GUIDELINES ON REGULATION AND CONTROL OF MIXED TRAFFIC IN URBAN AREAS

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GUIDELINES ON REGULATION AND CONTROL OF MIXED TRAFFIC IN URBAN AREAS

1. GENERAL

These Guidelines on Regulation and Control of Mixed Traffic in Urban Areas are based on a Paper on this subject by the Traffic Engineering Committee for Panel Discussion and published in 1975 in Volume 36-3 of the Journal of the Indian Roads Congress and discussed at Hyderabad on the 8th January, 1976.

The Traffic Engineering Committee (personnel given below) in their meeting held on the 21st August, 1976 modified and updated the Guidelines in the light of comments made at the above mentioned Panel Discussion:

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These Guidelines were later processed by the Specifications & Standards Committee in their meeting held on the 16th May 1977 and then approved by the Executive Committee and finally by the Council in their 90th meeting held on the 29th July 1977.

2. INTRODUCTION

2.1. Urban traffic in India is heterogeneous in character. It consists not only of fast moving motor traffic but also of primitive modes such as animal drawn vehicles. Motor traffic itself consists of cars, light vans, different kinds of commercial trucks, buses, scooters, auto-rickshaws, motor cycles, etc. Animal drawn vehicles could be bullock-carts, camel carts, or horse drawn vehicles. There is a considerable volume of cycle traffic and in some towns cycle rickshaws also ply. Hand-carts and rickshaws pulled by manual labour are also present. Pedestrian traffic is very heavy in urban streets due to high density of population. The very wide variety of traffic units with their great disparity of size and speed creates a number of problems and areas of conflict. The speeds of vehicles vary from 5 km per hour in the case of hand-carts to 50 k.p.h. or more for motor vehicles. Because of low speed of certain types of vehicles, the capacity of road is adversely affected and severe congestion occurs. Traffic speed drops down considerably causing delay. Constant stoppages, acceleration and deceleration and movement in low gears increase operational costs and wear and tear of vehicles. The conflict, confusion and irritation caused by mixed traffic result in a large number of accidents. The rapid increase in population of motor vehicles and cycles, combined with increase in pedestrian traffic, has exposed the inadequacy of our street system which was originally planned mainly for slow moving vehicles and for a more leisurely way of life. The future will only make the matters worse, if the present trend continues.

2.2. The problems are too complicated to offer any simple solution. Limitations of finance beyond the small budget of local authorities rule out the possibility of rebuilding the street system. But a great deal can be achieved by proper use of traffic engineering techniques. Regulation of traffic to conform to a certain desirable pattern will change the situation to a great extent. Regulation can be by measures such as segregation of traffic, traffic control and enforcement of traffic laws. So far as the introduction of new rules and regulations is concerned, it should always be borne in mind that only those regulations which find support from the community should be adopted and not those which are more likely to be broken than adopted by the general mass of the people. The latter type of laws and regulations only create distrust in the minds of the public and increase the habit of law-breaking thus vitiating the whole atmosphere and making the public completely unruly.

2.3. Traffic management measures involving traffic engineering improvements and regulation and control of movement of the
different categories of vehicles on the road system would ensure safe and efficient movement of traffic. At the same time, it is necessary that the road users are also properly educated about the measures of regulation through effective publicity. This would help in better participation of the road users in measures for regulation. While regulatory measures can improve a difficult existing situation somewhat, a permanent solution of the problem is only possible through proper land use planning which should be adopted in new planning areas.

3. EFFECT OF SLOW TRAFFIC ON CAPACITY

3.1. Slow traffic occupies the street space for longer time than the faster vehicles and hence reduces the capacity of the road. Slower vehicles mean more crossing and overtaking manoeuvres by the faster ones, thus reducing in turn the effective speed of the faster traffic. The slower traffic has also to slow down during crossing and overtaking by the faster ones in addition to running the risk of accidents during these manoeuvres. If the volume of slow moving traffic is predominant, a major portion of the carriageway is occupied by slow moving vehicles and the faster traffic has to slow down to almost the speed of the slow moving traffic in extreme cases. Apart from vast difference in speeds between different types forming the heterogeneous traffic composition, the different vehicles vary vastly in dimensions. Whereas a bus can be 8 m long and 2.40 m wide, a cycle-rickshaw will only be about 2 m long and 1.25 m wide, thus occupying considerably less space than the former.

3.2. The above discussion shows that the capacity of a road depends on many factors such as:

(i) volume of traffic;
(ii) composition of traffic;
(iii) speed of various vehicles in the traffic stream;
(iv) size of various vehicles;
(v) type of the road itself, i.e., whether single lane or two lane; whether dual carriageway or undivided carriageway; and
(vi) gradient of the road.

