Safe Road Infrastructure Design for Highways of Regional Countries

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International Road Federation, Geneva

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UN Economic & Social Commission for Asia & the Pacific
Bangkok
• About 1.24 Million People die each year as a result of Road Traffic Crashes.

• Road Traffic injuries are the leading cause of death among young people, aged 15-29 years.

• 91% of the World’s Fatalities on the roads occur in Low-income and middle-income countries, even though these countries have approximately half of the World’s vehicles.

• Half of those dying on the world’s roads are vulnerable road users - Pedestrians, Cyclists and Motorcyclists.

• Without action, road traffic crashes are predicted to result in the deaths of around 1.9 millions people annually by 2020.

From key facts above, Road Safety – an issue which need to be addressed from all fronts on urgent basis.
Projection of Fatalities in the World

Road Traffic Fatalities (millions)

Scenario 1: Do Nothing

94 million additional fatalities

Scenario 2: Act Now

There is Need to Act Now?

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World-Wide Injuries vs. Road Fatalities

- Road Traffic Injury highest cause of Global Injury

- Road Traffic injuries: 22.8%
- Other intentional injuries: 0.2%
- Violence: 10.8%
- War: 3.4%
- Poisons: 6.7%
- Falls: 7.5%
- Fires: 6.2%
- Drowning: 7.3%
- Other unintentional injuries: 18.1%
- Suicide: 16.9%

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Fatality rates are higher in Developing Countries

Fatalities per 10,000 crashes

<table>
<thead>
<tr>
<th>Country</th>
<th>Fatalities per 10,000 crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>66</td>
</tr>
<tr>
<td>Kenya</td>
<td>1786</td>
</tr>
<tr>
<td>India</td>
<td>2388</td>
</tr>
<tr>
<td>Vietnam</td>
<td>3181</td>
</tr>
</tbody>
</table>
• Road Safety is a Global issue in general & a **persistent problem** in the Developing World.

• There has been several initiatives towards achieving safer road and ensuring Road Safety in different parts of the world.

• **One of the major initiatives towards reducing road fatalities would be Safe Road Infrastructure to be put in place around the World.**

• The developed world has had the fortune of implementing a regime of Good and Safe Road Infrastructure with the obvious reduction in the trends & number of Road Fatalities.

• **The developing world need to put in place a good regime of Safe Road Infrastructure to have a sustained economic growth and healthy nation.**
Initiatives Towards Safer Road

• **United Nation : Decade of Action for Road Safety (2010-2020).**

  United Nation has declared the decade of 2010-2020 as the Decade of Action for Road Safety with Emphasis for Safe Roads for All & save 5 millions lives by 2020.

• **Commission for Global Road Safety**
  
a) Decade of Action for Road Safety

b) Safe & Sustainable Transport with Safety Systems & Speed Management

c) Safe roads for All Users

SAFE ROADS FOR ALL
IRF Initiatives Towards Safer Road

• IRF has a number of Road Programmes which aim to Concentrate the attention of the International Community towards Road Safety in particular regions.

• In Collaboration with the UN Economic Commission for Africa and other International agencies, the IRF supports the Trans–African Highway Network.

• The African Continent faces a number of challenges & the IRF gives help and input towards PPP, road Safety, Statistical Data Collection and Training.

• IRF aims to focus its attention on the needs of the Mediterranean Region & brings to this region personalized training seminars and regional conferences.
• As a Strong believer in continuing education, IRF provides members as well as the professionals worldwide with educational and professional development opportunities & resources.

• All the regional offices provide effective Training Programme on Road Safety, each differently, but complimentary to each other.

• The IRF Geneva Programme Centre specially deals with Training Videos and custom-made training.

• Ministers & Senior Road Officials from 15 Countries met at the UN office in Bangkok to discuss the recovery of infrastructure following disasters. A resolution requesting the IRF to help coordinate International Technical Assistance was unanimously adopted.
Basic Requirement for Safe Road Environment

Road Infrastructure Systems designed from historical knowledge from similar road environments

Safe Road Infrastructure Design

Continual monitoring of road operational and safety conditions
Immediate implementation of successful road safety models from the developed countries in the regional countries hinges on:

- Proper regulatory framework with necessary laws/legislations
- Obtaining adequate political priority for organizational reform and enactments of laws
Safety Issues Related to Road Infrastructure

