# LIFT STRUCTURAL PLAN AND DESIGN FOR KOLEJ KEDIAMAN TIGA UNIVERSITI MALAYSIA PAHANG

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Thesis submitted in partial fulfillment of the requirements
for the award of the degree of
Bachelor Civil Engineering

Faculty of Civil Engineering and Earth Resources
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JANUARY 2013

# ABSTRACT

In Malaysia, the lift will normally be built in the building that has five or more than five floors. Kolej KediamanTiga of Universiti Malaysia Pahang that are here are just four floors, the norm on new student registration will normally be delivery problems arise if the student can be placed in high benchmark suite. The main focus is the design of building lifts. In the design of this lift, one part to consider is the for machine room slab. Where machine room slab must be designed to carry the load right. After the need to design an appropriate wall to and also to design a suitable type of foundation based on the type of soil and the burden borne by the elevator building. All these structures are designed and analyzed using the Esteem software.

# ABSTRAK

Dalam Malaysia, lif kebiasaannya akan dibina dalam bangunan yang mempunyai lima ataulebihdari lima tingkat. Di Kolej KediamanTigaUniversiti Malaysia Pahang bangunan yang terdapat di sini adalah hanya empat tingkat, kebiasaannya pada hari pendaftaran pelajar baru kebiasaannya akan timbul masalah penghantaran barang jika pelajar tersebut dapat di tempatkan di bilik yang aras tinggi. Fokus utama adalah merekabentuk bangunan lif. Dalam rekabentuk lif ini, satu bahagian yang perlu dipertimbangkan ialah lantai untuk bilik mesin lif ditempatkan. Di mana lantai bilik mesin perlu direka untuk menanggung beban yang sesuai. Selepas itu perlu merekabentuk dinding yang sesuai dan juga merekabentuk jenis asas yang sesuai berdasarkan jenis tanah dan juga beban yang ditanggung oleh bangunan lif tersebut. Semua struktur ini direka dan dianalisia dengan menggunakan software Esteem.

# TABLE OF CONTENTS

## CHAPTER 3 METHODOLOGY

# LIST OF TABLE

# LIST OF FIGURES

## *LIST OF ABBREVIATIONS*

| | |
|---|---|
| SMRF | Special moment resisting frames |
| BS | British Standard |
| UBBL | Uniform Building by Law |
| RC | Reinforcement Concrete |
| 3D | Three dimensions |
| FEM | Finite Element analysis |

# CHAPTER 1

# INTRODUCTION

## 1.1 INTRODUCTION

An elevator can be considering as a transport device used to move goods or goods or people vertically in a building. In British English, lifts are known more commonly as lift. Lift is a kind of system in building to move people upward and downward vertically at height building. In Malaysia, usually lifts will be built in buildings with five or more than five floors this means moving for disabled people in buildings less than five storeys is limited. With that, came the one idea to design and analyze a lift. Design structure lift is to know the suitable the material and design structures lift. The advantage concrete compare steel is the durability concrete ishigh strength, a fire barrier and resistant to abrasion.

Even though we know most of the lift core is made of steel and is easy to install ready but there are also drawbacks. Steel systems will often utilize bar joists to support the floor structure, however, they too have rather low span-to-depth ratios. One of the major deficiencies of steel structures is that they have low fire-resistance characteristics and require the use of special partitions or fireproofing methods. Steel structures typically will employ frames to resist the applied lateral loads, which allow the architect much more flexibility over a shear wall system when designing the layout and functionality of the building. Additionally, steel is much lighter than concrete and this saves on erection costs. Steel also the ration strength or weight high, weakness at high temperatures and easy to rust.

## 1.2 PROBLEM STATEMENT

Normally the building height of more than five levels in Malaysia has a lift system to facilitate the move of these people. However, this facility is not provided in the building with less than five stages. At University Malaysia Pahang KolejKediamanTiga(KK3) have only four levels and no lift. During the beginning of every semester, new students are struggling to carry their belongings to the upper building floors and worst disable persons have no means at all to move up and down of high storey buildings at Universiti Malaysia Pahang (UMP). The lift is for use disable people to move between the levels. It easier to use lift every time for new student registration and also at the end of the learning session.

## 1.3 OBJECTIVE

Below are the main purposes for conducting this study:-

1. To demonstrate and to verify the concept of lift core design.
2. To determine the fundamental aspects of lift design with case study for lift structure for KolejKediamanTiga (KK3) Universiti Malaysia Pahang.

