



BRITISH
COLUMBIA

B.C. Community ROAD SAFETY TOOLKIT

RESOURCE KIT

Module

1

Protecting people who walk and cycle

Module 1



Disclaimer: The toolkit is designed to consolidate and disseminate knowledge about proven and promising road safety designs, strategies, and devices, rather than to provide technical knowledge. A strong effort was made to find and incorporate the most valid and reliable research about the various strategies in the toolkit. However, the nature of road safety research is such that knowledge on road safety continues to change, and therefore any claims drawn from the research should be approached with a critical mind. Local road authorities wishing to implement any designs, strategies, and devices in this toolkit should do so under the guidance of trained and professionally-certified engineers and experts.

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Protecting People Who Walk and Cycle: Our Most Vulnerable Road Users

This resource kit for the BC Community Road Safety Toolkit contains supplementary materials for “Module 1: Protecting People Who Walk and Cycle: Our Most Vulnerable Road Users,” and contains the following:

- A glossary of defined terms;
- Evidence of effectiveness for each safety design, strategy, or device in Module 1; and
- Further resources containing additional information on each item in Module 1.

Defined Terms

Arterial roads: higher-capacity roads used to move large volumes of traffic.

Collector roads: low-to-moderate capacity roads that allow traffic flow within larger neighbourhoods and distribute motor vehicle traffic between arterial roads and local roads

Local road authority: the local public body that has authority to install and maintain traffic control devices (i.e., road signs and signals), and install road safety infrastructure.

Local roads: roads that primarily serve local neighbourhood traffic, provide connections within communities, provide access to residential properties, and usually have on-street parking.

Major roads: arterial roads and collector roads.

Pedestrian: a person travelling by foot, skateboard/longboard, roller skates, push scooters, or any other small-wheeled form of transport, or using mobility assistance devices like wheelchairs or electric scooters. This toolkit uses the terms “pedestrians” and “people who walk” interchangeably.

Sight lines: the distance in any direction where different road users can easily see one another.

Signalized intersection: an intersection where road user movements are controlled by traffic lights.

Vulnerable road user: anyone outside of a motor vehicle including pedestrians, cyclists, people using mobility assistance devices (i.e., people who use wheelchairs, mobility scooters, etc.), and motorcyclists. These road users do not benefit from vehicle protections like crumple zones, airbags, and a protected passenger compartment. For the purposes of this toolkit, vulnerable road users also refers to skateboarders and longboarders, people using push scooters, and people using in-line skates.

Separating Road Users in Physical Space

Wider and Connected Sidewalks

References

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- Canadian Council of Motor Transport Administrators (2013). "Countermeasures to Improve Pedestrian Safety in Canada." Retrieved from: http://ccmta.ca/images/publications/pdf/CCMTA_Pedestrian_Report_Eng_FINAL.pdf

Further Resources

- Federation of Canadian Municipalities. "Sidewalk Design, Construction, and Maintenance: a Best Practice Guide to Sustainable Municipal Infrastructure": http://www.ogra.org/files/Roadside/Sidewalk_Design_Constructionand_Maintenance_EN.pdf
- NACTO Urban Street Design Guide. "Sidewalks": <http://nacto.org/publication/urban-street-design-guide/street-design-elements/sidewalks/>

Advance Stop Lines

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Further Resources

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Off-street Walking and Bicycle Paths

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Further Resources

- City of Toronto Transportation Services. "Toronto Multi-use Trail Design Guidelines": https://www1.toronto.ca/City%20Of%20Toronto/Transportation%20Services/Cycling/Files/pdf/TORONTO%20MULTI-USE%20TRAIL%20DESIGN%20GUIDELINES-December%202014_Fina_4.pdf

Diversion of Motor Vehicle Traffic from Residential Roads

References

- Crash Modification Factors Clearing House. Countermeasure: Implement home zone design in residential neighbourhoods. Retrieved from: http://www.cmfclearinghouse.org/study_detail.cfm?stid=189
- Crash Modification Factors Clearing House. Countermeasure: Install bicycle boulevard. Retrieved from: http://www.cmfclearinghouse.org/study_detail.cfm?stid=221
- Harris, M., Reynolds, C., Winters, M., Cripton, P., Shen, H., Chipman, M., Cusimano, M., Babul, S., Brubacher, J., Friedman, S., and Hunte, G. (2013). Comparing the Effects of Infrastructure on Bicycling Injury at Intersections and Non-intersections Using a Case-crossover Design. *Injury Prevention*, (19): 303-313. Retrieved from: <http://injuryprevention.bmj.com/content/early/2013/02/13/injuryprev-2012-040561.full.pdf>

Protected Intersections

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- Urban Systems. "City of Vancouver Pedestrian Safety Study, Final Report. 2014." Retrieved from: <http://vancouver.ca/files/cov/cycling-safety-study-final-report.pdf>

Further Resources

These posts by North American transport designer Nick Falbo and by Bicycle Dutch provide helpful videos, photos, and descriptions of how these intersections are designed:

- <http://www.protectedintersection.com>
- <https://bicycledutch.wordpress.com/2011/04/07/state-of-the-art-bikeway-design-or-is-it/>
- <https://bicycledutch.wordpress.com/2011/05/05/state-of-the-art-bikeway-design-a-further-look/>
- <https://bicycledutch.wordpress.com/2014/02/23/junction-design-in-the-netherlands/>

Curb Extensions and Pedestrian Refuge Islands

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Further Resources

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- Ontario Traffic Manual. "Traffic Crossing Facilities": <http://www.directtraffic.ca/wp-content/uploads/2014/02/Book-151.pdf>
- United States Federal Highway Administration. "Medians and Pedestrian Crossing Islands in Urban and Suburban Areas": http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_011.cfm

Danish Offsets

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- Pécheux, K., Bauer, J. and McLeod, P. (2009). "Pedestrian Safety Engineering and ITS-Based Countermeasures Program for Reducing Pedestrian Fatalities, Injury Conflicts and Other Surrogate Measures: Final System Impact Report." Report prepared for United States Department of Transportation. Retrieved from: http://safety.fhwa.dot.gov/ped_bike/tools_solve/ped_scdproj/sys_impact_rpt/sys_impact_rpt.pdf

Further Resources

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- University of Connecticut School of Engineering. "The When, Where and How of Mid-block Crosswalks": <https://www.t2center.uconn.edu/pdfs/Midblock%20Crosswalks%20Tech%20Brief.pdf>

Protected and Connected Bicycle Lanes

References

- Crash Modification Factors Clearing House. Countermeasure: Install cycle tracks, bike lanes or on-street cycling. Retrieved from: http://www.cmfclearinghouse.org/study_detail.cfm?stid=274
- Thomas, B. and DeRobertis, M. (2013). The Safety of Urban Cycle Tracks: a Review of the Literature. *Accident Analysis and Prevention*, 52, 219-227.
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- Winters, M. and Teschke, K. (2010) Route Preferences among Adults in the Near Market for Bicycling: Findings of the Cycling in Cities Study. *American Journal of Health Promotion*, 25: 40-47.

Further Resources

- NACTO Urban Bikeway Design Guide. "Cycle Tracks": <http://nacto.org/publication/urban-bikeway-design-guide/cycle-tracks/>
- People for Bikes "pro" and "con" guide to many different ways to create physical separation: <http://www.peopleforbikes.org/blog/entry/wonktastic-chart-rates-15-different-ways-to-protect-bike-lanes>
- Design Manual for Bicycle Traffic (often called the CROW Manual) available for purchase in English: <http://www.crow.nl/publicaties/design-manual-for-bicycle-traffic>
- Ontario Ministry of Transportation's Traffic Manual: [http://www.raqsb.mto.gov.on.ca/techpubs/eps.nsf/o/825810eb3ddd203385257d4a0063d934/\\$FILE/Ontario%20Traffic%20Manual%20-%20Book%2018.pdf](http://www.raqsb.mto.gov.on.ca/techpubs/eps.nsf/o/825810eb3ddd203385257d4a0063d934/$FILE/Ontario%20Traffic%20Manual%20-%20Book%2018.pdf)

Road Diets and Complete Streets

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Further Resources

- City of Edmonton. "The Way We Move: Complete Streets Guidelines": https://www.edmonton.ca/city_government/documents/Edmonton-Complete-Streets-Guidelines_05062013.pdf
- Victoria Transport Policy Institute. "Complete Streets – Designing Roads For Diverse Modes, Users and Activities": <http://www.vtpi.org/tdm/tdm133.htm>
- Chicago Department of Transportation. "Complete Streets Chicago: Design Guidelines": http://nacto.org/docs/usdg/complete_streets_chicago.pdf
- NACTO Urban Street Design Guide. "Residential Boulevard": <http://nacto.org/publication/urban-street-design-guide/streets/residential-boulevard/>
- Smart Growth America. "National Complete Streets Coalition": <http://www.smartgrowthamerica.org/complete-streets>
- United States Federal Highway Administration. "Going on a Road Diet": <http://www.fhwa.dot.gov/publications/publicroads/11septoct/05.cfm>
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Fused Grid Neighborhood Design

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- Masoud, A.R., Lee, A., Faghihi, F., and Lovegrove, G. (2015). Building Sustainably Safe and Healthy Communities with the Fused Grid Development Layout. Canadian Journal of Civil Engineering, 42(12), 1063-1072.
- Grammenos, F., and Lovegrove, G. (2015). Remaking the City Street Grid: a Model for Urban and Suburban Development. McFarland, page 150.

