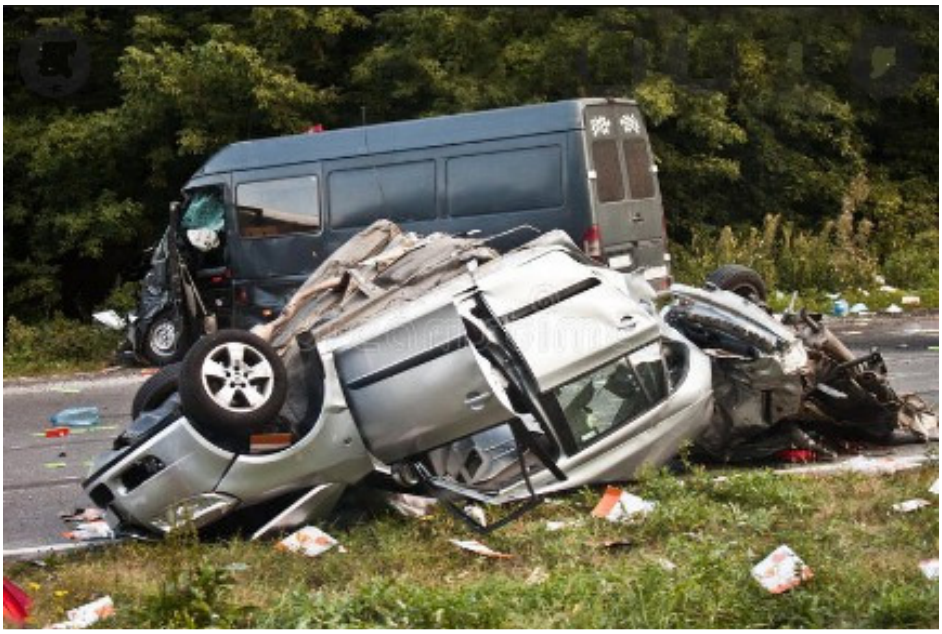


Road Safety

by

Traffic Management and Transportation Engineering
with Intelligent Transport System, Green Highways

Sandipan Goswami
B.Sc, B.E., M.Tech, FIE, C.Eng, PE (M)

PREFACE

The loss of lives and assets is significant in road accidents and is a very serious socio- economic issue. The book "**Road Safety by Traffic Management and Transportation Engineering with Intelligent Transport System, Green Highways**" provides a set of guidelines not only to improve road safety, but also to implement an efficient system in the country for effective management of implemented road safety improvement system. For procuring the book contact techsoftinfra@gmail.com.

The following are the web links of various websites and I request the readers to please refer to these important sites on this crucial issue. Referring to these websites, the book will be of great help to people concerned with road safety can serve better to the human community across the world.

1. United Nations on Traffic Accidents Take Toll on Social, Economic Progress, General Assembly Agrees, Adopting Resolution Improving Road Safety

https://www.un.org/press/en/2014/ga11498.doc.htm

2. World Bank on Road crashes are the biggest safety challenge for youths

https://blogs.worldbank.org/endpovertyinsouthasia/road-crashes-are-biggest-safety-challenge-youths

3. ResearchGate on Social Justice Approach to Road Safety in Kenya: Addressing the Uneven Distribution of Road Traffic Injuries and Deaths across Population Groups

https://www.researchgate.net/publication/45389690_Social_Justice_Approach_to_Road_Safety_in_Kenya_Addressing_the_Uneven_Distribution_of_Road_Traffic_Injuries_and_Deaths_across_Population_Groups

4. Springer Open on Road safety: challenges and opportunities in Latin America and the Caribbean

An estimated 1.3 million people die in traffic accidents each year worldwide and millions more are injured, with developing countries disproportionately affected. It is predicted that the number of global traffic deaths will be around 1.8 million annually by 2030, making it the eight cause of death in the world. This paper provides an overview of salient road safety issues in the Latin America and Caribbean (LAC) region. It also reviews existing theoretical and causal empirical evidence of interventions to improve road safety outcomes, concentrating on three core areas: safer roads and mobility, safer vehicles, and safer road users. Despite the existence of potentially cost-effective and life-saving interventions, there is surprisingly little rigorous evidence on the effectiveness of road safety programs in the LAC context. This paper discusses promising areas for policy experimentation and future research.

https://latinaer.springeropen.com/articles/10.1186/s40503-019-0078-0

5. Clinical Epidemiology and Global Health

Despite flows in Transport Policy, it is noticed many more proven wide social factors distressing the number of road traffic accidents including injuries and deaths. A wider social determinant among low socioeconomic groups including identity crises largely contributes towards an increased rate of road accidents in India.

https://cegh.net/article/S2213-3984(20)30159-7/fulltext

6. Asian development Bank (ADB) on Technical Assistance for Socioeconomic Impact of Road Crashes (Financed by the Poverty
Reduction Cooperation Fund)

https://www.adb.org/sites/default/files/project-document/69005/tar-stu-38081.pdf

The original text book is "**Road Safety by Traffic Management and Transportation Engineering with Intelligent Transport System, Green Highways**". We therefore request the readers to consider this book on a very noble ground for the human community across the world. By understanding the need of this book at the present time and in future by various Universities, Research Centers, and Government Departments across the world it will be a genuine favour by the readers to the human community worldwide.

Publishing author:
Sandipan Goswami

Email: techsoftinfra@gmail.com

Website: www.roadbridgedesign.com (Go to: Book Tutorials >> Road Safety)

Road Safety

by Traffic Management and Transportation Engineering with Intelligent Transport System, Green Highways

Book Synopsis

Road safety and accidents is a burning social issue at present time. The book "**Road Safety by Traffic Management and Transportation Engineering with Intelligent Transport System, Green Highways**" is for identifying the root causes of the issues and taking countermeasures for resolving the issues, by the governments, private sector and NGOs.

It discusses safety training and various measures that each developing and developed countries are to implement. It helps generate public awareness, various provisions, safety campaigns, funding for implementation, educating children, residents, pedestrians, drivers, police etc. along with engineering measures to a required extent as that is also a measure and should be addressed.

Road accident causes significant loss of lives and assets. The cost on every government in countries for compensating victims is significant and is also discussed in this book. This book is intended to be an important resource to refer to for social science reader community working in government sectors, private organizations, universities across the world.

This book is intended to be used by senior government officials at director general or secretary level in sectors that can have the responsibility on road safety in a country. The book can also act as a basic source of reference for faculties in the institution, aid agency officials, and other decision makers who are often assigned the job of improving road safety, they may be at least familiar with the key issues, elements, and opportunities relating to the improvement of road safety.

United Nations view 'Traffic Accidents Take Toll on Social, Economic Progress, and General Assembly' agrees, adopting resolution improving Road Safety. Deaths and injuries in road traffic accidents posed a serious threat to global health and had a negative impact on social and economic progress, as well as sustainable development, the General Assembly heard today.

The book "Road Safety" has discussed the formulations by The World Bank, the Asian Development Bank (ADB), that are highly effective and result oriented. This book is intended for conveying their views to larger sector of human community across the world. By adding some special chapters for the improved engineering and technology besides socio-economic and administrative steps the book further serves as a guide towards improving the road safety.

The book “Road Safety” has been designed for ease of use by different interest groups. It consists of six chapters followed by the two appendices. The arrangements are described in the following paragraphs. The improvement of road safety is possible through a multidisciplinary and comprehensive approach. Activities on measures need to be undertaken in each sector that have effect on the road safety. Implementation of the three priority actions in each sector would at least initiate improvements towards road safety and strengthen the ability of each country to begin to address its safety problems.

Chapter 1

This chapter is on ‘ISO and Road Safety Audit’ and discusses on best practice for road safety by traffic management.

ISO 39001 is the template to organize the process of improving road safety and performance pointers are provided in this document for organizations wishing to use ISO 39001. To describe the developing and implementing of an ISO 39001 road traffic safety management system, this guide provides a brief introduction by encouraging further enquiry and consideration.

ISO 39002 is the document that provides guidelines for good practices that can be adopted by organizations. To reduce the number of fatalities and serious injuries, the severity of injuries, and further to minimize damage to property and economic loss due to road crashes, these practices are intended.

ISO 39003 recommends that a mechanism should be provided to the manufacturers and distributors, by the Governments to enable formal declaration of compliance to an International Standard. Vehicle manufacturers are to give assurance that the vehicles’ design has considered and addressed the ethical issues identified within the standard, to the purchasers, end-users, and society as a whole.

Road Safety Audit Is a Positive Process – the earlier, the better, safer and cheaper. Road safety audit may be the only means that road safety is explicitly considered in a project. Road safety audit is a small cost, around 1-2% of total design costs but, offers great benefit.

Chapter 2

This chapter on ‘Road Safety and Administrative Setup’ has various sections and provides the change in scenario in traffic trends and accidents in detail along with need to attend road safety by developing and developed countries by following guidance in administrative setting up, discusses the motorization and growth in vehicle fleets, and illustrates recent trends in road accidents in those countries. It also discusses the socioeconomic cost of road accidents, showing that the problem has now become more acute, and argues for urgent action to be taken.

This chapter discusses how road safety action plans and interventions can be designed for maximum effect. It discusses the stages of road safety development in a country, and illustrates the kind of action and intervention that is needed through coordinated action. These proposes for raising awareness to developing prioritized road safety action plans and eventually developing three or five-year road safety programs. This chapter also discusses road safety goals and targets that can bring desired changes in road users behaviour (e.g., wearing of seat belts, helmets) thus resulting casualty reduction. Advice is also provided on how road safety initiatives can be financed.

It also discusses for improved monitoring and evaluation to ensure that maximum effect of accident reductions and institutional strengthening when such action plans and programs are implemented by covering all important aspects of road safety. The individual sector guidelines to be referred as those are needed by relevant users.

Each section summarizes the key points and priority actions relating to a specific sector followed by descriptions, in more detail, what needs to be done to develop effective road safety activity in that sector.

The necessary coordination and management of Road Safety is elaborated in the following sections:

Introduction and Overview
Trends in Road Safety
Road Safety Improvement Plans
Road Safety Management
Road Safety Accident Data Maintenance
Role of the Insurance Industry in Road Safety Funding
Planning and Design of Safe Roads
Improvement of Hazardous Locations
Road Safety Education of Children
Training and Testing of Drivers
Publicity and Campaign for Road Safety
Standard for Vehicle Safety
Traffic Legislation
Traffic Police for Law Enforcement
Emergency Assistance to Road Accident Victims
Road Safety Research
Costing of Road Accident

Chapter 3

This chapter is on 'Traffic Safety – Studies and Measures' and discusses on topics: Traffic Safety as a Public Health Priority, Conceptual Framework, Mediating Factors, Traffic Safety and Roadway Design, Roadway Width, On-Street Parking, Traffic-Calming Measures, Access Management, Intersection Control, Roadside Design, Pedestrian Countermeasures, Traffic Characteristics, Human Factors related to Driver Characteristics, Pedestrians, School Zones, Bicycles and Motorcycles, Road Safety Planning and Road Safety Audit.

Chapter 4

This chapter is on 'Highway Safety at Intersections and Roundabouts' and discusses on topics: Intersection Safety at High Speed Rural Expressways, Crash Data Methodology and Findings, Survey Methodology and Findings, Conventional safety improvements Pavement Conditions, , Innovative safety improvements, Studies on Highway Safety at Intersections on Superelevated Curves, Methods of Intersection Safety Analysis, Statistical Modeling, Count Data Models, Discrete Outcome Models, Results of Past Research, Geometric Characteristics, Process of Research Studies, Econometric Modeling, Crash Frequency Analysis, Severity Analysis, Binomial Test for Comparing Proportions, Safety Analysis of Intersections along Two-Lane and Four-Lane Roads , Model Sensitivity, Crash Type, Lighting Conditions, Weather Conditions, Crash Severity, Highway Safety at Roundabouts, Vehicle paths, Speed-curve relationship, Speed consistency, Design Vehicles, Geometric Elements, Entry width, Circulatory Roadway Width, Single-lane roundabouts, Double-lane roundabouts, Central Island, Entry Curves, Exit Curves, Splitter Islands, Pedestrian Crossings, Stopping Sight Distance,

Chapter 5

This chapter on 'Speed Limit and Highway Lighting' discusses about the primary objective of highway design and operations to make roads safe, it is necessary to build its various features to the operating speed, because the vehicle speed is a crucial control element in the road design process.

Chapter 6

This chapter '**Construction and Operational Safety**' discusses various essential measures to ensure the safety of construction workers and road users and design assessment of street lighting for road safety.

Chapter 7

This chapter on 'Intelligent Transport System (ITS) and FASTag' introduces the users of this book to various implementation of ITS for improved transport system and road safety to resolve the related issues in the developing countries.

'FASTag Systems' introduces the users of this book to the next generation traffic management and law enforcement are directing towards the 'Electronic Toll Collection (ETC)' system and camera/scanner surveillance for various advantageous features. It is therefore quite obvious to opt for the ETC system at Toll Plazas and electronic surveillance system in the roads for effective monitoring of traffic. Various Highway Authorities have rolled out program for Electronic Toll Collection and advanced traffic control system by implementing FASTag.

Chapter 8

This chapter on 'Green Highways' introduces the users of this book to various procedures and use of materials in the construction of highways for implementing the eco-friendly and economic construction. The use of harmless energy for driving vehicles is also discussed in this chapter.

Appendices

The appendices provide additional information. Appendix A mentions about a list of useful documents important for all readers, while Appendix B includes contacts of international organizations dealing with road safety, encouraging the formation of a network of road safety professionals and experts in the Asian and Pacific region.

The implementation of Intelligent Transport System (ITS) is the beginning towards overall improvement of traffic system that has significant and effective contribution towards improving the road safety. The various issues are discussed in details and the technology presently available to combat the demon of road accidents is also explained in this book to give readers the desired concept.

Concerns by Important Institutions:

1. United Nations on Traffic Accidents Take Toll on Social, Economic Progress, General Assembly Agrees, Adopting Resolution Improving Road Safety https://www.un.org/press/en/2014/ga11498.doc.htm

2. World Bank on Road crashes are the biggest safety challenge for youths https://blogs.worldbank.org/endpovertyinsouthasia/road-crashes-are-biggest-safety-challenge-youths

3. ResearchGate on Social Justice Approach to Road Safety in Kenya: Addressing the Uneven Distribution of Road Traffic Injuries and Deaths across Population Groups https://www.researchgate.net/publication/45389690_Social_Justice_Approach_to_Road_Safety_in_Kenya_Addressing_the_Uneven_Distribution_of_Road_Traffic_Injuries_and_Deaths_across_Population_Groups

4. Springer Open declared on Road safety: challenges and opportunities in Latin America and the Caribbean An estimated 1.3 million people die in traffic accidents each year worldwide and millions more are injured, with developing countries disproportionately affected. It is predicted that the number of global traffic deaths will be around 1.8 million annually by 2030, making it the eight cause of death in the world. This paper provides an overview of salient road safety issues in the Latin America and Caribbean (LAC) region. It also reviews existing theoretical and causal empirical evidence of interventions to improve road safety outcomes, concentrating on three core areas: safer roads and mobility, safer vehicles, and safer road users. This paper discusses promising areas for policy experimentation and future research. https://latinaer.springeropen.com/articles/10.1186/s40503-019-0078-0

5. Clinical Epidemiology and Global Health Despite flows in Transport Policy, it is noticed many more proven wide social factors distressing the number of road traffic accidents including injuries and deaths. A wider social determinant among low socioeconomic groups including identity crises largely contributes towards an increased rate of road accidents in India. https://cegh.net/article/S2213-3984(20)30159-7/fulltext

6. Asian development Bank (ADB) on Technical Assistance for Socioeconomic Impact of Road Crashes (Financed by the Poverty Reduction Cooperation Fund)
https://www.adb.org/sites/default/files/project-document/69005/tar-stu-38081.pdf

Sandipan Goswami
Author

Road Safety

by Traffic Management and Transportation Engineering
with Intelligent Transport System, Green Highways

Contents

Chapter 1 ISO and Road Safety Audit

Acronyms

ADB - Asian Development Bank
AADT - Annual Average Daily Traffic flow.
AAWT - Annual Average Weekday Traffic flow.
ADIS - Advanced Driver Information Systems; vehicle features that assist driver with planning, perception, analysis, and decision-making.
ANPR - Automatic Number Plate Recognition.
ANSI - American National Standards Institute.
AVCS - Advanced Vehicle Control Systems.
AVI - Automated Vehicle Identification.
AVL - Automated Vehicle Location.
AVLS - Automated Vehicle Location System.
ATCO - Association of Transport Coordinating Officers.
ATCO.CIF - Association of Transport Coordinating Officers Common Interchange Format (data structure for timetable data exchange).
Beacons - Short-range roadside transceivers for communicating between vehicles and the traffic management infrastructure.
B&W - Black & White.
CARS - Conference on Asian Road Safety
CSIR - Centre for Scientific and Industrial Research
CTEP - Calcutta Traffic Engineering Project (India)
CCTV - Closed Circuit television.
CEN - Comite European de Normalisation.
CH4 - Methane.
COBS - Control Office Base Station.
CO2 - Carbon Dioxide.
DITS - Dhaka Integrated Traffic Study (Bangladesh)
DAB - Digital Audio Broadcasting. Digital radio.
Dead-Reckoning - A technique that calculated the current location of a vehicle by measuring the distance and direction that the vehicle has travelled since leaving a known starting point.
DGPS - Differential GPS.
Differential Correction - A technique for overcoming GPS position determination errors; GPS receivers are placed at precisely identified control locations to Intelligent Transport Systems 27
Reference Material from COMPETENCE / TREATISE / E-ATOMIUM measure the difference between indicated GPS positions versus actual positions.
DRIVE - Dedicated Road Infrastructure for Vehicle safety in Europe.
e-GIF - Electronic Government Interoperability Framework.
ETC - Electronic Toll Collection.
FQP - Freight Quality Partnership.
Geocode - A code representing a political or geographic unit incorporated into a GIS.
GIS - Geographic Information System.
GPRS - General Packet Radio Service.
GPS - Global Positioning System.
GSM - Groupe Speciale Mobile.
HGV - Heavy Goods Vehicle.
HIOCC - High Occupancy Algorithm.

HOV - High-Occupancy Vehicle.
IHT - Institute of Highways and Transportation.
INGRID - Integrated Incident Detection.
IR - Infrared.
ITSO - Integrated Transport Smartcard Organisation.
KSI accidents - Killed or Seriously Injured. Part of the DfT's (formerly DETR's) 10-year plan to reduce KSI accidents.
Lao PDR - Lao People's Democratic Republic
LAN - Local Area Network.
LCD - Liquid Crystal Display.
LED - Light Emitting Diode.
MAAP - Microcomputer Accident Analysis Package
MIDAS - Motorway Incident Detection and Automatic Signalling.
MOVA - Microprocessor Optimised Vehicle Actuation.
NIEs - newly industrialized economies
NMHC - national major highways of the People'sRepublic of China
NMV - non-motorized vehicle
N_2O - Nitrous Oxide.
NOx - Oxides of Nitrogen.
NPV - Net Present Value.
ODA - Overseas Development Administration(United Kingdom)
OCR - Optical Character Recognition.
OS - Ordnance Survey.
OSGR - Ordnance Survey Grid Reference.
OUT - Outstation Transmission Unit.

Intelligent Transport Systems 28 Reference Material from COMPETENCE / TREATISE / E-ATOMIUM

P&D - Pay and Display.
PM_{10} - Air Pollutant - particle with a aerodynamic diameter of less than or equal to 10 microns.
PMR - Private Mobile Radio.
PDA - Personal Digital Assistant.
PDMCs - Pacific developing member countries(of the ADB)
PRC - People's Republic of China
RDS - Radio Data System.
RDS-TMC - Radio Data Systems incorporating a Traffic Message Channel (see TMC).
RFID - Radio Frequency Identification.
RTI - Road Transport Informatics; a European term for ITS.
RTPI - Real Time Passenger Information.
SMV - Slow moving vehicle
TRL - Transport Research Laboratory(United Kingdo)
TRR - Transport Research Record
SCATS - Sydney Coordinated Adaptive Traffic System.
SCOOT - Split, Cycle time and Offset, Optimisation Technique. An urban traffic control system.