But as stated above, all these factors lose their relevance when the “forced flow” conditions prevail because of the presence of a large number of slow moving vehicles which reduces the speed of total traffic flow to that of a crawl at the speed of the slowest moving traffic unit. Such a situation arises in the extremely congested streets and de-congestion is the only way out of such situations.
4. TRAFFIC ENGINEERING AND OTHER MEASURES

4.1. Segregation of Traffic

4.1.1. In view of the heterogeneous character and composition of traffic in the streets of our towns, it is obvious that segregation of different kinds of traffic, to the extent possible, would go a long way in minimising the hazards and discomforts. Measures of segregation can be enforced only to the extent the public will tolerate them and provided the administration can bear the financial burden of the improvement measures and these factors seem to be inhibiting the authorities a great deal in introducing them. But wherever such measures have been introduced, the results have been very encouraging and progressive municipalities are already introducing them. It may be mentioned that segregation of traffic can be achieved usually in three ways:

(i) physical segregation, by provision of separate cycle tracks, pedestrian subways etc.
(ii) segregation in relation to time, e.g., restricting entry of certain classes of vehicles during defined hours; and
(iii) segregation in relation to direction by one-way systems.

Any one or combination of these methods found suitable under given conditions of the locality could be adopted with profit.

4.1.2. Segregation of slow moving vehicles including cycles could be achieved by providing a separate lane of about 5 m width on either side of the main carriageway for the exclusive use of these vehicles. It is desirable to separate these lanes from the main carriageway by a verge of about 1.0 m width. If it is not possible to provide such verges, physical segregation of slow and fast vehicles lanes could be achieved by providing 15 cm high cement concrete/stone blocks of 30 x 30 cm square cross-sections at a clear gap of 30 cm.

4.2. Restriction of Slow-moving Traffic on Certain Roads

Slow moving traffic, such as bullock-carts, tongas, camel carts, cycle rickshaws and hand-carts, causes great impediments to the flow of vehicular traffic in the streets. In view of the economic condition prevailing in the country, it will not be possible to ban these vehicles absolutely from our streets and they will have to be tolerated. At the same time, wherever the streets are very congested or on the arterial roads with pedestrians and motor vehicles as the main roadusers, it is desirable to prohibit the slow moving traffic,
either totally or for a limited period in the day when the traffic is at its peak. Suggested periods of prohibition of slow moving traffic in cities are 9.00 to 12.00 hrs. and 16.00 to 20.00 hrs. but these can be varied to suit local conditions and needs. But wherever total prohibition is suggested, availability of a suitable alternative route or a substitute mode of transport is a must. Besides that, unless absolutely necessary and at the same time enforceable, cyclists must be excluded from such a regulation.

4.3. Restriction of Heavy Commercial Vehicles on Certain Streets

Heavy commercial transport vehicles occupy considerable space and cause serious impediments to traffic in narrow streets which are busy. Closing such streets for heavy commercial traffic is one way of preserving the utility of these streets and this expedient has been adopted in many towns and cities with profit. This restriction may be imposed during peak hours or even throughout the day, depending upon local conditions.

4.4. Restriction of Public Transport Buses on Certain Streets

In a similar way as above, restriction of entry to passenger buses on certain narrow and busy streets is widely practised because of the simplicity in enforcing it. However, while planning such restrictions, a lot of care should be exercised because for long range solution to traffic problems, public passenger transport should be given importance. As such only after very judicious consideration, if it is found that the residential and other streets do not permit safe operation because of their geometrics or high congestion and also that movement of buses affects the environment in these areas, such restrictions may be imposed. Even in such cases, the possibility of operating mini buses should be explored.

4.5. One-way Streets

Another convenient way of dealing with large volume of mixed traffic is to have a system of one-way streets, which would streamline the flow of traffic considerably. The advantages of one-way streets are (i) increased capacity, (ii) increased safety and (iii) improved operation. On the other hand, there are disadvantages such as (i) difficulty faced by new drivers not familiar with the locality and (ii) longer length of travel forced upon road users. By and large, one-way streets have proved useful in dealing with unmanageable volume of traffic on narrow streets. It is particularly advantageous for slow moving vehicles and pedestrians so far as their safety is concerned as the
system more or less segregates the fast moving traffic from the slow moving one. The system should, however, be decided upon only if parallel and adjacent streets of suitable capacity at a close distance, say 200 m, are available and if suitable arrangement is available for merging the two one-way streams at a suitable place into two-way street.

4.6 Avoiding Penetration of Through Traffic

4.6.1. It is a frequent occurrence to find that the main street of a town or city is clogged by through traffic which happens to be just passing through. It can be easily realised that when a street has already enough local pedestrian and vehicular traffic of its own to choke, it, the through traffic that has no business in the town would further congest it and cause accidents. It is a sound policy in all such cases to construct by-passes or ring roads to siphon off the through traffic so that the local traffic can be better managed. Where, however, the land width through the towns for the highway is adequate, say a minimum of 30 metre, parallel service roads could also be constructed so that the interference with through traffic is reduced.

4.6.2. Penetration of通过 traffic could similarly be avoided in the case of city centres (i.e., CBDs) by building relief roads or inner ring roads.

4.7. Bus Curb-loading Areas

4.7.1. Bus traffic in a city street presents problems regarding on-street loading and unloading facilities. If properly planned, these facilities can go a long way in ensuring safety and orderly traffic movement. The following guidelines should be kept in view in deciding their location:

(i) The bus stops should not be located too close to the intersections as they can cause obstruction to vehicular flow. The best situation is 75 m from the intersection on either side, preferably on the farther side of the intersection.

