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Coimbatore City Municipal Corporation

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CAPACITY ASSESSMENT AND ENHANCEMENT FOR SAFE STREET DESIGN AND ENABLING NMT INFRASTRUCTURE

VOLUME 4: QUICK REFERENCE GUIDE FOR STREET DESIGN

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Contents

Purpose of this booklet

This booklet serves as a ready reckoner reference for those working on street design projects with an emphasis on creating safe streets for all.

The booklet is organized under four chapters -

Chapter 1 deals with the design of infrastructure for walking and cycling and covers design standards and recommendations.

Chapter 2 deals with the design of the carriageway with a focus on reduction of speeds as a way to ensure safety for all street users.

Chapter 3 deals with the placement of above grade utilities in a manner that does not obstruct the clear passage for all street users.

Chapter 4 tabulates all the relevant codes and sections from the Indian Roads Congress pertaining to the design of streets.

1 *Creating safe spaces for everyone*

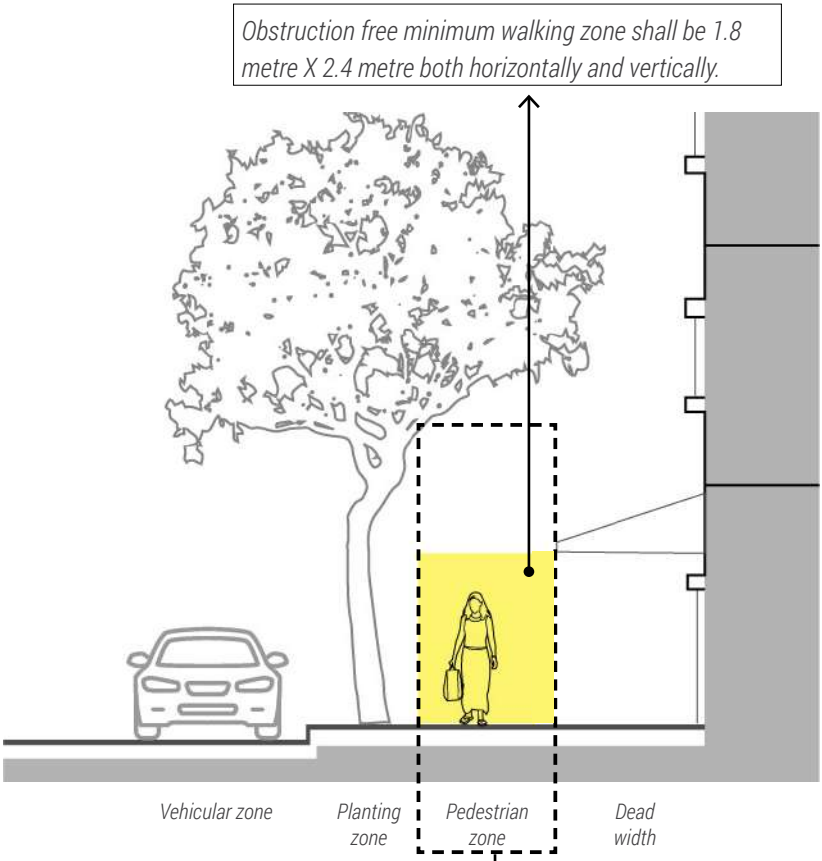
The creation of safe streets is fundamentally hinged on mapping all the user groups on a street and creating safe spaces for each of them. In other words, clearly delineating zones within the street right-of-way for all users after studying and analysing their specific requirements is an important step towards improving road safety.

This chapter covers key design aspects related to footpaths and cycle lanes as a way to urge those working on street design projects to start the design process with these aspects in mind.

This is also to ensure that there is an equitable distribution of space for pedestrians and cyclists within the street right-of-way because in current practice the prioritization of space allocation for these user groups comes last.

1.1 Footpaths

The area between the kerb and the property boundary used to support pedestrian movement along the street. Footpaths in some locations can support activities such as footpath dining. Wider footpaths improve pedestrian amenities, ease of movement and connectivity by allowing the provision of street furniture, shade trees and landscaping.



Source: IRC 103:2012

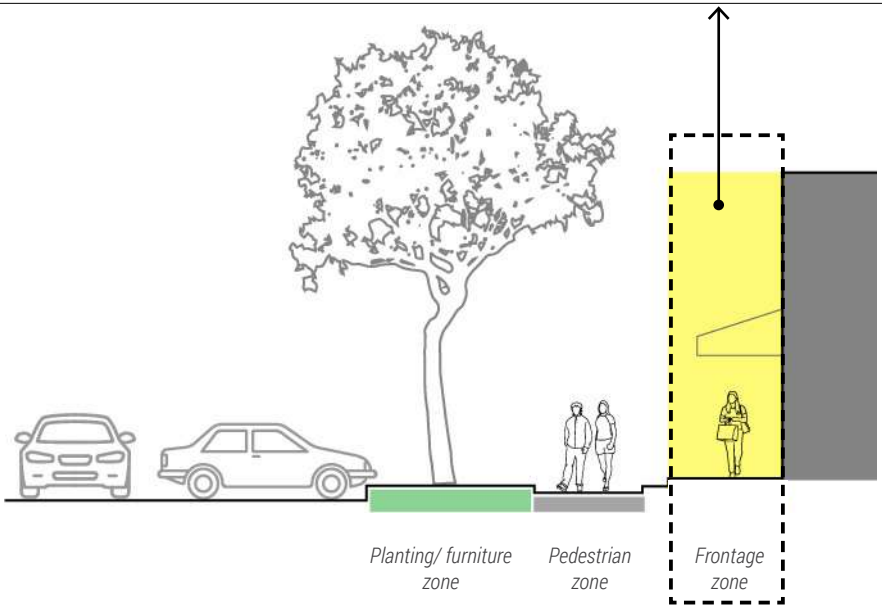
Required width of footpath as per adjacent land use

Minimum obstacle free walkway width in residential/ mixed use areas	1.8 metres
Commercial/ Mixed use areas	2.5 metres
Shopping frontages	3.5 to 4.5 metres
Bus stops	3 metres
High Intensity Commercial areas	4 metres

Source: IRC 103: 2012

In busy areas like bus stops, railway stations, recreational areas, the width of sidewalk should be suitably increased to account for accumulation of pedestrians.

