

# CAUSES AND MEASURES OF FALL ACCIDENTS ON RESTORATION WORK AFTER THE GREAT EAST JAPAN EARTHQUAKE

Hiroki Takahashi<sup>1</sup>, Tomohito Hori<sup>1</sup> and Yasuo Toyosawa<sup>1</sup>

*<sup>1</sup>National Institute of Occupational Safety and Health,  
1-4-6 Umezono, Kiyose, Tokyo 204-0024, Japan*

Many buildings and structures in the Tohoku region along the Pacific coast were destroyed by the Great East Japan Earthquake. It is feared that fall accidents will continue to occur during the restoration work related to this disaster because such falls have been the most prevalent form of recent work-related accidents. In this study, we analyse the fall accidents that have already occurred during the restoration work for the Great East Japan Earthquake with the purpose of preventing future fall accidents. A study of the number and causes of these accidents was conducted. Fall accidents have occurred most frequently from a roof or ladder. The main causes of the accidents are as follows: The operations chief was not present at the construction site and safety belts were not used on the roof. To make these findings accessible to the restoration workers, we have compiled the results into a simple illustrated booklet.

## Introduction

The Tohoku Earthquake occurred off the Pacific coast of Japan at 14:46 on March 11, 2011, followed by tsunamis and aftershocks. Many buildings and structures in the Tohoku region were devastated by the earthquake, tsunamis, and aftershocks, which together are referred to as the Great East Japan Earthquake.

During the demolition of a building damaged by an earthquake, there is a high risk that the building will collapse. Moreover, demolition and separate work are undertaken simultaneously at the same site, therefore increasing the likelihood of work-related accidents. It is feared that fall accidents will continue to occur during the restoration work related to the Great East Japan Earthquake because such incidents have been the most prevalent form of recent work-related accidents.

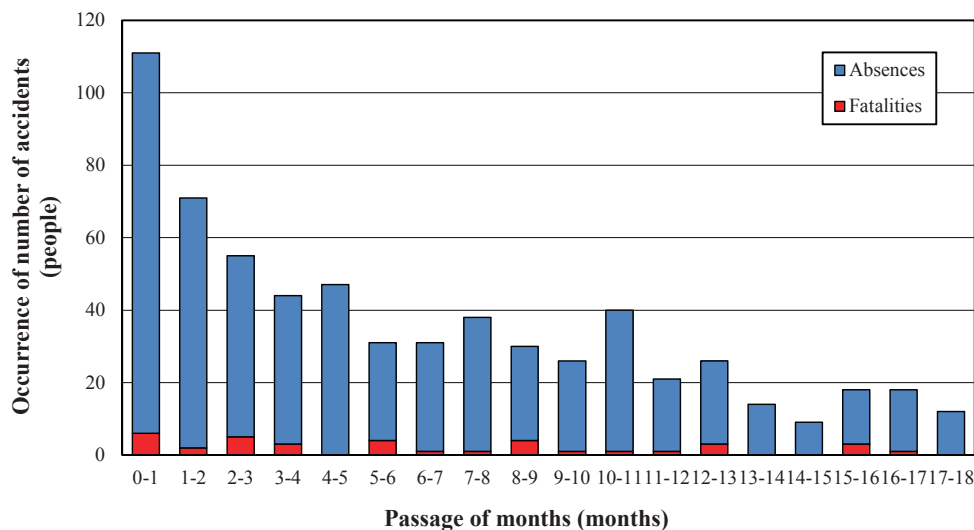
In this study, we analyse the fall accidents that have already occurred during the restoration work with a view to preventing future fall accidents. A study of the number and causes of these accidents was conducted. The data used in this study were taken from four days or more during the period of March 11, 2012 to September 11, 2013.

For practical use of these results, we have developed illustrations for each accident type and recommendation.

