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Helena, Montana
Experimental Program
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Construction Report on the Installation of Various Detectable Warning Devices (Truncated Domes) for Curb Ramps in the City of Great Falls, Project STPU 5201(11), 6th Street N. W.

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ACKNOWLEDGEMENT

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BACKGROUND

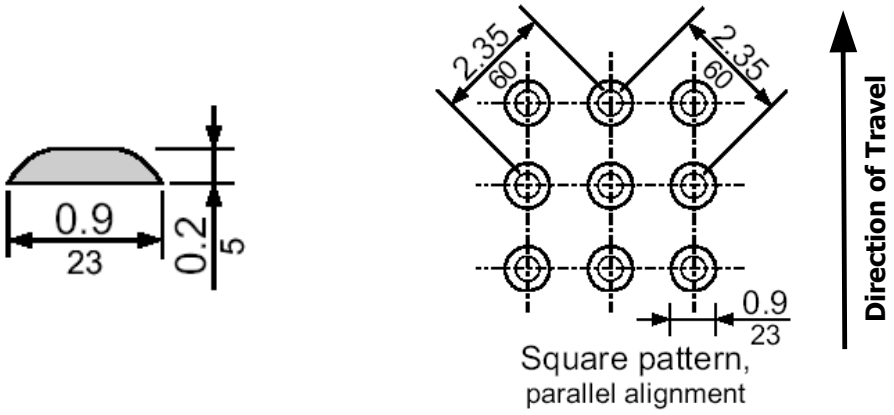
Through the Americans with Disabilities Act (ADA), states are now mandated to construct or alter facilities in a manner making them accessible to people with disabilities. The ADA access board published accessibility guidelines (ADAAG) for public right-of-ways addressing detectable warning devices (DWD) in 1991, and issued them for comment in 1992 and 1994. Based on concerns about the specifications, the board suspended its requirement for detectable warnings on the surface of curb ramps and other locations where pedestrian ways blend with vehicular ways without tactile cues. After continued discussion, the moratorium was ended in July of 2001 with revised accessibility guidelines being issued in June 2002. Truncated domes are now the standard at curb ramp crossing where tactile devices are needed for the visually impaired. The information derived from this experiment will assist the Department in choosing the optimum DWD for use on transportation facilities in the State of Montana.

RESEARCH OBJECTIVE

This project will evaluate the performance of seven truncated dome curb ramp systems for ease of installation and durability when subjected to normal winter maintenance and environmental conditions and pedestrian use. Fifteen site installations were chosen along selected crosswalks of 6th St. N. W. Attachment A details the experimental layout of these systems. Scott Keller, the Supervisor of the Montana State University Engineering Design Section, selected the detectable warning devices (DWD) through research of the products available. His selections of criteria were based on those products that (at this time) followed the prescribed DWD requirements based on the current suggested ADAAG specifications for curb ramp installations. The following is a list of the manufacturers and DWD systems installed on this project.

Detectable Warning Device	Manufacturer
Copolymer Composite Tiles	ADA Fabricators
Wet Anchor Box System	Disability Devices
Polyurethane Detectable Warning Mat	Disability Devices
Applied Truncated Domes	Vanguard ADA Systems
Applied Latex Modified Mortar Domes	Strongwarn Industries
Safti-Trax Plastic Sheets	Cote-L
Saft-Trax New Rubber mat	Cote-L

The parameters of the DWD systems are that each be placed as a panel 24” (61 cm) in depth and 60″ (152 cm) in width. The domes should conform to a specification of having a diameter of 0.9″ (23 mm), a height of 0.2″ (5 mm) and have a parallel alignment (square pattern) to better traverse the tactile device using wheelchairs.



The evaluation schedule will encompass early spring and late fall inspections, with the first assessment to be conducted in late October 2003. This project will

be evaluated until the year 2008. All report availability will be announced via email to pertinent engineering and maintenance staff at the Helena office and in the districts. Reports will be posted in PDF on the Department's Intranet/Internet web site located in the Research web page directory. Hard copies are available upon request through Research. The Federal Highway Administration has reviewed the experimental plan and approved the project as a formal experiment with an assigned project number of MT 00-05.

This report will document events from the researcher's point of view. The goal of the construction report is to establish a baseline of documentation that will assist with future performance evaluations with this project.

