11 SYNOPSIS:REMEDIES & RECOMMENDATIONS

Comparison of fatal accidents in top metros cities of India:

- Table 11.1 shows road accident and related parameters data of a few metropolitan cities of India for the year 2015.
- Considering different factors like area, population, vehicle population, road length etc. the figure of accidents can't be compared directly. But still, it is a fact that Delhi tops the list of fatal accidents; and the **death of 1622 people in a year, more than 4 people per day** is too many. It needs to be brought down and needs large scale improvement.
- Most of these **victims (around 60%) belong to the most productive age group of 20-40 years.** Most of these belong to **lower economic group using road as pedestrian (45% victims), Cyclists (4.1% victims) or two wheelers (35% victims).**
- **While developing our cities, we gave due importance to the free flow/smooth flow of traffic by making flyovers and underpasses but we ignored development of facilities for pedestrians,** who are the main victims in Road Accidents in our country, unlike developed country where cars/four wheelers are the major victims.

Table 11.1 Comparative status of Metropolitan Cities

S.No.	City	Area (Sq Km)	Total registered vehicle (lacks)	Population (lacks)	Road Length	Traffic Man power	Fatal Accident	Total Accidents	Accidents Per 10000 vehicles	Deaths per 10000 vehicles
1	Kolkata	243.6	30.97	140.35	1870	3613	**412**	4347	14.03	1.36
2	Mumbai	437.7*	23.32*	125.0**	1941*	3380*	**586**	23468	9.93*	2.28*
3	Hydrabad	650*	23.27*	91.0**	-	1186*	**425**	2761	11.11*	1.76*
4	Bangalore	709	59.49	108.39	11000	3594	**714**	4828	8.14	1.24
5	Chandigarh	114	10.21	11.02	1612	444	**124**	416	4.07	1.26
6	Chennai	1189*	44.57*	48**	-	4182*	**859**	7328	21.56*	2.50*
7	Delhi	1483	88.27	181.67	33198	5264	**1582**	8085	9.15	1.84
8	Pune	743*	31.2**	55.0**	1850*	980**	**419**	1443	5.03**	1.27**
	India	**32,87,263**		**125 cr.**			**131726**	**501423**	**26.8****	**7.6****

Source: BPR&D, MoRTH and Official websites

** figure belongs to year 2013 & * belongs to 2014

- **The number of foot over bridges/ subways for pedestrian is lesser than the number of flyovers.** A recent survey shows there were 127 FOBs/subways and 150 flyovers/underpasses in Delhi. The same could be case of most of the metropolitan cities of India. **Hence, our planning needs to be a little different in our country as per our requirement and needs.**

"The best way to get the desired result is to provide the conditions/ atmosphere to the users which make them themselves follow rules/paths willingly instead of forcing them to follow rules."

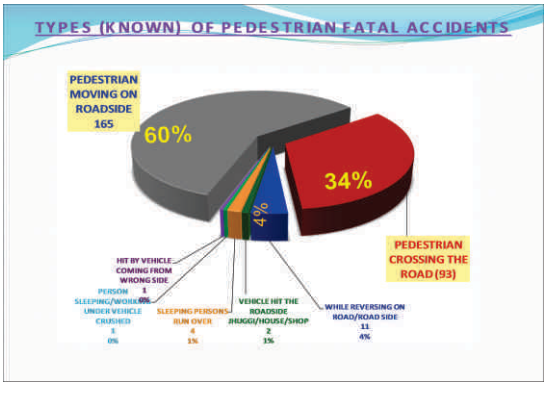
Land use and transport planning

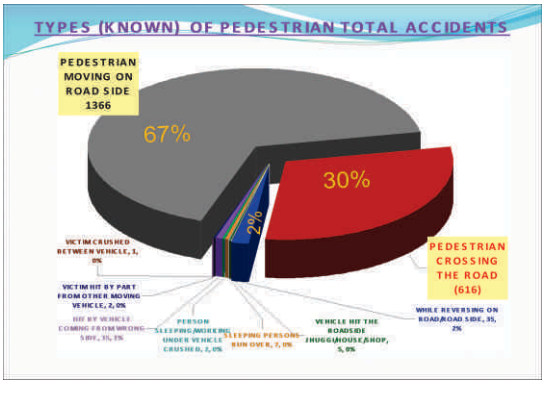
- **Prioritizing the needs of vulnerable road users includes recognizing the importance of the built environment when making political and planning** decisions. Some of the solutions lie in **appropriate modifications to the physical road environment and setting up a supportive policy framework rather than focusing only on human behaviour** as the primary cause of road traffic crashes. The examples presented below show efforts to incorporate the needs of vulnerable road users in planning for land use and transport.
- **Sweden's model of road safety** is frequently cited as good practice. **The "Vision Zero" road safety policy was** adopted by Sweden in the late 1990s is based on an understanding that the environment needs to be modified to take account of human's lack of tolerance to mechanical forces and the human tendency to make errors. **Sweden's sustainable road strategy thus aims to modify the environment while protecting road users from unacceptable levels of risk. As well as building bicycle and pedestrian lanes, tunnels and car-free play areas, other environmental solutions are being implemented to separate and protect these road users.** Where road users cannot be separated, the strategy acknowledges the need to give **pedestrian safety priority over car traffic – particularly by reducing speed.** (Ref. GLOBAL STATUS REPORT ON ROAD SAFETY (WHO)-2013).

PART – I PEDESTRIAN SAFETY : CREATING PEDESTRIAN FREE ROADS/ZONES

What we presently have for the pedestrians.

- A study was conducted on the type of accident pedestrian is involved in is given chart 11.1:





- It clearly shows that among the known types of pedestrian accidents 96% of all **pedestrian accidents are caused either while the pedestrian is moving (or standing) along the road side (66.6%) or the pedestrian is crossing the road (30%).**
- **The pedestrian is moving (or standing) along the road side (66.6%):** It depicts the condition of footpaths and waiting space for pedestrians (to get public transport) on most of the roads of Delhi. **As per a study 40% of the total Road Length of Delhi has NO Sidewalks!** (And the ones having sidewalks, lack in quality in terms of surface, width and

geometrics). **Source: RITES transport demand forcast study May, 2008.** The footpaths are missing on many of the main arterial roads of Delhi and where ever provided it's more or less nominal.

They are non-continuous, encroached, un-friendly, and poorly maintained on most of the roads of Delhi. Some examples are shown in the following pictures.

Pedestrian Difficulties (Some Examples)

Disappearing footpath

Obstructive Signages

Bushes on Footpath

Obstructions to Pedestrians

Inadequate width

Dangerous gaps

Encroachment on Footpath

Insensitive construction agencies

Parking of vehicle on footpath

Lack of continuous Footpath

Institutional Encroachment on Foot Path

Metro Construction

Obstruction on Footpath

Unusable Foot Path

Encroachment by Street Vendors on Footpath

Open Sewage on Footpath

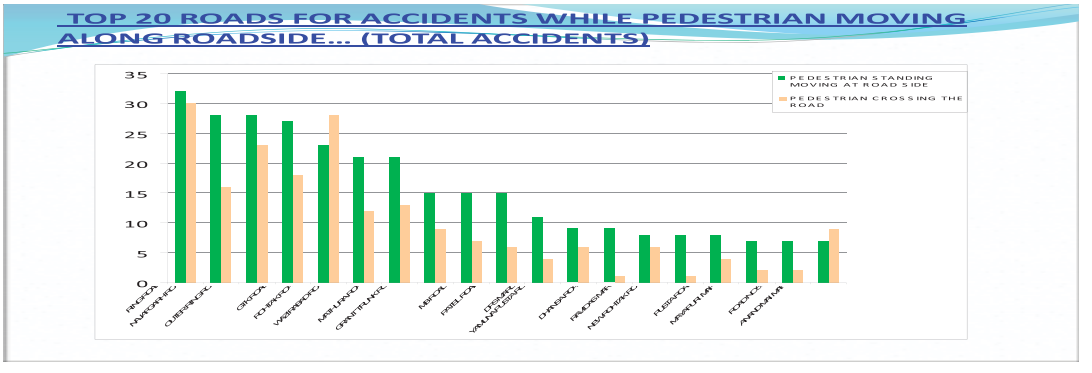
Electric Transformers on Footpath

Dustbin on Footpath

Unfriendly Footpath

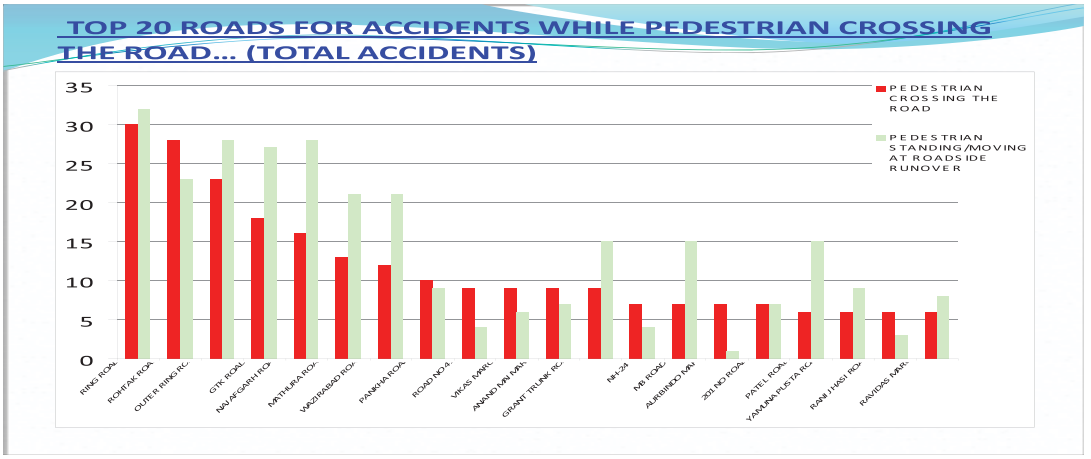
Taxi Stand on Footpath

Jhuggies on Footpath



- **The accidents caused while crossing the roads, accounts for 30% of pedestrian accidents,** highlights the importance of need of attention to pedestrian crossing facility.
- With **the increase in population both human and vehicular** there is struggle for space and mobility on the road. This brings the **human and vehicular conflict on the roads.** While the **vehicle driver is in hurry and speeds up at the maximum possible speed, there is limitation to the speed at which a pedestrian can move** (that too depend on the age, sex and health condition of the pedestrian and the luggage he/she is carrying). With the roads getting wider and wider to accommodate more and more vehicles, the road crossing is becoming more and more challenging. Any mis-calculation on part of any human (driver/ pedestrian) results in impact that injures the pedestrian and its **severity depends on the speed and the mass of the vehicle.**
- **The normal option for preventing such accidents is by providing signaled crossing for the pedestrians.** But this is done by stopping the vehicles for some time (few seconds or a minute). But with high density of pedestrians and their need to cross the roads this frequency of halting increases which lowers the average speed of vehicle and on some

congested roads this frequency becomes so high that average speed of vehicle comes down to 10-15 Km/hr (the average speed of a cycle) which takes off all the advantage of moving in vehicle that can move at far-far high speed. Thus, it is done at the cost of the mobility of vehicles. And in todays **fast moving world all the advantage of time saving by fast moving vehicles is lost. Long halting of vehicles adds the emission and pollution level.** It adds the frustration level and increases the chances of error.



- The other way out is the **segregation of traffic and pedestrians movement (for crossing). This can be done either lifting the "fast moving and heavy vehicles" (flyovers and elevated corridors) or by providing FOB** and subways. **FOBs are cheaper and safer than subways, flyovers and underpasses.** So it could be better option.
- The arrangement of making **FOB with guided paths can be preferred over pelican signal crossing** or red light crossing for pedestrians on NHs and high speed corridors for the following reasons:
  - The **risk factor is still higher in signal crossing due to the possibility of human error** and high speed of the vehicles corridors, especially during lean hours.
  - **Halting of traffic** even for few seconds or minutes **add to the congestion and pollution**, especially during peak hours.
  - This **halting** and slow movement of traffic on **mass level adds to the burden on GDP** due to extra fuel burning.
  - This also **increases the frustration** in the minds of driver and the pedestrian which sometimes lead to road rage.
- But there are few things that are to be taken care of while constructing FOB to make sure that it is effectively used.

