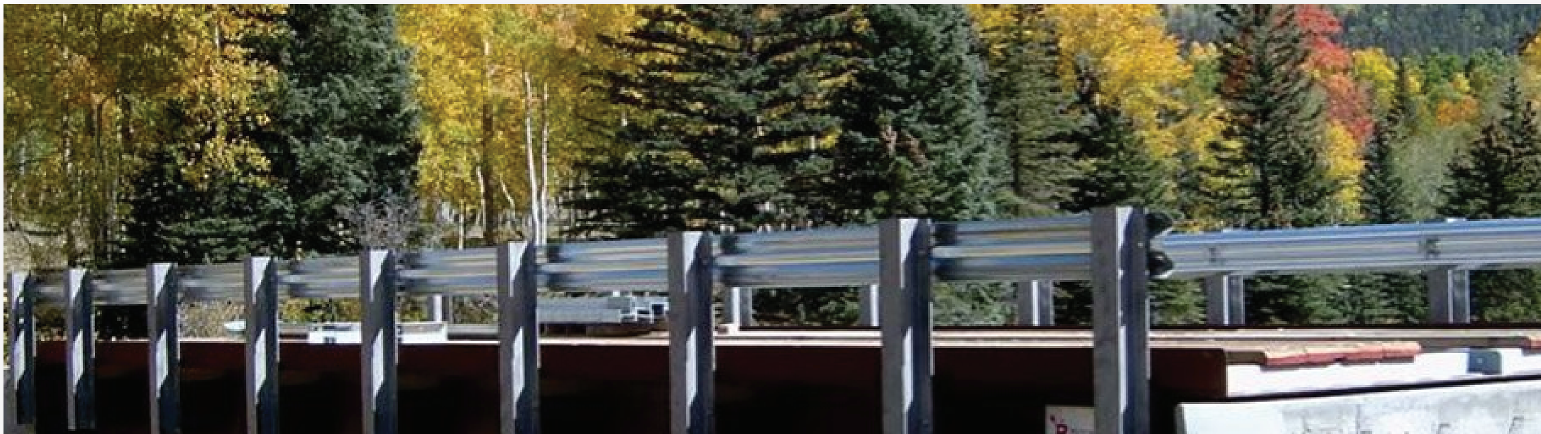
SHORT SPAN STEEL BRIDGE ALLIANCE™

Steel Offers High Value for Bridge Life Service and Life Cycle Costs



Introduction

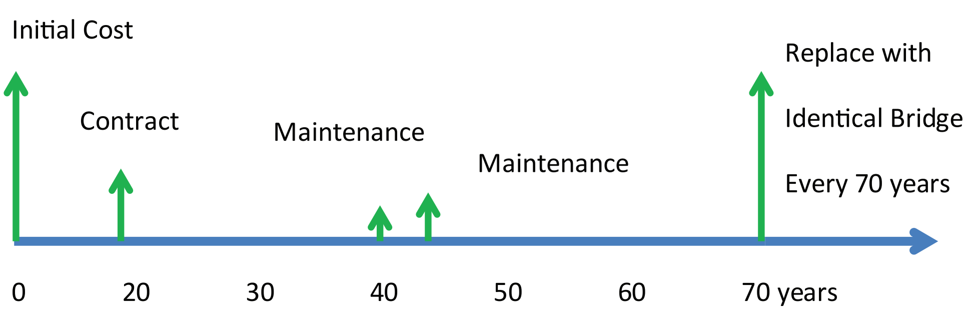
Historical Life Cycle Costs of Steel and Concrete Girder Bridges research conducted by Michael Barker, Ph.D., P.E., professor at the University of Wyoming, explores the initial costs, life cycle costs, future costs, and bridge life of 1,186 typical steel and concrete state bridges in Pennsylvania built between 1960 and 2010.

Dr. Barker frequently meets with county engineers and other bridge design professionals across the U.S. and takes questions on this topic, but there was no research comparing the two materials, so he undertook the project himself. He compiled a database from PennDOT historical data comparing five types of bridges, including concrete precast I-beam, box adjacent, and box spread bridges, and steel rolled beam and welded plate girder. **Results showed steel I-beams have the lowest average deterioration rate; have the longest average expected life (81 years); offer the lowest average initial and life cycle costs for short bridges; and have lower average future costs compared to initial costs**.

Life Cycle Cost Study

The Federal Highway Administration promotes consideration of Life Cycle Costs (LCC) in the design and engineering of bridges. LCC determines the "true cost" of bridge alternatives considering the time value of money. To compare the five types of bridges in the study, historical bridge initial and maintenance costs were converted to present-day dollars using historical construction cost indices. Future costs were discounted at a rate of 2.3 percent. The life cycle cost analyses employed use the Perpetual Present Value Cost (PPVC) of bridge alternatives for an equivalent comparison between the bridge types. PPVC (a form of Equivalent Uniform Annual Costs) is the present value cost of continuing the bridge into perpetuity. Results of the PennDOT database show all five types of bridges are competitive for initial costs, future costs, life cycle costs and bridge life. For any given bridge project, any of the five types may result in the lowest life cycle costs. Therefore, owners should consider both steel and concrete alternatives for an individual bridge project.

The life cycle of a typical bridge



Deterioration Rates

There are 6,587 bridges in the PennDOT inventory built between 1960 and 2010. They were used to determine the average deterioration rates (loss of condition rating per year) for the different types of bridges. To model the deterioration rate, it was assumed the superstructure condition rating decreased linearly over time. Table 1 presents the average deterioration rates for each bridge type. Steel I-beam bridges have the lowest average deterioration rate.

