

Quarterly Progress and Performance Indicators Report:

Project Number and Title: Project 1.13: Structural Integrity, Safety, and Durability of Critical Members and Connections of Old Railroad Bridges under Dynamic Service Loads and Conditions

Research Area: Thrust 1 -Transportation Infrastructure Monitoring & Assessment for Enhanced Life

PI: Ramesh B. Malla, Ph.D., F. ASCE, F. EMI, Professor, Department of Civil & Environmental Engineering, University of Connecticut, and **Institutional Lead** for US DOT Region 1 UTC-TIDC Program

Co-PI(s): N/A

Reporting Period: April 01, 2022, to June 30, 2022

Submission Date: June 30, 2022

*****IMPORTANT: Please fill out each section fully and reply with N/A for questions/sections with nothing to report. For ease of reporting to the USDOT, please do not remove, or change the order of, any sections/text. You may remove/add each rows in tables as needed. Thank you! *****
The report is due on the last day of the reporting period in .doc format to tidc@maine.edu.

Overview:

Provide **BRIEF** highlights of activities performed during the reporting period.

Research work performed over this reporting period has been aligned with task 1 to task 3 of the proposed task list:

- The research team has collected the list of Railroad Bridges in New Haven line in Connecticut operated by Metro North Railroad and categorized these bridges in terms of year built, bridge type and bridge material (Figure 1, 2& 3). And effort is underway to collect similar information form other New England states.
- The team has made good progress analyzing field test data and started finite element modeling and analysis of local members and connections like stringers (Figure 4), gusset plate and eye bars of railroad truss bridges.
- The team presented to K -5 students on June 24, 2022, and K-12 students on June 25, 2022 through the Connecticut Invention Convention (CIC), an internationally recognized non-profit educational organization based in Hartford, CT , about the railroad project in which the participants learned about the condition of railroad bridge in Connecticut and need for research to enhance their life.
- The research team held a meeting with the Technical Champions of the project from CT DOT, Amtrak, Genesee and Wyoming inc., Metro North Railroad and Polytec Inc. on June 30, 2022.

Meeting the Overarching Goals of the Project:

How did the previous items help you achieve the project goals and objects? Please give one bullet point for each bullet point listed above.

- Accumulation of in-depth information on bridges in New Haven line operated by Metro north, for example: year built, bridge type, bridge material, year rehabilitated, rating and critical members.
- Modeling and analysis of local members and critical connections to understand their behavior from the dynamic service loading of different trains- Amtrak Acela, Amtrak Regional and Metro North.
- K-12 Student outreach activities

Accomplishments:

List any accomplishments achieved under the project goals in bullet point form...

- Modeling and analysis of critical connections like gusset plate and eye bar based on the results from the global analysis.
- Dissemination of research results and Outreach to K-5 and K-12 students.
- The team continue to maintain strong collaboration with ConnDOT, Metro North and other rail industries.

Task, Milestone, and Budget Progress:

Complete the following tables to document the work toward each task and budget (add rows/remove rows as needed, make sure you complete the Overall Project progress row and include all tasks even if they have ended or have not been started) ...

Table 1: Task Progress			
Task Number: Title	Start Date	End Date	% Complete
Task 1: Literature search and existing data review	Oct 01, 2021	May 01, 2023	40%
Task 2: Global Analysis to Identify critical members and connections	Feb 01, 2022	May 01, 2022	25%
Task 3: Local Analysis to understand the Behavior of critical members and connections	May 01, 2022	Oct 01, 2022	30%
Task 4: Field tests to validate the FE model	Oct 01, 2022	Feb 01, 2023	0%
Task 5: Members and Connection strengthening and anti-wear methods	Feb 01, 2023	May 01, 2023	0%
Task 6: Final Report preparation and submission	May 01, 2023	Sep 30, 2023	0%

Table 2: Milestone Progress			
Milestone #: Description	Corresponding Deliverable	Start Date	End Date
Milestones will closely represent task items listed above	Quarterly and final reports	Will closely follow task dates (See Table 1 above)	Will closely follow task dates (See Table 1 above)

Table 3: Budget Progress		
Project Budget	Spend – Project to Date	% Project to Date (include the date)
<i>Enter Phase 1 Full Budget</i>	<i>Enter Phase 1 Full Spend Amount (Federal + Cost Share)</i>	<i>Enter Phase 1 % Spent</i>
Will be provided separately	Will be provided separately	Will be provided separately

Is your Research Project Applied or Advanced?

