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Integrally Christian Engineering Scholarship: A Case Study

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A Case Study of Integrally Christian Engineering

*By Justin Vander Werff**

Abstract

Engineering programs at Christian colleges typically focus primarily on undergraduate education. Likewise, faculty members drawn to Christian engineering education tend to have a strong desire to disciple young men and women in what it means to be faithful Christ followers in engineering. Consequently, engineering faculty tend to work long and hard to provide a solid education experience, leaving little time for anything else. However, institutional demands on faculty typically extend far past teaching, and one area that inevitably pops up in growing Christian engineering programs is research and scholarship. What is the place of research in a Christian engineering program? Does it have a place at all? And what should Christian engineering research look like? These are big questions, and a simple paper like this one cannot provide an exhaustive answer. However, as a baby step, this paper will examine a Christian lens through which engineering scholarship can be viewed and critiqued. This lens consists of five guiding principles for engineering that were developed based on the Creation-Fall-Redemption paradigm and presented previously¹. Using these guiding principles, engineering scholarship that was conducted in a typical university research format and published in a traditional engineering journal² will be carefully examined and critiqued. In doing so, my hope is that a bit of light will be shed on what integrally Christian engineering scholarship looks like, and that this understanding might provide insight on answering other questions in regards to research and scholarship in Christian engineering programs.

Introduction

Dordt College's "Founders' Vision," prominently displayed on our campus clock tower, states:

"An education that is Christian not merely in the sense that devotional exercises are appended to the ordinary work of the college, but in the larger and deeper sense that all the class work, all of the students' intellectual, emotional, and imaginative activities shall be permeated with the spirit and teaching of Christianity."¹

From its inception, our engineering department has been passionate about articulating what this vision means in the engineering profession and then seeking to instill it in our students. In fact, on a personal level, my passion for this vision was one of the main reasons I decided to venture away from my several years of service in the engineering industry and instead enter the world of engineering academia. I had the strong desire to help more young Christian men and women understand this vision, particularly how it plays out in engineering. However, another reason I made that decision was out of a recognition that, despite my passion for this vision, I still didn't have a complete grasp of the implications it had for engineering. I was eager for the opportunity

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to contemplate and study more carefully what engineering that is completely “permeated with the spirit and teaching of Christianity” looks like.

After several years, including several papers and presentations in the process, I have come to a couple of conclusions in this regard. First, on this side of eternity, I will never completely grasp what truly integral Christian engineering looks like. I certainly understand more particulars about what Christian faithfulness in engineering looks like, and I hope that in small ways I have contributed insights in this conversation, but I will not reach the pinnacle of this study. Second, although I will not attain the climax of this work in this life, I can joyfully continue in the confidence of Christ, knowing that He has already attained the ultimate victory and that He calls me to faithfully and responsibly serve as His hands and feet in His continuing work. In this paper, I pray that I can flesh out in a small way the beginning of what distinctively, integrally Christian engineering looks like by way of critiquing a bit of my engineering work over the past several years.

Guiding Principles: A Framework for Critiquing Christianly

In order to begin to recognize what distinctively, integrally Christian engineering looks like, we need to recognize that we do engineering, as we do all of life, in the metanarrative of Christ. Often this narrative is described as “Creation-Fall-Redemption,” recognizing that God created us and all things good, that human sin changed everything, and that Christ has paid the price for sin and continues to reconcile us and all of creation. To help recognize what implications the Creation-Fall-Redemption metanarrative has for engineering, five guiding principles have been developed:²

1. God created us and all things for His glory.
2. Our two-fold (but singular) mandate is to develop and keep God’s creation.
3. We are creaturely and finite; we are not saviors.
4. As Christ hands and feet, we are involved in the alleviation of both human and non-human suffering.
5. We live in the already and not yet of Christ’s reconciling work.

These principles have been developed not as the only Christian approach to engineering but as one framework that can provide guidance in discerning how to engineer in a way that is integrally Christian. The principles were developed as an outworking of the Creation-Fall-Redemption narrative². Since their development, they have been used as a way to evaluate the content of our engineering curriculum³ and the effectiveness of our curriculum⁴. As we have continued to exercise these principles in our curriculum, we continue to appreciate how this framework provides a usable means for Christian critique of engineering and technology.