(ii) Bus stops should as far as possible be so located as to disembark the passengers at safe places, such as curbs or islands.

(iii) For buses intending to turn right at an intersection, the stop should be sufficiently away from the intersection so that the bus can be manoeuvred from the curb to the extreme right lane well before the intersection.

(iv) Frequency of bus stops in busy streets should be kept as low as feasible consistent with passenger convenience in order to avoid congestion due to interference by stopping buses.
4.7.2. The curb-loading bus stops should preferably be planned by recessing the curb sufficiently so that the bus stops are completely out of the moving traffic lanes. The length of the recess should generally be 15 m for a single bus stop. For multiple bus stops, the above length can be increased by about 15 m for each bus. As buses, while parking and unparking at the bus stops, conflict with the movement of slow moving vehicles, the alignment of bus bay and slow traffic lane should be so arranged as to avoid conflict. Figs. 1, 2, 3 show layouts of bus stops suitable for different conditions.

4.7.3. On certain roads having a minimum of six lanes, the outer lanes can be reserved as bus lanes for the exclusive use of bus. This is preferable for roads with less intersections.

4.7.4. Introduction of the principle of exclusive bus lanes on either side of the carriageway is possible only if absolute segregation of traffic is carried out.

4.8. Loading and Unloading of Commercial Traffic

4.8.1. A frustrating result of the sudden rise in commercial road-based goods transport has been the congestion caused by it in urban streets due to loading and unloading operations. The streets which are already inadequate to cater to the needs of the pedestrians, cyclists, passenger cars, buses, etc., are further choked by the loading and unloading activities of goods vehicles carried on at the curbs. The pedestrian sidewalks become the recipients of the goods unloaded by the trucks or the goods to be loaded into the trucks from the godowns or business premises located along the streets. Not only does the on-the-street loading and unloading cause impediments to the flow of pedestrian traffic, but also the movement of freight from trucks to the storage places within the business premises causes extra time and effort to be wasted. The parking of trucks in the narrow streets deprives the street users of much needed space. Roads and streets being public property, it is questionable whether the trucks can monopolise a portion of it for loading and unloading, causing traffic congestion and hazards as a logical consequence and preempts the legitimate use of the sidewalk by the pedestrians.

4.8.2. One of the solutions to regulate this unhappy state of affairs is to insist on the provision of adequate loading and unloading facilities off the street by the owners of the business establishments alongside the road. While such a requirement will not be possible to enforce in case of existing premises or buildings,
Fig. 1. Layout of single bus bay
Fig. 2. Layout of single bus bay
Fig. 3. Layout of bus bay for two buses
the local municipal authorities can lay down regulations that no new buildings or premises intended for commercial, industrial or similar use and generating commercial goods traffic in an urban area where curb loading and unloading space is not available, should be allowed to be constructed unless truck loading and unloading facilities are in-built with the plot of the business premises. Such a zoning regulation could be part of the Municipal Building Byelaws. All buildings attracting commercial vehicular traffic such as hotels, hospitals, wholesale depots, godowns, booking offices of commercial transport companies, industries and manufacturing establishments could be brought within the purview of such a regulation which should be enforced strictly. But as stated above, these provisions do not solve the problems of existing establishments.

4.8.3. It is recommended that the following standards be adopted in determining the size of the space required for the truck (single unit) loading and unloading facilities off the street and located within the plot of the building:

(i) Depth: 8-10 m  
(ii) Width: 3.75 m  
(iii) Height (clearance): 4.25 m

Number of berths required for various types of buildings can be based on the I.R.C. Special Publication 12, entitled “Tentative Recommendations on Provision of Parking Spaces for Urban Areas”.

4.8.4. The solution of the existing problems lies in the provision of truck terminals away from the city centre with adequate accessibility and suitable links with the major generators of goods movement. By providing such terminals, slow moving vehicles will lose their role in goods transportation and thus they can be reduced, if not eliminated. Moreover, such a planning will obviate the need for heavy trucks to enter the central areas of the city, which can be served by smaller vehicles. Till such a provision is made, loading and unloading operations in congested areas, if possible, may be banned during the day time and permitted only during night hours.

4.9. Cycle Traffic

4.9.1. Need for segregation

Recent years have seen a phenomenal growth in cycle traffic
in and around towns and cities in the country. A sizable percentage of the urban population, specially of small and medium sized cities, uses bicycles for travel. The trend is likely to continue for many years to come. Since the cyclists use the road along with the fast traffic, there is conflict between the two types of traffic at narrow and congested streets, intersections, etc. The result is that the cyclists are involved in a number of accidents and free flow of traffic is hampered. It is, therefore, a sound policy to segregate cycle traffic when it is beyond safe limits. In fact the best policy would be to plan cycle tracks for the city as a whole. The detailed recommendations regarding the design and layout of cycle tracks under such circumstances are contained in the Indian Roads Congress Recommended Practice for the Design and Layout of Cycle Tracks, IRC: 11·1962; the following paragraphs give only the essential features of design and layout of segregated cycle tracks.

