2005
Indiana County Highway Departments
Bridge Replacement Cost Estimation Procedures

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compiled by

Indiana LTAP Center

Using information provided by the

Indiana County Highway Departments
and
The Indiana Department of Transportation

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Introduction

This report is intended to provide county bridge official a simple, straight forward method to estimate the costs of replacing county bridges. The report uses information from bridges constructed from 1997 through 2005, which was obtained through surveys completed by Indiana counties. Regressions were performed on the data and a spreadsheet prepared that allows users to input Average Daily Traffic (ADT) and the old bridge length to obtain an estimate for the cost of a replacement bridge. If the user knows the new deck area the data can be directly input into the spreadsheet as an alternate to ADT and old length.

All survey cost data was adjusted to 2005 dollars, using the Bureau of Labor Statistics inflation calculator. This report includes data from 377 bridges, in 46 counties. This report includes bridges built with both federal and local funds. The report is as accurate as the information from the surveys. A listing of all data used in the study is included in the appendices.

The average age of a bridge at the time of its replacement was 71 years. The average sufficiency rating at the time of replacement was 34. Construction costs are dependent on the bridge deck area, and the average bridge cost from the data is, $383,000. Because of a number of bridges with costs over $1,000,000 the data is skewed to the high end, or right skewed. The equations developed in this report should not be used for bridges less than 20 feet in length.

A discussion of the literature review is presented in the appendix. Raw data is also included in the appendix.

Methodology

This study used regression techniques to estimate bridge replacement costs. Survey data was obtained from Indiana counties and included data on construction costs, and ancillary costs including preliminary engineering, construction inspection, approach, and rights-of-way. Survey data also included;

- Year built for new and old bridges
- Number of spans and bridge material
- Average daily traffic
- New and old lengths and widths
- Bridge number and sufficiency rating

The approach was to provide a technique to allow the end user to provide minimum information and obtain a reasonably accurate estimate of bridge replacement costs. Since average daily traffic (ADT) is known for most county roads, at least estimated ADT, and the old bridge length is known, these two variables were used as the input. An alternate input was included if the user knew the new length and width of the bridges. Where the new bridge width is not know the ADT is used to determine the new bridge width. Table 55-3C and 3D from the INDOT Design Manual are used to produce Figure 1. There are separate lines plotted for local and federal funding. The old length is used to determine new length by an expansion factor. Figure 2 shows the expansion factor, which was obtained by dividing new bridge length by old bridge length and plotting this as a point on Figure 2. Once all survey points for lengths were plotted a best fit regression was performed and the equation of the regression line used to obtain new bridge length. Once the new lengths and widths were determined the deck area was calculated, and this deck area plotted against costs, resulting in Figures 3-5 being prepared. The best fit regressions for these figures are linear. Costs for construction inspection and preliminary engineering were included in Figures 6 and 7. Preliminary engineering and construction inspection are represented as percentages of total costs. Detailed information is presented for each figure.

While 377 surveys were included in the study, not all figures have 377 data points. Some surveys did not include all data requested, and costs for preliminary engineering and construction inspection included mostly consultant costs. Preliminary engineering and construction Inspection costs performed by county employees were not included except for a few counties and a limited number of bridges.

EXPLANATION OF FIGURES AND TABLES

Table of Equations

Each of the regression equations from the 7 graphs is included in the table of equations. Equation 1 is a polynomial regression and Equation 2 is an exponential regression. Equations 3-7 are all linear. The regression with the highest R squared value was used for each figure. R squared is a descriptive measure expressed as a number between 0 and 1. The closer it is to 1, the better the model is. Better is defined as a greater ability to predict. In this study the higher R squared value the better the cost estimate.

The estimated bridge cost accuracy will be limited to the data ranges from the surveys. Most surveys did not have ADT's above 12,500 or bridge lengths above 400 feet.

To make the estimation procedures simple for the end user, two methods of input are available. First the user can use ADT and old length to determine new deck area. The second option is to directly input the deck area. Since the second option is a known, the estimated costs using this procedure will be more accurate than estimating the bridge deck and then the costs. The deck estimation procedure is a useful tool though if the new bridge dimensions are unknown. Equations 1 and 2 are used to estimate deck area.

Equations 3-5 are deck area versus construction costs per square foot, total costs per square foot, and total cost. Deck area costs per square foot are included to show that as deck areas increase, the cost per square foot generally decrease. The spreadsheet can be used to compare not only total costs, but costs per square foot in the estimation. Many parts of the state have general costs per square foot data available for comparison. By including total costs per square foot to construction costs per square foot the user can see the effects of construction inspection, preliminary engineering, approach, and rights-of-way on a project.

Equations 6 and 7 include costs for preliminary engineering and construction inspection. These are essentially consultant costs as few costs were listed for county employees. Costs are included to allow the user to gauge the contributions these costs make to the overall expense of a new bridge.

Figure 1 Bridge Width Vs. Average Daily Traffic

Figure 1 shows the curves used to estimate new bridge width, using ADT. The figure shows two curves, one for federally funded bridges and one for locally funded bridges. The data to develop these curves came from the INDOT design manual table 55.3C and 55-3D. New bridge widths are dependent on the ADT. It is recommended that the ADT used is based on the maximum ADT projected during the life of the proposed new bridge.

Figure 2 Expansion Factors for Existing Bridge Length

Figure 2 shows the expansion factors curves. There is a single curve for both federally and locally funded bridge lengths. The curve is plotted against date obtained from a 1995 Federal Highway Administration Report *Recording and Coding Guide for the Structural Inventory and Appraisal of the Nation's Bridges* (Coding Guide).

To obtain the expansion curve, old and new bridge lengths were taken from the surveys returned by the counties. The lengths reported for the newly constructed bridges were divided by the lengths of the old bridges (New Length/Old Length) for each survey. Once plotted the regression with the highest R^2 value was used. The curve obtained from survey data and the Coding Guide curve are not only the same shape, but also at approximately the same location on the graph. The similar shape and location of the two curves offer some verification for the approach of this study.

The equation for the expansion factor varies slightly from the Equation 2 in the table of equations. The equation on Figure 2 is for the expansion factor. The equation on the table of equations is for the new bridge length. The equation was changed on the table to make calculations more straight forward. The exponent in the expansion factor was added to 1.0 to obtain the new bridge length equation. It was added because the exponent was negative.

Figure 3 Construction Cost per Square Foot

Figure 3 shows bridge construction cost per square foot. Data sets for locally and federally funded bridges are included. This figure includes only construction costs. Deck areas were plotted against construction costs for both federally and locally funded bridges. Linear regressions gave the highest R^2 values for both sets. From the graphs as the deck area increase the cost per square foot decreases for both funding sources. For local funding the slope of the regression line is twice that of the federally funded bridges.

Figure 4 Total Cost per Square Foot

Figure 4 shows the total bridge cost per square foot. The total costs include preliminary engineering, rights-of-way, construction costs, construction inspection and approach costs where provided. The slope of the federal regression line for Figure 4 is half as steep as the local regression line. The costs associated with construction inspection for local bridges are significantly higher, as can be seen in Figure 7. In part this accounts for the change in slope between Figure's 3 and 4. As in Figure 3 both federal and local regressions lines are negative, as is expected. As deck area increases the costs per square foot should decrease as is seen in these figures.

Figure 5 Total Bridge Cost

Figure 5 shows total bridge cost for federal and local funding. As deck area increases the total costs increase, as expected. The length of the local regression line is shorter and less steep than the federal line. The data set to support the predictability of future bridges using local funding is limited, resulting in this regression line. Most local bridges fall into the 2,000 to 8,000 square foot range. This limits 90% of the bridge costs under $1,000,000 for locally funded bridges. The regression equations for federal bridges has a smaller exponent than for local bridges but has a larger coefficient. Because of the larger coefficient, the bridge costs for federal bridges will be higher than local bridges through the range of deck areas seen in service.

Figure 6 Preliminary Engineering Cost as Percent of Construction Cost

Preliminary engineering costs as a percentage of construction costs are shown in Figure 6. Preliminary engineering costs for local bridges are less than for federal bridges. Many local bridges are designed and this design reused and adapted to another location. Consultants often offer discounts to counties that design a bridge for use in multiple locations. The scope and type of bridges at the local level are also less complicated, requiring less time to design. Federally funded bridges are often larger, take more time, and PE costs reflect this. For both funding sources however, the percentage of PE costs decrease as the deck area increases. Except for three counties, costs for preliminary engineering are from consultants. Most counties did not assign costs when their own staff performed preliminary engineering on bridges.

Figure 7 Construction Inspection Cost as Percent of Construction Cost

Figure 7 shows construction inspection (CI) costs as a percentage of construction costs. The local bridge inspection cost regression line is positive and increases as the bridge deck increases, with federal bridge inspection costs decreasing as bridge deck increases. The reason the local line has a positive slope was not determined, but may be caused by a lack of data. Again as in Figure 6, except for 3 counties the costs listed are all consultant costs.

User Cost Spreadsheet

The user cost spreadsheet was developed with the regression equations from Figures 1 to 7. The spreadsheet has options to estimate new bridge deck and cost, or the end user can input the new deck area and have costs estimated. The limits on the spreadsheet include ADT values from 1 to 12,500 and old bridge length values from 20 to 400 feet. There are no limitations on directly input data, but the relevant data ranges are the same for both input methods.

