

## **Development of the Detectable Warning Surface Tiles Standard Specification for the City of Winnipeg**

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## Abstract

The City of Winnipeg has developed a Standard Construction Specification for the application, material specification, design and installation of Detectable Warning Surface Tiles (DWST). The utilization of these tiles has proven to be an invaluable mechanism for supporting the City of Winnipeg's Universal Design Policy and making our streets safer for pedestrians of all ages and abilities.

Developed over the course of 10 years, the City has established a proven standard for the design, use and installation of DWST. During the development process the City has monitored the performance, installations procedures, durability and functionality of the DWST and has engaged the general public and stakeholders such as Canadian National Institute for the Blind, Vision Impaired Resource Network and the Mayor's Access Advisory Committee throughout the process with much success. Public Works also researched other jurisdictions that experience severe weather patterns similar to Winnipeg, particularly those with winter months.

Through this paper, the City of Winnipeg presents the current Standard Specification and describes all of the rationalization and lessons learned behind the development of the Standard. This will aid other jurisdictions in implementing their own Standards and expedite their development.

## Methodology

Early installation trials took place using the Americans with Disabilities Standard of installation at the corner of Portage Avenue and Dominion Street in Winnipeg, just outside the Canadian National Institute of the Blind offices. The product was a fiber-glass brick red 2' X 4' tile with truncated dome material. This location was purposefully chosen so the community of users could test the product texture, colour and placement during their daily activities. This installation was reviewed by all of the above mentioned groups (CNIB, VIRN and the AAC) for basic functionality and usability. The detectable warning test also included durability for snow removal and installation technique. What was found was that the red brick colour initially used was not conspicuous enough for people with extremely low but functional vision to identify as a warning. The truncated domed material was successful in that it was detectable by a long white cane.

Another trial installation that took place was at the Inkster Boulevard and McPhillips Street intersection as well as Notre Dame Avenue and Balmoral Street intersection. Various products, orientation and installation techniques, colour and texture were once again tested. Tiles were placed parallel to the curb ramp and also parallel to the path of travel. Due to the previous rejection of the brick red, highway yellow was the colour chosen for this test. This trial included highway yellow plastic composite tiles with truncated domes placed parallel to the path of travel. It was reviewed by the end users as well and was deemed a

success in terms of colour, texture and orientation of the tiles in the curb ramps. Consideration was given to how pedestrians of various abilities use the tiles including foot stability for persons with ambulatory difficulties, bumpiness for person who use small wheels, visibility for people with some usable vision and texture and orientation for those who are totally blind. Surveys were completed after various users walked these various trial intersection crossings and the following conclusions resulted:

- The installation of the product should be consistent with the user's needs
- Using a dark colour represents a hole in the sidewalk; as such users would walk around them to avoid the perceived hazard.
- The education and travel training provided by various local organizations determines how the user interprets their environment
- Organizations can vary in different jurisdictions with respect to education and training, therefore so is their interpretation of the built environment
- Bright yellow was the optimal colour as it was most recognizable for those with some usable vision, but considered legally blind. That makes for 80% of the visually impaired pedestrians.
- The tile can relay orientation information for the direction of the crossing, whereas the path of travel they are to proceed with is perpendicular to the length of the back of tile and parallel with the side of the tile.
- Dense composite plastic was determined to be the optimal material for many reasons:
  - Easy to cut
  - Lighter weight
  - Slip resistant in all seasons
  - Snow does not stick to it
  - Flexible
  - Durable
  - Economical
  - The plastic not only offer a detectable surface but also offers a distinct sound when a cane is dragged over it

Some jurisdictions such as Minneapolis place DWST parallel with the cast in place curb ramp. Winnipeg's specification states to place the tile parallel with the path of travel to provide the user with information on the direction they are to proceed in. This adds a new complexity during site layout as cutting is generally required to bring the tile closer to the curb ramp. This led to investigating varying dimensions of tiles and the use of multiple tiles. These were evaluated and it was determined that following dimensions are needed for durability, installation and user messaging:

- One side of the tile should be 610mm depth
- The back side of the tile should be 1220mm wide
- If one side is cut, the short side should be no less than 300mm in depth and the front side no less than 450mm wide.

Rationalization for where they are used and what they mean for pedestrians and the importance must be developed with end users and partnering to support education on their use.

- It is critical that the jurisdiction define where the DWST is to be applied; i.e. certain street classifications, not at public lanes, not at approaches, etc. As the application must be dictated by the local education and therefore it has a defined purpose and meaning. This will permit consistency and tell provide the user the same message throughout the jurisdiction.

