SDG ORIENTED STREET DESIGN GUIDELINE FOR PATIALA, PUNJAB

Guideline (version 2.0)

Transportation Research and Injury Prevention Programme
Indian Institute of Technology, Delhi

February 2020
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The team has worked closely with SGArchitects (Sandeep Gandhi, Pushkar Dhawale, Kartikay, Kanica Gola) who were engaged with the preparation of the General Alignment Drawings (GAD).

Cover Photo Credit: Samradh Singh Chauhan
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PART B: DESIGN

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The Sustainable Development Goals (SDGs) are a bold, universal agreement to end poverty in all its dimensions and craft an equal, just and secure world – for people, planet and prosperity by 2030 - by UNITED NATIONS

The 17 SDGs comprise of 169 targets to be achieved by 2030

The Government of India has played a leadership role in defining the SDGs.
**01 Introduction**

**WHY WAS THE GUIDELINE DEVELOPED?**

In 2015, the United Nations announced Agenda 2030, a mandate of development aimed at ending all forms of poverty in all countries, and to promote prosperity while protecting the planet. This Agenda, popularly known as Sustainable Development Goals, is a call to action for people, prosperity and planet.

Since 2017, TRIPP, IIT Delhi has been working on SDG Oriented Planning and Design in Small cities and Community Participation to develop approaches for Tier II and Tier III cities to adopt transport related SDGs in their city. One of these cities, the city of Patiala has one of the highest number of vehicles per capita in the country; a rate of 5 deaths every month due to road accidents.

Indian Road Congress (IRC) provides various guidelines to road making agencies and engineers, to plan, design, and construct streets based on standards. Table 1 shows a list of multiple guidelines to be referred by planning authorities and engineers for multiple details. Some of these guidelines have been updated. However, there are no city specific guideline that supports planning and design integrated with the Sustainable Development Goals.

SDG Oriented Street Design Guideline (PART A & B) for Patiala, Punjab aligns the planning and design approach to road safety and transport in Patiala with Global Goals. It supports Patiala in developing a local agenda and vision, oriented to the SDG framework. It delivers high quality planning and design of sustainable urban mobility roadmap (and related SDG) and street design according to international best practices and national policies and guidelines assisting the decision makers to develop SDG sound urban transport policies.

**WHO ARE THE INTENDED USERS?**

Patiala city is the administrative headquarters of Patiala district of Punjab and is located in the south eastern part of the state. The guideline supports the city agencies to develop a planning and design approach for implementing SDG oriented streets.

The agencies primarily include Patiala Urban Development Authority (PDA) established in 2002, which has the responsibility for balanced development including the areas in and around the Patiala’s Municipal limits.

Patiala Municipal Corporation is responsible for governing, developing and managing the city and related urban services. All road making agencies such as Public Works Department, Water and Utilities, Electricity Department report to the Hon. Commissioner of Patiala Municipal Corporation.

The guideline can also be used by other government and non-government organisations, consultants working on streets, transport and road safety. This can also be useful to students from design, engineering and planning institutions.

**STRUCTURE & CONTENT**

The guideline has been developed in two parts. Part B covers design guidance and offers support to develop SDG oriented street design and other infrastructure.

This guideline provides a detailed picture of Patiala and its road safety statistics followed by other design issues faced by various user groups in the city. Localization of the transport SDGs in city of Patiala - SDG 3.6 (Reduce road injuries and death), SDG 3.9 (Urban air pollution PM10 & PM2.5) and SDG 11.2 (Affordable & sustainable transport systems) has been covered in this study.

SDG Integrated Master Planning assists local governments and urban development authorities like PUDA to integrate their upcoming master plan with a strategy and road map to integrate SDG comprehensive mobility vision that leaves no one behind. It offers a course correction to development trajectory of cities so that they can grow with sustainable mobility choices and projects.

Part A covers planning guidance and focuses on the importance integrating SDG in the master plan process.

As part of the project, the guideline aligns the Master Plan of Patiala 2009-2031; one year after the targeted completion of Sustainable Development Goals in 2030.

As part of the project, First Information Report (FIR) data was collected from respective police stations of the city. Based on the fatality data, high crash locations were determined and audited with the ‘Urban Road Safety Audit’ toolkit. The audit results indicated improper pedestrian infrastructure, a complete neglect of bicycle infrastructure and signage in the road design and planning.

Over discussion with local authorities, SDG guideline was developed to support PUDA and MC Patiala, mainly responsible for planning and design of the road network of the city. A draft guideline was presented in a city level workshop in Feb 2019 and all stakeholders shared inputs and scope of improvement.

Based on the inputs by IATSS and city authorities, TRIPP finalised the guideline and presented it to the city along with a capacity workshop in September 2019.
<table>
<thead>
<tr>
<th>IRC Code</th>
<th>Name</th>
<th>Details for city engineers</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRC:11-2015</td>
<td>Recommended Practice for the Design and Layout of Cycle Tracks. (First Revision)</td>
<td>Road cross sections; Dimensions for cycle tracks (width, slope); Design details (pavements, edges, lighting, street furniture, traffic calming, signage etc.); Services and Utilities</td>
</tr>
<tr>
<td>IRC:35-2015</td>
<td>Code of Practice for Road Markings (Second Revision)</td>
<td>Material, Colour classification, Classification of markings (carriageway, edges, intersections etc.), Dimensions</td>
</tr>
<tr>
<td>IRC:65-2017</td>
<td>Guidelines for Planning and Design of Roundabouts (First Revision)</td>
<td>Planning and design of roundabouts</td>
</tr>
<tr>
<td>IRC:67-2012</td>
<td>Code of Practice for Road Signs (Third Revision)</td>
<td>Material, Placement, Dimensions and colour, Maintenance etc. of signs</td>
</tr>
<tr>
<td>IRC:69-1977</td>
<td>Space Standards for Roads in Urban Areas</td>
<td>Typical cross sections for various category of urban streets</td>
</tr>
<tr>
<td>IRC:70-2017</td>
<td>Regulation and Control of Mixed Traffic in Urban Areas (First Revision)</td>
<td>Traffic capacity on roads, Segregation of traffic, One way traffic streets, Bus bays, Loading/Unloading bays, Bicycle and pedestrian infrastructure requirements</td>
</tr>
<tr>
<td>IRC:79-1981</td>
<td>Recommended Practice for Road Delineators</td>
<td>Design standards for road delineators, reflectors and hazard markers</td>
</tr>
<tr>
<td>IRC:86-1983</td>
<td>Geometric Design Standards for Urban Roads in Plains</td>
<td>Cross sectional elements; Design of medians, kerbs and camber; alignment details, curve designs</td>
</tr>
<tr>
<td>IRC:92-2017</td>
<td>Guidelines for Design of Interchanges in Urban Areas (First Revision)</td>
<td>Planning interchanges</td>
</tr>
<tr>
<td>IRC:93-1985</td>
<td>Guidelines on Design and Installation of Road Traffic Signals</td>
<td>Technical aspects of signals, Height, Foundation, Maintenance</td>
</tr>
<tr>
<td>IRC Code</td>
<td>Name</td>
<td>Details for city engineers</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>IRC:99-2018</td>
<td>Guidelines for Traffic Calming Measures in Urban and Rural Areas (First Revision)</td>
<td>Traffic calming techniques, Dimensions and arrangement of various traffic calming measures, traffic calming at junctions,</td>
</tr>
<tr>
<td>IRC:103-2012</td>
<td>Guidelines for Pedestrian Facilities (First Revision)</td>
<td>Design standards for pedestrian facilities (width, height, pavement type, kerbs, kerb ramps etc.); disabled friendly requirements; maintenance of footpaths, pedestrian crossing types and design; subway and footover bridge specifications; Street furniture details)</td>
</tr>
<tr>
<td>IRC:106-1990</td>
<td>Guidelines for Capacity of Urban Roads in Plain Areas</td>
<td>Level of Service for urban roads, recommended design service volumes for urban roads, measures to improve capacity of urban roads</td>
</tr>
<tr>
<td>IRC:124-2017</td>
<td>Bus Rapid Transit (BRT) Design Guidelines for Indian Cities</td>
<td>Planning, design of Bus rapid transit system</td>
</tr>
<tr>
<td>IRC:SP:43-1994</td>
<td>Guidelines on Low-Cost Traffic Management Technique for Urban Areas</td>
<td>Techniques for regulating traffic, Details of traffic control devices (signs, markings, signals, barricades, cones, drums etc.)</td>
</tr>
<tr>
<td>IRC:SP:41-1994</td>
<td>Guidelines on Design of At-Grade Intersections in Rural &amp; Urban Areas</td>
<td>Intersection design (Capacity assessments, rotary/signalized, islands specifications, traffic control devices requirement and specifications)</td>
</tr>
</tbody>
</table>

Table 1: List of IRC guidelines for street design
MOBILITY & ROAD SAFETY: Almost half of the population in Patiala walks or cycles to work. Based on the modal share for work trips in Patiala (census 2011), this constitutes 46% of the total trips.

The city has one of the highest number of vehicles per capita in the country and private modes of transport have a 40% modal share in Patiala. There is mere 11% share of people travelling in buses. These trips are probably of the buses connecting the peripheral areas of the city i.e. the nearby villages.

Almost 80% of street users who die in road accidents are pedestrians, cyclists and motorcyclists.

There are multiple design issues with the way streets are currently built and used. This has been discussed in Chapter 02: Issues (PART A, SDG Planning and Design Guideline)

SDG ORIENTED APPROACH: Building on the principle of ‘leaving no one behind’, Agenda 2030 emphasizes on a holistic approach to achieve sustainable development for all.

SDGs are a local agenda, where targets need to be prioritised and adapted at the community level.

SDGs are a collective agenda – implementing the goals will require global cooperation on a scale and intensity that transcends traditional concepts of ‘partnership’.

SDGs are a people’s agenda – civil society is more than NGOs. People must be involved in the design, delivery, monitoring and evaluation of the SDGs on an ongoing basis and will improve effectiveness as well as accountability.

SDGs are universal in nature; they apply to all countries. They are integrated and mutually reinforcing.

PART A covers the need of SDG oriented street design through complete streets, principles of universal accessibility, social usability and a sustainable safe traffic system.

