

Use of Fiber-Reinforced Polymer Composites for Bridge Repairs in Montana

Project Kickoff Meeting Minutes
February 6, 2023, 10-11:30 am (Mountain time)
Zoom Meeting

Attendees:

Callejas, Vaneza – Meeting host
Ahmed, Emtiaz – MSU Grad Student
Berry, Micheal – MSU Faculty
Brandenberger, Stephanie – FHWA
Coon, Meghan – MDT Bridge Bureau
Crumly, David – Bridge Maintenance Engineer
Jenks, Jessica – Bridge Design Engineer
Kappes, Lenci – MDT Bridge Bureau
Matteson, Kirsten – MSU Faculty
Steffan, Tyler – Bridge Design Engineer
Strizich, Matt – FHWA

Vaneza introduces everyone

Meeting starts with a brief introduction of each attendee.

Kirsten gives presentation (slides attached) and there was discussion during (notes below)

- Example applications of FRP

Example applications of FRP – External wrapping for corrosion-damaged bridge in Michigan, CFRP sheet and U-wrap to retrofit a bridge in Missouri, Strengthening of bridge using CFRP NSM bar in South Korea, Repair of cracked cap beam using bonded FRP plate in New York.

- Project tasks

Project Task Descriptions – Task 0: Project management, Task 1: Literature review and identification of pursued application, Task 2: Close minor research gaps, Task 3: Implementation, Task 4: Monitoring bridge performance, Task 5: Analysis of results and reporting.

- Schedule

Schedule – Discussed dates for task 1, 2, and 3 reports. Current focus is task 1 (literature review) and narrowing down the topics MDT is most interested in.

Intermediate Discussion:

David Crumly: Asked about construction timeline and when FRP would be implemented since the construction window is narrow in Montana. Wants us to be aware about current projects sometimes not getting bids and how we'll need to plan ahead.

Kirsten Matteson: The contractors will be responsible for construction costs. The MSU research team and MDT technical panel will be helping/guiding them.

Lenci Kappes: Added that we'll be open ended and flexible. We'll involve the contractors as early as possible and get their feedback as well.

David Crumly: Mentioned there will be challenges if we do not have anything upfront to make anyone interested since it may be a relatively smaller project.

Lenci Kappes: We should be identifying the risks and be upfront with contractors about what we expect.

Tyler Steffan: Shared experience of working on Trail Creek bridges. Talked about joint mock up, acceptance criteria, inviting the contractors in meetings, Q/A session and recording the meeting, discussion on technical matters.

Kirsten Matteson: It was helpful having the back and forth with contractors before actual construction to know what the contractors are thinking about and shed light on the “minor research gaps”.

David Crumly: Engineers, contractors, and researchers work differently. Also added risk for short term projects.

Lenci Kappes: Mentioned we are just at the starting point now. Find out how powerful FRP is regarding time and strength.

David Crumly: For instance, FRP wrapping timber in emergency/temporary solution. It should not take long preparation.

- Literature review

Literature review – Will gather info on existing FRP uses on Montana bridges. Research team will reconnect with MDT members (Lenci and Tim Welter?) to discuss searching the MDT database. Some topics discussed: timber vs. concrete, surface preparation, debonding issues, application method, performance in extreme environments, and ideas from TP scope meeting, column seismic retrofitting.

David mentioned adding details to the Lit review for the different projects: what team was responsible, what was the total project scope, was it design, bid, build (DBB) or just a maintenance team, etc...

Also include details about smaller “patching” type projects as well.

- Discussion

Open discussion and Questions

David Crumly: Timber pile repair works great. Caps and girder repairs are challenging. Colorado DOT had a project on FRP for timber girder repair. They abandoned the project for some reasons. The contact person of the project is Natasha Butler.

Kirsten Matteson: We will reach out to Natasha Butler to discuss why they abandoned the project. We are keeping both timber and concrete for now. We will keep discussing and narrow down soon. We don't want to spend much time on something that MDT is not interested in or that won't be feasible.

David Crumly: Also mentioned some factors that affect the timber performance such as temperature, humidity.

David Crumly: Mentioned some points on literature review – if somebody already figured out, debonding issue, what type of inspection and repair, failure indication, how other state DOTs handled that, documentation of repair method(s).

Lenci Kappes: After finishing the project, we need to keep inspecting. He mentioned to look for what is good and what is bad. For example, what type of crack we are looking at and how we would fix that?

Meghan Coon: Mentioned that the project looks good, and she is interested in working on this.

Jessica Jenks: Mentioned that there are some potential bridges in Missoula district that could work for the implementation part of the project.

Tyler Steffan: Put two bridge numbers in chat box: UPN: 8802 (Br #05868) and UPN: 7659 (Br #02096).