Some of the Pros and Cons of present FOBs:

- If FOB is **situated away from the actual place of need**, so people prefer other means.

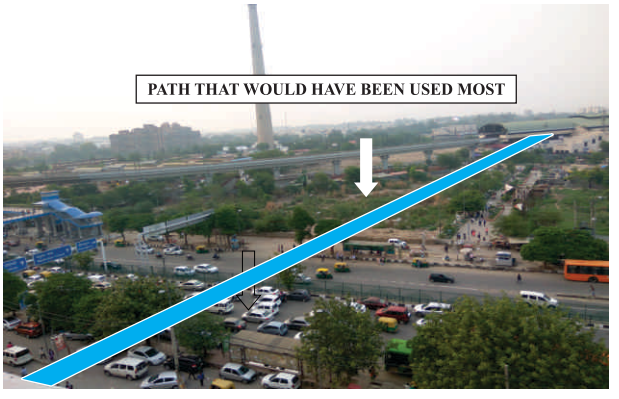

ACTUAL PATH OF NEED


WHAT PEOPLE PREFER:HIGH GRILLS BECOMES JUST HURDLES

- **If the FOB is provided at the intersections where actual crossings at the ground level is possible, people prefer to cross road at ground level,** so there no use of high grills provided on divider. Vehicle-pedestrian conflict remains and pedestrians continue to obstruct traffic risking their lives. The purpose of making FOB gets lost

- **People like comfort** and don't prefer climbing – getting down again climbing just to cross roads. When it is possible to provide a safe and more comfortable skyway directly and safely dropping them at the point of need/work.

- **When around 40% of passengers getting down have to go to the complex the mall** and the metro station can be connected by the skyways, with small exits at other points of attraction in between.



- **The extended dropping into the complex platform shall reduce the conflicts on the service road too.** These small one time efforts in construction can reduce numerous conflicts, and such small improvements can contribute in large scale reduction in congestion.

- **Unplanned ramp landing on opposite side of bus stand** or place of footfall becomes useless.

NO STAIR/ ESCLATORS TOWARDS BUSSTAND

LANDING NO WHERE

- **FOB on two lane roads with open intersection, without escalator** having ramp that increases the effective from 20 m to 200 mts never **attracts people** and is wastage of public money.

- The FOB or skyway **to be designed from the point of view of user.**
- To provide maximum facility to the user having **potential to attract people and has features to increase his comfort.**
- It may include **architectural design to provide facility at the right place** eg having escalator ramps , double story escalators.

STARTING RIGHT FROM THE EXIT PIONT OF VEHICLE (LIKE BUS STOP, METRO STATION)

CONNECTED BY SKYWAYS/ GUIDED PATHS

WITH LIFTS AND ESCLATORS, THE PROBABLITY OF USE REDUCE TO HALF WITHOUT ESCLATORS

HAVING SIDE GRILLS TO PREVENT PEDESTRIANS LANDING ON ROADS

POINTS CAN BE IDENTIFIED FOR MAKING FOB/SUBWAY ON SIMPLE CRITERIA LIKE 1000 PERSONS CROSSING THE ROAD FROM THE SAME POINT PER DAY.

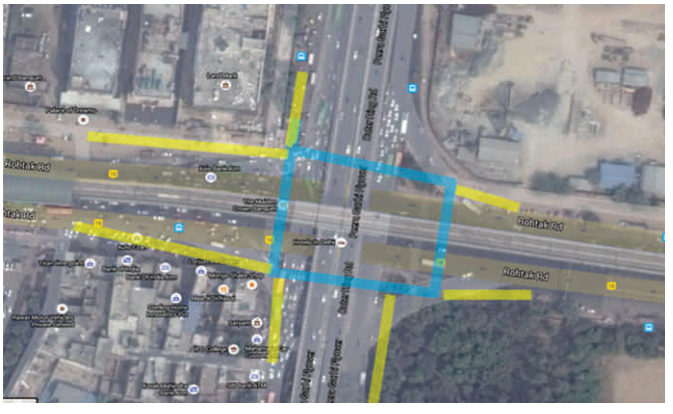
Thus, we need to set the priorities and improve our planning. We need to give the utmost importance to pedestrian safety, to secure these pedestrians from their killer vehicles. We need to segregate them from other road users. The simple steps that can be taken to achieve this are:

1. Number of accidents while pedestrian crossing the road on NH-8 was zero during 2015. It is completely covered by high grills on the median. Similar, action can be taken on other on NHs, Ring Road, Outer Ring Roads and major Arterial Roads and **high grills on the central verge should be fixed on all these roads.** All the pedestrian crossing on these roads should be closed (except at the major intersection), **but this should be done after making safe passage for pedestrians to cross the roads, proper FOB/Subway to be provided for pedestrian.**

2. The NHs pass through villages and other heavily populated areas. These roads are wide 6-8 lanes and have vehicles moving at high speed. These local people have to cross these roads for their daily needs and become victim of high speed and heavy vehicles. **To reduce accidents due importance to be**

given to their needs of local people and right arrangement should be made to cross the road.

3. If these roads are not elevated corridor the no. of FOBs provided for crossing the road should me more. **Many FOBs can be provided at small distances, if these are potential road crossing points. Life and safety of the locals is equally important and should not be ignored for speed.**
4. **If making FOB is not possible, proper pelican signal should be provided for pedestrians to cross the roads.**
5. **Providing of FOB/Subway should be must for all the six lane / eight lane or more roads.** Crossing Highways now a day, particularly in Delhi where the vehicle density is very high, is like crossing an unmanned railway track or rather tougher than it.
6. These **FOB/Subway/underpasses should be modified to accommodate slow moving vehicles (cycles/ Rickshaw/E-Rickshaw) at places where its number of is high.**
7. **Footpath should to be properly developed it should be separated from road by grills** to prevent pedestrians from coming on road.
8. **FOBs should be equipped with escalators to make it more people friendly.**
9. The **location/point of providing FOB should be as per the requirement of the users** (It has been found that shifting location even by 50 meters makes it ineffective).
10. **Similarly, the design of the FOB/Subway should be as per the requirement of the intersection or locations.** It can be/can also be extended to cover service road or extended up to the shopping mall complex's platform or into the bus terminal if it is more convenient for people using it and more is the need of most pedestrians landing there.
11. **Thus, we need to develop guided paths/skyways instead of just the foot over bridge/subways for pedestrians at the major intersections** and crossing. These guided paths should lead them to their desired destination ie bus stand/metro station/shopping complex etc.
12. There is movement of thousands of people as pedestrians at the intersections like Peera Ghari for changing direction of travel of public transport. Their movements on the roads create conflict with the vehicles. This makes them unsafe and also obstructs the vehicular movement which adds to the congestion and pollution.



13. **If elevated guided paths/FOB/skyways can be designed for their safe movement, right from the alighting point from first vehicle to the boarding point of second vehicle,** people will have not to move on road making themselves safe and also reducing traffic congestion.

14. **The encroachment of foot path by vendors needs to be discouraged/ removed.** Also the rehri and hand cart vendor needs to be removed from all these roads. The high grill segregating the foot path and roads will help this.

15. **Separate bus bay to be provided at all the bus stands extending the road side ways.** The bus bays should be long enough to accommodate 2-3 bus (as per the requirement needs of points) and grills with gap only at the position of gates to be provided at the bus stands (as provided in case of metro stations having high rush).

16. **All the major intersections like Peeragarhi, Singhu border, Mukharba chowk, ISBT etc. needs to be individually designed according to the composition of public transport (DTC, Cluster Buses, Roadways buses, Gramin Sewa, RTV, TSR, Rickshaw, E-Rickshaw etc)** and pedestrian destination at that stand/intersection (like shopping complex/metrostation/college etc) thus again segregation the pedestrians from road and not allowing them to come on road.

17. **A separate halting space for other public transport vehicle like TSRs/Gramin Sewa to be provided.** This again, separated by railing to make them stand in a single queue not allowing the pedestrians to come on road.

18. Important junctions like singhu border, peeragarhi chowk, madhubhan chowk, ISBT, mahipalpur flyover etc are to be developed into proper hubs where roadways passengers, DTC/CBUS passengers, Gramin Sewa, TSRs and E-Rickshaw etc are systematically available to the users safely interchanging from one mode to another and minimum or no movement of pedestrian on roads.

19. **Public convenience/dustbins should be provided at the hubs and at small distances on NHs** to facilitate the users and to keep the roads clean.

20. **Providing more information of modes of transport to the users at the exchange junctions like ISBT and Mukarba chowk** so that people particularly new comer easily get information of his next mode of transport at the exchange hub without roaming to much unnecessarily on the roads . This information can be in the form of:

    a. **Route maps of the DTC/Cluster buses like that of the metro route maps to be displayed on the bus stand** at least at the major intersections and transport hubs.

    b. **Sufficient direction boards for the passengers to get next connecting mode of transport** or to reach nearby important places safely through footpaths and foot over bridges.

21. **Thus we need to make all the NHs, Ring Road, Outer Ring Road and other important arterial roads by reducing the movement of pedestrians on the carpeted area of the road to minimum and making it virtually pedestrian free zones.**

PART – II (EXTRACTION OF SPACE)

The improperly parked vehicles not only add to congestion on road but also play direct/indirect role in causing an accident. Thus, there is need to extract road space from these unnecessarily parked vehicles:

- This can be done by making a quick **policy towards the disposal of old vehicles in which the state transport authorities can collect/call the over 10 years (diesel), and over 15 years (petrol) vehicles from the willing owners to deposit their old vehicles at the prescribed scrap rates.** This will not only guide the confused people wondering what to do with the old vehicle, but also it will make space on the roads and other parking area. As the **figures of these vehicles is around 25 lacks just for Delhi registered vehicle.**
- This will help in **reducing not only accidents but also pollution** by reducing congestion and by **bringing safer new vehicles on road.**
- Inviting the **private participation in making the multilevel (underground /Terrace) parking** spaces in highly congested residential and market places and allowing the parking rent/parking fee to be collected by the owning agency of the parking lot at the fixed/regulated rate.

  Later making legislation for not allowing to park on road or taxing the vehicles parked on road.
- **Parking 20-50 mts near intersection (or in the bus lane) can be restricted by making notification.**
- Similarly, **the corner (sweet) shop needs to be discouraged.** License of shops or banquet halls or other such places should not be renewed without parking place. (that is actually never available).
- **Road side parking can be alternated with morning and evening peak hours.**

PART – III (USE OF TECHNOLOGY)

In the digital world a lot many things are possible a lot more easily once our data is in digitized form. There is urgent need of digitization and integration of all the vehicular as well as driving license records data at all the authorities.

- The vehicle and the driver both are free to move anywhere in India hence can be involved in traffic violation or an accident anywhere in India. **This data should be centrally maintained can be accessed by officials from anywhere in India to ascertain the previous traffic violation and conviction in accidents.**
- **The Driving License data can be linked to the Adhaar Card to remove the duplicity.** It is found that the drivers are using more than one D/L issued from different authorities and their previous violations and involvement in accidents cannot be established.
- The road accident cases are registered U/S 279 IPC i.e. due to rash and negligent driving by the driver. Similarly, the entire driver related violation e.g. red light jumping, dangerous driving, drunken driving, stop line violation etc. are committed by the driver. The cause of accident in more than 77% cases is the driver's fault. So for most of the accident cases **it is the driver who commits the accidents. We need to identify those persons who are more probable to commit the accident again,** based on their previous track record of driving **and stop those persons from driving who are dangerous to other road users.**

- **In India more than 500000 road accident cases are registered U/S 279 IPC i.e. caused due to rash and negligent act of the driver. Around 1.37 lacs are fatal accidents.** The figure was more than 4 lacs for total accidents and more than 80000 for fatal accidents even in the year 2005. Assuming that Even if half of the cases ended in conviction, there is vast data bank of information of drivers but **this information of involvement of 200000 (approx.) driving license holder per year is never is never utilized and updated at the transport authority.** This is large figure and all this data goes in vain. And many of these drivers continue to drive on Indian roads even after getting convicted in one or more simple or fatal accident cases in different areas of India. This conviction details never gets updated at the transport authority and hence no action is taken by the authority.
- **The policy need to be made to send the conviction reports at the courts relating to road accident cases directly to the concerned transport authority to update the driving license record.** So that the appropriate action regarding suspension etc can be taken, particularly in case of repeated of offence/violations.
- **Similarly all the digital data of driver related traffic violation like red light jumping, dangerous driving, drunken driving or driving with over-speed should be clubbed with the driving license.** Wherever data is maintained in digital form it should be shared with the transport authority and clubbed with the centralized liscence record.
- **As the criminal data of is maintained at NCRB, similarly all the data of drivers involvement, conviction and traffic violation should be maintained at the transport authority and to clubbed with the license number.** Every involvement should be given appropriate negative points and the transport authority should take the appropriate action like suspension or cancellation of D/L accordingly immidiately.