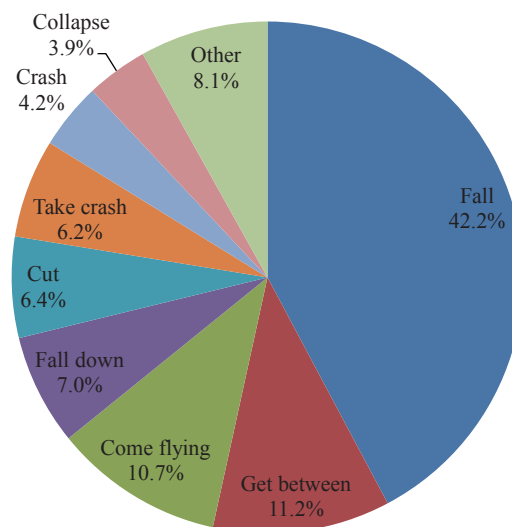
## Outline of all work accidents

To date, the work accidents of four days or more due to the restoration work after the Great East Japan Earthquake have involved 642 people (including 36 fatalities) from March 11, 2012 to September 11, 2013. The occurrence of number of accidents according to the number of months after the earthquake is shown in Figure 1. The most work accidents occurred within the first month after the earthquake, affecting 111 people (including 6 fatalities). The work accidents follow a decreasing trend with the lengthening of time after the earthquake. The number of work accidents after 17 to 18 months was 12 (including 0 fatalities).

The state of the occurrence of accidents by pattern is shown in Figure 2. Falls were the most common type of accident, affecting 271 people (42.2% of all work accidents). The “get between” group of accidents affected 72 people (11.2%), the “come flying” group of accidents affected 69 people (10.7%), and the “fall down” group of accidents affected 45 people (7.0%). These four types of accidents account for 71.1% of all work accidents. Falls mainly occurred during roof work.



**Figure 1. Relationship between occurrence of number of accidents and passage of months**



**Figure 2. The state of the occurrence of accidents by pattern**

## Outline of fall accidents

The state of the occurrence of the fall accidents that were biggest accident was analysed. An outline of fall accidents is shown in Figure 3.

