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Implementation of Cycle Tracks Along Churchill Avenue

Abstract

Public expectation for better cycling facilities has been steadily growing and to support this demand, Ottawa City Council, in 2010, set an ambitious cycling modal share target of 5% City-wide (8% within the Greenbelt) by 2021, a significant increase from the previous 2031 City-wide target of 3%. There are a number of reasons why increasing the number of cycling trips benefits the City and its residents: it provides a healthy alternative to car trips for short distances, it is a cost effective alternative for longer distances especially when combined with public transit, and it has a long term positive impact on urban design by facilitating less car-oriented lifestyles and land uses. However, the typical streets with shared car-cycling facilities or painted bicycle lanes - especially on faster, higher volume roads - are acceptable only to a relatively small percentage of the population: the experienced, vehicular cyclists. Achieving a significant increase of cycling modal share will require facilities that attract a much wider spectrum of the population, including cyclists who do not wish or do not feel comfortable to cycle between and adjacent to motor vehicles. One solution to this problem is the implementation of physically separated bicycle lanes, known as cycle tracks or protected lanes. Although cycle tracks have been successfully implemented in many European cities for decades, for many years they were not considered as a viable option in most North American cities, including Ottawa.

After the successful implementation of the Laurier Avenue segregated bicycle lane project in downtown Ottawa, which uses pre-cast curbs as the method of separation at midblock sections, the City recently implemented its first elevated cycle tracks along Churchill Avenue. In contrast to the Laurier facility, the 1.2 km long Churchill cycle track utilises the 'protected intersection' concept, which is another first in Ottawa.

The paper describes the main reasons and issues of introducing this new concept. The implementation of the protected intersection concept raised a number of technical, legal, and safety related questions which had to be addressed for the project to proceed. Some of the design elements applied in this project are also included in the recently published Ontario Traffic Manual Book 18: Cycling Facilities[i].

Although the implementation of the Churchill cycle tracks attracted considerable public support and no significant public controversy or opposition[ii], it has become obvious that existing Canadian traffic engineering and road design guidelines, practices, and traffic laws were created in such a way that they do not consider effective cycle track designs, and they must further evolve to fully support the widespread implementation of cycle tracks.

Planning Background

Cycling is enjoying something of a renaissance in most cities of the western world as a growing number of people see it as convenient, budget friendly mode of transportation and a fun way to build exercise into their daily routine. Many cities react to this resurgence of interest by investing in cycling facilities, supporting bicycle sharing programs, closing streets for motorised traffic and opening them for active transportation on specific days, and reallocating roadway space to active transportation.

The City of Ottawa along with the National Capital Commission (NCC) has a long history of supporting cycling both for recreational and utilitarian purposes. While the City has focused more on utilitarian cycling trips by providing painted bicycle lanes, paved shoulders and, more recently, segregated cycle tracks along busy roadways, the NCC has invested in multi-use pathways along scenic corridors. By the end of 2014, the combination of the these efforts resulted in 704 km of cycling network comprising bike lanes, paved shoulders, multi-use pathways, and cycle tracks.

Ottawa City Council has been providing significant support for cycling. In a landmark City Council Motion[iii], City staff was directed to accelerate efforts for making Ottawa more cycling friendly by increasing the previous City-wide cycling modal share target of 3% by 2031 to 5% by 2021. Recognising that the area within the Greenbelt has better potential for cycling than the suburbs, the modal share target for this area was set to 8% by 2021. City Council also directed staff to implement a network of segregated cycling facilities even if that may require the removal of parking spaces. The target setting was backed by an unprecedented investment of 28 million dollars for the period of 2011-2014. At the time, the target seemed to be very ambitious and perhaps even unachievable. However, the evidence from Portland, OR where the cycling modal share was increased from 1.1% in 1990 to 5.8% in 2009 suggested that by investing in infrastructure and by other measures, a significant increase in modal shares is feasible [iv]. Based on the 2011 Origin-Destination (OD) Survey[v] and the anticipated funding levels, the 2013 Ottawa Cycling Plan (OCP) refined the cycling modal share objectives for 2031 and set the target during the morning peak period to 8% for trips originating within the Greenbelt and 5% city-wide. Further breakdown of the targets reveal that within the inner area, the plan is to increase cycling modal share from the 8% in 2011 to 12% by 2031, while in the outer suburbs the planned increase is from the current 0% - 2% to 3% - 4% by 2031[vi] . Cycling modal shares of 10% and above have been achieved in a number of European cities [vii] (e.g. most Dutch and Danish cities, a number of German cities such as Muenster, Freiburg, Bremen, and Munich), and all of these cities have a network of segregated cycling facilities.

The OCP recognises both the potential and limitation of cycling as a mode of transportation. The two most frequent criticisms of focusing on cycling as a mode of transportation are the notion that the travel distances in Canadian cities and more specifically in Ottawa are too long for cycling, and that the winter climate makes cycling impractical.

