SAFETY AUDIT OF ROADS FOR PEDESTRIANS

By Dr. Nishi Mittal Head, Traffic Engineering & Safety Central Road Research Institute, New Delhi nishisafe@gmail.com

Indian Scenario

≻ More than 1,27,000 persons die on Indian roads annually (which was 95,000 in 2005) India has now dubious distinction of having highest fatalities amongst countries in transitions ≻India accounts for 10% of world road deaths



Indian Scenario

- ➢ It loses around 3% of its GDP on road traffic accidents.
- Majority of the accident victims fall in the age group 15-39 year (around 50-65 %) followed by 40-59 years (around 20 to 30 %)
- Road safety is now a public health issue and needs immediate attention



Percent Share of Persons Killed in Road Accidents by type of Motor Vehicle (Primarily Responsible) during 2009



belliX ercore to erad Share of Persons Killed in Road Accidents by Type of Road User Category during 2009



Road Accidents and Road To notication of Roads



Nost Productive Age-Group Persons are Killed in Road Accidents (2009)



Highway Development Programme and Road Safety in India

- Massive development and improvement of road network.
- > Highway network upgraded to 4/6 lane roads
- Provided golden chance for highway engineers and planners to plan and build road safety features
- However, initial experience indicates, it is not so



Impact of Up-gradation and widening of Highways

- Highway Development increased mobility for high speed traffic.
- But made life more miserable for VRU's as they were not experienced to cope with such road environment
- No adequate pedestrian footways provided or proposed.
- Required underpasses or pedestrian crossings not provided.





Road Safety Audit Studies carried-out by CRRI

- Road Safety Audit of Engineering
 Design for Construction Packages on NH-2, 900 km (15 packages)
- Road Safety Audit of Mumbai-Pune Expressway (2004)
- Road Safety Audit of Indore-Dewas bypass (2001)
- Road Safety Audit of Noida Toll Bridge (2003)
- Road Safety Audit of Delhi-Gurgaon Expressway (2006)
- Road Safety Audit of NHAI sponsored
 12 packages at Design and
 Construction Stages 1200 km (ongoing)





Road Safety Audit Studies

- Road Safety Audit of ODR's and MDR's in Punjab, 408 km (ongoing)
- Road Safety Audit of
 Mumbra Bypass on NH-4 (2009)
- Road Safety Audit on NH-4 and NH-7 (2005)





Research Studies for Vulnerable Road Users

•Safety Issues in Non – Motorized Transport in India (1999)

•Design Norms and Standards for Pedestrian Safety in India : Theory and Practice (2001)

•Non-Transport Usage of Limited Pedestrian Facilities (2001)

•Adequacy of Signal Timing for pedestrians (2011)

•Pedestrian Safety Practices in India (2001)







Research Studies for Vulnerable Road Users

•Safety Issues in Training Needs of Non-Motorized Drivers (2002)

•Mobility and Accessibility Problems of The Transport Disabled (2004)

•Pedestrian Facilities in and Around Metro Stations in Delhi (2009)

•Impact of Motorists not sharing the Road with Pedestrian (2010)







RSA Studies for Pedestrian

- In India pedestrian fatalities constitute around 40-50% of the total fatalities
- In India the pedestrians face quite unsafe situations.
- Some of the RSA studies for pedestrians are presented



Design Stage Audits for Pedestrians

Non provision of Service Road

•Non provision of service road at start of project road can promote lawless movement in hazardous manner because of built up areas.





Recommendations

•Provide service road for safe management of traffic in built up areas from Zeerakpur intersection to start point of project road.

Location of Bus bays too close to Intersections

•It overlaps and conflicts with the Intersection influence area.





Recommendations

•Provide bus bays away from Intersections influence area preferably after the Intersections.

Location of access from service road too close to Intersections



Recommendations

•Provide access away from Intersections influence area .

Pedestrian crossing Facilities at Intersections

•Stop line and Pedestrian Zebra crossing not provided properly

•Pedestrian desire line of crossing across the approach roads is not followed appropriately and is not integrated with stop line and zebra crossing markings etc. leading to a situation where pedestrians will try to cross at unauthorized places and put themselves to risk.



