Hyatt Regency Walkway Failure

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April 28, 2015

On July 17th, 1981, hundreds of people attended a dance at the Hyatt Regency Hotel in Kansas City, Missouri. Three walkways overlooked the dance floor from the second, third, and fourth floors. They were suspended by six metal rods, and the second-floor and fourth-floor walkways were supported by the same rods, as seen in Figure 1. At around 7:05pm, the support of the fourth-floor walkway gave out, and the walkway fell on top of the second-floor walkway and then to the floor, killing 114 people and injuring at least another 200. This deadly structural failure was the consequence of several unethical decisions made during manufacturing and construction from which all engineers must learn if they are to avoid disasters like this in the future.

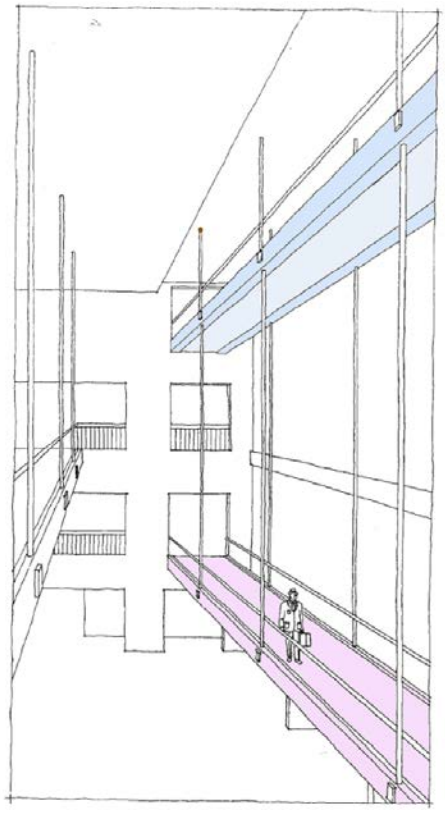

Figure 1: The design of the walkways placed the second and fourth walkways on the same support rods (Hyatt Regency Walkway Failure, 2014).

The simple explanation for this failure is obvious: the support rods simply could not handle the weight of the walkways and the crowd. A more detailed breakdown of the collapse

includes the forces from the weight of the walkways and the forces maintaining the walkways elevated at the supports. Gravity exerted a force pulling downward on the structures with a weight of approximately thirty-two tons per walkway (Roe, n.d.). To keep the walkways elevated, the sum of the forces from each support, called reaction forces, had to balance the downward pull of gravity. The reaction forces were provided by the supporting rods, which can be thought of as strings holding the walkways up, and were connected to beams running under the walkway. Like strings, if too much weight is hung on these rods, they break. Because the second and fourth walkways were aligned, the rods holding up the fourth-floor walkway were also under the strain of the second-floor walkway, thereby supporting twice the weight.

As people piled onto the walkways, the tension on the rods increased. Then the weight became too much for the supports to maintain equilibrium, which is the state in which all forces are balanced and the structure is stable. The nut supporting the fourth walkway tore through the box beam shown in Figure 2. It came loose, and with it the rod that connected the second to the fourth walkway. The two walkways, along with everyone on them, fell on the dance floor full of people. According to Jason Roe from the Kansas City library, survivors said that a period of silence followed the collapse. Once people began to realize what had happened, “screams and general panic spread” (Roe). The total deaths numbered 114, and many more were injured. It was the worst disaster in United States history in terms of the number of lives lost (Civil Engineering Careers, 2012).

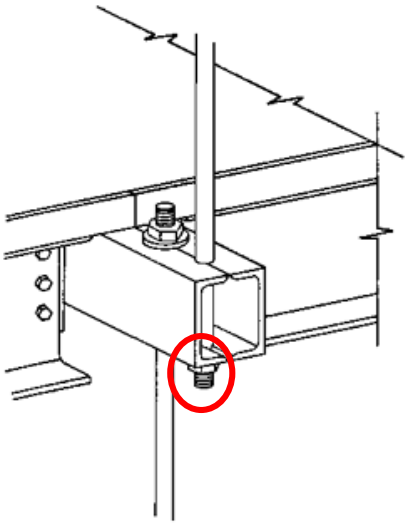

Figure 2: the support rod tore through the beam, causing the collapse of two walkways (Hyatt Regency Walkway Failure).

This disaster was not merely due to the overload on the walkways. A critical change in the design during construction made the walkways more susceptible to collapse. The original plans included only one rod at each of the joints, running all the way from the ceiling and supporting both the second and fourth floor walkways. Nuts attached to the box beams were supposed to support the weight of the fourth-floor walkway, placing only the weight of the higher walkway on the nuts. However, to make manufacturing, transportation, and construction easier, the fabricator changed the design to have two shorter rods for each original one since it was simpler to handle shorter rods. This appears to be essentially the same design, but the change placed significantly more weight on the bottom nut of the fourth-floor walkway (circled in red in Figure 2). Adding the burden of the second-floor walkway on the other taller walkway instead of the ceiling forced the nut to provide the reaction force to balance twice the weight. According to the article "Civil Engineer Disasters- The Hyatt Regency Walkway Collapse" there were several major mathematical and ethical failures during the design and construction of the walkways (Civil Engineering Careers, 2012). The first failure was the miscalculation of the weight that the

rods and nuts would have to support, leading to the use of inappropriate materials. In an interview for a Kansas City newspaper, civil engineer professor Bogdan Kuzmanovic is quoted as saying, “If some other type of washer were used, this could not happen.” The engineers who designed the walkways also failed to communicate with the fabricators and check the final structures to make sure the designs were followed thoroughly. Lastly, as the fabricators changed the design, nobody took the time to calculate the effects that the change would incur on the support structures. Several engineers lost their engineering licenses after the disaster.

Many lessons can be learned from this disaster; first among them is that engineers are responsible not only for the design of structures, but also for ensuring that designs are implemented as planned. It is not enough to simply design a structure on paper, calculate loads and choose materials. Like Henry Petroski said in his article “Failure is Always an Option,” engineers expect their designs to fail, and that is how they design failure-resistant structures (2003). Petroski said that “No one knows a machine or its failure modes as well as the engineers who created it” (2003). The same can be said for buildings or structures. Therefore, it is imperative that engineers are consulted regarding design changes during every step of construction. Lastly, engineers should also be responsible for administering a final check of the finished structure. As the designers, they would be best qualified to find potential sources of failure and to identify changes that increase the chance of accidents. After a deadly accident such as this, engineers must use the failures that led to it to learn and improve. If engineers set out to never make the same mistake twice, disasters such as the Hyatt Regency walkway collapse may be avoided and many lives can be saved.

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Petroski