International Journal of Engineering Science Invention
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 5 Issue 11|| November 2016 || PP. 90-94

The Study on Method to Determine the Priority in Sidewalk Installation on Rural Road

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Abstract:*A sidewalk as part of the road facilities to secure the pedestrian safety in Korea shall be provided when the pedestrian and vehicle traffic reach to a certain level but applying this regulation to the rural road where there are less pedestrian traffic but vehicle traffic at high speed and thus the driver's attention to the pedestrians is relatively low is not rational. Thus the installation of the sidewalk shall be determined, taking into account of the pedestrian traffic accident record and the characteristics from the viewpoint of traffic environment to the pedestrian. Installation of sidewalk is greatly dependent on economic efficiency, particularly to the rural road. For rational investment within the given budget, it's necessary to determine the priority with regard to sidewalk installation, considering the pedestrian safety, regional society's need and installation effect comprehensively. Thus this study is intended to propose the evaluation items and quantitative method with regard to the installation priority in consideration of the function of the road to be installed, regional social and cultural characteristics and overall road and traffic conditions such as pedestrian traffic pattern and school.*
Keywords:*sidewalk, rural road, pedestrian, priority, weight factor*

I. Introduction

Behind the rapid economic development in Korea, a volume-oriented and vehicle-focused policy has been mainly implemented. As a result, sidewalk was missing from the project, despite of the absolute need for the safety of the pedestrian near the town or school, due to budget problem, which has caused the threat to pedestrian traffic and accessibility as well as increased traffic accident while the pedestrian was walking. Poor traffic condition for the pedestrian accounts for 22% of the total accident and 38% of the death toll (2015) indicating the accident between vehicle and pedestrian, and thus safeguard for the pedestrian is more than critical now.

A sidewalk which is the part the road facilities for pedestrian traffic safety shall be provided in case of the pedestrian traffic 150 persons/day and vehicle traffic 2,000 cars/day in accordance with the 「Regulation on standard for road structure . facilities (2009). In urban road where pedestrian traffic is high, sidewalk is available mostly while rural road which fails to meet the installation requirements lacks the sidewalk in general. Given the seriousness of fatal pedestrian accident, life of rural residents and comfort traffic, safeguard for the pedestrians shall be provided as needed, but for rational investment within a given budget, it's necessary to determine the priority with regard to sidewalk installation, considering the pedestrian safety, regional society's need and installation effect comprehensively. Particularly, frequency of the accident at same spot and damage are important data in determining the safety of the spot which shall be considered in determining the priority of sidewalk installation but given the additional purpose to enhance the user's convenience and grant the passage right, besides the safety of the pedestrian, it's desirable to determine the priority, taking account of others such as accident pattern, damage and school zone function.

Thus this study is intended to propose the evaluation items and quantitative method with regard to the installation priority in consideration of the function of the road to be installed, regional social and cultural characteristics and overall road and traffic conditions such as pedestrian traffic pattern and school.

II. Review of the Standard for Installing Sidewalks

(1) Korea: Regulation on standard for road structure and facilities (2009, MOLIT)

A sidewalk shall be provided in case of the pedestrian traffic 150 persons/day and vehicle traffic 2,000 cars/day and a sidewalk shall be in principle separated from the vehicle traffic for safe and smooth traffic and economic condition, facility efficiency and improvement of traffic safeguard shall be considered. The width of sidewalk shall be at least 2.0m to accommodate two persons crossing each other at a time but when refurbishing existing rural and urban road or the available space is insufficient to provide 2.0m width, effective width may be reduced to 1.5m according to the regulation.

(2) USA: A Policy on Geometric Design of Highways &Streets(2001), Design and Safety of Pedestrian Facilities(1994)
Pedestrian's pattern is defined as follows in the United States, which is recommended in determining the location of sidewalk.

- The pedestrian tends not to consider 1.5km or longer as commuter distance.
- The pedestrian considers 1.0km or longer as the limit to walk to take the bus. 80% of walk to take the bus was 1.0km or less.
- 50% of Pedestrian walk is for shopping and 11% only for commuting and thus heaviest pedestrian traffic is around the noon, not commuting hours and mean walking speed is 0.8 ~ 1.8m/s.
- Regulation on width of sidewalk is defined as follows.
- Minimum 1.5m wide at commercial-industrial district with a 60cm-wide way marking
- Minimum 1.5m wide at residential area away from main commercial district with a 60cm-wide way marking
- Minimum 1.5m wide with a 60cm-wide way marking when 4 households or more per acre
- Minimum 1.2m wide with a 60cm-wide way marking when 4 households or less per acre

3) Australia: Guide to Traffic Engineering Practice Part13-Pedestrians(1995)
In Australia, sidewalk depending on pedestrian traffic only is considered not to be desirable because sidewalk may cause the pedestrian traffic and the sidewalk is provided to the location with heavy pedestrian traffic. Pedestrian traffic is excluded from regular investigation by the road manager and thus it's difficult to predict the pedestrian traffic and regional development density serves the indicator of the need for installing the sidewalk. 1.2m is appropriate as minimum width at most of the roads except commercial district and as the minimum width to accommodate the wheelchair is 0.9m, 1.8m is suggested as the minimum width to accommodate two wheelchairs.