Table of Equations

Equation 1 - New Bridge Width (ft)

Federal: [2E-7*(ADT)^2+0.0039(ADT)+27.93]
Local: ['-1.0E-07*(ADT)^2 +2.5E-03*(ADT) + 27.81]

ADT = Average Daily Traffic Count
Note: 0<ADT<10000

Equation 2 - New Bridge Length (ft)

Federal & Local: [2.789*(Lo)^ 0.8398]

Lo = Length of Bridge Being Replaced (ft)

Equation 3 - Construction Cost Per Square Foot of Deck Area

Federal: [-0.0022*(DECK AREA)+143.03]
Local: [-0.0048*(DECK AREA)+128.79]

Equation 4 - Total Cost Per Square Foot of Deck Area

Federal: [-0.0044*(DECK AREA)+216.44]
Local: [-0.0021*(DECK AREA)+165.16]

Equation 5 - Total Bridge Cost

Federal: [555.61*(DECK AEA)^0.8673]
Local: [126*(DECK AREA)^1.0002]

Equation 6 - Preliminary Engineering Costs as a Percent of Total Costs

Federal: [-3E-08*(TOTAL COST)+0.1473]*(100)
Local: [-3E-08*(TOTAL COST)+0.1228*(100)

BCC = Bridge Construction Cost found in Equation 5

Equation 7 - Construction Inspection Costs as a Percent of Total Costs

Federal: [-3E-08*(TOTAL COST)+0.1561]*(100)
Local: [4E-08*(TOTAL COST)+0.0394]*(100)

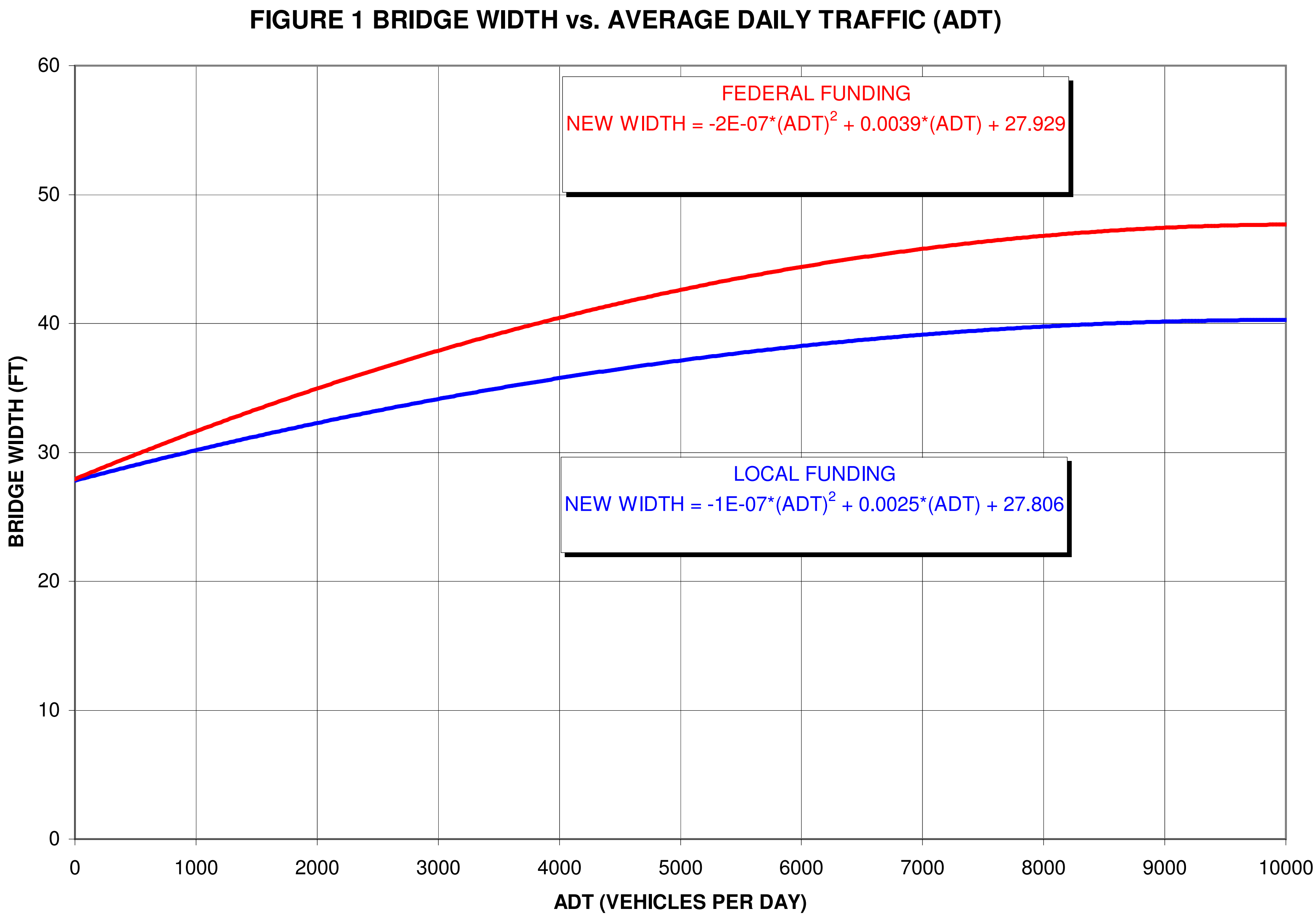


FIGURE 1 BRIDGE WIDTH vs. AVERAGE DAILY TRAFFIC (ADT)
FEDERAL FUNDING
NEW WIDTH = -2E-07*(ADT)^2 + 0.0039*(ADT) + 27.929
LOCAL FUNDING
NEW WIDTH = -1E-07*(ADT)^2 + 0.0025*(ADT) + 27.806
BRIDGE WIDTH (FT)
ADT (VEHICLES PER DAY)
0
10
20
30
40
50
60
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000

