Chief Minister Green
Road Infrastructure
Development Scheme
CM GRIDS (URBAN)

Volume 01 : Design Manual

PREPARED FOR URIDA BY JANA URBAN SPACE FOUNDATION

Manuals for

CM-GRIDS (Urban)

Chief Minister Green Road Infrastructure Development Scheme (Urban)

Volume 1 **Design Manual**

June 2024

Jana Urban Space

In Collaboration With

GOVERNMENT OF UTTAR PRADESH

URBAN ROAD INFRASTRUCTURE DEVELOPMENT AGENCY

Prepared by

Jana Urban Space

Jana Urban Space works towards transforming the quality of life in urban India through the streams of urban planning and design, across both policy and practice. Placing community and environmental sustainability at the heart of design, Jana Urban Space works on policies on land titling, spatial reforms, and street design guidelines, as well as regional plans, masterplans, and neighbourhood-level plans. The organization also focuses on the improvement of road infrastructure (Tender S.U.R.E.), rejuvenation of public spaces (markets, bus stands, lakes, parks, heritage and community centres), and the architecture of affordable housing.

Table of Contents

Foreword 6

List of Abbreviations 11

1. Introduction 13

1.1. About The CM GRIDS Design Manuals

2. Planning Principles 25

2.1. Classification Of Urban Roads

2.2. Components Of A Road

3. Design of R.O.W Elements 31

3.1. Road Alignment

3.2. Planning & Design Standards By Element

4. R.O.W Layouts 93

4.1. R.O.W Design

5. Design of Utilities 115

5.1. Planning & Design Standards By Utility

6. Design of Intersections 123

6.1. Planning & Design Of Intersections

Appendix I : List of Tables 130

Appendix II : List of Figures 131

Foreword

By Shri Yogi Adityanath
Chief Minister, Uttar Pradesh

In the pursuit of transforming Uttar Pradesh's urban landscape, the Chief Minister-Green Road Infrastructure Development Scheme (CM GRIDS) heralds a new era of sustainable development. Our state, with its vibrant urban centers, holds the key to driving economic growth and enhancing the quality of life for all citizens. Roads, as the lifelines of urban infrastructure, must evolve into integrated, green corridors that not only facilitate efficient mobility but also embody our commitment to environmental stewardship.

The CM GRIDS project is not merely a roadmap for urban development but a testament to our commitment to building a prosperous and sustainable future for Uttar Pradesh.

The vision of CM GRIDS is clear: to weave together roads that are more than mere thoroughfares. They are to be safe havens, sustainable arteries, and inclusive spaces that cater to the needs of all, from pedestrians to cyclists, ensuring seamless connectivity and promoting healthier lifestyles. By integrating modern technologies and eco-friendly practices into road construction, we aim to reduce carbon emissions and foster a greener environment across our cities.

Furthermore, CM GRIDS isn't just about constructing roads; it's about building communities and fostering economic vitality. By aligning our efforts with local aspirations and leveraging citizen participation, we are laying the foundation for vibrant, resilient neighborhoods that thrive on accessibility and social cohesion. This approach not only enhances urban mobility but also empowers urban local bodies towards financial autonomy, ensuring sustainable growth and development.

As we embark on this transformative journey, it is imperative that our roads reflect sensitivity to our cultural and historical heritage, blending modernity with tradition seamlessly also convergence with existing state-level schemes and robust management practices, CM GRIDS aims to set benchmarks in urban infrastructure development that inspire and endure. I commend the Urban Development Department and all stakeholders involved for their unwavering dedication to realizing this vision.

Together, let us forge ahead with confidence, knowing that through CM GRIDS, we are not just constructing roads; we are paving the way for a brighter tomorrow, where every street, every intersection, and every neighborhood contributes to the holistic development of our beloved state.

Shri Yogi Adityanath

Shri Yogi Adityanath
Chief Minister, Uttar Pradesh

Foreword

By Arvind Kumar Sharma, Retd. IAS

Cabinet Minister, UDD, Govt. of Uttar Pradesh

Our cities stand as crucibles of growth, vitality, and opportunity. With the highest number of urban bodies in India, our state is poised to lead the charge towards a future where urban infrastructure not only supports economic vigor but also enhances the quality of life for every citizen.

The Chief Minister-Green Road Infrastructure Development Scheme- Urban (CM-GRIDS) heralds a new era of integrated road networks that are not merely conduits of mobility but vibrant arteries pulsating with sustainability and inclusivity. As we march towards our goal of achieving a “One Trillion Economy” by 2027, CM-GRIDS emerges as a pivotal initiative to fortify our urban infrastructure, fostering both “Ease of Doing Business” and “Ease of Living”.

Safety lies at the heart of CM-GRIDS, with advanced road safety measures and meticulously designed intersections aimed at reducing accidents and ensuring secure passage for all commuters.

Under the visionary leadership of our Honorable Chief Minister, this scheme envisages roads that transcend mere thoroughfares, becoming cohesive hubs where civic amenities converge seamlessly with green spaces, solar-powered street lights, and smart transportation solutions. These integrated green roads, constructed with state-of-the-art techniques to minimize carbon footprint, epitomize our commitment to sustainable development and environmental stewardship.

The principles guiding CM-GRIDS underscore our holistic approach—where roads are designed not just for vehicular traffic but for pedestrians, cyclists, and differently-abled citizens, ensuring universal accessibility. Stakeholder participation is pivotal, with community input shaping road designs that resonate with local contexts, cultural heritage, and environmental sensitivities. Each road developed under this scheme is envisioned as a model of excellence, blending historical reverence with modern functionality, and setting benchmarks for sustainable urban living.

Together, through CM-GRIDS, we are not just building roads; we are sculpting the future of our cities—a future where every road leads to prosperity, sustainability, and inclusive growth.

Shri Arvind Kumar Sharma

Shri Arvind Kumar Sharma, Retd. IAS

Principal Secretary, UDD, Govt. of Uttar Pradesh

Foreword

By Shri Amrit Abhijat, IAS

Principal Secretary, UDD, Govt. of Uttar Pradesh

The CM GRIDS project stands as a pivotal initiative aimed at transforming our cities into vibrant hubs of sustainability and inclusivity. The “CM GRIDS - Design Guidelines” serve not just as a blueprint but as a catalyst for reshaping our urban fabric, aligning with our vision of a prosperous and sustainable future for all.

Uttar Pradesh, with its rapid urbanization and burgeoning economic activities, faces significant challenges in infrastructure development. The CM GRIDS project is our response to these challenges, emphasizing integrated road networks that are safe, sustainable, and inclusive. By integrating amenities like utility ducts, footpaths, green zones, and modern infrastructure such as solar energy-based streetlights and EV charging stations, we aim to enhance mobility, reduce carbon emissions, and foster economic growth across our urban landscape.

Our approach under CM GRIDS is not just about constructing roads but about reimagining urban spaces as cohesive ecosystems that promote community well-being and economic vitality.

By prioritizing road safety, advanced junction designs, and effective asset management, we ensure that our cities are not only livable but also thriving centers of innovation and opportunity.

Furthermore, CM GRIDS underscores our commitment to financial autonomy for urban local bodies, encouraging them to enhance revenue streams while promoting sustainable development. This initiative converges various state-level schemes to maximize impact and efficiency, ensuring that every rupee spent contributes to the holistic growth of our urban areas.

Just as Bengaluru has pioneered local solutions to urban challenges, Uttar Pradesh seeks to localize our approach through CM GRIDS. By tailoring our interventions to local contexts—be it historical, cultural, or ecological—we aim to preserve our heritage while embracing modernity.

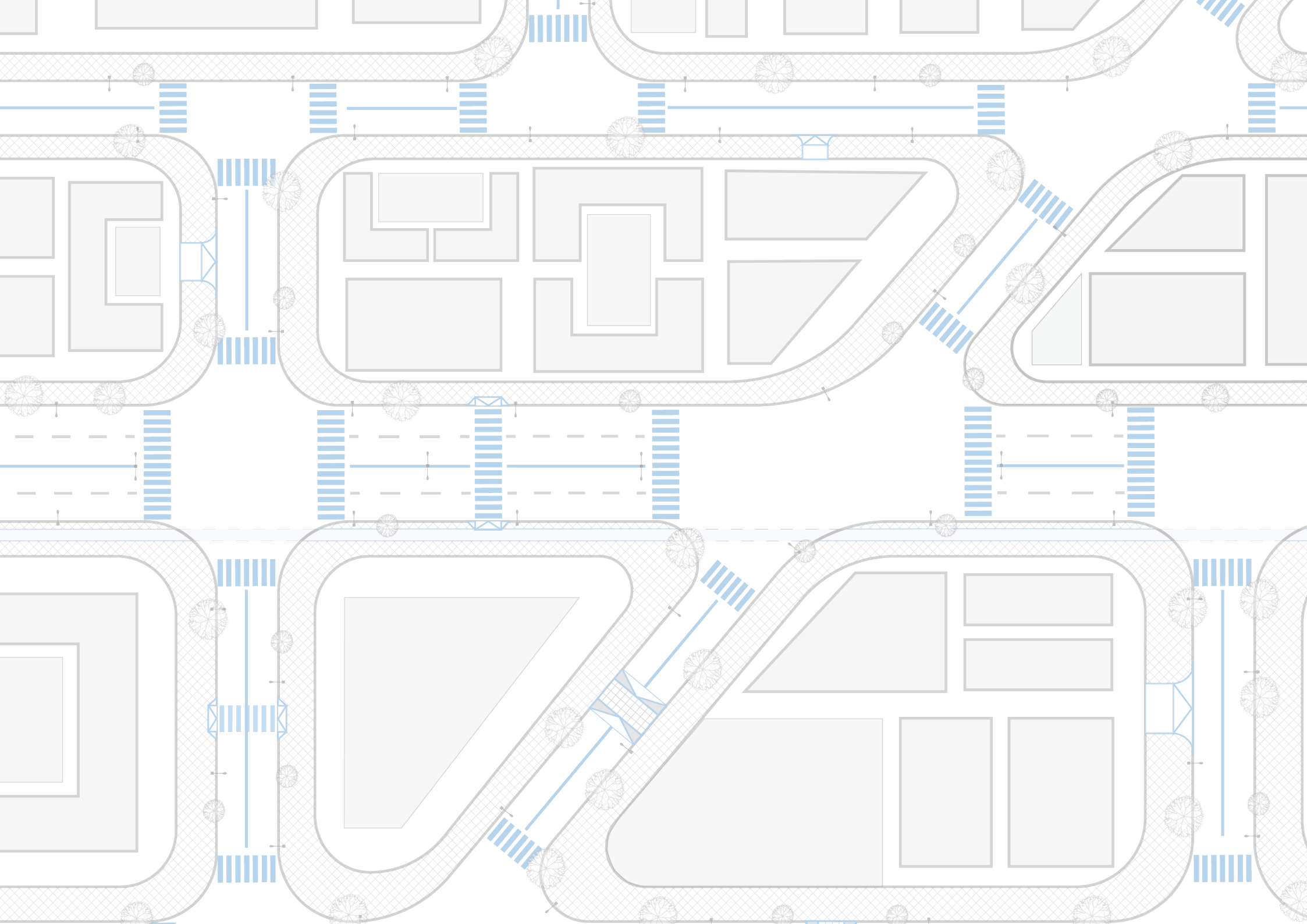
May these guidelines inspire all stakeholders—policymakers, urban planners, and citizens—to collaborate tirelessly towards building cities that are not only smart and efficient but also equitable and resilient.

This is an opportunity to shape a brighter future for generations to come, where every street, every neighborhood, and every city in Uttar Pradesh embodies our collective vision of prosperity and well-being.

Shri Amrit Abhijat

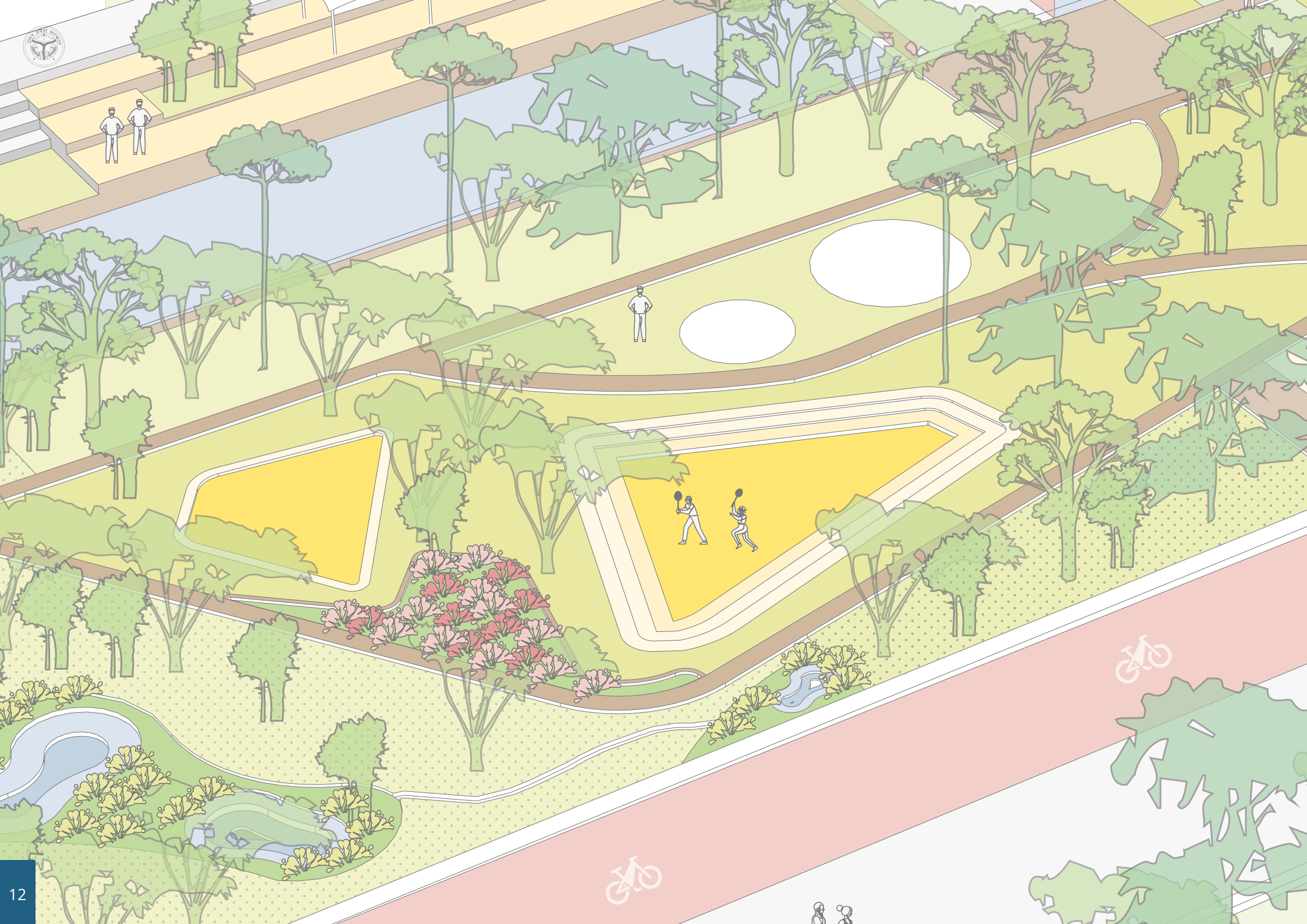
Shri G. Amrit Abhijat, IAS

Principal Secretary, UDD, Govt. of Uttar Pradesh



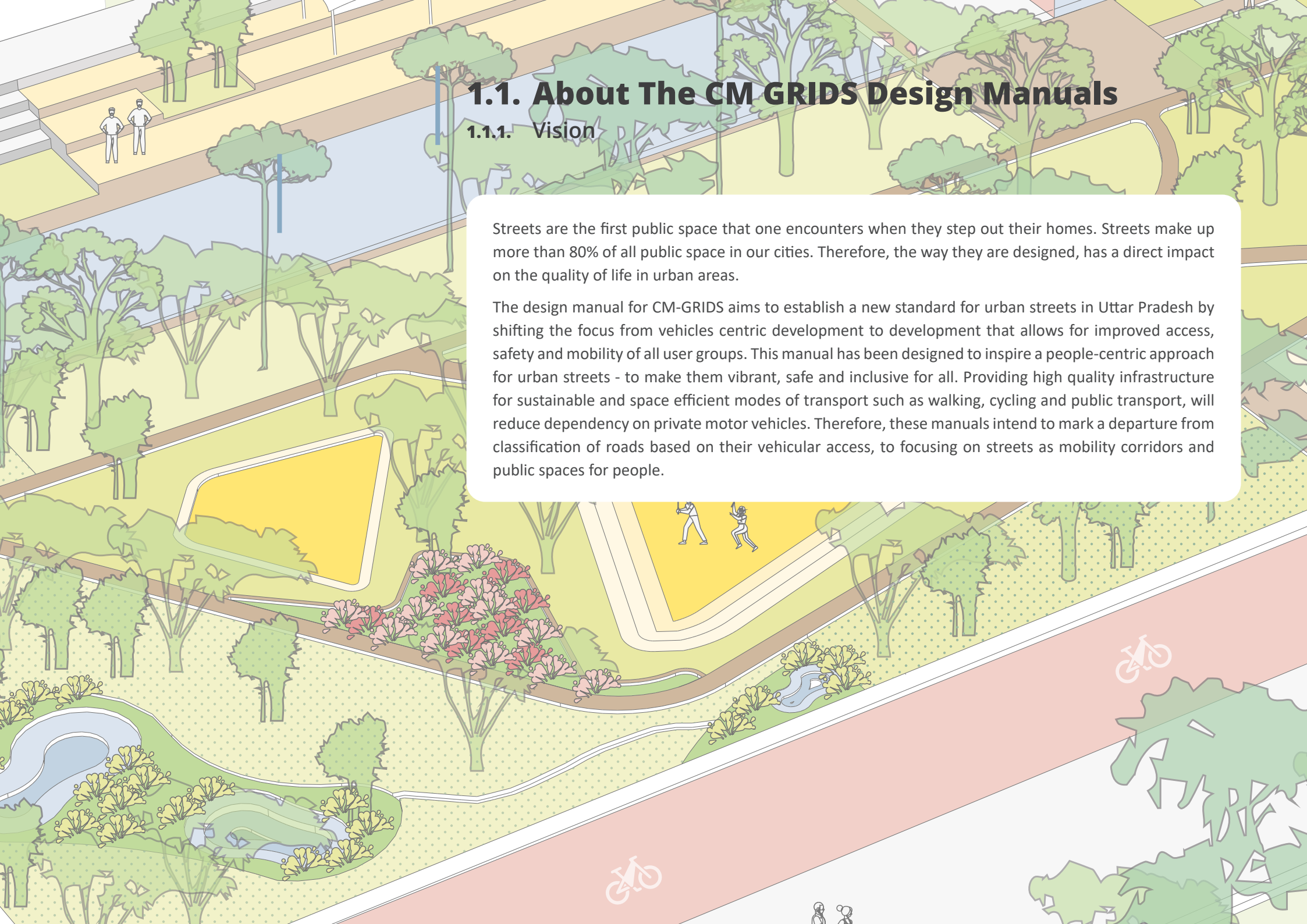
List of Abbreviations

ASTM	American Society for Testing and Materials
CBD	Central Business District
CI	Cast Iron
CM	Chief Minister
CPM	Critical Path Method
DI	Ductile Iron
DPR	Detailed Project Report
DLC	Dry Lean Concrete
DWC	Double Wall Corrugated
FRP	Fibre Reinforced Plastic
GFC	Good For Construction
GRIDS	Green Road Infrastructure Development Scheme
GSB	Granular Sub Base
HDPE	High Density Poly Ethylene
HUDCO	Housing and Urban Development Corp.
IAS	Indian Administrative Service
IRC	Indian Roads Congress
ITDP	Institution for Transportation and Development
LHS	Left Hand Side
LOS	Level Of Service
MLA	Member of the Legislative Assembly
NACTO	National Association of City Transportation Officials
NMT	Non-Motorised Transport
OFC	Optical Fiber Cable
PCC	Plain Cement Concrete
PDM	Precedence Diagramming Method
PPP	Public-Private Partnerships
PQC	Pavement Quality Concrete
PWC	PricewaterhouseCoopers
RCC	Reinforced Cement Concrete
RHS	Right Hand Side
ROW	Right Of Way
STP	Sewage Treatment Plant
S.U.R.E	Specifications for Urban Road Execution
TBM	Tunnel Boring Machine
TCA	Typical Contract Agreements
TCM	Traffic Calming Measures
ULB	Urban Local Bodies
UPVC	Un-plasticised Poly Vinyl Chloride
URIDA	Urban Road Infrastructure Development Agency
WBM	Water Bound Macadam
WMM	Wet Mix Macadam



1. Introduction

This section introduces the CM Grids project and its guiding principles, providing an overview of the manual. It also identifies the manual's users and stakeholders, explaining step-by-step how they can use it to build a CM Grids road.

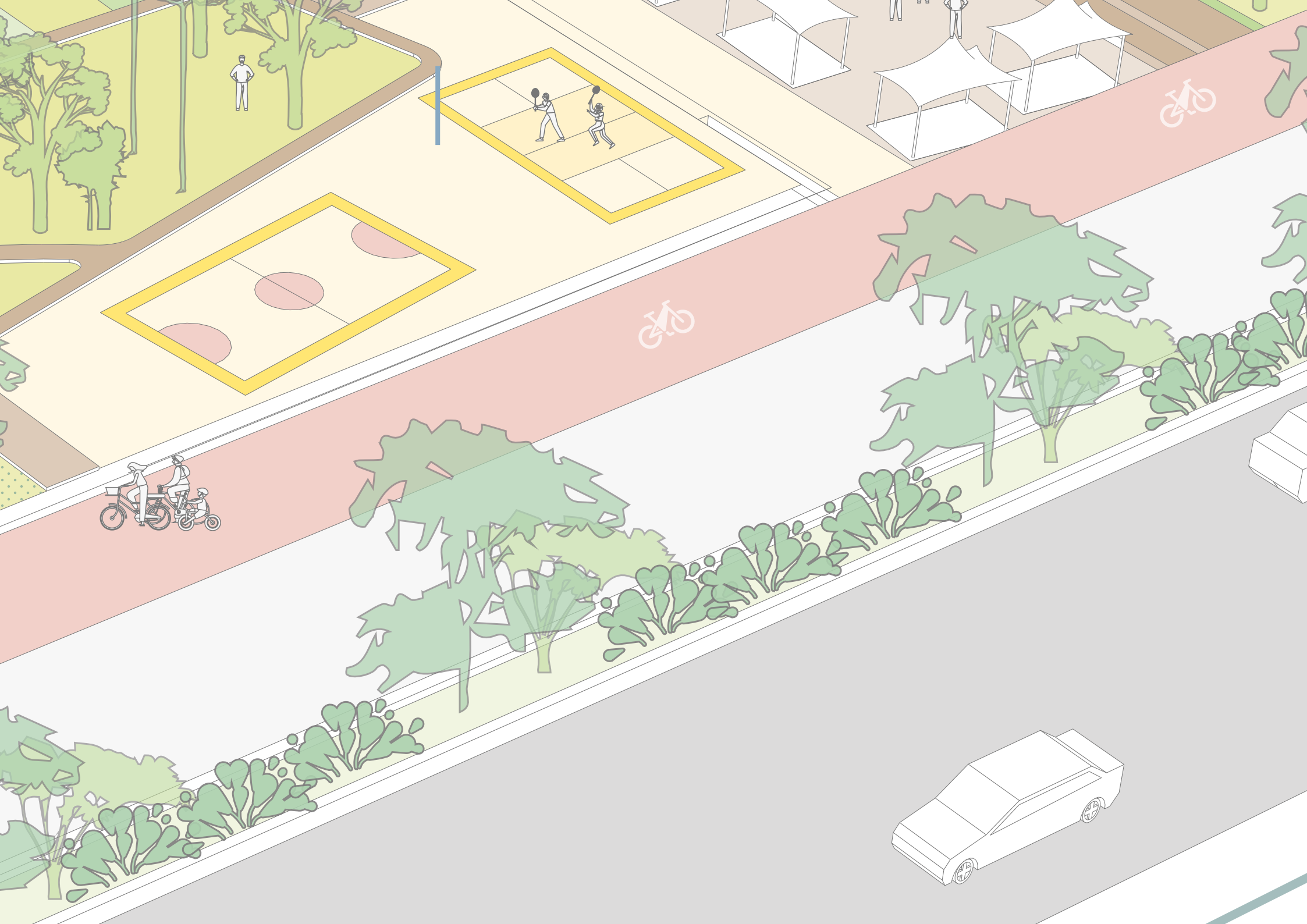


1.1. About The CM GRIDS Design Manuals

1.1.1. Vision

Streets are the first public space that one encounters when they step out their homes. Streets make up more than 80% of all public space in our cities. Therefore, the way they are designed, has a direct impact on the quality of life in urban areas.

The design manual for CM-GRIDS aims to establish a new standard for urban streets in Uttar Pradesh by shifting the focus from vehicles centric development to development that allows for improved access, safety and mobility of all user groups. This manual has been designed to inspire a people-centric approach for urban streets - to make them vibrant, safe and inclusive for all. Providing high quality infrastructure for sustainable and space efficient modes of transport such as walking, cycling and public transport, will reduce dependency on private motor vehicles. Therefore, these manuals intend to mark a departure from classification of roads based on their vehicular access, to focusing on streets as mobility corridors and public spaces for people.



1.1.2. Objectives

Streets make up more than 80% of all public space in our cities - the way they are designed, has a direct impact on the quality of life in urban areas

OVERVIEW : PEOPLE-CENTRIC STREETS

People-centric streets prioritize the well-being, safety, and quality of life of pedestrians, cyclists, and residents over vehicular traffic. Here are some reasons why we need such streets:

Health and Well-Being

- People-centric streets encourage walking, cycling, and physical activity. Regular exercise improves overall health and reduces the risk of chronic diseases.
- Accessible sidewalks, green spaces, and benches promote mental well-being and community interaction.

Safety

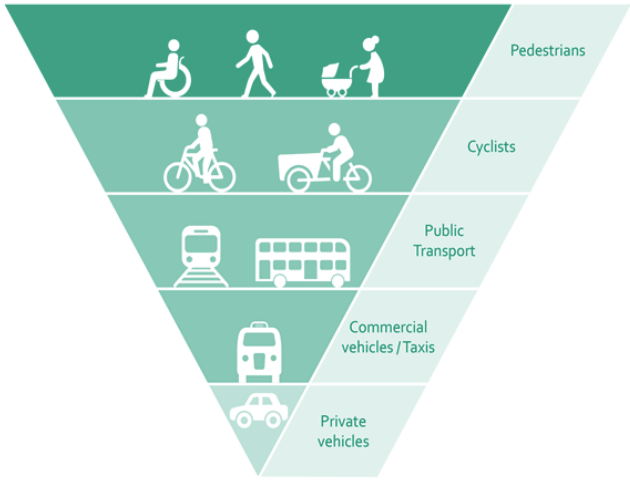
- Car-centric streets often prioritize speed and convenience, leading to crashes and fatalities.
- People-centric design includes features like cross walks, traffic calming measures, and well-lit pathways, enhancing safety for all road users.

Community Connection

- Streets designed for people foster social interaction. Sidewalk cafés, public art, and community events create vibrant neighbourhoods.
- Residents feel more connected when they can walk to local shops, parks, and gathering places.

Economic Benefits

- People-centric streets attract foot traffic, benefiting local businesses.
- Vibrant streetscapes increase property values and encourage investment.



Environmental Impact

- Reducing car dependency decreases air pollution, noise, and greenhouse gas emissions.
- People-centric streets promote sustainable modes of transportation.

ABOUT CM GRIDS

The Urban Development Department, Uttar Pradesh has launched an incentive-based scheme Chief Minister Green Road Infrastructure Development Scheme- Urban (CM-GRIDS) to promote social and economic development in the State and encourage economic autonomy in Urban Local Bodies (ULBs) through the development of urban roads. The Urban Development Department has also constituted Urban Road Infrastructure Development Agency (URIDA) for the implementation, operation and evaluation of CM-GRIDS.

DESIGN OBJECTIVES

Development of an integrated road network under CM GRIDS (URBAN) will provide mobility to all modes of transport, due to which easy access for the public to the transport system will be available.

In doing so, these manuals intend to mark a departure from classification of roads based on their vehicular access, to focusing on streets as mobility corridors and public spaces for people.

Urban streets must meet the demands and aspirations of the people using them now and those who will use them in the future in a manner that is sustainable and delivers quality public space. Contextualizing street design to the area, activities and needs of various users has been the approach in formulating these manuals.

These manuals seek to improve quality of life, in addition to social equity, environmental and economical sustainability by advocating:

- Universally accessible and comfortable streets for all irrespective of age, gender or ability
- Robust mobility network to increase citizens' access to essential social, economic and community services
- Cost-effective green streets to lower carbon emissions

1

ROADS FOR ALL

Roads developed under CM GRIDS (URBAN) will be accessible, friendly and safe for everyone irrespective of gender, age and especially vulnerable road users such as pedestrians, cyclists and persons with disabilities.

2

EASY ACCESS TO TRANSPORT SYSTEMS

Easy access to transport system prioritizes efficient connectivity and seamless integration with various modes of transportation to enhance overall mobility within the community.

3

ENVIRONMENT FRIENDLY GREEN ROADS

Green roads emphasizes sustainable practices such as greenery, retaining the existing tree cover, eco-friendly materials, and pollution mitigation measures to minimize environmental impact and promote biodiversity.

4

INNOVATIVE USE OF ROAD SPACE

Efficient use of road space will be promoted by exploring solutions such as car-free zones, smart parking systems and shared mobility options under CM GRIDS (URBAN).

5

STAKEHOLDER AND CITIZEN PARTICIPATION

Local communities, entrepreneurs and other stakeholders will be involved in the development of roads, so that roads are developed according to their needs and concerns.

6

SENSITIVITY TO LOCAL CONTEXT

Roads will be developed considering factors like area-specific social, cultural, ecological, historical heritage importance and street life.

7

CONVERGENCE BETWEEN DEPARTMENTS

For the successful implementation of the scheme, on-going schemes of various State/Centre Government and efforts of concerned departments shall be converged.

1.1.3. About The Manual

The aim of this manual is to help cities to create a network of integrated green roads that promote efficient mobility and economic growth, which can directly result in the upgradation of roads and the lives of its inhabitants across all ULBs in Uttar Pradesh. The manuals are structured with a vision of providing end to end assistance enabling the ULBs to apply the redesign template and implement it successfully on ground.

The Manuals for CM-GRIDS (Chief Minister Green Road Infrastructure Development Scheme- Urban) are a set of complete guidelines to develop an integrated road network, in terms of mobility for all modes of transport whilst promoting non-motorised transport / active mobility, creating safe intersections, and improving connectivity to public transit and essential social, economic and community services.

The manuals will look at streets holistically, from both surface level and subterranean level, and provides the solutions required to move away from the cyclical expenditure of cutting and digging up roads often with no improvement to the user experience. The manual mandates uniform travel lanes, an even pedestrian experience, and an improved public realm with plazas, landscapes, street furniture and signage.

The manuals are written in three volumes and are based on the Aim and principles of the CM-GRIDS

VOLUME 1

Will provide the design guidance for varying ROW conditions in Uttar Pradesh under Road R.O.W. Redesign and special conditions of:

- Road retrofitting
- Intersection design
- New works

It will consider the safety and convenience of the multiple users of roads as well as efficient storm water drainage, utility ducts, landscaping and more. The manual will provide technical designs for construction to guide engineers and contractors in the implementation.

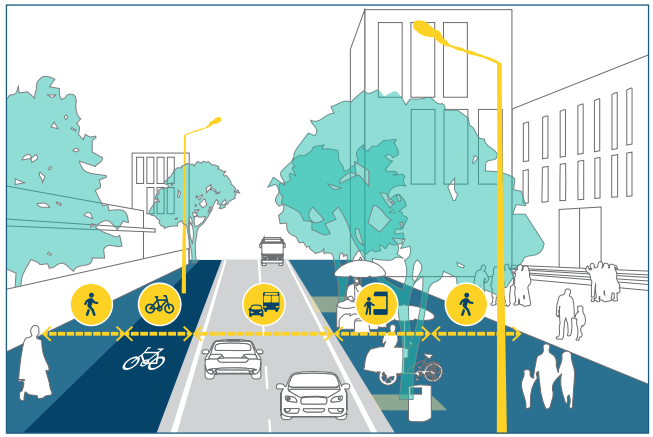
VOLUME 2

Will provide implementation guidelines and will include the sample Bill of Quantities (BoQ), sample Detailed Project Reports (DPR), contractor selection guidelines & Standard Bid Document (SBD), sample GFCs and job aids.

VOLUME 3

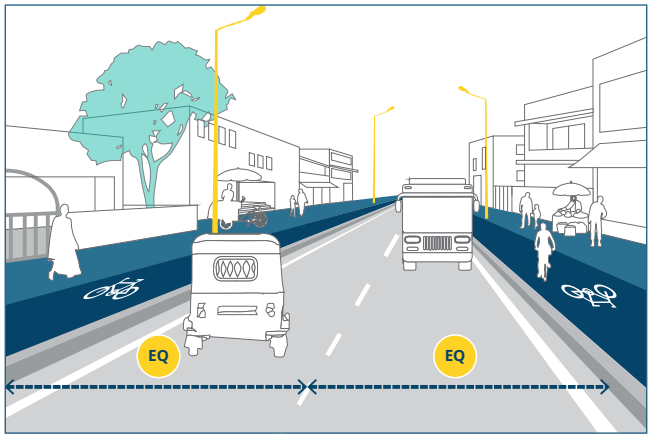
Will provide comprehensive guidelines for the maintenance of CM-GRIDS roads.

1.1.4. Principles Of CM GRIDS Roads



BALANCED RIGHT OF WAY

- Equal priority to all user groups
- Equitable distribution of road space.
- Space for amenities and street furniture.
- Public space and landscape inclusion.
- Designated vending

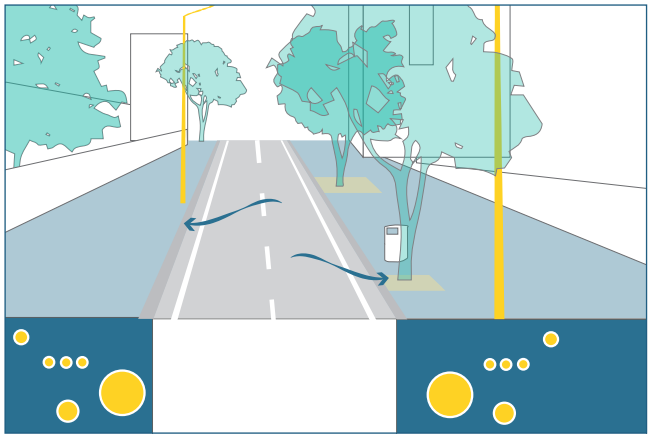


UNIFORM TRAVEL LANES

- Avoiding short spurts of speeding on wider stretches and addressing bottle-necks in road geometry.
- Allowing for lane discipline and steady speeds.

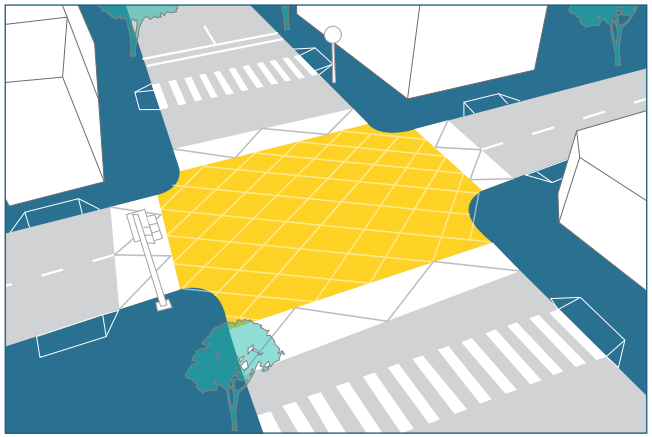
PROMOTE NON-MOTORIZED TRANSPORT (NMT)

- Prioritizing sustainable mobility with continuous, evenly paved footpaths and designated cycle tracks.
- Adequate shading & necessary NMT infrastructure.



INTEGRATED & ORGANISED UTILITIES

- Organised underground utilities contained beneath the footpath and providing both individual property and network connections.
- Robust storm water drainage.
- Good street lighting and safety for vulnerable groups.



SAFE INTERSECTIONS

- Improved geometry to ensure safe and efficient intersections
- Potential of place-making

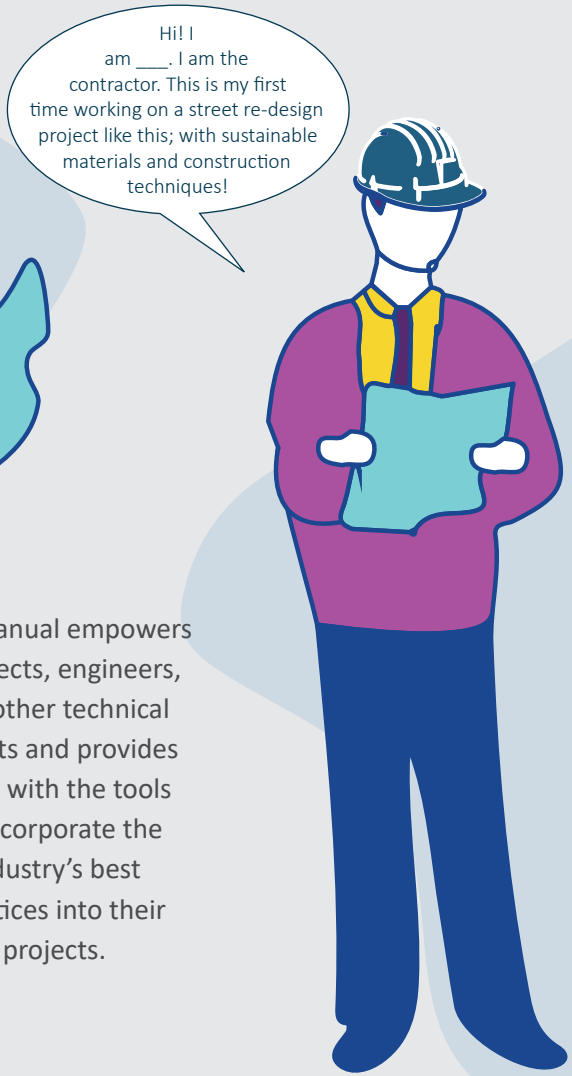
CONTRACT AND IMPLEMENTATION

- One overarching contract for maximum accountability
- Implementation processes covering inter-agency coordination, project sequencing and documentation
- Site monitoring and quality check-lists

1.1.5. Who is this manual for?

01.
TECHNICAL EXPERTS

This manual empowers architects, engineers, and other technical experts and provides them with the tools to incorporate the industry's best practices into their projects.



02.
CONTRACTORS

03.
BUREAUCRATS

The manual can support consistent design feedback across different levels of local government to ensure an equitable street redevelopment that is consistent with its policy and priorities.

04.
CITIZENS

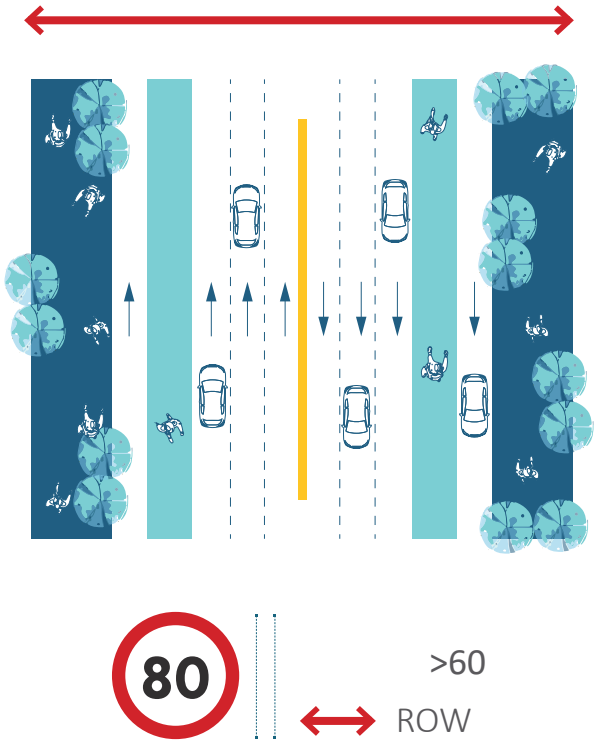
The manual can help empower citizens - with the tools to participate in the design process and planning conversations.

2. Planning Principles

2.1. Classification Of Urban Roads

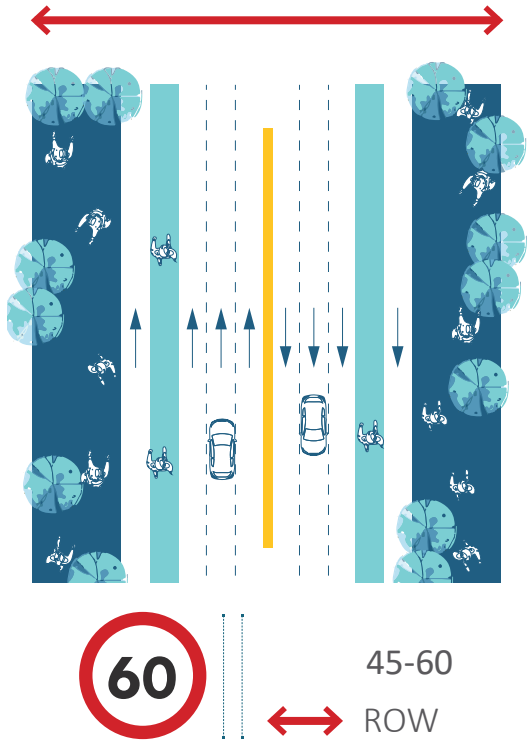
Based on the classification provided by IRC (IRC:118), there are five classes of urban roads that are covered under the CM GRIDS (Urban) Scheme.

2.1.1. Urban expressways



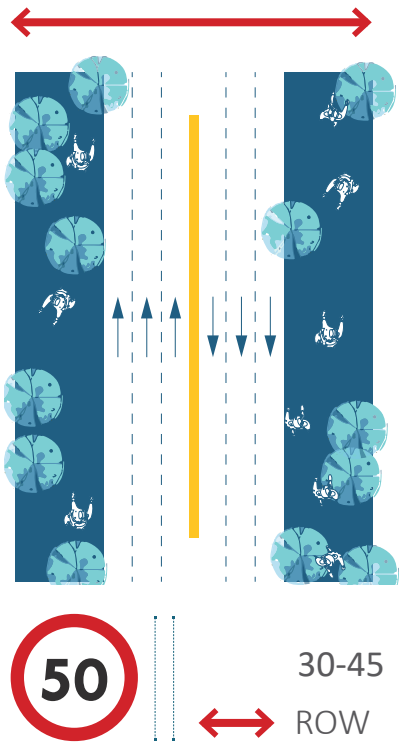
An urban expressway is a controlled-access, divided highway designed for high-speed traffic, connecting inter-city highways to city entry points, typically featuring grade-separated intersections and service roads.

2.1.2. Arterial roads



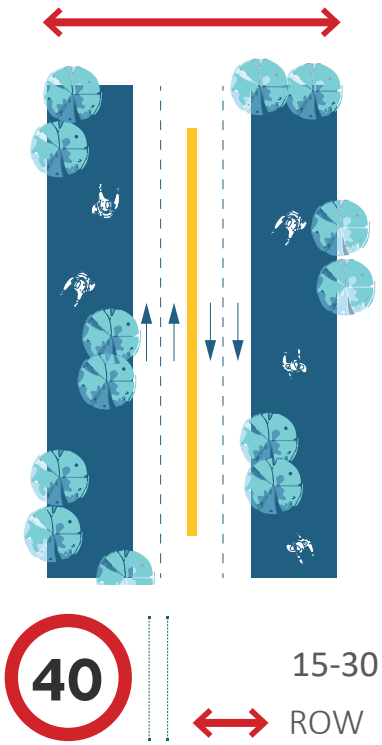
Arterial roads facilitate city-wide and long-distance travel, ensuring safe NMT facilities. On-street parking is restricted unless service lanes are available. Safety for pedestrians will be ensured by providing segregated at-grade level crossings.

