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ENVIRONMENT, NON-MOTORIZED TRANSPORT AND SAFETY:-

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Abstract:- While discussing issues concerning environment, non-motorized transport, and safety, this paper illustrates that unless the needs the non-motorized modes of traffic are met, it will be almost impossible to design any sustainable transport system for urban areas. If the infrastructure design does not meet the requirements of pedestrians, bicyclists and non- motorized rickshaws, all modes of transport operate in sub-optimal conditions. However, re-designing existing roads will not only provide a safer and convenient environment for non-motorized modes.

Index Terms- Environment, Transport, Traffic, Pedestrians, Rickshaw, Safety, Sustainable, Vehicles**.**

INTRODUCTION

A sustainable transport system must provide mobility and accessibility to all urban residents in a safe and environment friendly mode of transport. This is a complex and difficult task when the needs and demands of people belonging to different income groups are not only different but also often conflicting. For example, if a large proportion of the population cannot afford to use motorized transport –private vehicles or public buses- then they have to either walk or ride bicycle to work. Provision of safe infrastructure for bicyclists and pedestrians from motorized traffic or reduction in speeds of vehicles. Both measures could result in restricting mobility of car users.

Similarly, measures to reduce pollution may at times conflict with those needed for reduction in road accidents. For example, increases in average vehicle speeds may reduce emissions but they can result in an increase in accident rates. But, most public discussions and government policy documents dealing with transportation and health focus only on air pollution as the main concern. This is because air pollution is generally visible and its deleterious effects are palpable. It is easy for most people to connect the associations between quality of motor vehicles, exhaust fumes and increased morbidity due to pollution. But most individuals are not able to understand the complex interaction of factors associated with road accidents. Health problems due to pollution are seen as worthy of public action where as those due to injury and death in accidents as due to individual mistakes. Therefore, policy documents dealing with sustainable development for cities always include options for accident control.

In this paper we discuss some of issues concerning the environment, non- motorized transport, and safety. We illustrate that unless the needs of non-motorized modes of traffic are met it will be almost impossible to design any sustainable transportation system for urban areas. We show that pedestrians, bicyclists and non-motorized rickshaws are the most critical elements in mixed traffic. If the infrastructure design does not meet the requirements of these elements, all modes of transport operate in sub-optimal conditions. However, it is possible to redesign the existing roads to provide a safer and more convenient environment for non-motorized modes. This also results in improved efficiency of public transport vehicles and enhanced capacity of the corridor when measured in number of passengers transported per hour per lane.

SAFETY AND NON-MOTORIZED TRANSPORT

The increased mobility is distributed among many road users, usually realized in very small units of a few seconds. The safety benefit is sustained by a relatively smaller number of people who save many years of life (from premature death). An important issue involving transportation strategies aimed at increasing speeds of motorized vehicles is that pedestrians and other non-motorized road users who do not benefit from increased mobility sustain the increased accident risk. Thus the benefits accrue to one sub-group, while the dis-benefits are imposed on another. This has an important as all commuters have to operate as pedestrians also and their safety on the roads has to be ensured. We can assume that some of the pedestrian fatalities would include those who are bus commuters and only a few who are car users. It should be noted that a large proportion of the bus commuters are killed and injured in the process of entering or leaving the bus or when they fall of a moving bus or when they fall of a moving bus as there are no doors on public buses.

A large number of commuters are still using bicycles and other non-motorized modes of transport. Low-income residents living on the outskirts of the city also commute across the city to distant work centers and in search of employment. However, 65 percent of the population would have less money available for transportation. For these people, bicycles or walking is the only logical choice. This would not only lead to substantial savings in fuel but also drastically reduce air and noise pollution. This shift may create capacity for transfer to motor-cycle/scooter or car passengers to buses. In addition to bicycles, non-motorized rickshaws are used for delivery of goods like furniture, refrigerators, washing machines, etc. Semi-skilled workers, carpenters, masons, plumbers, and postman and courier services use bicycles. Therefore, the demand for bicycles and rickshaws exists in large numbers at present and is likely to exist in the future also. This situation is not explicitly recognized in policy documents and very little attention is given to improving the facilities for non-motorized modes.

Though de facto segregation takes place on two and three lane roads, an unacceptable danger exists to bicyclists because of conflicts with MVs. At two and three lane locations, it is a waste of resources not to provide a separate bicycle lane because one whole MV lane gets used by bicycles and other NMVs irrespective of bicycle density. Since primarily bicycles and other NMVs use the left most lane of the road, buses are unable to use the designated bus lanes and are forced to stop in the middle lanes and are forced to stop in the middle lane at bus stops. All modes of transport move in sub-optimal conditions in the absence of facilities for NMVS. This disrupts the smooth flow of traffic in all lanes and makes bicycling more hazardous. Therefore, providing a separate bicycle track would make more space available for motorized modes and make bicycling less hazardous. It is also obvious that in the absence of segregated NMV lanes on arterial roads, it is not possible to provide designated lanes for buses.

