

**NATIONAL SEMINAR  
ON  
SAFETY IN CONSTRUCTION**

**NEW DELHI  
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**SESSION-WISE ABSTRACTS OF THE PAPERS  
BY**

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CHIEF RAPPORTEUR**

**NATIONAL INSTITUTE OF CONSTRUCTION  
MANAGEMENT AND RESEARCH**

SESSION I

SAFETY IN CONSTRUCTION - AN OVERVIEW

- Chairman - Mr. K.C. Sharma,  
Add. Secretary,  
Ministry of Labour
- Co-Chairman - Mr. S.L. Passey,  
INTUC, New Delhi.
- Paper Presentation By - Prof. K.N. Vaid
- Title of the Paper - Safety in Construction in India:  
Current Status & Future Needs.

## SESSION II

### SAFETY STANDARDS AND LEGISLATION & THEIR IMPLEMENTATION

- Chairman - Mr. Harish Chandra,  
Director General,  
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- Co-Chairman - Mr. Guha Thakurta,  
General Manager,  
Gannon Dunkerley,  
Bombay.
- Chief Rapporteur - Prof. P.K. Muttagi
- Session Rapporteur - Mrs. Pavin Masilamani

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- Chairman - Mr. Ramesh L. Dalal  
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Dalal Consultants & Eng. Ltd.  
Bombay.
- Co-Chairman - Mr. K.C. Gupta  
Director General  
FASLI, Bombay.
- Chief Rapporteur - Prof. P.K. Muttagi
- Session Rapporteur - Mr. V.B. Pandit

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Chairman	- Dr. C.P. Thakur Member Parliament New Delhi
Co-Chairman	- Mr. G.C. Mathur Director, NBO New Delhi.
Chief Rapporteur	- Prof. P.K. Muttagi
Session Rapporteur	- Mr. S. Masilamani

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1        Reviewing the existing legal provisions, Mr. Malhotra notes that, at present, safety in construction industry is being taken care of by the bye-laws framed by the Municipalities within the municipal limits and by a set of provisions incorporated in the contracts of Public Works Departments, Military Engineering Service and similar works by the State Government, Port Authorities etc. The provisions are very inadequate and there is no enforcing machinery to check whether the safety provisions are actually made. Although reliable data are not available, the information collected from under the workmen compensation act and other sources, it has been found that the death rate was the highest in the building and construction industry. Enforcing law is difficult because of the special problems. They are :

- 2        1. Temporary duration of work sites  
          2. Seasonal employment  
          3. Extensive use of migrant labour  
          4. Small size of most construction firms  
          5. Extensive use of sub-contractors  
          6. Effects of weather including spans of long working hours to compensate with bad weather  
          7. High labour turnover  
          8. Welfare problems of construction workers  
          9. Competitive tendering

3        Occupational safety and health problems are generally considered as falling within the wider field of working conditions. Occupational safety and health legislation aims to protect workers from hazards at the work place, and to provide compensation for injury. Earlier the laws were concerned with subjects such as machinery guarding, protection from hazardous substances, first aid, and compensation for injury due to industrial accidents, and for occupational diseases. More recently, the trend has been towards other issues such as the prevention of occupational and non-occupational diseases (especially by periodic medical examinations) and protection of the working environment (eg. noise and dust control, lighting and ventilation



regulations). There are many laws intended to protect certain categories of workers, either because of vulnerability (women, young persons) or because they are exposed to particular hazards (mine workers, building and construction workers). Suitable legislation for specific industries exists, but nothing exists specially for construction industry.

The absence of any regulatory and protective legislation applicable to the construction industry is responsible for several abuses, such as employment of child or female labour under conditions which are not permissible in factories and mines. Though the central and state governments prescribe certain standards in respect of wages and other amenities to be provided by contractors, on government contract, these are not usually observed. The enforcement machinery is inadequate to look after a large number of contractors in their jurisdiction and they cannot visit these establishments so frequently as they should. The failure to take prompt action to check and rectify irregularities, pointed out by them encourages not only defaulting contractors but also makes law abiding elements among them negligent.

Safety rules have been framed for construction workers in the USA, Australia, Britain, USSR, West Germany and in many other countries. In India, there are several safety legislations which are passed to protect the interest of workers. They include Factories Act 48, The Workmen's Compensation Act 23, The Maternity Benefits Act 61, Employees State Insurance Act 48, The Mines Act 1952 and so on. These acts specify duties and responsibilities, child workers, registration, welfare provisions, holidays, special provisions, penalties and so on. They are not specially made applicable to construction industry. This needs to be looked into.

In this connection Mr. Guha Thakurta observes that no safety rules for construction workers could be framed judiciously nor could they be effectively implemented even when someone tried to formulate and apply. This is not an easy task. It calls for new approaches to safety including fundamental issues like management policy on

safety, objectives of a safety programme, organisation for safety, functions of safety, system methods and procedure for safety, assurance of safety and finally training for adoptability of all safety rules by all concerned. In other words, concern for safety, attention to safety and ensuring safety of operations are keynotes for safety regulations. Achieving safety is not an accidental one, it is the result of deliberate well directed efforts on all matters related to safety in relation to its planning, training and supervision and each one of these is to be based on sound concepts.

The International Labour Organisation has made extensive study on the subject and as a systematic approach they have divided construction occupations into eight categories. Simultaneously located occupational injury, diseases and their causes (refer to tables 2 & 3, in the paper). Tables 4A to 4H indicate how each category of construction worker as mentioned in Table 1 is subjected to occupational injuries and diseases.

