Journal of Health and Environmental Research
2017; 3(5): 72-83
http://www.sciencepublishinggroup.com/j/jher
doi: 10.11648/j.jher.20170305.11
ISSN: 2472-3584 (Print); ISSN: 2472-3592 (Online)

Case Report

Occupational Health and Safety Status of Ongoing Construction Work in Patuakhali Science and Technology University, Dumki, Patuakhali

Md. Mahmudul Hasan[1, *], Ruma Khanam[2], A. K. M. Mostafa Zaman[3], Md. Ibrahim[4]

[1]Department of Geo-Information Science and Earth Observation, Faculty of Disaster Management, Patuakhali Science and Technology University, Patuakhali, Bangladesh

[2]Department of Disaster Resilience and Engineering, Faculty of Disaster Management, Patuakhali Science and Technology University, Patuakhali, Bangladesh

[3]Department of Agronomy, Faculty of Agriculture, Patuakhali Science and Technology University, Patuakhali, Bangladesh

[4]Faculty of Disaster Management, Patuakhali Science and Technology University, Patuakhali, Bangladesh

Email address:

mahmudulhasandm30@gmail.com (Md. M. Hasan), rumakhan23dm@gmail.com (R. Khanam), mostafazaman@gmail.com (A. K. M. M. Zaman), ibrahimdm39@gmail.com (Md. Ibrahim)

[*]Corresponding author

To cite this article:

Md. Mahmudul Hasan, Ruma Khanam, A. K. M. Mostafa Zaman, Md. Ibrahim. Occupational Health and Safety Status of Ongoing Construction Work in Patuakhali Science and Technology University, Dumki, Patuakhali. *Journal of Health and Environmental Research.* Vol. 3, No. 5, 2017, pp. 72-83. doi: 10.11648/j.jher.20170305.11

Received: August 29, 2017; **Accepted**: September 27, 2017; **Published**: November 15, 2017

Abstract: The occupational health and safety is required employers to provide a healthy and safe working environment that is free from hazards. Construction work is one of the most dangerous occupations in the world. It causes more fatalities than any other occupational sector. Patuakhali Science and Technology University (PSTU) is located in Dumki Upazila of Patuakhali District of Barisal division in Bangladesh. Study focuses on to finding out the major health and safety related hazards in construction side in PSTU and to recommend some management options to reduce health related hazards and increase safety. The major health related hazards in PSTU construction site is falling from height; hit by falling object; trips and fall; back pain; muscular pain (due to manual handling); health problem caused by chemicals, dust, noise; injury from fire and other disaster. Sometimes they suffer from different types of diseases such as diarrhea, cholera, dysentery, jaundice, skin disease, typhoid, pneumonia, cough and malaria. For this reason the construction sector has been identified as one of the high-risk sectors in this country by the Department of Labor. In order to reduce injury and disease in the construction sector a Health and Safety accord has been signed between Government, Organized Business and Organized Labor Organizations. For better performance personal and a holistic approach must be needed.

Keywards: Occupation, Workers, Health, Safety, Construction, Management

1. Introduction

The construction industry is an important part of the economy in many countries and is often seen as a driver of economic growth especially in developing countries [1]. Owing to it's relatively labor intensive nature, construction works provide opportunities for employment for a wide range of people skilled, semi-skilled and unskilled. Despite its importance, construction industries are considered risky with frequent and high accidents rates and ill health problems to workers, practitioners and end users [2]. Patuakhali Science and Technology University (PSTU) is located in Dumki Upazila of Patuakhali District of Barisal division in Bangladesh. The major health related hazards in PSTU construction site is falling from height; hit by falling object; trips and fall; back pain; muscular pain; due to manual

handling; health problem caused by chemicals, dust, noise; injury from fire and other disaster. Sometimes they suffer from different types of diseases such as diarrhea, cholera, dysentery, jaundice, skin disease, typhoid, pneumonia, cough and malaria. The result of this research gives hope workers of the PSTU construction site to ensure their health and safety. The objectives of this research is; a) To finding out the major health and safety related hazards in construction site in PSTU and b) To recommend some management options to reduce health related hazards and increase safety.