2.1.3. Sub arterial roads



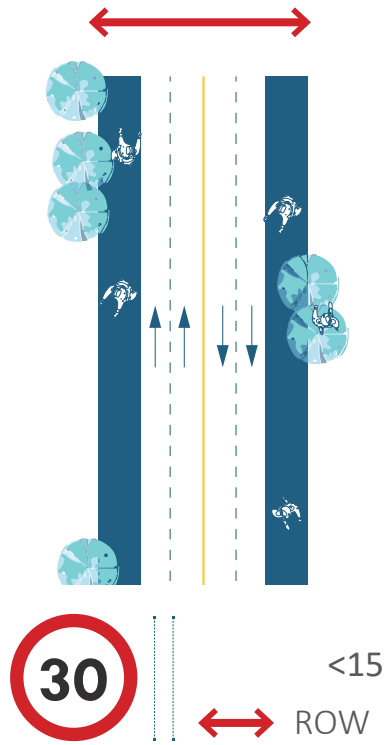
A general term denoting a road/street primarily for through traffic usually on a continuous route but offering somewhat lower level of traffic mobility than the arterial road. These are larger collector streets meant for movement through neighbourhoods and to connect to arterial roads.

2.1.5. Collector roads



A Street for collecting and distributing traffic from and to local streets and also for providing access to arterial/sub arterial roads. They shall be designed with dedicated footpaths. Various speed reduction measures will be employed to limit vehicle speeds to less than 40 km/h and ensure safety of NMT users.

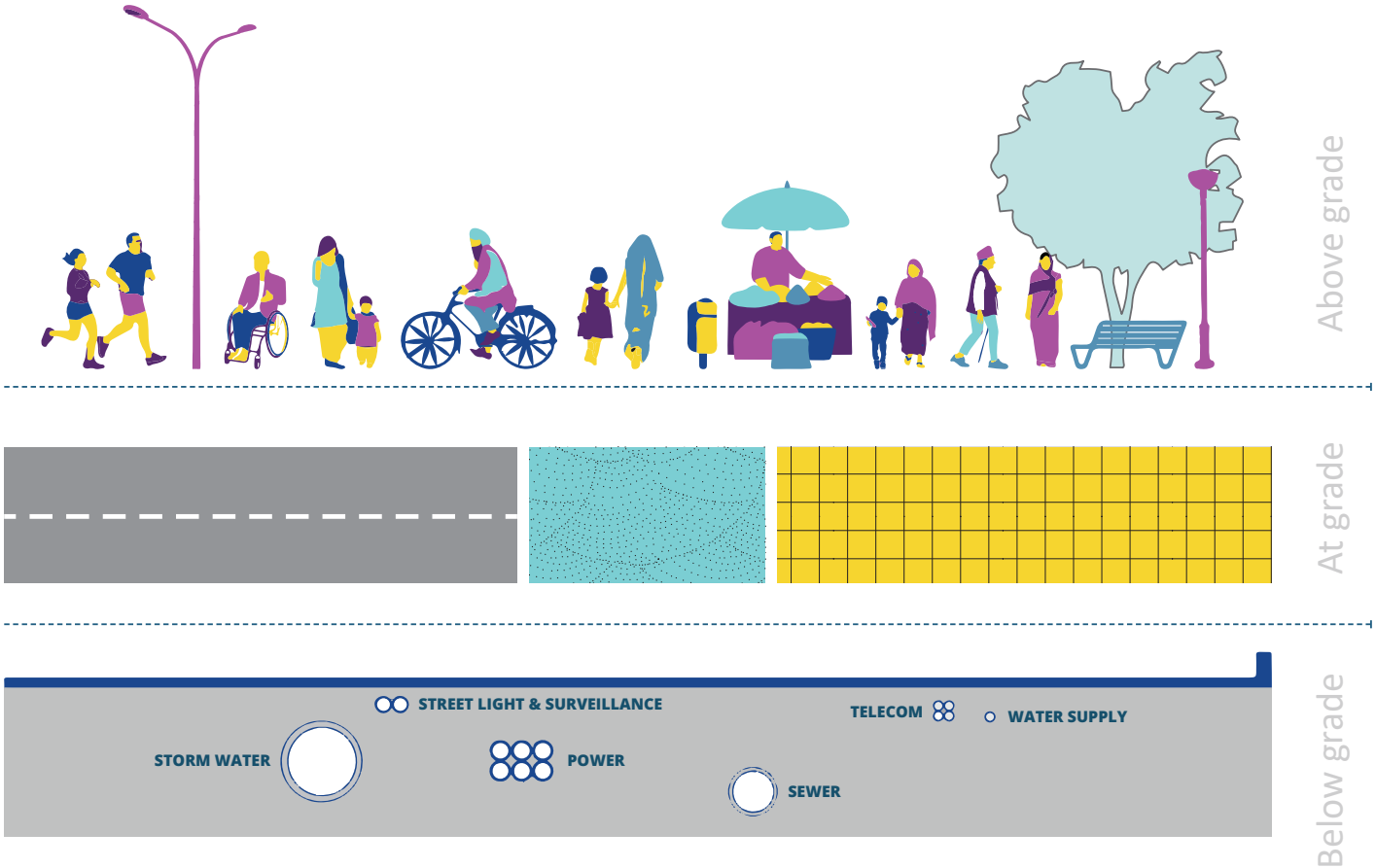
2.1.4. Local roads



A local street provides access to residences, businesses, prioritizing local activities over through traffic. It may lack dedicated footpaths and be designed as shared space favouring non-motorized transport. Traffic calming measures ensure vehicle speeds below 20 km/h for pedestrian safety.

2.2. Components Of A Road

Taking a holistic approach to street design that encompasses not just the at-grade design, but the below and above grades as well.



2.2.1. Below grade

Below the road surface, in urban areas, a plethora of utility lines criss-cross each other and haphazardly run beneath our streets. The aim, through CM GRIDS, is to neatly organise these utilities to make planning, access, and maintenance easier for cities. The utilities beneath the roads include :

- Water Supply
- Power Cables
- Sewer Lines
- Storm Water Drainage
- Telecom Cables
- Gas Lines

2.2.2. At grade

This refers to the elements of the road surface that physically supports the road users. This ranges from the paver blocks on footpaths to the kerb stones that support them and the asphalt of the vehicular carriageway. Broadly the components of the 'at-grade' portion are :

- Footpaths
- Kerb Stones
- Carriageway
- Cycle Tracks
- Road Paint Markings
- Pick/Drop and Parking

2.2.3. Above grade

The above-grade portion of the road is the elements of the ROW that road users actively interact with on a daily basis; from using signboards to navigate to resting on seaters and disposing waste in dustbins. Broadly, the components include :

- Signage
- Dustbins
- Seaters
- Landscaping
- Streetlighting
- Artworks / Sculptures
- Utility Boxes

3. Design of R.O.W Elements

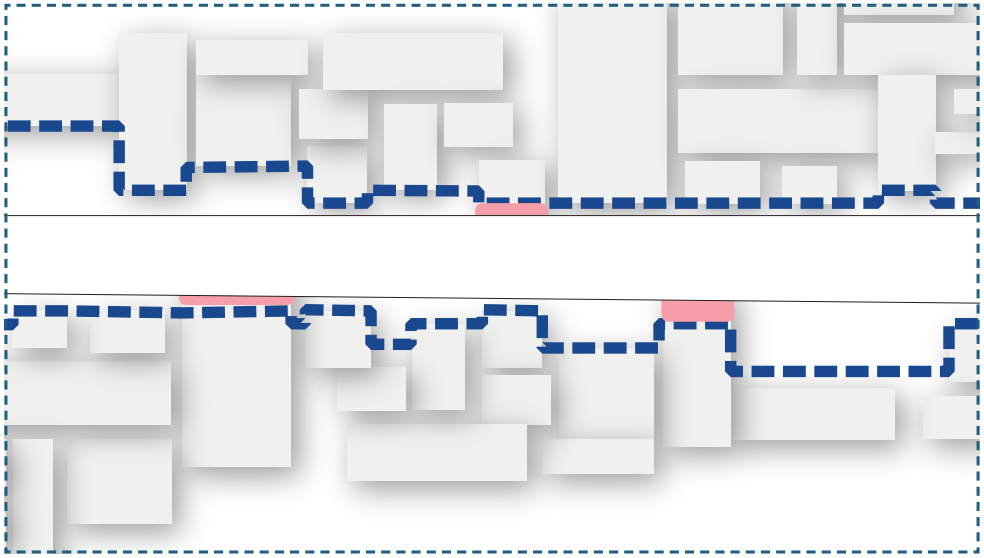
3.1. Road Alignment

Proper street alignment ensures efficient traffic flow and accommodates all travel modes, including pedestrians, cyclists, para-transit, and buses, by dividing the right of way appropriately.

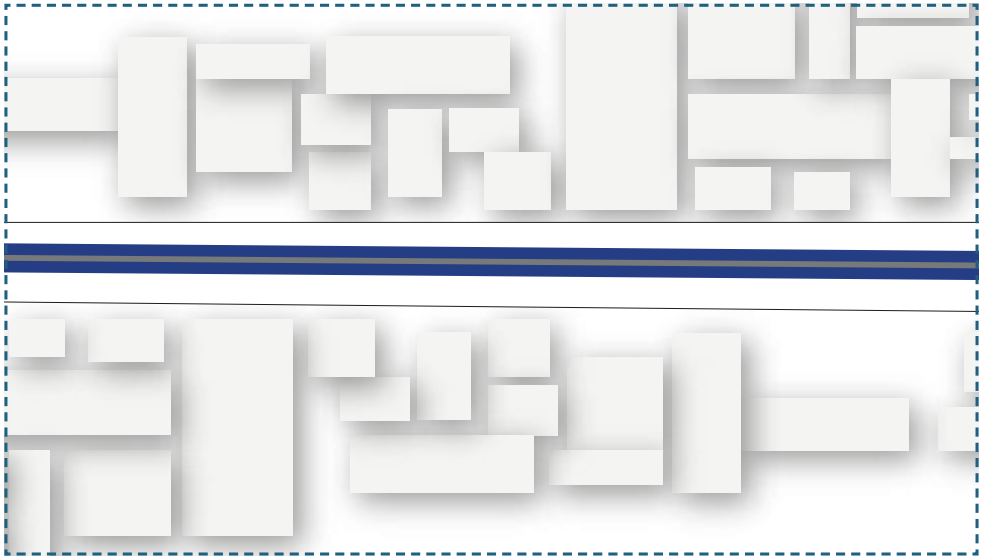
For the creation of the CM GRIDS road, broadly, the following steps are to be applied to create the road alignment and define the road geometry.

1. Define the property line
2. Define the centre line
3. Take equal offsets from the centre line to define each travel lane / bus lane / cycle lane and finally the footpath kerb edge.
4. Parking bays are to be carved out of the remaining space on either side of the road and as per the requirements of the surrounding context.
5. Provide ramps with crossing (or tabletop crossings) at regular intervals for pedestrian crossing.
6. Where space permits, landscape strip can be provided along the edge of the road.
7. All the remaining space is to be treated and paved as a continuous footpath area.
8. Additional elements (such as street furniture, dustbins, way-finding signage, etc. may be added along the footpath as long as it does not infringe on the free movement of pedestrians.
9. Street lights may be provided at regular intervals to prevent any dark spots on the carriageway and footpath..
10. Any large pockets of spaces along the footpath may be turned into plazas with sculptures, fountains, landscaping, etc.

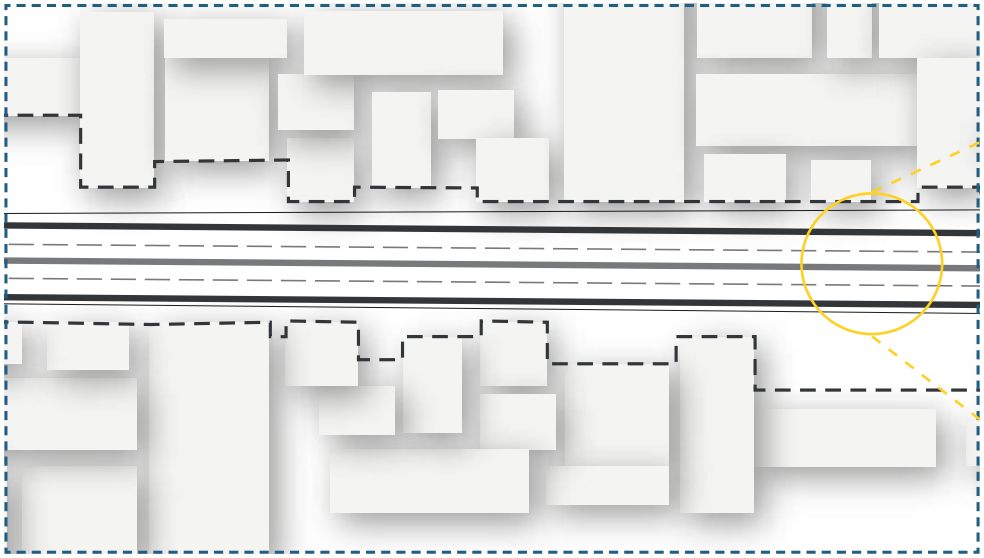
The above steps are illustrated in the following pages for added clarity.



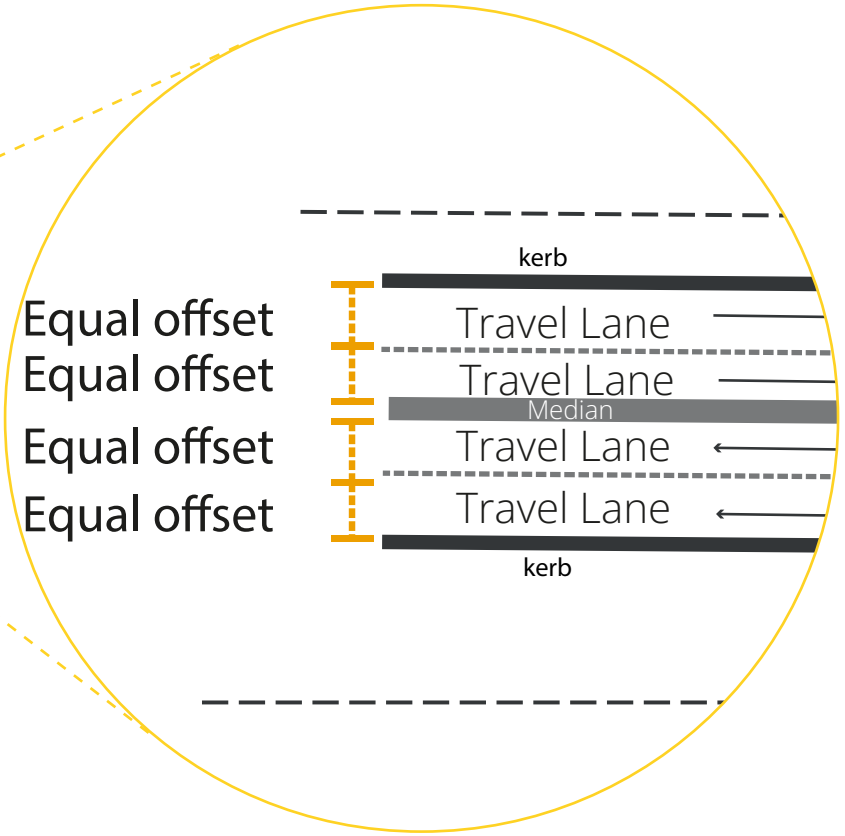
1 **DEFINE THE PROPERTY LINE**

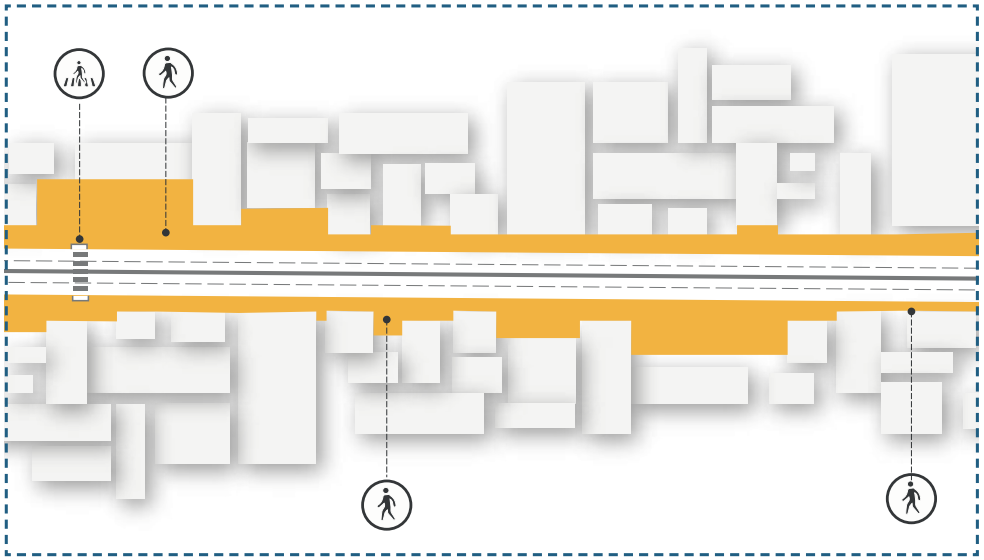


2 **DEFINE THE CENTRE LINE**

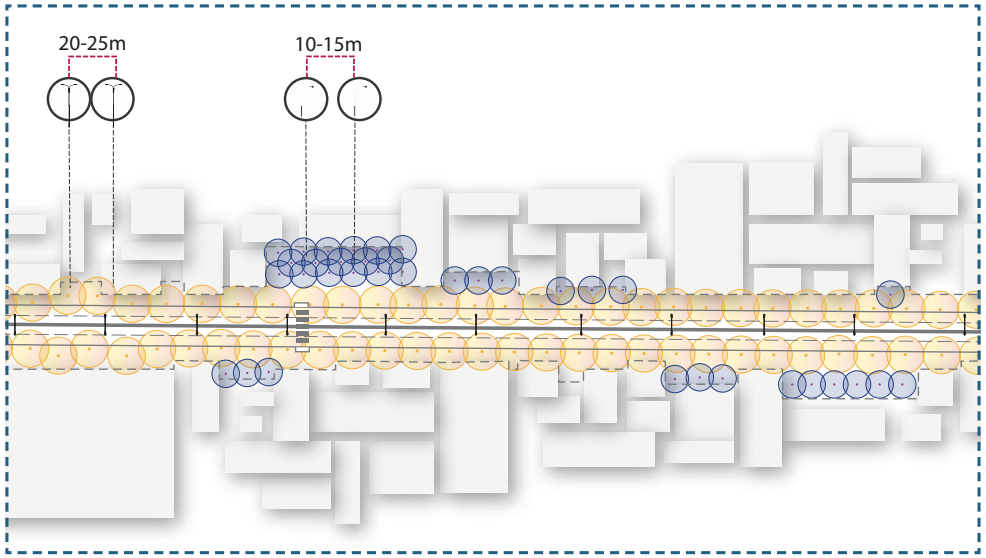


3 **TAKE EQUAL OFFSETS FROM THE CENTRE LINE**

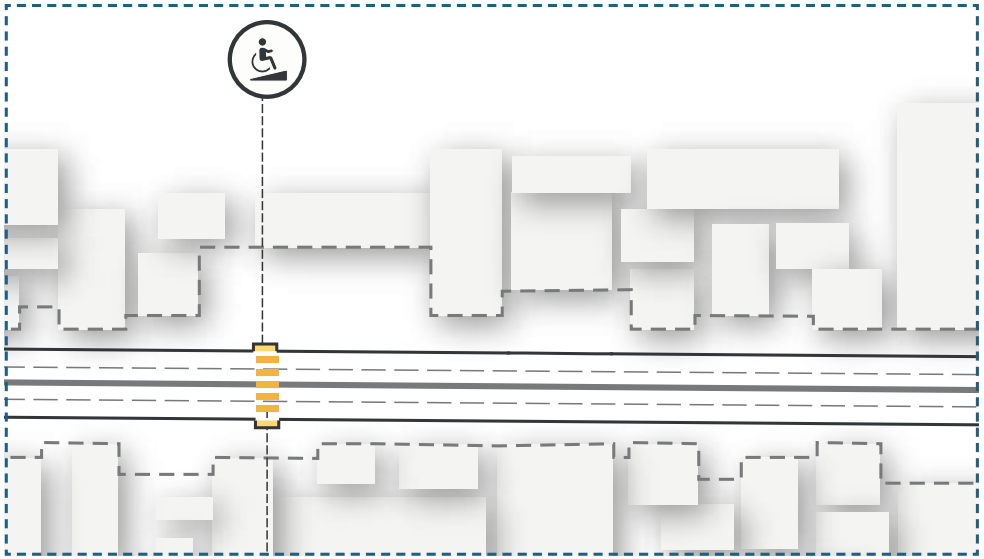




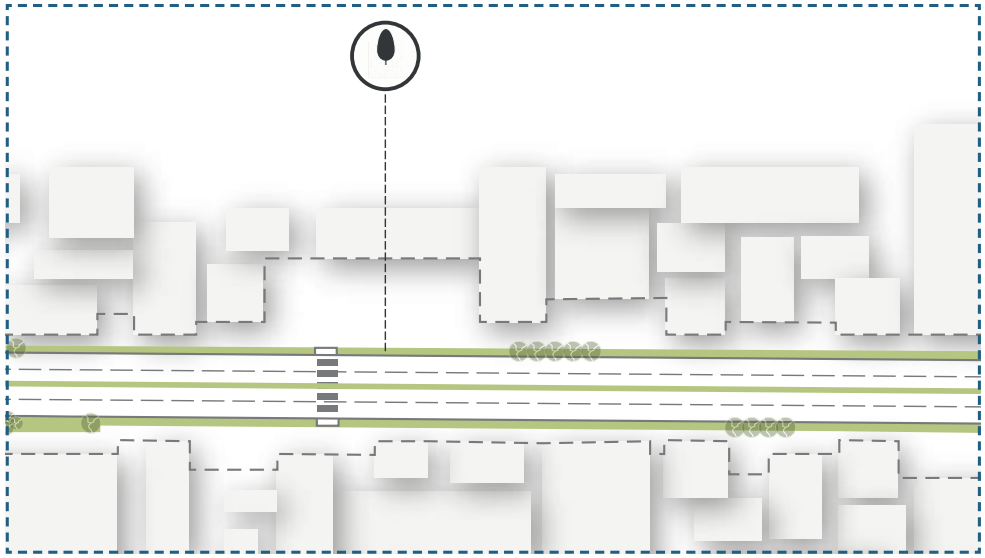
4 ALL BALANCE SPACE BECOMES FOOTPATH



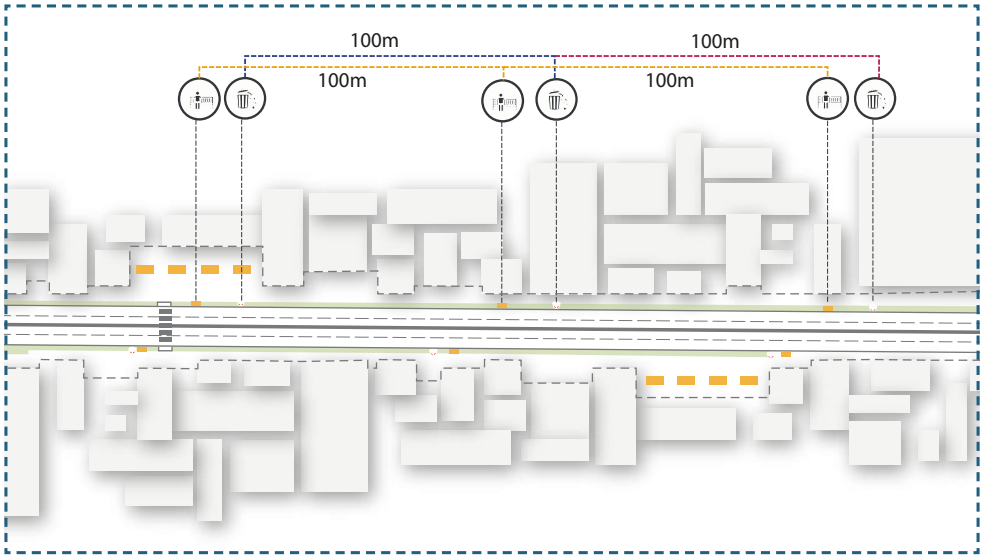
5 INCORPORATE STREET LIGHTING



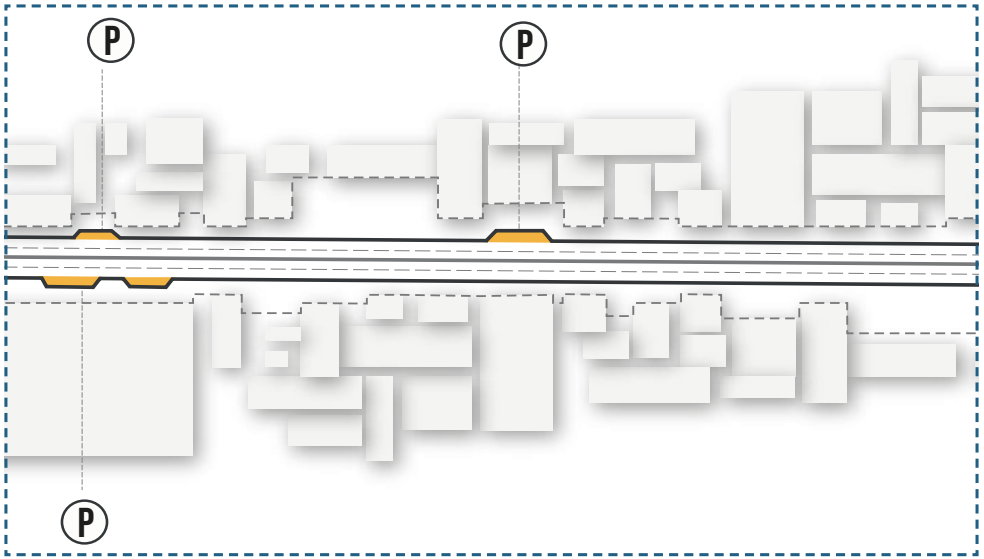
6 LAY OUT RAMPS & CROSSINGS POINTS



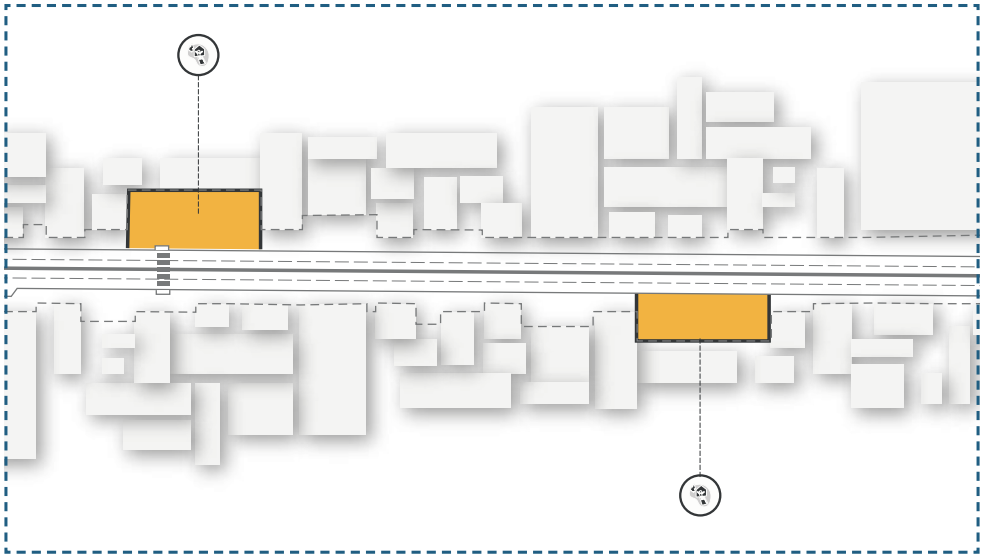
7 PROVIDE LANDSCAPE WHERE FEASIBLE*



8 PROVIDE STREET FURNITURE AS NEEDED*



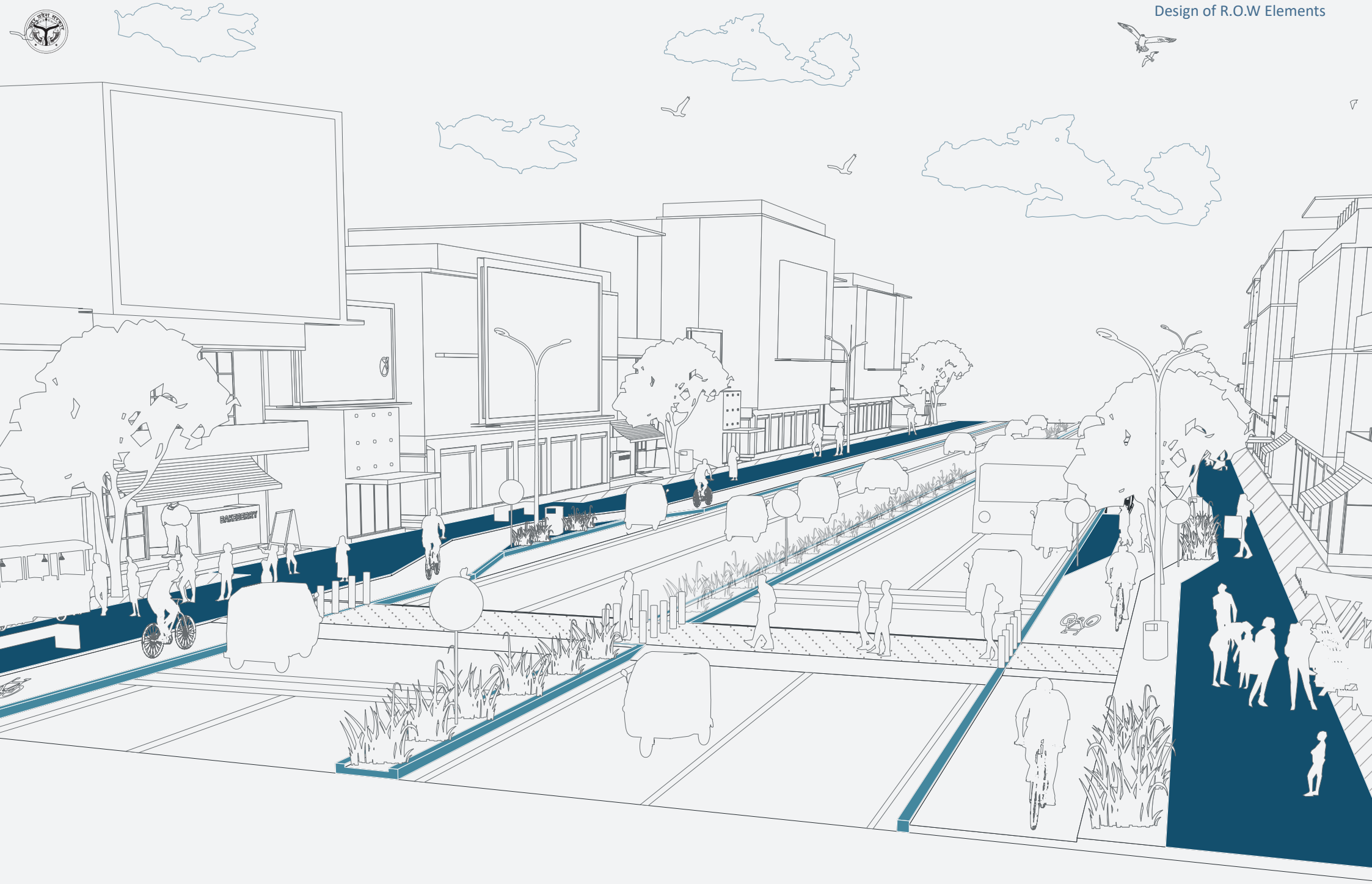
9 IDENTIFY SPACES FOR PARKING BAYS*



10 CONVERT LARGE SPACES INTO PLAZAS WITH AMENITIES

Note :

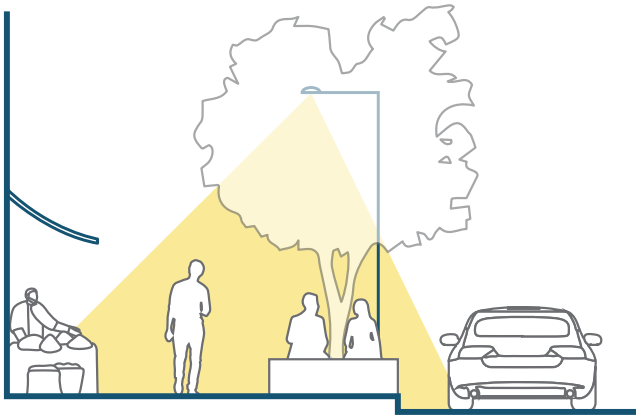
* Space allocation for parking bays, landscaping and street furniture is to be done only after ensuring that a minimum walking space of 2m is available on the footpath.


BAKERY

3.2. Planning & Design Standards By Element

3.2.1. Footpath & Kerbs

Good footpaths are well-lit, well shaded and safe while accommodating the needs of all road users.



PLANNING STANDARDS

It is important that there is a continuous unobstructed path for pedestrians and people with restricted mobility; not hindered by street furniture, utilities, vending or trees and landscape.

- The footpath should be separated from motorised travel lanes and cycling infrastructure. A level difference, kerbs, landscape strips with hedges and trees, bollards, paving patterns, paint etc. can be used to create this separation.
- It is preferable that the footpaths are at level and not broken / made to change level at vehicular entry /exits and instead the vehicles use a ramp to access the property.
- The width of the pedestrian pavement will vary based on the number of pedestrians using the street and the type of the street the footpath is located on. The width and LoS of the footpaths should be based on IRC:103-2022.
- Shaded footpaths are preferred in a country like India, for increased pedestrian comfort. Well lit footpaths with no dark spots are essential for women's safety as well as other vulnerable users.

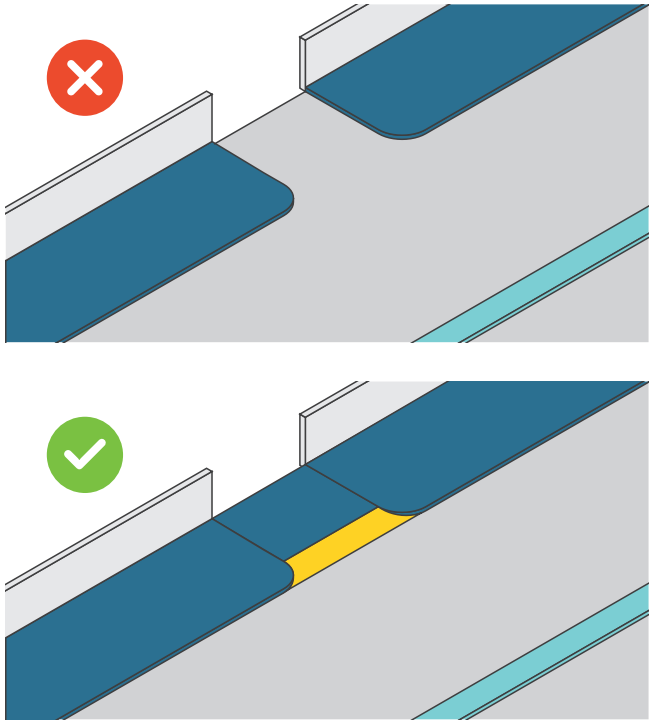
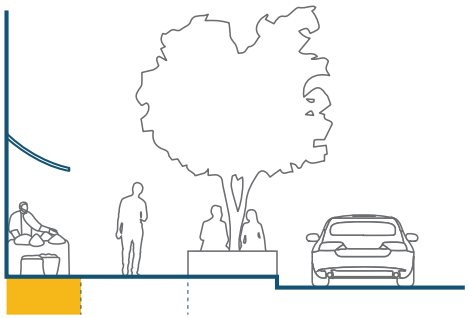
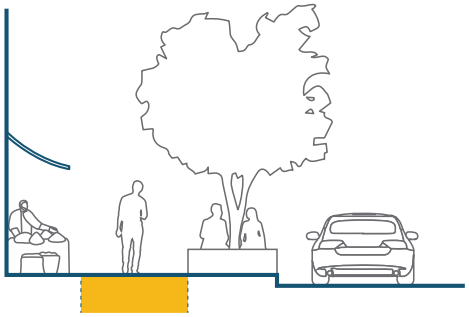


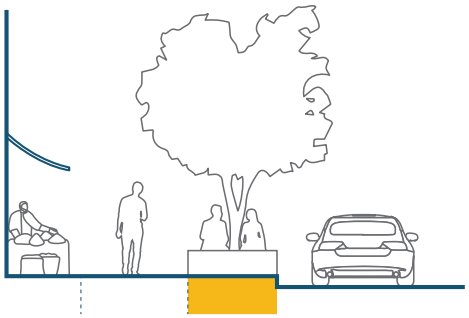
Figure 3.1 : Footpaths should not be broken or made to change level at vehicular entry /exits.



FRONTAGE ZONE



PEDESTRIAN ZONE



MULTI-UTILITY ZONE

As per IRC:103, footpaths should be planned in 3 different zones - pedestrian or walking zone, frontage or dead zone and multi utility zone.

- The frontage or dead zone provides a buffer between the pedestrian zone and property edge. Minimum 0.5 metre buffer space should be left from the building compound wall as pedestrians do not walk touching the wall. In case of shopfront, one metre frontage space is recommended to avoid hindrance from standing customers and products that may be displayed in the footpath. Street light can be placed in the frontage zone, however no elements of it should protrude inside the pedestrian zone.
- The pedestrian zone is a clear walking space for pedestrians without any obstructions. It is recommended to provide minimum 2 metre wide walking zone in residential areas to ensure 2 wheelchairs can pass each other simultaneously. A clear height of 2.4 metres from the finished footpath floor should be maintained in walking zone.
- Multi utility zone is the buffer space between The Walking zone and the carriage way. It is a space to provide seating, bus stops, IPT stands, landscape, trees, signage, telecom or electricity boxes, street vending or on-street parking. Minimum of 1.5 metre wide MUZ should be provided to accommodate all. Prepaids auto-rickshaw stand seating. And electrical and telecom junction boxes. A 2 metre wide amused should be provided for on street parking. of 4 wheelers cycles and 2 wheeler. More than one music can be provided for wider footpaths to accommodate street furniture, trees and other elements. However, walking zone should not be compromised.

DESIGN STANDARDS

The following points must be incorporated in the design of footpaths:

- The height of the footpath should be no more than 150mm from the adjoining finished carriageway level to ensure comfortable access to all pedestrians, especially for senior citizens and children.
- The surface of the footpath should be even, free from cracks and well drained and the surface texture should prevent skidding to ensure safety across all weather conditions.
- The traverse slope, along the footpath can range between 1:50 to 1:100. Steeper slopes can lead to falling or rolling back of wheelchairs.
- Any break in the surface, such as drainage channels or expansion joints, should not be greater than 10 mm and should be perpendicular to the direction of movement.
- Gentle slopes of 1:10 to 1:12 need to be provided

to ramp down the footpath at crossings and other areas where there is a level difference, to allow for universal access to the physically challenged, wheelchair users and for strollers.

- Table top crossings must be provided for continuous pedestrian movement at small side streets or at pedestrian priority areas. Table top crossing also improve the safety of both pedestrians and vehicles as they need to slow down before crossing.
- At crossings and at ramps that provide vehicular access to properties, bollards or other design elements that can prevent vehicles from using the footpath can be used.
- Tactile patterns and paving should be used to indicate directions, obstacles and crossings for the visually impaired.
- The footpath should be finished with a slope towards the storm water drain or landscape strip for rainwater run off.

MATERIAL SPECIFICATIONS

Footpaths can be finished with a variety of materials:

- Interlocking loose fixed paver blocks (60 to 75mm thk) with 50mm sand bed.
- Fixed paver blocks (60 to 75mm thk) with 100mm P.C.C. below.

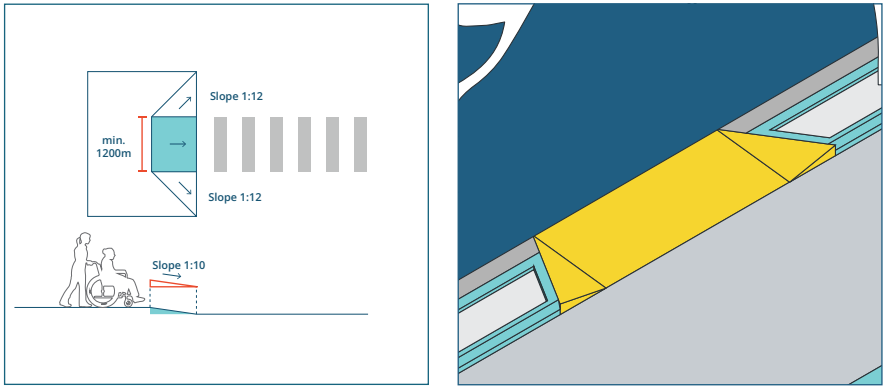


Figure 3.2 : Provide gentle slopes of 1 : 10 or 1 : 12 at crossings and level differences to ensure universal access for the physically challenged, wheelchair users, and strollers.

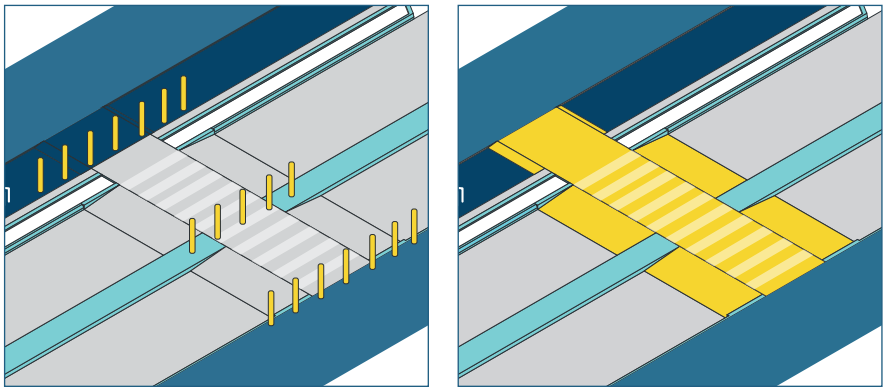


Figure 3.3 : Table top crossings ensure continuous pedestrian movement at side streets or priority areas, enhancing safety by requiring vehicles to slow down before crossing.

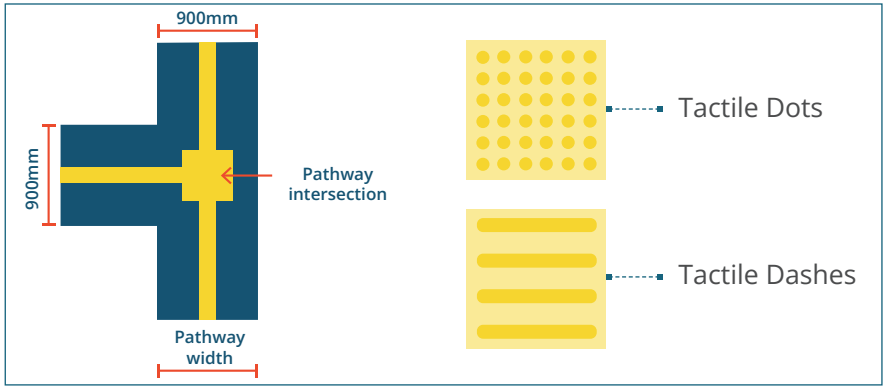


Figure 3.4 : Use tactile paving to guide the visually impaired with directions, obstacles, and crossings..

