TRIPP BULLETIN
VOL 5. NO.2 MONSOON 2008
TRANSPORTATION RESEARCH & INJURY PREVENTION PROGRAMME
INDIAN INSTITUTE OF TECHNOLOGY DELHI

IIT faculty members associated with TRIPP supervise research projects at undergraduate and postgraduate levels. The current and recently completed projects are listed below:

Ph.D. Scholars — *Current*

Highway design and traffic safety
Scholar: Afzal Hingora
Supervisors: *Geetam Tiwari and Dinesh Mohan*

Study of the effect of thigh and leg muscle activation on the response of human knee to impact loading
Scholar: Anurag Soni
Supervisors: *Anoop Chawla and Sudipto Mukherjee*

Constitutive models of soft tissue for human body-vehicle impact analysis
Scholar: B. Karthikeyan
Supervisors: *Sudipto Mukherjee and Anoop Chawla*

Tool for positioning human body FE model
Scholar: Dhaval Jani
Supervisors: *Anoop Chawla and Sudipto Mukherjee*

In-vivo measurement of constitutive properties
Scholar: Hemant N Warhatkar
Supervisor: *Anoop Chawla and Sudipto Mukherjee*

Non-motorized traffic (bicycle): demand estimation and integral planning
Scholar: Himani Jain
Supervisor: *Geetam Tiwari*

Urban bus route optimization
Scholar: Mukti Advani
Supervisor: *Geetam Tiwari*

Institutional and regulatory structure for providing urban public transport
Scholar: O.P. Agarwal
Supervisors: *Geetam Tiwari and V. Upadhyay*

To study the suitability of airbags for motorcyclists
Scholar: Prashant Vidhyadhar Bhosle
Supervisors: *Anoop Chawla and Sudipto Mukherjee*

Biomechanics of helmet impact
Scholar: Praveen Kumar Pinnoji
Supervisor: *Puneet Mahajan*

Estimation of externalities in public transport system
Scholar: Pradeep Singh Kharola
Supervisor: *Geetam Tiwari and Arun Kanda*

Sustainable urban development
Scholar: S K Lohia
Supervisor: *V. Upadhyay and Geetam Tiwari*

Impact of land use on public transport
Scholar: S S L N Sarma
Supervisor: *Geetam Tiwari*

Ph.D. Scholars — *Completed*

Transportation projects and their effects on the poor: integrating a social impact assessment methodology
Scholar: Anvita Anand
Supervisor: *Geetam Tiwari*

Optimal pricing of urban transport - a case of Delhi
Scholar: Akshay Sen
Supervisors: *Geetam Tiwari and V. Upadhyay*

M.Tech. Projects — *Completed*

Analysis of pedestrian behaviour
Student: Manjeet Singh Minhas
Supervisor: *N. Chatterjee*

Car accident reconstruction and head injury correlation
Student: Varun Grover.
Supervisor: *Anoop Chawla Sudipto Mukherjee*

Comparison of open and closed BRT system
Student: Narendr Singh Panwar
Supervisor: *Geetam Tiwari*

Road safety audit on selected National Highway
Student: Amit Aggarwal
Supervisor: *Geetam Tiwari*

Evaluating the ilmapct of free left turns on traffic behaviour at signalized intersections
Student: S.B. Ravi Gadepalli
Supervisor: *Geetam Tiwari*

B.Tech. Projects — *Completed*

Evaluation of free left turns at signalized junction
Student: Rahul Goel
Supervisor: *Geetam Tiwari*

Study of the performance and capacity of roundabouts in Delhi
Student: Tajinder Singh
Supervisor: *Geetam Tiwari*

Operational characteristics of bus rapid transit: open vs closed systems
Student: Aditya Medury
Supervisor: *Geetam Tiwar and R.R. Kalagai*

Study of operational characteristics of side and central lane bus rapid transit system
Student: Ankit Juneja.
Supervisor: *Geetam Tiwari*

Course Announcement

The Transportation Research and Injury Prevention Programme (TRIPP) at the Indian Institute of Technology, Delhi, Volvo Education and Research Foundations and the French National Institute for Transport and Safety Research (INRETS) France, are organizing an eight day "**International Course on Transportation Planning and Safety**". The course will be held in New Delhi, India, from 6-13 December 2008, and TRIPP will be the host institution. The course will have a common component for the first three days, followed by two parallel modules on Traffic Safety and Biomechanics and Crashworthiness.