### 4.9.2. Justification

Separate cycle tracks may be provided when the peak hour cycle traffic is 400 or more on routes with a motor vehicular traffic of 100-200 vehicles per hour. When the number of motor vehicles using the route is more than 200 per hour, separate cycle tracks may be justified even if cycle traffic is only 100 per hour.

### 4.9.3. Separate cycle tracks to be provided on both sides of the road

It is desirable to provide separate cycle tracks on both sides of a road and track on each side is designated for traffic in a particular direction.

### 4.9.4. Types of cycle tracks

Cycle tracks may be (i) adjacent to the carriageway at the same level and indicated by pavement marking (ii) adjacent to the carriageway but at a higher level, or (iii) separated from the carriageway by a verge at the same or different level. It is desirable that the verge separating the cycle tracks should be as wide as possible, the minimum being 1 m. Under exceptional circumstances, on streets with inadequate road land, verge could be reduced to 0.5 m.

### 4.9.5. Lane width

The lane width of a cycle track shall be 1 m. The minimum width of a cycle track shall be 2 lanes, i.e. 2 m. When designing
the width of cycle track, the future growth of cycle traffic should be suitably accounted for.

4.9.6. Riding surface and lighting

Cycle tracks should be constructed and maintained with care to encourage their use by the cyclists. Geometrics of cycle tracks should be as per IRC: 11-1962. Special care should be taken as regards the gradient of the tracks. The standard of lighting on cycle tracks should be equal to that of the main carriageway. It would, however, be desirable to have some distinctive features such as provision of poles of lower height, use of a different type of lamp or a different colour light emission from the luminaire.

4.9.7. Segregation of cycle traffic at intersections

4.9.7.1. It is desirable to segregate cycle traffic at intersections also since intersections are dangerous, accident-prone locations. This could be achieved by a suitable system of multi-phase signalisation.

4.9.7.2. Where cycle tracks are not segregated, suitable safety measures at intersections should be adopted, such as provision of separate lanes for cycle traffic, provision of cycle boxes ahead of stop line, and provision of turning cycle paths in conjunction with signalisation. These methods are shown in Fig. 4. Cyclist crossing must always be marked in accordance with IRC: 35-1970.

4.10. Pedestrian Traffic

4.10.1. A feature of city streets in our country is the preponderance of pedestrian traffic. This is attributable to many factors, chief among them being:

(i) the socio-economic condition of the people;
(ii) the high density of population in most of the towns and cities; and
(iii) the narrowness of the streets and roads.

The street system of most of the towns and cities was evolved years ago in an unplanned manner, when motorised vehicular traffic had not made its appearance. Houses were built along narrow streets without any provision for separate pedestrian sidewalks as the entire street was mainly used by the pedestrians and animal drawn vehicles. With the growth in population and the advent of the motor traffic, the streets have burst at their seams, giving rise to inordinate traffic delays for the motor vehicle users and anxiety.
1. PARALLEL PATH METHOD

2. TURN PATH METHOD

3. CYCLE BOX METHOD

Fig. 4. Segregation of cycle traffic at road intersection
and tension to the pedestrians. The number of pedestrians involved in accidents is staggering and this clearly underscores the need for effective regulation of pedestrian traffic. Basically there are two situations in the control of pedestrian traffic viz:

(i) areas where the streets are so narrow or the pedestrian traffic otherwise is so much that pedestrians must be completely protected from the effects of motor traffic. Creation of pedestrian precincts is a measure in this class; and

(ii) areas which have a preponderance of motor vehicles where the pedestrians have to be protected from conflicts with vehicles by such means as the provision of appropriate pedestrian crossings, separate sidewalks and pedestrian sub-ways.

4.10.2. Pedestrian precincts

There are a few important streets and roads in many towns of our country where the pedestrian traffic itself is so heavy that it will be worthwhile closing the streets to all traffic except pedestrians. Examples of these can be found in busy and narrow shopping streets of most of the towns and cities where shopping needs have grown so much that the streets can hardly cope with the pedestrians, leave alone the vehicular traffic. If the chaotic conditions of mixed traffic in these streets are to be improved, and the pedestrians enabled to move in comfort and safety to a reasonable degree, one is left with no alternative but to declare the locality a pedestrian precinct and totally prohibit any vehicular traffic whatsoever. One of the most important pre-requisites to such measures is that off-street parking facilities have got to be provided. With respect to the total ban on vehicles, some variations could no doubt be allowed. For instance, the ban may not be complete so far as the time factor is concerned i.e. some particular type of vehicles such as delivery vans, taxis and garbage trucks may be allowed during specified hours of the day or night. Ambulances and other such emergency vehicles etc., may be allowed even though no other traffic is permitted.