In order to study the situation and make suitable recommendations The Government of India set up, in 1985, an Expert Committee. Mr. Guha Thakurta worked on that Committee. He has discussed in his paper certain technological aspects, the precautions to be taken to protect the workers in excavation, tunnel and building work,

Mr. K. M. Mathur lays emphasis on duties and responsibilities. He says that although employer has the primary duty to create safe working condition, workers should equally accept that their right to a safe working environment created a corresponding duty to cooperate with employer. There is a need to promote collaboration between governments, employers and workers which will promote harmony. We have to develop guidelines for the responsibility of the employers to provide safety in construction.

Minimizing accidents could be achieved by :

- formulating guidelines for safety regulations covering all types of building and civil engineering works;
- inducting and enforcing proper safety regulations in the building industry;

- incorporating safety regulations in the building bye-laws and in contract agreements ;
- creating safety consciousness among all those engaged in buildings and civil engineering works like architects, engineers, builders, contractors, supervisors etc.

There is a proposal to make central legislation on safety in construction industry. The government has already appointed an Expert Committee. It will be necessary to formulate Indian standards covering each field separately. Bureau of Indian standards is engaged in formulation of guidelines in the form of codes, for safety regulations covering all types of building and civil engineering works. The paper discussed the details of the 18 Indian Standards already prepared.

Mr. Neale's paper brings out the similarities and differences in the situations in Britain and India. He observes that in the United Kingdom there is a comprehensive safety legislation, enforced by the Health and Safety Executive (HSE). Nevertheless, safety practice in the construction industry is poor. In a recent article in "New Civil Engineer" magazine, it was reported that there were 3500 serious injuries in 1986, including 120 deaths, which is an increase of 50% on 1980. Currently the HSE is conducting a vigorous campaign to improve safety practice, especially in the London area, and they have found that "in one in ten sites, something imminently dangerous was going on under the inspector's nose". From this we may conclude that legislation itself is not enough. Following the ILO guide to the management of construction projects, he has stressed the legal framework, knowledge, resources and senior management commitment and attitudes of those involved as the principal factors in effective health and safety management.

The principal instrument in the UK is the Health & Safety at Work Act 1974. It had evolved over many years, resulting in a patch work of laws for specific purposes, which nevertheless left

5. Attitude and certain actions of management and workers do affect implementing safety rules.

It is clear that the UK still has much to do to improve construction safety practice. We have comprehensive legislation, perhaps too much, but social and financial pressures make real progress difficult. I have little knowledge of the way in which you organise construction in India, but I suspect that we have some problems in common. Therefore, I hope that this review of UK legislation and practice, together with the problems revealed by Prof. Shimmin's work will form a basis for a productive discussion at this conference.

Mr. Kathuria and Mr. Gurnani observe that safety practices and instructions to be followed in construction industry have been covered extensively in the safety manuals issued by CWC|CPWD, NHPC, various ISI codes, Indian Electricity Act, 1910 and Indian Electricity Rules, 1956 as amended from time to time. The ISI has also brought out National Building Code, 1983 which inter-alia deals with safety in civil construction. A remedial clause is inserted in the contract to ensure implementation of safety requirements.

A comparative study of the existing contract conditions on safety and insurance shows that these vary sharply from department to department. These variations in contract conditions cause handicaps in actual execution. When contractors working in one state happen to get works in other neighbouring states, they are often confused and even non-plussed. The authors suggest the following measures :

1. Separate safety units should be created for all major projects to ensure implementation of safety programmes and maintenance of safety standards of working.
2. Important safety pre-requisites have been listed in this paper for the purpose of providing a safe working environment.
3. There is a need to rationalise and bring out uniformity in the clauses for safety measures and insurance in the contract agreements. This seminar may deliberate on this issue and make recommendations.

large numbers of working people without statutory protection. Examples of specific legislation are : the Factories Act, 1961 and the Offices, Shops and Railway Premises Act, 1963; in construction, the Construction (General Provisions) Regulations, 1961 and the Construction (Lifting Operations) Regulations, 1961. The Act specifies responsibilities of all those involved - employers, employees, suppliers, designers and so on. This all-embracing nature of responsibility is one of the strengths of the legislation. With better information, instruction and training, many accidents could be avoided. The difficulty is to make people personally aware, to cut through the commonly held, sub-conscious belief that "it will never happen to me". Training must be the most effective means of instilling knowledge and the will to operate in a safe way.

The commitment of resources to providing sound safety practice has to be the task of senior management. The attitudes and commitment of senior managers provides the foundation for the practice of the organisation. This, surely, is one of the main considerations of this conference.

Further, in Britain the nature of the legislation, and the precise and detailed way in which often it has been enforced, has caused safety to become associated with tedious bureaucracy; and strict adherence to safe practice is seen by many operatives as unmasculine and "soft".

Professor Shimmin in his latest study found the following :

1. Tight project constraints of time and cost created a "situation where time is money and safety considerations take second place".
2. There was confusion about who was responsible for site safety, partly caused by the extensive use of sub-contractors.
3. Safety officers were in a weak position.
4. In some cases the design of the permanent works made construction by safe means very difficult.

4. Accident report should be made compulsory both for the contractor and the owners of the projects to help keep relevant statistics and upgrade the safety measures where necessary.
5. The safety requirements of construction by contract should be standardised and a national safety code should be evolved which could be used by all sectors in the construction industry for contracts above a certain value which may be decided by this seminar.
6. Till such time a national safety code is developed and adopted universally, the applicable safety rules and standards which are to be referred to in a particular contract should be specifically mentioned in the construction contracts to avoid conflict during construction.

Construction safety legislation in the United States of America, says Professor R.E.Harris, has evolved out of the basic premise that every person has a right to a life that cannot be knowingly diminished. Popular demand created conditions that led to the establishment of laws by the several states to regulate and protect workers of all kinds. Initially set up to protect manufacturing occupations, these state safety codes were easily extended to the construction areas.

The United States Congress has enacted two statutes which contained wording specifically covering the construction industry. The first was the Construction Safety Act of 1969 and the second was the Williams-Steiger Occupational Safety and Health Act (OSHA) of 1970.