LOCALISING TRANSPORT SDGs: SDGs provide an umbrella framework and guidance to authorities to monitor progress, effectiveness and sustainability of urban transport in their cities. These may have been lacking in many aspects of development or community change.

Figure 1: Road Fatalities in Patiala
The framework also assists in setting up a local agenda and identifying goals and targets. This weaves into any long term planning that exists or can support in planning one.

The guideline focuses on Target 3.6 and 3.9 under SDG 3: Good Health and Well Being and Target 11.2, 11.6, 11.7 under SDG11: Sustainable Cities & Communities.

SDG INTEGRATED MASTER PLAN: PATIALA URBAN PLANNING & DEVELOPMENT AUTHORITY (PUDA) is responsible for the development of master Plans, zonal and layout plans. They also focus on land acquisition, pooling, township development, colony regularisation including local streets.

The Comprehensive Mobility Plan is prepared to develop a transport strategy for the future to cater to the anticipated transport demand. Patiala CMP was developed in 2012. The mobility plan seeks to “move people, not vehicles”. By emphasizing the pre-eminence of public transport and non-motorized transport and integrating the land use with transport networks, it seeks to achieve the objective of National Urban Transport Policy (NUTP).

According to mode of travel to place of work data (census, 2011), about 65 per cent of the existing trips in Patiala are within five kilometres distance. For developing a road map to improving public transportation in Patiala aligned to SDG 11.2, access to public transport has to be within 500m and with a frequency of availability every 20 minutes. Based on the commuter waiting time for public transport in Indian cities, 10 minutes has been considered.

A public transport system for 2030 has been proposed. This includes:

- 71.1 km of 8 standard city bus routes
- 25.4 km of 2 mini bus routes
- 40.8 km of 12 IPT routes
- 6.9 km of 1 moffusil route

By 2030, total public transport system will be available over 143 km of overall route length. With proposed route length, around 86% of area and population of city will be able to access public transportation within the distance of 500 m. (SDG 11.2).

However, 99% of the city will be able to access public transport within 1 km radius.
90% of overall road network of Patiala city comprised of Collector streets, Lower distributary streets and Local street having ROW between 6-30m and Speed limit below 30km/hr.

<table>
<thead>
<tr>
<th>Street Type</th>
<th>Total Street Length (in Km.)</th>
<th>Total Street Length (in %)</th>
<th>Street Length in MC Boundary (in Km.)</th>
<th>Street Length in MC Boundary (in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Street</td>
<td>41</td>
<td>18%</td>
<td>5</td>
<td>4%</td>
</tr>
<tr>
<td>Sub Arterial Street</td>
<td>11</td>
<td>5%</td>
<td>10</td>
<td>8%</td>
</tr>
<tr>
<td>Collector Street</td>
<td>100</td>
<td>43%</td>
<td>59</td>
<td>46%</td>
</tr>
<tr>
<td>Access Street</td>
<td>79</td>
<td>34%</td>
<td>54</td>
<td>42%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>231</td>
<td>100%</td>
<td>129</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure 5: Street Typology, Patiala
SDG Oriented Street Design Guideline for Patiala, Punjab

02 SDG Oriented Street Design

STREET NETWORK

Urban transport in Indian cities reflects the heterogeneity in the socio-economic and land use patterns. It is dominated by walk trips, non motorised modes such as bicycles and rickshaws, and motorised para transit and public transport depending on the size of the city.

A well functioning street infrastructure must fulfill the requirements of all street users. If the infrastructure design does not meet the requirements of these elements all modes of transport operate in sub-optimal conditions.

The street network is used by at least seven categories of motorized and non-motorised vehicles. Vehicles ranging in width from 0.60 m to 2.6 m, and capable of maximum speeds ranging from 15 km/h to 100 km/h, share the same street space. All these vehicles which have varied dynamics and static characteristics share the same carriageway. Thus traffic is characterised by a lack of effective channelisation, mode segregation or control of speeds.

To a formally trained planner, it looks like chaos moving towards total gridlock. Yet the people and goods keep getting through and may, by some measures, actually be faring better than in some controlled conditions. To allocate widths, it is important to understand the space required by each vehicle type.

Presence of Urban Freight: Freight and goods delivery is an important part of mobility. There are both motorised transport and goods cycle rickshaw present that are used to transport the goods within the city.

The infrastructure requirements for each depends upon the street type and street design speed. As mentioned in Code of Practice: Design of Urban Roads (Institute of Urban Transport and Ministry of Urban Development), the classification of urban street type is as follows:

A. Arterial Streets

They are the primary streets for ensuring mobility function. They carry the largest volumes of traffic and longest trips in a city. These streets have the maximum right of way amongst the four categories and cater to a speed limit of 50 km/h and a ROW of 50-80 m.

B. Sub Arterial Streets

This is context specific and is based on the function and the land use development it passes through and caters to a speed limit of 50 km/h (same as arterial streets). The ROW of this category of streets varies from 30-50 m.

C. Distributor/Collector Streets

As the name suggests, these are connector streets which distribute the traffic from access streets to arterial and sub arterial streets. They are characterized by mobility and access equally. They are characterized by a design speed of 30km/h and have a ROW midway of access streets and two types of arterial i.e. 12-30m.

D. Access Streets

They cater to a design speed of 15-30km/h and have a street right of way of 15m-30m. They carry relatively lower volumes of traffic at low speeds. They are characterized by access predominantly; they can be used for collector functions.

Based on the street type an appropriate design speed is adapted. The design speed governs the geometric design of the right of way and the cross section elements of the street.

### STREET TYPOLOGY

<table>
<thead>
<tr>
<th>Street Typology</th>
<th>Right of Way-ROW (m)</th>
<th>Design speed (km/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Streets</td>
<td>50-80</td>
<td>50</td>
</tr>
<tr>
<td>Sub Arterial Streets</td>
<td>30-50</td>
<td>50</td>
</tr>
<tr>
<td>Collector Streets</td>
<td>12 - 30</td>
<td>30</td>
</tr>
<tr>
<td>Access Streets</td>
<td>6 - 15</td>
<td>15</td>
</tr>
</tbody>
</table>

1 (Tiwari, G. 2000, “Encroachers or Service Providers?”, Seminar, 401, 26-31).
Figure 6: Patiala Road Network (Source Map, TRIPP, IIT Delhi)
Coherence and directness (Connectivity)

- To make the total city pedestrian and cycle friendly, the entire network needs to be cohesive. The lower the travel time, the higher the directness. At network level, a cohesive network would involve minimal detours for cyclists and pedestrians accessing it.

- Higher directness can be achieved not just within the NMT network but also on public transport corridors by using walking, cycles and rickshaws as feeders and providing parking and transfer infrastructure at stations to minimize delays.

Hence, there should be a complete NMT network connecting all destinations integrated with public transport lines and road networks.

Attractiveness and Comfort

- Plan some activities and break the monotony of the route and introduce visually and spatially attractive elements more apt to the scale of NMT users instead of stark, monotonous, long, barren walls.

- Eliminating traffic bottlenecks, steep gradients, nuisance caused by traffic noise and emissions, bad riding quality, presence of obstructions resulting in frequent braking or slowing down, etc.

Safety and Security

Pedestrians and cyclists are very vulnerable in the case of crashes. In common practice of increasing non motorised safety is to segregate them from motorized vehicles in time and space. For captive users, segregation by time is not a viable option as the journey between work and home is undertaken at almost the same time as other (motorized) modes (especially for shorter trips).

Here, the most effective option would be to segregate users into separate tracks or paths along the road network, (especially if the speed limit for MV is over 30 Km/hr). On other streets there is a need to reduce their speed difference by traffic calming without affecting directness or coherence.

Coherence

- Segments in the network should look similar to improve the legibility and usability of the bicycle infrastructure and there is provision of good connectivity between all origins and destinations.

- Constant width ensured through design with adequate widening at turns and rendering the same texture for typical scenarios across the network.

- Elimination of any missing links as well as standardization of intersections i.e. the shape, size and form of each category of junction solution.

Directness

Directness of bicycle infrastructure has to do with the amount of time and effort required by a pedestrian and a cyclist to undertake a journey. Therefore, major detours from their natural path should be avoided. As mentioned in the ‘Design manual for bicycle traffic’ (CROW, June 2007), directness has two components: in terms of distance and time.

Attractiveness

- To ensure attractiveness, care should be taken that the path of the cyclist should be clean and devoid of any dumped material that blocks movement.

- Location of spaces for hawkers and vendors, well integrated bus shelters, green areas, resting spaces, etc. and shaded NMT infrastructure are factors that are definitely attractive.

Safety and Security

- Prevention of collisions and reducing the conflicts and their impact will result in a safer travel.

- Provision of adequate and uniform lighting ensures enhanced usability as well as safer streets. Integration of spaces for hawkers and vendors, support facilities provides security and the necessary eyes on street.

- Safer Intersections can be provided by minimizing conflicts (and sub-conflicts), introducing traffic

Comfort

- Walking and riding comfort ensures usage. It is important that proper drainage should be provided with regular maintenance.
CROSS SECTION DESIGN

The street selected for planning is divided into various segments based on its function, form and use from the surveys mentioned earlier. The minimum and most available ROW conditions are selected for each stretch from the total station survey drawing, for the development of the cross section designs.

The main elements of a cross section design are given in Table 4.

The type and character of each urban road needs to be carefully detailed to respond to the functions it performs, i.e. providing mobility or access or both. Safety of road users is a major concern now because the number of traffic accidents and fatalities on urban roads has continued to increase in the past few years.

Therefore application of appropriate geometric design standards on urban roads is essential to ensure the safety to all road users. A design of the entire road cross-section holds considerable importance, as

- It governs the design speed of vehicles
- Reflects prioritization in space allocation
- Introduces concepts of universal design and traffic calming.

Following are examples of sub arterial, local distributor and access roads redesigned according to to criteria mentioned in Table 4.

DATA COLLECTION

Geometric Survey - A total station based geometric survey of the entire ROW along the length of the road is a basic requirement to undertake safe street design. A total station survey will give complete topographical data of existing underground and overhead features like services and utilities, the existing landscape, buildings and structures.

Activity Survey - An activity survey allows an understanding of the user requirements and behaviour, which cannot be reflected by a geometric survey. It records dynamic, formal and informal activities at the site, such as parking, hawking, service activities, etc.

