Sudan University of Science & Technology

College of Engineering

Mechanical Engineering

Production Department

A project Submitted in Partial Fulfillment of the Requirement for the Degree of B.Sc. of Mechanical Engineering Production

Design hydraulic system for the operation of the production line to assemble the beam

تصميم نظام هيدروليكي لتشغيل خط انتاج تجميع الكمر

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الإستهـــلال

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ (1)

الْحَمْدُ لِلَّهِ رَبِّ الْعَالَمِينَ (2) الرَّحْمَٰنِ الرَّحِيمِ (3) مَالِكِ يَوْمِ الدِّينِ (4) إِيَّاكَ نَعْبُدُ وَإِيَّاكَ نَسْتَعِينُ (5) اهْدِنَا الصِّرَاطَ الْمُسْتَقِيمَ (6) صِرَاطَ الَّذِينَ أَنْعَمْتَ عَلَيْهِمْ غَيْرِ الْمَغْضُوبِ عَلَيْهِمْ وَلَا الضَّالِّينَ (7)

صدق الله العظيم

سورة الفاتحة – الآيات (1-7)

الإهـــــداء

إلى من بلغ الرسالة وأدى الأمانة ونصح الأمة

سيدنا محمد صلى الله عليه وسلم

إلي حكمتي

وطريقي المستقيم

ذلك الينبوع من الصبر والتفاؤل والأمل

أُمي الغالية ..

وإلي ذلك السند الذي طالما توكأتُ عليه

وهششت به ضيم الحياة

من آثرني على نفسه ولو كان به خصاصة

أبي

إلي تلك الروح الباقية في قلبي

وأبي الأخر

إلى روح عمي وصديقي د. أحمد الشيخ

إلى ذلك المجبول من ورد النهار

الشامخ في دواخلنا علما وعلوا

أُستاذي الجليل د. جعفر عبدالحميد

أهدي هذا العمل

الشكر والعرفان

الشكر اولا واخيرا لله الذي انعم علينا بفضله باكمال هذا البحث المتواضع

وقد آن لنا في هذا الوقت وفي لحظة من احتشاد الروح ،ان نوصل صوت الشكر الى

اسرة مصنع ليدر للحديد

اسرة المصنع الالماني السوداني للهيدروليك

على روح التعاون والاخاء الثر

وكذلك الشكر الجزيل نسجية إلي من شد أزر كفاحنا ونحن نتجاسر لخوض غمار الحياة

د. جعفر عبدالحميد

Abstract

In this research, the Design of hydraulic system to operate the production line to purpose of assemble the beam was completed.

Firstly many types of hydraulic systems and the other systems which use to assemble the steel beam (manually and automatically) were studied, then all the contents of these systems with all the characteristics which distinguish them was defined to choosing the best ones between them.

A table of dimensions (2000 * 5000) mm was chosen to work as a sitting table which use to place the hydraulic system. It was considered in its selection to conform to the specifications of the factory table, which was designed for this system in terms of height, width and height.

The assembly process was divided into the web and flange assembly process, In the processes of assembling the web 15 cylinders operated synchronisms were selected to hold maximum weight of (7000 kg), In the processes of assembling the flange 12 cylinders operated synchronisms were selected to hold weight of (3000 kg) which Divided between the right and left flange, all of this cylinders in form of double acting and his maximum stroke to hold weight were determined.

All the other of hydraulic circuit component were designed by using valves and hydraulic power system under the operation pressure of 250 bar for industrial usage.

SolidWorks software was selected to design of the external frames of the system and the (FL-SIM) Fluid Simulation software for hydraulic circuit's simulation, after that the hydraulic circuit's suitability to raise the load was validated and the time to rise the load was taken into consideration.

This system can be operated by using electric or mechanical motor via the internal combustion engines to manage the pump feeding motors which make the fluid flow to lift the load.

The system is designed with valves with a manual control system, but if the digital control system was used, there will be better results.

// المستخلص

في هذا البحث تم تصميم نظام هيدروليكي لتجيمع الحديد الكمر ،في البداية تمت دراسة العديد من النُظم التي تعمل بالهيدروليك وكذلك نظم تجميع الحديد الكمر الألية واليدوية وتعريف كل محتويات هذه النُظم مع وضع كل الخصائص التي تميزها ومن ثم تم اختيار الأفضل منها.

أُختيرت طاولة بابعاد (2000*5000) ملم للعمل كطاولة يُوضع عليها النظام الهيدروليكي وقد رُوعِي في إختيارها أن تكون مطابقة لمواصفات طاولة المصنع الذي صُمِم له هذا النظام من حيث الطول والعرض والإرتفاع ،وقد تم تقسيم عملية التجميع إلي عملية تجميع الوب وأُختيرت لها عدد 15 أسطوانة هيدروليكة مزدوجة الفعل تعمل بالتزامن لتعليق أقصى حمل قُدر بـ7000 كجم والأخرى لتعليق الأجنحة الجانبية للكمر (الفلانش) وقد أُختير لها عدد 12 أسطوانة هيدروليكية.

تم إكمال تصميم بقية مكونات الدائرة بإستخدام صمامات تحكم اتجاهية ووحدة قدرة تحت ضغط تشغيل بلغ 250 بار للإستخدام الصناعي مع إختيار برنامج السوليدويرك لتصميم الأُطر الخارجية للمنظومة وبرنامج الفلويد سيموليشن لمحاكاة الدوئر الهيدروليكية.

بعد ذلك تم التحقق من صلاحية الدائرة وقابليتها لرفع الحمل مع أخذ الزمن في الإعتبار وقد أدخلت للبرنامج ثلاث قيم للحمل الواقع على النظام وقد تم رفعهُ في زمن لايتعدى 40 ثانية.

يمكن لهذا النظام أن يعمل بمحرك كهربي أو ميكانيكي عن طريق محركات الإحتراق الداخلي لإدارة الموتورات المغذية للمضخة والتي بدروها تجعل المائع ينساب لرفع الحمل.

النظام الذي تم تصميمه يعمل بصمامات ذات نظام تحكم يدوي ولكن إذا تم إستخدام نظام تجكم رقمي ستكون هنالك نتائج أفضل.

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CHAPTER I

Introduction

CHAPTER I

1.1 Introduction

The proportion of the great development in various fields of global manufacturing makes us in front of a big challenge to facing the life progress, to achieve desired by using shortest path and minimum or least possible cost, which sustain improve all processes and developing the production processes.

This develops include steel beam industry. Which was applied in many applications such as cars, trains buildings, and use in wide span of construction because it have many properties such as high durability, slight effect by weather factor and suitable to situation which Characterized fragility in the construction of the ground so the steel construction don't destroyed even the strongest earthquakes.

Steel beam also use in structure of buildings are much shorter than other buildings types in time which reduces the project costs to a minimum level.

As well as the possibility of moving the steel beam structure after dismantling it economically to any place without any losses.

Manufacture and assembly of the beam systems development continually, In the modern production systems, manual labor makes the production is slow such as status many factory operating manually in Sudan, in this project we try to change this situation by automate all system and production processes in LEADER factory by using hydraulic system in conformity with present needs of Sudanese industrial market.

1.2 problem statement

Slow or delay in the production process (assembly and welding) of beam in LEADER factory.

1.3 Research Importance

- Development work in factories and production facilities of the beam at the level of the country.
- Developing the production process.
- Reducing the labor cost by using hydraulic system.
- Replacement system
- handcrafts and traditional to produce the beam hydraulic system in LEADER factory.
- Reduce manual labor during the work of the production line and lost time.
- Increase the speed of production line.

1.4 Scope of the Study

This project will apply in leader factory. The design and construction of the hydraulic system is to lift up to a height of (500 mm) and carrying capacity of beam mass less than (7000 kilograms) which made of steel cold rolled.

1.5 Research Objectives

1\ Design hydraulic system for the operation of the production line to assemble the beam.

2\ Design hydraulic circuits for holding the flanges and positioning the web by using fluid simulation software.

3\ Determine required time to hold the maximum load.

CHAPTER II

Literature Review

Chapter II

2.1 **Introduction**

This chapter explains the mechanism and some of the previous studies for fabrication and built up steel beam and hydraulic system with explanation of all the components of the hydraulic system which help the designer to choose the better and most suitable component for each job.

2.2 **Types of beams**

Structural steel is one of the basic materials used in the construction of frames for most industrial buildings, bridges, and advanced base structures. Therefore, you, as a Seabee Steelworker, must have a thorough knowledge of various steel structural members.

Additionally, it is necessary before any structural steel is fabricated or erected, a plan of action and sequence of events be set up. The plans, sequences, and required materials are predetermined by the engineering section of a unit and are then drawn up as a set of blueprints.

Structural shapes manufactured in a wide variety of shapes of cross sections and sizes.

The three most common types of structural members are the W-shape (wide flange), the S-shape (American Standard I-beam), and the C-shape (American Standard channel). These three types are identified by the nominal depth, in inches, along the web and the weight per foot of length, in pounds. As an example, a W 12 x 27 indicates a W-shape (wide flange) with a web 12 inches deep and a weight of 27 pounds per linear foot. (Figure2.1, structure shapes) below shows the cross-sectional views of the W-, S-, shapes. (Song and Wen, 2000)

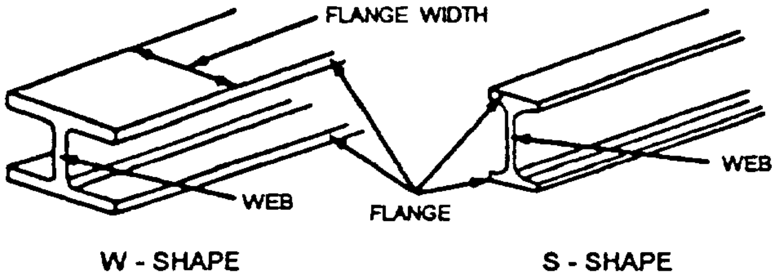


Figure 2.1: structure shapes

The S-shape is in the design of the inner surfaces of the flange. The W-shape has parallel inner and outer flange surfaces with a constant thickness, while the S-shape has a slope of approximately 17’ on the inner flange surfaces. The C-shape is similar to the S-shape in that its inner flange surface is also sloped approximately 17’.The W-SHAPE is a structural member whose cross section forms the letter H and is the most widely used structural member. It is designed so that its flanges provide strength in a horizontal plane, while the web gives strength in a vertical plane. W-shapes are used as beams, columns, truss members, and in other load-bearing applications.

The BEARING PILE (HP-shape) is almost identical to the W-shape. The only difference is that the flange thickness and web thickness of the bearing pile are equal, whereas the W-shape has different web and flange thicknesses.

The S-SHAPE (American Standard I-beam) is distinguished by its cross section being shaped like the letter I. S-shapes are used less frequently than W-shapes since the S-shapes possess less strength and are less adaptable than W-shapes.

The C-SHAPE (American Standard channel) has a cross section somewhat similar to the letter C. It is especially useful in locations where a single flat face without outstanding flanges on one side is required.
The C-shape is not very efficient for a beam or column when used alone. However, efficient built-up members may be constructed of channels assembled together with other structural shapes and connected by rivets or welds. (Song and Wen, 2000)

2.3 **Mechanism of assembly and welding steel beams**

A group of components or tools tied together by different systems (hydraulic, pneumatic, or by using electric motor), this system operating manual or with PLC (Programming logical control), hydraulic system this called mechanism of assembly and welding steel beams. (Anon, 2017)

2.4 Different types from mechanisms and methods of operation

There are deferent types of mechanisms to built-up beam**.** Here some factories and companies example:

2.4.1 BJCHI heavy industries public company limited

Figure 2.2: BJCHI work shop

In April 2016 the BJCHI work shop was founded to built-up beam. The built-up beam production line has a capacity of 25,000 tons per annum and possesses highly automated machines and equipment for plate cutting, T-Shape and H-Shape assembly, welding and the post-welding reformation of bending distortions. The current technical capabilities enable fabrication of nearly all beam specifications. (Table 2.1: BJCHIA) and (Figure 3, 4, 5: BJCHI) show the components of BJCHI workshop (Anon, 2017)

Table 2.1: BJCHIA components in built-up Beam workshop

Lifting And Moving Equipment	**Model Or Capacity**	**Quantity**
Cranes Hydraulic ,Type &Crawler	180,100,80,50,25 Ton	16
Tower Cranes Electrical Fixed Type	50 Mradius,10 TON	3
Over Head Cranes &Cantry Cranes	32,15,10,7.5,5 Ton	66
Transporter / Trailer	420,100,70,50,30 Ton	12
Forklift	30,23,15 12,8,5,3 Ton	12
Carco Trucks With Lifter	5-8 Ton	4
Boom Lift	500 Kg	16
Wheel Loader	1.8 M^3	2
Pump Car	12 M^3/Hr	2

Plate Rolling &Bending Equipment	**Model Or Capacity**	**Quantity**
Plate Rolling Machine	$40^{MM}T\times 3{,}100^{MM}$ W	3
Pipe Angle Bending Machine	$250^{MM}\times 250^{MM}\times 30^{MM}T$	1
Pipe Bending Machine	Ø8”×Sch 80	1
Hydraulic Press Machine	500 Ton	1

Cutting &Drilling Equipment	Model Capacity	Quantity
Cnc H-Beam Cutting & Drilling Machine	1,000^{MM}H X 800^{MM}W X 30mmt	4
Cnc Robot Coping Machine	1,000^{MM}H X 450^{MM}W X 30^{MM}T	2
Cnc Cutting & Drilling Combination Machine	500^{MM}H X 300^{MM}W X 20^{MM}T	2
Cnc Plate Cutting Machine	1 Plasma + 2 Gas Torch	5
Plate Drilling & Punching Machine	50^{MM}T X 325^{MM}D	6
Band Saw Machine	Ø30^{MM} - 430^{MM}	6
3 Axis Linear & Gantry Milling	Lm6200	1



Figure 2.3, 4, and 5: the components of BJCHI workshop

2.4.2 Automatic steel H-beam welding machine

In C.C.M Company for assembly and welding beam there are many steps, was mention here. The steps for positioning and assembly beam by using Automatic steel H-beam welding machine (2017)

a. Loading first flange.
b. Flange guiding rollers adjustment.
c. Web loading.
d. First arm side lifting.
e. Single tack welding.
f. T-beam entry in welding station.
g. Rolls adjustable in height to follow the beam during the welding process.
h. TBL roller automatic adjustment.
i. Flange straightening.
j. Straightening device.
k. Welding station with 2 SAW heads twin or tandem ARC.
l. Welded beam on out feed conveyor.
m. Hydraulic tilters for T-beam tilting after welding.
n. In feed –arm opening.
o. Loading second flange.
p. First arm side lifting.
q. T-beams loading.
r. Hydraulic stop flange device.
s. Single tack welding.
t. I-beam entry in welding station.
u. Flanges guidance.
v. Welding station with 2 SAW heads twin or tandem.
w. Complete I-beam welded (2017)

Figure2. 6,7,8,9,10,11,12.13:Automatic steel H-beam welding machine

2.4.3 Assembling and straightening M/C MODEL: KTAS-6080

In term from (2008-2017) was developed new mechanism. This equipment (figure 2.14,15: Integrated system) is our fruitful outcome from long experience in the structural steel industry. Main components are specially selected and combined to have high rigidity in order to maintain its permanent accuracy in spite of applications of long standing. Based on

10 working hours a day, this combined equipment is suitable for small quantity production less than 500 ton per month.

Reduced manpower required. Only 1 operator is required to handle this machine because of convenient operation system.

This combined machine for assembling & straightening saves space and investment cost and is suitable for limited workshop with short length and narrow width.

Camber beam based on work piece length 10m, the cambering below 30mm is covered by standard KTA-6080 and KTAS-6080, pressing flange and web. Flange straightening is completed by 1 time ~ 4 times rolling in accordance with work piece quality and flange thickness.(Anon, 2017)

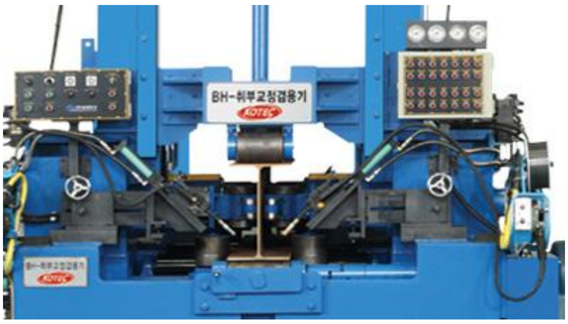



Figure 2.14,15: Integrated system for double purpose - assembling & straightening

Table 2.2: Specification of system for double purpose - assembling & straightening

Model	**Ktas-6080**	
Flange Capacity	Max. 800mm×70T(Assembly)	
	Max. 800mm×60T(Straight)-70T Or More Option Min. 200mm×16T	
Web Capacity	Standard	2,000mm
	Option	2,500-3,000-3,500mm
	Min. 312mm Inside	
Co2 Welding Source	500a	

Tack Welding Speed	Inviter Control(2~15mm/Min)
Straightening Speed	8m/Min
Straightening Pressure	148 Ton
Hydraulic Device	210kg/Cm2/ 150L
Hydraulic Pump Motor	11kw / 220/380V / 3P / 60Hz
Drive Motor	11kw / 289:1 / 220/380V / 3P / 60Hz
Dimension(W×L×H)	4,500×2,250×5,700mm
Weight	16Ton
Cambering Capacity: Min. 30~Max. 80mm(Option)/15mm Option : Electric Power(Customized)	

Figure 2.16: Camber beam

2.4.4 Beam assembly welding and straightening

This machine (Figure 2.17, 18, 19, and 20: Beam assembly welding and straightening)

Combines the latest technology with dynamic functionality to deliver exceptional results (Anon, 2017).

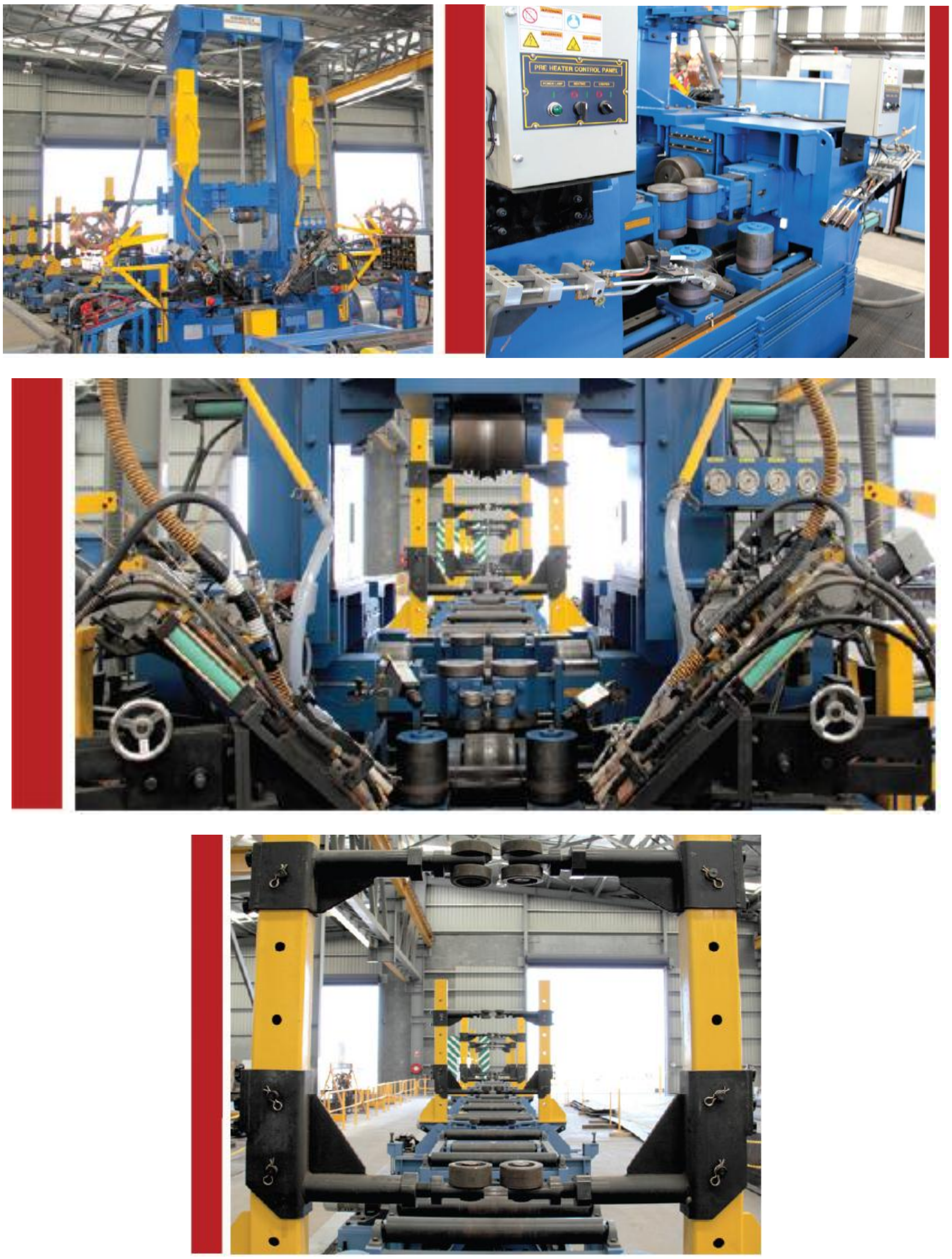


Figure 2.17, 18, 19, and 20: Beam assembly welding and straightening

2.5 hydraulic systems

All the industrial process need objects or mechanism to be moved, like some form of force from previous mechanism. This is generally accomplished by means of electrical equipment (such as motors or solenoids), or via devices driven by air (pneumatics) or liquids (hydraulics), dedicated to increase the force, velocity, torque and other requires.