TEST SECTION INSTALLATIONS

Each treatment type will be discussed in sufficient detail to allow the reader to understand the steps involved to install these DWD systems. The only installation performed by a vendor was the Applied Truncated Domes by Vanguard ADA Systems. All other installations were done by United Materials of Great Falls. For the United Materials personnel, this was the first opportunity they have had with DWD applications. Fifteen ramp locations were chosen along 6th St. N. W. between Central Ave. W. and N. W. Bypass for DWD installations. Seven products were used and randomly placed throughout the project. Attachment A lists the frequency of use for each treatment. The test sections were placed on the dates of July 24 & 25 and on August 4, 2003. The weather was warm & windy, with mostly overcast skies.


Figure 1

Figure 1 shows the typical crosswalk chosen for DWD application. Preparation of the crosswalks began with sandblasting and sweeping to

Figure 2

Figure 3

remove as much dirt and debris to insure adequate bond to the PCCP surface with the various bonding agents that will be used during installation (figure 2). Crosswalks that did not receive DWD systems were transverse grooved as seen in figure 3. It was noticed on some of the crosswalks that a longitudinal contraction joint was in the space where the DWD was to be installed. To insure a flat, consistent surface for placement of the systems, the contractor applied grout at the joint to the sites as needed. The product used was Dayton Superior RE-CRETE 20 minute set. Figure 4 shows the cured grout within a prepared DWD site.


Figure 4

PRODUCT INSTALLATION

Test Sections 3a & 3b:

Manufacturer: Disability Devices
Product: Polyurethane Detectable Warning Mat
Type: Urethane Tactile Warning Mat, one-part adhesive

Installation Procedure

The mats are supplied as 2′ x 3′ panels with beveled edges in a design of 12″ squares that is used to cut the mat down to the desired size of application. The contractor began with laying the polyurethane mats on the determined orientation of the crosswalk. Once the mat was placed correctly, duct tape outlined the outer edge (figure 5). The mat was then removed, the surfaced re-cleaned, and the tape became the template for applying the glue. The adhesive used was a one-part polyurethane, water-activated product that is specially produced for Disabilities Devices.


Figure 5

The backside surface of the mat was cleaned with acetone prior to the application of glue. The taped PCCP area and the underside of the mat received an even coat of adhesive using a conventional, foam-style paintbrush. Using a pump sprayer, water was misted on both surfaces of the wet bonding agent. This misting activates the adhesive process. Figures 6 & 7 show the application of the glue.


Figure 6


Figure 7

It was unsure what was the correct amount of water needed to properly activate the adhesion process due to the ambiguity of the manufacturers instructions. It states to 'mist' the surface but do not drown the adhesive.

The contractor then began applying the mats to the prepared surface by carefully laying the sheets to the interior of the taped template (figure 8) making sure the edges were tight between the two mats. Sandbags were placed atop of the mat to keep the mats in-place while the glue sets (figure 9). Cure time for the adhesive was approximately three hours.


Figure 8

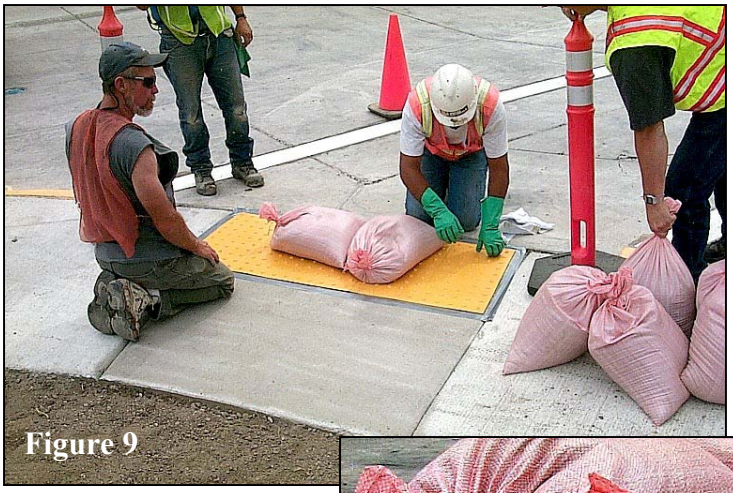


Figure 9

There was a problem that occurred during the curing time. The edges of the mat were curling up, with speculation that the chemical reaction of the adhesive may have caused the raised edges as seen in figure 10, the red arrows show where the activated glue is exiting from the side of the mat. As seen in figure 10, the sandbags were not completely covering the mat. Once the edge

