ACCIDENTS BY FALLS IN THE CONSTRUCTION INDUSTRY AND COUNTERMEASURES IN JAPAN

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Falls represent a serious hazard to workers in many industries, especially in the construction industry. Prevention of occupational accidents by falls in the construction industry is one of the top priorities in Japan. With the aim of identifying effective countermeasures against accidents caused by falls, data on 840 fatalities by falls that occurred during 2007–2011 and 2,938 casualties that resulted from falls during 2009–2010 were analysed. Areas where high-place work is conducted, such as roofs, beams, girders, scaffolding, ladders, and stepladders, accounted for a significant portion of the accidents due to falls. Based on the results of the analysis, countermeasures for preventing falls from such areas are discussed.

Introduction

There are many occupational accidents by falls in Japan (Figure 1). Among the occupational accidents in the construction industry, the ratio of the number of fall-related accidents to the number of all accidents resulting in casualties (absent from work for more than four days) is approximately 35%, and the ratio of the number of accidents causing fatalities is as high as approximately 43% (Figure 2). The prevention of occupational accidents by falls in the construction industry is a top priority in Japan. To establish effective countermeasures against accidents caused by falls, it is first necessary to analyse the accident data. In this paper, some countermeasures are discussed based on the results of such an analysis.

Occupational Accident Trends in Japan

The Ministry of Health, Labour, and Welfare (MHLW) reported 1,093 (construction 367) fatal accidents in 2012. Of these 1,093 (construction 367) fatality cases, 271 (construction 157) were associated with falls. In addition, of 119,576 (construction 17,073) fatal accidents and casualties (absent from work for more than four days) in 2012, there were 20,017 (construction 5,790) cases associated with falls.

There has been a long-term decline in the number of casualties due to occupational accidents from a peak of 1.72 million in 1968. However, 544,862 workers (number of new recipients of workmen's compensation insurance in 2012) are still victims of occupational accidents and injuries every year. The number of fatalities in the construction industry peaked at 6,712 in 1961 and has gradually declined since this peak. The number nearly halved in the four years from 1972 after the Industrial Safety and Health Law came into force. It has continued to decline steadily over time due to decreases in the amount of construction investment and the

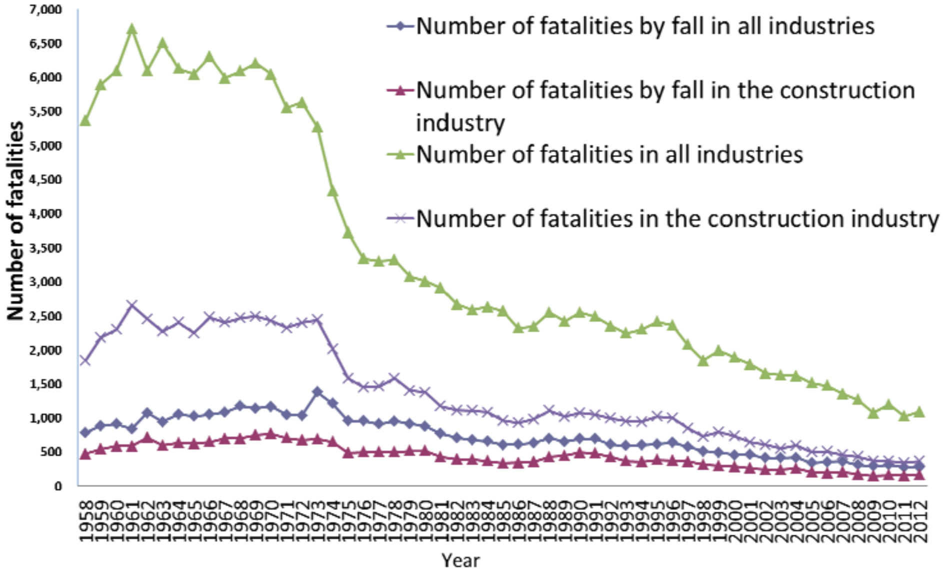


Figure 1. Trends in the number of fatalities in Japan (1958–2012)