Not using any information related to the driver is like knowingly allowing the more accidents to happen.

- **Cameras to be fixed by state at all the major intersections** on all the major roads at (prescribed distance) to monitor roads, traffic and to prosecute the violators for offences like over speed/red light jump, stop line, lane discipline etc.
- **Inspection of roads for up gradation, repair, light conditions** etc can be done through cameras.
- **The link/feed of the camera for prosecution should be send to directly the transport authorities, which can be appropriate action against vehicle owner** and communicate through GPS device/other vise and call the vehicle for prosecutions or other action like suspension of permit etc and also suspension/cancellation of driving license etc.
- **Fixing of GPS device with display screen can be made compulsory in all the commercial vehicle.** This device will be help in:
  (i) Checking the speed of vehicle.
  (ii) Checking entry conditions on roads.
  (iii) Identifying the vehicle involved in accidents/crime.
  (iv) It can act as medium to provide information to the user vehicle regarding entry condition/speed warning, jam condition and also his prosecution details.
- **Records and live data of GPS tracking to be kept at authority level it self, speed prosecution can be done directly by computers** using GPS information given

by GPS device after giving warning at the authority it self or can act as the speed regulator according to the area.

- Road wise speed limit data and entry condition data can be made available to driver through GPS device.
- **It can give information, warning, can act as speed governer or even prosecute based its scientific information** if the speed exceed the limit or it enters in no entry area.
- **ALCOHOL DETECTION SYSTEMS:** Internationally, drunken driving is considered to be a crucial road safety issue. **An alcohol ignition interlock device, a breath alcohol analyzer can be connected to the ignition of a vehicle, which cannot be started unless the driver passes the unit's breath alcohol tests.** It can be a major deterrent to drinking and driving.

PART – IV (IMPROVING ROAD CONDITION)

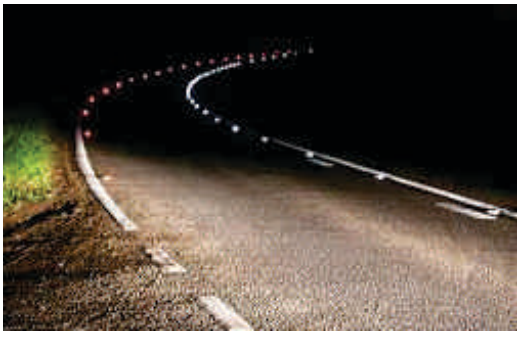
Road design, road environment, road marking and road furniture are important for facilitation of road users and smooth and safe flow of traffic. While the road design and environment assist the driver in safely moving the vehicle on road; the road sign, road marking and road furniture, if properly placed, helps in preventing the accidents and reducing the severity of accidents.

Thus, these are to be given due importance. Unfortunately, most of our roads (except in NDMC area) score poorly for these primary features of roads. All major arterial roads should be surveyed for following things can be done to improve the safety on the roads.

1. **Providing nose protection** to all the protruding noses on roads.

2. **Fixing reflectors** at start of all the dividers.

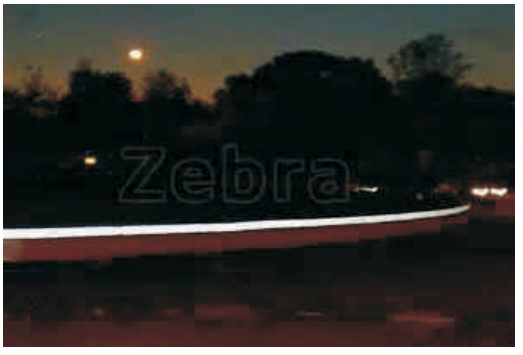
3. **Marking lane with reflective paints** on all the roads.



4. **Fixing of cats eye on these lane** marking as well as on the sides of the road.
5. **The road markings (lanes and stop lines etc.) should be should be repainted after regular intervals** (say three months or six months) because just in few months when it gets dull the reflective blaze is lost and its benefit during night is lost (when it is needed more).

Similarly, vehicles from halting arms of the signaled intersection encroach into the common area of intersection without stop line, which becomes cause of congestion or accidents. These vehicles can't be prosecuted manually or using technology taking photographs as it does not fulfill the legal requirement.

6. **Reflectors/reflective paints on side railing, poles, and trees of road.**



7. **Providing side protection/railing especially on bandh roads** or roads along with drains/canals etc.

8. **Road markings are helpful in changing the lane in advance to avoid the conflict** near the bifurcation point. Eg. For loops near Dhaula kuan or AIIMS.

9. **Illumination of roads should to be given importance particularly in outer and rural areas.** Many stretches of NHs, Outer ring road and other arterial roads remain dark and become the cause of accident. This nowhere gets pointed out. Illumination is important in preventing pedestrian and cyclist accidents.

10. **Cautionary sign** to be fixed well before schools, speed calmers, cuts in divider merging/diverging.

11. **Appropriate speed calming measures** to be made as per the requirement of the road.

12. **Pseudo speed breakers before intersections**, left turn start of divider or nose of flyover, at place of merging traffic be provided

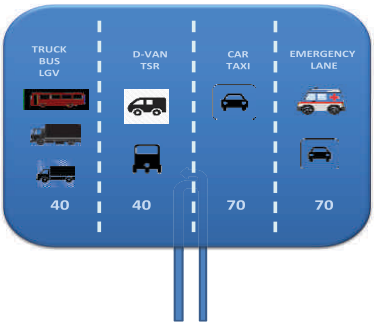
13. Speed calmers on major roads should be preceded and followed by the installation of **pseudo speed breakers**. It acts as better warning agents than display boards.
14. **Speed calmer**/mastic strips to be placed **on minor road just before it meets the major road**, it stops the random entry of small vehicles into fast and heavy movement of vehicle on major road.
15. Pseudo two wheeler tracks can be made for safe and disciplined movement of two wheelers on major roads at two wheeler Accident Prone Zones.
16. **Unnecessary cuts** on road medians should be **identified and closed.**
17. The merging of **minor roads**, having movements of two wheeler and slow moving vehicles should be studied and planned to **avoid direct merging into highways and other major roads**.
18. **Planning of intersections needs to be done as per the composition of the vehicular movement** for eg. at Shastri park red light importance is to be given to the slow moving vehicles and movement of the cycles, cycle rickshaws. Experts can be involved for the segregated safe movement of these vehicles.
19. Slow moving vehicles and two wheelers prefer to move in shorter wrong direction to cross the road if 'U' turn or the proper road crossing passage is a far away (more than a km.)

    For eg. as on NH-1 for vehicles coming on Sanjay Gandhi Transport Nagar, on Rangpuri on NH-8 and many cuts near Nangloi on NH-10. Such **facility can be provided by making underpass or providing service roads.**
20. All the major **intersection should be made of a little elevated with roughened surface to slow down** vehicles at intersection.
21. Besides **these roads can be improved by fixing overhead boards on NHs** and major (six/eight lane roads) showing **speed limit and vehicle permitted in that lane.**

DEVELOPING BOARDS FOR LANE DESCPLINE AND SPEED LIMIT AT START OF NH1 AT SINGHU BORDER AND AT MUKHARBA CHOCK.

22. These boards should also be fixed on the central verge a distance at each km.

BOARDS ON CENTRAL VERGE AT EVERY KM
TO REMIND AND CREATE IMPACT.



23. **The repair and construction work on road and road side should be well protected** with sufficient sign boards, reflectors, illuminators and appropriate number of volunteers to be deployed for managing traffic.

24. There should be **strict time limit for these repair work** and relaying of roads by the repairing authority should be a made essential. It is found that many road owning as well as other agencies like Jal board, sewer repair units, leave the roads inlaid even after completion of work.

25. **There should be coordination between different agencies which dig the road or road side** for fixing pipes (water, sever or gas), laying cables or repairing or upgrading footpath or divider etc. All the repairing **should be done with one time or minimum digging.** It has been found that hardly few months after the first agency has finished its work, the other agency digs the road. And people using the road continue to suffer again and again.

26. Quick repair of pot holes on the roads.

27. **Repairing/re-fixing of worn out** speed calming measures like mastics strip, rumble strips, pseudo breakers and fixing of cats eye should be done at regular intervals as in around six months these gets worn out and becomes ineffective.

28. **Anti-Glare Screens:** Anti-glare screens should be provided on the top of the median throughout the length of the Flyover for cutting the glare of the headlights of the vehicles.

Typical Installation of Anti-Glare Screens on the Median

29. **Cleaning of Pavement and Repaingint of Road Markings:** Periodic cleaning of the pavement on the deck of the flyover is required in order not to let the dust, sand or other granular materials accumulate on it. Also, repainting of all the Road Edge Markings, Centre Line Markings and Chevron Markings in the gore areas are required.

30. **Better Delineation of Road Edges:** Provision of road studs and clamp-type delineators throughout the length of the flyover is highly recommended. It is also recommended to periodically clean and/or repaint the crash barriers and median regularly in order to aid in better delineation of the road edges.

31. **Road Edge Delineators with Guide Posts:** The Guide Posts with Delineators shall be installed at a distance of 50 mm from the edge line. Constant distance should be maintained between the guide posts and the pavement edge on a section. For longitudinal spacing requirements, Section 5 or IRC:35-2015 should be followed.

Solar Delineator with Guide Posts and their Typical Installation

32. **Road Edge Delineators on Guard Rails:** These delineators shall be clamped on the guard rails wherever they are provided as shown in below. For longitudinal spacing requirements, Section 5 of IRC:35-2015 should be followed.

Solar Delineator (Clamp-Type) with Typical Installation

33. **Crash Cushions:** They are to be installed as nose protection measures at designated places to serve the dual purpose of road delineation (through chevron sheeting provided on the cylinder portion) as well as to attenutate the impact of a crash on vehicles. Their typical installation is shown below. They are required at all the diverging points on the flyover.

Typical Installation of Crash Cushions at the Gore Area

34. **Public conveniences with parking facility should be provided on both sides** of NHs and on all major roads to deter people to park their vehicles road only or road where can cause conjuction and accidents. Similarly, dustbin should be provided at visible spots on main roads to stop people littering of empty water bottles and waste/packaging of food and eatables, which can cause accidents when thrown on road from moving cars or buses.
35. Regular survey of road by road maintaining agency for improvement and repair on above mentioned points to be done.
36. Website/facebook/mobile app to be used to receive public complaints and suggestions.
37. Area incharge of road maintaining agency to be made responsible for keeping the road standards up to the mark.
38. Yearly road safety audit to be done on all major roads.

PART – V SPEED: What is known?

1. An increase in average speed is directly related both to the likelihood of a crash occurring and to the severity of the crash consequences.
2. A 5% increase in average speed leads to an approximately 10% increase in crashes that cause injuries, and a 20% increase in fatal crashes.
3. **Pedestrians have a 90% chance of surviving a car crash at 30 km/h or below, but less than a 50% chance of surviving impacts of 45 km/h or above.**
4. Safe speed thresholds vary according to different types of road, different types of collision and different road users, with their inherent vulnerabilities. Effective speed management needs to take these and other variables into account.
5. **Zones of 30 km/h can reduce crash risk and injury severity and are recommended in areas where vulnerable road users are particularly at risk.**
6. Apart from reducing road traffic injuries and deaths, lowering the average traffic speed can have other positive effects on health outcomes (e.g. by reducing respiratory problems associated with car emissions). (Ref. WHO GLOBAL STATUS REPORT ON ROAD SAFETY - 2013).

