ESTABLISHMENT OF SAFETY GUIDELINES FOR ELDERLY CONSTRUCTION WORKERS

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ABSTRACT: With the average life expectancy increasing thanks to better standards of living and medical technology, the number of elderly construction workers in construction sites rises every year to surpass the 450 thousand people in the construction industry (24.7% of all employees in the construction industry). Similarly, the percentage of fatal accidents involving elderly workers has stood at 41~46 percent for the past five years; note that this is significantly higher than the other age groups, making safety measures for dealing with this issue a matter of urgency. This study sought to propose appropriate safety guidelines for elderly construction workers aged 50 years and over by examining the changes in their physical and psychological functions and through the subsequent analysis of the current status and causes of fatal accidents involving them. The guidelines targeted ferroconcrete construction where accidents occur quite often; construction was classified into mold construction, reinforcing rod construction, and concrete construction. Mold construction was further classified into preparation, carry-in, processing, assembly, and disassembly, and reinforcing rod construction, into preparation/transport and processing/assembly. Safety guidelines for each process were presented by dividing them into three aspects considering the changes in the physical and psychological functions according to their ages and type of accident causes: work environment improvement, machinery and equipment improvement, and work method improvement.

Keywords: Elderly construction workers, fatal accidents, safety guidelines

1. INTRODUCTION

1.1 Background and Objectives of the Study

The age group that is most vulnerable to fatal accidents in the construction industry is the group of elderly workers aged 50 years and over. The number of elderly workers stood at 450 thousand (24.7% of the total number of workers in the construction industry) in 2006, growing every year to account for 41~46% of the total number of fatal accidents in the industry for the past five years; this is a fairly higher level compared to other age groups. To bring down considerably the number of accidents occurring in the industry, safety guidelines for elderly workers responsible for the high accident rates should be prepared.

Most of the safety measures for elderly construction workers are difficult to separate clearly from the general guidelines for all construction workers; in fact, majority of those that are effective for elderly workers are also effective for other age groups. As elderly workers grow older, however, their physical strength, reflex, balance, etc., deteriorate. Thus, special measures for them should be prepared considering this aspect. Accordingly, together with the promotion of development of equipment and instruments to complement their reduced physical functions, safety measures wherein the features of accidents involving elderly workers are considered should be established to prevent such accidents.

This study proposed safety guidelines for elderly construction workers to address the problem of their reduced physical and psychological functions and to improve work methods considering the features of the workers and work environment where they can work safely.

1.2 Research Scope and Methods

This study targeted elderly construction workers responsible for the highest accident rate in the construction industry and considered the changes in their physical and psychological functions according to the changes in their ages as a fundamental cause of the accidents involving them. The causes of accidents were analyzed considering the features of accidents involving them and changes in their physical and psychological functions as determined through precedent studies. Based on this, this study focused on the development of safety guidelines to minimize accidents involving elderly workers.

In addition, this study viewed the changes in the physical and psychological functions of elderly construction workers according to the changes in their age as a fundamental cause of the accidents involving them. A theoretical review of this aspect and

considerations in work for elderly workers was also carried out in this study.

Ferroconcrete construction was selected as the subject of the guidelines for elderly construction workers since this field records a higher accident rate among its workers than other construction types. The research scope of this study covered the presentation of safety guidelines for each type of accident causes wherein the physical and psychological functions of elderly workers were considered.

1.3 Literature Review

Dong-Chun Kim, Jin-Ho Kim, and Hwa-Jung Kim (2001) analyzed the issues in safety management and institutional and legal regulations and systemized the hindrance factors in implementing safety management and institutions. Based on the analyzed issues, they proposed measures for improvement from the viewpoint of actual work as a measure for the promotion of safety management in construction sites.

Sung-Seok Goh, Han-Min Lee, and Hyuk Song (2001) established a safety information system that provides safety-related information for each process in construction sites in connection with accident cases based on a database that enables searching by keyword by dividing similar accident cases according to their construction process.

Yong-Chol Yang, Hoon Choi, and Jae-Jun Kim (2004) provided the classification standards for checklists by establishing a classification system for detailed construction work for each construction type and presented methods of improving the checklists through a risk analysis of detailed construction work. After providing the methods of improving checklists and operation according to the presented results, they came up with a computer system for operating safety management checklists for the prevention of safety accidents.

In Korea, some studies on the features of accidents involving elderly construction workers and measures for preventing them are conducted after perceiving the seriousness of the accidents. Note, however, that they deal with the entire industry or some business types; understanding the features of accidents involving elderly construction workers in the construction industry through them is quite difficult. Studies on the safety management of the construction industry and better safety-related statutes and establishment of a construction-related safety information system and development of checklists are being conducted, but they usually lack considerations for elderly construction workers.