FIGURE 2 BRIDGE LENGTH EXPANSION FACTOR

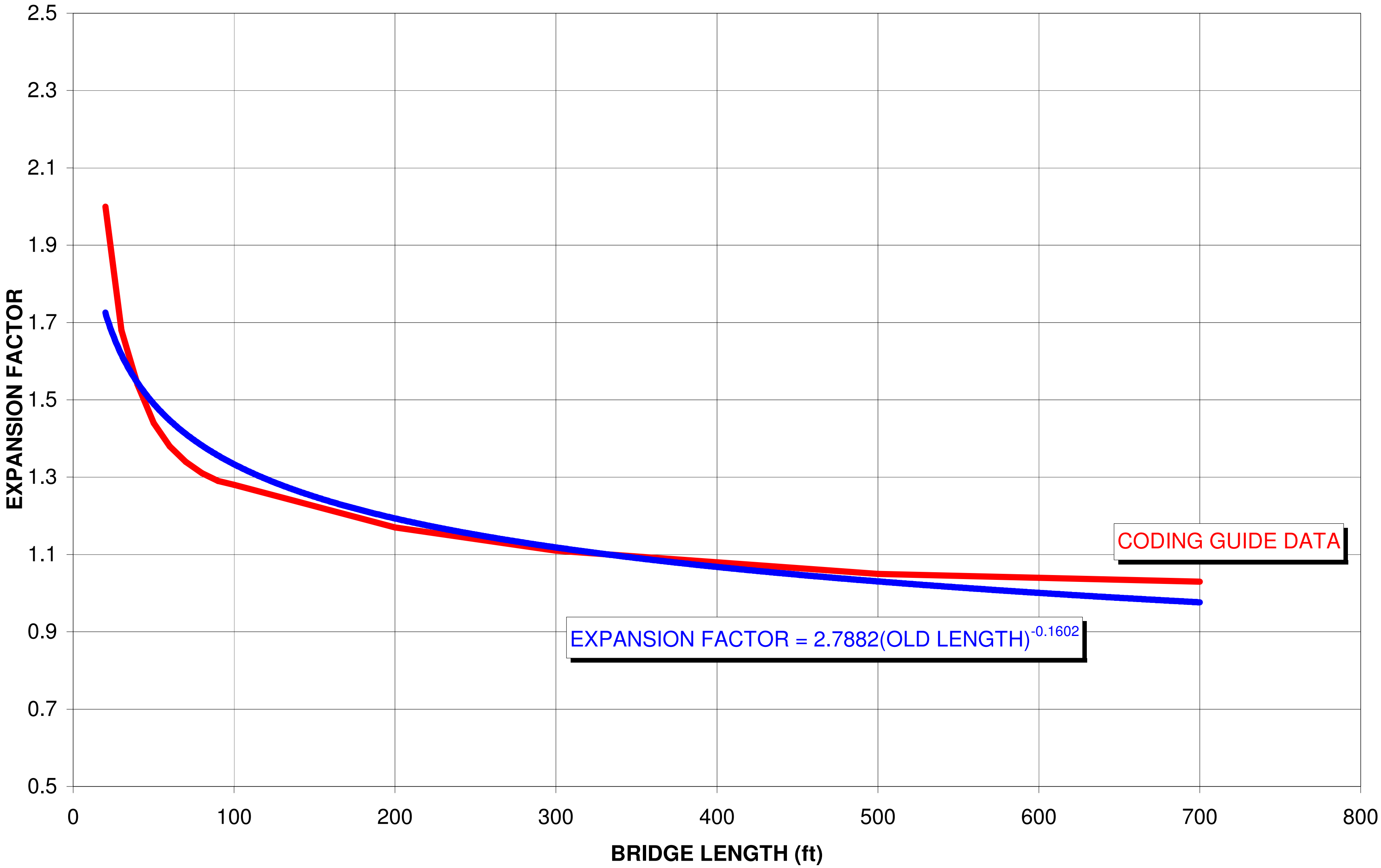


FIGURE 3 CONSTRUCTION COST PER SQUARE FOOT OF DECK AREA

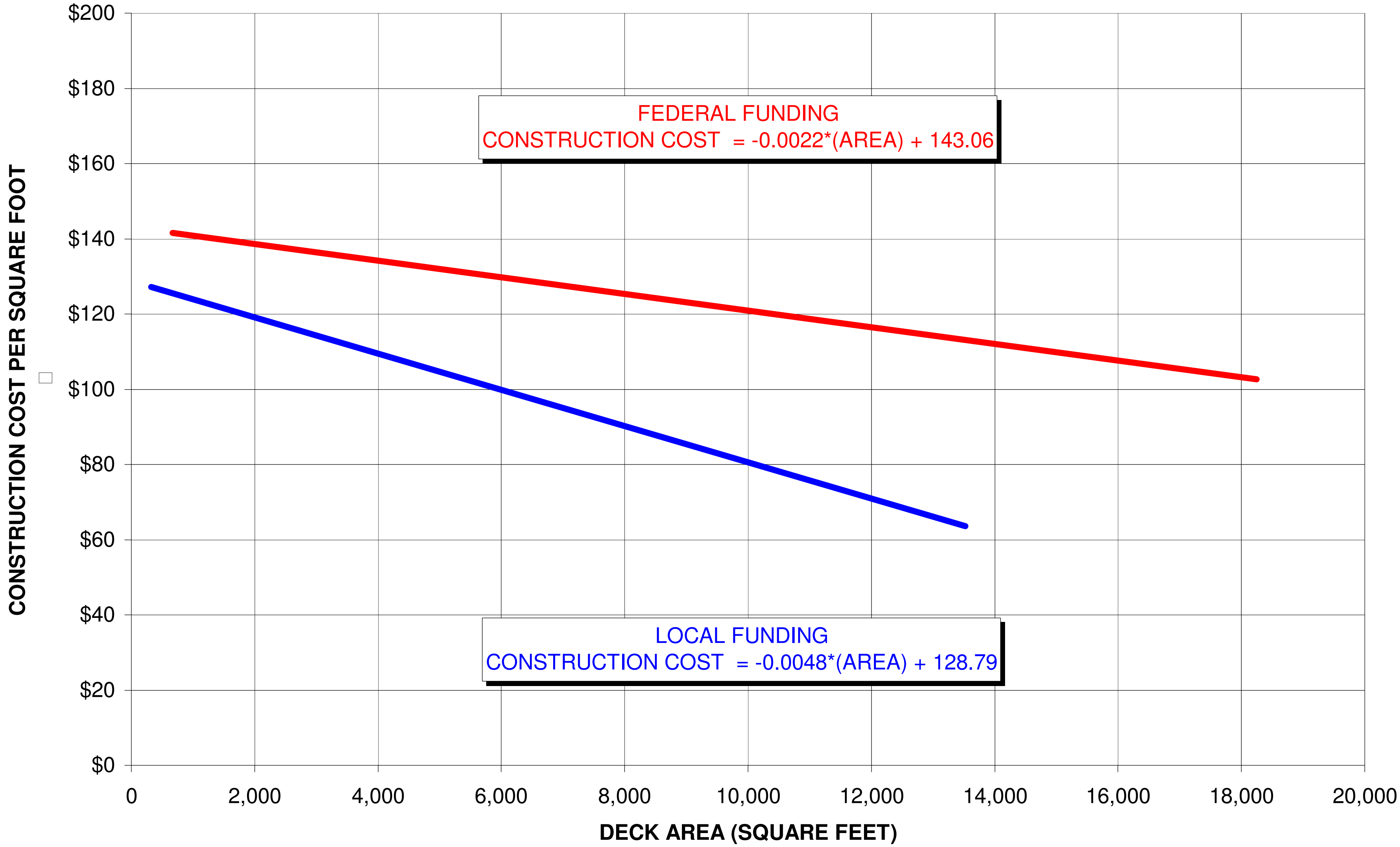


FIGURE 4 TOTAL COST PER SQUARE FOOT OF DECK AREA

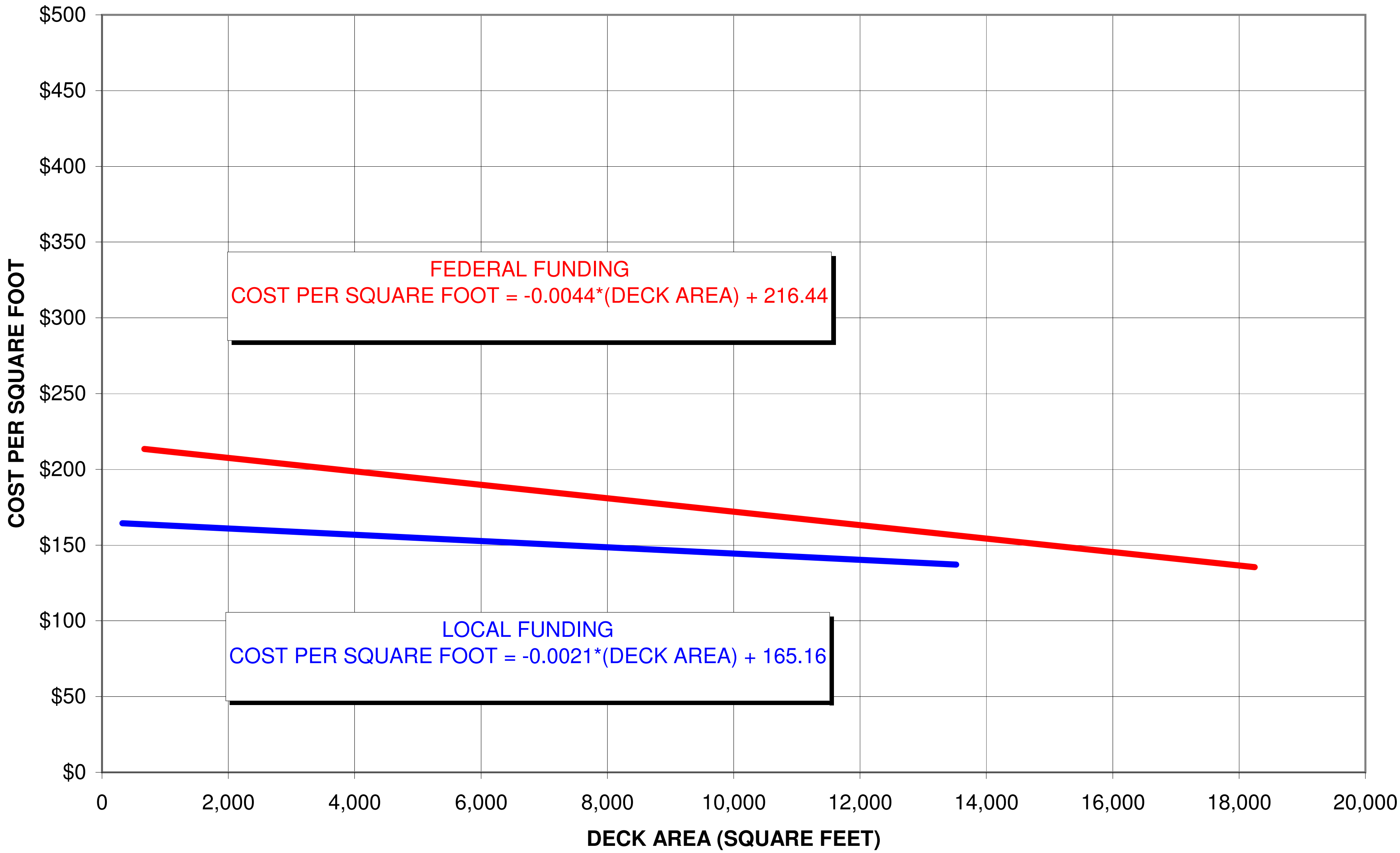


FIGURE 5 TOTAL BRIDGE COST

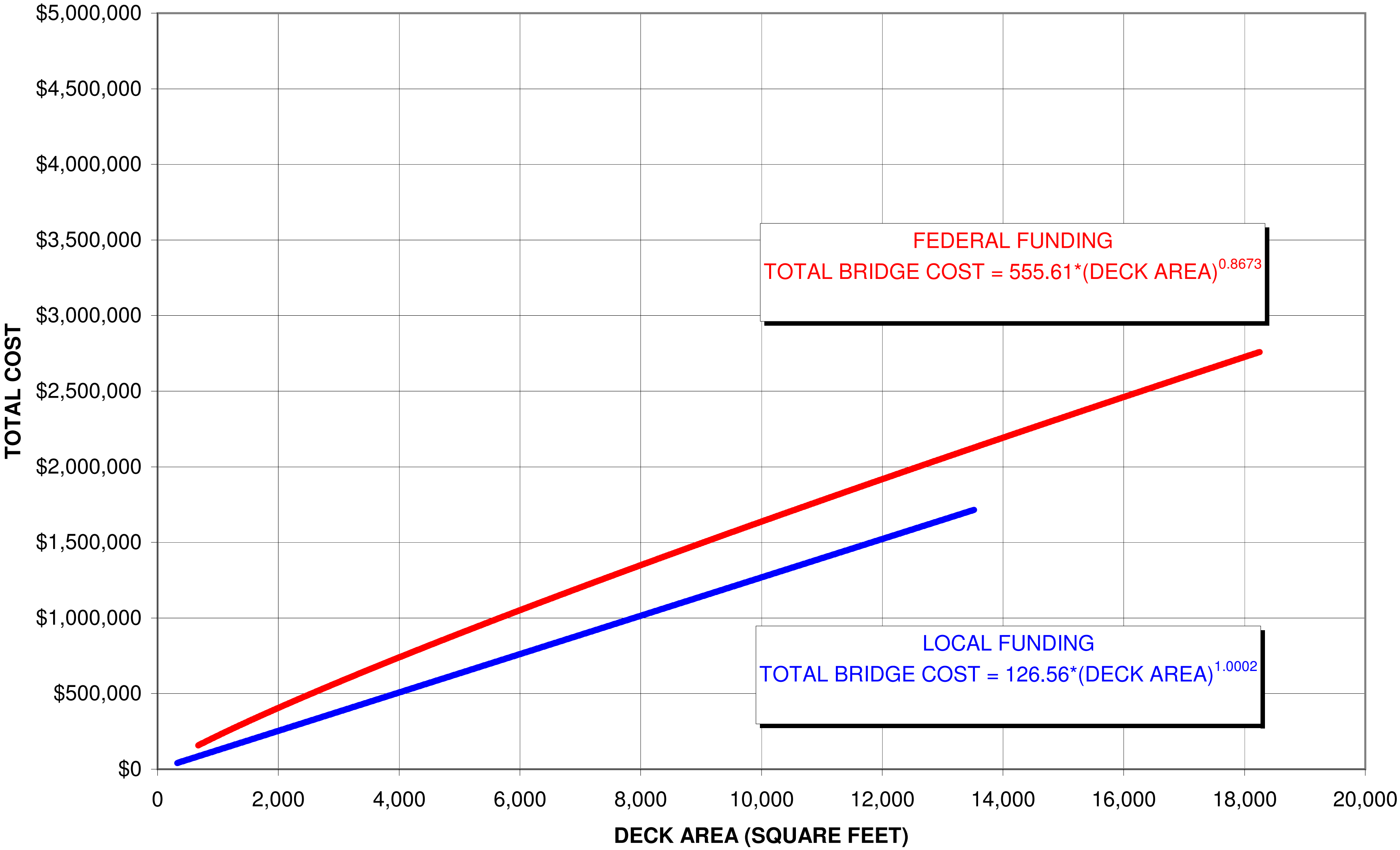


FIGURE 6 PRELIMINARY ENGINEERING COSTS AS PERCENT OF CONSTRUCTION COST

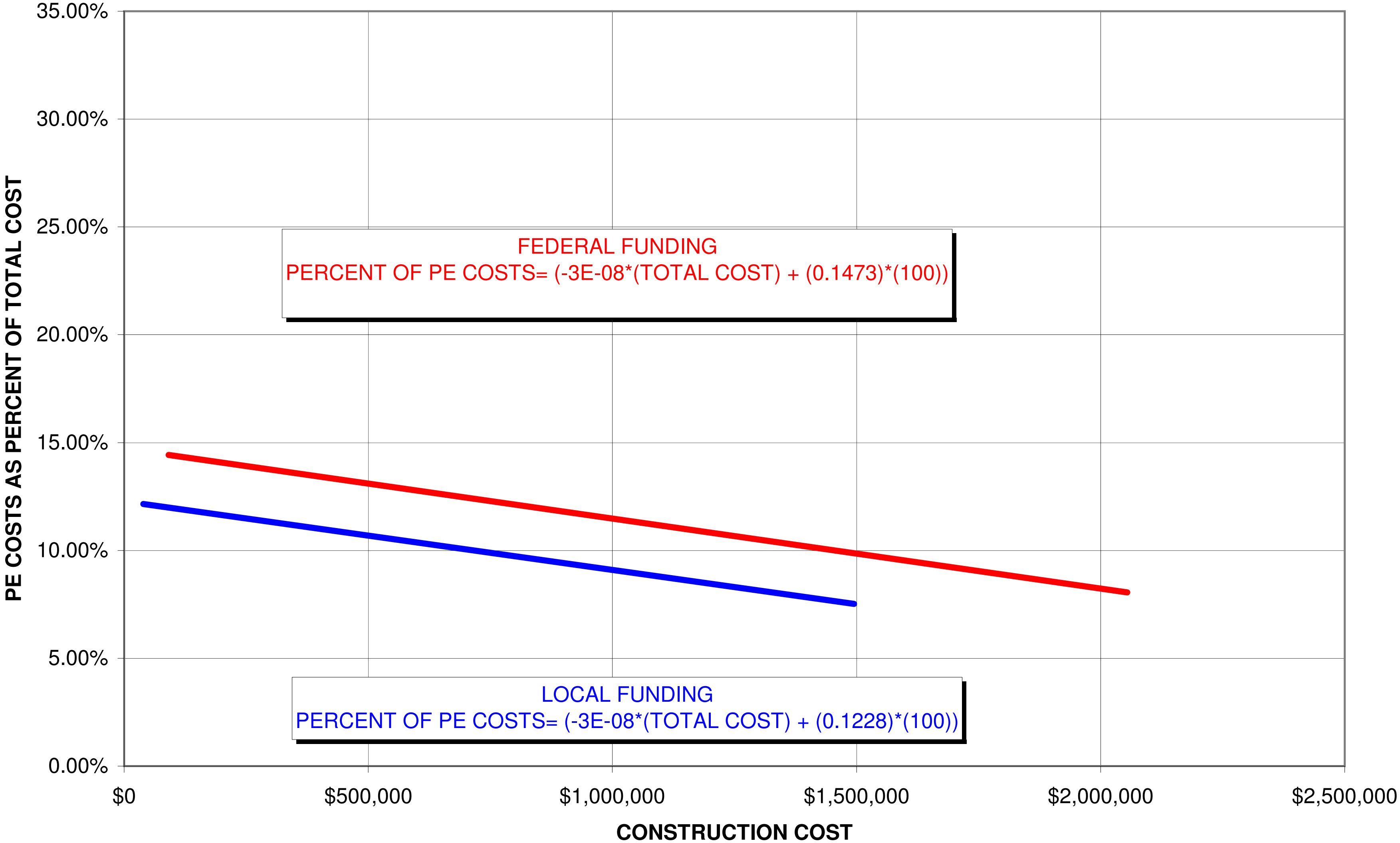
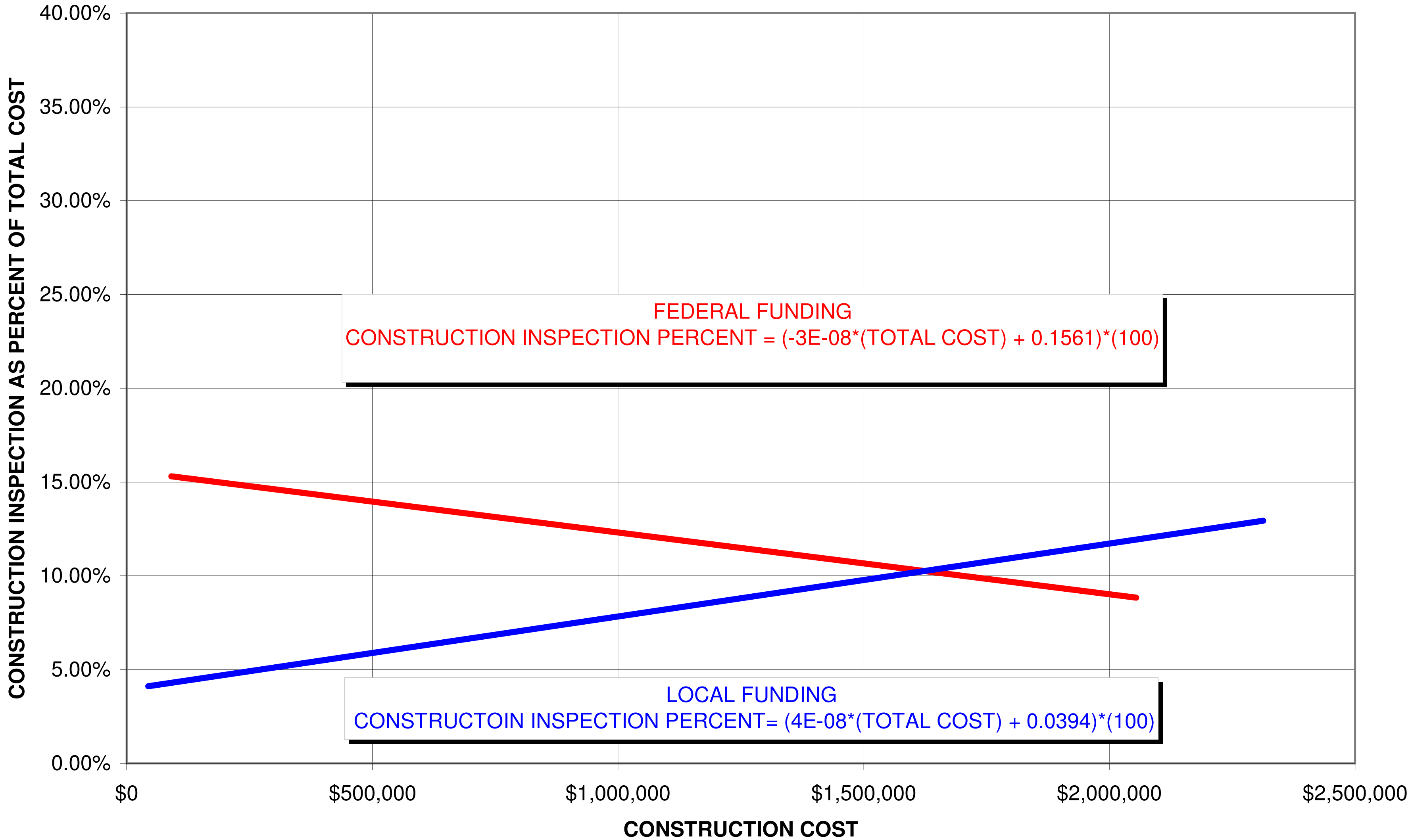


FIGURE 7 CONSTRUCTION INSPECTION COSTS AS PERCENT OF CONSTRUCTION COST



BRIDGE COST CALCULATOR

ENTER ADT	150
ENTER OLD BRIDGE LENGTH	20
NEW BRIDGE WIDTH	28.51
NEW BRIDGE LENGTH	34.52
DECK AREA SQUARE FEET	984.14
DECK LENGTH COMMENT	
TOTAL BRIDGE COST / SQUARE FOOT	$222.63
CONSTRUCTION COST / SQUARE FOOT	$140.86
CONSTRUCTION COST	$138,631.23
TOTAL BRIDGE COST	$219,103.62
RECOMMENDED FUNDING SOURCE	LOCAL

APPENDIX A BRIDGE DATA BY COUNTY

County	Bridge #	Old Bridge Year Built	Old Length (ft)	Old Width (ft)	New Bridge Year Built	New Length	New Width	Material	Number of Spans	Funding Source
ADAMS										
1	42	-	39.0	19.2	2005	68.8	28.5	Prestressed Concrete	1	Federal
1	66	-	13.0	23.0	2002	46.0	28.0	Prestressed Concrete	1	Local
1	71	-	16.0	20.0	2005	45.5	28.0	Prestressed Concrete	1	Local
1	77	-	23.0	20.5	2005	55.0	28.0	Prestressed Concrete	1	Local
1	83	-	33.0	22.3	2005	50.0	28.0	Prestressed Concrete	1	Local
1	90	-	29.0	22.5	2005	55.0	28.0	Prestressed Concrete	1	Local
1	110	-	49.0	20.2	2003	82.0	26.7	Prestressed Concrete	1	Local
1	130	-	24.0	20.1	2003	62.0	28.0	Prestressed Concrete	1	Local
1	131	-	44.0	21.0	2003	44.0	21.0	Prestressed Concrete	1	Local
1	140	-	29.0	22.0	2004	50.0	28.0	Prestressed Concrete	1	Local
1	144	-	40.0	18.0	2004	45.0	18.0	Prestressed Concrete	1	Local
1	164	-	22.0	18.0	2002	45.0	28.0	Prestressed Concrete	1	Local
1	179	-	15.0	19.0	2004	29.0	28.0	Prestressed Concrete	1	Local
1	00134	1969	0.0	0.0	1999	24.0	24.0	Steel	1	Local
1	00161	1960	18.0	25.0	2000	28.0	28.0	Prestressed Concrete	1	Local