PART – VI (LEGISTATION & CHANGE OF POLICY)

- Some laws can be amended and decisions can be made to make the traffic violations and offence deterrent. Similarly some changes can be made regarding permitted time limits of goods vehicle, location of liquor shops and spreading of level I (elevated) road network for segregation and smooth and safe flow of traffic. Points are discussed ahead in detail:

1. The offence of **fatal accident should be made non-bailable.**
2. **Penalty of road accident and violation traffic rules should be increased** to make it deterrent.
3. **Liquor shops should be removed from National Highways.**
4. Work of **peripheral ring road to divert and provide by pass route to non-destined vehicles entering in Delhi should be hastened** to decongest Delhi, to reduce pollution and to reduce road accidents.
5. **Restricting the time limit of HTV & Goods vehicles entering Delhi to (1200 to 0600 hrs).**
6. Making **ABS (Anti-lock Breaking System) compulsory for all the new registering vehicles.**
7. It should be made **compulsory for the two-wheeler company to provide two ISI marked helmet with every two-wheeler** sold. Manufacture can be directed to modify design **of two-wheelers to accommodate two helmets with/within the vehicle.**
8. **Sub standard quality helmets which are sold road side should be stopped.**
9. **Some policy should be made in regard to the long distance and long duration drivers.** For eg.
   I. Some guidelines/directions in this regard can be made that such **drivers take rests after continuous driving for four hours.**
   II. This should be valid for local cab drivers who overwork during day and night shifts and their fatigue

sometimes become the cause of accidents.

III. **Facilities of resting and eating points on NHs** should be developed at every 20 km so that it can be effectively utilized and implemented.

IV. **The fitness condition for vehicles** having long distance permit can be extended to **include the driver cabin condition and the facilities available to him.** It can include proper resting place for second driver, drinking water, light food for eating and small first aid kit etc.

10. Since ground level widening of road in almost done, **planning should include making roads at level-I elevated (or underground) level.** These are different from flyovers/underpasses as it covers not just one intersection, but a complete section or stretch of road, **taking the vehicle from one congestion free zone to the other congestion free zone without struggling through the slow speed traffic underneath or posing danger to the pedestrians moving there.**

This can be considered for:-

i. **Segregation of different types of traffic.**

ii. **Non stop flow of traffic on main arterial roads.**

iii. **Large scale reduction in fatal accidents.**

- The planning of elevated roads can be justified for the reasons discussed ahead.

Some of the facts that came to light in the road accident analysis done in the previous chapters are:

I. **Delhi roads carry vehicles of different size, mass, speed and compactness/ Strengths** eg. HTV's, Buses, Tempo, Cars, Two-wheelers, Hand carts, cycle rickshaw, cyclist and pedestrians all on the same road. Its like carrying Eggs, Stones, Plastic Balls, Nails and all types of vegetables together in a single bag that too without any separate safety packaging.

II. **Collusion** of two bodies on road **results in fatal accidents** if

a. **Speed is high** and

b. **Mass of impacting body is large.**

III. **24.49% (399 out of 1629) of the fatal accidents occurred on top roads** namely Ring Road, Outer Ring Road, Rohtak Road, GTK Road, Grant Trunk Road, NH-24, Mathura Road, NH-8.

IV. **83.54% of these victims include pedestrians, two-wheelers and cyclist.**

V. **87% of known offending vehicles include HTV's, Tempo and Cars.**

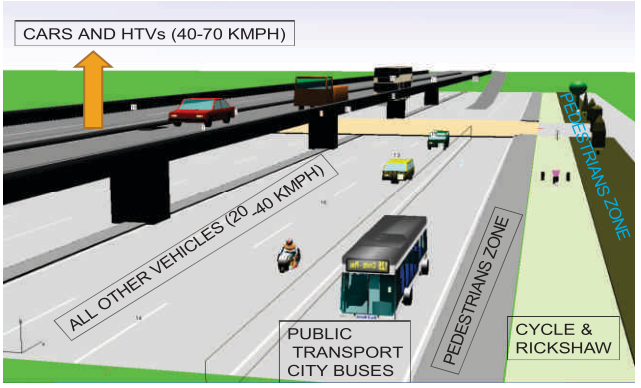
- The above mentioned roads are arterial life line of the city and help in reaching different parts of the city and criss-crossing the city.

Map 11.1 Delhi: National Highways, Ring Road and Outer Ring Road

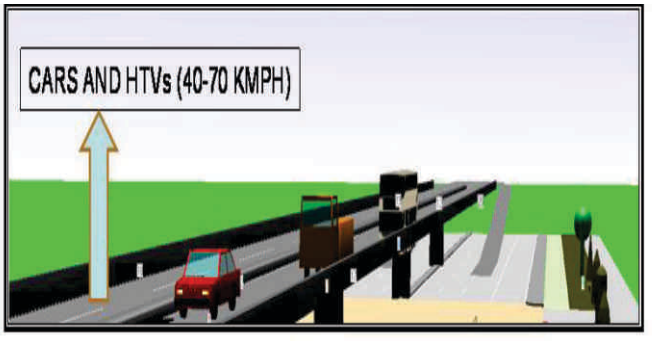
Remedy: The **simple solution can be by segregating above categories of vehicles/ road users as far as possible i.e. The heavy and high speed vehicles need to be isolated from most vulnerable pedestrians, two-wheelers, cyclist. This can be done by making different speed zones for different type of vehicles.** The vehicles can be classified into following groups:-

I. Cars, Trucks, Tempos, Other State Buses **(High Speed And Heavy Weight) (40-70 Kmph)**
II. **Cycles And Cycle-Rickshaws.**
III. **Public Transport (City Buses)**
IV. **Pedestrians.**
V. **And all others. (20-40 kmph)**

The first group **(40-70 kmph) zone can be separated form the rest by making completely elevated corridors** (not just flyovers). The detailed road design is given below.

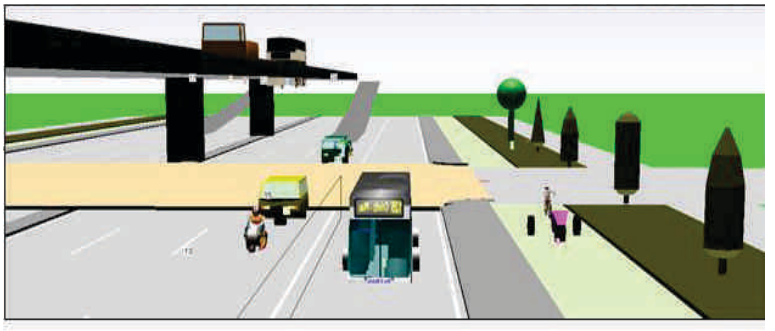


I. The Elevated corridor (Zone-1 40-70 Kmph)



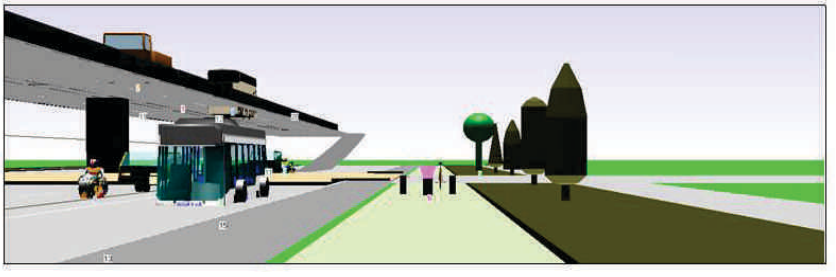
- It will **carry only four wheelers the cars, taxis, trucks, tempos, roadways and other state buses.**
- **Non-city buses,** no bus stands and **no pedestrians**.
- **No signals, no vendors, no encroachment** hence a virtual non-stopping zone.
- Hence no congestion. It will **carry the main bulk of Traffic.**
- Those intending to go left or right can get down before intersection.
- **Separate slant arm of road to be provided to climb or get down** of elevated corridor.
- The **speed can be monitored by cameras** fixed at different distances.
- **No pedestrians, no two-wheelers, no cycle/rickshaws, hence no accidents of theirs.**

II. The Public transport (city buses) section (zone-2)



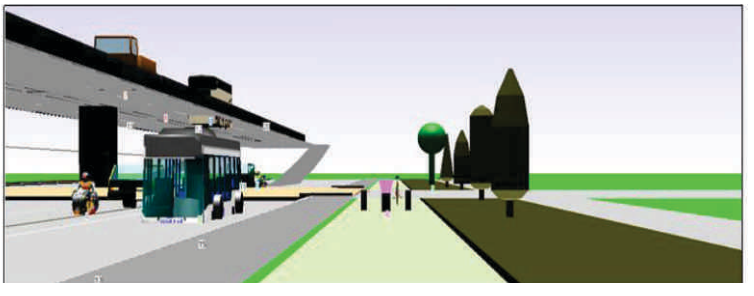
- It will carry **the DTC, Clusters and school buses and RTV's.**
- To be maintained more or less on the **BRT type format**. Separate zone for public transport, **but on the left side of the main road** separated by the grill from the main road on the ground level.
- Normal signal cycle as for other vehicle on the road. But will allow free flow as separated from the main bulk of traffic.
- **Entry and exit of passengers only at the bus stands.**
- No other vehicles allowed, so virtual safe public transport zone.
- No two-wheelers, no cycle/ rickshaws, hence no accidents of theirs.

III. The Cycle and Cycle-rickshaw zone (zone-3)



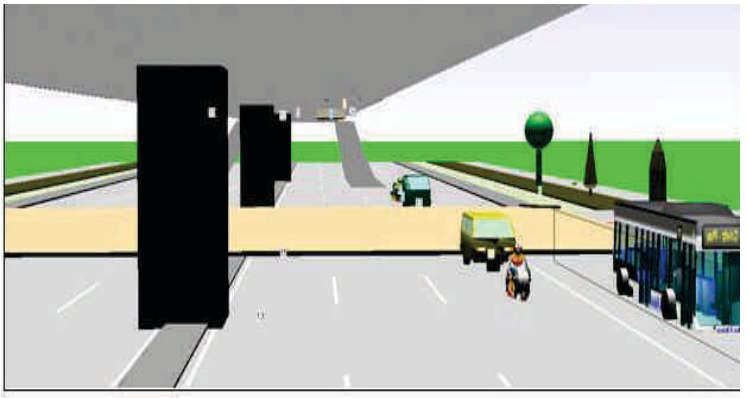
- Same on the style of BRT corridor on the left.
- It will carry **only cycles and cycle-rickshaw** safely (7% of victims).
- Shall follow the normal signal cycle at intersection.

IV. The Pedestrians zones



- On the **left of bus bay and on the left of cycle bay.**
- Pedestrian's path on the **opposite sides of the road to be connected by foot over bridges** passing under the elevated corridor.
- Foot over bridges to be provided if the normal intersection is far from a potential crossing point.

V. The miscellaneous bulk zone (zone-4, 20-40 Kmph)



- It will **carry all the miscellaneous bulk of Traffic.**
- **To keep safe, the two-wheelers are to be kept in it.**
- **All, including the vehicles descending from elevated corridor for left or right turn, have to follow the speed of the zone.**
- The **intersections are to be made of elevated and roughened stones to keep speed down.**
- Even if there are chances of accidents, the chances of it being fatal should be less.
- Normal signal cycles at intersection for all.
- **No vendors space (either on right or left) hence no encroachment hence smoother flow of traffic.**
- This arrangement will help in :
  - I. **Reducing accidents** by separating the major victims from their aggressors. If implemented on top arterial roads, **this can save 300-500 lives per year.**
  - II. **Increase the mobility of traffic**, particularly on the major roads.
  - III. **By-pass the heavy traffic** which un-necessarily burdens the city roads.
  - IV. **Improve the look of the capital city.**
  - V. **Reduce congestion and pollution**.

MEASURES TO REDUCE TRAFFIC CONFLICTS (AND HENCE CONGESTION, POLLUTION AND ROAD ACCIDENTS)

- **Principle :-** Reduction in conflict (perpendicular & head-on) in traffic movement and maintaining continuity of traffic flow.

1. Redesigning of intersections by removing signals:

- **Shortcomings/ disadvantages of traffic signals:-**

1. 75% of traffic remains static:

Consider an intersection having traffic flow of equal volume from all the four arms. With the normal signal cycle, traffic coming from any one direction can only be discharged at a time. This means that 75% of traffic will remain halted and only 25% of traffic shall move at one time.

This can happen even for the 4 cars approaching intersection from four different directions. 3 will have to wait for different timings and only one can move. Thus, signaled intersection can never make zero congestion, unless there is no traffic at all.

