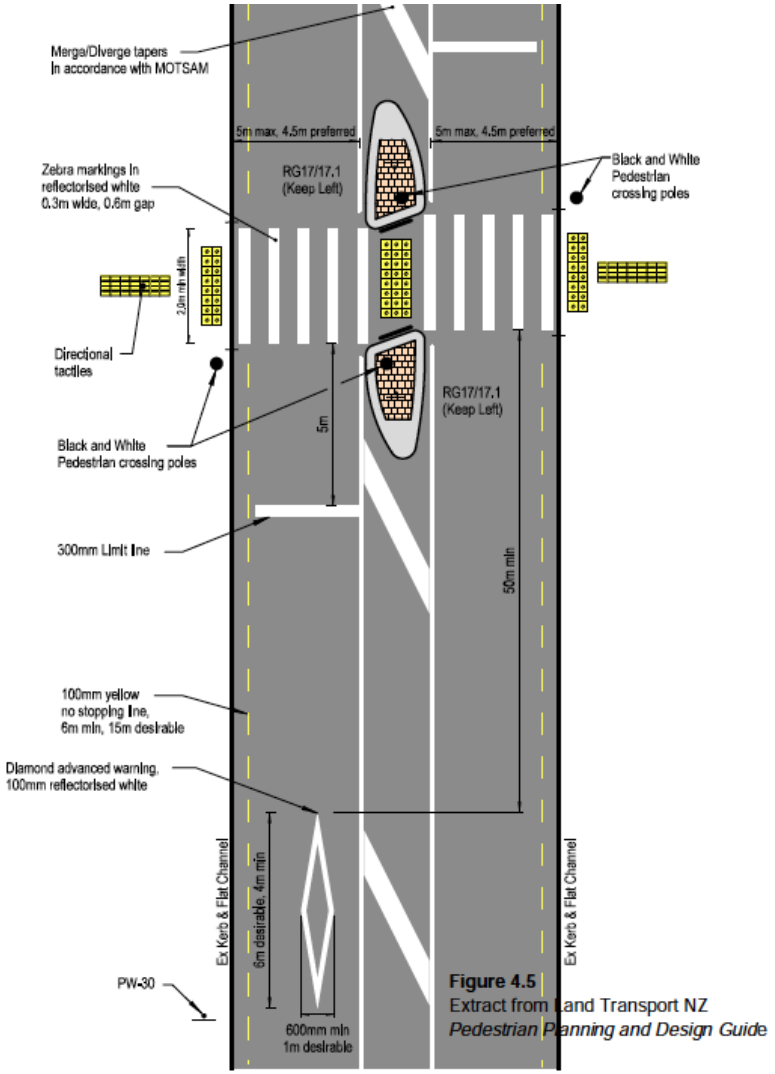


Figure 4.5
Extract from Land Transport NZ
Pedestrian Planning and Design Guide

Figure 33: Diagram showing the design of a crosswalk with pedestrian refuge.

3.5 Planning for Pedestrian Only Streets

As discussed in section 3.1, streets are not only for circulation and mobility, but also for place making (for people to walk, gather & socialize). Pedestrian only streets provide a great means for place making on selected roads. Following guidelines should be followed to plan for pedestrian only streets:

- High density of commercialization along the street.
- High level of pedestrian activity.
- Optimum lighting for safety.
- Good street infrastructure like seating and landscape.
- Preferably should be a collector or a local street.
- Carriageway operating overcapacity.
- Connecting streets with well-designed sidewalks.
- Public transportation accessibility nearby.
- Vehicle parking availability nearby (either on street or multistoried parking).
- Provision for loading and unloading goods (designating times for the same).

Pedestrian only zones should be protected from vehicle intrusion by use of physical restrictions such as bollards and enforcement.

3.6 Planning Bikeways along Sidewalk

When physically segregated bicycle lanes cannot be provided on the carriageway, bicycle lanes (or bikeways) should be planned along the sidewalk. An arrangement where bicycle lane forms a part of the sidewalk will be termed shared sidewalks. Bikeways can be provided in the following three ways:

- Bike lanes along the carriageway, Unsegregated.
- Bike lanes along the carriageway, Segregated.
- Bike lanes along the sidewalks.

Out of the three, bike lanes along the sidewalks, sharing space with the pedestrians provide greater safety as compared to bike lanes sharing the carriageway. However when a bicycle lane is planned on a shared sidewalk, sufficient additional width should be allocated to the sidewalk. A minimum of 1.5 m additional width for sidewalk should be allocated to accommodate bicycle lanes.

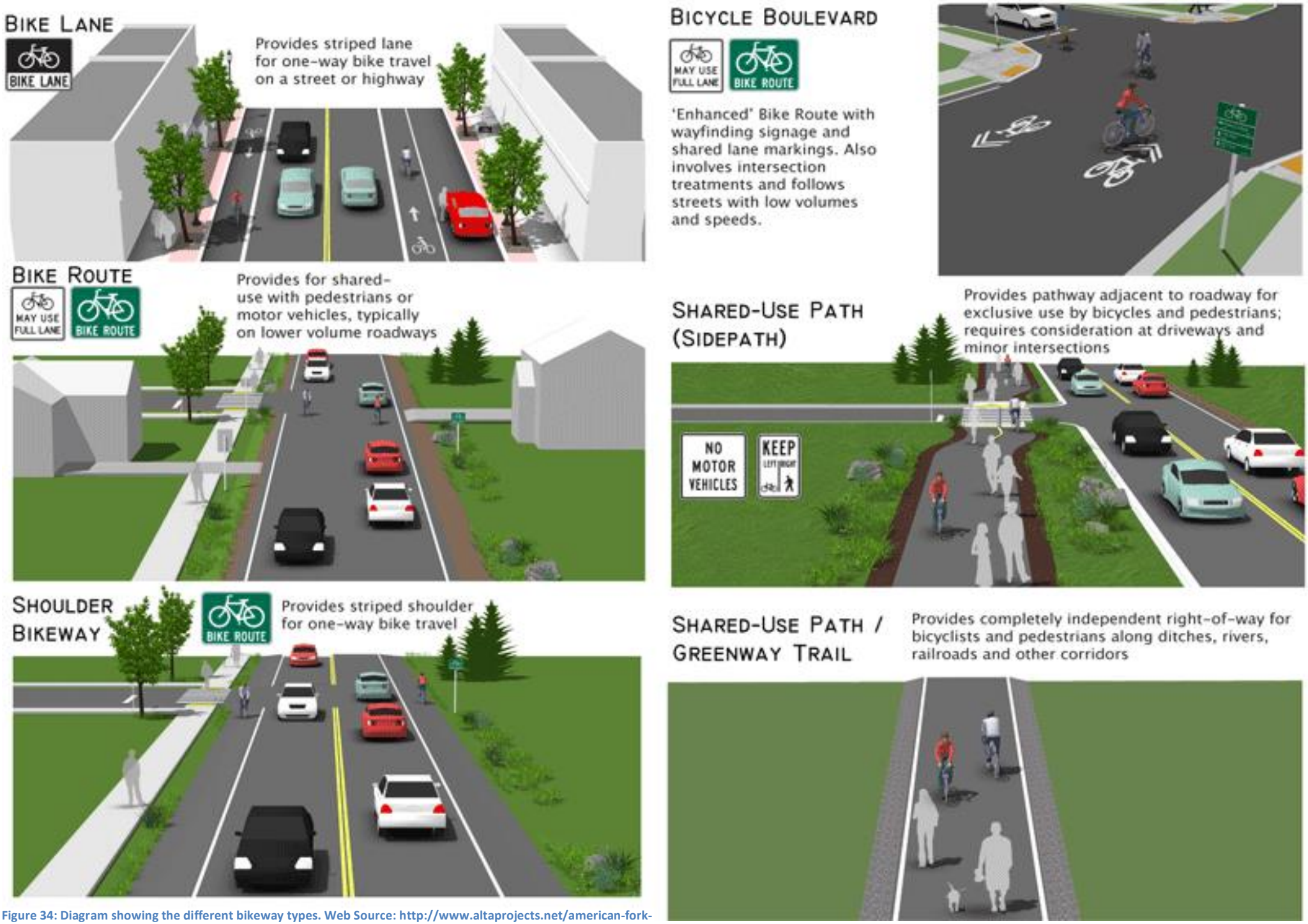


Figure 34: Diagram showing the different bikeway types. Web Source: http://www.altaprojects.net/american-fork-bicycle-and-pedestrian-master-plan/

3.7 Planning of Utilities on Sidewalk

Footpath/ Sidewalks, apart from accommodating pedestrians, also accommodate several roadside utilities (like bus shelters, light poles, transformers etc.) and pedestrian utilities (like benches, directional maps, etc.). Some guidance on location of bus shelters, provision of pedestrian lighting, provision of hawker space is provided in the subsequent pages.

3.7.1 Bus Shelter Location

Bus shelters can be carved out at niches in the street furnishing zone of the footpath/ sidewalk, such that pedestrians can walk clearly behind the bus shelter without getting into conflict with the people waiting at the bus stop. Other considerations for placement of bus stops are:

- Convenient location to major land use (pedestrian generator).
- Convenient to transfer.
- In commercial places bus stops should be located at every 200m -400 m intervals.
- Bus stops near intersections should be at least 50 m from the intersection curb.
- Bus stops shall be placed on the far side of an intersection.
- Bus stops should preferably be located away from busy driveways to avoid conflict between passenger alighting buses and the vehicles turning onto the road from the driveway.
- Bus stops on either side of the streets should be placed in a staggered manner, such that when two buses pass on either side, there is minimum traffic congestion at that point.
- Bus stops should be avoided at the entrance/ exit of any building/ complex.

Figure 35: Proposed Bus Shelter design modules by DULT

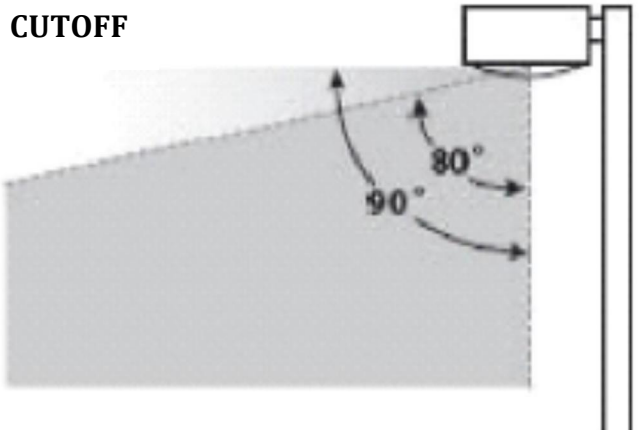
3.7.2 Pedestrian Lighting

Proper lighting is an important aspect for the perceived safety of a pedestrian facility. Pedestrian lighting should be provided:

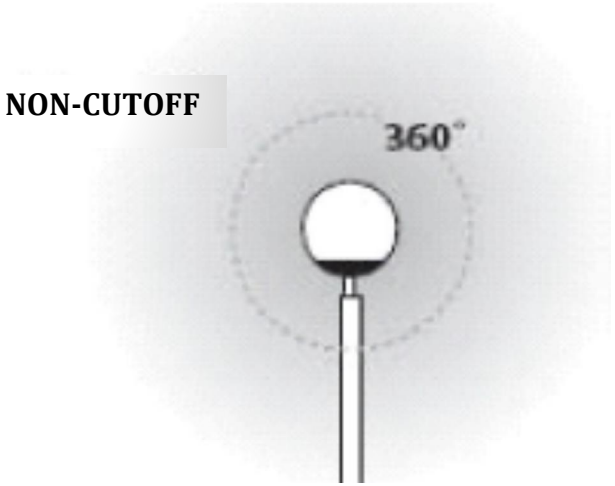
- Along the sidewalk,
- At street corners,
- At access to at-grade crosswalk, and,
- All subways and foot over bridges should be well lit.

For illuminating pedestrian facilities, pedestrian specific lighting is preferred over the general high mast street lighting. Pedestrian light poles are of low-mast, 3 to 5 meters tall. The following design aspects of pedestrian lighting are desirable:

- Full cutoff light fixture, which only directs light downwards, is preferable to reduce the ambient light and glare.
- Pedestrian lighting should be energy efficient.
- Trees and boarding should not obstruct the lighting.



ALLOWS:
25cd per 1000 lamp lumens at or above 90 degrees __ 2.5%
100 cd per 1000 lamp lumens at or above 90 degrees __ 10%



ALLOWS:
Unrestricted distribution of light at any angle

Figure 36: Pedestrian lighting

3.7.3 Hawker Zone

Designated Hawker Zones must be allowed to locate in areas where pedestrians tend to wait or congregate i.e. street intersections and near bus stops or major civic destinations, public offices, etc.

Hawkers provide a wide variety of services and amenities to people, at convenient locations – with negligible investment and infrastructural costs.

- They form the eyes of the street to keep streets safe
- They keep streets clean, busy, vibrant
- They provide a variety of cheaper food and retail options.
- They express our unique culture.
- They generate self-employment for a large number of people.

Hawkers must be given designated space within the road Right-of-Way, so that they don't occupy the minimum clear width required for pedestrians to walk. And to keep our streets clean, essential utilities also must be provided as outlined in the National Policy for Urban Street Vendors:

- Provide provisions for solid waste disposal
- Public toilets to maintain cleanliness.
- Aesthetic design of mobile stalls/ push carts
- Provision for electricity
- Provision for drinking water
- Provision for protective covers to protect their wares as well as themselves from heat, rain, dust etc.
- Storage facilities including cold storage.

3.8 Safety Consideration for Improving Pedestrian Environment

While many of the aspects discussed in this guideline has direct influence on pedestrian safety and comfort, two important aspects that significantly improve pedestrian safety through the restriction of vehicular speeds and movements are discussed here.

3.8.1 Traffic calming

Traffic calming pertains to use of measures to reduce vehicular speeds. Benefits of reduced speeds through traffic calming are:

- Provides motorists with additional time to react and avert conflicts with pedestrians
- Provides ample gaps in the traffic for pedestrians to safely cross the roads
- Discourages motorists (especially cars and larger vehicles) from predominantly using local roads to commute

Hence traffic-calming measures are recommended at all location on the road approaching conflicting areas between pedestrians and motorists. Specifically traffic calming measures are recommended at the following locations:

- Near all at-grade crosswalk without pedestrian signalization
- At signalized at-grade crosswalk with high speeds (speed limits greater than 35 km/hour).
- Near school zones (on roads 100 m on either side of a school).
- Around parks and recreational areas where significant pedestrians are expected.
- On local residential streets where significant cut-through commuter traffic exists.
- In heavily commercialized areas, where pedestrian traffic is more dominant than vehicular traffic.
- Any other locations where significant conflict between pedestrians and speeding vehicles is noticed.

Below is a list of various measures that can be used for traffic calming:

- Reduced lane width/reduced carriage way
    - Curb extensions/bulb outs.

