SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering

Signature
Name of Supervisor: Mr. Mohd Yusof Bin Taib
Position: Lecturer
Date:

Signature
Name of Panel: Mr. Azizuddin Bin Abd. Aziz
Position: Lecturer
Date:

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature
Name: Siti Fatimah Binti Ismail
ID Number: MA05043
Date:

ACKNOWLEDGEMENTS

I am grateful and would like to express my sincere gratitude to my supervisor Encik Mohd Yusof Bin Taib for his germinal ideas, invaluable guidance, continuous encouragement and constant support in making this research possible. He has always impressed me with his outstanding professional conduct, his strong conviction for science, and his belief that a degree program is only a start of a life-long learning experience. I appreciate his consistent support from the first day I applied to graduate program to these concluding moments. I am truly grateful for his progressive vision about my training in science, his tolerance of my naïve mistakes, and his commitment to my future career. I also would like to express very special thanks to Encik Zakri Bin Ghazali for their suggestions and co-operation throughout the study. I also sincerely thanks for the time spent proofreading and correcting my many mistakes.

My sincere thanks go to all my members of the student of the Mechanical Engineering who helped me in many ways and made my stay at UMP pleasant and unforgettable.

I acknowledge my sincere indebtedness and gratitude to my parents for their love, dream and sacrifice throughout my life. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to attain my goals. Special thanks should be given to my committee members. I would like to acknowledge their comments and suggestions, which was crucial for the successful completion of this study.

ABSTRACT

Lift is a kind of system in building to move people vertically. In Malaysia, most of the lifts in the buildings are available only five levels and above thus the movement of disable people below than five levels are limited. So, the idea of design and analysis of light weight and lift system for the use of disable people is developed. Disable people subjected for whom using wheelchair or more specifically people walking is difficult or impossible due to mental or physical illness, injury, or disability to move. The aim of design is transporting a disable people using wheelchair from ground floor to first floor. Design concept of lift is based on rails, electric motor and gears. A suitable rail, electric motor and gear have considered in this design. Another part of lift design is platform and space requirement of platform depend on space of wheelchair and capacity of lift design. All components have been selected in order to design reliable lift system. The structural and component model of lift will be developed using the SOLIDWORKS software. The three-dimension solid model is then imported to the ALGOR and COSMOS software to an analysis on the sustainable and movement of the lift system.

ABSTRAK

Lif ialah suatu sistem yang digunakan manusia untuk bergerak keatas dan kebawah. Dalam Malaysia, lif kebiasaannya akan dibina dalam bangunan yang mempunyai lima atau lebih dari lima tingkat, ini bermakna pergerakan untuk orang kurang upaya di dalam bangunan bawah dari lima tingkat akan terhad. Dengan itu, terbitlah satu idea untuk merekabentuk dan menganalisa sebuah lif yang ringan untuk kegunaan orang kurang upaya. Orang kurang upaya yang dimaksudkan ialah orang yang mengunakan kerusi roda atau dengan lebih tepat orang yang tidak boleh atau melalui kesukaran untuk berjalan berpunca daripada masalah kesakitan mental atau fizikal, kecederaan dan tidak mampu berjalan dengan baik. Focus utama rekabentuk lif ini adalah membawa orang kurang upaya terutamanya yang mengunakan kerusi roda begerak dari tingkat bawah ke tingkat pertama. Konsep rekabentuk lif terdiri daripada landasan, motor elektrik, dan gear. Landasan, motor elektrik, dan gear yang bersesuaian dipilih dalam mereka bentuk sebuah lif. Dalam rekabentuk lif ini, satu lagi bahagian yang perlu dipertimbangkan ialah pelantar dan ruangan pelantar yang bergantung kepada keluasan sebuah kerusi roda and kapasiti sebuah lif. Semua komponen dalam sebuah lif dipastikan terlebih dahulu sebelum merekabentuk sebuah lif yang lengkap. Semua struktur dan penyambungan component model sebuah lif direkabentuk dalam software SOLIDWORK. Kemudian, rekabentuk tiga penjuru tersebut akan dianalisa dalam software ALGOR dan COSMOS(motion) untuk menganalisis kekukuhan dan pergerakan lif tersebut.

TABLE OF CONTENTS

TABLE OF TABLE

LIST OF FIGURES

LIST OF SYMBOLS

σ	stress
F	force
A	area
ε	strain
ΔL	difference between original length and deformation length
L	length

LIST OF ABBREVIATION

AISI	American iron and steel institute
AVI	Audio video interleave
CAD	Computer-aided drafting
CM	Cosmos motion
D/A	Digital analog
DSW	Department of Social Welfare Malaysia
VVVF	Variable voltage variable frequency

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Malaysia has a population of 27.17 million people and total of 197,519 disabled people have registered with the Department of Social Welfare Malaysia (DSW) at the end of 2006. This figure is not a true reflection of the number of disabled people as registration is voluntary.

As citizens of this country, the disable people as minority group have a right in education, employment, proper housing, medical care, accessible transportation, a barrier-free environment, sports and recreation and also a right to participate in all aspects of life. Base on Disable Issues for the 9th Malaysia Plan state that government seriously concern to Improvement in the overall quality of life for people with disabilities by alleviating them from deprivation, hardship and poverty. Disable people especially using wheelchair should have the opportunities and improved living conditions resulting from social and economic development.

Statistics provided by the Higher Education Ministry last year show that there were 183 registered disabled students studying at pubic higher education institutions. Higher Education Management Department director-general Prof Datuk Dr Hassan Said says the figure for the 2007/2008 academic year will increase as the Ministry is still considering appeals from disabled students. Table 1 shows the statistic of disable people students at public HEI before academic year of 2007/08.

Table 1.1: The breakdown for last year is:

University	No. of break down
Universiti Malaya	29
Universiti Sains Malaysia	20
Universiti Kebangsaan Malaysia	28
Universiti Teknologi Mara	29
Universiti Utara Malaysia	14
Universiti Pendidikan Sultan Idris	14
Universiti Teknologi Malaysia	11
Universiti Putra Malaysia	10
International Islamic University Malaysia	10
Universiti Malaysia Terengganu	6
Universiti Darul Iman	5
Universiti Malaysia Sabah	3
Universiti Sains Islam Malaysia	2
Universiti Teknikal Malaysia Melaka	1
Universiti Malaysia Pahang	1

About 50% of disable students are expected using wheelchair as their medium of movements. The statistic only recovered for students already have registered as disable students. There are some emergency cases students are coincidently faces trouble and loss mental or physical part permanently or some distances of time. Therefore, the statistic of disable students in higher education institutions will be more than the statistic in the table 1.1 and the number of disable students using wheelchair also higher than stated percentages.

An elevator can be consider as a transport device used to move goods or people vertically in a building. In British English and other Commonwealth English’s, elevators are known more commonly as lifts. Lift began as simple rope or chain hoists. A lift is essentially a platform that is pulled up and down by a mechanical means. A modern day lift consists of a cab (also called a "cage" or "car") mounted on a platform within an enclosed space called a shaft, or in Commonwealth countries called a "hoistway". In the past, lift drive mechanisms were powered by steam and water hydraulic pistons. In a "traction" lift, cars are pulled up by means of rolling steel ropes over a deeply grooved pulley, commonly called a sheave in the industry. The weight of the car is balanced with a counterweight.

1.2 PROPBLEM STATEMENT

Usually, large building which consist more than five levels in Malaysia has lift system to facilitate the moving of these people. However, the facility is not provided in building with less than five levels. Thus, this project is aiming to design and analyze a light weight of lift system for the use of disable people to move between the ground floor and the first floor of the building.

1.3 OBJECTIVE

The objective of this project to design and analysis a light weight lift system for disable people.

1.4 SCOPE OF STUDY

The design and analysis of the lift system study about literature review existence elevator, then design a suitable elevator based on the objective, continue with analysis and simulation on the sustainable and movement of the lift system.

The literature review is about finding detail information about roped and hydraulic. The roped elevator is driven by a rope and an electric motor, while the hydraulic elevator is driven by a cylinder and fluid power [2]. The control scheme of a hydraulic elevator consists of three control steps [1]. The first step is the pressure compensation step, second the velocity tracking control step, and third the destination position control step.

The lift system is aiming to move a disable people to the first floor of building only a level to transporting a disable people and is with wheel chair. There are contains five main components that are platform, rail, electric motor, and gear. Beside that, an Emergency button also attach to the platform in case of user safety. Another safety required in the design is a safety door switch, by using this switch the lift will do not operate when the door does not close properly.

In the analysis work, all loads in the lift system have been considered such as total load of the lift system and the average load of passenger includes the wheelchair. Then stress strain analysis using ALGOR software will be done at the parameters of the design lift system. The vertical movement of lift design will be show in the analysis using COSMOS software.

CHAPTER 2

LITERITURE REVIEW

2.1 INTRODUCTION

The first powered elevators appeared around 1830, when factories began using central power systems to drive rope-and-pulley lifts. In several decades later, the electric elevators appeared in the 1880s and the elevators were attached on high building.

Currently, there are two types of elevators, hydraulic and traction or roped. The hydraulic elevator consists of a cab attached to the top of a hydraulic jack similar to a jack used for a car lift in a service station. The hydraulic jack assembly normally extends below the lowest floor and is operated by a hydraulic pump and reservoir, both of which are usually located in a separate room adjacent to the elevator shaft. Hydraulic elevators are the type generally used in single-family residences. The second type is the roped elevator. This is the system that is most commonly associated with elevators. The roped system consists of a cable that is connected to the top of the cab and is operated by an electric motor located in a penthouse above the elevator shaft.

2.2 ROPED ELEVATOR

The basic mechanism of roped elevator dynamic system with respective components is shown in figure2.1. The elevator consists of four major inertial elements which are the drive sheave, elevator car, counter weight and compensation sheave [6]. Each of the inertial components connected to each other with rope segments whose length vary as the elevator car move up and down the hoistway. The mass of the car can vary depending on the number of passenger.

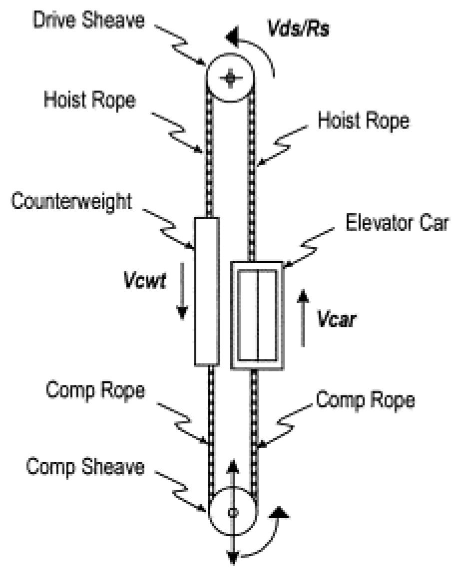


Figure2.1: Schematic of basic mechanism of the elevator system **(**Young Man Cho and Rajesh Rajamani,2001).

The structure dynamics of hoistway ropes using mass approximation to get the force transmission delay in each of four difference rope segments. Each of the ropes segment are consist of difference type because the ropes have difference parameter values for stiffness, mass, and damping. In addition, stiffness and damping value of dampers connected to an inertial ground for drive sheave, compensation sheave rotation, and translation, counterweight, and elevator cab are also included in the model.

2.2.1 The Velocity Control of Roped Elevator

The roped elevator control input given by the torque to drive the sheave motor and payload. The velocity control system also depends on the behavior of the first two modes at the bottom for the hoistway with the position of the elevator car. This could be determined by random input test at difference point at hoistway. The behavior of the first rope mode is illustrated in figure 2.2 for transfer function between the velocities of the drive sheave to the velocity of the car. The stiffness and damping are absolute and real values of the poles at the corresponding frequency.

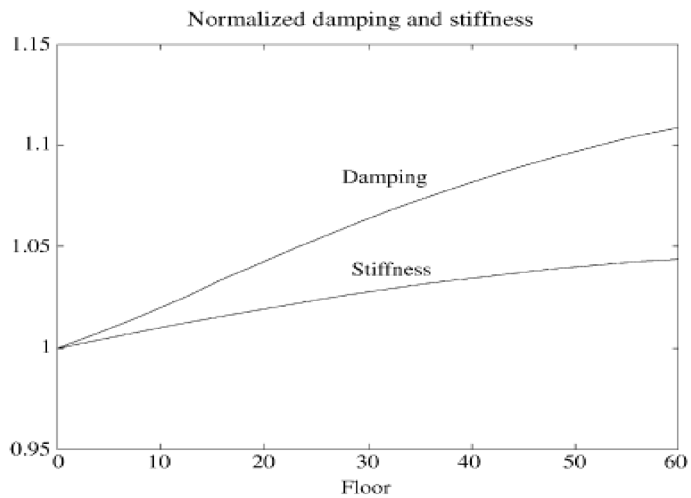
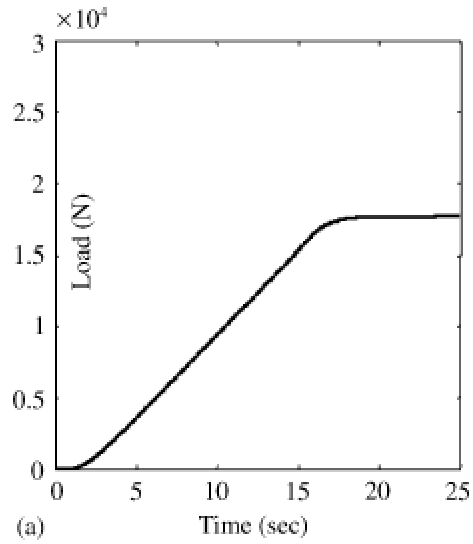


Figure 2.2: The variations of the first rope mode observe in drive sheave. Car velocity transfer function.

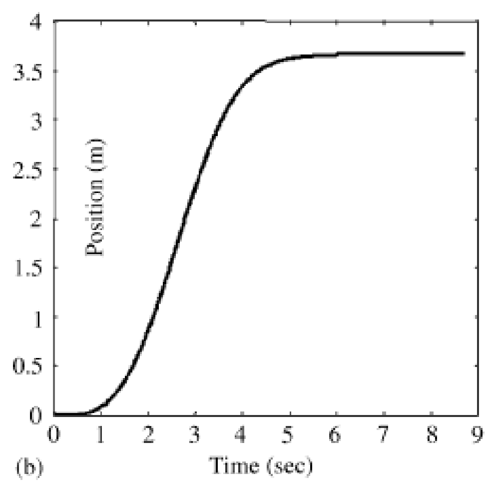
The systems get more stable as the elevator car approaches the top of the hoistway. This controller based on the dynamics at the bottom of the hoistway, the system require for non linear closed loop stability. Then notice that the behavior can be approximate well by using height of 60 floors corresponding to the height of 200m.

The elevator system from the central view point also provides two sensor measurement, car position and drive sheave velocity, and the single control in the form of torque actuation through a motor to a drive sheave. To evaluate the performance for the elevator vertical ride, a set of standardized test is often used in practice [6]. Saligrama. R. Venkatesh, Young Man Cho and Jongwon Kim are concern about re-leveling error and vertical ride quality.

Re-leveling error is a measure of the elevator system response to increase or decrease of payload in the elevator car. The test required that the elevator car be regulated to within 6mm of the target floor position quickly in response to any pay load ranging from 0% to 100% capacity [6]. A smooth profile as shown in the figure 2.3 is typically used as basis for measurement re-leveling. This profile simulates the effect of increasing the payload from 10% to 50% in 15 seconds.



(a)



(b)

Figure 2.3: (a) Typical load profile for simulating re-leveling performance (b) A run profile for evaluating vertical ride quality

This simulation is about the times elevator system takes 18 people to get into an elevator. The simulation need to be carried out at all locations of the elevator car as payload is increased. The elevator car sags below that floor level and the elevator control system quickly response to the load and re-leveling the elevator car so that the car never move from the floor level.

