

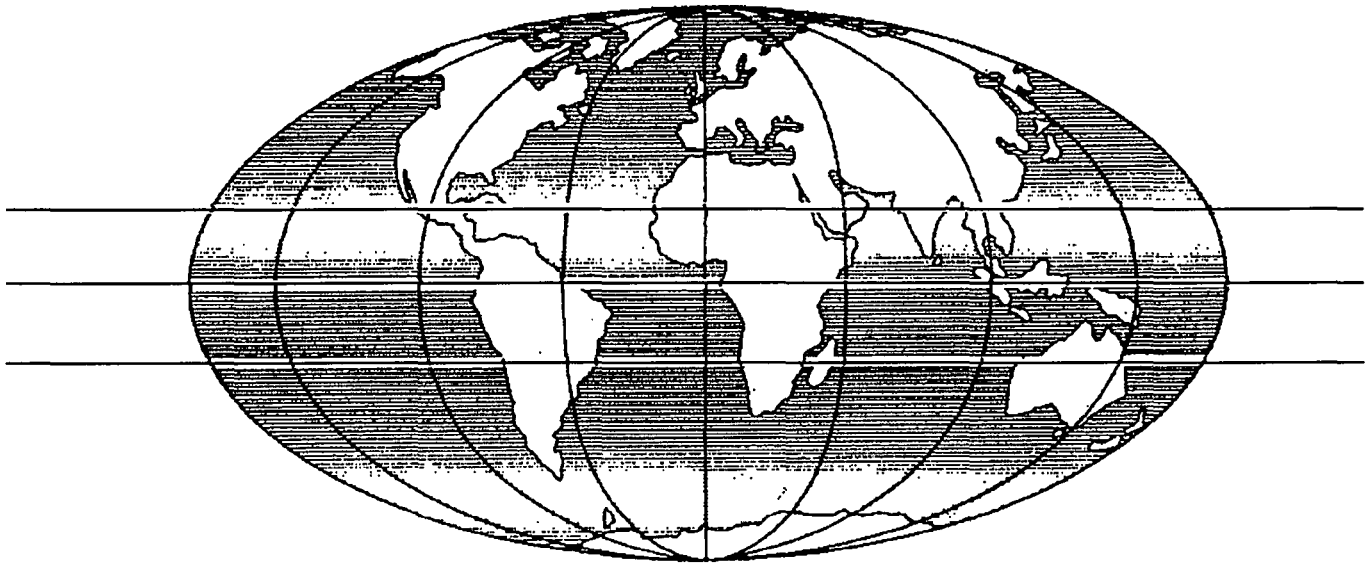


ODA

Reprint

TITLE Traffic calming: principles and applications

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INTRODUCTION TO TRAFFIC CALMING

Rajesh Patel, Geetam Tiwari and Dinesh Mohan

Illustration by: Shirshendu Ghosh

1994

**Centre for Biomedical Engineering
Indian Institute of Technology
New Delhi**

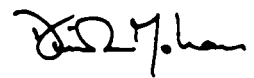
FOREWORD

Road designers and traffic planners have been confronted with the problem of managing traffic in urban areas for more than a century. They are faced with conflicting demands of ensuring efficient mobility, minimum fuel consumption, least pollution and maximum safety. No society around the world has been able to come up with all encompassing guidelines yet.

The western nations concentrated on improving mobility and speeds upto the 1970s. In the last twenty five years, the societal demand for safety and a clean environment has forced the planners to question their earlier assumptions about the so called "economic benefits" of higher speeds. Some studies also show that as road capacities are increased in urban areas, people change their travel patterns and congest the higher capacity roads. Some experts claim that it is actually foolish to plan for average speeds of more than 15-20 kph on city roads.

The current thinking is that roads in cities should be designed such that vehicles are not able to operate at maximum speeds greater than 40-50 kph. This makes traffic move with less acceleration and deceleration, while average speeds remain around 15-20 kph. This is called "traffic calming". Experience shows that when traffic calming principles are used in road design, accidents and pollution reduce and neighbourhoods become more livable.

In this booklet we are introducing some of these concepts. These have to be experimented with and new concepts evolved from experience in Indian roads. After some experience with these experiments we would be in a position to come up with a handbook on traffic calming principles for India.



DINESH MOHAN

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5. Acknowledgement

INTRODUCTION

Indian cities are characterised by heterogenous traffic (mix of nonmotorised and motorised modes) and mixed landuse patterns. In small and medium size cities, two-wheelers and slow moving vehicles (bicycles, rickshaws and animal carts) are the predominant modes of transport, with little or no organised intermediate public transport (IPT) and public transport. In larger cities, IPT and public transport modes play a very important role in addition to personal cars and two-wheelers.

Nonmotorised modes (NMT) (bicycles, pedestrians and other slow moving vehicles) constitute a significant share of the total traffic in Indian cities. Share of NMT at peak hour varies from 30-70%. The proportion of trips undertaken by bicycles ranges between 15 and 35 percent, the share tending to be higher in the medium size cities. Share of NMT does not necessarily reduce with growth in the city size; however role of NMT changes. Every motorised public transport trip involves access trip by NMT at each end. Thus NMT including walking continues to play a very important role in meeting the travel demand in Indian cities.

Mixed landuse (co-existence of commercial residential and institutional patterns) is another important characteristic of Indian urban areas. This is partly achieved by plan to contain the average trip length. Rising land prices is another major factor responsible for mixed landuse.

For instance, land prices in Delhi have been rising at a rate of 30-40% per annum. This has affected the landuse patterns as well as planned densities of many neighborhoods. Generally, single family dwelling units have been converted to multistoreyed flats and space has been rented/bought by commercial and institutional owners by out-bidding the residential occupants. Thus urban land market dynamics has also helped in promoting mixed landuse patterns in several neighborhoods.

Consequently, Indian urban neighborhoods are characterised by urban streets and spaces used for multiple purpose by heterogenous travel modes. The existing road designs are not able to meet the conflicting needs of various modes.

There is an urgent need to redesign our urban spaces. It requires reordering of transportation priorities. There is a need to safely accommodate pedestrians and cyclists on city streets without

Pedestrian injuries at impact speeds.

IMPACT SPEED kmph	DEATHS %	INJURED %	UNINJURED %
65	85	15	NIL
50	45	50	5
30	5	65	30

shunting them to inferior paths. It includes setting more exclusive space for public transport and giving pedestrians and bicyclists priority over cars at certain places. One of the major principles of such design is to make motorized traffic move with less variation in speeds. International research experience suggests that when maximum motorized vehicle speeds are kept below 30 kph the incidence of pedestrian and bicycle fatalities drops dramatically.

Such measures have been successfully implemented in several European cities. These are generally classified as Traffic Calming measures.

The vehicle characteristics and landuse patterns may be different and more complex in Indian urban areas as compared to European cities, however, the principle of traffic calming is equally relevant. An important pre-requisite for peaceful road sharing by pedestrians bicyclists and motorized traffic is the lowering of vehicle speeds.

Speed reducing features when well integrated in the street environment have been successful in turning the traffic zones into mixed-use and shared surface areas, to live, work and move. Such measures contribute to improvement in overall efficiency of all travel modes. Some of these measures have been illustrated in this booklet. These have been especially modified to suit the Indian traffic and landuse patterns.

Remember:

- o Most of us are pedestrians at one time or another, whether as shoppers, joggers, going to work, catching a bus, or simply to take some fresh air.
- o The chances of a pedestrian being killed when struck by a vehicle rises dramatically with an increase in impact speed.
- o Pedestrians' judgement of vehicle speeds deteriorate progressively as speed increases.
- o Children have a lesser ability than adults to assess speeds.
- o When maximum vehicle speeds are kept below 30 kmph the incidence of pedestrian and bicycle fatalities drops dramatically.

INTERNATIONAL RECOMMENDATIONS

Traffic Calming Through Integrated Urban Planning (H.G. Vahl, J.Giskes)

- * Residential areas should be made for people and not for vehicles. It would therefore be better to adapt cars to residential life instead of the other way around.
- * Street design should integrate traffic, urban living and road safety criteria. It should be self-enforcing and therefore results in calm, civilized and controlled driver behaviour.
- * Trucks and buses should be able to have access to and use redesigned open spaces, junctions, etc. But this invitation should not result in street widths letting cars play the leading part.
- * Traffic safety requirement can be included in municipal and state maintenance programmes, allowing for relatively economical modifications of street and roads.

Policies for Health Promoting Transport, U.K.

- * Most roads have several functions minor roads in residential areas have important functions such as providing space for play and social interaction, while their travel function is limited to providing access to properties.
- * On heavily trafficked roads, more account should be taken of the needs of pedestrians and cyclists. Examples include
 - pedestrian crossing facilities
 - pedestrianisation of shopping centres
 - cycle lanes
- * There should be area wide engineering measures to reduce traffic speeds and volumes and give pedestrians and cyclists priority over motor vehicles.

Long term policy for road safety, Ministry of Transport and Public Works, The Netherlands.

* It has been shown that the residential areas become much safer in terms of traffic accidents if vehicle speed is restricted to 30kph.

* Road safety is of major importance without the participant being consciously aware of it.

* The ultimate goal in road design is to prevent the road user from being able to make that final mistake in chain of events that leads to an accident.

Agenda for Safe Access in a Stable Environment (International Association of Traffic and Safety Sciences)

* Speeds on local roads can be reduced by modifying horizontal and vertical alignment, selective closure and repaving of roads.

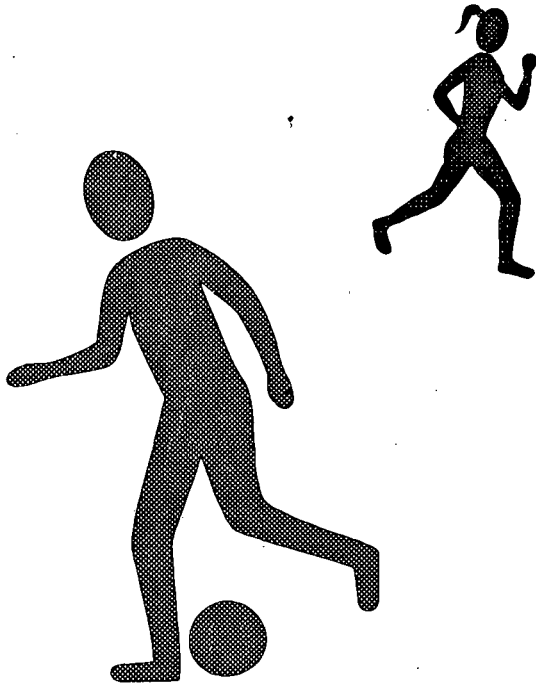
* Radical changes in road design are likely to be uncomfortable at least for some people in the short term. But they should be brought about because the alternative is to continue to put up with many and severe adverse effects of road traffic in its present form.