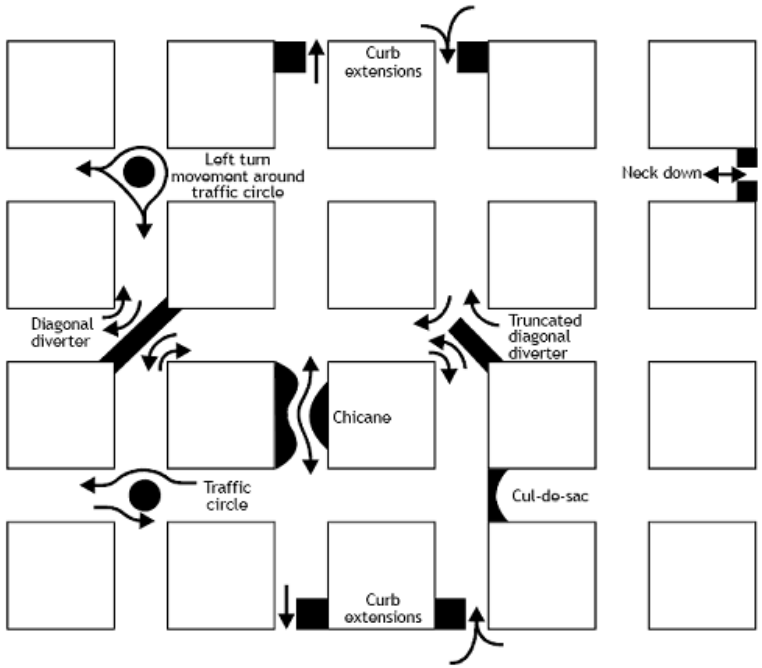
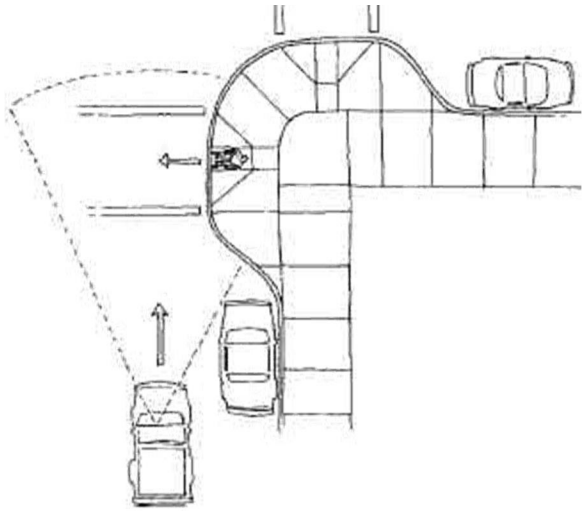


Figure 37: Examples of traffic calming elements. Source: Federal Highway Administration University Course on Bicycle and Pedestrian Transportation; Web Source: http://www.fhwa.dot.gov/publications/research/safety/pedbike/05085/chapt20.cfm

Figure 38: The diagram below shows the curb extension and bulb-out of the curbs for better visibility of pedestrians by the vehicles



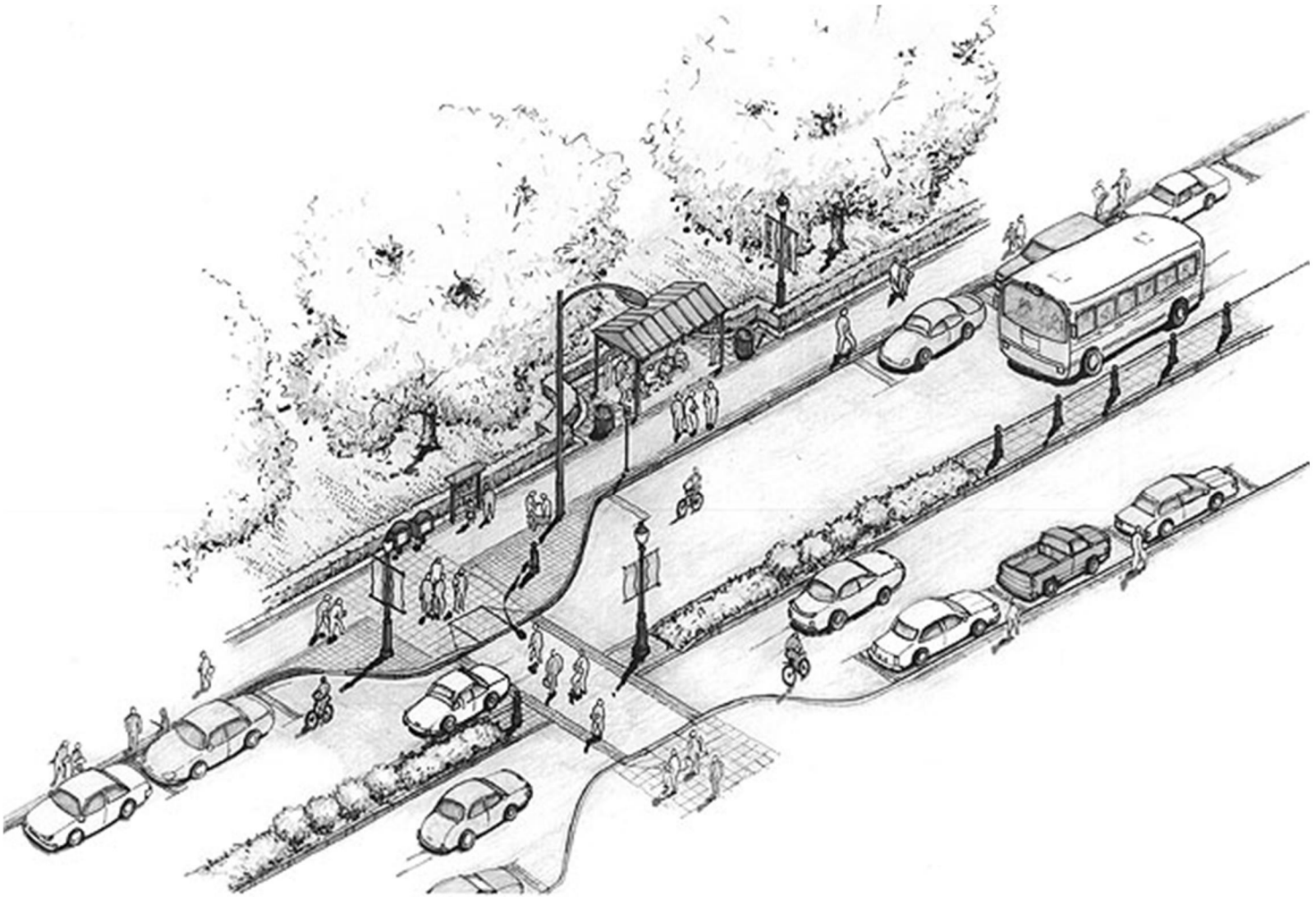


Figure 39: Refuge islands can be used at midblock locations, channelized right turns, or at long intersection crossings. Kimley-Horn and Associates, Inc.

    - Use Lane Markings.
- Speed humps or rumble strips.
- Road curvatures that is only maneuverable at lower speeds.
- Landscaping with trees on both sides of a carriageway.

- Chicanes and round-abouts in residential and heavily commercialized areas, which will need the driver to be alert at all times.

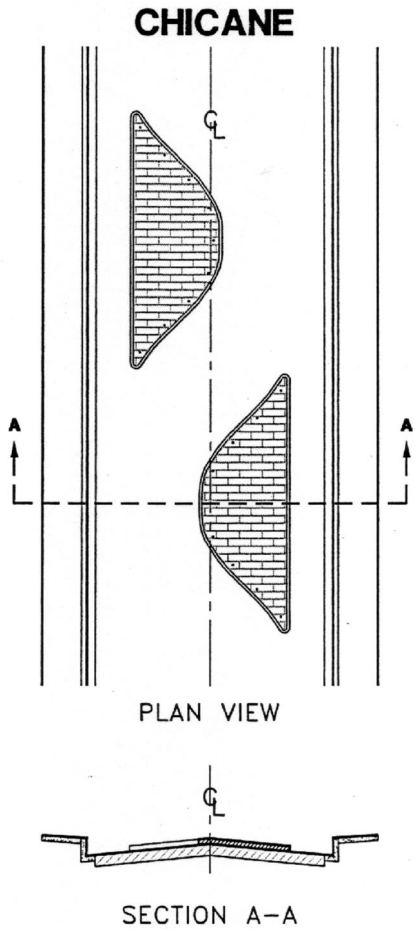


Figure 40: Chicanes as a traffic calming element.

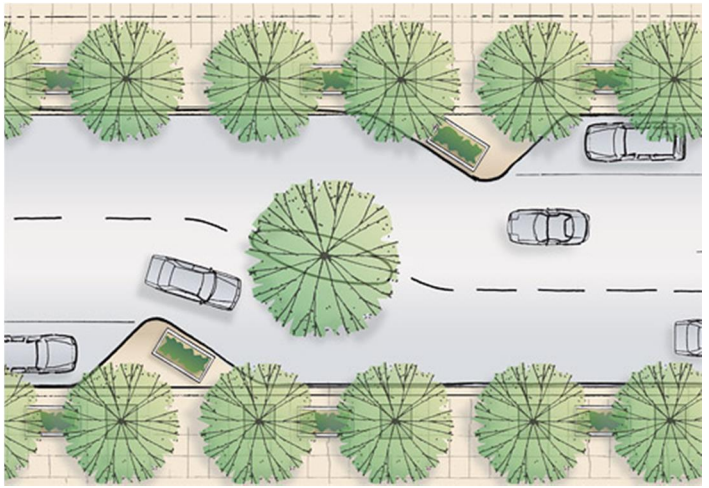


Figure 41: Road with Chicanes

3.8.1.1 *Footpath/ Sidewalk protection from vehicle intrusion*

Footpaths/ Sidewalks are often found misused by motorists (especially 2-wheelers) to get ahead of queue at congested intersections.

Figure 42: Pedestrian facilities being used by Two-wheelers

This can significantly compromise safety of pedestrians. When such intrusion of vehicles on sidewalk is observed, sidewalks should be barricaded with railings. Bollards should be strategically used on sidewalks, medians, and pedestrian refuges and at access to crosswalks to discourage vehicles from using the pedestrian facilities. However when bollards are used spacing between the bollards should be designed for wheel chair maneuverability (approximately 42 inches spacing is recommended).

Sidewalks along all arterial roads and highways shall be protected by use of railings. The railings should be able to withstand the impact of a crash at the roadway design speed without allowing the crashed vehicle to intrude onto the sidewalk. Additionally, on sidewalks along arterials and highways, trees and plants can be set at frequent intervals to shield the pedestrians from fast moving traffic to increase the perception of safety for pedestrians.

Case Study 4.1 – Malleswaram, Bangalore

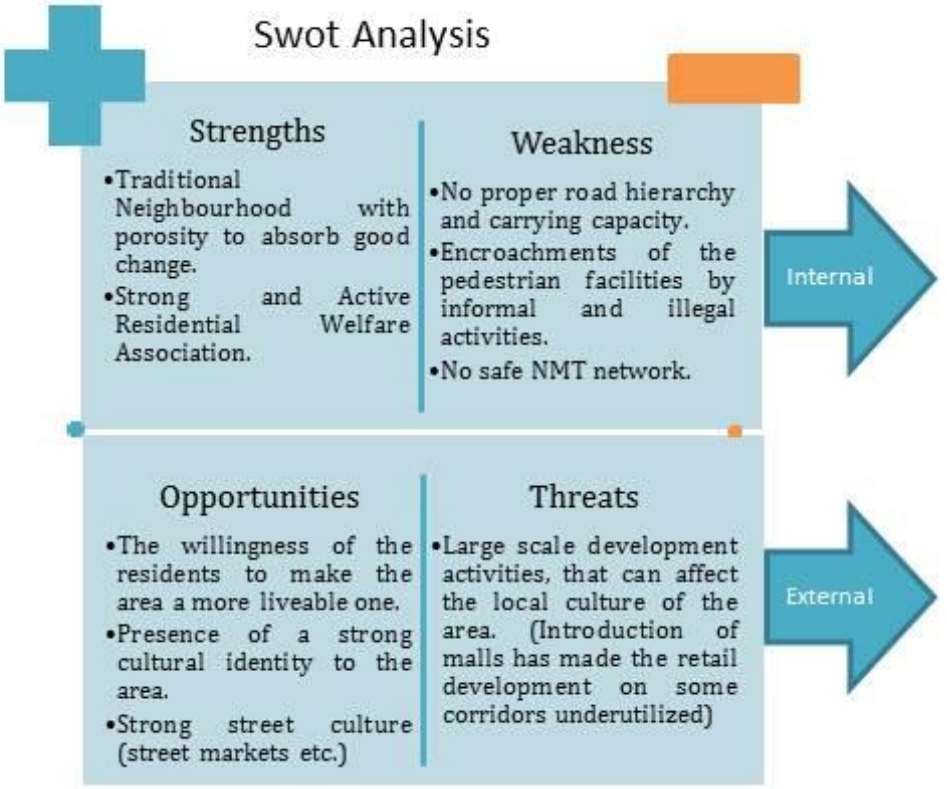
Introduction To The Area

Malleswaram is one of the oldest residential neighbourhoods, and a cultural hub situated towards the north-west of Bangalore city centre. Apart from being a cultural hub, Malleswaram also imposes the traffic one has to crawl through on Sampige and other adjacent roads

M{A}P Study Area:

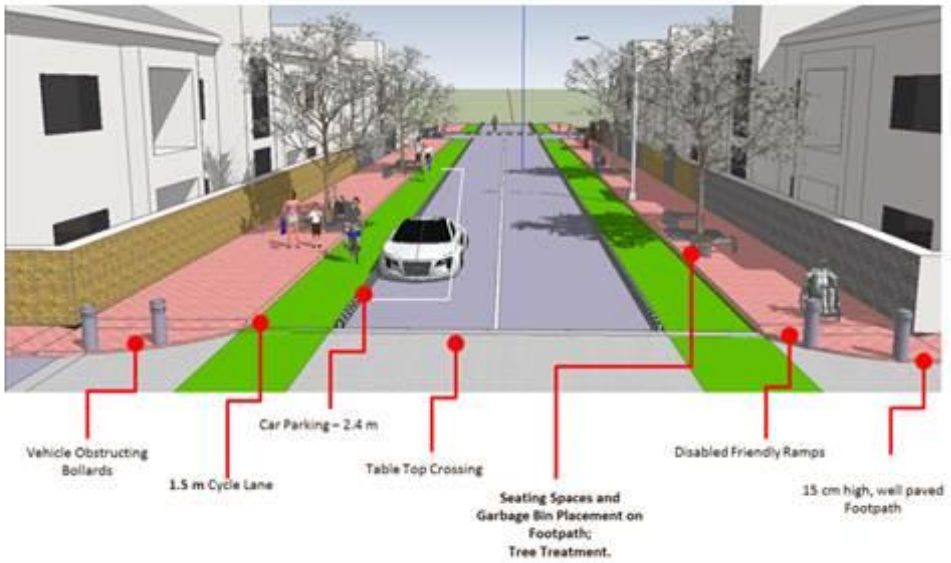
- **Area : 1.7sq km**
- **Boundaries:**
  - **North: 18th Cross Road**
  - **East : Sampige Road**
  - **South : 5th Cross Road or Mahakavi Kuvempu Road**
  - **West : Railway Line**
- **Land use**
  - **Residential : 70%**
  - **Commercial : 15%**
  - **Recreational : 3%**
  - **Institutional : 10%**

