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DETERMINING THE TRAFFIC SAFETY MANAGEMENT CRITERIA IN HIGHWAY MAINTENANCE WORKS FROM ROAD USERS' PERSPECTIVE

Suhaila Ali^a and Nur 'Ain Ismail^b

Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA (Perak), Malaysia
^asuhail110@perak.uitm.edu.my, ^bnurai948@perak.uitm.edu.my

Abstract

Road traffic injuries are a major public health problem and a leading cause of death, injury and disability around the world. Better plans, transparent process, and public support are some of the benefits that road managers can obtain by educating and involving the general public. This paper examines the perception of highway users towards the installation of the traffic safety equipment during road maintenance work and also determines the traffic safety management criteria in ensuring the traffic control signs and equipment in meeting the highway users' needs. A survey has been conducted among the Malaysian road users from Ipoh to Kuala Lumpur. The researcher found that the overall perceptions of the respondents stated the installation of the traffic safety equipment during road maintenance work progress is below the average level. In term of traffic safety management criteria it must have criteria like all the traffic safety equipment should be brighter and visible from long distance, instruct drivers to follow a path away from where work is being done and concessionaire should be aware of their equipment in good condition and should do routine maintenance. From the analysis that has been carried out, the result shows that the management should improve the safety in work zones from the perception of respondents were analysed and discussed.

Keywords: Traffic Safety Management Criteria, Traffic Safety Equipment, Malaysian Road User's Perspective.

1. Introduction

Handling traffic in work zones is challenging because the work activity presents an abnormal and often disruptive environment to the highway users. Highway users accustomed to a clear, unobstructed roadway are required to recognize and avoid closed lanes, workers in or near the roadway, and a variety of fixed object hazards. The maintenance activities or construction activities may also present an interesting view to many highway users that can divert their attention from the driving task. Traffic safety is a major issue at work zones. When the traveling path of the highway users is occupied with maintenance activity or work activity, conflict arises between the requirements of the construction workers and the desires of the traveling public. Work sites create potential hazards because they confront the highway users with unexpected and sometimes confusing situations, create obstructions which the highway users may run into, divert the highway users attention from the driving task and expose the maintenance or construction workers to the moving traffic. This paper will determine the traffic safety management criteria in highway maintenance works from road users' perspective in order to come to a conclusion on what are the traffic safety management criteria in ensuring the traffic control signs and equipments are meeting the highway users' needs.

2. Literature Review

The traffic safety management is that it finds traffic accident's rule, adopts the traffic legislate, makes regulation of the traffic safety management and implements the controls of the traffic. Traffic Management is a critical aspect of any construction or maintenance work on any road, expressway or bridge that is open to traffic. Any works carried

out alongside live traffic present unexpected situations, distracting users and exposing them to a high degree of vulnerability and risk. It is important that special care be taken in implementing adequate traffic management to ensure a smooth, safe and comfortable drive for road users.

2.1 Traffic Safety Management Criteria

The characteristics of traffic are the result of many varied and complex interactions among the four primary elements of the traffic system which are road users, vehicles, roadways and controls. Traffic system would become easy if the various components attain the same characteristics. According to Hafizi (2010), effectiveness of traffic safety management requires a basic understanding of these four elements; i) road users, ii) vehicles, iii) roadways and iv) traffic control devices.

Traffic control devices is the communication of traffic laws and regulations to road users because these devices are the only means of transmitting operational rules to drivers, they must be clear, easily interpreted and commanding of attention. Arthur (1999) has argued that clear and uniform is an essential part of highway and traffic engineering. Road users depend upon this information and guidance on the roadway. Simplicity is achieved through the extensive use of colour, shape and pattern codes in a uniform fashion, which, after repeated exposure, drivers readily comprehend.

2.2 Traffic Safety Equipment

As included in the ‘Arahan Teknik Jalan’ (2C/85) (1985) - Manual on Traffic Control Devices, Temporary Signs and Work Zones Control, some traffic safety equipment methods that are commonly used in work zones (Table 2.1) which are used to warn, guide, or regulate traffic.