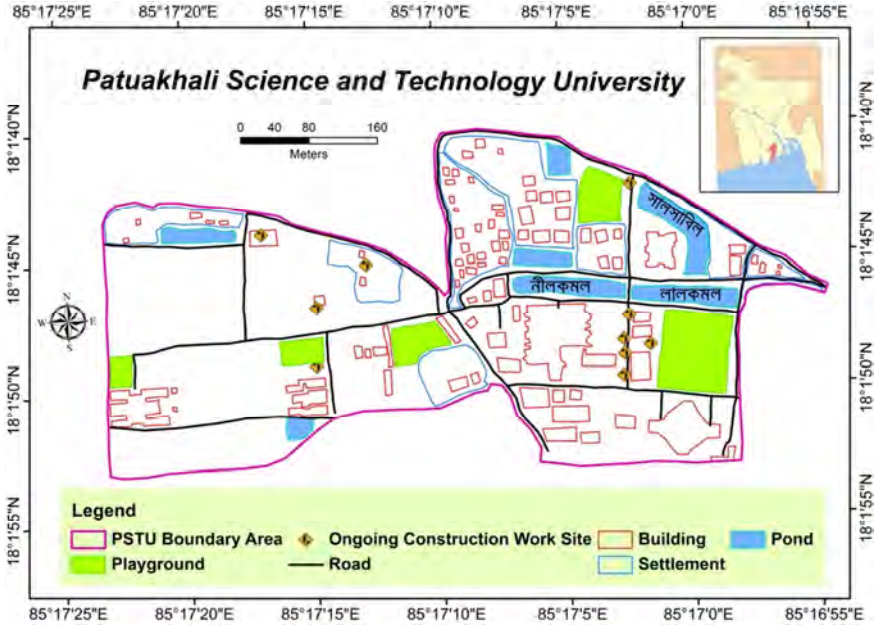


Figure 1. *Study area map (prepared by ArcGIS 10.0 software).*

2. Literature Review

The current rapid economic development has brought changes in workplaces in developing countries [3] and the organization of occupational health and safety services is not yet resilient enough to handle the growing demands for workers [4]. Construction hazards have received considerable attention over the last two decades [5]. Researchers internationally have examined hazards, consequences, and costs and developed numerous interventions and tailored controls [6]. Health and safety at work are considered to be very important issues as they are intrinsically linked with the overall well-being of working people [7]. The consequences of construction hazards can be severe in terms of morbidity and mortality. Analysis of these incidence data calculated an average cost of US$27,000 per incident in construction, almost double the US$15,000 cost per case for all industry [8]. An estimated 7% to 10% of the global workforce works in the construction industry, but the sector accounts for 30% to 40% of occupational fatal accidents worldwide: at least 60,000 per year [9, 10]. The risks are similar worldwide, and are in many cases safety-related [11]. Falls from heights can cause significant injuries, are often fatal, and the fundamental approach necessary to prevent this accident outcome was described over 3300 years ago (Deuteronomy 22:8). Even so, the numbers for construction fatalities, injuries, and related costs are generally flat or continue to rise in the US, New Zealand, Taiwan, and The Netherlands (NL) [12-15]. Many construction tasks also present physical hazards, e.g. noise, vibration, and handling loads. Occupational hearing loss in the construction sector remains significant, even in nations with strong regulations [16]. An estimated 30% of construction workers have musculoskeletal disorders (MSD) and back pain, even though basic solutions have been available for 100 years [17]. However, over 50% of all construction laborers complain about dust, apparently without being aware that virtually all construction dust contains hazardous substances like silica and wood [18]. Occupational safety and health have been repeatedly mentioned as a fundamental right of every worker, and are referenced in the Alma Ata Declaration on Primary Health Care (1978), the WHO constitution, the UN's Global Strategy on Health for All (2000), the ILO Convention (1919) and in many other multilateral conventions and documents along with the National Labor Law of Bangladesh [19]. However, status of occupational health and safety in developing countries like Bangladesh is especially problematic [20], with workers bound to work in an unsafe working environment where there is little regard for safety issues and inadequate monitoring from any public or civil society agency [21]. Poor safety and health record of locations where poor people are 'employed' also contributes to worsening the situation [22]. Hence, occupational health and safety is very important irrespective of the type of employment, or size or sector or location of the workplace because of its strong connection with extreme poverty and wellbeing [23].

No systematic method is used for risk assessment, but rather risks are assessed based on individual judgment guided by experience, educational background and existing regulations [24]. Meanwhile, risk information is communicated through

toolbox meetings, informal discussions, and controlled by using personal protective equipment (PPE). The regulatory system, the organization/company system, the individual system and the work environment have impact on health and safety risk management [25]. Site location, site configuration, procurement system and complexity of design are the main challenges hampering health and safety risk management [26]. Incorporating of key project stakeholders is necessity such as client and design team and other consultants in managing health and safety risk. Improving health and safety in the construction industry therefore continues to remain a priority [27].

Construction work: Construction work means any work in connection with:

a. The construction, erection, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure.
b. The construction, erection, maintenance, demolition or dismantling of any bridge, dam, canal, road, railway, runway, sewer or water reticulation system; or the moving of earth, clearing of land, the making of excavation, piling, or any similar civil engineering structure or type of work.

Construction site means a work place where construction work is being performed and construction contractor is an employer who performs construction work [28].

