Sudan University of Science and Technology
College of Engineering
School of Mechanical Engineering
(Production Department)

Design of Hydraulic Scissor Lift

A project submitted in partial fulfillment for the Requirements of the Degree of B.Sc. (Honor) in Mechanical engineering (production)

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الآية

بسم الله الرحمن الرحيم

قال تعالى:**(قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا ۖ إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ)**

سورة البقرة (32)

Dedication

We dedicate this thesis to:

School of Mechanical Engineering

Sudan University of Science and Technology,

Our parents: words are just not expressive enough,

They introduced us to the joy of reading from birth enabling such a study to take place today,

Our brothers, sisters and our best friends, without them none of our success will be possible.

And a special appreciation to our friends Eng. MOHAMED ABDULKHALIG and Dr.ONNAB MOHAMED.

Acknowledgement

All praise and thanks to Allah who provide us with the ability to complete this work. We are thankful to our families who are always supportive and helpful throughout our studies.

We would like to express our special appreciation and gratitude to our advisor **Dr.ALTAYEB HASSAN** for being such a source of inspiration and motivation to us.

Their patience and advises on our research and writing this thesis have been invaluable.

ABSTRACT

This thesis is mainly focused on force acting on the hydraulic scissor lift when it is extended and contracted. Generally, a hydraulic scissor lift is used for lifting and holding heavy weight components. Material selection plays a key role in designing a machine and also influence on several factor such as durability, reliability, strength, resistance which finally leads to increase the life of scissor lift.

The design is performed by considering hydraulic scissor lift as a portable, compact and much suitable for medium type of load application. Drafting & drawing of hydraulic system scissor lift is done using SOLIDWORKS with suitable modeling and imported to ANSYS work bench for meshing and analysis. Hence, the analysis of the scissor lift includes Total deformation load, Equivalent stress, was done in ANSYS and all responsible parameters were analyzed in order to check the compatibility of the design value.

المستخلص

يركز هذا البحث بشكل اساسي على فعل القوة المؤثرة على الرافعة الهيدروليكية المقصية عند التمدد والانقباض.

بصورة عامة, تعمل الرافعة الهيدروليكية المقصية على رفع وحمل الاحمال الثقيلة. اختيار المواد يلعب دورا رئيسيا في تصميم المنظومة والتاثير على عوامل عديدة مثل: التحمل والمقاومة والموثوقية التي تعمل على امكانية الرفع.

والتحليل SOLIDWORKتم التصميم على ان تكون الاحمال متوسطة , وذلك باستخدام برنامج بواسطة برنامج الانسيس لحساب جميع الاحمال والاجهادات, وكذلك حساب جميع المعاملات لضمان انسجام المنظومة.

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Chapter One

INTRODUCTION

1.1 Introduction:

A scissor lift or mechanism 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 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.

The name scissors lift originated from the ability of the device to open (expand) and close (contract) just like a scissors. Considering the need for this kind of mechanism, estimating as well the cost of expanding energy more that result gotten as well the maintenance etc. it is better to adopt this design concept to the production of the machine.

The initial idea of design considered was the design of a single hydraulic ram for heavy duty vehicles and putting it underneath, but this has limitations as to the height and stability, and someone will be beneath controlling it. It was rather found out that; there is a possibility of the individual ascending/descending, to be controlling the device himself. Therefore further research was made to see how to achieve this aim.

A scissors lift is attached to a piece of equipment having a work station known as scissors lift table that houses the pump, the reservoir, the generator, control valves and connections and the motor. A scissors lift does not go as high as a boom lift; it sacrifices heights for a large work station. Where more height is needed, a boom lift can be used.

1.2 Problem Statement:

With the limitations encountered in the use of ropes, ladders, scaffold and mechanical scissors lifts in getting to elevated height such as the amount of load to be carried, comfortability, time consumption, much energy expended etc. the idea of a hydraulically powered scissors lift which will overcome the above stated limitations is used.

1.3 Scope of the Study:

The design of the hydraulic scissors lift is to lift up to a height of 3.7m and carrying capacity of less than 500kg (500 kilograms) with the available engineering materials.

