CHAPTER 1. INTRODUCTION

1.1. BACKGROUND

Construction activities, particularly those involving complex foundations like raft foundations, are inherently fraught with risks that can lead to accidents, injuries, and significant economic losses. A raft foundation, also known as a mat foundation, is a large, thick concrete slab that supports all or some of the columns and/or walls of a structure. A raft also can support an entire structure, such as a silo, storage tank, chimney, tower, and foundation machinery (Das & Das, 2014). The construction process involves excavation, reinforcement, concrete pouring, and curing, each stage presenting unique hazards such as soil collapse, equipment failures, and worker exposure to hazardous materials. In response to these challenges, Safe Work Method Statements (SWMS) have emerged as a critical tool in occupational health and safety (OHS) management. SWMS are documented procedures that outline the hazards associated with specific tasks, the risks involved, and the control measures to mitigate them, ensuring compliance with regulatory standards and promoting a proactive safety culture (Borys, 2012). Safe Work Method Statements are, basically, a set of instructions for how to complete a prescribed task as safely as can reasonably be expected (Getting Home Safely, 2012).

Despite their widespread adoption, Recent regulatory reviews indicate that traditional SWMS function primarily as static administrative controls, often lacking integration with the dynamic risk assessment required on complex sites (Lingard & Wakefield, 2019; Safe Work Australia, 2014). This gap can result in fragmented safety practices, where risks are addressed reactively rather than through a holistic, evidence-based approach. For instance, while SWMS may identify immediate hazards, they frequently overlook broader systemic factors such as site-specific geotechnical conditions, human factors, and dynamic environmental variables in raft foundation construction. A SWMS should be short and focus on describing the specific hazards identified for the high risk construction work to be undertaken and the control measures to be put in place so the work is carried out safely (Safe Work Australia, 2014) This limitation underscores the need for an integrated risk-based framework that combines quantitative risk modeling, stakeholder engagement, and continuous monitoring to enhance the efficacy of SWMS.

The development of such a framework is timely, given the escalating complexity of modern construction projects driven by urbanization and technological advancements. Reports

from global safety organizations highlight that construction remains one of the most hazardous industries, with foundation work contributing disproportionately to fatalities. For example, the International Labour Organization (2010) estimates that construction accounts for over 30% of occupational fatalities worldwide, with foundation-related incidents often linked to inadequate risk management. In Australia alone, data from Safe Work Australia (2024) indicates that excavation and earthmoving activities, core to raft foundation construction, result in numerous incidents annually, prompting calls for more robust safety protocol. To address these issues, this research proposes a framework that integrates SWMS directly into the raft foundation construction process. The framework combines insights from risk management and engineering to turn theoretical risk assessments into steps for on-site implementation. By integrating probabilistic risk analysis, the proposed system is designed to be more flexible, allowing it to adapt to the specific context and changing realities of a project.

1.2. OBJECTIVES AND BENEFITS

1.2.1. Objectives

This research aims to achieve the following objectives:

1. To identify the specific, convergent hazards and systemic risk factors associated with the primary phases of raft foundation construction (excavation, steel reinforcement, and concrete pouring).
2. To formulate the core principles and components of an integrated risk-based framework that can be applied to SWMS.
3. To develop a conceptual integrated risk-based framework designed specifically to enhance the function and effectiveness of Safe Work Method Statements (SWMS) for raft foundation construction.

1.2.2. Benefits

The expected benefits from this research are:

1. Providing a method to enhance project predictability and efficiency by identifying and integrating key risks (like geotechnical issues) into safety planning.
2. Providing a model for generating site-specific, risk-informed SWMS that fulfill the intent of WHS regulations, not just the administrative requirements.

1.3. SCOPE AND LIMITATIONS

The following points define the specific focus of this study and the boundaries of the research:

1. The primary scope of this research is strictly confined to the Construction Safety management of the substructure phase, specifically focusing on the execution of raft foundation systems. The analysis is narrowed down to four critical operational phases: excavation, pile driving, steel rebar installation, and mass concreting.
2. The research findings are based from a qualitative analysis of pre-construction documentation, specifically focusing on the development of the Work Breakdown Structure (WBS) and Work Method Statement (WMS). The risk assessment is performed through a standardized Hazard Identification and Risk Assessment framework, validated through Expert Judgement and interviews. This study represents a "pre-construction risk profile" and does not incorporate real-time on-site field observations, dynamic workforce behavioral data, or unexpected soil issues that only appear during actual construction.
3. The scope of safety control selection is limited to the Integrated Determining Control (IDC) and Safety in Design (SiD) principles. The final output is the formulation of an Integrated Safe Work Method Statement (SWMS), and 3D visualization of the final raft foundation design

1.4. SYSTEMATIC WRITING

The systematic writing of this final project is as follows

CHAPTER I : INTRODUCTION: This chapter has outlined the research context, defined the key problems and objectives, and clarified the study's significance and boundaries.

CHAPTER II : LITERATURE REVIEW : This chapter explores the theoretical foundations of the research, focusing on construction safety concepts and established risk assessment models. It also examines the regulatory frameworks which are critical for developing the integrated SWMS.

CHAPTER III : RESEARCH METHODOLOGY : This chapter outlines the methodological framework of the study. It details the research design and data collection procedures, followed by a specific explanation of the protocols used for hazard identification and risk assessment. Finally, it describes the analytical techniques applied to interpret the data.

CHAPTER IV : RESULTS AND DISCUSSION : Here, the research findings are analyzed and interpreted. The chapter breaks down the data collected from the risk assessment process and compares it against established safety standards. It concludes by discussing the implications of these results for the implementation of SWMS in raft foundation projects.

CHAPTER V : CLOSING : This section presents the final conclusions drawn from the analysis. It summarizes the study's contributions to the field and outlines a roadmap for future improvements and research opportunities.