Smart Card: An electronic information carrier system that uses plastic cards, about the size of a credit card, with an imbedded integrated circuit that stores and processes information.

TAG - Transport Appraisal Guidance.
TCC - Traffic Control Centre.

TFT - Thin Film Transistor.
TMC - Traffic Message Channel (with RDS); transmits, on FM subcarriers, digital codes representing standardised traffic information messages to be decoded and displayed (or spoken) in any given language by in-vehicle receiver.
TOC - Traffic Operations Centre.
TRO - Traffic Regulation Order.
TSRGD - Traffic Signs Regulations and General Directions 2002.
UK - United Kingdom
UNDP - United Nations Development Programme
UN/ESCAP - United Nations Economic and SocialCommission for Asia and the Pacific
US - United States
VRU - vulnerable road user
UTC - Urban Traffic Control.
UTMC - Urban Traffic Management and Control.
VMS - Variable Message Signs; highway signs which can change the message they display.
Strategic VMS - Give drivers information about key problems on the network well before they come across them e.g. "Accident ahead".
Tactical VMS - Give drivers more local information to allow them to re-route or alter travel plans.
VOC - Volatile Organic Compound.
VRU - Vulnerable Road User.
VSL - Variable Speed Limits.

WGS-84 - World Geodetic System 1984; a widely accepted, standardised system of geodetic Coordinates of latitude and longitude. Used by the Navstar GPS.
WIM - Weigh-In-Motion; a technology for determining the weight of a commercial vehicle without requiring it to stop on a scale; uses AVI to identify the vehicles; employs technologies that measure the dynamic tyre forces of the moving vehicle, and then estimates the corresponding tyre loads for a static vehicle.
XML - Extensible Markup Language.

Measurements

km	- kilometre
km/h	- kilometre per hour
m	- meter
mph	- miles per hour
m/s	- meters per second
ped/m2	- pedestrians per square meter
ped/min/m	- pedestrians per minute per meter

Conversions

1 mph = 1.6 km/h
1 yard = 0.91 meter

Appendix - A

This Appendix lists some of the important and useful documents, guidelines, and manuals exist in industrialized countries that would be worth acquiring by road safety professionals in developing countries of the Asian and Pacific region. Some of the more important and relevant of these are indicated below. The Road Engi- neering Association of Asia and Australasia (REAAA) guide (Reference 7) provides an excellent overview on other road safety resources available from around the world.

1. Guidelines for Accident Reduction and Prevention (International Edition). Institution ofHighways and Transportation. 1990.

Available (in English) from Institution of Highways and Transportation, 6 Endsleigh Street, London WC1H 0DZ, United Kingdom
Tel: (44 171) 387 2525, Fax: (44 171) 387 2808

2. Guidelines for the Safety Audit of Highways. Institution of Highways and Transportation. 1996.

Available (in English) from 6 Endsleigh Street, London WC1H 0DZ, United Kingdom
Tel: (44 171) 387 2525, Fax: (44 171) 387 2808

3. Guide to Traffic Engineering Practice: Part 4 Road Crashes. 1988.

Available (in English) from National Association of Australian State Road Authorities (NAASRA), Austroads,
P.O. Box 659, Haymarket, New South Wales 2000, AustraliaTel: (61 2) 218 6218
Fax: (61 2) 281 7458

4. Organization for Economic Co-operation and Development (OECD) Road Research Reports

Various reports and publications including:
Targeted Road Safety Programmes (1994);
Road Infrastructure Rehabilitation and Safety Strategies in Central and East Europe(1995);
Improving Road Safety by Attitude Modification
(1994); andMarketing of Traffic Safety (1993).
These are available (in English) from OECD Road Transport Research Programme, 2, rue André-Pascal, 75775, Paris Cedex 16, France
Tel: (33 1) 4524 8200, Fax: (33 1) 4524 8176

5. Road Safety Engineering Manual. 1992.

Available (in English) from the Royal Society for the Prevention of Accidents (RoSPA),Cannon House, The Priory Queensway, Birmingham BA 6BS, United Kingdom
Tel: (44 21) 200 2461, Fax: (44 21) 200 1254

6. Road Safety Handbook. Institute of Transport Economics. 1982.

Available (in Norwegian and Russian) from Institute of Transport Economics, P.O. Box6110 Etterstad, M-0602, Oslo, Norway
Tel: (47 2) 257 3800, Fax: (47 2) 257 0290

Appendix - B

This Appendix lists some of the important organizations involved and active in road safety and who may be of interest to decision makers in the developing world.

1. International and funding organizations active in supporting road safety

United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)
(Transport, Communications and Tourism Division)
Rajadamnern Avenue Bangkok 10200 THAILAND
Tel: (66 2) 288 1234
Fax: (66 2) 288 1000

World Health Organization (WHO) (Injury Prevention Programme) Avenue Appia 20
United Nations Building ch-1211 Geneva 27 SWITZERLAND
Tel: (41 22) 791 2111
Fax: (41 22) 791 0746

The World Bank 1818 H Street NW
Washington, DC 20433 UNITED STATES
Tel: (1 202) 477 1234
Fax: (1 202) 477 6391

Asian Development Bank (ADB)
P.O. Box 789, 0980 Manila PHILIPPINES
Tel: (63 2) 632 6803/632 6463
Fax: (63 2) 636 2423

2. Bilateral aid agencies most active in the Asian and Pacific region on road safety

Australian Agency for International Development (AusAid)
G.P.O. Box 887 Canberra, ACT 2601 AUSTRALIA
Tel: (61 6) 278 4000
Fax: (61 6) 276 4880

Overseas Development Administration (ODA) 94 Victoria Street London SW1E 5JL UNITED KINGDOM Tel: (44 171) 917 0588
Fax: (44 171) 917 0016

Japan International Cooperation Agency (JICA)
P.O. Box No. 216, 48/F Shinjuki Building, 1-1, Nishi-Shinjuku 2-Chome Shinjuku-ku
Tokyo, 163-04 JAPAN
Tel: (81 3) 3346 5197
Fax: (81 3) 3346 5094

3. International technical organizations with safety interests

Institute of Transportation Engineers 525 School Street SW
Suite 410
Washington, DC 20024-2797 UNITED STATES
Tel: (1 202) 554 8050
Fax: (1 202) 863 5486

Permanent International Association of Road Congress (PIARC)
27 Rue Gueneguad
75006 Paris FRANCE
Tel: (33 1) 4633 7190
Fax: (33 1) 4633 8460

International Road Federation (IRF) 525 School Street SW
Washington, DC 20024-2797 UNITED STATES
Tel: (1 202) 544 2106
Fax: (1 202) 479 0828

Prevention Routier International 75 Rue de Mamer
L-8081 LUXEMBOURG Tel: (35 2) 31 8341
Fax: (35 2) 31 1460

Organisation for Economic Co-opera- tion and Development (OECD)
2 Rue Andre Pascal F-75775 Paris Cedex 16
FRANCE
Tel: (33 1) 4524 9594
Fax: (33 1) 4524 7960

Road Engineering Association of Asia and Australasia (REAAA)
Chairman REAAA Technical Committee c/o Burwood Highway
Vermont South Victoria 3133 AUSTRALIA
Tel: (61 3) 9881 1555
Fax: (61 3) 9887 8104

4. Research institutes and organizations undertaking road safety research of relevance to developing countries

ARRB Transport Research Ltd. 500 Burwood Highway
Vermont South Victoria 3133 AUSTRALIA
Tel: (61 3) 9881 1555
Fax: (61 3) 9887 8104

International Association of Traffic and Safety Sciences (IATSS)
6-20-2 Yaesu Chuo-ku Tokyo 104 JAPAN
Tel: (81 3) 3273 7884
Fax: (81 3) 3272 7054

Federal Highway Administration Office of International Programs US Department of Transportation 400 Seventh Street SW Washington, DC 20590
UNITED STATES Tel: (1 202) 366 0111
Fax: (1 202) 366 9626

Institute for Road Safety Research
P.O. Box 170
2260 AD Leidschendam THE NETHERLANDS
Duindoorn 32
Tel: (31 70) 320 9323
Fax: (31 70) 320 1261

Swedish National Road & Transport Research Institute (VTI)
S-581, 95 Linkoping SWEDEN
Tel: (46 13) 203 000
Fax: (46 13) 141 436

Technical Research Centre of Finland (SVOV)
Road, Traffic, and Geotechnical Laboratory Traffic Section/Safety Team Sahkomiehentie 3
FIN-02150 ESPOO FINLAND
Tel: (35 8) 0456 4591
Fax: (35 8) 046 4850

Institute of Transport Economics
P.O. Box 6110 Etterstad
N-0602 Oslo NORWAY
Tel: (47 22) 573 800
Fax: (47 22) 570 290

Institut National de Recherch (INRETS) Sur les Transports et leur Sécurité
2 Avenue du Général Malleret-Joinville 94114 Arcueil Cedex
FRANCE
Tel: (33 47) 407 163
Fax: (33 45) 475 606

Transport Research Laboratory (TRL) Overseas Centre
Old Wokingham Road Crowthorne
Berkshire RG11 6AU UNITED KINGDOM Tel: (44 1344) 773 131
Fax: (44 1344) 770 3056

5. Research organizations in the region active on road safety issues

Central Road Research Institute (CRRI)
P.O. CRRI Mathura Road New Delhi 110020 INDIA
Tel: (91 11) 691 2268
Fax: (91 11) 684 5943

National Tansport Research Centre (NTRC) Ministry of Communications
Sector H-8/3 Islamabad PAKISTAN
Tel: (92 51) 253 676
Fax: (92 51) 253 651

Indian Institute of Technology (IIT)
New Delhi 110016 INDIA
Tel: (91 11) 685 8703
Fax: (91 11) 686 2037

Institute of Road Engineering (IRE) Jl Raya Timur 264
P.O. Box 2 UJB Bandung 40294 INDONESIA
Tel: (62 22) 780 2251
Fax: (62 22) 780 2253

Traffic Management Research Institute (TMRI)
Public Security Ministry 1 Qianxiang Lane 1 Qianrong Road
Wuxi, Jiangsu
PEOPLE S REPUBLIC OF CHINA Tel: (86 510) 551 6123
Fax: (86 510) 551 5315

Transport Engineering Design Incorporation (TEDI)
Ministry of Transport and Communications 278 Ton Duc Thang
Hanoi VIET NAM
Tel: (84 4) 851 8366

6. Others/individuals

European Transport Safety Committee (ETSC)
Rue du Cornet 34 B-1040
Brussels BELGIUM
Tel: (32 2) 230 4106, 4004
Fax: (32 2) 230 4215

Global Traffic Safety Trust International (GTST)
c/o Royal Australasian College of Surgeons Spring Street
Melbourne Victoria 3000 AUSTRALIA
Tel: (61 3) 622 1033
Fax: (61 3) 663 4075

References

4 Traffic Safety – Studies and Measures

Reference:

1 Alphand, F., U. Noelle, and B. Guichet. 1991. Roundabouts and road safety: State of the art in France. *Intersections without traffic signals II*, ed. W. Brilon, 107-25. Berlin: Springer-Verlag.

2 American Association of State Highway and Transportation Officials (AASHTO). 2004a. *A policy on geometric design of highways and streets,* 4th ed. Washington, DC: American Association of State Highway and Transportation Officials- 2004b. *A guide for achieving flexibility in highway design.* Washington, DC: American Association of State Highway and Transportation Officials.

3 Balkin, S., and J. K. Ord. 2001. Assessing the impact of speed limit increases on fatal interstate crashes. *Journal of Transportation and Statistics* 4 (1): 1-26.

4 Bath, S. 1993. *Influence of socioeconomic factors on the exposure to crash risk for young drivers.* Vancouver: Traffic Safety Research Dept., Insurance Corporation of British Columbia.

5 Bicycle Federation of America. 1998. Creating walkable communities: A guide for local governments. Mid-America Regional Council, Kansas City, MO. http://www.bikewalk.org/pdfs/ncbwpubwalkablecomm.pdf.

6 Bissell, H. H., and L. G. Neudorff. 1980. Criteria for removing traffic signals. ITE 1980 Washington, DC: Compendium of Technical Papers, Institute of Transportation Engineers.

7 Bowman, B. L., and R. L. Vecellio. 1994. Effects of urban and suburban median types on both vehicular and pedestrian safety. *Transportation Research Record* 1445, TRB. Washington, DC: National Research Council.

8 Box, P. C. 2000. Curb parking findings revisited. Transportation Research E-Circular. Washington, DC: Transportation Research Board. 2002. Angle parking issues revisited. *ITE Journal* 72 (3): 36-47. 2004. Curb-parking problems: Overview. *Journal of Transportation Engineering* 130 (1): 1-5.

9

10 Brown, M. 1995. *The design of roundabouts: State of the art review.* London: HMSO.

11 Brude, U., and J. Larsson. 2000. What roundabout design provides the highest possible safety? *Nordic Road Transport Research* 12:17-21.

12 Burden, D., and P. Lagerwey. 1999. *Road diets: Fixing the big roads*. High Springs, FL: Walkable Communities.

13 Butler, P. 1996. *Automobile insurance pricing.* National Organization for Women (www.now.org), presented at National Conference on Women's Travel Issues.

14 Claessen, J. G., and D. R. Jones. 1994. The road safety effectiveness of raised wide medians. *Proceedings of the 17th Australian Road Research Board Conference* 17 (5): 269-87.

15 Clark, J. E. 1985. High speeds and volumes on residential streets: An analysis of physical street characteristics as causes in Sacramento, California. *ITE 1985 Compendium of Technical Papers.* Washington, DC: Institute of Transportation Engineers.

16 Committee on Access Management. 2003. *Access management manual*. Washington, DC: Transportation Research Board.

17 Committee on Geometric Design. 2004. *Context-sensitive design around the country: Some examples.* Washington, DC: Transportation Research Board.

18 Congress for the New Urbanism. 2002. *Civilizing downtown highways: Putting New Urbanism to work on California's highways.* San Francisco, CA.

19 County Surveyors Society. 1994. *Traffic calming in practice.* London: Landor Publishing.

20 Daisa, J. 2006. *Proposed recommended practice: Context sensitive solutions in designing major urban thoroughfares for walkable communities.* Washington, DC: Institute of Transportation Engineers.

21 Duany, A., and E. Talen. 2002. Transect planning. *Journal of the American Planning Association* 68 (3): 245-66.

22 Dumbaugh, E. 2005a. Safe streets, livable streets. *Journal of the American Planning Association* 71 (3): 283-98-2005b. Safe streets, livable streets: A positive approach to urban roadside design*.* PhD diss., Georgia Institute of Technology-2006a. *Enhancing the Safety and Operational Performance of Arterial Roadways in the Atlanta Metropolitan Region.* Report Submitted to the Atlanta Regional Commission-2006b. The design of safe urban roadsides: An empirical analysis. *Transportation Research Record* 1961:74-82.

23 Ebbecke, J. M., and J. J. Schuster. 1977. Areawide impact of traffic control devices. *Transportation Research Record* 644:54-57.

24 Environmental Protection Agency (EPA). 2004. Characteristics and performance of regional transportation systems. Washington, DC.

25 Ewing, R. 1999. *Traffic calming state-of-the-practice.* Washington, DC: Institute of Transportation Engineers-2001. Impacts of traffic calming. *Transportation Quarterly* 55 (1): 33-45- 2002. Impediments to context-sensitive Main Street design. *Transportation Quarterly* 56 (4): 51-64.

26 Ewing, R., and R. Cervero. 2001. Travel and the built environment. Transportation Research Record 1780:87-114.

27 Ewing, R., R. Pendall, and D. Chen. 2002. Measuring sprawl and its impact. Washington, DC: Smart Growth America/U.S. Environmental Protection Agency-2003. Measuring sprawl and its transportation impacts. Transportation Research Record 1832:175-83.

28 Ewing, R., R. Schieber, and C. V. Zegeer. 2003. Urban sprawl as a risk factor in motor vehicle occupant and pedestrian fatalities American Journal of Public Health 93:1541-45.

29 Farouki, O. T., and W. J. Nixon. 1976. The effect of width of suburban roads on the mean free speed of cars. Traffic Engineering and Control 17:518-19.

30 Federal Highway Administration. 2001. Geometric design practices for European roads. Publication No. FHWA-PL-01-026. Washington, DC: U.S. Department of Transportation.

31 Fitzpatrick, K., P. Carlson, M. Brewer, and M. Wooldridge. 2001. Design factors that affect driver speed on suburban streets. Transportation Research Record 1751:18-25.

32 Fitzpatrick, K., S. Turner, M. Brewer, P. Carlson, N. Lalani, B. Ullman, N. Trout, E. S. Park, D. Lord, and J. Whitacre. 2006. Improving pedestrian safety at unsignalized crossing. TCRP Report 112/NCHRP Report 562, Washington, DC: Transportation Research Board.

33 Florida Department of Transportation. 2006. Median handbook— Interim version. Tallahassee: Florida Department of Transportation.

34 Garder, P. E. 2004. The impact of speed and other variables on pedestrian safety in Maine. Accident Analysis and Prevention 36 (4): 533-42.

35 Gattis, J. L. 2000. Urban street cross section and speed issues. Transportation Research E-Circular. Washington, DC: Transportation Research Board.

36 Gattis, J. L., and A. Watts. 1999. Urban street speed related to width and functional class. Journal of Transportation Engineering 125 (3): 193-200.

37 Geddes, E. 1996. Safety benefits of traffic calming. Vancouver: Insurance Corporation of British Columbia.

38 Geoplan. 1994. Evaluation of pedestrian road safety facilities. Report prepared for the Road Safety Bureau, Roads and Traffic Authority (New South Wales) by Geoplan Urban and Traffic Planning.

39

40 Gluck, J., H. S. Levinson, and V. Stover. 1999. Impacts of access management techniques. NCHRP Report 420. Washington, DC: Transportation Research Board.

41 Hadayeghi, A., A. S. Shalaby, and B. N. Persaud. 2003. Macrolevel accident prediction models for evaluating safety of urban transportation systems. Transportation Research Record 1840:87-95

42 Hadayeghi, A., A. S. Shalaby, B. N. Persaud, and C. Cheung.2006. Temporal transferability and updating of zonal level accident prediction models. Accident Analysis and Prevention 38 (3): 579-89.

43 Hakkert, A. S., V. Gitelman, and E. Ben-Shabat. 2002. An evaluation of crosswalk warning systems: Effects on pedestrian and vehicle behaviour. Transportation Research Part F. 5(4): 275-292.

44 Hall, J. W., C. J. Burton, D. G. Coppage, and L. V. Dickinson. 1976. Roadside hazards on nonfreeway facilities. Transportation Research Record 601:56-58.

45 Harwood, D. W. 1986. Multilane design alternatives for improving suburban highways. NCHRP Report 282. Washington, DC: Transportation Research Board, National Research Council. -- 1990. Effective utilization of street width on urban arterials. National Cooperative Highway Research Program Report 330. Washington, DC: Transportation Research Board, National Research Council.

46 Hauer, E. 1999. Safety in geometric design standards.
47 http://members.rogers.com/hauer/Pubs/09Safety%20in%20Geometric%20Design.pdf (accessed January 11, 2005).

48 Hauer, E., and P. Garder. 1986. Research into the validity of the traffic conflicts technique. Accident Analysis and Prevention 18:471-81.

49 Heimbach, C. L., P. D. Cribbins, and M. S. Chang. 1983. Some partial consequences of reduced traffic lane widths on urban arterials. Transportation Research Record 923:69-72.

50 Hess, P. M., A. V. Moudon, and J. M. Matlick. 2004. Pedestrian safety and transit corridors. Journal of Public Transportation 7(2): 73-93.

51 Huang, H. F., J. R. Stewart, and C. V. Zegeer. 2002. Evaluation of lane reduction "road diet" measures on crashes and injuries. Transportation Research Record 1784:80-90.

52 Hummer, J. E., and C. F. Lewis. 2000. Operational capacity of three-lane cross-sections. Report FHWA/NC/2000-003. Raleigh: Center for Transportation Engineering Studies, North Carolina State University.