Table 1. Width of sidewalk in Australia

Installation requirements	Width
General minimum width Absolute minimum width	1.2m 0.9m
High pedestrian traffic	2.4m
Width to accommodate 2 wheelchairs Absolute minimum width	1.8m 1.5m
The handicapped	1.0 ~ 1.8m

4) Canada: Roads and Transportation Association of Canada, Manual of Geometric Design Standards for Canadian Roads(1986)
In Canada, a sidewalk shall be, in principle, provided along the urban road at both sides, except the traffic is very low. And a sidewalk shall be provided on rural road where densely populated or commercially developed area.On assumption that the sidewalk is not used for other purpose, 1.8m width is proposed when multi families are concentrated. When neighboring the school, office or factory, additional width is need because the pedestrian might be concentrated at peak hours and at least 2.5m width is needed near the shopping or recreation facilities and additional width may be required. As a pair of pedestrian is usual, 1.5m is considered the minimum width. Table 2 shows the standard for sidewalk by country.

Table 2. Standard for sidewalk by country

	Korea	USA	Australia	Canada
Installation location	Pedestrian 150ped/day Vehicle 2,000veh/day	No specific standard	Considering regional development density	-All in urban area -School, shopping center etc in rural area
Min width	1.5m	1.5m	1.2m	1.5m
Features	Specific guideline for sidewalk	-Regulation on safeguard for the handicapped -Design considering pedestrian pattern recommended	-Need of design considering the old & infirm stressed -Guideline for crosswalk (pedestrian island) by road	No specific guideline for sidewalk
Separation from road	-Separation using curb and fence -Higher than road surface	No specific standard	No specific standard	Guideline for vertical and inclined curb

Method to Determine the Priority for Sidewalk Installation

1) Determination of the importance by evaluation item (survey)

To determine the evaluation elements to be considered in deciding the priority for sidewalk on rural road by the traffic & road experts, the survey of the experts in the field of road plan, design and safety which totaled 30 persons was conducted.

Among the elements that may influence on pedestrian safety and passage right, the data that can be collected by the road management agency was gathered. As a result of analysis, the experts answered that pedestrian traffic shall be considered first and surrounding development, pedestrian traffic accident and pedestrian-related operation factor shall be also included (see Table 3). Weighted value was determined by comparing the point distributed depending on importance (1~5) and the sum calculated in a way of multiplying by the number of respondent.

Table 3. Distribution of respondents to importance in determining the priority to sidewalk

Category	Respondents					total	weight value	Note
	not important at all	not important	average	important	very important			
surrounding development	0	0	2	15	13	30	131	-
pedestrian accident	0	0	4	11	15	30	131	pedestrian fatality , number of accident
vehicle traffic	2	4	12	8	4	30	98	-
pedestrian traffic	0	1	1	7	21	30	138	-
speed limit	3	7	12	8	0	30	85	-
road width factors	0	2	16	12	0	30	100	road width, paved/unpaved shoulder width, No. of lane
geometry	1	13	10	6	0	30	81	tangent /curve section
comments	0	1	11	12	6	30	113	resident, official, police, insurance company, road management agency
pedestrian- related factor	0	0	5	18	7	30	122	bus stop, pedestrian signal, crosswalk, stop line or centerline discontinued

Base : not important at all=1, not important=2, average=3, important=4, very important=5

2) Definition of methodology to estimate the score for evaluating the priority

Evaluation factors in determining the priority were further classified depending on effect on pedestrian safety and categorized into 2~5 grades as Table 4. 10 was given to the highest need and was evenly distributed by number of grade.

Table 4. Evaluation factors and point by grade

Evaluation factors	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Student's path	top priority to the school zone				
pedestrian traffic (ped/day)	300 ≤	200 ≤	150 ≤	100 ≤	100 >
point	10	8	6	4	2
pedestrian accident (acc/year)	top 25%	top 50%	top 75%	top 100%	0
point	10	8	6	4	2
surrounding development	downtown	rural shops	rural house	rural farmland	-
point	10	7.5	5	2.5	-
urgency of sidewalk	high	average	low	-	-
point	10	6	3	-	-
shoulder width (m)	1.0 <	1.0 ≤	1.5 ≤	2.0 ≤	-
point	10	7.5	5	2.5	-
vehicle traffic(veh/day)	10,000 ≤	5,000 ≤	2,000 ≤	1,000 ≤	1,000 <
point	10	8	6	4	2
speed limit (km/h)	70 ≤	60 ≤	50 ≤	40 ≤	40 <
point	10	8	6	4	2

Weighted value by evaluation factor for the priority to sidewalk was determined based on survey with the experts which was arranged in order of higher score and classified into 3 groups to give weighted value 3:2:1. 3 was given to pedestrian traffic, pedestrian accident and surrounding development and 2 was given to urgency of sidewalk and shoulder width and 1 was given to daily traffic and speed limit. But the points on the student's movement path was given the top priority even in case of low points considering the pedestrians are children who are vulnerable to the accident.

