PROCEEDINGS

2\textsuperscript{nd} International Conference on Sustainable Technology Development (ICSTD)

“Developing Sustainable Technology for A Better Future”

Bali, October 31\textsuperscript{st} 2012

UDAYANA UNIVERSITY PRESS
2012
CIVIL ENGINEERING

C 01 Studies on Transport-Modes in the Region of Southern Bali
I Wayan Suripto, Achmad Wirakusumo, Indranjaya D. Mertawar 
C 02 Characteristics of Sand Sheet Asphalt Mixture Utilizing Waste Aggregates
I Wayan, Arie HbHAYA, Pani Purnawana WINAYA, Pani Anggi NAEKIWAT \nC 10 The Effect Of Rainfall Characteristic Change For The Result Of Global Climate Change And The Impact To Flood Problem
I Gons Regri Sia Dikuan, I Putu Gunawan Suryawana Parthana 
C 13 Islamic Bank Participation in Indonesia Infrastructure Provision
Apsara Dhu Rosania, Leey Tzu, Rambo, Tigor Oppughy, Feroz Chining 
C 14 Identification of Factors of Road Safety Problems in Indonesia and Recommended Solutions to Improve Road Safety
Achmad Sudjana, En Qusar Surahman SUKBISTI 
C 15 Concrete Wall Panel From Styrofoam Waste with Woven Fabric Reinforcement
Andi Panuttya Wibawa 
C 15 Numerical Modeling of Reinforced Concrete Beams Repaired with Polymer-Modified Mortars
Luhul M. Matalaka, Fanonwa du Porto 
C 16 The addition of Copra Oil and Sand to the Soil of Bali Village Traditional Houses Increases the Residents’ Safety Amusing from Earthquake Load
I Wayan Suripto 
C 17 Geometry Non-Linearity and Performance Based Design Procedure for pavements in a Developing Country (Indonesia)
G.A. Siregar, F. Mandal, & T. Swales 
C 18 RESTRUCTURING PUBLIC TRANSPORT NETWORK FOR KENDANG STATION IN DENPASAR CITY
Puta Ali Sudharmay, Ratu Pudjawati 
C 19 RECLAMATION ENVIRONMENT VISION AS AN ALTERNATIVE DEVELOPMENT FOR PORT FACILITY: Literature Review Case application
I Wayan Bakers K R 

A 63 STAGE HOUSE: AS GORONTALO'S VERMULAR ARCHITECTURE
Indra Putra Ashkri, Wultra Sembila Shara 
A 64 Introduction to Javanese Architecture, Java’s Forgotten Little China
Le Princ Chontrai 

PROCEEDINGS

2nd International Conference on Sustainable Technology Development

"Developing Sustainable Technology for A Better Future"

Bali, October 31st, 2012

Scientific Committee:

Prof. I Wayan Radawa (Udayana University, Indonesia)
Prof. Sayegh (President of World Renewable Energy)
Prof. Dan Kao Chor (Chonbuk National University, South Korea)
Prof. Budhina Indrananda (University of Wollongong, Australia)
Prof. Jae Kyun Lim (Chonbuk National University, South Korea)
Prof. Ruizhao (University of Science and Technology, China)
Prof. Mustafa Dewidar (South Valley University, Egypt)
Prof. Alexander Cuthbert (University of New South Wales, Australia)
Prof. Tjak Gd. Tita Nourida (Udayana University, Indonesia)
Prof. I Made Ali Karyawasa S. (Udayana University, Indonesia)
Prof. L.A. Karunata (Udayana University, Indonesia)
Dr. Vu Cong Hau (Ho Chi Minh City University of Technology, Vietnam)
Dr. G A M. Sanwile (Udayana University, Indonesia)
Dr. W Gede Arista (Udayana University, Indonesia)
Dr. D.M. Priyanta W. (Udayana University, Indonesia)
Dr. I K G. Dharmendra Pratama (Udayana University, Indonesia)

Published by: Udayana University Press
Kampus Universitas Udayana Denpasar

Identification of Factors of Road Safety Problems in Indonesia and Recommended Solutions to Improve Road Safety

A. Caroline SUTANDI\textsuperscript{a}, Efraim Mtimanta SURBAKTI\textsuperscript{b}

\textsuperscript{a}Civil Engineering Department
Faculty of Engineering
Parahyangan Catholic University
Ciumbuleit 94 Bandung 40141
Indonesia
Fax: +62 22 233692
Email: caroline@unpar.ac.id

\textsuperscript{b}Civil Engineering Department
Faculty of Engineering
Parahyangan Catholic University
Ciumbuleit 94 Bandung 40141
Indonesia

