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A Simple Guide to Detectable Warning Systems

Outside the hospital emergency room door, the sidewalk of the loading zone is flush with the driveway. There is no change-of-level to be negotiated by patients with limited mobility, people using walkers or wheelchairs...a clear advantage. But it is also a life-threatening danger to someone who is blind or visually impaired, who has no way of knowing when they have left the safety of the sidewalk and entered an active roadway. To warn visually impaired pedestrians of danger, a margin of detectable warnings is installed at the edge of the sidewalk, in the form of a strip of bright yellow truncated domes.

Detectable warnings are required anyplace where a pedestrian pathway blends with a vehicular pathway, without curb or railing. Under the Americans With Disabilities Act of 1991 (ADA), detectable warnings must mark certain very common intersections of pedestrian and vehicle traffic, or certain other dangerous environments. Increasingly, they are being installed in places where they improve safety even beyond the requirement of the law.

Unfortunately, several different sets of guidelines have been published about the size, spacing and alignment of domes, and there is some confusion about what is required. There are also a wide variety of dome products available. This article will try to unravel some of those mysteries.

The detectable warning strip in the emergency-room driveway of the Inland Valley Medical Center in Wildomar, CA warns a blind or visually-impaired person that they are about to enter a traffic lane.

Background

When the ADA was passed, and curb-cuts and wheel-chair ramps began to appear in public places, it became apparent that they posed a potential hazard for visually impaired and blind people. The ADA also mandated detectable warnings, but that requirement was suspended from 1994 to 2001 to allow study of the best kinds of detectable warnings, and possible problems associated with them. Studies of the various detectable warning types revealed that truncated domes were the most effective for detection both by a cane and underfoot. Draft guidelines were written by the U.S. Access Board, which advises the Department of

Justice, the go-to agency on ADA enforcement. The draft guidelines were published for comment, revised, and published for further comment, hence some of the confusion.

The revised draft guidelines published in 2005[1] is the most recent guidance on dome standards. The guidelines specify ranges for the size and spacing of domes:

- Dome base diameter: 23 mm (0.9 in) to 36 mm (1.4 in)
- Dome top diameter: 50% to 65% of the base diameter
- Spacing: 41 mm (1.6 in) to 61 mm (2.4 in)
- Alignment: rows of dome perpendicular or radial to the grade break between the ramp, landing, or blended transition and the street.
- Size of the warning strip: 610 mm (24 in) minimum in the direction of travel, and the full width of the curb ramp (exclusive of flares), landing, or blended transition.
- The warning surface must contrast visually with adjacent gutter, street or highway, or walkway surfaces, either light-on-dark or dark-on-light.

Most detectable warning systems have some form of slip-resistant surface, either in the form of a uniform grittiness or individually molded points.

A wealth of information can be found at the Access Board website, www.access-board.gov.

This leaves room for a range of products, and there are several systems of precast or prefabricated domes available. They divide into three basic categories: rigid tiles or blocks designed for installation by embedding in new concrete, rigid tiles for surface application to concrete, and flexible mats for bonding to concrete or asphalt surfaces. There are no available systems for embedding in asphalt.

Concrete-Embedded Solutions

There are three types of materials used for embedment: plastic, metal (stainless steel or cast iron), and concrete.

Concrete "tiles" are essentially precast pieces of pavement designed to substitute for the regular pavement. They are typically made in square or rectangular blocks. They are as durable as concrete pavement. Visual contrast may be somewhat less, as concrete colors tend to be more muted than colors that can be achieved with the reflective coatings or brighter plastics.

Plastic or "composite" tiles are generally a hollow, molded shell. The underside has some provision for locking into the concrete, such as a series of fins with holes in them that flowing concrete squeezes through. Repair of an embedded tile requires replacement, involving jackhammering out the concrete, a process that can be expensive and cause traffic disruption.

Replaceable embedded composite systems are offered, apparently in response to problems of embedded composites wearing out or being damaged. They are made with an embedment unit that is cast into the fresh concrete, and the shell bolts onto it after the concrete has hardened.

Embedded and replaceable-embedded systems made of metal – stainless steel

or cast iron – are available, and are installed in a manner similar to composite embedment systems.

As with all new concrete, embedded installations should be allowed to cure for 28 days before use.

The chief disadvantage of embedded systems is the expense and traffic-disruption of repairs. A replaceable embedded system overcomes this problem, but raises the initial cost.

