



DESIGN RESOURCES

DR-06 Pedestrian Winter Accessibility

Pedestrian Winter Accessibility

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Issue and Its Importance to Universal Design and to Stakeholders

Outdoor environments that are usable in bare ground conditions are not necessarily usable in snow/ice covered conditions (Wennberg et al., 2009). For example, a smooth and even pavement in summer may become unusable in winter due to blocking heaps of snow blocking the path. Therefore, even though all barriers have been eliminated according to the Americans with Disabilities Act Accessibility Guidelines (ADAAG), there are still barriers to access remaining in snow/ice conditions that have not been accounted for in these guidelines. Accessibility for the general public and people with disabilities in a year-round perspective needs to be further examined and a guideline for promoting universal winter accessibilities needs to be established.

Existing Research/Evidence

A review of 18 studies, provided by Owen et al., concludes that walking among people of all ages is associated with aesthetic attributes, convenience of facilities for walking, accessibility of destinations, and perceptions about traffic and busy roads (Owen et al., 2004). There are often barriers to good access in the outdoor environment due to poor design and maintenance of pedestrian facilities. Such barriers include narrow pavements, poor crossing facilities, high curbs, uneven or slippery surfaces, stairs without handrails, lack of benches, poor lighting, etc. (Carlsson, 2004; Lavery et al., 1996; Stahl et al., 2008). Even though these studies have identified numerous environmental factors associated with accessibility in general, they have mainly focused on bare-ground conditions. In some areas of the world, e.g. the Nordic countries, parts of the US, Canada, and Japan, snow and ice are barriers to access during winter (and how to keep outdoor environments universally accessible the year-round is an issue yet to be examined Pudas & Fjellstrom, 2007).

A few studies have been conducted in the field of winter accessibility. Studies from Sweden (Pudas & Fjellstrom, 2007; Wennberg et al., 2009), Canada (Li & Fernie, 2009; Ryser & Halseth, 2008), and Japan (Muraleetharan et al., 2005; Shintani et al., 2003; Takahashi et al., 2007; Tokunaga et al., 2007) suggested that even though accessibility issues have been emphasised in current guidelines on accessibility, pedestrians' needs are not fulfilled by current guidelines. For example, winter maintenance, demands for climate responsive designs, and the need for shelters are neglected.

- Pudas and Fjellström (2007) compared accessibility in bare-ground and snow/ice conditions by means of an inventory. They showed that for people with reduced mobility-related functional limitations, there is decreased accessibility in snow/ice conditions regarding unevenness, slipperiness and sight. For people with reduced perception and cognition, snow/ice conditions bring considerable deterioration regarding visual and tactile guidance. Signs and other information may be covered by snow, which also makes orientation more difficult. Hence, snow/ice conditions place great pressure on planners and practitioners involved in maintenance in order to achieve accessible and usable outdoor environments during the winter season as well.

- Wennberg et al. examined the perceived importance of environmental factors concerning the outdoor environment in both bare ground and snow/ice conditions (Wennberg et al., 2009). They found that ice prevention is considered more important than snow removal. Snow removal on a detailed level (e.g. removal of heaps of snow on pavements and zebra crossings) and on route level (e.g. snow removal immediately) are both important as well. This study also indicates the importance of being aware that several recurring minor barriers may make an otherwise accessible environment unusable. Thus, the authors emphasise the need for a travel chain perspective when planning for accessible and usable environments.
- Ryser and Halseth found that, despite expressed interest in winter city development, professionals and decision makers involved in the development process do not possess sufficient knowledge about climate responsive design to apply these principles to everyday practice (Ryser & Halseth, 2008). More importantly, knowledge about climate responsive design did not appear to be a major consideration in creating or evaluating commercial redevelopment projects. A range of educational, attitudinal, regulatory, structural, and political barriers impede the development of an institutional framework to support the implementation of climate responsive design.

