

**HEALTH AND SAFETY MANAGEMENT PRACTICES
OF ROAD CONSTRUCTION PROJECTS IN
SRI LANKA**

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Degree of Master of Science

Department of Building Economics

University of Moratuwa

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Dissertation submitted in partial fulfillment of the requirements for the Degree of
Master of Science in Occupational Safety and Health Management

Department of Building Economics
University of Moratuwa

Sri Lanka

August 2016

DECLARATION

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Dissertation Supervisor

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ABSTRACT

Health and Safety Management Practices of Road Construction Projects in Sri Lanka

Road construction workers are exposed to hazards. This study attempts to identify, health and safety practices prevailing in road construction projects, issues and propose measures to mitigate. The study was confined to seven contract packages implemented under Northern Road Connectivity Project (Additional Financing) funded by Asian Development Bank (ADB). Five of them were located in the North Central Province while the other two were in Northern Province. Data was gathered through questionnaires, interviews and observations. Questionnaire comprised six major criteria, namely, training and supervision, safe work procedures, communication, reporting safety, management commitment and injury and return to work. Study revealed that workers are exposed to hazards of frequent and heavy lifting, noise and vibration, hazardous substances such as oil, gas, hydraulic fluid, welding fumes, heavy vehicle operation, working in blasting faces, clearing operations, slips, trips and falls, struck by, being struck by falling objects, hand-arm-whole body vibration, dust, sources of noise, electrical hazards etc. In asphalted areas workers are exposed to high temperatures and Polycyclic Aromatic Hydro Carbons (PAHC) which are carcinogenic. Working in excavated areas is prone to collapse of slopes. Workers are also prone to ergonomic issues caused due to manual handling and awkward postures. Main causes of accidents have been identified as fall from height, fall of objects, struck on stationary objects, struck by moving objects, struck on moving objects, caught in between, exposure to heat, exposure to electricity and exposure to harmful substances. Information gathered from 250 respondents revealed a high positive response in overall health and safety management practices. Five of the six criteria concerned showed a high positive response of greater than 78 percent. Communication recorded the lowest. Contract package wise comparison shows that P3 and P4 had a low positive response in the criteria concerned other than management commitment. Interviews conducted with Project Managers revealed a high commitment. Safety Committees were nonexistent in six of the seven packages except (P2). Observations revealed safety lapses such as working without PPE, working under unsafe conditions, non barricading hazardous zones, lack of warning sign boards and deploying non competent flagmen etc. It is recommended to conduct awareness programmes through Labour Department Officials prior to commencement of construction work, qualified Safety Officers should be employed, sites should be thoroughly inspected to eradicate hazards, work zones should be safe for workers, consultant's field staff should check adequacy of precautionary measures, importance of PPE should be emphasized, hazard areas should be properly barricaded, trained flagman should be deployed, records of toolbox meetings should be maintained, near misses should be recorded, Safety Policy should be accessible to all workers, officials from the Labour Department should visit the sites to check compliance.

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Abbreviations

ADB	Asian Development Bank
HIRA	Hazard Identification and Risk Assessment
ILO	International Labour Organization
OHS	Occupational Health and Safety
OHSAS	Occupational Health and Safety Assessment Series
OHSMS	Occupational Health and Safety Management System
OSH&W	Occupational Safety Health and Welfare
PAHC	Polycyclic Aromatic Hydro Carbons
PPE	Personal Protective Equipment
PWD	Public Works Department
RDA	Road Development Authority
SD&CC	State Development and Construction Cooperation
TCEO	Territorial Civil Engineering Organization
WHO	World Health Organization



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CHAPTER ONE

1. INTRODUCTION

1.1 Background

Roads are the main mode of the transportation system throughout the world. The history of road development in Sri Lanka dates back to the British Colonial period in 1818. The first of the roads to be constructed was the road connecting Kandy and Colombo which was followed by the road connecting Colombo and the Naval Base of Trincomalee (Skinner, 1891). In the recent past the road network of Sri Lanka was developed by several public authorities. Public Works Department (PWD) was the first authority involved in road construction while in 1969 Department of Highways was formed and entrusted to develop and maintain all classes of roads namely A, B, C, D and E. Later in 1983 the Road Development Authority (RDA) was formed under the Ministry of Highways by Road Development Authority Act No73 of 1981. With devolution of power to Provincial Councils in 1989, roads classified under C, D and E classes were vested to Provincial Councils while the development and maintenance of National Highways categorized as Class A and B roads were entrusted to RDA (RDA, 2014).

The current road density of Sri Lanka which is estimated as 1.6 km of roads per square kilometer is very high when compared to its regional peers (CILT Convention, 2013). Recorded information reveals that Sri Lanka has an extensive road network system extending to a total length of approximately 116,862km comprising 11,902km of national highways (Classes A and B), 16,532km of provincial roads (classes C and D), and 88,428km of roads maintained by Local Authorities, Estates and State agencies. The government policy on road development emphasises building a national highway system and an integrated road network, improvising the management of the existing road network, strengthening traffic management and implementation by regulatory agencies and promoting private sector participation in investment in new roads

The total length of National Highways maintained by Road Development Authority (RDA) by 2014 is approximately 11,694km. The current Government policy framework has given the priority for road development and subsequently National Road Master Plan has been developed to direct the policies focusing on the construction of expressways and highways, widening of highways, reduction of traffic congestion, road maintenance and rehabilitation and bridge rehabilitation and reconstruction. Information given in the Annual Report of the Ministry of Finance and Planning, 2012, reveals that investment on road development has increased from Rs. 49 billion in 2007 to Rs. 179 billion in 2012. It further states that Rs. 132 billion has been invested on national road development, Rs. 32 billion on provincial roads and Rs. 15 billion on rural roads. According to the 2013 annual report of the Ministry of Finance and Planning the total investment on road sector at both national and provincial level is recorded as Rs. 159 billion. The above statistics show an increasing trend in investment for road construction projects in the past.

The dawn of peace after cessation of the war, which lasted for nearly three decades in Sri Lanka, urged the need to implement rapid development programmes in the country. The Government's vision for the development emphasized the improvement of living standards of people in remote areas including the war torn areas in the Northern, Eastern and North Central provinces of Sri Lanka. Most of the towns and villages in the above areas were severely affected due to war and infrastructure development was one of the major challenges faced by the government. It has been identified that the dilapidated conditions, lack of drains, poor alignments, narrow road sections, structurally damaged culverts, bridges and causeways of the roads contribute to high vehicular operation cost, long travel time and high transport cost. Considering the above facts decisions have been taken to develop these roads with standard two/ four lane status to assist the existing and predicted traffic flow of the area in future. In addition the road network provides direct access to other areas of the country, for the people to engage in a number of social and economic activities. Further it will strengthen the National Highways Network efficiency in Sri Lanka, thereby establishing a smooth traffic flow, reduce cost and travel time incurred by users of the road network, increase the lifetime of

the roads by appropriate periodic maintenance and consequently contributing to economic development of the country (IEE, NRCP, RDA, 2012). These development initiatives provided a large number of employment opportunities for skilled and unskilled worker. Further it provided opportunities to expand the knowledge, experience and capacities of contractors both local and global. Among the major activities involved in road construction work includes clearing and grubbing, roadway excavations, sub grade compaction, trimming and leveling, embankment construction, sub base construction, shoulder construction, ABC laying, priming, asphaltting, culvert construction and bridge construction. All aforementioned construction activities expose workers to health and safety hazards of different magnitudes. During construction period general public especially those residing to the proximity of construction areas and the commuters also get affected to varying degree.

Workers involved in road construction are exposed to hazards from outside and inside the work zones. Falls, electrical, struck by and caught between are considered as common hazards. Apart from those exposure to dust, noise, hand, arm and whole body vibration and ergonomic issues can be considered as other major hazards.



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The construction work in Sri Lanka is labour intensive and highly depends on skilled and unskilled workers with varying educational backgrounds and thus has a high potential for injuries (Rameezdeen et al., 2003). RaufdeenRameezdeen (as cited in Somasundarswaran, Brammananda, Akeel and Rajakumar) in their study concerning Evaluation of Safety Level at Construction Sites in Sri Lanka, reveals that about 25% of the total labour accidents were from construction industry and fatal accident rates in construction industry were higher than other industries. The statistics of the Industrial Safety Division of the Department of Labour reveals that about 1,800 work related accidents are reported in Sri Lanka annually, while 80 of them are fatal. Palipana, in an interview has mentioned that the statistics do not reflect the true picture as reporting of occupational accidents is poor in Sri Lanka (Palipana, 2014, October 08).

Studies carried out in U. S. A. reveals that 962 fatal accidents have occurred in road construction sites during the period of 2003 to 2010 (Pegula, 2013). It further states that half of the deaths have occurred due to vehicles or mobile equipment striking the workers. Wickramatillaka (as cited in Madurawala) shows that 15% of total admissions due to injuries at the Colombo National Hospital in 2011 were work related and further states that it is estimated that only 1% of the estimated work related accidents are reported in Sri Lanka. There is hardly any recorded information or statistics concerning accidents related to road construction work in Sri Lanka.

Concerning Occupational Safety, Health and Welfare (OSH&W), legislation is enacted to prevent workers being harmed by the work they are expected to perform. The main objective of OSH legislation is to ensure, protection against any adverse effects arising out of any industrial activity or employment, to the lives, limbs and other faculties bestowed on persons by birth.

The currently applicable main legislations pertaining to Occupational Safety and Health in Sri Lanka can be listed as follows.



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The Factories Ordinance, No.45 of 1942 which came in to force on the 1 January 1950, Chapter XIV in the Penal Code captioned, “Of offences affecting the public health, safety, convenience, decency and morale”, Presidential Directive, PD/498 dated, 01.08.1995, captioned “Safety precautions to be taken in the construction of buildings”, Workmen’s Compensation Ordinance, Mines and Minerals Act, Explosives Act etc.. In addition to the above legislations, Sri Lanka Standards Institution has adapted OHSAS 18001 of 2007 as SLS OHSAS 18001 of 2007. Apart from the above Sri Lanka has ratified several International Conventions concerning worker safety viz. Tripartite Consultation (International Labour Standards) Convention, 1976 ratified on 17 March 1994, Labour Inspection Convention, 1947 No. 81 ratified on 03 April 1956, Workmen’s Compensation (Occupational diseases) Convention No.18, 1925, ratified on 17 May 1952.

1.2 Research Problem

The donor funded road construction projects in Sri Lanka emphasizes the safety management as mandatory requirements and to fulfill the above conditions client has included the construction site safety management requirements in bidding documents. Contractors are bound to prepare Safety Management Plans as per the guidance given and should fulfill all the requirements of the approved Safety Management Plan. Further legislative enactments and legal provisions are in force to protect workers from occupational health and safety hazards.

Even though contractual obligations and legal provisions are prevalent, it is apparent that several issues related to Health and Safety Management occurs in the road construction sites.

Hence, the question arises as to why safety issues are still prevalent in most of the construction sites, although the contractual and legal obligations concerning Health and Safety Management in road construction projects are in force.



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1.3 Aim and Objectives

The aim of the proposed study is to investigate the major health and safety issues prevalent in road construction projects that are being implemented in the country and to propose recommendations that would enhance the health and safety management standards in road construction sites.

The main objectives of the proposed study are to;

- Identify the health and safety issues prevailing in road construction projects
- Identify health and safety management practices of road construction projects in Northern and North Central Provinces of Sri Lanka.
- Identify reasons for prevailing issues in health and safety management in road construction projects in Northern and North Central Provinces of Sri Lanka.
- To propose recommendations to enhance safety management in road construction sites.

1.4 Methodology

Information concerning Health and Safety Management issues in road construction projects and relevant regulations in force was gathered through literature survey.

To inspect the status of safety management practices, information was gathered from the workforce and management staff of respective contractors, through field surveys.

To gather data interviews, questionnaires and site observations were used. Both descriptive and analytical survey methods were adopted.

1.5 Scope

The study considered the road construction projects which are currently being implemented in the country. The study was confined to seven road construction projects implemented under the Northern Road Connectivity Project (Additional Financing), that were based in Northern and North Central Provinces of Sri Lanka. Please refer Chapter three, section 3.4 for detailed information.