Recommendations

• Straight movement along the slip roads can be integrated with that along the main road and extra conflicts may be avoided. Proper pedestrian management / circulation plan with signal phasing be provided.

Facilities for Pedestrians and NMT across Project- Road

• Proposed PUP at km 58.704 is narrow (1x1.6x2.5) and steep as it will be also used by NMT and 2wheelers.



Recommendations

•Provide wider facility with proper slope to accommodate the expected crossing traffic

Facilities for Pedestrians and NMT across Project- Road

Non Provision of Pedestrians
 Facility at km 60.100 at Bitna
 High School across Project
 Highway.







Recommendations

 Pedestrian Under Pass may be Provided as the Project Road is at embankments.

Wrong Signage for "School Ahead"

A school sign is provided at location 54+900 has been shown. It is shown only in direction towards Parwanoo but not in the reverse direction.



<u>Recommendation:</u> Signs for school ahead should be provided on both directions. Also there should be advisory speed limits and "Go Slow" plate advising motorists to slow down while approaching school area.

ADEQUACY OF TRAFFIC SIGNAL TIMINGS FOR PEDESTRIANS AT INTERSECTIONS



Sites Selected

- Ashram Intersection
- Sarai Kalekhan Intersection
- Burari Intersection
- Dhaulakuan Intersection
- Shastri Park Intersection

Accidents at Burari Intersection

S.No	Year	Persons	Persons	Total No of
		Killed	Injured	Accidents
1.	2008	18	18	36
2.	2009	13	14	27

- Pedestrians formed 56% of the total victims.
- 37 % of the total accidents occurred between the time slot 22:00 hrs to 01:00 hrs, and 11% of the total accidents occurred between the time slot 01:00 hrs-05:00 hrs and 8 % of the total accidents occurred between the time slot 18:00 hrs-20:00 hrs.

Classified Volume Count Survey at Burari



Two wheelers formed around 47% followed by Small Cars 14%, Auto rickshaws around 6%, Big Car around 15%. Light commercial vehicles 12%, bus around 4%, Heavy vehicles like Trucks around 2%.

Pedestrian Volume Count Survey at Burari

Pedestrian volumes along Sidewalks

Direction	Pedestrian hourly Volume (P)		
ISBT to Model			
Town	98		
Model Town to			
Karnal	14		
Karnal to Buradi	166		
Buradi to ISBT	176		

Pedestrian hourly volume is maximum (176) from Buradi to ISBT followed by from Karnal to Buradi (166).

Pedestrian Volume Count Survey at Burari

Pedestrian volumes across approaches and PV² values Sidewalks

Approa ch	Directio n	Hourly Traffic Volume (V)	Pedestria n hourly Volume (P)	PV² Index Values
ICDT	UP	3012	626	2.47 x
1301	Down	3270	020	10 ¹⁰
Modal Town	UP	1022	04	5.16 x
	Down	1428	60	8 ¹⁰
Karnal	UP	3182	106	7.75 x
Ramai	Down	3108	170	9 ¹⁰
	UP	2054		1.86 x
Buradi	Down	1464	150	9 ¹⁰

• At all the four approach roads PV² index values are more than threshold value (2 X 10⁸)

Pedestrian Volume Count Survey at Burari

Pedestrian Signal timings and wastages due to violation

Approach	Direction	Time available for Pedestrian Crossings (Sec)	Time Wasted due to traffic violation (sec)	Effective Time available for crossing (sec)	Width of road to Cross (m)	Required Pedestrian walking speed (Kmph)
ISBT	UP	90	10	80	37.8	1.701
	Down					
Modal Town	UP	70	13	57	25.2	1.59
	Down					
Karnal	UP	25	13	12	39	<u>11.70</u>
	Down					
Buradi	UP	65	12	53	33.9	2.30
	Down					

The walking speeds required on some approaches are as high as 11.7 Kmph. These speeds are difficult even for the able bodied young people not to speak of the handicapped persons, old age people, woman and Children.

