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ROAD SAFETY DESIGN STANDARDS: A TRAFFIC MANAGEMENT APPROACH IN THE PROVINCE OF CAGAYAN

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ABSTRACT

It is widely recognized that road and traffic engineering measures have an important role to play in contributing to safer roads. This study determined the extent of compliance of the Department of Public Works and Highways (DPWH) in the Province of Cagayan on road safety design standards and determined whether the identified variables affect their extent of compliance with road safety design standards. The purpose of the study is to generate additional information to ensure road safety within the province. The study uses descriptive and correlation research design.

Findings indicate that the DPWH "much" comply with the road safety design standards. The provision on road surface is given emphasis while provisions on parking, pedestrian facilities and intersection warnings are given least attention. Moreover, findings revealed that there were differences in the extent of compliance with road safety standards among personnel when grouped according to their number of training hours while their educational attainment and length of service shows no significant differences in their extent of compliance.
Based from the findings, it is concluded that the occurrence of road accidents within the Province of Cagayan is not only due to driver's error, vehicle and enforcement factor but also due to the inability of the engineering to fully comply with the existing road safety engineering standards.

Based on the findings, it is recommended that: the DPWH should provide additional traffic control devices on parking signs and well-regulated parking areas; safer and controlled pedestrian facilities and; additional intersectional traffic control and regulatory signs.

KEYWORDS:

Road Safety, Parking, Road Surface, Intersection, Pedestrian facilities

INTRODUCTION:

The Global status report on road safety *2015*, indicates that worldwide the total number of road traffic deaths has plateaued at 1.25 million per year, with the highest road traffic fatality rates in low-income countries [1]. In Southeast Asia Region, road traffic injuries kill approximately 316, 000 people each year. These deaths account for 25% of the global total of road traffic deaths. The South-East Asia region has a road traffic death rate of 17.0 per 100 000 population [2].

In the Philippines, the World Health Organization (WHO) said 53% of reported road traffic fatalities in the country are riders of motorized two- or three-wheeler vehicles. Pedestrians make up the second biggest chunk of road user deaths at 19%, followed by drivers of four-wheeled vehicles at 14% and their passengers at 11% [3].

In the Cagayan Valley Region, the province of Cagayan is one of the leading from among the five (5) provinces in the region as far as accident rate is concerned [4].

The province of Cagayan lies in the northeastern part of mainland Luzon, approximately 17° 30' north and 121° 15' east, occupying the lower basin of the Cagayan River. Tuguegarao City, its capital is 483 kilometers north of Manila, about one hour by air travel, and ten hours by land, through the Maharlika Highway, also known as the Cagayan Valley Road [5].

The Cagayan Police Provincial Office recorded 2,679 cases of road accident from year 2015-2016 which involved

2,828 motor vehicles.The most tragic road accidents in Cagayan that happened was on September 2003 when a passenger bus collided with another bus and a van before plunging into a ravine that killed at least 14 people and injuring 31 along a winding mountainous road in Gattaran town [6]. Another fatal accident happened on February 15, 2010 somewhere in Piat Cagayan when a passenger jeep and a truck collided with each other killing fourteen (14) people; mostly students and thirteen (13) were injured. The underlying causes of these accidents includes human error, vehicle and road factor [6].

This study assessed the extent of compliance of the Department of Public Works and Highways (DPWH), on the existing road safety design standards to come up with recommendations vital in ensuring road safety. The DPWH is an agency responsible in planning, designing, as well as the construction and maintenance of roads and bridges in the Philippines. Road Safety Design Standards are those standardized principles and necessary elements of roads which must be provided or followed by Road Safety Planners or Engineers to ensure safety for all type of road users.

In as much as the entire process of road transport is conducted on roads, its quality, size and engineering characteristics will have a considerable contribution to the increase or decrease of road traffic accident risks. Creating safer roads for motorist and pedestrians is crucial, the

WHO said. Real, sustained successes at reducing global road traffic deaths will only happen when road design takes into consideration the needs of all road users," the agency added [3].

OBJECTIVES OF THE STUDY

This study has been initiated to:

1) Determine the extent to which the Department of Public Works and Highways comply with the road safety design standards and;
2) Determine whether there is a significant difference between the extent to which the Department of Public Works and Highways comply with the road safety design standards when grouped according to their educational attainment, length of service and training.