1.6 Chapter Breakdown

Chapter 01 – Chapter one describes the background of the research and comprises the aim and objectives, research methodology and the scope of the research

Chapter 02 – Chapter two comprises the literature survey concerning the research topic. Previously published research papers, journal articles, books, reports and electronic media etc. concerning health and safety management in road construction were used to collect relevant information for this chapter.

Chapter 03 – Chapter three consists the research methodology and analytical methods that was used for the research study.

Chapter 04 – Chapter four presents the analysis of the gathered data and discuss the results and findings of the research study.

Chapter 05 – Chapter five consists the conclusions and recommendations based on the results of analyzed data.

1.7 – Summary

The current chapter describes the general background, research problem, aim and objectives, methodology and the scope of the research study. Road construction is one of the major construction activities currently being implemented in the country where a large number of workers both skilled and unskilled are employed. Road construction includes a range of activities that expose workers to health and safety hazards of different magnitudes. Although legislative enactments and contractual obligations are in force in road construction projects it is apparent that health and safety issues are prevalent in construction sites. The study would lead in to identify the issues in health and safety management in road construction projects and the resultant recommendations would help the implementing organizations to enhance their safety performance and also would help the workers to perform their duties in a secure and safe environment.



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CHAPTER TWO

2. LITERATURE REVIEW

2.1 Introduction

Occupational Health and Safety (OHS) in construction sites is mainly about protecting people from injury at work or from becoming ill through appropriate precaution measures. The current chapter contains material and detailed information gathered from published research papers, paper articles and electronic media. Gathered information are arranged under subheadings on Occupational Health and Safety, Occupational Health and Safety Management System, road construction sector in Sri Lanka, Occupational Health and Safety issues in road construction, Importance of occupational health and safety management in road construction and legislations pertaining to Occupational Health and Safety in Sri Lanka.

2.2 Occupational Health and Safety

As per the definition mentioned in the constitution of World Health Organization (WHO), occupational health deals with all aspects of health and safety in the work place and has a strong focus on primary prevention of hazards. Health is defined as a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity (<http://www.who.int/governance/eb/whoconstitutionen.pdf>). The convention concerning Occupation Safety, Health and Working Environment, (No. 155 of 1981) of the International Labour Organization (ILO), defines the term health in relation to work, indicates not merely the absence of disease or infirmity; it also includes the physical and mental elements affecting health which are directly related to safety and hygiene at work. The definition adopted by the Joint ILO/WHO Committee on Occupational Health (1950), as cited in Report III (Part1B) of 98th Session (2009) of International Labour Conference, states that occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection

of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities and; to summarize: the adaptation of work to man and of each man to his job. It further states that the main focus in occupational health is on three different objectives: (i) the maintenance and promotion of workers' health and working capacity; (ii) the improvement of working environment and work to become conducive to safety and health and (iii) development of work organizations and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and smooth operation and may enhance productivity of the undertakings. The concept of working culture is intended in this context to mean a reflection of the essential value systems adopted by the undertaking concerned. Such a culture is reflected in practice in the managerial systems, personnel policy, principles for participation, training policies and quality management of the undertaking.

Dias (2009) reveals that the construction industry as one of the biggest industrial employers in many countries of the world and estimates the number of construction workers in the world at more than 110 million (between 5 to 10% of the world's workforce), and further says that in many countries double that number depend, directly or indirectly, on the construction sector.

The ILO Handbook states that the construction industry has changed in recent decades and many of those involved in the construction process recognize the positive influence on productivity of good occupational safety and health where they recognize that prevention measures are an investment rather than a cost. Further studies in European Union countries and elsewhere have shown that the cost of occupational accidents is about double the cost of measures that would prevent them (European Commission, 2003) These prevention measures consist of action during the design, the planning and the execution of the construction project.

Construction professionals know the hazards and the corresponding preventive measures; and in many cases those measures are being taken in most countries.

Meanwhile, accidents continue to happen, although in some regions and countries there have been significantly fewer accidents (especially fatal accidents) in the last few decades.

Occupational Health and Safety Management Systems adopted and implemented according to the OHSAS18001:2007 would help the organizations to improve the standard of health and safety within the organization leading in to reduction in ill health situations, reduce insurance costs, reduce absenteeism, lower liabilities and increase the morale of workers.

Safety is defined as control of accidental loss where control includes both prevention of accidents and minimization of losses when accidents occur. Some of the basic aspects of health and safety management include identification of hazards, risks, risk assessment and implementation of control measures.

According to the OHSAS 18001:2007 hazard is defined as a source, situation, or act with a potential for harm in terms of human injury or ill health or a combination of these where ill health refers to identifiable adverse physical or mental condition arising from and/or made worse by a work, activity and/or work related situation. Incident refers to a work related event in which an injury or ill health (regardless of severity) or fatality occurred or could have occurred. Risk is a combination of likelihood of occurrence of a hazardous event, exposure and the severity of injury or ill health that can be caused by the event or exposures.

Hazards include slips, falls, lifting and handling hazards, operation hazards, dismantling, maintenance repairs, commissioning, fire, explosion, vehicle, violence, inhalation, eye damage, skin contact electric shocks etc. Resulting injuries could be minor, major or severe.

Hazard identification considers the different types of hazards in the work place namely, physical, chemical, biological, psychosocial, ergonomic and physiological. Risk assessment is the process of evaluating risks arising from hazards taking in to

account the adequacy of any existing controls and deciding whether or not the risk is acceptable. Hazard Identification and Risk Assessment (HIRA) process reveal the requirement of implementing control measures.

Control measures are categorized in to four major constituents namely elimination, substitution, engineering/ administrative control and Personal Protective Equipment (PPE). In elimination the design should be modified to eliminate the hazard. In substitution a less hazardous materials are used or system energy is reduced, in engineering control ventilation systems, machine guarding, interlocks, sound enclosures etc. are used. In administration control, safety signs, hazardous area marking, photo luminescent signs, markings for pedestrian walkways, warning sirens, lights, alarms, safety procedures, equipment inspections, access controls, tagging and work permits etc. are used. The last of the hierarchy of control measures is the Personnel Protective Equipment (PPE). These include safety glasses, hearing protection, face shields, safety harness and lanyards, glouses, helmets etc.

2.3 Occupational Health and Safety Management System



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Occupational Health and Safety Management System is a major requirement of OSHAS 18001 standards. It helps organizations to manage their safety standards and wellbeing of their employees and reduce accidents. Cost of accidents is more expensive than realized. Accident costs include both direct and indirect costs. Direct costs involve workmen compensation claims, medical costs, indemnity payments etc. while indirect costs include training, property damage, accident investigation, increased insurance, work delays, administration costs, low morale, reduced productivity, lost time by supervisors, cost of training replacement workers, overtime payments, legal fees, negative publicity, damage to customer relations etc.

Occupational Health and Safety Management System (OHSMS) is a comprehensive and integrated system that ensures all work at the facility is conducted safely. It should be fully documented and accessible and comprehensible to those that need to use it. It recognizes the potential for errors and establishes effective control

measures which are fully implemented to ensure that errors do not result in accident or near misses. It comprises a set of work practices and procedures for monitoring and improving the safety and health of all aspects of operation.

Effective Health and Safety Management System consists of five major elements, namely, Management, leadership and employee involvement, worksite analysis, hazard prevention, hazard control, safety and health training.

Management, leadership and employee participation requires management to develop OHSMS. Policy is aimed at continually improving by reducing risks, ensured employee participation, confirms with organizational requirements, comply with laws and relations. Management commitment provides motivation and resources while employee involvement allows workers to develop and express commitment to safety and health.

Elements of successful Occupational Health and Safety management can be depicted as follows



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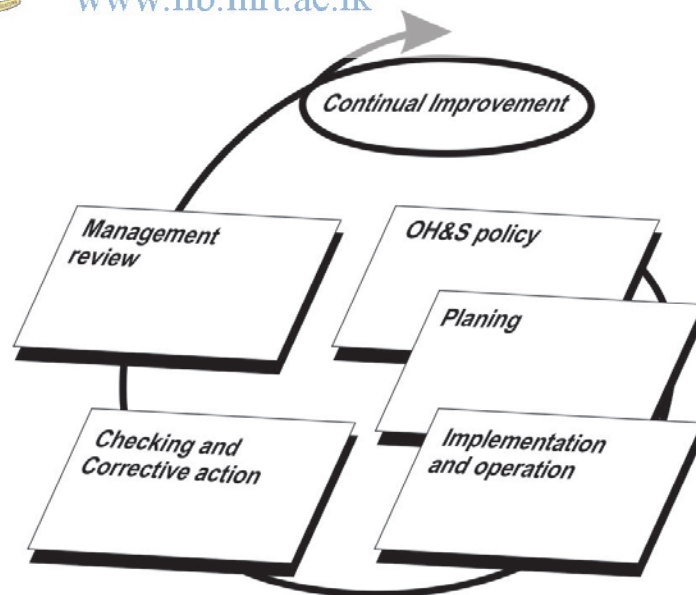


Fig. 2.1: Elements of successful Occupational Health and Safety Management

(Source: OHSAS 18001, 1999)

2.4 Overview of Road Construction in Sri Lanka

Roads are the main mode of the transportation system throughout the world. The history of road development in Sri Lanka dates back to 1818, where the British Governor, decided that Kandyan kingdom should be controlled through a network of roads which would connect the principal towns both with each other and with the Maritime Provinces over which the British had stronger control. In the 1950s the main road network of the country was developed and maintained by the Public Works Department. In the mid-1960s the Public Works Department was responsible only for the Development and Maintenance of the Public Roads and Buildings. In 1969 a major policy change was made and a new Department of Highways was formed solely for the Development and Maintenance of the A, B, C, D and E class roads maintained by the then Department of Public Works, and the total length of these roads was approximately 28,000 km.

Later in 1971, Territorial Civil Engineering Organization (TCEO) was formed to take over the major functions of the Highways Department. Until 1970 design and construction of all major bridges in the country were done by the Public Works Department (PWD) and Highways Department. Along with the formation of the TCEO another organization known as State Development and Construction Corporation (SD & CC) was formed to undertake the construction of bridges and other civil engineering works. Subsequently a major re-organization of the Highways Sector was effected in 1978, when the TCEO was abolished and functions of the TCEO transferred back to the Highways Department. In 1983 the Road Development Authority (RDA) was formed under the Ministry of Highways incorporated by the RDA Act No 73 of 1981. The functions of the RDA were expanded in 1986, when it became the successor to the then Department of Highways. In 1986, the RDA was entrusted with the responsibility of developing and maintaining all classified roads in the country (A, B, C, D and E class roads) totaling upto approximately 28,000 kms of roads and the bridges thereon. In 1989 with the devolution of power under the 13th amendment to the constitution, the C, D and E class roads totalling approximately 17,000 kms and the bridges thereon were handed over to the Provincial Councils.

Since then the RDA is entrusted with the development and maintenance of the National Highway Network comprising the Trunk (A class) and Main (B class) roads. The National Highway Network consists of 11, 694 km of roads and 4,048 bridges (span of more than 3m) as at end 2005 including the roads taken over as National Highways during the past few years.

Sri Lanka's road network is dense and well laden providing connectivity to the country's population and centers of economic activity. The network density is highest in Asia, as the number of road kilometers per population (1000 people) exceeds the related indicators of both Pakistan and densely populated Bangladesh. Despite the extensive and dense network of roads, mobility has become a major constraint in Sri Lanka. (Road density: Sri Lanka – 5.19, Bangladesh – 2.0, Pakistan – 1.69)

Current network comprises about 11,700 km of national highways, categorized as Class A and B roads. Provincial roads belonging to classes C, D and E consist of 15,000km while about 65,000km of roads are under the purview of local authorities and 24,000 km of roads are controlled by Irrigation, Wildlife and other authorities.(National Road Master Plan, 2007).

It has been identified that more than 50% of the entire road network including national and provincial networks are in poor dilapidated conditions requiring either rehabilitation or upgrading.