Recommendations at Burari

- The pedestrian speed required on Karnal approach as high as 11.7 Kmph. This speed cannot be achieved even by any healthy person. Hence, it is recommended to provide pedestrian signal for 45 sec to keep the normal speed below 3.5 kmph.
- Considering providing zebra markings wherever absent and maintain at worn out places.
- There is absence of sidewalks partly on some approaches and the width is also not as per standards. Hence, it is recommended to provide pedestrian friendly sidewalks.
- All the four left turns at the intersection are free left turns and pedestrians have to cross at their own risk. In order to avoid this, it is recommended to provide signalised left turn in co-ordination with other movements.

Signal Time wasted at different intersections due to violations

Name of Intersection	Name of Approach	Time Wasted due to Traffic Violations (%)	Free Left Turns Provided	Remarks
	South Ex	12.5	Yes	
Achrom	Bhogal	5.9	Yes	
Ashram	Kale khan	11.1	Yes	
	Apollo	5.7	Yes	
	ISBT	11.1	Yes	
Dunani	Modal Town	18.6	Yes	
Burari	Karnal	52	No	
	Burari	18.5	No	
	Gurgaon (Airport)	48.8	Yes	Extreme Two lanes
Dhaula Kuan	Dhaula Kuan (AIIMS)	17.5	Yes	
	Delhi Cant			
	(Janakpuri)	0	No	
	ISBT	6.8	No	
Chestri Derl	Khajuri	13.2	No	
Snastri Park	Shastri Park	10.5	No	
	Shadara	63	No	

Pedestrian opinion survey

Frequency of Road Crossing





Percentage Difficulty of Road Crossing

Pedestrian opinion survey

TypesofConflictsPedestriansFacedwhileRoadCrossing

Visibility of Traffic Signals while Road Crossing







Pedestrian openion survey

Feelings of Anxiety & Physical Pain while Road Crossing



Problems faced by the pedestrians while Road Crossing



Pedestrian opinion survey

Causes of Conflict





Preferred Time for Road Crossing

Pedestrian opinion survey

Perception of Beggars related to Hazards

Safety while road crossing




Pedestrian opinion survey

Causes of Vulnerability of Pedestrians



Conclusions

- **PV²** index values are more than 2 X 10⁸ at most of the intersections which is a standard value decided to provide grade separated facility and indicates the requirement of grade separated pedestrian facilities. However, grade separated facilities are not provided in the above selected intersections.
- In spite of the absence of grade separated facilities provided at these locations and heavy pedestrian and vehicle volume observed at no arm of any junction studied, pedestrian phase signal is provided to cater to the needs of the pedestrians.

Conclusions (Contd....)

- At these junctions in the absence of grade separated facilities and exclusive pedestrian phase signal, pedestrians cross when there is red signal for the vehicles. It was observed that 8-40% allotted time is washed due to traffic violations i.e. motorists especially two-wheeler riders and cyclists do not stop even when it is red light. So effective time left for pedestrians to cross is not sufficient.
- At many locations required walking speed to cross was as high as 11 km. Per hour which is impossible even for the able bodied pedestrians not to speak of the elderly, women and disabled population.

Conclusions (Contd....)

• At many locations, free left turns and U-turns are provided and so the pedestrians do not find any exclusive and safe time and are forced to cross in between the moving traffic. This makes the crossing activity very hazardous for the pedestrians especially to elderly, women and disabled pedestrians.

Survey of Pedestrian Crossing Facilities in Delhi by CRRI (2007)

- CRRI carried out following surveys in year 2007 at 5 four-arm intersections and six Tintersections and 150-200 metre approach roads to these intersections
- Physical and environmental parameters of pedestrian facilities
- Opinion survey of pedestrians
- Opinion survey of motorists
- Observed behaviour of pedestrians and motorists

Pedestrian Facilities Available

 Zebra crossing was available only at 38% surveyed Four-arm intersections and 45% T-Intersections.

 Pedestrian signal was available only at 5% surveyed four arm intersections at and 2% Tintersections

Available Pedestrian Facilities

- At 30% surveyed four arm intersections and 40% T-intersections, encroachment was there
- Only at 10% four arm intersections and 21% T-intersections, pedestrian Refuge Islands were available.
- So very few pedestrian crossing facilities are available.