## 1.4 SCOPE OF STUDY

Study scope has been set in this study as a guideline to achieve the objectives. The research scopes are:

To planning and design structure of lift or core lift as vertical transport, firstly finding detail information about studying the lift already exists in many buildings today. Then, decide the loading and design a suitable structure of lift based on the objective, which is to design structureof lift and then continue with analysison

the sustainable structure of lift.The core lift is designed by using ESTEEM structural software 6.2.5.8 to select suitable slab, shear wall and foundation. The structure is analyzed dynamically only in linear range and is in the form 3-D spaced frame. The foundation is fixed to the ground and soil interaction is neglected. After that verify the result by manual calculation and lastly prepare structural layout plan.

## 1.5 Expected Outcome

This research produce how to design a structure of lift or lift core that suitable for KolejKediamanTiga (KK3) using Esteem software.

## 1.6 Chapter Summary

The focus of this study, the problem and the concept to solve the problem will be discussed. This chapter is all about the problem statement that want to solve the problem so before to settle this problem we must to objective. In this chapter it was proposed that scope of study to use Esteem structure software and manual calculation.

In the next chapter, a review of the literature related to this project is undertaken.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

Literature review is where information on particular area was discussed. It is the summarization and also the synthesizing of research sources without adding any new ideas into these sources. Information obtained from various sources is very important for the understanding and also as groundwork of background of a conducted study. In this chapter, the planning and design core lift will be discussed using ESTEEM software. EsteemPlus (version 6.6) integrates with the advanced Finite Element auto-modeling to make 3-D analysis, design, detailing, drafting and quantity take-off for reinforced concrete building structural system. By integrating user-friendly GUI, EsteemPlus easily generates a comprehensive and accurate output of every slab, beam, column, shear wall, liftcore, pad and pile footing of the whole structure with minimum time and effort.

**Table 2.1:**Literature on lift slab structure instability during construction

| Problem Statement | Study/ Project Objectives | Study/Project Methodology | Data Collection / Experimental Setup | Results & Analysis | Conclusion & Recommend ation | Reference |
|---|---|---|---|---|---|---|
| Lift slab structures are one of the most efficient and economic ways of construction .However, the unstable condition of such structures, during the construction stages, has caused some disasters, such as the collapse of L'Ambianee Plaza in Bridgeport, CT, which killed 28 workers. | To find a solution for the unstable condition of the structure during construction, to protect this valuable and efficient construction method from becoming extinct | During the construction, the slabs are lifted by hydraulic jacks, parked at intermediate positions along the height of the columns.<br>The lower slab is usually parked at its final position, while the rest are parked above it at different locations.<br>The lifting process continues while the workers work at the lower levels to fully integrate the slabs with the columns.<br>In the mean time at the ground level the concrete shear walls are poured, after the columns are fully integrated at one level above, to give the structure the much more needed rigidity | Case studies on previous projects.<br>Carry out to develop a mathematical model it was necessary to describe the construction process and its stages. | $P_{cr} = \frac{\pi^2}{4h^2} \frac{\sum_1^n EI}{\sum_{i=1}^n \alpha_i \left[\frac{\pi h_i}{h} - \sin\frac{\pi h_i}{h}\right]}$<br>P= is the critical load;<br>h is the height of the columns the top of the concrete shear walls to the center of the highest parked group of slabs;<br>hi is the height of the columns from the top of the shear walls to the center of parked slabs at level I;<br>EI are the modulus of elasticity and total moment of inertia of the columns | The formula is easy to apply numerically and accurate enough to indicate that a specific stage of construction is stable or not | M. Rusk. 2000. Lift slab structures instability during construction. United State: American Society of Civil Engineers. |

