Tools for Measuring Roadway Suitability for Bicycles

Context

Most North American cities have recognized the need for and the benefit of encouraging bicycle use for recreational and commuting purposes. However, in many cases, the ability of bicycle transportation to ease traffic congestion and air quality problems is hampered by the need for bicyclists to travel along streets that are not specifically designed or designated for them. A large body of information (see Sources of Information) has been developed that can help transportation planners base decisions that affect the safety, comfort and level of use of bicycles on quantitative performance measures. This Issue Paper examines the features, benefits and limitations of two tools that have been used by transportation planners over the past decade:

1. The Bicycle Compatibility Index (BCI); and
2. The Bicycle Level of Service (BLOS)

Bicycle suitability measures, analogous to those used for motorized travel, are useful for helping planners, engineers and decision-makers evaluate existing road and path facilities, identify appropriate improvements and prioritize projects. These methods provide transportation planning professionals with ways for discerning and describing cycling conditions on planned roadway facilities and for evaluating design options during the functional design process.

www.pedbikeimages.org/ photographer: Dan Burden

The Bicycle Compatibility Index

The Bicycle Compatibility Index[1] (BCI) was developed for the U.S. Federal Highway Administration (FHWA) in 1998 to help transportation planners develop or improve roadways that are shared by cyclists and thereby increase the comfort, safety and utilization of bicycle transportation. Comfort levels were developed by showing bicyclists videotapes of selected road segments. Eight independent variables related to their perceived safety were selected along with three adjustment factors as follows:

- The presence (or absence) of a bike lane or paved shoulder
- The width of the bike lane or paved shoulder
- The width of the curb traffic lane
- The motor vehicle traffic volume in the curb traffic lane
- The motor vehicle traffic volume in the other traffic lanes
- The speed of the motor vehicle traffic
- The presence of a parking lane that is utilized
- The nature of the adjacent land use
- The volume of truck traffic
- The amount of parking turnover
- The amount of right-turning traffic

The indices that are calculated are used to determine levels of service (LOS) in six categories that range from extremely low to extremely high (Table 1). The levels of service provide planners the capability to assess the compatibility of roadways for shared-use operations by motorists and bicyclists, and to plan for and design roadways that are bicycle-compatible.

Table 1 - BCI ranges and levels of service

BCI Range	Level of Service (LOS)	Compatibility Level[1]
≤1.50	A	Extremely high
1.50-2.30	B	Very high
2.31-3.40	C	Moderately high
3.41-4.40	D	Moderately low
4.41-5.30	E	Very low
>5.30	F	Extremely low

1. Qualifiers for compatibility level are for the average adult bicyclist.

The BCI allows planners and designers to: 1) produce bicycle compatibility maps that can help bicyclists select routes; 2) identify the most appropriate routes to include in bicycle route network; and 3) identify weak links and prioritize roadway improvement projects to correct deficiencies.

Using the BCI for proposed or projected conditions allows a designer to: 1) assess the bicycle level of service and compatibility level of roadway design projects (new or retrofit); 2) assess the impact of proposed developments or changes in land use that may change traffic volumes and/or patterns; and 3) provide input to long-range transportation plans for maintaining or enhancing bicycle compatibility levels.

The BCI was developed in the recognition that bicyclist's perceptions of comfort range with their ability. As a result of these differences, separate BCI models were produced for casual recreational, experienced-recreational and experienced-commuter bicyclists, and a blended index was developed for all bicyclists. As it is likely that a given roadway bicycle route will be used by riders of all experience levels, it is normal practice for planners to use the BCI model for all bicyclists. Where casual bicyclists are expected, it is recommended that bicycle routes be designed to provide a level of service of at least 'moderately high.'

The BCI report includes examples and Excel spreadsheets that can be used for data entry and for developing indices and levels of service.

