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DEVELOPMENT OF TRAFFIC ACCIDENT PREDICTION MODELS BY TRAFFIC AND ROAD CHARACTERISTICS IN URBAN AREAS

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Abstract: The current procedure of estimating accident reduction benefit applies fixed accident rates for each road level. So that estimating accident reduction benefit is not considering the various characteristics of roadway geometries and traffics. In order to solve the problems mentioned in the above, models were developed considering the characteristics of roadway alignments and traffic characteristics. The developed models can be used to estimate the accident rates on new or improved roads. First of all, factors influence accident rates were selected. Those factors such as traffic volumes, intersections, connecting roads, pedestrian traffic signals, existence of median barrier, lanes are also selected based upon the obtain ability at the planning stage of roads. In this study, roads were classified into 4 groups based on lanes, roads level and the existence of median barriers. The regression analysis had been performed for each group with actual data associated with traffic, roads and accidents.

Key Words: classified by the road, factors of physical, traffic accident curtail benefit

1. INTRODUCTION

1.1 Purposes and Background of Study

Along with continuous increase in automobiles, the number of traffic accidents in Korea has increasing to 255,303 cases in 1990 to 290,481 cases in 2000, decrease to 240,832 cases in 2003. But, the death cost has amounted to around 10,000 every year, so in turn the damages from that accounts for more than 10 trillion won yearly. The number of traffic accidents based on 2001, have different from by road types such as express highway of 3.44accidnet/km, general national highway of 5.92accident /km, rural way of 1.49accident/km, because different factors of road as road types have affected accidents. When road types and characteristics change, characteristics of traffic accidents also change but we have seen yet a proper measure to predict changes of traffic accidents according to traffic characteristics and road types. That is, the same accident rate application of road grades in calculating reduction for traffic accident costs has not reflected road types and their physical characteristics. So this study is to develop a systematic accident prediction model reflected by physical characteristics of road types through a survey of characteristics of roads and accidents in urban areas of Korea. By developing accident prediction model by road types, it is possible to predict traffic accident by physical characteristics of roads, and also could be used to presume accident costs when survey of validity of road building up and repairing from the result**.**

1.2 Procedure and Range of Study

The space range of the study is national ways and rural ways in urban areas of North of Cheolla province in Korea, and the contents range is analyzed as road types the relations between road characteristics and traffic accidents occurred on the roads in urban areas. The time range has limited the current survey data and accident data by urban region(expect of accident data occur in intersections) from 2001~2003.

The process of the study is as the below.

1 step: Setting of study target and overview about accident model development

2 step: Showing of classification critical by road grade through overview Korea and abroad

3 step: Section division and characteristics factors of roads selection by road types.

4 step: Survey roads selection and field survey

5 step: Development of accident prediction model by road types using multiple regressions

6 step: Model suitability examination and the Conclusion

2. REFERENCE OVERVIEW

2.1 Traffic Accident Costs Calculation Examples of Korea and Abroad

2.1.1 Traffic Accident Costs Examples in Japan

The calculation of traffic accident costs of Japan is divided into general highways and express highways based on injured accidents. In the case of general highways, the calculation includes traffic volumes and the number of intersections by distinguishing two-lane and more than

four-lanes according to the existence of median barrier and road-location characteristics. And for basic data of the calculation of traffic accident costs, considering death cost per accident, average accident costs, average loss per physical accident, congestion cost from traffic accidents by road types, it proposes and reflects average accident costs based on injured accidents.

2.1.2 Calculation Examples of Traffic Accident Costs in Korea

The standard for accident reduction benefit on roads in Korea applies the number of accident rate unit as table 1 which calculates traffic accident reduction benefit. Such standard suggests comprehensive accident unit, and applies cost unit per accident, showing no consideration of types and characteristics of roads. In addition, because of no reflection of characteristics of roads and traffic on the same type road, it could be impossible to predict exactly accident which makes quantitative analysis difficult for improvements of the existing roads.

Table 1. The Number of Accident and Accident Costs by Road Type

Road Type	Number of Accident/km	100 million, death accident costs/km	100million, number of injured/km	Number of death accident/km
Express Highways	**3.44**	**1.78**	**43.56**	**0.33**
General National Highways	**5.92**	**6.78**	**196.48**	**0.31**
Rural Ways	**1.49**	**4.89**	**126.07**	**0.08**

Note) Korea Development Institute (2001), standard guideline study of preliminary validity survey of road usiness.