2.3 HYDRAULIC ELEVATOR

The hydraulic elevator consist of a control schemes to make sure the passenger feel comfortable using this elevator. The control scheme of hydraulic elevator consist of three schemes control steps which is the load pressure compensation step, the velocity tracking control step and the destination position control step[1]. The load pressure compensation step reduces the joint of the car that may produce an uncomfortable ride for passenger. The velocity tracking control makes the car follow a reference velocity profile that help the passenger feel comfortable during the movement of elevator. The third control scheme the destination position control reduces the position error which may exist after the velocity tracking control at the target position.

The hydraulic vector system was divided into two parts, a mechanical part that includes car, rope, and pulleys, and a hydraulic part that includes the cylinder, logic valve, hydraulic power unit, and pipes as show in the figure 2.4 below. There is a hydraulic pump built in the hydraulic power unit connected directly to an electric motor to generate fluid power and controls the velocity of the car. A smooth transportation of car depends on smooth movement of the cylinder generate by hydraulic power. Every each of the part is very importance to transport the passenger to the destination position.

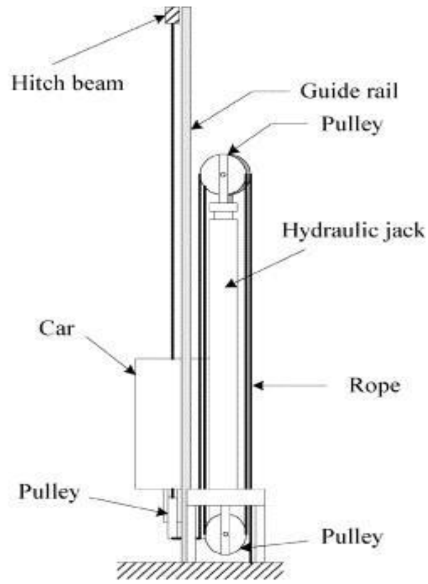


Figure 2.4: hydraulic elevator (Chang-Sei Kim, Keum-Shik Hong and Moon-Ki Kim**)**

2.3.1 Control Speed System of the Hydraulic Elevator.

The hydraulic elevator was improved with the rapid development of modern science and technology. Most of hydraulic systems are used electro hydraulic proportional technology to analyze an ideal operating state [2]. In recent years the designer gradually adopted to design high technology of the hydraulic elevator which makes hydraulic elevator more steady with pressure loads, dynamic response in velocity tracking and stable when reach the destination position. The hydraulic elevator is based on the technique cores of variable voltage variable frequency (VVVF) were developed with development of computer control show in the figure 2.5. Perfect control of the VVVF hydraulic elevator is realized by combining the control of the motor revolutions with a flowrate transducer or velocity transducer of excellent performance [2].

The control systems of the VVVF hydraulic elevator consist of two parts. The first is upward running system which consists of VVVF motor and the constant delivery pump.

The second is the downward running system which consists of hydraulic motor, electric motor, and energy feedback.

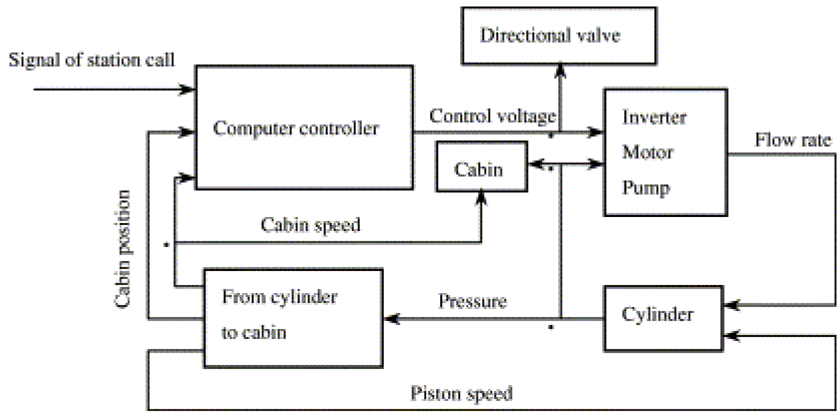


Figure 2.5: Block diagram of VVVF hydraulic elevator system (Yang Huayong , Yang Jian , and Xu Bing,2004).

The VVVF hydraulic elevator is moving upward when the elevator begin to run up, the upward signal is send by the computer controller and its transferred into the inverter by D/A according to the input signal, the inverter drive the motor, when the output pressure of the pump is larger than payload, the hydraulic oil opens a one-way valve and flow into the cylinder to make the piston move upward.

Meanwhile, the VVVF hydraulic elevator is moving downward when the elevator begins to run down, the pressure pre-balance is controlled first at both side of the one way valve. Once the pressure pre-balance controller has finished, the hydraulic elevator starts to descend. The control signal given by the computer controller will switch electric motor to run from upward direction to a reverse direction and the electric motor begins to generate electricity at that time. During entire downward process, the computer controlled continuously calibrates control signals according to the ideal curve of velocity and practical running. The practical running curve of the elevator always coincides with the ideal running curve.

The displacements and velocities of importance inertial masses have been measured from the test facilities and the transfer function among system has been computed [5]. The experimental results of the upward direction of the hydraulic elevator under the condition of no load are shown in the figure 2.6. As shown n the figure 2.6 Curve 1 is the ideal speed curve of the computer controller, meanwhile curve 2 is the practical measured speed curve and curve 3 is the practical pressure measured. The experiment result shows that the shapes of the curves are closer to the ideal speed curve given.

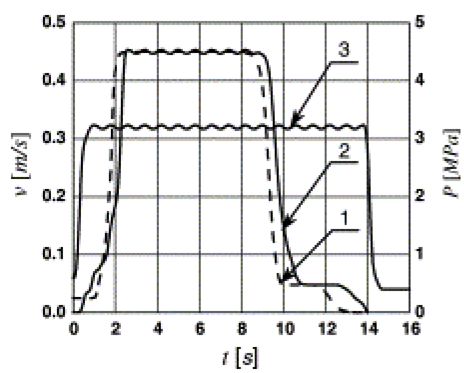


Figure 2.6: Experimental result of upward direction 1)ideal speed, 2)practical speed and 2)practical pressure.

The experiment results of the downward direction of the hydraulic elevator under the condition of no load are shown in figure 2.7. As shown in the figure 2.7 curve 1 is the ideal speed curve of the computer controller, meanwhile curve 2 is the practical measured speed curve, and the curve 3 is the practical pressure measured. Unbalance torque and the friction between the cabin and its sliding rail will result in increased static frictional force and will prevent the elevator from starting.

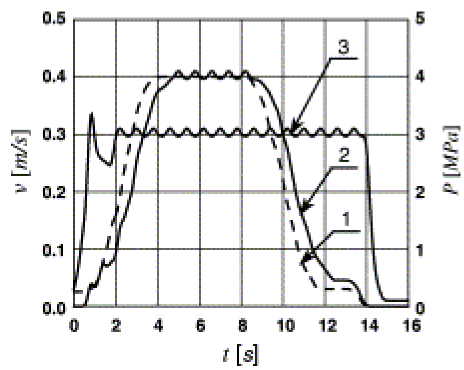


Figure 2.7: Experimental result of downward direction 1)ideal speed, 2)practical speed, 3)practical pressure.

2.3.2 The Destination Control System

In an elevator system passenger service during up-peak was prepared. There are several criteria describing elevator and passenger service, such as round trip time and interval, passenger waiting time, ride time inside a car and journey time [4]. The elevator service time at an entrance floor is the time interval between sequential elevator departures for upper floors. The time a passenger spends in an elevator traveling up to the destination floor is different from the elevator service time. It depends on the destination floor, the number of intermediate stops before the destination, and the passenger loading and unloading times. The passenger ride time inside the car and the total time a passenger spends in an elevator system are deduced using transition probabilities between the floors.

2.3.3 High Elevator Design Planning

The modern system in high rise buildings consists of several group of elevators with centralized control. The elevator planning is to configure a suitable system to be built. The elevator group must satisfy specific minimum requirements for a number of standard criteria. In elevator also is desirable to optimize the configuration in the terms of other criteria related to the performance, economy and service level of he elevator system.

The suitable elevator group can serve the traffic of a high rise building. The traffic must be estimated by using the building specifications which is the number of the floor, their height, the floor area and the building types. The travel height can be calculated from the number of floor and their height, and the total population can be estimate according the type of building and the floor area [3].

The performance of groups of elevator is mainly determined by the number and size of the car, speed, acceleration, door types and the group control performance. Usual performance criteria are the handling capacity and the interval calculated in the up peak situation, the up peak handling capacity is the percentage of population per 5 minutes that can be transport from lobby to the upper floors at a buildings.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

The design process of the lift system for disable people consists of five steps to realize the objective of design. The five steps including literature review, design concept, modeling lift system using solidwork software, analysis the lift system using algor software and then carry out simulate of the lift using cosmos motion software.

Literature review has been carried out existing lift or elevator system installed in the building higher than five levels. The second step is design concept of the lift system consist of design geometrical, design parameter, material selection and assembly process that are needed in designing the lift system. The third step is modeling lift system using solidwork software where as this software show parameter and assembly process of the lift. The fourth step is analyzing the lift system using algor software to analyze the capability of the lift system to transport the disable people from the ground floor to the first floor. Finally the fifth step which is simulation using cosmos motion software where the software will shows the movement analysis of the lift system. All of the mentioned steps above are shown in flowchart of methodology in the figure 3.1 below.

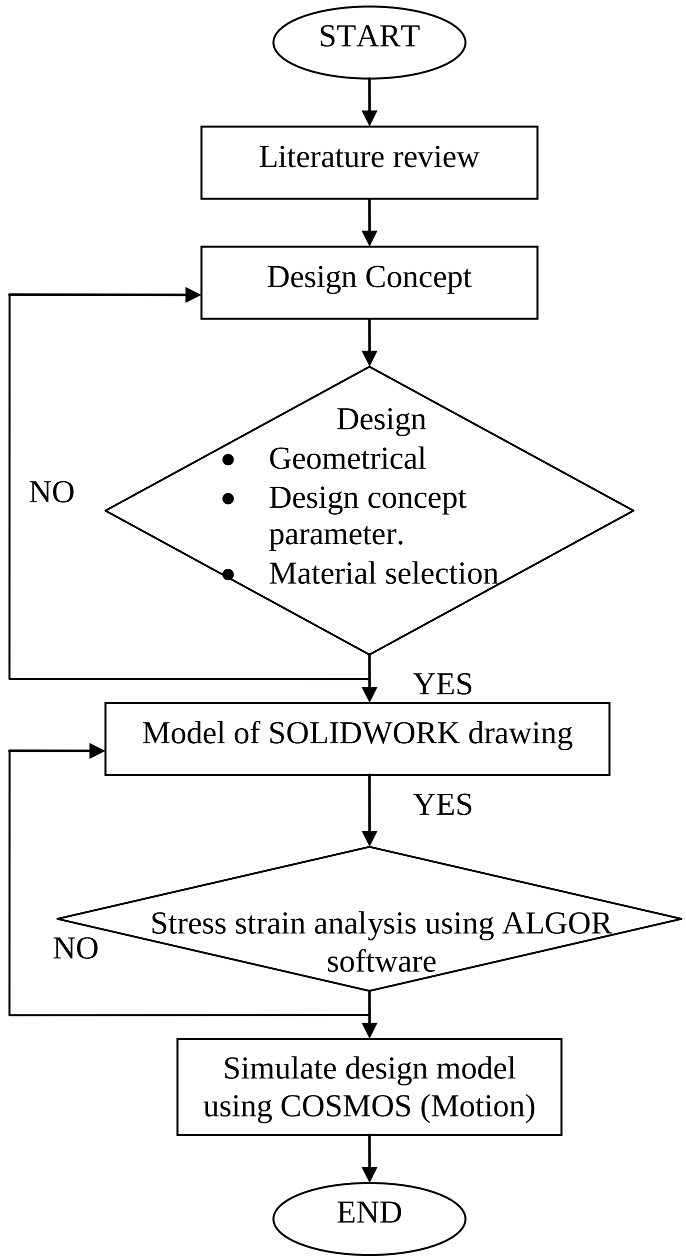


Figure 3.1: Flowchart of methodology.

3.2 FIRST STEP: LITERITURE REVIEW

Based on the literature study of the lift or elevator system higher than five levels this project is focus on the design and operating systems of the hydraulic and roped elevator. The basic mechanism design, velocity system, loads pressure system on the platform or car, and the destination position of the hydraulic and roped lift or elevator systems are the importance information to achieve the desired objectives.

The basic mechanism design of the hydraulic lift system such as cylinder and hydraulic power and roped lift system likes motor and rope is very useful to produce power and movement for the lift system. By using those basic mechanisms design of lift system the cab or platform can move in the vertical direction from lower to higher level of the building. In other to design a lift system needs generating power system, hoistway system and platform to transport people in vertical movement.

The velocity system and loads pressure system are also importance to identify a suitable design parameter of the lift system. The height, times, load, power and other information parameters in the lift system needs to be identified when choosing the components for the lift system. The load pressure of the lift system is depends on the capability of generating powers from electric motor.

The movement and the destination position of the system are connected to the power sources. The power sources that connected to the platform need to shut down when it achieve the destination position. An automatic control is use to install in the power generator so that the lift system can stop in the right destination position.

3.3 SECOND STEP: DESIGN CONCEPT

The lift system consists of a platform attached to the four rails used for guides platform lift moving in vertical direction. The rails are assembles to each side of platform lift in other to balances the platform when moving upwards and downwards. The moving of lift depends on electric motor that has low velocity and able to withstand large amount of loading capacity. The electric motor is installed inside motor box on the right side of platform shown in the figure 3.2.

The basic components of lift include rack and pinion gears connected to the electric motor system. When the control system sending signal the electric to move up to first-level floor the system controlled by an electric motor start moving. So, the rotational movement of electric motor will rotate pinion gear that mounted at electric motor shaft. Then, rotational movement of pinion gear converts to verticals movement when pinion gear attach with rack gear as shown in the figure 3.2. As rack gear mounted vertically so, the lift move upward also. As the lift platform approaches the desired level, the signal is sent to the motor to shut off, thus stopping the electric motor and the subsequent movement of the rack and pinion gears. When it is the time for the lift platform to move down to ground level the motor electric that have reversible speed will moving reverse rotational and slowly moving down.