Towards Safer Roads in Developing Countries, A Guide for Planners and Engineers, T.R.L., UK.

* Excessive speeds and driver inattention are a common occurrence at accident blackspots. Countermeasures designed to alert drivers to the condition and to encourage or face them to reduce speed can be effective in such circumstances.

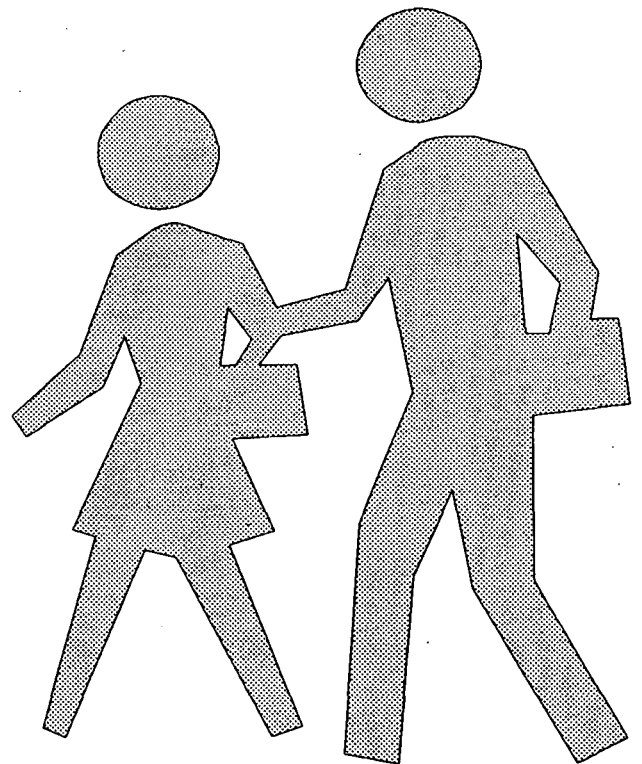
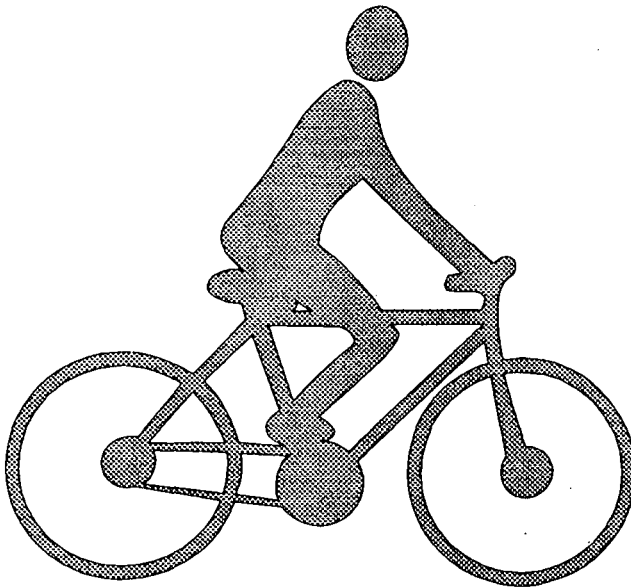
* Self enforcing devices, such as road humps are especially desirable in countries where enforcement is limited.

TRAFFIC CALMING MEASURES

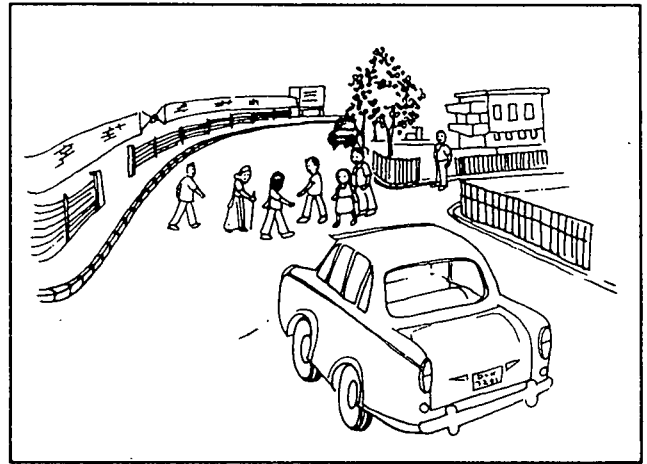
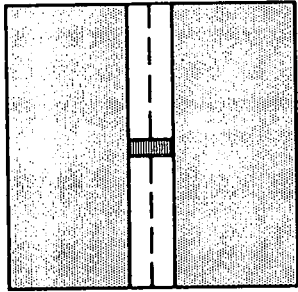


The following pages illustrate some of the traffic calming measures which can be experimented with in India. These designs have been adapted from many of the successful measures already adopted in Europe.

In India, the traffic mix is very different from that in Europe. We have a much larger number of bicyclists, rickshaws, human and animal pulled carts and motorized two-wheelers. Therefore, it is very important for us to experiment with these designs and then evolve new designs which suit our environment better.



Pedestrian Crossing at midblocks of undivided arterials:

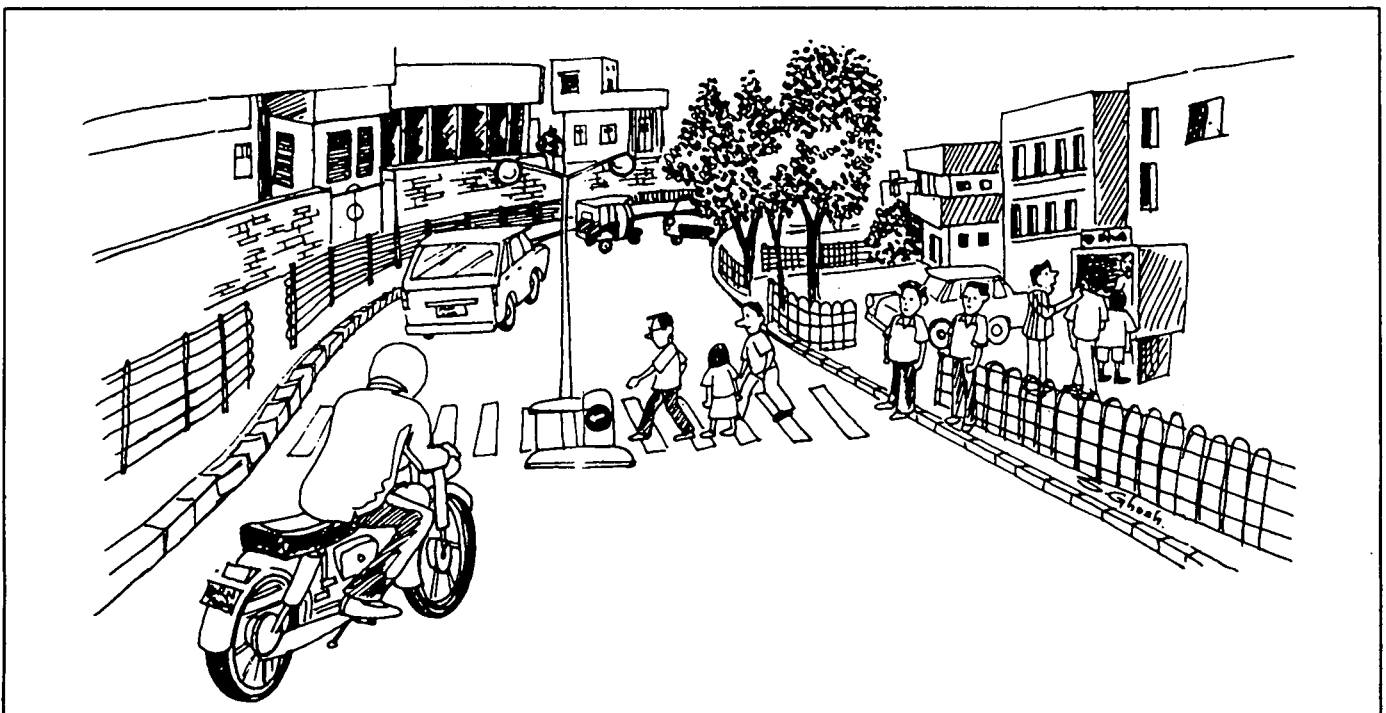


Problems:

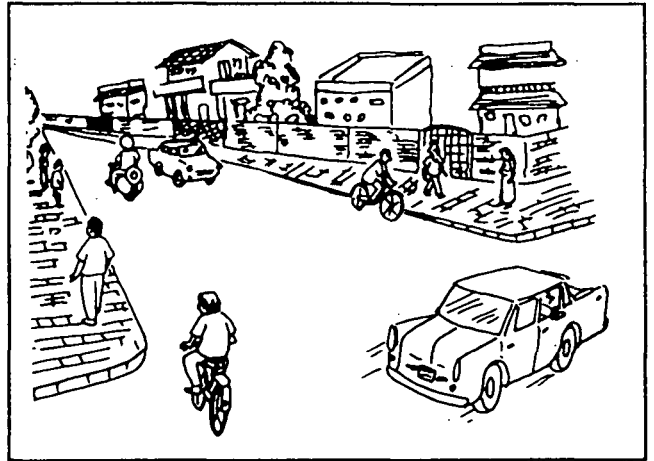
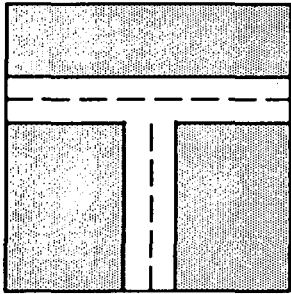
- o Pedestrians have to cross traffic coming from both directions.
- o Many times the gap between vehicles does not permit the crossing of the complete width of the road without stopping.

Solutions:

- o Pedestrian island provides safe waiting space in the middle of the road.



