TOD KP

PLAN+DESIGN

INTRODUCTION

The ‘Plan+Design’ step of the Framework contains a series of detailed planning principles and design components to formulate TOD plans at various scales of intervention [city, corridor, station area and site scales] and in varying contexts.

TOD Global Platform for Sustainable Cities WORLD BANK GROUP IBI

ABOUT PLAN+DESIGN

The 'Plan+Design' step of this framework focuses on providing guidance on design values that underpin TOD as well as the planning process. It also presents action strategies and tools to create a more compact land development pattern hinged upon prioritization of pedestrians and cyclists.

TOD is the integration of transportation and land use planning, combined with an emphasis on the 'spaces between' – quality open space, multi-uses and streetscape interventions that contribute to urban placemaking. Critical to the success of an efficient and effective TOD strategy is a common vocabulary for different stakeholders that from the outset focuses on walking, cycling and public transit as primary modes of movement and not personal vehicles. It also takes into consideration the generally ignored inter-dependent impacts of land use, transportation and infrastructure networks and real estate economics at multiple levels.

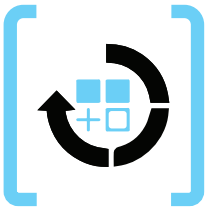
Many existing resources address this need for a common TOD design vocabulary. Leading among them are the TOD Standard (Institute of Transportation and Development Policy 2017) and the TOD Corridor Course (World Bank Group and World Resource Institute 2015), which are global publications. In addition, many low and middle-income countries have also developed preliminary TOD design guidelines, such as the TOD Guidance Document (Ministry of Urban Development, India 2016), TOD Guide for Urban Communities (CTS-EMBARQ Mexico, 2014), and Design Manual for Low Carbon Development (The Energy Foundation, China Sustainable Cities Program, Calthorpe Associates, 2012).

To stitch these principles together, it is important to integrate them with design standards, development review processes, and regulatory mechanisms. The Plan + Design Knowledge Products include a TOD Zoning Code template (PD-R01) and TOD Planning Principles and Design Guidelines (PD-R02) as ready resources as a starting point for cities that are interested in applying the TOD design values into standards and regulations.

The Plan + Design Knowledge Products also provide "how-to" guides for TOD planning at various scales that integrate clear processes and mechanisms by which the public, private, and community sectors can shape TODs with the changing landscape of cities. The planning guides allow for developing actionable tasks that can be adjusted based on various context, transit mode and local factors such as development typology (Greenfields, urban infill or redevelopment). However, at times there are challenges when it becomes difficult to reconcile the design standards with one another and entails some complicated choices at the expense of other users. Striking the right balance to achieve well-planned TOD would require certain priorities and trade-offs. The Plan + Design Knowledge Products are not presented as standards but as suggestions with corresponding references to allow cities the space to achieve the right balance.

Finally, the Knowledge Products presented here must be read in conjunction with the monitoring and evaluation framework and key performance criteria suggested in the Implementation step of the TOD Framework. Design considerations and standards should ideally be adjusted based on the feedback received from the monitoring and evaluation exercise in a given context.

KNOWLEDGE PRODUCTS



'HOW-TO' GUIDES

- **PD-H01** **How To Prepare A City-Wide TOD Plan** *(Step-by-Step Guide)*
- **PD-H02** **How To Prepare A Corridor TOD Plan** *(Step-by-Step Guide)*
- **PD-H03** **How To Prepare A Station Area Plan** *(Step-by-Step Guide)*
- **PD-H04** **How To Prepare A Site Level TOD Plan** *(Step-by-Step Guide)*
- **PD-H05** **How To Develop TOD Supportive Zoning Framework** *(Step-by-Step Guide)*
- **PD-H06** **Land Amalgamation Framework** *(Step-by-Step Guide)*
- **PD-H07** **How To Plan Safe Access for TOD** *(Guideline)*

RESOURCES

- **PD-R01** **TOD Planning Principles & Design Guidelines** *(Ref Doc.)*
- **PD-R02** **TOD Zoning Code Template** *(Ref Doc.)*
- **PD-R03** **Land Use And Transportation Integration Best Practices** *(Ref Doc.)*
- **PD-R04** **Pedestrian Friendly Design Best Practices** *(Ref Doc.)*

PROCUREMENT

- **PD-P01** **TOD Plans Terms Of Reference** *(TOR Template)*

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TOD KP

PD-H01

HOW TO PREPARE A CITY-WIDE TOD PLAN

The city-wide planning tool aims to provide the foundation for subsequent scales of TOD implementation by analyzing the existing transit corridors at the city-level and establishing goals for their TOD development. By identifying land use, current activity, transit demand and influence zones, goals and priorities can be established to draft a city-wide TOD plan. Establishing the statutory relevance of this plan will then guide development at the corridor, station area and site contexts.

Type: Step-by-Step Guide

TOD

Global Platform for Sustainable Cities

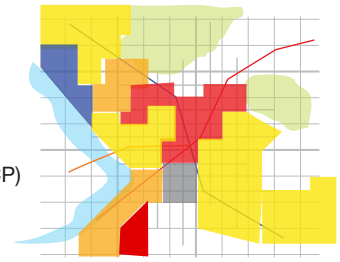
WORLD BANK GROUP

IBI

01 MAP LAND USES AND KEY DEVELOPMENTS

CITIZEN'S INPUT

To understand the distribution of residential, employment and institutional uses in the city.



DATA SOURCES

- Satellite Image/GIS Data
- As per the approved Master Plan (MP)/Development Plan (DP)/Comprehensive Plan (CP)
- Field Surveys along major transit corridors
- Stakeholder Workshop

02 IDENTIFY ACTIVITY GENERATORS

CITIZEN'S INPUT

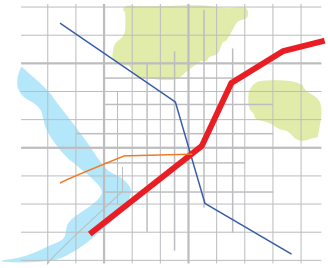
To help identify routes of high commuter traffic and origin-destination travel patterns. [**Housing, Employment and Recreational Centers**]

DATA SOURCES

- As per approved MP/DP/CP
- Field Surveys along major transit corridors
- List of Approved Developments
- Stakeholder Workshop

03 IDENTIFY PRIORITY TRANSIT DEMAND CORRIDORS

Based on population distribution, land use plans, location of activity centers and travel demand forecasting (if available) for the transit type proposed.



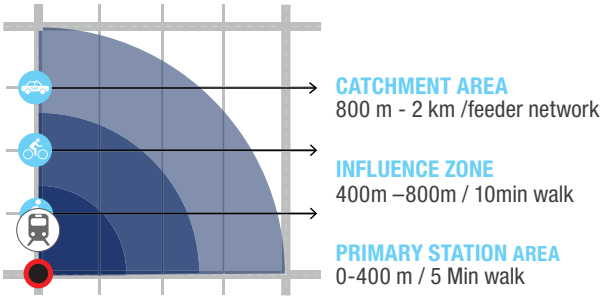
DATA SOURCES

- As per approved MP/ DP/ CP
- Mobility Plan/Transportation Plan
- Transit System Detailed Report
- Latest Census Population and Projected Estimates as per MP/DP/CP
- Right-of-way widths: Google earth/satellite images/field surveys/street views

[Refer to **AS-H02** *How to undertake Rapid Transit Alternatives Assessment]*

04 DELINEATE INFLUENCE ZONE OF TRANSIT

To determine the catchment area around transit routes where transit-supportive development needs to be prioritized.

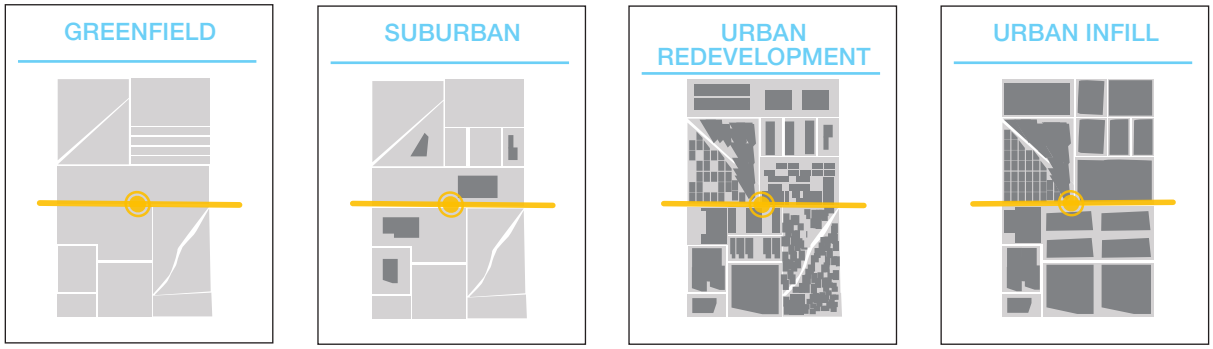


DATA SOURCES

- Existing Station Locations
- Satellite Imagery/Google Street View
- GIS Database for land parcels, road network and natural features
- Master Plan/Development Plan/Comprehensive Plan
- Mobility Plan/Transport Plan
- Field Survey

05 DETERMINE DEVELOPMENT CONTEXT

To determine the real estate market dynamics, land availability and ROW constraints, including road safety considerations.



[Refer to **AS-A02** *TOD Scale & Context Assessment]*

06 IDENTIFY GOALS AND TARGETS

CITIZEN'S INPUT

For different areas within the TOD influence zone, based on city vision, growth scenarios, multi-stakeholder participation and road safety requirements.

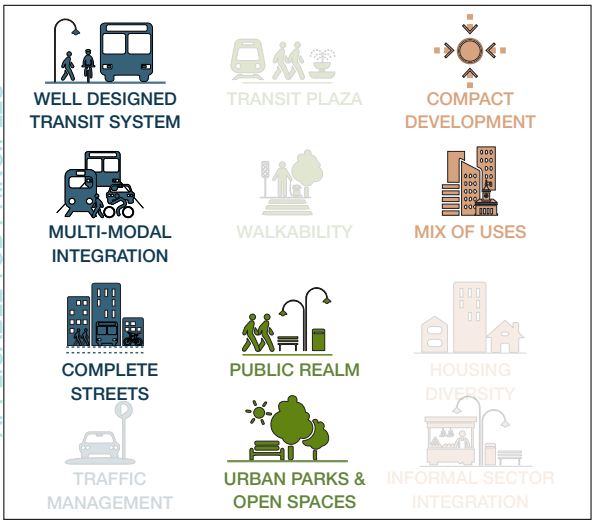
[Refer to **AS-A01** *TOD Readiness Assessment and* **AS-H04** *How to do Road Safety Assessment]*

07 DRAFT CITY-WIDE TOD PLAN

Implementing TOD at a city-wide level includes policy recommendations and actions related to various TOD principles across various TOD implementing agencies, identified below:

COMPONENTS OF A CITY LEVEL PLAN

- City-wide Policy recommendations including road safety in TOD areas
- Master Plan Integration
- Typology of corridors and stations (AS-A03)
- Zoning Codes



08 ESTABLISH STATUTORY RELEVANCE

Options to establish statutory relevance for TOD principles include:

OPTION 1	OPTION 2	OPTION 3
Include a TOD chapter in Master Plan/ Development Plan/Comprehensive Plan as an amendment	Create a TOD policy as a special law that supersedes the existing regulations	Establish a TOD overlay district as a special area in existing development regulations

Pune, India

TOD KP

PD-H02

HOW TO PREPARE A CORRIDOR TOD PLAN

Corridor planning is essential to ensuring inter-modal connectivity between stations areas, as well as the creation of complementary stations along each transit corridor. Stations must be integrated and accessible to allow for a network of transit-oriented places, which exist within the framework of an overarching city-wide TOD plan.

Type: Step-by-Step Guide

WORLD BANK GROUP · TOD · Global Platform for Sustainable Cities · gef · UKaid from the British people · GRSF Global Road Safety Facility · IBI · WRI INDIA

TOD KP

01 MAP TRANSIT ALIGNMENT AND STATION LOCATIONS

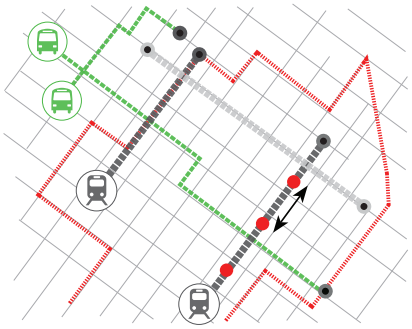
To understand transit system features and station characteristics.

TRANSIT TYPE
BRTS | MRTS | Commuter Rail

PHASING
Priority Corridor(s)

ALIGNMENT
System Coverage

STATION SPACING
Average distance between stations



DATA SOURCES

- Transit System Detailed Report
- Mobility Plan/Transport Plan
- Master Plan/Development Plan/Comprehensive Plan

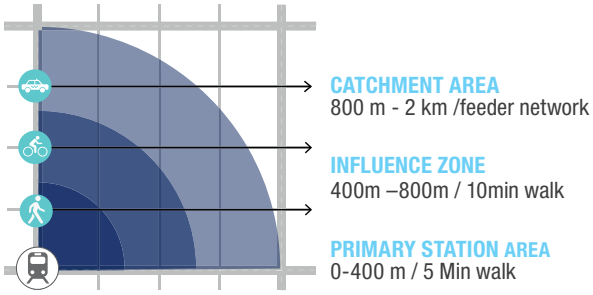
[Refer to **AS-H02** *How to undertake Rapid Transit Alternative Analysis]*

02 DELINEATE INFLUENCE ZONE ALONG CORRIDOR

To determine the catchment area around transit routes where transit-supportive development needs to be prioritized.

DATA SOURCES

- Existing Station Locations
- Satellite Imagery
- Google Street View
- GIS Database for land parcels, road network and natural features
- Master Plan/Development Plan/Comprehensive Plan
- Mobility Plan/Transport Plan
- Field Survey



03 ANALYZE DEVELOPMENT OPPORTUNITIES

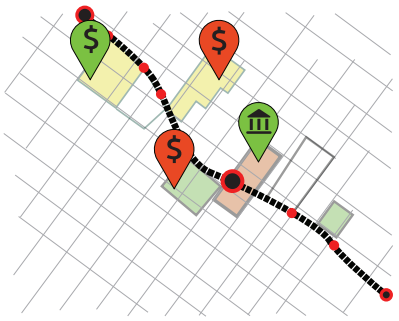
CITIZEN'S INPUTS

To understand development context and capacity for intensification along transit corridor(s).

DEVELOPMENT PATTERN
Plot Sizes | Land Use Changes | Distribution of Employment & Residential Uses

LAND OWNERSHIP AND VACANT LANDS

REAL ESTATE MARKET POTENTIAL
Property Values | Undeveloped Lands | FAR Utilization



DATA SOURCES

- Real Estate Market Assessment Reports
- Land Values from Real Estate Developers
- GIS Database
- Field Survey
- Stakeholder Engagement
- Existing/Proposed Land Uses
- Flood and Vulnerability Maps (to avoid areas at risk)
- Refer to AS-A03

04 ASSESS INFRASTRUCTURE CARRYING CAPACITIES

To understand the maximum number of people that can be supported along the corridor through optimum utilization of the available resources and keeping in view road safety considerations.

POPULATION ANALYSIS
Growth Trends

PEDESTRIAN AND BICYCLE INFRASTRUCTURE + TRAFFIC
Level of Service Benchmarks | Road inventory | Number of users

UTILITIES
Water | Waste | Energy | Drainage

TRANSIT
Service Coverage | Ridership | Estimates

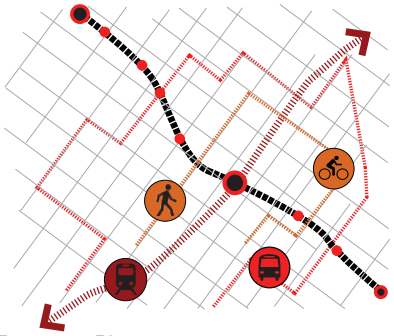
DATA SOURCES

- Transit System Detailed Report
- Master Plan/Development Plan/Comprehensive Plan
- Mobility Plan/Transport Plan/ Traffic studies
- Traffic Impact Studies
- Infrastructure Detailed report
- User count studies for peak and off-peak hours for weekend and weekdays

[Refer to **AS-H03** *How to undertake Infrastructure Carrying Capacity Assessment and* **AS-H04** *How to do Road Safety Assessment]*

05 EVALUATE CONNECTIVITY ALTERNATIVES

To provide seamless linkages and safe transfers between priority corridor(s) and the city's other transportation network.



CONNECTIONS TO LOCAL BUS FEEDER ROUTES

CONNECTIONS TO PEDESTRIAN & BICYCLE NETWORK

CONNECTIONS TO OTHER PREMIUM TRANSIT CORRIDORS

DATA SOURCES

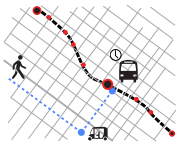
- Bus System Detailed Report/ Paratransit studies
- Route Rationalization Studies
- Pedestrian Network Plan/ Greenway & Trail System Plans
- Cycling Network Plans
- Mobility Plan/Transport Plan
- Field Surveys
- Google Street Map

[Refer to **AS-H02** *How to undertake Rapid Transit Alternative Analysis and* **PD-H07** *How to plan Safe Access for TOD]*

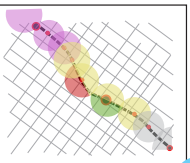
06 PREPARE CORRIDOR TOD STRATEGIC PLAN

To create a phased implementation plan for prioritizing station areas and level of intervention needed to maximize TOD potential.

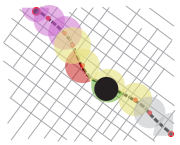
NETWORK LEVEL IMPROVEMENTS



STATION AREA TYPOLOGIES



PRIORITY STATION AREAS



STREET HIERARCHY

CATALYST PROJECTS

TOD ZONING CODE

[Refer to **PD 07** *TOD Zoning Code Template]*

Greenfield BRT Corridor, Rio, Brazil

TOD KP

PD-H03

HOW-TO PREPARE A STATION AREA PLAN

Plans at the station-level are more detailed and design-oriented. This tool aims to assist with the implementation of specific designs and urban design guidelines, as well as streetscape and smaller scale real estate investment.

Type: Step-by-Step Guide

WORLD BANK GROUP TOD Global Platform for Sustainable Cities gef UKaid from the British people GRSF Global Road Safety Facility IBI WRI INDIA

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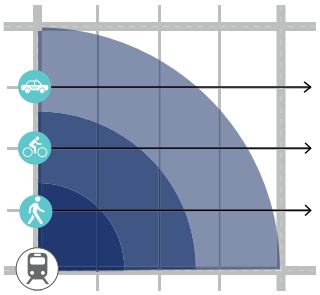
01 DELINEATE AND REFINE STATION AREA BOUNDARY

Station area boundaries are defined by the distance people walk in a set duration of time.

An effective strategy will work to increase the size of station area planning boundaries for transit stations by providing alternative mobility choices.



CATCHMENT AREA
800 m - 2 km /feeder network

INFLUENCE ZONE
400m –800m / 10min walk

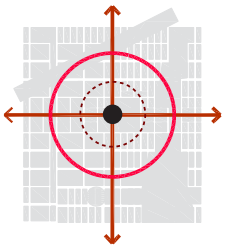
PRIMARY STATION AREA
0-400 m / 5 Min walk

DATA SOURCES

- Satellite Imagery
- Google Street View
- GIS Database for land parcels, road network and natural features
- Master Plan (MP)/ Development Plan (DP)/ Comprehensive Plan (CP)
- Transportation/Mobility Plan
- Field Survey

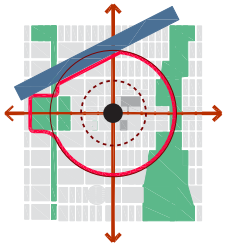
WALKING DISTANCE FROM TRANSIT STATION

Willingness to walk up to 10 minutes to a given station at 5km/hr, is defined by 800m radial circle boundary centered on the station.



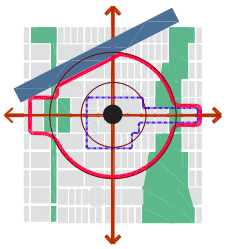
NATURAL ENVIRONMENT FEATURES

The boundary is remapped to include natural systems, greenways, waterways, opens space and barriers, such as major roadways and rail corridors.



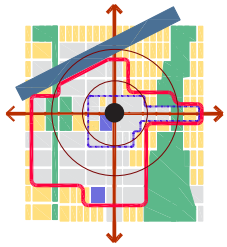
PED-SHED ANALYSIS

Ped shed is short for pedestrian shed. Ped sheds have irregular shapes because they cover the actual distance walked, not the linear (aerial) distance.



EXISTING BUILT ENVIRONMENT

Existing large-scale developments, destinations and community features beyond a 10-minute walking distance.



02 CREATE INVENTORY AND ANALYZE EXISTING CONDITIONS

CITIZEN'S INPUT

ACCESSIBILITY

Position within Public Transport Network | Road inventory | Pedestrian & Cycle Network | Street Grid | Intersections and mid-block crossings

Continuity of Road Network | Traffic Volume Count

Multi-modal Integration: Station Entry | Parking Management | Bus Stops

INFRASTRUCTURE

Physical: Drainage | Sewer | Water | Waste | Telecommunication

Social: Parks | Public Amenities | Street Vendors | Road Safety | Community Centers

Environmental Features: Natural Drainage | Topography

Heritage: Tangible (Built) | Intangible (Culture/Arts)

DEVELOPMENT

Land Attributes: Existing & Proposed (Use + Ownership + Plot Sizes)

Development: Population Densities + FAR utilization + Activity centers

Job Densities

DATA SOURCES

- Development and real estate market trends from stakeholder workshop/ focus group discussion
- MP/DP/CP
- Transportation/Mobility Plan
- Infrastructure Plans
- Field Survey

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03 CONDUCT SWOT ANALYSIS

CITIZEN'S INPUT

STRENGTHS are favorable conditions to be built upon. **WEAKNESSES** are unfavorable conditions to be considered. **OPPORTUNITIES** are potential improvements and favorable conditions that will help achieve project goals. **THREATS** are the potential barriers to the realization of project goals.
Categorize SWOT based on:

- Urban Design & Placemaking
- Land Use Attributes
- Crash data and blackspot identification
- Access to Transit
- Pedestrian and Cycle Mobility
- Safe design elements
- Parking Management
- Context: Development/ Redevelopment/Greenfield

04 DEVELOP STATION AREA PROGRAMMING ALTERNATIVES

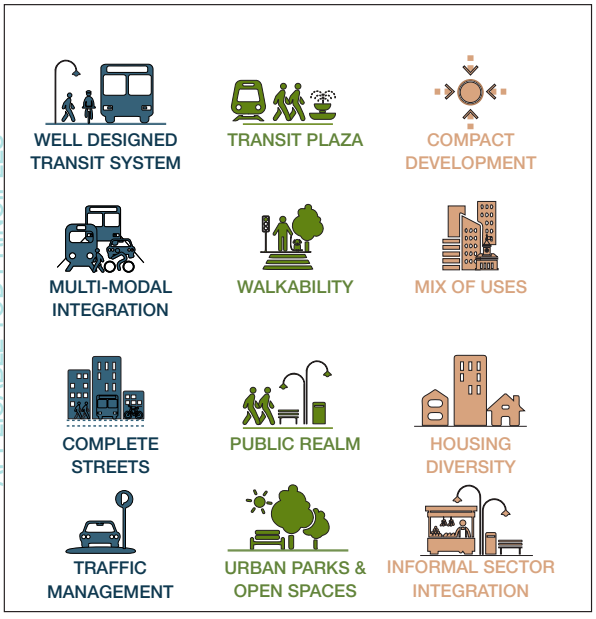
Programming alternatives may include scenarios on how the TOD station area may evolve over time:

- Accessibility Scenarios that include road safety measures
- Housing Development Scenario
- Employment Development Scenario

05 PREPARE STATION AREA CONCEPT PLAN

COMPONENTS OF A STATION AREA PLAN

- Spatial Layout Plan illustrating connectivity, land use mix, and building densities
- Circulation & Multi-modal Integration Plan
- Area-wide Parking Plan
- Physical Infrastructure Plan
- Landscape and Open Space Plan
- Architectural and Urban Design Guidelines
- Real Estate Market Potential Strategy
- Catalyst Redevelopment Projects
- Capital Improvements Program
- Phasing Strategy
- Branding and Communication Strategy



Curitiba, Brazil

TOD K P

PD-H04

HOW-TO PREPARE A SITE LEVEL TOD PLAN

A step-by-step process guided by a series of task-based actions that will assist cities to plan and implement TOD at the site level

Type: Step-by-Step Guide

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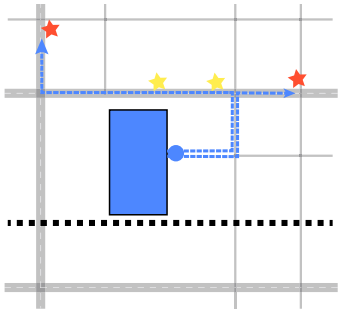
01 IDENTIFY SITE CONTEXT

To understand the development opportunities and constraints.

ASSESS THE SITE CONTEXT BASED ON

- Location
- Connectivity
- Surrounding Development



02 REVIEW OF PLANNING DOCUMENTS

To apply development norms within the transit influence zone.

DATA SOURCES

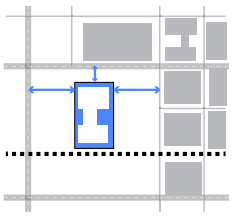
- Land Use as per Master Plan/Development Plan/ Comprehensive plan/Overlays if applicable
- Building Regulations
- Road safety policies and street design guidelines
- Other relevant Policies and Codes

03 CONDUCT EXISTING CONDITIONS BASELINE ASSESSMENT

To gain an understanding of the existing or desired level of activity to develop TOD projects. Elements include:

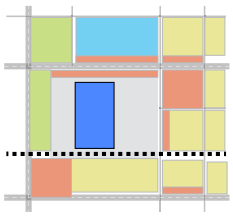
STATION AREA CHARACTER

Site History | Population | City-wide Context



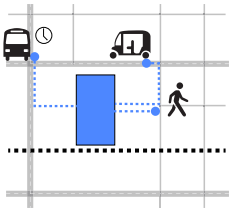
DEVELOPMENT

Existing/Proposed Land Use | Surrounding Buildings | Land Ownership



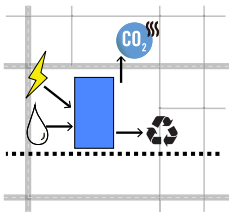
ACCESSIBILITY

Pedestrian and Bicycle Network and safety | Safe access to mass transit | Feeder Transport network| First and last mile connectivity



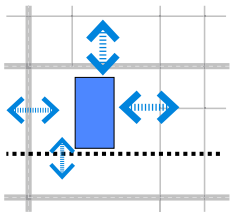
EXISTING INFRASTRUCTURE

Roadways | Utilities | Safety assessment for all road users | Public Facilities



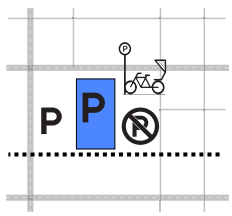
URBAN DESIGN

Street Grid and inventory | Setbacks | Heights | Building Forms | Open Spaces



PARKING

On-Street | Off-Street | Legal and Illegal Spaces | Park and Ride | Cycle parking | IPT parking



TOD KP

04 CONDUCT AN OPPORTUNITIES AND CONSTRAINTS ANALYSIS

To gauge the level of interventions needed to make the site TOD compatible.

COMPONENTS TO BE EVALUATED

- Real Estate Potential
- Mobility & Circulation
- Road Safety
- Mix of Land Uses
- Urban Design

05 PREPARE SITE DEVELOPMENT PROGRAM ALTERNATIVES

To determine the highest and best use for the site and select a preferred alternative.

EXAMPLE
Improving Connectivity

EXAMPLE
Enabling Road Safety

EXAMPLE
Optimizing mix of uses

EXAMPLE
Creating Destination

06 DEVELOP CONCEPTUAL SITE MASTER PLAN AND URBAN DESIGN SCHEME

To translate the site development program into a physical layout plan with supporting street design and built form.

COMPONENTS OF A SITE LEVEL PLAN

- Physical Site Plan
- Building Architecture
- Circulation Plan including road safety measures
- Parking Plan
- Landscape Plan
- Site Infrastructure Plan
- Phasing Strategy

07 FINANCIAL AND IMPLEMENTATION STRATEGY

COMPONENTS:

- Project costs and revenues
- Phasing Plan
- Institutional Framework

Muscat, Oman

TOD KP

PD-H05

HOW TO DEVELOP A TOD SUPPORTIVE ZONING FRAMEWORK

Guideline for the government to prepare/revise TOD supportive zoning ordinances, including revisions for pedestrian activities, urban design and parking restrictions.

Type: Step-by-Step Guide

WORLD BANK GROUP
TOD
Global Platform for Sustainable Cities
gef
UKaid from the British people
GRSF Global Road Safety Facility
IBI
WRI INDIA

TOD KP

01 REVIEW & ASSESS EXISTING REGULATIONS

- Identify existing regulations that do not work, are obsolete, are not developer friendly and/or are being constantly superseded during site plan approval stage.
- Identify local and national mandates or policies for ensuring safe roads for all users.
- Evaluate whether existing FARs are being utilized–this also provides an indication of market demand and absorption potential.
- Assess if the regulations include urban design, pedestrian and cyclist access, and general road safety design guidelines.

DATA SOURCES

- Land Use as per Master Plan/Development Plan/ Comprehensive plan/ Overlays if applicable
- Building Regulations
- Street Design Guidelines
- Relevant Policies and Codes

02 ENGAGE DEVELOPERS IN MODIFYING DEVELOPMENT NORMS

Organize a workshop with multiple developers to identify:

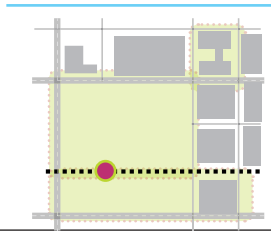
- Shortcomings of existing regulations
- Which regulation's work and what needs to change
- Which regulation's need to be included

03 ASSESS & DOCUMENT EXISTING GROUND CONDITIONS

Based on the various scales of intended interventions, to gain an understanding of the existing or desired nature of development, parameters to be studied shall include:

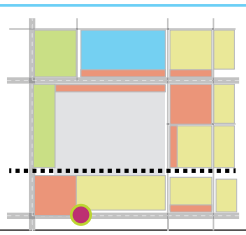
STATION AREA CHARACTER

Site History | Population | City-wide Context



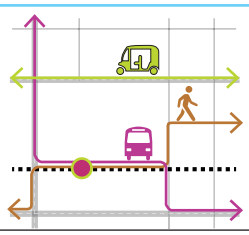
DEVELOPMENT

Existing/Proposed Land Use | Surrounding Buildings | Land Ownership | Incentives for financial tools for builders to enable road safety | Speed zones



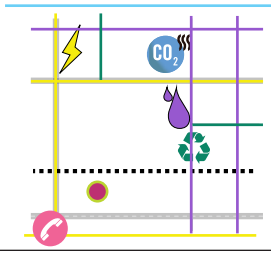
ACCESSIBILITY

Pedestrian and Bicycle Network and safety | Safe access to mass transit | Feeder Transport network| First and last mile connectivity



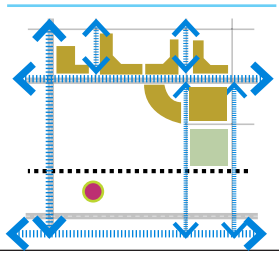
EXISTING INFRASTRUCTURE

Roadways | Utilities | Safety assessment for all road users | Public Facilities



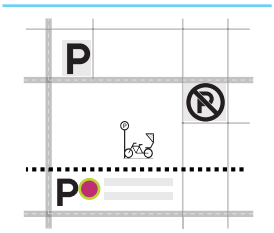
URBAN DESIGN

Street Grid and inventory | Setbacks | Heights | Building Forms | Open Spaces | Traffic calming and safety elements



PARKING

On-Street | Off-Street | Legal and Illegal Spaces | Park and Ride | Cycle parking | IPT parking | Parking Tariffs



TOD KP

04 ESTABLISH TOD ZONING VARIATIONS

TOD Zones
- Core Area
- Primary Zone
- Influence Zone

Built Form
- Building Use
- Plot Size
- Building Height
- FAR and TDR
- Incentives enabling road safety

Transport
- Road Width
- Travel Lanes
- Road Types
- Speed zones
- Travel restrictions and closures, for walking and cycling zones

Special Area
- TOD Typologies
- Heritage Area
- Tax districts for financing TOD and road safety improvements
- Others

Miscellaneous
- Topography
- Natural Features
- Physical Barriers
- Physical Barriers
- Infrastructure and green cover.

05 UPDATE/AMEND CITY DEVELOPMENT REGULATIONS/ORDINANCE (DCRS)

Replace existing regulations where possible or create new transit supportive regulations related to (at minimum):

PD-R02 TOD ZONING CODE TEMPLATE

- Setbacks
- Block Width
- Complete Streets Standard
- Pedestrian & Bicycle Standards
- Suggested Land Use Mix
- Density Matrix
- Street Frontage
- Parking

To establish statutory relevance, one of the following options could be utilized:

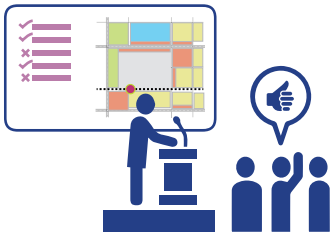
OPTION 01:
Include a TOD chapter in Master Plan/Development Plan/ Comprehensive Plan as an amendment

OPTION 02:
Create a TOD policy as a special law that supersedes the existing regulations

OPTION 03:
Establish a TOD overlay district as a special area in existing development regulations

06 INITIATE DEVELOPMENT REVIEW PROCESS

- Incorporate updated regulations in draft form to:
  - Existing Master Plan
  - Master Plan Update (if underway)
- Follow the city's existing protocol for the development review process, including:
  - Public consultations
  - Presentations to stakeholder,
  - Objections & suggestions phase to seek inputs from the community



07 NOTIFY TOD ZONING AMENDMENTS

Follow the city's existing protocol for amendments to regulations notification

Bogota, Colombia

TOD KP

PD-H06

LAND AMALGAMATION FRAMEWORK

A step-by-step planning process to guide the restructuring of land for large-scale TOD interventions

Type: Step-by-Step Guide

TOD Global Platform for Sustainable Cities WORLD BANK GROUP IBI

ABOUT THE PLAN+DESIGN TOOL

PURPOSE

Land amalgamation is required for the purpose of assembling land for urban expansion, infill development, or redevelopment. In this process, the original landowners or occupants voluntarily contribute a certain percentage of their land to the government or other project initiators and, in return, receive compensation in the form of money, serviced land, or any other form of incentive.

CONTEXT

The land amalgamation process can be carried out in three different contexts, namely greenfield, infill, or redevelopment projects.

FOR GREENFIELD PROJECTS

Land amalgamation in greenfield projects can be undertaken in areas where there is land available. These can be farmlands, unused land in the outskirts, etc.

FOR URBAN INFILL PROJECTS

Underutilized and vacant lands have huge potential for urban infill near TOD areas. These lands should be amalgamated to be developed as high-density and serviced area.

FOR REDEVELOPMENT PROJECTS

Redevelopment projects can be undertaken by amalgamating lands that have blighted, unused structures, or in decayed inner city areas.

01 PREPARATION OF LAND

CITIZEN'S INPUT

1 DEFINE TOD AREA

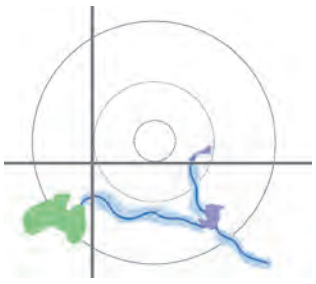
Define the TOD station area within 5-10 minutes walking distance of the transit station.

2 IDENTIFY PROPERTIES FOR LAND AMALGAMATION

Identify properties that can be incorporated for an Amalgamation Plan.

GREENFIELD

- Exclude natural features
- Rationalize boundaries based on physical barriers, such as bridges, flyovers, etc., that act as a barrier

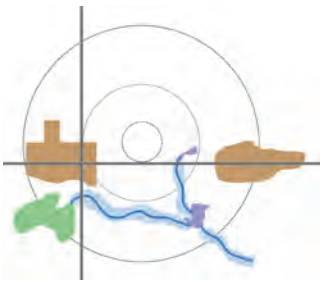


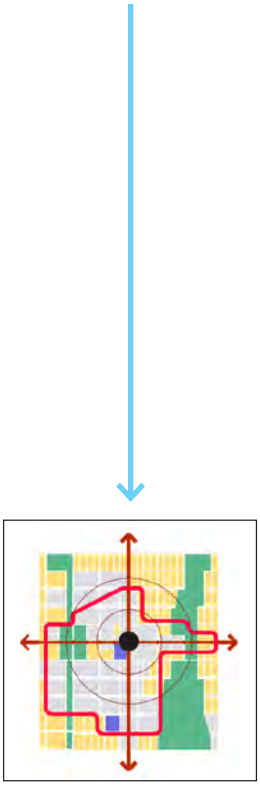
URBAN INFILL

- Exclude natural features
- Include underutilized, vacant and government-owned lands

REDEVELOPMENT

- Exclude natural features
- Include blighted and unused structures
- Include decayed inner-city areas





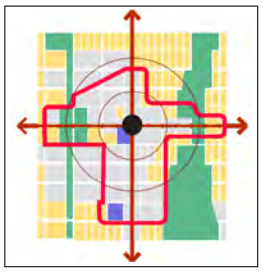
3 REFINE LAND AMALGAMATION BOUNDARY

Refine the final project area boundary based on the following parameters:

- Clarity on ownership of land
- Whether the land falls under "No Development Zone" as specified by the State/Region/Nation
- Owner's consensus
- Check with Zonal Regulations

The following instruments can be followed to assemble land that is more viable for development:

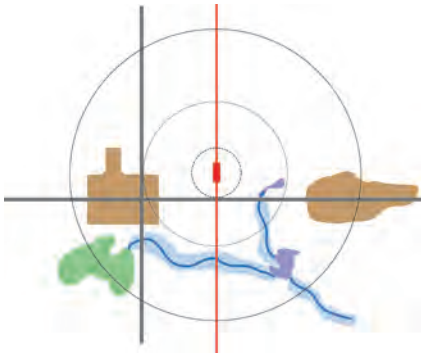
- LAND SWAPPING
- LAND SHARING
- LAND ACQUISITION
- LAND READJUSTMENT
- TRANSFER OF DEVELOPMENT RIGHTS



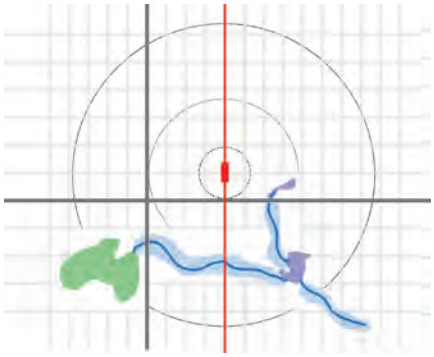
02 PREPARING A LAND ASSEMBLY PLAN

CITIZEN'S INPUT

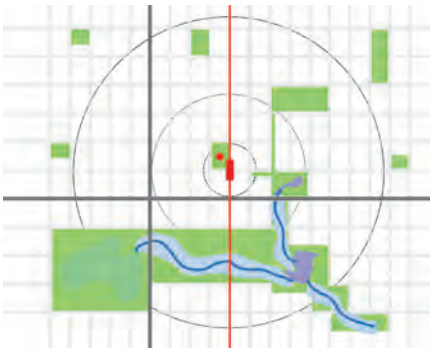
Create a Land Assembly Plan within the amalgamated area through a layered consideration of all the TOD requirements. The TOD requirements to be considered are listed below.



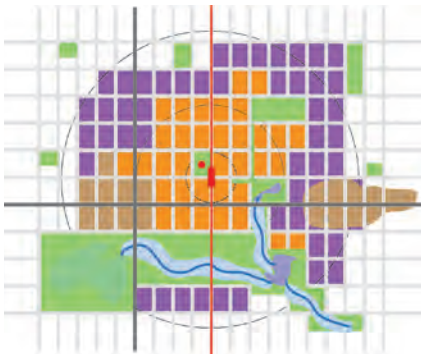
1 TRANSIT STATION



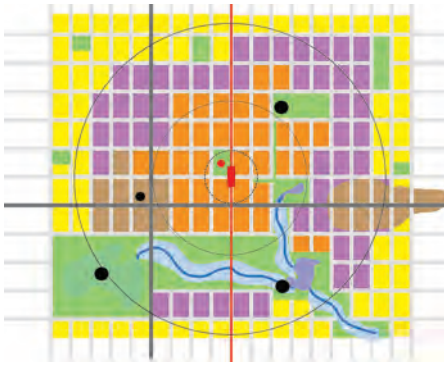
2 STREET GRIDS



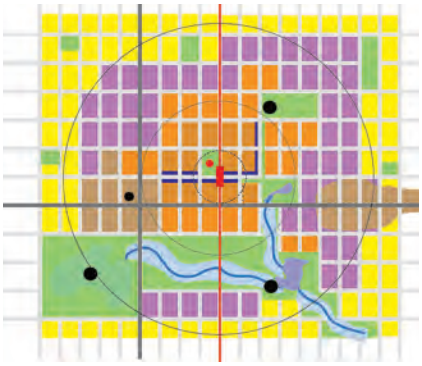
3 TRANSIT PLAZA AND URBAN PLACES



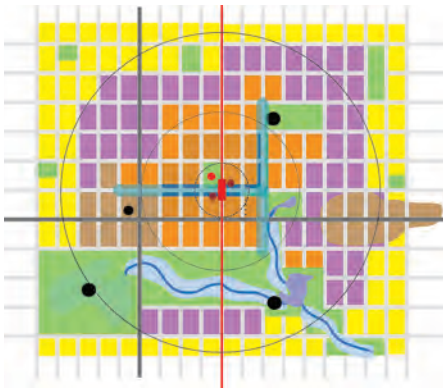
4 HIGH TO LOW DENSITIES



5 AMENITIES AND INFRASTRUCTURE

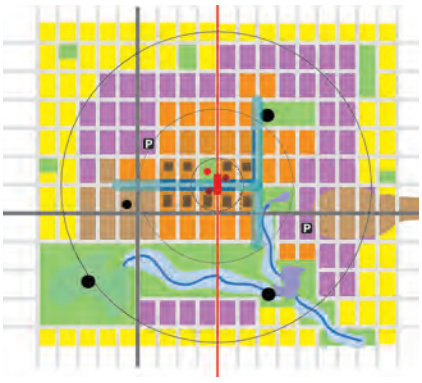


6 RETAIL AND COMMERCIAL



7 INTERMODAL CONNECTIONS

8 PARKING



9 BUILT FORM

03 IDENTIFY DELIVERY MODE

Identify the appropriate delivery mode for implementing the project. A combination of public and private modes of delivery may also be considered for separate components of the project.

PUBLIC

For delivering the project through a public mode, the following steps will be considered:

- Phased costing needs for the development
- Identification of sources for financing the project, including public funding for public works improvements, public housing and capital markets for financing development work

PRIVATE

For delivering the project through a private mode, the following shall be considered:

- Structuring of PPP/other partnerships
- If the project is undertaken by a private party or a community organization, then regulations must be prepared to ensure TOD-compliant development
- Cost estimation of public works necessary for the development

04 PREPARE PROJECT DELIVERY PLAN

CITIZEN'S INPUT

Prepare a Project Delivery Plan, including a phased implementation plan and supporting institutional and regulatory formations, as required.

1 PHASING AND IMPLEMENTATION

It shall consist of different stages, such as a pre-planning stage, planning and design stage, implementation stage, and monitoring and evaluation stage. These stages may be modified as per different project requirements.

[Refer to IM-H02 *How to Develop TOD Phasing Strategy]*

2 NOTIFY REGULATIONS

To allow development in accordance with the regulations, they must be notified. The TOD principles that must be incorporated in regulations include:

3 CREATE AN INSTITUTIONAL AUTHORITY OR BODY FOR IMPLEMENTATION

Based on the delivery mode selected, a specific implementation body must be formed with sufficient accountability mechanisms to ensure equitable development and minimal displacement of original residents.

Pune, India

TOD K P

PD-H07

HOW TO PLAN SAFE ACCESS FOR TOD

Type: Reference Guide

WORLD BANK GROUP TOD Global Platform for Sustainable Cities gef UKaid from the British people GRSF Global Road Safety Facility IBI WRI INDIA

INTRODUCTION

An easily understood notion of TOD planning relates to the intensification of development around the transit station. This is achieved through two strategies; increasing built-up density and diversifying permissible land-uses. With such dense urban environments, the number of users in the public realm also increases significantly, posing safety concerns for all users. This also requires the provision of networks safe access to transit stations and efficient connections between these developments and transit stations – which is often neglected. If these networks are not adequately provided, then it discourages the use of transit to access these developments, resulting in a much lower transit patronage than should be expected.

In order to achieve safe networks within a TOD area, the "Sustainable Safety" principles of functionality, homogeneity and predictability will need to be looked more comprehensively for planning and designing of roads, so that they align with the TOD principles and can be integrated with the local context, to develop implementable on-ground design strategies. These three Sustainable Safety principles tailored for TOD requirements have been briefly explained below:

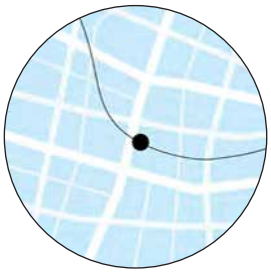
1. **Functionality of roads in TOD area:** While assessing road safety it is critical to understand the mixed function of the road network – whether it is an arterial road that includes a mix of transit or a connector that caters to traffic accessing the developments in the TOD or feeders that focus on accessing the transit stations as well as distributing traffic within the station area. The planning and design considerations are therefore made keeping in mind the mixed function in the street. The functions of the road in a TOD are also related to the mix of land use along it and may vary through the time of the day impacting the volume of users on it.

2. **Homogeneity of road design in TOD area:** Homogeneity of road design refers to the prevention of large differences in speed, mass and direction. The road network in a TOD area caters to all kinds of speeds and volume of vehicles within its ROW – slow moving pedestrians and persons with needs, cyclists, faster moving cars and other motor vehicles, feeder services such as IPT and public buses, and high speed mass transit vehicles such as BRT or metro rails. It is crucial to ascertain the capacity of these network based on the function they serve and segregate the users and different modes by using protective measures or adequate buffers between the modes to ensure maximum safety. It is supported by orienting streets towards the station, determining directionality of these streets to enable ease of traffic flow within the station areas, and maintaining speeds based on the immediate context – nature of land use and function of the streets. These principles are detailed out on PD-H07 subsection Capacity, Orientation and Safety; as well as in safety design guidelines provided in PD-R02.

3. **Predictability of road network in TOD area:** This refers to the usability of the road space – "are the road users familiar with the behavior demanded by different road types, and what they may expect from them and others". The design of road infrastructure and amenities are such that the users can recognize the type of road and are aware of its function. Within a TOD, higher mix of users, reinforces the need for predictability to achieve safety. Prioritization of road users, distribution of lanes within a ROW, stops and utilities, markings on the roads, signage, visibility, movement lines at intersections (especially for pedestrians, cyclists and other vulnerable users) gets highlighted.

5 PRINCIPLES OF TOD ZONE NETWORK PLANNING

The most critical aspect for the creation of a strong interlinkage between the transit station and the developments within station area is network planning. In our assessment, there are five key principles of network planning for TOD zones, which are presented below.



COVERAGE

The network should have an extensive reach, such that every property within the TOD zone is connected to the network.

CONTINUITY

There should not be missing links (gaps) in the network.

ORIENTATION

The network should be oriented towards the transit station, providing as direct connectivity as possible.

CAPACITY

The capacity of the network should be adequate to meet the high volumes of transit commuters, particularly along the trunk routes leading to the station.

SAFETY

Achieving a high standard of safety should be the guiding principle behind each and every decision on network planning; especially for the safety of vulnerable road users.

"Coverage" helps define the extent of street network and accessibility for different road users and hence provide for suitable solutions to ensure safe access. "Continuity" refers to the connectivity within the network and its density, ensures equitable access to the transit without congesting any area, and channelize traffic flow within the TOD zone. "Orientation" is facilitating the directed movement to and from transit stations and hence help in placing required infrastructure for safe movement. "Capacity" refers to the spatial quality of the network for all road users to ensure adequate space within the ROW based on the volumes of each type of user the network is catering to. Lastly "Safety" refers to creation of safer and segregated infrastructure within the network to avoid any type of crash or ensuring lower speed allowing the safe sharing of infrastructure. These as principles of network planning, help in creating framework for implementing physical safety measures.

For example, sidewalks are designed to function separate from vehicular travel lanes and cycle infrastructure. They are designed as per best practices and recommended design guidelines to accommodate the anticipated number of pedestrians using the segment of the network depending on how it connects to the transit station and any other node within the station area. However, these attributes will become redundant if the sidewalks are not part of a network that is not continuous and connect different nodes within the TOD area including the transit station.

These 5 Principles of Station area Network Planning for a TOD are thus derived from the three key road safety principles. The following sections cover these five principles in more detail, which includes guidelines and strategies on how to implement them.

Refer PD-R02 *TOD Planning Principles for detailed guidelines for designing safe infrastructure based on road safety and network planning principles.*

PRINCIPLE 1: Coverage

The principle of Coverage, with respect to station area network planning, means that every property within the defined influence area, must connect to a network leading to the station.

- It is neither practical nor desirable, for the coverage of every network to be as extensive as another. The importance of direct access of a network will depend upon the property's location with relation to the station.
- Thus, an important step in planning the coverage of feeder networks is to first define the realms of each network within the TOD zone.