Design Guidelines

Despite the implications of poorly designed urban spaces on pedestrian mobility and comfort during winter season have been explored in the winter cities and urban design literature (Pressman, 1995; Matus, 1988; Givoni, 1998), few cities have incorporated climate responsive design principles into their decision-making framework (Ryser & Halseth, 2008). Pressman notes that although Canada has “some of the best designed and managed environments in the world, they tend to be exceptions rather than the rule” (Pressman, 1985). In the auto-oriented culture of Canada and the United States, many northern cities have ignored the pedestrian in winter time, with most attention and resources devoted to keeping streets and highways clear of snow and ice for the automobile (Coleman, 2001). Road authorities in Japan have developed guidelines to conduct snow and ice control operations for roadways, however, their recent guidelines still lack guidance on how to provide safe, accessible, and comfortable pedestrian environment in winter (Tokunaga, 2007). In Europe, although accessibility is a part of the agenda adopted by the EU council of Lisbon 2000 targeting 2010 as the goal for full accessibility (Euro Access, 2008), no standard or guideline takes the dynamics of the environment, for example snow/ice conditions during winter, into consideration. Therefore, in order to improve universal accessibility in winter, current knowledge about winter maintenance and climate responsive design need to become institutionalized as part of the pedestrian facility design process through appropriate regulations and guidelines.

Summary of Related New Research Accomplished by RERC-UD

Li et al. used a web-based survey method to investigate to what extent the weather and surface conditions affect pedestrians’ perception about the winter accessibility and to determine which pedestrian facilities pose the most problems in the winter (Li et al. 2009). Their results showed that cold weather itself had little impact on the frequency of outdoor excursions among middle-aged and older adults while the presence of snow and ice on the ground kept people, especially older adults at home. The survey found that the key conditions decreasing winter accessibility were icy sidewalks and puddles at street crossings and curb ramps. While communities have

recognized the need to improve snow and ice removal, little attention has been paid to curb ramp design which is especially ineffective in winter when the bottom of the ramps pool with rain, snow and ice, making them hazardous and inaccessible to nearly all users. Alternative designs to curb ramps are needed.

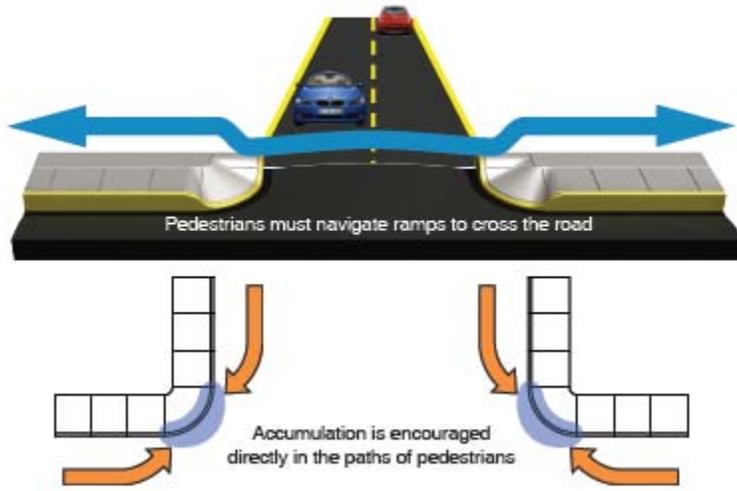
Li and Fernie conducted a study to determine whether pedestrian behaviour became more risky in inclement weather through the investigation of street crossing behaviour and compliance under different weather and road surface conditions at a busy two-stage crossing (Li & Fernie, 2009). The results show that road crossing behaviour in inclement weather conditions was less safe than in fine weather. The designs of signal timing and configuration of the center refuge island of the busy intersection studied also adversely influenced pedestrian behaviour at this crossing. Adverse weather conditions caused more people to disobey traffic signals. This paper presents new information on the compliance with pedestrian traffic signals at a two-stage crossing and emphasizes the need to consider the influence of traffic signal design and weather conditions on pedestrians' behaviour. More studies are needed to develop traffic control techniques particularly to allow pedestrians to cross wide two-stage crossings in safety.