Abstract: Road safety is a large problem around the world. Indonesia is also experience road safety crisis. The road crashes in Indonesia cause over 40,000 people die on the road each year. Without serious effort and real action implemented, the number will increase rapidly. Therefore, a study of road safety in Indonesia is crucial. The aim of this study is to identify more detail regarding road safety problems in Indonesia and then provide recommended solutions to improve the road safety. Case study is carried out on Purbaleunyi Toll Road in West Java, Indonesia. Descriptive analysis is used in this study. Results indicated that road safety problems cause by 74.74\% human error, 22.16\% vehicle, 2.177\% road geometric, and 75.36\% at clear weather. Recommended solutions provided are dissemination of the importance of road safety to road users, vehicle worthiness, complete implementation of road furniture, regular road audit, and implementation of ITS.

Key Words: identification, road safety problems, recommended solutions.

1. INTRODUCTION

Indonesia is experiencing a serious road safety problem, wherein 40,000 people die on road crashes each year. The number will increase rapidly if there is no serious effort and real action implemented. The condition might worse because of rapid increase of vehicle number, population number, and economic rate every year. Furthermore, there is poor recorded of accident occurrence and road condition that cause the accident rate is lower than the real condition. Whereas, road safety problems have large impact to economic. Asian Development Bank has estimated that road crashes cost in Indonesia is approximately 2.8 percent of GDP annually (IndII, 2010).

The aim of this study is to identify more detail regarding road safety problems in Indonesia and then provide recommended solutions to improve the road safety. Case study is carried out on Purbaleunyi Toll Road in West Java, Indonesia, wherein road accident data is well recorded. Descriptive analysis is used in this study. Results in this study are not only beneficial to toll roads in Indonesia but also to other road function in Indonesia and in other countries that have similar road condition.

2. ROAD SAFETY PROBLEMS

Principle of Road Safety
Transportation system is designed to facilitate movement of people and goods. Transportation service is closely related to safety aspect for people and goods. With guaranteed aspect of safety transport, right of transport users is protected and there is no unpredictable cost that inflicts the society (MTI, 2007). Act of Republic of Indonesia number 38 year 2004 regarding Road said that road safety is about road surface condition and road geometric condition and Act of Republic of Indonesia number 22 year 2009 regarding Traffic and Road Transportation said that traffic and road transportation safety is a condition wherein every person is escape from accident risk while traveling.

Road safety problem consists of three elements: the human, the vehicle and the road (IndII, 2010). An accident is an unexpected and unintentionally incident on the road involving vehicle with or without other road users that cause casualty or property damage only. Whereas, a crash is an impact cause human or animal wounded. High effort should be done to reduce number and rate of cause of accident and crash (IndII, 2010; MTI, 2007).

**Road Safety the Global Issue**
Road crashes are a major global health problem. They kill more than 1.3 million people worldwide each year. Another fifty million people are injured, many so badly they will never work again. Furthermore, ninety percent of the deaths are in low and middle income countries like Indonesia (Jordan, Phillip, 2011; IndII, 2010). This is only the formal record. Police record usually has the accident report that has a lower number than the real one.

**Road Safety in Indonesia**
Indonesia is experiencing a serious road safety problem. Data indicated that 40,000 people die on road crashes each year. Among Asean countries, Indonesia is only at the seventh below Singapore, Brunei Darussalam, Myanmar, Vietnam, Malaysia, and Cambodia in the effort to design safer road. As occur in many developing countries, function of management of road safer institution in Indonesia is not well developed. Whereas Act of Republic of Indonesia number 22 year 2009 regarding Traffic and Road Transportation determine the responsibility of government regarding safer road in Indonesia.

Another serious problem is poor investigation to determine blackspot location. A blackspot is a location on the road that has a high number of crashes. It might be at an intersection or on a curve road of highway. It is known for its crash frequency and usually also for its crash severity. In order to determine blackspot locations, support of accurate database is required. While it is still difficult to obtain accurate, up to date and complete number of traffic accident (Jordan, Phillip, 2011; IndII, 2010; MTI, 2007; Proctor, Steve, et al. 2003; Silcock, Ross, 1991).

