Safety Science 70 (2014) 262–269

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/ssci

# Fatal events in residential roofing

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ARTICLE INFO

*Article history:*
Received 21 November 2013
Received in revised form 1 April 2014
Accepted 25 June 2014

*Keywords:*
Residential construction
Roofing fatalities
Fall protection
Safety standards

ABSTRACT

Residential roofing is a high risk occupation, more than nine times as risky as the average occupation and more than three times as risky as the average construction trade. To better understand the factors involved in residential roofing fatalities, 112 case reports filed by Occupational Safety and Health investigators for the years 2005–2010 were examined. In almost all of the recorded cases there was no adherence to the then current safety standards. It was found that there was little or no appropriate use of fall protection practices or equipment and that employer planning and employee training was minimal. Specific standards violated were examined as well as the monetary penalties assessed. In addition to an increase in the size of the penalties, it is hoped the recent national program "Campaign to Prevent Falls in Construction", with its emphasis on planning, needed equipment, and training will prove fruitful in mitigating falls from roofs.



## 1. Introduction

Since 1971, the major goal of the United States Occupational Safety and Health Administration (OSHA) has been to reduce workplace injuries and fatalities. While overall there has been considerable success in this endeavor, there have also been areas of disappointment. One area which has experienced limited improvement in fatality reduction is residential roofing. Here we will examine the residential roofing industry and the factors associated with roofing fatalities in an effort to better understand the issues and challenges it faces in reducing this statistic.

The first decade of this century saw significant progress in the reduction of occupational construction fatalities from a total of 1154 in 2000 to a total of 774 in 2010. While the reduction in fatalities is to be welcomed, it should be noted that some of the 33% reduction in fatalities was accompanied by an 18.7% reduction in construction industry employment. Indeed, the decade embraces two quite opposite periods. During the first of these sub-periods, to 2006, employment peaked at 7,691,000 a 13.3% increase from 2000, but fatalities also increased by 7.4%. This represented an improvement certainly, but not as significant an improvement as in other periods. During the second sub-period, 2006–2010, employment fell by 28.3%, but fatalities fell by an even greater rate of 37.5%. As a matter of record it should be noted that a longer time horizon yields a brighter picture since from 1992 to 2010 fatalities fell by nearly 16% while employment increased by nearly 20%. (Employment: BLS, 2012; Fatalities; BLS, 2012a).

Since 1992 the frequency of work-related fatal events for all industries fell for three of the four most prominent fatality categories: highway incidents, homicides, and struck by object. The one major category running counter to this trend was "falls". For the 1992–2010 period falls experienced an increase in the absolute number of fatalities (from 600 to 635) and had the least reduction in relative terms compared to the peak observations for the period (25% versus 42% for the other three categories). This suggests examination of the fatal fall phenomena as an important area of investigation if progress in reducing fatal work events is to be achieved.

For 2010 the Bureau of Labor Statistics reported 774 fatalities in construction relative to 4206 reported for the entire private sector. This ranked "construction" as number one in fatalities and fourth in terms of fatal injury rates among the fifteen industrial sectors identified. All falls accounted for about 14% of worker deaths in 2010 with 18% of that total represented by falls from roofs. When examined by occupation, 57 deaths involved roofers and the fatality rate was 32.4 per 100,000. Taking into account the 2010 "all industry" rate of 3.8 per 100,000 full-time workers contrasted to 9.8 for construction, roofing was nearly nine times as risky as the average occupation and 3.3 times as risky as the average construction trade. (BLS, 2011).

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http://dx.doi.org/10.1016/j.ssci.2014.06.013
0925-7535/

Understanding fatal events involving the residential roofing industry requires an understanding of the nature of the industry itself. Common characteristics of the industry are:

(1) Industry structure
   a. Typically small firms. Often 10 or fewer employees.
   b. Nonunion.
   c. Low capital requirements. May be limited to a truck, ladders and, at best, minimal safety gear.
   d. Transient nature. Because of low capital requirements and, perhaps legal issues, entry and exit is easy. Most firms are sole proprietorships.
   e. No specialized managerial skill.
(2) Environment
   a. Workplace is hazardous. The work environment is elevated, usually sloped, and the surface is often slippery.
   b. Movement is essential, with or without assistance gear.
   c. Weather often makes for a hostile environment.
(3) Workforce
   a. Skill level is low. Not generally regarded as a "skilled trade" and little or no formal training is provided.
   b. The work tends to be seasonal. It may be difficult for an individual to commit to the roofing industry because continuous employment may not be possible.
   c. Relatively high proportion of foreign-born workers. This has been shown to give rise to communication problems when dealing with safety issues.