Pneumatics and hydraulics are thought to be a mechanical engineer's subject. In practice, techniques (and, more important, the faultfinding methodology) tend to be more akin to the ideas used in electronics and process control. (Andrew Parr, 2006)

2.5.1 Industrial prime movers

Any industrial processes require objects or substances to be moved from one location to another, or a force to be applied to hold, shape or compress a product.

Fluid based systems using liquids as transmission media are called hydraulic systems (from the Greek words hydra for water and aulos for a pipe; descriptions which imply fluids are water although oils are more commonly used). Gas-based systems are called Pneumatic systems (from the Greek pneumn for wind or breath).

The main **advantages** and **disadvantages** of pneumatic or hydraulic systems both arise out of the different characteristics of low density compressible gases and (relatively) high density incompressible liquids. A pneumatic system, for example, tends to have a 'softer' action than a hydraulic system which can be prone to producing noisy and wear inducing shocks in the piping. A liquid-based hydraulic system, however, can operate at far higher pressures than a pneumatic system and, consequently, can be used to provide very large forces. (Andrew Parr, 2006)

2.5.2Comparison between Electrical, Hydraulic and Pneumatic system

Table2.3: Electrical, Hydraulics and pneumatics

	Electrical	**Hydraulic**	**Pneumatic**
Energy Source	Usually From Outside Supplier	Electric Motor Or Diesel Driven	Electric Motor Or Diesel Driven
Energy Storage	Limited (Batteries)	Limited (Accumulator)	Good (Reservoir)
Distribution System	Excellent, With Minimal Loss	Limited Basically A Local Facility	Good. Can Be Treated As A Plant Wide Service
Energy Cost	Lowest	Medium	Highest
Rotary Actuators	AC & DC Motors. Good Control On DC Motors. AC Motors Cheap	Low Speed. Good Control. Can Be Stalled	Wide Speed Range. Accurate Speed Control Difficult
Linear Actuator	Short Motion Via Solenoid. Otherwise Via Mechanical Conversion	Cylinders. Very High Force	Cylinders. Medium Force
Controllable Force	Possible With Solenoid & DC Motors Complicated By Need For Cooling	Controllable High Force	Controllable Medium Force
Points To Note	Danger From Electric Shock	Leakage Dangerous And Unsightly. Fire Hazard	Noise

Any measurement system requires definition of the six units used to measure:

Length Mass, Time Temperature, Electrical current, light intensity.

Of these, hydraulic/pneumatic engineers are primarily concerned with the first three. Other units (such as velocity, force, pressure). (Parr, 2000)

2.5.3 Application of hydraulic system in manufacturing

Hydraulic systems was applied in wide range for beam manufacturing, here some example of it:

2.5.3.1 Hydraulic Lift

Hydraulic lift is a device for carrying persons and loads from one floor to another, in a multi-stores building. The hydraulic lifts are of the following types:

1. Direct acting hydraulic lift and
2. Suspended hydraulic lift.

The direct acting hydraulic lift consist of a ram sliding in a cylinder. A platform or a cage is fitted to the top end of ram on which goods may be placed or the persons may stand. As the liquid under pressure is admitted to the cylinder, the ram moves up and the cage is lifted. The lift of the cage is equal to the stroke of the ram. The cage moves in the downward direction when the liquid from the fixed cylinder is removed.

The suspended hydraulic lift is a modified form of the direct acting hydraulic lift. It is fitted with a jigger which is exactly, same as in the case of a hydraulic crane. The cage is suspended by ropes. It runs between guides of hard wood round steel. In order to balance the weight of the cage sliding balance weights are provided. (Anon, 2017)

2.5.3.2 A scissor lift

Is a device used to extend or position a platform by mechanical means. The term “scissor” comes from the mechanic which has folding supports in criss cross “X” pattern. The extension or displacement motion is achieved by the application of force to one or more supports, resulting in an elongation of the cross pattern. The force applied to extend the scissors mechanism may by hydraulic, pneumatic or mechanical (via a lead screw or rack and pinion system).

The need for the use of lift is very paramount and it runs across labs, workshops, factories, residential/commercial buildings to repair street lights, fixing of bill boards, electric bulbs etc. expanded and less-efficient, the engineers may run into one or more problems when in use show (figure 2.21,22) (Google.com, 2017).

Figure 2.21, 22: A scissor lift

2.5.4 Fluid flow

Hydraulic and pneumatic systems are both concerned with the flow of a fluid (liquid or gas) down a pipe. Flow is a loose term that generally has three distinct meanings:

a) Volumetric flow

Is used to measure volume of fluid passing a point per unit of time. Where the fluid is a compressible gas, temperature and pressure must be specified or flow normalized to some standard temperature and pressure.

b) Mass flow

Measures the mass of fluid passing the point in unit time

c) Velocity of flow

Measures linear speed (in ms^{-1}, say) past the point of measurement. (Parr, 2000)

2.5.5 Hydraulic components

Hydraulic system have many components, every unit or component have some concepts, that component are:

2.5.5.1 Hydraulic pumps

A hydraulic pump Figure below takes oil from a tank and delivers it to the rest of the hydraulic circuit. In doing so it raises oil pressure to the required level. The operation of such a pump is illustrated in Figure (2.23). On hydraulic circuit diagrams a pump is represented by the symbols of Figure (2.24), with the arrowhead showing the direction of flow.

Hydraulic pumps are generally driven at constant speed by a three phase AC induction motor rotating at 1500 rpm in the UK (with a 50 Hz supply) and at 1200 or 1800 rpm in the USA (with a 60 Hz supply). Often pump and motor are supplied as one combined unit. As an AC motor requires some form of starter, the complete arrangement illustrated in Figure (2. 25) is needed.

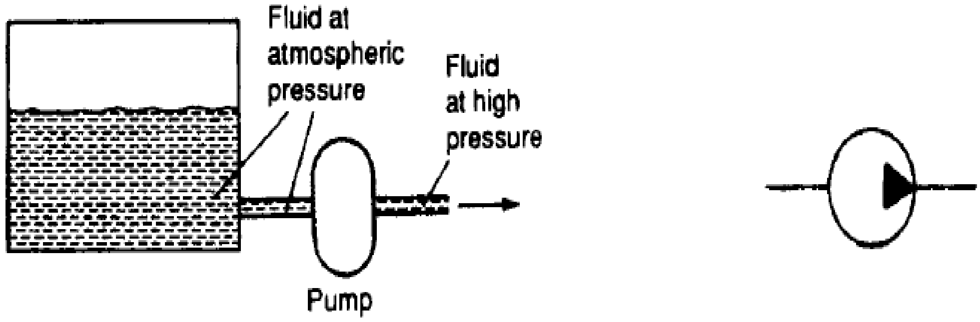


Figure 2.23, 24: Operation of a pump and Pump symbol

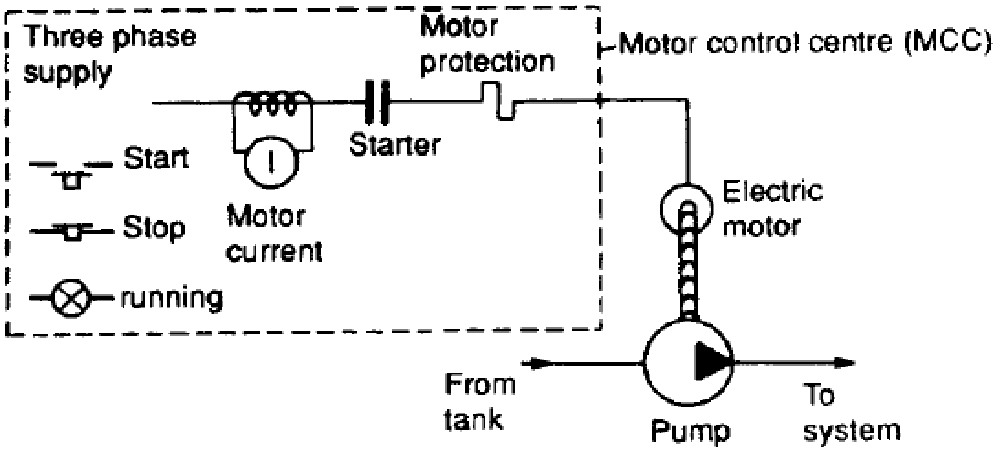


Figure 2.25: Pump associated components

There are two types of pump (for fluids) or compressor (for gases) illustrated in Figure (2.26, 27). Typical of the first type is the centrifugal pump. Devices such as that shown in Figure (2.26) are known as hydrodynamic pumps, and are primarily used to shift fluid from one location to another at relatively low pressures. Water pumps are a typical application. (Parr, 2000)

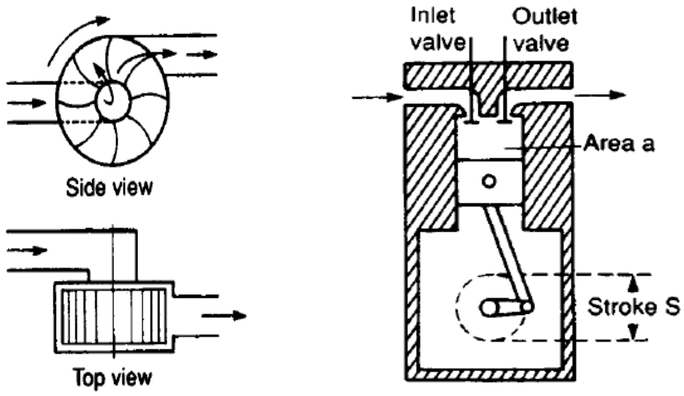


Figure 2.26, 27: Hydrodynamic pump and Positive displacement pump

Figure (2.27) shows a simple piston pump called a positive displacement or hydrostatic pump. As the piston is driven down, the inlet valve opens and a volume of fluid (determined by the cross section area of the piston and the length of stroke) is drawn into the cylinder. Next, the piston is driven up with the inlet valve closed and the outlet valve open, driving the same volume of fluid to the pump outlet.

Should the pump stop, one of the two valves will always be closed, so there is no route for fluid to leak back. Exit pressure is therefore maintained (assuming there are no downstream return routes).

More important, though, is the fact that the pump delivers a fixed volume of fluid from inlet to outlet each cycle regardless of pressure at the outlet port. Unlike the hydrodynamic pump described earlier, a piston pump has no inherent maximum pressure determined by pump leakage: if it drives into a dead end load with no return route (as can easily occur in an inactive hydraulic system with all valves closed) the pressure rises continuously with each pump stroke until either piping or the pump itself fails. (Parr, 2000)

2.5.5.2 Pump types

There are essentially three different types of positive displacement pump used in hydraulic systems.

I. Gear pumps
II. Vane pumps
III. Piston pumps

I. Gear pumps

The simplest and most robust positive displacement pump, having just two moving parts, is the gear pump. Its parts are non-reciprocating, move at constant speed and experience a uniform force. Internal construction, shown in Figure (2.28), consists of just two close meshing gear wheels which rotate as shown. The direction of rotation of the gears should be carefully noted; it is the opposite of that intuitively expected by most people. As the teeth come out of mesh at the center, a partial vacuum is formed which draws fluid into the inlet chamber. Fluid is trapped between the outer teeth and the pump housing, causing a continual transfer of fluid from inlet chamber to outlet chamber where it is discharged to the system. (Parr, 2000)

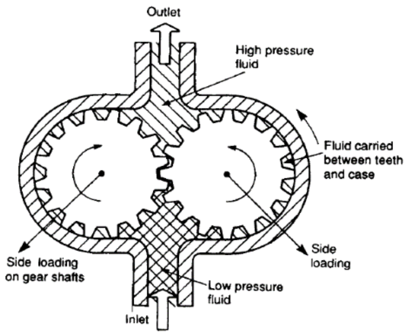


Figure 2.28: Gear pump

The displacement of Pump is determined by: volume of fluid between each pair of teeth; number of teeth; and speed of rotation. Note the working principle of this pump when it rotates the teeth of gear carrying oil from iterance port to exit port.

The performance of this type of pumps are limited by leakage and the ability of the pump to withstand the pressure differential between inlet and outlet ports. The gear pump requires closely meshing gears, minimum clearance between teeth and housing and small space between face of teeth or gear and side of plates. Sometime we notes wear in plate of pump caused by dirt particles in the hydraulic fluid, so cleanliness and filtration are particularly important. Typically, gear pumps are used at pressures up to about 150 bar and capacities of around 150 g.p.m (6751 min-1). Volumetric efficiency of gear pumps at 90% is lowest of the three pump types.

There are some variations of the basic gear pump. Gears have been replaced by lobes giving a pump called a lobe pump. (Parr, 2000)

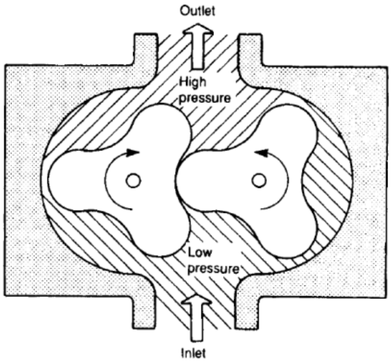


Figure 2.29: The lobe pump

Another variation called the internal gear pump where an external driven gear wheel is connected to a smaller internal gear, with fluid separation as gears disengage being performed by a crescent-shaped molding.

Internal gear pumps operate at lower capacities and pressures (typically 70 bar) than other pump types. (Parr, 2000)

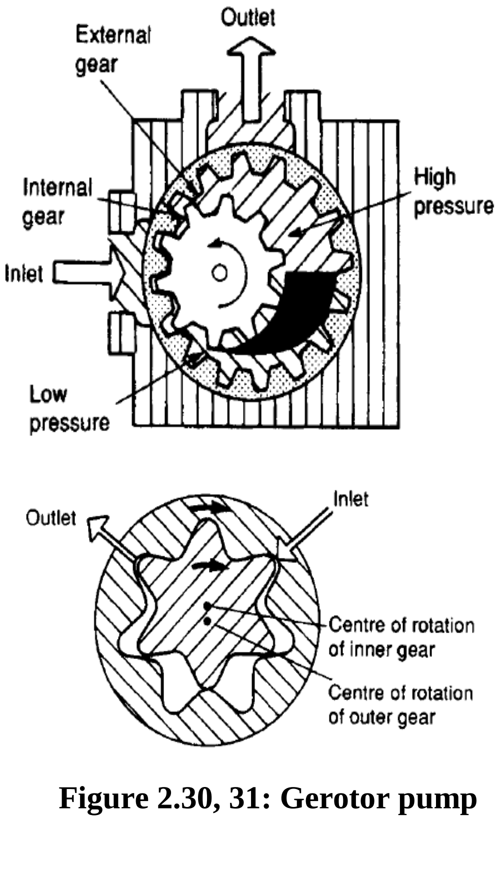


Figure 2.30, 31: Gerotor pump

II. Vane pump

Vane pump reduces this leakage by using spring (or hydraulic) loaded vanes slotted into a driven rotor, as illustrated in the two examples of Figure below. The major source of leakage in a gear pump arises from the small gaps between teeth, and also between teeth and pump housing.

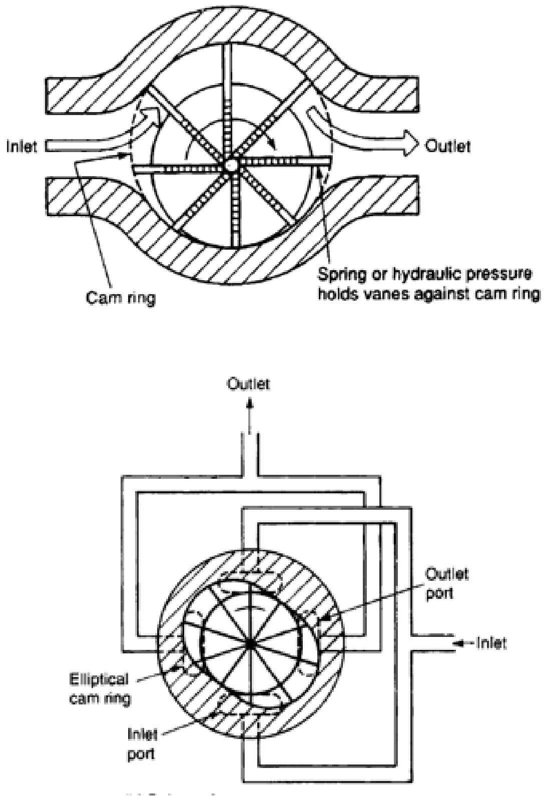


Figure 2.32, 33: Vane pump

In the pump shown in Figure (Figure 2.32, 33, the rotor is offset within the housing, and the vanes constrained by a cam ring as they cross inlet and outlet ports.

he difference in pressure between outlet and inlet ports creates a severe load on the vanes and a large side load on the rotor shaft which can lead to bearing failure. (Parr, 2000)

III. Piston pumps

A piston pump is superficially similar to a motor car engine, and a simple single cylinder arrangement was shown earlier in Figure below.

Such a simple pump, however, delivering a single pulse of fluid per revolution, generates unacceptably large pressure pulses into the system. Practical piston pumps therefore employ multiple cylinders and pistons to smooth out fluid delivery, and much ingenuity goes into designing multi cylinder pumps which are surprisingly compact. More reliable, and cheaper. (Parr, 2000)

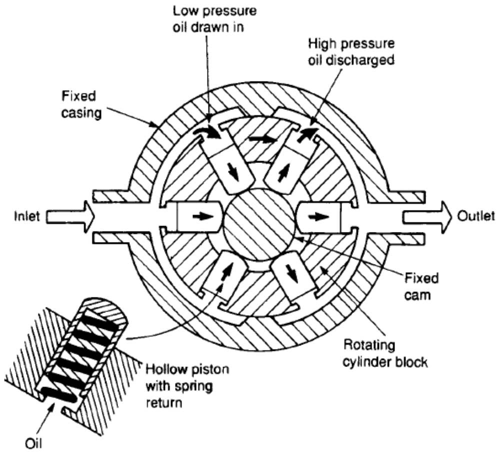


Figure 2.34: Piston pump with stationary cam and rotating block

Table 2.4: comparison of hydraulic pump types

Type	*Maximum pressure (bar)*	*Maximum flow (1/min)*	*Variable displacement*	*Positive displacement*
Centrifugal	20	3000	No	No
Gear	175	300	No	Yes
Vane	175	500	Yes	Yes
Axial piston (port-plate)	300	500	Yes	Yes
Axial piston (valved)	700	650	Yes	Yes
In-line piston	1000	100	Yes	Yes

- **Combination pumps and Loading valves**

Many hydraulic applications are similar to Figure 2.16, where a work piece is held in place by a hydraulic ram. There are essentially two distinct requirements for this operation. As the cylinder extends or retracts a large volume of fluid is required at a low pressure (sufficient just to overcome friction). As the work piece is gripped, the requirement changes to a high pressure but minimal fluid volume. (Parr, 2000)

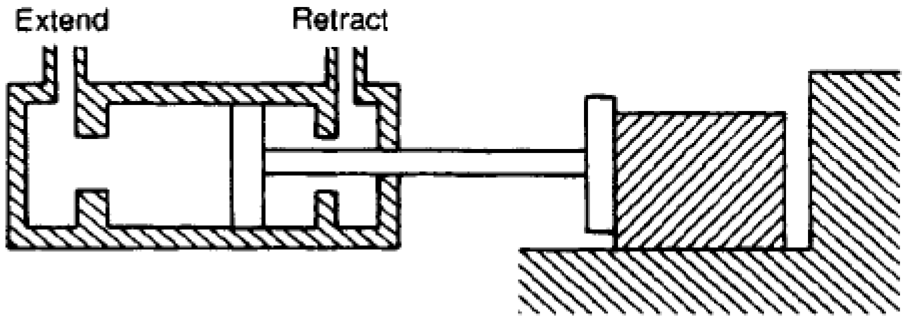


Figure 2.35: clamping cylinder

Expression below shows that allowing excess fluid from a pump to return to the tank by a pressure relief valve is wasteful of energy and can lead to a rapid rise in temperature of the fluid as the wasted energy is converted to heat. It is normally undesirable to start and stop the pump to match load requirements, as this causes shock loads to pump, motor and couplings. (Parr, 2000)

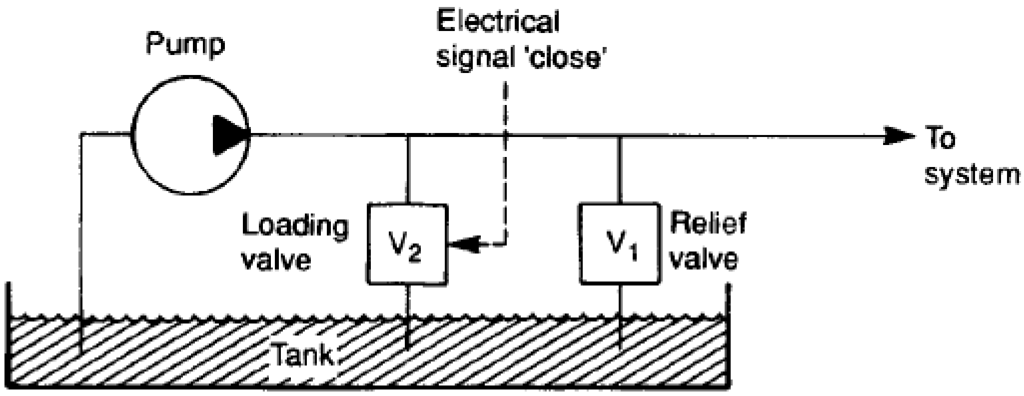


Figure 2.36: Loading valves

2.5.5.3 Filters

Filters are used to prevent dirt entering the vulnerable parts of the system, and are generally specified in microns or meshes per linear inch (sieve number).