The 2011 OD survey revealed that the average trip length by cycling is approximately 5 km and that 90% are shorter than 8 km. This finding was not surprising, it is similar to other jurisdictions and indicates that most people who are currently cycling find the 5 km distance - which takes about 15-30 minutes - suitable for cycling. The survey also revealed that about 45% of individual trips are not longer than 5 km,

but the cycling modal share is still only between 0 and 3% in most areas of the city v. It is not suggested that all trips of up to 5 km are suitable for a bicycle instead of a car, but there appears to be significant potential for growth. Cycling facilities that provide both perceived and real safety to users are part of the solution to capture a larger market share, especially for short trips (up to 5 km).

Another opportunity for significantly increasing cycling modal share exists with the daily trips students make to and from schools. Looking back a couple of decades, the decline in the number of children walking or cycling to school is evident. Between 2000 and 2010 the percentage of Canadian children and youth using inactive modes of transportation to and from school increased from 51% to 62% [viii]. One of the more prevalent reasons why parents drive their children (including teenagers) to school and other activities is fear for their safety while biking on city roads. Coupled with the fact that the trip to and from school tends to be short for many children (as schools are typically dispersed throughout a city's residential neighbourhoods), providing safe cycling routes for students is an essential step to getting more children biking to school.

Winter climate including low temperatures and snow is often cited by critics as a reason why cycling cannot be successful in Ottawa. While it is obvious that cycling is mostly a seasonal activity and warmer weather draws out more cyclists than colder weather, the cycling modal share during the cycling season in cities with colder climates, snow, rain, and wind, such as Montreal, Helsinki, Oulu, Amsterdam, and Copenhagen, have higher cycling modal shares than almost any city with moderate or warmer climates. This indicates that climate is one factor but not the most important one. Land use density, travel distances, the provision of low stress cycling facilities (e.g. separated from vehicles), and winter maintenance of cycling facilities are all factors that can make a city with less favourable climate more cycling friendly than a warmer city. A recent survey [ix] in Ottawa indicated that cycling during the cycling season is connected to travel choices throughout the year. Cyclists who take on cycling during fair weather tend to utilise other sustainable transportation modes during unfavourable weather conditions. In the survey, about 2000 cyclists were asked about their mode of travel during the winter season; while only about 16% of all cyclists keep on pedalling all year around, about 60% of those who stopped cycling switched to other sustainable modes including transit, walking or carpooling.

Need for Better Cycling Facilities

The number of bicycle commutes in Canada rose by approximately 42% between 1996 and 2006, and in terms of modal share the increase was from 1.1% to 1.3% [iv]. Although this growth is encouraging, the modal share is still a relatively small number. Ottawa's cycling modal share has historically been higher than the Canadian average, it has also shown an impressive City-wide growth between 2005 and 2011 from 1.7% to 2.4% for the morning peak period [vi], and it has significant potential for further growth.

Based on the aforementioned survey [ix], only a small percentage of the population is comfortable riding in traffic, and about 60% of the population would be willing to cycle if there were appropriate facilities. Therefore, if a city plans to increase cycling modal share significantly, it must develop facilities that are acceptable for the majority of the population. There is growing evidence [x, xi] that cycle tracks separated from traffic but running along city streets are in this category. For example, the recent 1.3 km project

along Laurier Avenue in downtown Ottawa demonstrated that a bicycle lane separated from traffic by pre-cast curbs and parked cars along a busy downtown street can have a dramatic positive impact on the number of cyclists [xii] .

The concept of separating cyclists from motorised vehicles has been applied for decades in a number of European cities. Although the exact design of facilities may vary from country to country, the concept is typically based on the following considerations:

- Cyclists are vulnerable road users, very similar to pedestrians, thus they have to be protected from much heavier and faster vehicles by the design of the infrastructure. Grouping users by their masses is one of the principles of the Dutch Sustainable Safety approach [xiii]. As a result, cyclists are treated at intersections very similarly to pedestrians (but not requiring them to dismount). This is in contrast to the approach that groups cyclists in the same category with much heavier cars and trucks and requires cyclists to follow the same movements at intersections as motorists.
- Although the designs of cycle tracks strive to minimise the potential for cyclist-pedestrian conflicts, it is recognised that the consequences of these conflicts are much less than those of cyclist-motorist conflicts. The minimisation of these conflicts is often based on common courtesy and social norms, not exclusively on absolute right of way assignment rules.

The ultimate objective of the cycle track design is to provide safe and attractive facilities to people who cycle (and walk adjacent to it) and to increase the cycling modal share. The primary objective of cycle tracks is not to facilitate the fastest possible movement of cyclists; however, when roads become congested, cycle tracks provide travel time advantages as well.

