COMPLETE STREETS
DESIGN WORKBOOK

Smart City
MISSION TRANSFORM-NATION

सत्यमेव जयते
Ministry of Housing and Urban Affairs
Government of India

ITDP

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Ministry of Housing and Urban Affairs
Government of India

The Ministry of Housing and Urban Affairs is the apex authority of Government of India to formulate policies, coordinate the activities of various Central Ministries, State Governments and other nodal authorities and monitor programmes related to issues of housing and urban affairs in the country. The Smart Cities Mission was launched by the Ministry in 2015 to promote sustainable and inclusive cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions.

ITDP

The Institute for Transportation and Development Policy works around the world to design and implement high quality transport and urban development systems and policy solutions that make cities more livable, equitable, and sustainable.

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introduction

Several Indian cities are improving pedestrian and cyclist infrastructure by leveraging the Smart City Mission. For example, Tamil Nadu, a state with 12 cities selected under the Smart City Mission has allocated approximately Rs 2500 crores towards the implementation of 500 kilometres of complete street design projects , including pedestrianisation, pedestrian-friendly streets, and intersection design. Many cities have initiated work on redesigning their streets.

However, owing to the lack of a single guiding document for street design, cities are currently following different methods and standards. There is thus an urgent need for a national-level document that serves as guidelines for the design of complete streets.

Smart Cities Mission - Ministry of Housing and Urban Affairs presents Volume 4 of the Complete Streets Toolkit, the 'Complete Streets Design Workbook', for Smart Cities across India. This document elaborates on the best practice standards and guidelines as well as the process of designing complete streets to city officials, engineers, urban designers and consultants.

The document is divided into seven sections:

•Street Design Principles
•Street Design Elements
•Street Design Templates
•Intersection Design
•Transit System and the streets
•Street Materials
•Participatory Street Design

The document introduces the user to the key street design principles. Street design templates have been used to show how the different street elements can be combined to provide varying degrees of liveability and mobility. The document also provides a step by step intersection design process, providing templates for integrating street access to mass transit. The user is also provided information on street materials and other design elements. The importance of participatory street design is stressed, to ensure the process of street design doesn't happen in isolation without involving the end users or the other agencies pivotal to the operation of the street.

Other volumes of this toolkit are:

i. Complete Streets Policy Framework
ii.Complete Streets Policy Workbook
iii. Complete Streets Planning Workbook
iv.Complete Streets Design Workbook
v. Complete Streets Implementation Workbook and
vi.Complete Streets Evaluation Metrics
vii. Complete Streets Best Practices

creating complete streets

Complete Street A street designed to cater to the needs of all users and uses, through equitable allocation of road space is referred to as a complete street.

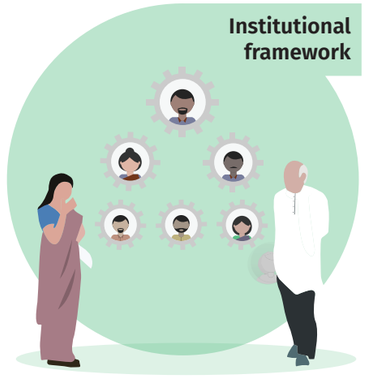
Volume 01 of the Complete Streets Toolkit - Complete Streets Policy Framework - adresses the rationale for making improvements to streets.

Transforming successful pilots into larger city-wide networks of complete streets requires cities to embrace a progressive long-term vision. This can be achieved by adopting a Complete Streets Policy.

Volume 02 of the Complete Streets Toolkit - the Complete Streets Policy Workbook - for Smart Cities across India, provides a step-by-step approach for developing and adopting a Complete Street Policy that is supported by a strong institutional set-up.

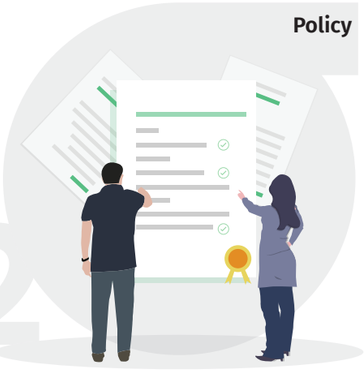
Volume 03 of the Complete Streets Toolkit - Complete Streets Planning Workbook - provides a step-by step guidance to city officials, engineers, planners and consultants on creating a city-wide walking and cycling networks.

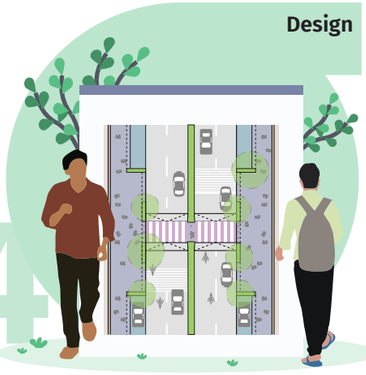
The output created through this process includes a long-term masterplan for a Complete Streets network with proposed phasing and estimated investment. These include streets with continuous footpaths, segregated cycle tracks (where possible), safe intersections, uniform carriageways and organised parking; as well as greenways, pedestrian-only streets, non-motorised vehicle and public transport priority streets, shared-streets, and junction redesign projects.

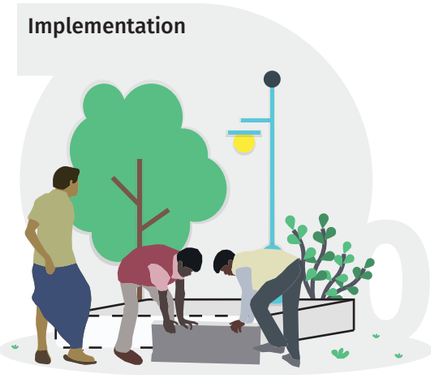


Creation of complete streets involves cooperation and collaboration between multiple stakeholders (such as urban local bodies, traffic police, planning agencies, consultants, experts, community groups and others) at different stages, at both the city and zonal level. Setting-up a dedicated committee and cell, as elaborated in volume 02, is an essential step to ensure the successful implementation of the complete streets projects.

It is important to obtain the reviews and approval from various stakeholders at each stage of the process of creation of complete streets to ensure that the end product caters to the expectation and needs of all.







More often than not, the process of creating complete streets happens in isolation without involving the end users or the other agencies pivotal to the operation of the street. This leads to a disconnect between the local context and the design, which eventually renders the redesigned street unusable.

A participatory approach to street design involves the stakeholders - government representatives, public, NGOs, etc - in the design process to ensure that the final design caters to the needs of the intended users. The result of such a process is invariably more feasible and also innovative.

Many cities have initiated work on redesigning their streets. However, owing to the lack of a single guiding document for street design, cities are currently following different methods and standards. There is thus an urgent need for a national-level document that serves as guidelines for the design of complete streets.

Volume 04 of the Complete Streets Toolkit - the Complete Streets Design Workbook - for Smart Cities across India, elaborates on the best practice standards and guidelines as well as the process designing complete streets to city officials, engineers, urban designers, and consultants.

Apart from design execution, the mismanagement of the entire construction process can cause delays and inconvenience to residents. The diversion of traffic, dug-up roads with poor attention to on-site safety, obstruction at property entrances, and water logging add to the problems of residents.

Volume 05 of the Complete Streets Toolkit - the Complete Streets Implementation Workbook - for Smart Cities across India, aims to highlight the typical steps of project implementation that can ensure a good final product - a truly Complete Street.

contents

List of acronyms

BoQ	Bill of quantities
BRR	Bus Route Roads
BRT	Bus Rapid Transit
CS	Complete Streets
CSMP	Complete Streets Master Plan
DBM	Dense Bitumen Macadam
DIP	Ductile Iron Pipes
DLC	Dry Lean Concrete
DWC	Double wall corrugated
FFL	Finished Floor Level
FRP	Fibre Reinforced Plastic
GIS	Geographic Information System
HDPE	High Density Polyethylene
HRIDAY	Heritage City Development and Augmentation Yojana
IRC	The Indian Road Congress
IPT	Informal Public Transport
MEP	Mechanical, Electrical and Plumbing
MLCP	Multi-Level Car Parking

List of acronyms

MRT	Mass Rapid Transit
MS	Mild Steel
MUZ	Multi-Utility Zone
MoRTH	The Ministry of Road Transport and Highways
NMT	Non-Motorised Transport
PCC	Plain Cement Concrete
PCU	Passenger Car Unit
PMV	Personal Motor Vehicle
PQC	Pavement Quality Concrete
PVC	Polyvinyl Chloride
RCC	Reinforced Cement Concrete
RCC NP3	Reinforced Cement Concrete - Non-Pressurised class 3
RfP	Request for Proposal
RoW	Right-of-Way
ToR	Terms of Reference
ULB	Urban Local Body
WBM	Water Based Macadam
WMM	Wet Mix Macadam

definitions

Accessibility Facilities offered to people to reach social and economic opportunities, measured in terms of the time, money, comfort, and safety that is associated with reaching such opportunities.

Average trip length The average distance covered by a transport mode for a trip. This is commonly measured in kilometres.

Bus rapid transit (BRT) High quality bus-based mass transit system that delivers fast, comfortable, reliable, and cost-effective urban mobility through the provision of segregated right-of-way infrastructure, rapid and frequent operations, and excellence in marketing and customer service.

Bulb-out Lateral extensions of the footpath into the carriageway to reduce the crossing distance for pedestrians. They reduce vehicle speeds, provide enhanced protection and visibility for pedestrians, and lower the time taken to cross the street.

Complete streets Streets that are designed to cater to the needs of all users and activities, through equitable allocation of road space. Complete streets provide safe and inclusive environments that support users of all age groups, genders, and physical dispositions. They also guarantee efficient mobility by focusing on moving people, user safety, universal accessibility, vitality and liveability, sensitivity to local context, and environmental sustainability.

Eyes on the street Informal surveillance of any street by the residents, shopkeepers, and other users of the street.

Greenway A linear, landscaped pedestrian or bicycle route based on natural passages such as canals, rivers, or other scenic courses. It is typically for recreational use, with an emphasis on conserving and preserving vegetation.

Informal Public Transport (IPT) This includes vehicles like share autos, vans, minibuses that operate on a shared or per seat basis on specific routes, in an unregulated or semi-regulated environment, and with no government support. The service may or may not have a predefined “fare structure”.

Mass rapid transit (MRT) A high quality public transport system characterized by high capacity, comfort, overall attractiveness, use of technology in passenger information system, and ensuring reliability using dedicated right of way for transit vehicles (i.e. rail tracks or bus lanes).

Mobility Conditions under which an individual is capable of traveling in the urban environment.

Mode share The share of total trips carried out by different modes of urban transport including, but not limited to walking, cycling, bus, rail, share auto-rickshaws, private auto, two wheelers, and cars.

Non-motorized transport (NMT) All forms of human powered transportation including, but not limited to, walking and cycling.

On-street parking The space occupied by parked vehicles along the edge of the street or carriageway which otherwise could have been used by motorized or non-motorized traffic.

Off–street parking The term refers to the dedicated spaces provided for parked vehicles outside the right-of-way. It includes parking lots, multi-level car parking and other off-street facilities.

Public Transport (PT) Shared passenger vehicle which is publicly available for multiple users.

Parking management A mechanism to facilitate efficient use of street space to ensure additional space dedicated for pedestrians, cyclists, public transport, and motorists. In addition, over time, collecting a fee for parking can manage its demand and ensure that personal motor vehicle users compensate the city for the use of valuable land on which they park their vehicles.

Right of Way (RoW) Measure of the width of the road taken from compound wall/edge on one side of the street to that on the other side.

Shared street A street where formal distinctions between spaces allocated for various users, is removed. The concept of shared streets is to ensure that each street user becomes progressively more aware and considerate of the others in the street. Specific design interventions can be made to force the vehicles to slow down and match the pace of those on foot.

Sustainable transport modes The following modes are categorized as “sustainable modes” of urban transport because, when compared with personal motor vehicles, they consume the least amount of road space and fuel per person-km and also cost much less to build the infrastructure: walking, cycling, and public transport (including a regular bus service as well as MRT systems).

Traffic calming Traffic calming measures ensure pedestrian and vehicle safety by reducing the speed of motor vehicles through vertical and/or horizontal displacements, real/perceived narrowing of carriageways, material/colour changes that signal conflict point, or complete closure of streets for vehicular traffic.

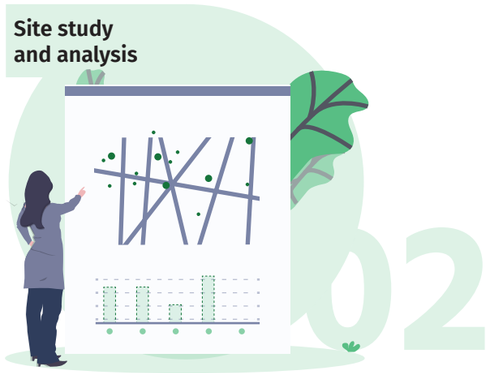
street design process

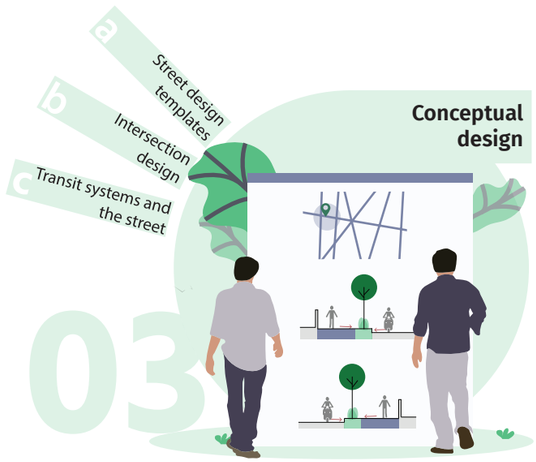
Step 01 & 02

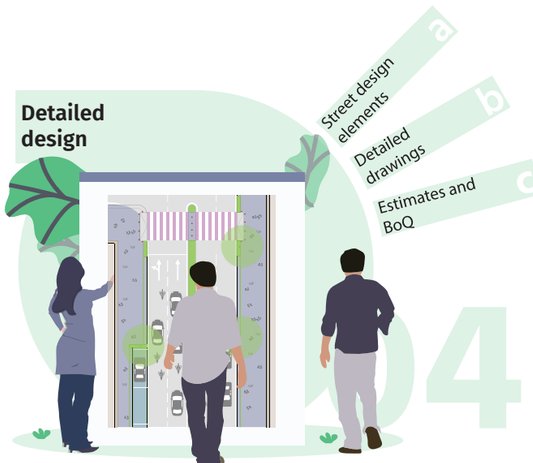
The street design process begins with the hiring of a qualified consultant (urban designer/architect) by the city using an RfP with stringent qualification criteria. The city then shares its vision of complete streets with the designer to enable them to envisage the expected outcome. The Urban Local Body also helps the designer identify high-priority streets within the package(s) allotted to commence designing.

The designer commences his work with a thorough study of the project area to help identify the appropriate solutions for local conditions. Based on this analysis, the designer then develops conceptual designs. This includes a selection of standard mid-block street templates, kerb-line drawings for intersections, and basic layouts for streets with mass rapid transit systems.

The outcomes and design decisions at the end of every stage of the design process must be approved by a high-powered Apex Committee (or a review committee). The institutional framework, established for the creation of complete streets, ensures smooth progress through constant monitoring and periodic reviews.







Step 03 & 04

The next step involves the provision of detailed designs for various street elements by following best practice standards and guidelines and choosing appropriate materials. During this stage, the consultant prepares construction drawings and cost estimates for the Bill of Quantities.

The consultant then creates tender documents to hire a contractor who will be implementing the design on-ground. Consultants must carry out regular site visits to monitor construction accuracy and to address any issues that may come up during construction.

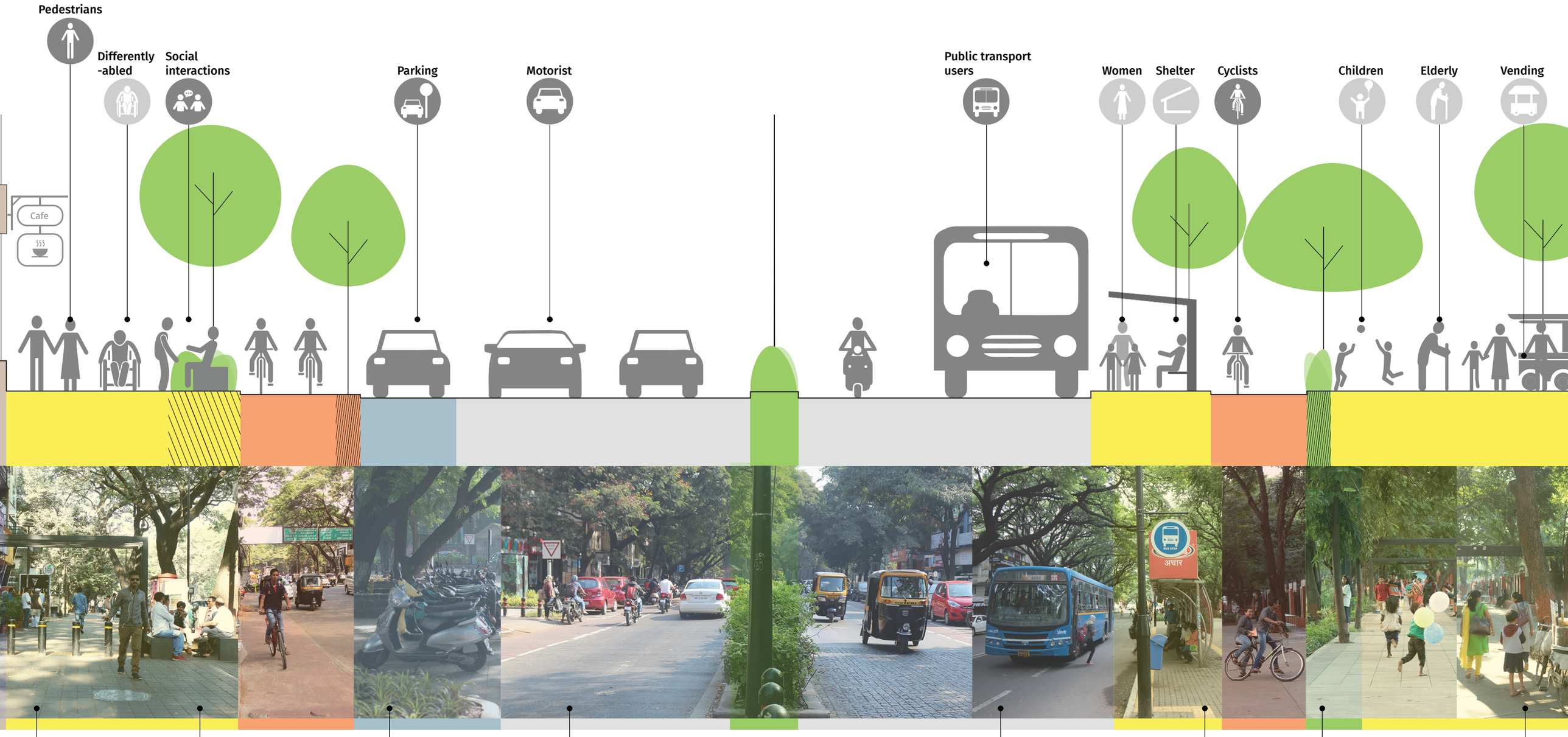
A participatory approach is essential for the success of the project. Throughout the design process, the city along with the designer should engage in public consultations with the public. This will strengthen their relationship and also improve the long-term sustainability of the project.

1

STREET DESIGN PRINCIPLES

1.1 complete street

A street designed to cater to the needs of all users and uses, through equitable allocation of road space.



Active building edge
To improve vibrancy and safety

Footpath
With a multi-utility zone

Parking bays
along with on-street parking management

Carriageway
Of an optimal and uniform width

Transit facilities
To improve efficiency of the street

Cycle track
Segregated from fast-moving traffic

Buffer zones
To separate varying speeds

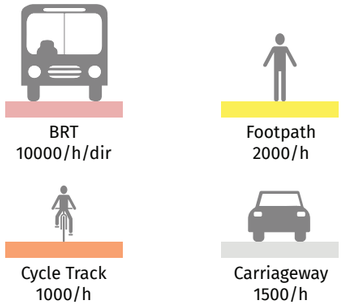
Vending zones
With a vending management plan

A Tale of Two Streets | YouTube
https://www.youtube.com/watch?v=fTv5063oqcc

principles of a complete street

efficient mobility

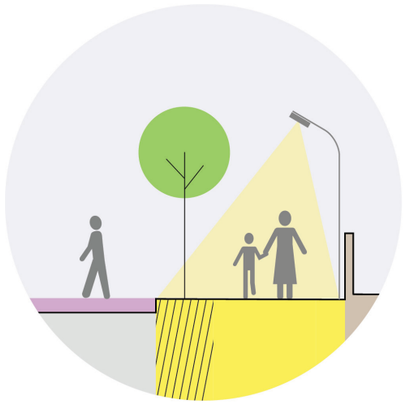
A complete street ensures efficient mobility by offering multiple modes of travel, especially high quality facilities for public and non-motorised transport. With a greater capacity, a complete street moves more people by allocating space equitably for all users, and not prioritising only the private motor vehicles.

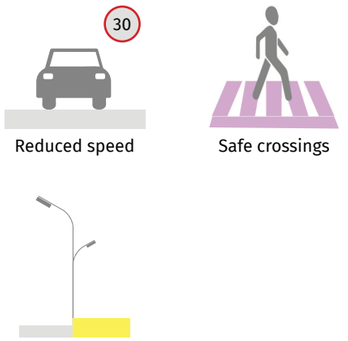


Hourly capacity of a complete street = 26500 people

safety

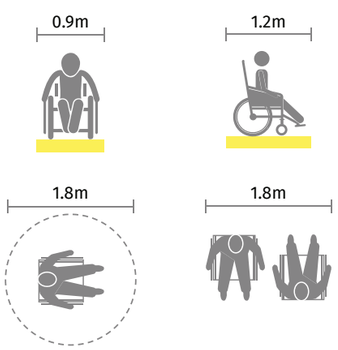
A complete street is safe for all user groups by providing segregated spaces for each and incorporating traffic calming measures. A complete street ensures personal safety as well, with good lighting and 'eyes on the street' through active edges and vending.



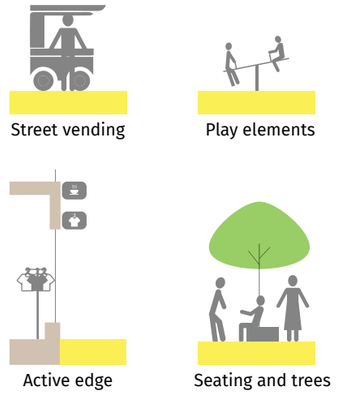


universal accessibility

A complete street should be accessible by all, including the differently-abled. Continuous and even-surfaced footpaths, table top crossings and ramps and tactile pavers wherever level differences occur are some measures to ensure universal accessibility.

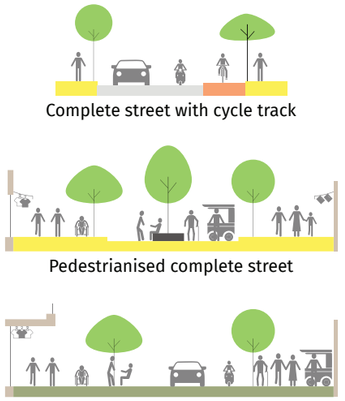


Base dimensions for universally accessible design



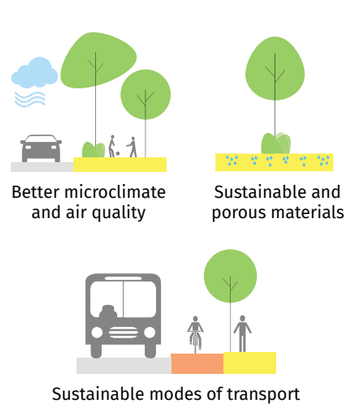
liveability

A complete street is full of life, with elements that improve activity. Improved liveability improves conditions for extisting users, attracts more users, increases retail activity and transforms the street into a vital public space.



sensitivity to local context

A complete street is designed to suit the local context, factoring in local street activities, patterns of pedestrian movement, nearby land uses and the needs of the people. Design interventions can range from elements added to the street to street-level interventions like shared or pedestrianised streets.



environmental sustainability

A complete street promotes sustainable modes of transport and has the scope to improve local climatic conditions. Trees and plants on streets help absorb pollutants and reducing heat. Well-designed complete streets also help properly capture and channel rainwater.

** The same principle applies for cycle tracks as well, whose height should be maintained at 10cm throughout.*

1.2 design principles

01 one street, one width

A street with varying carriageway width along its length will allow more vehicles to accumulate in the wider portions. Bottlenecks are created when these vehicles reach the narrow portions of the street. Varying carriageway width also allows wrong-side driving and overtaking.

Streets should maintain uniform carriageway widths to streamline motor vehicle traffic and reduce congestion. Footpath width can be made to vary.

Fig. (above)
Rajiv Gandhi Expressway, Chennai, with varying carriageway width

Fig. (below)
West Avenue Road, Chennai, with a uniform carriageway

one footpath, one level 02

A footpath with recurrent breaks (at property entrances, side streets, etc) becomes difficult to walk on and inaccessible to the differently-abled. People do not prefer to climb on to a footpath whose height exceeds 0.15m. Frequent obstructions discourage people from walking on the footpath.

Footpaths should be continuous, of uniform height, and obstacle-free to provide better pedestrian accessibility, comfort and safety.*

Fig. (above)
Chennai

Fig. (below)
Mooparappan Street, Chennai

** The same principle applies for cycle tracks as well, whose height should be maintained at 10cm throughout.*

03 make complex intersections compact

Vast intersections with large turning radii allow vehicles to turn at high speeds, thus putting both pedestrians and vehicles at risk. Pedestrians also have to cross long distances at such intersections. Due to unused space which is generally evident from the accumulation of dust on the road, wrong-side driving becomes common at intersections.

Compact intersections allow for efficient and safe use of road space, with more room for street furniture to liven up the junctions.

Fig. (above & below)
Before and after making the TV Swamy - DB Road Intersection in Coimbatore compact.

park it right 04

Since free parking invites more car use, on-street parking has to be managed. Perpendicular and angular parking orientations take up valuable road space that could have otherwise been used for NMT infrastructure. If adequate space is not provided, parking will eventually spillover to the space dedicated for other uses.

A complete street has dedicated and managed spaces for on-street parallel parking — after adequate provisions have been made for pedestrian facilities.

Fig. (above & below)
Before and after provision of streamlined parking in Besant Nagar Second Avenue, Chennai

1.3 street typology

introduction

The success of any road network system is often attributed to the distinct order or hierarchy of streets. Based on their function and carrying capacities, the permissible speeds, street widths, and physical characteristics are designated and the streets are then classified into Arterial, Collector, and Local streets.

typology

arterial streets

Arterial streets connect various urban centres in a city. While these streets may be narrow or wide and with or without regular access to properties, they encourage through movement of traffic across the city.

collector streets

Collector streets connect local streets with arterial streets and collect traffic with slower speeds from the former and distribute it to the latter. They usually go to or come from a neighbourhood.

local streets

Majority of trips originate or end in local streets. With the lowest speed limits, local streets carry low volumes of traffic. Their main purpose is to provide access to adjoining properties.

Element	Presence (yes, no, maybe) in		
	Arterial street	Collector street	Local street
Segregated footpath	✔	✔	Only on streets with RoW ≥ 12m
Segregated cycle track	Only on streets with RoW ≥ 24m	Cycling in mixed traffic with traffic calming	Cycling in mixed traffic with traffic calming
On-street parking	✘	✔	✔
Carriageway (*refer street design elements for details)	Not more than 3 lanes per direction	Not more than 2 lanes per direction	Not more than 1 lane per direction
At-grade crossings	✔	✔	✔
Public Transport	✔	✔	✘
Mass Rapid Transport	○	✘	✘
Service lane	○	✘	✘

Table 01:
Street elements and their presence in arterial, collector and local streets

Fig. (top)
JM Road - an arterial street in Pune

Fig. (middle)
DP Road - a collector street in Pune

Fig. (bottom)
Mooparappan Street - a local street in Chennai

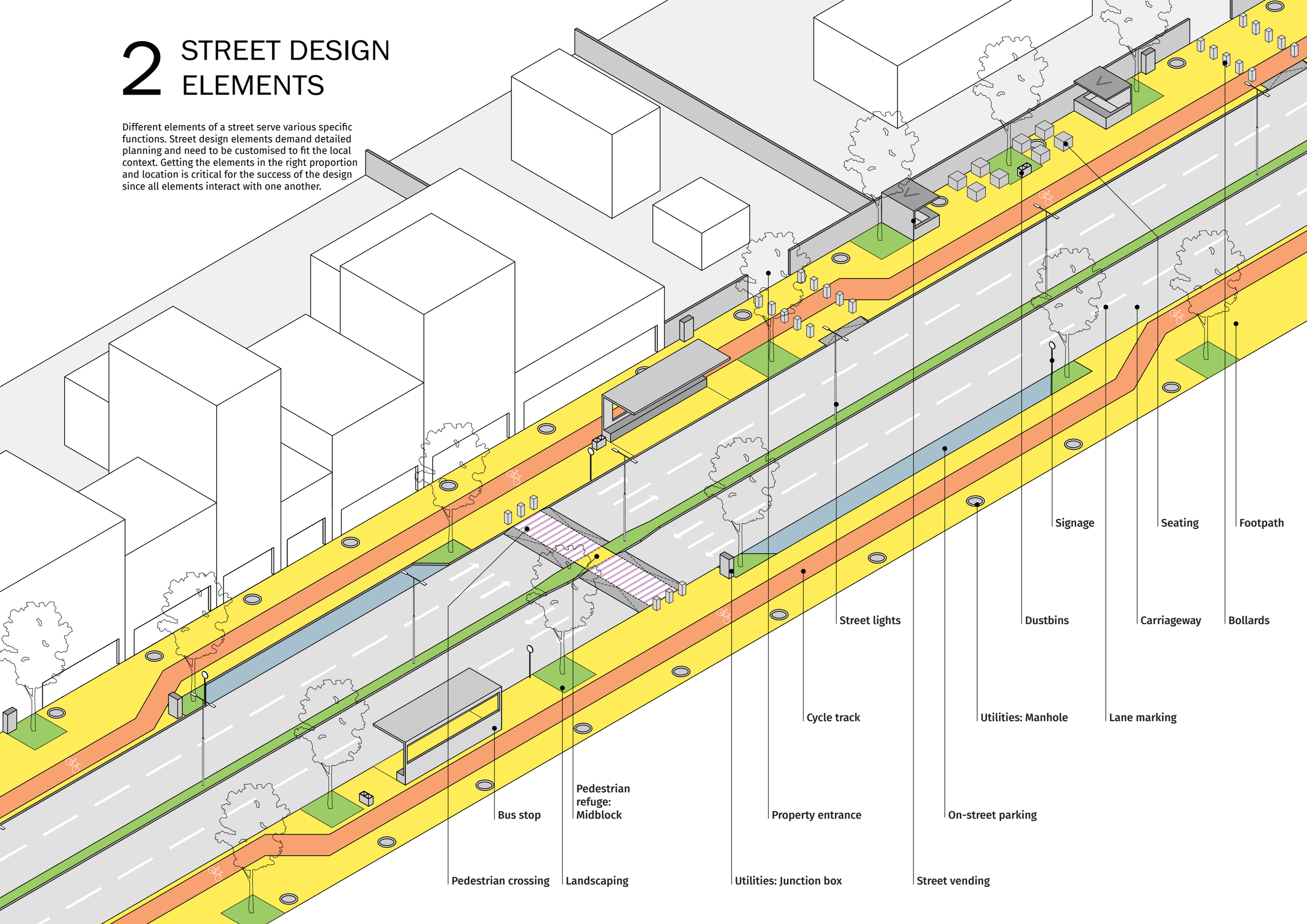
2

STREET DESIGN ELEMENTS

footpath | cycletrack | on-street parking | carriageway | service lane | pedestrian crossings

2 STREET DESIGN ELEMENTS

Different elements of a street serve various specific functions. Street design elements demand detailed planning and need to be customised to fit the local context. Getting the elements in the right proportion and location is critical for the success of the design since all elements interact with one another.



2.1 footpath

what good footpaths achieve

Good footpaths promote safe and comfortable pedestrian mobility. They are accessible to all users including women, children, elderly and the differently-abled. Good footpaths constitute the primary public space of a city, where people can sit, meet, talk and eat.

challenges

The space left over after creating the carriageway and parking is usually designated as the footpath. Utilities become obstacles to walking. Even with an adequate width, a footpath may be difficult to use if it is not continuous or constructed with high kerb heights and steps.

design recommendations

zones

Pedestrian zone: Continuous walking space clear of any obstructions; at least 1.8 m wide

Frontage/dead zone: Provides a buffer between the pedestrian zone and the property edge

Multi-utility zone (MUZ): Space for vending, street furniture, landscape, bus stops, and property access ramps; location and size of MUZ depend on the width of the footpath

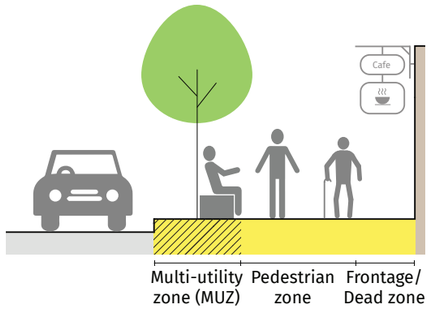
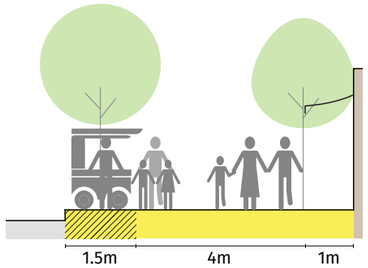


Fig. (above)
Patulas Road, Chennai

Fig. (below)
Besant Nagar Second Avenue, Chennai

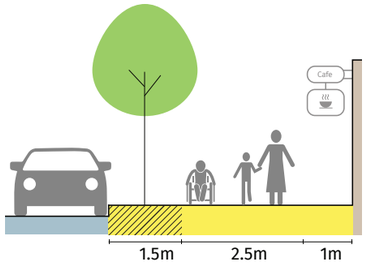
Pedestrians First: Tools for a Walkable City | YouTube
https://www.youtube.com/watch?v=GAeW0_5md8U

width



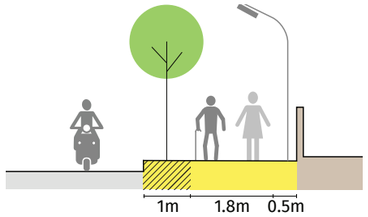
high intensity commercial

Clear width of the pedestrian zone in a high-intensity commercial area should be atleast 4m to accommodate high footfall.



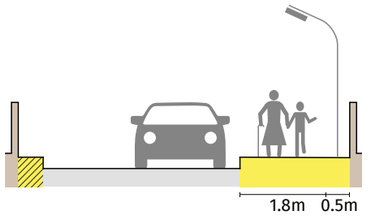
commercial

Clear width of the pedestrian zone in a commercial area should be atleast 2.5m.



residential

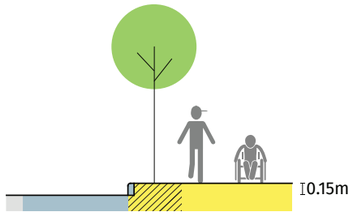
Clear width of the pedestrian zone in a residential area should be a minimum of 1.8m for two wheelchairs to pass each other.



narrow streets

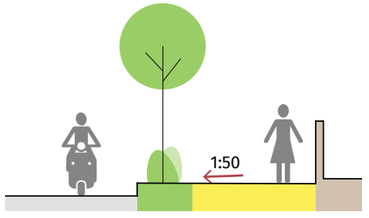
In narrow streets, MUZ can be optional or provided as discontinuous patches.

height



height

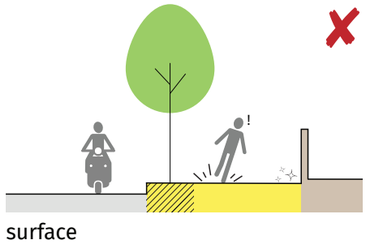
Footpaths should be 0.15m high (top of kerb should be at 0.15m) so that they aren't surmountable for vehicles.



gradient

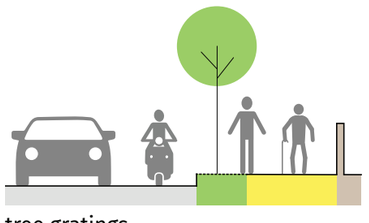
Footpaths should have adequate gradient for surface runoff.

surface



surface

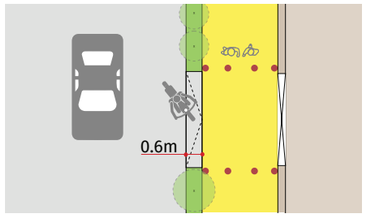
Surface of the footpath should be of a tough, anti-skid material to ensure usability and safety in all weather conditions.



tree gratings

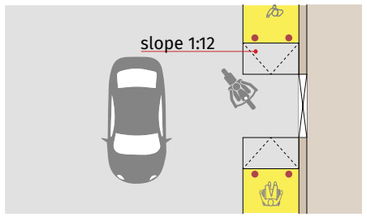
Surmountable gratings, with holes that are perpendicular to the movement of wheels of a wheelchair, should be used over tree pits to increase the effective width of the footpath.

continuity



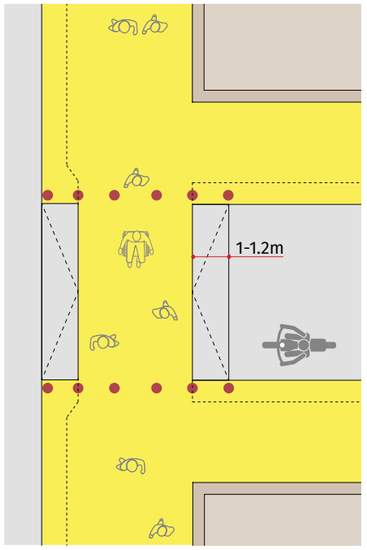
property entrances

Wide footpath: Footpath should continue across property entrances with 0.6m wide vehicle access ramp along the edge.



property entrances

Narrow footpath: Where there is not enough width for an entrance ramp, footpath should slope gradually (< 1:12) to reach ground level at property entrances for wheelchair users.

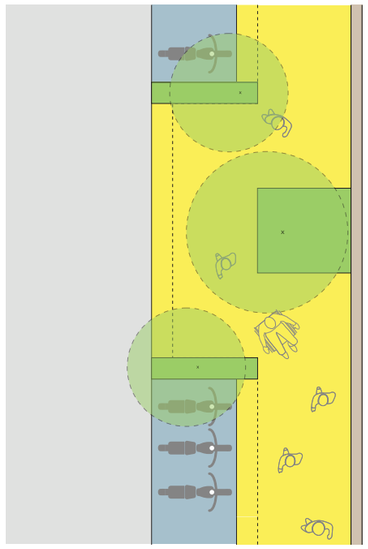


tabletop

Footpath should continue across side streets with 1 - 1.2m wide ramps for vehicle access; footpath width shall not be reduced to provide ramps for vehicles.

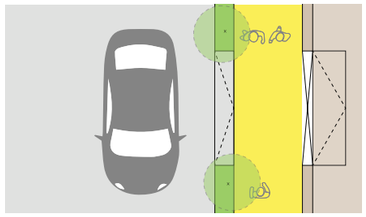
Fig.
Footpath continuing across a side street in Besant Nagar Second Avenue, Chennai

obstructions



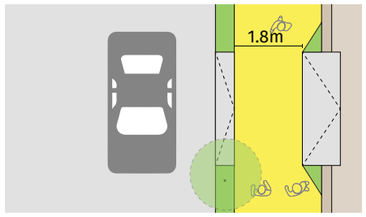
bulb-outs

If permanent obstructions are present, footpath should be widened through bulb-outs in the parking lane to ensure minimum clear width for walking.



access to properties

Entrance ramps or steps should be within properties, and not encroach or obstruct movement on footpath.