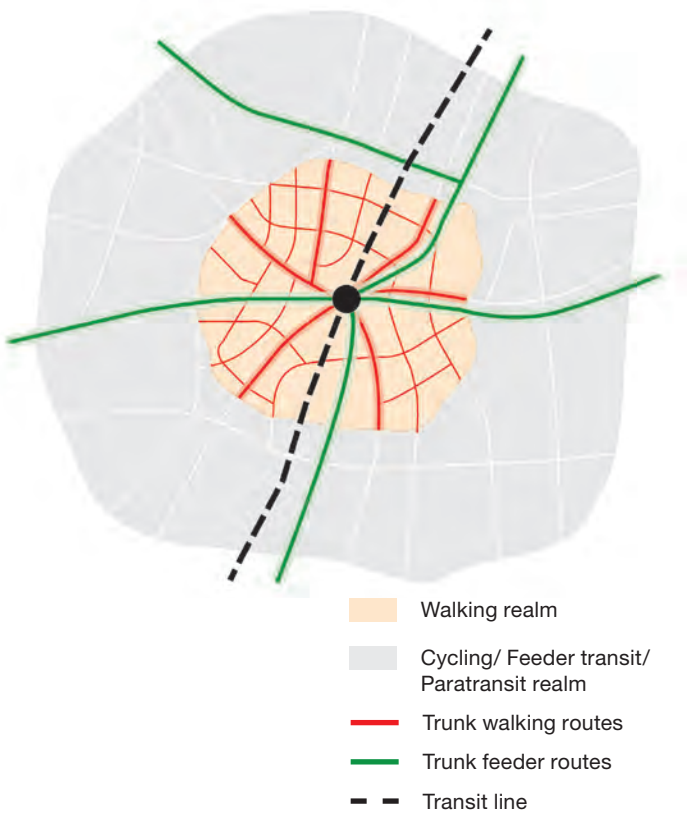
SAFETY IMPLICATIONS

If access networks do not have adequate coverage, then safety in the station area is adversely impacted. Lack of connectivity reduces the mode choices available to the commuter, which increases their dependence on personal motor-vehicles, thereby increasing traffic volume. There is clear evidence to show a strong correlation between traffic volume and road crash

DEFINING THE NETWORK REALMS

- A station area in the denser parts of the city, where transit network coverage is high, will normally only have two realms for the planning of access namely
  - The walking realm and
  - The area outside the walking realm.
- The walking realm is normally considered as what an average commuter can walk in 5-10 minutes, which is about 400 to 800m.
- In low-density, suburban areas, a higher walking reach of 10 - 15 minutes (800m - 1.2km) may be considered.

The following diagram depicts the realms of a typical station area in a medium to high density urban area.



The different realms for planning of station area

- The boundary of the walking realm will not follow a straight line radius around the station, but will take an irregular shape determined by local land-use and street networks. Typically, the higher the density of the street network, (and smaller the block sizes), the larger is the walking realm.
- The realms for cycling is much higher, typically to the order of 3 - 5 times the size of the walking realm; based on an average cycling speed of 18 to 25km/h, and an average willingness to cycle time of 10 - 15 minutes.
- Similarly, depending on context, the feeder service or paratransit realms are likely to reach up to 3 - 5km from the transit station, which typically extend up to and beyond the TOD zone boundary.
- A key component for the planning of these realms is the delineation of trunk routes leading to the station. It is not possible for every property to have direct connectivity to the station across all realms. The more practical solution is to connect properties to a few trunk routes leading to the station. This creates a strong an extensive network that offers multiple choices to the commuter. Such networks follow what is described as the hub-and-spoke model. The station is the center and trunk routes radiate outward from it. Further along, lesser capacity routes branch out of the trunk routes, forming a cohesive network.
- It is not practical to provide distinct networks for each feeder mode. The key principle to follow here is priority in network planning. This refers to a hierarchy of priority when planning for the mobility needs of different modes.
- Walking should sit on the top of this priority list, with access by personal motor-vehicles being the least priority. This is not a unique idea to TOD zone planning, but is rather a general guiding principle for creating sustainable, people-friendly cities. However, these guidelines become more relevant from the perspective of TOD, given the focus of prioritizing commute by transit.

ESTABLISHING PRIORITY IN NETWORK PLANNING

1. **Walking:**
   Walking is the most pertinent mode for first and last mile connectivity in almost any given circumstance. There is likely to be a high volume of walking commuters within the walking realm, and hence it is important that the network meets a high level of capacity and mobility. Outside the walking realm, walking infrastructure can be of lower capacity and mobility. However, it is still essential to have network coverage in this zone as well, because walking is likely to be used in combination with other feeder modes to access the station.

2. **Cycling and Feeder Transit Services:**
   Next in priority are the cycling and feeder transit services, (if applicable). As discussed earlier, the realms of the two will likely be the same in high density, urban areas, and both services can offer strong connectivity to the main transit line, depending on the context. The need for segregated infrastructure would be established based on volumes and differential speed. However, the shared network lines need to be planned and designed in a manner that offers a high level of safety and mobility for these modes.

3. **Para-transit and shared vehicles:**
   In some cases, para-transit modes, (taxis, rickshaws, etc.), may serve as feeder services to the transit station. This becomes more relevant in suburban areas, where some properties may not be within walking distance of the station or a feeder transit service. Recent innovations in mobility have also introduced the use of shared vehicles, (that can be self-driven) performing the function of first and last mile connectivity. In most cases, paratransit vehicles will share the same street networks of general vehicles. However, in the vicinity of the station, they may require special infrastructure to allow for safe and convenient transfer to and from transit. In general, paratransit services should be next in line of priority in the station area network planning.

4. **Personal motor-vehicles:**
   In some contexts, personal motor-vehicles may serve to provide first mile connectivity to transit. This may be relevant in low-density, suburban areas, that do not have access to other feeder modes. This entails the provision of adequate, long-term parking infrastructure in the vicinity of the station, which is only going to be viable in low-density areas. In most cases, personal motor vehicles should have the least priority in station area network planning.

PRIORITY 1
Walking

PRIORITY 2
Cycling & Feeder Transit Services

PRIORITY 3
Para-transit & Shared vehicles

PRIORITY 4
Personal motor vehicles

Adaptation of hierarchy of priority for mobility planning, prominent in many global cities at the forefront of sustainability. This hierarchy of priorities is all the more relevant for station areas, given the focus of moving people away from personal vehicles and onto transit.

PRINCIPLE 2: Continuity

Network continuity within the context of the station area, means that every property should be seamlessly connected to every other property, and to the transit station. This means that there should not be any gaps or missing links in the network, where a commuter is forced to use other components of the general road network that may not be designed for this mode.

- If access networks to the station are not continuous, then it forces the commuter to use other elements of the road infrastructure that do not meet its safety requirements.
- The critical importance of network continuity is often neglected in cities in developing countries, where infrastructure provision is scattered and disjointed, making it near impossible to complete a trip entirely along the network.
- When implementing a station area plan, an integral step is to implement measures to augment and complete the feeder networks. In built-up, dense urban areas, it is generally difficult to build new infrastructure to complete the network, other more practical strategies are incorporated to achieve a satisfactory result.

4 MEASURES TO BRIDGE NETWORK GAPS

1. Developing off-road connectors
2. Using development incentives to augment the network
3. Developing grade-separated infrastructure
4. Designing for shared infrastructure

DEVELOPING OFF-ROAD CONNECTORS

- When planning the feeder network, an initial step is to develop a comprehensive map of the station area. This map will have important layers, such as the street network, land-use, property ownership and building footprint.
- This map can then be analyzed to identify missing links, which is then juxtaposed against adjacent land-use and property development, in order to identify opportunities to create off-road connections. Such a spatial study will help to identify, at least, the physical possibilities for completing the network.
- Some opportunities that should be assessed are:
  - Are there any vacant/ open plots in the vicinity?
  - Is there city-owned land, which may be easier to modify?
  - Are there parks or gardens nearby that can be utilized to create walking or cycling paths?
  - Are there gaps between building footprints that may be acquired to create a link in the network?
- The next, more complex step is to develop institutional strategies that would allow for this to happen.

Refer PD-R02 *for more details on developing off-road connectors*

USING DEVELOPMENT INCENTIVES TO AUGMENT THE NETWORK

The implementation of a TOD strategy is a golden opportunity for urban transformation within the TOD influence area. An integral component of a TOD policy is to intensify development around transit, by creating development incentives. A key strategy in this regard grants landowners two boons - additional Floor Space Index (FSI) and permission to transform land-use to more lucrative uses, such as commercial development. Property owners stand to make tremendous financial gains from this transformation.

In order to ensure that the objectives of social infrastructure within the station area are also met, the city should link these incentives to different terms and conditions.

Terms and conditions for bridging network gaps:

- Break up large land parcels: The city can include a condition in the TOD policy or the applicable zoning regulations, that requires plot holdings beyond a given size to be divided, with a public right-of-way created in between.
- Implement and incentivize easement rights: Easement refers to the right to enter and cross another person's private property in order to access a public right-of-way.

Such a strategy may be implemented for large land parcels and can be linked to additional FSI in built-up urban areas. Such easement rights can be restricted to non- motorized transport only, which also stand to benefit the property in question if it is a retail-commercial establishment.

- **Utilize building setbacks:** Amalgamate building setbacks between adjacent buildings to create new rights-of-way. These links should be restricted to pedestrian and cycling movement ideally, because building setbacks are not likely to be wide enough to accommodate motor-vehicle traffic.
- **Incentivize landowners to build missing networks:** The City develops a network plan that includes the use of private land. It then works with different landowners to build the various sections of the network, ensuring seamless connectivity between the different sections. Landowners may be incentivized to build these missing sections, as a partnership model with the City. This will help provide direct, safe and convenient access to the transit station thus increasing the footfall of potential customers and improving the commercial viability of their property. The City benefits with sharing of initial capital expenditure, and subsequent maintenance of the infrastructure - typically managed by the private landowner.

Refer Finance knowledge Product **FI-R01** *for more zoning incentives and other incentives that would facilitate road safety inclusion during TOD implementation.*

DEVELOPING GRADE-SEPARATED INFRASTRUCTURE

- In some extreme cases, one may consider the use of grade-separated infrastructure, either elevated or underground, to overcome a missing link in the network.
- Such measures must only be used as a last resort, when all other at-grade measures have been exhausted; because of its high capital cost, difficulty in access for mobility-impaired users, negative impact on the built-environment, and high propensity for decay due to disuse.
- Grade-separated infrastructure forces the commuter to climb up and down.
- Grade-separated infrastructure must generally be considered to augment the network and should not be used in lieu of at-grade facilities.
- Where provided, it is advantageous to directly link with the transit station, especially if the station infrastructure is at the same grade. This eliminates the need of changing grades, at-least, at one end of a transit-access trip.

Refer **PD-R02** *for more details on developing grade-separated connectors*

DESIGNING FOR SHARED INFRASTRUCTURE

- In most built-up urban environments, it is not going to be practical to develop distinct networks for all feeder modes.
- There will be instances where modes will just have to share infrastructure along certain sections of the network.
- If designed appropriately, this can still ensure a high level of safety and mobility for all road users.
- The key guiding principle to follow here is, "*when infrastructure is meant to be shared, design it to meet the mobility needs of the most vulnerable road user*". For instance, if the carriageway must be shared between motor-vehicles and cyclists, then the design speed should be one that is safe for cyclists.

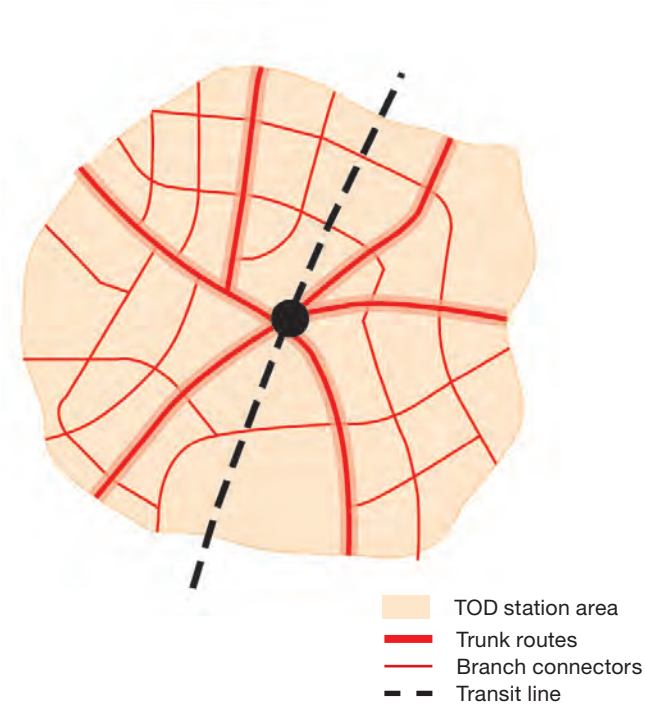
The measures to plan for a shared street are discussed in further detail under the fifth Principle of Safety.

Further, the design guides for shared streets are covered in **PD-R02**

PRINCIPLE 3: Orientation

This principle places the station as the anchor point of the network. The key component to ensure a network is well-oriented towards the station is to identify and develop trunk routes. This means the planning of networks that connect properties to the transit station as directly as possible.

A built-up urban environment rarely offers such a clean slate to plan the feeder network. Here, one has to work within the limitations of the existing built environment as well as the available right-of-way.



Oriented the feeder network in a greenfield station area

3 ASPECTS TO DETERMINING THE ALIGNMENT OF TRUNK ROUTES

1. Determine the main nodes
2. Assess strategies to minimize deviations
3. Assess favorability of local conditions

DETERMINING THE MAIN NODES

A key aspect of network planning in built-up areas is to first identify the main nodes in the station area, besides the station.

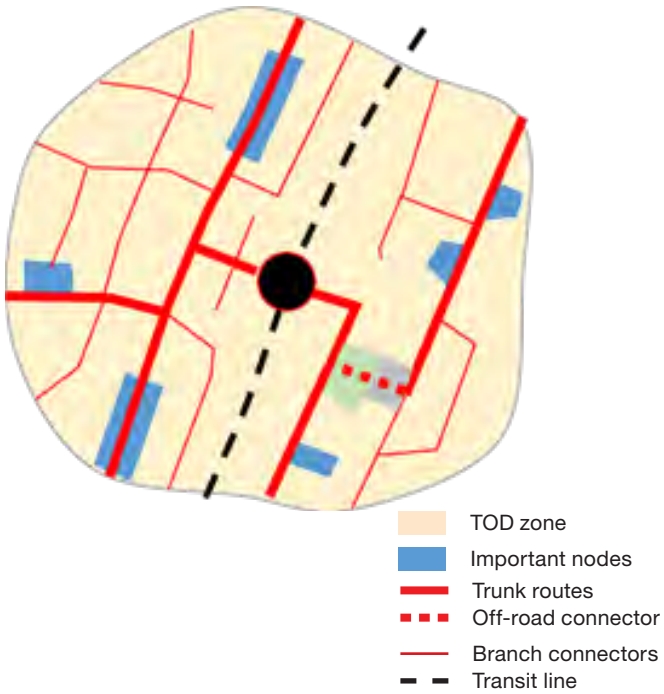
- These nodes are any location that are likely to have a high footfall, such as an office complex, a major retail street, a hospital, an educational building, etc. They may either be single points or stretches of corridor, (as in the case of a shopping street).
- Once these locations have been identified on a map, the next step is to overlay them on the road network of the station area. The objective is to determine how these nodes align with each other and transit station, and how to connect them with the least number of routes in the shortest possible distances.
- One may begin by drawing straight lines between these nodes and the transit station. If two or more lines are near one another, then consider the possibility of a single connector to these nodes.
- The next step is to trace a path along the existing right-of way, that approximates as closely as possible to the straight-line connector to the station.

ASSESSING STRATEGIES TO MINIMIZE DEVIATIONS

- Once an approximate path for a trunk route is determined, the next step is to analyze it to reduce any deviations in this route using the measures discussed earlier in Principle 2: Continuity.
- The measures under “Continuity” will have to be assessed together and analyzed for their relative cost versus benefit.
- This is likely to be an iterative process, where all options are assessed, in order to determine the optimal solution.
- It is also likely that different measures will be viable for different sections of the route, and the final solution is likely to be a combination of one or more strategy.

ASSESSING FAVORABILITY OF LOCAL CONDITIONS

- Network alignment not only includes creating a continuous linkage to the station but also must take into consideration local conditions, such as adjacent land-use, infrastructure capacity, etc.
- It is important to determine if the adjacent land-use supports the selection of this trunk route alignment, keeping in mind that this will entail higher traffic volume and/or pedestrian footfall.
- Furthermore, one has to determine if the infrastructure capacity along each section of the alignment is adequate to meet its requirement as a trunk route. There are multiple strategies that must be first assessed to augment the capacity, before a decision is made. These strategies are described in more detail under the next section, Principle 4: Capacity.
- The final feeder network plan for built-up station areas may have some imperfections but will be the best plan for the given conditions.



Feeder network planning in a built-up environment.

Here, the existing streets were not oriented towards the station to begin with as they primarily ran parallel to the transit corridor. Hence it is not possible to completely orient the feeder networks to the station. However, it is still possible to identify close to direct lines between the main nodes and the station, and adopt different strategies to minimize the deviations (Principle 2) and increase capacity (Principle 4).

PRINCIPLE 4: Capacity

Capacity deliberations are most pertinent in the planning of the trunk routes along the network. A TOD involves creating concentrated nodes of moderate-to-high density developments supporting a balanced mix of diverse land uses which are located within 5-10 minutes of walking distance or 800m-1km from mass rapid transit stations. This integration of transportation network and land use around a station area, with elements such as market demands, environmental systems etc, allows for placement of employment, entertainment, leisure and residential uses near each other around the rapid transit stations. This allows for reduced trip lengths and number of trips and prioritizes public transit use and reduces dependency on private motor vehicles.

A dense development implies higher number of users within the area, concentrating around the station, and getting distributed outwards towards the 'nodes' through the road network. However, this also poses safety issues, as different road users are interacting within the same space, raising issues of capacity. Measures to augment network capacity have to start with land use planning and transit service planning, which is supported by the following augmentation methods.

MEASURES TO AUGMENT NETWORK CAPACITY

1. Reallocate road space
2. Incorporate building setbacks
3. Eliminate on-street parking & streamline other road uses
4. Create one-way street networks
5. Reduce interruptions in flow
6. Provide more entry & exits at the station

REALLOCATING ROAD SPACE

- The most important tool to ensure adequate capacity is to reorganize the use of road space in the station areas.
- Road space is a critical and finite commodity, especially in built-up urban areas. The judicious allocation of this space plays an important role in determining the quality and safety of mobility in the station areas.
- Generally, national street design codes are inadequate for station areas, in their prescriptions on minimums for pedestrian infrastructure.
- Along major trunk routes in a station area, a minimum footpath width of 5 meters may be warranted. To determine what's appropriate, it is important to carry out pedestrian volume by capacity studies for the walking network,and reallocate road space to accommodate wider footpaths that can meet the desired Level of Service for pedestrians.
- For the cycling network, it is recommended that segregated cycle paths be provided on all trunk routes leading to the station, especially when the road way is shared with high-speed or high volume vehicular traffic. This may not always be feasible, given local constraints; but this must be the starting guiding position for cycle network planning.
- It may not be feasible to adopt dedicated transit lanes for feeder transit services. However, it would be advisable to restrict other ancillary road uses on these corridors to allow for the safe and smooth movement of transit vehicles. For instance, on-street parking could be restricted along these routes, and additional curb space provided at all bus-stops to accommodate waiting commuters.

The inadequate walking infrastructure, right outside a transit station in Mumbai, India, cannot accommodate the large volume of pedestrians commuters. This forces pedestrians onto the carriageway, resulting in a very unsafe traffic situation.
(Source: © WRI India)

- Para-transit vehicles benefit from dedicated spaces for picking up passengers. However, unlike transit services, para-transit services are not restricted to fixed routes. Hence the locations of these pick-up spaces should be determined by high demand land-uses, such as retail, office, institutional developments, etc.
- For integrating building setbacks into pedestrian networks, a TOD policy can be introduced to allow for the transformation of the ground-floor of a residential property for commercial uses along major trunk routes.
- The city can link the permissions to develop ground-floor retail activities to the condition that the road-abutting compound wall is removed, and the setback is maintained as an extension of the public footpath. The ownership of this space can remain with the property owner, but its built conditions and usage will be guided by the city TOD policy.

Refer to **FI-R01** *Development Incentives for more zoning incentives and other incentives that would facilitate road safety inclusion during TOD implementation.*

INCORPORATING BUILDING SETBACKS

Earlier in Principle 2: Continuity, "use of development incentives to incorporate building setbacks into the feeder network", was discussed in reference of creating new links in the feeder network. In this section, it will be discussed with respect to increasing the capacity along the existing network.

- Typically, residential building have a setback along the road front and building edge is recessed from the compound wall edge. A TOD policy can be introduced to allow for the transformation of the ground-floor of a residential property for commercial uses along major trunk routes.
- In this scenario, the existence of a setback and a compound wall along the road edge may not be as beneficial as when the property had exclusively residential usage.
- The city can link the permissions to develop ground-floor retail activities to the condition that the road-abutting compound wall is removed, and the setback is maintained as an extension of the public footpath. The ownership of this space can remain with the property owner, but its built conditions and usage will be guided by the city TOD policy.

Refer to **FI-R01** *Development Incentives for more zoning incentives and measures for assimilating setbacks.*

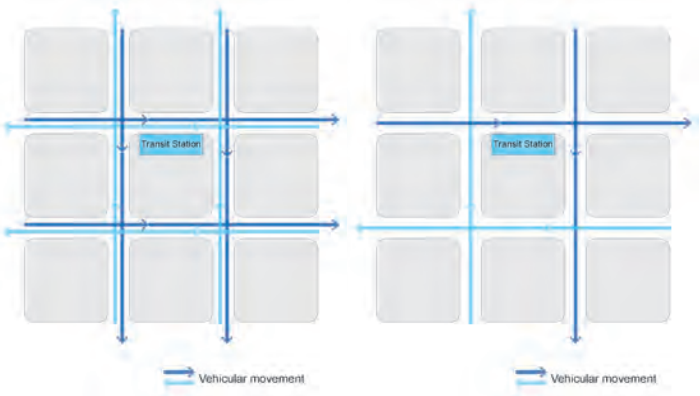
REDUCING ON-STREET PARKING AND STREAMLINING OTHER ROAD USES

- An effective way to free-up road space is to reduce the provision of on-street parking, especially along the trunk feeder routes leading to the station. This additional space can then be allocated to footpaths, cycle lanes or feeder-bus lanes.
- Within a TOD, due to the transit services there is a lesser dependence on private vehicles. Limitations on parking will encourage more commuters to use transit.
- It may also be possible to better utilize road space by streamlining other road elements, such as utility boxes, bus-stops, street-vending areas, taxi stands, freight loading/unloading areas, etc.

CREATING ONE-WAY STREET NETWORKS

- If there is a good network of parallel streets, and relatively small block sizes in the vicinity of stations, a network of one-way streets, alternatively running in opposite directions may be created.
- Typically, one-way streets require less carriageway than two-way streets, as they eliminate the need for a median or to have multiple lanes.
- One-way street networks also have the added advantage of being easier to manage at intersections, (because of lesser permissible turns); therefore, requiring fewer signal phases than a regular two-way intersection. This reduces the waiting time for feeder modes (transit, cycle or walking) to cross the intersection.
- A one-way C-shaped loop is also a great way to connect to the transit station. By making loop one-way for vehicular traffic, more road space can be allocated to other feeder network infrastructure, such as footpaths, cycle lanes and station transfer points.
- It must be noted here that converting a two-way street to one-way street is carried out to improve the carrying capacity of the street. This should not be confused with traffic calming design measures.

Refer to **PD-R02** *TOD Planning Principles & Design Guidelines for information about traffic calming measures.*



Existing conditions with two-way circulation of streets (Left), converted to one-way circulation of streets to have improved network capacity

ONE-WAY REROUTING OF STREETS

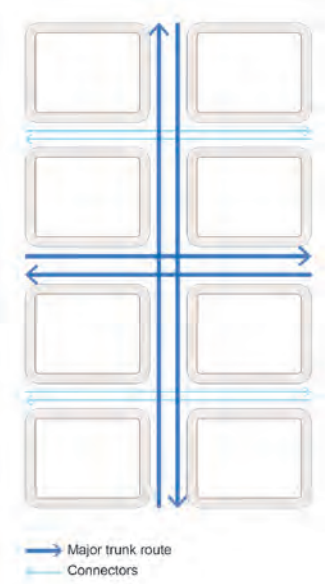
Santacruz Railway Station area - Mumbai, India:

Parallel streets in the station area have been made one-way in opposite directions, creating a looped connection between the 2-way main street and the transit station. (Note: Here, traffic drives on the left)

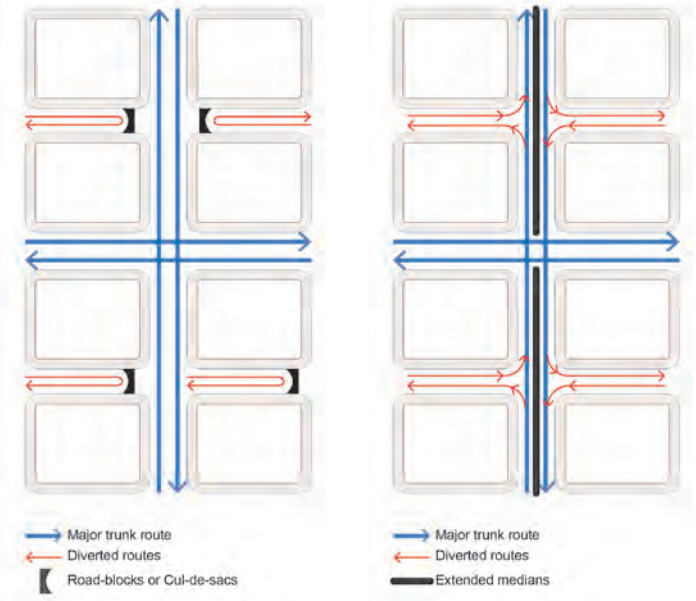
(Base map procured from Google maps.)

REDUCING INTERRUPTIONS IN FLOW

- The capacity of a trunk route on a feeder network is not only determined by the road space allocated to it, but also by the frequency of interruptions to its flow.
- The more frequent the interruptions to free-flow conditions, the greater will be the reduction in capacity.
- A crucial aspect of trunk route planning along the network is the adoption of various strategies to minimize interruptions, mainly through the diversion of conflicting traffic movements.
- Measures for reducing interruptions in flow:
    1. Eliminate traffic intersections along major trunk routes leading to the station. This can be achieved by converting intersecting streets into cul-de-sacs or by modifying the intersection to only allow vehicles to enter and exit the minor street, but not cut across the trunk route

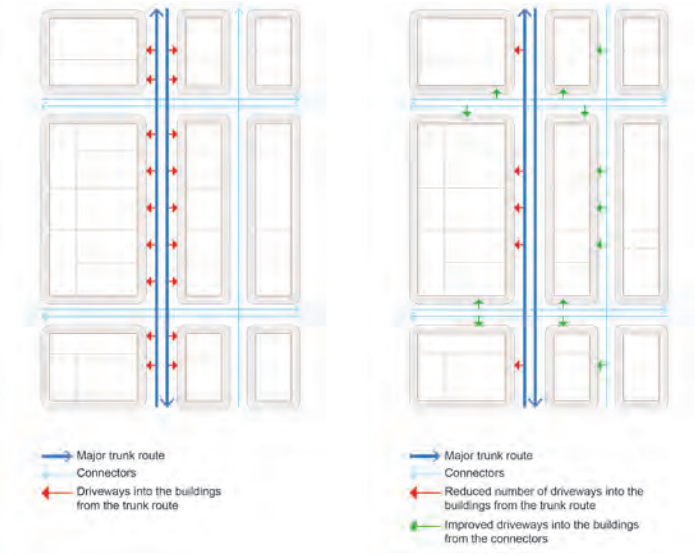


Existing conditions with greater number of intersections along the major trunk route.



Measures for reducing interruptions to flow: Road closures creating cul-de-sacs that help reduce number intersections (Left) and, Extended medians to reduce number of intersections (Right)

2. Limit the number of driveways on the main trunk routes. This reduces the number of breaks along the sidewalk, again improving free-flow conditions.



Existing conditions with driveways to buildings from trunk route. (Left), Reducing number of driveways into developments along the trunk route and providing entrances from connectors. (Right)

- Another important measure especially pertinent to feeder transit service, is signal priority. Signal phasing can be designed to give more green time for traffic and pedestrians along the main trunk routes.
- It should be noted that for every situation with at-grade transport lines, some amount of interruptions is unavoidable. At certain points, the trunk routes will have to cross other roads. The objective, therefore, is not so much to eliminate all interruption, but to minimize them where possible, and to design them in a safe and appropriate manner where unavoidable.

PROVIDING MORE ENTRIES AND EXITS AT THE STATION

- The capacity of any network is determined by its most constrained point. In the context of feeder networks, this point is often the immediate station area, which has the highest volume of commuters utilizing the smallest amount of space.
- Measures to avoid bottleneck:

1. Station infrastructure can be designed with multiple entries and exits, directly taking people further along on the feeder network.
2. One can even consider different points of access for commuters on different modes, to reduce the load at one location.

PRINCIPLE 5: Safety

Planning for the safe provision of access networks in a station area, requires certain hard decisions that may lessen the mobility of other traffic in favor of the safety and mobility of the feeder network traffic.

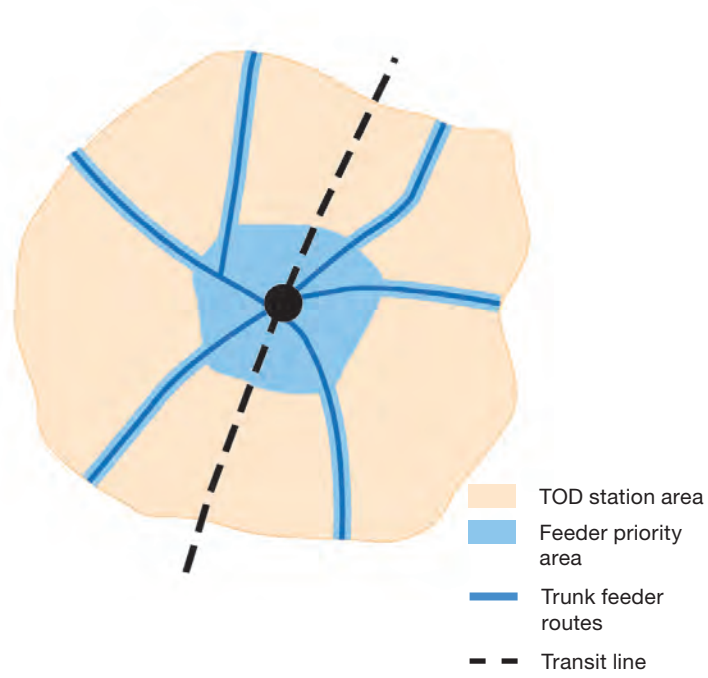
Traffic in a station area, (both vehicular and pedestrian), can broadly be divided into two buckets:

1. Traffic destined to or originating from the station;
2. Traffic not concerned with the station in any way.

- In most instances, the priorities of these two groups will clash with each other. For instance, the loading and unloading activities of freight vehicles, servicing shops in the station area, may impede the mobility of commuters to the station. However, the principle of safety must have the highest priority.
- Balancing these conflicting priorities can be made easier by defining the boundaries within a station area, where the priorities of transit commuters are to be placed higher than those of other traffic.
- Typically, in the area closest to the station, traffic bound to the station must be given the highest priority. Similarly, traffic directed to and from the station should be of high priority along all the major trunk feeder routes leading to the station.
- Once the feeder priority areas of the station area are defined, the next step is to determine measures to ensure a high level of safety for the feeder modes in question.

MEASURES TO IMPROVE SAFETY

1. Provide dedicated infrastructure
2. Implement speed zoning & traffic-calming measures
3. Reduce vehicular traffic volume



Determining the feeder priority area in the station area.

PROVIDING DEDICATED INFRASTRUCTURE

- The safest measure, though not always the most practical, is to provide dedicated infrastructure for each feeder network which includes footpaths, pedestrian walkways, cycle lanes and bus lanes.
- Dedicated infrastructure is a good measure on wide trunk routes, especially where there is a high volume of vehicular traffic, moving at a very high speed.
- Excluding infrastructure for walking, it is not necessary, or even desirable, for the entire feeder network to be made up of dedicated infrastructure. A good network will utilize a combination of dedicated infrastructure, (where needed), and traffic-calmed shared streets for the remainder.
- Planning for safety requires the determination of where dedicated infrastructure is appropriate and is determined by the intersection of two aspects - desirability and feasibility.
- Desirability relates to the provision of dedicated infrastructure only where it is warranted from the perspective of improving safety. Whereas, feasibility relates to dedicated infrastructure provisions only where it is feasible to do so.

- Dedicated infrastructure can take two forms:
    1. **Physically segregated infrastructure:** This kind of dedicated infrastructure is physically segregated from other traffic, using curb, fence, median, landscaping etc. Generally, the segregated infrastructure doesn't continue over intersections, to allow for traffic to pass.
    2. **Lane-marked infrastructure:** It relies on lane-marking and road signage to convey the information instead of using physical infrastructure to segregate traffic,.
- From the perspective of safety, segregated infrastructure is generally safer, especially for vulnerable road users like pedestrians and cyclists.

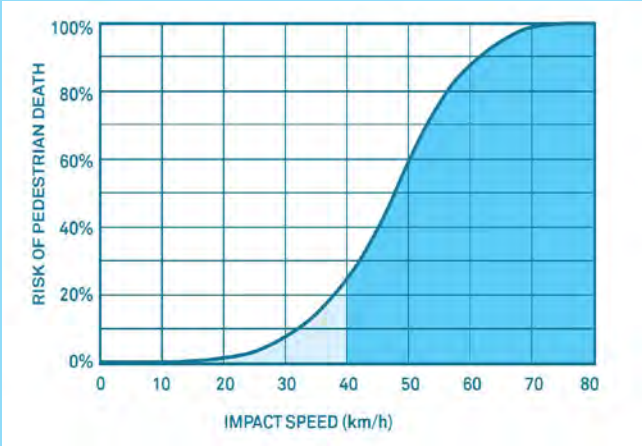
IMPLEMENTING SPEED ZONING AND TRAFFIC-CALMING MEASURES

- Speed zoning is the single most effect measure for the provision of safe mobility in the station areas. Recommended speeds for station area planning:
    - **5km/h:** Narrow streets where traffic & pedestrians share the road
    - **15-30km/h:** All streets within the station walking realm & neighborhood streets outside the walking realm
    - **30km/h:** Trunk feeder bus / cyclist routes to the station
    - **50km/h:** Maximum prescribed design speed for all other roads in the station areas

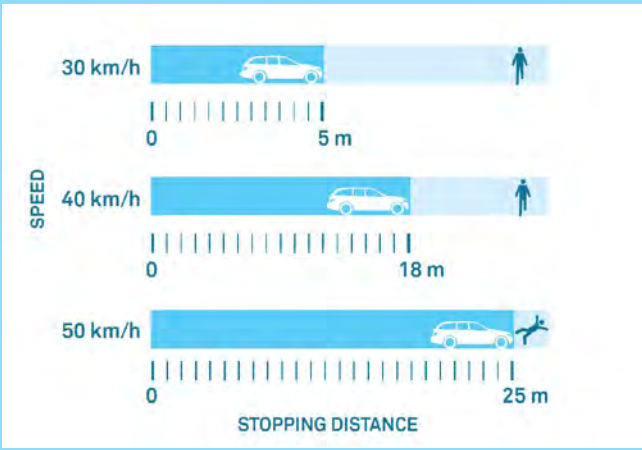
Low-speed zones in Fortaleza, Brazil, prioritize pedestrian safety
(Source: © WRI)

VEHICLE SPEED AND RISK

Vehicle speed determines the severity of crashes and injuries sustained. Researches have shown that vehicular speeds below 30km/h, drastically reduce the risk of fatalities. The fatality risk for pedestrians with vehicles traveling at 50km/h is more than twice as high as the risk at 40km/h and more than five times higher than the risk at 30km/h as can be seen in the graph below.



Additionally, vehicle speeds also affect the potential to avoid crashes. Higher speeds reduce the driver's capacity to stop in time, reduce the maneuvering ability to avoid a crash, difficult to make turns or drive along curves, and cause others to misjudge timing of approaching vehicles. The figure below shows the relationship between vehicular speeds and stopping distances.



(Source: NACTO Global Street Design Guide)

NOTE: These studies were conducted in high-income countries and there is evidence to suggest that this relationship might be even more extreme in low- and middle-income countries

- Desired speed should be achieved through a combination of enforcement and design measures.
- It is recommended to adopt a uniform speed limit for the walking realm across all station area in the city. In certain short sections, where the high pedestrian volumes, coupled with local traffic accessibility demands, a significantly lower speed limit (of 5km/h) may be desirable.
- It is prudent to note that it is not feasible for a cycling network in a station area to entirely consist of segregated cycle lanes. Such infrastructure is desirable and warranted on trunk routes with high traffic speeds and volume. However, at other locations cyclists will share the road with other traffic, and such shared streets will be an integral part of the station area cycling network.
- It is also important to note that speed zoning doesn't merely entail enforcing speed limits through regulation, but also requires the implementation of appropriate traffic-calming infrastructure to ensure that the design speed is in sync with the speed regulation.
- Automated Enforcement (AE) refers to all forms of technology which detect and record violation of any road rule without direct human involvement. Speed cameras enforcing speed limits are a common application of AE. Over speeding and other illegal behaviors, including disobeying a red light signal, mobile or cellular phone use, incorrect lane use, and non-restraint use can be detected using an automated enforcement approach. The use of technology should be considered as one part of a comprehensive speed management approach that includes road infrastructure and roadside policing as well. This technology requires adequate support of robust database of vehicle registration, high-quality camera sensitivities and calibrations, and supportive regulations and policies.

REDUCING VEHICULAR TRAFFIC VOLUME

- There are different measures that can be considered to reduce traffic volume in the station areas, particularly in the walking realm. The measures are discussed here:

1. **Restrictive measures:** Traffic volume in the walking realm can be significantly reduced, by adopting strategies to discourage personal motor-vehicle usage. For instance, reducing parking availability, or increasing the cost of parking, in the walking realm encourages more commuters to avoid personal motor-vehicle usage.
2. **Regulatory measures:** Another strategy is to adopt regulatory measures, such as restricting certain vehicle classes during peak commuter time periods. For instance, freight vehicles may not be allowed in the walking realm from 8:00 AM to 9:00 PM.
3. **Alternate bypass routes:** Traffic volume in the walking realm can also be reduced through the creation of alternate routes that bypass this area. For instance, a new road may be developed to carry through traffic that does not originate, or is not destined to, a location within the walking realm.
4. **Eliminating through traffic:** Another measure to limit traffic volume within the walking realm is to convert certain streets into dead-ends (cul-de-sacs) or loops back to the same road outside the walking realm. This discourages the use of these streets by any traffic that is not locally-bound. Loops are preferable to cul-de-sacs because often the streets in the near vicinity of the station are not wide enough to accommodate a functional cul-de-sac.
5. **Full pedestrianization of streets:** Pedestrian-only paved streets could be created for routes in the TOD station area that connect to the transit station with developments having high footfall, or generate heavy pedestrian traffic due to commercial and recreational activities along those routes. Barring access for emergency vehicles and delivery vehicles during certain hours, no motor-vehicle is allowed in these streets.

Pedestrian only street in Sao Paulo, Brazil
Source: © WRI

- Outside the walking realm, the undue diversion of vehicular traffic is not recommended. However, along main transit feeder lines and/or cycling routes, traffic diversion may be considered to enhance safety.

Bogota, Colombia

TOD KP

PD-R01

TOD ZONING CODE TEMPLATE

Template zoning ordinance/guideline for governments to use, including provisions on pedestrian pathways, activity generating uses, porous urban design, parking restrictions, shared parking provision, etc.

Type: Reference Document

TOD Global Platform for Sustainable Cities WORLD BANK GROUP IBI

TOD KP

ABOUT THE PLAN+DESIGN TOOL

PURPOSE

Establishing an appropriate zoning framework for TOD projects is essential to achieving good design and upholding best practices in transit-oriented development. An effective zoning framework allows for easy and unambiguous enforcement. The approach to writing zoning codes must depend on the planning framework applicable to the city. Most cities in low and middle-income countries, where zoning codes are used, follow the conventional Euclidean or Single-use Zoning format. This format relies on a land use-based definition of development of building standards.

Traditionally, Euclidean Zoning formats have been based on automobile-oriented planning practices and regulations are catered towards managing the impacts of specific land uses by segregating them spatially. This has led to sprawled development patterns, with limited connectivity. Poorer communities, in particular, have suffered from lack of access to jobs and opportunities because of such segregation. The TOD planning paradigm is fundamentally based on reversing segregation and allowing for compact, mixed-use developments within close proximity to transit. Consequently, zoning codes need revision to ensure the success of your city's TOD.

This Knowledge Product provides the resources listed below. The resources are based on industry-led best practices, but should be tailored to the context-specific conditions and considerations of your city.

Disclaimer: *The Transit-Orientated Development Implementation Resources & Tools knowledge product is designed to provide a high-level framework for the implementation of TOD and offer direction to cities in addressing barriers at all stages. As the context in low and middle-income cities varies, the application of the knowledge product must be adapted to local needs and priorities, and customized on a case-by-case basis.*

RESOURCES:

I SAMPLE ZONING CODES

As a reference, Case studies have been assembled to highlight zoning efforts in the few cities in low and middle-income countries where TOD is implemented statutorily that may serve as references for future efforts globally.

II MODEL ZONING CODE KEY ELEMENTS

TOD elements that are found to be most commonly used in zoning codes from the case studies are listed and explained here. These elements form the basis of a TOD zoning code. To understand how to incorporate these elements into your city's zoning code, refer to the detailed templates.

III MODEL ZONING TEMPLATES

These templates can be used by city authorities as a base to develop zoning codes and ordinances for their respective cities. Two types of zoning templates are provided here:

IIIA. The Model TOD Overlay Zoning Ordinance:

This model template is adapted from the Model Transit-Oriented District Overlay Zoning Ordinance resource by Reconnecting America (Valley Connections 2001). It provides a city the opportunity to create a "TOD Overlay Zone" over an existing base zoning framework. All the development parcels that lie within the TOD Overlay Zone are either required to or have the option to follow the regulations of the overlay zone. When the model template is applied to a city, the TOD Overlay Zone must be clearly defined to avoid ambiguity in property selection.

IIIB. The Model TOD Form-Based Code:

This model template is adapted from the Smart Code Version 9.2 (Center for Applied Transect Studies; 2008). This template is based on the innovative form-based code paradigm, where building standards will be defined based on the station area typology rather than land use.

These Codes may be used as a replacement or as an overlay to the existing base zoning framework. All the development parcels that lie within a specific station area typology would need to adhere to form-based regulations for that specific typology. When the model template is applied to a city, the TOD Station Area Typologies and their boundary delineation must be clearly defined to avoid ambiguity in property selection.

A form-based code is a land development regulation that fosters predictable built results and a high-quality public realm by using physical form (rather than separation of uses) as the organizing principle for the code. A form-based code is a regulation, not a mere guideline, adopted into city, town, or county law. A form-based code offers a powerful alternative to conventional zoning regulation. (Form-Based Codes Institute n.d.)

A TOD station area typology is a powerful tool to prioritize where and when to make investments, determine the types of investments that are appropriate in varying transit communities, and guide the timing and scale of those investments. A TOD typology provides a means of classifying and differentiating the many transit communities throughout a city by grouping them based on key shared characteristics. (Salat and Ollivier 2016)

REFERENCES

Center for Applied Transect Studies;. 2008. SmartCode Version 9.2. USA.

City of Johannesburg: Department of Development Planning. 2016. "Spatial Development Framework 2040 City of Johannesburg Metropolitan Municipality." Johannesburg.

n.d. Form Based Codes Institute. Accessed 8 18, 2018. https://formbasedcodes.org/definition/.

ITDP (Institute for Transportation and Development Policy) . 2008. "TOD Standard v9.3."

NRDA (Naya Raipur Development Authority). 2013. "Naya Raipur Transit Oriented Development Study." Naya Raipur. Consultant Report: IBI Group

Salat, Serge, and Gerald Ollivier. 2017. *Transforming Urban Space through Transit Oriented Development - The 3V Approach*. Washington DC: World Bank Group.

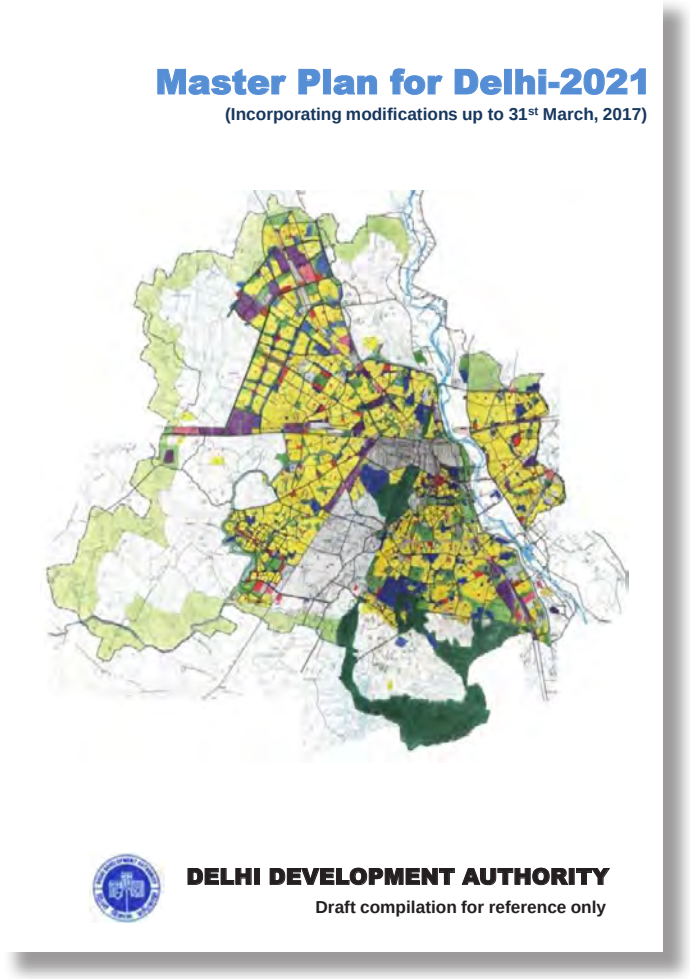
UD&UHD (Urban Development and Urban Housing Department). 2017. "Comprehensive General Development Control Regulation - 2017." Gandhinagar.

UTTIPEC (Unified Traffic and Transportation Infrastructure (Planning & Engineering) Centre), WRI India. 2014. Transit Oriented Development Manual – Delhi TOD Policy and Regulations Interpretation. New Delhi.

Valley Connections. 2001. Model Transit-Oriented District Overlay Zoning Ordinance. http://www.reconnectingamerica.org/assets/Uploads/bestpractice230.pdf, California: Community Design + Architecture, Inc.

SAMPLE ZONING CODE

DELHI TOD POLICY AND MASTER PLAN 2021, INDIA



KEY ELEMENTS

1 TOD Zone

The TOD Policy in Delhi was framed within the Influence Zone along MRTS corridor, designated as the Transit-oriented Development Zone in the Master Plan for Delhi 2021, modified with the latest revisions in 2017. This zone comprises of all the areas lying within 500m of the metro transit corridor on either sides. This area is expected to be delineated in the Zonal Development Plans to avoid ambiguity. The Master Plan incorporates TOD as a redevelopment strategy, encouraging private landowners to assemble and redevelop lands that have high TOD potential. (WRI [World Resources Institute] 2007)

Figure 1: TOD Influence Zone Delineation, Delhi TOD Policy Manual
Source: Reproduced from UTTIPEC, WRI India (2014)

2 FAR and Density:

Higher densities are allowed for all developments that are planned on individual or amalgamated land parcels of a size of 1Ha or more. A minimum mandatory Floor Area Ratio (FAR) is imposed for housing for the economically weaker section. This norm is intended to encourage land pooling as a redevelopment strategy in the TOD influence zones. Larger land parcels allow Delhi Development Authority (DDA) to extract land for public use including open spaces and transit plazas.

3 Mix of Uses:

Minimum 30% residential use, 10% commercial use, and 10% public amenities are compulsorily required on all land parcels irrespective of their dominant land use as per the Master Plan. Within the minimum residential area requirement, the Master Plan mandates housing units to be of smaller sizes. This is intended to encourage economic diversity within transit influence zones. Smaller unit sizes allow buyers the flexibility of purchasing small units in case of budget limitations and purchasing multiple units and combining them in case of larger family sizes. However, in practice, this requirement has been the most difficult to meet, because it increases the planned density of the development substantially. This, in turn, increases the infrastructural and parking requirement for the development.

4 Road Network:

A minimum 20% of the land is required to be reserved for roads, adhering to the principles of 250m center-to-center road density of vehicular roads and 100m center-to-center density of the pedestrian network. These roads will be handed over to the Government as public roads, but will be maintained and kept encroachment free by the Developer Entity.

5 Open Spaces:

A minimum of 20% of the land is required to be reserved for green open spaces for public use, adhering to principles of inclusion and another 10% green space for private use. In parcels smaller than 1 HA, private open space is allowable in the form of common terraces, rooftops or podiums.

6 Public Facilities:

Public facilities like schools and health facilities are required to be provided as part of the development.

7 Green Buildings:

The built form of the development is required to achieve a minimum of 3 stars or gold rating as per the Indian Green Building Standards.

8 Traffic Impact:

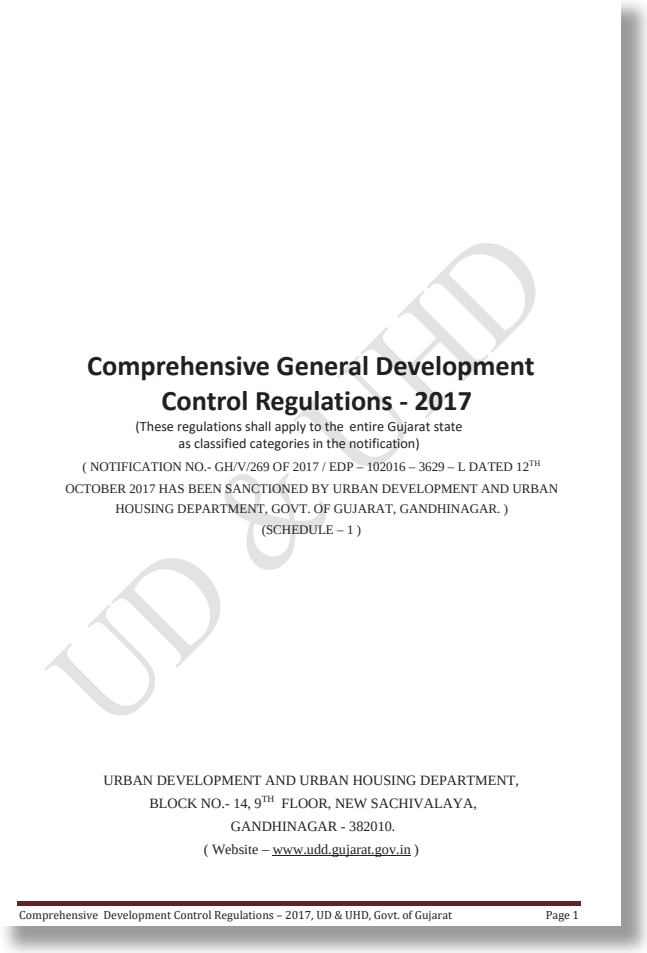
It is expected to be assessed and mitigated through traffic management measures.