- Applied** (*The systematic study to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.*)
- Advanced** (*An intermediate research effort between basic research and applied research. This study bridges basic (study to understand fundamental aspects of phenomena without specific applications in mind) and applied research and includes transformative change rather than incremental advances. The investigation into the use of basic research results to an area of application without a specific problem to resolve.*)

Education and Workforce Development:

Answer the following questions (N/A if there is nothing to report):

1. Did you provide any workforce development or training opportunities to transportation professionals (already in the field)? If so, what was the training? When was it offered? How many people attended? (i.e. The research team provided an in the field training for the SAR technology for 3 maintenance crew members of the MassDOT on 3/31/2021. The members learned how to use the technology and interpret the data.)
 - N/A
2. Did you hold meetings with any transportation industry organizations or DOTs? If so, what was the meeting's purpose? When was it offered? How many people attended? (i.e. The research team held a meeting with MaineDOT to update them on the progress of the research findings and how the findings can be implemented on 3/31/2021. 15 DOT maintenance members were present at the meeting.)
 - Virtual meeting held on June 30th, 2022, from 1:00 PM to 2:45 PM (ET) with 6 Technical Champions and representatives from the CT DOT, Amtrak, Metro-North Railroad Co., Genesee and Wyoming Inc., and Polytec Inc., provide project update and receive feedback.
3. Did you host/participant in any K-12 education outreach activities? If so, what was the activity? What was the target age/grade level of the participants? How many students/teachers attended? When was the activity held? (i.e. 25 8th graders and 2 teachers visited the concrete lab and created small concrete trinkets like Legos on 3/31/2021. They learned about the different types of fibers that can be used in the concrete.)
 - Presented Early College Innovation Panel virtual presentation on the topic related to the railroad transportation infrastructure to K -5 students on June 24, 2022, and K-12 students on June 25, 2022, through Connecticut Invention Convention (CIC), an internationally recognized non-profit educational organization based in Hartford, CT. A promotional flyer was prepared and shared with the CIC student list widely through e-mail and its social media platforms (See Appendix A). Students learned about different types of railroad bridges, different parts in railroad bridges, different material used in railroad bridge construction, different types of trains operated in New England, challenges railroad bridges facing and their remedies. The research team also conveys a message of need of more research and innovation to enhance the life of more than 115 years old railroad bridges in New England. The presentation sessions have been video recorded and are being made available to watch by the CIC students from around the State of Connecticut.

Technology Transfer:

Complete all of the tables below and provide additional information where requested. Please provide ALL requested information as this is one of the most important sections for reporting to the USDOT. **ONLY provide information relevant to this reporting period.**

Use the table below to complete information about conference sessions, workshops, webinars, seminars, or other events you led/attended where you shared findings as a result of the work you conducted on this project:

Table 4: Presentations at Conferences, Workshops, Seminars, and Other Events

Type	Title	Citation	Event & Intended Audience	Location	Date(s)
<i>i.e. Conference, Symposium, DOT/AOT presentation, Seminar, etc.</i>	<i>Presentation Title</i>	<i>Full Citation</i>	<i>Name of event (i.e. TIDC 1st Annual Conference) or who was the presentation given to?</i>		
Presentation	Railroad Transportation: Trains, Bridges, and Tracks	Max Raha, Santosh Dhakal, Celso Cruz De Oliveira, Prof. Ramesh Malla, “Railroad Transportation: Trains, Bridges, and Tracks,” Oral presentation/video recording, K -5 students’ program, Connecticut Invention Convention (CIC), Hartford, CT (Virtual), June 24, 2022 (4:30 PM – 5:30 PM)	Connecticut Invention Convention (CIC) <i>Early College Innovation Panel:</i> K-5 Students	Connecticut Invention Convention (CIC), Hartford, CT (Virtual)	June 24 2022
Presentation	Railroad Infrastructure: USDOT Railroad Bridge Research Project at UConn	Max Raha, Santosh Dhakal, Celso Cruz De Oliveira, Prof. Ramesh Malla, “Railroad Infrastructure: USDOT Railroad Bridge Research Project at UConn,” Oral presentation/video recording, K -12 students’ program, Connecticut Invention Convention (CIC), Hartford, CT (Virtual), June 25, 2022 (4:30 PM-5:30 PM)	Connecticut Invention Convention (CIC) <i>Early College Innovation Panel</i> Grade 6-12 Students	Connecticut Invention convention (CIC), Hartford, CT (Virtual)	June 25 2022

Use the table below to report any publications, technical reports, peer-reviewed articles, newspaper articles referencing your work, graduate papers, dissertations, etc. written as a result of the work you conducted on this project. Please list only completed items and exclude work in progress.