4.10.3. Pedestrian sidewalks

4.10.3.1. Separation of pedestrian traffic and vehicular traffic with the provision of pedestrian sidewalks ensures safety of pedestrians and results in less chance of pedestrians, specially children, the aged and the physically handicapped, from entering the carriageway even unintentionally. It is, therefore, strongly recommended that pedestrian sidewalks be provided on all new facilities, and on all existing facilities as far as practicable.
4.10.3.2. To be effective, the sidewalks should be provided on either side of the road and should be raised above the general carriageway level. To be attractive for use by pedestrians, the sidewalk should be properly surfaced or paved, as pedestrians are loathe to use sidewalks of ordinary earth which are dusty in summer and muddy in rains. The sidewalks should be sloped adequately, ranging from 1 in 40 to 1 in 30 which will be sufficient to drain away the rain water. The cuts in the curbs to provide access to driveways into abutting properties should be minimised. Where cycle tracks are provided on same level as the sidewalks, the pedestrian sidewalks should be close to the abutting buildings. If adequate land width is available, the sidewalk should preferably be set back from the kerb by providing a boulevard which can be utilised for overhead and underground utilities, trees, etc.

4.10.3.3. The utility of pedestrian sidewalks is eroded by hawkers and vendors and permission given by the municipal authorities in many towns for the shopkeepers to extend the shop limits beyond the built-up area for temporary use such as display windows and platforms. These conditions should be severely discouraged by strict enforcement of rules framed for the comfort and convenience of pedestrian movement on sidewalks.

4.10.3.4. The width of the sidewalk depends upon the expected pedestrian traffic and may be fixed with the help of the following guidelines subject to not being less than 1.5 m:

**TABLE 1. CAPACITY OF SIDEWALKS OF DIFFERENT WIDTHS**

<table>
<thead>
<tr>
<th>Width of sidewalk</th>
<th>Anticipated capacity (Number of persons per hour)</th>
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</thead>
<tbody>
<tr>
<td></td>
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If the sidewalks are located in shopping areas, the width should be increased by 1 m which is the "dead width" not available for pedestrians. In other areas where the sidewalk is immediately
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If the sidewalks are located in shopping areas, the width should be increased by 1 m which is the "dead width" not available for pedestrians. In other areas where the sidewalk is immediately
adjoining a building or a fence, the "dead width" can be adopted as a 0.5 m. In planning a new facility or an improvement, the future growth of traffic should be considered and the exact width of the sidewalk should be fixed according to what the pedestrian volume at present is and what it is likely to become in foreseeable future. The following widths should be considered as minimum:

**TABLE 2. MINIMUM WIDTH OF SIDEWALK FOR VARIOUS TYPES OF STREETS IN DIFFERENT TYPES OF LOCATIONS**

<table>
<thead>
<tr>
<th>Type of district</th>
<th>Type of street</th>
<th>Minimum width of sidewalk in metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial and business areas</td>
<td>Main street</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Minor street</td>
<td>2</td>
</tr>
<tr>
<td>Residential areas</td>
<td>Main street</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Minor street</td>
<td>1.5</td>
</tr>
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</table>

4.10.4. Cross-walks

4.10.4.1. Crossing of carriageway by the pedestrians only at authorised places minimises traffic hazards to a great extent. As a result of this, the tendency to jay-walk is curbed and the confusion and conflict between pedestrians crossing a road and vehicular traffic is reduced.

4.10.4.2. Pedestrian cross-walks should be provided at important intersections where substantial conflict exists between vehicular and pedestrian movements. These should be so marked that the pedestrians are subjected to minimum inconvenience and the vehicular traffic too is not unduly disrupted. Pedestrian crossings are also provided at locations other than intersections where considerable pedestrian traffic accumulates, e.g., at midblocks and schools.

4.10.4.3. In locating pedestrian cross-walks, unreasonably indirect crossings should be avoided. The cross-walk position should not substantially increase the distance the pedestrians have to walk. Wherever possible, the cross-walk should cross the carriageway at right angles so as to minimise the pedestrian exposure to vehicular traffic.

4.10.4.4. The location of the pedestrian cross-walk at
intersections should fulfil the following conditions to ensure safety of the traffic:

(i) adequate visibility so that the driver of an approaching vehicle has clear view of the traffic on the cross-walk and on the pedestrian sidewalks;
(ii) sufficient space on the pedestrian side-walks for the pedestrians to wait; and
(iii) freedom from obstruction, such as, trees, sign posts and lamp posts in the path of the pedestrians at either end of the cross-walk.

Preferred location of pedestrian cross-walks at different types of intersections is shown in Fig 5.

4.10.4.5. To be effective, the pedestrian crossings should be clearly marked. The standards for the road markings at pedestrian cross-walks are indicated in the Indian Roads Congress 35-1970 "Code of Practice for Road Markings". At intersections where stop lines are provided, the distance between the stop line and the pedestrian cross-walks should not be less than 2 m nor more than 3 m. A warning sign to indicate that the pedestrian cross-walk is ahead should be installed invariably when the crossing is not controlled by a traffic signal.

4.10.4.6. The width of the pedestrian cross-walks is governed by local requirements but in no case should it be less than the width of pedestrian side-walks. The maximum width of pedestrian cross-walks shall not ordinarily exceed 4 m.

4.10.4.7 Pedestrian crossings can be:

(i) uncontrolled pedestrian crossings, or
(ii) controlled pedestrian crossings.

