CONNEXIONS – AMÉNAGEMENT DE CROISEMENTS DE VOIES CYCLABLES SÉCURITAIRES ET PERFORMANTS

CONNECTIONS - DESIGNING SAFE AND EFFICIENT BIKE-PATH CONNECTIONS

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RÉSUMÉ

Le vélo connaît une popularité de plus en plus grande dans les centres urbains. L'expansion régulière du réseau de voies cyclables contribue de façon importante à cette hausse de popularité. Il s'ensuit que les connexions entre les pistes se multiplient également au même rythme, certaines d'entre elles croisant souvent des routes existantes, ce qui crée ainsi des problématiques complexes.

Lors de l'aménagement d'une voie cyclable, la plupart des designs et des meilleures pratiques prévoient un corridor pour le cycliste lors de sa traversée, permettant d'éviter les conflits entre cyclistes et automobilistes. Peu d'attention est toutefois portée sur la façon dont le cycliste se déplace dans l'intersection et sur les manoeuvres pouvant être faites par les différents types de cyclistes. Il en résulte des designs considérés comme peu performants par les cyclistes, et pouvant engendrer des situations frustrantes pour tous les usagers.

La conception d'une connexion de pistes cyclables sécuritaire et performante est une opération difficile et complexe, d'autant plus que les pistes présentent une configuration pouvant varier l'une de l'autre, à la différence des routes: piste cyclable, bande cyclable, piste en site propre, etc. Pour être fonctionnelle et performante, le design de chaque connexion variera donc en fonction des caractéristiques des pistes.

La connexion constitue l'étape la plus importante lors de la conception de pistes cyclables axées sur la sécurité et la performance. Les besoins et les mouvements des cyclistes doivent alors être analysés et compris avant d'appliquer les directives et les meilleures pratiques de conception. Certaines connexions sont faciles à analyser; d'autres gèrent des modèles de mouvements complexes, dépendamment du type de cycliste traversant la connexion.

Concevoir une piste cyclable sécuritaire et performante n'est pas chose facile. Il existe toutefois de très bons guides de conception et une bonne documentation sur les meilleures pratiques, permettant d'accéder facilement aux meilleures pratiques et à la méthode de conception à utiliser pour la majorité des cas. Cependant, en cas de conception de connexion de pistes cyclables, il ne suffit pas de concevoir une intersection prévoyant une traversée en toute sécurité des usagers et une cohabitation harmonieuse entre automobilistes et cyclistes. Il est tout aussi important d'analyser les mouvements des cyclistes dans la zone de la connexion afin de comprendre leurs besoins, pour aménager des voies cyclables sécuritaires et performantes, et des zones d'attente et de dépassement adaptées au niveau d'expertise des usagers.

Mots-clés : circulation, voies cyclables, transport actif, connexion, géométrie, design

ABSTRACT

Cycling becomes more and more popular in urban centers, not least because the mileage of bike paths increases steadily. As bike paths multiply, so do connections of these facilities. More often than not, these connections fall into intersections with existing motorways, creating very complex situations. Most designs and best practices try to create a place for the cyclist as he crosses the intersections and try to avoid conflicts between cyclists and motorists. However, very little focus is on how the cyclist moves through the intersection, and how to allow for the movements of different types of cyclists. This is especially true in cases where multiple bike paths cross. This leads to designs that are perceived as less than optimal by cyclists, and that may create frustrating situations for all users.

Designing a safe and efficient connection of a bike path through an intersection is a daunting task. Even more so since bike paths can have, unlike roadways, very different configurations: we may find bike lanes, cycle tracks, separated bike facilities and even more. They all need different types of connections to make the design work well.

Multiple types of bike facilities exist. Connections between these bike paths are the most important design step, when striving to provide safe and efficient bike paths. In order to correctly apply and adopt existing design guidelines and best practices, cyclists' needs and movements need to be analysed and understood.

Some connections are easier to analyse than others, that create more complex patterns and that may show different patterns depending on the cyclists crossing the connection.

Designing safe and efficient bike facilities is not easy. However, very good guidance is available in the form of numerous guide-lines. These documentations allow for an easy access to best practices and allow for an easy design process in most cases.

The most difficult task, however, is the design of connecting bike paths: it is not enough to design an intersection that allows for safe passage and cohabitation of motorists and cyclists. It is equally important to understand cyclists' needs by analysing their movements throughout the connection. Once this analysis is done, it is paramount providing safe paths, waiting areas and efficient passing zones, adapted to the level of expertise of potential users.

Keywords: traffic, bike lanes, active transportation, connection, geometry, design

INTRODUCTION

Cycling becomes more and more popular in urban centers, not least because the mileage of bike paths increases steadily. As bike paths multiply, so do connections of these facilities. More often than not, these connections fall into intersections with existing motorways, creating very complex situations. Most designs and best practices try to create a place for the cyclist as he crosses the intersections and try to avoid conflicts between cyclists and motorists. However, very little focus is on how the cyclist moves through the intersection, and how to allow for the movements of different types of cyclists. This is especially true in cases where multiple bike paths cross. This leads to designs that are perceived as less than optimal by cyclists, and that may create frustrating situations for all users.

Designing a safe and efficient connection of a bike path through an intersection is a daunting task. Even more so since bike paths can have, unlike roadways, very different configurations: we may find bike lanes, cycle tracks, separated bike facilities and even more. They all need different types of connections to make the design work well.

This paper gives an overview of the different types of bike paths currently implemented in urban areas (bike lanes, one-way protected cycle tracks, raised cycle tracks, two-way cycle tracks, etc.), and then moves on to show the complexity of connecting bike paths within intersections.