1.4 Objective of the Project:

1. Mechanical design of scissor lift.
2. Static analysis for the mechanical design.
3. Hydraulic circuit.

1.5 Significance of the Study:

The design of a hydraulic scissors lift is to lift a worker together with the working equipment comfortably and safely to a required working height not easily accessible. It may be used without a necessary external assistance or assistance from a second party due to the concept of the design. This project will be an important engineering tool or device used in maintenance jobs. Changing of street lights, painting of high buildings and walls. Also in workshops or factories.

1.6 Project Layout:

This project consist of five chapters shown the stages of work, the schedule of work is shown below.

Gantt chart											
	Dec	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
Ch. 1											
Ch. 2											
Ch. 3											
Ch. 4											
Ch. 5											

Table1 .1 project layout (Gantt chart 2016-2017)

Chapter Two
LITERATURE REVIEW

2.1 Introduction:

Mans quest for improvement has never been satisfied. The drive towards better and greater scientific and technological outcome has made the world dynamic. Before now, several scientists and engineers have done a lot of work as regards the scissors lift in general. A review of some of that work gives the design and construction of a hydraulic scissors lift a platform.

2.2 Upright's Scissor Lift:

In Selma California, there is a manufacturer of aerial platforms by name "UPRIGHT", this world – wide company was founded in 1946, and now it manufactures and distributes its product.

Upright was founded by an engineer, Walkce Johnson who created and sold the first platform which was called a "scissors lift" due to the steel cross bricking that supported the platform giving it the product name "magic carpet". The magic carpet was able to provide instant revenue for the young company due to its quick popularity among its companies.

Wikipedia further explained that the company constructed innovating and by early 1930s their product included the X – series scissors lift. By 1986, they had introduced their first sigma arm lift, model SL20. In 1990, they improved upon their product line by introducing the sigma arm speed level. This feature continued to be unique to be upright product and allow self-leveling of the platform on rough terrains

Upright introduced an equal innovative family of boom lift in 1990s. In 1995 they produced their first trailer mounted boom. The 8P37 (known as AS38) in 1996. This truly innovated company has left their mark with the other products including compact scissors design and modular alloy bridging, as well as expanding the versatility of instant span towers with aircraft docking and faced system, you will find upright products, especially the scissors lift, as standard equipment for a variety of application it is now a visual application in numerous fields and locations.

Figure 2.1 (Upright scissors lift)

2.3 Scaffold:

Scaffold allows workers to transport themselves and their materials to elevated heights, usually up and down in an unfinished building. Scaffolds are designed to allow workers get to elevated heights; they are used in building sites and construction sites but used mainly in building sites.

Scaffold is cross section of pipes, irons or woods which are arranged in such a way that workers or operators can climb on the arranged pipes to get to elevated heights.

Scaffolds cannot be adjusted automatically and they only can remain fixed the way it is arranged unless rearranged. The tubes are either steel or aluminum, although composite scaffolding using filament wound tubes of glass fiber in a nylon or polyester matrix. If steel, they are either “black” or galvanized. The tubes come in a variety of length and a standard diameter of 48.3mm. The basic difference between the two types of tubes is the lower weight of aluminum tubes (1.7kg/m as opposed to 4.4kg/m) and also a greater flexibility and so less resistance to force. Tubes are generally bought in 6.3m length and can be cut down to certain typical sizes.

Boards provide a working surface for users of the scaffold. They are seasoned wood and are very strong. Scaffolds for increased height are preferably made of hardened materials like metal pipes. After arranging the pipes, a flat materials usually made of wood is placed on top so that the worker can stand comfortable on top.

Figure2. 2 (scaffold)

2.4 Boom Lift:

Boom lifts are used for lifting materials especially on construction sites, they are designed to carry heavy equipment and materials from one place to another. They are usually connected to cars or trucks that move from one place to another.

Boom lifts can lift materials and equipment high to height so great that carrying this equipment by other means will almost be impossible.