53 Humphreys, J. B. 1978. Safety aspects of curb parking. Washington, DC: Federal Highway Administration.

54 Institute of Transportation Engineers. 2001. A study of angle parking accidents. Traffic Safety Committee, Arizona Section. Washington, DC: Institute of Transportation Engineers.

55 Jacobs, J. 1961. The death and life of great American cities. New York: Random House.

56 Jacobsen, P. L. 2003. Safety in numbers: More walkers and bi cyclists, safer walking and bicycling. Injury Prevention 9: 205-09

57 Jacquemart, G. 1998. Synthesis of highway practice 264: Modern roundabout practice in the United States. National Cooperative Highway Research Program. Washington, DC: National Academy Press.

58 Johnston, R. E. 1962. Experience with narrow medians. Proceedings of the 1st Australian Road Research Board Conference 1 (1): 489-99.

59 Kmet, L., P. Brasher, and C. Macarthur. 2003. A small area study of motor vehicle crash fatalities in Alberta, Canada. Accident Analysis and Prevention 35 (2): 177-82.

60 Knaap, K. K., and K. Giese. 2001. Guidelines for the conversion of urban four-lane undivided roadways to three-lane two-way left-turn facilities. Ames: Center for Transportation Research

61 and Education, Iowa State University.

62 Knoblauch, R. L., M. Nitzburg, and R. F. Seifert. 2001. Pedestrian crosswalk case studies: Sacramento, California; Richmond, Virginia; Buffalo, New York; Stillwater, Minnesota. Report

63 No. FHWA-RD-00-103. McLean, VA: Federal Highway Administration.

64 Knoblauch, R. L., and P. D. Raymond. 2000. The effect of crosswalk markings on vehicle speeds in Maryland, Virginia, and Arizona. Report No. FHWA-RD-00-101. McLean, VA: Federal Highway Administration.

65 Knoblauch, R. L., B. H. Tustin, S. A. Smith, and M. T. Pietrucha. 1988. Investigation of exposure-based pedestrian accident areas: Crosswalks, sidewalks, local streets, and major arterials. Washington, DC: Federal Highway Administration.

66 Ladrón de Guevara, F. S. P. Washington, and J. Oh. 2004. Forecasting travel crashes at the planning levels: Simultaneous negative binomial crash model applied in Tucson, Arizona. Transportation Research Record 1897:191-99.

67 Lamm, R., B. Psarianos, and T. Mailender. 1999. Highway design and traffic safety engineering handbook. New York: McGraw Hill.

68 Lee, J., and F. Mannering. 1999. Analysis of roadside accident frequency and severity and roadside safety management. Olympia: Washington State Department of Transportation.

69 Leong, H. J. W. 1970. The effect of kerbed median strips on accidents on urban roads. Proceedings of the 5th Australian Road Research Board Conference 5 (3): 338-64.

70 Levine, N., K. E. Kim, and L. H. Nitz. 1995a. Spatial analysis of Honolulu motor vehicle crashes: I. Spatial analysis. Accident Analysis and Prevention 27 (5): 663-74-1995b. Spatial analysis of Honolulu motor vehicle crashes: II. Zonal generators. Accident Analysis and Prevention 27 (5): 675-85.

71 Litman, T., and S. Fitzroy. 2005. Safe travels: Evaluating mobility management traffic safety impacts. Victoria, BC: Victoria Transport Policy Institute.

72

73 Lovegrove, G. R., and T. Sayed. 2006. Macro-level collision prediction models for evaluating neighbourhood traffic safety. Canadian Journal of Civil Engineering 33 (5): 609-21.

74

75 Lucy, W. 2003. Mortality risk associated with leaving home: Recognized the relevance of the built environment. American Journal of Public Health 93 (9): 1564-69.

76 Lucy, W., and R. Rabalais. 2002. Traffic fatalities and homicides by strangers: Danger of leaving home in cities, inner suburbs, and outer suburbs. Charlottesville: University of Virginia.

77 Mahalel, D., and Z. Szternfeld. 1986. Safety improvements and driver perception. Accident Analysis and Prevention 18 (1): 37-42.

78 Marks, H. 1957. Subdividing for traffic safety. Traffic Quarterly (July): 308-25.

79 Maycock, G., and R. D. Hall. 1984. Crashes at four-arm roundabouts. TRRL Laboratory Report LR 1120. Crowthorne, UK: Transport and Road Research Laboratory.

80 McCoy, P. T., M. Ramanujam, M. Moussavi, and J. L. Ballard. 1990. Safety comparison of types of parking on urban streets in Nebraska. Transportation Research Record 1270:28-41.

81

82 McCoy, T. A., P. T. McCoy, R. J. Hadan, and V. A. Singh. 1991. Safety evaluation of converting on-street parking from parallel to angle. Transportation Research Record 1327: 36-41.

83 Milton, J. and F. Mannering. 1998. The relationship among highway geometrics, traffic-related elements and motor-vehicle accident frequencies. Transportation 25:395-413.

84 Minnesota Department of Transportation. 2002. Access operations study: Analysis of traffic signal spacing on four-lane arterials. Saint Paul, MN: Minnesota Department of Transportation.

85 Mokdad, A. H., J. S. Mark, D. F. Stroup, and J. L. Gerberding. 2004. Actual causes of death in the United States, 2000. Journal of the American Planning Association 291:1238-45.

86 Naderi, J. R. 2003. Landscape design in the clear zone: The effects of landscape variables on pedestrian health and driver safety. In Transportation Research Board, 82nd Annual Conference Proceedings. Washington, DC: Transportation Research Board. CD-ROM.

87 Nevada Department of Transportation. 1999. Access management system and standards. Carson City: Nevada Department of Transportation.

88 Noland, R. B. 2001. Traffic fatalities and injuries: Are reductions the result of “improvements” in highway design standards? Transportation Research Board 80th Annual Conference Proceedings. Washington, DC: Transportation Research Board. CD-ROM

89 Noland, R. B., and L. Oh. 2004. The effect of infrastructure and demographic change on traffic-related fatalities and crashes: A case study of Illinois county-level data. Accident Analysis
90 and Prevention 36:525-32.

91 Organisation for Economic Co-Operation and Development (OECD). 1998. Safety of vulnerable road users. Publication No. DSTI/DOT/RTR/RS7(98)1/FINAL. Paris: OECD.

92 Persaud, B., E. Hauer, R. A. Retting, R. Vallurupalli, and K. Mucsi. 1997. Crash reductions related to traffic signal removal in Philadelphia. Accident Analysis and Prevention 29:803-10.

93 Persaud, B. N., R. A. Retting, P. E. Garder, and D. Lord. 2002. Crash reductions following installation of roundabouts in the United States. Arlington, VA: Insurance Institute for Highway
94 Safety.

95 Prevedouros, P. D. 2001. Evaluation of in-pavement flashing lights on a six-lane arterial pedestrian crossing. Proceedings of the 71st Annual Meeting of the Institute of Transportation Engineers, Institute of Transportation Engineers. Washington, DC. CD-ROM.

96 Retting, R. A., S. A. Ferguson, and A. T. McCartt. 2003. A review of evidence-based traffic engineering measures designed to reduce pedestrian-motor vehicle crashes. American Journal of Public Health 93 (9): 1456-63.
97 Roberts, I., R. Norton, R. Jackson, R. Dunn, and I. Hassal. 1995. Effect of environmental factors on risk of injury of child pedestrians by motor vehicles: A case-control study. British Medical Journal 310:91-94

98 Robinson, B. W. 2000. Roundabouts: An information guide. Washington, DC: Federal Highway Administration.

99 Robinson, D. 2005. Safety in numbers: More walkers and bicyclists, safer walking and bicycling. Bicycle Federation Australia. http://www.bfa.asn.au/bfanew/pdf/publications/safety_in_numbers.pdf (accessed June 12, 2006).

100 S&K Transportation Consultants. 2000. Access management, location and design. Participant notebook for NHI course 133078. Washington, DC: National Highway Institute, Federal
101 Highway Administration.

102 Sawalha, Z., and T. Sayed. 2001. Evaluating safety on urban arterial roadways. Journal of Transportation Engineering 127 (2): 151-58.

103 Schoon, C. C., and J. van Minnen. 1993. Accidents on roundabouts: II. Second study into the road hazard presented by roundabouts, particularly with regard to cyclists and moped
104 riders. R-93-16. The Netherlands: SWOV Institute for Road Safety Research - 1994. The safety of roundabouts in the Netherlands. Traffic Engineering and Control 35 (3): 142-48.

105 Scriven, R. W. 1986. Raised median strips—A highly effective road safety measure. Proceedings of the 13th Australian Road Research Board Conference 13 (9): 46-53.

106 Seburn, T. J. 1967. Relationship between curb uses and traffic accidents. Traffic Engineering 37 (18): 42-47.

107 Smart Growth Network. N.d. Getting to smart growth. International City/County Management Association. Chicago. http://www.smartgrowth.org/pdf/gettosg.pdf.

108 Study Tour Team. 2001. Geometric design practices for European roads. Washington, DC: Federal Highway Administration.

109 Surface Transportation Policy Project (STPP). 2000. Mean streets. http://www.transact.org/PDFs/ms2000/ms2000.pdf -. 2002. Mean streets. http://www.transact.org/PDFs/ms2002/MeanStreets2002.pdf- 2004. Mean streets. http://www.transact.org/library/reports_html/ms2004/pdf/Final_Mean_Streets_2004_4.pdf.

110 Swift, P., D. Painter, and M. Goldstein. 2008. Residential street typology and injury accident frequency. http://www.newurbanengineering.com.

111 Syrek. D. 1955. Accident rates at intersections. Traffic Engineering 25:312-16.

112 Tester, J. M., G. W. Rutherford, Z. Wald, and M. W. Rutherford. 2004. Matched case-control study evaluating the effectiveness of speed humps in reducing child pedestrian injuries. American Journal of Public Health 94:646-50.

113 Texas Transportation Institute (TTI). 1982. On-street parking, synthesis of safety research related to traffic control and roadway elements. Washington, DC: Federal Highway Administration.

114 Transportation Research Board. 2003. A guide for addressing run-off-road collisions. NCHRP 500, vol. 6. Washington, DC: National Research Council - 2005. TRB special report 282: Does the built environment influence physical activity/ Examining the evidence. Washington, DC: Transportation Research Board.

115 Transportation Research Institute. 1997. Stopping sight distance and decision sight distance. Discussion Paper No. 8.A. Salem, OR: Oregon Department of Transportation.

116 Trowbridge, M. J., and N. C. McDonald. 2008. Urban sprawl and miles driven daily by teenagers in the United States. American Journal of Preventive Medicine 34 (3): 202-06.

117 Turner, D. S., and E. S. Manfield. 1990. Urban trees and roadside safety. Journal of Transportation Engineering 16 (1): 90-103.

118 UK Department for Transport. 1997. Killing speed and saving lives. London: UK Department of Transport - 2007. Manual for streets. London: Thomas Telford.

119 Untermann, R. K. 1990. Street design—Reassessing the function, safety, and comfort of streets for pedestrians. The road less traveled: Getting there by other means, 11th International Pedestrian Conference. Boulder, CO: City of Boulder.

120 Van Houten, R., and J. E. L. Malenfant. 1999. Canadian research on pedestrian safety. McLean, VA: Federal Highway Administration.

121 Van Houten, R., R. A. Retting, C. Farmer, and J. Van Houten. 2000. Field evaluation of a leading pedestrian interval signal phase at three urban intersections. Transportation Research Record 1734:86-92.

122 Vitaliano, D. F., and J. Held. 1991. Road accident external effects: An empirical assessment. Applied Econometrics 23:373-78.

123 World Health Organization. 2004. World report on road traffic injury prevention. Geneva: World Health Organization.

124 Zegeer, C. V., and F. M. Counci1. 1995. Safety relationships associated with cross-sectional roadway elements. Transportation Research Record 1512:29-36.

125 Zegeer, C. V., C. Seiderman, P. Lagerwey, M. Cynecki, M. Ronkin, and R. Schnieder. 2002a. Pedestrian facilities users guide—Providing safety and mobility. Report No. FHWA-RD-102-01. Washington, DC: Federal Highway Administration.

126 Zegeer, C. V., J. R. Stewart, H. H. Huang, and P. A. Lagerwey. 2002b. Safety effects of marked vs. unmarked crosswalks at uncontrolled locations: Executive summary and recommended
127 guidelines. Report No. FHWA-RD-01-075. Washington, DC: Federal Highway Administration.

128 Zeigler, A. J. 1986. Guide to the management of roadside trees. Report No. FHWAIP-86-17. Lansing: Michigan Department of Transportation.

2 Highway Safety at Intersections and Roundabouts

References for Intersection Safety

Source of excerpts and Illustrations

Savolainen Andrzej and P. Tarko, Safety of Intersections on High-Speed Road Segments with Superelevation, Joint Transportation Research Program, Civil Engineering, Purdue University, Purdue e-Pubs

Safer Intersections for Rural Highways, NCHRP Report 650, NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM, TRB of the National Academies

Rural Expressway Intersection Safety, Centre for Transportation Research and Education, Iowa State University

References

American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Intersections, Washington, D.C., 2001.

Bared, J.G. and H. Lum, “Safety Evaluation of Intersection Design Elements (Pilot Study),” Transportation Research Board Conference Presentation, Washington, D.C., 1992.

Bauer, K.M. and D. Harwood, Statistical Models of At-Grade Intersection Accidents, Report No. FHWA-RD-96-125, Federal Highway Administration, McLean, Va., 1996.

Blower, D., K.L. Campbell, and P.E. Green, “Accident Rates for Heavy Truck-Tractors in Michigan,” Accident Analysis and Prevention 25 (3): 307-321, 1993.

Bonneson, J.A. and P.T. McCoy, “Estimation of Safety at Two-Way Stop-Controlled Intersections on Rural Highways,” Transportation Research Record 1401: 83-89, 1993.

Cameron, A. and P. Trivedi, “Regression Based Tests for Over-dispersion in the Poisson Model,” Journal of Econometrics 31, 255-274, 1990.

Chang, L.-Y. and F. Mannering, “Analysis of Injury Severity and Vehicle Occupancy in Truck- and Non-truck-involved Accidents”, Accident Analysis and Prevention, Vol. 31, No. 5, 579-592, 1999.

David, N.A. and J.R. Norman, Motor Vehicle Accidents in Relation to Geometric and Traffic Features of Highway Intersections, Volume II – Research Report, Report No. FHWA-RD-76-129, Federal Highway Administration and National Highway Traffic Safety Administration, Washington, D.C., 1975.

G.D. Hamilton Associates Consulting Ltd., Traffic Conflict Procedures, Manual, Second Edition, Insurance Corporation of British Columbia.

Greene, W.H., LIMDEP, Version 7.0, Econometric Software, 1998.

Greene, W.H., Econometric Analysis, 5th Edition, Prentice Hall, New York, 2002.

Hakkert, A.S. and D. Mahalel, “Estimating the Number of Accidents at Intersections From a Knowledge of the Traffic Flows on the Approaches,” Accident Analysis and Prevention 10: 69-79, 1978.

Hanna, J.T., T.E. Flynn, and W.L. Tyler, “Characteristics of Intersection Accidents in Rural Municipalities,” Transportation Research Record 601: 79-82, 1976.

Harwood, D.W., M.T. Pietrucha, M.D. Woolridge, R.E. Brydia, and K. Fitzpatrick, Median Intersection Design, National Cooperative Highway Research Program Report 375, Transportation Research Board, National Research Council, National Academy Press, Washington, D.C., 1995.

Hauer, E., “The Harm Done by Tests of Significance,” Accident Analysis and Prevention, Vol. 36, No. 3: 495-500, 2004.

Hauer, E., J.C.N. Ng, and J. Lovell, “Estimation of Safety at Signalized Intersections,” Transportation Research Record 1185: 48-61, 1988.

King, G.F. and R.B. Goldblatt, “Relationship of Accident Patterns to Type of Intersection Control,” Transportation Research Record 540: 1-12, 1975.

McCoy, P.T., E.J. Tripi, and J.A. Bonneson, Guidelines for Realignment of Skewed Intersections, Nebraska Department of Roads Research Project Number RESI (0099) P471, 1994.

McGee, H.W., W.E. Hughes, and K. Daily, Effect of Highway Standards on Safety, National Cooperative Highway Research Program Report 374, Transportation Research Board, National

Research Council, National Academy Press, Washington, D.C., 1995. Miaou, S.P., “The Relationship Between Truck Accidents and Geometric Design of Road Sections: Poisson Versus Negative Binomial Regressions,” Accident Analysis and Prevention 26 (4), 471-482, 1994.

Missouri Highway and Transportation Department, Manual on Identification, Analysis and Correction of High-Accident Locations, Technology Transfer Assistance Program, Missouri Highway and Transportation Department, Second Edition, 1990.

Pickering, D., R.D. Hall, and M. Grimmer, Accidents at Rural T-Junctions, Research Report 65, Transport and Road Research Laboratory, Department of Transport, Crowthorne, Berkshire, United Kindom, 1986.

Pietrucha, M.T., T.R. Pieples, and P.M. Garvey, "An Evaluation of the Pennsylvania Road Safety Audit Pilot Program, Transportation Research Record, Transportation Research Board, National Research Council, National Academy Press, Washington, D.C., 2000.

Poch, M. and F. Mannering, "Negative Binomial Analysis of Intersection-Accident Frequencies," Journal of Transportation Engineering 122 (2): 105-113, 1996.

Shankar, V., F. Mannering, and W. Barfield, "Effect of Roadway Geometrics and Environmental Factors on Rural Freeway Accident Frequencies," Accident Analysis and Prevention 27 (3): 371- 389, 1995.

Tarko, A.P., K. C. Sinha, S. Eranky, H. Brown, E. Roberts, R. Scinteie, and S. Islam, Crash Reduction Factors For Improvement Activities in Indiana, Joint Highway Research Project, final report, June 2000.

Tarko, A.P. and M. Kanodia, Hazard Elimination Program-Manual on Improving Safety of Indiana Road Intersection and Sections, Report No. FHWA/IN/JTRP-2003/19, Joint Transportation Research Program, West Lafayette, IN, 2004.

U.S. Department of Transportation, Manual on Uniform Traffic Control Devices: Millenium Edition, 2001.

Vogt, A. and J.G. Bared, Accident Models for Two-Lane Rural Roads: Segments and Intersections, Report No. FHWA-RD-98-133, Federal Highway Administration, McLean, Va., 1998.

Vogt, A. Crash Models for Rural Intersections: Four-Lane by Two-Lane Stop-Controlled and Two-Lane by Two-Lane Signalized, Report No. FHWA-RD-99-128, McLean, Va., 1999. 81

Vuong, Q., "Likelihood Ratio Tests for Model Selection and Non-nested Hypotheses, Econometrica 57, 307-334, 1989.

Washington, S.P., M.G. Karlaftis, and F. Mannering, Statistical and Econometric Methods for Transportation Data Analysis, CRC Press, Boca Raton, FL, 2003.

Zegeer, C.V., J. Hummer, L. Herf, D. Reinhurf, and W. Hunter, Safety Cost-Effectiveness of Incremental Changes in Cross-Section Design – Informational Guide, Report No. FHWA-RD-87-094, McLean, Va., 1987.

Zegeer, C.V., J.R. Stewart, F.M. Council, D.W. Reinfurt, and E. Hamilton, "Safety Effects of Geometric Improvements on Horizontal Curves", Transportation Research Record 1356, 1992.

References for Safety at Roundabouts

Department of Transport of Northrhine-Westfalia, Germany. Empfehlungen zum Einsatz und zur Gestaltung von Mini-Kreisverkehrsplaetzen (Guidelines for the Use and Design of Mini-Roundabouts). Dusseldorf, Germany, 1999.

Queensland Department of Main Roads (QDMR). Relationships between Roundabout Geometry and Accident Rates. Queensland, Australia: Infrastructure Design of the Technology Division of QDMR, April 1998.

Department of Transport (United Kingdom). Geometric Design of Roundabouts. TD 16/93. September 1993.

American Association of State Highway and Transportation Officials (AASHTO). A Policy on Geometric Design of Highways and Streets. Washington, D.C.: AASHTO, 1994.