The Construction Safety Act was passed to apply to construction projects financed in whole or part by federal funds. It prohibits contractors holding such contracts from requiring workers to work under conditions that can be considered unsanitary, unhealthful or unsafe. The Secretary of Labour was empowered to determine the standards to be used and to administer the statute.

OSHA was signed into law on December 29, 1970 to insure, in so far as possible, that every worker in the United States has a safe and healthful place of work. The act applies to employers engaged in interstate commerce, including those in construction. It imposes two substantive duties on the employer :

1. It requires the employer to comply with all standards issued by OSHA.
2. It requires the employer to furnish a workplace free from "recognized hazards that are causing or are likely to cause death or serious physical harm".

The safety regulations developed for the Construction Safety Act have been included with the regulations of OSHA. Further, under the act, employers must keep and preserve stipulated records of recordable occupational injuries and illnesses.

Employees or their representatives can demand inspections of their employer's premises by making direct complaints in writing to the Department of Labour. If the complaint is deemed to be valid, a special OSHA inspection is made as soon as possible. Employers may not discriminate against any employee for filing such a complaint.

## Major Points arising from the Papers

- Safety legislation for construction industry - present status, difficulties in implementation in different sites, special advantages, limitations
- Accident prevention - legal requirements for different groups: owners, contractors, employees
- laws and practices for construction safety and health in India and other countries, what can we borrow
- ISI standards for safety in construction industry, problems of revision, updating and implementation
- Standards of safety in construction equipment and machinery
- In house standards and their relevance
- Present method of payment of compensation to workers and others in the case of accident, injury etc. What legal methods can be introduced
- Legal provisions to regulate service conditions, annual leave, in the case of disease, death, injury etc.
- Incorporating safety regulations in building bye-laws
- Law to make suppliers to provide adequate information about the use and conditions of operation of their products
- Adequate precautions and legal provisions against fires, explosions and electric shocks
- Providing adequate health, hygiene and welfare and first aid facilities in construction sites
- Ensuring that plant and machines used at work site are designed, constructed and installed so as to be safe from risks to health
- Providing protection of safety and health to workers against toxic or dangerous substances and articles in use, manufacture, handling and transportation
- Even in the United States inspite of stringent laws construction injuries continue to rise and ways are still being sought to bring these rates down to at least the level of other industries,



## SESSION III

## SAFETY AND PRODUCTIVITY - TECHNICAL ASPECTS

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While discussing the nature of accidents, Mr.Reddi observes that accidents occur due to a variety of reasons. Every project site involves peculiarities of construction distinct to the site. In addition, factors such as the temporary nature of the establishment, short-term duration of the project activity, seasonal employment as well as migrant labour, people speaking different languages and high labour turn over all contribute to the complexity of the problem.

The risks and damaging consequences of accidents increase enormously with increasing mechanisation. In order to ensure that the methods of construction are not left unplanned and not left to the worker to deal with all the time, it is necessary that a detailed methods statement is prepared in advance and the concerned persons get familiar with the methods statement. Such a statement will include the basis for choice of machines, output expected, considerations of factors of safety against over-loading and loss of stability, ground conditions, access roads for construction equipment, safe operating practices, limitations of particular equipment etc.

Mr.Reddi has identified a number of elements which lead to hazards, and indicated the methods of minimizing the accidents. These include health of equipment operators, excessive noise and vibration, moving parts of equipment, vehicles, cranes, tower cranes, lifting gear, hoist and lifts, wire ropes, pulley blocks, temporary power supply and so on. With regard to the bearing of safety on economy, Mr.Reddi concludes that all things considered, the total cost will come as an unpleasant surprise to any employer. As such there should be no doubt that the safest method will prove to be the most economic method in the long run.

Mr.Lakshmanan lays stress on safety measures to be taken to prevent accidents. The suggestion he makes appear to be practical, realistic and economical in the long run. Some have been reproduced below.

Whenever the buildings are designed, the foundations are to be designed for the normally adopted number of storeys plus one extra floor.

Concrete should be thoroughly mixed and rammed properly and the top surface should be levelled.

When RCC framed structures are to be built, care should be taken to leave a small gap at the junction of brickwork and RCC columns, beams etc. so that load is directly passed on to the predesigned members and not to the brickmasonry walls.

He also discusses the precautions to be taken while constructing basement heights, the frames of doors, the flooring and weathering and scaffolding. He makes several practical suggestions for engineers and other technical people.

Mr. Chawla notes that accidents can be attributed to inefficient and economic working, negligence and poor construction management policies. Merely by providing safety measures it does not ensure or insulate the project from any accident but it can reduce or minimise the accidents to a great extent. Much more needs to be done. He has specified the tasks and responsibilities of architects, consultants, engineers, employer, workers, manufacturers, and dealers. He has also elaborated how to use work place, equipments and structures and discussed the details of safety organisation. While discussing the importance of structures and equipment, Mr. Chawla comments that the structures for construction, eg. scaffolding, gangways, towers and equipments including lifting appliances and other machines should be of sound material and quality and be free from potent defects. They should be strong enough to withstand the loads and stresses which they have to bear. He has discussed the precautions to be taken in scaffolding, working platforms and suggested safety organisations.

Mr. Ganapathy lays considerable stress on prevention of fires. He says worldwide experience shows that incidents of fires and failure of structures and equipment are of frequent. These account for major proportion of losses in construction. The claims incurred by the general insurance industry in India on risks covered under relevant policies give an indication of the magnitude of losses in the country. In 1986 for instance, the claims incurred has been estimated at about Rs.100 crores. This only represents the direct losses on insured risks. Considering that indirect losses are invariably several times higher than the direct losses and that all risks are not insured, the total losses would be colossal.

