International Conference on Transportation Systems Planning and Operation, IIT Madras, Chennai, India, 18-20 February, 2004

Road Safety Audit for Cities

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Abstract: The Indian transport system is rated as one of the most accident prone system with more than 14 accidents per thousand vehicles every year. To minimize the risk of accidents, adopting Road Safety Audit (RSA) is necessary. RSA is a process in which experts attempt to identify potentially dangerous features in the highway environment. It is important to improve safety in cities, but many local transportation agencies do not implement a road safety improvement program. This often is due to limitations on funding, expertise, and time. The Road Safety Audit Review (RSAR) process is a viable option for aiding local transportation agencies in addressing safety issues. An attempt was made to suggest Road safety audit procedure which can be used for the basic safety needs for cities in India. A checklist has been devised to suit the needs of the medium Indian cities for conducting a safety audit.

1. Introduction

Traffic accidents constitute one of the major public health problems adversely affecting the welfare and prosperity of developing countries. Their occurrence indicates a failure by the road facility, vehicle and vehicle operator separately or jointly. By the year 2020 forecasts suggests that road accidents as a cause of death or disability lie in the sixth place out of hundred separately identified causes (WHO[1]1999).

In spite of very low rate of registrations of motor vehicles compared to many developed countries, the accident rates (per vehicle basis) in India are alarmingly high. This situation is partly explained by the heterogeneous mix of vehicles sharing the same right of way on the road system. There is an accident in every 2 minutes in India and every 9 minutes a person dies.

It is a strongly felt that most of the accidents that occur on the city streets are not caused merely due to drivers fault or negligence but also due to other related factors such as abrupt changes in road conditions, vehicle flow characteristics and road user behavior. A systematic procedure in the form of road safety audit has to be adapted for cities to ameliorate the safety aspects. Road safety audits are a proactive approach to accident prevention. New roads built today which become accident black spots tomorrow are going to extract a very high cost from the community in form of accidents and rectification works. With the rapid growth of motorisation and vehicles in large numbers coming on to the roads in cities, the need for RSA is not only great but urgent.

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Austroads RSA procedures are used to form the basic structure for the safety audit for city roads. The steps of the safety audit for city roads have been framed using the identified needs of medium cities. A check list has been devised suiting to the local needs of the cities.

2. Global Accident Scenario

It has been estimated that over 300000 persons die and 10 to 15 million persons are injured every single year in road accidents through out the world (TRL[2], 1994). The problem of deaths and injury as a result of road accidents is now acknowledged to be a global phenomenon with authorities in virtually all countries of the world concerned about the growth in the number of people killed and seriously injured on their roads. In recent years there have been two major studies of causes of death worldwide, which have been published in the 'Global Burden of Disease' (1996, World Health Organisation, World Bank and Harvard University[3]) and in the 'World Health Report – Making a Difference' (WHO[1] 1999).These publications show that in 1990 road accidents as a cause of death or disability were by no means insignificant, lying in ninth place out of a total of over 100 separately identified causes. However, by the year 2020 forecasts suggest that as a cause of death, road accidents will move up to sixth place and in terms of years of life lost (YLL) and 'disability-adjusted life years' (DALYs) will be in second and third place respectively. DALYs express years of life lost to premature death and also years lived with a disability, adjusted for the severity of the disability (Gof Jacobs[4]).

The developing countries are undergoing dynamic economic changes with a fast growth of motorisation as one of its effects. Over the last two decades, the numbers of vehicles are increasing enormously. An infrastructure that does not meet the requirements of growing needs, no possibility to monitor the traffic, no effective programmes to reduce negative consequences of the developing individual motorisation are the root causes of the road accidents.

In India National Highways form the primary road system in the country with a total length of about 52000 km. Every year about 80000 accidents take place on the National Highways. Though India's share of vehicular population is hardly 1% of the worlds, but her share of road accidents is nearly 6%. Nearly 80,000 people die of road traffic accidents and around 1.6 lakh people become partially or totally disabled every year in India. It results in mammoth economic loss to the nation. Correspondingly, there are about 9,500 deaths and almost 30,000 injuries in Andhra Pradesh. In Hyderabad, there are about 3,000 accidents and 400 deaths every year (IHS[5], 2003).