Table 5: Submitted/Accepted Publications, Technical Reports, Theses, Dissertations, Papers, and Reports				
Type	Title	Citation	Date	Status
<i>i.e. Peer-reviewed journal, conference paper, book, policy paper, magazine/newspaper article</i>	<i>Publication title</i>	<i>Full citation</i>		<i>i.e. Submitted, accepted, under review (by org. submitted to)</i>
N/A	N/A	N/A	N/A	N/A

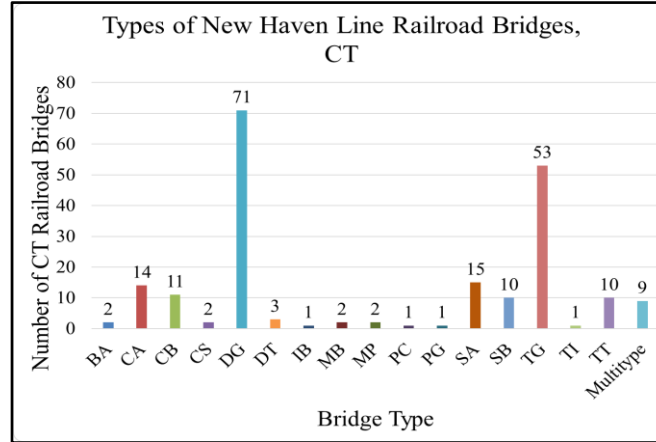
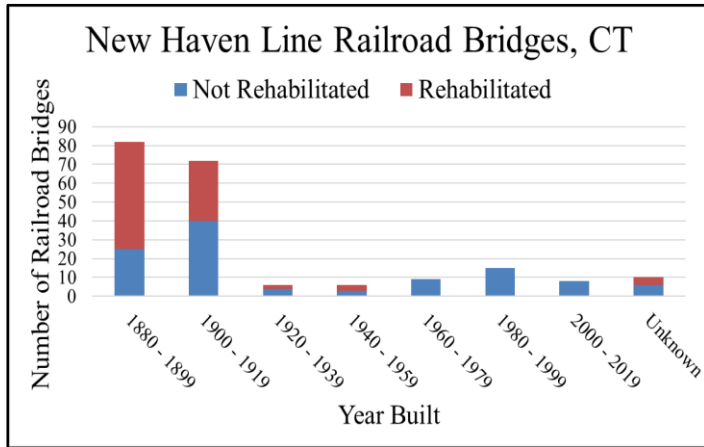
Answer the following questions (N/A if there is nothing to report):

1. Did you deploy any technology during the reporting period through pilot or demonstration studies as a result of this work? If so, what was the technology? When was it deployed?
 - N/A
2. Was any technology adopted by industry or transportation agencies as a result of this work? If so, what was the technology? When was it adopted? Who adopted the technology?
 - N/A
3. Did findings from this research project result in changing industry or transportation agency practices, decision making, or policies? If so, what was the change? When was the change implemented? Who adopted the change?
 - N/A
4. Were any licenses granted to industry as a result of findings from this work? If so, when? To whom was the license granted?
 - N/A
5. Were any patent applications submitted as a result of findings from this research? If so, please provide a copy of the patent application with your report.
 - N/A
6. Did industry organizations or DOTs provide cost-share (cash or in-kind) to your research during the reporting period? Who was the organization? Please provide an in-kind support invoice from the organization with your report (this is kept confidential and used for record keeping purposes only).

Yes. Polytec, Inc. Hudson, MA), Metro-North Railroad (Bridgeport CT), CT DOT (Newington, CT)

Please add figures/images that can be included on the website and/or in marketing/social media materials to further clarify your research to the general public. This is very important to our Technology Transfer initiatives.

