MIROS
IN DEPTH CRASH INVESTIGATION– CONCEPT, METHOD & PROCEDURE

ENGR AHMAD NOOR SYUKRI Z.ABIDIN

HEAD
CRASH RECONSTRUCTION UNIT
VEHICLE SAFETY & BIOMECHANICS RESEARCH CENTRE
MALAYSIAN INSTITUTE OF ROAD SAFETY RESEARCH
ROAD CRASH: ELEMENTS

- Vehicles
- Human
- Road
- System
The primary purpose of research-based, in-depth crash investigation is to identify in detail as many factors as possible that contribute to crashes and the resulting injuries, in particular, factors that have not previously been identified.

The results of these investigations are reported to the federal government, road authorities, the automotive industry and other stakeholders.

Ultimately, this process can be expected to lead to the development of countermeasures that will prevent the same crash from happening again.

Source: CASR, 2007
RESEARCH-BASED CRASH INVESTIGATION

Levels of Research Based Crash Investigation

- Base
- Intermediate
- In Depth
## DIFFERENT LEVELS IN RESEARCH BASED CRASH INVESTIGATION

<table>
<thead>
<tr>
<th>Level</th>
<th>Base Level</th>
<th>Intermediate Level</th>
<th>In Depth Level</th>
</tr>
</thead>
</table>
| Data Source | ▪ Traffic police accident reports  
▪ National road transport statistics | ▪ Traffic police accident reports  
▪ Observation at sites  
▪ Additional evidence from police officers or witnesses  
▪ Judicial reports | ▪ Traffic police accident reports  
▪ Observation at sites  
▪ Technical inspection of vehicle damages  
▪ Clinical assessment of injuries  
▪ Additional evidence from police officers or witnesses  
▪ Interviews with occupants involved |

### Functions

- **Base Level**
  - To **access crash situations** (who, where, when, what circumstances)
  - To **examine trends** in traffic volume, risk, make forecasts
  - To **evaluate** effects of legislation and other countermeasures

- **Intermediate Level**
  - To **identify and diagnose** hazardous road locations (where, how, what)
  - To **reconstruct accidents** to determine useful countermeasures

- **In Depth Level**
  - To **assess crash causes**
  - To **assess injury causation mechanisms**
  - To **study** crash and injury prevention measures
  - To **reconstruct accidents** to determine useful countermeasures/recommendations
  - To **monitor** the effectiveness of specific legislation and non legislative measures
EXAMPLES OF CRASH INVESTIGATION IN THE EU

Base Level

CARE (Community database of Accidents resulting in death or injury on the Road in Europe) 1993
• Source of funding: EU/National governments
• Number of cases per year: N/A
• Geographical Area: All EU member states

IRTAD (International Road Traffic and Accident Database) 1970
• Source of funding: OECD Road Transport Research Programme
• Number of cases per year: 350
• Geographical Area: 28 OECD countries

EHLASS (European Home and Leisure Accident Surveillance System) 1995
• Source of funding: National governments with additional EC funding
• Number of cases per year: N/A
• Geographical Area: Several EU countries
EXAMPLES OF
CRASH INVESTIGATION IN THE EU

Intermediate Level

GDV (Institute for Vehicle Safety, Germany) 1969
• Source of funding: German Insurance Association
• Number of cases per year: over 1000
• Geographical Area: Germany

SARAC (Safety Rating Advisory Committee)
• Source of funding: European Commission, insurance companies, car manufacturers
• Number of cases per year: N/A
• Geographical Area: Countries involve in the project (Japan, Australia, USA etc)

TUG (Technical University of Graz, Austria) 1995
• Source of funding: Legal expert witness cases with accident reconstruction
• Number of cases per year: 150
• Geographical Area: Austria

VALT (Finland) 1972
• Source of funding: Finnish insurance companies and government
• Number of cases per year: 450
• Geographical Area: Finland
EXAMPLES OF CRASH INVESTIGATION IN THE EU

In Depth Level

GIDAS (German In Depth Accident Study, Germany) 1999
- Source of funding: German government (Hannover), German car industry (Dresden)
- Number of cases per year: 2000
- Geographical Area: Hannover & Dresden