Adjoining Landuse	Minimum Pedestrian Zone Width	Minimum dead / frontage zone width	Minimum Multi-Utility Zone Width	Minimum Total Footpath Width
Residential	2.0 m	0.5 m	1.5 m	4.0 m *(for a 15m wide street with a 6m undivided carriageway)*
Neighbourhood Level Commercial Street	2.5 m	1.0 m	1.5 m	5.0 m *(for a 18m wide street with a 7m undivided carriageway)*
City Level Commercial Street	4.0 m	1.0 m	1.5 m	6.5 m *(for a 21m wide street with a 7m undivided carriageway)*

Table 3.1 : Recommended minimum clear width of different zones on footpaths along different land uses and edge conditions as per IRC:103

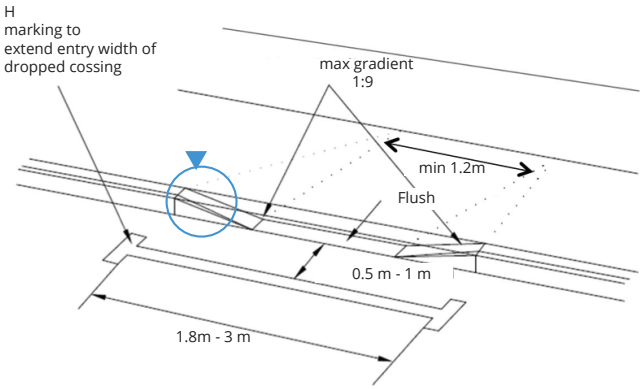


Figure 3.5 : Drop-kerb detail.

- Natural stones such as granite, rough kota, etc
- Pre-cast concrete slabs
- Stamped concrete
- Footpaths must edged with pre-cast kerbs.

KERBS

The kerb is a key element that helps segregate user groups on the road. However, its primary purpose is to protect and strengthen the pavement edge.

Kerbs are usually made of concrete with a height varying from 150mm - 250mm. There are various types of kerb designs to accommodate the different types of segregations required. The matrix in Table 3.2 illustrates what kerbs to use where.

» **Tip :** It is strongly recommended that pre-cast concrete M40 kerbs be used. However where unavoidable, cast-in-situ concrete kerbs can also be used. However, in that case, steel reinforcement may be required.

The primary kerb types are :

1. Footpath kerb: It is recommended that pre-cast chamfered kerbs, with a clear height of 150mm are used between the footpath and cycle track/ travel lane/ parking. The chamfered side should face the open side. Kerbs should be coloured in black and white. In school zones, the colour should be red and white
2. Median kerb: It is recommended that pre-cast chamfered kerbs with a minimum clear height of

300mm is used for medians, with the chamfered edge facing the open sides. The median kerbs can have concrete/ paver blocks or landscape in the space between them. It is recommended that a minimum space of 100mm be maintained between the kerbs for stability. Kerbs should be coloured in Yellow and black.

3. Cycle track kerb: A single kerb of with a minimum clear height of 200mm, a width of 200mm and chamfered edges can be provided to separate the cycle track from other modes of travel. Where possible two chamfered kerbs with concrete/ paver blocks or landscape as a buffer can also be used to separate the cycle track from other modes of travel.
4. Drop kerbs: These are used in areas to ramp footpaths and cycle tracks up or down and to facilitate mobility for persons with disabilities. For instance at pedestrian crossings, the footpath will be ramped to the street level along with kerb ramps. Refer Figure 3.5 for detail.
5. Drain kerbs: These are either saucer shaped or inclined kerbs meant to collect the storm water run-off from roads and divert it into the nearest storm water catch pit or chamber. Drain kerbs prevent ponding on the roads which will eventually result in potholes and cracks.

Footpath	-				
Landscape Strip	Flat Kerb	-			
Cycle Track	Chamfered Kerb	Chamfered Kerb	-		
Parking	Chamfered Kerb	Chamfered Kerb	Chamfered Kerb	-	
Travel Lane	Chamfered Kerb + Drain Kerb	Chamfered Kerb + Drain Kerb	Cycle Track Kerb + Drain Kerb	Drain Kerb	-
	Footpath	**Landscape Strip**	**Cycle Track**	**Parking**	**Travel Lane**

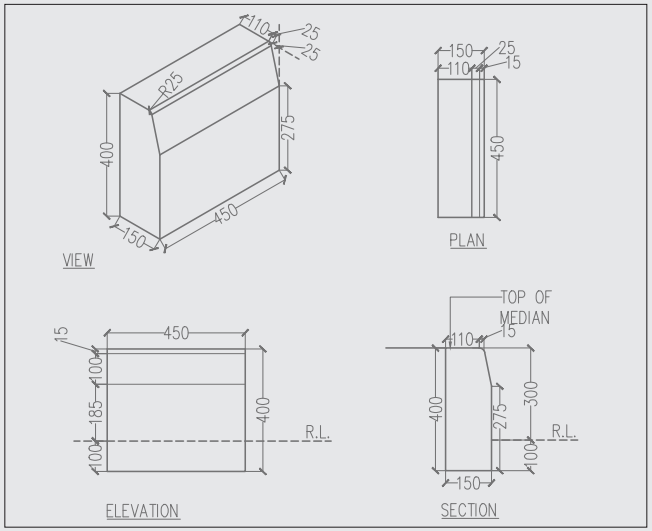
Table 3.2 : Kerb type matrix

	Traffic Signs	**Street Light**	**Tree / Plants**	**Dustbins**
Distance from kerb (meters)	0.6 m	0.5 m	0.7 m	0.2 m

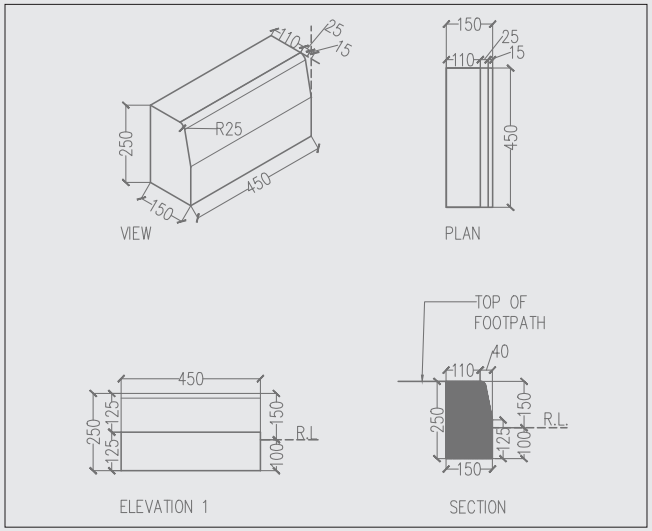
Table 3.3 : Distance from kerb to street design elements

Key Points from IRC:103.

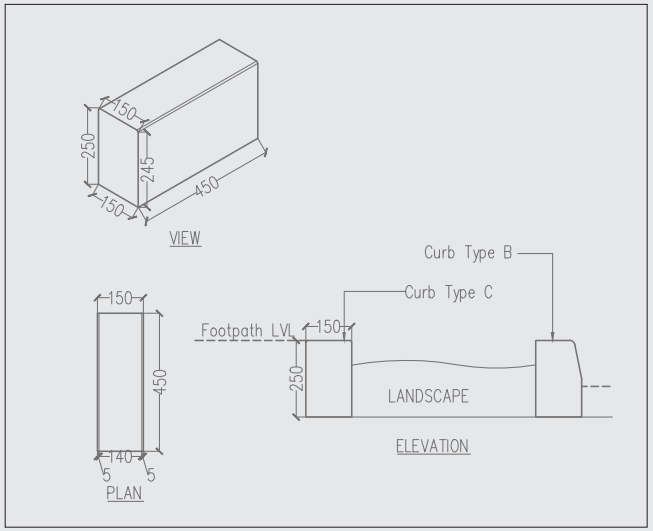
- Minimum walking / pedestrian zone with in residential areas should be 2.0m. The width will increase for commercial areas.
- The height of the footpath should not exceed 150 mm.
- Footpath should be continuous and at the same level throughout the length of the road.



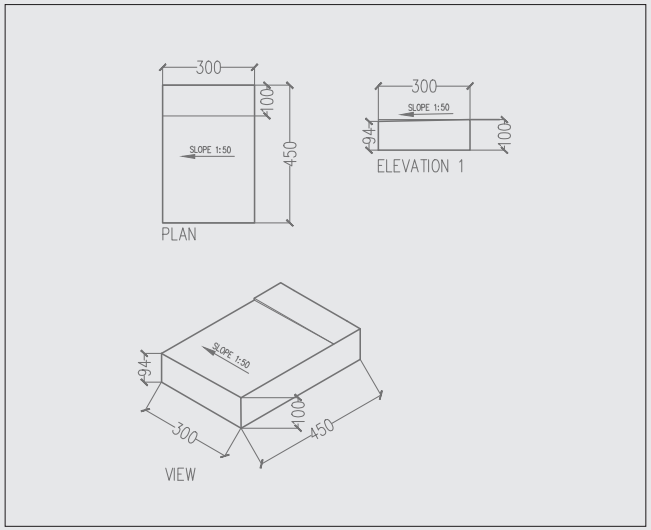
Median Kerb



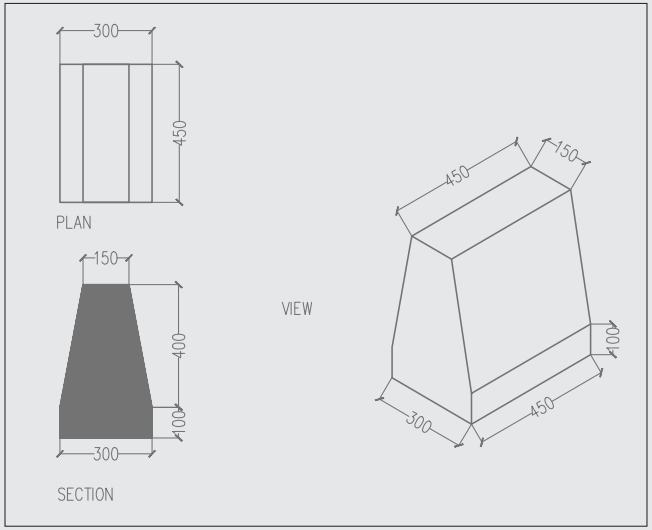
Chamfered Kerb



Flat Kerb b/w Footpath and Landscape

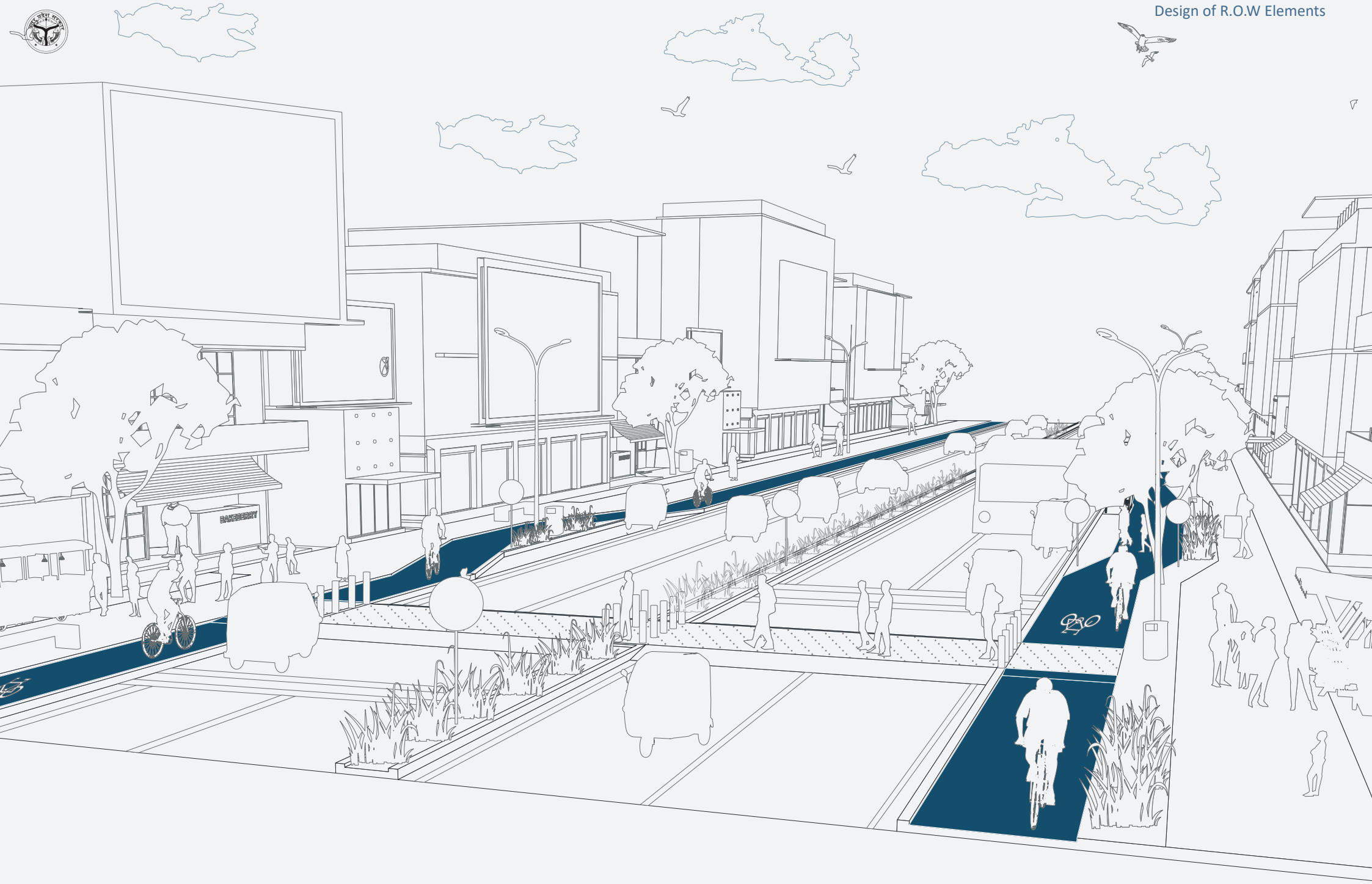


Flat Drain Kerb - End (Cast in Situ)



Median Kerb Between Travel Lanes

Figure 3.6 : (Facing) Image of a Tender SURE road in Bengaluru illustrating the on-ground implementation of the key points mentioned in this chapter.


BAKERY

3.2.2. Cycle Infrastructure

PLANNING STANDARDS

Cycling has always been part of urban mobility in India, but a lack of safe routes, risk of crashes coupled with other societal aspirations and economic pressures has resulted in it not being a preferred choice of mobility.

There are certain principles that need to be followed while designing good cycling infrastructure. It is important that the cycling infrastructure is :

- Cohesive
- Creates a direct route for its users
- Safe
- Attractive
- Comfortable

As detailed in IRC:11, the type of cycling infrastructure to be designed may vary based on its role in the larger cycling network, road type and demand level. Refer Table 3.4 for details on the recommendations by road types. On all types of roads, segregation/safe speed is to be ensured for the safe, smooth, and continuous movement of cycles.

	Arterial Road	**Sub-Arterial Road**	**Collector Road**	**Local Street**
	45 - 60m	**30 - 45m**	**15 - 30m**	**10 - 15m**
Type of Infrastructure	Segregated Cycle Track	Segregated Cycle Track	Segregated Cycle Track / Shared Street	Shared Street
Minimum width	Bidirectional - 3m Unidirectional - 2m			-
Level	+100mm from Carraigeway			-
Gradient	1:12 to 1:20(minimum)			

Table 3.4 : Recommended cycling infrastructure & track width, level and gradient as per IRC:11

Cycle tracks should be shaded where possible with trees and well lit for increased safety.

With the provision of connected cycle infrastructure including cycle tracks, cycle shares and cycle stands, cycling as a viable choice of transport can be promoted across all age groups.

It is desirable to re-design R.O.W.s prioritising cycle infrastructure in all arterial, sub-arterial and collector roads by:

- Narrowing existing travel lanes
- Removing a travel lane
- Removing parking
- Covering drains and extending the footpath

Vehicular entries and parking are to be factored into the design.

As cyclists travel in a speed that is less than vehicular speeds and far greater that pedestrian speeds, it is ideal to separate cycle tracks from other modes of travel through level differences, kerbs, landscape, bollards etc.

TYPES OF CYCLING INFRASTRUCTURE

Cycle Tracks

These are cycling infrastructure that are both vertically and horizontally segregated from the carriageway.

- Cycle tracks are necessary on streets with speed limit above 30 km/h.
- The minimum width of a unidirectional cycle track should be 2m and for a bidirectional track, it should be 3m. Height of the cycle track should be minimum of 100mm from carriageway.
- Surface should preferably be of concrete or asphalt

Cycle Lanes

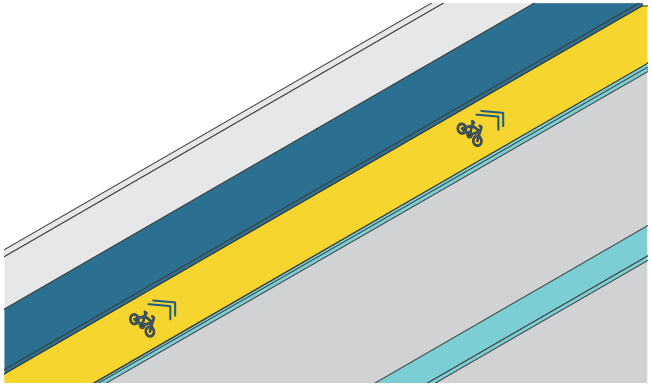
These are cycling infrastructure with no segregation from the carriageway. Cycle lanes are generally identified though a strip of paint or coloured asphalt along the curb or parking.

- Minimum width of a cycle lane should be 1.5m.
- The level and the surface finish are the same as that of the carriageway.

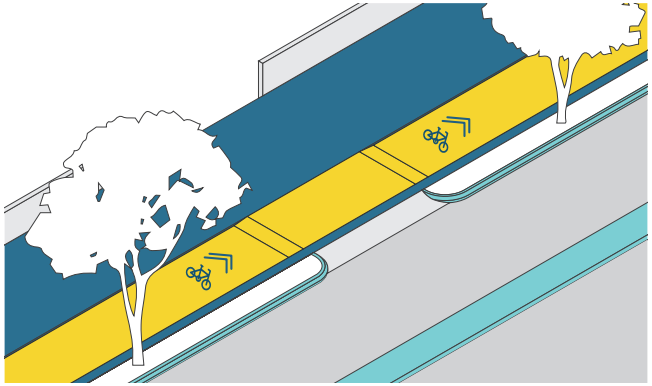
Cycle lanes do not provide any protection to cyclists and can be easily encroached by motorised vehicles. It is therefore not recommended since it only provides a false sense of protection.

» **Tip :** Wherever cycle lanes are painted, traffic calming elements need to be installed on streets to keep vehicular speeds below 30km/h.

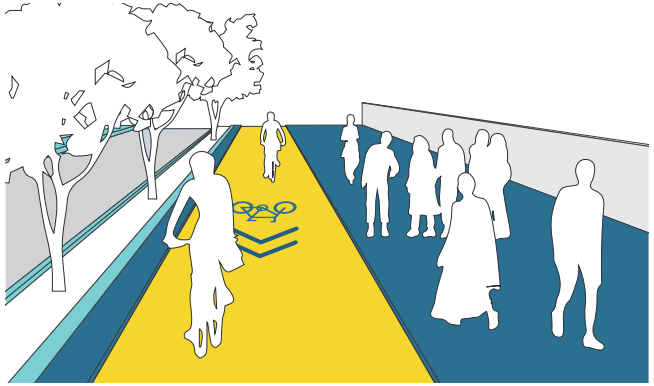
Figure 3.7 : (Facing Page) Illustration of the key design considerations for cycle tracks.



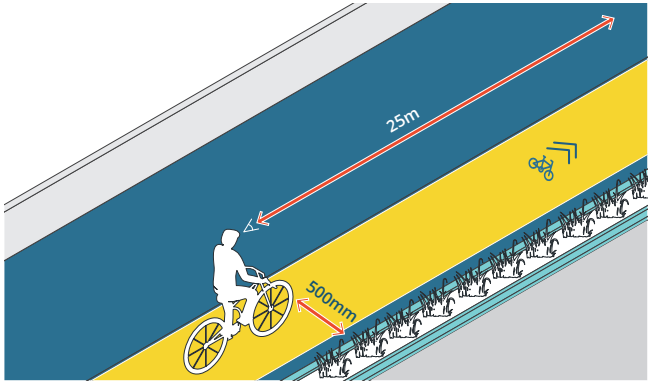
It is preferable that cycle tracks are continuous and at one level. Cycle tracks can be marked along the travel lane or designated tracks separated from other modes of movement.



Vehicular entries and parking are to be factored into the design. Cycle tracks should be shaded where possible with trees and well lit for increased safety.

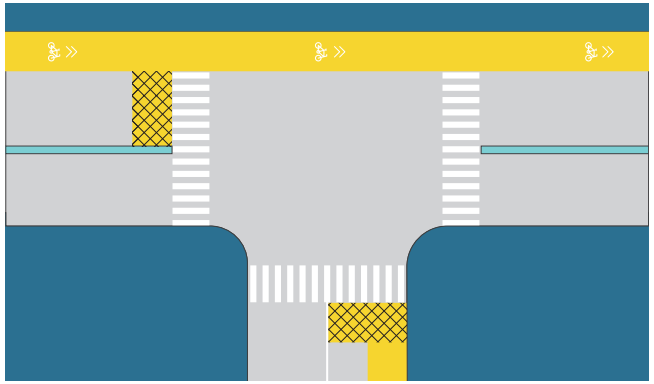


As cyclists travel in a speed that is less than vehicular speeds and far greater that pedestrian speeds, it is ideal to separate cycle tracks from other modes of travel through level differences, kerbs, landscape, bollards etc.



Cyclist should have clear view of a minimum of 25m. Additionally, a clearance of 50cm from hedges is required.

Cycle symbols will need to be stencilled onto cycle tracks at every 50m.



Cycle crossings along with pedestrian crossings are to be provided at intersections and side roads.

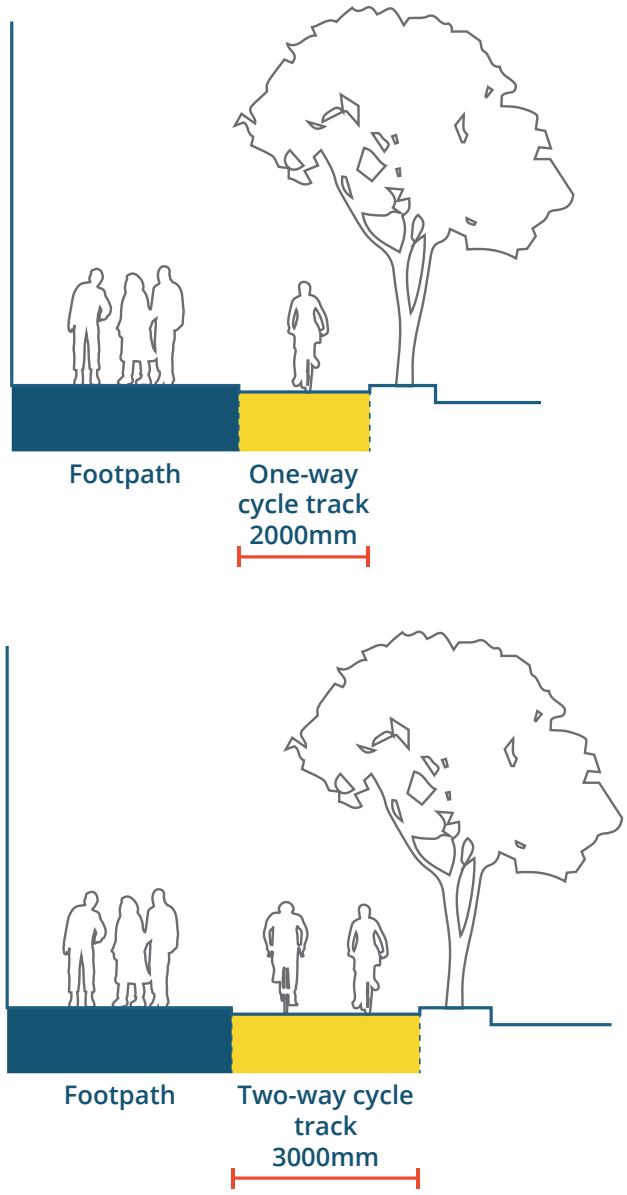


Figure 3.8 : Recommended widths of cycle tracks as per IRC:11

Segregated Cycle Lanes

These are cycling infrastructure that are on the same level as the carriageway but segregated by road markings / flexible bollards / green belt. The segregation ensures the safety of cyclists.

- For unidirectional movement, a minimum lane width of 2m is recommended, while bidirectional lanes should be at least 3m wide.
- Encroachment by two-wheelers and auto rickshaws for parking and driving is a common issue, necessitating a design that prevents this.

Shared NMT Infrastructure

On streets with wide footpaths, but low levels of pedestrians and cyclists, the footpath can be used as a shared NMT lane. Here, the cycling path is defined only by paint marking and is the same level as the footpath.

This intervention is not recommended on streets with high footfalls as it will lead to increase in conflicts.

DESIGN STANDARDS

Cycle tracks should be finished with a smooth surface - asphalt or concrete.

- Paver blocks and manhole covers are to be avoided on cycle tracks. Where manhole covers are unavoidable, they should be level with the surrounding surface.
- If the cycle track has to change levels, a ramp with a gentle slope of 1:10 or greater is preferred.
- Cycle crossings along with pedestrian crossings are to be provided at intersections and side roads.

MATERIAL SPECIFICATIONS

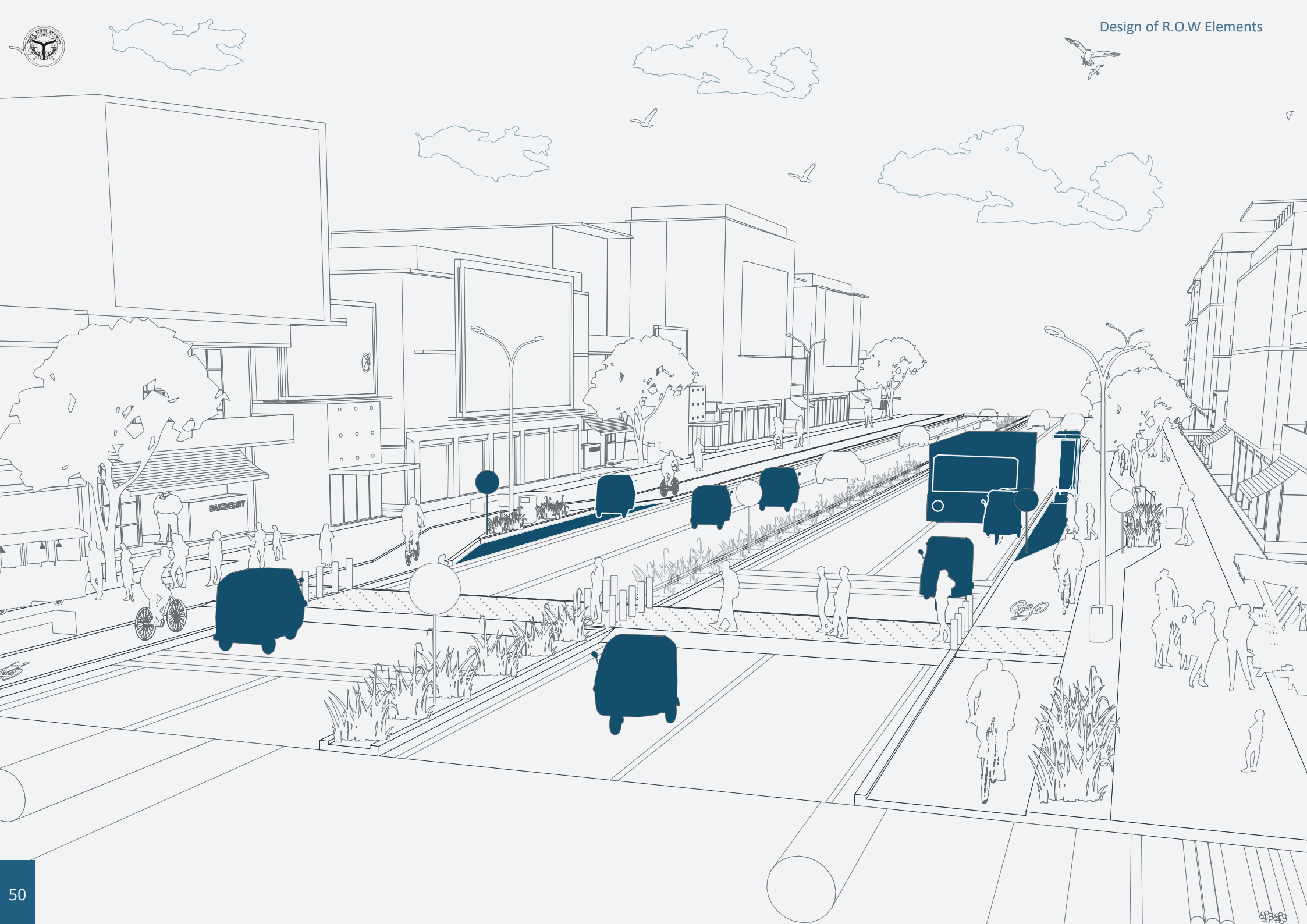
Cycle tracks can be finished with asphalt and concrete, with and without paint. Note that cycle symbols will need to be stencilled onto the road every 50m.

Key Points from IRC:86.

- Cycle tracks are necessary where vehicular speeds exceed 30 km/h
- Only paint marking on the carriageway gives a false sense of security and should be avoided.
- Two way cycle tracks are recommended where there are very few median cuts for crossing.

Figure 3.9 : (Facing Page) Image from Tender SURE Bengaluru showing shared NMT infrastructure on low footfall roads.


KA03AC7584


BARBERRY

3.2.3. Public Transport Infrastructure (Para Transit, Bus Stops, Etc.)

Dedicated para-transit and bus lanes improve public transport efficiency, reduce travel time, minimize traffic congestion, and ensure reliable, accessible transportation.

Defining a para transit lane with dedicated drop off and waiting zones also helps in providing a streamlined movement and continuous flow of traffic.

PLANNING STANDARDS

Intermediate Public Transport (IPT) fills gaps in conventional transit coverage, connecting under served neighbourhoods with modes like auto-rickshaws, e-rickshaws, minivans, and cycle rickshaws. IPT also eases road congestion and reduces pollution by encouraging shared rides.

Therefore, accommodating IPT with pick-up/drop-off points, parking spaces, and exclusive lanes is essential.

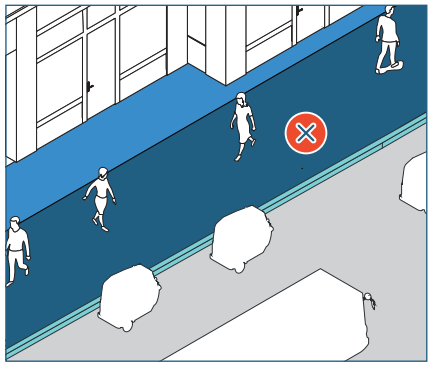


Figure 3.10 : Para-transit modes should have a dedicated drop off/ pick up zones, to avoid clashes with other vehicular movements.

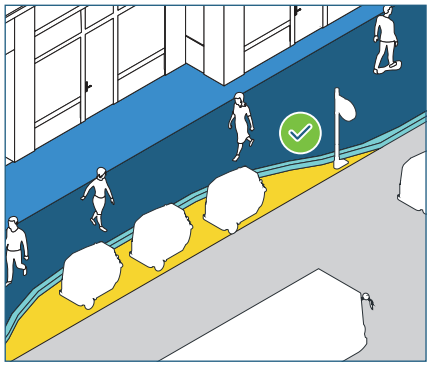


Figure 3.11 : Hence a 2m wide drop off zone can be provided with signage indicating dedicated zone for para transit modes.

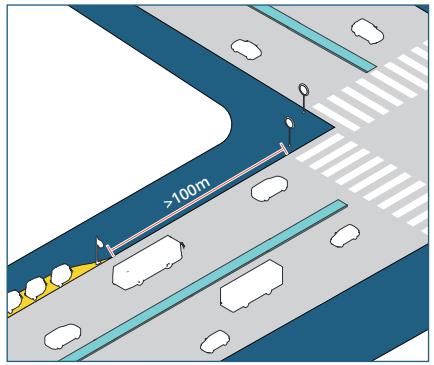


Figure 3.12 : The para-transit drop off zones should be minimus 100m away from intersections to avoid congestion and clash of movement.

S.No.	Walking Distance from Station Exit	Facility/amenity and preferred location
1	Within 50m	Bus stops, vendor zones, cycle-rental stations, cycle parking stand, public toilets
2	Within 100m	High occupancy feeder stop/stand
3	Within 150m	Cycle-rickshaw stand, other intermediate public transport / autorickshaw stand
4	Beyond 150m	Private car/taxi “drop-off” location only (No parking)
5	Beyond 500m	Off-street car parking facility should be discouraged. It may be considered in case of pedestrianization of streets and only after an on-street parking management system has been implemented

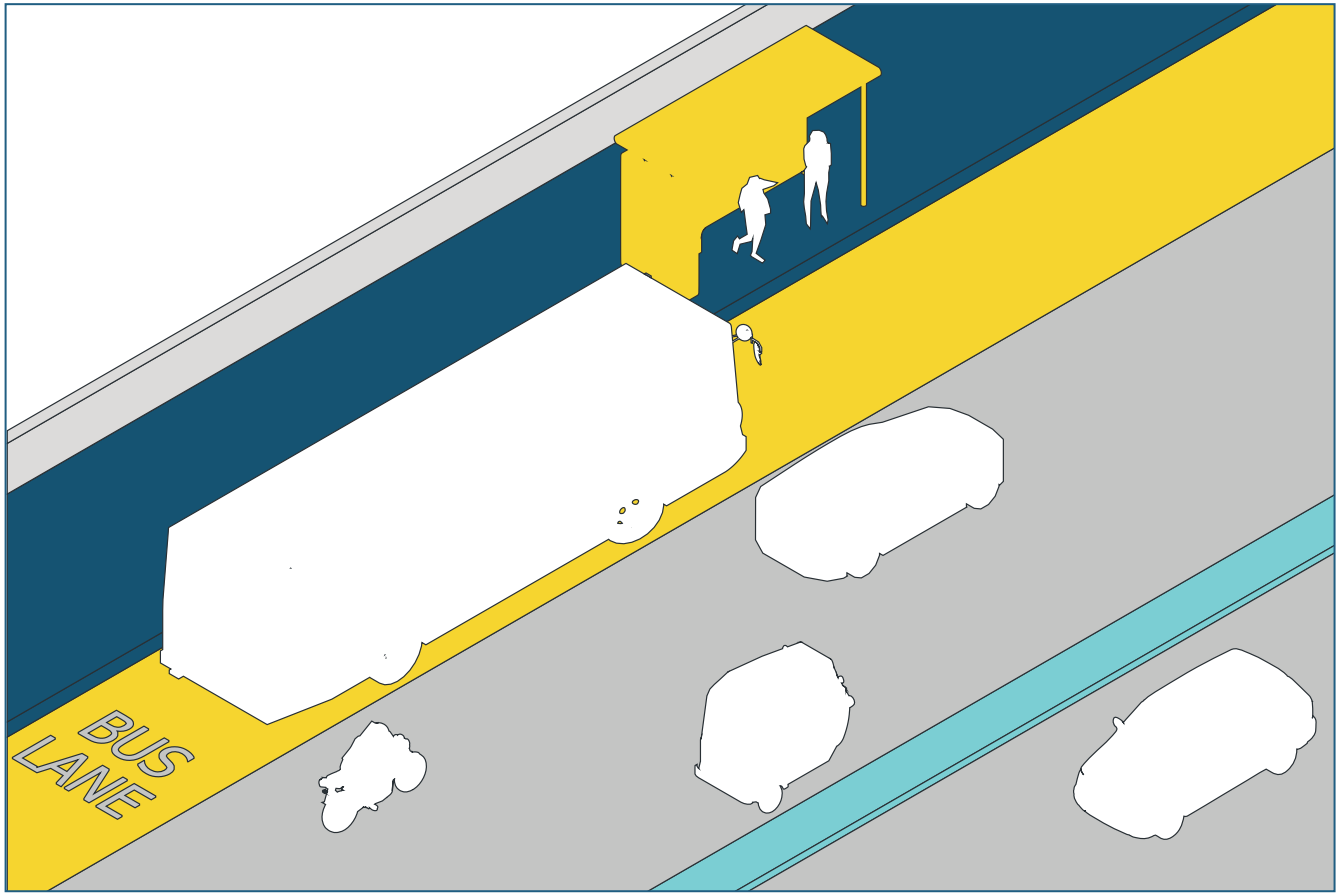
Table 3.5 : Recommended distance of various facilities from entry/exit of mass transit stations; as per IRC.118.2018

DESIGN STANDARDS

Bus stop / lanes

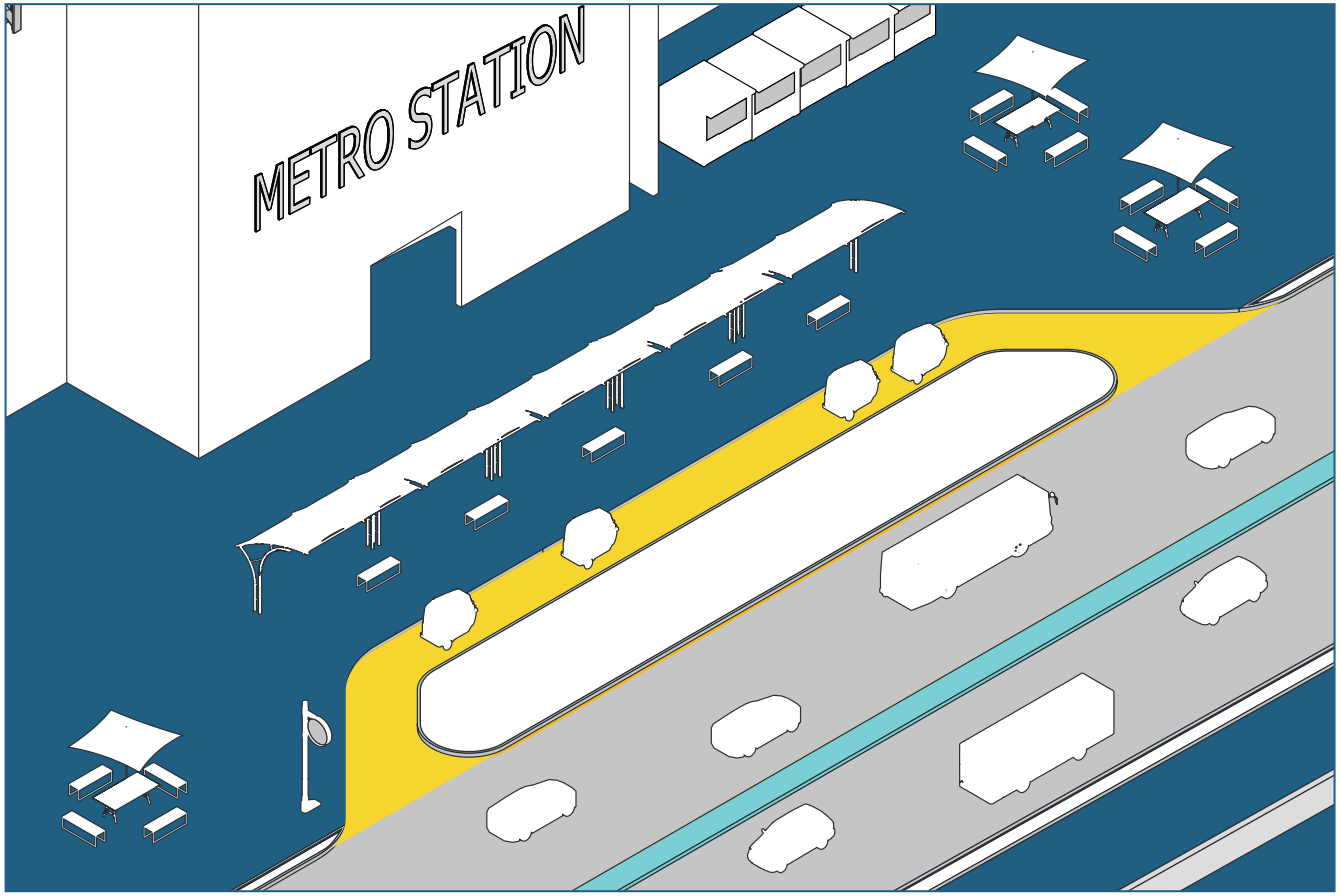
Bus stops play an integral Part in street design. They provide a safe and comfortable space for passengers to wait.

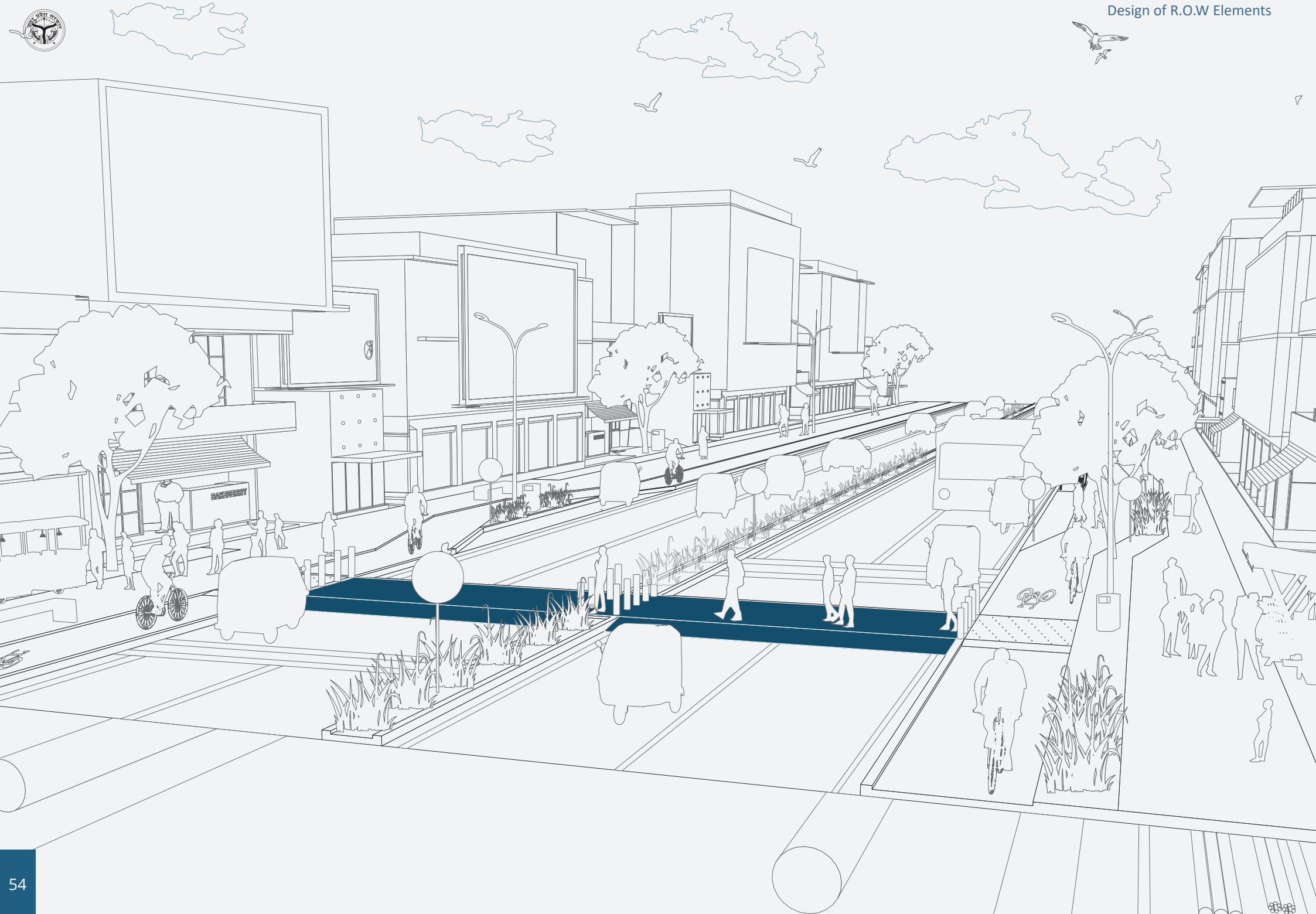
- The location of the bus stop is extremely important for the efficient funtioning of the street and footpath.
  - » On footpaths above 4.5 metres width or in MUZs - Bus stops should be placed at the kerb edge, to ensure continuous movement of pedestrians.
  - » On footpaths below 4.5 metre width - Bus stops should be placed along the property edge to provide sufficient space for pedestrians to walk.
- Bus stop should be well lit and well shaded. They should have a clear waiting space of 1.2 metres (minimum).
- Seating should be provided especially for elders, caregivers with young children, pregnant women, and persons with disabilities.
- Bus stop waiting area should be at the same level as the footpath.
- Area around the bus stop should be planned to accommodate vendors, signage, advertisement, landscape and pickup / drop facilities for IPT.



