Detectable Warning Plate Life Cycle Cost Comparison:

Cast Iron vs. Plastic

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Executive Summary

The Americans with Disabilities Act (ADA) requires detectable warnings be placed in locations where pedestrian traffic will intersect with vehicular traffic, these locations generally include; curb ramps, transportation platforms, and pedestrian entrances to parking lots. The purpose of detectable warnings is to provide visually impaired persons with a visual, textural and audible warning that the pedestrian area is going to come into contact with vehicular, rail or other traffic. For the purposes of this paper, detectable warnings will be referred to as detectable warning plates (DWP).

Over the years, several different materials have been utilized to provide DWPs including; cast iron, plastic (polymer), steel, aluminum, formed concrete and pavers. The two most common material types used for DWPs are cast iron and varying forms of plastic. Research was conducted related to the life cycle cost (LCC) differences between wet set embedded plastic and cast iron DWPs. This paper provides the results of that research and includes the breakeven LCC between plastic and cast iron DWPs. Overall, it was assumed that a cast iron detectable warning surface would last a minimum of 25 years. From a LCC standpoint, plastic would have to last at least 25 years to compare to cast iron. Based on the qualitative evidence available, it is unlikely plastic will last as long as cast iron, particularly in areas that have snow and ice during the winter months. The overall conclusion is that cast iron detectable warning surfaces have a lower cost of ownership than plastic.

Introduction

Detectable warning plates (DWPs) are used throughout the United States and the world to provide a visual, textural and audible warning for visually impaired pedestrians where the dedicated pedestrian comes to an end and merges with vehicular or other traffic. Common locations for DWPs are curb ramps, park lot entrances, rail and bus platforms etc. In the United States, the ADA Standards for Accessible Design (ADA Standards) provides the basic design requirements for DWPs. Section 705 of the ADA Standards states that DWPs shall consist of truncated domes of a specific size and spacing and that the DWP shall visually contrast with the surrounding area. The ADA Standards do not provide specifications related to material type, performance, or durability. As a result of the ADA Standards not specifying material types, several different materials are currently in use including, but not necessarily limited to: cast iron, stamped steel and aluminum, plastic (Polymer), formed concrete and paver bricks. The two most common materials specified on the State Department of Transportation (DOT) level are cast iron and plastic.

State Departments of Transportation, municipalities, transit agencies and commercial developers are the most common DWP end users. When choosing a DWP material, often times, the lowest cost alternative is selected, provided it meets the ADA Standards. The DWP with lowest initial upfront cost may not always be the lowest cost alternative when reviewing the cost over the entire life of the product. Through our research, we were unable to find one comprehensive document that compared the LCC of varying materials. In an effort to provide a comprehensive review of plastic and cast iron DWPs, we interviewed

customers, installers, end users, and reviewed DOT data to gain as much information as possible about material cost, installation cost, and life span. This data was used to perform a comparative analysis of plastic verses cast iron LCC at various life spans.

Life Cycle Cost Analysis

Life Cycle Cost Analysis Explained

Before going into the detail of the analysis, it is important to define Life Cycle Costing or LCC. Life Cycle Costing is a method that aggregates all costs that will be incurred over the life span of an asset. These costs will include the initial investment, along with any further investment, such as operating cost, maintenance and repair, and upgrades. Life Cycle Costing is a valuable tool when selecting a product, including for something as complex as which vehicle to buy or as simple as a DWP. The LCC of a product allows an end user or specifier to make a quick, informed decision as to which product to purchase provided the products meet the same basic requirements or specifications.

Analysis

To perform an accurate LCC it is important to know the life span of the product. It was difficult to find information regarding the life span of plastic DWPs. There have been studies that have been conducted by DOTs and others that have looked at durability from a qualitative standpoint. At this time, however, we were unable to find a definitive lifespan for plastic. We did determine, that in general, cast iron warning plates are more durable than plastic. Cast iron has been used successfully for manhole covers and drainage castings for over 100-years and there are some castings that are over 100 years old that are still in service. From a durability and lifespan standpoint, cast iron outlasts the infrastructure it is installed in.

The Vermont Agency of Transportation (VTrans) studied various materials over several years to identify the relative durability. Figures 1 and 2 below show the difference between plastic and cast iron and evidence that cast iron lasts longer than plastic. With the knowledge of cast iron's extensive use and durability in municipal castings, it was assumed that the life span of cast iron DWPs is the same as the concrete sidewalk they are installed in.

Figure 1. VTrans Plastic DWP
(Installed 2004, Photo 2013)

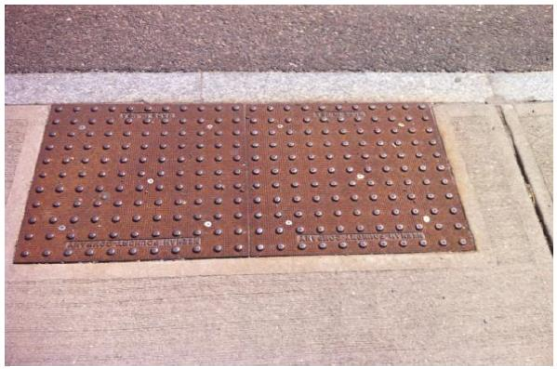

Figure 2. VTrans Cast Iron DWP
(Installed 2005, Photo 2013)

According to the Federal Highway Administration (FHWA) concrete sidewalks can last as long as 80 years. The FHWA states that many cities consider 25 years to be the expected lifespan for a concrete sidewalk. For the purposes of our analysis we assumed that a cast iron DWP, properly installed, would last at least 25 years without any additional maintenance. Since the exact lifespan of plastic DWPs is unknown, the LCC was completed assuming different life spans for plastic DWPs.