In the past two decades the policy of the Government of Sri Lanka was to rehabilitate the existing road infrastructure. There was a rapid increase in traffic volume during the past decade which created a shortage to meet the demand. The studies carried out on this regard has revealed that rehabilitation and widening of existing roads to cope up with future traffic at a meaningful level of service is a difficult task without large scale acquisition and demolition of buildings and relocating service utilities.

To improve the road network and to fulfill the requirements Road Development Authority has proposed Highway / Expressway systems. The Expressways and Highways proposed involve six major projects namely, Colombo – Katunayake Expressway, Southern Expressway, Outer Circular Highway, Colombo – Kandy Expressway, Colombo – Jaffna Expressway, Extension of Southern Expressway. Two of the above projects, namely, Southern Expressway and Colombo – Katunayake Expressway have been completed while a part of the Outer Circular Highway has been completed. Other projects are scheduled to be commenced soon in the near future.

Construction of highways and rehabilitation and upgrading of existing roads involve a range of activities and some of the major civil work construction activities include; site clearing and excavation, road formation improvement, embankment construction, sub base construction, dense graded aggregate with surfacing of asphalt concreting overlay, concreting, road markings, traffic signs placing, bridge construction, culvert construction, relocation of utilities etc.



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There is a heavy demand for construction materials such as aggregate and soil for road construction and all these requirements are provided through metal quarries and borrow pits usually located away from the construction sites. Some of the quarries and borrow pits are owned by contractors involved in road construction while the rest is provided through privately owned sites.

Currently road construction work in Sri Lanka is handled by both foreign and Sri Lankan Contractors. Some of the local leading contractors involved in road construction can be listed as follows; International Construction Consortium (ICC), MAGA Engineering, MTD Walkers, RN Constructions (Pvt) Ltd, Sathuta Builders (Pvt) Ltd., State Development and Construction Corporation (SD&CC),. Access Engineering Ltd, CML-MTD Construction Ltd, Daya Constructions (Pvt) Ltd, Hovael Construction (Pvt) Ltd, KDA Weerasinghe & Company (Pvt) Ltd, KD Ebert & Sons Holdings (Pvt) Ltd, Nawaloka Construction Company (Pvt), NEM Constructions Private Ltd, PND Constructions (Pvt) Ltd, Sierra Construction (Pvt)

Ltd, Tudawe Brothers (Pvt.) Ltd, V V. Karunarathe and Company, RR Construction, Edward and Christie (Pvt.) Ltd, Consulting Engineers and Contractors (Pvt) Ltd etc.(ICTAD,2015).

2.5 Health and Safety Issues Related to Road Construction

All previously mentioned road construction activities exert potential health hazards. Findings of the studies carried out in work associated with quarry and borrow pit operations, asphaltting, excavations, ergonomics and fatal accidents related to road construction work can be described as follows.

2.5.1 Occupational health and safety issues associated with quarries and borrow pit operation

Operation of borrow pits and quarries expose workers to great risks. Borrow pit is an area where material usually soil, gravel, sand or weathered rock has been dug for use as a natural granular material for use in road construction. Types of material normally obtained from a borrow pit are natural soil or gravel for production of gravel wearing course. Quarry is an open excavation from where rock is obtained usually by blasting to produce rock aggregate for the use in road construction. Road construction material obtained from quarries include; graded crushed stone for bases (G1 – G4), crushed stone for sub base production (G5) where natural gravel are not available, graded crushed stone for the production of surface surfacing stone, graded crushed aggregates for the production of asphalt, graded crushed concrete aggregates (course and fine), blasted rock for dump rock, rip rap, gabions and pitching (South African National Roads Agency, 2013)

Occupational Health and Safety inspections conducted on various quarry and borrow pit operations in Newfoundland, has identified number of deficiencies or unacceptable practices that are being carried out. These deficiencies have the potential to cause immediate and long term health issues if precautionary measures are not implemented in time. The deficiencies identified include, heights of faces and benches are too high for equipment being used, lack of dust suppression systems for drills, crushers, conveyors, roads etc., lack of medical surveillance for workers,

improper removal and storage of over burden from the quarry edge, lack of proper/adequate crusher conveyor equipment guarding, lack of hearing conservation programme implementation and lack of appropriate HEPA filtration systems positive pressurization in operation cabs (<http://www.gs.gov.nl.ca/ohs>).

Quarrying has been identified as one of the most dangerous industries to work and it has been noted that quarry workers are twice as likely to be killed in an accident at work as construction workers and 13 times more likely to die at work as those in manufacturing industries (<http://oshaeuropa.eu>). The use of long earth moving machinery and vehicles, handling of explosives and heavy loads, ever present airborne dust and working in dangerous sites are the main causal factors that increase the risk of accidents and occupational diseases. Most of the fatalities in quarrying sector are associated with maintenance work, the use of vehicles and fixed machinery and falls from height.

Further Quarry workers are exposed to many hazards including frequent and heavy lifting, noise and vibration and hazardous substances such as oil, gas, hydraulic fluid, and welding fumes etc. In addition most of them work in awkward positions and often use high pressure hoses and vessels or work on machines that are still running. The most common risks and hazards identified in quarries include working on faces and clearing up operations, risks associated with vehicle operations, machinery related accidents, slips, trips and falls, struck by, being struck by falling objects, exposure to hand – arm vibration, whole body vibration, risk associated with manual handling, dust, sources of noise including stone crushers, conveyor belts, explosions, engine noise from heavy vehicles and exposure to extreme weather conditions.

Workers engaged in maintenance of faces and roadways in quarries are exposed to hazards such as falling trees and other material sliding from the tailings area on to people and machines, noise from machinery and equipment, dust from activities such as drilling, blasting and crushing, and from vehicle operation, falling objects such as rocks, slips, trips and fall from height, collision of maintenance vehicles, maintenance vehicles falling over unstable and unsafe edges, uneven terrain causing

unpredictable movement of vehicles and reversing vehicles. Workers maintaining and repairing rock drills are at risk of slips, trips and falls from the rock drill when entering the machine, being injured by drill rod or entangled in its mechanism, effects of the noise and dust created by the drill. Workers engaged in maintaining and repairing excavators, wheel loaders and caterpillars are exposed to falls from the vehicle, being trapped or crushed as a result of unsafe lifting devices and practices, inadvertent rolling and moving of vehicles. Hazards associated with the maintenance of stone crushers and other processing plants include ergonomic issues such as working in awkward positions, electrical hazards caused by improper insulation of electrical components, dust and noise. Conveyor belts pose a great hazard to workers involved in maintenance work as maintenance is often carried out while the belts are still running. The risks involved in the maintenance repair work of conveyor belts include being injured by running conveyor belts or when the belt starts up unexpectedly, falling from elevated belts, dust and noise. Maintenance and repair work of screening equipment involves high levels of exposure to noise and dust (<http://osha.europa.eu>).



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2.5.2 Occupational health and safety issues associated with asphaltting

Workers engaged in asphalt paving are also exposed to health hazards. Asphalt is a cement like semi solid or solid produced by distillation of crude oil during petroleum refining. In the US it is estimated that around 300,000 workers are employed in hot mix asphalt facilities and paving sites. It has been found that asphalt fumes generated at high temperatures are more likely to generate carcinogenic polycyclic aromatic hydrocarbons (PAHC) than fumes generated at lower temperatures. Studies of asphalt fume exposures in workers have repeatedly reported irritant symptoms of the serous membranes of the conjunctivae (eye irritants) and the mucus membranes of the upper respiratory tract (nasal and throat irritation). Studies also have indicated that some workers involved in asphalt paving operations experienced lower respiratory tract symptoms (coughing, wheezing, and shortness of breath) and pulmonary function changes. Further bronchitis which is possibly related to lower respiratory tract irritation has also been reported among asphalt workers and highway maintenance workers (Hazard review, 2000)

2.5.3 Risks involved in excavation work

Road construction work also includes high risk work such as deep excavations especially in bridge and culvert construction sites. The workplace solutions published by the Centre for Disease Control and Prevention of National Institute of Occupational Safety and Health states that workers who dig or excavate trenches are at risk of death if they enter an unprotected trench and the walls collapse. Deatherage, Furches, Radcliffe, Schriver and Wagner, 2004 as cited in the workplace solutions states that a single cubic yard of dirt weigh more than 3,000 pounds which can fatally crush or suffocate workers and even small solid pieces of dirt can cause serious injuries. According to Deatherage et al. (2004), OSHA requires that all excavations 5 feet deep or greater should make use of protection options such as sloping the ground, benching the ground, shoring the trench with supports such as planking and hydraulic jacks, or shielding the trench using trench boxes. The report further states that the stability of soil and the hazards that workers face depends on factors such as type of soil, water content of soil, environmental conditions, proximity to backfilled excavations, weight of heavy equipment or tools and vibration from machines and motor vehicles.



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2.5.4 Occupational ergonomic issues in road construction

Ergonomics is another important area in road construction sector that needs special attention. Choi, Hudson, Kangas, Jungen, Maple and Bowen, 2007, in their study on occupational ergonomic issues in highway construction has identified that construction workers are at significant risk of musculoskeletal injury, specially related to the work they perform. It has been identified that many of the injuries that occur in the construction industry are caused due to manual material handling and awkward postures. In construction work the job frequently changes where the job can range from above the shoulder work to below the knee work and a variety in between. The surface that workers work also changes frequently throughout the day contributing again for ergonomic issues. The study of Choi et.al (2007) further reveal that majority of the injuries were sprain/strain, followed by back injuries, cuts, contusions, eye injury, fractures and burns respectively. Further the study has

revealed that most prevalent sources of injury as, over exertion, followed by motion/position and slip/trip respectively. Other recorded sources include, tool/machinery, sharp edges, struck by and chemicals. The study has also revealed that most of the contractors did not have site specific ergonomic programmes.

2.5.5 Fatal accidents in road construction sites

Ahamed, Nafeel, Rishath and Dissanayake in their study on site safety of Sri Lankan building construction, states that occurrence of accidents is common in the construction industry and safety is considered as a critical issue compared to other industries. Accidents lead to tragedies such as injury or death to persons, damage to property and the environment. Accidents also cause direct and indirect costs that would have an impact on economy due to delays in construction processes. It has been found that delays and total expenses following an accident are usually much higher than the original cost of establishing and maintaining safety standards.

Main causes of accidents in construction field have been identified as, fall from height, fall of objects, struck on stationary objects, struck by moving objects, struck on moving objects, caught in between, exposure to heat, exposure to electricity, exposure to harmful substances.

A study carried out by the Portuguese Road Institute has identified road construction as a potentially hazardous occupation involving different phases and parties. An analysis of accident records had shown that the main hazards included falls and being hit by objects with most accidents occurring in the morning and mainly on viaducts and bridges. It has also revealed that a system was needed to ensure effective health and safety coordination of contractors during road construction work. It further states that it is essential to establish a system to provide common safety framework for all parties involved in construction projects and emphasizes to systematically establish the health and safety obligations and responsibilities of each party, contractors to establish health and safety systems in place complying with the government authorities, to incorporate an effective monitoring system, promote safety culture

within the organization and with contractors and to be integrated with other management activities such as quality assurance and cost effectiveness. (IEP, The Portuguese Road Institute, 2010).

The studies of ILO estimates the number of fatal occupational accidents in the construction industry at about 60 000 every year with about 64% in the Asia and Pacific region, 17% in the Americas, 10% in Africa and 9% in Europe (ILO,2015).

A study carried out by the National Institute for Occupational Safety and Health has revealed that highway and street construction workers are at risk of fatal and serious nonfatal injuries when working in the vicinity of passing motorists, construction vehicles and equipment. The report states that each year more than 100 workers are killed and over 20,000 are injured in highway and street construction industry (Pratt, Fosbroke, and Marsh, 2001)

In most instances road construction workers perform their work very close to moving equipment. According to Pratt et.al. (2001), the majority of fatalities occurring in highway construction work zones involve a worker being struck by a piece of construction equipment or another type of vehicle. It further states that a worker in this industry is likely to be struck by a piece of construction equipment inside the work zone as by passing traffic. Authors further reveal that half of the fatalities involving construction equipment occur while the equipment is reversing. It further states that the blind areas associated with construction equipment contribute to making the road construction a dangerous occupation.

