



TRANSPORT DEPARTMENT

Government of NCT of Delhi

सत्यमेव जयते



PWD BUS LANE MARKING

REPORT

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SGA sustainable
mobility
solutions

HumanQind

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1. Introduction

In April 2022, Transport Department GNCTD initiated enforcement of bus lanes (buses to use the left-most lane of the carriageway) (Bus Lane Driving TPT Order, 2022). This initiative required buses and heavy goods vehicles to drive only in the single left-most lane, designated as bus lane. All other vehicles were permitted to drive in this lane. Buses and heavy goods vehicles faced steep fines if they were found driving in any other lane of the carriageway. In the initial days of implementation of this scheme, bus drivers faced many obstructions in the designated bus lane and found it difficult to remain within the bus lane.

Often the left lane was occupied by parked vehicles, or used by bicycles and other non-motorised vehicles, and sometimes by street vendors. This is common in most Indian cities because generally urban roads are not designed to address the needs of non-motorized road users and, other activities such as intermediate transport (three-wheelers) movement/parking, vending spaces, etc. These activities are generally forced on the carriageway, occupying the kerb side edge, which means they overlap with the designated bus lane. In addition, unregulated parking of vehicles also occupies the kerb side edge of the carriageway. Additionally, there can be unforeseen eventualities such as vehicle breakdown, requiring emergency parking or maintenance, which also takes place on the kerb side edge of the carriageway. This means that buses face a significant number of obstructions in their operations and their effort to minimize the length for which they can remain outside the designated bus lane, leads to frequent decelerations. This has resulted in significant loss of operational speed and failure in completing daily schedules and has been confirmed by both DIMTS, Ltd. and Delhi Transport Corporation (DTC) as shown in Figure 1 and Figure 2.

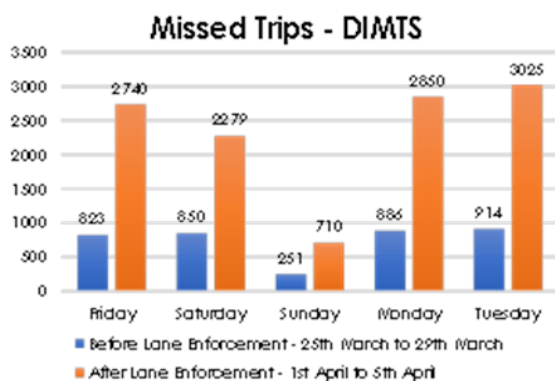


Figure 1 Missed trips by DIMTS Buses

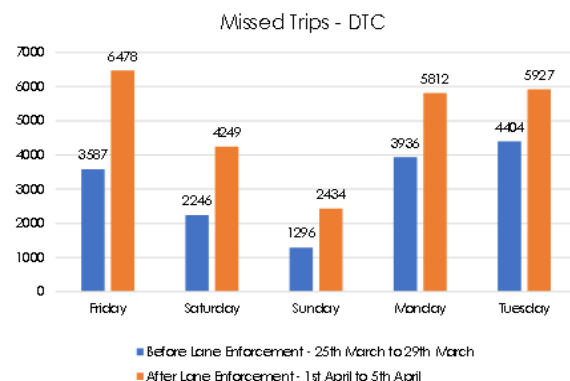


Figure 2 Missed trips by DTC Buses

Based on the operational data collected during initial week of the bus lane enforcement drive both DTC and DIMTS identified the critical stretches where encroachment of the bus lanes was affecting bus operations.

Based on observations, Transport Department, GNCTD requested Transportation Research and Injury Prevention Centre (TRIP-C, IIT D) to evaluate this problem and suggest actions that can allow enforcement of bus lane without significant loss in the operational performance of buses.

The project team at TRIP-C, discussed the issues with the bus operators, based on which it was decided that a pilot stretch will be selected for experimenting with new bus lane designs that can address these issues. Bus lanes and MV lanes were re-marked on a 4.4km length of inner ring road from Raja Garden Intersection to Britannia Chowk. This experimental design of bus lanes was suggested in one of the existing street design guidelines developed by TRIP-C, IITD (Tiwari & Gandhi, 2013). The experiment suggested a revised street marking design approach, to reallocate space on existing carriageway to accommodate functions that can cause friction to the movement of buses (in the bus lane). The approach suggested marking lane widths (as per available carriageway width) from the median side, resulting in a left-over space of between 1-3m between the bus lane and the left edge kerb. This space is designated as a Multi Utility Zone (MUZ). TRIP-C project team provided all the revised lane marking designs and provide supervisory support to assist in implementation, while the implementation was undertaken by the local PWD office near Rajdhani College.

Bus movement was monitored to evaluate the impact of the revised design on the compliance of bus lanes and the bus performance in terms of operational speed. Findings suggest that the new bus lane designs increased the operational speed of the buses by 17% to 23% while the amount of time the buses were forced to move outside the bus lane was reduced from 49% - 53% to 10% - 13%. Details are given in the report (Tiwari et al., 2022) These findings cemented the efficacy of these designs in improving bus lane compliance, and the same were approved by Hon'ble Minister PWD for implementation throughout Delhi in a phased manner, during a meeting on 28 July 2022

Capacity Building Workshop

In order to scale up the implementation of the new bus lane designs throughout Delhi, a detailed design template for undertaking the new carriageway marking was developed. This template was presented to all PWD junior engineers (JE), superintendent engineers (SE) and executive engineers (EE) in an introductory workshop which was held at Delhi secretariat on 10 August 2022. Following this meeting a series of capacity building workshops were undertaken with between 3-5 divisions at a time. These workshops were designed for one-on-one discussions with the engineers, on application pavement design marking template to specific site conditions. The details of these workshop have been presented below (Table 1) and pictures (Figure 3). The list of participants of the workshop has been presented in Annexure 2.

Dates & Participants

Table 1: List of Workshops

Workshops				
S. No	Date	Venue	Participants	No. of participants
1	10th August 2022	Secretariat, Delhi	All PWD officials and engineers	Around 150 participants
2	2nd September 2022	TRIP-Centre, IIT Delhi	From 2 divisions includes North-West road division-1 and central and New Delhi Road Division	12 Participants
3	30th September 2022	TRIP-Centre, IIT Delhi	From 6 divisions includes West Road Division, Northwest Road-II, Southwest Road-I, Southeast Road-I, SRD-I and Shahdara Road Division	38 Participants
4	10th October 2022	TRIP-Centre, IIT Delhi	From South Road-I&II, East Road and West Road-II	19 Participants
5	12th October 2022	TRIP-Centre, IIT Delhi	From the remaining divisions of PWD	Around 40 Participants



Figure 3: Workshop Photographs

2. Lane Marking Approach

This section covers the revised marking approach for bus lane, required on-site to improve compliance of bus lane enforcement scheme.

These designs are based on lane width and marking designs included in existing guidelines (MOUD, 2012); (IRC-35, 2015); (IRC-67, 2021); (CROW, 1998). The lane width in most parts of Delhi is wider than the required width for the MV lanes and bus lanes designed for 50km/h design speed. For example, a 3-lane carriageway for 50km/h speed limit requires lanes widths of 3.1 m and 3.3m for motor vehicles and buses respectively. Including lane marking width and shy away distance, the total width of carriageway required can be a minimum of 9.9m. However, the general carriageway width available on a 3-lane road is found to be more than 11.0m. In addition, the carriageway width is not uniform and exceeds 11m at few locations. This means that the additional 1.2m wide lane (including shy-away width) is available on the kerb side if the lane marking is initiated from the median side. This is good enough to accommodate E-rickshaw, etc., near bus stops. Thus, by this simple lane marking approach with widths as per specifications, starting from median side, space for MUZ/Cycle Lane on the kerb side can be created without reducing the number of lanes for motorized vehicles. This space accommodates the side friction, and it is easier for buses to move uninterruptedly in the bus lane.

A revised street marking design approach includes reallocating space on existing carriageway for accommodating functions that can cause friction to the movement of buses (in the bus lane). The additional lane (MUZ lane) which can be between 0.8-3m wide is referred to as the Multi Utility Zone (MUZ). The following are the key points that needs to be followed during lane marking:

- The lanes reserved for the buses without physical separation shall be provided with white line as bus lane markings.
- Bus lane are being marked on divided roads (4-6-8 lanes).
- All measurement to start from median edge.
- Mark out minimum width of each lane.
- Minimum and desirable width are provided for different lanes, which can be used according to the road width present on site.
- All lane marking and signages follow IRC guidelines.
- If extra space is available keep the width of the lane constant.
- Varying widths available- Two options for lane configuration as per carriageway width available (minimum - desired).
- Buses to avoid using flyovers as far as possible, bus stops could be shifted closer to the intersection and under flyover.

3. Area of Application

Definitions

1. **Segment** - A continuous stretch of roadway or carriageway between two intersections or between the foot of two consecutive flyovers or between the foot of flyover and an immediate intersection, whichever is less in distance.
2. **Lane Width** – The width allocated to lanes for motorists, buses, cycles, and other vehicles. It is basically the clear width between lane marking.
3. **Shy Away** - The additional width for kerb shyness from the median, the distance between median and first marking.
4. **MUZ** - A Multi Utility Zone is a space that accommodates the functions that can cause friction to the movement of buses (in bus lane). These include slow moving vehicles (such as cycles and e-rickshaw), breakdown vehicles, etc. This is also known as Non-Motorized Vehicle (NMV) Lane.