2. Low traffic discharge speed:-

In continuation of above assumption, if the maximum speed of movement of traffic flowing from the green signaled arm is 30Km/hr, the average speed of movement is (since the traffic started from rest)

$$\text{Average Speed} = \frac{(30+0)}{2} \text{ Km/hr} = 15 \text{ Km/hr}$$

But the actual speed of the whole traffic at the intersection (assuming equal traffic on all sides) is one fourth i.e 3.75 Km/hr

Actual Speed of discharge at intersection

$$= \frac{(15)}{4} \text{ Km/hr} = 3.75 \text{ Km/hr}$$

That is why it takes too much time to clear and normalize the traffic at signaled intersection.

3. Vehicle starts from zero speed:-

It also takes more time for a vehicle to start and pick-up from zero speed.

4. Adjustment of signal timings for different arms:-

The signal timing can never be according to the actual volume of traffic, in the four arms of the intersection, unless it is controlled manually. Many times vehicles on the three sides have to wait, even when the intersection is clear and there is no vehicle on the fourth green signaled section of the road. (This also prompts drivers to jump the red light and may cause accidents)

5. Synchronization of traffic signals can never be perfect:-

If there are traffic signals at small distances on a road stretch, say at every half or one Km of road, there is always a problem of synchronization of traffic signals. It is difficult to achieve perfect synchronization of all the consecutive traffic signals for all volumes of traffic.

6. Most Accident Prone Zones are intersections:-

As per the study conducted by Accident Research Cell, among the 176 Accidents Prone Zones identified during year 2015, 115 are the intersections of different types (normal intersections, T Points, Y Points etc.). Classification of above Accident Prone Zones into their types with their numbers is listed below:-

i. Multi-level intersection (33).
ii. T-Intersection (28).
iii. Intersection (26).
iv. Multi-intersection (26).
v. Metro station (17).
vi. Highway village (12).

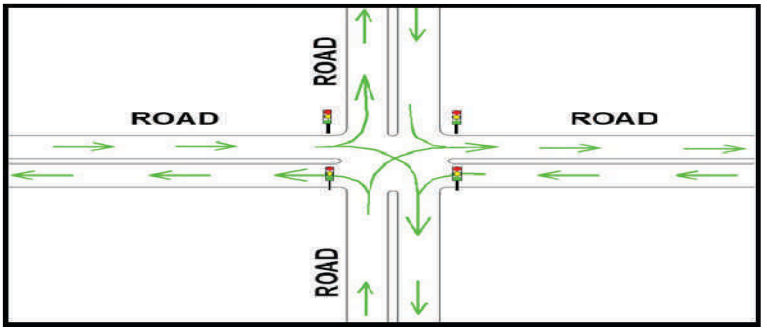
vii. Exchange hub (9).
viii. Hospital (8).
ix. Road stretch (6).
x. Bus stand (5).
xi. Flyover (3).
xii. Y-Intersection (2).
xiii. Round about (1).

There is only one round about among these accidents prone zones. One of reason is that it prevents the right angled conflict of vehicular movement as there is no straight crossing by the vehicles across the intersections. Hence, the Vehicle slows down at it.

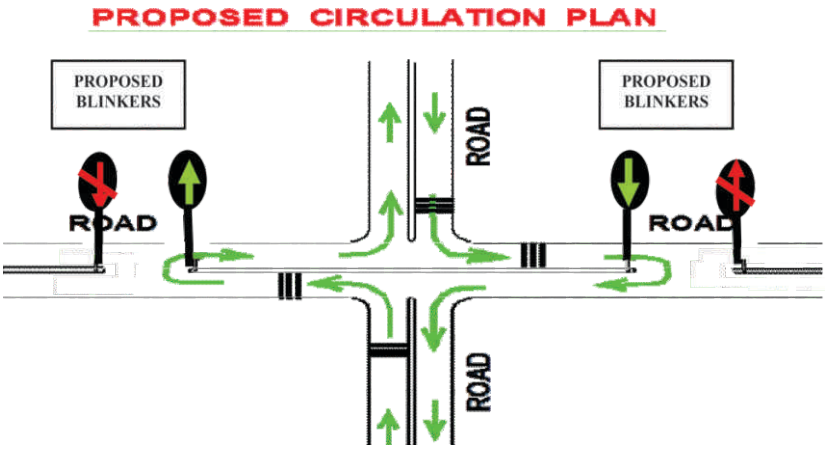
Alternative Method of Traffic Movement/ Proposal for continuous and non-stop movement of traffic at intersections and junctions (What can be done?)

- **The Concept of Oval Round About:-**

  Let us consider a normal intersection of two roads (with medians) meeting each other perpendicularly. In the conventional intersection, as shown below, there is an open area for crossing at the junction point of two roads. Traffic crosses this area for moving in all the four directions. This area has conflict of traffic coming from all directions. This conflict is prevented by making it signaled crossing, by allowing flow of traffic from one side at a time.



Now consider another arrangement of this intersection where the crossing at the intersection is closed for one of the roads (minor one) by the median of the major road and opening in the median are provided at a short distance (50 to 500 mtrs) depending on the volume of the traffic as given below.



As shown above, traffic can move in all directions by taking 'U' turn at the opening provided on the two sides, without conflicting directly at the intersection. Blinking signals can be provided at the cuts to clarify the direction flow of traffic allowed at cut provided in the median.

Advantages

1. **100% traffic in motion simultaneously:**

   The advantage of this arrangement is that there is continuous flow of traffic from all sides simultaneously, without halting of traffic coming from any arms.

   Thus, even if the actual average speed of movement of traffic on two roads is 20Km/hr and 10 Km/hr on the two intersecting roads the actual average speed of movement of whole traffic moving at the intersection (assuming equal volume of traffic from each side) is

   Average speed of movement of whole traffic moving at the intersection

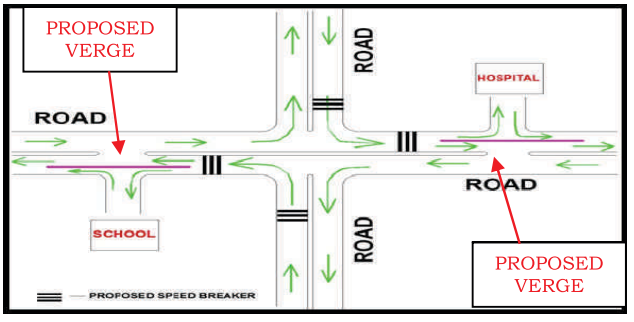
   $$= \frac{(20+10)}{2} \text{ Km/hr} = 15 \text{ Km/hr.}$$

   This is much higher than the conventional signal controlled flow of traffic where average speed of whole traffic crossing the junction was around 3.75 Km/Hr (even with the traffic moving at a speed 30 Km/hr). Thus, this gives better clearance of traffic and reduces congestion. (Similar arrangements of traffic flow at intersection have worked effectively well during construction of elevated corridors on Outer Ring Road at Deepali Chowk and Jaipur Golden Red Light etc.).

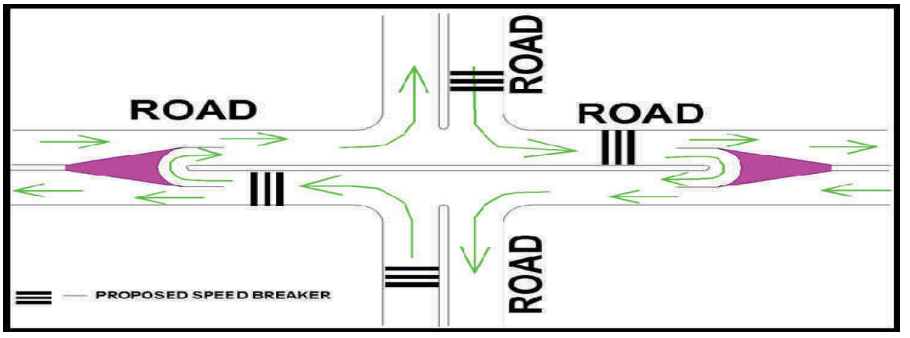
2. **Second advantage is that it reduces the chance of head-on collision to zero** (unless there is wrong side movement) and also reduces the chance of perpendicular impact. The vehicle approaching the intersection from minor roads has to slow down to cross it. In fact, it virtually acts as roundabout of different shape.
3. **There is no need of unnecessary halting of traffic** from three sides when the intersection is vacant.
4. **Reduces red light jump violation.**
5. **Acts as self regulator** depending on the volume of traffic coming from different sides. There is no need to change signal timing for different arms of intersections.
6. There is almost continuous flow of traffic from all directions and no vehicle halts to zero speed at the intersection.

Precautions to be taken while designing oval round abouts :-

1. **It must be ensured that there is no direct opening of any minor road, or any petrol pump or school or society close to the cut provided in median** as this could lead to wrong side or transverse movement of vehicles. This can reduce its effectiveness. Such direct flow should be prevented.



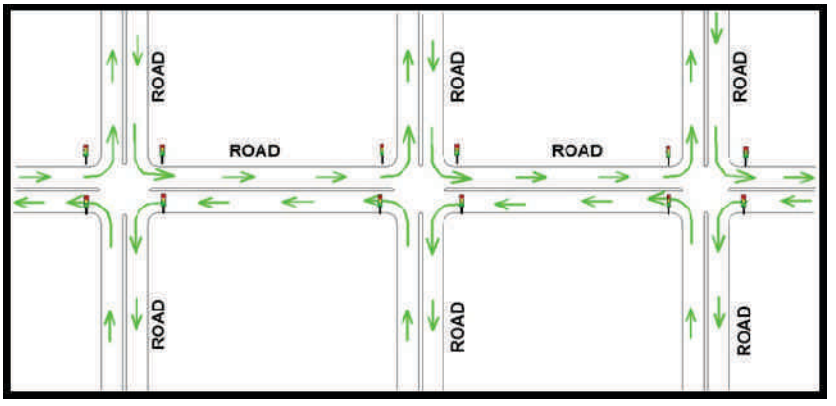
2. **Protection cover can be provided for safe 'U' turn of vehicles, if it is a major road.** Similar system is already working at many intersections for eg. Under Outer Ring Road elevated corridors at Jaipur Golden, at Bhajan Pura on Wazirabad Road and at Brar Square on Ring Road.



3. **Speed Calmer can be provided where the minor road meets the major roads and a little before the cut for the 'U' turn** to slow down the vehicles. (Speed-calmers to be preceded and succeeded by the pseudo-breakers. This acts as better warning than just warning sign boards.)
4. **If the pedestrian movement crossing the intersection is high, "all vehicle red and all pedestrians green" signal can be introduced** at the intersection for 20-30 seconds, after a 3 or 5 min. interval, for pedestrians to cross for all directions simultaneously. Timing of signal depending on the volume of pedestrians crossing the intersection.
5. **Routes of some of the buses may be modified to ensure the smoother flow of traffic.** It has to be ensured that the large buses do not halt the complete traffic while taking 'U' turn. If the frequency of bus movement is high, the route can be extended up to the appropriate spot so that it can turn smoothly.
6. **Similarly, the turning of heavy goods vehicles to be allowed from the appropriate spot only** (not at any U turn) where the road is wide, to avoid unnecessary halting of whole traffic.
7. **Numbers of cuts for right turn to be kept limited** and at proper reasonable distance, say at least ½ a km even on minor roads. (And such cuts not necessarily provided for every intersection or junction of roads)
8. **No parking/halting of public transport vehicle near the cut to be done to maintain the continuity of traffic flow.** Any parking of vehicle or halting of public transport vehicles for boarding and de boarding, clustering of TSR looking for passengers shall hinder the free flow of traffic.

2. Making stretches signal free (without building flyover and underpasses).

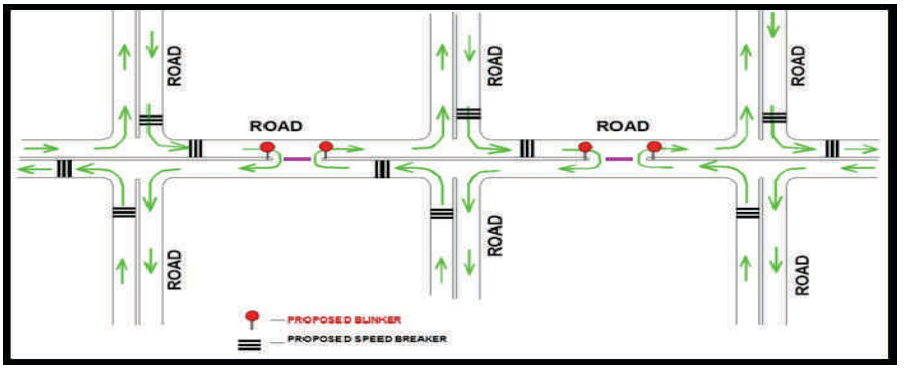
Consider a road stretch of few kms having intersections with light signals at every ½ km, 1 km or even lesser stretches of road. Such road can be between two major intersections joining two major roads eg. Rohtak road between Punjabi Bagh Chowk and peergarhi or roads inside Dwarka and Rohini eg K.N. Katju Marg, Road no 41 etc. These all have signaled crossing at small distances. The existing road stretches can be as depicted as given below.