Traffic, Parking and Accident Surveys - Traffic surveys provide an assessment of current vehicular (motorized and non-motorized) as well pedestrian traffic demand on the corridor. Parking surveys record the current usage of land at different times of the day by parking– both formal and informal.

Typical survey drawing with activity survey near Patiala Bus Stand.

Figure 7: Cross section design should respond to current activities

Figure 8: Representation of street activity on drawing
Figure 9: Cross Section Design according to street type
Source: Planning and Design for Cycle Infrastructure, TRIPP, 2014

ROAD TYPOLOGY: ARTERIAL & SUB ARTERIAL

prototype 01

NOTE: Plantation of tree only when service belt width of width 1500mm

prototype 03

prototype 04

prototype 05

ROAD TYPOLOGY: DISTRIBUTOR

prototype 01

prototype 02

prototype 03

NOTE: Plantation of tree only when service belt width of width 1500mm

ROAD TYPOLOGY: ACCESS

prototype 01

prototype 02

prototype 03

LEGEND
- EDGE OF ROW
- CARRIAGEWAY: minimum 2 lanes each direction divided by a median
- SERVICE BELT
- SERVICE LANE/ PARKING Width: 2m (minimum)
- PARKING BAY
- Based on the available width the parking can be both directions in parallel, perpendicular and angular configurations.
- CYCLE LANE
  Desirable Width: 1500mm
- CYCLE TRACK
  Desirable Width: 2500mm Height: 50mm - 100mm
- CYCLE TRACK
  Desirable Width: 1800mm (minimum) Height: 150mm
- BOARDING BAY
  Width: 750 mm (min), Height: 150mm (maximum)
- TREE BELT / SWALE
  Width: 1500mm (desirable) Chamber to drain
- FOOTPATH
  Width: 1800mm (minimum) Height: 150mm
### Table 2: Cross Section Design according to road type

**Source:** Planning and Design for Cycle Infrastructure, TRIPP, 2014

<table>
<thead>
<tr>
<th>Carriageway</th>
<th>Arterial Streets</th>
<th>Sub Arterial Streets</th>
<th>Collector Streets</th>
<th>Access Streets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria</td>
<td>50 km/h</td>
<td>50 km/h</td>
<td>&lt;=30km/hr</td>
<td>&lt;= 15 km/hr</td>
</tr>
<tr>
<td>ROW</td>
<td>50m – 80m</td>
<td>30m – 50m</td>
<td>12m – 30m</td>
<td>6m – 15m</td>
</tr>
<tr>
<td>Gradient</td>
<td>2%</td>
<td>2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of lanes</td>
<td>Maximum 6 to 8 lanes divided (using a raised median);</td>
<td>Maximum 4 to 6 lanes divided (using a raised median);</td>
<td>Maximum 4 lanes of 3.0m width each (excluding marking) or 2 lanes of 2.75m to 3.1m width each (excluding marking) with or without an intermittent median</td>
<td>1 to 2 lanes, (undivided); of 2.75 to 3.0m width each</td>
</tr>
<tr>
<td>Maximum Width for car lane</td>
<td>3.0 to 3.3m width each(excluding lane marking)</td>
<td>3.0 to 3.3m width each(excluding lane marking)</td>
<td>3.1m width each</td>
<td>2.75 to 3.0m width each</td>
</tr>
<tr>
<td>Maximum Width for bus lane / Mixed lane</td>
<td>3.3m - 3.5m</td>
<td>3.3m - 3.5m (segregated) excluding lane marking</td>
<td>Mixed traffic</td>
<td></td>
</tr>
</tbody>
</table>

#### Non Motorised Vehicle

<table>
<thead>
<tr>
<th>Segregated Cycle Track</th>
<th>Segregated Cycle Track</th>
<th>Cycle Lane</th>
<th>Mixed \traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Between Carriageway or street parking and footpath on either edge of the carriageway</td>
<td>Between Carriageway or street parking and footpath on either edge of the carriageway</td>
<td>On the edge of the carriageway, adjacent to the footpath or parking.</td>
</tr>
<tr>
<td>Gradient</td>
<td>1:12 – 1:20 (min)</td>
<td>1:12 – 1:20 (min)</td>
<td>1:12 – 1:20 (min)</td>
</tr>
<tr>
<td>Desirable</td>
<td>Lane width</td>
<td>Lane width</td>
<td>Lane width</td>
</tr>
<tr>
<td>Level</td>
<td>0.0m</td>
<td>0.0m</td>
<td>0.0m</td>
</tr>
<tr>
<td>Minimum Width</td>
<td>2.2 for a two lane cycle track and 3m to 4m for a common cycle track and footpath (not more than a length of 40m).</td>
<td>2.2 for a two lane cycle track and 3m to 4m for a common cycle track and footpath (not more than a length of 40m).</td>
<td>1.2m painted cycle lane.</td>
</tr>
</tbody>
</table>

#### Pedestrian Paths

| Pedestrian Paths |
|------------------|------------------|------------------|------------------|------------------|
| Gradient         | 1:20             | 1:20             | 1:20             | 1:20             |
| Level            | +150mm           | +150mm           | +150mm           | 0.0m             |
| Lane width       | 2.5m (including curbs) to 5.5m each side. However where secondary footpaths are available along service lane, the minimum width of secondary paths can be 1.5m minimum(including curbs) | 2.5m (including curbs) each side. | 2.5m (including curbs) each side. | 0.25m (including curbs) each side. |
| *Based on site observation, if required, the secondary/side footpaths could equal or larger than the primary path* | | | | |
| Minimum Width    | 1.8m             | 1.8m             | 1.8m             | 1.8m             |

* To be applied on both directions of ROW for streets which have uni-direction vehicular traffic

#### Green Belt / Utility Zone

<table>
<thead>
<tr>
<th>Green Belt / Utility Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
</tr>
<tr>
<td>Location</td>
</tr>
</tbody>
</table>

#### Parking

<table>
<thead>
<tr>
<th>Parking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Levels</td>
</tr>
</tbody>
</table>

Note: In special cases, there are conditions on arterial and sub arterial streets where the ROW gets constricted to a minimum of 24m. In such conditions, the continuity of the NMT and pedestrian infrastructure is important without creating a bottle neck in the arterial/sub arterial flow. A segregated cycle track and footpath can be easily achieved with 2 lanes in both directions.
Sub - Arterial Streets

BHUPINDRA ROAD

PROPOSAL 01
Carriageway redesigned as 7.1m carriageway & 2m parking lane (as existing section has perpendicular parking on both side)
Distance between two parking bays is 3-5m which will be landscape area.
2.5m wide Cycle track with 3.6-4.4m wide footpath
Raised pedestrian crossings has been proposed at every 250m.

PROPOSAL 02
Median shifted towards right side by 2m to integrate parking and service road.
Separate cycle tracks & Footpath width. Green belt between cycle track and motorised lane
Service lane - angular parking on one side and Parallel parking on the other
Integrated space for hawkers/vendors.

PROPOSAL 03
Median shifted towards right side by 1m to integrate parking and service road.
Separate cycle tracks & Footpath width. Green belt between cycle track and motorised lane
Service lane - angular parking on one side and Parallel parking on the other
Integrated space for hawkers/vendors.

EXISTING SECTION
Observations:
1. Lack of footpath for pedestrian & bicycle infrastructure
2. Inappropriate lane width
3. Lack of pedestrian crossing
4. No designated parking facilities & No space for hawkers

Figure 10: Bhupindra Road
Figure 11: Existing Section, Bhupindra Road

Land-use:
LHS: Mixed use | RHS: Mixed use
Figure 12: Proposed Plan 1, Bhupindra Road

Figure 13: Proposed Section 1, Bhupindra Road
PROPOSAL 02

PROPOSED PLAN

Figure 14: Proposed Plan 2, Bhupindra Road

PROPOSED SECTION

Figure 15: Proposed Section 2, Bhupindra Road
PROPOSED PLAN

Figure 16: Proposed Plan 3, Bhupindra Road

PROPOSED SECTION

Figure 17: Proposed Section 3, Bhupindra Road
**Collector Streets**

### Rajpura Road

**LAND USE:**
LHS: Public Semi-Public | RHS: Commercial

#### EXISTING SECTION

**Observations:**
1. Lack of footpath and crossings for pedestrian.
2. Lack of slow moving/bicycle infrastructure.
3. Inappropriate carriageway width
4. Improper parking facilities

#### PROPOSAL 01

- Existing 7.8m wide Carriageway (on both side) reduced to 7.1m
- Added 2.5m wide Cycle track with 1.8m wide footpath (on both side) in proposal 1
- Raised pedestrian crossings has been proposed at every 250m.
- 0.8m wide Multi Utility Zone (MUZ) has been proposed for services and acts as a separator to segregate motorized and non motorized traffic.
- 1.20m wide median has been provided which will act as a refuge space for pedestrians at crossing.

#### PROPOSAL 02

- Provision of 1.8m wide Separate cycle tracks and 1.8m wide footpath
- Green belt/MUZ between cycle track and motorised lanes for services which also help to reduce friction between fast and slow moving traffic
- Provision of proper division of lanes with pedestrian crossings
- 1.30m wide median has been provided which will act as a refuge space for pedestrians at crossing.
Figure 20: Proposed Plan 1, Rajpura Road

PROPOSED SECTION

Figure 21: Proposed Section 1, Rajpura Road
PROPOSED PLAN

PROPOSED SECTION

Figure 22: Proposed Plan 2, Rajpura Road

Figure 23: Proposed Section 2, Rajpura Road
Lower Collector Streets

Factory Road

Observations:
1. Pedestrian lanes not maintained well
2. No segregated cycle track
3. Dedicated Parking space in front of commercial area, but not managed properly
4. Lane markings are missing

**EXISTING SECTION**

**PROPOSAL 01**
Carriageway (on both side)
1.5m wide painted Cycle lane with 2.15-2.75m wide footpath (on both side)
Raised pedestrian crossings has been proposed at every 250m.

**PROPOSAL 02**
Cyclists shares the main carriageway as ROW is less than 18m.
Wider footpaths for the pedestrians with parallel parking bays near commercial area.

**PROPOSAL 03**
Wider footpaths for pedestrians on both side.
Provision for parallel parking considering the amount of activity happening around the road.