CONFLICTS BETWEEN SAFETY AND ENVIRONMENT

The above discussion demonstrates that:

- Non-motorized modes of transport constitute a significant proportion of all trips made in Delhi and are likely to do so in the future.
- Increase in use of public transport also results in an increase in walking/bicycling trips.
- At present pedestrians and bicyclists have a much higher risk per trip of being involved in an accident than those using cars .
- It is not possible to have efficient bus transport systems with designated lanes for buses unless segregated lanes are provided for non-motorized transport.

Sustainable transportation options rely heavily on promotion of public transport and non-motorized modes. However, the actual policies promoted do not recognize the conflicts inherent in some of the measures suggested. The government of India in 1977 prepared a white paper on population in Delhi (GOI 1997). Sub-sequently an Environmental Pollution Control Authority was setup for the city. Some of the measures suggested for reducing vehicular pollution are given below:

- Construction of expressways and grade separated intersections.
- Introduction of one way streets and introduction of synchronized signals and area traffic control systems.
- Construction of a metro rail transport system.
- Phasing out of older buses and increase in number of buses.

EFFECT OF EXPRESSWAYS, WIDE ROADS AND GRADE SEPARATED JUNCTIONS

Construction of expressways through or around cities and grade separated junctions may encourage higher speeds, greater use of private vehicles and longer trip lengths. Higher speeds always results in an increase in the incidence and severity of accidents unless very special counter measures are put in place for control of injuries. The relationship between impact speed and probability of death for a pedestrian (Anderson. 1995).These data

show that an S-shaped curve describes the relationship between car impact speed and probability of death for a pedestrian. This probability of death starts increasing dramatically at speeds greater than 30Km/h and flattens out at levels above 95 percent at 60Km/h. A similar relationship would be true for bicyclists and motorcyclists.
Thus very small increases in speeds can result in large increases in deaths and injuries. This increase in risk has the maximum effect on pedestrians and bicyclists resulting in lower use rates of public transport services. Wide roads and expressways (especially elevated sections) and grade separated junctions also divide the urban landscape into separate zones. It becomes very difficult for people to cross these arteries on foot or using other non-motorized modes. As explained above, this has the effect of discouraging public transport use, as all commuters using buses have to cross the road at least two times for every round trip at the origin or the destination. Elevated roads also reduce the attractiveness of business and entertainment activity in their vicinity.
Grade separated junctions have a similar effect. The area occupied by grade separated intersections is much greater than ordinary intersections. The location of bus stops at grade separated intersections is such that commuters have to walk greater distances for changing bus routes. This can discourage those who own private means of motorized transport from using public transportation modes. In addition, because of the increase in walking distance and road widths, pedestrians and commuters would be exposed to higher accident risks. This would further discourage use of public transportation by children, disabled persons and other vulnerable road users. This is very well illustrated by the environmental impact assessment done for the construction of the inner ring road in Guangzhou, China (GMG 1999). This inner ring road is a "Modern high-speed road running around the centre of the city". The funds invested for construction were loaned by the World Bank. A detailed environmental protection and monitoring plan has been worked out for this project. Some of the important guidelines are outlined below:

- Increase distances between residential houses, sensitive areas and the ring road.
- Minimum distance between road and buildings 20m.
- First row of buildings not suitable for schools, hospitals, etc. These should not be within 100m of the road.
- Buildings sensitive to vibrations not to be within 40m of the road.
- Strict controls of heavy vehicle use at night to prevent noise pollution.
- Strict control of speeding by all vehicles to limit noise.
- Elevated roads should be reduced as far as possible and double-layer or multi- layer roads should not be adopted.

This shows that any high capacity road inside a city influences land use around it and makes it and makes it less people friendly. Owners of residential houses also tend to shift away from such locations. The experience of large cities in china shows that construction of such high capacity roads has not even improved traffic congestion levels: An international review of the performance of advanced traffic control systems (ATCS) concludes that "ATCS may have shown promising results in computer simulations under controlled environment but they have failed to produce results under actual traffic conditions. The heterogeneous nature of traffic in Indian cities is not modeled in the existing ATCS and therefore, their success is highly suspect (Saraf, 1998)

PLANNING FOR BICYCLES AND NON-MOTORIZED VEHICLES IN DELHI

A detailed study completed in Delhi, India, shows how existing roads can be redesigned within the given right of way (ROW) to provide for an exclusive lane for NMT modes (bicycles and three wheeled rickshaws) (Tiwari,1999). The bicycle/non-motorized vehicle plan has been developed for Delhi to fulfill the following objectives :(1) Traffic flow of all vehicles using that corridor should improve: (2) Number of accidents involving bicyclists should reduce: (3) potential bicyclists should be encouraged to use bicycles.
The proposed plans have focused at the three levels of bicycle facilities as follows :(1) Network route planning; (2) Road section planning ; (3) Intersection planning.