2. THEORETICAL REVIEW

2.1 Features of Physical and Psychological Functions according to Change in Age

Compared to young people, middle-aged or elderly people have poorer endurance, reflex, eyesight, hearing, and thinking skills; their muscles, ligaments, joints, and cartilages are weaker, and they are more vulnerable to industrial accidents than young people.

The physical and psychological functions of middle-aged or elderly people have the following features: (1) their physiological functions such as sensing function and balancing function deteriorate rapidly; the flexibility of their lenses decreases, and their eyesight blurs and deteriorates; communication and danger signals in construction sites mostly rely on hearing, but their sense of hearing deteriorates as they grow older; misunderstanding and forgetfulness with regard to the delivery of decisions (such as work directions) occur quite often; (2) their general physical strength (e.g., grasping power, strength of stomach and legs, etc.) starts to decline; (3) they retain the high skills they acquired from training, but their adaptation to new skills (methods) is relatively lower; (4) individual gaps by aging in their physical and psychological functions widen; this suggests that their resistance to diseases and recovery of physical strength deteriorate as they grow older; moreover, due to their reduced physical functions, they often contract cerebrovascular, cardiovascular, and musculoskeletal diseases.

2.2 2 Considerations in Construction Work

Since the physiological functions of humans deteriorate, and psychological changes occur as they age, the production efficiency of elderly workers decreases, and the probability of occurrence of accidents or diseases in the course of performing their work rises. Since accidents involving elderly construction workers increase because their reduced physical functions hinder them from assuming the burden of work, accidents can be minimized if the amount or speed of their work is adjusted.

The adjustment of the weight of objects lifted by elderly construction workers and the transfer of heavy objects by more than two persons or through the use of aiding instruments are some of the considerations in construction work for the prevention of accidents and better productivity considering their reduced physical strength. Since elderly construction workers have poorer balancing sense, their work posture should be considered so that unstable posture is not assumed; in case kinetic work is done repeatedly, one should not spend more than an hour per day doing the same work. Moreover, elderly workers have poorer eyesight; the accommodation of distance and adaptation to darkness and light by their eyes are poorer than those of their young counterparts. Thus, the intensity of illumination at construction sites should be more than 600Lux. Although the noise level can vary according to the details of the work and the oral exchange of information may become difficult if there is background noise. As elderly workers grow older, their hearing declines considerably. As such, the noise level of offices should be less than 55dB or 45dB during intensive work.

3. ESTABLISHMENT OF SAFETY GUIDELINES

3.1 Scope of Safety Guidelines

In this study, the scope of safety guidelines for elderly construction workers was limited to ferroconcrete

construction where accidents involving elderly workers frequently occur. Based on the 「Concrete Construction Standard Safety Guidelines」, safety measures for each type of causes of accidents were added; safety guidelines were presented by attaching work methods wherein changes in the physical and psychological functions of elderly workers were considered.

In this study, the classification system for ferroconcrete construction was reorganized (Table 1) by referring to the 「Concrete Construction Safety Management Manual」, 「Process for Safe Ferroconcrete Construction (focusing on APT construction)」, and 「Standard Safety Guidelines for Concrete Construction」.

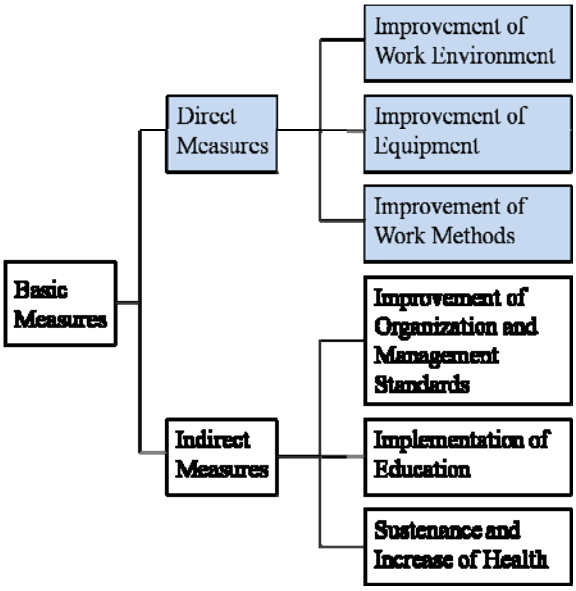
Table 1. Classification System for Safety Guidelines

Classification System for Safety Guidelines		
Ferroconcrete Construction	Mold Construction	Preparation/Carry-in/Processing
		Assembly
		Disassembly
	Reinforcing rod Construction	Preparation/Transport
		Processing/Assembly
	Concrete Construction	concrete-casting/compacting/curing

3.2 Constitution of Safety Guidelines

Measures for the prevention of accidents were classified into direct and indirect ones. Direct measures involved the improvement of the work environment, equipment, and work methods, whereas indirect measures included the improvement of the organization and management standards, implementation of education, and sustenance and improvement of health (see Figure 1).

