Street Design Guidelines for Greater Mumbai

January 2014

EMBARQ India

STREET DESIGN GUIDELINES FOR GREATER MUMBAI

Introduction

While 51% of all trips in Mumbai are by walking[1], yet pedestrians are the most vulnerable road user. 58% of all fatalities are pedestrians[2]. Walking and public transport trips constitute 88% of all trips in the city. Further 60% of trips to public transport are on foot and 80% of trips are less than 15 minutes.[3]

The objective of this document is to propose a non-motorized transport strategy for Mumbai along with pedestrian oriented street design guidelines to enable safe and comfortable walking environments. These are conceptualized under the umbrella of the National Urban Transport Policy (2006), which states that "people occupy center-stage in our cities and all plans would be for their common benefit and well-being". NUTP's objective is to bring about a more equitable allocation of road space with people, rather than vehicles, as its main focus.

I. Non-motorized Transport Strategy

There is a need to frame a non-motorized transport strategy for Mumbai with the objective of preserving NMT modal shares, improving NMT infrastructure and with a zero tolerance for pedestrian injuries and fatalities.

It is recommended that the Comprehensive Mobility Plan (CMP) create a city-level NMT network plan, which clearly defines and shows city-level NMT only streets, city-level NMT priority streets and NMT priority zones. The suggested criteria for identifying them are:

NMT only streets: These are streets which cater to pedestrians and non-motorized vehicles only. These can include existing and proposed routes through city-level public open spaces, along natural water courses, beaches and need to connect to city roads.

NMT priority streets: These are streets which prioritize NMT movement as they witness high NMT volumes. These can be along public transport corridors i.e. metro-rail, monorail and roads with high density of bus routes

NMT priority zones: These can be considered as 750-1km[4] area around major generators / attractors. They are characterized by high NMT volumes and have an impact on the surrounding street network. These zones can be designated in the CMP and the detailing can be undertaken through local area mobility plans.

The NMT priority zones can include but not be limited to areas around city-level public open spaces, transit oriented development (TOD) zones, bus terminals, business districts, markets, market areas in the inner city, gaothans / koliwadas, institutions with large pedestrian and non-motorized vehicle (NMV) generators (hospitals, educational institutions)

[1] DP for Greater Mumbai (2014- 2034) Preparatory Studies Report: Part II- Assessment of existing situation
[2] Traffic Police
[3] DP for Greater Mumbai (2014- 2034) Preparatory Studies Report: Part II- Assessment of existing situation
[4] According to a study by IIT Roorkee, 912m was the willingness to walk in Mumbai.

II. Street Design Guidelines

Approach

Since Mumbai has high public transport and non-motorized modal shares, the street design guidelines should aim to preserve these modal shares by providing sufficient, safe, comfortable and convenient NMT infrastructure.

Mumbai is also characterized by mixed-use development. Hence lower vehicular speeds and high pedestrian volumes can be observed even on sub-arterial or collector streets (like SV Road and Linking Road respectively). Additionally, while street vendors are considered as "encroachment", their role in providing access to affordable goods and services and creating walkable neighbourhoods needs to be acknowledged.[5] These contribute to the "liveability" of Mumbai's streets; create a vibrant public realm and "street eyes" i.e. natural surveillance systems. Finally, in Mumbai, streets also perform the role of public spaces where activities like sitting, resting, eating etc. are observed. Therefore, street design needs to also consider the adjoining development and amenities for pedestrians and cyclists in addition to the through movement of vehicles. To reiterate the words of Louis Kahn, the street is a community room.

Road Classification

A street hierarchy is suggested based on the transport function, street width and its length. It includes arterial, sub-arterial, major collector, minor collector, local streets and NMT streets.

Arterial roads include expressways, which are characterized by high vehicular volumes and through movement; service lanes for access to plots or grade-separated pedestrian access at non-signalized intersections. They may also support mass transit infrastructure. Their widths generally range from 120-150 feet (36.61-45.70 m). Some examples include Western and Eastern expressways and Jogeshwari Vikhroli Link Road.

Sub-arterial roads are those that run through the city connecting different wards and are generally characterized by mixed-use development, plot accesses and high density of bus routes. Their widths generally range from 100-120 feet (30.51-36.60 m) and may also support mass transit infrastructure. Some examples include Andheri-Kurla Road and Swami Vivekanand Road

Major collector roads are those that run through multiple neighbourhoods or form their spine or edge. Their widths generally range from 60-100 feet (18.31-30.50 m). They could be characterized by mixed-use development, a significant number of bus routes and may also support mass transit infrastructure. Some examples include Central Road (MIDC Marol), Gulmohar road or North-South road 10 in Juhu Scheme.

Minor collector roads are those which collect traffic from local streets. They maybe classified with single land-uses and few bus routes. Their widths generally range from 46-60 feet (14.10-18.30 m). Some examples include Road no 11 and 16, MIDC Marol.

Local streets are those whose main purpose is to provide access to plots. They are characterized by low vehicular volumes and pedestrians and vehicles share road space. In many instances, no footpaths are observed and these streets are also used as leisure or public open spaces (through street games). Their widths are generally upto 14m.

Existing non-motorized routes can be classified as pedestrian routes, cycling routes and NMT routes. Promenades are included as part of pedestrian routes. Some examples include pedestrian paths cutting across Oval and Cross maidans, Marine Drive, Bandra Bandstand and Carter road promenades.

[5] Prof Sharit Bhowmik has written multiple articles on the role of street vendors in India and in Mumbai

It is recommended that streets be designed using the principles outlined below. The guidelines also recommend percentage allocation of road space and guidelines for designing other elements like on-street parking, crossings etc.

Motorized Vehicular Speeds

A design speed is recommended for each type of street. Vehicular speeds have an important role in creating safe streets. It is insufficient to regulate speeds through signage and traffic calming measures have to be introduced to achieve desired speeds. Research has proven that when vehicular speeds increase more than 40 km/hr, the likelihood of a fatality exponentially increases with a collision.[6]

Netherlands, which has developed a national road safety policy and pioneered the approach in reducing fatalities and injuries through traffic calming has a 50-70km/hr speed limit for urban arterials, 50km/hr for urban roads and 30km/hr for residential areas[7]. However, Mumbai has a higher density of bus routes along sub-arterial and major collector roads, higher density of people and more mixed-use development along with lower levels of enforcement. Therefore it is recommended that the speeds along urban arterial roads be limited to 50km/hr, speeds on sub-arterial and collector streets be limited to 30km/hr.