Table 2.1 – Requirements, functions and characteristics of safety equipments that commonly used.

| Traffic Safety Equipments | Requirements / Functions / Characteristics of equipments |
|--|---|
| Temporary Signs | A survey indicated that half of truck drivers wanted to see warning signs 3–5 miles in advance (Burde, 2008). Garber and Woo (1990) found that static traffic signs could effectively reduce crashes in work zones on urban two-lane highways when used together with flaggers. |
| Lighting Devices | Four lighting devices commonly used in work zones are floodlights, flashing warning beacons, warning lights, and steady burn electric lamps which raise drivers’ attention, warn drivers of complicated travel conditions, and/or illuminate work zones at night. Some studies (Huebschman et al. 2003; Arnold 2003) found that flashing warning lights were one of the most effective approaches for reducing speeds in work zones. |
| Pavement Markings | Pavement markings can be used to control speeds. |
| Delineators | Delineators should not be used alone as channelizing devices in work zones but may be used to supplement these channelizing devices in outlining the correct vehicle path. They are not to be used as a warning device. The delineators should be white on the left side and red on the right side of the roadway. On the right edge of divided highways and on one way roadways, they shall be yellow. |
| Channelizing Devices | Channelizing devices include cones, tubular markers, vertical panels, drums, barricades, and temporary raised islands. The results of a study (Pain, R.F., McGee H.W. and Knapp, B. G., 1983) showed that most of the channelizing devices were effective in alerting and guiding drivers, but the devices only obtained their maximum effectiveness when properly deployed as a system or array of devices. Garber and Woo (1990), however, found that the use of barricades in any combination of traffic control devices on urban multilane highways seemed to reduce the effectiveness of other traffic control devices. |
| Hand Signaling Signs or Flags | Flaggers are qualified personnel with high-visibility safety apparel who are equipped with handheld devices such as STOP/SLOW paddles, lights, and red flags to control road users through work zones. Hill (2003) proved that flaggers were effective in reducing fatal work zone crashes. However, a study by Benekohal et al. (1995) as cited in Burde (2008) indicated that there was a need for improving flagging for heavy truck traffic. Their survey showed that one-third of the surveyed truck drivers responded that flaggers were hard to see, and half of them thought the directions of flaggers were confusing. |
| Arrow Panels and Portable Changeable Message Signs | Arrow panels and portable changeable message signs usually contain luminous panels with high visibility, which makes them an ideal traffic control supplement in both daytime and nighttime. Richards and Dudek (1986) commented that changeable message signs could result in only modest speed reductions (less than 10 mph) when used alone and would lose their effectiveness when operated continuously for long periods with the same messages. Huebschman et al. (2003) argued that changeable message signs were actually no more effective than traditional message panels. |
| Portable Barriers | There are four primary functions of barriers: i) Keep traffic from entering a work area or from hitting an exposed object or excavation, ii) Provide positive protection for workers, iii) Separate two-way traffic, and |

| | |
|--|--|
| | iv) Protect construction such as false work bridges. |
|--|--|

3. Methodology

Data are obtained through questionnaires to applicable highway users at the northern PLUS highway from Ipoh to Kuala Lumpur. The selection of the respondents is according to judgmental sampling. A set of questionnaire was distributed to the highway user. Out of 500 copies of the questionnaires that were sent out by the researcher to highway user, only 294 copies were duly answered and replied. This implies that, only 59% of the respondents have responded to the survey. The data were analyzed by using the software Statistical Package for Social Science 20 (SPSS 20) was used to analyses the questionnaire returned by respondents.

4. Result and Analysis

The increment in population and motorization led to a consequent increase in the number of road traffic accidents. The respondents were asked to identify the perception of highway users towards the installation of the traffic safety equipments during the road maintenance works. The respondents were also given an opportunity to give their perception on the traffic safety management but not all respondent respond for that perception.