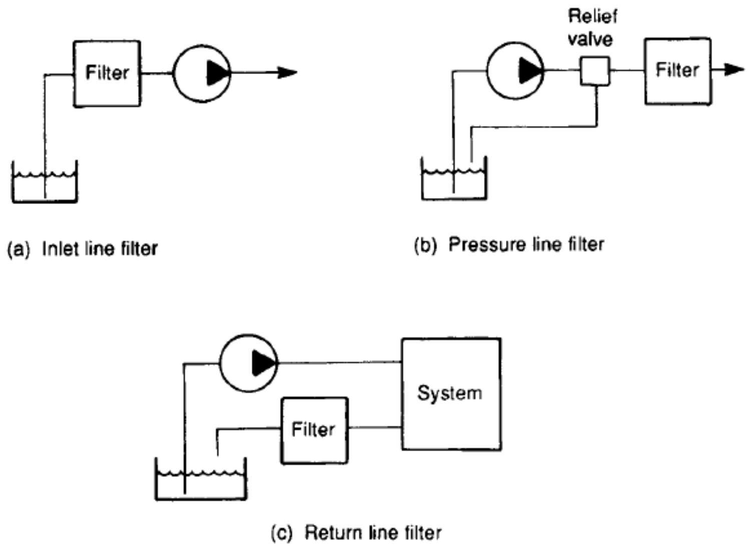


Figure 2.37(a), (b), (c): Filter positions

Inlet line filters protect the pump, but must be designed to give a low pressure drop or the pump will not be able to raise fluid from the tank. Low pressure drop implies a coarse filter or a large physical size.

Pressure line filters placed after the pump protect valves and actuators and can be finer and smaller. They must, however, be able to withstand full system operating pressure. Most systems use pressure line filtering (Parr, 2000)

2.5.5.4 Control valves

Control valves is very important to hydraulic system to direct and regulate the flow of fluid from compressor or pump to the various load devices.

Valves are used for many purposes, an infinite position valve can take up any position between open and closed and used to modulate flow or pressure. Relief valves described in earlier chapters are simple infinite position valves. Used to allow or block flow of fluid. Such valves are called finite position valves.

An analogy between the two types of valve is the comparison between an electric light dimmer and a simple on/off switch. Connections to other component of a hydraulic system are termed 'ports', a simple on/off valve has two ports. Most control valves have four ports shown in hydraulic figure (2.40) in both the load is connected to ports labeled A, B and the pressure supply (from pump) to port E In the hydraulic valve, fluid is returned to the tank from port T.

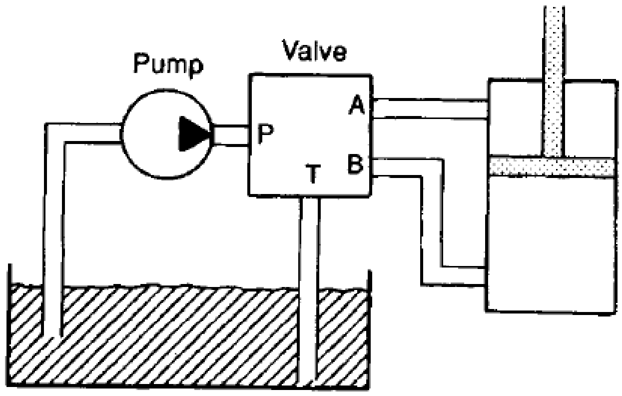


Figure 2.38: Valves in a hydraulic system

It have a two positions; extend or retract. This valve has two control positions (and the ram simply drives to one end or other of its stroke). Other valves has three positions; extend, off, retract. The valve in Figure (2.39(a)) is called a two position valve, while that in Figure (2.39(b)) is a three position valve.

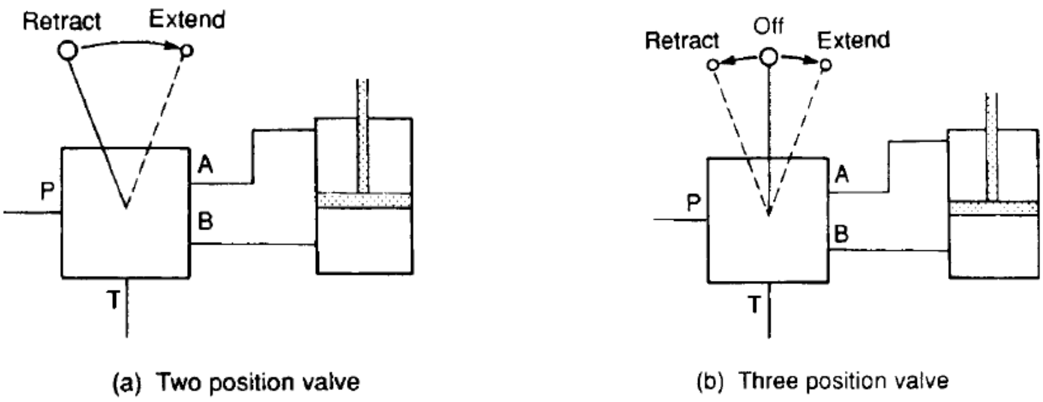


Figure 2.39(a), (b): Valve control positions

Finite position valves are commonly described as a sport /position valve where *port* is the number of ports and *position* is the number of positions. Therefore illustrates a 4/2 valve, and the Figure below shows a 4/3 valve. A simple block/allow valve is a 2/2 valve (Parr, 2000)

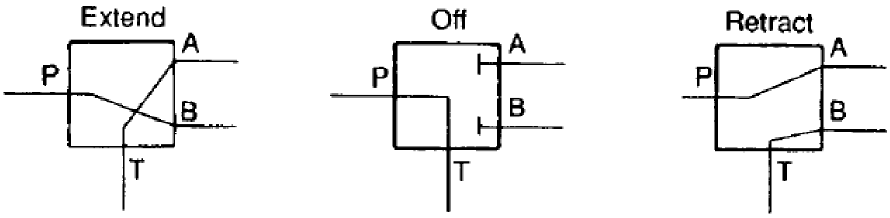


Figure 2.40: Possible valve action for a 4/3 valve

2.5.5.5 Types of control valve

I. poppet valves
II. spool valves
III. Rotary valves

I. Poppet valves

Have a simple discs and cones or balls are used in conjunction with simple valve seats to control flow. Figure below shows the construction and symbol of a simple 2/2 normally-closed valve, where depression of the pushbutton lifts the ball off its seat and allows fluid to flow from port P to port A. When the button is released, spring and fluid pressure force the ball up again closing the valve. (Parr, 2000)

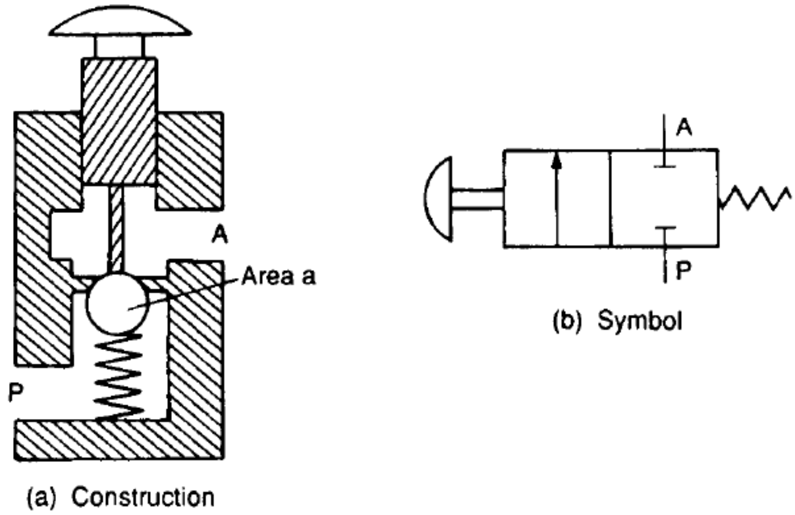


Figure 2.41(a), (b): Simple 2/2 poppet valve

II. Spool valves

Spool (or slide) valves are constructed with a spool moving horizontally within the valve body, as shown for the 4/2 valve in Figure below. Raised areas called 'lands' block or open ports to give the required operation.

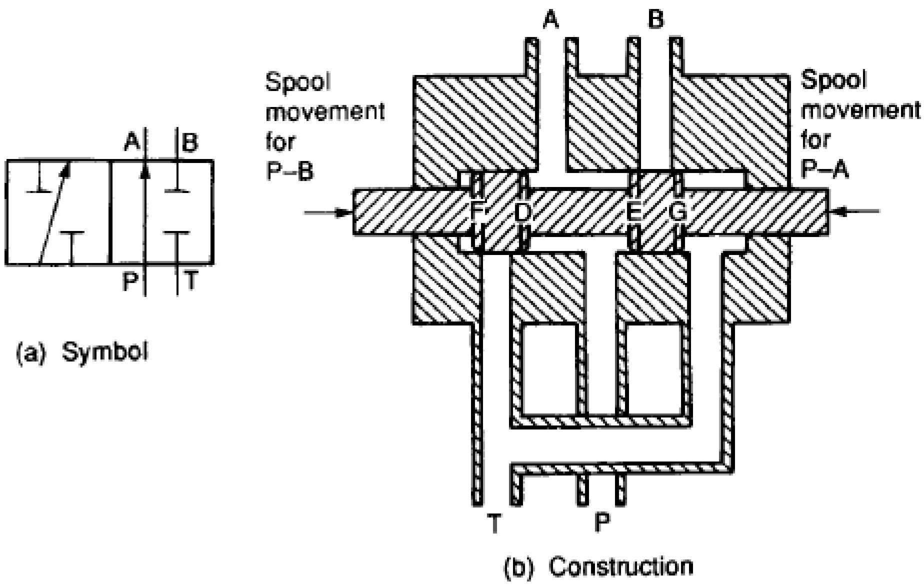


Figure 2.42 (a), (b): Two-way spool valve

Figure below is a change over 4/2 spool valve. Comparison of the valves shown in Figures (2.42(a), (b)) shows they have the same body construction, the only difference being the size and position of lands on the spool. This is a major cost-saving advantage of spool valves; different operations can be achieved with a common body and different spools. This obviously reduces manufacturing costs. (Parr, 2000)

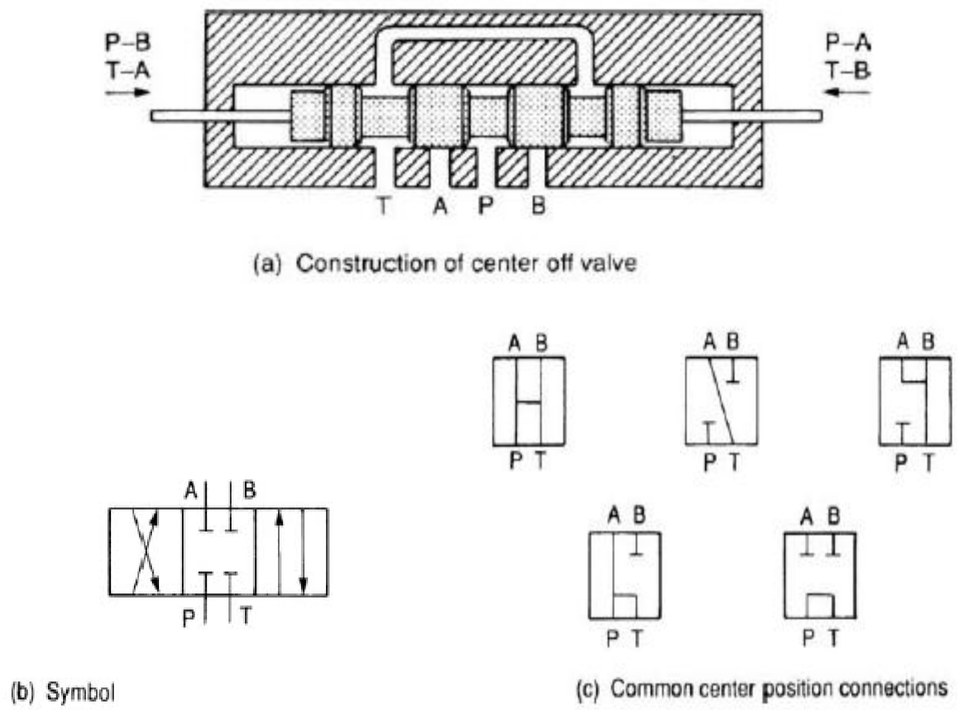


Figure 2.43(a), (b), (c): Three position four-way valves

III. Rotary valves

Rotary valves consist of a rotating spool which aligns with holes in the valve casing to give the required operation. Figure (2.44(a), (b)) shows the construction and symbol of a typical valve with center off action. Rotary valves are compact, simple and have low operating forces. They are, however, low pressure devices and are consequently mainly used for hand operation in pneumatic systems. (Parr,2000)

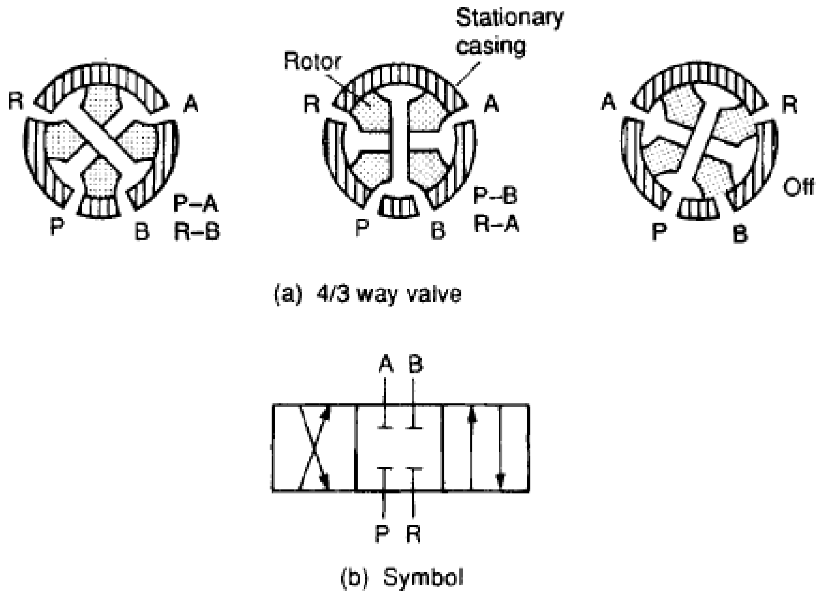


Figure 2.44(a), (b): Rotary valves

2.5.5.6 Actuators

A hydraulic system is generally concerned with moving, gripping or applying force to an object. Devices which actually achieve this objective are called actuators, and can be split into three basic types:

I. Linear actuators.
II. Rotary actuators.
III. The third type of actuator is used to operate flow control valves for process control. (Parr, 2000)

I. Linear actuators

Cylinder consider the basic linear actuator is the, or ram, shown in schematic form in Figure below. Practical constructional details are discussed later. The cylinder consists of a piston, radius R, moving in a bore. The piston is connected to a rod of radius r which drives the load. Obviously if pressure is applied to port X (with port Y venting) the piston extends. Similarly, if pressure is applied to port Y (with port Z venting), the piston retracts. The force applied by a piston depends on both the area and the applied pressure. For the extend stroke, area A is given by "a' R^2. For a pressure P applied to port X, the extend force available

$$\frac{f}{c} = p * \pi * R^2 \qquad (2.1)$$

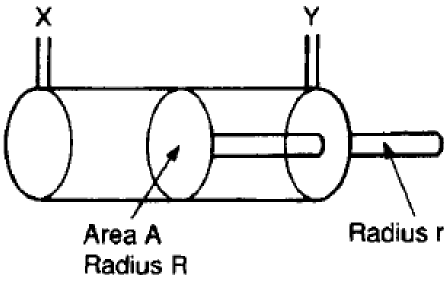


Figure 2.45: A simple cylinder

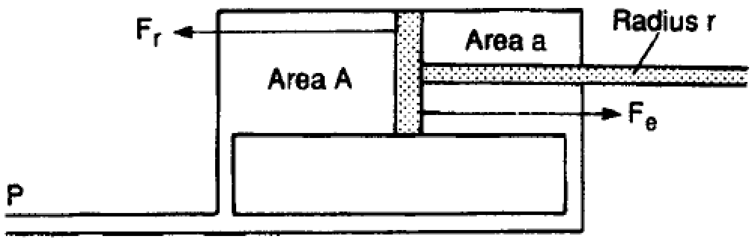


Figure 2.46: Pressure applied to both sides of piston

Hydraulic linear actuators are constructed in a similar manner, Figure (2.47) shows the construction of a double-acting cylinder. Five locations can be seen where seals are required to prevent leakage. To some extent, the art of cylinder design is in choice of seals, a topic discussed further in a later section.

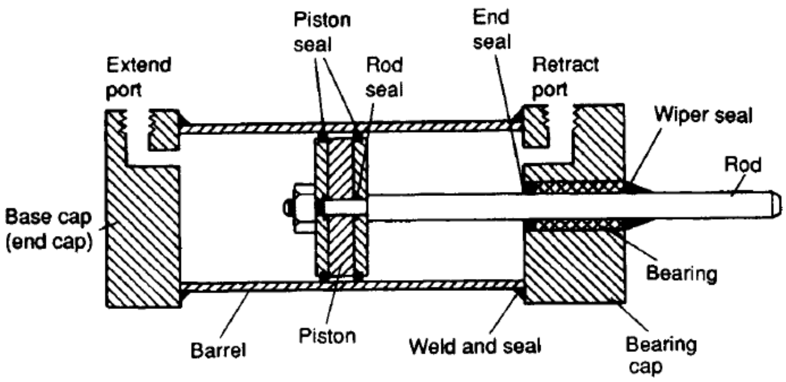


Figure 2.47: Construction of a typical cylinder

There are five basic parts in a cylinder; two end caps (a base cap and a bearing cap) with port connections, a cylinder barrel, a piston and the rod itself. This basic construction allows fairly simple manufacture as end caps and pistons are common to cylinders of the same diameter, and only (relatively) cheap barrels and rods need to be changed to give different length cylinders. End caps can be secured to the barrel by welding, tie rods or by threaded connection. Basic constructional details are shown in Figure (2.48). The inner surface of the barrel needs to be very smooth to prevent wear and leakage. Generally a seamless drawn steel tube is used which is machined (honed) to an accurate finish. In applications (Parr, 2000)

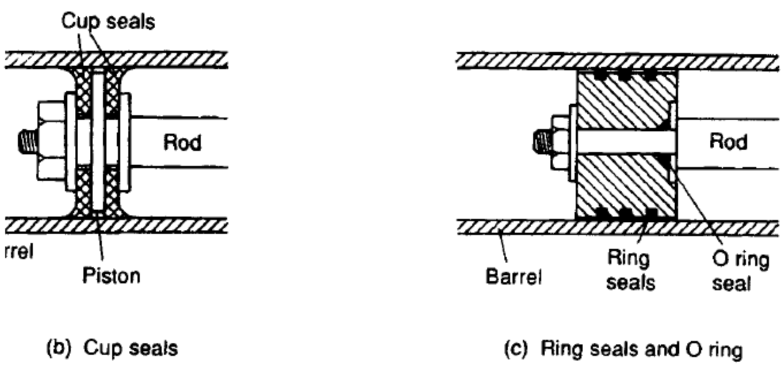


Figure 2.48: Cylinder constructional details

Cylinder mounting is determined by the application. Two basic types are shown in Figure (2.49). The clamp of Figure (2.49(a)) requires a simple fixed mounting. The pusher of Figure (2.49(b)) requires a cylinder mount which can pivot.

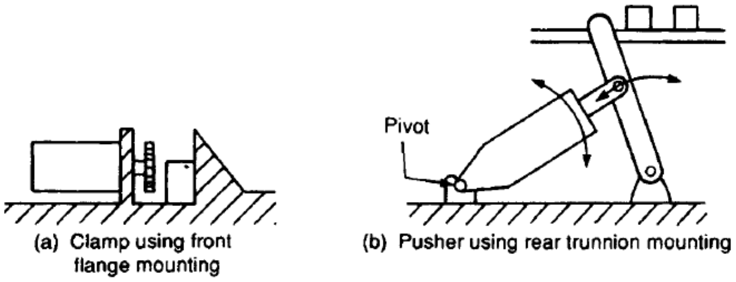


Figure 2.49(a), (b): Basic mounting types

Figure (2.50) shows various mounting methods using these two basic types. The effects of side loads should be considered on non-center line mountings such as the foot mount. Swivel mounting obviously requires flexible pipes.
(Parr, 2000)

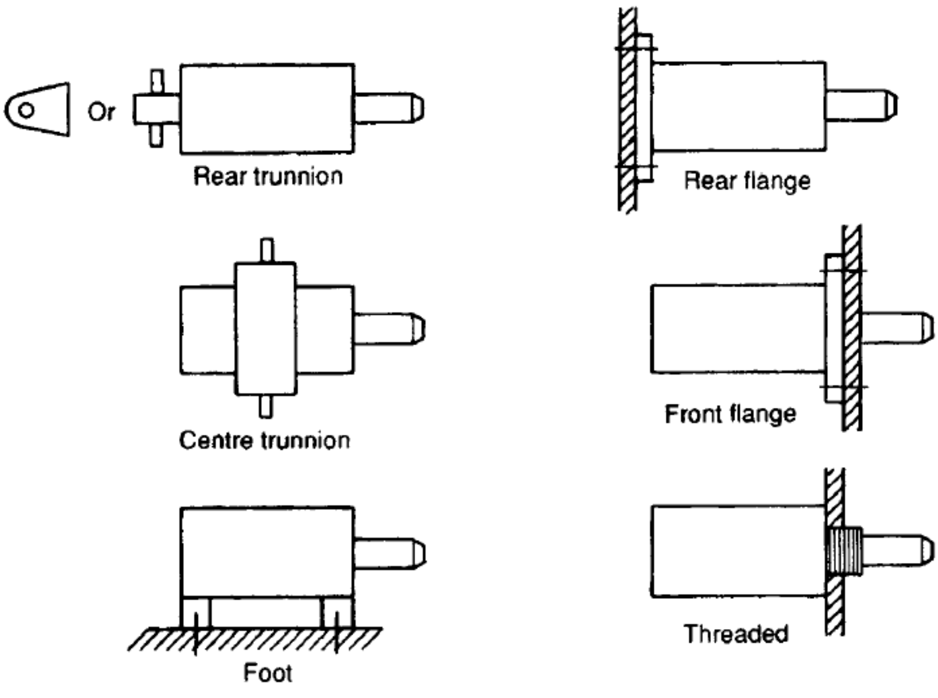


Figure 2.50: Methods of cylinder mounting

II. **Rotary actuators**

Rotary actuators are the hydraulic equivalents of electric motors. For a given torque, or power, a rotary actuator is more compact than an equivalent motor, cannot be damaged by an indefinite stall and can safely be used in an explosive atmosphere.