Para-Transit (Auto, E-Rickshaw, etc.)

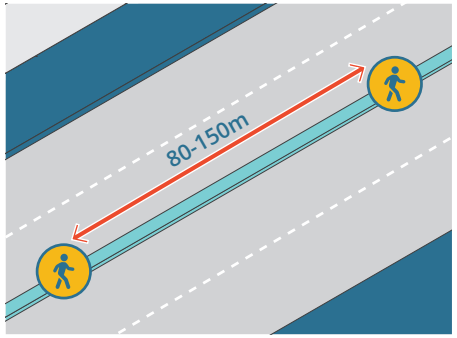
- The para-transit drop off zones should be near other transit stations like metro and bus stops so that it is easier to switch modes of travel. This will enhance last mile connectivity.
- The para-transit drop off zones can also be included within transit stations for mare efficient integration of mobility modes.




BAKERY

3.2.4. Crossings

There must be pedestrian crossings every 80 - 150m. This will allow for improved connectivity and walk-ability.



PLANNING STANDARDS

Continuous, evenly paved, safe footpaths and cycle tracks provide for linear movement of pedestrians and cyclists. Crossings are required to provide for a safe passage across the road. Where possible, separate crossings are to be provided for pedestrians and cyclists.

Crossings are required at all intersections, where there is a break in the footpath and cycle track and also at mid block points and near public transit nodes, educational institutes and other points of interest. There must be pedestrian crossings every 80-150m in urban areas. This will allow for improved connectivity and walk ability.

The safest crossings are signalized, allowing for sufficient crossing times for pedestrians and cyclists. At intersections, the NMT signals will be combined with vehicular traffic lights. On wide roads and intersections, a refuge island of a minimum width of 1.2m should be provided at the median and at free lefts for road safety.

At midpoint crossings - a push button signal (pelican/ puffin) may be provided to stop vehicular traffic on-demand and allow for pedestrians to cross. For tabletop crossings, signage indicating a crossing zone must be provided 30 to 50m ahead allowing vehicles to slow down.

On arterial roads, high speed roads and areas with railway lines and other large physical infrastructure, at grade crossings may not be possible due to vehicle speeds, train movement etc. Overhead crossings via foot over bridges and underground crossings via subways can be considered in these areas. For both foot over bridges and subways, lifts, lighting, visibility and porosity are important for safety. Where possible, activity such as vending should be incorporated with the crossings to create eyes-on-the street.

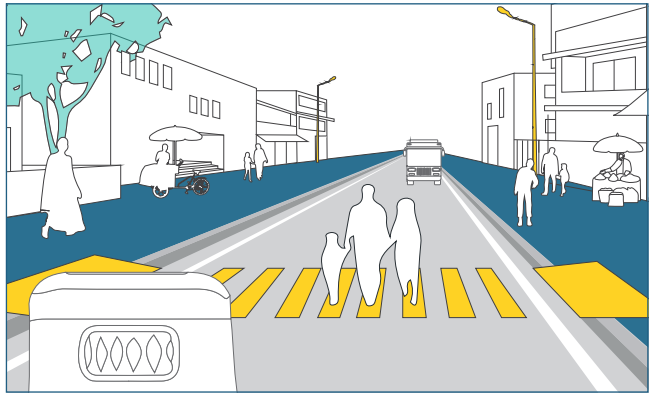
Key Points from IRC:86.

- At - grade pedestrian crossings should be provided every 80-150 m.
- Zebra crossings should be minimum 2m wide and can increase to 4m at streets with high pedestrian footfall.
- Pedestrian / cycle refuge on median should be minimum 1.2m wide.

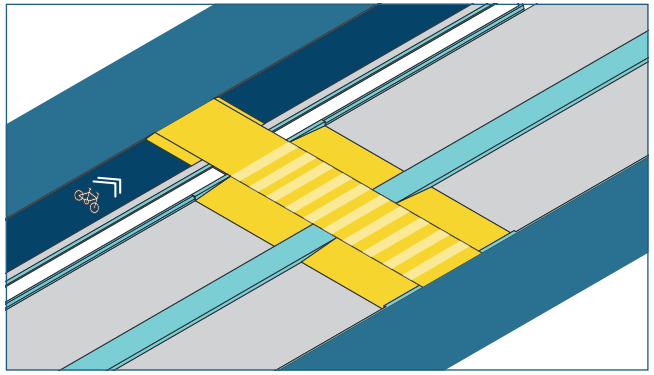
Figure 3.13 : Design standards for the five types of pedestrian crossings.

Pedestrian zebra crossing: These crossings are marked with evenly spaced white stripes on the vehicular travel lane, providing a safe passage for pedestrians. In general the width of the painted strip and the gap between two strips is 500mm, each.

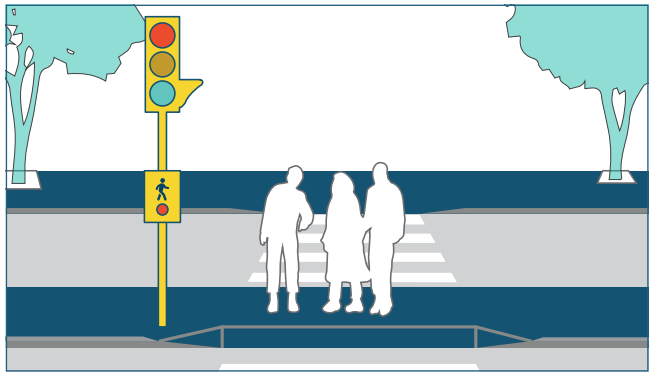
The footpath needs to ramp down at the crossings to provide universal accessibility. There must be space near the ramps for pedestrians to wait and cross the road, without hindering thorough pedestrian movement.

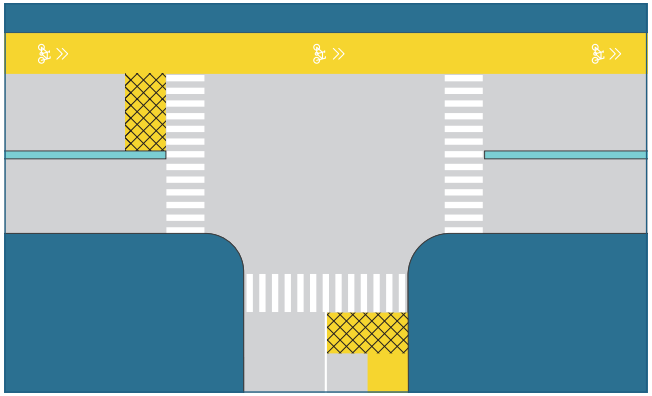


Tabletop crossing: In certain areas the crossing maybe raised to the level of the footpath, with ramps for vehicular access. This is a tabletop crossing and mostly used over smaller side roads and in pedestrian priority areas.

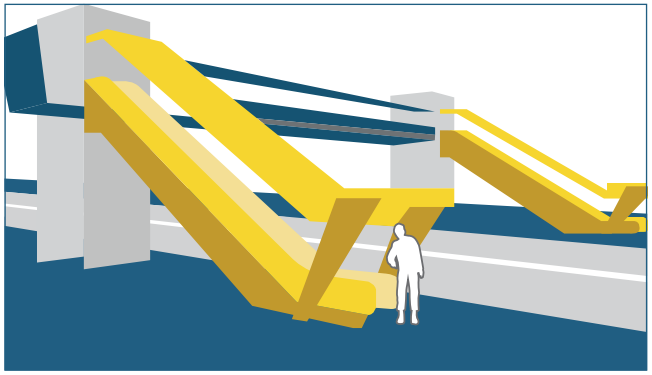


Signalised, pedestrian push button crossings: These are called pelican/ puffin crossings and are usually located at mid-block. For wide roads, a refuge island and an additional push button may be required at the median. When a mid-block signalised crossing is combined with cycle crossings, they are called toucan crossings.

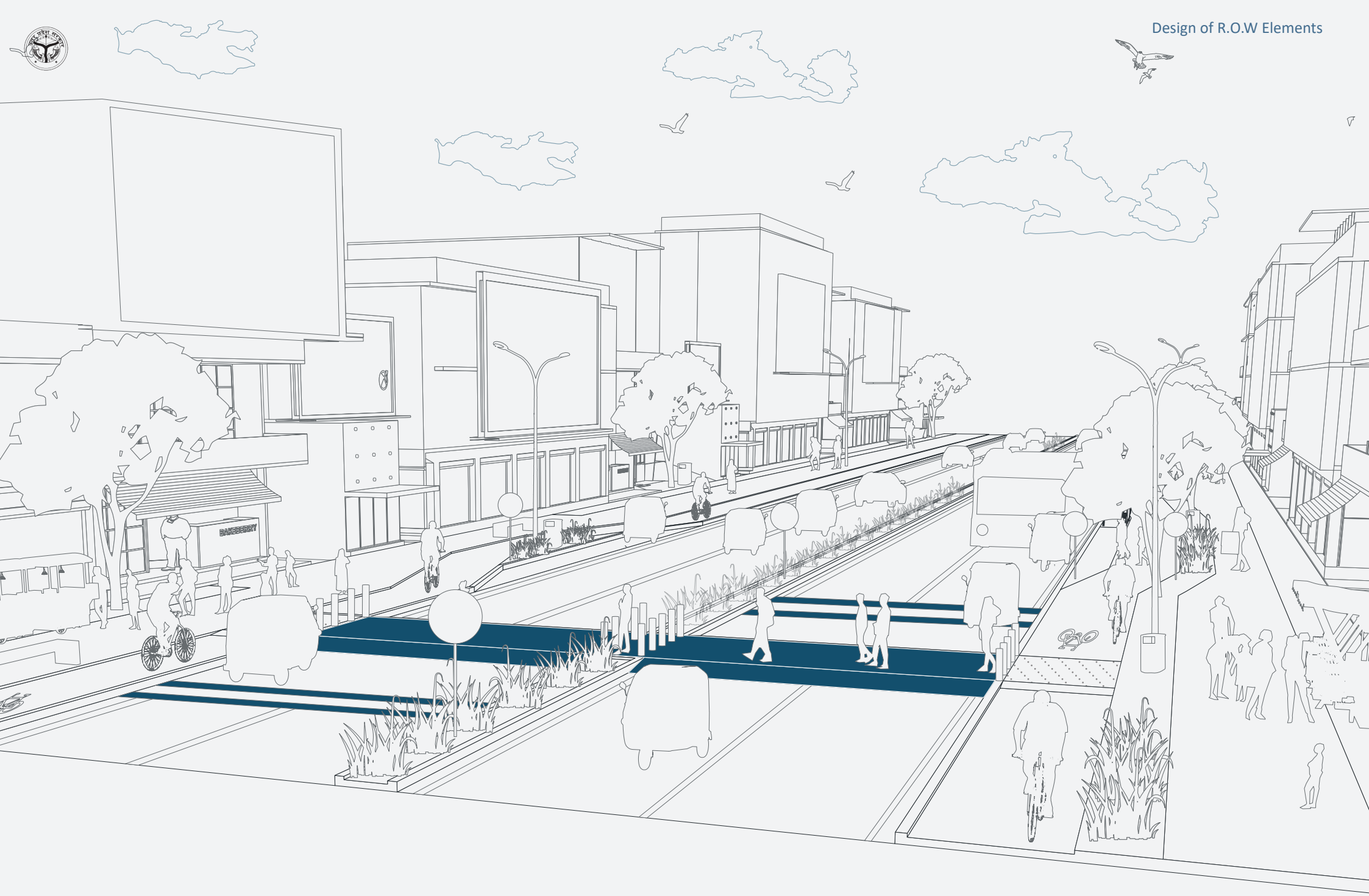




Cycle crossings: These are dedicated crossings marked with paint lines along with/ adjacent to the zebra crossings. Some intersections may have a designated signal system for cyclists and in some they may share it with pedestrians.



Grade separated crossings: These can be either foot over bridges (FOB) or subways and require detailed architectural and structural design. They are not preferred in dense urban areas but are important to cross high speed corridors, railway lines etc. Both FOBs and subways should not hinder at-grade pedestrian movement and should be designed to allow visibility from the road, universal access and good lighting. FOBs should also provide a clear height of 6m over the vehicular carriageway to allow for unhindered movement of fire-trucks and heavy vehicles.


BARBERRY

3.2.5. Traffic Calming Measures

Traffic calming plays a crucial role in creating safer and more liveable urban environments. The benefits include -

- Enhanced Safety : Traffic calming measures contribute to a more tranquil atmosphere in neighbourhoods. By reducing vehicle speeds, they create streets where people feel safer to walk, cycle, and let their children play.
- Shift in Focus : Instead of prioritizing only vehicle movement, traffic calming shifts the focus to providing streets that cater to all users. These measures promote well-being and foster a stronger sense of community by creating spaces where people can interact and enjoy their surroundings.
- Quality of Life : Slower traffic and reduced noise levels enhance the overall quality of life for residents. Streets designed with traffic calming elements become more inviting, encouraging social interaction and outdoor activities.

PLANNING STANDARDS

Traffic Calming Measures (TCM) on roads - such as changing alignment, introducing barriers, etc. reduce traffic volume speed. This improves the road safety and liveability standards, especially to residential neighbourhoods, school zones and pedestrian priority areas. Average reduction in traffic volume using TCMs are indicated in Table 3.6.

Roundabouts

Require traffic to circulate around a centre island. Unlike traffic circles, roundabouts are used on higher volume streets to allocate right-of-way between competing movements.

Median barriers

Are islands located along the centreline of a street and continuing through intersection so as to block through movement at a cross street.

Raised Intersections

Are flat raised areas covering an entire intersection, with ramps on all approaches and often with brick or other textured materials on the flat section. They usually rise to the level of the sidewalk, or slightly below to provide a “lip” that is detectable by the visually impaired. By modifying the level of the intersection, the cross-walks are more readily perceived by motorists to be “pedestrian territory”.

Sl. No.	Traffic Calming Measure	Average % reduction of traffic volume
1.	Speed Humps	20
2.	Speed Tables	25
3.	Traffic Circles	30
4.	Narrowing	45
5.	Full-Closure	60
6.	Half-Closure	80
7.	Diagonal Diverters	90

Table 3.6 : Traffic volume reduction due to adoption TCM *(TCM, R.Ewings, Washington Institute of Transport. Published in APA Planners Press and American Society of Civil Engineer, 2009)*

Raised intersections are good for intersections with substantial pedestrian activity, and areas where other traffic calming measures would be unacceptable because they take away scarce parking spaces.

Forced Turns:

Forced Turn islands are raised islands that block certain movements on approaches to an intersection. They are good for local street connections to main streets where through traffic volume along the continuing local street is a problem, and main streets where left-turns or through movements out of the side street are unsafe.

One-way

When the volume on a particular stretch goes beyond the capacity of road creates congestion, and frequent blockades for the traffic flow. In such cases, the traffic is allowed in one single direction.

Speed hump

Are rounded raised areas placed across the carriageway. The profile of a speed-hump can be circular, parabolic, or sinusoidal. They are generally 3.5m long and 12 to 15cm high-speed humps are suggested 5m ahead on a minor road meeting a major road.

Speed tables

Are flat-topped speed humps often constructed with brick or other textured materials on the flat section. The profile of speed tables is trapezoidal. Generally, the top width of the speed table would be around 3m and bottom width is 6m. Speed tables are good for locations where low speeds are desired but a somewhat smooth ride is needed for larger vehicles.

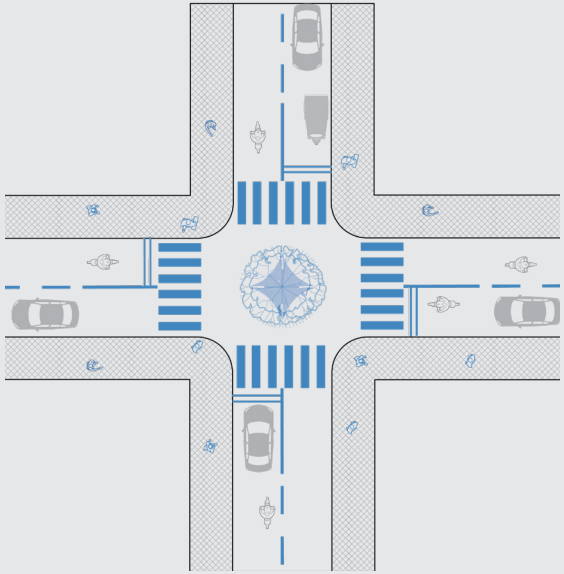
Raised crosswalks

Are speed tables outfitted with cross-walk markings and signage to channelize pedestrian crossings, providing pedestrians with a level street crossing. Also, by raising the level of the crossing, pedestrians are more visible to approaching motorists. Raised cross-walks are good for locations where pedestrian crossings occur at haphazard locations and vehicle speeds are excessive.

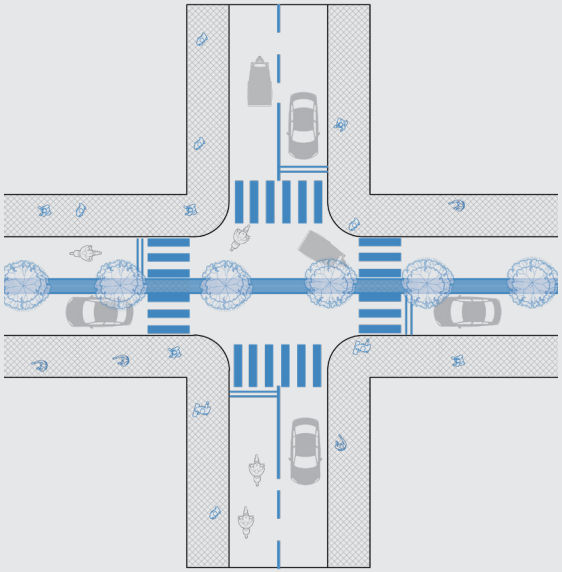
Traffic circles

Are raised islands, placed in intersections around which traffic circulates. They are good for calming intersections, especially within neighbourhoods, where large vehicle traffic is not a major concern but speeds, volumes, and safety are problems.

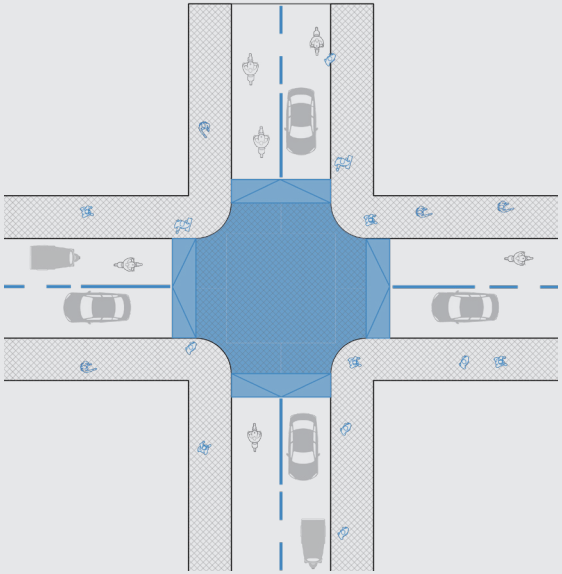
Figure 3.14 : (Facing Page) Illustration showing some common types of traffic calming measures.



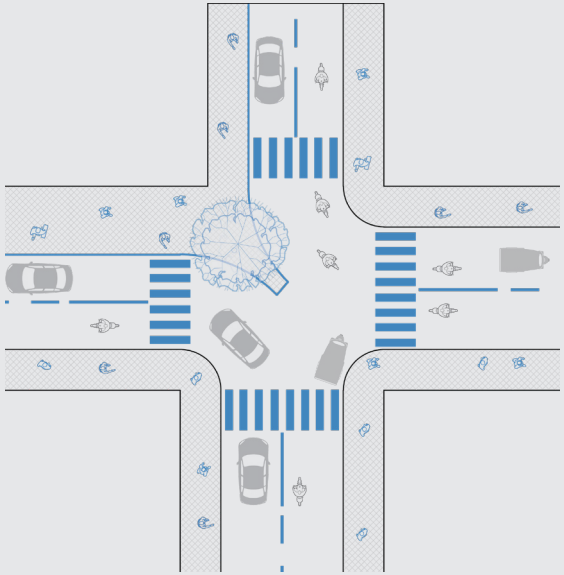
Roundabouts



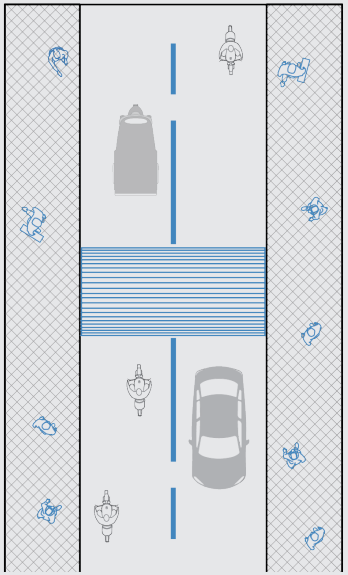
Median Barriers



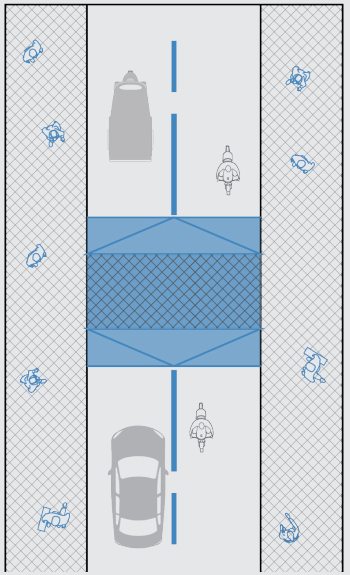
Raised Intersections



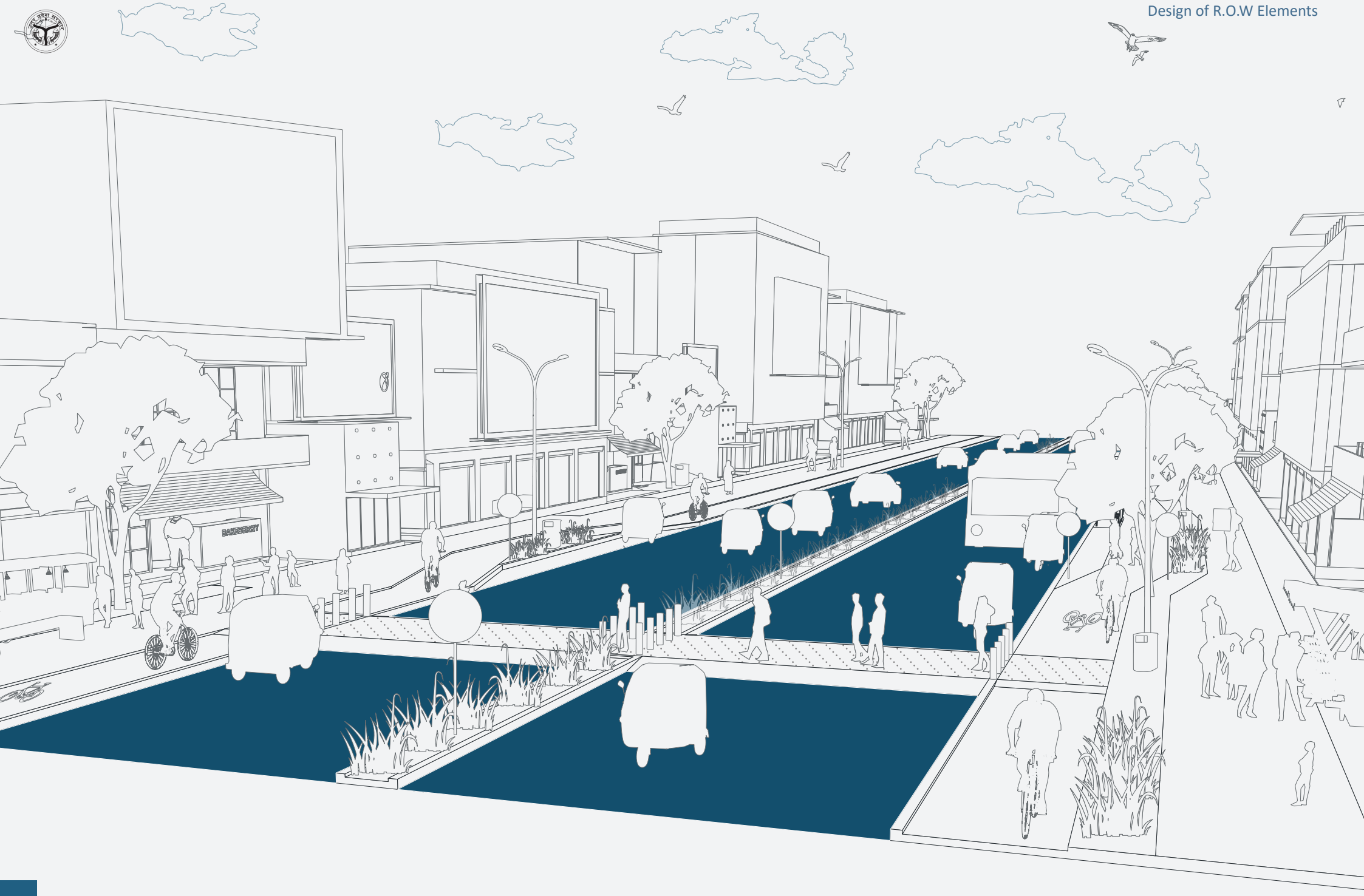
Forced Turns



Speed Humps



Speed Table


BAKEBERRY

3.2.6. Travel Lane

PLANNING STANDARDS

A travel lane is the portion of the road allocated to a single line movement of vehicles; it is indicated on the pavement by painted longitudinal lines or embedded markers. The key factors that govern the width of travel lanes are :

- Classification of road
- Desired speed
- Volume of traffic expected

Wider the lane widths, higher would be the vehicular speed.

It is good practice for all travel lanes on a road to be of equal width.

» **Tip :** A key principle to be considered is the uniformity of the travel lane. A travel lane will not be efficient when its width changes frequently or unexpectedly. The typical width of travel lanes can be designed as mentioned in Table 3.7.

Turn lanes

Turn lanes need to be provided near major intersections for exclusive movement of right and left turning vehicles. In such places space for the medians is used. The length of the turn needs to be calculated based on the turning traffic volume.

Level of service (LoS)

Level of service (LoS) of a road depends on the carrying capacity of the road, which is dependent on the efficiency of available travel lanes. If the volume of the traffic on any particular lane increases more than its carrying capacity, or the travel lane is not completely available for through traffic, that road offers poor level of service to the traffic flow.

DESIGN STANDARDS

For existing roads, the narrowest width of the travel lane is to be taken and re-divided into required number of travel lanes. It is, in general, a good practice for all travel lanes on a road to be of equal width.

In order to ensure proper storm water drainage on the travel lane, the following design guidelines must be followed for efficient run-off management:

- Travel lanes should also have a cross sectional slope towards the storm-water drains and be levelled to prevent ponding.
- If there are storm-water drains on both sides of the road, a bi-camber should be maintained with the centreline as the ridge.
- If the storm-water line is on one side of the road, a

Road Categorization	Traffic Volume	ROW - Right of Way (m)	Design Speed (kmph)	Number of Travel Lanes	Typical Lane Width (m)
Arterial	High	> 40m	80	6	3.50
Sub-Arterial	High / Medium High	30 - 40m	60	4 - 6	3.50
Collector	Medium Low	20 - 30m	40	4	3.20
Local (2 Way)	Low	10 - 20m	30	2	3.00
Local (1 Way)	Low	10 - 20m	30	3	3.00
Sub-Local (2 way)	Low	< 10m	15	-	2.75
Sub-Local (1 way)	Low	< 10m	15	-	3.00

Table 3.7 : Recommended travel lane details for urban roads.

uni-camber must be maintained with the footpath on the opposite side being the ridge.

- If the storm-water drain is at the centre of the road, then the slope must be maintained towards the centre.
- A cross sectional slope of 1:50 is acceptable for travel lanes. Where the longitudinal slopes are high, the cross sectional slopes are to be minimised.

MATERIAL SPECIFICATIONS

Travel lanes can be finished with asphalt, concrete, W.B.M (Water Bound Macadam) or murram.

- For asphalt roads, the old road must be scarified to a depth of 50mm (or based on the depth of the new layers to be laid) and then the new road laid as per specifications.
- For new concrete roads the following specifications are to be followed. A surface layer of 100 - 200mm M30 PQC (Pavement Quality Concrete) followed by 100 - 150mm WBM / WMM. For greenfield projects, an additional layer of 150mm GSB (Granular Sub Base) can be added below the GSB to improve stability.
- WBM and Murram roads are only laid as interim solutions and must be upgraded when feasible.

Figure 3.15 illustrates commonly used specifications for asphalt and concrete Roads. However, the thickness of each layer will vary based on the strengthening requirement of each road and must be cross-referenced with on-ground tests such as Benkelman Deflection test.

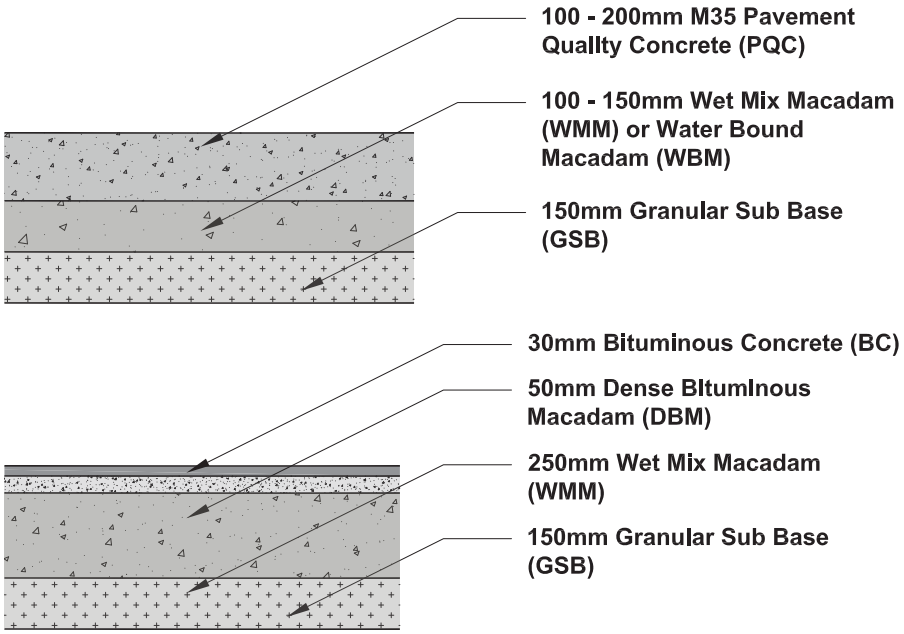
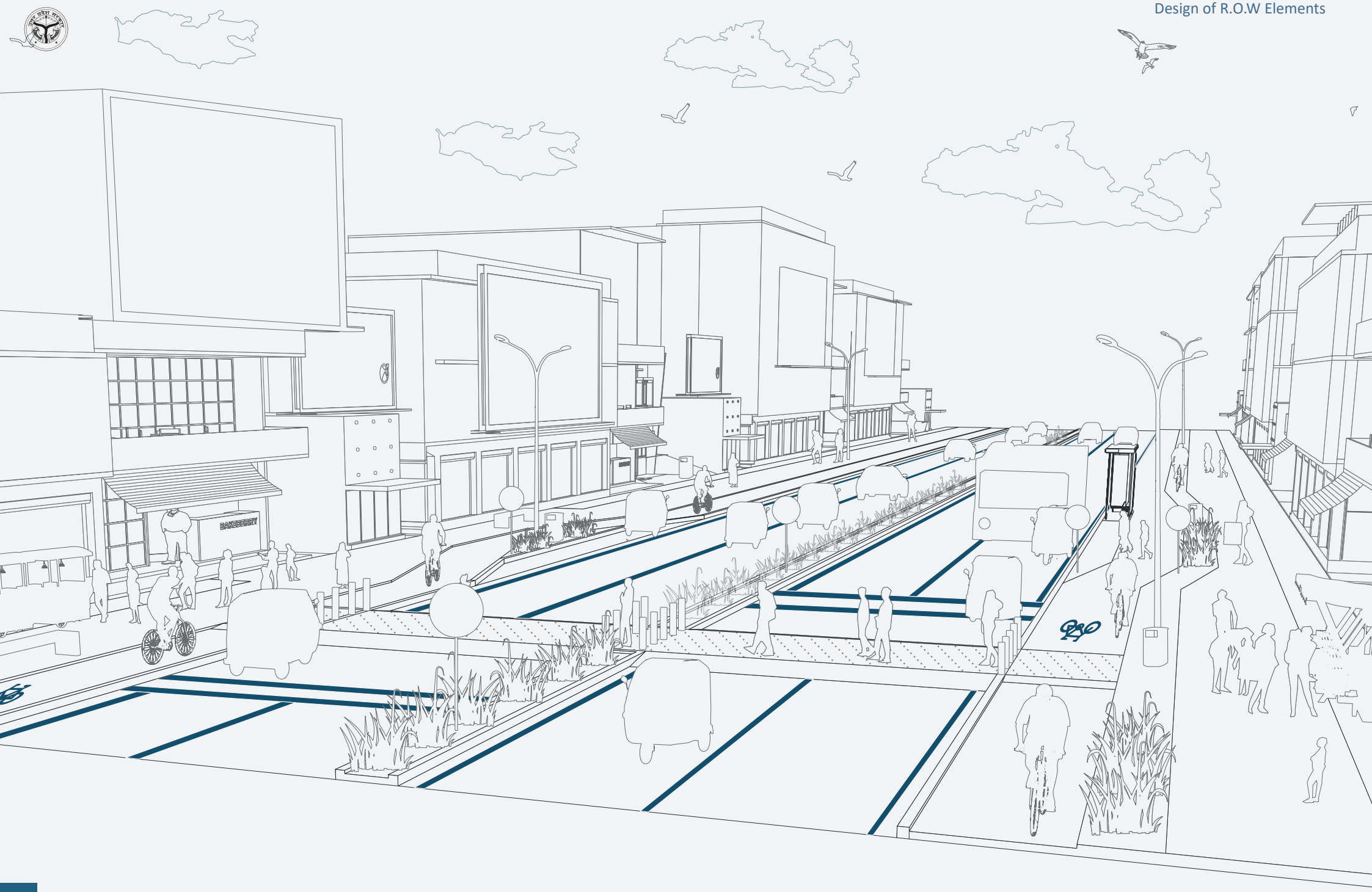


Figure 3.15 : Sub grade layers for concrete and asphalt roads.

Key Points from IRC:86.

- 3.5m is the maximum recommended width per lane.
- For access roads to residential areas, a lower lane width of 3m is permissible.
- Minimum width of urban road without kerb shall be 5.5 m including allowances for a stalled vehicle and pedestrian movement.

Figure 3.16 : (Right) Uniform travel lanes enabling smooth movement of vehicles along the Tender SURE's Residency road in Bengaluru.


BAKERY

3.2.7. Lane Markings

Road Paint Colour	Use Case
White	• All carriageway markings except those intended for parking restrictions.
Yellow	• Markings intended for parking restrictions • Continuous centre and barrier line markings.

Table 3.8 : Retro-reflective paint use case by colour.

PLANNING STANDARDS

Road markings are lines, patterns, words or devices that are set-into, applied or attached to the carriageway or kerbs to guide and control traffic. These markings can serve as a psychological barrier or signify the delineation of traffic path and its lateral clearance from traffic hazards. Painted road markings have the advantage of conveying the required information to the user without distracting his/her attention from the travel lanes during poor visibility due to dust or heavy rains.

Additionally, travel lane markings in and around the vicinity of an intersection can be used to guide orderly movement of traffic around congestion points. The type of road marking used is the function of several variables such as speed of traffic, availability of space, etc.

DESIGN STANDARDS

- Pavement edge lines indicate the edge of the carriageway and the limit of the traffic lane. The edge line is indicated as a single continuous line placed about 100 - 150mm from the edge. The width of the line can be 100 / 150mm. This line will be a dashed line at parking bays, property entry/ exits and side roads. Reflective road studs can be fixed on the paint lines.
- Dashed paint lines are to be used to define travel lanes. These are generally 150mm thick. Refer Table 3.9 for detailed guidelines.
- Continuous paint lines are also recommended on either side of the median, placed 100-150mm from the edge. The width of the line can be 100 / 150mm.
- Where medians are not possible two continuous paint lines with a gap in between or a single paint line can be used to separate travel lane directions. Reflective studs can be fixed on these paint lines.
- Where grade separation is not possible between the vehicular travel lanes and cycle tracks, continuous paint lines (single or double line) can be used for separation. The entire cycle track can be painted, or a cycle stencil can be painted at 50m intervals. This principal also applies to at grade footpaths.

Road Categorization	Dashed Marking Thickness (mm)	Dashed Marking Length (mm)	Dashed Marking Gap (mm)	Solid Line Thickness (mm)	Double Solid Line Thickness (mm)	Double Solid Line Gap (mm)	Pavement Edge Line Thk (mm)	Pavement Edge Line Gap (mm)
	A	B	C	D	E	F	G	H
2 Lane Road	150	3,000	4,500	-	-	-	150	150
4 Lane Road	100	1,500	3,000	150	-	-	150	150
6 Lane Road (or more)	100	1,500	3,000		150	100	150	150

Table 3.9 : Road marking details for travel lanes marking on urban roads.

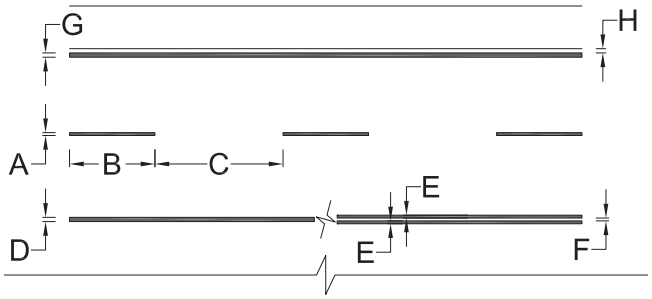


Figure 3.17 : Key for road marking details.

MATERIAL SPECIFICATIONS

It is recommended that retro reflective thermoplastic paint of approved colours. Refer Table 3.8 for use case across colours.

For details on the thickness of the paint lines, refer Table 3.9 and Figure 3.17.

REFLECTIVE ROAD STUDS

Reflective road studs are provided along with the paint lines for increased road safety. They are important in high speed roads, roads with sharp turnings and areas with poor visibility as they help significantly lower the number of accidents.

- It is recommended that the studs be placed along with the paint lines at the edge of the kerb and where required on either side of the median.
- Where there is no median, road studs can be integrated with the paint lines in the centre, segregating traffic moving in opposite directions.
- Road studs can also be used to demarcate the cycle track edges.
- Reflective road studs are generally raised with sloped edges. They are designed to withstand heavy loads and harsh weather conditions.
- The spacing between studs is generally 9m for vehicular travel lanes, but can be reduced to 6m in no-overtaking zones and in areas where there are sharp turns, or an obstruction on the travel lane such as protruding trees.
- Studs must be provided on both centre line and edge line of the road.

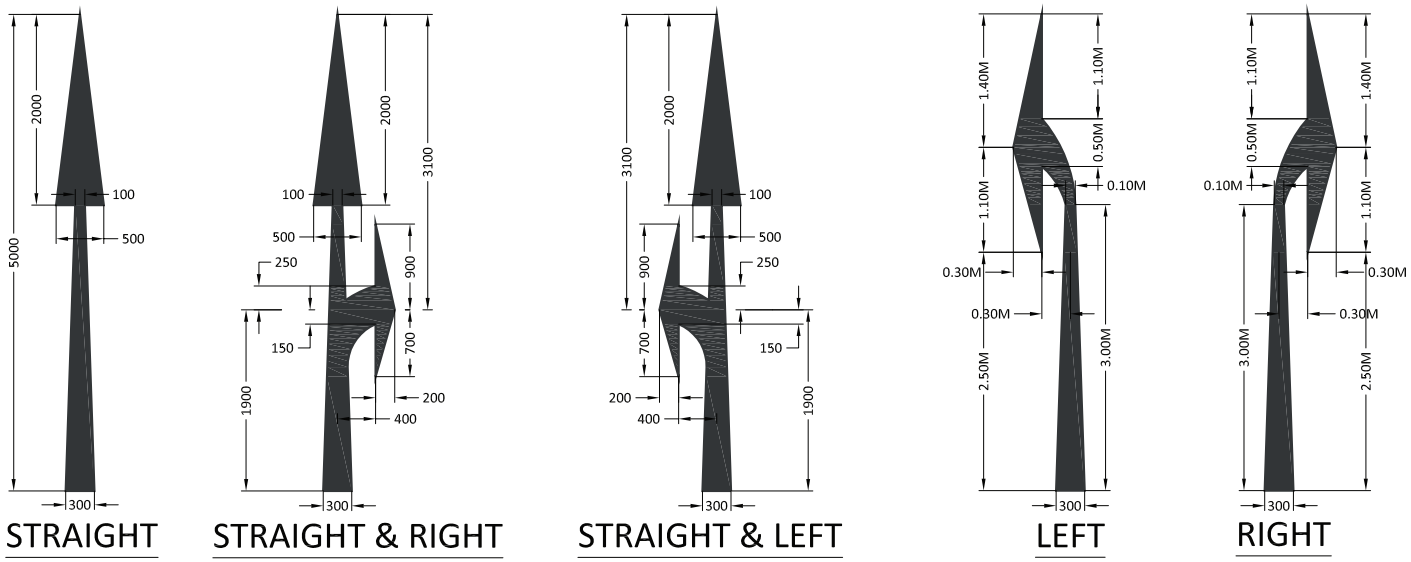


Figure 3.18 : Lane arrows with dimensions

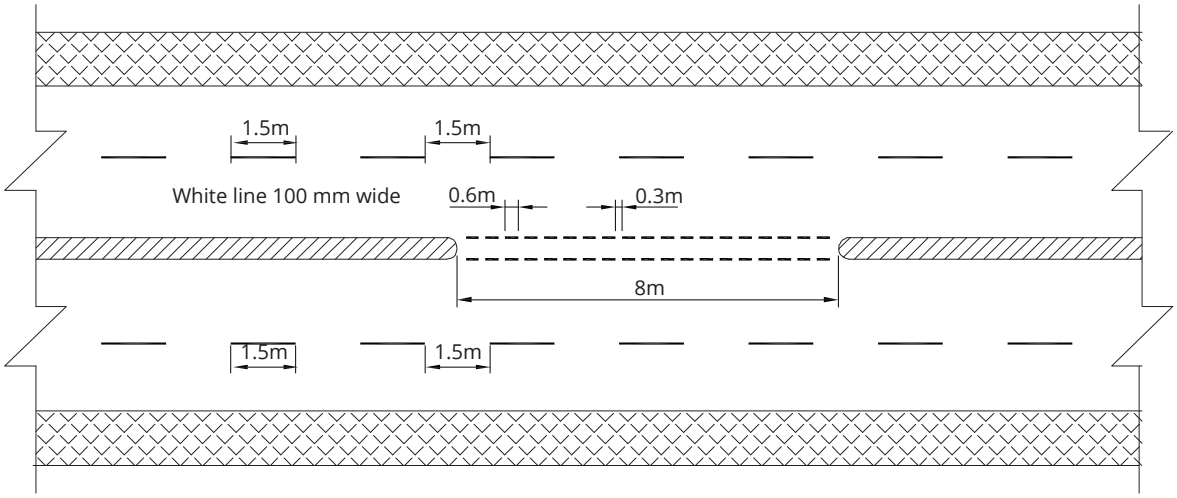


Figure 3.19 : Paint markings for median openings

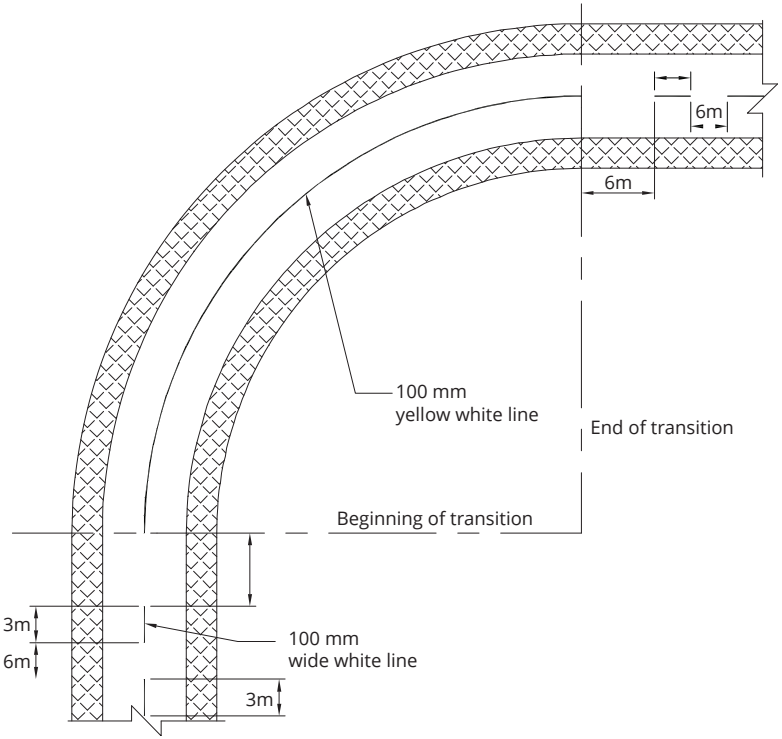


Figure 3.20 : Paint Marking at sharp curves.

