Avoiding Railroad Crossings Hazards to Cyclists

Ziwen Ling#, Christopher R. Cherry*, Nirbesh Dhakal†

#Department of Civil and Environmental Engineering
University of Tennessee
311 John D. Tickle Building, Knoxville, TN 37995-2313, USA
email: zling@vols.utk.edu

*Department of Civil and Environmental Engineering
University of Tennessee
321 John D. Tickle Building, Knoxville, TN 37995-2313, USA
email: cherry@utk.edu
(corresponding author)

†Department of Civil and Environmental Engineering
University of Tennessee
311 John D. Tickle Building, Knoxville, TN 37995-2313, USA
email: ndhakal@vols.utk.edu

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1 INTRODUCTION

Many cities throughout the world have been making effort to improve cycling infrastructure. As cycling increases, safety challenges manifest around infrastructure that was not carefully designed for cyclists. Most research on cyclist safety is focused on crashes involving cars or trucks, pedestrians, or even riding under the influence. Only a few studies address single-bicycle crashes, and fewer still focus on crashes that involve crossing railway tracks, where the cyclist loses control when their wheel interacts with the rail flangeway, as shown in Figure 1. There are over 100,000 at-grade rail crossings in the USA in 2015 [1]. Additionally, many cities have on-road streetcar and tram tracks with continuous bicycle conflict zones The American Association of State Highway and Transportation Officials (AASHTO) focuses on crossing angle, crossing surface, bikeway width, and flange opening as key factors to railroad grade crossing for bicycles [2]. Noyce [3] pointed out road designers should minimize the negative effects of the flangeway gap since it would create safety hazard for bicyclists. However, to date there are no empirical analyses or data to assess the mechanics of single bicycle crashes at railroad crossings. Moreover, this problem is under researched, in part, because single-bicycle crashes are rarely reported in official road crash statistics with enough detail to inform policy or design [4, 5]. This study, recently published [6] aims to fill this important gap by focusing on the mechanics of bicycle crashes caused by railway tracks, building models that will integrate the most important factors influencing bicycle crashes on tracks, and suggesting solutions for grade crossings. The results of this study could also be extended to streetcar or other rail crossings.

2 METHODS

This study relies on continuous video monitoring of a heavily traveled grade crossing, covering more than 2,000 crossings and including 32 single-bicycle crashes. A representative random sample of 100 successful crossings were drawn from the population and the video data dissected to assess crash factors, including demographic, riding behavior, bicycle characteristics, and environmental characteristics. A binary logistic regression model was built to explore the key factors to cross successfully or crash.

3 RESULTS

Figure 2 shows the percentage of successful and unsuccessful crossings for the population of crashes and the sample of non-crashes. Near 90% of the crashes occurred at angles less than 30°, whereas 74% of the successful crossings approaches were greater than 30°. Still, nearly one quarter of crossings less than the critical 30° threshold are successful. According the binary logistic model, group riders, women, road bikes (with narrow tires), and wet and dark roadway conditions all contribute to higher crash rates. Facilities that share these characteristics should be designed with increased scrutiny. Crash rates are reduced dramatically at approach angles greater than 30°, and (in our dataset), non-existent at angles greater than 60°. We suggest countermeasures, like jughandle designs, that improve the crossing angle for cyclists. Improving crossing angle up to 90° is ideal but often infeasible due to right of way constraints. Any crossing angle more than 30° would be highly effective at reducing crashes and providing crossing angles greater than 60° would effectively eliminate them. Design guidance should not limit crossing angles to greater than a 60° approach when larger angles are not feasible. The crossing studied here was infeasible to construct at a crossing angle that approached 90°. Responding to the problem, the City of Knoxville did construct a jughandle design (Figure 3) with a tangent angles of 57°, with a possible minimum angle of 37° (inside-to-outside of bike lane). This design has effectively eliminated crashes except in cases where cyclists traverse the hashmarks and cross at low angles.