For variable speed applications, the complexity and maintenance requirements of a rotary actuator are similar to a thermistor-controlled DC drive, but for fixed speed applications, the AC induction motor (which can, for practical purposes, be fitted and forgotten) is simpler to install and maintain. A rotary actuator (or, for that matter, an electric motor) can be defined in terms of the torque it produces and its running speed, usually given in revs per minute (rpm). Definition of torque is illustrated in Figure (2.51), where a rotary motion is produced against a force of F Newton's acting at a radial distance d meters from a shaft center. The device is then producing a torque T given by the expression:

$$T = Fd \text{ Nm} \qquad (2.2)$$

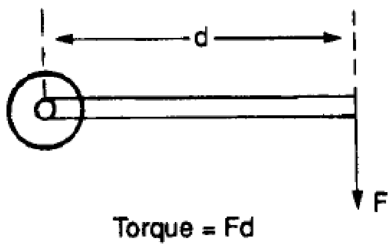


Figure 2.51: Definition of torque

2.5.5.7 Hydraulic accessories

Hydraulic system have accessories like reservoirs, Hydraulic fluids and hydraulic piping, hosing and connections.

I. Hydraulic reservoirs

A hydraulic system is closed, and the oil used is stored in a tank or reservoir to which it is returned after use. Although probably the most mundane part of the system, the design and maintenance of the reservoir is of paramount importance for reliable operation. Figure below shows details of a typical reservoir. The volume of fluid in a tank varies according to temperature and the state of the actuators in the system, being minimum at low temperature with all cylinders extended, and maximum at high temperature with all cylinders retracted. Normally the tank volume is set at the larger of four times the pump draw per minute or twice the external system volume. A substantial space must be provided above the fluid surface to allow for expansion and to prevent any froth on the surface from spilling out. (Parr, 2000)

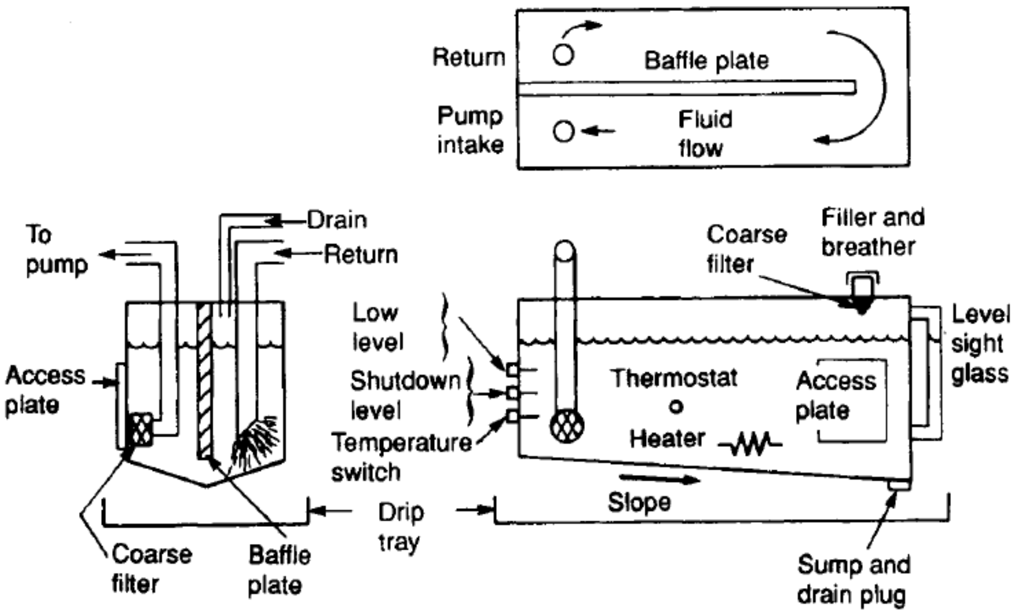


Figure 2.52: Construction of a hydraulic reservoir

II. Hydraulic fluids

The liquid in a hydraulic system is used to convey energy and produce the required force at the actuators. Very early systems used water but water has many disadvantages. Modern fluids therefore been developed.

The fluid conveys power in a hydraulic circuit, but it must also have other properties. Moving parts in valves do not have seals; instead they rely on fine machining of spools and body to form the seal in conjunction with the fluid. Despite fine machining, irregularities still occur on the surface, shown in exaggerated form on Figure (2.53(a)). The fluid is required to pass between the two surfaces, holding them apart as Figure (2.53(b)), to reduce friction and prevent metal-to-metal contact which causes premature wear. Sealing and lubrication are therefore two important properties of hydraulic fluid.

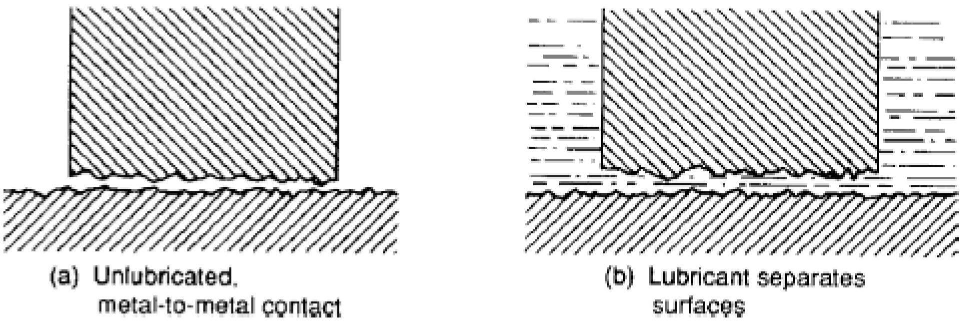


Figure 2.53(a), (b): Need for lubrication from hydraulic fluid

The temperature of hydraulic fluid tends to rise with the work done, an ideal operating temperature being around 50 C. The fluid must be able to convey heat from where it is generated (valves, actuators, frictional losses in pipes) and must not be affected itself by temperature changes.

Some synthetic fluids interact with nitrile and neoprene, and special paint is needed on the inside of the reservoir with some fluids. The fluid must therefore be chosen to be compatible with the rest of the system.

The fluid itself comes under attack from oxygen in air. Oxidation of fluid (usually based on carbon and hydrogen molecules) leads to deleterious changes in characteristics and the formation of sludge orvgum at low velocity points in the system. The resulting oxidation products are acidic in nature, leading to corrosion. The fluid of course must be chemically stable and not suffer from oxidation. The temperature of fluid strongly influences the rate of oxidation; which rises rapidly with increasing temperature.

(Parr, 2000)

III. Hydraulic piping, hosing and connections

The differences between hydraulic and pneumatic piping primarily arise from the far higher operating pressures in a hydraulic system. Particular care has to be taken to check the pressure rating of pipes, tubing, hosing and fittings, specified as the bursting pressure. A safety factor is defined as:

$$\text{safety factor} = \frac{\text{bursting pressu}}{\text{working pressu}} \longrightarrow (2.3)$$

The choice of piping or tubing is usually a direct consequence of pressure rating. These can be manufactured as welded, or drawn (seamless) pipe. Welded pipe has an inherent weakness down the welded seam, making seamless pipes or tubing the preferred choice for all but the lowest pressure hydraulic systems. (Parr, 2000)

CHAPTER III

Methodology

CHAPTER III

3.1 Introduction

This chapter had been more illustrative to have understanding of the system. To understand how to build and design a hydraulic circuit for the production line of beam.

The hydraulic system use as a completed circuit to assembled H and I beam by using some component working together to establish some task such as moving, holding and positioning of beam. This component selected and calculated according to many lows cited in this chapter.

3.2 The sequences of the activities to complete the project

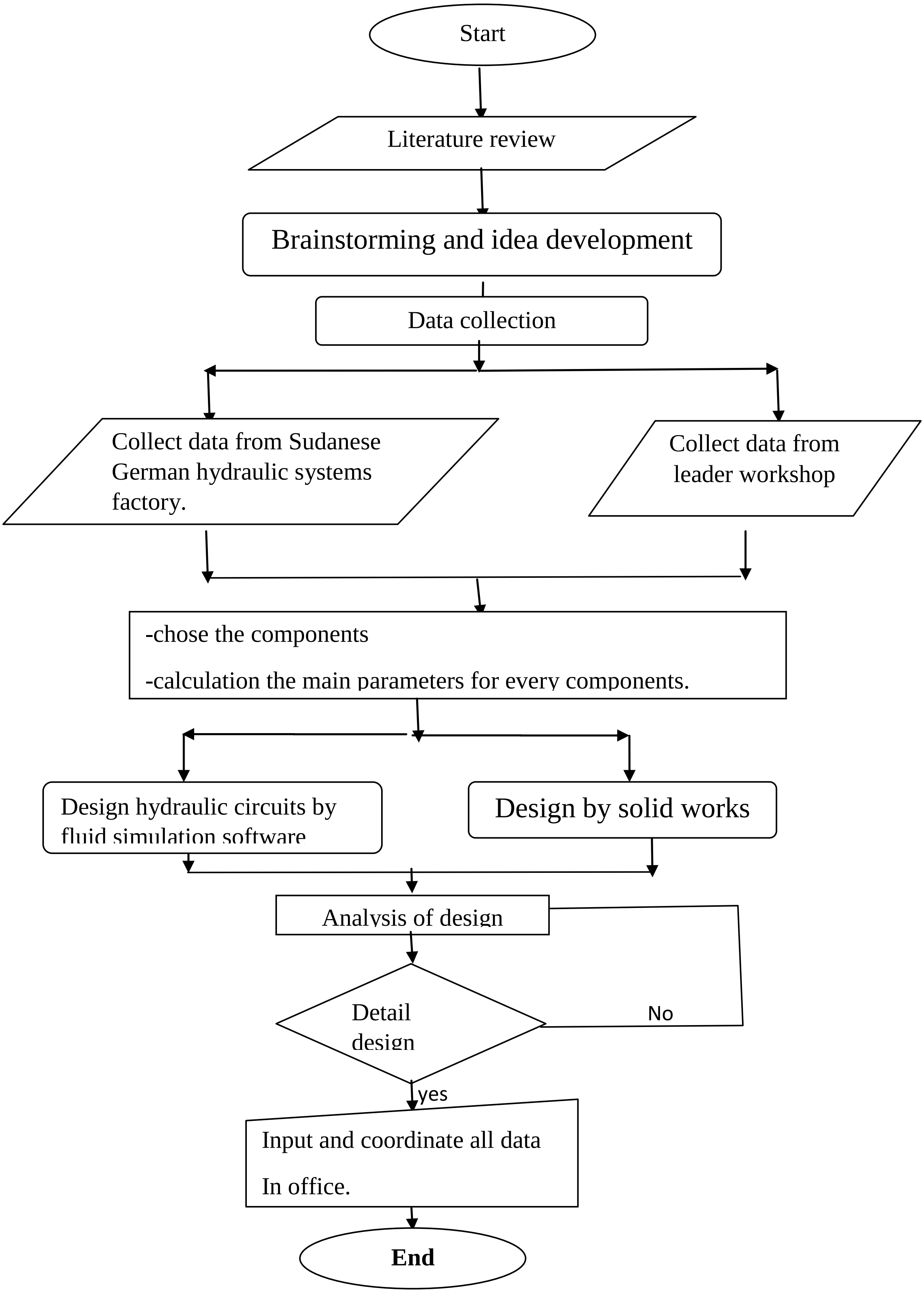


Figure 3.1: flow chart for project, 2017

3.3 The Beam dimensions

From leader factory production's line as shown in figure (3.1) The maximum length of raw beam is 6000mm and 1500 mm in maximum width and the thickness of beam (4, 5, 6, 8, 10, 12, 15, 20, 25, 30, and 40) mm. Row beam dissected by dissect machines for the appropriate and predetermined dimension to divide it into flange and web.

For example the web and flange dimensions represented at code (HI300-5-12*150) and determine according to the work requirements or needs:

- 300 represent length of flange.
- 5 represent the thickness of web.
- 12 represent the thickness of flange.
- 150 represent the length of beam.

Figure 3.2: The manual production line, leader factory

3.4 solid works software

The most advanced method of geometric modeling in three dimensions. Solid modeling is the representation of the solid parts of the object on your computer.

3.4.1 Advantages of Solid Modeling

Solid modeling is one of the most important applications of the CAD software helps the designer to see the designed object as if it were the real manufactured product. It can be seen from various directions and in various views. This helps the designer to be sure that the object looks exactly as they wanted it to be. It also gives additional vision to the designer as to what more changes as to what changes can be done in the object.

3.5 fluid simulation software

FL-SIM is a software to model and simulation of hydraulic circuits to see suitability of circuit component, showing any errors and connecting between hydraulic systems and others system which use to operations.

3.6 The Design of production line concepts

To design a Beam production line, there are two lines must take into account to show all things in this design clearly, one of them is a design of external frame which burden all statically weight.

And the other is a design of hydraulic circuits which help in holding and positioning processes at the frame of the production line.

This relation measure the space from the center of the flange to the end of it:

$$l = (D - T)/2 \qquad \text{..........................} \ (1.3)$$

Where:

L: the distance from the center of the flange.

D: the total length of the flange.

T: the thickness of the web

3.6.1 Design of External Frame

- The main purpose of this frame to burden all system in case of all components in statically position and also to fixing hydraulic components in case of moving.
- The design depends on the dimensions which take from LEADER factory.
- fabricated from steel cold rolled.

The total length of production line consisting many units(figure 3.2) if we need to line equal 9 meter we use 3 units and make distance between them equal to 400mm.

Table 3.1: Dimensions for hydraulic circuit

NO	Descriptions	Dimensions in (mm)
1	Total length of unit	3000 mm
2	The width of unit	2000 mm
3	The height of unit	700 mm
4	Distance between units	400 mm

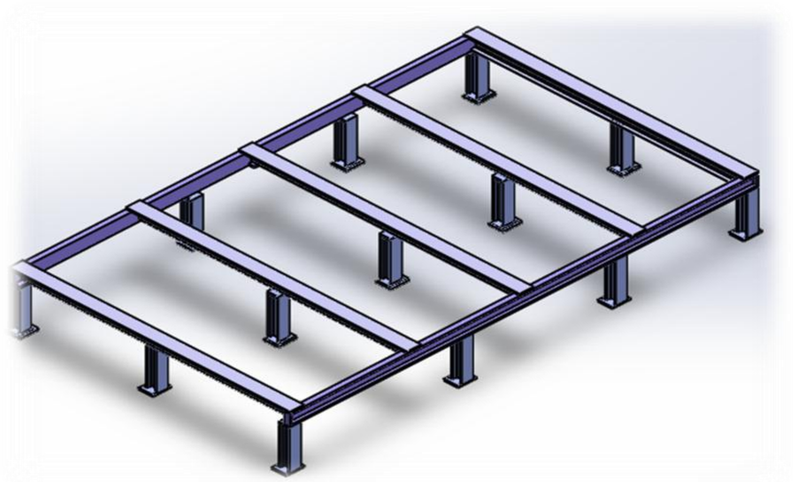


Figure 3.3: table of system, solid work

(Production line unit)

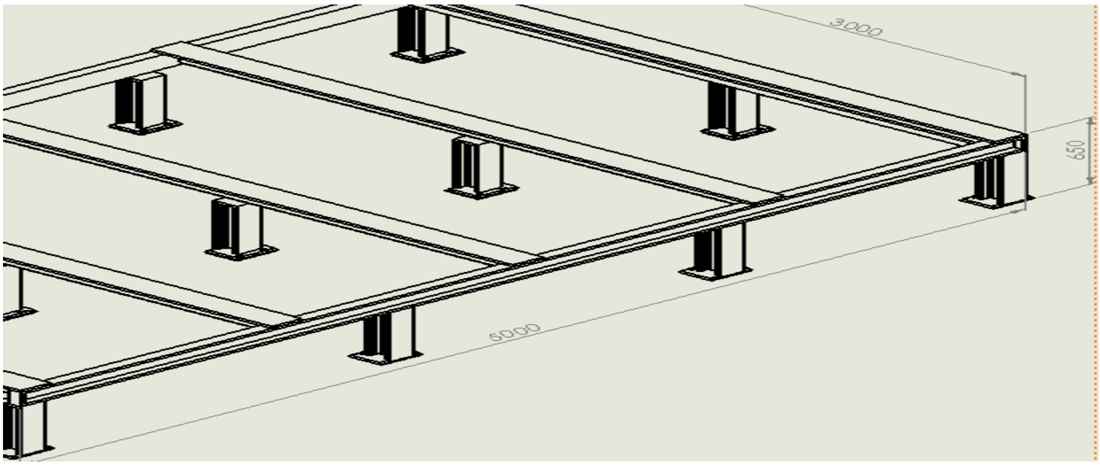


Figure 3.4: table of system, solid work

3.6.2 Design of hydraulic circuits

The system consist three circuits to holding and positioning beams

- Hydraulic circuit to holding web.
- Hydraulic circuit to holding right flange.
- Hydraulic circuit to holding left flange.

3.7 assumptions of hydraulic component from fluid simulation software

There are many assumptions to use or to selection of component from fluid simulations

3.7.1 The pump unit (power system)

Choose the power system with below considerations:

- Pressure relive valve

  Operating pressure (0.01 to 40) Mpa.

- Pump

  Flow (0 to 500) lit/min.

  Internal leakage (0 to 100) lit/ (min*Mpa).

3.7.2 The filter

Hydraulic resistance (0.0001 to 0.1*10^{-7}) Mpa/($\frac{1}{min}$)^2) with the curve show the relation between flow (lit/min) plotting on X axis, and pressure (bar) plotting on Y axis. This curve show the value of hydraulic resistance.

3.7.3 Reservoir

The volume of reservoir (0.01 to 100) lit.

3.7.4 The Tank

The volume of the tank must be 3 to 5 once more than volume of pump.

3.7.5 The control valves

1- Configurable directional control valves
2- Frequently used way valves
3- Shutoff valves and flow control valves
4- Pressure control valves
5- Proportional valves

- **Operation of Right and Left actuation**
  - Manually
  - Mechanically
  - Electrically
- **Hydraulic resistance**

  Hydraulic resistance (0.0001 to 0.1*10^{-7}) Mpa/($\frac{1}{min}$)^2) with the curve show the relation between flow (lit/min) plotting on X axis, and pressure (bar) plotting on Y axis. (FESTO fluid simulation, 2017)

3.7.6 The cooler

Hydraulic resistance (0.0001 to 0.1*10^{-7}) Mpa/($\frac{1}{min}$)^2)

3.7.7 The Actuators (cylinders)

- **Description**

  Double acting cylinder

- **Piston rod type**

  Double acting

- **Other parameters**
  - Maximum stroke (1 to 5000) mm
  - Piston position (0 to 5000) mm
  - Piston diameter (1 to 1000) mm
  - Piston rod diameter(0 to 1000)mm
  - Mounting angle (angular degrees 0 to 360°)
  - Internal leakage (0 to 100) lit/(min*Mpa)
  - Piston area (mm^2)
  - Ring area (mm^2)
  - Moving mass or external load (0 to 10000)kg
  - Friction between piston and rod surface (static and sliding friction coefficient)
  - Force profile
  - Actuating labels (label, begin and end) , to all distance equal (0 to 200) mm

3.7.8 The hydraulic connection

(FESTO fluidsimulation, 2017)

3.8 Hydraulic circuit to holding web

From data above we assumed this concepts to build up web circuit.

❖ Assumptions

Table 3.2: specifications of hydraulic circuit

Type	Specification
Number of cylinder	15 cylinders
cylinder diameter	63 mm
Length of beams	6000 mm

Stroke length	500 mm
Total weight	68.67 KN
Speed to moving load	2 cm/sec
Maximum operating pressure (Industrial hydraulic).	250 bar
Speed of pump	300 rpm
Efficiency of system η	0.9
Elasticity modulus (E)	210GN/m²
Safety factor (v)	3.5

3.9 Hydraulic circuit to holding flanges

From data above we assumed this concepts to build up flanges circuits.