The local streets could be envisioned as traffic calmed, walking and recreation spaces with speeds of 15-25km/hr, as was observed in the woonerfs in the Netherlands[8] or home zones in the United Kingdom[9]. However, unlike woonerfs, footpaths are still recommended for local streets in Mumbai (where possible).

Countries like the United Kingdom and Netherlands have enacted legislation to create 30km/hr zones. It is recommended that the NMT priority zones (outlined in above) should also be designated as 30km/hr zones in the Comprehensive Mobility Plan. They should not be restricted only to residential areas in Mumbai.

The following guidelines are recommended for different street design elements.

1. Footpaths

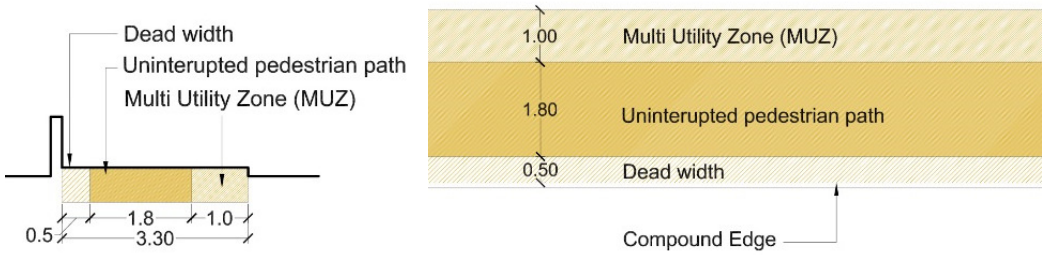
It is recommended that footpaths be designed as per IRC 103-2012: Guidelines for Pedestrian Facilities, which adopts a level of service approach for determining widths of footpaths. It further recommends dividing the footpath into the following zones:

a. Dead zone: This abuts the building or compound wall and maybe used as planters, display in retail areas etc. While a minimum of 0.5m is assumed, its width must increase to 1m in commercial-retail areas.

b. Uninterrupted Pedestrian Path: It accommodates clear and unobstructed pedestrian walkway. While IRC 103 recommends a minimum 1.8m, it is subject to achieving a level of service B or C.

c. Multi Utility Zone (MUZ): It accommodates functions like street furniture, bus stops, auto/ taxi stops, utility boxes, fire hydrants, street vendors, landscape, etc. IRC 103 recommends a minimum of 1.80m. However, where there are space constraints, a minimum width of 1m maybe considered.

[6] Tefft. B. 2013. Impact speed and a pedestrian's risk of severe injury or death: Accident Analysis & Prevention
[7] SWOV. 2002. Road Safety Policy in the Netherlands: Facing the Future
[8] SWOV. 1986. Woonerfs and other experiments in the Netherlands. Built Environment 12 (1/2): p. 20-29 http://www.swov.nl/rapport/R-86-23.pdf. Accessed on 6th March 2014
[9] Department of Transport (UK).2002. Home Zones: Challenging the future of our streets



Using the above guidelines, a minimum footpath of 3.3m is recommended in residential areas and 4.6m in commercial-retail areas, subject to achieving a level of service B or C as per IRC 103- 2012 Guidelines for Pedestrian Facilities. It is also recommended that the kerb height at no point be more than 150mm and guidelines for universal access, access ramps should be followed as per IRC 103- 2012 Guidelines for Pedestrian Facilities.

2. Traffic calming

Traffic calming is a combination of set of street design and management strategies that helps in balancing traffic on street with other users. Traffic calming techniques aim to lessen the impact of motor vehicle traffic by slowing it down, or literally "calming" it. This helps build human-scale places and an environment friendly for pedestrians. It is insufficient to regulate speeds through signage. Traffic calming elements are physically self-enforcing and drivers are forced to slow down to desired speed limits.

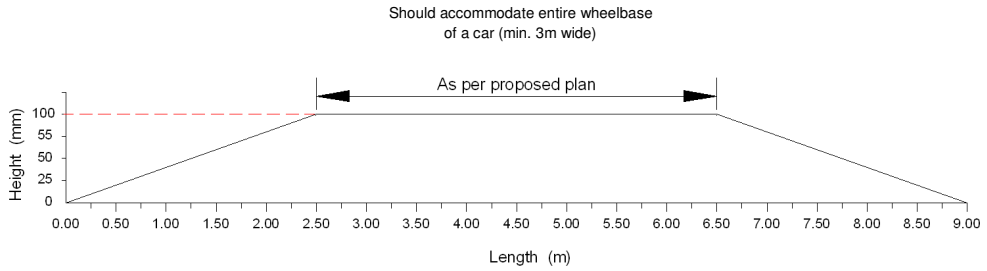
a. Carriageway and lane widths: Since the right of way of Indian roads tends to vary, it is suggested that after obtaining the desired minimum footpath, the street be designed from the centre keeping a constant carriageway. This will avoid bottle necks. However, at no point should the footpath be treated as a "left-over space".

It is recommended that traffic lane widths be reduced, such that they vary from 2.7m[10] to 3.0m except for arterial roads. 3.5m traffic lane widths must be considered for arterial roads[11] only.

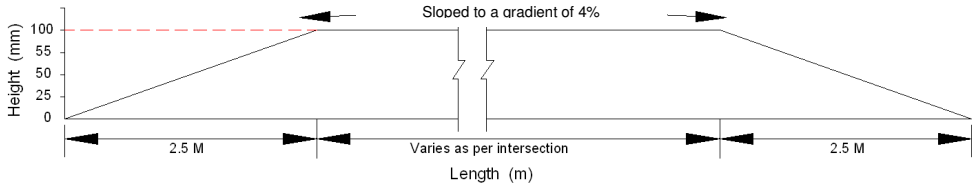
b. Raised crossings and intersections: Raised crossings are speed tables at the location of crosswalks. It provides both speed control and greater pedestrian protection. Raised junction/ intersection areas (plateau) are effective speed reducing measures at junctions. Treatment of junction corners by the use of a textured road surface is useful for slowing down turning traffic. It warns drivers that special care must be taken at intersections for pedestrian safety. While deciding width of raised crossing, care should be taken that the entire wheelbase of a car can be accommodated on the flat portion of the crossing which is minimum 3m. Slope as per standards should be provided to ensure sufficient drainage. The raised crossings and intersections are to be constructed as per the following guidelines.

