

# AN INDICATOR ABOUT CONSTRUCTION SAFETY – A STUDY

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**Abstract**—Safety is the major issue in the construction industry. The accidents happening in the construction sites are the superior cause for the loss of the precious lives of the humans in the construction sector. The rate of accidents taking place in the construction field is climbing higher day by day. Hence it is mandatory to prevent such accidents to avoid further fatality of humans. In this paper, the survey is taken about construction accidents occurring all over the world. Then the causes of the construction accidents are analysed and finally, the preventives measures for the accidents are discussed.

**KEYWORDS**—CAUSES, CONSTRUCTION ACCIDENT, FATALITY, PREVENTION, SAFETY.

## I. INTRODUCTION

Construction is one of the world's major industries. Despite mechanization, the industry is still largely labour-intensive and the safety and health risks that workers face are amongst some of the greatest in any sector of employment. Because of the very nature of construction site work, the working environments are frequently changing, and the safety and health risks that workers face also change. Both the human and the economic costs of accidents and ill-health at work worldwide are enormous. The ILO firmly believes that work related accidents and ill-health can and indeed must be prevented and that action is needed at international, regional, national and enterprise levels to achieve this. (I.L.O., 2005)

## II. ACCIDENT SURVEY

Construction work is a dangerous land-based job. Some construction site jobs include: building houses, roads, workplaces and repair and maintain infrastructures. This work includes many hazardous task and conditions such as working with height, excavation, noise, dust, power tools and equipment. Construction work has been increasing in developing and undeveloped countries over the past few years along with an increase in occupational fatalities.

### 2.1 Worldwide Accidents

The construction industry is one of the world's major industries. Although it is difficult to obtain accurate statistics in an industry in which many accidents go undetected and unreported, in many countries known fatal accidents, and those involving loss of working time, frequently exceed those in any other manufacturing industry. Contributing to the high rate of accidents are those characteristics of the industry which distinguish it from the rest of the manufacturing sector (I.L.O., 1995).

#### GLOBAL ESTIMATES OF WORK-RELATED FATALITIES (2003)

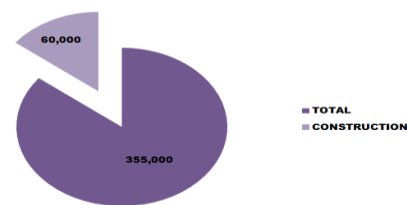


Figure 1:Survey

There are annually at least 60 000 fatal accidents on construction sites around the world, according to ILO estimates. This means that one fatal accident occurs every ten minutes in this sector, and that around 17% of all fatal accidents at work (1 in every 6) happen on construction sites. Young workers aged 15-24 are much more likely to suffer non-fatal but serious accidents at work compared to their older colleagues. The safety risks that construction workers face arise from the nature of the job including working at

heights (falls from roofs, scaffolding, ladders etc), excavation work (trench collapses and earth-moving machinery), the use of lifting machinery (cranes and builders hoists), the use of electrical equipment and hand-tools and from other site vehicles. (I.L.O., 2005)

TABLE 2.1

ESTIMATED NUMBERS OF FATAL AND NON –FATAL ACCIDENTS WORLDWIDE

Region	Economically active population	Total employment	Estimated fatal accidents (ILO)	Fatal accidents reported to the ILO	Estimated accidents, 3 days	All accidents reported to the ILO
EME	419,732,002	394,720,947	15,879	14,316	12,118,393	7,527,083
FSE	183,089,714	161,762,008	17,416	7,853	13,291,069	343,004
IND	443,860,000	402,510,000	40,133	222	30,627,865	928
CHN	740,703,800	733,705,100	90,295	12,736	68,909,715	61,329
OAI	415,527,598	344,569,424	76,886	3,051	58,676,113	141,349
SSA	279,680,390	19,347,698	53,292	145	40,670,012	27,015
LAC	219,083,179	192,033,807	39,372	2,009	30,046,941	776,938
MEC	135,220,721	76,443,255	17,977	1,416	13,719,565	153,785
World	2,836,897,404		351,251	41,748	268,059,671	9,031,431