A great majority of accidents leading to losses result from failure to deal with hazards which could have been foreseen or easily recognised. That the accident problems are particularly severe in the developing countries suggests a widening gap between increasing hazard potentials and loss prevention efforts. This gap needs to be closed in the interest of profitability, economic progress of the country and above all, prevention of avoidable human sufferings.

Mr. Ganapathy discusses how accidents on account of cranes can be avoided. He has given the details of selection of cranes, siting, erection and dismantling, safety in operation and collapse of structures and precautions to be taken against them.

Writing about fire in construction industry, Mr. Purushottam says that construction activity affords numerous opportunities for outbreak of fires since the control of the sources of ignition as well as the measures to limit fire spread are often very poorly organised. A fire in a construction project not only damages equipment and injures people, it will also delay the project completion and result in cost escalation. He provides useful data to support his observations.

Fire accidents at construction sites have reached an alarming situation since many organisational and technical aspects of fire safety have been ignored for long. Both laymen and construction specialists continue to think that fire hazard is small when a building is under construction. On the technical front, the increasing use of plastics for building materials, insulation, facades, piping, enhances dangers of fire spread. Open storage of large quantities of materials ranging from scrap to sophisticated components adds to the hazards.

The paper also discusses several preventive measures. In conclusion, Mr. Purushottam observes that construction projects can be made reasonably safe against fires by proper advance planning and providing the necessary budget as well as facilities as described above

A very essential part of any construction activity, says Mr. Dugad, is to ensure safety for both, the personnel and the equipment. In this paper, he has listed a series of precautions to be taken to prevent accidents during normal everyday operation of construction equipments. These steps are by no means exhaustive and additional precautions may be necessary depending on the conditions at job sites.

Mr. Dugad has suggested measures to prevent accidents in work site, safety regulations, machines and equipments, shutting down and parking, working with hydraulics, motor graders, paver finisher and hot mix plant.

Mr. Mihir Kumar Chakrabarti says that reliable data on status of safety in the construction stage of any project is rarely available in our country. At most of the construction sites, there is neither any system for regular safety inspection, nor any for reporting, recording and analysis of accident data. Construction sites of thermal power plants in India are no exception. Of late, however, Bharat Heavy Electricals Limited (BHEL) and National Thermal Power Corporation (NTPC) have initiated process of regular safety

Despite problems, some organisations have achieved success in the area of safety at work. Major construction firms which have organised themselves to be efficient and prosperous have also tried to organise themselves to do their work in as safe a manner. Relationship between safety and efficiency has been understood by such firms at the senior most levels and efforts made to share such understanding with managers and supervisors at the middle and lower levels.

A majority of accidents are caused by a failure to take elementary tried and tested precautions and not by causes which could be described as technological. There is, therefore, not much value in allocating responsibility for safety to technical experts alone, when the remedy is more likely to be in the hands of the line manager and the way he carries out his duties. Those firms which have organised themselves to be prosperous and efficient are usually the ones who have organised themselves for the promotion of health and safety. For a majority of employers, the health and safety problem is not one requiring a high level of expenditure to control advanced technology. The majority of accidents in any enterprise arise from failures to do simple things well. Some accidents are due to technological advancement. Efforts need to be made to control them.

Mr. G. C. Mathur observes that human factors play a predominant role not only in the incidence of accidents, but also in preventing accidents. As such, a thorough study of all human factors is necessary to devise ways and means to avoid and minimise accidents in construction and strive to ensure full safety to that the workers could concentrate on the execution of jobs assigned to them and improve their productivity. He mentions poverty, casual employment, fatigue, lack of awareness, work environment, safety equipment, cost of equipment etc. are the impediments to safety. Mr. Mathur has recommended several measures including group insurance scheme for workers to improve the situation.

inspection and reporting, recording and analysis of accident data at thermal power plant construction sites under their control. Mr.Chakrabarti has made an attempt to outline the status of safety in the construction stage of thermal power plants in India based on BHEL experience. He has given the detailed statistics of types of accidents, causes of accidents, causes of fire property damage and so on.

Accident statistics given in the paper, he adds, do not reveal the total status of safety at thermal power plant construction sites, since there are many other agencies working at such sites and most of them neither report nor maintain records of all accidents. However, the status revealed by the limited data is enough for all concerned to sit up and take notice.

Though the situation is serious and the status of safety in the construction stage of thermal power plants in our country is far from satisfactory, everything is not out of control. Realising the gravity of the situation two major power stations constructing agencies like Bharat Heavy Electricals Ltd. and National Thermal Power Corporation have initiated steps to improve the status of safety. Experience in BHEL appears to be encouraging. Since objective of this paper is only to focus attention on the status of safety, details of control measures initiated by BHEL are not discussed here. However, isolated efforts by one or two organisations cannot improve the situation.

National institutes like Central and Regional Labour Institutes and NICMAR should conduct studies in different types of construction industries to collect data on accidents and analyse them with a view to identify control measures.

Mr.Chakrabarti says that work at construction sites changes frequently due to physical working conditions. New hazards continually arise concerning the safety and health of people engaged. Such hazards also pose a threat to the safety and optimum utilisation potential of valuable construction materials, equipment and facilities.

Mr. Xavier and Mr. Ghosh note that the majority of all accidents are due to human failings and despite the terrific increase of machines over the past twenty years, there has been no corresponding increase in the percentage of machine accidents. Due to these accidents, a lot of useful time is lost at the working site resulting in lower productivity. This paper deals with various safety measures to be observed in order to attain higher productivity in the construction industry.

The authors discuss the safety measures to be taken in the operations like excavation, scaffolding, lifting, use of cranes and electricity.