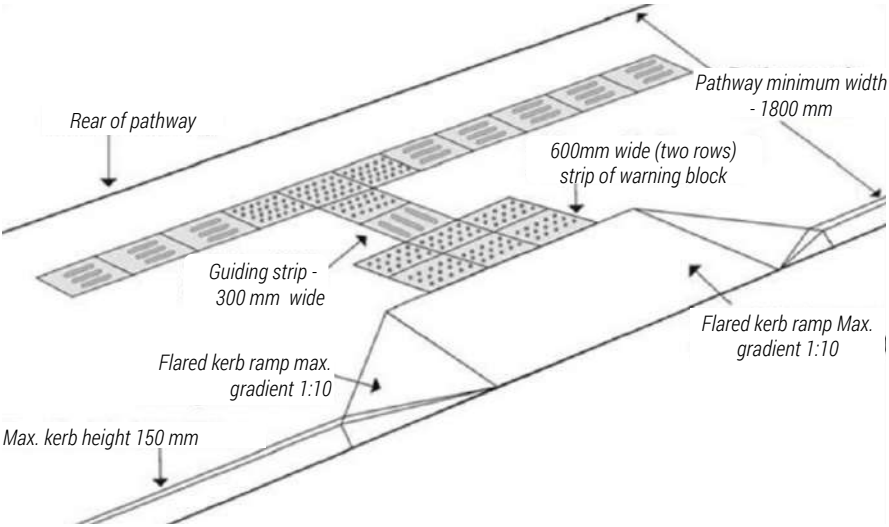
For footpaths in shopping area, an extra one metre should be added to the stipulated 4 metre width. In other situations where footpaths pass next to buildings and fences, a dead width of 0.5 metres can be added.[1]



[1]*Source: IRC 103:2012 and Street design guidelines UTTIPEC DDA 2009*

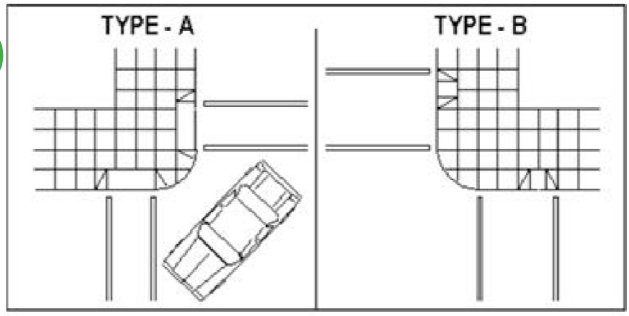
1.2 Kerb ramps

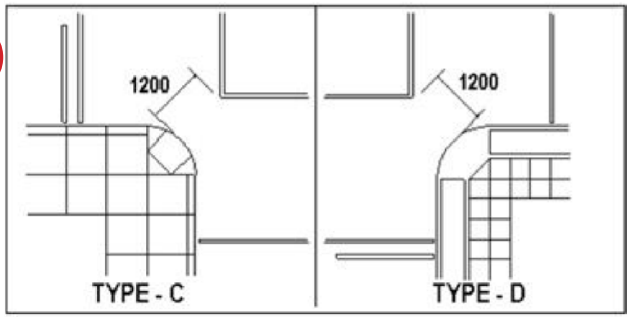
Kerb ramps need to be provided while designing footpaths to ensure that persons with disabilities are able to enter and exit the pedestrian zone safely.



Kerb ramp placement

Kerb ramps also need to be placed in correct locations to enable safe crossing at intersections as well.





Source: Harmonised Guidelines

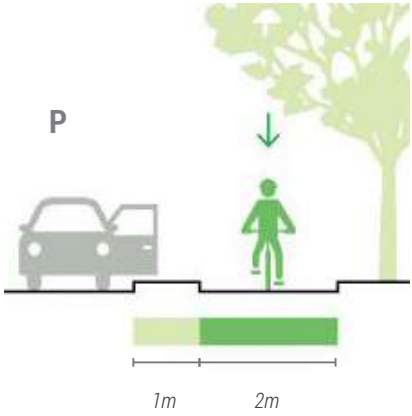
1.3 Property access ramps

Among its many functions, streets also provide access to properties along them. While pedestrians can access these properties from the footpath abutting them, it is required to provide access for vehicles to enter these properties wherever required. However, while doing so it is important to take care that the pedestrian zone's continuity is not compromised.

Property access ramps must therefore be located along the edge of the footpath as shown in the illustration above. It is recommended to keep the length of the ramp at 0.6 metres and maintain a clear 1.8 metres width beyond the ramp. In segments where there is no access ramp, it the edge can be treated as a planting strip as well to add to visual quality of the streetscape.

1.4 Cycle tracks

When cyclists use the carriageway along with other motorized vehicles, they increase the risk of accidents for themselves as well as hamper the flow of traffic because of the difference in speeds at which they travel. It is therefore recommended to provide a segregated lane for cyclists to ensure both safety as well as free flow of traffic.



As per IRC 11 - 1962, separate cycle tracks may be provided when the peak hour cycle traffic count is 400 or more and the traffic count of motorized vehicles is 100 or more. However, when the traffic count of motorized vehicles is 200 or more, separate cycle tracks are justified even if the cycle traffic is only 100 per hour.

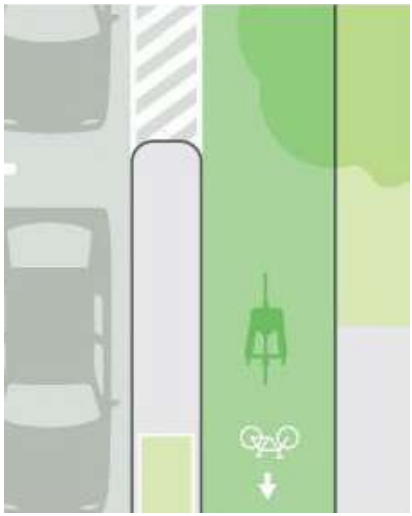


Image source: NACTO

The minimum width required for a single cyclist is 1 metre and the minimum width of a cycle track should not be less than 2 lanes i.e. 2 metres.

Width of cycle track		*Capacity in number of cycles / hour*	
		One-way traffic	*Two-way traffic*
Two lanes	(3m)	250 to 600	50 to 250
Three lanes	(4m)	over 600	250 to 600
Four lanes	(5m)	----	over 600

Source: IRC 86 - 1983

2 *Reducing traffic speeds*

Another key factor for creating safe streets is the control of traffic speeds on urban roads.

A car traveling at 50 km/hr will require 13 metres to stop while a car traveling at 40 km/ hr will require less than 8.5 metres. The risk of death is 20 times more at 80 km/hr than at 30 km/hr for the car's occupants.

For pedestrians and cyclists, at 30km/hr there is a 90% survival rate on collision. This reduces to 50% survival rate at 45km/hr and 0% survival rate at 80km/hr.

This chapter covers key design aspects related to road geometry for motorized vehicles within the street right-of-way - the design of carriageways, safe crossings for pedestrians, intersection design and parking.

