

EVALUATION OF PEDESTRIAN FACILITIES IN PATNA

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Abstract— The paper discusses the evaluation of pedestrian facilities such as sidewalks and crosswalk along with their pedestrian level of service. The city under study was Patna. A total of 10 locations have been studied for sidewalk and six locations for crosswalk and their adequacy have been checked as per the guidelines mentioned in IRC 103:2012. Pedestrian level of service at each location have also been calculated based on the delay faced by the pedestrians due to vehicular movement at intersections.

Keywords— Sidewalk, Crosswalk, Pedestrian level of service, Delay, Vehicular movement

I. INTRODUCTION

A person who travels on his foot instead of using any vehicle is called a pedestrian. People on wheelchair or those using roller skates to travel are also termed as pedestrian. Basically anyone walking on footpath, crosswalk or on road are called pedestrian. Walking where on one hand saves fuel which results in less pollution emission, it has also health benefits. Nowadays commercial and residential areas are being developed which is more walk able so as to reduce pollution emission and to also make surrounding safe and secure. For short trips up to 1-2 km it is the most adequate and suitable mode of transportation. The initiation and termination of every journey is by walking. In between the walking trips other modes of transportation are also involved. Walking as a sustainable and suitable mode of travel is understood worldwide and cannot be neglected.

II. IMPORTANCE OF STUDY

High road accidents rates have been seen in recent years and pedestrians are the main group of people who get affected by it. They are the most vulnerable group. Vehicular traffic has increased many folds in past few years and since there is not adequate or in some cases none at all facilities for pedestrians to walk they walk on road which is very dangerous and also leads to accidents. Footpaths on roads are either not present at all or if present are not maintained properly. Similarly when crosswalk facilities are not adequately provided it increases the risk of accident of pedestrians crossing the road. In case of crosswalk at signalised intersection no dedicated time slot is given to pedestrians to cross which increases delay and tendency to run on the crosswalk which is not desirable.

The study entitled **Evaluation of Pedestrian Facilities in Patna** has been taken up to assess adequacy and quality of the sidewalk and crosswalk facilities for pedestrians in this city and their pedestrian level of service. As pedestrians are most vulnerable among road accidents victims, the study aims to highlight the need for providing better pedestrian facilities to save them from road accidents.

III. DATA FOR ANALYSIS

A. SIDEWALKS

There are nine parameters affecting the quality of service of a footpath facility out of which six are pertaining to the physical characteristics of the footpath facility, like footpath width, surface of footpath, obstacles, encroachment, potential of vehicular conflict and continuity of footpath. The three user factors are pedestrian volume, security, comfort and environment.

Under this study, all nine parameters are studied in detail.

For example evaluation of footpath width at all the location has been shown in Table I along with a figure I which shows the adequacy of footpath width in percentage.

Table I. Footpath Width

Serial No.	Name of Road	Site of Study	Type of areas as per IRC:103	Min. width as per IRC:103(m)	Observed width (m)	Remarks
1	Railway station- Fraser Road	Near Buddha memorial park	Commercial/ Mixed use areas	2.5	1.53	Not OK
2	Gandhi Maidan	Near SBI zonal office	Shopping frontages	3.5-4.5	3.93	OK

3	Fraser Road- Hotel Maurya	Near Radio station	Bus Stop	3.0	3.02	OK
4	Income Tax Road- Exhibition Road	Near Indira Gandhi planetarium	Commercial/ Mixed use areas	2.5	1.33	Not OK
5	Boring Road- Income Tax Road	Mount Carmel Convent School	Bus Stop	3.0	2.38	Not OK
6	Sheikhpura- Bailey Road	Near zoo Gate no.1	Commercial/ Mixed use areas	2.5	2.93	OK
7	Boring Road- S.K. Road	Near Children's Park	Shopping Frontages	3.5-4.5	4.01	OK
8	Polytechnic – Kurzi Mod	Near P & M Mall	Shopping Frontages	3.5-4.5	1.37	Not OK
9	Patliputra- polytechnic Mod	Near Polytechnic college	Residential/ Mixed use areas	1.8	1.22	Not OK
10	Haz Bhawan- Phulwarisharif	Near Zoo Gate no.2	Residential/ Mixed use areas	1.8	1.57	Not Ok