In addition to the above norms, the Master Plan also prescribed Street Design Regulations to be followed within the streets planned in a development under the TOD scheme. The street design elements are intended:

- Promote Preferable Public Transport Use
- For Safety of All Road Uses by Design
- For Pedestrian Safety, Comfort and Convenience on All Streets
- For climatic comfort for all Road Users
- To ensure universal accessibility and amenities for all street users
- To reduce Urban Heat Island Effect and Aid Natural Storm Water Management

SAMPLE ZONING CODE

COMPREHENSIVE GENERAL DCR - 2017 GANDHINAGAR, AND AHMEDABAD URBAN DEVELOPMENT AUTHORITY (AUDA) DEVELOPMENT PLAN, INDIA



Comprehensive General Development Control Regulations - 2017

(These regulations shall apply to the entire Gujarat state as classified categories in the notification)

(NOTIFICATION NO.- GH/V/269 OF 2017 / EDP – 102016 – 3629 – L DATED 12TH OCTOBER 2017 HAS BEEN SANCTIONED BY URBAN DEVELOPMENT AND URBAN HOUSING DEPARTMENT, GOVT. OF GUJARAT, GANDHINAGAR.)

(SCHEDULE – 1)

URBAN DEVELOPMENT AND URBAN HOUSING DEPARTMENT,
BLOCK NO.- 14, 9TH FLOOR, NEW SACHIVALAYA,
GANDHINAGAR - 382010.
(Website – www.udd.gujarat.gov.in)

Comprehensive Development Control Regulations – 2017, UD & UHD, Govt. of Gujarat Page 1

KEY ELEMENTS

1 Smart City and TOZ

TOZ is an overlay zone which provides opportunities for mixed-use and high-density development along the Bus Rapid Transit (BRT) corridor and Metro Rail Transit (MRT) corridor except in Core Walled City, Industrial Zone – General, Industrial Zone – Special, SPD-2 Science Park and on GIDC Estates. High-density development permissible in areas falling within 200m on both sides on transit corridor in case of AUDA and RUDA and in case of smart city node.

[Refer to Section 7.1.11 Smart City & TOZ (SPD-5)]

Sr. No	Use Zone / Use as per Development Plan of Competent Authority	As mentioned	
		Conceptulised Use Zone	Code
(1)	(2)	(3)	(4)
38	Transport Oriented Zone, Smart City Node/ Transport Node, Highdensity zone available in both the sides of 200 mtr. from the edge of the road.	Smart City & TOZ	SPD5

Source: Reproduced from UD&UHD (2017)

2 Use Zone and Permissible Uses

The comprehensive Development Control Regulation permits mixed-use development on Smart City & TOZ zone with permissible uses of Residence, Commercial and Green Institutional Zone.

[Refer to Table 7.3.1: USE ZONE AND PERMISSIBLE USES]

Sr. No.	Conceptulized Use Zone	Code	Permissible Uses
(1)	(2)	(3)	(4)
33	Special Plan Development Zone – 1	SPD1	As per GIFT Master Plan.
34	Special Plan Development Zone - 2	SPD2	As per SRFDCL Master Plan.
35	Special Plan Development Zone - 3	SPD3	Those permissible in R1.
36	Special Plan Development Zone - 4	SPD4	Those permissible in R1.
37	Smart City & TOZ	SPD5	Those permissible in R1,C1,REZ.

Source: Reproduced from UD&UHD (2017)

3 Permissible FAR

Smart City & TOZ allow a Base FAR of 1.8 on a building unit and a chargeable FAR of 2.2. Maximum FAR of 4.0 is permissible.

[Refer to Section 7.7 Floor Space Index (F.S.I) for different categories, Table 7.7.6 Use Zone and F.S.I.: Category D1 RUDA.]

Sr.No.	Zone	Code	Base F.S.I	Chargeable F.S.I	Maximum Permissible F.S.I
(1)	(2)	(3)	(5)	(6)	(7)
1	City Area - A	GM	2.25	-	2.25
2	City Area - B	GM	2.00	0.5	2.5
3	Gamtal	GM	2.25	-	2.25
4	Gamtal Extension	GME	1.5	-	1.5
5	TOZ	SPD5	1.8	2.2	4.0

Source: Reproduced from UD&UHD (2017)

Uses as per Knowledge and Industrial Zone (KZ) and Residential Affordable Housing (RAH) with respective permissible FSI specified as under:

No.	Proposed Use	BaseFSI	Additional Chargeable FSI @ 40% Of Jantry Rate	
			Within TOZ	Out Side TOZ
1	Knowledge Zone (KZ) & Residential Affordable Housing (RAH)	1.8	2	0.9

Source: Reproduced from UD&UHD (2017)

An Additional Chargeable FAR of 2.0 is permissible at a 40% Jantry Rate within TOZ zone.

[Refer to 20.1.2: Permissible Uses & FSI in Closed Textile Mill Zone (CZ)]

4 Permissible Ground Coverage

Entire Area available after providing for the required margins, Common plot and other Regulations may be utilized for construction of the superstructure.

5 Parking

For Building- Units within the Transit-Oriented Zone with Commercial Use (Mercantile -1), The minimum parking requirement shall be 35% of Total Utilized FAR and 20% of the required parking shall be provided as Visitor Parking.

[Refer Section 13.2.1 Relaxation in Parking]

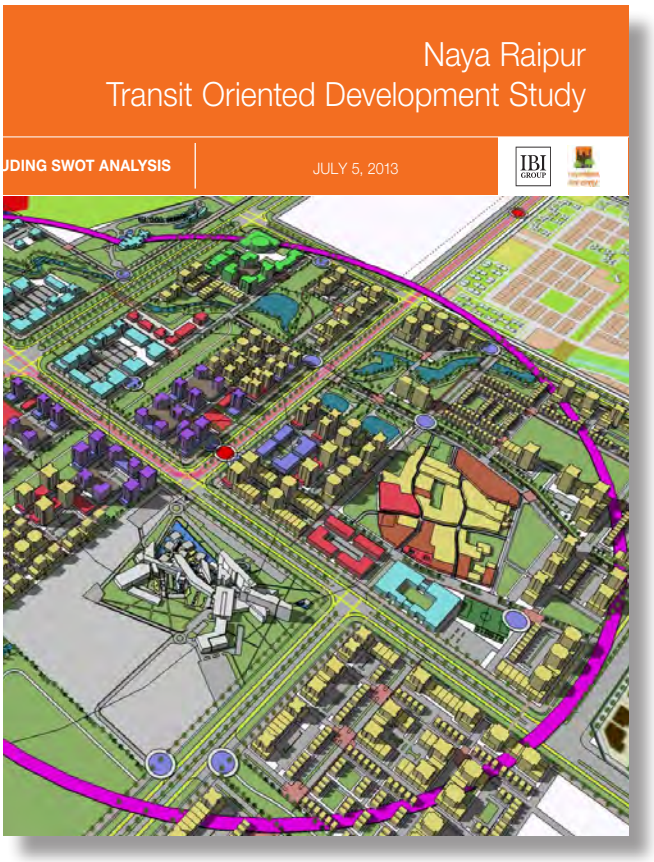
Type of Use	Minimum Parking Required	Visitor's Parking and Remarks
Mercantile-1	35% of Total Utilised FSI	20% of the required parking shall b provided as visitors parking
Note: In case the maximum permissible FSI is not utilised, for any extension/additions in the future, additional parking shall have to be provided as required for this additional utilised FSI.		

Source: Reproduced from UD&UHD (2017)

[Note: good TOD practice in TOD shifts the parking approach to maximum parking requirements instead of minimum ones]

In case of Metro Rail Transit (MRT) corridor the regulations of the Transit Oriented Zone shall be applicable only after finalization and notification of the MRT corridors by the Comprehensive Development Control Regulations – 2017, UD & UHD, Govt. of Gujarat.

NAYA RAIPUR TRANSIT-ORIENTED DEVELOPMENT STUDY



KEY ELEMENTS

1 Multimodal Transit Station

Rapid Transit Stations Local feeder bus stops must be located within 50m of rapid transit stations. Bus stops may be located within station premises or along the street right-of-way. IPT stands must be located within 150m of rapid transit stations. Parking shall be provided for 2-wheelers and cycles within 400m of all rapid transit stations. A parking space for the differently-abled must be provided within close proximity of a rapid transit station. Car drop-off bays must be provided within 150m of rapid transit stations.

Intermediate Public Transport IPT stands should be spread throughout the city, such that an IPT stand should be within 300m walking distance from anywhere in the city. IPT stands should be located such that the resulting passenger queues do not block pedestrian or NMV movement. Clear directions for forming queues at IPT stands shall be placed at all IPT stands.

2 Interconnected Street Pattern

An interconnected street pattern is a traditional urban design technique that reduces congestion, encourages travel choice and supports mixed-use development. Block lengths should not exceed 200m.

	Total ROW Min & Max	Maximum C/C Intervals between Street Intersections
City Arterial Roads		
Major	30m - 48m (excluding green buffer)	200m
Minor	24m - 36m (excluding green buffer)	200m
Intra-Sectoral Roads		
Local Collector Streets	15m - 24m	100m
Neighbourhood Streets	12m - 18m	100m
Shared Village Streets	12m - 20m	
Service Lane	5m - 6m	N/A

Source: Reproduced from NRDA (2013)

3 Mixed Used Development

A mix of diverse and complementary land uses in a compact pattern allows residents and workers to walk to work or to shop rather than driving for all daily needs. All projects and sites within the Mixed Use (MU) zones may have a mix of uses. A variety of shared parks and multi-use public spaces shall be provided, which can be active round-the-clock and open for use by users of a variety of age groups, income groups and gender, and also reduce number and length of trips. Selective plots within the MU Zone shall be applied with vertical mixed-use requirements incorporating 2 or more uses. A minimum of 50% of total street frontage length of any TOD project should have an active frontage with a mix of at least two types of uses with different peak hours of activity stacked vertically, to provide round-the-clock 'eyes on the street'. A minimum of 20% of FAR for all Residential Group Housing projects to be allocated to rental or for-sale housing with unit sizes no larger than 40 sq.m.

4 Walkability

Pedestrian-friendly environments allow walking to be a pleasant, safe, and efficient alternative to (or extension of) the automobile. This includes design features such as safe crossing points near transit stations, shaded pedestrian routes, and continuous sidewalks and paths.

Table 1: Table: Pedestrian Mobility

Table 3: Pedestrian Mobility Standards	
Pedestrian clearance requirements	Minimum clear width = 1.8M
	Minimum clear height = 2.4M
Pedestrian path	Minimum width on residential street = 2M
	Minimum width on commercial/mixed use street = 2.5M
Kerb height	Maximum height = 150MM
Pedestrian crossings	Minimum width = 3M
	Preferred C/C spacing = 100M
Accessibility	Maximum ramp gradient = 1:12
	Minimum ramp width = 1.2M
Pedestrian refuge islands	Minimum width = 2.5M
Bollards	Minimum spacing = 1.2M

Source: Reproduced from NRDA (2013)

Road design standards should be pedestrian-friendly:

Lane widths: narrower lanes encourage slower travel by vehicles. Lane widths on urban streets should not exceed 3M.

Turning radii: tightening turning radii require vehicles to slow down while making turns. Turning radii should not exceed 4.5M for urban streets and 7.5M for arterial streets. Channelized left turn lanes must be avoided.

Kerb extensions: commonly used traffic calming measure at intersections to reduce travel speed.

5 Compact Development

The scale of transit-oriented development approximates the scale of the pedestrian. The extent of these neighborhoods is based on a comfortable walking distance from the edge to center (approximately 400 to 800m in radius).

Table 2: Table: Ground Coverage, FAR, Height and Other Controls

Use Premise (Plot Sizes)	Minimum Ground Coverage (%)	Maximum Ground Coverage (%)	Minimum FAR	Maximum FAR	Maximum Height (m)	Other Controls
A. RESIDENTIAL						
All types in MU - 5	65	85	4		70m (for group housing min 400sqm)	The maximum standard for net density permissible for any TOD project within the SAP is 300 du /ha.
All types in MU - 10	65	85	2		70m (for group housing min 400sqm)	Minimum standard for net density permissible for any TOD project within the SAP is 250 pph
B. INDUSTRIAL						
Large Flatted Group Industry > 2.25HA not permissible in MU Zones						
C. SPECIAL INDUSTRY						
All types in MU - 5	65	85	4		50m	
All types in MU - 10	65	85	2		50m	
D. COMMERCIAL - RETAIL						
All types in MU - 5	65	85	4		70m	
All types in MU - 10	65	85	2		70m	
E. COMMERCIAL - WHOLESALE						
Wholesale trade / Warehousing (integrated development) > 2.25HA not permissible in MU Zones						
F. PUBLIC / SEMI-PUBLIC						
All types in MU - 5	65	85	4		70m	
All types in MU - 10	65	85	2		70m	

Table 3: Table: Minimum Frontage Standards

Street ROW	Minimum Frontage
> 24M	70%
18 - 24M	60%
< 18M	0%

Source: Reproduced from NRDA (2013)

Table 4: Table: Active Frontage Standards

TOD Zone	Minimum Active Frontage for Commercial/ Mixed-use buildings	Minimum Active Frontage for Residential buildings
MU-5	70%	50%
MU-10	50%	30%
Rest of the City	30%	10%

Source: Reproduced from NRDA (2013)

Intermediate Public Transport IPT stands should be spread throughout the city, such that an IPT stand should be within 300m walking distance from anywhere in the city. IPT stands should be located such that the resulting passenger queues do not block pedestrian or NMV movement. Clear directions for forming queues at IPT stands shall be placed at all IPT stands.

6 Street Facing Building

Buildings should be placed near streets, not behind parking areas, to better define the street. Street front retail should be provided to humanize the building wall and activate the sidewalk. Building entrances should be close to transit entrances.

S. No.	Plot Size (in sqm.)	Minimum Setbacks in MU Zones			
		Front	Rear	Side (1)	Side (2)
1	40-60	0	5	0	0
2	Above 60 & upto 120	0	5	0	0
3	Above 120 & upto 250	0	5	0	0
4	Above 250 & upto 500	0	5	0	5
5	Above 500 & upto 1000	0	5	0	5
6	Above 1000 & upto 2000	1	5	3	3
7	Above 2000 & upto 4000	1	5	6	6
8	Above 4000 & upto 10,000	1	5	6	6
9	Above 10,000	1	5	6	6

Source: Reproduced from NRDA (2013)

Within MU zones, maximum front setbacks will be maintained as defined below

S. No.	Use	Maximum Setbacks	
		Public ROW >24m	Public ROW <24m
1	Commercial, retail, offices and non residential Uses	3m	3m
2	Institutional / industrial etc.	3m	5m
3	Residential	5m	5m

Source: Reproduced from NRDA (2013)

7 Bicycle Friendly Streets/Parking

Bicycles are efficient ways to expand the service area of the station without relying on automobiles or bus service. Bike lanes, bike routes, and secure parking make the bicycle an easy option.

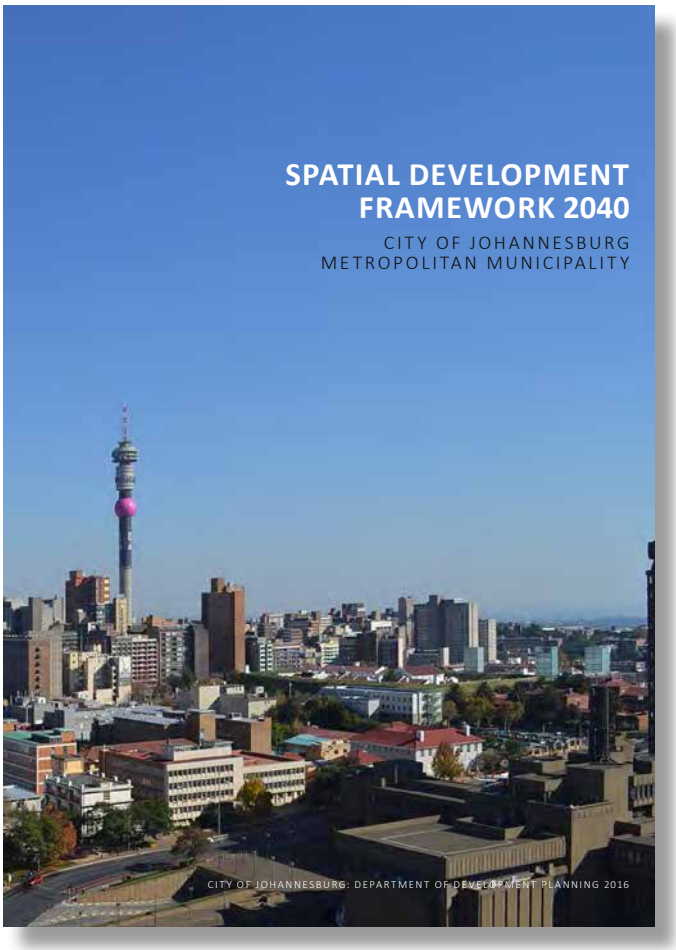
Table 9: NMT Standards

Segregated NMT paths/ trails	Minimum width = 2.5M
	Minimum buffer between NMT path and MV lanes = 1M
Marked NMT lanes	Minimum width = 2M
Vertical clearance	Minimum vertical clearance = 2.5M
Minimum horizontal radius	Minimum horizontal curve radius = 10m
Gradients	Maximum gradient = 1: 30 for length not exceeding 90m.
	Steeper gradients may be allowed for very short distances
	Maximum gradient = 1:70 for length not exceeding 500m.

Source: Reproduced from NRDA (2013)

- Bicycle markings on the roadway shall be clear. NMT paths and lanes should be colored in a distinct color to avoid confusion. NMT conflict zones shall be identified and marked with a different color to alert drivers of impending conflicts with NMVs.
- NMT crossing infrastructure design shall ensure a barrier-free environment for all including, raised crossings and additional traffic calming interventions, audible signals, curb ramps, etc.
- Bicycle boxes may be used at major signalized intersections to provide cyclist priority and safety.
- NMT paths or lanes should never be terminated abruptly due to a sudden change in ROW width or at a T-junction. Ramps should be provided where necessary to enable novice cyclists to shift to pedestrian paths.
- Cyclists should have a clear view of at least 25m straight ahead and 60m ahead on slopes.
- On-street NMT parking should be provided throughout the city, such that at least one NMT parking would be within a 300m radius from anywhere in the city.
- Private commercial developments should be encouraged to accommodate bicycle amenities such as showers, change rooms, and lockers. Incentives should be offered to developers or employers who install such facilities in their premises.

SPATIAL DEVELOPMENT FRAMEWORK 2040, CITY OF JOHANNESBURG METROPOLITAN MUNICIPALITY



1 Form-Based codes to supplement zoning in transformation Zone

Introducing Form-Based Codes as spatial policy on a local or regional scale in Johannesburg has the following goals:

- To supplement, not replace, traditional zoning tools to allow for a more desirable built form.
- To define what form the built environment should take, and what land uses should be in place.
- To offer design requirements to be applied in specific areas.
- To deal with context-specific aspects such as interaction with the street (shops and commercial activities, and permeability on the ground floor), height, interaction of building facades, parking location (on street, underground, or in a manner that does not create a parking 'buffer' between the street and the building), pedestrian accessibility and contribution to shared visions for the built environment.

2 Land Value Capture

The infrastructure needed to support new development can be financed, based on the projected returns. It is important in this case, that:

- Rates increases are considered thoroughly, and in consultation with finance experts and lenders to ensure realistic predictions;
- Rates increases from the specific developments are ring-fenced to service the specific infrastructure loans;
- That risk on the infrastructure loans is shared by private developers and the city, to ensure mutual commitment to realizing the goals of such a project;
- Inclusive social return (such as inclusionary housing and a percentage of public space) is set out as a requirement for this type of infrastructure funding.

3 Transit Oriented Development (TOD) Nodes

- TOD is identified as a priority programme, with the objective to encourage the optimal development of transit hubs across the city, that provide access to affordable accommodation, intense economic activities, transport, high-quality spaces, amenities and social services.
- TOD nodes are a key aspect of the compact polycentric vision for Johannesburg. Stations, in this regard, act not only as

points for accessing public transit, but as catalysts for growth. Stations should act as points of departure and arrival and are thus promoted as areas of intensification of high-density, mixed land uses.

- TOD nodes are those that are specifically linked to transit facilities. These nodes should ideally offer a range of mixed uses relating to the function and scale of the transit node. TOD areas have great potential for offering good quality of life through the creation of intense mixed-use precincts that can accommodate a range of economic opportunities within walking distance from public transport.
- These nodes vary in size and function. The largest TOD nodes are anchored by multi-modal stations. A large number of TOD precincts are anchored by PRASA rail stations, however, generally speaking, the development potential around these stations has not been realized. At a more localized scale, BRT stations will contribute significantly to the achievement of TOD precincts in the city. As a matter of principle, low density, single-storey, single-use developments are not acceptable within TOD nodes.

4 Density

The goal of the density regulations is to assist the city in curbing urban sprawl and locating the bulk of the city's residents across all income groups close to urban amenities, specifically public transportation infrastructure, jobs, economic opportunities and social infrastructure.

Higher residential densities will be allowed where developers show that they will deliver inclusionary housing. To qualify, the inclusionary housing proportion of the development must cater to households earning less than R7000 a month, equivalent to USD95 (10/2018), with a total monthly housing cost of 30% of household income per month (for rental or purchase). Density bonuses will be awarded proportionally to the percentage of inclusionary units per development (i.e. 30% inclusionary units would result in a 30% density bonus in du/ha), up to a maximum density bonus of 50%. To qualify, at least 20% of the total units applied for should be for inclusionary housing. The Transit Development Node within 500m walking distance of Rea Vaya/BRT bus station would have a minimum density of 60du/ha.

5 Land readjustment

With land readjustment, a group of neighboring landowners come together in a partnership and pool their land to jointly plan and service their adjoining plots. Part of the land can also be sold to offset development costs. The resulting costs and benefits of the project are equitably shared among public bodies, landowners and developers. During the readjustment, part of the land will often be used for infrastructure or public space. The public sector can stimulate this process by devising incentives that promote collective action.

Land readjustment involves a change in people's legal relationships in the same way that it alters their physical ones. This means that there are three fundamental considerations:

(1) To provide the framework within which relationships can be changed in a clear and predictable manner that results in mutual (public and private) benefit.

(2) To ensure that the framework is fair and will treat individuals and groups equitably, particularly the poor, women and the vulnerable, including private landowners and the wider citizenry of the city.

(3) To provide the vehicle for the implementation of government policy on the ground, legal mechanisms are needed to address issues such as site selection, the level of land contributions, the land valuation mechanism, sales and transfers of land after the project has been announced, handling disputes, combatting speculation, the classification of land in the plan, the types of formal land rights to be allocated, and financial arrangements.

6 Housing

The Spatial Development Framework 2040 provides a housing vision and approach and locational principles for housing, including housing for the poor, state delivered housing, informal settlements, backyard homes and inclusionary housing. The Inner City is targeted to accommodate a large number of new low income and affordable housing opportunities, including public rental housing, mainly through conversion of buildings. The development of inclusionary housing is a key priority to ensure that the City's residents are housed adequately, in close proximity to job opportunities, public transport as well as social amenities.

MODEL ZONING CODE KEY ELEMENTS

FAR AND DENSITY

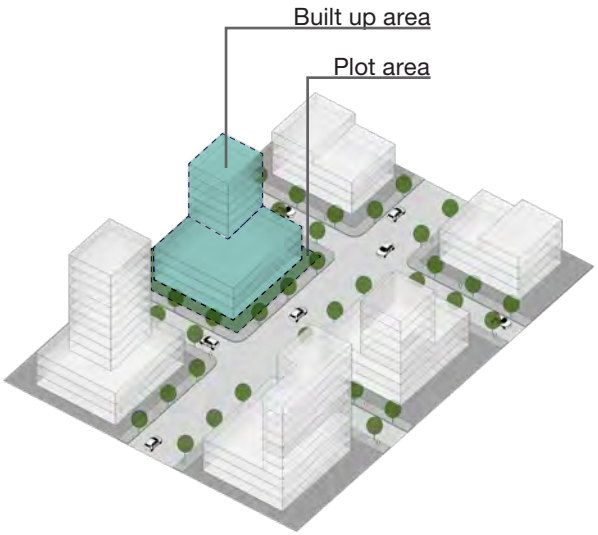
Floor area ratio (FAR) and Density norms are needed to ensure densities are strategically distributed across the urban area as a means to create compact city forms near transit proximities. The FAR is representative of the intensity of built form. It is a function of the total floor area of the building as a fraction of the total area of the development parcel. It is used as an instrument to control the density of a place by imposing maximum permissible FAR norms. In TOD zones, FAR norms need relaxation to allow for higher density buildings.

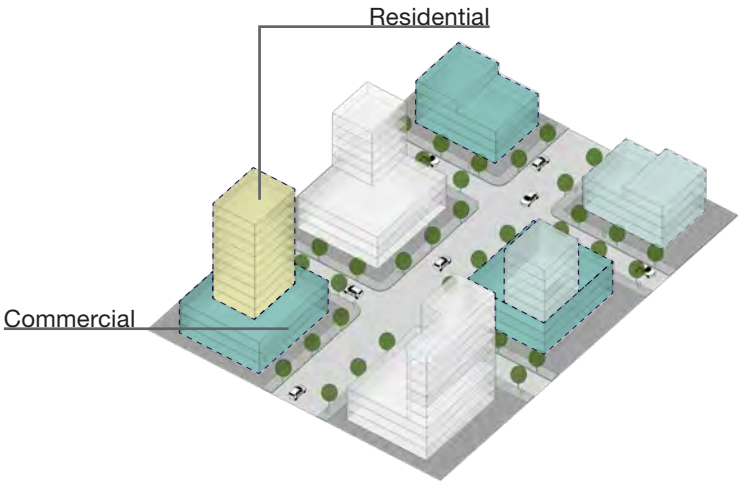
Alternatively, other measures to control residential density are also used, for example, Persons Per Hectare (PPH) or Dwelling Unit Per Hectare (DU/HA) thresholds. The density may also be influenced by norms for building heights, podium heights and step-backs and lot coverage.

MIXED USE

Mixed land use promotes more efficient land use patterns by increasing options for residents to access retail, commercial and civic services, employment and recreational facilities within walking distance. Mixed use is codified in the zoning code through Permissible Land Uses or Building Functions, and Non-Permissible Land Uses or Building Functions. Permissible Land Use/ Building Function Regulations must allow for complementary uses to be mixed, ensuring optimal and shared use of resources such as streets and parking. Non-Permissible Uses must discourage automobile-oriented uses such as large industries, car showrooms, cemeteries, etc.

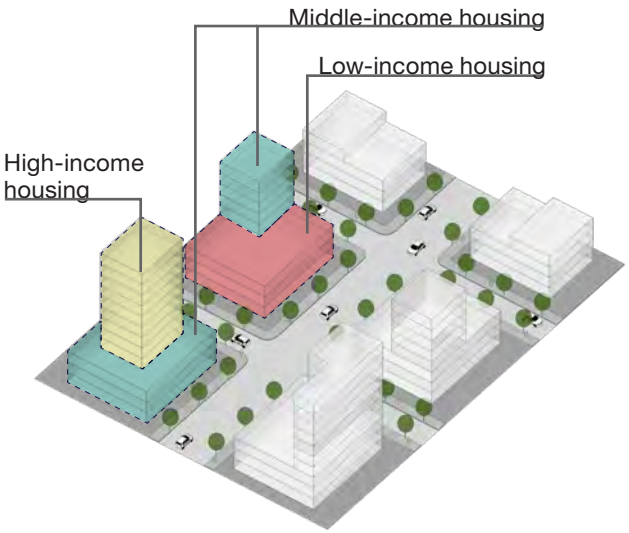
Other Design Guidelines for Mixed Use are suggested in PD-R01 TOD Planning Principles.





HOUSING DIVERSITY

A mix of housing types based on sizes and residential types may be provided within the TOD Zone or Station Area. This will allow for means to ensure that housing affordability is maintained within walking distance of transit. The mix of housing units and types within a corridor or station area can be dictated through minimum standards for inclusionary housing provision or affordable housing incentives. An inclusionary housing provision is operationalized by requiring a percentage of housing units to be within a specific range of unit sizes. The affordable housing incentive provision is operationalized by offering development incentives such as density bonuses or transfer of development rights. Other incentives are suggested in FI-R01 Development Incentives.

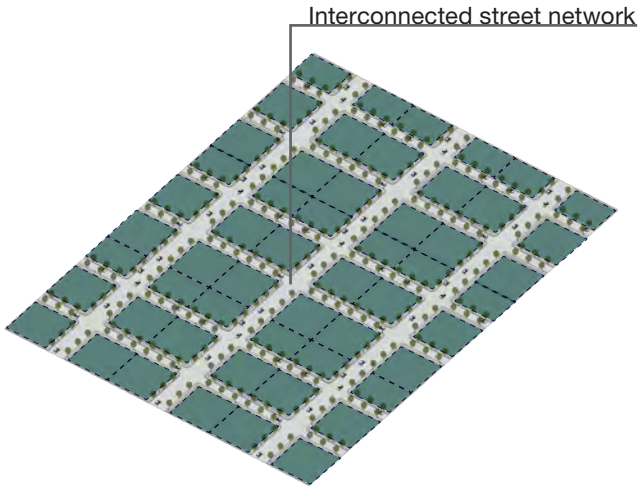


STREET NETWORK

The street network is controlled through block width and street design standards. Landforms, topography, natural features (waterbodies, forests) and physical barriers (railway lines, roads, existing developments) may influence street network standards.

Block widths are intended to increase the intersection density per sq. unit within the station area. Intersection density is the number of intersections in an area. It corresponds closely to block size– the greater the intersection density, the smaller the blocks. Small blocks make a neighborhood walkable.. Additionally, street standards can be provided for public streets within private developments or accessing private sites. These standards depend on the type of roadway and the level of service required and may be codified in the form of minimum widths for pedestrian sidewalks, cycle lanes, and traffic calming requirements.

Other Design Guidelines for Street Network are suggested in PD-R01 TOD Planning Principles.

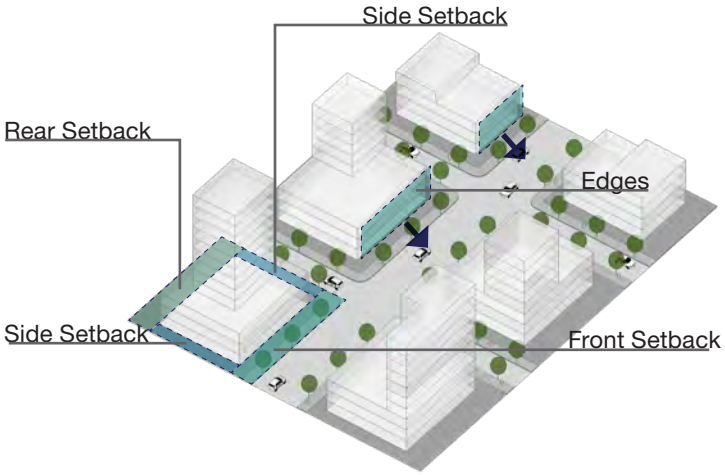


MODEL ZONING CODE KEY ELEMENTS

EDGES

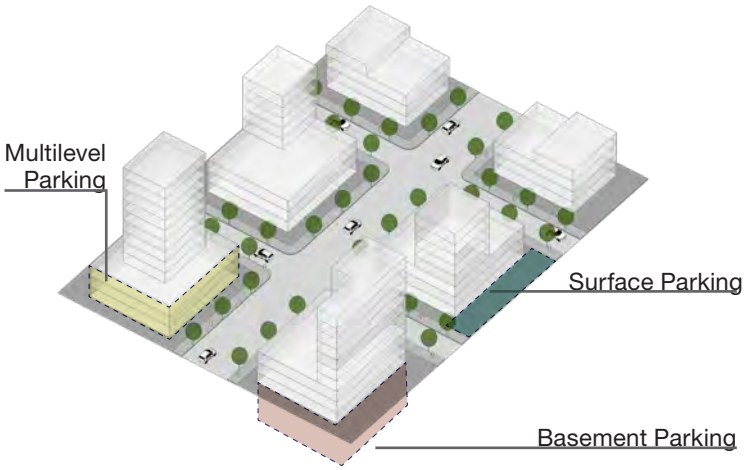
The transition zone between the building and the street is defined by the building setback and street frontage. Building setbacks should be reduced either to zero or shallow setbacks in the TOD Zone or station area to allow for a legible street edge. Buildings should be oriented towards the pedestrian, with active uses located along the sidewalk and not located behind parking lots or blank walls. Optimum setback needs are usually dictated by state/federal firefighting requirements and light and ventilation needs.

Street frontage requirements address the orientation of a building in relation to the street. They typically require a minimum percentage of a building facade to occupy a primary street frontage. Some portion of the frontage may be required to be transparent or interact with the street through shop fronts. Mandatory shop line requirements may be proposed along key streets to ensure active uses are oriented towards the street.



PARKING

Parking needs need to be rationalized in TOD Zones or station areas. Allow for flexibility in parking provisions, based on the specific development and transportation contexts. The trend is to move from minimum parking requirements to maximum parking requirements. Develop adjustment factors that can be applied when evaluating parking supply, while ensuring parking caps and maximums are respected. Shared parking standards and unbundled parking norms may be used to make the most out of parking provisions. The quantity of parking per built-up area impacts maximum development densities. Thus it is extremely important to reduce parking requirements or apply maximum caps if higher densities are proposed.



MODEL TRANSIT-ORIENTED DEVELOPMENT OVERLAY ZONING ORDINANCE

This model template is adapted from the Model Transit-Oriented District Overlay Zoning Ordinance resource by Reconnecting America (Valley Connections 2001). It provides a city the opportunity to create a "TOD Overlay Zone" over an existing base zoning framework. All the development parcels that lie within the TOD Overlay Zone are either required to or have the option to follow the regulations of the overlay zone. When the model template is applied to a city, the TOD Overlay Zone must be clearly defined to avoid ambiguity in property selection.

The original model zoning ordinance is available here: www.reconnectingamerica.org/assets/Uploads/bestpractice230.pdf

1. PURPOSE AND INTENT

The purpose of the Transit-Oriented District is to encourage an appropriate mixture and density of activity around transit stations to increase ridership along the transport corridor and promote alternative modes of transportation to the automobile. The consequent intent is to decrease auto-dependency and mitigate the effects of congestion and pollution. These regulations seek to achieve this by providing a pedestrian-, bicycle-, and transit-supportive environment configured in a compact pattern and a complementary mix of land uses all within a comfortable walking and bicycling distance from stations.

Transit-Oriented Development often occurs as infill and reuse within areas of existing development. The regulations within this ordinance vary in some cases from other ordinances related to infill development in the City, because of the additional need to support transit ridership.

OBJECTIVES

The specific objectives of this district are to:

- Encourage people to walk, ride a bicycle or use transit;
- Allow for a mix of uses to create an environment that engages people at the pedestrian scale;
- Achieve a compact pattern of development that is more conducive to walking and bicycling;
- Provide a high level of amenities that create a comfortable environment for pedestrians, bicyclists, and other users;
- Maintain an adequate level of parking and access for automobiles;
- Create fine-grained detail in architectural and urban form that provides interest and complexity at the level of the pedestrian and bicyclist;
- Encourage uses that allow round-the-clock activity around transit stations;
- Provide sufficient density of employees, residents and recreational users to support transit;
- Generate a relatively high percentage of trips serviceable by transit.

INTRODUCING THE OVERLAY ZONE

This is an overlay zone established in Transit-Oriented Development (TOD) principles, which provides the opportunity for mixed-use and higher density development along the transport corridor. This zone takes precedence over all underlying zones, except conservation areas and special areas, by encouraging compact, mixed-use development. Sustainable transit-oriented densification could be achieved through incentivizing the development of additional floor space along the transit corridors and station areas. The concept of Transit Oriented Development shall be adopted for development within this zone, such that the maximum number of people can live, work or find means of recreation within walking/ cycling distance of the transit corridors. This overlay Zone shall establish separate densities and development regulations applicable to any development in the TOD Zone. The TOD Zones will establish high-density environments in the city where bus feeder connectivity is optimum. This zone can benefit from more transit-friendly urban design.

DEFINITIONS

These definitions shall apply only to the Transit-Oriented District Overlay District.

Accessory Dwelling

units that are “secondary” or subordinate to the primary residence and situated on the same lot as the primary residence.

Access way

a formalized path, walkway, or other physical connection that allows pedestrians to efficiently reach destinations.

Clear Window

the amount of glass surface of a window that allows 100% visual permeability.

Commercial Parking Facility

a parking structure or a surface parking lot operated for profit that has parking spaces that are not accessory to a primary use. This term does not include a park-and-ride lot.

Compact Development

the planning concept of using site design and urban design techniques to decrease the amount of land needed to develop a given amount of land use. In the case of TOD, this is done with the goal of improving transit access.

Density

a unit of measurement that divides persons, floor area, or dwelling units per the gross or net measurement of a discreet area e.g., acres, square feet, square miles. Density requirements in this document are expressed as gross densities with the land area including the area of the parcel, specific to the use including its yard and any parking provided, plus the area of one-half of the street right-of-way upon which the parcel fronts.

Drive-Through Facility

facilities allowing transactions for goods or services without leaving a motor vehicle.

Finished Floor

the ultimate grade at which a structural floor will be constructed including added decorative and finished surfaces.

Floor Area Ratio (FAR)

the amount of enclosed gross floor area in relation to the amount of site area. For example, a floor area ratio of 0.5 is equal to one square foot of floor area for every two square feet of site area.

Frontage

the linear edge of a property adjacent to the property line abutting a street, public right-of-way.

Gradient

the change in density, height, and/or land use occurring in stages, degrees, or even and continuous change.

Greenway

a singular or a series of vegetative, linear corridors, natural or man-made, which may contain active or passive recreational uses or which may prohibit human activity altogether in order to preserve sensitive areas. These are usually associated with riparian systems, but may also include transportation corridors.

Human Scale

the size and proportion of a physical element that closely relates to the human body e.g., a 16-foot lamp post vs. a 30-foot lamp post, and a façade with vertically oriented framed windows vs. a façade with a continuous and unarticulated window wall.

Interior of Lot

the area within a parcel that does not contain a side which is adjacent to a public or private right-of-way for an access way or street.

Live-Work

a residential unit that is also used for commercial purposes for a time, with a minimum of 50% of the total building area given to the commercial use within the same structure as the residential component.

Major Pedestrian Route

the primary route or space used by “Pedestrians” as defined in this section.

Mixed-Use

Development contained within a single-parcel (horizontally or vertically) or adjacent parcels that contains different uses that are complementary to each other and provide activity throughout the day.

Open Space

a private or public open land area that is currently undeveloped; it may be maintained as open space into the future or it could be developed.

Parking Structure

a parking garage located above ground or underground consisting of one or more levels, not surface parking.

Park-and-Ride Lot

A parking structure or surface parking lot intended primarily for use by persons riding transit or carpooling, and that is owned or operated either by a transit agency or by another entity with the concurrence of the transit agency.

Parking, Off-Street

formal or informal parking located within a parcel and outside a private or public right-of-way.

Parking, On-Street

formal or informal parking located within a private or public right-of-way and outside of a parcel.

Pedestrian

a pedestrian means people who walk, sit, stand, or use a wheelchair in public spaces, be they children, teens, adults, elderly, people with disabilities, workers, residents, shoppers or people watchers, etc.

Pedestrian Activity

the congregation of persons in an area whose primary means of transportation is by foot.

Pedestrian-oriented Design (PeD)

The design of communities, neighborhoods, streetscapes, sites, and buildings that emphasizes pedestrian access, comfort, and visual interest. Transit-Oriented Design is a particular type of PeD that includes design and intensity of land use to support transit in addition to pedestrians.

Pedestrian Way

a linear space or an area where the primary users are pedestrians and that may also accommodate bicyclists.

Pergola

an arbor or passageway with a roof or trellis on which climbing plants can grow.

Portico

a porch or walkway with a roof supported by columns, often leading to the entrance of a building.

Porch

an open or enclosed gallery or room attached to the outside of a building, typically serving as a semi-public space prior to a building entry.

Primary Front Façade

the façade of a building that is meant to take importance over the remaining façades of a building, typically fronting onto a public or private street or pedestrian access way.

Setback

the distance between the building façade and the property line of the parcel in which the building is located.

Shared Parking

parking that is utilized by two or more uses taking into account the variable peak demand times of each use; the uses can be located on more than one parcel.

Station Area

the core area of the TOD within closest proximity of the transit platform e.g., within 300 to 500 feet of the platform.

Street-Facing

the façade of a building that is adjacent to a public or private right-of-way.

Transit-Oriented Development (TOD)

a development pattern characterized by a mix of uses surrounding a transit platform where streets have a high level of connectivity, blocks are small, and streetscape, buildings, and uses cater to the pedestrian.

Transit Platform

A designated transit loading and waiting area as assigned by the public transit agency.

Transit Station

the area including the platform which supports transit usage and that is owned by the transit authority.

Transit Street

a street that contains s transit line.

Transparent

a surface which allows objects on the other side to be easily seen.

Visual Permeability

the ability of vertical surfaces to allow viewers to see through to the other side e.g., windows and open fencing.

Walking Radius

the distance beyond a central point from which a person is willing to walk. This distance will vary depending on existing barriers, the walking environment, and the availability of destinations.

2. APPLICABILITY AND GENERAL PROVISIONS

The City of _____'s Transit-Oriented Development Overlay District(s) (TOD) shall apply to lands delineated on the City's official zoning map as adopted on _____ and generally within an 800m walking radius (or distance) of a transit platform. All land uses and development including, but not limited to buildings, drives, parking areas, landscaping, streets, alleys, greenways, and pedestrian/bicycle ways designated to be within this district, shall be located and developed in accordance with the following provisions. The standards of the TOD shall not apply to development for which approval was granted prior to the adoption of these regulations and for development for which the city has issued building permits.

3. INCONSISTENCIES OF UNDERLYING DISTRICTS

In the event that the underlying zoning district standards or other ordinance or regulations are inconsistent with these Overlay Zoning Ordinance standards or any other provisions herein, the TOD standards shall control within the specific TOD district.

4. PERMITTED USES

For properties within the Transit-Oriented Development Overlay District the following uses are permitted:

	Retail	Office	Industrial	Mixed-Use	Res>7du/ac	Res<7da/ac
Retail/Commercial						
Convenience Retail						
Retail and Service Uses						
Hotel or Motel Lodging						
Mixed Use						
Live-Work						
Mixed-Use						
Office						
Professional Offices						
Other Offices						
Civic						
Day Care Facilities						
Post Offices						
Schools & Community Buildings						
Government Offices						
Hospitals/Clinics						
Sports Facilities						
Residential						
Single-Family Detached						
Single-Family Attached						
Apartments						
Accessory Units						

5. PROHIBITED USES

For property within the Transit-Oriented Development Overlay District the following uses are prohibited:

- Boat dealers, resellers, repair, and leasing
- Bulk retail and wholesale uses including building materials, food and beverage sales, restaurant suppliers, etc.
- Car washes
- Cemeteries
- Cold Storage Plants
- Commercial Equipment and Construction Equipment, Sales, Service and Rental
- Drive-in Businesses
- Exterior Display of Goods and Exterior Storage
- Funeral Homes and Mortuaries
- Gas Station accessory uses such as mini-marts, convenience food and sundries sales
- Golf Courses including miniature golf courses
- Grocery stores with building footprints over 50,000 square feet
- Heavy Commercial Services
- Heating Fuel Sales
- Junk Yards and Motor Vehicle Wrecking Yards
- Kennels, excluding those accessory to veterinary clinics
- Manufactured Home sale
- Motorized vehicles dealers, resellers, repair, leasing, service stations, including oil and lubrication services, tire and muffler installation and service, body shops, or other motor vehicle services, but excluding retail or wholesale outlets selling motor vehicle parts and accessories without provision for on-site installation
- Nurseries or Greenhouses
- RV Parks or Mobile Home Parks and campgrounds
- Solid waste transfer stations
- “Telecom Hotels”
- Towing services
- Truck stops and Uses Related to Trucking excluding loading and unloading for permitted commercial uses
- Uses that require building footprints over [insert building footprint maximum area desired by jurisdiction, could vary by distance from transit platform and existing station area context, authors of this Model Overlay Ordinance recommend 30,000] sq. ft.10 with the exception of Civic Uses and Sports Facilities.
- Warehouses, Mini-Warehouses, Storage Facilities, and Mini-Storage Facilities (Indoor and Outdoor)

6. DEVELOPMENT STANDARDS FOR PERMITTED USES

SETBACKS AND BUILT-TO-LINE

Setbacks and Build-to Lines for Non-Residential and Mixed-Uses

The following standards shall apply to new non-residential and mixed-use development within the TOD Overlay District.

Table 5: Non-Residential & Mixed-Use Setbacks and Build-to Lines

Distance from Station	Max. Building Setback
0-150m	
150-400m	
400-800m	

Features such as overhangs, porticos, balconies, loggias, arcades, covered (non-enclosed) bicycle parking, pergolas, and similar architectural features placed on the front (street-facing) side of the building are allowed within the setback.

Setbacks and Build-to Lines for Residential Uses

The following standards shall apply to new residential development within the TOD Overlay District.

Table 6: Residential Setbacks and Build-to Lines

Distance from Station	Max. Building Setback
0-150m	
150-400m	
400-800m	

DENSITY, AREA, BUILDING AND REGULATIONS

DENSITY

Densities for Non-Residential and Mixed–Uses:

New non-residential and mixed-use development within the TOD Overlay District shall achieve minimum FARs as stated in the table below and a maximum of 125% of the FAR given in the underlying zone.

Table 7: Non-Residential & Mixed-Use Densities

Distance from Station	Minimum FAR
0-150m	
150-400m	
400-800m	

Densities for Residential Uses:

New residential uses within the TOD Overlay District shall achieve densities according to the following table and a maximum of 150% of the average density given in the underlying zone.

Table 8: Residential Densities

Distance from Station	Min. Residential Density
0-150m	
150-400m	
400-800m	

BUILDING HEIGHTS

For all new development and the vertical alteration of existing development, building heights within the TOD Overlay District shall conform to the following table.

Table 9: Building Heights

Distance from Station	Max. Building Heights
0-150m	
150-400m	
400-800m	

GROUND COVERAGE

New development within the TOD Overlay District shall achieve ground coverage according to the following table or the underlying zoning designation's maximum lot coverage, whichever is higher.

Table 10: Ground Coverage

Distance from Station	Max. Ground Coverage
0-150m	
150-400m	
400-800m	

BUILDING FRONTAGE AND FACADES

In order to support the pedestrian-oriented environment within the TOD station area, building frontages onto streets and open spaces shall be maximized. Building frontage within the TOD Overlay District shall achieve the requirements as outlined in the following table:

Table 11: Building frontage

Distance from Station	Min. Building Frontage as a Percentage of Lot Frontage
0-150m	
150-400m	
400-800m	

Clear windows shall encompass, at a minimum, 50% of the building façade length fronting onto a street within the area from 1 m to 2 m above adjacent interior finished floor and adjacent sidewalk grade. Blank walls shall not occupy over 30% of the principal frontage for non-residential buildings and 50% for residential buildings, and a section of blank wall shall not exceed 6 m feet without being interrupted by a window or entry.

BUILDING ENTRY

If a building is adjacent to the transit platform, transit station, a transit street, or a major pedestrian access way, at least one main building entry shall be oriented to the adjacent transit platform, transit station, transit street and/or major pedestrian access way. A pedestrian way shall be provided from the building entry to the transit platform, transit station, transit street or major pedestrian access way.

To allow for their use, residential porches shall have a minimum clear depth of 2 m and shall be a minimum of 4.6 square meters.

7. STREET AND SIDEWALK REGULATIONS

Minimum Width

Sidewalks within the TOD Overlay District shall have a minimum 75cm clear space for circulation with the exception of residential areas with a density of less than 12 units per acre where the width may be reduced to 1.8 m.

Private Use of Sidewalks

Exterior storage on sidewalks is prohibited. Outdoor seating for food and drink establishments and pedestrian-oriented accessory uses, such as sales display for flowers, small shops, food, or drink stands, are exempt from this requirement. Outdoor service of alcoholic beverages shall be clearly demarcated from public spaces. In all cases, a minimum 8-foot clear pedestrian circulation path shall be maintained along the sidewalk.

Sign Regulations

New signage within the TOD Overlay District shall conform to the standards stated herein and Section.

Signage shall not reduce clear sidewalk width to less than 2.5 m. Opaque signage shall not reduce the visual permeability of street-fronting windows to less than the minimum clear window requirement.

8. PARKING AND LOADING REGULATIONS

Automobile Parking Requirements Per Floor Area or Unit Size and Land Use Type

For new development within the TOD Overlay District, the number of required parking spaces (on-street and off-street) shall be based upon the following table which summarizes the maximum number of parking spaces required for permitted uses:

Table 12: Automobile Parking “Maximums” for Permitted Uses

RETAIL/COMMERCIAL	
Bank	1.0 space for each __ square meters of gross floor area
Bars/Nightclubs	1.0 space for each __square meters of gross floor area
Bed & Breakfast	1.0 space per room or suite of rooms
Bookstores	1.0 space for each __square meters of gross floor area
Convenience Retail	1.0 space for each __square meters of gross floor area
Dry Cleaners	1.0 space for each __square meters of gross floor area
Eating and Drinking Establishments	1.0 space for each __square meters of gross floor area
Hotel or Motel Lodging	1.0 spaces per room or suite of rooms
Live-Work	1.25 spaces per dwelling unit and 1 space for each employee not residing in the dwelling unit
Lodging limited Bed and Breakfast Inn	1.0 space for each room or suite of rooms
MIXED USE	
Mixed-Use	1.0 space for each __square meters of gross floor area
Retail and Service Uses	1.0 space for each __square meters of gross floor area
OFFICE	
Professional Offices	1.0 space for each __square meters of gross floor area
Other Offices	1.0 space for each __square meters of gross floor area

CIVIC	
Day Care Facilities	__ spaces per employee
Gov't Offices	1.0 space for each __square meters of gross floor area
Lodges/Clubs	1.0 space for each __square meters of gross floor area
Hospitals/Clinics	1.0 space for each __square meters of gross floor area
Museums	1.0 space for each __square meters of gross floor area
Post Offices	1.0 space for each __square meters of gross floor area
Schools-Elementary/Jr. High	10 spaces + __ per classroom
Schools-High/College	__ spaces per student and staff
Sports Facilities	1.0 space for each __square meters of gross floor area
Theaters	__ spaces per seat
Worship	__ spaces per seat
RESIDENTIAL	
Studios and Efficiencies	__spaces per dwelling unit
1 Bedroom	__spaces per dwelling unit
2 Bedroom	__spaces per dwelling unit
3 Bedroom	__spaces per dwelling unit
Accessory Units	__space per accessory dwelling unit
AUTOMOBILE PARKING "MAXIMUMS" FOR PERMITTED USES	
Boarding Houses	__space per bedroom
Nursing Home	__space per bed
Elderly Housing	__space per bed
INDUSTRIAL	
Manufacturing/Light Industry	1.0 spaces per__square meter of gross floor area

9. ON-STREET PARKING

For new development occurring within the TOD Overlay District, on-street parking along the use's lot frontage shall count towards the parking requirements for uses on the lot set forth within the regulations of this Overlay District.

