TRIPP BULLETIN
VOL. 7 NO.1 SUMMER 2010
TRANSPORTATION RESEARCH & INJURY PREVENTION PROGRAMME
INDIAN INSTITUTE OF TECHNOLOGY DELHI

Publications

Repositioning the human body lower extremity FE model
Jani D, Chawla A, Mukherjee S, Goyal R, Nataraju V (2009)
SAE International Journal of Passenger Cars – Mechanical Systems Vol. 2 No 1, pp 1024-1030.

Response of tonic lower limb FE model in various real life car-pedestrian impact configurations – a parametric study for standing posture
Soni A, Chawla A, Mukherjee S, Malhotra R(2009)
Int. J. Vehicle Safety, Vol. 4, No. 1.

Response of lower limb in full scale car-pedestrian low speed lateral impact- Influence of muscle contraction
Soni A, Chawla A, Mukherjee S, Malhora R (2009)
International Journal of Crashworthiness, Vol. 14, No. 4, pp. 339–348.

Characterization of human passive muscles for impact loads using genetic algorithm and inverse finite element methods
Chawla A, Mukherjee S and Karthikeyan B(2009)
Biomechanics and modelling in mechanobiology, Vol. 9, Issue 1, pp 67-76.

Dynamic characterization of bovine medial collateral ligaments
A Chawla, S Mukherjee, H Warhatkar, R Malhotra(2009)
IRCOBI Conference Proceedings. International Research Council on the Biomechanics of Injury, York, pp 109-113.

Effect of muscle contraction in high speed car pedestrian impact–simulations for walking posture
Anurag Soni, Anoop Chawla, Sudipto Mukherjee, Rajesh Malhotra (2009)
IRCOBI Conference Proceedings. International Research Council on the Biomechanics of Injury, York, pp 237-250.

Human body FE model repositioning: a step towards posture specific – human body models (PS-HBM)
Dhaval Jani, Anoop Chawla, Sudipto Mukherjee, Rahul Goyal, V Nataraju (2009)
IRCOBI Conference Proceedings. International Research Council on the Biomechanics of Injury, New York, pp 327-340.

Effect of muscle contraction in low speed car-pedestrian impact – simulations for walking posture
Anurag Soni, Anoop Chawla, Sudipto Mukherjee, Rajesh Malhotra(2009)
21st ESV, Stuttgart, Paper Number 09-0366-O.

Sensitivity analysis of muscle parameters and identification of effective muscles in low speed lateral impact
Anurag Soni, Anoop Chawla, Sudipto Mukherjee, Rajesh Malhotra(2009)
SAE World Congress, Detriot, Paper 2009-01-1211.

Experimental study of variation between quasi-static and dynamic load deformation properties of medial collateral knee ligaments
Hemant Warhatkar, Anoop Chawla, Sudipto Mukherjee, Rajesh Malhotra(2009)
SAE World Congress, Detriot, Paper 2009-01-0392 .

Damage and delamination study in composite shells for a motorcycle helmet
Pinnoji PK and Mahajan P. (2009)
15th International Conference on Composite Structures (ICCS15), Porto, Portugal.

Road safety in India: challenges and opportunities
Dinesh Mohan, Omer Tsimhoni, Michael Sivak and Michael J. Flannagan, (2009)
University of Michigan, Transportation Research Institute, Ann Arbor, MI. Report No. UMTRI-2009-I, pp.1-57.

Aerodynamics of a bus with open windows
Yelmule, M.M., Kale, S.R. and Veeravalli, S.V. (2009)
Int. J. Heavy Vehicle Systems, Vol. 16, No. 4, pp. 459-488.

Developing and validating a simulation model for heterogeneous traffic
C. Mallikarjuna, and K. Ramachandra Rao. (2009)
TRB Annual Meeting, Washington.

Characteristics of intercity air travel in India
A.M. Jain, and K. Ramachandra Rao. (2009)
14th HKSTS Conference, Hong Kong.

Cellular automata model for heterogeneous traffic
C. Mallikarjuna, A. Phanindra and K. Ramachandra Rao (2009)
Journal of Transportation Engineering-ASCE, Vol. 135, No.4, pp 174-182.