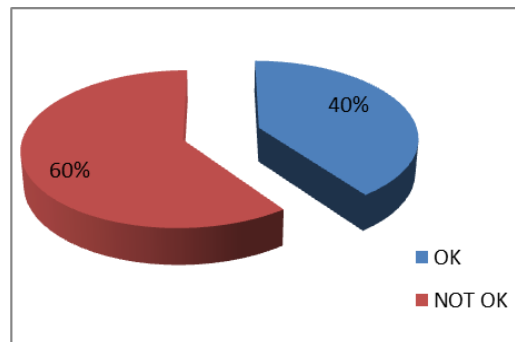


Figure I. Adequacy of footpath width

Similarly all the parameters mentioned in the IRC 103:2012 guidelines have been studied at all the locations and adequacy of the same have been determined and shown in the form of pie chart in Fig II to Fig IX.

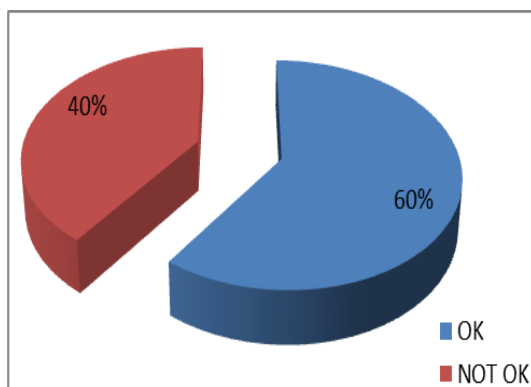


Figure II. Footpath surface

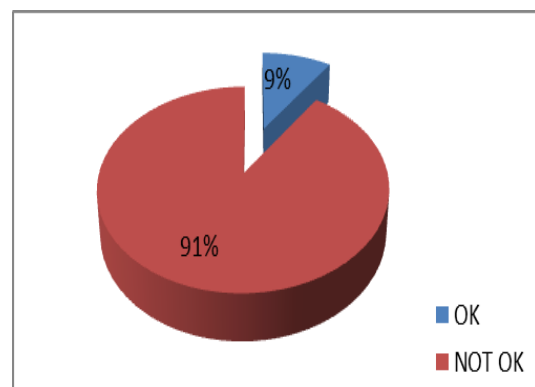


Figure III. Footpath obstructions

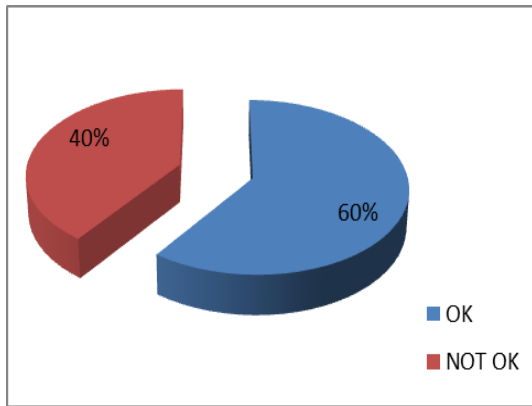


Figure IV. Footpath Encroachment

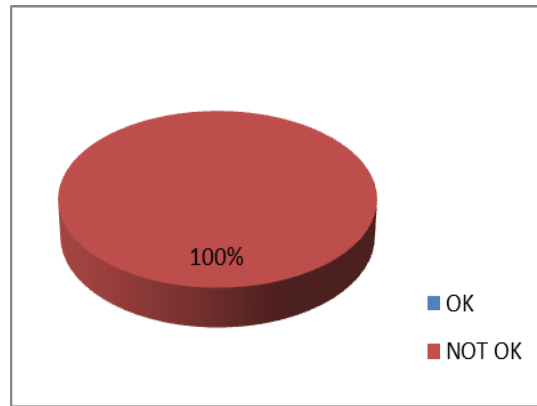