10. BICYCLE PARKING

Convenient bicycle facilities should also be provided within the TOD district. The following bicycle parking requirements shall be applied within the TOD district. Bicycle parking shall be provided at 1 space per 186 square meter feet of commercial floor area.

11. OFF-STREET PARKING LOCATION

Non-Residential and Multi-Family Uses

Surface Parking Lots

Off-street parking location for new development within the TOD Overlay District shall conform to the following requirements:

Off-street parking shall be located to the rear and/or interior of a lot such that its visibility from a street shall be minimized. At-grade, above-, or below-ground parking structures shall be permitted. At-grade parking structures shall have a minimum frontage. Surface parking lots shall be placed between the structure and a side or rear lot line. Where a lot fronts onto two or more streets, parking shall be located accordingly:

- Along the street with the least amount of commercial activity
- Along the street with the least amount of pedestrian activity if the lot is located along two or more commercial streets with equal amounts of commercial activity.

A maximum 2 m high wall or fence shall separate parking lots from abutting residential uses with a minimum 1.2m landscaped buffer. Walls and fences shall take on the character of residential uses.

12. SINGLE-FAMILY RESIDENTIAL USES

Garages, whether attached or detached, shall be set back at least 3 m behind the primary front façade of the buildings they serve. The primary front façade shall comprise at least 50% of the overall width of the primary residence and the 3 m setback shall not be measured from projections such as bay windows and porches, but from the façade of the wall which encloses the building.

13. LOCATION OF VEHICLE ACCESS

Conflicts between pedestrians and vehicles entering and exiting parking lots shall be minimized. Access from pedestrian-oriented streets shall be avoided unless no other reasonable access is available, such as in lots with a single street frontage and no alley. Where alleys are present, driveways leading to parking lots, and loading and service areas shall be accessed from the alley. Lots with more than one street frontage and no alley shall locate vehicular access along the street with the least amount of pedestrian activity. All loading and service drives shall be of a depth that prevents loading and service vehicles from obstructing the sidewalk and roadway.

Entrances to loading and service areas shall be screened from view. Access driveways shall not dominate the street frontage. Driveway widths shall be minimized to reduce their presence along the street. Where feasible, driveways shall be consolidated within the single lot and shared with adjacent properties to minimize their encroachment upon sidewalks. Shared driveway agreements shall be utilized where possible for shared parking, and loading and service areas. To avoid encroaching upon sidewalks and creating uneven pedestrian surfaces, driveway slopes shall be located between the roadside edge of the sidewalk and the curb.

14. LOADING AND SERVICE AREA LOCATION

Loading, service, and refuse areas shall be located at the interior of the lot and screened from view with walls, trellises, planting, berms, or by integration into the design of the building. Walls shall not exceed 2 m in height. Solid walls shall be landscaped to soften their appearance and shall be made of finished materials to match the primary building. Decorative elements, variation in materials, and articulation shall be used.

MODEL TOD FORM-BASED CODE

This model template is adapted from the Smart Code Version 9.2 (Center for Applied Transect Studies; 2008). This template is based on the innovative form-based code paradigm, where building standards will be defined based on the station area typology rather than land use.

These Codes may be used as a replacement or as an overlay to the existing base zoning framework. All the development parcels that lie within a specific station area typology would need to adhere to form-based regulations for that specific typology. When the model template is applied to a city, the TOD Station Area Typologies and their boundary delineation must be clearly defined to avoid ambiguity in property selection.

The Original Code is available here: https://transect.org/codes.html

Station areas along corridors are set in different urban contexts, play different roles in the transportation network and present unique challenges and opportunities. Successful approaches to built form around a Station Area that acts as a main interface into the rapid transit network may not be appropriate for a station area that serves as a key transfer point between different modes. Similarly, appropriate intensification strategies at a very urbanized hub may be very different from a regional destination or a greenfield low-density area. Every station area, whether existing or proposed, faces unique challenges and will require specially tailored strategies to develop high-performing TOD projects.

This Form-based Code is prepared for seven key station area typologies that depict typical planning considerations. Station area typologies are typically established based on:

- Existing land use character
- Transport functions including right-of-way, availability of multiple modes, and connectivity to the citywide network
- Land availability for future development
- Susceptibility to change - for example, age of buildings
- Mobility network (including block size and mobility barriers)
- Infrastructure carrying capacity

In the context of low and middle-income countries, typical station area typologies may include:

- Intermodal Gateways
- Employment Centres
- Destination Nodes
- Transit Neighborhoods
- Urban Core(CBD)
- Infill Neighborhoods
- New Residential Area

STATION AREA TYPOLOGIES

	Intermodal Gateways	Employment Centres	Destination Nodes
	 *Milwaukee Intermodal Station*	 *Raffles Place, Singapore*	 *Mahalaxmi, Bangalore*
What are the characteristics of the Station Area?	Significant hubs of transport activity with supporting commercial and informal activities	Significant center of economic and community activity. Stations serve the main public/semi public-amenities & offices of the city.	Stations which provide access to unique destinations.
What is the Character of Land Use Mix & Density?	Moderate- to high-density mix of industrial, commercial, employment, public - semi public / cultural and residential uses.	Moderate to high-density mix of employment, public-semi public / cultural uses. Some residential and local- retail also supported.	Moderate to low-density mix of public-semi public and cultural uses. Some residential and local-retail also supported.
What are the major planning & development challenges?	Integrating dense mix of housing and employment uses while maintaining ease of access to transit stations. Illegal parking and hawker encroachment can create a false sense of congestion.	Introducing housing into predominantly employment/ public-semi-public uses and improving connections/ access to transit.	Creating sustainable off-peak uses and accommodating peak travel demand.
What are land development opportunities?	Moderate chance of land availability	Less possibility of land availability	Less possibility of land availability

Transit Neighborhoods	Urban Core (CBD)	Infill Neighborhoods	New Residential Areas
 *Teleferico Do Alemao, Riode Janeiro*	 *Church Gate, Mumbai*	 *Koh-e-fiza, Bhopal*	 *Guatemala City*
Predominantly residential district with good access to regional and subregional centres	Significant center of economic, community and cultural activity with regional-scale retail destinations.	Predominantly residential districts located just outside the core/old city	Predominantly residential district outside the core/old city area with good access to the core city
Potential for community and regional-serving retail but need to balance demands and conflict with surrounding destination retail.	High-density with commercial uses (>75%) + a moderate mix of other uses such as institutions, and residential within a 5 min (400m) walking radius.	Moderate-to high-density with predominantly residential and moderate mix of Commercial, public semi public & community facilities	Moderate-to high-density mix with predominantly residential supported with commercial & community facilities
Integrating affordable housing in the product mix to increase transit ridership. Provide greater opportunities for commercial activities and informal markets to support household needs.	Integrating high-density housing into existing mix of housing and employment to support local-serving retail and improving connections/ access to transit	Integrating new housing and supporting local-serving retail Improving connections/ access to transit”	Expanding local-serving retail opportunities and high-density housing opportunities
Less possibility of land availability	Mostly infill developments & retrofitting uses	Very less chance of land availability	Moderate chance of land availability

	Note: All requirements in this Table are subject to calibration for local context.	INTERMODAL GATEWAY	EMPLOYMENT NODE	DESTINATION NODE	TRANSIT NEIGHBORHOODS
a.	BASE RESIDENTIAL DENSITY				
	Dwelling units per hectare				
b.	BLOCK SIZE				
	Block perimeter				
c.	THOROUGHFARES				
	Arterial				
	Sub-arterial				
	Collector				
	Neighborhood streets				
	Bike facilities				
	Pedestrian priority streets				
	Shared street				
d.	CIVIC SPACES				
	Park				
	Green				
	Square				
	Plaza				
	Playground				
e.	LOT OCCUPATION				
	Lot Width				
	Lot Coverage				
f.	DEVELOPMENT STANDARDS				
	Minimum height				
	Maximum height				
	Maximum podium height				
	Minimum podium stepback				
g.	SETBACKS - PRINCIPAL BUILDING				
	Front Setback Principal				

URBAN CORE	INFILL NEIGHBORHOODS	NEW RESIDENTIAL AREAS	BASELINE STANDARDS		
			High	Medium	Low
			Highest density should be within 500m catchment	Medium density should be within 1000m catchment	Lower density should be beyond the 1000m catchment
			150m	130m	110m

Dubai, UAE

TOD KP

PD-R02

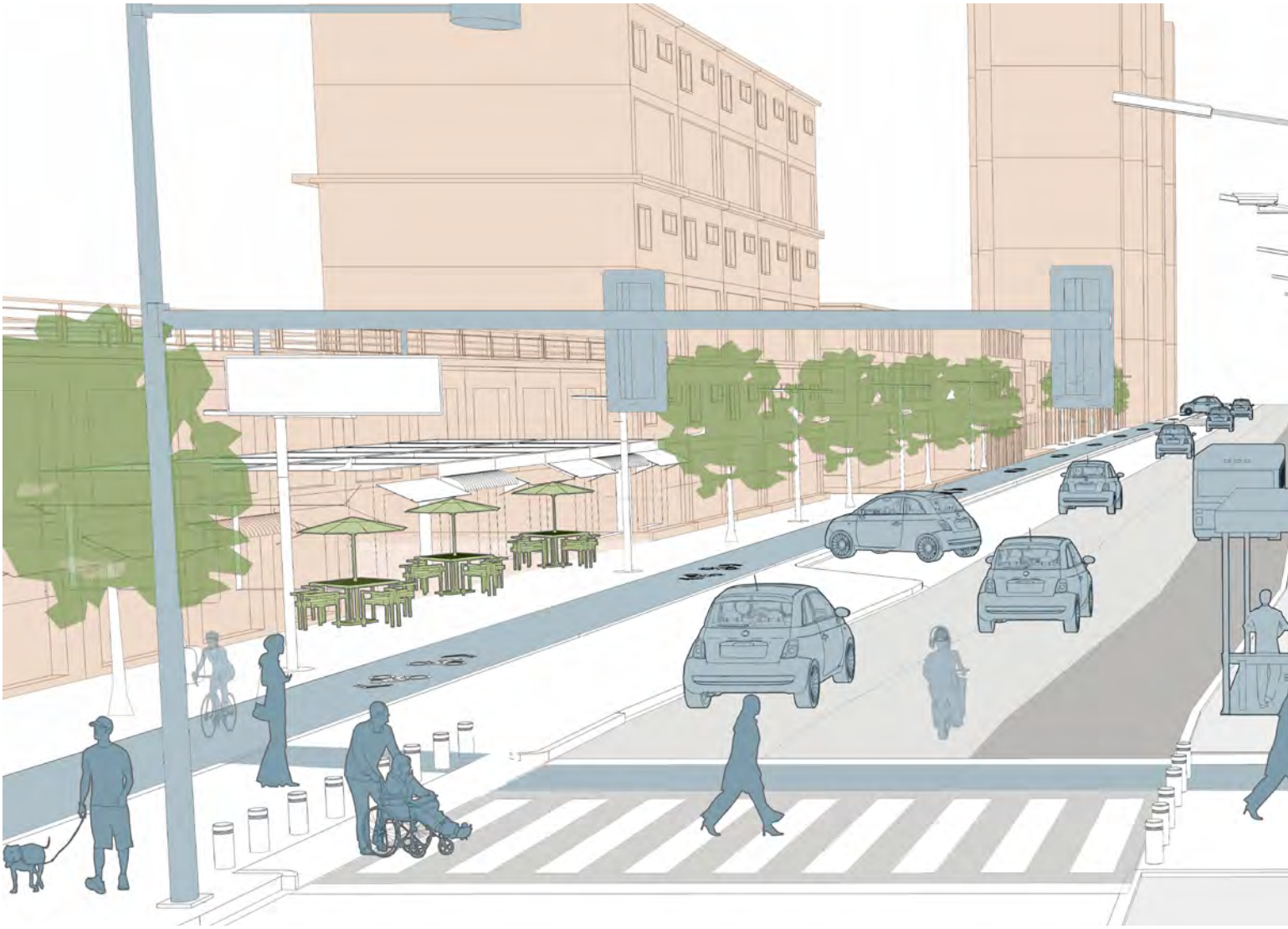
TOD PLANNING PRINCIPLES

A series of detailed planning principles and design components to formulate TOD plans at various scales of intervention

Type: Reference Document

WORLD BANK GROUP · TOD · Global Platform for Sustainable Cities · gef · UKaid from the British people · GRSF Global Road Safety Facility · IBI · WRI INDIA

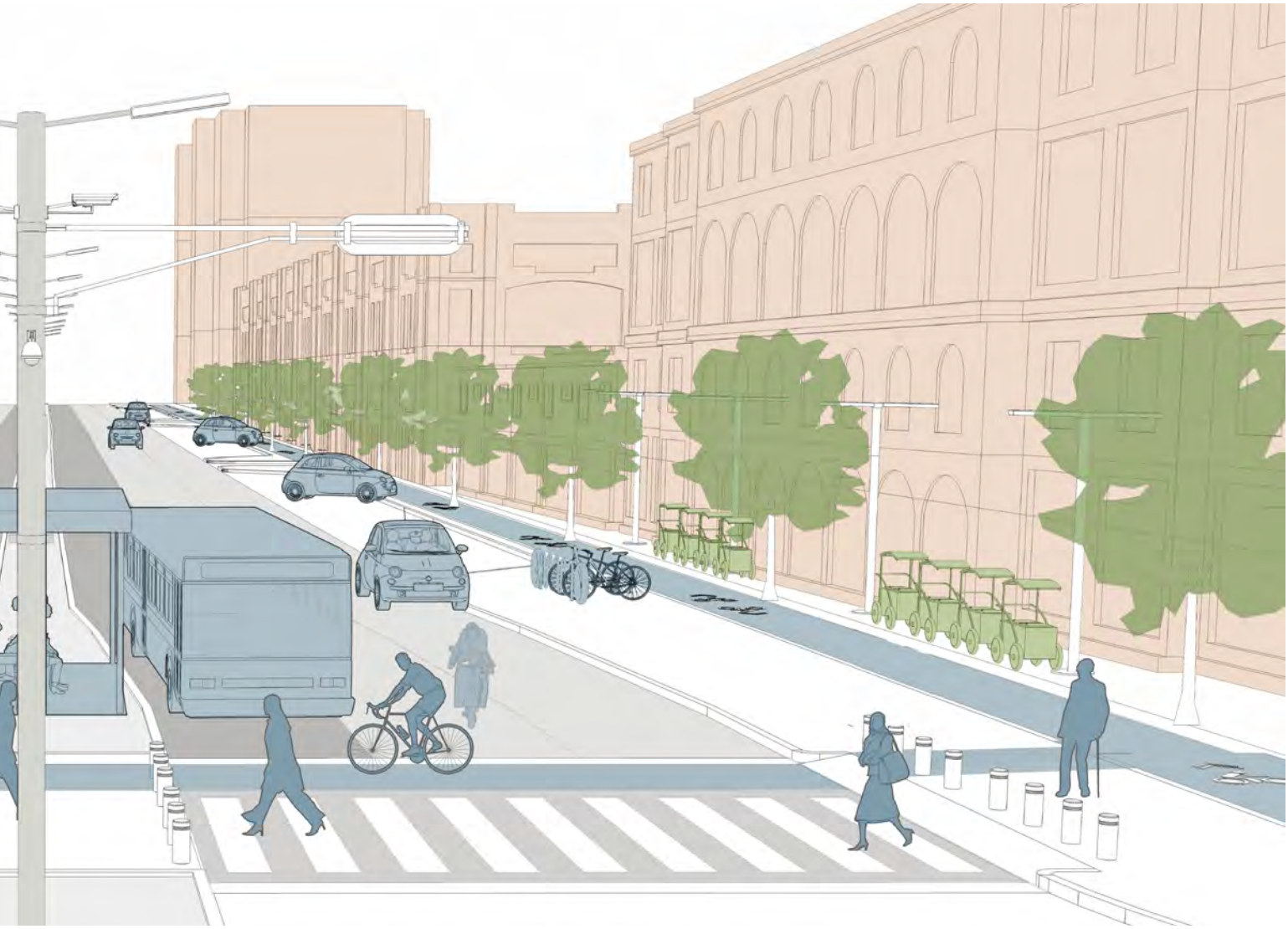
TOD DESIGN PRINCIPLES



TRANSIT (TRANSPORTATION)

The different transportation modes (transit, walking, bicycle, cars, taxis, etc.) and the infrastructure and amenities (lanes, parking spots, transit stops, stations, sidewalks, etc.) that allow residents to travel safely, conveniently, and comfortably, whichever mode they choose.

ORIENTED (OPEN SPACE)



The public spaces (plazas, patios, parks, sidewalks, etc.) that form the transition between transportation facilities and buildings, also known as 'the spaces between' where the life of the city plays out. Can be public or private property, but should be designed to be accessible, friendly, and fun for all.

DEVELOPMENT (BUILT ENVIRONMENT)

The built-up areas, primarily private parcels, where different human activities occur that support varied housing, employment, shipping, and other uses. In the TOD model, buildings should relate to and activate surrounding open spaces and support transit ridership by adequate density.

TRANSIT (TRANSPORTATION) COMPONENTS

WELL DESIGNED TRANSIT SYSTEM

T1

Encourage high-quality station architecture and public realm that is sensitive to the surrounding built context and must provide amenities, including retail, to ensure a comfortable and seamless commuter experience.

MULTI-MODAL INTEGRATION

T2

Seamless integration of transit modes, systems, and routes must be ensured, while considering efficient links to all modes of access, users and abilities, to and from the station.

COMPLETE STREETS

T3

Enable street design that ensures safe access for all users, including pedestrians, cyclists, motorists and transit riders, by providing equitable distribution of road space.

TRAFFIC MANAGEMENT

T4

Incorporate safe speed strategies for traffic around transit stops along with measures on traffic demand management and reduced parking demand to promote sustainable mobility choices.

ORIENTED (OPEN SPACE) COMPONENTS

TRANSIT PLAZA

O1

Promote congregational activities through inclusive and context-sensitive variety in architecture and landscaping around transit stations.

WALKABILITY

O2

Focus on providing an attractive pedestrian environment that is continuous, forms a network and offers an array of experiences and amenities.

PUBLIC REALM

O3

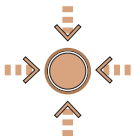
Provide visual interest at the pedestrian scale through thoughtful landscaping and building design, which will encourage people to use the public realm and help contribute to an active street life.

URBAN PARKS & OPEN SPACES

O4

Create open areas such as amenity spaces, green spaces, playgrounds, parks and natural areas, plazas, civic squares, etc. within a five-minute walking radius of residents.

DEVELOPMENT (BUILT ENVIRONMENT) COMPONENTS



COMPACT DEVELOPMENT

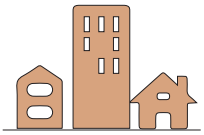
D1

Optimize employment and residential densities along a transit corridor or station area, based on the carrying capacities of transit and NMT infrastructure, to promote walking and transit use.

MIX OF USES

D2

Promote more efficient land use patterns by providing residents with access to retail, commercial and civic services, employment and recreational facilities without needing to travel by automobile.



HOUSING DIVERSITY

D3

Provide a diversity of housing choices, which includes a mixture of types, styles, price ranges and tenure, within a 10-minute walking distance from a transit station, to foster the creation of equitable TODs.

INFORMAL SECTOR INTEGRATION

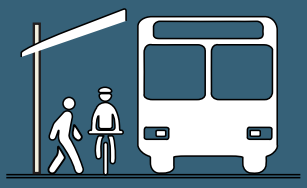
D4

Strive to achieve inclusive development in TODs by addressing the needs of the informal sector in all aspects of policy, planning and design for street vendors, settlements and transportation services

TOD SUPPORTIVE PRINCIPLES

CLIMATE RESILIENCE	**S1**	Identify high-risk areas to design TOD projects in consideration with the anticipated hazards and failures associated with climate change & environmental variations. ***Reference: Climate resilient development index: theoretical framework, selection criteria & fit-for-purpose indicators, European Commission*** *https://ec.europa.eu/jrc/sites/jrcsh/files/ReqNo_JRC94771_lb-na-27126-en-n.pdf*
INCLUSIVENESS	**S2**	Adopt inclusive development of TOD areas at all stages & scales by means of incorporating the needs of diverse user groups including gender, age, abilities & socio-economic segments. ***Reference: Towards an Inclusive and Low Carbon Transit Oriented development in Indian Cities, Shakti Foundation*** *http://shaktifoundation.in/wp-content/uploads/2017/11/TOD-India.pdf*
LAND VALUE CAPTURE	**S3**	Adopt development based land value capture as a financial mechanism for upgrading infrastructure along TOD corridors and station areas. ***Reference: Financing Transit Oriented Development with Land Values, World Bank Group, 2015*** *https://openknowledge.worldbank.org/handle/10986/21286*
UNIVERSAL ACCESSIBILITY	**S4**	Meet and exceed the requirements of accessibility guidelines and standards of all users with different abilities in building or retrofitting pedestrian environments. ***Reference: Environment for Disabled and Elderly Persons, CPWD (1998)***
SUSTAINABLE INFRASTRUCTURE	**S5**	Prioritize and implement innovative green building practices in all aspects of providing or upgrading infrastructure including, energy, water, landscape and waste management. ***Reference: LEED for Neighborhood Development*** *www.nrdc.org/cities/smartgrowth/files/citizens_guide_LEED-ND.pdf*
BICYCLE FRIENDLY	**S6**	Expand accessibility in TOD areas by promoting bicycles as an alternate or preferred sustainable and healthy mode of choice. ***Reference: National Guidance Document on Public Bicycle Sharing, MoHUA*** *(http://mohua.gov.in/cms/sustain-sutp-PBS.php)*
TECHNOLOGY INTEGRATION	**S7**	Adopt smart technologies within TOD projects such as fare integration, smart parking, real-time information, to provide public transit service an edge over automobiles. ***Reference: ITS Toolkit, IUT*** *(http://www.iutindia.org/capacityBuilding/Toolkits.aspx)*

T1



WELL DESIGNED TRANSIT SYSTEM

Encourage high-quality station architecture and public realm that is sensitive to the surrounding built context and must provide amenities, including retail, to ensure a comfortable and seamless commuter experience.

RISK & MITIGATION

- Transit agencies have a strong say on where the transit infrastructure is built, and hence influence the potential of TOD. Often, the transit stops are planned in less expensive locations, far from jobs and housing areas, which diminish the outcomes early on.
  Transit station designs are many times planned by transit agencies without considering options for joint developments or other mechanisms to improve integration at the station area scale.
- Placement of transit stops has to be in concurrence with the emerging locations that foster private development.

Recreio Shopping BRT station, Rio de Janeiro, Brazil

1. DESIGN CONTEXT-SPECIFIC TRANSIT SYSTEMS

- Transit corridors must be located in proximity to a city's current or planned urban footprint. City officials must assess where enough transit demand exists to sustain public transportation, or where there is potential for future development (based on integrated land use and transportation plans), and route primary and secondary transit systems to these areas in order to accommodate and create demand.

  -Module 4: Design Components of TOD, WRI, 2015

- A TOD corridor should be designed with the goal of incorporating and connecting as many types of transit systems to one other to create a more robust transit network, but not all stations across a corridor will demand the same variety and capacity of transit options. The types of transit options will depend on various factors including proximity to the urban core, and to dense residential and economic hubs.

  -Module 4: Design Components of TOD, WRI, 2015

- When planning a TOD corridor, it is necessary to understand the existing demand at each station, based on existing and projected economic conditions. This will help to prioritize the stations that should plan for the greatest hierarchy of public transit systems.

  -Module 4: Design Components of TOD, WRI, 2015

- Consider a transit alternative analysis to determine the most effective and cost-efficient mode for the context.
  - Bus Rapid Transit System should be considered for demand greater than 2000 passengers per hour per direction.

  -TOD Guidance Document, MOUD, 2016

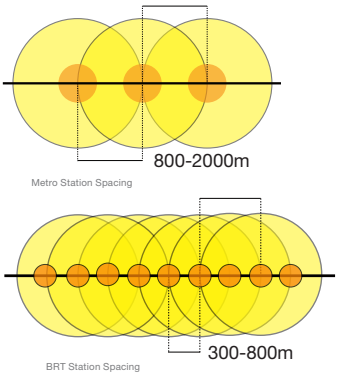
  - Metro Rail should be considered for demand greater than 15000 passengers per hour per direction.

  -TOD Guidance Document, MOUD, 2016

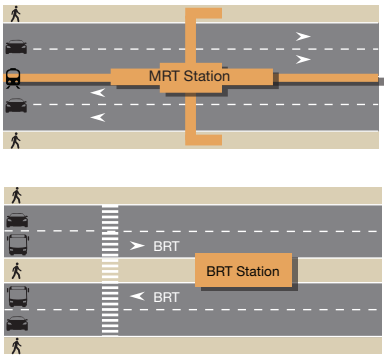
Refer E **PRIMARY STATION AREA DESIGN** for design guidance on station area design

+ REFER OTHER PRINCIPLES

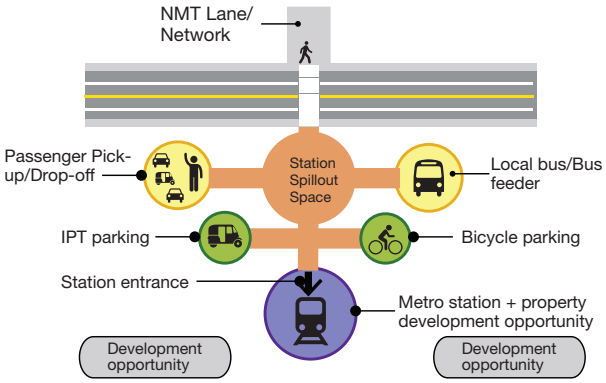
T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4



Station Spacing | *source: MOUD, 2016*



Station Placement | *source: MOUD, 2016*



Multi-modal integration at transit station | *source: MOUD, 2016*

2. CREATE BARRIER FREE MOVEMENT SPACES

- The maximum acceptable walking distance to the nearest rapid transit station is defined as 1,000m and 500m for a frequent local bus service that connects to a rapid transit network within less than 5 kilometers.

  -Adapted from TOD Standard, ITDP, 2017

- The transfer station should be designed for short, convenient and all-accessible connections with the rapid transit service.

  -Adapted from TOD Standard, ITDP, 2017

- In addition to variety, efforts should be made to integrate the various forms of public transit. This can be achieved through measures such as integrated fare systems across the different systems; easy access to transfer between systems, and combined operations to ensure higher quality, complementary and complete public transit system network.

  -Module 4: Design Components of TOD, WRI

3. PROVIDE CUSTOMER AMENITY TO ENHANCE COMFORT, SAFETY AND INFORMATION

- Convenience: Provide retail opportunities at transit stations to offer food, drink and services such as banks or dry cleaners.
- Comfort and Safety: Transit stations should provide comfortable and secure places to sit and wait with amenities such as washrooms and secure bike storage.
- Information: Provide a high level of customer service at stations, including staffed customer service kiosks, real-time and static information displays, wireless internet and pay telephones.

  -Adapted from Mobility Hub Guidelines, Metrolinx, 2011

+ REFER OTHER KNOWLEDGE PRODUCTS

AS A01, A02, H02, P02 | EN C01, C02, H01, R01, P01 | PD H01, H02, H03, H07, R03, P01 | FI A01, A02, H01, H02, R01, R02, R03 | IM A01, A02, H01, H02, P01

T2

MULTI-MODAL INTEGRATION

Seamless integration of transit modes, systems, and routes must be ensured, while considering efficient links to all modes of access, users and abilities, to and from the station.

RISK & MITIGATION

- Different agencies for various modes of transit, with lack of inter-agency coordination, hinders the seamless and efficient integration of transit for users.
- A multi-agency task force could be set up to address the interdependent needs of multi-modal integration at various levels from planning routes to provision of PPUDO at transit stops.

Informal transit at MG road metro station, Delhi, India

1. DESIGN FOR EFFICIENT INTER-MODAL TRANSFERS TO CREATE A SEAMLESS TRANSIT EXPERIENCE

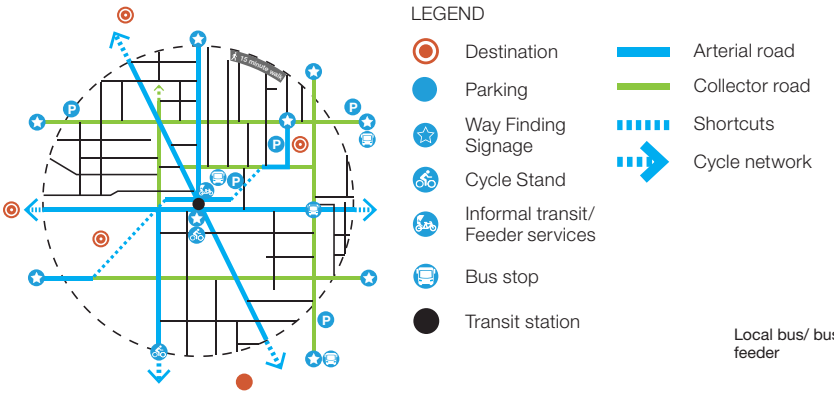
- Coordinate local feeder transit service schedules and routes to provide seamless connectivity between local, regional, and rapid transit services by reducing waiting times.
- Adopt transit priority measures to ensure the efficient movement of surface transit to and from the station area. Intermodal integration of formal public transport, paratransit and cycle sharing should be within 200m from each other.

APPROX. WALKING DISTANCE FROM EXITS	FACILITY/AMENITY AND PREFERRED LOCATION:
Within 100 m	Bus stops; vendor zones; convenience shopping; cycle-rental station, high occupancy feeder stop/ stand, public toilets; pedestrian-only plazas.
Beyond 100 m	Private car/taxi “drop-off” location only; validated car parking facility for metro users (park & ride) may be provided.
Within 500m	Cycle-rickshaw stand; cycle-parking stand; informal transit and ride-sharing services/auto-rickshaw stand, improved lighting, proper signage, information for modal interchange and way-finding; interchange between any two mass rapid transit modes (Railway, Metro, BRTS, etc.)

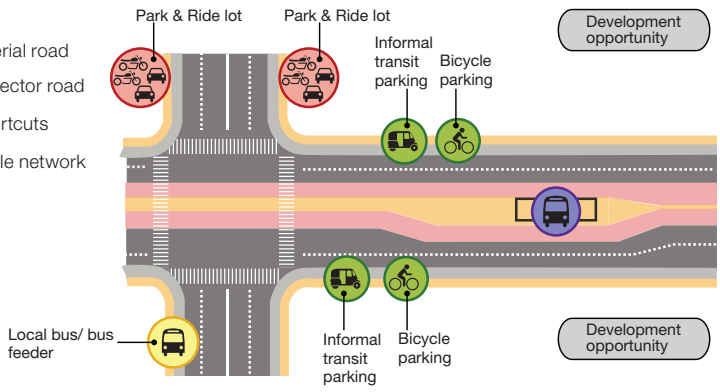
Refer E **PRIMARY STATION AREA DESIGN** for multi-modal integration guidance

+ REFER OTHER PRINCIPLES

T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4



Different access and mobility solutions around transit station | *source: MOUD, 2016*



Multi-modal options at transit station | *source: MOUD, 2016*

2. FOCUS ON THE NEEDS OF FIRST AND LAST MILE CONNECTIVITY

- Dedicated and physically segregated bicycle tracks with width of 2m or more, one in each direction, should be provided on all streets with total motor vehicle carriageway larger than 10m (not ROW) after providing adequately sized footpaths in each direction based on pedestrian traffic.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Provide designated parking for informal transit within 150m of walking distance from the station exit.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Cycle rickshaw parking and three-wheeler parking bays of 1.5m width should be provided near the junctions.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Desired average waiting time for a pedestrian is not more than 45 seconds.

+ REFER OTHER KNOWLEDGE PRODUCTS

AS A01, A02, A04, H02, P02	EN C01, C02, H01, R01, P01	PD H01, H02, H03, R03, P01	FI A01, A02, H01, H02, R01, R02, R03	IM A01, A02, H01, H02, P01

T3

COMPLETE STREETS

Enable street design that ensures safe access for all users, including pedestrians, cyclists, motorists and transit riders, by providing equitable distribution of road space.

RISK & MITIGATION

- Addressing competing needs of space from diverse user groups in an existing built context deters the objective of designing complete streets due to lack of available space.
- Street upgrades within various agencies and different timelines hinders the implementation of complete streets.
- Prioritizing other initiatives that help support the complete streets objective including traffic management, promoting walking & bicycling culture to be addressed in parallel.
- Inter-agency coordination and institutional support to bring the agencies together mitigates the risks on differing timelines.

W Pender Street & Hornby Street, Vancouver, Canada

1. DESIGN THE STREETS FOR THE ENTIRE RIGHT OF WAY

- Multi-Utility Zone (MUZ) of minimum 1.8 m width should be provided on all Collector and Arterial Roads, to accommodate bus stops, street utilities, trees, street furniture, planting for stormwater management; informal transit and ride-sharing services/ NMT stands, paid idle parking, etc.

-Adapted from TOD Guidance Document, MOUD, 2016

2. CREATE A BALANCE BETWEEN NEEDS OF ALL USERS AND MODES OF TRAVEL

- No vehicular street R/W within 500m of TOD station shall be more than 30m unless already notified in the Master Plan.

-Adapted from TOD Guidance Document, MOUD, 2016

- In a slow-speed local street (below 30km/h), the optimum width for a carriageway is 3 m for one-way movement and 4.5 m for two-way movement.

-Adapted from TOD Guidance Document, MOUD, 2016

- Create dedicated and protected bike lanes, at least 3m wide in each direction, on all streets except low-speed local streets.

-Adapted from The Energy Foundation, 2012

Refer

A **WALKING INFRASTRUCTURE,**

B **CYCLING INFRASTRUCTURE,**

C **FEEDER TRANSIT AND PARATRANSIT INFRASTRUCTURE and**

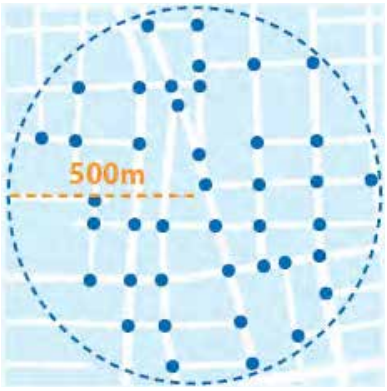
D **TRAFFIC CALMING MEASURES FOR SHARED STREETS**

for design guidance on Complete Streets design

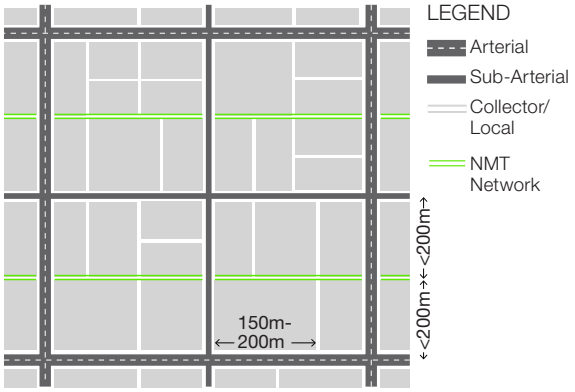
+ REFER OTHER PRINCIPLES

T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4

Building Edge-to-Edge Design | *source: MOUD, 2016*



Intersection Density | *source: MOUD, 2016*



Block Sizes & Street Hierarchy | *source: MOUD, 2016*

3. DESIGN STREETS IN CONTEXT TO ITS ABUTTING LAND USES

- A continuous unobstructed footpath on each side of all streets with ROW wider than 12m. Commercial/Mixed Use- 2.0m, Shopping frontages- 2.5m, Bus Stops- 3m, High-Intensity Commercial Areas-4m.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Building edges and building frontages should be incorporated in the street design.
- Building frontages should be accessible to the public as far as possible.

4. DEVELOP AN INTERCONNECTED STREET NETWORK TO PROVIDE DIRECT CONNECTIONS TO THE TRANSIT STATION

- Block sizes should be minimized to avoid the creation of inhospitable super-blocks. These types of long blocks can deter walking, as they increase the perceived distance between locations. Recommended block size: 150-200m (WRI +MOUD)

  -Adapted from TOD Guidance Document, MOUD, 2016

  -Module 4: Design Components of TOD, WRI, 2015

- Area of blocks surrounded by public access pedestrian/cyclist streets or pathways not to exceed 2 ha. In existing built-up areas, statutory planning to be done for breaking up blocks with an area of more than 2 Ha, to provide publicly accessible pedestrian thoroughfare.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Preferred density of pedestrian-friendly intersections: 50 intersections per squarekm.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Hierarchy of street network:
  - Arterial - 50m to 80m - 50km/hr
  - Sub-Arterial - 30m to 50m - 50km/hr
  - Distributor - 12m to 30m - 30km/hr
  - Access - 6m to 15m - 15km/hr

+ REFER OTHER KNOWLEDGE PRODUCTS

AS H03, P03 | EN C01, C02, H01, R01, P01 | PD H01, H02, H03, H07, R03, P01 | FI A01, A02, H01, H02, R01, R02, R03 | IM A01, A02, H01, H02, P01

T4

TRAFFIC MANAGEMENT

Incorporate safe speed strategies for traffic around transit stops along with measures on traffic demand management and reduced parking demand to promote sustainable mobility choices.

RISK & MITIGATION

- Growing dependency on automobile coupled with the tendency to sprawled development.
- Lack of appropriate parking policies and provision of distinct parking supply to address the needs for parking.
- Sensitizing officials in charge of traffic and transportation towards the needs of transit and NMT users.
- Adequate measures on updating policies and enforcement of traffic rules to focus on NMT users and their needs.

Park and Ride facility at Chattarpur Metro Station Parking, Delhi, India

1. REDUCE VEHICULAR TRIPS IN THE STATION AREA

- Vehicle Demand Management (VDM): Adopt strategies and policies to reduce or redistribute travel demand for private vehicles. Discouraging use of private vehicles by means of congestion pricing, registration fee, alongside with provision of high-quality public transit facilities are some of the means to address VDM.

  -Module 4: Design Components of TOD, WRI, 2015

- On streets with ROW of 18m or less, if pedestrian traffic is greater than 8000 per hour in both directions together, the entire ROW should be notified for pedestrianization.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Streets meant primarily for NMT movement as well as all streets of ROW 12m or below, should be limited to a maximum speed of 20km/hr by design.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Narrow streets that allow one-way motor traffic, as well as bicycles and pedestrians, will significantly reduce congestion. Replace major arterials wider than 45m with efficient one-way couples (two narrower one-way couples).

  -Adapted from The Energy Foundation, 2012

Refer

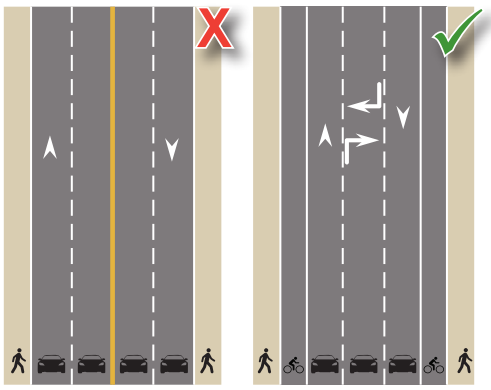
C FEEDER TRANSIT AND PARATRANSIT INFRASTRUCTURE and

for guidance on Traffic speeds management

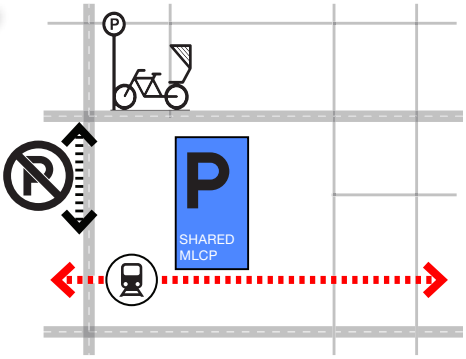
+ REFER OTHER PRINCIPLES

T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4

Traffic calming | *source: WRI, 2015*



Appropriate allocation of road space | *source: MOUD, 2016*



Station Parking | *source: MOUD, 2016*

2. OPTIMIZE TRAFFIC SPEEDS ON HEAVY TRAFFIC ROADS TO PROTECT MULTI-MODAL USERS AT TRANSIT STATIONS

- Disperse high traffic volumes over multiple parallel human-scale streets rather than concentrating traffic on fewer major arterial streets.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Limit speed on urban arterial roads and sub-arterial streets to 50kmph and on collector and local streets to 30kmph.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Traffic calming of all streets with ROW of 12m or less through the narrowing of driveways and meandering path with the use of trees, islands and street furniture.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Mid-block crossings every 250m on average. Min: 5 safe street-level crossings/km.

3. REGULATE PARKING NEEDS AROUND THE STATION AREA

- Short-Term Parking (on-street & off-street): Approximately 70% of the total parking space/slots capacity to be kept for short-term parking near the station.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Park-and-Ride Lots: Park-and-Ride facilities for private modes may be provided only at Terminal MRTS Stations or major Multi-modal Interchanges.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Special parking spaces should be designated on-street for differently abled, at a ratio of 1 for every 25 parking spaces. These parking spaces should have 1.2m access zones.

- At least 50% and preferably 100% of the total parking facilities (based on ECS) provided for any new/ redevelopment/retrofit project greater than 2000 sqm plot area, shall be provided as a Shared Parking facility.

- Minimum parking rates may be fixed but maximum rates be variable based on market forces, similar to all real estate space in the city.

- Increase fee exponentially with decreasing distance to BRTS/Metro Rail stations.

+ REFER OTHER KNOWLEDGE PRODUCTS

AS A01, A02, A04, H02, P02 | EN C01, C02, H01, R01, P01 | PD H01, H02, H03, R03, P01 | FI A01, A02, H01, H02, R01, R02, R03 | IM A01, A02, H01, H02, P01

O1

TRANSIT PLAZA

Promote congregational activities through inclusive and context-sensitive variety in architecture and landscaping around transit stations.

RISK & MITIGATION

- Transit route planning involves alignments passing through various contexts and space constraints, risking the provision of transit plazas at stops. Provision of standardized transit stop designs that lack distinguished character prohibits consideration of transit plaza Lack of sufficient land ownership by the transit agency.
- Station area plans should be made along with transit plans so that appropriate plazas are also designed. Space for transit plaza could be created through urban design guidelines or regulations over private properties.

Transit Plaza at center square MRT, Raffles Place, Singapore

1. ADOPT MEASURES TO CREATE EFFICIENT AND DISTINCT CIRCULATION AREAS THAT CATER TO INTER-MODAL TRANSFER AROUND TRANSIT STOPS

- Adopt transit priority measures to ensure the efficient movement of surface transit to and from the station area.

-Adapted from Mobility Hub Guidelines, Metrolinx, 2011

- Provide clearly marked and protected access for pedestrians and cyclists at station areas to minimize conflicts, particularly at passenger pick-up and drop-offs (PPUDO), bus facilities, and parking access points.

-Adapted from Mobility Hub Guidelines, Metrolinx, 2011

- Provide secure and plentiful bicycle parking at station entrances with additional cycling amenities at high volume locations.

-Adapted from Mobility Hub Guidelines, Metrolinx, 2011

Refer

D TRAFFIC CALMING MEASURES FOR SHARED STREETS

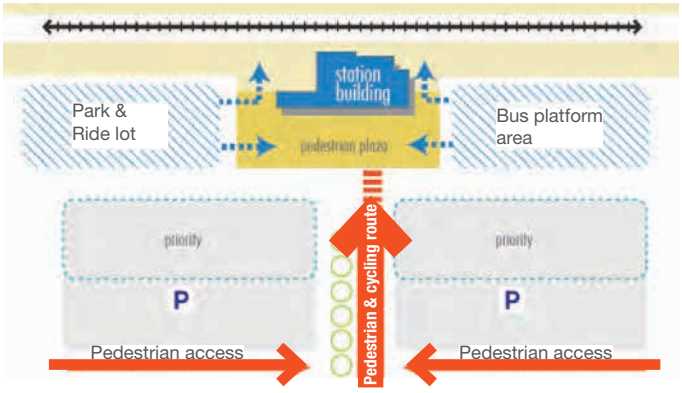
E PRIMARY STATION AREA DESIGN

for design guidance on Transit plaza and Station a design

+ REFER OTHER PRINCIPLES

T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4

Protected pedestrian zone at transit station | *source: MOUD, 2016*



Transit plaza connections | *source: Metrolinx, 2011*

2. PEDESTRIAN FIRST MEASURES HAVE TO BE PRIORITIZED AROUND THE TRANSIT PLAZA

- Provide an attractive pedestrian environment with a high level of priority, safety, and amenities.

  -Adapted from Mobility Hub Guidelines, Metrolinx, 2011

- Ensure the plazas respond to local needs both functional and architectural.

  -Adapted from Mobility Hub Guidelines, Metrolinx, 2011

- Public plazas with community amenities such as gathering places, public information kiosks, public art displays and opportunities for small convenience-oriented retail uses.

  -Adapted from Mobility Hub Guidelines, Metrolinx, 2011

- In waiting areas, include a variety of comfortable seating types and locations.

  -Adapted from Mobility Hub Guidelines, Metrolinx, 2011

- Use fountains, landscaping and building elements (such as low walls) to buffer traffic noise.

  -Adapted from Mobility Hub Guidelines, Metrolinx, 2011

- Incorporate natural landscape elements and other green design features such as drought-resistant plantings, permeable surfaces and recycled/able materials.

  -Adapted from Mobility Hub Guidelines, Metrolinx, 2011

- Recommended area of pedestrian spill out space > 1.9 sqm/ped.

  -Adapted from TOD Guidance Document, MOUD, 2016

+ REFER OTHER KNOWLEDGE PRODUCTS

AS | EN C01, C02 | PD H03, H04, H05, H06, P01 | FI A02, H02, R01, R03 | IM A01, A02, H01, H02, P01

O2

WALKABILITY

Focus on providing an attractive pedestrian environment that is continuous, forms a network and offers an array of experiences and amenities.

RISK & MITIGATION

- Lack of technical capacities and sensitivity towards pedestrian needs.
  Lack of a walkable mix of uses because of discordant land use regulations.
- Consider formulation of NMT cells within at relevant levels within the local authorities to address the needs of walking.

Pedestrian Amenities, Tianjin, China

1. PROVIDE APPROPRIATE NETWORK AND WIDTH OF CONTINUOUS FOOTPATHS

- A concerted effort to create connected & contiguous networks for cycling & walking must be made at the corridor level, detailed to the level of each station area.
- Adopt sidewalks to be designed using a three-section strategy:
  - Service zone: contains space allocation for urban furniture, vegetation, stormwater management and infrastructure
  - Pedestrian flow zone: strictly dedicated to pedestrian movement, free of all obstructions. This zone must cater to all users with different abilities and age groups moving in both directions.
  - Front-of-building zone: transition zone from public to private property, could be utilized for outdoor seating, signage, porches, planting etc.
  - Additionally, a fourth zone could be added, if space permits for bicycles, as an additional section of the sidewalk of as part of the street.

Refer

A WALKING INFRASTRUCTURE

for design guidance on Walkability

+ REFER OTHER PRINCIPLES

T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4

Pedestrian environment | *Source: MOUD, 2016*

Active street edge | *Source: MOUD, 2016*

2. MAKE WALKING A COMFORTABLE CHOICE

- Street trees:
  - At least 125 trees perkm for streets with ROW smaller than 12m.
  - At least 125 trees perkm per footpath on streets with ROW greater than 12m.
- Street Lighting: Spacing should be uniform with the distance based on the minimum illumination required.
- Street Furniture: Benches, trash, receptacles, bollards, vending kiosks, signage to be provided adequately.
- Public Facilities: Provide Accessible Public Toilets at every 500-800m distance – preferably located close to bus stops for easy access by pedestrians and public transport users.

-Adapted from TOD Guidance Document, MOUD, 2016

3. MAINTAIN ACTIVE STREET EDGES TO CREATE SAFE WALKING

- Active frontages include arcades, shopfronts, entrance doorways, access points, entry/exits and transparent windows of active areas facing the primary access street.

-Adapted from TOD Guidance Document, MOUD, 2016

- Primary pedestrian access for buildings from the main street, with location as per shortest walking distance from nearest bus stop.

-Adapted from TOD Guidance Document, MOUD, 2016

- Vehicular/service access should be from secondary street wherever access to the building is possible from multiple streets.

-Adapted from TOD Guidance Document, MOUD, 2016

- Compound walls, if present, should be transparent above a height of 100cm. High-security government buildings may apply for an exemption.

-Adapted from TOD Guidance Document, MOUD, 2016

+ REFER OTHER KNOWLEDGE PRODUCTS

AS A01, A02, A04, P02 | EN C01, C02, H01 | PD H03, H04, H05, H06, P01 | FI A02, H02, R01, R03 | IM A01, A02, H01, H02, P01

O3

PUBLIC REALM

Provide visual interest at the pedestrian scale through thoughtful landscaping and building design, which will encourage people to use the public realm and help contribute to an active street life.

RISK & MITIGATION

- Lack of micro-planning mechanisms or allocation of budgets with public agencies hinders the investments in public realm improvement projects.
- Investments in infrastructure to support the quantum of development envisioned for a particular place is critical to TOD. The public sector needs to invest in infrastructure to alleviate the cost burden from prospective private developments.

Public Realm, Sao Paulo, Brazil

1. INCORPORATE PROVISION OF PUBLIC REALM AT ALL SCALES OF TOD PLANNING

- A neighborhood park accessible by 800m walking or bicycle trip, and a public sports venue accessible by 1,200m walking or bicycle trip.

-Module 4: Design Components of TOD, WRI

- Public spaces must be designed to integrate with existing urban space and meet the needs of local residents. To properly integrate a public space network, the public spaces within the network should connect with each other and with a neighborhood's primary leisure spaces. This network can be connected through a system of sidewalks, pedestrian paths, or cycling paths.

-Module 4: Design Components of TOD, WRI, 2015

- When streets are thought of as public spaces, opportunities for community enhancement are created. Community streets can be used for a variety of purposes, including such events as food fairs, festivals, games, and parades.

-Module 4: Design Components of TOD, WRI, 2015

- Through the establishment of mixed-use districts, encouragement of streetscape that are created for all user experiences (not just vehicles), sidewalks that are built for multiple purposes including green space, pedestrian experience, and aesthetic transitioning to adjacent businesses and residences, zoning codes can be powerful tools.

