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Venue Safety Strategies: Guardrails and the Line-of-Sight Exemption

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Major risk categories in sport venue safety include natural disasters, acts of terrorism, and rioting. However, sport venue safety takes numerous forms, and generally speaking, as facilities become bigger, with more people and more moving parts, they become much more complex. For example, facilities may use closed circuit televisions (CCTVs), facial recognition systems, bollards to prevent ramming, police surveillance towers, command centers, magnetometers to screen for weapons, and more basic risk management strategies to deal with intoxicated fans, fly balls, errant pucks, and holes in the field of play that may cause injury to people or equipment.

Although it is critical for sport venues to examine major risks that can injure many people at once, such as a terrorist attack, the more common issues are going to be simple, individual injury cases, including slips and falls, trips and falls, fights in the stands, and numerous other issues. Unfortunately, smaller issues can quickly gain prominence when there are so many fans and so many games. An example of this entails fans being hit by foul balls. For years, baseball stadiums relied on the “assumption of risk” defense, which asserts that if a fan was hit by a foul ball they should not recover compensatory or punitive damages for their injuries, no matter how serious they were. However, due to national attention, often pushed by social media and videos of people being injured by foul balls, Major League Baseball (MLB) encouraged all their teams, both in the majors and minors, to expand the amount of netting used at ballparks. Stadiums were encouraged to extend netting past the dugouts with many extending to the foul poles to protect fans. By 2020, all MLB teams had expanded their netting. This was not due just to the social media buzz, but also numerous reported cases and one death in 2018 (Lehren & Tak, 2019).

In addition to foul ball protection issues identified through news stories and various articles/studies, there are many other hazards present, especially as it relates to the venue itself. There have been several major incidents in stadiums and arenas with fans falling over railings. These incidents are tragic and have resulted in several fatalities over the years.

This article will examine safety issues related to railings at sporting events and why there needs to be action taken to protect fans. Similar to how MLB acted to better protect fans from foul balls, teams and/or venues need to act independently to increase railing heights. If sport facility managers and or venues do not proactively address this railing height issue, then architects, building inspectors, and others should seek to change the building code to eliminate the fans continued exposure to unnecessary hazards. The current line-of-sight exception (minimum 26") allows for railings that are too often dangerously inadequate to protect fans.

History of Railing Dangers

From 1969 to 2011, there were 22 fall-related fatalities at major league ballparks (Gorman & Weeks, 2015); Dunne et al. (2019) identified 20 incidents and 12 deaths between 1981 and 2017. More specifically, Steinbach (2009) highlighted three deaths and eight serious injuries associated with railing-related incidents from 2000 to 2009. The injuries primarily involved men in their early 20s, but some people who were injured in these incidents were those on a level below who had no warning someone might fall on them. Incidents included five falls at professional baseball games, one each at college and professional football games, one at a professional hockey game, as well as during two concerts staged at sports venues (Steinbach, 2009).

Three deaths over the past 15 years were reported in an ESPN story. One death at Coors Field in Denver occurred in May 2011, one at Turner Field in Atlanta in May 2008, and one at Shea Stadium in New York in April 2008. Each of these cases entailed men falling while trying to slide down a staircase or escalator railings. Officials ruled alcohol a factor in the incidents in Denver and Atlanta (Lavigne, 2011). These were not the only incidents involving serious injuries or deaths near or by a railing (Steinbach, 2012).

One of the most publicized railing death cases happened on July 7, 2011, when 39-year-old Shannon Stone fell to his death over a 33" rail at Globe Life Park. The Texas Rangers determined after that incident that their existing rail heights were inadequate to guarantee the safety of fans who were engaged in activities at their seats other than sitting. The team raised the railing height to 46" all over the park in preparation for the next season at a cost of \$1.1 million (Durrett, 2012).

Most recently in 2021, a mother and toddler died when they fell over a railing in a picnic bench area at Petco Park in San Diego. Prior to the fall, the mother had a close call while jumping on a picnic table bench with her 2-year-old son in her arms near the ledge of an upper concourse. The mother and child started jumping on the table a second time, and that is when they fell to their deaths (Griffin & Jarin, 2021).

These incidents raise three important questions:

1. Why are the requirements for guardrails not more stringent?
2. Should guardrails be higher at ballparks and concert venues where fans regularly engage in "atypical" behaviors and movements?
3. Should guardrails be stronger to accommodate the weight of multiple fans leaning over at the same time?