Figure V. Footpath continuity

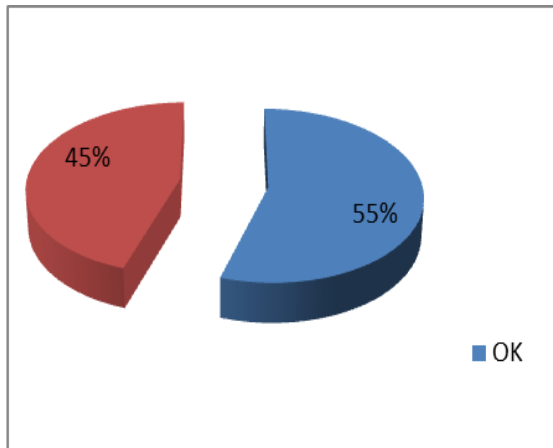


Figure VI. Footpath heights and guard rails

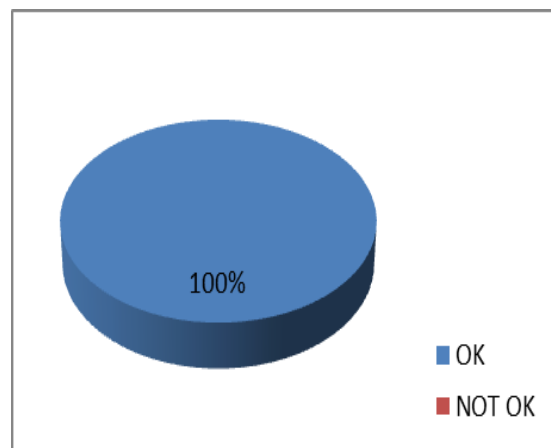


Figure VII. Safety and security features

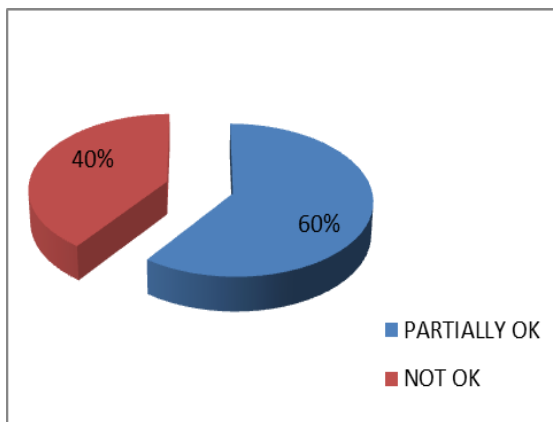


Figure VIII. Comfort of users

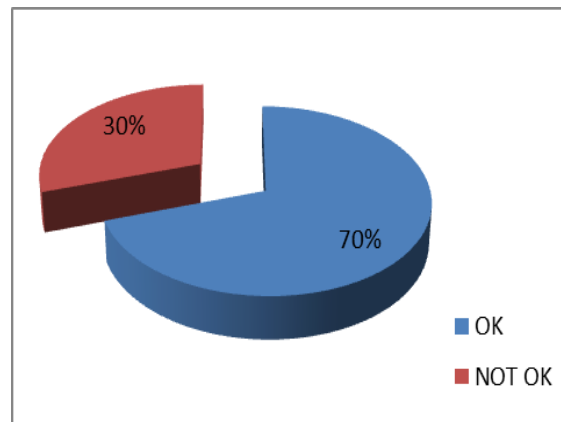


Figure IX Cleanliness of footpath/ surrounding

1. EVALUATION OF QUALITY AND SAFETY OF SIDEWALKS

Evaluation of sidewalks as per the guidelines has been done and mentioned in Table II and in the form of bar graph in Figure X.

