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Study on Safety of Pedestrian at Mid-block Crossings in Urban Areas of Developing Countries

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Abstract— In developing countries, like India, there has been a rapid increase in the pedestrian volumes and traffic-pedestrian conflicts in the last few decades and that calls for increase in the pedestrian safety facilities at mid-block crossings in the CBD area. In the present study video graphic technique was used and the data was collected at different study locations in the CBD area of the city where the high pedestrian flows were observed. The final results were obtained from the questionnaire survey and the data was analysed from composition of respondents. To enhance safety of pedestrians at mid-block crossings under mixed traffic conditions. In future there is a need to improve the pedestrian safety facilities at mid-block crossings in urban areas.

Keywords——Pedestrian, Questionnaire, Mid-block locations, Inventory pedestrian safety issues, safety Measures

I. INTRODUCTION

In India, the Srinagar Metropolitan Area (SMA) there is a lack of cross-marking facilities for pedestrian on urban roads under mixed traffic conditions, and we studied as per IRC 103-2012 guidelines [4] for safety of mid-block crossing in urban areas.

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

At grade pedestrian crossing near midblock, raised pedestrian crossing (Figure 9) should be made mandatory in case of multilane roads with heavy volume of vehicular traffic and as shown in Table 1.

Table1. Standards for Mid-Block Pedestrian Crossing

• Residential area	• Spacing range: every 80 – 250m • Coordinated with entry points of complexes; location of Bus/train stops, public facilities ..etc
• Commercial / mixed land uses	• Spacing range: every 80 – 150m
• High intensity commercial areas	• Pedestrianzations if possible

(Source: Guidelines for Pedestrian Facilities, IRC 103-2012)

II. OBJECTIVES OF STUDY

The overall objective is to study the behavior of the pedestrians when they cross the road at mid-block crossings. The main objectives of this study are:

(i) Identification of the safety measures and pedestrian safety issues at midblock crossings in urban areas.
(ii) To recognize the general crossing behaviour of pedestrians at mid-block crossings.
(iii) To suggest improvement measures at mid-block crossings under mixed traffic conditions.

III. LITERATURE REVIEW

The current review of literature were studies about the crossing at mid-blocks in urban areas under mixed traffic and homogeneous traffic conditions and as shown in Table 2.

Table 2. The details of crossing treatment at Mid -block crossings

S No	*Treatment*	*Author*	*Subject or Method*
1	**Zebra Crossing**	Ekman and Elvik, 1997 (cited in Sanca, 2002)	They do not believe that marked road crossings have a positive safety effect for pedestrians. They argue that collision risks can be higher at marked crossings with no other facilities (e.g. zebra crossing) as they give pedestrian a false sense of security because the road markings are not as visible to vehicles as they are to pedestrians.
2	**Stop Lines**	Van Houten et al, 2001 [1] Allen, Bygrave and Harper, 2005	The Local Transport Note 1/04 suggests that, 'increasing the distance between the stop line and the crossing studs from 2m to 3m has been proven to improve safety and comfort for pedestrians by positioning waiting motor vehicles further from the crossing point'. Canadian research has shown that putting give way markings 10 metres in advance of the crossing reduced conflicts between pedestrians and vehicles from 16.8% to 4.3%. A study for TfL examined the behaviour of road users at Advanced Stop Lines (ASLs) designed to allow priority to cyclists. The study found that all vehicles that encroached at control sites went into the pedestrian crossing, compared with 12% at ASL sites. This indicated that an ASL can provide a buffer zone that discourages vehicles from blocking the pedestrian crossing.
3.	**Raised Crossings**	Sanca (2002), Jones and Farmer (1993) and Zegeer et al (2001) [2]. Sanca (2002)	the effect of introducing raised zebra or signal-controlled crossings is a reduction in vehicle speed and an increase in vehicles giving way to pedestrians, both of which give a safety benefit to pedestrians and a significantly lower pedestrian collision rate. He does, however, warn that this measure should not be introduced if sight distance is limited, if the street is steep or if the road is a bus route or emergency route. Special care should be paid to drainage.
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4.	**Pedestrian Refuge Islands/Medians**	Zegeer *et al*, 2001 Zegeer,1991 (Lalani, 1976) [3]	Research has shown that painted medians (that were not raised) do not offer significant safety benefits to pedestrians compared with no median at all. Relatively few studies have been conducted on the safety effects of pedestrian refuges however one study undertaken in London (Lalani, 1976) examined the effects of many roadway improvements, including pedestrian refuges. This study concluded that the provision of refuges decreased vehicle collisions, but surprisingly increased pedestrian collisions. Significant collision reductions were only obtained at sites where the purpose of the refuge was very clearly established,i.e. installed for safety reasons, reinforcement of the hatch markings etc.
5.	**Pedestrian Crossings with Narrowing**	Sanca (2002) [2]	Road narrowing at a crossing can be achieved by widening the footway and therefore reducing the width to cross. It is a measure suitable for low volume streets. According to Sanca (2002) narrowing at a pedestrian crossing is an effective way to reduce traffic speeds and increase drivers' awareness of other road users.
6.	**Vehicle Activated Signs**	Sanca (2002) [2]	These signs improve drivers' speed and give way behaviour, and are well accepted by drivers. Pedestrians who use the crossings think it is easier and more convenient to cross.