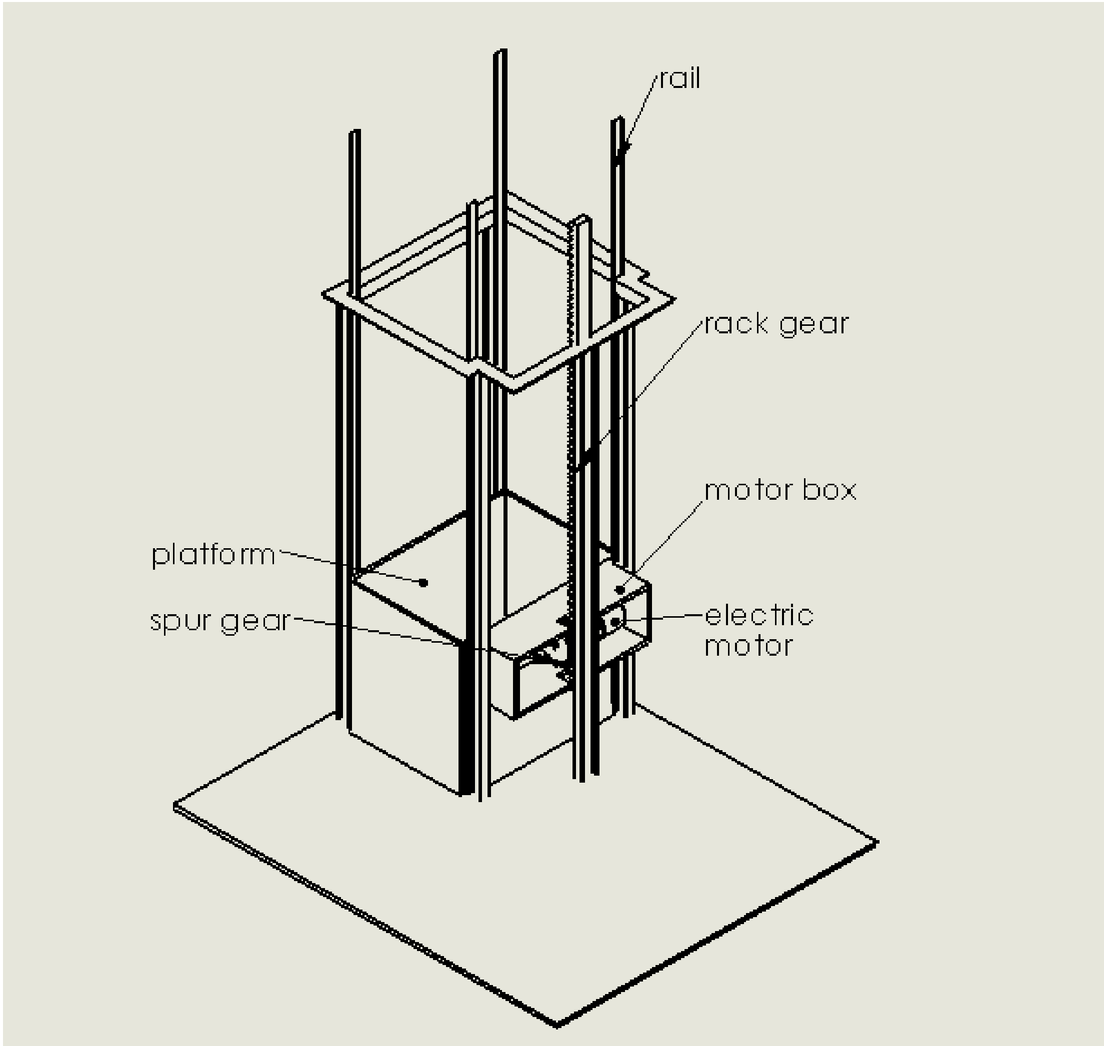
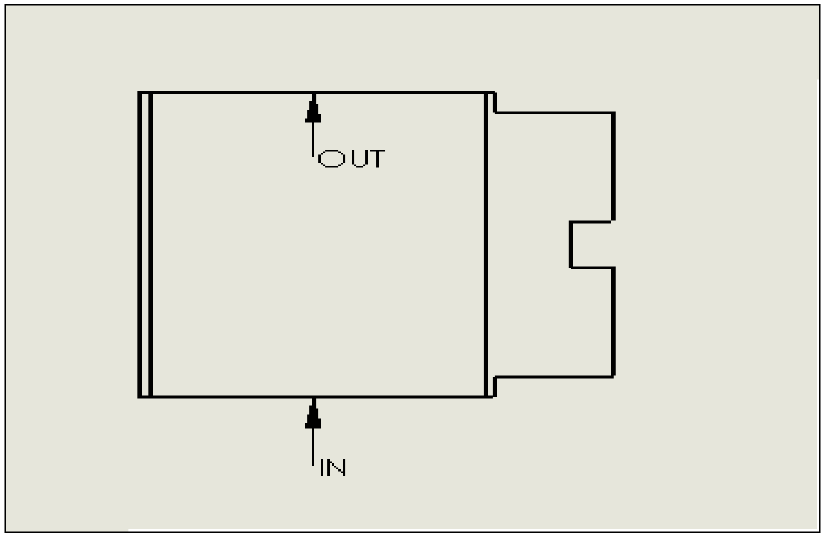
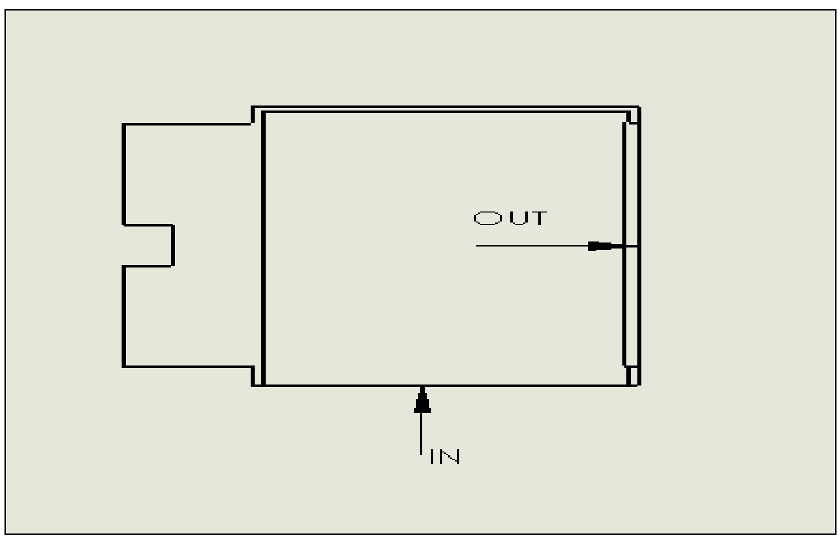


Figure 3.2: The design concept of the lift system.

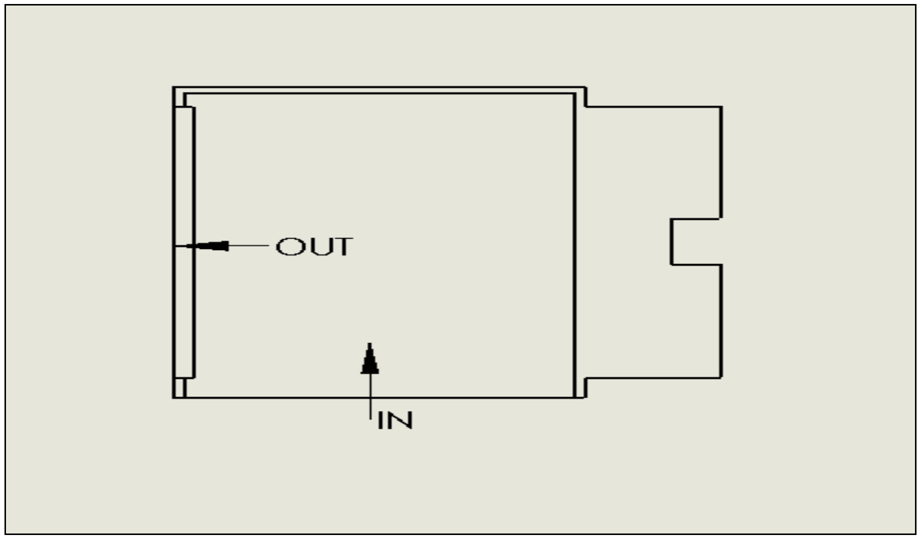
The space of the platform must fix with one disable with or without wheelchair. The measurement of maximum size and weight of a people with wheelchair was calculated to make sure the platform fix with the passenger. The designs of platform shows in the figure were fixed with passenger with variation of exit direction. First, direct through exit, second right through exit, third left through exit and reverse exit show in the figure 3.3.



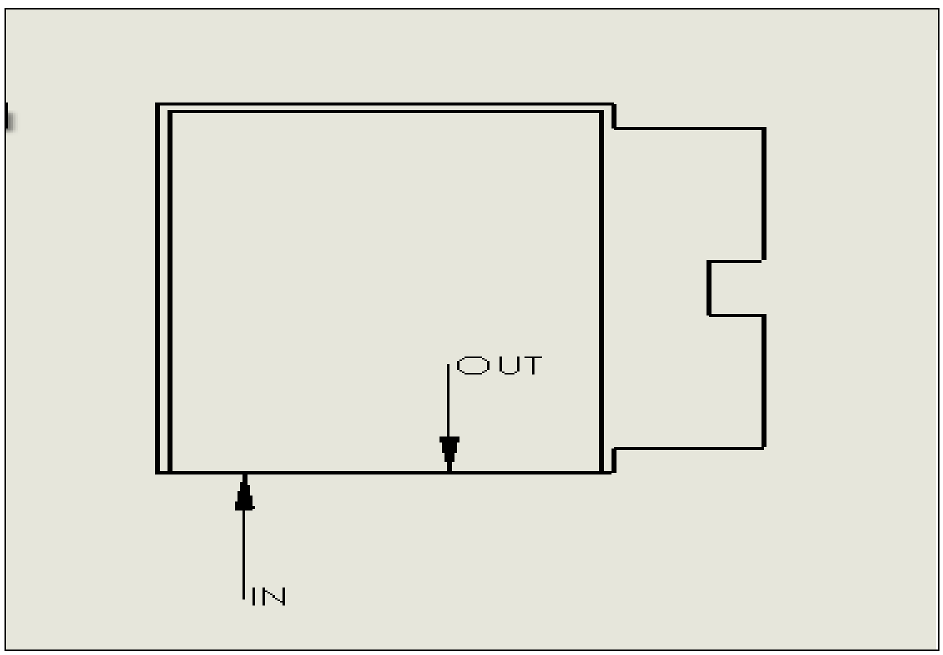
(a)



(b)



(c)



(d)

Figure 3.3: (a) direct through exit (b) second right through exit (c) third left through exit (d) reverse exit

3.4 THIRD STEP: MODELLING LIFT SYSTEM USING SOLIDWORK SOFTWARE.

In the modeling of lift system, all parameters and components involve in the lift system are selected such as platform, gears, rails and electric motor. In the moving parts of the lift system, mechanisms of gears are involved in the lift system. The rack and pinion gears are the simplest mechanism of the lift system because the system does not trough complex installations system. The linear rack gear type use as rack gear and for pinion gear a spur gear type was selected.

After finished selecting the suitable component, the next step is generating the entire related component in computer by using solidwork. This is the importance step before performing simulation. This solidwork is computer added mechanical design software. This software is choose because of it capability for designer to sketch idea of the design in three-dimensional models and can produce detail technical drawing. Besides that, by using this software it enables user to design much faster and precise.

Solidwork designs of the component are based on 3D design. To make the design of the lift system must follow several command of design which is sketch, features, and assemblies. The sketching command is about creating the structure of the design by know where to put the dimension of the design in the measurement process of the components design and apply all the relations.

Next are the features and assemblies process. The features process is about selecting the appropriate features for each component and determines the best features that could be apply. Then the assemblies process is about selecting the component and assemble by mate surface component to another surface component by identifying the type of mate that should be applied. The assembly of the part involve shown in the figure 3.4.

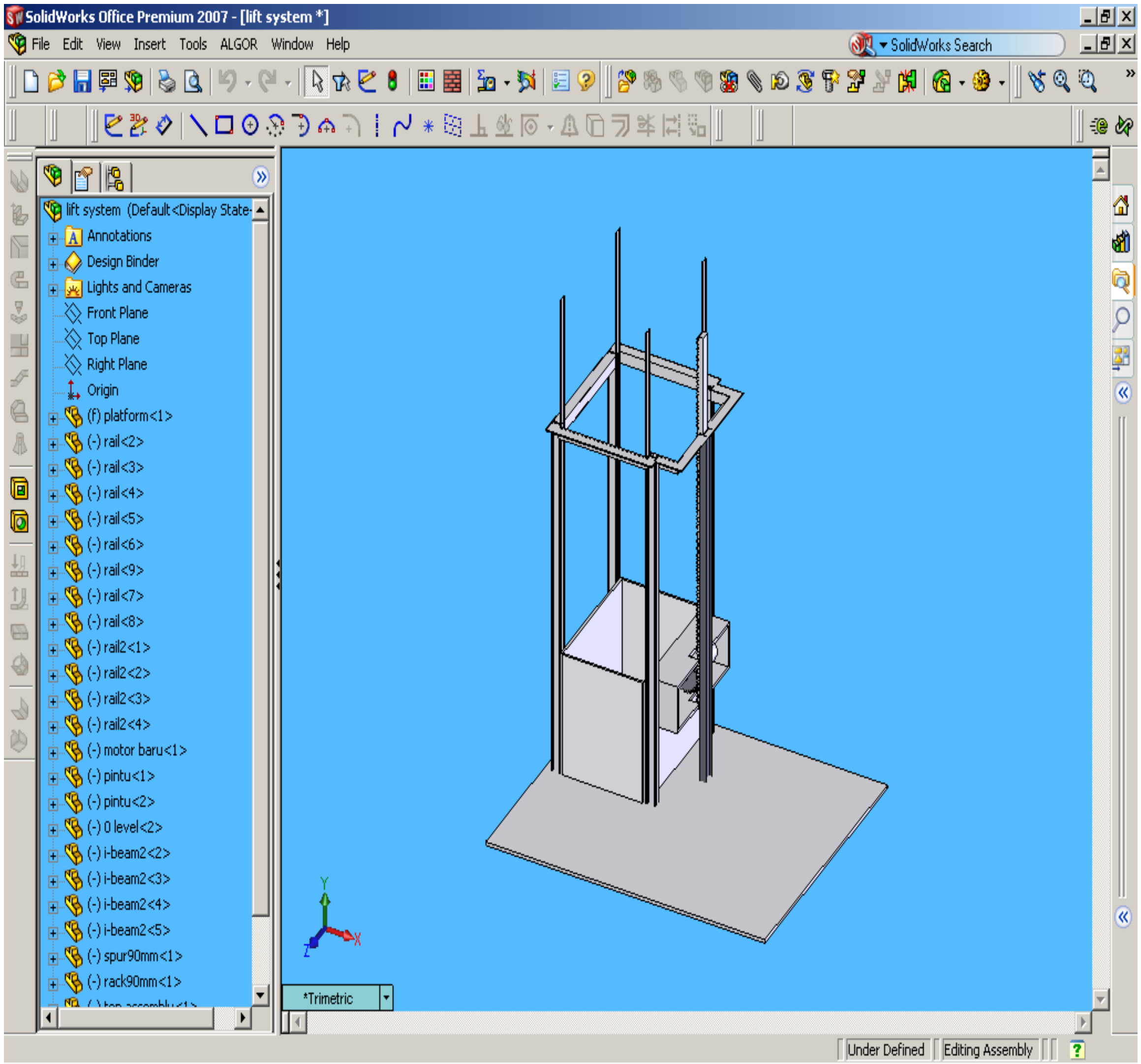


Figure 3.4: Assembly of the lift system.

After all the component had been assembled, the next step is to setting the simulation using ALGOR software. However, before doing simulation makes sure the designs are suitable if not the design should through the modification processes.

3.5 FORTH STEP: STRESS AND STRAIN ANALYISIS 0F THE LIFT SYSTEM USING ALGOR SOFTWARE.

This step is to define actual condition and sustainability of the lift system when loads were attached. The process is importance to make sure that the analysis could give the accurate and precise result. Stress and strain analysis is a useful mathematics tool that can do structure analysis of the lift system design. The stress and strain analysis using ALGOR software is used to analyze the critical part or structure of the lift system.

The stress and strain analysis of the system consists of several steps to define the actual condition into simulation condition. The steps are choosing the critical part, defining the meshing and material properties, defining boundary condition, applying load and then run the simulation to obtaining the solution. The critical parts of the lift system use to be analyzed are platform structure with beam and the connection between gears. The critical part was analyzed in separated file.

Firstly, the meshing and material properties of the part were defined. The materials properties are depend on material selection that was decided before designing the lift system. The material property of platform is galvanizing steel, beam is AISI 1005 steel, and gears are using same material which is AISI 1045 steel. Then define the boundary condition of each part of the system. The boundary conditions represent the actual condition of the critical parts.

The next step is applying loads to the critical part. The load on the platform structure is starting from the optimum value for the lift system which is 2000N. The loads of 2000N represent the maximum capacity of the passenger attach on the platform. Then the final part is the connection between gears carried load of 4000N with the same case of rail and beam. The loads represent the summation of the passenger capacity and the weight of platform that is assembles with the rail and beam.

