

# The Analysis of User Cost according to Timing of National Highway Pavement Maintenance – Focusing on the Maesang Bridge Section in Korea

Yunsik Kim<sup>1</sup> and Minjae Lee<sup>2</sup>

**Abstract:** The traffic volume on the road shows various trends reflecting regional characteristics for monthly and hourly, and economic loss affecting users varies according to the selected period for the maintenance of road pavements. Therefore, in this study, the user cost (or delay cost) for monthly and hourly on the work zone near the Maesang Bridge Section on Poseung-Gu, Pyeongtaek-si, Gyeonggi-do was calculated using the time series models and VISSIM, and based on the result, the effect of user cost reduction according to the selection of best maintenance period was examined. The analysis result showed that the month of the lowest user cost occurred due to the maintenance of target section was January (10,293,258 KRW/Day×1km) and the month of the greatest user cost occurred was November (13,337,495 KRW/Day×1km).

**Keywords:** User Cost, Delay Cost, Traffic Flow Model, Vissim

## I. INTRODUCTION

The importance of efficient SOC(Social overhead capital) facility management has been recognized by Korea as well as many advanced countries so that many studies are being carried out, and various analysis techniques including LCCA(Life cycle cost analysis) and probability analysis are being introduced for decision making on efficient asset management of SOC.

In LCCA, decision making was carried out previously by drawing conclusions based on the administrator cost, but the user cost is being considered and reflected on decision making recently.

Meanwhile, the road traffic volume tends to reflect regional characteristics and the characteristics of time series changes. If the maintenance period is selected by considering such characteristics of time series changes of traffic volume, it would be possible to minimize user cost in decision making.

In order to examine the user cost reduction effect according to the selection of optimal maintenance period, the monthly and hourly user cost for a specific target zone due to the maintenance was estimated.

## II. ANALYSIS OF USER COST ACCORDING TO TIMING OF MAINTENANCE

137 zones, where traffic volume data could be collected, out of 345 zones included in the application scope of national road maintenance budget were identified through the connection with TMS(Traffic monitoring system), and Maesang Bridge section was selected randomly as the target zone and the analysis was carried out. VISSIM simulation was used as the analysis method to estimate the traffic flow model of the target zone, and the monthly and hourly user cost was calculated using the estimated traffic flow model and the road benefit calculation model from investment evaluation guide for transportation facilities (Fifth revision) and the conclusion was drawn.

As a result of estimating the Greenshields model, Greenberg model and underwood model based on the simulation result using VISSIM, the coefficient of determination ( $R^2$ ) of Underwood model were 0.8629 and 0.9168 respectively, higher in comparison to the models as shown in Table I. so it was determined as the most appropriate model. Therefore, the speed according to hourly traffic volume of target zone using the Underwood model was calculated. Table II shows the VQK curve of

TABLE I  
 COEFFICIENT OF DETERMINATION OF TRAFFIC FLOW MODEL

Classification	Before work		During work	
	Number of observation (n)	Coefficient of determination ( $R^2$ )	Number of observation	Coefficient of determination ( $R^2$ )
Greenshields	26,578 units	0.8445	16,610 units	0.819
Greenberg		0.6705		0.7632
underwood		0.8629		0.9168

<sup>1</sup> Yunsik Kim' Ph.D candidate, Daejeon Yuseong-gu Daehak-ro 99 Chungnam University College of Engineering 2 130, yskim@cnu.ac.kr

<sup>2</sup> Minjae Lee' Professor, Daejeon Yuseong-gu Daehak-ro 99 Chungnam University College of Engineering 2 218, lmjcm@cnu.ac.kr (\*Corresponding Author)