Railing Height

Although the aforementioned examples focus on fans going over railings, there are numerous other examples of injuries in the stands. The cause of injuries can range from fans falling between slats and guardrails to collapsed bleachers. The United States Consumer Products Safety Commission (CPSC) issued Guidelines for Retrofitting Bleachers in 2001. The guide highlighted that there was an annual average of 19,100 bleacher-associated injuries treated in emergency rooms. Data from 1999 alone showed 22,100 bleacher-associated injuries treated in hospitals. Approximately 6,100 of these injuries were a result of the person falling from, or through, bleachers onto the surface below. A larger number of these falls (4,910) involved children (CPSC, 2000). One recommendation from the CPSC was that the top surface of a bleacher's guardrail should be at least 42" above the leading edge of the footboard, seatboard, or aisle, whichever is adjacent to the guardrail (U.S. CPSC, 2001). The CPSC's 42" rail height recommendation was intended to prevent inadvertent falls over the railings by all but the tallest 1% of adults. It further reflected a consensus from different organizations that advocated for a 42" guardrail height.

The International Building Code (IBC) states that guardrail systems are required along open-sided walking surfaces, including mezzanines, equipment platforms, aisles, stairs, ramps, and landings that are located more than 30" (762 mm) measured vertically to the floor or grade below at any point within 36" (914 mm) horizontally to the edge of the open side (IBC, 2021).

Further, "required guards shall not be less than 42" (1067 mm) high" (IBC, 2021).

However, the IBC provides exceptions to the 42" (107cm) minimum height requirements for "sightline-constrained guard heights" and reads as follows:

Unless subject to the requirements of Section 1030.17.4, a fascia or railing system in accordance with the guard requirements of Section 1015 and having a minimum height of 26" (660 mm) shall be provided where the floor or foot-board elevation is more than 30" (762 mm) above the floor or grade below and the fascia or railing would otherwise interfere with the sightlines of immediately adjacent seating.

Greg Sweeney, director of technical design at sport architecture company Rossetti, indicated that the 26" railing height was written into the IBC because people are not walking directly into the railing (which is why railing at the end of a down staircase needs to be 40"), but rather walking alongside the railing—even if it was at knee height for many people (Steinbach, 2009).

The 26" minimum height for front-row railings dates back to 1929 when it was included in the National Fire Protection Association (NFPA) Building Exits Code. The guide set building safety standards for numerous building types and was a "one-size-fits-all" approach. The code was not developed specifically for sport or entertainment venues; it was created in response to the Triangle Shirtwaist Factory incident, which killed 146 people during a 1911 fire in New York City (Lavigne, 2011).

Robert Solomon, NFPA Building Fire Protection and Life Safety division manager in 2011, said the original code developers likely set the standard at a height where railings would not impede someone's view and that it was designed mainly for theaters and symphony halls rather than ballparks and arenas (Lavigne, 2011). This is why it is called the line-of-sight exemption.

Even with some anecdotal information and opinions, MLB stadiums' average railing heights

around 2010 were closer to 26". The ESPN show "Outside the Lines" contacted officials with all 30 Major League Baseball ballparks in 2011 to examine the heights of their front-row railings at these stadiums. Only 10 teams responded with actual measurements, which ranged from 26" to 36". As previously mentioned, the 26" height is the minimum allowed by the IBC and some local building codes (Lavigne, 2011).

Mr. Stone, who fell at the Texas Ranger ballpark fall, measured 6' 3" tall and fell over a 33" railing. The railing came up to just below Stone's belt buckle. A 42" railing would have rested just above Stone's hips. For most people, a 42" railing would reach around one's stomach and would be even higher for shorter people (Lavigne, 2011). The potential problem with a 42" railing is that it could be in the line of sight of someone sitting down in the front row. That is why the debate continues to exist: It is a battle between safety and what will allow for the best venue usage.

Everyone's center of gravity influences when and how they might fall over a railing. Taller people have a higher center of gravity, which means that a low railing is more dangerous for a tall person compared with a shorter person whose center of gravity is closer to the 26" railing height. Thus, a shorter person is less likely to fall over a 26" railing. Brauer (2016) noted, "Therefore, if 99% of the population is less than 6' 6" tall, a 42 in. high top rail will prevent rotation over the rail for all but very few people. Using this estimating method, a 45" railing would protect people who are 7 feet tall" (p. 128). Thus, a text focused on training engineers to be more safety conscious includes several cases associated with falls at stadiums and how the center of gravity is one of the key considerations to examine in those cases. Additionally, the National Center for Health Statistics (2016) reported the average height of American men and women over 20 years old between the years 1999 to 2016 to be 5' 9" (69"). Based on the second quartile height data of the U.S. population, the approximate height of the guardrails should not be less than 36".

