SAFETY IN DEVELOPING COUNTRIES: PROFESSIONAL AND BUREAUCRATIC PROBLEMS

By Enno "Ed" Koehn,[1] Fellow, ASCE, Rupesh K. Kothari,[2] and Chih-Shing Pan[3]

ABSTRACT: In the United States, the Occupational Safety and Health Administration (OSHA) was created to enhance safety in the workplace. Employers are subject to OSHA site inspections and must conform to a set of comprehensive rules and regulations. In contrast, in a developing country such as India, comprehensive and universal safety regulations have not been developed. Workers are generally unskilled or semiskilled, poorly paid, temporarily employed, exhibit low production (productivity) rates, and often migrate in a group from one place to another in search of work. Typically, laborers are not trained in safe work practices, and there tends to be a lack of management commitment to safety programs and various safety procedures. In contrast, in a newly developed country such as Taiwan, the owner and the contractor are assigned joint responsibility for claims resulting from occupational accidents. A basic safety-control system, emphasizing the establishment of a safety committee and self inspection, has been developed to control project safety. This system may be universally applicable to both developed and developing regions.

INTRODUCTION

Throughout the world, the construction area of civil engineering is one of the most hazardous industries (Suazo and Jaselskis 1993). The major causes of accidents are related to the unique nature of the industry, human behavior, difficult work-site conditions, and poor safety management, which results in unsafe work methods, equipment, and procedures (*Improving* 1988). However, safety is not a luxury, and may be considered an important function to be used against unnecessary loss of property, injury, or death. Preventing occupational injuries and illness should be a primary concern of all employers. Especially in developing countries, there must be an effort to raise the level of awareness among both employees and employers of the importance of health and safety at work sites. Emphasis in both developing and developed countries should be placed on training and the utilization of comprehensive safety programs (*A Bill* 1993).

This paper discusses the approach towards safety in a developed country, the United States (OSHA 1983; *Zero* 1993), and a typical developing country, India (Gajare 1992). In addition, input from a newly developed country, Taiwan, is also considered (*Labor* 1993). Comparisons are made and suggestions are offered for achieving safety during the construction of a project.

IMPORTANCE OF SAFETY

A survey of the U.S. construction industry shows that the majority of contractors annually spend less than $25,000 on safety education (Korman et al. 1990). This is a relatively small expenditure. Nevertheless, according to a Business Round Table report, the cost of an effective construction safety and health program in the United States is approximately 2.5% of direct labor costs (*Improving* 1988). It has also been found that management support is vital for any successful safety program (*Zero* 1993). In this regard, studies have shown that hazards on sites can be controlled and accidents can be prevented through the implementation of basic safety practices leading to a sound construction-safety program. The implementation, operation, and monitoring responsibility of the program should be clearly defined at the beginning of construction activities. It must include the following (Hislop 1991):

1. A comprehensive safety policy statement
2. A review of constructability
3. Reliable contractor screening
4. Preconstruction meetings (safety review)
5. Inspection
6. Good housekeeping

Accidents in the civil/construction industry tend to be costly in both human and financial terms. These expenses may be concentrated in the areas of health care, litigation, management's time, workers' compensation, and Occupational Health and Safety Administration (OSHA) sanctions. Other expenses include transportation costs, loss of productivity of workers, cost of fixing or replacing damaged equipment or materials, and the cost of hiring new workers (Hinze 1992). In this regard, it appears that organizations pay for the cost of safety either through the uncontrolled cost of accidents or through the controlled costs of a safety program. It appears, therefore, that accident prevention should be a prime concern for any constructor. To emphasize safety during the construction process, it is recommended that a construction firm operating in the United States consider the following (Amrien 1992):

1. Having knowledge of the particular OSHA rules and regulations involved with the work under construction
2. Setting up policies and procedures and insuring that they are accomplished per plans and specifications
3. Scheduling safety training for construction workers, managers, and design professionals
4. Developing a written safety program and including penalties for failure to follow OSHA regulations
5. Conducting regular safety meetings
6. Posting appropriate material safety data sheets (MSDS), if necessary

Safety of both project personnel and construction workers cannot be guaranteed by legislation alone, nor should safety be the sole responsibility of the employer, the contractor. Employees must be involved. Job safety must be a team effort and can be achieved by training and education. The organi-

[1]Prof. and Chair, Dept. of Civ. Engrg., Lamar Univ., P.O. Box 10024, Beaumont, TX 77710.

