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Bicycle safe Intersection design: A critical review

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Abstract — *Bicycles are sustainable form of transport having advantages like less noise pollution, less congestion, less accidents and less maintenance costs compared with motorized modes . Bicycling also offers an affordable transport option to the low income group especially in developing countries like India which find it difficult to afford any form of motorized transport it can form an important means for accessing destinations particularly for trips that are too long for walking or are not served by transit Despite these benefits, bicycling is not a popular choice in Indian cities among commuters . The main obstacles to boosting the bicycle as a regular mode of transport are safety concerns due to interactions with motorized traffic . We know that protected cycle lanes are the key to getting the average person to consider traveling by bicycle. Protected cycle tracks, use curbs, planters, or parking to buffer bicyclists from moving cars . there is still a problem, The protected bicycle lanes lose their benefits when they reach intersections We need to make intersections just as safe and secure as the lanes that lead into them. What the Protected bicycle Lane needs is the Protected Intersection by providing different elements based on analysis of collected data of intersection .*

Keywords*-bicycle safe intersection, capacity of intersection, geometric dimensions of intersection, volume of approaches*

I. INTRODUCTION

Bicycles are sustainable form of transport having advantages like less noise pollution, less congestion, less accidents and less maintenance costs compared with motorized modes. Bicycling also offers an affordable transport option to the low income group, especially in developing countries like India, which find it difficult to afford any form of motorized transport Pucher Indeed, it can form an important means for accessing destinations particularly for trips that are too long for walking or are not served by transit. Despite these benefits, bicycling is not a popular choice in Indian cities among commuters. The impediments to bicycling include factors like long trip distances of commuters, harsh weather conditions, difficulty to use it in nonutility trips entertainment, recreation, etc.), infrastructure unavailability, extreme traffic conditions, and a lack of health and environment. consciousness among people. These barriers are, in one way or the other, manifestation of the internal and social considerations of commuters such as their current attitude, social norm perception, and built environment considerations. The effects of these impediments may change from individual to individual depending on their perception of bicycling and their level of experience with cycling For example, non-cyclists may value these impediments quite differently from cyclists Further, the effect of these impediments may also have a link with an individual's perception of bicycling during his childhood. Dill and Voros associate an individual's childhood bicycle usage with his habit that decides the current bicycle usage. Eliciting this childhood perception can extract the necessary steps that can maintain a respondent's bicycle usage even after his transition from childhood to adulthood. There is an absence of studies that educes this correlation . A futurist author, H.G. Wells (1866–1946) stated: ''Cycle tracks will abound in utopia" The bicycle as a green and sustainable mode of transport is gaining ground I one estimate half of the morning trips in the US is less than 5 miles should it be made by 24 min cycling, no job is left for transport engineers. Governments across the world have started to invest in more bicycle facilities. A strong correlation has been reported between the usage rate of bicycles and health indices . Fortunately the use of bicycle is on the rise so much so some coined the term of ''bicycling renaissance" The main obstacles to boosting the bicycle as a regular mode of transport are safety concerns due to interactions with motorized traffic. Urban areas account for 40% of road fatalities Although traffic safety has improved remark- ably in recent years, it has been focused on the safety of motor vehicles. However, 50% of the victims of urban road crashes were pedestrians or cyclists .In general, bicyclists identify safety as one of their highest priorities in selecting bicycle routes. A common characteristic of countries with a high cycling mode share is the provision of cycle tracks (separated bikeways along streets) on major routes. For this reason, physically separated bicycle paths have received increasing attentions from researchers. Wardman et al. (2007) forecasted that a completely segregated bicycle roadway would result in a 55% increase in bicycling. A survey conducted in Canada corroborated that physically separated pathways were preferred by cyclists and encouraged more cycling Another study in Canada reported that the injury risk of cycling on cycle tracks is less than cycling in streets. We know that protected cycle lanes are the key to getting the average person to consider traveling by bicycle. Sharing busy traffic lanes with cars is absolutely unacceptable, and separation by a line of paint is often not enough. Protected cycle tracks, use curbs, planters, or parking to buffer bicyclists from moving cars . there is still a problem,The protected bicycle lanes lose their benefits when they reach intersections. The buffer falls away, and you're faced with an ambiguous collection of green paint, dashed lines and bicycle symbols. One popular where cars and bikes share the lane configuration is called "a mixing zone" It doesn't matter how safe and protected your bicycle lane is if intersections are

risky, stressful experiences. SO,We need to make intersections just as safe and secure as the lanes that lead into them. What the Protected bicycle Lane needs is the Protected Intersection.

