CHAPTER ONE

1.0 Introduction

1.1 Background

Concrete slabs are fundamental components in modern construction, primarily reinforced with steel to handle tensile stresses. However, due to rising costs and environmental concerns associated with steel production, alternative reinforcement materials are gaining attention. Timber, a renewable and lightweight material, presents a potential reinforcement alternative, especially when sustainably sourced and treated for structural applications. Composite structural systems combine two or more materials with different mechanical properties to achieve performance benefits that exceed those of individual components. In structural engineering, the most common composite systems include steel-reinforced concrete and timber-concrete composites (TCC). These systems are designed to exploit the compressive strength of concrete and the tensile strength of another material — typically steel. However, with rising awareness of environmental sustainability and circular economy principles, alternative composite systems involving timber as a reinforcing or load-sharing component are gaining interest.

Timber has been used as a building material for thousands of years due to its natural abundance, workability, and renewable nature. It possesses a high strength-to-weight ratio and is readily available in many regions of the world. In modern engineering, timber is increasingly used in the form of engineered wood products such Glued Laminated Timber (Glulam), Laminated Veneer Lumber (LVL) and Cross-Laminated Timber (CLT). These engineered products overcome the limitations of natural wood—such as anisotropy, dimensional instability, and strength variability—by providing consistent performance and improved mechanical properties. Reinforced concrete is one of the most widely used construction materials worldwide due to its versatility, strength, and relative economy. Traditionally, reinforcement is achieved with steel bars (rebar), which provide the necessary tensile resistance that concrete lacks. However, steel has several drawbacks such as high carbon footprint due to energy-intensive manufacturing, susceptibility to corrosion in aggressive environments, heavy weight, increasing transportation and structural loads and rising costs of raw materials. These challenges have led researchers and engineers to explore alternative reinforcement materials, including fiber-reinforced polymers (FRPs), bamboo, and timber.

In consequence of the consumers choosing industrialized products, among other effects, activities are suppressed in rural areas or even in small towns, and renewable materials are wasted and causing permanent pollution. In this sense, it becomes obvious that ecological materials satisfy such fundamental requirements, making use of agricultural by-products such as rice husk, coconut fibres, sisal and bamboo and therefore minimizing energy consumption, conserving non-renewable natural resources, reducing pollution and maintaining a healthy environment. Bamboo is one material, which will have a tremendous economical advantage, as it reaches its full growth in just a few months and reaches its maximum mechanical resistance in just few years. Moreover, it exists in abundance in tropical and subtropical regions of the globe. The energy necessary to produce 1m3 per unit stress projected in practice for materials commonly used in civil construction, such as steel or concrete, has been compared with that of bamboo. It was found that for steel it is necessary to spend 50 times more energy than for bamboo . The tensile strength of bamboo is relatively high and can reach 370MPa. This makes bamboo an attractive alternative to steel in tensile loading applications. This is due to the fact that the ratio of tensile strength to specific weight of bamboo is six times greater than that of steel.

The development of timber-reinforced concrete slabs is rooted in the pursuit of sustainable, efficient, and locally adaptable structural systems. By combining concrete's compressive strength with timber's renewable tensile performance, TRC slabs offer a compelling alternative for modern construction. However, successful implementation depends on addressing technical challenges related to bond behavior, durability, moisture effects, and standardization. This background establishes the foundation for further investigation into the performance, feasibility, and application of timber-reinforced concrete slab system.

1.2 Objectives

To evaluate the physical and mechanical properties of the sandal wood through review.

To evaluate the structural performance of timber-reinforced concrete slabs.

To compare mechanical performance against steel-reinforced slabs.

1.3 Scope

The study focuses on slabs using timber as primary reinforcement. Hardwood such as Teak timber is considered as reinforcement in concrete. The specimen preparation were done in accordance with BS 8110 for reinforcement preparation