4.1 *The Relationship between the Age and Gender of Respondents and the Satisfaction with the Installation of Traffic Safety Equipment in the Highway Maintenance Work Zone*

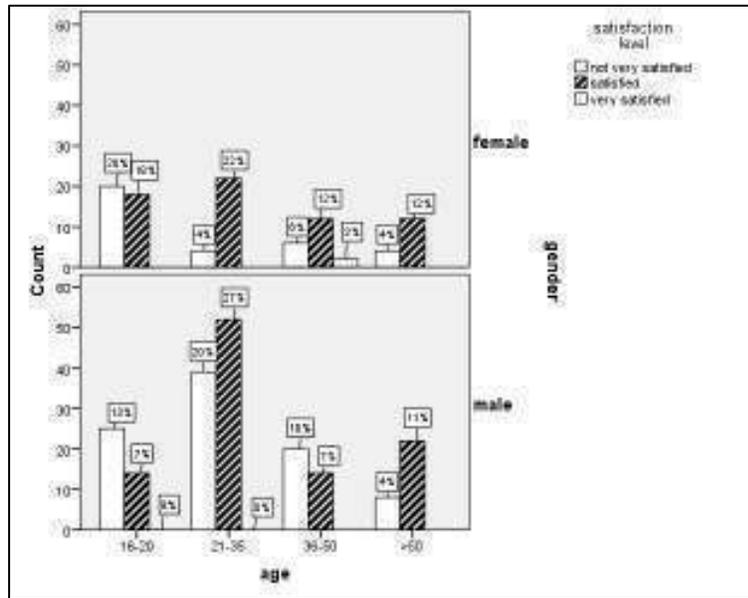


Figure 4.1: Bar Charts of Age and Gender of Respondents and the Satisfaction with the Installation of Traffic Safety Equipment in the Highway Maintenance Work Zone

Figure 4.1 shows the relationship between the age and gender of respondents and the satisfaction with the installation of traffic safety equipment in the highway maintenance work zone. Based on age and gender, majority of ages from 16-20 (13% male and 20% female) are feeling not very satisfied, age from 21-35 (27% male and 22% female) and ages 50 years and above (11% male and 12% female) are feeling satisfied.

4.2 *The relationship between ages and gender of respondent and journey's affected due the installation of traffic safety equipment at work zones area.*

Based on ages and gender respondents', it shows different perception of ages and gender respondents on journey's affected due the installation of traffic safety equipment at work zones area. Based on overall ranking of types of equipment affected to the journeys of drivers, it shows installation of cones (2.46- moderately affected), concrete barriers and plastic barrier (2.37 –inconvenience), and PE Drums (2.29- inconvenience) is the top third of highest ranking affected to the journeys of drivers. While, installation of the advance warning (1.99- inconvenience) are the lowest ranking affected the journeys of drivers. Refer Table 4.1.

Table 4.1: The relationship between ages and gender of respondent and journey's affected due the installation of traffic safety equipment at work zones area.

| No | Types of Safety Equipment | 16-20 | | | | 21-35 | | | | 36-50 | | | | >50 | | | |
|----|---------------------------------------|-------|------|--------|------|-------|------|--------|------|-------|------|--------|------|------|------|--------|------|
| | | Male | | Female | | Male | | Female | | Male | | Female | | Male | | Female | |
| | | Mean | Rank | Mean | Rank | Mean | Rank | Mean | Rank | Mean | Rank | Mean | Rank | Mean | Rank | Mean | Rank |
| 1 | Concrete Barrier | 2.64 | 1 | 3.00 | 1 | 2.54 | 2 | 1.75 | 3 | 1.88 | 5 | 1.89 | 5 | 2.29 | 3 | 2.00 | 3 |
| 2 | Cones | 2.59 | 2 | 3.00 | 1 | 2.57 | 1 | 1.83 | 2 | 2.06 | 2 | 2.33 | 1 | 2.36 | 2 | 2.38 | 1 |
| 3 | The Robotic Flagman | 2.44 | 5 | 2.61 | 4 | 1.84 | 7 | 1.50 | 5 | 1.94 | 4 | 2.22 | 2 | 2.14 | 4 | 1.50 | 5 |
| 4 | Chevron Lights | 2.49 | 4 | 2.61 | 4 | 1.81 | 8 | 1.42 | 6 | 2.00 | 3 | 2.11 | 3 | 2.07 | 5 | 1.75 | 4 |
| 5 | Arrow Signs | 2.33 | 7 | 2.44 | 5 | 1.76 | 9 | 1.50 | 5 | 2.00 | 3 | 1.89 | 5 | 1.93 | 6 | 1.50 | 6 |
| 6 | PE Drums | 2.33 | 7 | 2.94 | 2 | 2.27 | 4 | 1.83 | 2 | 2.12 | 1 | 2.00 | 4 | 2.36 | 2 | 2.00 | 3 |
| 7 | Plastic Barrier | 2.54 | 3 | 2.94 | 2 | 2.38 | 3 | 1.92 | 1 | 2.12 | 1 | 2.00 | 4 | 2.50 | 1 | 2.00 | 3 |
| 8 | Temporary Post Advance Warning System | 2.38 | 6 | 2.83 | 3 | 2.25 | 5 | 1.83 | 2 | 2.00 | 3 | 2.22 | 2 | 2.36 | 2 | 2.13 | 2 |
| 9 | PVMS | 2.33 | 7 | 2.61 | 4 | 1.81 | 8 | 1.50 | 5 | 1.88 | 5 | 2.11 | 3 | 2.07 | 5 | 1.38 | 7 |
| 10 | PVMS | 2.33 | 7 | 2.61 | 4 | 1.85 | 6 | 1.58 | 4 | 1.88 | 5 | 2.00 | 4 | 2.07 | 5 | 1.50 | 5 |