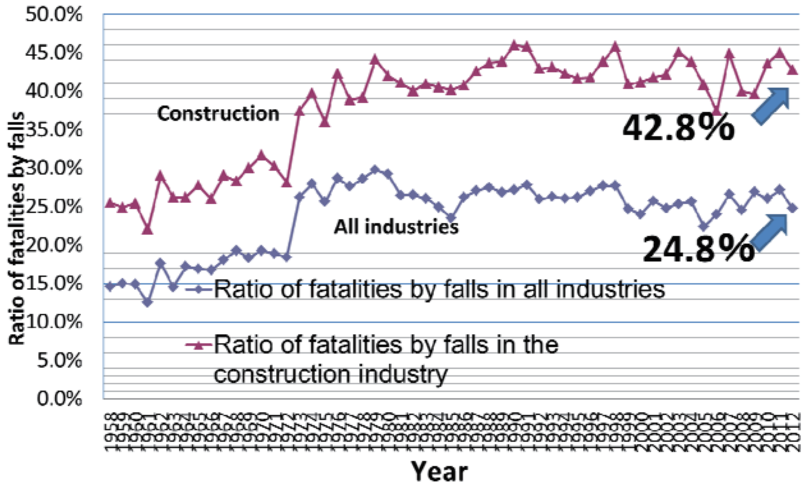


Figure 2. Trends in the ratio of fatalities by falls in Japan (1958–2012)

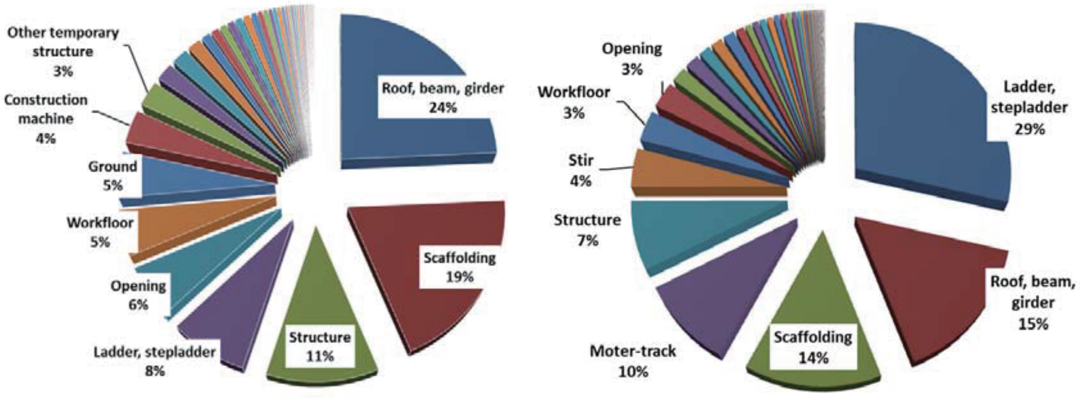
number of workers. However, the number of casualties has continuously increased during the past three years. In addition, the number of fatalities has repeatedly increased and decreased in recent years.

Analysis of Occupational Accidents by Falls

In this paper, 840 fatalities by falls that occurred during 2007–2011 and 2,938 casualties (data on one-fourth of casualties extracted from all databases of casualties) due to falls that occurred during 2009–2010 published on the MHLW's website (e.g. MHLW, 2013) were analysed.

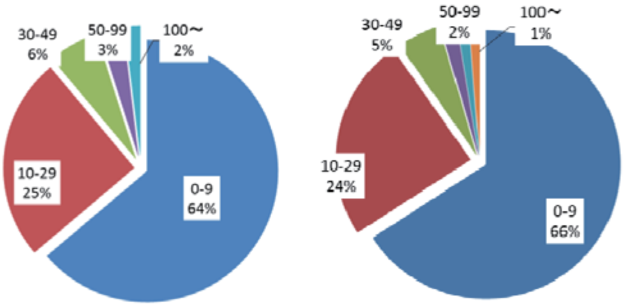
Analysis by type of construction work

A greater number of accidents occurred in building construction than in civil engineering. When the data were sorted by type of work, nearly half of the accidents due to falls occurred in wooden building construction and steel and reinforced concrete building construction. 17% of fatalities and 24% of casualties occurred in wooden building construction, and 16% of fatalities and 15% of casualties occurred in steel and reinforced concrete building construction.



Fatalities **Casualties**

Figure 3. Places where falls occurred in the construction industry



Fatalities **Casualties**

Figure 4. Number of employees in the company where falls occurred

Analysis by places where falls occurred

Regarding the places where the accidents resulting in casualties occurred, sites of high-place work, such as "ladders and stepladders" ranked first, followed by "roofs, beams, girders" and "scaffoldings" in that order. Regarding places where fatal accidents occurred, "roofs, beams, and girders" ranked first, followed by "scaffoldings" and "building structures" in that order. (Figure 3) On the steel and reinforced concrete building construction sites, the fatalities were mainly due to falls from scaffolding and falls from building beams. As to the type of work, a large number of the accidents occurred during exterior finishing work, temporary work (particularly the erection and dismantling of scaffolds), and steel work. On the wooden building construction sites, roofs, beams, scaffolds, ladders, and stepladders were the main workplaces where the fatalities by falls occurred.