Table 2: Minimum and Desired Carriageway Width required for different lanes road

S.No.	No. of lanes	Carriageway width (per direction) where minimum lane and marking dimensions are applicable (m)	Carriageway width (per direction) where desirable lane and marking dimensions are applicable (m)
1	4-lane divided carriageway	7.4- 8.6	8.7- 10.4
2	6-lane divided carriageway	10.5- 11.7	11.8-13.5
3	8-lane divided carriageway	13.6- 14.8	14.9 and above

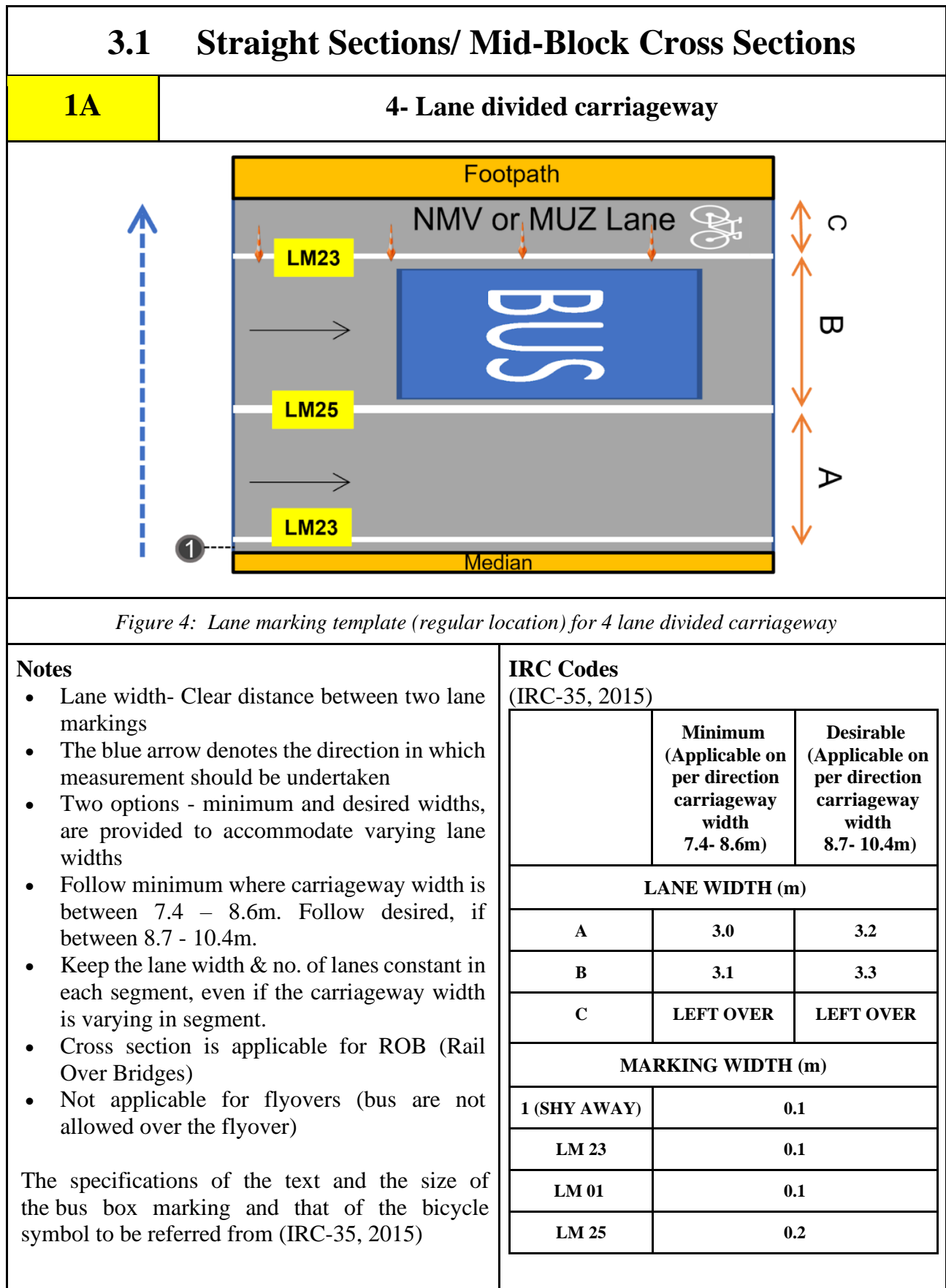
Table 3: Minimum and Desired Lane Widths

S.No.	Lanes	Minimum width (m)	Maximum width (m)
1	MV Lane	3	3.2
2	Bus Lane	3.1	3.3
3	MUZ	Left Over	Left Over

Table 4: Marking Widths

S.No.	Markings	Marking Width (m)
1	Shy-away	0.1
2	Longitudinal Marking LM 23	0.1
3	Longitudinal Marking LM 01 (Broken)	0.1
4	Longitudinal Marking LM 25	0.2
5	Longitudinal Marking LM 16 (Broken)	0.2
6	Transverse Marking TM 04	0.1

This section covers the required lane marking scenarios required for bus lane marking



3.1 Straight Sections/ Mid-Block Cross Sections

1B

6- Lane divided carriageway

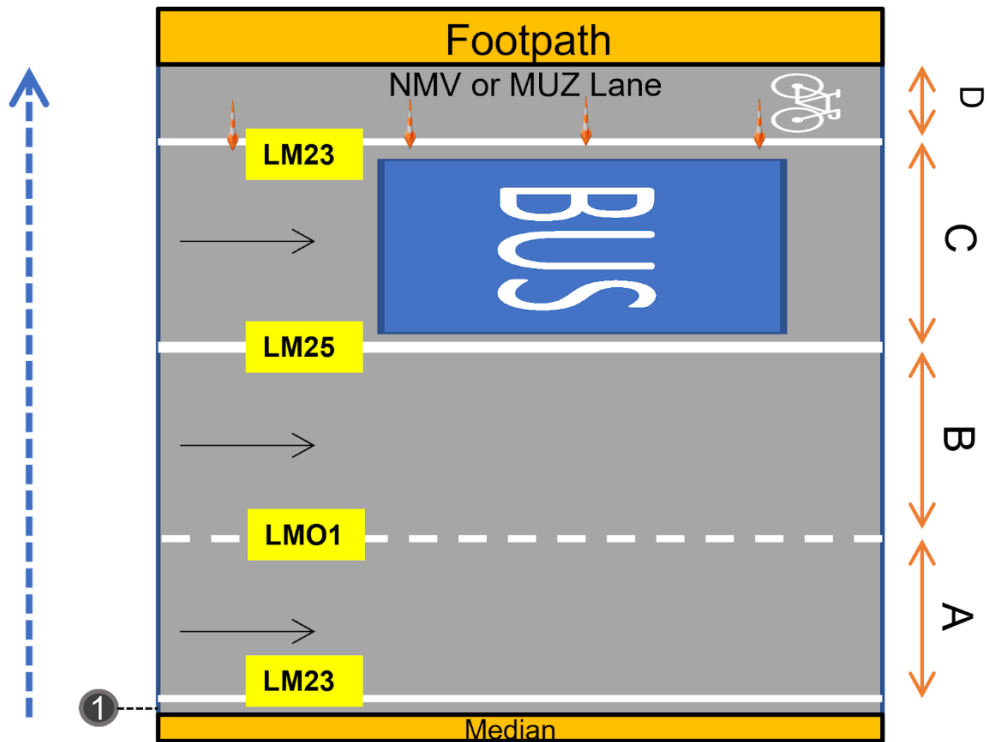


Figure 5: Lane marking template (regular location) for 6 lane carriageways

Notes

- Lane width- Clear distance between two lane markings
- The blue arrow denotes the direction in which measurement should be undertaken
- Two options - minimum and desired widths, are provided to accommodate varying lane widths
- Follow minimum where carriageway width is between 10.5 – 11.7m. Follow desired, if between 11.8 - 13.5m.
- Keep the lane width & no. of lanes constant in each segment, even if the carriageway width is varying in segment.
- Cross section is applicable for ROB (Rail Over Bridges)
- Not applicable for flyovers (bus are not allowed over the flyover)

The specifications of the text and the size of the bus box marking and that of the bicycle symbol to be referred from (IRC-35, 2015)

IRC Codes

(IRC-35, 2015)

	Minimum (Applicable on per direction carriageway width 10.5-11.7m)	Desirable (Applicable on per direction carriageway width 11.8-13.5m)
LANE WIDTH (m)		
A	3.0	3.2
B	3.0	3.2
C	3.1	3.3
D	LEFT OVER	LEFT OVER
MARKING WIDTH (m)		
1 (SHY AWAY)	0.1	
LM 23	0.1	
LM 01	0.1	
LM 25	0.2	

3.1 Straight Sections/ Mid-Block Cross Sections

1C

8- Lane divided carriageway

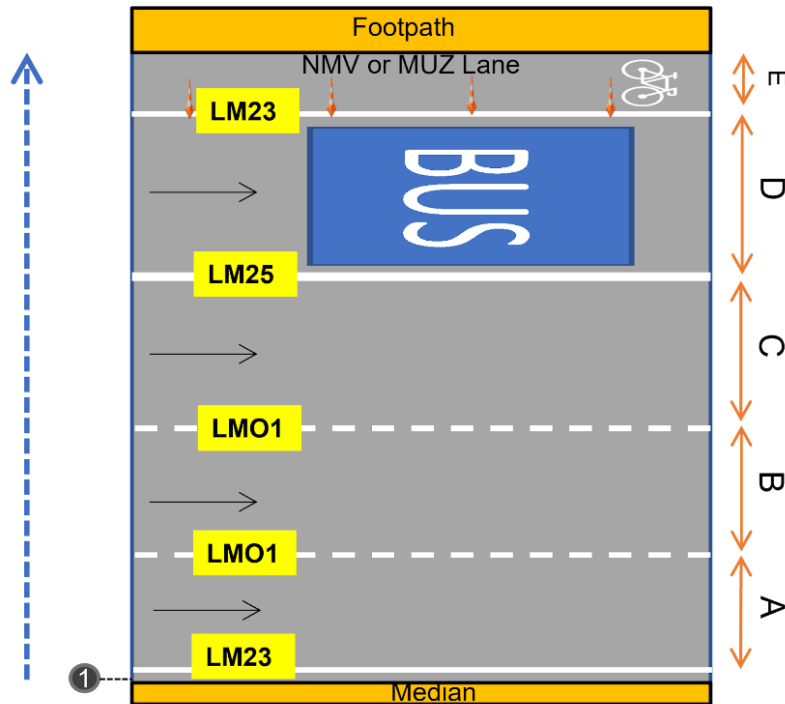


Figure 6: Lane marking template (regular location) for 8 lane carriageways

Notes

- Lane width- Clear distance between two lane markings
- The blue arrow denotes the direction in which measurement should be undertaken
- Two options - minimum and desired widths, are provided to accommodate varying lane widths
- Follow minimum where carriageway width is between 13.6 – 14.8m. Follow desired, if 14.9m and above.
- Keep the lane width & no. of lanes constant in each segment, even if the carriageway width is varying in segment.
- Cross section is applicable for ROB (Rail Over Bridges)
- Not applicable for flyovers (bus are not allowed over the flyover)