IV. STUDY METHODOLOGY

A. Selection of study locations:

Here, two sites have been selected. The selected sites and their corresponding data are mentioned below:

Location 1: Hazratbal Road, near Kashmir university (KU)

Figure 1. Midblock Crossing at hazratbal road
(Source: Google Satellite Map Srinagar City accessed on 04/03/2018)

Figure 2. Midblock Crossing Near Nishat Garden
(Source: Google Satellite Map Srinagar City accessed on 04/03/2018)

B. Inventory pedestrian safety issues at mid-block crossing:

After visiting each and every site we have collected the major pedestrian safety issues and the lack of facilities which are responsible for the pedestrian fatalities.

Site 3: Burn Hall School, Residency Road

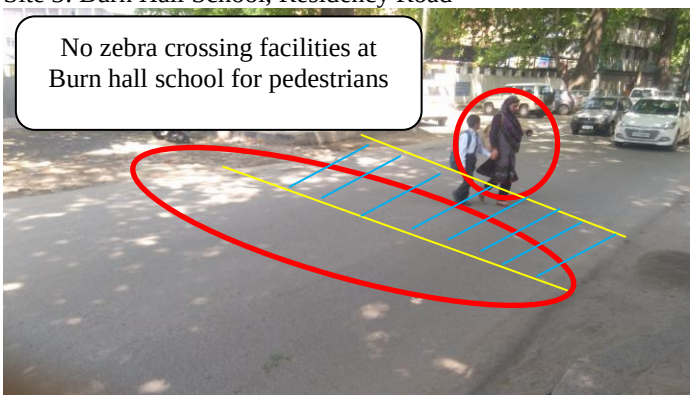

Figure 3. Midblock Crossing at Burn Hall School, Residency Road
(Source: Captured by camera on 24/04/2018)

C. The safety issues of this site are as follows:

- Poor visibility of the road markings for the pedestrian at the midblock crossings.
- Absence of traffic signs.
- Absence of traffic signals.
- Absence of STOP line and road humps.
- No special provision for the physically disabled people.
- Speed of the traffic is high so that pedestrian face lot of difficulties while crossing the road especially during the peak hours.
- Surface condition of the road is not good. It becomes slippery in wet condition.