1	00028	1937	23.0	21.0	1997	44.0	28.0	Prestressed Concrete	1	Local
1	00145	1939	24.0	22.0	1999	29.0	28.0	Prestressed Concrete	1	Local
1	00154	1940	21.0	19.0	2000	40.0	28.0	Prestressed Concrete	1	Local
1	00158	1933	26.0	20.0	1998	41.0	28.0	Prestressed Concrete	1	Local
1	00097	1925	69.0	20.0	2000	107.0	26.0	Prestressed Concrete	3	Federal
1	00108	1925	69.0	20.0	2000	140.0	27.0	Prestressed Concrete	3	Federal
1	00072	1919	35.0	22.0	1999	80.0	28.0	Prestressed Concrete	3	Local
1	00119	1920	37.0	20.0	2000	67.0	28.0	Prestressed Concrete	1	Local
1	00128	1920	31.0	22.0	2000	50.0	28.0	Prestressed Concrete	1	Local
BARTHOMOLEW										
3	17	1925	103.0	17.6	2004	121.1	28.5	Concrete Continuous	1	Local
3	6	1936	95.0	20.7	2002	149.5	28.0	Concrete Continuous	3	Local
3	307	1930	27.0	18.1	2003	24.2	31.3	Timber	1	Local
3	197	1920	30.0	16.7	2004	43.5	28.7	Concrete Continuous	1	Local
3	124	1967	60.0	21.1	2004	119.5	28.5	Concrete Continuous	3	Local
3	67	1899	39.0	15.7	2005	61.0	28.0	Concrete Continuous	1	Local
3	64	1930	43.0	14.5	2005	72.5	28.5	Concrete Continuous	3	Local
3	55	1908	67.0	17.0	2005	89.3	28.5	Prestressed Concrete	1	Lcoal
3	52	1930	32.0	29.1	2005	71.6	30.5	Concrete Continuous	3	Local
3	6	1936	95.0	20.7	2002	149.5	28.0	Concrete Continuous	3	Local
3	2	1935	61.0	18.1	2002	95.4	28.1	Concrete Continuous	1	Local
3	00292	1974	84.0	28.0	1999	143.0	28.0	Prestressed Concrete	3	Local
3	00177	1965	40.0	19.0	2000	110.0	28.0	Prestressed Concrete	3	Local
3	00178	1965	61.0	19.0	2000	80.0	28.0	Concrete Continuous	3	Local
3	00205	1950	31.0	16.0	1997	42.0	30.0	Timber	3	Local
3	00175	1949	38.0	24.0	1997	54.0	28.0	Timber	3	Local
3	00153	1943	60.0	22.0	1998	75.0	26.0	Prestressed Concrete	3	Local
3	00034	1937	30.0	24.0	1997	50.0	28.0	Prestressed Concrete	1	Local
3	00180	1930	28.0	19.0	1998	42.0	28.0	Timber	3	Local
3	00022	1927	50.0	22.0	1997	54.0	28.0	Prestressed Concrete	1	Local
3	00086	1921	33.0	16.0	1999	53.0	24.0	Prestressed Concrete	1	Local
3	00087	1920	36.0	18.0	1998	59.0	28.0	Prestressed Concrete	1	Local