[2]Engr., Dames and Moore, 1701 Gulf Rd., Rolling Meadows, IL 60008; formerly, Grad. Student, Dept. of Civ. Engrg., Lamar Univ., Beaumont, TX.

[3]Grad. Student, Dept. of Civ. Engrg., Lamar Univ., Beaumont, TX.

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zational benefits of an effective safety program have been found to be increased profits, improved reputation and image, and reduction in insurance premiums. Most importantly, however, there is a decrease in accidents on the job site.

CONSTRUCTION SAFETY IN DEVELOPING COUNTRIES (INDIA)

Construction in developing countries such as India is more labor-intensive than that in the developed areas of the globe, involving 2.5–10 times as many workers per activity (Koehn and Regmi 1991). Typically, workers tend to be unskilled and migrate in a group, with or without their families, throughout the country in search of employment. In fact, they are divided into various factions. For example, in India, productive laborers in the excavation and earthwork area often come from the state of Andra Pradesh, concrete laborers from Karnataka, carpenters from Rajasthan, masons from Uttar Pradesh, and fitters (reinforcing bars) from Bihar. Communication problems related to differences in language, religion, and culture tend to inhibit safety on the work site.

In numerous developing countries such as India, there is a significant difference between large and small contractors. Most large firms do have a safety policy, on paper, but employees generally are not aware of its existence. Nevertheless, a number of major constructors exhibit a concern for safety and have established various safety procedures. They also provide training for workers and maintain safety personnel on the job site. These constructors have developed such policies and programs because they wish to maintain their excellent reputation and be able to undertake international construction work in the Persian Gulf, Africa, and Russia. They have found it a benefit to care for the welfare of their engineering staff and workers.

For the majority of contractors, however, maximizing profit is the prime concern. Unsafe conditions exist on many sites, both large and small, and laborers are subjected to numerous hazards. Even large national firms who execute megaprojects in different parts of India with a typical workforce consisting of 100 technical staff, 500 skilled labors, and 2,000 unskilled labors do not have effective safety programs.

On many sites, no training programs for the staff and workers exist; therefore, no orientation for new staff or workers is conducted, hazards are not pointed out, and no safety meetings are held. Employees are required to learn from their own mistakes or experience. In addition, lack of medical facilities, shanty housing, and substandard sanitation tend to exist on remote projects. Workers undertake a risk while at work, and the following problem areas, some of which exist in the United States and other areas of the world, are common:

1. While excavating in deep trenches (with no proper shoring or bracing), accidents due to cave-ins often occur.
2. Concreting is done mainly by laborers, and cement burns due to the unavailability of protective gloves and boots are common.
3. Workers fall from heights due to weak scaffolding and the unavailability of safety belts,
4. Workers sustain injuries on the head, fingers, eyes, feet, and face due to the absence of personal protection equipment.
5. There is improper housekeeping.

Lack of understanding of the job and poor equipment maintenance are also major causes of accidents.

Injuries generally are unreported; however, if necessary, a laborer might receive first aid or preliminary medical care. In most cases, specialized medical treatment or compensation is unavailable. Workers themselves consider accidents as due to their own negligence, and accept that construction is a dangerous occupation. Nevertheless, major accidents involving the death of a worker may be reported due to the financial expenses and litigation that could be involved.

Maintenance and inspection schedules often are not followed, and only after a breakdown is equipment repaired. This approach leads to loss of time, idle workers, and project delays. It may also cause damage to property. Breakdown of concrete mixers, vibrators, water pumps, and tractors are common. Electrocution is also a major hazard, due to the use of substandard electrical equipment and ungrounded cables. Workers, especially young ones, take chances, and often do not follow safety norms or use personal protective equipment. Also, laborers and staff sometimes are under the influence of alcohol and drugs. Unfortunately, crew members are not checked for drugs and alcohol before the start of and during work.

One of the factors that prevents a developing country such as India from developing a construction-safety program is pervasive corruption, a by-product of the system of bureaucratic controls (Singh 1992). As an example, for any accident that takes place on-site due to lack of safety practices, the particular low-level activity supervisor (engineer/technician), not the construction manager, is theoretically held responsible and may, in exceptional cases, be subject to physical abuse and harm from the victim's group of friends. In extreme circumstances, the supervisor may also be charged with a criminal offense. However, cash payments are usually accepted in lieu of pressing charges. In addition, because workers are usually not residents of the local area and are often unaware of their rights, accidents are often not reported to the proper authorities or, if reported, are lost in the local bureaucracy.