The uncontrolled pedestrian crossings are those where the pedestrian cross-walk is marked by studs or paints but not controlled by any system of signals. Flashing beacons may, however, be provided at uncontrolled pedestrian crossings where there is sporadic appearance of pedestrians and high speed of vehicles. Controlled pedestrian cross-walks are those where the passage of pedestrians and vehicles conflicting with each other is regulated by traffic signals.

4.10.4.8. Depending upon the conditions, the signals can be actuated either by means of pedestrian detectors or by pedestrian push buttons. The latter should be suitable for rigorous service.
Fig. 5. Location of pedestrian crossing
4.10.5. Refuge Island

4.10.5.1. The safety of pedestrians is enhanced by the provision of pedestrian refuge islands on roads having wide carriageway. The main function of a refuge island is to provide a place of safety for pedestrians who cannot cross the entire carriageway at one time in safety.

4.10.5.2. Refuge islands should not be located so as to create a hazard for motor vehicles. The design of the island should be carefully planned so that its shape will conform to natural vehicular paths and such that a raised island will not constitute a hazard in the carriageway. The island should be clearly visible at all times and sufficiently in advance so that the motorists will not be surprised by its presence. The refuge island should be provided with vertical curbs which should be suitably reflectorised and illuminated.

4.10.6. Pedestrian guard-rails

4.10.6.1. For the control and regulation of pedestrian traffic in heavily trafficked urban areas, the pedestrian guard-rails occupy an important place. The guard-rails are provided either to block the passage of pedestrian at particular locations or to provide guidance in the proper direction of pedestrian traffic so that the pedestrians cross the streets at predetermined and safe locations. The pedestrian guard-rails should be used wherever the uncontrolled crossing of the carriageway by pedestrians would seriously impede and delay vehicular movements and cause hazard to the pedestrians. The following situations generally warrant the provision of pedestrian guard-rails:

(i) at complex intersections where because of physical and traffic conditions pedestrians are subject to unusual or extreme hazards if permitted to cross indiscriminately;

(ii) at public transport loading islands where it is necessary to confine pedestrians to travel on predetermined cross-walks areas;

(iii) at locations where it is necessary to compel the pedestrians to use facilities such as overpass or subway;

(iv) at locations of exits from schools, factories, cinema houses, stadiums, etc. where there will be sudden surge of crowd, and where pedestrians will be tempted to cross the carriageway at their will without regard to vehicular traffic,
4.10.6.2. The pedestrian guard-rails should be of sufficient height and so constructed as to make it difficult for pedestrians to go through or jump over. They should be of sturdy design.

4.10.7. Sub-ways and over-bridges

The provision of sub-ways or overbridges for the exclusive use of pedestrians may be thought of at exceptional locations where the pedestrian volume crossing a wide carriageway is extremely large and cannot be regulated by other traffic control measures without causing undue delay both to the pedestrians and the vehicular traffic. An example of such locations is the exit from a metropolitan suburban railway station, which generates heavy volume of pedestrian traffic. Pedestrian sub-ways constructed should be well-lighted and ventilated. As pedestrian bridges and sub-ways are usually fairly short and are intended solely for movement, a higher capacity than of ordinary side-walks is recommended. The recommended capacity is not more than 50 persons per minute per m on the level and 35 persons per minute per m on stairs or ramps.

4.11. Road signs and markings

For guiding the road users regarding the regulatory measures discussed in the earlier paragraphs and also for warning them of potential hazards, road signs and markings should be installed as per the recommendations worked out by the Indian Roads Congress. The authorities concerned should give adequate importance to the placement and maintenance of these traffic control devices.

5. CROSS-SECTIONAL ELEMENTS

5.1 The design speed of a street for mixed traffic will depend upon the volume and composition of traffic and the use that street is likely to be put i.e., the classification thereof. The cross-section of an urban street for mixed traffic will depend upon various factors such as volume, type, number, and modes of traffic using the street, whether any particular type of traffic has been segregated, and whether separate parking lanes have been provided or not.

5.2. The width of carriageway for vehicular traffic may be adopted as given in Table 3.
TABLE 3 WIDTH OF CARRIAGEWAY

<table>
<thead>
<tr>
<th>Single lane</th>
<th>Two lanes without raised kerbs</th>
<th>Two lanes with raised kerbs</th>
<th>Multi-lane pavements per lane**</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.75 m</td>
<td>7.0 m</td>
<td>7.5 m</td>
<td>3.5 m</td>
</tr>
</tbody>
</table>

**Total width should be increased by 0.5 m if there are kerbs on both sides.

5.3. The width of separate parking lane, wherever provided may be kept 3.0 m.

5.4. The width of cycle track, wherever separate tracks are provided, may be as indicated in para 4.9.5.

5.4. The width of pedestrian sidewalks may be as indicated para 4.10.3.4.

6. INTERSECTION DESIGN

6.1. Intersections are important parts of a highway governing the efficiency, speed, capacity and safety of traffic operations. With highways carrying mixed traffic, having varied and conflicting characteristics, the design and control of intersections gains an added importance. If traffic is adequately segregated, as part of the measure to improve mixed traffic flow, the design of intersection becomes critical and needs close attention.

