Low-Stress Bicycling and Bike Network Connectivity

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The most fundamental need in a bicycling network is low-stress connectivity, that is, providing routes between people's origins and destinations that do not require cyclists to use links that exceed their tolerance for traffic stress, and that do not involve an undue level of detour. Evaluating network connectivity therefore requires both a set of criteria for tolerable levels of traffic stress and measures of connectivity appropriate to a bikeway network.

We propose criteria by which road segments can be classified into four levels of traffic stress (LTS), corresponding to four levels of traffic tolerance in the population. LTS 1 is suitable for children; LTS 2, based on Dutch bikeway design criteria, represents the traffic stress that most adults will tolerate; LTS 3 and 4 represent greater levels of stress. As a case study, every street in San Jose, California was classified by LTS. Maps in which only lower stress links are displayed reveal a city fractured into low-stress islands separated from one another by barriers that can only be crossed using high stress links.

To measure connectivity, two points in the network are said to be connected at a given level of traffic stress if there is a path connecting them that uses only links that do not exceed that level of stress and whose length does not exceed a detour criterion (25% longer than the most direct path). For the network as a whole, demand-weighted connectivity is the fraction of trips in the regional trip table whose origin and destination are connected at a given level of stress. Demand data is disaggregated to the block level because traffic analysis zones (TAZs) are too coarse a geographic unit for evaluating connectivity by bicycle. In San Jose, for work trips up to 6 miles long , demand-weighted connectivity at LTS 2 was foun to be 4.7%, providing a good explanation for the city's low bicycling share. With a hypothetical slate of improvements totaling 32 miles in length but with strategically placed segments that provide low-stress connectivity across barriers, this measure of connectivity is almost tripled.

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Peter Furth is a Professor of Civil Engineering at Northeastern University, where he does research in transit operations analysis, traffic signal control, and bicycle transportation. He earned his BS, MS, and PhD degrees at MIT and has published more than 50 papers and book chapters. He has taught bicycle facility design in courses and workshops since 2007, including summer courses in the Netherlands introducing American students to Dutch urban planning and bikeway design. His bicycle-related research projects include studying the safety of along-road bike paths in Montreal, mapping existing and potential greenways in the Boston area, network analysis of low-stress bicycle routes in San Jose (CA), and analyzing the operational characteristics of different bike lane configurations. He is the inventor of the Bicycle Priority Lane marking used in Massachusetts and in Minneapolis, and is a contributing author to the *Bikeway Design Guide* published by the National Association of City Transportation Officials. He developed the bicycle network plan for Brookline, MA, and has participated in the design of many bikeways (bike paths and bike lanes) in the Boston area. He is active with the Transportation Research Board, the Association of Pedestrian and Bicycle Professionals, the American Society of Civil Engineers, the Institute of Transportation Engineers, the Boston Cyclists Union, the Massachusetts Bicycle Coalition, and the bicycle advisory committees of Boston and Brookline.