3. Materials and Methods

Building construction is necessary for a sustainable development but it should be constructed in a proper way with least possible health and environmental negative impacts. Project involves with the construction of the buildings at Patuakhali Science and Technology University, Dumki, Patuakhali. The number of students of this University is near about 3000. For the large number of students it's have not enough student's hall for accommodation and academic building for class room. There have already several constructions in this university but this quantity exceeds the demand. For this reason this constructions is very much needed for the student of this University. Due to construction work, workers suffer different health related hazard and there is no concern to the responsible authority, so, study think that Patuakhali Science and Technology University, Dumki, Patuakhali is the right places for research.

Data were collected total of 30 workers interviews. Workers are selected randomly. Selected workers are mixed group like as old people, middle age and the younger people. Major health hazards, vulnerability, occupational changes and displacement and the present safety condition was a major point to know from them through focus group discussions. In this regard key informants' were interviewed and questionnaires were also finalized. Observation techniques were also adopted to understand the major health hazard, vulnerable zones and risk factors of this area due to construction work.

Focus group discussions were conducted with the people to know about the major health hazard and safety standard. FGD also done to find out their thinking about the problems they face and the way they are planning for solution of their problems.

Interviews were taken with different professionals for experiencing the true information in this particular area; cause of the locals is direct observers of the problems. They do not have vast idea about the hidden causes of the hazards, so, study needs the experience of the experts of that particular area. Study analyzes the fact with checking and rechecking of their ideas. The key informants were selected based upon their expertise on the relevant subject matters required for analyzing the issue carefully. Apart from questionnaire, their comments were also taken into consideration.

During the interview of the people, all data were recorded properly in a notebook. If any data seems to be confused, data was corrected through revisit. Study took help from the previous researchers to collect information. The collected data was manually coded according to the objective of the study. All the collected data were summarized and examined carefully. Then data were made MS Excel sheet. Study also collected primary data and secondary data.

Primary data are first-hand information, data were collected through various methods such as observation, interviewing, transect walk, key informant interview and focus group discussion. The observation methods are participated structured and controlled. The interview method of collecting data involves presentation of oral-verbal stimulating and reply in terms of oral-verbal personal response. Study also complete one focus group discussions (FGD).

This study concerned relevant secondary sources of data and information such as statistical records, survey records, written documents, different relevant books, articles, reports, journals and research paper. Moreover, study reflects the general scenario of health hazard and safety standard of PSTU construction works, which could be able to open a new window in occupational health and safety assessment of construction works in PSTU.

4. Result and Discussion

Maximum worker of the PSTU working site have no idea about occupational health and safety. They have no training how to use equipment but some have little bit knowledge, gathered from working experienced of long period of time on construction site.

4.1. Types of Health Hazards on Construction Sites of PSTU

Health and safety hazards are divided into two categories, namely the physical injury hazards and the ill-health hazards. Hazard of physical injury include death consequences. Hazard of ill-health can only be notified after a long period and shall cause sickness or death after a certain period of time. The following are common hazards on construction sites of PSTU irrespective of the physical injury or ill-health problems.

1. Falling from height
2. Hit by falling object, trips and fall

3. Back pain, muscular pain, due to manual handling
4. Health problem caused by chemicals
5. Health problem caused by dust
6. Health problem caused by noise
7. Crushed moving equipment's, cuts by equipment's and hand-led tools
8. Health problem caused by too long bending and twisting
9. Injury from fire and other disaster
10. Covered by earthwork during excavation of basement and trenches
11. Bullying and stress

4.1.1. Height

The main hazards associated with working at height at

PSTU are people and objects falling below. Falls from height have been viewed as one of the most frequent killers of the workers on construction sites. Study shows that nearly 15(fifteen) workers are injured and 00(zero) workers are killed each year at PSTU construction site. Study find that, falls from heights are the leading cause of occupational injuries on construction sites of PSTU. In PSTU work-related falls from heights represented more than 10% of all fatal incidents. Common PSTU construction site falls include roof-related falls, crane falls, scaffolding falls, elevator shaft falls, falls resulting from holes in flooring, and falling objects. These may occur as a result of inadequate edge protection, or from objects in storage being poorly secured. Workers at risk of falling from a height include painters, masons, decorators and window cleaners and those who undertake one-off jobs without proper training, planning or equipment.

4.1.2. Slips and Trips

Slips and trips are seen as the most common workplace hazards and contribute to over a third of all major injuries in PSTU construction site. Over 10(ten) workers suffered serious injury because of a slip or trip last year. They occur in almost all workplaces of PSTU and 95 % of major slips result in broken bones. Study revealed that slips account for 18% of all injuries and 25% of workers' compensation payments at PSTU construction site. Slips contributed to 85% of falls on the same level and over 30% of falls from height as well as a significant number of musculoskeletal injuries sustained after slipping. They can also be the initial cause of a range of other types of accidents, such as falls from heights. Slips and trips are caused at PSTU construction site when materials are scattered everywhere haphazardly, the floor is wet or greasy, inappropriate footwear is worn, mainly by casual employees and visitors, something large or heavy is being carried, reducing one's balance, and when the lighting is poor.