II. OBJECTIVES

1.Find out the problem of particular selected location of Intersection Where we actually want to develop Bicycle Friendly Infrastructure. Observing the location by Videography & than analysis it.
2. Suggest Best alternative Which will make intersection safer and suitable to reduce the risk to bicyclist & inhance safety so people encourage to utilize this system.

III. LITERATURURE REVIEW

3.1 Sohail Zangenehpoura,Jillian Straussa,Luis F. Miranda-Morenob, Nicolas Saunierca studied that cities in North America have been building bicycle infrastructure, in particular cycle tracks, with the intention of promoting urban cycling and improving cyclist safety. These facilities have been built and expanded but very little research has been done to investigate the safety impacts of cycle tracks, in particular at intersections, where cyclists interact with turning motor-vehicles. Some safety research has looked at injury data and most have reached the conclusion that cycle tracks have positive effects of cyclist safety. The objective of this work is to investigate the safety effects of cycle tracks at signalized intersections using a case–control study. For this purpose, a video-based method is proposed for analyzing the post-encroachment time as a surrogate measure of the severity of the interactions between cyclists and turning vehicles travelling in the same direction. Using the city of Montreal as the case study, a sample of intersections with and without cycle tracks on the right and left sides of the road were carefully selected accounting for intersection geometry and traffic volumes. More than 90 h of video were collected from 23intersections and processed to obtain cyclist and motor-vehicle trajectories and interactions. After cyclist and motor-vehicle interactions were defined, ordered log it models with random effects were developed to evaluate the safety effects of cycle tracks at intersections. Based on the extracted data from the recorded videos, it was found that intersection approaches with cycle tracks on the right are safer than intersection approaches with no cycle track. However, intersections with cycle tracks on the left compared to no cycle tracks seem to be significantly safer. Results also identify that the likelihood of a cyclist being involved in a dangerous interaction increases with increasing turning vehicle flow and decreases as the size of the cyclist group arriving at the intersection increases. The results highlight the important role of cycle tracks and the factors that increase or decrease cyclist safety. Results need however to be confirmed using longer periods of video data.

3.2 Tanja Kidholm Osmann Madsen , Harry Lahrmann studied In some countries and in particular in some cities, cycling is a frequently used mode of transportation. For instance, in Copenhagen and Amsterdam the bicycle share is higher than 30% (DTU Transport, 2014). However, travelling relatively unprotected, cyclists run a high risk if they are involved in accidents. In 2014, more than 2000 cyclist fatalities were registered in Europe (European Commission, 2015).Bicycle facilities such as bicycle tracks (separated from the road with curbs) and bicycle lanes (separated from the road with painted lines) have frequently been constructed in Denmark as a means of improving the safety of cyclists and the sense of security to promote cycling. However, studies have shown that bicycle tracks do not improve the safety of cyclists. Although the number of bicycle accidents decreases on road sections with bicycle tracks, more accidents occur in intersections. Agerholm, Caspersen, Madsen, & Lahrmann, 2006; Bach, Rosbach, & Jørgensen, 1985; Gårder, Leden, & Thedéen, 1994;Jensen, 2006; Jørgensen & Rabani, 1969; Linderholm, 1992; Wegman & Dijkstra, 1988). The increase is composed of a higher amount of turning accidents compared to intersections without bicycle tracks (Jensen, 2006; Jørgensen & Rabani, 1969) and is particularly high in signalized intersections (Jensen, 2006). Bicycle lanes are less safe for cyclists on road sections compared to both bicycle tracks and no bicycle facility, but the bicycle lanes seem to have no influence on the number of injured cyclists in intersections compared to no bicycle facility (Nielsen, Andersen, & Lei, 1996; Wegman & Dijkstra, 1988). However, Jensen (2006) found an increase (statistically insignificant) in the number of injured cyclists and moped riders in intersections as well as on road sections after the construction of bicycle lanes. The differences in the safety effects of bicycle tracks and bicycle lanes suggest that, although bicycle facilities result in more accidents involving cyclists in intersections, some layouts may be safer than others. Previous studies have primarily compared various geometric layouts of bicycle facilities in signalized intersections under the assumption that the best layout is safer for cyclists independently of the traffic volume and thus compared layouts with different traffic volumes by controlling for these differences (see e.g. Buch & Jensen, 2012; Herrstedt, 1979). So far, only a few studies have assessed the risk of cyclists for different bicycle facilities using varying traffic volumes, an example is Linderholm (1992). However, it has been indicated that the best layout of bicycle facilities depends on the traffic volume in the intersection (Vejregelrådet, 2010). Though, it is still unknown at which traffic volume the various bicycle facilities should be used in order to construct cycling crossings that are as safe as possible. The purpose of this study is to compare the safety of cyclists for commonly used Danish bicycle facility layouts in signalized intersections to assess which layout is better at various traffic volumes and to develop methods to facilitate this comparison. The study is carried out as a traffic conflict study based on video recordings from five intersection arms with different designs of bicycle tracks.