MAIDS (Motorcycle In depth Accident Study) 1998
- Source of funding: ACEM (Motorcycle industry in Europe)
- Number of cases per year: 500
- Geographical Area: Netherlands, Spain, Germany, Italy, France

OTS (On The Spot Study, UK) 2000
- Source of funding: UK Department of Transport
- Number of cases per year: 500
- Geographical Area: UK

EACS (European Accident Causation Study) 1997
- Source of funding: Car industry through ACEA with EU support
- Number of cases per year: 450
- Geographical Area: Several European countries
CRASH RECONSTRUCTION UNIT

Director General

- Road User Behavioral Change Research Centre
- Vehicle Safety and Biomechanics Research Centre
- Road Safety Engineering and Environment Research Centre
- Administration and Finances Division
- Publications and Knowledge Management Division

Crash Reconstruction Unit
1. ACCESS AND DISCLOSURE OF DATA
2. EXAMINATION OF PHYSICAL ENTITIES
3. COLLECTION OF SAMPLE
4. REPRESENTATION IN CIVIL PROCEEDING
5. RETENTION OF DATA
MIROS CRASH INVESTIGATION

- Cases Attended: More than 800 cases
- Geographical Area: Malaysia
- Fund: Ministry of Transport
- Strength:
  - 6 Mechanical Engineers,
  - 1 Biomechanical Engineer,
  - 1 Forensic Scientist
  - 1 Material Engineer
  - 5 Support Staffs
  - 3 Drivers

Number of Investigated Crashes by Year

![Bar chart showing the number of investigated crashes by year from 2007 to 2014. The number of crashes ranges from 64 in 2007 to 186 in 2013.](image_url)
INVESTIGATED CASES

Number of Investigated Cases

<table>
<thead>
<tr>
<th>Year</th>
<th>Operation</th>
<th>Project Based</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>64</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>0</td>
<td>170</td>
</tr>
<tr>
<td>2009</td>
<td>106</td>
<td>0</td>
</tr>
<tr>
<td>2010</td>
<td>98</td>
<td>0</td>
</tr>
<tr>
<td>2011</td>
<td>68</td>
<td>74</td>
</tr>
<tr>
<td>2012</td>
<td>44</td>
<td>82</td>
</tr>
<tr>
<td>2013</td>
<td>56</td>
<td>94</td>
</tr>
<tr>
<td>2014</td>
<td>130</td>
<td>0</td>
</tr>
</tbody>
</table>

Total Numbers of Casualties

<table>
<thead>
<tr>
<th>Year</th>
<th>Fatal</th>
<th>Severe</th>
<th>Slight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>195</td>
<td>248</td>
<td>284</td>
</tr>
<tr>
<td>2008</td>
<td>10204</td>
<td>156</td>
<td>157</td>
</tr>
<tr>
<td>2009</td>
<td>300</td>
<td>248</td>
<td>284</td>
</tr>
<tr>
<td>2010</td>
<td>284</td>
<td>300</td>
<td>284</td>
</tr>
<tr>
<td>2011</td>
<td>133</td>
<td>164</td>
<td>300</td>
</tr>
<tr>
<td>2012</td>
<td>75</td>
<td>300</td>
<td>284</td>
</tr>
<tr>
<td>2013</td>
<td>80</td>
<td>110</td>
<td>114</td>
</tr>
<tr>
<td>2014</td>
<td>57</td>
<td>38</td>
<td>97</td>
</tr>
</tbody>
</table>

Proportion of Vehicles Involved

- Car
- Trailer/Lorry
- Bus
- 4WD
- Van
- Motorcycle
- MPV/SUV
- Road Furniture
- Pedestrian
INVESTIGATION CRITERIA

National Inquiry by Ministry
- Cases which come to the interest of ministry
- Usually involve high number of fatalities
- Report to minister for cabinet decision for potential new policies/regulations

Non Inquiry
- Cases which involve 3 fatalities & above
- Cases with 1 fatality involving commercial vehicles
- Focus issues related to MIROS current & future research

Special Interest
- Cases involving special interest (ambulance, fire, government vehicles)

Project Based
- Crashes involving motorcycles
- Road crashes during festive season (focused enforcement)
- Crashes involving passenger cars (hospital based localized investigation)
STANDARD OPERATING PROCEDURE

Crash Notification → Team Preparation → Site & Vehicle Data Collection → Analysis & Report Writing
NOTIFICATION