Further Resources

The following resources can help guide the implementation of fused grid neighbourhood development:

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- Corbett, J., and Corbett, M. (2000). Designing Sustainable Communities: Learning From Village Homes. Island Press.
- Fusedgrid.ca: "The Fused Grid – A Contemporary Urban Pattern": <http://www.fusedgrid.ca/fusedgrid.php>
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Separating Road Users in Time

Pedestrian Scramble Intersections

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Leading Pedestrian Intervals

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Further Resources

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- United States Federal Highway Administration. "Guidelines and Recommendations to Accommodate Older Drivers and Pedestrians." Page 35: <http://www.fhwa.dot.gov/publications/research/safety/humanfac/01051/>

Adequate Pedestrian Crossing Times and Signal Cycle Lengths

References

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- NACTO Urban Street Design Guide. "Signal Cycle Lengths." Retrieved from: <http://nacto.org/publication/urban-street-design-guide/intersection-design-elements/traffic-signals/signal-cycle-lengths/>
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- Transportation Association of Canada (2013). "New Guidelines Adopted for Pedestrian Walking Speeds." TAC News, 39, 12. Retrieved from: <http://tac-atc.ca/sites/tac-atc.ca/files/site/doc/resources/winter2013-web.pdf>

Further Resources

- Transportation Association of Canada. "Pedestrian Crossing Control Guide, Second Edition." This document is available for purchase from the TAC bookstore: http://tac-atc.ca/en/publications?combine=&year=112®ular_price_value_op=%3E%3D®ular_price_value%5Bvalue%5D=o®ular_price_value%5Bmin%5D=®ular_price_value%5Bmax%5D=&=Search
- NACTO Urban Street Design Guide. "Signal Cycle Lengths": <http://nacto.org/publication/urban-street-design-guide/intersection-design-elements/traffic-signals/signal-cycle-lengths/>
- NACTO Urban Street Design Guide. "Signalization Principles": <http://nacto.org/publication/urban-street-design-guide/intersection-design-elements/traffic-signals/signalization-principles/>

Bicycle Boxes and Two-stage Left-turns

References

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Safe Bus Stop Placement and Design

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B.C. Community ROAD SAFETY TOOLKIT RESOURCE KIT

Module 1: Protecting people who walk and cycle

Further Resources

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- TransLink and Urban Systems. "Universally Accessible Bus Stop Design Guidelines." Final Report: http://www.translink.ca/~media/Documents/rider_guide/access_transit/Universally%20Accessible%20Bus%20Stop%20Design%20Guidelines.ashx
- United States Federal Highway Administration. "Pedestrian Road Safety Audit Guidelines and Prompt Lists": http://www.pedbikeinfo.org/pdf/PlanDesign_Tools_Audits_PedRSA.pdf
- United States Federal Highway Administration. "A Review of Pedestrian Safety Research in the United States and Abroad": <http://www.fhwa.dot.gov/publications/research/safety/pedbike/03042/part3.cfm>
- Streetsmn. "The Importance of Floating Bus Stops": <http://streets.mn/2015/05/18/the-importance-of-floating-bus-stops/>
- Transit Cooperative Research Program. "Guidelines for the Location and Design of Bus Stops": http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf
- TriMet Bus Stop Guidelines: http://nacto.org/docs/usdg/bus_stop_guidelines_trimet.pdf



Increasing the Visibility of People Who Walk and Cycle

Safe Crosswalk Signalization

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- Hughes, R., Huang, H., Zegeer, C., and Cynecki, M. (2000). "Evaluation of Automated Pedestrian Detection at Signalized Intersections" (No. FHWA-RD-00-097).

Further Resources

- Transport Association of Canada Pedestrian Crossing Control Guide, Second Edition. This document is available for purchase from the TAC bookstore: http://tac-atc.ca/en/publications?combine=&year=112®ular_price_value_op=%3E%3D®ular_price_value%5Bvalue%5D=o®ular_price_value%5Bmin%5D=®ular_price_value%5Bmax%5D=&=&Search
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In-street Yield to Pedestrians Crosswalk Signs

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Rectangular Rapid Flashing Beacons

References

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Further Resources

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Raised Crossings

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Further Resources

NACTO has two useful resources, one on raised crossings and one on raised intersections:

- <http://nacto.org/publication/urban-street-design-guide/intersections/intersections-of-major-and-minor-streets/>
- <http://nacto.org/publication/urban-street-design-guide/intersections/minor-intersections/raised-intersections/>

The following resource describes Dutch designs for raised crossings. It complements the NACTO resources above by explicitly including cycling facilities.

- <https://departmentfortransport.wordpress.com/2012/08/21/continuous-paths-across-minor-junctions/>

Coloured Bicycle Lanes

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- NACTO Urban Bikeway Design Guide. "Bikeway Signing and Marking": <http://nacto.org/publication/urban-bikeway-design-guide/bikeway-signing-marking/>

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Priority Signalling and Right-of-way for Buses

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- NACTO Transit Street Design Guide: <http://nacto.org/publication/transit-street-design-guide/>
- Transportation Association of Canada Guidelines for Planning and Implementation of Transit Priority Measures (TPM) in Urban Areas: <http://conf.tac-atc.ca/english/annualconference/tac2013/session10/stewart.pdf>

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B.C. Community ROAD SAFETY **TOOLKIT** RESOURCE KIT
Module 1: Protecting people who walk and cycle



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