Pedestrian crossing at T-Junction:

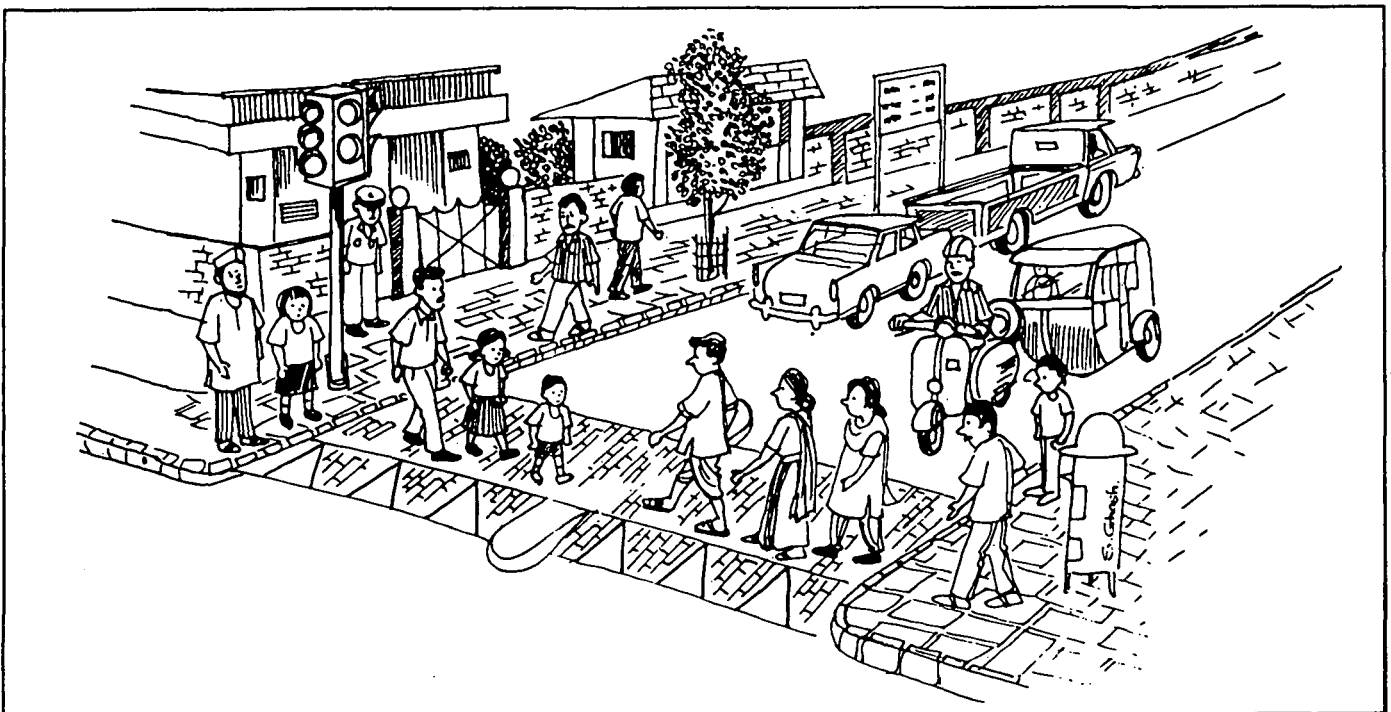


Problem:

- o Vehicles turning at high speed at T-junctions pose danger to pedestrians crossing the road.

Solution:

- o Raised pedestrian platform acts as a speed hump.
- o Divided channelizer controls traffic flow of incoming and outgoing vehicles and provides a safe waiting space in the middle for pedestrians.
- o Different colours and surface textures highlight the pedestrian crossing.



TRAFFIC CALMING MEASURES

The layout drawing shows how different traffic calming measures can be effectively used at suitable places in urban areas. The illustration has been adapted from Traffic Advisory unit leaflet 1/87, Department of Transport, U.K. and modified to suit Indian conditions.

This schematic drawing is not intended to mean that the full range of measures can necessarily be implemented in such close proximity.

ROAD HUMPS

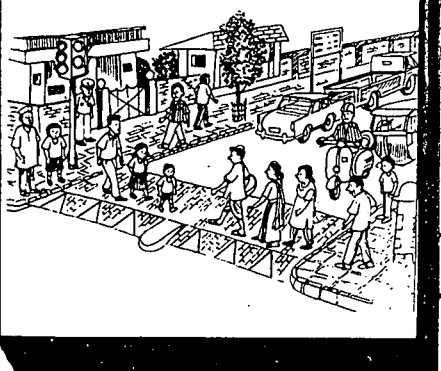
The new regulations (published in 1986) should make it easier to find suitable sites and use this technique more widely.

FOOTWAY WIDENING

This technique can be helpful in discouraging parking close to junctions, and make it easier and safer for pedestrians to cross.


ENTRY TREATMENT

This method, using granite setts or other textured surface treatments, may have fewer legal problems than treatment across junctions, but may also be less effective unless radii are made very tight. The aim is to provide an entry or "gateway" image, reducing speed by both physical and psychological means.



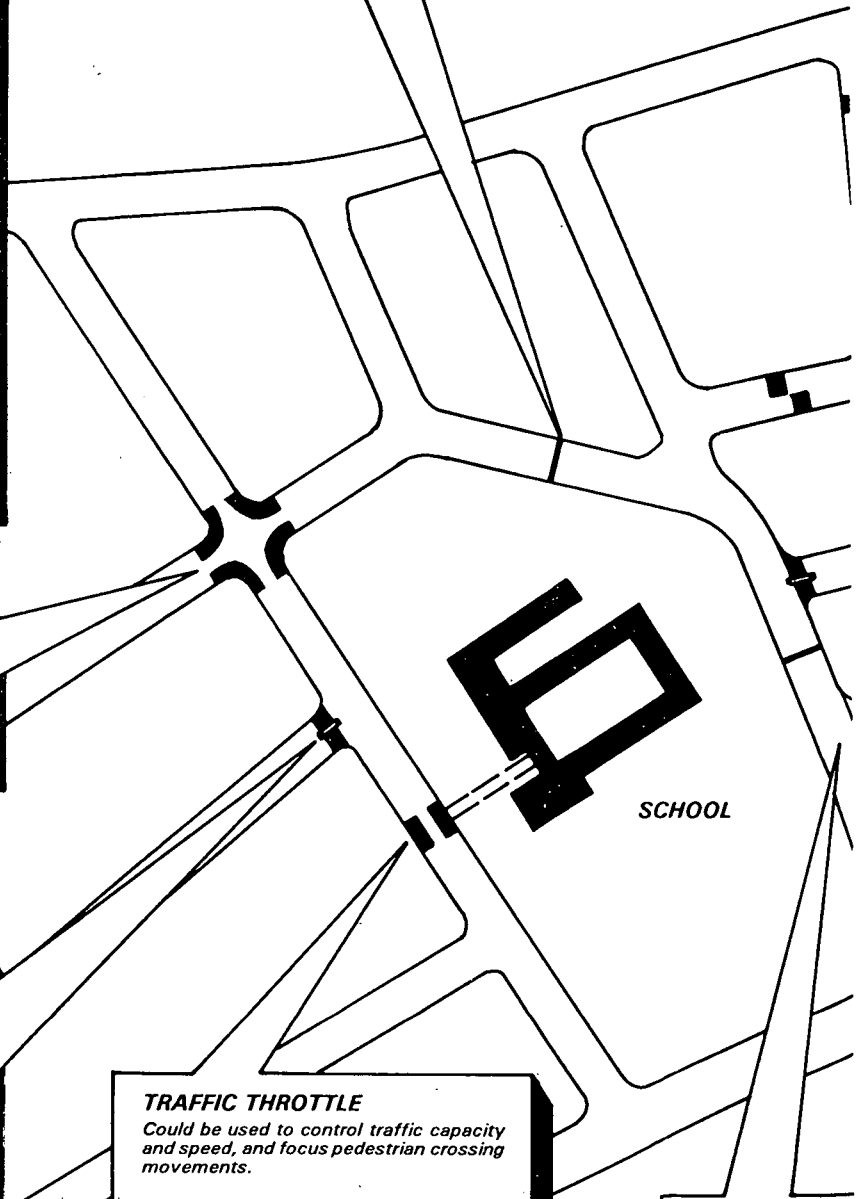
TRAFFIC THROTTLE

Could be used to control traffic capacity and speed, and focus pedestrian crossing movements.



TREATMENT AT JUNCTIONS

This can reduce vehicle speed, improve pedestrian crossing, experimental scheme, investigate different possible confusion, vehicular priority.

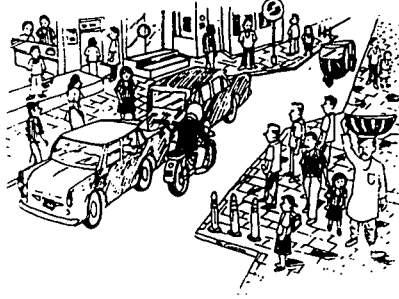


RUMBLE STRIPS

A line of granite setts at intervals, though not speed control devices in themselves, can act as a warning or reminder to drivers that they are in a residential street and should limit their speed.

CHICANES

Where full closure or speed humps are undesirable or impracticable, chicanes may offer a means of reducing traffic speeds or capacity. Many different layouts are possible, and the effect can even be produced by parking provision staggered on alternate sides of the roads.

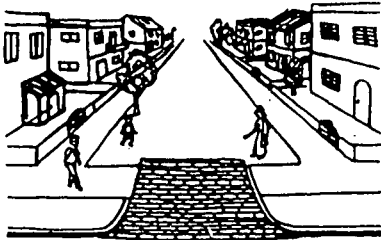


WIDTH RESTRICTIONS

These can be used to remove large vehicles. It should be remembered however that they can also be a barrier to fire tenders and emergency vehicles. Some designs permit use by such vehicles by means of lockable posts or ramped islands.