2.1 Carriageway lane widths

Carriageway widths as prescribed by the Indian Roads Congress are as listed below:

Description	*Width (metre)*
Single lane without kerb	3.50
2-lane without kerb	7.00
2-lane with kerb	7.50
3-lane with or without kerb	10.5 / 11.0
4-lane with or without kerb	14.0
6-lane with or without kerb	21.0

For access roads to residential areas, a lower lane width of 3 metres is permissible.
Minimum width of a kerbed urban road is 5.5 metres including allowance for a stalled vehicle.

Source: IRC 86 - 1983

In narrow streets, lane widths may be reduced to 3 metres for bus lanes and 2.75 metres for other vehicles as a traffic calming measure.

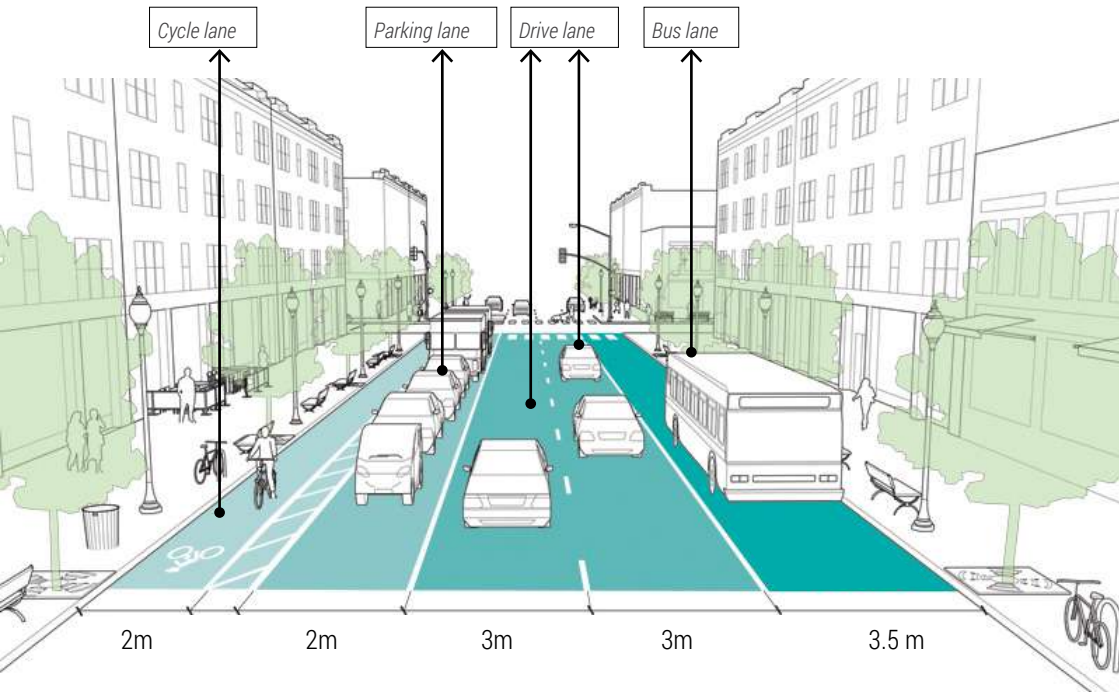


Illustration showing carriageway widths on a one way typical street consisting of cycle lane, parking, drive and bus lane. Image source: NACTO

2.2 Pedestrian crossings

Pedestrian must be given the shortest possible direct route to cross the street.

The width of the pedestrian crossing must be adequate and should generally lie within a range of 2 to 4 metres. For divided carriageways, the crossing should, as far as possible, proceed uninterrupted through the median strip. In the event of the median strip being used as pedestrian refuge island, adequate width of the median must be provided.

Source: IRC 103:2012

Image source: NACTO

Table top pedestrian crossings

Table top crossings can be considered where a distributor/ side street meets a busy arterial road. This helps to control speeds of vehicles that are turning in or out of the arterial road thereby ensuring safety for pedestrians who may be crossing these side streets. This also means that pedestrians can continue to walk at the same level without having to step up or down at the street crossing. It must be noted that table top crossings may not be appropriate for crossing an arterial road itself.

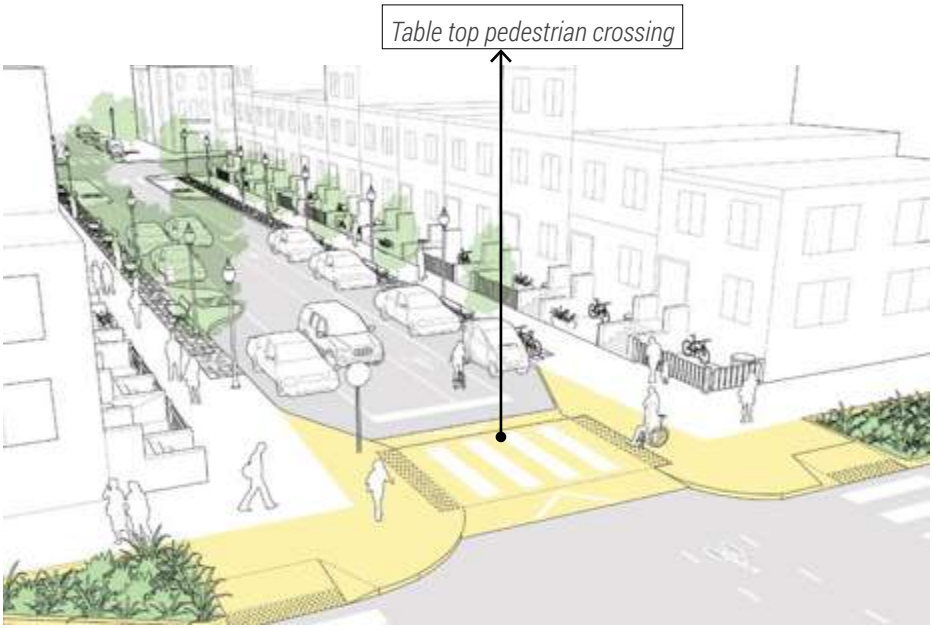


Image source: NACTO

Mid-block crossings standards

Mid-block crossings must be provided for people to cross the street safely between building entries or bus stop locations or active land uses on opposite sides of the street.

Residential areas	Spacing Range : Every 80-250 metres Coordinated with entry points of complexes; location of bus / train stops, public facilities etc.
Commercial / Mixed use areas	Spacing Range : Every 80-150 metres
High Intensity Commercial areas	Pedestrianization if possible

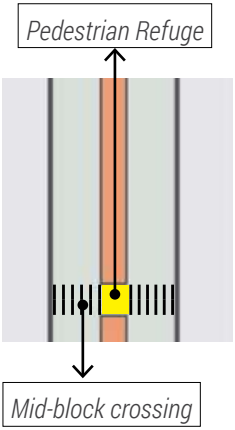
Source: IRC 103:2012

Pedestrian refuge width

The width of the median to accommodate a refuge island should be an absolute minimum of 1.2 metres.