Insert figures here



BA=Brick Arch
CA=Concrete Arch
CB=Concrete Box Culvert
CS=Concrete Slab
DG=Deck Girder
DT=Deck Truss **IB**=I-Beam
MB=Metal pipe Culvert
PC=Prestressed Concrete Slab
PG=Prestressed Girder
SA=Stone Arch
SB=Stone Box Culvert
TG=Through Girder
TI=Timber Trestle
TT=Through Truss

Figure 1 – Number of bridges-Built vs Rehabilitated by Year Built (Metro North manages New Haven line in CT)

Figure 2 – Number of bridges by Bridge Type (Metro North manages New Haven line in CT)

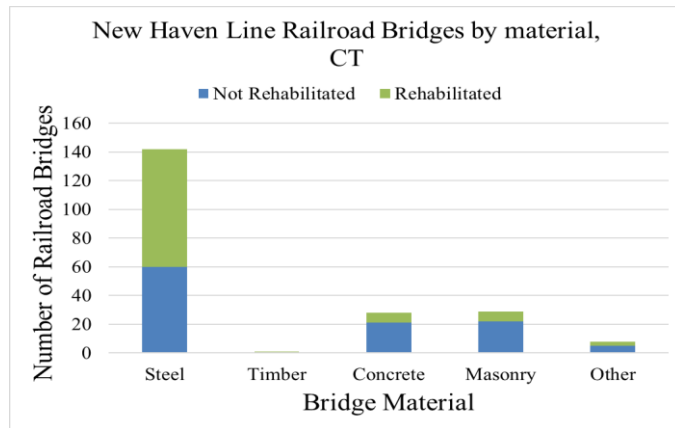


Figure 3 – Number of bridges by Bridge Material (Metro North manages New Haven line in CT)

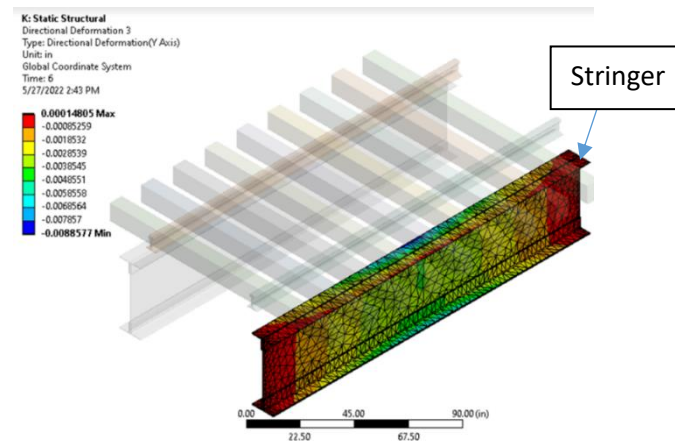


Figure 4 – FEM model of a stringer, Devon Bridge, CT

Describe any additional activities involving the dissemination of research results not listed above under the following headings:

Outputs:

Definition: Any new or improved process, practice, technology, software, training aid, or other tangible product resulting from research and development activities. They are used to improve the efficiency, effectiveness, and safety of transportation systems. List any outputs accomplished during this reporting period:

- The team has made good progress developing procedure for analyzing field test data and finite element modeling and analysis of local members and connections like stringers, gusset plate and eye bars of truss railroad bridges.

Outcomes:

Definition: The application of outputs; any changes made to the transportation system, or its regulatory, legislative, or policy framework resulting from research and development activities. List any outcomes accomplished during this reporting period:

- N/A

Impacts:

Definition: The effects of the outcomes on the transportation system such as reduced fatalities, decreased capital or operating costs, community impacts, or environmental benefits. The reported impacts from UTCs are used for the assessment of each UTC and to make a case for Federal funding of research and education by demonstrating the impacts that UTC funding has had on technology and education. NOTE: The U.S. DOT uses this information to assess how the research and education programs (a) improve the operation and safety of the transportation system; (b) increase the body of knowledge and technologies; (c) enlarge the pool of people trained to develop knowledge and utilize technologies; and (d) improves the physical, institutional, and information resources that enable people to have access to training and new technologies. List any outcomes accomplished during this reporting period:

- N/A, project still on earlier stage.