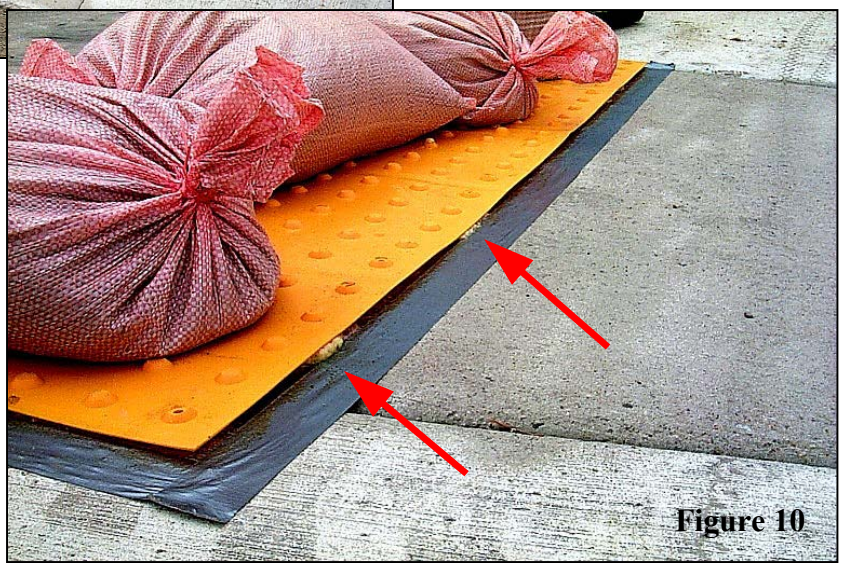


Figure 10

curling was noticed, the contractor placed the bags over the entire mat area to secure the edges. This appeared to work fairly well as it kept the edges down and allowed the mat to adhere to the PCCP. Once the glue was cured and the mat was sufficiently secured to the walk, the attachment holes at the edges of the 12″ bevel squares were drilled out and yellow, nylon anchors were hammered into the pre-drilled holes. The perimeter tape was removed. The final step in installation was to seal the outer edges and the interior mat seams with special glues supplied by the manufacturer. Figure 11 is the completed installation.

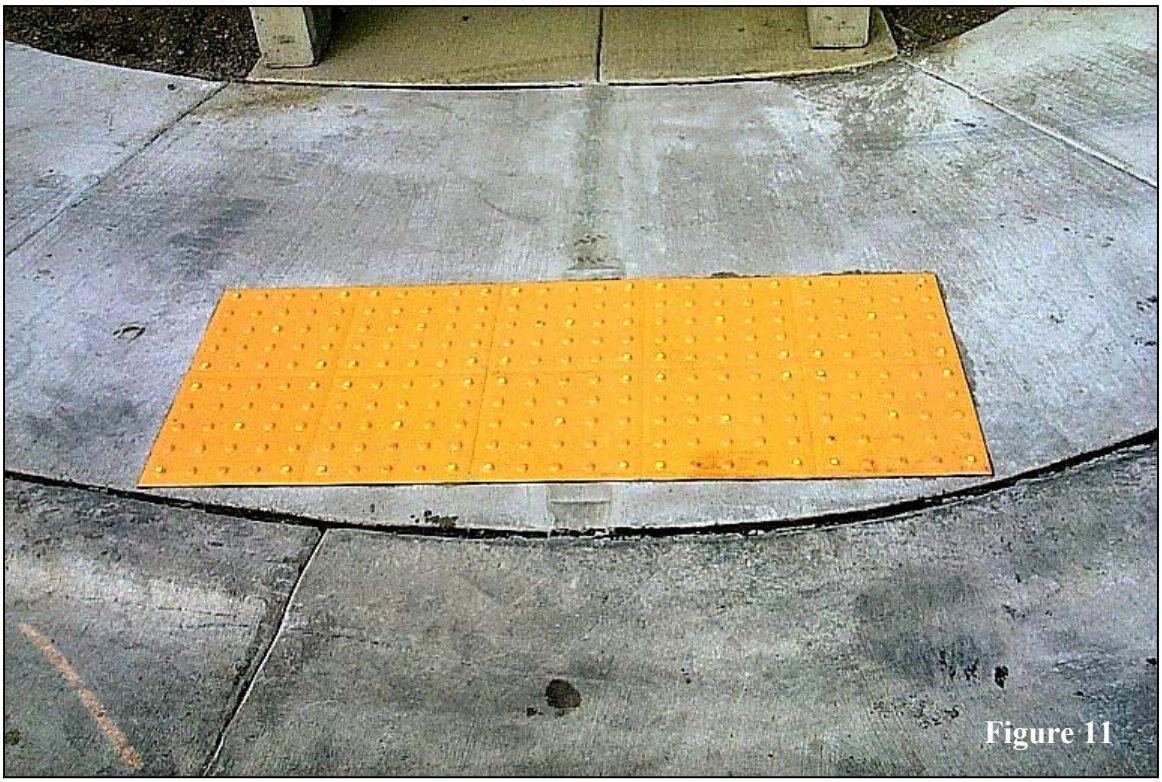


Figure 11

PRODUCT INSTALLATION

Test Sections: 1a, 1b & 1c

Manufacturer: ADA Fabricators
Product: Copolymer Composite Tiles
Type: Inline Dome Tactile Curb Ramp