Owners and consultants do stress safety before work commences, but as the work progresses their concern for deadlines becomes a priority and they tend to pay less attention to safety. On large projects, the owners may provide medical facilities at the site, but ultimately safety is the contractors' responsibility.

Significant Labor Legislation in Developing Countries (India)

To improve the working conditions of the labor force in the country, the Indian government has enacted specific labor legislation (Gajare 1992). The most important are the Minimum Wage Act, the Workmen's Compensation Act of 1923 (modified in 1962), and the Contract Labor (Regulation and Abolition) Act of 1970.

The Minimum Wage Act was enacted for the welfare of labor. In a developing country such as India, where unemployment is high, employees often work for low wages. The act establishes a minimum-wage rate in a number of industries such as construction, in which there are opportunities for the exploitation of labor. To take inflation under consideration, the wages are periodically revised by an advisory committee appointed by the central government.

The object of the Workmen's Compensation Act of 1923 is to protect the victims of accidents and their families from hardship arising out of and in the course of employment. This act covers workers employed in hazardous occupations but excludes those employed in clerical or administrative work. The act provides for the payment of compensation for injuries incurred on work sites. Compensation is not payable for injuries due to negligence, disobedience, the consumption of drugs or alcohol, or sickness due to diseases not contracted during employment. However, compensation is generally paid

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in the event of the death of a worker. An award equivalent to three months' wages is the standard monetary settlement.

The Contract Labor Act of 1970 was enacted to regulate the employment of contract labor in specific occupations and to provide for its abolition in particular circumstances. It also provides for improving the service condition of contract labor. The act is of importance to the construction industry, in which a large portion of work is executed by contract labor. The law provides for the establishment of a central advisory contract labor board to advise the central and state governments on administration of the legislation. The principal provisions of the Act provide for the registration of general (major) contractors/constructors, the licensing of labor contractors, the welfare and health of contract labor, and the payment of wages. The legislation requires that the general (major) contractor/constructor must provide a minimum level of facilities for the welfare and health of contract employees on a work site. In addition, if a labor contractor fails to make payment to the contract workers within a prescribed period, then the general (major) contractor/constructor is required to pay the contract workers and recover the amount from the labor contractor.

To enforce compliance with the rules and regulations enacted by the foregoing legislation, work sites are periodically inspected by government officials. Unfortunately, inspections are not regularly conducted. In addition, contractors should perhaps be subject to a citation or fine for unsafe conditions or hazards existing on a project. As in other countries, the profession should also consider the development of safety standards and procedures for various construction operations. This is especially needed during the summer months, when employees often work in scorching heat. It is not uncommon at this time of year for workers to become ill due to heat exhaustion. The availability of liquids and proper work/rest cycles should be enforced during this period.

Safe Work Sites in Developed and Developing Areas

One method that may be used to increase site safety is to involve employees in developing a safety program. Many employees are aware of significantly more field hazards than their employers and can suggest ideas which will reduce accidents. In addition, by involving employees in the planning, safety orientation, and training process, they become aware that they are executing their own safety program. Also, individuals may be recognized for maintaining a good safety record. In addition, designers can play an important role in reducing accidents, thereby providing a safer work place for construction personnel. Worker safety should be considered during the design process and, ideally, should be continuously updated during actual construction operations. It must be recognized that design decisions have an impact on job-site safety (Hinze and Wiegand 1992). This is an item that is often overlooked. Other suggestions for establishing a safe workplace are as follows:

1. A wide variety of machinery and equipment for materials handling should be available on site (Niskanen and Lauttalammi 1989).
2. Employees required to enter confined spaces must be instructed concerning potential hazards, precautions to be taken, and the use of protective equipment (Bradford 1993).
3. Excavation and scaffolding work are two of the most hazardous jobs in the construction industry with the greatest number of fatalities resulting from earth caveins. Contractors in the United States must conform to the OSHA standards for trenching and excavation work, and developing areas such as India may consider developing similar standards. Another option available is to require structural and geotechnical engineers to review and approve the contractors' lateral support and scaffolding designs and, if necessary, provide on-site inspection during construction.
4. High technology, such as radio remote control, that may improve the safety and the maneuvering ability of construction machinery and equipment should be used, if applicable (Rayzak 1991).
5. Robots should be used as much as possible to improve safety (Normile and Skibniewski 1989).

Unfortunately, in developing countries such as India, which has a labor-intensive construction industry, the use of modern technology may be resisted by both governmental officials and workers. In most cases, however, technology can be adapted to suit local needs.