County	Bridge #	Old Bridge Year Built	Old Length (ft)	Old Width (ft)	New Bridge Year Built	New Length	New Width	Material	Number of Spans	Funding Source
BOONE										
6	00068	-	0.0	0.0	1997	140.0	27.0	Steel	3	Federal
7	00101	1932	38.0	12.0	1997	80.0	24.0	Prestressed Concrete	3	Federal
7	00053	1925	26.0	15.0	1999	58.0	24.0	Prestressed Concrete	1	Local
CASS										
9	133	1970	13.0	16.0	2004	55.0	28.2	Prestressed Concrete	1	Local
9	78	-	ND	ND	2002	26.0	28.0	Concrete Continuous	1	Local
9	503	1960	21.0	24.0	2005	20.0	73.0	Concrete Continuous	1	Local
9	52	1950	38.0	20.0	2005	36.0	48.0	Concrete Continuous	1	Local
9	60	1960	12.7	18.0	2004	30.0	28.0	Concrete Continuous	1	Local
9	00082	-	28.0	22.0	-	57.0	28.0	Prestressed Concrete	1	Local
9	00004	-	29.0	18.0	-	26.0	25.0	Timber	1	Local
9	00007	-	28.0	19.0	-	26.0	25.0	Timber	1	Local
9	00102	1935	30.0	22.0	2001	57.0	28.0	Prestressed Concrete	1	Local
9	00101	1930	28.0	19.0	2001	57.0	28.0	Prestressed Concrete	1	Local
CLARK										
10	00022	-	0.0	0.0	1997	128.0	30.0	Concrete Continuous	3	Federal
10	00050	1925	84.0	23.0	1999	160.0	30.0	Prestressed Concrete	3	Federal
DAVIESS										
14	130	1910	122.0	14.0	2003	249.0	24.0	Prestressed Concrete	3	Local
14	00312	-	18.0	18.0	1997	25.0	24.0	Concrete Continuous	1	Local
14	00167	1959	46.0	18.0	1996	80.0	26.0	Concrete Continuous	3	Local
14	00019	1945	31.0	17.0	1997	40.0	26.0	Concrete Continuous	1	Local
14	00018	1934	26.0	18.0	1996	40.0	26.0	Concrete Continuous	1	Local
14	00165	1929	31.0	18.0	1996	46.0	24.0	Prestressed Concrete	1	Local
14	00223	1912	100.0	14.0	2000	132.0	27.0	Steel	1	Local
DUBOIS										
19	278	-		7.0				Concrete Continuous	1	Local
19	276	-	18.0	18.0	2004	25.0	26.0	Concrete Continuous	1	Local
19	275	-		-	2004	28.3	40.0	Steel	1	Local
19	274	-	10.0	25.0	2004	28.5	40.0	Concrete Continuous	1	Local
19	272	-	19.0	27.0	2003	27.0	52.0	Steel	1	Local
19	271	-	40.0	9.0	2003	26.0	26.0	Steel	1	Local
19	270	-	-	-	2003	26.0	26.0	Steel	1	Local
19	268	-	-	-	2002	30.0	51.0	Steel	1	Local
19	267	-	8.7	40.0	2002	28.0	42.0	Steel	1	Local
19	266	-	18.0	18.0	2001	33.3	26.0	Steel	1	Local
19	265	-	18.0	20.0	2001	26.0	26.0	Steel	1	Local
19	240	-	37.0	20.6	2003	77.5	26.0	Steel	1	Local
19	186	-	36.5	18.1	2001	42.0	26.0	Steel	1	Local
19	142	-	66.0	28.2	2004	57.5	26.0	Steel	1	Local
19	44	-	38.0	12.0	2005	50.0	26.0	Steel	1	Local

County	Bridge #	Old Bridge Year Built	Old Length (ft)	Old Width (ft)	New Bridge Year Built	New Length	New Width	Material	Number of Spans	Funding Source
19	73	-	-	-	2005	100.0	26.5	Steel	1	Local
19	00263	-	0.0	0.0	-	22.0	26.0	Steel	1	Local
19	00178	1962	32.0	22.0	1997	58.0	26.0	Steel	1	Local
19	00172	1960	34.0	22.0	1997	66.0	26.0	Steel	1	Local
19	00237	1961	40.0	19.0	2000	66.0	26.0	Steel	1	Local
19	00107	1959	61.0	20.0	1999	72.0	26.0	Steel	1	Local
19	00057	1930	38.0	18.0	1997	41.0	26.0	Steel	1	Local
19	00192	1930	20.0	19.0	1998	32.0	26.0	Steel	1	Local
19	00193	1930	23.0	20.0	1999	40.0	26.0	Steel	1	Local
19	00131	1920	30.0	18.0	1997	31.0	26.0	Steel	1	Local
19	00086	1921	30.0	19.0	1998	20.0	26.0	Steel	1	Local
19	00130	1920	30.0	18.0	1998	30.0	26.0	Steel	1	Local
19	00138	1919	58.0	16.0	1998	58.0	26.0	Steel	1	Local
19	00089	1910	38.0	15.0	1999	38.0	26.0	Steel	1	Local
19	00028	1896	76.0	12.0	1997	92.0	26.0	Steel	1	Local
19	00046	1890	116.0	14.0	1997	130.0	24.0	Steel	1	Local
						ELKHART				
20	00366	1959	151.0	50.0	2001	204.0	52.0	Prestressed Concrete	3	Local
						FLOYD				
22	25	1940	30.5	14.3	2004	32.3	25.5	Prestressed Concrete	1	Local
22	37	1947	39.8	37.7	2002	86.0	26.0	Concrete Continuous	1	Federal
22	57	1922	30.5	15.5	2003	29.0	28.0	Prestressed Concrete	1	Local
22	61	1935	42.0	16.0	2004	86.0	29.0	Prestressed Concrete	1	Local
22	73	1940	21.0	13.3	2003	30.0	21.0	Prestressed Concrete	1	Local
22	00062	1927	150.0	14.0	1999	153.0	24.0	Prestressed Concrete	3	Federal
						FOUNTAIN				
23	7	1910	152.0	14.5	2002	334.0	26.6	Concrete Continuous	3	Federal
23	63	1910	134.0	13.5	2004	144.0	24.0	Concrete Continuous	2	Federal
23	129	1928	47.0	20.0	2004	48.0	24.0	Concrete Continuous	1	Local
23	00102	1915	61.0	22.0	1998	56.0	24.0	Prestressed Concrete	1	Local
23	00099	1910	60.0	14.0	1997	56.0	24.0	Prestressed Concrete	1	Local
23	00086	1910	36.0	14.0	2000	45.0	24.0	Prestressed Concrete	1	Local
23	124	1928	66.0	27.8	2004	66.0	28.0	Concrete Continuous	1	Local
						FRANKLIN				
24	40	1940	75.0	12.0	2005	91.3	24.5	Steel	1	Local
24	87	1940	25.0	12.0	2003	28.0	24.0	Steel	3	Local
24	86	1940	26.0	12.0	2004	28.0	24.0	Steel	3	Local
24	169	1900	18.0	13.0	2004	35.0	32.5	Concrete Continuous	1	Local
24	96	1935	24.0	19.5	2002	34.0	30.0	Concrete Continuous	1	Local
24	156	1961	30.0	16.0	2004	30.0	20.0	Steel	1	Local
24	141	1925	26.0	15.8	2002	33.0	30.2	Concrete Continuous	1	Local
24	47	1911	35.0	16.3	2003	36.0	30.0	Concrete Continuous	1	Local
24	26	1950	17.0	15.0	2003	56.0	30.0	Steel	3	Local
24	13	1935	35.0	19.3	2004	26.0	30.0	Steel	1	Local

County	Bridge #	Old Bridge Year Built	Old Length (ft)	Old Width (ft)	New Bridge Year Built	New Length	New Width	Material	Number of Spans	Funding Source
24	60	1918	35.0	23.0	2005	40.0	28.0	Steel	1	Local
24	00161	1982	35.0	22.0	1997	41.0	33.0	Prestressed Concrete	1	Local
24	00068	1961	76.0	23.0	2001	74.0	28.0	Prestressed Concrete	1	Local
24	00017	1926	485.0	21.0	1999	507.0	32.0	Prestressed Concrete	5	Federal
24	00036	1927	128.0	18.0	2000	150.0	24.0	Prestressed Concrete	3	Federal
24	00098	1926	34.0	22.0	1999	34.0	32.0	Concrete Continuous	1	Local
24	00085	1925	33.0	23.0	1999	50.0	28.0	Prestressed Concrete	1	Local
24	00099	1909	58.0	18.0	2000	38.0	30.0	Concrete Continuous	1	Local
24	00043	1905	25.0	22.0	1999	65.0	24.0	Concrete Continuous	1	Local
24	00095	1905	36.0	20.0	2000	41.0	28.0	Concrete Continuous	1	Local
24	00097	1904	83.0	16.0	2000	227.0	26.0	Prestressed Concrete	2	Federal
						FULTON				
25	2	1940	207.0	22.0	2005	225.0	30.0	Prestressed Concrete	3	Federal
25	00086	1950	60.0	22.0	1997	88.0	24.0	Prestressed Concrete	3	Federal
25	00066	1950	60.0	21.0	1999	70.0	25.0	Prestressed Concrete	3	Federal
						GIBSON				
26	00087	-	144.0	16.0	1998	152.0	28.0	Prestressed Concrete	3	Federal
26	00246	1929	76.0	16.0	1999	117.0	28.0	Prestressed Concrete	3	Federal
26	00309	1905	47.0	14.0	2000	156.0	28.0	Prestressed Concrete	3	Federal
						HAMILTON				
29	203	-	-	-	2002	32.0	29.3	Concrete Continuous	1	Local
29	197	1930	24.0	30.5	2002	34.0	33.3	Timber	1	Local
29	196	1933	39.0	26.3	2002	49.0	33.3	Timber	3	Local
29	195	1930	28.0	26.5	2002	34.0	33.3	Timber	1	Local
29	193	1919	59.0	20.3	2004	67.0	38.3	Prestressed Concrete	1	Local
29	190	1915	28.0	20.3	2003	137.0	30.5	Prestressed Concrete	3	Local
29	189	-	-	-	2002	50.0	36.3	Prestressed Concrete	1	Local
29	181	1930	27.0	22.3	2003	104.0	43.3	Concrete Continuous	3	Local
29	177	-	15.0	16.0	2002	27.0	42.0	Steel	2	Local
29	176	1919	59.0	20.3	2003	73.0	35.0	Concrete Continuous	3	Local
29	168	1973	55.0	28.5	2003	91.0	82.4	Prestressed Concrete	1	Local
29	156	-	15.0	35.0	2003	22.0	40.0	Concrete Continuous	1	Local
29	153	-	-	-	2003	294.0	34.8	Prestressed Concrete	5	Local
29	144	1925	32.0	20.0	2002	60.0	32.5	Timber	3	Local
29	141	1930	27.0	19.7	2003	82.0	57.3	Concrete Continuous	3	Local
29	123	1913	30.0	18.3	2002	60.0	31.0	Timber	3	Local
29	120	1920	54.0	18.0	2002	77.0	35.0	Concrete Continuous	3	Local
29	99	-	11.0	20.0	2003	22.0	32.0	Concrete Continuous	1	Local
29	88	1925	36.0	20.0	2003	81.0	32.5	Concrete Continuous	3	Local
29	80	1935	53.0	27.0	2002	44.0	32.0	Concrete Continuous	1	Local
29	73	1928	24.0	22.0	2003	30.0	32.0	Concrete Continuous	1	Local
29	66	1940	41.0	21.0	2002	49.0	33.0	Timber	3	Local
29	45	1919	23.0	20.5	2002	32.0	33.0	Timber	1	Local
29	39	1930	31.0	22.0	2002	54.0	33.0	Timber	3	Local
29	32		16.0	25.0	2003	62.0	40.0	Timber	3	Local