2.2 Accident Prediction Model of Interior and Abroad

Zeeger(1998), based on data for two-lane of 5,000miles of 7 states in the US, developed an accident model with subordinate variable of accident rates by accident types and independent variables of the whole width of shoulder, the width of lane, road vertical alignment, average a daily traffic volume. The result showed that accident rate was decreasing with smooth vertical alignment, as more less ADT and wider of lane, whole shoulder, as more less accidents. Hadi and Aruldhas(1998) developed an accident model by road-grade for Florida state. Using the independent variables were constant road length, AADT, the width of lane and shoulder, and the types and width of median barrier, existence of curve, speed limit, grade and the number of intersections. The result found that to widen the width of median barrier on the four-lane roads enhanced safety and roads with two-way and left-turn median barrier were safer than non-separation roads.

2.3 Relations between Accident-induction Factors and Accidents

Kay Fitzpatrick(2001), applied the geometric structure variables such as the width of lane, existence of median barrier, curve radius, deflection angle, so examined the relations with

accidents. Particularly, in road section of unlike width of lane has been shown an important variable through the model. In the study of Bonneson and Mccoy(2001), they developed accident prediction model according to each condition by distinguishing separation and non-separation of left-turn lane separating roads away from median separation facilities. As a result, they proposed that accidents were affected by AADT, length of roads, density, and land use and so on.

3. CLASSIFICATION OF ROADS AND SELECTION OF SECTIONS

3.1 Classification Standard of Roads

3.1.1 Road Classification Standard of Aboard

Study Group on Road Investment Evaluation of Japan Institute(2000), Guidelines for the Evaluation of Road Investment Projects, was separated roads into express highway and general highway for calculation of traffic accident costs. Also which has calculated accident costs taking into consideration of existence of median barrier and the number of lane(two-lanes/four-lanes), physical factors and road location characteristics in terms of general highways. The FHWA in US, Planning and Scheduling Work Zone Traffic Control(1981) was classified express highways and multi lane roads into three categories of urban area, suburban area and rural area. In addition, they presumed accident rate by separation of roads, the number of lane roads and access control by road types.

Table 2. Roads Classification of the US FHWA

Number of Lane			General Arterial Roads		Major Arterial Roads	
			Urban Areas	Rural Areas	Urban Areas	Rural Areas
2			●	●		
4	Median Barrier	Existence	●	●	●	●
		No Existence	●	●		
6~8					●	

Note) FHWA, Safety Effectiveness of Highway Design Features, Vol. Ⅰ.1992.

FHWA(1992) has classified into general arterial highways and major arterial highways as functions of roads like Table 2, in order to see the relations between road characteristics and safety in regression models. And roads were classified considering location factor of roads resulting in rural areas and urban areas, and according to physical factor as like the number of lane roads and the existence of median barrier.

3.1.2 Roads Classification of Korea

The road classification of Korea has largely two of jurisdiction/function classification. Jurisdiction classification includes express highway, national highway, special city way, wide-area city way, rural way, city way, county way, and gu-way elucidated in article 11 of the way laws. Article 3 regulation of structure and facilities standard of roads classifies roads by functions into express highways and general highways. General highways are divided into major arterial highways, minor arterial highways, and distribution highways and local highways.

Table 3. Current Roads Classification of Korea

Way Laws (Jurisdiction)	**Rules about Structure and Facilities Standard of Roads(Function)**
1. Express national highways 2. General national highways 3. Special city ways Wide-area city ways 4. Rural ways 5. City ways 6. County ways 8. Gu ways	1. Express highways - Urban area : urban express highways - Rural area : express highways 2. General ways **- Urban area** · Major arterial ways · Minor arterial ways · Distribution ways · Local ways **- Rural area** · Major arterial ways · Minor arterial ways · Distribution ways · Local ways

3.1.3 Road Classification Standard of This Study

This study classified road grades by connecting road classification of rules(function) for structure and auxiliaries standard with way laws(jurisdiction). First, we classified roads into express ways and general highways, considering factors of road location, we divided regions into urban and rural areas according to road locations. For express highways, there are differences from physical factors between urban areas and rural areas, but North of Cheolla province in this study has no big cities so, this paper didn't classify express highways into urban areas and rural ones and generally classified only areas into urban and rural areas.