Network route planning: Detailed origin destination analysis of bicycle users shows that there is a need for a continuous network for bicyclists covering the whole of Delhi. This is because there are no areas where they are not present.
Since a majority of the bicyclists are captive riders who are daily commuters (with no other mode choice owing to economic compulsions) the proposed network must enable direct and safe bicycle-travel within a coherent system. The proposed routes must guarantee minimum trip lengths (directness) and minimize the number of encounters between cyclists and motor vehicles (safety).
The ROW of existing arterial roads in Delhi ranges from 30m to 90m.All these roads need to be developed as an integral part of the bicycle network. Routes with the highest (expected) use graduate to the through routes of

the plan. But volume does not have to be the only criterion on the basis of which a route is designated an element of the main network. To achieve a recognizable and coherent structure and to avoid discontinuities means that less intensively used routes have to be included in the main network. The same considerations apply with the joining of the designed network to the main routes of other cycling-network-networks, especially on the outskirts of an urban area (transition inside/outside built up area). The principle of continuity is more important here than that of (limit of) volume.

The development process can be prioritized to meet the three objectives of the bicycle master plan. The bicycle network should be developed in the following phases:

Phase I: The routes which have heavy bicycle traffic sharing the road space with other traffic should be developed in the first phase because this would result in improving flow of bicycles as well as public transport buses and motorized private modes which are affected by the presence of bicycle on the same carriage way. This will cover 90km of road length.

Phase II: Routes which should be developed in the second phase are the major arterials which carry MV traffic at speeds of 50 km/h but were not included in phase I .In non-peak hours and at night when the visibility is poor, bicyclists are exposed to a high risk of fatal accidents on these roads; therefore a well-designed network will ensure safety of bicyclists on these routes. Phase II includes four radicals and two ring roads in the city. The network length covered in this phase is 276km.

Phase III: Remaining roads with at least 30m ROW will be developed as a part of bicycle network level plan in this phase.

Phase IV: In the fourth phase bicycle routes are proposed through parks and green belts. This would primarily be additional network capacity for bicyclists.

Detailed designs for road cross sections and intersections have been prepared on the basis of following criteria:

1. Physically segregated bicycle tracks on routes which have >30m ROW.
2. Recommended lane width for MVs on main carriageway 3m (minimum).
3. Recommended lane width for buses 3.3m (minimum).
4. Recommended lane width for bicycle 2.5m (minimum).
5. Separate service lane and footpath.
6. Intersection modification to include the following.

No free left turn for MVS. Modification of traffic signal cycles. Road side furniture to ensure safe bicycle movement and minimize interference from motorized two wheelers.

Capacity estimates of the new cross sections shows three to four fold increase in number of passengers travelling through the same corridor. The new cross sections also result in enhanced efficiency of the public transport buses that can be given the curbside lane or central two lanes for buses as per the site demand. Physically segregated lanes also improve safety of the vulnerable road users by reducing the conflicts between motorized and non-motorized modes.

PLANNING FOR HEALTHIER TRANSPORT

Buses and non-motorized modes of transport will remain the backbone of mobility in LIC mega-cities. Bus use has to be increased without increasing pollution or the rate of road accidents. This would be possible only if the follow conditions are met:

Public transport:

(1) The cost effectiveness of metro rail systems be evaluated very carefully. Current evidence suggests that metro rail systems, especially the construction of two or three lines at great cost, do not help in reduction of private vehicle use, congestion or pollution.

(2) Design and development of modern and sophisticated high capacity bus systems be given priority in megacities of Asia.

(3) Introduction of bus engine and transmission technologies that ensure clean burning and efficient combustion of the passenger loads and driving cycles experienced in Asian megacities.

(4) Safe entry and exit procedures for bus passengers. This would include all buses to be equipped with closing doors, low floors, and appropriately designed bus stand.

(5) Operation of buses at safe speeds. This will require setting of realistic trip times and installation of speed limiting devices in buses.

(6) Bus stop locations that ensure route changes are convenient and safe for commuters.

(7) Development of safer bus front designs and standards. Since a significant proportion of road users fatalities involve buses in low income countries, it would be very important to develop such designs.

Particularly in view of the fact that increases in bus numbers can mean an increase in conflict between them and other road users. Recent studies suggest that such designs are technically feasible.

SEGREGATED LANES FOR NON-MOTORIZED TRANSPORT AND SAFER PEDESTRIAN FACILITIES

Urban and road design characteristics that ensure the safety of ***pedestrians*** and bicyclists.
(1) Provision of segregated bicycle lanes on all arterial roads.
(2) Wider use of traffic calming techniques, keeping peak vehicle speeds below 50km/h on arterial roads and 30km/h on residential streets and shopping areas.
(3) Convenient Street crossing facilities for pedestrians.

CONCLUSION

The above recommendations have to be considered in an overall context where safety and environment research efforts are not conducted in complete isolation. We have to move toward adoption and implementation of schemes that remain at human health. The authors of a report on integration of strategies for safety and environment published by the OECD suggest the following guidelines for policy makers [OECD: 1997].
Ask leading questions about safety and environmental goals at the conceptual stage of the project and look beyond the immediate boundaries of the scheme. The safety and environmental consequences of changes transport and land use should be made more explicit in technical and public assessments.

There should be simultaneous consideration of safety and environmental issues by involving all concerned agencies.

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