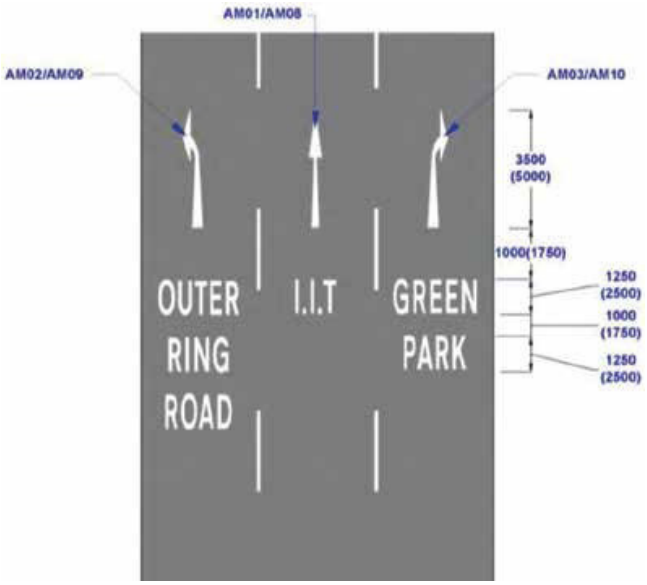


Figure 3.21 : Worded Lane Destination Markings

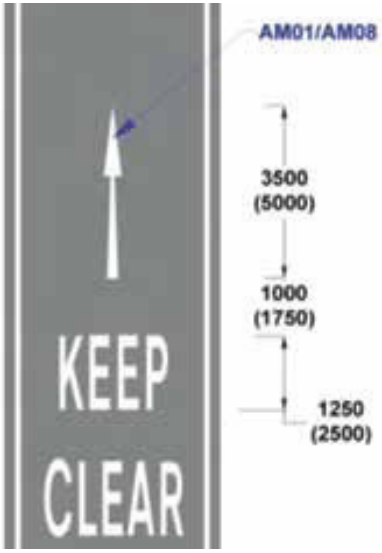


Figure 3.22 : Mandatory Markings

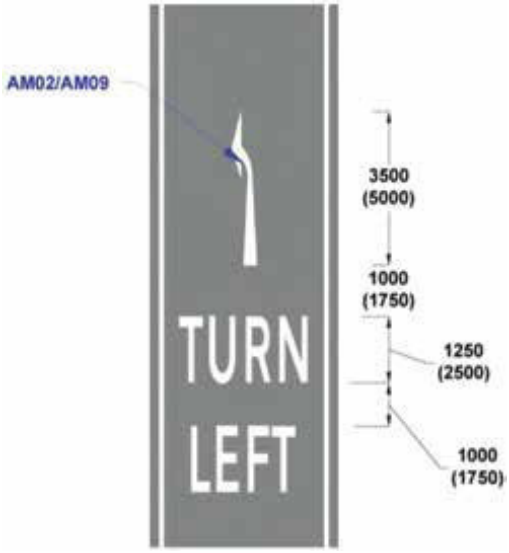


Figure 3.23 : Mandatory Turn Arrows

Worded lane destination markings reinforce the advance direction sign in conformity. Its letter size depends on speed limit:

- 1250 mm for speed up to 50 kmph
- 2500 mm for speed more than 50 kmph

These markings should be used at distance of equal to longest peak hour queue. It can be helpful to locate arrows in conjunction with direction signs and only two directions can be shown on one arrow.

Lane arrows supplemented with the legend “TURN LEFT”, “TURN RIGHT” and “AHEAD ONLY” is prescribed. entry into a one-way road where all traffic is required to turn in the same direction.

Key Points from IRC:35.

- KEEP CLEAR at that the part of the carriageway at intersections which should be left clear.
- The markings can also be used to reinforce a green arrow traffic signal or a regulatory turn sign.

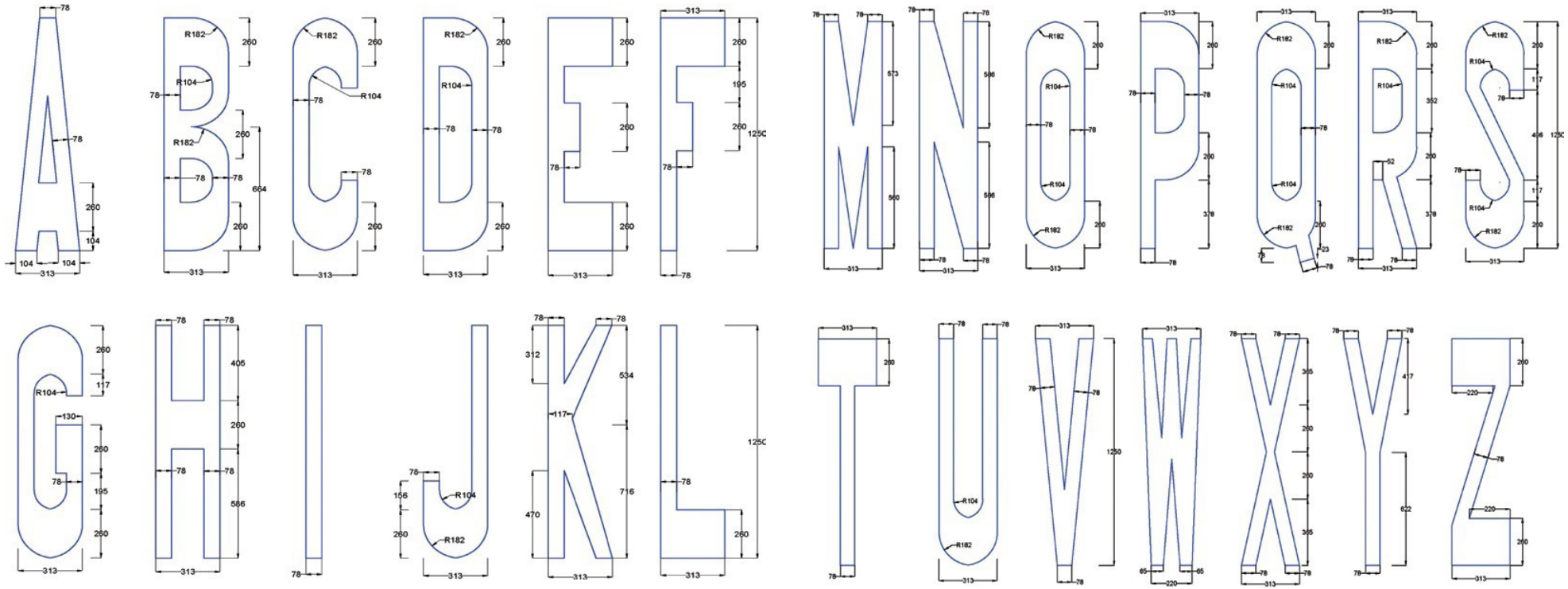


Figure 3.24 : Details of Letters (Speed upto 50 kmph)

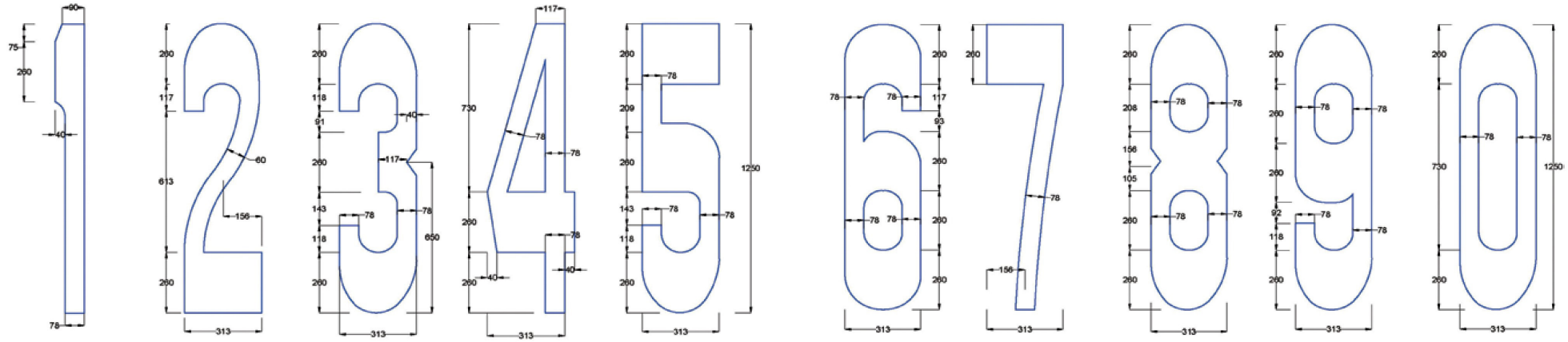
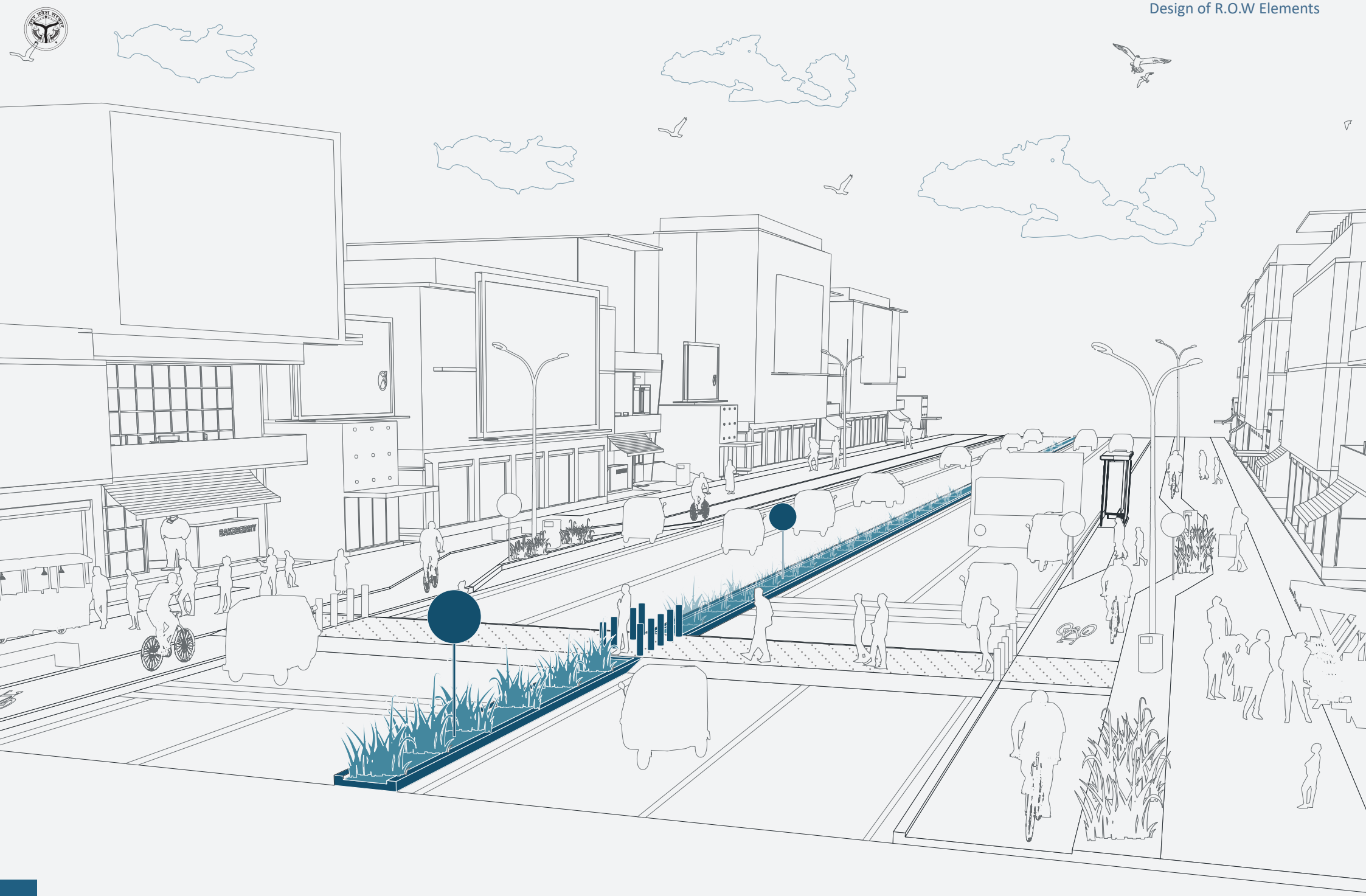


Figure 3.25 : Details of Numerals (Speed upto 50 kmph)


BAKESBERRY

3.2.8. Median

Landscape medians are preferred over solid concrete medians.

PLANNING STANDARDS

A median is a physical barrier between travel lanes, to segregate traffic moving in different directions. While medians are essential for road safety on high speed roads, arterial and sub arterial roads, they are a good to have on collector roads. On local roads and neighborhood streets medians are not recommended as the right of way is shared by a wide variety of users.

While the purpose of the median is to segregate traffic moving in different directions, breaks are required at intersections and at junctions where important side roads meet the main road. The size of the break can be regulated to allow for different modes of traffic. In the case of large medians, they can be narrowed before an intersection to provide for an additional waiting lane.

Medians also need to have breaks in them to allow for pedestrian and cycle crossings at designated intervals. These breaks should also act as refuge islands for pedestrians and cyclists to wait between crossings.

DESIGN STANDARDS

- The minimum height of the median is to be 300mm.
- The width of the median will depend on the R.O.W. available. A minimum width of 300mm is recommended. For medians of greater than 300mm width, two pre-cast kerbs can be used with the chamfered sides facing the travel lanes. The medians can be finished with a variety of

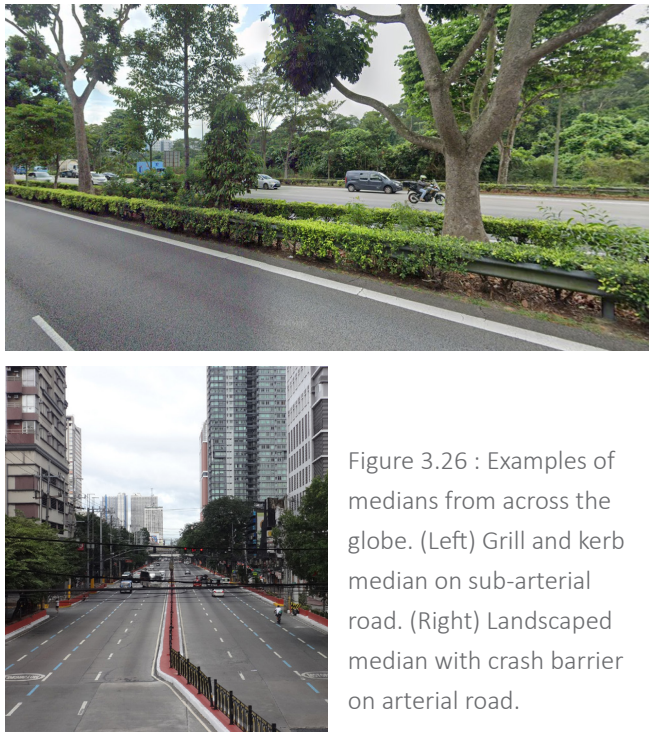


Figure 3.26 : Examples of medians from across the globe. (Left) Grill and kerb median on sub-arterial road. (Right) Landscaped median with crash barrier on arterial road.

Figure 3.27 : Medians at intersections, ensuring clear visibility of the entire junction.

materials, but landscape is preferred for improved aesthetics.

- Medians can also be fixed with metal grills to prevent jay- walking and deter pedestrians from crossing the roads in a haphazard manner and increasing risk of crashes.
- Where the width of the median is equal to or greater than 500mm, street lights and sign boards can also be fixed on the median.
- On some roads the storm water drain can run below the median, with catch pits at regular intervals. The minimum width of median in this case should be 1.2m.
- Median ends can be curved or straight as per the site requirement.

» **Tip :** Medians at intersections must be dipped down to ensure clear visibility of the entire junction and to allow for pedestrian refuge areas. Some examples of median designs at intersections can be found in Figure 3.22.

MATERIAL SPECIFICATIONS

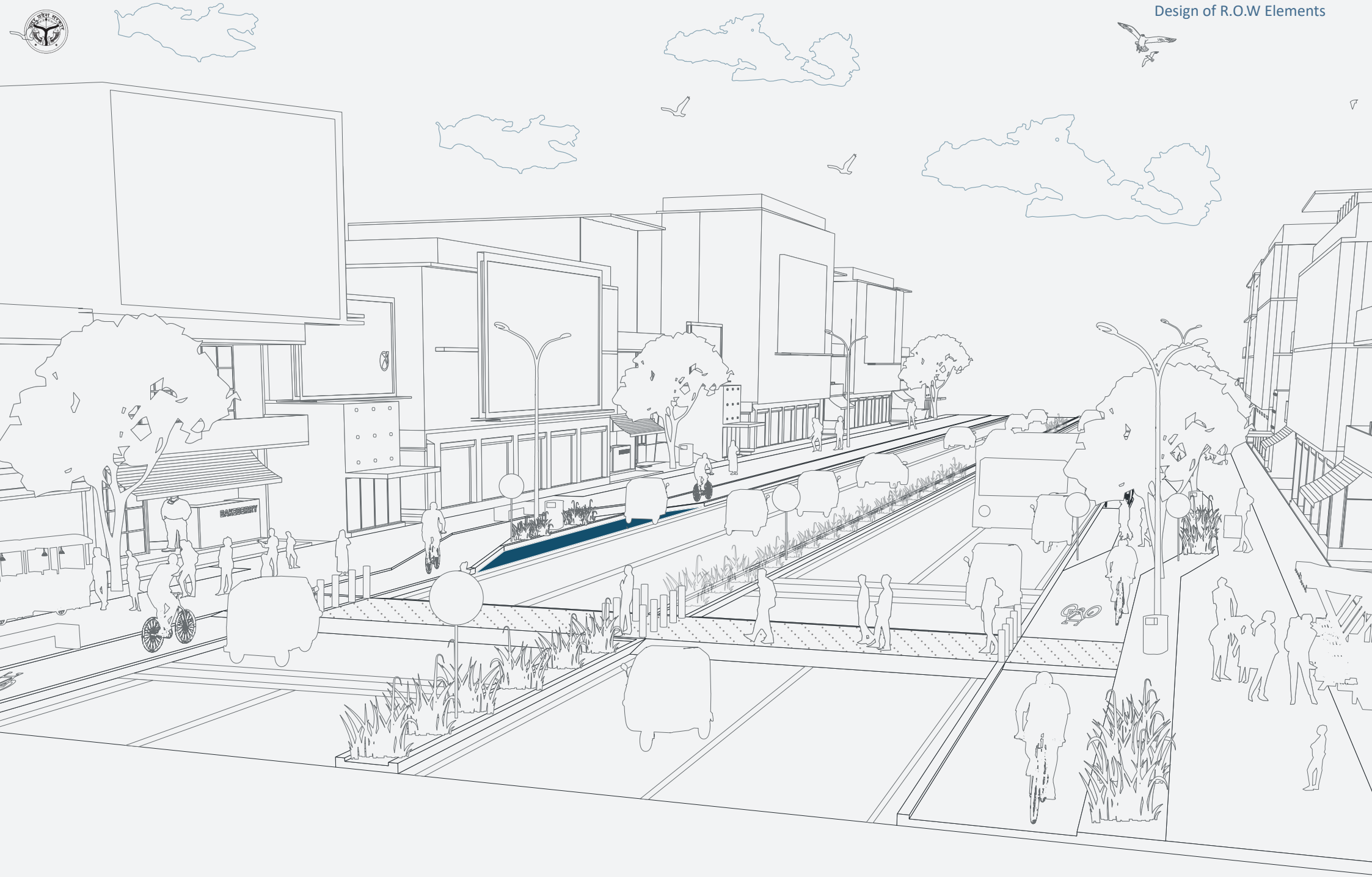
Pre-cast kerbs with M40 concrete and a clear height of 300mm are preferred for medians. In case pre-cast kerbs are not readily available, cast-in-situ concrete , with reinforcement can also be used.

The space between the kerbs can be finished with concrete, paver blocks or landscape. For landscape the width between the kerbs needs to be a minimum of 300mm.

Key Points from IRC.

- Roads with more than 4 lanes can be provided with a median. However, for 4 lane roads, use of medians should be judicious and take into account safety, traffic volumes, etc.
- The minimum width of a median should be 1.2 m. As far as possible, the median should be of uniform width in a particular section. However, where changes are unavoidable, a transition of 1 in 15 to 1 in 20 must be provided.
- Minimum refuge area for pedestrians must be 1.2m. However, roads with 4 or more traffic lanes shall have medians with pedestrian refuge of minimum 3 m waiting area, with bollards located in the refuge space to enhance pedestrian safety.
- Instead of fences, medians should be landscaped and used for storm-water filtration and management wherever possible

Figure 3.28 : Image showcasing how a median can even transform into a public space at junctions and intersections when the road geometry is planned out strategically. Image from Tedner SURE's Commisariat road in Bengaluru.


BARBEQUE

3.2.9. On-Street Parking

PLANNING STANDARDS

With rapidly increasing volumes of vehicular traffic on urban roads everyday, the impact is not just on traffic movement, but on pedestrian movement and access to dwellings.

As we move towards a more sustainable future, the focus globally is to design cities and streets for people, to promote non-motorised transport and public transit and by doing so, minimise the need for on-street parking.

It is therefore important to assess the demand for parking in a particular area and provide on-street parking judiciously.

» **Tip :** On- street parking must only be provided after giving adequate space for pedestrian movement, landscape strips and cycle infrastructure.

Consideration for provision of parking type:

- Free public parking : Should be avoided. Residents and shopkeepers to obtain subsidized permits and unauthorized parking to be enforced.
- Paid public parking : In designated areas and streets around transit stops, commercial areas and high traffic destinations.
- Paid private parking : Through PPP models for hi-tech multilevel parking in CBD areas, key traffic centres, around major rail, metro or bus terminals and where pedestrian priority is desirable.
- Lay-bys are to be provided in school zones, public transit zones and near shopping areas for drop offs/pick ups. A 5 minute parking only rule must be enforced on these bays. Depending on the demand, the length of the lay-by can accommodate between one to four vehicles.
- Designated parking bays for auto and e-rickshawstands are to be provided near public, social and civic infrastructure and near transit hubs.

Parking should not be allowed within 30m from an intersection.

DESIGN STANDARDS

As per IRC:103, the parking bay dimensions for parallel parking four-wheelers should be 2.00m x 6.00m. Where additional parking capacity is desired and service lane is available, angled parking may be adopted. Angled and perpendicular parking of cars on the main carriageway should be avoided.

Table 3.10 : Parking space requirements.

Sl. No.	Type of Parking	Standard Space (m)	Notes
1	Parallel	2.00 x 6.00	• Most preffered in urban roads • Less space occupied • Better visibility during entry and exit • Can be changed between cars and 2 wheelers
2	90°	2.50 x 5.50	• To be avoided for on-street parking • Effective in off-street parking lots/MLCP • Most efficient and economical since it accommodates the most vehicles per liner meter.
3	60°	To be avoided	• To be avoided for on-street parking • Ideal for fast turnover or short term use. • Inefficient circulation patterns and one-way aisles. • Ideal for Collector or sub-arterial roads.
4	30°	2.00 x 5.00	

Street parking must not hinder any other form of movement.

Standard parking dimensions required for different parking angles are outlined in Table 3.10.

As a rule of thumb, 1 car parking space = 4 two-wheeler slots = 10 cycle parking slots. A typical two-wheeler parking space is 1m x 2m.

Parallel parking space for one autorickshaw, e-rickshaw and cycle rickshaw should be 1.5m x 3m.

Cycle parking systems such as wheel clamps or inclined wheel braces may be provided near transit stations, bus stops, market places, public spaces etc.

MATERIAL SPECIFICATIONS

The parking bays can be finished with heavy duty paver blocks of thickness 80mm and above. GSB and sub grade below is recommended. Parking bays can also be finished with concrete and asphalt with similar specifications to the travel lane.

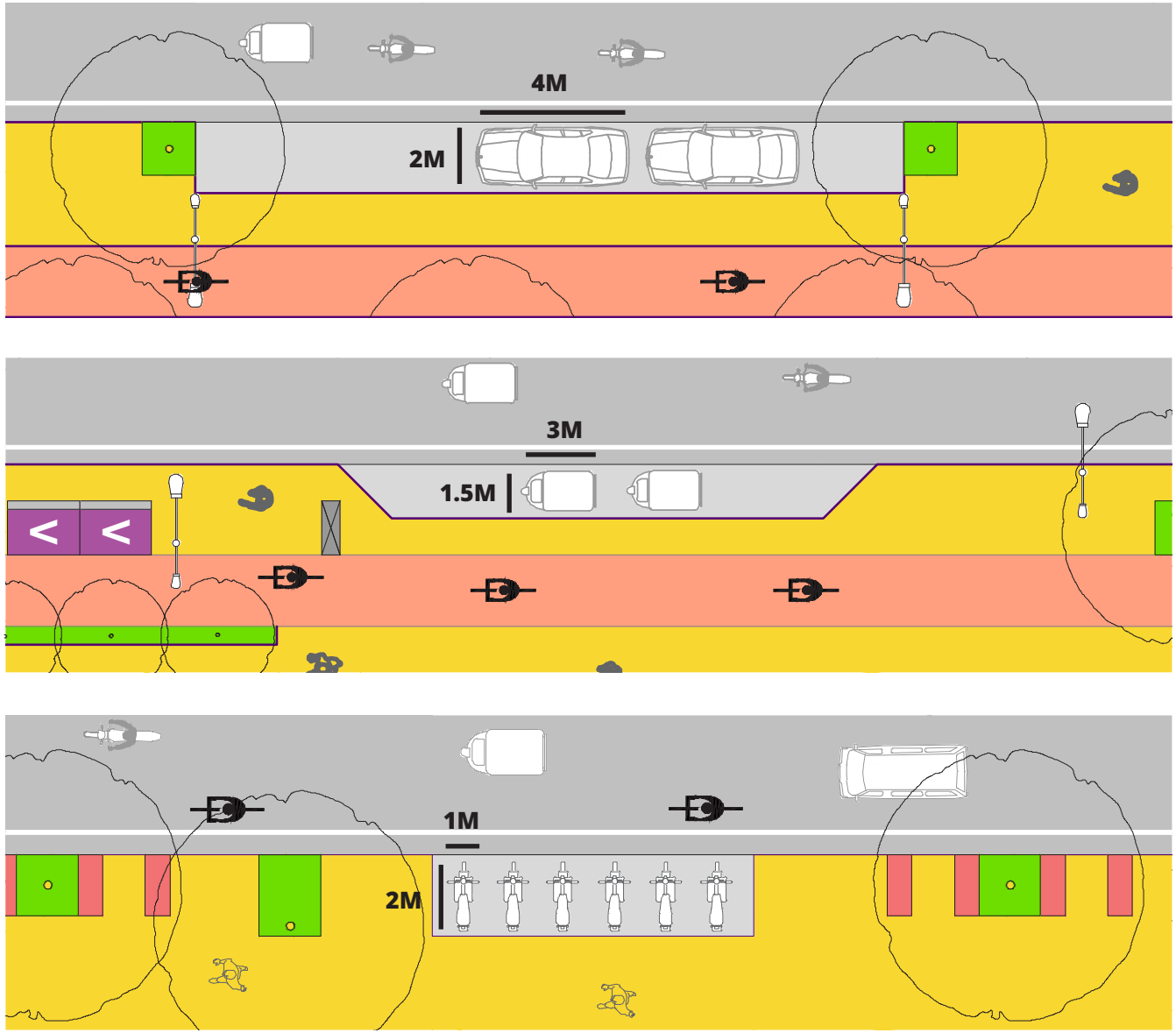
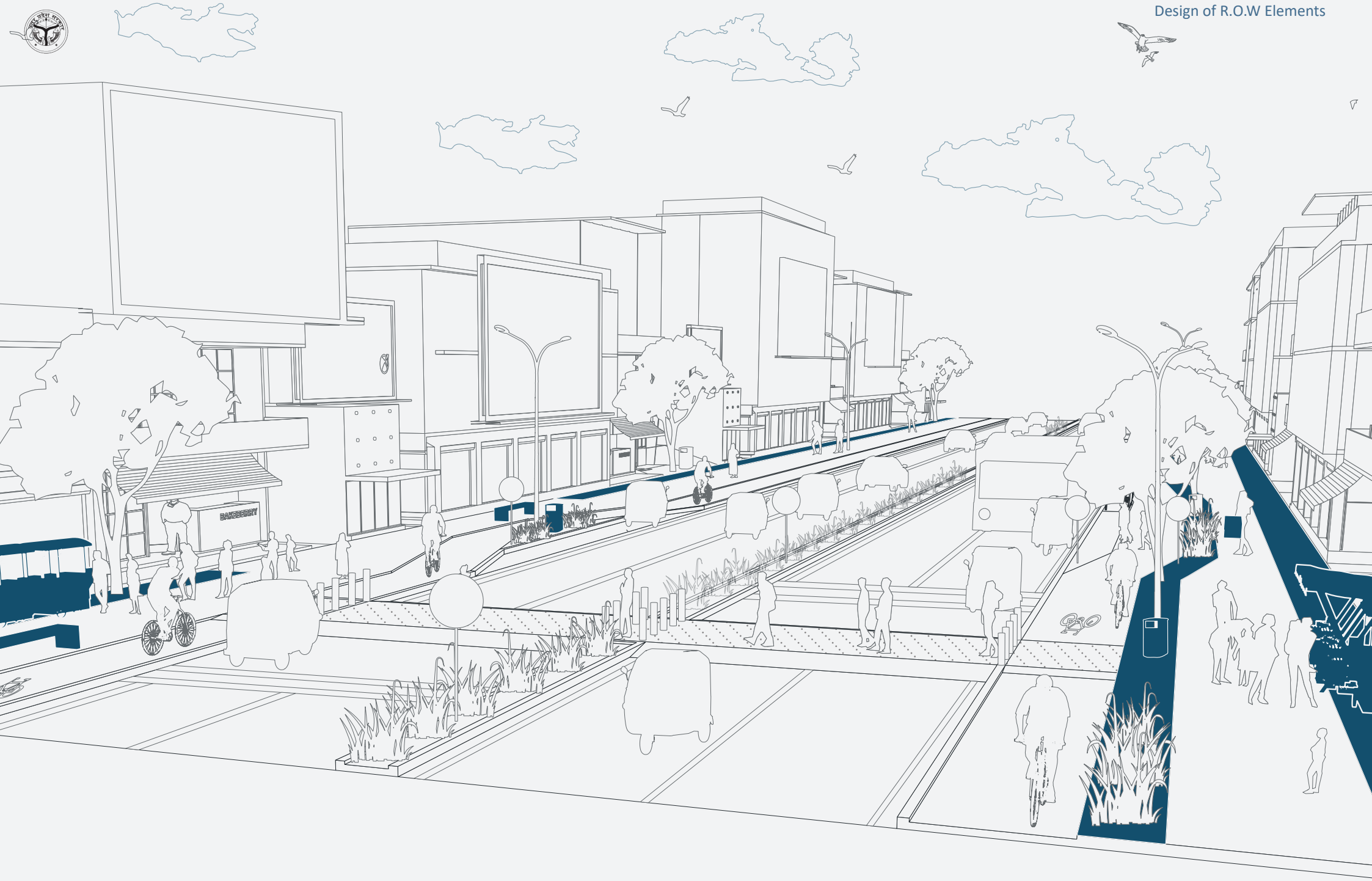


Figure 3.29 : Parking bay dimensions for parallel parking of four wheelers and autorickshaws and perpendicular parking of two wheelers.


RASBERRY

3.2.10. Vendor Zones & Street Furniture

Street Vending

Street vending provides city residents with convenient access to affordable goods and services, across various income groups; particularly benefiting the poor. Street vendors also play a vital role in urban areas by contributing to the vibrancy and diversity of city life and adding to the principle of 'eyes on street', thus making streets feel safer to use.

In India, street vendors make up 2.5 percent of the urban population. Considering an average household size of five and multiple income streams, more than 10 percent of urban households likely rely on street vending. Therefore, it is crucial to establish better and more "formal" vending areas, especially along major streets and near public transportation hubs.

Dedicated and organized vending zones ensure

- Pedestrian safety
- Reduce sidewalk congestion
- Support local vendors, and
- Maintain a clean, orderly streetscape.

Despite all of the above, street vendors often face challenges due to insufficient space and infrastructure.

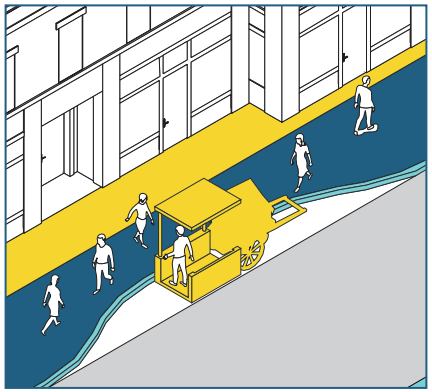


Figure 3.30 : Street vendors should be placed in high-demand areas, such as near major intersections, public transport stops, and parks.

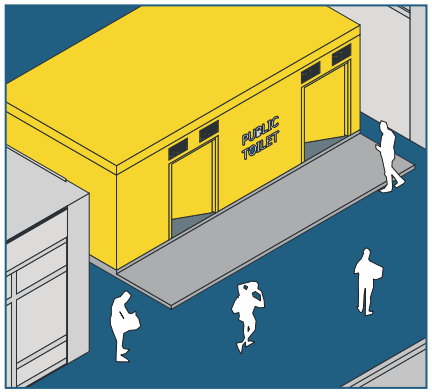


Figure 3.31 : Essential infrastructure, including cooperatively managed water taps, electricity points, trash bins, and public toilets, should be provided.

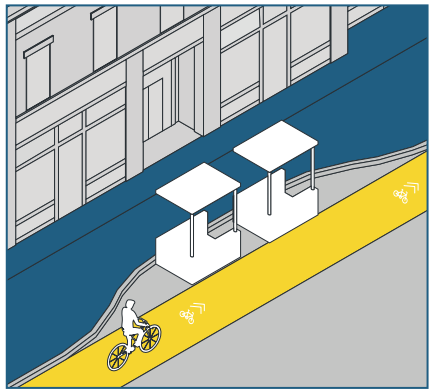


Figure 3.32 : Vending areas should be located to maintain the continuity of cycle tracks and footpaths.

To accommodate them better, the following steps are to be taken :

Map and Enumerate Vendors

Accurate mapping of street vendor populations helps in planning and allocation of spaces. Involving vendors or their representative organizations in data collection ensures a more complete census.

Efficiently Use Existing Spaces

Re purposing existing spaces, such as elevated walkways or underpasses, can provide areas for vending. Designating “multi-utility zones” in footpaths creates built-in space for vendors.

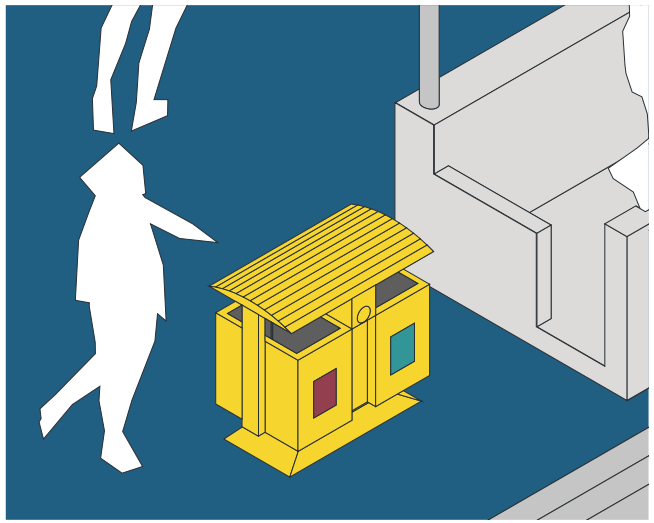
Consider Amenities

Co-locating amenities like trash cans, power connections, clean water sources, accessible pathways, and shelter benefits both vendors and the public

Street Furniture

Street furniture plays a crucial role in shaping urban environments, enhancing functionality, aesthetics, and overall experience.

This mainly includes signage, dustbins, seating benches, etc. These are required to enhance user experience and convenience on the street.

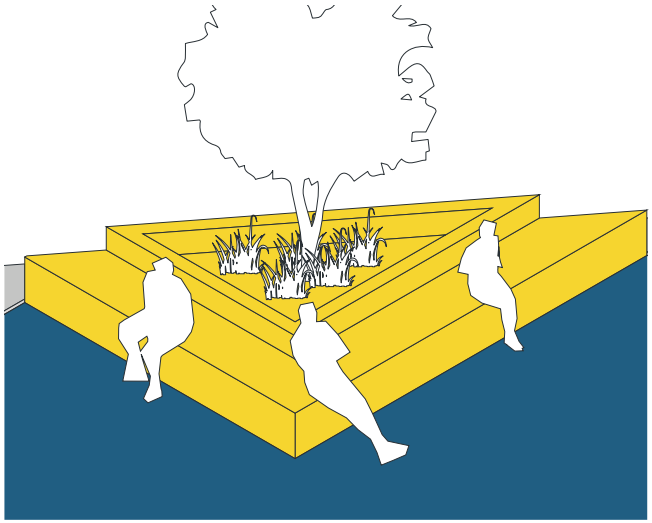


Dustbins

Street-side dustbins are meant to have a capacity of 5 to 10 litres, and can be fixed to the footpath on a pole or attached to a street light pole.

It is recommended that at least two bins (one for wet waste and one for dry waste) be provided at 30m intervals.

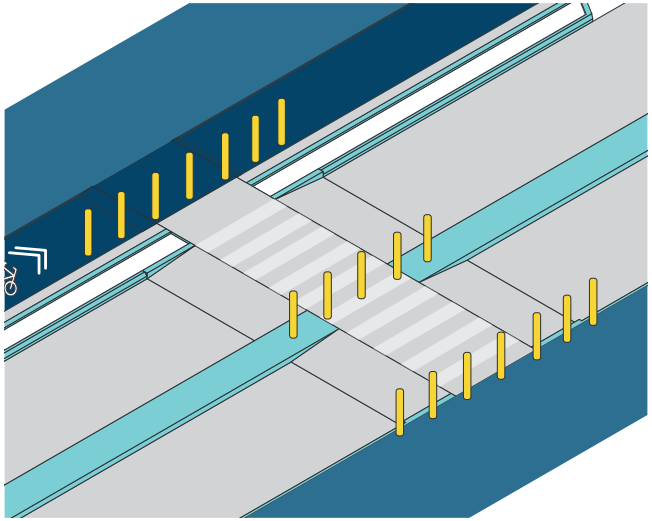
While the dustbins should be fixed to deter theft, they should either swing or have detachable baskets to allow for easy removal of waste.



Benches

Benches, a type of public furniture, are a common sight along roadsides, particularly on sidewalks or pedestrian walkways. They provide a welcome rest stop for people on foot, allowing them to take a break, admire their surroundings, or socialize with others.

These benches are typically placed strategically, considering factors like sun and shade, pedestrian flow, and scenic views.

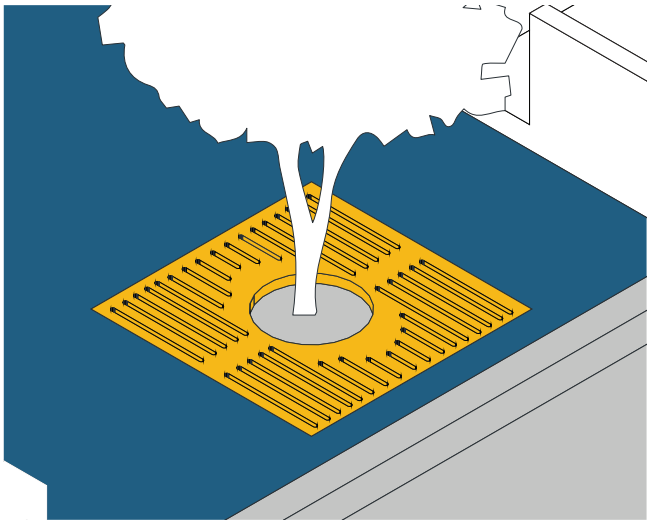


Bollards

Bollards are mainly used to prevent motorised transport from encroaching on non-motorised areas of the street, but can also be used for other types of user segregation; such as separating strolling and walking areas of a street from seating and gathering areas, or vending areas.

Spacing between bollards should be 1.2m to 1.5m to allow for strollers and wheelchair access.

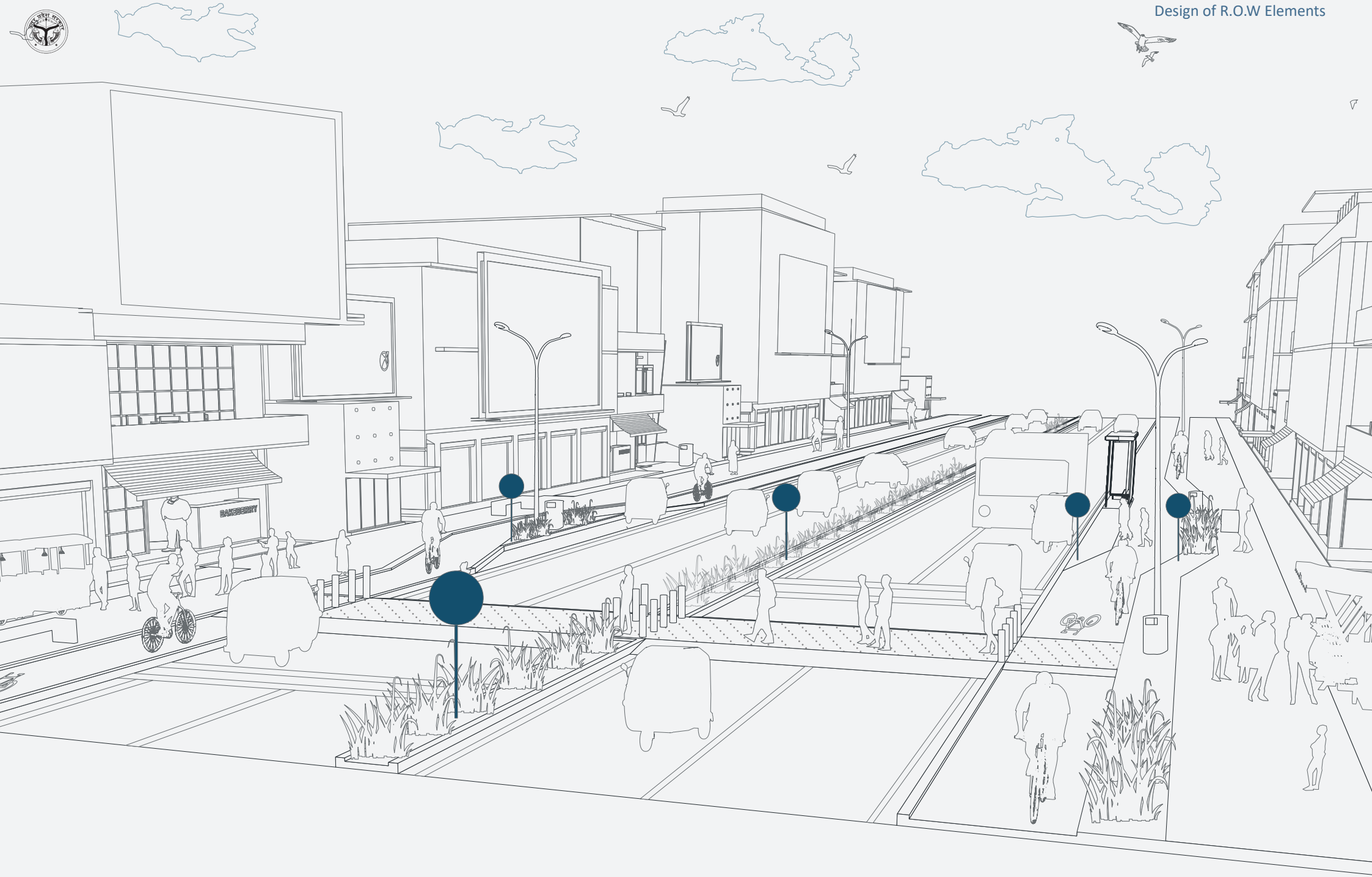
Bollards can be made of metal or concrete and can vary in height and diameter from slender bollards of 50mm diameter and 1000mm height to rounded stone bollards that are 600mm in height



Gratings/tree pits

Tree pits and grates are both urban solutions for protecting and nurturing street trees. Tree pits are open areas filled with soil around the base of a tree, often used in parks, plazas or along the carriageway on the edge of footpath/MUZ.