Figure 24 : Factory Road
Figure 25 : Existing Section, Factory Road
**Proposed Plan:**

Figure 26: Proposed Plan 1, Factory Road

**Proposed Section:**

Figure 27: Proposed Section 1, Factory Road

---

PROPOSAL 01
PROPOSAL 02

PROPOSED PLAN

Figure 28: Proposed Plan 2, Factory Road

PROPOSED SECTION

Figure 29: Proposed Section 2, Factory Road
PROPOSAL 03

PROPOSED PLAN

Figure 30: Proposed Plan 3, Factory Road

PROPOSED SECTION

Figure 31: Proposed Section 3, Bhupindra Road
Local Streets

**Access Road (generic)**

These are used for access functions to adjoining properties and areas. A majority of trips in urban areas usually originate or terminate on these streets. They cater to a design speed of 15-30 km/h and have a street right of way of 15m-30m. They carry relatively lower volumes of traffic at low speeds. They are characterized by access predominantly; they can be used for collector functions.

![Access Street (existing)](source)

**EXISTING SECTION**

- **SHOP**
- **FOOTPATH**
- **M.V. LANE**
- **FOOTPATH**

![Access Street (Proposed)](source)

**PROPOSED SECTION**

- **FOOTPATH**
- **CARRIAGEWAY**
- **FOOTPATH**

**Figure 32: Access Street (existing)**
Source: SGArchitects, New Delhi

**Figure 33: Access Street (Proposed)**
Source: SGArchitects, New Delhi

**Figure 34: Access Street (Before)**

**Figure 35: Access Street (After)**
Figure 36: Exiting Alignment and Activity Survey, near Kali Mata Mandir, Mall Road
Figure 37: Proposed Design, near Kali Mata Mandir, Mall Road
INTERSECTION DESIGN

Intersection functions to control conflicting and merging traffic and to achieve this, intersections are designed on certain geometric parameters and are broadly classified into three main heads. Designers are often faced with tough choices of prioritizing the conflicting requirements of one mode over another. Here the key is to apply the most appropriate solution based on the type of junction as well site conditions/constraints.

The three main types of junction solutions are:
1. Un signalized intersection,
2. Signalized Junctions
3. Roundabouts

Different combinations of the intersection type is determined primarily by the number of intersecting legs, the topography, the character of the intersecting streets, the traffic volumes, patterns, and speeds, and the desired type of operation.

Types of intersection depending on the geometric forms are as follows

3- Leg Junction, 4- Leg Junction, Multi-Leg Junction

Grade Separated Facilities: There are various solutions possible between junctions of different street types. Grade separation of intersecting motorized vehicle carriageway (flyovers, etc) is a high cost intersection design solution, which may be suitable for use on highways or express ways. Such solutions are not desirable within the built up areas or urban limits due to their adverse impact on accidents, pollution, etc.

However, grade separation of cycle and pedestrian traffic across high-speed and high volume motorized vehicle carriageway may often be advisable to ensure safety of cyclists and pedestrians.

Wide streets and grade-separated junctions divide the urban landscape into separate zones. It becomes very difficult for people to cross these arteries on foot or using other non-motorised modes. This has the effect of discouraging public transport use, as all commuters using buses have to cross the street at least two times for every round trip at the origin or the destination.

The area occupied by grade separated intersections is much greater than ordinary intersections. The location of bus stops at grade separated intersections is often changed from the present location which is close to the intersection to the foot of the flyover.

There are various aspects of intersections including signaling and detailing.

More Info
1. Design of Urban Roads, Code of Practice (Part-2) : Intersection
2. Design of Urban Roads, Code of Practice (Part-5) : Traffic Calming
3. Planning and Design Guideline for Cycle Infrastructure

Figure 38: Best Practise - Raised Crossing (Unsignalised)

Figure 39: Signalised Intersections - Unsafe and improper design
**Roundabout**

**Pros**
- Reduces the number of conflicts to eight as against 32 in un-signalized intersections.
- Ensures safety through speed reduction by design. This is particularly useful at late night hours when speeds are high and compliance of signals and traffic rules is low.
- Minimal or no delays for all street users including cyclists.

**Cons**
- Roundabouts are not very effective for more than two circulatory lanes. They have capacity limitations and may not be able to handle a very high volume of traffic.

**Signalised Intersection**

**Pros**
- Signalized intersections can handle high traffic volumes. This can be achieved by accommodating wider carriageway with more number of lanes.

**Cons**
- Four times the number of conflicts than the roundabout.
- Safety is ensured by eliminating conflicts through signalization – high dependence on enforcement.
- Higher delays for all street users including cyclists.

Table 3: Comparison between Roundabout and Signalised Junction

Source: Code of Practice II, IIT, 2013

<table>
<thead>
<tr>
<th>Roundabout</th>
<th>Intersection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
<td><strong>Pros</strong></td>
</tr>
<tr>
<td>Reduces the number of conflicts to eight as against 32 in un-signalized intersections.</td>
<td>Signalized intersections can handle high traffic volumes. This can be achieved by accommodating wider carriageway with more number of lanes.</td>
</tr>
<tr>
<td>Ensures safety through speed reduction by design. This is particularly useful at late night hours when speeds are high and compliance of signals and traffic rules is low.</td>
<td>Safety is ensured by eliminating conflicts through signalization – high dependence on enforcement.</td>
</tr>
<tr>
<td>Minimal or no delays for all street users including cyclists.</td>
<td>Higher delays for all street users including cyclists.</td>
</tr>
</tbody>
</table>

**Figure 2-6 Arterial to Arterial**

**Roundabout**

**Signalised Intersection**

**Figure 2-24 Roundabout**

**Arterial to Arterial (no free left turn)**

**Figure 2-24 Roundabout**

**Signalised Intersections - Unsafe and improper design**

Source: Design of Urban Roads: Intersection

**Table 2-1 Criteria to provide a Signalized Intersection - Minimum Vehicular volume**

<table>
<thead>
<tr>
<th>Major Street (any type)</th>
<th>Minor Street (any type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of lanes for moving traffic on each approach</td>
<td>Motor Vehicle per hour on major street (both direction)</td>
</tr>
<tr>
<td>1</td>
<td>650</td>
</tr>
<tr>
<td>2 or more</td>
<td>800</td>
</tr>
<tr>
<td>1</td>
<td>650</td>
</tr>
<tr>
<td>2 or more</td>
<td>800</td>
</tr>
</tbody>
</table>
Exiting Alignment and Activity Survey, Fountain Chowk, Patiala

Figure 40: Existing Alignment and Activity Survey, Fountain Chowk
Proposed Design, Fountain Chowk, Patiala

Figure 41: Proposed Alignment, Fountain Chowk
The safety interventions in a roundabout can promote:

- Improved roundabout design
- Safer pedestrian movement
- Reduced conflicts
- Clear carriageway

Design features that have been introduced in fountain chowk are:

- Improved geometry
- Over runnable apron
- Flat top raised crossings on all approaches
- Space for TSR parking
- Space for street hawkers

**Figure 42 : Safety Interventions in Fountain Chowk**

**HIGHWAY AS URBAN STREETS**

As discussed in Street Design Guideline PART A: Planning, any highway entering city boundary should be treated as an urban street and the speed and design should be governed by the typology of the street.

The average safety score observed for the three high crash locations was 33 out of 100. The locations included Rajpura Road (Near Santoshi Mata Mandir/Hotel Eqbal Inn) and Rajpura Road (Near Punjabi University), a part of highway connecting Patiala to various other parts of Punjab and even other states.

Rajpura Road (Near Punjab University): At this location, high speeds were recorded within the city.

- Cars = 60-75 km/h
- Bikes = 50-60 km/h
- Trucks and Buses = 50-55 km/h

Along with high speed, there was no safe infrastructure for pedestrians and cyclist. The footpaths were absent despite available space on road sides and there was an absence of crossing infrastructure.

Proposed design interventions at such locations should focus on reduction of speed, providing audible markers and safe infrastructure for vulnerable road users like pedestrians and cyclists.

Some intervention proposed on these hotspots are as follows:

- Provision of rumble strips to control speed
- Signage and
- On-street parking bays
- Provision of crash barriers
Figure 47: Rumble Strips and Signage

Figure 48: Proposed Interventions, Rajpura Road (Punjabi University)
CROSSING THE STREET

The distance between two junctions should be 500m – 700m each, to offer commuters a comfortable walking distance. In case the distance is more, a signalized crossing needs to be added at a mid block to facilitate safe at grade crossing.

Figure below showcases proposed crossings and junction typology. Only, if it is not possible to introduce a new crossing due to high speed traffic on a highway/expressway, grade separated crossing facilities should be provided which comply with universal accessible principles.

In order of preference, half subways precede foot over bridges in a grade separated facility.

1. At Grade

Figure 49: At Grade Crossing, Delhi

2. Half - Subways

3. Foot over Bridges

More Info:
2. Design of Urban Roads, Code of Practice (Part-1): Cross Section
Curb Side Street Infrastructure

People use streets as social spaces. All components of road design and various road users interact in such a manner that it creates an urban system. This urban system fosters public spaces.

For eg. at a bus shelter, one may find hawkers, autos, rickshaws, some area where cars drop/ pick commuters. Similarly at the corner of an intersection, there are places where toilet blocks for better visibility and also advertisements are placed for revenue generation. In front of colleges, universities, offices, one may find hawkers and para transit modes that are service providers to students and people coming/ going to offices. People meet on streets and look for places to sit. In scorching summer months, it is a tree line that makes commute a bit easy.

In order to generate public activity on streets, it is vital to integrate such conditions at the same location as today.

Some key components to be integrated are:

- **Bus Shelters** – When curb side shelters are installed on the street, it needs to be connected to the pedestrian path.
- **Hawker Spaces** – Presence of hawkers and street vendors provides security and services to street commuters. Allocation of a dedicated space shall also
make the street more lively and interesting.

- Para Transit – TSR and Cycle rickshaw are feeder services and need to be integrated in the cross section as well as intersections at critical locations to enhance seamless multi-modal accessibility.

Apart from the above, toilets, other public amenities, resting areas and seating are also important. They provide comfort and rest areas for both pedestrians and cyclists. They can help in identifying an area of different function. The use of street furniture definitely assists in improvement of the urban quality of street infrastructure. In addition to its aesthetic quality, street furniture plays a role in segregating spaces and adding facility for different users.