Application of GPS for traffic studies
K. Ramachandra Rao and A. Mohan Rao (2009)
Urban Transport Journal. 8:1, pp 44-55.

Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport
Woodcock J, Edwards P, Tonne C., Tiwari, G. et al(2009)
The Lancet, 2009DOI:10. 1016/SO140-6736(09)61714-1

Case study of pedesrian risk behavior and survival analysis
U. Gupta, G. Tiwari, N. Chatterjee and J. Fazio (2009)
Proceedings of the Eastern Asia Society for Transportation Studies. Surabaya, Indonesia.

Research & Consultancy Projects

Sustainable Urban Transport in Less Motorised Countries: Research and Training
Sponsor *Volvo Research & Educational Foundations*
Team *D. Mohan, G. Tiwari, A. Chawla, S. Mukherjee, S.R. Kale, P. Mahajan, S. Sanghi, and N. Chatterjee*

Estimation of Emissions and Fuel Consumption of in-use Vehicles in Different Driving Conditions.
Sponsor *Petroleum Conservation Research Association*
Team *G Tiwari, S.R. Kale, R.R. Kalaga and D. Mohan*

Review of Contractual Provisions, Establishment of Work-zone Safety Audit Procedure Conducting Work-Zone Safety Audit and Strengthening Work Zone Safety Implementation for Lucknow-Muzaffarpur National Highway Project (LMNHP).
Sponsor *National Highway Authority of India*
Team *K.N. Jha, G. Tiwari, R.R. Kalaga, D. Mohan and S. Mukherjee*

Bicycle Partnership Programme(BPP)
Sponsor Interface for Cycling Expertise (Ice), The Netherlands
Team *G Tiwari, and D. Mohan*

Scholarships

Volvo Foundation Research Scholarship awarded to **Ms. Himani Jain, Ms Mariya Khatoon, Mr. Mike W.J. Arun and Mr. Amit Agarwal**

Sumant Moolgaokar Research Scholarship awarded to **Mr. Jani Dhaval Ashvinkumar**

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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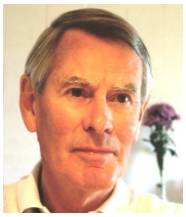
The Future of Traffic Safety and Sustainable Transport*



Murray Mackay, OBE, FREng, is Emeritus Professor of Transport Safety, University of Birmingham, England. He established the Birmingham Accident Research Centre at the University of Birmingham in 1964, and ran it until 1996.

In this paper I seek to outline the appropriate technologies and policies which may help India tackle the increasing burden of road traffic injuries. All of us can learn from the experiences and research over the last hundred years of motorisation. I also want to discuss how to create different and appropriate solutions for a growing country in a period when demands for energy and climate change and the consequences of carbon emissions are becoming obvious to everyone. My main concern is traffic safety, and how it must move up the list of priorities within a sustainable transport system. In the end, I conclude that an environmentally sustainable transport system and traffic safety are not just complementary to each other, they are mutually dependent. You cannot have one without the other.

Traffic safety represents one of those elite subjects, like cricket, politics and religion, about which everybody instinctively knows what is right. It is a subject which has had more than its fair share of pre-scientific, prejudiced, folklore thinking. Thus the traditional approach to reducing road accidents has been that it is "obvious" that they should be prevented from taking place, and because the predominant "cause" of road accidents rests on road user errors of one sort or another, it is again "obvious" that road user behaviour needs to be changed. Current estimates indicate that there were 1.2 million traffic fatalities globally in 2004 (WHO 2009). However under-reporting, particularly in low and middle income countries, means that this number is likely an under-estimate. Most reporting systems rely on police data.Fundamental to understanding the situation in low and middle income countries (LICs and MICs) is to appreciate that the casualties are very different from those occurring in HICs. The great majority of the fatalities in LICs and MICs are pedestrians, motorcyclists (MTWs) and bicyclists, not vehicle occupants. Fatalities are only a part of the overall traffic injury picture. On a number of measures the surviving casualties are a greater burden on society. In economic terms, or in terms of medical and social costs, the survivors are more important. For every death there are at least 4 survivors with serious, permanent disabilities, brain damage, spinal cord injury or major loss of function of the lower limbs which inhibits walking (ETSC 2007). The costs of those survivors, often young and with a normal lifespan, are extremely high in both economic and social dimensions.