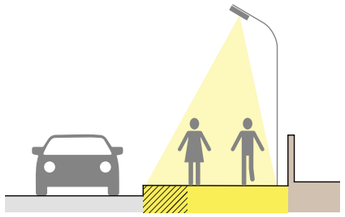


access to properties

If unavoidable, they can extend into the footpath provided a clear width of 1.8m is available for pedestrian movement.

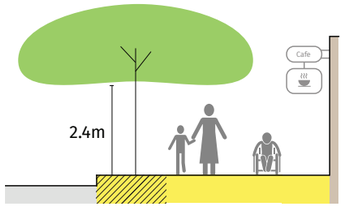
Fig.
Church Street, Bangalore

safety and comfort



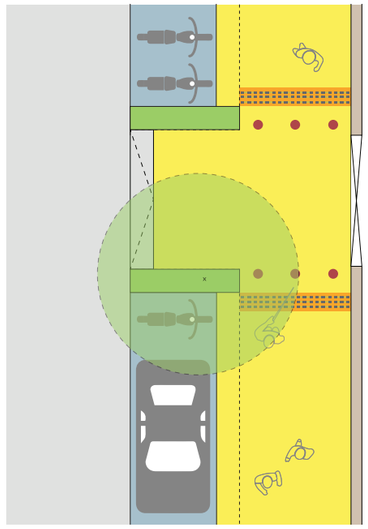
lighting

Footpath should be well-lit without any dark spots.



shade

Footpath should be well-shaded. Trees should be pruned to maintain a vertical clearance of 2.4m in the walking area.



tactile pavers

Tactile pavers must be used as warning strips near all locations on the footpath with conflicting uses like property entrances.

Fig. (right)
DP Road, Pune

Fig. (facing page)
St. Marks Road, Bangalore

** Tactile pavers may also be used as guiding tiles on the footpath if the layout is approved by a UA specialist.*

2.1.1 street furniture

what good street furniture achieves

Good street furniture provides people safe and comfortable places to sit, rest, and interact with each other. It includes services-related infrastructure such as:
• dustbins • seating • street lights
• signage • bollards

challenges

Poorly located street furniture often become obstacles to free pedestrian movement.

Maintenance of street furniture is often inadequate. *Eg. Broken benches not repaired promptly and overflowing garbage bins not emptied regularly.* Installation of street furniture must be accompanied by a maintenance plan involving local partners.

design recommendations

location

All street furniture should be located such that they are convenient to use, universally accessible, do not obstruct movement and provide easy access for street cleaning.

material

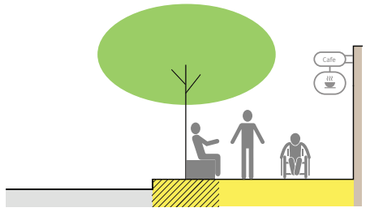
The street furniture should be made of materials that are durable, easy and cheap to maintain, safe, aesthetically pleasing, easily available in case of repairs and/or replacement, and have a low resale value.

Fig. (above)
JM Road, Pune

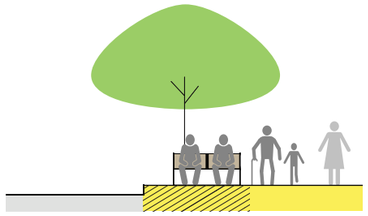
Fig. (below)
DP Road, Pune

Street Furniture in Paris | YouTube
https://www.youtube.com/watch?v=6QoWdGIywb4

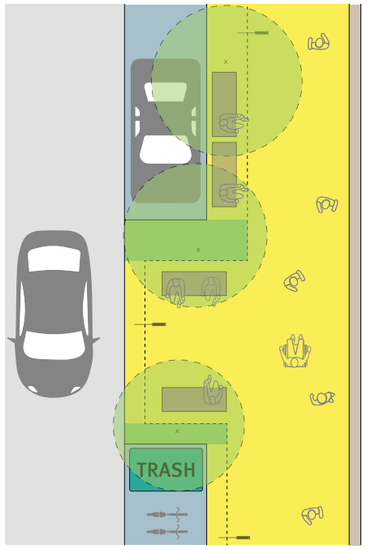
New York Street Furniture | YouTube
https://www.youtube.com/watch?v=yfNLpMADxGY



shade
Wherever seating is provided, climatic comfort should be ensured and the seating should be well shaded.



use
Seating should be designed in a way that encourages sitting and completely discourages lying down.

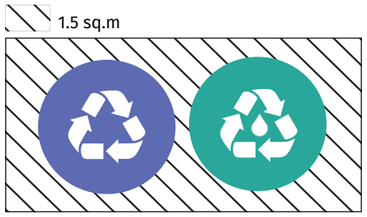


orientation
Seating in bulb-outs should be perpendicular to the pedestrian movement.

Shaded seating under tree

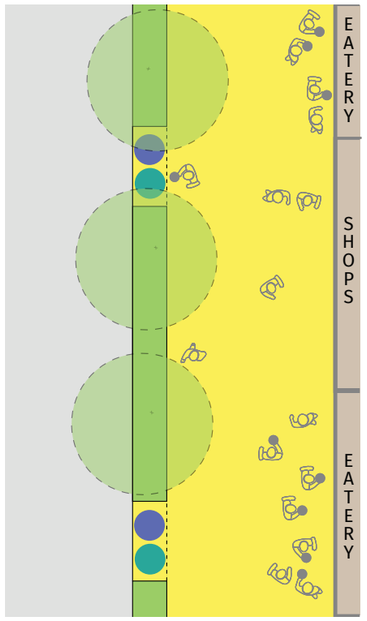
Fig.
DP Road, Pune

2.1.1.B dustbins



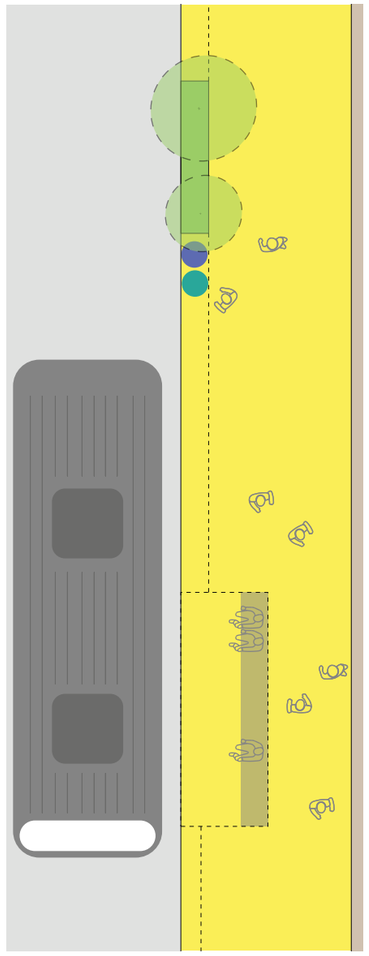
size

Separate bins should be provided for wet and recyclable waste; total space allocated should not exceed 1.5 sq.m.



adjacent activity

Dustbins should be provided at regular intervals according to adjacent land uses and activity.

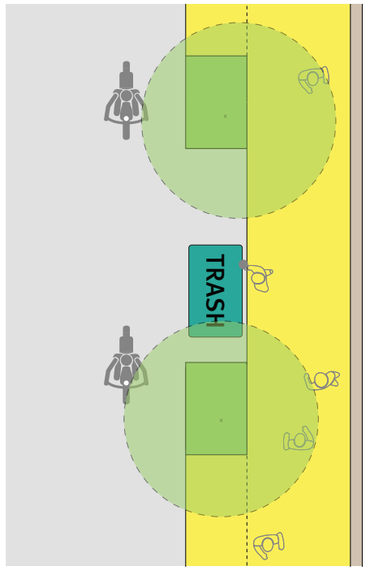


location

Dustbins should be placed near all transit stations, parking areas and junctions owing to the high people activity expected there.

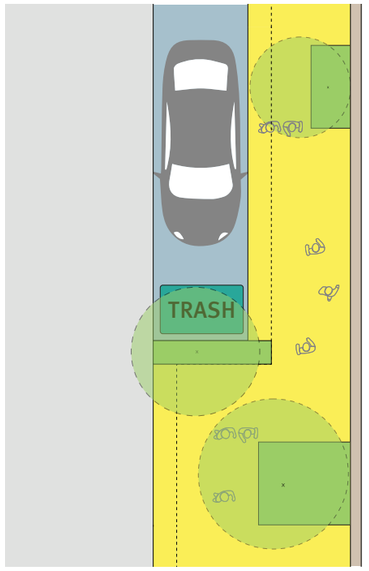
Fig.
JM Road, Pune

garbage containers 2.1.1.C



niches

Garbage containers should be placed in niches (1x3m per container) in the multi-utility zone for easy lifting.



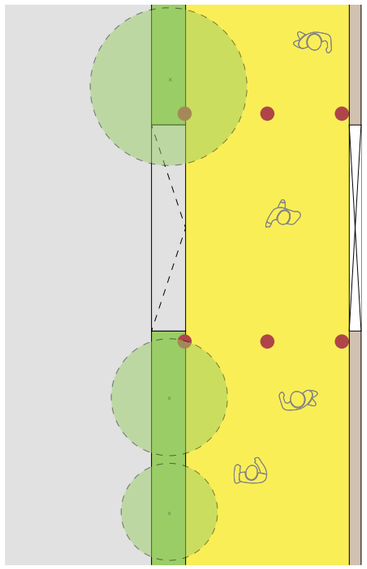
in parking bays

Garbage containers can also be placed within parking bays.

Fig.
Harrington Road, Chennai

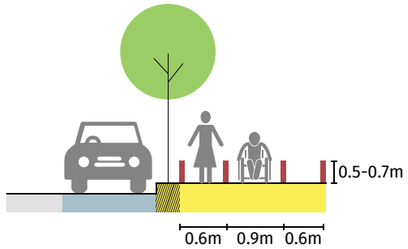
** A solid waste management plan is required to ensure proper placement of containers.*

2.1.1.D bollards



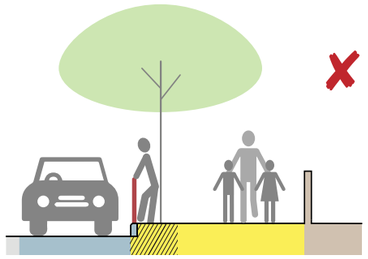
location

Bollards, with reflector strips, should be provided at property entrances and ramps to prevent parking of vehicles, especially cars, on footpaths.



placement

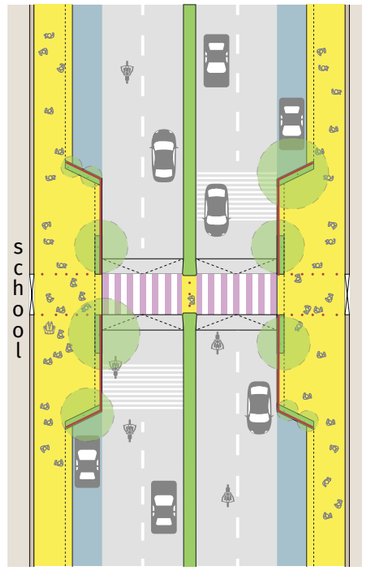
Bollards should be 0.5-0.7m high with a clear width of 0.6m between them; 0.9m clear width for wheelchairs.



no railings

Railings on the footpath should generally be avoided as they obstruct access on to and off the footpath.

railings 2.1.1.E



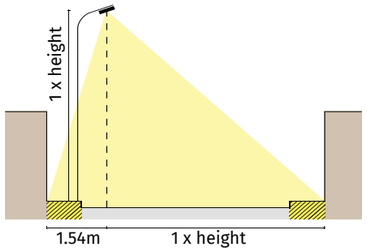
exceptions

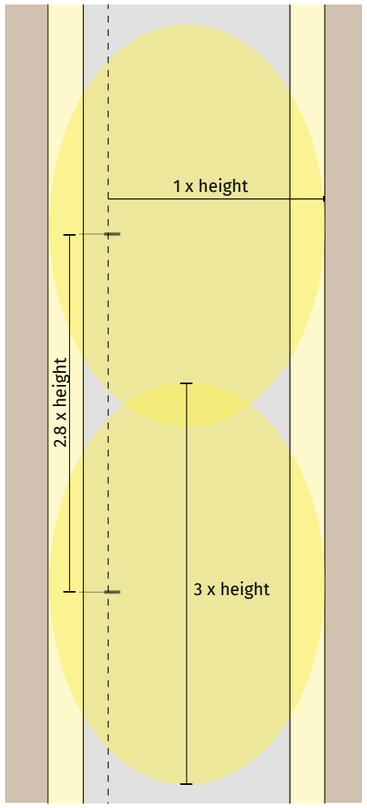
At junctions and near schools, 0.7m high railings can be provided to ensure that pedestrians use only the defined crossings.

Fig.
Church Street, Bangalore

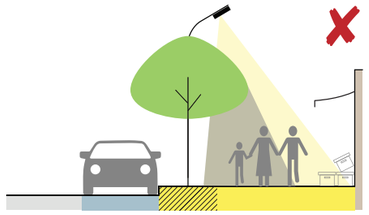
Fig.
Harrington Road, Chennai

2.1.1.F street lights

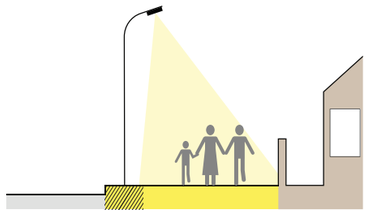




spacing
Spacing between two light poles should be approximately three times the height of the fixture to ensure complete coverage.



dark spots
Trees or advertisement hoardings should not impede illumination.

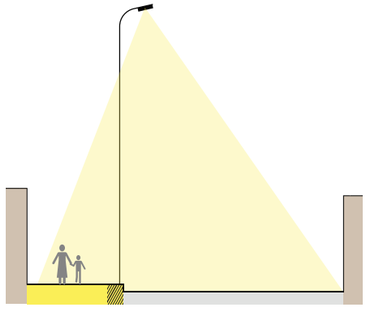


height
Light poles should be no higher than 12m so as to reduce undesirable illumination of private properties.

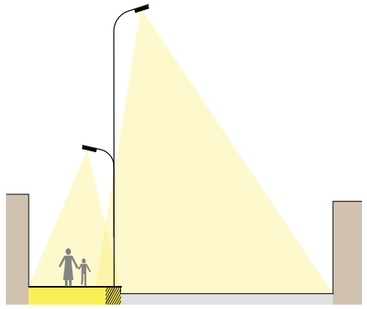
Street type	Pole height (m)	Spacing (m)
Footpath or cycle track (< 5 m width)	3–6	9–16
Local street (< 9 m width)	8–10	25–27
Arterial or collector (> 9 m width)	10–12	30–33

Table 01: Height and spacing of light poles according to street types

narrow streets

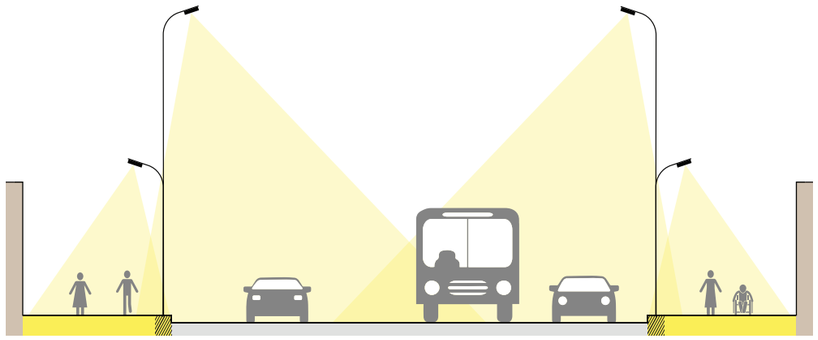


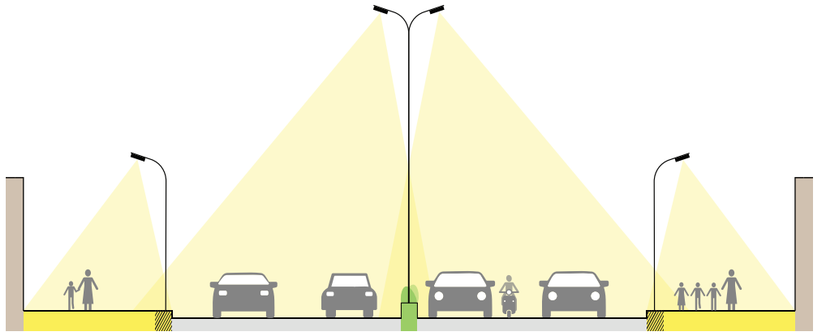
single light
A single light in the MUZ can be used if it illuminates the entire RoW (upto 12m).



additional pedestrian light
Else, a pedestrian light should be fixed at a lower level on the same pole to avoid clutter.

wide streets





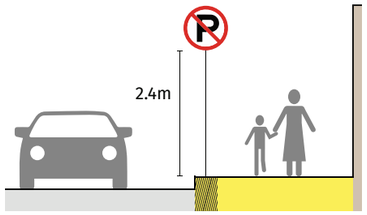
wide streets (above)
For RoW ≥ 24m, pedestrian and street lights can be combined in a single pole in the MUZ to avoid clutter, provided there is proper illumination.

wide streets (below)
As an alternative, median poles can be used for the carriageway and pedestrian lights should be provided separately.

Note: It is recommended to use only LED for street lighting due to its low energy consumption and hence, the above-mentioned specifications are for LED lights. Solar lighting systems should be encouraged, subject to economic and security considerations.

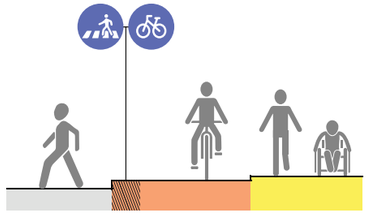
These guidelines are basic recommendations. A lighting consultant may be engaged to contextualise these and develop detailed designs.

2.1.1.G signage



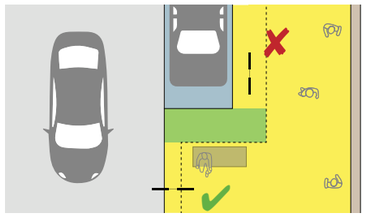
location

Signage should be located at the edge of the footpath with min. 2.4m vertical clearance below the lowest point of the board.



multiple signs

Multiple informatory signs and advertisements can be combined on a single pole to reduce clutter.



orientation

Signage should be placed perpendicular to the line of traffic, on the left side of the road with clear visibility.

details

Please refer to signages in **IRC 067 (2012): Code of Practice for Road Signs** for further details.

Fig.
Harrington Road, Chennai

2.1.2 utilities

what well-planned utilities achieve

The placement of above and below ground utilities at the appropriate locations in the right-of-way ensures unconstrained movement of pedestrians while providing easy access for maintenance.

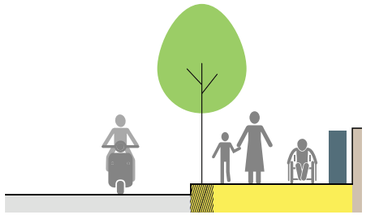
challenges

Utilities are generally placed at the edge of the right-of-way under the footpath. This can create obstacles to pedestrians: either through the location of above-ground utility boxes/ manholes on the footpath or through the differential settlement of the footpath after the ground is opened for maintenance.

In fast-growing urban areas, provision of underground utilities is a major challenge. Therefore, proper planning and mapping of utilities is an essential city management priority.

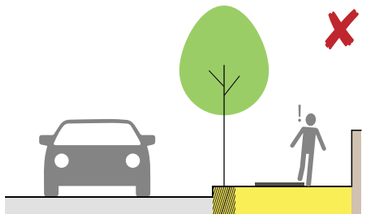
design recommendations

above-ground



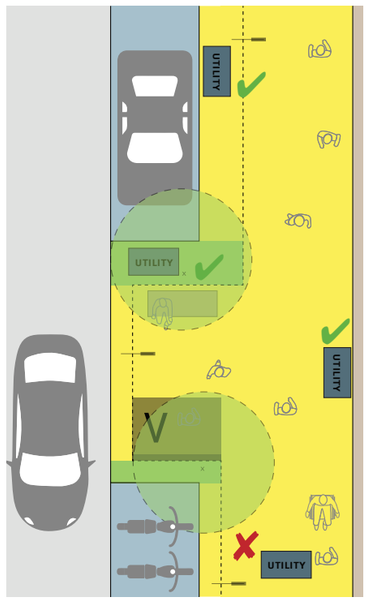
utility box orientation

Utility boxes must be parallel to the pedestrian movement with adequate clearance of minimum 2m for through movement.



manhole cover

Manhole covers should be flush with the surface so as to have minimal level difference.



utility box location

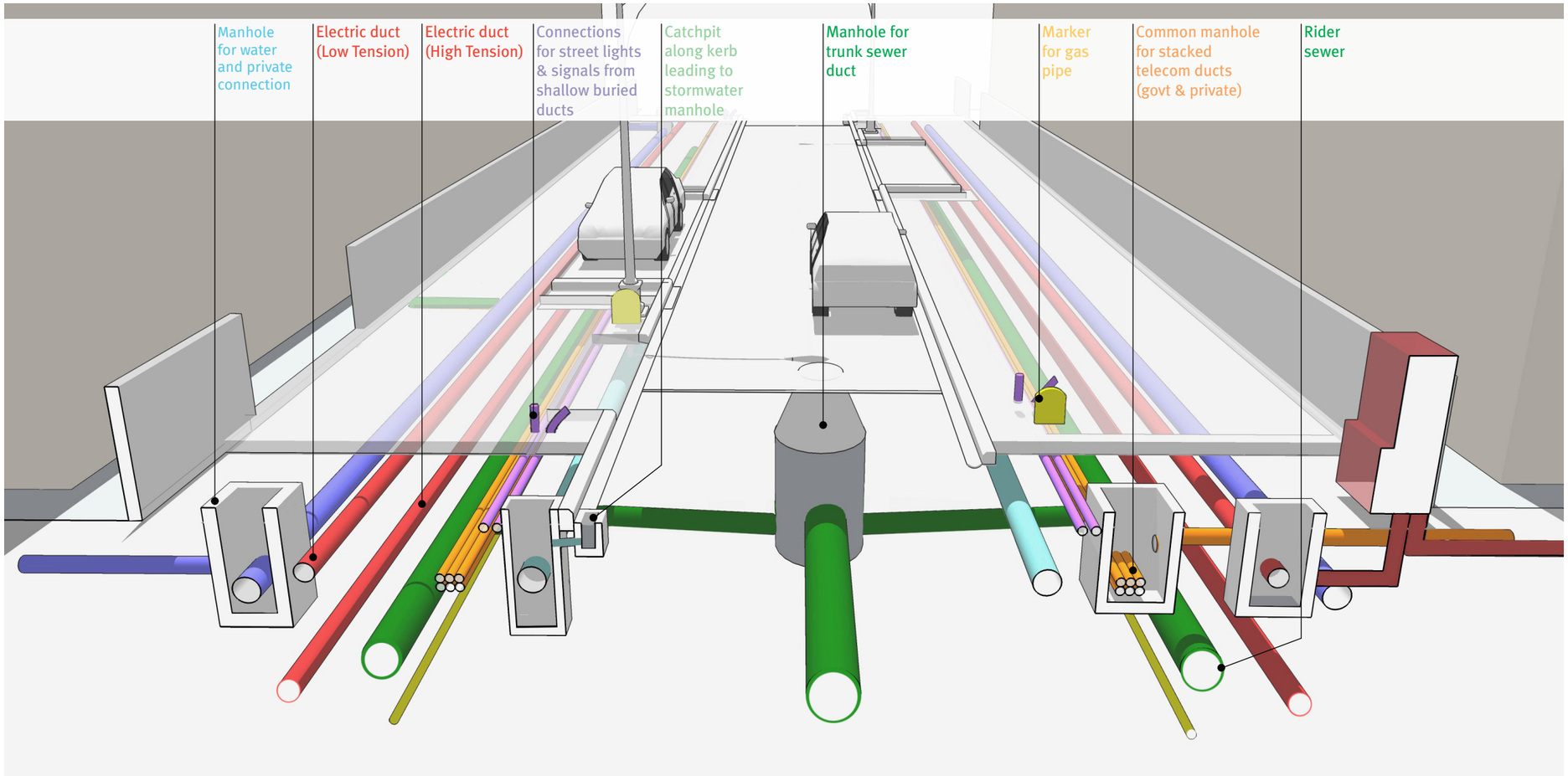
Utility boxes should be placed in bulb-outs, landscaping areas or in the frontage zone without disrupting pedestrian movement.

Fig. (above)
Manholes provided to allow access for maintaining the ducts in Pune

Fig. (above)
Location of manholes in bulb-outs in JM Road, Pune

Fig. (below)
Attractive metal perforated covers for utility boxes in DP Road, Pune

below-ground



trenches vs. ducts

Ducts are recommended over trenches for all underground utilities, provided that manholes are located at regular intervals.

Category	Water	Electricity		Street Lighting & other fixtures		Stormwater
Utility Type	Main	Low-tension	High-tension	Side lines	At median	Main
Duct Material	MS/DIP	HDPE DWC	RCC-NP3	HDPE	HDPE	RCC-NP3
Duct size (dia)	0.15-0.3m	0.15-0.3m	0.3-0.45	0.1-0.2m	0.3m	0.5-1.2m

Category	Sewage		Telecommunications		Private connections	Additional ducts
Utility Type	Rider sewer	Trunk sewer (under median)	Copper cables	Optic Fibres OFC	For each utility	Future additions
Duct Material	RCC Hume Pipe	RCC Hume Pipe	HDPE	HDPE	PVC/HDPE	HDPE
Duct size (dia)	0.3-0.45m	0.5-1m.	0.1-0.3m	0.1-0.3m	0.1m	0.15m

Fig. (above) Underground utilities across the cross-section of the road

2.1.3 bus stops

what good bus stops achieve

Good bus stops provide safe and comfortable waiting spaces, are easy to identify, and do not obstruct pedestrian paths and cycle tracks.

challenges

Bus stops are often located at the edge of the RoW and the footpath width is reduced to create a “bus bay” in the assumption that buses will pull over into the niche. However, buses stop in their original path and the vehicles behind the bus attempt to drive by the left, thus causing a hazard for passengers trying to board the bus.

design recommendations

location on footpath

(a) Footpath ≥ 4.5m: Bus stop at kerb edge, ensuring continuous footpaths and cycle tracks by diverting them behind the stop

(b) Footpath < 4.5m: Bus stop pushed to the wall to ensure sufficient space in the front for pedestrians

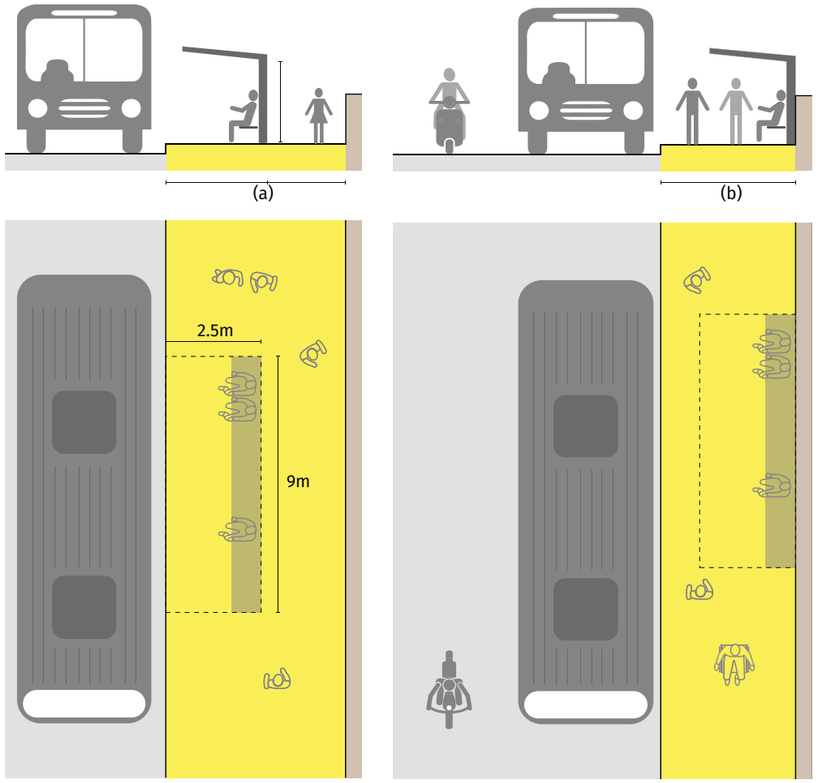
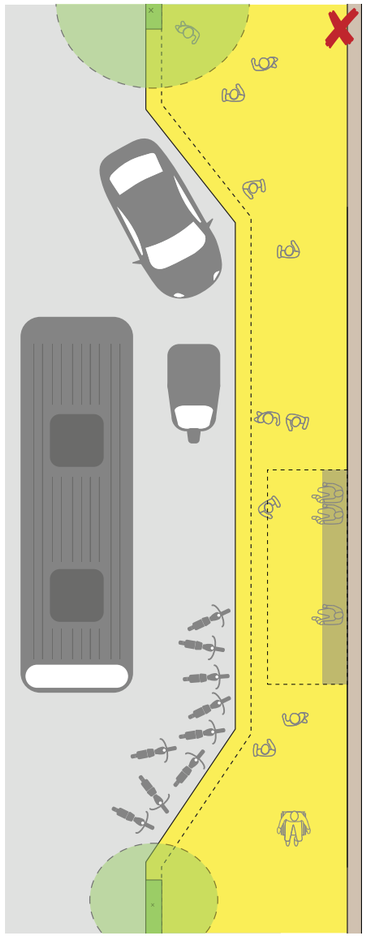


Fig. (above)
OMR, Chennai

Fig. (above)
Bus stop at edge of footpath with width greater than 4.5m in JM Road, Pune

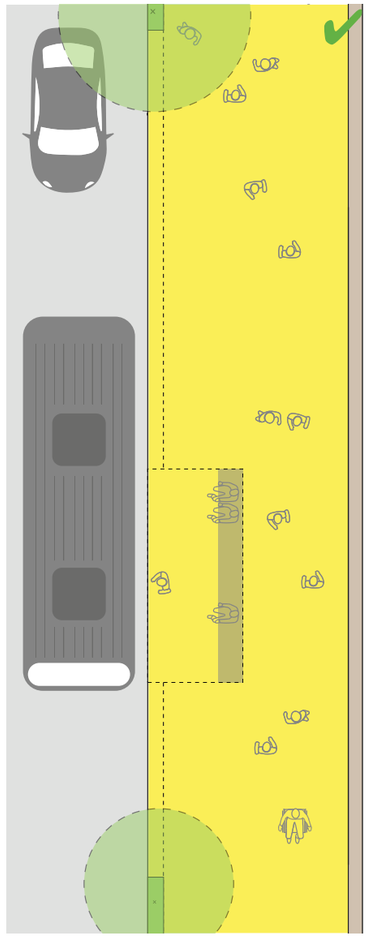
Fig. (below)
Bus stop at property edge on footpath with width less than 4.5m in Binny Road, Chennai

distance of bus stops



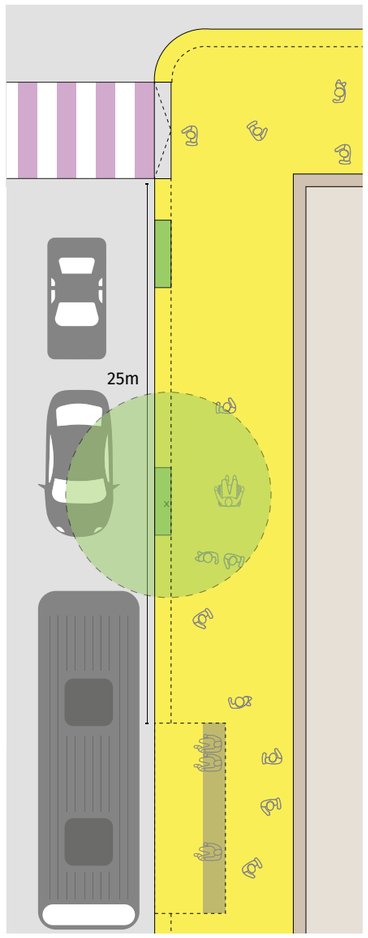
no bus bays

Bus bays must be avoided as they encourage haphazard parking and endanger the lives of passengers as they board amidst traffic.



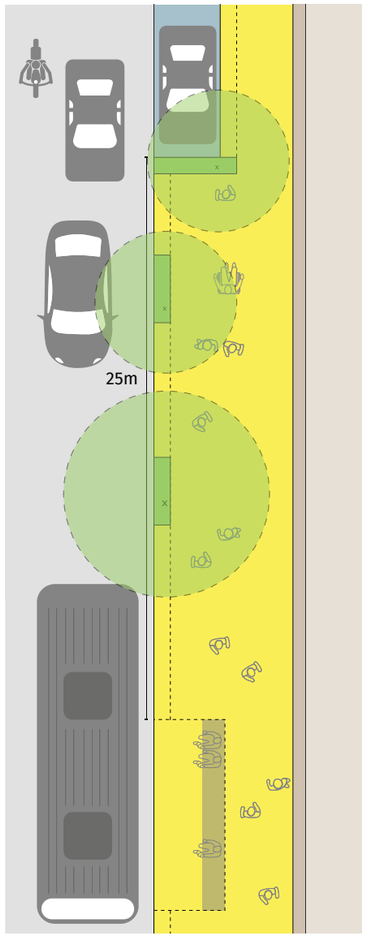
bus stop adjacent to line of travel

Bus stops must always be placed adjacent to the bus' line of travel.



junctions

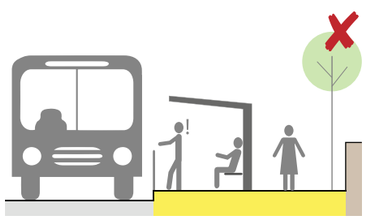
Bus stops should be located 25m from the junctions near cross streets with safe pedestrian crossings at the intersection. This provides sufficient queuing space for buses.



parking

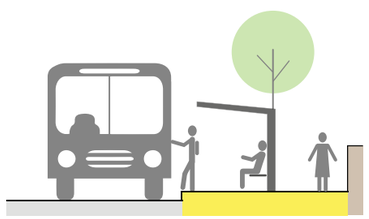
In case of a parking lane, the bus stop should be on a bulb-out; no parking 25m before and after the bus stop.

usability



no railings

Guard rails / railings at the kerb edge should not be provided as they obstruct easy alighting.

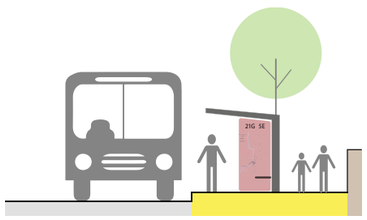


level

Bus stops should be at the same level as the footpath and have proper gradient for surface runoff to avoid water logging especially during monsoons.

comfort

Bus stops should be sufficiently shaded and well lit, with compact seating.



information display

Route information maps and helplines should be displayed perpendicular to pedestrian movement (parallel on narrow footpaths) and not behind the bus stop.

2.1.4 street vending

what street vending spaces achieve

Well-planned spaces for street vending provide citizens with secure and dignified areas for the trade of goods and services. Vending provides for an important social space and serves as a form of security for those walking on the street, especially women.

challenges

Existing street design neglects street vending owing to the perception that vending is illegal and makes a city look dirty, antiquated, and impoverished. As a result, vendors use footpaths or the carriageway.

Too often, street vendors play a cat-and-mouse game with the administration and police, which is costly and inefficient for both sides.

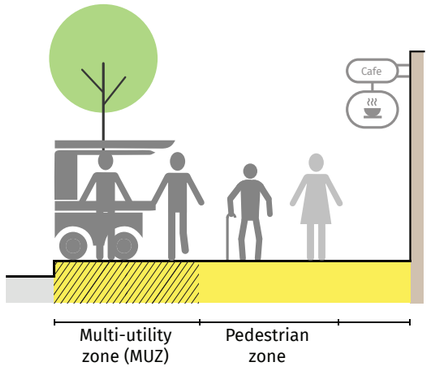
design recommendations

location

The national street vendors act makes it mandatory to accommodate vending areas in the street designs. These street vending areas should always include spaces for spillover.

They should be located such that they do not obstruct/encroach on footpaths and cycle tracks. A clear pedestrian zone of width 1.8m should be provided beyond the vending spaces and their spillovers.

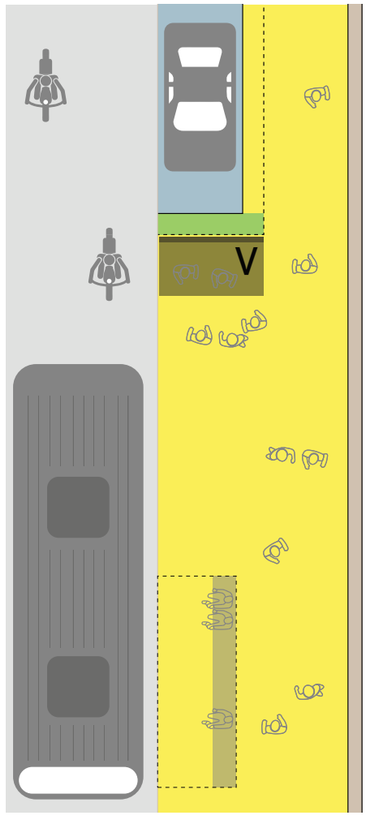
It is preferable to provide vending spaces in the MUZ.



Sufficient space for pedestrian movement beyond vending areas

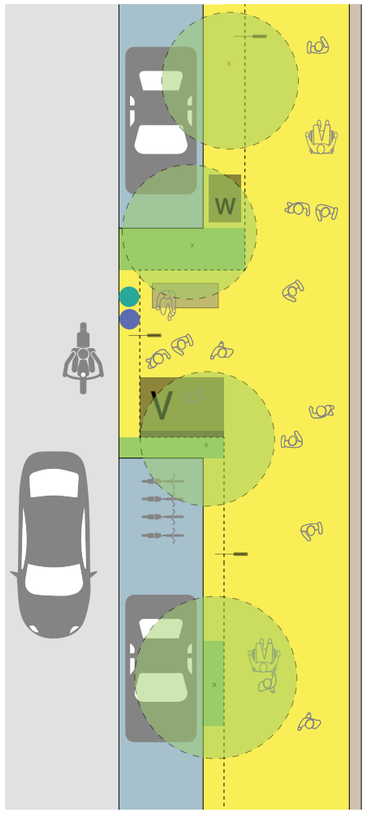
Fig. (above)
Harrington Road, Chennai

Fig. (below)
OMR, Chennai



demand based

Demarcated vending spaces should be provided based on existing demand, especially near public transport stops, parks, and temples with adequate spillover spaces.



amenities

Supporting infrastructure like water taps, electricity points, trash bins, and public toilets should be provided, to prevent squalor around vending areas.

Fig.
JM Road, Pune

** A vending management plan is required for preventing mis-management of footpaths and ensuring inclusive streets for vendors.*

2.1.5 landscaping

what good landscaping achieves

Landscaping improves the liveability of streets and provides shade to pedestrians, cyclists, vendors, and public transport passengers. It helps in tackling urban air pollution while enhancing the aesthetic qualities of streets.

challenges

Landscaping of streets is often seen only as a beautification exercise, with shrubs and flowers which serve an aesthetic function but do little else to improve comfort for pedestrians and cyclists.

Trees are often avoided out of fear that drivers will run into them, or that they may disturb the carriageway, storm water pipes, and other utilities.

design recommendations

raised tree pits

Raised tree pits, that also serve as seating, should be provided around existing trees with exposed roots.

tree pit size

(a) Wide footpath: Size of the tree pits should be at least 1.5mx1.5m to accommodate roots at full maturity.