Stephanie Brandenberger: Added that discussion is great. Important for us to keep an open mind. Know what other states did. Why Colorado DOT stepped out? Likes the idea of potentially going the maintenance project route instead of DBB.

Kirsten Matteson: Mentioned applying the FRP strengthening/repairs on a few bridges, smaller scale.

Lenci Kappes: Added applying on 3 to 4 different scenarios, state maintenance type projects, small scale.

David Crumly: Mentioned bridges with postings. If there is crack, this can be a starting point.

Tyler Steffan: Talked about bridge ratings and why they are important. Also, brought up the point that sometimes the rating isn't actually increased after repairs. Make sure we know what affects our repair/strengthening will have on the bridge (and rating).

David Crumly: Agrees with Tyler. Talked about load ratings, super and sub structure ratings. Look at load posted bridges first. Do we also need to repair, or just strengthen?

Stephanie Brandenberger: Remember to keep strengthening in mind. Not just repairs.

Kirsten Matteson: Mentioned we'll dive into literature review now. We will discuss what we find and take input from MDT technical panel.

Lenci Kappes: Talked about quarterly and intermediate reports. Told to keep an open eye and inform if anyone comes across bridge projects that may be good for implementation.

Vaneza Callejas: Mentioned participation is crucial. Reminded TP about giving comments and keeping the project going.

Vaneza thanked everyone and wrapped up the meeting.

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Kick-off Meeting, 02/06/2023

Kirsten Matteson, PhD
Michael Berry, PhD
Emtiaz Ahmed, MS, GRA

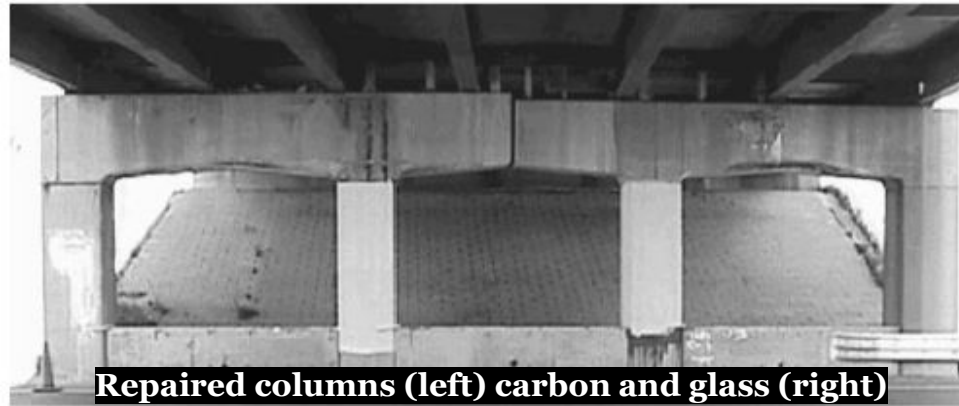
Outline

- Example Applications
- Project Tasks
- Schedule
- Literature review
- Discussion

Example Applications



Corrosion damage



Repaired columns (left) carbon and glass (right)

Repairing of four corrosion damaged columns using **external wrapping** under the I-96 overpass, Lansing Road, Lansing, **Michigan** (Harichandran and Baiyasi 2000)



Damaged Area in the Girder



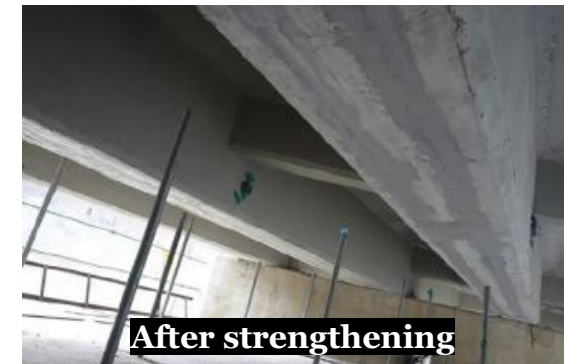
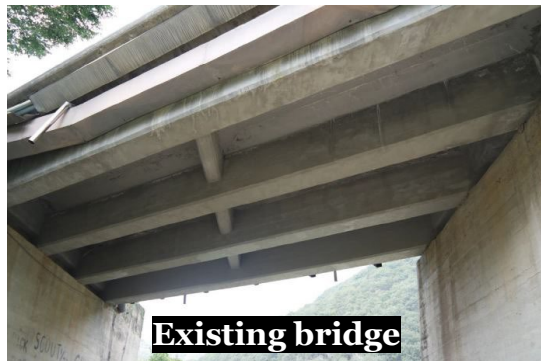
Application of CFRP Sheets



U-Wraps Installation

Retrofitting of Bridge A5657 using **CFRP sheet and U-wrap** over Gasconade River, South of Dixon, **Missouri** (Parretti et al. 2003)

Example Applications cont...