Two opposing global trends dominate national and international politics and industry at the present time. First, it is predicted that the demand for energy will almost double by 2030. Secondly, global warming is strongly related to absolute increases in greenhouse gases and a proportion of those gases most likely come from human activity.Thus concerns about the immediate effects of air pollution, especially in India's large conurbations, combined with the broader issues of greenhouse gases and global warming, come together and lead to the need for a fundamental rethink about the nature of the vehicles we drive and the environments in which we use them.

These environmental concerns coupled with the growing recognition that the current levels of deaths and injuries in traffic accidents, the attendant social and economic costs, and the annual foreseeable increases in those costs if a laisse faire attitude continues, means that environmental and safety issues must be studied as two parts of the same problem.

Injury is a consequence of an intolerable amount of mechanical (kinetic) energy being transferred into the human frame. Kinetic energy increases according to the square of the velocity. Thus the role of speed, particularly in the mixed road user environment of big cities, is a dominant factor in injury risk. Speed also of course influences energy consumption, pollution, noise, stress on road users and vehicle and highway maintenance. Thus speeding is endemic in almost all motorised countries. The enforcement of speed limits is now done in many western countries with the use of speed cameras and fines, but that requires an effective enforcement agency coupled with a transparent legal system. Having excessive power therefore leads to excessive speeds, excessive braking, increased injury risks for all road users, especially VRUs, increased energy use, increased greenhouse gases and air pollution with further health risks, increased noise, increased road and tyre wear, and a pervasive level of fear in many road users.

Indian cities have already reached levels of congestion equal to or worse than that of European and American cities. The heterogeneous nature of Indian traffic, with large numbers of motorcycles, cyclists, three-wheeled taxis, as well as cars, trucks and buses, in fact results in higher flows of equivalent passenger car units than classical traffic flow theory predicts, based on western traffic mix. The history of attempts to reduce congestion all over the world by providing more and more roads is one of failure. Traffic volumes merely grow to fill up the additional capacity.

Therefore alternatives must be developed to meet the demands of less congestion, greater safety and less pollution. The most obvious and immediate priority for city governments is to develop appropriate public transport. Dedicated bus lanes with cheap, comfortable and frequent services are needed, coupled with parking policies and road pricing regimes to discourage private car and motorcycle use. Provision of separate bicycle and pedestrian lanes with preferential treatment at junctions are needed. Speed control and traffic calming are central to reducing traffic injury risk. Roundabouts, chicanes, speed humps, pedestrian refuges, improved street lighting, distinct facilities for pedestrians and cyclists are all well established countermeasures for the urban environment.

Tax, parking and fuel pricing policies can actively discourage large, polluting vehicles and are now used in many countries very aggressively. Electric bicycles and scooters are an attractive option which should be encouraged for urban Indian traffic. Given the traffic mix in urban India and a specified upper limit to its speed of say 65 km/hr then the standard crash performance requirements for conventional cars are not necessarily appropriate for a city car. The prime safety concern must be pedestrian (and VRU) protection. Careful control of the front exterior geometry and compliance of the structures which will be struck by pedestrians can provide major benefits. European standards exist for exterior design to reduce pedestrian injuries, but they are not as effective as they could be.

**Excerpts from: Mackay, M. (2010) "The Future of Traffic Safety and Sustainable Transportation" 3rd Annual TRIPP Lecture, TRIPP-RP10-01. Transportation Research & Injury Prevention Programme. Indian Institute of Technology, New Delhi.*
Full text available at: http://web.iitd.ac.in/~tripp/3rd%20tripp%20lecture%20mackay%20final.o.pdf

This is one area of vehicle design where the Indian vehicle industry could be a world leader.