-Module 4: Design Components of TOD, WRI, 2015

Refer

A **WALKING INFRASTRUCTURE,**

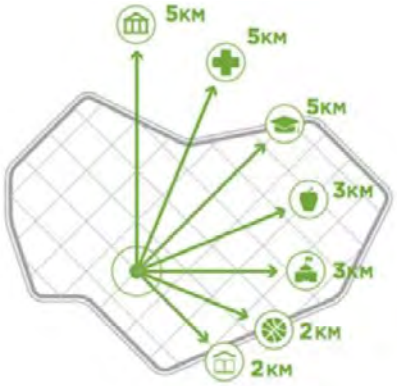
B **CYCLING INFRASTRUCTURE,**

D **TRAFFIC CALMING MEASURES FOR SHARED STREETS**

for design guidance on Public Realm design

+ **REFER OTHER PRINCIPLES**

T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4



Regional facilities | *source: WRI, 2015*

Shared community streets | *source: WRI, 2015*

Place identity | *source: WRI, 2015*

2. PROVISION OF PUBLIC SPACES IMPROVES QUALITY OF LIFE

- Provision of public and green spaces can seem in direct conflict with TOD's density goals; however, the two design components must be thought of as complementary. Balancing the two design components to achieve high density and green and public space is not only possible, but necessary.

  -Module 4: Design Components of TOD, WRI, 2015

- Important local landmarks, including heritage buildings, churches, and monuments, must be preserved to keep a community's history alive. TOD design can serve to increase access to historical locations; for example, pedestrian zones can be created around important monuments and buildings, improving connectivity between important historical sites.

  -Module 4: Design Components of TOD, WRI, 2015

  -Adapted from TOD Guidance Document, MOUD, 2016

3. DESIGN OF PUBLIC SPACES MUST BE SENSITIVE TO LOCAL HERITAGE AND CONTEXT

- Preservation of local identity is key in defining unique places and creating a sense of belonging among residents, which are central for TOD projects. Effort should be made to recognize local assets when planning a TOD project. TOD design can serve to complement, enhance, and reflect local cultural, heritage/historical, and environmental features.

  -Module 4: Design Components of TOD, WRI, 2015

- The architectural features of a TOD project should take local context into consideration. Existing buildings can be used as prototypes, and properties of local architecture, including construction materials and facade colors, can influence TOD design.

  -Module 4: Design Components of TOD, WRI, 2015

- TOD projects should also take a community's cultural traditions into consideration when designing development for a neighborhood. If a community has traditional festivals, parades, or weekly markets, these customs must be accommodated through design.

  -Module 4: Design Components of TOD, WRI, 2015

+ REFER OTHER KNOWLEDGE PRODUCTS

AS | EN C01, C02 | PD H03, H04, H05, H06, H07, P01 | FI A02, H02, R01, R03 | IM A01, A02, H01, H02, P01

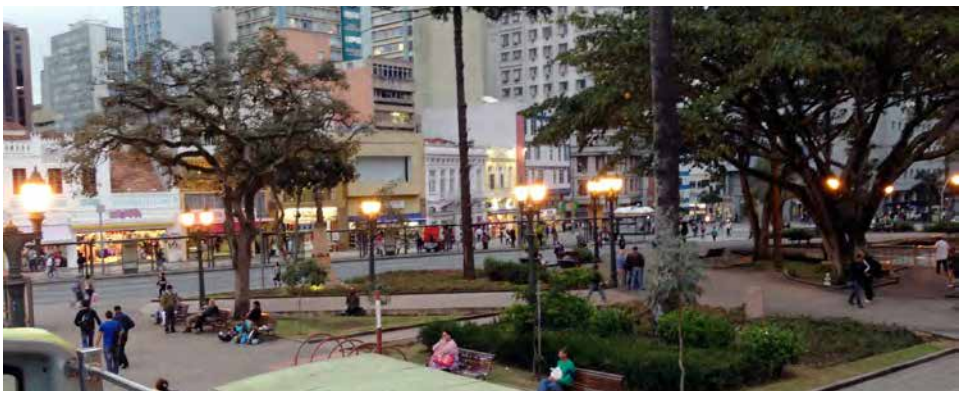
O4

URBAN PARKS & OPEN SPACES

Create open areas such as amenity spaces, green spaces, playgrounds, parks and natural areas, plazas, civic squares, etc. within a five-minute walking radius of residents.

RISK & MITIGATION

- Lack of focus on open spaces in planning, along with an inappropriate allocation of funds towards upgrading facilities in parks and open spaces.
  Open spaces as potential areas for encroachments requires adequate measures on design and enforcement.



Public open space, Curitiba, Brazil

1. PROVIDE OPTIONS FOR OUTDOOR RECREATION, LEISURE AND PLAY AREAS TO PROMOTE HEALTHY COMMUNITIES WITHIN TOD AREAS

- Access to parks and playgrounds is particularly important to the urban poor, who have little access to private facilities and few opportunities to break away temporarily from urban life.

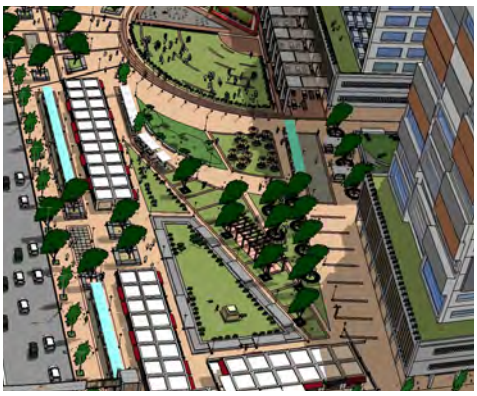
-Adapted from TOD Standard, ITDP, 2017

- A TOD project's designed green spaces should be open to the general public, and access to these areas should be prioritized for non-motorized means of transit.

-Module 4: Design Components of TOD, WRI, 2015

+ REFER OTHER PRINCIPLES

T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4



Open space within TOD area | *source: MOUD, 2016*

Strategic green areas | *source: WRI, 2015*

Public space networks | *source: WRI, 2015*

2. IMPROVE ECOLOGICAL FOOTPRINT OF TOD AREAS

- Public parks and playgrounds have multiple benefits—from improved air quality, to reduced heat island effects, to the increased physical and mental health and comfort of residents.

  -Adapted from TOD Standard, ITDP, 2017

- TOD design can be integrated with the local environment, including such features as rivers, cliffs, agricultural lands, forests, and regional fauna and floral. Natural areas should be protected from development for the capturing of CO2, aquifer replenishment, and maintenance of biodiversity.

  -Module 4: Design Components of TOD, WRI, 2015

- Public and green spaces also provide opportunities for city officials to incorporate risk and natural resource management into city planning.

  -Module 4: Design Components of TOD, WRI, 2015

- Preservation of sensitive or critical ecosystems and creation of buffers along waterways protect against habitat loss and species extinction, while at the same time improving aesthetics, access to green space, and natural resource production.

  -Module 4: Design Components of TOD, WRI, 2015

3. PROMOTE ENHANCED CONNECTIVITY TO TRANSIT THROUGH PARKS

- While retail and playgrounds should, ideally, be no further than 600m away from any point within a neighborhood, schools and markets should be less than a 1km trip.

  -Module 4: Design Components of TOD, WRI, 2015

- Identify opportunities to provide 'cut-throughs' (i.e. across parking lots or through parks, where such cut-throughs shorten access routes.)

  -Adapted from TOD Guidance Document, MOUD, 2016

+ REFER OTHER KNOWLEDGE PRODUCTS

AS | EN C01, C02 | PD H03, H04, H05, H06, P01 | FI A02, H02, R01, R03 | IM A01, A02, H01, H02, P01

D1

COMPACT DEVELOPMENT

Optimize employment and residential densities along a transit corridor or station area, based on carrying capacities of transit and informal transit infrastructure, to promote walking and transit use.

RISK & MITIGATION

- Undue focus on increasing FARs and densities independent of market forces and absorption capacity fails the objective of achieving compact development. On the contrary, highly compact built up environments may result in deteriorating quality of life with lack of appropriate public open spaces.
- Engaging with private sector early on to create awareness and capacity building would benefit to promote TOD.

City development, Bogota, Colombia

1. ADOPT DIFFERENTIAL LAND USE DENSITIES AS PART OF STATUTORY PLANS

- Incorporate varying densities based on the development potential of different areas.

-Adapted from TOD Guidance Document, MOUD, 2016

- Distribution of FSI has to be varied depending upon the FSI already consumed, proposed land use zoning, and accessibility, particularly, areas in proximity to public transit stations, in order to ensure efficiency of use of land.

-Adapted from TOD Guidance Document, MOUD, 2016

- To establish articulated densities along transit corridors, Building codes can be changed to increase the maximum floor-area-ratio (FAR) permitted and allow for development on smaller plot sizes.

-Module 4: Design Components of TOD, WRI, 2015

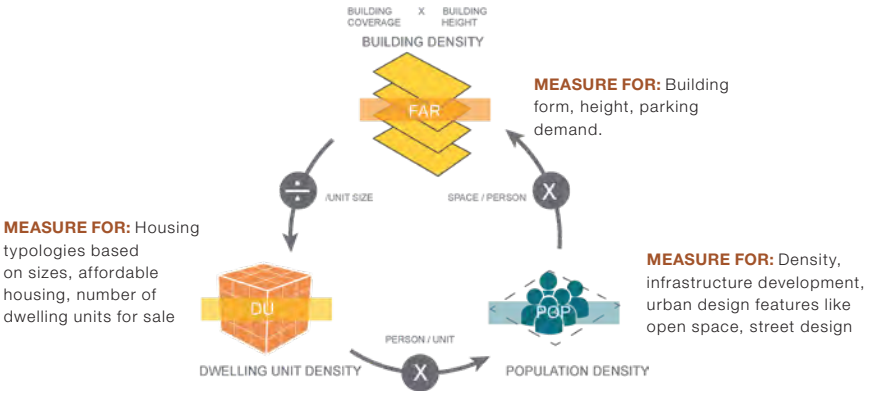
- Land consolidation can be facilitated for larger developments.

-Module 4: Design Components of TOD, WRI, 2015

+ REFER OTHER PRINCIPLES

T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4

Transition between built form | *source: Metrolinx, 2011*



Quantitative measurements of density | *source: MOUD, 2016*

2. CREATE HIGH-DENSITY NODES BY MEANS OF PREMIUM FARS OR BONUSING

- A typical density bonus program sets a base density that a development may achieve 'by right' and a maximum density that can be achieved by conformance to higher standards or through the provision of qualifying amenities/ benefits/premium paid.
- High-quality design, improved infrastructure, and high-quality amenities also attract and support additional density without producing the sensation of congestion.

-Module 4: Design Components of TOD, WRI, 2015

- Planning should take into account the level of connectivity of a station, to align human and economic densities, mass transit capacity and network characteristics for greater accessibility.

-Module 4: Design Components of TOD, WRI, 2015

3. ENSURE OPTIMUM POPULATION AND HOUSING DENSITIES

- Design for buildings and unit sizes can also be adopted to increase density. On smaller size properties, micro-unit apartments or offices can be introduced to increase density; their compact design can raise the number of units able to be constructed within an apartment or office building.

-Module 4: Design Components of TOD, WRI, 2015

- Minimum standards must be prescribed for urban areas that begin to be transit supportive developments.

-Adapted from TOD Guidance Document, MOUD, 2016

- New development in the peripheral zone should be allowed only if it abuts existing developed areas with prescribed minimum density and mix of uses.

-Adapted from TOD Guidance Document, MOUD, 2016

- Both residential & commercial density should be designed to match the area's peak-hour transit, walk and bike capacity.

-Adapted from The Energy Foundation, 2012

+ REFER OTHER KNOWLEDGE PRODUCTS

AS A01, A02, A03, H01, R01, P01 | EN C01, C02 | PD H01, H02, H03, H04, H05, H06, R02, R03, R04, P01 | FI A01, A02, H01, H02, R01, R02, R03 | IM A01, A02, H01, H02, P01

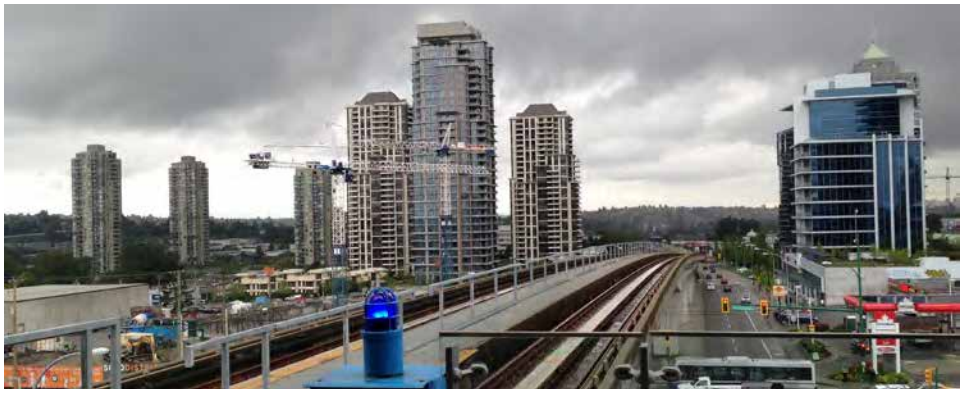
D2

MIX OF USES

Promote more efficient land use patterns by providing residents access to retail, commercial and civic services, employment and recreational facilities without needing to travel by automobile.

RISK & MITIGATION

- Miscalculation in feasibility studies of development projects due to added risks associated by working with the public sector, specific TOD requirements of projects on providing street-facing buildings, a mix of uses or green building techniques, hamper the success rates of TOD projects.
- Lack of market acceptance for mixed-use properties.



Mix of uses at Burnaby, Vancouver, Canada

1. RESIDENTIAL AND NON-RESIDENTIAL USES COMBINED WITHIN THE SAME OR ADJACENT BLOCKS

- **Internally Complementary**: residential and nonresidential uses form a complementary mix within the development. A development is defined as internally complementary if residential uses account for no less than 15% and no more than 85% of the total developed floor area.

-Adapted from TOD Standard, ITDP, 2017

- **Contextually Complementary:** the project's predominant share of floor area is dedicated to uses complementary to the uses predominant in the surrounding station catchment area. A development is defined as contextually complementary if either: more than half of its floor area is dedicated to uses that balance the category of uses predominant in the station catchment area, or the development is internally complementary and located in a station area with a residential use balance between 40% and 60%.

-Adapted from TOD Standard, ITDP, 2017

+ REFER OTHER PRINCIPLES

T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4

Land ownership | *source: MOUD, 2016*

Use setbacks in some areas to create plazas

View of building maintained through transparency

Commercial or mixed-use street frontages

Various types of active building frontages | *source: MOUD, 2016*

2. ACCESS TO LOCAL SERVICES

- Entrances within a 500m walking distance of fresh food sources and a 1,000m walking distance of primary or elementary schools and a healthcare service or a pharmacy.

  -Adapted from TOD Standard, ITDP, 2017

- Provide effective basic accessibility from the residences to facilities and commerce.
  - Retail that is, at most, a 600m trip
  - A playground that is, at most, a 600m trip.
  - A preschool and an elementary school that are, at most, a 1km trip.
  - A space destined for open or movable markets that is, at most, a 1km trip.

  -Module 4: Design Components of TOD, WRI, 2015

3. ACTIVE GROUND FLOOR

- **Boundary Walls:** In all TOD projects, boundary walls along any edge facing a public open space, pathway, road, park, etc. shall be prohibited. In case enclosure of sites is required, translucent fencing shall be used.

  -Adapted from TOD Guidance Document, MOUD, 2016

- **Active Frontage:** Active frontages include arcades, shop-fronts, entrance doorways, access points, entry/exits and transparent windows of active areas facing the primary access street. It is considered visually active if 20% or more of the length of its abutting building frontage is visually active.

  -Adapted from TOD Standard, ITDP, 2017

  -Adapted from TOD Guidance Document, MOUD, 2016

- **Setbacks:** For Integrated TOD Schemes, provide zero front setback and other setbacks no greater than 5m for private buildings and 10m for public buildings, and for any of the other façades.

  -Module 4: Design Components of TOD, WRI, 2015

  -Adapted from TOD Guidance Document, MOUD, 2016

+ REFER OTHER KNOWLEDGE PRODUCTS

AS A01, H01, R01, P01 | EN C01, C02 | PD H01, H02, H03, H04, H05, H06, R02, R03, R04, P01 | FI A01, A02, H01, H02, R01, R02, R03 | IM A01, A02, H01, H02, P01

D3

HOUSING DIVERSITY

Provide a diversity of housing choices, which includes a mixture of types, styles, price ranges and tenure, within a 10-minute walking distance from a transit station, to foster the creation of equitable TODs.

RISK & MITIGATION

- High standards of development burden the project with additional costs, coupled with hampered financial returns due to affordability, provision of services & amenities.
  Land speculation at the onset of transit infrastructure implementation burdens the affordability of housing demand.
- Incorporating opportunities for zoning code exceptions, re-scaling projects, identifying new funding sources are a few measures that could help successful provision of housing supply.

Neighborhood of Copacabana Beach, Rio de Janeiro, Brazil

1. PROVIDE FORMAL SUPPLY OF AFFORDABLE HOUSING STOCK WITHIN TOD AREAS

- All apartments/group housing private and government scheme with a plot size exceeding 2000 sqm must compulsorily reserve a minimum FAR for affordable housing units, as mandated by local acts or policies.
- Ensure all TOD projects provide for the needs of diverse income groups including Economically Weaker Sections (EWS), Lower Income Groups (LIG) & Middle-Income Groups (MIG) as an integral component of the housing units with relevant unit sizes.

+ REFER OTHER PRINCIPLES

T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4

Housing typologies | *source: MOUD, 2016*

Balanced mix of housing choices along transit corridor | *source: MOUD, 2016*

2. ENSURE MINIMUM SUPPLY OF AFFORDABLE HOUSING OPTIONS FOR LOW & MIDDLE-INCOME GROUPS

- Minimum percentage of FAR for all TOD projects to be allocated to rental or for sale housing or low-income families.
- Housing options should accommodate a mix of income levels and age groups. (China)
- Mix housing, shops and services within commercial districts to create 24-hour communities.

-Adapted from The Energy Foundation, 2012

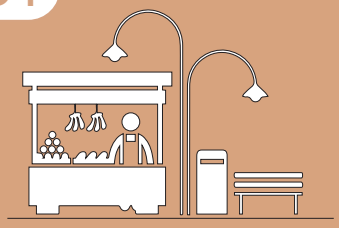
3. ADOPT INCENTIVES IN PROMOTING HOUSING FOR ALL IN TOD AREAS

- The developer may be entitled to receive additional FAR equivalent to 100% of the built-up area utilized for EWS and 50% of the built-up area utilized for LIG units.
- Projects providing affordable housing within TOD areas shall be eligible for following incentives to the extent of EWS and Housing mix by units LIG housing in terms of FAR used, over and above the mandatory reservations:
  - Fast track approval process
  - Exemption from Building Plan sanction fee

+ REFER OTHER KNOWLEDGE PRODUCTS

AS A01, A03, H01, R01, P01 | EN C01, C02 | PD H01, H02, H03, H04, H05, H06, R02, R03, R04, P01 | FI A01, A02, H01, H02, R01, R02, R03 | IM A01, A02, H01, H02, P01

D4



INFORMAL SECTOR INTEGRATION

Strive to achieve inclusive development in TODs by addressing the needs of the informal sector in all aspects of policy, planning and design for street vendors, settlements and transportation services

RISK & MITIGATION

- Lack of detailed inventory and dynamic variations that require continuous updates on the inventory hinders the provision of space and facilities
- Lack of a comprehensive policy for incorporating informal sector in planning processes.
- Creation of a digital inventory of the informal sector with regular updates resonates with the provision of space and amenities
- Incorporate the informal sector in all planning and infrastructure interventions to work in conjunction to with them.

Slum development at Asalpha metro station housing diversity, Mumbai, India

1. INCORPORATE STREET VENDORS AND THEIR NEEDS IN PUBLIC REALM

- Vending zones shall be provided at regular intervals (approx. 10-minute walk from every home/workplace).

  -Adapted from TOD Standard, ITDP, 2017

- Vending spaces should be marked in addition and adjacent to the walking path, especially along high pedestrian volume areas to activate the street and make it safe.

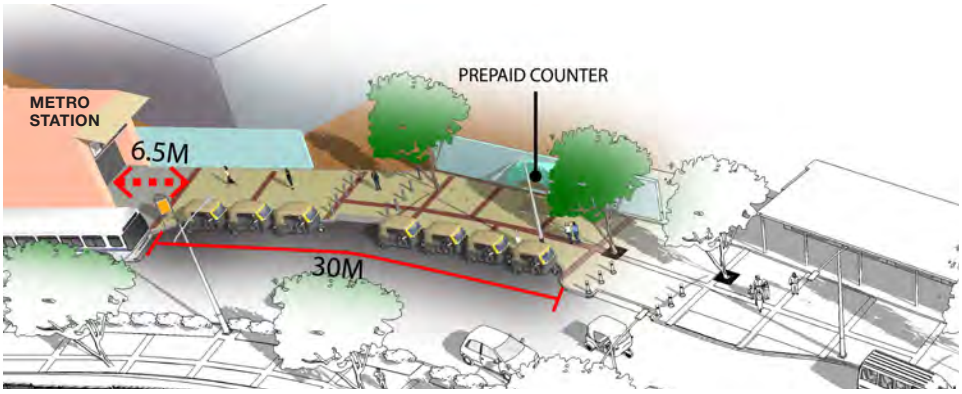
  -Adapted from TOD Guidance Document, MOUD, 2016

- Determination of vending zones as restriction-free-vending zones, restricted vending zones and no-vending zones.

  -Adapted from TOD Guidance Document, MOUD, 2016

+ REFER OTHER PRINCIPLES

T1 T2 T3 T4 | O1 O2 O3 O4 | D1 D2 D3 D4



Designated informal transit zone | *source: MOUD, 2016*

Designated vending zones | *source: MOUD, 2016*

2. DESIGN FOR INTEGRATED INFORMAL TRANSPORT SECTOR NEEDS AT TRANSIT STOPS AND STATION AREAS

- Organize informal transit and ride-sharing services within 800m from transit station facility through Dial-an-auto/rickshaw services, prepaid booths, Passenger Pick-up & Drop-off areas or Remote Informal Transit/Taxi Parking lots.

  -Adapted from TOD Guidance Document, MOUD, 2016

- Multi-Utility Zone (MUZ) of minimum 1.8m width should be provided to accommodate bus stops, street utilities, trees, informal transit/NMT stands.

  -Adapted from TOD Guidance Document, MOUD, 2016

3. INFORMAL SETTLEMENTS HAVE TO BE CONSIDERED IN REDEVELOPMENT PROPOSALS

- Preparation of Slum Redevelopment Plan as per relevant Guidelines; or Slum Redevelopment with private sector participation; or Town Planning Schemes for land pooling and plot reconstruction in greenfield areas.

  -Adapted from TOD Guidance Document, MOUD, 2016

+ REFER OTHER KNOWLEDGE PRODUCTS

AS A01, A02, A03, H01, R01, P01 | EN C01, C02, H01 | PD H03, H04, H05, H06, P01 | FI A01, A02, H01, H02, R01, R02, R03 | IM A01, A02, H01, H02, P01

A WALKING INFRASTRUCTURE

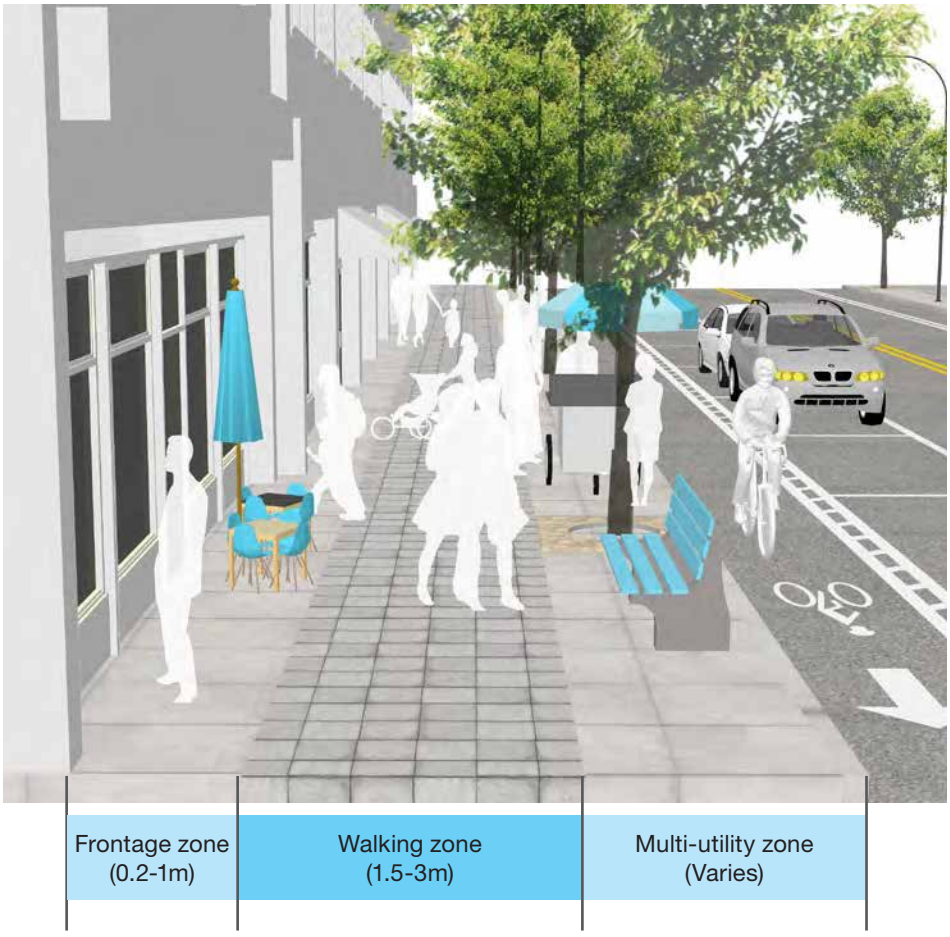
Walking is the most important mode in any station area, not just for direct access to the transit station, but also, as the most likely means of first and last mile connectivity to other commute modes. The most crucial component of the walking network is obviously the footpath; that is the area along the general right-of-way that is assigned specifically for pedestrians. A cohesive and dense network of footpaths, (of adequate capacity), ensures a high level of safety for walking in the station areas.

Footpath Design

The footpath is the most crucial component of the walking network. The footpath is that component of the street that is assigned for the specific use of pedestrians.

Not all the space on a footpath is meant exclusively for walking. A well-functioning footpath will have spaces assigned for other important elements and uses. A footpath comprises of three components:

1. Frontage zone: This is the area touching the boundary of the right-of-away, that is, abutting the property edge line or compound wall. It is meant to accommodate spill-over uses from the adjacent property. This area is not considered to be part of the walking zone, because, normally, pedestrians avoid walking in close proximity to a wall or a building.
2. Walking zone: It is the area immediately adjacent to the frontage zone which is actually used by pedestrians to walk. This space should be kept free of encumbrances that impede walking.
3. Multi-utility zone: It is the area, normally located between the walking zone and the traffic or parking lane. It's use will vary depending on the context, to accommodate street vending, street furniture, trees, utility boxes, light poles, signal posts, signage posts, crossing waiting areas, etc.



Three components of a footpath

The three stated components of the footpath are notional. Their actual space requirements are likely to vary along the corridor, depending upon the context along the right-of-way, as well as the adjacent land-use.

FRONTAGE ZONE CONSIDERATIONS

- The width of the frontage zone can be thought out to be between 0.2 to 1 meter. In the case of a residential area, the frontage zone needn't be very wide.
- If there is a commercial establishment along the road edge, then the frontage zone should be assumed to be wide enough to accommodate spill-over activity, like waiting, window-shopping, etc.
- In the case of large developments, such as a shopping mall, office complex, public or institutional building, it is a good practice to ensure that building setbacks are designed to serve as additional frontage zones.
- This ensures that there is no spillage of activity onto the walking zone and can be achieved through design regulations that stipulate a soft edge between the property and the right-of-way, without f a boundary wall.

Compound wall impact on the walking path

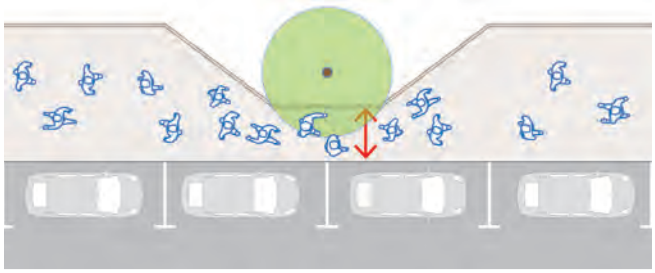
- In many high-density areas, there may be a gap between a desirable frontage zone width and what is practically possible on-ground. In such cases, compromises are unavoidable.
- One strategy that can be adopted to reduce the necessary width of the frontage zone is to place regulations that eliminate or control the height of the compound wall. If the compound wall is absent, (or below waist level), then pedestrians are more likely to use the space near the edge of the footpath. Moreover, high compound walks encourage the misuse of the footpath edge, which is then prone to decay over time. This further dissuades pedestrians from walking close to the road-edge, and if left unchecked, this decay can gradually encompass the entire footpath.
- Regulations should also be put in place to disallow the use of pointed / barb-wired fencing and to restrict vertical obstructions, (such as shop hoardings, gates, planter pots, low-height canopy roofs, etc). All these elements discourage pedestrians from walking close to the road edge.

WALKING PATH WIDTH

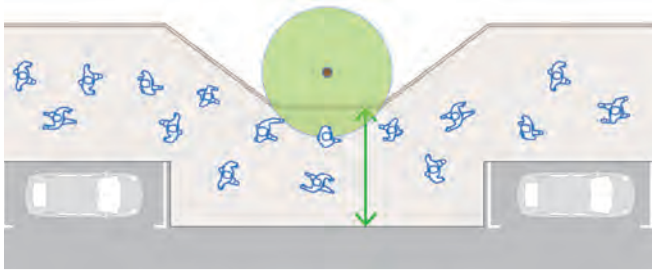
- The most important design consideration for the walking zone is to ensure it has adequate width and is free of any hindrance. For feeder lines to the main walking routes, a walking path width of 1.5m minimum may be acceptable, as this allows two pedestrians to cross each other without hindrance.
- In compromised situations, provisions for the frontage zone or the multi-utility zone may be reduced, before considering reducing the walking path width beyond 1.5m.
- For the main trunk walking routes leading to the transit station, the ideal provision will depend on projected commuter volume, the desired pedestrian Level of Service and total available right-of-way.
- Typically, 3m should be the minimum width for the walking zone on a trunk route.

Deviations in the walking path

In some situations, deviations in the walking path are unavoidable - on account of the presence of a tree or a difficult-to-relocate utility box. In such cases, the walking path should be designed to curve around the encumbrance, preferably with



Immovable obstructions on the footpath restrict pedestrian movement



Deviations made around immovable obstructions along walking path

a gradual transition.

Distinguishing the walking path

- Visual cues to distinguish the walking zone, may be provided by using softer design elements, such as a different pavement style or surface treatment (paved versus landscaped), or creating a marginal height difference.
- These cues aid in guiding road user behavior, informing people about the appropriate use of the space.

Walking path continuity

- An important design consideration for the walking zone is to ensure a uniform height along the entire length of the footpath by maintaining the same height for the walking path across property entrances and exits. There are two aspects as to how this can be achieved:
    1. Planning aspect - restricting vehicular access on main pedestrian routes; and
    2. Design aspect - bringing vehicles up to the footpath height using ramps (accommodated in the multi-utility zone on the traffic lane side, and in the frontage zone or within the property on the property edge side.

Footpath height

- The recommended footpath height for any urban area, including a station area, is normally 10 to 15cm.
- Footpaths greater than 15cm high are cumbersome for pedestrians, especially mobility impaired users.
- They make the provision of accessibility ramps very challenging as they take up the entire width of the footpath. In many cases, footpaths are not wide enough to accommodate the ramp, without significantly increasing the steepness of the slope and make the ramp inaccessible.
- When footpaths are not wide enough to accommodate the 15cm high ramp, then consider reducing the height of the footpath to 10 cm in this section. A 10cm high footpath requires a 50% shorter ramp than a 15 cm high footpath.
- This measure must be used sparingly and with caution, because a 10 cm high footpath is easier to be mounted by vehicles, which may encourage erring motorists to park or drive on the footpath.
- Footpath can also be at the same level as the road with separation achieved by bollards, curbs or different pavement material.

MULTI-UTILITY ZONE DESIGN

There is no standard width for this zone, as it will depend on context and the available right-of-way. Typically, this zone is the best place to absorb any variations in the width of the right-of-way, as this space can be widened or narrowed as required.

- The multi-utility zone can accommodate the uses and functions that are essential for the pedestrian environment, apart from the walking space like seating and waiting areas and street-vending.
- This zone can also accommodate other fixed elements in the right-of-way, such as trees, lamp posts, signal posts, signage posts, utility boxes, etc.
- Multi-utility zone also as a buffer between pedestrians and fast moving traffic, increasing the level of safety.
- It is also essential to have an 'active sidewalk' that can be achieved through active frontage from commercial and recreational activities at the street level of the developments as well as encouraging vending and other activities in the multi-utility zone. This ensures there

Active building frontage and on-street vending along a sidewalk in Mumbai, India

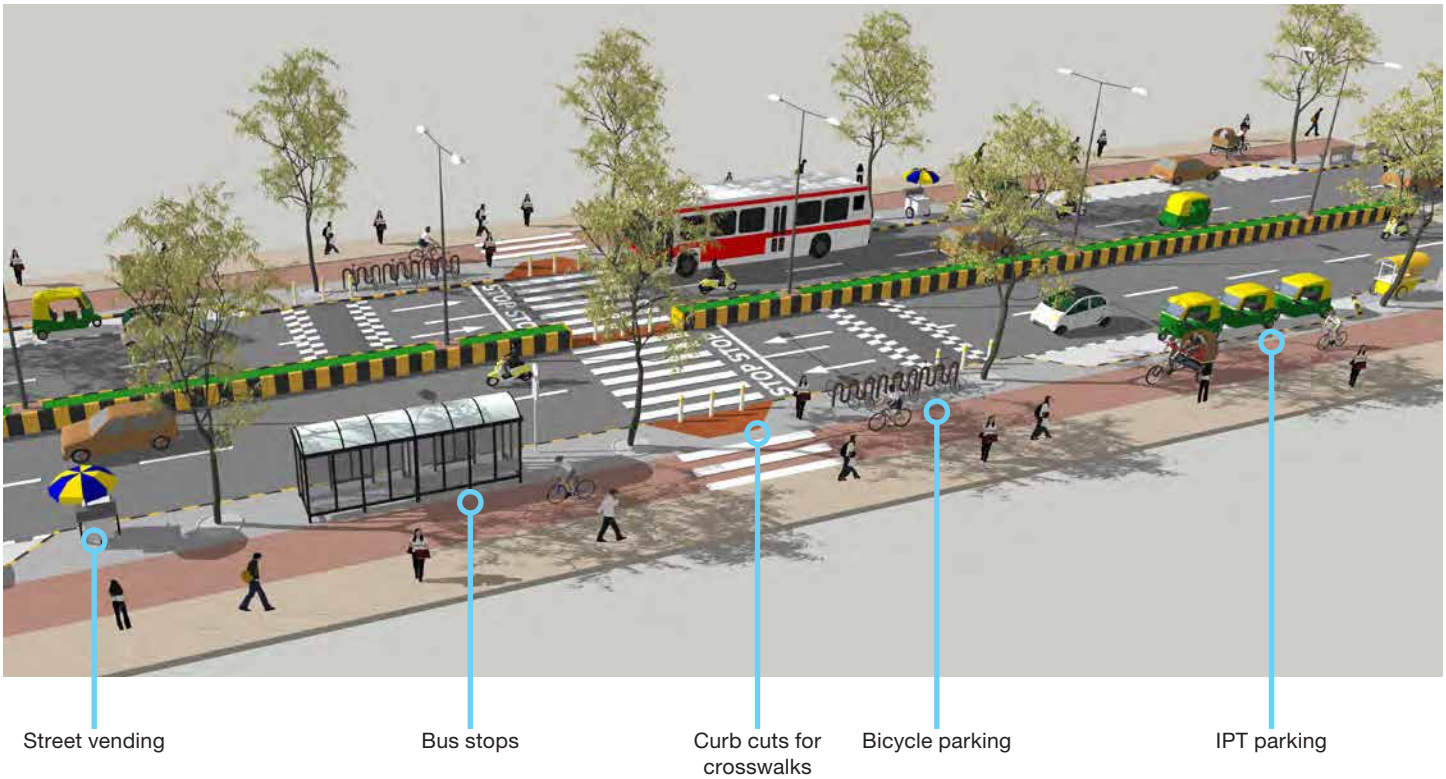
are 'eyes-on-street' and provides a sense of security to pedestrians.

STREETLIGHTS

Improved street lighting, along with providing a sense of security, contributes towards increased safety and prevents road traffic crashes, injuries and fatalities due to improved visibility. It enables motor vehicle drivers, cyclists and pedestrians to move safely and comfortably, by reducing the risk of traffic accidents and improving personal safety.

Lack of activities on the sidewalk and inadequate streetlighting can create unsafe experience for pedestrians and force them to use the vehicle travel lanes which are typically more well lit. This raises conflicts between the different road users leading to potential crashes.

- The streetlights should preferably be placed in the multi-utility zone, clear of pedestrian walkways. It's placement can be coordinated with other street elements such as trees, signage, seating, vending etc. so that they do not impede proper illumination.
- Lighting must be directed downwards as up lighting might result in spillage of light, wastage of energy, and create night sky light pollutions.
- 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.
- Additional lighting should be provided at conflict points.



Typical multi-utility zone with different types of uses

Crossing Design

The design of safe crossings is a crucial component of the walking network for a station area. There are many important considerations for pedestrian crossings, which are discussed over the following sub-sections.

CROSSING FREQUENCY AND LOCATION

The most important aspects of pedestrian crossing provision is their frequency and location. From the perspective of access to the transit station, crossings must be provided such that the continuity of the walking network is maintained.

A station area with a higher density of crossing opportunities is typically safer and better for walking:

- Crossing infrastructure must be provided at all intersections.
- Block sizes should be limited such that intersections crossings are not more than 150-200m apart in the high-density areas close to the station. In already developed areas, it may not be possible to modify block sizes, hence mid-block crossings may be provided.

It should be noted here that in the earlier Knowledge Product of PD-H07, the subsection on “Capacity” recommends reduction of interruptions on trunk routes, in order to keep the traffic moving. These interruptions arise due to access points for vehicles into the buildings or land parcels. It has been recommended that these access related interruptions be shifted to parallel tertiary streets or feeder routes. These interruptions are within the recommended 150-200m (discussed above) of consecutive pedestrian crossings. This modification of access points would therefore not hinder the pedestrian movement in the area.

CROSSING WIDTH

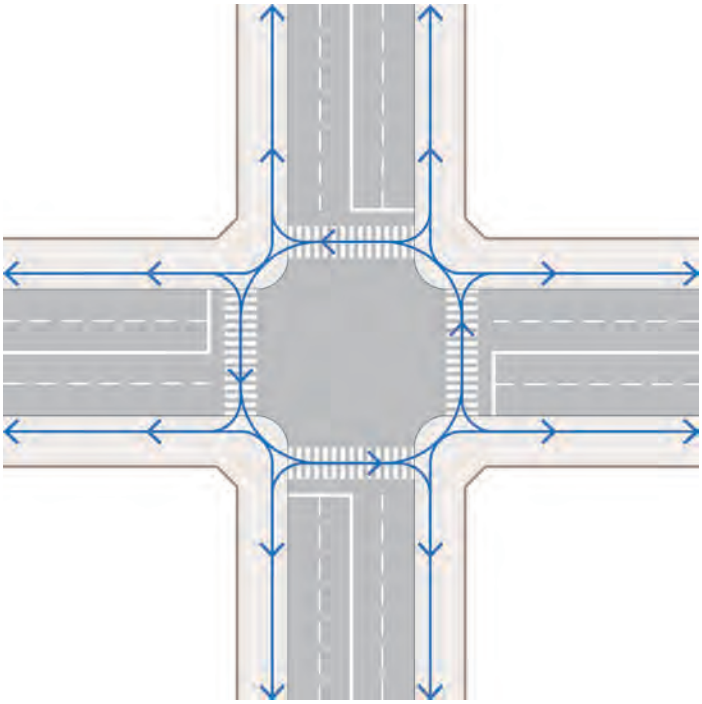
- A pedestrian crossing must be at least as wide as the footpaths that it connects.
- An even wider crossing width may be desirable, as it allows for more people to cross at the same time, which reduces delay and allows for shorter pedestrian signal cycles.
- For a wider crossing, it is recommended to have a minimum width of 3m, though a width closer to 5m may be desirable on high volume routes that connect to mass transit stations or BRT stops catering to high volume of pedestrians going towards and coming out from the stations or BRT stops.

CROSSING ALIGNMENT

Deciding on the alignment of a pedestrian crossing raises two questions:

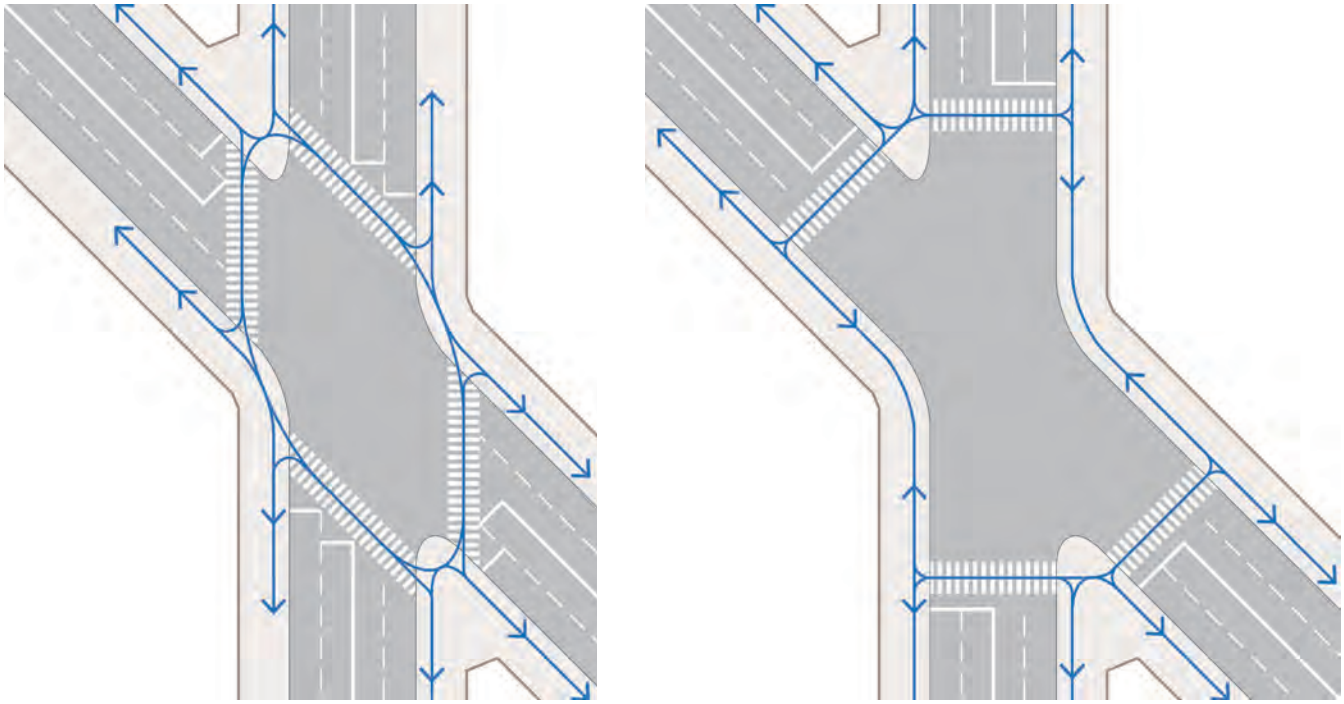
1. Should the crossings be so aligned that it continues the natural walking path between the two adjoining footpaths? Or
2. Should it be aligned perpendicular to the traffic lanes, such that crossing distance is minimized?

- The natural walking path and the shortest crossing distance will align perfectly with each other in a 4-arm intersection, where both roads are at right angles to each other.



Natural walking path and desire lines for a right-angled intersection.

- If the angle of the intersection is skewed, then there will be a deviation in the two paths. So the question becomes, which parameter should one follow.
    - For unsignalized intersections, choose the alignment that minimizes the crossing distance. This reduces the amount of time that the pedestrian is put into potential conflict with vehicular traffic. Moreover, it positions the pedestrian and traffic perpendicular to each other, which improves their visibility of each other.
    - For signalized intersections, pedestrians will want to avoid deviations to their natural walking path. It is recommended aligning the crossing as close as possible to the straight line connecting the two footpaths.



Movement patterns in a skewed intersection Crosswalks along desired lines (Left) Crosswalks along shortest distance (Right)

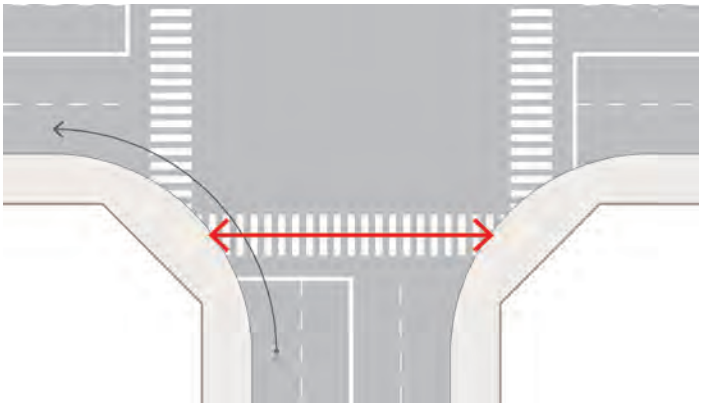
INTERSECTION DESIGN

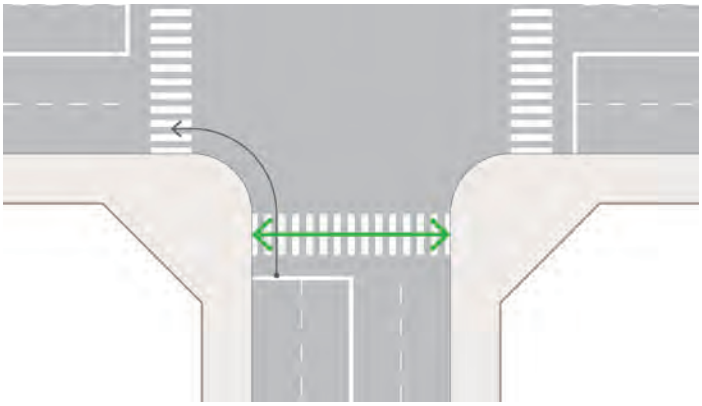
Intersection corner curvature

The curvature of intersection corners has a significant impact on pedestrian safety.

- A generous curvature allows vehicles to make free turns at intersections at high speeds, which puts pedestrian at risks, particularly at unsignalized intersections.
- A wide curvature also increases the size of the intersection, which increased the area of undefined road space where conflicts may arise.
- Pedestrian crossings get pushed further back and away from the natural crossings path.
- A wide intersection curvature reduces the availability of space to accommodate pedestrians waiting to cross the road.

It is recommended to have intersection corner curvature radius approximately 4-6m, which allows for most vehicles to make a safe turn at a slow speed.





Reducing intersection corner curvature increases pedestrian safety as it enables drivers to turn at significantly slower speeds and also reduce pedestrian crossing time.

Slip lanes

- Slip lanes may be provided to give turning vehicles an exclusive lane. This is not desirable in most urban contexts, from the perspective of pedestrian safety.
- If the removal of the slip lane is not possible, it is recommended to ensure that traffic speeds are brought down close to zero, through traffic calming measures and signage like “Yield to Pedestrians” for vehicular traffic.
- The traffic islands created due to provision of slip lane infrastructure must be accessible to pedestrians and should be utilized to accommodate pedestrian waiting areas and accessibility ramps.

BEFORE

TACTICAL INTERVENTION

AFTER

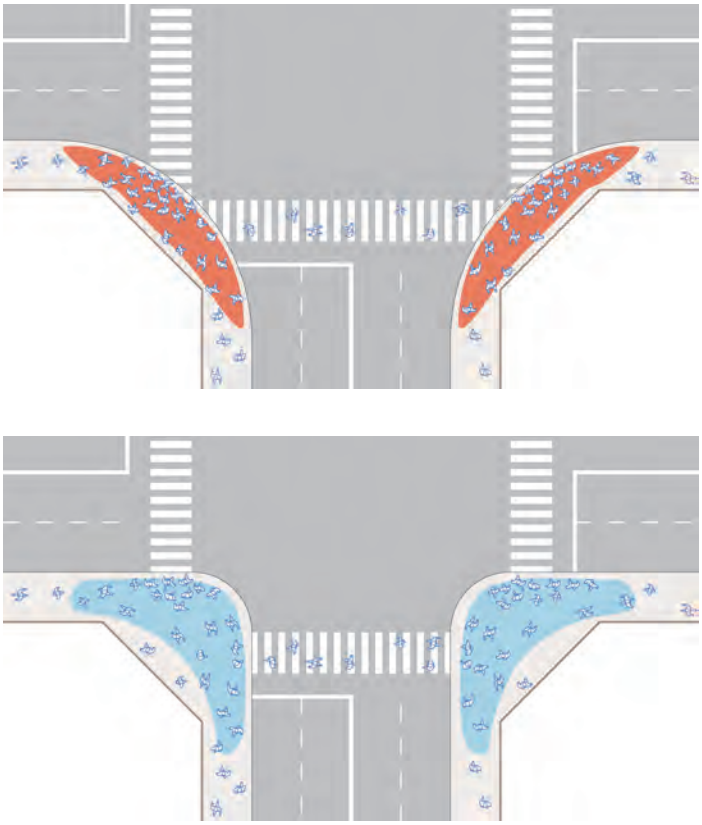
Slip lanes provided as part of HP Intersection redesign in Mumbai, India

(Source: WRI India)

Pedestrian waiting area

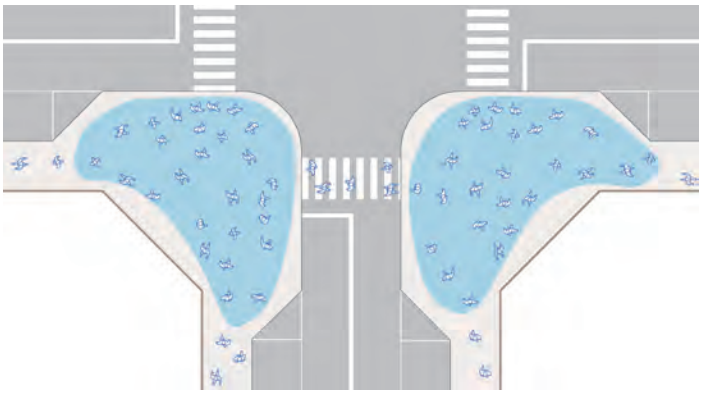
The pedestrian waiting area is an important component of a crossing. This space is especially important for signalized intersections to accumulate the build-up of pedestrians waiting for their light to turn green.