3. Road Safety Audit (RSA)

The Road Safety Audit (RSA) originated in the United Kingdom during the 1980s. Today the approach is used by the U.K, Australia, New Zealand and Denmark as part of their

national safety programmes. "Austroads" is the national association of road transport and traffic authorities in Australia which is responsible for the establishment of uniform standards and practices within the overall Australian transport system. Austroads[6] (2001) defines Road Safety Audit as "a formal examination of an existing or future road or traffic project, in which an independent, qualified team reports on the project's accident potential and safety performance".

The main objective of a road safety audit is to ensure that all the new Highway schemes operate as safely as is practicable. This means that safety should be considered throughout the whole preparation and construction of any project (IHT[7], 1996). A road safety audit ensures a high level of safety for all road users on new and existing roads through identification of potential safety problems and consideration of methods to eliminate or reduce the accident potential. Established safety principles are applied to the planning, design, construction, maintenance and operation aspects of the road way. Safety is considered from the viewpoint of all roadway users including motorists, motorcyclists, pedestrians and bicyclists (ETSC[8], 1997). According to Austroads[6] (2001) road safety audits are performed on the feasibility, preliminary design, detailed design, pre-opening stages, and/or an existing road.

The different stages are as follows,

Stage 1 Audit: During Feasibility Study

By providing a specific safety input at feasibility stage of major schemes, particularly in urban areas, road safety audit can influence route choice, standards, impact on and continuity with the existing network, junction provision etc.

Stage 2 Audit: Completion of Preliminary Design

On completion of preliminary design, to assess horizontal and vertical alignments, sight lines and layout of junctions including slip roads and lay-byes. After this stage, land acquisition and other associated legal matters become finalized.

Stage 3 Audit: Completion of Detailed Design

On completion of detailed design and before preparation of contract documents, to assess detailed junction layout, markings, signs, signals, lighting details etc. Typical considerations include geometric layout, line markings, signals, lighting, signing, intersection details, clearances to road side objects and provisions for vulnerable road users.

Stage 4 Audit: pre-opening stage audit

Immediately prior to opening of scheme, involving the site staff and local traffic police. This should take the form of driving and when appropriate, walking or cycling the new route. This is checked during night time also to check signage delineation and other darkness-related issues.

Stage 5 Audit: safety reviews of existing roads

Safety Audit methodology is also successful on existing roads. In fact, the existing roads represent the present condition of the road after completion of construction as well as any hazardous conditions that may have been created during its lifetime such as encroachments, ribbon development or deterioration of road conditions as well as traffic conditions etc,.

Regular audits of existing roads allow road safety hazards to be identified before they result in accidents.

4. Need for Adapting RSA for Cities in India

Growth in urbanization and in number of vehicles has led to increased traffic congestion in urban centers and CBD areas thereby increasing the traffic accidents on road networks which were never designed for the volumes and type of traffic which they are now required to carry. In addition the unplanned urban growth has led to incompatible land uses with high levels of passenger pedestrian/vehicle conflicts. The drift from rural areas to cities often resulted in large number of new urban residents unused for such high traffic levels. As a result there had been a severe deterioration in driving conditions and significant increase in the hazards to and competition between different classes of road users of the road system.

Table 1. Road Accidents in Indian Cities from 1992-1998

Sl no	City	1992	1993	1994	1995	1996	1997	1998
1	Ahmedabad	2321	2198	1814	1971	2573	3220	2949
2	Bangalore	7370	7648	8198	8677	8474	8722	8360
3	Calcutta	8413	7548	NA	8895	9294	10260	10999
4	Chennai	5597	5548	4807	5000	5458	5171	5121
5	Cochin	1493	1710	2275	3062	2379	2363	2418
6	Delhi	8519	8503	9050	10138	11315	10957	10217
7	Hyderabad	1681	1771	1930	2015	2034	2108	2208
8	Jaipur	1255	1713	1903	2067	1922	2022	2077
9	Mumbai	25029	7008	6892	6810	7779	7421	6980
10	Nagpur	1087	984	1076	1212	1575	1496	1644
11	Pune	2757	1559	2184	2592	2279	2687	2644
12	Coimbatore	964	864	992	1056	1150	1152	1301
13	Indore	1355	NA	NA	NA	2354	2370	2140
14	Ludhiana	138	193	208	229	256	NA	NA
15	Madurai	812	NA	NA	NA	778	941	1440
16	Surat	883	708	NA	NA	1379	1434	1440
17	Vadodara	1532	1487	1448	1493	1669	1780	1897
18	Vishakapatnam	797	NA	NA	NA	773	890	990

Source: Handbook on Transport Statistics in India 1999, Ministry of Surface Transport.