V(a). CASE STUDY OF HAZRATBAL ROAD, NEAR KASHMIR UNIVERSITY (KU)

- Insufficient space for on-street parking.
- Average crossing speed is 1.2 to 1.55m/sec
- Width of the road :21.10 m
- Dimension of the midblock: 2.46 m x 0.4 m
- Spacing of the midblock strips:0.4 m

The safety issues of this site are as follows:

- Absence of road marking.
- No special provision for the physically disabled people.
- Absence of traffic signals.
- Absence of STOP line and road humps.
- Speed of the traffic is high so that pedestrian face lot of difficulties while crossing the road especially during the peak hours.
- Traffic volume is also high due to nation highway (Srinagar-Leh Highway).
- Surface condition of the road poor.
- Width of the road **:**7.2m

SITE 4: Hazratbal Road, Near KU

Figure 4. Mid-block crossing at Hazratbal Road, near KU
(Source: Captured by Camera on 22/04/2018)

V(b). CASE STUDY OF NISHAT GARDEN

The safety issues of this site are as follows:

- Poor visibility of the road markings for the pedestrian at the midblock crossings.
- Traffic signs are not visible.
- Absence of traffic signals.
- Absence of STOP line and road humps.
- Speed of the traffic is high so that pedestrian face lot of difficulties while crossing the road especially during the peak hours.
- Surface condition of the road is good. It becomes slippery in wet condition.
- Insufficient space for on-street parking.
- Width of the road :19.84m
- Dimension of the midblock: 2.46 m x 0.4 m
- Spacing of the midblock strips**:** 0.4 m

SITE 5: Nishat Garden

Figure 5. Mid-block crossing near Nishat garden
(Source: Captured by Camera on 22/04/2018)

VI. RESULTS OF VIDEO GRAPHIC AND QUESTIONNAIRE SURVEYS

Results after conducting various types of surveys have been shown below. The various collected statistics are pedestrian volume, traffic volume, age of pedestrian etc. By collecting all these variables, peak pedestrian volume can be figured out. The midblock crossings can be rated according to the obtained peak pedestrian volume. Some of questionnaire survey results as discussed given in Figure 6 to Figure 10.

1. Would you say the overall quality and condition of your areas transportation system is?

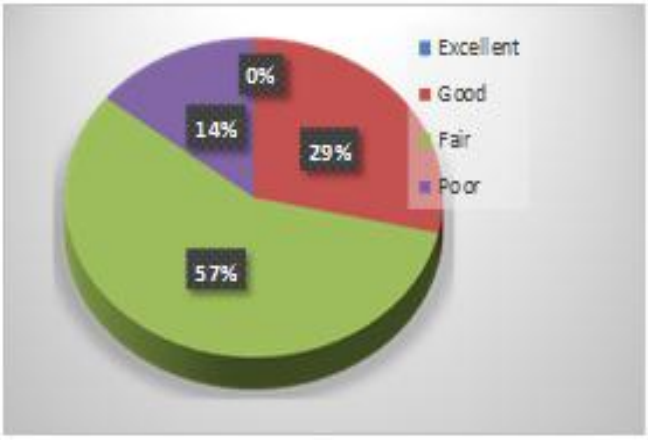

Figure 6. Pie Chart represents response of pedestrian

Answer: 57% rated the present transportation system as fair, 29% valued it as good and 14% replied that the condition is pathetic.

2. Is the width of midblock crossing is sufficient?

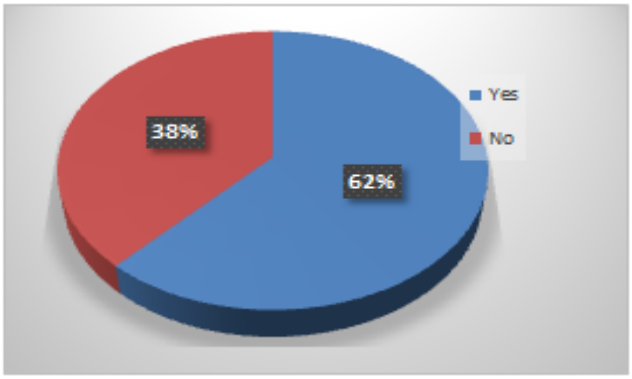

Figure 7. Pie Chart represents response of pedestrian

Answer: 62% people think that width of midblock crossing is adequate whereas 38% think the width of midblock is insufficient.