Strengthening of the Buhung Bridge using **CFRP NSM bar**, Gyeonggi-do, South Korea (Lee et al. 2018)



Repair of cracked cap beam using **bonded FRP plate**, East Church Street bridge, Over State Route 17 City of Elmira, **New York** (Hag-elsafi et al. 2002)

Project Tasks

Task	Description
1. Project management	<ul style="list-style-type: none"> - The project will be managed in terms of contractual compliance, budget and schedule, administrative tasks, and communications with the Technical Panel.
2. Literature review and identification of pursued application	<ul style="list-style-type: none"> - Applications MDT has already pursued and documenting level of success of each. - Research on MDT's biggest needs. - Decision point for choosing the application(s) we'll pursue.
3. Close minor research gaps	<ul style="list-style-type: none"> - Focuses on <ul style="list-style-type: none"> • gathering info required for chosen application(s). • closing minor research gaps. - Identifying what needs to be tested, what questions need to be answered.
4. Implementation	<ul style="list-style-type: none"> - Identifying potential bridge - Aiding MDT with developing material specifications (or modifying existing ones if needed). - Assisting contractors with mockup and actual construction.
5. Monitoring bridge performance	<ul style="list-style-type: none"> - The bridge will be monitored routinely. - Any potential sign of damage will be documented.
6. Analysis of results and reporting	<ul style="list-style-type: none"> - Results will be collected and analyzed thoroughly. - A comprehensive final report will be presented.

Schedule

Activities	Dates	Project Quarters 1-12											
		1	2	3	4	5	6	7	8	9	10	11	12
		Jan 1 - Mar 31, 2023	Apr 1 - Jun 30, 2023	Jul 1 - Sep 30, 2023	Oct 1 - Dec 31, 2023	Jan 1 - Mar 31, 2024	Apr 1 - Jun 30, 2024	Jul 1 - Sep 30, 2024	Oct 1 - Dec 31, 2024	Jan 1 - Mar 31, 2025	Apr 1 - Jun 30, 2025	Jul 1 - Sep 30, 2025	Oct 1 - Dec 31, 2025
Kick-off Meeting	02/06/2023	X											
Task 0 - Project Management		X	X	X	X	X	X	X	X	X	X	X	X
Task 1 - Literature Review and Identification of Pursued Application		X	X							X	X	X	X
Task 1 Report	6/23/2023		X										
Intermediate Technical Panel Meeting	7/10/2023			X									
Task 2 - Close Minor Research Gaps				X	X	X	X	X					
Task 2 Report	8/30/2024							X					
Task 3 - Implementation							X	X	X	X			
Task 3 Report	3/28/2025									X			
Task 4 - Monitoring Bridge Performance										X	X	X	X
Task 5 - Analysis of Results and Reporting			X				X	X	X	X	X	X	X
Draft Final Report	8/29/2025											X	
Project Summary Report	10/10/2025												X
Performance Measures Report	10/10/2025												X
Project Poster	10/10/2025												X
Final Report	11/21/2025												X
Final Presentation and Webinar	12/12/2025												X
Implementation Meeting	12/12/2025												X
Implementation Report	12/19/2025												X

Literature Review

- Use of FRP in existing Montana bridge strengthening and repair projects.
- Material properties, specifications, and application methods documented by other researchers and state agencies. Specifically:
 - Timber vs. concrete repairs.
 - Surface preparation.
 - Typical application methods.
 - Debonding mitigation.
 - Performance in extreme environments.

Literature Review

Other ideas from TP Scope meeting

- Repairing deteriorating sub-structures.
- Strengthening super structure to increase load ratings.
- How to deal with hard to reach “vertical” applications?
- Learning what other states are doing with NSM strengthening bars.
- Column seismic retrofitting.

Discussion

- Thoughts from TP on direction of literature review
- Best way to search bridges in MDT database?

References

- Harichandran R & Baiyasi M. (2000). *Repair of Corrosion-Damaged Columns Using FRP Wraps*. Research Report RC-1386, Michigan Department of Transportation, Lansing, MI.
- Parretti R, Nanni A, Cox J, Jones C and Mayo R (2003). *Flexural Strengthening of Impacted PC Girder with FRP Composites. Field Applications of FRP Reinforcement: Case Studies*. Editors: Sami Rizkalla and Antonio Nanni, 2003. ACI International SP215, pp.249-261.
- Lee, H., Jung, W. T., & Chung, W. (2018). Field test of an old RC bridge before and after NSM strengthening. *Composite Structures*, 202(March), 793–801. <https://doi.org/10.1016/j.compstruct.2018.04.024>
- Hag-elsafi, O., Lund, R., & Alampalli, S. (2002). *Strengthening of Church Street Bridge Pier Capbeam Using Bonded FRP Composite Plates : Strengthening and Load Testing*.