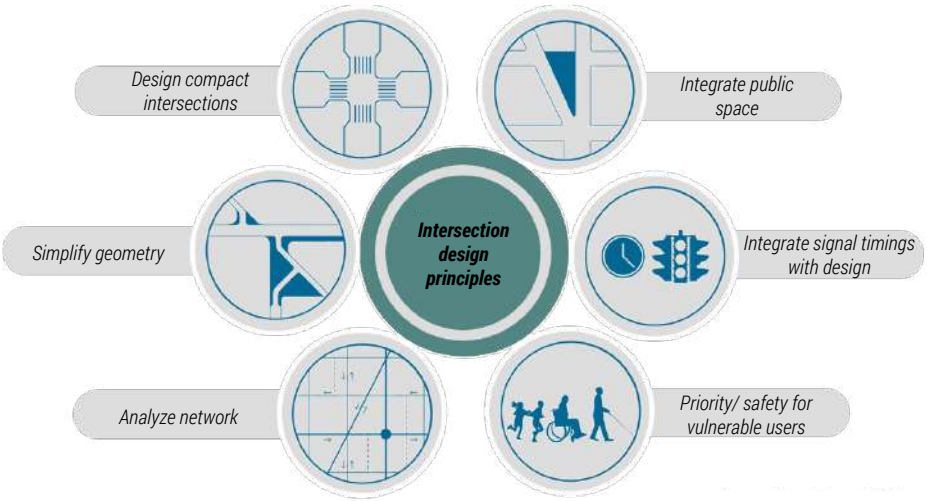
In the case of a staggered crossing arrangement to prevent two wheelers from using the refuge island, the minimum clear width between guard rails must be 2 metres to allow two wheelchair users to pass one another.

Source: IRC 103:2012



2.3 Intersection design

Intersections or street crossings are potential points of conflict between different user groups if they are not designed well. The diagram below presents key design principles that can help to overcome the safety hazard effectively:

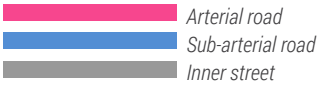


Source: Adapted from NACTO - Global Street Design Initiative

The following set of diagrams show a step by step process of how to work with intersections keeping the above six principles in mind:

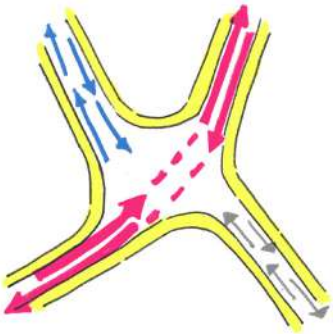
Step 1 - Understanding the street hierarchy

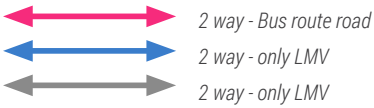
This step helps us understand which street has priority of traffic flow based on its location within the wider street network.



Step 2 - Understanding the traffic flows & vehicular counts

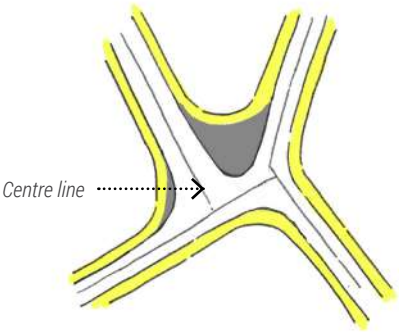
This step helps us understand the traffic flows based on modes of transport and direction of movement.





Step 3 - Simplifying the geometry of intersection

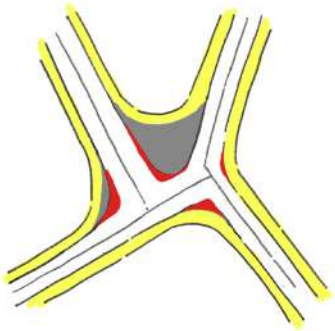
Tracing a centre line for all the streets that meet at an intersection is a precursor to simplifying the geometry. This will give us the required room to tighten the turning radii in step 4.



Step 4 - Tightening the turning radius

Smaller turning radii increases pedestrian safety by

- *shortening crossing distance*
- *increasing pedestrian visibility for drivers*
- *decreasing vehicle turning speed; and*
- *making drivers look out for pedestrians while taking the turn.*



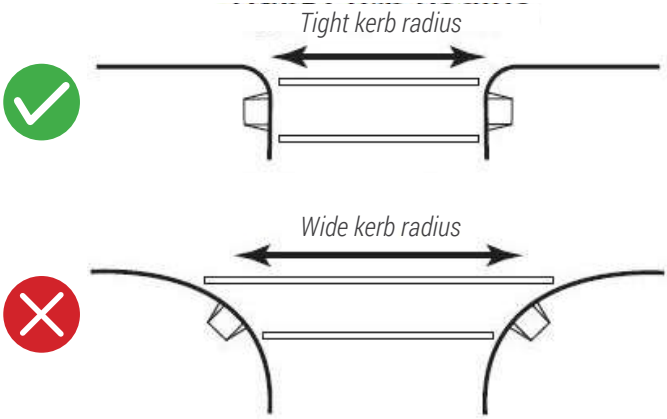
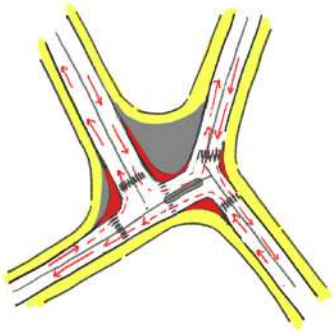
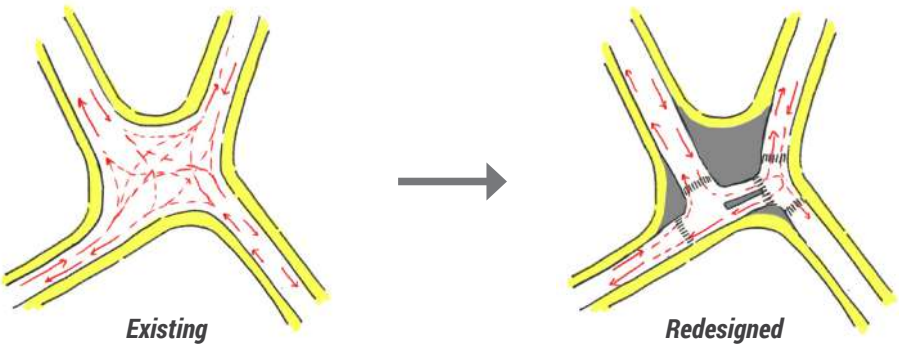


Image source: Strongtowns.org

Step 5 - Addition of pedestrian crossings & refuge islands

The last step is to determine the nature of the pedestrian crossings - kerb drop crossing, table top crossing, crossing with refuge island etc.