4.1.3. Equipment, Machinery, Tools and Transport

Vehicles are necessary for transporting goods and people. However, many people die and are injured due to being struck and crushed by equipment and machinery at PSTU construction sites, especially by reversing machinery, site machinery falling in the excavation area, machines overturning due to travelling down a steep slope, and material falling from construction equipment especially haulage trucks, hitting people behind it or nearby. Crush injuries can have a wide range of serious effects, including fractures, internal injuries, head and brain injuries, and back injuries. In some cases, a crush injury may result in amputation and permanent disability of the affected worker. Meanwhile, many workers are injured due to being chopped and cuts by equipment and hand held working tools such as chisels, screwdrivers, knives, saws, harmers, nails and drilling machines. The greatest hazards posed by hand tools results from misused and improper maintenance.

4.1.4. Electricity

Electricity is widely used on PSTU construction sites but has the potential to be very hazardous with possible fatal results. Someone coming into contact with a live electrical conductor will get a shock that may lead to injuries or even death. In PSTU 2% of all fatalities at work are caused by electric shocks. Most injuries and deaths from electricity at PSTU construction sites are due to, using poorly maintained electrical equipment, working near overhead high tension lines or domestic electricity supplies, contact with underground power cables during excavation work and working without appropriate safety gear.

Short-circuit system of electricity create fire hazard problems. Fire is one of another major hazard that construction workers could face on PSTU construction site. Although fire hazards are not seen as such as a high risk compared with falling from a height and slipping and tripping. Every year 5(five) construction sites workers are injured as a result of fire. Fires on construction site are caused by braising work carried out by plumbers, gas lines for underground work, power lines, power leads and tools, machinery requiring petrol and diesel, and hazardous chemicals.

4.1.5. Manual Handling

Manual handling is defined as the movement of a load by human effort. It can include any activity requiring the use of force exerted by a person to lift, push, pull, carry or otherwise restrain any moving or stationary object. It has been argued that lifting bricks, cement blocks and cement bags weighing 50 kilos has been regarded as risky activities on construction sites of PSTU. Back injuries and emasculatory disorders, sciatica, hernias and slipped are the most serious of construction site injuries. Study revealed that in PSTU construction site, 25% of injuries are back injuries. Almost 30% of all PSTU construction workers complain of back pain that requires over thirty days off. The average number of days of work missed by a construction worker is higher than in other fields of employment at PSTU.

4.1.6. Noise

PSTU workers expose to excessive noise at work which reduces their hearing performance. Some activities on PSTU construction sites are extremely noisy, for example, rock breaking during demolition work or the operation of a jack hammer. The use of vibrating wicker plates, electric tools, explosive powered nail guns and vibrators during concrete pours; all cause specific noise problems for the operators and

workers in the vicinity of PSTU.

4.1.7. Chemicals Substances

PSTU construction activities involve using chemicals which pose health and safety risks to workers. For example solvents of many different kinds are used in paints, varnishes, pesticides used to treat timber, bonding agents, lacquers and adhesives. At the construction site, workers exposed to chemicals by breathing them in, ingestion and absorption through the eyes or skin. Chemicals at PSTU work sites causes worker headaches, eye irritation, dizziness, faintness, sleepiness and affect judgment and coordination. Chemical substances damage to the central nervous system and harm the skin, liver, kidneys and cardiovascular system. Some solvents increase the likelihood of cancer, reproductive problems, reduce fertility, cause birth defects and miscarriages. Some paints and varnishes; bonding agents and resins; cause asthma and dermatitis. Welding fumes which may include a cocktail of metal fumes, cause serious health problems in the long term. As chemicals are absorbed, workers respiratory system, brain and internal organs are slowly affected.

4.1.8. Dust

Dust is a common hazard on building works at PSTU construction sites. The health risks associated with a dusty jobs depend on the type of dust (physical, chemical and mineralogical), which will determine its toxicological properties, and hence the resulting health effect; and the exposure, which determines the dose. PSTU construction site workers exposed huge dust which increases the chance of adverse health effects, minor impairment to irreversible diseases and even life-threatening conditions. There are higher death rates from respiratory disease and from lung and stomach cancers in dusty trades. At PSTU construction sites cement, silica and wood dust and dust from medium-density fiber board poses particular risks.

4.1.9. Welding Fumes and Gases

Welding fume exposure in the workplace is a serious occupational hazard in PSTU construction sites. All welding processes produce fumes, but the most fumes are produced during arc welding. The contents of the welding fumes depend on the components of the base metal, coatings and/or filler materials and the temperatures used in the welding process. Types of metals commonly found in welding fumes at PSTU construction sites include aluminum, beryllium, cadmium oxides, chromium, copper, fluorides, iron oxide, lead, manganese, molybdenum, nickel, vanadium and zinc oxides. Welding fumes also produce gases, which can contain carbon monoxide, fluorine, hydrogen fluoride, nitrogen oxide and ozone. Inhalation of these fumes is very hazardous to a workers health, even more so if the worker is a smoker. Effect of welding fumes and gases of PSTU construction sites workers includes hoarseness, sore throat, eye irritation and metal fume fever and the long-term effects includes bronchitis, cancer and may cause damage to the central nervous system.