Installation Procedure

The tile comes in 24″ x 24″ x 1/8″ panels. Each panel has two 1/2″ flanges which are inserted into sawcut grooves in the pavement. The tiles have beveled edges and preformed holes for fastening. The contractor began by saw cutting grooves into the PCCP approximately 1/2″ wide and 3/4″ deep to accept the footprint of the tile flange. Figure 12 shows the installer cutting the grooves with a hand-held concrete saw. The flanged tiles are shown in the right of the image. The sawed groves are then cleaned out with forced air and ready for tile placement. The adhesive (Hydroment Ultra-set Waterproofing and Anti-fracture Membrane) is applied onto the PCCP surface using a conventional v-notched trowel. The adhesive is not used in the sawed grooves. Once the Hydroment is applied evenly over the tile footprint, the tiles are ready for insertion. The tiles are carefully laid into the grooves and pressed firmly to the ground. The tiles are beveled at the edge, which makes a clean seam once all three are in place. Using a hammer drill, the contractor drills the holes in the pre-formed fastener locations to a


Figure 12

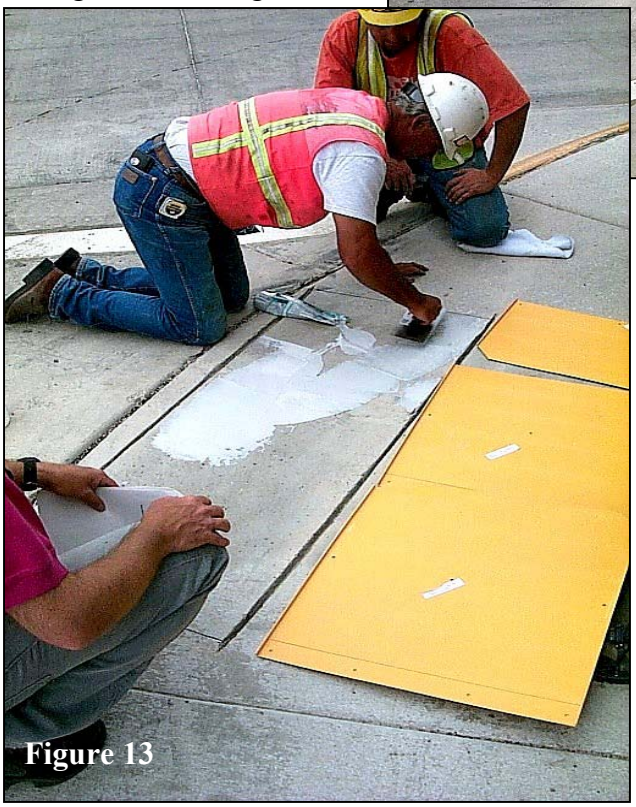


Figure 13

minimum depth of 1-3/4″. Using the supplied fastener the mat is hammered to the PCCP (figures 14 & 15). The fastener installation must take place within one hour of applying the adhesive. The installation is finished by caulking the perimeter joints of the tiles using conventional DAP polyurethane sealant (figure 16).


Figure 14


Figure 15


Finished Installation


Figure 16

PRODUCT INSTALLATION

Test Section: 2

Manufacturer: Disabilities Devices
Product: Wet Anchor Box
Type: In-Situ Mat Application

Installation Procedure


Figure 17

This product is designed to be placed directly into fresh PCCP. This application is not recommended for use in asphalt. Figure 17 shows the crew placing concrete into the formed ramp. After the PCCP has been summarily finished, a plastic box, 2-1/2″ deep in two sections, (2′ x 3′ & 2′ x 2′) is pushed into the wet concrete no more than 1/8″ above the concrete surface (figure 18). Since there were two pieces, they needed to be attached. The attachments used were not strong enough to keep the two box sections together while being pressed into the concrete. The panels separated about 1/2″. It was determined that a more substantial connector would have been needed to prevent the sections from spreading (as shown by the red arrows in figure 19). The box (or panels) has perforations in it to allow the excess soup to bleed into the box. Once the installer is assured the box is correctly in-place, the excess concrete in and