The main concern when designing connections should be identifying and understanding cyclists' movements, and then implementing known best practices. Firstly, in order to guide the reader, a brief overview of best practices will be presented. Then the problem of identifying and designing for movements of cyclists, using connections between bike paths will be explained. Finally, with the help of case studies, it will be shown how to successfully design and implement safe and efficient connections that both cyclists and motorists appreciate while minimizing potential safety risks.

BIKE PATHS

Many different types of bike paths exist in today's urban areas. Some cater to different types of cyclists; while others are the result of different design preferences of the country or the city they are implemented in.

Generally speaking, there are eight different types of bike paths:

- Bike lanes;
- Left-side bike lanes;
- Contra-flow bike lanes;
- Buffered bike lanes;
- One-way protected cycle tracks;
- Raised cycle tracks;
- Two-way cycle tracks;
- Separated bike facilities.

Figure 1 Bike lane – Burgmauer, Cologne, Germany

Source: www.radgefahren.de/wer-hat-den-schwarzen-peter-225

Figure 2 Left-side bike lane – Eigth Avenue, New York

Source: BicyclesOnly/Flickr

Figure 3 Contra-flow bike lane – Logan Avenue, Toronto

Source: biketoronto.ca

Figure 4 Buffered bike lane – Sir Francis Drake Boulevard, Fairfax, California

Source: marinebike.org

Figure 5 One-way protected cycle track – Copenhagen, Denmark

Source: copenhagenize.com

Figure 6 Raised cycle track – Avenue Edouard VII, Pau, France

Source: alternatives-paloises.com

Figure 7 Two-way cycle track – Maisonneuve Boulevard, Montreal

Source: Stephan Poulin

Figure 8 Separated bike facility – Norderney, Germany

Source: kalveram-norderney.de

BEST PRACTICES

For all these different types of bike paths, best practices and design guidelines exist and are readily available (NACTO Urban Bikeway Design Guide[i]; technical guide of Vélo Québec[ii]). The designer can therefore easily consult the different design guides available and adapt the best practices to the situation he is working on.

However, before beginning design work, it is paramount to identify the type of cyclist that will be using the bike path, the environment the bike path will cross, and site constraints. Site constraints should include potential connections with other, existing or projected bike paths.

The aforementioned guides apply mainly to bike path design and also to the design of intersections. However, designers need to understand the needs of cyclists using connections when designing a crossing of two bike paths. Once all aspects (types of cyclist, needs, and movements) are analysed and understood, the designer can then adapt the intersection design guidelines to the even more complex situation on hand.

CONNECTIONS

Before designing bike path connections, it is important to understand all movements that may be made at the intersection and how they may be made. Not all cyclists are equal, much unlike motorists: confident cyclists may use movements different from those of inexperienced cyclists.

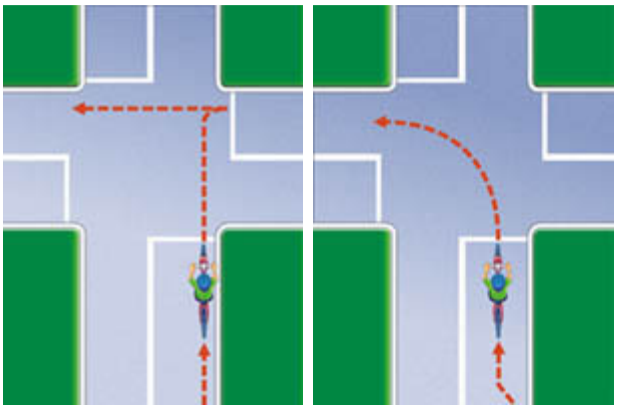
Figure 9 Confident cyclist

Figure 10 Interested cyclist

Figure 11 Inexperienced cyclist

Unlike motorists, not all cyclists are equal in the choice of their movements: the confident cyclist, for instance, will probably execute a left turn much like a motorist, whereas the interested cyclist will use a two stage left-turn, much like a pedestrian. Both ways are valid and safe, and the design should take both into consideration when appropriate. However, depending on to whom the bike paths cater, one of the two ways may not be required to be included in the design process.