According to material handling equipment from ask search engine, Boom lifts can move vertically, horizontally and sideways and some can even rotate depending on the circumstance. Boom lifts are very complex iron design and the jointed parts should be lubricated to reduce friction and improve efficiency. Boom lifts are formed mainly in construction sites and building sites. They are also utilized by Electrical companies and firms. They are very expensive and are not available in crude or semi mechanized type of production. Boom lift possess advantage over other types of lifts because it can lift heavy materials, keep them at elevated heights for a long period of time; rotate and the lift span of the equipment is long. Boom lift can fold together to become compressed and portable.

There are two basic types of boom lifts: straight boom lift and articulated boom lift. These units are often hydraulically powered.

2.4.1 The Straight Boom Lift:

Straight boom lifts are generally used for jobs that required a high reach without obstruction. The machines turntable can rotate 360^{o} with an extensible boom that can be raised vertically to below horizontally. The operator can maneuver and steer the vehicle while the boom is fully extended. It is available in gas, propane or diesel-powered models with two or four wheel drive.

Figure 2.3 (Straight Boom Lift)

2.4.2 Articulated Boom Lift:

Articulated boom lifts are used for jobs that require reaching up and over obstacles to gain access to a job not easily achieved by a straight telescopic boom. This lift is nearly identical to the straight boom lift in every aspects; except in the boom's ability to articulate. Articulation points on the boom allow it to bend in any number of different directions enabling it to maneuver around various obstacles on a job site.

Boom lifts can be equipped with out riggers to stabilize the unit while the boom is fully extended.

Figure 2.4 (Articulated Boom Lift)

2.5 Mechanical Scissors Lift:

The mechanical scissors lift is used for lifting materials especially on construction sites. This is one of the most recent advancement on scissors lift. There, the lift utilizes a belt drive system connected to a load screw which constructs the “X” pattern on tightening and expands it on loosening. The lead screw actually does the work, since the applied force from the wheel is converted to linear motion of the lift by help of the lead screw. This can be used to lift the working and equipment to a height.

A general knowledge however, regarding screws will reveal the loss due to friction in the screw threats. Therefore, the efficiency of this device is low due to losses in friction. Also, the power needed to drive the machine is manual, and much energy is expanded to achieve a desired result. Its suitability however, cannot be overemphasized as it can be used in almost every part of the country whether there is availability of electricity or not.

Figure 2.5 (Mechanical Scissors Lift)

2.6 Hydraulic Lift:

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

- Direct acting hydraulic lift and
- 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.

Figure 2.6 (Hydraulic Lift)

2.7 Hydraulic Scissors Lift:

Scissors lifts has developed overtime, and at each stage of its development, critical problems are solved.

The hydraulic type, but this time, the load screw is replaced by a hydraulic ram powered by a pump and on electric motor and generator. One outstanding feature about this design however. Is its independent operation and increased efficiency. Fluid power is one of the greater form of power where small input results in a very large output. This scissors lift can be handled by one person to a place of use, and power the generator. The lift does not lifting immediately, the operators climbs on the platform and switches open the hydraulic circuit thereby leading to an upward extension. When the required height is reached the circuit is closed, and lifting stops the control panel or station is located on the top frame. When work is done, the scissors lift is folded by hydraulic means and handled back to the point of collection.

Figure 2.7 (Hydraulic Scissor Lift)

