

9. CYCLE MARKINGS AT SIGNALISED INTERSECTIONS

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The purpose of this report is to inform the Sustainable Transport and Utilities Committee of the findings of a research project into the use, safety and effectiveness of cycle lane and box markings at intersections.

INTRODUCTION

In Christchurch, the first dedicated cycle queuing space was marked at a signalised intersection in the late 1970's as part of a joint investigation into cycle lane design, by the (then) National Roads Board. Surprisingly, the investigation did not actually examine the safety or use of the intersection marking. Despite this lack of study, the cycle lane projecting between two traffic lanes at signalised intersections is the only intersection marking recognised in New Zealand cycle facilities design and marking manuals.

Based on European and Australian designs, Christchurch began more widespread marking of cycle-spaces at signalised intersections in 1997.

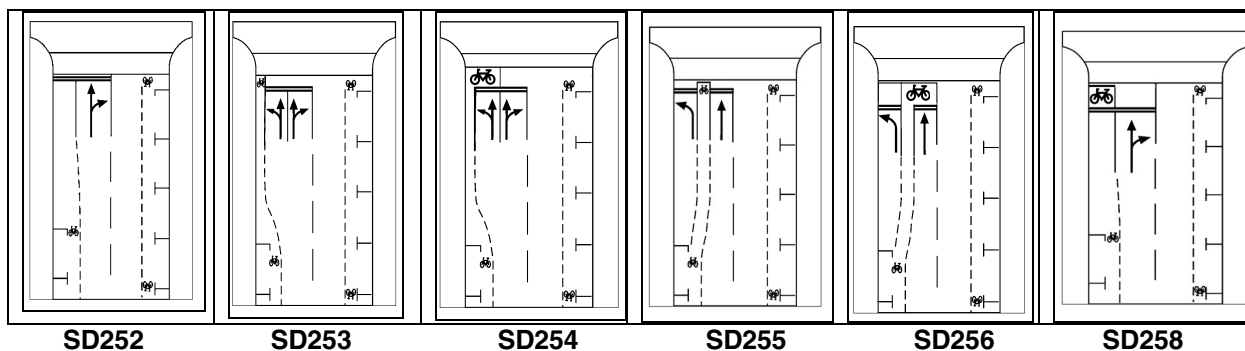
In 1999 the LTSA were concerned that the Advanced Cycle Lanes (ACL), and later, Advanced Stop Boxes (ASB), were being marked with no formal study of their safety effects. The CCC subsequently initiated a research project into the effects of the markings. This report outlines the study and results.

OUTLINE OF CONFIGURATIONS UNDER ASSESSMENT

The cycle markings at signalised intersections consist of two types. **ADVANCED CYCLE LANES (ACL)** are lanes marked between or to the side of traffic lanes. They project *forward of the traffic lane* limit lines. **ADVANCED STOP BOXES (ASB)** are **areas** marked *directly in front of the traffic lanes* for storage of cycles waiting to proceed through the traffic signals.

The primary objectives of cycle facilities at signalised intersections are both to improve the **physical safety** of cyclists using the intersection; and to reduce cyclists' **perceived** risks. The secondary objectives are to maintain or improve the physical safety of all other intersection users; and have a minimal impact on the effectiveness of the intersection operation.

The following detail the different configurations designed for use in Christchurch.



OUTLINE OF RESEARCH PROGRAMME

The research programme was structured to examine four different aspects of cycle facilities marked at signalised intersections.

- (1) A literature search to examine overseas cases where ACL and ASB had been marked and studied. For the literature search to be useful for this project, the overseas examples needed to be similar to Christchurch markings and be successful in achieving safety improvements.
- (2) Collision statistics from before and after ACL and ASB were marked were scrutinised, in comparison to the expected cycle and vehicle crash rate at these intersections. The collision analysis would be considered successful if the collision rates did not show a collision rate increase, and at the best, showed collision rates decreasing below the expected level.