Designing cycle tracks or other types of protected cycling facilities at midblock locations is relatively straightforward. However, a solution is also needed as these separated facilities reach intersections.

Figure 1 depicts the protected intersection design concept used regularly in The Netherlands and a number of other European countries. Cyclists and motorists are separated until the cycle track has to cross the roadway. Cyclists are not dropped into the travel lane as they approach the intersection because that design would introduces a gap into the otherwise low stress cycling facility. Cyclists crossing the roadway are controlled by signals, but cyclists crossing the paths of pedestrians are controlled by signage and/or pavement markings. The signalised part of the pedestrian crossing does not include the cycle track. Cyclists' right turns are not controlled by the signal at all, and left turns are carried out in two stages. After crossing the

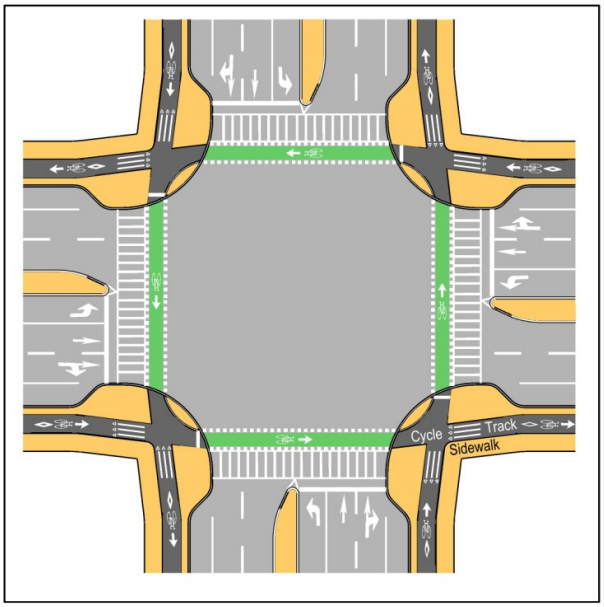

Figure 1: The protected intersection concept

first roadway, cyclists stop and wait for the green light at the curb, shielded by the protective safety island. This type of operation makes the movement of cyclists very predictable from both the motorist's and pedestrian's perspectives.

Typically cycle tracks have the greatest benefits along roadways where vehicle volumes and speeds are relatively high. This would apply to most arterial roadways and major collector roads (Figure 2). The benefits of the protected intersection design are most obvious at large intersections with multiple lanes and/or separate right turn lanes. At these intersections, even the most elaborate conventional approaches with multiple painted cycling lanes and/or bike boxes are inferior compared to the protected intersection design.

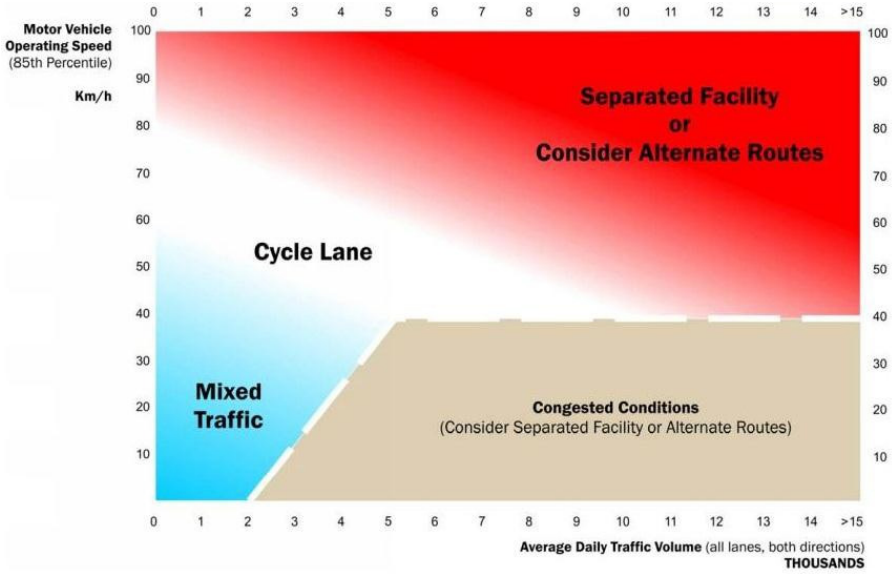

Figure 2: Ottawa's facility pre—selection nomograph [vi]

The Challenges of Implementing New Design Concepts

Although cycle tracks with protected intersections have been successfully implemented in a number of European cities for decades, the (partial) implementation of this concept along Churchill Ave in Ottawa is a first in Canada, and to the knowledge of the authors of this paper, it is the first in North America.