Chapter Three

METHODOLOGY

3.1 Methodology Flow Chart:

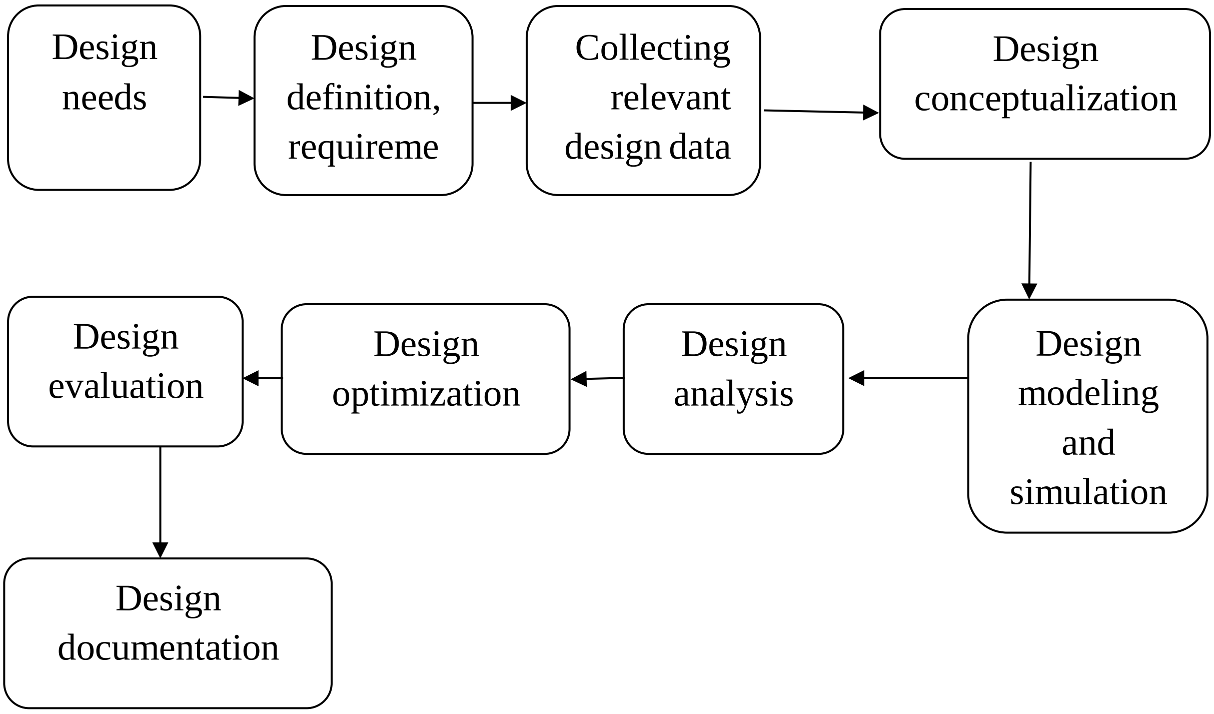

Figure 3.1 (Methodology Flow Chart)

3.2 Design Theory:

The project is divided to two parts mechanical system and hydraulic system.

3.2.1 Mechanical System:

Is the part which do the main task of the system (lift loads) and it consist of cross arms (X) which links between the top platform and the base platform. And it uses a specific type of power.

3.2.2 Hydraulic system:

Is used to control and transmit power. A pump driven by a prime mover such as an electric motor creates a flow of fluid, in which the pressure, direction and rate of flow are controlled by values. An actuator is used to convert the energy of the fluid back into mechanical power. The amount of output power developed depends upon the flow rate, the pressure drop a cross the actuator and its overall efficiency.