A study carried out by Pegula(2010) on fatal occupational injuries at road construction sites, reveals that during the period of 2003 to 2007 there were 639 fatal occupational injuries that had been occurred at road construction sites. Of the above 97 present were males. Worker struck by vehicle, mobile equipment has been identified as the most common event associated with fatal occupational injuries in road construction sites. The report further states that of the 639 total fatal occupational injuries at road construction sites during the said period, 305 had been due to worker being struck by a vehicle or mobile equipment. Of the total fatalities

100 fatally injured workers (33%) were employed as construction labourers. 37 (12%) were employed as highway maintenance workers. First line construction supervisors and managers accounted for 27 fatalities (9%) while crossing guards including flaggers accounted for 27 fatalities (9%). The study further revealed that 10 percent of the fatalities resulted from a worker being struck by dump truck that was backing up. 25 cases involved a worker being struck by a vehicle that did not have a back – up alarm. Drunk drivers also have caused the death of 10 workers during the above period.

2.6 Safety Behaviors and Practices

Vijayakumar (2007) has defined behavior as everything a person does that is observable and measurable. Safety behavior according to Mahmood, Mohd Isa, Mustafa, Abdul Aziz and Salleh, 2010 is described as the behavior that support safety practices and activities such as providing safety training and safety compliance and explains the core activities that need to be carried out by employees according to Occupational Safety and Health requirements to prevent workplace accidents. Johnson (2003) states that safety behaviour as the key to reducing the injuries at the work place and indirectly influence outcomes of the event before the injuries or accidents occur. A model developed by Fredrick (1982) referred to as ABC model as cited by Abang Abdullah et al., (2005) in Zin and Ismail (2012) in their study on “Employers’ behavioural safety compliance factors towards occupational safety and health improvement in the construction industry” explains that behavior is influenced by two noticeable factors namely activators and consequences. Enforcement on safety behavior factors plays a crucial role to encourage safety compliance before the consequences occur. It further states that many literatures on occupational safety agree that the noncompliance of the safety requirements as the main contributory factor in incidents and accident occurrence in majority of the industries. Jaselsky et.al (1996) as cited by Zin and Ismail (2012), has reported that commitment of the top management is crucial in achieving the organizational safety goals. Further the studies have revealed that most of the construction accidents occur as a result of noncompliance to safety requirements. Zohar (2002) cited in Zin and Ismail (2012),

has found that improved communication channels have resulted in decreased micro accidents and increase in using Personal Protective Equipment (PPE). Titas (2013) has identified two main reasons for unsafe behavior at work namely, lack of information about safety (“I do not know”) and poor attitude towards safety (“I do not care”). It is assumed that the number of accidents could be reduced if the employees were more informed or trained to behave safely. The study reveals that the reasons for major accidents on construction sites in European countries occur due to poor organization of work, lack of supervision and control, as well as the employee’s inability to assess operational risks. Further it states that a large number of work related failure to follow the occupational, health and safety requirements. Other important reason identified as the directly related to accidents in construction sector include lack of knowledge and training and insufficient understanding of the employee how to carry the assigned task in a safe manner.

2.7 Legislations Pertaining to OSH in Road Construction

Concerning Occupational Safety, Health and Welfare (OSH&W), legislation is enacted to prevent workers being harmed by the work they are expected to perform. The main objective of OSH legislation is to ensure, protection against any adverse effects arising out of any industrial activity or employment, to the lives, limbs and other faculties bestowed on persons by birth. To face the challenges of OSH&W due to rapid changes of technological progress it is expected to apply management interventions as given in the ILO – OSH 2001, (Guidelines on occupational safety and health management systems), British Standard, BS18004 of 2008 (Guide to achieve effective health and safety performance), Occupational Health and Safety Assessment Series – OHSAS 18001 of 2007 and OHSAS 18002 of 2008. The Sri Lanka Standards Institution has adapted OHSAS 18001 of 2007 as SLS OHSAS 18001 of 2007. The currently applicable main legislations pertaining to Occupational Safety and Health in Sri Lanka can be listed as follows.

- The Factories Ordinance, No.45 of 1942 which came in to force on the 1 January 1950.

- Chapter XIV in the Penal Code captioned, “Of offences affecting the public health, safety, convenience, decency and morale”
- Presidential Directive, PD/498 dated, 01.08.1995, captioned “Safety precautions to be taken in the construction of buildings”.
- Workmen’s Compensation Ordinance.
- Mines and Minerals Act (No.33 of 1992)
- Explosives Act (No.33 of 1969)

In addition to the above Sri Lanka has ratified several International Conventions concerning Health and Safety of workers, namely, C144 Tripartite Consultation (International Labour Standards) Convention, 1976 ratified on 17 March 1994, Labour Inspection Convention, 1947 No. 81 ratified on 03 April 1956, Workmen’s Compensation (Occupational diseases) Convention No.18, 1925, ratified on 17 May 1952.

2.8 Summary

This chapter comprises the information gathered from published books, journals, reports and electronic media concerning occupational health and safety issues of road construction on both Sri Lankan and global context. Description of Occupational Health and Safety, concept of Occupational Health and Safety Management System and how it could be used to manage health and safety in organizations is explained in the chapter. An overview of road construction in Sri Lanka is included and the occupational health and safety issues relevant to road construction work, , safety behaviour and practices and legislations pertaining to Occupational Safety and Health in Sri Lanka is included in the current chapter.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

Previous chapters dealt with the health and safety issues of workers involved in road construction activities. It is imperative to develop an appropriate method to collect and analyze data to achieve the aims and objectives identified in chapter 1. Hence this chapter describes the research process of the study comprising research process, data collection and data analysis.

3.2 Research process

Research process is a very important aspect of research studies and it comprises six major steps, namely, identification of the research problem, identification of the aim and objectives, literature survey, data collection, analysis of data and conclusions and recommendations. The research process can be depicted as follows.



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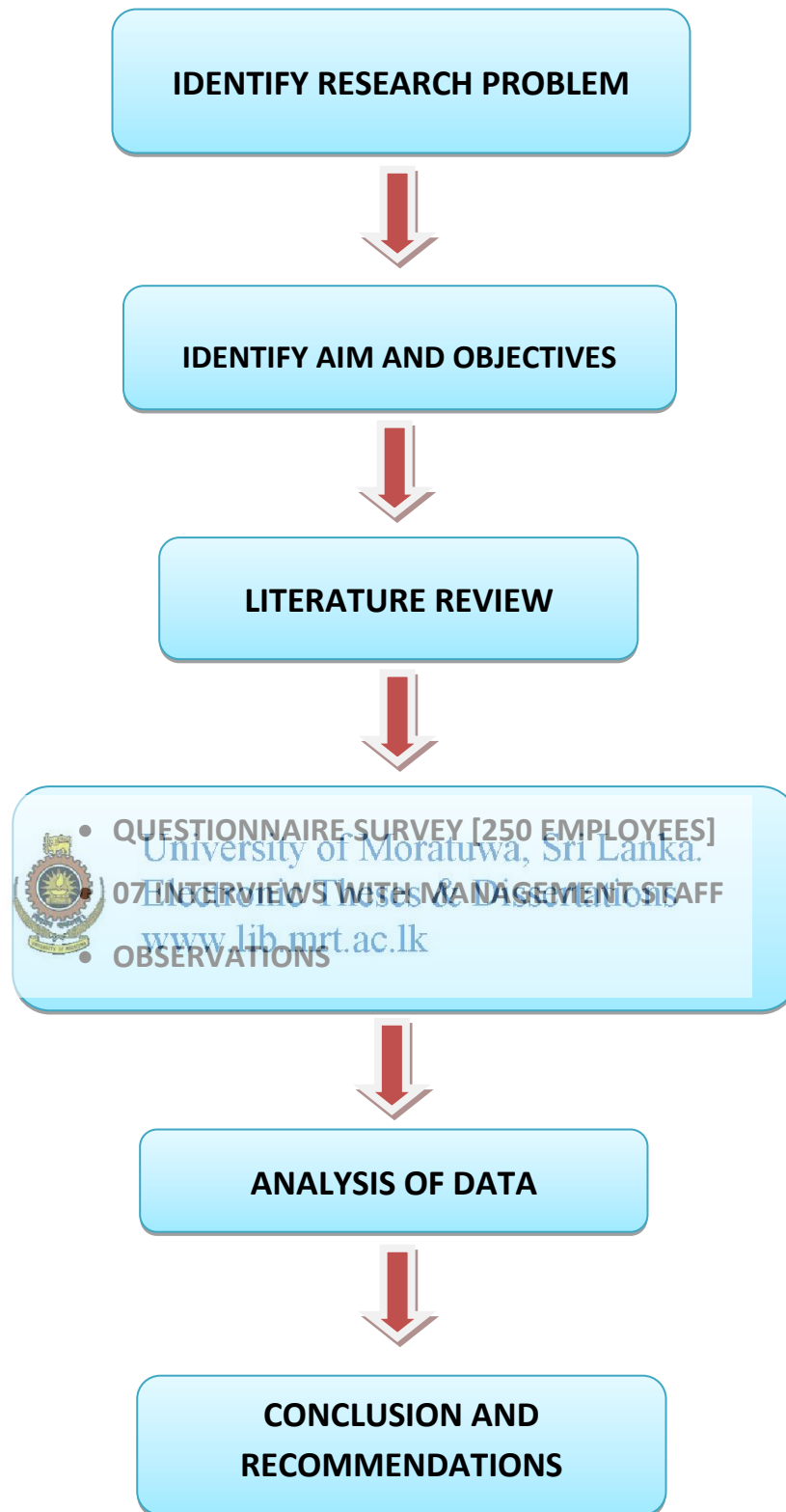


Fig. 3.1 Research process

3.3 Literature Survey

The review of literature is considered as the power source of the conceptual framework in conducting both quantitative qualitative researches (Taylor, 1992). In line with that a comprehensive literature survey was conducted to gather information concerning Occupational Health and Safety issues and management concerning road construction activities. Published books, journals, reports and electronic media were used to collect available information concerning the current status of road construction in Sri Lanka and the health and safety issues associated with the road construction in a global context.

3.4 Data collection

Three modes of data collection were used in the current study, namely, questionnaire survey, interviews, and field observations.

3.4.1 Questionnaire Survey

The questionnaire encompassed six major areas of Health and Safety Management, namely, Training and Supervision, Safe Work Procedures, Communication, Reporting Safety, Management Commitment and Injury and Return to Work. A total of twenty eight questions were included in the questionnaire. Copies of the questionnaire is annexed in Appendix A and Appendix B. Measures were taken to select representative samples from each contract package comprising more than 80 % of the workforce, where a total of 250 respondents were considered for the current study. Themes for the questionnaire were selected from information gathered through Work Cover, New South Wales.

Details of the seven contract packages (P1 – P7) are depicted below.

Table 3.1 Contract Packages considered for the study

Contract Package	Road Section	Chainage
P1	B283: Medawachchiya - Kebithigollewa	12+600km – 25+400km
P2	B211: Kebithigollewa - Padawiya	0+000 km – 15+500km
P3	AB19: Jaffna - Kytes	0+000 km – 10+000km
P4	AB19: Jaffna - Kytes	10+000 km – 20+275km
P5	A029: Vavuniya - Horowpotana	16+000 km – 22+000 km
P6	A029: Vavuniya - Horowpotana	04+900 km – 16+000 km
P7	B211: Kebithigollewa - Padawiya	15+000 km – 31+345 km

Status of the contract packages selected for the study are given in Table 3.2

Table 3.2 Status of the Contract Packages

Contract Package	Grade	Contract sum (SR)	Total work force	No. of Managers on Site	Status of Safety Officer	No. of reportable accidents	Project Completion Status
P1	CS2	721,601,220	60	02	Ex Serviceman with foreign exposure	Nil	75%
P2	CS2	885,271,800	65	02	Serves as Environmental and safety Officer, no prior experience on Safety Management	Nil	75%
P3	CS2	1,655,170,392	45	01	Supervisor assigned as Safety Officer no prior experience on Safety Management	Nil	80%

Contract Package	Grade	Contract sum (SLR)	Total work force	No. of Managers on Site	Status of Safety Officer	No. of reportable accidents	Project Completion Status
P4	CS2	1,210,086,576	40	01	Supervisor assigned as Safety Officer no prior experience on Safety Management	Nil	80%
P5	CS2	348,286,038	63	02	Serves as Environmental and safety Officer having two years experience in Safety Management	Nil	75%
P6	CS2	374,719,964	110	02	Supervisor assigned as Safety Officer no prior experience on Safety Management	Nil	50%
P7	CS2	1,020,286,976	43	01	Ex Serviceman	Nil	80%

Figure 3.2 shows the contract packages, P1, P2, P7, P5 and P6 which are located in the North Central Provinces of Sri Lanka while Figure 3.3 shows the two contract packages P3 and P4 located within the Jaffna Peninsula in Northern Province of Sri Lanka.