Table II Evaluation of quality and safety assessment of sidewalks

City	Extent of fulfilment of requirements for pedestrian facilities (%)									
	Physical Characteristics						User			Average
PATNA	1	2	3	4	5	6	7	8	9	10
		40	60	91.3	60	0	55	100	60	70

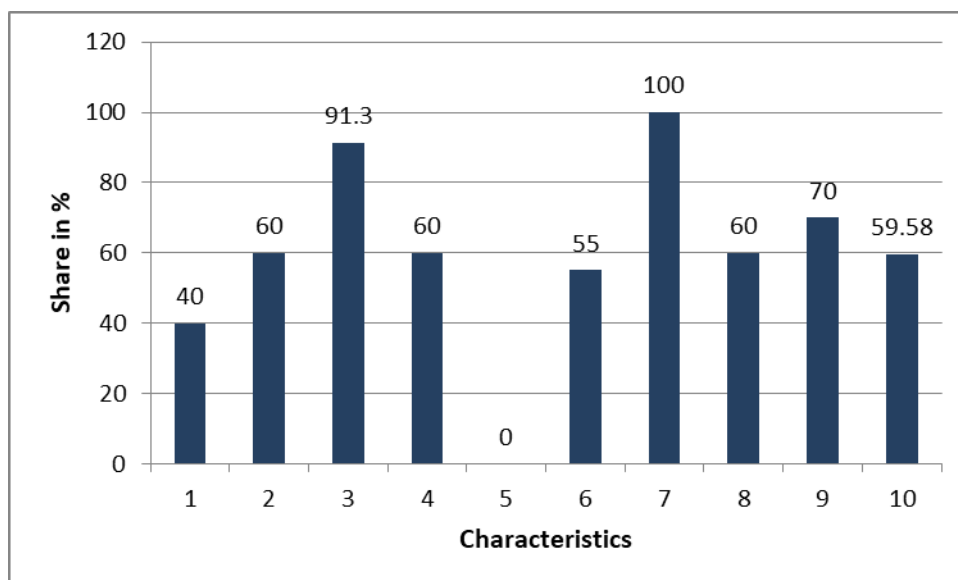


Figure X. Extent of fulfilment of requirements for pedestrian facilities (%)

- 1= Footpath width
- 2= Footpath surface
- 3= Footpath obstruction
- 4= Encroachment
- 5= Continuity
- 6= Potential of vehicle conflict
- 7= Safety and Security
- 8= Comfort
- 9= Walk environment
- 10= Average

B. PEDESTRIAN CROSSING

For the evaluation of pedestrian crossing a total of eight parameters were studied which affect the quality of service of a pedestrian crossing. They are Crosswalk Width, Signage and Marking, Continuity of Crosswalk, Refuge, Median Height, Dedicated time slots for crossing pedestrians, Facilities for Disabled and Visibility of crosswalk during night time.

Under this study, all the eight parameters are studied in detail at selected sites/locations.

For example adequacy of crosswalk width has been shown in Table III and the adequacy for the same is represented in the form of pie chart in figure XI

Table III. Crosswalk Width

Serial no.	Location	Minimum width as per IRC:103 (m)	Observation (m)	Remarks
1	Dakbunglaw	2 metre – 4 metre	3	OK
2	Fraser Road		3	OK
3	Income Tax Road		3	OK
4	Boring Road		3	OK
5	Rajbanshi Nagar		3	OK
6	Raja Bazar		3	OK

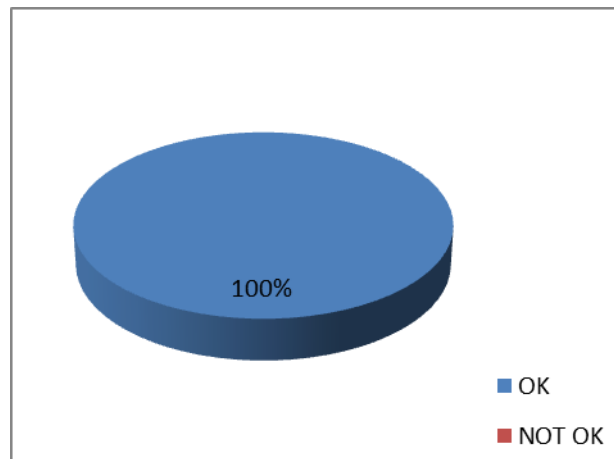


Figure XI Adequacy of crosswalk width

Similarly all the parameters mentioned in the IRC 103:2012 guidelines have been studied at all the locations and adequacy of the same have been determined and shown in the form of pie chart in Fig XII - XVIII.