Figure 1. Basic Measures for Prevention of Accidents



The guidelines in this study presented improvement directions focusing on the improvement of the work environment, improvement of equipment, and improvement of work methods as well as direct measures for preventing accidents involving elderly construction workers as predicted based on the features and causes of the accidents. The types of accidents in ferroconcrete construction are falls, collapses, and dropping; the elements that cause accidents include temporary installations, structures, materials, and cranes. These accidents can be prevented and reduced through the improvement of equipment so that elderly workers can use them easily and conveniently, improvement of the work environment at construction sites recording high accident rates, and improvement of work methods wherein the physical and psychological functions of elderly workers are considered.

Therefore, this study searched the risk factors (type of accident causes) in each detailed work of ferroconcrete construction and presented detailed safety measures, points that should be observed by elderly construction workers for each risk factor as divided into the improvement of the work environment, improvement of equipment, and improvement of work methods.

(1) Improvement of the Work Environment

Given the growing aging population, various physical and psychological changes occur. Therefore, the work environment or work details should be improved considering the physical capability according to the aging trend of construction workers. Accordingly, if the environment within the construction site improves, the reduced physical functions of elderly construction workers can be complemented.

For instance, if a measure is taken to make the flooring of the construction site even in preparation for or for carry-in for mold construction or reinforcing rod construction, risks of elderly construction workers with poor eyesight and balancing sense slipping or falling can be prevented. Moreover, since elderly construction workers have poorer sensing functions and balancing functions, the installation and disassembly of molds at places with unstable scaffold and concrete casting at open places may cause accidents such as falls. The dangers of these accidents can be minimized by improving the work environment, e.g., cleaning floors, passages, and stairs, installing “watch your step” signs, and arranging places to bring in frame molds.

The visual functions of elderly workers decline considerably as they grow older. In other words, since their ability to identify targets in dark places decreases, and the time taken to adjust to darkness obviously increases, night work is inappropriate. To complement such deteriorating visual functions of elderly workers, the intensity of illumination should be 600Lux both in the morning and evening as much as possible; if work needs to be done in a dark place at night, the lights within the work site should be bright (more than 100Lux).

(2) Improvement of Equipment

As one's age increases, one's physical and muscular strength decreases. Excessive work that does not consider this point can directly give rise to musculoskeletal diseases. Only if the demands of the work do not exceed one's declining physical ability can the reduction in their burdens due to work and consideration to prevent the deterioration of their productivity be desirable. Even a few changes in tools, equipment, and materials to enable elderly workers to complement their deteriorating physical and muscular abilities and to help them perform their work more easily can bring about considerable effects on the prevention of accidents.

Due to aging, elderly workers' muscular strength as required for the performance of work decreases. To deal with this issue, suspended ropes, suspended sacks, or forklift should be used to lift or lower materials, instruments, and tools. Moreover, musculoskeletal diseases can be prevented if equipment such as materials, machines, or tools are made lighter.

Elderly workers have lower ability to sustain their posture; when installing molds or assembling reinforcing rods, separate scaffoldings should be improved such as wider breadth, measures for preventing slipping, and installation of safety handrails and net for the prevention of falls on mobile scaffoldings to prevent predictable accidents. To prevent accidents such as falls or suffocations, which can occur during concrete-curing in concrete construction, handrails or lids should be installed when curing concrete in open places; when such is done in closed places, safety should be determined prior to entry and exit by an oxygen meter and a gas meter.