The following should be taken into consideration while adding street furniture:

- Vandal-Proof. All street furniture should be vandal-proof.
- Easy to install.
- Requires little or no maintenance.
- Attractive design.
- Economical design.
- Ease in production.

Use of dustbins and location of amenities such as public toilets, kiosks, information booths are other types of street furniture that make the infrastructure more attractive.

An attractive tree line and shade makes the entire street attractive. Use of hedges and green belts is recommended.

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**Hawker Spaces**

Bicycles, pedestrians and bus traffic attracts street vendors. Often the side streets and pedestrian paths are occupied by people selling food, drinks and other articles, which are demanded by these street users. Vendors often locate themselves at places, which are natural markets for them. A careful analysis of location of vendors, number of vendors at each location and type of services provided them shows the need of that environment, since they work under completely “free market” principles. If the services provided them were not required at those locations, then they would have no incentive to continue staying there.

However, street authorities and city authorities view their existence illegal. Highway design manuals recommends frequency and design of service area for motorized vehicles. Street vendors and hawkers serve the same function for pedestrians, bicyclists and bus users. As long as our urban streets are used by these modes, street vendors will remain inevitable and necessary. All modes of transport move in sub-optimal conditions in the absence of facilities for pedestrians and non-motorized vehicles. In case no provision is facilitated and no integration by design is undertaken, there is bound to be an encroachment on to the infrastructure provided for other users.


More Info:

2. Planning and Design Guideline for Cycle Infrastructure, 2014
3. Ready Reckoner, Urban Road Code 1, MoHUA
**Location of Bus Shelter**

By 2031, it is possible that mini buses, public transport will be introduced to support for sustainable mobility in the city. MC Patiala will need to address accessibility and other requisites for the commuters.

Bus Shelters need to be located every 500-700m. The activity survey will indicate that in the vicinity of the bus shelter, hawkers, cycle rickshaws, e-rickshaws etc. are present.

The bus shelters should be located between 20m - 40m at the near-side of the junctions (or roundabouts). There are two advantages:
1. Bus Stop slows the traffic approaching the intersection.
2. The Right of Way (ROW) of the roundabout is better used.
3. Bus Commuters have to walk less distance.

Design features around the bus stop include:
1. Dedicated spaces for NMV Parking, TSR Parking and short term car parking bays.
2. Table Tops to facilitate safe crossings.
3. Addition of rumble strips prior to table top crossing to slow traffic.
Integration of Feeder Service / E-rickshaw

Commercial stretches also have a high presence of hawkers and vendors. Since markets are also destinations, one can see rampant on-street parking as well as presence of cycle rickshaws, e-rickshaws bringing people and also acting as feeder to bus transportation.

Much of this encroaches pedestrian infrastructure and also creates high friction with other modes.

Space needs to be allocated while planning and integrate feeder infrastructure, vendors and hawkers as close to their previous location.
**Drainage:** Improper design of gully gratings, water collection on streets creates inconvenience for all street users especially the pedestrians and the cyclists. It should be taken care that no services that require regular maintenance should be laid below the cycle track. The green verges should have the provision of gratings that take surface water from the carriageway as well as the cycle track (slope 2%). Water travels through a pipe to the storm water drain. For distributor and access streets placing a collection grating along the edge of the footpath can be placed. A bell mouth arrangement to collect water is not recommended. The grating should be flush with the floor of the carriageway and the cover should not hamper the movement of cyclists. The cover of the grating should be perpendicular to the direction of the travel of bicyclists so that the tyre does strike it.

**Other Utilities:** There are various utilities running longitudinal and across the ROW of any category street. These include storm drains, underground and overhead electrical lines, gas pipelines, optical fibre cables and others. Usually it is seen that an annual maintenance is required which involves street work and therefore disruption of movement of traffic for a temporary period. In such a case, the location and depth of laying these utilities is of utmost importance. The important point is to rationalize all available existing and proposed services in order of their maintenance works and see that they do not come in the way of the efficiency and functioning of streets.

**Lighting:** Street lighting makes the available space legible for each street user. As per National Transportation planning and Research Centre (NATPAC) study, 1994, only 35-40% are functional at any given point of time. The illumination of a street is governed by the posted design speed. Lighting also adds to the comfort and is required for visibility of a roadway and it adds to the safety of all features of a street design. In fact, lighting is the basic street furniture required in the functioning of the safe streets.

Location of Poles is decided depending upon the category of the street. It could be the central verge or at the sides where a segregated cycle facility is...
available. Two luminaries can be mounted on a pole located between the carriageway and the cycle track at different height to light the required area with the required lux levels. This would also reduce the number of poles required and the vertical clutter on any given street.

**Color of Light:** Street lighting should produce enough intensity required for face recognition and objects from a particular sight distance. Especially for the purpose of social safety, women and children are a special group for whom the color of light is of added importance. White light is a preferred choice. The advantages of white light are as follows: In a segregated facility, it easily distinguishes between the fast and slow moving zones. It creates contrasts for pedestrians with tactile paving provided for the differently-able and the visually impaired.

**Signage:** The importance of a signage is that it keeps the street user informed of the following:
- Important destinations and routes
- Unexpected conditions
- Traffic laws
- Facilities like Public conveniences and Parking areas.
- Differently-abled environments, facilitated by the following elements:

**Inclusive Signages:** combination of easily recognisable symbols using contrasting colors, Audible Signals or Auditory Signals along with a Braille marking and International symbol of Accessibility (ISA). The international symbol of access (ISA) also known as the International Wheelchair Symbol. It is used as an informative sign with blue background and image of a person using a wheelchair overlaid in white.
- Guiding and Warner Tactile Blocks
- Railings wherever necessary

Signage is a comprehensive system of Regulatory, Informatory and Warning messages corresponding to the information for all street user groups. Refer IRC 67: code of practice 3.

**Marking:** Street markings are essential to guide the street users and to ensure a smoother flow of traffic. Markings have to be of standard color and dimensions and should be marked at appropriate places so as to optimize their visibility and effectiveness.
05 Costing

The costs presented are in Indian Rupees and are based on Delhi Schedule of Rates and standard market rates (in a metropolitan city) of 2005. It is important to note that these rates are indicative and cannot be applied directly.

Cycle Tracks (Table 04): The cost of per kilometre development of cycle tracks includes all related costs such as excavation, dismantling, preparation of sub bases, backfilling, etc. The costs have been calculated for three conditions. These include a 5.0m wide independent track and 2.5m wide cycle track on both sides of new road development or on either side of an existing road; where upgradation of an existing road to a bicycle friendly infrastructure is being undertaken.

Primary Footpath (Table 05): The cost per kilometre development of the footpath along the main carriageway and besides the cycle track or cycle lane has been calculated for a 2.5m wide footpath, on either side of the carriageway and finished in 60mm thick interlocking cement concrete tiles. Along the independent cycle track the footpath of 5.0m width is provided along one side of the cycle track.

Functional Lighting (Table 06): Per kilometre cost of functional street lighting would be as per code of practise for lighting of public thoroughfare (BIS, 1981). The cost for an independent track is based on 150 watt metal halide light sourced, with 6m high mounting, spaced at 20m centre to centre one edge of the cycle track (only a single row). The cost of lighting for cycle infrastructure along the road is based on 150 watt metal halide lamps facing the cycle track and/or pedestrian path and spaced every 20m centre to centre, while 400 watt HPSV lamps facing the carriageway and spaced at every 40m centre to centre. The metal halide light sources are mounted at 6m height whereas HPSV light sources are mounted at 12m height. The design provides for 12m and 6m poles spaced at 20m, interval centre to centre placed alternately. 12m poles have dual mounting, i.e. HPSV lamp mounted at 12m height and facing the carriageway and metal halide lamp mounted at 6m, and facing the cycle track. The light poles in the assumed design are proposed to be mounted either between cycle track and the carriageway or between cycle track and the footpath and should achieve a lighting level of average 40 lux across the cross section, with a uniformity ration of 40%. For some streets where service lanes are provided, additional light posts/sources may be required to be mounted at the edge of the carriageway to achieve the desired average of 40 lux. The cost of this additional row of poles has not been accounted for.

Storm Water Drain (Table 07): This includes per kilometer cost estimate for providing a 900mm diameter storm water drain. The drain size is assumed to be similar for all three requirements, i.e. independent tracks, tracks provided along a new road development and those provided as a part of an existing road up gradation. Cost of provision of storm water drain (as also the cost of functional lighting) has been calculated as a new drain provision even under upgradation of existing road, based on the assumption that either an adequate drainage provision may not exist, or it is an old choked drain requiring replacement. The drain pipe size is assumed based on the large distances between outfall points within the city. The drain collection system assumed for the costing is based on surface gully chambers and not bell mouths.