There is normally synchronization problem between the traffic signals of consecutive intersections and the vehicle has to stop more or less at every junction. This is the case with the conventional form of junction we are presently using.

Roads with normal intersection crossing were good, when the majority of vehicles were in primitive form i.e. mostly slow moving traffic, with intermittent motorized vehicles. With the increase in the number of motorized vehicles we transformed the same intersections into signaled intersections to create a system to prevent collision/accidents and to provide turn by turn discharge of traffic from four arms, preventing interlocking/grid locking of traffic at intersection. This worked well till the increase in the vehicular population was moderate. Now, when the increase in vehicles is enormous, which is mostly motorized vehicles, there is need of developing a system which can allow continuous flow of traffic from all the arms of intersections simultaneously. The stopping of vehicles at any section can cause congestion within minutes. One solution that we worked out was by constructing flyovers and underpasses. But this cannot be done at every intersection and on every road. Also, it does not do justice to movement of traffic on all the arms and in all the directions, unless the intersection is modified with many loops like that of 'Dhaula Kuan' or 'Mukarba Chowk'.

Let us consider another arrangement of traffic flow in which all these red lights at each intersection are removed and all the intersection where the minor roads meet the major road is closed by the median of the major road. Thus, stopping direct transverse movement of traffic from the minor road, across the major road. Instead a cut is provided at a distance as in the oval roundabout. The road stretch can be depicted as below.



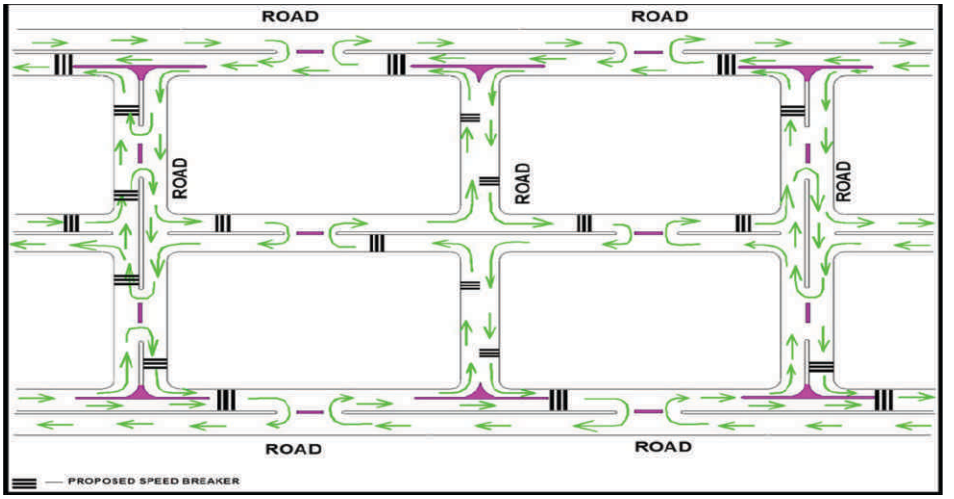
This will allow the continuous flow of traffic on the main road. Traffic at all the intersections will keep on moving and there shall be continuous discharge of traffic from all the arms of the intersections. It is in line with the basic principle of traffic flow "the movement of traffic in desired direction will always ease the traffic congestion and it is the stopping of traffic that increases it".

This can first be tested on small colony roads in Dwarka and Rohini for eg. K.N. Katju Marg or Dev Prakash Shastri Marg, Ridge Road etc.

If found successful, the system can be extended to other roads.

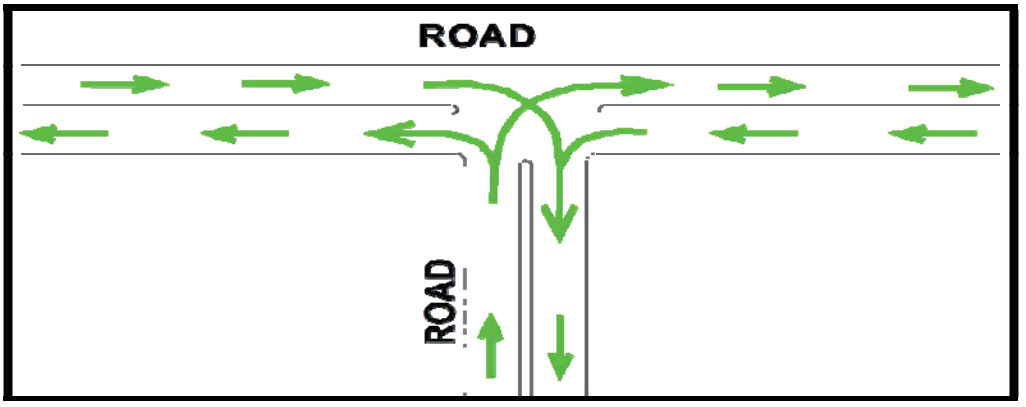
The directional flow of heavy traffic (i.e. heavy flow of traffic in one direction) during morning hours and is reverse direction during evening peak hours will assist smooth flow of traffic in this type of traffic flow arrangement.

This way complete grid can be made allowing continuous flow of traffic on all roads without signals at intersections (as in New Delhi area on most roads.)

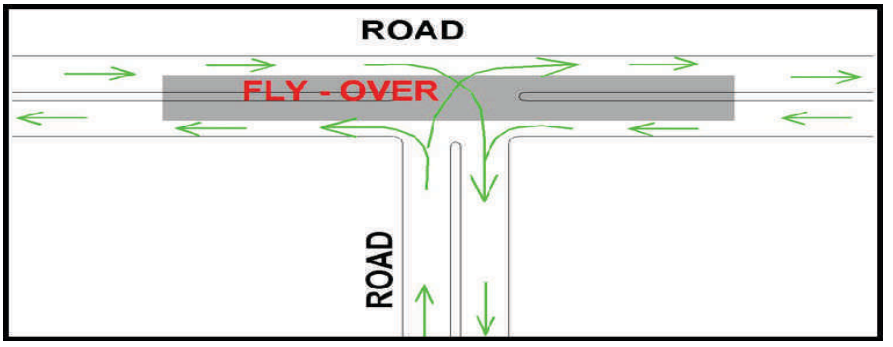


3. Flyover loops at 'T' point

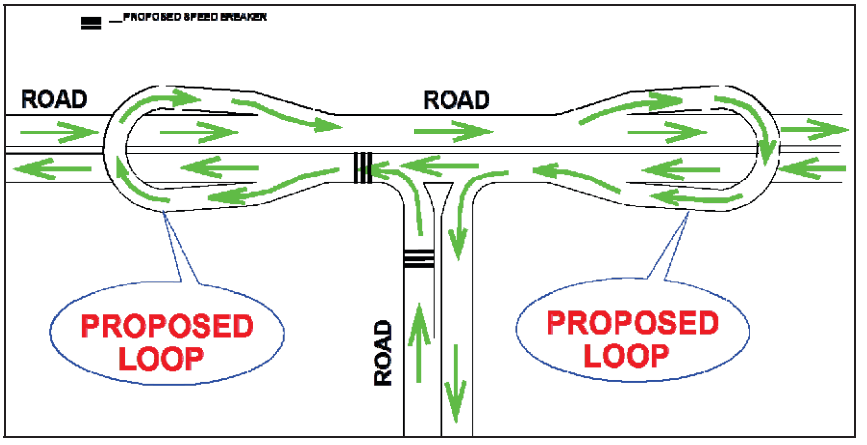
A normal 'T'-point intersection has three directional conflict points for the traffic moving in its three arms. These conflicts are prevented by providing traffic signals that allows turn wise movement of traffic at different arms of intersection. Violation by vehicles from any side may cause collision and hence an accident. The conflicted movement is shown below.



Using the conventional solution we think of making flyovers or underpasses on the main road. But this does not prevent the ground level conflicts; hence such multi-level intersections continue to remain accident prone zones.

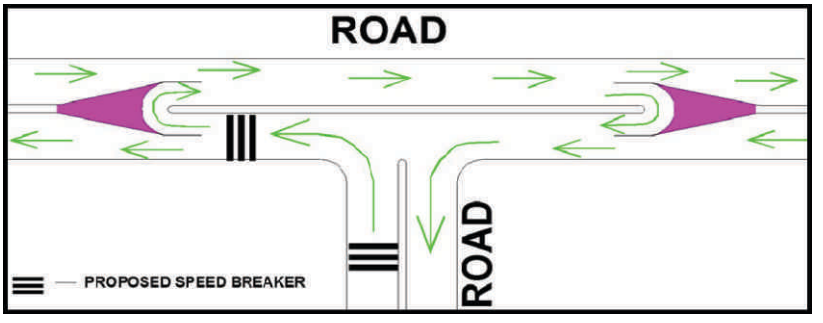


Instead, if the type of arrangement of traffic flow as depicted below is put in place, it shall reduce the conflicts of traffic movement by building just two flyover loops and shall ensure continuous flow of traffic from all the three arms of intersections.



The size of loop depends upon the volume of traffic at the intersection. This type of design can be good for T-points like Bhairon road-Ring road T-point and Majnu ka tila T-point on Ring road.

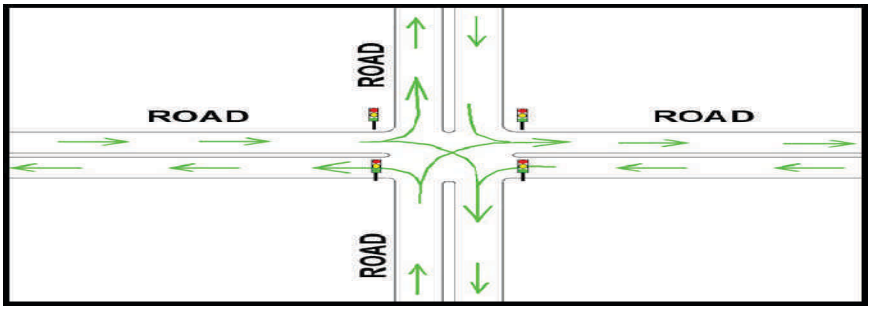
The other type of design of T-point intersection to give a continuous flow of traffic without making flyover loops is shown below. It needs greater stretch of road for vehicle to change the lanes before taking 'U' turn.



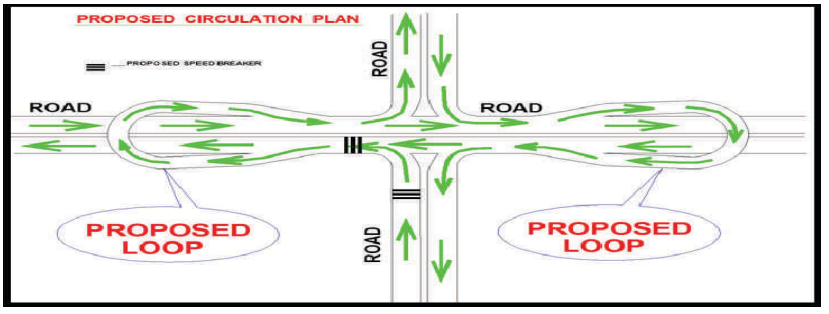
This type of arrangement needs more space and some protection design for vehicles taking 'U' turn, if it is high-speed corridor.

