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Evaluation of safe passage alternatives for non-motorized traffic across an existing highway bridge

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ABSTRACT

In the past, the primary focus of the transportation industry was safety and emission. At present, the focus is much broader and includes social sustainability in transportation equity, environmental justice, and public health. Hence, the emphasis is on increasing physical activities and expanding access to essential goods and services through non-motorized modes. Non-motorized transportation increases mobility choices, relieves congestion, promotes local economy, reduces greenhouse gas emission, promotes a healthy lifestyle, and improves quality of life. However, a majority of highway bridges on planned or existing non-motorized paths have become bottle-necks, and discourages efficient use of such facilities. At present, highway agencies evaluate bridge sites on a case-by-case basis to identify alternatives to provide non-motorized access across the bridges. Later, these alternatives with cost estimates are used for funding proposals. Hence, the need is to have a methodological process to evaluate a bridge site for the best possible alternatives and to develop cost estimates for funding proposals. This article presents safe passage alternatives for non-motorized traffic across an existing bridge, alternative analysis methodology, and an implementation example.

1. Introduction

1.1. Overview

In the past, the primary focus of the transportation industry was safety and emission. The Greenhouse Gas (GHG) emission data shows an increase in carbon dioxide (CO_2) discharge since the pre-industrial era. Between 1900 and 2008, the emission from fossil fuels has increased over 16 times and contributed to global warming (EEA, 2013; EPA, 2013; IPCC, 2007). Motorized transportation is one of the main contributors to the global warming due to vehicle CO_2 emissions. In 2004, transportation sector contribution to the global greenhouse gas emission was 13% (IPCC, 2007; WRI, 2014). Hence, various technologies or modes of transportation such as use of electric cars (vehicles powered by rechargeable batteries) and solar cars are being researched and implemented (APTA, 2008; UCSUSA, 2012).

At present, the focus is much broader and includes social sustainability in transportation equity, environmental justice, and public health. The emphasis is on increasing physical activities and expanding access to essential goods and services through non-motorized modes (TRB, 2015). However, in the U.S., a majority of the trips are by motorized vehicles. According to the statistics published by the United States Census Bureau in year 2013, approximately 1% and 10.4% of the trips completed within the country in a year were attributed to cycling and walking, respectively (United States Census Bureau, 2013). In 2005, the U.S. Congress introduced the Safe Routes to School (SRTS) program to enable and encourage children, including those with disabilities, to walk or bicycle to and from school. Increasing walking, biking, and other modes of active travel holds promise for reducing childhood and adults physical health problems and improving mental health, while reducing transportation costs, traffic congestion, and environmental impact. In summary, promoting non-motorized modes of transport decreases CO_2 emission as well promotes a healthy lifestyle, increases mobility choices, promotes local economy, and improves the quality of life (Fietsberaad, 2009; Kim and Ulfarsson, 2008).

In 2013, the Moving Ahead for Progress in the 21st Century Act (MAP-21), signed in 2012 by the U.S. President, authorized the Transportation Alternatives Program (TAP) to offer funding for programs and projects defined as *Transportation Alternatives* (FHWA, 2015). TAP defines the *Transportation Alternatives* as on- and off road pedestrian and bicycle facilities, infrastructure projects for

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improving non-driver access to public transportation and enhanced mobility, community improvement activities, and environmental mitigation; recreational trail projects; safe routes to school projects; and projects for planning, designing, or constructing boulevards and other roadways largely in the right-of-way of former divided highways. The national total reserved for the TAP is equal to 2 percent of the total amount authorized from the Highway Account of the Highway Trust Fund for Federal-aid highways each fiscal year. Thus, non-motorized plans have been develop by states, counties, regions and cities as efforts to allocate these funds and expand travel choices and enhance the transportation experience (FHWA, 2015).

Bridges are an integral part of an every road or path. A majority of highway bridges that are located on planned or existing non-motorized paths have become bottle-necks for non-motorized traffic. Consequently, cycling and walking appear much less appealing. At the local level, trails and sidewalks that are disconnected make such networks less attractive for those who would have chosen to walk or bike to work or school; the inconvenience or safety concerns are more than enough to make them feel obligated to use other modes of transport. At regional levels, non-motorized facilities, which are not properly integrated, are less attractive to long-distance cyclists or trail hikers. In addition to direct impacts on mobility, such improperly integrated facilities are detrimental to the tourism and economy of such regions.