- The space requirement of the pedestrian waiting area is likely to be very high on the trunk walking lines in a station area, and if adequate space is not provided, pedestrians may spill onto the traffic lane.
- The pedestrian waiting area must be kept distinct from the walking area, otherwise waiting pedestrians will hold up walkers who just want to pass through.
- The best way to ensure a large waiting space, is to keep the intersection corner curvature as tight as possible.



Tighter intersection corner curvature provides more waiting area for pedestrians.

- Another measure is to eliminate the parking lane, if present, at the intersection, and create a curb extension to accommodate the waiting area.



Curb extensions created by removing travel lanes. These further reduce crossing times for pedestrians

Accessibility ramps

The provision of ramps is an absolutely critical aspect to ensure that street infrastructure is accessible to all roads users, including wheelchair-bound pedestrians. Ramps not only benefit mobility-challenged road users, but are also useful for pedestrians pushing baby strollers, shopping carts, hand carts, luggage, trolleys, etc.

- A well-designed ramps consists of flared portions on either side of the ramp, (maximum slope of 1:12), that allow the wheeled unit to enter or cross the ramp from any side.
- Preferably, a landing portion (flat horizontal space) should be present at the end of the ramp to accommodate waiting commuters. However, if the footpath is not wide enough to allow for a landing, then the presence of side flares in the ramp, allow for a wheeled unit to traverse the ramp with ease.
- It is recommended to avoid the use of interlocking paver-blocks for ramps, as it is difficult to fit them to the complex slope geometry required for the different components of ramps. Cement concrete is a preferred material.
- It is preferable to maintain two separate ramps for each crossings at an intersection corner. However, if the footpath area is insufficient to have two ramps, then one can consider using a combined ramp.
- Care should be taken to design it such that the pedestrian doesn't enter the intersection along the diagonal, but does so in line with the crossing.

Traffic signals

All major intersections in the station areas must be equipped with traffic signals, which incorporate pedestrian signal cycles:

- Any crossing that has more than two lanes, without the presence of a median, must have a pedestrian signal.
- The pedestrian green phase must be long enough to allow for most pedestrians to cross the road in one phase. The pedestrian green times may have to be even longer on the main walking routes within the immediate station areas which may be synchronized with the timings of transit services to accommodate the higher volume of pedestrians going towards and coming out from the mass transit stations or BRT stops. These time synchronization are critical where interchanges between one mode to another takes place, and the connections aren't direct and require crossing a road to access the stations.
- Signal priority and signal synchronization for pedestrians allows for pedestrians to face a "green wave" (uninterrupted green phases as soon as they reach the intersection); which aids in the safe and convenient access to the station.
- Additional Intelligent Transportation System (ITS) technologies can be incorporated which include use of AE cameras to detect over speeding of vehicles and turning the signal red to ensure speeds under safety limits are maintained within the station area.
- Saw cut loop detectors can be buried at intersections to detect traffic presence and accordingly phase the signal cycles to avoid traffic jams that may impede movement of shared modes and feeder services.

Traffic calming elements

Traffic signals are generally not recommended for minor intersections, with 1 or 2 lanes. In these situations, other traffic calming measures may be adopted to ensure that pedestrians can cross the intersection safely.

Curb extensions can be utilized to reduce the crossing distance at the intersection. Speed humps and tables aid in slowing down vehicular traffic. For very minor side streets, one can consider continuing the footpath across the length of the intersection, using ramps to allow for vehicles to cross the footpath.

Mid-block crossing

- A mid-block crossing may be necessary if the block-size is very large.
- Traffic signals are recommended if the pedestrian has to cross more than 2 lanes without the presence of a median, or if there is a very high volume of traffic.
- It is recommended that mid-block crossings be accompanied by traffic calming infrastructure, such as speed humps or speed tables. Curb extensions may be provided by discontinuing parking lanes close to the mid-block crossing.

Off-road pedestrian path design

Off-road pedestrian paths may also be augmented with the utilization of grade-separated infrastructure. There are broadly two categories for such infrastructure:

- Infrastructure only meant to cross a single road, such as a Foot-over Bridges (FoBs) or an underpass.
- Grade-separated infrastructure of a much longer length that provides direct connectivity to multiple locations the transit station and may comprise of a network of interconnected sections. Such infrastructure is normally elevated, and commonly referred to as skywalks, though there are cases of sub-terrain pedestrian networks as well.

Foot-over-bridges (FoBs) or Underpasses

- FoBs and underpasses are not recommended as crossing substitutes as they are very expensive, and impractical to implement at each location.
- Pedestrians also do not prefer them, because of the physical exertion and time delay involved, in comparison to crossing at street level.
- This infrastructure is unfriendly to the needs of vulnerable users.
- The access points of such infrastructure tends to impede the free movement of the footpath, because of the presence of stairwells and elevator shafts.

Foot-over-bridge restricting pedestrian movement on the sidewalk near ITO metro station in New Delhi, India
(Source: © The World Bank)

Grade separated infrastructure

A grade-separated pedestrian networks may be useful to augment at-grade pedestrian infrastructure.

- They may also provide direct connectivity of major establishments to the transit station, which can be have a positive impact both for walking and for transit patronage.
- While there are contexts where the provision of such infrastructure has benefits, their provision must only be considered as addition to at-grade infrastructure.

Foot-over-bridge connecting to the mixed development at the Novena MRT Station, Singapore
(Source: © The World Bank)

B CYCLING INFRASTRUCTURE

Cycling is a healthy and sustainable mode of commute that can play an important role in enhancing connectivity to transit. It has a higher reach than walking, which greatly increases the commutable distance to the transit station.

The most crucial aspect for cycling safety is the design of street infrastructure. The cycling network for the station area will comprise of the judicious use of dedicated cycle lanes where viable, in combination with traffic-calmed, shared streets. This section covers best-practices for the provision of cycle lanes, with respect to the station areas. This includes aspects related to the provision, typology and design.

Cycle Lane Design

CYCLE LANE PROVISIONS

It is recommended to use dedicated cycle lanes on trunk routes of the cycling network, leading to the station. Normally, the trunk cycling corridors will also contain the trunk transit and motor-vehicular routes, and hence will have a high volume of large vehicles and fast-moving traffic. Thus, the provision of dedicated cycle lanes can have a significant positive outcome on cyclist safety.

It should be noted that the cycle lane is not only for bicyclists, but for all wheeled, active modes of transport, which includes wider vehicles, such as tricycles or cycle-rickshaws.

There are, broadly, two kinds of cycle lanes:

1. Physically segregated from vehicular traffic, either, by curbs, medians, railings or landscaping.
2. Marked cycle lanes provided on the main carriageway itself, normally delineated through the use of road-marking and roadside signage.

Physically segregated versus marked cycle lanes

- Segregated infrastructure reduce the possibility of a motor-vehicle entering the cycle lane and colliding with a cyclist.
- It is recommended to avoid use of railings to segregate, because it effectively reduces the usable width of the cycle lane, as cyclists don't tend to ride closer to the railings. Medians or landscape strips should be used instead.
- The use of lane-marked cycle lanes are often more practical as they cost less. The maintenance, cleanliness and drainage of lane-marked cycle lanes are a lot easier as compared to segregated infrastructure.

Directionality

- Typically, lane-marked cycle lanes are uni-directional, and cyclists are expected to ride in the same direction as traffic on their side of the road. In this case, cycle lanes are expected to be provided on both sides of a two-way road.
- It is recommended to avoid use of contraflow cycle lanes, where cyclists travel in the opposite direction of adjacent traffic as it puts them at risk of head-on collisions in case a motor-vehicle enters the cycle lane.
- Segregated cycle lanes can be uni-directional or bi-directional. When designed to be bi-directional, the cycle lane acts much like a footpath, and cycle crossings can be designed in sync with pedestrian crossings.
- The advantage of a bi-directional cycle lane is that it can be provided one side of the road. This helps with planning the cycling network in station areas, as it may allow for the provision of dedicated trunk route connectivity on roads with constrained space availability.

Width

- Uni-directional cycle lane must be at-least 1.5m wide and it will depend on whether there is parking space or a bus lane on the adjacent space. This allows for some buffer from traffic moving in the adjacent lane.
- It however does not provide enough width for a faster cyclist to overtake a slower one. For long block lengths, it is recommended to provide pull-out zones to allow for cyclists to safely overtake.

Uni-directional marked cycle lane

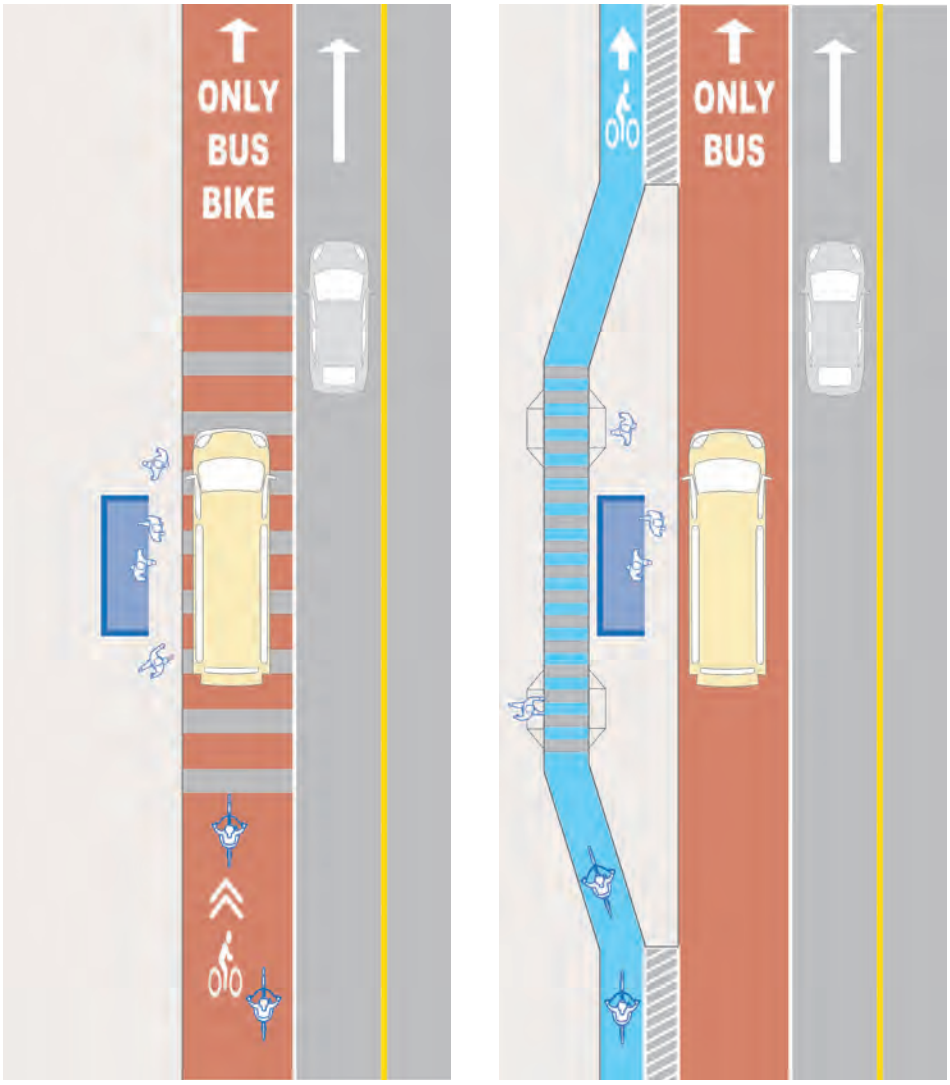
- `A bi-directional cycle lane must be at least 2.5m to allow for cycling units to pass each other.

Bi-directional marked cycle lane

Cycle lanes positioning across bus stops

The overlap of cycling routes and feeder bus routes can create potential safety conflicts. Buses need to stop next to the footpath to pick-up and drop-off commuters. This may mean that the bus has to cut into the cycle lane to access the bus stop. This is a potential safety risk, given the mass and speed of the bus in relation to the cyclist. This risk is further heightened by the fact that the bus driver has to change lanes behind the line of sight of the cyclist.

- It is recommended that cycling routes and bus-feeder routes be kept separate.
- Where sharing the route is unavoidable, the cycle lane be continued behind the bus stop, Here, the bus stop area is separated from the footpath, and commuters will have to cross the cycle lane to access the bus stop.

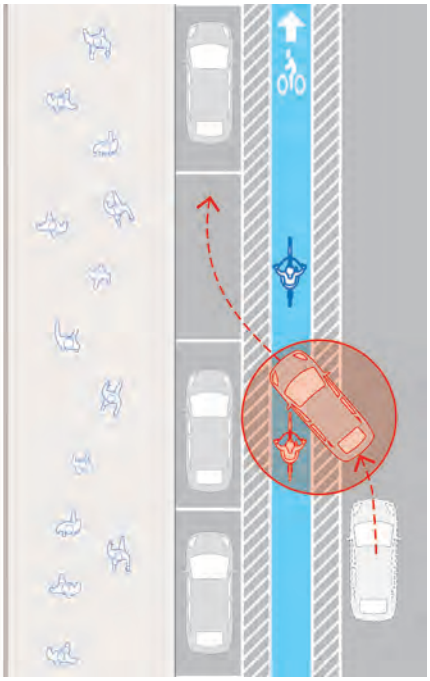


A shared bus and bike lane (Left) versus Separate bus and cycle lanes, with cycle lane going behind the bus stop (Right)

A bus station bypass in Rio de Janeiro, Brazil that raises the bicycle lane to the sidewalk level while bypassing the bus waiting area.
(Source: © WRI)

Cycle lanes and on-street parking

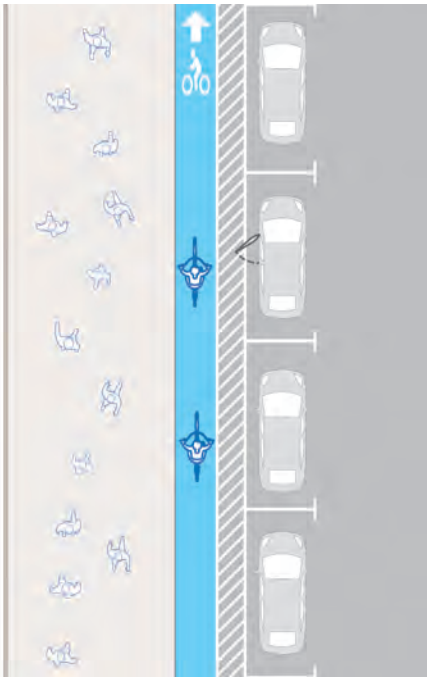
- On-street parking creates potential safety conflicts for cyclists.
- Vehicles benefit from being parked as close to the footpath as possible. This requires them to cut across the cycle lane creating safety concerns for cyclists.
- Moreover, when the door of a parked car is suddenly opened on the side of the cycle lane, it creates a safety hazard for the cyclist.



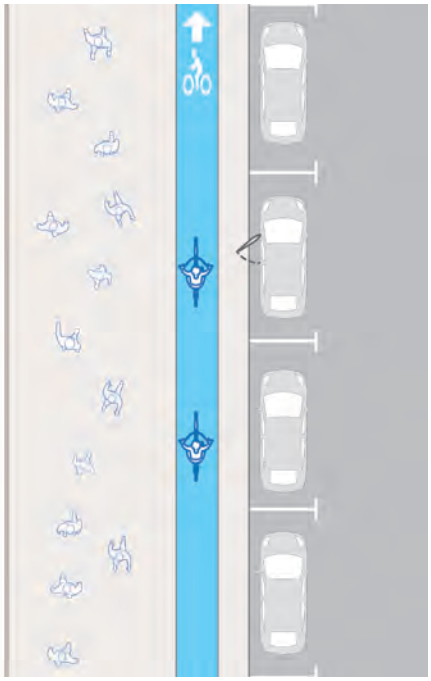
Vehicles cutting across cycle lanes to access on street parking adjacent to footpath create safety hazards for cyclists

Cycle lane designed closer to the footpath. Doors of cars opening on the side of cycle lane without adequate buffer may conflict with cyclists

- It is recommended that on-street parking be provided on streets with cycle lanes, only where there is a possibility to separate the parked vehicles from the cycle lane by a median.
- This median should be at least half a meter wide, to contain the width of an opened car door, and also allow people to enter and exit their car safely, without standing on the cycle lane.



Adequate buffer between cycle lane and parking lane allow for easy movement without hindrances.



Protected bike lanes with median as buffers are desirable.

Cycle lanes and driveways

- The trunk cycling routes to the transit station must have a smaller number of interruptions.
- Frequent property driveways along the route impact the mobility and safety of the cyclists on the trunk route. It is recommended that vehicular driveways on the main cycling route be closed, with access provided from an adjacent street.
- Where driveways are unavoidable, the continuity and priority of the cycle lane be clearly defined and maintained.
- If there is a height difference between the cycle lane and the main carriageway / driveway, then the vehicle access should be brought up to the level of the cycle lane.
- The lane markings across the driveway should be continued to reinforce the priority of cyclists over the space.

Intersections and cyclist movement

The design of intersections is a crucial aspect for the overall safety of the cycling network. Several design alternatives have been developed, which have different benefits and disadvantages with respect to the mobility and safety of cyclists.

It must be noted that whenever there is a cycle lane at an intersection, the traffic lights should include a traffic signal for cyclists as well. These may be synchronized with pedestrian lights. In larger intersections with multiple lanes, an advance phase cycle signal may also be provided.

A bicycle signal is provided along a protected bicycle lane in Istanbul, Turkey *(Source: © WRI)*

REGULAR TRAFFIC-CALMED INTERSECTION

It is important to note that not every intersection in the cycling network of a station area requires definitive cycling infrastructure. Often, the safest and most appropriate measure is simply to design the intersection with adequate traffic-calming elements, such that it is safe for all road users, including cyclists.

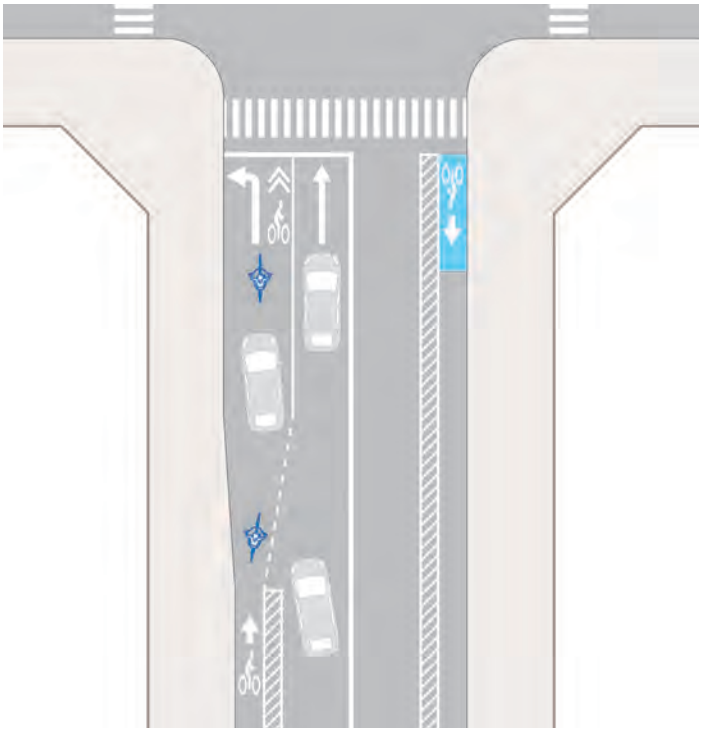
- These design-appropriate measures include, tighter intersection corner curb radius, speed-tables and speed humps, mini-roundabouts, etc.
  Refer 'Intersection design measures' section in D **TRAFFIC CALMING MEASURES FOR SHARED STREETS**
- Regular traffic-calmed intersections are most appropriate on the internal feeder routes of the cycling network, that typically run along neighborhood-level streets. They are expected to carry a lower volume of cycling and motor-vehicular traffic.

ADVANCED TERMINATION OF THE CYCLE LANE

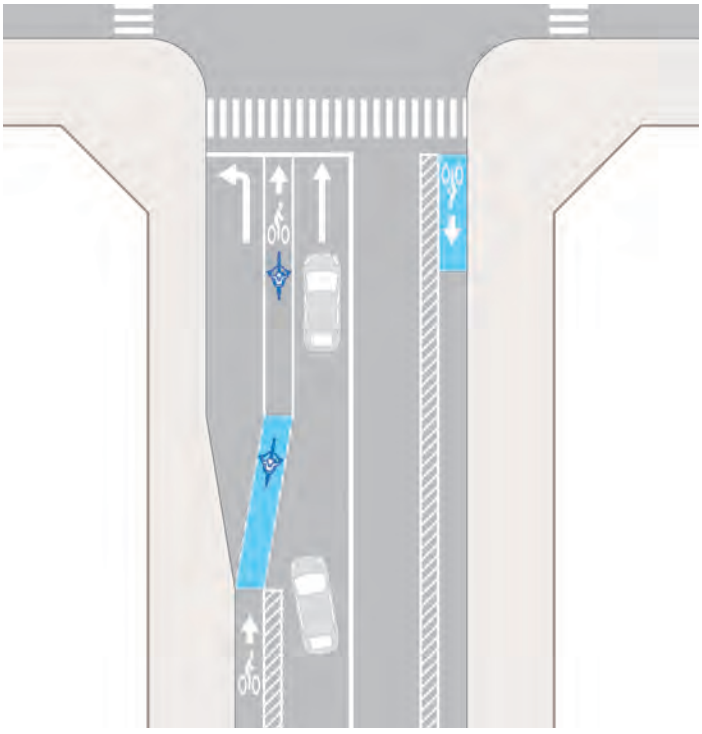
- A commonly applied measure is to terminate the dedicated cycle lane a few meters before the intersection.
- This allows cyclists who want to make a left turn, (in countries where traffic drives on the right), or right turn (in countries where traffic drives on the left) to leave the cycle lane and occupy the general traffic lane closest to the center of the road.
- Vehicular traffic that wants to make a free turn move in the lane closest to the footpath edge, in line with where the cycle would be if it wasn't terminated.
- This design is not recommended as it eliminates the dedicated cycle lane at the intersection. Intersections are the highest locations of potential crash conflict, which is where the benefits of dedicated infrastructure are likely to be the highest.
- The lateral cross movement of lane-changing cyclists and motor-vehicles put them into direct conflict with each other.

TURNING LANE BETWEEN CYCLE LANE AND FOOTPATH

- A modification of the previous design involves the continuation of the cycle lane till the intersection, with the provision of a turning lane between cycle lane and footpath.
- This design allows turning vehicles to avoid a conflict with cyclists wishing to continue straight through at the intersection; and provides the latter with a dedicated lane up to the intersection.
- However, this design also does not resolve the potential safety issues concerning the lateral movements of cyclists and vehicles, to access their respective turning lanes, creates potential crash conflict risks.



Advanced termination of bike lane as it nears an intersection.



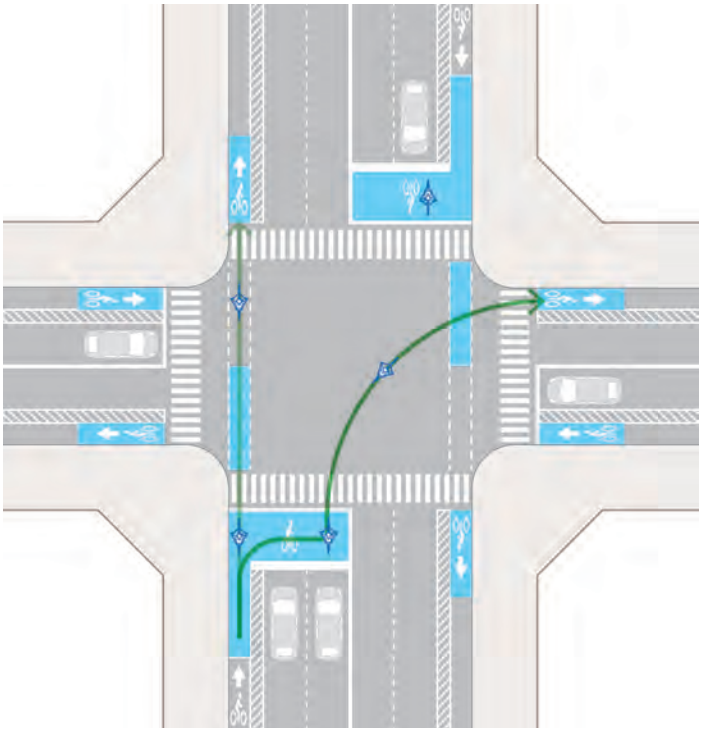
Turning lane inserted between cycle lane and footpath

CYCLE BOXES WITH 1-PHASE TURN

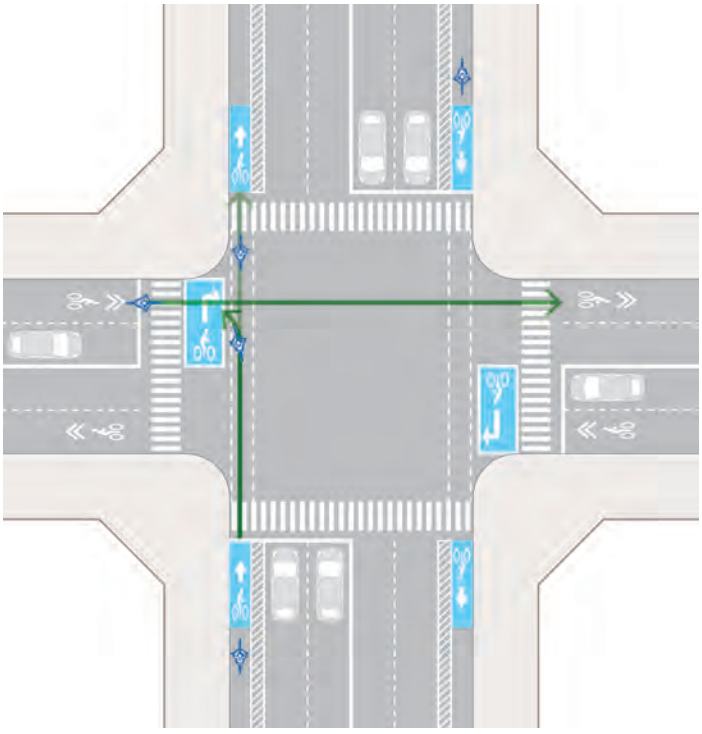
- Cycle boxes are dedicated waiting areas provided between the pedestrian crossing and an advanced stop line for general traffic.
- During a red signal phase, cyclists enter the cycle box and align themselves according to the direction they intend to go. The general traffic is not permitted to enter the cycle box during the red signal phase and waits behind the stop line.
- Normally, an advance green phase of a few seconds is provided to cyclists to allow them to clear the intersection area, before the light turns green for vehicular traffic.
- This design provides cyclists with a dedicated lane right up till the intersection. It also minimizes the possibility of conflict with turning vehicles.
- This design creates some ambiguity about where cyclists should wait when they reach the intersection during a green phase for vehicular traffic as they are expected to enter the cycle box only during a red signal phase for vehicular traffic.

CYCLE BOXES WITH 2-PHASE TURNS

- In a two phase turn, the cycle lane continues through the intersection till the mouth, closest to the footpath.
- If cyclists wants to turn opposite to the side of drive, they are expected to continue straight across the intersection, during the first green signal phase and wait in the cycle box, which is the demarcated space between the stop line and the pedestrian crossing of the perpendicular street.
- The cyclists adjust their orientation to point in the direction they intend to turn. Then, when the light turns green on this street, the cyclist continues straight, thus completing the right turn in two signal phases.
- The advantage of this design is that it allows for the provision of a dedicated cycle lane right till the mouth of the intersection and reduces ambiguity about where the cyclist has to wait during a green signal phase on their street.
- The disadvantage of this solution is that cyclists need two signal phases to make a right turn at the intersection.



Advanced stop lines with cycle boxes for cyclists to align in direction of turn



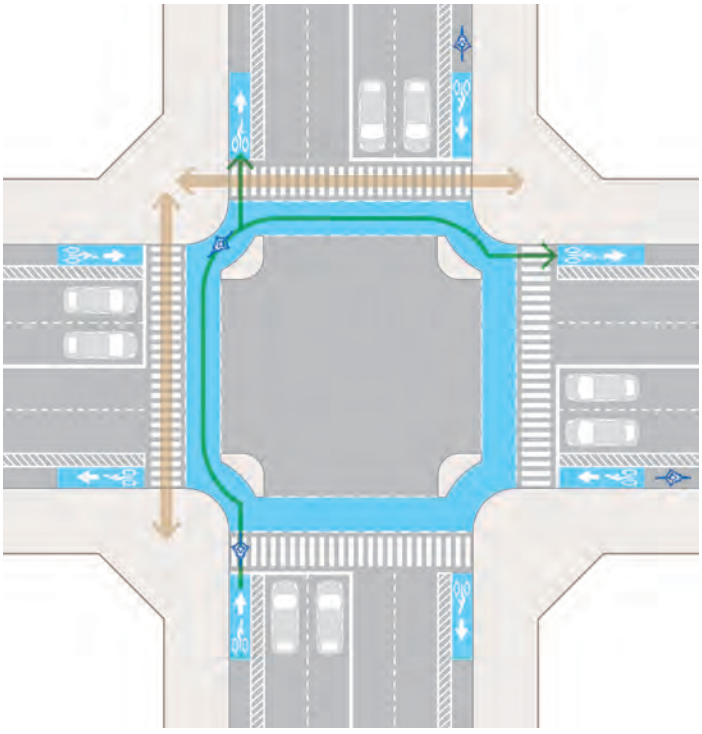
Two-phase cycle turn boxes

HOOKED CYCLE LANES

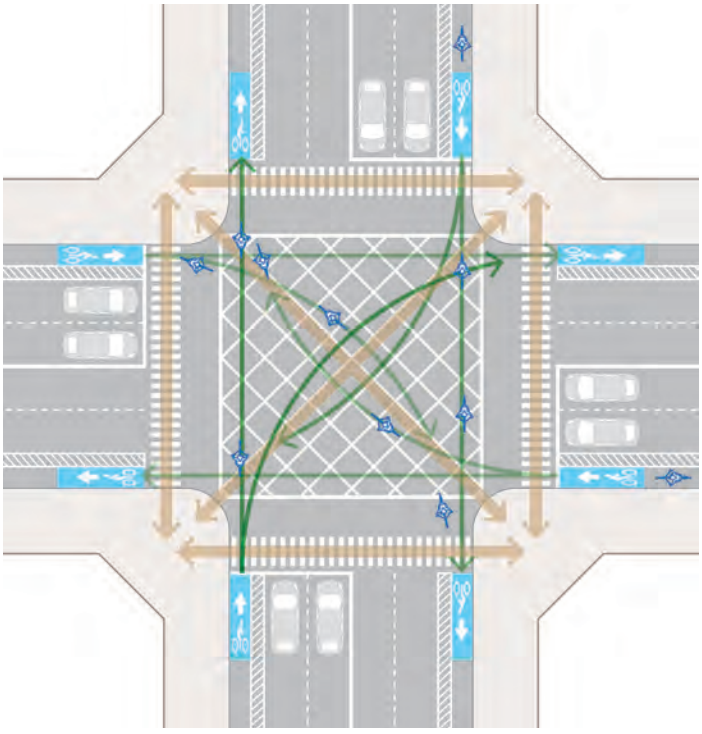
- A slight deviation in the cycle lane path is provided, to put cycle crossing adjacent to the pedestrian crossing, and functions in the same way.
- At a signalized intersection, they may share the same phase which makes the design clearer to all the different road users.
- This prevents cyclists from rushing into the intersection at high speeds and it aligns the cyclist perpendicular to traffic at the crossing, which allows for better visibility to the motorist and cyclist of each other.
- This design is also more conducive for bi-directional cycle lanes, as the cycle crossings behave similar to bi-directional pedestrian crossings.
- The disadvantage of this design is that it requires a longer maneuver to make a right turn (for traffic that drives on the left). Also, this design requires more intersection area than the cycle box design.

SCRAMBLE SIGNAL PHASE

- In a scramble signal phase, one phase in the signal cycle is dedicated exclusively for the movement of cyclists in all directions, while it is red light phase for vehicular traffic from all directions,
- Cyclists need to take precaution to avoid collision with one another. However, as cycles move much slower than motor-vehicular traffic, this is not much of a safety risk.
- The scramble signal phase for cyclists may be combined with a pedestrian scramble phase, if the numbers for both modes are conducive for such grouping.
- The advantage of a scramble signal phase is that it provides a dedicated crossing phase for cyclist, without potential for conflict with vehicular traffic and allows them to choose the shortest crossing distance across the intersection.
- On the other hand, the disadvantage of this design is that it adds one additional phase to each signal cycle, which may increase the delays for all other traffic at this intersection.



Cycle lanes hooked with pedestrian crossing

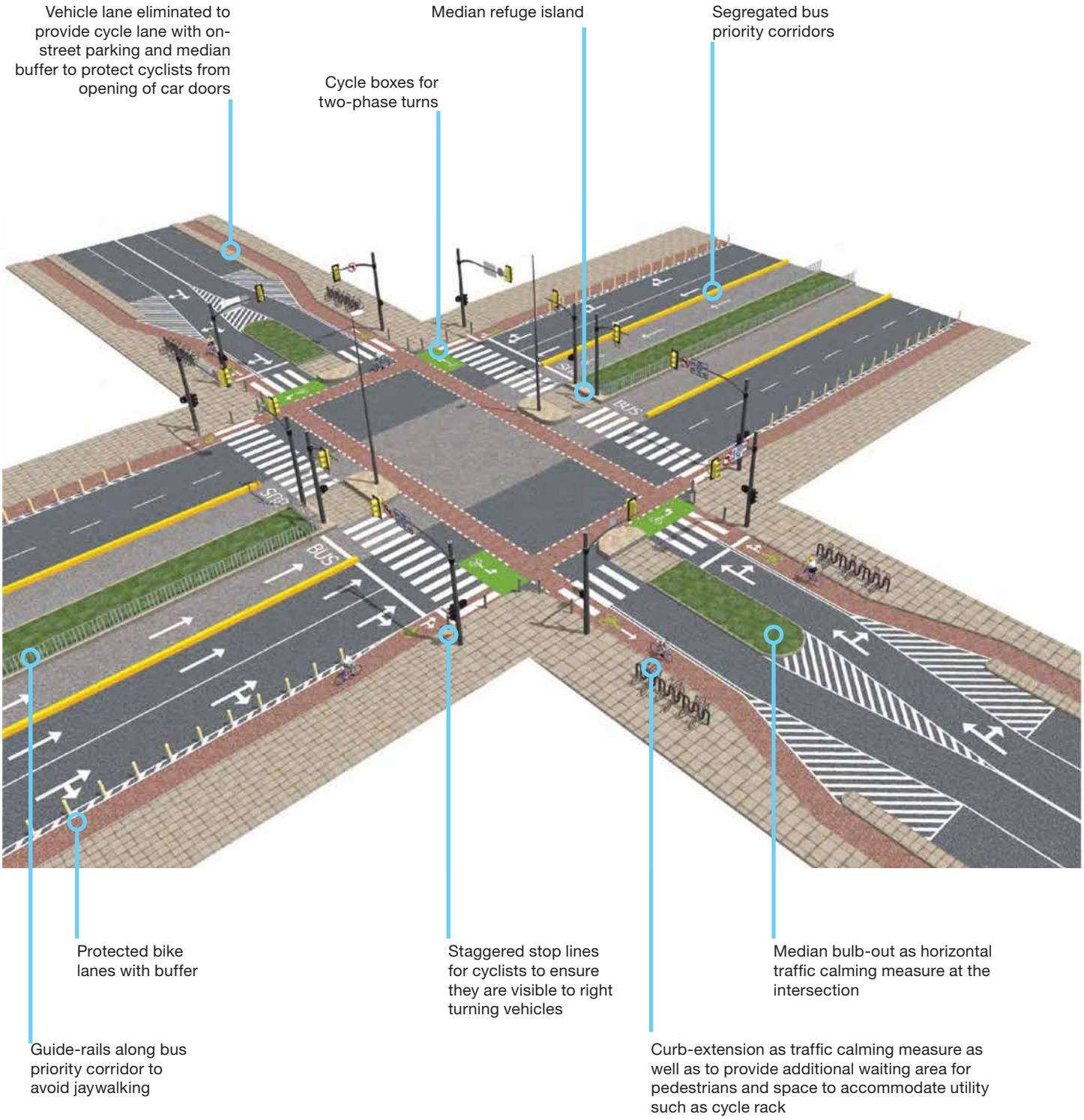


Single phase for cycle movement in all directions. Also, can be combined with pedestrian movement in all directions

Comparison of Suitability of different intersection typologies for cycling infrastructure

Type	Description	Advantage	Disadvantage	Suitability
Regular, traffic calmed intersection	No definitive cycling infrastructure is provided; but intersection is designed with speed control standards of a shared street.	Easy to implement. Doesn't require much street area.	It is not appropriate for high speed intersections, with high traffic volumes and/or high number of large vehicles.	Suitable for neighborhood, traffic calmed streets, that are normally unsignalized.
Advanced termination of the cycle lane	The cycle lane is terminated a few meters before the mouth of the intersection.	It allows motor-vehicles and cyclists to align themselves in the correct position at the intersection, depending upon the direction they intend to go.	No dedicated infrastructure for cyclists, where it's need the most. There is a risk of collision be-tween vehicles & cyclists, while they're changing lanes.	Should be used very sparingly, only after all other options are considered.
Provision of a turning lane between the cycle lane & footpath	A left turning lane* for general traffic is provided between the footpath and the cycle lane.	It allows cyclists to continue straight through the intersection, without conflict with left-turning motor-vehicles.	There is a risk of collision at the place where the cycle lane and the motor-vehicular lane cross each other.	Should be used very sparingly, only after all other options are considered.
Cycle boxes with 1-phase right turn*	Cyclists align themselves in a cycle box, (provided between the pedestrian crossing & the stop line)	It provides dedicated infrastructure right up to the intersection mouth. It allows cyclists to complete a turn in one signal phase.	It creates some ambiguity on where the cyclist should wait if it reaches the intersection during the green signal phase for vehicular traffic on the same arm of the intersection	Suitable for trunk cycling routes with a high volume of cyclists. It is especially useful when the majority of cyclist movement makes a right* at the intersection
Cycle boxes with 2-phase right turns*	During the green signal phase, cyclists intending to turn right enter the intersection and align themselves in the cycle box of the perpendicular street.	It provides dedicated infrastructure right up to the intersection mouth. The design is more intuitive to both cyclists and motorists.	It needs 2 signal phases for cyclists to complete a right turn.	Suitable for trunk cycling routes with a high volume of cyclists. An appropriate universal design principle, as it is likely to fit most contexts.
Hooked cycle lanes	The cycle lane is slightly deviated at the intersection to align it with adjacent street pedestrian crossing.	It slows down cyclists as they enter the intersection area. It provides better visibility for cyclists and motorists of each other.	It creates some deviation from the shortest path across the intersection for cyclists. It requires a larger intersection area to be implemented.	Appropriate and safe option wherever there is adequate inter-section area. It can be used for both signalized and unsignalized intersections.
Scramble signal phase	A separate signal phase is provided for cyclists to move to and from all arms of the intersection; all motor-vehicular traffic has a red light.	An intuitive design that allows for the free movement of cyclists in any direction.	The addition of a signal phase may affect intersection through-put which may result in longer delays for both motorists and cyclists.	Appropriate when there is a high volume of cyclist, with no single dominant direction of movement. Suitable for intersections with more than 4 arms

* Description is written on the context of countries where traffic drives on the left side of the road.



Two-phase cycle turn at intersection with Bus priority lanes
(Source: © WRI)

C FEEDER TRANSIT AND PARATRANSIT INFRASTRUCTURE

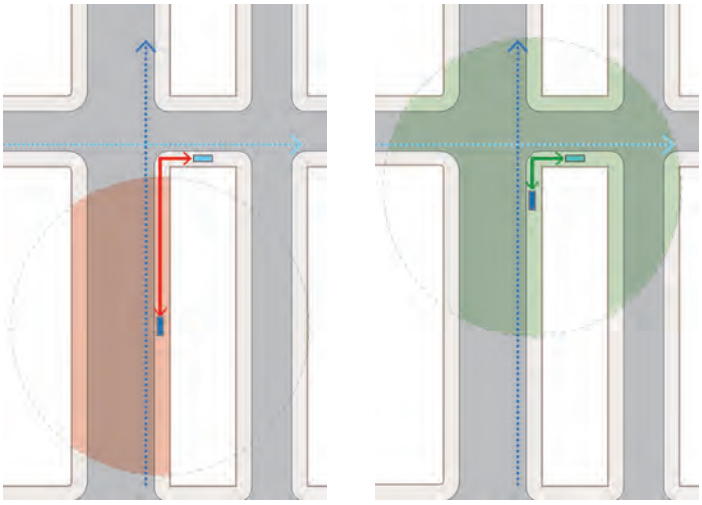
Feeder transit (generally in the form of buses) and paratransit (in the form of vans, taxicabs or auto-rickshaws) provide a valuable service in enhancing the commutable distance for transit users. This is particularly important for station areas in lower density area, where distances from the station may be too long for walking and cycling to be the only feeder alternatives.

In most cases, feeder transit and paratransit services will share the same road infrastructure as general motor-vehicular infrastructure.

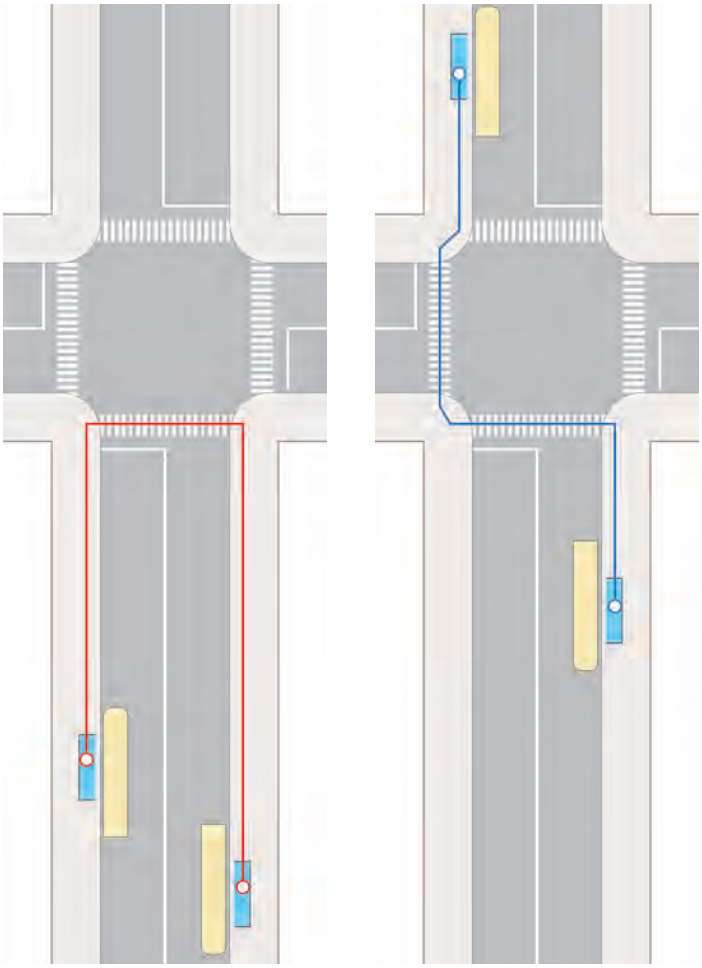
Bus stops near intersections

The intersection is an optimal location for a bus stop for two important reasons mentioned below:

1. A bus stop located at an intersection is likely to have a larger area within walking distance as compared to a mid-block stop, because of the intersection of streets moving in different directions.
2. It reduces the walking distance to transfer between two intersecting bus routes, if their respective bus stops are located at, (or near) the same intersection.



Comparing bus stop location at mid-block, having a limited reach and longer interchange distance (Left) versus a bus stop located near an intersection that increases the connectivity and reduces the interchange distance.



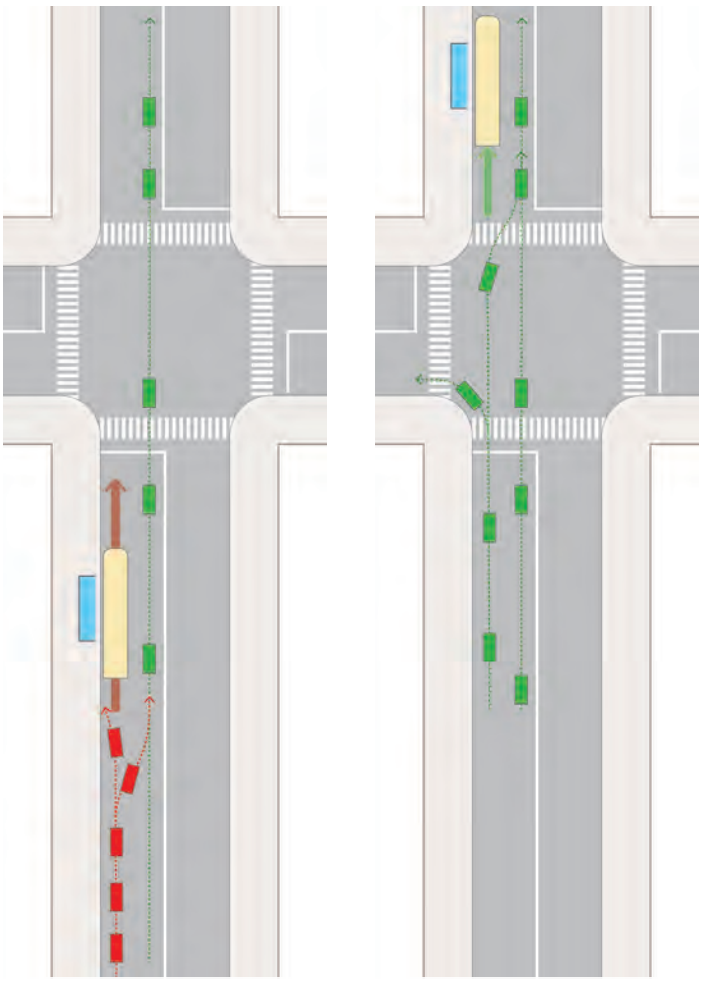
Comparing transfer distances of two stops that are positioned at mid-blocks (Left) versus two stops near the intersection (Right).

The presence of a bus stop in close proximity to an intersection can create certain challenges for traffic mobility and for safety.

- A bus waiting at its stop may hold up traffic trying to clear the intersection, which affects intersection throughput capacity.
- Furthermore, the waiting bus may act as a visual impediment for motorists and crossing pedestrians, which can have a negative impact on safety.

These issues raise some crucial concerns with respect to the design and positioning of bus stops at intersections.

If the bus stop were to be located just before the intersection, it may unnecessarily hold-up traffic behind it if the light is green as the motorists cannot overtake the bus and they would end up queuing behind the waiting bus.

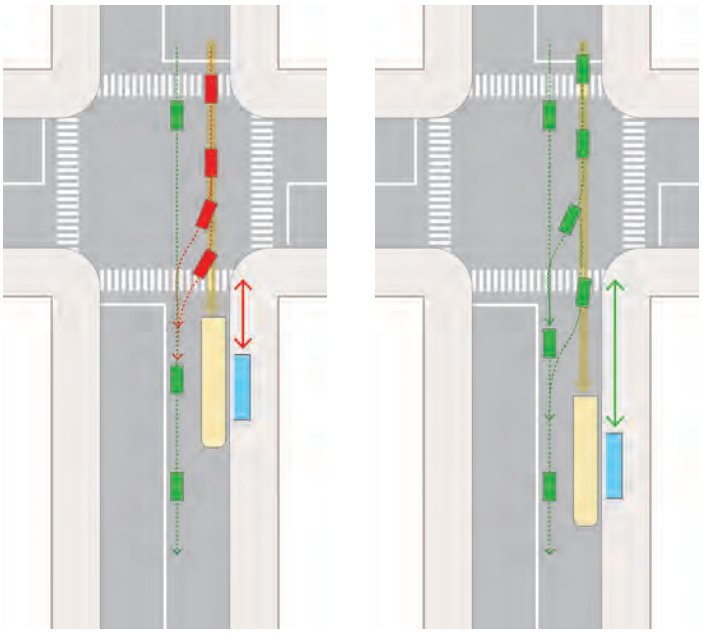


Comparing impact on moving traffic due to positioning of bus stops before an intersection (Left) and after the intersection (Right).

Curbside bus stops with marked bus lanes and barriers to avoid jaywalking
(Source: © WRI)

A bus stop is best positioned a few meters after the intersection as the bus would have to cross the intersection before reaching the stop. The bus stop should be located some distance away from the intersection to allow for vehicles entering this arm of the road to move out of the lane occupied by the bus in order to overtake the waiting bus. The advantage of this positioning is:

- It allows all traffic, (including the bus) to queue up in the correct lane, depending on which direction they intend to move.
- It does not hold up traffic that wants to go through or make a turn at the intersection. This is especially important for signalized intersections.
- The pedestrian crossing for this intersection (which will also service the bus stop) will be located behind the bus.
- It ensures that most bus commuters will walk back to the intersection in order to cross the road, putting them out of the blind spot created by the bus.



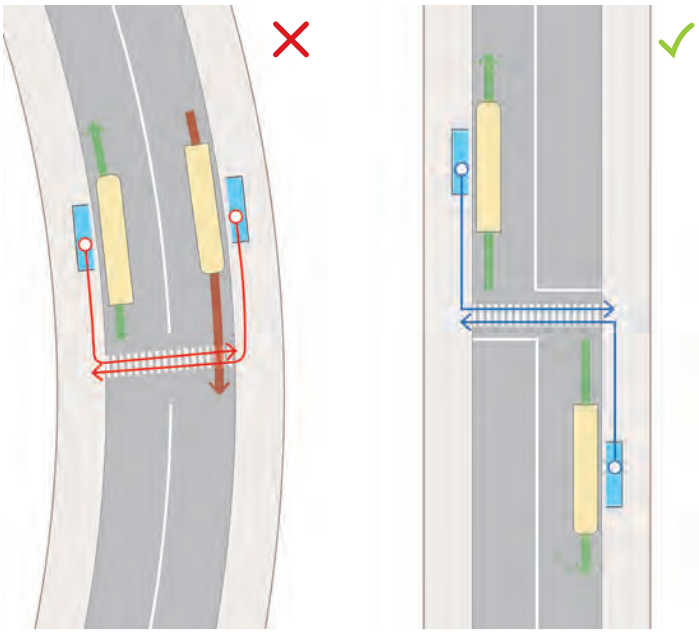
Comparing impact on moving traffic due to positioning of bus stops closer to the intersection (Left) and after a short distance from the intersection (Right).

