Task Agreement Number P14AC01504
Under
Cooperative Agreement Number P14AC01002
Between
The United States Department of the Interior
National Park Service
And the
National Society for the Preservation of Covered Bridges

HISTORIC COVERED BRIDGE PRESERVATION PROJECTS

ARTICLE I – BACKGROUND AND OBJECTIVES

Cooperative Agreement Number P14AC01002 was entered into by and between the Department of the Interior, National Park Service (NPS) and the National Society for the Preservation of Covered Bridges (NSPCB) for the purpose of executing a research project for the National Historic Covered Bridge Preservation Program. Unless otherwise specified herein, the terms and conditions as stated in the Cooperative Agreement will apply to this Task Agreement.

Project Title: Analyzing Existing Covered Bridge Floor Systems

ARTICLE II – LEGAL AUTHORITY

NPS enters into this Agreement pursuant to:

A. 16 U.S.C. §1g authorizes the NPS to enter into cooperative agreements that involve the transfer of NPS appropriated funds to state, local and tribal governments, other public entities, educational institutions, and private nonprofit organizations for the public purpose of carrying out National Park Service programs.

ARTICLE III – STATEMENT OF WORK

A. NSPCB agrees to:

1. Re-use the salvaged Town lattice trusses from the historic Bartonsville Covered Bridge, which was swept away in tropical storm Irene, and is available for use for research purposes by the NSPCB. The remains of this bridge would be used to investigate the interaction of the Town lattice system to carry and distribute loads, because their observed performance greatly exceeds the calculated strength.
2. Fabricate and install floor systems comprised of solid-sawn lumber. Construct temporary back walls and approaches to facilitate live load testing and experimentation. Alternate approaches will be considered.

3. Perform a literature search for previous investigations bearing on the present research subject.
4. Install strain gages on deck boards, floor beams and truss members. Install data capture equipment and software. Rent a suitable design vehicle (truck) and drive over bridge while recording the structural response. Repeat for different deck thicknesses and different methods and degrees of attaching deck to floor beams.
5. Real-world engineering testing will study and record bending moments in the floor plank and floor beams, moment in floor system and truss. NSPCB will be responsible for writing a testing plan, collecting data, and producing a final report comparing actual testing versus analytical analysis.
6. The primary goal will be to develop a model for the composite floor system behavior of covered bridges that agrees better with observed real-world behavior. This could lead to a new methodology to better calculate the strength of these bridge systems. The work would also attempt to develop guidelines for retrofitting shear fasteners (additional spikes or other means) to ensure that desired composite action of floor planks and floor beams is achieved.

B. NPS agrees to:

1. Provide funding and facilitate coordination for the task agreement. HAER will produce quarterly progress reports for Federal Highway Administration (FHWA).
2. Provide opportunities for student and professionals in engineering and other relevant disciplines to learn and develop architectural, engineering, and historical documentation skills, and to observe directly the administration and management of a national historic engineering documentation program. (See detailed Statement of Work appended to agreement);
3. Share resources, facilities, information, and expertise of its AutoCAD and engineering documentation knowledge to enhance the ability of NSPCB to advance its expertise in these areas;
4. Disseminate information and knowledge among public officials, private organizations, and individuals working with the Secretary of the Interior's *HABS/HAER Standards of Documentation*, and *Standards for the Treatment of Historic Properties*.

ARTICLE IV – TERM OF AGREEMENT

This Task Agreement will become effective on the date of final signature and extend through December 31, 2015.

ARTICLE V – KEY OFFICIALS

A. Key officials are essential to ensure maximum coordination and communication between the parties and the work being performed. They are:

1. **The NPS:**

Agreement Technical Representative:
Kristen O'Connell
Heritage Documentation Programs
1201 Eye St., NW, 2270
Washington, DC 20005
202-354-2177 office
202-371-6473 fax
Kristen_O'Connell@nps.gov

Awarding Officer:
Andrew E. Lubner
National Park Service
WASO Washington Contracting and Procurement Office (WCP)
P.O. Box 15287, MSWCP
Denver, CO 80225-0287
303-969-2378
andrew_lubner@nps.gov

2. **For NSPCB:**

Signatory:
William Caswell
President
National Society for the Preservation of Covered Bridges
535 Second NH Turnpike
Hillsboro, NH 03244
603-271-1572 office
wscaswell@yahoo.com

B. **Communications** - NSPCB will address any communication regarding this Agreement to the ATR with a copy to the Awarding Officer. Communications that relate solely to routine operational matters described in the current work plan may be sent only to the ATR

C. **Changes in Key Officials** - Neither the NPS nor NSPCB may make any permanent change in a key official without written notice to the other party reasonably in advance of the proposed change. The notice will include a justification with sufficient detail to permit evaluation of the impact of such a change on the scope of work

specified within this Agreement. Any permanent change in key officials will be made only by modification to this Agreement.