Introducing the cycle track concept with protected intersections has technical, legal, financial, and social/political challenges. The technical and legal challenges are likely the most complex. While the transportation engineering profession often strives to introduce new design elements and concepts, it must continuously consider the potential impacts on collisions and liability risks. The risks in terms of collisions and liability are not necessarily the same. It is often considered that the status quo provides the least exposure to liability, but the status quo does not necessarily provide the safest environment in terms of collisions. One approach to dealing with the technical challenges is to pursue implementation by carefully selecting the location where developing the technical solutions is easier and by introducing new concepts in phases. For example, through the implementation of the Laurier segregated bicycle lanes the concept of protected bicycle lanes along a midblock section has been introduced. As the next

step, the protected intersection concept was implemented along Churchill Avenue but only partially at two approaches to the intersections instead of all four. The next project, in this or in another corridor may introduce new elements, such as having cycle tracks approaching the intersection from all four directions. By this gradual implementation, the need to fully resolve some of the controversial issues - such as the best location of the stop bar on the cycle track and the best accommodation of left turns - is moved to a time when more knowledge and experience has been accumulated. An approach to deal with liability risks is to be over-precocious by over-designing some of the critical elements, by over-educating users, and by over-signing the facility.

In terms of financial issues, the challenge seems to be simpler. Rebuilding existing streets for the sole purpose of introducing cycle tracks with protected intersections is likely unaffordable for most, if not all, Canadian municipalities. However, when streets are built in new neighbourhoods or when aging underground utilities are rebuilt, by adding cycle tracks instead of painted bicycle lanes the total project cost is not likely to increase significantly and it may even decrease because the width of the road bed designed for heavy vehicles can be narrower. From that perspective, cycle tracks with protected intersections have great potential for building future sustainable communities and to be part of other infrastructure projects.

Finally, the social/political challenges have to be addressed to gain the required support for introducing a new concept. A significant proportion of experienced cyclists that are on the road today are, to a certain degree, comfortable with the existing facilities. Thus, a new concept that is implemented gradually without all the ultimate functionalities, may be seen as a step backward. For example, many experienced cyclists, who generally travel relatively fast and have adapted their lifestyle to the existing environment, find the partially implemented cycle track concept undesirable because it slows them down and introduces new conflicts with novice and slower cyclists that are attracted to the protected cycling infrastructure. There is also a fear that by introducing off-road facilities, motorists' tolerance for having cyclists in the regular travel lanes may erode. Both of these concerns are valid and the best solution is to fully develop the cycle track concept as fast as practicable and raise its quality to a level where it will be acceptable for most experienced cyclists as well. However, cycle tracks with protected intersections are designed to be appealing to 60%-70% of the population and are typically not appropriate for high speed cycling.

Why Churchill Avenue?

Churchill Avenue is a major north-south collector roadway with a 20 m right-of-way running through a mostly residential neighbourhood with some businesses along it. The 1.2km reconstructed section has 9 unsignalised and two signalised intersections, 50 km/hr speed limit, and has traffic volumes of 10,000 ADT. Before reconstruction, it had four lanes with the two curb lanes used mostly for parking. The lane edges were not clearly delineated from the asphalt sidewalk on the east side, and the street had a discontinuous and poorly defined asphalt sidewalk on the west side (Figure 3).

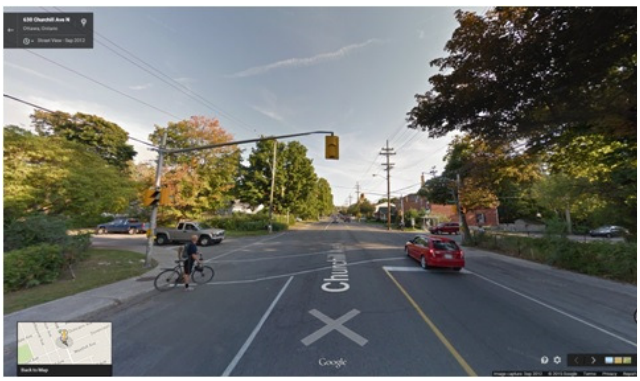

Figure 3: Before- four lane cross section with mixed flow operation
Source: Google image

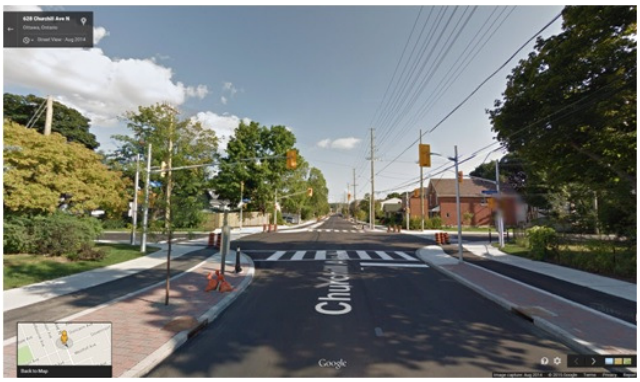

Figure 4: After – clear delineation of the cycling and pedestrian facility
Source: Google image

Churchill Avenue is identified as a route in Ottawa's cycling network; however, the City's Cycling Plan does not specify the type of facility that should be provided. The type of facility is typically determined as opportunities to implement them arise. In the case of this corridor, the opportunity to implement the cycle track came with the planned lifecycle replacement of underground utilities. The entire street had to be dug up and this created a "once in a life-time" opportunity to rearrange and enhance the street.