They allow for ample root growth and can be landscaped with additional plants. Tree grates, on the other hand, are typically made of metal or cast iron and sit on top of a tree pit. They provide structural support for pedestrians while allowing water and air to reach the roots below.


BARBERRY

3.2.11. Signage

Figure 3.33 : Common mandatory / regulatory signs.

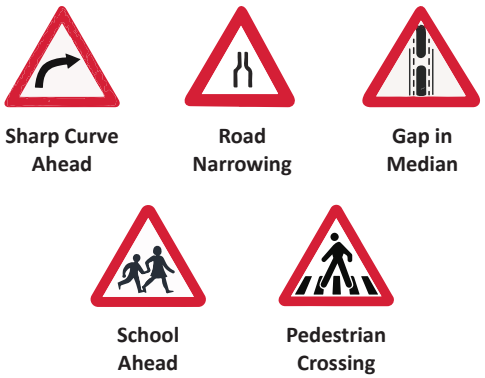


Figure 3.34 : Common cautionary / warning signs

Traffic signs for India are prescribed in Motor Vehicles Act, 1988.

Traffic signage serves an array of uses. They are extremely crucial to the safe and efficient functioning of an urban road.

- They promote road safety rules.
- They indicate the speed and direction of movement allowed
- They provide warnings of potential hazards
- They give users critical information about their destination, direction and distance to destination.

The Indian Roads Congress (IRC) prescribes 3 main typologies of signage (for vehicles) in IRC:67-2022. These are Mandatory / Regulator Signs, Cautionary / Warning Signs and Informatory / Guide Signs. Some common examples of each of these signs are listed below.

Mandatory / Regulatory Signs

Almost all mandatory or regulatory signs are circular in shape. They are used to indicate restrictions on vehicular movement such as “U-Turn Prohibited” or “Parking Prohibited”. They are also used to indicate speed limit on roads. These ‘restrictions’ signs have a red circular ring with black letters or arrows on a white background.

For mandatory signs giving positive instructions, a white symbol and blue background are used. They indicate what a driver must compulsorily do, for example, direction control signs.

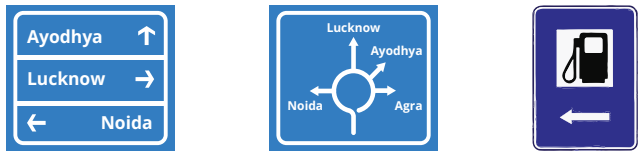
While all of the above are round, the only exceptions in shape the octagonal red STOP sign and the triangular GIVEWAY / YIELD sign. These two provide indication about right of way to drivers.

Cautionary / Warning Signs

These signs are triangular in shape with a red border and black symbol on a white background. They are used to caution or alert drivers to potential dangers or hazardous conditions. Some examples include, “Narrowing of Road”, “Gap in Median”, “School Ahead”, etc.

Informatory / Guide Signs

All Informatory signs and Guiding signs for facilities are rectangular in shape. Informatory Signs for facilities indicates location and direction to facilities like “fuel station” or “eating place” or “parking” and



Direction Information | **Round-about Information** | **Facility Information**

Figure 3.35 : Common Informatory / Guide Signs.

shall be a symbol within a rectangular board with blue background.

More details about the above types of signage including heights, clearances, orientation and material specifications can be gotten from IRC:67-2022.

Location of traffic signs

The signs shall be so placed that motorists and pedestrians can recognize them easily and in time. Normally the signs shall be placed on the left hand side of the road. On roads with 3 lanes or more per direction, the signboards shall also be placed on the median for better visibility.

» **Tip :** As per IRC standards, the signs should be erected not less than 60cm away from the edge of the kerb in case of kerbed roads and at a distance of 2-3m from the carriage way edge in case of unkerbed roads. Mounting height suggested is 1.5m for unkerbed roads and 2m for kerbed roads.

The signs shall be so placed that they do not obstruct vehicular traffic on the carriageway, and if placed on the shoulder / footpath / refuge island, they must have a clear height of 2.4m and should not obstruct pedestrian or cyclist movement.

Additional information regarding the minimum clear visibility distances for signs can be seen in Table 3.11. It must be noted that :

- For grade separated junction, two or three advance direction signs are to be provided. These shall be located at the start of diverging lane, 250 m to 750 m from the exit and additionally 750 m to 1500 m from the exit.
- The clear visibility distances indicated in the table are minimum values and greater distances should be provided wherever possible.
- Reassurance Signs shall normally be placed about 100-150 m after the junction.
- Place Identification Signs are normally placed about 90 m to 150 m in advance of the start of the built-up area and
- Flag type direction signs are generally installed at the nose of diverging lanes.

Orientation of signs

The signs shall be placed at right angles to the line of the approaching traffic. Signs relating to parking of vehicles and stop signs are to be placed at an angle between 30 and 45 degrees to the direction of traffic flow while ensuring there is no glare effect. On horizontal curves, the signage is to be determined with regard to the course of the approaching traffic.

Signage faces may be tilted upward / downward at road gradients visible to approaching traffic.

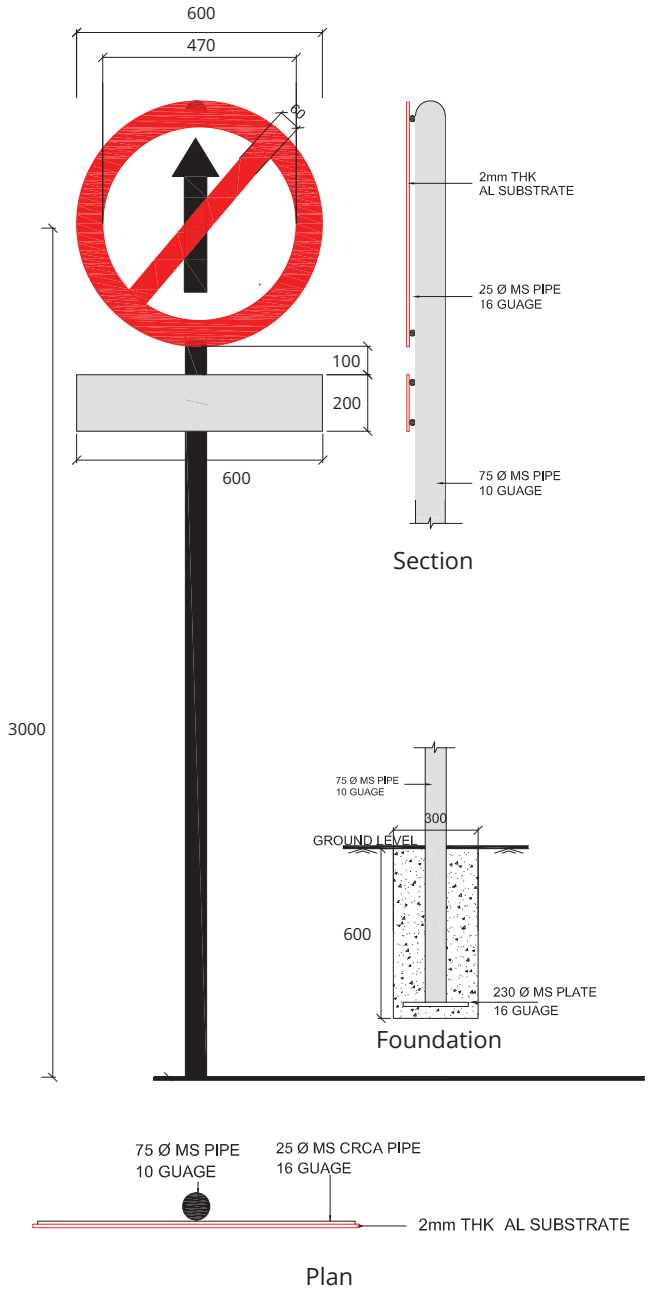
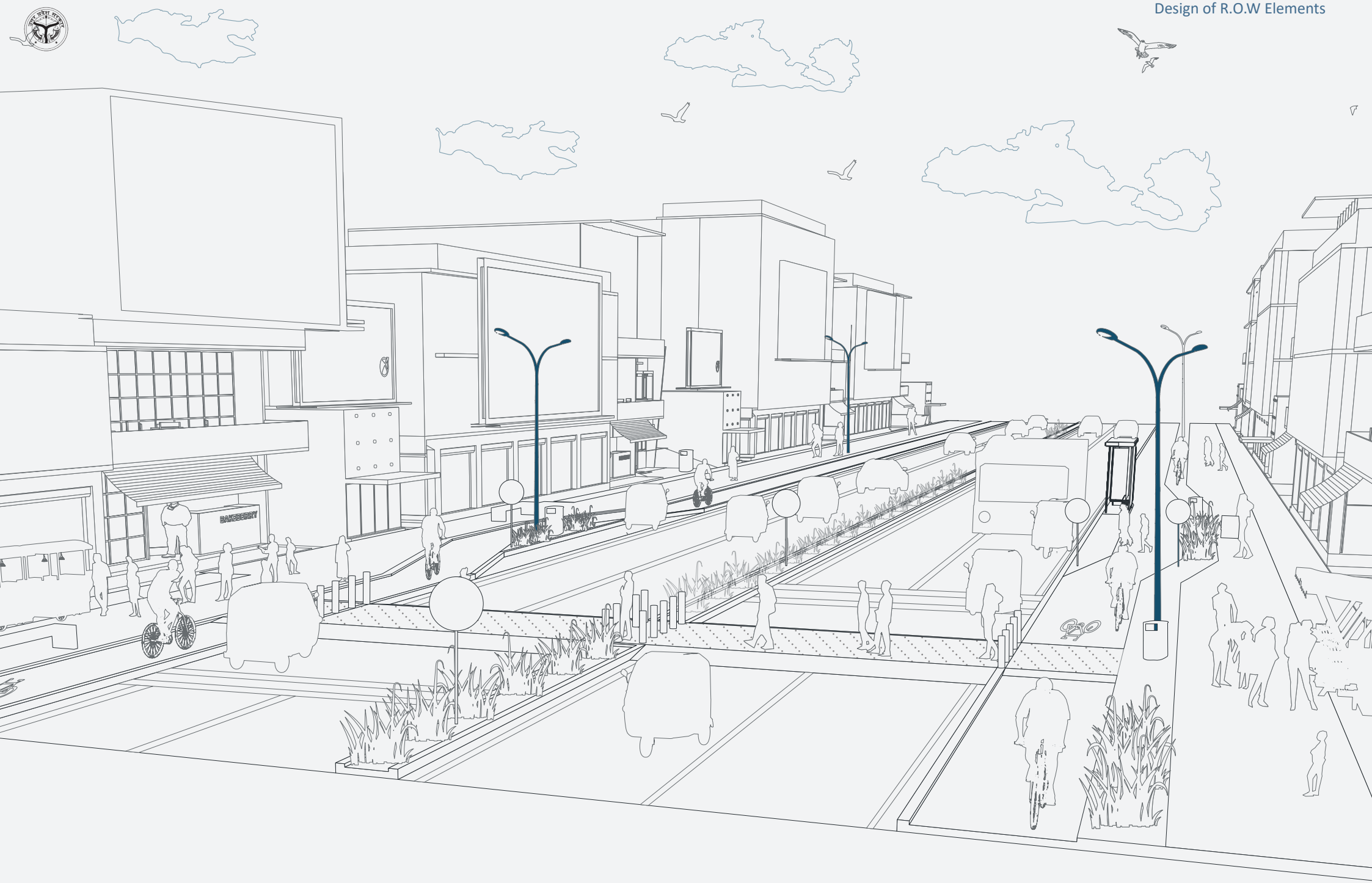


Figure 3.36 : A typical sign with fixing and foundation details

Design Speed (km/h)	Minimum Clear Visibility to Sign (Meters)		
	Advance Direction Signs	Flag Type Direction Signs/ Reassurance Signs / Place Identification Signs	Overhead Direction Signs
Up to 30	55	35	155
31 - 50	75	55	
51 - 65	95	65	
66 - 80	130	95	
81 - 100	160	115	190
101 - 120	230	165	250
121 - 150	255	180	285

Table 3.11 : Minimum clear visibility distance to signage based on design speed of the road


BAKERY

3.2.12. Streetlights

PLANNING STANDARDS

Street lights are important for providing safety of movement for pedestrians and motorists alike. The height of the street light poles and the distance between poles will be dictated by the R.O.W. of the road and the Lux level of the light fixture. However it must be ensured that the lighting is uniform and that there are no dark patches. Well lit roads allow for improved safety, especially for women and other vulnerable groups.

For arterial, sub-arterial and high speed roads, separate lights for motorists and non motorised transport can be provided. For collector and local streets the lights can be combined for both motorised and non-motorised transport. For narrower roads and shared streets, only pedestrian lights can be used.

Apart from street lighting for visibility and safety, lighting can also be used to improve the aesthetics and character of the street (shopping streets, boulevards etc.) and public space, and can be artistic and ornamental in nature.

Smart Lights and Smart Light Poles are also an option. They allow for integration of smart technologies with street lighting. They can include operational measures which allow for the lights to be turned on and off via mobile phones and computers, energy saving measures which allow for a dimming of the light every hour after midnight, as well as integration of the lights with internet provision, Wi-Fi, public addressing system, etc.

DESIGN STANDARDS

There are many types of street lights available in the market. However, for energy efficiency, LED lights are most preferred today. The selected light must be placed to provide uniform distribution with no dark spots. The Lux level of the light will be provided by the manufacturer and will guide the height of the light fixture and the spacing between lights. The thumb rule for the spacing of light poles is that the distance should be no more than three times the height of the pole.

Street light poles must be placed so as not to hinder any form of movement, tree canopy or underground utility.

Signage, flower baskets, advertisements, Wi-Fi, public addressing systems and surveillance cameras can be integrated with the street light poles.

Street light poles are hollow metal tubes which can be

Street Light Type	Height of Pole (meters)	Distance Between Poles (meters)	Use Condition
Pedestrian Light (Short)	4m	10 - 12m	Pedestrian Only Streets
Pedestrian Light (Tall)	6m	15 - 18m	At-grade Shared Streets
Single Arm Street Light (Short)	8m	20 - 25m	Collector & Local Roads
Double Arm Street Light (Short)	8m	20 - 25m	Arterial & Sub-Arterial
Single Arm Street Light (Tall)	10m	25 - 30m	Arterial & Highways
Double Arm Street Light	12m	30 - 35m	Arterial & Highways

Table 3.12 : Height and distance standards for street lights

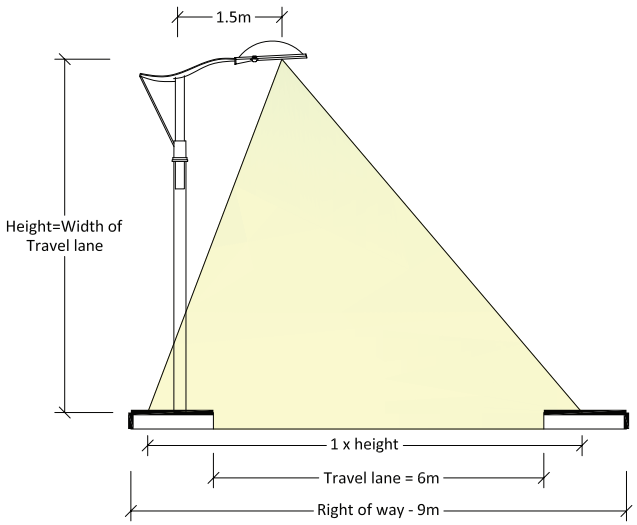


Figure 3.37 : Height- width and location guide for light poles

fabricated or bought ready made. The street lights are affixed to the pole with brackets. The standard heights of the street light poles are 12m, 10m, 8m, 6m and 4m and based on the width of the road, they can be placed on both sides or on one side of the road or in a staggered fashion. If there is a median, of clear width 500mm or more, a double armed pole can be placed in the centre.

For vehicular traffic, 8m high poles spaced ~24m apart are preferred. The light fixture is generally placed 1.5m away from the pole. Pedestrian lights are generally placed at a height of 4m. These can be post-top lanterns or extended from the pole with arms. The pole to pole distance is generally 12m. They can be attached to the street light pole or be provided on separate poles. 6m light poles work well for roads in between wide and narrow roads. They are generally placed at a distance of 18 m.

Please refer Table 3.12 for different scenarios of light pole heights and distances with respect to street type.

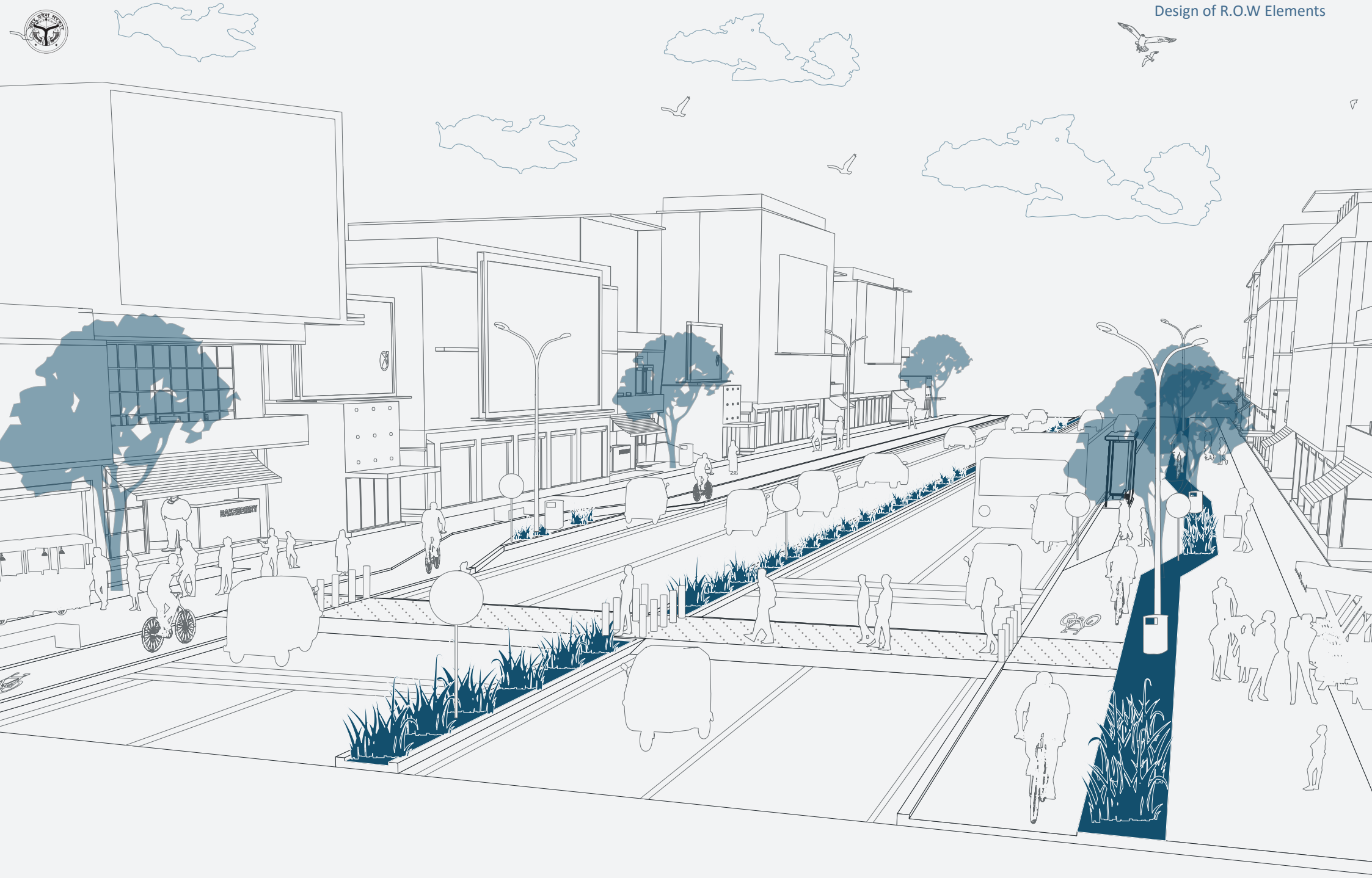
On very wide roads such as arterial and sub-arterial roads, an 8m double armed light pole may be provided on the median and 4m pedestrian lights on the footpath/cycle track. On sub-arterial and collector roads, without medians, 8m light poles may be placed 24m apart on both sides of the road, with an additional pedestrian light attached at a lower height to the main street light pole or between the street light poles. On local roads, 6m light poles may be placed in a staggered fashion. In certain areas, street light poles may not be sufficient. For example, at wide intersections, roundabouts etc. High mast lighting may be required in these areas. These poles are generally 10 to 12m high.

All poles must have a utility door with an allen key for maintenance and repairs of wires.

The depth of the light pole foundation will correspond to its height and needs to be reinforced concrete with a PCC bed. For instance, an 8m pole will require a 1.5m deep foundation. The foundation can also be partially raised above ground.

It must be noted that while LED lighting is energy-efficient, excessive use can cause light pollution and disturbance due to excessive lighting.

Figure 3.38 : Image of a Bangalore Smart City Tender SURE road illustrating the importance of adequate streetlighting on urban roads.


BAKERY

3.2.13. Landscape

PLANNING STANDARDS

Most Indian cities today lack adequate green cover, which has resulted in poor air quality, lack of shade for pedestrians and cyclists, poor ground water recharge etc.

Our streets provide for a unique opportunity to not only be mobility corridors but to also be green corridors that provide a shaded walking and cycling experience, improved air quality and enhanced aesthetics of the streetscape. Landscape can also be curated to create a unique and distinct character for the street.

Landscape can be integrated into the streetscape as trees, shrubs and ground cover; in designated areas, traffic islands and also as continuous strips / buffer zones to segregate different modes of mobility. It can even be provided as planters, hanging flower baskets and as bio-swales.

However, care must be taken so that provision of landscape does not hinder the visibility or mobility of road users.

DESIGN STANDARDS

Landscape elements in the street can be divided into the following types :

Trees

- All existing trees are to be saved and incorporated into the design. Roots of existing trees to be considered while laying new utilities to prevent damage and the canopy is to be considered while planning for street lights.
- New native trees are be planned for in pedestrian and cyclist areas to provide shade. Based on the canopy, trees can be planned 4 - 8m apart.
- Masonry tree pits are to be provided around new and existing trees. For old trees, the tree pit is a protection measure and the depth of the same should be 600mm. The depth of the tree pit for new trees should ensure that there is minimal lateral movement of roots, to prevent damage to utility lines.
- Based on the girth of the tree the tree pit size may vary. As per IRC:103, a minimum size of 1m x 1m is preferred. Tree pits can extend above the ground

and be integrated along with seaters as required. Ground cover (i.e. low shrubs, creepers and flowering plants) can be planted in the tree pit.

- Tree gratings can also be used to cover the tree pit, especially in areas where an existing tree blocks pedestrian movement. Stakes can be used to ensure that the tree grows straight and does not hinder other forms of movement.

Landscape strips

Based on the R.O.W., continuous strips of landscape can be provided along the footpath or cycle kerb. In some cases landscape strips can also be provided along the property edge, based on the land-use and property entry/ exits. The minimum clear width of the landscape strip should be 850mm for shrubs and 1.2m for trees. In continuous strips, shrubs can be planted between trees.

Median Landscape

Where the clear width between the median kerbs is greater than 850mm, shrubs can be planted. The shrubs need to be maintained to prevent spilling over onto the travel lane and obstructing visibility. Landscape must be avoided on the median at 20 meters ahead of intersections, U-turns and pedestrian crossing Trees are not preferred on medians.

Swales

These are designed for allowing increased percolation of storm water and are a sustainable solution for urban drainage. They also provide opportunities for greening - in terms of embankment plants in the sloped areas and spontaneous vegetation during non monsoon months.

Ornamental landscape

Flowering baskets can be hung from street lights for improved aesthetics, with a clear height of 2.4m from the footpath surface. Planters and ornamental landscaping can be included in public spaces in the streetscapes. If there are vertical elements such as flyover columns - creepers and vertical gardens can be planned for.

ADDITIONAL SPECIFICATIONS

For ease of operations and maintenance, it is strongly suggested that only local, indigenous tree and plant species be used. They are generally more hardy and promote sustainability. Fast growing, shade giving trees with shallow roots are preferred. While flowering trees provide character to the street, fruit bearing trees are to be avoided as are trees such as coconut trees which can be hazardous to pedestrians and motorists. Shrubs need to be less than 1m in height or pruned periodically so as not to visually block areas, resulting in unsafe pockets. Ornamental plants are to be used strategically to enhance the public realm.

Key Points from IRC:103.

- Tree pits should be a minimum of 1m x 1m and should be provided for all trees.
- A clear height of 2.4m should be maintained from finished footpath level
- The location of trees should be such that it does not block the view of the pedestrian and drivers at crossings and intersections.

Figure 3.39 : Well designed and well maintained greenery along urban roads can have a tremendous positive impact on the streetscape and user experience. Image from Moti Bagh, Delhi - redeveloped under PWD Delhi's Streetscaping Project

4. R.O.W Layouts

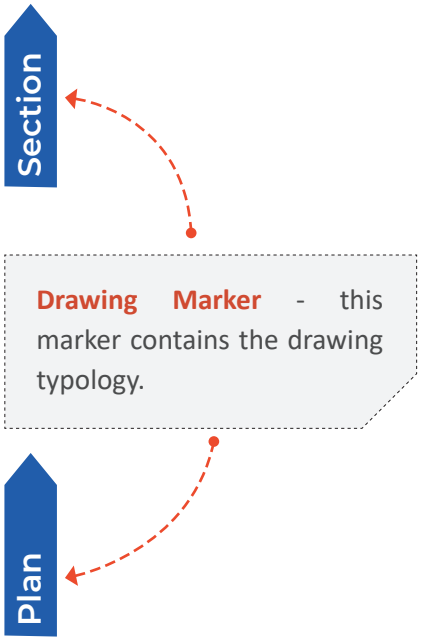
How to navigate through the section

ROW Marker - this tag indicates the ROW of the road.

Speed Indicator - this circle shows the design speed of the road.

Drawing Template - this space contains the template's section.

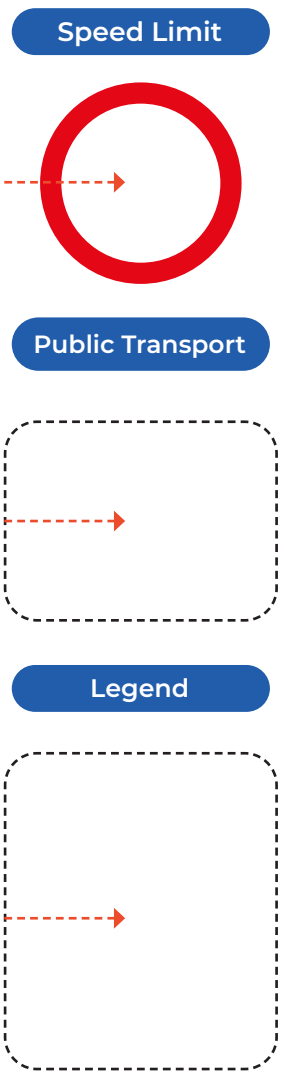
Public Transport Availability - this section indicates the modes of public transport possible.



Drawing Marker - this marker contains the drawing typology.

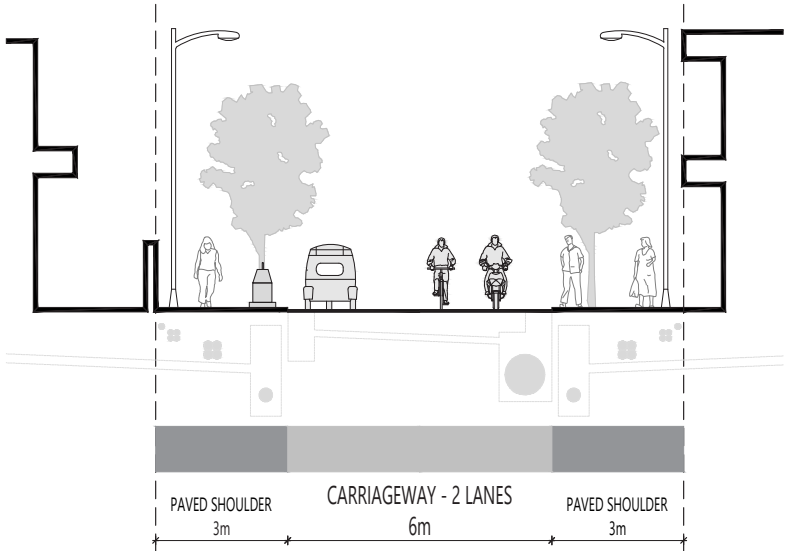
Drawing Template - this space contains the template's plan.

Legend - all lines / symbols used in the drawing are detailed here.

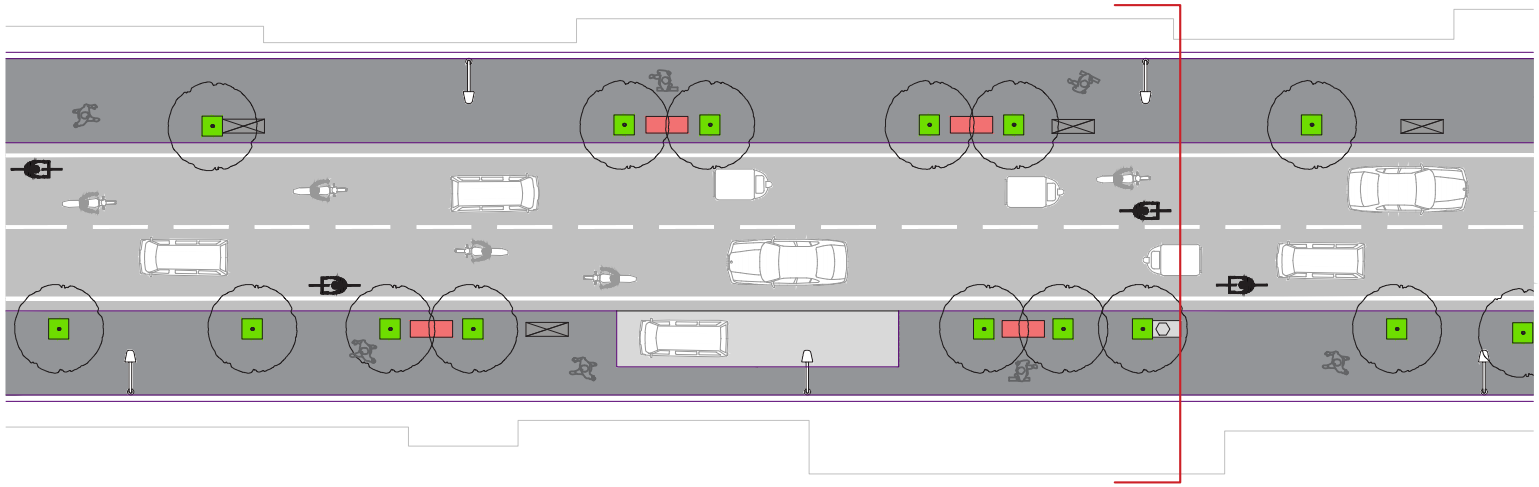


4.1. R.O.W Design

4.1.1. Less than 12M ROW-Shared local road



Section



Plan

< 12m ROW

Speed Limit

30

Public Transport

IPT

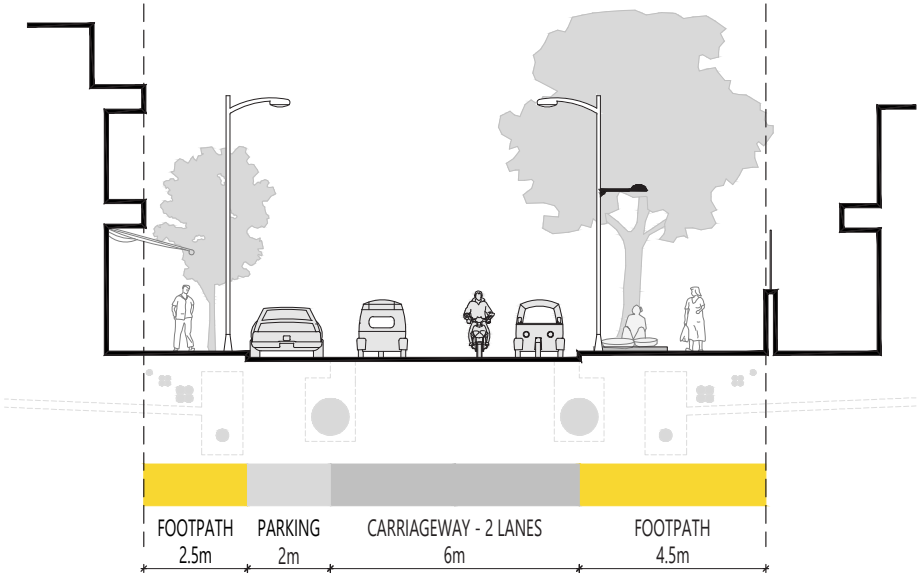
Legend

- V Vendors
- Utility box
- Seating
- T Wastebin
- Tree pit

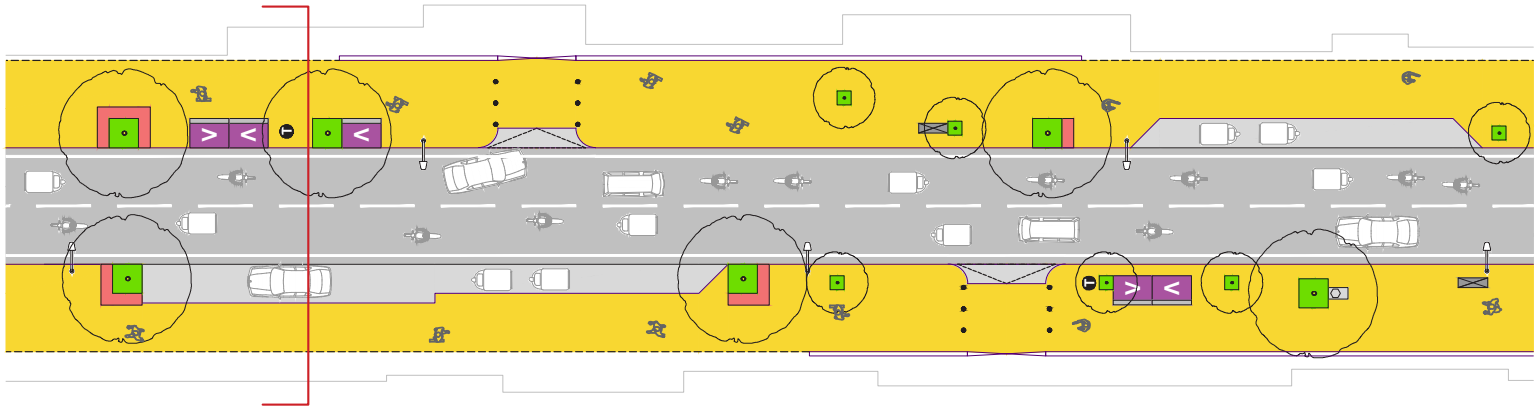
Drawings not to scale

4.1.2. 12-15M ROW-Local Road

Section



Plan



Speed Limit

30

Public Transport

IPT

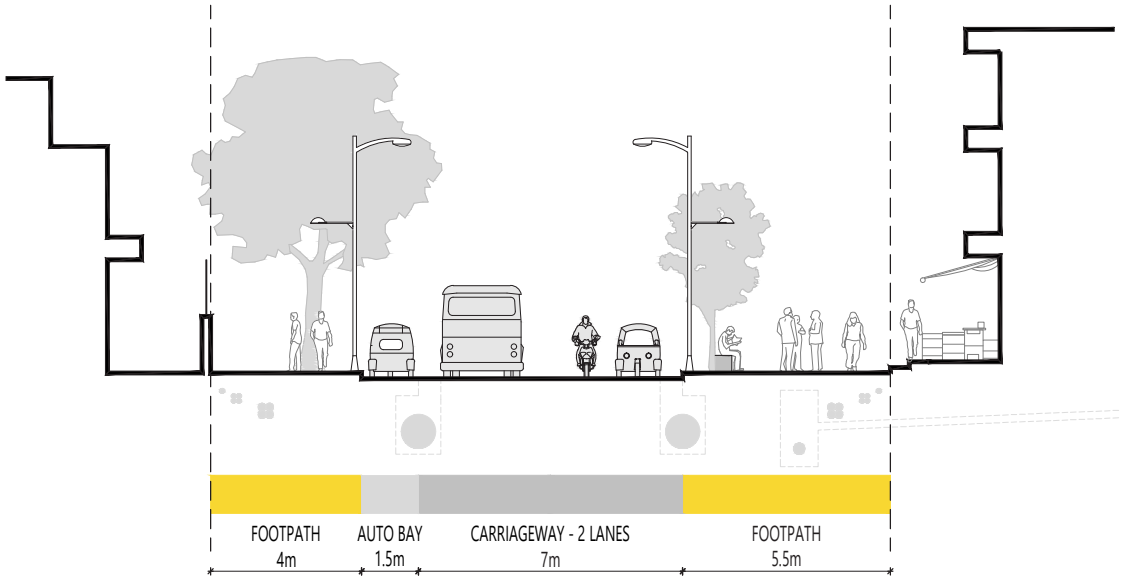
Legend

- Bollards
- Vendors
- Utility box
- Seating
- Temple
- Wastebin
- Tree pit

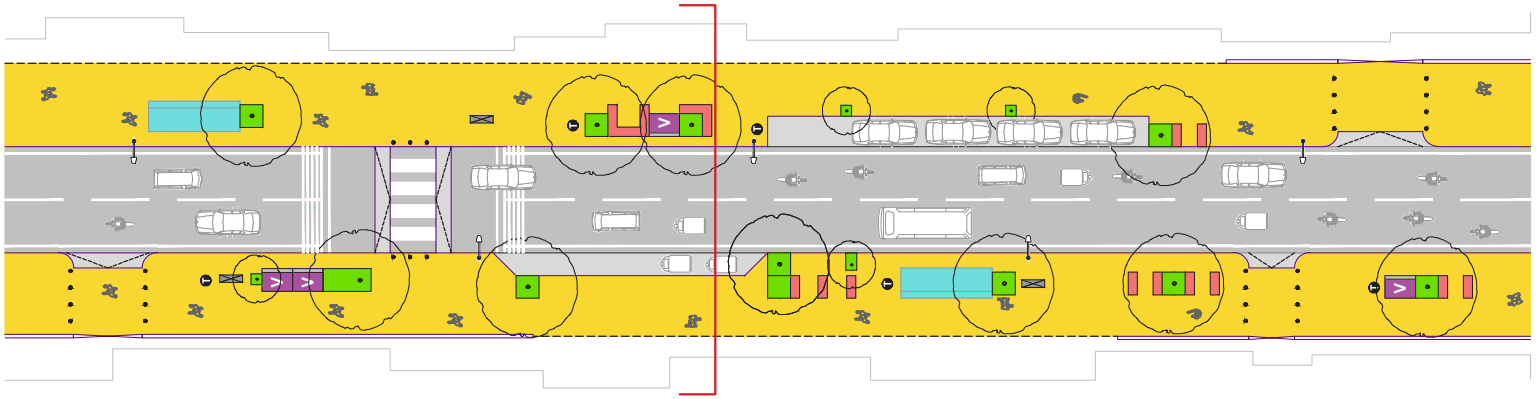
Drawings not to scale

4.1.3. 15-18M ROW-Local Road

Section



Plan



Speed Limit

40

Public Transport

IPT Bus

Legend

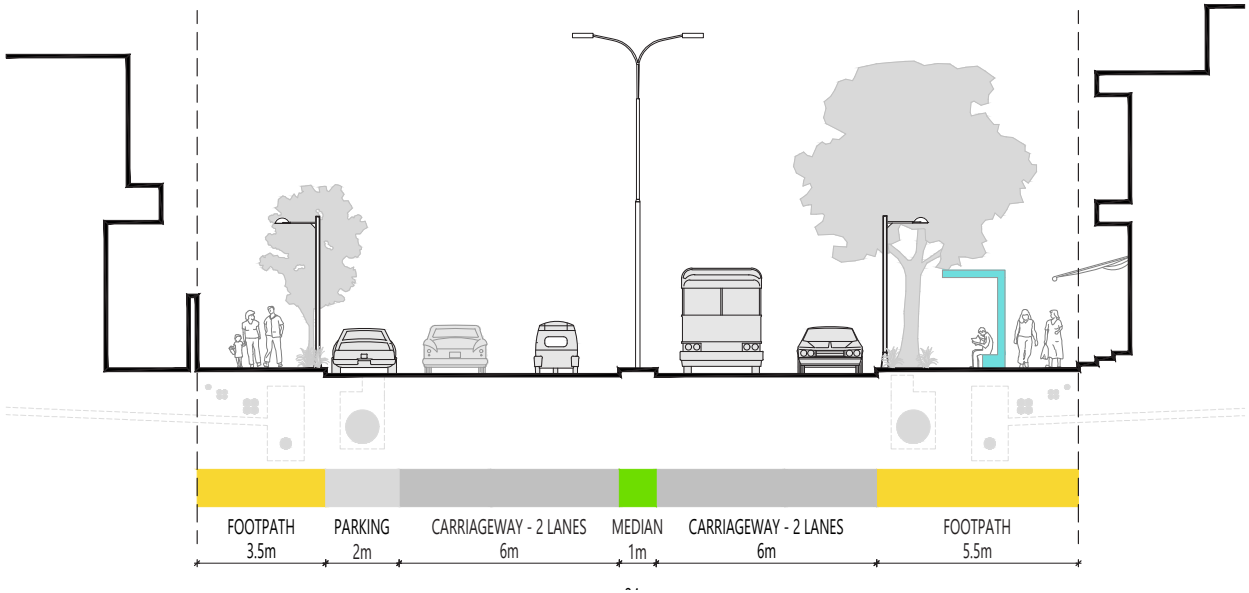
- Bollards
- Vendors
- Utility box
- Seating
- Temple
- Bus Stop
- Wastebin
- Tree pit