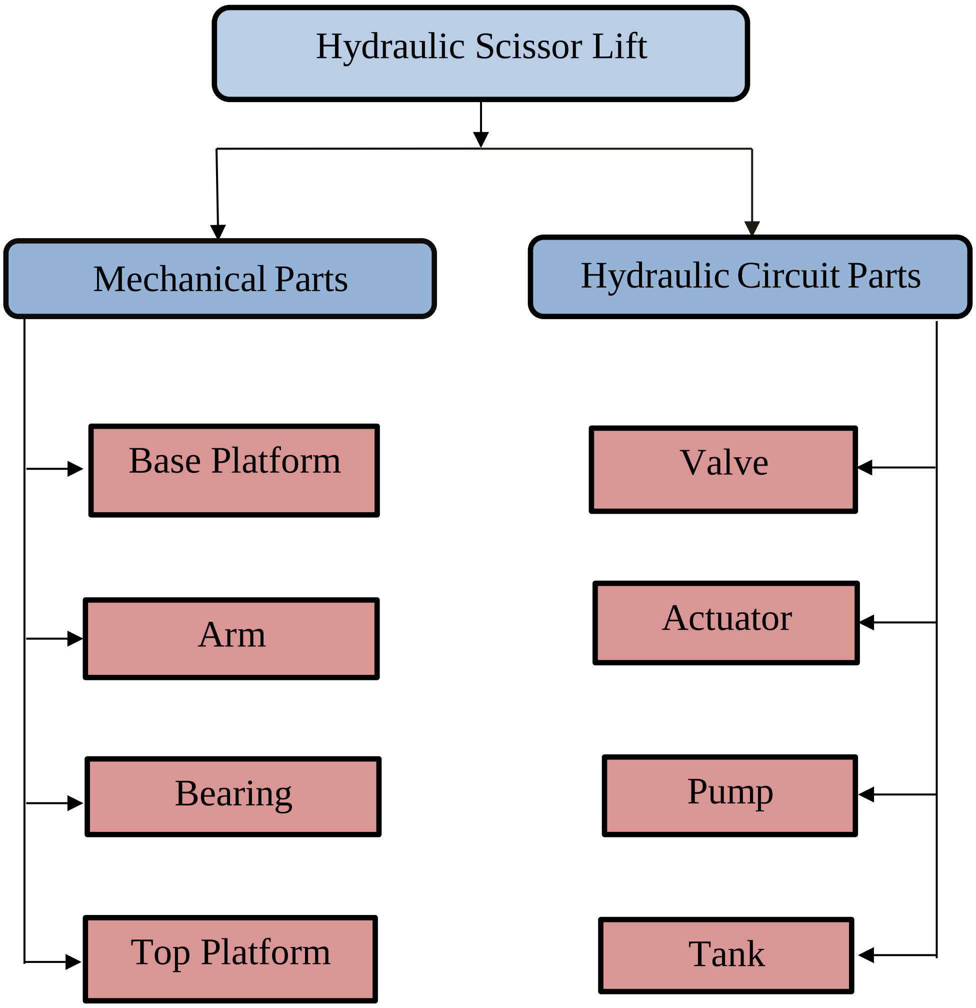

Figure 3.2 (System Parts)

3.2.1.1 Base Platform:

This component is subjected to the weight of the top plat form and the scissors arms. It is also responsible for the stability of the whole assembly, therefore strength. Hardness and stiffness are needed mechanical properties.

3.2.1.2 Scissor Arm:

This component is subjected to buckling load and bending load tending to break or cause bending of the components. Hence based on strength, stiffness, plasticity and hardness. A recommended material is stainless steel.

3.2.1.3 Bearing:

This component is the element that constrains relative motion to only the desired motion, and reduce friction between moving parts. In this system it tends to transmit the horizontal motion of the actuator to a vertical motion of the scissors.

3.2.1.4 Top Platform:

This component is subjected to the weight of the workman and his equipment, hence strength is required, the frame of the plat form is mild steel and the base is wood.