County	Bridge #	Old Bridge Year Built	Old Length (ft)	Old Width (ft)	New Bridge Year Built	New Length	New Width	Material	Number of Spans	Funding Source
29	31	1935	30.0	22.5	2003	62.0	33.0	Timber	3	Local
29	27	1913	28.0	18.5	2003	50.0	32.0	Timber	3	Local
29	25	1920	23.0	22.0	2002	26.0	32.0	Concrete Continuous	1	Local
29	6	-	13.0	18.0	2002	22.0	32.0	Concrete Continuous	1	Local
29	255	1945	22.0	25.8	2003	34.0	34.0	Concrete Continuous	1	Local
29	00061	-	0.0	0.0	1997	115.0	30.0	Prestressed Concrete	3	Federal
29	00166	-	32.0	25.0	-	83.0	70.0	Prestressed Concrete	3	Local
29	00259	-	28.0	22.0	-	24.0	30.0	Concrete Continuous	1	Local
29	00015	-	30.0	18.0	-	50.0	32.0	Timber	3	Local
29	00026	-	23.0	22.0	-	43.0	36.0	Prestressed Concrete	1	Local
29	00173	-	23.0	20.0	-	50.0	32.0	Prestressed Concrete	1	Local
29	00129	-	61.0	18.0	-	100.0	36.0	Prestressed Concrete	3	Federal
29	00185	-	37.0	19.0	-	47.0	32.0	Prestressed Concrete	1	Local
29	00061	-	87.0	19.0	-	116.0	30.0	Prestressed Concrete	3	Federal
29	00103	-	34.0	19.0	-	78.0	35.0	Prestressed Concrete	1	Local
29	00062	-	37.0	18.0	-	58.0	31.0	Timber	3	Local
29	00044	-	36.0	19.0	-	48.0	39.0	Prestressed Concrete	1	Local
						HANCOCK				
30	159	-	40.0	7.0						Local
30	00156	-	0.0	0.0	1999	25.0	20.0	Prestressed Concrete	1	Local
30	00126	-	0.0	0.0	1998	36.0	24.0	Prestressed Concrete	1	Local
30	00148	-	0.0	0.0	1998	32.0	24.0	Prestressed Concrete	1	Local
30	00150	-	0.0	0.0	1998	34.0	24.0	Prestressed Concrete	1	Local
30	00153	-	0.0	0.0	1998	34.0	24.0	Prestressed Concrete	1	Local
30	00152	-	0.0	0.0	1997	34.0	24.0	Prestressed Concrete	1	Local
30	00154	-	0.0	0.0	1998	40.0	24.0	Prestressed Concrete	1	Local
30	00032	1970	40.0	30.0	1998	58.0	31.0	Timber	3	Local
30	00065	1970	61.0	28.0	2000	177.0	42.0	Prestressed Concrete	3	Federal
30	00108	1935	103.0	20.0	2000	140.0	28.0	Prestressed Concrete	3	Federal
						HENDRICKS				
32	00002	1960	28.0	0.0	2000	33.0	24.0	Timber	1	Local
32	00220	1930	70.0	26.0	2000	136.0	61.0	Prestressed Concrete	3	Local
32	00142	1930	21.0	20.0	2000	59.0	36.0	Prestressed Concrete	1	Local
						HENRY				
33	00008	-	0.0	0.0	1999	85.0	24.0	Prestressed Concrete	3	Federal
						JACKSON				
36	357	-	-	-	2005	46.0	24.0	Prestressed Concrete	-	Local
36	353	-	-	-	2005	36.0	24.0	Prestressed Concrete	-	Local
36	352	-	-	-	2002	46.0	24.0	Prestressed Concrete	-	Local
36	106	-	-	-	2004	46.0	32.0	Prestressed Concrete	-	Local

County	Bridge #	Old Bridge Year Built	Old Length (ft)	Old Width (ft)	New Bridge Year Built	New Length	New Width	Material	Number of Spans	Funding Source
						JAY				
38	00501	1955	125.0	26.0	1995	124.0	34.0	Prestressed Concrete	3	Local
38	00044	1936	30.0	15.0	1999	40.0	24.0	Prestressed Concrete	1	Local
38	00218	1930	25.0	16.0	1997	28.0	24.0	Timber	1	Local
38	00184	1930	30.0	16.0	1997	26.0	24.0	Timber	1	Local
38	00275	1930	21.0	20.0	1998	26.0	24.0	Timber	1	Local
38	00245	1925	24.0	16.0	1997	21.0	24.0	inum, Wrought Iron, or Cas	1	Local
38	00144	1925	50.0	15.0	1999	63.0	24.0	Concrete Continuous	3	Local
38	00244	1920	30.0	17.0	1997	21.0	24.0	inum, Wrought Iron, or Cas	1	Local
38	00217	1920	25.0	16.0	1997	28.0	24.0	Timber	1	Local
38	00182	1920	21.0	19.0	1997	26.0	24.0	Timber	1	Local
38	00131	1920	29.0	24.0	1997	34.0	24.0	Prestressed Concrete	1	Local
38	00118	1920	29.0	16.0	1998	26.0	24.0	Timber	1	Local
38	00237	1910	58.0	16.0	1998	61.0	24.0	Prestressed Concrete	1	Local
38	00067	1910	24.0	15.0	1998	26.0	24.0	Timber	1	Local
38	00022	1900	38.0	24.0	1997	40.0	24.0	Prestressed Concrete	1	Local
38	00171	1899	40.0	15.0	1998	73.0	24.0	Prestressed Concrete	3	Local
38	00243	1879	35.0	15.0	1997	38.0	24.0	Prestressed Concrete	1	Local
						JEFFERSON				
39	00032	-	477.0	19.0	-	451.0	26.0	Prestressed Concrete	5	Federal
						JOHNSON				
41	00086	1950	40.0	23.0	2000	43.0	40.0	Concrete Continuous	1	Local
41	00608	1950	19.0	19.0	2000	30.0	108.0	Concrete Continuous	2	Local
41	00088	1940	40.0	25.0	1998	46.0	30.0	Concrete Continuous	1	Local
41	00064	1940	44.0	18.0	2000	48.0	26.0	Concrete Continuous	1	Local
41	00112	1930	27.0	14.0	1998	71.0	28.0	Concrete Continuous	3	Local
						KOSCIUSKO				
43	00141	1929	30.0	36.0	1999	20.0	56.0	Concrete Continuous	1	Local
43	00267	1920	37.0	31.0	2000	39.0	32.0	Concrete Continuous	1	Local
						LAGRANGE				
44	00022	-	16.0	24.0	1997	24.0	32.0	Concrete Continuous	1	Local
44	00082	-	10.0	25.0	1998	24.0	32.0	Timber	1	Local
44	00019	1900	38.0	16.0	1996	59.0	24.0	Concrete Continuous	1	Local
						LAKE				
45	00111	-	89.0	25.0	-	99.0	33.0	Prestressed Concrete	1	Local
45	00149	-	202.0	54.0	-	164.0	59.0	Prestressed Concrete	3	Local
45	00222	-	94.0	26.0	-	141.0	38.0	Prestressed Concrete	3	Local
45	00253	-	49.0	50.0	-	69.0	50.0	Prestressed Concrete	1	Local
45	00251	-	75.0	19.0	-	154.0	28.0	Prestressed Concrete	3	Local
45	00073	-	56.0	19.0	-	80.0	28.0	Prestressed Concrete	1	Local
45	00093	-	21.0	21.0	-	23.0	33.0	Timber	1	Local
45	00218	-	76.0	19.0	-	142.0	60.0	Prestressed Concrete	3	Federal

