National Institute for Occupational Safety and Health

Two Topics on Fall Safety Research Conducted by NIOSH – Div of Safety Research

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NORA Construction Sector Council Meeting
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Presentation Overview

- Fatality statistics for fall-related incidents, 2013-2018
- Fall Protection
  - Swing-fall research
- Fall Prevention
  - Slide-guard system evaluation
- Summary

Fall-related fatality statistics, 2013-2018

Fatality Data, 2013-2018 (1/2)

(Publicly accessible data from BLS, Census of Fatal Occupational Injuries, www.bls.gov/iif)

Category	2013	2014	2015	2016	2017	2018
Total U.S. Occupational Fatalities	4585	4821	4836	5190	5147	5250
Overall Fatality Rate, all U.S. Industries	3.3	3.4	3.4	3.6	3.5	3.5
Total U.S. Occupational Fatal Falls to Lower Level (Pct. of "Total U.S. Occ Fatalities")	595 (13%)	660 (14%)	648 (13%)	697 (13%)	713 (14%)	615 (12%)

Fatality Rate = # of fatalities / 100,000 FTE workers

Total Construction Fatalities	828	899	937	991	971	1008
Overall Fatality Rate, Constr'n Industry	9.7	9.8	10.1	10.1	9.5	9.5
Total Constr'n Fatal Falls to Lower Level (Pct. of "Total Construction Fatalities")	291 (35%)	345 (38%)	350 (37%)	370 (37%)	366 (38%)	320 (33%)

Fatality Data, 2013-2018 (2/2)

Category	2013	2014	2015	2016	2017	2018
Total Construction Fatalities	828	899	937	991	971	1008
Overall Fatality Rate, Constr'n Industry	9.7	9.8	10.1	10.1	9.5	9.5
Total Constr'n Fatal Falls to Lower Level (Pct. of "Total Construction Fatalities")	291 (35%)	345 (38%)	350 (37%)	370 (37%)	366 (38%)	320 (33%)

Fatality Rate = # of fatalities / 100,000 FTE workers

Total Fatalities, Structural Iron & Steel Wrkrs	---	15	17	16	14	15
Fatality Rate, Structural Iron & Steel Wrkrs	---	28.7	29.8	25.1	33.4	23.6
Ratio (I&SW Rate to Overall Constr'n Rate)	---	2.92	2.95	2.48	3.52	2.48
Total No. Fatalities, Roofers	72	83	75	101	91	96
Fatality Rate, Roofers	38.9	46.1	39.7	48.6	45.2	51.5
Ratio (Roofer Rate to Overall Constr'n Rate)	4.01	4.70	3.93	4.81	4.76	5.42

Construction Fatal Falls, Roof Related	107	109	106	123	121	114
Construction Fatal Falls, Roof Edge Only (Pct. of "Constr'n Fatal Falls, Roof Related")	46 (43%)	54 (50%)	50 (47%)	65 (53%)	56 (46%)	49 (43%)

Swing-Fall Research

Project Officer: Tony McKenzie, Ph.D., P.E.

Worker Tied Off on High Steel

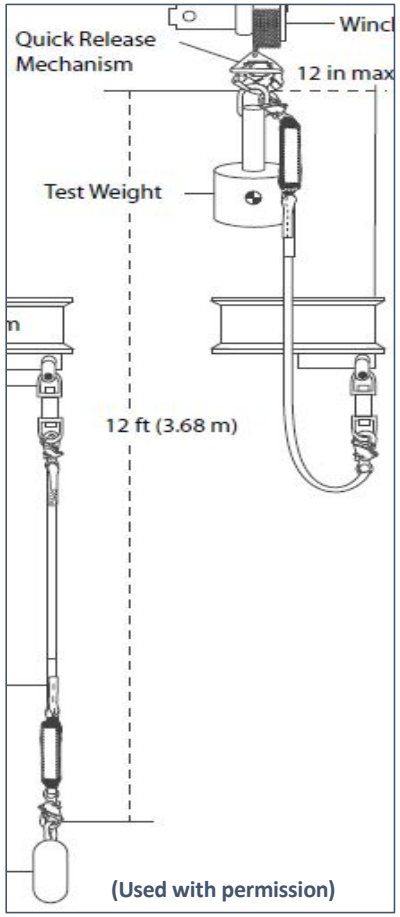
Request to investigate this situation was received from the ANSI/ASSP Z359 Committee