Mid-block bus stops

In some cases, the distance between successive intersections may be very far, warranting the need for a mid-block stop. In other cases, adjacent land-use conditions may dictate the location of the stop If a prominent node, such as an educational institution or a hospital, is located at the mid-block, then it may warrant the positioning of the stop as close to this node as possible.

There are certain aspects to be kept in mind regarding the provision of mid-block stops.

- Avoid locating the bus stops along curves or slopes in the roadway, as this effects visibility of crossing pedestrians.
- As a general principle, try to locate the bus stops on opposite sides of the road, such that they share a common pedestrian crossing that is located behind both stops.



Positioning of bus stops at mid-blocks.
Locating mid-block stops along curved roads should be avoided and should be positioned in a way so that they share common crosswalk behind both the stops.

Paratransit nodes

Paratransit normally operates along the general traffic roadway in mixed traffic conditions. Typically, pick-up and drop-off happens all along the roadway, except where there are legal restrictions against stopping. As such, paratransit commuters do not normally require specific street infrastructure elements.

Places where there is a high demand for paratransit services such as shopping malls, educational institutes, office complexes, etc. there tends to be a concentration of paratransit vehicles waiting to pick-up passengers which affects both traffic throughout and safety of pedestrians

- It is recommended to provide dedicated pick-up and drop-off infrastructure at all such nodes, to facilitate the orderly alignment of paratransit vehicles, which allow for passengers to embark and disembark these vehicles safely.
- The pick-up and drop-off zones function best when they are physically separated from each other, in a manner that allows for a paratransit vehicle to quickly move from the drop-off zone to the pick-up zone, (in order to pick-up new passengers). The length of each

D TRAFFIC-CALMING MEASURES FOR SHARED STREETS

A shared street is one where the infrastructure is designed to meet the mobility and safety standards of all road users. These standards are very different for motor-vehicle traffic than for non-motorized traffic. Thus, if a street is to be designed for all road users, it is essential that it meets the safety standards of the most vulnerable road users among them, namely pedestrians and cyclists.

The implementation of traffic-calming measures is an essential component of creating safe, shared streets. The provision of traffic-calmed, shared streets allows for the completion of the feeder networks, which is an essential principle of TOD access planning.

The most important aspects of developing safe, shared streets are:

1. Slow down traffic speed to decrease the probability of conflicts between road users, while also reducing the severity of a crash when it happens.
2. Reduction of traffic volume achieved mainly through the diversion of non-local traffic.

Shared street in Guatemala with different material, bollards and planters to reduce speeds of moving vehicles, creating safer space for other road users.
(Source: © The World Bank)

General design measures

This section considers some of the general traffic-calming design measures to make streets safe for all road users.

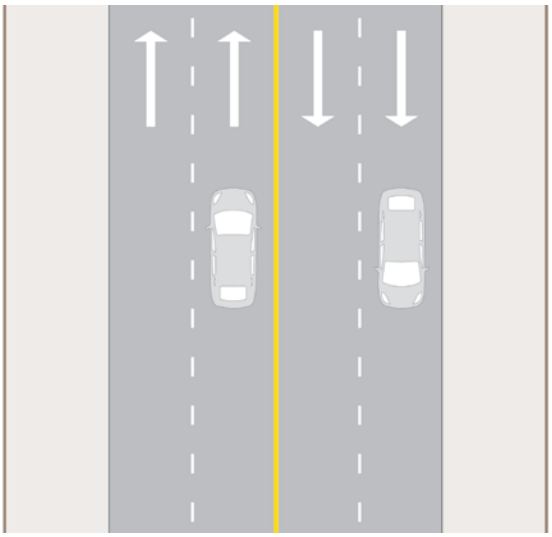
LANE DIET

The total width of the section of the road reserved for vehicular movement is often referred to as the carriageway. The width of this carriageway is a crucial factor in influencing traffic speed.

There are two aspects to be considered here:

1. The traffic lane width- Wider traffic lanes allow motorists to drive faster, because of perceived lower conflict risk with traffic in other lanes.
2. Number of traffic lanes- Greater number of traffic lanes result in increased carrying capacity, which improves traffic free-flow conditions, which further allows for faster travel.

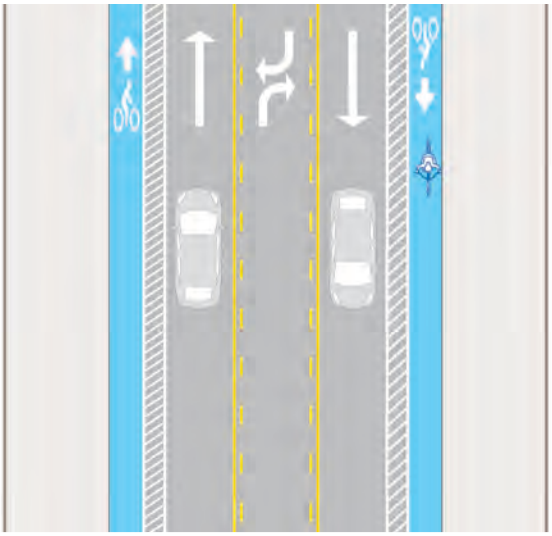
- Streets in many urban areas are designed with lane width of 3.5m and more which allows for a design speed in excess of 50km/h, which is an extremely unsafe speed for urban conditions. The design speed should be ideally closer to 30km/h. And for local, neighborhood streets, an even lower design speed is desirable.
- A traffic lane width of 3m (upper limit) is recommended for all shared streets. An exception may be made for roads that are part of the transit bus network, where the lane utilized by the bus, (in most cases adjacent to the footpath), may be as wide as 3.5m.
- For neighborhood streets, and even narrower lane width than 3m is desired.
- Generally, a shared street must not have more than 2 traffic lanes in either direction. Anything more than 2 lanes makes it difficult to implement a design speed close to 30km/h. In most cases, 1 lane in each direction is adequate for local, neighborhood streets.



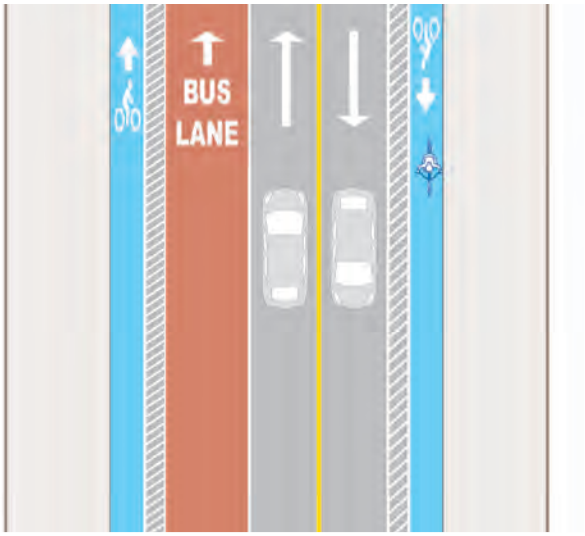
Existing distribution of ROW with wide travel lanes

If an existing bi-directional road with two lanes in each direction is to be redesigned along shared street principles, then consider converting the additional lanes into a parking lane; or utilizing the additional road width to increase space for other street elements, such as footpaths.

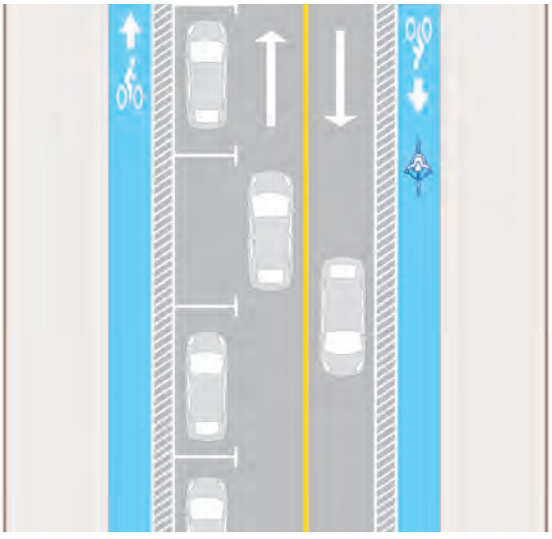
Here, it must be noted that it is a common traffic calming practice to convert a unidirectional road with two lanes into bi-directional road with a single lane in each along with other horizontal and vertical measures (discussed later in this section). It may also be redesigned to accommodate a buffered cycle lane or shared bus lane (in the same direction) to improve capacity of the street and segregate the modes – as discussed earlier in PD-H07 (sub-section Capacity).



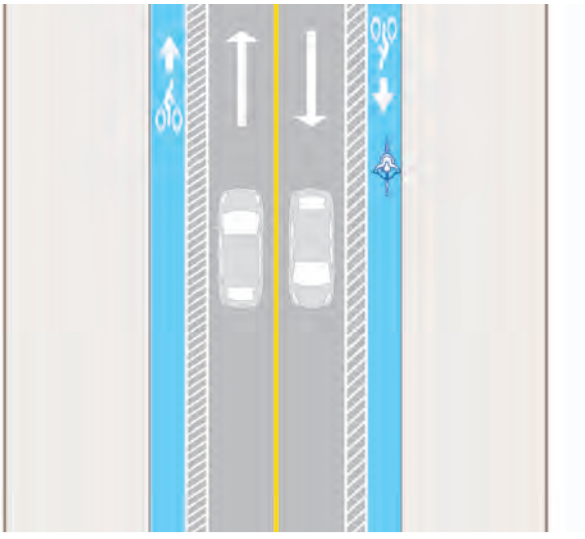
Redistributed ROW with narrower travel lanes, cycle lanes, and center turn lane



Redistributed ROW with narrower travel lanes, cycle lanes, and bus lane



Redistributed ROW with narrower travel lanes, cycle lanes, and on street parking



Redistributed ROW with narrower travel lanes, cycle lanes, and wider footpaths

FREQUENCY OF INTERRUPTIONS

The design principles for a shared street are counterintuitive to the design principles of trunk routes.

Trunk Routes

It is desirable to minimize interruptions along the trunk route by restricting median cuts, eliminating intersections and discouraging property accesses.

However, on certain kinds of shared streets, the high frequency of such interruptions may actually be desirable, as it increases conditions that disrupt through flow movement; which results in slowing down traffic.

Non-Trunk Routes

The central median may be removed to allow vehicles to cut across the center line to make turns into driveways. However, if it cannot be entirely removed, then the number of median breaks may be increased to achieve similar results

It is recommended to have fewer restrictions on property driveway accesses, as the frequency of the same, contribute to slowing down traffic.

URBAN DESIGN MEASURES

Traffic-calming measures include several engineering interventions to slow down of traffic. In addition, there are many urban design measures that act as visual cues, encouraging motorists to select the appropriate speed for this zone.

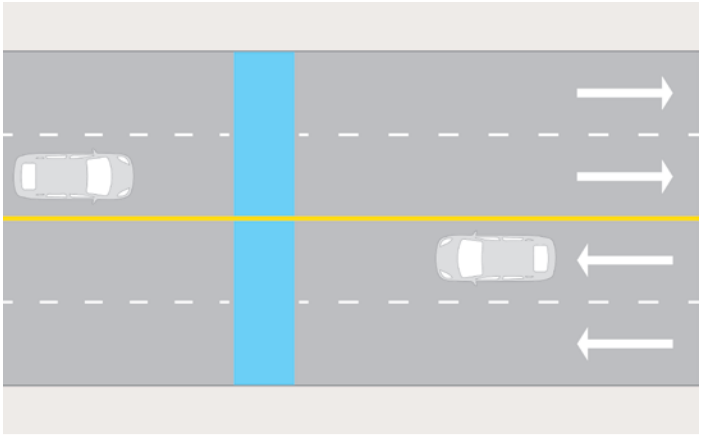
- The presence of setbacks along the road front have a psychological impact on speed selection.
    - A street where buildings are set nearer the road edge are perceived to be narrower than streets of similar widths, but where the buildings are further apart. This induces motorists to driver slower on the former kind of street, due to the narrower visibility range.
    - From a station area's planning perspective, regulations can be implemented to relax frontage setback norms, (where appropriate), to encourage more compact development.
- Trees planted close to the carriageway edge have a similar impact on speed selection.
- Softer streetscape elements may also be considered to signal to the motorists that they have entered a traffic-calmed street. This include measures such as change of carriageway surface material and color, as well as the increased use of landscaping and other street furniture.
- Another measure is to include more diverse road users, such as on-street parking and street-vending. These uses increase the perceived disruptions to the motorist, which encourages them to slow down.
- If there are definitive entry points into a neighborhood from a main street, it is a good practice to install a gateway feature across the entry point, which informs motorists that they're about to enter a different kind of right-of-way. This encourages them to slow down and choose the appropriate speed for this zone.

Mid-block design measures

SPEED HUMPS, SPEED TABLES AND SPEED BUMPS

There are three kinds of vertical deflectors, that are effective in controlling vehicular speed. They have slightly different design features which also impacts their functionality and applicability.

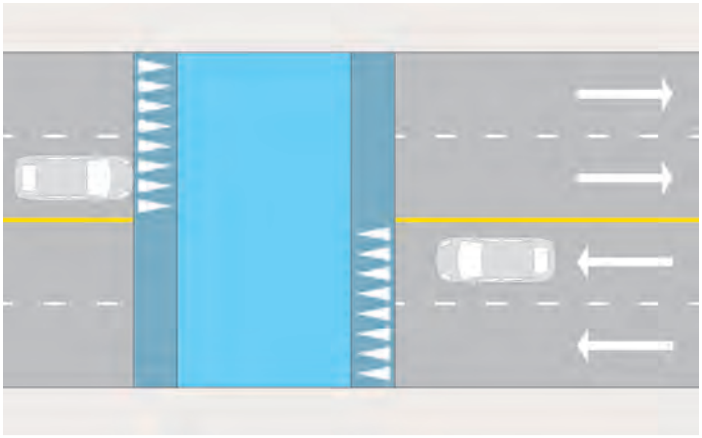
1. Speed humps: A speed hump refers to the curved, raised area, along the width of the carriageway, which causes a vertical deflection for vehicles as they traverse it, which induces motorists to slow down in order to cross the hump comfortably.



Speed hump

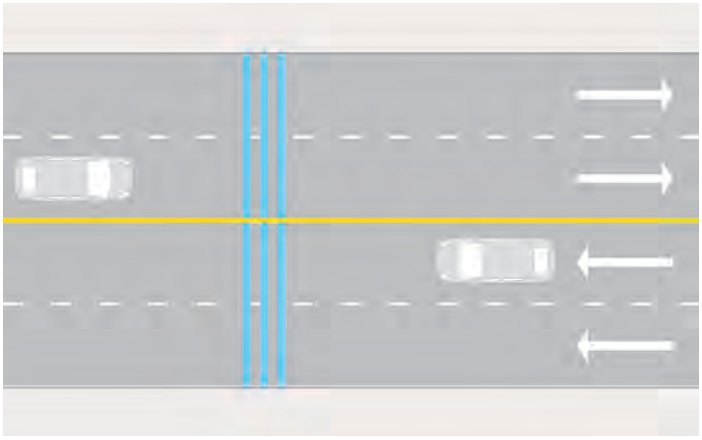
2. Speed tables: A speed table refers to an elongated speed hump, with a flattish section between the up and down slopes of the hump. A pedestrian crossing may be included along the flat section of a speed table.

   Speed humps or tables are recommended for local, neighborhood streets as a traffic-calming device. Speed bumps are normally not recommended for public streets, because of their abrupt impact on vehicles. They are more suitable for driveway or parkway entries.



Speed table

3. Speed bumps: A speed bump is significantly narrower in cross-sectional width than a speed hump, which causes a more striking vertical deflection for a traversing vehicle. A vehicle, normally, has to come to a near stop, in order to cross the hump comfortably.

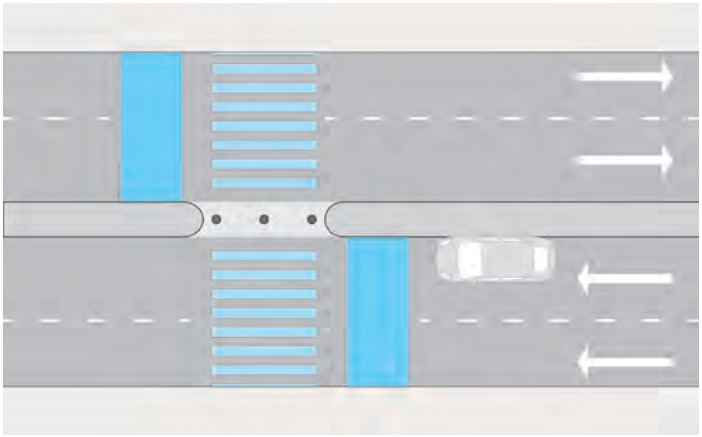


Speed bump

The frequency of speed humps along a stretch of road should be such that it discourages speeding in-between two humps. It is a good idea to provide speed humps before pedestrian crossings, especially in cities where motorists are unlikely to slow down for a crossing pedestrian. If there is no median barrier on the roadway, it is better to locate the pedestrian crossing on top of the speed table.

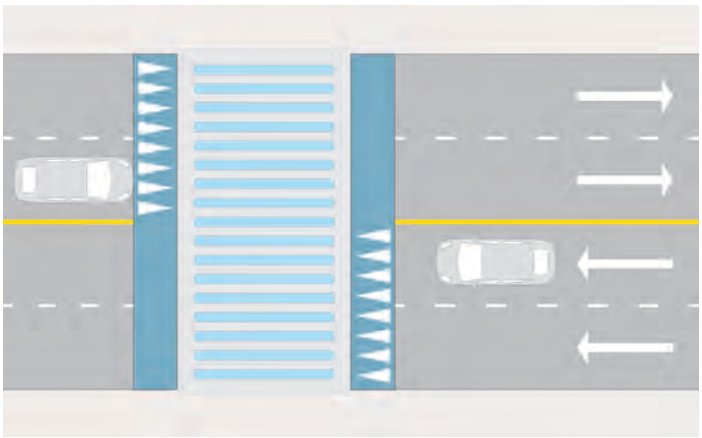
If such vertical speed controls are needed near to an intersection, it is recommended to use a speed hump instead of a speed table so that pedestrians don´t confuse it with a pedestrian crossing.

Speed humps must be avoided along curved sections of the road, or in sections where forward visibility of the roadway is low. Speed humps should also be avoided on sloping sections of the road. Normally, a speed hump should not be installed just before a traffic signal, as it affects the green phase traffic throughput for this signal.



Speed humps before pedestrian crossing

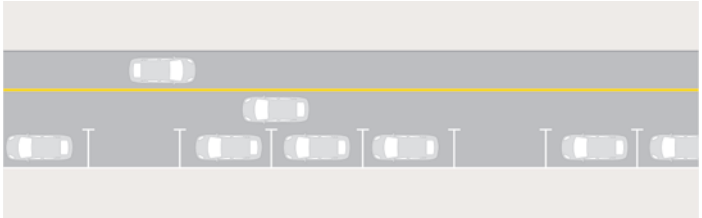
Speed table doubling up as a mid-block crossing with safety bollards in New Delhi, India
(Source: © The World Bank)



Pedestrian crossing on top of speed table

CHICANES, CURB-EXTENSIONS, BULB-OUTS AND STAGGERED ON-STREET PARKING

Speed humps, tables and bumps were examples of vertical traffic-calming deflectors. In addition, there are various horizontal traffic-calming deflectors that achieve a similar effect. The following types of horizontal traffic calming measures are applicable for both two-way and one-way streets.



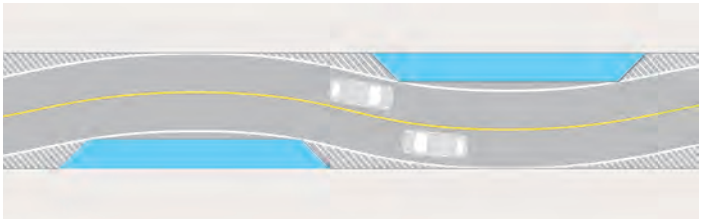
Typical existing street conditions with on-street parking

1. **Chicanes:** These refer to the series of physical deflectors that are installed along alternating sides of the road, which result in the creation of a serpentine-like roadway. This forces motorists to slow down as they steer left and right through the successive chicanes. Chicanes are a useful retrofit for long, neighborhood streets, though consideration should be given to their impact on cyclists and emergency vehicle movement.

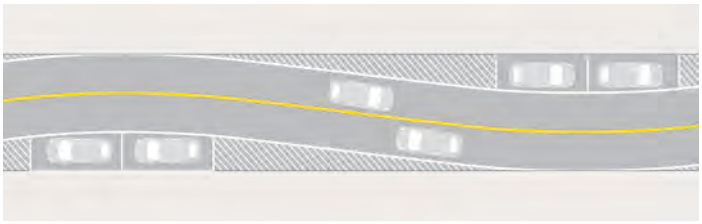
2. **Staggered on street parking:** A similar traffic-calming impact that chicanes provide can be achieved by staggering the provision of on-street parking. The presence of on-street parking has the added advantage of increasing perceived traffic disruptions, which induces motorists to drive slower.

3. **Curb Extensions:** This refers to the physical extension of the curb, (normally the footpath curb) into the carriageway, partly or fully cutting out a traffic lane. Curb extensions are also referred to as **Chokers,** because, they, in effect create a physical bottleneck, with the intention of choking traffic. This induces motorists to slow down while driving through the curb-extension area.

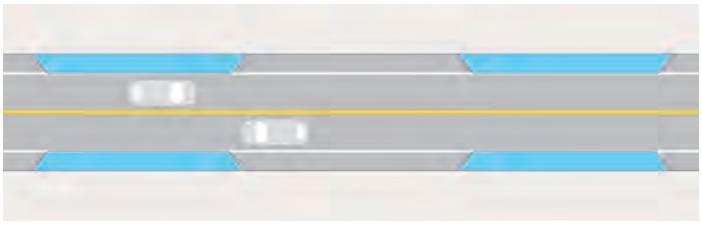
4. **Median Bulb-Out:** Curb-extensions may also be provided along a curbed median, which then creates, what is called a bulb-out in the center of the road. The advantage of such a bulb-out is that is allows for the inclusion of a pedestrian refuge area between the crossing, where pedestrians can stop and wait while crossing the road.



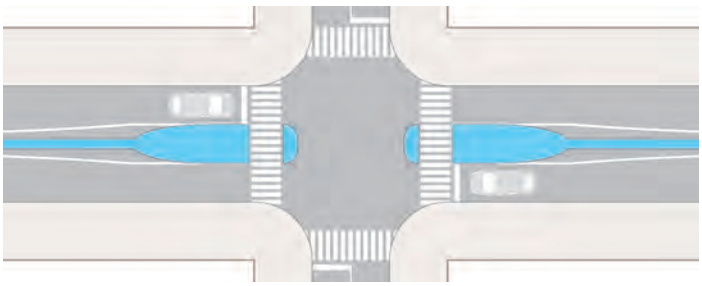
Chicanes



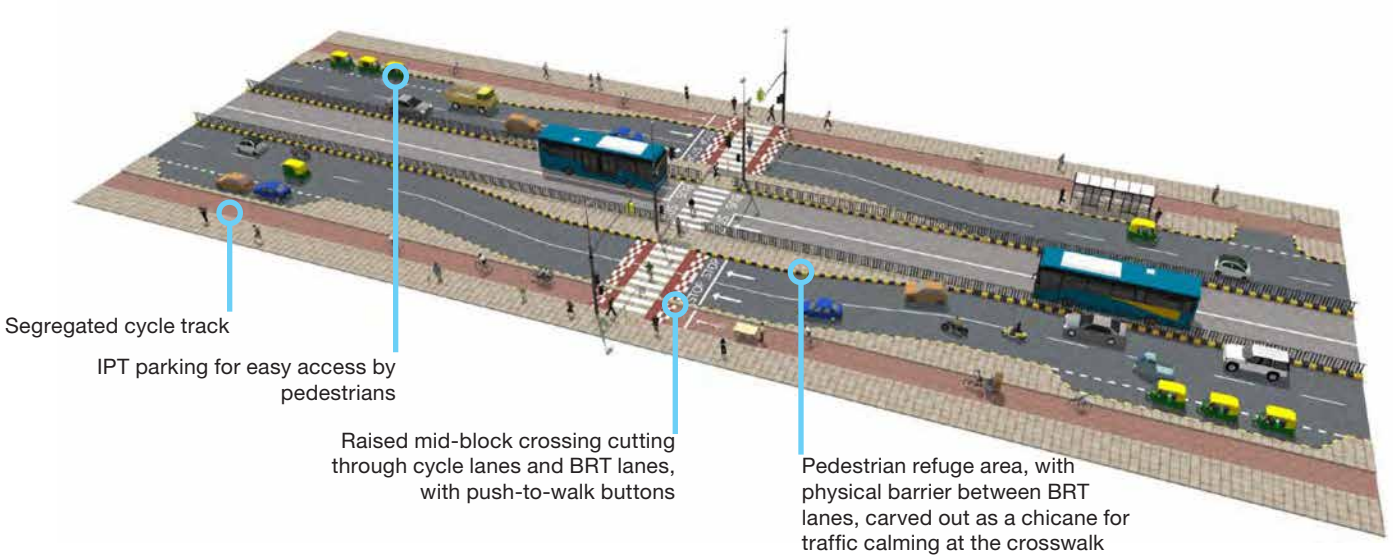
Staggered on-street parking



Curb extensions or chokers



Median bulb-out



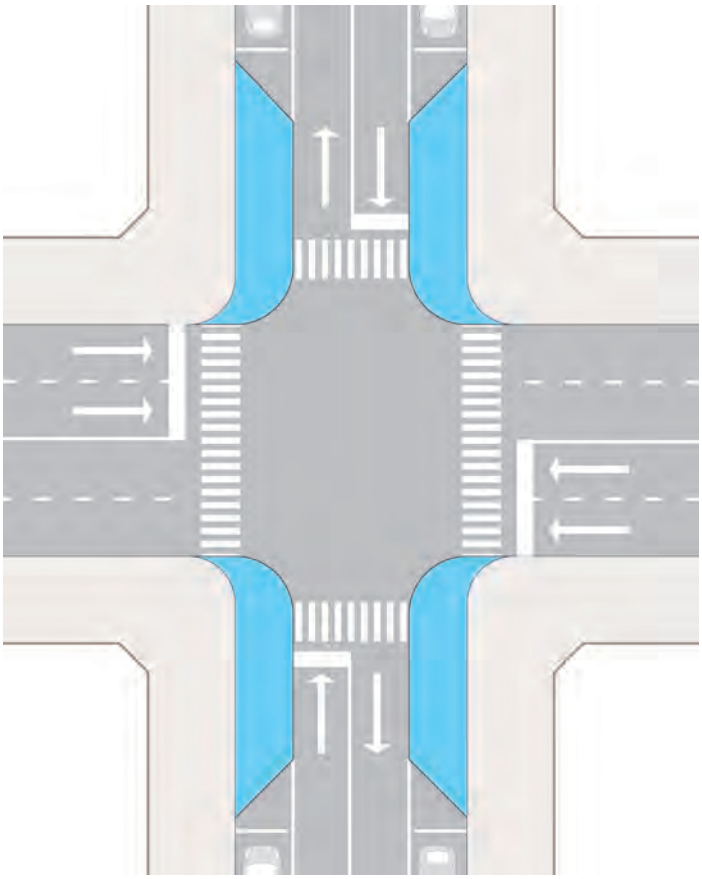
Mid-block crossings in BRT lane as a combination of horizontal and vertical traffic calming measures
(Source: © WRI India)

Intersection design measures

There are many physical design measures to slow down traffic crossing intersections that have been discussed in this sub-section.

TIGHTENING AND/OR EXTENDING CURB CORNERS

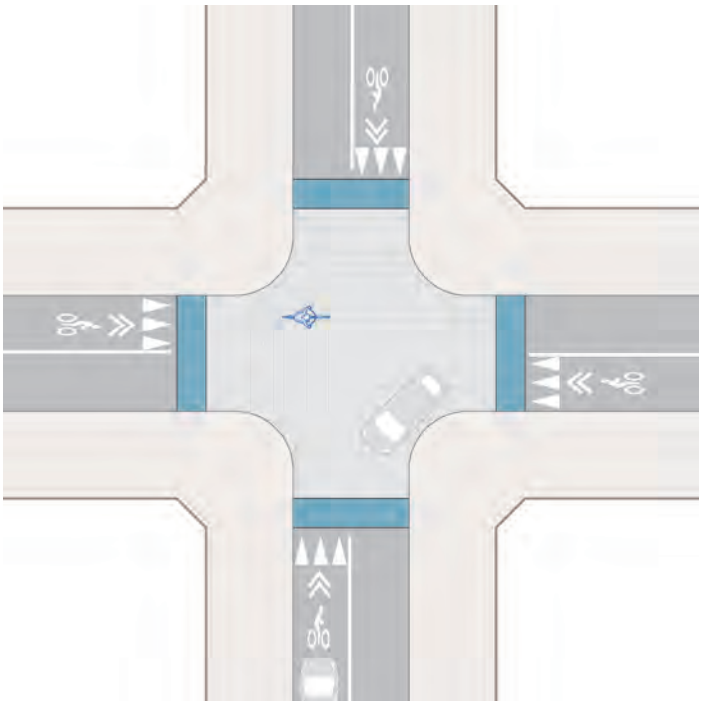
- The most important measure to reduce traffic speed at intersection is to minimize the radius of curb corners at intersections. A tighter corner induces motorists to slow down to make a turn, which adds to safety.
- It also increases the available footpath area at the intersection, which allows for safer crossing
- When designing intersections, a common mistake is to provide an intersection corner radius big enough to accommodate the turning path standards of the design vehicle. In doing so, one neglects to consider the difference between effective turning path and curb corner radius.
- The effective turning path can be wider than what is determined by the corner radius, especially if there is a parking lane adjacent to the traffic lane.
- Furthermore, for traffic-calmed streets with low-to-mid volume, it is not essential that the vehicle completes a left turn, (in the context where traffic drives on the left), from the leftmost lane to the leftmost lane. It is acceptable for the vehicle to traverse into the adjacent lane, in which case, the effective turning width is much wider.



Extending curb corners at intersections to create gateways

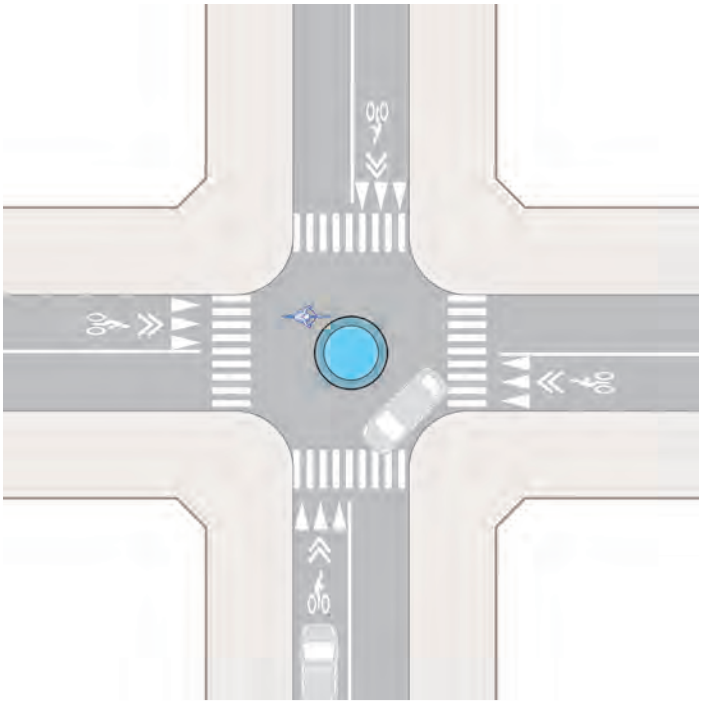
RAISED INTERSECTIONS AND MINI ROUNDABOUTS

- A raised intersection is an effective traffic-calming measure, applicable for unsignalized intersections between neighborhood streets.
- They are similar in profile to a speed table, wherein the entire intersection area is slightly raised to create a vertical displacement for traversing vehicles. This induces motorists to slow down when crossing the intersection.



Raised intersection, at the level of footpath and with a different material.

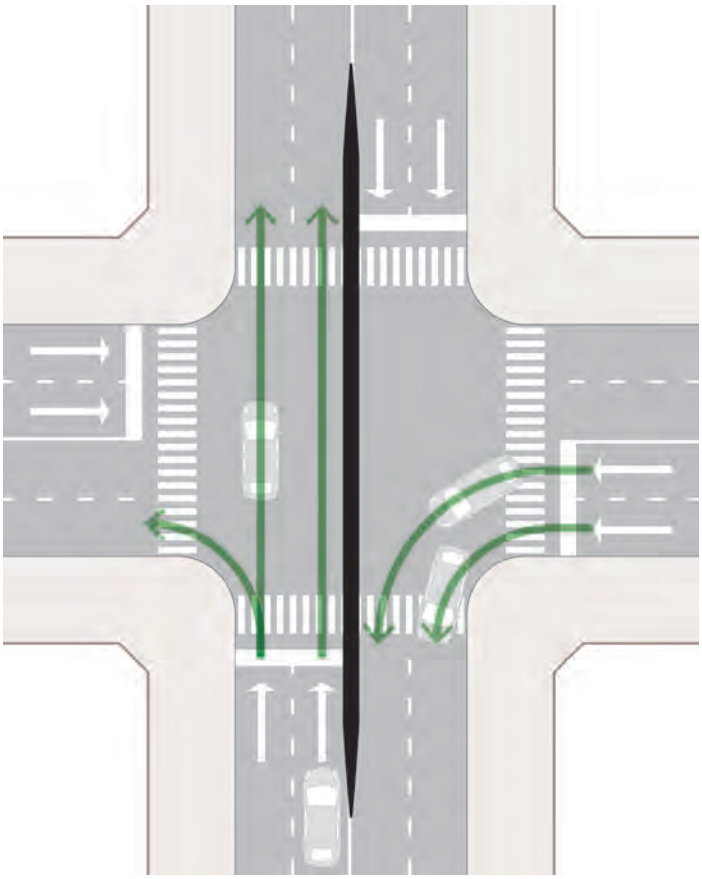
- Mini-roundabouts are another kind of useful traffic-calming intersection feature. It consists of a small circle located within the intersection area, which creates a lateral displacement for vehicles, forcing them to slow down.
- They differ in form and function from conventional roundabouts, which are much larger, and their primary function is to channelize traffic circulation, rather than slowing down traffic.
- A mini-roundabout acts a good marker of an entry point into a traffic-calmed zone, encouraging motorists to drive at the appropriate speed.



Mini roundabout

RESTRICTING MOVEMENT AT INTERSECTIONS

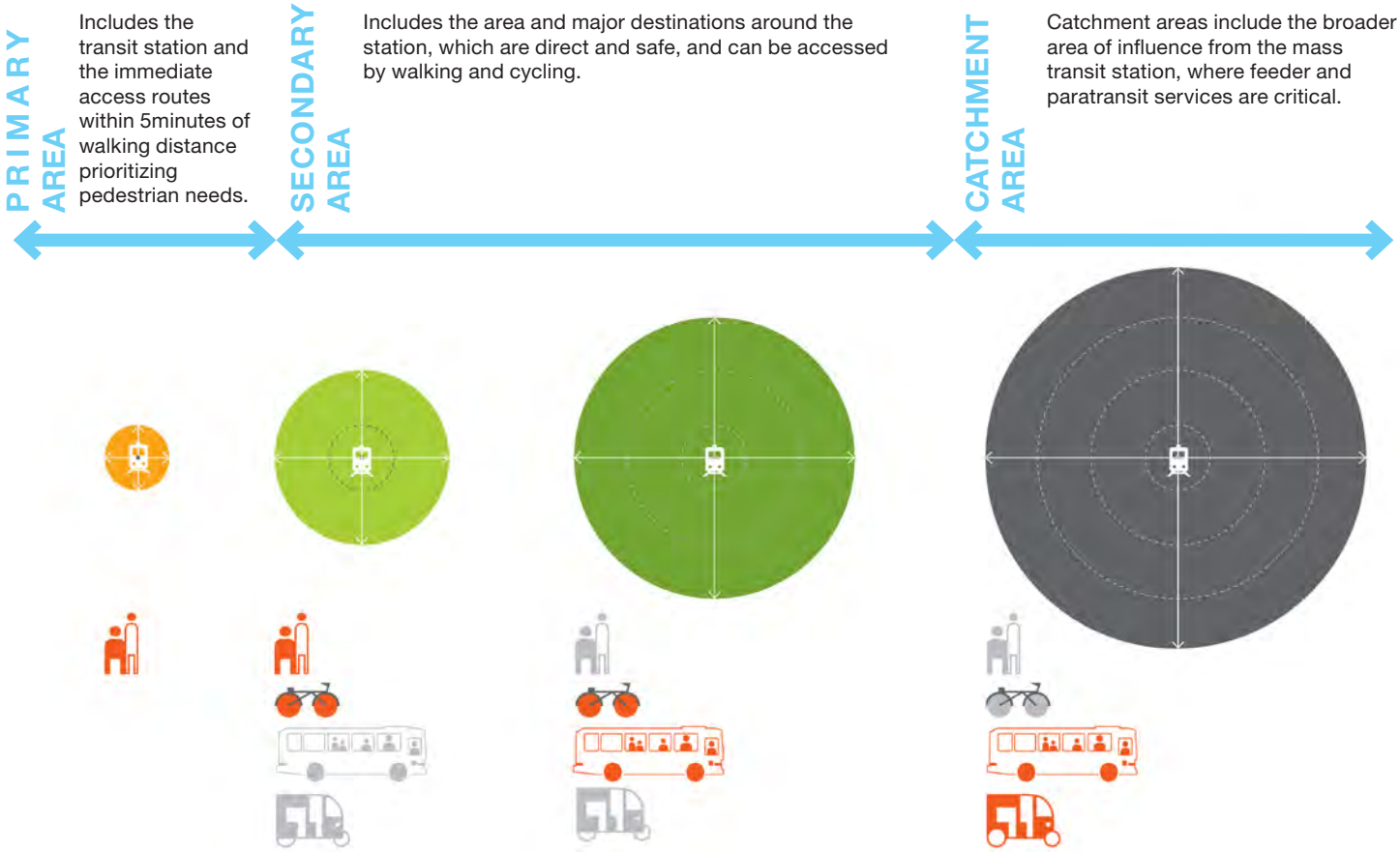
- Traffic-calming at intersections can be achieved by eliminating movements in certain direction, through the installation of physical barriers. This primarily impacts the volume of traffic using this intersection, (and the adjoining streets), by curtailing thoroughfare traffic.
- One such measure is to continue the median barrier across an intersection to prevent turning movement in one direction and prevent through movement in the other direction.
- Another measure is to install a diagonal barrier across the intersection, preventing through movement in either direction.



Restricting movement at intersections using barriers

E PRIMARY STATION AREA DESIGN

- The primary station area in the context of TOD, refers to the area immediately surrounding the transit station i.e. within 0 – 400m or 5 minutes walking, where the transfer of commuters between feeder modes and the main transit line takes place.
- This is the meeting point for the trunk routes of all feeder modes. Hence, safety and mobility challenges are the most crucial at the station area, given the high concentration of commuters and traffic into a relatively small space. To ensure maximum safety, this area must be kept car free, with only designated routes for IPT and feeder services.
- Infrastructure for the transfer of pedestrian commuters should be provided nearest to the station gates, followed by infrastructure for cyclists and feeder buses, then paratransit, and finally, for personal motor-vehicles. It is important to ensure that transit infrastructure, including station structures, do not impede the movement of any mode. It is commonly observed in many cities that the pillars of elevated transit stations completely block the sidewalks below them. In other cases, elevator shafts and stairways to the stations are placed across the sidewalk, forcing pedestrians to walk on the roadway.



Cycle parking facility and pedestrian only area at the entrance of Transmilenio in Bogota, Colombia
(Source: © The World Bank)

Station access points

A transit station with one access point can become a potential bottleneck for commuter movement, especially during the peak commuting hours of the day.

- For a high-volume station, it is recommended to provide multiple entries and exits to the station, ideally connecting to different roads and different directions of the station area.
- Station access points can also be separated according to the transfer mode. For instance, a direct access link may be provided, connecting the station to the feeder bus routes - separating the movement of bus commuters from other commuters.
- Often local access needs are combined with station access points. Access to underground mass transit stations also double up as underpasses to cross major roads. Similarly, BRT stops are often in the middle of a highway and hence is not safe to provide at-grade access. FOBs with ramps or elevators to access the stops are provided. However, if these stations are not functioning during some hours or closed, then the local access can get impeded due to closing of the access facility as well. It is advisable to have these FOBs or underpasses to remain functional all day long and have a connection made from these off-road connectors to the transit facility.
- Grade separated infrastructure can be utilized in conjunction with sidewalks, to increase access points to the stations from important nearby land-uses that are likely to generate a high footfall of commuters. Care should be taken to see that the pillars and related civil infrastructure for such structures do not impede the movement of pedestrians on the sidewalks below.
- BRT services requiring dedicated lanes must be protected using railings and median barriers to avoid jay walking, with access to stops provided at intersections with wider crosswalks or at mid-block crossings. Additional button-activated mid-block crossings must be provided in the station area where the blocks are large or a high volume of pedestrian movement is expected.

Designed access to DN Nagar Metro Station Mumbai near an intersection
(Source: © WRI India)

Pedestrians crossing along the median, especially with longer BRT Green phase.

(Many Latin American BRT Systems have such design including Macrobus in Guadalajara)

Wide at-grade refuge island in the median to accommodate passengers entering and exiting the BRT Station using a protected ramp.

Pedestrian access to a raised BRT station in the center of the ROW
(Source: © WRI)

Cycle rack on sidewalk along the road perpendicular to the BRT lane, allowing riders to lock the cycles and transfer to BRT system.

Facilities for cyclists to access the BRT station along with pedestrians
(Source: © WRI)

NMT ACCESS STREET AT NAVANAGAR BRT STATION, HUBLI-DHARWAD, INDIA

The street leading to the Navanagar BRT station in Hubli-Dharwad in India, is designed as an NMT street. A cycle track and a pedestrian pathway are placed on either side of the street, and activity areas are carved out in the central area for multiple uses. These include a play area for children, a park for seniors, a community gathering space for the neighborhood etc.

Proposed NMT Street connecting from the school to the BRT station Plaza

Schematic section indicating range of activities along the length of the NMT Street

Visualization through a cross section of the NMT Street showing a shared use community gathering space
(Source: © WRI)

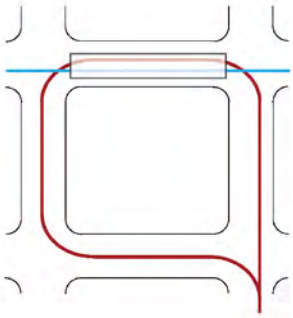
Transfer facility design

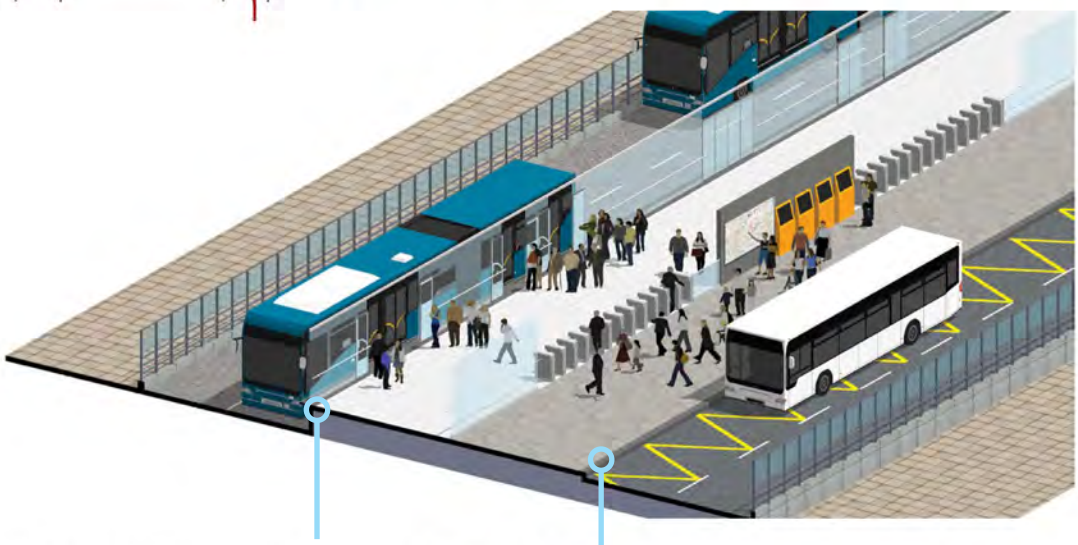
- Transfer zones should be provided in the vicinity of the transit station such that crossing requirements are eliminated or reduced.
- For instance, if a feeder bus-loop / terminal is located near the transit station, it is a good idea to ensure that there is no road in between the feeder bus-facility and the station access point.

TRANSMILENIO TERMINALS, BOGOTOA, COLOMBIA

A typical transfer station along Bogota, Colombia's TransMilenio BRT corridor includes an integrated transfer facility between the trunk BRT route and the feeder service. These terminals are designed to have a common central platform where both the services can dock on either side of the platform. This allows the passengers to transfer by simply crossing across the platform.

It is important to have proper integration between the two types of services to avoid overcrowding of the platform. The platform must be designed with adequate space to accommodate the expected volumes of passengers. Due to overcrowding of platforms in these transfer stations, passengers very often walk and wait in the bus lanes. Another challenge that these transfer facilities face is at the access point of the station which may lead to bottlenecks and even collision of the two types of buses. The diagram below along with photographs explain the transfer facility.





Platform height: Same as bus floor height

On this side of the terminal, the platform is 1 meter above street level, which would allow a typical high-floor, left-door bus to dock.

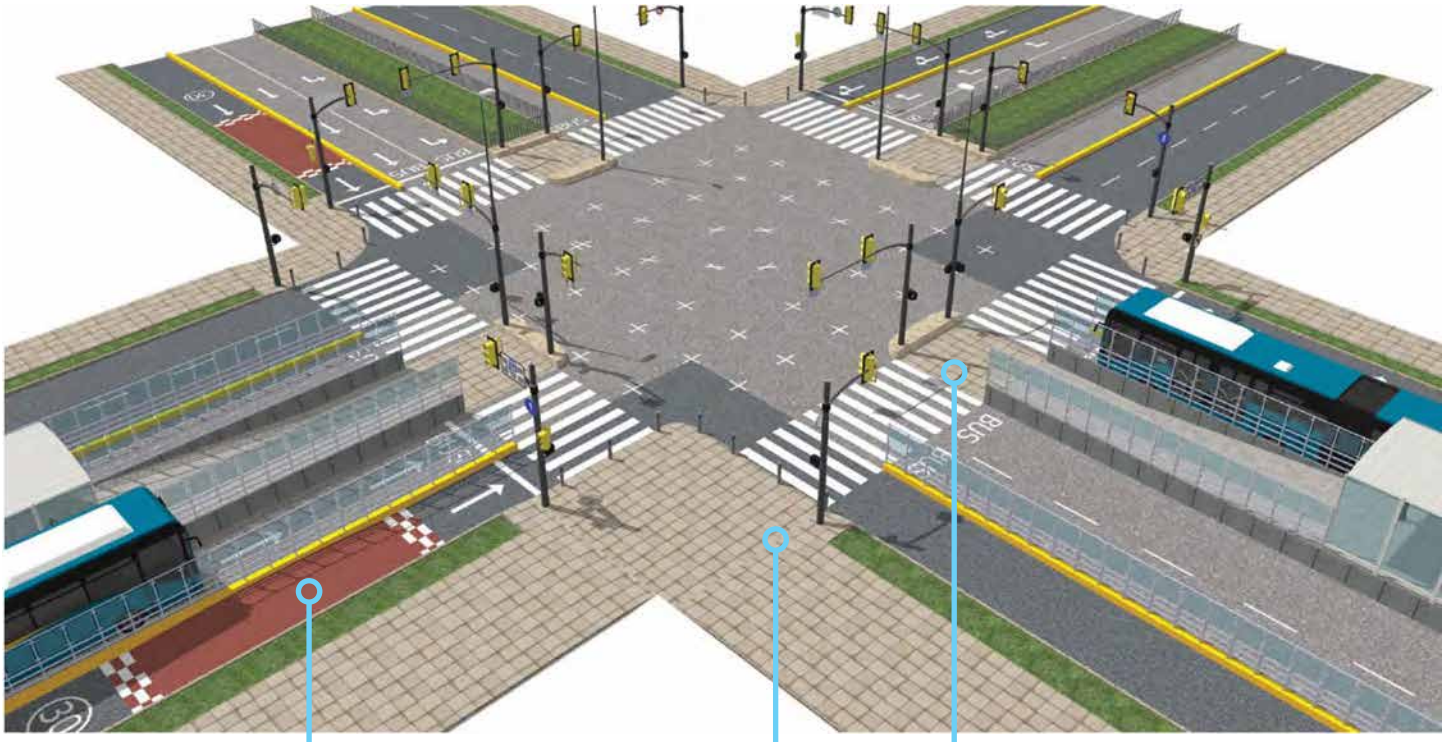
This side of the terminal should be used by high-floor BRT vehicles, It will likely be closed and feature offboard fare collection.

Platform height: 30 cm
The bus lanes on this side of the terminal are raised 70 cm above street level, so that the central platform can service low-floor buses on this side.

This side of the terminal should be used by conventional right-door buses. It can be open and feature onboard fare collection, but there must be guardrails on the outside of the terminal, to prevent pedestrians from crossing the bus lanes.

It is important to size the platform correctly so that it does not get overcrowded. Otherwise, there is a serious risk that some passengers will walk in the bus lanes.

- It may not always be possible to locate all transfer facilities on the same side of the transfer station. In such contexts, it is essential that safe crossing infrastructure is provided to access the station and a signalized crossing may be needed due to the high transfer volumes.



Transfer facility between two intersecting BRT Lines
(Source: © WRI)

- If the transit station is located at a different level than the road, the grade-separated connector may be extended across the width of this road.
- Grade-separated structures are not recommended for crossing the road. However, they are acceptable if they provide direct connectivity to the grade-separated station.
- It is important to separate the para-transit drop-off zones from the pick-up zone, to allow for the smooth functioning of such facilities.
- The drop-off zone should be located before the pick-up zone, which allows the driver to enter the pick-up zone after dropping off passengers. There should also be a provision for the vehicle to leave the drop-off zone, in case the driver does not want to pick up new passengers.
- Physical segregation of respective zones can ensure that the movement of paratransit vehicles does not impede the movement of feeder bus services.