(b) Narrow footpath: On narrow sidewalks, the same surface area can be achieved with tree pits of size 1.25x2.25m.

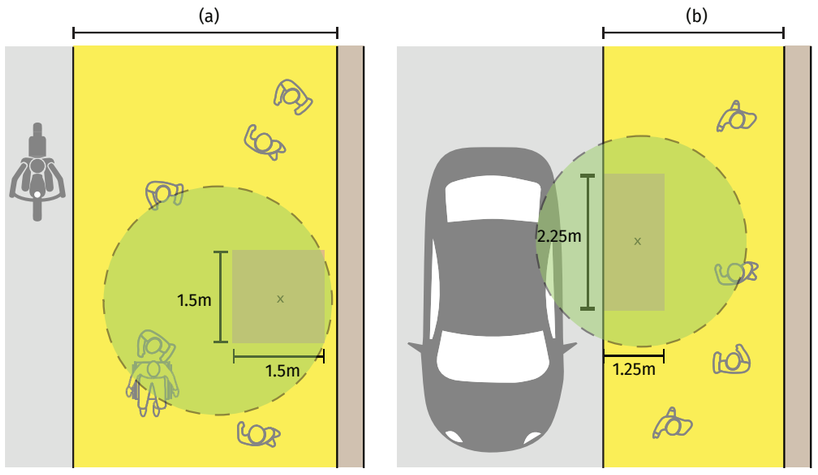
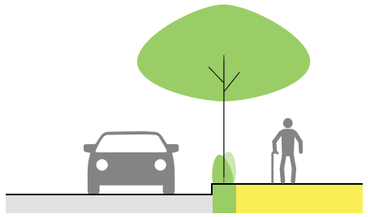


Fig. (above)
JM Road, Pune

Fig. (below)
Tree pit under construction around exposed roots in ITI Road, Pune

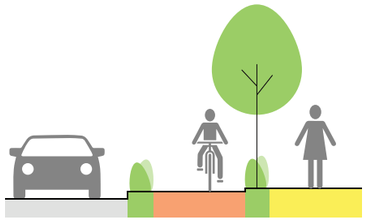
** These are generic recommendations. A landscape consultant and/or horticulturist may be engaged to develop detailed designs that are sensitive to local context.*

location



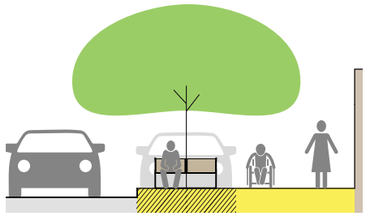
on the edge

The verge between footpath and carriageway can be landscaped with trees and short shrubs with frequent breaks.



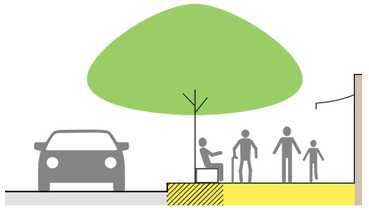
as buffer

Landscaping can be provided as a buffer between footpath and cycle track.



within bulb-outs in parking lane

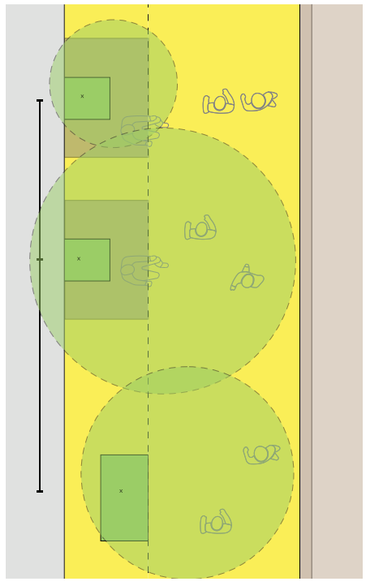
Bulb-outs within parking lane can be landscaped with large trees that shade the footpath and seating.



in the MUZ

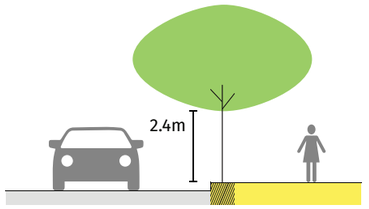
Landscaping can be done in the MUZ to serve as shade for seating.

safety and comfort



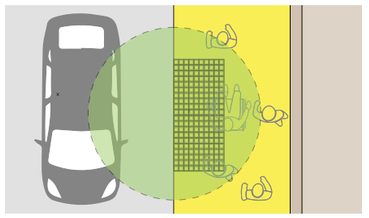
spacing

Trees should be appropriately spaced from each other based on the canopy size and shape, ensuring continuous shade.



vertical clearance

Vertical clearance of 2.4m should be maintained; branches should be pruned regularly in consultation with experts to ensure they do not block the street light.



tree gratings

Surmountable gratings, with holes that are perpendicular to the movement of wheels of a wheelchair, should be used over tree pits to increase the effective width of the footpath.

2.2 cycle track

what is a good cycle track?

Good cycle tracks are continuous, well shaded, provide for uninterrupted movement, and are physically separated from the carriageway to ensure safety and comfort. They are also protected from encroachment by parked vehicles, pedestrians, and street vendors.

challenges

Due to lack of physical separation of motorised and non-motorised vehicles, cyclists face safety hazards from faster moving traffic. Therefore, the provision of elevated and segregated cycle tracks is essential.

design recommendations

width

Cycle tracks should be atleast 2m wide for one-way movement and atleast 3m wide for two-way movement.

There has to be a vertical clearance of 2.4m in both cases, between the surface and the shading element above.

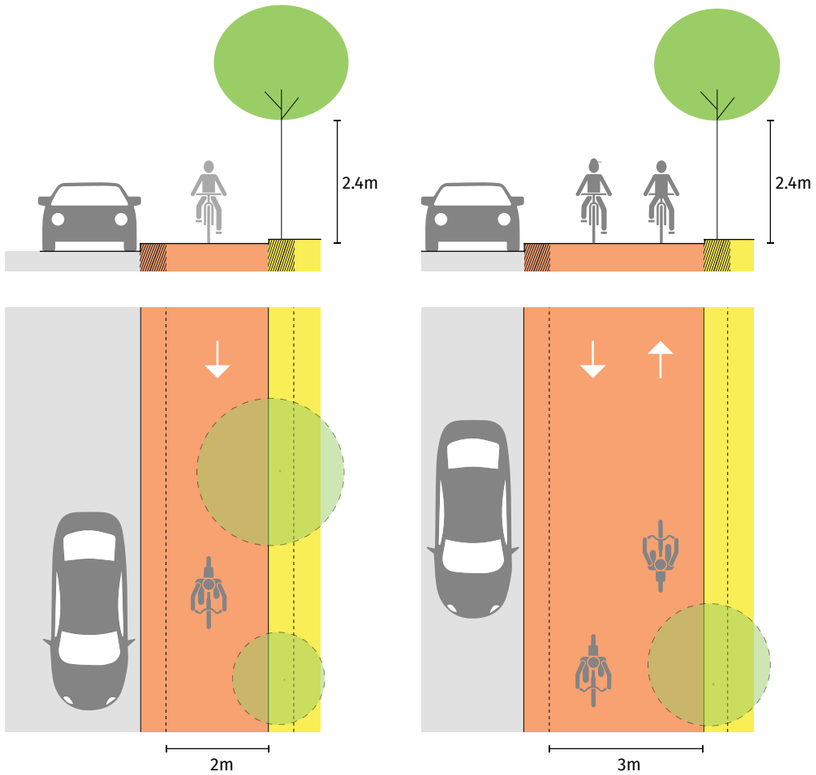
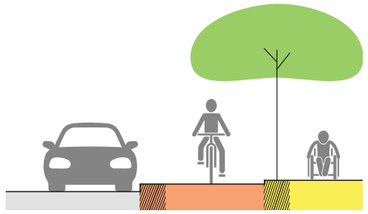


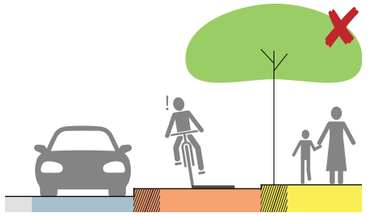
Fig. (above) Delhi

level surface



height

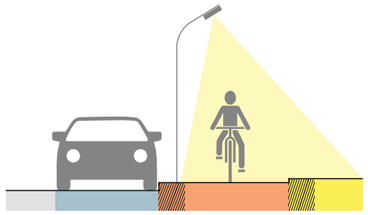
Cycle tracks should be raised above the carriageway at 0.1m, with footpath at +0.15m from the carriageway.



surface

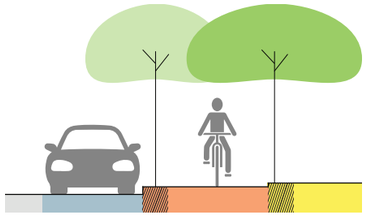
Surface of the cycle track should be even and free from undulations due to material or level of manhole covers.

safety and comfort



visibility

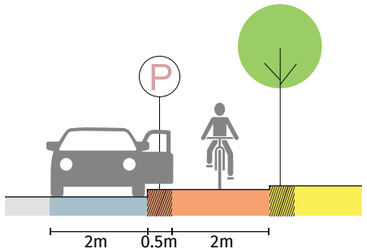
Cycle tracks should be well-lit and be clearly differentiated from footpath and carriageway through coloured surface and lane markings.



shade

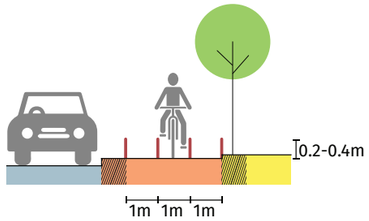
Continuous shade through tree cover should be provided to shelter cyclists from harsh weather.

Fig. JM Road, Pune



buffer

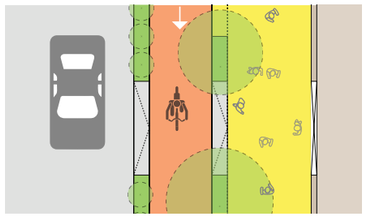
A buffer of 0.5m should be provided between cycle track and parking lane/carriageway to protect the cyclists from dooring.



bollards

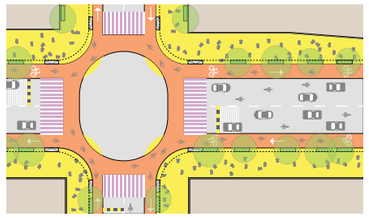
Bollards of height 0.2-0.4m should be placed at the start and end of cycle tracks with a clear width of 1m between, to prohibit entry of motor vehicles.

continuity



property entrances

At property entrances, the cycle track remains at the same level and vehicle access is provided by a ramp in the buffer.



intersections

Continuity of cycle tracks should be maintained across road intersections.

Fig.
DP Road, Pune

Fig. (facing page)
JM Road, Pune

2.3 on-street parking

what good on-street parking achieves

On-street parking is clearly designated, managed, charged, and restricted in volume, enabling access to nearby properties without disturbing the flow of motor vehicles, pedestrians, and cyclists.

challenges

When on-street parking is not designated clearly, parking accumulates organically near points of attraction. On streets with high vehicle volumes, this may cause congestion and delays.

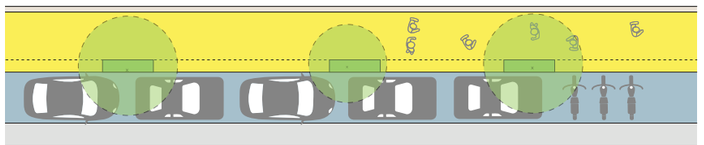
Where footpaths are not provided, haphazard parking creates difficult conditions for pedestrians, who are forced to weave their way through the parking area or walk on the other side of the parked vehicles amidst moving traffic.

Fig. (above)
St.Marks Road, Bangalore

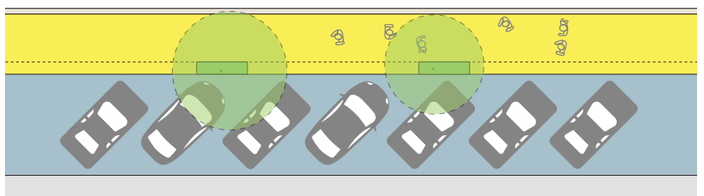
design recommendations

orientation

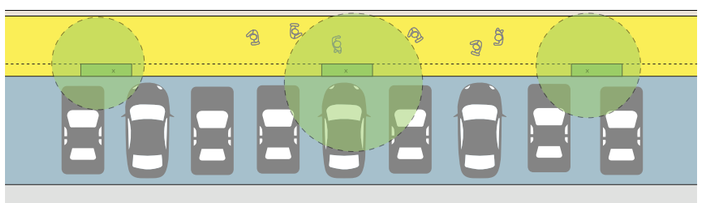
Parallel parking is recommended on streets where parking is permitted; inclined and perpendicular on-street car parking should be avoided since these orientations take up precious road space that could otherwise be used for NMT facilities.



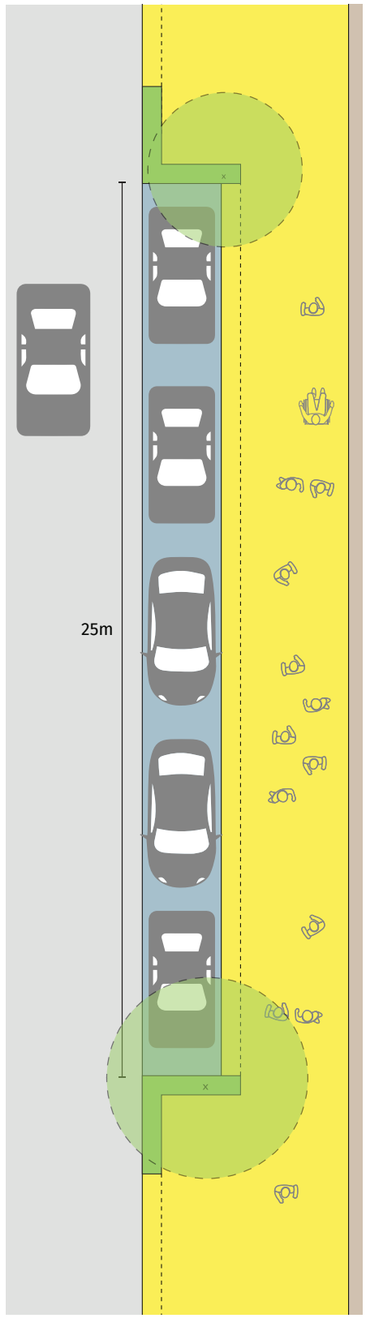
parallel parking



angular parking

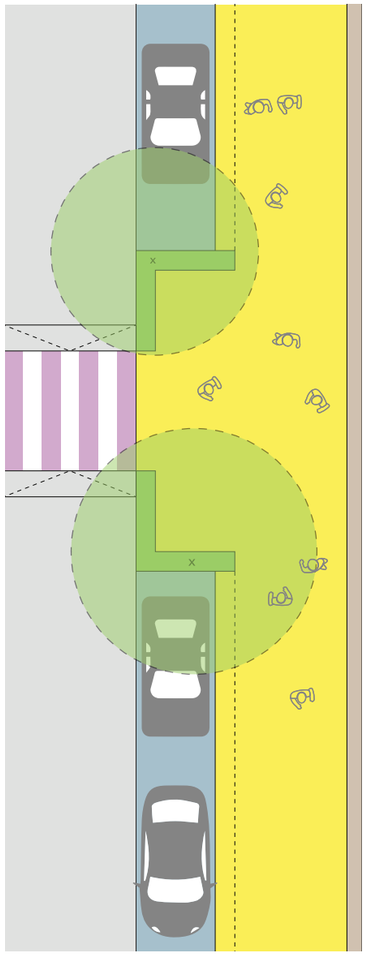


perpendicular parking



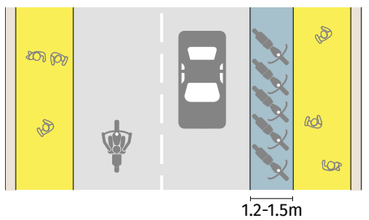
bulb-outs in parking bay

Parking should be interrupted by bulb-outs at intervals of 25m max - continuous parking dissuades people from using the footpath.



bulb-outs at crossings

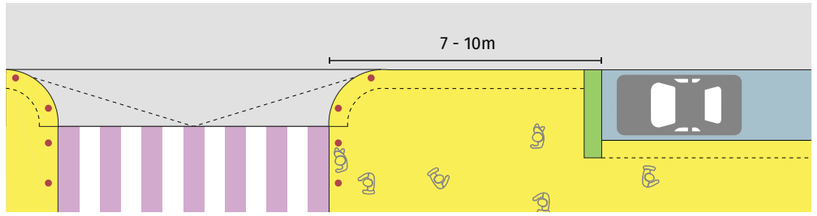
Where on-street parking is provided, bulb-outs should be designed at crossings for pedestrian safety and visibility.



narrow streets

On narrow streets with high density two wheeler parking, angular two wheeler parking (1.2-1.5m wide) is recommended.

parking near intersections

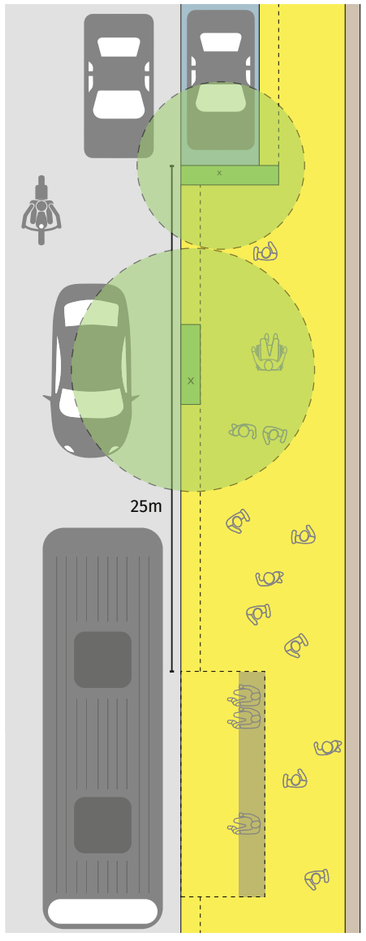


parking near intersections

To reduce conflicts between vehicles exiting the parking slots and those turning, parking should be located 7-10m from intersections.

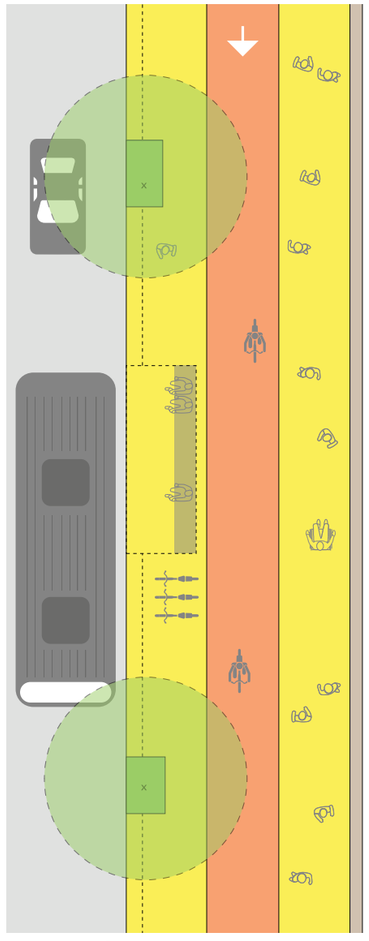
Please refer IRC 70 for additional information on on-street parking.

parking near bus stops



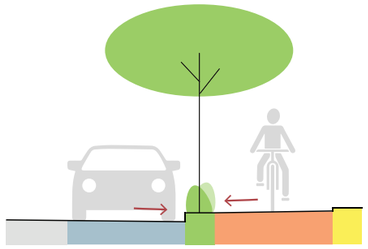
parking near bus stops

parking should be provided 25m before and after bus stops to give enough queuing space for buses without hindrance from vehicles parking and exiting the parking bay.



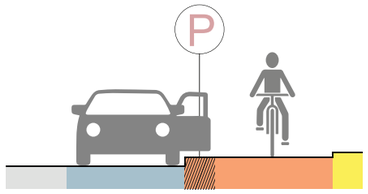
cycle parking

Dedicated cycle parking should be provided at public transport stops and stations and in commercial districts.



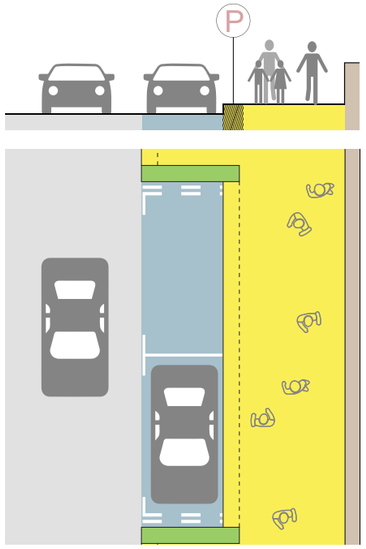
surface

The area allotted for parking should have a clean and leveled surface, free from water logging with proper drain facilities.



buffer

A 0.5m buffer is recommended along the footpath/cycletrack edge to ensure that vehicle overhangs do not affect movement.



visibility

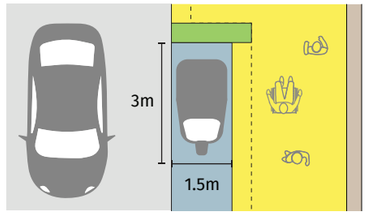
Parking bays should be well-marked and have signage perpendicular to direction of travel of vehicles for visibility.

Vehicle type	Parking slot dimension	ECS
Cycle	1m x 2m	0.2
Two-wheeler	1m x 2m	0.2
Car	2m x 5m	1
Mini bus	2.6m x 8m	1.5
Bus	2.6m x 15m	3.9
Heavy commercial vehicle	2.4m x 9m	2.2
Light commercial vehicle	2m x 5m	1

Table 02 (above):
Space required for parking different vehicles and their ECS value

Fig.
DP Road, Pune

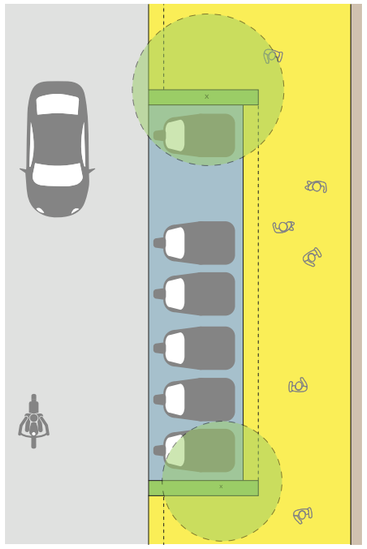
2.3.1 Informal Public Transport (IPT)



space for autorickshaws

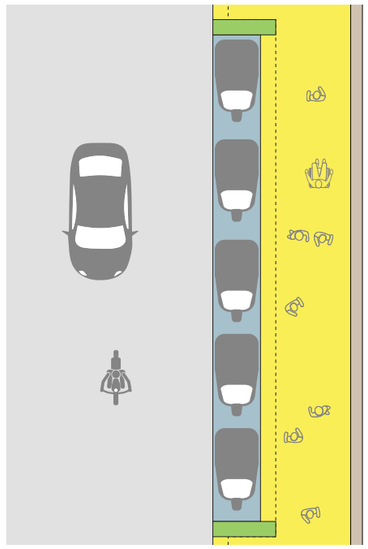
Parking space dimensions for one auto rickshaw - 3m x 1.5m

parking orientation



perpendicular

In case of wide footpaths, perpendicular parking can be provided for not more than 7 autos in one autorickshaw stand.

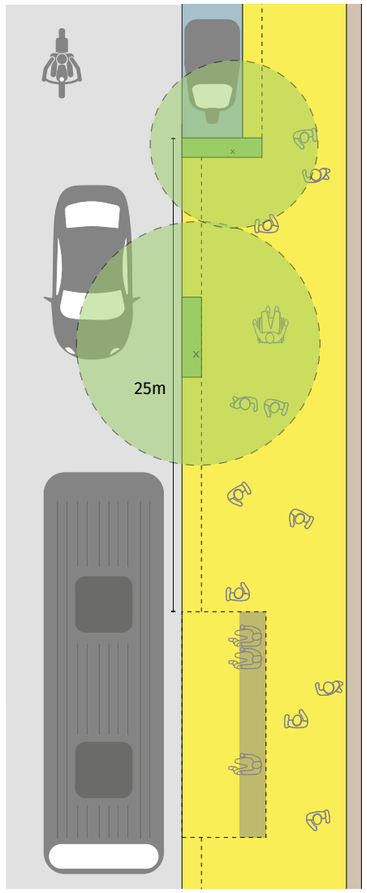


parallel

Parallel parking ensures ease of maneuvering and occupies less space. Where provided, the space must be for not more than 5 autos in one autorickshaw stand.

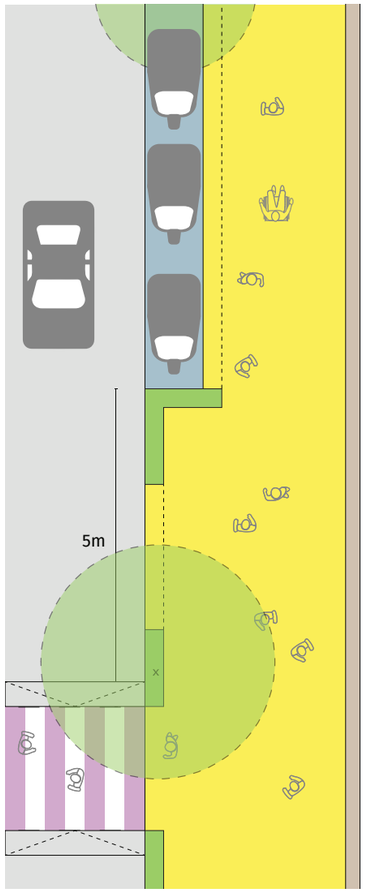
Fig.
KB Dasan Road, Chennai

IPT parking near bus stops, crossings and junctions



near bus stops

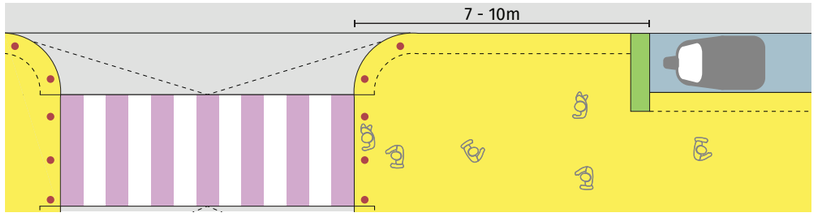
Rickshaw stands should preferably be located near bus stops and transit stations - 25m before and after bus stops.



near crossings

IPT stands should be located 5m before crossings; where located after crossings, additional queuing space should be provided so that vehicles do not obstruct the crossing.

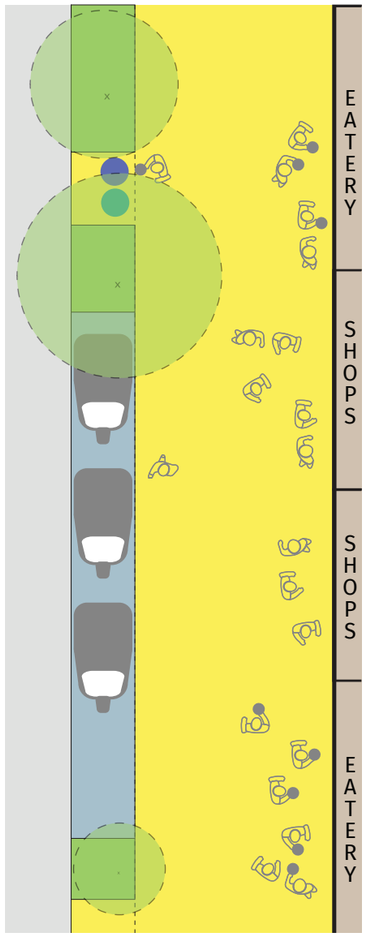
Fig.
DP Road, Pune



near junctions

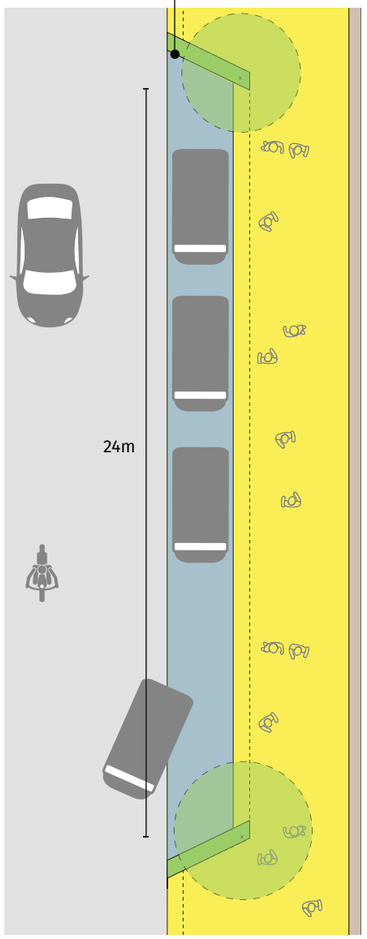
Rickshaw stands should be located 7-10m away from the intersection of local and feeder roads to reduce conflict.

Splays are allowed for drop-off bays since vehicles are expected to enter and exit quickly.



near high footfall areas

Rickshaw stands should preferably be located at places of high footfall - especially near hospitals and commercial areas.



other IPT modes

Drop-off bays can be provided for other IPT modes; however, they should not be longer than 24m since the bay will otherwise become another traffic lane.

Fig. (facing page)
E-Rickshaw stand, Ranchi

2.4 carriageway

what good carriageways achieve

The primary purpose of a carriageway is vehicle mobility. A good carriageway is designed for appropriate speeds suited to the street's role in the city's street network.

challenges

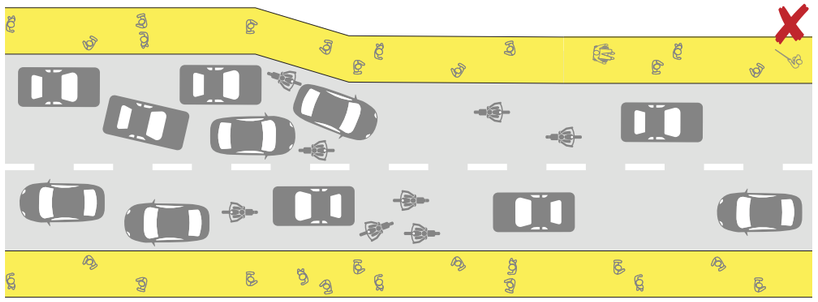
Since streets usually do not include separate spaces for walking, cycling, and street vending, carriageways end up accommodating these activities, compromising the vehicle throughput as well as safety and comfort for all users.

The width of a carriageway on a single stretch often varies in proportion to the right-of-way. This leads to short spurts of speeding and bottlenecks, and encourages wrong-direction driving.

design recommendations

constant width

Carriageway should have uniform width, thereby ensuring smooth flow of vehicles. The width should not increase in portions where a wider right-of-way is temporarily available. Wider carriageway segments cause traffic jams where the width narrows again.



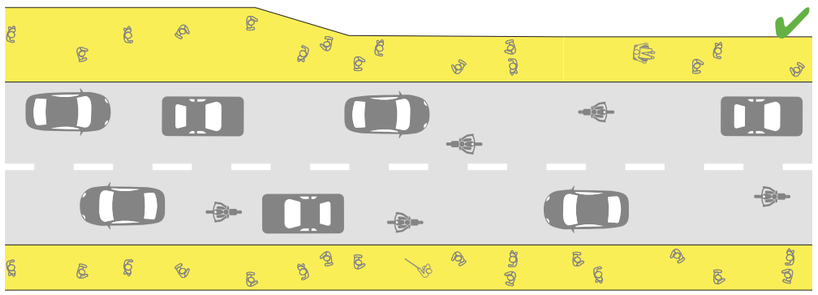
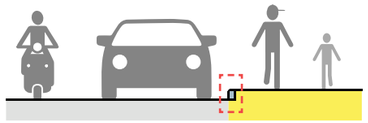
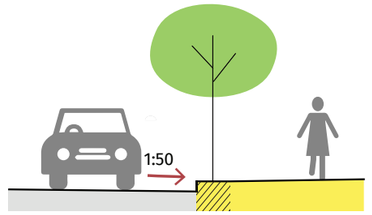


Fig. (above)
DP Road, Pune



carriageway edge
Carriageway should be clearly defined through kerbs and material differences.



gradient
Carriageway should have proper longitudinal gradient and camber (1:50) to allow for surface runoff.

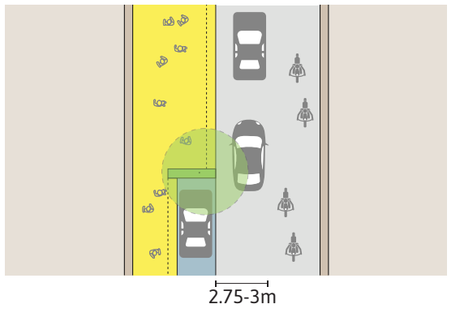
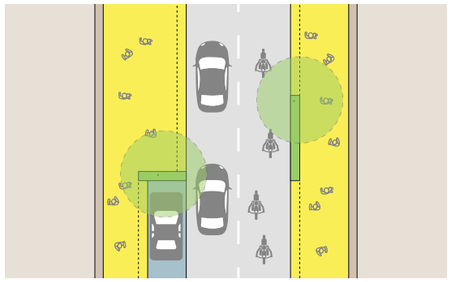
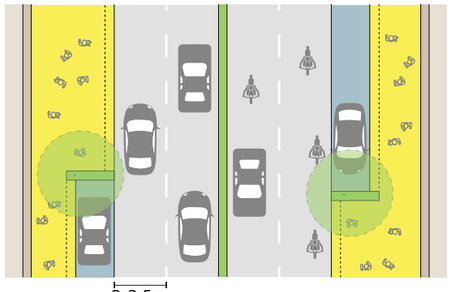
	Speed	RoW	Lane width
Local Street	>15km/hr <30km/hr	6-15m	 2.75-3m
Distributory	>30km/hr <50km/hr	12-30m	 3-3.5m
Arterial / Sub-arterial	50km/hr	30-50m	 3-3.5m

Table 03:
Edge-to-edge width of a traffic lane according to street categories. Lane width is defined by the function of the street rather than available right-of-way (Code of Practice-1 by MoUD)

2.4.1 lane marking

what good lane marking achieves

Lane markings delineate the carriageway, channelising movement and ensuring smooth and orderly flow of traffic for promoting road safety.

challenges

Markings fade often due to the quality of paint, the usage of roads and the weather conditions in India. As a result, frequent repainting is necessary. Visibility at night can be improved by embedding minute glass beads in the pavement marking material to produce a retro reflective surface.

basic markings

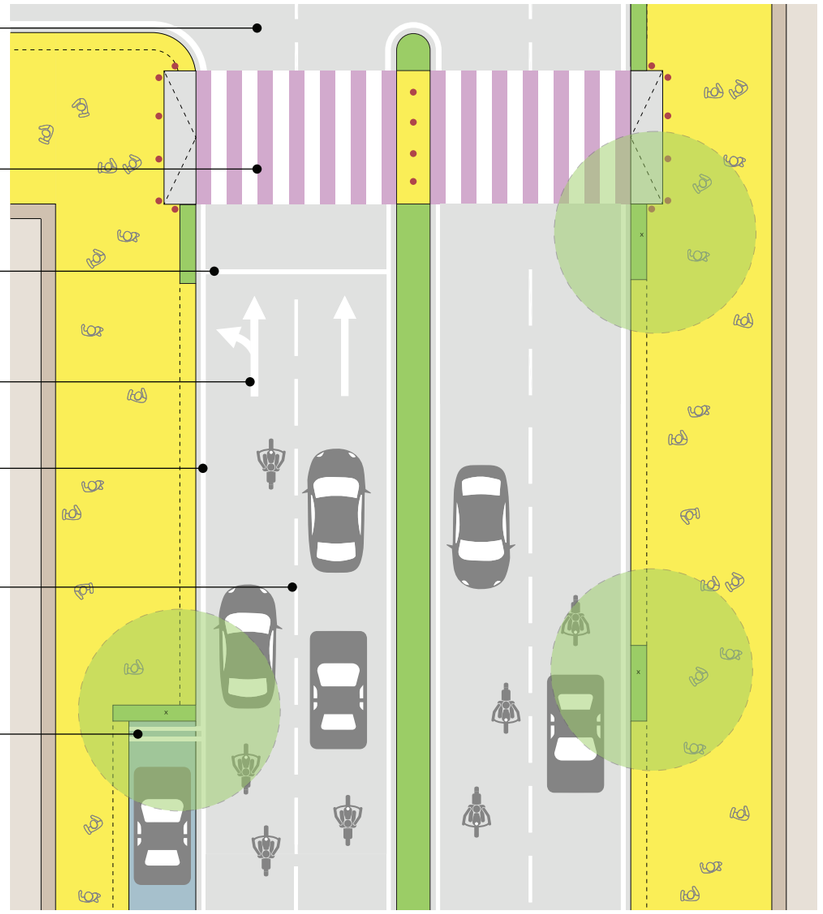


Fig. (above)
DP Road, Pune

Fig. (facing page)
Brigadier Hoshiyar Singh Marg, Delhi

2.4.2 traffic calming

what good traffic calming achieves

Well-designed traffic calming elements ensure pedestrian and vehicle safety by reducing the speed and potentially also the volume of vehicles.

challenges

Traffic calming is rejected as it is considered to hinder traffic flow in arterial streets. Roundabouts and tabletop crossings are cumbersome to construct because of temporary traffic diversions and may appear expensive. As a result, they are often not constructed.

However, traffic calming can provide benefits to safety at a nominal expense compared to the overall cost of road infrastructure.

design recommendations

criteria for selecting traffic calming elements

- Traffic and pedestrian volumes
- Frequency and types of accidents
- Carriageway width or intersection size
- Traffic mode to be calmed (Eg. a street closed for cars but left open for cyclists and pedestrians)

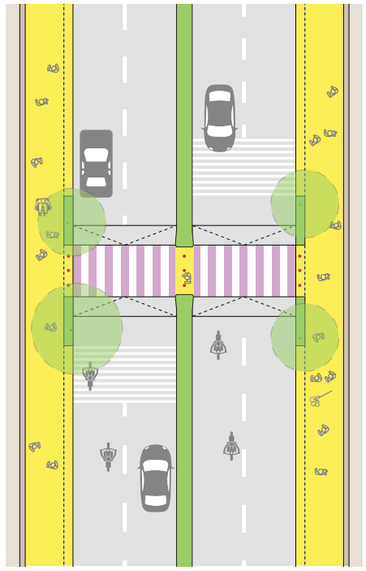
Fig. (above)
Ethiraj Salai, Chennai

Fig. (below)
A speed bump in Pune

Northern Blvd Turning Lane Curb Calming | YouTube
https://www.youtube.com/watch?v=W657-yX2-iQ

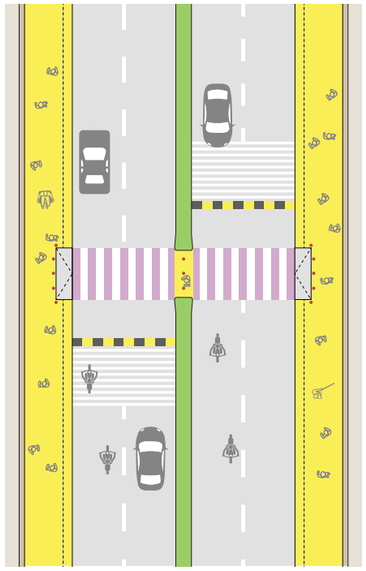
MBA: Traffic Calming | YouTube
https://www.youtube.com/watch?v=bkz026kKpRU

elements of vertical displacement



speed tables

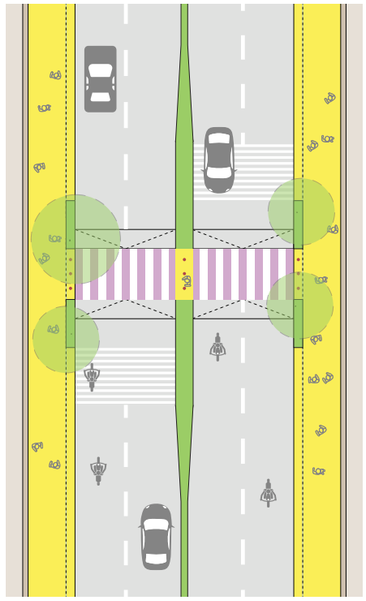
For streets with RoW≥21m and a high pedestrian footfall, midblock crossings should be tabletops with rumble strips.



speed bumps

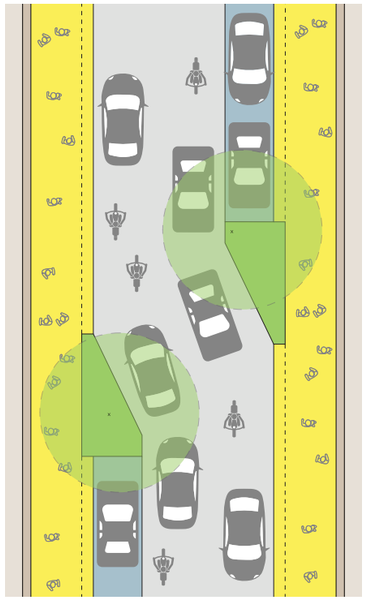
In streets with lesser footfall, speed bumps with rumble strips or cobble stones before pedestrian crossings can be provided.

elements of horizontal displacement



narrowing of carriageway

Narrowing of the carriageway with a wider median at midblock crossings reduces the vehicular speeds.



chicane

Creating deviations (chicane) with temporary/permanent barriers in the carriageway forces the vehicles to slow down.

combination of elements at intersections

Additional Information
Please refer to IRC 099:2018 for further information on Traffic calming measures in urban and rural areas.