The initial plan was to rebuild the street following a more traditional design with concrete sidewalks on both sides and one vehicle lane per direction with parking lanes on both sides and bulb-outs at unsignalised intersections. Cyclists would have traveled in the shared lane which was initially planned to be 4.1m wide.

The neighbourhood surrounding Churchill Avenue has been generally supportive of active transportation, and the Ward Councillor, encouraged by the initial success of the protected cycling facility along Laurier Avenue in the downtown area, suggested City staff revisit the initial design and consider the implementation of higher quality cycling facilities along this corridor as well.

Design Considerations

The overall design philosophy of the corridor differs from the traditional approach from a number of perspectives. First, where parking had been reinstated, instead of having cyclists between parked and moving vehicles, they are placed on the right side of parked vehicles. Second, instead of providing wide vehicle lanes that are generally required when the lane is shared by vehicles and cyclists, the design has narrower lanes (3.5m each) which has a traffic calming effect compared to the wider 4.1m shared lanes. Finally, the narrower lanes and the separation of the cycling facility provide shorter pedestrian crossings of the vehicle lanes at the intersections, thus pedestrians benefit as well. The design philosophy is based on the assumption that the consequences of potential cyclist-pedestrian conflicts are less severe than those of cyclist-motorist conflicts, and the conflicts are easier to manage.

Midblock sections

Designing the midblock sections of cycle tracks is simpler than designing intersections. At midblock sections attention has been given to the separation between pedestrians and cyclists, to the placement of various utility poles and trees, to the potential conflicts at driveways and transit stops, and to the minimisation of the dooring hazard.

The asphalt cycle track was constructed at the same level as the concrete sidewalk. A 10cm wide stamped concrete strip was inserted between the two facilities to provide guidance to visually impaired people and pavement markings were implemented along every block indicating the proper usage of the facility. The main advantage of the flush design is expected to be easier winter maintenance. Although the City does not yet have a plan to winter maintain this facility, it is expected that over time as the network of segregated cycling facilities expands, there will be more winter cyclists, and maintenance will become a more important factor. Furthermore this design requires less right-of-way, minimises the tripping hazard, and may also facilitate the movement of mobility scooters, if permitted.

It is recognised that the flush design compared to an alternative configuration with a vertical separation between the cycle track and sidewalk has some disadvantages. The lack of vertical separation and the relatively small horizontal separation (10cm stamped concrete) may not convey a very strong message to pedestrians and cyclists to stay on their own facility. However, based on the anticipated number of cyclists and pedestrians in this corridor, no significant long term conflicts are expected.