ARTICLE VI – AWARD AND PAYMENT

A. Financial Assistance: NPS will provide funding to NSPCB in an amount not to exceed $150,000.00 for the work described in Article III and in accordance with the approved budget (Attachment A). Any award beyond the current fiscal year is subject to availability of funds.

B. NSPCB shall request payment in accordance with the following:

1. **Method of Payment**. Payment will be made by advance and/or reimbursement through the Department of Treasury's ASAP system.
2. **Requesting Advances**. Requests for advances must be made submitted via the ASAP system. Requests may be submitted as frequently as required to meet the needs of the FA recipient to disburse funds for the Federal share of project costs. If feasible, each request should be timed so that payment is received on the same day that the funds are dispersed for direct project costs and/or the proportionate share of any allowable indirect costs. If same-day transfers are not feasible, advance payments must be as close to actual disbursements as administratively feasible.
3. **Requesting Reimbursement**. Requests for reimbursements must be submitted via the ASAP system. Requests for reimbursement should coincide with normal billing patterns. Each request must be limited to the amount of disbursements made for the Federal share of direct project costs and the proportionate share of allowable indirect costs incurred during that billing period.
4. **Adjusting payment requests for available cash**. Funds that are available from repayments to, and interest earned on, a revolving fund, program income, rebates, refunds, contract settlements, audit recoveries, credits, discounts, and interest earned on any of those funds must be disbursed before requesting additional cash payments.
5. **Bank Accounts**. All payments are made through electronic funds transfer to the bank account identified in the U.S Treasury ASAP system by the FA recipient.
6. **Supporting Documents and Agency Approval of Payments**. Additional supporting documentation and prior Agency (NPS) approval of payments may be required when/if a FA recipient is determined to be "high risk" or has performance issues. If prior Agency payment approval is in effect for an award, the ASAP system will notify the FA recipient when they submit a request for payment. The Recipient must then notify the NPS Awarding Officer identified on the Assistance Agreement that a payment request has been submitted. The NPS Awarding Officer may request additional information from the recipient to support the payment request prior to approving the release of funds, as deemed necessary. The FA recipient is required to comply with these requests.

Supporting documents may include invoices, copies of contracts, vendor quotes, and other expenditure explanations that justify the reimbursement requests.

ARTICLE VII – REPORTS AND/OR DELIVERABLES

A. Within 90 days of the end of the agreement a final SF-425 shall be provided to the Awarding Officer.

B. Within 90 days of the end of the agreement a final performance report shall be provided to the Awarding Officer.

C. Specific projects or activities for which funds are advanced will be tracked and reported by quarterly/semi-annual/annual submission of a SF-425 Federal Financial Report (FFR). A final SF-425 shall be submitted at the completion of the Agreement. The following reporting period end dates shall be used for interim reports: 3/31, 6/30, 9/30, 12/31.

ARTICLE VIII – MODIFICATION AND TERMINATION

This task agreement may be modified at any time, prior to the expiration date, by the mutual concurrence of NSPCB and the NPS. Modifications will be in writing, approved and signed by the NPS Awarding Officer and the NSPCB signatory official.

ARTICLE IX – ATTACHMENTS

The following documents are attached and made a part of this Task Agreement:

A. Budget
B. Research Plan

ARTICLE X - SIGNATURES

IN WITNESS WHEREOF, the parties hereto have executed this Task Agreement on the date(s) set forth below.

FOR THE NATIONAL SOCIETY FOR THE PRESERVATION OF COVERED BRIDGES

William S. Caswell Jr.
President

September 2, 2014
Date

FOR THE NATIONAL PARK SERVICE

Andrew E. Lubner
Awarding Officer

9/3/14
Date

ATTACHMENT A – BUDGET

ATTACHMENT A
Agency: *NPS*
Recipient: *NSPCB*
Title: *Analyze Existing CB Floor Systems*
Agreement #: *P14AC01002 / P14AC0XXXX*
Period:

INSTRUCTIONS: Only change the highlighted cells. First complete the cells highlighted in yellow followed by the cells highlighted in green. Completing the green cells involves breaking down the total project budget into the NPS and recipient funded items. The "Total Check" at the bottom of the worksheet will be 0 once all Total Project Budget dollars have been properly allocated to either NPS or the Recipient. The indirect cost rate used must be either 1) the negotiated rate with the cognizant agency or 2) certified in writing by the recipients independent auditor and applied to the NPS funded costs only (also note - indirect costs are not cost share eligible). If the recipient is not able to obtain an indirect cost rate as detailed, all costs must be detailed as direct.