Electrical and Telephone Services (Table 09): Development of cycle track along an existing carriageway may require re-location of some overhead poles and underground services related to telephone and electricity. This is based on the understanding that the electricity cables need to be accessed at the location where faults occur requiring frequent digging and trenching. These cables cannot be located under a concrete cycle track which will limit the access to such services. Poles cannot be allowed to be left within the cycle track and hence some may need to be shifted to another location. The costing for these procedures is based on the assumption that a single HT and two new LT cables may be required to be provided as an outcome of this shifting exercise on either side of the carriageway. For a new road development all services are new and hence the cost has been estimated accordingly. Since these electricity and telephone services are not directly related to cycle infrastructure but are a part of the road infrastructure they have not been accounted for in the cost of development of independent cycle...
Table 4: Sample costing for segregated cycle track

<table>
<thead>
<tr>
<th>Component</th>
<th>Independent Track</th>
<th>New Road Development</th>
<th>Upgradation of existing road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dismantling of existing surface and structures</td>
<td>0.00</td>
<td>0.00</td>
<td>1.79</td>
</tr>
<tr>
<td>Excavation</td>
<td>0.67</td>
<td>0.67</td>
<td>0.67</td>
</tr>
<tr>
<td>Base courses (GSB+DLC)</td>
<td>57.72</td>
<td>57.72</td>
<td>57.72</td>
</tr>
<tr>
<td>M40 CC pavement+pavement marking</td>
<td>81.55</td>
<td>81.55</td>
<td>81.55</td>
</tr>
<tr>
<td>CC Kerb stone segregator</td>
<td>0.00</td>
<td>3.60</td>
<td>3.60</td>
</tr>
<tr>
<td>Total</td>
<td>139.94</td>
<td>143.54</td>
<td>145.33</td>
</tr>
</tbody>
</table>

Table 5: Sample costing for footpath

<table>
<thead>
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<th>Independent Track</th>
<th>New Road Development</th>
<th>Upgradation of existing road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dismantling of existing surface and structures</td>
<td>0.00</td>
<td>0.00</td>
<td>4.13</td>
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<tr>
<td>Excavation</td>
<td>0.78</td>
<td>0.78</td>
<td>0.00</td>
</tr>
<tr>
<td>Base courses (GSB+DLC)</td>
<td>25.03</td>
<td>25.03</td>
<td>25.03</td>
</tr>
<tr>
<td>60mm thick CC paver blocks on sand bed</td>
<td>29.70</td>
<td>29.70</td>
<td>29.70</td>
</tr>
<tr>
<td>CC Kerb stone edges</td>
<td>7.20</td>
<td>7.20</td>
<td>7.20</td>
</tr>
<tr>
<td>Total</td>
<td>62.70</td>
<td>62.70</td>
<td>66.06</td>
</tr>
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</table>

Table 6: Sample costing for functional lighting

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<thead>
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<th>Component</th>
<th>Independent Track</th>
<th>New Road Development</th>
<th>Upgradation of existing road</th>
</tr>
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<tbody>
<tr>
<td>Foundations, including excavation</td>
<td>4.26</td>
<td>0.11</td>
<td>0.11</td>
</tr>
<tr>
<td>Provision of new light poles, with fittings, wires, etc.</td>
<td>24.75</td>
<td>74.50</td>
<td>74.50</td>
</tr>
<tr>
<td>Dismantling of existing light poles</td>
<td>0.00</td>
<td>0.00</td>
<td>6.00</td>
</tr>
<tr>
<td>Total</td>
<td>29.01</td>
<td>74.61</td>
<td>80.61</td>
</tr>
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Table 8: Sample costing for storm water drainage

<table>
<thead>
<tr>
<th>Component</th>
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<th>New Road Development</th>
<th>Upgradation of existing road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation, filling and preparation base for pipes</td>
<td>20.34</td>
<td>20.34</td>
<td>20.83</td>
</tr>
<tr>
<td>Laying of pipes</td>
<td>8.00</td>
<td>8.00</td>
<td>8.00</td>
</tr>
<tr>
<td>Development of Manholes</td>
<td>85.07</td>
<td>85.07</td>
<td>85.07</td>
</tr>
<tr>
<td>Provision of Gully chambers, including connection to Manholes, using 300mm dia., NP2 pipes</td>
<td>40.25</td>
<td>40.25</td>
<td>40.25</td>
</tr>
<tr>
<td>Total</td>
<td>153.66</td>
<td>153.66</td>
<td>154.15</td>
</tr>
</tbody>
</table>

Table 9: Sample costing for electrical and telephone poles

<table>
<thead>
<tr>
<th>Component</th>
<th>Independent Track</th>
<th>New Road Development</th>
<th>Upgradation of existing road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shifting of Existing overground services</td>
<td>0.00</td>
<td>0.00</td>
<td>8.80</td>
</tr>
<tr>
<td>Provision of new overground services</td>
<td>0.00</td>
<td>40.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Provision of new underground electrical cables (both HT and LT)</td>
<td>0.00</td>
<td>261.20</td>
<td>261.20</td>
</tr>
<tr>
<td>Total</td>
<td>0.00</td>
<td>301.20</td>
<td>270.00</td>
</tr>
</tbody>
</table>
tracks.

Carriageway (Table 10): The cost of development of a 6m wide, 2 lane carriageway along with 2m wide cycle lane for each direction (cost inclusive of both directions). The cost is only a part of complete road infrastructure design to make it cycle friendly and hence is not included for independent tracks. The cost for upgradation of existing streets is based on construction of streets from base courses for only 2m width for each direction. This is based on the assumption that re-alignment of the road would require limited width of the carriageway to be re-developed from the base. This is also the reason why the BC course or the top black layer may need to be removed, and re-laid to adjust the slopes and camber as per revised alignment. The cost for carriageway development for arterial streets may need to be adjusted to allow approximately 20% reduction on account of lower overall carriageway width for each direction to 2 lanes or 6.7m, as the cycle, lanes are replaced by cycle tracks on such streets.

Telecom Conduits (Table 11): Telecom conduits may be required to be provided separately under some arterial streets. These are generally located under the service road and carry optical fiber and other telecommunication cables. Such a development may be taken up to rationalize service provision along the streets when they are disturbed due to development or integration of cycle infrastructure. Since provision of telecom conduits is a part of road infrastructure it has not been accounted for in the development of independent cycle tracks.

Service Road (Table 12): Service streets are provided along arterial streets to cater to the access function of the road. The cost of development of six meter wide service streets on either side of the carriageway has been indicated. The cost for development is inclusive of base courses for new road development, whereas for upgradation of existing road, 1.5m wide development is considered with base courses.

Secondary Footpath (Table 13): Secondary footpaths are located at the edge of the ROW along the service lane on an arterial road. These only exist on an arterial road with service lanes, as on other streets the primary footpath is at the edge of the ROW. These may require to be developed as a part of the service lane development along streets where cycle infrastructure is included.

Sign Boards and Pavement Marking (Table 14): Pavement marking and sign boards are required both for cycle tracks as well as carriageways. The cost for road safety provisions for independent tracks as well as cycle infrastructure along the carriageway has been indicated. This does not include provisions for service lanes. The cost of pavement marking for cycle lane and cycle tracks have been shown separately. This is because cycle tracks include cycle box marking repeated every 100m which is not required for a segregated facility. The cost indicated is for development of a 2.5m wide footpath along the service lane on either side of the carriageway. The height of the footpath should be 0.15m.

Landscaping and Miscellaneous (Table 15): Plantation and landscaping elements are not only essential to ensure a good riding experience, they are necessary to protect the rider from harsh climatic conditions in most parts of the subcontinent. The cost estimate for new tree plantations, shrubs, grass, planters, benches, bollards, blinkers etc has been provided. The cost also includes provisions for changes in paving material at plazas etc.

Overall Road and Cycle Infrastructure Development Cost (Table 16): The analysis of individual component cost for streets with integrated cycle infrastructure reveal that integration of cycle specific infrastructure in a road development project only amounts to 10% of the overall road development or improvement cost. The analysis also highlights the issues that under current circumstances, most streets in the Indian subcontinent require an investment almost equal to development of new streets to upgrade them to cycle and pedestrian friendly streets as per current best practices and international standards. The approximate cost of development of new and upgradation for existing cycle friendly and integrated infrastructure has been provided.

It is important to note that though the above mentioned costs cover most items required for a street development they may not be complete. For example it does not include the cost for development of bus shelters, traffic signals, traffic calming measures (including raised crossings), cast of construction, safety equipment, etc.
Table 10: Sample costing for new carriageway

<table>
<thead>
<tr>
<th>Component</th>
<th>Independent Track</th>
<th>New Road Development</th>
<th>Upgradation of existing road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dismantling of existing road level footpath, and scrapping and removing top surface of existing carriageway</td>
<td>0.00</td>
<td>0.00</td>
<td>8.09</td>
</tr>
<tr>
<td>Scrapping/removing of top surface of existing carriageway</td>
<td>0.00</td>
<td>0.00</td>
<td>5.74</td>
</tr>
<tr>
<td>Carriageway, base layers upto DBM</td>
<td>0.00</td>
<td>262.47</td>
<td>65.62</td>
</tr>
<tr>
<td>Provision of new carriageway black top in asphaltic concrete</td>
<td>0.00</td>
<td>38.21</td>
<td>38.21</td>
</tr>
<tr>
<td>Development of 1.2m wide, 0.15m high central median, including excavation and finishing.</td>
<td>0.00</td>
<td>26.69</td>
<td>29.69</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.00</strong></td>
<td><strong>327.37</strong></td>
<td><strong>147.35</strong></td>
</tr>
</tbody>
</table>

Table 11: Sample costing for laying telecom conduits

<table>
<thead>
<tr>
<th>Component</th>
<th>Independent Track</th>
<th>New Road Development</th>
<th>Upgradation of existing road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation and refilling, including preparation of base</td>
<td>0.00</td>
<td>2.07</td>
<td>3.62</td>
</tr>
<tr>
<td>Provision of 700mm x 700mm manholes, 1.2m in depth</td>
<td>0.00</td>
<td>31.27</td>
<td>31.27</td>
</tr>
<tr>
<td>Provision of 450mm dia., NP2, cement concrete pipes</td>
<td>0.00</td>
<td>11.00</td>
<td>11.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.00</strong></td>
<td><strong>44.34</strong></td>
<td><strong>45.88</strong></td>
</tr>
</tbody>
</table>

Table 12: Sample costing for Service Road

<table>
<thead>
<tr>
<th>Component</th>
<th>Independent Track</th>
<th>New Road Development</th>
<th>Upgradation of existing road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dismantling of existing road level footpath, and scrapping and removing top surface of existing carriageway</td>
<td>0.00</td>
<td>0.00</td>
<td>6.07</td>
</tr>
<tr>
<td>Scrapping/removing of top surface of existing carriageway</td>
<td>0.00</td>
<td>0.00</td>
<td>4.30</td>
</tr>
<tr>
<td>Carriageway, base layers upto DBM</td>
<td>0.00</td>
<td>196.85</td>
<td>49.21</td>
</tr>
<tr>
<td>Provision of new carriageway black top in asphaltic concrete</td>
<td>0.00</td>
<td>28.66</td>
<td>28.66</td>
</tr>
<tr>
<td>Development of 1.2m wide, 0.15m high central median, including excavation and finishing.</td>
<td>0.00</td>
<td>20.01</td>
<td>22.26</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.00</strong></td>
<td><strong>245.53</strong></td>
<td><strong>110.51</strong></td>
</tr>
</tbody>
</table>
Table 13: Sample costing for Secondary Footpath