KEY: EME – Established Market Economies; FSE – Formerly Socialist Economies; IND – India; CHN – China; OAI – Other Asia and Islands; SSA – Sub-Saharan Africa; LAC – Latin-America and the Caribbean; MEC – Middle Eastern Crescent

'Estimated accidents, 3 days' means non-fatal accidents which result in absences for more than 3 daysSource: ILO, 2005

ESTIMATED RATE OF WORK-RELATED FATAL ACCIDENTS PER 100,000 WORKERS

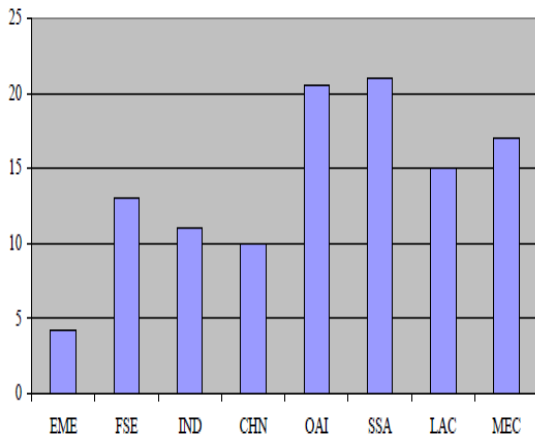
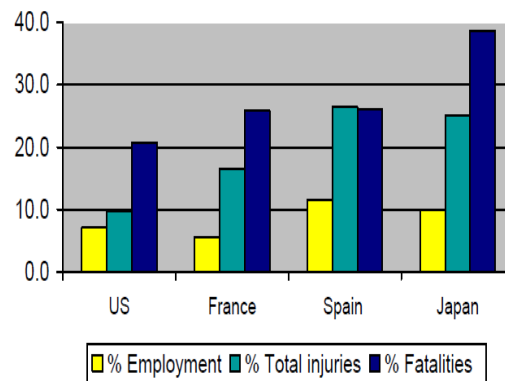


FIGURE 2.2 Source: ILO, 2005  
EMPLOYMENT AND OCCUPATIONAL ACCIDENTS IN CONSTRUCTION AS A PERCENTAGE OF ALL ECONOMIC

ACTIVITIES: EXAMPLES FROM



Source: ILO, 2003

The number of accidents occurrence in the United Kingdom alone saw a highly dominated figure coming from the construction sectors from the year 1995 to 2000. In the United States, accidents accounted for alone within the construction industry remains the most worrying dangerous sector although there was a substantial

SI. No	YEAR	INCIDENT	PLACE
1	2010	Formwork collapse	Australia
2	2011	Scaffolding collapse	New York
3	2011	Scaffolding collapse	Australia
4	2012	Scaffolding collapse	New York
5	2013	Scaffolding collapse	New York
6	2014	Scaffolding collapse	New York
7	2015	Scaffolding collapse	North Carolina
8	2015	Scaffolding collapse	Vietnam
9	2015	Scaffolding collapse	Singapore
10	2015	Scaffolding collapse	Houston
11	2016	Formwork collapse	Canada
12	2016	Scaffolding collapse	China
13	2016	Scaffolding collapse	New York

**TABLE 2.2**

2.2 Accidents in India

The construction industry is a major contributor towards India’s gross domestic production (GDP), both directly

decrease in the year 1999. However, its statistics remains above the average. In other Asian countries, Hong Kong reported a significant high level of injuries and fatalities encountered also in the construction industry followed by Japan. Malaysia, recorded a worrying increase in the numbers of accidents occurring at the construction sites by the Social Security Organization (SOCISO) indicating the number of permanent disabilities and fatalities from year 1996 to 2008. (Dayang Nailul Munna Abang Abdullah and Gloria Chai Mei Wern, 2010)

The list of some of the worldwide temporary structure accidents between the year 2010 and 2016 is listed below.