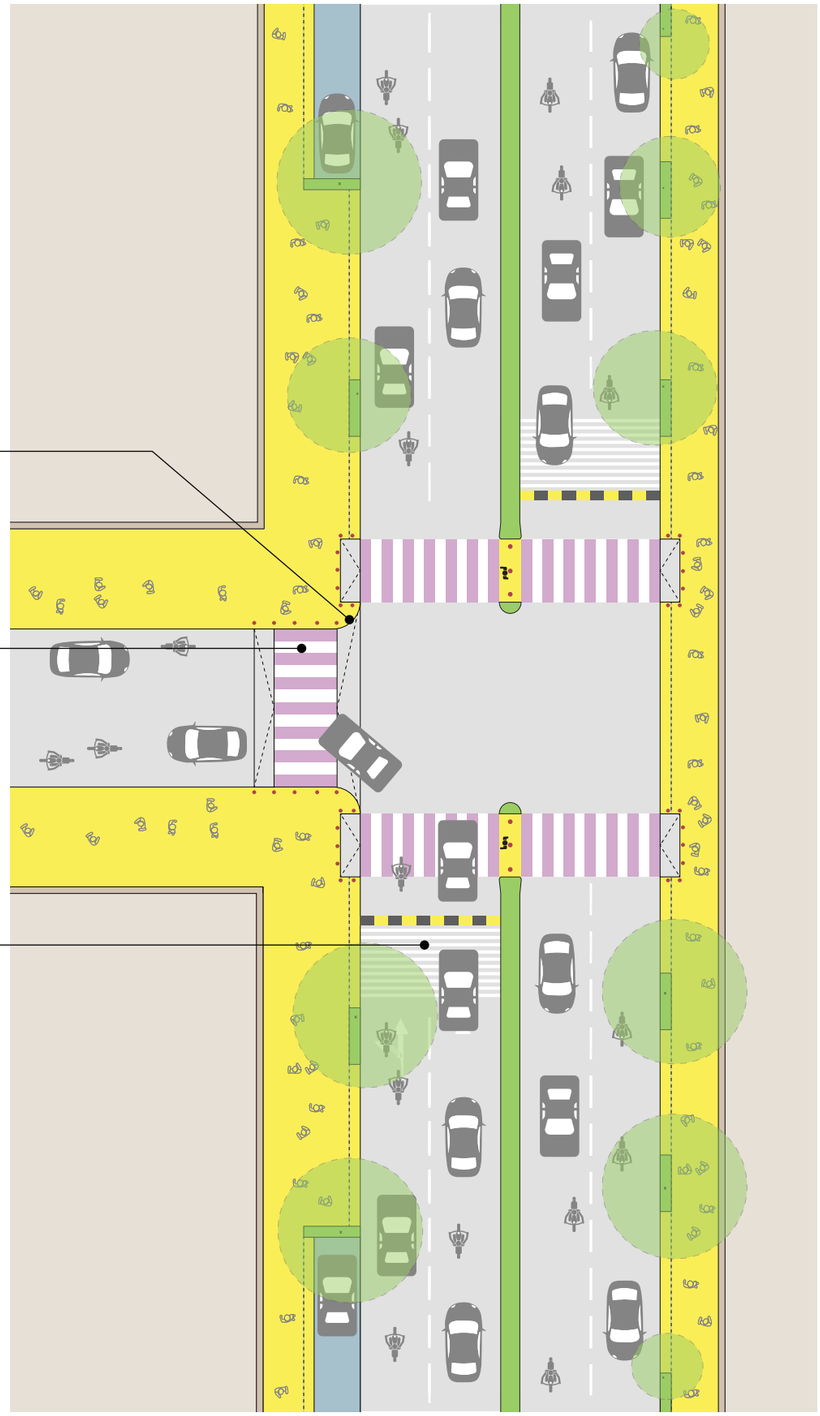


Fig. (facing page) Tabletop crossing across DP Road, a sub-arterial street in Pune that receives high pedestrian footfall

2.5 service lane

what good service lanes achieve

Well-designed service lanes improve safety and throughput of the carriageway by segregating property access points and parking from the main carriageway.

challenges

Service lanes that are wide enough for two-way car movements encourage speeding and wrong-side driving, thus defeating one of their primary roles: to provide safe pedestrian space.

Wide service lanes also invite encroachment by shops, parked vehicles, or street vendors.

design recommendations

criteria for a service lane

A service lane can be considered on a high volume arterial road of sufficient width and with high speed traffic if the following criteria are met.

i. property access points more than once every 15 m and/or
ii. active edge

lane width

A service lane should be 3 - 3.5m wide, excluding parking. The tight width discourages fast driving.

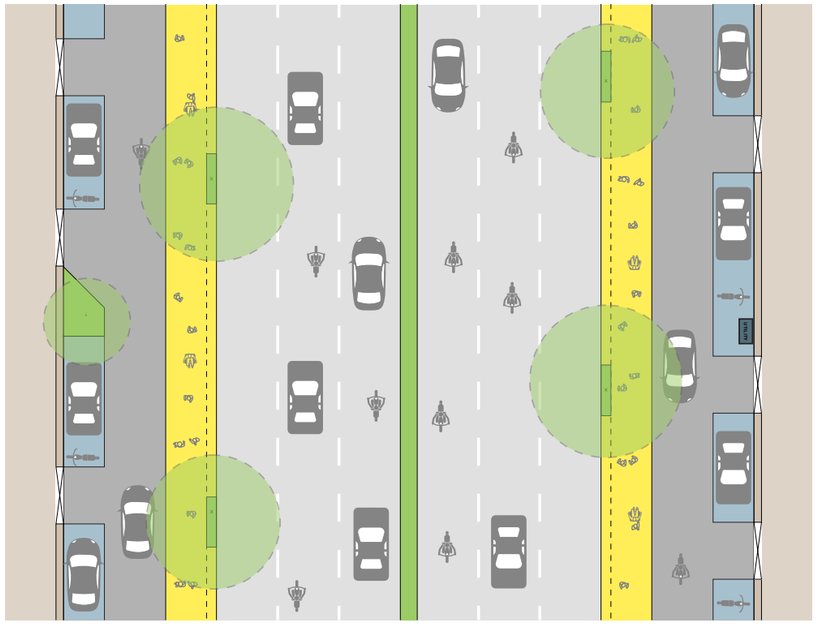
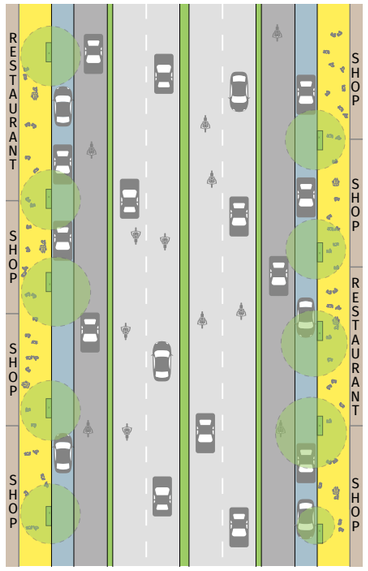


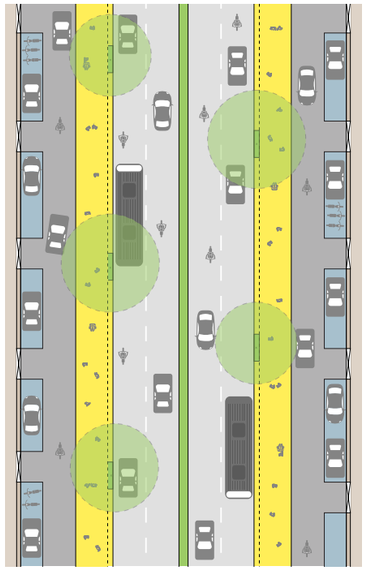
Fig. (above)
Piplod-Dumas Road, Surat

footpath and service lane depending on landuse



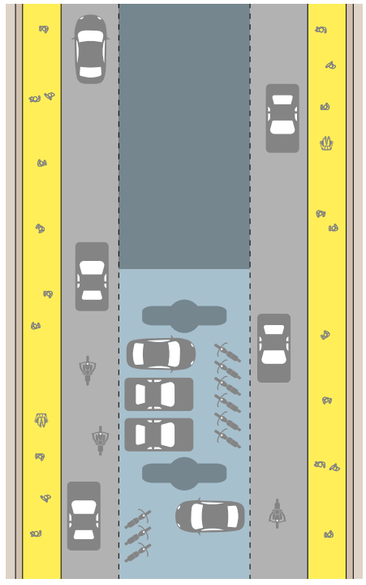
active street frontage

In areas with a porous boundary between the street and private properties, footpath should be located at the edge of the RoW.



inactive street frontage

In case of inactive street frontage, parking lane should be provided along the property edge and footpath along carriageway.



service lanes near flyovers

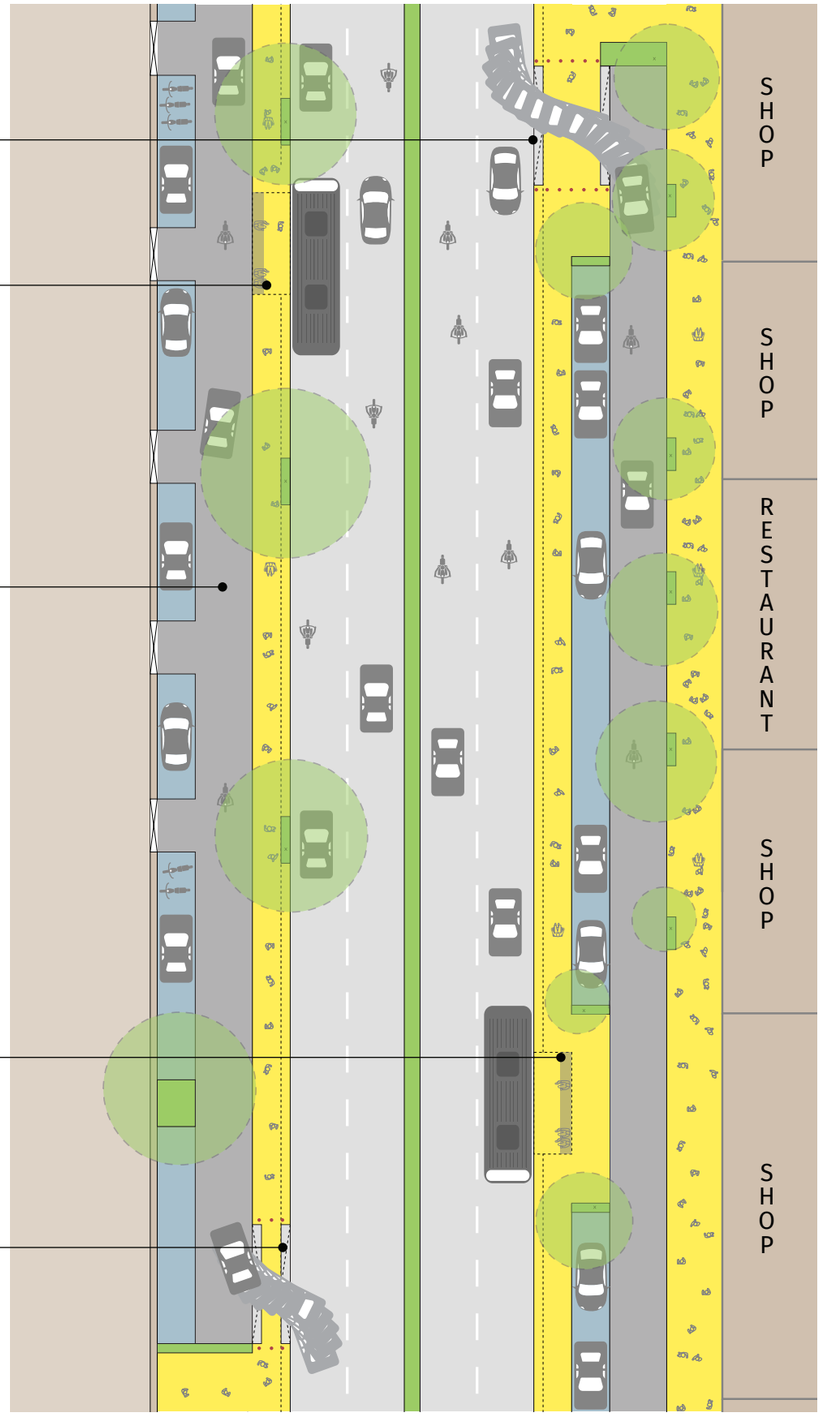
Service lane along flyovers should be 3-3.5m wide. Footpath of minimum width of 1.8m must be provided along the property edge. Parking can be shifted under the flyover.

workings of a service lane

Access
Access to service lanes should be provided via ramped crossings over the footpath and/or the cycle track

Location of bus stops
Bus stops should always be located along the carriageway edge

Shared space
Where dedicated cycle tracks are not provided, service lanes should be designed as slow, shared spaces for vehicles and cyclists.



Bus stop along active edge
Apart from the footpath along the active edge, additional footpath (of minimum width 1.8m) should be provided between the service lane and carriageway for the placement of the bus stop

Location of entry/exit
Access to service lanes should be provided at midblocks; service lanes should never start or end at an intersection

Fig. (facing page)
Pune

2.6 pedestrian crossings

what good crossings achieve

Good pedestrian crossings allow pedestrians to cross busy streets safely and conveniently.

challenges

To ensure uninterrupted flow of vehicles, many cities erect barriers along the centre to prevent pedestrians from crossing at regular intervals. However pedestrians tend to jump over these barricades, thus becoming prone to accidents.

Pedestrian crossings are often indicated only by painted zebra markings. Such visual indications do not provide any safety benefit to pedestrians.

design recommendations

tabletop crossings

Tabletop crossings are recommended in order to reduce vehicle speeds and also physically emphasise the presence of the pedestrian crossing.

width

Atleast 2m or as wide as the adjacent footpath, whichever is greater; 4m in areas of high pedestrian crossing movements, in accordance with IRC 103

height

Raised to the level of the adjacent footpath (maximum of 0.15m) with vehicle ramps of 1:8-1:10 slope

intervals

Every 150–250m

bulb-out

Bulb-outs to be provided in the parking lane at crossings at crossings to reduce the crossing distance

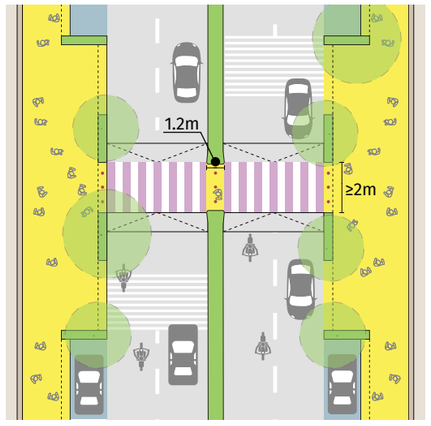
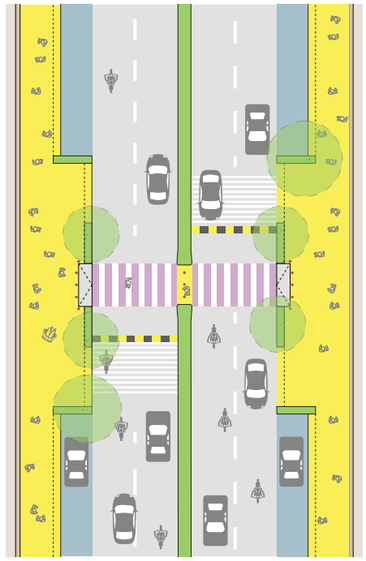


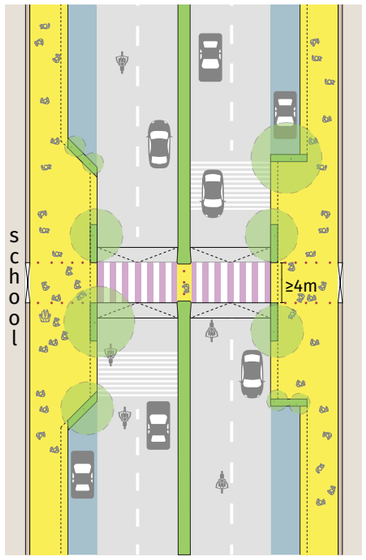
Fig. (above)
Harrington Road, Chennai

Fig. (below)
DP Road, Pune



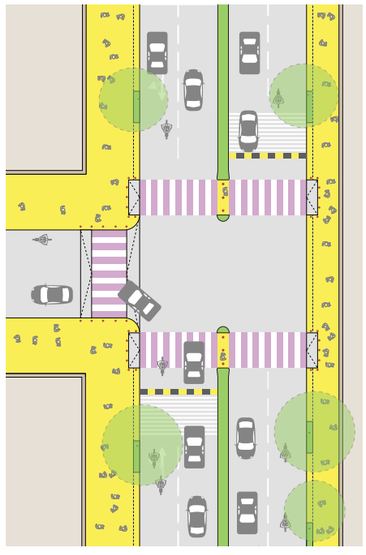
zebra crossings (at-grade)

Access: Footpath should be ramped down (slope < 1:10) to the level of the carriageway.
Intervals: Every 80-150m
Design: Speed bumps & rumble strips should be provided before the zebra crossings.



in front of schools

A tabletop crossing of at least 4m should be provided in front of schools. If vehicular access into the school is required, tabletop crossings should be provided 50m on either side of the gate.



at intersections

Crossings should be such that there is minimum deviation from the path of travel defined by the pedestrian zone in the footpath (pedestrian desire line).

foot-overbridges and subways

Foot-overbridges or subways are often inconvenient and hotspots for crime and sexual assault. Thus, pedestrians continue to cross at ground level at random locations, increasing the chances of a road crash.

Pedestrian foot-overbridges should be considered only on urban expressways where vehicle speeds are very high.

2.6.1 pedestrian refuges at midblock

what good medians achieve

A good median serves as a pedestrian refuge by reducing conflict between opposite directions of traffic and has frequent enough breaks to increase the number of pedestrian crossings and discourage motor vehicle users from driving in the wrong direction.

challenges

Medians that extend too far without opportunities to cross, turn right, or make a U-turn unnecessarily increase the total distance travelled by vehicles and thus encourage vehicle movement on the wrong side. Hence, provision of breaks at appropriate intervals in a median is critical.

If a median refuge is not wide enough, pedestrians may spill over into the carriageway while waiting for traffic to clear.

design recommendations

width

In order for the median to function as a safe and inclusive pedestrian refuge, a minimum width of 1.2m should be provided in accordance with IRC 103 to accommodate a wheelchair.

The median refuges should not be hindered by railings or high kerbs. Instead, bollards can be used to prevent motor vehicles from turning while ensuring pedestrian safety.

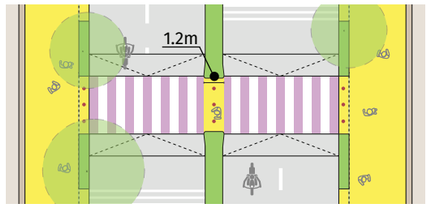
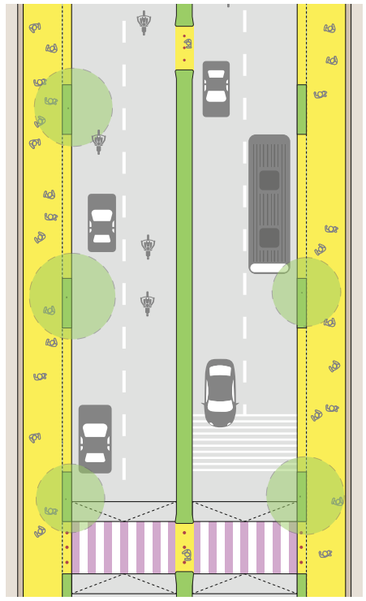


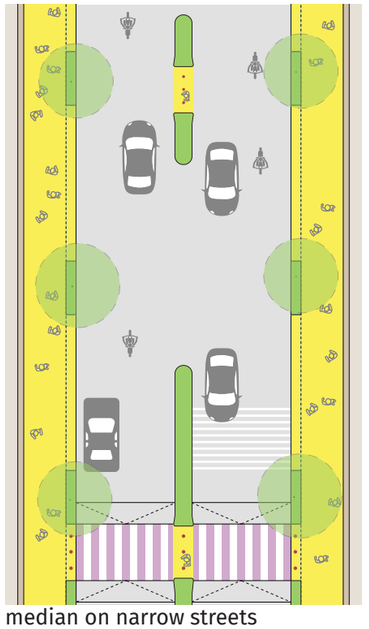
Fig. (above)
Marine Drive, Mumbai

Fig. (below)
Harrington Road, Chennai



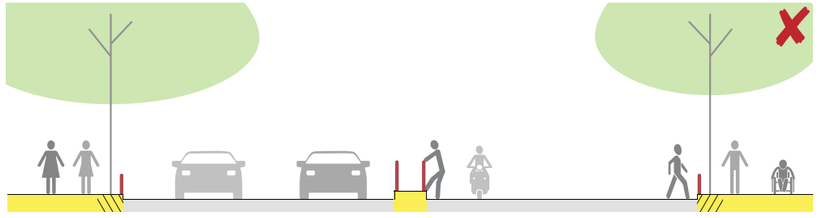
median on wide streets

If the street has 4 or more traffic lanes and a high traffic volume, continuous median of height 0.15m is advised.



median on narrow streets

On local, collector streets, periodic median segments between formal crossings function as pedestrian refuge islands.



railings

Railings and high curbs are not generally recommended.

They could be provided on high-speed arterial roads, with crossings at appropriate intervals.

Fig.
DP Road, Pune

2.6.2 pedestrian refuge islands

what good refuge islands achieve

Good refuge islands are large enough to handle observed pedestrian volumes at intersections and provide intermediate spaces where pedestrians can wait safely before crossing successive streams of traffic.

challenges

Refuge islands are mostly landscaped/ walled off and hence provide little or no space as a refuge.

Also, they are not wide enough, thereby resulting in spillover of pedestrians into the carriageway while waiting for traffic to clear.

design recommendations

criteria for refuge islands

Refuge islands should be provided at intersections where pedestrians have to cross more than two lanes of traffic in succession. These islands can also act as channelizers of traffic.

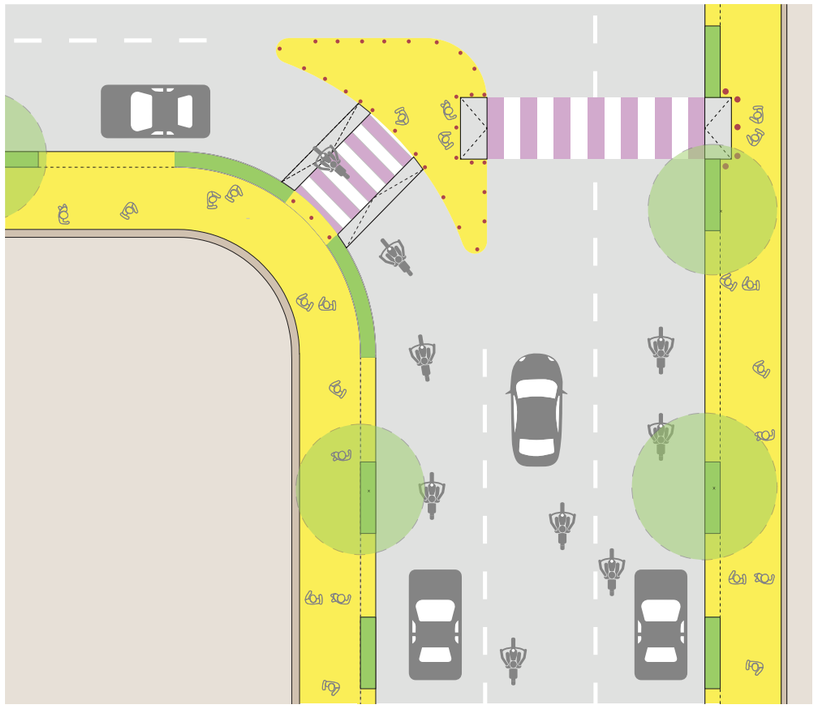
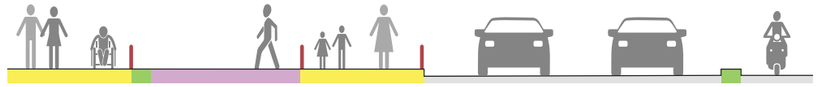


Fig. (above)
Mumbai

zones



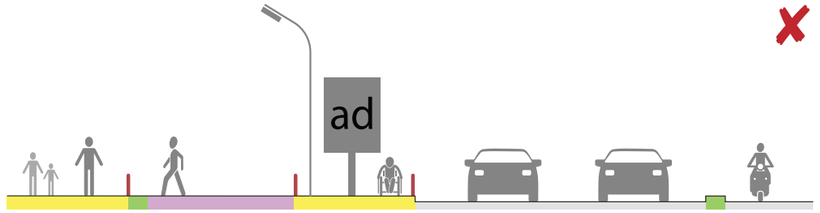
tabletop crossings

Tabletop crossings must be provided between the footpath and the refuge islands for safer crossing.

reflective bollards

Refuge islands should be at the same level as the footpath and highlighted by reflective bollards.

height



no obstructions

Light poles and signages, if any, should not obstruct pedestrians' movement and vision.

no advertisements

Advertisements should not be allowed on the entire refuge island.

Fig.
Pedestrian refuge in JM Road, Pune

2.7 shared streets

what good shared streets achieve

A well-designed shared street balances the needs of pedestrians, bicyclists, and motor vehicles. It is usually a local-access, narrow street without kerbs and sidewalks, and vehicles are slowed by placing trees, planters, and other obstacles in the street.

challenges

Inadequate pedestrian infrastructure has often converted Indian streets into shared streets. When not designed, this is unsafe as the pedestrians are forced to weave their way through traffic.

A common misconception about shared streets is that vehicles will be eliminated. The purpose of shared streets is to integrate street activities and travel modes through design and provide on-street parking strategically to reduce travel speeds.

Shared street is not a traffic calming method. It creates livable streets that encourage socializing, outdoor play for children, and walking and cycling.

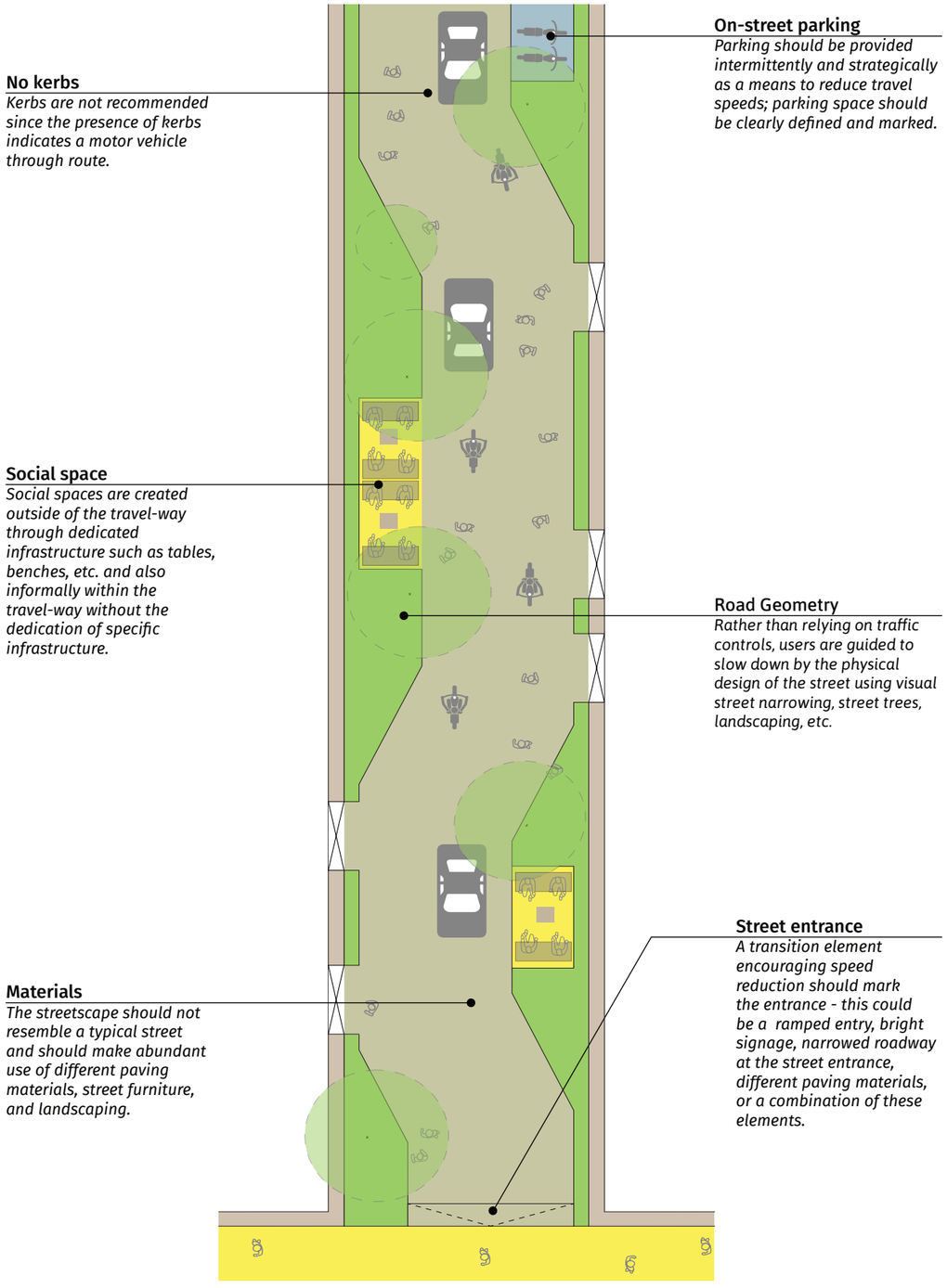
design recommendations

appropriate locations

Shared streets are generally provided in commercial areas with high pedestrian footfall and residential areas. In commercial areas, this can increase retail activity. They are not appropriate in streets that carry through traffic.

Fig. (above)
Church Street, Bangalore

Fig. (below)
Church Street, Bangalore

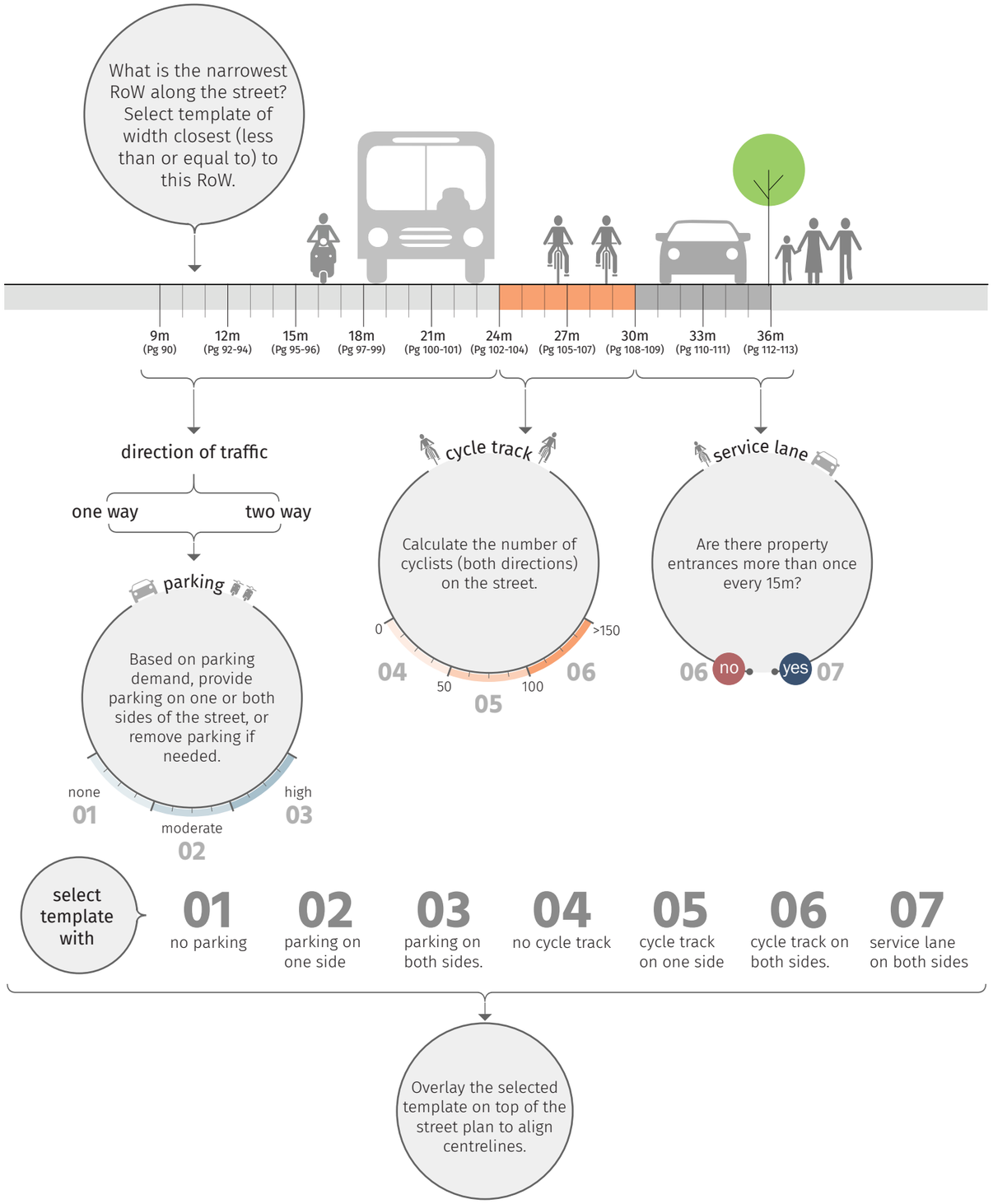


3

STREET DESIGN TEMPLATES

9m | 12m | 15m | 18m | 21m | 24m | 27m | 30m | 33m | 36m

3 STREET DESIGN TEMPLATES



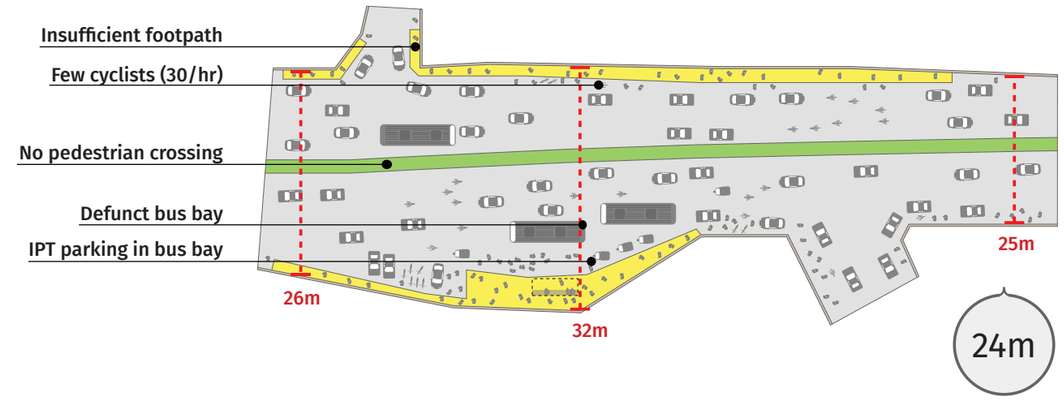
		DIRECTION OF TRAFFIC	PARKING DEMAND	CYCLE TRACK	SERVICE LANE
9m	pg 90	↑↓	no parking		
12m	pg 91	↑↓	one side		
	pg 92	↑↓	no parking		
	pg 93	↑↓	one side		
	pg 94	↑	one side		
15m	pg 95	↑↓	two sides		
	pg 96	↑	two sides		
18m	pg 97	↑↓	two sides		
	pg 98	↑↓	one side		
	pg 99	↑	two sides		
21m	pg 100	↑↓	two sides		
	pg 101	↑	two sides		
24m	pg 102	↑↓	two sides	two sides	
	pg 103	↑↓	two sides	one side	
	pg 104	↑↓	two sides	no cyle track	
27m	pg 105	↑↓	two sides	two sides	
	pg 106	↑↓	two sides	one side	
	pg 107	↑↓	two sides	no cyle track	
30m	pg 108	↑↓	two sides	no cyle track	two sides
	pg 109	↑↓	two sides	two sides	no service lane
33m	pg 110	↑↓	two sides	no cyle track	two sides
	pg 111	↑↓	two sides	two sides	no service lane
36m	pg 112	↑↓	two sides	two sides	two sides
	pg 113	↑↓	two sides	two sides	no service lane

3.1 design process

step 01

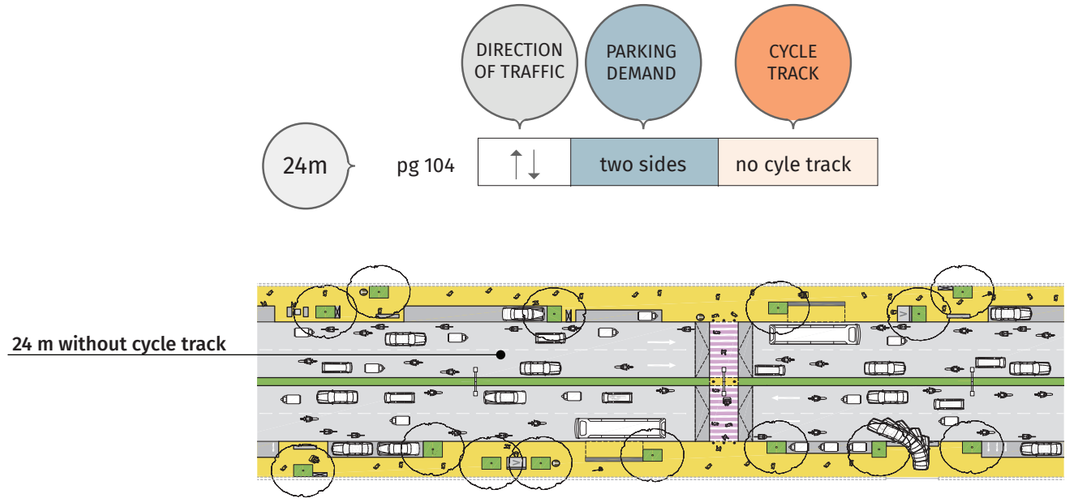
Study the existing conditions on the road. This includes the available Right-of-Way (RoW), pedestrian movement, desire lines, parking counts and violations, vehicular traffic etc.