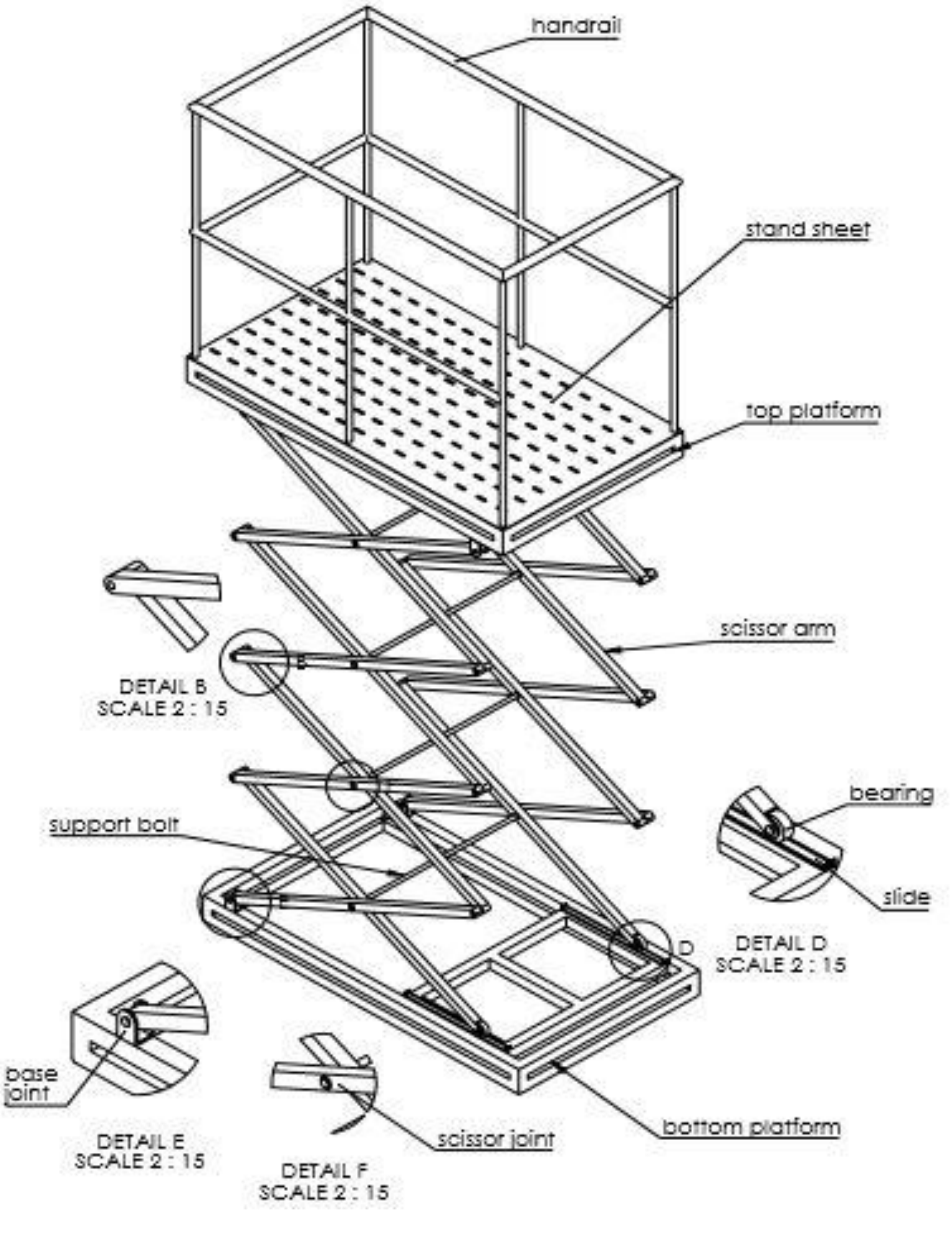

Figure 3.3 (Mechanical Assembly Sketch of Hydraulic Scissor Lift)

3.2.2.1 Hydraulic Valve:

A hydraulic valve properly directs the flow of a liquid medium, usually oil, through your hydraulic system. The direction of the hydraulic flow is determined by the position of a spool. A hydraulic system can only function – as per requirements – by using valves.

3.2.2.2 Actuator:

The actuator is the mechanism by which a control system acts upon an environment. The supplied main energy source may be electric current, hydraulic fluid pressure, or pneumatic pressure.

When the control signal is resaved, the actuator response by converting the energy into mechanical motion.

3.2.2.3 Hydraulic Pump:

Is a mechanical source of power that converts mechanical power into hydraulic energy. It generates flow with enough power to overcome pressure included by the load at the pump outlet.

3.2.2.4 Hydraulic Tank:

Is a container for holding the fluid required to supply the system including a reserve to cover any losses from minor leakage and evaporation. The tank can be designed to provide space for fluid expansion, permit air entrained in the fluid to escape, and to help cool the fluid.