Mr. Govind Sachdev observes that accidents do not occur naturally but do so on account of certain definite reasons, most of whom can be foreseen, controlled or avoided. Safety Manual have to be drawn up with the objective of preventing recurrence of avoidable accidents in the construction of projects as well as ensuring a uniform and safe procedure for all construction works. The project authorities shall be responsible to see that the provisions contained in such safety manuals are followed in all works under their control to achieve the desired degree of safety. In addition they should always be alert for adoption of such measures as would result in improved working conditions and elimination of hazards. They should take prompt and reasonable precautions indicated by local authorities. They shall also ensure that the sub-contractors working under their control at the projects also strictly observe safety methods.

Further, the construction industry employs a labour force which is more than that employed by any other industry. It is also the least organised; as a result there is a scope for exploitation of the labour. In spite of recent legislations the worker discontent is rampant and this has created new areas of conflict. Above all, The lack of proper attention to occupational safety and health measures has created a difficult situation. Unless proper steps are taken to improve the position, it is likely to create a more frustrating situation in this industry, in times to come.



Most of the accidents have been reported to have occurred because of negligence, ignorance and complacency on the part of either the worker or the management, or both. Even so, there is very little organisational efforts to bring about effective measures of safety in respect of the vast population employed in this country or even to compile dependable statistics of number and type of accidents

Mr. Sachdev discusses the details of several safety issues including accident reports, storage material, fire prevention and so on.

## SESSION III

## SAFETY AND PRODUCTIVITY - TECHNICAL ASPECTS

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6.	Safety While Working With Construction Equipment	J.K. Dugad	II	17-31
7.	Status of Safety In The Construction Stage of Thermal Power Plants in India	M.K.Chakrabarti	II	78-81
8.	Safety In Construction Technology and Management Aspects	M.K.Chakrabarti	III	1-9
9.	Human Factors & Construction Safety Management	G.C. Mathur	III	74-80
10.	Safety During Construction	Govind Sachdev	III	45-68
11.	Productivity Improvements Through Safety In Construction Industry	M. Xavier & S. Ghosh	III	36-44
12.	Safety In Nuclear Power Operations	P. Abraham	II	87-96

While discussing the nature of accidents, Mr.Reddi observes that accidents occur due to a variety of reasons. Every project site involves peculiarities of construction distinct to the site. In addition, factors such as the temporary nature of the establishment, short-term duration of the project activity, seasonal employment as well as migrant labour, people speaking different languages and high labour turn over all contribute to the complexity of the problem.

The risks and damaging consequences of accidents increase enormously with increasing mechanisation. In order to ensure that the methods of construction are not left unplanned and not left to the worker to deal with all the time, it is necessary that a detailed methods statement is prepared in advance and the concerned persons get familiar with the methods statement. Such a statement will include the basis for choice of machines, output expected, considerations of factors of safety against over-loading and loss of stability, ground conditions, access roads for construction equipment, safe operating practices, limitations of particular equipment etc.

Mr.Reddi has identified a number of elements which lead to hazards, and indicated the methods of minimizing the accidents. These include health of equipment operators, excessive noise and vibration, moving parts of equipment, vehicles, cranes, tower cranes, lifting gear, hoist and lifts, wire ropes, pulley blocks, temporary power supply and so on. With regard to the bearing of safety on economy, Mr.Reddi concludes that all things considered, the total cost will come as an unpleasant surprise to any employer. As such there should be no doubt that the safest method will prove to be the most economic method in the long run.

Mr.Lakshmanan lays stress on safety measures to be taken to prevent accidents. The suggestion he makes appear to be practical, realistic and economical in the long run. Some have been reproduced below.

Whenever the buildings are designed, the foundations are to be designed for the normally adopted number of storeys plus one extra floor.

Concrete should be thoroughly mixed and rammed properly and the top surface should be levelled.

When RCC framed structures are to be built, care should be taken to leave a small gap at the junction of brickwork and RCC columns, beams etc. so that load is directly passed on to the predesigned members and not to the brickmasonry walls.

He also discusses the precautions to be taken while constructing basement heights, the frames of doors, the flooring and weathering and scaffolding. He makes several practical suggestions for engineers and other technical people.

Mr. Chawla notes that accidents can be attributed to inefficient and economic working, negligence and poor construction management policies. Merely by providing safety measures it does not ensure or insulate the project from any accident but it can reduce or minimise the accidents to a great extent. Much more needs to be done. He has specified the tasks and responsibilities of architects, consultants, engineers, employer, workers, manufacturers, and dealers. He has also elaborated how to use work place, equipments and structures and discussed the details of safety organisation.

While discussing the importance of structures and equipment, Mr. Chawla comments that the structures for construction, eg. scaffolding, gangways, towers and equipments including lifting appliances and other machines should be of sound material and quality and be free from potent defects. They should be strong enough to withstand the loads and stresses which they have to bear. He has discussed the precautions to be taken in scaffolding, working platforms and suggested safety organisations.

Mr. Ganapathy lays considerable stress on prevention of fires. He says worldwide experience shows that incidents of fires and failure of structures and equipment are of frequent. These account for major proportion of losses in construction. The claims incurred by the general insurance industry in India on risks covered under relevant policies give an indication of the magnitude of losses in the country. In 1985 for instance, the claims incurred has been estimated at about Rs. 100 crores. This only represents the direct losses on insured risks. Considering that indirect losses are invariably several times higher than the direct losses and that all risks are not insured, the total losses would be colossal.

A great majority of accidents leading to losses result from failure to deal with hazards which could have been foreseen or easily recognised. That the accident problems are particularly severe in the developing countries suggests a widening gap between increasing hazard potentials and loss prevention efforts. This gap needs to be closed in the interest of profitability, economic progress of the country and above all, prevention of avoidable human sufferings.

Mr. Ganapathy discusses how accidents on account of cranes can be avoided. He has given the details of selection of cranes, siting, erection and dismantling, safety in operation and collapse of structures and precautions to be taken against them.