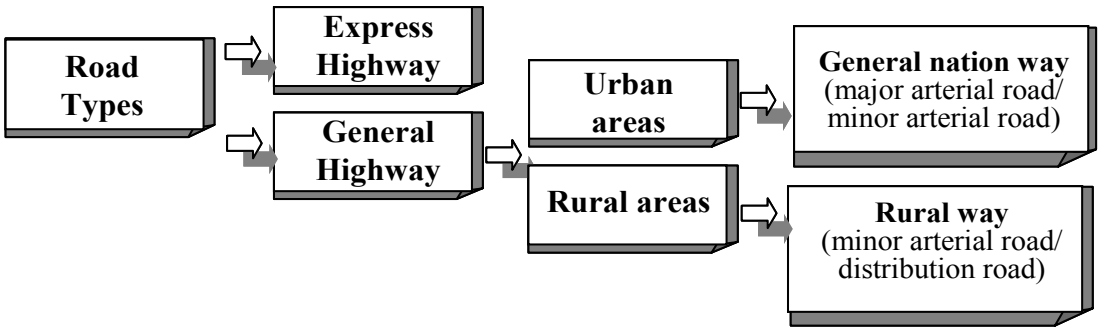

Figure 1. Road Classification Standard of This Study

Among them, we constructed a accident model by road types for express highways and general national ways(major arterial ways and parts of minor arterial ways) and rural ways(minor arterial ways and parts of distribution ways) of urban areas.

3.2 Classification Standard of Urban Areas and Rural Areas

The classification standard for urban areas and rural areas, based on the City Planning Law and article 7 of Local self-governed law, classified residential areas more than 50,000 population, a city[1] and residential areas more than 20,000 population[2], an Eup(a kind of small county) into urban areas in North of Cheolla province and the other parts of areas mentioned above as rural areas. Thus, among 6 cities and 8 guns, based on the population of 2000, we classified Jeonju, Gunsan, jeongeup, Gimje, Namwon, Iksan, Gochangeup of Gochng county, Buaneup of Buan county, Samryeeup of Wanju county as urban areas. We referred the data of 2000 National Statistical Office as population reference, but that data has a one or two year difference from traffic accident data.

3.3 Characteristics and Definition of Road Physical Factors

This study selected road physical factors matching road types from the beginning stage of road plan step and used data of traffic volumes and geometric structure. We used AADT(Annual Average Daily Traffic) as traffic volume data, selected existence of median barrier, the number of lane roads, the number of intersections, the number of connection roads, the number of pedestrian traffic signals in consideration easy to surveys and data collection of geometric structure data. The traffic volumes are one of many factors which affect driver's psychological state and could induce accidents and we selected AADT as a variable to look into accidents by traffic volumes. Traffic volume in section means including length because AADT (vehicle/day) was the same within selected sections. As well, according to the study of KimTae-wan(1996), it showed that accidents were reducing as increase in the number of lane, so we selected the number of lane as a variable for evaluating the affects of accidents by the number of lane which was based on the basis of road designs. According to the study by Walton, Long Gan and Morrison(1996), it has proposed that in case of establishing median barrier on the existing roads, median encroachment accidents could be reduced. So we selected to a variable of median barrier, to see affect to accident in existence & non-existence of median barrier. And we also selected pedestrian traffic signals as variable to see how much pedestrian traffic signal could affect accidents. We excluded accidents occurred on intersections in the accident data so that we adopted only pedestrian traffic signals(unit/km) at

1. City designate in Urban Planning Law and article 7 of Local self-governed law that residential areas more than 50,000 population and residential areas more than 20,000 population in case of Eup.
2. Population use http://www.nso.go.kr/cgi_bin/sws_999.cgi, population data of National Statistical Office(2000)

the sections except traffic signals on intersections that affect intersection accidents. Fee research team of FHWA(1992) reported that accidents are in proportion to the number of connection road, so to see how much the existence of intersection(unit/km) and connection road(unit/km), we selected as variables, the number of intersections, the number of connection road(driveway) in case of general ways. Although intersection characteristics intersection accident have determine the effects of accidents, we didn't know substantial characteristics of intersections in the beginning stage so we didn't include intersection accidents related data in this paper. Even if it is not easy to seize all connection roads in the route-determining level of planning step in case of connection roads, we selected connection road as variable in consideration of connection road to calculate construction costs of basic step and design one. In this paper, we were trying to develop an accident model by variables which represent physical characteristics of roads about the urban areas of express highways and general ways. As variables for this, we selected as mentioned above, traffic volumes, the number of lanes, median barrier, the number of connection roads(driveway), the number of intersections, and the number of pedestrian traffic signals.