Availability and Width of side walks

Intersection Type	Side Walk Availability (%age)	Side Walk width (%age)			
		< 0.9m	0.9 to 1.8m	1.8 to 2.7m	> 2.7m
Four-Arms	86	11	22	39	28
T-Intersections	67	8	33	42	17

Side Walk Height

Intersection Type	Side Walk Height (%age)					
	< 15 cm	15 - 22.5 cm	22.5 - 30 cm	30 - 37.5 cm	> 37.5 cm	
1.Four Arm Intersection	0	28	28	33	11	
2.T-Intersections	0	17	8	17	58	

Problem Faced by Pedestrians



Environmental Aspects of Footpaths



- On 20% surveyed four arm intersections and 64%Tintersections, potholes were observed.
- 25% surveyed four arm intersections were not found comfortable to walk upon.
- 15% surveyed four arm intersections were observed to be aesthetically displeasing

Results of the Survey

- At 38% four-arm intersections and 83% surveyed T-intersections, Pedestrian Refuge Islands were not available.
- Road Signs Markings and Signals were not adequately provided.

Opinion of Pedestrians

- Two third surveyed pedestrians said that it is unsafe to cross the road
- Around 65% pedestrians were of the view that allotted time given to cross is inadequate.
- 76% pedestrians felt that beggars and sellers create problem at intersections.

Opinion of Pedestrians

- Around 75% interviewed pedestrians were of the view that condition of footpaths at intersections is not proper.
- > 73% people felt that the width of footpaths is inadequate
- > 77% were of the view that height is more
- > 64% felt that walking on footpaths is not comfortable.

Opinion of Pedestrians

90% pedestrians felt that the situation has become more unsafe during last 5 years because of complex intersections (65%) width of footpath has been reduced (70%) speed of vehicles has increased (60%).

Gender-wise Opinion of Pedestrians

- More females (76%) felt that allotted time for crossing is inadequate – Males 51%
- 82% females felt that beggars create problems at intersections (82%)versus males (67%)
- More males take risk to cross the road (36%) in comparison to 15% females.
- 64% females thought footpath height more in comparison of 34% males.

View Point of Elderly Pedestrians

- People of older age group (45-60 years) stated more difficulty in crossing the roads (70%) in comparison to 49% for 15-30 years age group.
- Older people stated that they wait for red light to cross the road (68%) in comparison to 45% younger people.
- Older people asked for more time to cross 68% in comparison to 45% younger people

Opinion of Motorists

- Motorists felt that pedestrians create problems when on green light they just raise their hands and cross the road. (50%) jump the railing to cross the road (50%).
- 90% motorists felt that pedestrians should also be challan ed for violating traffic rules
- 60% drivers felt that pedestrians are not visible during night.

Reasons for Pedestrian Unsafe Situations

- The most important reason for pedestrian unsafe situations is apathy towards pedestrians.
- In our transport plans, the highest priority is accorded to uninterrupted flow of motor vehicles.
- The most important element of our transport plans – pedestrian has disappeared.

IN RURAL AND SEMI-URBAN AREAS, IT IS MOSTLY NON-MOTORISEDTRANSPORT ROAD USERS (60%-65% ROAD TRAFFIC FATALITIES)



Lack of rural footways forcing pedestrians to walk on the carriageway in India

Provision For NMT vehicles

CHARACTERISTICS OF NMT FATALITIES ON NATIONAL HIGHWAYS

- Severity
- Туре
- Temporal
- Vehicles Involved
- Location
- Age of Victims
- Socio-Economic Background

•Severity

72% pedestrian accidents were fatal,

24% grievous injury and only

6% were minor injury accidents(Reason : High Speed)

•Type

35% were side swipe

23% head on,

11% rear end and

8% were right angled (Reason : Narrow & Undivided carriage way – Lack of Pedestrian Facilities)

•Temporal

Evening Hours From 4 P.M. To 8 P.M. 29% (Reason Heavy Pedestrian Flows, Lighting And Conspicuity)

Vehicles Involved

Trucks 33%, Buses 20%, (Heavy Vehicles 53%),

Car/Jeep/Van 18% (Reason : Heavy Volume & High Speeds)