Research Needs (What still needs to be done)

- Improvement of methods for ice prevention and strategies for snow removal are needed on a detailed level, e.g. clearance of blocking heaps of snow on sidewalks and crossings, including how to handle clearance around poles and other objects. Future collaborations between researchers and people; responsible for road and sidewalk maintenance are needed.
- There is a lack of interest in pursuing climate responsive design due to a perception that inadequate winter maintenance is the sole source of the problem. More research is needed into how pedestrian facilities are used throughout the year, and under various weather conditions. It is important to understand whether certain barriers that occur during inclement weather conditions could be minimized or eliminated by implementing climate responsive designs. Future research should include but not be limited to:
 - Alternative designs to curb ramps (Figure 1);
 - Bus stop shelters with effective heating system.
- Research needs to investigate the relationship between injuries and the design of the pedestrian facilities. For example, injuries resulting from slipping and falling on icy surfaces have not been well documented. Detailed location data might support the need for climate responsive design of corresponding pedestrian facilities.
- The Finnish Meteorological Institute (FMI) has developed a numerical model to predict pavement conditions and to give notice of very slippery days (Ruotsalainen et al., 2004). The notice system not only reduces accidents by informing pedestrians but also helps the maintenance personnel to decide when and how to operate. Although the model results have been promising, more research is needed to improve the model and knowledge on this subject as well as to develop similar systems in the US and Canada.

(a)

Existing Crossing with Curb Ramps



(b)

Barrier-Free Crossing Design Concept

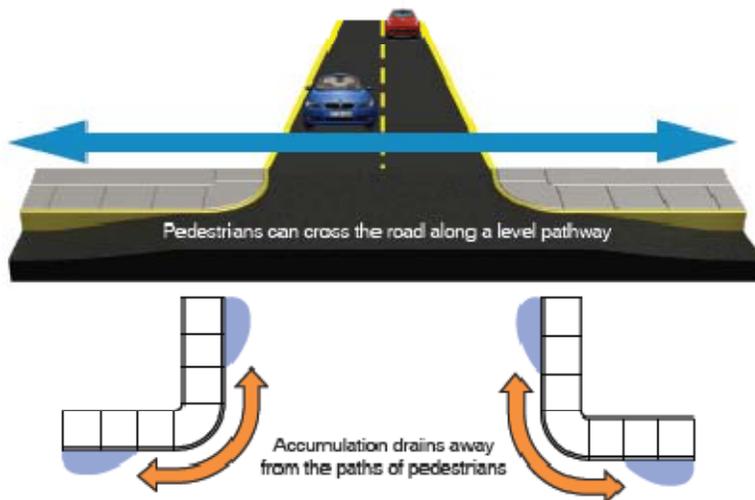


Figure 1: Alternative designs to curb ramps. (a) Current design; (b) Barrier-free pedestrian crossing.

Acknowledgements

This paper was developed in part with funding from the National Institute on Disability and Rehabilitation Research (NIDRR), U.S. Department of Education, through the Rehabilitation Engineering Research Center on Universal Design and the Built Environment (RERC-UD), a partnership between the Center for Inclusive Design and Environmental Access (IDeA) and the Ontario Rehabilitation Technology Consortium (ORTC).