3.3 Poul Greibe and Thomas Skallebaek Buch studied that Bicycle traffic has increased in the large cities in Denmark over the last 10-15 years. Moreover politicians wish to continue the growth making bicycling account for an even larger share of the urban area transportation. Similar objectives are found in many other countries, which also invest in a better cycling infrastructure. One of the measures taken in Denmark and elsewhere is the construction of cycle tracks in urban areas, which provide the necessary space for bicycle traffic and decrease perceived risk among cyclists.

At the same time, in Denmark the national objective is to reduce deaths and injuries in traffic, where cyclists currently account for approximately 20% of the total number of injuries reported by the police.

To achieve these objectives on increased safe cycling, a well-functioning and well-developed infrastructure for bicycle traffic is required.

In urban areas, junctions very often constitute a bottleneck in relation to cyclist pass ability. At the same time, the vast majority of accidents involving cyclists in urban areas occur in junctions. However, it should be noted that accidents on cycle tracks are underreported, because these accidents often are single accidents or accidents between cyclists and typically less severe than accidents between cyclists and vehicles.

Nevertheless, cycle tracks between junctions are also important in relation to cyclist safety and passability. An increase in the bicycle traffic volume will put a larger pressure on the most busy cycle tracks during rush hours, which may require an increase in the capacity of some of these cycle tracks. Meanwhile, the number of cargo bikes is growing, and these are characterised by other dimensions and driving behaviour, which may affect the capacity and safety of the cycle tracks. Supported by the Ministry of Transport, Trafitec has conducted a study (Buch and Greibe, 2014) to examine the issue. The main results are presented in this paper.

Objectives : The main objective of this study is to examine how widths of one-way cycle tracks in urban areas influence the behaviour, flow and capacity of bicycle traffic. Traffic safety has not been a part of the project but is of course a direct offshoot of the subject. Sections with one-way tracks along a road are the primary focus. Based on new empirical studies, we wish to assess the width of the cycle track in relation to cyclist behaviour (lateral position and speed) and capacity in order to provide guidance on widths of cycle tracks allowing safe and efficient bicycle traffic. To illustrate this, cyclist behaviour at different flow volumes and during overtaking has been studied. Furthermore, it has been examined how cargo bikes affect bicycle traffic.

3.4 Nick Falbo studied that protected bike lanes are the key to getting the average person to consider traveling by bike. Sharing busy traffic lanes with cars is absolutely unacceptable, and separation by a line of paint is often not enough. Protected Bike Lanes, also called cycle tracks, use curbs, planters, or parking to buffer bicyclists from moving cars. But there is still a problem; The protected bike lanes lose their benefits when they reach intersections. The buffer falls away, and you're faced with an ambiguous collection of green paint, dashed lines and bicycle symbols. One popular configuration is called "a mixing zone" where cars and bikes share the lane. It doesn't matter how safe and protected your bike lane is if intersections are risky, stressful experiences. We need to make intersections just as safe and secure as the lanes that lead into them. What the Protected Bike Lane needs, is the Protected Intersection. Modeled after Dutch intersection design6, the Protected Intersection brings the physical protection along with you as your ride through the crossing. A collection of design elements makes left turns simple and secure, right turns protected and fast, and provides straight through movements that minimize or eliminate conflicts from turning cars. With this design, riders will never feel stranded, exposed, or unsure of where to go and how to get there.