At present, highway agencies evaluate bridge sites on a case-by-case basis to identify alternatives to provide non-motorized access across the bridges. Later, these alternatives with cost estimates are used for funding proposals. With the typical funding mechanism implemented in the U.S., if a proposed project is selected and the cost is underestimated, interagency funding agreements may allow requesting an additional funding which cannot exceed more than 20 percent of the initial request. If the underestimate is excessive, the highway agency may self-fund the amount over the 20 percent threshold, or may resubmit the application with a revised cost estimate for the next meeting of the corresponding bridge council. Hence, the need is to have a methodological process to evaluate a bridge site for the best possible alternatives and to develop cost estimates for funding proposals. Addressing the need, this article presents a rational process that incorporates site and bridge specific data and relevant specifications to evaluate a site to identify the most suitable alternative(s) and to develop corresponding cost estimates. The specifications used in this study are the *AASHTO Guide for Planning, Design, and Operation of Pedestrian Facilities* (2004), the *AASHTO Geometric Design of Highways and Streets* (2011a), the *AASHTO Roadside Design Guide* (2011b), and the *AASHTO Guide for the Development of Bicycles Facilities* (2012). However, highway agencies can customize the process by incorporating agency specific guidelines and specifications to adopt this into their business practice.

2. Safe passage alternatives

A passage for non-motorized traffic across an existing highway bridge can be provided within or outside the bridge. Typical features of a bridge with non-motorized passages within a bridge are shown in Fig. 1. Accommodation of one or more of these features depending on several site and bridge specific parameters, the specification requirements, and user comfort levels will be further discussed.

2.1. Terminology and definitions

In order to help understand the content of this article, the following list of terminology and the definitions are presented:

- Bicycle lane: a portion of the roadway designated for bicyclists.
- Barrier: a reinforced concrete member used for crash protection.
- Inside lane(s): lanes other than the outside lanes.
- Non-motorized zone: a portion of the roadway designated for bicyclists and pedestrians.
- Outside lane: the lane closest to the edge of the road.
- Railing: a structure provided for protection of the facility users.
- Shared lane: a lane where bicyclists and vehicles share the roadway without any portion of the lane specially designated for the bicycle use. For a low volume of bicycle traffic, shared lane width is maintained at the same width as a typical traffic lane (i.e., no special provisions). If the expected bicycle volume is high, shared

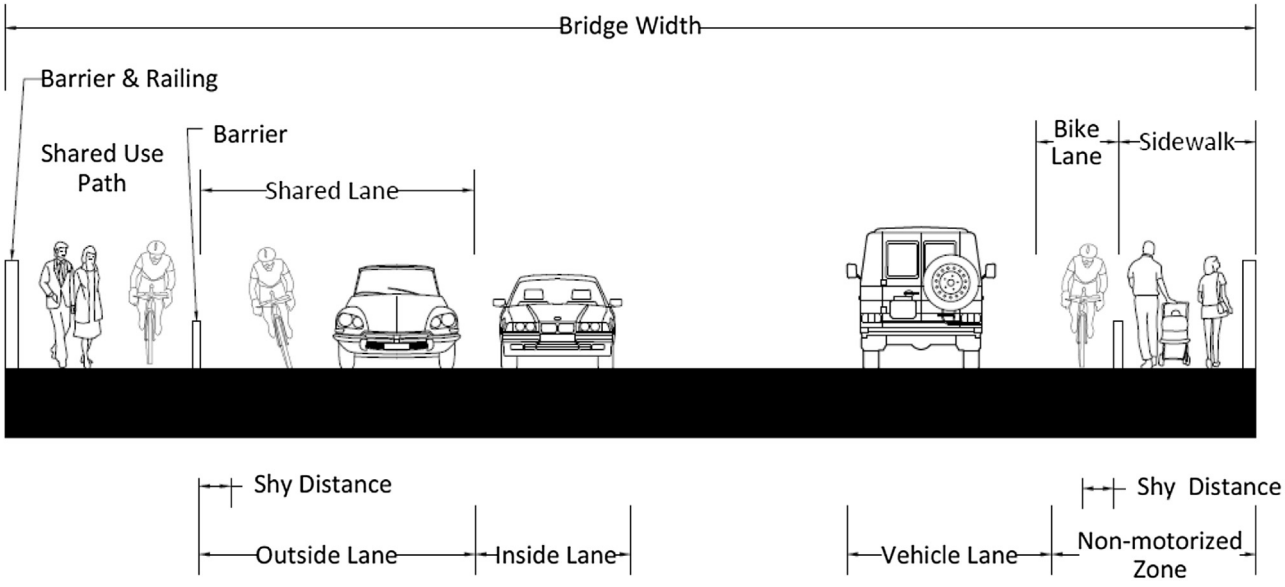

Fig. 1. Typical features of a bridge superstructure with non-motorized facilities.