Writing about fire in construction industry, Mr. Purushottam says that construction activity affords numerous opportunities for outbreak of fires since the control of the sources of ignition as well as the measures to limit fire spread are often very poorly organised. A fire in a construction project not only damages equipment and injures people, it will also delay the project completion and result in cost escalation. He provides useful data to support his observations.

Fire accidents at construction sites have reached an alarming situation since many organisational and technical aspects of fire safety have been ignored for long. Both laymen and construction specialists continue to think that fire hazard is small when a building is under construction. On the technical front, the increasing use of plastics for building materials, insulation, facades, piping, enhances dangers of fire spread. Open storage of large quantities of materials ranging from scrap to sophisticated components adds to the hazards.

The paper also discusses several preventive measures. In conclusion, Mr. Purushottam observes that construction projects can be made reasonably safe against fires by proper advance planning and providing the necessary budget as well as facilities as described above.

A very essential part of any construction activity, says Mr. Dugad, is to ensure safety for both, the personnel and the equipment. In this paper, he has listed a series of precautions to be taken to prevent accidents during normal everyday operation of construction equipments. These steps are by no means exhaustive and additional precautions may be necessary depending on the conditions at job sites.

Mr. Dugad has suggested measures to prevent accidents in work site, safety regulations, machines and equipments, shutting down and parking, working with hydraulics, motor graders, paver finisher and hot mix plant.

Mr. Mihir Kumar Chakrabarti says that reliable data on status of safety in the construction stage of any project is rarely available in our country. At most of the construction sites, there is neither any system for regular safety inspection, nor any for reporting, recording and analysis of accident data. Construction sites of thermal power plants in India are no exception. Of late, however, Bharat Heavy Electricals Limited (BHEL) and National Thermal Power Corporation (NTPC) have initiated process of regular safety

inspection and reporting, recording and analysis of accident data at thermal power plant construction sites under their control. Mr.Chakrabarti has made an attempt to outline the status of safety in the construction stage of thermal power plants in India based on BHEL experience. He has given the detailed statistics of types of accidents, causes of accidents, causes of fire property damage and so on.

Accident statistics given in the paper, he adds, do not reveal the total status of safety as thermal power plant construction sites, since there are many other agencies working at such sites and most of them neither report nor maintain records of all accidents. However, the status revealed by the limited data is enough for all concerned to sit up and take notice.

Though the situation is serious and the status of safety in the construction stage of thermal power plants in our country is far from satisfactory, everything is not out of control. Realising the gravity of the situation two major power stations constructing agencies like Bharat Heavy Electricals Ltd. and National Thermal Power Corporation have initiated steps to improve the status of safety. Experience in BHEL appears to be encouraging. Since objective of this paper is only to focus attention on the status of safety, details of control measures initiated by BHEL are not discussed here. However, isolated efforts by one or two organisations cannot improve the situation.

National institutes like Central and Regional Labour Institutes and NICMAR should conduct studies in different types of construction industries to collect data on accidents and analyse them with a view to identify control measures.

Mr.Chakrabarti says that work at construction sites changes frequently due to physical working conditions. New hazards continually arise concerning the safety and health of people engaged. Such hazards also pose a threat to the safety and optimum utilisation potential of valuable construction materials, equipment and facilities.

Despite problems, some organisations have achieved success in the area of safety at work. Major construction firms which have organised themselves to be efficient and prosperous have also tried to organise themselves to do their work in as safe a manner. Relationship between safety and efficiency has been understood by such firms at the senior most levels and efforts made to share such understanding with managers and supervisors at the middle and lower levels.

A majority of accidents are caused by a failure to take elementary tried and tested precautions and not by causes which could be described as technological. There is, therefore, not much value in allocating responsibility for safety to technical experts alone, when the remedy is more likely to be in the hands of the line manager and the way he carries out his duties.. Those firms which have organised themselves to be prosperous and efficient are usually the ones who have organised themselves for the promotion of health and safety. For a majority of employers, the health and safety problem is not one requiring a high level of expenditure to control advanced technology. The majority of accidents in any enterprise arise from failures to do simple things well. Some accidents are due to technological advancement. Efforts need to be made to control them.

Mr.C.C.Mathur observes that human factors play a predominant role not only in the incidence of accidents, but also in preventing accidents. As such, a thorough study of all human factors is necessary to devise ways and means to avoid and minimise accidents in construction and strive to ensure full safety to that the workers could concentrate on the execution of jobs assigned to them and improve their productivity. He mentions poverty, casual employment, fatigue, lack of awareness, work environment, safety equipment, cost of equipment etc. are the impediments to safety. Mr.Mathur has recommended several measures including group insurance scheme for workers to improve the situation.



Mr. Xavier and Mr. Ghosh note that the majority of all accidents are due to human failings and despite the terrific increase of machines over the past twenty years, there has been no corresponding increase in the percentage of machine accidents. Due to these accidents, a lot of useful time is lost at the working site resulting in lower productivity. This paper deals with various safety measures to be observed in order to attain higher productivity in the construction industry.

The authors discuss the safety measures to be taken in the operations like excavation, scaffolding, lifting, use of cranes and electricity.

Mr. Govind Sachdev observes that accidents do not occur naturally but do so on account of certain definite reasons, most of whom can be foreseen, controlled or avoided. Safety Manual have to be drawn up with the objective of preventing recurrence of avoidable accidents in the construction of projects as well as ensuring a uniform and safe procedure for all construction works. The project authorities shall be responsible to see that the provisions contained in such safety manuals are followed in all works under their control to achieve the desired degree of safety. In addition they should always be alert for adoption of such measures as would result in improved working conditions and elimination of hazards. They should take prompt and reasonable precautions indicated by local authorities. They shall also ensure that the sub-contractors working under their control at the projects also strictly observe safety methods.

