Using Accelerated Bridge Construction vs Conventional Bridge Construction for the Replacement of Route 250 bridge
(Technical Topic)

Evaluation of the Impacts Infrastructure Construction has on the Public and their Potential Solutions
(STS Topic)

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

The construction industry has been doing things in a similar way for years. This is even more prominent in bridge construction. Since the first bridge was constructed, the method has stayed consistent; first design, then foundation/soil work, and finally construction of the bridge components. This method is known as Conventional Bridge Construction, or CBC. New infrastructure is always being built or old infrastructure is being repaired across the United States. According to the Congressional Budget Office's website, "In 2017, spending by federal, state, and local governments for transportation and water infrastructure totaled $441 billion." With this high demand, projects are pushed to be done quicker without reducing the quality. This has led to a relatively new method called Accelerated Bridge Construction. This method is increasing in popularity over the last twenty years due to its ability to complete construction in a fraction of the time while still maintaining quality and safety (FHWA, 2011). The question that arises is if accelerated construction should be mainstreamed and used in standard practice or should it only be considered and implemented on a project to project basis. Accelerated construction, especially accelerated bridge construction, I believe, should be pushed to become standard practice in every state across America. If accelerated construction does not become mainstream then older, longer methods of construction will still be used in most projects which then lead to the public having to deal with construction issues such as relocation of traffic on a detour, construction of temporary bypasses which costs additional taxpayer money, general congestion due to lane closures during construction which all affect travel time expectations, or other community related issues.

To help determine if accelerated construction is the correct method for the Route 250 bridge rehabilitation, my capstone group will consider multiple alternatives and analyze which

alternative is the most engineering and economically feasible solution. From there, a cost-benefit analysis of accelerated bridge construction and conventional bridge construction will be done to determine which method works best for our preferred alternative. Independently, I will be researching the impact that construction can have on the public, specifically at the surrounding communities and businesses. Additionally, some research will be done to see the factors behind why accelerated construction hasn't become more of a standard practice over the last thirty years; specifically, from a construction company perspective.

Technical Topic: Using Accelerated Bridge Construction vs. Conventional Bridge Construction for the rehabilitation or replacement of US Route 250 bridge

Initiatives in the 1990s began to push for more research and implementation of accelerated construction. According to Mary Lou Ralls in "History of ABC Implementation in U.S," "In 1996 work toward a national accelerated construction initiative began following the publication of TRB Special Report 249, Building Momentum for Change (8), which recommended creation of a strategic forum to promote accelerated construction in highway infrastructure (3)." This was just the beginning of research and initiatives that would be done by the federal government, Federal Highway Administration, and Department of Transportation from various states in the late 1990s and early 2000s (Lou Ralls,3). Figure 1, shown below, simplistically illustrates the time comparison between the different bridge construction methods.