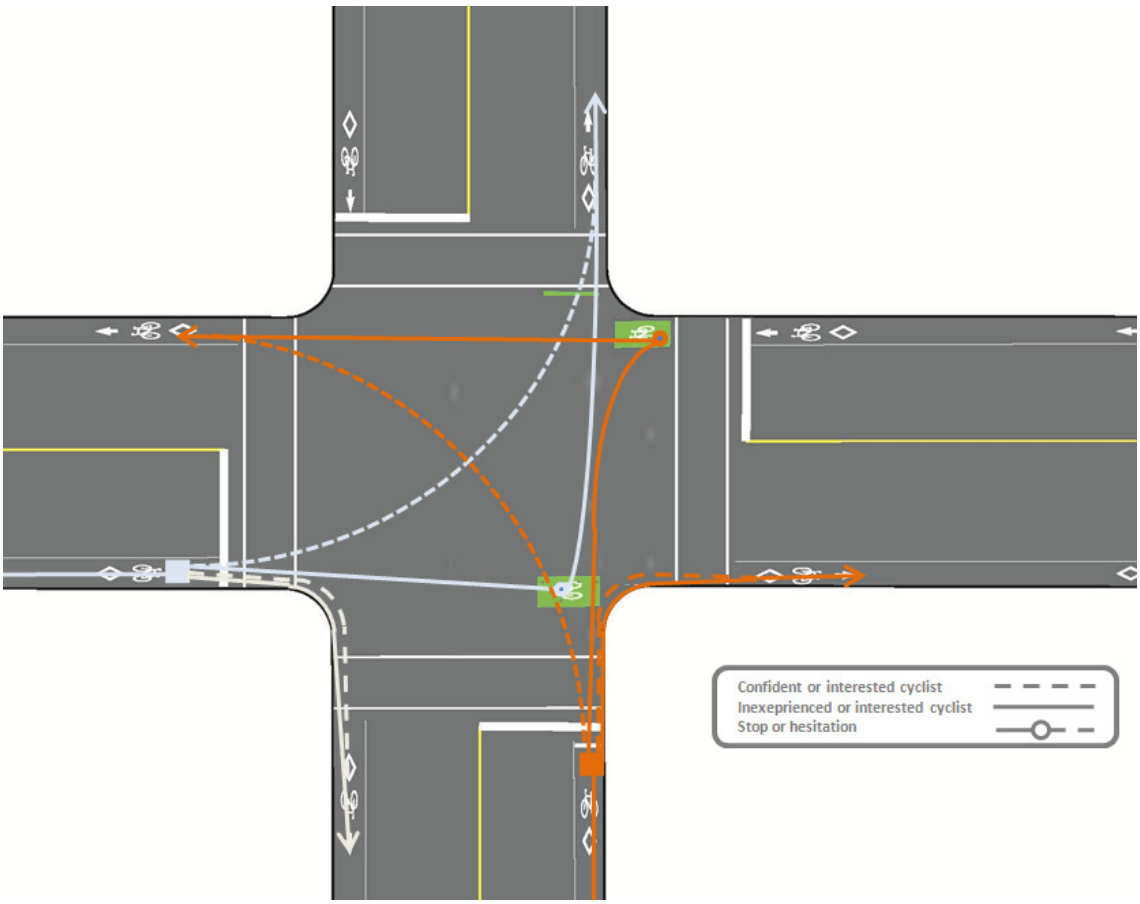
Figure 12 Left-turn movements for cyclists



Source : Société de l'assurance automobile Québec

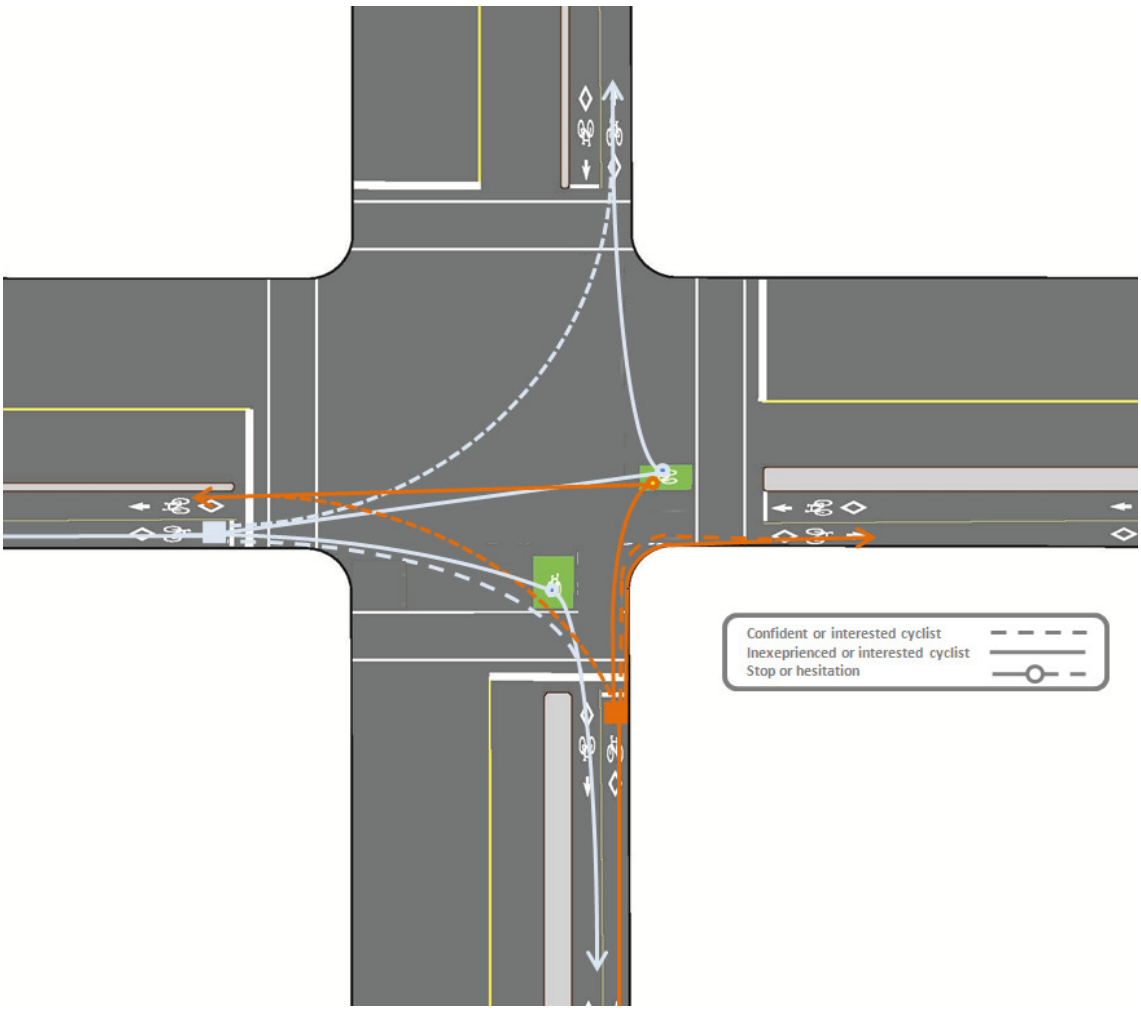
Once two bike paths cross, the design becomes much more complex, as can be seen in the two following figures.