| Problem Statement | Study/ Project Objectives | Study/Project Methodology | Data Collection / Experimental Setup | Results & Analysis | Conclusion & Recommend ation | Reference |
|---|---|---|---|---|---|---|
| The use of elevators during construction has been a well-defined practice in high-rise buildings. In high buildings the main objective for elevator use during construction is passenger transportation. The present study is based on a new concept, in which an elevator is used for a significantly longer period for both passenger and goods transport | To presents some results from a site supervisor construction site and relates the effects to health and safety, as well as efficiency, when materials are transferred by manual carrying or in an elevator. From collected the data on the use of the elevator and by measured the efficiency and safety | The observation data were gathered during 3 days. The data included information on the delivery of three different products and four different delivery processes traditional manual delivery and three advanced delivery systems using the tools developed.All measurements took place in the staircase, where the elevator was operating. | The automatic data collection system consisted of a computer linked to the network of the elevator.<br>The trip data included the following values recorded from each trip of the elevator:<br>• Date of the trip;<br>• User identification card ID<br>• Weight of load in elevator at the beginning of the trip<br>• Waiting and loading/unloading time<br>• Time and floor level of departure and arrival; and<br>• Total time of trip. | First the present analysis of elevator traffic data was to locate and identify the logistic bottlenecks. Second, elevator traffic data can be used to evaluate the amounts of work needed to perform logistic phases such as transportation, handling, and storage in general. | The use of a vertical transportatio n system diminishes physical loading as well as accident risk when compared to manual material handling. The use of a permanent elevator already in the construction phase is a suitable solution for this purpose. | Perttula.P, Korhonen.P, Lehtela.J, Rasa.P-L, Kitinoja.J-P, Makimattila.S, Leskinen.T. 2006. Improving the safety and efficiency of materials transfer at a construction site by using an elevator. Journal of Structural Engineering ASCE. |

**Literature 2.3:** Design of the tallest reinforced concrete structure in California

| Problem Statement | Study/ Project Objectives | Study/Project Methodology | Data Collection / Experimental Setup | Results & Analysis | Conclusion & Recommendation | Reference |
|---|---|---|---|---|---|---|
| The design of this building utilizes 10 ksi concrete, and reinforcing of grade 75. Even with these special materials, the reinforcing ratios were so dense for a project of this height that alternative systems had to be employed to allow for successful concrete placement | To study thepractical ways to reduce costs, speed construction, and simultaneoussl y achieve the goal of better consolidation. | The lateral system is comprised of a rectangular box shear wall core with concrete SMRF's located at the building perimeter. | From the construction the tower's dual lateral system is comprised of a 36-inch-thick concrete shear wall core and partial perimeter Special Moment Resisting Frames (SMRF). | Concrete spalling was observed in the test region around 0.003 in/in strain. The test specimens all showed a positive slope at the end of the test indicating that additional strength gain was probable.specimen lost their load carrying capacity The strain levels achieved in this test match well with other tests done on WRG (Giria, Saatcioglu 1996) and other tests done on conventionally reinforced high strength concrete specimens (Bing, Park, Tanaka, 2001). | While this project will be the tallest reinforced concrete building in California at the time it is completed, it is likely to be surpassed within a matter of a few years. Further research may be required in this area to reduce confinement steel requirements in order to allow the use of stronger concrete. | Roorda, D.D. and Rodrigues, N.J. 2008.Design of the tallest reinforced Concrete Structure in California – a 58-Story residential tower in San Francisco. Journal of Structural Engineering ASCE. |

**Literature 2.4:** KONE solutions for building without an elevator

| Problem Statement | Study/ Project Objectives | Study/Project Methodology | Data Collection / Experimental Setup | Results & Analysis | Conclusion | Reference |
|---|---|---|---|---|---|---|
| Installing a lift in a building existing dwelling to make buildings safer, easier and more convenient for residents and visitors of all ages, from babies in prams to older people. Elevator to make buildings more attractive to new residents. | Structural and aesthetic integration<br><br>Proper placement Also can install the elevator shaft attached to an outside wall of the building. In many cases the elevator shaft is built as a complete unit and then lifted into place. This can save time during construction | *first stage* investigated to made decision to install an elevator in your building. To collected information about regulations and more information.<br>The *second stage* the entire process from planning<br>The *third stage* the construction to installation<br>The *fourth stage* the final inspections. This ensures that the project will be completed on time and on budget. | Literature review, existing in the European Union and in Individual European countries to get started a step by step guide. | Solutions for buildings without an elevator. | This project began with a survey of the site, to determine what the best solution and the best way to implement it. Planning also includes support structure as possible and ensure wide access way enough to provide for fire-fighters in case of emergency. During the project, everything possible is done to minimize disruption to residents and ensure that no damage is done to the building. | KONE.(2008). Solutions for buildings without an elevator: A case Study. True stories about real building,PP.10. |

