A Framework for Bicycles at Intersections

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Summary

Bicycle planning in Australia has grown significantly in recent years. Off-road paths and on-road bicycle lanes are being constructed in many cities and towns. However, the on-road provision for cyclists at intersections appears to be an exception rather than the rule. It can be difficult to find space at intersections, and at times it appears there is reluctance by some designers to develop solutions for finding space. In other cases, the design does not always address the need to provide continuity for cyclists as they travel through the intersection.

This paper provides a practical framework for understanding how to provide on-road facilities for cyclists at intersections. The framework allows the simplification of complex designs by applying the "model bicycle intersection" and its six elements. The options within the six elements have also been identified making it a step by step process.

The model bicycle intersection is being successfully used in Victoria, Australia. VicRoads (the state road agency), in conjunction with a number of local Councils are using it to deliver an incremental approach to providing for cyclists at intersections. Those bicycle intersection elements, which can be provided within the current space balance, are being installed. Those elements for which there is currently no space will be addressed in the future when the space balance changes.

This incremental approach is acknowledging that a partial solution is better than no solution, and that a partial solution is just a phase on the journey to a total solution.

1. Introduction

Bicycle planning in Australia has grown significantly in recent years. Off-road paths are being constructed along creeks and waterways, rail reservations, and where space permits in road reservations. However, there is insufficient space to construct extensive off-road networks in most cities in towns. On-road bicycle lanes are therefore required to provide a comprehensive cycling network. In many cities and towns space is being found for on-road bicycle lanes. However, when the on-road bicycle lane approaches an intersection often the bicycle lane stops due to lack of space. Bicycles are competing with motor vehicles for the highly valued intersection space. Providing for cyclists at on-road intersections appears to be an exception rather than the rule.

A review of bicycle design guidelines from Australia (Austroads 1993), the Netherlands (C.R.O.W., 1993), United States of America (AASHTO, 1991), and the Great Britain (Cyclists Touring Club, 1996) found that the approach is usually based on providing discrete solutions for particular intersections types. However, there is a shortcoming in this type of approach. Designers are not given an overall framework to understand what is to be achieved and they are not given the tools to develop design solutions when they have not been detailed in the guidelines.

The design of intersections is complex. There are a number of users that all have their own requirements and the designer needs to balance these. In this complex process, some needs may be overlooked. It is therefore desirable to reduce this complex problem into a number of smaller and simpler design issues.

2. The Model Bicycle Intersection.

The model bicycle intersection was developed by Cumming (1999) after considering the different phases that cyclists pass through as they deal with road intersections. To achieve this, a number of design guidelines for bicycles were reviewed along with considering the needs of the other road users by using guidelines such as Austroads (1986).

In simple terms, as cyclists are approaching an intersection, they will ride along midblock in a bicycle lane and then undertake a manoeuvre to place them in the right position for the approach to the intersection. They will ride along the approach to the intersection, and if required to stop,