Figure 18


Figure 19

around the box is cleaned out with the interior of the box being wiped dry. The concrete is then left to set overnight. Figure 20 shows the completed wet-anchor box prior to the next day's mat installation. The next step is to apply the adhesive on both the underside of the mat and to the top of the prepared anchor box. According to the manufacture's instructions, the adhesive to be used was a 3M No. 80 or 90 spray-type contact bonding agent. It was then a matter of allowing the glue to dry and carefully aligning the mats with the surface holes (attachment for setting screws) of the box and pressing down firmly to set the glue. Unfortunately, the contractor had the wrong instructions and glued the mats according to another type of truncated dome installation. This installation incorrectly used a paint-on adhesive, which is activated by a water mist, to start a chemical reaction to promote adhesion to the mat and base surface. Figures 21 & 22 show the contractor painting on the glue prior to water misting and placing the mat to the anchor box. Once the mats were misted, they were positioned in the correct alignment within the box (figure 23).

Figure 20

Figure 21

Figure 23

Figure 22

The next step of the installation was to insert the attachment hardware into pre-formed holes located within a dome on the mat. The anchor hardware consisted of a yellow nylon pin in which the base of the anchor was set by hand into the holes (figure 24), then hammered flush to the mat (figure 25). Some of the pins were easily set by the hammer, where others seemed to be blocked and the top of the pins were broken off prior to being completely inserted into the holes (the red arrow in figure 25 points to one of the broken pins). Speculations as to why some of the anchors were not setting properly were attributed to misalignment of the mat to the box, or the excessive foaming action of the glue. As stated earlier, the wrong type of adhesive process was used with this installation. Soon after the mat was placed in the box, the glue began to foam excessively. This may have hindered the setting of the anchor pins. The adhesive was also exiting from the perimeter of the mat. This abnormal chemical reaction also distorted the surface of the mat. Once the glue had cured it took several hours to clean in and around the mat to give the installation an adequate appearance (figure 26). The mat still had an uneven surface due to the reaction of the glue. It is hoped this will settle out over time and use. This installation will be monitored closely to see if the incorrect adhesive application prematurely degrades the performance of the DWD.


Figure 24


Figure 25


Figure 26

Finished Installation

PRODUCT INSTALLATION

Test Sections: 5a, 5b & 5c

Manufacturer: Strongwarn Industries
Product: Applied Latex Modified Mortar Domes
Type: Surface Mortar Mold

Installation Procedure

This application uses a rubber mold to form the domes directly onto the prepared PCCP surface. The contractor begins by laying the rubber mold in the correct alignment with the ramp and securely taping the edges of the mold down (figure 27). The


Figure 27


Figure 28

supplied grout (Strongwarn-82 Dry Grout LT) was mixed to the manufacturers specifications using a variable drill and paddle mixer and five-gallon plastic bucket (figure 28). Once the installer determined the correct grout consistency, it was evenly applied to the tops of the mold using a trowel (figure 29). Care is taken to assure that the grout was entering through the top of mold, and completely filling the dome chamber.

The excess grout was then scraped off the mold and allowed to cure (figure 30). Curing was deemed complete when the grout becomes resistance to finger pressure at the top of the dome mold. The tape was then removed and the mold, starting at the corner, is carefully peeled


Figure 29


Figure 30

back to expose the set or cured domes. As seen in figure 31, as the mold is pulled away the domes remain on the surface of the pavement. For the most part the majority of the domes remained attached firmly to the surface. However, some of the domes remained in the