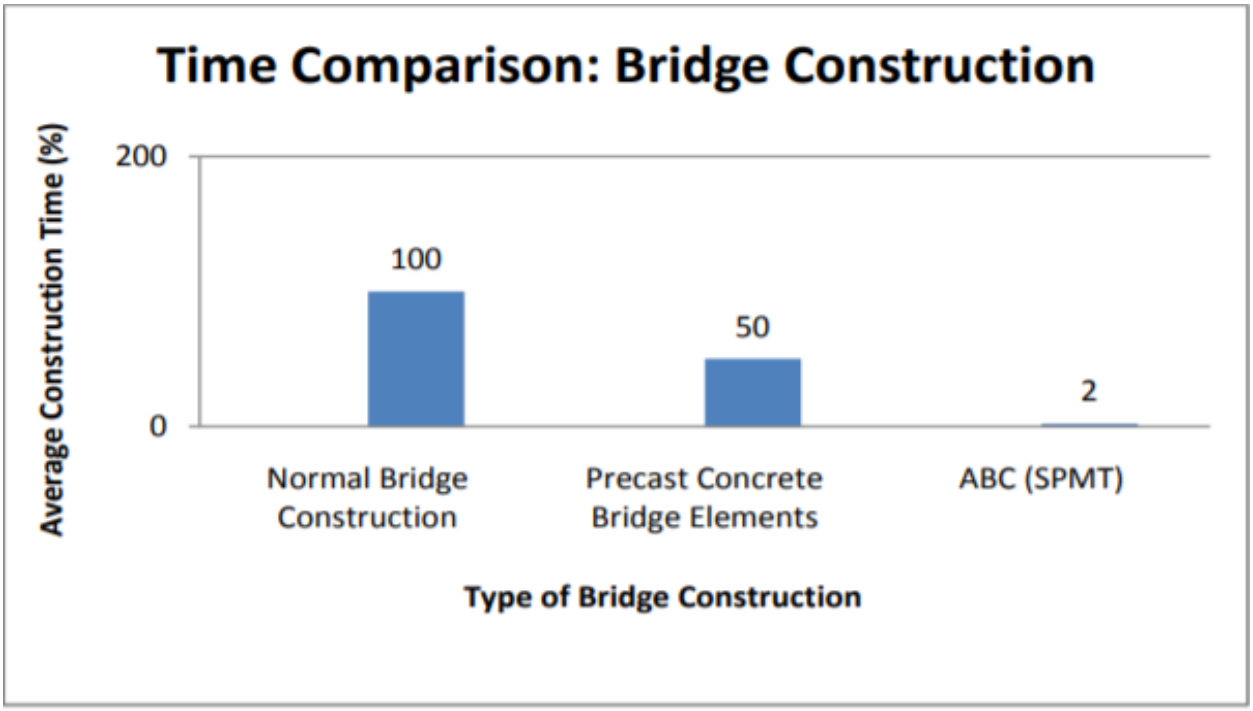

Figure 1: Time comparison of bridge construction approaches. (Lee, J. H., & McCullouch, B. G, 2009, August, p 65).

While Accelerated Bridge Construction is much more efficient, it is generally only used on smaller scale project or for unique traffic control issues at specific sites due to the higher cost and lack of technology to create and implement larger prefabricated bridge elements that would be needed on larger scale projects. A majority of design and construction companies are still only using accelerated construction for unique projects that require such a method and have not begun to make a switch to using accelerated construction as a more common method. This is mainly due to the fact that the higher cost of ABC could lead to that construction company not winning the bid for that project due to a competing company having a lower bid from using conventional methods. With all the benefits of this method, is Accelerated Bridge Construction the correct method for the rehabilitation of the Route 250 bridge? It has to make sense from an engineering and economic perspective along with having support from all the organization that will be involved from the Virginia Department of Transportation to the construction team that will

implement the design. If accelerated construction is not used on Route 250 bridge rehabilitation then users of this road can expect travel time delays for up to three months. This could lead to congestion of other roadways in Charlottesville if users feel the need to use an alternative route to get to their desired destination. Worker safety would also be an issue with conventional bridge construction since the majority of the bridge components are created on site so the construction workers would have to be cautious of the vehicles using the roadway while they construct these bridge components. Finally, the quality of the bridge components is decreased when they are done on site. According to the Federal Highway Administration, "Use of PBES (Prefabricated Bridge Elements and Systems) is one strategy that can meet the objectives to Accelerate Bridge Construction while providing additional benefits beyond those with only reducing on-site construction time: ABC improves: site constructability, total project delivery time, material quality and product durability, and work-zone safety for the traveling public and contractor personnel." This material quality and durability increase is due the prefabricated elements being created in a controlled environment where the strength is tested before leaving the plant while on site bridge elements are created in various environmental conditions from extreme heat to below freezing temperatures, which all have an impact on the 28 day strengthening process that concrete undergoes after being set. To help determine if accelerated construction is the right method for the Route 250 bridge, a series of alternatives will first be created and analyzed. Once a preferred alternative is identified, a cost-benefit analysis will be done to determine what construction method will be best for our project. So, once both of these are done, we will have our preferred alternative with the best construction method that will result in the most benefits for the Route 250 bridge.

STS Topic: Evaluation of the Impacts Infrastructure Construction has on the Public and their Potential Solutions

Construction is an endless process that is always going to be a part of our society. Construction, specifically highway construction, can often lead to congestion of the roadway. This congestion on one roadway can then cause a widespread effect on the surrounding roads and introduce travel delay for more than the users of the highway that is undergoing construction. In general, the public wants quality infrastructure that they know is safe for them to use and for the construction of said infrastructure to come as less of an inconvenience to them as possible. So, a less time consuming, more efficient construction method should be widely welcomed and accepted since it would cause less inconvenience for the users. It may not be accepted, however, that this time saving construction method would cost more money which could be coming directly from their tax dollars. Another issue is getting construction and design firms to coordinate and start implementing accelerated construction methods into more projects. The dilemma of having to choose between longer construction at a cheaper price or shorter construction at higher price will come into play as to which method is preferred and ultimately chosen for a given project. According to Bala Sivakumar, a professional engineer and ABC expert, “Projects typically cost 20% to 30% more than traditional bridge construction jobs.” Infrastructure construction can also impact local communities, especially small, local businesses that are near the construction project. According to research done by the Minnesota Department of Transportation, “Transportation construction projects in Minnesota have wide-ranging impacts that, depending on the size of the project, can have an impact on neighborhoods, entire communities, or sometimes even broader multi-county regions of the State... Often the impacts are very small and of short duration, such as during a routine maintenance project. Larger

construction projects, such as complete reconstruction of an interchange or highway corridor, have several direct and long-term impacts on the daily lives of people." These impacts stated above are far more prominent in the public sector since all the projects done by the state DOT programs and other public entities will generally affect the whole surrounding community due it being under taxpayer dollars and public property. Compared to the private sector where the project location is on a privately-owned piece of land and funded by the owner or other private entities which will lead to less disruption. Public infrastructure construction has been increasing over recent years while private construction has been in decline, as shown below in Figure 2.