There is great enthusiasm and much technical development over crash avoidance and injury mitigation systems within the car industry at present. Short range radar and automatic proximity braking, pedestrian detection systems, enhanced night vision, adaptive lighting systems, lane departure warning, brake assist, intelligent speed adaptation all offer some potential safety benefits. Predicting what these benefits might be is difficult because many of them alter the relationships between the driver, the vehicle and the road. Risk compensation is a well established phenomenon in man/machine relationships so many of the claims currently made for these new technologies may well be optimistic.

Current costs of these technologies rule them out for the majority of the new car fleet in India, but the application of some of these technologies in buses and trucks used in the urban environment would be appropriate at the present time. In particular, automatic proximity braking and pedestrian sensing systems would likely yield significant benefits.

Night-time collisions rates in both urban and rural conditions are roughly double daytime rates. For highways, vehicle lighting can be much improved with automatic lights and adaptive lights, where the headlights automatically adjust to the light output of approaching vehicles, the headlights turn when a bend is being negotiated and move vertically for hills and declines. LED lighting provides better performance and offers significant energy saving benefits, and will become widespread over the next decade.

The poor conspicuity of all vehicles and pedestrians, under both day and night conditions, is a frequent contributing factor noted in detailed crash investigation studies. White and reflecting materials provide tangible benefits and are legal requirements in many countries for trucks and buses.

Similarly speed governors are specified through regulations in many places for trucks and buses. Again this is an area where government must lead because the perception of the operators is that it puts them at a cost disadvantage.

So far I have concentrated on technological countermeasures relating to road design, traffic management and vehicle design. I have done so in the belief that, for India in particular, with the rapid growth in vehicle ownership, with very rapid urbanization, the low but increasing level of national income per head and the absence of many institutional arrangements taken for granted in high income countries, technological changes will be more effective than countermeasures aimed at changing road user behaviour. The history of traffic safety shows that behavioural changes to be effective require an underlying community structure for enforcement, a level of knowledge of what is good practice in terms of road user behaviour and an acceptance by the general public that individual freedoms have to be restricted for the common good.

Too often western consultants have been applying western countermeasures to the traffic injury problems of LICs. Too often they make implicit assumptions about large and efficient enforcement agencies and lots of expensive technology which in fact are absent in many low income countries. But there are some behaviour issues highlighted in a number of studies in LICs where rapid motorisation is occurring and behavioural change can be effective. Mandatory Seat Belt Use – When enforced, seat belt usage levels in LICs can reach levels of 70% for drivers, although lower for passengers. Helmet Use by MTWs – Again when enforced, helmet use levels can reach over 90% (Umar et al. 2000).

Driving and Alcohol – Although not adequately researched in India, it appears likely that alcohol is a factor in a significant and increasing number of traffic accidents, especially at night and also with pedestrians at night. Random breath testing does take place and when enforcement occurs there is a deterrent effect (ETSC 2003). But to be truly effective in changing attitudes to drinking and driving, random breath testing requires a level of testing and hence police resources which can only be done in HICs. For example in some states in Australia where random breath testing is practiced, on average one driver in three can expect to be tested once a year. In Britain the equivalent number is one driver in six. With such levels of testing real behavioural changes occur. By contrast in the United States where levels of testing are about one driver in a thousand, alcohol remains a factor in some 40% of fatalities.

The technology for detecting alcohol by sampling breath remotely from a sensor in the steering wheel is becoming available. This represents a new way of controlling drinking and driving which has obvious benefits, particularly for fleet operators and commercial drivers. Alcohol interlocks are now used as part of the sentencing procedures for drivers convicted of drinking and driving, but to be effective that requires robust and expensive policing procedures.

Fatigue – Although under researched it is highly likely that fatigue is a major factor, especially in night time accidents on the highways, and especially involving trucks and buses. Driving distances are long and the economic incentives to drive those long distances are attractive. In developing appropriate countermeasures for India's road system, there is a clear need for better knowledge about the characteristics and extent of traffic crashes, injuries and their consequences. Crash investigation is a specialized skill which needs to be recognized and nurtured within the police service and within highway departments. Establishing robust data collection systems means linking local, regional, state and national organizations together. Traffic crashes and their consequences cover both transport and health sectors. Hence data bases should also be linked. Only by knowing the nature and characteristics of Indian traffic accidents will it be possible to develop the most appropriate countermeasures. Only by having such data will it be possible to measure the effectiveness of changes which are made. Guesswork is no substitute for data.