Swing-Fall Test Apparatus

Load Cell Location Specified by Z359 Standard

Figure11: 12 ft. Free Fall Lanyard Performance Testing

ANSI/ASSP Z359.13, pg. 38



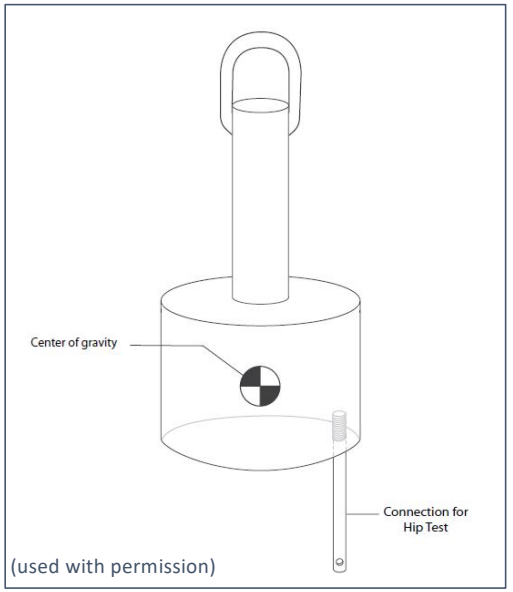
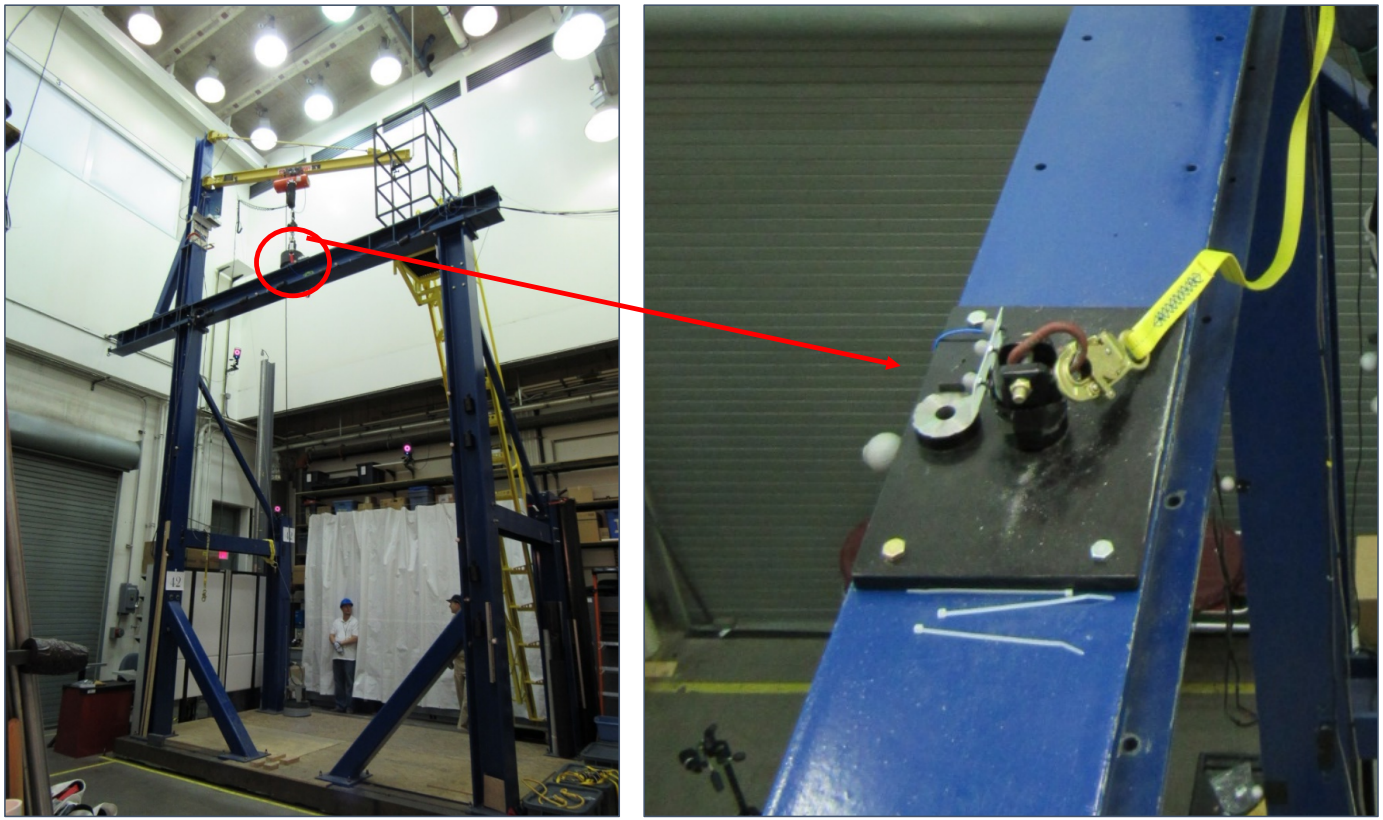


Figure 6: Example Test Weight ANSI/ASSE Z359.13 pg. 33 Desired Weight (282 lbs.)