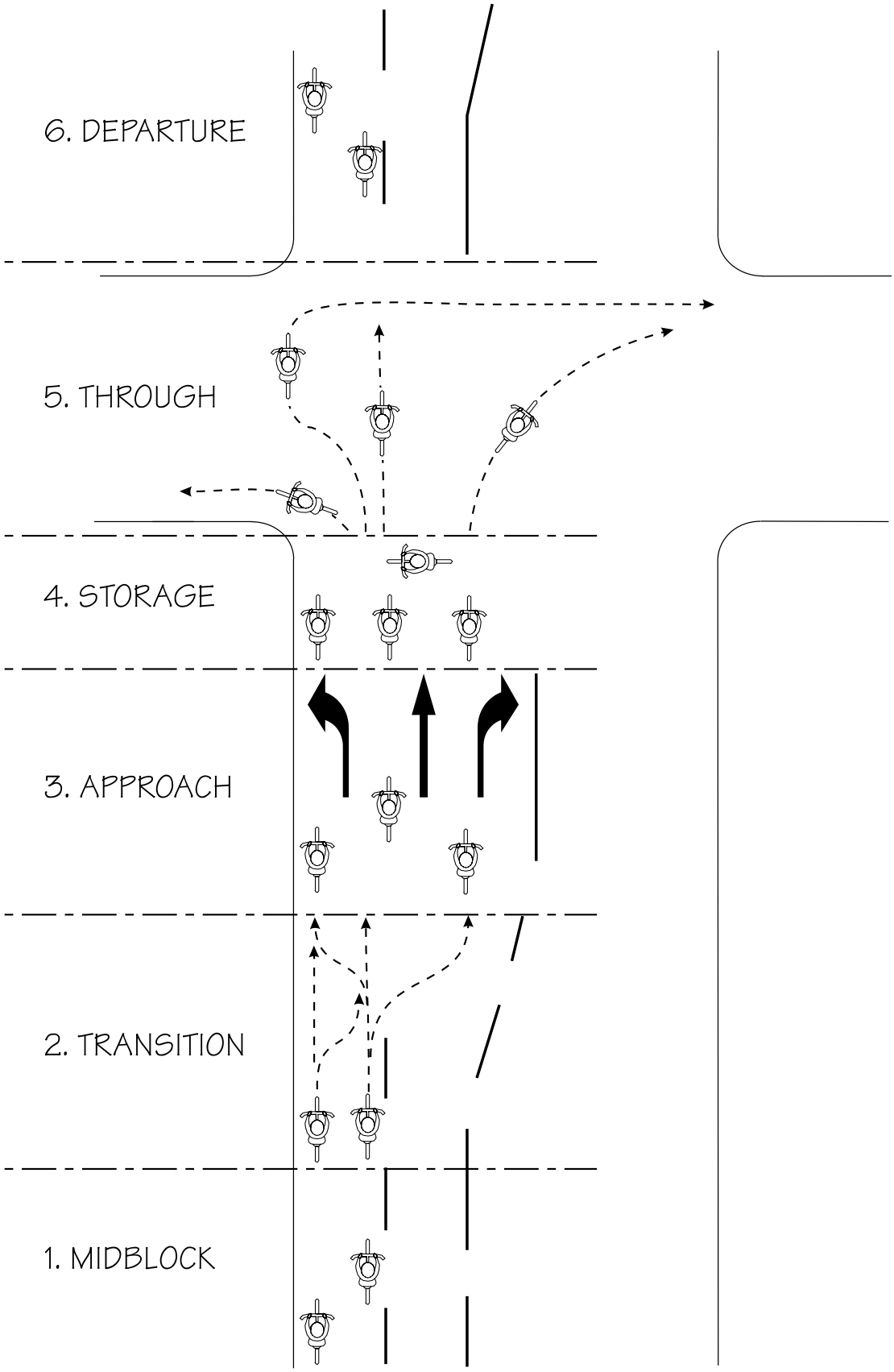

Figure 1. The model bicycle intersection and its six elements

they will store at the intersection until they are able to proceed. The cyclist will then proceed through the intersection, departing the intersection before ending up in the next midblock bicycle lane. From this understanding, the model bicycle intersection and its six elements were created. Figure 1 illustrates these six elements and the various positions that cyclists may need to place themselves given their need to travel through the intersection, but at the same time having to interact with motor vehicles.

The six elements of the model bicycle intersection are:

1. Midblock bicycle position on the road;
2. Transition from the midblock to the approach position;
3. Approach position at the intersection;
4. Storage of bicycles at the intersection when stopped;
5. Through movement to travel across the intersection; and
6. Departure from the intersection.

Understanding these six elements and their interaction with other road users, will allow the designers of bicycle facilities at intersections to better understand cyclists' needs. Designers can now reduce a complex problem into six smaller design issues and set about actively including all six elements in their designs.

3. Options Within The Six Intersection Elements

To encourage the designers of intersections to include all six elements, they need to be presented with the design options are available to them. Each element has been reviewed in the context of the needs of cyclists, and the needs of the motorist. It was found that there were usually 2 or 3 options of providing for cyclists within each element.

The most common options for each of the six elements is illustrated in Figure 2. The following is a simple description of each of the options and should be read in conjunction with Figure 2.