[10] Source: IRC 86- 1983 Geometric design standards for urban roads in plains
[11] Lane widths and urban roads- final report
https://www.bicyclenetwork.com.au/media/vanilla/file/Lane%20Widths%20Report_final.pdf

Raised Crossings

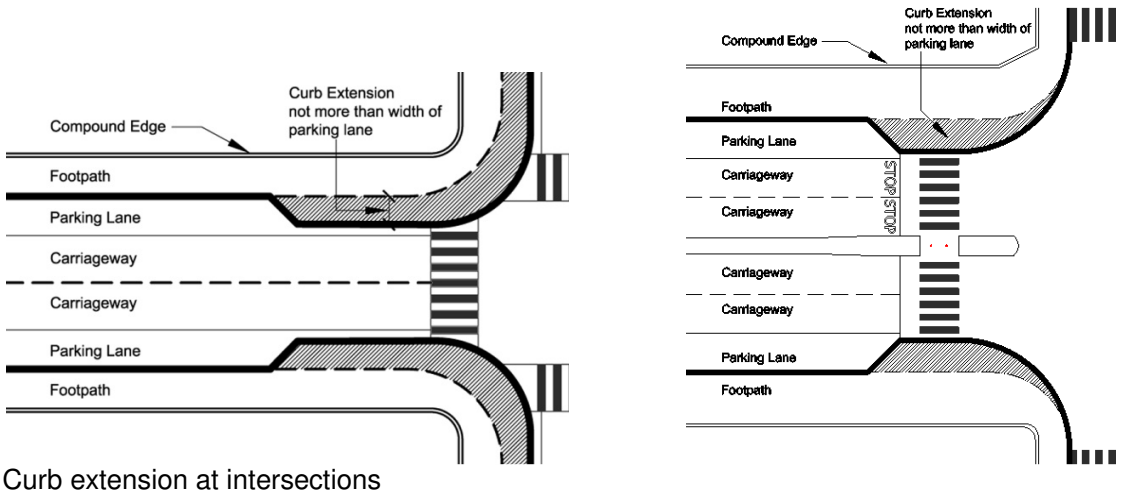


Raised Intersections



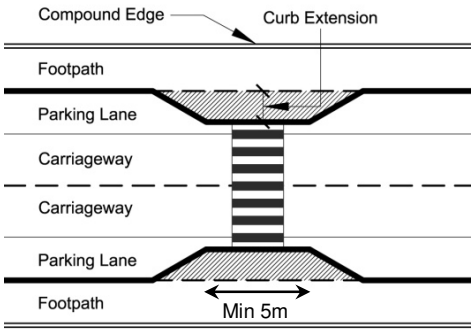
c. Tight turning radii: Tighter turning radii help in reducing turning speed of the vehicles. Nearby land uses (especially industrial uses) should be considered to design the proper turning radius. If the turning radius is too small, vehicles may ride over the curb, placing pedestrians in danger. A maximum turning radius of 12m is recommended.[12]

d. Curb extensions: Curb extensions are recommended at intersections to reduce crossing distance for pedestrians. They also slow down vehicles (without reducing the width of a carriageway) and prevent them from parking at intersections. At midblock curb extensions, care should be taken that street furniture and landscaping do not obstruct driver's view of pedestrians.



Curb extension at intersections

[12] UTTIPEC Street Design Guidelines

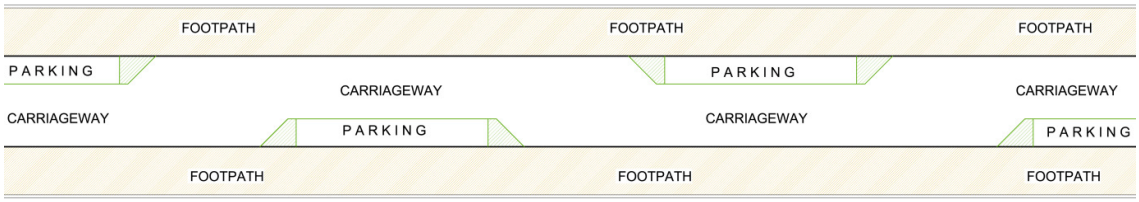


Curb extension at midblock

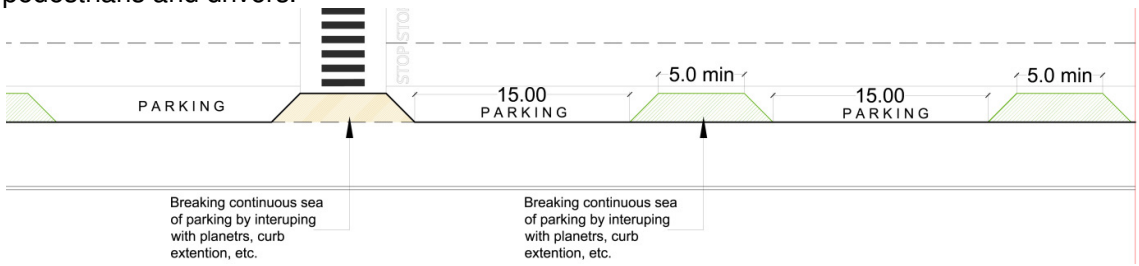
3. On- Street Parking

The minimum width of a parking bay is taken as 1.50m for auto-rickshaws and cycles, 2m for cars and two-wheelers and 2.5m for heavy vehicles. The parking of heavy vehicles on local streets can be regulated by restricting the width of the parking bay.

It is recommended that only one side on-street parking be permitted on streets less than 18.3m wide[13]. On-street parking can be staggered to serve as a traffic calming measure. It is recommended that parking bay should be clearly marked on all the streets.

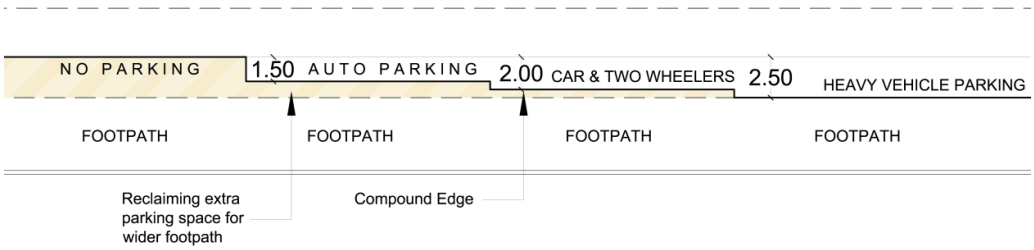


A continuous length of parking more than 3 vehicles or 15m should not be encouraged as it impedes access to the footpath. It can be broken down by mid-block curb extension. Care should be taken that these interuption do not block the visual connection between pedestrians and drivers.