Bicycle Level of Service (BLOS)

The Bicycle Level of Service[2] (BLOS) is another tool that can be used to assess the suitability of roadway configurations for bicycling. It is based on the experiences of riders on actual field courses, instead of cyclist reaction to filmed conditions, as in the case of the BCI. The BLOS dependence on traffic volume is logarithmic so that bicyclists' comfort level decreases logarithmically as traffic increases, and is particularly sensitive to the pavement surface quality and the volume of heavy vehicular traffic. The BLOS considers the following variables to assess the bicycle friendliness of a roadway, including:

- Through-lanes per direction
- The width of the curb traffic lane
- Presence of paved shoulder, bike lane, or marked parking area
- Bi-directional traffic volume
- Posted speed limit (mph)
- Percentage of heavy vehicles
- Pavement condition rating
- Percentage of road segment with occupied on-street parking
- On-street parking time limit

State agencies in the United States have used BLOS for planning purposes, and it is sometimes favoured due to its dependence on logarithmic traffic volume. Like the BCI, the output of the BLOS is a level of service ranging from A to F. A web-based calculator[2] is available (Figure 1) that provides a level of service rating for given roadway configurations (for both BLOS and BCI).

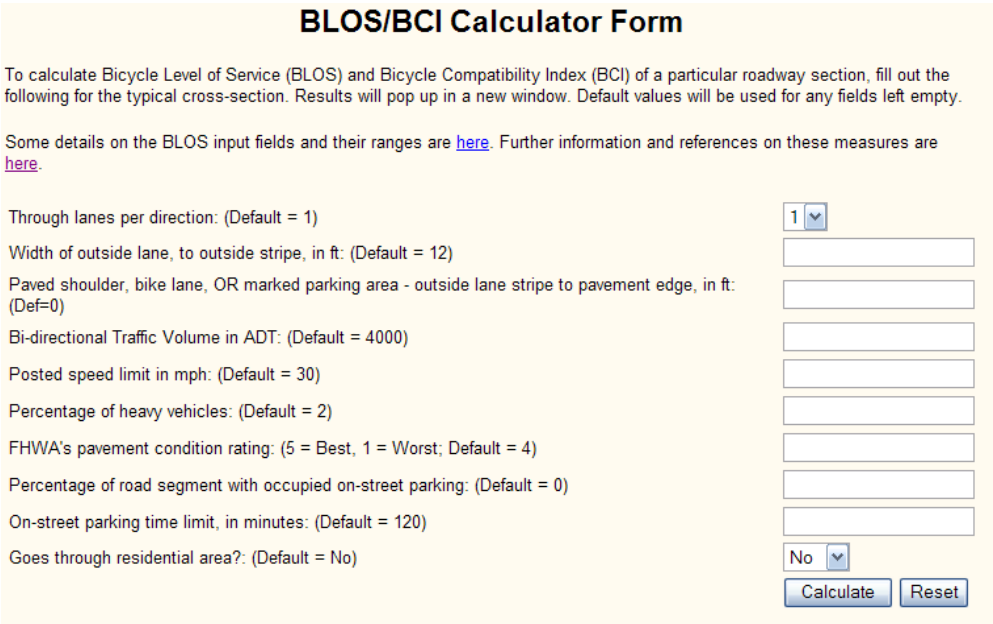

Figure 1 Sample input page for on-line bicycle compatibility calculations[2]

Examples of Uses

This section describes the experience that a few jurisdictions have had using performance-based tools for evaluating the bicycle friendliness of roadways.

Saskatoon, SK

The City of Saskatoon uses the Bicycle Compatibility Index to evaluate specific projects. It was attempted to meld the BCI with geographic information system (GIS) data to assess present infrastructure, but in some cases was found to indicate a requirement for a higher level of service when there was no apparent problem. For this reason, it has been used mostly for evaluating and comparing the cost/benefit of various bicycle roadway configurations. Rather than preference for a given option being based on professional opinion, it provides a standardized method for decision making.

City of Milwaukee, WIS

The City of Milwaukee uses the Bicycle Level of Service (BLOS) to examine roadway bicycle configuration options for specific projects. Like Saskatoon, Milwaukee attempted to apply a bicycle performance indicator tool broadly in combination with GIS information and found that this generated some inaccurate findings.