1. Midblock provision for cyclists will be in a bicycle lane that will be:
    - Kerbside bicycle lane where cyclists travel adjacent the kerb; or
    - Carside bicycle lane where cyclists travel adjacent to parked cars.
2. Transition is the move cyclists need to undertake to connect the midblock bicycle lane to the intersection approach bicycle lane. Transitions occur by:
    - Straight kerbside, where cyclists continues travelling in a bicycle lane adjacent to the kerb,
    - Offset left, where cyclists need to move from a midblock carside bicycle lane to an approach kerbside bicycle lane,
    - Straight carside, where cyclists move form a midblock carside bicycle lane to an approach carside bicycle lane,
    - Weave right, where cyclists need to move across a motor vehicle lane to be in the appropriate approach lane position.
3. Approach bicycle lanes are installed leading up to the intersection between the motor vehicle lanes. Approach bicycle lanes may be:
    - Kerbside, where the approach bicycle lane is adjacent the kerb,
    - Carside, where the approach bicycle lane is to the right of a motor vehicle left turn lane,
    - Rightside, where the approach bicycle lane is to the left of a motor vehicle right turn lane.

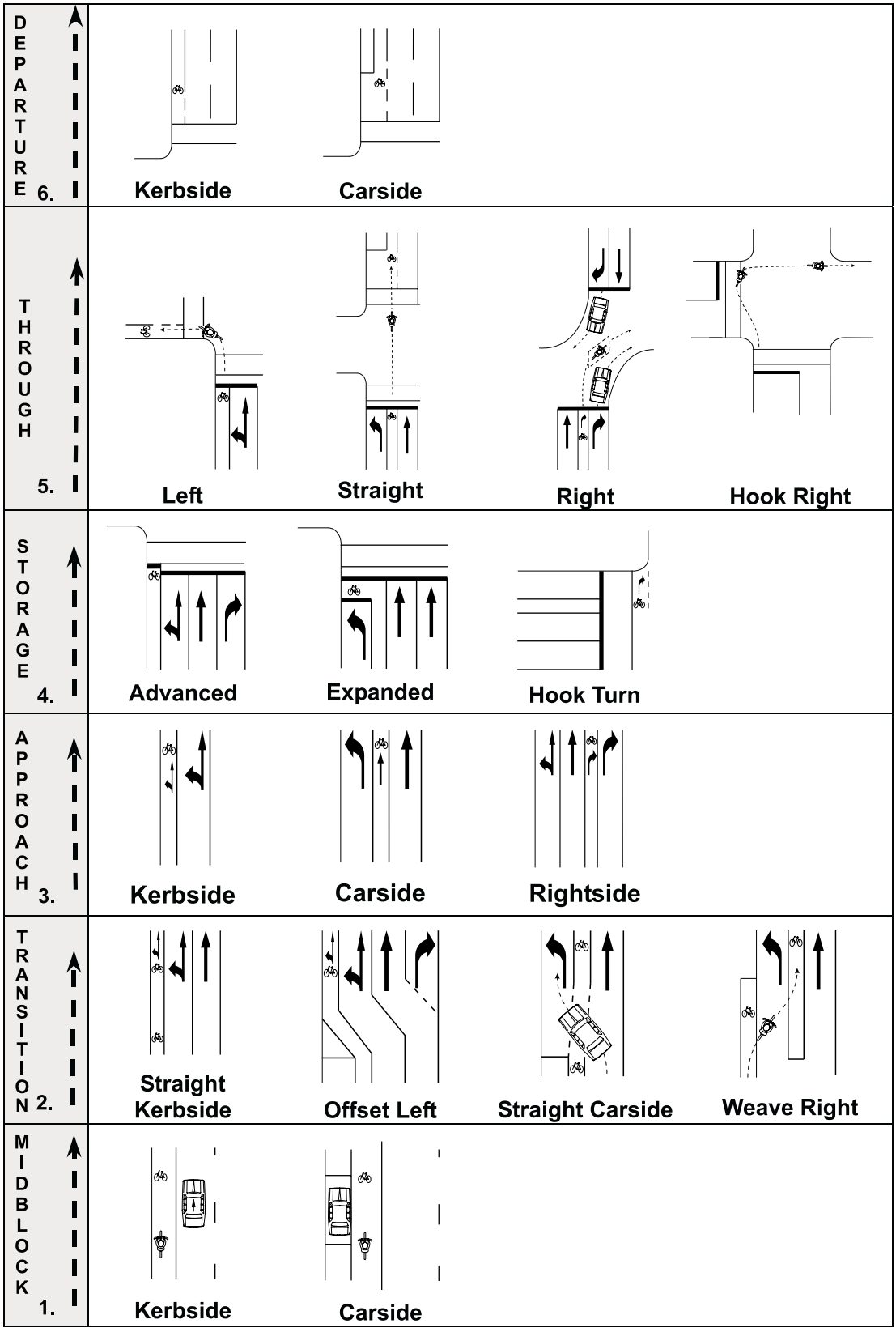

Figure 2. Options within the six elements of the “model bicycle intersection”

4. Storage of bicycles at the intersection is required when cyclists are stopped at the intersection. Storage can be provided by:
    - Advanced storage, where the stop line of the approach bicycle lane is in advance of the motor vehicle stop line,
    - Expanded storage, is provided by moving the motor vehicle stop line back to create a larger storage area,
    - Hook turn storage, provides an area adjacent the pedestrian crossing designating the location where cyclists should wait when undertaking a hook turn.
5. Through movements occur when cyclists pass through the intersection. These movements are:
    - Left through movements, when cyclists undertake a left turn,
    - Straight though movements, when cyclists travel from one side of the intersection through to the opposite side,
    - Right through movements, when cyclists turn right from the centre of the road,
    - Hook right through movements, when cyclists undertake a right turn from the left in two staged movements.
6. Departure bicycle lanes provide for cyclists as they leave the intersection. They can be provided for by:
    - Kerbside departure bicycle lanes adjacent to the kerb,
    - Carside departure bicycle lanes when car parking begins close to the intersection.

This framework provides a simple approach for designers to select the most appropriate solution give the needs of all road users.

5. The Practical Application