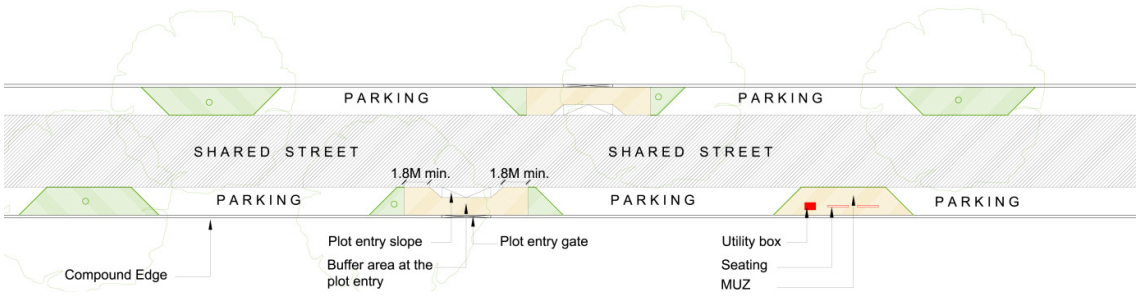


After estimating the parking requirements for different types of vehicles, the width of the parking bay can be reduced to regulate excess space for on-street parking.

[13] Refer street sections in the Appendix

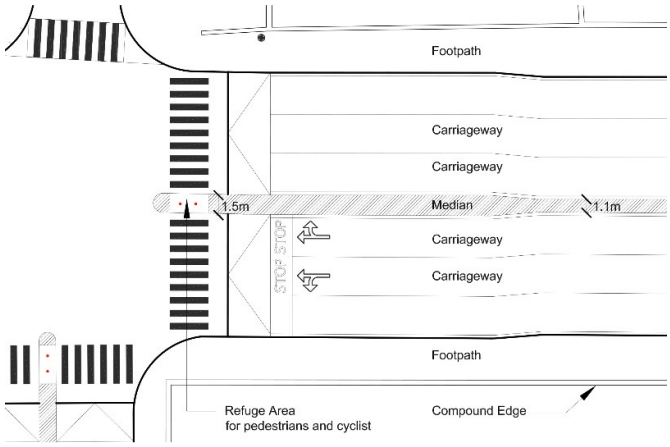


On shared streets with no footpath, parking can be used as a buffer. Protected waiting areas for pedestrians must be provided at plot entries. The parking bays can be separated with a MUZ.



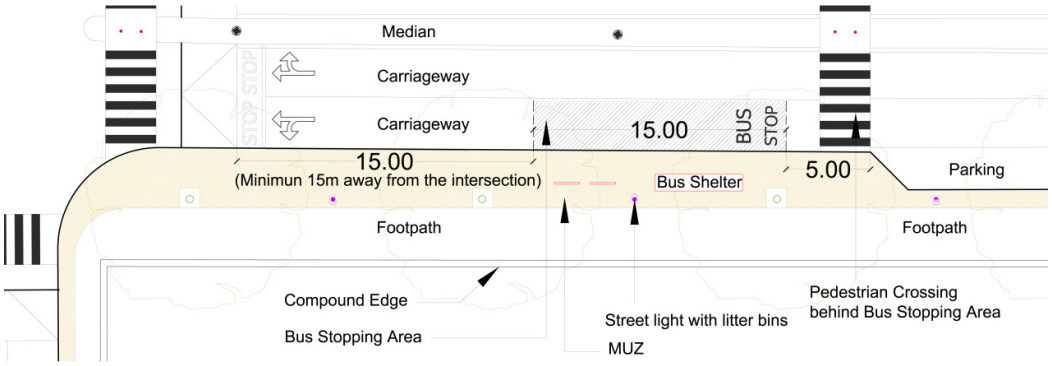
4. Median

The width of medians can vary from 1.0m to 1.5m. Care should be taken that cycles can be accommodated within the width of median at crossings and intersections.



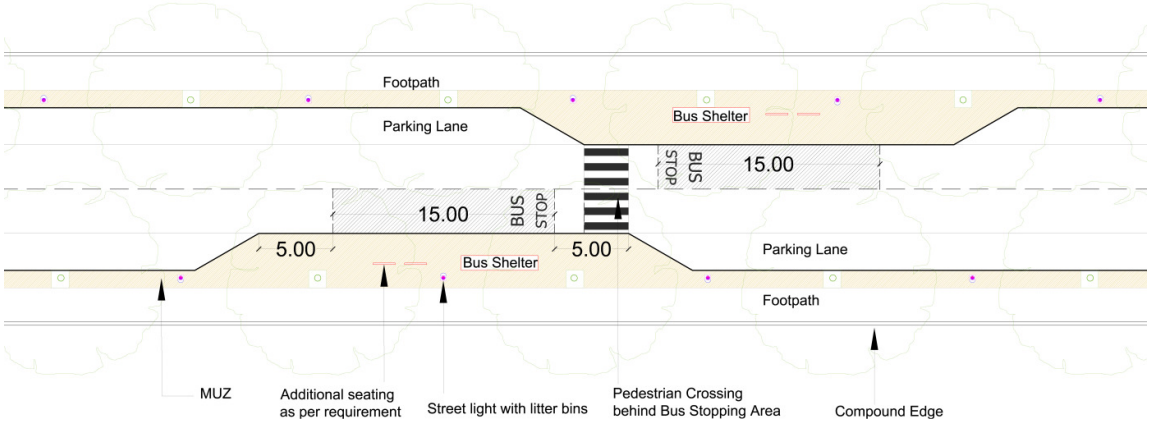
5. Bus Stops and Shelters

At bus shelters, parking lanes must be included within the footpath to create seating and waiting area for passengers. They should be clearly visible by the driver and not obstructed by trees and other street furniture.



Bus Stops near intersection

It is recommended that bus stopping area should be atleast 15m away from the junction. It is recommended that it is 15m long to accommodate a bus and should be clearly marked on the street. Pedestrian crossings can be provided behind the bus stopping area so that the bus driver's and pedestrian's vision is not obstructed.



Bus Stops at midblock

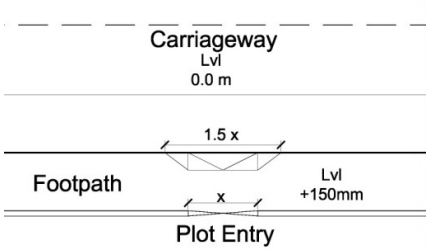
It is recommended that no parking be permitted for atleast 5m on each side of the bus stopping area. Street furniture such as bus shelter with sufficient shade and seating, garbage bins, additional seating if required and informational signage can be provided within the curb extension to suit the requirements of those waiting for the bus.

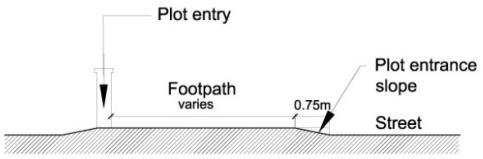
It is recommended that the compound wall edges behind the bus shelter be reduced to serve as additional seating areas and prevent pedestrians walking behind the bus shelters from feeling walled in.