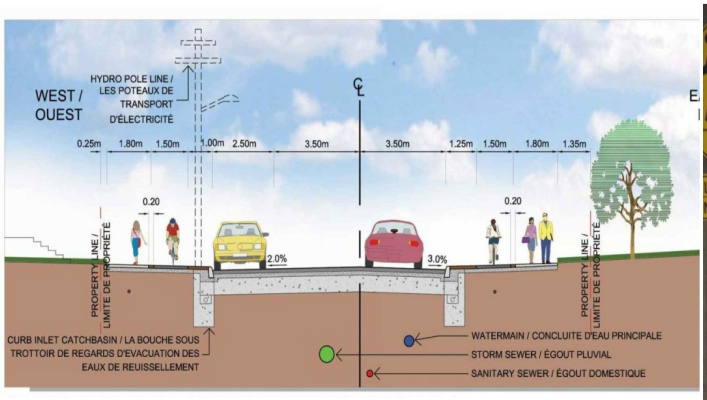

Figure 5:Typical cross section

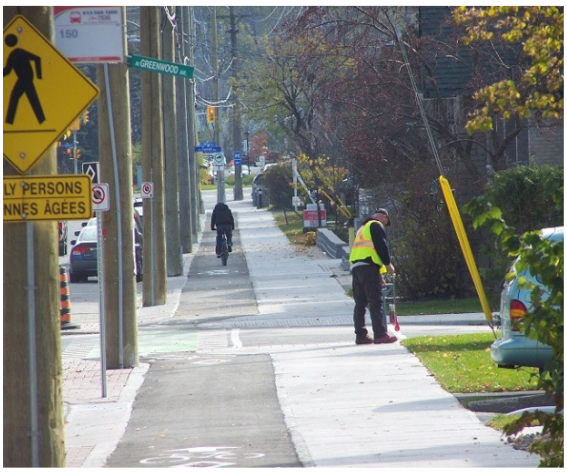

Figure 6: Separation of cycle track from vehicles

The corridor has a row of utility poles on the west side which were placed along the boulevard between the cycle track and the roadway for two reasons: to help control vehicular speeds by creating a visual friction to drivers and to increase the level of comfort for cyclists by inserting a physical barrier between them and motorised vehicles (Figure 6). Inserting the poles between the cycle track and the sidewalk was also considered as it would strengthen the separation between pedestrians and cyclists; however, that design would have less positive impact on vehicular speed management, which is important from both the pedestrians' and cyclists' perspectives.

By developing a boulevard between the cycle track and the roadway the potential for "dooring" incidents has been further reduced. Compared to the conventional design where parked vehicles are on the right hand side of cyclists, the selected design has a number of advantages: the chances of having a right hand side passenger door opened is less than having the driver's door opened (although drivers may be more careful than passengers); the 0.6 m boulevard helps in keeping cyclists out of the door zone; and even if a cyclist on a cycle track is knocked down by an opening door, he or she will not be at risk of a subsequent collision with another car that happens to be driving by at the same time.

The number of driveways along Churchill Avenue has been also highlighted as a potential concern. Most driveways are for private homes and are used relatively infrequently, but there are a few multi- family units and business as well that have driveways. It is expected that educating residents and business owners along the corridor will significantly reduce the risks of collisions between cyclists and cars at driveways. The City has delivered information sheets to every address along the street describing the new design and highlighted the safety hazards and the proper driver, cyclist, and pedestrian behaviours to minimise them.

Churchill Avenue has a 10 to 15 minute headway transit service with 7 curb-side bus stops in each direction. In addition, there is school bus parking in front of a school. All bus stop areas were designed with platforms between the cycle track and the stopped bus so that boarding and un-boarding happens from the platform and not from the cycle track. The cycle track along the bus stop area has special pavement markings, and there is signage indicating that pedestrians have the right of way (Figure 7, Figure 8).

Figure 7: Pavement markings at bus stops with wide lending area

Figure 8: Bus stop with narrow landing area

Intersection Design

The intersection design has a few unorthodox elements and was based on the 'protected intersection' design concept perfected by Dutch engineers and utilised in many European cities with some modifications to address local concerns. The main feature of the concept is that the cycle track is not

discontinued at the intersection, thus cyclists continue to be protected from vehicles travelling in the curb lane as long as possible. This is a fundamental departure from the conventional North American (NA) practice where cyclists are often mixed with right turning vehicles. The argument supporting the NA approach is that by mixing bicycles and motor vehicles as they approach the intersection motorists and cyclists become more aware of each other, and thus, the potential for the right hook collision is lowered.

The protected intersection concept is based on a different line of thinking. First, it recognises that most future cyclists who are attracted to cycle tracks would rather avoid sections where bicycles and vehicles have to mix, thus discontinuing the cycle track at the intersection is viewed as introducing a gap into the otherwise low stress midblock section. Second, by focusing on specific design elements and operational rules, the protected intersection is expected to be safer for all users compared to the conventional NA design. The main benefit of the implemented design is the expected positive impact on right turning hook collisions. This is achieved by focusing on three aspects of design: increasing visibility of the potential conflict area, reduction of turning speeds, and helping to establish eye contact between cyclists and motorists.

Increasing the visibility and awareness of cyclists in the conflict area

The awareness of the presence of cyclists has been enhanced by highlighting the cross ride using green pavement colour and “elephant’s feet” pavement markings (Figure 9).

Figure 9: Pavement markings at signalised intersection

Figure 10: Pavement markings at unsignalised intersection

Another important element of cycle track intersection design pertains to the position of cyclists when they stop for the red light. The protected intersection concept, as developed by the Dutch, assumes that cyclists stop and wait just before the curb prior to entering into the cross ride (Figure 11). This positioning puts the cyclist in front of the motorists stopped at the vehicular stop bar and within their cone of vision, thus ensuring the visibility of the cyclist before the light turns green. Furthermore, when the lights turn green, due to their advanced positioning, cyclists establish themselves in the cross ride first. Obviously, this scenario applies only when cyclists arrive at the intersection during the red light.