**3. PURBALEUNYI TOLL ROAD, WEST JAVA, INDONESIA**
Purbaleunyi (Purwakarta-Bandung-Cileunyi) toll road has 123 km long. The toll road is one of 13 toll roads in Indonesia. It makes travel time between Jakarta, the Capital City of Indonesia and Bandung the Capital City of West Java is only one and a half hours if there is no traffic congestion. Figure 1 describe map of Purbaleunyi toll road. In more detail, Purbaleunyi toll road is two-way road with four lanes with eleven toll gates and five bridges, i.e. Ciujung Bridge, Cisomang Bridge, Cikubang Bridge, Cipada Bridge, and Cimeta Bridge.
4. DATA COLLECTION

Data of Purbaleunyi toll road in 2010 and 2011 was obtained from Purbaleunyi Toll Road Division, PT. Jasa Marga (Persero), West Java Province and Police of West Java Province, Indonesia. Data collection per km long during 2010 and 2011 consist of geometric toll road data, accident numbers, accident causes, accident locations, accident date, accident weather, and accident type. Summary data regarding road accident on Purbaleunyi toll road is presented in Table 1 and blackspot area that has been determined earlier using UCL method (Surbakti, E.M., 2012; Gosalim, W., 2012) of Purbaleunyi toll road is presented in Table 2.

5. METHOD AND ANALYSIS

Descriptive method is used in this study, and analysis is carried out using data in Table 1 at blackspot area in Table 2 that has been determined earlier. It is indicated that road crashes increase 4% but people involved decrease 10% on ten corridors. In average, casualties consist of 60.4% light injuries, 32.1% heavy injuries, and 7.5% fatality. Among ten corridors, most crashes occurred on Jatiluhur-Padalarang Barat Corridor i.e. 43.79%, therefore Jatiluhur-Padalarang Barat Corridor has the highest number of blackspots. Most accident occurred are a single accident (42.75%) because of human error (74.74%), vehicle (22.16%), road geometric (2.17%) and at clear weather (75.36%). Based on accident type, the most accidents are accident on straight road (83.78%) on dry road surface (84.42%). Based on accident location, most road crashes occurred on the left lane (45.63%), on the right lane (24.98%), and on shoulder (15.97%) respectively.
Table 1. Detail data regarding road accident on Purbaleunyi toll road (PT Jasa Marga, 2010, 2011)

<table>
<thead>
<tr>
<th>Accident Data Information</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of road crashes</td>
<td>295</td>
<td>307</td>
</tr>
<tr>
<td>Number of people involved</td>
<td>636</td>
<td>573</td>
</tr>
<tr>
<td>Number of corridors</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Light injuries</td>
<td>64.15%</td>
<td>56.70%</td>
</tr>
<tr>
<td>Heavy injuries</td>
<td>29.72%</td>
<td>34.43%</td>
</tr>
<tr>
<td>Fatality</td>
<td>6.13%</td>
<td>8.87%</td>
</tr>
<tr>
<td>Number of road crashes on Jatiluhur-Padalarang Barat</td>
<td>46.67%</td>
<td>40.91%</td>
</tr>
<tr>
<td>Number of road crashes on other nine corridors</td>
<td>55.33%</td>
<td>59.09%</td>
</tr>
<tr>
<td>Single accident</td>
<td>43.50%</td>
<td>42.00%</td>
</tr>
<tr>
<td>Multiple accident</td>
<td>56.50%</td>
<td>58.00%</td>
</tr>
<tr>
<td>Human error (not alert, sleepy, drunk, poor discipline)</td>
<td>70.37%</td>
<td>79.11%</td>
</tr>
<tr>
<td>Vehicle (flat tire, broken brake, broken machine)</td>
<td>24.69%</td>
<td>19.63%</td>
</tr>
<tr>
<td>Road merging</td>
<td>3.70%</td>
<td>0.63%</td>
</tr>
<tr>
<td>Exhaust fumes</td>
<td>0.61%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Stopped car</td>
<td>0.62%</td>
<td>0.63%</td>
</tr>
<tr>
<td>Clear weather</td>
<td>70.98%</td>
<td>79.74%</td>
</tr>
<tr>
<td>Other weather</td>
<td>29.02%</td>
<td>20.26%</td>
</tr>
<tr>
<td>Accident on straight road</td>
<td>80.86%</td>
<td>86.69%</td>
</tr>
<tr>
<td>Accident on turning road</td>
<td>19.14%</td>
<td>13.31%</td>
</tr>
<tr>
<td>Accident on dry road surface</td>
<td>80.86%</td>
<td>87.97%</td>
</tr>
<tr>
<td>Accident on wet road surface</td>
<td>19.14%</td>
<td>12.03%</td>
</tr>
<tr>
<td>Road crashes on shoulder</td>
<td>13.58%</td>
<td>18.35%</td>
</tr>
<tr>
<td>Road crashes on left lane</td>
<td>47.53%</td>
<td>43.67%</td>
</tr>
<tr>
<td>Road crashes on right lane</td>
<td>26.54%</td>
<td>23.41%</td>
</tr>
<tr>
<td>Road crashes on toll gate</td>
<td>1.85%</td>
<td>1.89%</td>
</tr>
<tr>
<td>Road crashes on interchange</td>
<td>1.23%</td>
<td>0.63%</td>
</tr>
<tr>
<td>Road crashes on ramp</td>
<td>0.02%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Road crashes at median</td>
<td>0.61%</td>
<td>1.26%</td>
</tr>
<tr>
<td>Road crashes on ROW</td>
<td>8.64%</td>
<td>7.59%</td>
</tr>
</tbody>
</table>
Table 2. Blackspot area of Purbaleunyi toll road (Surbakti, 2012)