<table>
<thead>
<tr>
<th>Component</th>
<th>Independent Track</th>
<th>New Road Development</th>
<th>Upgradation of existing road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dismantling of existing surface and structures</td>
<td>0.00</td>
<td>0.00</td>
<td>4.13</td>
</tr>
<tr>
<td>Excavation</td>
<td>0.00</td>
<td>0.78</td>
<td>0.00</td>
</tr>
<tr>
<td>Base courses (GSB+DLC)</td>
<td>0.00</td>
<td>25.03</td>
<td>25.03</td>
</tr>
<tr>
<td>60mm thick CC paver blocks on sand bed</td>
<td>0.00</td>
<td>25.03</td>
<td></td>
</tr>
<tr>
<td>CC Kerb stone edges</td>
<td>0.00</td>
<td>7.20</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.00</strong></td>
<td><strong>62.70</strong></td>
<td><strong>66.06</strong></td>
</tr>
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</table>

Table 14: Sample costing for Signboard and Marking

<table>
<thead>
<tr>
<th>Component</th>
<th>Independent Track</th>
<th>New Road Development</th>
<th>Upgradation of existing road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Boards</td>
<td>0.6</td>
<td>12.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Regulatory and Warning sign boards</td>
<td>0.0</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Pavement marking for motor vehicle lanes</td>
<td>0.0</td>
<td>5.1</td>
<td>5.1</td>
</tr>
<tr>
<td>Reflector studs or audible warning devices</td>
<td>0.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Spring Posts/ Plastic bollards</td>
<td>0.0</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Pavement marking for cycle tracks</td>
<td>13.7</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Pavement marking for cycle lanes</td>
<td>25.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(distributory roads only)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14.3</strong></td>
<td><strong>47.4</strong></td>
<td><strong>47.4</strong></td>
</tr>
</tbody>
</table>

Table 15: Sample costing for Landscaping and Miscellaneous Items

<table>
<thead>
<tr>
<th>Component</th>
<th>Independent Track</th>
<th>New Road Development</th>
<th>Upgradation of existing road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Including new tree plantation, shrubs, grass, etc. (inclusive of preparation of soil, beds, etc.)</td>
<td>2.52</td>
<td>2.52</td>
<td>2.52</td>
</tr>
<tr>
<td>Benches, solar blinkers, ramps, tow walls, etc.</td>
<td>5.00</td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7.52</strong></td>
<td><strong>17.52</strong></td>
<td><strong>17.52</strong></td>
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</tbody>
</table>

Table 16: Sample costing for Overall Development for NMT infrastructure compared to cycling facility

<table>
<thead>
<tr>
<th>Development per km</th>
<th>Complete Road with Cycle Facility</th>
<th>Complete Road without Cycle Facility</th>
<th>Difference of Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Road (45m ROW)</td>
<td>1390.08</td>
<td>1246.18</td>
<td>143.9</td>
</tr>
<tr>
<td></td>
<td>1096.38</td>
<td>950.69</td>
<td>145.69</td>
</tr>
<tr>
<td>Distributory Road (24m ROW)</td>
<td>984.45</td>
<td>959.45</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>783.07</td>
<td>758.07</td>
<td>27</td>
</tr>
<tr>
<td>Local Road (12m ROW)</td>
<td>512.67</td>
<td>512.67</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>381.5</td>
<td>381.5</td>
<td>0</td>
</tr>
<tr>
<td>Independent Tracks</td>
<td>407.08</td>
<td>139.94</td>
<td>267.14</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>145.33</td>
<td>-</td>
</tr>
</tbody>
</table>
06 Audit

Audits can be used in any phase of project development from planning to construction. The main aim of an audit is to minimize the risk and severity of street crashes; to minimize the need for remedial works after construction; and to reduce the life costs of the project (Austroads, 2002).

It is intended to minimize the risk of a traffic crash and ensure that measures to eliminate or reduce identified urban roadway problems are fully considered. An audit case may refer to city, station area network, route or corridor etc.

City

For a city level audit, a sampling methodology needs to be undertaken. In the “Toolkit for preparing Low-carbon Comprehensive Mobility Plan (UNEP, 2012), a sampling methodology was undertaken to evaluate a city. A sample should include about 10% of the entire street network of the city covering all type of streets. The sampling methodology needs to be applied for household surveys and information about infrastructure inventory.

Corridor/Route

When a corridor or route is desired to be audited, the audit can be conducted for cycling infrastructure independent of the context or in relation to the context. In the Urban Road Safety Audit Toolkit (MoUD, 2012), the audit selection is based upon street type and context.

Transit Stops

The Public Transport Accessibility Toolkit ((MoUD, 2012) can be conducted either during the construction of a new public transport facility or in redesigning an existing facility. It is necessary to understand different access modes and plan for each and every one of these and potential access modes to ensure accessibility to PT. This helps in identifying the access modes for which inter-modal connectivity need to be provided in Indian cities. 5 types of modes were thus identified as pedestrian, cyclists, IPT users, bus users and private motor vehicle users. The area in which the audit has to be carried out is dependent on the type of street user.
Bibliography

2. (MoUD), M. o. U. D., 2012. Public Transport Accessibility Toolkitnt, s.l.: MoUD.
9. IRC11, 1962. IRC: 11, Recommended practice for the design and layout of cycle tracks, New Delhi: IRC.
21. SP:55, I., 2013. SP 55, Indian road Congress, s.l.: IRC.
28. UNEP, I. D., 2012. Toolkit for preparing Low carbon Comprehensive Mobility Plan (LCMP), s.l.: UNEP.
SECTION 1: MUNICIPAL AREA

Category 1: Sub Arterial Roads (50km/h)
- Samana Road
- Rajbaha Rd
- Head Post Road

Category 2: Collector Streets (30km/h)
- Lower Mall Road
- Mall Road, Near Kali Mandir
- Sirhind Road
- Gurudwara Road

Category 3: Lower Collector Streets (30km/h)
- Garden Colony Road
- Tripuri Main Market

SECTION 2: URBAN ESTATE
- Urban Estate

SECTION 3: TIRPURI
- Tirpuri Road

SECTION 4:
READY RECKONERS, CODE OF PRACTICE - 1
Sub - Arterial Streets

SAMANA ROAD

**Land-use:**
LHS: Semi Public | RHS: Semi Public

**PROPOSAL 01**
7.1m Carriageway (on both side) and 2m wide parallel parking bays
2.5m wide Cycle track with 2m wide footpath (on both side)
To cater this demand parallel Parking bays of 30m in length has been proposed.

**PROPOSAL 02**
7m Carriageway retaining the same median
Cycle track and sidewalk segregated by a 700mm verge
Separate Parking lane on both side of streets

**PROPOSAL 03**
Median retained and carriageway reduced by 1m
NMT Lane and sidewalk segregated by a 1000mm verge
Separate Parking on service lane on both side of streets.
Space for informal vendors and hawkers also provided along the pedestrian walk.

**EXISTING SECTION**
PROPOSED PLAN

PROPOSED SECTION

PROPOSAL 02
Sub - Arterial Streets

**RAJBAHA ROAD**

**EXISTING SECTION**

**PROPOSAL 01**
- 7.1m wide Carriageway (on both sides)
- 2.5m wide Cycle track with 2-2.2m wide footpath (on both side)
- 2m wide parallel parking lane has been designed along 4.5m wide service lane
- 0.8m wide MUZ has been proposed for services and to segregate motorized and non motorized traffic.
- 1.20m wide median has been provided which will act as a refuge space for pedestrians at crossing.

**PROPOSAL 02**
- 2.0m separate cycle tracks on both sides
- Multi utility zone for street parking
- Service lane with parallel parking
- Lighting for Pedestrian and cycle tracks
- Green belt between cycle track and motorised lane
- Footpath width – 2.0 m
Proposed Plan

Proposed Section
PROPOSAL 02

PROPOSED PLAN

PROPOSED SECTION
Sub - Arterial Streets

HEAD POST OFFICE ROAD

PROPOSAL 01
7.1m carriageway and 2m wide parallel parking bays on each side
2.5m wide Cycle track with 1.8m wide footpath (on both side)
Parking bays of 30m in length have been proposed to fulfil the parking demand (dist. Between two parking bays is 3-5m which will be landscapes).
Raised pedestrian crossings have been proposed at every 250m to reduce vehicular speed.

PROPOSAL 02
Carriage way reduced by 4m each side keeping the same median
NMT Lane and sidewalk segregated by a 700mm verge
Separate parking lane on one side of street where commercial landuse is present

EXISTING SECTION

Land Use: LHS: Public-Semi Public | RHS: Commercial & Residential
**Collector Streets**

**LOWER MALL ROAD**

**PROPOSAL 01**
- 6m Carriageway (on both side) reduced to 6m
- 2.5m wide Cycle track with 2.4m wide footpath (on both side)
- Raised pedestrian crossings has been proposed at every 250m.
- Existing green cover and trees has been preserved by providing 4m wide footpath and 4m wide green area.
- 0.8m wide MUZ has been proposed for services and to segregate motorized and non motorized traffic.

**PROPOSAL 02**
- Provision of wide carriageway to address significant volume of regional traffic (inter city) and intercity vehicles
- Provision of 2.0m wide Footpaths & 2.40m wide segregated cycle tracks on both sides.
- Proper maintenance of green buffers on both side of the street.
- 1.20m wide median has been provided which will act as a refuge space for pedestrians at crossing.

**EXISTING SECTION**

<table>
<thead>
<tr>
<th>8.00</th>
<th>9.00</th>
<th>1.20</th>
<th>9.00</th>
<th>2.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREEN COVER</td>
<td>MV LANE</td>
<td>MEDIAN</td>
<td>MV LANE</td>
<td>FOOTPATH</td>
</tr>
</tbody>
</table>
Collector Streets

MALL ROAD, NEAR KALI MANDIR

**PROPOSAL 01**

6m Carriageway (on both side)

2.5m wide Cycle track with 1.80m wide footpath (on one side) & 2m parking bay with 3.85m common cycle track footpath (on other side – near commercial area)

Existing section has parallel parking on one side. To cater this demand parallel Parking bays of 30m in length has been proposed.

Raised pedestrian crossings has been proposed at every 250m which will help to reduce vehicular speed.