In addition the inherent dangers are made even worse by poor road maintenance, badly designed intersections and inadequate provision for pedestrians. The metropolitan cities in

India have become accident concentration areas. Accident risk is quite serious in the metropolitan cities of India as is evident from Table 1.

Road fatalities constitute around 15 percent of total fatalities occurring in India in these cities. There is a wide variation in levels of personal safety amongst these cities. Personal safety which is deaths per lakh of population is lowest for Varanasi (28.0), followed by Delhi (21.6), Jaipur (14.5), Bangalore (13.4), Lucknow (13.2) and Kanpur (12.5) in the year 1991. (Nishi Mittal[10], S M Sarin, 2001). According to statistics of road accidents in India, MOST 1983-1992 the fatalities due to road accidents on national highways constitute about 25.3%, state highways 22.2% and low category roads constitute about 52.5%.

In urban areas motor vehicle occupants constitute 5-10 per cent of the fatalities and the rest are vulnerable road users. On highways, the proportions are 32 and 68 per cent respectively. Though the motor vehicle fatalities are higher on highways than in urban areas, as would be expected, the differences are not as high as in western countries. A vast majority (68%) of those getting killed on highways in India comprises vulnerable road users and this fact should be the guiding factor in future designs considerations (Dinesh Mohan[10] 2002).

In the view of the alarming situation prevailing in cities due to road accidents an effective programme for road safety has to be implemented in cities. A simple, easy to use safety programme is needed for the local agencies to implement road safety measures in cities. Due to limited funding available for local agencies a cost effective road safety programme is needed. Also the local agencies do not have sufficient accident data or traffic inventories, so a programme that does not rely on crash and traffic data is to be evolved.

Road safety audit can be used as an effective and powerful tool to aid the local agencies in developing a consistent roadway, minimising the accident risk and implementing cost-effective improvements based on solid traffic safety principles.

5. Road Safety Audit for Cities

The practice of RSA for cities is not implemented in many countries and little work was done in India. Keith A Haiar and Eugene M Wilson[11] (USA, 1998) had carried out research in developing a practical approach to identifying street safety needs for local governments. They had developed a street safety audit procedure for small cities, they had also developed check lists covering the fundamental intersection and traffic sign issues. Some work has also been done by Kiran Kumar[12], Bangalore University, 2002.He had given a checklist and conducted road safety audit for selected highways passing through Bangalore city.

Austroads guidelines have been recognized as very easy to read document and recently described as "the definitive document on safety audit, for its messages and recommended procedures transcend hemispheres and are applicable anywhere in the developed world" (Bulpitt[13], 1999). Austroads RSA procedures are used to form the basic structure for the safety audit for city roads. The steps of the safety audit for city roads have been framed using the identified needs of medium cities.

The steps of the Audit are modified according to the identified needs of the Indian cities. The steps of the suggested Audit are as follows:

5.1. Prioritization of roads and field studies

Before starting the safety Audit in the city, the analysis of accident data of the whole city may be used to decide which roads are to be audited first. For this the accident data collected from police records should be analyzed to locate the black spots. The causes for the accidents are analyzed from the data. The most causative factor is given importance while preparing the checklist.

As a part of the field studies the spot speed studies are carried out at different mid block sections and approach speeds are found at intersections. As the basis of the speed characteristics the existing geometric features could be evaluated for their ability to provide safety to vehicles. The volume studies are to be conducted at different points of the city roads. The locations are to be identified where the traffic volumes are exceeding the capacity.

5.2. Preparing the checklist

The checklist is prepared in order to help the auditor not to overlook something important. This checklist helps an auditor or a designer in identifying potential safety problems and knows the types of issues an auditor will addresses. A set of checklist has been presented at the end which has been proposed for a medium city. It is inevitable that these general checklists will not cover every issue for every country, so as experience build up, local planners and engineers should add their own additional questions and modify others where necessary to tailor the checklists to their needs.