Notes: 1.00- Not affected
2.00 -Inconvenience
3.00- Moderately affected
4.00- Seriously affected

4.3 Traffic Safety Management Criteria

Based on traffic safety management criteria, respondents are asked on four categories which are in term of i) roadwork signs, ii) diversion signs, iii) continuity of traffic flow and iv) traffic safety management criteria.

i) Location of roadwork signs

Figure 4.2 shows that majority of the respondents 126 (42.9%) who had responded to the questionnaire stated the traffic safety management criteria in term of roadwork signs during the recent works was below average level. However, 72 (24.5%) respondents' stated in poor level and 34 (11.6%) respondents' stated in average level. Only 62 (21.1%) of respondents stated it is in good level.

ii) Clear directions of diversion signs

Figure 4.3 shows that majority of the respondents 105 (35.7%) who had responded to the questionnaire stated the traffic safety management criteria in term of diversion signs during the recent works was below average level. However, 76 (25.9%) respondents' stated in poor level. Only 64 (21.8%) of respondents stated it is in good level.

iii) Continuity of traffic flow

In term of traffic flow management, majority of respondents 112 (38.1%) also stated it is in below average level. While 59 (20.1%) respondents were stated it is in good level and 74 (25.2%) was stated it is in poor level (Figure 4.4).

iv) Traffic Safety Management Criteria

Figure 4.5 shows the traffic safety management criteria required by respondents.. Based on age and gender, majority of ages from 16-20 (17% male and 34% female), ages from 21-35 (39% male and 18% female), ages from 36-50 (13% male and 18% female) and ages 50 years and above (14% male and 12% female) are need all the traffic safety

management must have criteria like all the traffic safety equipment should be more brighter and easy to see from long distance, will instruct drivers to follow a path away from where work is being done and concessionaire should aware their equipment in good condition and should do routine maintenance.