HYPOTHESIS

This research undertaking is guided by a lone hypothesis that:

1) There is no significant difference between the extent to which the Department of Public Works and Highways comply with the road safety design standards when grouped according to their profile variables.

STATEMENT OF THE PROBLEM

In order to attain the objectives of this study, the following two main questions are propounded.

1) What is the extent to which the Department of Public Works and Highways comply with the road safety design standards?
2) Is there a significant difference between the extent to which the Department of Public Works and Highways comply with the road safety design standards when grouped according to their educational attainment, length of service and training.

METHODOLOGY

Research Design

The study uses the descriptive and correlation research design since it measures the extent of compliance of the DPWH with the existing road safety design standards and the difference between the extents of compliance when grouped according to their profile variables.

Population and Locale of the Study

All personnel (59) of the DPWH in the three (3) Engineering Districts in the Province of Cagayan directly involved in the design, construction, and maintenance of roads, road signs and markings were taken as respondents.

The entire Province of Cagayan was selected as the locale of the study from among the five (5) provinces of the Cagayan Valley Region since Cagayan is considered as Regional Center and serves as the seat for most if not all Regional offices of the government. Likewise, Cagayan province is the seat of most Higher Education Institutions
(HEIs). Also, most tradeoff and business activities, as well as the tourism industry, are undertaken in the province. So, it caters to thousands of students, transients, traders, local and foreign tourist, employees for both government and private enterprise living not only within but beyond the province as well, using, either public or private transport making the place more susceptible to road traffic accidents. The study was undertaken in the year 2016 and it is limited only in measuring the extent of compliance of the DPWH on road safety design standards particularly on road surface; intersection; parking facilities; pedestrian facilities; traffic signs; pavement markings; and street lightings.

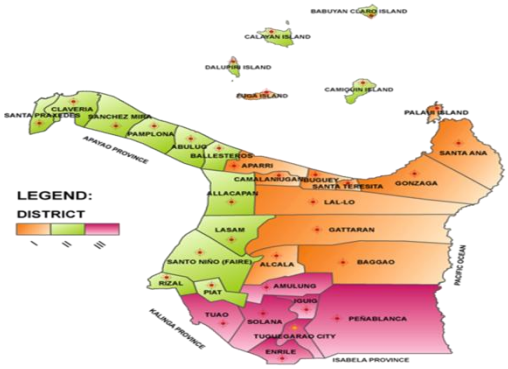

Fig. 1 Map of Cagayan

Data GatheringTool

The data were collected through a survey questionnaire. The questionnaire consists of two (2) separate parts. Part I of the questionnaire is designed to get the profile of the respondents. Part II of the questionnaire is designed to assess the level of compliance with road safety design standards. The questionnaire was patterned from the Highway Safety Design Standards Manual of the DPWH. The questionnaire was tested through the use of Cronbach's Alpha test. Cronbach's Alpha Based on Standardized Items of .733 indicates that the questionnaire is highly reliable.

Data Gathering Procedure

The questionnaire were personally administered and retrieved by the researcher. For ethical grounds, personal information, responses, and data given were treated with utmost confidentiality.

Treatment of the Data

To interpret and analyze the extent of compliance of the respondents with the existing road safety design standards, a four-point Likert scale was used:

Numerical Values	Mean Range	Verbal Interpretation
4	3.26-4.00	Very Much Complied
3	2.51-3.25	Much Complied
2	1.76-2.50	Moderately Complied
1	1.00-1.75	Not Complied

T-Test Statistics of Unequal Variance was used to analyze the degree of compliance with road safety design standards by personnel of the DPWH when group according to their educational attainment. The formula

t-test statistics, Unequal Variances:

$$t = \frac{\bar{x} - \bar{y}}{\sqrt{\frac{s_x^{\,2}}{n} + \frac{s_y^{\,2}}{m}}} \text{ with } v = \frac{\left(\frac{s_x^{\,2}}{n} + \frac{s_y^{\,2}}{m}\right)^2}{\frac{\left(\frac{s_x^{\,2}}{n}\right)^2}{n-1} + \frac{\left(\frac{s_y^{\,2}}{m}\right)^2}{m-1}} \text{ degrees of freedom}$$

where:

t-t-statistic

$\bar{x}$ - mean of the first group

$\bar{y}$ - mean of the second group

$s_x^{\,2}$ - variance of the first group

$s_y^{\,2}$ - variance of the second group

n- number of observations in the first group

m- number of observations in the second group

Analysis of variance (F-test) was used to analyze the differences in the extent of compliance with road safety design standards by the DPWH when grouped according to their length of service and number of training hours.