5.2.1. Safety audit check lists for existing roads in the city

I. General

Check:

- Are traffic lane widths and shoulder widths adequate for safe operation of vehicles?
- Are bus stops appropriately located with adequate clearance from the traffic lane for safety & visibility?
- Are provisions for parking satisfactory in relation to traffic operations and safety?
- Are there any sections of road which may cause confusion?

II.Intersections

Check

- Is the visibility of intersection or any approach limited by
    - Parking or queued traffic.

- Signs, utility poles, fences
- Embankments
- Buildings
- Vegetation
- Other sight obstructions

- Are hidden or unexpected intersection located at
  - Curves
  - At the end of streets
  - Streets that don't intersect at 90 degrees
- Is sight distance adequate for all movements and all users (children, bicyclists)?
- Are the pavement markings and intersection control signing satisfactory?
- Is the alignment of kerbs, traffic islands and medians satisfactory?

III. Traffic signs and markings

- Are sign visible day and night, at a distance that provides response time for motorists?
- Is sign visibility affected by
  - Vegetation, dist & other materials
  - Sharp curves
  - Steep hills
  - Other signs
  - Poor lighting
- Are the required signs provided or not?
- Do the sign supports conform to guidelines?
- Do the sign have a simple and clear message?
- Are all necessary pavement markings installed?
- Is delineation adequate and in accordance with guidelines?

IV. Vulnerable road users

- Are there appropriate travel paths and crossing points for pedestrians and cyclists?
- Is pavement width adequate for number of cyclists using the routes?
- Are adequate refuse islands provided for pedestrians at busy intersections?
- Are the footpath widths adequate for pedestrians?

V. Lighting and road side objects

- Is appropriate lighting installed at intersections, round abouts, pedestrian crossings?
- Are appropriate types of poles used for all locations and correctly installed?
- Are any street lights conflicting with signals?
- Are the electric poles and telephones interfering with traffic?
- Are any advertising hoardings are distracting the attention of drivers?
- Are any hoardings installed within a distance of 50m of any junction or 10m from carriageway edge?

- Are there any illuminated advertisements with flashing lights are a cause of distracting driver attention?

5.3. Conducting the safety audit

Ideally it is preferred to have an audit team compared of two or more members knowledgeable in the areas of traffic safety and management, road design, human factor analysis, and crash investigation and prevention. It is important that auditors should be trained and experienced moreover they should be unbiased and able to review the city roads in independent and objective manner (Austroads[6] 1994). The safety audit of roads in the city must start with a systematic process of reviewing all street facilities. Then an onsite inspection is then conducted. It is important to evaluate the safety of existing network considering all road users and the roads function and use.

The major intersections, areas with pedestrian/ vehicle interaction, mid block sections and analyzed black spots are good places to perform an audit. During the performance of the audit, the incorporation of the following four key points is important. (Keith A. Haiar[11], Eugene M. Wilson 1998).

- Consider safety from the perspective of all street user groups (motorists, pedestrians, children, bicyclists, etc.).
- Consider all traffic movements
- Consider the possible effect of environmental conditions (day, night, fog, rain, etc.).
- Consider how a more consistent street environment will enhance driver expectancy and promote safety.

5.4. Preparation of safety report and follow up evaluation

After completion of the safety audit of the each road, a final report is produced providing a description of the identified safety needs. The report should be a concise, brief document setting out a summary of measures to be taken and items identified that require remedial measures.

The completion meeting improves the auditors and individuals with jurisdiction over the road network of the city and those responsible for the budget (funding) of improvement of that roads. Documenting the safety actions and project scope, identified needs is recommended. Once the corrective action report has been finalized, the agreed actions need to be implemented.

6. Conclusions

In this paper the need for adapting the safety audit for cities has been highlighted. The practice of road safety audit for cities has not been taken up in India. The fatalities due to road accidents have been increasing by leaps and bounds. The non-motorised road users consisting of pedestrians, bicyclists and other slow moving vehicles are the most vulnerable group involved in road traffic accidents in almost every city in India. This is an alarming

situation. Hence RSA for cities is very urgent. Using the checklists that were developed suiting to the local conditions, RSA can be used as a cost effective and efficient safety programme. Even this RSA procedure can be used for big cities making some changes in the checklists.

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