Figure 13 Different movements at crossing of two bike lanes



Note: Only turning movements of two approaches are shown to facilitate comprehension of the figure.

Figure 14 Different movements at crossing of two two-lane cycle tracks

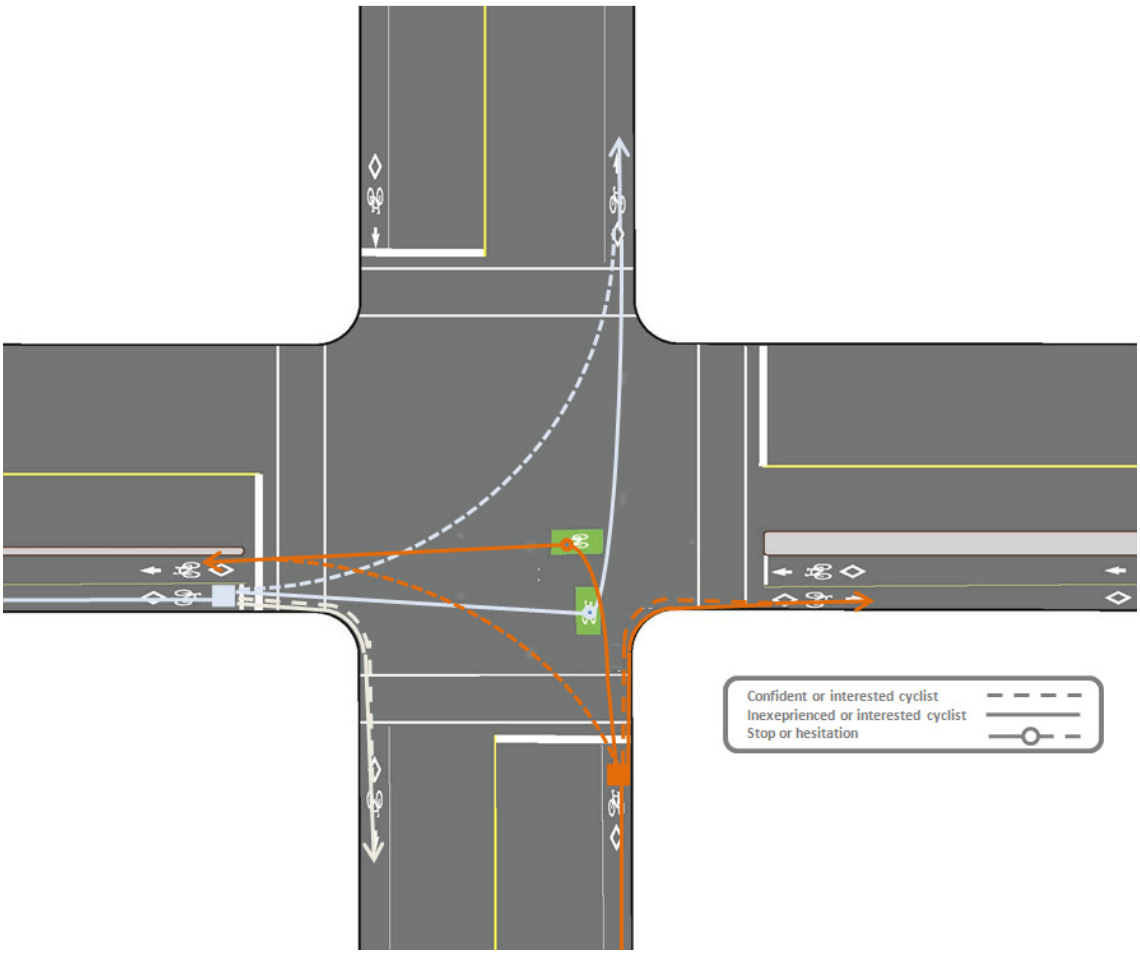


Note: Only turning movements of two approaches are shown to facilitate comprehension of the figure.

Some types of bike paths allow for easy, intuitive connections, since they are very similar to normal intersections as we all know them. Especially bike lanes are very easy to use for a cyclist, and easy to understand from a motorist's point of view. Other types of bike paths create very complex patterns, as illustrated in the example of a connection of two two-way protected cycle tracks.

Even more difficult are connections involving two different kinds of bike paths.

Figure 15 Different movements at crossing of two-lane cycle track with a bike lane



Note: Only turning movements of two approaches are shown to facilitate comprehension of the figure.

In order to understand and to be able to analyse cyclist's movements at a bike path connection, it is important to understand where the cyclist will pass, and where he will have to wait. Providing for safe and comfortable waiting areas is the most important task in designing a connection.

CASE STUDIES

Berri Street /Maisonneuve Boulevard (Montreal, Quebec)

Problem:

Connection between two protected two-lane cycle tracks at the busy intersection of Berri Street (North/South) and Maisonneuve Boulevard (East/West): Cross-street is one-way with no on-

street parking on the side of the cycle track, restricting thus greatly the space for possible waiting zones.