Analysis by size of the enterprises where falls occurred

Figure 4 shows the number of employees involved in the enterprises where the accidents due to falls occurred. About 65% of the accidents occurred in enterprises with fewer than nine employees. About 90% of the fatalities and casualties occurred in small-scale enterprises with fewer than 30 workers. Small-scale enterprises tended to have a greater number of fatalities and casualties than large-scale operations.

Countermeasures against Occupational Accidents by Falls

Countermeasures against falls from scaffolding

The National Institute of Occupational Safety and Health (JNIOSH) organized a committee for "Preventing Falling Accidents from Scaffolding" in May 2007. The aim of the committee was to review prevention measures for accidents that involve falling from scaffolding in view of the

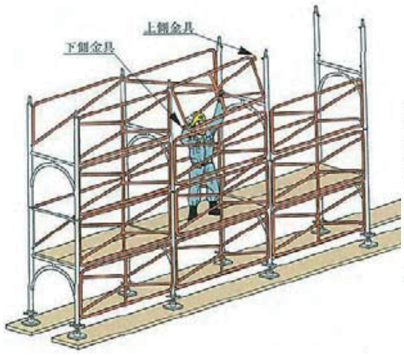


Figure 5. An example of guardrail-first erection method

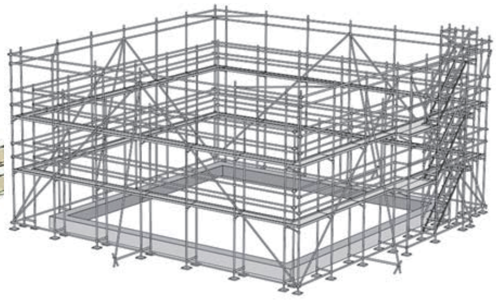


Figure 6. Precedent scaffolding erection method

situation of fall accidents from scaffolding and interviews with people working in the field. Based on the committee's proposals, the related Ordinance on Industrial Safety and Health was amended on June 1, 2009.

Strengthening measures for the prevention of falls from scaffolding by regulation

Measures proposed to expand and strengthen the provisions covering scaffolding guardrails, toe-boards, etc. and to prevent danger from falling objects under the current Ordinance on Industrial Safety and Health are given below.

For preventing falls

(a) Tube and coupling scaffolding : Require guardrails (height of at least 85 cm) and rails (height of 35 cm to 50 cm) (or equivalent measures).

(b) Prefabricated scaffolding : Require the installation of a rail (height of 35 cm to 50 cm) or a toe-board (height of at least 15 cm) in the cross bracing (or equivalent measures).

Promotion of the "guardrail-first erection method" for the erection and dismantling of scaffolding

To prevent fall-related accidents during the erection and dismantling of scaffolds, the MHLW recommends the "guardrail-first erection method". Together with a revision of the measures for preventing falls from scaffolding, the guidelines were also partially revised in 2009 with the aim of strengthening measures for the prevention of falls from scaffolding.

If this method were used, the risk of falls during the erection and dismantling of scaffolds would be quite small. Figure 5 shows typical scaffolding with this method (e.g. MHLW, 2003).

Promotion of the "precedent scaffolding erection method" for wooden house construction

Due to traditional Japanese customs, carpenters tend to build wooden houses without scaffolding. In 1996, the MHLW released the "precedent scaffolding erection method" guideline for low-rise building construction (wooden houses). Figure 6 shows scaffolding erected before the start of the construction of a wooden house (e.g. MHLW, 1996). In the decade since the MHLW released this guideline, the number of fatalities by falls in wooden building construction has decreased by about 70%.

Falls from single-row scaffolding

The amendment of the Ordinance on Industrial Safety and Health (2009) does not apply to single-row scaffolding. When it is difficult to erect two-row scaffolding or prefabricated scaffolding because of narrow spaces between houses, single-row scaffolding is allowed in Japan. The idea is that there will be no gaps if the single-row scaffolding is erected in these narrow spaces between houses.

However, "single row scaffolding" and "scaffolding assembled with stepladders and boards" accounted for more than 60% of fatalities related to falls for wooden house building.

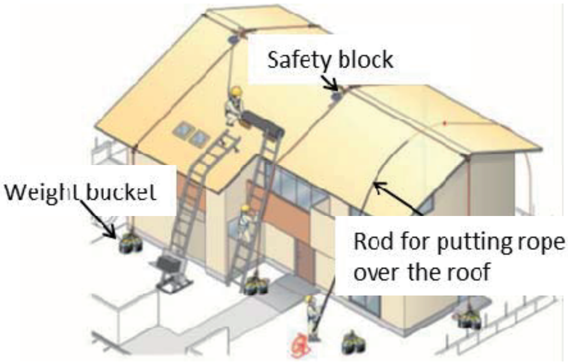


Figure 7. Roof repair work with safety features **Figure 8. Unsafe usage of stepladders**

Many of the falls occurred because of insufficient handrails, gaps between the wall of houses and scaffoldings.