3.4 Analysis Section Selection and the Actual Survey Data

3.4.1 Selection of Analysis Section

We look closely at rules and guideline 9 of structure and facility standard of roads, the design section means the sections between main intersections or main facilities. Based on this, we divided analysis sections of object roads. This paper chose analysis section in general ways, we selected intersections where the same grade roads meet and different grade roads meet based on main intersections for national ways and rural ways as sections. The sections were chosen as analysis points by intersections where two national ways meet, national way and rural way meet, two rural ways meet.

Table 4. Classification Standard of Sections of Object Roads

Road Type	Classification Standard
General Highways (National Ways and Rural Ways)	- Intersection between two national ways - Intersection between national way and rural way - Intersection between rural ways (accident data took place on intersection excluded)

As well, we divide analysis sections on the basis of intersections but accident of intersections was occurred various physical conditions of intersection accidents, we included the number of intersections (unit/km) but excluded accident occurred on the intersections in this study.

3.4.2 Actual Survey Data

In the study, for development of accident predictive model, we analyzed the relations between accidents and factors such as traffic conditions, road conditions and so forth for roads of urban areas within North of Cheolla province. Accident data was accident between 2001 to 2003 so, roads which had changed in terms of traffic conditions and road conditions after 2001 to 2003 were not included in the research. We used AADT as a traffic condition and considered the existence of median barrier as a road condition, and researched the number of existence within selected sections for intersection, connection roads(driveway) and pedestrian traffic signals. As well we studied the number of lanes by separating of two-lanes and four-lanes.

4. DEVELOPMENT OF ACCIDENT PREDICTIVE MODEL AND DATA ANALYSIS

4.1 Analysis of Explanatory Variables

Selected sections mentioned above were a total 102 sections of 55 of two-lane, 25 of four lanes in non-existence of median barrier and 22 of four lanes in existence of median barrier at Table 5. Among them, we developed an accident predictive model with the other analysis sections except the selected sections for model verification.

Table 5. Analysis and Verification Section of Analysis Object

Road Types (General Highways)	The number of total section	The number of analysis section	The number of verification section
Two-lanes	55 sections	40sections	15sections
Existence of Median Barrier	25sections	17sections	8sections
Non-existence of Median Barrier	22 sections	13sections	9sections
Total	102 sections	70sections	32sections

When we look closely the correlation coefficient between explanatory variables of general roads and accidents, as it shows at Table 6, the other variables except median barrier had positive correlation with accidents; median barrier had a negative correlation. Particularly, the number of intersections and pedestrian traffic signals both had the highest correlations with accidents, so we could judge that the number of intersections and pedestrian traffic signals have affected a great deal increase in the number of accident on national ways of urban areas and rural ways. On the other hand, the existence of median barrier has reduced the number of accident.

Table 6. Correlation Analysis between Accident and Variables of General Roads

Variables	Correlation Coefficient	Significant Level
Traffic Volume	0.381	0.001
Median Barrier	-0.336	0.554
Number of Lanes	0.569	0.000
Number of Intersections	0.684	0.000
Number of Connection roads	0.477	0.000
Number of Pedestrian Traffic Signals	0.598	0.000

4.2 Model Development

In this study we grasped factors, which most affected accidents in the urban areas to construct accidents prediction model reflected road characteristics factors according road grades. To select independent variables adapted for a model using grasped factors, we executed the correlation analysis between accidents and the variables suggested before.