6.2. Signal Controlled Intersections

For urban streets with a heavy flow of traffic, of which the pedestrian and cycle traffic forms a sizable portion, signal control of intersections is a valuable device. Because of the predetermined or traffic-induced assignment of right-of-way to the various movements, the signals provide for orderly movement of traffic of various types. Signal-controlled intersections, when so designed, can afford a safe passage for cyclists and pedestrians at busy intersections.

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6.3. Police Controlled Intersections

Police controlled intersections give right-of-way to various sets of streams of traffic in sequence and help in reducing the conflict between various types of traffic moving in different directions. They are able to deal with moderate traffic flows.

6.4. Other Intersections

6.4.1. There are other intersections where the movement of traffic is not controlled by any system of signalisation. The traffic is controlled only by signs and markings. Obviously, these types of intersections have serious limitations of safety and are recommended only where traffic does not warrant the adoption of signal or police control.

6.4.2. In view of the absence of better controls, the uncontrolled intersections should be adequately provided with channelising islands, signs and markings. Where separate pedestrian crosswalk is provided, the crosswalk should be marked on the pavement by paints and studs as per guidelines given in the Indian Roads Congress: 35-1970 “Code of Practice for Road Markings”.

7. LEGISLATIVE MEASURES

7.1. A good degree of relief from congestion, delay and accidents is obtained by controlling mixed traffic by means of suitable traffic laws and regulations. These regulations, though restrictive in nature, are in fact conducive to general welfare of the society. The regulations, however, should be rational and reasonable and should not be overdone as to cause public defiance and non-acceptance. The regulations should be developed progressively and altered to suit varying conditions during their usage. Regulations once formulated should be enforced strictly without any laxity so as to command respect.

7.2. Under the Motor Vehicles Act, 1939, amended from time to time, adequate measures of control of traffic have been laid down, covering aspects such as speed limits, limitations on use of vehicles on specified routes, parking places and traffic signs. The Act also empowers the State Governments to make suitable rules for the purpose of carrying into effect the provisions in the Act concerning control of traffic. The police authorities can also frame rules, in consultation with the local authorities, for regulation and control
of traffic. Some of the rules which are being enforced in certain States and local municipal authorities, in so far as they concern the regulation of mixed traffic, are given below. General traffic rules governing safety of traffic are not enumerated here.

7.3. Rules Concerning Speed of Vehicles

In view of the large variety of vehicles using the urban streets and the high volume of traffic obtaining in most of the streets, it is obviously necessary to control the speed of various types of vehicles. This measure will curb the tendency of reckless driving and prevent many accidents. The speed limits indicated in Table 4 are recommended as a measure of safety on urban roads under mixed traffic conditions. These are only for guidance and the actual limits may be imposed after duly considering all relevant conditions including percentage of mixed traffic.

TABLE 4. SPEED LIMITS FOR DIFFERENT TYPES OF VEHICLES UNDER MIXED TRAFFIC CONDITIONS

<table>
<thead>
<tr>
<th>Different categories of roads and streets</th>
<th>Speed limit in kilometres per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group I</td>
</tr>
<tr>
<td>Major Roads of Arterial/Sub-arterial character mostly in open and thinly built-up areas</td>
<td>50</td>
</tr>
<tr>
<td>Roads with moderate traffic situated in semi-built-up areas</td>
<td>40</td>
</tr>
<tr>
<td>Congested roads in built-up areas</td>
<td>30</td>
</tr>
</tbody>
</table>

7.4. Rules Concerning Parking of Vehicles

Parking of vehicles along the curb in urban streets deprives the traffic of much needed space and also causes hazards to traffic. Under mixed traffic conditions, restrictive rules for parking can be effectively used for traffic control. A variety of rules could be enforced, depending on local conditions, and a few representative ones are given below for guidance:

1. Complete prohibition of parking for any type of vehicle for all times;
2. Complete prohibition of parking for any type of vehicle during peak hours of traffic;
(3) prohibition of parking for a period exceeding 30 minutes on busy streets during the whole day or during peak hours of traffic;
(4) designating parking places for different types of vehicles such as private cars, taxis, scooters, horse-drawn vehicles, cycles, autorickshaws and cycle-rickshaws;
(5) making it obligatory for traffic to halt in a street at a distance not greater than 0.6 m from the edge of the curb or pavement;
(6) restriction of stopping or parking of vehicles:
   (i) within an intersection area and 75 m on either side;
   (ii) on a pedestrian crossing or within 6 m on either side of it; and
   (iii) near corners, bends, rise or safety zones, and also entrances and driveways of properties;
(7) making it necessary for vehicles to park parallel to the kerb, unless angular parking is specially permitted;
(8) restricting parking on sidewalk and cycle tracks;
(9) restricting parking within 10 m of a bus stop; and
(10) imposition of parking fee where necessary.

7.5. Rules Concerning Loading and Unloading of Commercial Goods Transport Vehicles

Commercial goods transport vehicles consume considerable space while loading and unloading and cause impediment to flow of vehicular traffic and pedestrians. The following rules could be enforced to regulate loading and unloading by commercial goods transport vehicles:

(1) making it necessary for the vehicles halting for the purpose of loading and unloading to draw up parallel to and alongside the kerb or edge of the pavement and not blocking a cross street; and
(2) restricting loading and unloading:
   (i) within an intersection area, and 75 m on either side;
   (ii) on a pedestrian crossing or within 6 m on either side of it;
   (iii) near corners, bends, safety zones, and also entrances and driveways of properties;
   (iv) on sidewalks and cycle tracks; and
   (v) within 10 m of a bus stop.