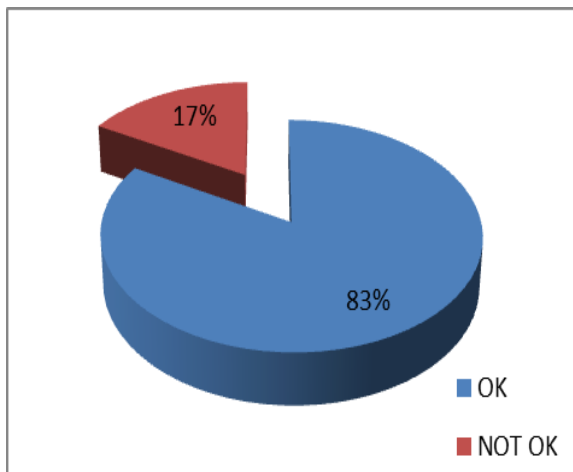


Figure XII. Signage and marking

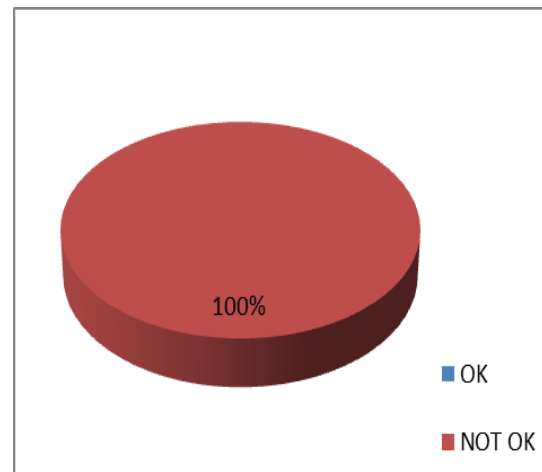


Figure XIII. Continuity of crosswalk

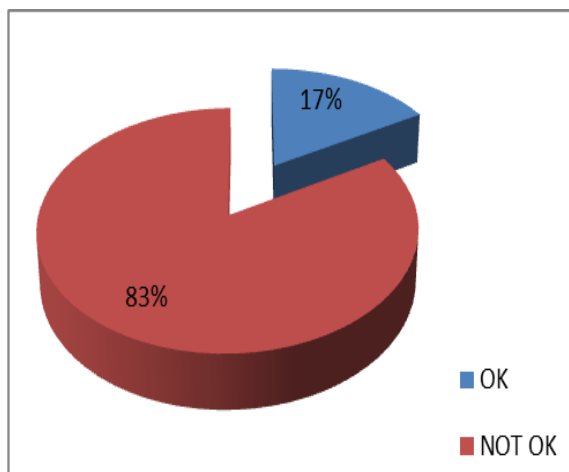


Figure XIV. Pedestrian Refuge

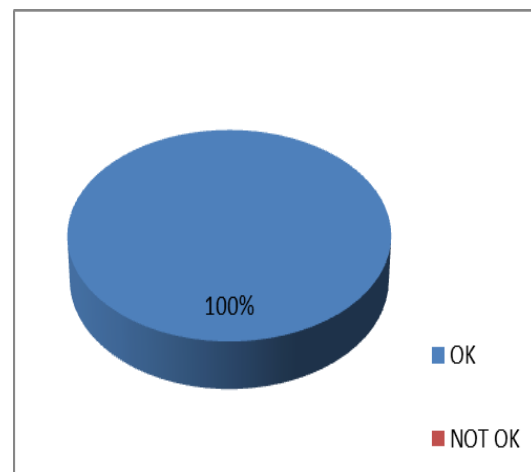


Figure XV. Median Height

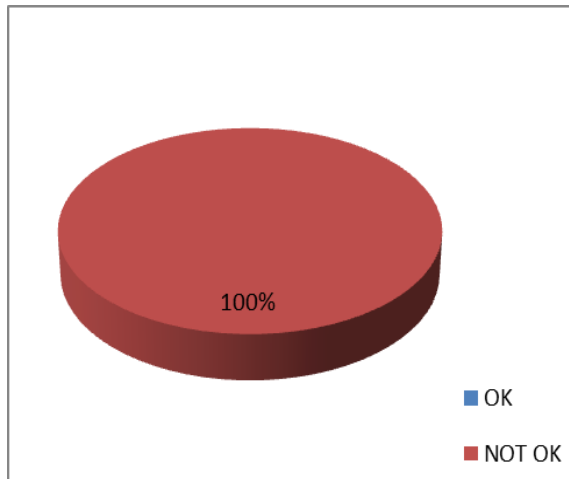


Figure XVI. Dedicated time slots for pedestrian to cross

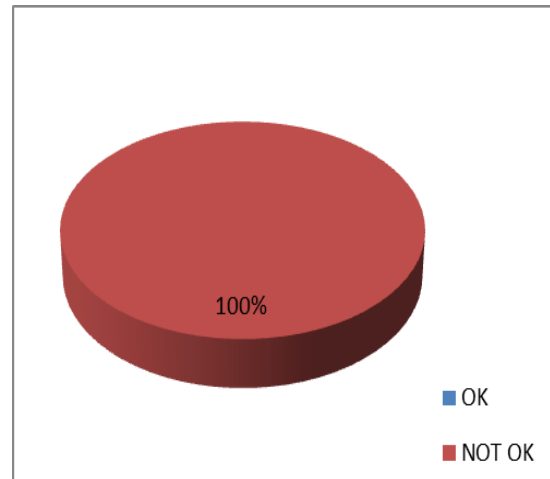


Figure XVII. Facilities for disabled pedestrians