TABLE II  
 VQK CURVE OF UNDERWOOD MODEL

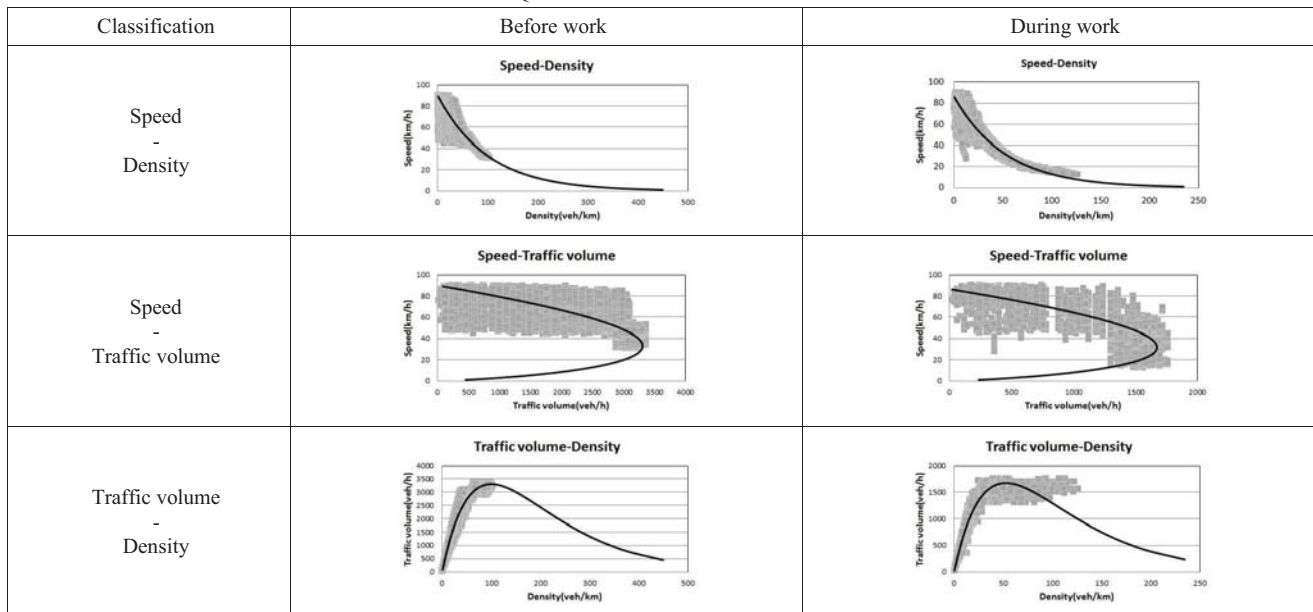


TABLE III  
 MONTHLY USER COST AND BENEFIT BEFORE AND AFTER WORK

Classification	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Before work	9,307,145	9,406,007	9,803,054	10,403,761	10,706,607	10,505,452	10,002,581	10,605,465	10,605,465	11,113,189	11,215,357	10,002,581
After work	10,293,258	10,431,303	11,001,929	11,924,947	12,425,111	12,088,371	11,299,679	12,255,018	12,255,018	13,145,572	13,337,495	11,299,679
User benefit	-986,112	-1,025,296	-1,198,875	-1,521,186	-1,718,503	-1,582,920	-1,297,098	-1,649,553	-1,649,553	-2,032,383	-2,122,138	-1,297,098

estimated Underwood model.

Monthly user cost and benefit before and after work on the target zone were calculated using the speed according to the hourly traffic volume of the target zone estimated by the Underwood model and the road benefit calculation model from investment evaluation guide for transportation facilities (Fifth revision) were calculated, and the result is as shown in Table III.

### III. CONCLUSION

The analysis result shows that the target zone with approximately 20,000 units of AADT passage is the zone where annual average user cost of 10,306,389 KRW/Day×1km occurs before work, and the highest user cost of 11,215,356 KRW/Day×1km occurs on November and the lowest user cost of 9,307,145 KRW/Day×1km occurs on January. Also, the annual average user cost of 11,813,115 KRW/Day×1km occurs, and the highest user cost of 13,337,495 KRW/Day×1km occurs on November and the lowest user cost of 10,293,258 KRW/Day×1km occurs on January.

Meanwhile, the user benefit due to the maintenance work was lowest on November as -2,032,383 KRW/Day×1km and highest on January as -986,112 KRW/Day×1km. In case the maintenance plan for the target zone is established in consideration of user cost, (except for January, February and December which are considered as not proper for the maintenance period) March is considered as the most proper period.

Also, in case it is assumed that the network-level road maintenance work which was similar AADT characteristics of the target zone is carried out for 30 days, the difference in the user cost due to works carried out on November and March is 70,066,980 KRW/30 Days×1km, and the difference in user cost and benefit is -27,697,890 KRW/30 Days×1km, showing that there is a significant difference in user cost and benefit that could be obtained through the establishment of proper maintenance plan.

### ACKNOWLEDGEMENT

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