The specifications of the text and the size of the bus box marking and that of the bicycle symbol to be referred from (IRC-35, 2015)

IRC Codes

(IRC-35, 2015)

	Minimum (Applicable on per direction carriageway width 13.6-14.8m)	Desirable (Applicable on per direction carriageway width 14.9m & above)
LANE WIDTH (m)		
A	3.0	3.2
B	3.0	3.2
C	3.0	3.2
D	3.1	3.3
E	LEFT OVER	LEFT OVER
MARKING WIDTH (m)		
1 (SHY AWAY)	0.1	
LM 23	0.1	
LM 01	0.1	
LM 25	0.2	

3.2 Bus Stop

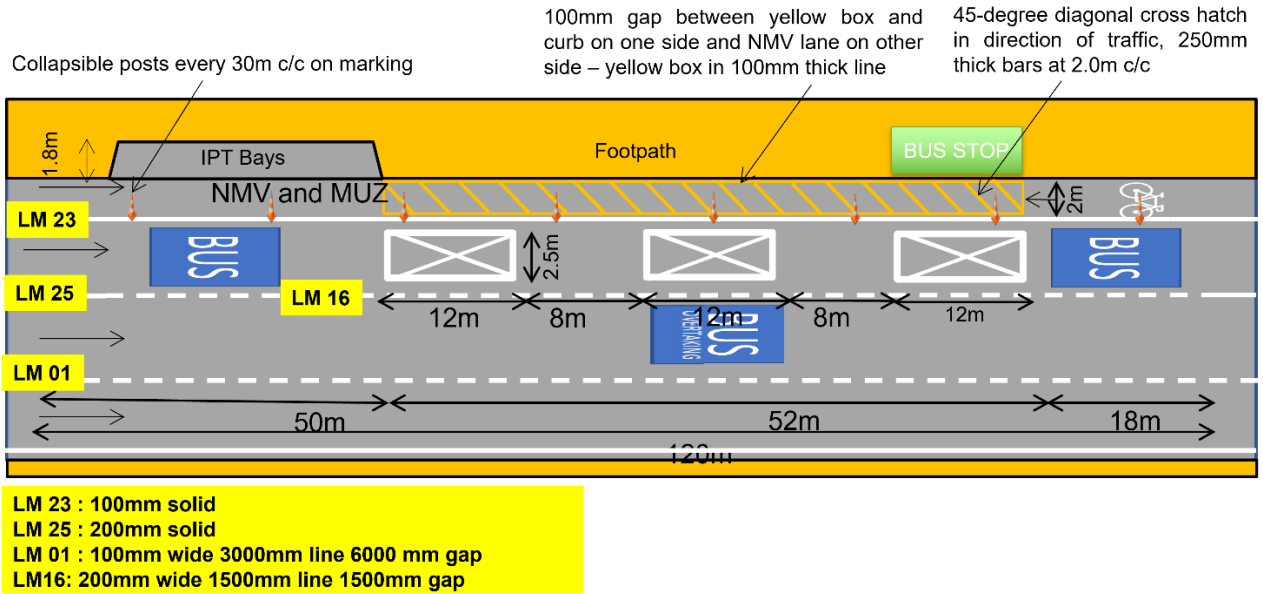


Figure 7: Pavement marking design template for Bus stops

Notes

- 2 to 3 bus boxes at each bus stop location
- Lane width- Clear distance between two lane markings
- Two options - minimum and desired widths, are provided to accommodate varying lane widths
- Keep the lane width & no. of lanes constant in each segment even if the carriageway width is varying in segment.
- The MUZ will be demarcated using hatch marking in yellow colour ((IRC-35, 2015; 7.6.1) for 2m width, even if MUZ is more then 2m. This area denotes a shared zone for bus passengers and cyclists.

The specifications of the text and the size of the bus box marking and that of the bicycle symbol to be referred from (IRC-35, 2015)

IRC Codes

(IRC-35, 2015)

	MARKING WIDTH (m)		
1 (SHY AWAY)	0.1		
LM 23	0.1		
LM 01	0.1		
LM 25	0.2		
LM 16	0.2		
Bus Box	12m length	2.5m width	8m Gap

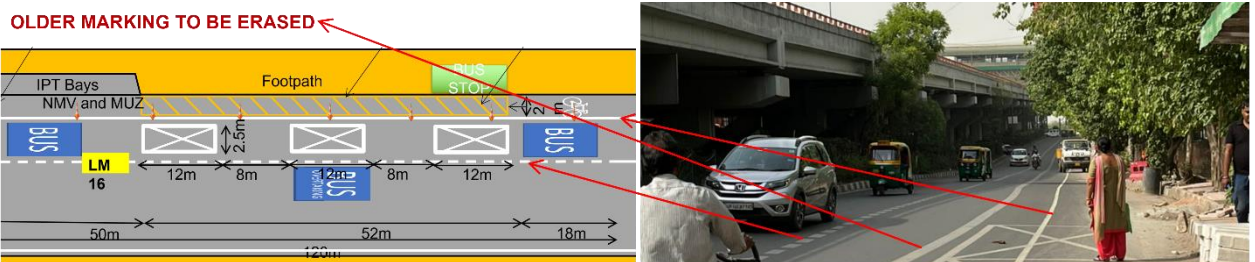


Figure 8: Pictorial representation for revised bus lane marking

3.3 Intersections

3A

Intersection

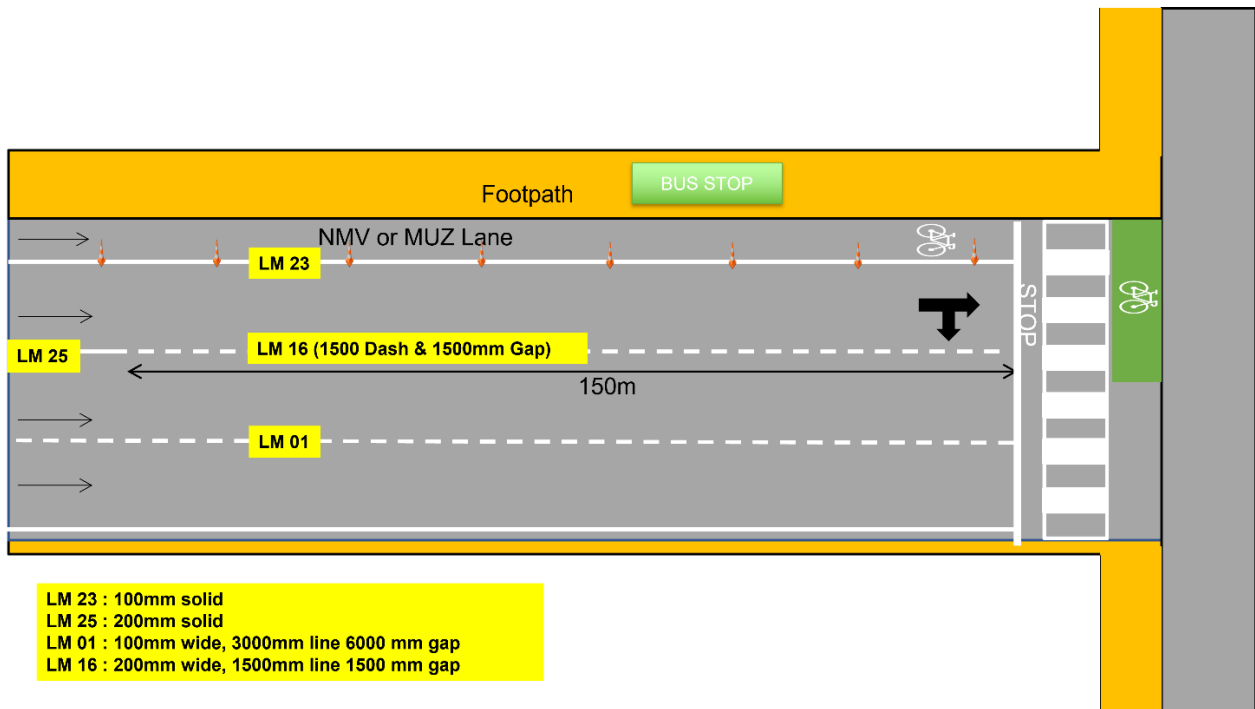


Figure 9: Bus Lane marking design at intersections are required to allow right turning buses to change lanes and thus exit the bus lane.

Notes

- Depending on the number of lanes that need to be transitioned, the solid bus lane marking is converted to a broken line marking at the rate of 50m, per lane transition (from left most to right most lane – for right turning buses). Total length of broken line- No. of lanes x 50m.
For e.g. If you have 2 lanes
Total length of broken line- 2 x 50 =100m
- Cycle box marking should be designed on the near side of intersections, after the zebra crossing up to the half length of the carriageway in green colour and detail of cycle symbol are in template 8.
- Lane width- Clear distance between two lane markings
- Keep the lane width & no. of lanes constant in each segment even if the carriageway width is varying in segment.