Table 2. Example of Safety Guidelines for Elderly Construction Workers (in Reinforcing Rod Construction)

Construction Type	Risks	Detailed Measures for Prevention of Accidents		
		Improvement in Work Environment	Improvement in Equipment	Improvement in Work Methods
Reinforcing Rod Construction -Transport -Assembly	Falls	◎ Since there are dangers of fall due to the poorer balancing sense of elderly workers, the floors should be safe and clean to prevent falls or slips..	○ Keep the shelves of frame molds in order. ○Keep the scaffolds in order.	◎ Elderly construction workers should wear shoes whose soles are not slippery.
	Dropping	◎ Since there are dangers of dropping due to the poorer nimbleness and longer reaction time of elderly workers, nets or equipment for the prevention of dropping should be installed in open places.	○ Use strong scaffolds for stocking reinforcing rods that can bear their weight. ○ When pulling up reinforcing rods, use a latch for the hook.	○ Lift, load, and unload reinforcing rods at a certain distance from structures to prevent them from bumping into each other and guide the movement of objects by installing guides.
	Lumbago	○ Places that can reduce the transporting times should be selected for carry-in. ○ If there are inclinations, the workplace should be arranged such that they are removed..	◎ The required muscular strength of elderly workers can decrease while carrying out work and sustaining their posture. Therefore, use suspended ropes and sacks when lifting or lowering materials, instru ○Use cranes.	◎ Elderly workers' average muscular strength is approximately 30% less than that of younger people. Therefore, when lifting objects, less than 20kg should be given to male workers, and less than 15kg, to female workers. ◎ When stocking or transferring objects, more than 2 workers should do the work together, or aiding instruments should be used depending on the weight or length of the objects.

(3) Improvement of Work Methods

Physical and psychological changes due to aging can have effects on the burdens of work, accident rate, and productivity of elderly construction workers. If work methods are improved to enable elderly construction workers to work easily, however, construction accidents can effectively be reduced.

OSHA (Occupational Safety and Health Administration) of the US set 34kg as the weight that can be instantly raised by anyone regardless of gender or age. The average muscular length of Korean people is 90% of that of Americans; that of people aged 50 years is 30% lower. Therefore, when lifting objects, male elderly workers should lift those weighing less than 21 kg, and female elderly workers, less than 15kg. Moreover, when carrying objects, less than 10kg should be given to male elderly workers, and less than 7kg, to their female counterparts. On the other hand, when stocking or transferring materials, more than two workers should do

the work together, or aiding instruments should be used depending on the length or weight of the materials.

Due to their poorer balancing functions, elderly workers may figure in accidents such as falls when working in places more than 2 high. To prevent this, the use of separate scaffoldings should be minimized; scaffoldings with strong structure should also be installed. In addition, when working in places where the risk of fall is high, one should wear a safety belt attached to safety belt-attaching equipment before starting work.

If they work with inappropriate posture or carry heavy objects, elderly workers can contract musculoskeletal diseases; unstable posture such as bending one's upper body should not be assumed when working and excessive strength should not be applied when disassembling molds, which should be disassembled according to the order of disassembly. Moreover, excessive transferring is not advisable; if kinetic work needs to be done repeatedly, one should not spend more than an hour per day with the same posture.

4. CONCLUSION

To establish safety guidelines for elderly workers, ferroconcrete construction – which is characterized by the high rate of accidents involving elderly workers -- was selected for the scope of this research. Ferroconcrete construction was divided into mold construction, reinforcing rod construction, and concrete construction. Mold construction consisted of preparation/carry-in/processing, assembly, and disassembly processes, whereas reinforcing rod construction was classified into preparation/transport and processing/assembly. Safety guidelines for each process were presented by dividing them into the improvement of the work environment, improvement of equipment, and improvement of work methods.

The safety guidelines presented in this study are expected to be helpful in reducing accidents involving elderly workers by providing the work environment where they can work easily and by making them perceive matters requiring their careful attention. Therefore, based on various analyses of construction accidents, safety guidelines that faithfully reflect the features of accidents involving elderly construction workers and their work should be developed.

REFERENCE

[1] Moon, Myong-Wan, Yang, Keek-Young, "A Study on the Establishment of the Accident Information Classification System in Construction Projects", *Theses collection of Architectural Institute of Korea*, Vol. 13(4), pp. 429-440, 1997.

[2] Yang, Yong-Chol, Choi, Hoon, Kim, Jae-Jun, "A Study of Methods on Safety Checklist Improvement and Integrated Operation with Schedule for Construction Accident Prevention", *Korean Journal of Construction Engineering and Management*, Vol. 5(2), pp. 123~131, 2004.

[3] Lee, Jeong-Cheol, Lee, Chan-Sik, "Accident Characteristics of Aged Construction Workers", *Theses collection of Architectural Institute of Korea*, Vol. 24(5), pp. 201-208, 2008.

[4] National Institute for Occupational Safety and Health, *Simple Solution : Ergonomics for Construction Workers*, 2007.

[5] Korea Occupational Safety & Health Agency, *Health and Safety for the Old Employees*, 2006