Pein, W.E. Trail Intersection Design Guidelines. Prepared for State Bicycle/Pedestrian Program, State Safety Office, Florida Department of Transportation. Highway Safety Research Center, University of North Carolina, September 1996.

Service d'Etudes Techniques des Routes et Autoroutes (SETRA—Center for Technical Studies of Roads and Highways). Aménagement des Carrefours Interurbains sur les Routes Principales (Design of Rural Intersections on Major Roads). Ministry of Transport and Housing, December 1998.

Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG). 36 CFR Part 1191. As amended through January 1998.

Fambro, D.B., et al. NCHRP Report 400: Determination of Stopping Sight Distances. National Cooperative Highway Research Program, Transportation Research Board, National Research Council. Washington, D.C.: National Academy Press, 1997.

Harwood, D.W., et al. NCHRP Report 383: Intersection Sight Distances. National Cooperative Highway Research Program, Transportation Research Board, National Research Council. Washington, D.C.: National Academy Press, 1996.

Austroads. Guide to Traffic Engineering Practice, Part 6—Roundabouts. Sydney, Australia: Austroads, 1993.

Florida Department of Transportation. Florida Roundabout Guide. Florida Department of Transportation, March 1996.

American Association of State Highway and Transportation Officials (AASHTO). Guide for Development of Bicycle Facilities. Washington, D.C.: AASHTO, 1991.

Krammes, R., et al. Horizontal Alignment Design Consistency for Rural Two-Lane Highways. Publication No. FHWA-RD-94-034. Washington, D.C.: Federal Highway
Administration, January 1995.

Sawers, C. Mini-roundabouts: Getting them right! . Canterbury, Kent, United Kingdom: Euro-Marketing Communications, 1996.

Brilon, W., and L. Bondzio. Untersuchung von Mini-Kreisverkehrsplaetzen (Investigation of Mini-Roundabouts). Ruhr-University Bochum, Germany, 1999.

3 Speed Limit and Highway Lighting

Reference:

1. Design Speed, Operating Speed, and Posted Speed Limit Practices, Prepared for Transportation Research Board, Washington, D.C., 82nd Annual Meeting, January 2003, TRB Paper Number 03-2725, by

   Kay Fitzpatrick, Research Engineer, Texas Transportation Institute, 3135 TAMU, College Station, TX 77843-3135, phone: 979/845-5249, fax: 979/845-6481, email: K-Fitzpatrick@tamu.edu

   Paul Carlson, Associate Research Engineer, Texas Transportation Institute, 3135, TAMU, College Station, TX 77843-3135, phone: 979/845-1728, fax 979/845-6006, email: Paul-Carlson@tamu.edu,

Marcus Brewer, Associate Transportation Researcher, Texas Transportation Institute, 3135 TAMU, College Station, TX 77843-3135, phone: 979/845-7321, fax: 979/845-6481, email: M-Brewer@tamu.edu

Mark D. Wooldridge, Associate Research Engineer, Texas Transportation Institute, 3135 TAMU, College Station, TX 77843-3135, phone: 979/845-7321, fax: 979/845-6481, email: M-Wooldridge@tamu.edu,

Sub- references-1:

1. Fitzpatrick, K., Carlson, P. J., Brewer, M.A., Wooldridge, M. D., and Miaou, S. P. "Design Speed, Operating Speed, and Posted Speed Practices." National Cooperative Highway Research Program Project 15-18 draft final report, July 2002.
2. American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets (2001).
3. Manual on Uniform Traffic Control Devices for Streets and Highways -- Millennium Edition. Federal Highway Administration, U.S. Department of Transportation, Washington, DC (2000).
4. R. Lamm and E. M. Choueiri. "Recommendations for Evaluating Horizontal Design Consistency Based on Investigations in the State of New York." Transportation Research Record 1122, 1987. Pp. 68-78.
5. Oppenlander. Variables Influencing Spot-Speed Characteristics—Review of the Literature. Special Report 89, Highway Research Board, Washington, D.C., 1966.
6. D.B. Fambro, R. L. Nowlin, S.P Warren, K.A. Lienau, J.M. Mounce, R.P. Bligh, K.K. Mak, and H.E. Ross. Geometric Guidelines for Suburban High-Speed Curb and Gutter Roadways. FHWA/TX-95/1347-1F, College Station, TX, May 1995.
7. Fitzpatrick, K., Elefteriadou, L., Harwood, D., Collins, J., McFadden, J., Anderson, I. B., Krammes, R. A., Irizarry, N., Parma, K., Bauer, K., and Passetti, K., "Speed Prediction for Two-Lane Rural Highways." Report FHWA-RD-98-171, Federal Highway Administration, Washington, DC (2000).
8. Fitzpatrick, K., Carlson, P. J., Wooldridge, M. D., and Brewer, M. A., "Design Factors That Affect Driver Speed on Suburban Arterials." Report FHWA/TX-00/1769-3. Texas Transportation Institute, College Station, TX (August 1999).
9. Poe, C. and Mason Jr., M., "Analyzing Influence of Geometric Design on Operating Speeds Along Low-Speed Urban Streets: Mixed Model Approach." Transportation Research Record 1737. Transportation Research Board, Washington, DC (2000) pp 18-25.
10. Parker, Jr., M. R., "Effects of Raising and Lowering Speed Limits on Selected Roadway Sections." Final Report, Publication No. FHWA-RD-92-084, Federal Highway Administration, Washington, DC (January 1997).
11. Fambro, D. B., Fitzpatrick, K., and Koppa, R. J., "Determination of Stopping Sight Distances." NCHRP Report 400, Transportation Research Board, Washington, DC (1997).
12. Krammes, R. A., Brackett, R. Q., Shafer, M. A., Ottesen, J. L., Anderson, I. B., Fink, K. L., Collins, K. M., Pendleton, O. J., and Messer, C. J., "Horizontal Alignment Design Consistency for Rural Two-Lane Highways." Research Report FHWA-RD-94-034. Federal Highway Administration, Washington, DC (1994).
13. Polus, A., Fitzpatrick, K., and Fambro, D., "Predicting Operating Speeds on Tangent Sections of Two-Lane Rural Highways." Transportation Research Record 1737. Transportation Research Board, Washington DC (2000) pp. 50-57.
14. Chowdhury, M. A., Warren, D. L., and Bissell, H., "Analysis of Advisory Speed Setting Criteria." Public Roads, Vol. 55, No. 3 (December 1991) pp. 65–71.
15. McLean, J. R., "Speeds, Friction Factors, and Alignment Design Standards." Research Report ARR 154. Australian Road Research Board, Victoria, Australia (1988).
16. McLean, J., "An Alternative to the Design Speed Concept for Low Speed Alignment Design." Transportation Research Record 702. Transportation Research Board, Washington, DC, (1979) pp. 55–63.

Sub- references-2:

1. AASHTO, A policy on geometric design of highway and streets, 1994
2. Blaschke, Joseph D. John M. Mason; Impact of the AASHTO green book on highway tort liability, TRR-100
3. C. A. O Flaherty, Editor, Transportation Planning and Traffic Engineering
4. Context-Sensitive Highway Design (http://www.scenic.org/roads.htm)

5. DelDOT Road Design Manual, Chap 3-Design Standards 2/1992.
6. Elmberg C.M., Effects of speed zoning in urban areas, M.S. Thesis, Purdue University, 5/1960.
7. Hassa, Gibreel, and S.M. Easa, Evaluation of Highway Consistency and Safety; Practical Application
8. Hierche E-U, R. Lamn, K. Dieterle and A. Nikpour, "Effects of highway improvements designed in confromity with the RAL-L on traffic safety of two lane rural highway"; Research Road Construction and Road Traffic Technique, Vol. 431, Minister of Transportation, Bonn Germany, 1984.
9. Horizontal Alignment Design Consistency for Two-Lane Highways, FHWA-RD-94-034,1995
10. Insurance Institute for Highway Safety, Highway Loss Data Institute, Speed and Speed Limits (http://www.hwysafety.org/safety_facts/qanda/speed_limits.htm)
11. Kalivoda, Eric, The effect of Design Speed on two lane rural highway safety, Phd.Thesis, 1995
12. Krammes R., Fitzpatrick K., Blaschke J., Fambro D., Speed: Understanding design, operating and posted speed, Report No. 1465-1
13. Lamm R., Psarioanos B., Mailaender T., Highway design and traffic safety engineering handbook, 1999
14. Mason, John M., Poe, Christopher M., Geometric Design Guidelines to Achieve Desired Operating Speed on Urban Streets, Institute of Transportation Engineers 65th Annual Meeting
15. Mc Kean J., An Alternative to the design speed concept for low speed alignment design, Australia
16. Road Research Board, Low Volume Roads: Second International Conference, Transportation Research Record 702, 1979
17. Messer C.J., J.M. Mounce and R.Q. Braquet., Highway geometric design consistency related to driver expectancy. FHWA, USDOT 1981
18. Mihailo Maletim, Vajo Anjus; Standard speeds and flows in the road design process, 1985.
19. Recommended guidelines for subdivision streets; ITE publication.
20. Reudiger Lamn, Elias M., Choueiri, Theodor Mailaender; Comparison of 1280.
21. Rural Road Design, Australia, 1999
22. Transafety Reporter, Survey investigates the Relationships among design speeds, operating speeds, and posted speed limits, 1997
23. Washington DOT Manual. Additional References are used in Section 8 – Additional Literature Review
24. "Design Speed Selection Recommendations" by Ardeshir Faghri, Ph.D., David Capparuccini and Tatiana Cvetek, Department of Civil and Environmental Engineering, University of Delaware, 355 Du Pont Hall, Newark, Delaware 19716, Tel. (302) 831-1446
25. Department of Transportation. Texas TxDOT http://onlinemanuals.txdot.gov/txdotmanuals/rdw/traffic_characteristics.htm

Speed factors on two-lane rural highways

Ref. Speed factors on two-lane rural highways in free-flow conditions, by Alberto M. Figueroa and Andrew P. Tarko, Purdue University, School of Civil Engineering, 550 Stadium Mall Drive, West Lafayette, IN 47907, Phone: (765) 494-5027, Fax: (765) 496-1105, Email: afiguero@purdue.edu and tarko@purdue.edu

References

1. Tarris, J., Poe, C., Mason, Jr., J., and K. Goulias. Predicting Operating Speeds on Low-Speed Urban Streets: Regression and Panel Analysis Approaches. In Transportation Research Record 1523, TRB, National Research Council, Washington, D.C., 1996, pp. 46-54.
2. Fitzpatrick, K., Carlson, P., Brewer, M., Wooldrige, M., and S. Miaou. Design Speed, Operating Speed and Posted Speed Practices. NCHRP Report 504. National Research Council, Washington, D.C., 2003.
3. Garber, N. and R. Gadiraju. Factors affecting speed variance and its influence on accidents. In Transportation Research Record 1213, TRB, National Research Council, Washington, D.C., 1989, pp. 64-71. 4. Collins, J., Fitzpatrick, K. Bauer, K. and Hardwood, D. Speed variability on rural two-lane highways. In Transportation Research Record 1658, TRB, National Research Council, Washington, D.C., 1999, pp. 60-69.
5. Yagar, S. and M. Van Aerde. Geometric and environmental effects on speeds of two-lane highways. Transportation Research Part A: Policy and Practice, Vol. 17A, No. 4, 1983, pp. 315-325.
6. Yagar, S. Predicting speeds for rural two-lane highways. Transportation Research Part A: Policy and Practice, Vol. 18A, No. 1, 1984, pp. 61-70.

7. Polus, A., Fitzpatrick, K., and D. Fambro. Predicting Operating Speeds on Tangent Sections of Two-Lane Rural Highways. In Transportation Research Record 1737, TRB, National Research Council, Washington, D.C., 2000, pp. 50-57.
8. Islam, N. and P. Seneviratne. Evaluation of design consistency of two-lane rural highways. ITE Journal, Vol. 64, No. 2, 1994, pp. 28-31.
9. McFadden J. and L. Elefteriadou. Evaluating horizontal alignment design consistency of two-lane rural highways. In Transportation Research Record 1737, TRB, National Research Council, Washington, D.C., 2000, pp. 9-17.
10. Fitzpatrick, K., Elefteriadou, L., Harwood, D., Collins, J., McFadden, J., Anderson, I., Krammes, R., Irizarry, N., Parma, K., Bauer, K. and K. Passetti. Speed Prediction for Two-Lane Rural Highways. Report FHWA-RD-99-171, FHWA, U.S. Department of Transportation, 1999.
11. Bonneson, J. (2001) Controls for horizontal curve design. Transportation Research Record 1751, pp. 82-89.
12. Polus, A., Poe, C. and Mason Jr, J. (1995) Review of international design speed practices in roadway geometric design. International Symposium on Highway Geometric Design Practices, Conference Proceedings, Boston, Massachusetts, Chapter 5, pp. 1–8.
13. Morgenstern, B., Mahoney, D. and B. Warady. Estimating total body weight in children on the basis of height and weight: A reevaluation of the formulas of Mellits and Cheek. Journal of the American Society of Nephrology. Vol. 13, 2002, pp. 1884-1888.
14. Morrell, C., Pearson, J., Brant, L. and S. Gordon-Salant. Construction of hearing percentiles in women with non-constant variance from the linear mixed-effects model. Statistics in Medicine. Vol. 16, 1997, pp. 2475-2488.
15. C. Hsiao. Analysis of Panel Data. Cambridge University Press, New York, U.S.A., 1986.
16. Figueroa, A. and A. Tarko. Reconciling Speed Limits with Design Speeds. Report FHWA/IN/JTRP-2004/07, Joint Transportation Research Program, Purdue University, 2004.
17. Poe, C. and M. Mason. Analyzing influence of geometric design on operating speeds along low-speed urban streets. In Transportation Research Record 1737, TRB, National Research Council, Washington, D.C., 2000, pp. 18-25.
18. AASHTO. A Policy on Geometric Design of Highways and Streets. 2001.
19. Washington, S., Karlaftis, M., and F. Mannering. Statistical and Econometric Methods for Transportation Data Analysis. Chapman & Hall / CRC Press LLC, Boca Raton, Florida, 2003.

Highway Lighting

References

The Impacts of Illumination Levels on Nighttime Safety at Roundabouts, A Dissertation Presented to The Academic Faculty By Franklin E. Gbologah, In Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in Civil Engineering, in the School of Civil and Environmental Engineering, Georgia Institute of Technology

1. AASHTO (2010). Highway Safety Manual, 1st Ed. Vol 1. American Association of State Highway and Transportation Officials, Washington DC.

2. AASHTO (2010). Highway Safety Manual, 1st Ed. Vol 3. American Association of State Highway and Transportation Officials.

3. Abdel-Aty, M., Wang, X., and Santos, J. (2009). "Identifying Intersection-Related Traffic Crashes for Accurate Safety Representation." In Institute of Transportation Engineers. ITE Journal, No. 79(12), p.p 38-44.

4. Al-Ghamdi, A.S. (2003). "Analysis of Traffic Accidents at Urban Intersections in Riyadh." In Accident Analysis & Prevention, No. 35(5), p.p 717-724.

5. Alisoglu, S. (2010). "Roundabout Vs Signalized Intersections: A Comprehensive Analysis." in Kansas Government Journal. Kansas Department of Transportation: Kansas.

6. Azhar, A.Svante, B. (2011). "Signal Control of Roundabouts." In Procedia - Social and Behavioral Sciences, No. 16, p.p 729-738.

7. Bassani, M.Mutani, G. (2012). "Effects of Environmental Lighting Conditions on Operating Speeds on Urban Arterials." In Transportation Research Record: Journal of the Transportation Research Board, No. 2298(-1), p.p 78-87.

8. Bertolotti, L.Salmon, M. (2005). "Do Embedded Roadway Lights Protect Sea Turtles?" In Environmental Management, No. 36(5), p.p 702-710.

9. Bhagavathula, R., Gibbons, R., and Edwards, C. (2015). "Relationship between Roadway Illumination Level and Nighttime Rural Intersection Safety." In Transportation Research Record: Journal of the Transportation Research Board, No. 2485, p.p 8.

10. Bo, L., Bhagwant, P., Craig, L., and Ravi, B. (2009). "Validation of a Full Bayes Methodology for Observational before-after Road Safety Studies and Application to Evaluation of Rural Signal Conversions." In Accident Analysis & Prevention, No. 41, p.p 574-580.

11. Box, P. (1970). "Intersections". in Traffic Control and Roadway Elements – Their Relationship to Highway Safety, Automotive Safety Foundation, Highway Users Federation for Safety and Mobility, Washington DC.

12. Box, P. (1970). "Relationship between Illumination and Freeway Accidents." Illuminating Research Institute New York.

13. Brons, J., Bullough, J., and Rea, M. (2007). "Light Pollution: Thinking inside the Box." In Lighting Journal (Rugby, England), No. 72(5), p.p 27-34.

14. Brons, J.A., Bullough, J.D., and Rea, M.S. (2008). "Outdoor Site-Lighting Performance: Comprehensive and Quantitative Framework for Assessing Light Pollution." In
15. Lighting Research and Technology, No. 40(3), p.p 201-224.

16. Bruneau, J.F.Morin, D. (2005). "Standard and Nonstandard Roadway Lighting Compared with Darkness at Rural Intersections." In Transportation Research Record: Journal of the Transportation Research Board, No. 1918, p.p 116-122.

17. Bryer, T. (2011). "Stop-Controlled Intersection Safety: Through Route Activated Warning Systems." FHWA-SA-11-015, Federal Highway Administration.

18. Bullough, J. (2002). "Interpreting Outdoor Luminaire Cutoff Classification." In Lighting Design and Application: LD and A, No. 32(7), p.p 44.

19. Bullough, J., Snyder, J., Skinner, N., Capo, R., Rizzo, P., and Besenecker, U. (2014). "Demonstration and Evaluation of New Approaches for Roundabout Lighting." Transportation Research Board 93rd Annual Meeting. Washington, DC.
20. California Energy Commision. (2005). "Outdoor Lighting Zones: General Information." Sacremento, CA.

21. Casol, M., Fiorentin, P., and Scroccaro, A. (2008). "On Road Measurements of the Luminance Coefficient of Paving." 16th IMEKO TC4 Symposium Exploring New

22. Frontiers of Instrumentation and Methods for Electrical and Electronic Measurements, . Florence, Italy. CEN. (2008c). "Road Lighting - Part 3: Calculation of Performance." In.

23. Chin, H.C.Quddus, M.A. (2003). "Applying the Random Effect Negative Binomial Model to Examine Traffic Accident Occurrence at Signalized Intersections." In Accident Analysis & Prevention, No. 35(2), p.p 253-259.

24. Cobb, J., Hargroves, R.A., Marsden, A.M., and Scott, P. (1979). "Road Lighting and Accidents." Meeting of the International Commision on Illumination (CIE). Kyoto, Japan.

25. Cottrell, D.Mu, S. (2005). "Utah Intersection Safety: Recurrent Crash Sites: Identification, Issues and Factors." University of Utah, Mountain Plains Consortium.

26. Daniels, S., Brijs, T., Nuyts, E., and Wets, G. (2010a). "Explaining Variation in Safety Performance of Roundabouts." In Accident Analysis & Prevention, No. 42(2), p.p 393-402.

27. Daniels, S., Nuyts, E., and Wets, G. (2008). "The Effects of Roundabouts on Traffic Safety for Bicyclists: An Observational Study." In Accident Analysis & Prevention, No. 40(2), p.p 518-526.

28. De Brabander, B.Vereeck, L. (2007). "Safety Effects of Roundabouts in Flanders: Signal Type, Speed Limits and Vulnerable Road Users." In Accident Analysis & Prevention, No. 39(3), p.p 591-599.

29. Donnell, E. (2015). "Statistical Issues in Relating Roadway Lighting to Safety." Transportation Research Board 94th Annual Meeting. Washington, DC.

30. Donnell, E., Porter, R.J., Shankar, V.N., Gross, F., Hu, W., Gemar, M., and Oh, J. (2011). "Estimating the Safety Effects of Roadway Lighting at Intersections: A Cross-Sectional Study Approach." 90th Annual Meeting of the Transportation Research Board. Washington D.C.: Transportation Research Board.