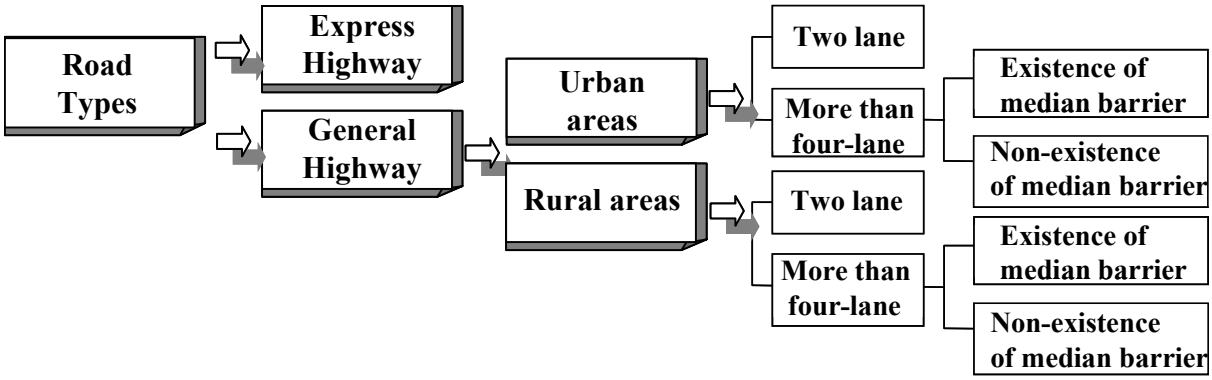

Figure 2. Road Classification of the This Study

For this model, we classified roads into express highways and general roads like Figure 2, and also divided general roads into urban/rural areas in consideration of location characteristics of the roads. Among them, we developed an accident prediction model using multi-regression method according to the number of lanes and existence of median barrier, physical variables of roads for urban areas.

4.2.1 Less than Two-Lane Roads

Looking into the correlation coefficient with accidents in case of less than two-lane from Table 7, among selected variables, the number of intersections and pedestrian traffic signals had the highest in terms of correlation with accidents as 0.602, 0.553 respectively, while the other variables showed low correlation. P values of both the number of intersections and pedestrian traffic signals, as 0.000 proved very significant in 95% of confidence.

Table 7. Correlation with Accidents in Two Lanes Roads

	Number of Accidents	Traffic Volume	Number of Intersections	Number of Connection roads	Number of Pedestrian Traffic Signals
Number of Accidents	1	0.306(0.024)	0.602(0.000)	0.186 (0.179)	0.553 (0.000)
Traffic Volumes	0.306(0.024)	1	0.346(0.010)	0.435 (0.001)	0.312 (0.087)
Number of Intersections	0.602(0.000)	0.346(0.010)	1	0.322 (0.018)	0.247 (0.050)
Number of Connection roads	0.186(0.179)	0.435(0.001)	0.322(0.018)	1	0.244 (0.187)
Number of Pedestrian Traffic Signals	0.553(0.000)	0.312(0.087)	0.247(0.050)	0.244 (0.187)	1

We made a model using multiple regression model seen from Table 8, R^2 was 0.537 so variables like the number of intersections and pedestrian traffic signals had a 53.7% of predictability about the model and P value of the model had 0.000 which showed the model was very significant. When we look into non-standardization coefficient of the selected model, as the number of intersection by one per km increases, accident increases by 1.164 per km, and the number of pedestrian traffic signals increases by one, accident case increases by 0.835 /km. When we look closely at Standardized Coefficient to compare affect of subordinate variables, we could see 0.437 of the number of intersections and 0.304 of pedestrian traffic signals, from that we could conclude the number of intersections had much more influence than the number of pedestrian traffic signals on accidents.

Table 8. Analysis Result of Model of Accident Predictive in Two Lanes Roads

R^2	Adjust R^2	Dubin-Watson	F	Sig.
0.537	0.515	2.294	29.621	0.000

Model	Non-Standardization Coefficient	Standardization Coefficient	t	Sig.	Collinearity Statistics		Condition Index
					Tolerance	VIF	
Constant	0.174	-	1.611	0.113	-	-	1.000
Number of Intersections	1.164	0.437	3.974	0.000	0.800	1.249	2.725
Number of Pedestrian Traffic Signals	0.835	0.304	2.584	0.013	0.800	1.249	3.000

Result of diagnosing multi-collinearity, tolerance limit values of 0.800, VIF values of 1.249 and condition index values of 2.725, 3.000 respectively, which meets the standard and it

appeared no problem in multi-collinearity we could see Dubin-Watson where we can examine autocorrelation of error is 2.294, explaining existence of independence of errors. The number of intersections has the largest effect on accidents in case of less than two-lane in the urban areas. Therefore, as the number of intersections becomes larger, accidents take place a lot, as average interval of intersections become shorter, the possibility of accidents could be high and it is desirable to reduce intersected roads and adjust the distribution intervals of intersections for minimizing accidents, we think. The result of accident case predictive model for two-lane is as the same as below.

$$Y=0.174+1.164\times(X_1) + 0.835\times(X_2) \quad (1)$$

Where,

Y: Number of Accident (accident/km), X_1: Number of Intersections (unit/km)

X_2: Number of Pedestrian Traffic Signals (unit/km)

