## Objectives and Impact

The objective of the proposal is to request a continuation of SPR-5(281) the *Steel Bridge Research, Inspection, Training, and Education Engineering Center (S-BRITE Engineering Center)* focused on existing steel highway bridges.This National *Center when initially proposed in 2013, has become a national Center leading education, training, research, and engineering benefitting the existing aging steel bridge and structure inventory*. Over the life of the project, ten (10) states, the US Army Corps, and FHWA have provided support through TPF-5(281) and continue to do so. Current funding is very strong and partner states continue to be added. Although the Center has been focused on highway bridges, it will also support stakeholders of steel railroad bridges as well as steel ancillary structures, such as lighting towers and sign supports. As a result, in-kind support from the railway industry has been strong as well. The Center has contributed to improved asset management decisions for DOTs, FHWA, and other partners relative to existing steel bridge inventory.

However, since the existing TPF-5(281) needs to sunset per FHWA guidelines, the Research Team, and the current active partners are requesting a continuation of this pooled fund study, albeit under a different TPF number. The original project objectives and deliverables remain unchanged. Nevertheless, a summary of the Center is presented below.

**Detailed Discussion**

**General**

As infrastructure continues to age, the engineers who designed and had first-hand knowledge of the then new structures (*e.g., the Interstate era*), eventually exit the workforce. Further, engineering programs, research, and associated coursework move forward and evolve over time. Obviously, these advances in education are essential to progress with *new* designs and *new* materials. However, the vast majority of the infrastructure is comprised of structures built with older materials, design philosophies, and construction practices that are no longer discussed in the classroom. The average age of a steel bridge in Indiana is about 50 years, and similar statistics are found throughout the US. Further, most of the major “landmark” river crossings are steel structures that are approaching or exceeded their design lives. A quick review of the brides crossing the Ohio, Hudson, or Mississippi Rivers provides stark reminders of the age of our infrastructure. Unfortunately, in many cases, this has left these critical structures effectively abandoned when it comes to ensuring their “healthcare” professionals are adequately trained. Clearly, a well rounded workforce must include engineers prepared to design the structures of the future working hand-in-hand with engineers prepared to maintain the structures of the past.

To successfully maintain the existing steel bridge inventory, expertise is needed in the areas of deterioration, fatigue, fracture, corrosion, repair/retrofit, coatings, materials, NDE, riveting, welding, fabrication, etc. There are multiple reasons for this loss of expertise, including budget cuts, natural attrition, and a diminishing pool of technical expertise related to aging infrastructure. Regardless of the cause, the effects are clearly seen in DOTs across the United States. Some of these needs must be addressed through new research, while others can be addressed through improved training. In some select cases, individual experts are needed for specific consultation in order to solve unique complex problems.

Utilizing some of Purdue’s existing strengths in education and research, the S-BRITE Center will continue to engage faculty and engineers from around the country in order to explore partnership opportunities in training and research. Finally, a “Distributed Expertise Network” (DEN), which includes specific experts from inside and outside of Purdue will be created to assist partners with specific complex problems.

The S-BRITE Center will fill a growing need in the transportation industry as relates to existing and aging steel bridges.

**Educational Aspects**

A long-term goal of the S-BRITE Center has been to create the next generation of bridge engineers and inspectors who are properly educated to be effective stewards of the existing aging steel bridge inventory. At the university level, the development of a new “minor” or certificate within Civil Engineering is proposed that will prepare engineering students for a career in the area of transportation structures. At the professional level, high-quality, specialized short courses for professionals will be developed and targeted at those individuals currently responsible for the existing infrastructure. The courses would go beyond the current NHI course level.

**Bridge Component Gallery**

Although training, education, and research are the overall focus of the Center, the cornerstone of the S-BRITE Engineering Center will be a multi-acre gallery which will include full-scale bridge structures, portions of complete structures, and individual components that will include a host of common and uncommon details used in steel bridges. Similar centers exist for the aircraft, ship, and offshore industries, though nothing has been developed for the steel bridge industry.

The gallery has provided a unique hands-on experience for education of individuals of all levels regarding steel fabrication, deterioration, inspection techniques, etc. The reader is encouraged to view the S-BRITE flyover video highlighting the scale of the bridge component gallery.

The video can be found at: <https://engineering.purdue.edu/CAI/SBRITE/Facilities>

Since the bridge components are not actually in service and are in more accessible conditions, costly traffic control and extensive fall-protection will not be required during training. Conveniently, they have been situated so that real-world conditions exist to truly simulate in-situ inspection conditions. The S-BRITE “living laboratory” has become incredibly useful for research tools being developed for inspection, durability modeling, and performance testing of inspectors.