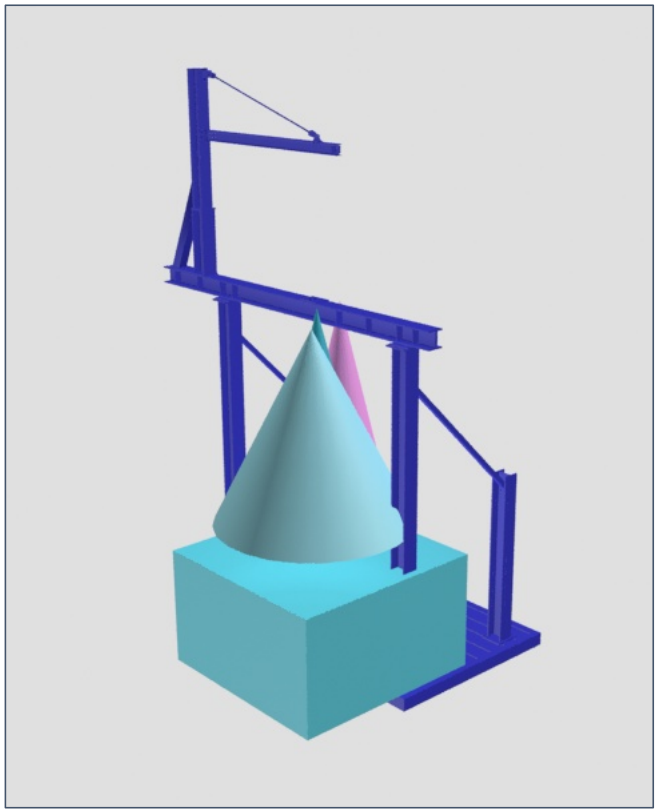
Load Cell and Harness Tie-off Location



Test Manikin with Markers to Track Movement

Three Horizontal Locations

Multiple Tests Result in a Swing-Fall Zone



Cone is the Swing-Fall Zone

Cube is the Safe Zone

Follow-on research determined the fall-arrest forces & the decelerations of the manikin compared to the round test weight

Results have been shared with the ANSI/ASSP Z359 Committee

Project Officer

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"Arresting Forces: Manikin vs the Weight Specified by ANSI/ASSP Z359" **E. A. "Tony" McKenzie, Jr. Ph.D., P.E. and Thomas G. Bobick, Ph.D., P.E., CSP, CPE;** ***Presented at the 2019 ASSP Professional Development Conference*****, New Orleans, LA, June 12, 2019**

"NIOSH: Swing Fall Analysis of Below D-Ring Anchorage" **E. A. "Tony" McKenzie, Jr. Ph.D., P.E. and Thomas G. Bobick, Ph.D., P.E., CSP, CPE;** ***Presented at the 2018 ASSP Professional Development Conference*****, San Antonio, TX, June 4, 2018**