Assumptions

Several assumptions were made when calculating the LCC of cast iron and plastic. A summary of the assumptions made is provided below.

- LCC time period = 25 years (estimated life of concrete curb ramp)
- Life span of cast Iron = 25 years (likely would last longer than 25-years)
- Life span of plastic – calculated LCC for 5, 10, 15, 20 and 25 year life spans
- Analysis for straight DWPs only, radial plates are excluded
- All DWPs analyzed are wet set embedded DWPs
- Replacement cost = initial upfront cost
- Assume inspection costs for Installed DWPs is the same for cast iron and
- Salvage value of DWPs is zero

Initial Upfront Costs

Initial upfront detectable warning costs include both the material and the installation of the material. To determine the initial upfront cost, state DOT historical bid data was reviewed. There are many state DOTs that allow multiple materials to be used for DWPs. To ensure accurate costs for both plastic and cast iron were obtained, only state DOTs that had detailed cost data based on material were reviewed. A total of 10 state DOTs were reviewed, three of the DOTs were reviewed for plastic and six were reviewed for cast iron, and one was reviewed for both materials. Table 1 summarizes the initial upfront costs by state DOT for cast iron DWPs and Table 2 summarizes the initial upfront costs by state DOT for plastic DWPs.

Table 1. Initial Upfront Costs – Cast Iron DWPs

State	Unit Cost per SF	Notes
Michigan	$37.71	Average Cost / SF 2020
Minnesota	$51.77	Average Cost/SF 2020
New Hampshire	$49.95	Average Cost / SF 2020
New York	$41.89	Average Cost/SF 2019-2020
Pennsylvania	$48.82	Average Cost/SF 2019-2021
Vermont	$45.10	Average Cost/SF 2015-2020
Wisconsin	$38.34	Average Cost/SF 2018-2020

Table 2. Initial Upfront Costs – Plastic DWPs

State	Unit Cost per SF	Notes
Indiana	$23.27	Based on site visits and project bid sheets
New Jersey	$29.72	Average Cost/SF 2019
Ohio	$26.70	Based on site visits and project bid sheets
Pennsylvania	$41.82	Average Cost/SF 2019-2021

Based on the data in Tables 1 and 2 above, the average initial cost/SF of cast iron DWPs is $44.80 and for plastic DWPs it is $30.38. Based on the data collected the average initial upfront cost for a cast iron DWP is about 47.5% higher than the initial upfront cost of plastic.

Life Cycle Cost Summary of Results

Utilizing the initial upfront cost information provided by state DOTs along with the assumptions made, the LCC at 5-year intervals were calculated for plastic and cast iron DWPs. A summary of the 5-year interval analysis is presented in Table 3. As can be seen in Table 3, cast iron is a more cost effective material selection assuming plastic will need to be replaced at least once in a 25-year period and cast iron will not. Based on the data collected, the average LCC for cast iron is $44.80 over a 25-year life span. Plastic would need to last at least 25 years to be cost competitive to cast iron over the life of the product. As was demonstrated through the VTrans study, plastic was already damaged in less than 10 years. If a 10 year

life for plastic is assumed, the LCC would be $91.14 which is more than double that of cast iron. If plastic DWPs could last 20 years, the LCC is $60.76 which is 35% more than cast iron over the same period.

Table 3. LCC Summary Table – please place on top of table

Cost Description	Cast Iron 25 yr life ($/SF)	Plastic 5 yr life ($/SF)	Plastic 10 yr life ($/SF)	Plastic 15 yr life ($/SF)	Plastic 20 yr life ($/SF)	Plastic 25 yr life ($/SF)
Initial Cost	$44.80	$30.38	$30.38	$30.38	$30.38	$30.38
1st Replacement	--	$30.38	$30.38	$30.38	$30.38	
2nd Replacement	--	$30.38	$30.38			
3rd Replacement	--	$30.38				
4th Replacement	--	$30.38				
TOTAL	**$44.80**	**$151.90**	**$91.14**	**$60.76**	**$60.76**	**$30.38**

Conclusion

The intent of this paper was to provide an objective look at the LCC of cast iron and plastic DWPs. Overall plastic DWPs will carry a LCC of at that is at a minimum 35% higher than cast iron and could be as much as 239% higher. The only instance in which plastic DWPs are more cost effective will occur if a plastic DWP has the same life span as cast iron. In addition, based on what is known about cast iron manholes and inlet grates, cast iron is likely to last well beyond 25 years, and will likely outlast the concrete it is cast in. Objectively, cast iron is a more cost effective solution for DWPs.

Sources

"5 Year Average Price List – ENGLISH, July 2015 – June 2020." *Vermont Agency of Transportation.*

"2019 Unit Price Summaries." *Indiana Department of Transportation*, Calendar Year 2019.

"Average Bid Prices for Awarded Contracts 1/1/2020 to 12/31/2020." *Minnesota Department of Transportation.*

"Average Unit Price List." *Wisconsin Department of Transportation,* 7 July 2020.

"Historical Bid Data Item Search (2016-2021)" *Ohio Department of Transportation.*

Michigan Department of Transportation.

New Hampshire Department of Transportation.

New Jersey Department of Transportation.

Pennsylvania Department of Transportation.

Tremblay, Jason P. "Assessment of Detectable Warning Products." *Vermont Agency of Transportation, Materials and Research Section,* 10 December 2013.

"Weight Average Item Price Report by Item, By Quarter." *New York State Department of Transportation,* January 1, 2019 to December 31, 2020.