EMBRACING CHANGE

Innovate or live in the past?

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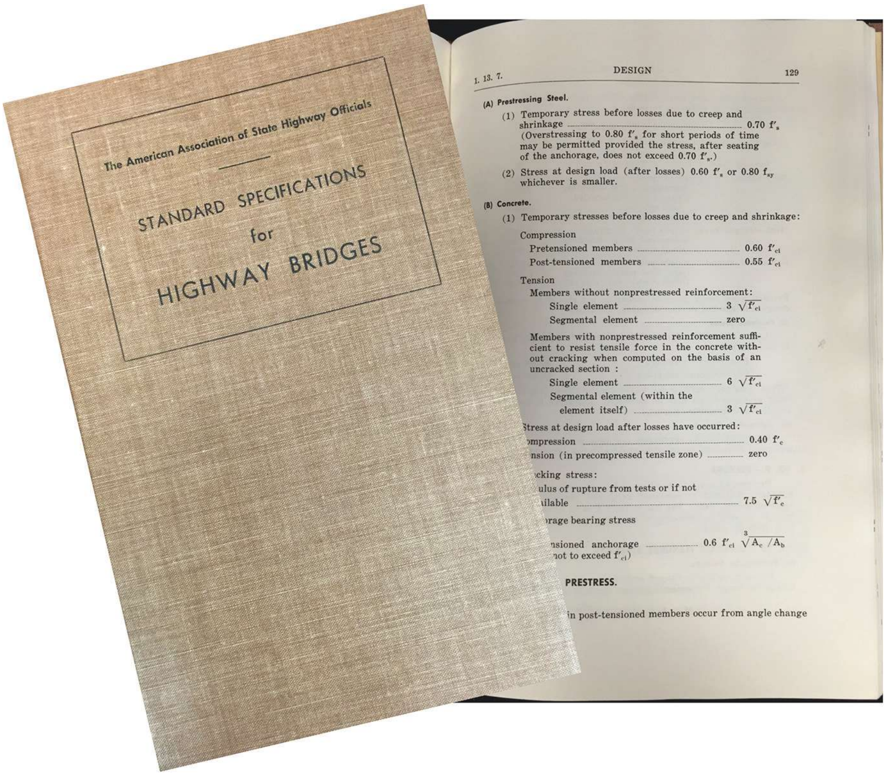
As human beings, certainly as structural engineers, most of us are change averse. We may have all said "if it ain't broke, don't fix it" or "this appears to be a solution in search of a problem" at some point in time in our structural engineering careers. Even if we may not have said it, we certainly heard others say it in our workplace, committee meetings, conferences, construction sites, and fabrication plants.

Yet, there have been significant innovations in designing and constructing concrete bridges over the years. The decision of what change to embrace is a complex process, and one that can be emotional rather than rational. In this article, I will share some of my thoughts on embracing change.

Like most things in life, embracing change becomes easier if it can be put into its full context. That is to say, it is always important to understand the technical, financial, fabrication, and construction benefits of a solution as we work on a problem. Often, the involvement of the appropriate representatives from industry, design, construction, and fabrication professionals may help define the problem, and the potential benefits of any generated solutions.

To illustrate this process, I will use two research projects[1-4] in which the University of Texas researchers studied the feasibility of increasing the allowable compressive stresses at prestress transfer. This value has remained unchanged since prestressed concrete was introduced in the American Association of State Highway Officials (AASHO) *Standard Specifications for Highway Bridges* in 1961.



American Association of State Highway Officials *Standard Specification for Highway Bridges* (1961). Photo: Ozzie Bayrak.

Before getting into technical details, it is important to note that the research projects that are used as an example benefited from the participation of engineers from the Texas Department of Transportation's (TxDOT's) bridge and construction divisions, as well as the precast concrete fabrication plants in Texas. This participation helped provide context to the problem. Let's take a look at that context.

From the beam fabrication standpoint, an increase in allowable compressive stresses from $0.60f_{ci}'$ can reduce the cementitious material content in the concrete, the cycle time in precast concrete fabrication plants, and external curing costs. From the structural design perspective, an increase in this limit can increase the span capability of a given prestressed concrete section by allowing the use of a larger number of strands. Finally, an increase in this compressive stress limit may result in a reduction of the number of debonded or harped strands, and therefore may simplify design and fabrication of a prestressed concrete beam.

The interplay between the fabrication and design benefits can be complex and it is not possible to invoke all of the aforementioned benefits simultaneously. Having understood all of the aforementioned benefits, the University of Texas researchers considered the downside of increasing the allowable compressive stress at prestress transfer.

Service load testing of a beam in the lab. Photo: David B. Birrcher.

More specifically, the researchers focused on the behavior of the bottom flanges of the pretensioned girders. If the precompressed tensile regions of girders are subjected to excessively high stresses, there can be internal damage to the microstructure of concrete, and premature cracking under service loads may occur. This cracking may create a durability concern that would not otherwise be present.

Weighing the fabrication and design benefits against the potential of creating a durability problem, and primarily through full-scale testing, the University of Texas researchers concluded that an increase from $0.60f_{ci}'$ to $0.65f_{ci}'$ was possible. During the American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Bridges and Structures (SCOBS) meeting in April 2015, AASHTO Committee T-10 presented this change as an agenda item and their recommendation for this change was approved. The 2016 Interim Revisions of the 7th edition of *AASHTO LRFD Bridge Design Specifications* will include this change.

This example involves a methodical research approach in which participation of the precast concrete industry, structural designers, and inspectors was solicited and understood by the research team. Consequently, it was possible to establish proper context to the problem. This context helped the researchers establish priorities such that relevant answers were obtained.

With all of that said, the change from $0.60f_{ci}'$ to $0.65f_{ci}'$ seems small. In my view, that is the reality of structural engineering in the twenty-first century. Small refinements with big benefits or small adjustments with big pay-offs are our new reality. There will always be a few game-changing advancements to our knowledge base and design practices. However, a great majority of the advancements to our knowledge will be "incremental" at first glance but "profound" in consequences.

In regards to embracing change, I must say that, at least in Texas, the change that stemmed from the previous example was embraced readily. We found that the inclusion of all stakeholders in defining the problem was very helpful. Some of the stakeholders were hoping to see no change, others were hoping for a bigger change. All of them accepted the research results and what was possible, regardless of their original hopes and expectations.

Finally, we must all understand that change will happen one way or another. Understanding the history of a technical issue provides additional context to the problem we are trying to solve. Understanding that history helps us embrace change and it should never be taken as living in the past. Certainly, living in the past and resting on our laurels would stifle innovation and progress and should be avoided at any cost.

References

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