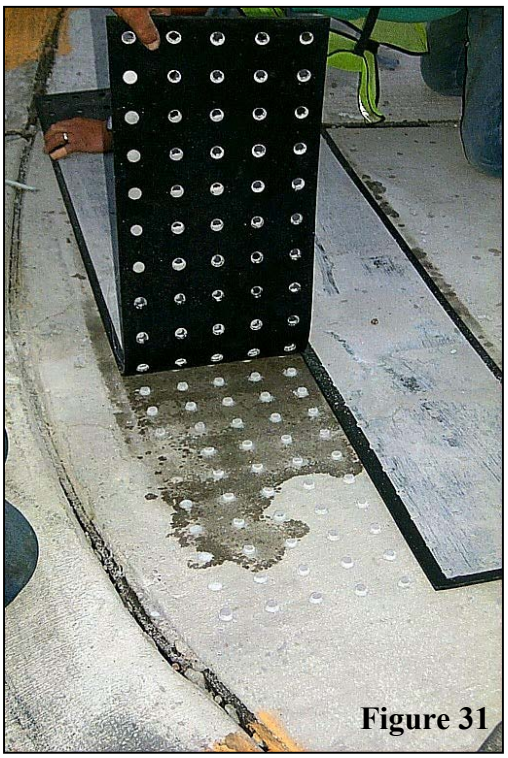


Figure 31

Figure 32

mold or were loose on the surface when the molds were removed (figure 32). It is difficult to determine the specific reasons for having loose domes due to the few installation of this type of DWD applications on the project. Figure 32 shows loose domes on a section of previously grouted construction joint. It was first speculated the loose domes were not adhering to the mortar, but it was found to have no relationship to dome adhesion. Other domes were just as tight regardless of the surface preparation.

Figure 33

Figure 34

The next step in the process was to re-tape the perimeter of the dome area for the first coat of pigmented primer. This primer will further adhere and strengthen the domes in place. The surface was made damp by using a spray bottle. The material was then spread out using a conventional medium nap roller taking care not to leave excess material on the surface that may decrease the

dome relief (figures 33 & 34). Two coats of primer were required for this installation. Once the primer had sufficiently dried, the final seal coat can them be rolled on in the same manner as was the primer coat. The seal coat also gave the surface a typical DWD color and better slip resistance (figure 35). Figure 36 is the completed installation.

Figure 35

Figure 36

PRODUCT INSTALLATION

Test Sections: 6a & 6b

Manufacturer: Cote-L Industries
Product: Safti-Trax Plastic Sheets
Type: Sheeted Rubber Domes

Installation Procedures

This product attaches rubber domes on clear plastic sheets that are pressed onto a prepared surface and then coated to keep the domes in place. The first step was to lay the dome sheet on the area where the mat was to be applied and stencil around the sheet with an easily seen marker (figure 37). The contractor then taped around the stenciled area (figure 38). A base coat of yellow primer was rolled on the inside of the taped area (figure 39). The dome sheets were then placed directly onto the fresh base coat and pressed down to gain adhesion (figures 40 &41). According to the manufacturers instructions, slices are cut into the plastic that will allow the base coat to cure faster and firmly attach the domes. It was found during the cutting, the domes would lose their adhesion from the plastic sheet and move loosely around on the wet surface. With the next installation of this type, the installer elected not to cut the plastic and to allow for a longer curing time that kept the domes from shifting on the

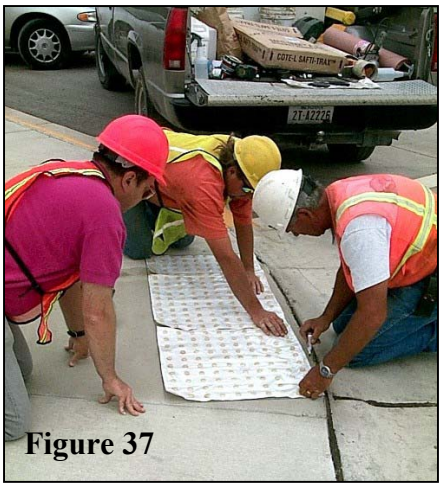


Figure 37


Figure 38


Figure 39


Figure 40


Figure 41

surface during the base coat curing process. Once the sheets were in place with the domes in the correct positions, the contractor laid a plywood sheet over the entire mat to keep the domes on the base while it dried. When the base coat had sufficiently cured, the plywood was removed; the clear plastic sheet was gently peeled off to expose the domes. It was noticed that some of the domes had not adhered to the base coat. Instead of removing the domes they were saved. The next step was to apply several coats of sealer to the surface of the truncated domes. The final coats are to securely attach the domes to the base and provide skid resistance. It was found that loose domes could be coated with the sealer and held in-place with a stick (or in this case a paint stirrer) as the installer rolled on the first coat of sealer (as seen in figure 42). This worked well in utilizing the loose domes. It is unsure if the sealer will supply adequate adhesion over time. One problem noticed during this installation is with the successive coatings over the domes. Unless the installer is careful, there may be a loss of relief due to over-coating as seen in figure 43. Domes are to have an approximate height of 5mm, compared with the thickness of the quarters place on the mat; the overuse of sealer has lost some of the dome relief by several millimeters. Figure 44 shows the DWD with the final coat of sealer prior to the removal of the tape.