- (3) Cyclists and drivers were surveyed to examine their understanding of the function of ACL and ASB and their attitudes toward the use of these facilities. This part of the study would be considered to be a success if the majority of both cyclists and drivers knew what the markings were for, knew how to use them properly, and indicated that they did use them properly.
- (4) Cyclist and driver behaviour was studied at a number of before/after marking intersections through video observation, to determine how the cycle spaces were actually being used. The study would be successful if the behaviour of cyclists and drivers matched that which would be expected for the new layouts.

RESEARCH RESULTS

The literature search determined that the markings in use in Christchurch are very similar to overseas designs, including those in Australia, UK, Denmark and the United States. All studies in those areas indicated that the markings in use offered functional and safety benefits, with negligible impact on intersection capacities. It was considered that the Christchurch markings met effective performance standards as a result of the literature survey.

The collision study showed style SD255 had a slight increase in all-vehicle collisions over the expected rate and the reasons behind this need to be investigated further. Taken as a whole, however, the study showed that all-vehicle collisions and cycle collisions at intersections with ACL and ASB were trending downwards at a faster rate than the expected collision rate. This indicated the overall safety benefit of the markings. The markings met the effective performance standard for safety.

The cyclist and driver attitude study clearly indicated that both cyclists and drivers understand the intended function of both ACL and ASB, and generally believe they make the intersection safer for both parties. The overall result is positive. However, cyclists find themselves frustrated by vehicles that stop over ACL and intimidated by vehicles stopping directly behind them in ASB. Cyclists have concerns about the functions of the facilities when making right turns. Drivers, on the other hand, appreciate the function of ACL but appear ambivalent about supporting the concept of ASB. They also find some difficulty in determining priority for left-turn drivers crossing straight-ahead cyclists. The study showed a lack of information about these facilities in the public domain and was also less than conclusive about the overall level of comfort for all users with these markings. It was concluded that the effective performance standard was only partially met for cyclist and driver attitudes.

The cyclist and driver behaviour survey strongly showed that the majority of cyclists changed movement patterns to use the ACL – improving the predictability of their movement and reducing the illegal straight-ahead movement from left-turn lanes. Difficulties arose where vehicles parked over the cycle lanes or intruded into ASB – not infrequent results. Relevant anecdotal comment would suggest that combined cycle-lane/traffic-lane width plays a significant part in kerb-side ACL infringement by vehicles. Due to the level of violation of cycle spaces, it was concluded that this performance standard was only partially met.

RESEARCH RESULTS – BY MARKING CATEGORY

Advanced Stop Box

The literature search indicates that ASB are well received by both cyclists and drivers when implemented in United Kingdom and United States. This study tends to confirm that cyclists like the function of the ASB. Christchurch cyclists express reservations about the fact that vehicles pull up and queue behind them when they (cyclists) are stopped ahead of the traffic lane.

Some Christchurch cyclists also indicated that they were concerned about the use of ASB for making right-turns. In most installations, ASB is not intended to assist right-turning cyclists. There appears to be an opportunity to clarify the purpose and best function of ASB in cyclists' minds.

Christchurch drivers are not enthusiastic about cyclists waiting ahead of them at a red signal, even though they understand the purpose of the ASB. The fact that recorded driver intrusion into ASB varies considerably, speaks to some uncertainty or ambivalence on their behalf. There is an opportunity to clarify the purpose and functioning of ASB in driver's minds too.

This study did not allow before-ASB/after-ASB collision comparison to be made, however, the crash pattern at ASB intersections has not raised any concerns.

From the overseas studies, it seems all ASB's marked have used coloured surfacing. None of the ASB used in this study have been coloured, but cyclists and drivers made positive comments toward the use of surface colours. There is scope to test the effect of coloured ASB surfacing both on attitudes and behaviours of drivers and cyclists in Christchurch.

Advanced Cycle Lanes

The cyclists' attitudes to ASB showed that they frequently find vehicles queued on the cycle lane feeding the stop box. The behaviour study indicated that drivers also use the ACL for queuing and movement sometimes. The rate at which vehicles block the lane is unsatisfactory.

Vehicles tend to queue in, or block the ACL marked between traffic lanes less than the kerbside version. This usually occurred when there were longer vehicle queues, but due to road geometry, vehicles sometimes have no option but to queue over ACL.