Movements:

Figure 16 Analyses of different movements (Berri/Maisonneuve) – Green phase on Berri (East-West)

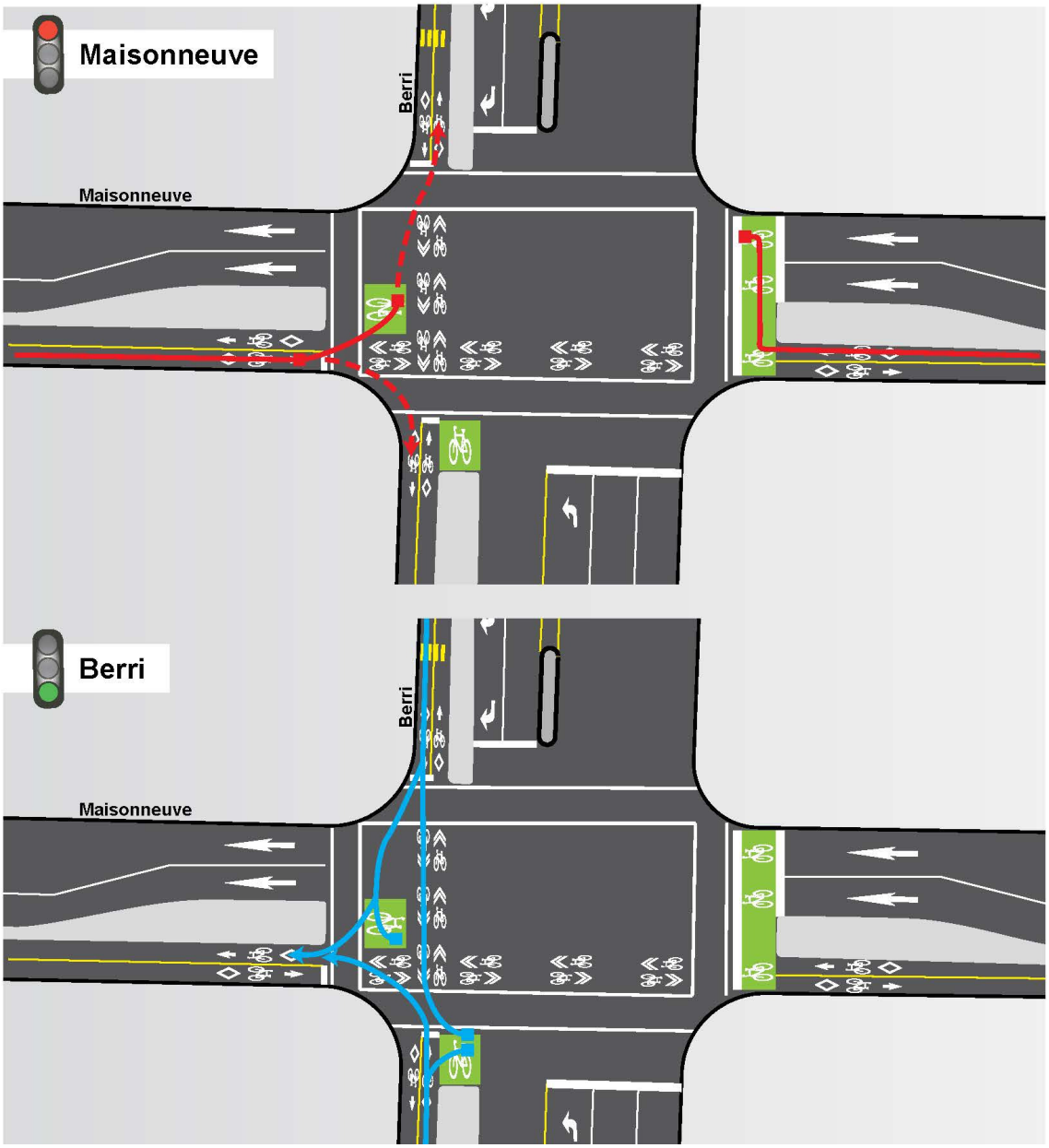
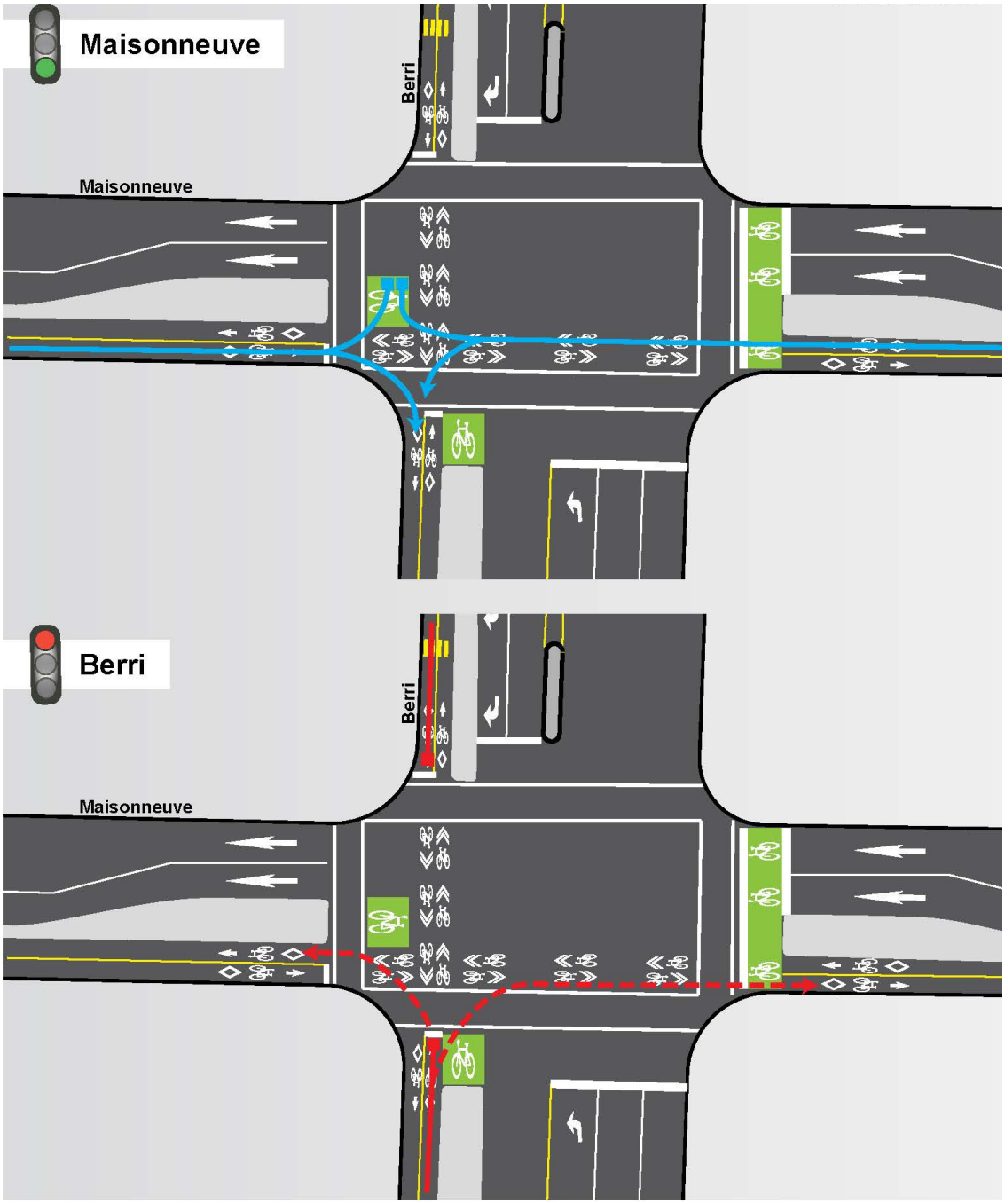


