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| library | **REVIEW**  Service Life of Roadside Barriers |
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There has been little research or documented data on the service life of roadside barriers. While a number of sources establish guidelines ranging from 15 to 50 years for the life of such assets, these estimates appear to be primarily assumptions used for modeling and planning purposes rather than numbers based on observation, maintenance records or research. Karim, Magnusson and Natanaelsson (2012) stated that the design process for the selection of road barriers could be enhanced by life-cycle analyses, but that such analyses are almost never done. Some of these authors earlier noted that decisions regarding road barrier selection tend to focus on safety performance and investment costs; life-cycle costs are often ignored in large part because of insufficient knowledge of barrier maintenance (Karim, Alam and Magnusson, 2011). A European conference paper indicated that those responsible for maintenance on road safety devices generally do not have a reliable method for systematic data collection (Grzyl, Kristowski, et al. 2017).

The 2012 NCHRP report, *Estimating Life Expectancies of Highway Assets, Vol. 1*, offers published life expectancies for many types of assets. However, guiderails and impact attenuators are listed as “other asset types” with no estimates given (Thompson, Ford, et al.). A quarterly progress report for the NCHRP project leading up to the 2012 report showed relevant references establishing the lower and upper boundaries for life expectancies of various highway assets; they noted that no references were found for guardrails/crash barriers (Sinha, Labi, 2009).

A report from the Midwest Regional University Transportation Center found that the service life of safety hardware was often shorter than the service life of an in-service highway segment. According to this study, planners should therefore assume that safety hardware projects would need to be implemented several times over the useful life of a highway segment (Li, Madanu, 2008).

Older reports also lacked specific data from research and records; a 1963 Michigan study recommended replacing black steel plate guardrail, which required frequent painting, with galvanized steel. The author acknowledged that the service life of the galvanized steel was not precisely known, but was expected to be between 8 and 15 years. A discussion following the body of the article assumed a life of at least 20 years before the appearance of rust of the base, and at least twice that time for complete failure of the coating to take place. The disparity between these two viewpoints illustrates the lack of reliable information.

Some of the estimates given lump all types of roadside barriers into a single category of estimated service life, while others give an expectation for a specific type of barrier. In a 2003 NCHRP Research Results Digest, author Charles Niessner said that new roadside barriers should have a design life of at least 20 years, and up to a 25% increase over this is desirable. Stephens (2005) anticipated a 20-year life cycle for roadside barriers on low volume and low-speed roads, and Texas DOT also uses a 20-year life in their Highway Safety Improvement Program (HSIP) Work Codes Table for the installation of median barriers. Sweden designs roadside barriers for the somewhat longer service life of 30 years (Karim, Magnusson, Natanaelsson, 2012), while Virginia DOT’s Preferred CMF (Crash Modification Factor) List assigns a 15-year life expectancy to cable barrier, median concrete barrier and roadside guardrail. In a calculation for estimating the cost of traffic safety equipment’s life cycle, Grzyl, Kristowski, et al. (2017) used an adopted lifetime of 15 years for concrete barriers in their example.

Several of the reviewed reports and articles dealt exclusively with cable barriers. An implementation recommendation developed by the Minnesota Dept. of Transportation noted that manufacturers considered 15 years a good estimate of service life for high-tension cable barrier; however the DOT task force felt that 20 years would be a more reasonable time frame (MnDOT, 2013). Iowa DOT determined on a 20-year life expectancy for median cable barriers as well (Savolainen, Kirsch, et al., 2018), and in her 2017 thesis, Ellen Nightingale also put forward a 20-25 year design life for the use of median cable barrier on Iowa roads.