6. Plot Entrance

In order to maintain continuity of footpath, raised driveways can be provided at plot entries where footpath continues at the same level but vehicles have to drive over a gentle slope to access the plot.

Plot entry should be limited to 3m. Depending on the type of vehicles, it could range from 3m - 5m. Width of plot entrance slope can be approximately 1.5 times the width of plot entry.





Plot entry at footpath level

7. Street Lights

Improved street lighting can contribute towards increasing safety. It can prevent road traffic crashes, injuries and fatalities. Street lighting not only reduces the risk of traffic accidents, but also their severity.

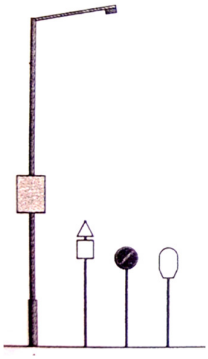
Lighting needs of pedestrians are different from those of vehicular traffic and therefore need to be designed and integrated within the overall lighting strategy for the street. This would aid the safety of pedestrians on pavements after dark.

The street lights should be placed in the MUZ, clear of pedestrian walkways. It can be cordinated with other street elements such as trees, hoardings etc., so that they do not obstruct illumination. Up lighting is not recommended to prevent spillage of light and wastage of energy.

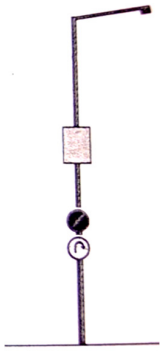
The height of light poles on all streets other than at major arterial intersections can be restricted to not more than 12m to avoid undesirable illumination of private properties. For pedestrian scale lighting, 3-5m high light poles are recommended to illuminate the foorpath adequately and avoid tree shadows. Wherever possible, street light and pedestrian lights can be combined.

Spacing should be based on the intensity of light, height of the fixture and clearances from tree canopies. White lighting at 25-40 lux for footpaths is recommended. It is recommended that colour contrast be maintained from the road surface.

Lighting engineers should be consulted for design calculations including pole heights, type of luminaries, etc. for achieving appropriate lighting levels in all parts of the street. (Source- IRC 103- 2012 Guidelines for Pedestrian Facilities and UTTIPEC)



Not Recommended

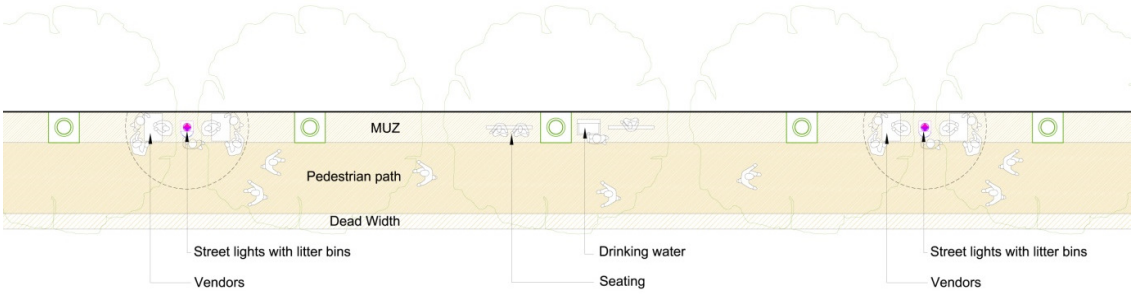


Recommended

(Source: Planning and design guidelines for Street Furniture for Mumbai and its suburbs- MCGM)

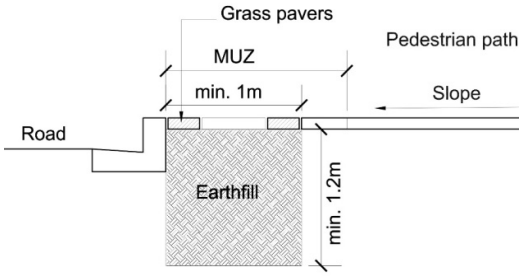
8. Vending/ Other Activities

Space for street vending should be considered while designing the footpath. Space for vending should be provided on the MUZ itself without obstructing the pedestrian path. Street furniture like garbage bins, vending carts, drinking water and seating for users can be provided in the side of vendor itself



9. Landscaping

While planning footpaths, care should be taken to retain existing trees. New trees can be planted or swales can be created in the MUZ. It is recommended that tree grating be flushed with the footpath level which will help in increasing the area for people to walk. On larger footpaths wherever space permits, tree guards can be used as seating. Sufficient slope should be ensured on the footpath for storm water drainage.

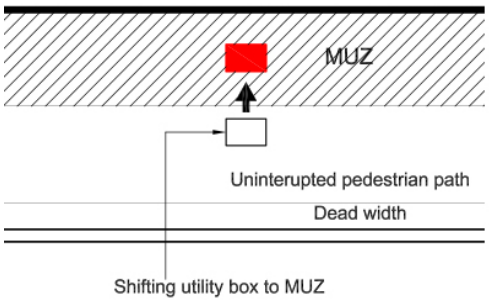


Flushed grating at Marine Drive

10. Utility Boxes

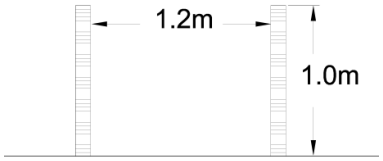
The existing utility boxes (Telephone, electricity etc) are not located consistently either towards the curb side or the plots. It is recommended that they be shifted preferably towards

the curb side, such that they do not block pedestrian movement.



11. Bollards

Bollards are used to stop vehicles from entering the footpath. They should be placed such that they permit a person with wheelchair to pass through.



Height and gap between bollards
(Source: IRC 103- 2012 Guidelines for Pedestrian Facilities)

III. Street Design Templates

A percentage allocation of road space is suggested for different widths and types of streets. The planned street widths in the Development Plan (1991) are taken as a starting point. The street section options are arrived at using the above guidelines and considering one-way and two-way streets. The space allocation for parking is included within the carriageway. The conceptual street sections are attached in the appendix as a reference.

