

Quarterly Progress Report:

Project Number and Title: 2.10 Durability Evaluation of Carbon Fiber Composite Strands in Highway Bridges
Research Area 2: New materials for longevity and constructability

PI: Roberto Lopez-Anido, University of Maine

Co-PI(s): Keith Berube and Andrew Goupee, University of Maine

Reporting Period: 10/01/2019 to 12/30/2019

Date: 12/23/19

Overview:

The work during the current period has included the following:

- Literature review on existing use of carbon fiber cables/rods in civil infrastructure; in excess of 50 sources processed to date.
- Review of 2018 Penobscot Narrows Bridge inspection report produced by Figg Engineering for MaineDOT.
- Background research on wireless data acquisition system options.
- Verification of continuous data acquisition capabilities at the bridge site.
- Debugging of data acquisition noise issues at PNB site.

The literature review on carbon fiber cables is part of the Durability Assessment (Task 4), while the review of the inspection report will aid with the Modeling (Task 3) and the Durability Assessment by providing the range of forces that can be expected at each cable-stay anchorage location. The remaining work is contributing to the upgrade of the data acquisition system (Task 1).

The current status of each task and the current state of the budget are presented in Tables 1 and 2, respectively.

Table 1: Task Progress

| Task Number | Start Date | End Date | Percent Complete |
|---|------------|------------|------------------|
| Task 1: Upgrade Data Acquisition System | 6/1/2019 | 8/31/2020 | 30% |
| Task 2: External Environmental Sensing | 1/1/2020 | 8/31/2020 | 0% |
| Task 3: Implement Analytical Model | 11/1/2019 | 5/30/2021 | 10% |
| Task 4: Durability Assessment | 11/1/2019 | 12/31/2021 | 15% |

Table 2: Budget Progress

| Entire Project Budget | Spend Amount | Spend Percentage to Date |
|-----------------------|--------------|--------------------------|
| \$339,457 | \$59,834 | 17.6% (12/31/2019) |

During this current reporting cycle, a seminar was presented by the project's graduate student and the project was featured in a state business online publication. Details are provided in Tables 3 and 4, respectively.

Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events

| Title | Event | Type | Location | Date(s) |
|--|--|---------|--------------------------------|------------------|
| Durability Evaluation of Carbon Fiber Composite Strands in Highway Bridges | UMaine Mechanical Engineering Seminar Series | Seminar | University of Maine, Orono, ME | October 18, 2019 |

Table 4: Publications and Submitted Papers and Reports

| Type | Title | Citation | Date | Status |
|-------------------------|----------|--|----------|------------------|
| Online Business Journal | Mainebiz | "Better bridges and roads: UMaine-led research coalition tackles the future of transportation", Mainebiz, October 28, 2019, Online at: https://www.mainebiz.biz/article/better- | 10/28/19 | Published Online |

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|--|--|--|--|--|
| | | bridges-and-roads-umaine-led-research-coalition-tackles-the-future-of-transportation | | |
|--|--|--|--|--|

Participants and Collaborators:

The principal investigators and graduate students that have participated in the project during the current reporting period are listed in Tables 5 and 6, respectively.

| Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members | | | |
|--|-------------------------|--|--|
| Individual Name | Email Address | Department | Role in Research |
| Roberto Lopez-Anido | RLA@maine.edu | UMaine Civil and Environmental Engineering | Project PI, Graduate student co-advisor, and Structural lead. |
| Keith Berube | keith.berube@maine.edu | UMaine Mechanical Engineering Technology | Project Co-PI and Data acquisition instrumentation lead. |
| Andrew Goupee | Andrew.goupee@maine.edu | UMaine Mechanical Engineering | Project Co-PI, Graduate student co-advisor, and Modeling lead. |

| Table 6: Student Participants during the reporting period | | | | |
|--|----------------------|--------------|------------------------|--------------------------|
| Student Name | Email Address | Class | Major | Role in research |
| Braedon Kohler | | Master's | Mechanical Engineering | Modeling and programming |

There were no students working on the project who graduated during the current reporting period.

| Table 7: Student Graduates | | | |
|-----------------------------------|-------------------------|---------------|------------------------|
| Student Name | Role in Research | Degree | Graduation Date |
| N/A | | | |

During the current reporting period the only outside collaborator has been the Maine DOT, as indicated in Table 8. Their contribution has been to provide PNB site access and PNB engineering reports.

| Table 8: Research Project Collaborators during the reporting period | | | | | | |
|--|-----------------|------------------------------------|------------------------|-------------------|-------------------------------|----------------------------|
| Organization | Location | Contribution to the Project | | | | |
| | | Financial Support | In-Kind Support | Facilities | Collaborative Research | Personnel Exchanges |
| Maine DOT | Augusta, ME | | x | | | |

The project is in the process of reaching out to other participating State DOTs for information on the use of carbon fiber cables/rods for civil infrastructure use in their states.

Changes:

The project schedule has been modified slightly in order to account for the graduate student's graduation date of May 2021.

Planned Activities:

The following activities are planned for the next three month period:

- Continue to obtain continuous data from different stay anchorage locations at the PNB site.
- Complete background research on wireless data acquisition (DAQ) options.

- Research environmental sensor options for external environment monitoring at the PNB site.
- Purchase wireless DAQ hardware.
- Start the development of the online interface for the DAQ system.
- Use the existing analytical model to process existing continuous data sets from prior years.
- Use the existing analytical model to process new continuous data sets as they are acquired.
- Continue with the literature review on the use of carbon fiber composite cables/rods in civil infrastructure.
- Complete a first draft of the literature review.