Highways England, a UK government organization responsible for operating and maintaining England’s motorways, publishes standards that specify “all components shall be designed to achieve a serviceable life of not less than: (a) 20 years for metal safety barriers, terminals, transitions, removable barrier sections and crash cushions; (b) 50 years for concrete safety barrier systems, except for temporary safety barriers where the serviceable life shall be not less than 10 years.” (Highways England, 2020). These figures were used in two of the reviewed reports: *Proposed Method for Estimating the Costs of Safety Barrier Life Cycle* (Gobis, Kristowski, Grzyl, 2018) and *Whole Life Cost-Benefit Analysis for Median Safety Barriers* (Williams, 2007).

Two studies that looked more closely at the service life of roadside safety hardware include a 2013 evaluation of treated wood and galvanized steel guardrail posts (Smith, 2013). The author noted that Washington State DOT anticipates that most guardrail posts will remain in service for up to 50 years; this includes wooden posts preserved according to specifications as well as galvanized posts. Oregon State University looked at wooden posts removed as a result of a project in Bellingham, WA after 20 years of service. The posts examined by OSU were chosen based on the fact that they showed some obvious signs of wear and decay; however only 3 of the 84 selected posts (4%) showed modulus of rupture (MOR) results less than the AASHTO standard. Posts that showed no visible decay pockets (48% of total) demonstrated strength nearly as high as new posts (per MOR testing), leading researchers to expect the posts had the ability to provide another 20 or more years of service in a guardrail system. The study also noted that galvanized steel in soil contact can be expected to have a continuous service life of 50 years.

In the second study, New Hampshire DOT looked at guardrails constructed from weathering steel (Cor-ten). This material had been used for guardrail installed on National Forest land since the 1970s, since it was considered aesthetically pleasing in scenic areas. However, it showed fairly rapid rates of deterioration when compared to galvanized rails; after 10-15 years of service, 50% of lap connections and 25% of the rail at mid-span were considered inadequate (showing 10% or greater section loss from the original thickness of 0.109”). After 15-20 years of service, 71% of the lap connections on the Cor-ten rails were failing, while the failure rate at mid-span remained at 25%. The DOT explored ways to prolong the service life of Cor-ten railing, eventually determining that this material was not suited for use in corrosive environments, a decision supported by the USFS. This same study found that galvanized rail of the same age showed no section loss (New Hampshire DOT, 2003).

Given the lack of solid data concerning the service life of roadside barriers, it seems that future research is called for. In the meantime, information from the manufacturers of component materials, such as the [American Galvanizers Association](https://galvanizeit.org/), might prove valuable in establishing baselines. The manufacturers and vendors of the barriers may also be able to provide estimates for service life of their products, although as brought out in the study done by MnDOT in 2013, companies may use a lower boundary for their estimates than the expectations set by agencies.

**REFERENCES**

Bolin, C.A., Smith, S.T. (2013). Life Cycle Assessment of CCA-Treated Wood highway Guard Rail Posts in the US with Comparisons to Galvanized Steel Guard Rail Posts. *Journal of Transportation Technologies*. 3(1). <https://www.scirp.org/html/7-3500098_27183.htm>

Cardone, S. (1963). Galvanizing Reduces Bridge Rail and Guardrail Maintenance in Michigan. <http://onlinepubs.trb.org/Onlinepubs/hrr/1963/11/11-004.pdf>

Grzyl, B., Dristowski, A., et al. (2017). Methods of Estimating the Cost of Traffic Safety Equipment’s Life Cycle. *MATEC Web of Conferences, 122, Gambit 2016*. <https://www.matecconferences.org/articles/matecconf/pdf/2017/36/matecconf_gambit2017_02003.pdf>

Highways England (2020 Amendment). *Volume 1 of the Specification for Highways Works, Series 400: Road Restraint Systems.* <https://www.standardsforhighways.co.uk/ha/standards/mchw/vol1/pdfs/MCHW%20Vol%201%20Series%20%20400%20web%20PDF.pdf>

Karim, H., Alam, M., Magnusson, R. (2011). Road Barrier Repair Costs and Influencing Factors. *Journal of Transportation Engineering,* 137(5). <https://ascelibrary.org/doi/10.1061/%28ASCE%29TE.1943-5436.0000227> (Can be downloaded from ODOT computers).