Integrally Christian Engineering Scholarship

As those of us involved in academia know, there is far more involved in education than simply teaching and curriculum. Accordingly, if we want the engineering education we provide to be integrally Christian, we need to consider and critique far more than simply our teaching and curriculum. Given the usefulness of the guiding principles as a tool for critiquing curriculum, it

seems appropriate to try out their effectiveness as a mechanism for Christianly critiquing other aspects related to engineering.

One of the first areas that comes to mind is engineering scholarship. If done well, scholarship alongside quality undergraduate education can be a win-win, providing faculty an opportunity to dig in to their areas of expertise, giving them an opportunity to provide wise insight that can make a difference in others' lives, and providing their students deeper and more authentic learning experiences. Of course, doing scholarship well, in a way that enhances our educational mission rather than detracts from it or dominates it, is much easier said than done. What is the place of research in a Christian engineering program? Does it have a place at all? And what should Christian engineering research look like? These questions have no easy answers, and a single simple paper will not provide a decisive conclusion. However, to provide a starting point for answering such questions, the following sections of this paper take a published piece of "traditional" engineering research and examine it through the lens of the five guiding principles.

Background: "Girder Load Distribution for Seismic Design of Integral Bridges"⁵

The research work considered in this case study is presented in the paper "Girder Load Distribution for Seismic Design of Integral Bridges."⁵ This paper was published in the *ASCE Journal of Bridge Engineering* in 2014. This journal is published by the American Society of Civil Engineers (ASCE), the professional society that is the gatekeeper of civil engineering infrastructure in the United States and around much of the world. The paper developed a comparison of how several different large scale experimental studies predicted that seismic load would travel through a particular type of bridge superstructure. It then went on to develop a simple analytical model that provided a relatively reliable technique of predicting this load distribution that was much simpler than the extensive experimental studies or even other fairly complex computer analysis techniques that had been used previously.

At first glance, this paper seems like any other technical research paper, so it may seem strange to try to critique this work from a Christian perspective. In fact, some might say that work like this paper is neutral, and it is silly or even misguided to Christianly critique it. However, if we are to take seriously the teaching of God's Word that "[t]he earth is the Lord's and the fullness thereof," (Psalm 24:1) and that God cares about reconciling "to himself all things, whether on earth or in heaven," (Colossians 1:20), I believe that we should be challenged to view every corner of the creation through a biblical lens. So, using the five principles as a framework for focusing that biblical lens, let's dig into the ASCE paper a little deeper.

The Case Study: Walking through the Five Guiding Principles

The first principle states that God created all things for His glory. There are at least two possible approaches to critiquing a particular engineering work in light of this principle. One approach would be to critique whether the work specifically acknowledges being done for God's glory. Unfortunately, most technical journals would quickly edit such motive-related material on the basis of the far-too-commonly-accepted dualistic separation of "faith" and "fact" (or perhaps we could say "motive" and "method"). There is no specific mention of God or His glory in the ASCE paper, so by this approach, this paper fails on this principle.

However, another approach for using the first principle would be to evaluate the underlying motive behind the work. For a neutral third party, this sort of critique would be difficult, if not impossible. However, if you are applying the principles to your own work, it is a little easier to self-critique in this area. For myself, I hope it is not too presumptuous or boastful to say that I truly do believe I have done all my engineering work, including the work related to this paper, to God's glory. His Spirit continues to convict me that His glory is the only motive worth striving for.

Prior to moving onto the second principle, and as a brief aside, I think it is worth mentioning that the overall obedience and normativity of a particular engineering work does not necessarily hinge exclusively on whether it is done in accordance with the first principle. John Calvin, in Chapter 2 of his *Institutes of the Christian Religion*, drives this point home in the following quote:

“In the reading of profane authors, the admirable light of truth displayed in them should remind us that the human mind, however much fallen and perverted from its original integrity, is still adorned and invested with admirable gifts from its Creator. If we reflect that the Spirit of God is the only fountain of truth, we will be careful, as we would avoid offering insult to him, not to reject or condemn truth wherever it appears... If the Lord has been pleased to assist us by the work and ministry of the ungodly in physics, dialectics, mathematics, and other similar sciences, let us avail ourselves of it.”⁶

We should not expect that someone operating from a non-Christian worldview can never produce an obedient idea or design, just as we should not expect that a Christian is guaranteed to produce a good, obedient design. However, that is why the five guiding principles are helpful, because all five principles help together to provide a framework, rather than simply a single criterion all by itself.