RESPONSIBILITY FOR PROJECT SAFETY (TAIWAN)

As has been mentioned, construction in a developing or developed region tends to be a relatively dangerous occupation. In fact, even a small amount of negligence may cause a major accident, which could be quite costly to a contractor. To reduce the financial risk, management support for safety programs in both developed and developing countries should be considered an economic necessity. This is in addition to the ethical and professional responsibility for providing a safe work site for all employees. In some countries, owners assume a degree of responsibility for accidents. For example, in Taiwan, the owner and the contractor are assigned joint responsibility for claims resulting from occupational accidents. This rule also applies to subcontractors (*Labor* 1993).

Recently, there has been an increasing interest in the United States concerning the responsibility for safety on construction projects. Some designers believe that there should be a consultant on the site who is involved with insuring construction safety ("ASCE Quality" 1994). However, most firms are against accepting responsibility for project safety at the job site. In fact, the courts have ruled that a design firm is not responsible for protecting workers at a site where the firm has no employees, did not supervise construction, and neither assumed nor had control of the work ("Firms" 1993).

Basic Safety-Control System (Taiwan)

An effective safety program may prevent many or most accidents on construction sites. As has been previously mentioned, in developing countries, safety is often neglected and not properly managed. In industrialized countries, safety is often considered by management as a priority item for discussion. However, in reality, safety is often assigned a low priority when project schedule and budget problems are encountered (Smith and Roth 1991). Firms in both developed and developing countries, therefore, should have interest in establishing a basic safety-control system. This system, utilized by some companies in Taiwan, should include the following principal activities: (1) planning and rules development; (2) problem identification; (3) safety inspection and report; (4) analysis and investigation; and (5) error correction and training.

Fig. 1 shows the activities and relationships of the basic safety-control system. To be effective, it is assumed that a safety committee, or similar organization, has been established by each company. The system should be designed systematically and developed as one of the vital segments of any project. As described in the following sections, it presents a general conceptual model for a workable safety program.

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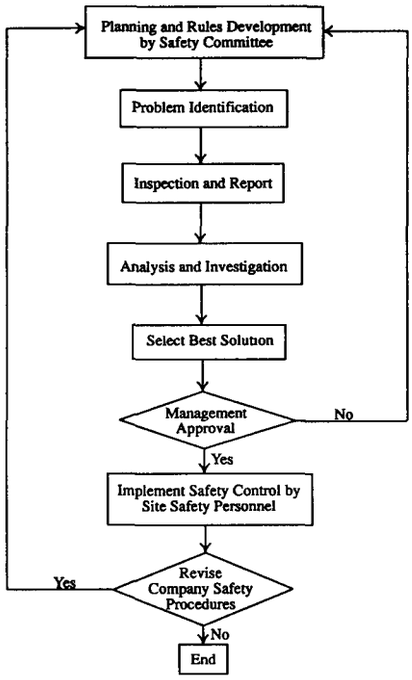

FIG. 1. Basic Safety-Control System

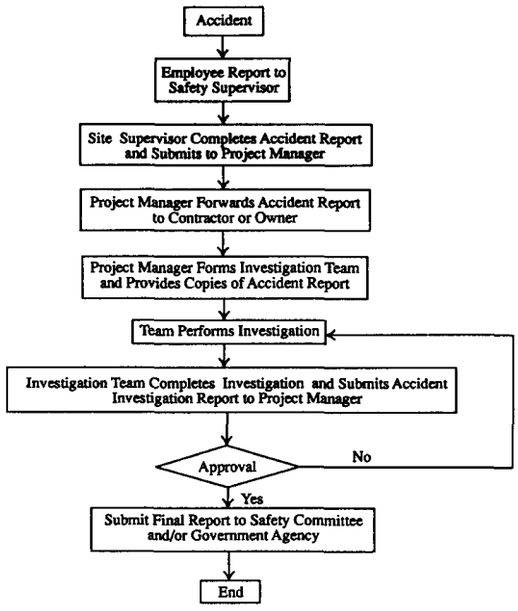

FIG. 2. Accident-Investigation System

Safety Committee (Taiwan)

For any construction project in the United States, the necessary requirements for a minimum standard of safety and health are listed in the OSHA standards for the construction industry (OSHA 1983). Other countries, however, may utilize their own safety standards. For example, in Taiwan, the Council of Labor Affairs is a governmental agency that establishes labor-safety rules and standards for construction firms operating in that country (*Labor* 1993).