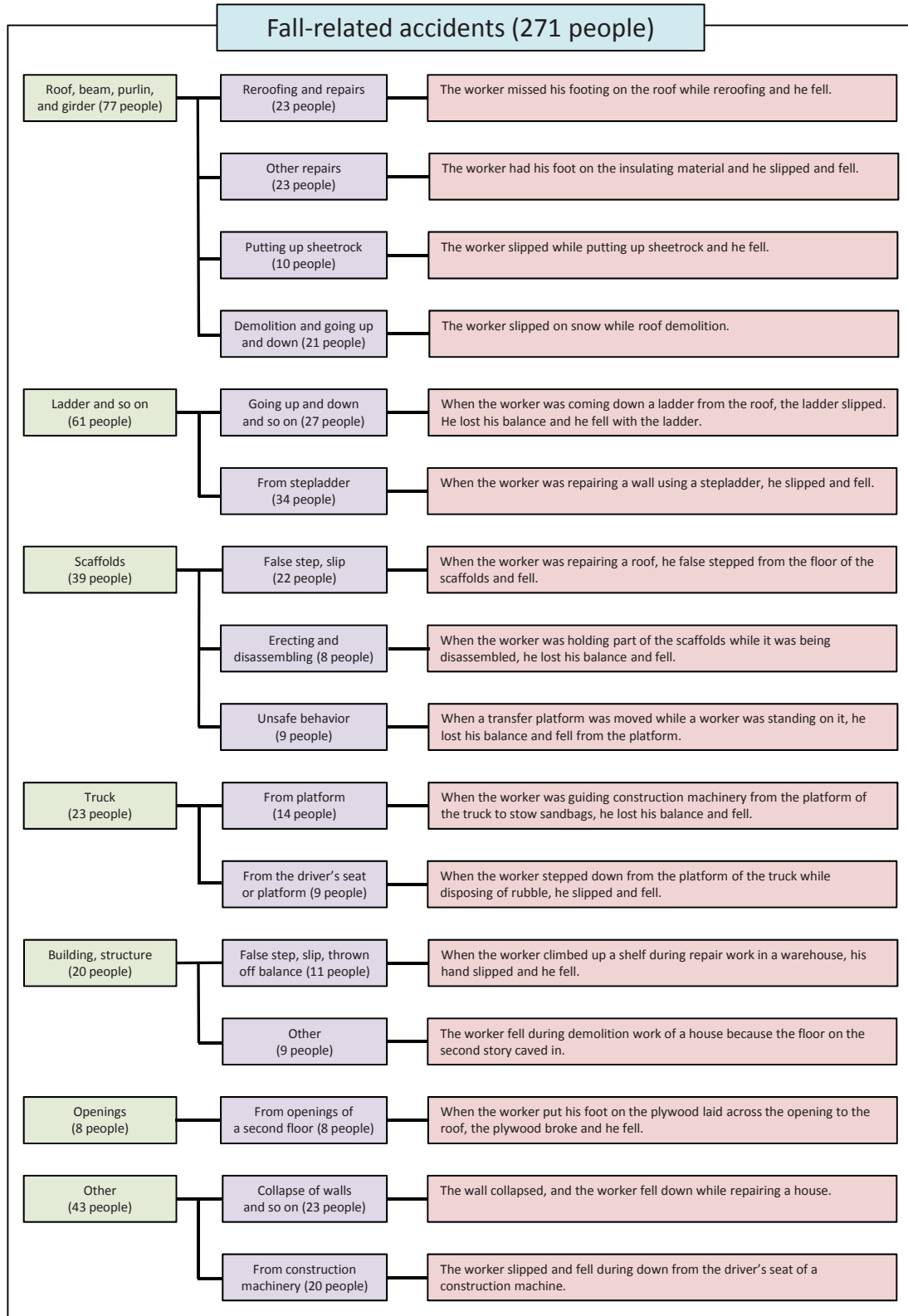


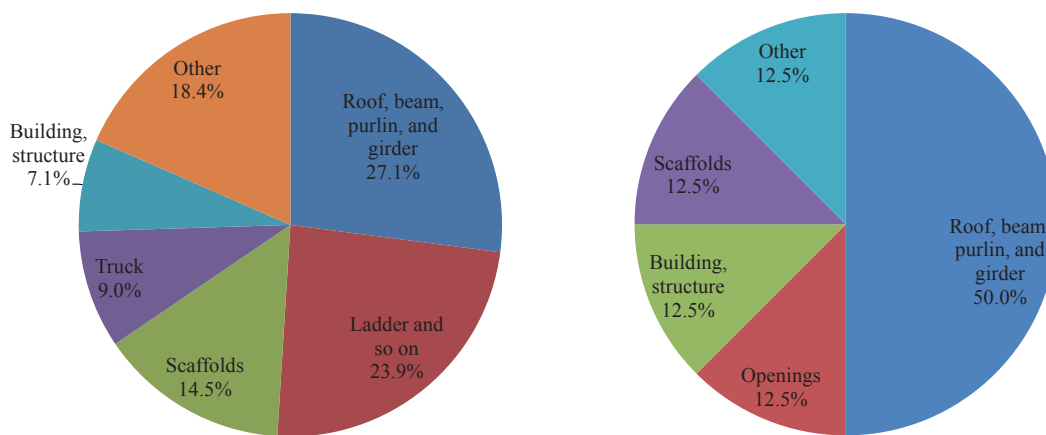
Figure 3. Outline of fall accidents

## Occurrence by causal agents

The state of the occurrence by causal agents in falls is shown in Figure 4. Figure 4(a) is accidents that led to an absence from work, and Figure 4(b) is the fatal accidents.

In the occurrence by causal agents of absence accidents, the “roof, beam, purlin, and girder” group affected 69 people (27.1%), the “ladder and so on” group affected 61 people (23.9%), the “scaffolds” group affected 37 people (14.5%), the “truck” group affected 23 people (9%), and the “building, structure” group affected 18 people (7.1%). Those five types of accidents comprise 81.6% of all falls.

The “roof, beam, purlin, and girder” group led to the most fatalities (8 people, 50% of fall fatalities). The “openings” group led to 2 fatalities (12.5%), the “building, structure” group led to 2 fatalities (12.5%), and the “scaffolds” group led to 2 fatalities (12.5%). Those four types of falls comprise 87.5% of all fall-related fatalities. The “ladder and so on” group did not cause any fatalities.



(a) Absence accidents

(b) Fatal accidents

Figure 4. The state of the occurrence by causal agents in falls

## Occurrence of sick and wounded

The state of the occurrence of sick and wounded due to falls is shown in Figure 5. “Fractures” were the most common type of fall injury, affecting 201 people (74.2% of all fall-related injuries). Bruising affected 50 people (18.5%), and “sprains and so on” affected 12 people (4.4%). Those three types of injuries account for 97% of all fall-related injuries.