❖ **Assumptions**

Table 3.3: specifications of hydraulic circuit

Type	Specification
Number of cylinder	6 cylinders
cylinder diameter	50 mm
Length of beams	6000 mm
Stroke length	700 mm
Total weight	14.715 KN
Speed to moving load	2 cm/sec
Maximum operating pressure (Industrial hydraulic).	250 bar
Speed of pump	300 rpm
Efficiency of system η	0.9
Elasticity modulus (E)	210GN/m²
Safety factor (v)	3.5

CHAPTER IV

Design and analysis

Chapter IV

4.1 Introduction

This chapter explains the selection of component (cylinders, the power of pump, the power and velocity of motor, and speed of cylinders). This component selected and calculated according to many lows cited in this chapter.

4.2 Calculations

Divided into two sections one of them is a calculation to selection the web circuit component, and other section is to selection of flange circuit component. Tables (4.2) and (4.3) show the all calculations which prepared in form of input, processing, and output.

4.2.1 Calculations for selection the web circuit component

Table 4.2: calculations of web circuit

Input	Processing	Output
F=68670N P=250 bar η=0.9	**Determine the diameter of cylinder:** $A(area)m^2 = \frac{F(force)N}{p(pressure)N/m^2} = \frac{68670}{250*10^5}$ D (diameter) $= \sqrt{\frac{4\,A}{\pi*\eta}} = \sqrt{\frac{4*2.7468*10^{-3}}{\pi*0.9}} =$ 0.06234m From standard value of cylinder choose Diameter equal to 63 mm.	D = 63 mm

E=210GN/m² V=3.5 d=36mm(rod diameter from table)	**The maximum value in the piston of cylinder which can be carried without hunched depend on:** I= $\frac{\pi * d^4}{64} = \frac{\pi * 0.036^4}{64}$ =8.245 * $10^{-3}\ m^4$ (1≡ section moment) F = $\frac{\pi * E * I}{l^2 * V}$ 68670 = $\frac{\pi * 210 * 10^6 * 8.245 * 10^{-3}}{l^2 * 3.5}$ L = 4.757m=4757mm	The maximum allowable length =(4757mm* 2)= 9514 mm 9514 mm > 500 mm (stroke of piston).
From standard table : $Q1$ = 18.7 lit/min $A1$=31.17 cm^2 $Q2$ = 12.6 lit/min $A2$=20.99 cm^2	**Speed of cylinder:** Speed of cylinder rod when it going out: V1 = $\frac{Q1}{A1}$ = $\frac{0.000311667\ m^3/\text{sec}}{31.17 * 10^{-4}\ m^2}$ Speed of cylinder rod when it going in: V2 = $\frac{Q2}{A2}$ = $\frac{0.00021\ m^3/\text{sec}}{20.99 * 10^{-4}}$	V1=0.0999 m/sec V2= 0.1m/sec
$Q1$ = 18.7 lit/min V(volume(lit) = 5*Q1	**Choose the Hydraulic motors:** **The velocity of motor:** Q1 = n (r.p.m) * V(volume(lit)) 18.70002 lit/min = n * 93.5001 lit	n= 0.2 r.p.m
P (pressure) = 250 bar V(volume) = 93.5 lit	**Turning moment (T):** From diagram (Characteristic of hydraulic motor, p: 3.3)	T = 400 N.m
T = 400 N.m n= 0.2 r.p.m	**The power of motor:** P (power 'watt') = T * 2 * π * n = 400 * 2 * π * 0.2 *60	p = 30159 watt

A(m^2) = ($31.17 * 10^{-4}$ m^2 V = (m/sec) $3.11388 * 10^{-4}$ m^3/sec	**Choose the pump:** Q(liter/min) = A(m^2) * V (m/sec) = ($31.17 * 10^{-4}$ m^2* 0.0999 m/sec) = $3.11388 * 10^{-4}$ m^3/sec	Q=18.68328lit/min
Ᵽ (pressure (Pascal)) = 250*10^5 Q(pump) = 18.68328 lit/min	**Choose the power of pump** P (power 'watt') = Ᵽ * Q = 250 * 10^5 * 18.68328	P=4670.82 watt
Q1=93.5001 lit	**The volume of tank:** V(volume(lit) = 5*Q1 = 5 * 93.5001 lit	**V** =467.5 lit

4.2.2calculatins for selection the flanges circuits' component

Table 4.3: calculations of flanges circuit

Input	Processing	Output
F=29430 N P=250 bar η=0.9	**Determine the diameter of cylinder:** $A(area)m^2 = \frac{F(force)N}{p(pressure)N/m^2} = \frac{29430}{250*10^5}$ D (diameter) = $\sqrt{\frac{4\,A}{\pi*\eta}}$ = $\sqrt{\frac{4*1.1772*10^{-3}}{\pi*0.9}}$= 0.041 m From standard value of cylinder choose diameter equal to 50 mm.	D=50mm
E=210GN/m² V=3.5 d=28 mm	**The maximum value in the piston of cylinder which can be carried without hunched depend on:** I= $\frac{\pi * d^4}{64}$= $\frac{\pi * 28^4}{64}$ =30171.856 mm^4	The maximum allowable length =(1.3901 * 2)=2.7802 m

	F perm = $\frac{\pi * E * I}{l^2 * V}$ 29430= $\frac{\pi * 210 * 10^6 * 30171.856}{l^2 * 3.5}$ L = 1.3901	
From standard table : $Q1$ = 11.8 lit/min $A1$=13.48 cm^2 $Q2$ = 8.1 lit/min $A2$=19.63 cm^2	**Speed of cylinder rod:** Speed of cylinder rod when it going in: V1 = $\frac{Q}{A1}$ = $\frac{1.96667 * 10^{-4}\ m^3/\text{sec}}{13.48 * 10^{-4} m^2}$ Speed of cylinder rod when it going out: V2 = $\frac{Q}{A2}$= $\frac{1.35 * 10^{-4}\ m^3/\text{sec}}{19.63 * 10^{-4} m^2}$	V1=0.145 m/sec V2= 0.07m/sec
$Q1$ = 11.8 lit/min V(volume(lit) = 5*Q1	**Choose the Hydraulic motors:** **The velocity of motor:** Q = n (R.P.M) * V(volume(lit)) 11.8 lit/min = n * 59 lit	N= 0.2 r.p.m
P (pressure) = 250 bar V(volume) = 59 lit	**Turning moment (T):** From diagram (Characteristic of hydraulic motor, p: 3.3)	T = 250N.m T=400 N.m
T = 400 N.m n= 0.2 r.p.m	**The power of motor:** P (power in watt) = T (N.M) * 2 * π * n = 400 N.m * 2 * π * 0.2 *60	p = 30159 watt
	Choose the pump: Q(liter/min) = A(m^2) * V (m/sec) = (19.63*$10^{-4} m^2$* 0.10036m/sec) = 1.9701 * $10^{-4}\ m^3$/sec	Q=0.19701lit/min

	Choose the power of pump: P (power (watt)) = Ᵽ (pressure (Pascal)) * Q (pump(lit/min)) $= 250 * 10^{5} * 19.63 * 10^{-4}$	<u>P=49075 watt</u>
	The volume of tank: = 5 * 59 lit	<u>V tank =295 lit</u>

4.3 Standard value

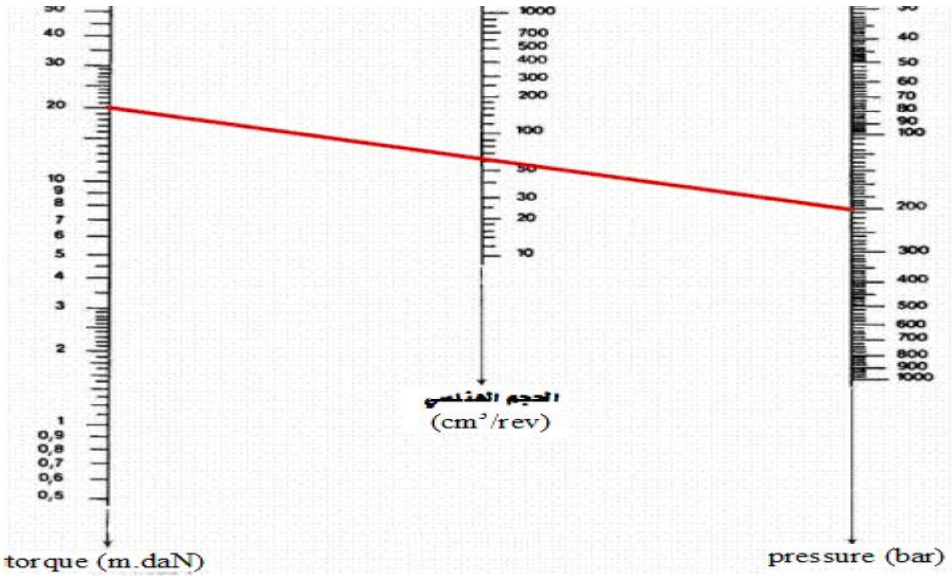


Figure 4.1: Characteristic of hydraulic motor

Table 4.4: The standard values of hydraulic parameters

Piston	Piston rod	Area ratio	Areas			Force at 160 bar [1)]			Flow at 0.1 m/s [2)]		
	rod	ratio	Piston	Rod	Annulus	Pushing	Diff.	Pulling	Out	Diff.	In
AL Ø mm	MM Ø mm	φ A_1/A_3	A_1 cm^2	A_2 cm^2	A_3 cm^2	F_1 kN	F_2 kN	F_3 kN	q_{V1} L/min	q_{V2} L/min	q_{V3} L/min
25	12 18	1.30 2.08	4.91	1.13 2.54	3.78 2.37	7.85	1.81 4.07	6.04 3.78	2.9	0.7 1.5	2.3 1.4
32	14 22	1.25 1.90	8.04	1.54 3.80	6.50 4.24	12.87	2.46 6.08	10.40 6.79	4.8	0.9 2.3	3.9 2.5
40	18 22 [12)] 28	1.25 1.43 1.96	12.56	2.54 3.80 6.16	10.02 8.77 6.40	20.11	4.07 6.08 9.85	16.03 14.02 10.25	7.5	1.5 2.3 3.7	6.0 5.3 3.8
50	22 28 [12)] 36	1.25 1.46 2.08	19.63	3.80 6.16 10.18	15.83 13.48 9.45	31.42	6.08 9.85 16.29	25.33 21.56 15.13	11.8	2.3 3.7 6.1	9.5 8.1 5.7
63	28 36 [12)] 45	1.25 1.48 2.04	31.17	6.16 10.18 15.90	25.01 20.99 15.27	49.88	9.85 16.29 25.45	40.02 33.59 24.43	18.7	3.7 6.1 9.5	15.0 12.6 9.2
80	36 45 [12)] 56	1.25 1.46 1.96	50.26	10.18 15.90 24.63	40.08 34.36 25.63	80.42	16.29 25.45 39.41	64.14 54.98 41.02	30.2	6.1 9.5 14.8	24.0 20.6 15.4
100	45 56 [12)] 70	1.25 1.46 1.96	78.54	15.90 24.63 38.48	62.64 53.91 40.06	125.66	25.45 39.41 61.58	100.21 86.26 64.09	47.1	9.5 14.8 23.1	37.6 32.3 24.0

4.4 fluid simulations design and analysis

To execute the circuit in fluid simulation software must configure to all component by using previous calculations.

4.4.1 The web circuit design

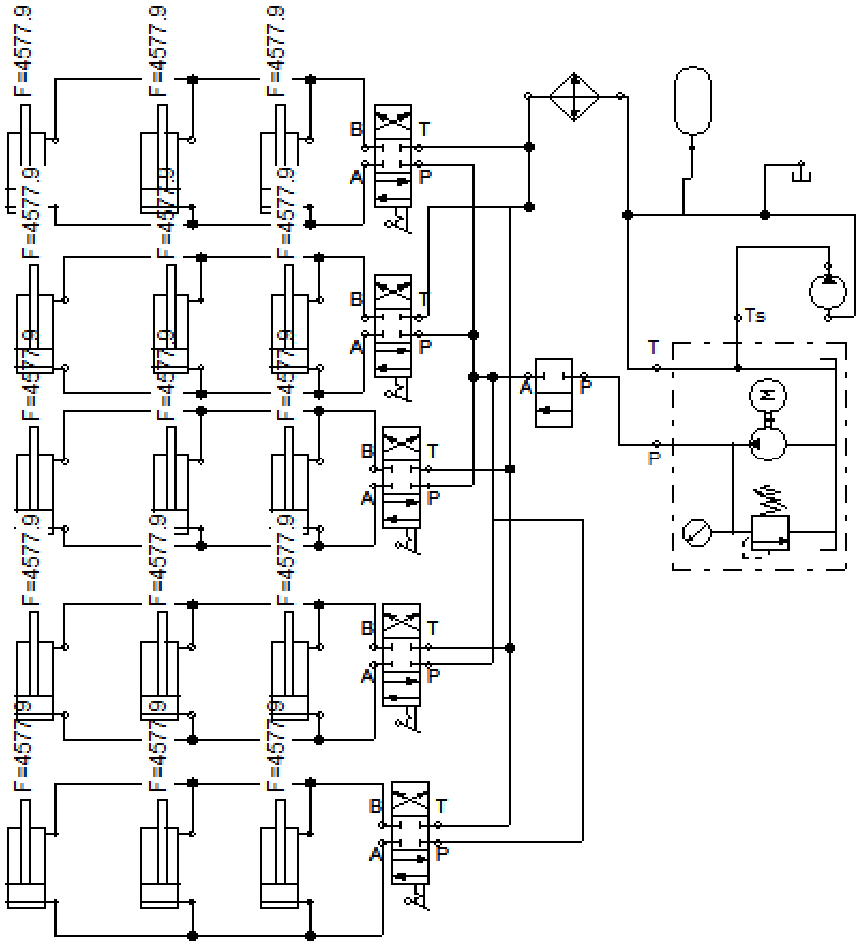


Figure 4.2: the web circuit

Configure the hydraulic component by entering all previous value which calculated above before execute or run the program to show and make us sure that the system will achieve the task in date time.