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Figure 1: An example for Bicycle Crash Mechanism at Railway Crossing

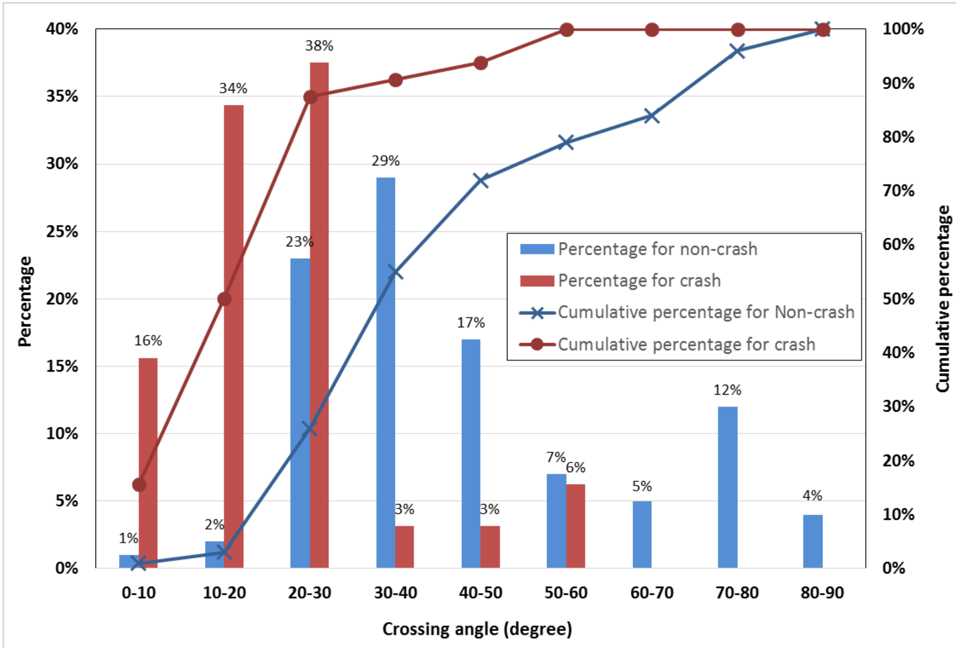

Figure 2: Crossing angle distribution comparison of non-crash and crash cases

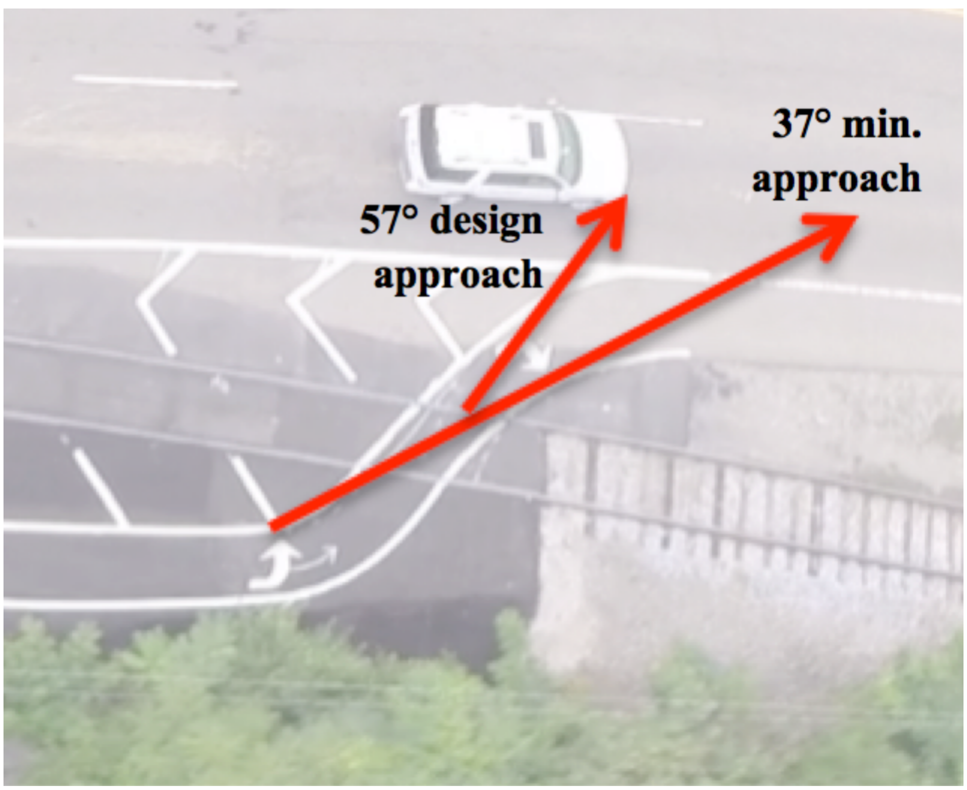

Figure 3: An example of jughandle design in the city of Knoxville