• Nationwide Catchment Area
• Based from Media Portal, Special Request etc.
NOTIFICATION PROCESS FLOW

- Case selection
- Clearance from respective Police Station
- Obtain Preliminary Information
- Documentation Preparation and Open Case
PREPARATION

Man power
Normally 2 personnel and 1 driver
Rotational Basis
Inquiry case may involve more

PPE
Safety Vest
Safety Shoes
Proper Attire

Tool And Equipment
Measurement Tools
Photography Equipment
UAV (Drones)

Logistics
3 vehicles equipped with safety beacons
Equipment And Tools

Measurement

Photography
Unmanned Aerial Vehicle (UAV)

- Accessibility
  - Traffic, ravine
- Top view
  - Thorough surveillance & analysis
DATA COLLECTION

Primary

Road Profiles
- Road Design and Environment
- Road Geometry
- Road Site Evidence

Vehicle Details
- Damage Profiles
- Restraint Wearing Evidence
- Internal Contacts

Occupant
- Internal collision
- Injury mechanism

Secondary

Reports from relevant agencies/authorities
Data Collection Forms

6 investigation forms – Developed in reference to Birmingham, Adelaide & GIDAS

Crash Investigation and Reconstruction Database (CIRD) – approx. 1000 fields
RECAP....

- What are the 4 processes in Crash Investigations SOP?
- Primary data is divided into 3 elements which are?
- Name 4 equipment used in crash investigations?
Vehicle Damage

Collision Damage Classification (CDC)=01FYAW6
Photography

8 angles of view of a vehicle
VIN and chassis number
BDM, BTM and BG
Company information
Tires
Car front hood’s interior
Seatbelt
Deployed airbag
Helmet (motorcycle)

8-point-view photographs

Note: Checklist of items could be more depending on the interest of each particular case i.e bus’s roof pillar, trailer’s under run bar etc
Story Telling Photos

- Very Far-Ranged View
- Far-Ranged View
- Medium-Ranged View
- Close-up View
- Extreme Close-up View
Crucial Vehicle Structure

Beam connecting longitudinal = transverse beam
longitudinal
outboard overhang of beam connecting longitudinals
beam connecting longitudinals
crush can
Damage Profiles

Crush Measurement (C1 – C6)

Crush Energy Calculation

Direct damage only

Delta-V
Collision Deformation Classification (CDC)

12FDEW2

is a 7 digit alpha numeric code used to classify any and all crash impact damage in a systematic fashion. It was created and is maintained by the Society of Automotive Engineers SAE and is used globally by all in the automotive safety industry.
CDC Coding

Direction of impact

General location of damage

Specific horizontal area

Specific vertical area

Damage pattern

Damage extent

As experienced by the vehicle
Split into 12 equal 30° sections
Coded as a clock face
Vehicle Details

Large tear mark might indicates that the tire was rolling - generally having high heat built-up pressure built-up. The burst created fatigue enhanced when the tire skidded along the road.

Frontal Right

Frontal Left

Indication that side wall skidded along the road due to sudden loss of pressure and undertaking the momentum/road from the bus.

Rear Left Outer

Minimum width for gangways 968mm in approval drawing. Standing requirement 657mm.

Moving-off element

Gearbox

Engine

Condition

Primary Type

Secondary In line Type

Secondary Out line Type
Vehicle Details

Frontal Left Upper

Minimum condition

Frontal Left Lower

Exceeded limit (contacted rivet)
Restraint Wearing
Road (Design And Environment)
Road (Geometry)
Aerial View (UAV)
Physical Evidences