Identify and demarcate all the different RoWs on the street between two consecutive intersections. The narrowest RoW will determine the maximum possible lanes in the carriageway along the entire street.



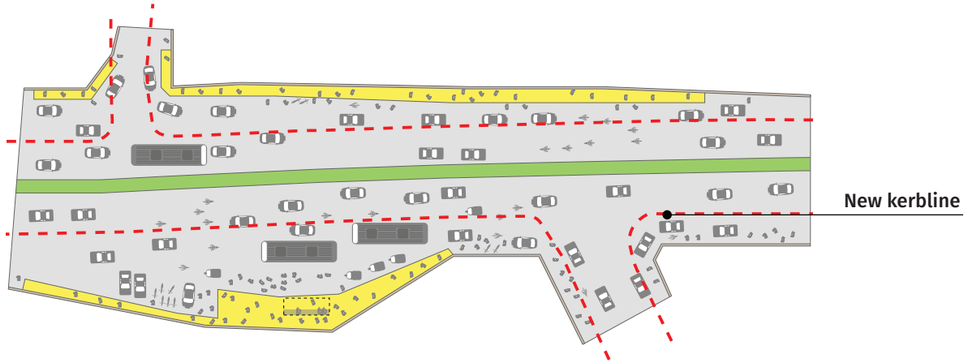
step 02

Based on the pedestrian, cyclist and parking counts observed in step 01, select a relevant template that is closest to the narrowest RoW. Given below is a template that has been chosen for this example.



step 03

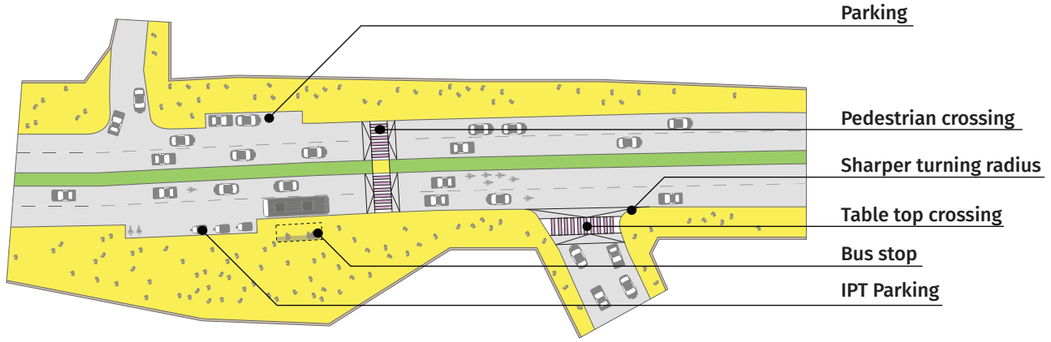
Overlay the selected template on the drawing of the street. Align the centrelines and mark the new kerblines on the drawing.



step 04

Refer to the 'Street design elements' section and detail out the street edge depending on the local context.

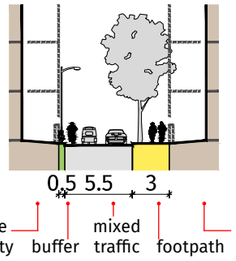
Provide sufficient parking spaces based on the requirements identified in step 01.

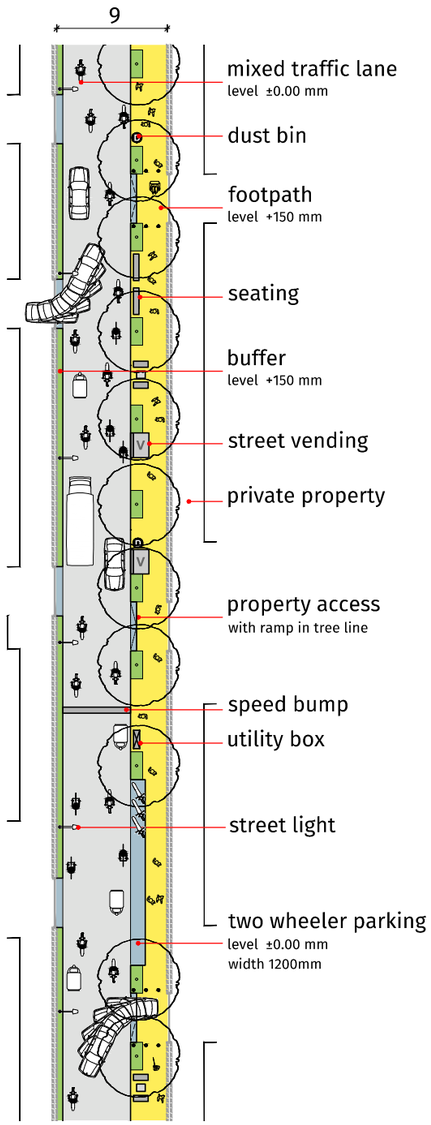


9M with footpath on one side

two way

footpath



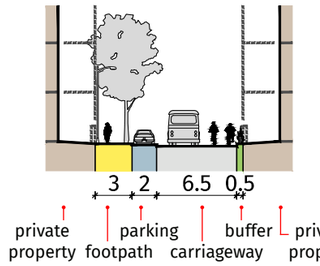


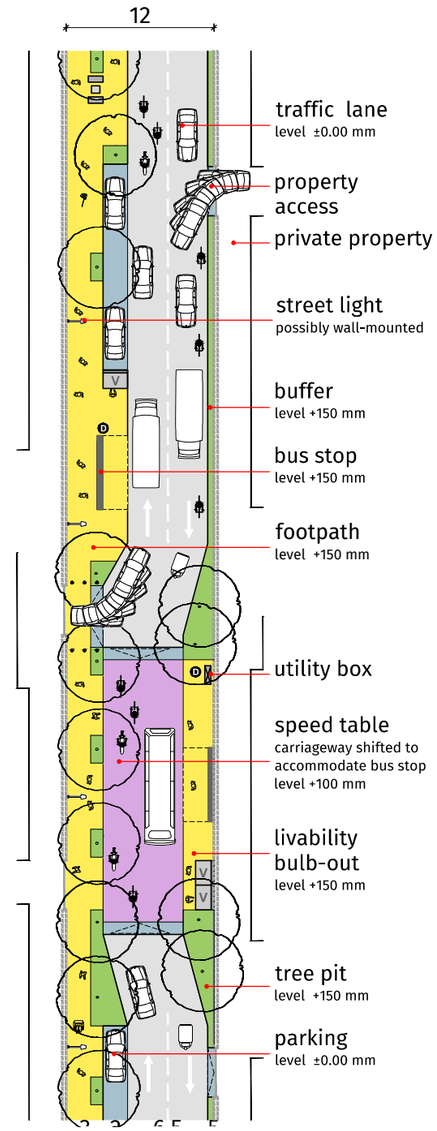
In a narrow street, it is recommended to provide footpath on one side so that pedestrians have a dedicated slow zone. This works especially well in residential areas.

two-way with footpath on one side 12M

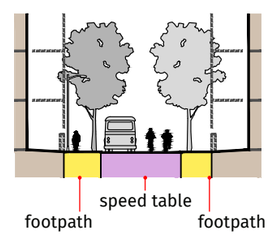
two way

footpath





To accomodate the bus stop on the other side, the carriageway is shifted, forming a chicane which also helps slow down vehicles. To improve the safety of the pedestrians crossing from the other side to reach the bus stop, the entire area is raised to create a speed table, which is easier to construct in the case of narrow streets.

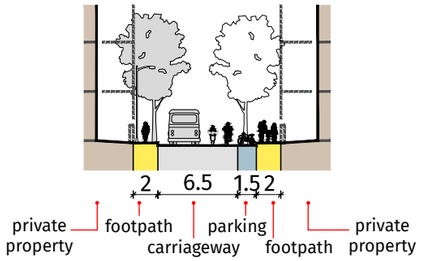


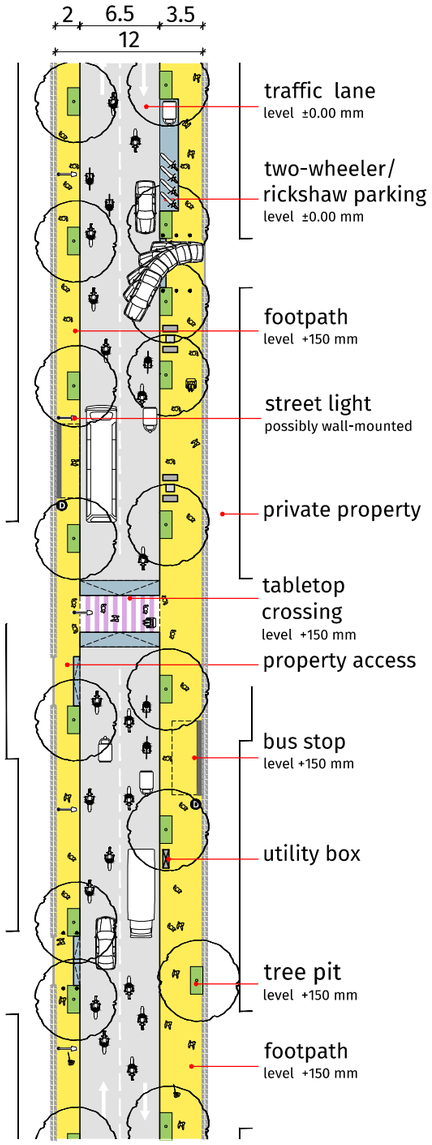
Section across speed table

12M two-way with parking on one side

two way

footpath



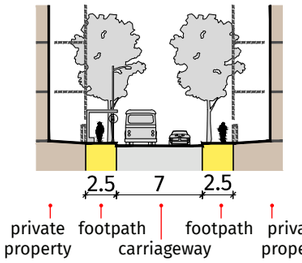


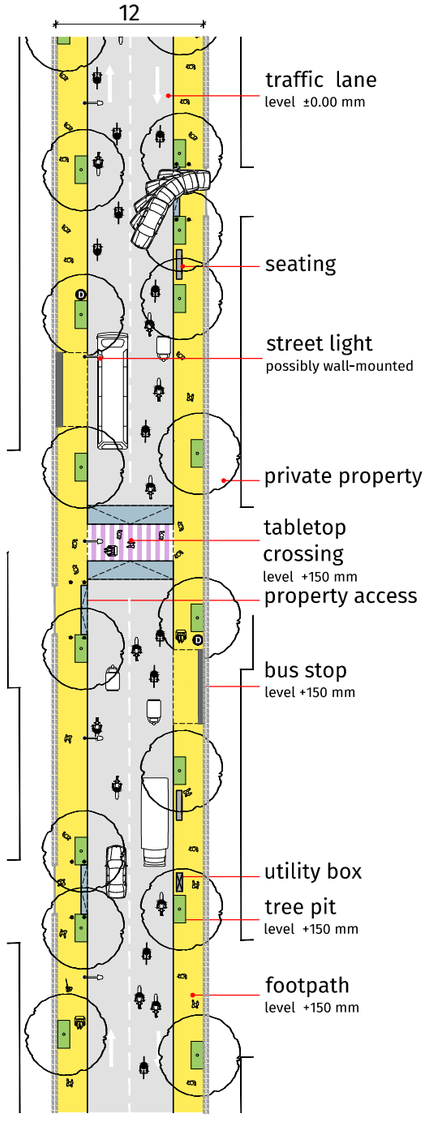
In a narrow street, if there is high commercial activity along both edges of the street, footpaths can be provided on both sides.

two-way with no parking 12M

two way

footpath

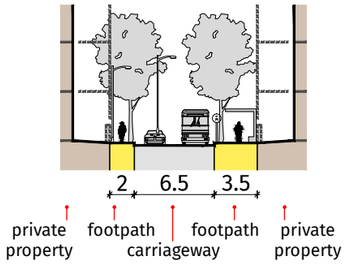


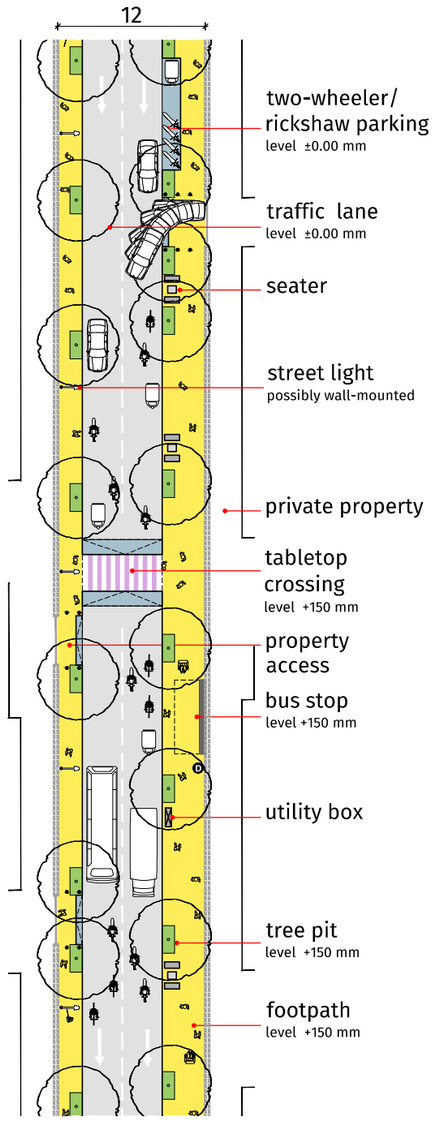


12M one-way with parking on one side

one way

footpath

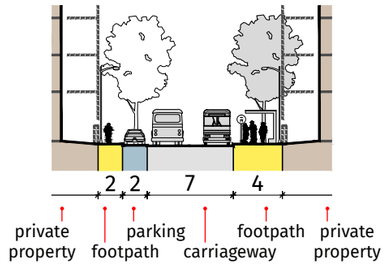


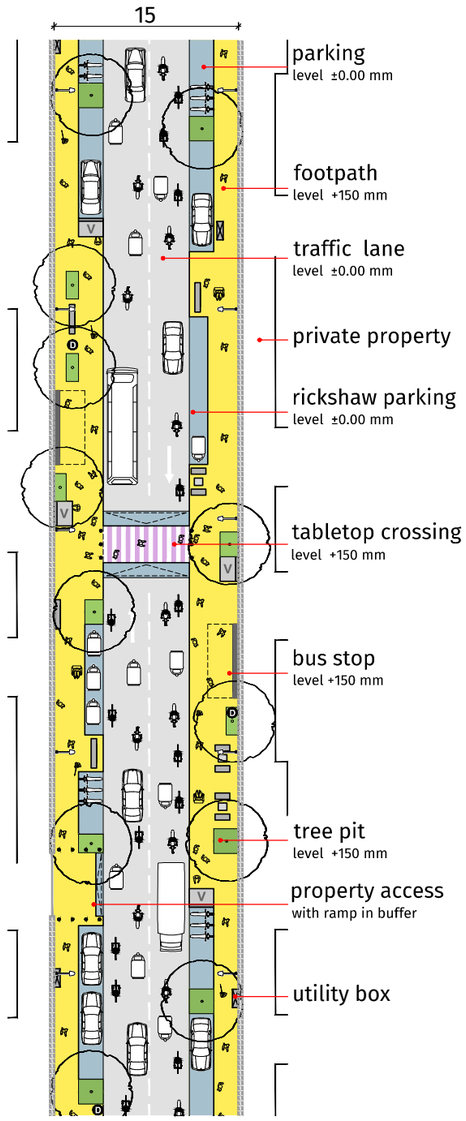


two-way with parking on both sides 15M

two way

footpath

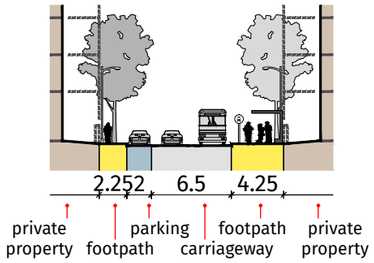


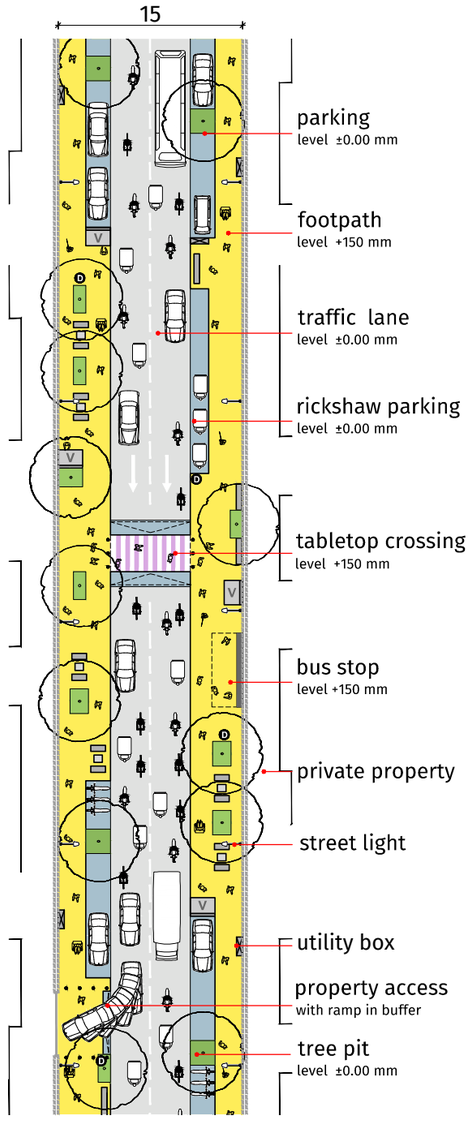


15M one-way with parking on both sides

one way

footpath

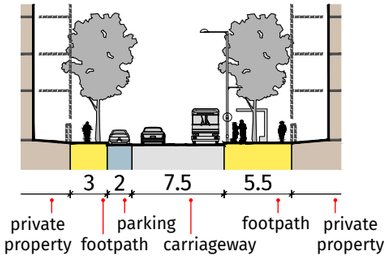


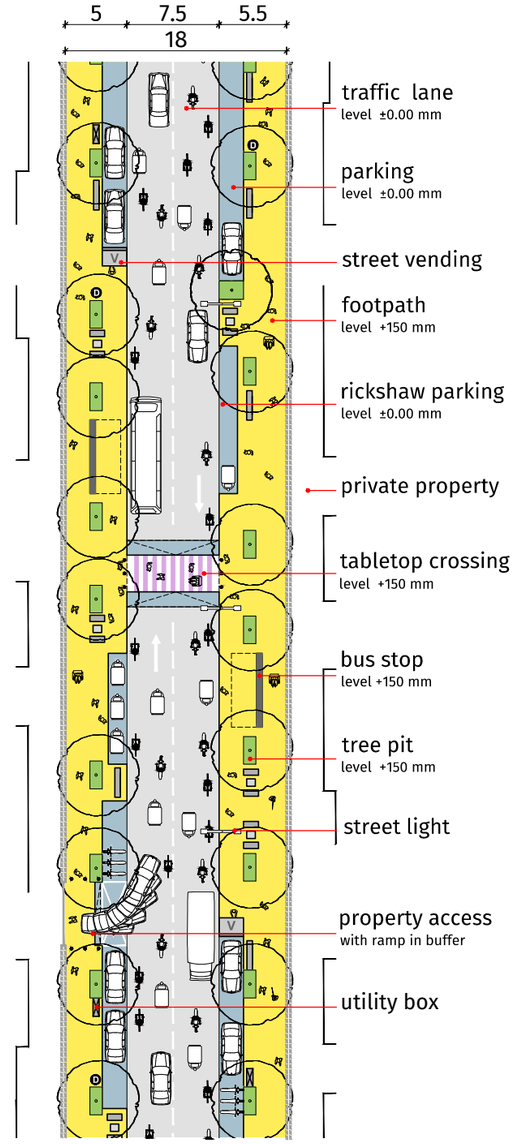


two way with parking on both sides 18M

two way

footpath



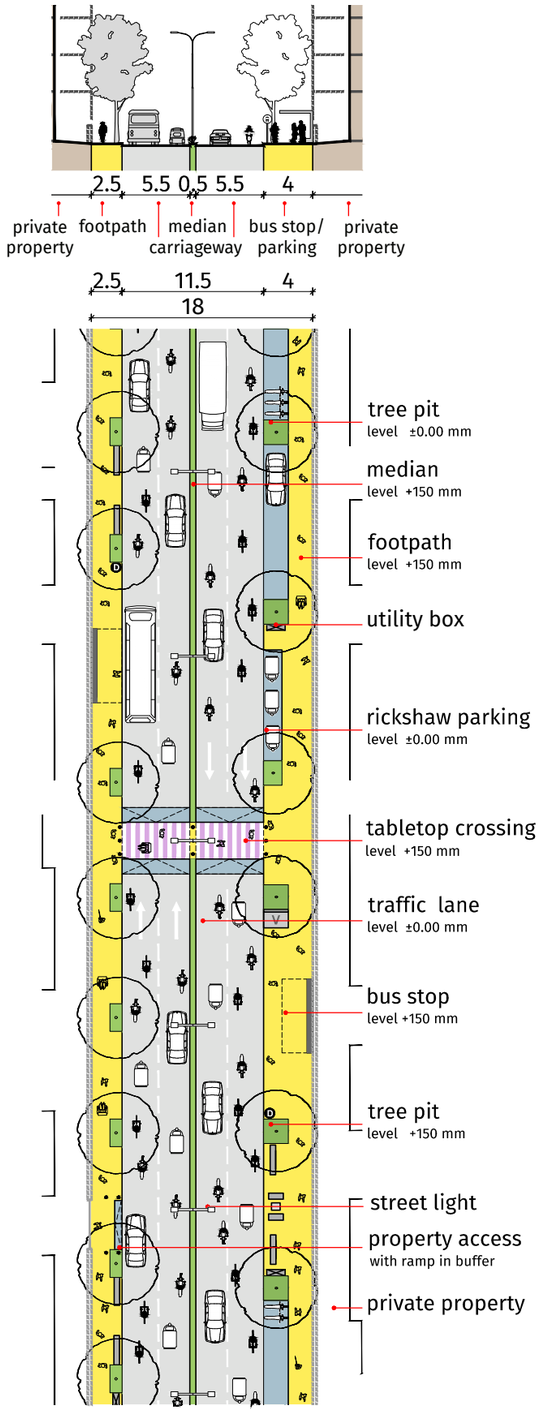


18M two-way with parking on one side

two way

footpath

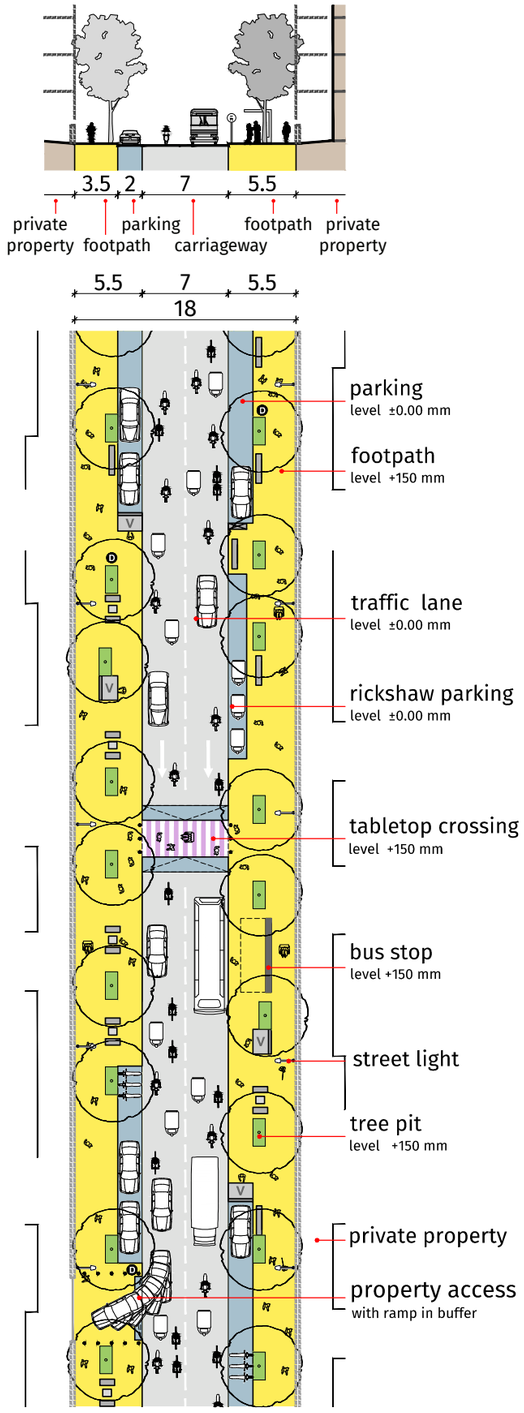
median



one-way with parking on both sides 18M

one way

footpath

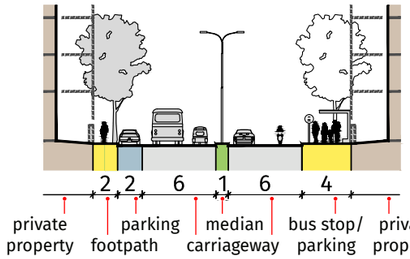


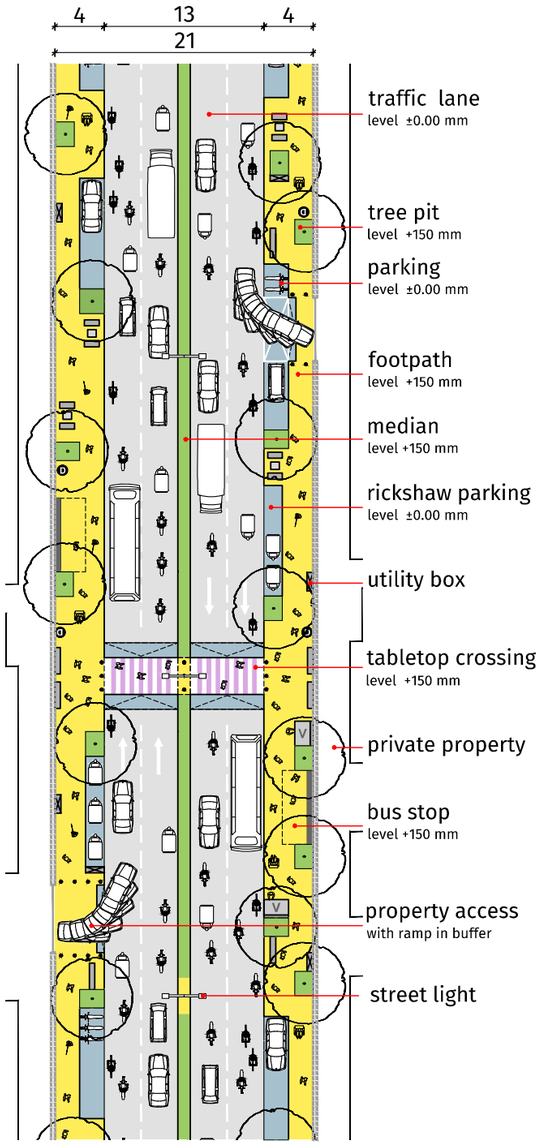
21M two-way with parking on both sides

two way

footpath

median



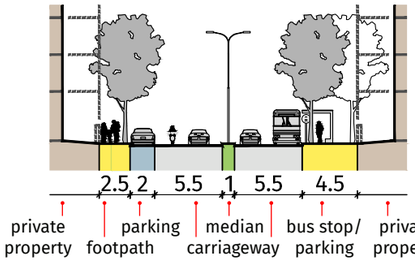


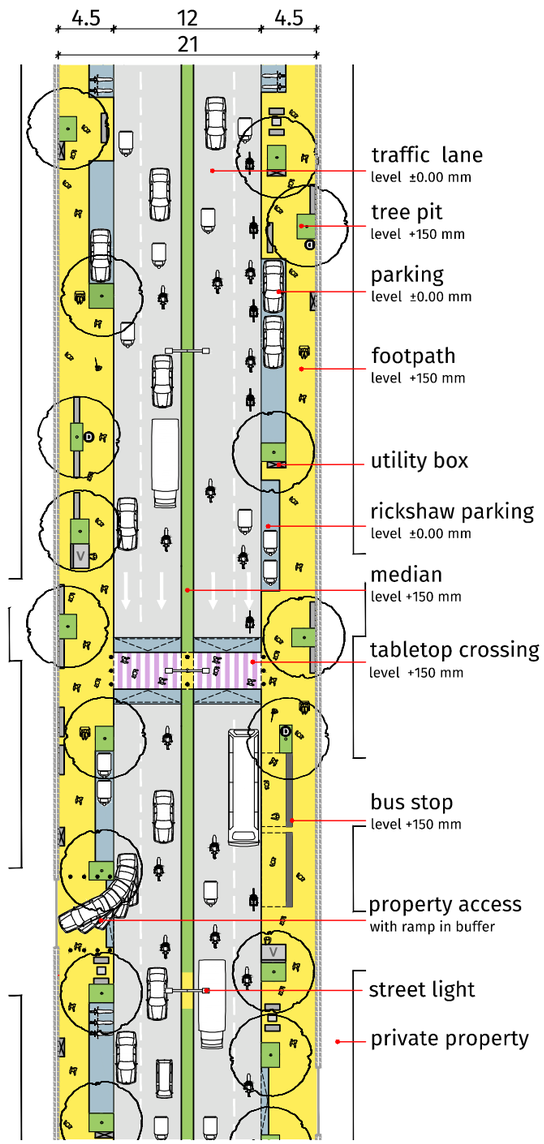
one-way with parking on both sides 21M

one way

footpath

median





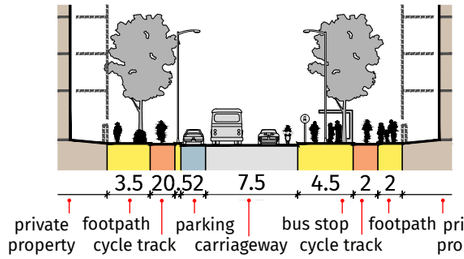
This is a special case found in many cities, where roads that were originally designed as two-way streets are made unidirectional. In such scenarios, interventions like adding a median, proper walkways, safer crossings and organised parking could help enhance pedestrian safety.