Let's return to the ASCE paper, considering the second principle related to working and keeping God's creation. Proper understanding of this principle may drastically affect the direction of a project. Do we approach a project from a humanist standpoint, where we are the dominator of the earth and its resources and they simply exist for us to exploit to our benefit? Or do we approach a project as a worshipper of the undeveloped creation, believing that it should be left untouched and unused? The proper posture realizes that either of the previous approaches are idolatrous, but that God's mandate to us is to use His good creation in a stewardly way to His glory and our neighbors' good, not worshipping either humankind or the undeveloped creation but recognizing that both are part of His creation and under the kingship of Christ. The book *Responsible Technology*⁷ provides valuable insight into how to approach engineering design normatively, so I will refrain from diving into that here. However, I do want to spend a bit of time looking at how the work in the ASCE paper recognized (or ignored) the single, two-fold mandate to develop and keep.

The meat of the work related to the development of an easier-to-use and analytically improved approach to predicting how seismic load travels through a bridge superstructure. The benefit of the improved model was two-fold. First, an analytical approach that was simpler than time-consuming, complex, and expensive computer models was more likely to be used by bridge engineers who might have otherwise might skipped the analysis. Second, an analytical approach that predicted

the load better made it more likely to design the superstructure more efficiently. Both benefits allowed a more stewardly use of resources (both time and material), fulfilling the “keep” portion of the mandate, and both benefits helped provide a safer design, fulfilling the “develop” portion of the mandate in a loving way that respects life but also provides usable infrastructure.

The third principle recognizes that as humans we are creaturely and finite. The work in the ASCE paper did well in this area, because a large part of it was devoted to recognizing that we would likely not find the perfect analytical model. Subsequently, it sought after a model that would be reasonably close to observed behavior and be able to provide a safe and stewardly design approach while recognizing that the model is simply a model and not a perfect predictor. An engineer coming from a humanist worldview might have a hard time accepting an imperfect model, even if the model is very well-suited to do what it is intended to do. However, a Christian who recognizes their fallibility and creaturely-ness can humbly use such a model carefully and appropriately to serve in particular circumstances.

The fourth principle recognizes that suffering happens both in the human and non-human creation. Working with earthquake loads seems to do well with this principle almost automatically, because there is a general acknowledgement of the uncertainty of time, place, and magnitude of earthquake loads, but then there is also an acknowledgement of the suffering people may go through because of an earthquake. At its heart, the work in the ASCE paper was devoted to developing safer structures that help prevent human suffering in the event of an earthquake, clearly recognizing the first part of this principle.

However, a critical critique could be made regarding how this work considered the suffering of the non-human creation. While this portion of this principle might be the most ambiguous of any of the five principles, at its heart it recognizes that Christ is reconciling everything to Himself, both us as His people but also the creation as it groans under the effects of sin. Perhaps another aspect of this principle that has not been fully fleshed out could be related to how we are called as humans to unfold the potential in creation, using language similar to what Leonard Kalsbeek⁸ introduced following in the intellectual tradition of Herman Dooyeweerd. The work in the ASCE paper is certainly involved with unfolding potential, as it helps use material resources to produce a safe bridge that provides a particular function. However, the work is at best ambivalent toward the harmony of the bridge with its surroundings; it does not address the aesthetic aspects of the bridge at all and it does not consider the interaction of the environment surrounding the bridge, other than during an earthquake event. The work could perhaps have been improved if a bit more time and effort could have been devoted to this line of thinking.

The fifth and final principle recognizes the “already and not yet” character of the era in which we currently live. This principle is similar to the first principle, in the sense that it is probably rarely specifically articulated, but yet likely lies at the heart of most engineering work that grows out of a Christian worldview. In this particular situation, the motivation for seeking to improve the seismic design of bridges is not to save the world or to create a humanistic utopia. The motivation is rather the recognition that, out of love for neighbor, we as engineers can do better at protecting people’s lives during earthquake events. Consequently, we strive to do such work out of grateful obedience for what Christ has already done for us. In addition, we do this work knowing that Christ

has purposes far greater than ours, and that He will use our work as He wills to build His kingdom. This knowledge can give us great hope and confidence. It takes the pressure of being a “savior” off our shoulders, which is a burden that many secular engineers bear. We also experience a great sense of fulfillment when we recognize that Christ uses us as His hands and feet in His work. He is, right now, reconciling His kingdom to Himself (cf. Colossians 1:20). This kingdom is not just an ethereal kingdom of a different realm but is a very tangible, physical, earthly kingdom that may very well look a lot more like our present world and life than we expect while at the same time looking far different than we could ever imagine.