Swot Analysis

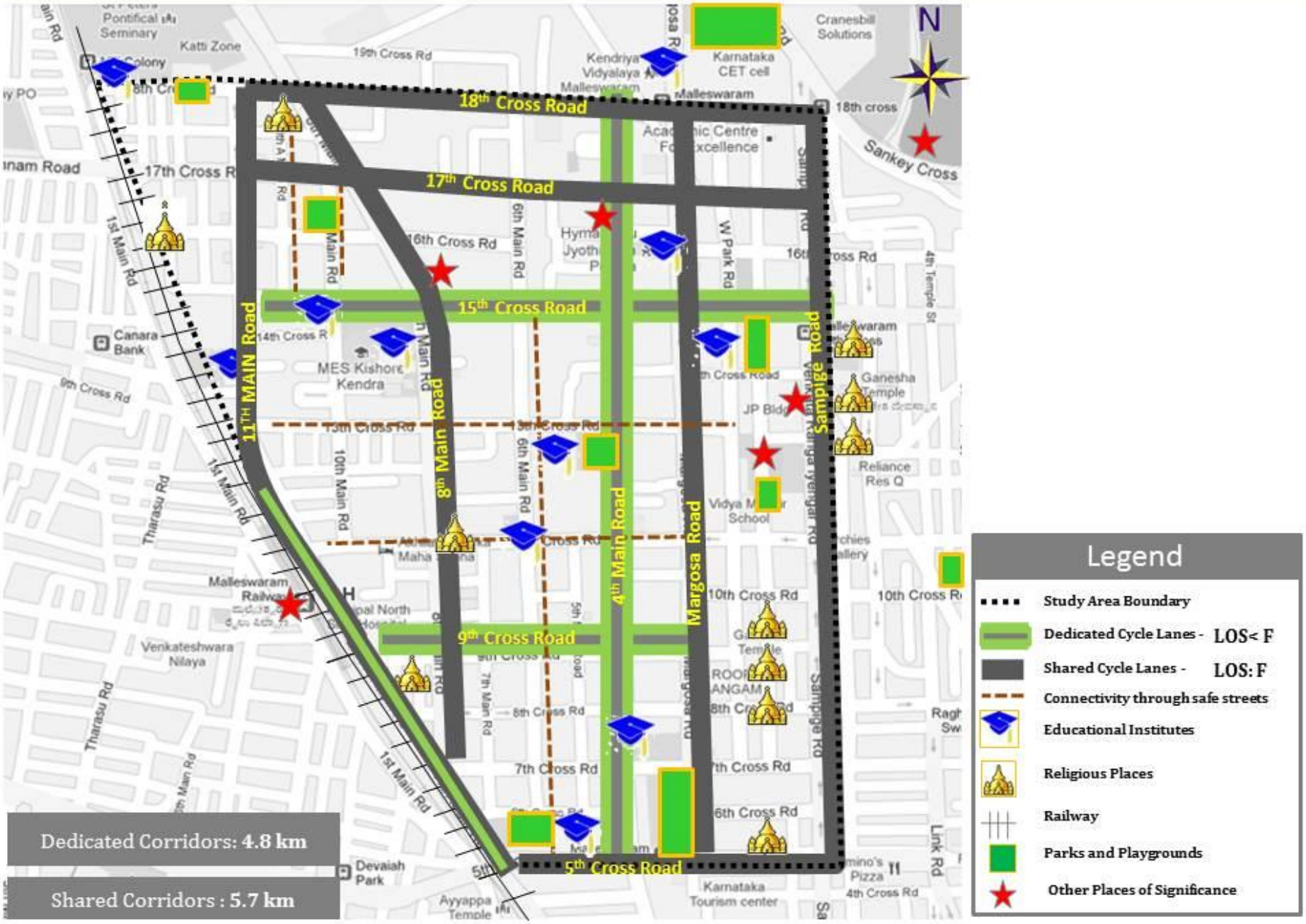


Description Of Pedestrian Improvements Proposed

The Malleswaram Accessibility Project's objective was to survey the existing modes of transport and the commuting problems of local people and use such data to create "Awareness" among the community regarding their neighbourhood and preparation of a Neighbourhood Accessibility Plan that places importance on sustainable transport modes as cycling, walking and Public Transportation.



NMT Network



4.1.2 CASE STUDY– Malleswaram, Bangalore

Case Study 4.2 – Gandhi Bazaar, Bangalore

Introduction to the Area

A Bazaar in South Bangalore with bustling hawking activity and pedestrian movement.

The street markets offer pedestrians an engaging experience, as the hawkers on the street sell fruits, vegetables, flowers and other ingredients used for daily Hindu ceremonial activities, plastic utilities, clothes, handicraft items and much more at nominal prices.

Apart from the robust street market, the retail in this area also provides all kinds of services like mobile phone and accessories buying and repair, groceries etc.

This area is found congested during evening peak hours and during festive seasons.

SWOT Analysis

Strengths

- Active street markets
- Traditional Bazaar and growth of hawking activities.

Weakness

- No road carrying capacity.
- Encroachments of the pedestrian facilities by informal activities.
- No safe NMT network.

Internal

Opportunities

- Presence of a strong cultural identity to the area.
- Strong street culture (street markets etc.)

Threats

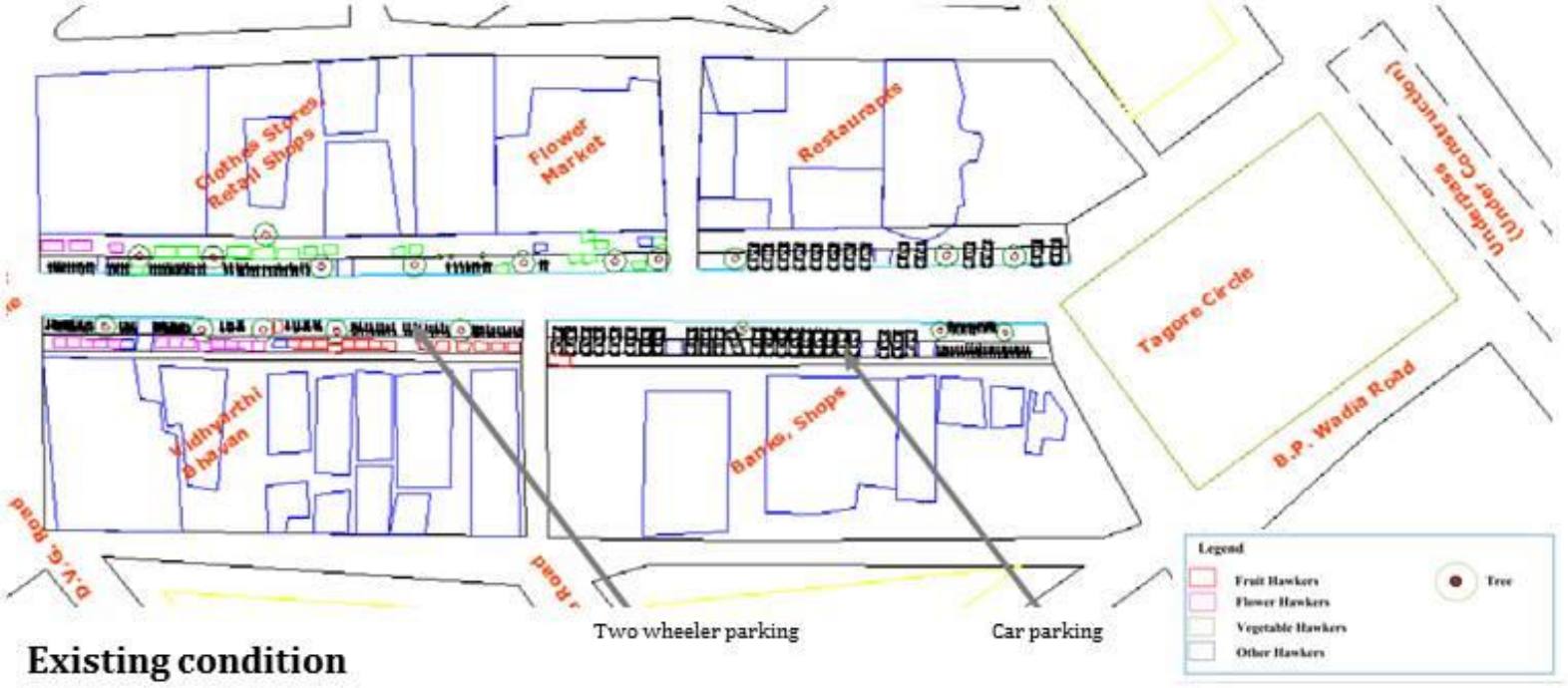
- Limited pedestrian infrastructure
- Uncontrolled/ Unregulated Growth of hawking activity.
- Growth of private vehicular activity in the area.
- More than 50% of the people surveyed opposing to the idea of complete pedestrianization.

External

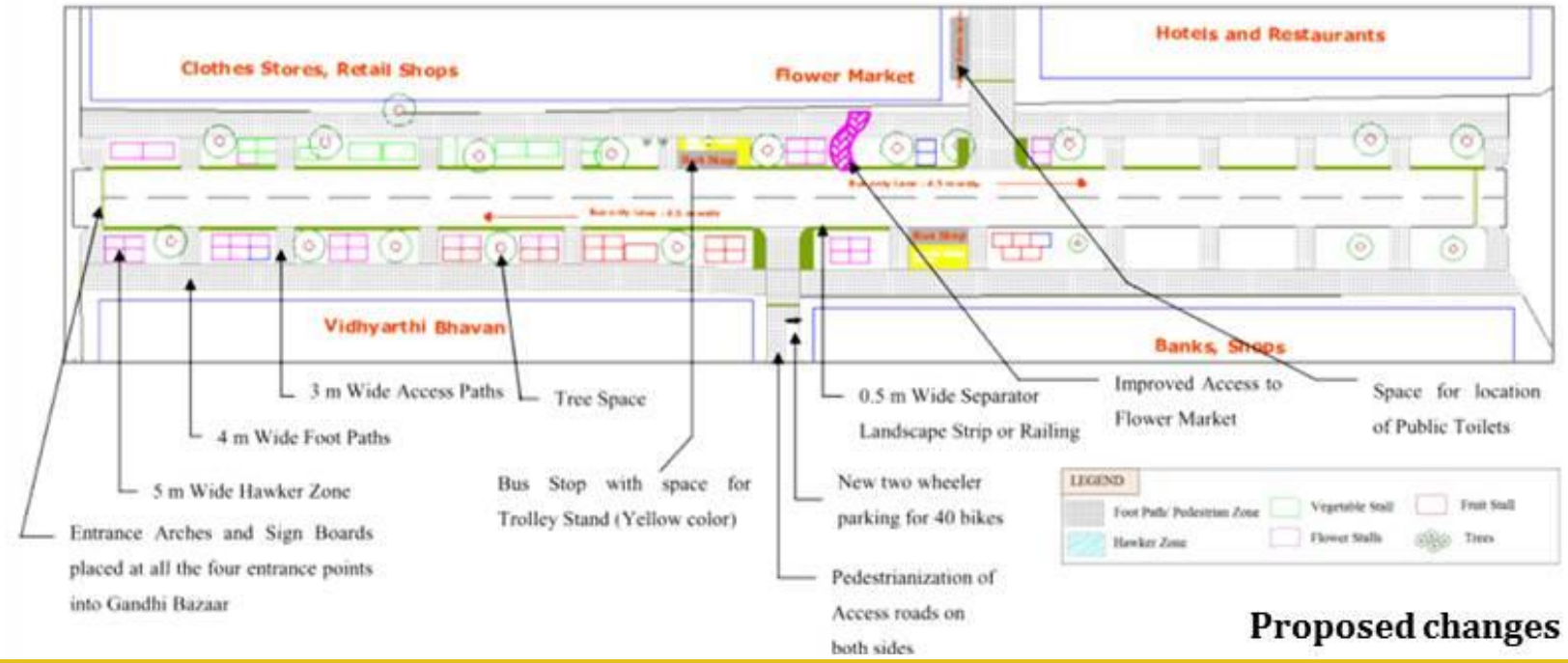
Description of the Proposals for Pedestrian Improvements

- Designed and designated places for hawkers, by product categorization of hawkers.
- Vehicular traffic allowed during off peak hours, and during peak hours the streets are completely pedestrianized, and vehicular traffic to be diverted along parallel roads.
- On street as well as Multi-Level parking facilities to be provided.
- During festival times, full pedestrianization of the area.
- Awareness program for the hawkers.
- Formation of Welfare association for the shopkeepers and Hawkers for their general maintenance and regulation.