4.1.10. Painting Spray/Mists

Employees of PSTU construction sites are exposed to highly volatile and toxic materials during painting spray. Painting spray is the process where a liquid coating substance, usually paint is changed into a mist or aerosol, in order to apply a coating onto an object or surface. Hazards associated with spray-painting involve exposure to hazardous substances through either inhaling of vapors, injection of paint or skin contact, fire and explosion, electricity, plant and noise.

Short-term health effects that spray painting cause are irritation contact dermatitis, burns to the skin and eyes, vomiting and diarrhea, irritation to the nose, throat and lungs, headaches, dizziness, nausea and fatigue. Long-term health effect result from spray-painting are occupational asthma, allergic contact dermatitis, lung cancer, 'painter's syndrome' which is prolonged inhalation of paints and solvents resulting in brain damage, damage to the reproductive system and kidney or liver damage.

4.2. Physical Stressors in the PSTU Construction Site

4.2.1. Illumination

The Environmental regulations for workplaces require an employer to ensure that the workplace be lighted. Health effects of PSTU workers exposed to excessive or poor lighting include eye discomfort, eye strain, eye irritation, blurred vision, dry burning eyes and headache.

4.2.2. Noise

Noise is commonly agreed to be unwanted sound. Noise is one of the mostly highly present physical stressor in the construction sectors of PSTU. Workers of PSTU exposed to noise above 85 dB noise-rating limits. Effects of noise exposure to workers health include tinnitus, annoyance, and hypertension, sleeping disorder, hearing impairment and hearing loss.

4.2.3. Vibration

Vibrations enter the body from the organ in contact with vibrating equipment, when an workers operates handheld equipment such as chainsaw or jackhammer; vibration affects hands and arms. When a worker sits or stands on a vibrating floor or seat the vibration affects almost the entire body of the workers.

4.2.4. Temperature

Both very cold and very hot temperatures could be dangerous to workers health. At PSTU construction site the most serious concern in a very hot environment is heat stroke and can be fatal if it does not get medical attention. Heat exhaustion and fainting are less serious type's illnesses which are not fatal but interfere with a person's ability to work. When workers are exposed to very cold temperatures, the concern to health is hypothermia or dangerous overcooling of the body. Another serious effect of cold exposure is frostbite or freezing of the exposed extremities such as fingers, toes, nose and ear lobes.

4.2.5. Radiation (Ultraviolet Rays)

PSTU construction site workers are exposed to too much (ultraviolet) radiation in the sunlight that can be harmful to the skin. Construction workers have a higher risk of skin cancer than many other workers due to long periods exposed to UV radiation from direct sunlight and UV rays reflected from nearby surfaces such as concrete. Short-term exposure cause reddening of the skin or blister the skin. Long-term exposure increases the chance of developing skin cancer.

4.2.6. Ergonomics

Workers of the PSTU construction site are exposed to ergonomic risk factors such as lifting heavy items, bending, reaching overhead, pushing and pulling heavy loads, working in an awkward body posture and performing the same task repetitively.

4.3. Psychological Stressors

Work-related stress can be an occupational health issue for the construction site of PSTU. Working long hours, having too much work to do at the same time, being bullied at work, family problems and distance from family are some of the factors that can cause stress among the workers.

4.4. Biological Stressors

Workers at the PSTU construction site may be exposed to vector-borne disease, microorganism's venomous wildlife, insects and poisonous plant during construction work (mostly during construction site establishment). Examples include poison, scorpions and spider bites, mosquitoes and snakes. Poor hygiene can also be a contributing factor to spreading disease. In that construction area only two toilets situated for minimum fifty workers both male and female and the toilets are unhygienic. Their cooking environment is unhealthy and they use pond water for cooking purposes. Diseases like cholera, diarrhea may occur which reduce the working efficiency and create food poisoning and other health related problems. In this construction site there are no standard site for waste disposal as a result they dispose the waste here and there that is very harmful for environment and create odor pollution, air pollution, spread vector borne diseases and water pollution which ultimately create pressure no worker health.