4.4.1.1 Configuration the hydraulic component (cylinders and rod)

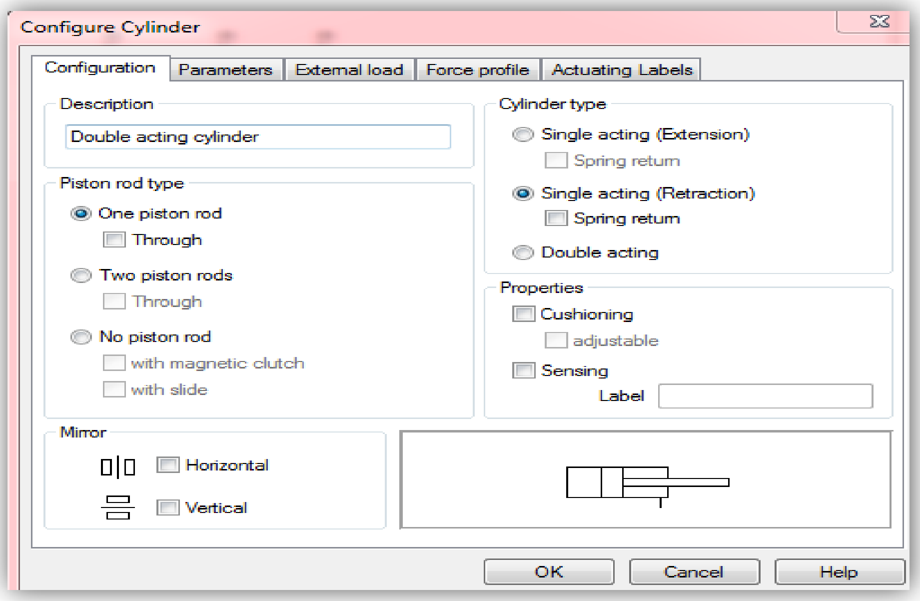


Figure 4.3: the web cylinder configuration

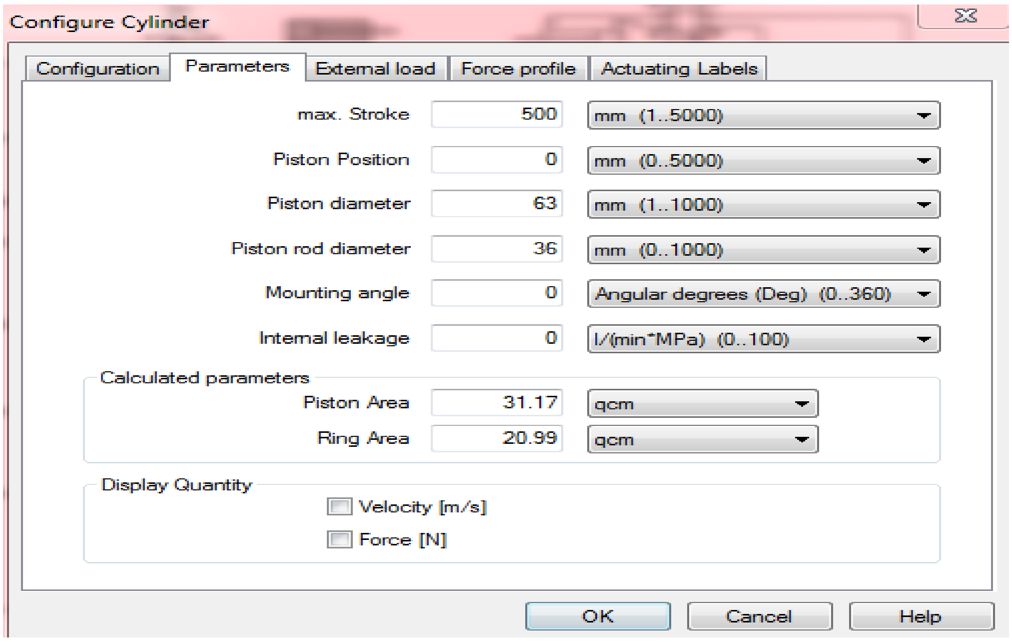


Figure 4.4: the web cylinder parameters

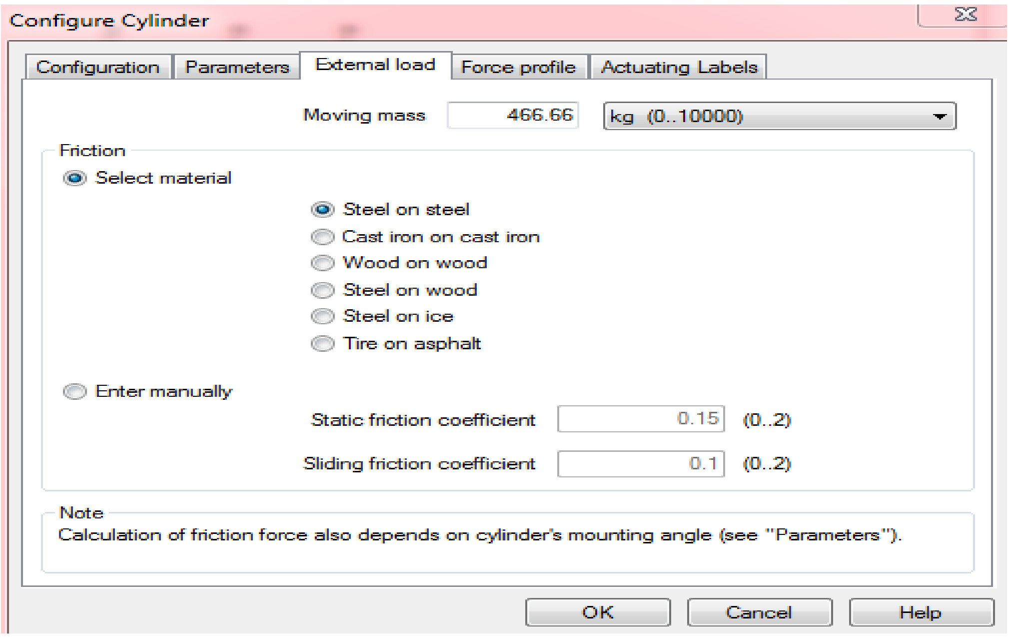


Figure 4.5: the web cylinder external load

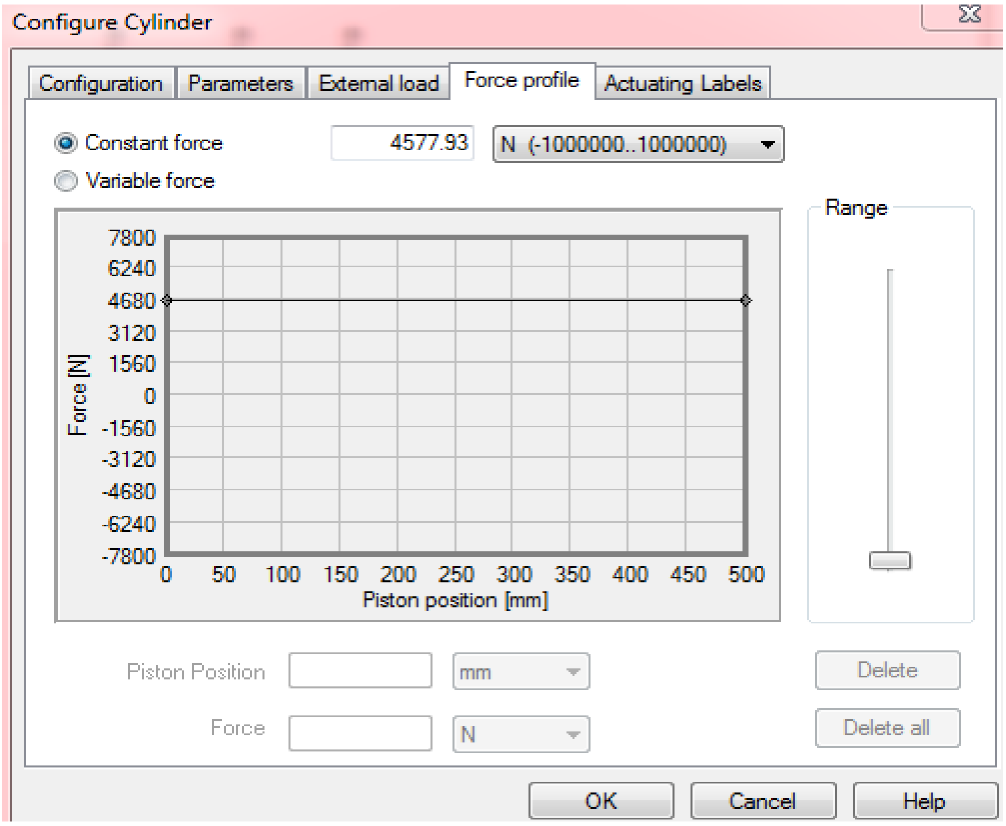


Figure 4.6: the web cylinder – force profile

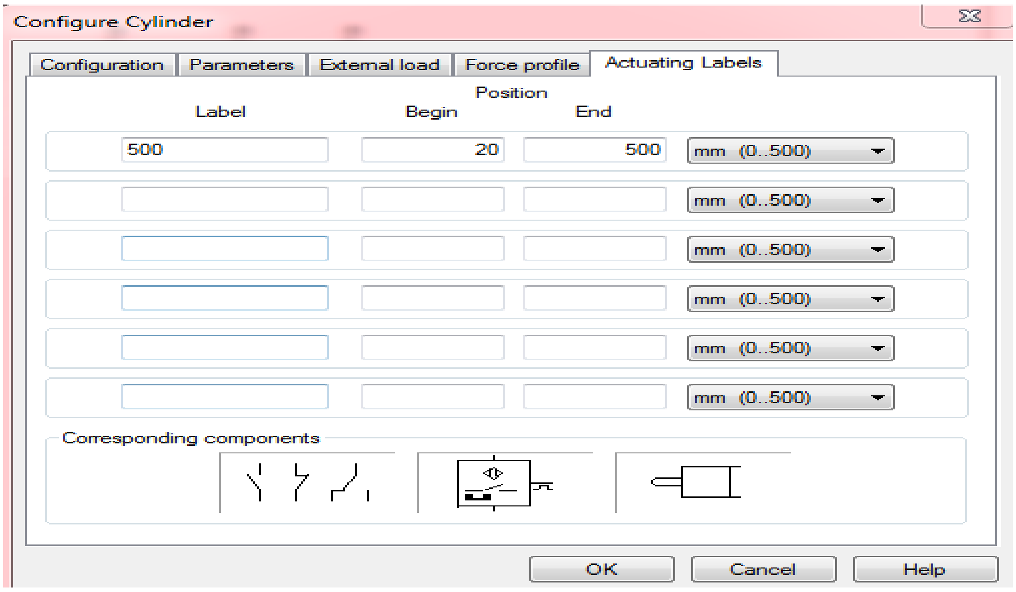


Figure 4.7: the web cylinder – actuating labels

4.4.1.2 Configuration the hydraulic component (valves)

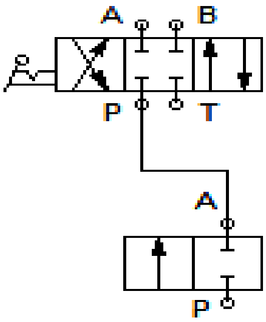


Figure 4.8: the valves

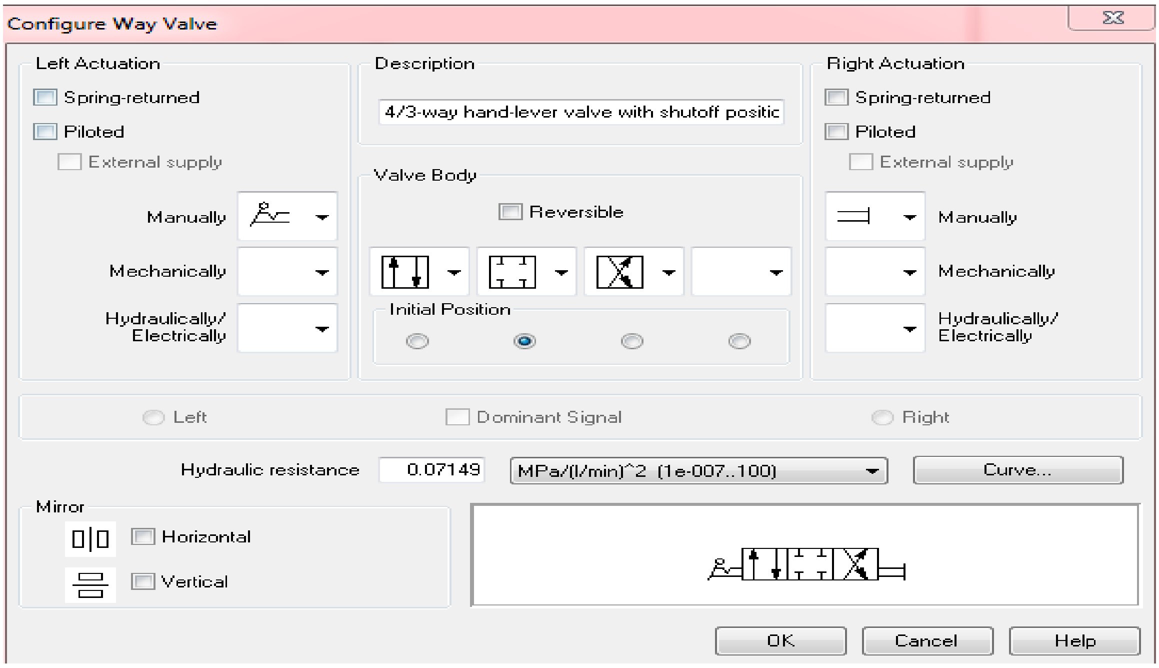


Figure 4.9: the web valves – configure way valves

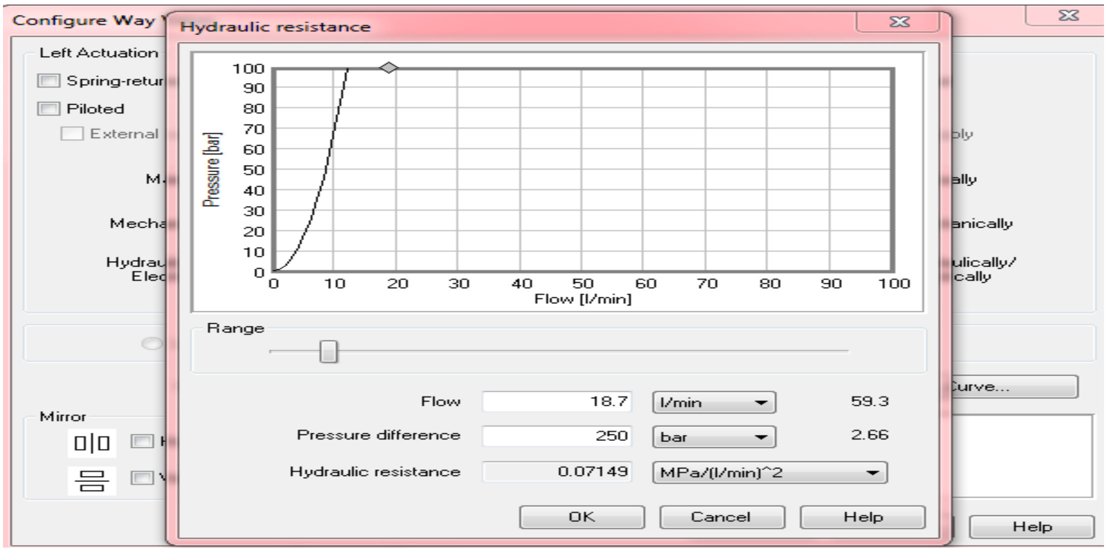


Figure 4.10: hydraulic resistance

4.4.1.3 Configuration the hydraulic component (cooler)

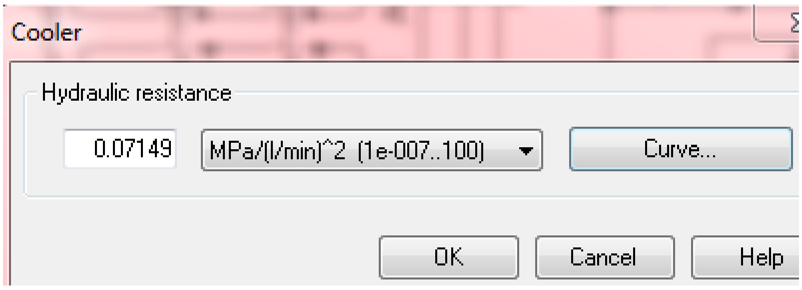


Figure 4.11: hydraulic resistance for cooler

4.4.1.4 Configuration the hydraulic component (Reservoir)

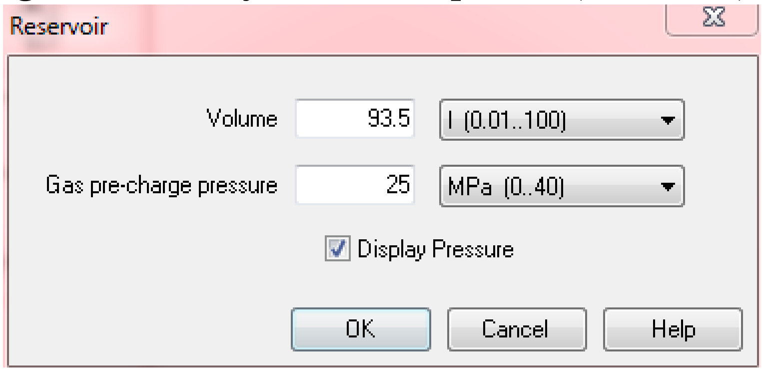


Figure 4.12: hydraulic Reservoir

4.4.1.5 Configuration the hydraulic component (pump unit)

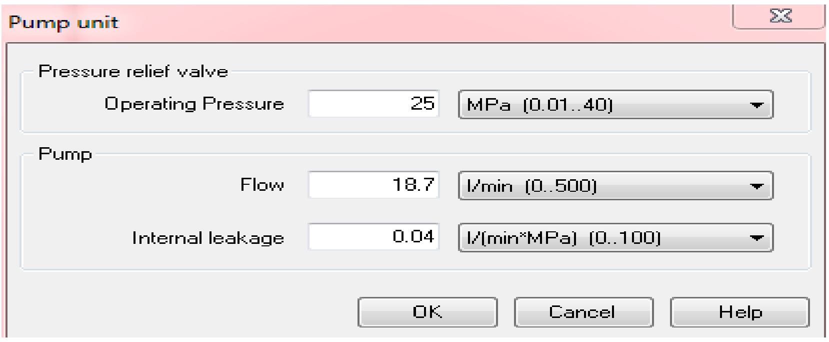


Figure 4.13: hydraulic power supply

4.4.2 Run the web circuit

By using stop watch run the circuit and observed the value of time when loading the hydraulic system is equal to maximum load (7000 kg), (5000 kg), and (4000 kg).

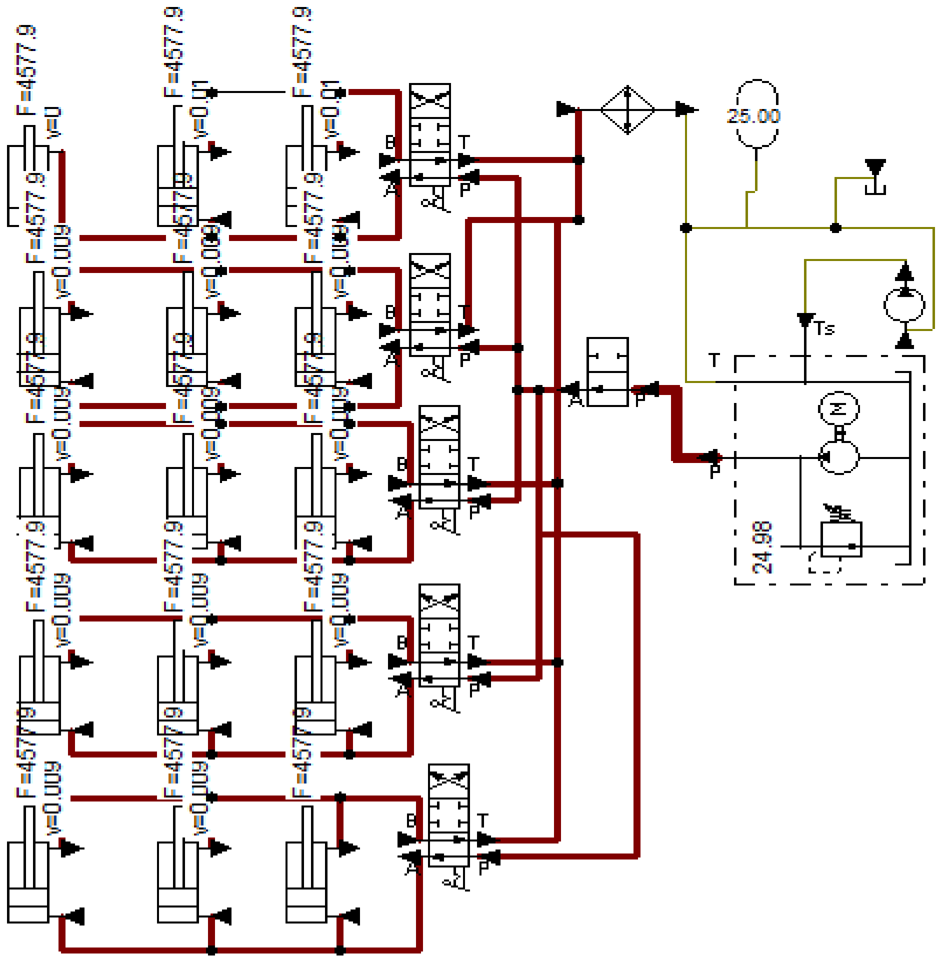


Figure 4.14: running circuit

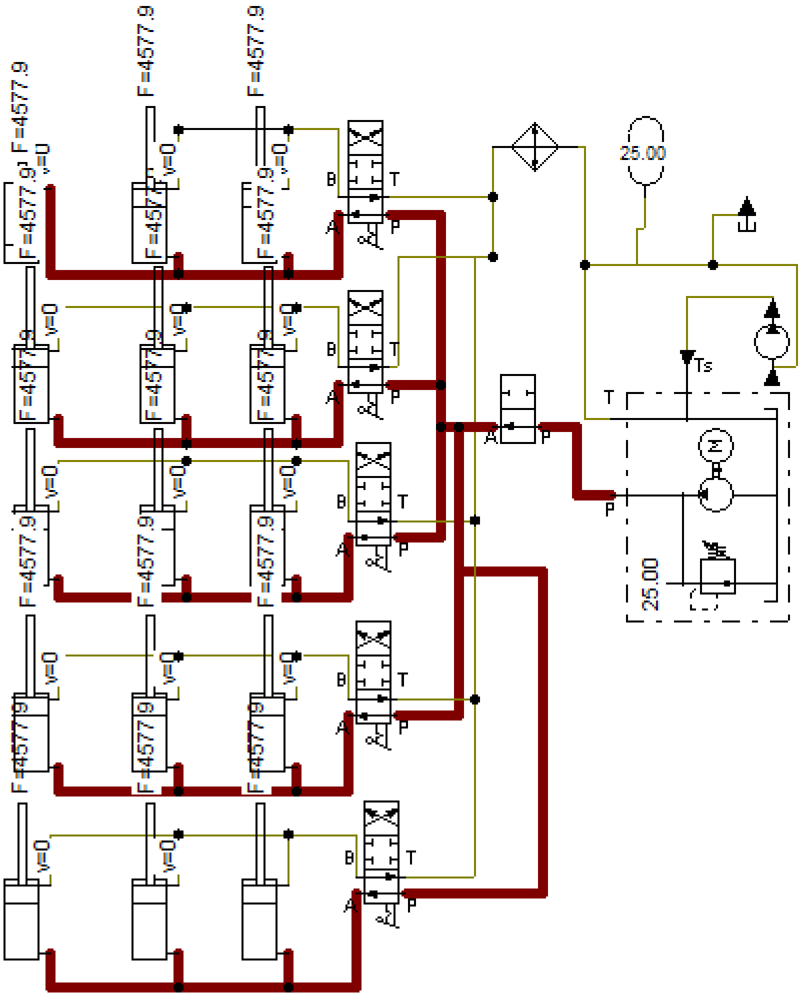


Figure 4.14: completed stroke

- When we use the load equal to 4000 kg the time equal 34.85 sec
- When we use the load equal to 5000 kg the time equal 35.69 sec
- When we use the load equal to 7000 kg the time equal 37.45 sec

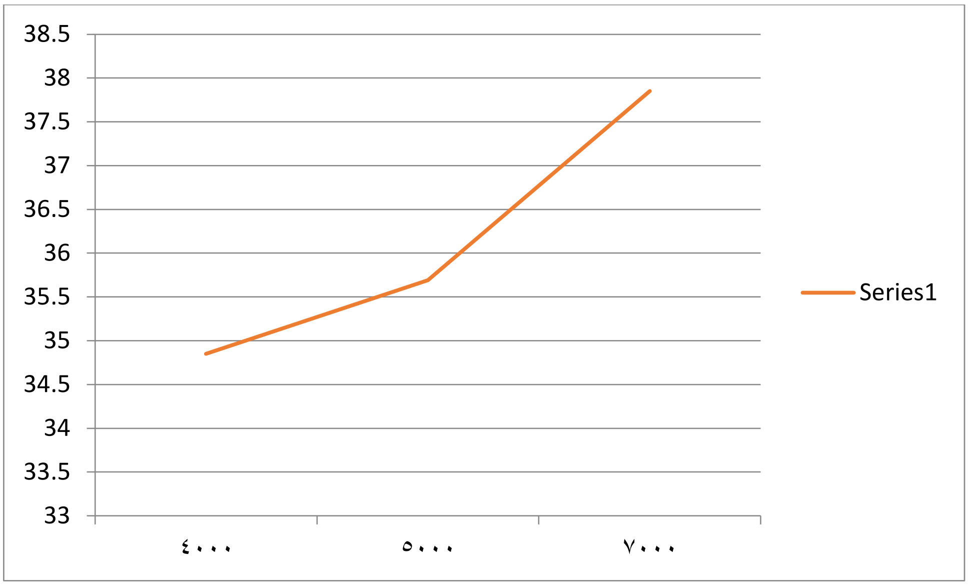
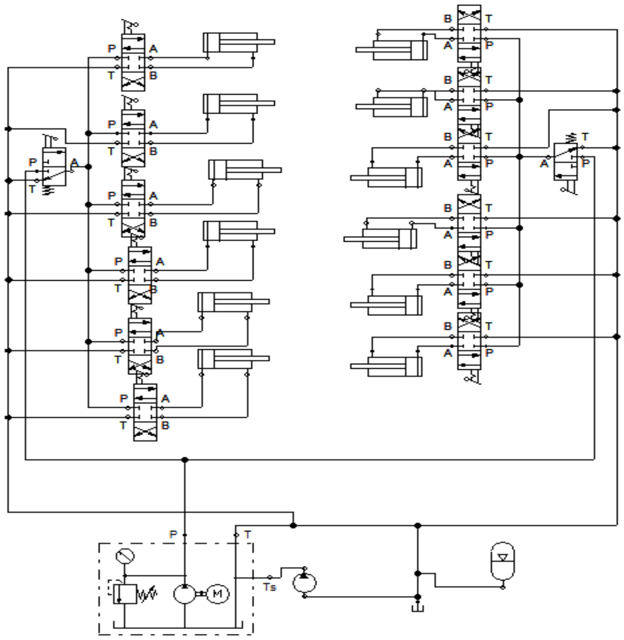