Economic growth in India has lead to an enormous increase in the demand for energy. At the same time urban air pollution and climate change issues lead to the need to reduce energy consumption and in particular reduce the use of fossil fuels. Along with those conflicts, urban traffic congestion, noise and the real fear of traffic injury dominate life in cities and on the highways. In moving towards a sustainable transport system all of these needs must be addressed. Sustainable transport will not become a reality unless traffic injury risk is reduced.

In this superficial review I have concentrated on the technological countermeasures possibly appropriate for Indian traffic, in the areas of highway design and traffic management, and vehicle design. I have done this because the history of traffic safety shows that engineering countermeasures work more quickly and more effectively than programmes aimed at altering behaviour. However, many of the measures which work in high income countries are not appropriate for Indian traffic because the vehicle fleet is so different. Thus there is a real need to develop new solutions recognizing the vulnerable road users in particular. Where motorcycles and pedestrians dominate, new traffic management solutions are required.

The use of safety and environmental audits for governments is an important mechanism in evaluating new road developments, traffic management schemes and vehicle technologies. Building that capacity to create a forgiving road system is the immediate challenge for government. Thus energy use, climate change, congestion and traffic safety are intimately linked. Sustainable energy and sustainable transport will only be addressed successfully if traffic safety is also addressed.

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News

Killer crashes: Fatal road traffic accidents in the UK.

Road traffic accidents are responsible for over 3000 deaths per year in the UK, according to Department for Transport figures. Although progress is being made in a number of areas, vehicle occupant fatalities have not been falling in line with casualty reduction targets for the year 2010. A sample of 1185 fatal vehicle occupant cases was considered, from ten UK police forces, from the years 1994-2005 inclusive. The main findings were: (1) over 65% of the accidents examined involved driving at excessive speed, a driver in excess of the legal alcohol limit, or the failure to wear a seat belt by a fatality, or some combination of these. (2) Young drivers have the great majority of their accidents by losing control on bends or curves, typically at night in rural areas and/or while driving for 'leisure' purposes. These accidents show high levels of speeding, alcohol involvement and recklessness. (3) Older drivers had fewer accidents, but those fatalities they were involved in tended to involve misjudgement and perceptual errors in 'right of way' collisions, typically in the daytime on rural rather than urban roads. Blameworthy right of way errors were notably high for drivers aged over 65 years, as a proportion of total fatal accidents in that age group.

Clarke, D. D., Ward, P., Bartle, C., & Truman, W. (2010). Accident Analysis & Prevention, 42, 764-770.

Why we fail to reduce urban road traffic volumes: Does it matter how planners frame the problem?

In a situation with competing objectives, and where knowledge is contested, the actors may choose what they consider as valid knowledge based on ideology, interests or position. Flyvbjerg (1998) found that in situations like this "power defines what counts as rationality and knowledge and thereby what counts as reality" (italics in original). The people who have the power define what count as valid objectives and knowledge. If the actors who promote objectives and knowledge within the new framing are not the most powerful actors in the game, this may be one explanation why plans resulting in increased road traffic volumes are still made...We have seen that the planning game is quite complex and involves a number of different actors. Planners are the actors who possess the professional knowledge in this field. How planners frame the problem influences what they see as important objectives, possible alternatives, valid methods for evaluation, etc. This affects the planning, the plans and the ultimate outcome in the form of traffic volumes. In order to reduce urban road traffic volumes, planning and development of urban land use and transport systems need to change. This requires planners to reframe the transport problem from 'predict and provide' towards 'coordinated land use and transport planning for reduced urban road traffic volumes'. This involves a change of objectives as well as applied knowledge. The empirical evidence presented in this article shows that some planners have reframed the problem while others have not. Here, there is a frame conflict situation. This frame conflict reduces the ability of the planning system to focus on both reducing traffic demand and applying strategies and means that would help to achieve the objective. It also opens the way for power to define what constitutes important objectives and valid knowledge. How planners frame the problem, including the frame conflict discussed here, thus appears to be one explanation why urban land use and transport systems are still planned and developed in ways that cause and allow growth in urban road traffic volumes.