3. What do you think about surface condition at mid-block?

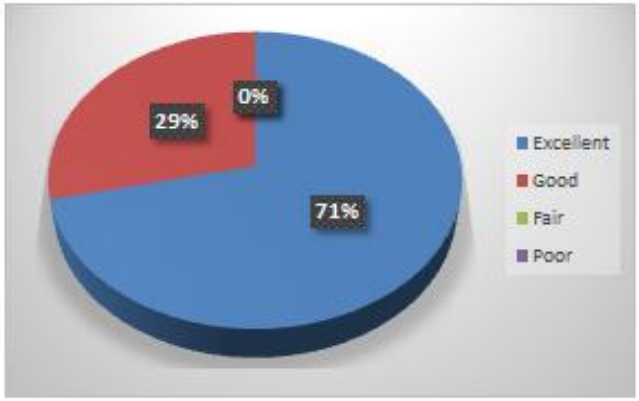

Figure 8. Pie Chart represents response of pedestrian

Answer: 71% people said the surface condition is excellent and 29% rated the surface as good.

4. Rate the infrastructure facilities on the mid-block (pedestrian behavior while answering the question at that time) ?

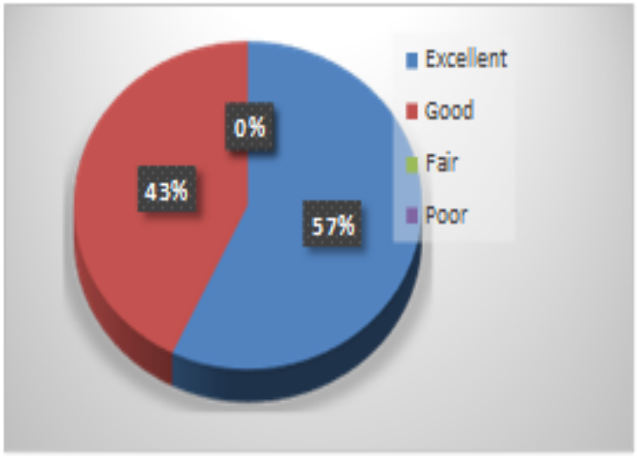

Figure 9. Pie Chart represents response of pedestrian

Answer: 57% respondents rated the infrastructure facilities on mid-block as excellent and 43% gave the good response for the infrastructure facilities on midblock.

5. Do you think this midblock is in need of improvement for pedestrian safety?

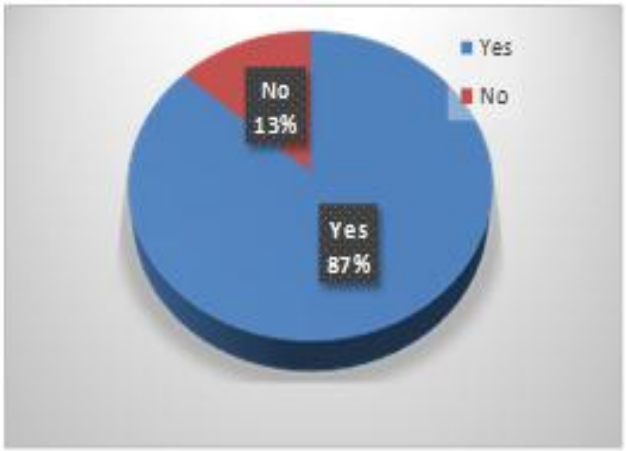

Figure 9. Pie Chart represents response of pedestrian

Answer: 87% people responded that present mid-block section needs improvement whereas 13% are satisfied with the current mid-block section.