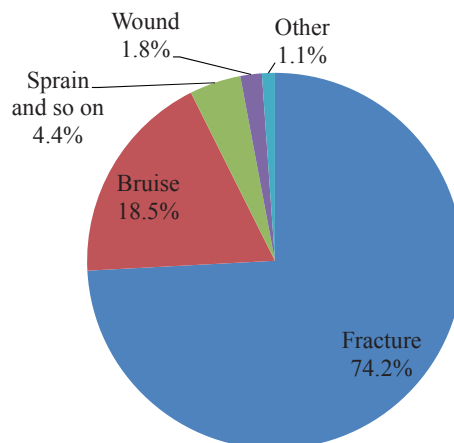


Figure 5. The state of the occurrence of sick and wounded due to falls

## **Conclusion**

### **Occurrence and causes**

In this study, we have analysed the falls related to the restoration work after the Great East Japan Earthquake with a view to preventing future falls. Falls were the most common type of work accident, affecting 271 people (42.2% of all work accidents).

In the fatal accidents caused by falls, the most common cause was falling from a roof and being hit on the head. In relation to absences from the workplace, the “roof” and “ladder and so on” groups were the most common due to the injuries they caused to the feet, chest, back, etc. The most common causes for these injuries were no operation chief on site, not using a safety belt on the roof, the ladder being set up inappropriately, and the lack of an assistant.

### **Measure of accidents**

Based on our results, the measures of falls during the restoration work after the Great East Japan Earthquake as follows:

1. You should thoroughly investigate the extent of damage to the building before beginning work. You should make a work project from those results.
2. You should have conscious of a safety work to each worker.
3. There should be an operations chief for each structure and type of building.
4. When the strength of a building is insufficient, you should review methods for increasing stability.
5. When you work over 2 meters from the ground, you should use work roof such as scaffolding. When you erect the scaffolding, you should devise measures to prevent falls, such as the installation of a net or using a safety belt. The scaffolds use actually a preceding method.
6. When you work in a high place, you should use good flexion and nonslip shoes.
7. The low-rise house is instability because a beam and so on is damaged. Therefore, you should not much work at high place work.
8. Ladders should be adequately wide and strong, with nonslip steps and a tip-over safety device. The ladder should be supported by an assistant.
9. For openings, you should use an enclosure, a guardrail, or a cover.

### **Practical use of the results**

For practical use of these results, we have developed illustrations for each accident type and recommendation (e.g., Takahashi, H., Hori, T., and Toyosawa, Y, 2013). An example of these illustrations is shown in Picture 1.