Figure 4.15: Relation between weight and time

4.4.3 The flange circuit



figuer 4.16: the flanges circuts

4.4.3.1 Configuration the hydraulic component (cylinders and rod)

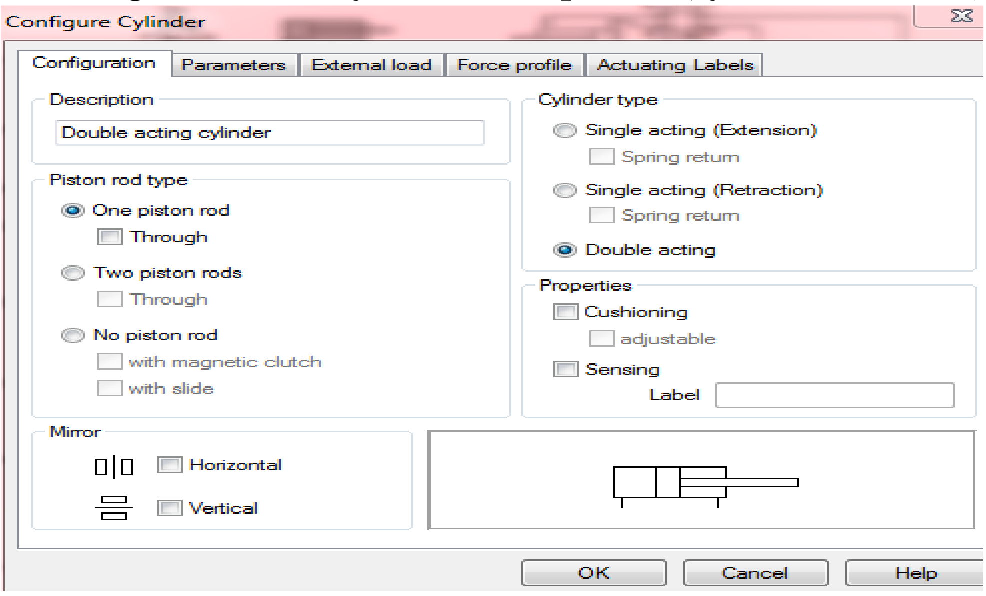


Figure 4.17: the flange cylinder configuration

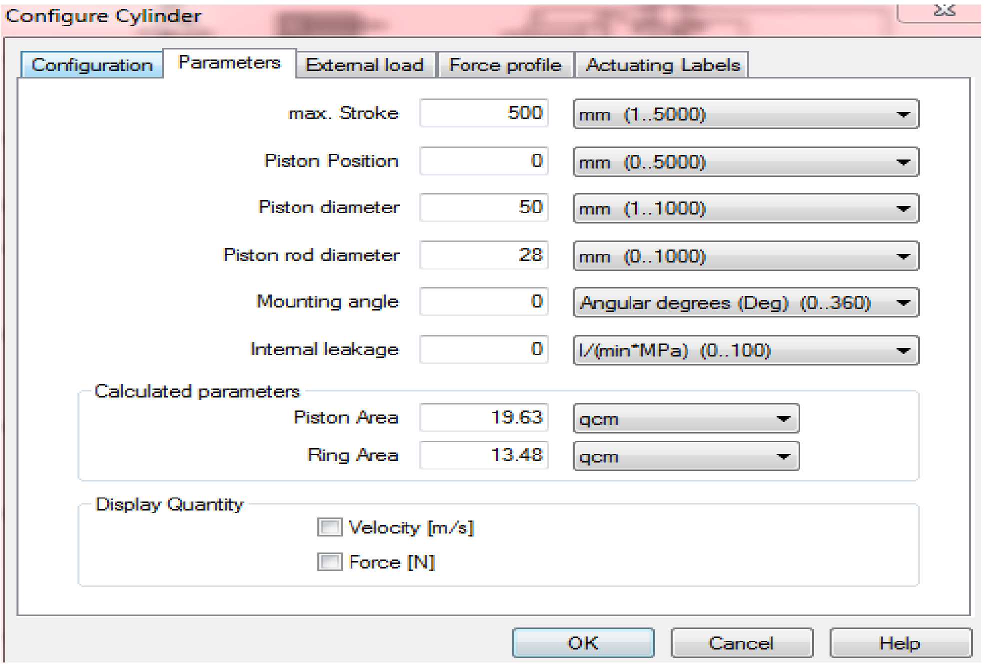


Figure 4.18: the flange cylinder parameters

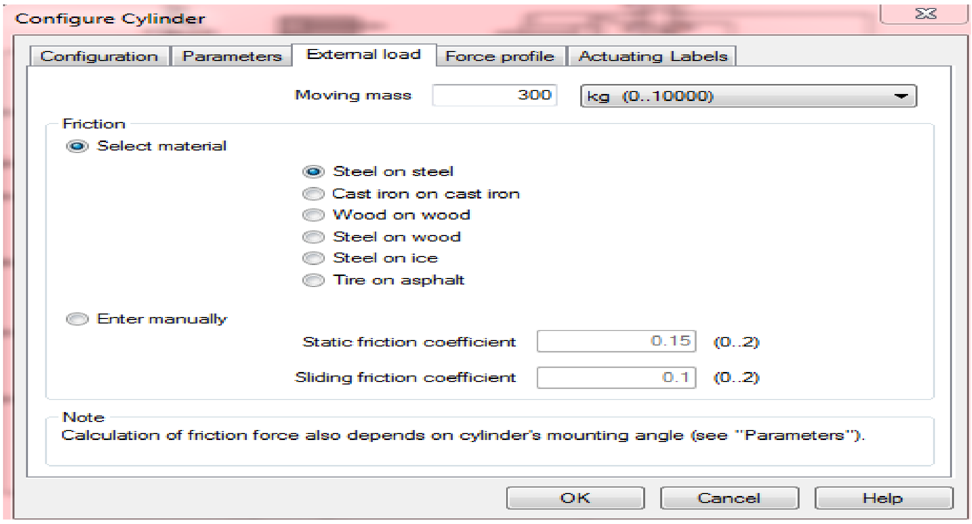


Figure 4.19: the flange cylinder external load

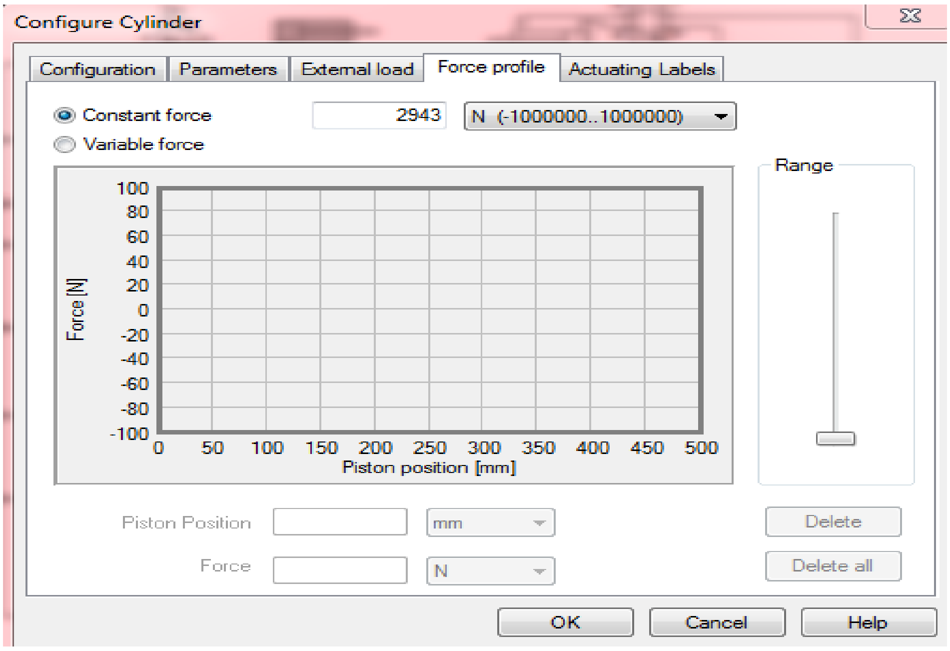


Figure 4.20: the flange cylinder force profile

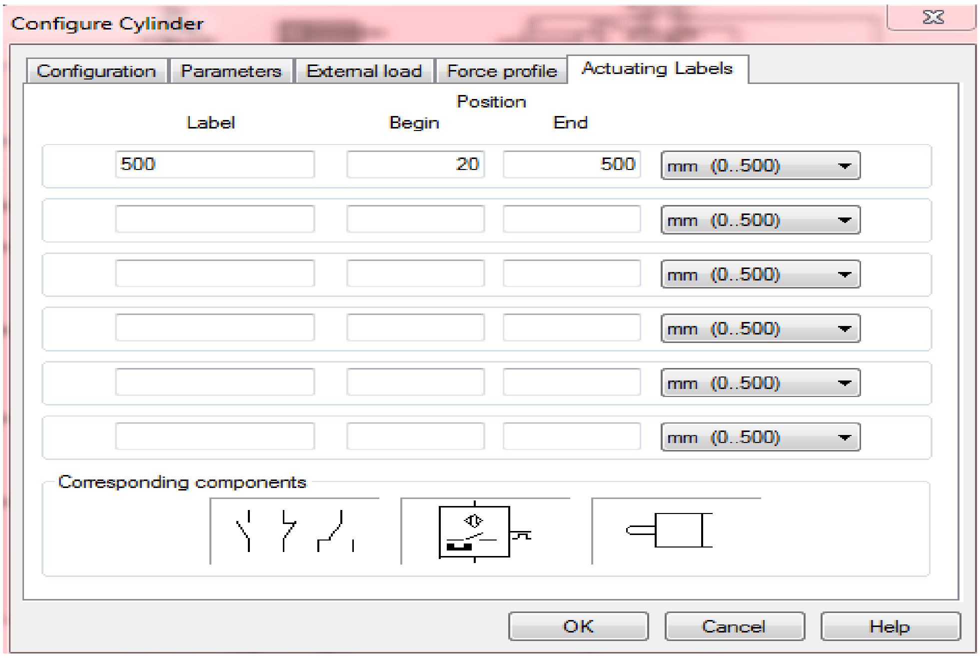
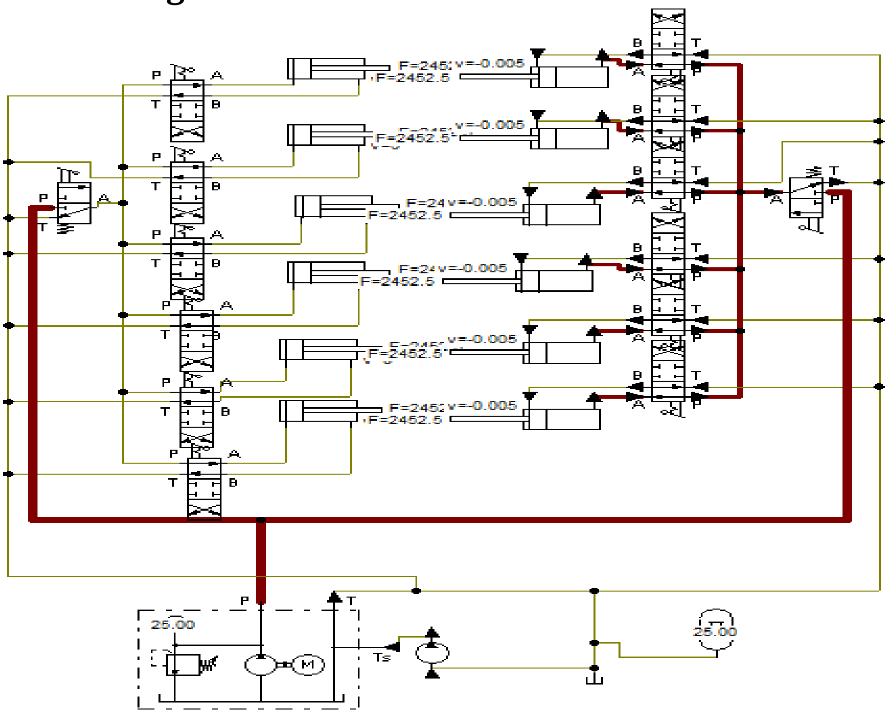