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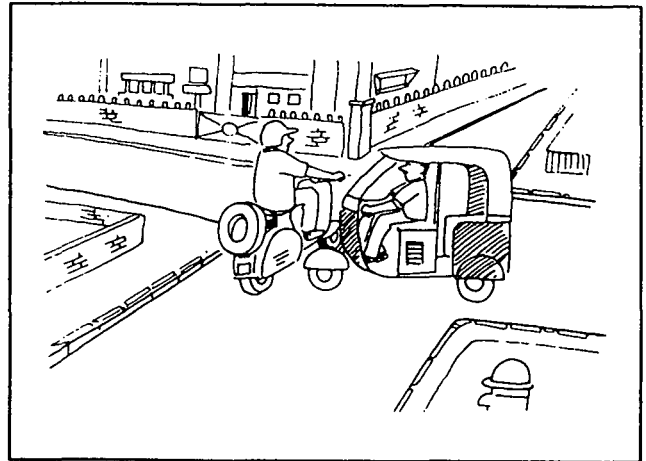
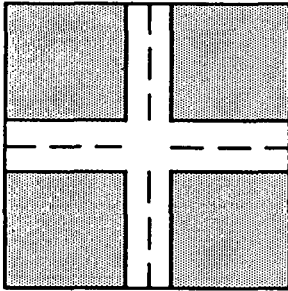
entry speeds and safety, but more are needed to methods and test for pedestrian and



ENVIRONMENTAL ROAD CLOSURES

Environmental road closures should always include cycle gaps, and wherever possible these should be designed to reduce the risk of obstruction by parked vehicles. Road closures should be used with care - they can cause turning and reversing problems, and like any measure which forces change in traffic patterns can sometimes re-distribute traffic to an unacceptable degree. It should also be borne in mind that thoughtless parking can block passable barriers intended for emergency vehicles.

Fourway uncontrolled junction:

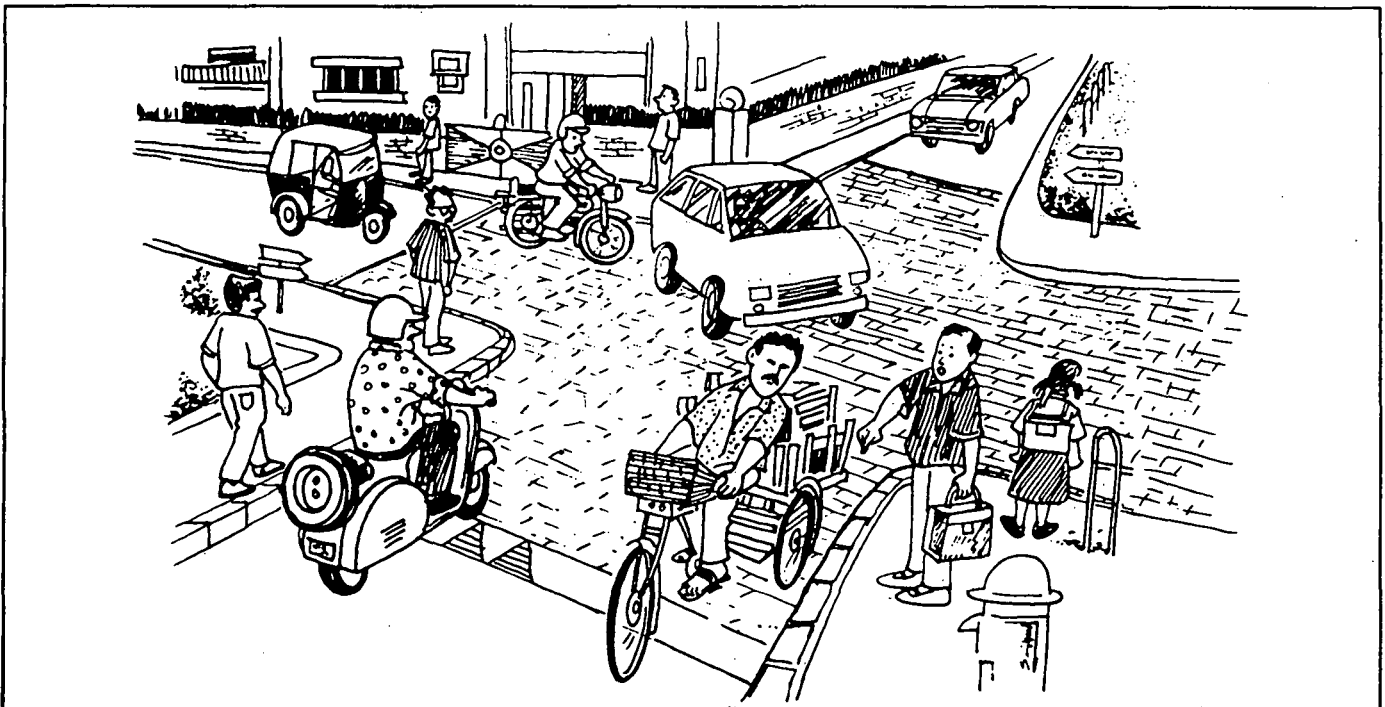


Problems:

- o Conflicts between speeding vehicles coming from different directions.
- o Conflicts between speeding vehicles and bicyclists and other slow moving vehicles.
- o Unsafe pedestrian crossing.

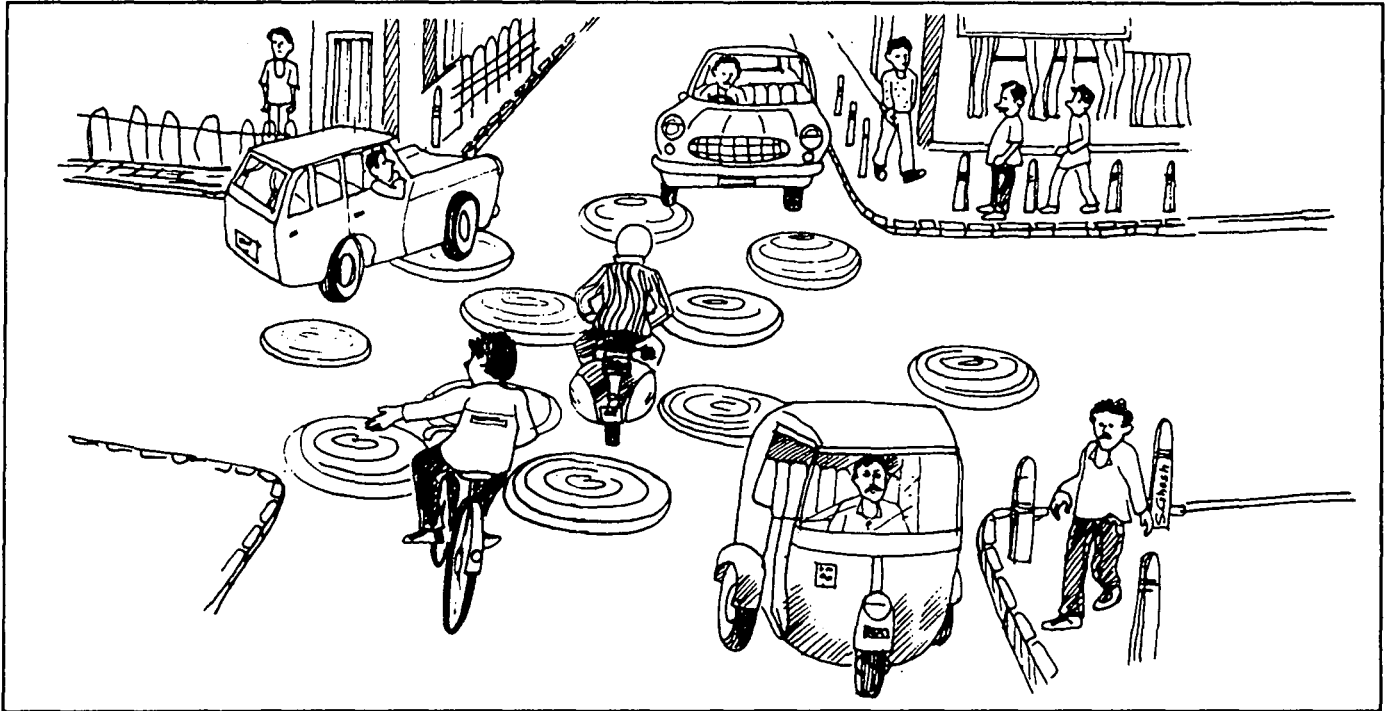
Solution A:

- o Raised platform with ramps (1:20) on all sides check vehicle speeds.
- o Different colour and texture enhances the visibility of the crossing.



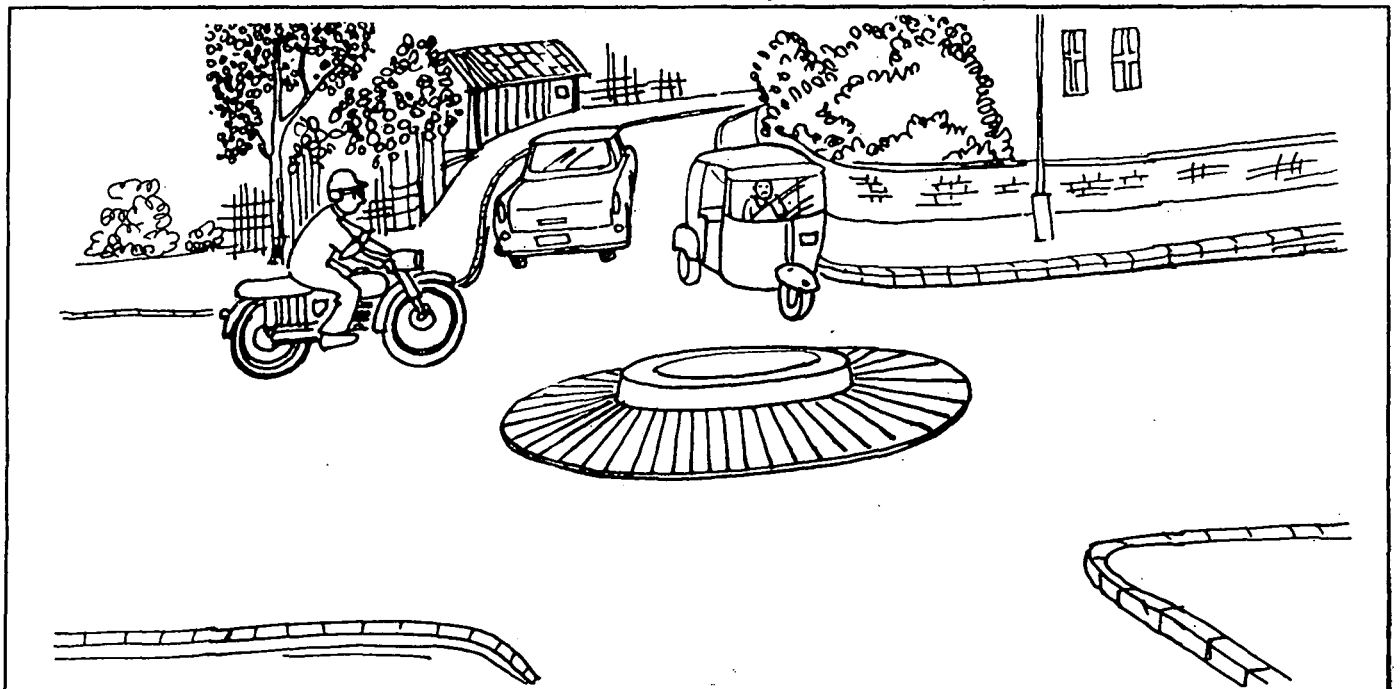
Solution B :

- o Several round humps (1 meter diameter and 50 mm high at the centre) placed at the crossing will force motorized vehicles including two wheelers to slow down. The gaps between them permits bicyclists to go without difficulty.
- o Different colour of the hump enhances visibility of the crossing and warns the motorized vehicles to slow down.