Tennoy, A. (2010). Why we fail to reduce urban road traffic volumes: Does it matter how planners frame the problem? Transport Policy, 17, 216-223.

It's a safety marketplace, and consumers are buying

Car safety ratings often grab the media spotlight. Sometimes they're published by the Institute, while other ratings are from the government or Consumer Reports. Bigger news than these periodic media splashes is the growth of the safety marketplace around the world, spurred by the availability of vehicle ratings from multiple sources. "These crashworthiness ratings aren't in competition. One isn't better than another," says Institute president Adrian Lund. "The key is to look at every available source of safety information and choose a car, pickup, or SUV with top ratings across the board. These vehicles are on the market, and buyers are finding them." A new poll confirms the attention that consumers are paying to safety, factoring it into their vehicle choices. In turn, this demand puts pressure on auto manufacturers to compete in the safety marketplace.

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Endowments for perpetual Chairs
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Transportation Research and Injury Prevention Programme
Room MS 808 (Main Building)
Indian Institute of Technology
Hauz Khas, New Delhi 110016, India
Phone: 91-11-26596361, 26858703
Fax: 91-11-26858703, 26851169
Email: mahesh@cbme.iitd.ernet.in
www.iitd.ac.in/tripp

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ABSTRACTS from some 2009 publications: a TRIPP bulletin insert

Dinesh Mohan, Omer Tsimhoni, Michael Sivak and Michael J. Flannagan (2009), 'Road safety in India: Challenges and opportunities', *University of Michigan, Transportation Research Institute, Ann Arbor, MI.* Report No. UMTRI-2009-I, pp.1-57.

Abstract: The present report was designed to analyze the traffic safety situation in India, and to identify countermeasures for areas in which the total harm caused by crashes can be substantially and readily reduced. The report focuses on two aspects of traffic safety in India: challenges and opportunities. The first part of the report provides a comprehensive analysis of the current traffic safety situation in India. It is pointed out in this analysis that fatality rates have increased both on highways and in urban areas during the past few years. Theoretical models suggest that the number of fatalities in India is not likely to start to decline for many years to come unless new policies are implemented. Based on the present analysis, the following six areas are identified as having potential for substantially reducing fatalities in India: (1) pedestrians and other non-motorists in urban areas, (2) pedestrians, other non-motorists, and slow vehicles on highways, (3) motorcycles and small cars in urban areas, (4) over-involvement of trucks and buses, (5) night-time driving, and (6) wrong-way drivers on divided highways. The second part of the report outlines several promising countermeasures for each of these six areas. The third part of the report presents a brief comparison of major traffic safety challenges in India and China.

Keywords: India, road safety, transportation safety, traffic crashes, road fatalities, motorization, driving, countermeasures

Soni, A., Chawla, A., Mukherjee, S., & Malhotra, R. (2009), 'Effect of muscle contraction in high speed car pedestrian impact - simulations for walking posture. *In 2009 IRCOBI Conference Proceedings*, Zurich, pp. 237-249.

Abstract: This paper investigates the effect of muscle contraction on lower extremity injuries for pedestrian walking posture in car-pedestrian lateral impact at 40 kmph. The full body model, PMALE, which was configured in symmetric standing posture, has been repositioned in the walking posture. Finite element simulations have then been performed using the PMALE in the walking posture and front structures of a car. Two impact configurations, i.e. impact on right (trailing) and on left (leading) leg have been simulated. Two pre-impact conditions, that of a symmetrically standing pedestrian, representing a cadaver and an unaware pedestrian have been simulated for both the impact configurations. Stretch based reflexive action was included in the simulations for an unaware pedestrian. It is concluded that (1) with muscle contraction risk of ligament failure decreases (2) in lateral impacts, MCL could be considered as the most vulnerable and LCL as the safest ligament (3) for a walking pedestrian, PCL would be at higher risk in case of impact on trailing leg whereas, ACL would be at higher risk if car strikes the leading leg (4) active muscles may not affect bone fracture in high speed car-pedestrian crashes.