• Safety in High Speed Roads
• Design for Safety in Urban and Rural Roads
• Safe Intersection Design
• Technology for Managing Traffic & Safety
• Road Safety Management Capacity
• Safety of Vulnerable Road Users
• Enforcement Issues Linked to Road Safety
• Infrastructure Safety through Road Safety Audit
• Safety in Road Projects with Public Private Partnership
• Institutional / Organizational Co-ordination for Road Safety
• Monitoring and Evaluation of Road Safety Projects
• Road Safety Awareness Campaigns
• Research on Road Safety
Safety in Different Stages (Planning, Design and Execution)

Road Safety can be enhanced by Highway Engineers at all the various stages of a project as follows:

A. Planning Stage –
   • Through Land Use Control
   • Providing Bypasses for congested towns and linking them by Spurs
   • Creating self contained zones to avoid non essential traffic in the neighborhood

B. Design Stage –
   • Designing “self explaining roads” and “forgiving road side” by selecting the most desirable design standards (and NOT the minimum standards) involving
     - Design Speed
     - Horizontal and Vertical Geometry
     - Cross-sectional elements,
     - Design of at-grade and grade separated junctions,
     - Provision of service roads for segregation of slow and fast traffic,
     - Designing effective road furniture viz. Guard Rails, Traffic signage, road side illumination provisions etc.
C. Construction Stage –

- Proper Separation of the construction zone through effective barricading
- Construction of proper traffic diversions
- Provision of Road Signage
- Environmental controls viz. reducing noise, dust etc.

D. Maintenance and Operation Stage – Providing an Automated Traffic Management System (ATMS) for safe operation of traffic and Incident Management. This includes providing mobile communication systems, variable message signs, weigh-in-motion system, central control room.

The key to safe road infrastructure design is Consistency of Standards so that the road user does not encounter unexpected situations.
### Elements of Engineering Planning and Design for Road Safety

<table>
<thead>
<tr>
<th>Design/Planning Element</th>
<th>Undesirable</th>
<th>Desirable</th>
<th>Principle applied</th>
</tr>
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<tbody>
<tr>
<td><strong>Alignment Selection and Land Use</strong></td>
<td><img src="image1" alt="Undesirable Alignment" /></td>
<td><img src="image2" alt="Desirable Alignment" /></td>
<td><strong>Major Arterials and Expressways should bypass major towns which should be connected by Spurs. There should be clear zones identified for linear land use control.</strong></td>
</tr>
<tr>
<td><strong>Horizontal Geometry</strong></td>
<td><img src="image3" alt="Undesirable Horizontal Geometry" /></td>
<td><img src="image4" alt="Desirable Horizontal Geometry" /></td>
<td><strong>Consistency of horizontal geometry avoiding monotonous straight lines or abrupt change of speed.</strong></td>
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<td>Horizontal Geometry</td>
<td><img src="image1" alt="Undesirable" /></td>
<td><img src="image2" alt="Desirable" /></td>
<td>Adequate offset distance from natural road side features.</td>
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<tr>
<td>Vertical Geometry</td>
<td><img src="image3" alt="Undesirable" /></td>
<td><img src="image4" alt="Desirable" /></td>
<td>Undivided Carriageways designed desirably for Overtaking Sight Distance (OSD)</td>
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<td>Cross-sectional Elements</td>
<td><img src="image1" alt="Undesirable Cross-sectional Elements" /></td>
<td><img src="image2" alt="Desirable Cross-sectional Elements" /></td>
<td>Wider Lane widths and shoulders for high speed roads</td>
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<td><img src="image3" alt="Undesirable Cross-sectional Elements" /></td>
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<td>Inside widening for sharp curves</td>
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<td>Cross-sectional Elements</td>
<td><img src="#" alt="Undesirable" /></td>
<td><img src="#" alt="Desirable" /></td>
<td>Wider depressed median for high speed roads to prevent glare and Jumping of Vehicles</td>
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<td>Cross-sectional Elements</td>
<td><img src="#" alt="Undesirable" /></td>
<td><img src="#" alt="Desirable" /></td>
<td>Recoverable slopes for out of control vehicles</td>
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<td>Cross-sectional Elements</td>
<td><img src="image1.png" alt="Undesirable Cross-sectional Elements" /></td>
<td><img src="image2.png" alt="Desirable Cross-sectional Elements" /></td>
<td>Separate slow moving non–motorized traffic (cycles, rickshaw etc) from fast moving traffic</td>
</tr>
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<td>Entry/Exit</td>
<td><img src="image3.png" alt="Undesirable Entry/Exit" /></td>
<td><img src="image4.png" alt="Desirable Entry/Exit" /></td>
<td>Entry Exit only through slip lanes with proper acceleration and deceleration lanes</td>
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<td>Passenger Transit</td>
<td><img src="image1" alt="Undesirable Diagram" /></td>
<td><img src="image2" alt="Desirable Diagram" /></td>
<td>Separate Lay bye for buses and taxis to avoid restriction and improve visibility</td>
</tr>
<tr>
<td>Junction Design</td>
<td><img src="image3" alt="Undesirable Diagram" /></td>
<td><img src="image4" alt="Desirable Diagram" /></td>
<td>Channelization, provision of stacking lanes, adequate turning radii</td>
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<td>Pedestrian Facilities in Urban Areas</td>
<td><img src="image1" alt="Undesirable Pedestrian Facilities" /></td>
<td><img src="image2" alt="Desirable Pedestrian Facilities" /></td>
<td>Provision of Raised Footpath for pedestrians in Urban Areas</td>
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<td>Facilities for differently abled</td>
<td><img src="image3" alt="Undesirable Facilities" /></td>
<td><img src="image4" alt="Desirable Facilities" /></td>
<td>Footpath merging in a slope with a cross street, bus bays flushed with foot boards etc.</td>
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<td>Barriers</td>
<td><img src="image1.jpg" alt="Non-standard Barriers" /></td>
<td><img src="image2.jpg" alt="Standard Barriers" /></td>
<td>Barriers should be designed to deflect the vehicle and not crash it.</td>
</tr>
<tr>
<td>Road Signs</td>
<td><img src="image3.jpg" alt="Non-standard Signs" /></td>
<td><img src="image4.jpg" alt="Standard Signs" /></td>
<td>The road signs should be standardized throughout the country.</td>
</tr>
<tr>
<td>Traffic Calming</td>
<td><img src="image5.jpg" alt="Non-standard Hump" /></td>
<td><img src="image6.jpg" alt="Standard Hump" /></td>
<td>Properly designed traffic calming devices like speed humps, rumble strips, small roundabouts.</td>
</tr>
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</table>
Some Good Practices of Safe Road Infrastructure Design
Good Practice of Safe Road Infrastructure Design