Personnel	Unit of Time (hour, day, week, month, % of salary, etc)	Qty (of hours, days, weeks, months, % of salary, etc.	Cost Per Unit of Time	Total Project Budget	NPS Funded Amount	Recipient Funded Amount	COMMENTS:
Qty of Position Position Description							
1 Project Director PE	days	31.00	832.00	25,792.00	25,792.00		
1 Research Engineer PE	days	45.50	832.00	38,656.00	37,266.00		
1	days						
1 Administrator	days	1.00	640.00	640.00	640.00		
			Subtotal Salaries	65,120.00	63,698.00	-	
Benefits		% of Compensation					
0		0%		-			
1 Research Engineer PE		0%		-			
1 Administrator				-			
			Subtotal Benefits	-	-	-	
			Subtotal Personnel	65,120.00	63,698.00	-	
		Qty	Cost Per				
Equipment (over $5k & useful life of more than 1 yr)							
Heavy equipment rental for assembly				5,000.00	5,000.00		
Equipment rental for fabrication and testing				3,860.00	3,860.00		
Equipment 3 Description				-			
			Subtotal Equipment	8,860.00	8,860.00	-	
Supplies		Qty	Cost Per				
Strain Gauge Equipment Rental		1.00	5,600.00	5,600.00	5,600.00		
Data Acquisition Equipmt & field supplies		1.00	1,100.00	1,100.00	1,100.00		
Timber, lumber, hardware				13,240.00	12,800.00		
2-40' trusses				20,000.00			
			Subtotal Supplies	39,940.00	19,500.00	-	
Travel	Unit of Measure	Qty	Cost Per				
Airfare	trips	1.00	2,200.00	2,200.00	2,200.00		
Lodging	days	15.00	83.00	1,245.00	1,245.00		
Per Diem	days	13.00	46.00	598.00	598.00		
Per Diem (first & last day @ 75% rate)	days	2.00	34.50	69.00	69.00		
Ground Transportation	days or mileage			-	-		
Housing Stipend	month			-	-		
Transportation Stipend	week			-	-		
			Subtotal Travel	4,112.00	4,112.00	-	
Other		Qty	Cost Per				
Liability Insurance				5,000.00			
Wood Coupon Testing at U of Maine		1.00	2,100.00	2,100.00	2,100.00		
2.5 month land lease		2.50	2,000.00	5,000.00	-		
Gravel fill, concrete backwalls and foundations		1.00	3,000.00	3,000.00	-		
Refuse removal and disposal		1.00	2,000.00	2,000.00	-		
Other 6 Description				-			
Other 7 Description				-			
Other 8 Description				-			
Other 9 Description				-			
Other 10 Description				-			
			Subtotal Other	17,100.00	2,100.00	-	
Contractual	Unit of Time	Qty	Cost Per				
Subcontract/Subaward 1 Resaw floor beams				2,200.00	2,200.00		
Subcontract/Subaward 2 Temporary abutments				2,200.00	2,200.00		
Subcontract/Subaward 3 Construction labor				47,330.00	47,330.00		
			Total Subcontract	51,730.00	51,730.00	-	
Total Direct Costs				186,862.00	150,000.00	-	
Indirect Costs							
0.00% of NPS Funded Direct Costs				-	-	-	
Total Costs				186,862.00	150,000.00	-	

Complete these cells as appropriate
Once yellow cells are completed, manually account for total project budget in NPS and recipient columns as well as In-Kind Cost Share below

Total Check (s/b 0)	36,862.00
Cost Share Check	0.00%
ICR Calc Check	0.00%

In-Kind Cost Share

Description	Source	# of Units	Value Per Unit*	Total
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
TOTAL				0.00

	Total NPS Funded	Total Recipient Funded (including In-Kind)	Total Agreement Amount
Total Agreement	150,000.00	-	150,000.00

* The value of a volunteer hour can be based the latest data from independentsector.org

Research Plan

prepared by

J. A. Barker Engineering, Inc. and Barns & Bridges of New England
on behalf of the
National Society for the Preservation of Covered Bridges

Problem Statement:

For most covered bridges the bridge floor and its supporting beams are, by traditional calculations, the weakest part of the bridge. However, it has been observed over many years for many covered bridges, that present design methods underestimate the strength of some decks and supporting beams by considerable margins. This has, in turn, put those covered bridges at risk because they are perceived as being weaker and less safe than they really are.

