

ABC-UTC January 2022 Research Seminar: Critical Impacting Factors/Trends on Bridge Design, Construction, and Operation for Future Planning

#	Questions	Responses
1	What is the consideration of Contractor Claims, weather and/or supply chain delays, and steel costs on bridge design, construction, and operations?	The recent global supply chain delays are causing the shortage on certain construction materials, thus impacting the cost and schedule of bridge construction and maintenance. The steel cost is increasing, with predictions that the prices may become even higher in the near future. All of these factors will eventually increase the construction cost of new bridges and repair and rehabilitation costs of old bridges.
2	Could you discuss Artificial Intelligence (AI) and/or Machine Learning in relation to bridge management best practices?	There is a growing trend of implementing AI and/or machine learning in bridge management best practices, especially in the academic field. However, before we use the new AI or machine learning algorithms, we need to make sure we have better practices in data governance or management. DOTs have large amounts of data, but these data are usually from heterogeneous sources and are not well connected to each other. For example, bridge inspection data are not necessarily linked with bridge maintenance costs. To better use AI or machine learning to manage our bridges or extract new knowledge, we need to first ensure that we manage our data in a systematic and easy to process manner.
3	Can you talk about the impact factors and trends on the bridge maintenance side also?	Multiple factors impact bridge maintenance. For example, the adoption of new techniques (e.g., structural health monitoring techniques such as using drones for inspection) may improve inspection safety and reduce maintenance efforts, and the use of new construction materials (e.g., new coating materials) may reduce bridge maintenance needs in the long run. On the other hand, more frequent extreme events may cause negative impacts on bridges in all aspects, such as accelerating material degradation, threatening structural integrity, delaying construction works, and increasing inspection and maintenance needs and costs.

4	Did you consider how each agency approaches maintenance of bridges (pro-active vs. re-active) when formulating conclusions?	I believe this question requires further study and conversations with each DOT. Different DOTs act differently toward bridge maintenance. Many DOTs still use the reactive approach. However, we think it is important that the DOTs understand and account for the impacts of these multiple factors on the future of bridges, so they can become more proactive to bridge planning and maintenance.
5	From a bridge construction perspective, what are the biggest quality assurance (QA) issues bridge owners are facing today?	I think the most important issue is the long-term durability of bridges. Our bridges are constructed according to design specifications and are well inspected before the completion of the project. However, the long-term durability of bridges cannot be guaranteed. Multiple factors may impact bridge durability, and one of the factors may be related to the types of materials and the construction techniques the contractors use. However, the contractors typically do not hold any responsibility as there are no warranty clauses in the contract documents. As a result, DOTs take full responsibility for the expenses of repair and maintenance. To motivate contractors to provide a long-lasting product, warranties are recommended as a way to improve the quality and durability of bridges.
6	How do you think civil engineering in the U.S. compares with other engineering disciplines globally in terms of the use of the latest technology?	I think there is a growing trend of using new technologies in the civil engineering area in the U.S. Many stakeholders agree that technological factors are among the factors that are most likely to happen. For integration of any new technologies (e.g., structural health monitoring techniques, new communication or navigation tools) into the bridge sector, there is a need for multi-sector stakeholder collaboration that engages government agencies, private industry, and multi-disciplinary researchers to comprehensively facilitate the development and deployment of new technologies from both technical and policy-making perspectives.
7	Is low carbon dioxide (CO ₂) emission concrete currently being specified by DOTs, or will it be in the near future?	Some DOTs (e.g., Caltrans) have approved the use of low-carbon cement. We will need more data and studies to better understand the trend of using low-carbon emission concrete in the future.

8	Is the use of glass fiber-reinforced polymer (GFRP) as a replacement for normal steel reinforcing becoming more accepted by DOTs?	Like any construction materials, there are pros and cons to the use of GFRP in replacing traditional steel reinforcing. The initial cost of the GFRP is a primary concern as it is considerably higher than traditional steel reinforcing. However, this higher initial cost may be offset by a reduction in the concrete cover and the elimination of corrosion inhibiting admixtures. A longer service life may be expected with reduced need for repairs and maintenance. Many stakeholders are calling for more studies on the life-cycle cost of using new materials such as GFRP to justify the benefits of using these materials.
Questions during Seminar		
9	Has your study (or others in the literature) considered the influence/relationship between the individual factors and how that affects the final recommendations?	We have tried to consider the interactions among multiple factors in our study. For example, travel behaviors are affected by advanced technologies (e.g., autonomous vehicles, shared mobility), which are regulated by policies and regulations, all of which could impact bridge design, construction, and operations in the future.
10	Will your future study be including other factors such as consumption, growth, population relocation/migration (urban to rural / inter-state movement), etc.?	We will consider multiple emerging factors in our future study, such as inflation, the infrastructure bill, population relocation, etc.
11	One of the issues I see is the way the specifications are written that allows contractors, especially design-build contractors, to try to cut costs, thus sacrificing durability. Do you have any comments on this?	I think it is important for the DOTs to consider implementing warranty systems in future bridge construction, which requires contractors to warrant the quality of bridges within certain amounts of time, thus ensuring durability.
12	There is a trend that longer and heavier trucks are requesting to cross DOT bridges. How does this affect the future trends of bridge design and maintenance?	We think this will affect bridge structural design, especially for long-span bridges. New design specifications will need to account for such impacts on future bridge design. I think more studies and experiments are needed to provide more specific recommendations on the potential change of design specifications.