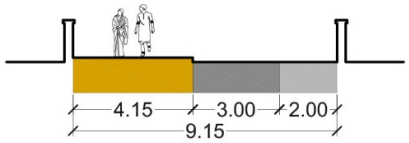
Street Width Ranges in Feet (Metres)	Street Type	Examples	Design Speed Limit	Percentage Allocation for Footpaths
120-150 (36.61-45.70 m)	Arterial	Western Expressway, Eastern Expressway	50 km/hr	45.70m: 37% total (26% for footpaths and 11% for NMVs is considered). Protected NMV tracks must be provided.
100-120 (30.51-36.60 m)	Sub-arterial	Andheri-Kurla Road, SV Road	30 km/hr	36.60m: 46% total (32% for footpaths and 14% for NMV tracks). Protected NMV tracks must be provided. 36.60m: Minimum 40% for roads with an elevated metro-corridor. Protected NMV tracks must be provided.
60-100 (18.31-30.50 m)	Major collector	Central Road (MIDC Marol), Gulmohar Road and North-South Road 10, Juhu Scheme	30 km/hr	27.45m: Minimum 35% NMVs share street with other motorized vehicles
46-60 (14.10-18.30 m)	Minor collector	Road No 11, Road No 16 (MIDC Marol)	30 km/hr	18.30m: Minimum 40% NMVs share street with other motorized vehicles
Upto 46 (Upto 14 m)	Local	Road No 1, 2, 3, 4 etc (MIDC Marol)	15-25 km/hr	9.15m: Minimum 45% 12.20m: Minimum 55% 13.40m: Minimum 60% NMVs share street with other motorized vehicles

Varies	NMT streets	Market streets include retail streets and those around mass-transit stations	It is recommended that market streets be converted to NMT only streets due to large volumes of people.

Appendix

A) 9.15m wide Local Street

Footpath	Carriageway	Parking	Median	NMV Lane

Option 1 Footpath allocation- 45%		For narrow streets, the entire footpath may be provided on one side of the street depending on the adjoining land use or type of street activities. On-street parking can become a buffer space between plot and the street. At plot entrances, a protected waiting area must be provided for pedestrians. (Refer guidelines for on-street parking)

B) 12.2m wide Local Street

Footpath | Carriageway | Parking | Median | NMV Lane

Option 1 Footpath allocation- 59%		One way streets with on- street parking on one-side can be considered. Parking can be staggered along the road to traffic calm the street. (Refer guidelines for on-street parking).
Option 2 Footpath allocation- 55%		For narrow local two-way streets, on-street parking may not be possible.

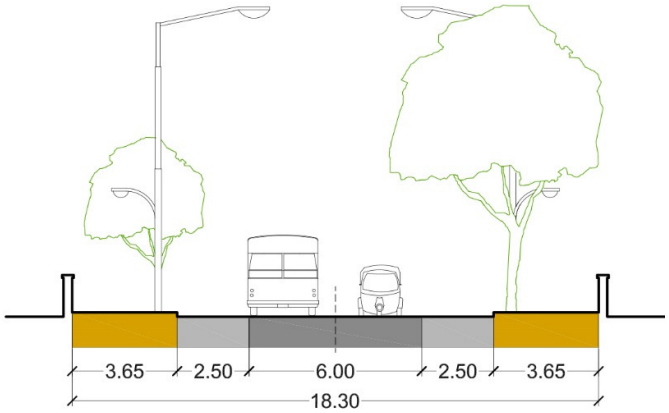
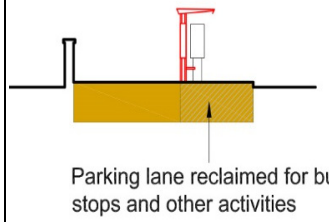
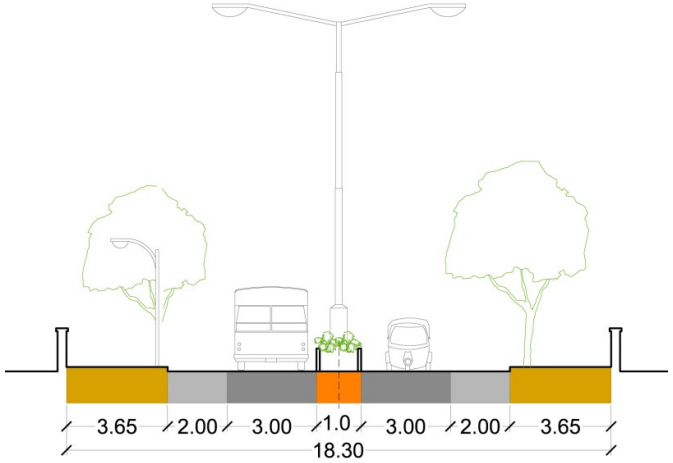
C) 13.4m wide Local Street

Footpath | Carriageway | Parking | Median | NMV Lane

Option 1 Footpath allocation- 63%		For one way streets, option of one side on-street parking with footpaths on both the sides can be considered. Parking can be staggered to serve as a traffic calming measure
Option 2 Footpath allocation- 59%		For narrow local two way streets, on-street parking may not be possible.

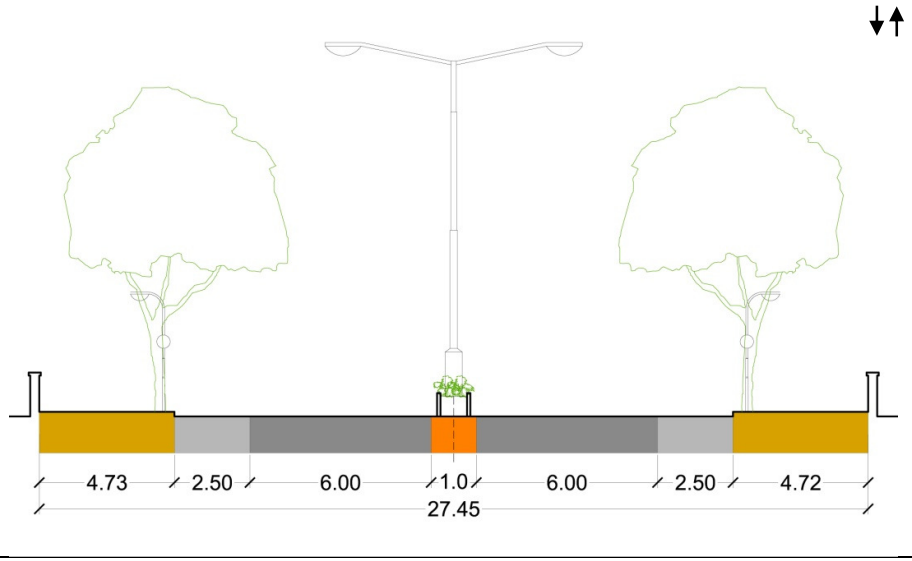
D) 18.3m wide Minor Collector Street

Footpath | Carriageway | Parking | Median | NMV Lane

Option 1 Footpath allocation- 40%		For minor collector streets, parking on both the sides can be considered. The width of parking bay can be identified through land use and street use. For streets in industrial or commercial-business areas, width of 2.5m can be considered for a parking bay and undivided carriageway can be proposed. The parking bay can be included within the footpath at bus stops, crossings and for NMT amenities. 
Option 2 Footpath allocation- 40%		For streets with light vehicle parking, width of 2m can be considered for the parking bay. Divided carriageway can be proposed for safety and calming. The parking bay can be included within the footpath at bus stops, crossings and for NMT amenities.