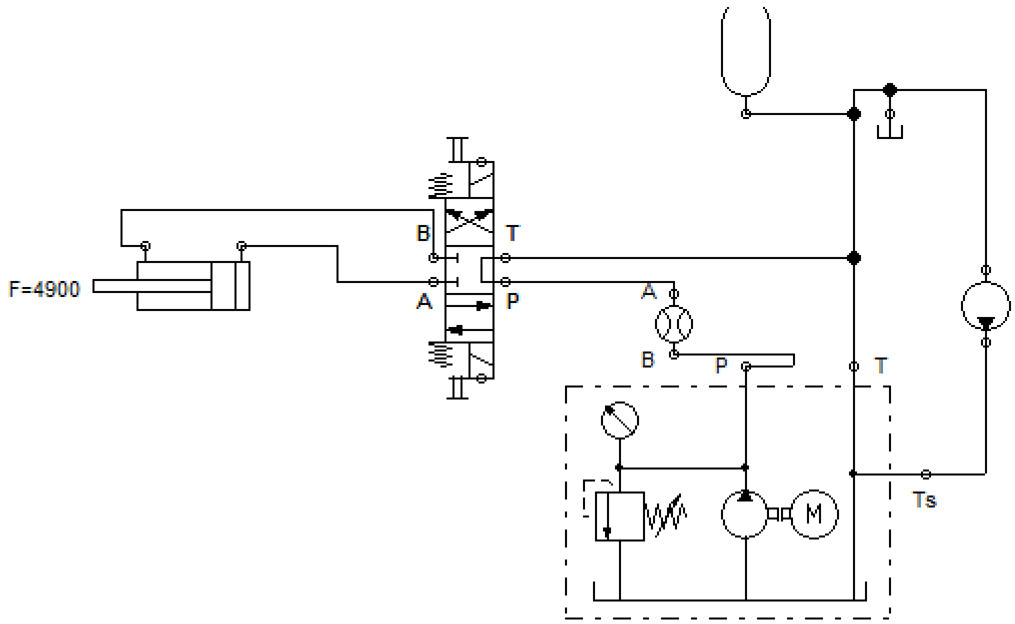

Figure 3.4 (Hydraulic Circuit Components of Hydraulic Scissor Lift)

3.3 Assumptions of the design:

The design of scissors lift is to lift up to a height of 3.7m and carrying capacity of less than 500kg (500 kilograms) which is driven by a hydraulic power. The structure of the scissor will build with stainless steel because of its high rust and corrosion resistance.

The maximum extension, an “X” arrangement of the lift moves 0.9m (900mm), and the total number of tiers of scissors (combined) Is 4, to lift a high of 3.7m. The base platform dimensions is 1400mm of length, 800mm of width, and 100mm of height from the ground.

At the maximum extension the angle of inclination will be 50 degree, and the distance between two scissors feet is 800mm. The Distance moved by sliding foot to full extension is 400mm.

3.4 Material Selection:

Material selection plays a very important role in machine design. For example, the cost of materials in any machine is a good determinant of the cost of the machine. More than the cost is the fact that materials are always a very decisive factor for a good design. The choice of the particular material for the machine depends on the particular purpose and the mode of operation of the machine components. Also, it depends on the expected mode of failure of the components.

The selection of the materials is done according to their mechanical properties (Strength, stiffness, elasticity, hardness and toughness) based on the particular working conditions.

The ***properties*** is:

- **Strength:** it is the ability of a material to resist the externally applied force without break down or yielding the internal resistance offered without break down or yielding the internally applied force is called stress.
- **Stiffness:** it is the ability of a material to resist deformation under stress.
- **Elasticity:** it is the property of a material to regain its original shape after deformation when the external force are removed.
- **Hardness:** is embraces difference properties such as resistance to water, scratching, deformation and machinability etc. it also measure of the ability of a metal to cut another metal.
- **Toughness:** it is the property of a material to resist fracture due to high impact loads like hammer blows, when heated. This property decreases.

3.4.1 Choice of stainless and mild steel:

3.4.1.1 Mild Steel:

Contains 0.05 to 0.3 percent carbons it has for almost all purpose replaced wrought iron, its greater strength giving it under viable advantages. Mild steel can be rolled, wielded and down. It can even be cast, though not very successfully.

Among its application are plates for ship building, bicycle frame tubes, mesh work, bolts, nuts, studs etc. solid and hollow constructional sections, sheet metal parts and steel castings such as flywheels and locomotive wheel centers.

3.4.1.2 Stainless Steel:

This is steel with high rust and corrosion resistance to meet specific application requirements. They also have high strength and toughness.
It is an alloy of iron with about 11% chromium and other metals like nickel, molybdenum etc. the properties of rust and corrosion resistance, toughness and strength, aesthetics and how coefficient of friction were considered to meet all requirements and the choice of stainless steel for the scissors members.