After defining all of the information needed in the analysis, the critical part can start run the analysis to obtain the solution. When finished analyzing the critical part, data of von mises stress and strain result were recorded. If the analysis process is failed then the lift system should be trough the modification process as suggested.

3.6 FIFTH STEP: SIMULATION OF DESIGN MODEL USING COSMOS (MOTION) SOFTWARE.

The design of the lift system is complete if analysis about the movement and the operation of the lift system occur. The movement and the operation of the system can be simulate by using cosmos(motion) software. The cosmos software concern all about the properties consist in the movement characteristics of the system. The properties consist in the software program are defining the moving and grounding parts, defining joint parts, run the simulation and defining result data. All parts involved in the system are defined in software because all of the parts are connected to the movement system. Then, moving and ground parts were defined from all the parts consist in the system. The electric motor, spur gear, rails arm and platform were decided as the moving parts of the system.

After decided the moving and the ground parts, the joint should be define between all of the parts. First, the joining parts between the moving electric motor and spur gear with revolute type of joint. The revolute joint between motor electric and spur gear rotate in z-axis with velocity of 4290deg/s. Second, the connection between platform and rails arm parts moving in translation type of joint. The translation between the joint parts is moving at y-axis with velocity of 300mm/s. Third joint is the connection between moving rails arm and ground rails. The joint is moving in translation at y-axis with velocity of 300mm/s. The simulations of the lift system consist between two parts which is moving upward and moving downward with the same moving type properties.

When complete defined the data needed for all the part, the lift system can start run the simulation of the all the moving and ground parts. Then, the simulation need to export AVI movie to get the data of simulation result in term of graphs.

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

The purpose of this chapter is to provide the further discussion from the analysis and simulation of the critical part and movement of the lift system. The analysis of critical part of the system was simulated using ALGOR software and analysis of the movement was simulated in COSMOS (motion) software. Then the result data of stress and strain obtain in the ALGOR soft ware and data of velocity, acceleration and moment obtain in COSMOS (motion) were recorded.

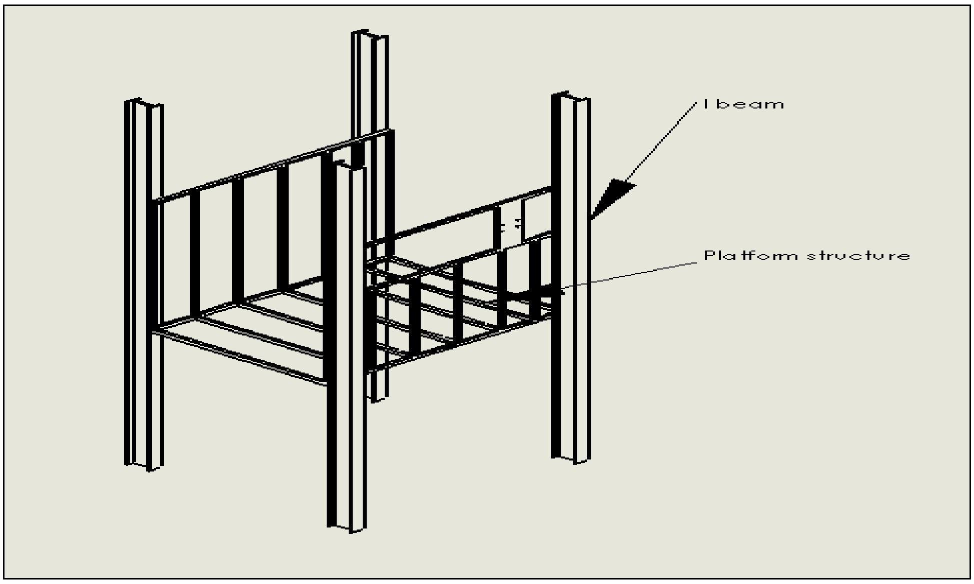
The stress and strain analysis is use to investigate about the sustainablility of the critical parts involved in the lift system. This analysis also discuss about stress allowable in each of the critical parts. Via velocity, acceleration, and moment analysis are discuss about the translation and rotating motion of each of the moving part.

4.2 ANALYSIS OF LIFT SYSTEM

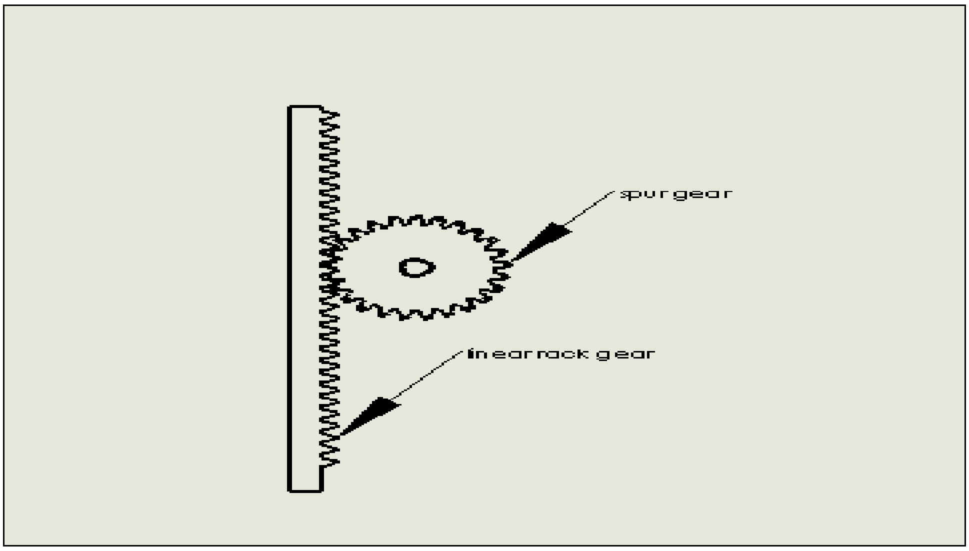
The lift system was analyzed using stress and strain analysis. The ALGOR software was used to determine the stress and the strain value after considering mesh, material properties, boundary condition and forces attach on the lift system. All the information involves in the analysis was based on the actual condition of the lift system. Then the result value was analyze in the increasing value of force attach on the lift system.

4.2.1 The Stress and Strain Analysis

The critical parts of the system consist of two primary parts which the first parts are platform, and I beam and second are spur and rack gear. The critical part of the lift system show in the figure 4.1.



(a)



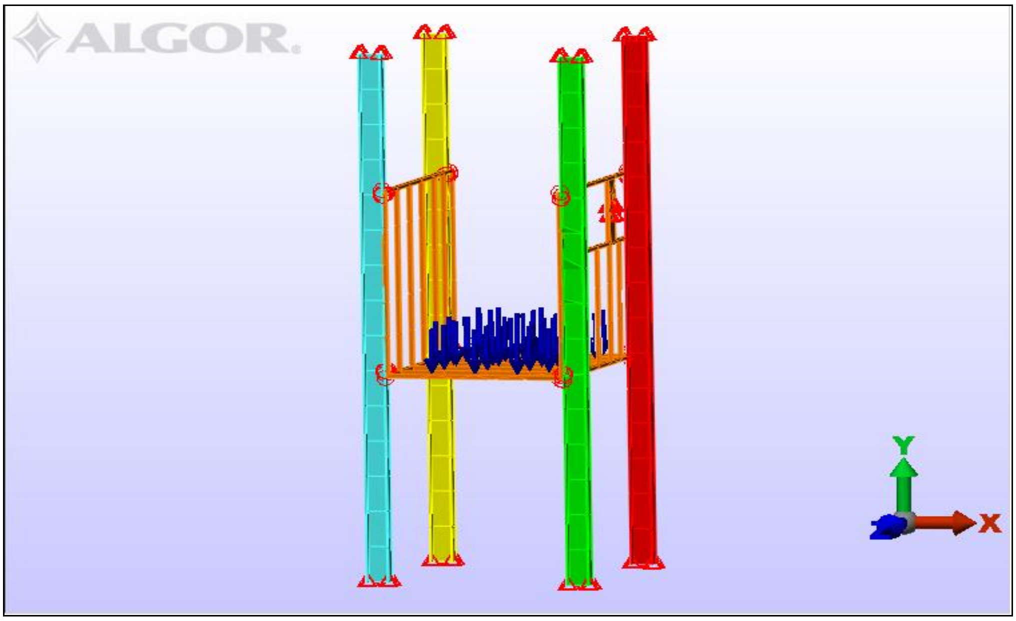
(b)

Figure 4.1 (a) The critical parts consist of I beam and platform (b) The critical parts consist of linear rack and spur gear.

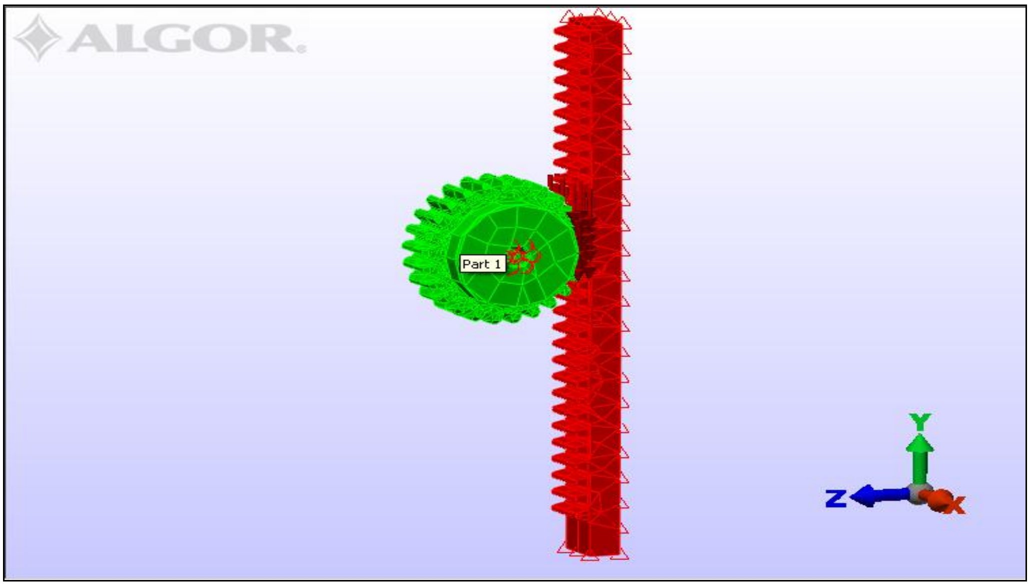
Figure 4.1 (a) shows the critical parts in the lift system. These parts were identified such that because the platform is used to sustain the force from passenger attached on the platform. The amount of the force applied on the platform is 2000N. The optimum force as mention is the maximum summation of the weight of one passenger and with wheelchair or without wheelchair. Then picture 4.2 (b) show the second primary part and this gears are use to bring the force from the platform with a passenger in the rotation condition. The summation of the platform and passenger is 4000N attach on the gears surfaces.

4.2.2 Analysis properties of the lift system

In the analysis, the software were generate the mesh of model structure first and then add boundary condition and force as show in the figure 4.2. The boundary condition and forces were created base on the actual condition such as the fix part and nodal forces.



(b)

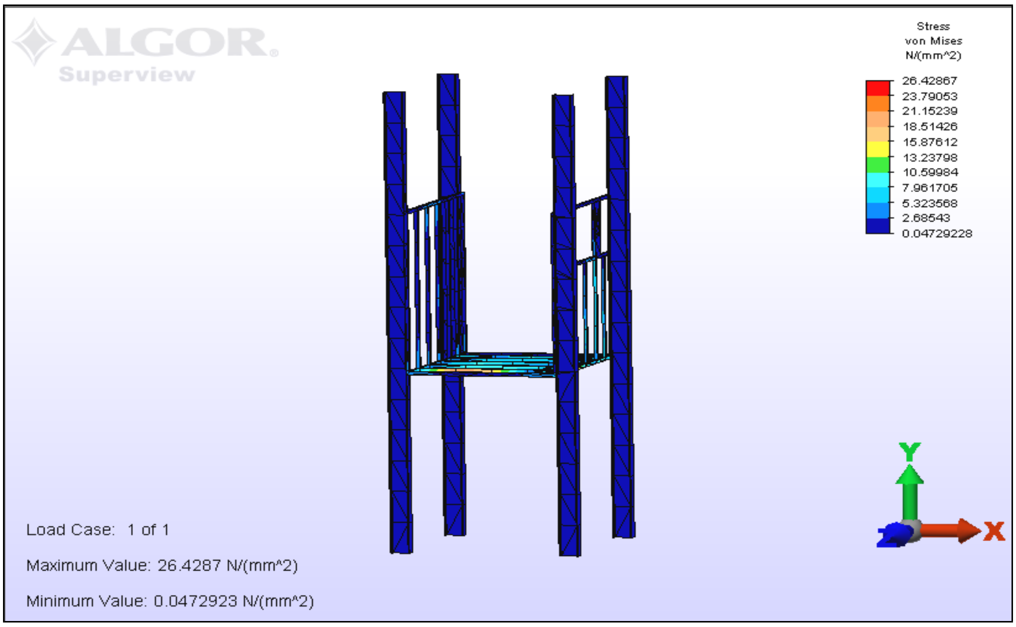


(b)

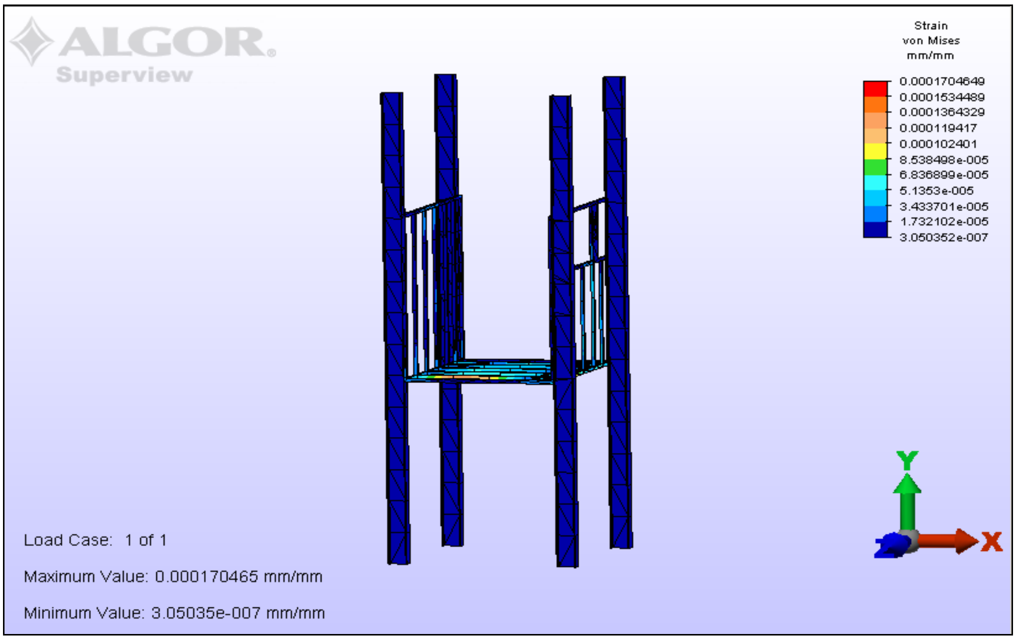
Figure 4.2 (a) The boundary condition and forces acting on the platform and (b) The boundary condition and forces acting on the gears.

The boundary condition and forces in the model structure was complete for the initial forces which is 2000N for figure 4.2 (a) and 4000N for figure 4.2 (b). Then the part was continued analyze with ten times analysis with increasing value of forces to get the accurate and precise result.

The result of analysis was recorded in stress and strain data. In the software analysis was recorded in the von misses stress and von misses strain data type of results. The von misses stress and strain data for platform and I beam were shown in figure 4.3 and von misses stress and strain for gears were shown in figure 4.4 with the maximum and minimum values. The von misses value result is the data of analysis in effected resulting areas.