The specifications of the Cycle box, text and the size of the bus box marking and that of the bicycle symbol to be referred from (IRC-35, 2015)

IRC Codes

(IRC-35, 2015)

	MARKING WIDTH (m)
1 (SHY AWAY)	0.1
LM 23	0.1
LM 01	0.1
LM 25	0.2
LM 16	0.2

3.3 Intersections

3B

Intersection with free left turn

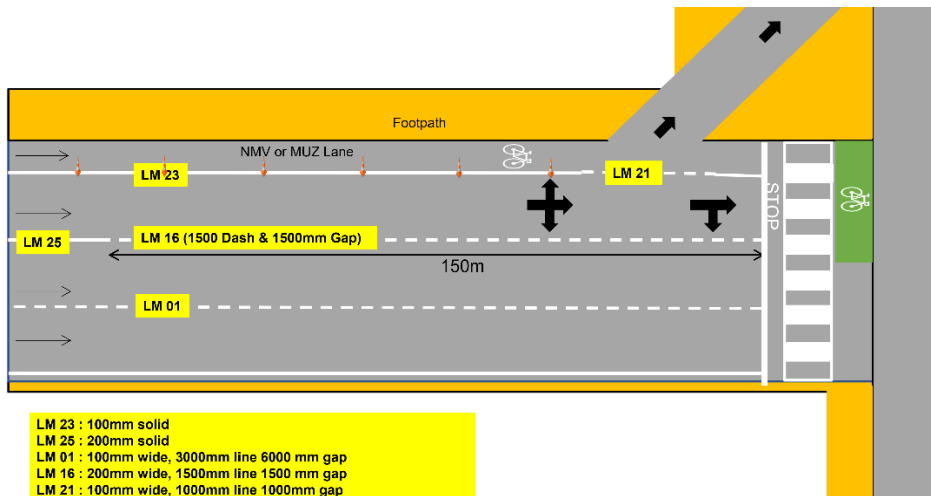


Figure 10: Bus Lane pavement marking design at intersection with free left turn

Notes

- Depending on the number of lanes that need to be transitioned, the solid bus lane marking is converted to a broken line marking at the rate of 50m, per lane transition (from left most to right most lane – for right turning buses). Total length of broken line- No. of lanes x 50m.
 For e.g. If you have 2 lanes
 Total length of broken line- 2 x 50 =100m
- Cycle box marking should be designed on the near side of intersections, after the zebra crossing up to the half length of the carriageway in green colour and detail of cycle symbol are in template 8.
- Lane width- Clear distance between two lane markings
- Keep the lane width & no. of lanes constant in each segment even if the carriageway width is varying in segment.

The specifications of the Cycle box, text and the size of the bus box marking and that of the bicycle symbol to be referred from (IRC-35, 2015)

IRC Codes

(IRC-35, 2015)

	MARKING WIDTH (m)
1 (SHY AWAY)	0.1
LM 23	0.1
LM 01	0.1
LM 25	0.2
LM 16	0.2
LM 21	0.1

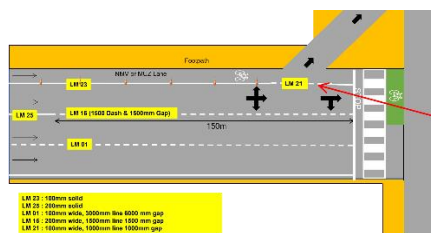


Figure 11: Pictorial representation for revised bus lane marking

3.3 Intersections

3C

Property entrances and side lanes

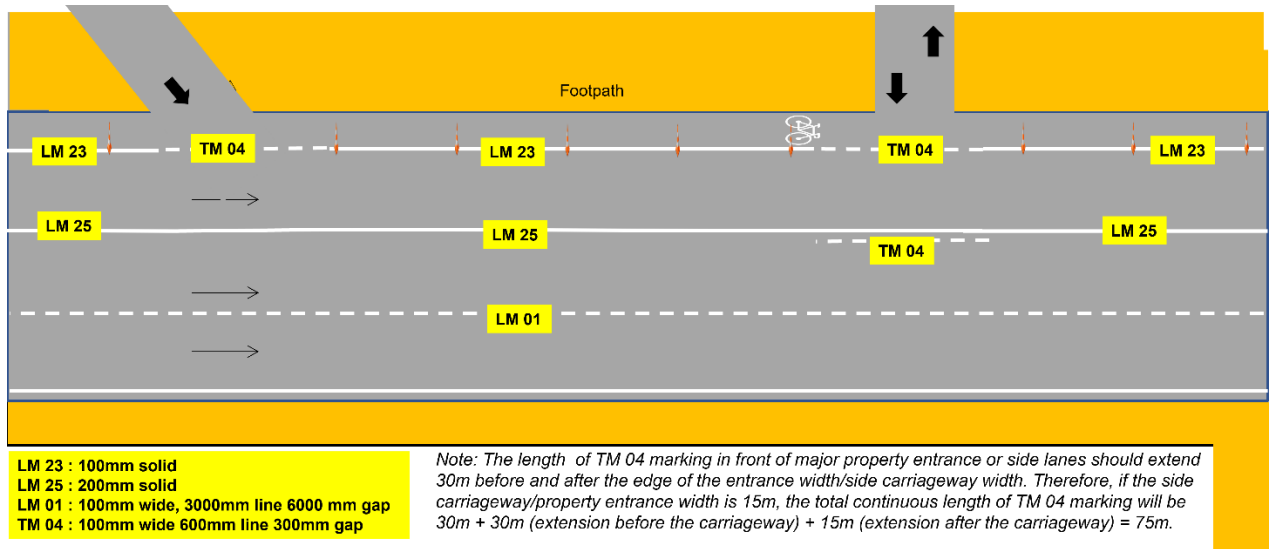


Figure 12: Bus Lane pavement marking design at property entrances and left turning lanes

Notes

- The length of Transverse Marking TM 04 marking in front of major property entrance or side lanes should extend 30m before and after the edge of the entrance width/side carriageway width.
- If the side carriageway/property entrance width is 15m, the total continuous length of TM 04 marking will be 30m + 30m (extension before the carriageway) + 15m (extension after the carriageway) = 75m.
- Lane width- Clear distance between two lane markings
- Keep the lane width & no. of lanes constant in each segment even if the carriageway width is varying in segment.

The specifications of the the size of the bus box marking and that of the bicycle symbol to be referred from (IRC-35, 2015)

IRC Codes

(IRC-35, 2015)

	MARKING WIDTH (m)
1 (SHY AWAY)	0.1
LM 23	0.1
LM 01	0.1
LM 25	0.2
TM 04	0.1

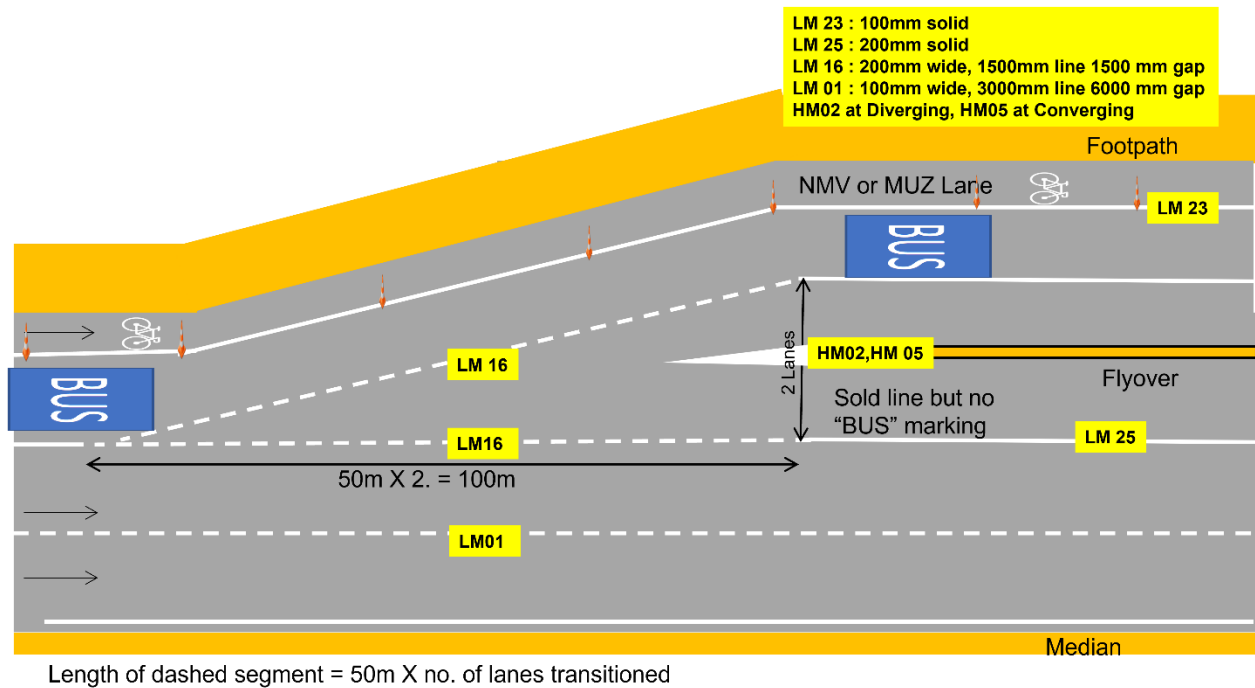


Figure 13: Bus Lane marking design at flyovers

Bus lane marking design at the base (both ends) of a flyover needs to allow heavy goods vehicles to exit the bus lane (where straight movement at signal under the flyover is not permitted) to change lanes in order to access the bridge. This requires a lane changing zone, equivalent to 50m, per lane that need to be traversed. The solid bus lane marking needs to be converted to a broken marking for this length of the road.