The 26" railing height exemption is unique to the United States. The Sports Ground Safety Authority (SGSA), based in the United Kingdom, publishes the Guide to Safety at Sports Grounds, which is informally referred to as the "Green Guide." Their standard requires a minimum guard height of 31.5" (800 mm) for sightline-constrained guard heights (SGSA, 2021).

Not only must railing designs consider minimum heights to prevent falls, they must also consider the forces or loads that they can withstand without failing. In sport event settings, many times multiple fans may move in unison toward a railing causing possible collapse. Recent incidents have illustrated railing failure under multiple persons loads such as the postgame railing collapse at the Washington Commanders' Fed-Ex Field causing five fans to fall (Keim, 2022). Additionally, a 2014 incident at Sadar Stadium in Pamplona, Spain, injured 60 fans who fell when a railing collapsed in a post-goal celebration (Associated Press, 2014). Special consideration needs to be given for areas within sport stadiums where railing load-bearing capacities should be increased due to the likelihood of multiple fans leaning against the railing at the same time. Although managers and attorneys can examine legal obligations and building code requirements, the railing load-bearing capacities can only be determined by a structural engineer. Thus, architects and engineers of sports and concert venues are often given the extremely challenging, and sometimes contradictory, design directive of maximizing the number of spectators, optimizing the spectator views, and managing the safety of the whole experience.

Practical Management Actions

One option to protect fans is for architects and builders to work with teams or venue owners to examine the proposed/existing design and develop solutions that will hopefully make venues safer. Besides raising railing heights, accommodations could be made by modifying the pitch of stairs or tiered seating installations in public venues, such that the seating areas are further removed from elevation drops where guard areas become necessary. This can be accomplished by adding a horizontal walking surface between the seating and the guardrails or providing an access aisle behind the first row of seating.

Brauer (2016) suggested a risk management strategy to help make lower railings safer through using glass or clear plastic above the railing height to help preserve the sight line, but also to provide some added protection. This can lead to its own challenges, such as lacking a bar to hold onto if one lost balance or fell, but the glass or plexiglass higher portions might prevent some falls.

Other suggestions include utilizing safety netting. That was the suggestion given by MLB's insurance agent based on ballparks in Chicago and Seattle that have used netting to help protect fans (Rankin, 2019). Netting is utilized at TopGolf venues to protect fans from injury after falling over an elevated driving platform. Although there is no rail, there are nets used to protect people from falling.

There is no singular correct solution, but having a hard target railing height based on biomechanical data and how people interact with the venue will be a significant step forward. Other strategies could include the layering approach to risk management. Utilizing this approach, venues can educate fans as to the possible concerns they might face when sitting in a specific area. This approach can include warnings on the back of tickets, announcements over the loudspeakers, announcements on the scoreboard, warning signs, netting, verbal warnings by ushers, videos from star players/coaches giving warnings, and so forth. Not every strategy needs to be undertaken, but the more elements available, the more likely a court will find the venue acted reasonably in protecting fans (Fried & Kastel, 2020).

Additional practical steps for preventing accidents with railings could include having railings painted a distinct color, so they visually stand out, as well as posting signs discouraging people from dancing, taking selfies, leaning over, and other possibly dangerous behavior near the railing.

Conclusion

Every building has some safety and security related issues, and sport venues are no exception. Although much attention is placed on hardening sport venues against terrorist attacks, there needs to be a balance between preparing for such events and more day-to-day incidents, such as falls. The sports world utilizes a tremendous amount of data in many areas, and some data can assist in making safety-related decisions, such as increasing the coverage of baseball netting to protect fans from foul balls. Even though building codes currently allow for a line-of-sight exception to the 42" high railing requirement, the number of serious injuries/deaths warrants going beyond just the basic compliance with a minimal safety option to embrace going above and beyond to protect fans. Although a 26" guardrail often preserves the line-of-sight, it does not serve its intended purpose as a "guardrail." Rather, a 26" guardrail is at odds with the recent history of incidents and prevalence of falls over railings under the generally required 42", with

what we know about the mechanics of a fall from elevation, and with the average human's center of gravity. Indeed, this issue merits further consideration. In addition to the obvious need for design modifications, widespread adoption by code and venue owners is of the utmost importance in preventing further injury and needless fatalities.

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