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An assessment of the asphalt shingle roofing process for residential buildings

Althea Arnold

University of Texas at Tyler, 3900 University Blvd, Tyler, Texas 75700 USA

Abstract

Asphalt shingle roofing is performed by specialty contractors in the construction industry with the roofing crew performing tasks in different areas on the roof simultaneously. While asphalt shingle roofing materials have improved, the roofing construction process has not changed significantly over the past 70 years.

This paper describes the process, factors that affect the productivity of the workers, and methods for calculating productivity in terms of man-hours worked and cost per unit output. Safety is also a concern in roofing. While falls from roofs are a major cause of injuries on the construction job site, other injuries common to roofers include sprains and strains to the back, knees and ankles. The trend of constructing steep roofs, common in Texas high end residential homes, are implicated in these injuries. Safety plans and worker safety climate are low priorities for financially strapped construction companies. Designing out the hazard would be more effective than Personal Protective Equipment (PPE) in preventing accidents in the roofing industry.

The paper concludes that research and development are needed to improve roofing construction methods to provide a safe and healthy environment for the worker and reduce costs of construction.

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1. Introduction

The Post World War II economic expansion brought about the wide spread use of asphalt shingles for residential roofing. These shingles were inexpensive and relatively easy to install. While the quality of materials have improved, the methodology for installing them has not changed significantly over the past 70 years. This study reviews the standard methodology for asphalt shingle installation and gives findings on the installation time and productivity. Common construction practices affect worker safety and designing out the hazard is more effective than Personal Protective Equipment (PPE) in preventing accidents. There have been great improvements to the quality of shingles due to the demand of home owners, but few to the methods of constructing the roof covering. A discussion of areas of research to improve installation methods is also included.

* Althea Arnold. Tel.: 903-566-7002; fax: 903-566-7337.
E-mail address: aarnold@uttyler.edu

2. Installation process

Roofing is performed by specialty contractors in the construction industry with 200,000 workers directly employed in the application of roofs. [1] Observation of local roofing companies shows the average roofing crew typically consists between 5 to 10 workers performing tasks in different areas on the roof simultaneously. Roofing contractors choose the number of workers depending on the size of the roof, the time frame for completion, and productivity of their crews. Factors that affect the productivity of the workers include the weather, temperature, wind speed, complexity of the roof, and slope of the roof.

2.1. The setup

Workers typically hand carry shingles to the roof although some roofing materials delivery companies will deliver the shingles to the roof. For shingle applications there will be one to two nailers and one helper working together depending on the type of shingle or roof being installed. The helper places a bundle of shingles near the nailer(s) and passes the individual shingles to the nailers. Each nailer then places the shingle in place and proceeds to attach the shingle using a roofing nail gun. Work begins on the lower left of the roof and proceeds to the right and up.

2.2. The action zone

The area where the nailer and helper are working is referred to as the Action Zone, as shown in Figure 1. The Action Zone moves with the workers as their work progresses across the roof. Several teams of two to three workers install shingles on different areas of the roof speeding up the process.



Figure 1. Each nailer is working in their own Action Zone.

2.3. Shingle bundles and squares

An average size house (232.3 square meters (SQM)) with a 6/12 slope (26.6°) uses 88 bundles of shingles assuming a simple gable roof with no architectural features such as dormers. And can be completed in one 8-hour day. This estimate assumes three bundles of shingles make up a “square” which is 9.29 SQM (100 square feet) of completed roof measured in the plane of the roof. Some shingle types require four bundles to make up a square. More complex roofs as shown in Figure 2, can use up to 100 bundles of shingles and require two 8-hour days to complete. Steeper roofs require more shingles and take longer to install, not just because of the additional square footage, but the steepness of the roof is harder to navigate and the workers fatigue more quickly requiring more breaks.

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