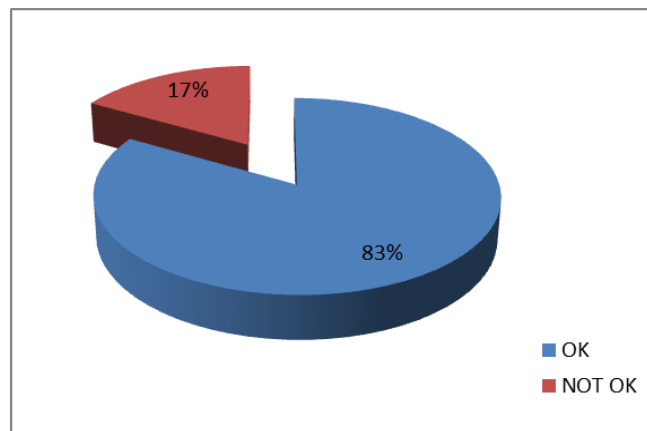


Figure XVIII. Night time visibility

1. EVALUATION OF QUALITY AND SAFETY OF CROSSWALK

Evaluation of crosswalks as per the guidelines has been done and mentioned in Table IV and in the form of bar graph in Figure XIX.

Table IV. Quality and safety assessment of Crosswalks

City	Extent of fulfilment of requirements for pedestrian facilities (%)								
	Characteristics								Average
PATNA	1	2	3	4	5	6	7	8	9
		100	83	0	17	100	0	0	83