Table 5. Weighted value by evaluation factor for sidewalk

Evaluation factor	Point	Order	W/value	Note
Student's path	-	-	-	Top priority
pedestrian traffic (ped/day)	138	1	3	-
pedestrian accident (acc/year)	131	2	3	-
surrounding development	131	3	3	-
urgency of sidewalk	113	4	2	-
shoulder width (m)	100	5	2	-
vehicle traffic(veh/day)	98	6	1	-
speed limit (km/h)	85	7	1	-

Table 6 is the evaluation score obtained by incorporating weighted value in Table 5 into the points by grade in Table 4 and evaluation points to determine the priority are calculated by summing up the individual points by evaluation factor.

Table 6. Classification of the grade and points considering weighted value

Evaluation factors	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Student's path	top priority to the school zone				
pedestrian traffic (ped/day)	300 ≤	200 ≤	150 ≤	100 ≤	100 >
point	30	24	18	12	6
pedestrian accident (acc/year)	top 25%	top 50%	top 75%	top 100%	0
point	30	24	18	12	6
surrounding development	downtown	rural shops	rural house	rural farmland	-
point	30	22.5	15	7.5	-
urgency of sidewalk	high	average	low	-	-
point	20	12	6	-	-
shoulder width (m)	1.0 <	1.0 ≤	1.5 ≤	2.0 ≤	-
point	20	15	10	5	-
vehicle traffic(veh/day)	10,000 ≤	5,000 ≤	2,000 ≤	1,000 ≤	1,000 <
point	10	8	6	4	2
speed limit (km/h)	70 ≤	60 ≤	50 ≤	40 ≤	40 <
point	10	8	6	4	2

Table 7 explains the calculation of evaluation point at the point using Table 6 by example.

Table 7. Example of the points calculated for a certain point

평가요소	Grade	standard	calculation of points
Student's path	No student's path		◦ No student's path function ◦ pedestrian traffic = 30 ◦ pedestrian accident = 6 ◦ surrounding development = 22.5 ◦ urgency of sidewalk= 12 ◦ shoulder width = 10 ◦ daily mean traffic= 8 ◦ speed limit = 8
pedestrian traffic (ped/day)	1	300 ≤	
point		30	
pedestrian accident (acc/year)	5	0	
point		6	

surrounding development point	2	rural shops 22.5	◦ Points at certain section = 30+6+22.5+12+10+8+6 = 94.5
urgency of sidewalk point	2	average 12	
shoulder width (m) point	3	1.5 ≤ 10	
vehicle traffic(veh/day) point	2	5,000 ≤ 8	
speed limit (km/h) point	2	60 ≤ 8	

III. Conclusion

The road is essential facilities for human activities which however requires a huge cost for construction. Road c onstruction is implemented, considering the road functionality, cost efficiency, safety and environment but as th e policy focuses on extending the length with a limited budget, inferior quality often causes the problem. Howe ver from the viewpoint of emphasizing the life safety and pedestrian-centered traffic system, sidewalk on rural r oad which has long been neglected to improve shall be provided extensively more than ever. Despite of such im portance, economic feasibility of road construction including sidewalk, limit in land available for sidewalk and l and acquisition still remain the pending issue to deal with.

Sidewalk has the limit to the great extent in terms of economic construction, particularly to the rural road. Thus decision shall be made taking into account of vehicle speed, visibility of the pedestrian and walking network co mprehensively, instead of focusing on pedestrian or vehicle traffic volume alone. In addition, a sidewalk plan sh all be developed from the viewpoint of overall road network, breaking from the regional facility issue in conside ration of the problem in aging society or increasing number of pedestrian. This study is intended to develop the evaluation items and quantitative method for determining the priority to provide the sidewalk, considering the g eneral road and traffic conditions through the survey of the experts and statistical analysis, which would make c ommitment to executing the limited budget in optimal way as well as establishing the pedestrian safety plan.

The energy for road transport is all imported and the need for reducing the domestic and nationwide energy cons umption is on the rise and public transport or bike is strongly recommended as the bike and walking which are e nvironment-friendly prevents environmental pollution as well as brings about the healthy life. In future, regional and interregional plan on bike path and pedestrian path shall be developed nationwide so as to provide the road system that will upgrade the people's life quality a notch.

Acknowledgements

This research was supported by a grant from a Strategy Research Project (Development of Enhancement and Evaluation Technologies for Driver's Visibility on Nighttime – 1st research field: Development of Enhancement Technology for Driver's Visibility on Nighttime) funded by the Korea Institute of Civil Engineering and Building Technology.

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