Participants and Collaborators:

Use the table below to list individuals (compensated or not) who have worked on the project other than students.

Table 6: Active Principal Investigators, faculty, administrators, and Management Team Members				
Individual Name & Title	Dates involved	Email Address	Department	Role in Research
Dr. Ramesh B. Malla, Professor (Principal Investigator)	Apr.-Jun. 2022	Ramesh.Malla@UConn.EDU	Civil & Environmental Engineering, University of Connecticut, Storrs, CT	Principal Investigator (PI)/ TIDC Institutional Lead, UConn

Use the table below to list **all** students who have participated in the project during the reporting period. (This includes all paid, unpaid, intern, independent study, or any other student that participated in this project.) **ALL FIELDS ARE REQUIRED.**

Table 7: Student Participants during the reporting period

Student Name	Start Date	End Date	Advisor	Email Address	Level	Major	Funding Source	Role in research
				<i>Email is not included in the external report and is only used for internal purposes.</i>	<i>(i.e. UG, MS, PhD)</i>		<i>(i.e. TIDC, Other university funds, unpaid intern, etc.</i>	<i>What work are they conducting? Please be descriptive. Student research assistant is not enough info.</i>
Celso de Oliveira	Apr. 01, 2022	Jun. 30, 2022	Dr. Ramesh Malla		Ph.D.	Structural Engineering/Civil Eng.	U.S. DOT UTC-TIDC & UConn	Literature Search/FEM Modeling
Santosh Dhakal	Apr. 01, 2022	Jun. 30, 2022	Dr. Ramesh Malla		M.S.	Structural Engineering /Civil Eng.	U.S. DOT UTC-TIDC & UConn	Literature Search/FEM modeling
Max Raha	May 15, 2022	Jun. 30, 2022	Dr. Ramesh Malla		B.S.	Civil Eng.	U.S. DOT UTC-TIDC & UConn	Literature Search

Use the table below to list any students who worked on this project and graduated or received a certificate during this reporting period. Include information about the student's accepted employment during the reporting period (i.e. the student is now working at MaineDOT) or if they are continuing their students through an advanced degree (list the degree and where they are attending).

Table 8: Students who Graduated During the Reporting Period

Student Name	Degree/Certificate Earned	Graduation/Certification Date	Did the student enter the transportation field or continue another degree at your university?
			Please list the organization or degree
Celso de Oliveira	Graduate Bridge Engineer Certificate	05/08/2022	Attending Ph.D. at UConn

Use the table below to list any students that participated in Industrial Internships during the reporting period:

Table 9: Industrial Internships

Student Name	Degree/Certificate Earned	Graduation/Certification Date	Did the student enter the transportation field or continue another degree at your university?
			Please list the organization or degree
N/A	N/A	N/A	N/A

Use the table below to list **organizations** that have been involved as partners on this project and their contribution to the project during the reporting period.

Table 10: Research Project Collaborators during the reporting period

Organization	Location	Contribution to the Project				
		Financial Support	In-Kind Support	Facilities	Collaborative Research	Personnel Exchanges
		List the amount	List the amount	Mark with an "x" where appropriate		
Conn DOT Contact persons: (1) Hareesh Dholakia-Transportation Engineering Supervisor, Rail Design (<i>Technical Champion</i>) (2) Mr. Manesh Dodia-Supervising Rail Officer, Rail Construction (<i>Technical Champion</i>)	Newington, CT		X		X	
Metro-North Railroad Co. Contact persons: (1) Warren Best-Assistant Deputy Director- Structures (<i>Technical Champion</i>) (2) Ms. Hong McConnell, Senior Structural Engineer	Bridgeport, CT		X		X	
Polytec, Inc., Contact Person: Mr. Mario Pineda, Territory Manager	Hudson, MA		X		X	
Amtrak	Philadelphia, PA				X	

Contact Person: Paul DelSignore, Deputy Chief Engineer – Structures						
Genesee & Wyoming Inc. Contact Person: Chad R. Boutet, Assistant Vice President - Engineering	Indianapolis, IN				X	

Use the table below to list **individuals** that have been involved as partners on this project and their contribution to the project during the reporting period. (**List your technical champion(s) in this table.** This also includes collaborations within the lead or partner universities who are not already listed as PIs; especially interdepartmental or interdisciplinary collaborations.)