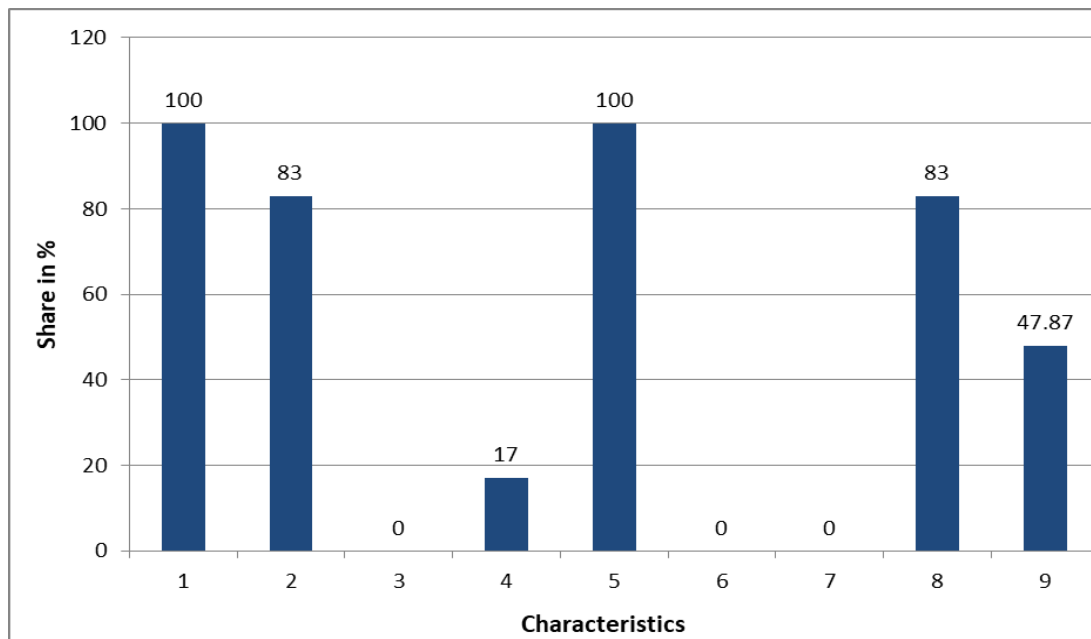


Figure XIX. Extent of fulfilment of requirements for pedestrian crossing (%)

- 1= Crosswalk width
- 2= Signage and Marking
- 3= Continuity of Crosswalk
- 4= Refuge
- 5= Median height
- 6= Safety
- 7= Facilities for disabled persons
- 8= Night time visibility
- 9 = Average

C. PEDESTRIAN LEVEL OF SERVICE

1. SIDEWALKS

Evaluation of Level of Service of sidewalk as per IRC: 103 are shown in Table V, and results of plos are mentioned in Table VI.

Table V. Guidelines for Pedestrian LOS as per IRC 103:2012

LOS	CHARACTERISTICS	
	Pedestrian space (m ² /p)	Flow rate (p/min/m)
A	>4.9	≤12
B	3.3-4.9	12-15
C	1.9-3.3	15-21
D	1.3-1.9	21-27
E	0.6-1.3	27-45
F	≤0.6	Varies

Table VI. Pedestrian Level of Service at Selected Sites

Serial No.	Name of Road	Flow rate (p/min/m)	LOS
1	Railway station- Fraser Road	13.85	B
2	Gandhi Maidan	6.71	A
3	Fraser Road- Hotel Maurya	5.76	A
4	Income Tax Road- Exhibition Road	15.48	C
5	Boring Road-Income Tax Road	23.86	D
6	Sheikhpura- Bailey Road	10.98	A
7	Boring Road- S.K. Road	5.83	A
8	Polytechnic – Kurzi Mod	21.6	D
9	Patliputra – polytechnic Mod	19.5	C
10	Haz Bhawan- Phulwarisharif	7.77	A

2. CROSSWALKS

Pedestrian delay is the key parameter for Level of Service assessment at signalised intersections. Highway capacity manual (HCM 2010), the most referred manual estimates pedestrian delay on the basis of signal cycle length and red phase duration.

The model for calculation of pedestrian delay is given by equation 1.

$$D_p = \frac{(C - W_{walk, min})^2}{2C} \quad \text{equation-1.}$$

Where, D_p - average pedestrian delay (s)

C - Cycle Length (s)

$G_{walk, min}$ – effective time for phase serving the minor street thorough movement.