**Literature 2.5:** A composite structural steel and concrete beam for building floor system

| Problem Statement | Study/ Project Objectives | Study/Project Methodology | Data Collection / Experimental Setup | Results & Analysis | Conclusion | Reference |
|---|---|---|---|---|---|---|
| The find composite structural steel and concrete for building floor systems | The primary objective of this project is to develop a composite structural steel and concrete for residential and commercial construction | The concept for the design of this system using calculation | Collect the data about design criteria, gravity loads, Lateral Analysis, deflections | The structural developed by design criteria, Gravity loads | This research has proposed, and designed a complete system for residential and commercial buildings | A composite structural steel and prestressed concrete beam for building floor systems.2012. University of Nebraska |

## 2.2 Summary

Table 2.1 to 2.5 summerized the key literature for the study. Lift slab structure are built in a method, which makes them inherently vulnerable to static and dynamic instability during the construction stages. The columns cannot be laterally braced in the areas where temporarily anchored slabs are to be lifted to higher level impossible. This situation requires the checking of the whole structure above the shear walls for its stability of such structures, based on the number of slabs, anchored temporary at different levels, the distances between those anchored groups and the rigidity of the columns.

In the next chapter, a review of the methodology related to this project is undertaken.

# CHAPTER 3

# METHODOLOGY

## 3.1 INTRODUCTION

This study was conducted to study the design and planning lift core at kolej kediamanTiga(KK3). Phases of work must be identified so that the objectives of the study can be achieved smoothly and systematically. First of all, there have been extensive meetings with supervisor to identify the title and objectives of this study. After the title and the objectives of the study were identified, literature review was conducted to collect information so that deep understandings about this study were achieved. From literature review and discussion with supervisor, scope of study was identified.

Investigation and analysis phases started with analysis loading related to this study. Data that were of this study are analysis loading using British Standard and analysis using ESTEEM software. Finally, the results from this study are appears in plan. In this chapter, the procedure of data gathering and the analysis of data will be discussed.

## 3.2 Flow of works

Figure 3.1 below shows the overall flow of work in this study for the design and planning lift core.