<table>
<thead>
<tr>
<th>Corridor on Purbaleunyi toll road</th>
<th>Number of Blackspot area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
</tr>
<tr>
<td>Kalihurip – Sadang</td>
<td>1</td>
</tr>
<tr>
<td>Sadang – Jatiluhur</td>
<td>4</td>
</tr>
<tr>
<td>Jatiluhur – Padalarang Barat</td>
<td>14</td>
</tr>
<tr>
<td>Padalarang Barat – Padalarang</td>
<td>1</td>
</tr>
<tr>
<td>Padalarang – Pasteur</td>
<td>3</td>
</tr>
<tr>
<td>Pasteur – Pasirkoja</td>
<td>0</td>
</tr>
<tr>
<td>Pasirkoja – Kopo</td>
<td>1</td>
</tr>
<tr>
<td>Kopo – Moh. Toha</td>
<td>2</td>
</tr>
<tr>
<td>Moh. Toha – Buah Batu</td>
<td>1</td>
</tr>
<tr>
<td>Buah Batu – Cileunyi</td>
<td>3</td>
</tr>
</tbody>
</table>

In conclusion, it can be analyzed that although number of road crashes increase but people involved decrease, actually, the number of road crashes per year are still high with light injuries as the most casualties. Based on data, single accident is the highest accident occurred. This type of accident can be caused by driver skill, driver behavior, driver health condition, and vehicle condition. Based on the location, most accident occurred on straight road and more detail on the left lane, right lane, and shoulder. It can be happened because the case study is toll road that usually has straight road and also has enough shoulder width, so that drivers who do not adhere to the traffic regulation, overtake other vehicles through the shoulder.

Although based on data, it is indicated that the highest cause of road accident is human error, but actually interaction among human, vehicle, and road is strong. Furthermore, based on analyzes earlier, solutions that can be recommended and can be applied in the field in order to reduce road safety problems are as follow:

- Earlier dissemination through education at kindergarten and primary school regarding the importance of road safety for road users is very beneficial;
- Regulation regarding vehicle worthiness has to be obeyed;
- For toll road that has to have minimum service standard for road infrastructure physically, road furniture has also to be implemented along the road to inform road users regarding road and environment conditions;
- Regularly road safety audit by road authority. Furthermore, the most important thing is to follow up any result reported from the road safety audit in order to reduce not only number but also rate of accident.

Moreover, solution that can be recommended is using Advanced Traffic Management Systems (ATMS) such as Incident Management and Advanced Traffic Information Systems (ATIS) such as Variable Message Signs (VMS) as a part of Intelligent Transportation Systems (ITS). In order to have maximum benefit of Incident Management and VMS for road users, support and availability of data collection tools in the field, management of accurate, complete, up to date, and continuous accident database and good control from Traffic Management Centre are required (PATH, ITS, 2011; Batarliene, Nijole, 2009; Sutandi, 2008;
6. CONCLUSIONS

This study identifies more detail regarding road safety problems in Indonesia and then provides recommended solutions to improve the road safety. Case study is carried out on Purbaleunyi Toll Road in West Java, Indonesia. Descriptive analysis is used in this study. Results indicated that road safety problems cause by 74.74% human error, 22.16% vehicle, 2.17% road geometric, and 75.36% at clear weather. Recommended solutions provided are dissemination of the importance of road safety to road users, vehicle worthiness, complete implementation of road furniture, regular road audit, and implementation of Incident Management and Variable Message Signs (VMS) as a part of Intelligent Transportation Systems (ITS). Results in this study are not only beneficial to toll roads in Indonesia but also to other road function in Indonesia and in other countries that have similar road condition.

REFERENCES


ITS (2001) Short Course of Intelligent Transportation Systems, The University of Queensland, Brisbane, Australia.

Jordan, Phillip (2011) Engineers Learn How to make Indonesia’s Roads Safer, Prakarsa Compendium, Indonesia Infrastructure Initiative (IndII), E-Trade Building, 7th Floor, jl. KH Wahid Hasyim no. 55 Menteng, Jakarta Pusat 10310.