The aim of the model bicycle intersection is to provide designers with a simplified approach to providing for cyclists at intersections. By presenting the model with its six elements, designers can break down a complex problem into a number of smaller and simpler problems. Then by considering the options for providing for cyclists within each element, designers should be able to select the most appropriate bicycle facility.

Current Practice in Australia

In Australia, midblock on-road bicycle lanes are becoming more popular and processes for evaluating the competing users of midblock space are becoming more widely used. However, at intersections the competition for space is making the provision of bicycle lanes more difficult.

In some new road projects, bicycle lanes at intersections are being provided. However, when retrofitting bicycle lanes to existing roads, the challenge of finding space for bicycle lanes is often considered to be too difficult. Transport planners usually aim to maximise the number of traffic lanes at intersections as this governs the motor vehicle capacity of the road. Most of the space is therefore used for motor vehicle lanes.

In addition to motor vehicle lanes, there is a need for space for pedestrians, for below and above ground services such as electricity, gas and water, and the community requires some green space such as landscaping and trees. Many times, the end result is that it is too hard to also provide space for cyclists.

Progressing to Bicycle Lanes at Intersections

As bicycle planning continues to evolve, bicycle planners often know the end result they would like to achieve. To get there they need to take incremental steps along the way. The question is how to get from a situation where very few intersections have bicycle facilities, to intersections having all six elements described above in the model bicycle intersection.

In Victoria, Australia, VicRoads (the state road agency), in conjunction with a number of local Councils, are increasing their understanding of how to provide for cyclists at intersections. When retrofitting bicycle facilities to existing intersections, these agencies are attempting to install as many of the six elements of the model bicycle intersection within the current space balance. Over time, the space balance may change, and these intersections can then be modified to include all six elements.

Cross Sectional Space verses Longitudinal Space

The approach of providing as many of the six elements as possible within the current space balance requires an understanding of the what existing space is available and where space can come from

In reviewing the space requirements for the six elements, it can be seen that the elements of midblock, transition, approach, through and departure all require space from the width of the road, or cross-sectional space. This contrasts with storage space. Storage space can be thought of as longitudinal space as it is found lengthways down the road.