References

- Carlsson G. (2004). Travelling by urban public transport: Exploration of usability problems in a travel chain perspective. *Scandinavian Journal of Occupational Therapy*, 11(2):78-89.
- Coleman PJ. (2001). Pedestrian Mobility in Winter. *Winter Cities*, 20(1):10-13.
- Euro Access. (2008). Accessible public transport: a view of Europe today—policies, laws and guidelines. [Internet]. [cited 2009 Dec 8]; Available from: <http://www.toi.no/getfile.php/Publikasjoner/T%D8I%20rapporter/2008/952-2008/952-2008.pdf>
- Givoni B. (1998). Climate considerations in building and urban design. John Wiley and Sons.
- Lavery I, Davey S, Woodside A, Ewart K. (1996). The vital role of street design and management in reducing barriers to older peoples' mobility. *Landscape and Urban Planning*, 35(2-3):181-192.
- Li Y, Fernie G. (2010). Pedestrian behavior and safety on a two-stage crossing with a center refuge island and the effect of winter weather on pedestrian compliance rate. *Accident Analysis & Prevention*. doi: .1016/j.aap.2010.01.004 10.
- Li Y, Hsu J, Fernie G. (2009). Considering Winter Issues to Improve Pedestrian Facilities. In: Fifth Annual Toronto Rehabilitation Institute Research Day. Toronto, Canada: p. 28.
- Matus V. (1988). Design for northern climates : cold-climate planning and environmental design /. New York ;: Van Nostrand Reinhold.
- Muraleetharan T, Meguro K, Adachi T, Hagiwar T, Kagaya S. (2005). Influence of Winter Road Conditions and Signal Delay on Pedestrian Route Choice in Japan's Snowiest Metropolis. *Transportation Research Record: Journal of the Transportation Research Board*. Jan 1;1939(-1):145-153.
- Owen N, Humpel N, Leslie E, Bauman A, Sallis J. (2004). Understanding environmental influences on walking: Review and research agenda. *American Journal of Preventive Medicine*, 27(1):67-76.
- Pressman N. (1985). Reshaping winter cities. Published under the auspices of Livable Winter City Association [by University of Waterloo Press].

Pressman N. (1995). Association WC. Northern cityscape: linking design to climate. Winter Cities Association.

Pudas M, Fjellström C. ACCESSIBLE WINTER CITY - TRANSED 2007 Program - TRANSED 2007 Conference - Accessible Transportation - Innovation - Transport Canada [Internet]. In: TRANSED 2007. 2007 [cited 2009 Dec 4]. Available from: <http://www.tc.gc.ca/policy/transed2007/pages/1194.htm>

Ruotsalainen J, Ruuhela R, Kangas M. (2004). Preventing pedestrian slipping accidents with help of a weather and pavement condition model [Internet]. In: Walk21-V Cities for People. Copenhagen, Denmark: 2004 [cited 2009 Sep 4]. Available from: <http://www.walk21.com/papers/Copenhagen%2004%20Ruotsalainen%20Preventing%20pedestrian%20slipping%20ac.pdf>

Ryser L, Halseth G. (2008). Institutional barriers to incorporating climate responsive design in commercial redevelopment. *Environment and Planning B: Planning and Design*, 35(1):34-55.

Shintani Y, Hara F, Fukumoto A, Akiyama T. (2003). Empirical Study on Walking Behavior In Icy Conditions and the Effect of Measures to Improve the Winter Pedestrian Environment. In: TRB 2003 Annual Meeting.

Ståhl A, Carlsson G, Hovbrandt P, Iwarsson S. (2008). "Let's go for a walk!": Identification and prioritisation of accessibility and safety measures involving elderly people in a residential area. *European Journal of Ageing*, 5(3):265-273.

Takahashi N, Tokunaga R, Asano M. (2007). STRATEGIC PDCA FOR PEDESTRIAN-FRIENDLY NORTHERN COMMUNITIES [Internet]. In: TRANSED 2007 Conference. [cited 2009 Sep 3]. Available from: <http://www.tc.gc.ca/policy/transed2007/pages/1126.htm>

Tokunaga R, Takahashi N, Asano M. (2007). MORE AND BETTER PRACTICE TO EVALUATE WINTER PEDESTRIAN MOBILITY [Internet]. In: TRANSED 2007 Conference. 2007 [cited 2009 Sep 3]. Available from: <http://www.tc.gc.ca/policy/transed2007/pages/1116.htm>

Wennberg H, Ståhl A, Hydén C. (2009). Older pedestrians' perceptions of the outdoor environment in a year-round perspective. *European Journal of Ageing* :1-14.



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