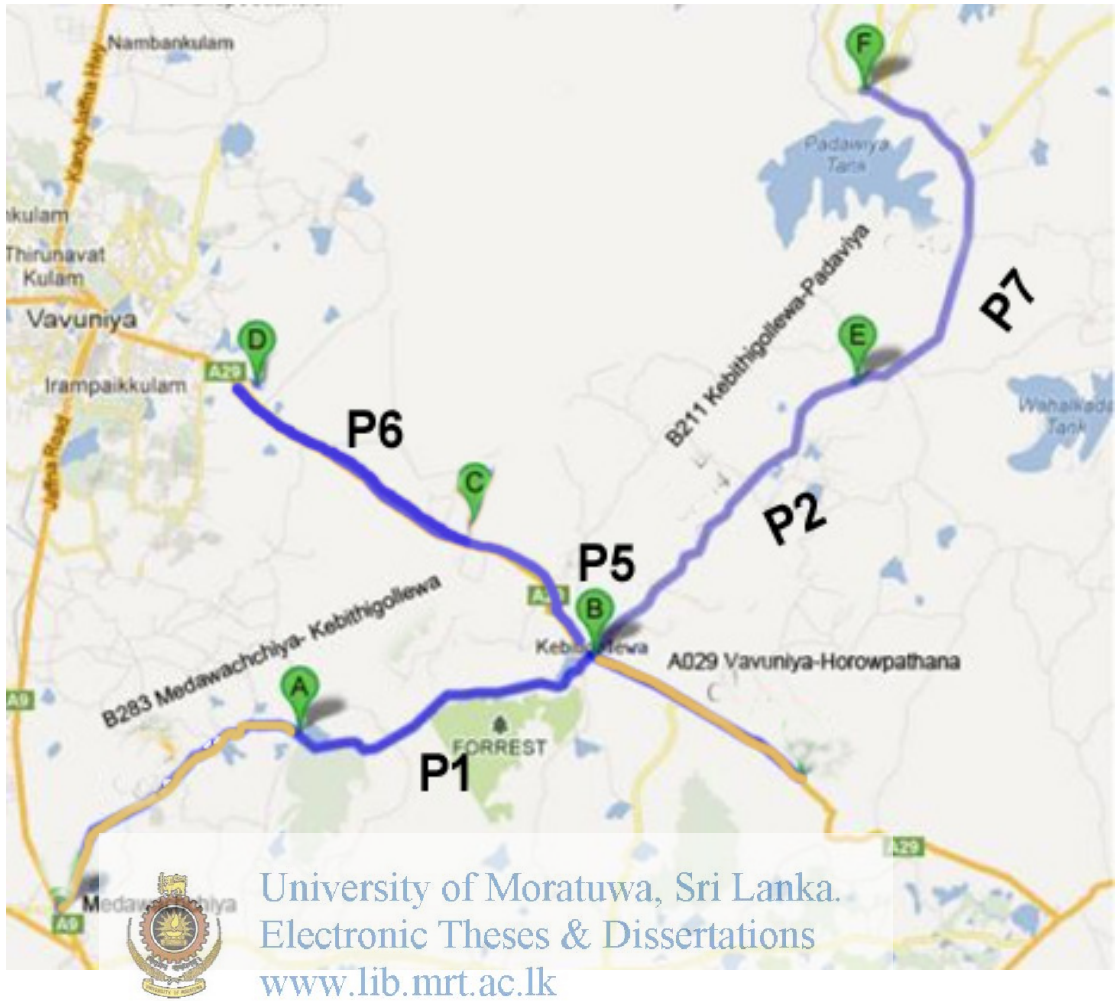


Fig. 3.2: Location of Contract Packages in North Central Province



Fig. 3.3: Location of Contract Packages in the Northern Province

3.4.2 Interviews

Seven interviews were conducted with the respective Project Managers of the seven Contract Packages to clarify the status of Health and Safety Management of the projects concerned. Factors considered in the interviews include availability of Safety Policy, adequate budgetary allocation for Safety Management, having a Safety Department/Unit, Employing a fulltime Safety Representative, Competency of Safety Officer, workers insurance scheme, provision of PPE, accident record keeping and accident investigation and reporting, conducting orientation programmes for new workers, conducting safety and health training programmes, availability of Safety Plan and conducting Safety inspections etc.

Table 3.3 Profile of the interviewees

Contract Package	Personal Interviewed	Caliber of the interviewee	Experience
P1	Project Manager	Civil Engineer	13 Years
P2	Project Manager	Chartered Engineer	12 Years
P3	Project Manager	Civil Engineer	09 Years
P4	Project Manager	Civil Engineer	10 Years
P5	Project Manager	Civil Engineer	10 Years
P6	Project Manager	Chartered Engineer	10Years
P7	Project Manager	Civil Engineer	10Years

3.4.3 Observations

Personal observations were recorded on the aspects of Health and Safety Management practices being implemented in all project sites during random visits made to the respective contract packages.

3.5 Data analysis

Gathered information was analyzed using both descriptive and statistical methods to ascertain the level of Health and Safety Management in the respective sites. The

cumulative response was assessed through obtaining the total value of positive and negative responses of the six criteria considered in the questionnaire separately and thereby depicting the resultant values in percentages. Contract Package wise comparison was done in a similar manner where total values of positive and negative responses were obtained for each criterion separately and the results were depicted in percentages. Information collected through the questionnaire survey was analyzed using Microsoft Excel, where the results were depicted in graphical form to ascertain the status of Health and Safety Management in the study area.

3.6 Summary

This chapter describes the research process and the methodology adopted for the current research study. Questionnaire Survey, interviews and field observations were adopted to achieve the aims and objectives of the study.



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CHAPTER FOUR

4.0 DATA ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter discusses the analysis of the data collected during the research study. This comprises the response rate of the questionnaire, details of respondents, and analysis of results which are depicted in graphical form, where overall health and safety management practices are given at the beginning followed by contract package wise comparison of the six criteria considered in the questionnaire. Findings of the interviews conducted with Project Managers and the field observations are also included in this chapter.

4.2 Response to Questionnaire

Measures were taken to distribute questionnaire among 80% of the work force of all contract packages concerned in the study. The number of questionnaires distributed among the employees and the number responded is given in table No. 4.1 and Table No. 4.2 depict the profile of respondents.

Table 4.1 Response Rate of the Questionnaire

Contract Package	Number of Questionnaires sent	Number of completed Questionnaires received	Response Rate
P1	45	35	77.7%
P2	47	35	74.4%
P3	35	25	71.4%
P4	25	19	76%
P5	45	36	80%
P6	85	71	83.5%
P7	35	29	82.8%

Table 4.2: Profile of Respondents

Contract Package	Supervisors	Machine Operators	Unskilled workers	Skilled workers	Total
P1	03	05	21	06	35
P2	02	06	22	05	35
P3	02	03	16	04	25
P4	02	03	10	04	19
P5	03	04	24	05	36
P6	04	06	53	08	71
P7	03	06	14	06	29
					250

4.3 Analysis of Results

The response rate for the questionnaire was fairly high and it was more than 71%. The data collected through the interviews were analyzed and are depicted in the following section, where overall response is discussed initially followed by Project wise comparison of Health and Safety Management criteria concerned in the study.



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4.3.1 The overall health and safety management practices

The cumulative results of the response to questionnaire received from the seven contract packages considered in the study can be depicted as follows.

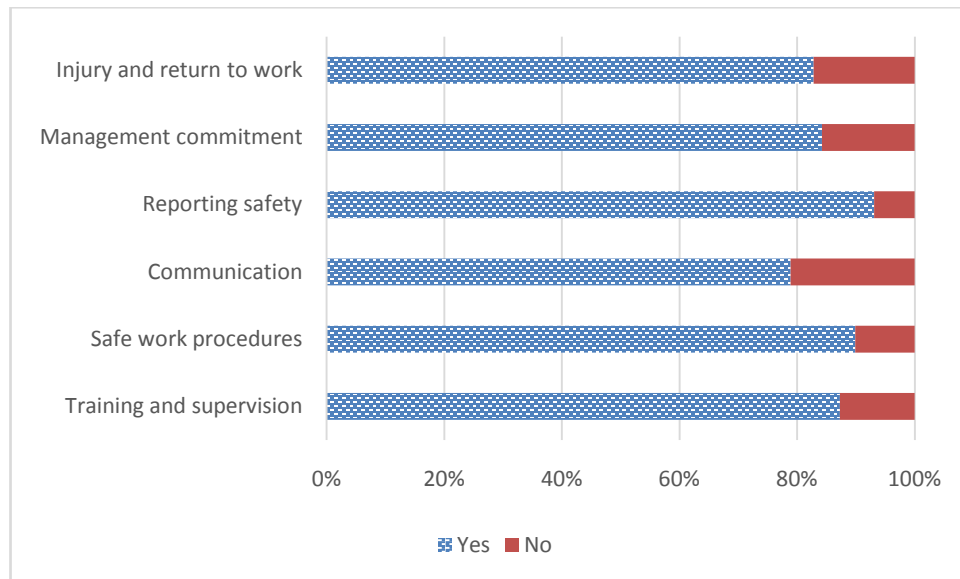


Fig.4.1: Overall response to Health and Safety Management Practices

Analysis of the overall response to Health and Safety Management Practices as depicted in Fig.4.1 shows that all the six main criteria selected for the study has a very high positive response of more than 78%. Five of the six areas surveyed, namely reporting safety, safe work procedures, training and supervision, management commitment and injury and return to work shows more than 80% positive responses in the descending order where reporting safety indicate highest percentage being 93.1%.

The above analysis reveals that the general practices of Health and Safety Management in the current study area are in a satisfactory level as far as the six criteria considered for the research are concerned. The least positive response was recorded in communication, where, the existence of communication system with management, involvement of employees in health and safety matters, response of management and safety committees were taken in to account in the survey. Interviews conducted with the respective managers also revealed that six of the seven contract packages have not formed safety committees.

Training and Supervision covered four areas namely provision of induction training, safe work procedures, assurance of safe work, and safety issues related to jobs and

had a positive response of 87.3 %. Interviews with the management also revealed that all contract packages conduct orientation training programmes, and provide safe work procedures and create awareness on safety issues related to relevant jobs.

Safe work procedures had a high response of 89.9%, where emphasis was given to risks involved in work, ensuring safe work procedures and the attitude of workers. All managers were of the view that they provide adequate safety work procedures and ensure the safety of workers while they are on duty. Further it was revealed that required Personal Protective Equipment (PPE) is provided to all workers.

Reporting safety, which included reporting procedures, response to reported incidents, encouragement of workers and prompt actions of management had the highest positive response of 93.1%. This was proved through the interviews and discussions had with the Project Managers, where all of them mentioned that proper reporting systems are being implemented in the respective projects. Accident record keeping, accident investigation and reporting systems were being practiced in all contract packages.



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Management commitment that included time, resources and money allocations, priority given, and the involvement of management in safety issues, had a response of 84.2%. All managers were of the view that they pay a high commitment towards health and safety management in the respective projects and further mentioned that they have allocated adequate budget for safety management and required resources are provided while they attend to all matters relevant to safety, apart from appointing a Safety Officer to be in charge of safety management in sites.

