Advanced Planning and Design for Cycling

Module 4 Intersections

SECTION 2
SIGNALISED INTERSECTION LAYOUT

Section Outline
Signalised Intersection Layout

• Refresher: 6 elements of intersection design
• Providing cycle lanes
• Advanced stop boxes and advanced stop lines
• Hook turns
• Cycle slip lanes
Six Elements of Continuity

1. Midblock
2. Transition
3. Approach
4. Storage
5. Through
6. Departure

Cumming et al.

Usefulness of Six Elements

- Structured approach to intersection design
  - *Can a cyclist get from every leg to every other leg?*
- Enables well-ordered audit of existing intersections
  - Designed for signalised intersections but can use with other types too
Why Provide Cycle Lanes?

• In general:
  – Promote cycling to other road users
  – Cyclists perceive cycle lane installations to increase LOS by one level

Why Provide Cycle Lanes?

• In the midblock
  – Ensure cyclists have space on the road (safety)
  – Protection from adverse effects that arise from speed differential between cyclists and motorists
  – Advantage cyclists over stationary traffic queues (cyclists legally allowed to undertake motor traffic with cycle lane)
Why Provide Cycle Lanes?

• At intersections
  – Increase cyclist-motorists intervisibility (safety)
  – Make cyclist behaviour more predictable
  – Enable cyclists to travel in their desired direction

Cycle Lane Provision Priority

• In Europe, providing kerbside lanes is generally given priority over carside lanes, even at intersections
Cycle Lane Provision Priority

- In NZ, we base provision on movements
- We generally prioritise cycle lanes for through cyclists over those for turning cyclists
  - Based on speed differential between cyclists and motor vehicles – highest differential in through lanes
  - CROW recommends max differential of 10km/h for weaving traffic
  - Safer for cyclists approaching limit line during green phase

Signalised Intersection Transitions

- Well designed transitions are important for cycle provision at signalised intersections
- Note unmarked LT lanes – discussed later on

Parking / no cycle lane  Parking / cycle lane  Kerbside cycle lane
Signalised Intersection Transitions

- Transition and storage locations depend on placement of departure provision

- Make transitions as cycle friendly as possible:
  - Control vehicle speeds
  - Short transition lengths
Markings Crossing Traffic Lanes

• Left turners must give way to cyclists
• Enhanced by continuity lines and coloured surfacing
• Road User Rule:
  – 2.3 (3): A driver may drive… in a lane that is unavailable to the driver… if:
    – (a) it is impracticable to proceed otherwise
    – (b) …can be done safely and without impeding other traffic
  – 2.3 (4) A driver may also drive wholly or partly in a lane that is unavailable to the driver… if the driver:
    – (a) drives in the lane to cross it…
    – (b) drives in the lane for the minimum length necessary… and for no more than a maximum length of 50 m; and
    – (c) gives way to vehicles entitled to use the lane

Finding Space

• Constraints:
  – Adjacent land uses
  – On street parking in the midblock
  – Providing for all movements at intersections
• Conflicting objectives
  – E.g. increasing road capacity for motor vehicles vs. accommodating cyclists

• We’ll be talking about finding space throughout the day
Cyclists Breaking Intersection Rules

- Cyclists may break traffic rules for their own safety, or out of impatience
- Most illegal behaviours may reduce the risk of common cycling crash types
  - They are reasonable ways of avoiding real risks, but may increase other real risks
- Risks can be controlled by
  - Engineering measures
  - OR simply by legalising the behaviour

Rule Broken – Why?

- Image of a cyclist at an intersection with vehicles passing by.
Advanced Stop Boxes and Stop Lines

• Advanced Stop Box (ASB):
  – Aka “head start storage area” (Austroads)
  – Allow cyclists to queue at intersections
  – Do not require presence of approach or departure cycle lanes (but very desirable!)

• Advanced Stop Line (ASL):
  – Continue a cycle lane further than adjacent traffic lane(s)
  – Should always be provided where ASBs are not feasible or desirable

Note: ASB concept developed and proven in Europe – but we need to remember that NZ has wider traffic lanes
ASB Useful with Mixed-Turn Lanes

ASB Design

- 3 m deep
- As wide as the traffic lane
- 0.2 m from pedestrian crosswalk line
- Cycle symbol
- Coloured surfacing
- Should not have to cross more than one through lane to get to right turn ASB
- Provision must be consistent with signal phasing operation
Advanced Stop Line

ASL Design

- 2 m deep
- As wide as the cycle lane
- 0.2 m from pedestrian crosswalk line
- Cycle symbol
- Coloured surfacing
  - Motor vehicle intrusion much less likely with colour

Koorey, 2009
ASB / ASL Pros and Cons

• ASBs do not require cycle lanes to be present in the intersection approach and transition
  – Easier to access with cycle lane
• ASLs have fewer ‘problems’
  – ASBs difficult if cyclists arrive during green
• Both require motorists to be set back further from intersection
  – Increased travel time through intersection
  – Decreased visibility around corners
  – Setback may already be required to accommodate swept paths

ASB with Approach Cycle Lane

[MOTSAM 3.34 (1)]
ASB without Approach Cycle Lane

• Road User Rule:
  – 3.2 (5a) While a steady red signal … is displayed…a driver of a vehicle facing the signal or signals must not enter the controlled area, but a cyclist may enter ahead of a marked vehicle limit line and stop behind a marked cycle limit line.