**LIST OF ACCIDENTS WORLDWIDE**

Source: Daily Newspapers

and indirectly. It employs 33 million people, and any improvements in the construction sector affect a number of associated industries such as cement, steel, technology, skill enhancement, etc (The Hindu, 2016). Every year, India loses an average of 2,658 people to different kinds of structural collapses; that is around 7 deaths a day (Naresh Fernandes et al, 2015). India has witnessed a significant number of building collapses in the past 18 months. There have been seven major building collapses in three Indian cities (Mumbai, Chennai, Vadodara) alone, resulting in a total of 234 deaths, along with innumerable injuries and economic losses (The Hindu business line, 2014). A study of building failures in the US covering 11 years from 1989 to 2000 recorded 225 failures (including both partial and total collapses) with a total loss of lives of 97 persons. This implies about 9 lives lost per year on average in the US, as compared to our record of 234 deaths in 18 months from just 7 selected collapses (The Hindu business line, 2014). India has seen frequent building collapses, many blamed on lax safety and substandard materials (BBC, 2014). The number of fatality caused by structural collapses in India in 10 years from 2003 to 2012 is given below graphically.

NUMBER OF FATALITY CAUSED BY STRUCTURAL COLLAPSES IN INDIA

SI. No	YEAR	INCIDENT	PLACE	NO. OF FATALITY
1	June 14, 2012	Collapse of building	Mahendiramedu, Coimbatore	2
2	August 3, 2012	Collapse of two storey building	Thiruvallikani, Chennai	2
3	August 6, 2012	Collapse of collage building	Kancheepuram	10
4	August 9, 2012	Crane crash at a metro rail site	Chennai	1
5	Sep 23, 2012	Collapse of multi storey building	Madurai	1
6	Sep 24, 2012	Collapse of multi storey building	Madurai	1
7	October 3, 2012	Collapse of old building	Triplicane, Chennai	2
8	May 14, 2013	Collapse of school building	Viruthunagar	1
9	June 30, 2013	Collapse of multi storey building	Thenampet, Chennai	1
10	July 19, 2013	Collapse of star hotel building	Mahabalipuram, Chennai	1
11	July 23, 2013	Collapse of multi storey building	Madurai	1
12	Sep 19, 2013	Collapse of shopping complex	Trichy	3
13	April 4, 2014	Collapse of hotel building	Puzhuthivakkam, Chennai	1
14	June 28, 2014	Collapse of multi storey building	Moulivakkam, Chennai	61
15	July 6, 2014	Collapse of godown compound wall	Thiruvallur	11
16	March 30, 2015	Collapse of formwork of university building	Thiruvarur	5

National Crime Records Bureau (NCRB) statistics show that Tamil Nadu accounts for a significantly larger number of deaths in building collapses than neighbours Andhra Pradesh, Karnataka and Kerala. NCRB data also reveals that more people are likely to die in a single collapse in Tamil Nadu than in other states (The Times of India, 2012).

Some structural collapse accidents in TamilNadu and Puducherry are given below: TABLE 2.3

STRUCTURAL COLLAPSE ACCIDENTS IN TAMILNADU AND PUDUCHERRY

LIST OF TEMPORARY STRUCTURE ACCIDENTS IN

INDIA

Source: Daily Newspapers

Sl. No	YEAR	INCIDENT	PLACE
1	July 26, 2012	Scaffolding collapse	Chennai
2	Sep 10, 2012	Scaffolding collapse	Puducherry
3	March 30, 2015	Collapse of formwork	TamilNadu
4	Dec 21, 2015	Scaffolding collapse	Nagercoil
5	Feb 02, 2016	Scaffolding collapse	Mumbai
6	April 25, 2016	Scaffolding collapse	Ghaziabad
7	April 06, 2016	Scaffolding collapse	Chennai
8	April 13, 2016	Scaffolding collapse	New Delhi
9	April 17, 2016	Collapse of formwork	Lucknow
10	Sep 03, 2016	Scaffolding collapse	Hyderabad
11	Sep 09, 2016	Scaffolding collapse	New Delhi
12	Oct 08, 2016	Scaffolding collapse	New Delhi
13	Oct 11, 2016	Scaffolding collapse	Chennai

Formwork is one of the most important factors in determining the success of a construction project in terms of speed, quality, cost and safety of work as it accounts to nearly 35-40% of the total RCC project cost and 75-80 % of the project time. Therefore, though formwork is considered as temporary work in the construction industry, it should not be treated as temporary, and due caution should be exercised while selecting a type of formwork by a civil engineer.