4.2.2 More than Four Lanes Roads in Non-Existence of Median Barrier

When we look into the correlation coefficient with accidents in case of more than four lanes and non-existence of median barrier from Table 9, we could see all variables had positive correlation with accidents, among them; both the number of intersections and connection roads had the highest correlation with accidents. Due to P values of both the number of intersections and connection roads with values less than 0.005, it appeared very significant within 95% of confidence. Particularly, the number of pedestrian traffic signals and the number of intersections showed negative correlation. The number of pedestrian traffic signals has been shown to drop in proportion to increase in the number of intersections within the same sections. After construction of the model using Stepwise method of multiple regression models, as it shows at Table 10, we could identify when R^2 was 0.672 so the number of intersections had 67.2% of predictability about the model.

Table 9. Correlation with Accident of Non-Existence of Median Barrier in Four Lanes

	Number of Accidents	**Traffic Volume**	**Number of Intersections**	**Number of Connection Roads**	**Number of Pedestrian Traffic Signals**
Number of Accident Cases	1.000	0.463(0.082)	0.820(0.082)	0.616(0.014)	0.320(0.245)
Traffic Volumes	0.463(0.082)	1.000	0.503(0.056)	0.591(0.020)	0.074(0.794)
Number of Intersections	0.820(0.000)	0.503(0.056)	1	0.734(0.002)	-0.126(0.653)
Number of Connection roads	0.616(0.014)	0.591(0.020)	0.734(0.002)	1	0.110(0.695)
Number of Pedestrian Traffic Signals	0.320(0.245)	0.074(0.794)	0.126(0.653)	0.110(0.695)	1

Table 10. Analysis Result of Accident Predictive Model of Non-Existence of Median Barrier in Four Lanes

R	R^2	Adjust R^2	Dubin-Watson	F	Sig.
0.820	0.672	0.647	2.445	26.681	0.000

Model	Non-Standardization Coefficient		Standardization Coefficient	t	Sig.
	B	SE	Beta		
Constant	0.920	1.083	-	0.849	0.411
Number of Intersections	3.135	0.607	0.820	5.165	0.000

P value also had a statistically significant level of 0.000. We judge Dubin-Watson value of 2.445 had an independence between errors. In case of four lanes and non-existence of median barrier, the result of traffic accident predictive model is as the same as formula (2).

$$Y=0.920+3.135\times(X_1) \quad (2)$$

Where,

Y: Number of Accident (accident/km), X_1: Number of Intersections (unit/km)

4.2.3 More than Four Lanes Roads in Existence of Median Barrier

When we look into the correlation coefficient with accidents in case of more than four lanes in existence of median barrier from Table 11, all selected independent variables showed positive correlation. Among them, correlation between traffic volumes and the number of intersections had the highest. All other independent variables except the number of pedestrian traffic signals had a significant level statistically because of P values of them indicating values less than 0.05.

Table 11. Correlation with Accidents of Existence of Median Barrier in Four Lanes

	Number of Accidents	Traffic Volume	Number of Intersections	Number of Connection roads	Number of Pedestrian Traffic Signals
Number of Accidents	1	0.700(0.016)	0.864(0.000)	0.667(0.025)	0.457(0.155)
Traffic Volumes	0.700(0.016)	1	0.728(0.011)	0.862(0.001)	0.390(0.235)
Number of Intersections	0.864(0.000)	0.728(0.011)	1	0.602(0.000)	0.158(0.735)
Number of Connection Roads	0.667(0.025)	0.862(0.001)	0.602(0.000)	1	0.676(0.022)
Number of Pedestrian Traffic Signals	0.457(0.155)	0.390(0.235)	0.158(0.735)	0.676(0.022)	1

We got that R^2 equals 0.746 at Table 12 by building up a model with Stepwise method of multiple regression model, P value was 0.001 and it was comparatively meaningful within 95% of confidence level in the whole model, and also we found that there was independence in among errors because Dubin-Watson value was 2.287.

Table 12. Analysis Result of Accident Prediction of Existence of Median Barrier in Four Lanes

R	R^2	Adjust R^2	Dubin-Watson	F	Sig.
0.864	0.746	0.717	2.287	26.386	0.001

Model	Non-Standardization Coefficient		Standardization Coefficient	t	Sig.
	B	SE	Beta		
Constant	0.729	0.456	-	1.601	0.144
Number of Intersections	1.757	0.342	0.920	5.137	0.001

The result of traffic accident predictive model, in case of four-lane and existence of median barrier, is as the same as formula (3).

$$Y=0.729+1.757\times(X_1) \quad (3)$$

Where,

Y: Accident (accident/km), X_1: Number of Intersections (unit/km)

A model formula constructed by road types in the urban area is as the same as.