The literature review found that ACL's were being used in Scandinavia and Australia quite successfully. A Scandinavian study also indicated improvements in collision rates from their introduction. No research suggests collision patterns became a problem.

The study of Christchurch collision rates noted reductions in both cycle and all-vehicle collisions after the introduction of ACL, although the between-traffic lanes ACL (SD255) – was accompanied by a slight rise in all-vehicle collisions. In practical terms this increased rate was based on observation of only 4 intersections over 2 years, and it is questionable whether this increase is statistically significant.

It should also be noted that the overall collision rate reduction is based on few (approx 50) intersections over three years maximum. In that time there were also other road safety improvements occurring. This means that it is not possible to confirm categorically that the collision rate reduction has been exclusively due to ACL marking. However, it is possible to say confidently that the markings have not created any cause for concern in the crash rate.

The majority of cyclists and vehicle drivers are clear on the main purpose of the ACL, although some cyclists expect them to function for right-turn movements too - a function for which they were not necessarily intended.

General Comments

The research, and anecdotal feedback collected during this study has identified areas where performance standards were not clearly reached. This may be attributed to a number of factors:

- Deficiencies in research (including gathering of data and integrity of some data),
- Inadequacies of the intersection markings themselves,
- Changes to the roading environment of which these markings are a small part,
- The level of understanding of the road markings by drivers and cyclists.

This study was not able to fully separate the effects of each of the above factors on the behaviour, attitudes and safety of cycle markings at intersections. However, the study findings indicate that whilst some of the performance standards are only partially met, none give sufficient cause for concern that would or should restrict or limit their use in the immediate future.

CONCLUSIONS AND RECOMMENDATIONS

It is concluded from this research that, while not all research performance standards were fully met, the positive aspects of the literature search, collision records, attitude and behaviour studies lead to the recommendation that Christchurch continue to mark ACL and ASB as part of cycle route development and intersection upgrades.

In addition, the following recommendations are made:

- A design review and re-survey needs to be conducted on combined cycle-lane/traffic-lane width to determine whether this influences vehicle intrusion into kerbside cycle lanes.
- A broad and sustained promotion and information programme should be conducted to raise the general level of awareness of the purpose and function of ACL and ASB.

- The effects of the use of coloured surfacing should be further investigated, as a higher visual profile of cycle spaces may positively influence some of the negative behaviours noted in this study.
- Collision rate assessments of cycle-marked intersections need to be continually updated to develop a more comprehensive picture of the effects of the marking types (both specific types and as a whole) on road safety.

Advanced Cycle Lanes and Advanced Stop Boxes are considered safe and appropriate treatments to continue implementing at signalised intersections throughout Christchurch.

NATURAL + PEOPLE + ECONOMIC STEP ASSESSMENT

#	CONDITION:	Meets condition ✓✓0*	HOW IT HELPS MEET CONDITION:
The Natural Step			
N1	Reduce non-renewable resource use	✓	Improvement to cycling conditions will encourage more cycle use.
N2	Eliminate emission of harmful substances	0	Effectively unchanged impacts on vehicle use
N3	Protect and restore biodiversity and ecosystems	0	No changes
N4	People needs met fairly and efficiently	NA	NA - See People Step + Economic Step
The People Step			
P1	Basic needs met	✓	Improvements to cycle safety balance equity in transport choice
P2	Full potential developed	0	
P3	Social capital enhanced	✓	Project achieves recognised health benefits
P4	Culture and identity protected	0	
P5	Governance and participatory democracy strengthened	0	
The Economic Step			
E1	Effective and efficient use of all resources	✓✓0*	Project offers economic benefits due to safety increases
E2	Job rich local economy	0	
E3	Financial sustainability	0	

Staff

Recommendation: That the information be received.

Chairman's

- Recommendation:**
1. That the Council continue to mark ACL and ASB on cycle routes and at intersection upgrades.
 2. That the recommendations in the report concerning design review, promotion and adoption, further investigation of coloured surfacing and collision rate assessments be implemented.