31. Donnell, E.T., Porter, R.J., and Shankar, V.N. (2010). "A Framework for Estimating the Safety Effects of Roadway Lighting at Intersections." In SAFETY SCIENCE, No. 48(10), p.p 1436-1444.

32. Elvik, R. (1995). "Meta-Analysis of Evaluations of Public Lighting as Accident Countermeasure." In Transportation Research Record, No. (1485), p.p 112-123.

33. FHWA. (1994). "The 1994 Annual Report on Highway Safety Improvement Programs." O.o.S. U.S. Department of Transportation Federal Highway Administration Washington, DC.

34. FHWA. (1996). "The 1996 Annual Report on Highway Safety Improvement Programs." U.S. Department of Transportation Federal Highway Administration Office of Safety Washington, DC.

35. FHWA. (2000). "Roundabouts : An Informational Guide." FHWA-RD-00-067,
36. FHWA. (2009). "Intersection Safety Issue Briefs: The National Intersection Problem."
37. FHWA-SA-10-005, Federal Highway Administration Washington, DC.
38. FHWA. (2012). "2012 Guidance Memorandum on Promoting the Implementation of Proven Safety Countermeasures."

39. FHWA (2012). "Proven Safety Countermeasures - Roundabouts." http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_005.pdf. (12/23/2013).

40. Flannery, A. (2001). "Geometric Design and Safety Aspects of Roundabouts." In Transportation Research Record, No. 1751(1), p.p 76.

41. Forrest, M.Yussuf, M. (2007). "Highway Safety Information System Guidebooks for the Minnesota State Data Files." Washington, DC.

42. Fotios, S., Boyce, P., and Ellis, C. (2005). "The Effect of Pavement Material on Road Lighting Performance." PPAD 9/100/77 UK.

43. Garder, P. (2012). "Fuel Consumption at a Modern Roundabout Vs. A Signalized Intersection: A Case Study Comparing Two Similar Intersections in Bangor, Maine." 91st Annual Meeting of the Transportation Research Board. Washington DC.

44. Gbologah, F., Samoylov, A., Guin, A., Hunter, M., Pass, D., and Rodgers, M. (2015). "Evaluation of Roundabout Illumination and Safety." In Submitted to Journal of Accident Prevention and Analysis, No.

45. Georgia Governor's Office of Highway Safety "Crash Injuries." http://www.gahighwaysafety.org/research/crash-injuries/. (7/14/2014).

46. Gibbons, R. Influence of Pavement Reflectivity on Target Visibility. University of Waterloo. 1997

47. Gibbons, R., Guo, F., Du, J., Medina, A., Lutkevich, P., Terry, T., and Li, Q. (2015). "Linking Road Lighting and Crash Safety." Transportation Research Board 94th Annual Meeting. Washington, DC.

48. Green, E.R., Agent, K.R., Barret, M.L., and Pigman, J.G. (2003). "Roadway Lighting and Driver Safety." KTC-03-12/SPR247-02-IF,

49. Green, J.Hargroves, R.A. (1979). "A Mobile Laboratory for Dynamic Road Lighting Measurement." In Lighting Research & Technology, No. (11), p.p 7.

50. Green, W.H. (2003). Econometric Analysis, Fith Ed. Prentice hall, Upper Saddle River, NJ.

51. Griffith, M. (1994). "Comparison of the Safety of Lighting Options for Urban Freeways." in Public Roads. Federal Highway Administration: Washington, DC.

52. Gross, F., Lyon, C., Persaud, B., and Srinivasan, R. (2013). "Safety Effectiveness of Converting Signalized Intersections to Roundabouts." In Accident Analysis and Prevention, No. 50, p.p 234-241.

53. Hallmark, S., Hawkins, N., Omar, S., Hans, Z., Kinsenbaw, C., Orellano, M., and Isebrands, H. (2008). "Strategies to Address Nighttime Crashes at Rural, Unsignalized Intersections." Center for Transportation and Education, Iowa State University.

54. Hammond, S., Hunter, C., and Chang, K. (2014). "The Effect of Additional Lane Length on Roundabout Delay". Transportation Research Board 93rd Annual Meeting. Washington DC: Transportation Research Board.

55. Hardwood, D., Bauer, K., Potts, I., Torbic, D., Richard, K., Rabbani, E., Hauer, E.,

56. Elefteriadou, L., and Griffith, M. (2003). "Safety Effectiveness of Intersection Left and Right Turn Lanes." In Transportation Research Record: Journal of the Transportation Research Board, No. 1840.

57. Hargroves, R.A.Scott, P. (1979). "Measurements of Road Lighting and Accident Results." In Public Lighting, No. (44), p.p 8.

58. Hauer, E. (1996). "Statistical Test of Difference between Expected Accident Frequencies." In TRANSPORTATION RESEARCH RECORD, No. (1542), p.p 24- 29.

59. Hauer, E. (1997). Observational before-after Studies in Road Safety. Pergamon, Oxford, OX, U.K. ; Tarrytown, N.Y., U.S.A.

60. Hauer, E. (2005). "Cause and Effect in Observational Cross-Sectional Studies in Road Safety." Transportation Research Board Annual Meeting.

61. Highways Agency. (2007). "Geometric Design of Roundabouts. Design Manual of Roads and Bridges, Vol 6, Section 2, Part 3, Td 16/07." London.

62. Hiscocks, P.Eng, P. (2011). "Measuring Luminance with a Digital Camera." In.

63. Hydén, C.Várhelyi, A. (2000). "The Effects on Safety, Time Consumption and Environment of Large Scale Use of Roundabouts in an Urban Area: A Case Study." In Accident Analysis & Prevention, No. 32(1), p.p 11-23.

64. IIHS. (2000). "Roundabouts Status Report."

65. Illuminating Engineering Society. (1999). "Lm 5099 - Iesna Guide for Photometric Measurement of Roadway Lighting Installations."

66. Illuminating Engineering Society. (2000). "Light Trespass: Research, Results, and Recommendations." New York.

67. Illuminating Engineering Society, "Roadway Lighting ", ANSI/IESNA RP-8-00 Reaffirmed 2005. Illumination Engineering Society of North America, New York.

68. Illuminating Engineering Society, "Design Guide for Roundabout Lighting", IES DG-19-08. Illuminating Engineering Society of North America, New York.

69. Illuminating Engineering Society. (2014). "Roadway Lighting Ansi/Ies Rp 8-14." RP 8-14, I.E. Society

70. Inanici, M.N. (2006). "Evaluation of High Dynamic Range Photography as a Luminance Data Acquisition System." In Lighting Research and Technology, No. 38(2), p.p 123-136.

71. Institute of Lighting Engineers. (2000). "Guidance Notes for the Reduction of Lighting Pollution." Warwickshire, U.

72. International Commission on Illumination. (1976). "Calculation and Measurement of Luminance and Illuminance in Road Lighting." CIE Publication No. 30,

73. International Commission on Illumination. (1982). "Calculation and Measurement of

74. Luminance and Illuminance in Road Lighting." CIE No. 30-2 (TC-4-6), Paris.

75. International Commission on Illumination. (1984). "Road Surfaces and Lighting." CIE No. 66,

76. International Commission on Illumination. (1992). "Road Lighting as an Accident Countermeasure." Publication No. 93, Central Bureau of the CIE Vienna. International Commission on Illumination. (2000). "Road Lighting Calculations." CIE 140 - 2000, Vienna, Austria.

77. International Commission on Illumination. (2003). "Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations." In PUBLICATIONS- COMMISSION INTERNATIONALE DE L ECLAIRAGE CIE, No. 150, p.p ALL.

78. International Commission on Illumination, "Cie 115:2010 Lighting of Roads for Motor and Pedestrian Traffic 2nd Edition", CIE Central Bureau, Austria.

79. Isebrands, H. (2009). "Crash Analysis of Roundabouts at Highspeed Rural Intersections." In Transportation Research Record: Journal of the Transportation Research Board, No. 2096, p.p 7.

80. Isebrands, H.Hallmark, S. (2012). "Statistical Analysis and Development of Crash Prediction Model for Roundabouts on High-Speed Rural Roadways." In Transportation Research Record: Journal of the Transportation Research Board, No. 2312(-1), p.p 3-13.

81. Isebrands, H., Hallmark, S., Hans, Z., McDonald, T., Preston, H., and Storm, R. (2004). "Safety Impacts of Street Lighting at Isolated Rural Intersections." Minesota Department of Transportation

82. Isebrands, H., Hallmark, S., Hans, Z., McDonald, T., Preston, H., and Storm, R. (2006). "Safety Impacts of Street Lighting at Isolated Rural Intersection - Part 2." MN/RC-2006-35, Minesota Department of Transportation

83. Isebrands, H., Hallmark, S., and Hawkins, N. (2014). "Effects of Approach Speed at Rural High-Speed Intersections." In Transportation Research Record: Journal of the Transportation Research Board, No. 2402(-1), p.p 67-77.

84. Isebrands, H., Hallmark, S., Li, W., McDonald, T., Storm, R., and Preston, H. (2010). "Roadway Lighting Shows Safety Benefits at Rural Intersections." In Journal ofTransportation Engineering, No. 136(11), p.p 949-955.

85. Jackett, M.Frith, W. (2012). "How Does the Level of Road Ligting Affect Crashes in New Zealand - a Pilot Study." New Zealand Transport Agency.

86. Jackett, M.Frith, W. (2013). "Quantifying the Impact of Road Lighting on Road Safety — a New Zealand Study." In IATSS Research, No. 36(2), p.p 139-145.

87. Jensen, S. (2013). "Safety Effects of Converting Intersections to Roundabouts." 92nd Annual Meeting of the Transportation Research Board. Washington, DC.

88. Joksch, H.Kostyniuk, L. (1998). "Modeling Intersection Crash Counts and Traffic Volume." FHWA-RD-98-096, Washington, DC.

89. Kansas Department of Transportation. (2003). "Kansas Roundabout Guide."

90. Keith, D.M. (2000). "Roadway Lighting Design for Optimization of Upd, Stv and Uplight." In Journal of the Illuminating Engineering Society, No. 29(2), p.p 15-21.

91. Keith, D.M. (2003). "Correlations of Roadway Uud Values to Upd, Uplight and Classifications." In JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY, No. 32(1), p.p 29-+.

92. Modern Roundabout - Inventory Database. Downloaded on 12/22/2013. http://roundabout.kittelson.com/Roundabouts/Search.

93. Kusuma, A.Koutsopoulos, H. (2011). "Critical Gap Analysis of Dual Lane Roundabouts." In Procedia - Social and Behavioral Sciences, No. 16, p.p 709-717.

94. Lenters, M. (2005). "Safety Auditing of Roundabouts." National Roundabout Conference. Colorado.

95. Lipinski, M.E.Wortman, R.H. (1978). "Effect of Illumination on Rural at-Grade Intersection Accidents." In Transportation Research Record, No. (611), p.p 3.

96. Lord, D.Persaud, B. (2000). "Accident Prediction Models with and without Trend: Application of the Generalized Estimating Equations Procedure." In Transportation Research Record: Journal of the Transportation Research Board, No. 1717(-1), p.p 102-108.

97. Lyon, C., Haq, A., Persaud, B., and Kodama, S. (2005). "Safety Performance Functions for Signalized Intersections in Large Urban Areas: Development and Applications to Evaluation Left-Turn Priority Treatment." In Transportation Research Record: Journal of the Transportation Research Board, No. 1908.

98. Manco, J. (2004). "The Hub of the Circus: A History of the Streetscape of the Circus, Bath."

99. Marks, V. (1977). "Effects of Reduced Intersection Lighting on Nightime Accident Frequency." Project HR-1003A, Iowa Department of Transportation.

100. McGee, H., Taori, S., and Persaud, B. (2003). "Nchrp 491: Crash Experience Warrant for Traffic Signals." NCHRP 491, T.R. Board Washington DC.

101. Medina, J., Avrenli, K., and Benekohal, R. (2013). "Field and Software Evaluation of Illuminance from Led Luminaires for Roadway Applications." In Transportation Research Record: Journal of the Transportation Research Board, No. 2384(-1), p.p 55-64.

102. Minoshima, O., Oka, K., Ikehara, K., and Inukai, N. (2006). "Research on Accident Reduction by Intersection Lighting." Road Engineering Association of Asia and Australia (REAAA). Philippines.

103. Miska, E., Leur, P., and Sayed, T. (1998). "Road Safety Performance Associated with Improved Traffic Signal Design and Increased Signal Conspicuity." http://mutcd.fhwa.dot.gov/pdfs/miska_02.pdf.(12/23/2013).

104. Mittra, S., Washington, S., and Van Schalkwyk, I. (2007). "Important Omitted Spatial Variables in Safety Models: Understanding Contributing Crash Causes at Intersections." TRB 86th Annual Meeting Compendium of Papers. Washington, DC.

105. Møller, M.Hels, T. (2008). "Cyclists' Perception of Risk in Roundabouts." In Accident Analysis & Prevention, No. 40(3), p.p 1055-1062.

106. Monsere, C.M.Fischer, E.L. (2008). "Safety Effects of Reducing Freeway Illumination for Energy Conservation." In Accident Analysis & Prevention, No. 40(5), p.p 1773-1780.

107. Montella, A. (2011). "Identifying Crash Contributory Factors at Urban Roundabouts and Using Association Rules to Explore Their Relationships to Different Crash Types." In Accident Analysis and Prevention, No. 43, p.p 1451-1463.

108. Niaki, M., Saunier, N., Miranda-Moreno, L., Amador, L., and Bruneau, J.-F. (2014). "Method for Road Lighting Audit and Safety Screening at Urban Intersections." In Transportation Research Record: Journal of the Transportation Research Board, No. 2458, p.p 27-36.

109. Nicholas, J. (1991). "A Road Lighting Survey Method for Accidents Sites." Report No. 4, North Carolina Department of Transportation. (1999). "North Carolina Crash Report Instruction Manual."

110. O'Flaherty (1997). Transport Planning and Traffic Engineering. John Wiley and Sons Inc New York.

111. Ourston Roundabout Engineering (2010). "Leif Ourston Receives Frank Blackmore Award." http://www.ourston.com/updates-archive/114.html.

112. Oya, H., Ando, K., and Kanoshima, H. (2002). "A Research on Interrelation between Illuminance at Intersections and Reduction in Traffic Accidents." In Journal of Light & Visual Environment, No. 26(1), p.p 1_29-1_34.

113. Painter, K.Farrington, D. (2001). "The Financial Benefits of Improved Street Light, Based on Crime Reduction." In Lighting Research & Technology, No. 33(1), p.p 3- 12.

114. Per Ole, W. (2009). "Effects of Road Lighting: An Analysis Based on Dutch Accident Statistics 1987–2006." In Accident Analysis and Prevention, No. 41, p.p 123-128.

115. Persaud, B., Council, F., Lyon, C., Ecles, K., and Griffith, M. (2005). "Multijurisdictional Safety Evaluation of Red Light Cameras." In Transportation Research Record: Journal of the Transportation Research Board, No. 1922.

116. Persaud, B.Lyon, C. (2007). "Empirical Bayes before–after Safety Studies: Lessons Learned from Two Decades of Experience and Future Directions." In Accident Analysis & Prevention, No. 39(3), p.p 546-555.

117. Persaud, B., Retting, R., Garder, P., and Lord, D. (2001). "Safety Effect of Roundabout Conversions in the United States: Empirical Bayes Observational before-after Study." In Transportation Research Record: Journal of the Transportation Research Board, No. 1751(-1), p.p 1-8.

118. Pochowski, A.L. (2011). "Review of Statewide Roundabout Policies." 90th Annual Meeting of the Transportation Research Board. Washington DC.

119. Preston, H.Schoenecker, T. (1999). "Safety Impacts of Street Lighting at Isolated Rural Intersections." 1999-17, Minnesota Department of Transportation. Qin, X., Bill, A.,

120. Chitturin, M., and Noyce, D. (2013). "Evaluation of Roundabout Safety." 92nd Annual Meeting of the Transportation Research Board. Washington, DC.

121. Rea, M., Bullough, J., Fay, C., Brons, J., Derlofske, J., and Donnell, E. (2009). "Review of the Safety Benefits and Other Effects of Roadway Lighting." NCHRP 5-19, NCHRP Washington, DC.

122. Retting, R., Persaud, B., Garder, P., and Lord, D. (2001). "Crash and Injury Reduction Following Installation of Roundabouts in the United States." In American Journal of Public Health, No. 91(4), p.p 628 - 631.

123. Robinson, B., Rodegerdts, L., Scarborough, W., Kittleson, W., Troutbeck, R., Brilon, W.,

124. Bondzio, L., Courage, K., Kyte, M., Mason, J., Flannery, A., Myers, E., Bunker,
125. J., and Jacquemart, G. (2000). "Roundabouts: An Informational Guide." FHWARD-00-067,

126. Rodegerdts, L. (2008). "Status of Roundabouts in North America."

127. Rodegerdts, L., Bansen, J., Tiesler, C., Knudsen, J., Myers, E., Johnsonm, M., Moule, M.,

128. Persaud, B., Lyon, C., Hallmark, S., Isebrands, H., Crown, R.B., Guichet, B., and O'Brin, A. (2010). "Roundabouts: An Informational Guide, 2nd Ed." NCHRP 672, Transportation Research Board.

129. Rodegerdts, L., Blogg, M., Wemple, E., Myers, E., Kyte, M., Dixon, K., List, G.,

130. Flannery, A., Troutbeck, R., Brilon, W., Wu, N., Persaud, B., Lyon, C., Harkey, D., and Carter, D. (2007a). "Roundabouts in the United States." NCHRP 572, Transportation Research Board.

131. Rodegerdts, L., Blogg, M., Wemple, E., Myers, E., Kyte, M., Dixon, M., List, G., Flannery, A., Troutbeck, R., Brilon, W., Wu, N., Persaud, B., Lyon, C., Harkey, D., and Carter, D. (2007b). "Nchrp Web-Only Document 94 - Appendixes to Nchrp 572: Roundabouts in the United States.": Transportation Research Board, Washington, DC.

132. Rodgers, M., Hunter, M., Samoylov, A., and Gbologah, F. (2014). "Evaluation of Current Practice for Illuminaton at Roundabouts: Safety Adn Illumination of Roundabouts - Phase 1. Estimation of the Safety Impact of Illumination at Roundabouts." G.D.o. Transportation

133. Rodgers, M., Hunter, M., Samoylov, A., Gbologah, F., and Berrebi, S. (2014). "Evaluation of Current Practice for Illumination at Roundabouts: Safety and Ilumination of Roundabouts - Phase 1. A Review of International Roundabout Lighting Practices, Polices, and Standards." G.D.o. Transportation

134. Schmidt, S., Long, S., and Harper, J. (2014). "Economic and Technical Feasibility of Led Lighting on State Routes in Missouri." Transportation Research Board 93rd Annual Meeting. Washington, DC: Transportation Research Board.

135. Schmitt, L. Calibration of the Hcm 2010 Single-Lane Roundabout Capacity Equations for Georgia Conditions (Phase 2). Georgia Institute of Technology. 2013

136. Schneider, C., Rasband, W., and Eliceiri, K. (2012). "Nih Image to Imagej: 25 Years of Image Analysis." In Nature Methods, No. 9(7), p.p 4.

137. Schoon, C.van Minnen, J. (1994). "The Safety of Roundabouts in the Netherlands." In Traffic Engineering Control, No., p.p 142-148.

138. Scott, P. (1980). "The Relationship between Road Lighting Quality and Accident Frequency." LR 929,

139. SETRA. (1998). "The Design of Interurban Intersections on Major Roads: At-Grade Intersections." Bagneuz, Cedex.

140. Shankar, V., Albin, R., Milton, J., and Mannering, F. (1998). "Evaluating Median Crossover Likelihoods with Clustered Accident Counts: An Empirical Inquiry Using the Random Effects Negative Binomial Model." In Transportation Research Record: Journal of the Transportation Research Board, No. 1635(-1), p.p 44-48.