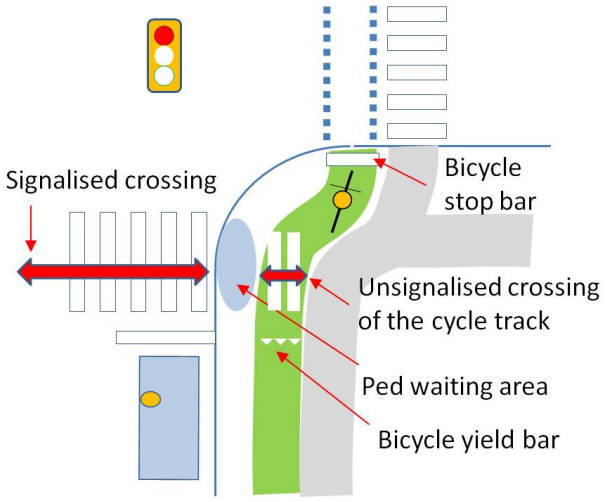

Figure 11: The "Dutch" design of pavement markings and signage indicating the required positioning of cyclists

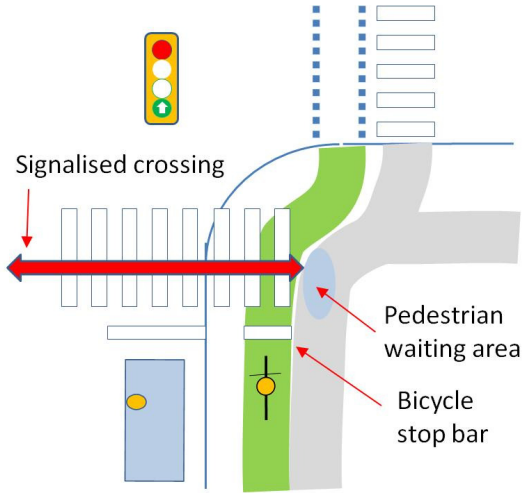

Figure 12: Implemented pavement markings and signage indicating the required positioning of cyclists

Although this concept has been used for decades in many European cities, its direct applicability to the Canadian context is not yet clear. By placing the bicycle stop bar close to the crossing, the cyclist and pedestrian movements upstream of the stop bar are not controlled by the signals, thus there is a potential for conflicts between pedestrians and cyclists. Furthermore, the breaking up of the pedestrian crossing to an unsignalised and signalised section may create difficulties for pedestrians with various disabilities.

Since the Dutch design has never been implemented in Ottawa, the relative significance of the above concerns is not known. Nevertheless, to mitigate these concerns, the bicycle stop bar was placed before the pedestrian crossing (Figure 12). To ensure that cyclists could still establish themselves first in the cross ride before right turning vehicles reach this location, the green signal for right and left turning vehicles is delayed by a few seconds. The operation of this setup and user behaviour will be monitored so that the most effective design in terms of safety, operations, and public understanding/acceptance could be developed in the future. This knowledge will be also useful to inform the discussion when developing new design guidelines and traffic laws.

Reduction of turning speeds

The visual "friction" built into the design with hydro poles and parked cars is expected to have an overall traffic calming effect on vehicular travel speeds. In addition, the pedestrian crossings and cross rides are raised at all un-signalised intersections to ensure slow turning speeds and to enhance both pedestrian and cycling safety.

Establishing eye-contact between turning motorists and cyclists

The design assumes that right turning vehicles have to yield to cyclists and pedestrians travelling straight through the intersection. However, a design which ensures that eye contact between right turning drivers and cyclists/pedestrians can be established is expected to have positive impact on safety. By

offsetting the cross ride from the curb lane as much as the available right of way allowed, the degree to which a driver has to turn his head to see an approaching cyclist has been reduced. Future monitoring of motorist-cyclist interactions will help determine whether the provided offset is sufficient and whether the offset creates some unintended user behaviour.

Legal and Regulatory Issues

The legislative issues surrounding cycle track implementation pertain mostly to the design of the protected intersection element. When cyclists are accommodated in shared vehicle-bicycle lanes, the legal framework is very simple; bicycles are considered to operate the same way as motorised vehicles. Cyclists have the legal right to occupy the lane, and they are expected to make right and left turns the same way as motorists. Although this is a very straightforward approach being in place for decades, it has not been embraced universally by either cyclists or motorists.

One example of the challenges of pursuing the above thinking manifests itself with painted bicycle lanes at intersections. Typically, the curb side bicycle lanes are dashed as they approach an intersection indicating the area where right turning vehicles should move close to the curb into the cyclists' space. Although this is considered by some to be a requirement under the Ontario Highway Traffic Act (HTA), this manoeuvre does typically not happen, motorists often make the right turn from their own lane after yielding to cyclists on their right side. The design of a protected intersection considers user behaviour and it enforces it by physically preventing right turning vehicles to drive into the area reserved for cyclists. Right turning vehicles are expected to yield to cyclists travelling straight through the intersection and the supporting signage is provided in the Ontario Traffic Manual Book 18 (Figure 13). However, the Ontario HTA needs to be updated to be more explicit about this type of operation.