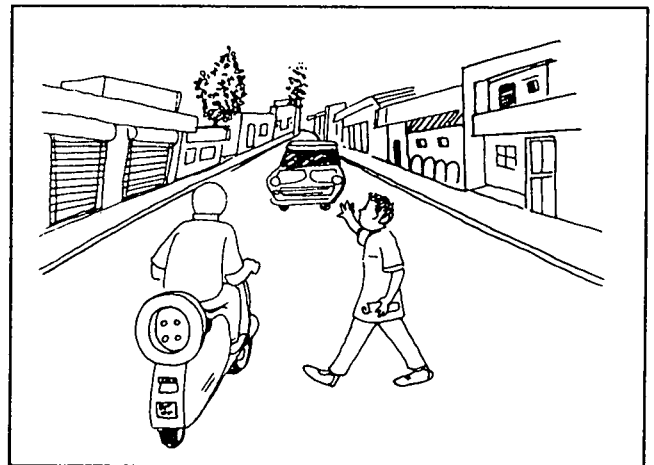
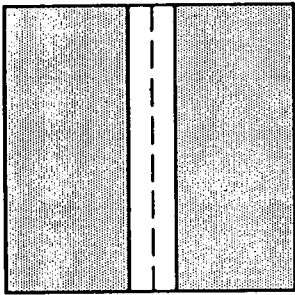


Solution C:

- o Overrun areas may be used on fourway uncontrolled junctions around small roundabout to deflect traffic away from a straight ahead and faster road. The overrun area around the roundabout will reduce some vehicle speeds of small motorized vehicles. At the same time it will allow larger vehicles to negotiate the junction without problems.



Traffic on Straight Roads :

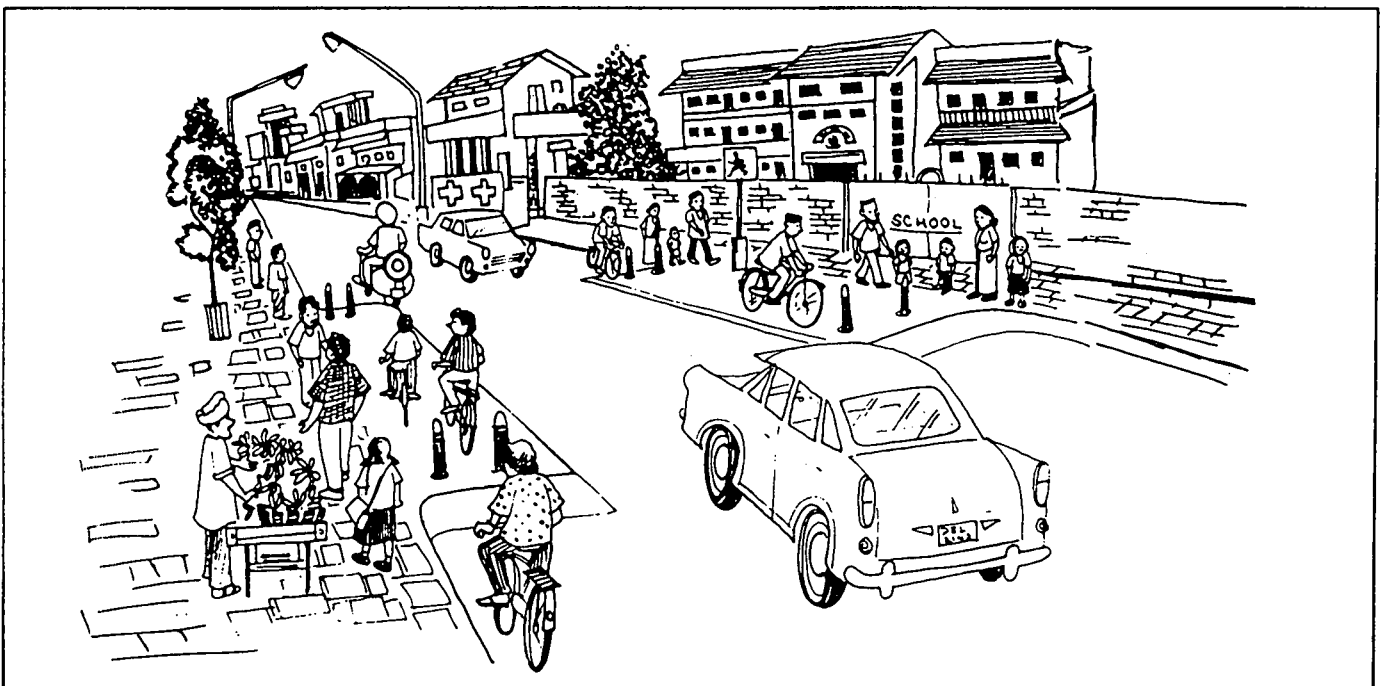


Problems :

- o Fast through traffic on straight roads poses danger for:
 1. Children playing on streets in residential areas.
 2. Heavy pedestrian traffic in commercial areas or markets.
 3. Children running across the street near school or playgrounds.

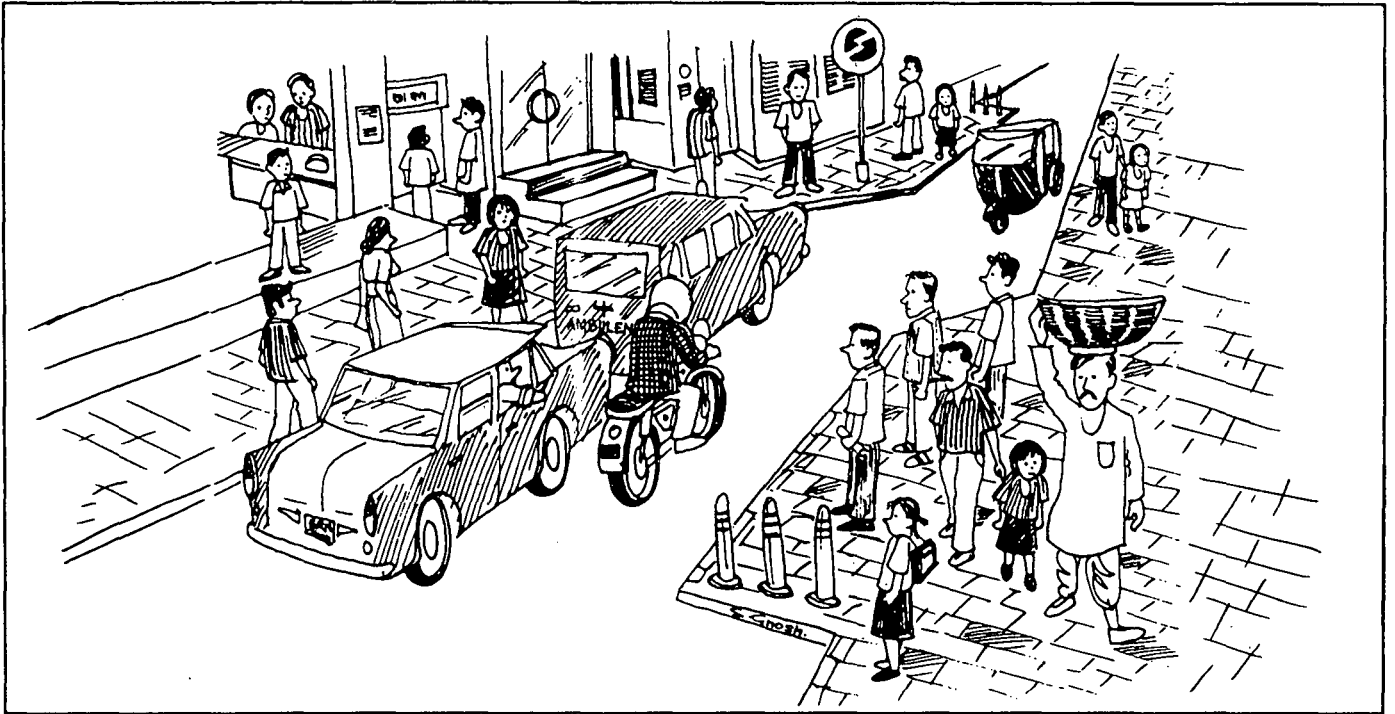
Solution A:

- o Two lane road is narrowed down to single lane for motorized vehicles by build outs on both sides of the road. This will reduce the speed of through vehicles and pedestrians will have
 - o to cross only single lane distance.
 - o Closely placed vertical posts will discourage motorized two wheelers to use the built up area, but they will allow bicyclists to pass through over built up area at slow speed.