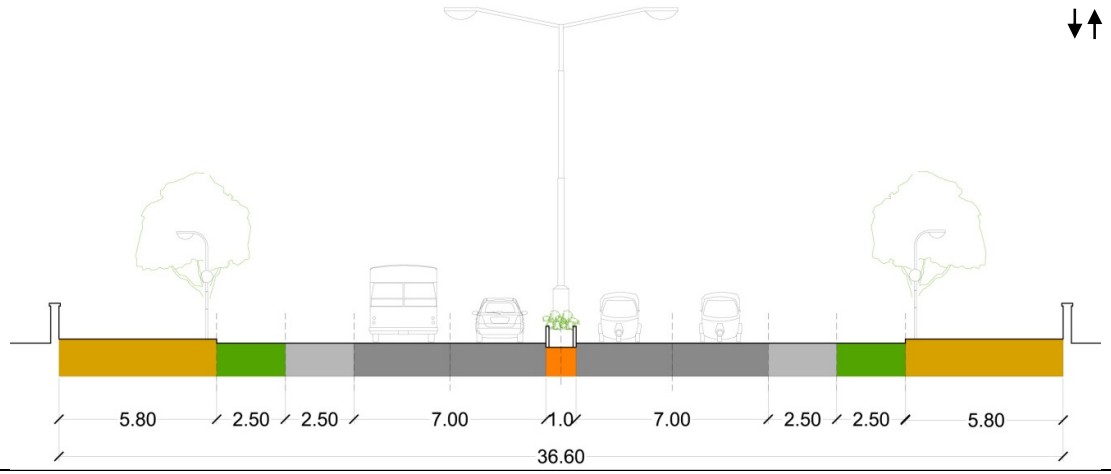
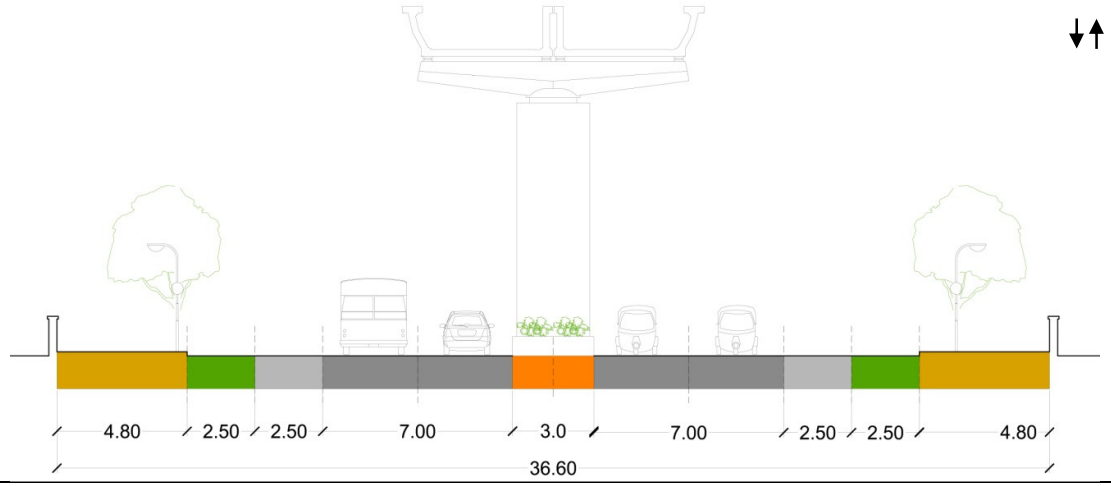
E) 27.45m wide Major Collector Street

Footpath	Carriageway	Parking	Median	NMV Lane

Option 1 Footpath allocation- 34%		Two lane divided carriageway can be proposed for major collector streets with parking on both sides. The parking bay can be included within the footpath at bus stops, crossings and for NMT amenities.