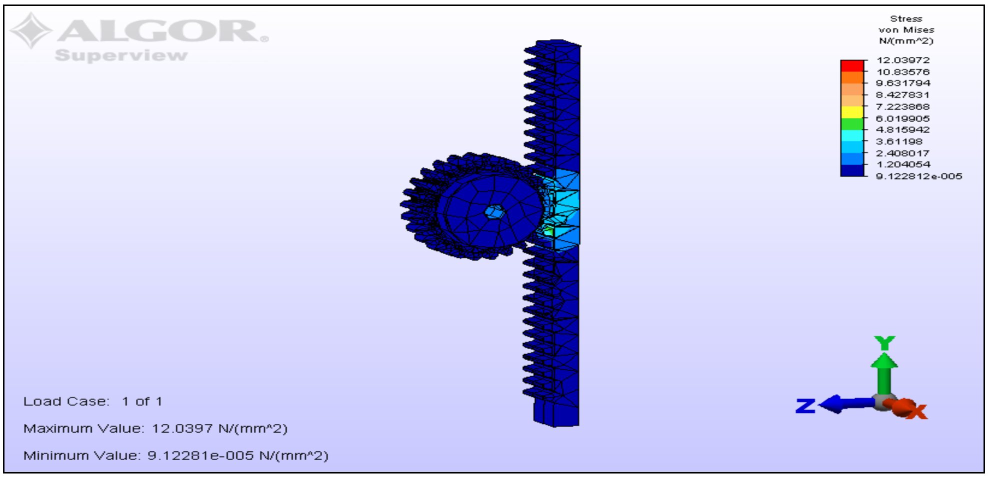


(a)

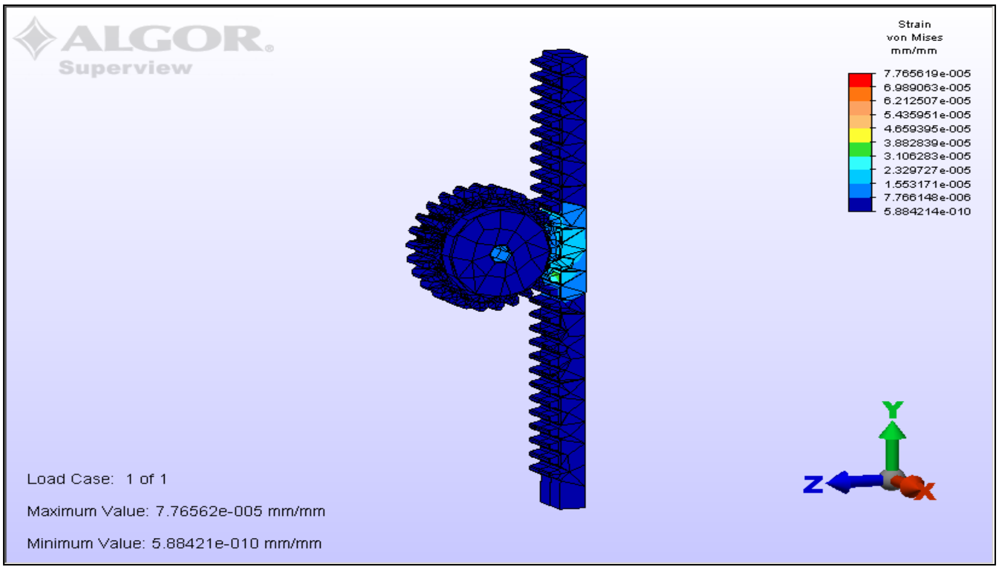


(b)

Figure 4.3 (a) The von misses stress data for platform and I beam model. (b) The von misses strain data for platform and I beam model.



(a)



(b)

Figure 4.4 (a) The von misses stress data for spur and linear rack gears model. (b) The von misses strain data for spur and linear rack gears model.

From figure 4.3 and 4.4 of the von misses stress and strain analysis, the resulting data show the various result data in difference effected areas. In the analysis data also gives the maximum and minimum base on the effected area involve in the data. Base on the analysis data, the result given is the effect of forces acting on the area.

4.2.3 Result Analysis of the Critical Part

In the analysis of the critical part, each critical part was analyzed using different value of forces. There were 10 different of forces acting on the reasonable area of parts. By using this method, it can define the sustainable part for the lift system. The result of analysis data was collected and arranged in to from of table for platform and I beam part shown in table 4.1 and spur and linear rack gears shown in table 4.2.

Table 4.1: Results analysis data of the maximum von misses stress and strain of the platform and beam part

Results data for platform and I beam			
No.	Load(N)	Max. Strain (mm/mm)	Max. Stress (N/mm)
1	2000	1.71E-04	2.64E+01
2	4000	3.41E-04	5.29E+01
3	6000	5.12E-04	7.95E+01
4	8000	6.82E-04	1.06E+02
5	10000	8.51E-04	1.32E+02
6	12000	1.02E-03	1.59E+02
7	14000	1.19E-03	1.85E+02
8	16000	1.36E-03	2.11E+02
9	18000	1.54E-03	2.38E+02
10	20000	1.71E-03	2.64E+02

Table 4.2: Results analysis data of the maximum von misses stress and strain of the spur and linear rack gears.

Results data for spur and linear rack gears			
No.	Load(N)	Max. Strain (mm/mm)	Max. Stress (N/mm^2)
1	4000	7.77E-05	1.20E+01
2	6000	1.16E-04	1.81E+01
3	8000	1.55E-04	2.41E+01
4	10000	1.94E-04	3.01E+01
5	20000	3.88E-04	6.02E+01
6	40000	7.78E-04	1.20E+02
7	60000	1.16E-03	1.81E+02
8	80000	1.55E-03	2.41E+02
9	100000	1.94E-03	3.01E+02
10	120000	2.33E-03	3.61E+02

The load in the table was predicted base on the material properties of each of the part. From the table range loads for platform and beam are 2000N to 20000N and range loads for gears are 4000N to 12000N interval.

4.2.4 **Discussion of the Analysis.**

The stress and strain analysis is about to determine the distribution of stresses and the deformation the assembly parts. First the data of von misses strain was collected to define as the deformation of the part per unit length. Then second the data of von misses stress was define as the forces acting on the parts per unit area.

When a load is applied to the particular part, deformation will be results. The deformation is elastic if it completely recovered immediately after load is removed. Purely elastic deformation is associated with stretching of the primary bonds in specimens. Stress is the force per unit area.

$$\sigma = F/A$$

Strain is elongation per unit length:

$$\varepsilon = \Delta L / L$$

By plotting the von misses stress verses the von misses strain as the increasing load applied to the part so as increased the yield a von misses stress-strain diagram. The graph of both critical part is compared between yield strength of the material and strength of the maximum force state in the lift system limitation. The comparison of the yield strength was shown on the graph 4.5 and 4.6.

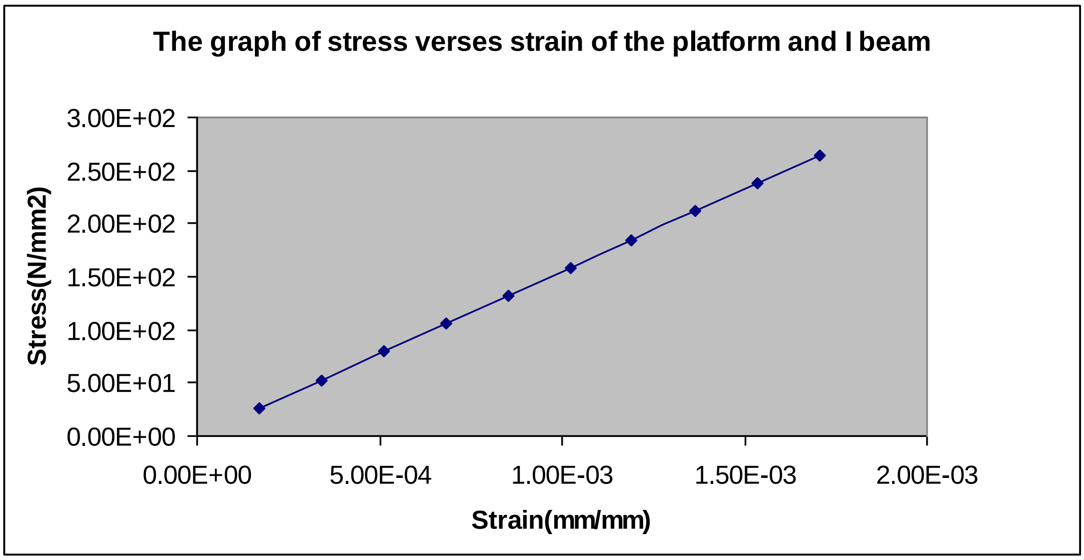


Figure 4.5: The graph of the yield strength of the platform and I beam.

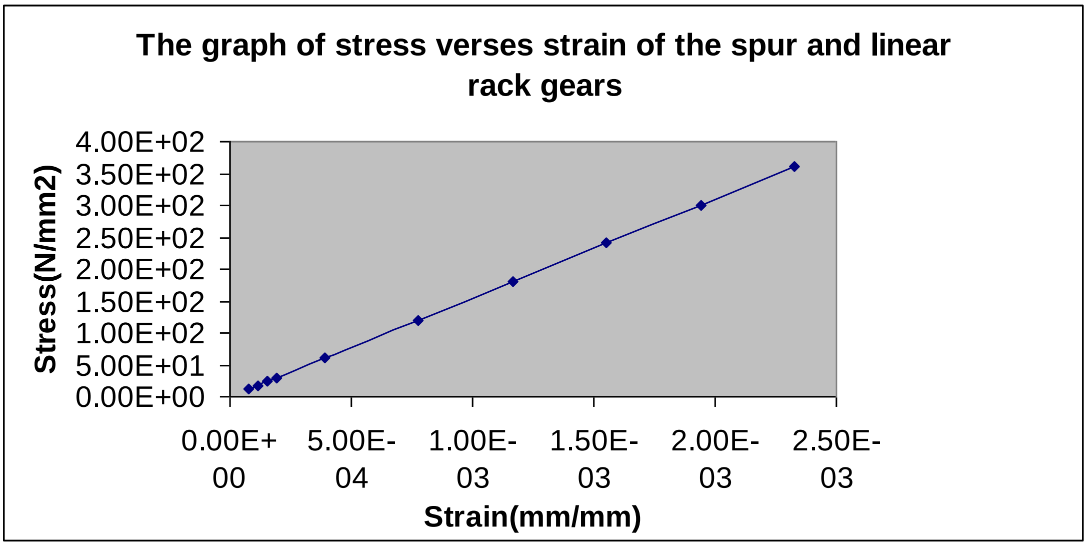


Figure 4.6: The graph of the yield strength of the spur and linear rack gears.

The yield strength of the part was determined by watching the load on the graph analysis. After increasing steadily, the load will observed to suddenly drop to slightly lower value, which is maintained for a certain period while the part keeps elongating. But in the graph analysis above show the increasing continually without dropping. According to further studied state that the result data given from analysis using software hardly defined the value of load drop to the lower value. So, the value of the yield strength was identify by the software in the properties of the material consist on the report of the analysis software.

Yield strength (σ_y) is the stress at which strain change from elastic deformation to plastic deformation, causing it to deform permanently. The value of yield strength of platform analysis is 200 kN/mm. Then the yield strength for gears connection is 351 kN/mm. The value of yield strength for each of the parts is show high gap of differences between the maximum stress values for the lift system.

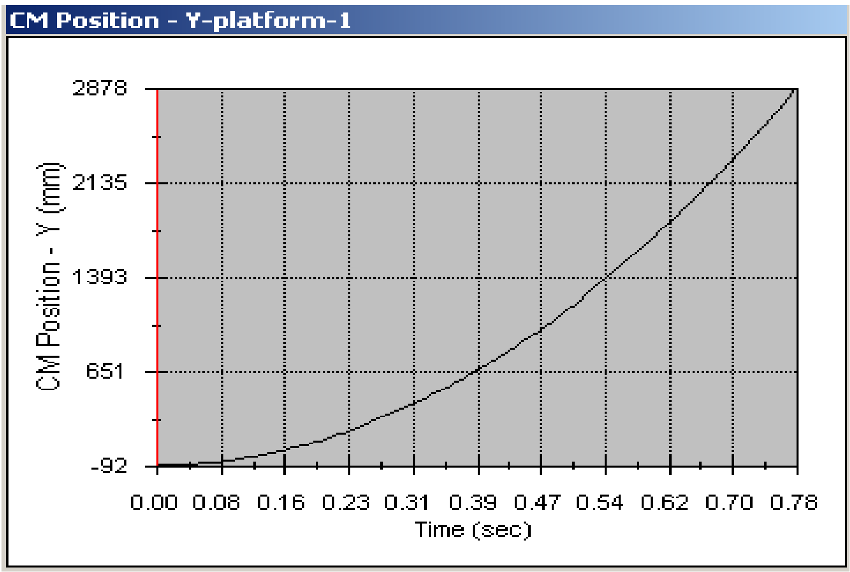
After the yield point, the specimens will undergo a period of strain hardening in which the stress increases again with increasing strain up to ultimate strength. If the specimens are unloaded at this point, stress- strain curve will be parallel to that portion of the curve between origin and the yield point. In the yield point the elongation the materials are permanent that mean the material was fails and unavailable for use.

4.3 SIMULATION OF THE LIFT SYSTEM

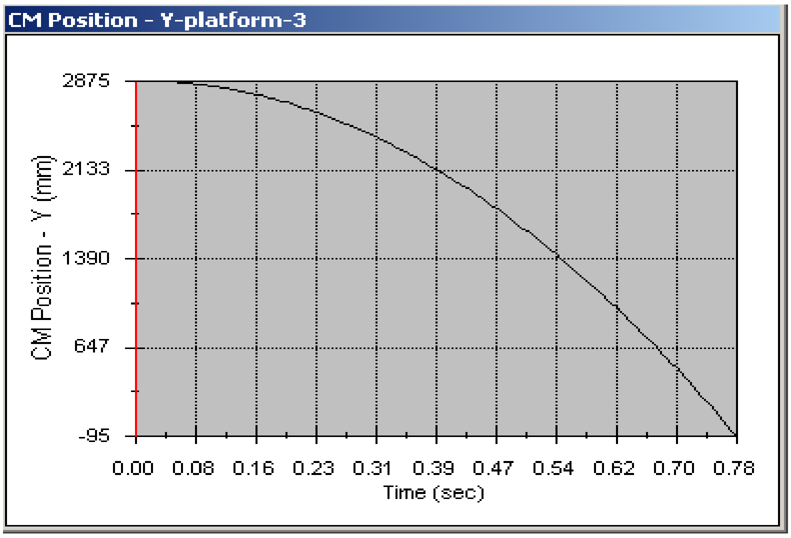
In this section is about movement results data from simulation using Cosmos (motion). The simulation results data consider in the lift system, the movement data of platform, and revolution of the motor and spur gear. The result of simulation are analyze in from of graph data.

4.3.1 The Movement of Platform

The platform simulation are divided in to three part of data result, first the result on the upward and downward position data, second the velocity data and third the acceleration data. The result of the movement upward and downward position was shown in the figure 4.7.