Bridge Type	Deterioration Rate
Steel I Beam	-0.0711
Steel I Girder	-0.0814
P/S Box - Adjacent	-0.0813
P/S Box - Spread	-0.0799
P/S I Beam	-0.0838

Table 1: Deterioration Rate

Bridge Life

To estimate the remaining life for each bridge, it is assumed the bridge will be replaced when the superstructure condition rating reaches 3 given the current condition and the deterioration rate in Table 1. Table 2 presents the average year built and the average bridge life for the different types of bridges in the Life Cycle Cost database. A useful method to analyze bridge life is to consider the probability a bridge will last at least 75 years (many owners' expectations). Figure 1 is the Cumulative Density Function demonstrating the Steel I-beam bridge's probability of 73 percent (the best of the bridge types) of lasting more than 75 years.

Bridge Type	Number of Bridges	Average Year Built	Average Bridge Life (years)
Steel I Beam	82	1981	81.3
Steel I Girder	230	1977	79.2
P/S Box - Adjacent	400	1985	74.0
P/S Box - Spread	581	1984	79.9
P/S I Beam	412	1984	74.5

Table 2: Average Bridge Life

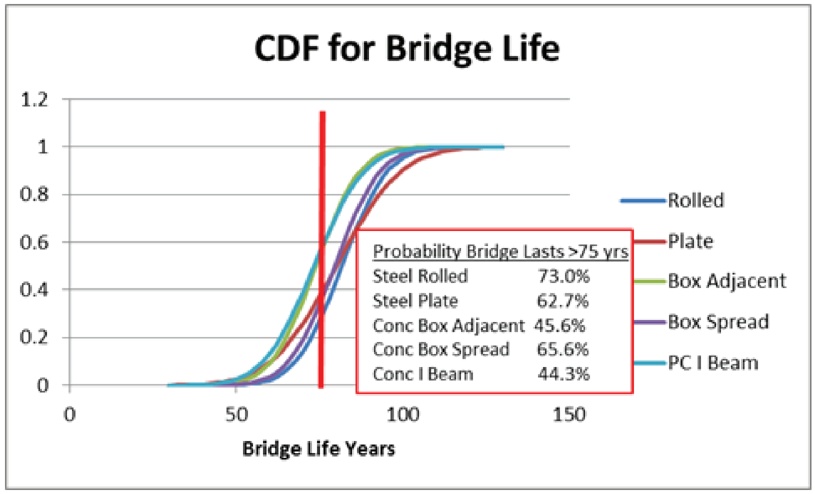


Figure 1: Cumulative Density Function of Bridge Life

Life Cycle Costs of Short-Length Bridges

County bridge inventories usually include bridges where most are less than 140 ft. in length. Table 3 shows the average perpetual present value costs and initial costs of bridges with a maximum length of 140 ft. Since plate girder bridges are not common in this bridge length, they are not included. Steel I-beam bridges have the lowest life cycle costs and the lowest initial costs compared to the other types. A useful method to analyze bridge life cycle costs is to consider the probability a bridge will cost less than a certain amount. Figure 2 is the Cumulative Density Function demonstrating the Steel I-beam bridge's probability of 68 percent (the best of the bridge types) of costing less than $300/ft^2.

	# Bridges	PPVC	Initial Cost	Avg Length	Avg # Spans
Steel I Beam	27	$266.24	$222.08	84	1.26
P/S Box - Adjacent	240	$292.38	$235.03	69	1.09
P/S Box - Spread	325	$272.20	$225.14	64	1.23
P/S I Beam	98	$281.64	$231.20	104	1.08

Table 3: Perpetual Present Value Costs of Bridges of 140 ft. and Less

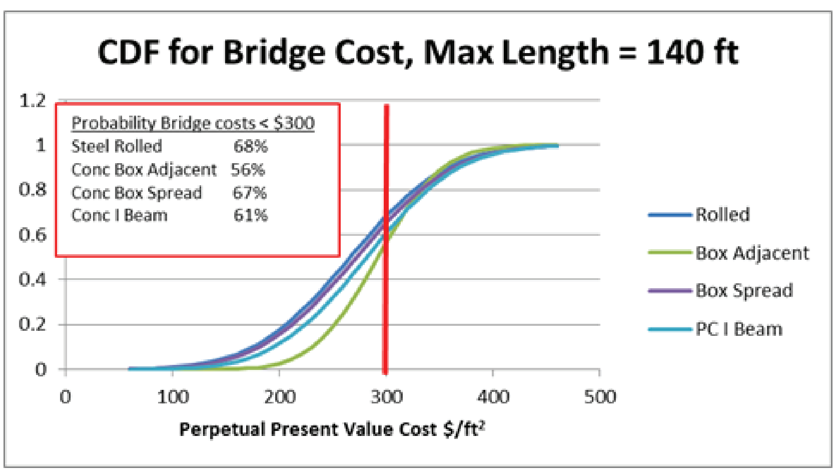


Figure 2: Cumulative Density Function of Perpetual Present Value Costs

Download the research report at www.ShortSpanSteelBridges.org

SHORT SPAN STEEL BRIDGE ALLIANCE™

The Short Span Steel Bridge Alliance (SSSBA) is the industry resource for information related to short span steel bridges in North America. The SSSBA's objective is to provide essential information to bridge owners and designers on the unique benefits, innovative designs, cost-competitiveness and performance related to using steel in short span installations up to 140 feet in length. SSSBA partners include bridge and culvert industry leaders, including manufacturers, fabricators and representatives of related associations and government organizations. To learn more, visit www.shortspansteelbridges.org or follow us on Twitter @ShortSpanSteel.

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