Figure 13 : Yield to cyclists when turning right sign

Another important challenge is the definition of the operation of cyclists and pedestrians at signalised intersections. For example, does the designated crosswalk, which typically extends from curb to curb, include the cycle track? The advantage of including the cycle track in the signalised pedestrian crosswalk is that the right of way can be explicitly assigned by the signal to either pedestrians or cyclists (Figure

12). However, if users do not find this set-up intuitive and practical, and pedestrians cross the cycle track during the 'don't walk' signal phase and wait for the 'walk' phase at the pedestrian waiting area near the curb, and cyclists ignore the advanced stop bar and wait at the curb, the design is not the most effective. The alternative approach is to remove the cycle track and the pedestrian waiting area from the designated pedestrian crosswalk (Figure 11). The advantage of this approach is that the flashing pedestrian 'don't walk' time could be reduced allowing for more flexible signal operation.

Furthermore, the intersection design has to satisfy the requirements of the Accessibility for Ontarians Disabilities Act (AODA). The current HTA, AODA, and various design guidelines are silent on this subject because the concept of protected intersections did not exist when they were written. Appropriate guidelines will have to evolve as we learn more about user behaviour and needs.

TAC's Traffic Signal Guidelines for Bicycles and the Ontario Traffic Manual Book 18 have recently made excellent progress in terms of addressing the needs of active transportation; however, they do not yet fully cover all the required design elements of protected intersections. It is expected that the experience gained with the Churchill cycle track and similar initiatives from other jurisdictions will help develop the most effective design of cycle tracks.

Conclusions

There is growing evidence that the development of low stress cycling facilities protected from motorised traffic is a key factor in making cycling attractive and cities cycling friendly. Cycle tracks with protected intersections could provide the required low stress and safe cycling environment for a large proportion of the population along busy and relatively high speed streets.

The implementation of the Churchill Avenue cycle track project is one step towards a better understanding of how cycle tracks should be designed and operated. It is also a step towards understanding how traffic laws and intersection design practices will have to evolve to gain the most benefit from this concept.

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REFERENCES:

[i] Cycling Facilities, Ontario Traffic Manual-Book 18, December 2013. Retrieved on 10 April 2015: Ontario Ministry of Transportation

[ii] Kitchissippi Times, 21 August, 2014. Retrieved on 18 April 2015: http://kitchissippi.com/cycle-track-churchill/

[iii] Ottawa City Council, 8 September 2010: Minutes 96- Taking Steps Towards a Cycling Friendly City

[iv] John Pucher and Ralph Buehler, Analysis of Bicycling Trends and Policies in Large North American Cities: Lessons from New York, Final Report, University Transport Research Center, March 2011

[v] 2011 NCR Household Origin-Destination Survey, Summary of Results, TRANS Committee, Jan 2013

[vi] Ottawa Cycling Plan, City of Ottawa 2013. Retrieved on 10 April 2015: http://ottawa.ca/en/residents/transportation-and-parking/cycling/ottawa-cycling-plan

[vii] John Pucher and Ralph Buehler, Making Cycling Irresistible: Lessons from The Netherlands, Denmark, and Germany, Transport Reviews, A Transnational Transdisciplinary Journal, 2008

[viii] Tremblay MS, Warburton DER, Janssen I, Paterson DH, Latimer AE, Rhodes RE, et al. New Canadian Physical Activity Guidelines. Applied Physiology, Nutrition, and Metabolism. 2011; 36(1): 36-46.

[ix] Ottawa Commuter Attitude Survey Final Report, May 27, 2013, Malatest & Associates Ltd. Retrieved on 10 April 2015: http://ottawa.ca/en/city-hall/public-consultations/planning-and-infrastructure/commuter-attitudes-survey

[x] Meghan Lesley Winters: Improving Public Health through Active Transportation: Understanding the Influence of the Built Environment on Decisions to Travel by Bicycle, Doctor of Philosophy Thesis, University of British Columbia, March 2011. Retrieved on 10 April 2015: https://circle.ubc.ca/bitstream/handle/2429/33377/ubc_2011_spring_winters_meghan.pdf?sequence=5

[xi] Thomas Nosal, Cycle-tracks, bicycle lanes & on-street cycling in Montreal: a preliminary comparison of the cyclist injury risk, Presented at the Transportation research Board Annual Meeting, Washington, D.C. 2012

[xii] Laurier Avenue Segregated Bicycle Lanes Pilot Project, Report to Transportation Committee, City of Ottawa, June 28, 2013. Retrieved on 10 April 2015: http://app05.ottawa.ca/sirepub/view.aspx?cabinet=published_meetings&fileid=70841

[xiii] Dakota Road Safety Knowledge System. Retrieved on 26 March 2015: http://safetyknowsys.swov.nl/Safety_issues/Pedestrians-and-cyclists.html