Notes

- Buses are not to use flyovers. Lanes are for heavy vehicles.
- Flyover- not to mark bus box lane marking, no need of MUZ
- No bus box to be painted. Lane width- Clear, between lane marking
- Keep the lane width & no. of lanes constant in each segment even if the carriageway width is varying in segment
- Chevron Marking should be provided at beginning and end of the flyover, HM02 at diverging and HM05 at converging

The specifications of the text and the size of the bus box marking and that of the bicycle symbol to be referred from (IRC-35, 2015)

IRC Codes (IRC-35, 2015)

	MARKING WIDTH (m)
1 (SHY AWAY)	0.1
LM 23	0.1
LM 01	0.1
LM 25	0.2
LM 16	0.2

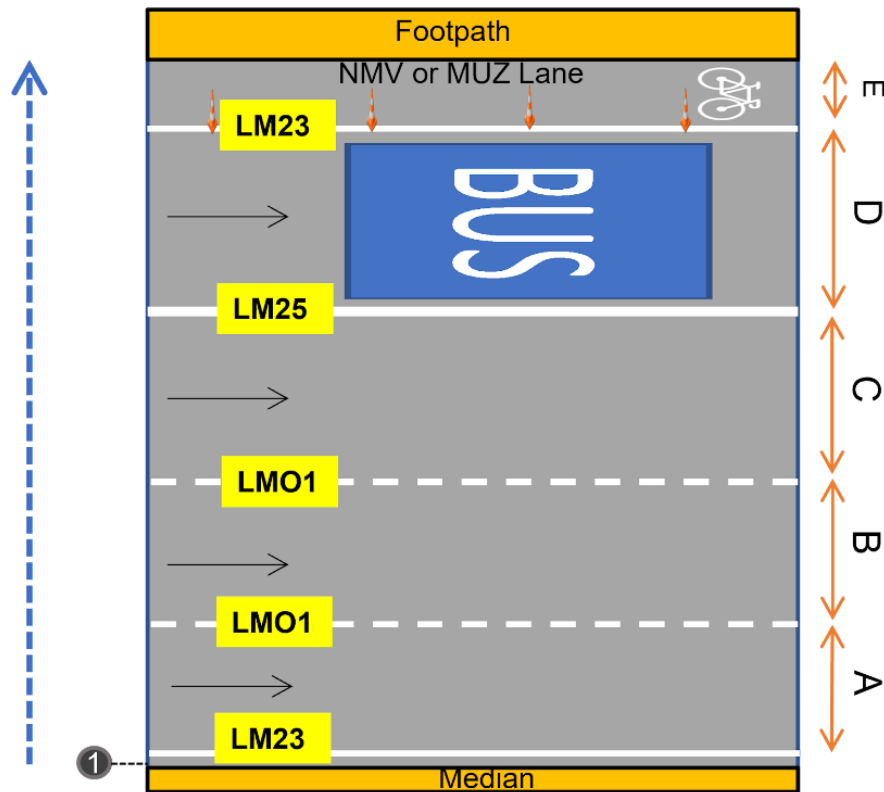


Figure 14: Same section as road cross sections and given is for 8 lanes.

Notes

- Same section as road cross sections refer 1A for 4 lanes, 1B for 6 lane and given above is for 8 lanes.
- Lane width- Clear distance between two lane markings
- The blue arrow denotes the direction in which measurement should be undertaken
- Two options - minimum and desired widths, are provided to accommodate varying lane widths
- Keep the lane width & no. of lanes constant in each segment, even if the carriageway width is varying in segment.
- Cross section is applicable for ROB (Rail Over Bridges)
- Not applicable for flyovers (bus are not allowed over the flyover)

The specifications of the text and the size of the bus box marking and that of the bicycle symbol to be referred from (IRC-35, 2015)

IRC Codes

(IRC-35, 2015)

	Minimum (Applicable on per direction carriageway width 13.6-14.8m)	Desirable (Applicable on per direction carriageway width 14.9m & above)
LANE WIDTH (m)		
A	3.0	3.2
B	3.0	3.2
C	3.0	3.2
D	3.1	3.3
E	LEFT OVER	LEFT OVER
MARKING WIDTH (m)		
1 (SHY AWAY)	0.1	
LM 23	0.1	
LM 01	0.1	
LM 25	0.2	

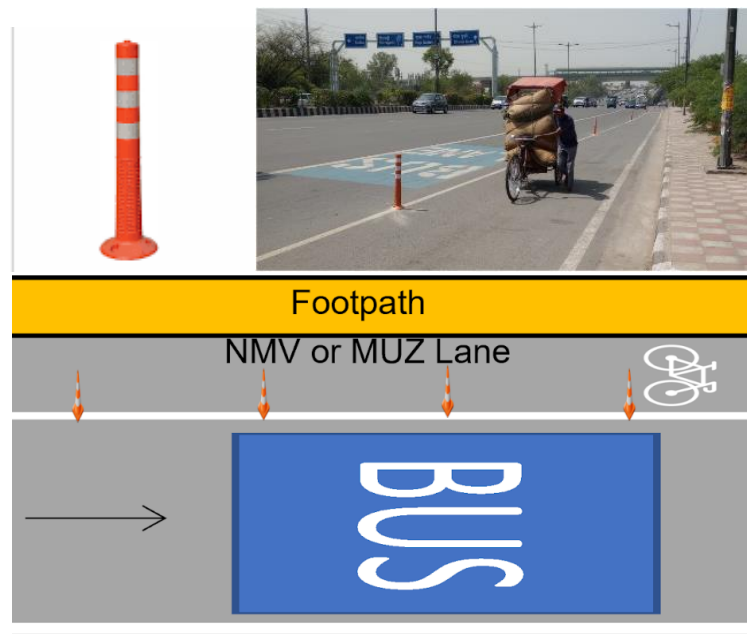


Figure 15: Applicability of spring post

Additionally, to offer better protection and higher visibility of cycle lane, spring posts shall be installed for delineation of bus lane and MUZ, on the left side of bus lane (lane marking segregating bus lane and MUZ/cycle lane) wherever the width permits (available width of this space is >2.0m), at an interval of 30m.

Notes

- Spring post must be provided for delineation or segregation of bus lane and MUZ
- Spring posts at 30m spacing especially at straight stretches.
- At bus stops and for MUZ if you get more than 2m wide then spring post can be installed
- Where clear width of MUZ reduces to less than 0.8m, bar markings and/or rumble strips (as per standards) should be added in the bus lane at the approach of the reduced width point – to warn drivers of cyclists/e-rickshaws expected in bus lane
- Keep the lane width & no. of lanes constant in each segment even if the carriageway width is varying in segment

IRC Codes

IRC SP:88

DIMENSIONS	
Minimum Height	750mm
Location	On the lane Marking
Distance Between Spring Post	30m C to C

3.7 Chevron and diagonal marking

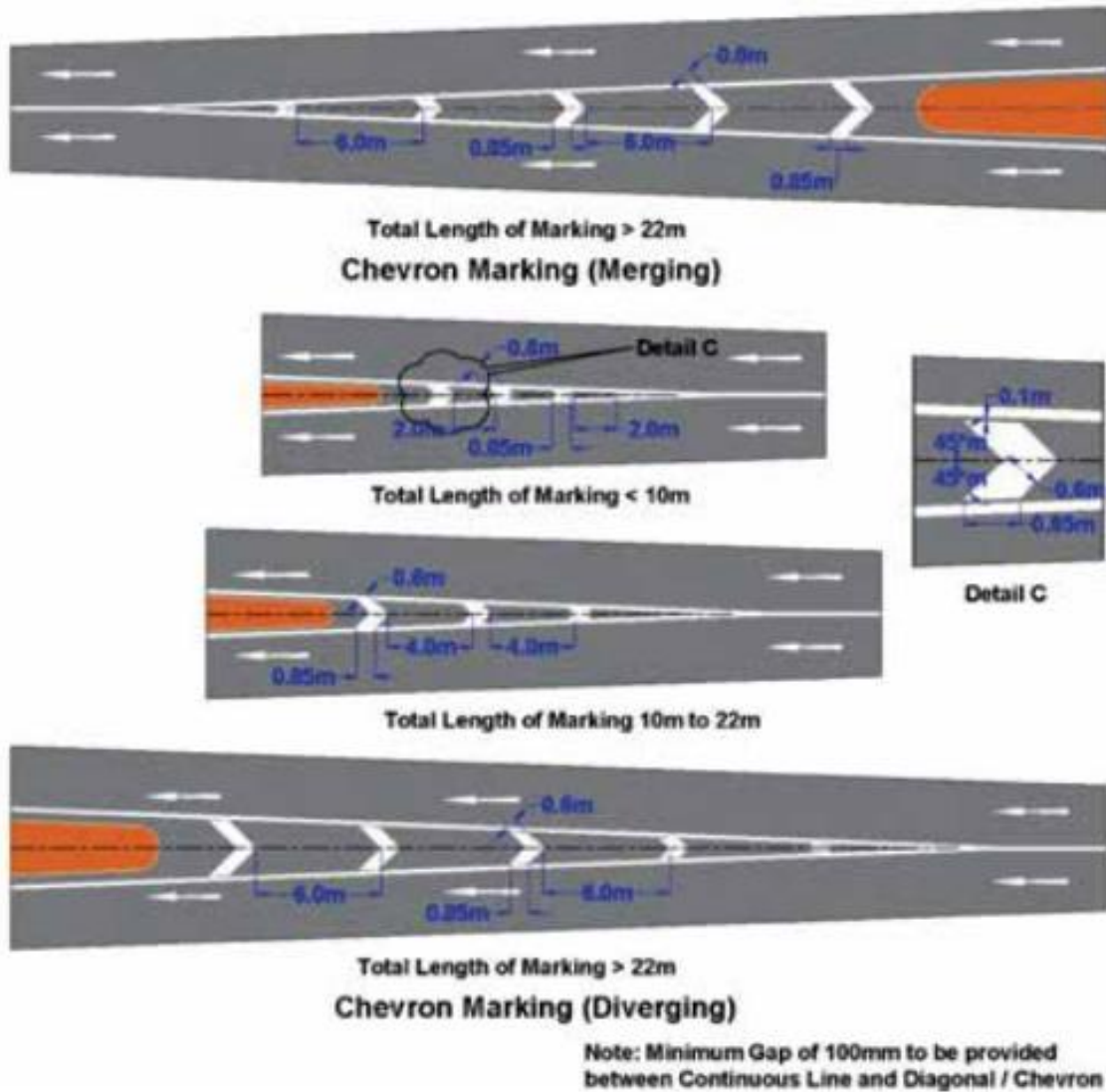


Figure 16: Details of Chevron and Diagonal Marking

Notes

- To direct the entering and exiting traffic into the proper angle for smooth movements of divergence and convergence.
- At beginning and end of the flyover

IRC Codes
(IRC-35, 2015)