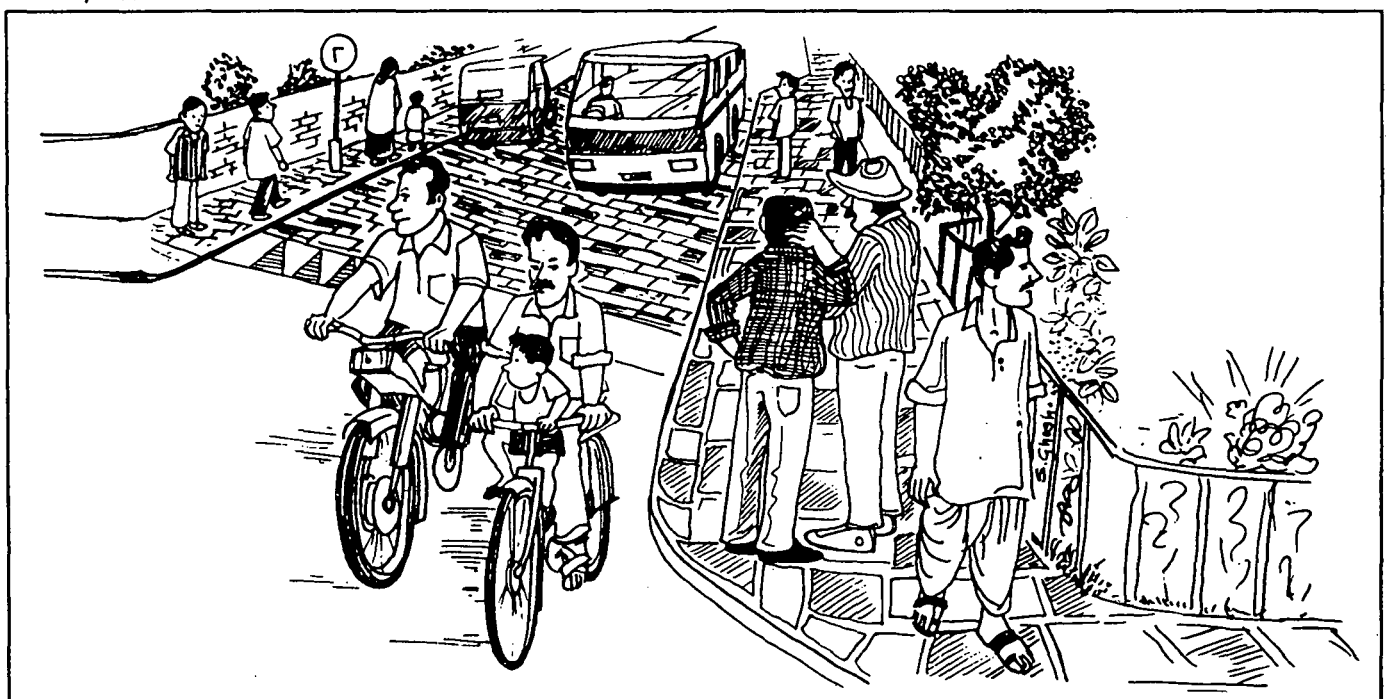
Solution B:

- o Two lane road is narrowed down by locating build outs alternately on each side of the carriageway. This will be effective in constraining vehicles speeds.



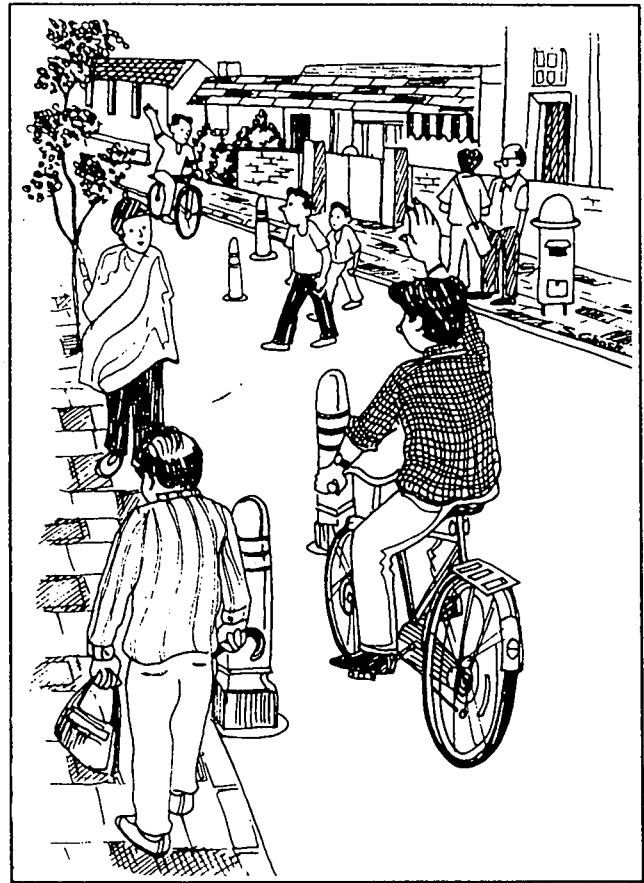
Solution C:

- o Raised platform with different texture surface will ensure a reduction in vehicle speeds. This may be used in midblocks as well where speed reduction is desirable.
- o Different colour of the platform area is recommended to improve its visibility.



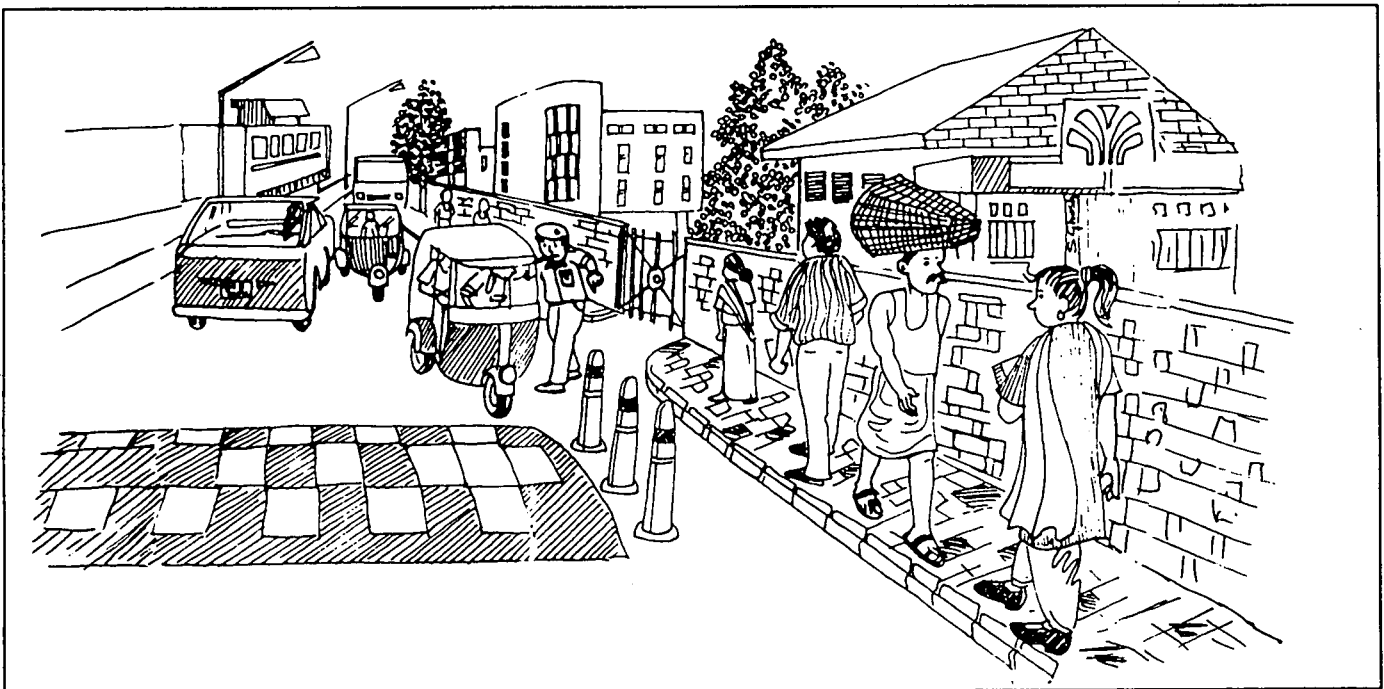
Solution D:

- o Narrow straight roads where it is not desirable to reduce the road width, vertical posts located on both sides of the roads can be used to control the speed of incoming and outgoing vehicles. Distance between two posts will permit bicyclists to pass through without any difficulties. Motorized two wheelers will not be able to pass through at high speeds.



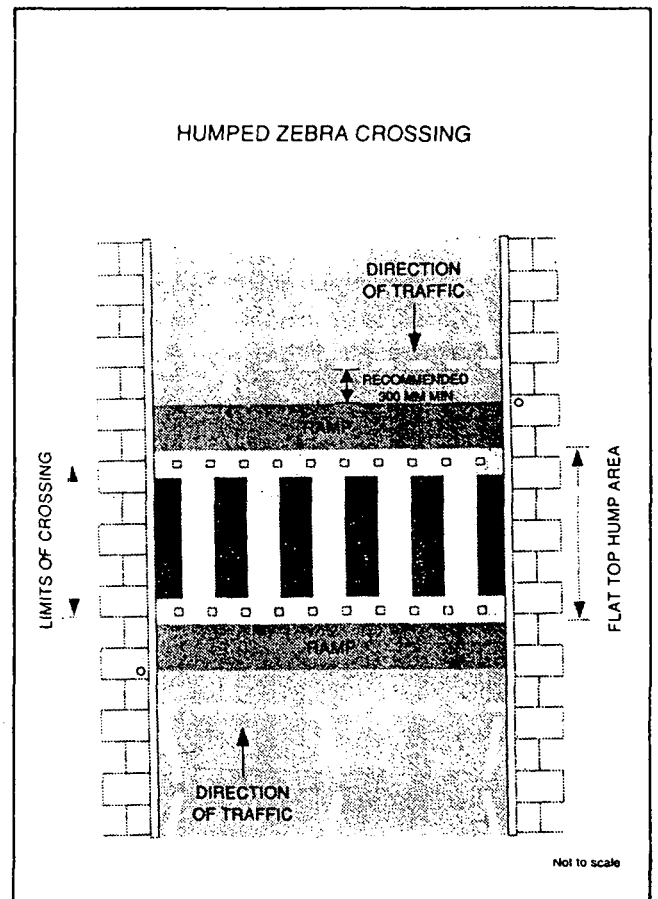
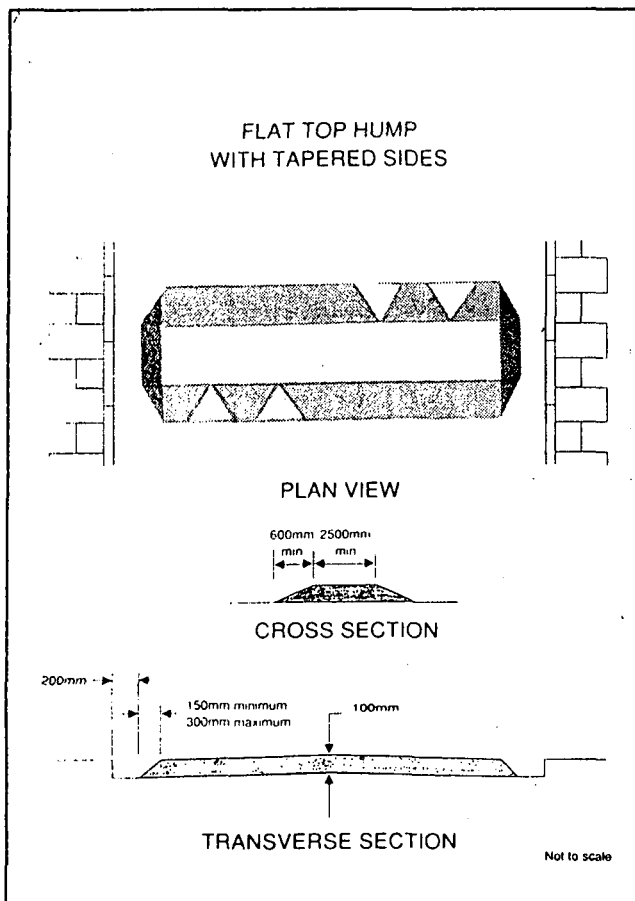
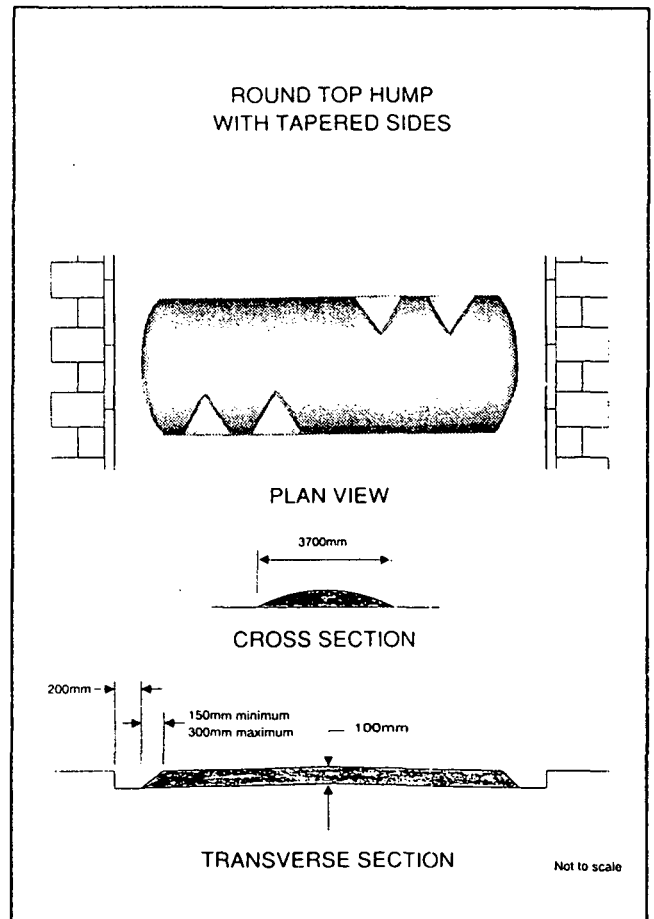
Solution E:

- o Raised hump with vertical posts on both sides will reduce the vehicle speed. Bicyclists will pass through the side gap without going over the hump.

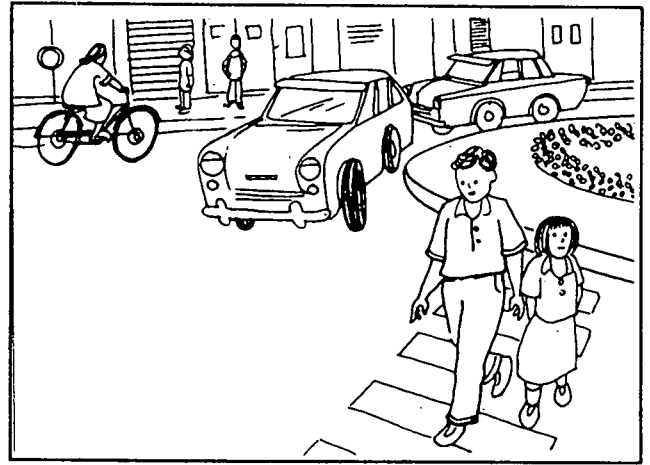
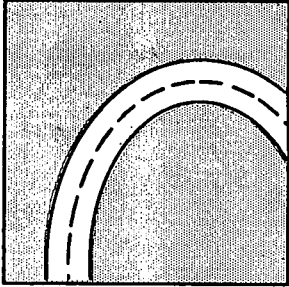


Recommended designs of road humps

Road humps are an extremely effective means of keeping vehicle speeds low. At low speeds, vehicles can cross these without causing undue discomfort to passengers, but as the speed increases, they become progressively more uncomfortable. Appropriate profiles and heights should be used according to local circumstances.



Traffic at road bends:



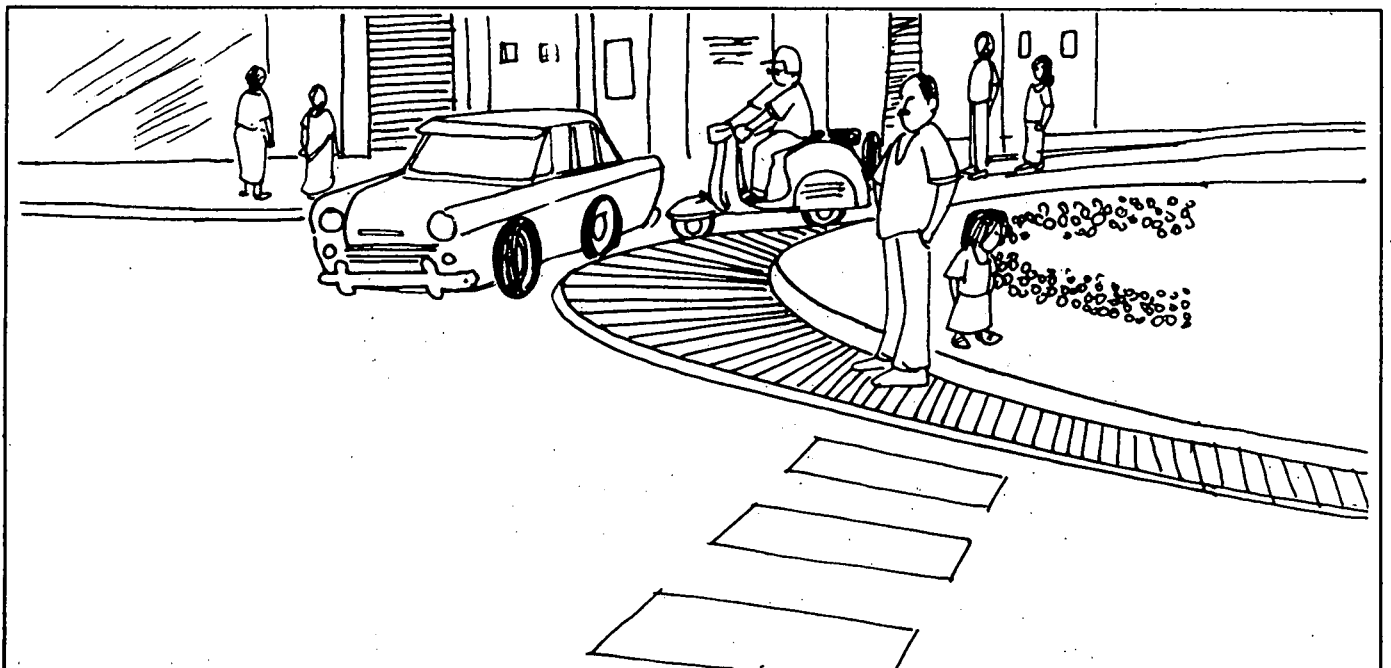
Problem:

- o Fast turning traffic at uncontrolled junctions creates unsafe conditions for non-motorized traffic and pedestrians in residential areas.

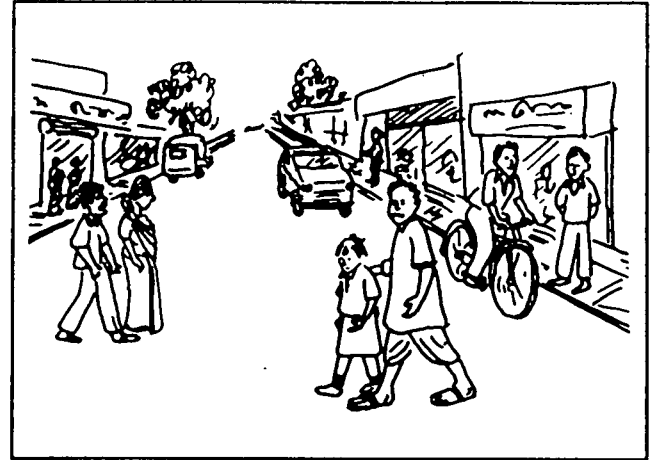
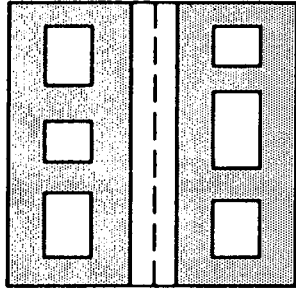
Solution:

- o Overrun area at road bends can be used to create optical illusion that the usable carriageway is narrower than it actually is. These areas when employed on bends

discourage motorized small vehicles to turn at higher speeds but still allow sufficient room for larger vehicles to negotiate them. Largest vehicles can move over these areas at lower speeds. Slope angle of the overrun area should not exceed 15° and surface should be of different texture and colour.