Skid marks

Yaw marks

Rut marks

Tire Imprint

Debris - POI
# Characteristics of Tire Marks

<table>
<thead>
<tr>
<th></th>
<th>SKIDMARK</th>
<th>YAWMARK</th>
<th>ACCELERATION STUFF</th>
<th>FLAT TIRE MARK</th>
<th>IMPRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WHEEL MOTION</strong></td>
<td>Slide, little or no roll</td>
<td>Rolling and sideslip</td>
<td>Powered wheels spin and slip</td>
<td>Rolling, no slip</td>
<td>Rolling, no slip</td>
</tr>
<tr>
<td><strong>OPERATION</strong></td>
<td>Braking</td>
<td>Steering</td>
<td>Speeding up</td>
<td>Rolling</td>
<td>None</td>
</tr>
<tr>
<td><strong>NUMBER FROM 4-TIERED VEH</strong></td>
<td>Mostly 2 or 4, also 1 or 3</td>
<td>1 to 4, usually 2 or 3</td>
<td>Usually 1 sometimes 2</td>
<td>Only 1 rarely 2</td>
<td>1 to 4</td>
</tr>
<tr>
<td><strong>RIGHT AND LEFT TIRES</strong></td>
<td>Equally strong</td>
<td>1 or 2 stronger</td>
<td>Equal if two</td>
<td>Usually 1, Rarely two</td>
<td>Any number</td>
</tr>
<tr>
<td><strong>FRONT AND REAR TIRES</strong></td>
<td>Front stronger</td>
<td>Dependent on weight distribution &amp; transfer</td>
<td>Only powered wheels</td>
<td>Either</td>
<td>Equally clear</td>
</tr>
<tr>
<td><strong>WIDTH</strong></td>
<td>If straight, same as tire</td>
<td>Varies from an inch to a foot</td>
<td>If straight same as tire</td>
<td>Tire tread edge and lighter side wall marks</td>
<td>Same as tire</td>
</tr>
<tr>
<td><strong>BEGINNING</strong></td>
<td>Faint</td>
<td>Always faint</td>
<td>Abrupt if from stop</td>
<td>Faint</td>
<td>Strong</td>
</tr>
<tr>
<td><strong>END</strong></td>
<td>Usually abrupt</td>
<td>Strong if at rest</td>
<td>Very gradual</td>
<td>No characteristic end</td>
<td>No characteristic end</td>
</tr>
<tr>
<td><strong>STRIATIONS</strong></td>
<td>Parallel with mark if straight</td>
<td>Always oblique or crosswise</td>
<td>Parallel to mark on a straight mark</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td><strong>OTHER DETAILS</strong></td>
<td>Outer edges maybe stronger</td>
<td>Curved May cross each other in a spin</td>
<td>Outer edges maybe stronger</td>
<td>Outer edges stronger</td>
<td>Tread design usually is apparent Maybe intermittent</td>
</tr>
<tr>
<td><strong>LENGTH (usually)</strong></td>
<td>1 to 500 feet</td>
<td>10 to 200 feet</td>
<td>0.5 to 50 feet</td>
<td>50 feet to 10 miles</td>
<td>Any length</td>
</tr>
</tbody>
</table>
RECAP....

- Name 1 of the different characteristics between skid marks and yaw marks?
- How many columns are there in CDC Coding?
- What is the degree of interval between the 12 sections in PDoF?
RECAP....
DATA ANALYSIS

- Collision Reconstruction and Kinematic Analysis
- Speed Analysis
- Occupant Injury Mechanism
- Material Analysis
On-site Investigation

- Obtaining important and reliable information on road crash
- Correctly interpret physical evidence:

  Approve/ disapprove theory of crash
  Guide direction for further investigation
Impacts
Matching of Vehicle Damages & Site Evidences
Collision Reconstruction & Kinematics Analysis

- Scientific process - Analyzing and rebuilding
- Physics law and engineering principal - conservation of linear momentum and energy
  - Kinematic of impacts - action of force in producing/changing motion of masses.
  - Qualitative dynamics - how vehicle impacted and came to rest
Kinematics Analysis
Speed Analysis

- Estimated speed - based on information gathered during on-site and vehicle inspection.
- Physics law and engineering principal is applied
- Important to answer:
  - Violation of speed limit
  - Driver trip management
- Determining impact speed:
  - Risk of injury severity
  - Probability of fatality
Delta-v

Law of conservation of momentum states that the sum of ‘velocity times mass’ terms remain constant i.e. before and after impact.

\[ m_1 v_1 + m_2 v_2 = m_1 v_f + m_2 v_f \]

Rearranging to get;

- Vehicle 1 delta-V = \( v_f - v_1 \)
- Vehicle 2 delta-V = \( v_f - v_2 \)

Is the difference between a vehicle’s immediate pre-impact and post-impact velocities.

\[ \text{Delta-V} = v_f - v_i \]

Delta-V is a vector, a quantity with both magnitude and direction.