(a)

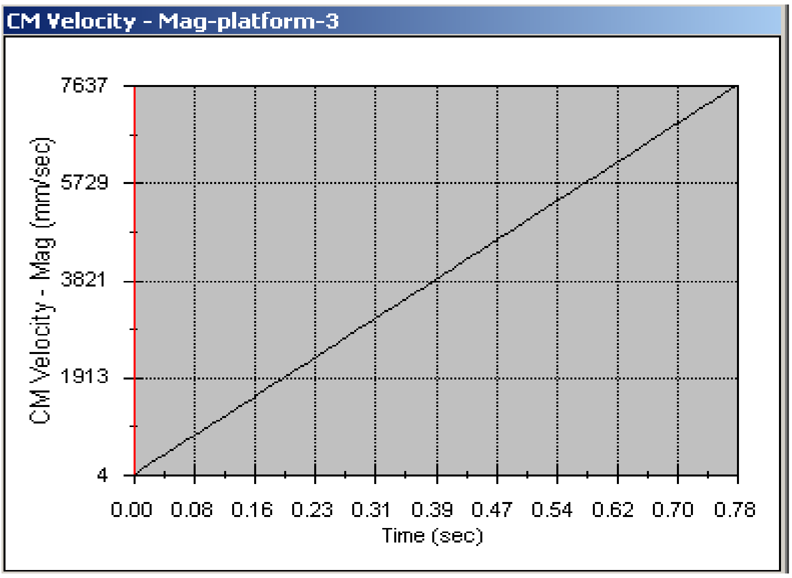


(b)

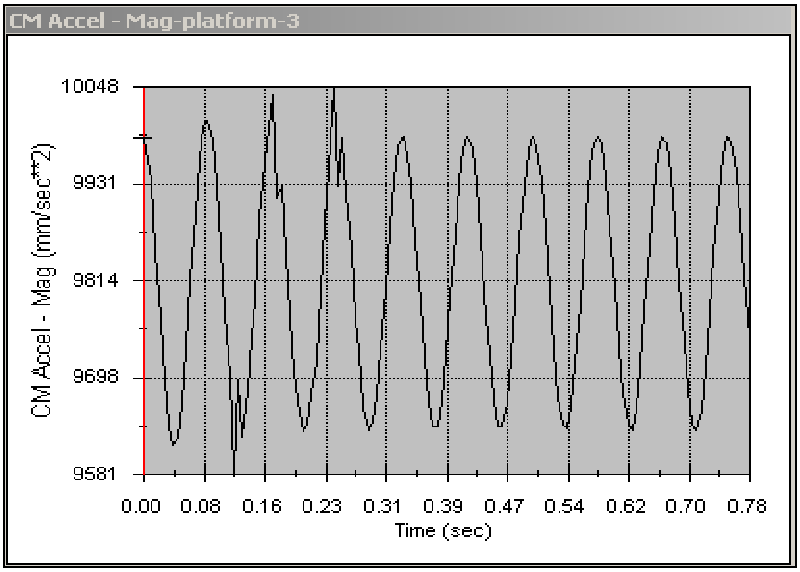
Figure 4.7: (a) the position of the platform in upward movement (b) the position of platform in downward movement.

The result graph CM position (mm) in y direction verses time (s) was shown in the graphs above. The positive quadratic graph was show in the increasing value of times in upward platform and the negative quadratic graph with increasing value of times for downward movement.

Second and third results are about the velocity and the acceleration of the platform data. The movement of the platform result data is effected from the connection between the rails arm. The graph of simulation results was shown in graph 4.



(a)



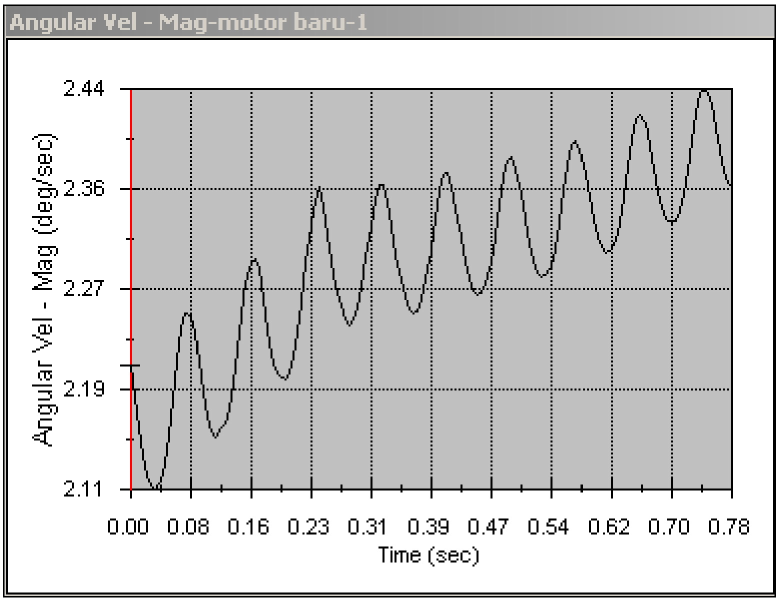
(b)

Graph 4: (a) the simulation CM velocity of the platform (b) the simulation CM acceleration of the platform.

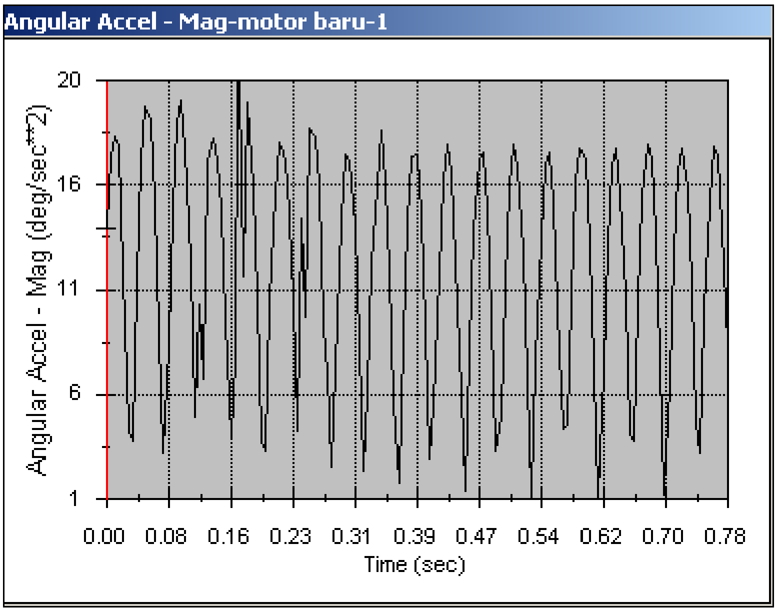
The graph CM velocity(mm/s) verses times(s) and CM acceleration(mm/s^2) was shown in the graph.

4.3.2 The Movement of electric motor and spur gear.

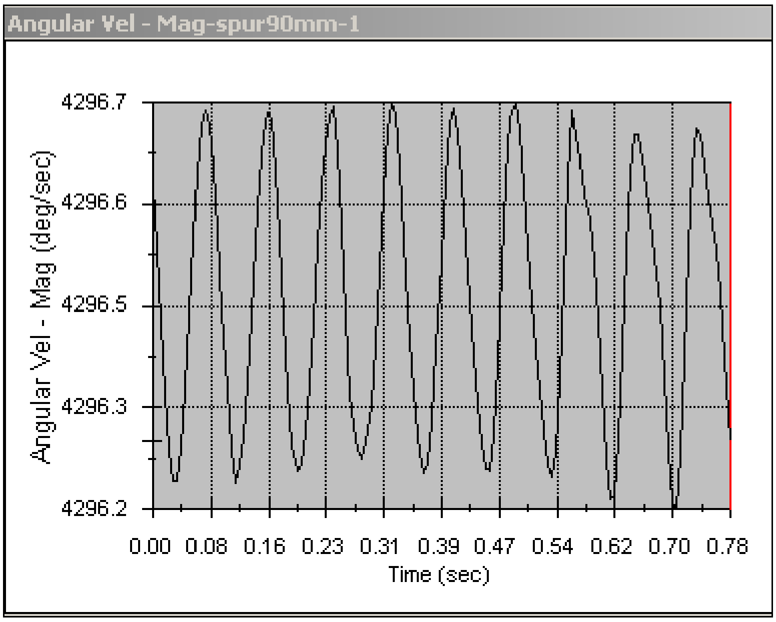
The simulation result of the electric motor and spur gear was analyzing using graph data. The velocity and acceleration was the data from the simulation result. The simulation result was shown the graph 5 and below. The angular velocity and acceleration type of data was collected in the simulations data because of the rotation movement involve to simulate the lift system.



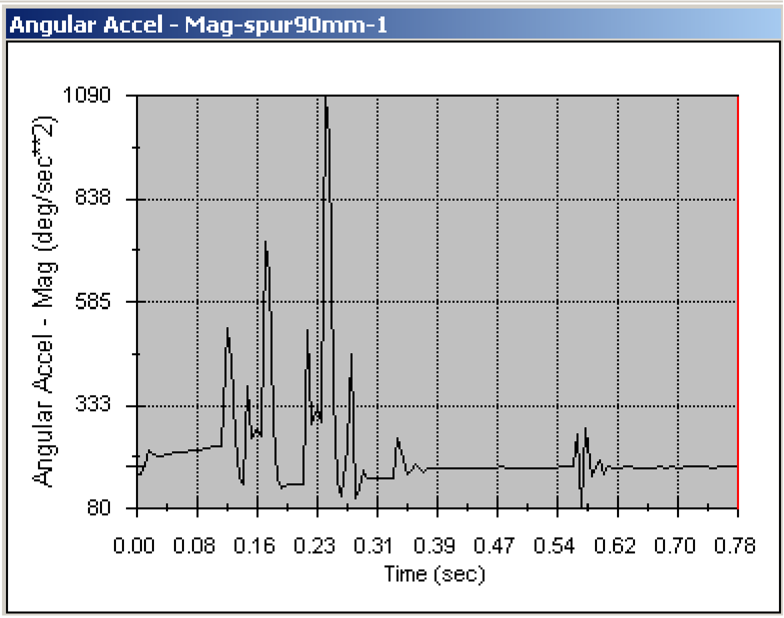
(a)


Angular Accel - Mag-motor baru-1
Angular Accel - Mag (deg/sec**2)
20
16
11
6
1
0.00 0.08 0.16 0.23 0.31 0.39 0.47 0.54 0.62 0.70 0.78
Time (sec)

(b)


Angular Vel - Mag-spur90mm-1
Angular Vel - Mag (deg/sec)
4296.7
4296.6
4296.5
4296.3
4296.2
0.00 0.08 0.16 0.23 0.31 0.39 0.47 0.54 0.62 0.70 0.78
Time (sec)

(c)



(d)

Graph 5: (a) the angular velocity of the motor (b) the angular acceleration of the motor (c) the angular velocity of the spur gear (d) the angular acceleration o the spur gear.

Graph 5(a) angular velocity (deg/s) verses time(s) for electric motor, graph 5(b) angular acceleration (deg/s^2) verses times for electric motor, graph 5(c) angular velocity (deg/s) verses times (s) for spur gear and graph 5(d) angular acceleration (deg/s^2) for spur gear.

4.3.2 The Simulation Discussion

In the simulation result, the movements of the platform are increasing with the value of time(s) and the position of the platform start from 0 to 2875mm. The movement of the spur gear and electric motor rotate in the z-axis to bring the upward and downward traveling for the platform. The maximum velocity of the electric motor is 2.44 deg/s and maximum acceleration is 20deg/s. Then the maximum value of the velocity and acceleration for spur gear are 4296.7deg/s and 1090 deg/s^2.

CHAPTER 5

CONCLUSION AND RECOMMANDATION

5.1 INTRODUCTION

The lift system was designed to increase the facility for disable people who has difficulty to move in the building below than five levels. The disable people hardly move in the building below than five levels because installation consideration of existence lifts in Malaysia. The installation consideration consist of the cost, energy and space waste if the common lift install in the lift below than five level.

5.2 LIFT SYSTEM

This design model was transporting a disable people in vertical motion from ground floor to the first floor. In this model design is useful to transporting disable people that may have difficulty moving in the building above than one floor with no installation of lift system. This lift only required small space and only fix with one passenger has walking problems and more specific the passenger moving using wheelchair.

The design model was developed using in complex mechanism system. The system builds from sustainable part from the lift system components. The lift system capable to sustain more than the maximum value of force as state before but for safety protection of the lift system so load should not be more than maximum load requirement.

5.3 RECOMMANDATION

The lift is capable to sustain the forces only one person with wheelchair or without wheelchair. The lift can improve by increasing the number of passenger same as existence lift install in the high building.

The lift system should have capability of traveling two or three level in the building below than five levels. Therefore, the disable people can reach the possible level by using the improvement lift.

The lift system will produce high quantity of noise, by that the lift system can improve by reducing the level of noise form the contacting gears and motor electric that use for generating power to the lift system.

REFERENCE:

1. Chang-Sei Kim, Keum-Shik Hong and Moon-Ki Kim, Nonlinear robust control of a hydraulic elevator: experiment-based modeling and two-stage Lyapunov redesign. *Control Engineering Practice*. **13**(2005): 789-803.
2. Yang Huayong , Yang Jian , and Xu Bing. Computational simulation and experimental research on speed control of VVVF hydraulic elevator. *Fuzzy System Applications in Control*. **12** (2004): 563-568.
3. Tommi Tervonen Henri Hakonen and Risto Lahdelma. Elevator planning with stochastic multicriteria acceptability analysis. *Special Issue on Multiple Criteria Decision Making for Engineering.* **36**(2008): 352-362.
4. Marja-Liisa Siikonen. Customer service in an elevator system during up-peak. *Transportation Research Part B: Methodological*. **31**(1997):127-139.
5. Young Man Cho and Rajesh Rajamani. Identification and experimental validation of a scalable elevator vertical dynamic model. *Control Engineering Practice*. **9**(2001):181-187.
6. Saligrama. R. Venkatesh, Young Man Cho, and Jongwon Kim, Robust control of vertical motions in ultra-high rise elevators. *Control Engineering Practice.* **10**(2002): 121-132.
7. Fredrik Roos, Hans Johansson and Jan Wikander (2005). Optimal selection of motor and gearhead in mechatronic applications. *An International Journal of Mechatronics.* **16**(1): 63-72.
8. Kaur, Chew.2007. Kuala Lumpur, Are we doing enough? *Star*July29
9. Rex Miller,Mark Richard Miller (2004).*Electric motors*. Canada:WILEY.
10. Y.S. Chen, C.S. Wang and Y.J. Yang**.** Combining vibration test with finite element analysis for the fatigue life estimation of PBGA components. *Microelectronics Reliability*. **48**(2008): 638-644.
11. David Bennett and Tarun Goswami**.** Finite element analysis of hip stem designs. *Materials & Design*. **29**(2008): 45-60.
12. Aaron S. Blicblau, Manmohan Singh, Eden McConnell and Melissa Pleaner**.** Stress analysis of a novice windsurfer sail by finite element analysis. *Mathematical and Computer Modelling*. **47**(2008): 1108-1116.

13. Amen Agbossou, Laurent Michel, Manuel Lagache and Patrice Hamelin. Strengthening slabs using externally-bonded strip composites: Analysis of concrete covers on the strengthening. *Composites Part B: Engineering*. **39**(2008): 1125-1135.

14. Faydor L. Litvin, Ignacio Gonzalez-Perez, Alfonso Fuentes, Daniele Vecchiato, Bruce D. Hansen and David Binney**.** Design, generation and stress analysis of face-gear drive with helical pinion. *Computer Methods in Applied Mechanics and Engineering***.** **194**(2005): 3870-3901.

15. Amir A. Kamouneh, Jun Ni, David Stephenson, Richard Vriesen and Garrold DeGrac. Diagnosis of involutometric issues in flat rolling of external helical gears through the use of finite-element models. *International Journal of Machine Tools and Manufacture*. **47**(2007): 1257-1262.

16. Fredrik Roos, Hans Johansson and Jan Wikander. Optimal selection of motor and gearhead in mechatronic applications. *Mechatronics*. **16**(2006): 63-72.

17. Norio Yamashita**,** Zu Guang Zhang**,** Akio Yamamoto**,** Masahiko Gondo and Toshiro Higuchi**.** Voltage-induction type electrostatic film motor driven by two- to four-phase ac voltage and electrostatic induction. *Sensors and Actuators A: Physical*. **140**(2007): 239-250.

18. Dinkar Prasad, Bibhu Prasad Panigrahi, and Sabyasachi SenGupta. Digital simulation and hardware implementation of a simple scheme for direct torque control of induction motor. *Energy Conversion and Management*. **49**(2008): 687-697.