4.2.1 CASE STUDY– Gandhi Bazaar, Bangalore



Existing condition



Proposed changes

4.2.2 CASE STUDY – Gandhi Bazaar, Bangalore

1. National Urban Transport Policy, *Ministry of Urban Development, Government of India* *Web-Source:* *http://urbanindia.nic.in/policies/TransportPolicy.pdf*
2. Draft Pedestrian Guidelines 2011, *Directorate of Urban Land Transport, Government of Karantaka*
3. Bangalore Mobility Indicators, Directorate of Urban Land Transport
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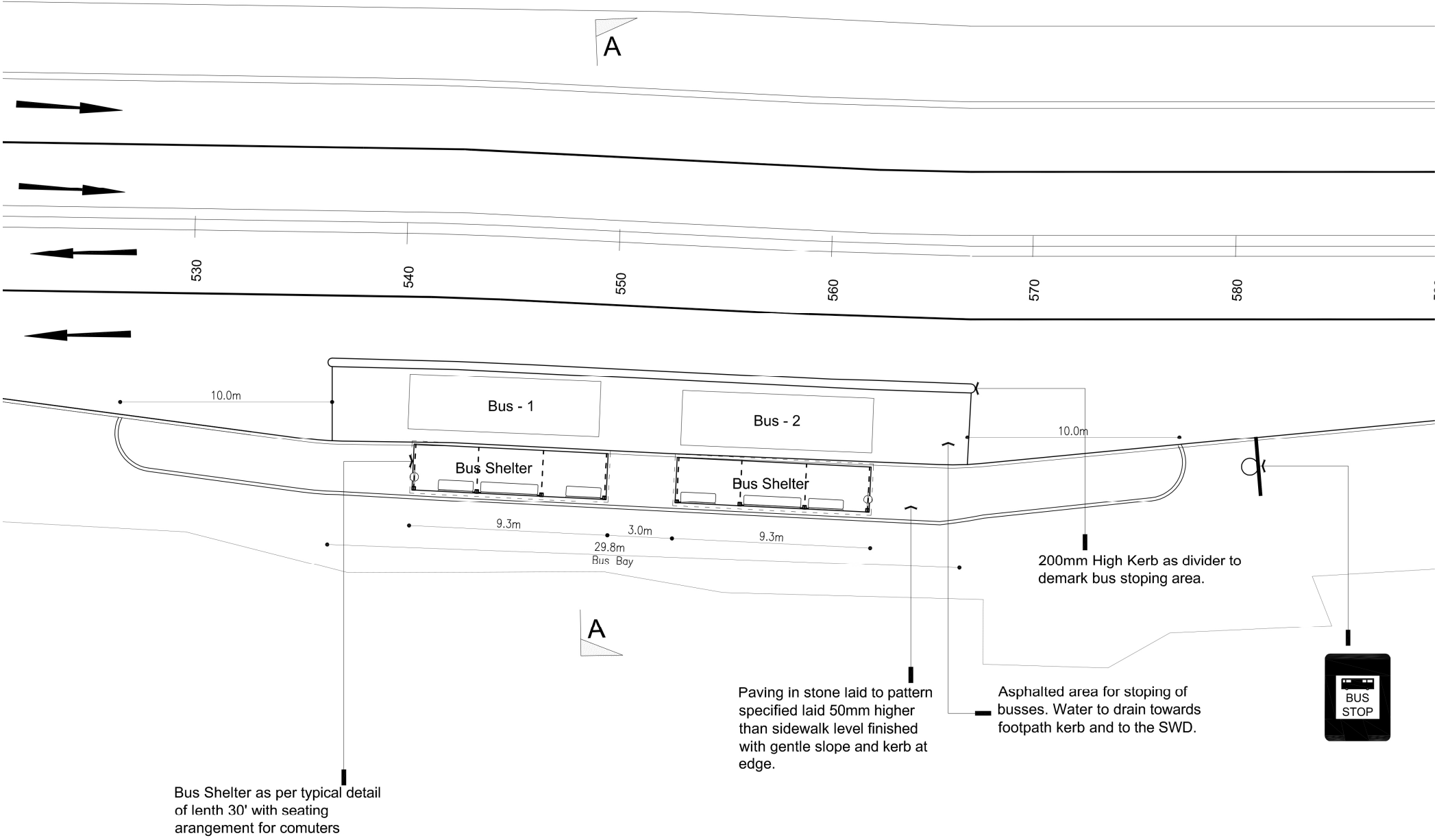
5. Public Realm Design Manual, A Summary of District of Columbia Regulations and Specifications for the Design of Public Space Elements; *Government of the District of Columbia*
6. A Healthy By Design Report, Road to Health: Improving walking and Cycling in Toronto, April-2012; *Web-source:* *http://www.toronto.ca/health/hphe/pdf/roadtohealth.pdf*
7. Wanderlust: A History of Walking; *Rebecca Solnit*
8. Pedestrian Facility/ Sidewalk Infrastructure Improvement Plan; *City of Roberta, Georgia*
9. Miscellaneous Pavement Markings, February 2010; *New Zealand Transport Agency, Waka Kotahi*
10. Portland pedestrian Design Guide, *City of Portland, Office of Transportation, Engineering and Development, Pedestrian Transportation Program.; Web source:* *http://www.portlandonline.com/index.cfm?a=437808&c=61813*
11. Photo Credits: Picture on the Cover Page of Chapter 2.0: City of Gulfport, Mississippi, USA; Downtown Gulfport Streetscape. *Source:* *http://www.hdrinc.com/portfolio/downtown-gulfport-streetscape-* *plan:*
12. Figure 3: City of Ottawa, Canada; Streetscape Design. *Source: http://chelkowski-urban-design.com/portfolio.php*

5.0 BIBLIOGRAPHY

6.0 ANNEXURE: BUS SHELTER DESIGN GUIDELINES



Vistar Consultants
374, Krishna Rukmini Complex,
Judicial Layout, R.T. Nagar,
Bangalore 560032

PROJECT:

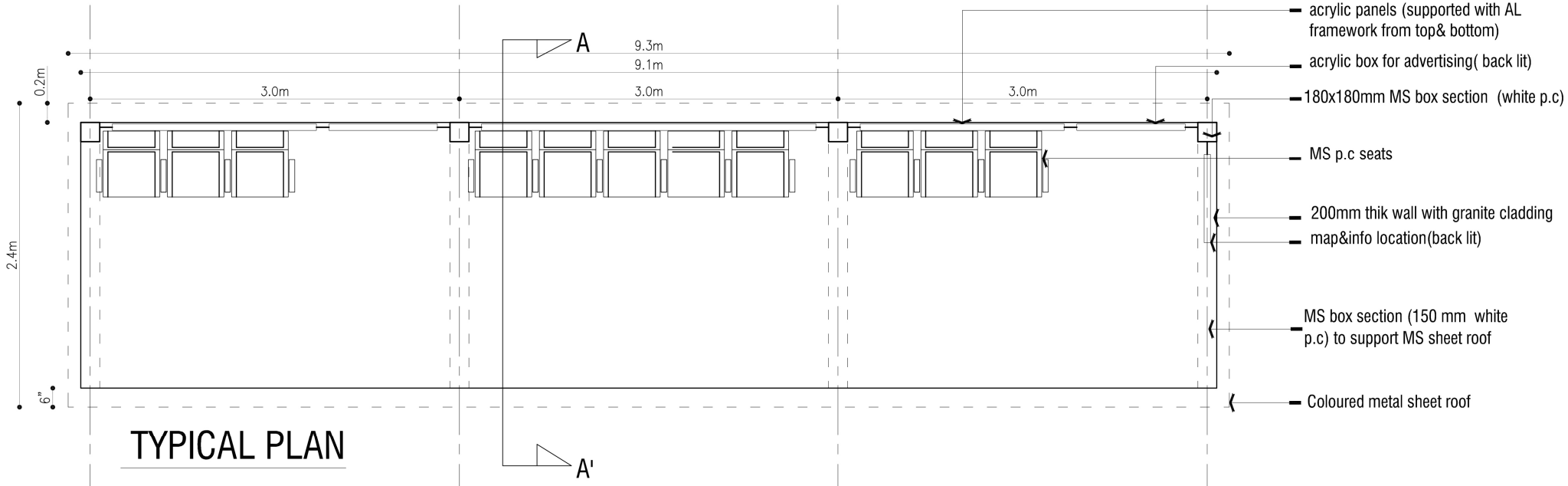
PROPOSED BUS SHELTER DESIGN FOR 'DULT' BANGALORE

Drawing Title	CONCEPT PLAN MG Road Adaptation	Drawn By	VP
		Checked By	VP
		Scale	1:6
	WORKING DRAWINGS	Drawing No.	AR-05
		CAD Ref.	Bus Stand Modules Meters.dwg

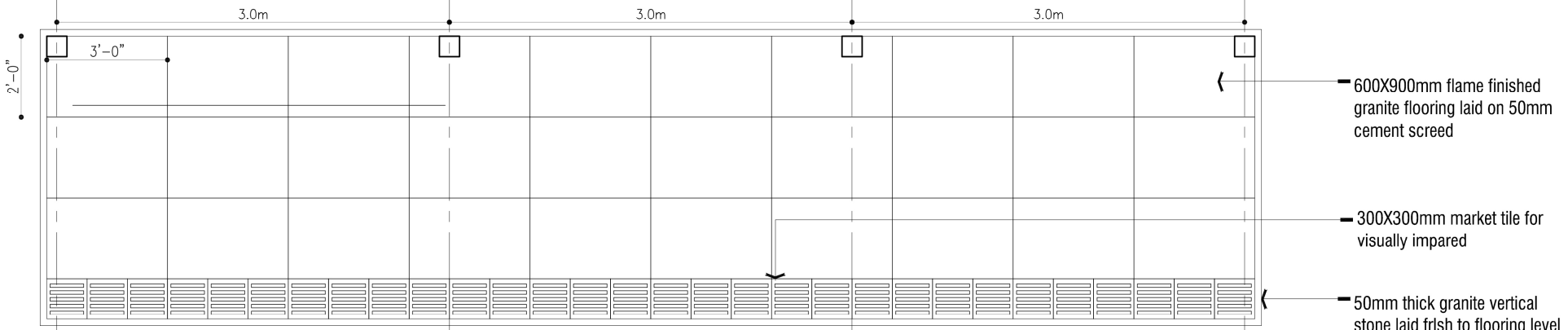
Date:

6.0 ANNEXURE: BUS SHELTER DESIGN GUIDELINES

A1



TYPICAL PLAN



FLOORING PLAN

Vistar Consultants
374, Krishna Rukmini Complex,
Judicial Jayout, R.T. Nagar,
Bangalore 560032

PROJECT:
PROPOSED BUS SHELTER DESIGN FOR 'DULT' BANGALORE

Drawing Title
CONCEPT PLAN

WORKING DRAWINGS

Drawn By	VP	Date:	2011/12/04
Checked By	VP		
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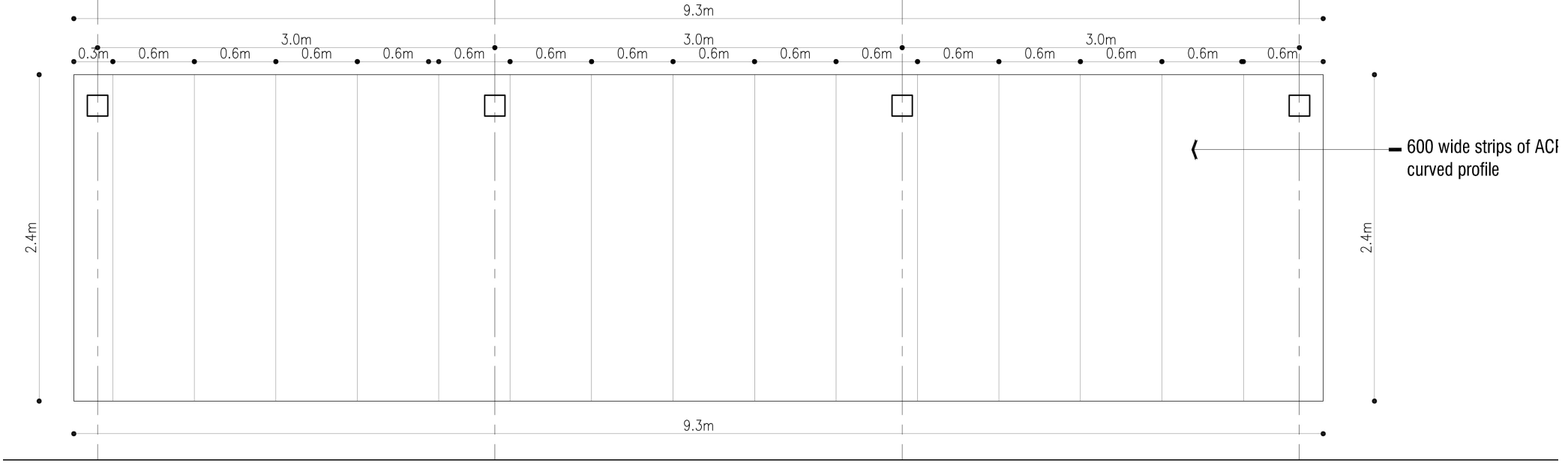
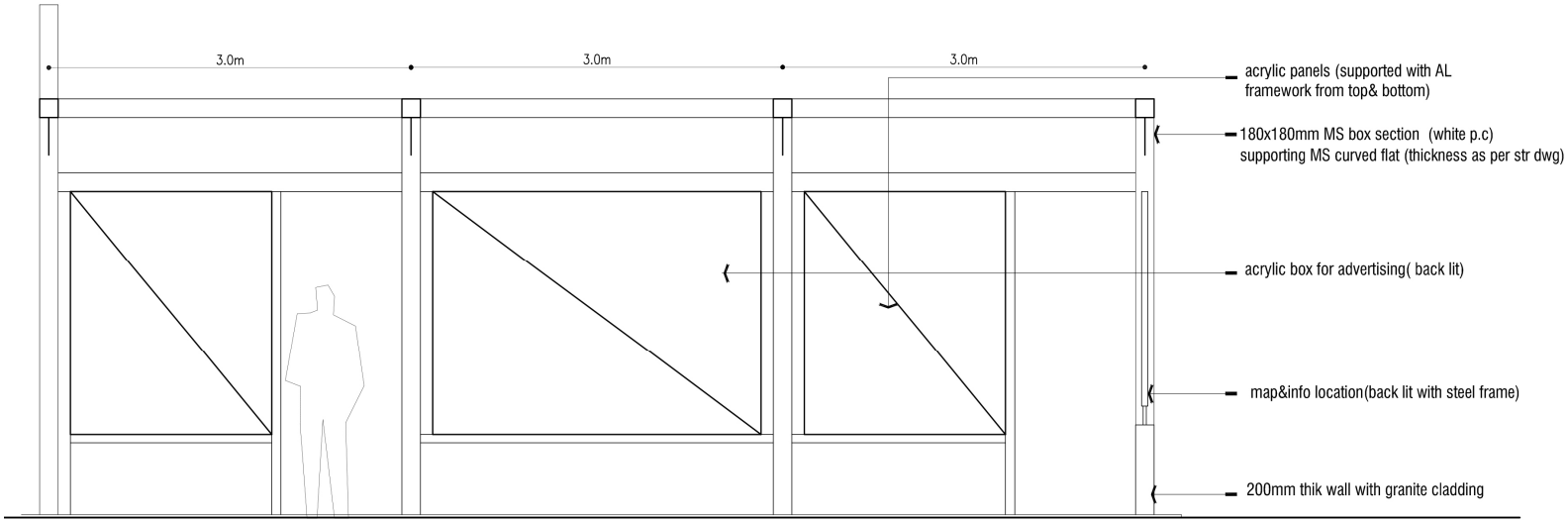
Drawing No.	AR-01	Rev	01
CAD Ref.	Bus Stand Modules Meters.dwg		





FRONT ELEVATION OF FRAME WORK

Vistar Consultants
374, Krishna Rukmini Complex,
Judicial Layout, R.T. Nagar,
Bangalore 560032

PROJECT:

PROPOSED BUS SHELTER DESIGN FOR 'DULT' BANGALORE

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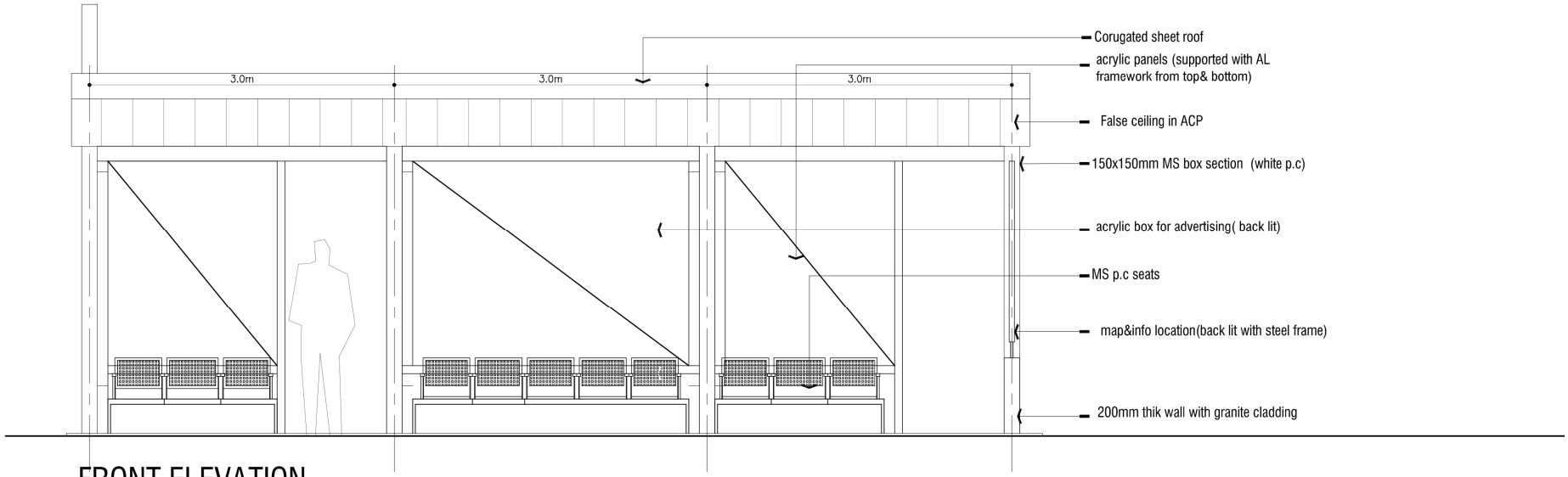
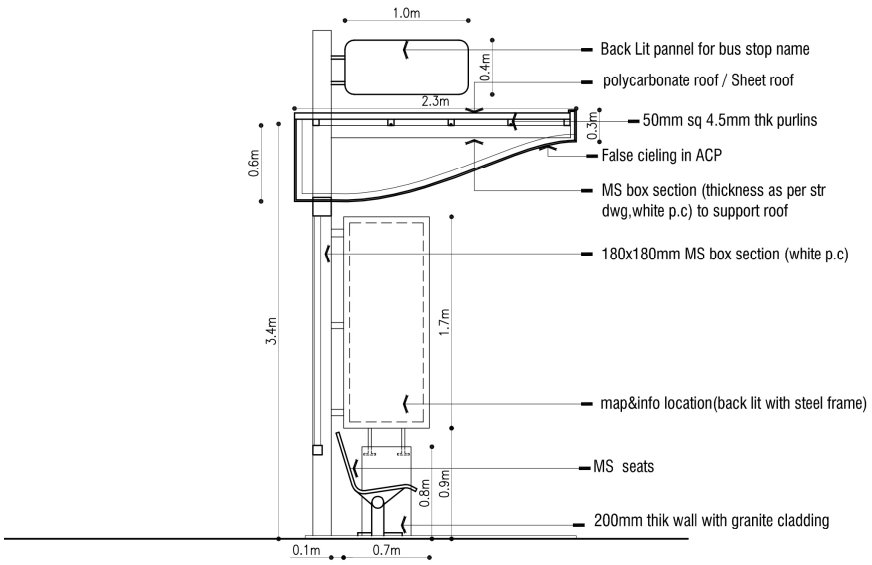
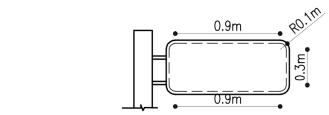


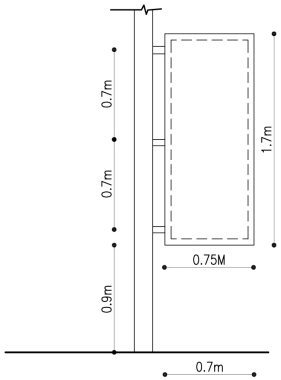
FRONT ELEVATION



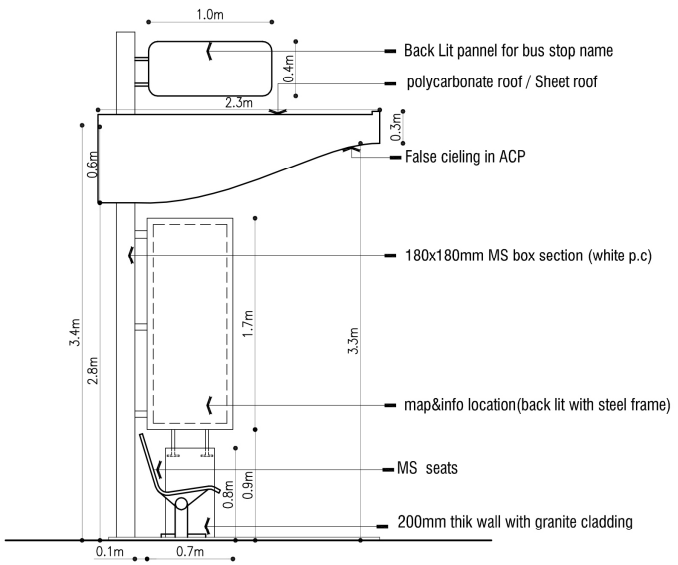
SECTION AA'



DETAIL A



DETAIL B



SIDE ELEVATION

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374, Krishna Rukmini Complex,
Judicial Layout, R.T. Nagar,
Bangalore 560032

PROJECT:

PROPOSED BUS SHELTER DESIGN FOR 'DULT' BANGALORE

Drawing Title	CONCEPT PLAN	Drawn By	VP	Date: 2011/12/04
		Checked By	VP	
		Scale	1:6	
	WORKING DRAWINGS	Drawing No.	AR-02	Rev 01
		CAD Ref.	Bus Stand Modules Meters.dwg	

6.0 ANNEXURE: BUS SHELTER DESIGN GUIDELINES

A4

ARCHITECTURAL SPECIFICATIONS

Sl.No.	Description	Unit	Quantity	Rate (INR Rs.)	Amount (INR Rs.)
1	Flame finished granite flooring 40mm thick for covered accomodation area laid on 25mm thick cement screed laid to slope towards road	sft	210	RATES AS PER THE LATEST PWD/ MARKET RATES	
2	50mm Thick Granite kerb as edge around granite flooring of covered accomodation area.	rft			
3	Marker tile 300 x 300 laid to slope towards road in covered accommodation area	sft	30		
4	Ceiling in ACP to profile with appropriate suspensions from roof structure	sft	240		
5	ACP cladding on sides of roof structure	sft	114		
6	Metal corrugated sheet roofing for roof structure	sft	120		
7	150 x 150mm MS gutter supported to roof with down take pipes	sft	30		
8	Metal chairs of approved design and make bolted or mounted to floor	nos	11		
9	Painting of steel members in white colour	sft	RO		
10	Back lit signages with metal frame and polycarbonate sheets grouted or welded to wall / frame	sft	18		
11	Interlocking pavers laid on 50mmm sand	sft			
	GRAND TOTAL	sft	RO		

STRUCTURAL SPECIFICATIONS

ITEM NO	DESCRIPTION Structural steel requirements	LENGTH	NO REQD.	UNIT WT. kg/m	WEIGHT OF ALL ITEM(kg)
1	PL 300 X12	300	8	94.20	67.82
2	PL 95 X10	100	32	78.50	23.86
3	SHS 113X113X5.4	3241	2	17.74	114.99
4	SHS 113X113X5.4	4188	1	17.74	74.30
5	SHS 113X113X5.4	3355	3	17.74	178.55
6	SHS 113X113X5.4	2641	2	17.74	93.70
7	SHS 113X113X5.4	2887	7	17.74	358.51
8	SHS 113X113X5.4	1953	4	17.74	138.58
9	SHS 113X113X5.4	1787	2	17.74	63.40
10	SHS 49X49X4	9114	5	5.95	271.14
11	SHS 49X49X4	778	2	5.95	9.26
		TOTAL			**1394.12**

STRUCTURAL SPECIFICATIONS

ITEM NO	DESCRIPTION	QTY (CUM)	QTY (Kgs)	Rate (INR)	Amount (INR)
1	Earthwork excavation for column footings, foundations,., in all sorts of soils and at all depths including filling back excavated earth to sides of foundations in layers not exceeding 150mm thick, carting away surplus earth away from the premises to the final place of disposal with all lead & lift ncluding spreading, levelling etc. wherever required and as directed.	**5.4**		**RATES AS PER THE LATEST PWD/ MARKET RATES**	
2	Providing & laying Plain cement concrete of mix 1:4:8 (1 cement: 4 cleaned & approved sand: 8 graded stone aggregate 40mm nominal size)for floorings etc., including consolidation, necessary formwork, curing etc., complete with all lead & lift for all materials & labour and as directed.	**13.5**			
3	Providing & laying Plain cement concrete of mix 1:4:8 (1 cement: 4 cleaned & approved sand: 8 graded stone aggregate 40mm nominal size) in foundations of walls & columns etc., including consolidation, necessary formwork, curing etc., complete with all lead & lift for all materials & labour and as directed.	**3.00**			
4	Providing & laying reinforced cement concrete of grade M20 using cleaned & approved sand and graded stone aggregate 20mm nominal size, for RCC works laid in layers of 150mm thick and well compacted by vibrating, curing, finishing the exposed surfaces with cement mortar, necessary centering & shuttering works, scaffolding etc., complete with all lead & lift for all materials & labour and as directed.	**1.64**			
5	Supplying, fabricating and fixing in position Mild steel/ High yield strength cold deformed steel bars of various dia. as per detailed drawings for reinforcement to RCC works including straightening, cutting, bending, hooking, lapping and/ or welding wherever required, placing in position, tieing with 18 gauge soft drawn galvanised annealed binding wire of double stranded including the cost of binding wire and anchoring to the adjoining members wherever necessary including all laps and wastages, providing & placing CM/ PVC cover blocks of suitable size to ensure specified cover to main reinforcement etc. complete all as per design, specifications with all lead & lift for all materials & labour and as directed, at all levels & locations.		99.7		
6	Fabrication and errection of structural steel hot dip galvanised with anchor fastners and welding as per drawings including cost of steel, necessary staging and enamel painting of two coats for structural steel menbers with anti corrossive treatement.		1394.12		
	Grand Total				

DIRECTORATE OF URBAN LAND TRANSPORT

CODE AND GUIDELINES FOR ROAD AND ITS FACILITIES – Road Hierarchy

December 2010

7.0 ANNEXURE: CODE AND GUIDELINES FOR ROAD AND ITS FACILITIES – ROAD HIERARCHY, December 2010

Transportation contributes to the economic, industrial, social and cultural development of any city/ country. Transportation is vital for the economic development of any region since every commodity produced needs transport at all stages whether it is food, clothing, industrial products, medicines etc. in the production stage, the distribution stage, transportation is required from the production centres viz. industries to marketing centres and later to the consumers. The inadequate transport facilities retard the process of socio-economic development of the region. The adequacy of transportation system of a region indicates its economic and social development.

The improved transportation network brings prosperity to the urban population. The prosperity and employment opportunities of urban areas attract population from other areas resulting in enhanced economic activities. Adequate mass transportation facilities are needed to cater the internal movements in urban areas such as daily movements to and from offices, schools, factories etc. transportation faclities are essential for rushing aid to areas affected by an emergency. To maintain law and order, it is required to have an efficient system of transport network. Road transportation is the is the only mode of transportation which could give maximum service to one and all. The other modes include transportion by air, water and railways. Walking is also a major mode of transport especially for lower travel lengths. Also, every trip starts and ends with walking. Non-motorized transprot i.e. Walkers (pedestrians) & Cyclists are observed to be the least previliged road users at present. Hence, high care and importance should be given for safety, accessibility aspects of pedestrians and cyclists.

Indian Road Congress (IRC) is a semi-official technical body formed in 1934 which is constituted to provide a forum for regular pooling of experience and ideas on all matters affecting the planning, construction & maintenance of roads in India, to recommend standard specifications. The IRC recommends specifications for various components like planning, design, construction, maintenance etc. it is a general specificaion to be followed throughout the country. The standards so set by IRC may not be completely adopted in all regions, which may demands some modifications as per local conditions. Hence, the document is brought out to bridge the gap between the standards set by IRC and the local conditions.

The document of Guidelines for Road Hierarchy is prepared by Directorate of Urban Land Transport, Urban Development Dept, Govt of Karnataka. The urban roads are classified based on the functinoal characteristics, connectivity and nature of traffic they carry. The cross-sections so explained below for various categories are intended to be followed by local bodies in all the cities in Karnataka. The same cross-sections are to be adhered to while any new road is proposed or for widening based on its respective category explained below. The new layouts developed by any urban development authorities across the state and all other private developers are mandated to follow the guidelines adopted through this document.

7.0 ANNEXURE: CODE AND GUIDELINES FOR ROAD AND ITS FACILITIES – ROAD HIERARCHY

Components of roadway:

Right of way (RoW) ¯ it is the width of land acquired for the road, along its alignment. It depends on the importance of road and possible future development. A minimum land width has to be prescribed for each category of road. all the components of roadway is included within the (RoW).

Carriageway ¯ The paved portion of the roadway on which vehicles move.

Footpath ¯ The portion of roadway designated for the movement of pedestrians. Footpath is segregated from the carriageway for the safety of pedestrians.

Median ¯ The roadway component which divides the movement of vehicles in a bi-directional flow.

Drain ¯ The provision made for the flow of rain water. Usually, drains are positioned along the edge of the cariageway (Open) or below the footpaths.

Road Hierarchy

The road systems within urban areas are classified as urban roads. These roads are classified on the functional features of its connectivity and the nature of traffic they carry. Urban roads are classified as

I. Arterial Roads

II. Sub-arterial Roads

III. Collector roads

IV. Local roads

1. Arterial Roads

- This category of roads are high density corridors catering as Municipal Link Roads to National Highways, State Highways and other PWD roads and serve as link roads to Air-Port, Railway Stations and intercity Bus Stations. Ring roads around cities and towns are also classified as Arterial roads.
- Significant intra-urban travel such as between Central Business District and outlying residential areas or between major suburban centers takes place on these corridors.
- Arterial should co-ordinate with the existing or proposed Arterial Roads.
- Roads connecting two or more National Highways, State Highways, and Ring Roads may also be considered as Arterial Roads.
- These generally have divided carriageway of four to six lanes with partial access and with or without service roads. Parking is not allowed on Carriageway at any time.
- Pedestrian crossings are allowed at junctions. Subways/ Foot over bridges at midblock sections.