4. Intersection having four arms:-

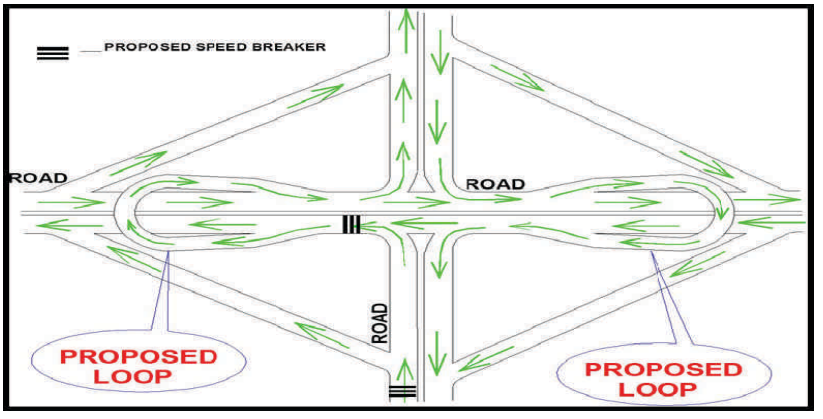
Consider the intersection having four arms flow of traffic movement. There are conflicts at the common area of the intersection in the movement of traffic from all the four arms. This is controlled by the signaled movement of traffic. Otherwise it may cause collision that may lead to accidents.



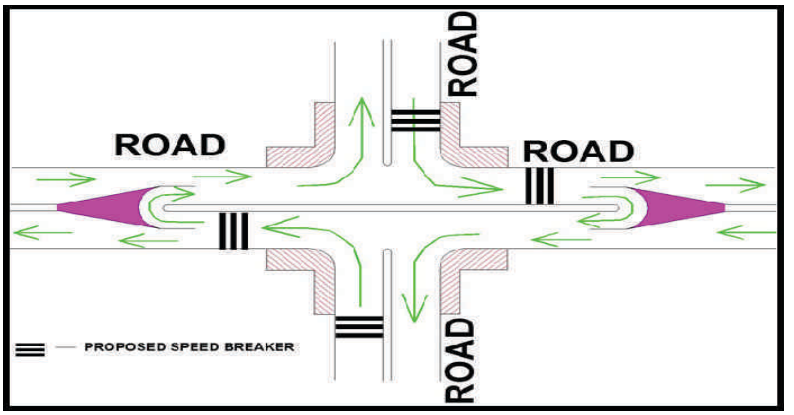
At such intersections traffic flow can be streamlined by constructing two flyover loops on the major road as in the previous case to allow the smooth flow of traffic at the intersection. Again the size of the loop depends on volume of the traffic at the intersection.



Separate free left turns can be provided to further reduce conflicts and smoothen the traffic movement.



The other arrangement can be of 'U' turn at the ground level, which needs greater stretch of roads for changing lanes safely and needs more space and some protection design at the place of 'U' turn, if it's a high speed corridor. The design of intersection is given below. Such intersection design can be helpful for continuous flow at traffic at intersection like Madhuban Chowk and Peeragarhi.



The places where there is heavy pedestrian movement across the intersection, an all red signal for vehicles and all green signal for pedestrian can be introduced for pedestrians to cross the intersection, with a gap of 3 or 5 minutes as per the requirement of the intersection. This can be done till better and safer road crossing facilities are developed for the pedestrians. Safe waiting platforms can be designed for pedestrians at the four corner sides so that pedestrians do not interrupt the free flow of traffic and become victims of some accident.

It is to ensure that there is continuous flow of traffic in the vicinity of intersections. Any parking of vehicle or halting of public transport vehicles for boarding and de boarding, clustering of TSR looking for passengers shall hinder the free flow of traffic. Separate/proper halting space to be developed for its.

5. Developing pseudo Two-wheeler tracks:-

There are around 55 lacs registered two-wheelers in Delhi. Their percentage share is around 64% of total vehicular population of Delhi. The percentage share is increasing every year.

Two-wheelers have been victims in around 34% of fatal road accidents during the year 2015. Two-wheeler riders were victims in 553 fatal and 3001 total accidents during the year 2015.

The percent share of two-wheeler as victims is increasing every year.

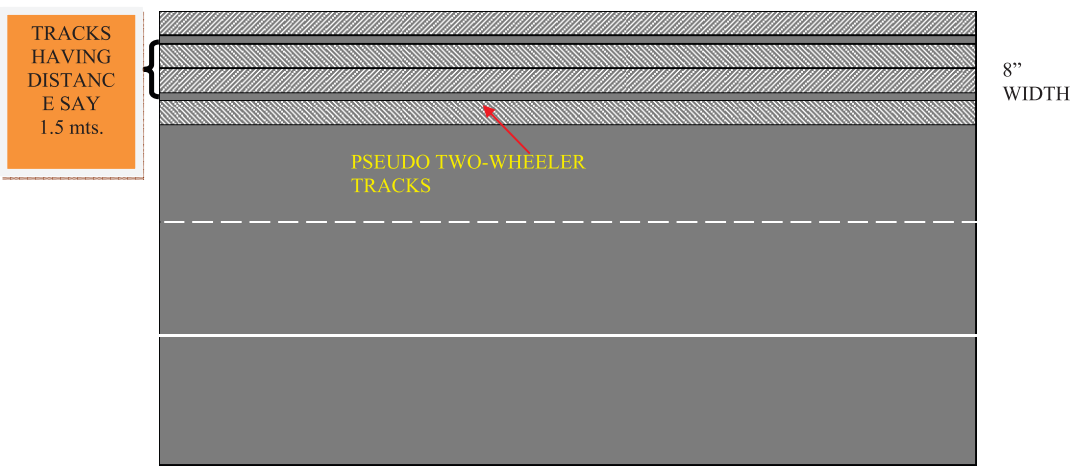
Year	TWW FATAL (victims)	TOTAL FATAL	PERCENTAGE
2012	560	1822	30.73 %
2013	596	1778	33.52 %
2014	555	1629	34.06 %
2015	553	1582	34.95 %

There are very few safety gadgets available for the two-wheeler riders. Though, a lot of research work has been done for the safety of the passengers in the cars, no solid protection is available for safety of two-wheeler riders, except for the helmet. Let it be anyone's fault, when there is impact, collision or even touching, it is the two-wheeler rider who remains at the receiving end. It results either in fatality or comparatively more severe injury to the riders. While the normal touching or brushing of vehicles results in only damage to vehicles, in case of two-wheeler it ends in injury or fatality.

With the ever-increasing population of vehicles on road, there is a struggle for space on road. Safety of two-wheeler riders has always been a cause of concern as, till now, no complete segregation for two-wheelers has been designed on the roads and no definite lane has been ear-marked for two-wheelers. On the left lane they are at the mercy of heavy commercial vehicles, while on the right they have to compete with high speed vehicles and in the middle lane they are exposed to the lane changing vehicles.

To secure these two-wheelers they can be segregated from other vehicles by developing pseudo two-wheeler tracks. These tracks can be designed using pseudo breaker strips as in the design given below.

PSUEDO-TWO WHEELER TRACKS MADE OF PSUDO BREAKER STRIPS



*The dedicated two-wheeler track should only be wide enough to accommodate the safe movement of two motorcycles/scooters at a time (simultaneously), without brushing each other but should not accommodate the axle length of four-wheeled vehicles so that four wheelers do not dare venture into the two wheeler track.

Where there is heavy two-wheeler movement or there are more two-wheeler accidents, such track can be placed on the extreme right lane of three or four lane road.

This arrangement shall allow disciplined straight movement of two-wheelers in two designated lines. It shall hinder their zig zag movement and also shall deter other four wheeled vehicles to normally enter this section (as there will be bumpy ride for all other vehicles except for the two-wheelers). At same time all vehicles can move in this area also, when there is congestion or heavy traffic in this section of road.

It can first be tested in small sections of two-wheeler accident prone zones like Madhuban Chowk underpass etc.

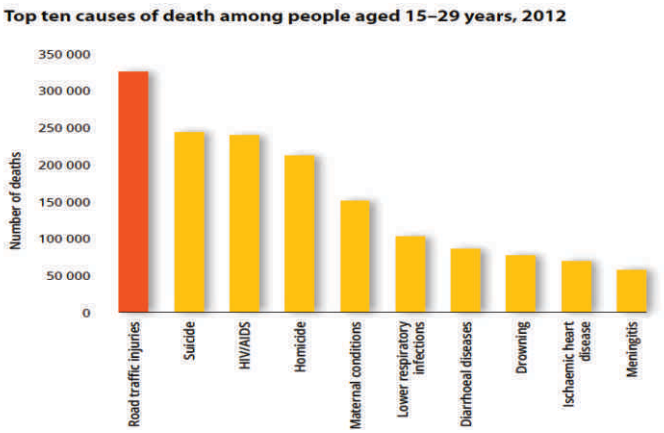
WHO GLOBAL STATUS REPORT ON ROAD SAFETY 2015:

More than 1.2 million people die each year on the world's roads, making road traffic injuries a leading cause of death globally. Most of these deaths are in low and middle income countries where rapid economic growth has been accompanied by increased motorization and road traffic injuries. As well as being a public health problem, road traffic injuries are a development issue: low- and middle – income countries lose approximately 3% of GDP as a result of road traffic crashes.

Although road traffic injuries have been a leading cause of mortality for many years, most traffic crashes are both predictable and preventable. There is considerable evidence on interventions that are effective at making roads safer: countries that have successfully implemented these interventions have seen corresponding reductions in road traffic deaths. Rolling out these interventions globally offers huge potential to mitigate future damage and save lives at a global level.

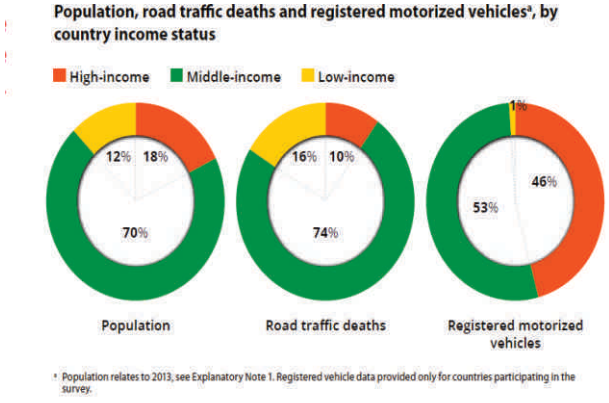
Some of the important points and extracts:

- Road traffic injuries are the number one cause of death among those aged 15-29.

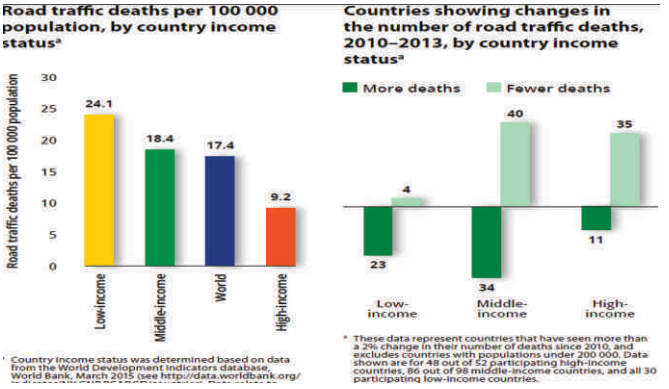


Source: Global Status report on road safety 2015: WHO

- Road traffic deaths and injuries in low and middle-income countries are estimated to cause economic losses of up to 5% of GDP.
- Road traffic death rates in low and middle-income countries are more than double those in high-income countries.

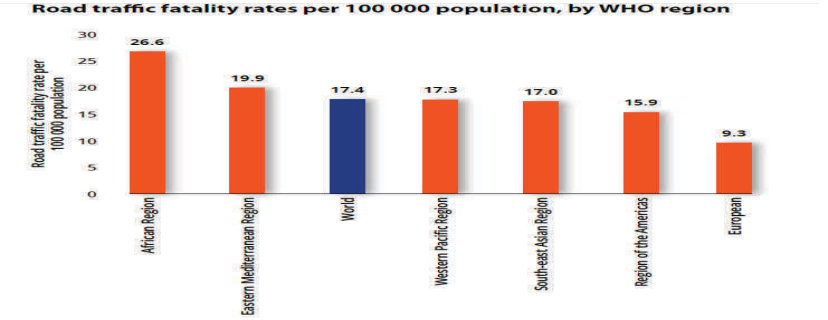


- Risk of deaths in a road crash remains highest in low- and middle-income countries
- 68 countries have seen a rise in road traffic deaths since 2010, while 79 have seen a decrease.