APPENDIX A

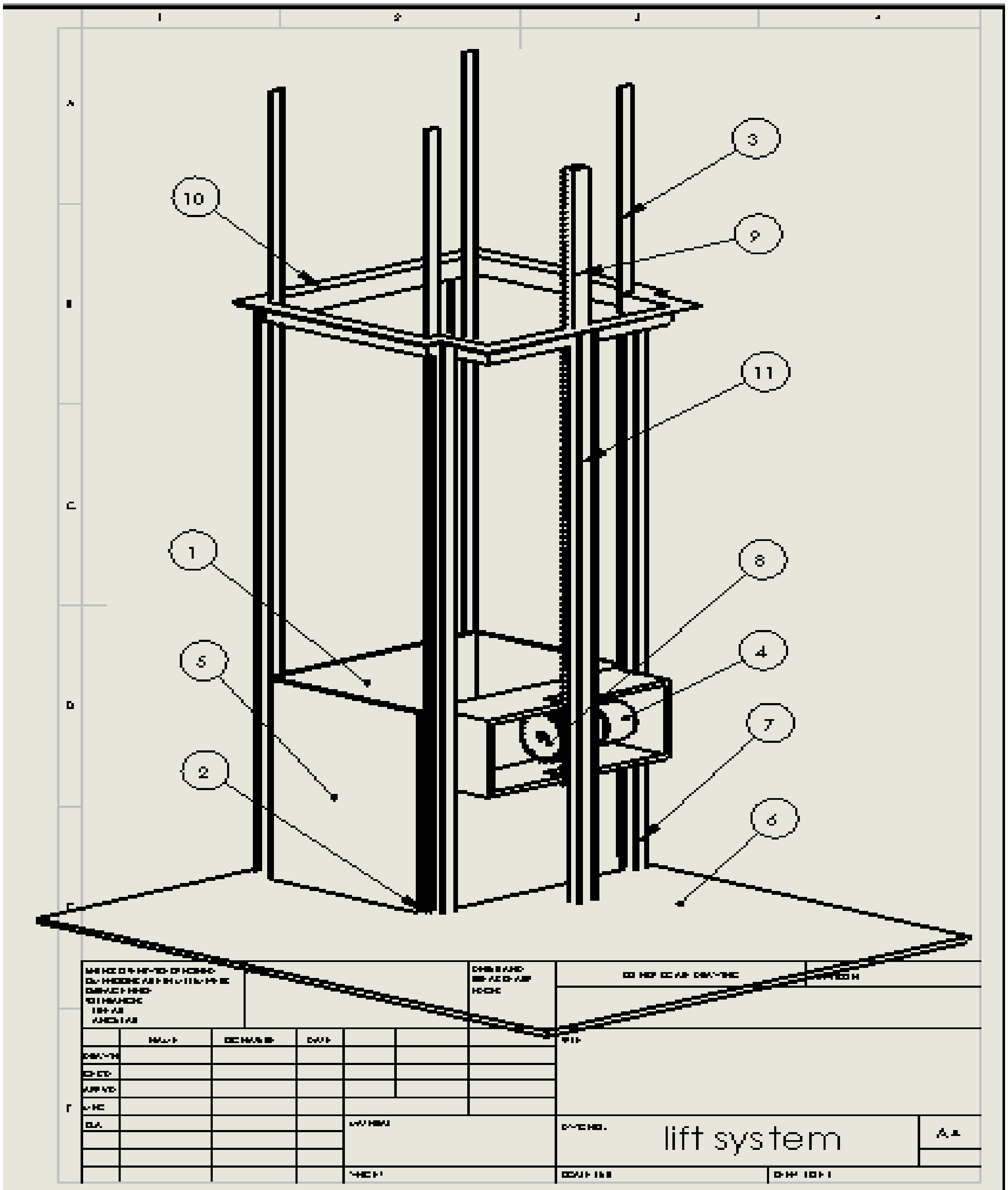


Figure A: Design of the lift system

APPENDIX B

Number	Part	Description	Quantity
1	Platform	Capacity:2000N Mass: 78.4205 kg	1
2	Rail arm	Rails arm connected between platform and rail	8
3	Rail	Guide movement of platform Length: 4066.80mm	4
4	Electric motor	Generate power to lift system Reversible motor (AC):41.4 hp Input voltage: 240V Control voltage: 24V Output speed: 35rpm Output torque: 38932 Output shaft: 4127.23kg	1
5	Door	Enter door Size: 1219.2mmx1033.98mm Mass:17.0kg	1
6	Floor	Lift start move from ground floor	
7	Exit door	Size: 1219.2mmx1033.98mm Mass:17.0kg	1
8	Spur gear	Connected to electric motor Mass: 42.9434 kg	1
9	Rack gear	Connected to spur gear Length:3200mm	1
10	Angle beam	Support platform in first floor Size: 1219.2mmx1033.98mm	1
11	I beam	Support rail Length: 3000mm	1

Table B: Description of lift system.