The recommended ROW for arterial roads is from 40 ¯ 45 m with widths of each component as detailed below:

- Carriageway : Divided carriageway of 6 lane: 3.5m for dedicated BRT lane and 7.5m (2lane) wide Motor vehicle lane on either side. Or 4 lane divided carriageway of 7.5m wide carriageway on either side.
- Median : 0 .3 m ¯ 1.20 m
- Buffer : 1m on either side between main carriageway and service roads. utilities can be carries along Buffer area.
- Service Roads : A minimum of 5.5 m (include utility plus drains)
- Cycle Track : 2.0m wide on either side at the edge of the service roads.
- Sidewalk : 2.5m on either side on the edge of the carriageway. 1.3m clear walkway is to be maintained without any obstructions like trees, light poles etc. if widths are available, footpath width may be increased.
- Median openings are proposed to be located at a distance of 1 Km apart.
- Parking on carriageway is strictly not allowed at any time.

A typical cross section is indicated below with RoW of 45m. It comprises of 1m Wide median. 11m drive way is provided on either side. This includes BRT lane of 3.5m wide including 0.5m kerb which separates the Motorized vehicle lane (MV lane 7.5m) from BRT lane. MV lane is proposed to carry private vehicles (cars, two/ three-wheelers, trucks, other buses etc). A buffer zone of 1 m is allocated to physically segregate main carriageway and service road. One buffer opening shall be spaced 1km apart between median openings for merging of traffic between Service road and main carriageway. Service road of minimum 5.5 m is proposed to carry Public Transport buses also. 2m wide bicycle lane is provided on the edge of service lane, utilities can be laid beneath the cycle track. 2.5m wide footpath is located at the edge of the RoW. There can be a physical segregation between service road and cycle track to avoid conflict of Non-Motorized Vehicles (NMV) with other fast moving vehicles. The cycle track is maintained at the same level of the service road, whereas pedestrian walkway is at 150mm above the level of cycle track. Cycle tracks and footpaths

The cross-section at the location where bus stops are proposed is indicated in figure 2 below. The width of bus stop is 3.8m wide. A gradual horizontal curve is to be provided from about a distance of 50m from either side of the bus stops along the road. The minimum length of the bus stop is to be maintained at 30m such that 2 buses can be parked at a time in the bus stop area. Bus stops should be located 75m from the junctions.

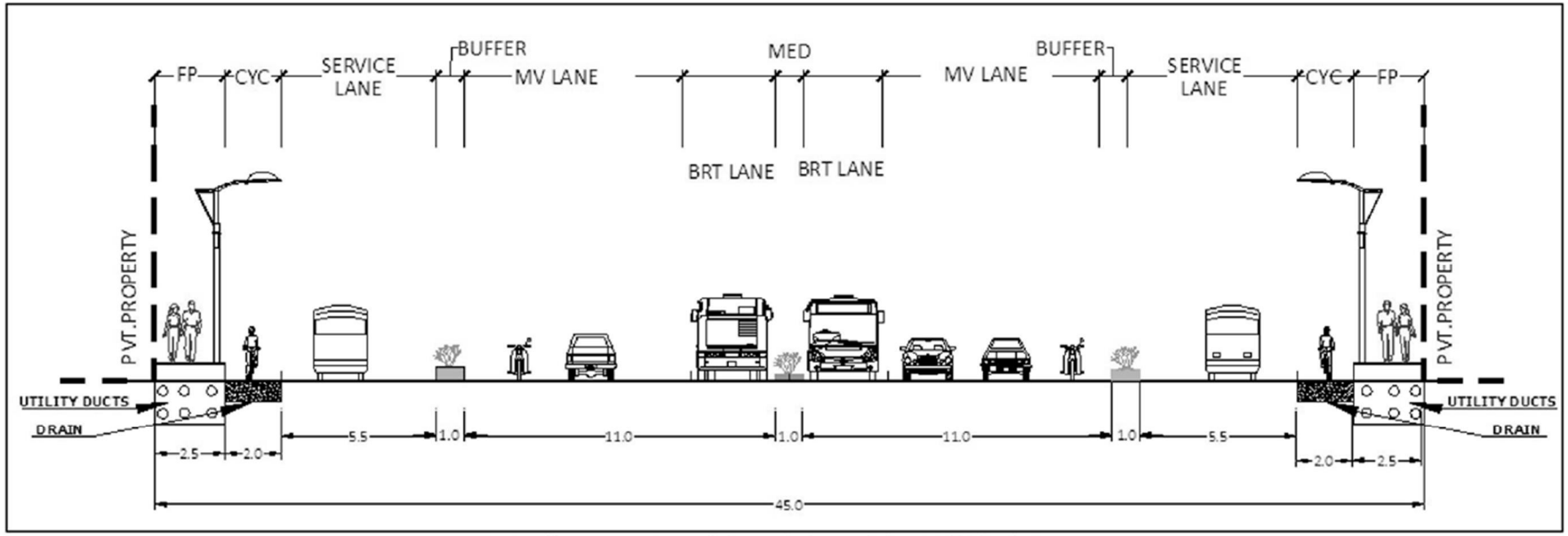

Fig 1: Cross-section of Arterial Road for ROW of 45 m

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Small shrubs to a height of about 1m are to be planted all along the median. The medians are proposed to facilitate for rain water harvesting such that rain water harvesting pits are provided at regular intervals all along the median and the buffer area. Electrical poles are positioned buffer zones which can light both the section of main carriageway and the service road. Buffer can have openings to discharge surface water of main carriageway to the drains across the service road.

The cross slopes of the carriageway is provided to drain the rain water towards the edge of the road. Drains are provided beneath the edge of the cycle track.

Utilities like electrical / telephone cables etc is facilitated beneath buffer and the pedestrian pathway. The detailed cross ¯ section of utility ducts are explained in utility management section.

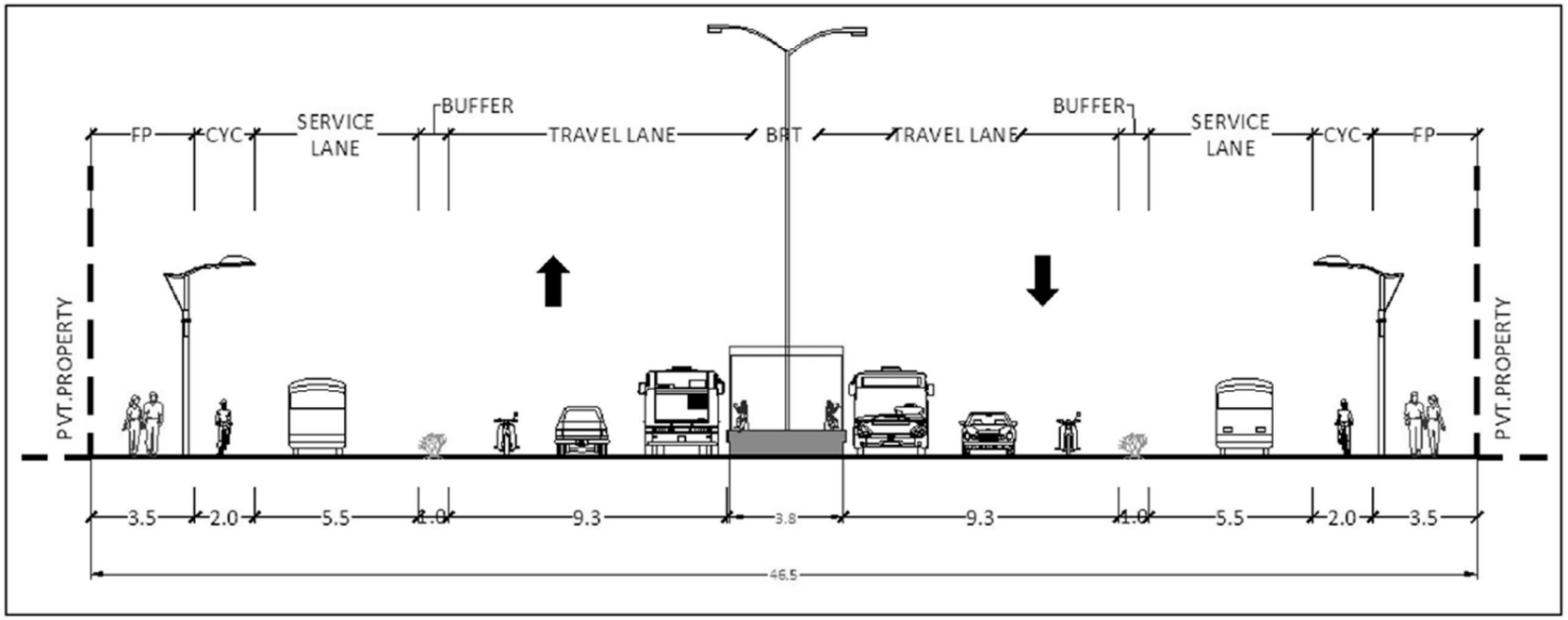

Fig 2(a): Cross – section at BRT stations

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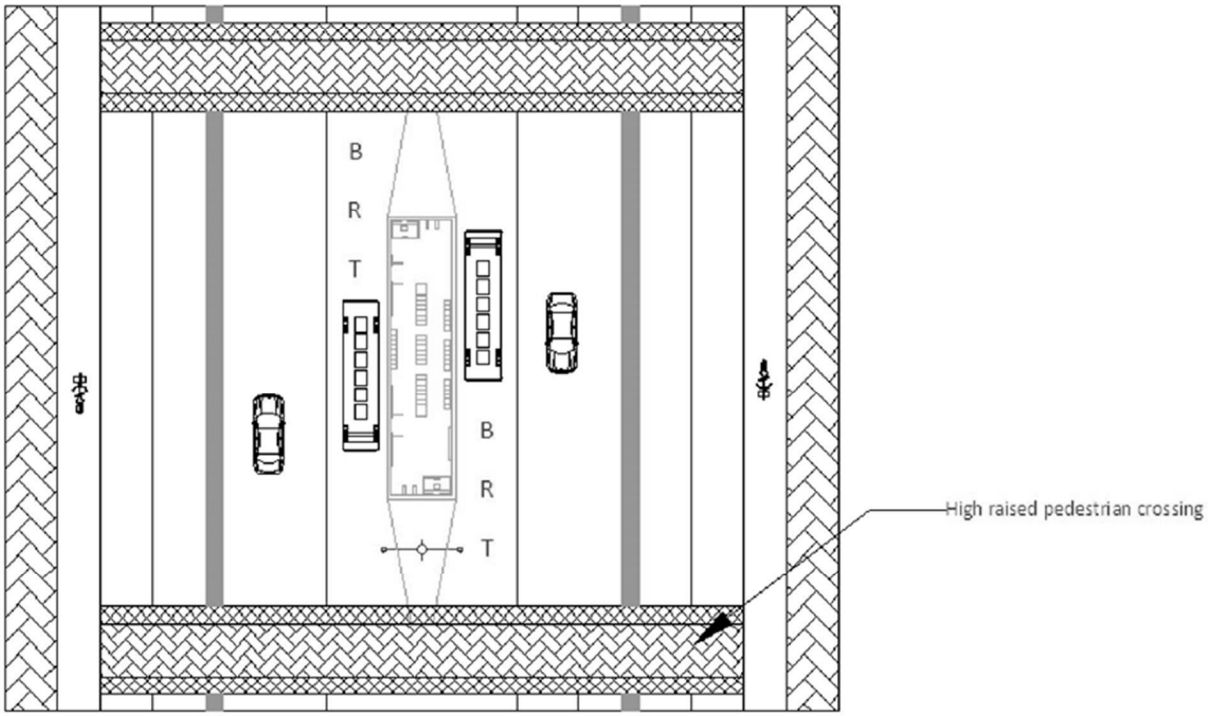

Fig 2(b): Typical Plan at BRT Bus stops

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2. Sub-Arterial Roads

Sub-Arterial roads are functionally similar to Arterials with comparatively medium density of traffic. These have lower level of mobility. The recommended ROW for Sub-arterial road varies from 25-35m. These also act as feeder roads to arterial roads. The median and the main carriageway remains the same as arterial roads. It is mandatory to include BRT lane along sub-arterial roads to enhance Public Transport. Also, a cycle lane of 2.0m and footpath of 2.5m is provided on either edges of the RoW.

Typical cross section of arterial road with 35m wide ROW is given below.

- Carriageway : 11m on either side. 3.5m for dedicated BRT lane and 7.5m(2lane) wide MV lane on either side
- Median : 0 .3 m ¯ 1.20 m.
- Buffer zone : 1.4 m wide buffer zone on either side at the edge of the carriageway.
- Cycle Track :2.0m wide on either side.
- Sidewalk :2.5m on either side on the edge of the roadway.

The provision for drains, light poles and utilities remain same as explained in earlier section of Arterial roads. Median opening is kept at a distance of 500m.

Pedestrian crossing: preference should be given for at grade pedestrian crossing, while movement of vehicle can be maintained either at lower or upper levels. The details of pedestrian crossings are mentioned in the section of pedestrian improvement section.