As a result of all of these factors, the residential roofing industry is characterized by a high level of hazard coupled with an environment which may not be conducive to mitigation activities on the part of either management or labor.

## 2. Materials and methods

In late 2011 at the request of OSHA, the Construction Industry Research and Policy Center at the University of Tennessee, Knoxville (CIRPC) undertook a study of the circumstances surrounding residential roofing fatalities. The database consisted of 112 case reports filed by OSHA Compliance Safety and Health Officers (CSHO's) following a detailed investigation of each fatal event. The reports were broadly representative of the nation as a whole and included more than 90% of the events during the period of 2005–1010. Included were events involving both single family (83) and multi-family housing (29). Cases were reviewed based on standard safety guidelines in effect during the construction time period. Particular attention was paid to a number of options which could be utilized to provide a degree of protection for roofers. Here are some of the alternatives:

(1) For a low slope roof (4/12 or less incline)
   - A warning line consisting of a flagged rope or wire at least 6 feet (1.8 m) from the edge and 34–39 inches (0.8–1.0 m) high.
   - A safety monitor. He/she must be a competent (i.e., trained and authorized) person usually with no other duties than assuring the safety of the worker(s).
(2) For higher-slope roofs
   - Slide guards, if the eave is no more than 25 feet (7.6 m) from the ground and the slope is less than or equal to 8/12. Slide guards are boards placed parallel to the eave and held in place by brackets.
   - Personal fall arrest system. This consists of a harness worn by the roofer and attached to a lanyard which is properly anchored to the roof.

In 1999 OSHA issued "Interim Fall Protection Compliance Guidelines for Residential Construction" which tended to relax the fall protection standards established in the regular OSHA standards. It is these interim standards which were in place during the 2005–2010 period under investigation.

A complete picture of the applicable regulations can be seen in Fig. 1. As shown, the interim guidelines only came into force in situations where the eave height was 25 feet (7.6 m) or less. If that criterion was met, alternate approaches to meeting the standards were triggered depending on the slope of the roof.

In December of 2010 OSHA cancelled the interim guidelines in effect since 1999 and established new enforcement policies based on the residential construction standards found in the Code of Federal Regulations (See 29 CFR Part 1926 Subpart M – Fall Protection). Fig. 2 illustrates the new regulations which were promulgated in June of 2011. It is clear that the new regulations are more stringent than the interim regulations: they apply to activity 6 feet (1.8 m) or more above lower levels and, except in unusual cases, require the use of guardrails, safety nets, or personal fall arrest systems. As such, our analysis of the cases studied here may serve at some future time as a benchmark to measure the effect of the changes in standards mandated by the new policy.

## 3. Results

### 3.1. Characteristics of the study population and events

A snapshot of the industry that emerges from these case reports buttresses the characterization of the industry described earlier:

(1) The operating environment is hazardous. Sixty percent of the known slope cases involved a roof slope of 3/12 or greater and in 20% of these cases the slope exceeded 8/12.
(2) In nearly 75% of the cases, the fall distance exceeded 15 feet (4.6 m).
(3) In nearly 50% of the fatalities, employees were reported to be untrained and more than 10% had less than four weeks experience.
(4) The Hispanic[1] element in the study population approached 37% as compared to a 2012 Hispanic construction industry workforce of nearly 25%.

Roof slope and eave height are important factors in the application of roofing standards. While roof slope characteristics were not reported in about 25% of the cases, some 60% of the fatalities were identified as involving roofs of 8/12 slope or less. Of the 83 cases where roof slope was recorded, information was also available on eave height. For low slope roofs (<4/12), the largest number of fatalities (14) occurred at eaves of 7–15 feet (2.1–4.6 m), 9 cases were reported at 16–25 feet (4.9–7.6 m), and 6 recorded at 36 feet (11 m) or more, thus accounting for 29 of the 30 cases with known eave height. In the intermediate slope category (4/12–8/12) the eaves tended to be somewhat higher with 21 cases reporting 16–25 foot (4.9–7.6 m) eaves, and 7 reporting 26–35 foot (7.9–10.7 m) eaves, thus accounting for 28 of the 33 fatality cases with known eave height. For high slope roofs (>8/12), the distribution was similar to that for the intermediate category, with 9 of the 14 cases with known eave height reporting a 16–25 foot (4.9–7.6 m) range. Overall, of the known eave cases, 28% of the fatalities were 15 feet (4.6 m) or less, 46% were in the 16–25 foot (4.9–7.6 m) category, and 25% involved eaves of 25 feet (7.6 m) or greater.

[1] In this document the term "Hispanic" refers to a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race. As of 2012 some 24.4% of the construction industry workforce was classified as Hispanic.