Figure 42


Figure 43


Figure 44

PRODUCT INSTALLATION

Test Section: 7

Manufacturer: Cote-L Industries
Product: Safti-Trax Rubber Mat
Type: Flexible Truncated Domed Mat

Installation Procedures

This application was the quickest to perform with a minimum of tasks to complete the installation. The mats are flexible rubber made in 2′ x 2′ sheets that can be easily cut to the desired size of treatment. The sheets are placed on the cleaned PCCP surface and stenciled around the perimeter then removed. According to the manufacturers instructions, the adhesive is to be applied to the back of the mats then placed onto the surface. The type of bonding agent used was Sika Sikaflex 11FC Construction Adhesive. Due to the bendable nature of the mat material, the contractor determined it was better to apply the glue directly to the ramp surface and trowel the material to the edge of the stenciling (figure 45). The mats are then placed on the prepared surface, making sure the interior seams are tight with each other (figures 46 & 47). Once all the mats are in, the interior and exterior edges are cleaned of excess glue. The mat was covered completely with sandbags to insure an even set to the concrete surface. Figure 48 is the completed DWD.


Figure 45


Figure 46


Figure 47


Figure 48

PRODUCT INSTALLATION

Test Sections: 4a, 4b & 4c

Manufacturer: Vanguard ADA Systems of America
Product: Applied Truncated Domes
Type: On-site Dome Manufacture using Molds

Installation Procedures

This was the only DWD application not installed by United Materials. A representative of Vanguard ADA performed the work. This product uses catalytic type mix and use of a mold to produce the domes directly onto a prepared surface. Figure 49 is the Vanguard equipment trailer used onsite at the installations. The first step of manufacturing the truncated domes was to thoroughly clean the area using an electric blower. Since all the selected sites for these installations were previously sandblasted, the operator did not need to use a solvent or concrete grinder as may normally be needed with other DWD sites. Once the site was clean, the mats were laid out in the section of the ramp where the DWD was to be installed. The perimeter of the mat was outlined in tape (figure 50). A sealer was applied to the interior of the taped surface. This sealer filled in the minor divots and porous features of the concrete to create a better bonding surface, and to prevent moisture from wicking through the concrete that may degrade the bonding of the DWD to the ramp. The sealer goes on white and cures to an opaque appearance (figure 51). In addition, the installer spreads a thin layer of reflective glass beads prior to the sealer curing. This enhances a better bond when the yellow base is applied. The sealer coat may take up to three hours to set depending on humidity and

Figure 49

Figure 50


Figure 51


Figure 52


Figure 53

temperature. After the installer had determined the sealer sufficiently dried, a first coat of yellow base was rolled onto the sealed surface (figure 52). This was the surface in which the domes were molded onto. The base was allowed to dry and the tape was then removed (figure 53). The next step was to position the rubber molds onto the readied base (figure 54). Once the molds were in the correct position the installer began preparing the base for use in molding domes. The mold material was the same product as the initial yellow base. A catalyst was added to the base to thicken the material to hold a dome shape during the molding process. The mold base was tested and adjusted with the catalyst several times to insure proper consistency prior to casting (figure 55). Before beginning the molding phase, the installer set up a pneumatic mat-washing device. This machine was filled with paint thinner to clean the mats immediately after molding had taken place (figure 56). The used molds are rolled up and placed in a tumbler, which rotates through the solvent cleaning the mats. Once out of the machine the mats dried quickly and were ready for the next round of installations.


Figure 54


Figure 55


Figure 56


Figure 57


Figure 58

The molding began by pouring a small amount of base onto the top of the mat mold and gently squeegee the material into the tops of the holes (figures 57 & 58). The installer was careful to work enough of the base to completely fill all the voids in the mold. The mats were in three sections. The excess base was moved across the first mat onto the adjacent mat. The mold was then ready to be rolled back to expose the domes. The mold is grabbed at the front and peeled slowly back to allow the base material to release from the mold and remain on the surface of the ramp (figure 59). As seen in figure 60, the installer continues to spread the base to the next mold, working his way to the last section of mold to complete dome casting. With the first site application, some of the domes were over flattened (figure 61); this was corrected with the next sites by adjusting the consistency of the base.