Details of the course can be accessed from - www.iitd.ac.in/tripp

The **Transportation Research and Injury Prevention Programme (TRIPP)** at the Indian Institute of Technology Delhi, is an interdisciplinary programme focussing on the reduction of adverse health effects of road transport. TRIPP attempts to integrate all issues concerned with transportation in order to promote safety, cleaner air, and energy conservation. Faculty members are involved in planning safer urban and inter-city transportation systems, and developing designs for vehicles, safety equipment and infrastructure for the future. Activities include applied research projects, special courses and workshops, and supervision of student projects at postgraduate and undergraduate levels. Projects are done in collaboration with associated departments and centres at IIT Delhi, government departments, industry and international agencies.

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The BRTS in Delhi

A low floor bus at the bus shelter

The first summer issue of the TRIPP Bulletin, 2004, carried out introductory story on the Bus Rapid Transit Systems (BRTS) and their relevance in our world today. It was a comprehensive and nuanced reportage on the BRTS system in general and its implications for our growing cities today. In the winter issue of 2005, we examined in some detail the initial steps taken by the government of Delhi to plan, design and implement the BRTS in the capital city of the country. In the monsoon issue of 2007, there was an extended and detailed essay on Urban Transport Planning. This necessarily touched upon the BRTS world-wide.

With this monsoon issue of 2008 we report on the story so far on the BRTS in Delhi. The proposal for BRTS in Delhi was first mooted in 1996. This recommendation was part of a report submitted to the Central Pollution Board of India. The main motivation behind this proposal was to address the problem of growing road traffic injuries and fatalities and pollution in the city. This report was examined by the Transport Department if the Delhi initiated Government and policies were initiated to take it forward. Finally, an international workshop was organized by the Delhi Transport Corporation and IDFC (Infrastructure Development Finance Company) in 2001 to enable a detailed discussion about the concept among international and national experts and stakeholders. Following this the government set up the committee on sustainable transport chaired by the Chief Secretary of Delhi. On the recommendation of this committee, RITES was awarded the contract to prepare a detailed feasibility report and plans for implementing BRT on five selected corridors in Delhi in 2003. Detailed designs were prepared based on new (2003-2004) traffic surveys at all 33 junctions along the corridor. The detailed topographical survey included the exact locations of all services and trees along the entire length of the carriageway where the BRT was to be introduced. The government held extensive consultations with every relevant Department and consulted all stakeholders including public utilities, resident welfare associations along the proposed corridor, etc. The progress of the work along the corridor was closely monitored by EPCA (Environment Pollution Control Authority) in Delhi. The government funded an international workshop in December 2005 where experts from all over the world and India were invited to examine the design details of the Delhi project. It is only after the finalization of these details that the project was approved.

On 20th April, 2008, 5km of the proposed 12km corridor of the Delhi BRTs from Ambedkar Nagar to Moolchand was thrown open for the initial trial run. All public transport buses (like the DTC, the Bluelines, chartered buses and other private bus operators) were allowed on to the corridor. School buses did not use the corridor on this occasion as it was only a trial run.

The concept of central bus lanes, the location and operation of the bus shelters and the signages of the BRT system as a whole, was new to the Delhi public. Accordingly the authorities had put in trained traffic marshals to manage the traffic and movement of people. DIMTS (Delhi Integrated Multi-Modal Transit System Ltd.) had specially trained 300 bus drivers who were expected to use the corridor. Even so, it proved to be a continuation of the learning curve for them, in spite of their prior training. After the first few weeks the early glitches that were apparent on the opening day gradually decreased over time. Buses carry upto 62% of the commuters on the BRT corridor; bicyclists make up another 18%. Cars, motorcyclists and auto-rickshaws together account for only 20% of commuters on the corridor. A travel-time study commissioned by the DIMTS concluded that while the BRT may reduce congestion it does not add to it. In an opinion poll conducted by NDTV, a private TV channel, 88% of the commuters felt that the BRTs was an improvement on the old public transport system, 71% felt it would reduce travel time; 61% of car drivers said that they found the driving easier in the BRT corridor as buses had a lane of their own. The speed for cars remain the same on the BRT as any other road while the speed of buses on the BRT increases. This is because the BRT is a public transport priority corridor and hence all design elements must subserve this priority.

Though not universal, the central lane is the preferred location for the bus in most cities of the world; this is largely because it avoids coming into conflict with left turning traffic; it has increased throughput unlike buses on the curbside lanes which are forced to stop for other left turning vehicles; it is also safer because the high volume of bicyclists, motorized two-wheelers and three-wheelers do not come into conflict with it. This separation also ensures that cars do not get stuck behind buses halting at bus stops. Bus movement has to be separated from car movement so that bus travel speeds are not less than that of cars. The divider separating the dedicated bus lanes in the Delhi BRTS are as per international standards and reflect a sensitivity to local needs; the divider consists of a 0.75m wide band of diagonally (at 45 degree angle to the bus lane) oriented rumble strips. The parallel gap between the rumble strips are 0.6m and the rumble strips are themselves 25mm in height.. Any unfortunate incident like a breakdown on the BRT corridor can be addressed immediately and effectively without inconveniencing the others on the road because the median separating the two bus lanes is a mountable rumble strip; the stalled bus can be easily overtaken by the ambulance or the other buses as per the ground requirements at the time. Buses already run at a frequency of 5 to 10 minutes on all routes. At peak hours, buses move in a platoon of 10 to 12 buses. These are some of the main reasons for preferring the central lanes for the buses in the corridor.