Figure 17 Analyses of different movements (Berri/Maisonneuve) – Green phase on Maisonneuve (East-West)

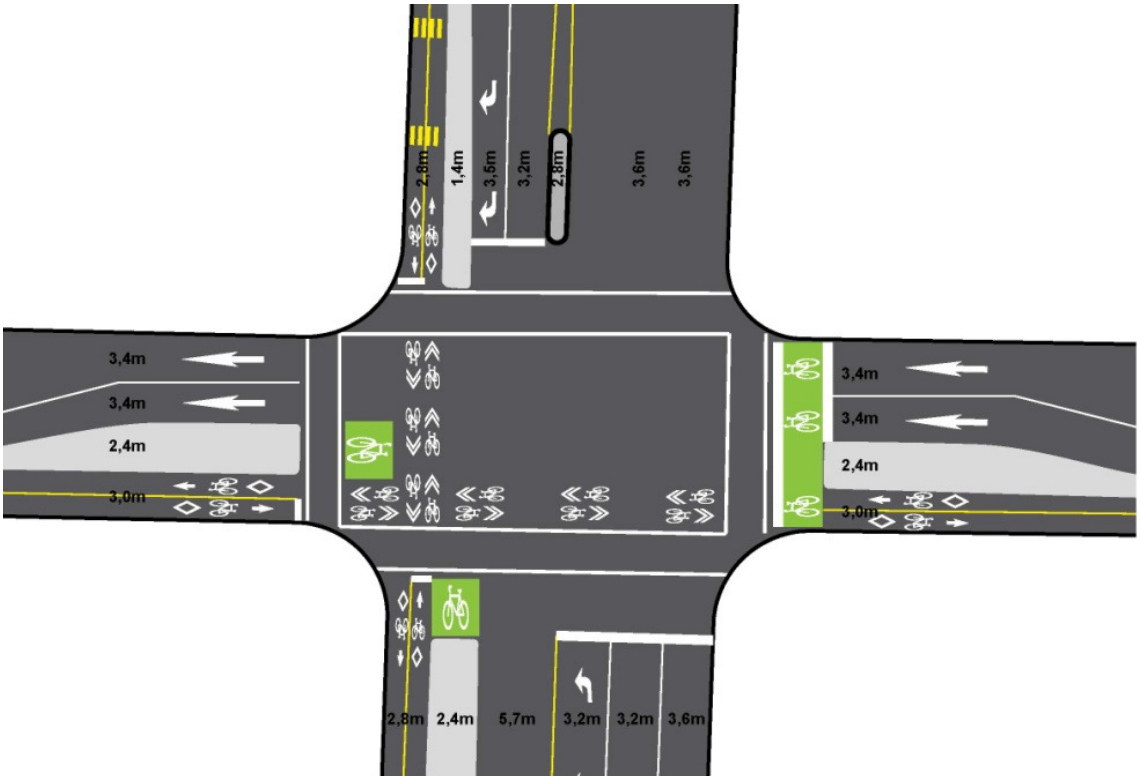


As illustrated on the figures above, the physical barriers between the roadway and the two-way cycle track make movements for all cyclists very much alike, by confining them to the cycle track until the intersection. However, when taking signal timing into consideration, it becomes clear that large waiting areas would be needed: Those areas should provide safe zones for cyclists waiting for their turn and should allow for easy through movements at the same time. Additionally, different interpretations of when a movement is allowed should be considered: a

cyclist arriving at a red light on the West approach and turning right might consider the green ball on the main-street as his signal, after having stopped at the corner.