141. Spacek, P. (2004). "Basis of the Swiss Design Standard for Roundabout." In Transportation Research Record, No. (1881), p.p 27-35.

142. Troutbeck, R. (1993). "Capacity and Design of Traffic Circles in Australia." In Transportation Research Record, No. 1368, p.p 68-74.

143. Uddin, W., Headrick, J., and Sullivan, J. (2012). "Performance Evaluation of Roundabouts for Traffic Flow Improvements and Crash Reductions at a Highway Interchange in Oxford, Ms." 91st Annual Meeting of the Transportation Research Board. Washington, DC.

144. Ulfarsson, G.Shankar, V. (2003). "Accident Count Model Based on Multiyear Cross-Sectional Roadway Data with Serial Correlation." In Transportation Research Record: Journal of the Transportation Research Board, No. 1840(-1), p.p 193-197.

145. Uncu, I.Kayaku, M. (2010). "Analysis of Visibility Level in Road Lighting Using Image Processing Techniques." In Scientific Research and Essays, No. 5(18), p.p 6.

146. Walker, F.W.Roberts, S.E. (1976). "Influence of Lighting on Accident Frequency at Highway Intersections." In Transportation Research Record, No. (562), p.p 73-78.

147. Wang, X., Abdel-Aty, M., and Brady, P. (2006). "Crash Estimation at Signalized Intersections: Significant Factors and Temporal Effect." In Transportation Research Record: Journal of the Transportation Research Board, No. 1953(-1), p.p 10-20.

148. Wisconsin Department of Transportation. (2001). "Roundabout Guide."

149. Wortman, R.H.Lipinski, M.E. (1974). "Rural at-Grade Intersection Illumination."

150. Wuller, D.Gabele, H. (2007). "The Usage of Digital Cameras as Luminance Meters." Place of Publication: San Jose, CA, USA. Country of Publication: USA.: SPIE -The International Society for Optical Engineering.

151. Zhou, H.G., Pirinccioglu, F., and Hsu, P. (2009). "A New Roadway Lighting Measurement System." In Transportation Research Part C-Emerging Technologies, No. 17(3), p.p 274-284.

152. Zirkel, B., Park, S., McFadden, J., Angelastro, M., and McCarthy, L. (2013). "Influence of Sight Distance on Crash Rates and Operating Speeds at Low-Volume Single-Lane Roundabouts in the United States." In Transportation Research Record: Journal of the Transportation Research Board, No. 2389(-1), p.p 42-50.

4 Construction and Operational Safety

By: Kendall Jones, Editor, ConstructConnect, on June 3rd, 2022
https://www.constructconnect.com/blog/10-road-construction-work-zone-safety-tips

Road traffic safety. From Wikipedia, the free encyclopedia
https://en.wikipedia.org/wiki/Road_traffic_safety

5 Road Safety and Administrative Setup

Trends in Road Safety

References:
For more information on ADB, visit: http://www.adb.org
Figure 5.58 - Countries with Traffic Related Accident Deaths
Ref. https://en.wikipedia.org/wiki/List_of_countries_by_traffic-related_death_rate

Road Safety Improvement Plans

References

1. Gerondeau, C. 1993. *Road Safety Financing and the Use of Motor Insurance Levies*: Proceedings of First Conference on Asian Road Safety (CARS1). Kuala Lumpur, Malaysia: JKR, Jalon Salahuddin.

2. Lundebye, S., and T. E. Wetteland. 1997. Financing of Road Safety Actions: Proceedings of Third African Road Safety Congress. Pretoria, South Africa: Economic Commission for Africa and Organisation for Economic Co-operation and Development (OECD).

3. FASTagPro: Recharge any FASTag online without login in 2 minutes
https://www.fastagpro.com/recharge

4. RFID technology and what role does it play in FASTag
https://www.financialexpress.com/auto/

5. Theory and Applications of Economics in Highway and Transport Planning, by Dr. Vinay Maitri, Dr. P. K. Sarkar, Standard Publishers Distributors.

Road Safety Management

References and Key Documents

1. World Bank Road Safety Policy Seminar for Central and Eastern Europe. 1994. Budapest, Hungary.

2. New Zealand Officials Committee on Road Safety. 1991. New Zealand National Road Safety Plan. New Zealand.

3. Ross, A., and M. Mwiraria. 1991. Review of World Bank Experience in Road Safety. Technical Paper INU 93. Washington, DC: World Bank.

4. Organization for Economic Co-opera tion and Development (OECD) 1996. Targeted Road Safety Programs Road Research Report. Paris, France: OECD.

5. ADB/United Nations Economic and Social Commission for Asia and the Pacific (UN/ESCAP) Road Safety Seminar/Workshop for the Asian and Pacific Region. Bangkok, Thailand, 1996.

6. UN/ESCAP. 1997. Guidelines on Action Plans and Program. Bangkok, Thailand: UN/ESCAP.

Road Accident Data Maintenance

Road Safety Funding by Insurance Industry

References

1. Lundebye, S., and T. E. Wetteland. 1997.*Financing of Road Safety Actions*. Proceedings of Third African Road Safety Congress. Pretoria, South Africa: Economic Commission for Africa and Organization for Economic Co-operation and Development (OECD).

2. Lowe, P. 1994. *Financing Road Safety Activities*. Paper presented at World Bank Policy Seminar on Road Safety in Central and Eastern Europe. Budapest, Hungary.

3. United Nations Economic and Social Commission for Asia and the Pacific(UN/ESCAP). 1997.*Guidelines on Action Plans and Programmes*. Bangkok, Thailand: UN/ESCAP.

4. InsuranceInstituteofHighwaySafety,1005 North Glebe Road, Arlington, VA22201,US.

5. Loss Prevention Association of India, Warden House, Sir Pheroze shah Mehta Road, Mumbai, India 400001.

Planning and Design of Safe Roads

References

1. Transport Research Laboratory (TRL). 1994. Towards Safer Roads in Developing

Countries: A Guide for Planners and Engineers. Overseas Centre, TRL, Old Wokingham Road, Crowthorne, Berkshire RG45 6AU, UK.
2. AASHTO. 1990. A Policy in Geometric Design of Highways and Streets.
3. AASHTO, Institute for Transportation Studies, Berkeley, US.
4. NAASRA. 1988. Guide to Traffic Engineering Practice. P.O. Box 489, Milsons Point, Sydney, NSW 2061, Australia.
5. Department of Transport. 1996. Departmental Standards and Advice Notes Department of Transport, The Stationery Office, Publications Centre, P.O. Box 276,

London SW8 5DT, UK.

6. ADB. 1998. Vulnerable Road Users: ADB RETA 5620 Project; 1998. Asian Development Bank, P.O. Box 789, 0980 Manila, Philippines.
7. PADECO Co., Ltd. 1996. Nonmotorized Vehicles. Report produced for the World Bank, Washington, DC, US.
8. Institution of Highways and Transportation. 1996. Guidelines for The Safety Audit of Highways. Institution of Highways and Transportation, 6 Endsleigh Street, London W1H 0DZ, UK.
9. AusRoads. 1994. Road Safety Audit. AusRoads, Level 9, Robell House, 287 Elizabeth Street, Sydney, NSW 2000, Australia.

Improvement of Hazardous Locations

References

1. Institution of Highways and Transportation. 1990. Highway Safety

2. Guidelines Accident Reduction and Prevention (International Edition). UK.

3. Transport Research Laboratory(TRL).1991. Towards Safer Roads in Developing Countries: A Guide for Planners and Engineers. Overseas Centre, TRL, Old Workingham Road, Crowthorne, BerkshireRG456AU,UK.

4. Royal Society for the Prevention of Accidents (RoSPA). 1992. Road Safety Engineering Manual. RoSPA, Cannon House, The Priority, Queensway, BirminghamB46BS,UK.

5. National Association of Australian StateRoad Authorities (NAASRA). 1988. Guide to Traffic Engineering Practice: Part 4, Road Crashes. NAASRA, P.O. Box 489, Milson Point, NSW 2061, Australia.

6. EnvironmentalandTransportPlanning.1992. Civilized Streets. A Guide to TrafficCalming.10ClermontTerrace,Brighton,UK.

7. Bangalore Road Safety Project. 1994. Frazer Town subproject area. Bangalore City Traffic Police/Bangalore University, Bangalore, India.

8. Baguley, C. J. 1995. Progress Towards the National Casualty Reduction Target Since

1991. Proceedings of Seminar on Road Safety. Damansara. JKR, Government of Malaysia, Jalan Salahuddin, Kuala Lumpur, Malaysia.

Road Safety Education of Children

References

1. Department of Transport (DoT). 1995.Road Safety Education in Schools: Good Practice Guidelines. UK: DoT.

2. DoT. 1996.Child Development and the Aims of Road Safety Education: A Re-view and Analysis. Road Safety Research Report No.1.UK:DoT.

3. More information can be obtained on Road Safety Officers (RSO) from the Institute of Road Safety Officers, 16Southlands Avenue, Louth, Lincoln-shire LN11 8EW, UK. Tel: (44 1507)327028.

4. Child-to-Child Trust, Institute of Education, 20 Bedford Way, London WC1HOAL, UK. Tel: (44 171) 612 6650; Fax:(44171)6126645.

5. Information about resources and teaching aids can be obtained from: the Royal Society for the Prevention of Accidents (RoSPA), Cannon House, The Priory Queensway, Birmingham B46BS,UK.Tel: (44 121) 200 2461; Fax: (44 121)2001254.

6. British Institute of Traffic Education Research (BITER), Kent House, KentStreet,BirminghamB56QF,UK. Tel:(44 121) 622 2402; Fax: (44 121) 6223450.

7. National Road Safety Committee, P.O.Box 7125, Nasinu, Suva, Fiji. Tel: (679)394886;Fax:(679)393253.

Ram Badan Joshi, Private Boarding School Organization, Kathmandu, Nepal. Fax: (977)1412572.

Training and Testing of Drivers

References

1. Information on driving tests or driver training in the UK can be obtained from: DSA Head Office, Stanley House, 56Talbot Street, Nottingham NG1 5GU,UK.Fax:(44115)9557735.

2. Information on examiner training can be obtained from: The Training Manager, DSA Training Establishment, Paul Waller Avenue, Cardington, Bedford MK453ST, UK. Fax:(441234)742728.

3. DSA. 1992. *Driving Skills: The Driving Manual*. UK: The Stationery Office (ISBN0115510540).

4. DSA. 1995. *Driving Skills: Your Driving Test.* UK: The Stationery Office (ISBN 011551158X).

Information on 3 and 4 can be obtained from; The Stationery Office, P.O. Box No. 276, London SW8 5DT, UK, or Overseas Sales, The Stationery Office, Fax: (44 171) 873 8203

Publicity and Campaign for Road Safety

References

1. Hastings, G., and A. Haywood. 1991. Social Marketing and Communication in Health Promotion: Health Promotion International. UK: Oxford University Press.

2. Glanz, K. et al. (Ed.). 1990. Health Behavior and Health Education. California, US: Jossey-Bass.

3. Organization for Economic Co-operation and Development (OECD). 1971. Road Safety Campaigns: Design and Evaluation — The Use of Mass Communication for the Modification of Road User Behavior. Paris, France: Road Transport Research, OECD (out of print).

4. OECD. 1975. Manual on Road Safety Campaigns. Paris, France: Road Trans- port Research, OECD.

5. OECD. 1993. Marketing of Traffic Safety . Paris, France: Road Transport Research, OECD.

6. OECD. 1994. Improving Road Safety by Attitude Modification. Paris, France: Road Transport Research, OECD.

7. Preusser, D. F., and R. D. Blomberg (Ed. J. A. Rothengatter). 1987. Development and Validation of a Road Safety Public Education Process: Road Users and Traffic Safety. The Netherlands: Van Gorcum.

Standard for Vehicle Safety

References:

1 United Kingdom Vehicle Inspectorate. Cars and Light Commercial Vehicle Testing (ISBN0115510532).

2 United Kingdom Vehicle Inspectorate. Motor Cycle Testing (ISBN 0 11 5510052).

3 United Kingdom Vehicle Inspectorate. Heavy Goods Vehicle Inspection Manual(ISBN011551063X).

4 United Kingdom Vehicle Inspectorate. Public Service Vehicle Inspection Manual (ISBN0115510702).

5 United Kingdom Vehicle Inspectorate. Ministry of Transport Testing Guide (ISBN 0 11 551056 7). The Stationery Office.

6 Ing Guido. CITA Working Group, Promotion of the Vehicle Inspection.

7 Paper: Technical Inspection. CITA absi, Rue de la Technologie 21/25B 1082, Brussels, Belgium. Tel: (32 24)69070; Fax: (32 24) 690 795.

Items 2-6 can be obtained from Stationery Office Bookshop, P.O. Box 276, London SW8 5DT, UK. Tel: (44 171) 873 0011; Fax: (44 171)873 8200.

Traffic Legislation

References

1. Road Safety (Traffic) Regulations 1988: Road Safety Act 1986. Victoria, Australia.
2. National Committee on Uniform Traffic Laws and Ordinances: Uniform Vehicle Codeand Model Traffic Ordinance.1992. Evanston, Illinois, US.
3. Southern Africa Transport and Communications Commission (SATCC). 1990.*The SATCC Road Traffic Signs Manua*l. Norway: Institute of Transport Economics.
4. SATCC. *SATCC Highway Code*. Norway: Institute of Transport Economics.
5. Zaal, D. 1994. *Traffic Law Enforcement*: A Review of the Literature. Australia: Federal Office of Road Safety.
6. Axup,D.1993. *Enforcement*: *Traffic Safety Toolbox*. Washington, DC, US: Institute of Transportation Engineers.
7. Legal Research Board.1992.*RoadTransport Rules.* Laws of Malaysia. Malaysia: International Law Book Services.

Traffic Police and Law Enforcement

References

1. No. 6 (SW) Region Police Driving School, Wiltshire Police Headquarters, London Road, Devizes, Wiltshire SN102DN,UK.Fax:(441380)734196.
2. Northwestern Traffic Institute, P.O. Box1409,Evanston, Illinois60204,US.
3. Axup, D. 1993.Enforcement: Traffic Safety Toolbox. Washington, DC, US: Institute of Traffic Engineers.
4. Baker, J., and L. Frickle. 1986.TrafficAccident Investigation Manual(9th edition). Evanston, US: Northwestern Traffic Institute.
5. Frickle, L. Traffic Accident Reconstruction.1986.US: Northwestern Institute, Evanston (ISBNUS09126420706).
6. Neades, J., and R. Ward. 1996.Principles of Accident Reconstruction: Vols. 1 (Theory) and 2 (Practice). UK: Wiltshire6 Regional Driving School, Devizes (ISBN1900452006).
7. Neades, J., and R. Ward. 1996. Surveying for Accident Investigation. UK: Wiltshire 6 Regional Driving School, Devizes (ISBN09126420706).
8. TrafficPatrolOfficersManual.1997.UK:Wiltshire6RegionalDrivingSchool, Devizes.

Emergency Assistance to Road Accident Victims

References

1. Schwartz, G. R., P. Safer, J. H. Stone, P. B. Storey, and D. K. Wagner, (Eds.). 1986. *Principles and Practice of Emergency Medicine* (second ed.). Philadelphia, US: W. B. Saunders.

(Vol.
II, Part IV, Emergency Medical Systems, pp. 1,371- 1,491.)
2. WHO. 1984. Consultation on Emergency Medical Organization: Report on a WHO meeting, Washington, DC, September 1983. Geneva, Switzerland: WHO.

Road Safety Research

References

1. Central Road Research Institute. 1995. Annual Report 1994-95. New Delhi, India.
2. IIT. 1995. *The Work Done 1991-1995*.New Delhi, India: IIT.
3. TRL. 1994. "Microcomputer Accident Analysis Package, Version 5 (MAAP 5)User Manual." UK: TRL.
4. Hills, B. L., and C. J. Baguley. 1993. "Accident Data Collection and Analysis: the Use of the Microcomputer Package MAAP in Five Asian Countries": Proceedings of the Asian Road Safety Conference, Kuala Lumpur, Malaysia, October 1993.
5. REAAA. 1992. Road Safety Resources for Developing Countries. Victoria, Australia: Australian Road Research Board, Ltd.
6. TRL. 1991. Towards Safer Roads in Developing Countries. UK: TRL.

Costing of Road Accident

References

1. Chand, M. 1995. "Cost of Road Accidents in India — with Special Reference to Kerala." Pune, India: *Indian Journal of Transport Management*, July 1995.
2. Central Road Research Institute. (CRRI). 1982. *Road User Costs*. New Delhi, India: CRRI.
3. Ghee C. E., et al. 1997. *Socio-Economic Aspects of Road Accidents in Developing Countries*. UK: TRL Report TRL247.
4. Alfaro, J. L., M. Chapuis and F. Fabre (eds.). 1994. *Cost 313 Socio-Economic Costs of Road Accidents*. Final Report.European Commission, 200 Rue de la Loi, BU 31 5/33, Brussels, Belgium.
5. TRL. 1995. *Costing Road Accidents in Developing Countries*. Overseas Road Note 10. UK: TRL.
6. Andreassan, D. 1993. *Road Accident Costs and Their Use*. Victoria, Australia: Australian Road Research Board Special Briefing.
7. Forkenbrock, D., N. Foster, and T. Pogue. 1994. Safety and Highway In- vestment. US: University of Iowa.
8. Department of Transport. 1994. "Valuation of Road Accidents." Highways Economics Note No. 1 1994. UK: Department of Transport.
9. Elvik, R. 1995. "An Analysis of Official Economic Valuations of Traffic Accident Fatalities in 20 Motorized Countries." Accident Analysis and Prevention, Vol. 27, No. 2, 1995. US.
10. Department of Transport. 1995. Road Accidents Great Britain 1994: The Casualty Report. UK: The Stationery Office (see also 1968-1991, and 1993).

In case the controlling measures are effectively imposed, it will be of great help to human community across the world. The following are the web links of important sites on this crucial social issue:

1. United Nations on Traffic Accidents Take Toll on Social, Economic Progress, General Assembly Agrees, Adopting Resolution Improving Road Safety
https://www.un.org/press/en/2014/ga11498.doc.htm

2. World Bank on Road crashes are the biggest safety challenge for youths
https://blogs.worldbank.org/endpovertyinsouthasia/road-crashes-are-biggest-safety-challenge-youths

3. Asian development Bank (ADB) on Technical Assistance for Socioeconomic Impact of Road Crashes (Financed bythe Poverty Reduction Cooperation Fund)
https://www.adb.org/sites/default/files/project-document/69005/tar-stu-38081.pdf

4. ResearchGate on Social Justice Approach to Road Safety in Kenya: Addressing the Uneven Distribution of Road Traffic Injuries and Deaths across Population Groups
https://www.researchgate.net/publication/45389690_Social_Justice_Approach_to_Road_Safety_in_Kenya_Addressing_the_Uneven_Distribution_of_Road_Traffic_Injuries_and_Deaths_across_Population_Groups

5. Clinical Epidemiology and Global Health: Despite flows in Transport Policy, it is noticed that many more proven wide social factors are distressing the number of road traffic accidents including injuries and deaths. A wider social determinant among low socioeconomic groups including identity crises largely contributes towards an increased rate of road accidents in India.
https://cegh.net/article/S2213-3984(20)30159-7/fulltext

6 Intelligent Transport Systems (ITS)

References

The following literature and websites have been used to set up these written materials. Here you can find further information, project results and good / best practice case studies.

Blokland, M., Mouris, R. (2005) Gedragseffecten multimodale reisinformatie (Behavioural Effects of Multimodal Travel Information). Report to Dutch Ministry of Transport, AdviesDienst Verkeer en Vervoer (Travel and Transport Advisory Service), Rotterdam

Carsten O.M.J. and Tate F.N. (2005) Intelligent speed adaptation: accident savings and cost–benefit analysis Accident Analysis & Prevention, Volume 37, Issue 3, May 2005, Pages 407-416

Winnett M A & Wheeler A H (2002) Vehicle-activated signs – a large-scale evaluation, TRL Report 548.