Source: Global Status report on road safety 2015: WHO

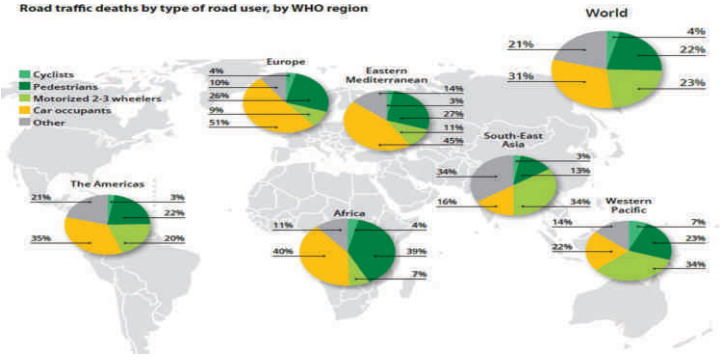
- The risk of a road traffic death is highest in the African Region.
- The Eastern Mediterranean Region is the only region where high-income countries have a higher road traffic death rate than low- or middle-income countries.



Source: Global Status report on road safety 2015: WHO

Road traffic deaths among pedestrians, cyclists and motorcyclists are intolerably high. More attention must be given to the needs of pedestrians and cyclists.

- More than half of countries (92) report policies to increase walking and cycling, compared to 68 in 2010.



Source: Global Status report on road safety 2015: WHO

Making walking and cycling safer is critical to reducing the number of road traffic deaths and is important for achieving the decade of action for road safety's aim to promote non motorized forms of transport. And if public health is to be improved by encouraging forms of travel involving physical activity, making walking and cycling safer needs to be given special attention.

Motorcyclist safety must be prioritized too globally:

- Nearly a quarter of all road traffic deaths are among motorcyclists. However, this too is disproportionately distributed across the world, with **the South-East Asian Region and Western Pacific Region each accounting for 34% of the world's motorcyclists deaths** compared to the African Region which account for 7%.
- In the Region of the Americas, the proportion of motorcycle deaths rose from 15% to 20% of the total road traffic deaths between 2010 and 2013.
- **Preventing motorcyclist head injuries is becoming increasingly urgent as motorcycle use rises.**
- Helmet laws should cover all riders and specify a helmet quality standard.
- Helmet must be of good quality to be effective.
- Few countries meet best practice when it comes to helmet laws and helmet standards.
- Children legally allowed as motorcycle passengers must be required to wear a helmet.
- Other promising strategies that protect motorcyclists while this report only addresses helmets as a critical factor to the safety of motorcyclists, there is an increasing body of evidence that relates to other measures that can enhance safety among this group. For example, mandating advanced braking systems (ABS) for all motorcycles, as recently introduced in the European Union, has shown to mitigate injuries and be cost effective; **creating lanes exclusive to motorcycle use and requiring daytime running lights that increase motorcyclist visibility are both effective injury reduction strategies,** while the use of protective clothing is considered a promising strategy.

Data on road traffic fatalities are essential for monitoring country-level trends, tailoring prevention efforts, assessing progress and comparing the scale of road traffic deaths relative to deaths from other causes

- Data on road traffic fatalities are not robust in many countries.
- For every person that dies in a road traffic crash there are at least 20 others that sustain non-fatal injuries. These injuries can have considerable impact on quality of life, and often carry with them significant economic costs.

Quality of care at scene of the crash:

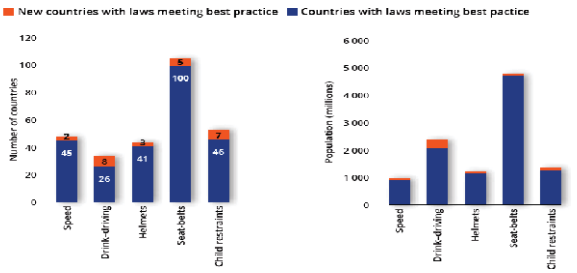
In high-income countries, delivering emergency care at the scene of the collision and getting crash victims quickly to a health-care facility is often performed by professionally trained providers using sophisticated equipment and designated vehicles. However, in low-income countries, laypeople such as community leaders, police, or taxi drivers who are trained in basic injury care and the coordination of transportation to a health-care facility can also fulfil these roles.

Road safety laws improve road user behaviour - a critical factor in road safety- to reduce road traffic crashes, injuries and deaths.

- A number of countries have achieved sustained reductions in traffic - related injuries and fatalities through effective road safety programmes that have included legislative change. The most positive changes to road user behaviour

happen when road safety legislation is supported by strong and sustained enforcement, and where the public is made aware of the reasons behind the new law and the consequences of noncompliance.

- Best practice in drafting and implementing good road safety laws can be used by countries embarking on road safety legislative reform, through it should be recognized that **road safety legislation is a dynamic field and that best practice evolves over time.**
- While there is clear evidence that enforcement is critical to the success of laws, the levels of enforcement required for maximum impact are often less readily available and depend on factors such as political will, available resources and competing priorities at a national level.



Source: Global Status report on road safety 2015: WHO

Reducing speed: Speed is a critical risk factor for road traffic injuries.

As average traffic speed increases, so too does the likelihood of a crash. If a crash does happen, the risk of death and serious injury is greater at higher speeds, especially for pedestrians, cyclists and motorcyclists. Male and young drivers are more likely to speed, while other factors likely to influence speed include alcohol, road layout, traffic density and weather conditions.

- **Where motorized traffic mixes with pedestrians, cyclists and moped riders, the speed limit must be under 30km/h.** This is due to the vulnerability of these road users at increasing speed, **an adult pedestrian has less than a 20% chance of dying if struck by a car at less than 50km/h but almost a 60% risk of dying if hit at 80km/h.**
- 47 countries, representing approximately 950 million people, have urban speed laws that meet best practice.

Laws based on blood alcohol concentration (BAC) limits can reduce road traffic crashes.

- **Young and novice drivers** are at a much-increased risk of road traffic crashes when under the influence of alcohol compared to older and more experienced drivers.
- **Commercial drivers** involved in drunken driving have more serious outcomes.
- **Alcohol ignition interlocks (or alcolocks)**, are automatic control systems designed to prevent driving with excess alcohol. They require the driver to blow into an in-car breathalyzer before starting the ignition. If the device detects alcohol in excess of the threshold value (which can be set a different levels), the vehicle will not start. Alco locks have been shown to be effective in preventing recidivism for both first time and repeat offenders and can play an important role in rehabilitation programmes (36,37).
- Only 53 countries test all drivers who die

in a crash for alcohol use.

Just over half of all countries have enacted good seat-belt laws.

- 105 countries, representing 4.8 billion people, have seat-belt laws that cover both front and rear-seat occupants.
- Protecting children requires properly fitting restraints.
- 159 countries address drug-driving in their road safety legislation but in most cases these laws are too vague to be effective.

Mobile phone use creates various types of distraction: visual, auditory, manual and cognitive. Texting involves cognitive distraction, as well as longer periods of both manual and visual distraction.

- An overview of available data suggests that **driver talking on a mobile phone are approximately four times more likely to be involved in a crash** than those who are not.
- **Hands-free phones appear to have no significant advantage over hand-held phones-** most likely because the most dangerous type of distraction (cognitive) applies equally to both.
- Evidence on effective ways to reduce mobile phone use while driving is still evolving.
- Legislation prohibiting the use of hand-held phones while driving exists in 139 countries; while a further 31 countries prohibit both hand-held and hands-free phones.

Policymakers must give more attention to making vehicles and roads safer.

- Most countries fail to apply minimum UN safety standards to new cars.
- Electronic Stability Control (ESC) is effective at reducing crashes and saving lives but only 46 countries apply a mandatory ESC regulation.
- Standards protecting occupants in front and side impact crashes are poorly implemented.
- Electronic stability control is highly effective and should be mandatory in all vehicles.
- Pedestrians account for 39% of road traffic deaths in the African Region, yet only one African country has signed up to **the UN safety standard that protects pedestrians in the event of a crash.**
- Vehicles can be built to better protect pedestrians. This report shows that pedestrians comprise 22% of all road traffic deaths- approximately 275000 deaths a year globally. The most serious pedestrian injuries are usually caused by the direct impact of the vehicle rather than by being thrown into the road. The severity of injury is influenced by factors such as speed and type of vehicle, and by the design of the front of the vehicle.
- Until recently, vehicle design incorporated few features to protect pedestrians, but there is an increasing effort to include design elements that reduce the likelihood of pedestrian collision and/or reduce the severity of pedestrian injury in the event of a crash. **Softer bumpers, combined with better bonnet area clearance and removal of unnecessarily rigid structures are required to reduce the severity of a pedestrian impact with a car.** The UN regulation for pedestrian protection encourages the design of these more "forgiving" car fronts.
- Vehicles sold in 80% of all countries fail to meet priority safety standards.

High-performing countries explore how to make transport more sustainable.

- **Road infrastructure has traditionally maximized mobility and economic efficiency at the expense of safety, particularly for non-motorized road**

users who are the most vulnerable. Indeed, as motorization increases worldwide, walking and cycling have become less common and more dangerous in many countries. The traffic mix in many countries means that pedestrians and cyclists share the road with high-speed vehicles, forcing them to negotiate dangerous situations and fast-moving traffic. **Planning decisions have been made without sufficient attention to the needs of these groups – for example, cycle paths and foot paths are frequently not part of an integrated network.** At the same time, traffic congestion resulting from rapid motorization means the transport and mobility demands of local communities are frequently no met. Changes are now required to optimize the movement of people and freight with road safety in mind. This optimization needs to take into account the mix and safety of all road users. Measures to promote walking and cycling are also in line with other global moves to fight obesity and reduce no communicable diseases (such as heart disease, diabetes) and improve the quality of urban life. **These changes are more pertinent than ever for low- and middle-income countries, which are now moving rapidly towards much higher levels of motorization, increased levels of air pollution and more sedentary lifestyles.**

- **A key strategy for achieving a safe traffic system for pedestrians and cyclists is to separate these different kinds of road use, eliminating conflicts between high-speed and vulnerable road users. Safety benefits of measures such as building separate cycle lanes are positive.** Danish studies, for example, showed a 35% reduction in cyclist casualties after cycle tracks were constructed alongside urban roads. Separating road users is also relevant for countries with high proportions of motorcyclists, notably those in the South-East Asian Region and the Western Pacific Region. Yet currently only half (91) of all countries in the survey have policies to separate vulnerable road users from high-speed traffic.
- Safe road systems consider the needs of all road users.
- 91 countries have policies to separate vulnerable road users from high-speed traffic.
- 138 countries currently assess parts of existing road safety networks.

Safe through design Ensuring safety measures are implemented when road infrastructure projects are designed can result in important safety gains for all road users.

- This is particularly true where road design and maintenance are underpinned by a Safe System approach that makes allowances for human error. **The use of infrastructure treatments to help manage speed and reduce the likelihood of a crash (for example through widening of the road, or raised pedestrian crossings), and treatments to mitigate the severity of the crash infrastructural (for example, using roadside barriers and roundabouts) all contribute to less death and injury on the road. Identifying which are the most dangerous roads, who uses these roads and which road users are most likely to be injured can all help to determine which affordable engineering counter measures are most essential for upgrading the road and making it safer.**

A multifaceted approach is required for the most effective and long-lasting changes to be made to national road safety.

Such changes have been achieved in a number of high-performing countries that have taken on the Safe System approach, and

have seen reductions in road traffic deaths and injuries despite increasing motorization.

- Political will is crucial to driving such changes, but this report shows that action is particularly necessary on a number of specific issues.
- Changing road user behaviour is key component of the Safe Systems approach. Setting and enforcing good laws relating to key behavioural risk factors can be effective at realizing such change.
- **Lack of enforcement frequently undermines the potential of road safety laws** to reduce injuries and deaths. More work is needed to explore the best ways to optimize enforcement of existing road safety laws.
- **Insufficient attention has been paid to the needs of pedestrians, cyclists and motorcyclists, who together makeup 49% of all global road traffic deaths.** Making the world's roads safer will not be possible unless the needs of these road users are considered in all approaches to road safety- including the way roads are built and the way vehicles are manufactured. Making walking and cycling safer will also have other positive co-benefits if these non-motorized forms of transport become more popular, including more physical exercise, reduced emissions, and the health benefits associated with such changes.

The Sustainable Development goals include a target of 50% reduction in road traffic deaths and injuries by 2020.