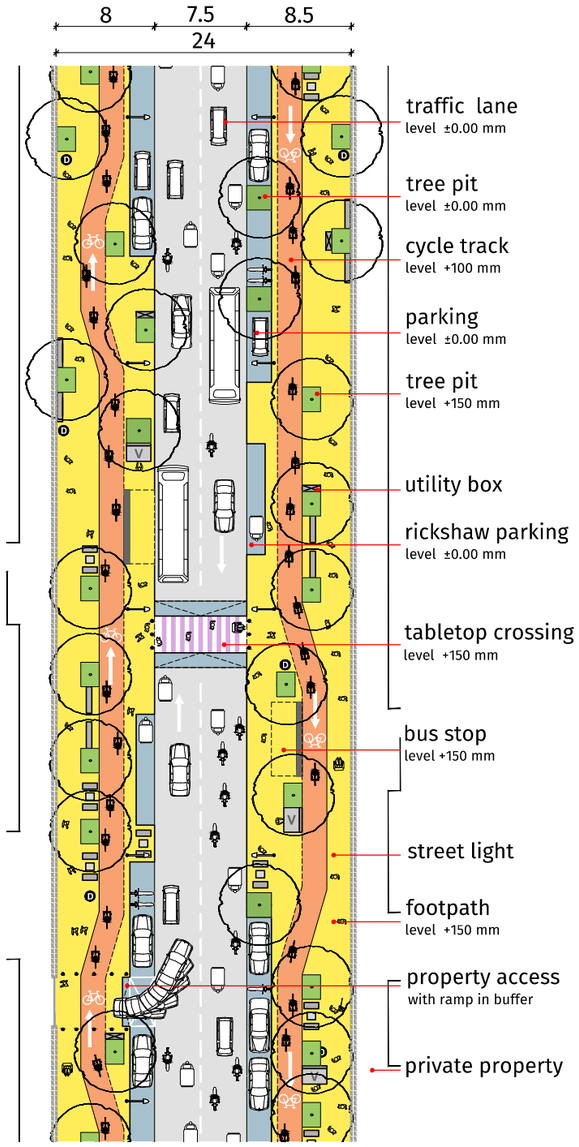
24M with cycle track on both sides

two way

footpath

cycle track





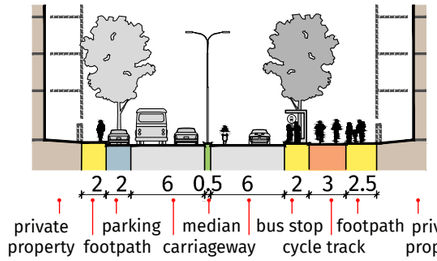
with cycle track on one side 24M

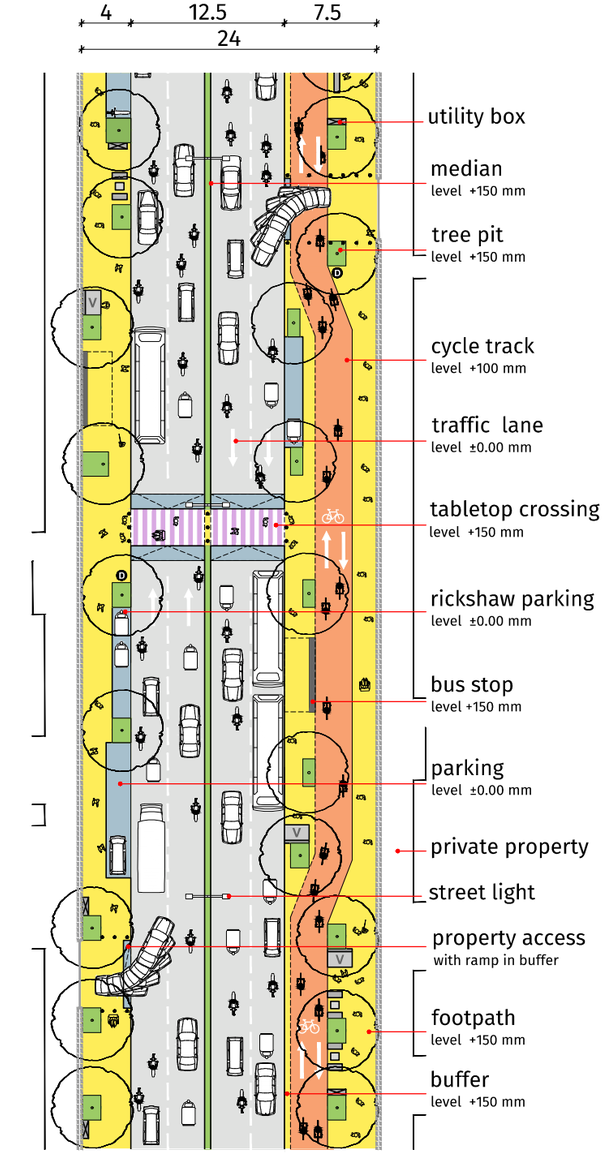
two way

footpath

cycle track

median



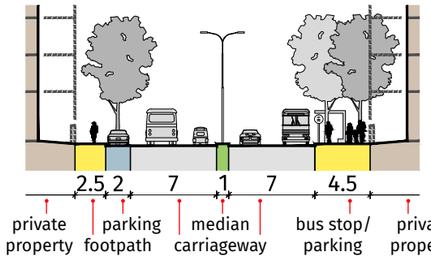


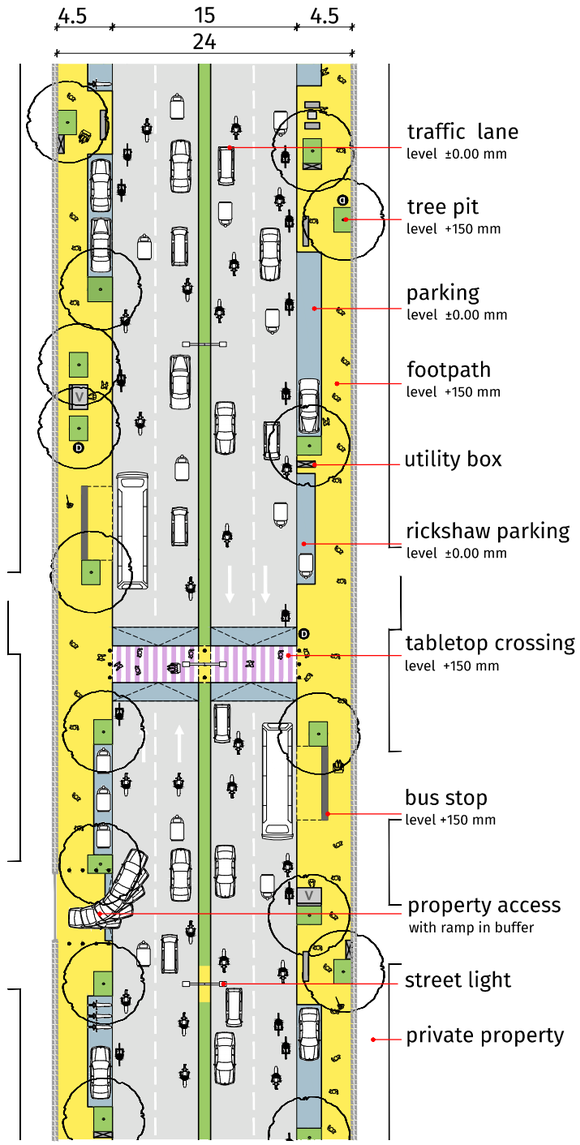
24M without cycle track

two way

footpath

median





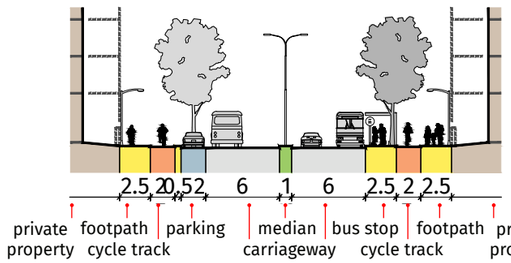
with cycle track on both sides 27M

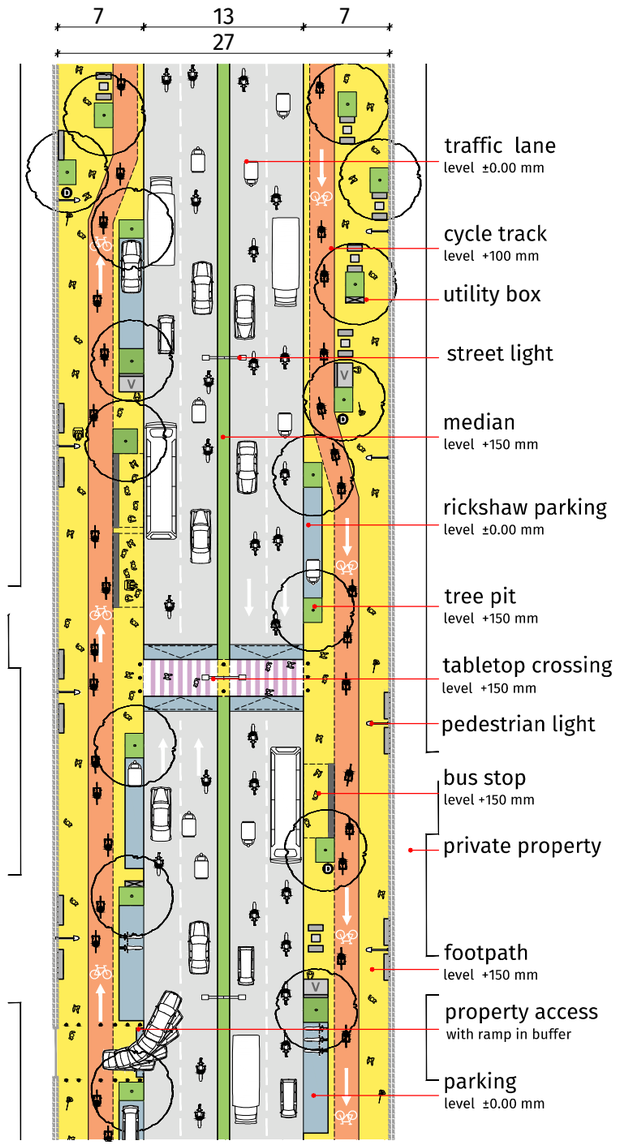
two way

footpath

cycle track

median





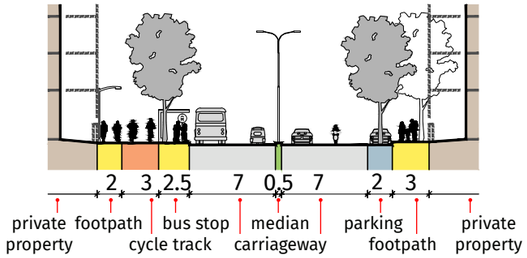
27M with cycle track on one side

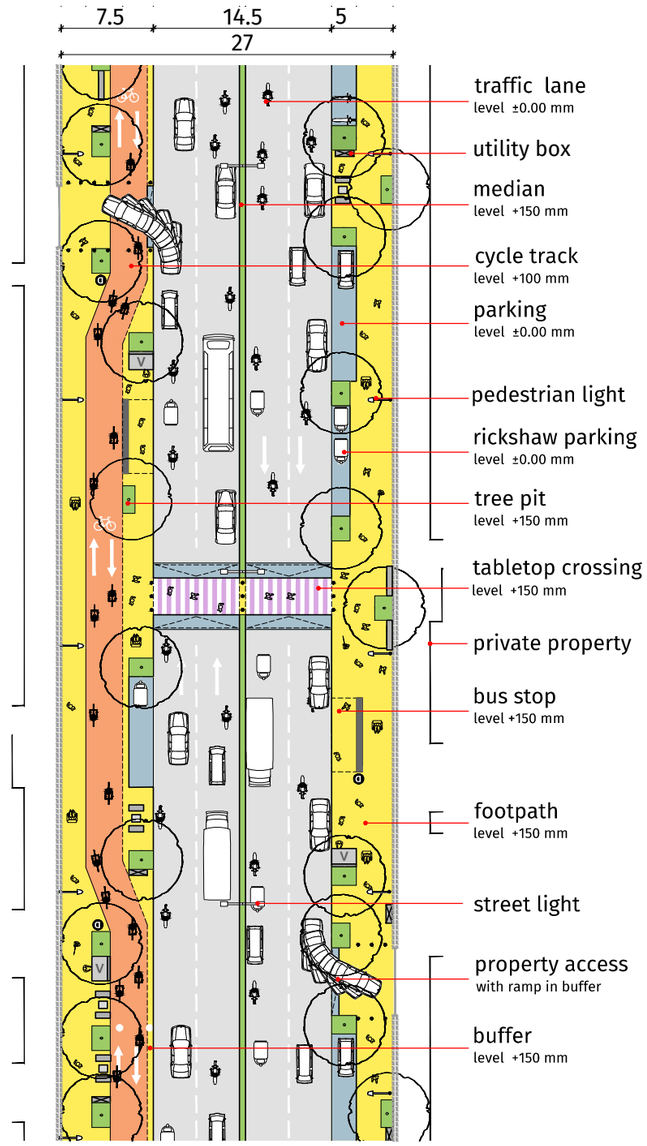
two way

footpath

cycle track

median



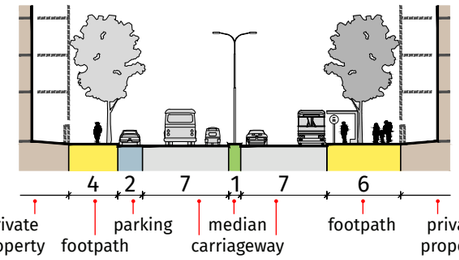


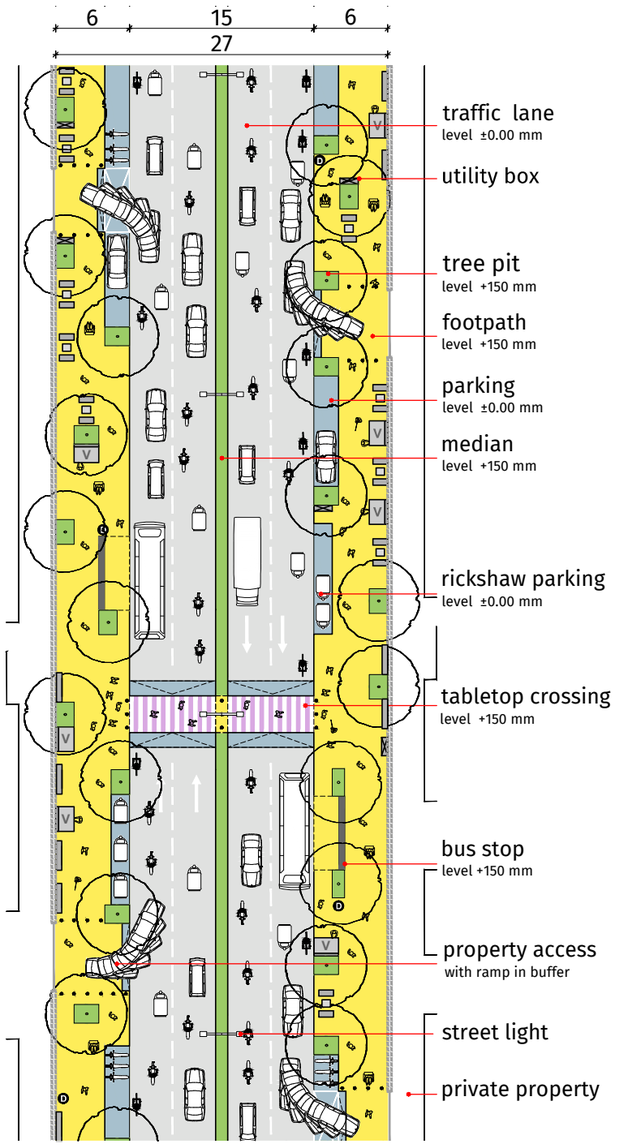
without cycle track 27M

two way

footpath

median





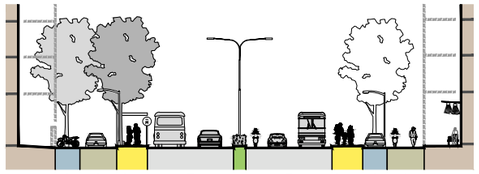
30M with shared service lane

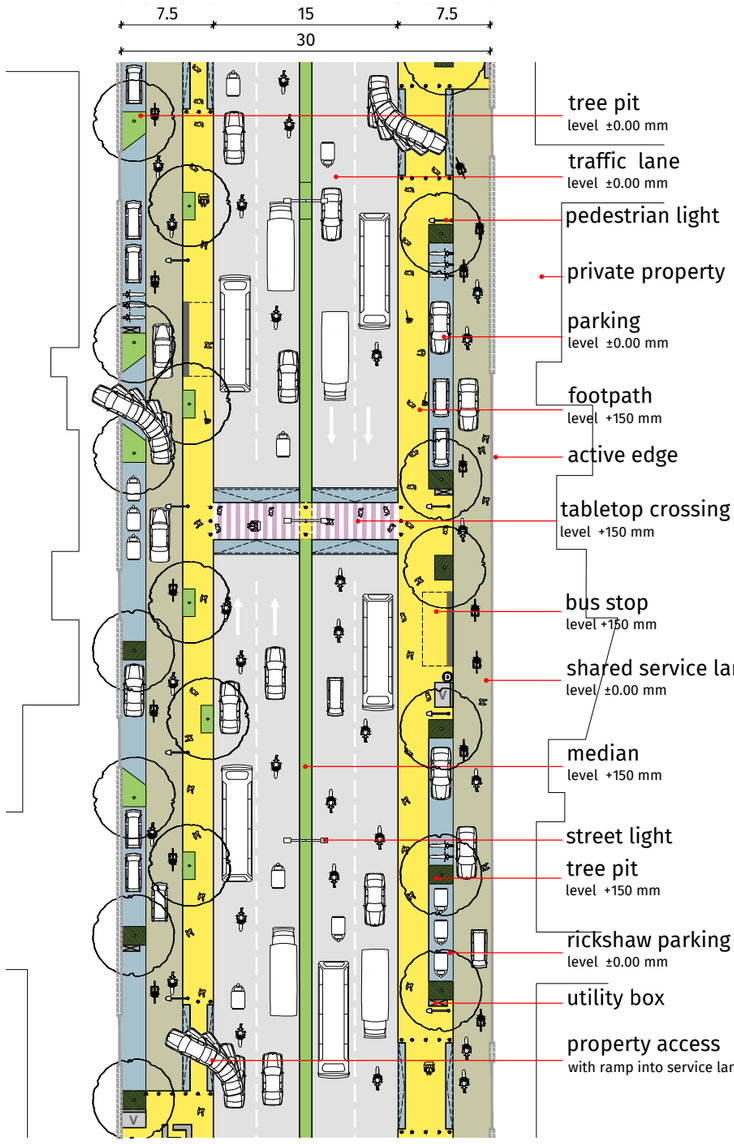
two way

footpath

median

shared lane





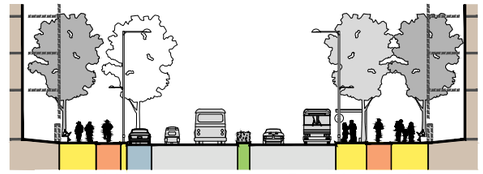
with cycle track on both sides 30M

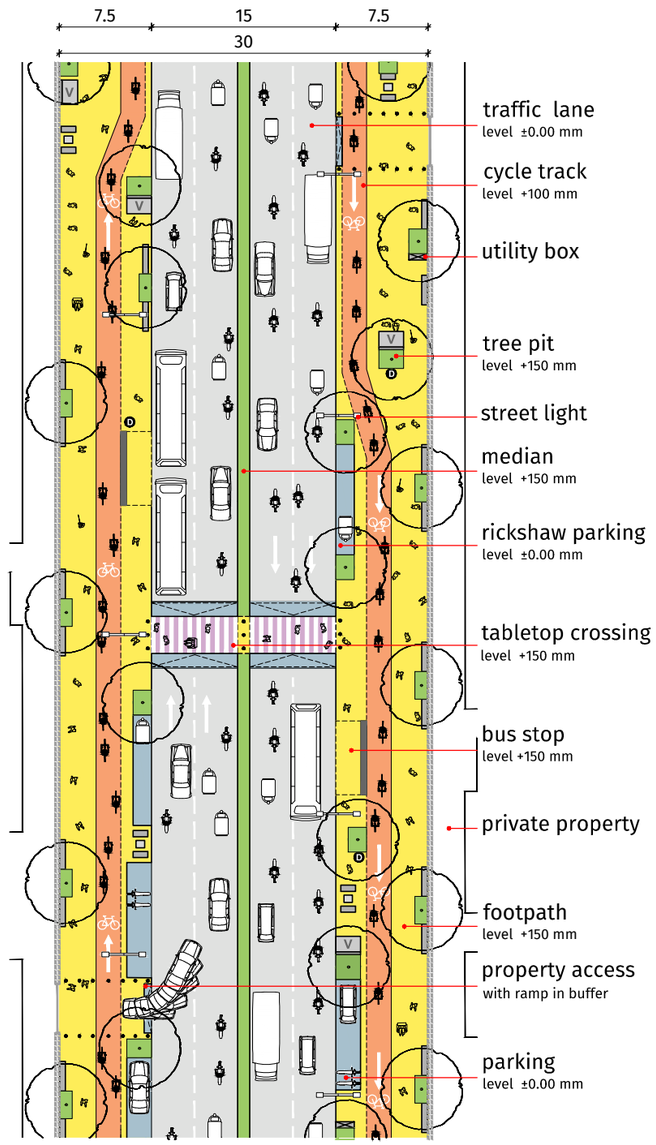
two way

footpath

cycle track

median





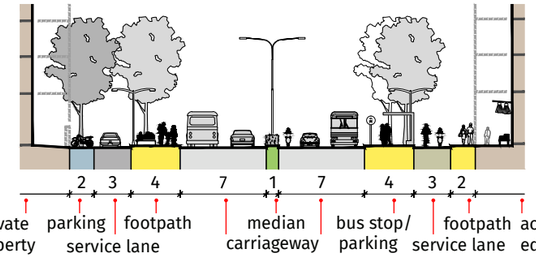
33M with shared service lane

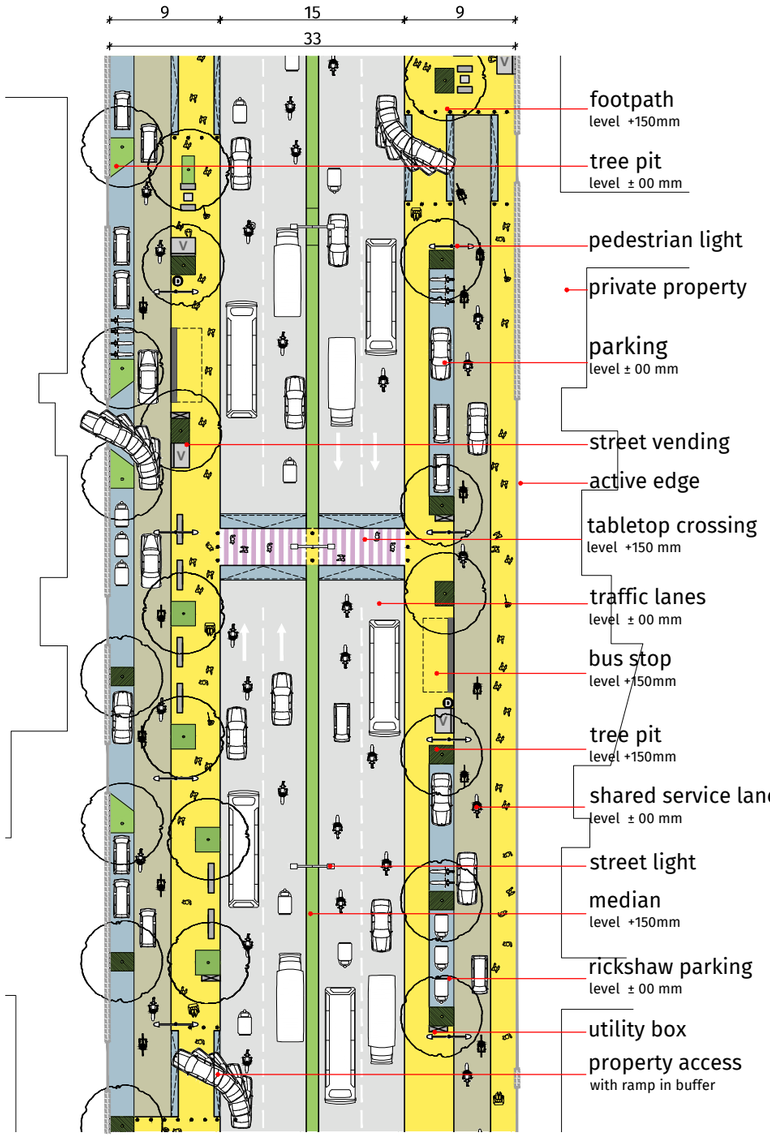
two way

footpath

median

shared lane





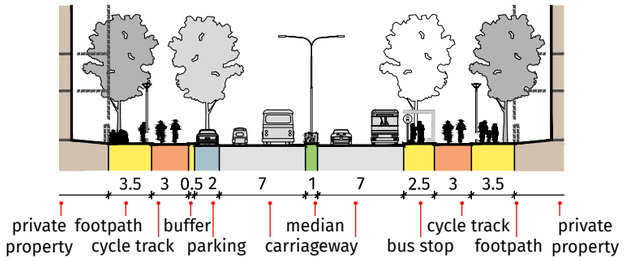
33M with cycle track on both sides

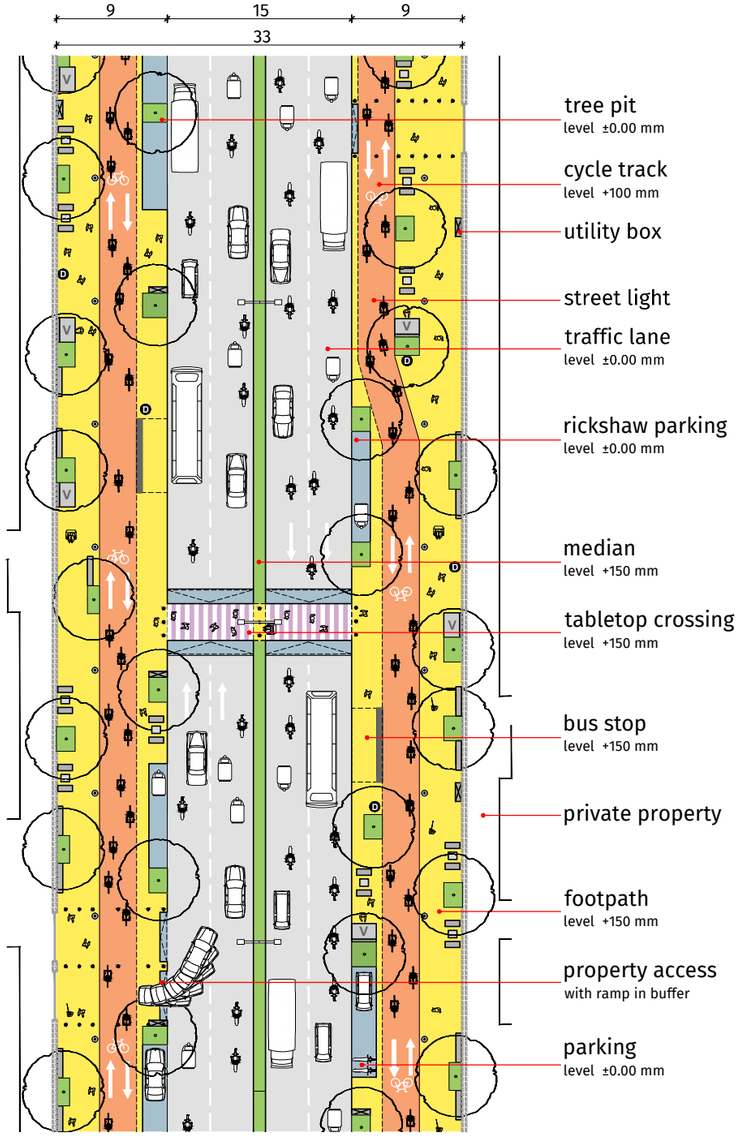
two way

footpath

cycle track

median





36M with service lane and cycle track

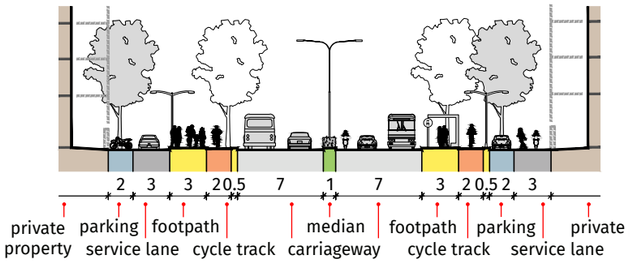
two way

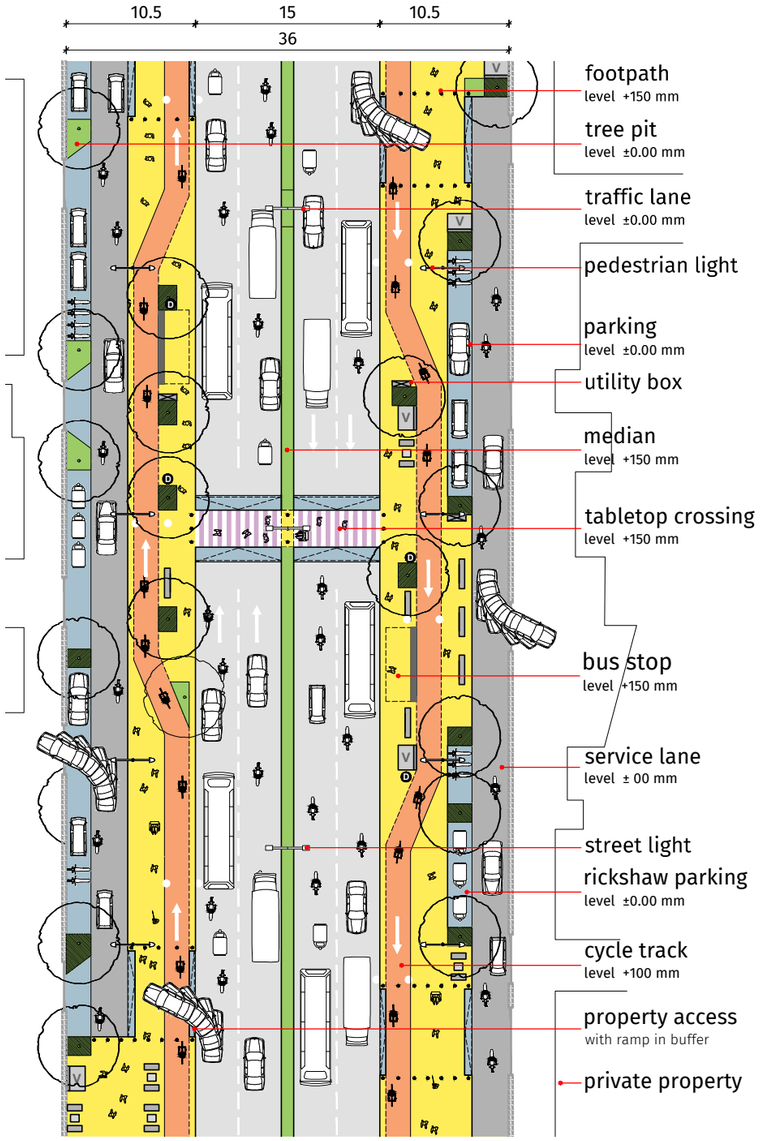
footpath

cycle track

median

service lane





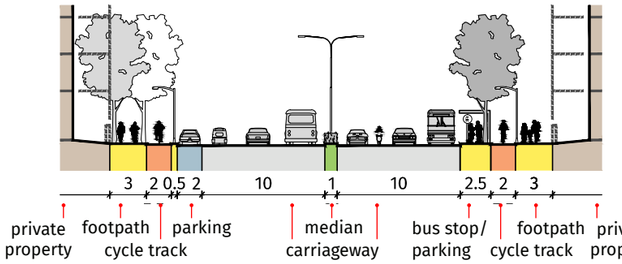
with cycle track 36M

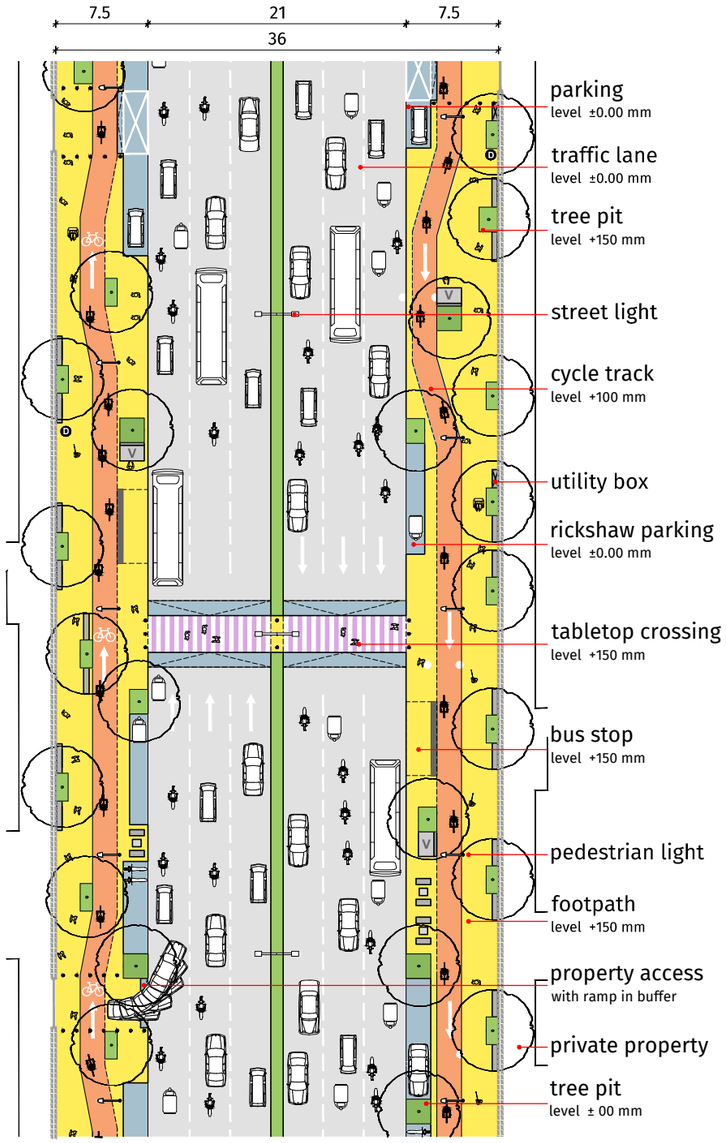
two way

footpath

cycle track

median





4

INTERSECTION DESIGN

4 INTERSECTION DESIGN

Intersection design involves weighing the potentially conflicting goals of safety and vehicle throughput. The quality of an intersection can vary significantly depending on its various design features. It is desirable to design an intersection that prioritises throughput of public transport, cycles, and pedestrians. This section briefly introduces the basic elements of intersections and then provides a step-by-step guide for designing intersections.

Turning radius

Turning radius at intersections should be 4m on local and collector streets and maximum 9m on arterial and sub-arterial streets. Small turning radius ensures slowing down of vehicles at the turn and increases pedestrian safety while crossing.

Medians

Medians reduce conflicts and enable pedestrians to analyse a single direction of traffic at a time. Tall, bushy plants should be avoided in medians as they obstruct pedestrian visibility.

Crossings

Crossings denote areas for pedestrian movement when perpendicular traffic is stopped. They should be accompanied by physical traffic calming measures such as speed tables at unsignalised intersections.

Refuge Islands

Refuge islands reduce the number of traffic lanes pedestrians must cross at a time. The island must remain free of landscaping and fencing in order to serve as a refuge for pedestrians.

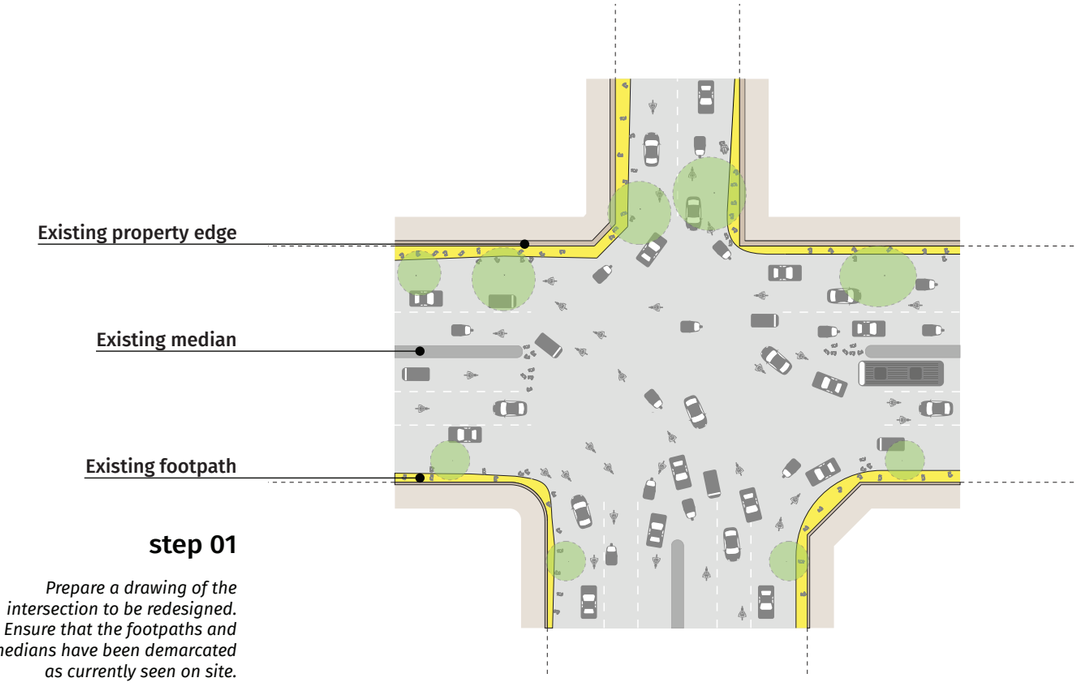
Levels

Level of the carriageway at pedestrian crossings across left turn pockets can be raised to that of the footpath in order to improve safety and convenience for pedestrians. As pedestrians cross to the footpath on the opposite side, they remain at the same level.

Left turn pockets

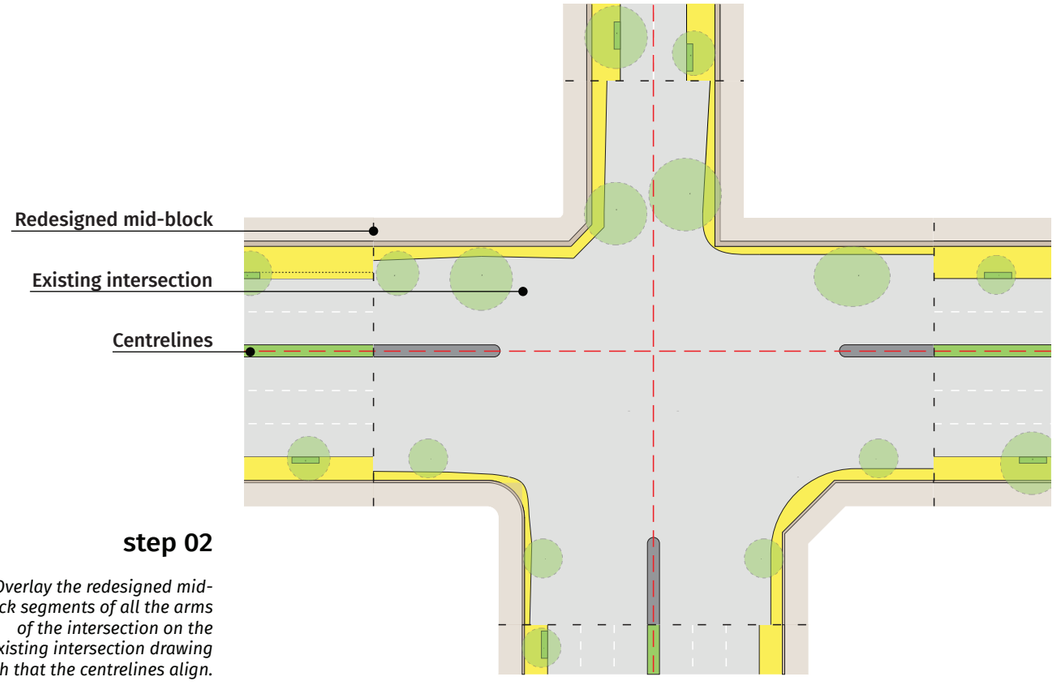
Left turn pockets can increase junction capacity by allowing vehicles to make free left turns. The preferred design incorporates a 30° angle of approach. Since vehicles enter the outgoing arm at a more abrupt angle, they are compelled to reduce their speeds.

4.1 design process



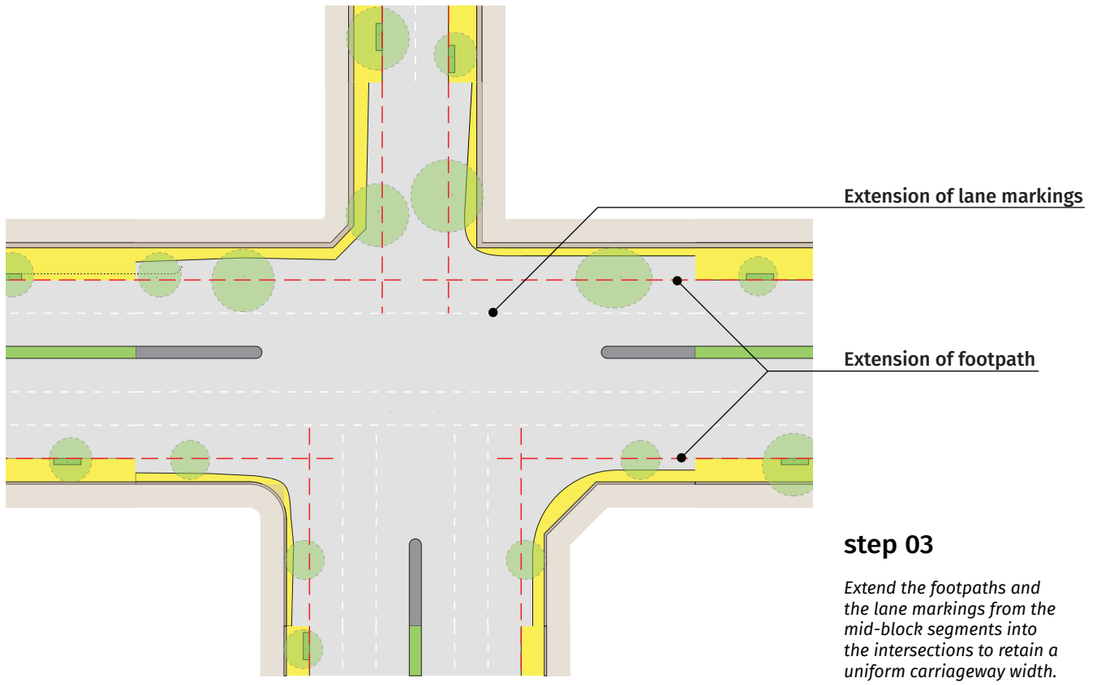
step 01

Prepare a drawing of the intersection to be redesigned. Ensure that the footpaths and medians have been demarcated as currently seen on site.



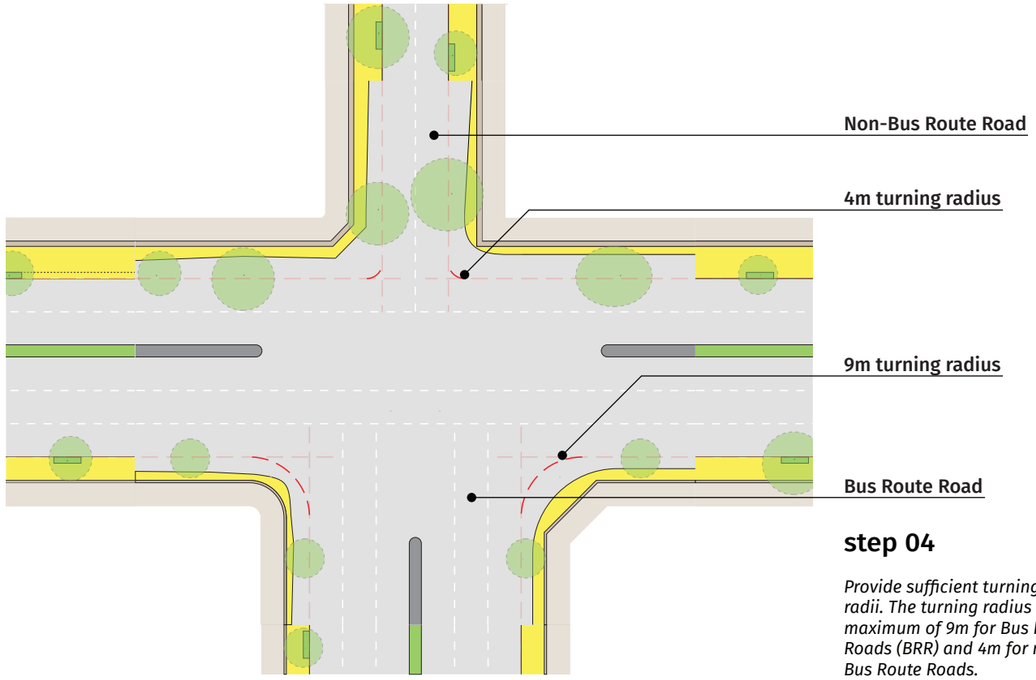
step 02

Overlay the redesigned mid-block segments of all the arms of the intersection on the existing intersection drawing such that the centrelines align.



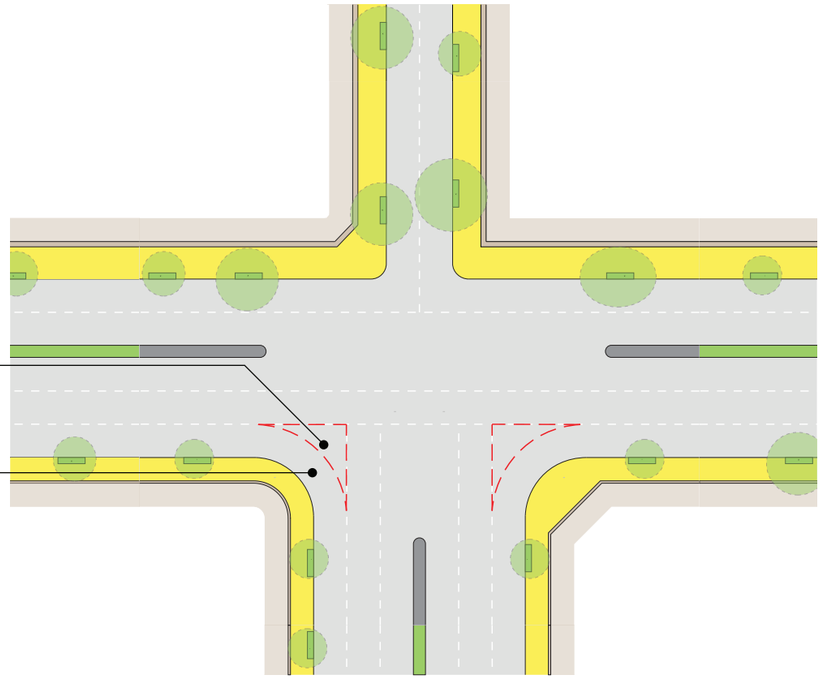
step 03

Extend the footpaths and the lane markings from the mid-block segments into the intersections to retain a uniform carriageway width.



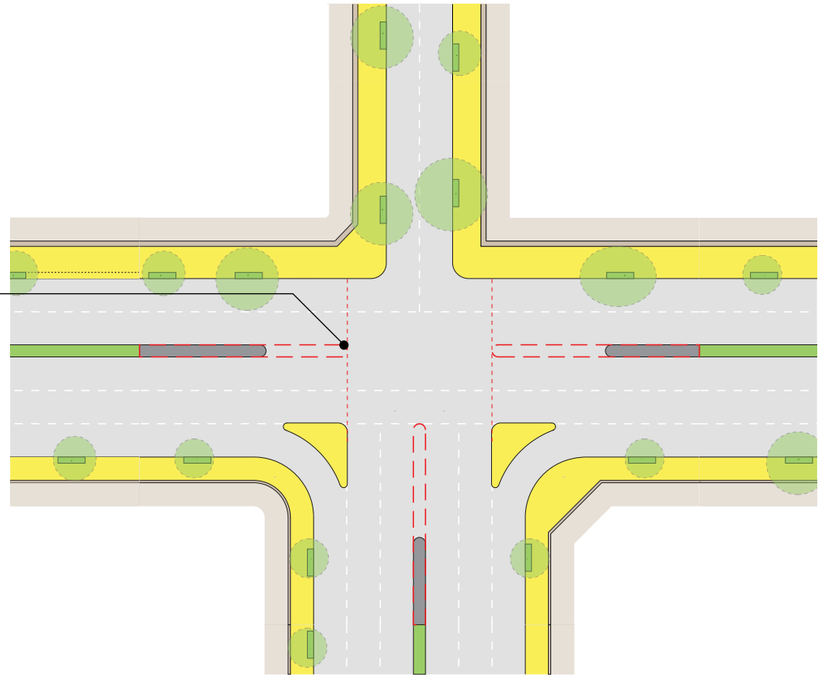
step 04

Provide sufficient turning radii. The turning radius is a maximum of 9m for Bus Route Roads (BRR) and 4m for non-Bus Route Roads.