There are four main elements to protected intersection designs:

The Corner Refuge Island :

The corner refuge island is the key element that makes these intersections function. This island brings the protective barrier from the bike lane far into the intersection. Think of it like a curb extension for bicyclists.

The island physically separates bicyclists as they make right turns, and provide a secure refuge for those waiting at a red signal protected from moving cars.

The Forward Stop Bar :

Paired with the corner refuge island is a forward stop bar for bicyclists7. While people driving must stop back behind the crosswalk, people on bikes may yield to pedestrians, and stop at a bicycle waiting area farther ahead in the intersection. Bicyclists turning left also use this space to wait when making a left turn.

The advantage of this design is three fold: The forward stop location makes bicyclists incredibly visible to drivers waiting at a red light; the physical distance ahead of cars gives bicyclist an effective head start when the light turns green8; and the distance of the road that bicyclists need to cross is greatly reduced.

The Setback Crossing :

In Protected Intersections, the bike lane bends away from the intersection creating in a setback bicycle and pedestrian crossing. In contrast to conventional bicycle crossing that run next to moving cars, the setback crossings provide the space and time for everyone to react to potential conflicts.

The critical dimension is one car-length of space between the traffic lane and the bicycle crossing, around 6 meters9. This space is often already present in the parking and buffer space of the protected bike lane. With this design, drivers turn 90 degrees to face the bike lane before they even cross it, making people on bikes highly visible and out of the driver's blind spot. To allow for adequate reaction time for all users, use a small effective corner radius to encourage a slow driver turning speed of 5-10 mph .

Bicycle-Friendly Signal Phasing :

The last, element of a protected intersection is the use of bicycle specific signals and bicycle-friendly signal phasing. Just as important the physical design of intersections is the use of signals to control how and when different people can proceed. At its most secure, a protected signal phase for bicyclists will use red signals to prevent any conflicting car turning movements12. There is no risk of right or left hooks from cars when they are prohibited from turning while bicyclists are traveling through.

A variation of the protected signal phase is to give all car movements the red signal, and all bicyclist movements a green. This simultaneous green phase13 gives full rein of the intersection to bicyclists, allowing through movements in all directions at once, left turns in one stage and even full U-turns through the intersection. Even at high-volumes, bicyclists are good at negotiating shared space and will have no trouble staying out of each others way. When it is not possible to prohibit conflicting movements entirely, an alternate approach is to provide a leading bicycle interval15. This is a head-start green light for bikes of anywhere from 2 to 5 seconds. It provides them a little extra time to get rolling, enter the intersection, and maybe even clear it completely before people driving start to move .

Taken together, these design elements create a safe, clear experience for all people using the street. Signals control movements, refuge islands create protected spaces, and proper positioning of crossings and conflict points provides everyone with the time and space necessary to react to potential risks.

While the protected intersection design is unconventional and nonstandard the US, so were protected bike lanes only a few years ago. Using these design concepts, planners, designers and engineers can bring the protection of their bike lanes into the space where people need it the most, and finally provide a safe place for people of all ages and abilities to ride.

IV. CONCLUSION

Collect this data for All the approach during the peak hour of traffic at morning and evening for 2 hours for weekend day and during the working day. For collecting this Data we use videography of the location than analys it. Based on this analysis we will get the volume of the vehicle per hours during peak hour of traffic . Based on the physical dimension of intersection ,prepare the autocad two dimensional drawing of intersection. By using this drawing ,put the following elements which is enhance the safety and smooth operation of bicycle manoeuring.

i. A corner refuge island
ii. A forward stop bar for bicycling
iii. A setback bike pedestrian crossing
iv. Bicycle friendly signal phasing

Based on the analysis of data collected, provide the dimension of the above elements .provide this dimension in such a way that in doesn't affect the space required for the other mode of traffic as per min standard of IRC.

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