Karim, H., Magnusson R., Natanaelsson, K. (2012). Life-Cycle Analyses for Road Barriers. *Journal of Transportation Engineering,* 138 (7). <https://ascelibrary.org/doi/pdf/10.1061/%28ASCE%29TE.1943-5436.0000391>

Kazimierz, J., Gobis, A., et al. (2018). *Proposed Method for Estimating the Costs of Safety Barrier Life Cycle.* [proposed-method-for-estimating-the-costs-of-safety-barrier-life-cycle\_36524.pdf](file:///C:/Users/odot26p/Downloads/proposed-method-for-estimating-the-costs-of-safety-barrier-life-cycle_36524.pdf)

Li, Z., Madanu, S. (2008). *A Methodology for Integrating Roadway Safety Hardware Management into the Overall Highway Asset Management Program*. <https://minds.wisconsin.edu/handle/1793/54187>

Minnesota Dept. of Transportation (2013). Recommendations for the Implementation of High Tension Cable Barrier in Minnesota. <https://www.dot.state.mn.us/trafficeng/reports/htcbfinalreport.pdf>

New Hampshire DOT. (2003). Prolonging Service Life of Weathering Steel Guardrail. *Focus on Research, April 2003.* <https://www.nh.gov/dot/org/projectdevelopment/materials/research/documents/2003-2news.pdf>

Associated poster: <https://www.nh.gov/dot/org/projectdevelopment/materials/research/projects/documents/mps1999-07_poster.pdf>

Niessner, C, (2003) *Development of an Improved Roadside Barrier System – Phase 1. (NCHRP Research Results Digest 273)*. <http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rrd_273.pdf>

Nightingale, E. 2017. *Effectiveness of Median Cable Barrier in Iowa*. <https://core.ac.uk/download/pdf/141671017.pdf>

Savolainen, P., Kirsch, T., et al. (2018). In-Service Performance Evaluation of Median Cable Barrier in Iowa. <http://publications.iowa.gov/28699/1/Iowa_median_cable_barrier_eval_Final%20Report.pdf>

Sinha, K.,Labi, S. (2009). *Quarterly progress report on Project 08-71 Methodology for Estimating Life Expectancies of Highway Assets.* <https://engineering.purdue.edu/LEHA/NCHRP%2008-71/Work%20Reports/ProgReport_October%2009.pdf>

Smith, Stephen. 2013. *Economic Evaluation of Treated Wood and Galvanized Steel Guardrail Posts*. <https://preservedwood.org/portals/0/documents/EconEval_Guardrail.pdf>

Stephens, L. (2005). *Barrier Guide for Low Volume and Low Speed Roads (FHWA).* <https://flh.fhwa.dot.gov/resources/design/library/FLH-Barrier-Guide.pdf>

Texas Dept. of Transportation (2020*). HSIP Work Codes Table*. <https://ftp.txdot.gov/pub/txdot-info/trf/hsip/work-codes-table.pdf>. Related to the Highway Safety Improvement Program Manual: <https://www.txdot.gov/inside-txdot/forms-publications/publications/highway-safety.html>

Thompson, P., Ford, K, et al. (2012). *Estimating Life Expectancies of Highway Assets, Volume 1: Guidebook (NCHRP 713*). <http://www.trb.org/Main/Blurbs/167189.aspx>

Virginia Dept. of Transportation (No Date). *Virginia State Preferred CMF List.* <https://www.virginiadot.org/business/resources/HSIP/Virginia_State_Preferred_CMF_List.pdf>

Williams, G. (2007). *Whole Life Cost-Benefit Analysis for Median Safety Barriers*. <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/520512/PPR_279_-_WLC-B_Analysis_of_Median_Safety_Fences_-_v2.pdf>