The formula is expressed as:

F-test = SSb / SSw

where:

SSb =Mean sum of squares between groups

SSw = Means sum of squares within groups

RESULTS AND DISCUSSION

Table 1

Extent of Compliance of the DPWH with Road Safety Design Standards.

Road Safety Design Standards	**Weighted Mean**	**Descriptive Interpretation**
Road Surface	3.45	Very Much Complied
On Intersection	2.98	Much Complied
Parking Facilities	2.73	Much Complied
Pedestrian Facilities	2.89	Much Complied
Traffic Signs	3.21	Much Complied
Pavement Markings	3.17	Much Complied
Street Lightings	3.12	Much Complied
Overall Mean	3.08	Much Complied

As gleaned from Table 1, an overall mean of 3.08 means “much” complied indicates that the DPWH comply with considerable degree the provisions on road safety design standards. It means that the DPWH observed with an acceptable degree the road safety standards as provided by the DPWH Road Safety Design Manual that establishes and maintains safe road design principles for roads. However, the data suggest that the provision of road safety standards are not fully met which contributed in some way to the occurrence of road accidents. This further implies that road accidents happened in the Province within the study period is not only due to driver’s error and the inability of the traffic enforcers to detect violations.

An area mean of 3.45 means “very much” complied suggest that the DPWH fully meet the provision on road surface like road width standards, provision of the drainage system, application of skid resistance, sufficient road edges and maintenance of the road surface. This manifests that the DPWH observe good engineering practices in the planning, design, construction, and maintenance of highways within the Province as far as traffic efficiency and safety is concerned. Hence, it can be construed that traffic accidents within the province are not attributed to the defects of the road surface.

Moreover, pedestrians are not adequately protected against speeding motor vehicles since speed limiting devices, pedestrian crossing lanes and humps are said to be lacking and

poorly maintained. Also, maintenance of sidewalk for pedestrians are lacking Moreover, an area mean of 2.73 and 2.89 being the lowest though still interpreted as “much” complied indicates that provisions on parking facilities and pedestrian facilities respectively is given least attention by the DPWH. It implies that parking facilities are lacking and there are inadequate control mechanisms and procedures relating to parking regulations. This is evidenced by uncontrolled parking for any types of motor vehicles within busy streets and on along national highways particularly in front of public markets of most municipalities within the province.

Moreover, pedestrians are not adequately protected against speeding motor vehicles since speed limiting devices, pedestrian crossing lanes and humps are said to be lacking and poorly maintained. Also, maintenance of sidewalk for pedestrians are lacking as evidenced by the presence of sidewalk vendors, roadside hoardings and advertisement board prompting pedestrians to use the carriageway or roadway endangering themselves.Findings yielded are supported by Juma [7] which disclosed that 72% of drivers in Tanzania says that there is insufficient street parking. It serves as one of the underlying factors of an accident in the said place [7]. Hamza also revealed in his study in Libya that death and disabilities in Libya are due to several factors such as the poor state of the infrastructure [8]. Moreover, Sancaand Zanulefound out that road with insufficient speed limiting devices and road warning for slowing down serves as one of the causal factors of an accident[9,10]. Hence, the safest way to cater to the needs of the pedestrians is to provide separate areas for them to use which are free from any obstructions [11].

Table 2

Compliance of the DPWH with Road Safety Design Standards when Grouped According to Educational Attainment.