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An Areal view of the BRTS at a junction

There are certain features to the Delhi BRTS worth remarking like the location of the bus shelters at the junctions, the design features of the bus shelters themselves and the two parallel platforms for the bus commuters in each direction. Bus shelters are located at the near side of the junction. From the commuter's point of view, this is the safest place to cross the road because all traffic must come to a halt at the red light; this makes for a safer and easier route transfer. At the four-way junction commuters can access all directions with equal facility; in this way, the catchment area of the bus system increases. Overhead bridges for commuters at mid block stops have been used in a few cities, like Bogota; mid-block stops increase walking distances for bus users, and many users have difficulty going up slopes or steps. However, the positioning of the bus shelter at junctions obviates the need for overhead bridges for commuters. While this advantage accrues to the commuter, sometimes the space available for other motorized vehicles at the junction may reduce marginally.

In the current BRTS design the bus platforms are set back by 20m to accommodate at least four buses on each platform. The first bus occupies this space while the other three are at the platform. At the green signal all eight buses standing at the two parallel platforms can go through the junction. This still leaves some more time in the green phase for about four more buses to go through the junction. If the bus shelters were not at the junction, pedestrians would need a separate set of traffic signals to safely cross the road which would delay the vehicular movement on the corridor. Bus dwell time is combined with the red light phase to minimize delays to buses. This longer dwell time is safer for commuters. For the Delhi BRT system, the corridor is used by (36) routes with 8-10 buses standing at the junction during the red phase. To accommodate four buses on a single platform would need a platform that is over 120m long. In order to avoid this, two parallel platforms have been created.

The Delhi BRT system is an open system as distinct from a closed system. Of all the buses plying this corridor, four routes (424, 419, 423, 462) use it from the beginning (Ambedkar Nagar) to end (ISBT); other buses join and depart from the corridor at various junctions as per their route requirements. This reduces the need for transfers and feeder buses which is desirable for short (6 to 8 km) trips. This system benefits the largest number of commuters possible; the benefits to the commuter accrue in accordance with the time/distance s/hr travels on the corridor. The bus system in Bogota (like the one proposed for Ahmedabad), is a closed system with feeder buses; Bogota has longer trip lengths than Delhi and other Indian cities and a completely different land use pattern. These closed systems may provide short term operational efficiency at the cost of losing patronage while in Indian cities which have mixed land use patterns and short trip lengths; the open system is to be preferred.

Low floor buses were introduced to Delhi for the first time in India with the coming of the BRTS. These buses have floors that are level with the platforms in the bus shelters, making for the safety and convenience of all passengers including children, the infirm and those who are physically challenged; because of this, there is a considerable saving of time in alighting and disembarking at the bus shelters. Noting these advantages, the government of Delhi has decided to introduce low-floor buses on all its routes.

A dedicated cycle track runs the entire length of the BRT corridor from Ambedkar Nagar to Moolchand. These tracks are used by cyclists, cycle rickshaws, and hand carts. This track is 2.5m wide. It has been found that the traffic flow of cyclists on this track is between 1500 to 2000 cycles per hour in each direction. It has been noticed that weak enforcement by the authorities has allowed encroachment on this dedicated cycle path of motorized two and three wheelers and small cars. This is both disruptive and dangerous – partly defeating the main purpose of the BRTs.

Weak enforcement by the authorities: motorised two wheelers on the cycle track

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News

Surveillance alone is not the answer

One popular theme in the injury prevention literature is the perceived need for more and better surveillance. This arises because of the belief that surveillance is a prerequisite for preventive programs. I have serious reservations about this belief and I could even argue that an undue emphasis on surveillance could be harmful. That, admittedly extreme, view applies when surveillance fails to achieve its most critical objective while consuming resources that could be better directed elsewhere. If all that is wanted is numbers, a registry should suffice, and these too are far cheaper than a full-blown surveillance system. But I must be clear the ideal solution is to make surveillance serve the goal of prevention. This requires the establishment of a permanent health department division with responsibility for injury prevention and control. Anything short of this is almost certain to lead to the same disappointments and frustrations I have repeatedly expressed.
Ultimately, surveillance requires a recipient of the information who has the mandate, resources, and determination to take the appropriate action. Surveillance is sterile and pointless if it is not somehow tied to preventive interventions. I challenge readers to send examples where this has happened and I will humbly eat my words.
Dr. Barry Pless, Clinical Research, Montreal Childrens Hospital, 2300 Tupper, F259 Montreal, Canada H3H1P3. Injury Prevention August 2008 Vol 14 No. 4, 220-221.

