ANALYSIS OF KEY FACTORS THAT AFFECT BICYCLE LEVEL OF SERVICE

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ABSTRACT

In this paper are analyzed the factors which influence the bicycle level of service in urban streets and intended to give an overview of the factors most likely to affect bicycle Level of Service. The most important variables were found to be analyzed: number of right hand side driveways, segment length, parking and shoulder width, pavement condition, and parking occupancy. Auto speed and all the variables that affect it can also influence the bike score with faster speeds making the LOS score worse. The shoulder parking, lane width and pavement condition will be analyzed as main factors which affecting bicycle LOS. In this paper will be used Bicycle Level of Service Model (Version 2.0) which is the most accurate model of evaluating the bicycling conditions of shared roadway environments.

Keywords: level of service, traffic flow, pavement condition, parking occupancy, segment length, shoulder width.

1. INTRODUCTION

Road suitability measures have been developed in recent years that help planners, engineers and citizens to understand how well their roads serve bicyclists.

This study was done for the first time in Prishtina and focused to arterial, fast local roads and local roads, because they have different geometric characteristics and different volumes of motor vehicle traffic at the highest speeds and often provide the worst service bicyclists who choose to use them (Fig.1).

In this paper are used data from Municipality of Prishtina (Department of Transportation) for the arterial and collector road network. Road suitability measures use informations about a road, such as traffic volumes and speeds, lane widths and sidewalk dimensions, to rate the bicycle friendliness of the road.
It should also be noted that the Microsoft Excel is used to calculate the geometric and other input data, while LOS grade in the charts are obtain with the help of Transcad and Mathcad software.

![Figure 1. Arterial, fast local and local road in Prishtina](image)

2. BICYCLE LEVEL OF SERVICE MODEL

Bicycle Level of Service (BLOS) model (Version 2.0) was developed as a linear regression model by transportation researchers. The BLOS regression equation (version 2.0) provides a discomfort and inconvenience score for bicycle travel by taking into account four prevailing roadway and traffic conditions:

1. Peak traffic flow in the outside lane
2. Speed of traffic and percent of heavy traffic
3. Pavement surface condition
4. Pavement width available for bicycling

The first three variables are impact scores and reflect perceived challenges to bicycling. The fourth variable is a benefit score and reflects perceived opportunities to bicycling. Landis et al. developed the Bicycle Level of Service (1997) using a different technique. The research involved riders on actual field courses, instead of cyclist reaction to filmed conditions.

BLOS is similar to BCI in its sensitivity to curb lane width. Its traffic volume dependence is logarithmic, increasing the impact of changes at low and medium traffic levels. Additional paved shoulder or bike lane width affect the BLOS score somewhat more than the BCI. Ignored are development type, parking, and right-turning traffic, but bad pavement surfaces and higher heavy vehicular traffic have a major impact. Further work is planned for rural highways and for central business district roads with high parking turnover. As a result, Version 2.0 has the highest correlation coefficient (R2 = 0.77) of any form of the Bicycle LOS Model.
BLOS = 0.507 ln \left( \frac{Vol_{15}}{ln} \right) + 0.199 SP_t(1 + 10.38 HV)^2 + 7.066 \left( \frac{1}{PR_5} \right)^2 - 0.005 (W_e)^2 + 0.760 \quad (1)

Where:

\( Vol_{15} \) = Volume of directional traffic in 15 minutes = \( (ADT \cdot D \cdot K_d)/(4 \cdot PHD) \),

\( ADT \) = Average Daily Traffic on the segment,

\( D \) = Directional Factor,

\( K_d \) = Peak to Daily Factor,

\( PHF \) = Peak Hour Factor,

\( L_n \) = Number of directional through lanes,

\( SP_t \) = Effective speed limit = \( 1.1199 \cdot \ln(SP \cdot 20) + 0.8103 \), where \( SP \) is the posted speed limit,

\( HV \) = Percentage of heavy vehicles (as defined in the 1994 Highway Capacity Manual)