Average pedestrian delay has been calculated at all the locations using above equation. The data regarding signal timing at various intersections were recorded and is presented in Table VII.

Table VII. Average pedestrian delay at various intersections

S.No.	Location	Cycle Length (s)	$G_{walk, min}$ (s)	Average pedestrian delay (s)
1	Dakbunglaw	242	190	5.58
2	Fraser Road	210	149	8.86
3	Income Tax Road	186	119	12.06
4	Boring Road	226	156	10.84
5	Rajbanshi Nagar	148	84	13.83
6	Raja Bazar	238	183	6.35

Table VIII shows pedestrian level of service criteria based on pedestrian delay presented by IRC: 103-2012

Table VIII. Pedestrian Level of Service at Road Crossing

Level of Service	Waiting Time in seconds
A	≤ 3
B	4 – 13
C	14 – 38
D	39 – 64
E	65 – 90
F	≥ 90

Based on the data collected and further processing it using equation- 1 to find average pedestrian delay, Level of Service was found at various locations and is presented in Table IX.

Table IX. Level of Service at selected Sites

S.No.	Location	Average pedestrian delay (s)	Level of Service
1	Dakbunglaw	5.58	B
2	Fraser Road	8.86	B
3	Income Tax Road	12.06	B
4	Boring Road	10.84	B
5	Rajbanshi Nagar	13.83	C
6	Raja Bazar	6.35	B

IV. CONCLUSIONS

A. SIDEWALKS

1. The adequacy of footpath width in Patna is found to be 40%, which is very less. The reason could be initially due to bad planning and not giving due credit to pedestrian safety.
2. 40% of the footpath surface in Patna are not as per directions given in IRC. This is mainly due to improper maintenance by the authorities in charge.
3. Only about 9% of footpath were found to be hindered with obstructions and 40% of the footpath were encroached.
4. Continuity of the footpath in the Patna was totally absent.
5. About 45% of the footpath did not have adequate footpath height and guard rails which protect them from vehicular traffic and as far as comfort is concerned 40% were not as per norms.
6. Safety and security for pedestrians was 100%. Cleanliness of footpath were found to be satisfactory and around 70% of the footpath were found to be clean and with proper clean surrounding.
7. Overall 59.58% of the footpaths in Patna were found to be as per IRC 103:2012 norms.
8. As far as Level of Service is concerned there was huge variation in it. While some sidewalks have Level of Service of 'A' while some were found to be at 'D'. Five sidewalks were found to be having Level of Service of 'A', while two sidewalks have PLOS of 'D'.

B. PEDESTRIAN CROSSING

1. The adequacy of crosswalk width was found to be 100%. All the crosswalks under study were having appropriate width as per IRC norms.
2. In respect of Signage and Marking 83% of the crosswalks were found to be adequate, while only 17% of the crosswalks in the city were having proper pedestrian refuge. Median height was found to be appropriate at all the sites.
3. Continuity characteristics of crosswalks (ramps to crosswalk from adjacent sidewalks) and dedicated time slots for pedestrian to cross the road were found to be totally absent.
4. All the pedestrian crossing in the city under study is devoid of facilities for disabled. Facilities for wheelchair to pass, push buttons and flashing beacons for blind people were not augmented in the design.
5. As far as Night time Visibility is concerned 83% of the crosswalks were well illuminated by the street lights which to safety for pedestrians and avoid accidents during night time. One site is found to have improper lightning facilities.
6. Level of Service was found to be 'B' at five sites which shows that delay faced by the pedestrian is very less and is considered good as far as Level of Service is concerned. One site was found to be having Level of Service of 'C'

V. REFERENCES

1. *Highway Capacity Manual (2010)*, Special Report No. 209, Washington, D, C; Transportation Research Board.
2. <http://en.wikipedia.org/wiki/Pedestrian>
3. IRC: 103-2012, "Guidelines For Pedestrian Facilities", Indian Roads Congress, New Delhi.