Using fall-arrest equipment correctly is integral to safety. A shock-absorbing lanyard improperly rubbing against a sharp edge, could cause "catastrophic failure" according to recent research.

Extreme heat and sharp-edge contact a concern for fall-arrest systems

By Gail Johnson

Reliable fall-arrest systems are critical safety equipment for workers at risk. Falls from heights continue to be the major factor in worker deaths in general construction and are some of the most frequent and costly incidents in B.C. workplaces. New research supported by WorkSafeBC looks into how the reliability of fall-arrest systems could be affected by various environmental and workplace factors like dirt, heat, UV light, and cuts.

Carolyn Sparrey, associate professor in the field of Mechatronic Systems Engineering at Simon Fraser University, set out to study the effects of various exposures on the performance of fall-arrest systems, with funding through an Innovation at Work research grant from WorkSafeBC.

Manufacturers are required to make fall protection systems that meet the standards set out by the Canadian Standards Association (CSA) or the American National Standards Institute (ANSI). While they do of course test their lanyards and harnesses for compliance and the effects of wear and tear, they often don't publicly publish their results, and very little independent research has been done. Sparrey and her team wanted to perform independent analysis on how fall equipment was affected by work-related wear or damage, or the effects of contact with a sharp or rounded edge.

"We know falls are one of the most common causes of workplace injury," says Sparrey. "I realized research in this area could inspire better design of fall arrest systems and better outcomes for workers."

Putting fall protection to the test

Sparrey's team tested several styles of shock-absorbing lanyards in dynamic drop tests to determine the effects of environmental exposure, tool damage, and contact with rough and sharp edges on fall arrest dynamics.

It was a collaborative project. They tested the lanyards in a CSA-compliant drop test facility, built for this study, at the Steel Trades program at the British Columbia

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Institute of Technology (BCIT), in collaboration with JADE Engineers Inc, a consulting engineering company. Ironworker students also helped with the testing, giving them a unique view into what can go terribly wrong if any piece of safety equipment is compromised.

The researchers found that exposure to environmental factors such as dirt and debris contamination, tool cuts, or contact with a rounded edge did not significantly affect the fall arrest dynamics of energy-absorbing equipment.

Even on brand-new equipment, high temperature tool damage and contact with sharp edges were found to negatively impact the strength and energy-absorbing capabilities of shock-absorbing lanyards to a large degree. In fact, these factors resulted in "catastrophic failures" of several lanyards during testing, says Sparrey.

Consider the effects of high temperatures resulting from a plasma torch or a cutting tool being used near a lanyard, for instance.

"In one case, it baked the lanyard and melted it," Sparrey says, noting that damage anywhere along the length of a bungee-style lanyard could compromise the functionality of the energy-absorbing mechanism even when the external webbing is intact. "Some of them just had one spot along the whole length affected by high temperature and the rest of the length looked beautiful, but that is still risking failure."

Sharp-edge contact also proved problematic. As a lanyard goes over such a surface, friction can wear down the webbing. Occupational Health and Safety (OHS) guidelines, as well as manufacturer specifications, require that fall equipment be examined thoroughly before use, but the effects of certain kinds of wear on a lanyard's performance aren't necessarily apparent to the naked eye, according to the researchers.

Bungee-style lanyards were more likely to fail from edge contact because of the distributed nature of the energy absorber, which also made them susceptible to localized tool damage. The preliminary findings of Sparrey's research suggest that using these types of lanyards might not be advisable in workplaces where welding, plasma torch, tool damage, or sharp edge contact may occur. OHS guidelines currently support this finding, as the regulation stipulates that when a tool is being used that could sever or burn fall protection, the lanyard, safety strap or lifeline should be made of wire rope.

Securing workers' safety

While the need for fall protection systems is well-established, the study highlights the need for further study of how fall-protection systems work in real-world situations.

"We have little information regarding fall-protection systems and how those systems and their components will work in real world scenarios, specifically in situations where significant environmental hazards like heat, sparks, sharp edges, and UV radiation are present," says Mike McKoryk, chief instructor of Steel Trades at BCIT, of the lack of independent study in this field. "More work needs to be done to evaluate how fall protection components perform in conjunction with each other and in situations where more than just the hazard of a fall is present.

"This information would then be used to better educate workers and industry on how to integrate fall protection systems with the intent to establish holistic best practices for systems in the field," he says.

The research also had an impact on the workers of tomorrow. The BCIT ironworker students will, after graduation, find themselves working high above the ground, on buildings and bridges. Being involved in the

testing gave them a rare glimpse into the importance of fall protection and the reason workplace-safety research matters. "The transfer of knowledge that occurs by working alongside ironworkers is even better than I could have hoped," says Sparrey. "They ask great questions based on their experience that will inform the next stages of this research."

"This innovative study went beyond testing fall-arrest systems," says Lori Guiton, WorkSafeBC director of Research Services. "Because ironworking students at BCIT had an opportunity to contribute to the project, they got to learn about the research process and help to shape future stages of the work. Dr. Sparrey's research could also lead to enhancements in the design of fall-arrest systems, ultimately keeping workers in dangerous professions like construction and ironwork a lot safer on the job."

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