All vehicles are assumed to reach a common post-impact velocity with their collision partner(s).
# Impact Speeds & Energy

## Configuration Details

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Direction 0.00 deg</th>
<th>Direction -10.00 deg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>150.00 deg</td>
<td>20.00 deg</td>
</tr>
<tr>
<td>Entry angle</td>
<td>150.00 deg</td>
<td></td>
</tr>
</tbody>
</table>

### Pre Impact Speeds (by damage)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Isawa (Long)</th>
<th>N/A</th>
<th>Isawa (Lat)</th>
<th>N/A</th>
<th>Wis (Long)</th>
<th>N/A</th>
<th>Wis (Lat)</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N/A</td>
<td></td>
<td>N/A</td>
<td></td>
<td>N/A</td>
<td></td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

### Predicted Side Slip

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted sideslip 1</td>
<td>N/A</td>
</tr>
<tr>
<td>Predicted sideslip 2</td>
<td>N/A</td>
</tr>
</tbody>
</table>

## Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Isawa</th>
<th>Wis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delta V (Total)</td>
<td>46.73</td>
<td>46.73</td>
</tr>
<tr>
<td>Delta V (Longitudinal)</td>
<td>-48.98</td>
<td>-43.97</td>
</tr>
<tr>
<td>Delta V (Lateral)</td>
<td>0.13</td>
<td>-76</td>
</tr>
<tr>
<td>Angular Vel. Change</td>
<td>-129.85</td>
<td>64.5</td>
</tr>
<tr>
<td>Energy Dissipated (J)</td>
<td>88372</td>
<td>114937</td>
</tr>
<tr>
<td>Magnitude of Force (N)</td>
<td>2147589</td>
<td>319459</td>
</tr>
<tr>
<td>Force direction</td>
<td>-10</td>
<td>20 deg</td>
</tr>
</tbody>
</table>

### Pre Impact motion

<table>
<thead>
<tr>
<th>Component</th>
<th>Isawa</th>
<th>Wis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Longitudinal</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lateral</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sideslip</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Pre Impact motion by moment

<table>
<thead>
<tr>
<th>Component</th>
<th>Isawa</th>
<th>Wis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Longitudinal</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lateral</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sideslip</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Speed Calculation

Utilizing kinematics equations:

\[ v_1 = v_0 + a \cdot t \]  \hspace{1cm} (Eq. 1)

\[ v_1 = v_0^2 + 2 \cdot a \cdot s \]  \hspace{1cm} (Eq. 2)

In which \( a = f \cdot g \),

\( v_1 \) is the final velocity, \( v_0 \) is the initial velocity,
\( a \) is the acceleration, \( s \) is the distance travelled
\( f \) is the drag factor, \( g \) is gravity acceleration.
\( t \) is the duration of velocity changes from \( v_0 \) to \( v_1 \),

Minimum Travelling Speed = Speed that a vehicle had to travel, at the very least, to leave that type of brake marks.
Calculation Method

Based on vehicle damage intrusion
Crush energy – Delta V

Based on length of brake marks (kinematics approach)
\[ S = 15.9 \sqrt{(f+e)(R)} \]

where \( f \) is drag factor and \( e \) is super elevation

Other factors to be considered:

\[ R = \frac{C^2}{8M} + \frac{M}{2} \]

\[ R = \frac{80 \times 80}{8 \times 9} + \frac{9}{2} \]

\[ R = \frac{6400}{72} + \frac{9}{2} \]

\[ R = 88.88 + 4.5 \]

\[ R = 93.38 \]

\[ R = 93\frac{3}{4} \]
Minimum Speed to Rollover

- When centrifugal force \( \frac{mv^2}{(gR) \tan \theta} \) > potential energy \( (mg) \), the bus will start to roll.
- The bus tipped on its side when kinetic energy \( (KE = \frac{1}{2} mv^2) \) > potential energy \( (PE = mg\Delta h) \).
- Assumptions:
  - Radius of the curve, \( R \)
  - Angle between height of CG and horizontal position of CG, \( \theta = \) Angle
- Thus, the maximum speed for the bus to negotiate the curve without rollover is 88.29 km/h.