\( PR_5 \) = FHWA's 5-point pavement surface condition rating (5 = best)

\( W_e \) = Average effective width of outside through lane:

\( W_e = W_e - (10 \cdot OSPA) \) where \( Wl = 0 \),

\( W_e = W_e - Wl (1 - 2 \cdot OSPA) \) where \( Wl > 0 \) & \( W_{ps} = 0 \),

\( W_e = W_e + Wl - 2(10 \cdot OSPA) \) where \( Wl > 0 \), \( W_{ps} > 0 \) and bike lane exists,

\( W_e \) = Total width of outside lane (and shoulder) pavement

\( OSPA \) = Fraction of segment with occupied on-street parking

\( Wl \) = Width of paving between outside lane stripe and edge of pavement

\( W_{ps} \) = Width of pavement striped for on-street parking

\( W_e \) = Effective width as a function of traffic volume

\( W_e = W_t \) if \( ADT > 4000 \) veh/day

\( W_e = W_t \left( 2 - \left( \frac{ADT}{4000} \right) \right) \) if \( ADT < 4000 \) and road is undivided and unstriped.

Bicycle Level of Service ranges associated with level of service (LOS) designations:

<table>
<thead>
<tr>
<th>BLOS</th>
<th>( \leq 1.50 )</th>
<th>1.51-2.50</th>
<th>2.51-3.50</th>
<th>3.51-4.50</th>
<th>4.51-5.50</th>
<th>( &gt;5.50 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS Level</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
</tbody>
</table>

3. APPLICATION OF BLOS MODEL - APPLICATION EXAMPLES

Based on the BLOS model, the factors that most significantly affect the bicycle level of service on shared roadways in Pristina are the lane widths, the motor vehicle traffic volume and the pavement surface condition. The presence of a bicycle lane is a major factor in the BLOS model, indicating that bicyclists who participated in the BLOS study generally felt more comfortable on roadways with space designated for their use.

Figure 2, 3 and 4, provides several examples of the BLOS methodology applied to arterial, fast local road and local road, with different geometric characteristics and different volumes of motor vehicle.
Figure 2. BLOS Application Examples for Arterial road

Figure 3. BLOS Application Examples for Fast Local Road

Figure 4. BLOS Application Examples for Local Road
Previous research found that a large number of variables had an effect on bicycle LOS. But, the most important variables were found to be analysed in this research are: traffic volume, parking and shoulder width, pavement condition, and parking occupancy. Graphical representations of these factors’ affect on bicycle LOS are shown in Figure 4, 5 and 6.

As shown in Fig. 4, effect of increasing traffic volume worsens steadily from very low to very high traffic and BLOS show relatively little change until higher traffic levels. The final two main factors affecting bicycle LOS are pavement condition and parking occupancy (Fig.5 and Fig.6).

Pavement condition is rated on a 1-5 scale developed by the Federal Highway Administration (FHWA) with 1 being the worst and 5 being the best. The bicycle LOS methodology developed by NCHRP 3-70 has little sensitivity after pavement condition 3 but is highly sensitive to bad pavement.

Parked cars tend to force bicyclists closer to moving traffic which will reduce their overall experience of the study corridor. With no parked cars on the street, the parking spacesessentially act as a large shoulder for bikes to use. This improves the LOS score by about 10% over a street where 50% of the length is occupied by parked vehicles.
4. CONCLUSIONS

Although bicycle LOS was found to be sensitive to a large number of factors, LOS score could not improve dramatically unless the pavement condition was poor. Poor pavement condition can result deterioration in bicycle LOS much more than parking occupancy and traffic volume. The study results underscore the influence that on-street parking has on bicycle route choice and the space occupied by parked vehicles has a negative impact on biking. Finally, the analysis clearly emphasizes, effect of increasing traffic volume worsens steadily from very low to very high traffic and BLOS show relatively little change until higher traffic levels. Although these issues cannot be resolved without previous research, this study offers important insights into the importance of key factors which affect bicycle level of service for arterials.

REFERENCES