The cross ¯ sections for the sub-arterial roads with ROW 26.3m and 23.0m is as shown below

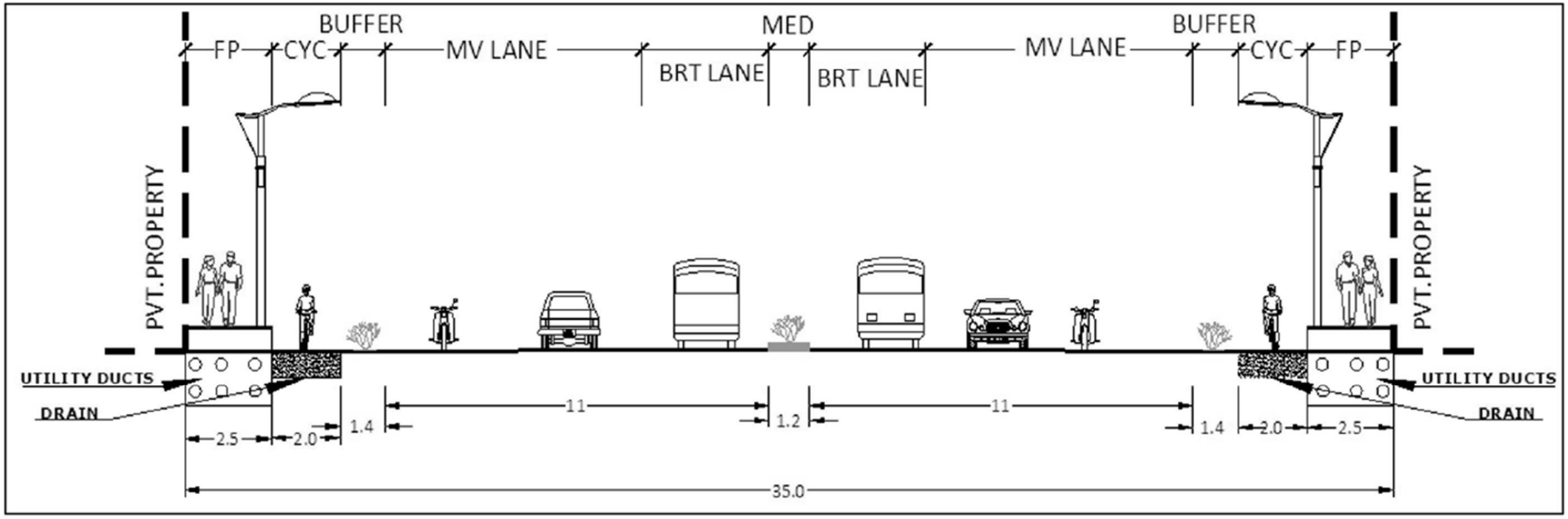

Fig 3: Sub-Arterial road with ROW of 35.0m

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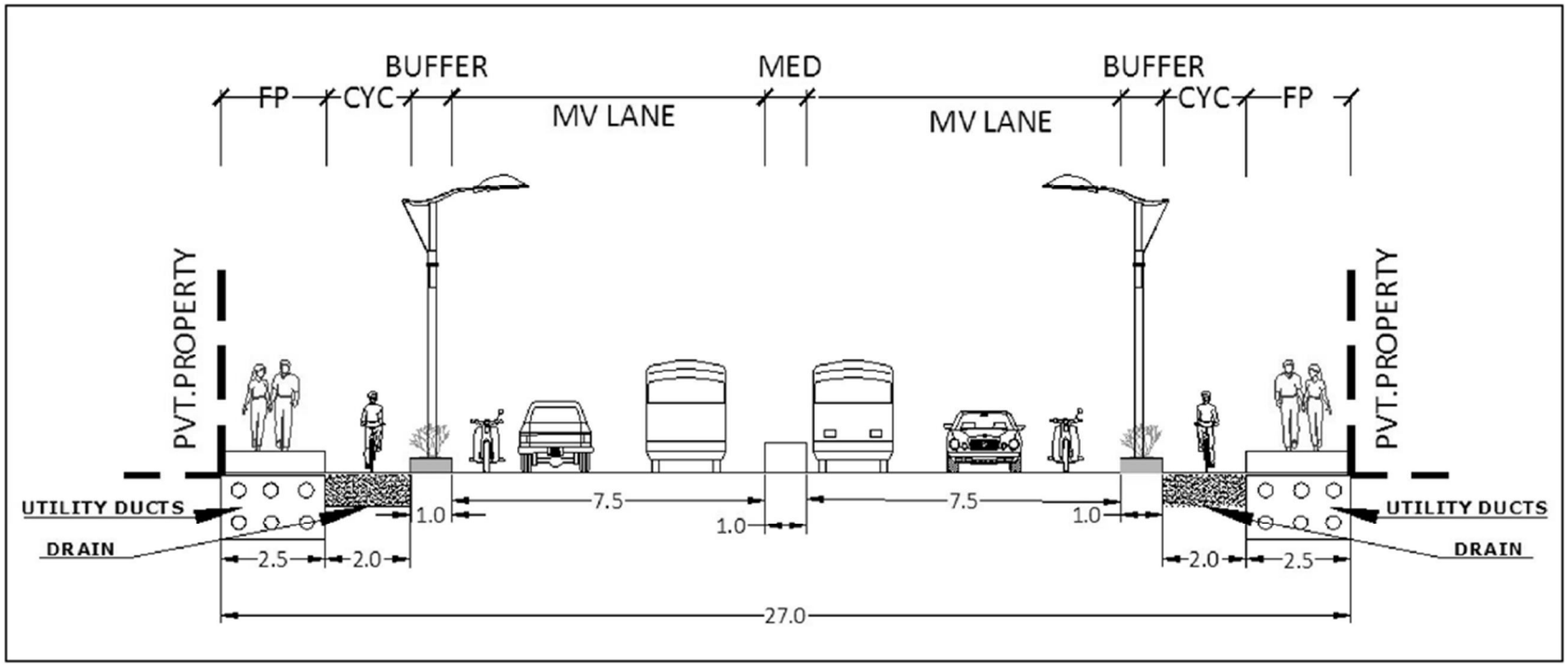

Fig 3(a): Sub-Arterial road with ROW of 27 m

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3. Collector Roads

The function of collector streets is to collect traffic from local roads and feed it to the arterial and sub-arterial roads and vice-versa.

These are basically located in residential neighborhoods, business areas and industrial areas. Normally, full access is allowed on these streets from abutting properties.

The road proposed is 3 to 4- lanes with road marking to separate vehicular movement on either direction. A typical cross-section with ROW of 24.0m is as indicated below.

Collector streets with 24.0m wide ROW fig 4(a)

- Carriageway : 15m for MV Lane, with 4 lanes for the movement of motorized vehicles in both the directions. bidirectional movement has to be segregated with barricading in the middle of the carriageway.
- Cycle Track :2.0m wide on either side.
- Sidewalk :2.5m on either side on the edge of the roadway.

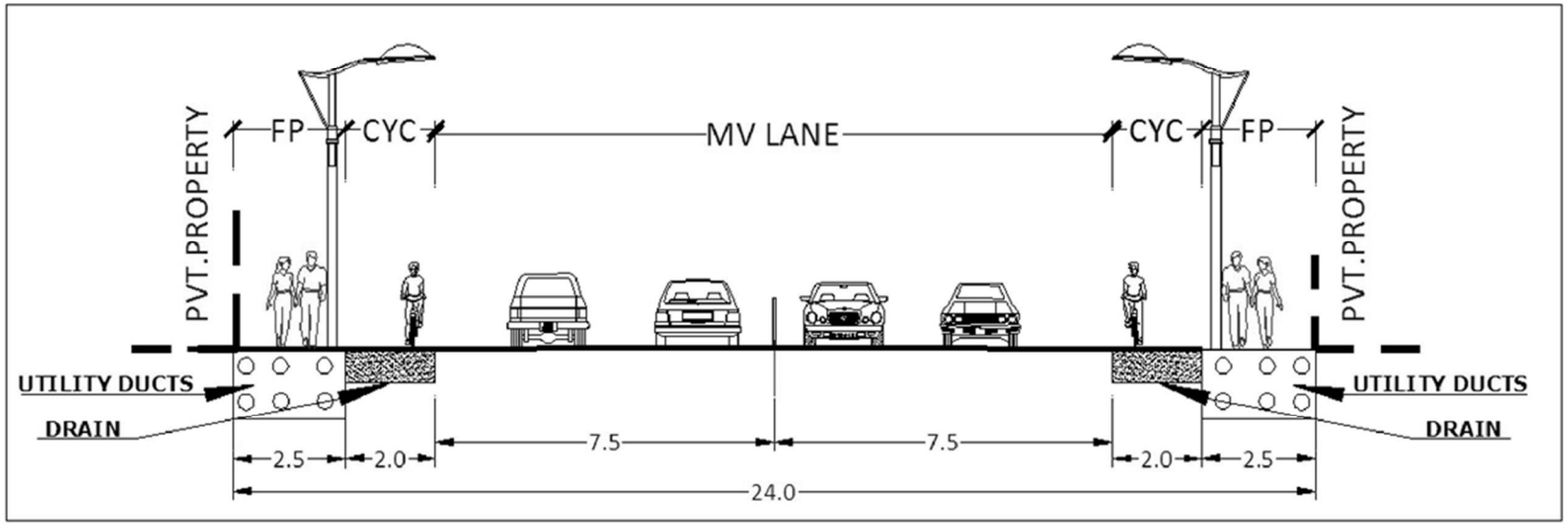

Fig 4(a): Collector Street with ROW of 24.0 m

Local roads can also accommodate for Bus lane of 7m wide for two way movement. The middle lane of Collector roads can be segregated for movement of buses with a width of 3.5m on either side. This may be provided with a road marking.

Collector roads with 25.0m wide ROW fig 4 (b)

- Carriageway : 16m wide carriageway with a provision of 3.5m wide segregated Bus lane on either side. 4.5m wide MV lane on either side.
- Cycle Track :2.0m wide on either side.
- Sidewalk :2.5m on either side on the edge of the roadway.

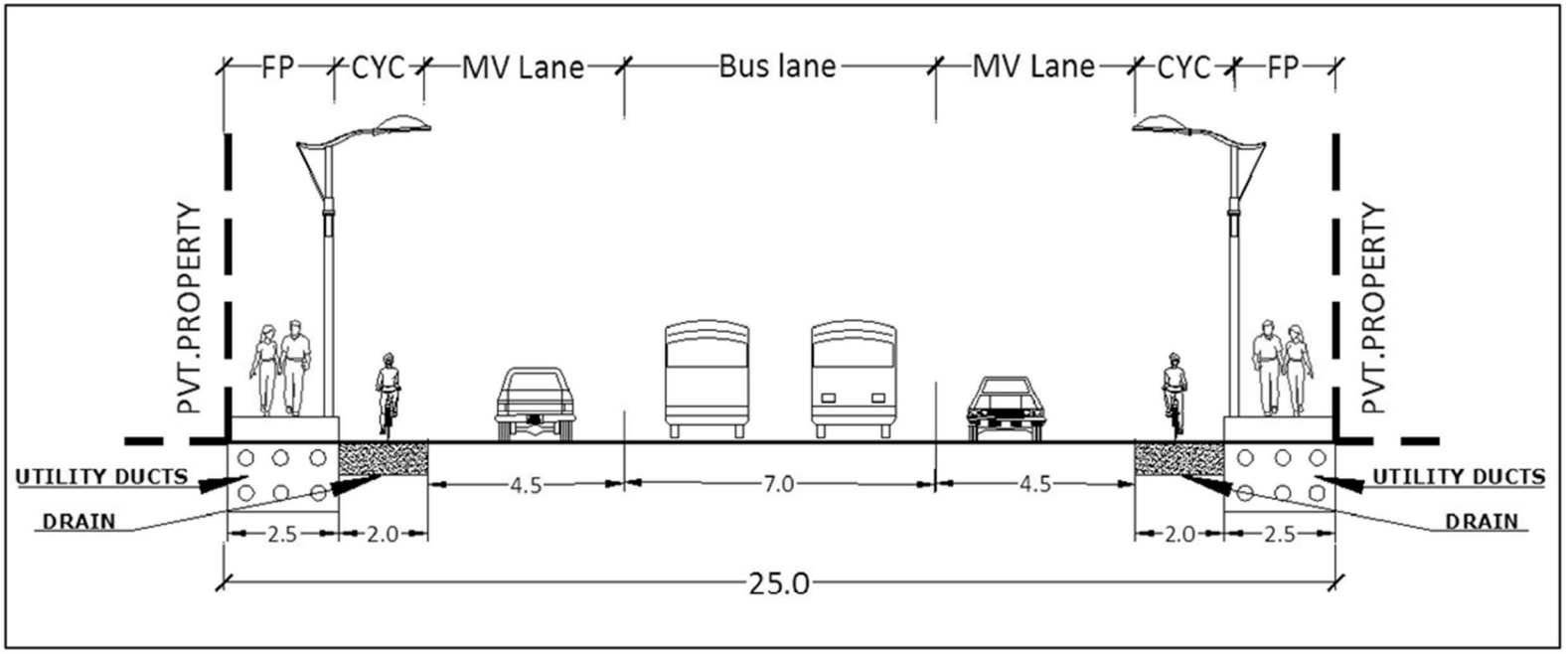

Fig 4(b): Collector Street with ROW of 25.0 m with Bus lane at the centre of the carriageway

4. Local Streets

These are primarily to provide access to abutting property (Mostly residential) and normally do not carry large volumes of traffic. Majority of trips in urban areas either originate from or terminate on these streets.

Unrestricted pedestrian movement is allowed on these roads as these are primary section of road. A minimum of 7.0m wide carriageway is provided for movement of vehicles. A minimum of 2.0m wide pedestrian walkway is provided with drain to be located beneath the pedestrian walkway. Typical cross-section is given below. The cyclists will use the MV lane as there is no segregated lane for cycles in Local streets.

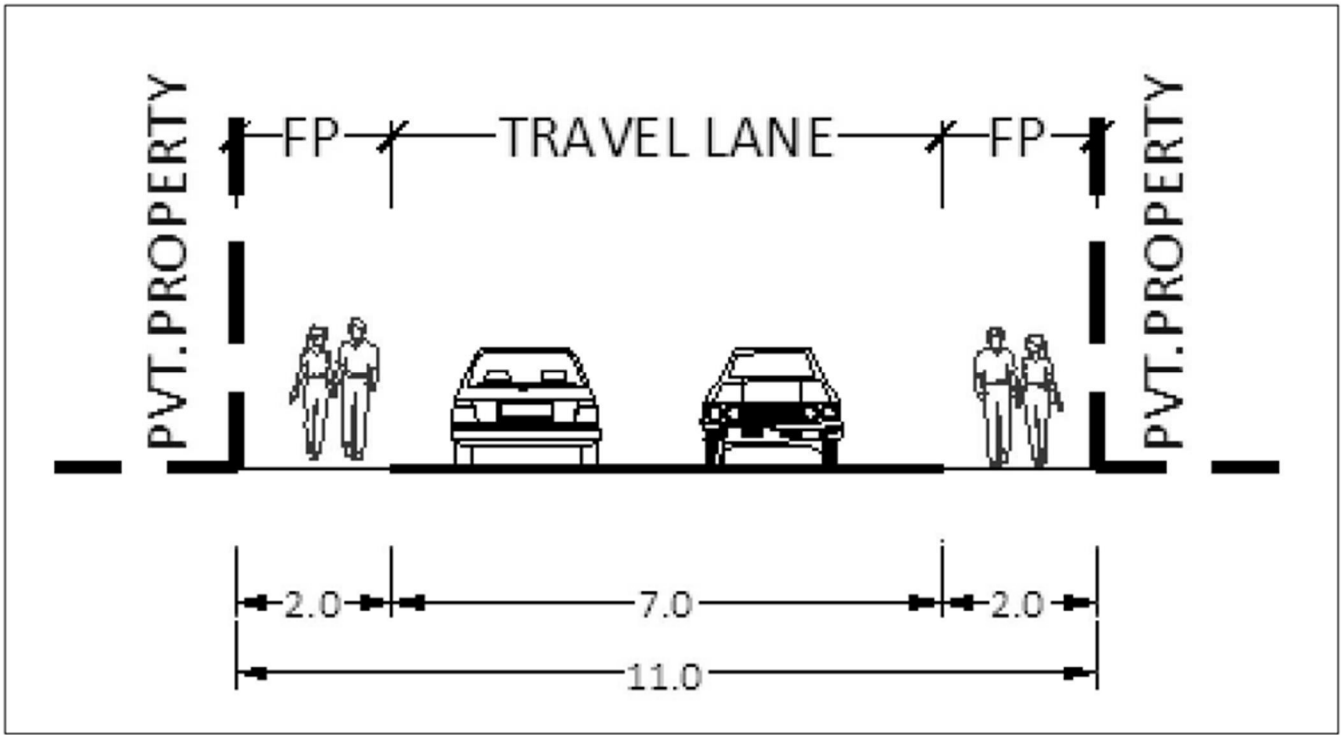

Fig 5: Local Street with ROW of 11.0m

5. Utility management system

Utility is an entity (whether publicly or privately owned) which provides, or intends to provide, water, sewerage, drainage, gas, electricity, telephone, telecommunication or other like services. Utilities are key component of a road.

a. Surface utilities are, street lighting, signs and signages, traffic signals, bus stops, parking, street furniture, bollards, waste disposal units and fire protection systems. The image below shows set of surface utility systems, like, traffic signal, zicom camera, transformer, RMU, electric pole, pedestrian signal, concrete pedestals/ footing, street light, trees, parked vehicles, signs, are present on the footpath.