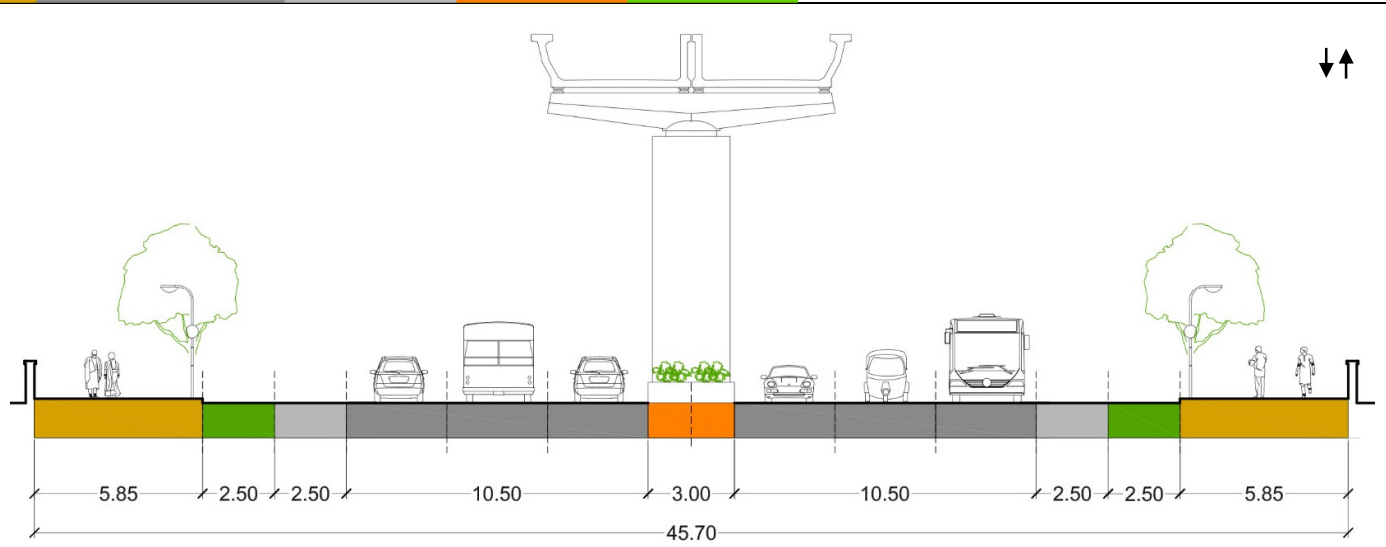
F) 36.6m wide Sub Arterial Street

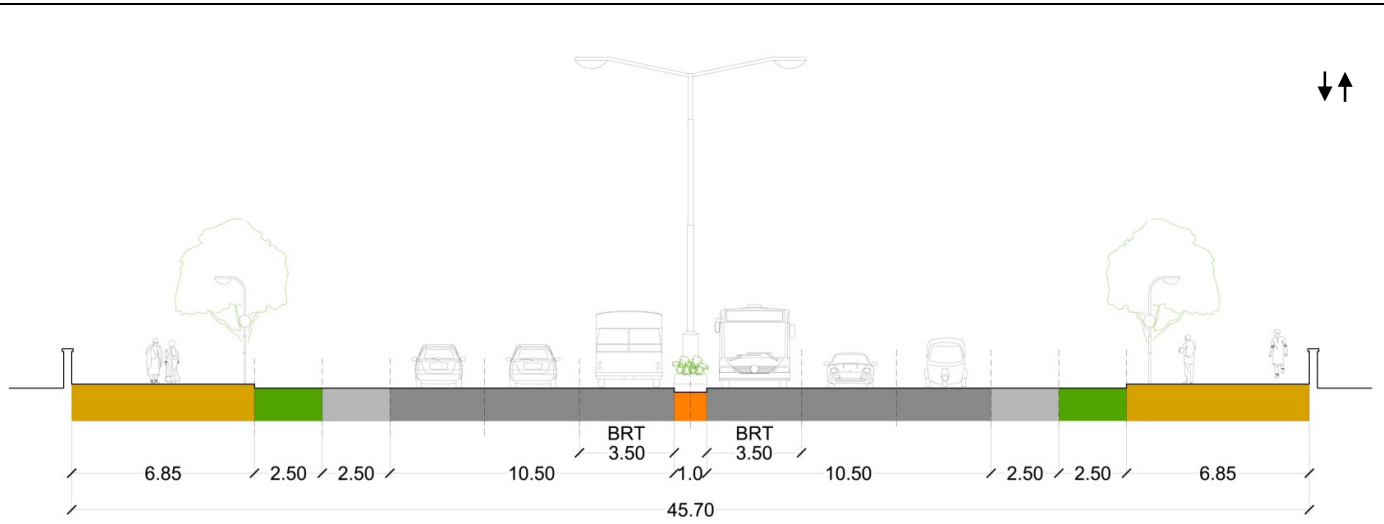
Footpath | Carriageway | Parking | Median | NMV Lane

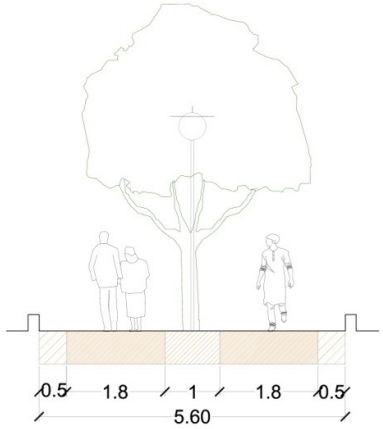
Option 1 Footpath allocation- 32% NMT allocation- 14%		Dedicated NMV tracks must be considered. Divided carriageway must be proposed for safety. The parking bay can be included within the footpath at bus stops, crossings and for NMT amenities.
Option 2 Footpath allocation- 26% NMT allocation- 14%		Roads with mass transit corridors must be considered as NMT-priority streets. Dedicated NMV tracks must be considered. The parking bay can be included within the footpath at bus stops, crossings and for NMT amenities. On-street parking must be regulated through pricing.

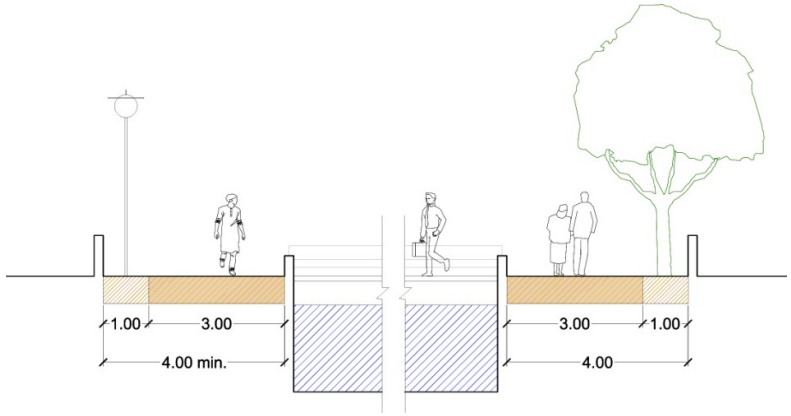
G) 45.7m wide Arterial Street

Footpath	Carriageway	Parking	Median	NMV Lane

Option 1 Footpath allocation- 26% NMT allocation- 11%		Roads with mass transit corridors must be considered as NMT-priority streets. Dedicated NMV tracks must be considered. The parking bay can be included within the footpath at bus stops, crossings and for NMT amenities. On-street parking must be regulated through pricing.

Option 2 Footpath allocation-29.9% NMT allocation-10.9%		Roads with mass transit corridors must be considered as NMT-priority streets. Dedicated NMV tracks must be considered. The parking bay can be included within the footpath at bus stops, crossings and for NMT amenities. On-street parking must be regulated through pricing.

H) NMT Streets Dead width Pedestrian path Multi utiliy zone		
Option 1 5.6m wide		Ideally the NMT streets should include a pedestrian and cycling route. They are separated by a shared multi-utility zone.
Option 2 4.0m wide		If only a pedestrian or cycling route is proposed, minimum 4m is recommended with an uninterrupted walking or cycling zone (2.50m), dead zone (0.50m) and a multi-utility zone (1m). The MUZ can be considered at one of the curb edges.

J) long natural water courses Dead width Pedestrian path Multi utiliy zone		
7m and 4m wide		Open space along natural water courses can be used as pedestrian and cycling routes. These are recommended to be atleast 7.0m wide to include a pedestrian path, cycling track, dead zone, a multi-utility zone and a buffer zone. If there are space constraints, a minimum 4m is recommended, of which 3m can be used for service vehicles to clean the natural drain. An additional minimum 1m is recommended as a multi-utility zone for street furniture, signage, vending and lighting. In such cases, the pedestrian paths and cycling routes can be provided on different sides of the natural drain. Cross connections can be provided depending on the larger pedestrian network plan, but not exceeding 100m.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