July 2020 Research Seminar: Synthesis of Available Methods for Repair of Reinforced Concrete and Prestressed Concrete Girders		
#	**Questions**	**Responses**
	Decision Process	
1	Are there any clear thresholds for repair or replacement ?	No, but please have a look at the damage classification in Table 1.1 of the final report, which will be uploaded soon to the research project web page on the ABC-UTC website.
2	What are the considerations for using these methods / analyses between repairing damaged girders or strengthening existing deficient girders?	They can be used for both.
3	How does one estimate how long a repair will last? This is important for assessing life-cycle cost of repair versus replacement.	This depends on the specific conditions of the project: the type and extent of the damage, the durability of the chosen repair material, the quality of the implementation of the repair, etc.
4	What is the long-term serviceability and durability of the various repair methods?	This depends on the specific conditions of the project: the type and extent of the damage, the durability of the chosen repair material, the quality of the implementation of the repair, etc.
	Prestressed Beam Repairs	
5	How do you repair prestressed beams when the bottom prestressing strands are broken and/or badly deteriorated?	Strand splicing might be used in these situations to restore the prestressing force. Please refer to the final report which will be uploaded soon to the research project web page on the ABC-UTC website.
6	Can you comment on the use of carbon fiber reinforced polymer (CFRP) anchors and CFRP sheets for shear strengthening of prestressed concrete girders?	There is a complete section dedicated to this in the final report which will be uploaded soon to the research project web page on the ABC-UTC website.
7	How do you repair girders with exposed strands since patching doesn't re-engage the prestressing?	Refer to Question 5.

8	When repairing concrete in pretensioned beams, the repair concrete is not prestressed. Is there anything that can be done to address this?	Refer to Question 5.
9	Has anyone developed a repair for prestressed box beams?	Yes, for instance, please check out the following reference from Kentucky DOT: Simpson, I., et al. (2006). "Shear repair of P/C box beams using carbon fiber reinforced polymer (CFRP) fabric."
10	Can you comment on the repair of spalled concrete at bearings for box beams? This is a serious issue in New Jersey for older (e.g., 60-year) box beam bridges.	Spalling of the concrete at the girder ends can cause shear deficiency of the girder. There is an entire section addressing this in the final report which will be uploaded soon to the research project web page on the ABC-UTC website.
	Comparisons	
11	Are there any studies comparing fiber (CAN) to steel (USA) reinforced beams? How do cast-in-place concrete bridges compare to precast/prestressed bridges?	We have not encountered such studies.
12	Can you provide cost comparisons and time comparisons for these repair methods?	Time and cost can be very project specific. They depend on many parameters such as: the type and extent of the damage, the characteristics of the chosen repair material, the available technologies for the implementation of the repair, etc.
13	Can you discuss the top 3 most expensive repair decisions that you would recommend using as an alternative approach?	Recommendations based on the type of the girder deficiency can be found in the final report which will be uploaded soon to the research project web page on the ABC-UTC website.
14	Were concrete patches considered and compared to fiber reinforced polymer (FRP) repairs?	Concrete patches are not studied in this project. Only repair methods that help retain the lost strength of the girders are studied.
	Other	
15	Do any states have standard drawings for different types of prestressed concrete beam repairs?	Yes, please check out the reference list of our final report (which will be uploaded soon to the research project web page on the ABC-UTC website) for DOT-related references.

16	Do you recommend any pre-qualifications or certifications for contractors performing this type of work?	We are not in a position to answer this question.
17	What are the methods to strengthen concrete structures that are in good shape but were designed to older standards?	Based on the specific strengthening needs, the same methods used for repair can be used here as well.
18	Can you comment on proper ways to wrap concrete beams with FRP, not to strengthen, but just to protect from future deterioration and corrosion?	Please refer to the "repair for serviceability" section in the final report (which will be uploaded soon to the research project web page on the ABC-UTC website).
19	How do you select the best protection for mixed concrete when exposed to a corrosive environment?	This was out of our study's scope.
20	What are the rehabilitation methods for existing concrete structures that are susceptible to alkali-silica reaction (ASR) or delayed ettringite formation (DEF)?	This was out of our study's scope.
21	Are there any special repair considerations or techniques for repairing lightweight concrete?	We have not encountered any such references.
22	Did you come across any asymmetric applications of FRP wrap for shear strength improvements?	We have not.
23	Can you comment on fiber reinforced concrete (FRP) repairs?	The majority of the references used in this study utilized an FRP-based material for the repair. Please refer to our final report for more details. The final report will be uploaded soon to the research project web page on the ABC-UTC website.
24	Are there any projects in Peru where the aforementioned techniques have been applied?	We have not encountered any studies from Peru.
	Questions during Seminar	
25	How do you repair reinforced concrete beams constructed with longitudinal cold joints above the neutral axis?	N/A