Keywords: PMALE, lower extremity model, finite element model, dynamic simulation, muscle contraction, standing posture, walking posture, car-pedestrian impact, knee injury.

Yelmule, M.M., Kale, S.R. and Veeravalli, S.V. (2009) 'Aerodynamics of a bus with open windows', *Int. J. Heavy Vehicle Systems*, Vol. 16, No. 4, pp. 459-488.

Abstract: Most passenger trips worldwide are in open window buses where airflow due to motion provides comfort. The aerodynamics of such a bus was studied. Flow visualisations in a water channel using a 1:25 model showed highly turbulent inflow and outflow through rear and front windows, respectively. Large Eddy Simulation (LES) at the full-scale Reynolds number confirmed these features. Seven different interventions (in the form of slots on different surfaces) were considered. It was found that for the best configuration, the drag was reduced by 29% and the comfort zone increased from 11 % to 52% of the passenger volume.

Keywords: bus; open windows; aerodynamics; air circulation; intervention; drag; comfort level.

Soni A, Chawla A, Mukherjee S., & Malhotra R. (2009), 'Response of lower limb in full scale car-pedestrian low speed lateral iompact-influence of muscle contraction', *Int Journal of Crashworthiness, Vol. 14 No. 4, pp. 339-348.*

Abstract: This paper investigates the effect of muscle contraction on lower extremity injuries in car-pedestrian lateral impact. A full-body pedestrian model with active muscles has been developed. Finite element simulations have then been performed using the full-body model and front structure of a car. Two pre-impact conditions, that of a symmetrically standing pedestrian, representing a cadaver and an unaware pedestrian, have been simulated. Stretch-based reflexive action was included in the simulations for an unaware pedestrian. The results show that due to muscle contraction (1) peak strain in all the knee ligaments reduces, (2) von Mises stresses in tibia and fibula increase and may fail and (3) knee joint effective stiffness increases by 58% in lateral bending.

Keywords: A-LEMS; lower extremity model; finite element model; dynamic simulation; muscle contraction; standing posture; car-pedestrian impact; knee injury

P.K. Pinnoji, P. Mahajan, N. Bourdet, C. Deck, R. Willinger (2009) 'Impact dynamics of metal foam shells for motorcycle helmets: Experiments & numerical modeling', *International Journal of Impact Engineering*, Vol. xxx pp.1-11.

Abstract: To reduce the weight of the motorcycle helmet, metal foam for outer shell in place of conventional thermoplastics was tested. The dynamic behaviour of this new helmet was studied through experiments and numerical modeling. Open-face motorcycle helmets were designed with metal foam shell and impact experiments were performed with these helmets fitted on a headform. A finite element model was developed and the predicted acceleration of headform from this model was validated against the experiments. The mechanical behaviour of full-face helmets with metal foam shell was investigated next. The FE analysis was performed separately with rigid and deformable heads. Head injury criterion (with rigid head) and stresses in brain (with deformable head) were evaluated separately for metal foam shell and ABS shell helmets. The helmet impact performance is examined with two separate densities of metal foam. The shell with low-density metal foam (150 kg/m3) gives a better performance compared to ABS shell. The metal foam shell showed significant visible plastic deformation in the impact region

Keywords: Helmets, metal foam, impact, finite elements.

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Continued from overleaf:

Woodcock J, Edwards P., Tonne C., Tiwari, G. Et al (2009) 'Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport'. ***The Lancet, 2009DOI: 10. 1016/SO140-6736(09)61714-1.***