League of Illinois Bicyclists

The League of Illinois Bicyclists works to maintain and increase access to public facilities to enhance the use of bicycles for transportation and recreation. It has used the Bicycle Level of Service (BLOS) for planning and advocacy purposes. Although major Illinois cities like Chicago have developed their own standardized methods for facilitating bicycle travel, the League has used BLOS to assist smaller Illinois cities plan and implement improved bicycle opportunities.

Benefits

This issue paper describes two methods for assessing the suitability of roadways for bicycle travel, and there may be other methods that have been custom developed by municipalities. Whichever method is used, performance measures help to remove subjectivity when options are assessed for providing safe, comfortable bicycling opportunities in relation to cost.

Limitations

Both the BCI and the BLOS have been used successively and readers interested in adopting a bicycle suitability measure are encouraged to review both and select one that best suits particular requirements. Ideally, quantified measure of roadway suitability for bicycle travel using either BCI or BLOS could be used for:

- Identifying needs and missing links
- Comparing various design options
- Priorizing bicycle facility projects
- Developing bicycle suitability maps

The BCI report provides examples for three different uses: 1) evaluation of existing conditions; 2) evaluation of proposed roadway designs; and, 3) planning for a bicycle

corridor. However, as explained earlier, some jurisdictions use bicycle suitability ratings only for evaluating proposed designs. It is the experience of both the Cities of Saskatoon and Milwaukee, that bicycle suitability measures are good tools for *supporting* decisions but not for *making* decisions, but other jurisdictions (such as the league of Illinois Bicyclists) have successfully applied them to a wider range of planning applications.

The BCI and BLOS were developed for and represent mid-block street segments only and are primarily intended for use on through streets in urban settings. The ratings do not account for major intersections along the route where cyclists may encounter a stop sign or traffic signal. An attempt has been made to develop a level of service rating for intersections but this remains a weak link in transportation planning for bicycles.

Lessons Learned

Bicycling is being increasingly recognized as an important means of transportation that can help ease congestion and air quality problems. The Bicycle Compatibility Index (BCI) and Bicycles Level of Service (BLOS) are tools for evaluating the suitability of roadways for bicycle travel. The use of either of the tools provides a consistent, scientific method for assessing suitability for bicycles, and both systems allow users to see the impact of altering a variable such as roadway width, or, the cost/benefit of a wide curb lane versus a bicycle lane. In addition to the two evaluation tools described here, there is a substantial amount of information available that transportation planners can use to develop designs and policies that offer the possibility of maximizing bicycle use and safety at a reasonable cost and based on scientific principles.

Sources of Information

Performance Measure Tools

1. The Bicycle Compatibility Index: A Level of Service Concept, Implementation Manual, Federal Highway Administration, FHWA-RD-98-095 http://safety.fhwa.dot.gov/tools/docs/bci.pdf
2. Bicycle Level of Service Calculator: http://www.bikelib.org/roads/blos/blosform.htm

Design Guides

1. Transportation Association of Canada (TAC) Bikeway Traffic Control Guidelines: https://mediant.magma.ca/tacatc/bookstore/products.cfm?catid=12&subcatid=21&prodid=63
2. Technical Handbook of Bikeway Design, Vélo Québec: http://www.velo.qc.ca/english/bikewaysdesign.php
3. City of Chicago Bike Lane Design Guide: http://egov.cityofchicago.org/webportal/COCWebPortal/COC_EDITORIAL/bike_lane.pdf
4. City of Toronto, Guidelines for the Design of Bicycle Facilities: http://www.toronto.ca/planning/pdf/bicycle_parking_guidelines_final_may08.pdf

Other Information

1. FHWA bicycle safety resources and research: http://www.tfhrc.gov/safety/pab.htm
2. League of Illinois Bicyclists: http://www.bikelib.org/#
3. Pro Walk/Pro Bike: http://www.bikewalk.org/2008conference/index.html

4. Bicycling information: http://www.bicyclinginfo.org/
5. Evaluation of On-Street Bicycle Facilities Added to Existing Roadways, I. Hallett, D. Luskin and R. Machemehl, Center for Transportation Research, The University of Texas at Austin: http://www.utexas.edu/research/ctr/pdf_reports/0_5157_1.pdf