The end result after the five steps will look like the diagrams above.
The gray patches in the redesigned intersection drawing indicate land parcels within the street right-of-way which can be reclaimed to accommodate the footpath, waiting area or public spaces which are both functional and visually appealing.

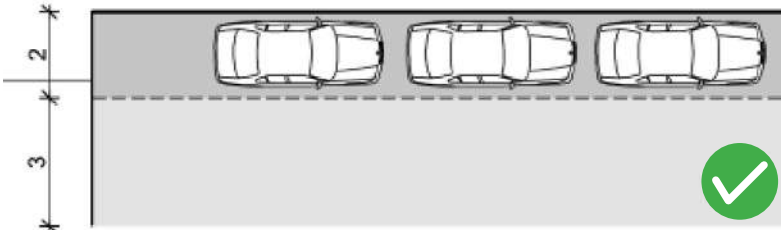
2.4 Parking

Provision for some on-street vehicular parking is also to be considered while designing streets. It is recommended to arrive at the requirement of parking spaces as per parking demand assessment for the street and its immediate vicinity as a whole rather than assess demand for a single street. This will ensure that the parking can be distributed across the vicinity rather than having the entire street length given to parking.
It should also be kept in mind to reduce the number of parking spaces provided.

Space requirement for various parking layouts as per Indian car sizes

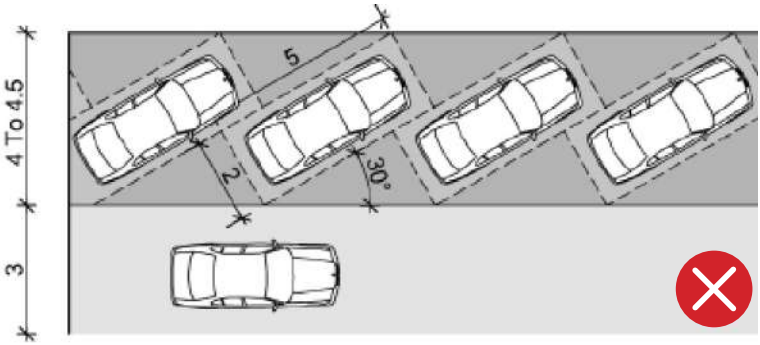
Angle (degrees)	*0 / Parallel*	*30*	*45*	*60*	*90*
Maneuvering space width (m)	3	3	4.5	5	7
Parking space width (m)	2	2.3	2.5	2.5	2.5
Space per car (sq.m)	25	33	33	30	30

Parallel parking



Minimum obstruction to traffic flow when parked car reverses and merges with traffic flow

Angular parking



Perpendicular parking

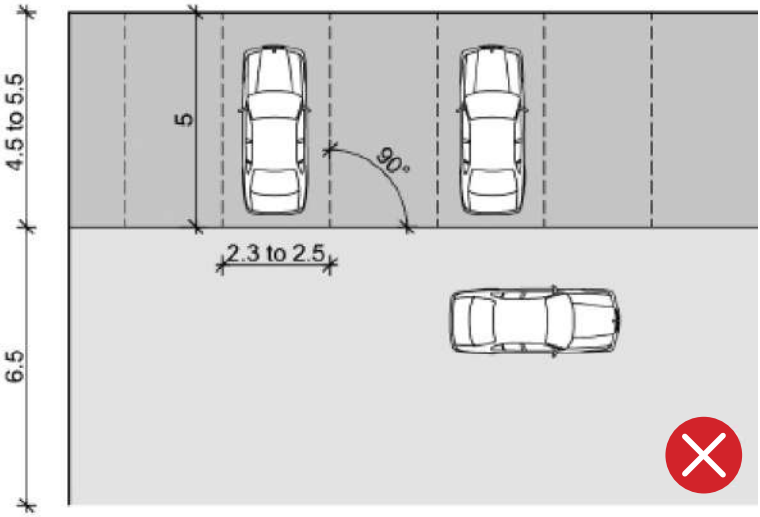
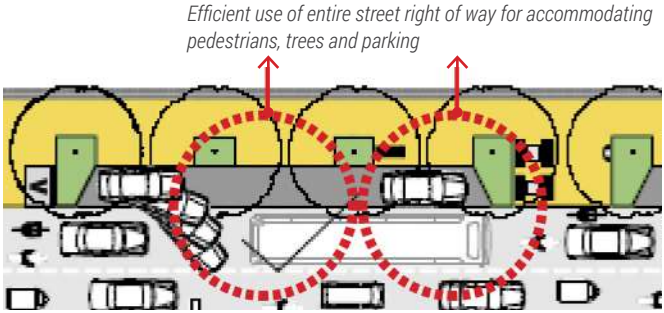
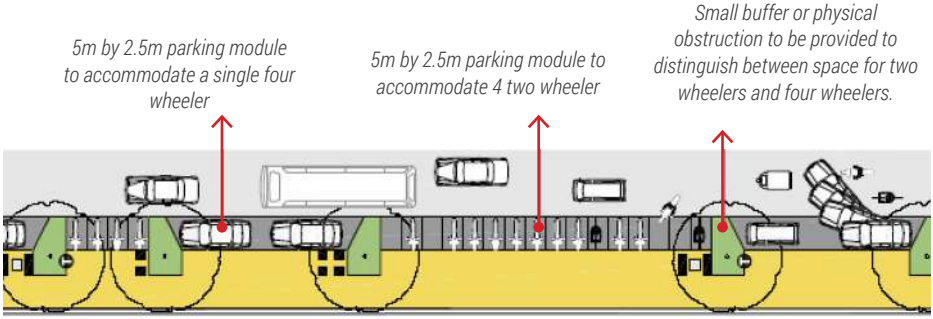


Image source: ITDP

Parallel parking configuration



Parking module sizes



Parking near bus stops

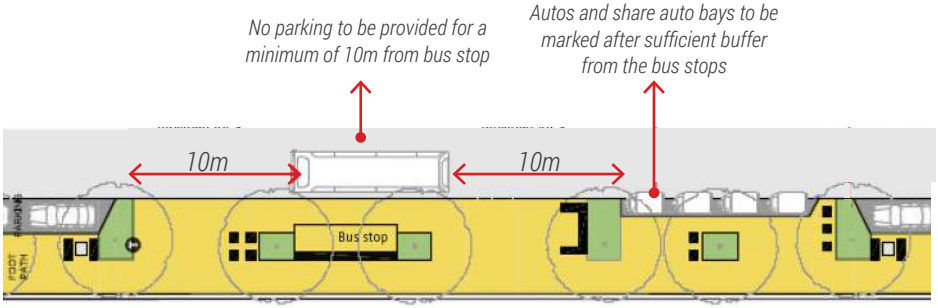


Image source: ITDP

3 *Working with above grade utilities*

Streets are also carriers for utilities that service the properties along them. These include but are not limited to water supply, sewerage connections, storm water drains, electric cables, telecommunication cables and gas lines. Utilities may have an underground component, an above grade component or both. For example, electric cables running below the ground will have a transformer or distribution box placed visibly in the streetscape. Drain lines running below will have inspection chambers at regular intervals which need to be accessed from the street level through manhole covers.