The low load limit decreases the usability of those bridges, increasing calls for their replacement. It also causes heavy-handed, inappropriate deck and floor beam replacements that may be unnecessary. Low load limit ratings for timber floor systems increases the tendency for repair engineers (or road supervisors) to replace the historically accurate timber decks with twentieth-century materials such as (a) glulam floor beams, (b) glulam deck panels, (c) fiber reinforced polymer deck panels or (d) large steel beams from abutment to abutment, with the trusses reduced to mere decorations. The proposed research could combat this trend and increase the authenticity of the preserved structures (the covered bridges).

Research Objective:

The project's research objective is to establish a correspondence between measured stresses in the components of actual bridge decks and supporting beams under actual truck loads and the several ways of calculating the same values. This is viewed as important information to enable improved design procedures. The working hypothesis is that the bridge deck, when fastened to the supporting beams, strengthens those beams in ways that current design methods do not adequately address. It is further hypothesized that the amount of strengthening will vary with the quality and number of the fasteners (spikes or screws). As a result, if the composite structural behavior of timber decks and floor beams is better understood, the actual strength of the floor system for load rating purposes will probably increase. Better understanding of behavior could lighten the floor beams and deck, which increases the capacity of the main trusses to carry vehicles. User safety would not be decreased, but should be increased as a result of a combined experimental + analytical research project into the topic. The results will probably help

local (county and park) workers replace decks with locally produced, historically correct decks. These should also be more economical than more drastic modifications.

Project Description:

Current design and load rating procedures consist of comparing calculated maximum stresses in the deck boards and supporting beams with maximum values established for the wood species and grade employed. This basic approach, the comparison of calculated values with presumptive wood strength, holds whether the general design method is allowable stress, load factor, or Load and Resistance Factor Design (LRFD). The three ways of most interest in calculating stresses in timber decks and supporting beams are:

1) The American Association of State Highway Transportation Officials (AASHTO) empirical design methods
2) Classical beam and deck theory
3) Finite element models

To develop an improved design methodology, it will be necessary to establish better correspondence between deck system (floor and supporting beams considered together) geometry and deck stresses under load. The following research steps are proposed.

1. Conduct a literature search of previously conducted research about the behavior of timber decks on timber supporting beams.

2. Rebuild a 40-foot section of a salvaged historic covered bridge Town Lattice truss that was partially destroyed by Hurricane Irene. Then place reclaimed floor beams at the original spacing and build multiple test decks with new material. Once completed, the Bartonsville Bridge will contain 85% of the original fabric. Then instrument deck, floor beams and trusses with strain gauges, and drive through the bridge with H-10 loaded trucks. The different test decks would have variations in:

a) Deck thickness and number of layers
b) Fastener type, size and spacing
c) Vary the path that the truck travels through the bridge.

Key structural components would be instrumented with strain gauges, which would be, in turn, connected to a data logger and computer with data acquisition software. It is proposed to use an AASHTO H10 standard design truck as the load to be applied. The number of deck and fastener combinations that can be studied within the available funding is estimated to be at least 4 levels of fastening quality times at least two different deck thicknesses. Only the most common floor beam arrangement will be studied: transverse floor beams at approximately two-foot intervals directly supporting longitudinal deck planking. This system is used on all Town Lattice Truss bridges and on most Howe Truss bridges.

3. Compare the results of the instrumented tests with the stresses calculated by the three methods noted above, 1) AASHTO formulas, 2) classical analysis, 3) finite element analysis.

4. Assess which of the three analysis methods gives the best correspondence with the full sized tests, and suggest analysis methods that would be acceptably accurate and simple enough for daily use by practicing engineers.

5. Prepare a report summarizing the findings of the research project.

6. At the sole expense of the Town of Rockingham, Vermont, the truss constructed for this Task Agreement will be transformed into an historically accurate representation of the original Bartonsville Bridge. The structure will be placed adjacent to the new replacement Bartonsville Bridge as an information kiosk.