Section on injury and return to work considered the awareness of employees about what they should do when an injury is occurred, the measures that employers take to create awareness and the facility to return to work after recovery from an injury, and it had a fairly high response of 82.8 percent. Interviews conducted with Project Managers revealed that they conduct regular awareness programmes concerning safety issues and display information on safety precautionary measures while all

Project Managers confirmed that return to work programme is in effect in the respective contract packages.

4.3.2 Contract package wise comparison of health and safety management criteria

The response of individual contract packages on the six health and safety management criteria shows a marked difference to each other. Comparison of response to each criterion can be described as follows.

4.3.2.1 Training and supervision

Project wise comparison of Training and Supervision which addressed the areas of provision of induction training to new recruits, training given on safe work procedures, Management commitment towards ensuring working safely and degree of awareness creation on safety issues can be depicted as follows.

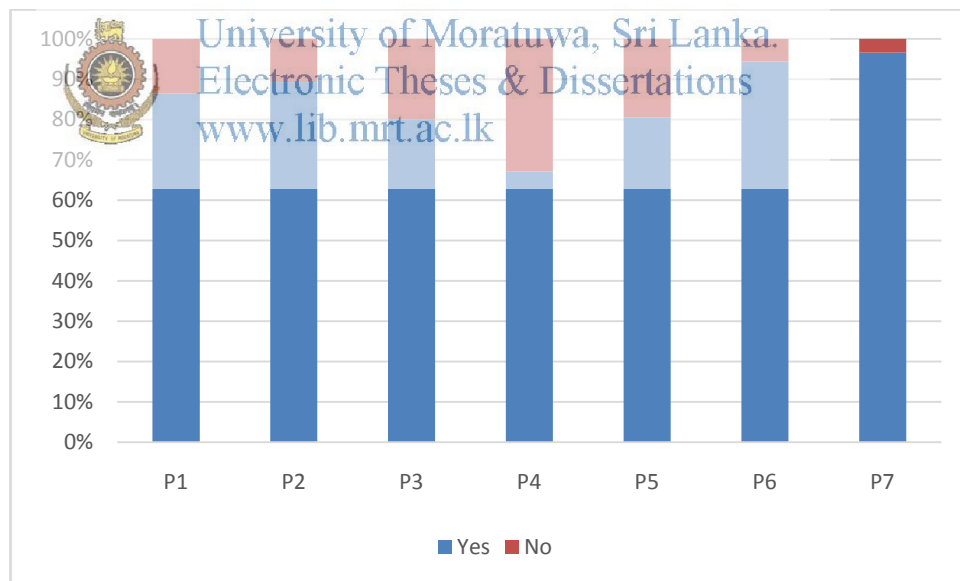


Fig. 4.2: Comparison of the response to Training and Supervision

As depicted in Fig.4.2, the comparison of the response to Training and Supervision shows that, all packages except P4 has a high positive response of more than 80% where P4 had 67.1%. This shows that majority of the projects address the area of

Training and Supervision in an acceptable manner. Of the seven packages P6 and P7 has got a very high response of more than 94% which could be attributed to addressing the areas concerned under training and supervision in a successful manner. The interviews conducted with Project Managers revealed that P3 and P4 did not have a qualified Safety Officers to address issues related to safety management which may have contributed towards the less response. Rest of the packages had experienced Safety Officers and revealed that regular toolbox meetings are conducted on safety issues.

4.3.2.2 Safe work procedures

Safe work procedures which comprised five areas, namely, safety risks related to job tasks, work procedures to address risks involved in jobs, reviewing and updating procedures, and the learning safe work procedures also show a varying response and the results can be depicted as follows.

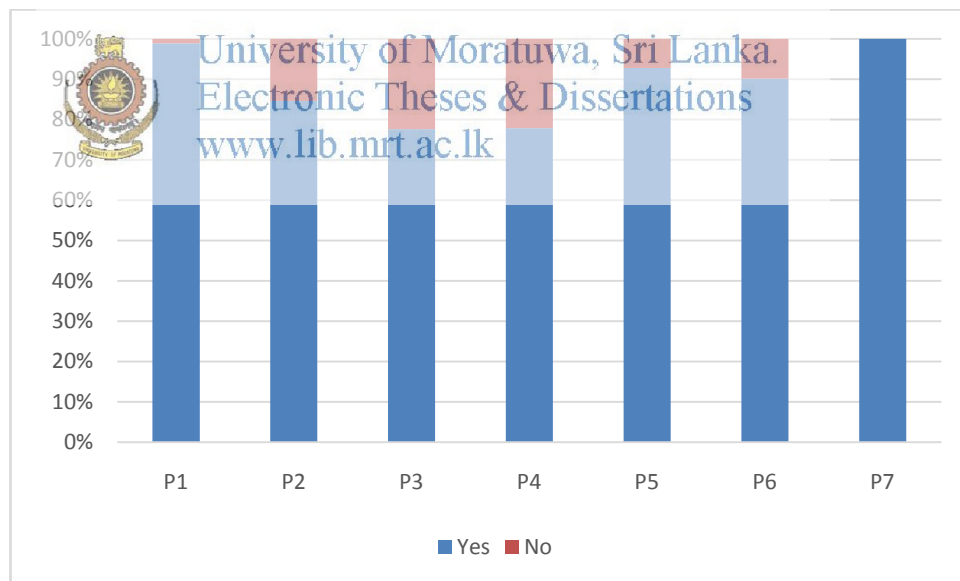


Fig.4.3: Comparison of the response to Safe Work Procedures

Comparison given in Fig. 4.3 shows a high response where five contract packages except P3 and P4 has recorded positive response of more than 84% while P7 had the highest being 100% positive. High response of P7, P1, P5, P6 and P2 can be attributed to the commitment of the Safety Officers. P3 and P4 recorded the low

response of 77.6 and 77.9% indicating that comparatively low response could be attributed to not having capable experienced Safety Officers to handle safety issues within the site which was revealed during the interviews with respective Project Managers.

4.3.2.3 Communication

Communication considered four aspects, namely, availability of communication system with Management concerning health and safety, involvement of employees in safety matters, response of management on safety issues and formation of safety committees. Comparison of results can be depicted as follows.

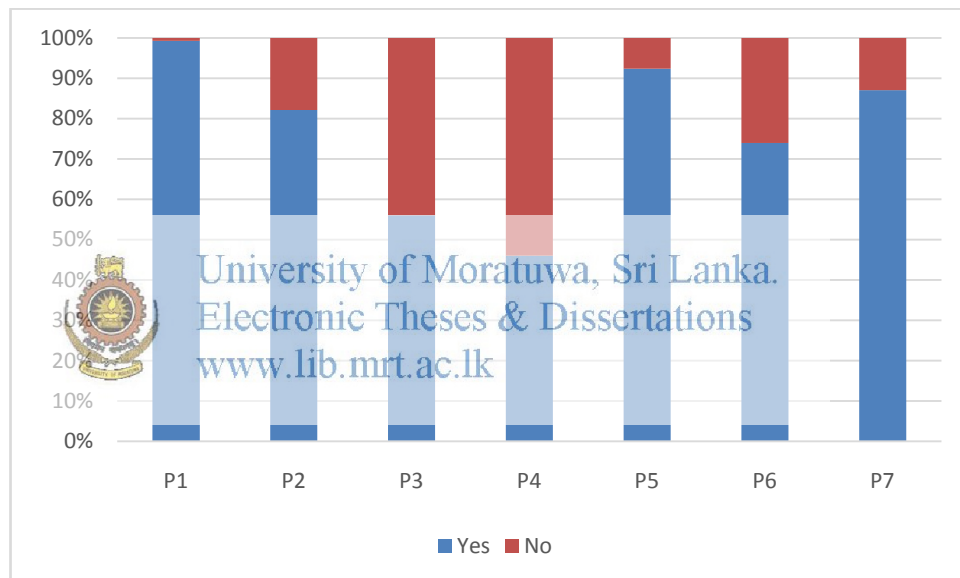


Fig. 4.4: Comparison of the response to Communication

The results depicted in Fig. 4.4 reveals that five of the contract packages had a positive response of more than 73% while the other two namely P3 and P4 recorded positive responses of 56% and 46.1% respectively. P3 and P4 are located in Jaffna Peninsula. The interviews conducted with the respective Project Managers revealed that there is a difficulty in communication, as majority of the workers were Tamil speaking. The language barrier would have been the main reason for lesser response in P3 and P4. Comparatively high response of other packages could be attributed to the commitment of the Health and Safety staff of respective contract packages. The

study further revealed that six of the contract packages except P2 have not formed safety committees in the respective sites.

4.3.2.4 Reporting safety

Reporting safety comprised six areas viz., having safety reporting procedures, reporting safety incidents, encouragement given to report safety incidents, follow up actions, reviewing and updating and response to reported issues. Comparison of results can be illustrated as follows.

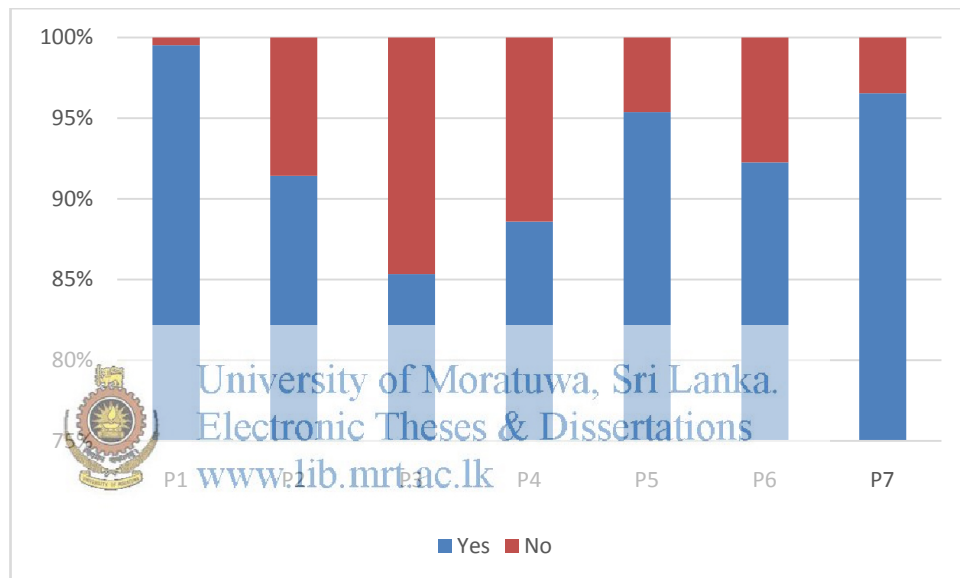


Fig. 4.5 Comparison of the response to Reporting Safety

Reporting Safety as given in Fig. 4.5 shows a very high response in all contract packages where the positive response of all packages was more than 85%. This shows a high integrity in the area of reporting safety in all packages. Results further reveals that P1 and P7 had a very high response of 99% and 96.5% respectively, which could be due to the high level of commitment made by the experienced Safety Officers. However, comparatively low values are recorded in P3 and P4 which may be due to the reasons mentioned in previous comparisons. Interviews conducted with the Project Managers revealed that in all packages the workers are encouraged to report any vulnerable incident that might lead in to health and safety

hazard. Observations also revealed that all contract packages maintain recording procedures.

4.3.2.5 Management commitment

Management commitment is an important aspect in Health and Safety Management in construction sites. In the current study Management Commitment considered six aspects, namely, Manager's view on safety, adequacy of time and resource allocation, level of priority given to safety management, involvement of management in safety issues and employee's views of health and safety in relation to self and the organization. Contract wise response to Management commitment can be depicted as follows.