Road Safety Design Standards/ Educational Attainment	**College Grad (53)**		**MA/MS Graduate(6)**	
	Mean	**DI**	**Mean**	**DI**
Road Surface	3.48	VMC	3.42	VMC
On Intersection	3.10	MC	2.85	MC
Parking Facilities	2.77	MC	2.68	MC
Pedestrian Facilities	3.00	MC	2.78	MC
Traffic Signs	3.27	VMC	3.15	MC
Pavement Markings	3.29	VMC	3.05	MC
Street Lightings	3.22	VMC	3.02	MC
Overall Weighted Mean	**3.16**	**MC**	**2.99**	**MC**

As gleaned from Table 2, an overall weighted mean of 3.16 and 2.99 which means “much” comply indicates that the DPWH comply with considerable degree all the provisions on road safety standards regardless of their educational attainment whether they are bachelor’s or

Master's degree holders. An area mean of 3.48 and 3.42 means "very much" complied indicates that respondents who finished a bachelor's degree and masters' degree respectively fully comply with the requirements of the road surface. It implies that regardless of the degree obtained by the respondents, they equally gave utmost importance on the safety elements of a road surface. However, the data shows that respondents who finished a bachelor's degree "very much" or fully comply with the road safety provisions on traffic signs and pavement markings as revealed by an area mean 3.27 and 3.29 respectively while their counterparts fail to comply fully said road safety provisions.An area mean of 2.77 and 2.68 being the lowest but still interpreted as "much" complied implies that both groups of respondent whose educational attainment is bachelor's degree and master's degree respectively indicates that they equally meet the provisions on parking facilities, but they gave the least attention to it. Moreover, the data suggested that those who are college graduate and who are usually newly hired or employed are much more forceful to comply with the road safety standards than their counterparts.

Table 3

Difference on Extent of Compliance of the DPWH with Road Safety Design Standards when Grouped According to Educational Attainment.

Road Safety Design Standards	**College Graduate**			**MA/MS Graduate/Units**			*t*	*df*	*p-value*
	$\bar{x}$	*s*	*n*	$\bar{x}$	*s*	*n*			
Overall	**3.16**	**0.55**	**53**	**2.99**	**0.35**	**6**	**1.17**	**8.04**	**0.277**

The difference in the extent of compliance among there spondents' personnel of the DPWH was analyzed with t-test statistics of unequal variances. The null hypothesis was that the DPWH personnel did not differ in their extent of compliance when grouped according to their educational attainment. The alternative hypothesis was that there were differences in the extent of their compliance. Results of comparison on the compliance between college graduates and MA/MS graduates or those with units of the DPWH personnel with the road safety standards suggests that there are no significant differences were seen ($t(8.04)=1.17$, $p>0.05$).This result means that there were no differences in the extent of

compliance with road safety design standards among the personnel of the DPWH when grouped according to their educational attainment.

Table 4
Extent of Compliance of the DPWH with Road Safety Design Standards when Grouped According to Length of Service.

Road Safety Design Standards/ Length of Service	**1-10 years (46)**		**11-20 years (3)**		**21-30 years (5)**		**31 years + (5)**	
	Mean	**DI**	**Mean**	**DI**	**Mean**	**DI**	**Mean**	**DI**
Road Surface	3.59	VMC	3.46	VMC	3.61	VMC	3.34	VMC
On Intersec-tion	3.23	MC	2.73	MC	3.17	MC	3.05	MC
Parking Facilities	2.90	MC	2.20	MDC	2.81	MC	2.81	MC
Pedestrian Facilities	3.17	MC	2.80	MC	2.89	MC	2.65	MC
Traffic Signs	3.43	VMC	3.00	MC	3.05	MC	3.05	MC
Pavement	3.43	VMC	3.20	MC	3.17	MC	3.13	MC

Markings								
Street Lightings	3.40	VMC	2.93	MC	2.97	MC	2.97	MC
Weighted Mean	**3.31**	**VMC**	**2.90**	**MC**	**3.10**	**3.10**	**3.00**	**MC**

As shown in Table 4, a weighted mean of 3.31 which means “very much” comply shows that the DPWH personnel whose number of years in the service is 1-10 years fully comply with the provision on road safety design standards. On the other hand, a weighted mean of 2.90, 3.10, and 3.00 manifest that respondents whose number of years in the service ranges from 11-20, 21-30 and 31 years above respectively much comply with the road safety standards. This result shows that those who have been in the service for ten years is much more compliant with road safety standards than their counterparts. However, the data suggested that the three groups of respondents equally comply with the road surface to the fullest extent as shown by an area mean of 3.59, 3.46 and 3.61. It implies that whether the respondents are newly employed or have been in the service for many years, they observed the provisions on the road surface at the same level. This further implies that most respondents are under obligation to follow the standards on road surface like the standards on road width, provision of the drainage system, application of skid resistance, sufficient road edges, and maintenance of the road surface since the road itself serves as the primary avenue of all land-based transport affairs.