Drawings not to scale

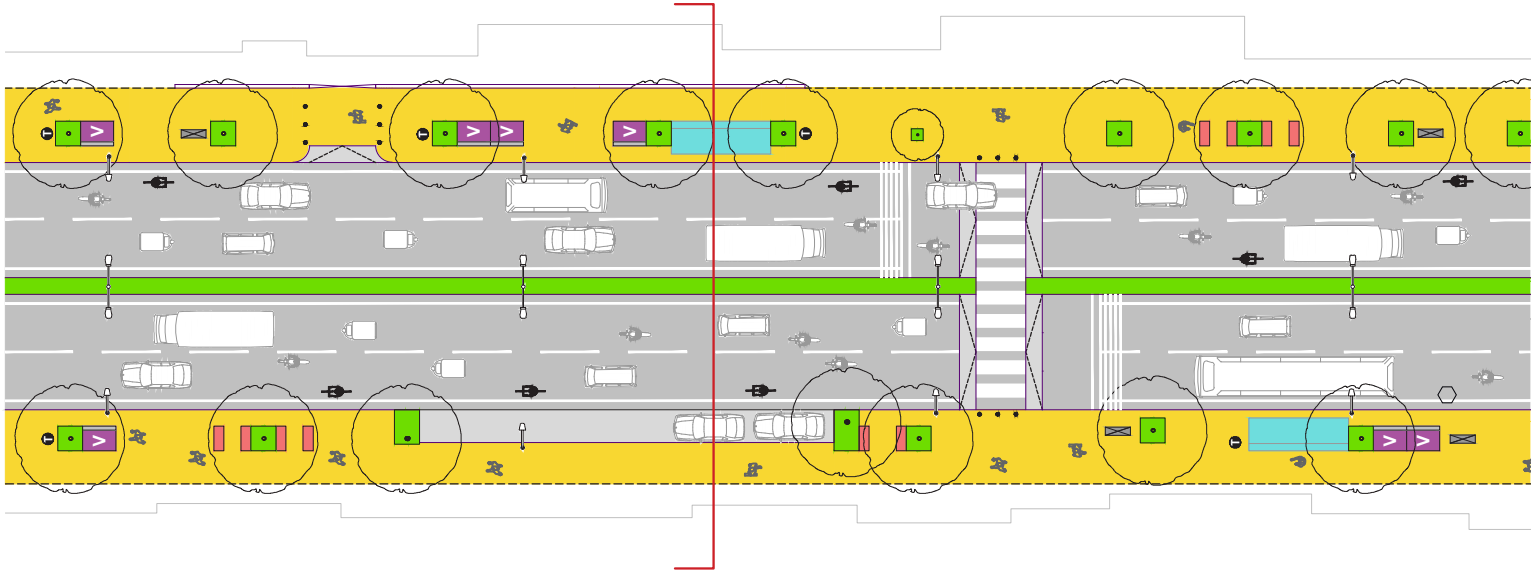

MNGL
GAS
PIPE
LINE

4.1.4. 18-24M ROW-Collector Road

Section



Plan



Speed Limit

40

Public Transport

IPT Bus

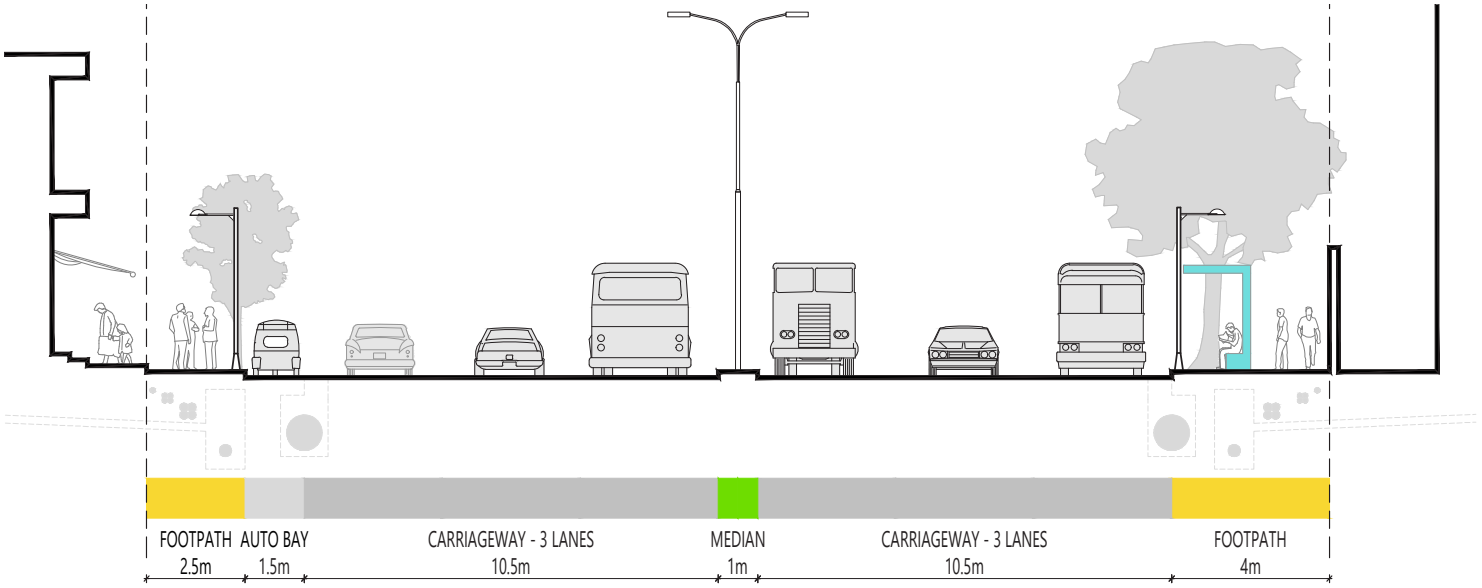
Legend

- Bollards
- Vendors
- Utility box
- Seating
- Temple
- Bus Stop
- Wastebin
- Tree pit

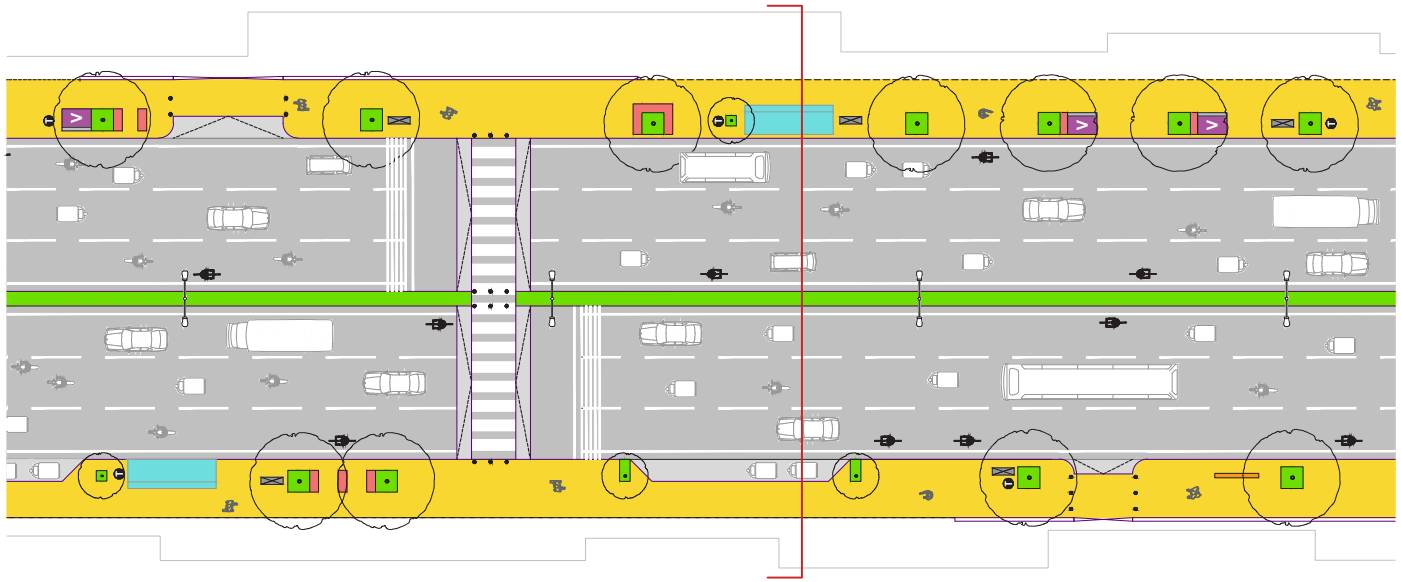
Drawings not to scale

4.1.5. 24-30M ROW-Sub - Arterial Road

Section



Plan



Speed Limit

40

Public Transport

IPT Bus

Legend

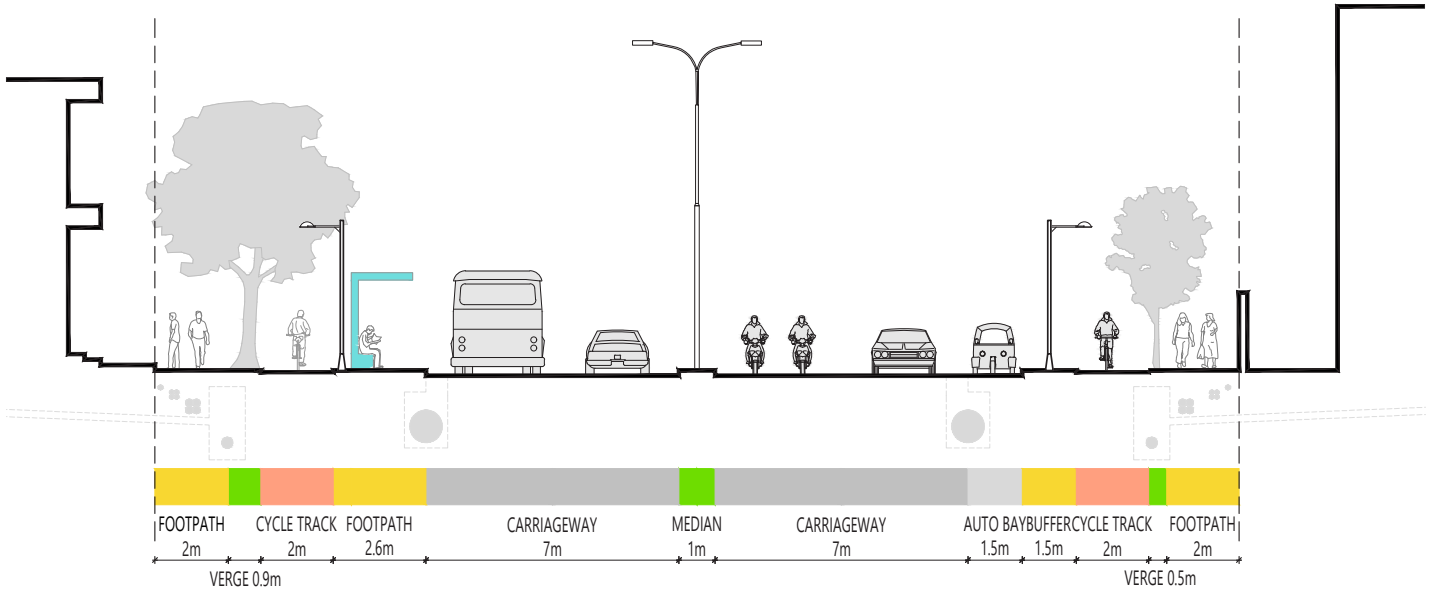
- Bollards
- Vendors
- Utility box
- Seating
- Temple
- Bus Stop
- Wastebin
- Tree pit

Drawings not to scale

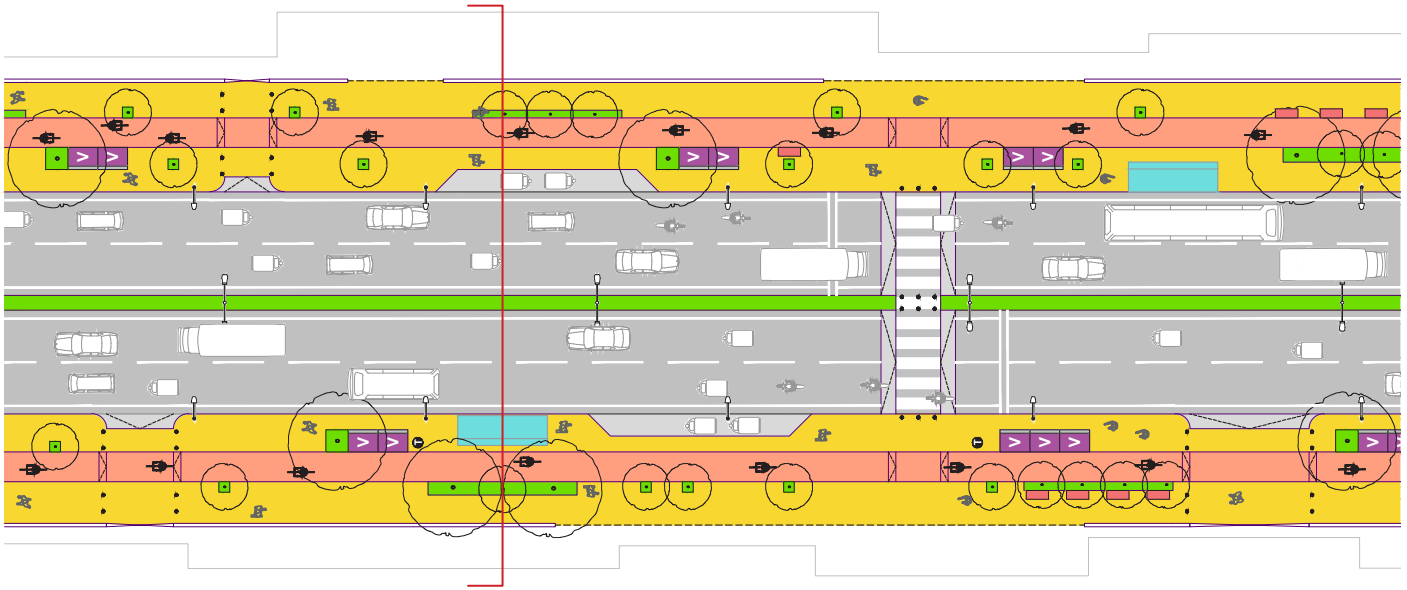

BUS STOP

4.1.6. 24-30M ROW-Sub - Arterial Road with Cycle track

Section



Plan



Speed Limit

Public Transport

IPT Bus

Legend

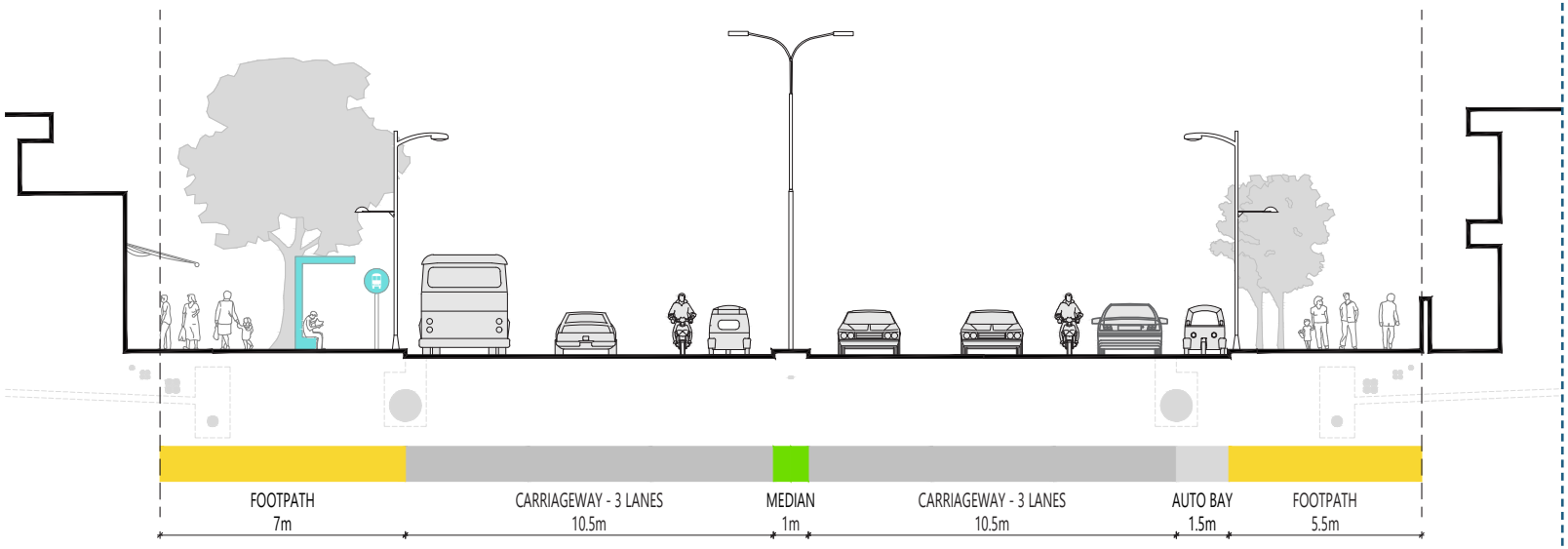
- Bollards
- Vendors
- Utility box
- Seating
- Temple
- Bus Stop
- Wastebin
- Tree pit

Drawings not to scale

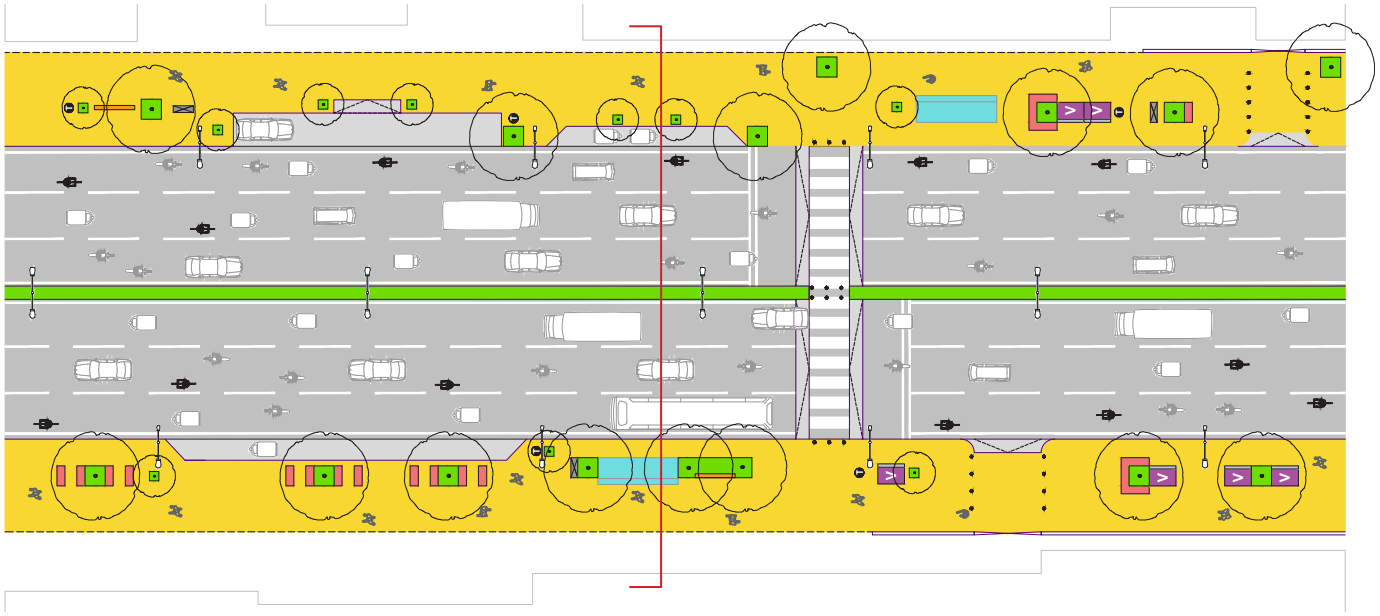

DIGRAFTS BHAWAN

4.1.7. 30-36M ROW-Sub -Arterial Road

Section



Plan



Speed Limit

50

Public Transport

IPT Bus

Legend

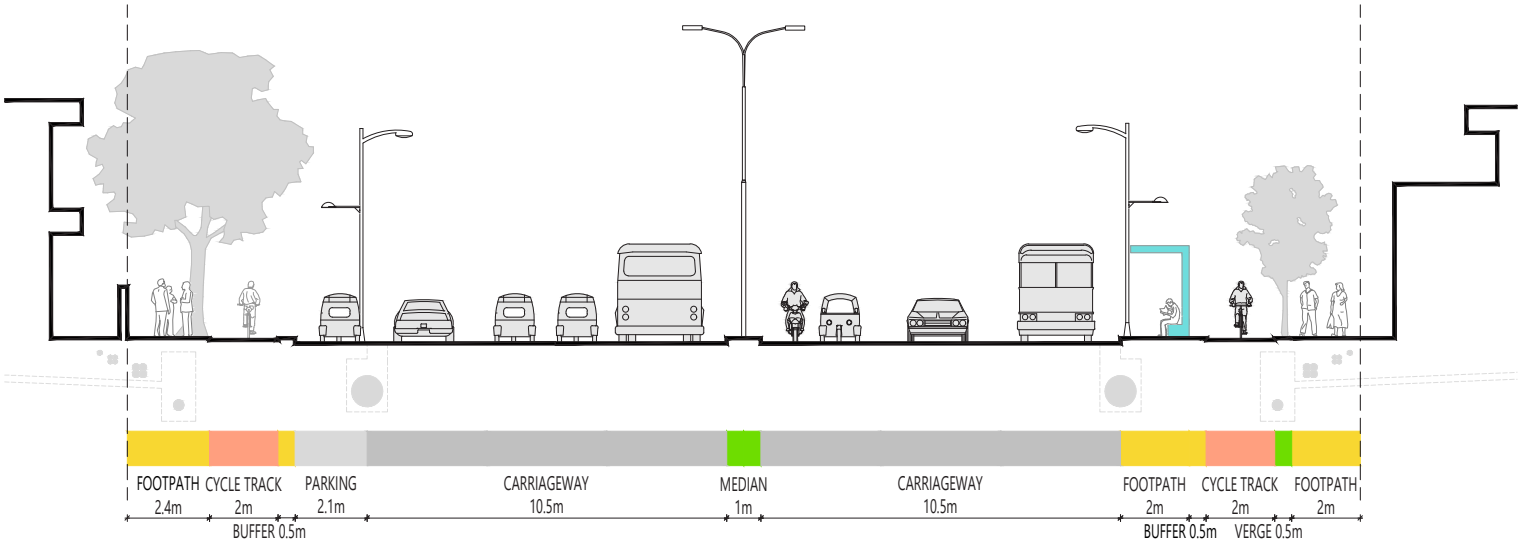
- Bollards
- Vendors
- Utility box
- Seating
- Temple
- Bus Stop
- Wastebin
- Tree pit
- Art Installation

Drawings not to scale

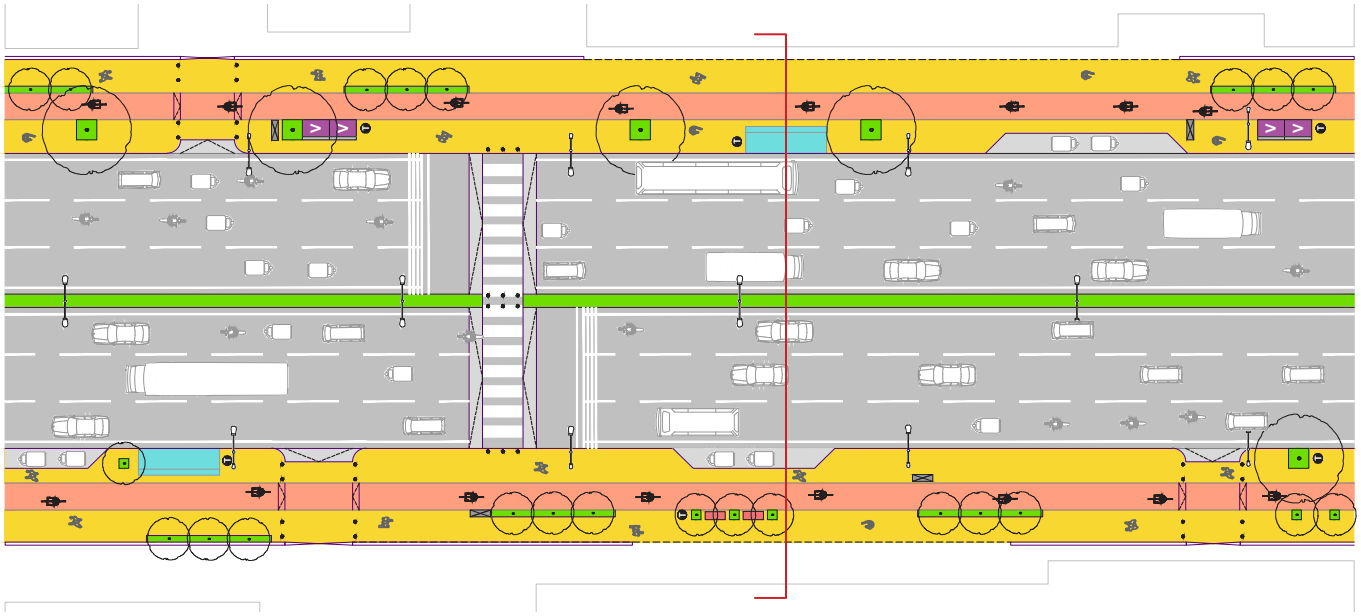

Bengaluru
SMART CITY

4.1.8. 30-36M ROW-Sub - Arterial Road with Cycle track

Section



Plan



Speed Limit

50

Public Transport

IPT Bus

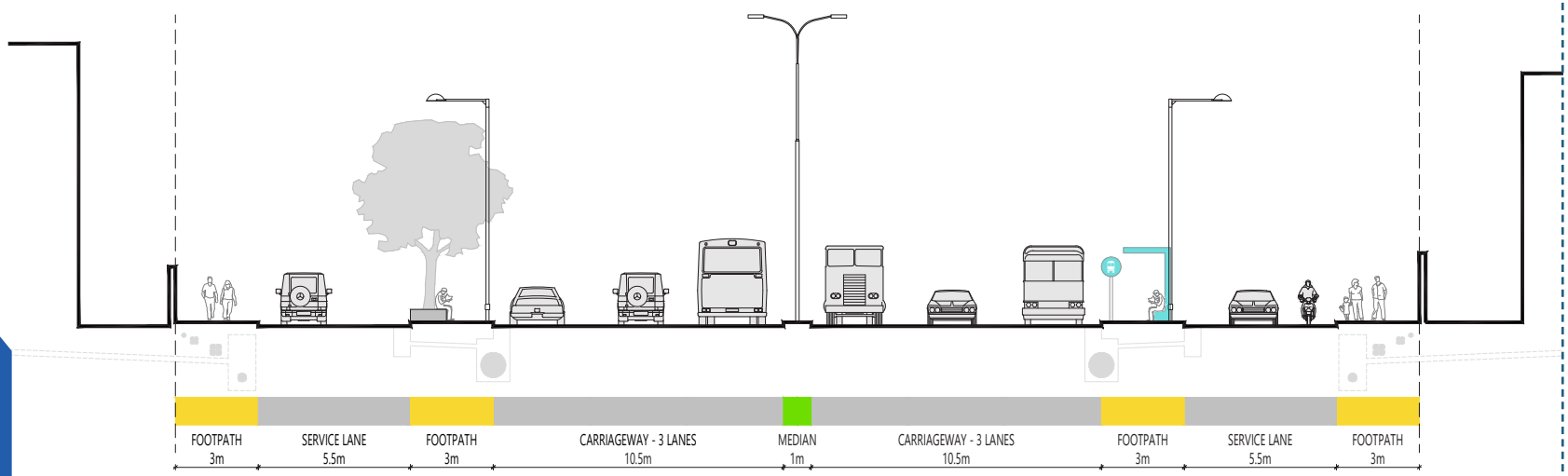
Legend

- Bollards
- Vendors
- Utility box
- Seating
- Temple
- Bus Stop
- Wastebin
- Tree pit
- Art Installation

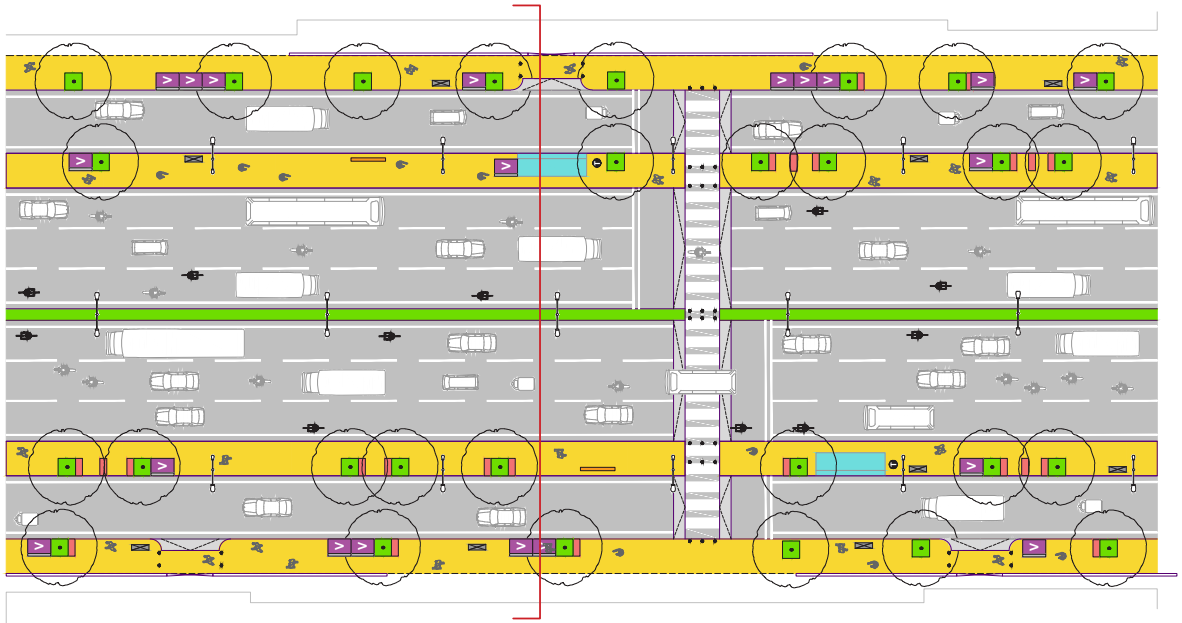
Drawings not to scale

4.1.9. 36-45M ROW-Sub -Arterial Road

Section



Plan



Speed Limit

50

Public Transport

IPT Bus

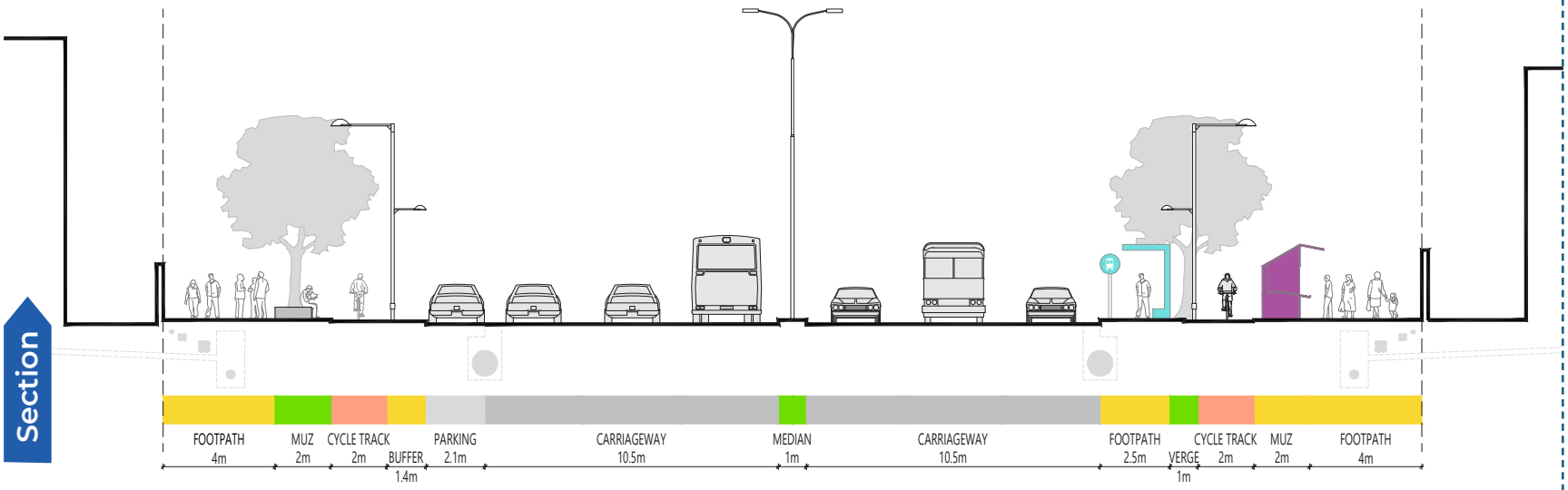
Legend

- Bollards
- Vendors
- Utility box
- Seating
- Temple
- Bus Stop
- Wastebin
- Tree pit
- Art Installation

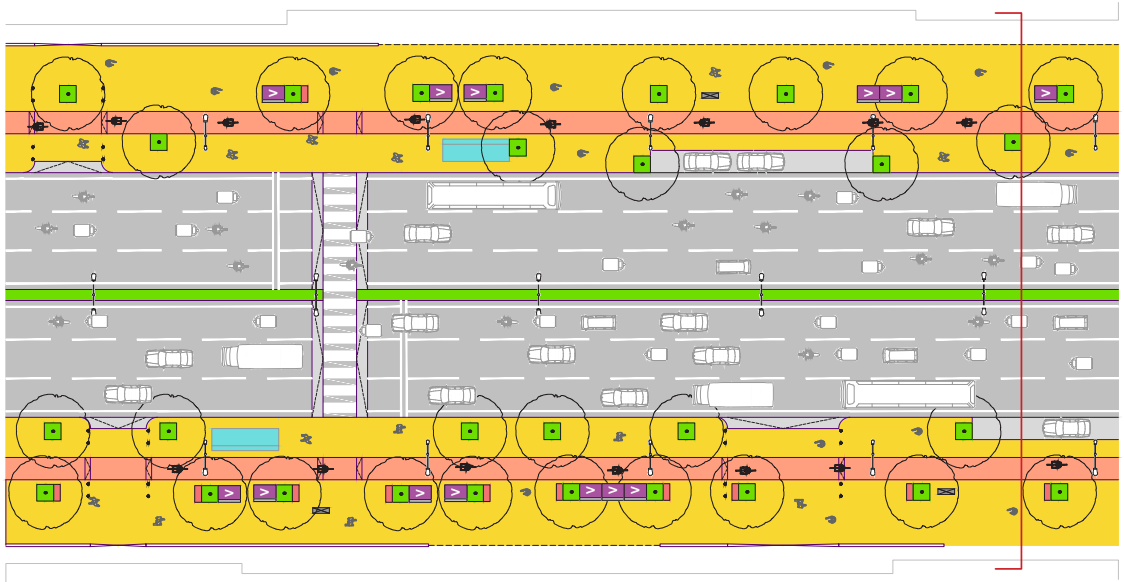
Drawings not to scale

4.1.10. 36-45M ROW-Sub -Arterial Road with Cycle Track

Section



Plan



Speed Limit

50

Public Transport

IPT Bus

Legend

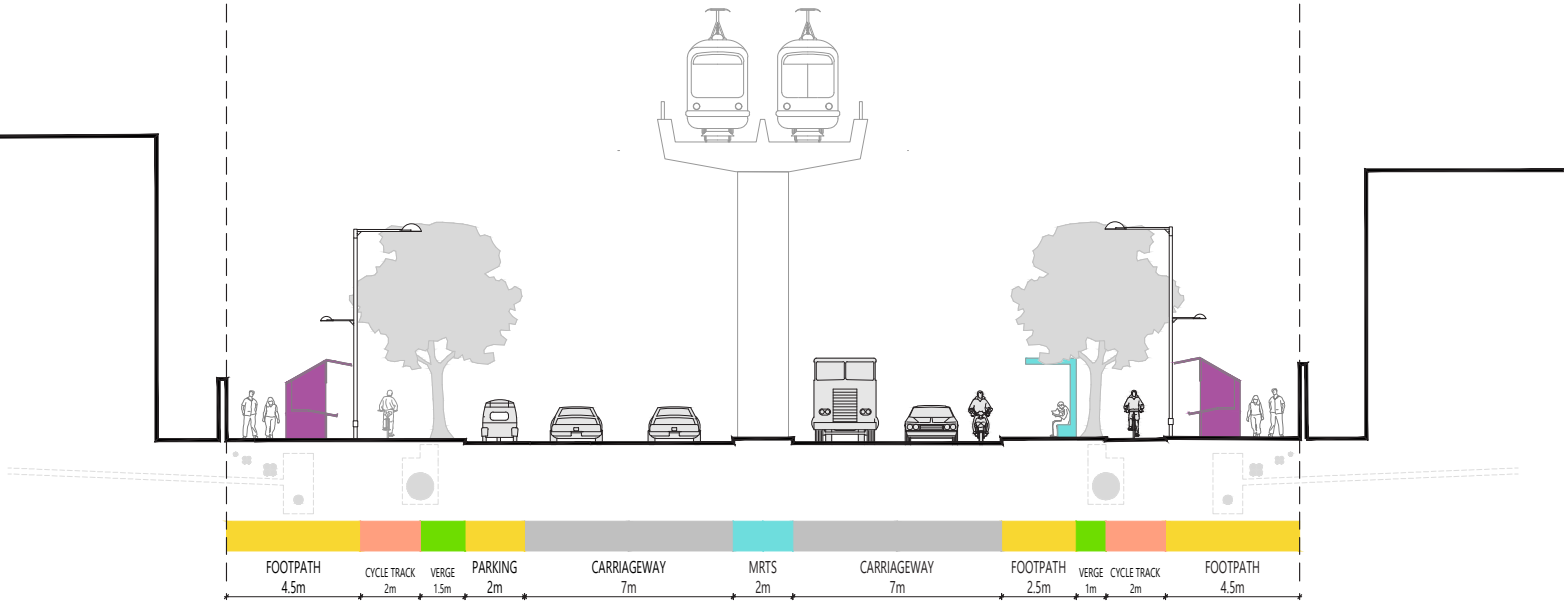
- Bollards
- Vendors
- Utility box
- Seating
- Temple
- Bus Stop
- Wastebin
- Tree pit
- Art Installation

Drawings not to scale

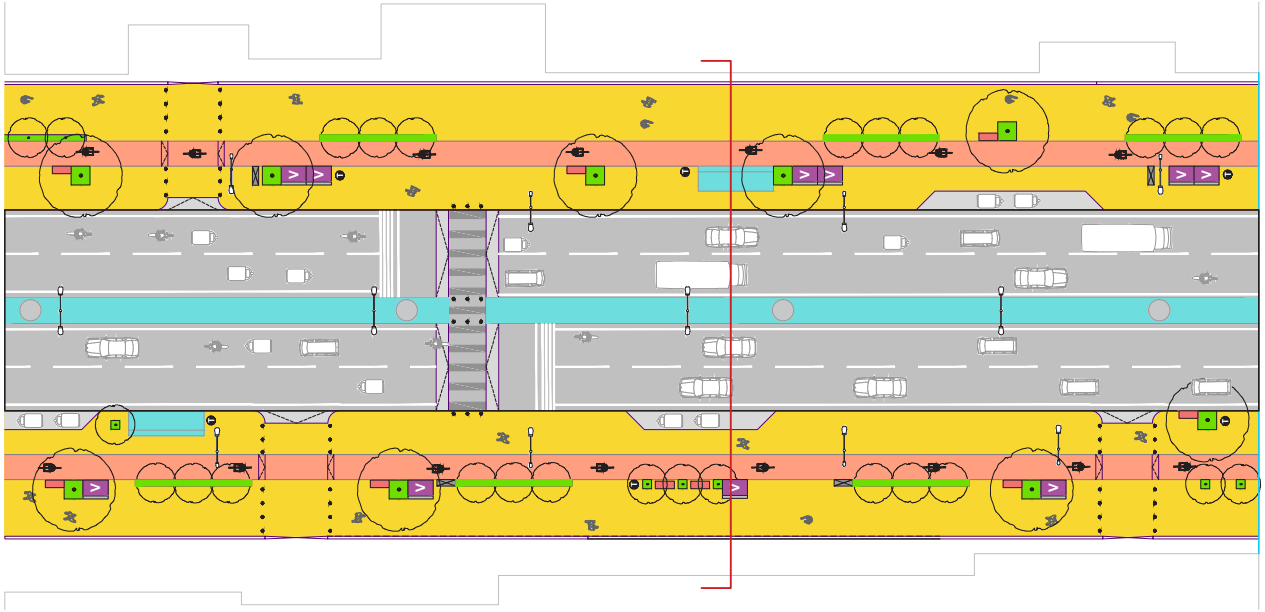
Source: LMRC (Metro Rail News)

4.1.11. 36-45M ROW-Sub - Arterial Road with Cycle and MRTS network

Section



Plan



Speed Limit

50

Public Transport

IPT Bus

Legend

- Bollards
- Vendors
- Utility box
- Seating
- Temple
- Bus Stop
- Wastebin
- Tree pit
- Metro Pillar

Drawings not to scale

5. Design of Intersections

5.1. Planning & Design Of Intersections

Water supply, gas & telecom must be laid closer to the property edge.

A road intersection is a point at which two or more roads cross. This area is designated for movement to turn directions. Overall traffic flow depends on the performance of the intersections.

Intersection design needs to be based on factors such as users, geometric configurations, volume of travel, capacity of roads and traffic control requirements.

Intersection Variable

1. Number of roads converging
    - » The number of roads converging governs the configuration and shape of the intersection. Typically there are three or four legs in any intersection; however intersections with 5 or 6 legs are also formed where three roads converge.
2. R.O.W. widths of intersecting roads
    - » In urban road hierarchy, traffic flows from sub-local to local or collector; local to collector; collector to sub-arterial and sub-arterial to arterial.
    - » Intersections formed due to local + local and local + collector roads would require traffic calming and signboards to manage traffic. But when two major R.O.W.s intersect, detailed designing is required.
3. Intersections design should be based on the amount of traffic moving through a junctions. In general, the following can be applied to decide on the type of intervention required :
    - » Traffic < 3,000 vehicles/hr – Calming measure
    - » 3,000 - 6,000 vehicles/hr – Mini traffic circle or rotary
    - » 6,000 - 8,000 vehicle/hr - signalised intersection
    - » 10,000 & above vehicles/hr – Grade separators

Table 6.1 indicates the type of intersection design to adopt based on the traffic generated.

TYPES OF INTERSECTIONS

Simple intersections

An intersection where the R.O.W. widths of all converging legs are the same and additional space for turning traffic is not needed or cannot be provided due to constraints of adjacent land use. This type of intersection is suitable for locations where two local roads meets another or with a low volume collector

Intersection formed due to merging of	Mini Traffic Circle (slightly more than rotary)	Rotary with Single Circulatory Lane (3,000 vehicles per hour)	Rotary with Double Circulatory Lane (3,000 vehicles per hour)	Signalised (up to 10,000 vehicles per hour)	Grade separator (Above 10,000 vehicles per hour)
Arterial + Arterial					+
Arterial + Sub Arterial					+
Arterial + Collector Street				+	+
Sub Arterial + Sub Arterial				+	+
Sub Arterial + Collector				+	+
Collector + Collector		+	+	+	
Collector + Local Street		+	+		
Local Street + Local Street	+				

Table 5.1 : Recommended intersection based on intersecting road types.

road. Pedestrian crossing distance in this type of intersection is the lowest of all intersections.