Durability and maintenance are of critical concern for economic and safety reasons. It was noted that jurisdictions such as Grand Forks and Fargo, North Dakota use bobcats with brushes to clean the curb ramps down to a bare level of pavement during winter snow events. That is not the practice in Winnipeg. Our jurisdiction uses bobcats with blades that scrape to within a hard packed level of clearing the snow and to bare surface within the downtown limits. This affected the decision for type of material to be utilized within the specification in Winnipeg.

Following the identification of the optimal material, size, colour, orientation and definition of use the City of Winnipeg developed an implementation plan. Initial installations were based on the existing snow clearing prioritized route system which included regional streets. This decision was based on heightened pedestrian use and economics. Installations occurred during street and sidewalk renewal projects and during the construction of any new arterial streets. As the City works closely with the community in testing DWST installations they realized that because people who are vision impaired rely heavily on public transit to move from home to destinations, collector streets were recognized as a priority for navigation to bus stops. Therefore within two years collector streets were added to the program of installation. Additionally, because of the risk factors related to vision impaired community learning to use the crossings at roundabouts they were included as a priority for installation.

An annual budgetary program now dedicates funding for the installation of the tiles at various locations. This facilitates locations to be added such as near schools, hospitals, public buildings and allows the majority of users to use the tiles in their daily activities.

#### Description of durability testing and monitoring

It is important to note the standard specifications developed take into consideration Winnipeg's climate and soil conditions. The plastic/fiberglass offers flexibility for movement and ease of installation. These tiles have held up well against snow clearing operations. Having the top of the domes flush with the top of the sidewalk is critical for maintain the maximum number of domes. It is not atypical for some domes to be shaved off due to the diversity of contractors and the varying levels of inspection during installation, however the

tiles still function as the yellow base is still intact and the shave domes still produce a distinct sound when a cane is dragged over. It is reported that the yellow colour remains visible enough during winter snow events and that it still provides some level of security to the users.

Particular attention during the installation process of the DWST closely followed the manufactures instructions, including drilling holes to relieve buoyancy during curing. Weights were used on top of the tile to reduce buoyancy during installation. Full time inspection during installation is key for proper placement. Monitoring over time was also necessary to observe the impact of wear and tear and snow clearing.

To summarize all of the tested materials in chronological order:

- Deep cut jointer to form transverse grooves in a sidewalk ramp
  - Not visible enough
  - Grooves filled in with debris in the winter
  - Cleaning would not be feasible for a large number of ramps
  - Not detectable under foot or with a white cane.
- Brick Red Dome Tiles
  - Colour contract was insufficient
- Charcoal domes pavers
  - Reasonably durable, locally made, but could not provide the desired yellow colour
- Surface Mount with epoxy and screws
  - Did not withstand snow clearing operations
- Surface Mount with Anchors
  - Did not withstand snow clearing operations
  - Issues with ice lensing
- Detectable Warning Surface (Cast-in-place Composite) as an inline truncated dome pattern in accordance with ADA and ADAAG Guidelines
  - Successful. Various tests performed including storing at -30C and trying to smash with a sledge hammer
- Nylon Coated Iron
  - Nylon was subject to peeling and was very slippery. Actual install trails where not performed due to the degree of slipping at -30C.

### Conclusion

An important message received from the end users is to “keep it simple”. Over application of the detectable surfaces deems them ineffective in the built environment. They are meant to communicate a warning of danger to the user so if they are overused that warning becomes meaningless. In Winnipeg, the community of end users also informed us that providing information with respect to directional alignment of the intersection crossing is very important.

Rationalization on where the detectable panels are used and what they mean for pedestrians is critical for their placement. It is evident that it is important for a partnership to be established to support education with the community on their use. The value of cross education between user need and engineering expertise helps each learn and better understand the value and intent behind developing and providing a clear and consistent DWST standard of installation in the built environment.

This means, it is critical that the jurisdiction and the user groups work together to define where the DWST is to be applied; i.e. certain street classifications, not at public lanes, not at approaches, etc. The application must be dictated by local user experience and education. The DWST must have a defined purpose and meaning to those who require them for safety. This will permit consistency of application, providing the user the same message throughout the jurisdiction. This also provides clear direction for the technical installers as they place them in projects.

There were challenges in developing a clear and concise standard. Given the variability of boulevard widths, inconsistent curb radii, sidewalk setbacks and intersection skew angles, Winnipeg has trialed the use of 0.3m depth tiles. Although this maximizes flexibility and ease of installation, the local users have stated that the 0.3m depth tiles provided insufficient area to detect as a warning. There is also insufficient depth to aid in providing information to the user about the direction of crossing. Therefore 0.3m depth tiles are only being used as an exception through a special variance to standard application.