Design:

Figure 18 Design (Berri/Maisonneuve)



Discussion:

The proposed design allows for safe turns, provides safe waiting areas, and allows for through traffic to easily pass through the intersection. However, the location of bike boxes (to the left) may not be intuitive for all cyclists, especially inexperienced ones. In the present case, the bike path being situated on a commuter link, most cyclists are experienced and therefore the design may work well.

Durlacher Allee / Tullastrasse, Karlsruhe, Germany

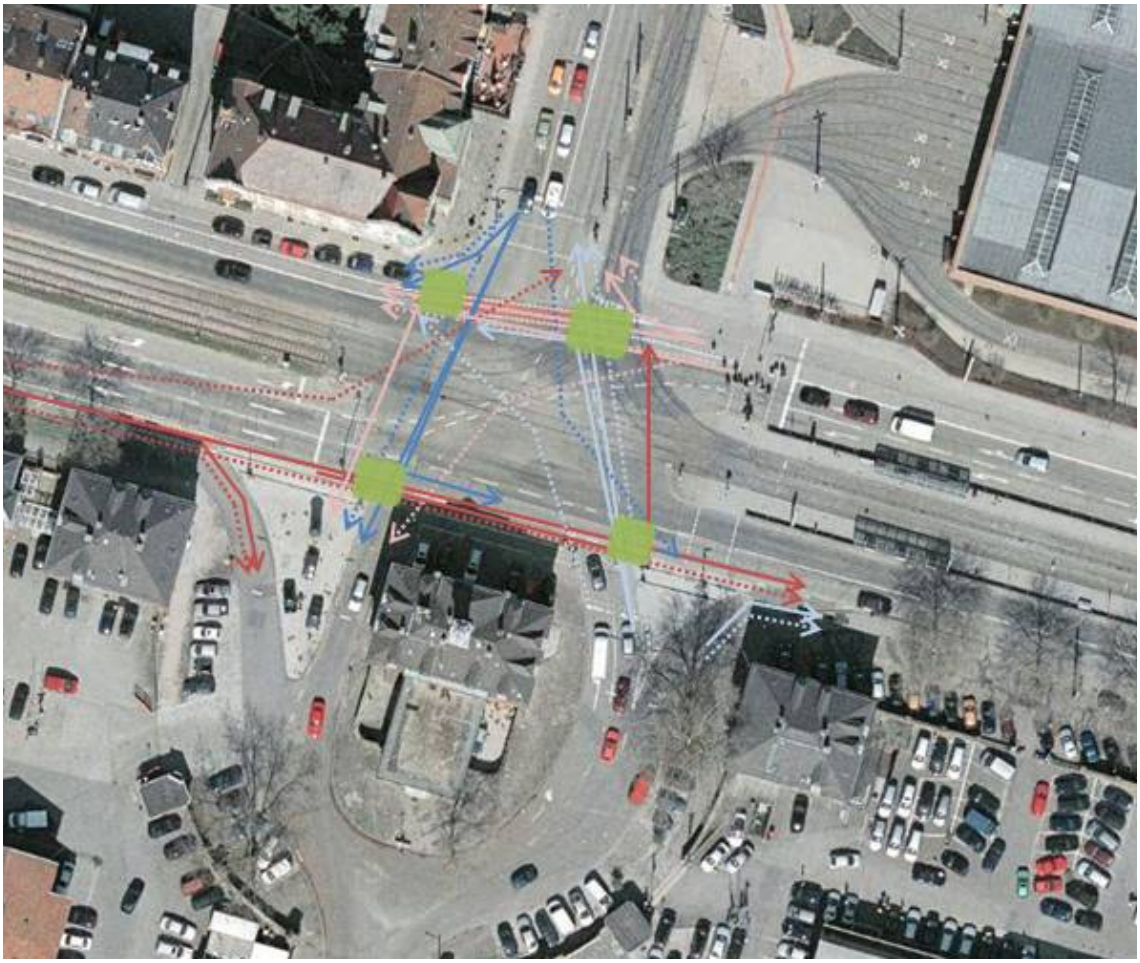
Problem:

Connection of two one-lane cycle tracks through a very busy intersection: East/West is a mayor bike thoroughfare on Durlacher Alle, North/South is an important local link on Tullastrasse.

The geometry provides ample space for all movements. The presence of islands allows for safe waiting areas, but does not provide for free-flow movements for cyclists but rather invites crossing at multiple intervals. Left turns from the cycle track are problematic since they are in conflict with heavy through traffic flows.