Further, the construction industry employs a labour force which is more than that employed by any other industry. It is also the least organised; as a result there is a scope for exploitation of the labour. In spite of recent legislations the worker discontent is rampant and this has created new areas of conflict. Above all, The lack of proper attention to occupational safety and health measures has created a difficult situation. Unless proper steps are taken to improve the position, it is likely to create a more frustrating situation in this industry, in times to come.

Most of the accidents have been reported to have occurred because of negligence, ignorance and complacency on the part of either the worker or the management, or both. Even so, there is very little organisational efforts to bring about effective measures of safety in respect of the vast population employed in this country or even to compile dependable statistics of number and type of accidents

Mr.Sachdev discusses the details of several safety issues including accident reports, storage material, fire prevention and so on.

## SESSION IV

### SAFETY EDUCATION, TRAINING, & MANAGEMENT ASPECTS & ROLE OF GOVERNMENT, EMPLOYERS AND TRADE UNIONS

#### PAPERS FOR THE SESSION

Sr.No.	Title	Authors' Name	Reference	
			Vol.	Page
1.	Sub-Contracting & Safety	G.K.Shukla	II	160-159
2.	Problems in Implementing of Safety among the Contract Workers	V.K. Agarwal	II	152-159
3.	Motivation - Our Experience in Construction Safety	R. Mukundan	II	139-151
4.	Accident Prevention & Safety	K.G. Desai	II	110-116
5.	Ergonomics Application to Construction Industry for Safety & Productivity	S. Raja & S. Prasanna	II	165-172
6.	Establishing a Safety Programme	NICMAR	II	97-109
7.	Organising Safety Training In Industry	CLI	VI	81-112
8.	Safety In Construction: The Role of Government, Employers and Trade Unions	S.Masilamani	III	113-123
9.	Safety & Health in Construction Industry In India: Some Managerial & Educational Aspects	E.Haribabu	III	124-136
10.	Training in Construction Safety Management	G.C.Mathur	III	74-80

Mr.G.K.Shukla draws the attention of readers to the complexity of the situation at a construction site. Most of the new project, he notes, are very large and call for different kinds of expertise. Different agencies and groups with varied targets, equipments and time schedule,work on the same site without much coordination and generally without any overall authority. It becomes very difficult to observe and implement safety rules. Such a situation may lead to accidents. In other words, contracting and sub-contracting is unavoidable. But this itself may create a situation which leads to accidents. He suggests several measures including coordination of all the groups in planning, use of equipments as per specifications, proper testing and calibration of equipments and so on. He has identified a number of causes of accidents and also suggested several remedies for the consideration of the seminar.

Mr.V.K.Agarwal feels that implementation of safety in construction is difficult due to certain peculiarities of labour and attitude of contractors who are their direct employers. He narrates several case studies to support his observation. Major factors which come on the way of implementing safety rules are attitudes of workers, absence of job skill, job training and lack of experience, fatalistic attitude, piece rate jobs, migratory nature of job, attitude of contractors, inadequate precautions, poor quality of tools and shackles and poor supervision. He has made several suggestions including issuing special passes to the workers engaged in the hazardous jobs, eg., painting, rigging, welding jobs at heights. In all tender notices, and work orders, clear instructions should be given to do the job safely and the contractor has to provide safety appliances to the workers and giving contracts to contractors/sub-contractors after ensuring that he has adequate supervisory staff and trained and experienced workers.

According to Mr. Mukundan, understanding the motivation of people is important. To use safety device to protect one's fingers from a saw is, perhaps, indicative of motivation of safe practices, but the desire to ignore a safety device because it might decrease production is also motivated.

Safety professionals are usually put under pressure to motivate top management in promoting safety in company's operations. Motivating supervisors is indeed a "tricky" issue since they normally expect monetary gain if they are assigned to take care of "safety" of their employees in addition to their normal duties.

Motivating workmen is not an easy task since they have to strongly get convinced that management is really interested in their safety and it is not just a "lip" service.

Narrating the experience of his own firm, Mr. Mukundan adds, In ECC Construction Group of Larsen & Toubro Limited, Safety is given utmost priority in all its construction operations.

Mr. Mukundan says to motivate the employees the following measures may be useful.

1. Cost benefit analysis will certainly help in motivating the senior executives to commit for safety.
2. Safety trophy scheme and certificate of merit
3. Identifying the safe supervisors|managers
4. Organising safety posters|stickers|slogans
5. Organising safety week programmes
6. In-housing training programme
7. In-house journal

Prof. K.G. Desai emphasises the role of human factor in accident prevention. He observes that accidents occur primarily due to human failures and therefore they are preventable. For instance, employees operating machines are likely to resort to short cut to save a little energy and slowly develop unsafe habits.

Similarly, workers may not use safety devices. Such wrong habits and practices may lead to accidents. With adequate training and effective supervision, it is possible to correct such tendencies.

Celebrating safety weeks, organising exhibitions, displaying posters, launching safety campaigns, do play an important role in arousing safety consciousness, but it is not enough. What is important is that construction industry should collect regularly factual information about accidents and use it in training the employees. They must maintain machinery and equipment properly and give adequate training and supervise the work of the employees. Such activities should be built in the working system.

Mr.V.B.Pandit attempts to find out the details of accidents that have occurred. He believes that it is possible to collect the requisite data. In fact as per existing rules, every major accident had to be reported to the government. Mr.Pandit's paper contains valuable data which throw considerable light on different types of accidents. He has also suggested topics and identified personnel who need training.

Mr.Raja and Mr.Prasanna discuss, in their paper, the application of "Ergonomics" or "Human Factors Engineering" principles, as a possible solution to the problems of safety at work on construction sites. It is a discipline which aims at the application of human biological sciences in conjunction with Engineering Sciences to achieve the optimum mutual adjustment of man and his work and the benefits are measured in terms of human efficiency and well-being.