Please note that websites may be closed after a certain period.

http://www.utmc.gov.uk/research/index.htm
http://www.utmc.gov.uk
http://www.its-assist.org.uk/links.htm
http://www.trafficlinq.com/its.htm
http://www.eu-spirit.com/
http://www.itsnetwork.org/
http://www.cordis.lu/telematics/tap_transport/home.html

1. Directive 2010/40/Eu of the European Parliament and of the Council of 7 July 2010 . eur-lex.europa.eu(http://eur-lex.europa.eu/LexUriSe rv/LexUriServ.do?uri=OJ:L:2010:207:0001:0013:EN:PDF)

2. "Reducing delay due to traffic congestion. [Social Impact]. ITS. The Intelligent Transportation Systems Centre and Test bed" . SIOR, Social Impact Open Repository. Archived from the original on 2017-09-05. Retrieved 2017-09-05.(https://web. archive.org/web/20170905144020/http://sior.ub.edu/jspui/cris/sociali mpact/socialimpact00438) (http://sior.ub.edu/jspui/cris/socialimpact/s ocialimpact00438)

3. "Smart tech to end fwy congestion" . PerthNow. 2020-07-07.Retrieved 2020-10-07.(https://www.perthnow.com.au/ne ws/transport/way-of-the-future-perths-47m-smart-freeway-to-be-switc hed-on-in-august-ng-b881601834z)

4. Monahan, Torin (2007). ""War Rooms" of the Street: Surveillance Practices in Transportation Control Centres" (PDF). The Communication Review.10 (4): 367–389. CiteSeerX 10.1.1.691.8788 .doi:10.1080/10714420701715456 . S2CID 44101831 .(http://publicsurveillanc e.com/papers/war_rooms.pdf) (https://citeseerx.ist.ps u.edu/viewdoc/summary?doi=10.1.1.691.8788) (https://doi.org/10.1080%2F10714 420701715456) (https://api.semanticscholar.org/C orpusID:44101831)

5. "Frequently Asked Questions" .Intelligent Transportation Systems Joint Program Office. United States Department of Transportation. Retrieved 10 November 2016.(http://www.its.dot.gov/faqs.htm)

6. Tarnoff, Philip John, Bullock, Darcy M, Young, Stanley E, et al."Continuing Evolution of Travel Time Data Information Collection and Processing", Transportation Research Board Annual Meeting 2009Paper #09-2030. TRB 88th Annual Meeting Compendium of PapersDVD

7. Mohan, Prashanth, Venkata N. Padmanabhan, and Ramachandran Ramjee. *Nericell: rich monitoring of road and traffic conditions usingmobile smartphones.* Proceedings of the 6th ACM conference on Embedded network sensor systems. ACM, 2008.

8. Ahmed, Hazem; EL-Darieby, Mohamed; Abdulhai, Baher; Morgan,Yasser (2008-01-13). "Bluetooth- and Wi-Fi-Based Mesh Network Platform for Traffic Monitoring" . *Transportation Research Board 87th Annual Meeting*.(https://trid.trb.org/view.aspx?id=8482 40)

9. Tyagi, V., Kalyanaraman, S., Krishnapuram, R. (2012). "Vehicular Traffic Density State Estimation Based on Cumulative Road Acoustics". *IEEE Transactions on Intelligent Transportation Systems*.13 (3): 1156–1166. doi:10.1109/TITS.2012.2190509 . S2CID 14434273 .(https://doi.org/1 0.1109%2FTITS.2012.2190509) (https://api.sema nticscholar.org/CorpusID:14434273)

10. "Comparison of Stopped Vehicle Detection (SVD) Technologies for Smart Motorway Applications" . *Ogier Electronics*. Retrieved 4 May 2020.(http://ogierelectronics.com/compariso n-of-svd-technology.php)

11. "Smart motorway evidence stock take and action plan" . *GOV.UK*. Retrieved 2020-04-

(https://www.g ov.uk/government/publications/smart-motorway-evidence-stocktake-andaction-plan)

12. Joshi, V., Rajamani, N., Takayuki, K., Prathapaneni, N.,Subramaniam, L. V. (2013). *Information Fusion Based Learning forFrugal Traffic State Sensing*. Proceedings of the Twenty-Third International Joint Conference on Artificial Intelligence.

13. Keating, Dave. "All Cars In Europe Can Now Call The Police Themselves" .*Forbes*. Retrieved 2019-09-25. (https://www.forbes.com/sites/davekeating/2018/04/01/ starting-today-all-cars-in-europe-can-call-the-police-themselves/)

14. Gleeson, Colin. "New cars to automatically inform authorities of crashes" . *TheIrish Times*. Retrieved 2019-09-25.(https://www.irishtimes.com/news/ireland/irish-news/new-ca rs-to-automatically-inform-authorities-of-crashes-1.3447079)

15. *Report (HC 15, 2004–05): Tackling congestion by making better use of England's motorways and trunk roads (Full Report)* (PDF), National Audit Office, 26 November 2004, retrieved 2009-09-17(http://www.na o.org.uk/publications/nao_reports/04-05/040515.pdf)

16. Trend in Road Accidents, Japan Archived 2009-05-21 at the Wayback Machine. nilim.go.jp (http://www.nilim.go.jp/english/confe rence/asia2006/8-6.pdf) (https://web.archive.org/web/20090 521071120/http://www.nilim.go.jp/english/conference/asia2006/8-6.p df)

17. 3rd eSafety Forum, 25 March 2004

18. European Commission, Directorate-General “Information Society”, Directorate C “Miniaturisation, Embedded Systems and Societal Applications”, Unit C.5 “ICT for Transport and the Environment”, "Towards Cooperative Systems for Road Transport", Transport Clustering Meeting, 8 Nov. 2004 .(http://cordis.europa.eu/pub/ist/doc s/dir_c/trans/towards_coop_sys_road_trans_en.pdf)

19. "ITS World Congress" . *Promotional web site*. Retrieved 10 November 2016.(http://itsworldcongress.com/)

20. "Introducing the Network of National ITS Associations!" . *Promotional web site*. Retrieved 10 November 2016.(http://itsnetw ork.org/)

External Web Links

- Intelligent transportation system at Curlie (https://curlie.org/Science/Technology/Transportation/Intelligent_Systems/)

- ITS Handbook available for free download
- U.S. Department of Transportation – Intelligent Transportation Systems Joint Program Office website
- Guide to Federal ITS Research – U.S. Department of Transportation (http://road-network-operations.piarc.org/) (http://www.its.dot.gov)

  (http://its.dot.gov/factsheets/pdf/ITS_MiniFactBooklet_V11.pdf)

- ITS Safety Applications Factsheet – U.S. Department of Transportation
- SMART Highways Magazine
- ISO standardization of intelligent transport systems
- CEN standardization of intelligent transport systems
  (http://its.dot.gov/factsheets/pdf/JPO_SafetySolutions_v3.pdf)

  (http://smarthighways.net/) (https://www.iso.org/committee/54706.html)

  (https://www.itsstandards.eu/)

- 6.2.3 Variable speed limits
  Readers should have a look at the web page by the following link:

  http://europa.eu.int/comm/dgs/energy_transport/galileo/index_en.htm,

- 6.2.6 Parking Management
  (CONVERGE project– see the web link as mentioned below),

  http://www.cordis.lu/telematics/tap_transport/research/projectsum/converge.html).

- 6.2.9 Speeding Detection
  Point speed cameras

  (http://www.dft.gov.uk/stellent/groups/dft_rdsafety/documents/downloadable/dft_rdsafety_610816.pdf - page 4.)

  Intelligent Speed Adaptation (ISA)

  http://www.rws-avv.nl/servlet/page?_pageid=121&_dad=portal30&_schema=PORTAL30

  &p_folder_id=7737.

- 6.2.11 Multimodal Trip Planning
  www.transportdirect.info, http://www.travel-andtransport.com or www.ns.nl, and

  http://www.utmc.gov.uk/research/index.htm

  The study mentions a number of multimodal portals including

  http://www.utrecht.nl/smartsite.dws?id=13776&mw=1003&w=18&p=3352&parFrom=3352&infFrom=3352 (in Dutch), http://www.bayerninfo.de/index_e.html (in English),

  http://www.smarttrek.org/index.html (in English, Seattle area) and

- 6.2.17 UTMC Systems and the System Architecture on which they depend
  (Sourced from http://www.utmc.gov.uk/guidance/index.htm (UK DfT))

- 6.3.4 ITS in action for Access control and Road Pricing
  http://www.stockholmsforsoket.se/templates/page.aspx?id=2453

- 6.3.5 ITS in action for multimodal trip planning

7 Green Highways

References For: Section 7.2 Plantation of Trees in Green Highways

[1] Green Highways (Plantation, Transplantation, Beautification & Maintenance) Policy – 2015

References For: Section 7.3 Vehicles using CNG (Compressed Natural Gas) as fuel in Green Highways

[1] There are some limited prospects in the rail sector though the volumes are not likely to be material.

[2] The currency of data for each country varies, in most cases numbers are for the years 2016 to 2018.

[3] This is an approximation based on global fleet numbers provided by the International Organization of Motor Vehicle Manufacturers, OICA. http://www.oica.net/category/vehicles-in-use/ and NGV Global.

[4] Armenia has an even higher level of saturation at 69 per cent though the total number of NGVs is only 300,000.

[5] Energy Aspects (forthcoming).)

[6] The data is from the IEA's World Energy Balance Master File which contains detailed statistics underpinning the WEO.

[7] 1 m3 of gas = 1.032 litres of diesel.

[8] 1 litre of diesel = 3.32 GGE

[9] Analysis by Energy Insights (forthcoming) suggests that gas consumption in China in 2017 was around 33 Bcm. Whilst this number includes gas consumed in the shipping sector it suggests an even higher average consumption figure for road vehicles.

[10] See for example https://www.transportenvironment.org/publications/natural-gas-vehicles-%E2%80%93-road-nowhere

[11] 45 per cent arising from production, processing and liquefaction, 32 per cent from transmission, distribution and storage, 15 per cent from LNG feedstock transportation, and eight per cent from dispensing. The WTT element can vary significantly with different gas sources.

[12] https://www.dieselnet.com/standards/eu/hd.php.

[13] https://www.ngvglobal.com/blog/vw-utilise-100-scania-lng-trucks-greener-logistics-0920.

[14] See for example https://www.drax.com/technology/can-electricity-power-heavy-duty-vehicles/ and https://www.ukhaulier.co.uk/news/road-transport/trucks/fully-battery-electric-driven-truck-for-heavy-duty-distribution-mercedes- benz-eactros-starts-in-the-murg-valley-emission-free-and-quiet-transportation/./

[15] Spiers et al 2019 and Transport & Environment 2018.

[16 In 2017 a Stralis NP 4×2 tractor unit pulling a tri-axle box van trailer and running at a gross vehicle weight of 30 metric tons has just completed a 1,728 km road journey without needing to refuel.

[17] CNG tanks cannot fit on a 6x2 tractor unit – see https://www.gasrec.co.uk/cng-lng/

[18 https://www.ngvglobal.com/blog/uk-fuel-differential-freeze-a-boost-for-ngv-hgvs-1110#more-56245.

[19] https://www.edie.net/news/6/John-Lewis-and-Waitrose-to-power-delivery-fleet-on-bio-methane-by- 28-green-gb-week/.

[20] This is based on a $27,000/year for regular diesel and $11,500/year for LNG at about $7.60/MMBtu. (Article in Natural Gas World, 1.10.18)

[21] http://www.ngvglobal.com/blog/uk-bus-operator-first-to-run-cng-minibuses-1107#more-56161.

[22] https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport.

[23] https://www.lngworldnews.com/eu-funds-german-lng-fueling-project/./

[24] https://www.naturalgasworld.com/gasum-to-develop-swedish-lbg-unit-65004.

[25] http://www.ngvglobal.com/blog/natural-gas-for-trucks-promoted-by-german-transport-ministry-0617#more-54069.

References For: Section: 7.4 Electrical Vehicles Integrated with Renewable Energy Sources for Sustainable Mobility in Green Highways

https://www.intechopen.com/chapters/60938

Author details

Michela Longo1*, Federica Foiadelli1 and Wahiba Yaïci2
*Address all correspondence to: michela.longo@polimi.it

(i) Department of Energy, Politecnico di Milano, Milan, Italy (ii) Canmet ENERGY Research Centre, Natural Resources Canada, Ottawa, Ontario, Canada

[1] Environment and Climate Change Canada. Canadian Environmental Sustainability Indicators, Greenhouse Gas Emissions. 2016. Available from: www.ec.gc.ca/indicateursindicators/default.asp?lang=en&n=FBF8455E [Accessed: 2018-02-20]

[2] Government of Canada. Canada's Way Forward on Climate Change, The Paris Agreement. 2016. Available from: http://climatechange.gc.ca/default.asp?lang=En&n=24700154-1 [Accessed: 2018-02-20]

[3] Office of the Parliamentary Budget Officer. Canada's Greenhouse Gas Emissions: Developments, Prospects and Reductions. 2016. Available from: http://www.pbo-pb.gc.ca/web/default/files/Documents/Reports/2016/ClimateChange/PBO_Climate_Change_EN.pdf [Accessed: 2018-02-20]

[4] European Commission. A European Strategy for Low-Mission Mobility. Brussels. 2016.Available from: https://ec.europa.eu/clima/policies/transport_en [Accessed: 2018-03-02]

[5] Thomas CES. Transportation options in a carbon constrained world: Hybrids, plug-in hybrids, biofuels, fuel cell electric vehicles, and battery electric vehicles. International Journal of Hydrogen Energy. 2009;34:9279-9296. DOI: 10.1016/j.ijhydene.2009.09.058

[6] Richardson DB. Electric vehicles and the electric grid: A review of modeling approaches, impacts, and renewable energy integration. Renewable and Sustainable Energy Reviews. 2013; 19:247-254. DOI: 10.1016/j.rser.2012.11.042

[7] Mwasilu F, Justo JJ, Kim E-K, Do TD, Jung J-W. Electric vehicles and smart grid interaction: A review on vehicle to grid and renewable energy sources integration. Renewable and Sustainable Energy Reviews. 2014;34:501-516. DOI: 10.1016/j.rser.2014.03.031

[8] Liu L, Kong F, Liu X, Peng Y, Wang Q. A review on electric vehicles interacting with renewable energy in smart grid. Renewable and Sustainable Energy Reviews. 2015;51: 648-661. DOI: 10.1016/j.rser.2015.06.036

[9] European Commission. Community Research and Development and Development Information Service (CORDIS), eMobilita, Electromobility in urban transport: A multidimensional innovation (socio-economic and environmental effects). Available from: https://cordis.europa.eu/project/rcn/207049_en.html [Accessed: 2018-03-25] Electric Vehicles Integrated with Renewable Energy Sources for Sustainable Mobility
http://dx.doi.org/10.5772/intechopen.76788

[10] European Commission, Community Research and Development and Development Information Service (CORDIS), NeMo: Hyper-Network for electroMobility. Available from: https://cordis.europa.eu/project/rcn/204973_en.html [Accessed: 2018-03-25]

[11] European Commission, Community Research and Development and Development Information Service (CORDIS), OSEM-EV (Optimised and Systematic Energy Management in Electric Vehicles). Available from: http://cordis.europa.eu/project/rcn/194883_en.html [Accessed: 2018-03-25]

[12] European Environment Agency. Electric vehicles and the energy sector—Impacts on Europe's future emissions. 2016. Available from: https://www.eea.europa.eu/themes/transport/electric-vehicles/electric-vehicles-and-energy [Accessed: 2018-02-20]

[13] Tan KM, Ramachandaramurthy VK, Yong JY. Integration of electric vehicles in smart grid: A review on vehicle to grid technologies and optimization techniques. Renewable and Sustainable Energy Reviews. 2016;53:720-732. DOI: 10.1016/j.rser.2015.09.012

[14] Dubarry M, Devie A, McKenzie K. Durability and reliability of electric vehicle batteries under electric utility grid operations: Bidirectional charging impact analysis. Journal of Power Sources. 2017;358:39-49. DOI: 10.1016/j.jpowsour.2017.05.015

[15] Shaukata N, Khan B, Ali SM, Mehmood CA, Khan J, Farid U, Majid M, Anwar SM, Jawad M, Ullah Z. A survey on electric vehicle transportation within smart grid system. Renewable and Sustainable Energy Reviews. 2018;81:1329-1349. DOI: 10.1016/j.rser.2017.05.092

[16] Pinson P, Christensen LEA, Madsen H, Sørensen PE, Donovan MH, Jensen LE. Regime switching modelling of the fluctuations of offshore wind generation. Journal of Wind Engineering & Industrial Aerodynamics. 2008;96(2):2327-2347. DOI: 10.1016/j.jweia.2008.03.010

[17] Jabr RA, Pal BC. Intermittent wind generation in optimal power flow dispatching. IET Generation, Transmission & Distribution. 2009;3(1):66-74. DOI: 10.1049/iet-gtd:20080273

[18] Bollen MHJ, Zhong J, Zavoda F, Meyer J, McEachern A, Corcoles Lopez F. Power quality aspects of smart grids. In: Proceedings of International Conference on Renewable Energies and Power Quality (ICREPQ'10); 23-25 March 2010; Granada, Spain. DOI: 10.24084/repqj08.58

[19] Kempton W, Letendre SE. Electric vehicles as a new power source for electric utilities. Transportation Research Part D: Transport and Environment. 1997;2(3):157-175. DOI: 10. 1016/S1361-9209(97)00001-1

[20] Clement-Nyns K, Haesen E, Driesen J. The impact of charging plug-in hybrid electric vehicles on a residential distribution grid. IEEE Transactions on Power Systems. 2010; 25(1):371-380. DOI: 10.1109/TPWRS.2009.2036481

[21] Kempton W, Tomic J. Vehicle-to-grid power implementation: From stabilizing the grid to supporting large-scale renewable energy. Journal of Power Sources. 2005;144(1):280-294. DOI: 10.1016/j.jpowsour.2004.12.022, New Trends in Electrical Vehicle Powertrains

[22] Kempton W, Udo V, Huber K, Komara K, Letendre S, Brunner SD, Pearre N. A test of vehicle-to-grid (V2G) for energy storage and frequency regulation in the PJM system. Technical Report, MAGIC Consortium, Jan., 2009. Available at: http://www.magicconsortium.org/_Media/test-v2g-in-pjm-jan09.pdf [Accessed: 2018-02-20]

[23] Pillai JR, Bak-Jensen B. Integration of vehicle-to-grid in the western Danish power system. IEEE Transactions on Sustainable Energy. 2011;2(1):12-19. DOI: 10.1109/TSTE.2010. 2072938

[24] Galus MD, Koch S, Andersson G. Provision of load frequency control by PHEVs, controllable loads, and a cogeneration unit. IEEE Transactions on Industrial Electronics. 2011;58(10):4568-4582. DOI: 10.1109/TIE.2011.2107715

[25] Hay C, Togeby M, Bang NC, Søndergren C, Hansen LH. Introducing electric vehicles into the current electricity markets. Project Report, EDISON Deliverable D2.3. May, 2010

[26] Energinet.dk. Energinet.dk's ancillary services strategy. Aug. 2011. Available from: www. energinet.dk [Accessed: 2018-02-20]

[27] Lopes JAP, Almeida PMR, Soares FJ. Using vehicle-to-grid to maximize the integration of intermittent renewable energy resources in islanded electric grids. In: Proceedings of the International Conference on Clean Electrical Power (ICCEP '09); 9-11 June 2009; Capri, Italy. DOI: 10.1109/ICCEP.2009.5212041

[28] Lopes JAP, Polenz SA, Moreira CL, Cherkaoui R. Identification of control and management strategies for LV unbalanced microgrids with plugged-in electric vehicles. Electric Power Systems Research. 2010;80(1):898-906. DOI: 10.1016/j.epsr.2009.12.013

[29] Bessa RJ, Matos MA. Economic and technical management of an aggregation agent for electric vehicles: A literature survey. International Transactions on Electrical Energy Systems. 2011;22:334-350. DOI: 10.1002/etep.565

[30] Birnie D. Solar-to-vehicle (S2V) systems for powering commuters of the future. Journal of Power Sources. 2009;186(2):539-542. DOI: 10.1016/j.jpowsour.2008.09.118