6. If so, why is this midblock in need of improvement?

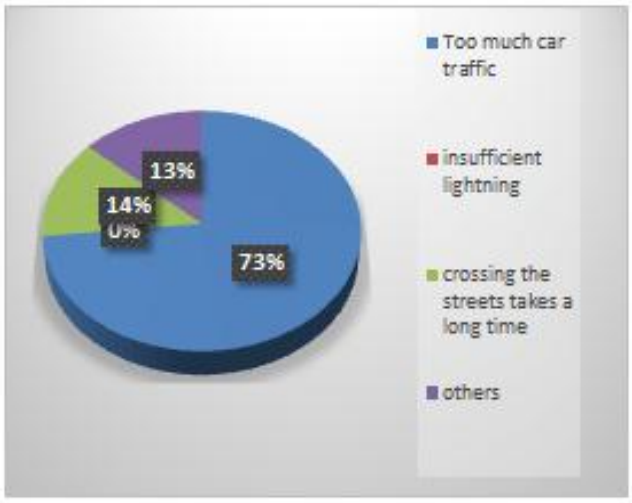

Figure 10. Pie Chart represents response of pedestrian

Answer: 73% people want the midblock section to get improved due to too much car traffic, 14% want up gradation on account of delay which occurs while crossing and 13% gave miscellaneous reasons for the enhancement of the midblock section.

VII. CONCLUSION

In Srinagar metropolitan area there is lack of pedestrian safety facilities at mid-block crossing in the CBD areas of selected locations in the city. In future there is scope to provide pedestrian signal, pavement markings and traffic signs for safety of pedestrians in urban areas of developing countries. The following general pedestrian safety measures will be proposed in next further study.

General safety measures:-
Some of the general measures which can be taken at midblock crossings are as follows –

A. Refuge Island:

Refuge islands are raised medians placed in the centre of the roadway at midblock locations. Refuge islands are intended to assist pedestrians in crossing wide streets by providing a safe "refuge" in the centre of the road, allowing pedestrians to cross one direction of traffic at a time. The presence of a refuge island reduces the time a pedestrian must wait for an adequate gap in the traffic stream and reduces the crossing distance that they must face at one time. Pedestrian refuge islands are particularly suitable near pedestrian generators such as hospitals, schools, malls, etc., and may form part of a larger street scraping plan.

Figure 10. Refuge Island (Source:http://www.tcat.ca/wp-content/uploads/2016/07/pedrefugeilsand.jpg)

B. Kerb Extensions:

Kerb extensions "extend" the sidewalk or kerb line at specific points to reduce the width of the travelled portion of the roadway or extend out into the spaced allocated for kerb side parking. Kerb extensions reduce the distance pedestrians have to walk, hence pedestrians require smaller gaps in traffic in order to cross and pedestrian delays are likely to be shorter. Kerb extensions can provide a refuge for pedestrians, improve the sight distance and sight lines for both pedestrians and motorists, and may also be considered as a traffic calming measure.

Figure 11. Kerb extension(Source:http://www.roadsafety/wp-content/uploads/2016/07/pedrefugeilsand.jpg)

C. Raised Crosswalk:

A raised crosswalk is a marked pedestrian crossing point at an intersection or mid-block location constructed at a higher elevation than the adjacent roadway. The raised surface improves drivers' awareness of the potential for pedestrians and has a traffic calming effect as one of its effects is to reduce speed. Raised crosswalk applications should be considered within the context of the road authority's traffic calming policies and practices.

Figure 12. Raised crosswalk (Source:http://wp-content/uploads/2016/07/pedrefugeilsand.jpg)

D. Pedestrian Warning Signs:

Warning signs are used to alert drivers to danger or potential danger ahead. They indicate a need for extra caution by road users and may require a reduction in speed or other man oeuvre. This section contains advice on when to use each sign. Adequate warning signs can greatly assist road safety. To be most effective however, they should be used sparingly.