Table 11: Other Collaborators				
Collaborator Name and Title	Contact Information	Organization and Department	Date(s) Involved	Contribution to Research
	<i>For internal use only</i>			<i>(i.e. technical champion, technical advisory board, test samples, on-site equipment, data, etc.)</i>
Haresh Dholakia, Transportation Engineering Supervisor, Rail Design		Connecticut Department of Transportation (Conn DOT), Newington, CT	Apr.-Jun. 2022	Technical Champion
Manesh Dodia, Supervising Rail Officer, Rail Construction		Connecticut Department of Transportation (Conn DOT), Newington, CT	Apr.-Jun. 2022	Technical Champion
Warren Best, Assistant Deputy Director- Structures		Metro-North Railroad Company, Bridgeport, CT	Apr.-Jun. 2022	Technical Champion
Mario Pineda, Territory Manager		Polytec Inc., Hudson, MA	Apr.-Jun. 2022	Technical Champion
Paul DelSignore, Deputy Chief Engineer – Structures		Amtrak, Philadelphia, PA	Apr.-Jun. 2022	Technical Champion
Chad R. Boutet, Assistant Vice President - Engineering		Genesee & Wyoming Inc., Indianapolis, IN	Apr.-Jun. 2022	Technical Champion
McConnell Hong Sr. Structural Engineer		Metro-North Railroad Company, Bridgeport, CT	Apr.-Jun. 2022	Senior Engineer/Logistic contact

Use the following table to list any transportation related course that were taught or led by researchers associated with this research project during the reporting period:

Table 12: Course List						
Course Code	Course Title	Level	University	Professor	Semester	# of Students
<i>i.e. CE 123</i>		<i>Grad or undergrad?</i>	<i>Where was the course taught?</i>	<i>Who taught the course?</i>	<i>Enter Spring, Fall, Summer, Winter and the year</i>	<i>How many students were enrolled in the class?</i>
CE 5122	Advance Mechanics of Material	Grad	Storrs, CT	Prof. R. Malla	Spring 2021	9
CE 3630	Design of Steel Structures	Undergrad / lab class	Storrs, CT	Celso de Oliveira (Teaching Assistant)	Spring 2022	45
CE 4510	Foundation Design	Undergrad	Storrs, CT	Santosh Dhakal (Teaching Assistant)	Spring 2022	60

Changes:

List any actual or anticipated problems or delays and actions or plans to resolve them (list no-cost extension requests here) ...

- N/A

List any changes in approach and the reasons for the change...

- N/A

Planned Activities:

List the activities planned during the next quarter.

Research activities planned for next quarter include the following:

- Continue to work on literature search to find more project relevant information.
- Continue modeling and analysis of critical connections like gusset plate and eye bars.
- Perform field testing on selected bridge members, using strain-gauges, accelerometers, and Laser Doppler Vibrometer.
- Analyze field test data and make comparison with the results from the FEM.

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UCONN CIVIL & ENVIRONMENTAL ENGINEERING

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Ramesh Malla
Professor



Celso Cruz de Oliveira
Ph.D. Student



Santosh Dhakal
M.S. Student



Max Raha
Undergrad Student

K - 5TH GRADE **June 24th, 2022 | 4:30 – 5:30pm ET**

Join us aboard for a discussion on the history of railroads and make interesting discoveries about the trains and railways of today! Hear about the major milestones of railroad infrastructure presented by UConn students and professor while answering with prizes to be awarded at the end for students with the most correct answers.

TOPICS:

- + Oldest railroads around the world
- + Different types of railroad bridges
- + Future of trains

EarlyCollegeInnovationPanelK-5.eventbrite.com

6 - 12TH GRADE **June 25th, 2022 | 4:30 – 5:30pm ET**

Join us to learn about the inner workings of today's railroads and to hear about one of the many research projects happening at the University of Connecticut. There will be a Q&A session at the end in which students will be given the opportunity to interact with a professor as well as undergraduate and graduate level students of UConn.

TOPICS:

- + Brief history of railroads and railroad bridges
- + UConn Railroad Bridge Research Project
- + Current Events such as railroad delays and high speed rail in the US

EarlyCollegeInnovationPanel6-12.eventbrite.com

Figure 5 – K-5 grade students and 6-12 grade students Presentation Flyer