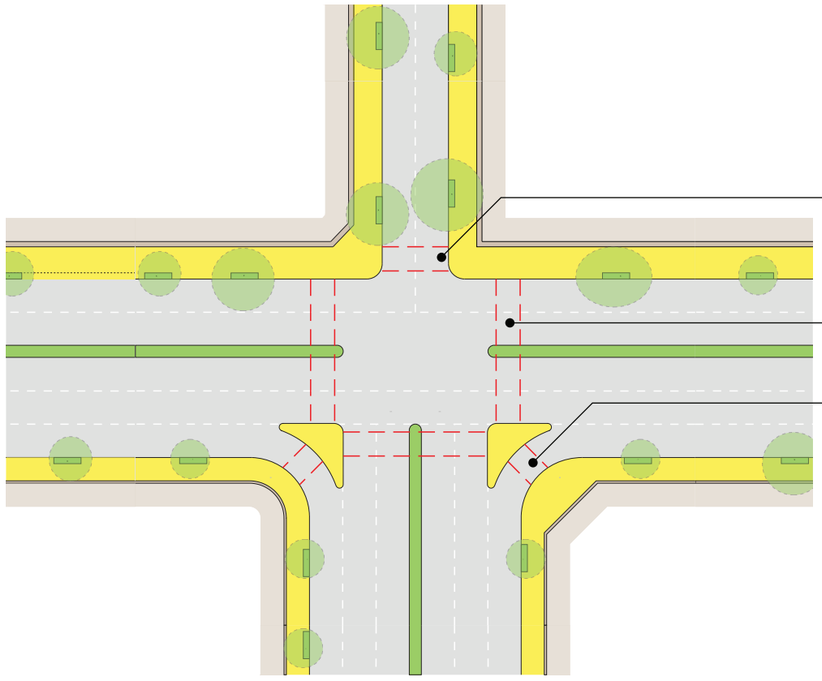
step 05

Where continuous flow of traffic has been observed, provide a left turning lane. Introduce a triangular traffic island to ensure pedestrian safety.



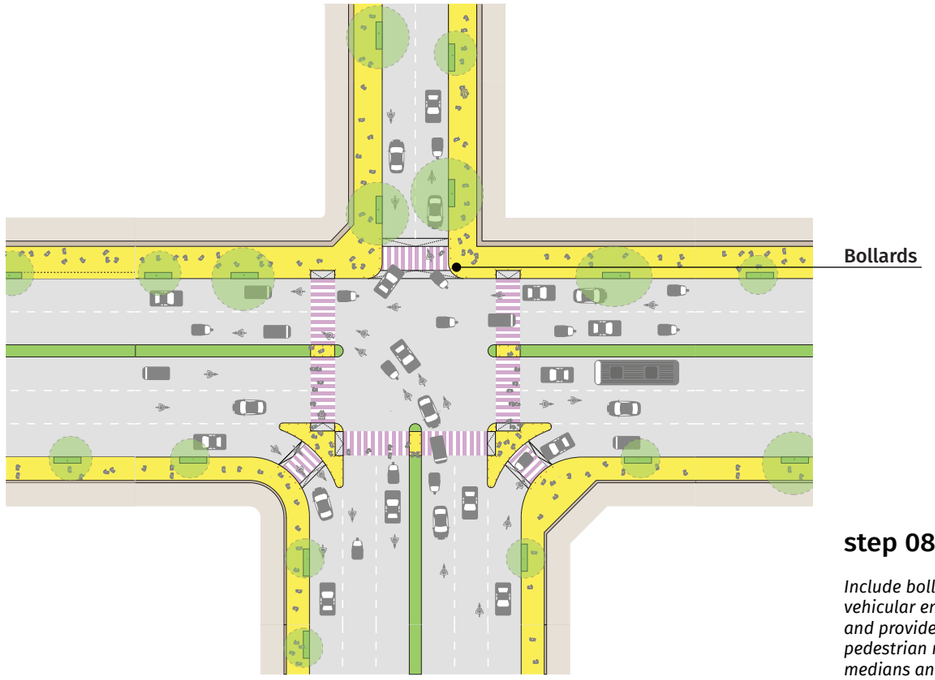
step 06

Extend the medians into the intersection, up to the traffic islands. This would prevent wrong side driving and ensure safety of pedestrian crossings.



step 07

Provide at-grade crossings with pedestrian access ramps across all arms of the intersection. Left turn pockets and side streets should have tabletop crossings.



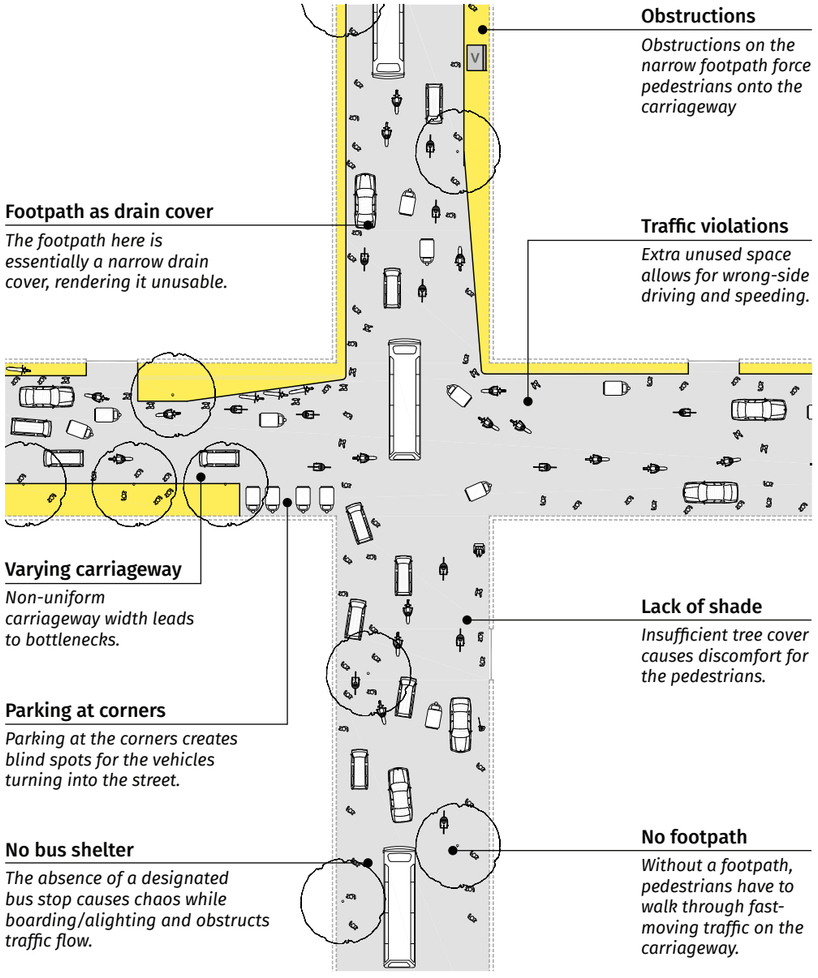
step 08

Include bollards to prevent vehicular entry into footpaths and provide unhindered pedestrian refuges in the medians and traffic islands.

+ example | roundabout

before

Two 2-way 12m streets with buses plying and haphazard parking, meet perpendicularly in an unsignalised intersection.



Obstructions

Obstructions on the narrow footpath force pedestrians onto the carriageway

Footpath as drain cover

The footpath here is essentially a narrow drain cover, rendering it unusable.

Traffic violations

Extra unused space allows for wrong-side driving and speeding.

Varying carriageway

Non-uniform carriageway width leads to bottlenecks.

Lack of shade

Insufficient tree cover causes discomfort for the pedestrians.

Parking at corners

Parking at the corners creates blind spots for the vehicles turning into the street.

No bus shelter

The absence of a designated bus stop causes chaos while boarding/alighting and obstructs traffic flow.

No footpath

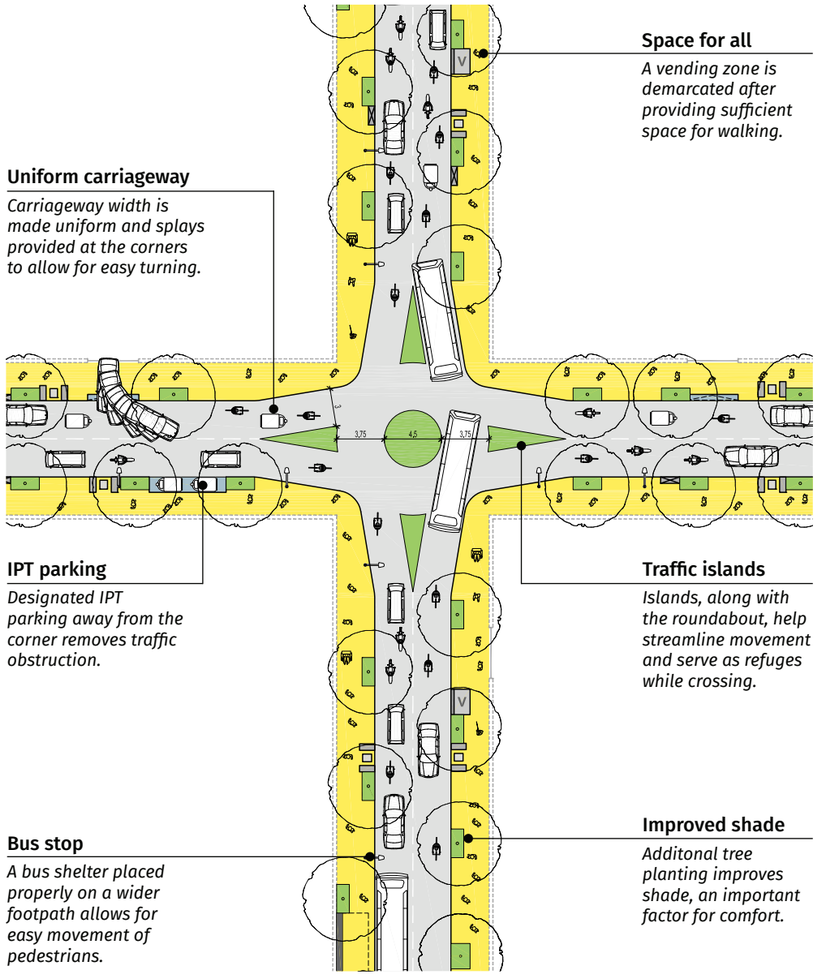
Without a footpath, pedestrians have to walk through fast-moving traffic on the carriageway.

Fig.
A roundabout and traffic islands under construction on Pantheon Road in Chennai.

after

In unsignalised intersections, a roundabout can improve safety by consolidating intersection movements and reducing speeds. Roundabouts also simplify right turns, which are a major cause of intersection crashes.

In streets with high heavy vehicle movement, roundabouts may be constructed with aprons that are surmountable by trucks and buses but not by cars and two-wheelers.



Space for all

A vending zone is demarcated after providing sufficient space for walking.

Uniform carriageway

Carriageway width is made uniform and splays provided at the corners to allow for easy turning.

IPT parking

Designated IPT parking away from the corner removes traffic obstruction.

Traffic islands

Islands, along with the roundabout, help streamline movement and serve as refuges while crossing.

Bus stop

A bus shelter placed properly on a wider footpath allows for easy movement of pedestrians.

Improved shade

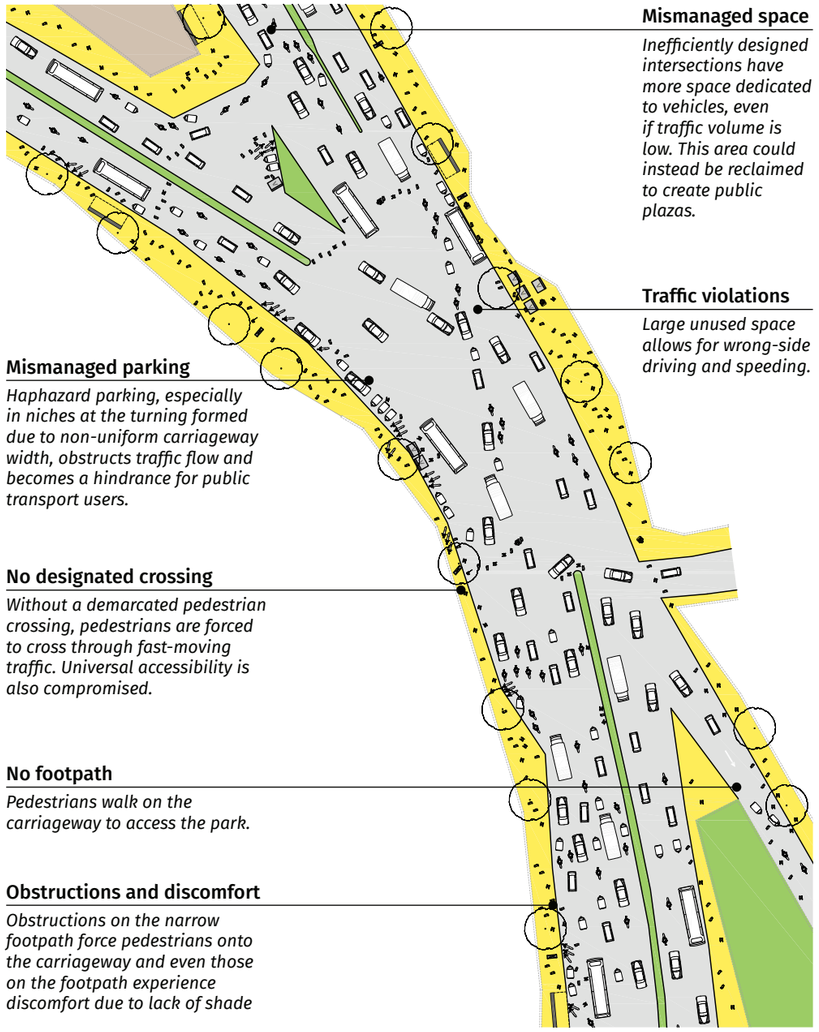
Additonal tree planting improves shade, an important factor for comfort.

Fig.
Differently-shaped roundabouts used to streamline traffic in Kenya.

X example | complex intersection

before

A busy arterial highway branches off into an arterial road and a local one-way street while also meeting a 4-lane street and another local street at angles, forming a complex X-intersection.



Mismanaged space

Inefficiently designed intersections have more space dedicated to vehicles, even if traffic volume is low. This area could instead be reclaimed to create public plazas.

Traffic violations

Large unused space allows for wrong-side driving and speeding.

Mismanaged parking

Haphazard parking, especially in niches at the turning formed due to non-uniform carriageway width, obstructs traffic flow and becomes a hindrance for public transport users.

No designated crossing

Without a demarcated pedestrian crossing, pedestrians are forced to cross through fast-moving traffic. Universal accessibility is also compromised.

No footpath

Pedestrians walk on the carriageway to access the park.

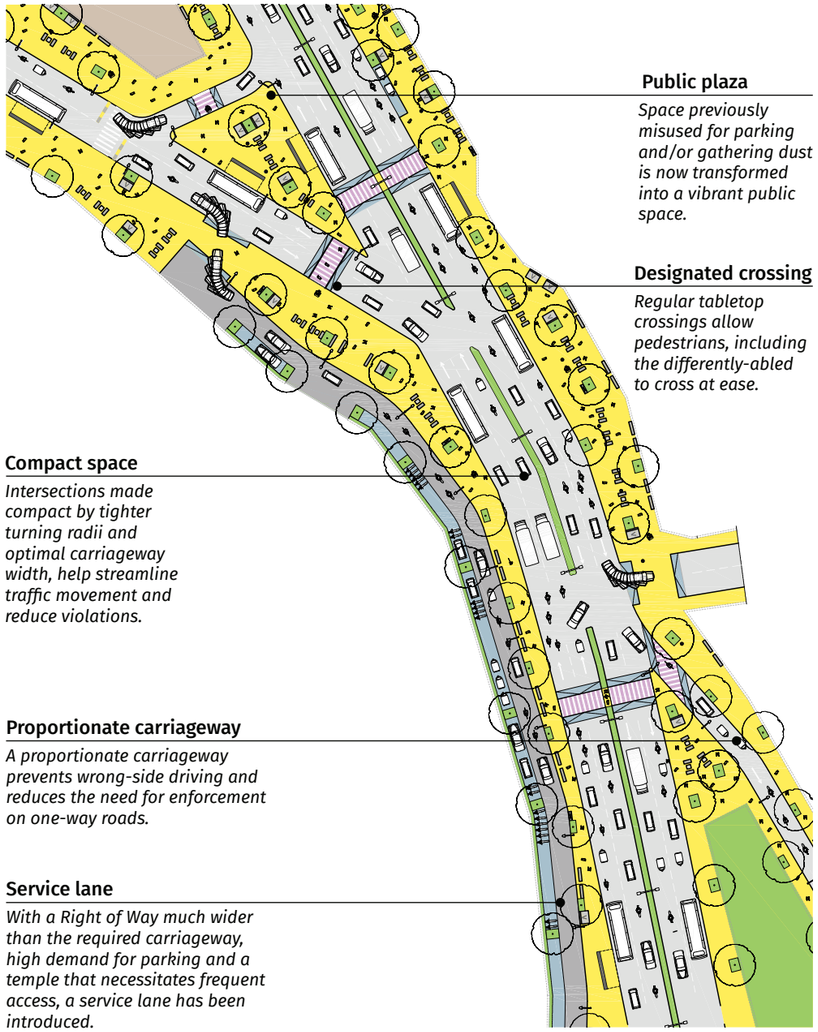
Obstructions and discomfort

Obstructions on the narrow footpath force pedestrians onto the carriageway and even those on the footpath experience discomfort due to lack of shade

Fig.
Testing out the redesign of a complex X-intersection in Buenos Aires with kerb extensions, refuges and a plaza.

after

Often, streets in an organically formed urban setup meet at angles, forming non-orthogonal intersections. Creating perpendicular angles where possible and making the space compact by adding public plazas significantly enhance the safety and liveability of the intersection.



Public plaza

Space previously misused for parking and/or gathering dust is now transformed into a vibrant public space.

Designated crossing

Regular tabletop crossings allow pedestrians, including the differently-abled to cross at ease.

Compact space

Intersections made compact by tighter turning radii and optimal carriageway width, help streamline traffic movement and reduce violations.

Proportionate carriageway

A proportionate carriageway prevents wrong-side driving and reduces the need for enforcement on one-way roads.

Service lane

With a Right of Way much wider than the required carriageway, high demand for parking and a temple that necessitates frequent access, a service lane has been introduced.

Fig.
The plaza formed at the intersection of Brigade and Residency roads in Bangalore is the site of the Sapper War Memorial, an interesting public space in the city. (Source: Google Earth)

5

TRANSIT SYSTEMS AND THE STREET

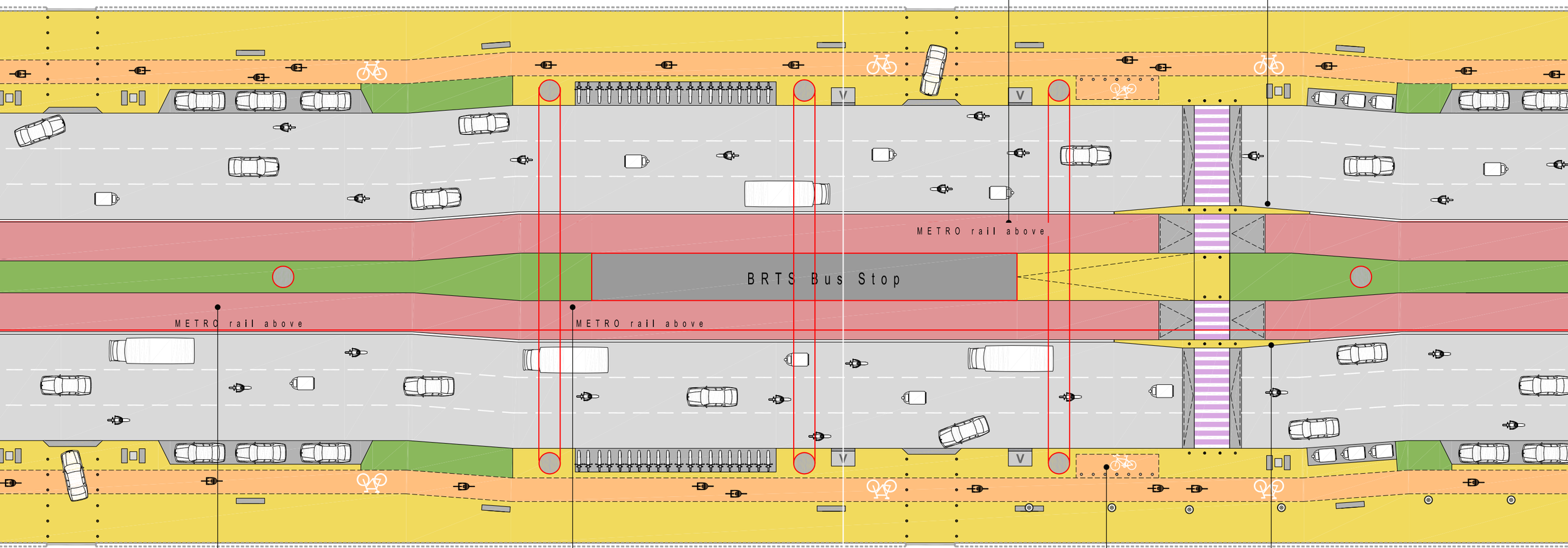
30m BRT | 42m BRT | 30M Metro | 36m Metro | 45m Metro

5 TRANSIT SYSTEMS AND THE STREET

With evergrowing number of private motor vehicles on the street, mass transit systems are becoming more appealing to cities across India. While offering high capacity, high quality public transport, these systems form a significant component of the street and hence have to be designed in context.

Multimodal integration
When two or more transit systems are present on the same street, it is critical for both agencies to coordinate and design to ensure seamless flow for the passengers.

Accessibility
Passengers may have trouble reaching transit stations unless pedestrian refuges and traffic calming measures improve pedestrian safety.



IRC BRT Guidelines
For detailed guidelines to design BRT systems, refer to IRC BRT design Guidelines

IRC BRT Guidelines
For detailed guidelines to design BRT systems, refer to IRC BRT design Guidelines

Bicycle-sharing
Public bicycle sharing stations placed next to transit stations enhance last mile connectivity.

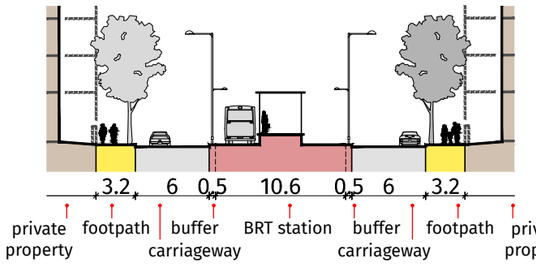
Periodic crossings
Transit systems can become a barrier to pedestrian and cyclist movement if at-grade crosswalks are not provided at reasonable intervals.

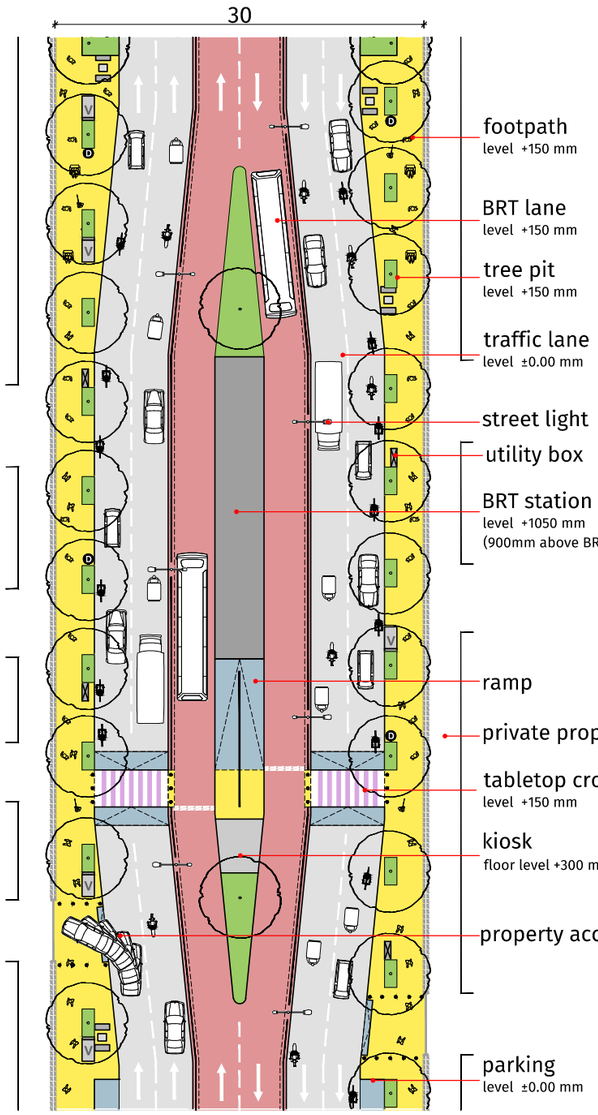
30M brt

two way

footpath

brt





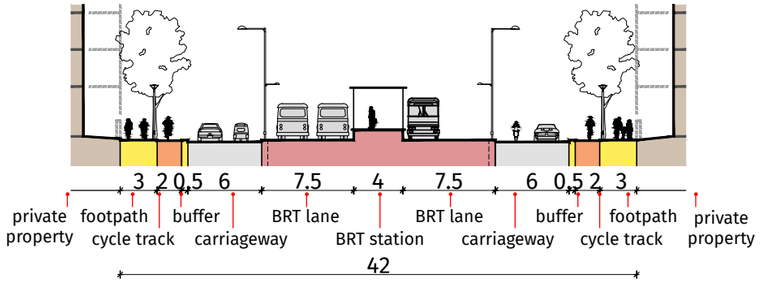
brt with passing lanes 42M

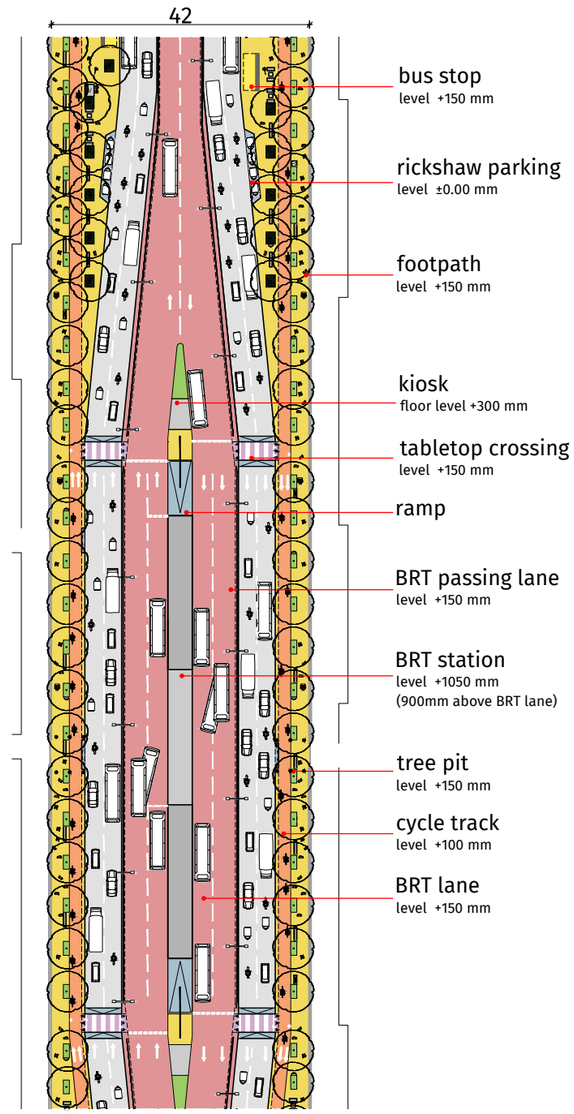
two way

footpath

cycle track

brt





Passing lanes can increase the passenger capacity by allowing express buses to overtake local buses at certain stations, like in the Transmilenio BRT system in Bogotá, Colombia.

** To enable the readers to perceive all the elements associated with a street of 42m RoW with a BRT lane, the scale of the plan and section have been changed.*

30M metro with cycle track on both sides

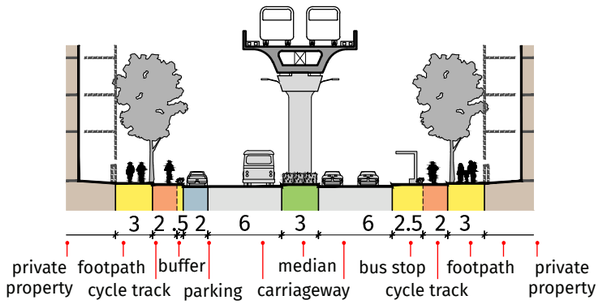
two way

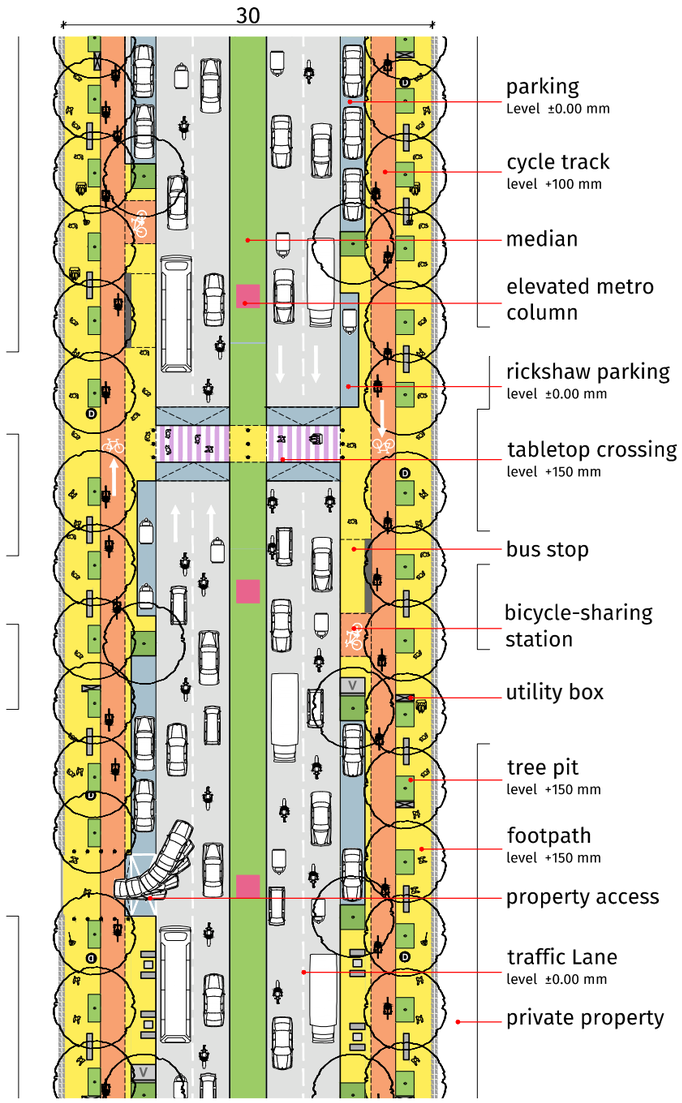
footpath

cycle track

median

metro





Cycle tracks on metro corridors enhance last-mile connectivity.

metro with cycle track on one side 30M

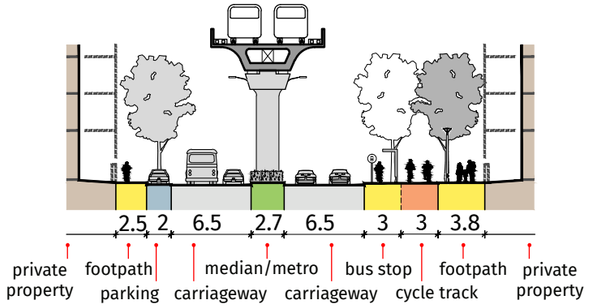
two way

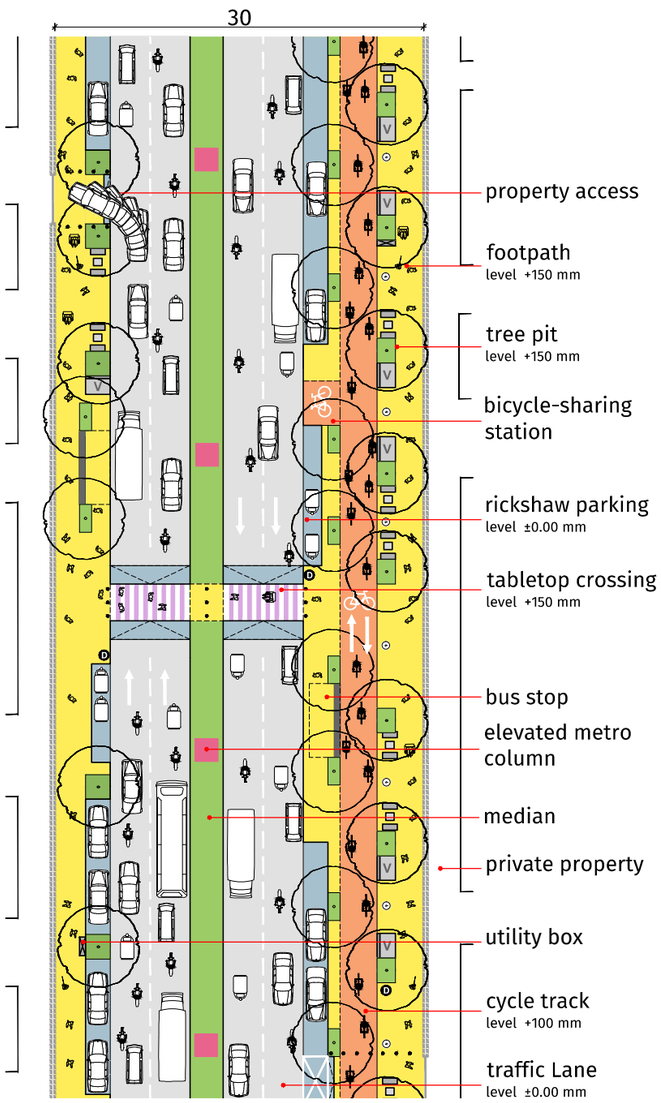
footpath

cycle track

median

metro





Where a wider carriageway is required, a 2-way cycle track can be provided on one side of the street, with the elevated metro columns to be planned off-centre.