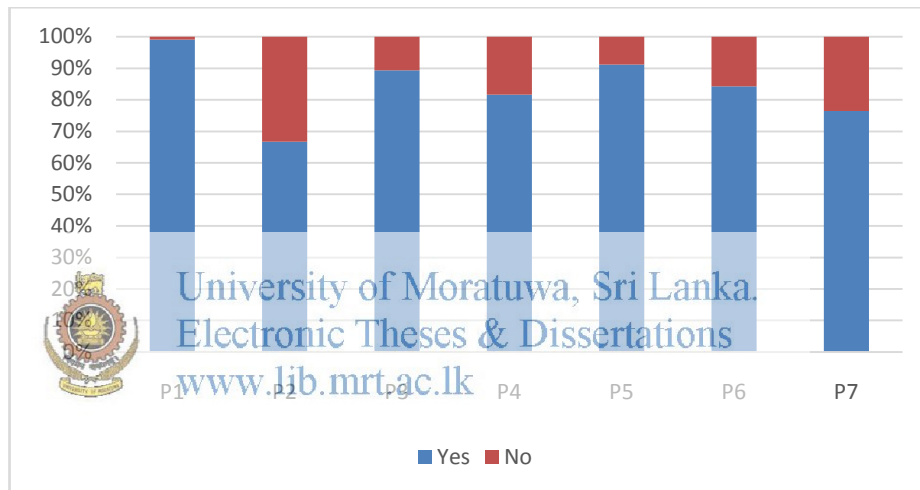


Fig. 4.6 Comparison of the response to Management Commitment

Analysis of results shown in Fig. 4.6 reveals that all packages except P2 had a high positive response of more than 76% while P2 recorded positive response of 66.7%. Comparatively low figure for P2 may be due to lack of concern towards Health and Safety Management practices especially with respect to the involvement of management in safety issues. P3 and P4 shows a higher value compared to other criteria considered so far and it reveals that there is a greater commitment of Management towards Health and Safety Management which was also revealed through the interviews. Although P2 showed the lowest, the outcome of the interview was otherwise. P1 shows the highest where the commitment of Management including Safety Officer is comparatively greater than others. The reason could be

attributed to the fact that the Safety Officer concerned is a qualified and experienced person compared to the others and much dedicated to his duties.

4.3.2.6 Injury and return to work

Injury and return to work is also an important area of Health and Safety Management, where employability of workers is ensured after exposing to injuries. This section dealt with the degree of awareness on the kind of action they do when faced with an injury, injury management and availability of return to work programme. Results of package wise response can be depicted as follows.

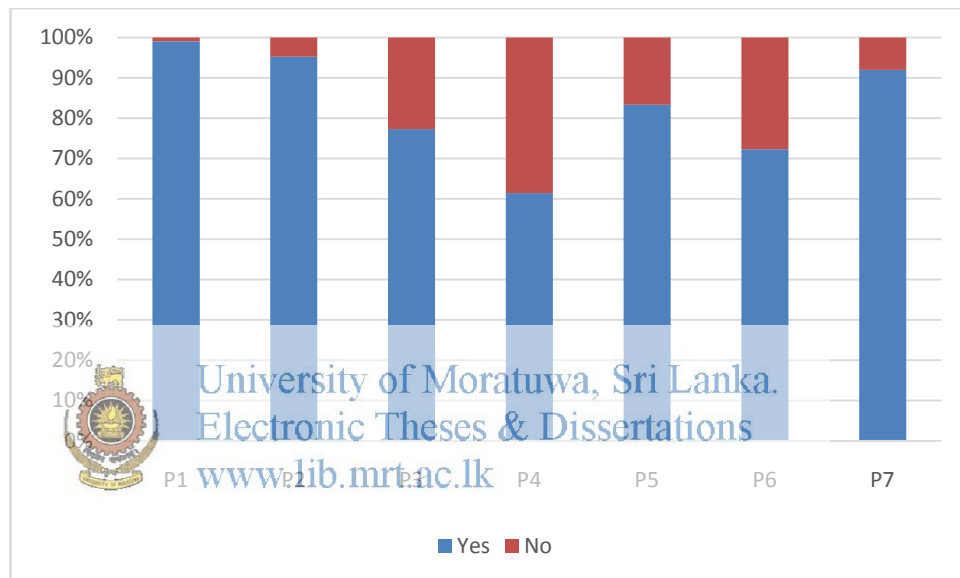


Fig. 4.7 Comparison of the response to Injury and Return to Work

As given in Fig. 4.7, all packages except P4 show a high positive response of more than 72%. P4 had a positive response of 61.4%. The reduced value of P3 and P4 can be due to the reasons mentioned in the previous analysis. However the interview with the respective Project Managers revealed that there is a programme in effect for return to work after injuries in both contract packages. Discussions had with all Project Managers revealed that they are willing to employ back the workers who return back after injuries, if they are in a healthy position to perform the duties assigned.

Further to above mentioned analysis, discussions held with the Project Managers concerning the status of Health and Safety Management Practices revealed that all contract packages have relevant Safety Policies, adequate budgetary allocations for safety management practices within the project, separate unit for safety management, effective workers insurance scheme, provision of PPE for workers, accident record keeping system, accident investigation and reporting system etc. It was also revealed that orientation programmes for new workers and safety and health training programmes are conducted in all contract packages concerned. It further revealed that training programmes on HIV/AIDS and STD were conducted in all packages as a fulfillment of requirement of the donor agency. All packages had Safety Plans while regular safety inspections are being conducted in all packages. Further regular toolbox meetings are conducted in all packages. All packages except one (P6) had fulltime Safety Representatives. One of the negative factors revealed in the discussions was that Safety Committees were nonexistent in six of the seven packages except (P2).

Concerning provision of PPE it was revealed that except safety harness, ear plugs and face shields all the others namely, dust masks, safety goggles, hand gloves, safety helmets, reflective jackets, safety shoes etc. are provided by all concerned parties. Interviewees were of the opinion that safety harness was not required for the current projects as working at heights was not envisaged in construction activities. It was revealed that three of the seven packages have not provided ear plugs and one package has not provided face shields.

The observations during visits made to respective construction sites revealed several lapses in Health and Safety Management in most of the construction sites. The prominent issue was concerning wearing Personal Protective Equipment. In many sites workers were on duty without wearing appropriate PPE. In many sites they were not wearing Hard Hats (Helmets). However most of the workers in all sites concerned were wearing reflective jackets. Those who were doing skilled jobs such as welding work were equipped with necessary PPE. Majority of workers involved in embankment construction work and ancillary work were not wearing gloves and

shoes. In bridge construction sites, there were incidences where workers were not wearing appropriate PPE such as helmets, shoes, gloves etc. There were instances where worker were not wearing respiratory masks especially in the areas they were exposed to severe dust emission such as in quarries and metal crushers.

Further, working under unsafe conditions such as unprotected scaffoldings was also observed in structural construction sites. Unsafe heavy machinery operation without flagman also was observed in some of the construction sites.

Shortcomings were also observed in the areas of barricading hazardous zones, placing appropriate warning signs and deploying trained flagmen etc.

It is apparent that all contract packages have provided necessary PPE to their workers, however the observations reveal that a considerable number of workers do not wear all the PPE that were provided, while on duty. It was revealed that in some cases workers are reluctant to wear PPE as they are not accustomed to use it and feel uncomfortable with the gears while performing their job at site and consider it as a barrier to their work output. It may also be due to inadequate instructions and training on the use and maintenance of PPE, provided to workers.

Although it was mentioned that all contract packages conduct regular toolbox meetings and safety inspections, several shortcomings were observed as mentioned earlier. It shows the inadequacy of toolbox meetings and training programmes that needs more attention.

4.4 Summary

Questionnaire comprising six main areas of health and safety management namely, training and supervision, safe work procedures, communication, reporting safety, management commitment and return to work was distributed among the workers of seven contract packages in the Northern and North Central Provinces of Sri Lanka. The study had a good response rate of more than 71% where a total of 250

respondents were considered. Analysis of results revealed a high positive response of more than 78% in the overall response of Health and Safety management. Of the six criteria considered, reporting safety showed the highest response of 93.1% while the lowest was recorded in communication. Six of the seven contract packages have not formed safety committees. Rest of the criteria concerned had responses of more than 80%. Managers were of the view that special attention is given to health and safety management where adequate budget and required resources are provided. Contract package wise comparison of the criteria reveals that except P3 and P4 others show a comparatively high response. The low response of P3 and P4 could be attributed to non availability of experienced Safety Officers and the difficulties faced in communication. Discussions revealed that all contract packages have Safety Policies, separate unit for safety management, workers insurance scheme, provision of PPE, accident record keeping system, accident investigation and reporting system etc. Observations revealed safety lapses such as working without PPE, working under unsafe conditions, non barricading hazardous zones, lack of warning sign boards and deploying non competent flagmen etc.



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CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study identified the following health and safety management issues in road construction projects. Exposure of workers to high risks in operation of quarries, borrow pits, metal crushers etc. where workers are exposed to hazards of frequent and heavy lifting, noise and vibration, hazardous substances such as oil, gas, hydraulic fluid, welding fumes, heavy vehicle operation, working in blasting faces, clearing operations, slips, trips and falls, struck by, being struck by falling objects, hand-arm-whole body vibration, dust, sources of noise, electrical hazards etc. In asphaltting areas workers are exposed to high temperatures and Polycyclic Aromatic Hydro Carbons (PAHC) which are carcinogenic and could lead in to eye irritation, nasal and throat irritation, lower respiratory tract symptoms, pulmonary function changes and bronchitis. Working in excavated areas is prone to collapse of slopes. Workers are also prone to ergonomic issues caused due to manual handling and awkward postures. Among the injuries identified are sprains/strains leading in to back injuries, cuts, contusions, eye injury, fractures and burns. Main causes of accidents have been identified as fall from height, fall of objects, struck on stationary objects, struck by moving objects, struck on moving objects, caught in between, exposure to heat, exposure to electricity and exposure to harmful substances.

Questionnaire survey conducted with 250 employees of seven contract packages involved in road construction projects located in the Northern and North Central Provinces of Sri Lanka revealed a high positive response in overall health and safety management practices. Five of the six criteria concerned, namely, training and supervision, safe work procedures, reporting safety, management commitment and injury and return to work showed a high positive response of greater than 78 percent. Communication recorded the lowest positive response and it was revealed that there is a drawback in involvement of employees in health and safety matters and response

of management. Safety Committees were not formed in all contract packages except (P2).


Project Wise comparison shows that P3 and P4 had a low positive response in the criteria concerned other than management commitment. The main reasons for the lower positive response could be attributed to, not having a qualified Safety Officer to address the safety issues and communication gap due to language barrier as the projects concerned were located in Jaffna Peninsula.


Interviews conducted with Project Managers revealed that a high commitment is made on health and safety management in work sites. All contract packages had relevant Safety Policies, budgetary allocations for safety management practices within the project, separate unit for safety management, effective workers insurance scheme, provision of PPE for workers, accident record keeping system, accident investigation and reporting system etc. It was also revealed that orientation programmes for new workers and safety and health training programmes are conducted in all contract packages concerned. Awareness training programmes on HIV/AIDS and STD have been conducted in all packages. All packages had Safety Plans while regular safety inspections are being conducted in all packages. Regular toolbox meetings are conducted in all packages. All packages except one (P6) had fulltime Safety Officer. One of the negative factors revealed in the discussions was that Safety Committees were nonexistent in six of the seven packages except (P2).

Concerning provision of PPE it was revealed that except safety harness, ear plugs and face shields all the others namely, dust masks, safety goggles, hand gloves, safety helmets, reflective jackets, safety shoes etc. are provided by all concerned parties. It was revealed that three of the seven packages have not provided ear plugs and one package has not provided face shields.

5.2 Recommendations

Table 5.1 Issues identified and recommendations

Issues Identified	Recommendations
<p>Low response on communication</p>	<ul style="list-style-type: none"> • Communications with Managers needs to be improved • Employees should be encouraged to get involved in matters related to safety • Safety Committees headed by Project Managers should be formed and frequently meet to discuss matters related to safety • Awareness must be created among all employees about the functioning of Safety Committee and encourage them to report on any safety related issues • Effective induction training programmes should be conducted for the new recruits.
<p>Working under unsafe conditions</p> 	<ul style="list-style-type: none"> • Hazard Identification and Risk Assessments (HIRA) should be conducted for all work sites. • Measures should be taken to eradicate hazards in work sites. • Safe work procedures should be established for all workers. • Work procedures should be reviewed periodically • Regular toolbox meetings should be conducted and relevant safety issues should be discussed and ensure that workers are aware of the dangers and take precautionary measures to avoid them. • Warning signs should be erected at appropriate locations
<p>Working without PPE</p>	<ul style="list-style-type: none"> • Awareness on the importance of PPE should be emphasized • Site Supervisors should emphasize that all the workers are equipped with PPE and wear them while on duty.
<p>Unsafe Heavy Machinery Operation</p>	<ul style="list-style-type: none"> • Strict measures should be taken to deploy trained flagmen to guide heavy machinery operators.