Abstract: We used Comparative Risk Assessment methods to estimate the health effects of alternative urban land transport scenarios for two settings—London, UK and Delhi, India. For each setting, we compared a business-as-usual 2030 projection (without policies for reduction of greenhouse gases) with alternative scenarios—lower-carbon-emission motor vehicles, increased active travel, and a combination of the two. We developed separate models that linked transport scenarios with physical activity, air pollution, and risk of road traffic injury. In both cities, we noted that reduction in carbon dioxide emissions through an increase in active travel and less use of motor vehicles had larger health benefits per million population (7332 disability-adjusted life-years [DALYs] in London, and 12 516 in Delhi in 1 year) than from the increased use of lower-emission motor vehicles (160 DALYs in London, and 1696 in Delhi). However, combination of active travel and lower-emission motor vehicles would give the largest benefits (7439 DALYs in London, 12 995 in Delhi), notably from a reduction in the number of years of life lost from ischaemic heart disease (10—19% in London, 11—25% in Delhi). Although uncertainties remain, climate change mitigation in transport should benefit public health substantially. Policies to increase the acceptability, appeal, and safety of active urban travel, and discourage travel in private motor vehicles would provide larger health benefits than would policies that focus solely on lower-emission motor vehicles.

Keywords: Green house gas, DALY, climate change, public health.

C. Mallikarjuna, A. Phanindra and K. Ramachandra Rao (2009). 'Cellular automata model for heterogeneous traffic'. ***Journal of Transportation Engineering-ASCE, Vol. 135, No. 4, pp. 174-182.***

Abstract: There exists a need for traffic flow modelling in developing countries on account of the growth in personalized traffic. For many developing cities, traffic management schemes are gaining importance. The core of any traffic management scheme is a better understanding of traffic behaviour. Since the traffic is heterogeneous in nature and vehicle characteristics vary widely, it is not known whether any conventional microscopic (car following) or macroscopic models are applicable to developing countries. In most of the simulation models, either space or time or both are considered as continuous variables, and since these models involve numerous elements (various vehicle types, different road conditions etc.), they require immense computational time. The objective of this study is to achieve a better computational efficiency in modelling complex traffic systems for different scenarios. The model developed in the present study is based on the Nagel and Schreckenberg's (NS) approach (1992). In the NS model, interactions between different elements (vehicles, road and driver) were considered implicitly and even though this basic model could not reproduce all the observed traffic characteristics, it was however able to reproduce the trends observed in real traffic. The model has undergone many changes since then and its applicability is now extended to model network traffic flows (Simon and Nagel, 1998). A detailed literature review is presented in the next section which is followed by discussion on the basic structure of the CA model and its evaluation with time. Later, some modifications are proposed and a new model is developed. The significance of different parameters and the results of the model are discussed in the next section and finally, the validation of the model and its limitations are discussed.

Keword: computational efficiency, modelling traffic systems, heterogeneous traffic

Udit Gupta, Geetam Tiwari, Niladri Chatterjee and Joseph Fazio (2009). Case study of pedestrian risk behavior and survival analysis. ***Proceedings of the Eastern Asia Society for Transportation Studies, Vol. 7.***

Abstract: In order to improve traffic flow, signal-free, grade-separated intersections in Delhi have often replaced signalized intersections. Evaluating the impact of signal free intersections on pedestrians is important when nearly fifty percent fatalities in the city involve pedestrians. Examining a pedestrian sample before and after site reconstruction produces a better understanding of the subsequent changes in pedestrian risk behavior. Strategically placed camcorders viewed pedestrians and approaching traffic. Data reduction measured the accepted time gap of each pedestrian making an unsafe crossing and the average speeds of the approaching vehicle groups. A pedestrian survey provided additional information. Sixty two percent pedestrian accepted gap less than 4 seconds(exposed to high risk) after site reconstruction compared to fifteen percent pedestrian accepting similar gap before the site reconstruction. More than 35 percent of pedestrian stage crossings had accepted gaps less than one second as compared to 6 percent of pedestrian stage crossings before reconstruction. After reconstruction, 22% of pedestrians did not use the pedestrian underpass and continued unsafe crossings at the site.

Pedestrian exposure to greater risks of bodily injury and death with site reconstruction occurred despite the presence of an underpass and median barrier. Pedestrians had exposure to higher risks after the construction of the signal-free crossing. Not all pedestrians used the pedestrian subway. The design and location of the pedestrian subway needs modification.

Keywords: Pedestrian behavior, traffic flow, intersections.