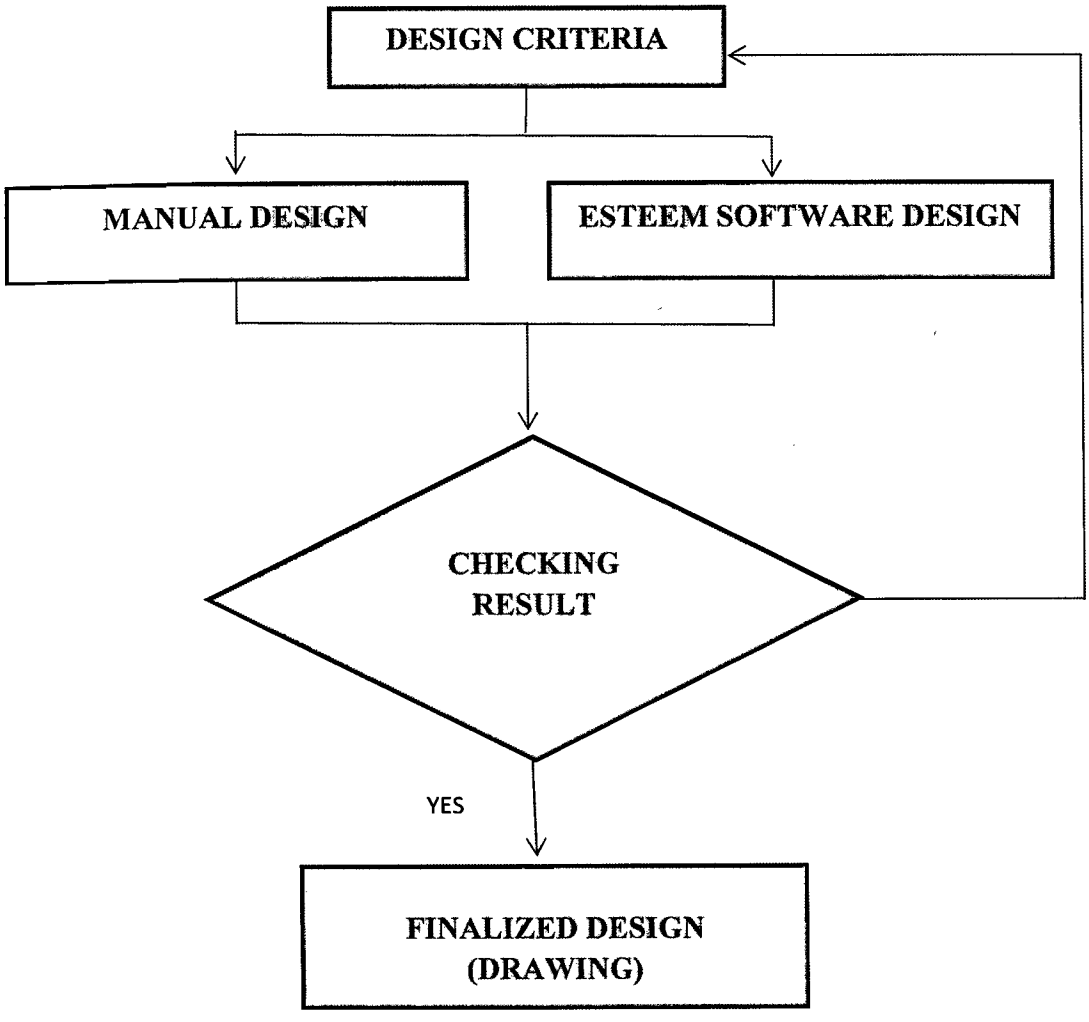


**Figure 3.1**: Project Flow Chart

## 3.3 Design criteria of Plan Building Used

The study will be carried out for a multistory building with a of 4 story height building. There reinforced concrete building which are based on a self-design plan lift core using ESTEEM. The structure will be analyzed dynamically in a three from frame analysis.

### 3.3.1 Self- Design Lift Core

Lift core is a vertical shaft in a building to permit the passage of a lift core consists of four levels are designed based BS8110:1997. Additionally lift core is also design using ESTEEM software. Table 3.1 shows the properties used in the design.

**Table 3.1:** Properties that Used in the Design

| Structural Element | Concrete Strength ($N/mm^2$) | Reinforcement Bar Characteristic Strength ($N/mm^2$) | Cover (mm) |
|---|---|---|---|
| Slab | 30 | 460 | 25 |
| Beam | 30 | 460 | 25 |
| Column | 30 | 460 | 25 |
| Core Lift | 30 | 460 | 25 |
| Pile Footing | 30 | 460 | 25 |

### 3.3.2 System Considered and Motions Used in Analysis

The building selected for this study is four level reinforced concrete space for symmetric plan building. These self-design buildings will be analyzed as 3-D linear dynamic analysis.

## 3.4 Manual design

The manual design is very important to make sure that what the design using software are valid so the manual design must have the step and include overall design,stability also the structure should be so arranged that it can transmit dead, and imposed loads in a direct manner to the foundations. For the required period of fire resistance (prescribed in the Building Regulations), the structure should have adequate loadbearing capacity, limit the temperature rise on the far face by sufficient insulation.

### 3.4.1 Loading

The loads to be used in calculation are:

a) Characteristic dead load,$G_k$the weightof the structure complete with finishes. The load from machine also must be include and bearing load cabin also to take.
b) Characteristic imposed load, $Q_k$(Bs 6399) and also refer to Uniform building by law (UBBL).

### 3.4.2 Limit State

This manual adopts the limit-state principle and the partial factor format. For ultimate limit state the design load are obtained by multiplying the characteristic loads. For serviceability limit states provided that span/effective depth ratio and bar diameter and spacing rules are observed it will not necessary to check for serviceability limit states.

### 3.4.3 Design of slab for machine room

The first step in preparing the final design is to complete the design of the slabs. This is necessary in order that the final loading is determined for the design of the frame. The general procedure to be adopted is as check that the cross-section and cover comply with requirements for the fire resistance, than check that cover and concrete grade comply with requirements for durability, after that calculate bending moments and shear forces, calculate reinforcements and make final check on span/ depth ratio.

### 3.4.4 Design of lift core Shear Wall

This subsection describes the final design of reinforced concrete walls that may provide the lateral stability to reinforced concrete framed buildings. The general procedure to be adopted is as follows check that walls providing lateral stability, then check the slenderness of the walls within every storey height, check that cover and concrete comply with durability requirements, then calculate axial loads and moments lastly design section and reinforcement.