Storage space should therefore be the easiest of the six elements to find space for. There is no reason why this space can't be found at all intersections. It is acknowledged that some technical details such as repositioning motor vehicle detector loops and reviewing signal clearance times through the intersection may need to be considered.

Finding space for Departure and Through Elements

There are opportunities to find space for the departure and through elements of bicycle lanes at intersections, and still maintain the current space balance. This is often because there are left turn and right turn motor vehicle lanes on the approach to the intersection and the corresponding space for these lanes is not required on the departure side of the intersection.

If the bicycle storage element has been provided, and space for the departure and through bicycle lanes have been found, then three of the six elements have been provided for. This is a significant step forward, considering that in the beginning there were no intersection bicycle facilities, and there is sometimes an attitude that nothing can be done.

Finding Space for Approach and Transition Bicycle Lanes

Finding space for bicycle lanes in the approach and transition elements is usually more difficult than the other elements. At most existing intersections, motor vehicle lanes are at their minimum widths, medians have been narrowed to provide right turn lanes, and left turn lanes have been indented in the footpath/nature strip area. Finding space for these elements is usually difficult within the existing space balance.

The space balance will need to change. Traffic lanes may need to be removed, medians or footpaths further narrowed, or a solution using off-road paths developed. These proposals may not be immediately acceptable. The approach currently being taken in Victoria, Australia is to identify opportunities in the future when the balance between the users of the road space can be changed.

Approach Bicycle Lanes verse Departure Bicycle Lanes

There are intersections where there is space for bicycle lanes at the approach to the intersection, or space for bicycle lanes on the departure side of the intersection, but not both. A decision needs to be made whether approach lanes or departure lanes best serve cyclists.

Bicycle lanes on the approach will allow the cyclists to have dedicated space from midblock, through transition and approach, and into storage. However, as the cyclists passes through the intersection, they need to merge with the motor vehicles on the departure side as there is not bicycle lane, and then join the midblock bicycle lane further along the road. Cyclists travelling at 20 – 30 km/hr merging with motor vehicles travelling at potentially 60 or 70 km/hr is not desirable.

The other scenario is when there are bicycle lanes on the departure side but not on the approach side of the intersection. If the intersection is signalised, during the red phase, cyclists will reach the end of the midblock bicycle lane, travel between the stationary motor vehicles making their way to the storage area at the front of the queue. Then when they proceed they have the

departure side bicycle lanes to ride into. If the traffic signals are green, cyclists need to either merge with the through traffic or ride in the slower speed environment in the left turn lane, and then proceed through the intersection into the departure side bicycle lane.

Whilst neither of these solutions are ideal, it is considered that when choice between approach bicycle lanes or departure bicycle lanes at intersections must be made, the departure side bicycle lanes are preferred. This avoids the merge with motor vehicles on the departure side.

An Incremental Approach

The above outlines an incremental approach being taken at a number of intersections in Victoria, Australia. Whilst it may be argued that not fully providing for cyclists at intersections is compromising cyclists safety, the challenge is to find the appropriate balance, and still find space for bicycle facilities.

This incremental approach is advocating that a partial solution is better than no solution. It demonstrates that the state road agency and local Councils are making progress and cyclists are acknowledging this progress. However, when the move from the partial solution to a more total solution will occur is unknown. The space balance will need to change and it is unknown when this will be acceptable.

6. Conclusion

The model bicycle intersection and its six elements is proving to be a practical tool to assist in the design of bicycle facilities at intersections. It has simplified a complex design problem into a number of smaller and more manageable design elements. Designers are using this approach when providing for cyclists at new intersections, and when trying to retrofit facilities to existing intersections.

The model bicycle intersection is being used to facilitate an in incremental approach to retrofitting bicycle facilities to existing intersections. It allows the easier elements such as storage, through and departure bicycle facilities to be retrofitted, often within the existing space balance. The more difficult elements such as approach and transition can then be considered in the future, when it is acceptable for the space balance to be changed.

This incremental approach is acknowledging that a partial solution is better than no solution, and that a partial solution is just a phase on the journey to a total solution.

7. Notes

The views expressed in this paper are those of the author and may not necessarily reflect those of VicRoads.

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