36M metro with service lane and cycle track on both sides

two way

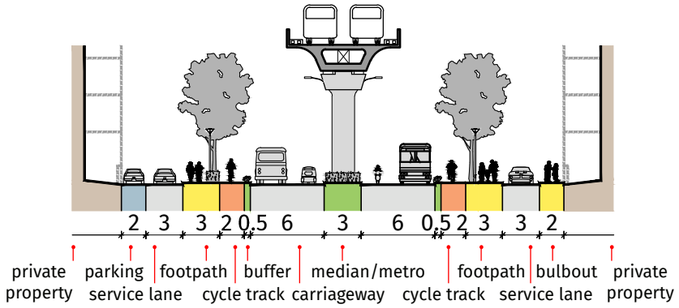
footpath

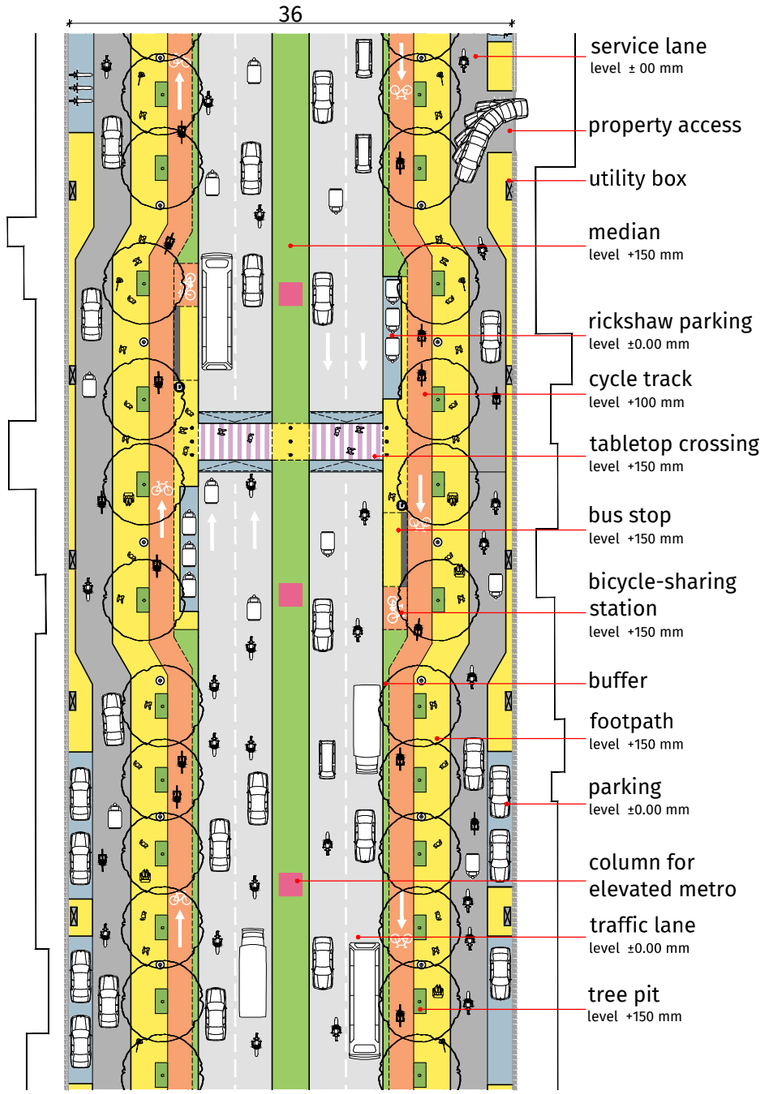
cycle track

median

service lane

metro





metro with cycle track on both sides 36M

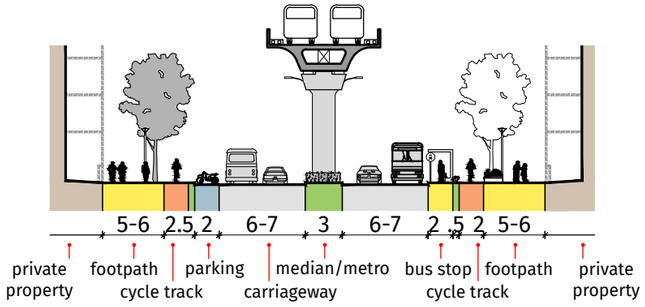
two way

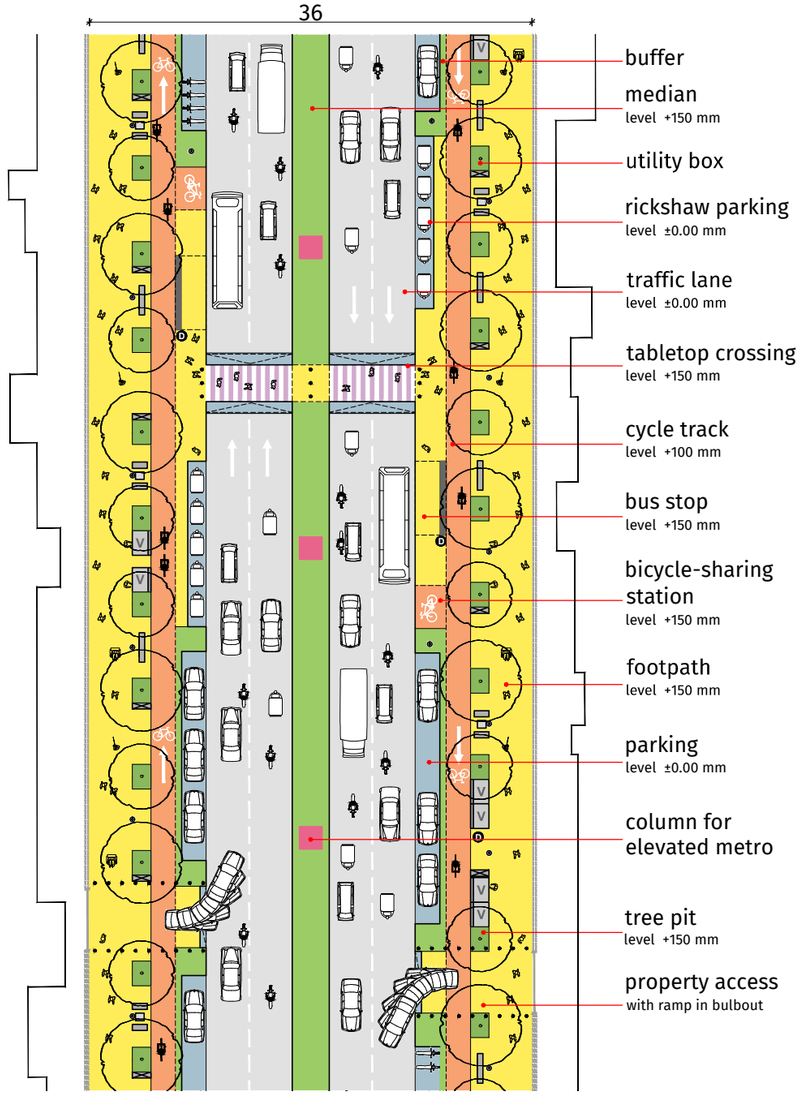
footpath

cycle track

median

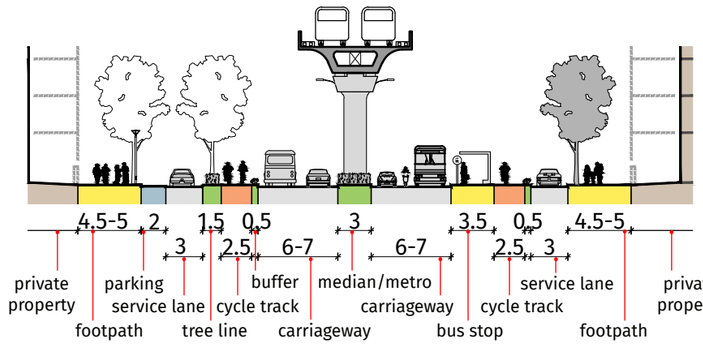
metro

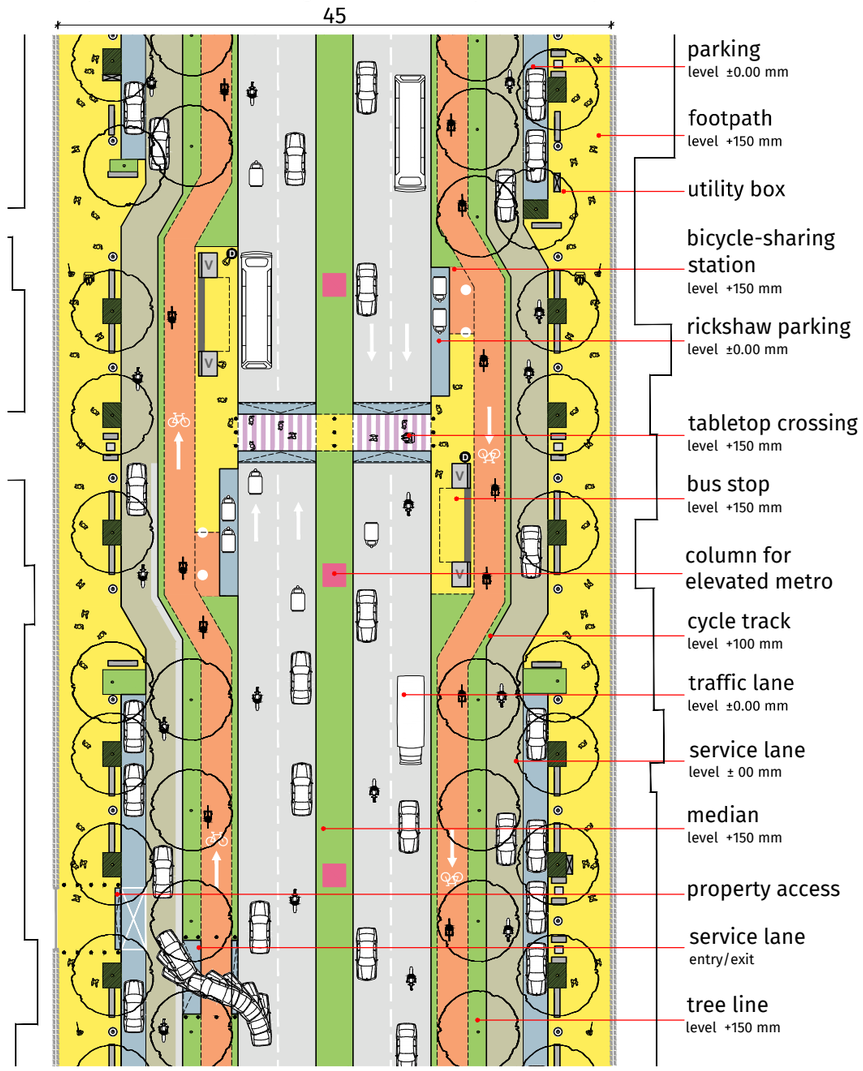




45M metro with service lane and cycle track on both sides

two way
footpath
cycle track
median
service lane
metro

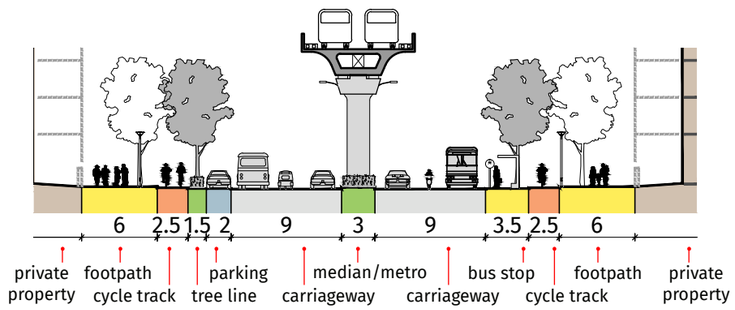


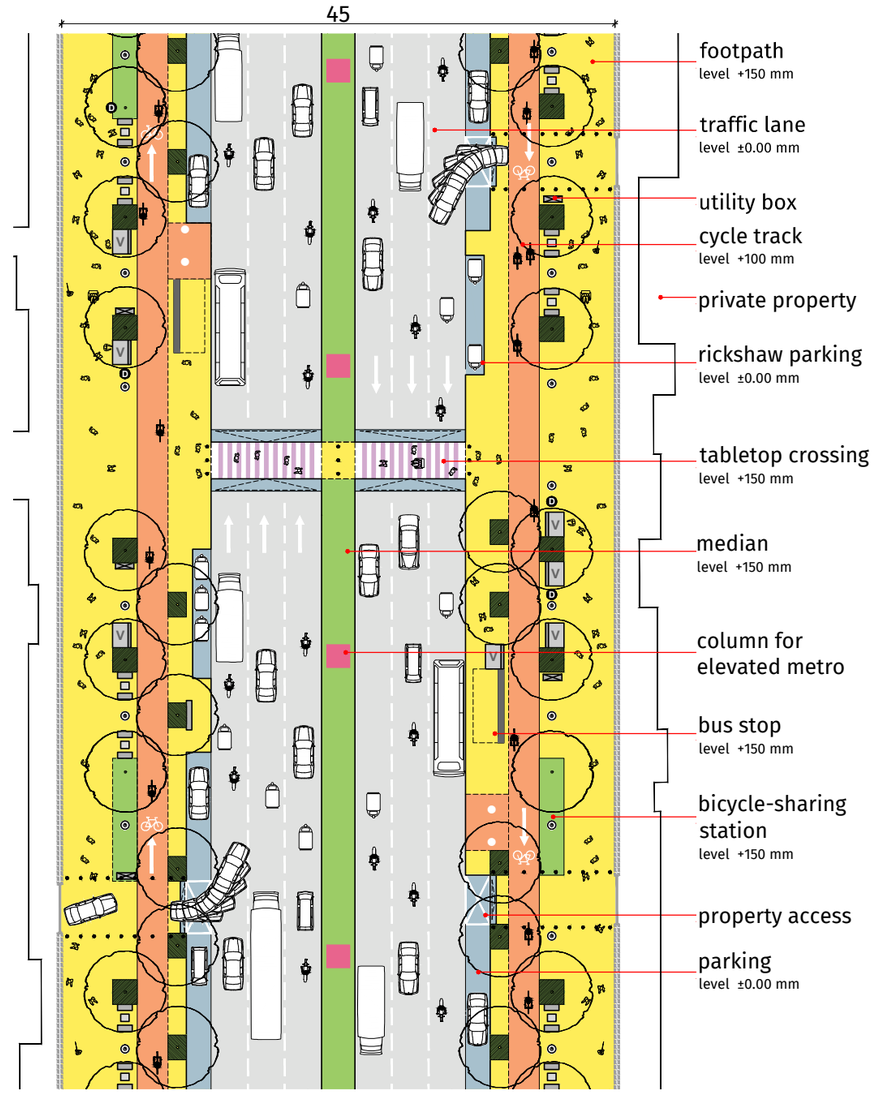


The carriageway width can be decided according to the characteristic of the street. If it is a corridor meant only for mobility, wider carriageway can be provided.

metro with cycle track on both sides 45M

two way
footpath
cycle track
median
metro





6

STREET MATERIALS

flooring finish | bollards | seating

6.0 materials

what good materials achieve

Materials play an important role in deciding the usability of the design. Good materials go hand-in-hand with the design and help achieve the intended purpose of the street element.

challenges

Material selection is usually put on the back burner until the final stages of the design process. This leads to insufficient detailing and confusion while preparing the estimates.

When materials are not selected properly, the streets become unfit for use in a short while either due to difficulty in maintenance or wearing away.

criteria for material selection

Materials used in streets should be

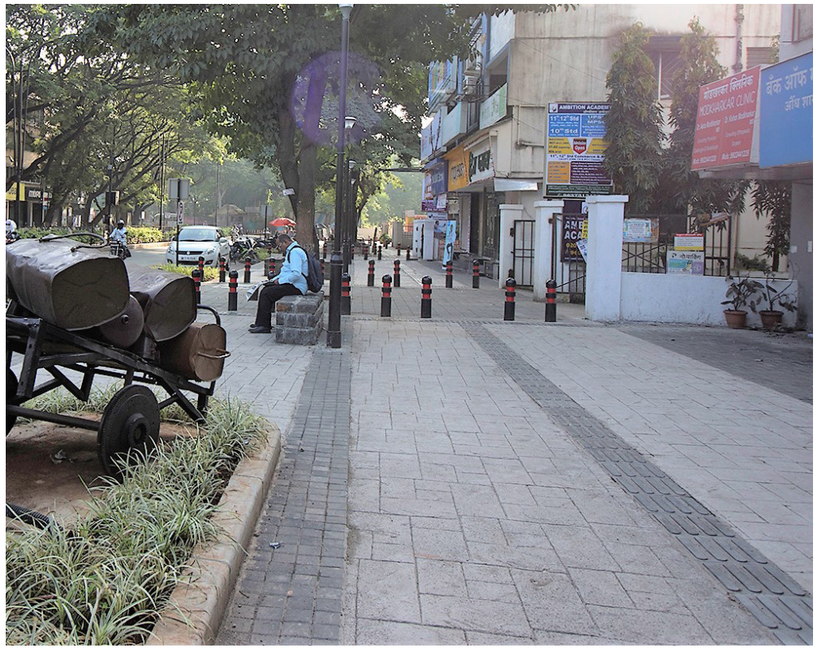
- Durable
- Easy to install
- Easy and inexpensive to maintain
- Slip resistant
- Easy to dismantle and repair
- Easy to clean
- Highly resistant to vandalism
- Universally accessible

Fig. (above)
A variety of materials chosen for each element, in correlation with each other and the design, makes DP Road in Aundh a delight to use

Fig. (below)
A combination of stamped concrete, concrete pavers and tactile cement tiles used in DP Road, Pune

flooring finish 6.1

cast in-situ



PCC stamped concrete

Pros
- *Variety of stencils available*
- *Monolithic surface; does not start dismantling like pavers*
- *Uniform finish*
- *Easy to clean and maintain*

Cons
- *Stamping too deep may disrupt wheelchair movement*
- *Expansion joints should be provided to prevent cracking*
- *Has to be demolished in case of future repairs of underground utilities*
- *Need additional care during curing to avoid paw-prints*

Application
On footpaths, landscaping, plazas; intricate stencils not recommended for cycle track

Fig.
DP Road, Pune

PCC broom finish

Pros
- *Relatively quick to install*
- *Grooves provide sufficient grip*
- *Cheaper than other PCC finishes*
- *Monolithic surface; does not start dismantling like pavers*
- *Uniform finish*

Cons
- *Finish has to be even to avoid poor cycling experience*
- *Looks fairly plain*
- *Expansion joints should be provided to prevent cracking*
- *Has to be demolished in case of future repairs of underground utilities*
- *Need additional care during curing to avoid paw-prints*

Application
On footpaths, cycle tracks, parking bays, and carriageway

Fig.
Broom finish on a cycle track in FC Road, Pune

PCC pigmented concrete

Pros
- *Adds color to the street*
- *Can be combined with other finishes for variations in design*
- *Relatively quick to install*
- *Monolithic surface; does not start dismantling like pavers*
- *Uniform finish*
- *Easy to clean and maintain*

Cons
- *Color wears off with time resulting in a dull look*
- *Expansion joints should be provided to prevent cracking*
- *Has to be demolished in case of future repairs of under-ground utilities*
- *Need additional care during curing to avoid paw-prints*

Application
Generally used to differentiate between functions for instance pigmented concrete on cycle track in JM Road, Pune (Fig.)

Rubberised floor finish

Pros
- *EPDM rubber surface helps in impact absorption*
- *Reduces the risk of permanent injury by cushioning the fall*
- *Highly durable, less prone to weathering*
- *Offers permeability*

Cons
- *Comparatively expensive*
- *Seams prone to vandalism and staining*

Application
On footpaths, particularly in play areas for children

Fig.
Rubberised floor finish for the play areas on the footpath in JM Road, Pune

unit paving - natural stone

stone blocks

Pros
- *Highly durable, less prone to weathering; 0.08m thick stone blocks can be used for bearing vehicular load as well*
- *Can be laid in variety of design patterns*
- *Easy to dismantle for future repairs*

Cons
- *Expensive; heavy to transport*
- *Results in uneven surface and sinking if sub-base is not prepared with care*
- *Prone to dismantling if kerbs are not installed properly*

Application
On carriageways for slowing traffic, landscaped zones, shared streets, at entries for gates and ramps; avoided on footpath due to its highly undulated surface

Fig.
SM Street, Kozhikode

stone slabs / tiles

Pros
- *Thicker slabs are durable; less prone to weathering*
- *Can also be used as cladding for seating to compliment the pavement finish*

Cons
- *Expensive and heavy*
- *Thinner slabs prone to breakage if mishandled or dropped*
- *Labour-intensive to install*
- *Slippery during rains if polished*
- *Results in uneven surface and sinking if sub-base is not prepared with care*

Application
Sandblasted/leather finished stone on footpath - generally in select projects; not recommended on cycle tracks and load-bearing areas

Fig.
Harrington Road, Chennai

unit paving - manufactured

concrete blocks

Pros
• Variety of sizes, colours and patterns available
• Cost-effective
• Easier to install than stone slabs
• Anti-skid due to rough surface

Cons
• Results in uneven surface and sinking if the base is not prepared with care
• Un-chamfered edges may lead to chipping of blocks
• May become pigmented and slippery due to growth of moss on constant exposure to water

Application
On footpaths, parking bays, and carriageways to control speeds; not recommended on cycle tracks

Fig.
Paver blocks of different sizes and colors on the footpath in JM Road, Pune

cement tiles

Pros
• Cost-effective
• Lighter than stone tiles, stone/concrete pavers
• Available with different textures, colours, design patterns and shapes

Cons
• Heavy, prone to breakage if mishandled or dropped
• More labour-intensive to install than PCC finish
• Slippery during rains if without anti-skid studs
• Results in uneven surface and sinking if the base is not prepared with care
• Prone to dismantling

Application
On footpaths, especially tactile flooring; not recommended on parking bays and cycle tracks

Fig.
Raman Street, Chennai

permeable concrete blocks

Pros
• Offers a porous surface that enables water percolation
• Variety of sizes, colours and patterns available
• Cost-effective
• Easier to install
• Anti-skid due to rough surface

Cons
• Improper composition of the material can result in loss of durability
• Requires regular cleaning to avoid blockage due oil and dust
• Results in uneven surface and sinking if the base is not strong and stable

Application
On footpaths, parking spots, plazas etc.

Fig.
DP Road, Pune

interlocking tiles

Pros
• Variety of sizes, colours and patterns available
• Cost-effective
• Easier to install than stone slabs
• Anti-skid due to rough surface

Cons
• Results in uneven surface and sinking if the base is not prepared with care
• More labour-intensive to install than PCC finish
• Prone to dismantling
• May become pigmented and slippery due to growth of moss on constant exposure to water

Application
On footpaths and parking bays; not recommended on cycle tracks

Fig.
Pinjala Subramaniam Road, Chennai

6.2 bollards

pigmented RCC

Pros
- *Pigment added to concrete mixture results in homogenity, as opposed to painted bollard*
- *Cost-effective*
- *Lighter than stone bollards, making it easier to handle*
- *Can be cast in different shapes as per design*

Cons
- *Tend to chip off with time*
- *Lighter colours fade off with time leading to dull look*

Fig.
DP Road, Pune

stone

Pros
- *Durable*

Cons
- *Tend to break at the grooves*
- *Expensive*

Fig.
Harrington Road, Chennai

galvanised iron

Pros
- *More cost-effective than stone bollards*
- *Lighter than stone bollards, making it easier to handle*
- *Can be fabricated in different shapes as per design*

Cons
- *Paint tends to chip off*
- *More expensive than RCC bollards*

Fig.
Church Street, Bangalore

stainless steel

Pros
- *More cost-effective than stone bollards*
- *Lighter than stone bollards, making it easier to handle*

Cons
- *Limited in shape - generally available only as pipes*
- *Less aesthetical as compared to other types of bollards*

Fig.
Stainless steel bollard
(Source: Wikimedia Commons)

6.3 seating

stone

Pros
- *Highly durable, less prone to weathering*
- *Does not chip away easily*

Cons
- *Expensive*
- *Labour-intensive to install*

Fig.
DP Road, Pune

precast concrete

Pros
- *Cost-effective*
- *Can be cast in different shapes as per design*
- *Pigmented concrete mixture results in homogenity, as opposed to painted seats*

Cons
- *Tends to chip off with time*
- *If painted, color chips off with time*

Fig.
JM Road, Pune

metal

Pros
- *Can be fabricated with varying degrees of ornamentation - highly suited for traditional design themes*
- *Durable*
- *Less prone to weathering*

Cons
- *Becomes easily hot or cold depending on outside temperature, making it uncomfortable to use*
- *Hard and not comfortable to use for long - preferred to avoid squatters*
- *Paint tends to chip off*
- *Rusts with time*
- *Tends to be easy to steal*

Fig.
Metal bench (Source: Wikimedia Commons)

FRP

Pros
- *Can be cast in different shapes as per design*
- *Pigment added to FRP mixture results in homogenity, as opposed to painted seats*
- *Can be made translucent, providing for embedded lighting options*
- *Durable, being plastic in nature*

Cons
- *Expensive*
- *Relatively difficult to source, owing to fewer FRP vendors dealing with seating*

5

PARTICIPATORY STREET DESIGN

government and non governmental organisations | public participation | review committee

5.0 participatory street design

what good participatory street design achieves

A participatory approach to street design involves the stakeholders - government representatives, public, NGOs, etc - in the design process to ensure that the final design caters to the needs of the intended users. The result of such a process is invariably more feasible and also innovative.

Stakeholder engagement is a process by itself, to be initiated prior to starting the design. Coordination with certain stakeholders throughout the design process is essential. Once the basic design is ready, the designer with support from the city, should present the same to the stakeholders and get their feedback to make relevant updates. A review committee should be set up to oversee the designs produced by the designer. A collaborative effort of this kind will eventually lead to a successful design.

challenges

There is a common misconception that a participatory process is time consuming. More often than not, the process of street design happens in isolation without involving the end users or the other agencies pivotal to the operation of the street. This leads to a disconnect between the local context and the design, which eventually renders the redesigned street unusable.

In many cases, there is a lack of dedicated funding for conducting these stakeholder engagements. In addition, there is a need to develop internal capacities of the city corporations to conduct, survey, and analyse public responses.

Fig.
Erode

govt and non-govt organisations 5.1

Consultation

Different governmental and non-governmental organisations will have information and expertise that are pertinent to the design of streets. This includes information on existing conditions and infrastructure, and future requirements. The designer should collate this data in consultation with the organisations, which will in turn inform the design.

Coordination

During the design process, the designer should coordinate with various stakeholders to ensure that the proposal is in line with local needs. This is essential for a holistic and sustainable end-product. The designer should also coordinate with other designers working on street design projects in the neighbourhood, so there is correlation and a similar design language.

Approval

The drawings produced and infrastructure proposed by the designer should finally be officially approved by relevant agencies.

Organisation	Role in consultation, coordination & approval
Governmental Authorities	
Road Engineers	• Provide relevant engineering information such as ideal location of infrastructure, required slopes, etc. • Assist in modification of traffic plan, if required • Approve drawings and details
Traffic Police	• Provide information on existing traffic conditions and movement • Help map accident points • Approve drawings and traffic plan (if modified)
Representative from Transport Authority	• Provide information on existing bus routes and shelters to be added/moved • Approve location of shelters, traffic plan (if modified)
Utility Agencies	
Electricity Telecom Water Supply and Sewage Stormwater Gas	• Assist in mapping existing utilities • Provide information on planned projects if any, such as shifting of overhead cables to underground, etc. • Provide information on future requirements • Approve proposed details and relevant drawings
Landscape Specialist	
Parks Department/External Horticulturist	• Provide repository of names of existing species • Provide information on the extent of roots underground, to plan utilities accordingly • Recommend sizes of tree pits and extent of excavation around trees in special cases • Recommend new trees to be planted
Non-governmental Organisations	
Organisations working for safer streets, cyclist groups, environmentalists, etc.	Recommend design solutions from view points representing different aspects of street usage
Project Management Consultant	
	• Arrange coordination meetings • Manage exchange of information • Ensure quality control

Table 04:
Role of various organisations in consultation, coordination and approval

5.2 public participation

Consultation

As the conceptual design stage is initiated, the designer with support from the city should take initiative to invite suggestions from the public/end users. This helps the designer understand the local needs and hence design as per context.

Engagement for feedback

Once the conceptual design and drawings are ready, the design team should engage with the citizens to inform them about the proposal and get their feedback. This engagement can be in the form of a discussion, workshop, charette or even a tactical urbanism intervention where the user gets to participate in a trial of the design. The design can then be updated based on relevant feedback.

Collaboration

This can be in the form of an MoU with shopkeepers about shop frontages where the ownership continues to remain with the shopkeepers but the facade is demolished, encroachments are managed, and the floor is finished to match the foothpath, thereby creating a much larger and uniformly designed space for pedestrians.

Categories of end users to be considered for public participation
Residents and/or Representatives of Resident Welfare Associations
Shopkeepers and/or Representatives of Shopkeepers Associations
IPT drivers and/or Representatives of IPT drivers unions
Local NGOs and community-based organisations

Table 05 (above): Categories of end users to be considered for public participation

Fig. (below) Natesan Park, Chennai

Shoppers talk Pedestrian Plaza | YouTube
https://www.youtube.com/watch?v=fmamNi_akAM

review committee 5.3

The city should set up and convene regular meetings of the Review Committee to oversee detailed design produced by consultants as well as to address inter-agency issues that may arise during this process.

	Members of the Review Committee
Officials and engineers from the city corporations	• Engineers from Roads department • Zone Engineers
Public transport agencies	Representative(s) from Metropolitan Transport Corporation
Traffic police	Representative(s) from traffic police
Local planning authority	Representative(s) from the city's Development Authority
Non-government or community organisations	Representatives from Non-government and community organisations.
External urban design experts	

Table 06 (above): Members from various Governmental and Non-Governmental agencies who make up the review committee

Fig. (below) Coimbatore

ANNEXURES

list of references

list of references

Following are some of the acts, laws and initiatives undertaken until now by Central, State Governments and other organizations in the road and transportation sector prominently related to vehicles, road construction, road users. The Complete Streets framework toolkit has taken into consideration the information and suggestions as mentioned in these studies.

Indian Road Congress Guidelines

The Indian Roads Congress (IRC) was set up by the Government of India in consultation with the State Governments in December, 1934 and is a registered society under the Registration of Society Act. It is the premier body of Highways Engineers in India. The Principal objectives of the India Roads Congress are to provide a national forum for regular pooling of experience and ideas on all matters concerned with the construction and maintenance of highways, to recommend standard specifications and to provide a platform for the expression of professional opinion on matters relating to roads and road transport including those of organizations and administration. It also publishes Journals, monthly magazines and research bulletins.

Few of such journals regarding design of urban roads have been considered in the study for the framework documents. The documents recommend to follow the given IRC for the technical specifications and details for construction of street elements:

1. IRC: 35-2015 Code of Practice for Road Markings
2. IRC: 36-2010 Recommended Practice for Construction of Earth Embankments and Subgrade for Road Works
3. IRC: 37-2012 Guidelines for the Design of Flexible pavements
4. IRC: 67-2012 Code of practice for Road Signs
5. IRC: 70-2017 Guidelines on Regulation and Control of Mixed Traffic in Urban Areas
6. IRC: 98-2011 Guidelines on Accommodation of Utility Services on Roads in Urban Areas
7. IRC: 99-2018 Guidelines for Traffic Calming Measures in Urban and Rural Areas
8. IRC: 103-2012 Guidelines for Pedestrian Facilities
9. IRC:SP: 50-2013 Guidelines on Urban Drainage
10. IRC:SP: 055 Guidelines on Traffic Management in Work Zones
11. IRC:SP: 057 Guidelines for Quality Systems for Road Construction
12. IRC:SP: 112-2017 Manual for Quality Control in Road and Bridge Works
13. IRC:SP: 117-2018 Manual on Universal Accessibility for Urban Roads and Streets
14. IRC:SP:119-2018 Manual of Planting and Landscaping of Urban Roads

MoRTH Specifications

The Ministry of Road Transport and Highways is a ministry of the Government of India, is the apex body for formulation and administration of the rules, regulations and laws relating to road transport, and transport research in India. Some of the MoRTH regulations and specifications referred in the Complete Streets framework documents have been listed below:

1. MoRTH Section 300: Earthwork, Erosion Control and Drainage
2. MoRTH Section 400: Sub-Base, Bases Not-Bituminous and Shoulders
3. MoRTH Section 500: Base and Surface Courses (Bituminous)
4. MoRTH Section 800: Traffic Signs, Markings and Other Road Appurtenances

Design of Urban Roads-Code of Practice, 2012[1]

The code of practice for designing of urban roads has been prepared by the Transportation Research and Injury Prevention Programme (TRIPP) for the Institute of Urban Transport (IUT), Ministry of Urban Development. The primary purpose of this document is to provide a code of practice for various Urban Road Components. It has been developed in five parts:

Part I : Urban road cross section design
Part II : Intersection design
Part III: Road markings
Part IV : Signages
Part V : Traffic Calming methods

Among other recommended codes, the document has two major variations from IRC codes in terms of road design for intended speed limit and linking of lane width with speed limit.

Motor vehicles Act[2]

The Motor Vehicles Act, 1988 is an Act of the Parliament of India which regulates all aspects of road transport vehicles. The Act came into force from 1 July 1989. It replaced Motor Vehicles Act, 1939 which earlier replaced the first such enactment Motor Vehicles Act, 1914. The Act provides in detail the legislative provisions regarding licensing of drivers/ conductors, registration of motor vehicles, control of motor vehicles through permits, special provisions relating to state transport undertakings, traffic regulation, insurance, liability, offences and penalties, etc.

Disabilities Act[3]

The Rights of Persons with Disabilities act replaces the Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995. It fulfills the obligations to the United National Convention on the Rights of Persons with Disabilities (UNCRPD), to which India is a signatory. The Act came into force during December 2016.

Accessibility is one of the rights that is given importance under this act which makes it mandatory to provide for disabled friendly design of public places including roads and streets.The Rules under this Act have specified the Standards for Accessibility through Harmonised Guidelines and Space Standards for Barrier Free Built Environment for Persons With Disabilities and Elderly Persons.[4] The guidelines prepared by Ministry of Urban Development are comprehensive guidelines inclusive of all provisions updated and harmonized to act as an easy reference Practitioner's Guide for Barrier Free Designs with universal access, responding to the varying needs of the persons with disabilities.

The Guidelines and Toolkits for Urban Transport Development

The Guidelines and Toolkits for Urban Transport Development were prepared by a Technical Assistance on Urban Transport Strategy (TA 4836-IND) funded by the Asian Development Bank for the Ministry of Urban Development (MoUD), Government of India.

[1] http://mohua.gov.in/cms/Design-of-Urban.php
[2] http://www.tn.gov.in/sta/Mvact1988.pdf
http://164.100.47.4/BillsTexts/LSBillTexts/PassedLoksabha/214C_2016_LS_Eng.pdf
[3] http://disabilityaffairs.gov.in/upload/uploadfiles/files/RPWD%20ACT%202016.pdf
[4] https://cpwd.gov.in/Publication/Harmonisedguidelinesdreleasedon23rdMarch2016.pdf

These documents are designed to help decision makers and practitioners in states and municipal governments who are concerned with urban transport development in medium-sized cities in India.

It consists of 5 modules addressing topics like -
- Comprehensive mobility plans[5]
- Bus Rapid Transit Systems (BRTS)
- Guidelines for Bus service improvement
- Guidelines for parking measure
- Guidelines for NMT measures.

The National Urban Transport Policy (April 2006)[6]

It was approved by GOI to tackle urban mobility issues to ensure a safe and sustainable urban mobility in the coming decades. It provides for integrated land use and transport plans in cities, coordinated planning for urban transport, people oriented equitable allocation of road space, capital support in the form of equity participation and or viability gap funding, innovative financing, dedicated urban transport funds, non-motorised transport, car restraint measures, clean fuel and vehicle technology, private sector participation and pilot projects in cities to establish models of best practices.

Recommendations of working group on 12th FYP[7]

The Working Group on Urban Transport for the 12th Five Year Plan has made recommendations on investments and plans on 9 broad themes in urban transport which were identified in line with the National Urban Transport Policy (NUTP) developed by the Government of India.

Study on traffic and transportation policies and strategies in Urban Areas in India, MOUD, 2008[8]

The study aimed at updating the transportation information and projections made from the previous study 'Traffic and transportation policies and strategies in Urban Areas in India 1994' in order to review the National Urban Transport Policy in light of the new and comprehensive data provided within this report.

Service Level Benchmarking, 2009[9]

Since 2009, the Ministry of Housing and Urban Affairs (then titled Ministry of Urban Development) has adopted the practice of service level benchmarking. Through the SLB initiative, the Ministry hoped to create a robust set of indicators across sectors for which data would be collected at the city levels and collated and published at the National level. This would then help create a ranking for cities, aided by a positive competitive spirit. At the same time, cities were also expected to set targets for themselves and better their performances over time.

[5] https://smartnet.niua.org/sites/default/files/resources/file_1016201405372097.pdf
[6] http://www.iutindia.org/downloads/Documents.aspx
[7] http://planningcommission.gov.in/aboutus/committee/wrkgrp12/hud/wg_%20urban%20Transport.pdf
[8] http://mohua.gov.in/upload/uploadfiles/files/final_Report.pdf
[9] http://mohua.gov.in/upload/uploadfiles/files/Service_level.pdf

Within urban transport, pedestrian and non-motorized transport facilities were assigned indicators -such as the share of city roads with footpaths and the coverage and efficiency of street lighting etc.

National Mission on sustainable habitats: Report of the Sub-Committee on Urban Transport

Under the National Action Plan for Climate Change, the National Mission on Sustainable Habitat has been launched to cover various aspects which include better urban planning and modal shift to public transport. Regarding Urban Transport, the objectives of the National Mission on Sustainable Habitat (NMSH) are "To address the issue of mitigating climate change by taking appropriate action with respect to the transport sector such as evolving integrated land use and transportation plans, achieving a modal shift from private to public mode of transportation, encouraging the use of non-motorised transport, improving fuel efficiency, and encouraging use of alternative fuels etc.

UTTIPEC Guidelines for street design[10]

As per the recommendations of National Urban Transport Policy, DDA, Delhi has notified Unified Traffic and Transportation Infrastructure (Plg. & Engg.) Centre (UTTIPEC) to enhance mobility, reduce congestion and to promote traffic safety by adopting standard transport planning practices.

Recently UTTIPEC has published street design guidelines to promote sustainable transportation system in the city of Delhi.

The Street Vendors (Protection of Livelihood and Regulation of Street Vending) Act, 2014[11]

Street Vendors (Protection of Livelihood and Regulation of Street Vending) Act, 2014 is an Act of the Parliament of India. This Act was drafted with the legislative intent of protecting the livelihood rights of street vendors as well as regulating street vending through demarcation of vending zones, conditions for and restrictions on street vending. The Act now governs over all matters in regards to the rights and duties of the street vendors in India.

Chennai Non-Motorised Transport Policy, 2014[12]

The Chennai Municipal Corporation adopted a progressive non-motorised policy in October 2014 to make walking and cycling its priority. The policy aims to arrest the current decline in walking and cycling in the city by creating safe and pleasant network of footpaths, cycle tracks, greenways and other NMT facilities.

[10] http://smartcities.gov.in/upload/uploadfiles/files/StreetGuidelines_DDA.pdf
[11] http://legislative.gov.in/sites/default/files/A2014-7.pdf
[12] https://www.itdp.in/wp-content/uploads/2014/10/NMT-Policy.pdf

Urban Street Design Guidelines, Pune 2016[13]

In accordance with the key principles of moving people before vehicles in National urban Transport Policy, the Municipal Corporation of Pune adopted the 'Urban Street Design Guidelines' as a new policy document aimed at 'equitable allocation of street space'. The guidelines give an overview of various elements that go into designing streets, making them universally accessible and also provide standard templates for different sizes and uses of streets.

Policy for Pedestrian Facilities and Safety, Pune 2016[14]

The Municipal Corporation of Pune, in 2016 adopted a Pedestrian Facilities and Safety Policy, keeping in view the focus set in NUTP and CMP for Pune. The Policy establishes good quality public transport system as well as safe, adequate and usable facilities for pedestrians and cyclists as the solutions to city's traffic problems and aims at providing consistent, high quality pedestrian infrastructure with equitable allocation of road space.

Public Parking Policy, Pune 2016[15]

The policy on Public Parking adopted by Pune Municipal Corporation in 2016, is expected to help the city in becoming more 'people friendly' than 'vehicle friendly'. The Policy aspries to discourages usage of private modes, encourages efficient use of available parking spaces, aids in evolving a better transportation system, builds a strategy to reduce congestion, pollution, and also helps the public transport system to grow.

NMT Guidance document, 2016[16]

The Guidance Documents for preparing Non-Motorised Transport (NMT) plans has been undertaken by the Sustainable Urban Transport Project, Ministry of Urban Development (MoUD), Government of India (GOI) with support from Global Environment Facility (GEF), UNDP and World Bank. The focus of the Guidance Document is to establish a systematic process for plan preparation, serving more as an implementation manual with checklists of potential alternatives, rather than providing technical standards for development of detailed specifications.

Coimbatore Street Design & Management Policy, 2017[17]

Keeping with the approach set-out in NUTP-2006, the Coimbatore City Municipal Corporation (CCMC) adopted a Street Design & Management Policy to ensure the implementation of high-quality transport systems. The Policy seeks to achieve an environment that supports more equitable allocation of road space by incorporating a focus on non-motorised transport (NMT) and public transport (PT) in the planning, design, managing, and budgeting stages.

[13] https://pmc.gov.in/sites/default/files/road_img/USDG_Final_July2016.pdf
[14] http://smartcities.gov.in/upload/development/5a9009c9843cdPolicy%20for%20Pedestrian%20Facilities%20and%20Safety%20in%20Pune%20City.pdf
[15] https://pmc.gov.in/sites/default/files/project-glimpses/PMC-public-parking-policy-English-revised-March2016-Final.pdf
[16] https://smartnet.niua.org/sites/default/files/resources/nmtguidancefinal.pdf
[17] https://www.itdp.in/wp-content/uploads/2018/01/CoimbatoreStreetDesignandManagementPolicy_ITDP_170218.pdf

Ease of Living Index, 2018[18]

The SLB initiative has been reimagined and expanded into the Ease of Living Index, covering more sectors and aspects of citizen lives. Within transport however, the larger set of indicators remain largely similar to the earlier SLBs.

Specifications for Urban Road Execution, Tender SURE

Bangalore City Connect Foundation (BCCF) in conjunction with Indian Urban Space Foundation (IUSF) approached the state government of Karnataka to build an Urban road and tender manual in 2010. The publication contains guidelines on designs, specification and procurement of contract for urban roads execution with the priority on the comfort and safety of pedestrians and cyclists, as well as recognizing the needs of street vendors and hawkers.

Urban Street Design Guide, NACTO

NACTO's (a non-profit organization) 'Urban Street Design Guide' gives guidance through toolbox and tactics that cities can use to make streets safer, more liveable, and more economically vibrant. The Guide outlines both a clear vision for complete streets and a basic road map for how to bring them to fruition.

Better Streets, Better Cities, ITDP[19]

A street design manual for Indian cities prepared by ITDP, (a not for profit organization) that discusses design details of various street elements and street sections on 'complete streets' principle.

Parking Basics, ITDP[20]

Parking Basics a guiding document by ITDP, outlines the key principles and steps involved in managing on-street parking and regulating off-street parking.

Footpath Design: A guide to creating footpaths, ITDP[21]

The footpath design guide prepared by ITDP is a quick reference guide which highlights key concepts from the IRC Guidelines, including footpath design standards. The guide also draws from local and international best practice for some themes not covered in the IRC publication.

[18] https://easeofliving.niua.org/assets/upload/pdfs/ease-of-living-national-report.pdf
[19] https://www.itdp.org/wp-content/uploads/2011/12/Better-Streets-Better-Cities-ITDP-2011.pdf
[20] https://www.itdp.org/wp-content/uploads/2015/10/Parking-Basics.pdf
[21] https://www.itdp.in/wp-content/uploads/2014/04/05.-Footpath-Design_Handout.pdf

Footpath Fix, ITDP[22]

Footpath Fix the second volume after Footpath Design is a step-by-step guide on footpath construction detailing for urban designers, municipal engineers, and contractors.The guide aims to highlight the steps of footpath construction in a chronological order, from pre-excavation to above-ground construction. It also features necessary precautions, drawing from experience on-ground, that must be taken into consideration at each stage of construction.

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[22] https://www.itdp.in/wp-content/uploads/2018/07/Footpath-Fix.pdf


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