It is necessary to assemble single-row scaffolding in such a way that there are not any gaps or spaces where workers could fall through.

Falls from roofs

Many fall-related accidents occurred during repair works for roofs of houses damaged in the Great East Japan Earthquake in 2011. Subsequently, the JNIOSH formed a committee to prevent falls from roofs and buildings and drew up a report in cooperation with the Japan Safety Appliances Association. The MHLW has disseminated the details of this report and instructed construction-related companies on its content. Figure 7 shows an illustration of the system introduced in the report for roof repair work or installation work for solar panels. The system includes a number of safety features (main safety rope, harness-type safety belt, safety block, weight buckets, rod for putting rope over the roof, etc.) (e.g. JNIOSH & JSAA, 2012).

Falls from collapsed slate roofs remain a major problem in roof work. Further attention is needed to help prevent falls from slate roofs.

Falls from ladders and stepladders

Figure 3 shows that 8% of fatalities and 29% of casualties due to falls from ladders and stepladders occurred in the construction industry. Further analysis revealed that wooden house building with ladders and stepladders accounted for one-third of all fatalities due to falls.

Figure 8 shows typical unsafe usage of stepladders. There is a risk that the stepladders may turn over backward or forward because they are unstable.

One of the main causes of stepladder-related accidents seems to be insufficient worker's (including that of the supervisor and employer) knowledge about safety issues pertaining to ladder and stepladder usage.

12th Occupational Accident Prevention Plan

Since 1958, the MHLW has created a revised version of the Occupational Accident Prevention Plan 11 times and positively implemented various policies based on these plans. Based on recent occupational accidents and social changes, the 12th Occupational Accident Prevention Plan, a five-year plan that will last from 2013 through 2017, was launched in April 2013.
The 12th plan contains the following activities:

The construction industry aims to reduce the number of fatal accidents by more than 20% in 2017 compared with 2012. Promotion of fall-related accident prevention measures will be implemented by the construction industry as follows:
(a) Promotion of measures to prevent accidents due to falls from various places
In addition to promoting scaffolding-accident prevention measures, devices and methods to prevent accidents caused by falls from ladders and roofs should be developed and diffused
(b) Diffusion of harness-type safety belts

The use of safety belts, which ease the impact at the time of a fall, should be regulated, with harness-type safety belts made mandatory under certain conditions.
(c) Review and implementation of prevention measures for falls from openings, falls from beams, and falls from slate roofs.

Conclusion

To identify effective countermeasures against accidents caused by falls, data on 840 fatalities by falls that occurred during 2007–2011 and 2,938 casualties by falls that occurred during 2009–2010 were analysed. Based on the results of the analysis, some countermeasures are discussed.

The main points of the paper are outlined below:
(1) In 2012, of 1,093 (construction 367) fatality cases, 271 (construction 157) were associated with falls. The ratio of the number of accidents resulting in fatalities was as high as approximately 43%. The prevention of occupational accidents by falls is a top priority in Japan.
(2) Nearly half of accidents due to falls have occurred in wooden building construction and steel and reinforced concrete building construction in the construction industry.
(3) Regarding places where accidents resulting in casualties occur, sites of high-place work, such as ladders and stepladders, ranked first. With regard to where fatalities occur, roofs, beams, and girders ranked first, followed by scaffoldings.
(4) About 90% of the fatalities and casualties occurred in small-scale enterprises with fewer than 30 workers. Small-scale enterprises tended to have a greater number of fatalities and casualties than large-scale operations.
(5) The following three major countermeasures against falls from scaffoldings have been put in place:
  1) Strengthening measures for the prevention of falls from scaffolding by amendment of regulation
  2) Promotion of the guardrail-first erection method for the erection and dismantling of scaffolding
  3) Promotion of the precedent scaffolding erection method for wooden house construction
(6) Many of the fall-related accidents occurred because of insufficient handrails on scaffolding and gaps between walls of houses with single-row scaffolding. Single-row scaffolding must be assembled properly to ensure there are no gaps or spaces through which a worker could fall.
(7) Preventing falls from roofs is a major concern. Safety procedures during repair work or during installation work for solar panels should be developed and popularized.
(8) One cause of falls from ladders or stepladders is insufficient knowledge about safety usage of the equipment. Safety education for proper usage with good education material is needed.

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