Intersections with additional turning lanes

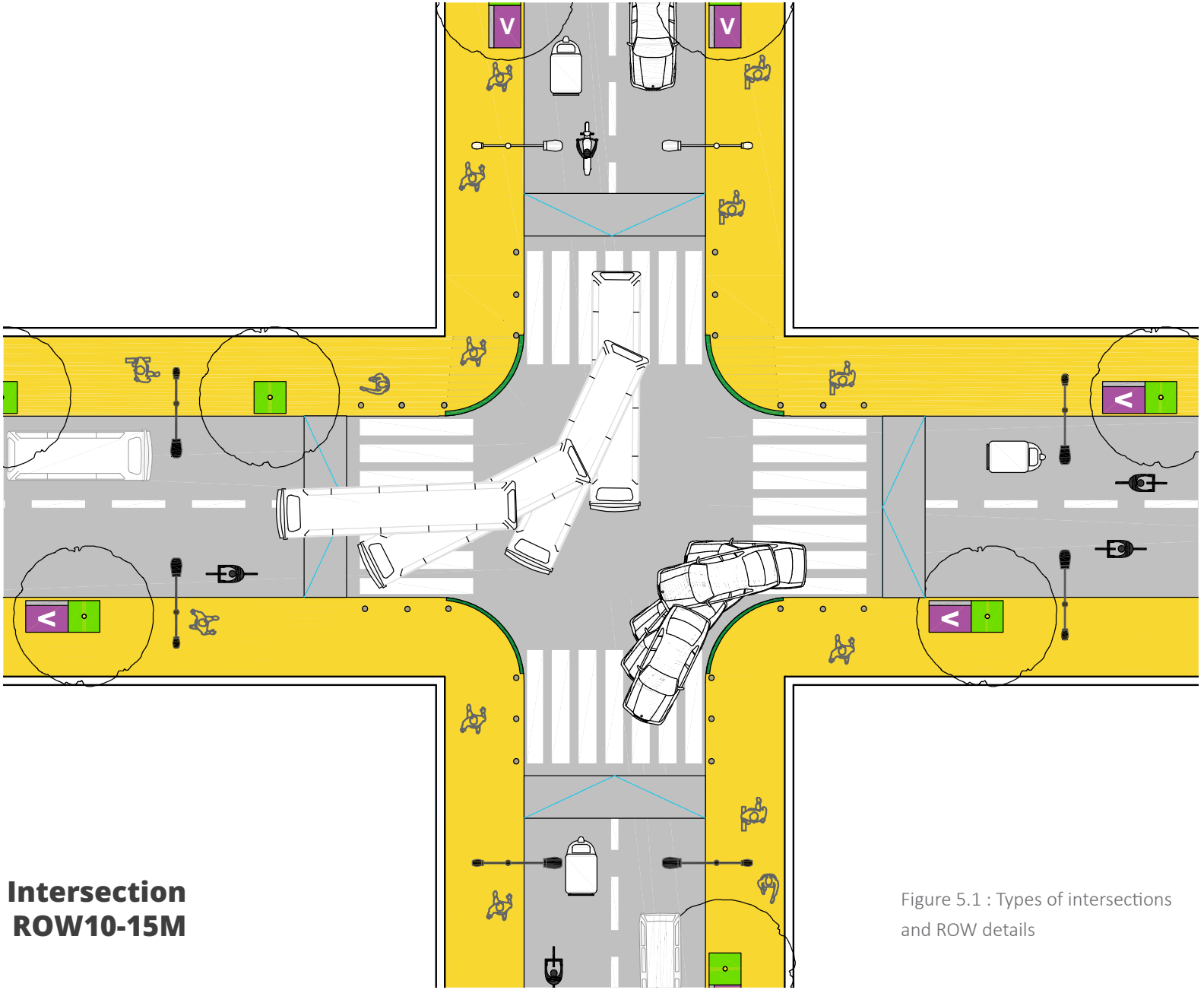
In certain locations with high volume traffic, additional lanes need to be provided to accommodate turning traffic and to create additional capacity for through traffic. This is achieved by utilizing the space in the medians, utility corridors or by flaring. Crossing distance and time for pedestrians increase in this type. This needs to be factored in the design to create adequate pedestrian refuge areas and traffic controlling.

Channelised intersections

Raised islands and/or roads markings are used to channelize or designate vehicular paths in the intersections. Channelization helps in control, direction or division of vehicular paths for better traffic management of motorised and non-motorised vehicles. Locations for traffic control devices, utilities should be factored in the design. The channel islands and median spaces should provide refuge areas for crossing pedestrians, since channelised intersections generally tend to be on wider R.O.W.s.

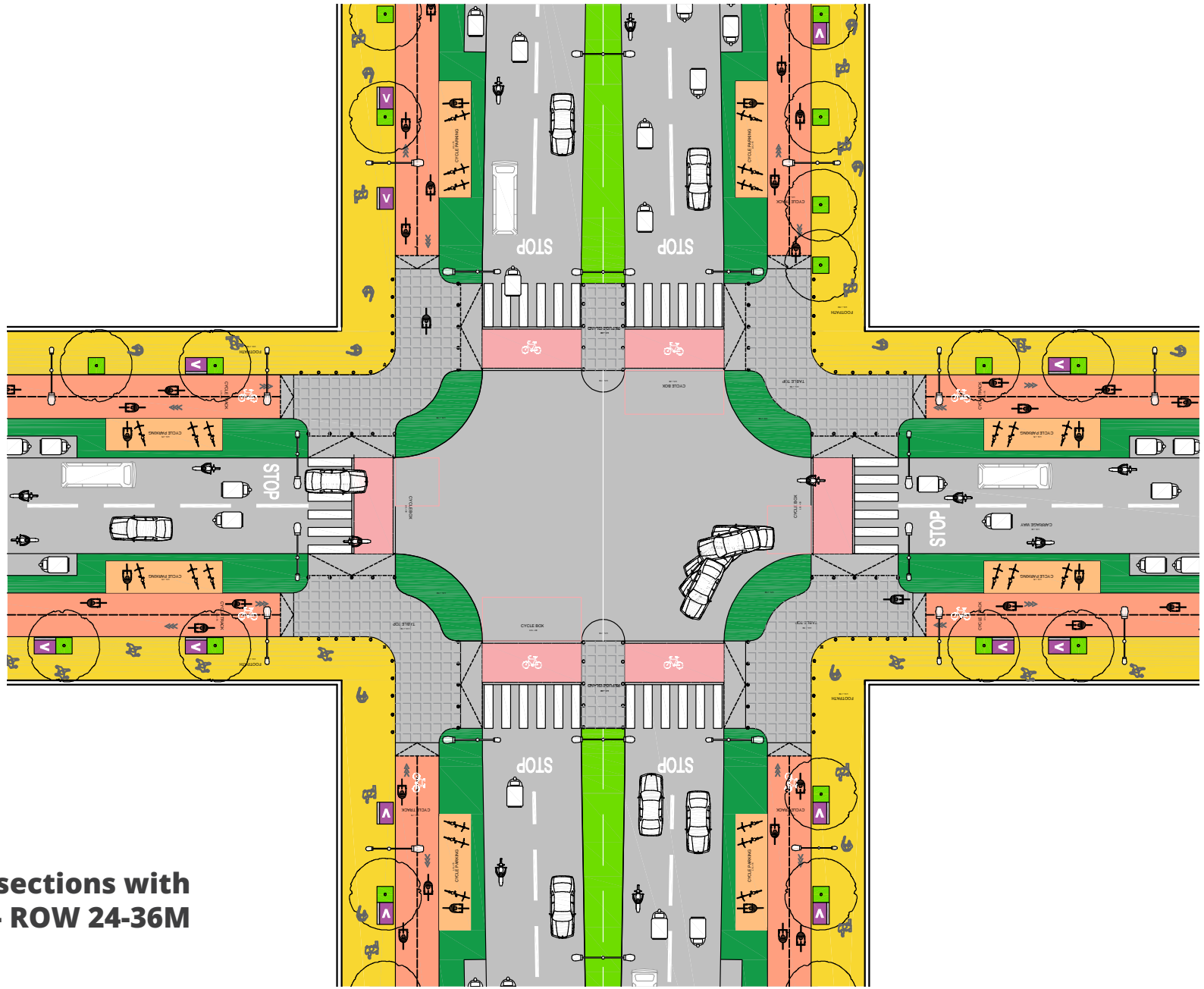
Roundabout intersections

Roundabouts channel movement of traffic in one direction around a central island. The vehicles from the converging roads move around the central island in clockwise direction in an orderly manner and weave out of the rotary movement into their desired direction. A roundabout may be for three-arm or four-arm or

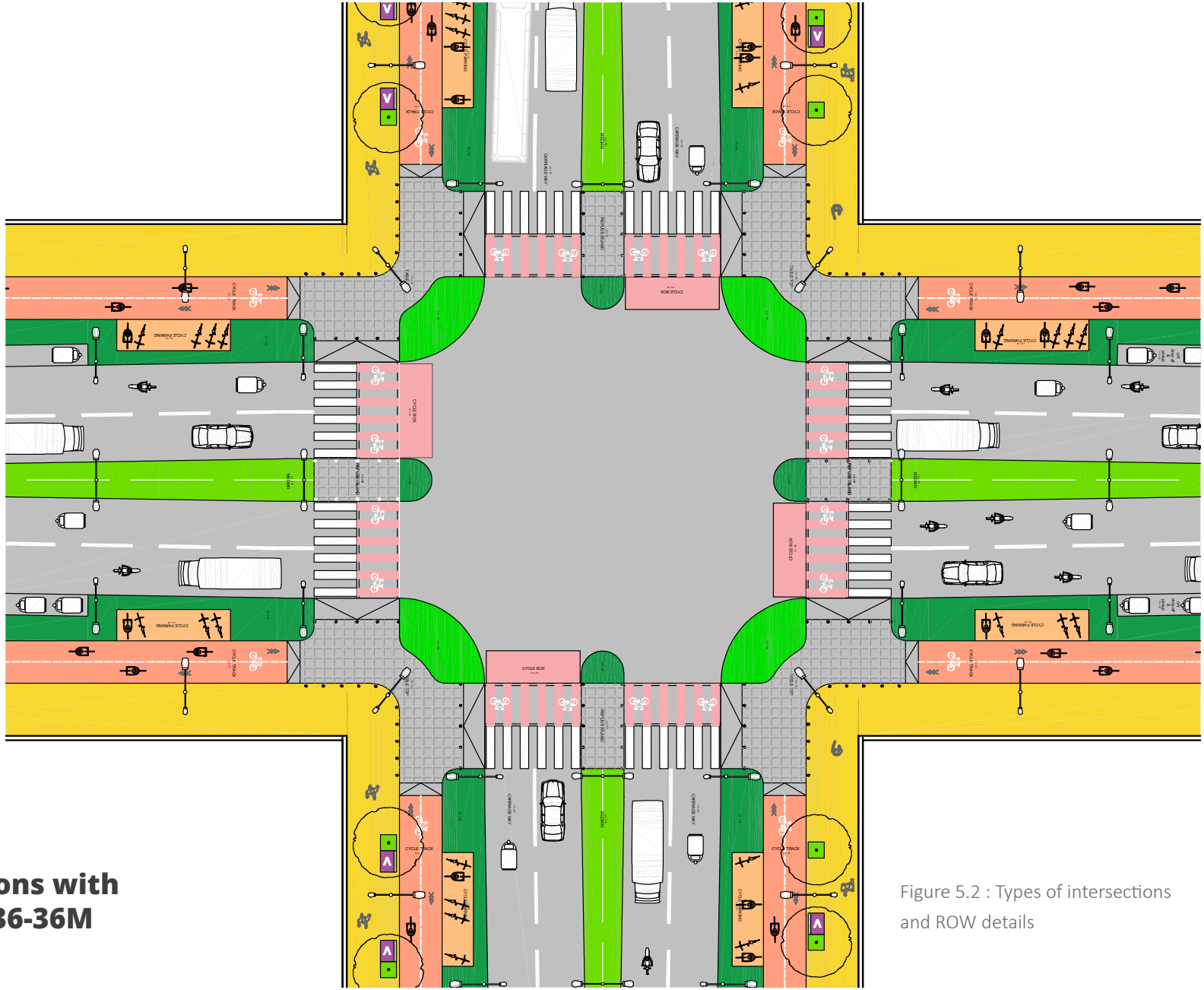


Unsignalised Intersection
ROW10-15M

Figure 5.1 : Types of intersections and ROW details



Signalised Intersections with Cycle Track - ROW 24-36M



Signalised Intersections with Cycle Track - ROW 36-36M

Figure 5.2 : Types of intersections and ROW details

more. The central island is generally circular in shape, but can also be oval or dumbbell shaped. A roundabout intersection has less conflict points than a traditional intersection and is also considered safer.

Mini traffic circles are types of roundabouts characterized by a circle of small diameter and traversable islands (central island and splitter island). Mini-circles offer most of the benefits of regular roundabouts with added benefit of a smaller footprint. As with roundabouts, mini-circles are a type of intersection rather than merely a traffic calming measure, although they may produce some traffic calming effects. They are best suited to environments where speed are already low and environmental constraints would preclude the use of a larger roundabout with a raised central island.

Grade Separated Intersections

Grade separated intersections can be used in locations where high volume through traffic needs be given preferential treatment. They are required when two major roads meet - arterial with arterial or sub-arterial, where volumes are high. There are various types of interchange designs such as 'trumpet interchange', 'diamond interchange', 'cloverleaf interchange' and 'rotary interchange'. These are conventional interchanges that require large space which is scarcely available in any Indian cities and construction duration is longer.

TREATMENT OF INTERSECTIONS

Majority of crashes happen at intersection because of blind spots especially at free left turns. Speed control measures need to be adopted to cut the speed. In vicinity of residential neighbourhoods, transit centres and hospitals, appropriate traffic calming measures should be provided.

The erection of median barricades on certain roads in Bangalore city are believed to have led to a significant reduction in the number of crashes. Fatal crashes have reduced by 40%. Injury crashes have reduced by 43% and property damage crashes have reduced by 43%.

SIGHT DISTANCE AT INTERSECTIONS

Sight distance is measured along the major roadway from the center of the entrance lane of the minor roadway to the center of the nearest approach lane (right or left) of the major roadway. Intersection sight distance is crucial for the safe operation of roadways, especially at uncontrolled intersections, to allow drivers to cross without causing delays or crashes. Drivers approaching an uncontrolled intersection on a cross street must have sufficient sight distance across the intersection corners to adjust speeds or stop. There is no distinction between daytime and nighttime vision conditions at intersections, as it is assumed that the headlights of approaching cars will be visible across the corner area, indicating their presence before they come into view.

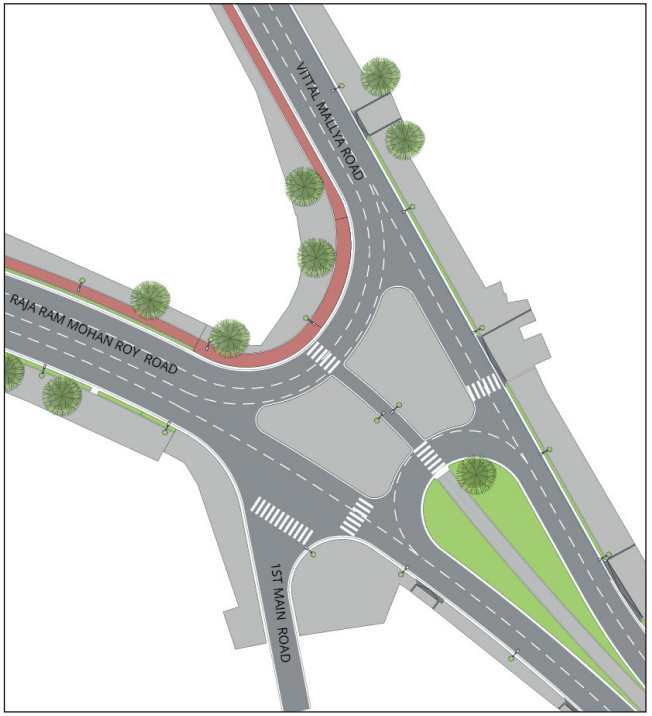


Figure 5.3 : Proposal for junction redesign as per Tender SURE standards at Raja Ram Mohan Roy Road, Bengaluru.

Figure 5.4 : Intersection redesign by Jana Urban Space at St. Marks Road, Bengaluru.

At signalized intersections, the first vehicle stopped on one approach should be visible to the driver of the first vehicle stopped on each of the other approaches.

Table 6.2 indicates visibility distances along major roads of the intersection: the visibility distance is measured from the intersecting point of through sight of major road and minor road.

SIGNALISED INTERSECTION

A traffic signal is a traffic control device operated manually, electrically or mechanically by which traffic is alternately directed to stop and proceed. The traffic signal passes on its information using a universal colour code red, amber and green.

Traffic signals are installed at two locations, one on the footpath towards left of approaching vehicles (termed as primary signal) and other on the opposite side of the road (termed as secondary signal). Signal poles are installed at a distance of 0.6m from the kerb. In instances where a central median is not available, the secondary signal may be located on the right footpath.

The signal poles shall be installed in pits of 900 mm x 900 mm x 1050 mm deep embedded in M20 concrete to a minimum of 300 mm below ground level and 300 mm above ground level. The circular area of embedding concrete shall have a minimum diameter of 450 mm. All the cables supplying power to the controller and signal heads shall run through RCC ducts when these are required to cross the travel lanes. The ducts are of 150mm internal diameter and laid at a depth of about 750 mm from the level of the travel lanes.

MARKING FOR INTERSECTION

In addition to the warning lines on approaches to intersections, directional arrows should be used to guide drivers in advance approaching busy intersections. Because of the low angle at which such markings are viewed, these are elongated in the direction of the traffic flow to provide adequate legibility. For speeds up to 50 kms per hour the arrows should be 3.5 m in length. For higher speeds, the length should be 5 m.

Cycle crossing and waiting

Markings for cyclist crossing should be provided wherever a cycle track crosses a road. The cycle track crossing should ideally be adjacent to a pedestrian crossing when such a crossing is also provided. Rectangular box space is provided for cyclists to wait during signals. The waiting area must be : (width of travel lane) x (one bicycle length).

Stop line

Stop lines are solid white lines provided transversely to the carriage way and used to indicate the point behind which vehicles are required to stop in compliance with the STOP sign, traffic signal or traffic police. The width of stop line as per current Indian practice for urban and suburban roads are 20 cm.

Table 5.2 : Access and mobility priority.

Road Element		Road Type				
		Arterial	**Sub Arterial**	**Collector**	**Local**	**Sub Local**
Priority		**Mobility**		**Mobility + Access**	**Access**	
Footpath		+ +	+ +	+	+	Shared Path
Bicycle		+ +	+ +	+	Shared Path	
Public Transport		+	+	+		
Parking	Bicycle		Minimal	+	+	Minimal
	2 - 3 Wheelers		Should be avoided	+	+	Prohibited
	4 Wheelers		Should be avoided	+	+	
Traffic Calming Measure				+	+	

+ Footpath and bicycle paths need to be adequately separated from the main travel area for safety

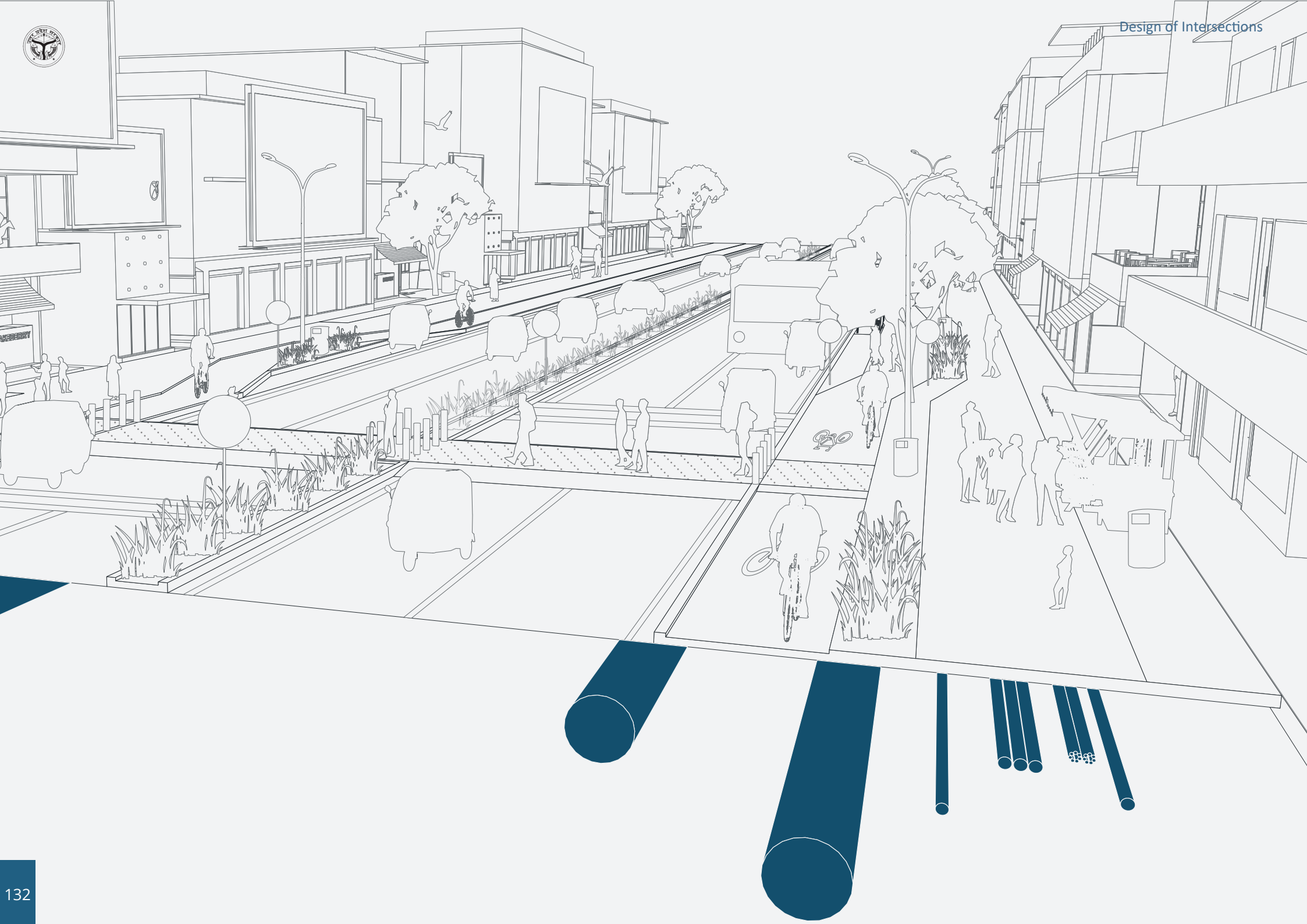
Stop lines are ordinarily located not less than 1m and not more than 3m in advance and parallel to the nearest boundary of pedestrian crossing marking.

Pedestrian crossings

Pedestrian crossings are marked at all intersections where there is substantial conflict between vehicle and pedestrian movements. The location of the pedestrian crossing should be selected properly to ensure adequate visibility, sufficient space on footpath for the pedestrian to wait and freedom from obstructions. As per current IRC standard, the minimum width of the pedestrian crossing should be 2m and the maximum width should be 4m and the marking bands should be 0.5m in width and 0.5m apart.

Box marking

A box junction is a traffic control measure designed to prevent gridlock at busy road junctions. The surface of the junction is marked with a criss-cross grid of diagonal painted lines and vehicles may not enter the area so marked unless their exit from the junction is clear. Drivers MUST NOT enter the box until exit road or lane is clear. However, one may enter the box and wait when you want to turn right, and are only stopped from doing so by oncoming traffic, or by other vehicles waiting to turn right.



6. Design of Utilities

6.1. Planning & Design Standards By Utility

Water supply, gas & telecom must be laid closer to the property edge.

As highlighted in the earlier chapters, a key principle of CM-GRIDS is to provide organised underground utilities (sewage, water supply, power telecom, gas, surveillance and storm water) contained within the footpath on both sides of the travel lane. This allows for a holistic approach to street design that encompasses not just the at-grade design, but the below and above grade as well.

The utilities will be provided with inspection chambers at regular intervals for maintenance and repair, negating the need to dig up the road. They are to provide for both individual property connections and connect to the larger network of the city's infrastructure seamlessly.

The aim is to prepare a cohesive integrated road network plan both above and below ground, that is future-proof, and increases the life of the infrastructure by negating the need for digging and fixing the road for utility repair and maintenance.

The location, depth, diameter of pipes and size of chambers and other aspects of the utility design, including connecting points, invert levels etc., will have to be arrived at in coordination with the concerned utility agencies of the respective city.

In terms of horizontal location of the different utilities, water supply, gas and telecom are recommended to be laid closer to the property edge, and the storm water line at the edge of the travel lane. Power and sewer are to be laid between these utilities. All utilities must be laid to avoid tree roots.:

STORM WATER DRAINAGE

Sustainable storm water management must be accounted for on all categories of roads to minimize flooding and loss of life and property in Uttar Pradesh.

It is recommended that the storm water system of a street be planned for only surface runoff from the street, and all individual properties use rainwater harvesting to sustainably improve the ground water table within their properties. In certain areas like dense neighbourhoods, marketplaces etc, this may not be feasible and storm water drainage of the street must have additional capacity and provide for connections to collect the storm water from the individual properties.

- The storm water drains should be protected from the entry of sewage, sullage and industrial effluents as they mostly connect to nallahs / streams / rivers and other natural water bodies.

- It is strongly recommended that a pipe-and-chamber storm water system be provided at the edges of the travel lane on both sides for wider roads and one side for the collector and local roads. The diameter of the pipe will have to vary based on expected capacity and can range from 300mm to 1200mm.
- As the pipes are pre-cast, they are less likely to break, or leak. The pipe system prevents properties from connecting their sewage and sullage into the drains and allows for other perpendicular utility lines to cross over easily.
- The slope of the pipe must allow for efficient and quick drainage of the water to the disposal point. Compacted earth must be provided under the pipe to prevent sinking. As far as possible a gravity flow must be designed for.
- Catch pits or inlets are to be provided for at 20 to 30m intervals. The road slopes need to be designed to allow for collection and direction of the surface storm water to the inlets, which will then transport the storm water to the chambers and then to the pipes, via which the water will be taken to nearest disposal point.
- Shoulder or saucer drains along the road edge have been proposed to ensure quick evacuation of water from the roads to prevent water logging that may damage the roads causing potholes. Refer drain kerb detail.
- The catch pits and chambers are to be built out of reinforced concrete and the minimum size of the chamber should be 1000mm x 1000mm. The invert levels of the chamber must follow the slope of the pipe, leading to the disposal point. All chambers must be de-silted before and after the monsoons.
- Chamber covers can be metal/ pre-cast concrete or fibre-reinforced plastic (FRP) or Fibre reinforced concrete (FRC) and of standard sizes such as 600mm x 600mm or 900mm x 900mm.
- All inlets must be fixed with gratings designed to filter out large solid water, leaves, plastic packets etc. from entering the drains. The gratings can be vertical or horizontal.
- In case, in certain areas, a pipe-and-chamber system is not possible, an R.C.C box drain can be used. It is however recommended that the drain be placed at the edge of the travel lane and not towards property edge. The drain covers should be partially fixed and partially openable. The covers can be pre-cast concrete or natural stone. Box drains require to be cleaned regularly to prevent flooding.

SWALES

Swales are linear depressions provided along the roads that provide for storm water collection, conveyance and allow for filtered ground water percolation. They can be provided in isolation or in addition to /

The storm water line must be laid at the edge of the travel lane.

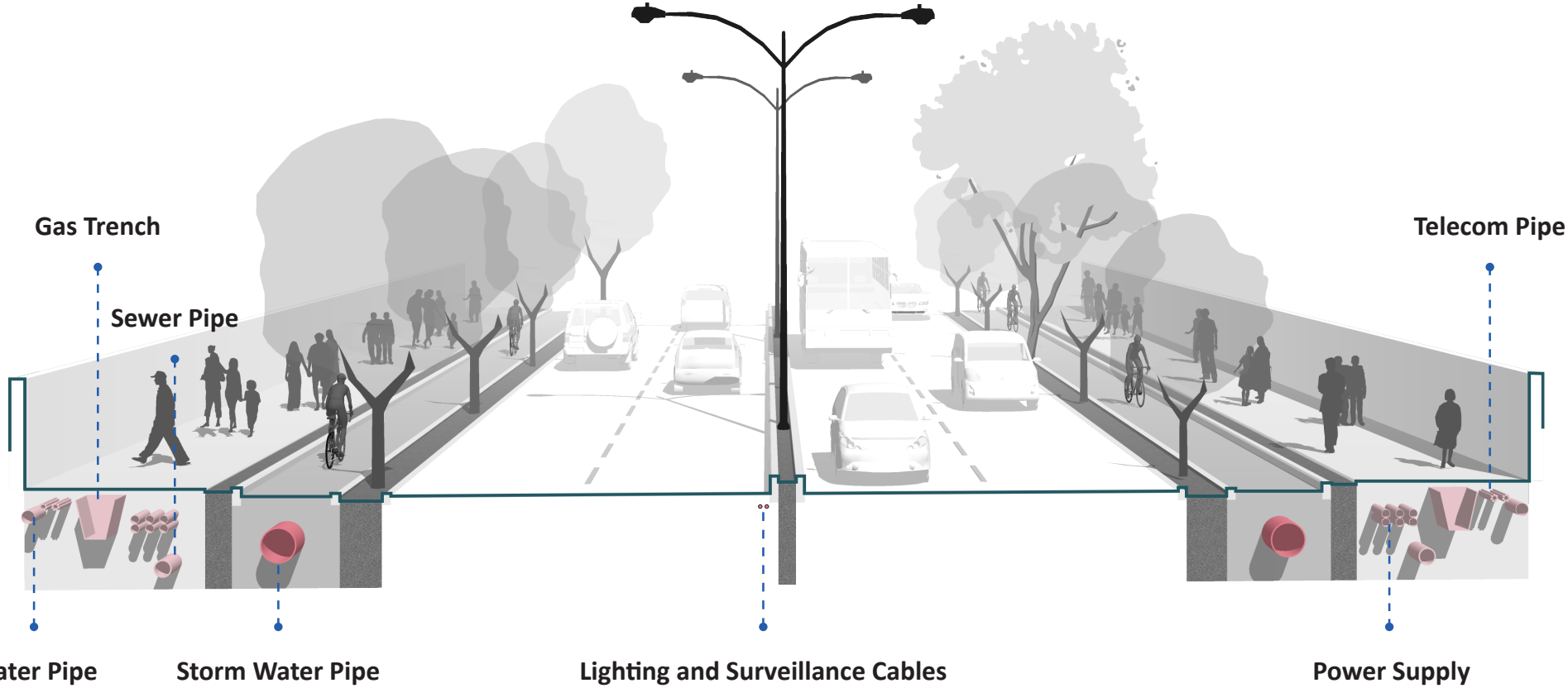


Figure 6.1 : A typical cross section showing the organised underground utilities within the R.O.W, beneath a CM GRIDS road.
The utility lines are grade-separated and have regular chambers for easy access.

combined with the pipe-and-chamber system. Swales may simply be grass-lined or more densely vegetated and / or landscaped. They can reduce storm water run-off volumes and peak flows by slowing the flow of water and allow for filtered ground water percolation via pipes with graded fillers. This is very important to maintain the overall water table of an urban area. This, combined with their ease of maintenance, make swales a smart and sustainable choice for urban drainage.

SEWER

The sewage system designed under roads should collect household waste water in a pipe-and-chamber system and dispose it via a hierarchy of pipes (collector - sub-main - main) to the nearest STP.

It is strongly recommended that pipes be provided on both sides of the road with inspection chambers at 20m intervals. Pipes on one side only or pipes laid in the centre of the road will result in a lot of road cutting for repair and maintenance. Some streets may also have sub mains and mains which will not collect sewage from individual properties.

- Individual property connections need to be provided to the chambers via flexible pipes (HDPE/ DWC etc).

» **Tip :** Pipe-to-pipe connections are to be avoided as they severely hamper the strength of the sewer line; making the network susceptible to cracks and leaks.

- The depth of the sewer pipes should be greater than all other utilities (especially water supply) to prevent contamination in case of a leakage. Levels and slopes must be maintained to prevent back-flow. Gravity flow must be maintained as much as possible.
- Sewer pipes must be of a non-reactive material and the diameter will depend on both current and future capacity, the surrounding land-use and number of properties.
- Sewer chambers are to be built of reinforced concrete and of a minimum size of 1000mm x 1000mm.
- Chamber covers can be metal/ pre-cast concrete or FRP/FRC and of standard sizes such as 600mm x 600mm or 900mm x 900mm.

For areas not serviced by a piped sewer system, there may be other systems in place such as faecal sludge management. In such cases, a pipe and chamber system beneath the roads will not be required.

WATER SUPPLY

The water supply planned under the street must be cognizant of (and designed in coordination with) the respective department to seamlessly fit into the larger water supply planned for the city; in terms of diameter, gravity flow, pressure flow, valve locations etc. Water supply pipes can be made of Cast Iron (CI)

or Ductile Iron (DI) or HDPE/ DWC. Individual property connections can be provided via UPVC pipes of varying diameters based on size and capacity of property. Some streets may have water mains, through lines which will not provide for property connections.

Water supply lines, in general, require chambers only at valve locations, and the chamber size will be determined by the concerned department

POWER SUPPLY

Power lines need to taken underground as much as possible. Overhead lines in urban areas can be dangerous to life and property; especially during monsoons and cyclones.

Based on the R.O.W. width and the requirements of the power department, ducts / pipes and chambers can be provided on either side of the road to carry HT and LT cables.

A separate 50mm diameter HDPE pipe is required for power supply to street lights.

Electrical transformers | RMUs | SFPs

Electrical utilities that can not be placed underground must be both located and oriented to not hinder pedestrian movement in any form.

They must be located at the widest point of the R.O.W.; preferably in a designated area or bay.

They must be oriented such that the longer side is along the length of the road, so as to take minimal width.

Where possible, they must be visually screened using metal screens, public art, landscape etc.

TELECOM

In most cities, some telecom providers lay lines underground, but in a haphazard manner under the vehicular carriageway, and some suspend it overhead from trees to buildings leading to a spaghetti tangle of cables and visual clutter.

It is strongly recommended that ducts or pipes be provided with chambers at regular intervals under the footpath on both sides of the road for telecom providers. This also provides an opportunity for the municipality to raise revenue for underground infrastructure.

4-way and 7-way multi-ducts are recommended for Telecom lines as they can efficiently pack multiple service providers into a single line.

UTILITY DUCT

There may occasionally be a requirement of a future provision for utilities without disturbing the footpath/ cycle track / carriage way. In such cases, an RCC or masonry utility duct is recommended with loose fixed paver blocks on top to enable the easy laying

of the utility line at a later date. The surface can be further differentiated with a coloured band or material difference. This will allow the agencies to lay the utilities in this space without disrupting or damaging other parts of the road. The minimum clear width of the duct should be 600mm.

OTHERS

Other utilities such as gas and surveillance can be provided for based on the requirements of each urban area and in coordination with the appropriate agency.

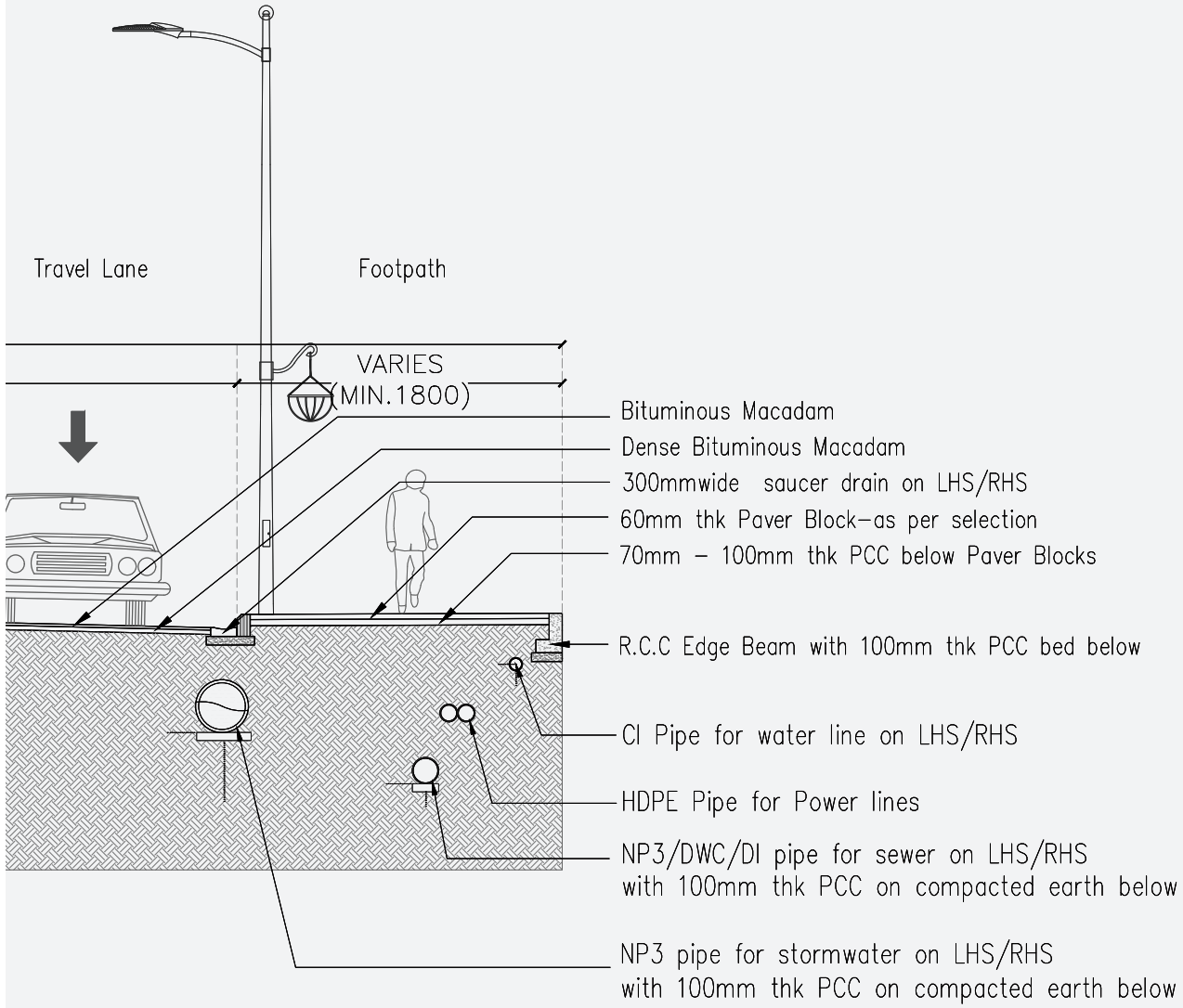


Figure 6.2 : A typical section showcasing the utilities below the road, with recommended specifications for each utility

Appendix I : List of Tables

Table 3.1 : Recommended minimum clear width of different zones on footpaths along different land uses and edge conditions as per IRC:103 40

Table 3.3 : Distance from kerb to street design elements 41

Table 3.2 : Kerb type matrix 41

Table 3.4 : Recommended cycling infrastructure & track width, level and gradient as per IRC:11 45

Table 3.5 : Recommended distance of various facilities from entry/exit of mass transit stations; as per IRC.118.2018 51

Table 3.6 : Traffic volume reduction due to adoption TCM *(TCM, R.Ewings, Washington Institute of Transport. Published in APA Planners Press and American Society of Civil Engineer, 2009)* *60*

Table 3.7 : Recommended travel lane details for urban roads. 64

Table 3.8 : Retro-reflective paint use case by colour. 67

Table 3.9 : Road marking details for travel lanes marking on urban roads. 68

Table 3.10 : Parking space requirements. 76

Table 3.11 : Minimum clear visibility distance to signage based on design speed of the road 85

Table 3.12 : Height and distance standards for street lights 88

Table 6.1 : Recommended intersection based on intersecting road types. 127

Table 6.2 : Access and mobility priority. 131

Appendix II : List of Figures

Figure 3.1 : Footpaths should not be broken or made to change level at vehicular entry /exits. 37

Figure 3.2 : Provide gentle slopes of 1 : 10 or 1 : 12 at crossings and level differences to ensure universal access for the physically challenged, wheelchair users, and strollers. 39

Figure 3.3 : Table top crossings ensure continuous pedestrian movement at side streets or priority areas, enhancing safety by requiring vehicles to slow down before crossing. 39

Figure 3.4 : Use tactile paving to guide the visually impaired with directions, obstacles, and crossings.. 39

Figure 3.5 : Drop-kerb detail. 40

Figure 3.6 : (Facing) Image of a Tender SURE road in Bengaluru illustrating the on-ground implementation of the key points mentioned in this chapter. 42

Figure 3.7 : (Facing Page) Illustration of the key design considerations for cycle tracks. 46

Figure 3.8 : Recommended widths of cycle tracks as per IRC:11 48

Figure 3.9 : (Facing Page) Image from Tender SURE Bengaluru showing shared NMT infrastructure on low footfall roads. 48

Figure 3.10 : Para-transit modes should have a dedicated drop off/ pick up zones, to avoid clashes with other vehicular movements. 51

Figure 3.11 : Hence a 2m wide drop off zone can be provided with signage indicating dedicated zone for para transit modes. 51

Figure 3.12 : The para-transit drop off zones should be minimus 100m away from intersections to avoid congestion and clash of movement. 51

Figure 3.13 : Design standards for the five types of pedestrian crossings. 56

Figure 3.14 : (Facing Page) Illustration showing some common types of traffic calming measures. 60

Figure 3.15 : Sub grade layers for concrete and asphalt roads. 65

Figure 3.16 : (Right) Uniform travel lanes enabling smooth movement of vehicles along

the Tender SURE's Residency road in Bengaluru. 65

Figure 3.17 : Key for road marking details. 68

Figure 3.19 : Lane arrows with dimensions 69

Figure 3.18 : Paint markings for median openings. 69

Figure 3.20 : Paint Marking at sharp curves. 69

Figure 3.21 : Examples of medians from across the globe. (Left) Grill and kerb median on sub-arterial road. (Right) Landscaped median with crash barrier on arterial road. 71

Figure 3.22 : Medians at intersections, ensuring clear visibility of the entire junction. 72

Figure 3.23 : Image showcasing how a median can even transform into a public space at junctions and intersections when the road geometry is planned out strategically. Image from Tedner SURE's Commisariat road in Bengaluru. 73

Figure 3.24 : Parking bay dimensions for parallel parking of four wheelers and autorickshaws and perpendicular parking of two wheelers. 77

Figure 3.25 : Street vendors should be placed in high-demand areas, such as near major intersections, public transport stops, and parks. 79

Figure 3.26 : Essential infrastructure, including cooperatively managed water taps, electricity points, trash bins, and public toilets, should be provided. 79

Figure 3.27 : Vending areas should be located to maintain the continuity of cycle tracks and footpaths. 79

Figure 3.28 : Common mandatory / regulatory signs. 83

Figure 3.29 : Common cautionary / warning signs 83

Figure 3.30 : Common Informatory / Guide Signs. 84

Figure 3.31 : A typical sign with fixing and foundation details 85

Figure 3.32 : Height - width and location guide for light poles 88

Figure 3.33 : Image of a Bangalore Smart City Tender SURE road illustrating the importance of adequate streetlighting on urban roads. 89

Figure 3.34 : Well designed, maintained greenery along urban roads can have a tremendous positive impact on streetscape-user experience. Image from Moti Bagh, Delhi - redeveloped under PWD Delhi's Streetscaping Project 93

Figure 5.1 : A typical cross section showing the organised underground utilities within the R.O.W, beneath a CM GRIDS road. The utility lines are grade-separated and have regular chambers for easy access. 120

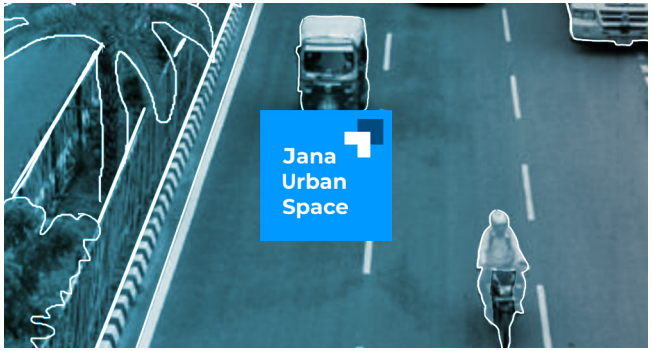
Figure 5.2 : A typical section showcasing the utilities below the road, with recommended specifications for each utility 123

Figure 6.1 : Types of intersections common across urban roads in India. 128

Figure 6.2 : Proposal for junction redesign as per Tender SURE standards at Raja Ram Mohan Roy Road, Bengaluru. 129

Figure 6.3 : Intersection redesign by Jana Urban Space at St. Marks Road, Bengaluru. 130


उत्तर प्रदेश सरकार


Jana
Urban
Space


URIDA
URBAN ROAD INFRASTRUCTURE DEVELOPMENT AGENCY