![Diagram showing a cyclist entering before a vehicle]

MOTSAM 3.34 (2)

ASB without Approach Cycle Lane

• Road User Rule:
  – 2.4: If road markings or traffic signs designate specific lanes for specific manoeuvres at the approaches to an intersection, a driver must not use any lane except for the manoeuvre appropriate to its marking or signage.

• Therefore, existing left turn arrow removed to allow cyclists to legally travel straight from ASB

![Diagram showing the removal of the left turn arrow]
ASB separate from Cycle Lane

- Limit lines in straight line regardless of whether a lane has an ASB in front
- Should not have to cross more than one through lane to get to right turn lane
- ASBs should not extend across more than two adjacent lanes if no approach cycle lane is provided.

Inappropriate use of ASBs

- Error: stop boxes extend across three lanes
- Error: staggered limit lines
Inappropriate use of ASBs

Error: stop boxes extend across three lanes

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Appropriate use of ASBs

Remedy: use an ASL or ASB kerbside and in front of RT lane

Remedy: use an ASL and / or ASBs in front of turning lanes only
Non-Signalised Intersections

• Generally ASBs should only be used at signalised intersections
  — Traffic waits at limit line for a gap, not a green light

• ASLs can be used at non-signalised intersections
  — Still need to consider compatibility with traffic lanes
    (lane designations, setback)

Exercise 1: ASB placement

• Design ASBs for the five scenarios
  — (separate sheet)

• Assume no lead left turn phases
Hook Turns

- Preferred option at multi-lane signals
  - Also mixed T-R lanes
- Cyclists complete a right turn in two stages
- Commonly provided farside / departure (shown)
  - Nearside / approach example shown later

Hook Turns - Limitations

- Hook turn not possible in this location
  - Not supported by phasing
  - No through phase from south approach
- Would require additional hardware and phasing
Hook Turns – Legalities

- Road User Rule amendment (2009):
  - 2.5A (1) A cyclist may enter an intersection by making:
    - (a) A right turn
    - (b) A hook turn in accordance with subclause (2)
  - Subclause 2.5A (2) explains the hook turn manoeuvre
    - Does not require a marked hook turn box
    - Can be performed at unsignalised intersections also

- Endorsed by NZTA
  - Included in MOTSAM
- Manoeuvre taught in schools

Hook Turn Design

- Placement depends on lane configuration and signal phasing

Location of hook turn box if left turn lane has exclusive phase
Hook Turn Stencil

• Orientation of symbol and arrow is critical to public awareness

Approach

Departure

MOTSAM 3.35a

Hook Turn Design

• Size depends on number of cyclists to be accommodated
• Arrow is integral part of marking (missing on photo)
• Cycle symbol orientation (wrong on photo)
• Minimum depth of 1.5 m
• Minimum area of 3 m²
Hook Turn Box Alignment

- Should not impede through cyclists!

Hook Turns – make use clear

- For the approach not meant to use the hook turn, use colour and clear limit line
- Also may reduce encroachment
Hook Turn Pros and Cons

- Aids cyclists in turning right without:
  - Negotiating traffic to get into right turn approach lane
  - Negotiating opposing traffic to perform filter turn
  - Useful during peak traffic, or for less confident users
- Users may feel vulnerable waiting in hook turn box for start of next phase
- Relatively new facility in NZ – many cyclists still not aware about how to use them
  - Motorists may also be confused

Hook Turn Examples

- Non-NZ style
- Gent, Belgium

Hook Turn Examples

- Non-NZ style
- Berlin, Germany

Hook Turn Examples

- Christchurch
  - Arrow is an integral part of the marking
  - Cycle symbol incorrectly aligned

http://viastrada.co.nz/story/hook-turns
**Approach Hook Turn**

- Off peak or experienced cyclists use blue route
- Novice or peak period cyclists use red route
  - Dedicated cycle facility (no peds)

**Cycle Slip Lanes**

- Reduces delay
  - Don’t always have to require cyclists to stop at signalised intersections
- Use for left turns or the head of a T intersection
Cycle Slip Lanes cont’d

• Would be ideal at this location (How not to do it)

St Asaph St / Hagley Ave, Christchurch

Cycle Slip Lanes cont’d

• Cyclists will generally proceed illegally on red after filtering through pedestrians
• Avoids getting pinched
• Good reason to have a slip lane
Cycle Slip Lanes cont’d

• Here is an example of how to do it

Moorhouse / Waltham intersection, Christchurch

Cycle Slip Lanes cont’d

• Ensure crossfall enables rain to carry debris off slip lane – monitor maintenance regime
• Squared slip lane for left turning motor traffic
  – slows merge speeds and protects through cyclists on main road

Double slip lanes at Te Awe Awe / Fitzherbert signals
Photo: Glenn Connelly, PNCC
Every intersection is different...

- What is wrong with this scheme?
  - note that leftmost south departure lane goes onto motorway

- 2 min to come up with problems
Summary

• 6 Elements of intersection continuity
• ASBs
  – With or without approach cycle lane
  – Never across more than 2 lanes from cycle lane
  – In front of unmarked left turn lane
• ASLs
  – Provide wherever ASB not feasible / desirable
• Hook turns
  – Two-staged right turn, good for heavy traffic, less confident users
  – Placement based on phasing and lane configuration
  – Near side and far side
• Cycle slip lanes