Figure 4.21: the flange cylinder actuating labels

4.4.4 Run the flange circuit



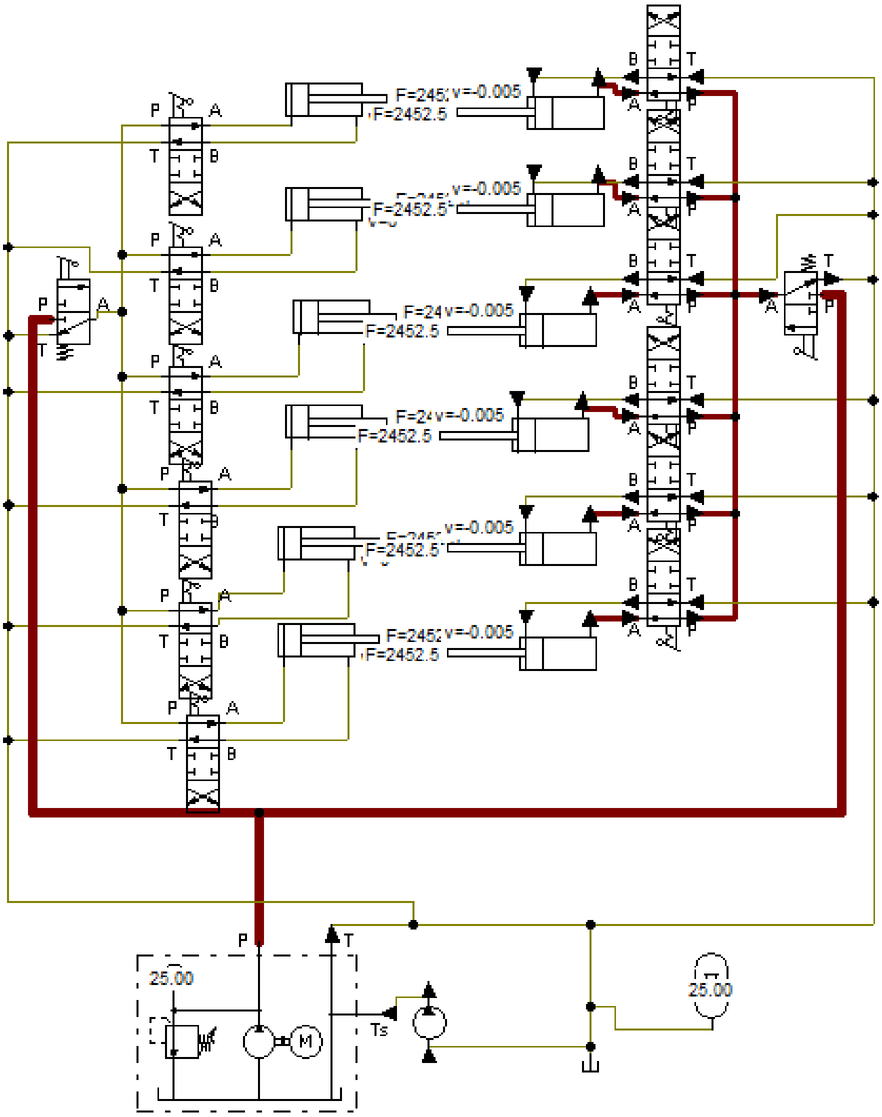


Figure 4.22: completed stroke on right side

4.5 Design by using solid works

In this sections all the external frame drawn by using solid work

4.5.1 Design of flange lever

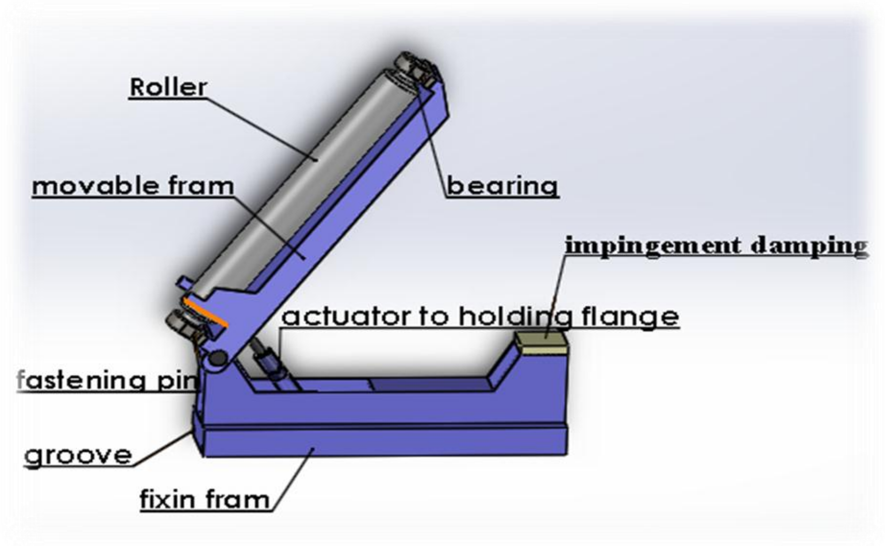


Figure 4.23: design of flange lever

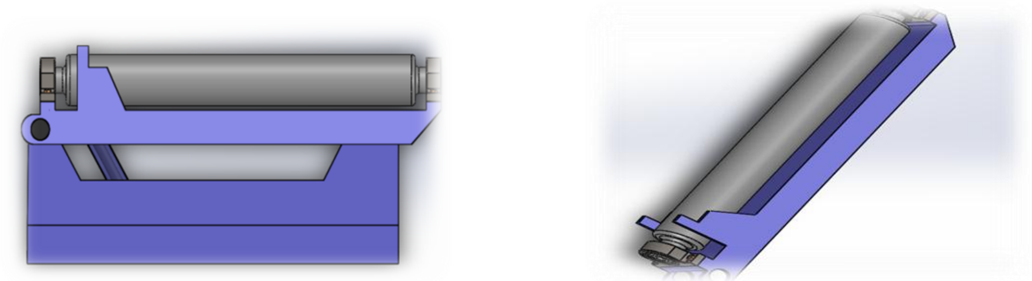


Figure 4.24: component of flange lever

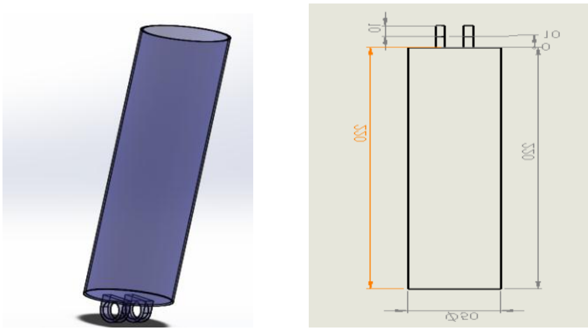


Figure 4.25: cylinder of flange lever

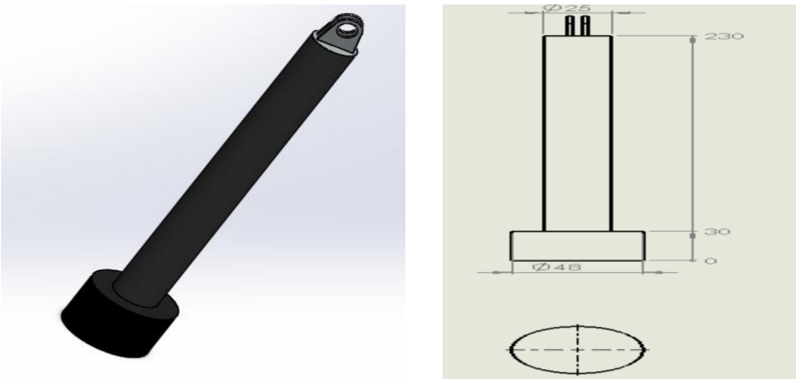


Figure 4.26: cylinder rod

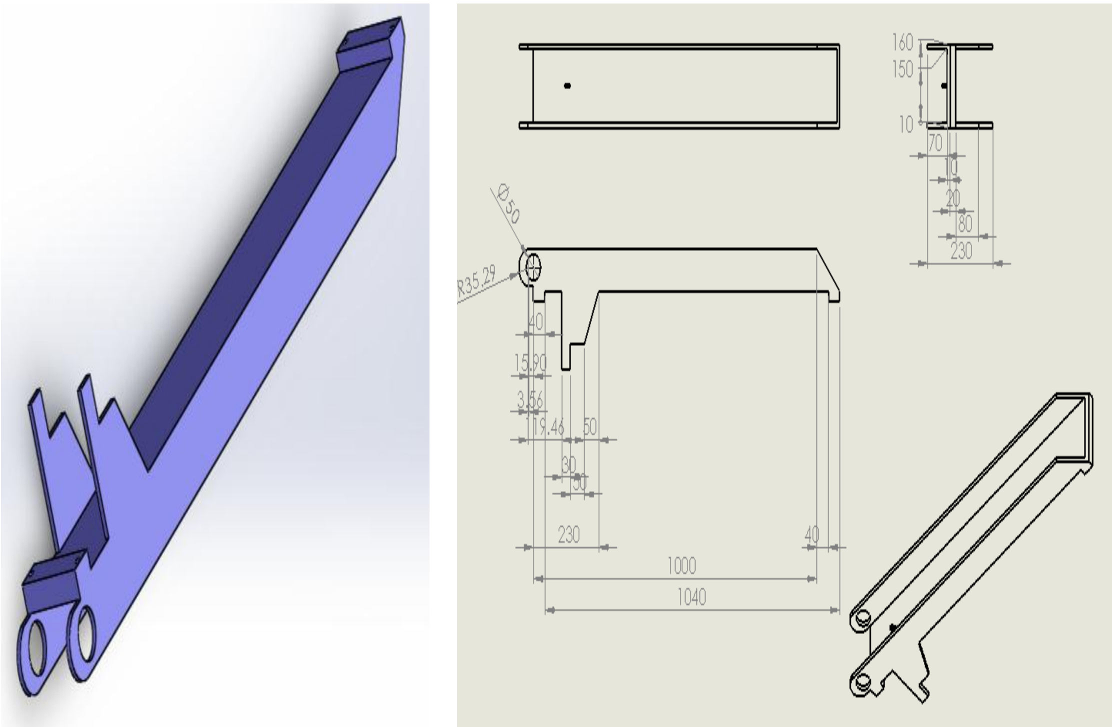


Figure 4.27: drawing of external frame of lever

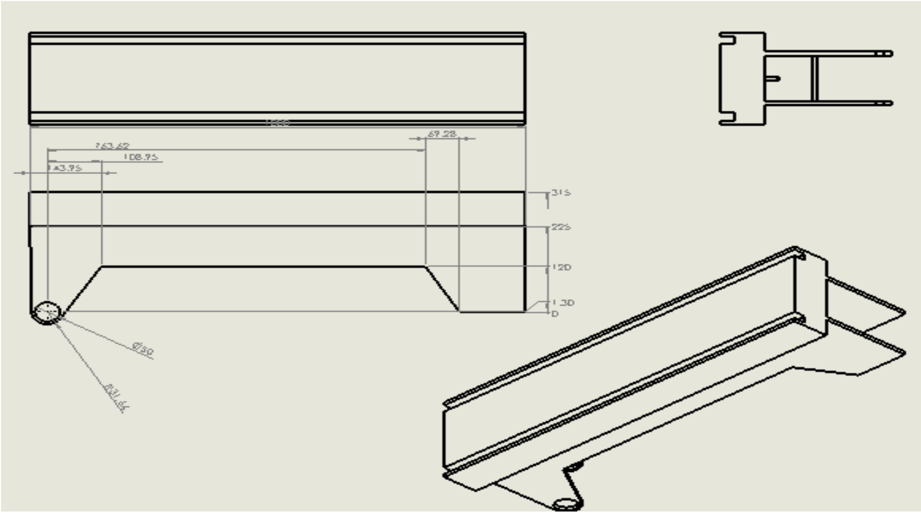


Figure 4.28: external frame of lever

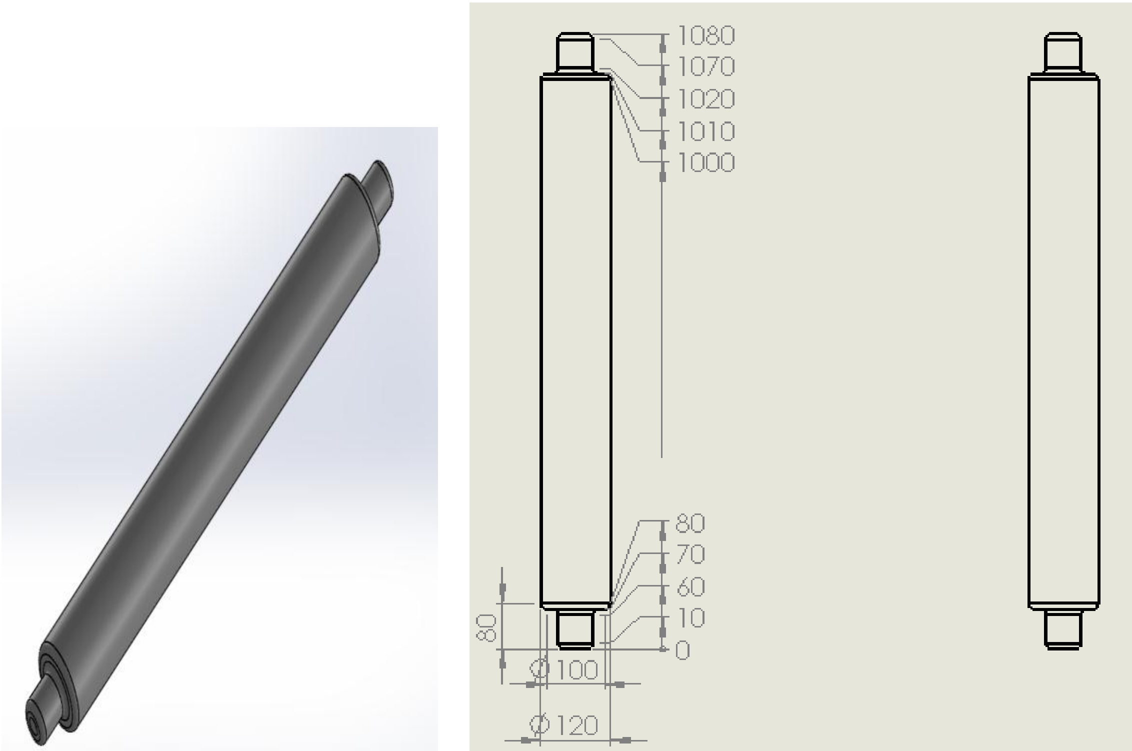


Figure 4.29: router of lever

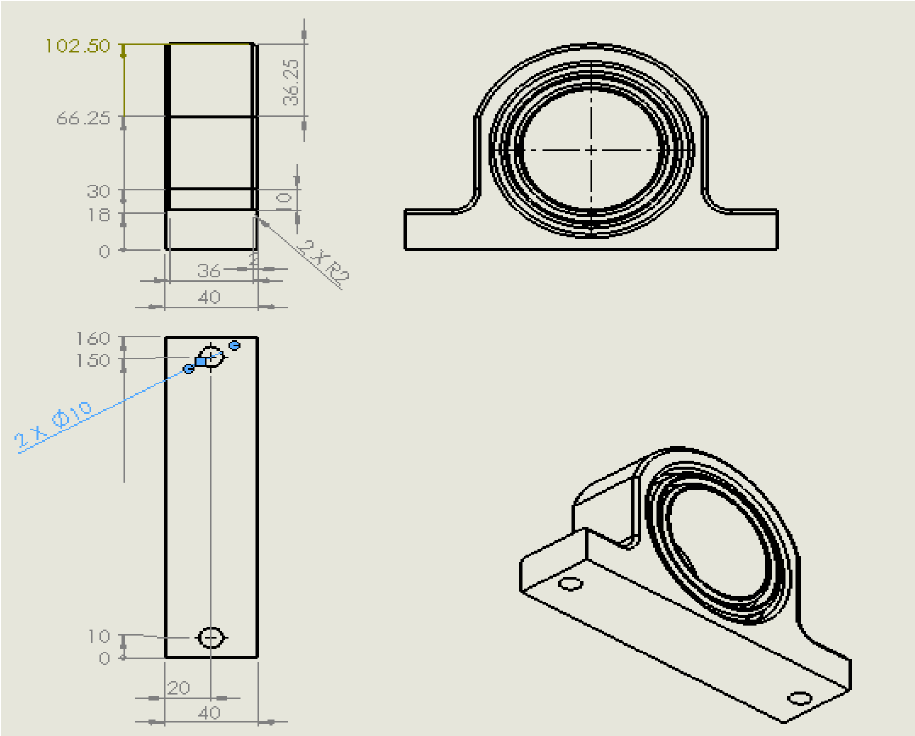


Figure 4.30: bearing to hold router

.

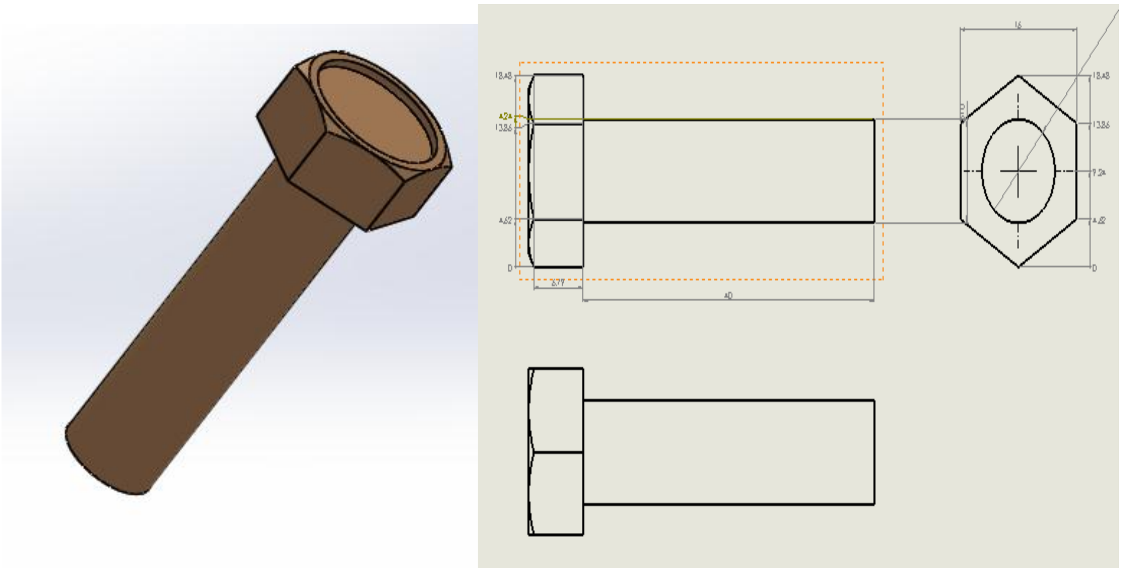
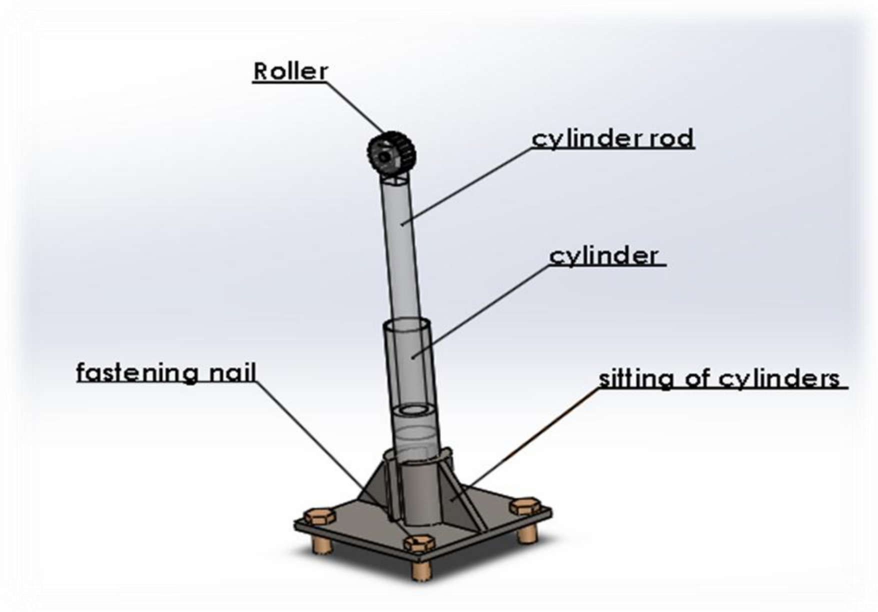


Figure 4.31: connecting nail

4.5.2 Design of web lever



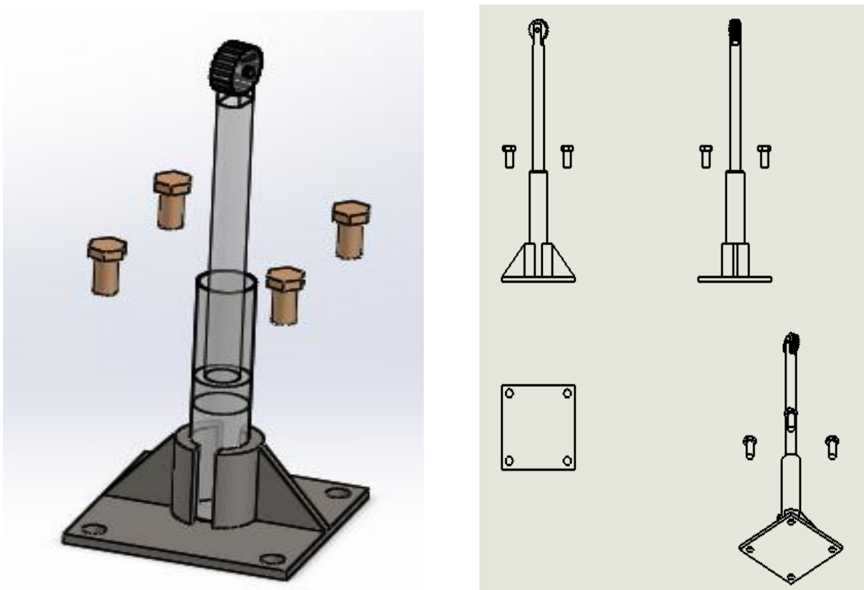


Figure 4.32: web holding system

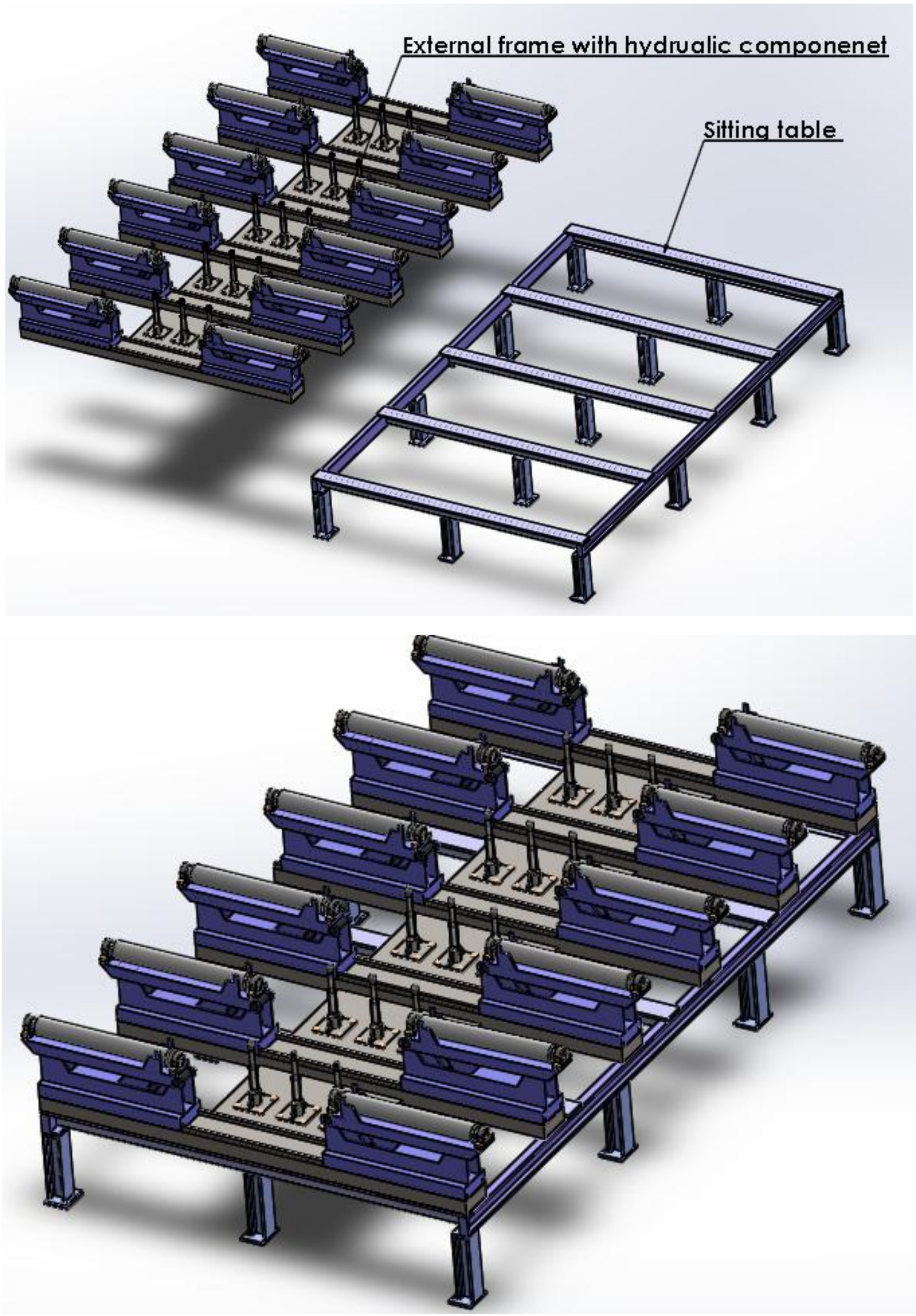


Figure 4.33: the new system

CHAPTER V

Conclusion and Recommendation

Chapter V

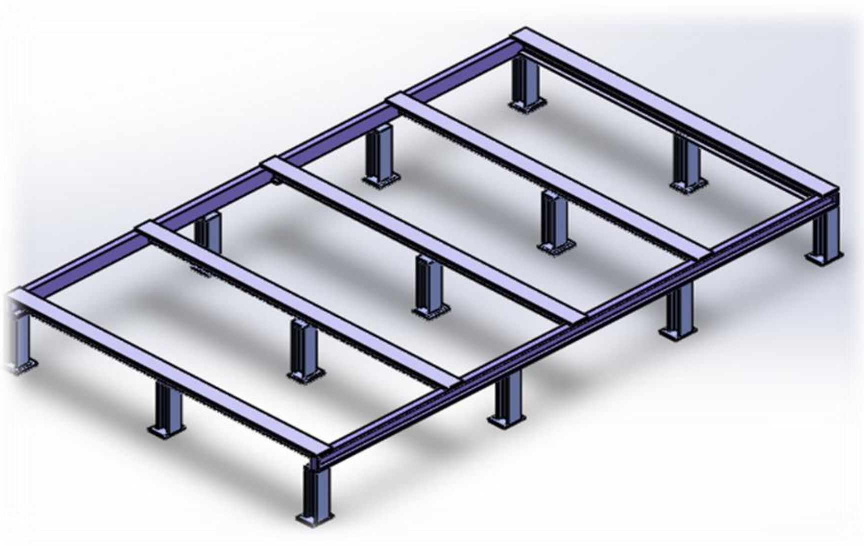


Figure 5.1: the previous system in factory

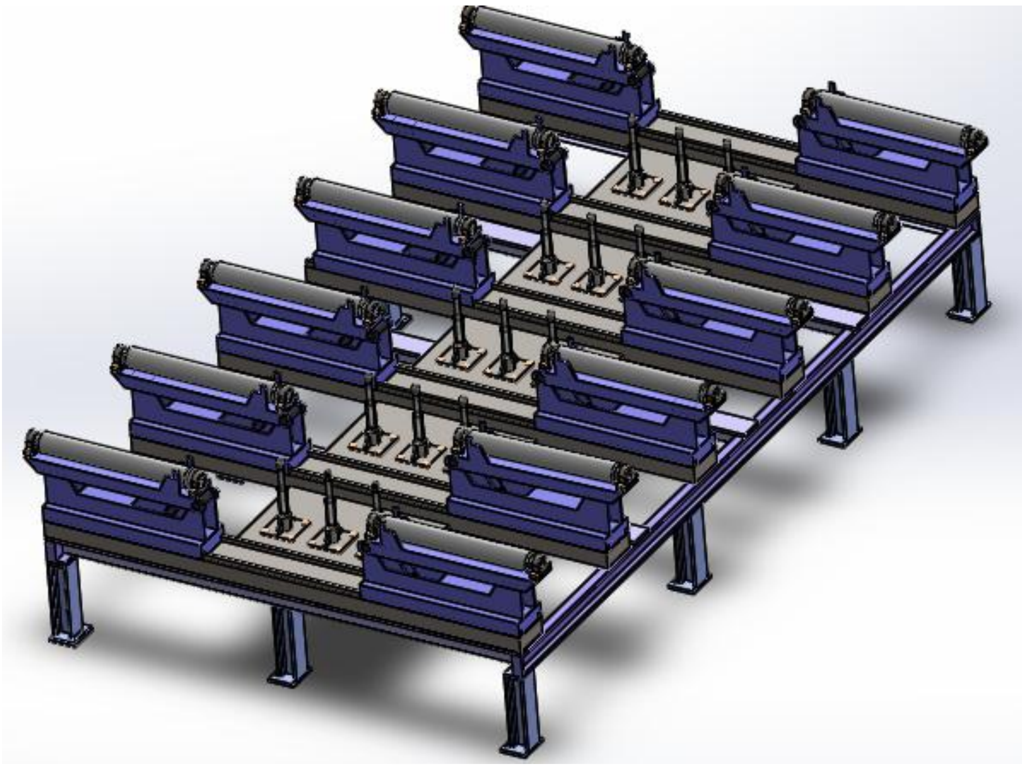


Figure 5.2: the new system

5.1 Conclusion

From the obtained results one can conclude:

1. The design of the system was done in solid works software
2. The design of hydraulic circuits was worked and hydraulic cylinder was carried out meeting the required design standards in fluid simulation software
3. The hydraulic circuits are suitable for maximum load industry
4. The required time to holding the beam equal 40 second when loading the hydraulic system by maximum load (7000 kg).

5.2 Recommendation

For the future work, the followings are recommended:

1- Connect between the solidwork software and fluid simulations by using serial visual port software to make both running together.

2- Introduce the electrical circuit in fluid simulations software.

3- Chang the manually control of valve to be running with (PLC) systems

4- Calculate all the parameters which effect of the stability of systems, vibrations, noise of component and mechanics of martial.

5- Presenting the Feasibility study to overall system to purpose of increasing productivity

Reference:

- Song, S. and Wen, Y. (2000). Structural redundancy of dual and steel moment frame systems under seismic excitation. Urbana, Ill.: Dept. of Civil Engineering, University of Illinois at Urbana-Champaign.

- Anon, (2017). [Online] Available at: Http://BJCHIA Company [Accessed 22 Oct. 2017].

- (2017). [video] C.C.M: www.nuoacmm.com.

- Anon, (2017). [online] Available at: http://kumkwang21.tradekorea.com/product/detail/P228167/Assembling-and-straightening-machine.html?minisiteprodgroupno= [Accessed 20 Oct. 2017].

- Anon, (2017). [online] Available at: http://www.samarasgroup [Accessed 20 Oct. 2017].

- Parr, E. (2000). Hydraulics and pneumatics. Oxford: Butterworth-Heinemann.

- Anon, (2017). [online] Available at: http://gupta 2006 [Accessed 22 Oct. 2017].

- Google.com. (2017). Hydraulic Lift - Google Search. [online] Available at: https://www.google.com/search?q=Hydraulic+Lift&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiRkp-

w6_zWAhVFwBQKHQIPAYMQ_AUICigB&biw=1366&bih=613#imgrc=hIkyP59dGlMyuM: [Accessed 20 Oct. 2017].

- FESTO fluidsimulation. (2017).

- Redirect Notice, Google.com , Available at :

- https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwj3jcylxv7WAhWBzxQKHUZ9BbEQjhwIBQ&url=https%3A%2F%2Fwww.indiamart.com%2Fproddetail%2Fhydraulic-scissor-lift-3961350333.html&psig=AOvVaw0ts5jdllIZvAWur4Q45hlD&ust=1508507745606721