Table 1. *Health hazard and incident profile of study site.*

SL.	Types of Hazard	Injured (%)	Death (%)	Fatal incidents (%)
1.	Waking at height	25	0	10%
2.	Manual handling (carrying cement bags or bricks/block?)	70	0	18%
3.	Overcrowded site	50	0	15%
4.	Handling heavy load	30	0	10%
6.	Noise (using block/ brick cutting machine)	60	0	15%
7.	Dust (mortal/ cement)	80	0	5%
8.	Bending, twisting while laying blocks/ bricks	50	0	5%

(Source: Field survey 2017)

Table 2. *Worker state of mind about safe when working (Source: Field survey 2017).*

SL.	Types of Hazard	1	2	3	4	5
1.	Waking at height					5
2.	Manual handling			3		
3.	Overcrowded site				4	
4.	Handling heavy load				4	
5.	Manual handling (carrying cement bags or bricks/block?)		2			
6.	Noise (using block/ brick cutting machine)				4	
7.	Dust (mortal/ cement)		2			
8.	Bending, twisting while laying blocks/ bricks				4	

1=very safe, 2=safe, 3=moderate safe, 4=not safe, 5=not safe at all

Table 3. *Information of worker affected by the following disease.*

Sl	Name of the Disease	How many workers	For How many times	For how many days
1.	Diarrhea	5	1	3
2.	Dysentery	25	4	2
3.	Jaundice	8	1	15
4.	Skin disease	25	3	20
5.	Typhoid	5	1	7
6.	Pneumonia	10	1	10
7.	Cough	12	2	7
8.	Malaria	5	1	5

(Source: Field survey 2017)

4.5. Vulnerability and Safety Assessment

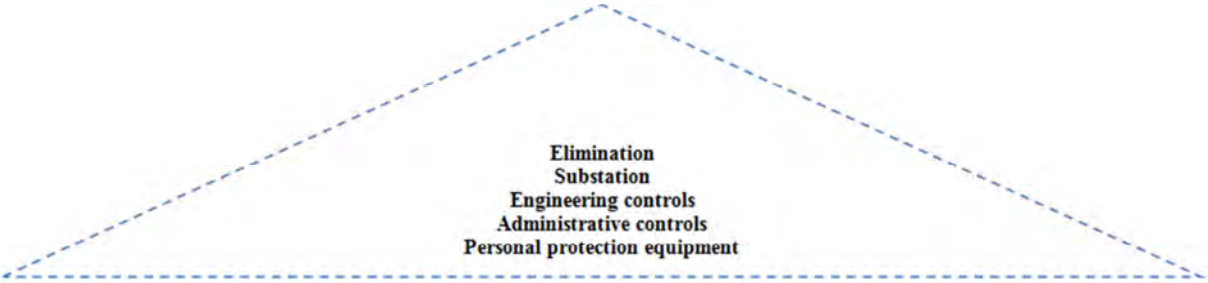
Worker of PSTU construction site are highly vulnerable to falling from height, falling object, noise and inhalation of dust from cement. Workers are moderately safe from these health hazards and some types of specific hazard they are not safe at all. Sometimes they suffer from different types of diseases such as diarrhea, cholera, dysentery, jaundice, skin disease, typhoid, pneumonia, cough and malaria.

5. Management Options to Reduce Health Related Hazards and Safety

The construction site of PSTU has no health and safety policy towards workers. They do not follow any mechanisms to protect them from these health hazards. The challenges facing on managing health and safety on construction site is that the ignorance of conductors. Conductors' thinking is that they are able to work on this situation without any protection and it is not only extra cost but also rest of low profit. They release their liability only saying that work carefully and safely. Some management options to reduce health related hazards and safety are discussed in this study.

5.1. Proposed Hierarchy of Control for Environmental Stressors

If the hazards cannot be removed the employer must have control measures in place to prevent workers from exposure to hazards/danger.



Option 1: Hierarchy of control	Option 2:Different approach to control
(Elimination) - can be by substitution of chemicals used or automation	**Selection of workers** by doing the pre-employment examination, interview, psychological testing and pre-placement medical examination
(Engineering control) – by isolating the process (noise zones), screening (welding zones) or by introducing wet spray method in a dusty environment (dusty environment)	**Induction** of employees on legislative requirement (OHSACT): good housekeeping policy and procedure, personal hygiene, signs and symptoms of excessive exposure to substances and educational programs
(Administrative control) – by demarcation, good housekeeping and training. Control access, safe working procedure and reduce number of exposed employees	**Control at source** by eliminating the problem by automation or substitution, or change process
(Personal protective equipment) - using masks, goggles or hearing protectors etc.	a. **Control along the path**: Partition or screening, and insulation b. **Control at worker**: limiting time of exposure, issuing personal protecting equipment c. Improve work environment

Figure 2. *Proposed hierarchy of control for environmental stressors.*

5.2. Who Should Be Involved in Health and Safety

Occupational health and safety is a team effort, it requires constant inter-action between employer, workers and Government.

5.2.1. Duties of the Employer

a. Provide and maintain a safe system of work
b. Identify hazards and evaluate risks
c. Take steps to eliminate or mitigate all hazards before resorting to PPE
d. Provide information, training and supervision
e. Provide means to apply safety measures
f. Don't permit employees to work unsafely
g. Enforce health and safety measures at work
h. Ensure that every person on the premises knows the Act
i. Ensure that supervisor have work-related safety training
j. Empower supervisors with authority.