<table>
<thead>
<tr>
<th>Angle (°)</th>
<th>Estimated Speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>165.71371</td>
</tr>
<tr>
<td>7</td>
<td>142.1341821</td>
</tr>
<tr>
<td>8</td>
<td>124.4622655</td>
</tr>
<tr>
<td>9</td>
<td>110.7287927</td>
</tr>
<tr>
<td>10</td>
<td>99.75226736</td>
</tr>
<tr>
<td>11</td>
<td>90.78083248</td>
</tr>
</tbody>
</table>
Other Data Analysis: Seatbelt Wearing

Zone of deformation extent

<table>
<thead>
<tr>
<th>Status</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unbelted</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Belted</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

Frontal impact

Status A
- Unbelted: 2, 4
- Belted: 3, 7

Status B
- Unbelted: 2, 4
- Belted: 3, 7

Transition point A

Transition point B
Technical Reports

Kuala Kangsar Crash Investigation
KM 254 North-South Expressway (PLUS)

Abdul Rahmat Abdul Manap
Zainudin Jaafar
Tung Kee Sheng
Dr. Wong Siew Yuen
Muhammad Husamm bin Hamidebullah
Prof. Dr. Radin Umar Radin Saluddin

Bukit Gantang Crash Investigation
KM 229 North-South Expressway (PLUS)

Abdul Rahmat Abdul Manap
Ahmad Hafiz Azri
Mohd. Khairuddin Rahman
Mohd. Haji Md. Ismail
Zainudin Jaafar
Mohd. Saleem Saluddin
Prof. Dr. Radin Umar Radin Saluddin

Jelapang Crash Investigation
North-South Expressway (PLUS) Toll Plaza

Associate Professor Dr. Wong Siew Yuen
Crash Team Members:
Mohd. Haji Ismail
Zainudin Jaafar
Mohd. Saleem Saluddin
Ahmad Hafiz Azri
Ahmad Noor Syukri Zainal Abidin


Genting Highlands Crash Investigation
KM 3.6 Genting Highlands–Kuala Lumpur Road

Yong Siew Yuen
Mohd. Haji Ismail
Zainudin Jaafar
Mohd. Saleem Saluddin
Ahmad Hafiz Azri
Ahmad Noor Syukri Zainal Abidin

MRR 05/2012

Research Report
MIROS Crash Investigation and Reconstruction

Ahmad Haji Ismail
Ahmad Noor Syukri Zainal Abidin
Mohd. Haji Md. Ismail
Mohd. Saleem Saluddin
Ahmad Haji Azri

MRR 05/2012

MALAYSIAN INSTITUTE OF ROAD SAFETY RESEARCH
NATIONAL POLICIES & PROCEDURES

**UNECE International Regulations**
- UNR 66 – Strength of superstructure for large passenger vehicles
- UNR 80 – Seat anchorage for large passenger vehicles

**Upgrading of Barrier System**
- Upgrade guardrails from TL 2 to TL 3-TL 6

**SHE Code of Practice**
- Safety Health & Environment Code of Practice for Commercial Vehicles

**Rear Seatbelt Policy**
- Policy enforced on 1st January 2009
### Other Countermeasures and Actions from Recommendations

<table>
<thead>
<tr>
<th>Countermeasures</th>
<th>Year</th>
<th>Action</th>
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<tr>
<td>1. Relocation of Jelapang Toll Plaza</td>
<td>2007</td>
<td>PLUS</td>
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<td>2. Improvement of Road Signage involving Emergency Escape Ramp at Jelapang Toll Plaza</td>
<td>2007</td>
<td>PLUS</td>
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<td>3. Removal of Jati trees along North-South Expressway (PLUS)</td>
<td>2008</td>
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<td>5. Upgrading of Barrier System along Spg Pulai-Cameron Highlands Road</td>
<td>2012</td>
<td>PWD</td>
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<td>6. Upgrading of Barrier System along Genting Highlands Road</td>
<td>2014</td>
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<td>7. Improvement of Speed Management System along Genting Highlands Road</td>
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<td>8. Improvement of Road Signage involving Emergency Escape Ramp at Jelapang Toll Plaza</td>
<td>2014</td>
<td>GENM</td>
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<td>10. Establishment of Malaysia Transport Safety Board</td>
<td>2014</td>
<td>MOT</td>
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THANK YOU

ansyukri@miros.gov.my

cru@miros.gov.my