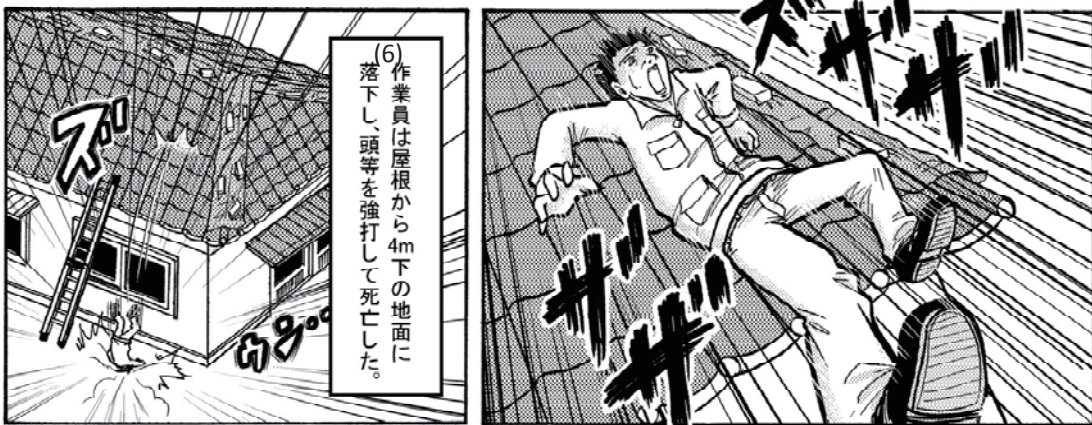
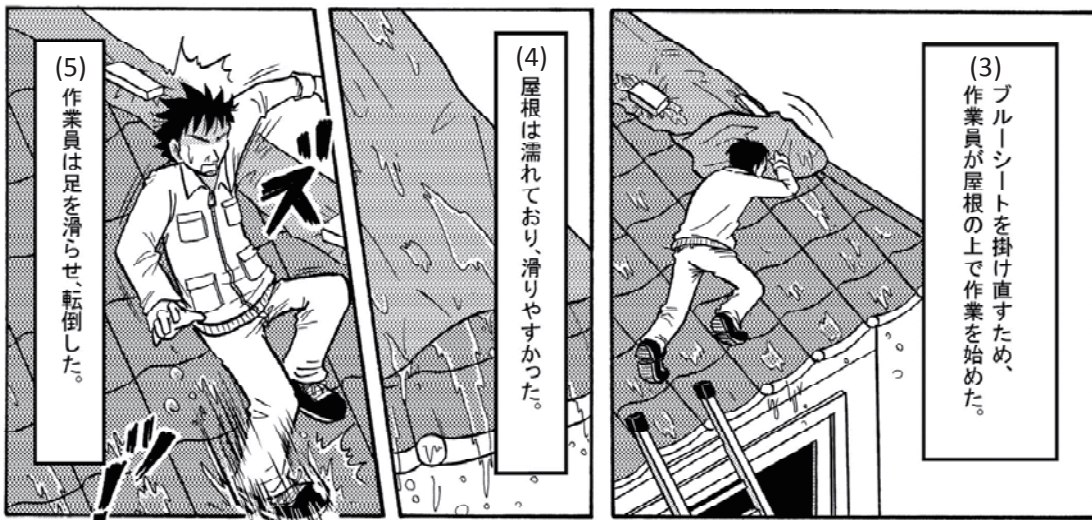
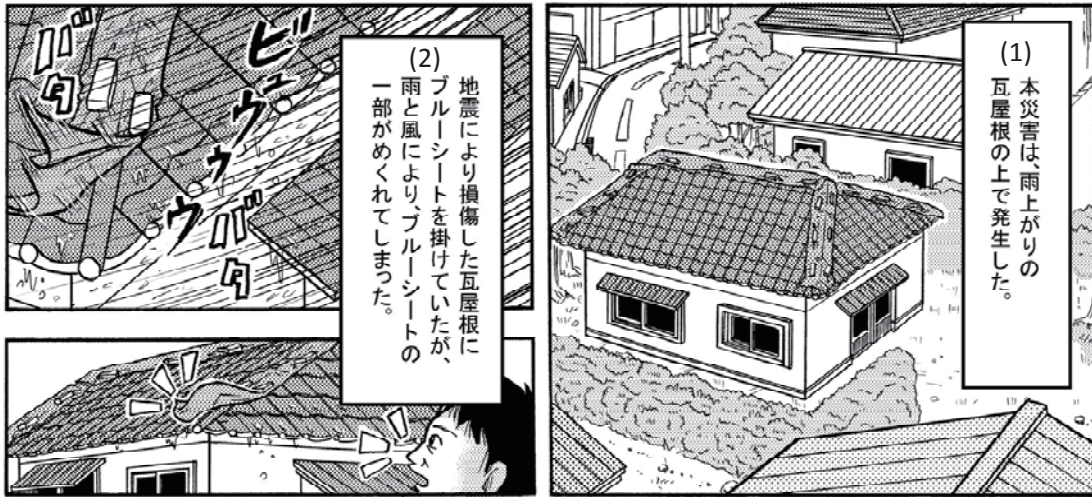
### **Acknowledgment**

This work was supported by Construction Industry Workers' Compensation Friendly Society. The picture was drawn by cartoonist Shinnosuke Tsuchida. We are gratefully acknowledged here.

### **References**

Takahashi, H., Hori, T., and Toyosawa, Y. (2013). Causes and measures of work accidents on restoration work of the Great East Japan Earthquake [in Japanese]. Tokyo: National Institute of Occupational Safety and Health, and Construction Industry Workers' Compensation Friendly Society.





- (1) This accident occurred on the roof after a rainfall.
- (2) A blue sheet was covering a damaged roof, but a part of the sheet was torn free by the rain and the wind.
- (3) The worker began to repair the sheet on the roof.
- (4) The roof was wet and slippery.
- (5) The worker slipped and fell.
- (6) The worker fell from the roof and hit his head and died.

Picture 1. The worker fell when he was repairing the blue sheet on the roof