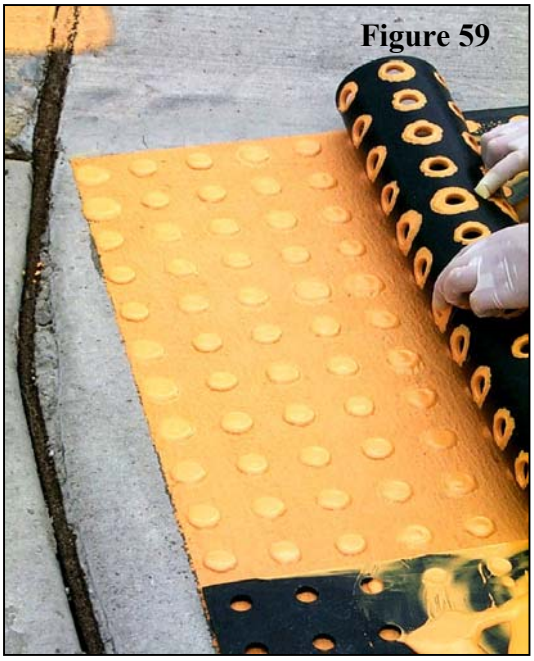


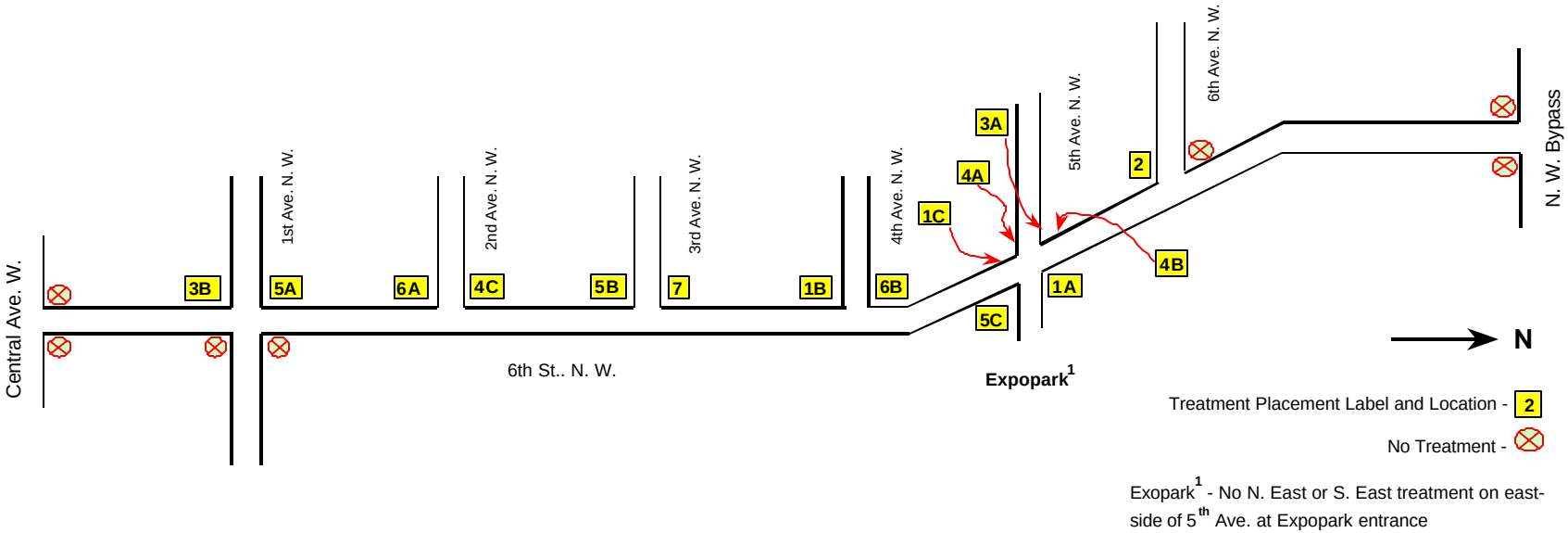
Figure 59


Figure 60


Figure 61

After the domes sufficiently cured, tape was reapplied around the DWD to allow the installer to roll on the final coat. This last coat was to give the mat a uniform appearance and better skid resistance (figure 62). The tape was removed and the installation complete. A full cure takes about 2-3 hours depending on temperature and humidity. Figure 63 is the completed DWD.

Treatment Type	Manufacturers	Label	Frequency
Copolymer Composite Tiles	ADA Fabricators	1	3 (a, b & c)
Wet Anchor Box System	Disability Devices	2	1
Polyurethane Detectable Warning Mat	Disability Devices	3	2 (a & b)
Applied Truncated Domes	Vanguard ADA Systems	4	3 (a, b & c)
Applied Latex Modified Mortar Domes	Strongwarn Industries	5	3 (a, b & c)
Safti-Trax Plastic Sheets	Cote-L	6	2 (a & b)
Safti-Trax New Rubber Mat	Cote-L	7	1



Experimental Layout
Detectable Warning Devices
Truncated Domes for Curb Ramps
Project STPU 5201(11)
Great Falls