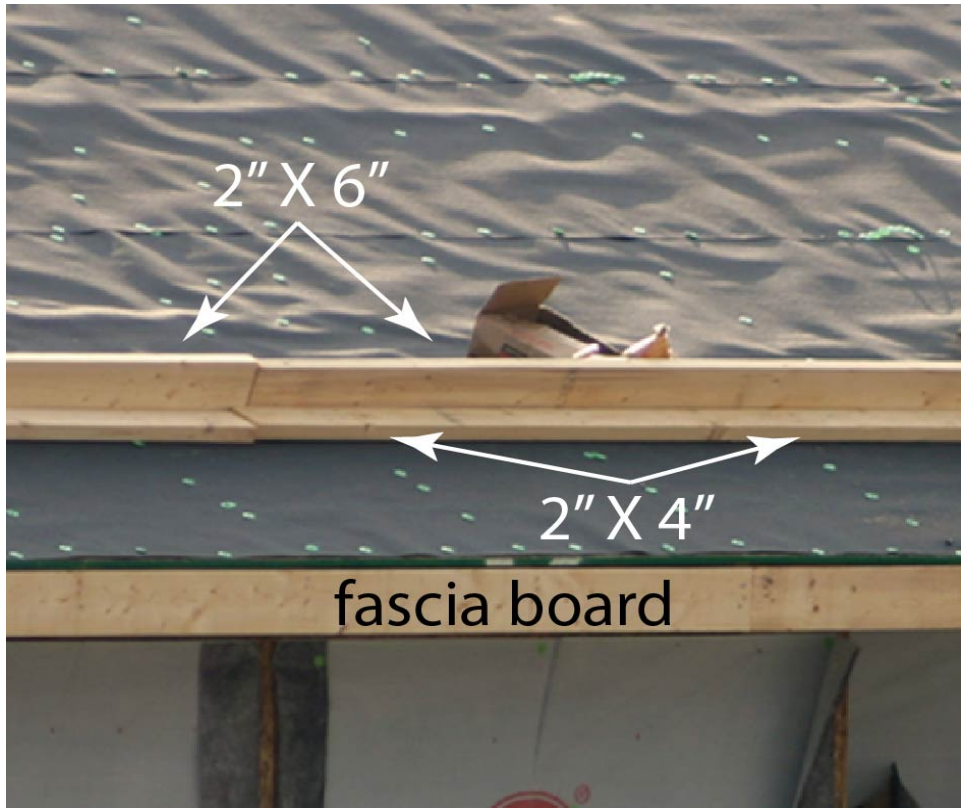
McKenzie, Jr., E. A., T.G. Bobick, M. Hause, "Proper Lanyard Choice Should Match the End Application," ***in review, to be submitted to Professional Safety Journal***

Fall Prevention – Slide Guard System

Project Officer: Thomas Bobick, Ph.D., P.E., CSP, CPE

Typical Real World Usage

<u>Typical slide guard arrangement</u>:
2” x 6” boards supported by 2” x 4” boards; system nailed to roof every two feet.



Evaluate a slide guard system at the roof edge

In 2011, OSHA eliminated the use of slide guards as the “sole means” of complying with the fall protection requirements. However, slide guards could be used in conjunction with personal fall-arrest systems

Research study intent:
Evaluate effectiveness of slide guard set-up for preventing a test manikin from sliding over the roof edge of two roof slopes

Test manikin served as a surrogate for an unconscious worker

Two test slopes

34° slope test roof
(8-in-12)

45° slope test roof
(12-in-12)

Materials Tested, Dry Condition Only

- **Three sheathing materials**
  - Plywood
  - OSB
  - Green Board
- **Five underlayment materials**
  - No. 30 Felt paper
  - Synthetic Material A
  - Synthetic Material B
  - Synthetic Material C
  - Synthetic Material D

  (Cannot name these materials; could be viewed as an endorsement or a criticism)

34° Roof Slope

45° Roof Slope

Summary of 16 Manikin Slides

Material	34° Slope		45° Slope	
	Manikin stayed on roof / M. went off roof		M. stayed on roof / M. went off roof	
OSB	Yes		No	Went over SG like speed bump
Plywood	Yes		No	Went over SG like speed bump
Green Board	Yes		No	Went over SG like speed bump
No. 30 Felt Paper	Yes		No	Went over SG like speed bump
Synthetic Material A	No	Knocked SG off roof	No	Knocked SG off roof
Synthetic Material B	Yes		No	Knocked SG off roof
Synthetic Material C	Yes		Yes	
Synthetic Material D	Yes		No	Went over SG like speed bump

Take Home Message

- A slide guard system installed at the eave of a roof slope of 34° (8-in-12) or shallower can be an effective *supplement* to a company's overall fall-protection plan, but should never be considered as the sole means to achieve work site fall protection compliance
- Using a slide guard system on a roof slope of 45° (12-in-12) would **not** be an effective supplement to a company's overall fall-protection plan
- Contractors should consider purchasing & using synthetic underlayment materials with higher coefficient-of-friction values. This type of information may be available from the suppliers of underlayment materials used on steep-sloped roofs

Project Officer

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Bobick, T.G., E.A. McKenzie, Jr., J.R. Powers, Jr., "Slide Guard Effectiveness on Steep-sloped Roofs," accepted for publication, *Professional Safety Journal*, tentative February 2021

Summary

Summary

- Fall-related research has been conducted by NIOSH – Division of Safety Research for more than 20 years
- In addition to these two topics, other fall protection and fall prevention research projects have been conducted and have resulted in a positive impact on worker safety
- Future projects will include the use of artificial intelligence (AI) and Robotics (including exoskeletons) in the construction industry to reduce worker exposures to hazardous conditions

Thank You – Any Questions or Comments?

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

Mention of any company or product does not constitute endorsement by NIOSH.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.