5.2.2. Duties of Workers

a. Take reasonable care of their own health and safety
b. Cooperate with the worker to enable him/her to comply with the Act
c. Carry out any lawful order, and obey the health and safety rules
d. Report any unsafe situation to the employer or to the health and safety representative.

5.2.3. Functions of an Inspector

a. Enter any workplace without notice to conduct an inspection
b. Conduct incident investigations and interview workers

c. Conduct information session with employees, employers or Organized Labor
d. Attend and solve dispute or complains between employers and workers
e. Prohibit dangerous work or activities.

6. Conclusion and Recommendation

This study aimed to determine the current health and safety risk on construction sites of PSTU, focusing on risk assessment, risk communication and risk control. Study revealed that worker of PSTU construction site are highly vulnerable to falling from height, falling object, noise, inhalation of dust from cement, slips and trips, fire, chemicals substances, aggression, violence and bullying, welding fumes and gases, painting spray/mists. Workers are moderately safe from these health hazards and some types of specific hazard they are not safe at all. They also suffer from physical, psychological and biological stressor. Sometimes they suffer from different types of diseases such as diarrhea, cholera, dysentery, jaundice, skin disease, typhoid, pneumonia, cough and malaria. Study also discloses that PPE is the main item used for risk control but there is not enough PPE on this construction sites.

Based on factors influencing risk management, the study exposes that legal system plays a major role in risk assessment, communication and control. Regular inspections, penalties and compliance certificates issued by regulatory institutions influence risk management more. Furthermore, the organizational culture of safety is another factor influencing risk management. It is observed that construction area with a safety culture considered health and safety when employing the site manager, the safety coordinator and safety officer. Knowledge of health and safety is a criterion for employment. Meanwhile firms with a safety culture provide resources for site workers, such as PPE and training. Additionally, individual characteristics such as experience of those working on construction sites, their educational background and knowledge of health and safety matters also influence health and safety risk management.

An important contribution from this study is that one cannot rely and be dependent on risk management systems as applied in construction sites. There is a need for a systematic approach and a wider perspective that includes individual's judgment, while at the same time an holistic approach which consider all project phases such as design, procurement and construction. Some others issues that needed to be followed strictly at PSTU construction site; water release after use; clean the surrounding environment; establish sanitary toilet; use deep tub well water for both drinking and cooking purposes; ensure healthy cooking and eating environment; increase awareness about the sanitation among the workers; establish a permanent waste disposal site; make regulation about follow the working rule; follow the health and safety risk management conceptual framework; rising awareness about hazardous material and must ware personal protective equipment when work. So it can be conclude that, occupational health and safety is a team effort, it requires constant inter-action between employer, workers and government.

Appendix: Construction Area Related Important Photos

Construction site photo

Figure 3. *Bangabandhu hall construction site.*

Figure 4. *Under constructing view.*

Construction Material Photo

Figure 5. *Brick and sized wood.*

Figure 6. *Sand deposits for construction purpose.*

Figure 7. *Rod and surki.*

Water and Sanitation Facilities Photo

Toilet for the construction worker

Figure 8. *Unhygienic toilet facility.*

Figure 9. *Unhygienic condition of urinate.*

Pollution Related Photo

Air Pollution

Figure 10. *This brick breaking machine causes pollution.*

Figure 11. *Dry dust cause air pollution.*

Figure 12. *Uncovered sand deposit.*

Odor Pollution

Figure 13. *Odor pollution through unhygienic.*

Figure 14. *Cooking material and decomposed things through here and there.*

Personal Protective Equipment Related Photos

Figure 15. *Construction workers doing risky work without taking any personal protective equipment.*

Figure 16. *Working without safety net and helmet.*

Hazardous Materials Photo

Figure 17. *Hazardous Materials.*

Figure 18. *Hazardous material keep on the floor and worker is affected.*

No Specific Place for Storage of Construction tools

Figure 19. *Haphazardly keep the construction tools.*

Figure 20. *Wasted tools and rods.*

No Specific Legislation for Children

Figure 21. *Children freely roaming in the construction area.*

Hazardous electricity line

Figure 22. *Hazardous electricity line.*

Cooking Environment related photo:

Figure 23. *Unhygienic kitchen.*

Biological stressors related photo:

Figure 24. *Storage water which is the source of mosquito.*

References

[1] Phoya, S. (2012). Thesis for the degree of licentiate of engineering health and safety risk management in building construction sites in tanzania.

[2] Planning, C., & Division, D. (2014). Occupational health and safety specification for construction works contracts, (march).

[3] Kumie, A., Amera, T., Berhane, K., Samet, J., Hundal, N., Michael, F. G., & Gilliland, F. (2016). Occupational Health and Safety in Ethiopia: A review of Situational Analysis and Needs Assessment. Ethiopian Journal of Health Development, 30(1), 17-27.