[31] Bollen M, Hassan F. Integration of distributed generation in the power system. Chapter 5: Voltage Magnitude Variations. 5th ed. John Wiley & Sons Inc.; 2011. DOI: 10.1002/9781118029039

[32] Corfee K, Korinek D, Cassel W, Hewicker C, Zillmer J, Pereira Morgado M, Ziegler H, Tong N, Hawkins D, Cernadas J. Distributed generation in Europe–Physical infrastructure and distributed generation connection, Memo. Available from: http://www.clean-coalition.org/site/wp-content/uploads/2012/11/Memo-1_Physical-Infrastructureand-DG-Interconnection.pdf [Accessed: 2018-02-20]

[33] Etherden N, Bollen MHJ. Increasing the hosting capacity of distribution networks by curtailment of renewable energy sources. In: Proceedings of PowerTech; 19-23 June 2011; Trondheim, Norway. DOI: 10.1109/PTC.2011.6019292 Electric Vehicles Integrated with Renewable Energy Sources for Sustainable Mobility http://dx.doi.org/10.5772/intechopen.76788

[34] Carvalho P, Correia P, Ferreira L. Distributed reactive power generation control for voltage rise mitigation in distribution networks. EEE Transactions on Power Systems. 2008;23(2):766-772. DOI: 10.1109/TPWRS.2008.919203

[35] Tonkoski R, Lopes LAC, El-Fowly T. Coordinated active power curtailment of grid connected PV inverters for overvoltage prevention. IEEE Transactions on Sustainable Energy. 2011;2(2):139-147. DOI: 10.1109/TSTE.2010.2098483

[36] Fawzy T, Premm D, Bletterie B, Gorsek A. Active contribution of PV inverters to voltage control—From a smart grid vision to full-scale implementation. e & i Elektrotechnik und Informationstechnik. 2011;128(4):110-115. DOI: 10.1007/s00502-011-0820-z

[37] Demirok E, Casado Gonzalez P, Frederiksen KHB, Sera D, Rodriguez P, Teodorescu R. Local reactive power control methods for overvoltage prevention of distributed solar inverters in low-voltage grids. IEEE Journal of Photovoltaics. 2011;1(2):174-182. DOI: 10.1109/JPHOTOV.2011.2174821

[38] Marra F, Fawzy YT, Bülo T, BlažicBlazic B. Energy storage options for voltage support in low-voltage grids with high penetration of photovoltaic. In: Proceeding 2012 3rd IEEE PES International Conference and Exhibition on Innovative Smart Grid Technologies (ISGT Europe '13); 14-17 October 2012; Berlin, Germany. DOI: 10.1109/ISGTEurope.2012.6465690

[39] Liu X, Aichhorn A, Liu L, Li H. Coordinated control of distributed energy storage system with tap changer transformers for voltage rise mitigation under high photovoltaic penetration. IEEE Transactions on Smart Grid. 2012;3(2):897-906. DOI: 10.1109/TSG.2011. 2177501

[40] Kempton W, Tomic J, Letendre SE, Brooks A, Lipman T. Vehicle to grid power: Battery, hybrid, and fuel cell vehicles as resources for distributed electric power in California. Working Paper Series ECD-ITS-RR-01-03, Jun. 2001. Available from: http://escholarship.org/uc/item/5cc9g0jp [Accessed: 2018-02-20]

[41] Commission of the European Communitie. Regulation (EEC) No 4064/89 Merger Procedure. Mar. 1999. [Online]. Available from: www.ec.europa.eu [Accessed: 2018-02-20]

[42] Galus MD, Zima M, Andersson G. On integration of plug-in hybrid electric vehicles into existing power system structures. Energy Policy. 2010;38(11):6736-6745. DOI: 10.1016/j.enpol.2010.06.043

[43] Fell K, Huber K, Zink B. Assessment of plug-in electric vehicle integration with ISO/RTO systems. Technical Report, Mar. 2010. Available from: http://www.isorto.org/atf/cf/%7B5B4E85C6-7EAC-40A0-8DC3003829518EBD%7D/IRC_Report_Assessment_of_Plugin_Electric_Vehicle_Integration_with_ISORTO_Systems_03232010.pdf [Accessed:2018-02-20]

[44] Brooks A, Gage T. Integration of electric drive vehicles with the electric power grid—A new value stream. In: 18th Internat. Electric Vehicle Symposium and Exhibition, Oct. 2001, New Trends in Electrical Vehicle Powertrains

[45] Bessa RJ, Matos MA, Soares FJ, Lopes JAO. Optimized bidding of a EV aggregation agent in the electricity market. IEEE Transactions on Smart Grid. 2012;3(1):443-452. DOI: 10.1109/TSG.2011.2159632

[46] Lopes JAP, Soares FJ, Almeida PMR. Integration of electric vehicles in the electric power system. In: Proceeding of the IEEE, 04 October 2010; pp. 168-183. DOI: 10.1109/JPROC.2010.2066250

[47] Galus MD, Andersson G. Demand management of grid connected plug-in hybrid electric vehicles. In: Proceedings of the Energy 2030 Conference (ENERGY 2008); 17-18 November 2008; Atlanta, GA, USA. DOI: 10.1109/ENERGY.2008.4781014

[48] Brenna M, Foiadelli F, Longo M. The exploitation of vehicle-to-grid function for power quality improvement in a smart grid. IEEE Transactions on Intelligent Transportation Systems. 2014;15(5):2169-2177. DOI: 10.1109/TITS.2014.2312206

[49] Kanchev H, Di Lu F, Colas V, Lazarov B. Energy management and operational planning of a microgrid with a PV-based active generator for smart grid applications. IEEE Transactions on Industrial Electronics. 2011;58(10):4583-4592. DOI: 10.1109/TIE.2011.2119451

[50] Liserre M, Sauter T, Hung JY. Future energy systems, integrating renewable energy sources into the smart power grid through industrial electronics. IEEE Industrial Electronics Magazine. 2010;4(1):18-37. DOI: 10.1109/MIE.2010.935861 Electric Vehicles Integrated with Renewable Energy Sources for Sustainable Mobility http://dx.doi.org/10.5772/intechopen.76788

References For: Section 7.5 Utilizing recycled materials by avoiding disposals in Eco friendly Green Highways Construction

Robin L. Schroeder has been with the Federal Highway Administration for 15 years. For the past three years, he has worked in the Materials Branch of the Construction and Maintenance Division in Washington, D.C., where he is extensively involved with the use of recycled materials in highway construction. In that capacity, he was the primary coordinator of a symposium that was held last year in Denver, Colo., on the use of recycled materials in highway construction. He also helped to develop a report to Congress concerning recycled materials as required by Section 1038 of ISTEA. He earned a bachelor's degree in civil engineering from Oregon State University, and he is a registered professional engineer in the state of Washington.

Primary Source: TRB Weekly, https://trid.trb.org/view/413914
Record URL: http://www.fhwa.dot.gov/publications/publicroads/94fall/p94au32.cfm
Availability: Find a library where document is available. Order URL: http://worldcat.org/oclc/1586080
Corporate Authors: Federal Highway Administration
1200 New Jersey Avenue, SE, Washington, DC United States 20590

(1) R.J. Collins and S.K. Ciesielski. *Recycling and Use of Waste Materials and Byproducts in Highway Construction,* Volumes 1 & 2, 1993.

(2) Imtiaz Ahmed. *Use of Waste Materials in Highway Construction,* Report No. FHWA/IN/JHRP-91/3, 1991.

(3) Cheryl Solomon. *Slag--Iron and Steel*, Annual Report, U.S. Department of the Interior, Bureau of Mines, Washington, D.C., 1992.

(4) K. Sakai, et al. "Properties of Granulated Blast-Furnace Slag Cement Concrete," *Proceedings of the Fourth International Conference on Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete*, Istanbul, Turkey, May 1992.

(5) S. Nagataki, et al. "Properties of Concrete Using Newly Developed Low-Heat Cements and Experiments with Mass Concrete Model," *Proceedings of the Fourth International Conference on Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete*, Istanbul, Turkey, May 1992.

(6) K. Togawa, et al. "Study on the Effects of Blast-Furnace Slag on Properties of No-Slump Concrete Mixtures," *Proceedings of the Fourth International Conference on Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete*, Istanbul, Turkey, May 1992.

(7) American Association of State Highway and Transportation Officials, Subcommittee on Construction, Quality Construction Task Force. "Use of Waste Materials in Highway Construction," unpublished report, August 1993.

(8) Availability of Mining Wastes and Their Potential for Use as a Highway Material--Executive Summary, Publication No. FHWA-RD-78-28, Federal Highway Administration, Washington D.C., September 1977.

(9) Tim Ramirez. *79-12 Steel Slag Aggregate in Bituminous Mixtures--Final Report,* Pennsylvania Department of Transportation, 1992.

(10) Characterization of Municipal Solid Waste in the United States: 1992 Update, Executive Summary. Report No. EPA/530-S-92-019, Environmental Protection Agency, Washington, D.C., 1992.

(11) Engineering and Environmental Aspects of Recycled Materials for Highway Construction, Volume I: Final Report. FHWA Contract No. DTFH61-92-C-00060, Federal Highway Administration, Washington D.C., 1993.

(12) "Recycled plastic finds home in asphalt binder," *Roads & Bridges,* March 1993, pp. 41-47.

(13) Engineering News Record, February 22, 1993, p. 42.

(14) Anton Horner. "Use of Scrap Tire Rubber in Carsonite Noise Barrier," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities*, October 1993.

(15) Peter Eng. Alberta Transportation and Utilities, Research and Development Report No. ABTR/RD/TM-92/09, Project No. 91021, June 1993.

(16) "'Glasphalt' utilization dependent upon availability." *Roads & Bridges*, February 1993, pp. 59-61.

(17) Clean Washington Center. *Using Recycled Glass as a Construction Aggregate, a Summary of the Glass Feedstock Evaluation Project.* Seattle, 1993.

(18) George Dewey, et al. "Municipal Waste Combustor Ash as an Aggregate Substitute in Bituminous Mixture," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities*, October 1993.

(19) Three-Year Results on the Performance of Incinerator Residue in a Bituminous Base, Publication No. FHWA-RD-78-144, Federal Highway Administration, Washington, D.C., 1978.

(20) Macro Pasetto. "Cement Stabilization of Urban Solid Waste Slags and Ashes in Road Base and Sub-Base Layers," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities,* October 1993.

(21) North Carolina Department of Transportation Materials and Tests Unit. "A Laboratory Evaluation on the Effects of Ground Tire Rubber on Strength Performance of Concrete," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities,* October 1993.

(22) Dana N. Humphrey and Robert A. Eaton. "Tire Chips as a Subgrade Insulation--Field Trial," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities,* October 1993.

(23) Youjiang Wang, et al. "Fiber Reinforced Concrete Using Recycled Carpet Industrial Waste and Its Potential Use in Highway Construction," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities,* October 1993.

(24) Jeffery Groom, et al. "Use of Waste Nylon Fibers in Portland Cement Concrete to Reduce Plastic Shrinkage Cracking," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities*, October 1993.

(25) Gregory Scot Gordon, et al. "Use of Waste Fibers in Asphalt Concrete," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities,* October 1993.

(26) J.D. Brock. "From Roofing Shingles to Roads," Technical Paper T-20, 1990.

(27) Mary Stroup-Gardiner, et al. "Permanent Deformation and Low Temperature Behavior of Roofing-Modified HMA," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities,* October 1993.

(28) "Shingle Scrap in Asphalt Concrete," unpublished report, Study No. 9PR1010, Minnesota Department of Transportation, 1991.

(29) Donald Saylak, et al. "Applications for FGD Byproduct Gypsum," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities,* October 1993.

(30) "Fly ash sets standard for recycled material use," *Roads & Bridges,* November 1992, pp. 50-56.

(31) David Q. Hunsucker, et al. "Evaluating the Use of Ponded Fly Ash in Roadway Base Course," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities,* October 1993.

(32) A.R. Dawson, et al. "Some British Experience of the Behavior of Furnace Bottom Ash and Slate Waste for Pavement Foundations," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities,* October 1993.

(33) E. Eleni Vassiladou, et al. "Utilization of Fly and Bottom Ash as a Partial Fine Aggregate Replacement in Asphalt Concrete Mixtures," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities,* October 1993.

(34) William Wolfe, et al. "Truck Ramp Construction from Clean Coal Technology Waste Products," *Symposium Proceedings - Recovery and Effective Reuse of Discarded Materials and Byproducts for Construction of Highway Facilities,* October 1993.

8 FASTag Systems

References:

1. FASTagPro: Recharge any FASTag online without login in 2 minutes
   https://fastagpro.com/recharge

2. RFID technology and what role does it play in FASTag
   https://www.financialexpress.com/auto/

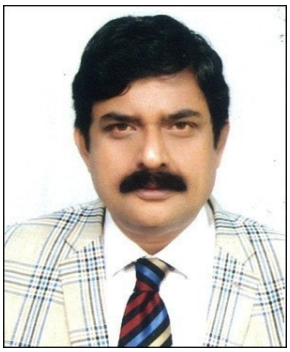
3. Theory and Applications of Economics in Highway and Transport Planning, by Dr. Vinay Maitri, Dr. P. K. Sarkar, Standard Publishers Distributors

Road Safety

by Traffic Management and Transportation Engineering with Intelligent Transport System, Green Highways

Author

Sandipan Goswami



Sandipan Goswami received his bachelor's degree in Science from the University of Calcutta in 1978, bachelor's degree in civil engineering from the University of Calcutta in 1983 and master's degree in civil engineering, with specialization in soil mechanics and foundation engineering from Indian Institute of Technology - Kharagpur in 1985.

Over the span of 37 years he became well known for his technical contribution to the Academic Institutes, Project Authorities, engineering consultants and construction companies to make various Feasibility studies, DPRs and construction projects successful for various State and Central Government projects.

Sandipan Goswami was honored with titles 'Fellow of the Institution of Engineers' in India and Professional Engineer (PE) as Foreign Engineer, by Board of Engineers, Malaysia in 1997. He is life member of Indian Roads Congress (IRC) and is certified as 'Chartered Engineer' by the institution of engineers.

Sandipan Goswami pursued a career in transportation engineering. His areas of work include the reliability of the design for the construction of highway, tunnel and bridges of concrete and steel structures in the perspective of users' safety. He has been a consultant to the World Bank to review the DPRs and identifying the safety issues and the countermeasures as well for the road users. He was assigned to review of various DPRs, Design audit, Safety Audit for Highway, Bridges in various States highway projects assigned by 'The World Bank'.

Sandipan Goswami studied various safety uses and developed countermeasures for traffic safety at road intersections, interchanges, roundabouts, high speed rural sections in inter-state highway projects. He reviewed the safety audit conducted by consultants. He also worked for institutional development, capacity building with e-governance, construction management for Govt. of Himachal Pradesh, funded by the World Bank.

Sandipan Goswami worked for different engineering companies as Halcrow, SNC Lavalin, Egis, Lea Associates, CES (Jacobs), Deloitte Touche Tohmatsu, Adani Road Transport Limited etc. He has participated in the lead roles in the design and construction of thousands of kilometers highways, hill roads, low cost rural roads, tunnels, bridges and structures in India, Malaysia and Bangladesh.

Sandipan Goswami worked as Team Leader of Independent Engineer in the construction of National Highway project, and as Team Leader of Authority Engineer in the construction of Access Controlled Nagpur - Mumbai Super Communication Expressway (Maharashtra Samruddhi Mahamarg) In the State of Maharashtra on EPC Mode for Package - 14, project of Maharashtra State Road Development Corporation Ltd. (MSRDC). This included NATM Drill and Blast Twin-Tube 6-Lane continuous Tunnel of length 7.74 km and PSC-Via-ducts at either end.

Sandipan Goswami worked as Team Leader in the DPR State Highway Project, Package 19 on behalf of Consulting Engineering Services (I) Pvt. Ltd. (Presently Jacobs), worked as Team Leader for detail engineering design for DPR of Ropar to Phagwara four lane highway (80 km approx.) In the state of Punjab, Punjab Infrastructure Development Board (PIDB), including three level ROB (highway-elevated bridge and underground tunnel, junction improvements etc. and worked as Team Leader in the Feasibility Studies for Six-Laning of NH 5, Vishakhapatnam to Anakapalli to Rajahmundry,

Sandipan Goswami also worked as Team Leader in detail engineering design of 24 km long (approx.) expressway with six-Lane carriageway and about 10 km elevated section with at grade service roads in PPP model in Bangladesh and detail engineering design of 256 km long four-lane West Coast expressway in BOT model in Malaysia.

Sandipan Goswami also worked for Design and Build of various national and state highway projects, Bored Tunnel for Metro Rails projects, Airport Planning and Design projects etc. As Senior Design Engineer he for Vehicular Tunnels in Kuala Lumpur City Centre, Malaysia.

Sandipan Goswami delivered lectures as visiting faculty in National Institute for Training of Highway Engineers (NITHE, presently Indian Academy of Highway Engineers, IAHE), under Ministry of Road Transport and Highways, Govt. of India, on Project Preparations for Highway, Bridge and Tunnel projects for engineers who came from government departments of India, Africa etc. He was honored by National Institute for Training of Highway Engineers (NITHE, presently Indian Academy of Highway Engineers, IAHE), under Ministry of Road Transport and Highways, Govt. of India. He also conducted seminars, workshops and hand on practices on various types of projects at various IITs, NITs and other engineering universities.

Sandipan Goswami has published the widely appreciated technical paper on "Project Development – Development of Rural Road Infrastructure, IRC" and many other technical and safety related articles in ResearchGate (Germany) and Academia (USA).

Sandipan Goswami received the awards namely, i) Rashtriya Gaurav (National Pride) Award, ii) Managing Projects – A Systems Approach – this received Award from the CMD of NPCC), iii) Recipient of Millennium Achievers Gold Medal by International Institute of Success Awareness. Sandipan Goswami is the author of the following books:

1. The book title: Computer Aided Bridge Engineering
   Publisher: Nova Science Publishers, New York, USA
   ISBN: 978-1-68507-413-5
   Web page: https://novapublishers.com/shop/computer-aided-bridge-engineering-detail-design-of-pre-stressed-concrete-i-girder-box-girder-bridges/

   Software used: ASTRA Pro (Standard used AASHTO LRFD, Eurocode2, IRC 112, IRC 6)
   Download from website: www.techsoftglobal.com,
   Email: techsoftinfra@gmail.com

2. The book title: Computer Aided Highway Engineering
   Publisher: Taylor and Francis, CRC Press, Routeledge, Boca Raton, Florida, USA.
   ISBN: 978-0-367-49338-7
   Webpage: https://www.taylorfrancis.com/books/mono/10.1201/9781003045830/computer-aided-highway-engineering-sandipan-goswami-pradip-sarkar

   Software used: HEADS Pro (Standard used, AASHTO, IRC)
   Download from website: www.techsoftglobal.com,
   Email: techsoftinfra@gmail.com

3. The book title: Pavement Engineering – Design, Construction and Maintenance
   Publisher: PHI Learning (Formerly, Prentice-Hall)
   ISBN: 9789391818104
   Web page: https://www.phindia.com/Books/Author/OTc4OTM5MTgxODEwNA

   Software used: HEADS Pro (Standard used, AASHTO, IRC)
   Download from website: www.techsoftglobal.com,
   Email: techsoftinfra@gmail.com

Sandipan Goswami, Personal email: sandipanmails@gmail.com
URL for Book Tutorials / Author's Profile: https://www.roadbridgedesign.com/#
Tutorial videos: https://www.youtube.com/channel/UCLY751jDWngqMfhKrlRcVwA/playlists

The books include various theory descriptions, examples, tutorials and industrial applications. The softwares have been in use for last 22 years in Highway, Railway, Bridge, Tunnel, Pavement, Metro Railway, LRTs, MRTs, Elevated transport corridors, Airports, Irrigation, Open Pit Mining projects in various countries.

The resources mentioned above appropriately suffice the requirements of Engineering Universities, Research Institutions, Faculties, Students, Engineers in the Industry, Professionals, Consultants, Contractors, Project Authorities, Government Departments and agencies.