Memorandum ME EN 3400 (Spring 2024)

To: Russ Askren

From: Brandon Lim

Date: 2/10/2024

Subject: Reading/Writing1

cc: N/A

Attachments: N/A

1. **Identify the chapter or article you read, by author and title, distinguishing between book title and chapter title using IEEE bibliographic conventions.**

[1] H. Petroski, *To Engineer is Human: The role of Failure in Successful Design*. New York: Vintage, 1992, pp. 85-97.

1. **Create a message (a single simple sentence (remember from reading Doumont)) that matches the article. Provide textual justification from the article to support your message.**

Although the history of engineering design failures can be very tragic and unwanted, these failures are great lessons for engineers to study so mistakes in their own work can be avoided.

“Thus the tragedy no doubt made a lot of inexperienced detailers suddenly much more experienced.[1]”

“That is a very positive lesson, and thus the failure of an engineering structure, tragic as it may be, need never be for naught. [1]”

“However, if the cause of failure is understood, then any other similar structures should come under close scrutiny and the incontrovertible lesson of a single failed structure is what not to do in future designs.[1]”

“Thus the lessons of failures generally pinpoint weak links…The weak link can be avoided or strengthened in future designs[1]”

1. **Summarize the content of article, with a focus on the engineering aspects of the content. Summarizing the content of the article should not simply provide a chronological summary of the article (the author did this, then the author did something else), but should show that you have digested and synthesized the content of the article in a manner that reflects our engineering interests. The summary must be comprehensive. For example, if the author uses four examples to demonstrate the message, I expect to see each example summarized and explain how it supports the message. Your summary should be complete and support the message you identify for the article.**

In 1981, the Kansas City Hyatt Regency Hotel hosted many viewers for a city event. These viewers watched the streets that were filled with performances from the hotels skywalks’ which unfortunately collapsed and injured many people. After much investigation of the structures that supported the walkway, the engineers found that the original design of the skywalk, that had sub-par safety conventions compared to building code standards, was deviated away from due to its seemingly impossible construction. The modification made to the support structure failed to look at the details and overlooked the major stresses which resulted in the collapse of the skywalk. Although an experienced designer and engineer could have possibly caught these mistakes, the inexperienced engineers became more experienced because of this failure.

Two years after the Hyatt Regency Hotel incident, the Connecticut Turnpike section of an elevated highway collapsed into the Mianus River. This failure was caused by the re-routing of vehicles through the elevated highway section where the structure could not adequately support the load. After investigation, a consensus was reached about the main failure mechanism being weak support links that held the highway section cantilevered above the ground. Some disputed that the links had been weakened due to overlooked forces acting on the bridge while the main designing firm argued it was a result of poor maintenance. Regardless of the process that caused the links to weaken, just like the Hyatt Regency Hotel incident, the elevated highway collapse was a result of overlooked details.

In 1967 the Point Pleasant Bridge that spanned across the Ohio River collapsed because of non-conventional suspension loading. Suspension bridges prior to the Point Pleasant Bridge all used round suspension cables as seen in modern suspension bridges today. However, the design of the Point Pleasant Bridge chose to use “eyebars” that resembled giant chain links for suspension instead. These chain links made inspection difficult and accelerated corrosion. When one link had corroded to the point of defect, the links around it would carry its load until eventually the bridge’s weight and number of vehicles caused the bridge to collapse. As seen in the hotel and elevated highway incidents, the minor details of stress and corrosion ultimately led to the collapse of the bridge.

From all these failures, engineers and maintenance workers did not consider the minor details that ultimately propagated into catastrophic disasters until the failures happened. As seen in the DC-10 airplane in 1979 when one crashed when taking off from Chicago’s O’Hare Field due to a flange defect, all DC-10 airplanes after the incident were inspected, repaired, and maintained going forward to ensure its safety. This is only a solution that could have been uncovered from the failure of engineers. As a result of failures within engineering, weak links in past designs can be avoided in future designs. This shows the importance for engineers to study the failures of the past.

1. **Make observations (at least 3) about communication techniques that you found effective (or ineffective). If the article has images, take a careful look at how they are constructed, what the caption says, and how the article makes use of the images in the text. Or, identify a paragraph or section that is particularly well put together. What makes it work that way? Or, find a complex idea that was very well explained. What made the explanation work? Make sure you explain the technique with adequate justification that indicates you could use (or avoid) the technique. Since the articles are all PDFs, snipping examples to include in your memo is useful and recommended. These snips do not need to use proper figure formatting or referencing techniques.**

* “Since the engine attachment assembly on the DC-10 was not suspected to be weakening before the fatal crash no one paid any special attention to it. However, as soon as the cracked flange was identified as the cause of the Chicago crash, the flanges of all DC-10s, which had been grounded pending the discovery of the cause of the failure, were inspected. [1] “
  + I found this to be very effective in arguing the point that engineering failures are important. When listing examples of failures in engineering, Petroski does a good job of describing why the failure happened but, in this quote, he directly gives a positive result that came out of the failure. I would use this technique often because it gives the audience a clear image of a cause and effect which strengthens the information.
* “However, if the cause of failure is understood, then any other similar structures should come under close scrutiny and the incontrovertible lesson of a single failed structure is what not to do in future designs. That is a very positive lesson, and thus the failure of an engineering structure, tragic as it may be, need never be for naught. [1]”
  + I found this to be very effective as the last point made in the entire chapter. This quote wraps up the main message of the chapter using effective redundancy. As seen in all the examples listed in the chapter, the main message that is conveyed is that engineers can make easy errors when it comes to the details. However, when these failures are understood, they can be great lessons. Restating this in a different way at the end of the chapter really brings everything together and enforces the knowledge to the audience.
* “Thus the tragedy no doubt made a lot of inexperienced detailers suddenly much more experienced. And it is precisely to keep these lessons in the minds of young engineers that failures should be a permanent part of the engineering literature. [1]”
  + This is effective in the way that it previously gave a very detailed explanation about a failure that caused a lot of harm. Then, this quote follows the explanation to support the main argument of the chapter about the necessity of failure for engineers. This quote took all the failures listed in the incident and turned it into a lesson rather than just a block of information about the skywalk collapsing. I think this is a technique to remember for my own work because it gives a reason why information is being presented rather than just presenting the information.