[4] Biswas, G., Bhattacharya, A., & Bhattacharya, R. (2017). Occupational health status of construction workers: A review. International Journal of Medical Science and Public Health, 6(4), 669-675.

[5] Flanagan, M. E., Seixas, N., Becker, P., Takacs, B., & Camp, J. (2006). Silica exposure on construction sites: results of an exposure monitoring data compilation project. Journal of occupational and environmental hygiene, 3(3), 144-152.

[6] Project report on quartz in construction [Internet]. The Hague (Netherlands): Labor Inspectorate. 2008 [cited 2009 Feb 21]. Available from: http://docs.minszw.nl/pdf//38/2008/38_2008_6_18355.pdf. Dutch

[7] Robson, l. S., Clarke, J. A., Cullen, K., Bielecky, A., Severin, C., Bigelow, P. L., Mahood, Q. (2007). The effectiveness of occupational health and safety management system interventions : a systematic review, 45, 329–353.

[8] Waehrer, G. M., Dong, X. S., Miller, T., Haile, E., & Men, Y. (2007). Costs of occupational injuries in construction in the United States. Accident Analysis & Prevention, 39(6), 1258-1266.

[9] Murie, F. (2007). Building safety—An international perspective. International journal of occupational and environmental health, 13(1), 5-11.

[10] Facts on safety at work [Internet]. Geneva (Switzerland): International Labour Office. 2005 [cited 2005 Apr 18]. Available from: http://www.ilocarib.org.tt/portal/images/stories/contenido/pdf/Fact Sheets/Fact Sheet OSH.pdf.

[11] Holmes, N., Lingard, H., Yesilyurt, Z., & De Munk, F. (1999). An exploratory study of meanings of risk control for long term and acute effect occupational health and safety risks in small business construction firms. Journal of Safety Research, 30(4), 251-261.

[12] Ale, B. J., Bellamy, L. J., Baksteen, H., Damen, M., Goossens, L. H., Hale, A. R.,... & Whiston, J. Y. (2008). Accidents in the construction industry in the Netherlands: An analysis of accident reports using Storybuilder. Reliability Engineering & System Safety, 93(10), 1523-1533.

[13] Census of fatal occupational injuries [Internet]. Washington, DC: Bureau of Labor Statistics. 2007 [cited 2009 Feb 21]. Available from: http://www.bls.gov/news.release/cfoi.toc.htm.

[14] Bentley, T. A., Hide, S., Tappin, D., Moore, D., Legg, S., Ashby, L., & Parker, R. (2006). Investigating risk factors for slips, trips and falls in New Zealand residential construction using incident-centred and incident-independent methods. Ergonomics, 49(1), 62-77.

[15] Chi, C. F., Chang, T. C., & Ting, H. I. (2005). Accident patterns and prevention measures for fatal occupational falls in the construction industry. Applied ergonomics, 36(4), 391-400.

[16] Nelson, D. I., Nelson, R. Y., Concha-Barrientos, M., & Fingerhut, M. (2005). The global burden of occupational noise-induced hearing loss. American journal of industrial medicine, 48(6), 446-458.

[17] Weinstein, M. G., Hecker, S. F., Hess, J. A., & Kincl, L. (2007). A roadmap to diffuse ergonomic innovations in the construction industry: there is nothing so practical as a good theory. International journal of occupational and environmental health, 13(1), 46-55.

[18] Van Thienen, G., & Spee, T. (2008). Health Effects of construction materials and construction products. J App Occup Sci, 14(13), 2-23.

[19] Akhter, S., Salahuddin, A. F. M., Iqbal, M., Malek, A., & Jahan, N. (2010). Health and occupational safety for female workforce of garment industries in bangladesh, m(1), 65–70.

[20] Adisesh, A., Rawbone, R., Foxlow, J., & Harris-Roberts, J. (2007). Occupational health standards in the construction industry. HSL publication.

[21] Act, F., & Rule, F. (1979). Occupational safety and health in bangladesh, 1–67.

[22] Nahrgang, J. D., Morgeson, F. P., & Hofmann, D. A. (2011). Safety at work: a meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes.

[23] Akram, O. (2014). Occupational health and safety in urban and peri-urban bangladesh : an important cause and consequence of extreme poverty, (may).

[24] Adisesh, A., Rawbone, R., Foxlow, J., & Roberts, J. H. (2007). Occupational health standards in the construction industry.

[25] Health, W. (2011). Chapter 1 preliminary introductory matters, (xx), 1–145.

[26] Siu, O. L., Phillips, D. R., & Leung, T. W. (2004). Safety climate and safety performance among construction workers in Hong Kong: The role of psychological strains as mediators. Accident Analysis & Prevention, 36(3), 359-366.

[27] Series, S. A. (2007). Occupational health and safety management systems, 1–28.

[28] Environmental, C., & Assessment, P. (2006). Construction stage 2006.