County	Bridge #	Old Bridge Year Built	Old Length (ft)	Old Width (ft)	New Bridge Year Built	New Length	New Width	Material	Number of Spans	Funding Source
45	00054	-	36.0	0.0	-	126.0	33.0	Prestressed Concrete	3	Local
45	00275	-	48.0	19.0	-	94.0	34.0	Prestressed Concrete	3	Local
45	00219	-	76.0	20.0	-	104.0	38.0	Prestressed Concrete	3	Federal
45	00115	-	50.0	21.0	-	78.0	32.0	Prestressed Concrete	1	Local
						LAWRENCE				
47	00045	1925	35.0	18.0	1997	38.0	24.0	Prestressed Concrete	1	Local
47	00085	1920	132.0	12.0	2000	212.0	24.0	Prestressed Concrete	3	Local
						MONROE				
53	00625	-	0.0	0.0	1998	223.0	24.0	Prestressed Concrete	3	Federal
						MONTGOMERY				
54	00212	1950	70.0	16.0	2000	72.0	24.0	Prestressed Concrete	1	Local
54	00090	1930	42.0	16.0	1998	87.0	28.0	Prestressed Concrete	3	Federal
54	00033	1925	35.0	18.0	2000	35.0	25.0	Steel	1	Local
54	00510	1920	30.0	33.0	1998	29.0	35.0	Prestressed Concrete	1	Local
54	00170	1920	25.0	20.0	1999	22.0	20.0	Steel	1	Local
54	00122	1914	80.0	16.0	1999	81.0	24.0	Prestressed Concrete	1	Local
54	00201	1910	107.0	16.0	1999	105.0	25.0	Prestressed Concrete	3	Local
54	00168	1910	51.0	16.0	1999	72.0	24.0	Prestressed Concrete	3	Local
54	00045	1910	162.0	16.0	2000	367.0	29.0	Prestressed Concrete	3	Federal
54	00039	1893	182.0	16.0	1997	277.0	26.0	Prestressed Concrete	3	Federal
						MORGAN				
55	00087	1936	27.0	16.0	1997	31.0	24.0	Prestressed Concrete	1	Local
55	00128	1935	32.0	18.0	1999	39.0	24.0	Prestressed Concrete	1	Local
55	00094	1925	40.0	18.0	1999	45.0	24.0	Prestressed Concrete	1	Local
55	00042	1875	99.0	16.0	1997	147.0	29.0	Prestressed Concrete	3	Local
						PARKE				
61	559	1965	31.0	24.2	2004	30.0	50.0	-	2	Local
61	54	1960	31.0	20.0	2002	34.0	24.9	-	1	Local
61	00054	1960	28.0	22.0	2000	35.0	25.0	Steel	1	Local
61	00033	1900	21.0	18.0	1997	21.0	26.0	inum, Wrought Iron, or Cas	1	Local
						PIKE				
63	00143	1950	30.0	15.0	1997	30.0	19.0	Steel	1	Local
63	00151	1940	26.0	14.0	2000	27.0	20.0	Steel	1	Local
63	00156	1930	134.0	14.0	1999	112.0	20.0	Prestressed Concrete	1	Federal
63	00089	1925	21.0	15.0	1997	26.0	17.0	Concrete Continuous	1	Local
63	00013	1920	27.0	14.0	1997	52.0	24.0	Prestressed Concrete	1	Local
63	00129	1920	96.0	15.0	1998	82.0	20.0	Prestressed Concrete	1	Local
						PORTER				
64	00123	1961	44.0	22.0	1997	42.0	56.0	Prestressed Concrete	1	Local
64	00125	1931	62.0	21.0	2000	67.0	35.0	Prestressed Concrete	1	Federal

County	Bridge #	Old Bridge Year Built	Old Length (ft)	Old Width (ft)	New Bridge Year Built	New Length	New Width	Material	Number of Spans	Funding Source
64	00189	1905	105.0	18.0	1997	303.0	34.0	Prestressed Concrete	3	Federal
						PULASKI				
66	00172	1910	76.0	16.0	1998	117.0	24.0	Prestressed Concrete	3	Local
						PUTNAM				
67	11	1905	83.0	16.0	2005	83.0	24.0	Concrete Continuous	1	Local
						RUSH				
70	00252	1968	44.0	20.0	1999	40.0	28.0	Prestressed Concrete	1	Local
70	00178	1935	35.0	26.0	1998	74.0	28.0	Prestressed Concrete	3	Local
70	00079	1930	27.0	20.0	1999	36.0	28.0	Prestressed Concrete	1	Local
70	00165	-	27.0	18.0	-	40.0	28.0	Prestressed Concrete	1	Local
70	00187	1921	102.0	17.0	1997	142.0	27.0	Prestressed Concrete	3	Federal
70	00163	1920	49.0	26.0	2000	61.0	29.0	Prestressed Concrete	1	Local
70	00192	1915	227.0	19.0	1998	256.0	24.0	Prestressed Concrete	3	Federal
70	00147	1893	185.0	17.0	1997	267.0	24.0	Prestressed Concrete	3	Federal
						ST. JOSEPH				
71	S603	1980	6.3	26.0	2005	12.0	48.0	Concrete Continuous	1	Local
71	S586	1955	9.0	36.4	2003	137.0	36.0	Concrete Continuous	1	Local
71	S541	1925	20.0	26.0	2003	20.0	33.0	Concrete Continuous	1	Local
71	208	1900	385.0	47.4	2002	385.0	47.4	Prestressed Concrete	5	Federal
71	S527	1930	19.0	38.0	2003	24.0	40.0	Prestressed Concrete	1	Local
71	S505	1954	8.0	22.0	2004	8.0	58.0	Steel	1	Local
71	S636	1972	4.0	22.0	2005	14.0	48.0	Concrete Continuous	1	Local
71	209	1906	490.0	73.2	2004	483.0	72.0	Concrete Continuous	4	Federal
71	S634	1970	5.0	22.0	2005	5.0	65.0	Steel	1	Local
71	81	1925	33.0	22.0	2003	65.0	32.5	Concrete Continuous	1	Federal
71	201	1954	396.0	36.0	2002	396.0	36.0	Steel	5	Federal
71	211	1940	257.0	53.0	2004	257.0	53.0	Concrete Continuous	3	Federal
71	00034	1935	33.0	26.0	1998	68.0	28.0	Timber	3	Local
71	00063	1925	51.0	21.0	1997	62.0	26.0	Timber	3	Local
71	00089	1925	37.0	22.0	1999	74.0	30.0	Concrete Continuous	3	Federal
71	00019	1924	24.0	26.0	1999	74.0	30.0	Concrete Continuous	3	Federal
						SULLIVAN				
77	00029	-	0.0	0.0	2000	54.0	24.0	Prestressed Concrete	1	Local
77	00171	1970	34.0	21.0	1998	72.0	24.0	Prestressed Concrete	3	Local
77	00022	1935	35.0	22.0	1998	50.0	24.0	Prestressed Concrete	1	Local
77	00272	1930	28.0	18.0	2000	44.0	24.0	Prestressed Concrete	1	Local
77	00145	1925	34.0	20.0	1998	50.0	24.0	Prestressed Concrete	1	Local
77	00148	1925	46.0	16.0	2000	60.0	24.0	Prestressed Concrete	1	Local
77	00120	1920	23.0	23.0	1998	34.0	24.0	Prestressed Concrete	1	Local
77	00110	1910	49.0	14.0	1998	72.0	24.0	Prestressed Concrete	3	Local

County	Bridge #	Old Bridge Year Built	Old Length (ft)	Old Width (ft)	New Bridge Year Built	New Length	New Width	Material	Number of Spans	Funding Source
					TIPPECANOE					
79	44	1925	66.0	23.0	2002	63.0	26.6	Concrete Continuous	3	Local
79	58	1928	75.0	25.0	2002	95.0	27.0	Concrete Continuous	3	Local
79	526	-	-	-	2002	260.0	52.0	Concrete Continuous	2	Local
79	60	-	-	-	2002	22.0	24.0	Concrete Continuous	1	Local
79	61	-	-	-	2002	31.0	24.0	Concrete Continuous	1	Local
79	62	-	-	-	2003	69.0	71.3	Concrete Continuous	3	Local
79	95	1955	20.1	24.9	2005	49.8	34.3	Prestressed Concrete	1	Local
79	97	1955	27.0	32.5	2005	37.6	34.3	Prestressed Concrete	1	Local
79	00092	1930	104.0	20.0	1998	130.0	27.0	Concrete Continuous	3	Local
79	00195	1930	35.0	20.0	1998	98.0	26.0	Concrete Continuous	3	Local
					TIPTON					
80	00025	1975	52.0	28.0	2000	52.0	35.0	Prestressed Concrete	1	Federal
80	00083	1969	62.0	27.0	1999	62.0	28.0	Prestressed Concrete	1	Local
80	00045	1960	73.0	21.0	2000	73.0	21.0	Prestressed Concrete	1	Local
80	00048	1950	50.0	19.0	2000	85.0	26.0	Prestressed Concrete	3	Federal
80	00005	1910	29.0	16.0	2000	53.0	28.0	Prestressed Concrete	1	Local
80	00028	1910	26.0	16.0	2000	62.0	28.0	Prestressed Concrete	1	Local
80	00051	1908	40.0	15.0	1998	75.0	26.0	Prestressed Concrete	3	Federal
					VANDERBURGH					
82	1935	-	-	-	2005	46.6	24.2	Steel	1	Local
82	1532	-	-	-	2003	27.0	28.0	Timber	1	Local
82	830	1909	55.0	18.2	2002	80.0	28.0	Prestressed Concrete	1	Local
82	1930	1975	48.0	26.0	2003	56.0	28.0	Prestressed Concrete	1	Local
82	410	-	-	-	2004	26.0	28.0	Timber	1	Local
82	00220	1925	40.0	18.0	1999	70.0	24.0	Prestressed Concrete	1	Local
82	01545	1923	66.0	20.0	1999	52.0	28.0	Prestressed Concrete	1	Local
82	01961	1920	35.0	20.0	2000	52.0	28.0	Prestressed Concrete	1	Local
82	00273	1920	31.0	24.0	2000	56.0	32.0	Prestressed Concrete	1	Local
82	01300	1910	69.0	16.0	1997	77.0	24.0	Timber	3	Local
					VERMILLION					
83	00076	-	0.0	0.0	-	148.0	24.0	Prestressed Concrete	3	Federal
					WABASH					
85	00182	-	20.0	18.0	1998	26.0	18.0	inium, Wrought Iron, or Cas	1	Local
85	00509	1889	262.0	18.0	2001	335.0	43.0	Concrete Continuous	6	Federal
					WARREN					
86	00140	1956	32.0	16.0	1999	32.0	24.0	Steel	1	Local
86	00017	1915	39.0	17.0	1999	39.0	22.0	Steel	1	Local
86	00018	1899	29.0	22.0	1998	34.0	27.0	Steel	1	Local
86	00020	1899	61.0	16.0	1998	62.0	28.0	Prestressed Concrete	1	Local
86	00025	1894	61.0	16.0	1998	62.0	28.0	Prestressed Concrete	1	Local
86	00056	1887	152.0	16.0	2000	160.0	28.0	Prestressed Concrete	3	Federal