Location

Junctions 28%, Inhabitated 23%

Bus-Stands 15%, Two Third at these locations

(Reason : More pedestrians with lack of pedestrian facilities)

Age of victims

more productive age group people are involved in road traffic accidents (reason : more exposure)

Socio-Economic background

C

Labourers are the most accident prone in areas.	rural
More females as they perform more walking trips	
Elderly, disabled, women, children, etc. lare to walk on present day footways	don't



Provision For NMT vehicles

FACILITIES PROVIDED TO NMT ROAD USERS ON NH2

Till now provision of facilities for non motorized vehicles seems to be a residual and not the prime consideration

In situations of space constraints, compromise is always made by cutting pedestrian facilities and not by reducing the carriageway

WALKWAYS

For footways, only width is mentioned and that too not varying according to pedestrian flows.

This proposed width is the minimum of just 1.5 m for any footway (as per IRC guidelines), sometimes even below this – just 1.0 m

Contd.

64

Contd.

Pedestrian footways are suggested on drainage facilities which will raise the height of footways thus making them non-usable for elderly, women and the infirm

Footways on drainage will have other safety implications also as drain cover next to a well used carriageway or service road is likely to be broken within weeks by truck parking

SERVICE ROADS

At many locations width of service roads provided is inadequate (3.5m)

Service roads in the absence of adequate parking facilities will be blocked by parked vehicles

Adequate lighting at built up areas is not suggested

The width of the walkways has to be designed according to pedestrian flows

Contd.

Contd.

Nothing is mentioned about how the speeds would be reduced at critical locations like built up areas, at curves, educational institutes etc.

The bypasses/underpasses at required heavily built up areas like Handia, Baraut, Gopiganj etc. are not suggested thus may create more pedestrian – vehicular conflicts at high speed locations.

RECOMMENDATIONS SUGGESTED FOR PROVISION OF NON-MOTORIZED VEHICLES

WALKWAYS

Reconsider the cross-section to ensure an adequate provision of footways specifically in the built up areas.

The walkways height, surface, type, continuity are to be specified.

Construct drains in urban areas at critical pedestrian locations by using buried pipes and manholes and thus allowing concrete or paved footways to be installed

SERVICE ROADS

Provide Width of the Service Roads According to Pedestrian and Non-Motorised Traffic Flows

Provide Adequate Parking Spaces to Avoid Parking on Service Roads and Shoulders

Ensure Service Roads Remain Service Roads

Traffic Calming Techniques are to be suggested at Built-up Areas



Provide Crossing Facilities At Bus Stops

Provide pedestrian refuge Islands of minimum 1.8 width as well as pedestrian friendly

At bus intersections, include a pedestrian only phase

BUS BAYS

Ensure that all required bus bays are constructed, not just those shown on drawings

Show bus bay lengths, depths, tapers and footway widths as minimum dimensions

Add a note stating bus bays and footpath areas need to be increased at busy locations depending on available space

Effects of Apathy Towards Pedestrians

- Because of public apathy towards pedestrians, the type of roads constructed now-a-days do not fulfill the needs of pedestrians
- Inadequate pedestrian facilities
- Inadequate and uncomfortable footpaths
- Inadequate Light
- Inadequate Road crossing facilities
Problems Faced by Pedestrians





Lack of rural footways forcing pedestrians to walk on the carriageway in India





contd...

Problems Faced by Pedestrians

- Problem in crossing wide and multi-lane roads
- High speed of vehicles
- Complex intersections
- Long waiting time at Intersections
- Less countermeasures for pedestrian safety
- Lack of continuous walking
- Adverse Road Design for Pedestrians

Adverse Road Design for Pedestrians



Reasons for Road Accidents at Intersections

 Improper Design of Intersections
Inadequate Traffic Engineering
Driver Education and Licensing
Drivers Disregard Traffic Control at Intersections.

Strategies for Making Safer Cross Walks

- Pedestrian Refuge Islands
- Curb Extensions (or bull-outs
- Median
- Zebra crossings
- Traffic Signal controlled pedestrian crossings
- Grade separated pedestrian crossings
- F.O.B. and subways

Thank You