Surface-Applied Tiles for Concrete

Rigid tiles are made for surface-applied installation on existing concrete; there are presently no rigid tile systems for surface application to asphalt. The tiles are made of a composite material with a base about 9.5 mm (3/16 in) thick or more, and domes rising an additional 5 mm (.2 in). Thick tiles - more than 6.4 mm (1/4 in) - require a beveled edge to prevent trip hazards and enable wheelchair passage. Tiles are available in a range of colors that comply with federal standards.

Rigid tiles are applied to cured concrete with adhesives, but most adhesives must be supplemented with anchor bolts inserted into the concrete substrate. Some rigid tiles are adhered to the pavement only in narrow strips, not on the entire bottom surface. For example, in designs that feature a hollow space under portions of the tile that produces an audible difference when tapped with a cane. Sound-on-cane contact was recommended by the Access Board for interior detectable warnings (not for exterior applications) in the 2002 edition of the ADA guidelines.[2] There is no mention of sound-on-cane contact in the 2005 Draft Guidelines section R304, which deals with exterior applications.

Curing time before resumption of traffic depends on the particular adhesive used and on site conditions, but is generally one day or less.

Flexible Mats for Asphalt or Concrete

Flexible mats can be bonded to either concrete or asphalt. The most widely available flexible mat product is a multi-layer system that uses precast domes factory-attached to the mat. The system has a very low profile, with a base about 2 mm (1/16 in) thick, and requires no beveled edge.

The individual domes are pre-cast concrete, bonded to a fiberglass-reinforced mat. The mat is cut to exact shape and then fixed to the concrete or asphalt using an adhesive that has equally strong adhesion to both mat and substrate. Two additional top layers are applied: first, slip-resistance grit, then a colored, high-contrast reflective coating that has similar durability to paint roadway used for stripes, which seal the installation. The reflective coating is available in a range of colors that comply with federal standards and custom colors are possible.

Mat systems generally require minimal curing. Foot- and light-vehicle traffic can be resumed the same day.

Issues and Answers

Both rigid tiles and flexible mats satisfy ADA requirements and both perform their warning functions adequately. The chief differences between them are

in installation and repair. In locations with complex shapes such as radiuses or non-right angles, a significant difference in function for wheelchair riders may also result.

Rigid tiles, whether embedded or surface applied, are square and rectangular units in a limited range of sizes. If the installation includes radiuses, odd angles, or areas that are not exact multiples of the available-sizes, the installer has to cut the tiles, generally using a diamond-tipped blade on a saw or mini-grinder. This can sometimes slice through individual domes, leaving partial domes sticking up.

Radiuses present a challenge to rigid tiles: tile sides are straight lines. Moreover, surface-applied tiles must present a beveled edge to prevent trip hazards. The tile cannot be cut away to match the radius without slicing off the bevel too. This conflict between curved pathway and straight tile-edge is usually resolved by slicing tiles into a series of long, narrow trapezoids that fit together to approximate the radius. When fitted together, the rows of domes no longer align in straight lines from one tile to the next. This can potentially cause problems for wheelchair riders or people using wheeled walkers that roll between the rows. Flexible mats are trimmed to the radius edge without any alteration of the alignment of domes.

Fitting around obstacles such as bollards, hydrants or other fixtures can require extensive cutting. With tile, this means the use of multiple pieces, which can be labor-intensive. Flexible mats come in long rolls that can be cut by hand using a razor-knife and trimmed to any angle, curvature or length. In places where a dome falls in the line of a cut, the individual dome can simply be removed from the mat. The ease of installation of such systems has reportedly prompted some facilities managers to install dome-mats as skateboard deterrents.

Truncated dome tiles or mats can become damaged. In the case of tiles, the entire tile is replaced. Flexible mats can be replaced in small sections, even dome-by-dome and recoated to an as-new condition.

The Future

Detectable warnings are required in public places under law in the U.S. and have been since 2001. Year by year domes on sidewalk curb-cuts and traffic islands are becoming more the norm. Current products have benefitted from the first few years of the design evolution and reliable materials for most situations are now widely available.❖

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[1] Revised Draft Guidelines for Accessible Public Rights-of-Way, Section R304 *Detectable Warnings*, November 23, 2005.

[2] *ADA Accessibility Guidelines for Buildings and Facilities* (ADAAG), September 2002, Section 4.29.2.