Main road passing through shopping area:



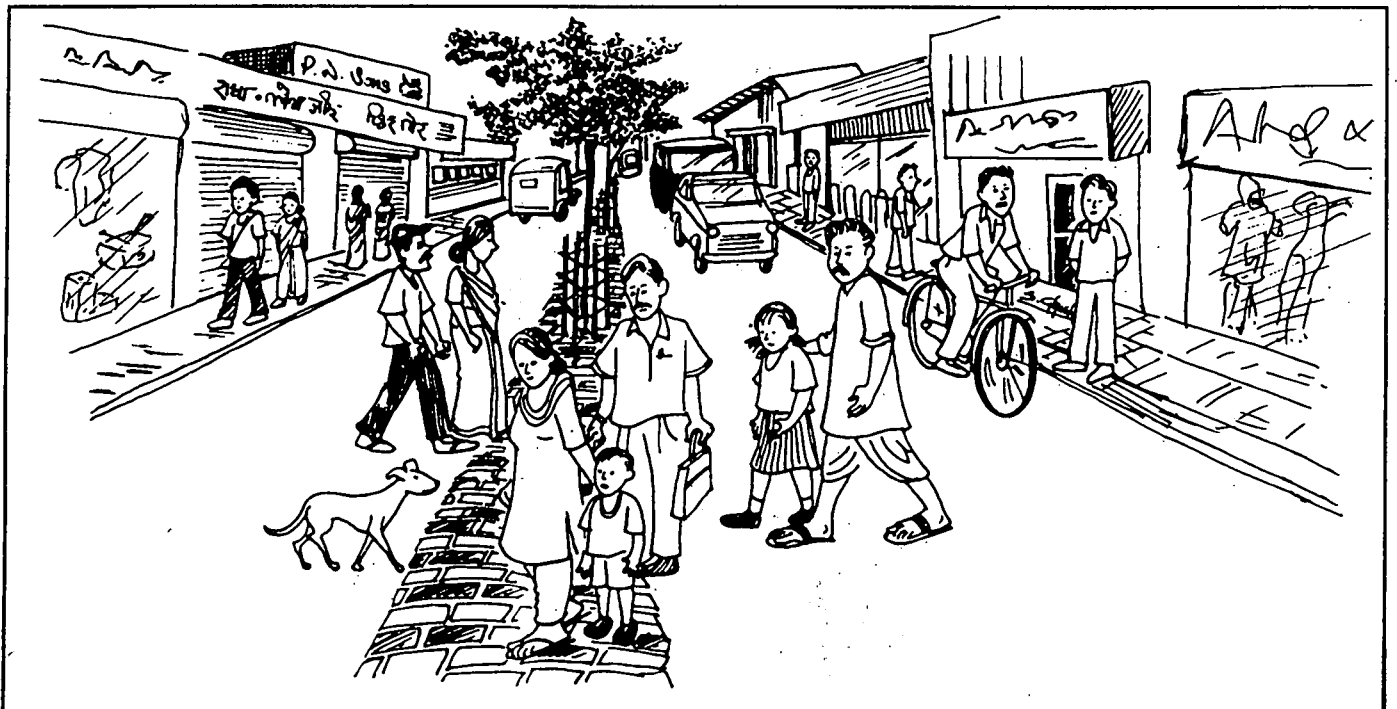
Problem:

- o Pedestrians move across the road over a long stretch of the shopping area. They have difficulties in crossing the wide road through traffic coming from both directions.

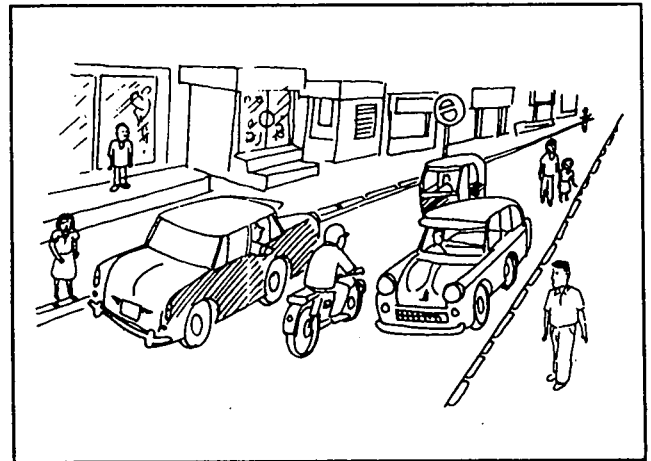
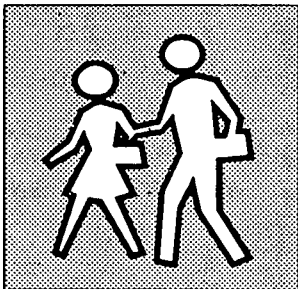
Solution:

- o Raised central verge sloping on both sides on a main road through the market place will narrow down the carriageway and will discourage overtaking and high speeds.

Sloping sides will allow large vehicles to move slowly over it. Broad central verge will also act as island for the pedestrians crossing the road.



Footpath for pedestrians:

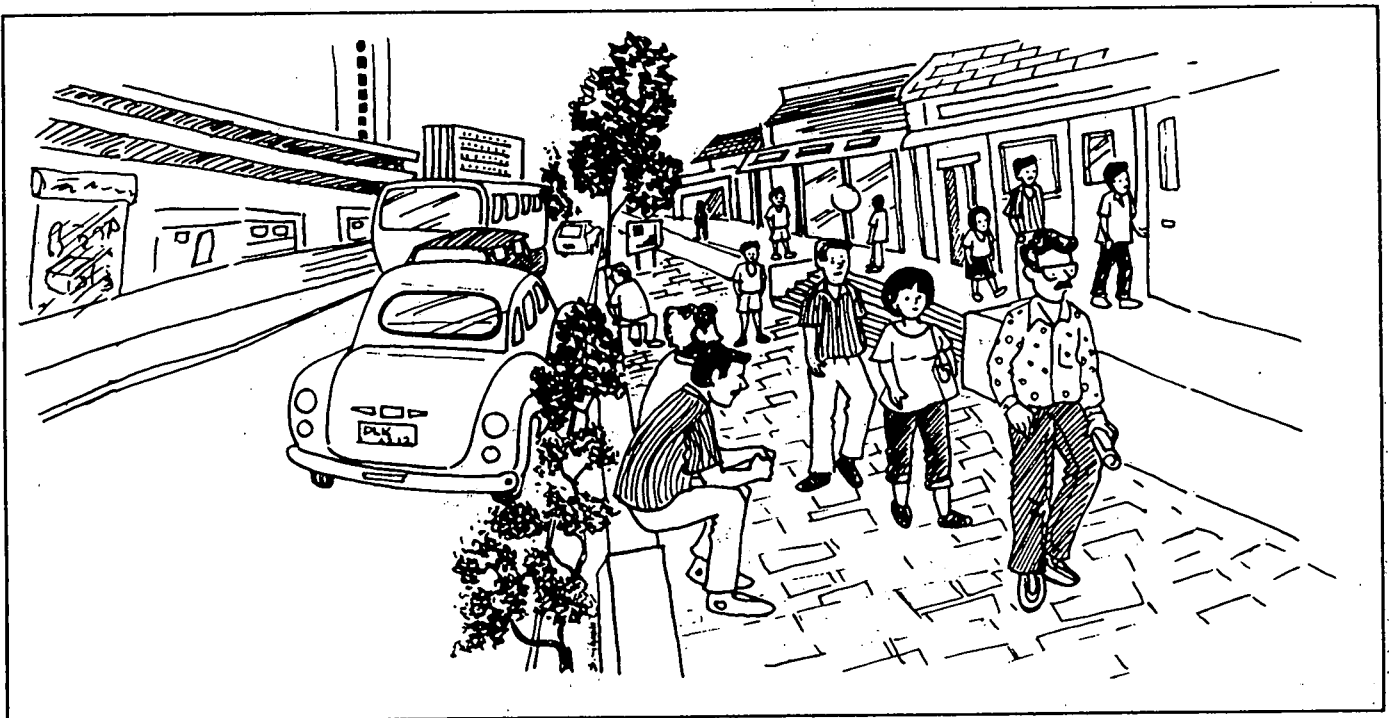


Problem:

- o Heavy pedestrian traffic along commercial streets spills over on the main carriageway. This creates unsafe conditions for pedestrians.

Solution :

- o Wide segregated pedestrian footway can be designed by reducing the width of main carriageway. It will also reduce vehicle speeds.



SUMMARY

SELECTION CRITERIA FOR TRAFFIC CALMING MEASURES

OBJECTIVES MEASURES	Reduce Through Traffic Volume	Reduce Mid-Block Traffic Speed	* Reduce Accidents/ Severity	Increase Drivers Awareness of the Local Environment	Self Enforcement	Minimise Change to Local Access	Minimise Parking Loss	Landscape Potential
<u>THROUGH TRAFFIC REDUCTION:</u>								
Full Road Closure	M	A	M	A	M	L	A	M
Partial Road Closure	M	A	A	L	A	A	A	A
Driveway Link	M	A	L	A	A	M	L	M
Regulatory Signs	L	L	L	L	L	L	M	L
One-way Street	M	L	L	L	L	L	M	L
<u>SPEED REDUCTION:</u>								
Road Humps	A	M	A	A	M	M	A	A
Parallel Slow Point	A	M	A	A	A	M	L	A
Angled Slow Point	A	M	A	A	A	M	L	A
Offset Slow Point	A	M	A	A	A	M	L	A
Mid-block Islands	L	M	A	L	A	M	M	A
T-Intersection Deviation	A	L#	A	L	A	M	L	A
<u>ACCIDENT REDUCTION/ INTERSECTION CONTROL:</u>								
Stop Signs	A	L	A#	L	L	M	M	L
Giveaway Signs	L	L	A#	L	L	M	M	L
Roundabout	A	L#	A#	A	M	M	M	M
Staggered T-Junctions	L	L	A#	A	M	M	A	A
<u>THRESHOLD TREATMENTS:</u>								
Entry Threshold	L	L	L	M	A	M	A	M
Splitter Island	L	L	L	M	A	M	A	A
Driveway Entry	A	L	L	M	A	M	A	M
Raised Pavement	L	L	L	M	A	M	L	A

Ability to meet objectives: M = Most potential
 A = Average potential
 L = Least potential

Effective at Intersection
 * Excludes Device Related Accidents

ACKNOWLEDGEMENTS

1. Drawings adapted by Mr. Shirshendu Ghosh.
2. Sources of information:
 - * Traffic Calming Through Integrated Urban Planning (H.G. Vahl, J.Giskes), May 1990.
 - * Policies for Health Promoting Transport, U.K., leaflet.
 - * Long term policy for road safety, Ministry of Transport and Public Works, The Netherlands, leaflet.
 - * Agenda for Safe Access in a Stable Environment (International Association of Traffic and Safety Sciences), leaflet.
 - * Traffic advisory leaflets 1/87, 2/90, 7/91, 7/93 & 12/93, Department of Transport, U.K.
 - * Road Accidents . in Focus -9, Parliamentary Advisory Council for Transport Safety, U.K., leaflet.
 - * Savoir Faire - Et Techniques, Centre d'Etude des Transports Urbains, Department Voirie - Espace public, 1990, France.
 - * Towards Safer Roads in Developing Countries, A Guide for Planners and Engineers, Transport Research Laboratory, U.K. and Overseas Development Administration, U.K., 1991.