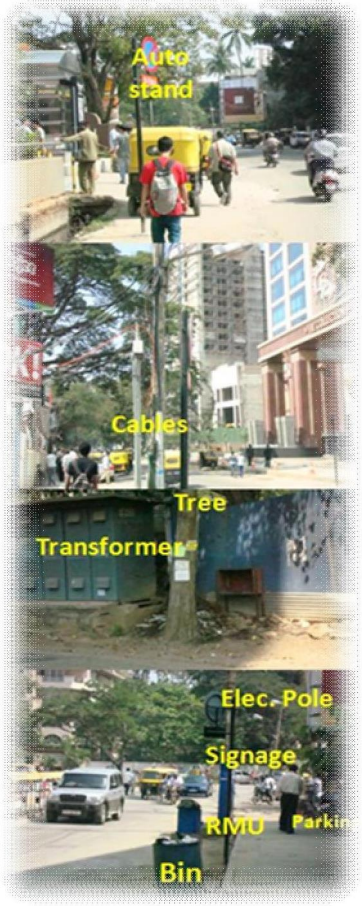

Image 1: Presence of utilities - OFCs, cables, hoardings, advertisements, street light and signage (Source: BCCF)

b. Sub surface utilities comprises, storm water drain, sewerage lines, water supply lines, telecommunication wires, electricity lines and gas lines. The drawing below shows the detailing of space allocation of sub surface utilities.

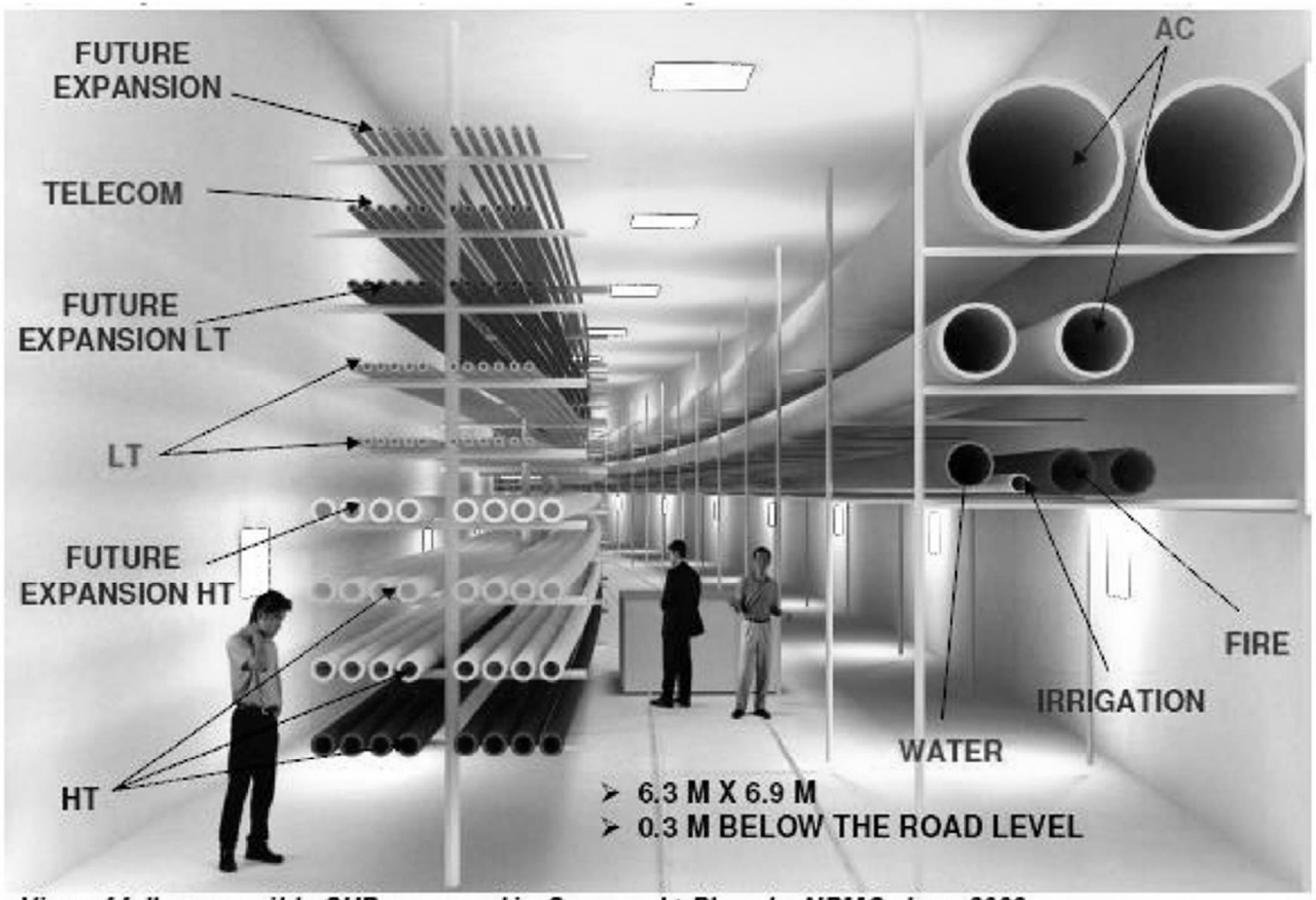

Fig 2 : Section for accommodation of utilities at sub-surface level.

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5.1 Sub surface Utility lines can be grouped under the following five categories, each having distinct characteristics:

1. Sewer and drainage lines:

Sewer and drainage lines have generally gravitational flow and are laid at substantial depth, the actual depth depending on the topography of the area. They normally require deeper and wider trenches for installation, and are provided with manholes at intervals. These manholes should be avoided laying in the carriage way as far as possible. The cover of the manhole should be made of Cement concrete. A typical plan of the storm water drain cover is as shown. It is suggested to provide a PCC layer around the manhole, which differentiates the pavement section and the man-hole. Provision for manhole lid is made at the center of the PCC Layer over the hole. This would avoid digging the pavement for maintenance during cleaning process.

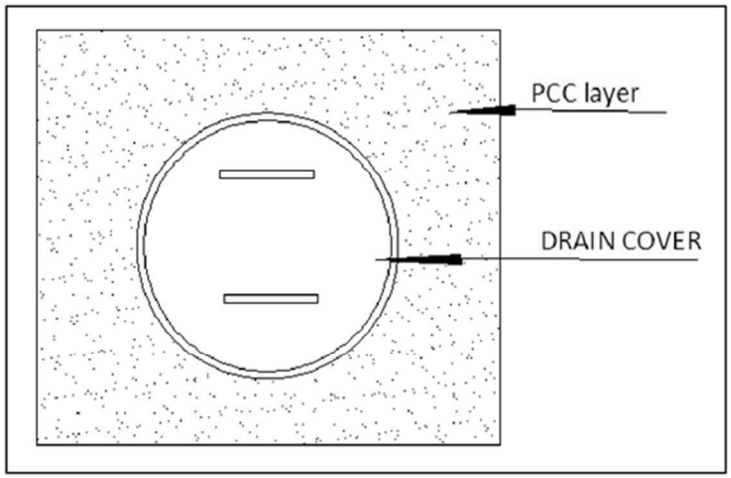

Fig3: plan for man-hole lid with PCC layer

Storm water drains shall be in the form of pre-cast, RCC or masonry drains and shall be covered with RCC slab in urban scenarios. Storm water drain size varies as per the runoff based on the type of urban road. Trunk sewer lines are laid at 2 to 6m.

2. Water supply lines:

   Water supply lines are laid at 0.6m to 1.5m. Service lines are laid at lower depths and trunk lines are at 1.5m depth.

3. Electricity cables:

   Electricity cables are of different types, namely, lighting cables and high tension cables. These cables should not be laid close to water supply lines to avoid short circuit. High tension cables should not be laid in the proximity of telecommunication cables and optic fibre cables because of possible electrical interference due to induced voltage. Electric cable are laid at 0.6m to 2m depth.

4. Telecommunication cables and optic fiber cables:

   The privatization of telecom, power, gas and other utilities has put immense pressure on urban roads. Multi utility ducts or common utility ducts are easy solutions for urban roads. Telecommunication cables are laid at 0.6m to 2m.

5. Gas pipelines and those carrying combustible materials:

   Gas pipelines are new concept in India, cities like, Mumbai and Delhi have implemented this in pilot basis. These are laid at a depth of 2m to 3m. Utmost care shall be taken so that other service lines should not come in contact with these pipes.

5.2 Scheme of ducts and drain below Footpath

During the discussions in the Right of way sub-committee, it was decided that Ducts and Drains (refer Fig 4) must be provided below the foot-path to accommodate, Storm water drains, HT electric lines, optical fiber cable, etc. It was also decided in the meeting, that road side furniture and landscaping which is essential part of urban roads should be given dedicated space so that pedestrians will get a clear walking zone (refer fig 5).

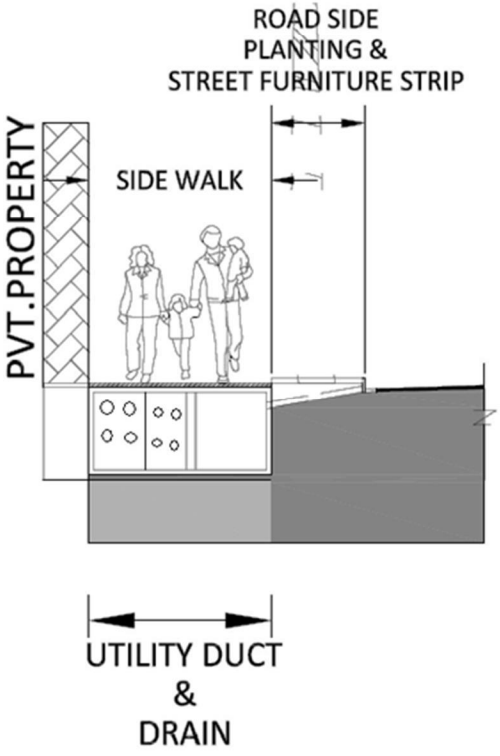

Fig 4: Cross section of footpath (Source: BCCF)

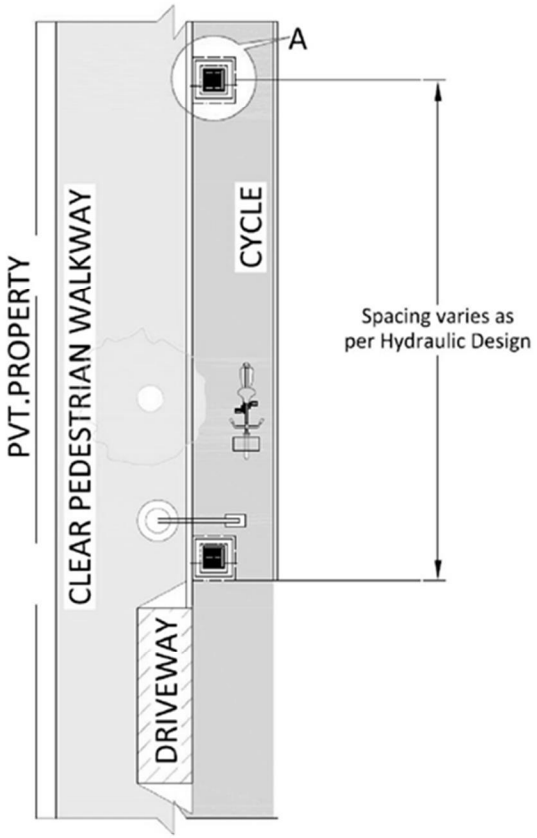

Fig 5: Plan view of footpath (Source: BCCF)

General Recommendations

1. No trees shall be allowed to plant within a distance of 30mtrs from the intersection.
2. Trees shall not be planted in medians. Shrubs to a height of 1.2m may be planted. Where median is narrow plants in RC pots can be planted.
3. Street lights and signal poles shall be shifted to end of the R-o-W. A light pole can be designed for cantilever type that can originate from one corner of a intersection without causing any obstruction for the driver (refer drawing 3).
4. Signs and signages shall be installed free of visual obstruction
5. Sight distance/visibility triangle must be clear of obstruction
6. Utility lines that cross within an intersection should be designed to withstand traffic load. Man holes and inspection chambers shall be provided on the footpath instead of R-o-W
7. A protocol prescribed in IRC 98 (under revision) shall be followed in order to carry out utility works
8. Storm water inlets shall be designed such that storm water is drained off as quickly as possible from R-o-W
9. Operations in the public right-of-way by utility companies necessitate proper co-ordination between these companies and public road authorities to ensure the responsible utilization of this public resource by all parties involved
10. Ground penetrating radar survey should be carried out by the road agency to know inventory of utility lines below the carriage way. Reason being, the high tension electric lines were laid underneath the carriageway 30 ¯ 40 years before!
11. Permission to be taken 3 days in advance from road authority. In case of emergency, must contact Chief Engineer or responsible authority and get written permission
12. Other utility provider should be aware of this activity
13. Utility provider must barricade the area before they begin the work (Barricading, Agency name, contact numbers are to be displayed for public)
14. Sign boards(men at work) should be placed 100mtrs ahead of the work
15. After repairs fill with sand/ robo sand/quarry dust and water profusely
16. This shall be followed by WMM to minimum thickness 225 mm and up to neighboring surface level
17. Bituminous layer may be laid after a few days after removing extra thickness of WMM and to same depth as that of neighboring surface and specification and work to be executed by utility departments through agencies listed by road authority
18. Road repair should be done on weekends or off-peak hours during weekdays and road opening should be avoided during rainy days except in case of emergency.

IRC 98 (under revision) to be referred for more details about guidelines and road opening protocol. .

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TOYS TOYS
KEMP
Curzon Court
SONY
LEGO
Barbie
A CHILD'S 1ST FRIEND