According to this agency, a firm must establish a safety committee. The committee is empowered to research, discuss, coordinate, and make suggestions related to labor safety affairs at the job site. In addition to the contractor, the committee members may include the owner, design consultant(s), safety personnel, and subcontractors. The structural and geotechnical engineers are usually included on the safety committee, because they have great expertise associated with the safety of temporary structures and facilities.

It is noteworthy that the U.S. Congress is presently considering legislation that would revise OSHA regulations and mandate the establishment of safety committees for the domestic construction industry (*A Bill* 1993). Committees representing both management and labor will most likely be recommended. In another country, Norway, firms with more than 10 employees must establish an internal control or self-inspection system, including a safety committee, to insure safe working conditions. Employee participation is mandated because it is considered their democratic right to be involved. Furthermore, it is perceived that employees possess the experience and influence to insure that realistic rules and regulations will be established and subsequently complied with in practice (*Internal* 1991).

Responsibility for Safety Inspection (Taiwan)

The employer shall, according to the rules and standards in Taiwan (*Labor* 1993), establish a schedule to conduct a self-inspection program for the project under consideration. Daily inspections are strongly recommended for construction firms. They should be designed to discover unsafe practices and procedures in addition to anticipating possible future hazardous conditions on the site. Various forms may be utilized for the inspection process.

In Taiwan, self-inspection is an established procedure for large firms. In fact, it is recommended that daily on-site responsibilities must include the following:

1. Inspections required by various government agencies
2. Inspection of the design and installation of temporary facilities
3. Issuance of daily reports on all job conditions
4. The ability to interpret detailed technical drawings

It is hoped that the inspections will reduce the possibility of accidents. However, if an accident occurs, an accident report form must be completed. Accidents do not always cause injuries. Nevertheless, if an injury does occur, an injury report form must also be submitted. All accidents, injury and noninjury, should be investigated and an accident investigation report may be utilized in the process. The relationship between the accident reporting and investigation system and the company/project management is shown in Fig. 2.

A basic safety-control system including accident analysis and investigation, as shown in Figs. 1 and 2, is an important element of any safety program. In addition, safety analysis and training may be used to correct unsafe actions. In fact, safety analysis should indicate the safe method to be utilized, expose potential hazards, and include the posting of precautions that must be undertaken. Furthermore, to maintain a safe environment, safety programs should include periodic refresher training, including the dissemination of information from the safety analysis and investigation committee. Attendance should be required for all personnel at the jobsite.

SUMMARY AND CONCLUSIONS

The civil engineering design and construction industry faces serious safety problems. In a developed country such as the United States, emphasis is concentrated on education, training, and the compilation of information concerning the avoidance of safety hazards. A governmental agency, OSHA, is assigned an important role in ensuring the health and safety at the workplace. Workers in the United States are aware of

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their rights and responsibilities, human life has a great deal of value, and consideration is given by constructors to avoid accidents as much as possible. In this regard, OSHA rules and regulations tend to be the standard to be followed. Using this approach, the belief appears to be that where profit is the motive, there is no substitute for strong safety legislation that is seriously enforced by the government.

In a developing country such as India, laws to protect laborers may not be strictly enforced. Also, contractors and their employees tend to ignore basic safety rules and regulations. In addition, safety programs and inspection procedures have often not been established and/or utilized to protect workers and reduce onsite hazards. Nevertheless, due to the complexities involved with various site-specific conditions, it is strongly recommended that additional research should be conducted involving safety in developing regions.

The responsibility for construction-project safety, however, varies throughout the world. For example, in Taiwan, the owner and the contractor are assigned joint responsibility for claims resulting from occupational accidents. In addition, a firm must establish a safety committee. The committee is empowered to research, discuss, coordinate, and make suggestions related to labor safety affairs at the job site. Furthermore, in Taiwan, an employer shall establish a schedule to conduct a self-inspection program for the project under consideration. Daily inspections are strongly recommended for construction firms. They should be designed to discover unsafe practices and procedures in addition to anticipating possible future hazardous conditions on the site.

Especially for international firms, the proper selection of local subcontractors is vital to maintain a safe project. In this regard, in both developed and developing countries the contractor should be responsible for establishing a safety program and training all personnel on safe operating procedures. Continuous self-inspection at the site and the use of a safety analysis and investigation committee should be required. Refresher training and education must also be available to increase and maintain the level of safety awareness of various personnel at all levels.

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