Unresolved issues involve areas of sidewalk where the path of travel overlaps at an intersection with narrow boulevards. When pedestrians are walking along a sidewalk, their desired path of travel is continuous, in a straight line across an intersection. When boulevards are narrow and sidewalks are near the back of the curb, this could result in DWST overlapping; placed such that they would not provide key messaging required for proper intersection crossing alignment. This could lead to user confusion and placing the pedestrian into a skewed travel pattern.

There is a potential that a pedestrian who is blind could travel into the center of the intersection rather than maintaining their straight alignment across the street or become disoriented in the vehicular travel lanes creating an unsafe situation. It was believed that this could be mitigated by utilizing smaller tiles however testing with local users showed us that smaller tiles are not functional for them. They were deemed not detectable or visible enough to be functional. Winnipeg's solution is to bring the curb ramp around the radius such that it can be properly placed to create a shorter and more directional crossing, thus achieving the key message of warning and direction. This solution pulls the pedestrian away from their alignment on the sidewalk but could create a shorter and straighter pedestrian crossing the vehicular lanes. This is not a perfect solution but the key is to build a specification that will lead to city wide consistency of application. This allows our travel training partners at CNIB to better educate the users in how the sidewalk and intersection

patterns work throughout the city. This in turn creates a much more consistent, predictable and usable pedestrian system.

To avoid overuse or misuse of DWST, Winnipeg has developed a specification for installing DWST with the following key messages:

- Generally DWST are only used at intersections
- Public lane and approaches will not include DWST
- DWST shall be placed near a loading edge of a Bus Rapid Transit platform due to the significant drop off
- the long edge of the tile must be perpendicular to the path of travel
- Two tiles are required for 3.5 m multiuse pathways, preserving a space between the two tiles for small wheels to ride through without risk of falls. This serves as a warning to cyclists that they are sharing the facility with pedestrians.
- Given the variety of radii at curb ramps the tiles may require to be trimmed to a specified maximum to bring the tile as close to the curb edge as possible while maintaining accurate direction
- Yellow is specified as it is the most conspicuous of the colours in the colour palette
- A non-slip surface is critical given the slipperiness during wet or winter weather
- Durability is critical to avoid trip hazards and to maximize detectability
- Material flexibility assists with installation, necessary in clay type soil conditions
- All crossings should have a tile on both sides of the crossing to inform the beginning and end of the crossing.
- If the tiles are installed on sidewalks with 2% longitudinal grade leading to the curb ramps, they will not pond water

### Recommendations

Lessons learned during the development of the standard installation of DWST in Winnipeg include a better understanding of the cost implications. Cost of installation is approximately \$430.00 per tile in new curb ramp concrete works. In a reconstruction project, to include tiles at all four corners of an intersection meant approximately 2.7% additional cost.

Boulevard width and sidewalk setbacks can have a varying effect on the positioning of the DWST and therefore may have to be varied from the standard specification. Being mindful of meeting the intent of usability for the end user at each individual site is important to consider. Any variation can be achieved through inspections on site. Education of municipal staff and contractors is critical in ensuring consistency of installation.

Minimizing the height of the domes above the sidewalk height not only provides for a more comfortable walking surface but also reduces the possibility of domes being sheared off during snow clearing operations. This can be achieved through the use of weights during installation and curing.

Each jurisdiction may have special conditions and nuances that require them to run trials of placement, products and applications with their local organizations and stakeholders to meet local user needs.

DWST installation was unanimously accepted by all users in the City of Winnipeg. Their application and placement have been kept consistent and the local users are being educated successfully to use them. Achieving consensus is not very common given the varying needs of users with varying abilities, yet with a clear specification for installation, the domes do not present any negative impact to people using small wheelchair (strollers) or wheelchairs users of varying abilities. The domes can be used by all vision impaired user devices including small canes, ball canes or service dogs. These tiles are a small investment to provide convenience to pedestrians of all ages and abilities.

It is important to remember that the development of a rigorous standard can be time consuming, and that achieving a Universal Design standard is something we strive to constantly improve. What it really comes down to is the “keep it simple” principle. In the end, the achievement is a comfortable, safe, walkable City that accommodates all users, regardless of their age or ability.

### Reference Information

Visit the City Standard Construction Specifications at:  
<http://www.winnipeg.ca/matmgt/Spec/Default.stm>

The following specifications are relevant:  
CW3326

The following Standard Details are relevant:  
SD-229AA  
SD-229AB  
SD-229AE  
SD-229AF  
SD-229BB  
SD-229E

The City of Winnipeg’s approved product list for Surface Works:  
[http://www.winnipeg.ca/finance/findata/matmgt/std\\_const\\_spec/current/Docs/Approved\\_Products\\_Surface\\_Works.pdf](http://www.winnipeg.ca/finance/findata/matmgt/std_const_spec/current/Docs/Approved_Products_Surface_Works.pdf)