Issues Identified	Recommendations
	<ul style="list-style-type: none"> • Machinery should be equipped with audible reverse horns. • Heavy machinery operating area should be properly demarcated with warning sign boards and measures should be taken to prevent workers and public entering in to the work zone.
Incapacity of Safety Officers	<ul style="list-style-type: none"> • Well qualified experienced Safety Officers should be employed • Appropriate training on safety management should be provided for the Safety Officers to strengthen their capacities • Safety Officers should develop their capacities to identify hazards and conduct appropriate tool box meetings and ensure that safe work zones are provided for workers before deploying them.
Management commitment 	<ul style="list-style-type: none"> • Managers must pay more attention to health and safety management issues within his command area. • Safety must be given a high priority in worksites • Managers must get involved in all matters relevant to safety.
Safety Violations	<ul style="list-style-type: none"> • Random visits to work sites should be conducted to identify the shortcomings and measures should be taken to rectify them. • Officials from the Labour Department should visit the construction sites randomly to check the compliance.

- Further research on Health and Safety Management in road construction projects are suggested to improve the health and safety of the workers engaged in road construction work.

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Appendices

Appendix – A Sample Questionnaire

Analysis of Health and Safety Management Practices in Road Construction Projects in Northern and North Central Provinces of Sri Lanka - Questionnaire

Aim of the study:

The aim of the study is to investigate the major health and safety management issues prevalent in road construction projects that are being implemented in the Northern and North Central Provinces of Sri Lanka and to propose recommendations that would enhance the health and safety management standards in road construction sites.

Objectives of the study:

- Identify the health and safety issues prevailing in road construction projects
- Inspect health and safety management practices of road construction projects in Northern and North Central Provinces of Sri Lanka
- Determine reasons for prevailing issues in health and safety management in road construction projects.
- To propose recommendations to enhance safety management in road construction sites.

Scope:

The study will be confined to seven construction projects currently being implemented under the Northern Road Connectivity Project (Additional Financing) that are based in Northern and North Central Provinces of Sri Lanka.

Questionnaire:

Focus of the questionnaire is to assess the Health and Safety Management status of road construction projects in Sri Lanka. Your cooperation in completing this questionnaire is greatly appreciated and your response will be treated confidentially and used for academic purpose only.

Date: _____ Name of Company: _____
 Name of the Project: _____ Location: _____
 Name of Respondent: _____ Gender: _____
 Age: _____
 Occupation: _____

Training and Supervision

1. Do you all get induction training when you join your company?

Yes	No

2. Were you given training on safe work procedures for your job?

Yes	No

3. Does your Manager/Supervisor check or make sure that you can do the work safely?

Yes	No

4. Are you all made aware of the safety issues related to your job?

Yes	No

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5. Does your company work out all the job/tasks that have safety risks?

Yes	No

6. Does your company have safe working procedures for all task based activities in your area that have safety risks?

Yes	No

7. Do you follow the safe work procedures?

Yes	No

8. Does your company review and update your safe work procedures?

Yes	No

9. Do you have enough time to learn the safe work procedures?

Yes	No

Communication

10. Do you have a communication system with your Manager concerning health and safety?

Yes	No

11. Are you /your representative involved in safety matters?

Yes	No

12. Does the management take notice of what you say about safety?

Yes	No

13. Do you know who your safety committee member (or safety rep.) is?

Yes	No

Reporting safety

14. Do you have a safety reporting procedure (for incidents and issues) and are you using it?

Yes	No

15. Do you report safety incidents?

Yes	No

16. Are you encouraged to report safety incidents?

Yes	No

17. Are the safety incident reports followed up?

Yes	No

18. Does your safety training get reviewed or updated if there is an incident?

Yes	No

19. Does your company take immediate action if you report a serious problem where someone could get hurt?

Yes	No

Management commitment

20. Do your Managers understand what they and you should do regarding safety?

Yes	No

21. Is the time put in to safety matters enough?

Yes	No

22. Do you feel that the resources and money allocated for safety is enough?

Yes	No

23. Is safety given a high priority in your company?

Yes	No

24. Does the management get involved in safety issues?

Yes	No

25. Do you feel that your health and safety matters in your organization?

Yes	No

Injury and return to work

26. Do you know whom to ask about what to do if you get injured?

Yes	No

27. Does your company display information regarding injury management?

Yes	No

28. Do you have a return to work programme?

Yes	No



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4. ඔබ සියළු දෙනාගේම ආරක්‍ෂාව සම්බන්ධයෙන් අදාළ ප්‍රශ්න පිළිබඳ ඔව් () නැත ()
දැනුවත් කිරීමකලාද?

ආරක්‍ෂාව සහිතව වැඩ කිරීමේ ක්‍රමවේද

5. ඔබ ආයතනය, ආරක්‍ෂණ අවදානම් සහිත රැකියා පිළිබඳ ඔව් () නැත ()
ඔබ දැනුවත් කර සිටිනවාද?

6. ඔබ ආයතනයේ සෑම වැඩකරුවකුටම ආරක්‍ෂණ සහිතව වැඩ කිරීමේ ක්‍රමවේදයන්
විබේදනයන් විබේදනයන් ඔව් () නැත ()

ඔව් () නැත ()

7. ඔබ ආරක්ෂා සහිත වචන කිරීමේ ක්‍රමවේදයන් අනුගමනය කරනවාද?
8. ඔබ ආයතනය ආරක්ෂා සහිත වචන කිරීමේ ක්‍රියාදාමයන් සොයා බලා හිරු
රුව විමසනවාද? ඔව් () නැත ()
9. ඔබ ආරක්ෂාව සහිත වචන කිරීමේ ක්‍රමවේදයන් පිළිබඳව විමසා ඔව් () නැත ()
(ඉගෙන දැනගැනීමට කාලයක් (අවශ්‍ය ප්‍රමාණයට) තිබෙනවාද?

සන්නිවේදනය

10. ඔබගේ කළමනාකාරනුමාස මග සෞඛ්‍යය ආරක්ෂාව පිළිබඳ
සාකච්ඡා කිරීමට සන්නිවේදන ක්‍රමයක් තිබෙනවාද? ඔව් () නැත ()
11. ඔබ/ඔබගේ නියෝජිතයා, ආරක්ෂණ වැඩ පිලිවෙල පිළිබඳ ඔව් () නැත ()
වැඩසටහන්වලට සහභාගි වෙනවාද?
12. ඔබ ආරක්ෂණය හා සම්බන්ධව යමක් පවසනවා නම් එය ඔව් () නැත ()
කළමනාකාරිත්වය සොයා බලනවාද?
13. ඔබ ආයතනයේ ආරක්ෂණ කමිටුවේ සාමාජිකයන් කවරින්ද යන්නද ඔව් () නැත ()
න්නවාද?



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ආරක්ෂාව පිළිබඳ වාර්තා කිරීම

14. ආරක්ෂණයට අදාළ දැනුම් දීමේ ක්‍රමවේදයක් තිබෙනවාද? ඔව් () නැත ()
ඔබ එය පිළිපදිනවාද?
15. ඔබ ආරක්ෂණය පිළිබඳ යමක් සිදුවුවහොත් එය දන්වා සිටිනවාද? ඔව් () නැත ()
16. ආරක්ෂණයට අදාළ කරුණු වාර්තා ඔව් () නැත ()
කිරීමට ඔබ වදින්නවාද?
17. ආරක්ෂණ සිදුවීම් වලට අදාළ වාර්තා
ඔව් () නැත () පසු විපරමක්
කරනවාද?

18. යම්කිසිසිදුවීමක්වුවහොත් ඒ ගැන විමසා ආරක්ෂණ පුහුණුවීම් වැඩසටහන්/ අළුත් කරනවාද? ඔව්() නැත()

19. ඔබ ආයතනය, යම්කෙතෙක් අනතුරු කටපත් විය හැකි හැකි තත්වයක් වාර්තා කලහොත් ඒ පිළිබඳව ඉක්මන් ප්‍රතිචාරයක් දක්වනවාද? ඔව්() නැත()

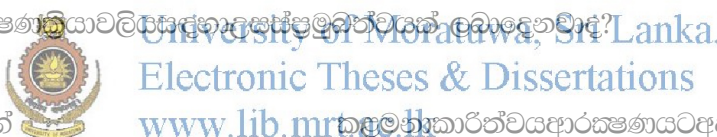
කළමනාකාරිත්වයේ කැපවීම

20. ඔබගේ කළමනාකාරිත්වයට ආරක්ෂණය පිළිබඳව ඔවුන් සහඔබ ගත යුතු ක්‍රියා මාර්ග ගැන තේරුමක් තිබෙනවාද? ඔව්() නැත()

21. ඔබ සිතන අන්දමට ආරක්ෂණ ක්‍රියාවලිය සඳහා කැපකොට තිබෙන කාලය ප්‍රමාණවත්ද? ඔව්() නැත()

22. ඔබ සිතන අන්දමට ආරක්ෂණ ක්‍රියාවලිය සඳහා යොදා තිබෙන සම්පත් හා මුදල් ප්‍රමාණවත්ද? ඔව්() නැත()

23. ආරක්ෂණ ක්‍රියාවලිය සඳහා අසපු ඔබගේ වයස් ලබා දෙනවාද? ඔව්() නැත()



24. ඔබගේ කළමනාකාරිත්වය ආරක්ෂණයට අදාළ ප්‍රශ්න සඳහා සම්බන්ධ වෙනවාද? ඔව්() නැත()

25. ඔබගේ සෞඛ්‍ය සහ ආරක්ෂාව ඔබ ආයතනයට අදාළ යැයි සිතනවාද? ඔව්() නැත()

අනතුරකින් පසු නැවත සේවයට පැමිණීම

26. ඔබට අනතුරක් වුවහොත් කටයුතු කරන ආකාරය පිළිබඳ දැනගන්නේ කාගෙන්දැයි දන්නවාද? ඔව්() නැත()

27. ඔබ ආයතනයේ, අනතුරු කළමනාකරනය පිළිබඳ විස්තර ප්‍රදර්ශනය කොට තිබෙනවාද? ඔව්() නැත()

28. අනතුරකින් පසු නැවත වැඩට පැමිණීම පිළිබඳව යම් කිසි වැඩසටහනක්

ඔව් () නැත ()

නිබඳ නවාද?



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Appendix – C; Results of Cumulative response for the questionnaire

	Yes	No
Training and supervision	838	127
Safe work procedures	1124	126
Communication	789	211
Reporting safety	1397	103
Management commitment	1264	236
Injury and return to work	621	129

Appendix – D; Results of the Comparison of Training and Supervision

	Yes	No
P1	121	19
P2	125	15
P3	80	20
P4	51	25
P5	116	28
P6	268	16
P7	112	4

Appendix – E; Results of the Comparison of Communication

	Yes	No
P1	139	1
P2	115	25
P3	56	44
P4	35	41
P5	133	11
P6	210	74
P7	101	15

Appendix – F; Results of the Comparison of Safe Work Procedures

	Yes	No
P1	173	2
P2	148	27
P3	97	28
P4	74	21
P5	167	13
P6	320	35
P7	145	0

Appendix – G; Results of the Comparison of Reporting System

	Yes	No
P1	209	1
P2	192	18
P3	128	22
P4	101	13
P5	206	10
P6	393	33
P7	168	6

Appendix – H; Results of the Comparison of Management Commitment

	Yes	No
P1	208	2
P2	140	70
P3	134	16
P4	93	21
P5	197	19
P6	359	67
P7	133	41


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Appendix – I; Results of the Comparison of Injury and Return to Work

	Yes	No
P1	104	1
P2	100	5
P3	58	17
P4	35	22
P5	90	18
P6	154	59
P7	80	7