Table 13. Model Formula by Road Types

Road Types			Model Formula
General Highways	Two Lanes		$Y=0.174+1.164\times(X_1)+0.835\times(X_2)$
	More than Four-lane	Existence of Median Barrier	$Y=0.920+3.135\times(X_1)$
		Non-existence of Median Barrier	$Y=0.729+1.757\times(X_1)$

Where, Y: Number of Accidents (accident/km), X_1: Number of Intersections (accident/km)
X_2: Number of Pedestrian Traffic Signals (accident/km)

5. VERIFICATION OF MODEL

It is necessary that prediction accident cases from our analysis of data should be verified for having a confidence with real accident data. We verified an accident prediction model developed and selected by 15 of two lane, 8 of non-existence of median barrier in four-lane, 9

of existence of median barrier in four lane for verification. The result showed that R of model by road types were all meaningful statistically, as you see Figure 3 ~ Figure 5, we could see it has shown a little bit good estimation because of all the same distribution between prediction accident data and actual accident ones. Besides, we verified actual accident data and estimation by statistical method using minimum root square error(Root Mean Square Error; RMSE).

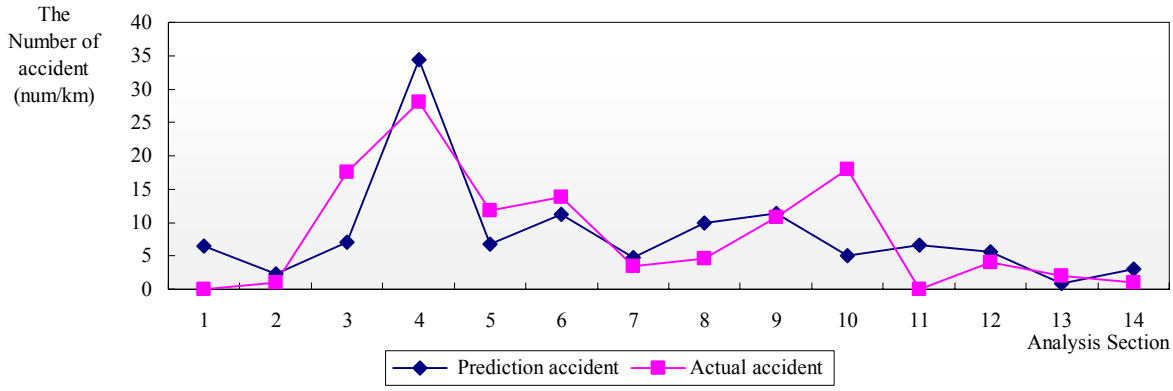

Figure 3. Comparison of Prediction/Actual Accident in two lanes

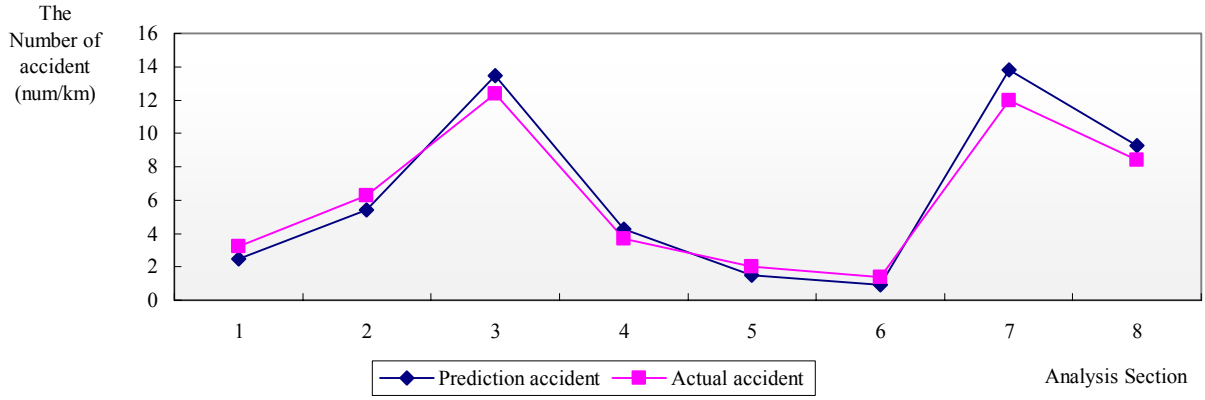

Figure 4. Comparison of Prediction/Actual Accident of Existence of Median Barrier in Four lanes