**PROPOSAL 02**

Median width increased from 500mm to 1000mm.

Uniform carriageway width of 6m

Sidewalks width of 2.55m & 3.0m respectively.

**EXISTING SECTION**

Land Use: LHS: Public-Semi Public | RHS: Commercial
Collector Streets

SIRHIND ROAD

Land-use:
LHS: Mixed Use | RHS: Mixed Use

PROPOSAL 01
6m Carriageway (on both side)
2.3m wide Cycle track with 1.8m wide footpath (on one side)
2m parking bays with 2.95m common cycle track footpath (near commercial area)
Raised pedestrian crossings has been proposed at every 250m.

PROPOSAL 02
Separate lanes are provided for pedestrians, cyclists and vehicles.
Parallel parking for vehicles commuting to the commercial and market area on the street.
Median can be widened at the junctions & crossings to act as a refuge space.

PROPOSAL 03
7.00m two lane carriageway to address the volume of freight traffic on this street (presence of various small industries and godowns)
Based on volume, if a bigger carriageway is required for the freight vehicles, this prototype will be more suitable.

EXISTING SECTION

Speed Limit (km/h)
30
Collector Streets

GURUDWARA ROAD

Land-use: LHS: Semi Public | RHS: Commercial

**PROPOSAL 01**
6m Carriageway (on both side)
Parking bays of 30m in length has been proposed to fulfil the parking demand (distance between two parking bays is 3-5m which will be landscaped).
Raised pedestrian crossings at every 250m.

**PROPOSAL 02**
6m Carriageway (on both side). Cyclists share the 3.7m footpath
1.5m wide painted cycle lane and 2.2m wide footpath (on both side)
Raised pedestrian crossings has been proposed at every 250m which will help to reduce vehicular speed.

**PROPOSAL 03**
5.5 m Carriageway
Multi utility zone (MUZ) of 2.2m with TSR parking bay
0.6 m Median

Median moved to accommodate the NMT lane while keeping the existing 12.5m green buffer on both the sides.

**EXISTING SECTION**

<table>
<thead>
<tr>
<th>2.00</th>
<th>7.50</th>
<th>1.20</th>
<th>7.50</th>
<th>1.80</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOOTPATH</td>
<td>MV LINE</td>
<td>MEDIAN</td>
<td>MV LINE</td>
<td>FOOTPATH</td>
</tr>
</tbody>
</table>

SDG Oriented Street Design Guideline for Patiala, Punjab
PROPOSAL 01

PROPOSED PLAN

PROPOSED SECTION
PROPOSAL 03

PROPOSED PLAN

PROPOSED SECTION
PROPOSAL 04

PROPOSED PLAN

PROPOSED SECTION
Lower Collector Streets

GARDEN COLONY ROAD

Land-use:
LHS: Mixed Use | RHS: Mixed Use

PROPOSAL 01
4.5m wide Carriageway (on both side)
1.5m wide painted Cycle lane with 2.15-2.75m wide footpath (on both side)
Raised pedestrian crossings has been proposed at every 250m.

PROPOSAL 02
Bicycle users share the main carriageway as ROW is less than 18m.
Wider footpaths for the pedestrians with parallel parking bays near commercial area.

PROPOSAL 03
Wider footpaths for the pedestrians on both side
Provision for parallel parking considering the amount of activity happening around the street.

EXISTING SECTION

<table>
<thead>
<tr>
<th></th>
<th>4.00</th>
<th>4.75</th>
<th>0.50</th>
<th>4.75</th>
<th>3.40</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHOULDER</td>
<td>MV LANE</td>
<td>MEDIAN</td>
<td>MV LANE</td>
<td>SHOULDER</td>
<td></td>
</tr>
</tbody>
</table>

Speed Limit (km/h)

17.40

83
PROPOSED PLAN

PROPOSED SECTION

17.40

2.75 1.50 4.50 0.50 4.50 1.50 2.15

FOOTPATH  PAINTED CYCLE TRACK  MV LANE  MEDIAN  MV LANE  PAINTED CYCLE TRACK  FOOTPATH
PROPOSAL 03

PROPOSED PLAN

PROPOSED SECTION
TRIPURI MAIN MARKET ROAD

**EXISTING SECTION**

- **Land-use:**
  - LHS: Mixed Use | RHS: Mixed Use

- **PROPOSAL 01**
  - 6m Carriageway (on both sides)
  - 1.5m wide painted cycle lane with 1.85m wide footpath (on both side)
  - Parallel parking bays of 30m in length have been proposed.
  - Distance between two parking bays is 3-5m which will be landscape area.
  - Raised pedestrian crossings has been proposed at every 250m

- **PROPOSAL 02**
  - Carriageway is reduced to half from the existing scenario since half of the carriageway was used for on street parking.
  - Provision of parking lane (2m), MUZ (1.25m) and sidewalks (1.8m)

- **PROPOSAL 03**
  - Carriage way reduced to half to accommodate cycle track (1.25m) and MUZ with parking bay (2m).
PROPOSAL 01

PROPOSED PLAN

PROPOSED SECTION
PROPOSAL 02

PROPOSED PLAN

PROPOSED SECTION
PROPOSED PLAN

PROPOSED SECTION
URBAN ESTATE
SDG Oriented Street Design Guideline for Patiala, Punjab

**SAMPLE ROAD 01**

**PROPOSED PLAN**

**Type: LOWER DISTRIBUTORY ROAD**

Speed Limit: 30km/h

Land-use:
- LHS: Commercial
- RHS: Residential

**PROPOSED**

1. 6M Carriageway
2. Parallel Parking is provided on the Commercial side.
3. Distance between two parking bays is 3-5m which will be landscaped.
4. Raised pedestrian crossings has been proposed at every 250m

**EXISTING SECTION**

**PROPOSED SECTION**
**SAMPLE ROAD 02**

Type: LOWER DISTRIBUTORY ROAD

Speed Limit: 30km/h

Land-use:
LHS: PSP
RHS: Un-Developed

**PROPOSED**

1. 6M Carriageway
2. 1.5m painted Cycle lane on both sides and a Parallel Parking bay is provided on one side.
3. Distance Between two parking bays is 3-5m which will be landscaped.
4. Raised pedestrian crossings has been proposed at every 250m.

**EXISTING SECTION**

**PROPOSED SECTION**
Type: ACCESS ROAD
Speed Limit: 15km/h
Land-use: LHS: Residential  RHS: Residential

PROPOSED 01
1.68 m segregated footpath available on both the sides. Remaining 6 m will be a shared space between motorised and non-motorised vehicles.

PROPOSED 02
1.8 m Parking available on both the sides. Remaining 5.7 m will be used as a shared space.
PROPOSED PLAN 02

SAMPLE ROAD 04

Type: ACCESS ROAD
Speed Limit: 15 km/h
Land-use:
LHS: Residential
RHS: Un-developed

PROPOSED 01
2.0m segregated footpath available on both the sides. Remaining 6m will be a shared space between motorised and non-motorised vehicles.

PROPOSED 02
1.8m Parking available on both the sides. Remaining 5.77m will be used as a shared space.
Type: Distributor Road

Speed Limit: 30 km/h

Land-use: LHS: Residential  RHS: Residential

PROPOSED
6m carriageway on both sides
1.5 m painted bicycle lane on both sides
Parallel parking bays of 30m length
Raised pedestrian crossings at every 250m
**SAMPLE ROAD 06**

**Type:** Access Road  
**Speed Limit:** 15 km/h  
**Land-use:**  
LHS: Mixed Use  
RHS: Mixed Use

**EXISTING SECTION**

**PROPOSED SECTION**

1.8m from one side of the road is reserved for street parking and the rest 5.4m will be used as a shared space.

**PROPOSED PLAN**
### Residential Zone

<table>
<thead>
<tr>
<th>Type of Road</th>
<th>ROW(m)</th>
<th>Bus lane</th>
<th>lane (width)- One lane in each direction</th>
<th>Lane width- two lanes in each direction</th>
<th>Remaining Lane widths</th>
<th>Footpath (on each Side)</th>
<th>Green and Parking</th>
<th>Cycle Track / lane</th>
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Table 15: Ready Reckoner, Urban Road Code 1, MoHUA
<table>
<thead>
<tr>
<th>ROW(m)</th>
<th>Bus lane</th>
<th>Carriage Way(width)</th>
<th>Footpath</th>
<th>Cycle Track / lane</th>
<th>Service road</th>
<th>Parking</th>
<th>Green</th>
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<td>1.80m min</td>
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<td>3.1 m</td>
<td>1.80m min</td>
<td>1.5 m painted</td>
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<tr>
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<td>1.80m min</td>
<td>1.5 m painted</td>
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<td>19</td>
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<td>2.0m min</td>
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<td>2.0m min</td>
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<tr>
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<td>2.0m min</td>
<td>1.5 m painted</td>
<td>nil</td>
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</tr>
<tr>
<td>25</td>
<td>painted</td>
<td>3.1 m</td>
<td>2.0m min</td>
<td>2.2 m segregated</td>
<td>nil</td>
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</tr>
<tr>
<td>26</td>
<td>painted</td>
<td>3.1 m</td>
<td>2.0m min</td>
<td>2.2 m segregated</td>
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</table>

Table 5-12: Ready Reckoner for Commercial Zone above 30m ROW

<table>
<thead>
<tr>
<th>Type of Road</th>
<th>ROW (m)</th>
<th>Bus lane</th>
<th>lane (width)</th>
<th>two lane in each direction</th>
<th>Lane width (three lanes in each direction)</th>
<th>Remaining Lane width</th>
<th>Footpath (on each side)</th>
<th>Cycle Track</th>
<th>Serv ice Belt</th>
<th>Remaining for MUZ</th>
<th>SERVICE LANE (WITH PARKING)</th>
<th>Hawker Space as Priority</th>
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<tbody>
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Table 16: Ready Reckoner, Urban Road Code 1, MoHUA
Table 17: Ready Reckoner, Urban Road Code 1, MoHUA

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<td>0.75</td>
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<td>0.75</td>
<td>12.5</td>
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<td>3</td>
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<td>3( on both side with intermediate parking bays)</td>
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<td>21.6</td>
<td>2.5</td>
<td>3</td>
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Table 18: Ready Reckoner, Urban Road Code 1, MoHUA