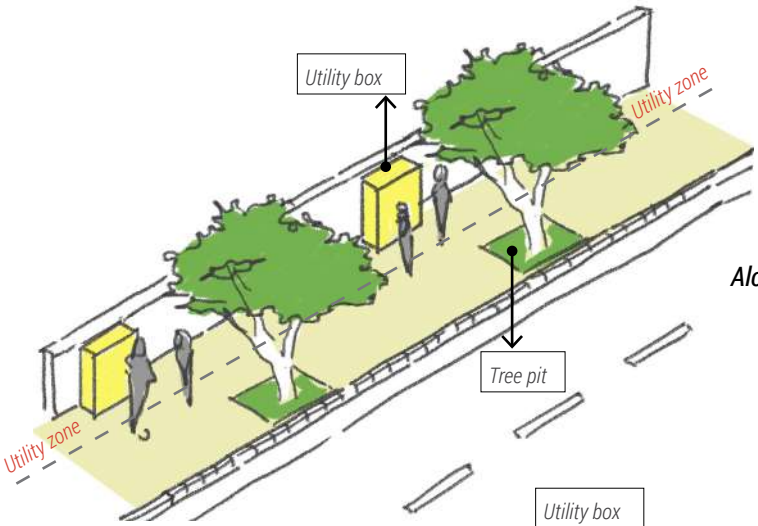
In addition, there are other utilities such as street lights, street signage, waste bins and other street furniture that are also placed on a street.

It is important to keep in mind that the placement of all these utilities will have to be in a manner that does not hinder the flow of other users on a street whether it is pedestrians, cyclists or motorized vehicles.

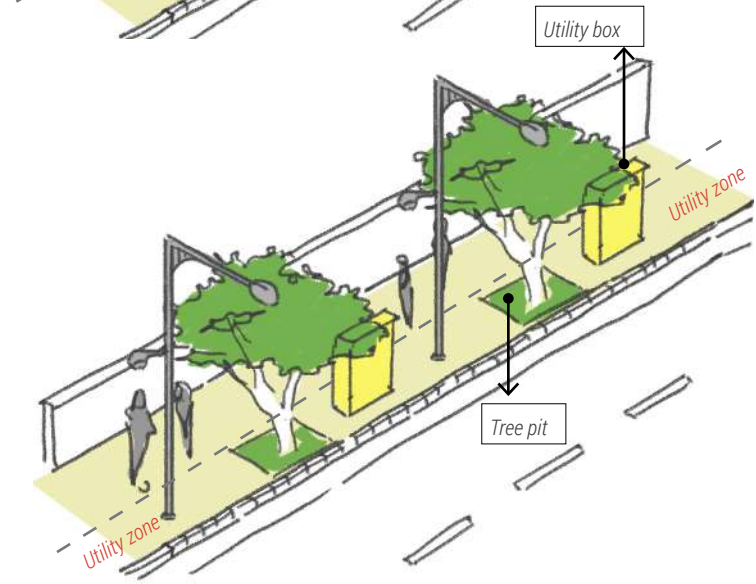
3.1 Defining utility zones

It is recommended that all above grade utilities are streamlined within the street right-of-way in a manner that does not obstruct the movement of pedestrians or cyclists.

Wherever possible, it is advisable to define a utility zone and to place all above grade utilities - transformers / electric distribution boxes/ section feeders / telecommunications boxes / post boxes - within the utility zone either along the property edge or along the kerb edge.