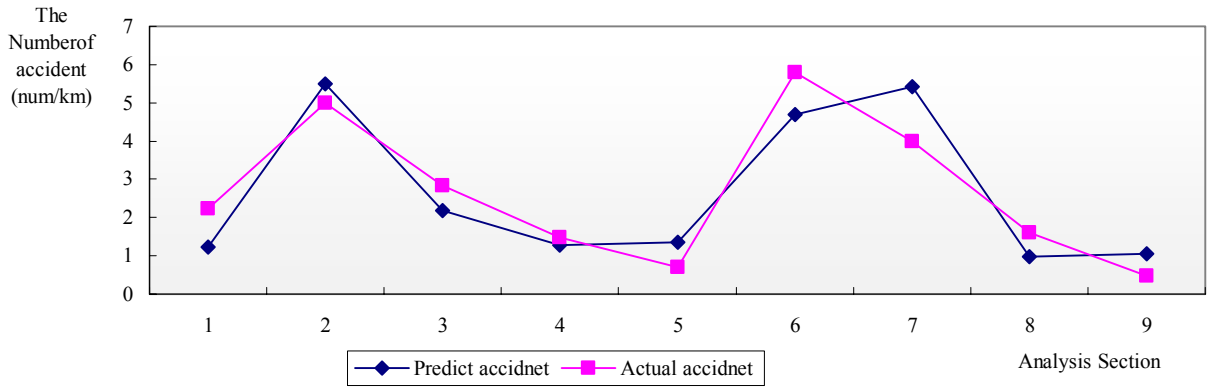

Figure 5. Comparison of Prediction/Actual Accident of Non-Existence of Median Barrier in Four Lanes

After verifying a model built up by each road type, we found RMSE of two lanes in the urban areas, four lanes in the urban areas in existence of median barrier, four lanes in the urban areas in non-existence of median barrier, 0.748accidnet/km, 0.905accidne /km, 1.028accidne/km respectively like Table 14 and we concluded that this was relatively significant in term of accident data.

Table 14. Minimum Root Square Error by Each Road Type

Road Type		RMSE(accident/km)
General Highways	Two Lanes	0.748
	More than Four-lane, Non-existence of Median Barrier	0.905
	More than Four-lane, Existence of Median Barrier	1.028

6. CONCLUSIONS

This study suggested a method to prediction accidents by considering physical and traffic characteristics of each road. For this, we analyzed road-characteristic causes to accidents of single roads of national highway and local roads within city areas in North Cheolla province and selected road-characteristics causes affected accidents analyzing the relations between causes and accidents. The standard for selection was to be main factors which could be acquired at the road plan steps, you could see each cause was similar to accidents statistically. Based on this, we proposed a model to prediction accident-occurring possibilities of those sections according to the physical factors of the roads. The results from accident prediction model developed by selected variables showed that in case of two lanes road, the number of intersections and pedestrian traffic signals, and in case of the existence of four lanes road and median barrier, the number of connection road respectively. The values compared to accident per road type accident/km suggested by our results and the Korea Development Institute is shown at Table 15.

Table 15. Death Costs from Accidents for Each Road Type

Korea Development Institute		Test Result in This Study			
Road Type	Number of Accidents per km	Road Type			Number of Accidents per km
General National Road	5.92	Two Lanes		General national ways	5.41
				Local road	0.72
		Four Lanes	Non -Barrier	General national ways	3.73
				Local road	1.41
Local Road	1.49		Existence Barrier	General national ways	2.63
				Local road	1.28

Although standards both the Korea Development Institute and our study are different and difficult for direct comparison, as a whole, they have similar results. However, our study applied more detailed classification standard and predicted accidents. If you use the result of this research, you could execute safety evaluation about various alternatives in case planning new road business and could calculate results in detail for accidents reduction benefit when survey for validity of road business. This study has a limit to research North Cheolla province data, which requires a comprehensive study based on nationwide accidents documents. And we judge it needs to divide the regions into urban and rural areas by the gaps of intersections to the accident predictive model from the start of the planning, so it is expected that some other researchers take part in the study considering the gaps of intersections from now on.

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