7.6. Rules Concerning Motor Cycles and Scooters

Motor cycles and scooters constitute a good percentage of mixed traffic in the urban streets and it is essential that some special rules regarding the number of persons carried by them, loading etc.,
are enforced for regulating traffic. Some of the rules having a bearing on mixed traffic flow could be as follows:

(1) restricting the load projections on the sides to about 0.5 m from the longitudinal middle of the motor cycle, on the front to about 0.6 m from the front wheel and on the rear to about 1.0 m from the rear wheel;
(2) restricting the number of passengers to not more than two (one driver and one pillion rider) when no side car is attached and to not more than four when a side car is attached. In the case of learner drivers, no pillion rider or passenger in side-car is to be allowed; and
(3) prohibiting scooters and motorcycles from towing any trailer (not being a side-car)

7.7. Rules Concerning Pedal Cycles

Pedal cycles form a large portion of urban traffic in the country. In order to ensure smooth and safe flow of cycle traffic under mixed traffic conditions, the following rules are recommended for adoption:

(1) stipulating that not more than two bicycles shall remain abreast except at separate cycle tracks;
(2) prohibiting cyclists from using sidewalks;
(3) making it obligatory for cyclists to use separate cycle tracks wherever provided;
(4) prohibiting cyclists from being towed by any other vehicle;
(5) prohibiting cyclists from carrying any other person on the cycle;
(6) making it necessary for cyclists to keep to the extreme left of the carriageway where no separate cycle tracks are provided; and
(7) making it compulsory for the cyclists to have a head lamp, back reflector, and rear mudguard painted white in the bottom portion.

7.8. Rules Governing Carriage of Long Pipes, Iron Rods, etc.

Long lengths of pipes, iron rods, structural, etc., hinder traffic flow. They should be permitted to be carried in busy streets only during lean traffic periods. Such projecting material should always be provided with red flags and during night hours with red lanterns or lights.

7.9. Rules Concerning Hand-carts

Hand-carts are frequently used in towns and cities for carrying goods. For ensuring safety of travel, it is necessary that the size and load to be carried by hand-carts be regulated. The following are some of the rules that could be adopted to advantage:
(1) restricting the length of the load to 3 m and height to 2.5 m (measured from ground) and laying down that the width of load should not exceed the width of hand-cart by 0.3 m;
(2) restricting the use of hand-carts carrying long rods and pipes greater than 5 m length, unless accompanied by four attendants. Such projecting material should always be provided with red flags and during night hours with red lanterns or lights;
(3) stipulating that if the load exceeds 225 kg., two able bodied attendants should be provided, and for lesser loads, one attendant should be provided; and
(4) stipulating that hand-carts carrying loads in excess of 500 kg should be provided with pneumatic tyres and efficient brakes.

7.10. Rules Governing Animal Drawn Vehicles

(1) restricting animal drawn traffic carrying long pipes, rods, bamboos etc., more than 5 m in length. Such projecting material should always be provided with red flags and during night hours with red lanterns.

(2) restricting the height, length and width of load to safe limits, depending upon the size of the carriage; and

(3) laying down that the animal drawn traffic should invariably keep to the extreme left of the carriageway having mixed traffic.

7.11. Rules Governing Animals on Streets

The following rules governing the use of streets by animals could be helpful:

(1) prohibiting animals such as camels and elephants from being driven on the busy streets;

(2) regulating that the cattle in droves shall not be driven on busy streets at peak periods of traffic;

(3) laying down that cattle in droves shall be accompanied by sufficient number of attendants to completely keep them under control;

(4) requiring that a rider of a horse should keep to the extreme left of the carriageway as far as possible;

(5) prohibiting use of sidewalks and cycle tracks by horse-riders.

7.12. Rules Governing Pedestrians

Apart from the general rules as to pedestrian safety, the following regulatory provisions deserve to be enforced to control traffic composed of vehicles and pedestrians:
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(1) requiring that, wherever side-walks are provided, the pedestrians should keep to the sidewalks.
(2) laying down that wherever pedestrian crossings are provided, pedestrians should not cross a carriageway at any place other than at the crosswalk; and
(3) laying down that wherever sub-ways or overbridges are provided for cross movement, pedestrians shall not use the carriageway for crossing.

7.13. General Rules to Promote Pedestrian Movement on Sidewalks

In order to encourage the pedestrians to use sidewalks, wherever they are provided, rules should be enforced prohibiting hawkers and peddlars from occupying sidewalks. Rules should also be enforced preventing abutting shop-keepers from erecting temporary structures, projections and platforms on the side-walks.


In metropolitan cities, the pressure on traffic is already too much and it is highly desirable that the slow moving vehicles should gradually be eliminated from the traffic pattern. One of the measures that may be adopted with profit is to ban all fresh permits for hand-carts and other slow moving vehicles.