APPENDIX C

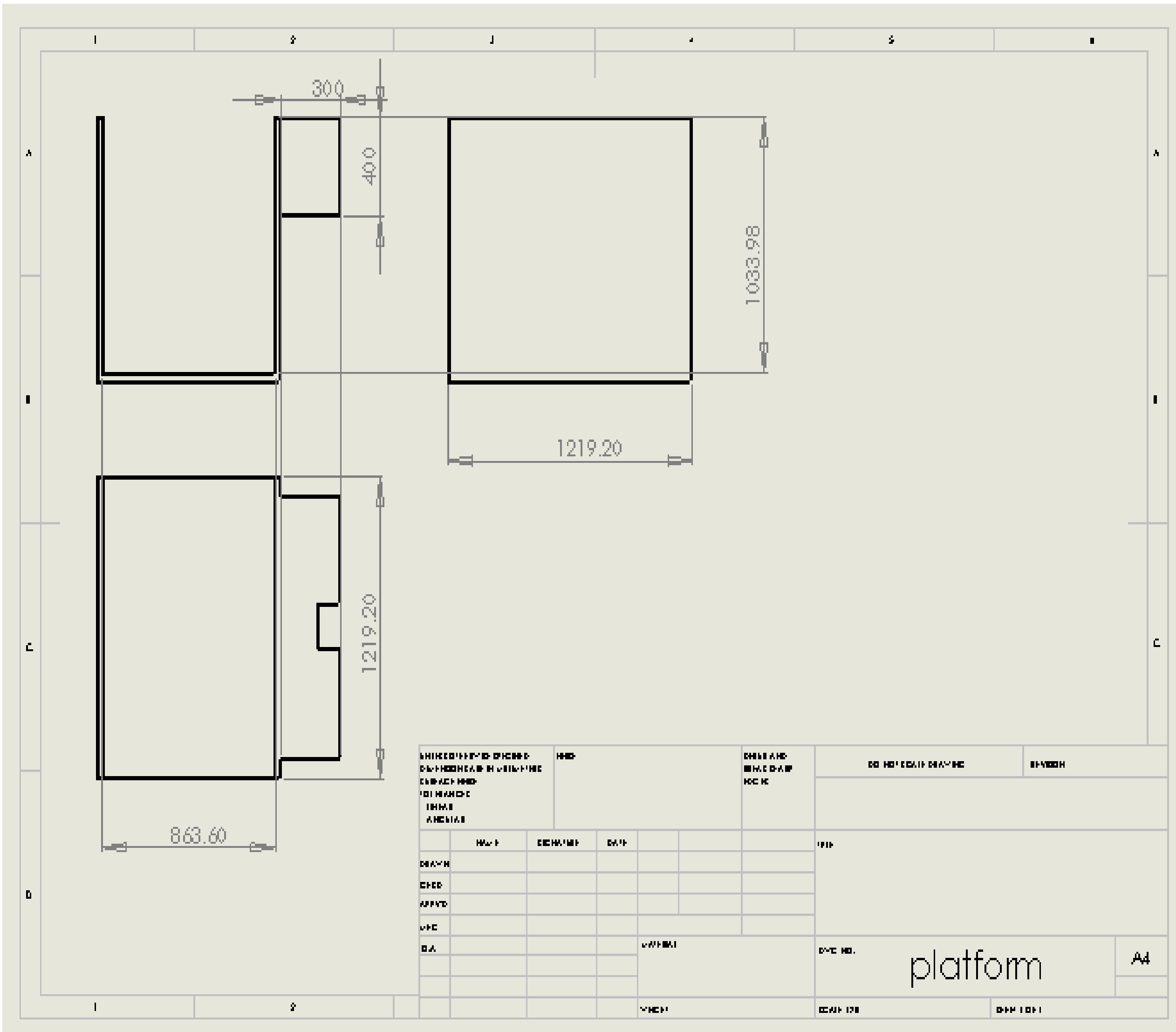


Figure C: Dimension of platform

APPENDIX D

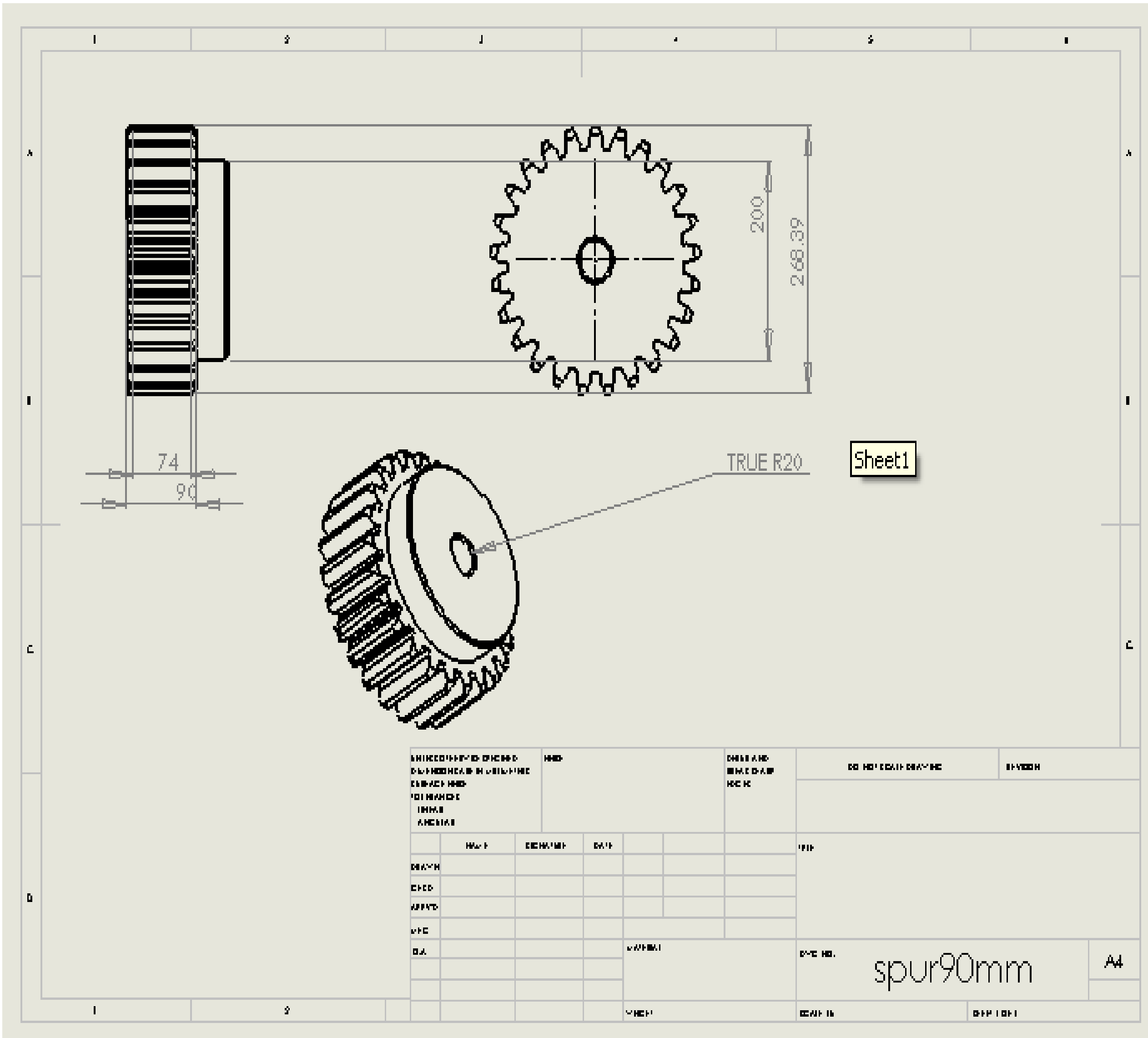


Figure D: Dimension of spur gear

APPENDIX E

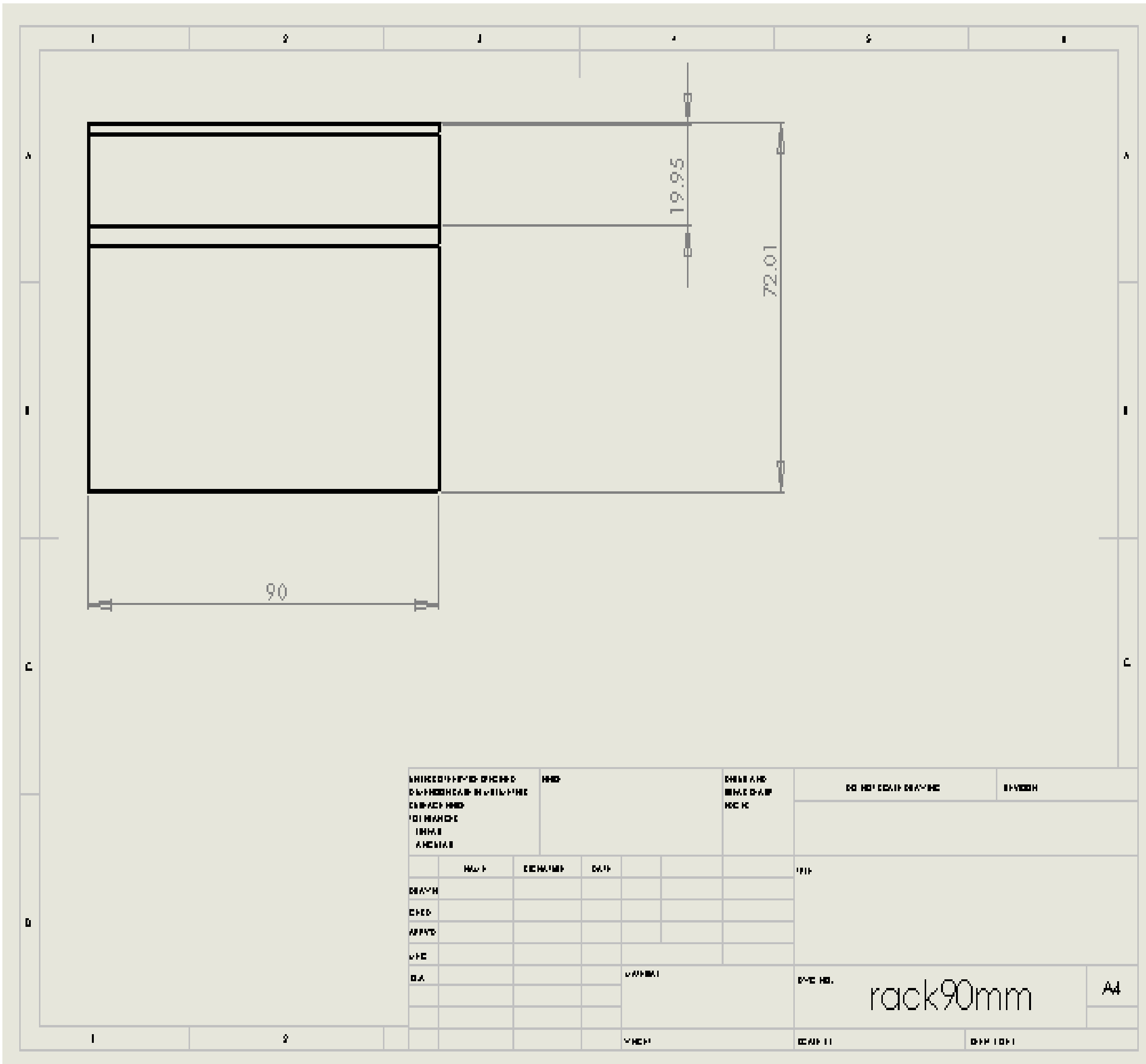


Figure E: Dimension of rack gear

APPENDIX F

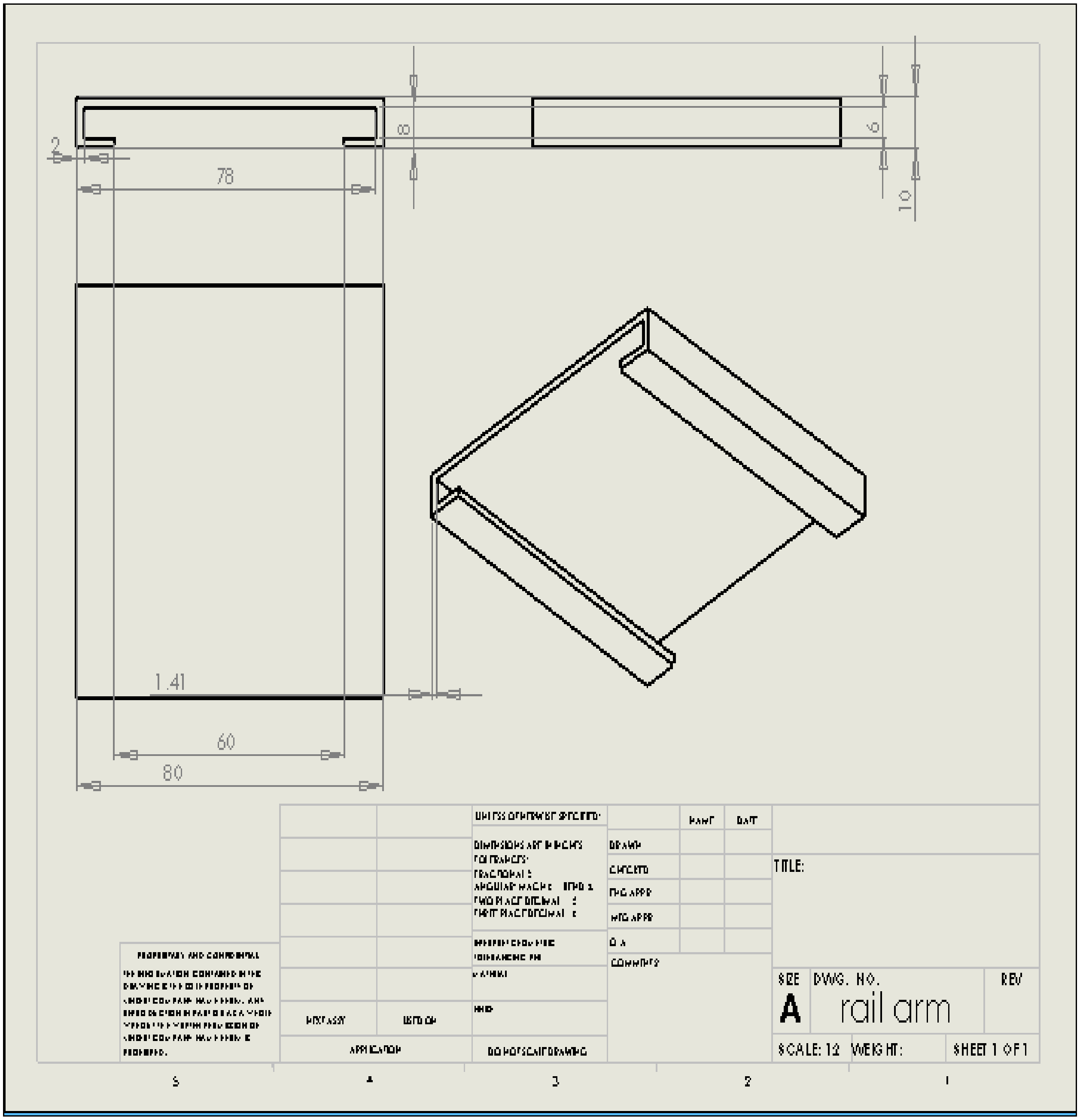


Figure F: Dimension of rail arm

APPENDIX G

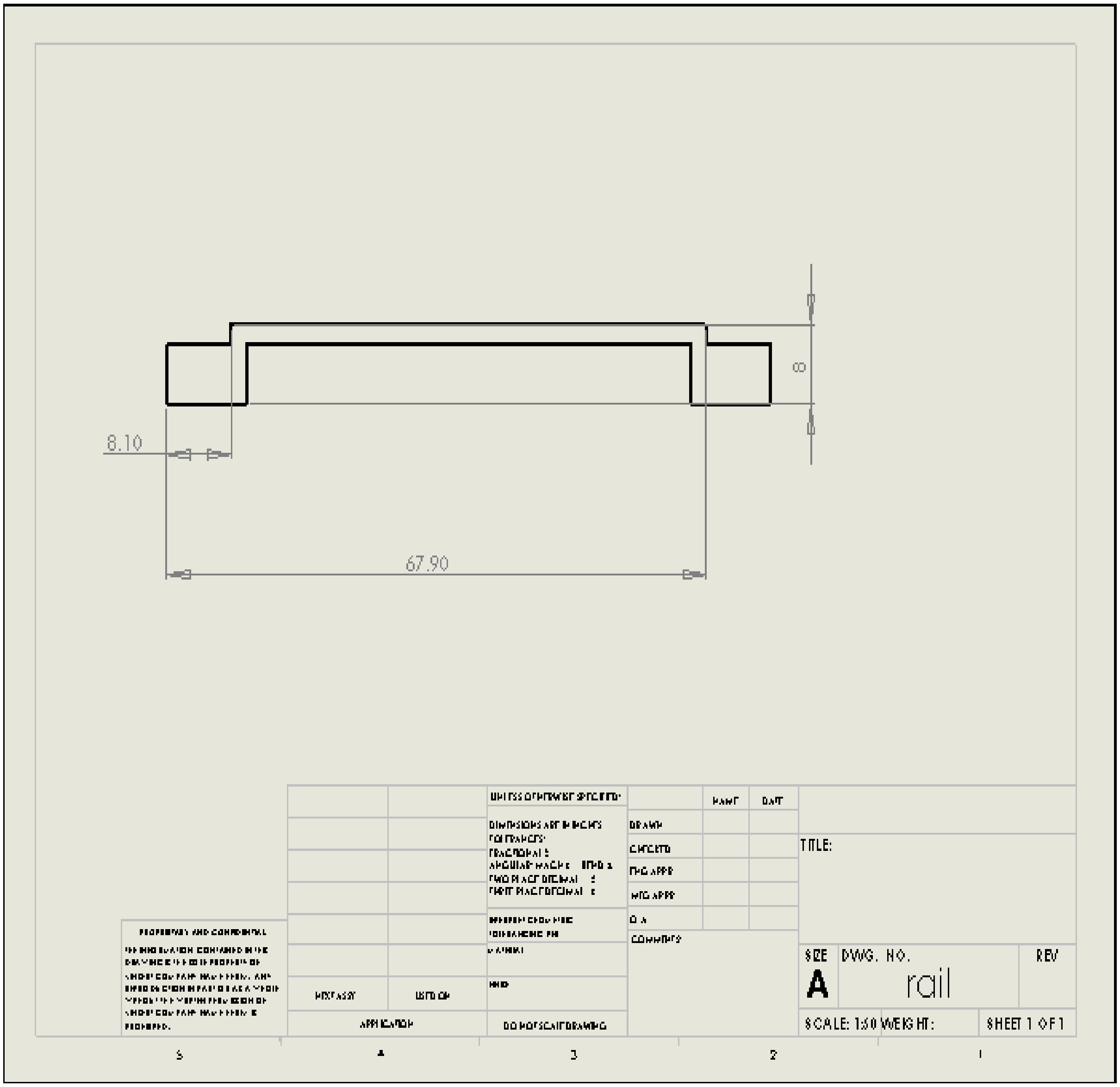


Figure G: Dimension of rail

APPENDIX H

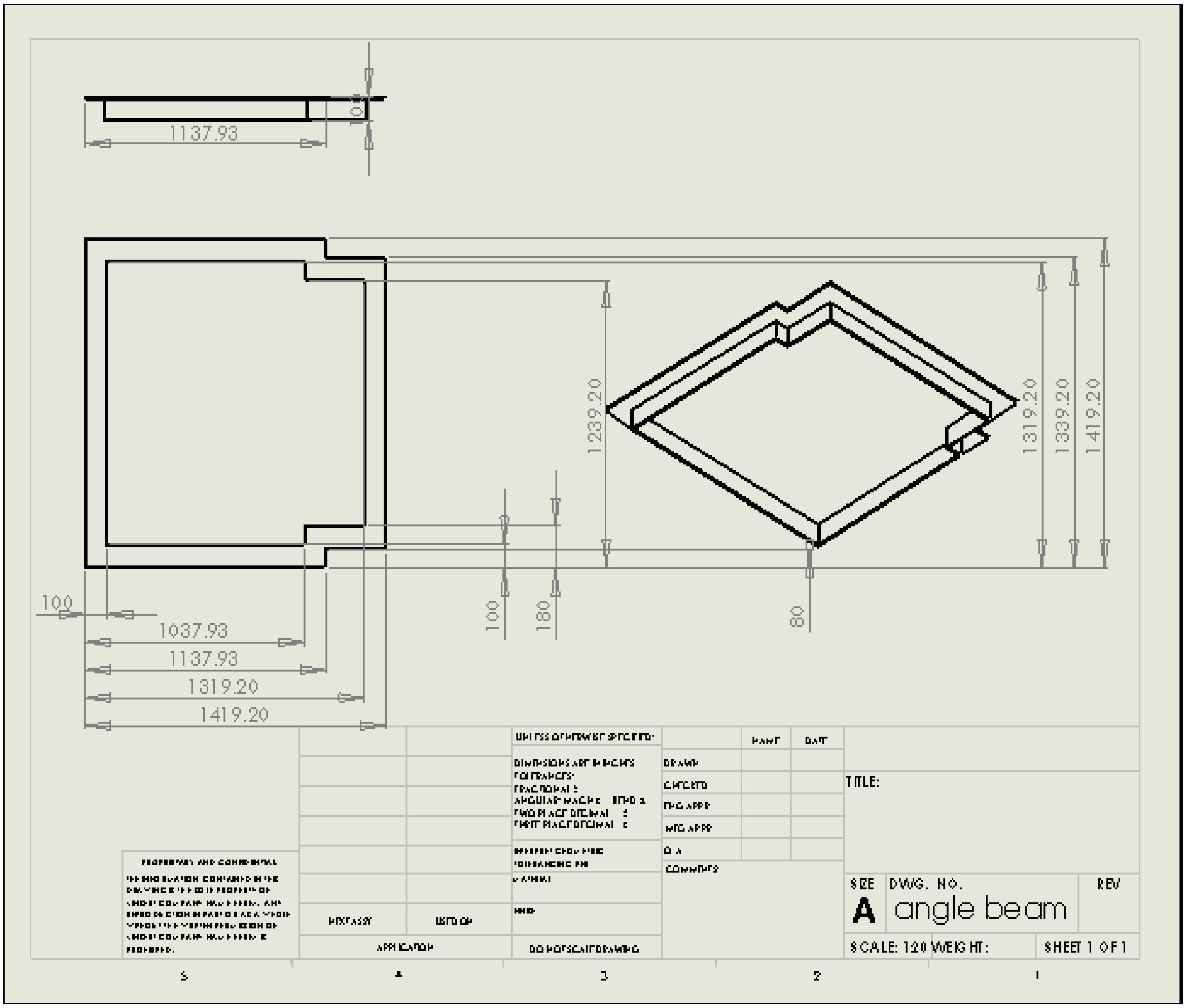


Figure H: Dimension of angle beam

APPENDIX I

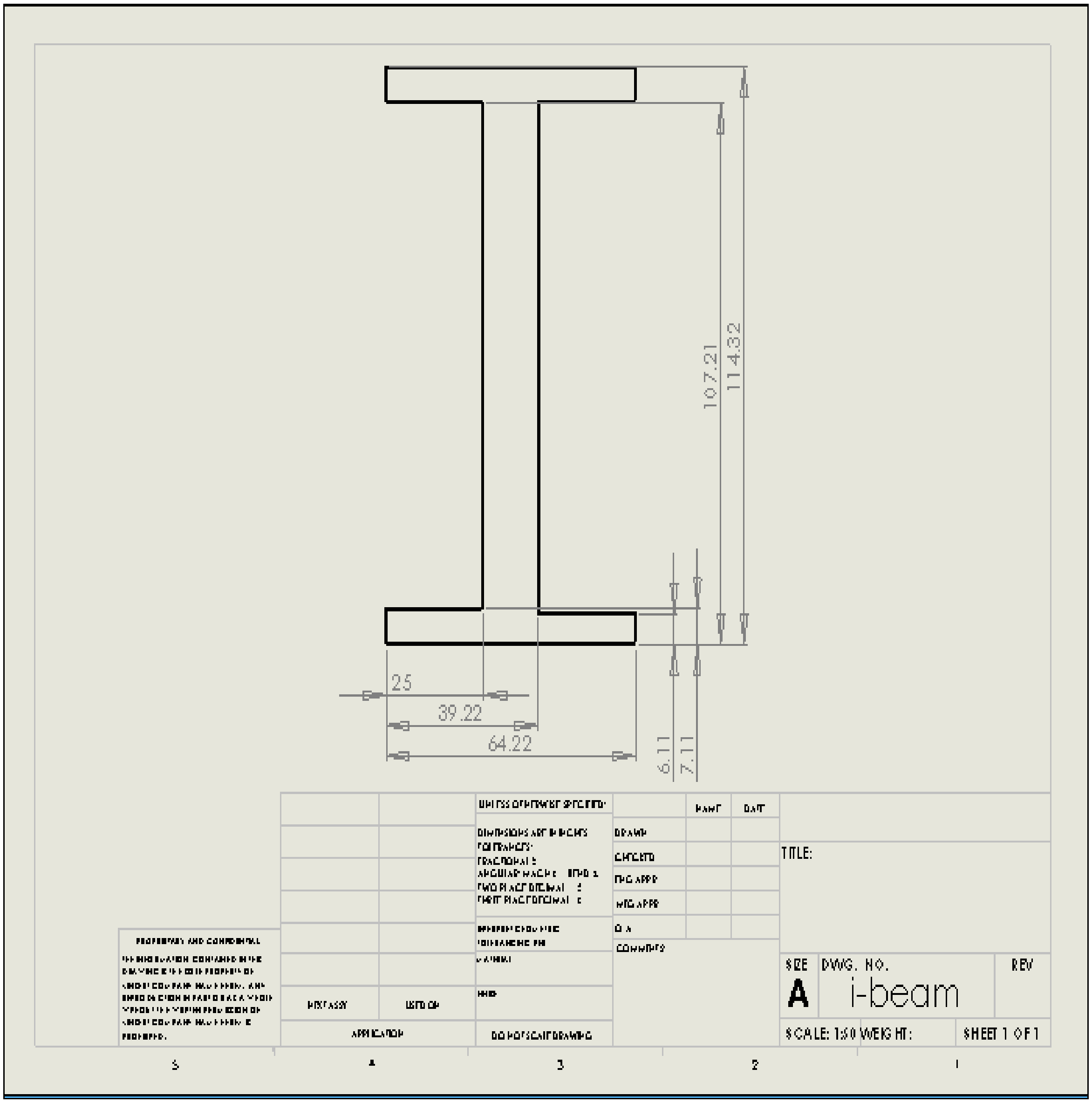


Figure H: Dimension of I beam