Helmet use and the risk of neck or cervical spine injury among users of motorized two-wheel vehicles

A population-based study involving injured riders from the Rhone Road Trauma Registry from 1996 to 2005 was done to quantify the effects of wearing a helmet on head and facial injury among users of motorized two-wheel vehicles and to determine if helmet use increases the risk of neck and cervical spine injury. Victims were only included if they had an injury to a body region other than (or in addition to) the head, face, neck, or cervical spine. Helmet use significantly decreased the risk of head and facial injuries. The adjusted odds ratios for non-helmeted riders were 2.43 (95% CI 2.05 to 2.87) and 3.02 (95% CI 2.48 to 3.67), respectively. There was no association between helmet use and the occurrence of neck or cervical spine injuries. The adjusted odds ratios for non-helmeted riders were 0.86 (95% CI 0.60 to 1.23) and 1.04 (95% CI 0.78 to 1.39), respectively. Helmets protect users of motorized two-wheel vehicles against head and facial injury without increasing the risk of neck or cervical spine injury.
A. Moskal, J-L Martin, B. Laumon. Injury Prevention 2008; 14: 238-244.

How to obtain a healthy journey to school

Danish children walk and cycle a lot and at the same time have one of the best child road safety records in the western part of world. Based on several studies, the paper describes how Denmark has obtained a good child road safety and why Danish children choose to walk and cycle. Child road safety has predominantly been improved due to higher seat belt use and many implemented local safety measures such as campaigns and physical safe routes to school projects. It is mostly safe routes to school projects that include speed reducing measures and signalisation of junctions that are successful. The distance from home to school is an important factor in children's transport mode choice. Since about half of Danish children have less than 1.5 km to school the decentralised school structure with many fairly small schools is an important reason to the many walking and bicycle journeys. Road design and motorised traffic volumes do influence children's mode choice, but to a rather limited extent.

Traffic calming with emphasis on speed reducing measures has a beneficial safety effect and does make children shift from car and bus on school journeys and instead use the bicycle. It seems that the high level of child road safety in Denmark to a great extent has been reached by many local efforts in the municipalities. The legislation forces the municipalities to work with child road safety and this may be an important reason for the many local efforts. The decentralised school structure can possibly explain the high level of walking and cycling among Danish school children,
Søren Underlien Jensen, Trafitec, Research Park Scion-DTU, Diplomvej 376, 2800 Lyngby, Denmark. Transportation Research Part A (2008), 42 : 475–486

Alcohol and fatal accidents in the United States—A time series analysis for 1950–2002

Yearly data on fatal accidents by gender and age were analysed in relation to per capita alcohol consumption for 1950–2002 using the Box–Jenkins technique for time series analysis. A 1-L increase in per capita consumption was on average followed by 4.4 male deaths per 100,000 inhabitants, but had no significant effect on female accident mortality. Regarding specific categories of accidents, the effect on fatal motor vehicle accidents accounted for a large part of the overall effect for men and was also significant for women. The US effect estimate for overall male accidents was however equally strong as in Northern Europe (5.2) or Canada (5.9), and stronger than that found in Central and Southern Europe (2.1 and 1.6, respectively). With respect to alcohol and fatal motor vehicle accidents, the association for men of 3.2 was stronger than in Europe and more similar to the Canadian finding (3.6). Per capita alcohol consumption has at least partly been an explanation for the development of male fatal accidents and particularly motor vehicle accident rates in the post-war United States. High traffic density and relatively high legal limits for drunken driving blood alcohol concentration (BAC) are suggested to explain the strong association found between alcohol and fatal motor vehicle accidents. The results also suggest that a reduction in per capita consumption would have its most preventive impact on fatal accidents among younger males

Mats Ramstedt. Centre for Social Research on Alcohol and Drugs (SoRAD), Stockholm University, Sveaplan, SE-106 91 Stockholm, Sweden. Accident Analysis & Prevention, Volume 40, Issue 4, July 2008, Pages 1273-1281.

Establishment funds have been received from
Ministry of Industry, Government of India
Asian Institute of Transport Development
Tata Motors
Volvo Research and Education Foundations

Endowments for perpetual Chairs
Volvo Chair for Urban Transport
CONFER, India: TRIPP Chair for Transportation Planning

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