GRADE SEPARATED TRANSFERS AT THANE STATION AREA, THANE, INDIA

The Mumbai Metropolitan Region Development Authority and Thane Municipal Corporation implemented traffic management infrastructure projects around the Thane suburban railway station in the Mumbai metropolitan region. Public bus services and IPT infrastructure are grade-separated. An elevated deck is constructed for public and state transport buses. It connects to the suburban railway ticketing booths through sky-walks and foot over bridges. There are at-grade auto-rickshaw pick up and drop off points with waiting and queuing areas for passengers. A lane has also been reserved for private motorized vehicles.

Thane Suburban station in India with lower level for auto-rickshaws and upper levels for bus bays. It connects to the road level via elevated walkways
(Source: © WRI India)

Para-transit access and transfers to transit station and connections for vehicular traffic and through motor-vehicle free shared streets
(Source: © WRI)

Bhubaneswar, India

TOD KP

PD-R03

LAND USE AND TRANSPORTATION INTEGRATION BEST PRACTICES

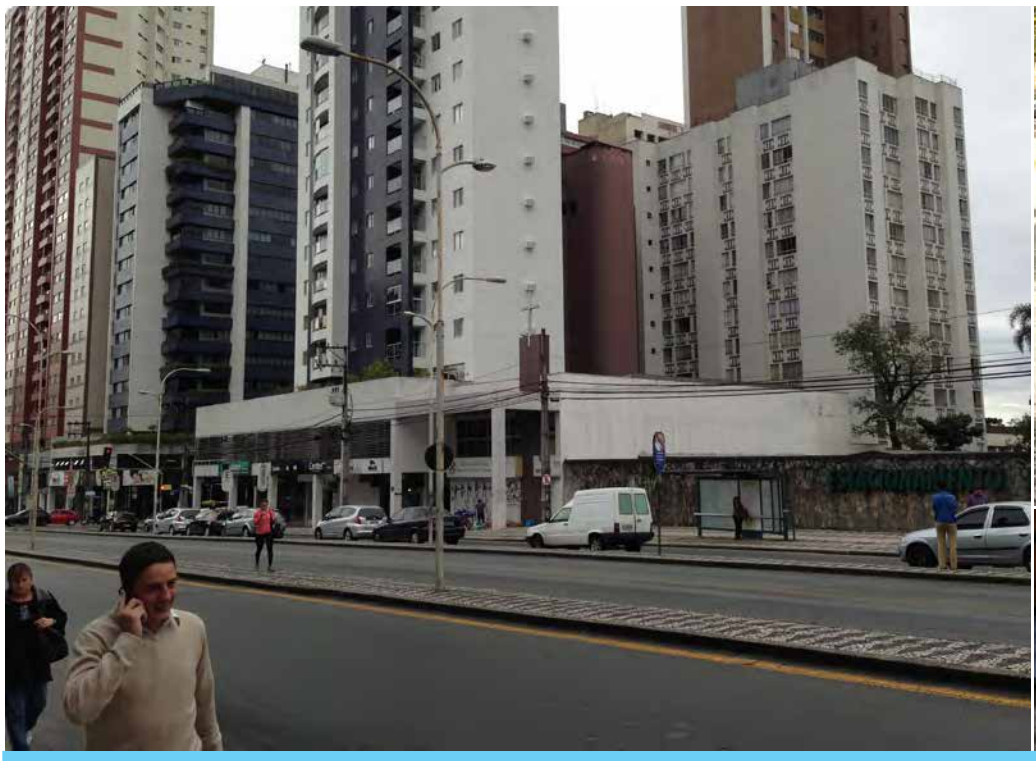
Examples of land use and transportation integration that influenced significant improvements in cities

Type: Reference Document

TOD Global Platform for Sustainable Cities WORLD BANK GROUP IBI

TOD KP

Disclaimer: *The Transit-Orientated Development Implementation Resources & Tools knowledge product is designed to provide a high-level framework for the implementation of TOD and offer direction to cities in addressing barriers at all stages. As the context in low and middle-income cities varies, the application of the knowledge product must be adapted to local needs and priorities, and customized on a case-by-case basis.*



CURITIBA, BRAZIL

+ PROJECT INFORMATION

Location: Curitiba, Parana, Brazil

Funding: URBS (Govt.)

Timeline: 40 Years

Project Settings: Mixed-use (residential/ commercial) main street

Overview:

Curitiba is home to nearly 2 million people. Between 1950-2005, Curitiba's metropolitan area witnessed a sixfold increase in its population- from 300,000 inhabitants in 1950 to 1.9 million in 2005. It is one of Brazil's wealthiest cities and has one of the highest private car-ownership rates in Brazil, yet it averages more transit trips than New York, Rio or Sao Paolo.

PROJECT STORY

The **URBS**- Urbanization of Curitiba was created in 1963 with the purpose of administering the Fund for the Urbanization of Curitiba, to develop infrastructure projects.

The **Curitiba Institute of Research and Urban Planning (IPPUC)** was created on **December 1st, 1965** to execute and develop urban plans.

The 1965 Master Plan set the stage for Curitiba's linear transit-oriented urban form by **1) limiting circular sprawl moving outward from the urban core**, thus decreasing congestion focused downtown;

2) **creating structural axes corridors, lined with high-density mixed-use development** that would taper to lower-density away from the corridors; 3) typical structural corridors in a trinary road system.

+ DESIGN DETAILS

Walkability: Streets with an existing high-level of pedestrian activity have been pedestrianized, along with streets within 400m of the bus corridor, to minimize the need for vehicles.

Flexible planning: Along the structural axes, only the first two floors can extend to property lines. Half of the ground and first floors are mandated to be dedicated to retail uses. Retail-commercial uses at the street level are exempt from FAR calculation.

Compact development: The 'structural axes' concept of high-intensity development has created corridors with high travel demand. Initially, FARs of 6.0 were permitted; later in the 1990s, maximum FARs were lowered to 5.0 for offices and 4.0 for residential. Incentives were given to developers to increase residential density close to the transit corridors.

+ APPLICABILITY

Context: Transit for urban areas with high volumes of vehicles

Scale: Corridor | Station Area | Site

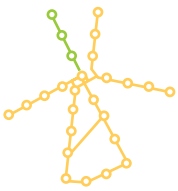
Related TOD Principles:

Complete streets, managed parking, bicycle-friendly, architectural diversity

1972- 1992

The first **20km were planned in 1972** and built in 1973 and the first two BRT corridors were **opened in 1974. In 1979, feeder and inter-district buses were integrated with the BRT, creating the Rede Integrada de Transporte (RIT).** Due to the success of the BRT, by 1982, all five BRT corridors were planned and fully functional.

In 1992, **the iconic circular boarding platforms were introduced** along with the **use of biarticulated buses** to increase system capacity.



1992-2009

The new **Green line BRT corridor** was opened.

MEDELLIN, COLOMBIA

+ PROJECT INFORMATION

Location: Medellin, Antioquia, Colombia

Funding: Municipal Corporation (Govt.)

Timeline: 13 Years

Project Settings: Urban area

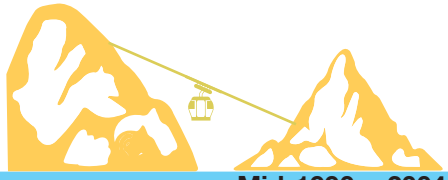
Overview:

Medellin is the second largest city in Colombia and the capital of Colombia's mountainous Antioquia province. Taking into consideration the large number of commuters from the slopes towards the city, and its own topographical restrictions for development, it came up with an efficient land use and transportation integration plan for the city.

PROJECT STORY

1930s

The cable-car technology was initially used for **exporting coffee from the city of Manizales to the south of Medellin.**



Mid-1990s -2004

When Sergio Fajardo became Mayor of Medellín in 2004, the "Medellín, Commitment of all the Citizens" plan for the city was enacted. One of its fundamental axes was described as **"Social Urbanism." One of the** main guidelines was an Integrated Metropolitan Transport System that must be used as the organizing axis of mobility and projects in the city. **All projects have to be directly linked to the main transport system.**

Image: Nigel Burgher (Flickr)
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+ DESIGN DETAILS

Complete Streets: Existing streets were redesigned to widen sidewalks, reduce automobile lanes and include and strengthen bicycle infrastructure. In hilly parts of the city, walkability was enhanced through escalators.

Seamless Integration of Modes: The transit system in Medellin is comprised of heavy rail, BRT, buses and gondola systems, which are effectively integrated to ensure reach to the farthest corners of the city.

Well Designed Transit Station: The metro-cable stations created plazas underneath the station platform and created pedestrian connections with the surrounding areas to improve connectivity.

Bicycle Friendly: Medellin's bicycle infrastructure focuses on separated bike paths, located within sidewalks. There are also dedicated pelican signals at important intersections.

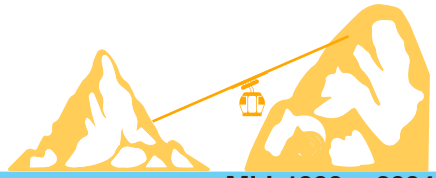
+ APPLICABILITY

Context: Transit for areas with topographical restrictions

Scale: Corridor | Station Area | Site

Related TOD Principles:

Urban parks and open spaces, public realm



Mid-1990s -2004

The Northeastern Urban Integration Project in Medellín **(Proyecto Urbano Integral, or PUI) was initiated by the City of Medellín in 2004. Working with the community to conceptualize, develop and construct new open-space networks, the designers of the PUI have sensitively integrated mobility infrastructure with the strategic goals of large and socially complex projects, by developing processes that promote ownership by the community.**

2010-2015

Line K was the initial line and was **opened in 2004 and Line J in 2008.** In **2010, Line L was introduced** and was connected to Arvi Park. It is **part of a social project** to cater to the masses. Two additional lines H and M have also been introduced.

TOD KP

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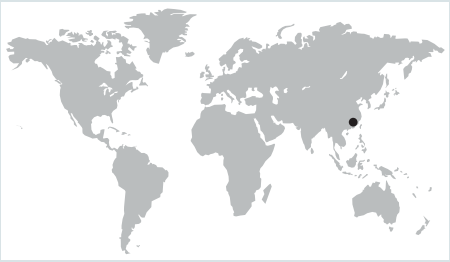
SHENZHEN, CHINA

+ PROJECT INFORMATION



Location: Shenzhen, Guangdong, China

Funding: Municipal Corporation (Govt.)

Timeline: Ongoing

Project Settings: Urban area, suburban ares

Overview:

Shenzhen has become one of the frontier cities that is leading the economic growth of China, as the first of the nation's five Special Economic Zones SEZ (The Economist, 2010). Since the early 2000s, Shenzhen has started to design a new development strategy for the city called the Shenzhen 2030 Urban Development Strategy.

PROJECT STORY

1983

In late 1983, Party Secretary of Shenzhen Mayor Liang Xiang led a team to Singapore to study its mass transit system. Upon returning it was decided that 30 meters on each side of Shennan Avenue should be protected as a green belt and to set aside a 16-meter wide median reserved for a light rail or light metro line.

1984 -1992

In 1984, it was concluded that a light metro system would not sufficient capacity for the growing population and traffic in Shenzhen, as indicated by the Shenzhen Special Economic Zone Master Plan (1985–2000)

Image: Wahsaw
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+ DESIGN DETAILS

Compact development: Large-scale construction has been led by the Master Plan (1996-2010) to develop a hierarchical city network. Shenzhen allows the densities for residential and office developments around transit stations to fluctuate within a certain range. This gives Shenzhen's Planning and Land Resources Committee the discretion to change the densities based on context. For example, Bitou Station: Affordable housing—FAR 2.0, schools and residential housing—FAR 3.0, commercial and office developments—FAR 6.0.

Flexible Planning: Shenzhen expanded land development rights, issuing development rights according to land uses on different building floors. This encourages mixed-use development, as commercial, residential and underground transit building rights can be obtained separately.

+ APPLICABILITY

Context: Urban, Suburban, Greenfield

Scale: City | Corridor | Neighbourhood Station

Related TOD Principles:

Architectural variety, housing diversity, walkability

1984 -1992

Alternatively, a heavy rail subway line was proposed along Shennan Avenue. The Central Planning Department approved the Shennan Avenue line in 1992.

1994-1996

Beginning in 1994, the Shenzhen urban rail network master plan was drafted to be incorporated into the Shenzhen City Master Plan (1996–2010). Nine lines of rail defined the visions for the city urban rail network.

1998- present

Phase I (1998-2004)- Line 1 and Line 4

Phase II (2007-2011)- network expanded from 64 km to 177 km.

Phase III (2012-2020)- Lines 6, 7, 8, 9, and 11

Polanco, Mexico

TOD K P

PD-R04

PEDESTRIAN FRIENDLY DESIGN BEST PRACTICES

Small-scale iterative pedestrian friendly examples in low-middle income countries that influenced significant improvements in the area.

Type: Reference Document

TOD

Global Platform for Sustainable Cities

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MATUNGA FLYOVER, MUMBAI, INDIA

+ PROJECT FACTS

Location: Mumbai, Maharashtra, India

Project Size: 600m x 12 metres

Total Project Cost: 50 million (INR)

Funding: Municipal Corporation (Govt.)

Timeline: 5 Years

Project Settings: Mixed-Use (Residential/Commercial) Main Street

Overview:

Mumbai, the capital city of Maharashtra, is the most populous city in India and the fifth most populous city in the world. The city accounts for only 1.1 square meters of open space—gardens, parks, recreation grounds (RG) and playgrounds (PG)—per person (Open Mumbai, 2012). The site is located in one of the planned areas of Mumbai.

PROJECT STORY

2011-2013

1.5-km long and 17m wide flyover was built at a cost of 700 million(INR) from the Maheshwari Udyan to Tulpule Chowk flyover.

The space under the flyover **turned into a hangout zone for hawkers, gamblers, drug addicts** as well as encroached by illegal parking

2011-2013

Residents requested the **Municipal Corporation (BMC) for barricading the entire stretch**

About **40 people crowd-sourced funds and hired 24X7 private security** for two years.

Engaged 10-12 BMC sweepers to clean the stretch to avoid dumping and encroachment.

+ DESIGN DETAILS

Walkway: Designed 600m long pathway in blue color to resemble River Narmada with some stretches designed as Narmada ghat where people can sit.

Safety: The stretch is equipped with rotatable CCTV cameras, colorful lights and security officials.

Public Convenience: Art installation, small plants and dustbins are lined up on both sides of the space.

Events: Activities are organized on Sunday morning dividing the area below the flyover into different zones like health, live performance, traditional games, indoor games and outdoor games zone.

+ APPLICABILITY

Context: Underutilized spaces under the elevated transit corridors

Scale: Corridor | Station Area | Site

2013-2014

Residents **formed a group 'One Matunga'** and designed a **children's park with 600-meter long and 12-meter wide meandering jogging track** that is shaped like the Narmada river.

2014-2016

The group presented the idea to various government authorities for developing a small garden in that space.

After successful petitioning, it got the **final approval and in June 2015, BMC began to redevelop the area**.

Embroiled in some political differences, the park was finally **inaugurated in June 2016**

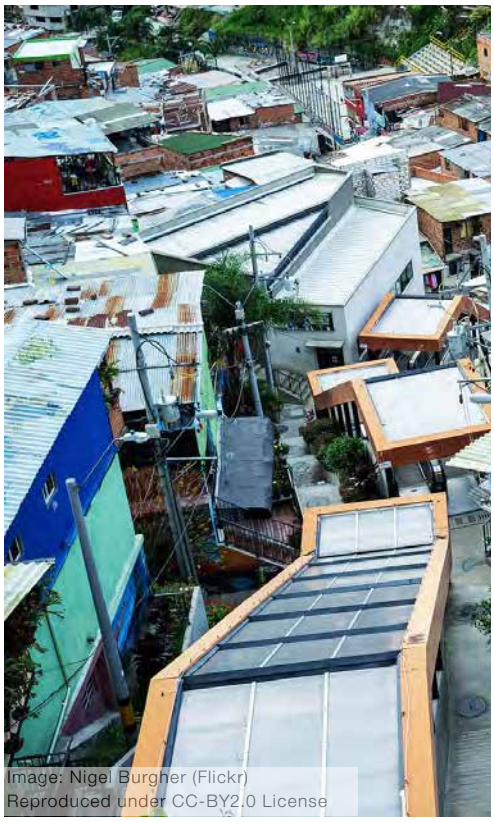

Image: Nigel Burgher (Flickr)
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MEDELLIN, COLOMBIA, LATIN AMERICA

+ PROJECT FACTS

Location: Medellin, Colombia, Latin America

Project Size: Not Available

Total Project Cost: Approx 3.5 million USD

Funding: Government (City funding)

Timeline: 7 Years

Project Settings: Residential Neighborhood (Transit Connections - Streets & Plazas)

Overview:

Comuna 13 also known as San Javier, is one of the 16 barrios (neighborhoods) in Medellin. The neighborhood is built on steep hills outside of the main city consisting of tiny houses and cottages connected by streets, paths and stairs. Access to the barrio was a perennial challenge, making the provision of security as difficult as accessibility to schools.

PROJECT STORY

1980's-2000s

Known as one of the most violent cities in the world, Comuna 13 had an invisible territorial boundary set by a dominating group that led to strong social tensions, large class differences, and unemployment in the area.

2002

The Colombian army, police, air force and paramilitary groups launched the biggest military intervention **Operation Orion** to fight against illegal activities displacing and impacting displaced local residents

2002's

Residents **protested against the violence in the area** with white rags raised for peace and solidarity.

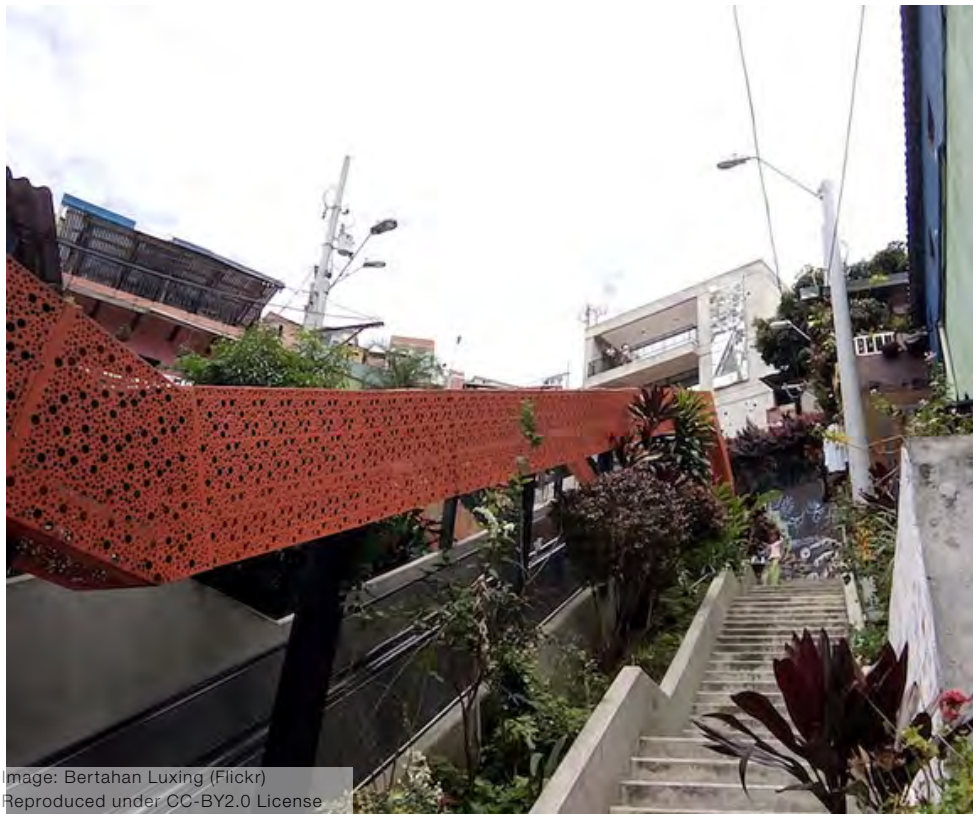

Image: Bertahan Luxing (Flickr)
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+ DESIGN DETAILS

Street Art: The Streets were painted with graffiti depicting the authentic history of Comuna 13, and the huge impact on people's lives.

Escalators: The installation of six sections of a giant 384 meters outdoor orange-roofed escalator was built into the mountainside for accessing neighborhoods on the hillside.

Shaded streets: Harvestable fruit trees are planned on the courtyard and along the pedestrian walkway to provide shade and comfort and to cool down the atmosphere in summer.

Public Space: Location for installation of six set of escalators were selected to connect libraries, schools, kindergartens, open sports facilities and public places.

+ APPLICABILITY

Context: Creative solution to overcome accessibility challenges to transit stations in hilly regions.

Scale: Station Area | Corridor

2002-2008

Residents and local artists started **painting walls with beautiful mural graffiti** in memory of innocent people who died in the conflict.

2008

The elected mayor invested a huge amount of money in **a new cable car line in San Javier Station** to integrate this Comuna with other surrounding communities.

2011

The city **created electric escalators to allow people to reach the station in 6-minutes instead of a 25-minutes climb.** The escalators have decorative metal canopies, air-conditioning and connect to public plazas, terraces and amphitheaters.

BOGOTA, COLOMBIA, LATIN AMERICA

+ PROJECT FACTS

Location: Jimenez Avenue, Bogota, Colombia

Project Size: Not Available

Total Project Cost: Not Available

Funding: Government Funded

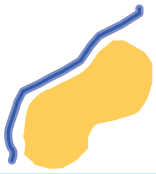
Timeline: 11 years (1996-2007)

Project Settings: Mixed-Use (Institutional/ Commercial) Main Street

Overview:

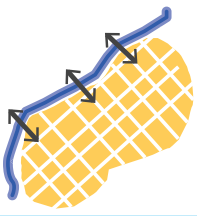
The street originally built over the San Francisco River into a brick-paved paseo featuring native trees, ribbon-like water fountains running along the sloping course, and brick pavement for the Transmilenio. The effect was to create a friendly relationship between public transport and pedestrian traffic while revitalizing the public spaces.

PROJECT STORY

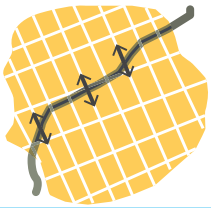


COLONIAL PERIOD

San Francisco River (today Jimenez Avenue) defined the City's northern limit.



When the city started to grow beyond these natural limits, urban planners adapted the orthogonal geometry of the city to the river's meandering path.



1990's

By the early twentieth century, the San Francisco River was essentially a sewer and a garbage dump.

+ DESIGN DETAILS

Public Place: The highly congested street was transformed into a partially pedestrian way equipped with street furniture to serve the Transmilenio system

Landscaping: construction of a watercourse along the avenue, consisting of a continuous descending line of small basins or pools, makes reference to the San Francisco River.

Street Vendors: Accommodates many mobile vendors providing livelihood assistance.

Safety: The site is supervised by a dozen of security guards who are recognizable by their uniforms gives certain people an ambiguous status of the place

Urban Redevelopment: The old historical buildings were renovated along this axis for high-end housing, hotels and commerce.

+ APPLICABILITY

Context: Urban Redevelopment, creating pedestrian-only streets

Scale: Station Area | Corridor

1999-2002

For reviving the old city center, the city first planned infrastructure investment for the new public transportation system (Bus Rapid Transit, named Transmilenio).

2002

A decision was made to hire a renowned architect to design the segment that would enter the city center, through the Av. Jimenez.

Today

The road was closed for private vehicles, creating a pedestrian plaza using cobblestone as opposed to asphalt and recovering the water element that was lost with development.

Bogota, Colombia

TOD KP

PD-P01

TOD PLANS TERMS OF REFERENCE

Template for hiring a consultant to prepare TOD plans at the required scale.

Type: Reference Document

TOD Global Platform for Sustainable Cities WORLD BANK GROUP IBI

BACKGROUND

The Terms of Reference for a TOD Plan should provide the following background material:

- **Study Area:** The TOR must define the approximate area for which the Plan is to be developed. The study area must coincide as far as possible with jurisdictional boundaries for which population and employment data is readily available. The Background should also summarize the details of transport services including the primary and feeder modes available.
- **Existing Development:** The Background section should provide a summarized description of existing development and ongoing activities, including any information on real estate opportunities and challenges.
- **Benchmarks and Guidelines:** The Background section should also provide information on resources that a consultant is expected to refer to while preparing the Plan, specifically including TOD Planning Guidelines or Design Standards.
- **Bibliography of Reference Plans, Policies and Studies**
- **List of Project Stakeholders**

OBJECTIVE OF THE ASSIGNMENT

The objective of the assignment is determined by the scale and context of the Study Area:

a. City-level TOD Plan:
   - o Prepare a basis for a spatial growth strategy and density optimization
   - o Identify priority areas for investment for both transit and real estate development

b. Corridor-level TOD Plan:
   - o Prepare a land use and density strategy along the transit corridor to optimize transit availability and affordability
   - o Identify multimodal integration strategies with supporting transit and feeder services.
   - o Identify stations with high-level of challenges and/or opportunities.

c. Station Area Plan:
   - o Prepare a block plan for development prioritizing TOD principles
   - o Prepare public realm plan for a high-quality walking and cycling experience outside the station
   - o Identify catalyst projects for real estate development

d. Greenfield/ Suburban TOD Plan
   - o Prepare a master plan that leverages transit connectivity in walkable neighborhood units

e. Urban Infill TOD Plan
   - o Prepare a plan that identifies opportunities for infill development to optimize densities around transit

f. Urban Redevelopment
   - o Prepare land restructuring plan to leverage transit connectivity

SCOPE OF ACTIVITIES

CITY-LEVEL TOD PLAN

TASK 1 – DATA COMPILATION AND INVENTORY:

- **Review of Existing Documents & Studies:** Compile and review of the previously completed and current planning efforts underway in the Study Area with the intent to identify gaps and consistencies of the various policies, strategies and development projects when assessed against a backdrop of TOD Principles (Refer Guidance Document) under the following broad categories:
  - Planning & regulatory context
  - Regional context
  - Mobility & Access
  - Land Use, Public realm & Urban Design
- **Undertake site visits(s) & prepare an inventory of the planning & physical characteristics of the Study Area** –The existing conditions inventory will include the preparation of a detailed base map and a series of inventory maps and photographs.
- **Existing Conditions Inventory:** Map the existing data using AutoCAD and GIS mapping procedures. Inventory will include the following at a minimum:
  - Existing land uses
  - Proposed land uses
  - Zoning
  - Major nodes & activity centers
  - Major roads & infrastructure (Parking)
  - Existing natural features
  - Proposed key developments
- **Develop Case Studies and Best Practices in Transit-oriented Development:** Select best practices that demonstrate successful TOD projects nationally and internationally in similar context. The case studies will highlight successes, failures and lessons learned.
- **Undertake focus group meetings & key interviews** with stakeholders to help generate buy-in, identify major issues confronting the project and the social, economic, and political goals for the project.
- **Review of existing real estate needs at the city-level** to summarixe the findings of a city-level real estate analysis [see AS-P01] in terms of demand of different types across the urban space.

TASK 2 – STUDY AREA ANALYSIS

- **Analysis, Baseline Conditions Assessment and SWOT analysis:** Undertake an analysis of baseline conditions and prepare Weaknesses & Threats maps - utilize the existing conditions inventory to evaluate the physical characteristics of the study area.
- **Identify priority transit corridors**- Prioritize the "right" corridor to determine momentum for TOD based on the following parameters:
  - **Map existing land uses, proposed land uses and key developments** to understand the distribution of residential, employment and institutional uses in the city.
  - **Identify activity generators:** Map housing, employment and recreational centers to determine the desired lines and identify routes of high commuter traffic.
- **Delineate influence zone of transit** to determine the area around transit routes or stations, where transit-supportive development needs to be prioritized based on:
  - Population Density
  - Employment Density
  - Accessibility
  - Environmental Context
- **Identify development context:** TOD Planning must take into consideration different aspects of the city and the context before beginning the planning of TOD. It helps in integrating sustainable development principles at the outset by respecting and nurturing existing environmental and settlements. The development context can be identified as:
  - Greenfield
  - Urban Infill
  - Redevelopment
- **Conduct an analysis of opportunities around all stations** to develop a preliminary typology of stations based on their node place, and market potential view (for example - see Salat and Ollivier Transforming the urban space through TOD: the 3V approach) with the existing transit network and the proposed future network.
- **Identify preliminary goals and targets** with respect to the institutional support, plans, policies and development market.

TASK 3 – VISIONING AND STAKEHOLDER ENGAGEMENT, TOD "CHARRETTE"

An organized design workshop; where more focus will be to create a vision for TOD plan. Invite and engage key stakeholders including elected officials and staff from various agencies to the visioning workshop. Focused charrette shall achieve the following objectives:

- Articulate quantitatively and qualitatively how TOD could support the city social, economic and environmental objectives;
- Discuss the integration of land use, transportation, and infrastructure and solicit implementation strategies from charrette participants;
- Share and revalidate the identified transit-first goals and targets;
- Prioritize goals into short-term, mid-term, and long-term opportunities; and
- Identify the market, generate project interest and solicit feedback.

TASK 4 – RESILIENCE STRATEGY – ANALYSIS OF RISKS & ADAPTABLE PLANNING

Unlike disaster preparedness, urban resilience should focus on strengthening the City-Level TOD Plan to adapt to and disruption that may occur. Traditional TOD/land use planning is built on assumptions about a future state considering population growth, modal split, market understanding and demand for specific development/land use types amongst others. However, the introduction of disasters such as resulting from climate change e.g. flooding or extreme weather events could significantly impact the TOD planning. An innovative City-level TOD Plan needs to better account for such uncertainty, and plan for adaptable methods that can respond to changes to the city's physical, economic or social conditions.

- **Assess risks specific to the City** (including climate-related risks) that may impact the realization of the land use, transportation and infrastructure implementation to its fullest potential
- **Develop objectives and goals** related to resilience through a participatory process
- **Provide risk-informed planning recommendations** for the following to ensure adaptable planning and informed decision making for the TOD recommendations
  - **Land Planning for Emergencies -** Develop a strategy for during and post-disaster recovery to ensure critical emergency response
  - **Land Planning for Adaptability –** Develop a strategy for the zoning /land uses to adapt to the City's physical, economic or social conditions**.**

TASK 5 – DRAFT TRANSIT-ORIENTED DEVELOPMENT RECOMMENDATIONS

- **Prepare a draft conceptual TOD Plan:** Recommend modifications to the Development Plan and/or land development regulations, policy changes, DCR amendments in order to achieve the desired intent of TOD within the city. Draft TOD Recommendations Plan should be inclusive of the followings:
  - Parking Management Tools
  - Infrastructure Upgrades
  - First & Last Mile Connectivity
  - Differential Densities
  - Desired Land Use Mix
  - Financial Strategy
  - Public Transport Goals
  - Affordable Housing
  - City-level amenities (such as parks, major health and education centers)

TASK 6 – IDENTIFY A FINANCING STRATEGY

- Develop an understanding of the city's financing system impacting implementation of TOD related land development and infrastructure projects.
- Introduce innovative funding tools to integrate TOD within the city's urban management and financing systems
- Develop a Capital Investment Strategy for TOD station areas and projects.

TASK 7 – IDENTIFY A PHASING AND IMPLEMENTATION STRATEGY INCLUDING CATALYST PROJECTS

- **Prepare a phasing for the TOD Plan** which includes preliminary recommendations to enable the City/development and planning agency to systematically implement the recommendations of the TOD Plan.
- **Technical Capacity Building Recommendations:** Assessment of existing capacity of the Planning teams and to identify gaps and to recommend measures of augmentation of Technical Capacity.

CORRIDOR-LEVEL TOD PLAN

TASK 1 – DATA COMPILATION AND INVENTORY:

- **Review of Existing Documents & Studies:** Review and analysis of the previously completed and current planning efforts underway in the Study Area with the intent to identify gaps and consistencies of the various policies, strategies and development projects when assessed against a backdrop of promoting TOD Principles under the following broad categories:
  - Planning & regulatory context
  - Regional context
  - Mobility & Access
  - Land Use, Public realm & Urban Design
  - Transit & Station Area
- **Undertake site visits(s) & prepare an inventory of the planning & physical characteristics of the Study Area** –The existing conditions inventory will include the preparation of a detailed base map and a series of inventory maps and photographs.
- **Existing Conditions Inventory:** Map the existing data using AutoCAD and GIS mapping procedures. Inventory will include the following at a minimum:
  - Existing land use
  - Proposed land uses
  - Land Ownership
  - Parking
  - Zoning
  - Major nodes & activity centers
  - Major roads & infrastructure
  - Existing Natural features
  - Parks and Open Spaces
  - Proposed key developments
  - Circulation and Accessibility, with special emphasis on Multimodal Integration and NMT infrastructure
- **Develop Case Studies and Best Practices in Transit Oriented Development:** Select best practices that demonstrate successful TOD projects nationally and internationally in similar context. The case studies will highlight successes, failures and lessons learned.
- **Undertake focus group meetings & key interviews** with stakeholders to help generate buy-in, identify major issues confronting the project and the social, economic, and political goals for the project.
- **Review of existing real estate needs at the city-level** to summarixe the findings of a city-level real estate analysis [see AS-P01] in terms of demand of different types across the urban space.

TASK 2 – STUDY AREA ANALYSIS

- **Study the transit and the station characteristics (planned/existing):** There are key differences in TOD strategies for different transit mode. Undertake an analysis of baseline conditions and prepare SWOT maps- utilize the existing conditions inventory to evaluate the physical characteristics of the study area
- **Delineate influence zone:** Identify the catchment area around station by transit type where TOD interventions can be applied.
  - Boundary may be defined by a 5–10 minute walking distance
  - Larger catchment area can be defined as the areas that are accessible by feeder transit
- **Identify preliminary goals and targets** with respect to the institutional support, plans, policies and development market

TASK 3 – VISIONING AND STAKEHOLDER ENGAGEMENT, TOD "CHARRETTE"

An organized design workshop; where more focus will be to create a vision for TOD plan. Invite and engage key stakeholders including elected officials and staff from various agencies to the visioning workshop. Focused charrette shall achieve the following objectives:

- Articulate quantitatively and qualitatively how TOD could support the city social, economic and environmental objectives;
- Discuss the integration of land use, transportation, and infrastructure and solicit implementation strategies from charrette participants;
- Share and revalidate the identified transit-first goals and targets;
- Prioritize goals into short-term, mid-term, and long-term opportunities; and
- Identify the market, generate project interest and solicit feedback.

TASK 4 –DEFINE STATION AREA TYPOLOGIES AND PRIORITIZATION OF TOD AREAS:

- **Identify Station Area Typologies in relation to the urban context and character**- Station areas along a transit corridor are set in different urban contexts, play different roles in the transportation network, and present unique challenges and opportunities.
- **Conduct an analysis of opportunities around all stations** to develop a preliminary typology of stations based on their node place, and market potential view (for example - see Salat and Ollivier Transforming the urban space through TOD: the 3V approach) with the existing transit network and the proposed future network. The typologies will include the following at a minimum:
  - Urban Context
  - Station Area Character
  - Predominant land use & intensification potential
  - Land use mix and density & FAR's
  - Key site characteristics
  - Planning & development challenges
  - Ideal Land use mix
  - Transportation Parameters and location within the network
  - Multimodal Integration
- **Create a vision for each of the identified station types in terms of ultimate character and development form:** Based on this vision, land use mix, urban design and parking policies and a set of development standards should be developed in order to provide the basis of a regulatory framework that would allow this vision to be achieved.
- **Develop a selection criteria matrix to identify the prioritized TOD areas:** Based on the following (but not limited to) quantitative and qualitative parameters
  - Identify development/ redevelopment potential based on:
    - » Land availability and ownership- presence of underutilized lots, vacant lots, lots of large block sizes, and properties in dilapidated conditions
    - » Allowable land uses
    - » Future/ proposed development patterns
    - » Real Estate Market Potential
  - Higher transit ridership (expected/proposed)
  - Presence of intermodal service
  - Typology and applicability of the number of stations of the same typology
  - Higher land use mixes

- Station area character
- Market Potential - for residential, office, and retail mixed-use development based on interviews with knowledgeable real estate development groups and review of other studies and planning documents

TASK 5 – RESILIENCE STRATEGY – ANALYSIS OF RISKS & ADAPTABLE PLANNING

Resilience should focus on strengthening the Corridor-Level TOD Plan to adapt and respond to changes in the physical, economic or social conditions. Traditional TOD/land use planning at the station level is built on assumptions about a future state considering population growth, modal split, market understanding and demand for specific development/land use types amongst others. Introduction of disasters such as resulting from climate change e.g. flooding or extreme weather events could significantly impact the TOD planning. An innovative corridor-level TOD Plan needs to better account for such uncertainty, as well as be adaptable to changing market conditions.

- **Assess risks specific to the Corridor** (including climate-related risks) that may impact the realization of the land use, transportation and infrastructure implementation to its fullest potential
- **Develop objectives and goals** related to resilience through a participatory process
- **Provide risk-informed planning recommendations** for the following to ensure adaptable planning and informed decision making for the TOD recommendations
  - **Land Planning for Emergencies -** Develop a strategy for during and post-disaster recovery to ensure critical emergency response.
  - **Land Planning for Adaptability –** Develop a strategy for the zoning /land uses to adapt to the changes in the physical, economic or social conditions.

TASK 6 – DRAFT TRANSIT ORIENTED DEVELOPMENT RECOMMENDATIONS

- **Create a conceptual Corridor Plan**
  - **Establish and/or reconnect street grid** – develop a comprehensive street grid of small blocks, accommodating pedestrian, vehicular and cycling connections
  - **Summarize the potential overall development** (existing development, redevelopment or new development) along the corridor and at each station.
  - **Provide intermodal connections** - near transit stations, for IPT with the intention of establishing a well-connected, efficient, transportation system, providing robust connections throughout the community for all modes.
  - **Develop appropriate parking strategies** with reduced parking as the goal- Encourage use of on-street parking to meet parking requirements. Conceal parking structures within development or screen from view on low-value land
  - **Upgrade the Infrastructure carrying capacity** to support the increased demand
- **Integration of TOD Plan with Zonal Development Plan/ Local Area Plan**
- **Identify Priority Station Areas as TOD demonstration project.**

TASK 7 – IDENTIFY A FINANCING STRATEGY

- Develop an understanding of the city's financing system impacting implementation of TOD related land development and infrastructure projects.
- Introduce innovative funding tools to integrate TOD within the city's urban management and financing systems
- Develop a Capital Investment Strategy for TOD station areas and projects.

TASK 8 – IDENTIFY A PHASING AND IMPLEMENTATION STRATEGY INCLUDING CATALYST PROJECTS

- **Prepare a phasing for the TOD Plan** which includes preliminary recommendations to enable the City/development and planning agency to systematically implement the recommendations of the TOD Plan.
- **Technical Capacity Building Recommendations:** Assessment of existing capacity of the Planning teams and to identify gaps and to recommend measures of augmentation of Technical Capacity.

STATION-LEVEL TOD PLAN

TASK 1 – DATA COMPILATION AND INVENTORY:

- **Review of Existing Documents & Studies:** Review and analysis of the previously completed and current planning efforts underway in the Study Area with the intent to identify gaps and consistencies of the various policies, strategies and development projects when assessed against a backdrop of promoting TOD Principles under the following broad categories:
  - Planning & regulatory context
  - Regional context and relevance within the network
  - Mobility & Access
  - Land Use, Public realm & Urban Design
  - Transit & Station Area
- **Undertake site visits(s) & prepare an inventory of the planning & physical characteristics of the Study Area** –The existing conditions inventory will include the preparation of a detailed base map and a series of inventory maps and photographs.
- **Existing Conditions Inventory:** Map the existing data using AutoCAD and GIS mapping procedures. Inventory will include the following at a minimum:
  - Existing land use
  - Proposed land uses
  - Land ownership
  - Parking
  - Zoning
  - Circulation and Accessibility, with special emphasis on Multimodal Integration and NMT infrastructure
  - Public facilities
  - Major nodes & activity centers
  - Public realm & urban design elements
    - Parks, Open Space and Plazas
    - Sidewalk conditions
    - Natural Features
    - Lighting and signage conditions
    - Utilities
  - Proposed key developments
- **Develop Case Studies and Best Practices in Transit Oriented Development:** Select best practices that demonstrate successful TOD projects nationally and internationally for similar station types. The case studies will highlight successes, failures and lessons learned.
- **Undertake focus group meetings & key interviews** with stakeholders to help generate buy-in, identify major issues confronting the project and the social, economic, and political goals for the project.

TASK 2 – STUDY AREA ANALYSIS

- **Delineate Boundaries for TOD Study Area and Influence Area:** Refine TOD study boundary taking into account the existing and proposed site conditions in the following order:
  - Walking Distance from Transit Station based on Willingness to Walk
  - Existing Road Network
  - Ped-Shed Analysis
  - Critical Destinations beyond 10mins
  - Natural Environment Boundaries
  - Existing Built Environment
  - Existing Land Ownership
- **Analysis, Baseline Conditions Assessment and SWOT analysis:**
  - Identify the development character of the station area based on:
    - Station Typology
    - Market Realities
    - Community Needs
  - Undertake an analysis of baseline conditions and prepare SWOT maps based on TOD planning Principles broadly classified into:
    - Accessibility
    - Urban Form and Development
    - Transit & Station amenities
- **Identify preliminary goals and targets** with respect to the institutional support, plans, policies and development market

TASK 3 – VISIONING AND STAKEHOLDER ENGAGEMENT, TOD "CHARRETTE"

An organized design workshop; where more focus will be to create a vision for TOD plan. Invite and engage key stakeholders including elected officials and staff from various agencies to the visioning workshop. Focused charrette shall achieve the following objectives:

- Discuss the integration of land use, transportation, and infrastructure and solicit implementation strategies from charrette participants;
- Share and revalidate the identified transit-first goals and targets;
- Prioritize goals into short-term, mid-term, and long-term opportunities; and
- Identify the market, generate project interest and solicit feedback.

TASK 4 – RESILIENCE STRATEGY – ANALYSIS OF RISKS & ADAPTABLE PLANNING

Resilience should focus on strengthening the Station-Level TOD Plan to adapt and respond to changes in the physical, economic or social conditions. Traditional TOD/land use planning at the station level is built on assumptions about a future state considering population growth, modal split, market understanding and demand for specific development/land use types amongst others. Introduction of disasters such as resulting from climate change e.g. flooding or extreme weather events could significantly impact the TOD planning. An innovative station-level TOD Plan needs to better account for such uncertainty, as well as be adaptable to changing market conditions.

- **Assess risks specific to the station area** (including climate-related risks) that may impact the realization of the land use, transportation and infrastructure implementation to its fullest potential
- **Develop objectives and goals** related to resilience through a participatory process
- **Provide risk-informed planning recommendations** for the following to ensure adaptable planning and informed decision making for the TOD recommendations
    - **Land Planning for Emergencies -** Develop a strategy for during and post-disaster recovery to ensure critical emergency response.
    - **Land Planning for Adaptability –** Develop a strategy for the zoning /land uses to adapt to the changes in the physical, economic or social conditions

TASK 5 – DRAFT TRANSIT ORIENTED DEVELOPMENT RECOMMENDATIONS

- **Prepare a Conceptual Plan** incorporating the TOD Planning Principles (TOD Guidance Document - 1.3) under the themes: Integrated Transportation | NMT Accessibility | Compact Development | Liveability.
- **Prioritize**—'quick-win' public realm investments as catalyst projects and low-cost demonstration projects to showcase future transformations envisioned in TODs.
- **Prepare transit supportive development code at the station level** which will include the following at a minimum
    - **Develop appropriate parking strategies** with reduced parking as the goal
    - **Urban form**- compact development, articulated densities, mix of uses, integrate informal sector, active building frontage, and housing typology

TASK 6 – IDENTIFY A FINANCING STRATEGY

- Develop an understanding of the city's financing system impacting implementation of TOD related land development and infrastructure projects.
- Introduce innovative funding tools to integrate TOD within the city's urban management and financing systems
- Develop a Capital Investment Strategy for TOD station areas and projects.

TASK 7– IDENTIFY A PHASING AND IMPLEMENTATION STRATEGY INCLUDING CATALYST PROJECTS

- **Prepare a phasing for the TOD Plan** which includes preliminary recommendations to enable the City/development and planning agency to systematically implement the recommendations of the TOD Plan.
- **Technical Capacity Building Recommendations:** Assessment of existing capacity of the Planning teams and to identify gaps and to recommend measures of augmentation of Technical Capacity.

SITE-LEVEL TOD PLAN

TASK 1 – DATA COMPILATION AND INVENTORY:

- **Review of Existing Documents & Studies:** Review and analysis of the previously completed and current planning efforts underway in the Study Area with the intent to identify gaps and consistencies of the various policies, strategies and development projects when assessed against a backdrop of promoting TOD Principles under the following broad categories:
  - Planning & regulatory context
  - Regional context
  - Mobility & Access
  - Land Use, Public realm & Urban Design
  - Transit & Station Area
- **Undertake site visits(s) & prepare an inventory of the planning & physical characteristics of the Study Area** –The existing conditions inventory will include the preparation of a detailed base map and a series of inventory maps and photographs.
- **Existing Conditions Inventory:** Map the existing data using AutoCAD and GIS mapping procedures. Inventory will include the following at a minimum:
  - Existing land use
  - Proposed land uses
  - Land ownership
  - Parking
  - Zoning
  - Circulation and Accessibility, with special emphasis on Multimodal Integration and NMT infrastructure
  - Public facilities
  - Major nodes & activity centers
  - Public realm & urban design elements
    - Parks, Open Space and Plazas
    - Sidewalk conditions
    - Natural Features
    - Lighting and signage conditions
    - Utilities
  - Proposed key developments

TASK 2 – STUDY AREA ANALYSIS

- **Identify development context:** TOD Planning must take into consideration different aspects of the city and the context before beginning the planning of TOD. It helps in integrating sustainable development principles at the outset by respecting and nurturing existing environmental and settlements. The development context can be identified as:
  - Greenfield
  - Urban Infill
  - Redevelopment

- **Analysis, Baseline Conditions Assessment and SWOT analysis:** Undertake an analysis of baseline conditions and prepare Weaknesses & Threats maps - utilize the existing conditions inventory to evaluate the physical characteristics of the study area.
- **Identify preliminary goals and targets** with respect to the institutional support, plans, policies and development market
- **Create a development program**
  - Site Layout Plan- proposed land use mix
  - Detailed Development Programme
  - Infrastructure Upgrades Plan
- **Prepare the Real Estate Market Feasibility Study based on**
  - Demand assessment of the site
  - Feasibility assessment/study of the proposal

TASK 3 – VISIONING AND STAKEHOLDER ENGAGEMENT, TOD "CHARRETTE"

An organized design workshop; where more focus will be to create a vision for TOD plan. Invite and engage key stakeholders including elected officials and staff from various agencies to the visioning workshop. Focused charrette shall achieve the following objectives:

- Discuss the integration of land use, transportation, and infrastructure and solicit implementation strategies from charrette participants;
- Share and revalidate the identified transit-first goals and targets;
- Prioritize goals into short-term, mid-term, and long-term opportunities; and
- Identify the market, generate project interest and solicit feedback.

TASK 4 – RESILIENCE STRATEGY – ANALYSIS OF RISKS & ADAPTABLE PLANNING

Resilience should focus on strengthening the Site-Level TOD Plan to adapt and respond to changes in the market conditions. Traditional TOD/land use planning at the site level is built on assumptions about a future state considering market understanding and demand for specific development/land use types amongst others. Introduction of disasters such as resulting from climate change e.g. flooding or extreme weather events could significantly impact the site plan. An innovative site-level TOD Plan needs to better account for such uncertainty, as well as be adaptable to changing market conditions.

- **Assess site-specific risks** (including climate-related risks) that may impact the realization of development potential
- **Develop objectives and goals** related to resilience
- **Provide risk-informed planning recommendations** for the following to ensure adaptable planning and informed decision making for the TOD recommendations
  - **Land Planning for Emergencies -** Develop a strategy for during and post-disaster recovery to ensure critical emergency response.
  - **Land Planning for Adaptability –** Develop a strategy for the zoning/land uses to adapt to market realities

TASK 5 – DRAFT TRANSIT ORIENTED DEVELOPMENT RECOMMENDATIONS

- **Prepare a Conceptual Master Plan** include the following at a minimum
  - **Built Form**
    - Site Layout Plan- proposed land use mix
    - Detailed Development Programme
    - Infrastructure Upgrades Plan
  - **Placemaking**
    - Public Realm Strategy
    - Access Management
    - Transit Plaza Design
    - Streetscape Improvement
  - **Mobility and Circulation Strategy**
    - Pedestrian Accessibility Plan
    - Traffic Circulation Plan
    - Road Network Design
    - Parking Management
- **Prioritize**—'quick-win' public realm investments as catalyst projects and low-cost demonstration projects to showcase future transformations envisioned in TODs.

TASK 5 – IDENTIFY A FINANCING STRATEGY

- Develop an understanding of the city's financing system impacting implementation of TOD related land development and infrastructure projects.
- Introduce innovative funding tools to integrate TOD within the city's urban management and financing systems
- Develop a Capital Investment Strategy for TOD station areas and projects.

TASK 6 – IDENTIFY A PHASING AND IMPLEMENTATION STRATEGY INCLUDING CATALYST PROJECTS

- **Prepare a phasing for the TOD Plan** which includes preliminary recommendations to enable the City/development and planning agency to systematically implement the recommendations of the TOD Plan.
- **Technical Capacity Building Recommendations:** Assessment of existing capacity of the Planning teams and to identify gaps and to recommend measures of augmentation of Technical Capacity.

DELIVERABLES

TASK	DELIVERABLE	TIMELINE
1	**Inception Report** including problem statement, goals, objectives, study needs and methods	M + 2 weeks
2	Memo #1: Study Area Analysis	M + 2 months
3	Memo #2: Stakeholder Engagement Summary	M + 3 months
4	Memo #3: Resilience Strategy	M + 4 months
5	Memo #4: Draft TOD Plan Recommendations	M + 6 months
6	Memo #5: Financing and Implementation Strategy	M + 7 months
7	Final TOD Plan	M + 8 months

QUALIFICATION OF CONSULTANTS

The Consultant Team must have experience in at least:

A. One similar TOD Study

OR

B. At least two Infrastructure Development Plans that followed compact development principles

The Consultant Team must include the following key expertise:

	Key Experts	Year of Experience
1	Project Manager and Senior Urban Planner	15 years
2	Urban Planner	5-10 years
2	Urban Designer	5-10 years
3	Transport Planner	5-10 years
4	Environmental Planner	5-10 years
5	Regulatory Expert	5-10 years
6	Municipal Finance Specialist	5-10 years

Curitiba, Brazil