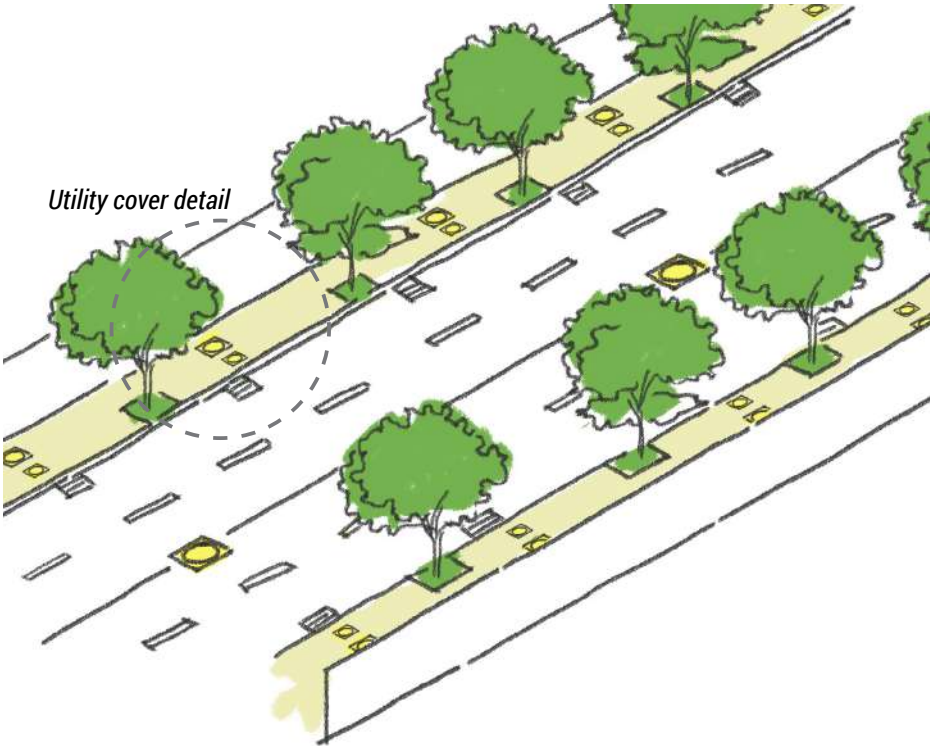
Along property edge

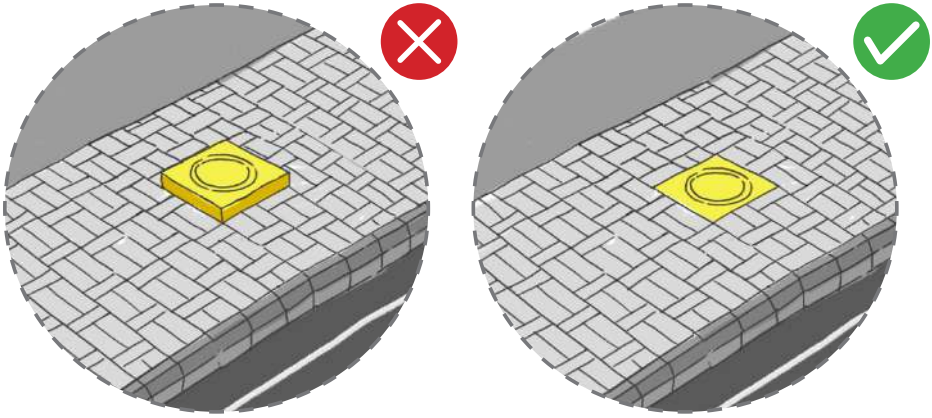


Along kerb edge

3.2 Placement of utility chamber covers

With regard to the placement of inspection chamber covers/ manholes, it is highly recommended that care be taken to properly flush them to the level of the sidewalk. This is to ensure that these covers do not become obstructions while walking or cycling.





4 *Codes for designing safe streets*

The following table lists applicable codes as prescribed by the Indian Road Congress (IRC) which may be relevant while designing safe streets:

S. No.	*Street design element*	*Code number*	*Key design guidelines*
1	Footpath and Pedestrian Crossings	IRC: 86-2018 – Sec 5.1/ IRC: 103-2012	Refer to minimum widths, footpath heights, turning radii, pedestrian refuge, kerbs. Slip roads are undesirable on signalized intersections. Zebra Crossing width = 2-4m
2	Recommended Carriageway Widths	IRC: 86-2018 – Sec 5.4	Referred to recommendation of 3.5m carriageway widths on arterial and sub-arterial roads. 3m permissible on access roads to residential areas.
3	Stopping Sight Distance	IRC: 86-2018 – Sec 7.1	Refer to safe stopping distance for arterials and sub-arterials = 80m; for other roads = 45m
4	Road Signs	IRC: 67-2012	Refer to guidance for placement and specifications for: • Mandatory/ Regulatory (circle shaped) – Prohibitory Regulation/ Operation Control/ Compulsory Direction Control • Cautionary/Warning Signs (triangle shaped)

S. No.	*Street design element*	*Code number*	*Key design guidelines*	
4	Pavement Markings	IRC: 35-2015	Reference: Table: A.1: Longitudinal Markings (LM) Table: A.2: Transverse Markings (TM) Table: A.3: Hazard Markings (HM) Table: A.4: Block Markings (BM)	Table: A.5/B.1 Arrow Markings (AM) Table: A.5: Arrow Markings (AM) Table: A.6: Directional Markings (DM) Table: C.1: Details of Letters & Numerals
5	Markings for At-Grade Intersections	IRC: 35-2015 – Section 9	Refer to use conditions at intersections for Pavement Markings, Stop Line, Diagonal and Chevron Markings, Continuity Markings, Lane Change & Merging/ Diverging Markings, Hatch Markings, Arrows and Supplementary messages.	
7	Design and Installation of Road Traffic Signals	IRC: 93-1985 – sec 12	Refer to guidance on transverse location of traffic signal supports and controller cabinets	

5 *Glossary of terms*

Accessibility	The ease with which a building, place or facility can be reached by people and/or goods and services. Accessibility can be shown on a plan or described in terms of pedestrian and vehicle movements, walking distance from public transport, travel time or population distribution.
Active Edges/ Frontages	Ground floor uses which accommodate activities and provide a level of interaction between pedestrians and the building uses including cafes/ restaurants, shops, library etc. Active frontages/edges increase casual surveillance and improve the vitality and safety of an area.
Amenity	Design, aesthetic or other features of a development (building or public space) that increase its marketability or usability to the public. Examples of amenities include: good architecture, open space, landscaping, street furniture, an outdoor amphitheater, public art etc.
Barrier-free design/ Universal access design	Building and site design which is accessible to all people, regardless of age and abilities.
Block	The area bounded by a set of streets and undivided by any other significant streets carrying vehicular traffic. A block may be designed to be cut through by pedestrian thoroughfares.
Buffer	A strip of land identified on a site plan or by a zoning ordinance established to provide separation between land uses that are incompatible. Normally, the area is landscaped and kept as open space.
Building access	The entry / exit points of a building for pedestrians & vehicles

Building line The line formed by the frontages of buildings along a street. The building line can be shown on a plan or section.

Building orientation The positioning of the building on site with respect to the street and the cardinal directions.

Bulb-Out Widened sidewalk areas at intersections or mid-block crossings, often in place of on-street parking, thereby narrowing the pedestrian crossing distance over a right-of-way.

Bus priority lane A highway or street lane reserved primarily for buses, either all day or during specified periods. It may be used by other traffic under certain circumstances, such as making a right or left turn, or by taxis, motorcycles, or carpools that meet specific requirements described in the traffic laws of the specific jurisdiction. Bus priority lanes reduce travel time and improve the quality and reliability of bus commute

Circulation Movement patterns of people and goods. Includes pedestrians, cyclists, vehicular traffic, transit systems and freight.

Eyes on the street People whose presence in adjacent buildings or on the street make it feel safer. Jane Jacobs' refers to the 'eyes on the street' concept in her book, The Death and Life of Great American Cities (1961) in the chapter where she discusses safety and the sidewalk. She notes that 'there must be eyes upon the street, eyes belonging to those we might call the natural proprietors of the street'.

Footpath Is defined by the area between the kerb and the property boundary used to support pedestrian movement along the street. Footpaths in some locations can support activities such as footpath dining. Wider footpaths improve pedestrian amenities, ease of movement and connectivity by allowing the provision of street furniture, shade trees and landscaping.

Frontage The width of a single lot, measured parallel to the right-of-way.

Frontage zone The area adjacent to the property line where transitions between the public sidewalk and the space within buildings occur. (also dead width)

Landmark Buildings, structures and spaces which create distinct visual orientation points that provide a sense of location to the observer within the neighbourhood or district, such as that created by a significant natural feature or by an architectural form which is highly distinctive relative to its surrounding environment

Mapping Technique used for communicating information about the physical environment. Maps may represent physical features such as land and climate conditions or abstract concepts such as view corridors and pedestrian nodes.