Moreover, an area mean of 2.90, 2.20 and 2.81 being the lowest mean or responses from the respondents indicate that regardless of their years in the service, they gave the least attention or compliance with the provisions on parking. It further entails that parking facilities and parking signs are said to be neither lacking nor fully maintained. Moreover, a control mechanism is lacking, and regulatory measures relative to parking are ineffectively implemented.

Table 5
Differences in Extent of Compliance by the DPWH with Road Safety Design Standards when Grouped According to Length of Service.

Source of Variance	Sum of Squares Squares	df	Mean Square	F ratio
Between	48.0396	3	16.0132	1.1537
Within	763.4	55	13.88	
Total	802.72	58		
(f .05, 3, 55) = 2.92	**Decision: Fail to Reject Ho**			

Analysis of Variance (ANOVA) was used to analyze the collected data on the differences in the extent of compliance on road safety design standards among the DPWH personnel when grouped according to their length of service. The null hypothesis was that the personnel do not differ in their extent of compliance when grouped according to their length of service. The alternative hypothesis was that there were differences in the extent of their compliance.

The result of the analysis (Table 5) revealed a computed F value of 1.1537 and the tabular F value is 2.92. Since the computed value is lower than the tabular value, the null hypothesis is accepted. This result means that the DPWH personnel do not differ in their extent of compliance with road safety design standards when grouped according to their number of years in the service. This further implies that regardless of the number of years in the service the personnel had, it has nothing to do with their extent of compliance with road safety standards.

Table 6
Extent of Compliance of the DPWH with Road Safety Design Standards when Grouped According to Number of Training Hours.

Road Safety Design Standards / Training Hours	1-160 hrs		161-320 hrs		321+hrs	
	Mean	Descriptive Interpretation	Mean	Descriptive Interpretation	Mean	Descriptive Interpretation
Road Surface	3.56	VMC	3.63	CVM	3.39	VMC
On Intersection	3.24	MC	3.10	MC	2.92	MC
Parking Facilities	2.94	MC	2.83	MC	2.25	MDC

Pedestrian Facilities	3.18	MC	3.09	MC	2.35	MDC
Traffic Signs	3.48	VMC	3.21	MC	2.65	MC
Pavement Markings	3.40	VMC	3.52	VMC	2.82	MC
Street Lightings	3.40	VMC	3.25	MC	2.55	MC
Weighted Mean	**3.31**	**VMC**	**3.23**	**MC**	**2.70**	**MC**

As shown in Table 6, a weighted mean of 3.31 which means “very much” complied indicates that respondent personnel from the DPWH whose number of training hours is up to 160 hours fully comply with the road safety standards. While personnel whose number of training hours is from 161-320 and 321 and beyond “much” comply with the provision of road safety standards as shown by a weighted mean of 3.21 and 3.74 respectively. The result suggests that personnel who have lesser number of training hours is said to be more compliant than personnel who have the higher number of training hours and expected to be more informed with the standards of road safety. Consequently, since these personnel possess further training and experience regarding road safety, they have the higher inclination to be more judicious and careful in implementing, maintenance and evaluation of road safety projects. Moreover, an area mean of 3.56, 3.63 and 3.39 indicate that the three groups of respondents “very much” comply with the provision on road surface. It means that regardless of the number of training hours the personnel had, they equally comply with the provisions on road surface. Also, an area mean of 3.48 and 3.40 suggest that respondent personnel whose number of training hours ranges to 160 “very much” comply with the provisions on traffic signs, pavement markings, and street lightings respectively. While an area means of 3.52 means “very much” complied indicates that personnel whose training hours ranges to 161 to 320 fully comply with the provisions on pavement markings.

However, an area mean of 2.94 and 2.83 being the lowest though still interpreted as “much” complied indicates that the provisions on parking are given less attention by the respondents except those respondents having the highest number of training hours wherein they “moderately” comply with the said road safety standard. Such findings indicated that from among the provisions on road safety standards, parking facilities, parking signs, including regulatory control relative to its use is given less consideration.