"Ergonomics" also called the "Human Factors Engineering" is a new discipline. Its concepts and practices can be successfully applied to promote safety, to protect health and comfort of workmen, and above all to increase the productivity. A novel approach to the evaluation of fatigue allowances combining time study techniques and ergonomic practices has been presented for application in construction industry.

NICMAR has produced a document entitled, Establishing a Safety programme, for the seminar. It is an interesting and well-presented document. It spells out the actions to be taken to establish and organize a workable safety programme. The document says, although the construction companies vary in size, number of sites, nature of location, number of workers, technology and the attitudes of the top management, it is possible to suggest a common action for different types of organisations. The paper has identified key aspects which should be considered in establishing a new safety programme. The document spells out the details.

The document states the contests among the various departments of a company to achieve the best record in terms of freedom from lost time accidents (or some other measure of safety performance) are quite popular with many safety men. Awards can take many forms; a dinner for all members of the winning department, a plaque to be displayed on the wall, or prizes or cash to each employee. Contests have their place as a means of arousing interest in safety. However, some safety officers lose sight of the fundamentals of safety and place practically all of the emphasis upon contests and gimmicks.

**If** a safety officer places most of his faith in contests and attention getting gimmicks, he will tend to neglect the fundamentals of hazard elimination, training, job analysis and enforcement. The trouble with these contests and award programmes is that they operate at the fringes. Safety must be an integral part of every worker's and supervisor's job.

The Central Labour Institute has contributed a detailed paper for this seminar on Organising Safety Training in Industry. An accident prevention and occupational health hazard control programme, the paper says, can only be effective if the following organisational strategies are adopted.

- inculcating consciousness to be safe
- developing awareness to potential hazards
- providing safety guards and safety facilities
- developing safe procedures and practices

It is not just sufficient to provide safety guards and facilities. Effective use of them is possible only if employees know why guards and facilities are required and how it helps to prevent potential accidents besides knowing how to use and maintain them.

Spotting the potential hazard is not a one-time process. It has to be a continuous process in view of the dynamic nature of work-people technology relationship. It is, therefore, necessary to spot new hazards and take preventive actions.

Although management may strongly believe and support the programme of accident prevention and take necessary action to strengthen it, it is the safety performance on the shop floor that matters. The man on the shop being the real implementor of safety, he has to have the necessary training.

The paper presents the details of organising safety training including different approaches, analysing lost time accidents, conducting hazard survey, interviewing people, identifying needs and priorities, assessing training requirements, determining contents, deciding methods, evaluation measures, implementation and feedback.

Mr.Masilamani observes that safety in construction industry is a joint effort. All the three parties, i.e. government, employer and employee should actively involve themselves and contribute towards safety in the right sense. He has analysed the role of the government, the employers and workers' organisation in promoting safety.

Mr.G.C.Mathur observes that management of safety in construction is an exacting day-to-day and minute to minute task. To have a proper appreciation of all the factors and the situations that crop up, it is necessary to acquire training in construction safety and specialisation to enhance the capability and skill for tackling



various unique situations that are confronted with in practice. No doubt a thorough theoretical base and knowledge are of great consequence in developing an analytical approach to all problems with a view to devising workable solutions, the practical aspects are of great significance in implementing all the safety measures.

Mr. Mathur feels that appreciation or basic programme of safety in construction should be made mandatory for all concerned. Those who desire to acquire specialisation in the field should be provided opportunities for specialised training to enhance their knowledge and skills.

Dr. Haribabu's paper stresses the need for creating institutional mechanisms for (a) training professional safety personnel; (b) developing extension education and educational material; (c) carrying out research based on field studies to achieve a better understanding of the dynamics of industrial relations, workers characteristics and attitudes of employers for effective management of safety and health in construction industry in India.

Health hazards in construction include, among others, heat, radiation, noise, dust, shocks, vibrations and toxic chemicals. Some are minor hazards and some others major. Many workers take care of minor hazards by applying oil to their skin at the end of the day's work. However, some hazards may cause serious health problems with short-term and long-term effects. Exposure to dust from various sources lead to respiratory disorders which may become chronic. Similarly exposure to toxic chemicals can cause skin and respiratory disorders. It is important to list out indigenous or modern medicines which can help workers and provisions should be made at the work site.

The products of construction industry are meant for use by someone. The user may also get exposed to safety hazards if the client and the contractor commit errors in design and execution of construction projects. Several fire accidents occurred in the high rise buildings that have been turned over to the users in Indian metropolitan cities in the recent past. Users' interest should be taken into account.

For effective implementation of safety and health regulations, organization of separate safety departments in construction firms is a prerequisite. Institutional facilities which aim at creating, disseminating educational material on safety and health must be strengthened. In the absence of collective bargaining agencies and unorganized and risky nature of construction industry state must assume greater role in regulating industrial relations in construction industry.

## Major Points arising from the Papers

- For each project there must be a separate task force to ensure safety.
- At tendering stage, safety measures should be one of the main causes of contract.
- Incentive payment for safe working
- Safety education in teaching programme of Engineering and other technical institutes.
- Group training scheme for safety
- Training for different groups - supervisors, workers etc.
- There is need to rationalise and bring about uniformity in clauses for safety measures and insurance in the contract agreement
- Accident proneness - is it possible to identify employees who are accident prone
- Motivating employees in taking appropriate action to ensure safety
- Role of construction agencies in organising training
- Government has to enact a comprehensive law for construction workers
- Trade unions should mobilise the construction workers and convince them for safety management
- A comprehensive model legislation for safety in construction should be formulated by the central government on the lines of which the state governments can enact suitable legislation
- Incentives for improving safety and ensuring accident free execution of works should be provided
- Transfer of new technology from industrialised countries adds new dimensions to the existing problem of safety in construction industry
- Contractors discourage voluntary organisations from running creches for children of construction workers