**Distributed Expertise Network (DEN)**

To help fill the technical voids found at most DOTs, a unique team of experts have been assembled through the S-BRITE Center to create a Distributed Expertise Network (the DEN). Some of these individuals are local to Purdue at the Center while others are located at their respective institution. The DEN serves the role that no longer exists in many individual state DOTs today, specifically the existence of a group of highly specialized technical experts that are “on-call” to assist as issues arise. These experts are effectively “on call” to the Center and the participants, and have been able to travel to the participant’s location if required and per the funding level provided. There is no need for special subcontracts between the individual state and the expert since the agreements are already be in place as participants of the Center.

**Levels of Commitment**

Since states have different needs and resources, three different levels or “tiers” of contributions were developed with each tier receiving defined benefits. Participants will be stakeholders in the direction of the Center, research program directions, and coursework development. It is noted that although the fees associated with participation were developed over seven years ago, no increases have been made to date. Details are contained in the Table below.

Tier 1A and Tier 1B

**Tier 1A**

* + - * + $ 30,000 per year for 2 years for a total commitment of $ 60,000
        + This level provides support for the administration and policy development for center operations and strategic plan as well as for course development, traditional research and the gallery development and maintenance.
        + Specific deliverables will include 1 training course at the stakeholder’s facility for up to 30 people as well as 1 training course for up to 2 people including travel to Purdue University for specialized training at the bridge gallery or attending short courses. The two can attend the same training or each can attend training for up to two different topics (e.g., 1 individuals may attend one course and 1 may attend a different course). It also includes 8 hours of specific assistance through the DEN.

**Tier 1B**

* + - * + $ 30,000 per year for 2 years for a total commitment of $ 60,000
        + This level provides support for the administration and policy development for center operations and strategic plan as well as for course development, traditional research and the gallery development and maintenance. Tier 1B provides the participant more involvement in research and
        + Specific deliverables will include 1 training course at the stakeholder’s facility for up to 30 people. It also includes 12 hours of specific assistance through the DEN.

**Tier 2**

* + - * + $ 50,000 per year for 2 years for a total commitment of $ 100,000
        + This level provides support for the administration and policy development for center operations and strategic plan as well as for course development, traditional research and the gallery development and maintenance.
        + Specific deliverables will include 1 training course at the stakeholder’s facility for up to 50 people as well as 1 training course for up to 5 people including travel to Purdue University for specialized training at the bridge gallery or attending short courses. The five can attend the same training or each can attend training for up to two different topics (e.g., 2 individuals may attend one course and 3 may attend a different course). It also includes 20 hours of specific assistance through the DEN.

**Tier 3:**

* + - * + $ 100,000 per year for 2 years for a total commitment of $ 200,000
        + This level provides support for the administration and policy development for center operations and strategic plan as well as for course development, research and the gallery development and maintenance.
        + Specific deliverables will include 2 training courses at the stakeholder’s facility for up to 50 people as well as 2 training course for up to 10 people including travel to Purdue University for specialized training at the bridge gallery or attending short courses. The ten can attend the same training or each can attend separate training for up to three different topics. It also includes 40 hours of specific assistance through the solutions center.

**Tier 4:**

* $ 150,000 per year for 2 years for a total commitment of $ 300,000
* This level provides support for the administration and policy development for center operations and strategic plan as well as for course development, research and the gallery development and maintenance.
* Specific deliverables will include 3 training courses at the stakeholder’s facility for up to 50 people as well as 3 training course for up to 15 people including travel to Purdue University for specialized training at the bridge gallery or attending short courses. The 15 can attend the same training or each can attend separate training for up to four different topics. It also includes 60 hours of specific assistance through the solutions center.

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| **Categories** | **Approximate Distribution of Commitment** | | | | |
| **Tier 1A** | **Tier 1B** | **Tier 2** | **Tier 3** | **Tier 4** |
| Administration / Policy Development & Implementation | $2,500 | $3,000 | $4,000 | $8,000 | $12,000 |
| New Course Development (Professional Training, New Inspector Certification Program, and Graduate, Undergrad, and Technical School Courses) | $3,000 | $3,000 | $7,500 | $15,000 | $22,500 |
| Traditional Research | $7,500 | $10,500 | $5,500 | $11,000 | $16,500 |
| Professional Training | $9,000 | $7,000 | $12,500 | $25,000 | $37,500 |
| Database and access to Distributed Expertise Network (DEN)4 | $3,000 | $4,000 | $5,500 | $11,000 | $16,500 |
| Development and Maintenance of Bridge Component Gallery at Purdue University | $5,000 | $2,500 | $15,000 | $30,000 | $45,000 |
| Yearly Commitment | $50,000 | $30,000 | $50,000 | $100,000 | $150,000 |