Source: Daily newspapers

In India, 60% of the building failures are caused due to formwork collapse, 8% are due to premature removal of shore and 18% due to faulty materials (The Times of India, 2015). The list of some of the temporary structure accidents in India in recent years is listed below.

I. CAUSES OF ACCIDENTS

Efforts to reduce construction failures by studying their causes have led to a meaningful reduction in occurrence (Janet K. Yates and Edward E. Lockely, 2002). There are numerous causes for construction accidents which are enlisted briefly as follows.

3.1 General Causes

There are several common causes of construction site accidents. Here are some of the common causes of accidents in the construction industry,

- Slip and falls, often caused by unsafe working conditions.
- Stepladders, which can tip over or even collapse.
- Failure to follow state safety regulations for scaffolding, which can collapse.
- Carelessness during work.
- Trenches and excavation walls collapsing when not installed correctly.
- Caught by or between vehicles.
- Crushed by machineries.
- Power tool accidents, especially when eye and ear protection are not worn.
- Lack of protective suit and tools.
- Struck by falling object.
- Disobeying the government rules for safety.
- Lack of safety inspection.
- Lack of awareness and training among the workers.
- Other human errors and so on.

3.2 Common Deficiencies In Design

Following common design deficiencies leading or contributing to failure should be avoided:

- a) Lack of allowance in design for such loadings as wind, power buggies placing equipment and temporary material storage;
- b) Insufficient allowance for eccentric loading due to placement sequence;
- c) Failure to investigate bearing stresses in members in contact with shores and struts;
- d) Failure to provide proper lateral bracing or lacing of shoring;
- e) Failure to investigate the slenderness ratio of compression members;
- f) Inadequate provisions to tie corners of intersecting cantilevered form together;

- g) Failure to account for loads imposed on anchorages during gap closure in aligning formwork;
- h) Overstressed reshoring. (IS 14687: 1999)

## II. PREVENTIVE MEASURES

Construction procedures should be planned in advance to ensure the safety of personnel and equipments and the integrity of the finished structure (IS 14687: 1999). The preventive measures for the accidents occurring in the construction industry are further discussed.

### 4.1 General Preventive Measures

The accidents in the construction field are enormous and obviously, there are numerous preventive measures in which some of them are given below.

- Follow safety regulations and codes.
- Usage of Personal Protective Equipment (PPE)
- Create awareness about the dangers in the work.
- Using hard helmets along with chin strip.
- Provide safety training.
- Usage of ear protection.
- Conduct safety meetings.
- Conduct regular safety inspection.
- Usage of other safety tools.
- Provide safety nets in the construction site.
- Usage of prevention devices.
- Secure the electric wires in the construction site.
- Provide other safety facilities in the construction site and so on.

### 4.2 Indian Regulations

There are a number of Indian regulations dealing with the working conditions of construction workers. The main Indian regulations are:

- Building & Other Construction Workers (Regulation of Employment and Conditions of Services) Act, 1996.
- Building & Other Construction Workers (Regulation of Employment and Conditions of Services) Central Rules, 1998.
- Building & Other Construction Workers Welfare Cess Act, 1996.

The codes in force to take care of the working conditions and safety of the construction workers are:

- The National Building Code of India, SP 7: 2005.

- Indian standard Handbook on Construction Safety Practices, SP 70: 2001.
- Indian Standard Safety Code for Scaffolds and Ladders, Part I Scaffolds, IS 3696 (Part I): 1987.
- Indian Standard Scaffolds and Ladders - Code of Safety, Part 2 Ladders, IS 3696 (Part 2): 1991 and so on.

## III. CONCLUSION

Safety is a matter of concern in the construction industry. The survey taken reveals in detail about the accidents and the fatalities occurred in various parts of the world. Based on the accident survey, the general causes for the construction accidents were found and the proper preventive measures are suggested precisely in this paper. Thus, it is concluded that the construction accidents can be prevented and the human lives can be saved only if the preventive measures are implemented mandatorily in the construction field.

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