Movements:

Figure 19 Analysis of movements (Durlacher Allee/Tullastrasse)



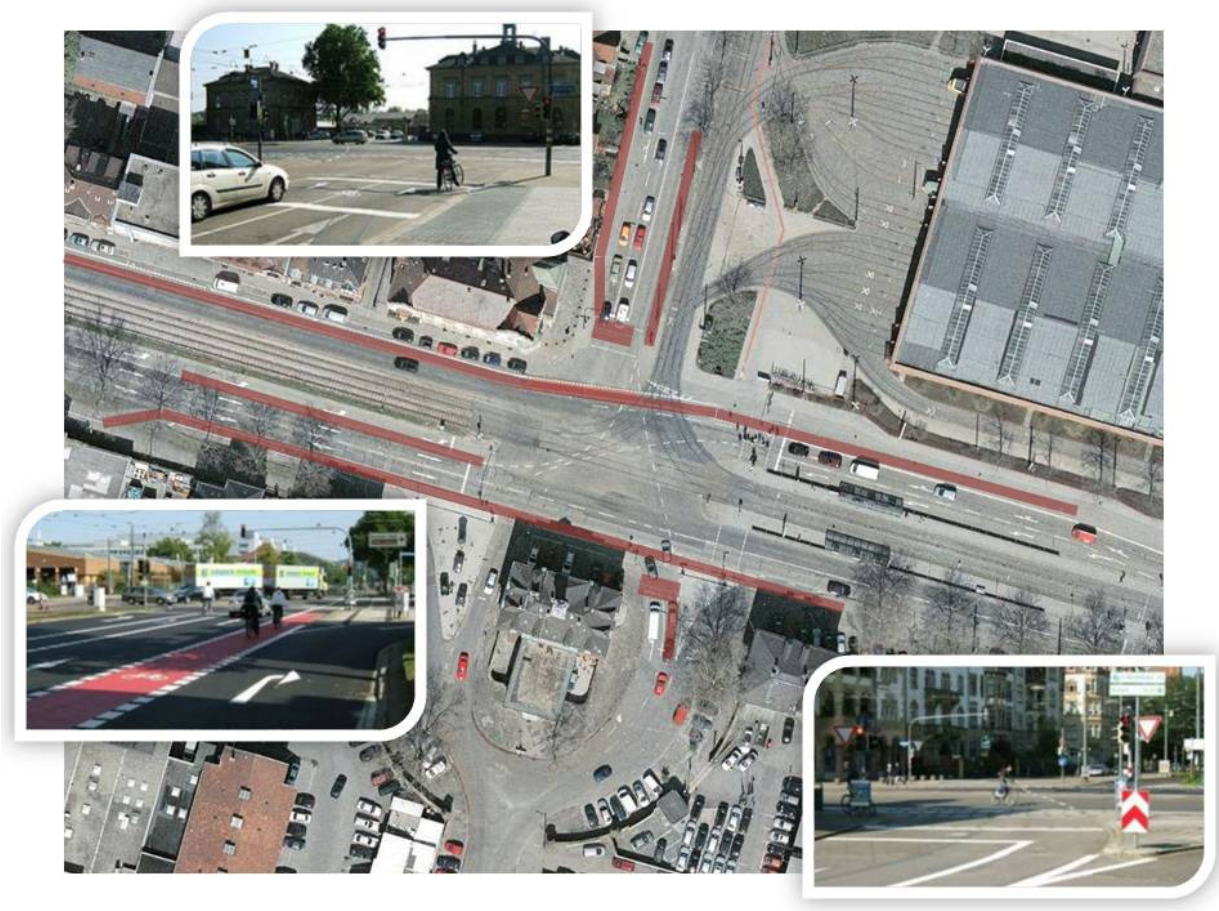
Source : photo – Google (2005)

The design with raised cycle tracks should make all cyclist types using the same movements, since they would not be able to leave the tracks before the intersection. However, the fact that the tracks are moved onto the street shortly before the intersection in order to increase visibility nullifies this point.

The left turns are problematic: different types of cyclists would use different paths, calling for waiting zones for the two-stage left-turns and for safe accommodation of one-stage left-turns into the motorist traffic. Moreover, the ample space (islands, large lanes) should allow to easily accommodating through movements by providing bypass lanes or waiting zones.

Design:

Figure 20 Design (Durlacher Allee/Tullastrasse)



Source : photo – Google (2005)

The cyclists are led from cycle tracks onto cycle lanes to safely and visibly cross the intersections. In order to eliminate the multiple stops, signal timings were changed to provide enough time for cyclists to cross the entire intersection (East/West) without having to stop at islands.

For cyclists turning left from the East/West street, waiting areas are provided (within the islands and therefore somewhat in conflict with pedestrians) and additional separate left-turn lanes are implemented to allow for one-stage turns. Cyclists on the North/South street can take advantage of bike-boxes that are easily accessible to comfortably make turns onto the main street.

Discussion:

The proposed design allows for safe left-turns. However, the use of dedicated left-turn lanes may not be comfortable for all cyclists, especially inexperienced ones. In the present case, most cyclists are enthusiasts and therefore the design works well (implemented 2007).

CONCLUSION

Designing safe and efficient bike facilities is not easy. However, very good guidance is available in the form of numerous guide-lines. These documentations allow for an easy access to best practices and allow for an easy design process in most cases.

The most difficult task, however, is the design of connecting bike paths: it is not enough to design an intersection that allows for safe passage and cohabitation of motorists and cyclists. It is equally important to understand cyclists' needs by analysing their movements throughout the connection.

Cyclists may use different paths for turning movements and a good and safe design should take this fact into consideration. If all possible paths are analysed and incorporated into the design of the intersection, it is possible to create a safe environment for all users and to accommodate the needs of all potential users.

Analysing cyclist's paths may even allow for designers to evaluate whether different types of bike paths in the network are compatible. If this kind evaluation is done early in the planning or design process, choosing the right type of bike path for a new link in the network can eliminate unwanted connection types and unsafe conditions.

Analysing paths through intersections and incorporating the needs of different kinds of cyclists is paramount to providing safe paths, waiting areas and efficient passing zones.

REFERENCES

[i] NACTO Urban Bikeway Design Guide, National Association of City Transportation Officials

[ii] Planning and design for pedestrians and cyclists, Vélo Québec,