Possible Case Studies to Consider in Future Work

The ASCE paper has been briefly considered in light of the guiding principles as an example of critiquing “traditional” engineering work through the lens of a biblical worldview. Prior to making specific conclusions related to this critique, brief consideration is given here of other possible case studies that could be helpful in future work.

“A cost-effective integral bridge system with precast concrete I-girders for seismic application”

One possible case study would be the work presented in “A cost-effective integral bridge system with precast concrete I-girders for seismic application,”⁹ published in the September-October 2015 issue of *PCI Journal*. This paper presents related work to the work in the ASCE paper discussed above; however, it focuses more on the experimental portion of the study. As such, a case study of this work could flesh out unique aspects of both the work and the principles, helping to provide an integrally Christian lens through which to view large-scale experimental research.

Involvement in the ASCE Iowa Section

Another interesting case study would be the work of our institution’s ASCE Student Chapter and the professional involvement of Christian engineering faculty in ASCE. The student chapter is a part of the same ASCE organization that produces the journal that published the paper considered for the case study in the preceding section. The student chapter operates under the oversight of the regional ASCE section, which has a membership of over 800 practicing engineers and also oversees the student chapters at two large state universities. The ASCE organization is, in many ways, the direction-setter for civil engineering infrastructure across the country. Our student chapter provides a unique connection for students to begin to see how they can be difference makers in the 21st century, and a careful study of this work through the lens of the five principles would likely bring new insights and help us to utilize this resource even more.

Externships

The past couple of summers, engineering students from our institution have participated in summer research “externships.” These externships would be fascinating and likely very helpful case studies. In these externships, the students provided local companies with structural engineering insight under the advisory capacity of engineering faculty members. At the surface, the externship experiences might seem like run-of-the-mill technical work; however, an examination of these opportunities in light of the five guiding principles might reveal unique ways that God has used

them. Such consideration might shed light on how these opportunities did well in reflecting Christ and His work but also how future opportunities could be improved in doing so.

Conclusion

This brief work of considering the case study of the ASCE paper through the lens of the five guiding principles has been valuable. While the principles have been implemented and discussed already for a few years with students for big-picture thinking, this case study is the initial attempt at applying them to a particular engineering work. Doing so has increased my conviction that they can provide valuable insight into what it really means to do engineering in light of Christ's Creation-Fall-Redemption story.

After walking through this case study, it seems that in their current form the first and fifth principles have a slightly different character from the other three principles. While the second, third, and fourth principles can be directly related to engineering decisions and particular forms of technological projects, the first and fifth principles seem to do better describing the posture of the Christian engineer who is engaging these projects. There is an appropriateness in the principles encouraging both direction and posture in considering whether work is integrally Christian. Direction is certainly important, in recognizing that responses that are obedient and faithful to Christ's work and fall may indeed look different than disobedient, selfish responses, and these responses may have a direct impact on the work we do and the projects we create. However, posture is also very important, as we recognize in accordance with the insight from Calvin provided earlier that non-Christians may produce "good" work in the sense that it is true and productive, even though it was produced without a recognition of Christ and His ultimate truth. The five principles are helpful in providing guidance in both the posture and direction of engineering work.

This walk through the five principles has also shed light on possible limitations. In particular, the principles in their current form do not highlight our task as humans to unfold the potential of creation as Christ's hands and feet in His ongoing creative work. The second principle hints at this important mandate, but it focuses more on the two-fold mandate to develop and conserve rather than highlighting our original creative mandate to unfold. The fourth principle focuses on alleviating suffering, which is certainly essential in our work but also does not get at the original "good" mandate to unfold the creation. Future work might be helpful in articulating the Scriptural call to unfold the creation, either by better fleshing out the second or fourth principle or perhaps by introducing a new principle related to this mandate.

Overall, the Spirit is using this work to continue to convict me of the importance of integrally Christian engineering. Whether through the framework of the guiding principles or some other method of biblical critique, we should daily be examining all aspects of our engineering and educational work in light of its faithfulness to Christ. I pray that He will continue to work in all of us to increase our conviction of His all-encompassing Kingship and that He may continue to reveal to us the practical applications of this Kingship.

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