County	Bridge #	Old Bridge Year Built	Old Length (ft)	Old Width (ft)	New Bridge Year Built	New Length	New Width	Material	Number of Spans	Funding Source
					WARRICK					
87	48	1930	81.0	16.9	2005	88.0	28.0	Concrete Continuous	1	Local
87	41	1920	29.5	14.0	2004	42.0	28.0	Concrete Continuous	1	Local
					WASHINGTON					
88	130	1925	45.0	21.0	2003	60.0	24.0	Prestressed Concrete	1	Local
88	228	-	-	-	2003	40.0	24.0	Prestressed Concrete	1	Local
88	180	1965	23.0	20.0	2005	30.0	24.0	Prestressed Concrete	1	Local
88	169	1932	41.0	20.0	2005	50.0	24.0	Prestressed Concrete	1	Local
88	21	1920	101.0	16.0	2002	64.0	24.0	Prestressed Concrete	1	Local
88	120	1885	123.0	12.0	2002	140.0	24.0	Prestressed Concrete	3	Local
					WAYNE					
89	602	1932	23.0	33.0	2002	29.0	33.0	Concrete Continuous	1	Local
89	601	1920	27.0	22.6	2002	26.0	29.0	Concrete Continuous	1	Local
89	62	1920	39.0	21.0	2002	28.0	28.0	Concrete Continuous		Local
89	509	1940	32.0	60.0	2002	32.0	60.0	Concrete Continuous	1	Local
89	73	1920	24.0	16.0	2003	24.0	40.0	Concrete Continuous	1	Local
89	171	1920	125.0	18.0	2003	154.0	26.5	Concrete Continuous	1	Local
89	15	1925	258.0	19.0	2003	228.0	28.0	Concrete Continuous	1	Federal
89	23	1930	27.0	33.0	2004	26.0	31.3	Concrete Continuous	1	Local
89	72	1910	157.0	17.0	2004	178.0	28.0	Concrete Continuous	1	Federal
89	00096	1950	28.0	24.0	1999	28.0	24.0	Steel	2	Federal
89	00226	1925	60.0	14.0	1998	92.0	26.0	Concrete Continuous	3	Local
89	00206	1925	75.0	14.0	2000	91.0	26.0	Concrete Continuous	3	Local
89	00125	1918	157.0	16.0	1999	190.0	28.0	Concrete Continuous	3	Federal
89	00009	1914	250.0	16.0	1998	284.0	26.0	Concrete Continuous	3	Federal
89	00176	1912	55.0	18.0	1999	74.0	28.0	Concrete Continuous	3	Local
89	00138	1911	70.0	16.0	1998	82.0	26.0	Concrete Continuous	3	Local
89	00052	1910	166.0	14.0	2000	182.0	28.0	Concrete Continuous	3	Federal
89	00121	1909	128.0	14.0	1999	157.0	26.0	Concrete Continuous	3	Local
89	00178	1909	61.0	14.0	2000	80.0	26.0	Concrete Continuous	3	Local
					WHITE					
91	105	1961	75.0	21.8	2005	105.0	28.0	Concrete Continuous	3	Local
91	228	1963	126.0	22.0	2004	131.0	32.0	Concrete Continuous	3	Local
					WHITLEY					
92	00101	-	0.0	0.0	1997	51.0	24.0	Prestressed Concrete	1	Local
92	00120	-	0.0	0.0	1998	51.0	24.0	Prestressed Concrete	1	Local
92	00085	1978	25.0	0.0	1998	61.0	24.0	Prestressed Concrete	1	Local
92	00087	1978	24.0	0.0	1998	61.0	24.0	Prestressed Concrete	1	Local
92	00004	1952	62.0	28.0	2000	85.0	28.0	Prestressed Concrete	1	Local
92	00081	1948	30.0	21.0	1999	63.0	32.0	Steel	1	Local
92	00002	-	28.0	24.0	-	49.0	29.0	Steel	1	Local
92	00092	1930	38.0	22.0	1997	56.0	24.0	Prestressed Concrete	1	Local
92	00045	1927	27.0	24.0	1998	61.0	24.0	Prestressed Concrete	1	Local

APPENDIX B LITERATURE REVIEW

A number of researchers have studied the estimation of construction projects and bridges specifically. These studies vary from sophisticated models with intricate calculations which produce detailed and highly accurate estimates to more straight forward approaches using regression techniques, which are somewhat less accurate unless large data sets are used, but produce straight forward simple estimation procedures that can be used by anyone with basic knowledge of spreadsheets and mathematics.

The relevant publications to the Bridge Cost Estimate Study include a regression study by M Saito, "Statistical Models for the Estimation of Bridge Replacement Costs."(3). Saito divides replacement costs into four categories: superstructure, substructure, approach construction and other costs which include mobilization, demobilization, traffic control and demolition. Regressions were performed on various data sets to estimate costs of the four categories. This is similar to the LTAP study, but uses different inputs than the LTAP study.

Bidding costs have been used to attempt to predict final construction costs, in the Wright and Williams 2001 study "Using Bidding Statistics to Predict Completed Construction Cost" (5). In their study they found that the final completed construction cost often are greater than the low bid. They found that the relationship between the low bid and the final cost indicates that the final costs increase as a power of the low bid. Reasons for cost overruns included bidding errors, poor design, project complexity or poor project management, location weather and the availability of materials. This study was not limited to replacement of bridges, new highways, reconstructed highways and rehabilitation, among other project types were studied.

Specific studies to compare the bridge cost estimate methods to other similar methods being used was undertaken. One such publication "recording and Coding Guide for the Structural Inventory and Appraisal of the Nation's Bridges" (4) was used to support the bridge length expansion used in the LTAP study. The survey data collection was plotted against the curve in the Coding Guide, and the two curves were very close, both in position and shape. Using this similar technique in the LTAP study resulted in very good estimates of new bridge lengths.

The approach and techniques used in the LTAP Bridge Cost Estimation Study is similar and agrees well with other studies methods and results. The uniqueness of the LTAP study is that is applies to Indiana County bridges, funded both locally and federally. The current limitation is the low number of data points. Of the more than 12,000 county bridges this study includes only 377. Every attempt was made to include additional data sets, and as new data sets become available the model will be updated to provide greater estimation accuracy.

REFERENCES

(1) Boussabaine, A. H. and Elhag, T. M. “A Neuro-fuzzy Model for Predicting Construction Cost.” EUFIT, Liverpool, U.K., September 1998.

(2) Chengalur-Smith, I. N., Ballou, D. P., and Pazer, H. L. “Modeling the Cost of Bridge Rehabilitation.” *Transportation Research A*, Vol. 31, July 1997, p. 281-93.

(3) Saito, M., Sinha, K. C., and Anderson, V. L. “Statistical Models for the Estimation of Bridge Replacement Costs.” *Transportation Research A*, Vol. 25, no.6, November 1991, p.339-50.

(4) U.S. Department of Transportation, Federal Highway Administration. Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation’s Bridges. December 1995, p. 61.

(5) Wright, M. G. and Williams, T. P. “Using Bidding Statistics to Predict Completed Construction Cost.” *The Engineering Economist*, Vol. 46, no.2, 2001, p. 114-28.

APPENDIX C SURVEY

Indiana Local Technical Assistance Program FAX Broadcast from the office of Tom Martin, Indiana LTAP Director:

The Indiana LTAP Center is updating a report first prepared in 2002 titled "Modeling the Cost of Bridge Replacement for Indiana County Highway Departments". This survey will help us estimate the cost of updating all deficient or obsolete bridges to a sufficient level. We understand that you are very busy with the regular work you have and this survey isn't high on your priority list, but it would be very helpful to us if you would take the time to fill this out. The information collected from this survey can generate a number of helpful reports that will be passed onto you. We are concerned with bridges that were replaced within the past three years, 2002 to present. Please fill in the following information according to these directions. If your county has more than one bridge built since 2002, please complete a survey for each bridge.

Thanks,

Tom Martin
Director, Indiana LTAP

Directions

County name and bridge number will be the identifier in our report. Please fill in the county name and county bridge number on these lines.

1. Bridge information – This asks for some of the geometric and structural information of the new and replaced bridges (see tables).
2. Preliminary Engineering – Who performed the preliminary engineering work and how much did it cost?
3. Contract type – Was the work performed by an outside contractor, or was the work completed by the LPA work force? Was it union or non union labor?
4. Right-of-Way – Give the total number of acres of permanent Right-of-Way needed to complete the project (including donated) and the total cost. This information is requested only for federal aid type projects.
5. Construction Inspection – Indicate who performed the construction inspection and the cost

Material Type

1	Concrete	6	Prestressed Concrete Continuous
2	Concrete Continuous	7	Timber
3	Steel	8	Masonry
4	Steel Continuous	9	Aluminum, Wrought Iron, or Cast Iron
5	Prestressed Concrete	0	Other

Construction Type

01	Slab	13	Suspension
02	Stringer / Multi-beam or Girder	14	Stayed Girder
03	Girder and Floor beam System	15	Movable - Lift
04	Tee Beam	16	Movable –Bascule
05	Box Beam or Girders - Multiple	17	Movable - Swing
06	Box Beam or Girders – Single or Spread	18	Tunnel
07	Frame	19	Culvert
08	Orthotropic	20	Mixed Types
09	Truss - Deck	21	Segmental Box Girder
10	Truss - Thru	22	Channel Beam
11	Arch - Deck	00	Other
12	Arch - Thru		

Foundation Type

A	Concrete Spread Footings – No Piles	L	None – U. F.
B	Timber Spread Footings	M	Other
C	Stone Spread Footings	N	N/A
D	Concrete Spread Footings – On Piles	O	Unknown Type
E	Concrete Cap on Soil – On Piles	P	Timber Cap – On Soil – Buried Piles (Pier Widened)
F	Steel Piles – H Columns		
G	Steel Piles - Shells	Q	Combination of A and I (Pier Widened)
H	Steel Piles - Caissons	R	Combination of A and D (Pier Widened)
I	Timber	S	Other Combinations (Pier Widened)
J	Concrete – Steel Encased	T	Combination of C and A (Pier Widened)
K	Concrete – Steel Reinforced		

This information is available in the NBI Bridge Inspection Report as Item 43A (Material Type), Item 43B (Construction Type), and Item 113B (Foundation Type),

Bridge Cost Survey

County: _____________ Bridge Number: ____________

Bridge Information

Old Bridge

1 Year Built: _________

2 Length: _________

3 Width: _________

4 Spans: _________

5 Sufficiency Rating: ______________

6 ADT___________

New Bridge

7 Year Built: _________

8 Length: _________

9 Width: _________

10 Spans: _________

11 Approach Length: _________

12 Material Type: _________

13 Construction Type: _________

14 Foundation Type: _________

Preliminary Engineering

15 Consultant / In-House / Supplier (circle one)

16 Cost: $ _________

17 Funding source: Local / Federal / Other_________ (circle one)

Right-of-Way / R-O-W Engineering (Permanent R/W only.)

18 Consultant / In-House (circle one)

19 Required (Permanent): _________acres

20 Total Cost: $ _________

21 Funding source: Local / Federal / Other_________ (circle one)

Construction

22 Contractor / In-House / Vendor (circle one)

23 Union / Non-Union (circle one) (optional)

24 Bridge Cost: $ _________

25 Approach's Cost: $ _________

26 Funding source: Local / Federal / Other_________ (circle one)

Construction Inspection

27 Consultant / In-House (circle one)

28 Cost: $ _________

29 Funding source: Local / Federal / Other_________ (circle one)