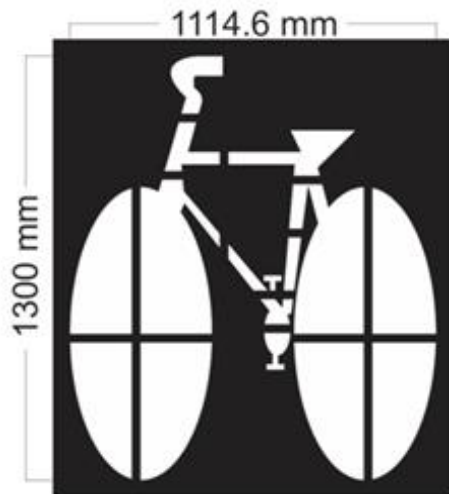


Figure 17: Cycle symbol marking design for MUZ lane(L)

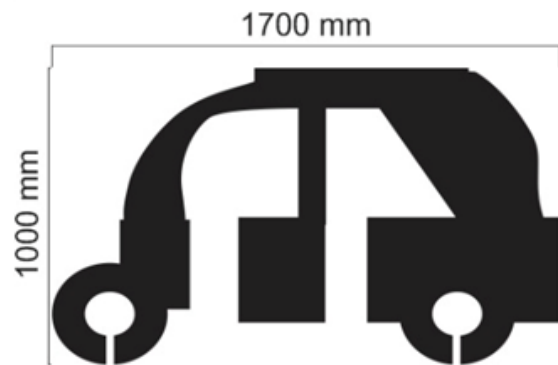


Figure 18: TSR parking pavement marking(R)

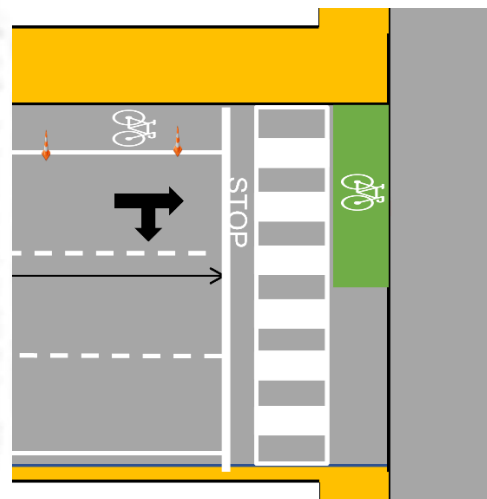
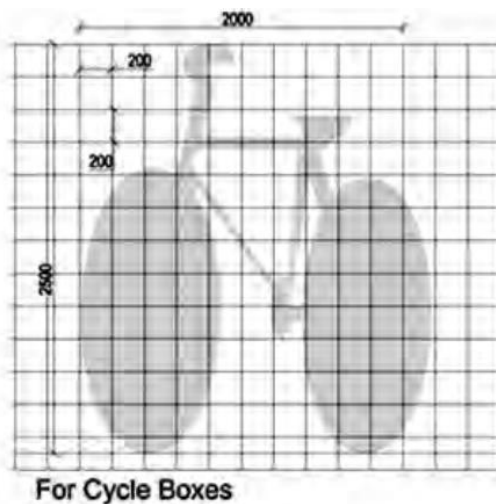


Figure 19: Cycle box marking details for cycle box at zebra crossing

In addition to standard lane marking, special pavement markings are required to demarcate the MUZ/cycle lane to direct the movement of buses, bus commuters and other vehicles at bus stops and intersections.

Notes

- TSR Marking over blue background
- Cycle Box over green background
- Cycle box marking should be designed on the near side of intersections, after the zebra crossing up to the half length of the carriageway in green colour.

IRC Codes (IRC-35, 2015)

DIMENSIONS (mm)		
	Length	Width
Cycle Box	1300	1114.6
TSR Parking	1000	1700



Figure 20: Sign board designs for the pilot stretch, to facilitate bus lane compliance

To ensure free movement of buses in the bus lane, enforcement against illegal or unplanned for street parking is required. To facilitate this, regulatory sign boards are required to indicate no parking, no stopping zones. Additionally informatory sign boards are required to indicate where parking for IPT can take place without leading to bus lane obstructions.

Notes

- The signages should be adequately visible.
- For any other signage relevant to site condition please refer (Indian Road Congress-67, 2021)

IRC Codes

(Indian Road Congress-67 , 2021)

SIZE OF SIGN BOARDS		
Sign	Height (mm)	Width (mm)
Halt and go	1220mm	915mm
No Parking	1220mm	915mm
Tow Away Zone	1220mm	915mm
No Stopping No Standing	1220mm	915mm

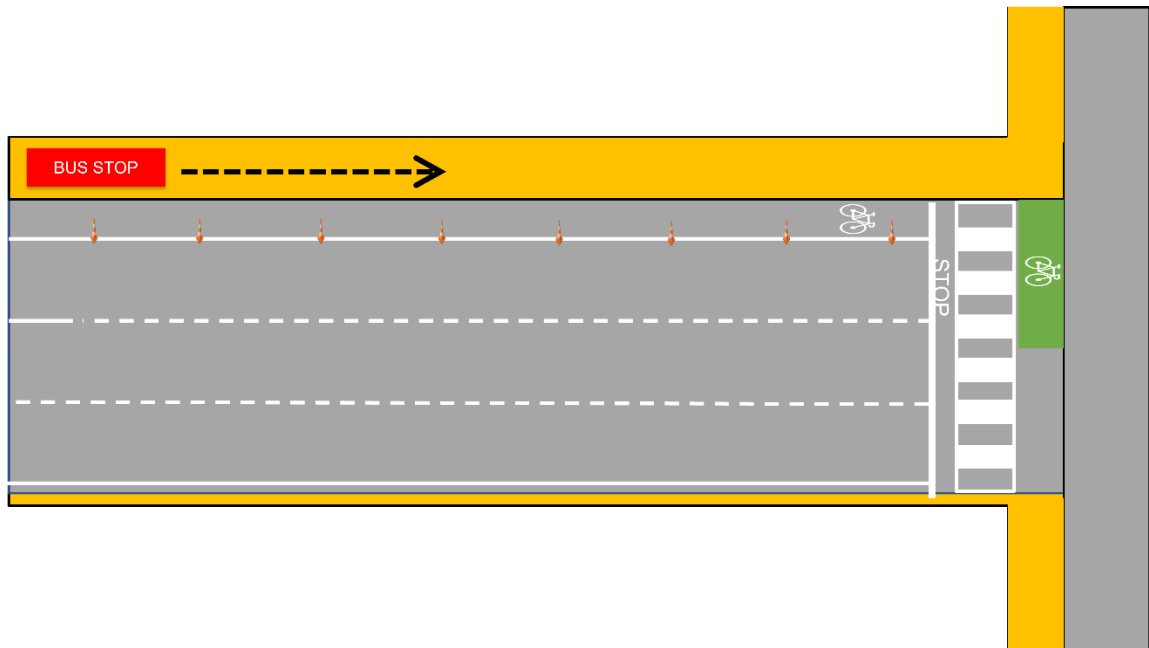


Figure 21: Existing bus stop

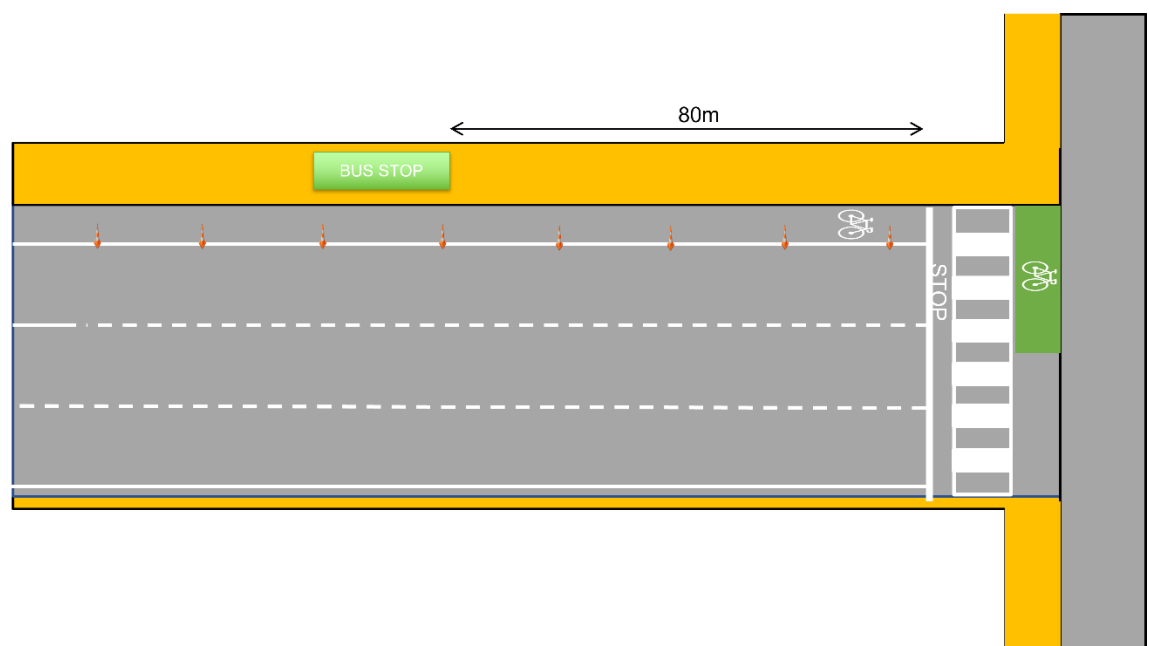


Figure 22: Proposed bus stop

Location of the bus stop is important to ensure safe crossing of passengers. Deboarding/boarding passengers prefer to cross the road using the shortest distance. Therefore, all bus stops need to locate near safe crossings or safe pedestrian crossings need to be provided at all planned bus stop locations. In urban conditions this can be achieved by locating bus stops within 80m of the stop line/zebra crossing at signalised intersections. In case of flyovers, buses should not use the flyovers and should pass through signalised intersection (with bus stops within 80m of the junction) at ground level so that passengers can access safe signalised crossing at the intersection