Mild Side Slope (Forgiving road Side Treatment)

Recovery Zone (Hard Shoulder)
Good Practice of Safe Road Infrastructure Design

Road Side Feature (Protected with Guardrails)

Bevelled End of a concrete culvert (Safer Design)
Good Practice of Safe Road Infrastructure Design

Recoverable Fill Slope

Rock face cutting shielded with safety barrier

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Good Practice of Safe Road Infrastructure Design

Safer road Design: roundabout
(At Grade with Non-motorised mode segregation)

Safer road Design:
Grade Separation
At Busy Intersection
(with segregated passage for pedestrians and local traffic)
Good Practice of Safe Road Infrastructure Design

Safer road design: Depressed Median

Safer Road Design: Speed Camera / Radar Photo

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Good Practice of Safe Road Infrastructure Design

Safer Road Design:
- Speed Limit
- Painted on the Asphalt

Safer road design:
- Speed Calming Measures

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Safer road design: 
Adequate Design for 
Non Motorized Traffic

Safer road design: 
Adequate Refuge for 
Pedestrians
Shortage in Expertise
• Shortage of experienced road safety auditors calls for training and capacity building.

Revision of Codes & Manuals
• Revisions of codes and manual are required in view of prevailing road user behavior/safety culture /mix of traffic/VRUs present in the road system

Peer-to-Peer Program:
• National & State Highway Agencies to consider to commence peer-to-peer program where assistance in road safety will be sought from a peer at free of cost.

Centres of Excellence & Accreditation System:
• Establish centers of excellence to train road safety engineers,
• An Accreditation System for safety auditors

The IRF-ARRB Course for Safety Auditors continuing since 2010 in New Delhi is a good beginning, offering a five days course in the sub-continent at an affordable price and exclusively focusing on safety engineering.
• Road fatality trajectory is going up alarmingly in low income countries. But developed countries could contain through infrastructure safety and other educational and enforcement programs.

• Immediate implementation of successful road safety models in some regional countries requires institutional reforms/change in legislation. However, safety engineering can be carried without any structural change in existing implementation framework

Ways to Improve infrastructure safety in regional countries:

1. Road Agencies to adopt road safety audit in all stages of road development and to make them mandatory.

2. Training and capacity building to enhance safety engineering expertise.

3. Revise codes and manuals in view of improved vehicle technology and prevailing road user behavior.

4. At national level initiate Peer–to-Peer program and establish center of excellence and Road Safety Auditor’s Accreditation system.
Thank you.