Job-Site Safety Institute®

Effectiveness of Level Tools and Instruction on Optimal Ladder Setup

Purpose

The Job-Site Safety Institute provided a grant to the University of Utah to quantify the barriers of safe ladder setup. Falls from height are the leading cause of accidents in construction, contributing to 36% of fatal injuries, with ladder use being the leading source of fatal falls. The project aims to measure how leveling tools, instruction/training, and ground conditions influence ladder setup safety.

Problem

Despite existing safety practices for optimal ladder setup, ladder base movement (slipping sideways or outward) remains a frequent cause of falls, particularly impacting small contractors in residential construction. There remains a disconnect between recommended ladder setup procedures and what workers actually do on the jobsite.

Research Aims

1. Determine the leveling tool that yields the optimal ladder setup angle and lowest ladder tip risk.
2. Determine the impact of instruction on optimal ladder setup.
3. Assess level tool preference for ladder setup and extract the observed and perceived barriers towards safe ladder setup.
4. Determine the impact of ladder-ground surface on optimal ladder setup and ladder tip risk.

Key Insights

Residential construction workers were recruited to perform common work tasks, which consisted of setting up a ladder, ascending the ladder to an elevated platform, hammering a support beam to an adjacent heightened frame, and descending the ladder. Overall, the research found that built-in ladder leveling tools improve safety, but worker behavior and training retention are barriers. Key findings include:

- **Built-in leveling systems lead to safer ladder setups.** Ladders tested with built-in levels aid residential construction workers in achieving the recommended ladder setup angle of 75.5° (degrees).
- **Explicit safety instruction works, but its benefits are not retained over time.** Detailed training on ladder use led to more accurate ladder setup but setup accuracy decreased significantly, highlighting the need for ongoing training or new tools (e.g., active alerts) to reinforce safe setup.
- **Workers willing to adopt new safety equipment.** Workers feel extremely confident in setting up a ladder for work, however there was no clear favorite among ladder level tools (e.g., ladder with built-in levels, NIOSH Ladder Safety mobile phone app).
- **Surface type and slope clearly affect safety.**
    - Sloped surfaces increase slip risk during ladder, especially when transitioning on and off the ladder.
    - High-friction surfaces are safer; sloped/muddy conditions elevate ladder slip risk.
    - A lower available coefficient of friction (ACOF) and greater required coefficient of friction (RCOF) increase ladder slip risk.
    - Concrete had the highest friction across three surface materials (concrete, tile, wood), regardless of the ladder shoe type.
    - Stone pavers have the best friction among three ground surface materials (vinyl, stone pavers, Trex decking)—even in muddy conditions—Figure 1.

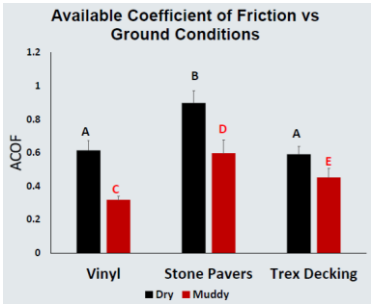

Figure 1. Available Coefficient of Friction values across ground and weather conditions. Unmatched letters indicate significant difference in ACOF values across ground conditions.

View the full report at **jssafety.org**.

JSI's goal is that everyone in the construction industry who goes to work comes home safely to their family. Our mission is a research and educational organization dedicated to eliminating job-site related injuries and deaths in the construction industry.

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