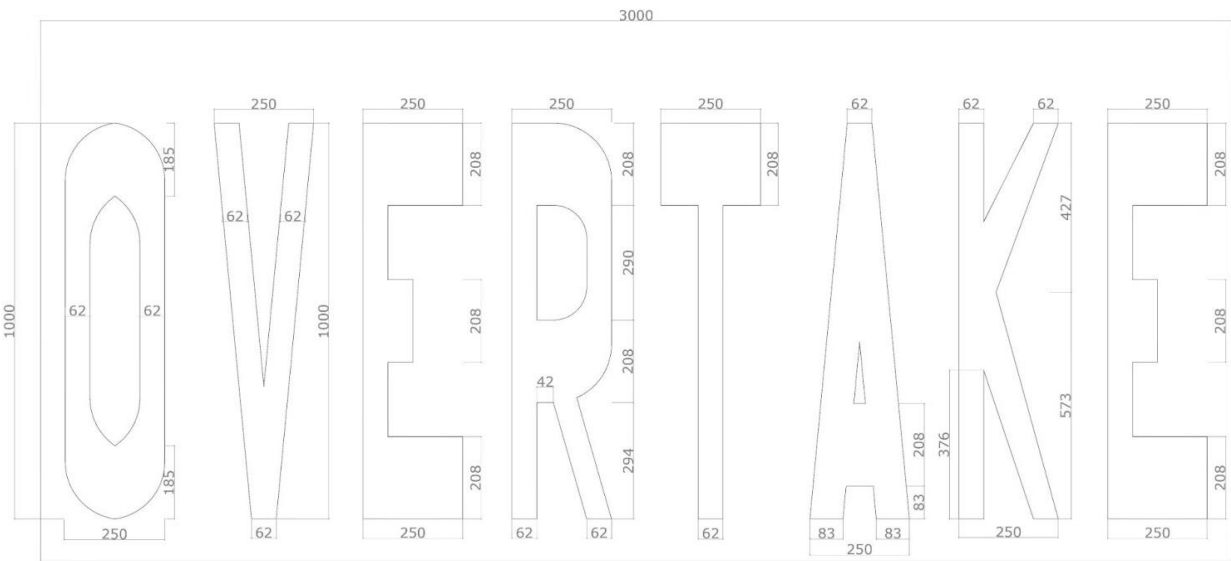


Figure 23: Overtake text details

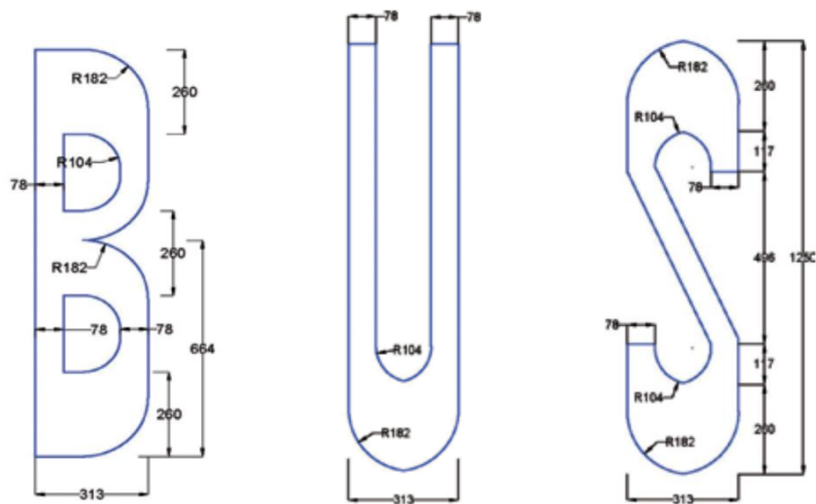


Figure 24: Bus text details

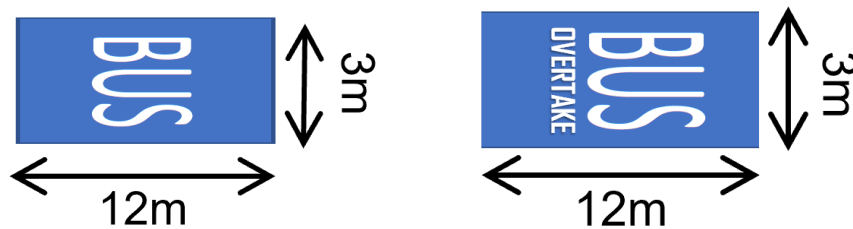


Figure 25: Bus and bus overtake text with blue background (3m x 12m)

Notes

- Bus should be written over blue background in white text.
- Overtake should be written over blue background in white text.

IRC Codes

(IRC-35, 2015)

4. Implementation

This section includes the step-by-step implementation process for bus lane marking

1. **Prepare** the drawings based on total station surveys or other dimension drawings of the site.
2. **Identify** and demarcate segments on the site plan, with maximum continuous/consistent carriageway width and nominate these segments for applicable lane marking design template (presented earlier) – example: identify number of lanes applicable (as per carriageway width) along with minimum/desirable lane width applicable on mid-block segments, identify flyover segment, intersection segment, bus stop segments,
3. **Conduct** a site visit in daytime to mark lane widths (temporary) on cross-section as per designs, at regular intervals (50 to 250m) in the presence of concerned stakeholders such as contractor, traffic police, etc.
4. **Schedule** and undertake implementation of bus lane marking at night, with adequate work zone safety (safety gear, lighting, barricading, etc.)
5. Erase or mask the existing pavement markings to avoid any confusion.

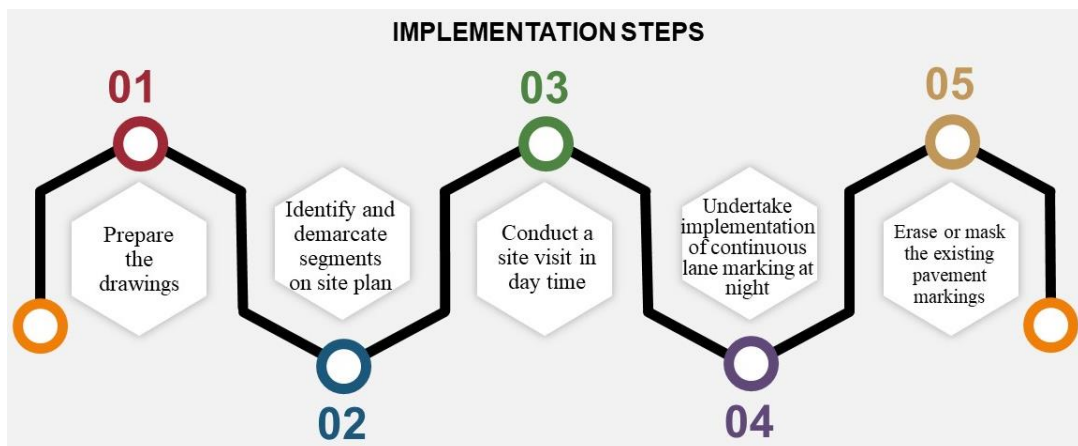


Figure 26: Implementation steps

5. Final Recommendations

This section includes the final recommendations for execution of bus lane marking.

1. New bus lane marking design is required to be undertaken, on all corridors/ road segments where bus lane compliance is to be enforced.
2. Ensure minimum/desirable lane widths and number of lanes (as per design template) based on continuous carriageway width.
3. Where the MUZ width is more than 2m, spring posts should be installed to segregate MUZ from bus lane.
4. Bus stops could be shifted closer to intersections, and along the slip lanes near the intersection at the base of the flyovers¹.
5. Keep the lane width and number of lanes constant in each segment even if the carriageway width is varying within the segment. In such cases number of lanes and lane width (desirable or minimum dimensions) should be applied as per minimum continuous carriageway width (excluding pinch points)².
6. Location of the bus stop is important to ensure safe crossing of passengers. Deboarding/boarding passengers prefer to cross the road using the shortest distance. Therefore, all bus stops need to locate near safe crossings or safe pedestrian crossings need to be provided at all planned bus stop locations. In urban conditions this can be achieved by locating bus stops within 80m of the stop line/zebra crossing at signalised intersections. In case of flyovers, buses should not use the flyovers and should pass through signalised intersection (with bus stops within 80m of the junction) at ground level so that passengers can access safe signalised crossing at the intersection
7. Spring posts shall be installed for delineation of bus lane and MUZ, on the left side of bus lane (lane marking segregating bus lane and MUZ/cycle lane) wherever the width permits (MUZ width is >2.0m), at an interval of 30m (centre to centre).
8. Special pavement marking (cycle symbol as per IRC-35, 2015) are required to demarcate the MUZ/cycle lane to direct the movement.
9. While implementing the new bus lane marking designs, engineers may encounter specific conditions that are not yet covered in the design templates or not included in the training. Engineers may need to adapt the provided designs OR existing guidelines for such situations.

¹ As per Delhi Transport Department notification buses to not use any flyovers (road over bridges) and are instead required to go through the signalized intersections below the flyover. This is applicable at flyovers where straight movement of vehicles (parallel to flyover alignment) is permitted/planned at ground level.

² A part of the segment less than 80m length which has lesser carriageway width than that of the majority of the segment length. This definition is applicable only when a single pinch point is present or multiple pinch point length do not total to more than 1/4th of the segment length.

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<https://mail.google.com/mail/u/0/#search/gandhi.sandeep%40gmail.com/FMfcgzGrbHmZWbIRZhrWPRnpWlsKZMJF?projector=1&messagePartId=0.1>

Annexure 1

1. LONGITUDINAL MARKING

3.1 Longitudinal Marking (LM)

The longitudinal marking are generally provided along the traffic movement. The broken lines, single/double continuous lines and continuity lines are classified under Longitudinal Marking and abbreviated as LM01, LM02, LM03 etc. for easy referencing as given in **Table A.1**. The applications of these markings are described in respective sections.