Mid-Block Connections Linkages between two streets with the purpose of breaking up large blocks. The new connection provides an alternative way to the footpath/street grid and can be either a road or a pathway. It improves connectivity and accessibility through a precinct by adding to the choice of routes. They should ideally be designed to have uses other than as mid-block pedestrian links e.g. laneway or library/gallery galleria.

Mixed Use A mix of uses within a building, or a site, or within a particular area, possibly including employment, residential, commercial, live/work, or retail. As an example, mixed use development can have shops on the ground floor with residential apartments above (vertical mix) or an office next to a residential apartment building within the same development (horizontal mix).

Modal Split How the total number of trips in an area or to a destination is split between different means of transport, such as train, bus, car, walking and cycling. A change in modal split is referred to as modal shift and multi-modal refers to several different means of transport.

Node A place where activity and routes are concentrated; a point of interchange in a transport network. Kevin Lynch defines nodes as 'points, the strategic spots in a city into which an observer can enter, and which are the intensive foci to and from which he is traveling. They may be primarily junctions, places of a break in transportation, a crossing or convergence of paths, moments of shift from one structure to another.
Or the nodes may simply be concentrations, which gain their importance from being the condensation of some use or physical character, as a street-corner hangout or an enclosed square'. (also hotspot)

Para transit Forms of transportation services that are more flexible and personalized than conventional fixed-route, fixed-schedule service. The vehicles are usually low- or medium-capacity vehicles, and the service offered is adjustable in various degrees to individual users' desires. Its categories are public, which is available to any user who pays a pre-determined fare (e.g., autos, share autos) and semi-public, which is available only to people of a certain group, such as the elderly, employees of a company, or residents of a neighbourhood (e.g., vanpools, subscription buses). These services are usually informal and oftentimes fill the gaps in the public transport network.

Parking demand Refers to the amount of parking that is estimated to be used at a particular time, place, and price.

Pedestrian All people on foot or moving at walking speed, including those who use mobility aids (wheelchairs, scooters, etc.), persons with strollers and buggies, and frail elderly persons.

Pedshed The area within a 10-minute walk band around a train station. Pedsheds are ideal locations for relatively dense housing development.

Placemaking Placemaking involves the planning, design, management and programming of public spaces. It addresses how we collectively shape our public realm to maximize shared value. Placemaking facilitates creative patterns of activities and connections (cultural, economic, social, ecological) that define a place and support its ongoing evolution. Placemaking is rooted in community-based participation and in concerned with building both the settlement patterns and the communal capacity for people to thrive with each other and our natural world.

Plaza A community gathering space, sometimes called a square, usually designed with seating areas, and with a variety of ground-plane finishes such as hard-surfaces, lawn and landscaping. It is often designed as a focal point with an amenity such as a fountain, and it may be bounded on one or more sides by a civic or commercial use in the neighborhood or commercial center.

Precinct An urban quarter; a distinct local area; an area with a defined boundary.

Primary Streets Active for all modes of transport, but have less vehicular traffic than do avenues, so they are the most balanced streets downtown. Used to move people within the downtown.

Public Art Site specific artwork created to enhance and animate publicly accessible spaces through artistic interpretations that range from individual sculpture to integrated architectural and landscape features and treatments.

Public Realm The public and semi-public spaces of the city, especially the street spaces of the city from building face to the opposite building face (including the façade, front yard, sidewalk and streets) and open space such as parks and squares. These spaces are available, without charge, for everyone to use or see and are also called the public domain.

Right-of-way (RoW) That part of the street space including the space above and below the surface that is publicly owned and lies between the property lines. This space is generally established for the use of pedestrians, vehicles, or utilities.

Road hierarchy A classification of roads and streets. Road hierarchy for highway engineers includes access roads, distributor roads, collector roads and arterial road according to their role in the network as carriers of traffic and to the volume of traffic they can carry whereas road hierarchy for urban designers includes mews, residential streets, high streets and boulevards according to their scale and to their role in relation to people on foot.

Spine A street or streets along which a specific activity is concentrated.

Square An urban space, landscaped or paved, and enclosed wholly or partly by buildings. Also referred to as a piazza, quadrangle, courtyard or plaza.

Stakeholder A stakeholder is any person, organization, institution, social group, or society at large that has a stake of a particular space

Street furniture A collective term for the various elements installed on streets and roads. It includes seating, bollards, bus shelters, fountains, signage, light fixtures, fire hydrants, telephones, trash receptacles, mailboxes, newspaper boxes, kiosks.etc. all of which contribute to the street scene.

Street reclaiming	Reusing the space saved through reduced car use to enhance the social, cultural and economic life of a neighbourhood.
Streetscape	The distinguishing elements and character of a particular street as created by its width, degree of curvature, paving materials, design of the street furniture, pedestrian amenities and setback and form of surrounding buildings.
Traffic calming	Measures to reduce the speed of motor traffic, particularly in residential areas. They include education, enforcement and engineering (the three Es).
Transit	A system of conveyance (typically bus, train or tram) provided collectively- by the public sector or the private sector, or a mixture of the two.
User group	The different group of people who use the space
Walkability	A condition of a system of routes which are barrier free, interesting, safe, well-lit, comfortable and inviting to pedestrian travel. Essentially, the ease with which it is possible to walk around an area, from one point to another.
Way finding	The information which orients users of an area to ensure their ability to navigate through an area. This information includes but is not limited to signs, graphic communications, streetscape elements, building design and the street network.

Ministry of Housing and Urban Affairs (MoHUA) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH are jointly implementing the technical cooperation project "Integrated Sustainable Urban Transport Systems for Smart Cities (SMART-SUT)", commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ). The project works with the three Smart Cities of Bhubaneshwar, Coimbatore, and Kochi and respective state governments of Odisha, Tamil Nadu, and Kerala to promote low carbon mobility planning, and to plan and implement sustainable urban transport projects in the fields of public transport, non-motorised transport and modal integration.

As part of the Indo-German bilateral cooperation, both countries have also agreed upon a strategic partnership - Green Urban Mobility Partnership (GUMP) between Ministry of Housing and Urban Affairs (MoHUA) and Federal Ministry for Economic Cooperation and Development (BMZ). Within the framework of the partnership's technical and financial cooperation, the German government will support improvements in green urban mobility infrastructure and services, strengthen capacities of national, state, and local institutions to design and implement sustainable, inclusive, and smart mobility solutions in Indian cities. As part of the GUMP partnership, Germany will also be supporting expansion of public transport infrastructure, multimodal integration, low-emission or zero-emission technologies, and promotion of non-motorised transport in India. Through this strategic partnership, India and Germany intend to jointly achieve effective international contributions to fight climate change.