26	Is applying the mortar to the underside of a beam difficult if it's against gravity?	Using proper formwork should facilitate that.
27	Is there any concern that a patched section would be stiffer than adjacent undamaged sections, due to the increased moment of inertia?	
28	Pages 24 - 26: Steps for repair, need to include shoring first to restore capacity. Steps for repair, need to include rebar cleaning, splicing of new rebar if employed.	These steps were not included in the presentatio, but they can be found in our final report which will be uploaded soon to the research project web page on the ABC-UTC website.
29	How are agencies coding FRP strengthening or repair as an inspection element? It seems these installations are requiring special inspection and defect coding.	This was out of our study scope.
30	When repairs are being made on bridge girders, is the lane of traffic above the girders being repaired closed in order to minimize deflections and vibrations on the girder being repaired?	It depends on the type of the repair and the available technology for its implementation. The deflections and vibrations should not generally affect the repair application process. But even if closure of the traffic lanes is necessary, the closure time will definitely be shorter compared to the traffic closure needed for girder replacement.
31	Page 39/41, FRP appears to be the mostly applied method. Is it because research papers are the most literature reviewed?	Being well-researched is one reason for this recommendation. But the most important reason is enhanced characteristics of FRP based materials compared to others. Please see Table 2-1 in our final report for a list of pros and cons of different repair materials. The final report will be uploaded soon to the research project web page on the ABC-UTC website.
32	Can you share the long-term behavior of these repairs? What would you recommend if rebars are corroded after the repair over time and show rusty stains on FRP wraps?	Long-term behavior of the repairs depends on the specific conditions of the project: the type and extent of the damage, the durability of the chosen repair material, the quality of the implementation of the repair, etc. Proper maintenance of the repair is definitely an important topic but is not covered in this current research.

33	What do you think of centered shear pins installed from the deck to improve shear strength?	We have not seen this strengthening technique in the literature.
34	There are some negative issues associated with fire proofing. These include not being able to inspect the girders after fireproofing and reduction of vertical clearance.	Thank you for pointing this out. Using cement-based composites instead of epoxy for the installation of the FRP material is also an option.
35	Are the repair splices for prestressing strands capable of restoring the full prestressing force?	Please refer to the "strand splicing" section in the final report (which will be uploaded soon to the research project web page on the ABC-UTC website).
36	After applying the CFRP methods of repairs, the reinforced concrete or prestressed concrete girders will be obscured from inspection. Is there technology available for inspection, as the concrete surfaces will not be seen?	This is a good question, but inspection methods are not studied in this project.
37	This seminar is concentrated on repair by FRP. Is there any concern on future inspection since the concrete is covered?	This is a good question, but inspection methods are not studied in this project.
38	Regarding durability issues of repair methods, can you clarify the presumed life of the repair methods?	This depends on the specific conditions of the project: the type and extent of the damage, the durability of the chosen repair material, the quality of the implementation of the repair, etc.
39	After an FRP repair is done, are there visual indicators that will show if the FRP is still bonded to the original beam, that can be used during in-service inspections?	This is a good question, but inspection methods are not studied in this project.
40	Regarding durability, did your answer apply to the bonded FRP-concrete system, or just the FRP material alone?	Durability of the FRP material alone is discussed in our final report which will soon be uploaded to the research project web page on the ABC-UTC website. Durability of the repair system, however, depends on the specific conditions of the project: the type and extent of the damage, the durability of the chosen repair material, the quality of the implementation of the repair, etc.

41	When we do strand splicing, we typically splice the strands, tension them using the coupling, preload the bridge using a loaded truck, and then pour the concrete for the patch.	Thank you for the useful information.
42	We will preload the girder with a dump truck in the lane above prior to repair.	Thank you for the useful information.
43	I was told that the concrete in the bottom of a prestressed beam is just there to protect the strands. It would be easy to patch, and there is no need to "prestress" that patch. You can punch a huge hole through the bottom of a concrete beam, and it's fine as long as the strands are OK. Is that a valid understanding, or is it more complex than that?	In our view, this seems to be a valid understanding; yes.
44	Based on the questions being asked, and in line with my issues, there are agencies who can't afford to perform the expensive FRP and similar repairs and don't need the strengthening, but rather protection. We wind up patching beam end spalls, and applying a waterproofing coating. I think it would be hellpful, for the future, besides cathodic protection, to know what materials are best to clean existing strands, patch areas with concrete, etc. In other words, what is the best "bandaid." For example, we have performed a repair which removes exterior concrete to strands, and casts a full-height block to provide further protection.	Thank you for the information. The cost of the repair is definitely a major concern. In the literature that we encountered, however, if the damage was too expensive to be repaired, the decision was to replace the girder instead.
45	Comment: Surprised you wouldn't remove live load from the girder before repairs.	This was not included in the presentation in the interest of time. Please refer to our final report under repair process/special considerations for more information. The final report will be uploaded soon to the research project web page on the ABC-UTC website.