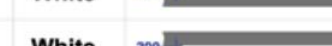

3.1.1 As traffic moves forward, the broken longitudinal markings can be crossed, whereas continuous longitudinal markings shall not be crossed.

3.1.2 The purpose of longitudinal marking is to navigate the driver for forward movements and to prohibit overtaking manoeuvring at certain at hazardous locations. In a multi-lane road, the lane boundary established by longitudinal marking really guide to avoid side swipe and head on collision accidents.

3.1.3 The continuous longitudinal marking line can be single and double lines and are not expected to cross in normal condition. The double continuous lines are used to make the compliance prominent and to reinforce the message that it shall never be crossed. In urban roads having space constraints, the construction of raised median will reduce the traffic able width in roads and double prohibitive marking is always a solution to streamline the traffic, provided the road user behaviour is mature enough to have strict compliance.

3.1.4 The continuous longitudinal marking in yellow colour is to signify that the marking provided is strictly prohibitive in nature and not to be straddled by the vehicles.

Longitudinal Markings used are: LM 01, LM 19, LM 21, LM 23, LM 25

LM01	Broken	3000	6000	100	White	
LM16	Broken	1500	1500	200	White	
LM20	Broken	500	500	150	White	
LM21	Broken	1000	1000	100	White	
LM22	Broken	1000	1000	150	White	
LM23	Continuous	NA	NA	100	White	
LM24	Continuous	NA	NA	150	White	
LM25	Continuous	NA	NA	200	White	

2. TRANSVERSE MARKING

3.2 Transverse Markings (TM)

The marking provided across the carriageway for traffic control with broken lines, single/double continuous lines such as Stop marking and Give way marking are classified under

Transverse Marking (TM) and are abbreviated as TM01, TM02, TM03 etc. as given in **Table A.2**. The applications of these markings are described in respective sections.

3.2.1 The transverse marking establishes the traffic control, lest it would lead to crashes, and therefore, its compliance is vital. The road authority shall always ensure the installation of transverse marking and continued maintenance.

3.2.2 The transverse marking shall always be accompanied with corresponding sign.

Transverse Markings used are TM 04

TM04	Broken	600	300	100	White	
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3. HAZARD MARKING

3.3 Hazard Marking (HM)

The pavement marking that facilitating traffic merging/diverging, prohibiting to cross-over and to deflect the traffic ahead of hazardous situations, generally done with like chevron and diagonal marking, hatch marking and prohibitory marking and such markings are classified under Hazard Marking and are abbreviated as HM01, HM02, HM03 etc. as given in **Table A.3**. The applications of these markings are described in respective sections.

3.3.1 Since hazard marking are provided ahead of diverging and merging and around a hazardous location, its compliance is also vital. The hazard marking shall always be accompanied with appropriate sign.

7.6 Hatch Markings

7.6.1 Where traffic has to be deflected in an unusual situation, mere edge line will not be effective, in which hatch marking as shown in **Fig. 7.3** should be considered. In the hatch markings also where traffic has to be shifted, taper rate as per **Table 7.2** shall be applied. HM18/HM19 marking shown in **Table A.3** are the hatch markings and shall be applied for markings to create refuge islands.

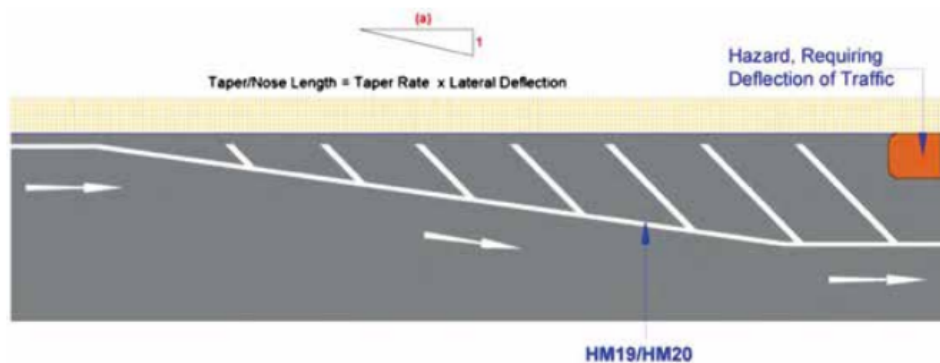


Fig. 7.3 Hatch Marking

HM19	Deflecting	150	200	4000	White	
HM20	Deflecting	150	200	6000	White	
HM12	Ladder Hatching	100/150	200	4000	Yellow	
HM13	Ladder Hatching	100/150	200	6000	Yellow	
HM14	Continuous	One Solid Line of 100mm		NA	Yellow	
HM15	Continuous	One Solid Line of 150mm		NA	Yellow	

Foot of the Flyover

HM02	Chevron (Diverging)	150	600	4000	White	
HM05	Chevron (Converging)	150	600	4000	White	

4. BLOCK MARKING

3.4 Block Marking (BM)

The zebra crossing for pedestrians, triangular and checkered marking for speed breakers and Giveaway symbol which are painted in blocks on carriageway are classified under Block Marking and are abbreviated as BM01, BM02, BM03 etc. for easy referencing as given in **Table A.4**. The applications of these markings are described in respective sections.

3.4.1 The application of thermoplastic paint for block marking is generally different from longitudinal marking. The quality of block marking with adequate visibility is of utmost importance.

BM08	Cycle Symbol	As Shown	NA	White	
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5. FACILITY MARKING

3.7 Facility Marking (FM)

The marking for parking, the word messages for buses, cyclists and disabled ones are classified under Facility Marking and are abbreviated as FM 01, FM 02, FM03 etc. for easy referencing as given in **Table A.7**. The applications of these markings are described in the respective sections.

2.6 Colour Pattern for Markings

The general colour pattern followed for road marking and various background surfaces are given below:

2.6.1 White

Because of the visibility and good contrast against the road surface, the white colour should be widely used for road markings.

2.6.2 Yellow

The longitudinal marking in yellow colour should be used to convey message where it is not permitted to cross the markings. Yellow colour is also used to show parking restrictions and to impose other traffic control. Yellow colour is defined as per IS Colour No. 356.

2.6.3 Blue

The blue colour should be used to indicate new and special markings which are not conventional. Blue is the colour of public transportation including three wheelers, scooter and rickshaws. The blue colour shall be used to indicate dedicated bus lanes in the Bus Rapid Transit (BRT) corridor on urban streets. In the bus lanes being marked across the intersection, the blue marking should be used to inform the road users that the lane is specifically meant for buses and other vehicle should not drive or stop in this lane.

2.6.4 Green

The green colour should be deployed to distinguish the bicycle and non-motorised transport facilities provided on the road. Green colour background should be marked at the intersection to give priority to the cyclists and pedestrians in crossing the road. When the motorized vehicles and non-motorized vehicles share the same carriageway, the green background

lanes are preferred. When dedicated non-motorized lanes are built, a special green cycle boxes should also be used.

2.6.5 Red/Purple

Where multiple road users are sharing the road space on hazardous locations, the red colour marking is primarily used to help people understand the danger. Red marking is highly recommended on hazardous intersections and also at places where pedestrians traffic conflict with the motorized traffic.

Annexure 2

List of attendees

(Workshop for PWD Engineers, Government of NCT Delhi- 30 September 2022)

WORKSHOP FOR PWD ENGINEERS, GOVERNMENT OF NCT DELHI				
30 th September 2022, TRIP Centre, IIT Delhi				
Attended by				
S.No.	Name of Officer	Division	Mobile No.	Signature
1.	M.K. Dwivedi	NWR-2	9810526609	
2.	Prabhat Srivastava	NWR-1	7428410100	
3.	Rahul Agrawal	NWR-2	9887732778	
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5.	M.K. Singh	SWR-1	9991073881	
6.	RAJIV BASSI	WR-1	8826653643	
7.	RAKESH KUMAR CHAUDHARI	WR-1	7017925342	
8.	Ajay Kumar	Shahdara Road (M-211)	8168045926	
9.	Vivek Kumar	NWR-2	9460393997	
10.	Narendra Singh Kathait	SWR-I	8628854892	
11.	Brijesh Naranya	SWR-I	9962299146	
12.	Davender Kumar	SRD-1	9849285636	
13.	Pankaj Kumar	SRD-1/JE	7503911703	
14.	Ashok Kumar Verma	SWR-I	880037067	
15.	Yogendra Pandey	SWR-1	9810809354	
16.	Harish Pathak	EE/SWR-1	9818634934	
17.	S.S. Chauhan	EE/WR-1	9891542796	
18.	Dashwant Sherrap	AE/NWR-23	8377978994	
19.	Malay Mayank VadaV	JE / M-2114	9717206734	
20.	Anresh Kumar Meena	AE-M211 M-2114 (Shahdara Road str)	8826620221	

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23	Supinder Singh	NWR-2	9212319202	
24.	Yogendra Chakravarti	NUR-2	8527370302	
25.	R.D. Meena	M-211	9414206010	
28.	Yogesh Hada	SER-1	8209708026	
29.	Nitesh Kr. Yadav	SER-1 (M-412)	7905830351	
30	Hara Ram Jai	Shahdara Road DIV	9785374500	
31	Prashant Anand	WR-1	9350679131	
32.	A.S. Bhatija	WR-1	9718423533	
33-	chandrish	SER-1	9721882545	
34	Nishi Jena	SER-1	7007907180	
35	Sunil Kumar.	SWR-1	9413424954	
36	Rajendra Yadav	SWR-1	8938832020	
37.	MUKESH AECIVIL	SER-1	9599688228	
38	P. K. Sharma	SRD-1		

List of attendees

(Workshop for PWD Engineers, Government of NCT Delhi- 10 October 2022)

WORKSHOP FOR PWD ENGINEERS, GOVERNMENT OF NCT DELHI
10th October 2022, TRIP Centre, IIT Delhi

Attended by				
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5	Ramakant Meena	South Road-2	8287270445	
6	BJENDER SINGH	South Rd-2	9729822676	
7	VED PRAKASH SINGH	East Road	9899265234	
8	Krishan Kumar Yadav	South Road-1	9462052673	
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