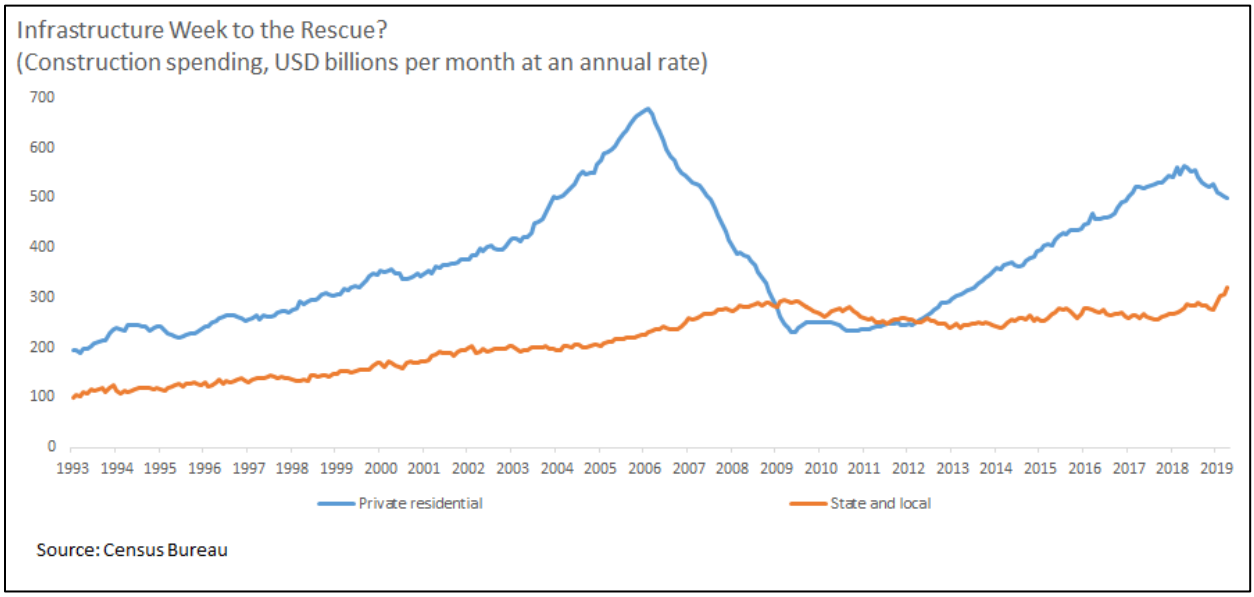

Figure 1: The amount of money spent on construction from private, shown as the blue line, versus public sector spending, shown as the orange line. (Klein M. A. (2019). Retrieved from https://www.barrons.com/articles/the-cure-for-the-home-building-downturn-an-infrastructure-boom-51559725200

With this increase in public sector construction, issues similar to those stated above will continue to become more prominent and need to be considered in more projects moving forward. From a neighborhood/community perspective, the introduction of a new or improved highway may introduce more traffic flow through their community which could introduce safety concerns and may just affect their livelihood depending on the community. From a business perspective, if

traffic is diverted away from the businesses due to it being right next to or near an ongoing construction project then that business may have little to no profit for months depending on the size of the project. These few months of little to no profit may be the deciding factor as to whether they can continue to stay open or having to close down, especially for small, local businesses. The construction method chosen could have a wide range of impacts depending on whether the construction time would be weeks versus months. So, the method chosen should vary from project to project. Public hearings and opinions would have to be heard for the larger projects that would affect the most people to see what they prefer. From MnDOT's research, they have implemented small business outreach as an essential part of their public participation process along with many other programs and processes that will allow for more public opinion and assistance to small businesses when deciding on projects and during the construction of them. Another option to help reduce these impacts would be to better educate the general public of all the complexities that have to be taken into account while designing and constructing the infrastructure so that more productive and informed opinions can be heard on a wide range of public infrastructure projects that are ongoing and ones that will ultimately come in the future.

Conclusion

In order to limit the public impact while maintaining quality and safety of the replacement of the US Route 250 bridge over Little Ivy Creek, my capstone group will be developing a bridge replacement design that ensures quality and safety for the users of Route 250. In addition, my research will contribute an understanding of the vast majority of impacts that small- or large-scale infrastructure construction can have on the surrounding communities and businesses. With this, I can implement solutions that will help mitigate the impacts that construction may have. If both of these projects are successful, it will result in a better

understanding of the social impacts that construction can cause and the potential solutions to lessening the impacts of said issues. Finally, it will assist in providing methods of how accelerated bridge construction tools can be implemented to reduce the public impact due to construction related issues and delays.

Word Count: 1870

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