Figure 13. pedestrian warning signs (Source:http://warningsign/uploads/2016/07/pedrefugeilsand.jpg)

E. Use of Speed Breakers:

These are the small undulations which are made on the surface on the road, due to which drivers of the vehicles are forced to reduce the speed of their vehicles.

Figure 14. speed breaker (Source:https://s3.ap-southeast-1.amazonaws.com/images.deccanchronicle.com/dc-Cover)

F. Use of 3D Paint on road:

This type of paint can be used to give an illusion of some obstruction to the driver when he is speeding up.

Figure 15. 3D Paint (Source:https://www.firstpost.com/photos/optical-illusion-delhi-gets-its-first-3d-zebra-crossing-at-rajaji-road-2893888.html)

G. Proposed midblock crossings:

The ideal midblock crossing consists of all the facilities such as:

- There must be proper lightening facilities.
- It should consist of stop line before the crossings.
- Proper midblock marking.
- Consists of speed breaker or road humps.
- Proper installation of traffic signs and signals.
- Proper facilities of on-street parking.

As per IRC guidelines 103-2012 for pedestrian safety facilities

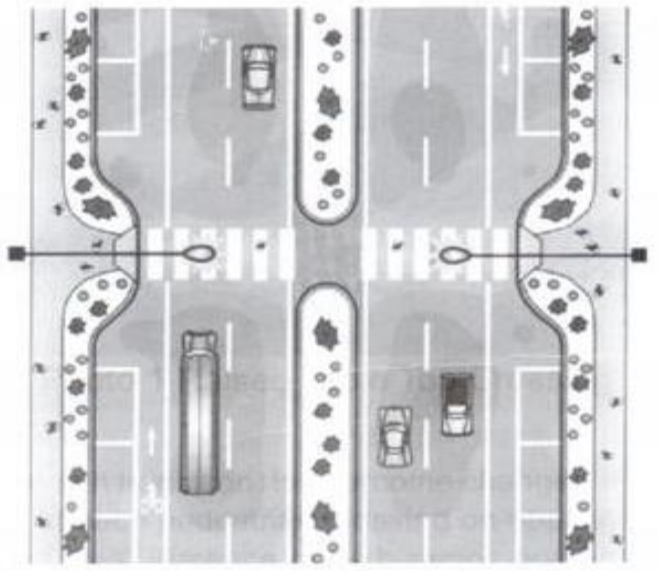

Figure 16. Midblock crossing kerb extensions (Source: Guidelines for pedestrian facilities, IRC 103-2012)

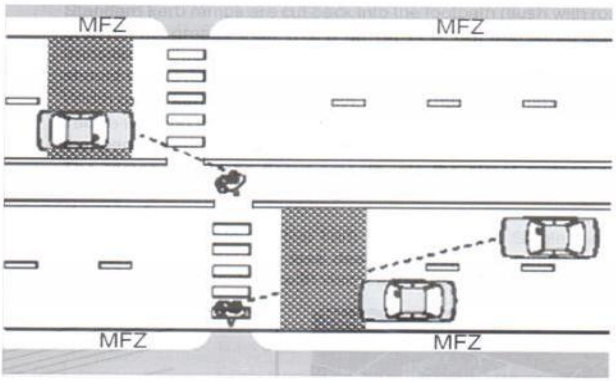

Figure 17. A Midblock crossing with a median refuge (Source: Guidelines for pedestrian Facilities, IRC 103-2012)

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AUTHORS PROFILE

The first author is Adinarayana. Badveeti was born in Andhra Pradesh in 1992. He received the B.Tech degree in Civil Engineering from the University of JNTUK, Andhra Pradesh in 2013 and M.Tech degree in Transportation Engineering from University of JNTUH in 2015. He is currently working as Ph.D (Research scholar) in Transportation Engineering & Planning Division, Civil Engineering Department from National Institute of Technology (NIT), Srinagar, Jammu & Kashmir, India.

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