Table 7
Differences in Extent of Compliance of the DPWH with Road Safety Standards when Grouped According to the Number of Training Hours.

Source of Variance	**Sum of Squares**	**df**	**Mean Square**	**f ratio**
Between	93.8317	2	46.9158	114.05
Within	23.4483	56	.41137	
Total	**117.28**	**58**		
(f .05, 2, 56) = 3.32		**Decision: Reject Ho**		

Analysis of Variance (ANOVA) was used to analyze the collected data on the differences in the extent of compliance on road safety standards among DPWH Personnel when grouped according to their number of training hours. The null hypothesis was that the personnel do not differ in their extent of compliance while the alternative hypothesis was that there were differences in the extent of their compliance. The result of the analysis (Table 7) revealed a computed F value of 114.05 and the tabular F value is 3.32. Since the computed value is higher than the tabular value, the null hypothesis is rejected.

This result means that the DPWH Personnel differ in their extent of compliance with road safety design standards when grouped according to their number of training hours. This further means that the higher the number of training hours obtained, the higher the extent of compliance of the DPWH Personnel with the road safety design standards.

RECOMMENDATIONS:

Based on the findings, it is recommended that:

1. The DPWH should provide additional traffic control devices on parking signs;
2. Provision of additional and well-regulated parking areas;
3. Safer and controlled pedestrian facilities free of obstructions;
4. Provision of additional intersectional traffic control and regulatory signs; and
5. Continuous training of the DPWH personnel directly involved in planning, construction and maintenance of road facilities.

CONCLUSION:

Based from the findings, it is concluded that road system within the province of Cagayan are compliant with the existing road safety design standards. However, parking facilities, pedestrian facilities and intersection security measures are said to be lacking.

Moreover, it can be said that the occurrence of road accidents within the Province of Cagayan is not only due to driver's error, vehicle and enforcement factor but also due to the inability of the engineering to fully comply with the existing road safety engineering standards.

REFERENCES:

[1] Global Status Report on Road Safety (2015). Available from http://violence_injury/2015/en/
[2] Road Safety in the South-East Asia Region (2015) World Health Organization, Regional Office for South-East Asia, Indraprastha Estate, Mahatma Gandhi Marg, New Delhi. Available from http://www.who.int/entity/violence_injury_prevention/road_safety_status/ 2015/
[3] Road Deaths in PH: Most are Motorcycle Riders, Pedestrians. Available from https://www.rappler.com/nation/ road -safety-report-2015-who-philippines.
[4] Cagayan Valley Statistical Yearbook 2013. National Economic Development Authority, Regional Office No. 2, Regional Government Center, Carig Sur, Tuguegarao City. Published by Regional Development Council (RDC) 2's Regional Research and Statistics Committee.
[5] Cagayan, Location, Land Area and Political Subdivisions. (2015). Online available from http://cagayano.tripod.com/
[6] Charlie Lagasca (2010). 14 killed, 13 Hurt in Cagayan Road Mishap. Online available from http://beta.philstar.com/headlines /2010/02/16/549813/
[7] Juma, S. H. (2015). Assessment of Road User's Awareness on Strategies for Controlling Road Traffic Accidents: A Case Study of Kigoma-Ujiji Municipality. http://repository.out.ac.tz/id/eprint/1291
[8] Hamza, MA. D. (2005). A Study of Road Accidents, Causalities and their Injury Patterns in Libya. School of Mechanical & Systems Engineering, University of Newcastle Tyne, United Kingdom. http://theses.ncl.ac.uk/jspui/handle/10443/225
[9] Sanca, M. (2002). Application of Design for Safer Urban Roads and Junctions: Selected Countermeasures. Department of Science and Technology, Linkoping University, Linkoping, Sweden.
[10] Zanule, P. G. (2015). Road Management System and Road Safety in Uganda. University of Liverpool, United Kingdom. scholarworks.waldenu.edu
[11] Department of Public Works and Highways Manual on Road Safety Standards, May 2012 (pdf)
[12] Department of Public Works and Highways Manual on Road Signs and Pavement Markings, May 2012 (pdf)