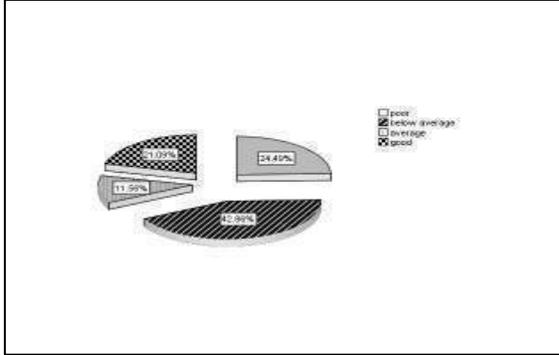


Figure 4.2: Location of roadwork signs

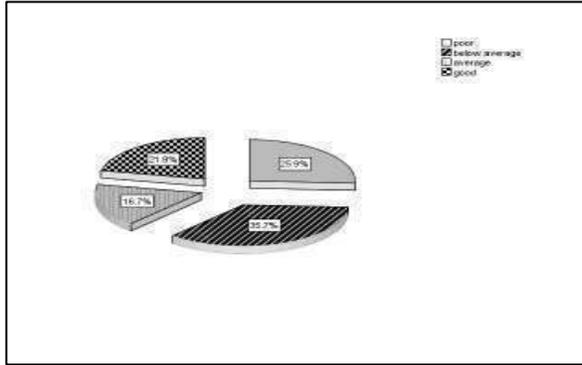
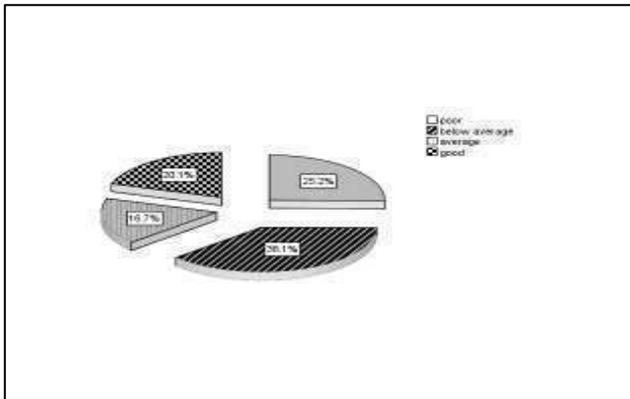


Figure 4.3: Clear directions of diversion signs



5. Conclusion

Majority respondents expect the improvements to the road surface to be done safely and without restricting the flow of traffic through the work zone. The safe and efficient flow of traffic through work zones has been, and continues to be, a major concern to the maintenance concession. Based on analysis, i) the installation of the traffic safety equipments such as cones, concrete barriers and plastic barrier and PE drums during the road maintenance works affected to the journeys of drivers, and ii) traffic safety management criteria in term of location of roadwork signs

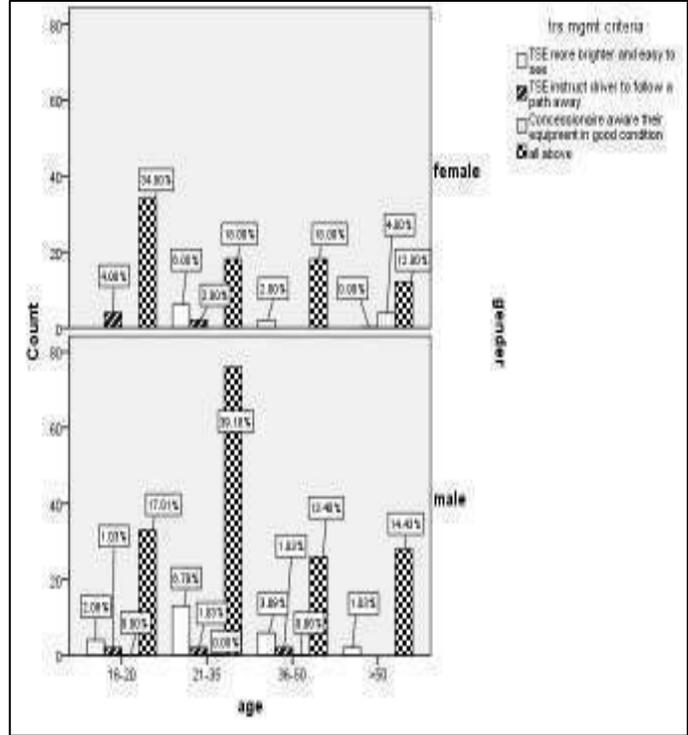


Figure 4.5: Traffic Safety Management Criteria

Figure 4.4: Continuity of traffic flow

during the recent works from respondents' perception now are at below average level. There are a lot of suggestions from respondents' perception to improvement the road traffic safety in highway maintenance works zone. The perceptions of highway users in term of clear directions of diversion signs majority of the respondents also is below average level. In term of traffic flow management, majority of respondents also stated it is below average level. In term of traffic safety management criteria all the traffic safety equipment must have criteria like all the traffic safety

equipment should be more brighter and easy to see from long distance, will instruct drivers to follow a path away from where work is being done and concessionaire should aware their equipment in good condition and should do routine maintenance. Based on the respondents' perception, this study hopes relevant parties are concerning to the respond given to improve the road traffic safety in highway maintenance work.

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