3.5 Cylinder Selection:

The hydraulic cylinder (or the hydraulic actuator) is a mechanical actuator that is used to give a unidirectional stroke. It has many applications, notably in engineering.

3.5.1 Single Acting Cylinder:

Single acting cylinders use hydraulic oil for a power stroke in one direction only. The return stroke is affected by a mechanical in one direction only. The return stroke is affected by a mechanical spring located inside the cylinder. For single acting cylinders with no spring, some external actin force on the piston rod causes its return.

3.5.2 Double Acting Cylinder:

Double acting cylinder uses compressed air or hydraulic fluid to pour both the forward and return strokes. This makes them ideal for bushing and pulling and pulling within the same application they are suitable for full stroke working only at slow speed which results in gentle contact at the ends of stroke.

3.6 Mathematical Model:

Each hydraulic scissor design involves mathematical modeling of the mechanical design and hydraulic design, and we're going to take them briefly in below.

3.6.1 Mechanical Design:

To determine the weight of the mechanical loads:

$$\mathbf{F=m*g} \qquad \text{-------------} \ (3.1)$$

F: force [N]

m: mass [Kg]

g: gravity [m/s^2]

3.5.2 Hydraulic Design:

To determine the diameter of the cylinder:

$$\mathbf{D = \sqrt{4F/\pi P\eta}} \qquad \text{-------------} \ (3.2)$$

D: diameter [m]

F: force [N]

P: pressure [bar]

η: efficiency (0.9)

π: constant (3.14)

To determine velocity:

$$V = Q/A \qquad \text{-----------} \ (3.3)$$

V: velocity [m/s]

Q: flow rate [L/min]

A: area [m²]

To determine the area:

$$A = \pi d^2/4 \qquad \text{----------} \ (3.4)$$

A: area [m²]

d: diameter [m]

π: constant (3.14)

To determine the volume of the tank:

$$V_{tank} = 3 * Q \qquad \text{-----------} \ (3.5)$$

V_{tank}: the volume [m³]

Q: flow rate [L/min]

Table 3.1 Standard values of cylinder diameter, rod diameter.

Bore dia.	Rod dia.	Rod end Threads style 4	Rod end Threads style 7	Areas: (mm²) Piston	Areas: (mm²) Rod	Areas: (mm²) Annulus	Area ratios			Port Sizes BSP/G (inches)	Port Sizes ISO 6149-1
25	12	M10x1.25	-	491	113	378	1.299	0.770	4.340		M14x1.5
	18	M14x1.5	M10x1.25		254	236	**2.076**	0.482	1.929		
32	14	M12x1.25	-	804	154	650	1.237	0.809	5.224		M14x1.5
	22	M16x1.5	M12x1.25		380	424	**1.896**	0.527	2.116		
40	18	M14x1.5	-	1,257	254	1,002	1.254	0.798	4.938		M18x1.5
	28	M20x1.5	M14x1.5		616	641	**1.961**	0.510	2.041		
50	22	M16x1.5	-	1,963	380	1,583	1.240	0.806	5.165		M22x1.5
	28	M20x1.5	M16x1.5		616	1,348	1.457	0.686	3.189		
	36	M27x2	M16x1.5		1,018	946	**2.076**	0.482	1.929		
63	28	M20x1.5	-	3,117	616	2,501	1.246	0.802	5.063		M22x1.5
	36	M27x2	M20x1.5		1,018	2,099	1.485	0.673	3.063		
	45	M33x2	M20x1.5		1,590	1,527	**2.042**	0.490	1.960		
80	36	M27x2	-	5,027	1,018	4,009	1.254	0.798	4.938		M27x2
	45	M33x2	M27x2		1,590	3,436	1.463	0.684	3.160		
	56	M42x2	M27x2		2,463	2,564	**1.961**	0.510	2.041		
100	45	M33x2	-	7,854	1,590	6,264	1.254	0.798	4.938		M27x2
	56	M42x2	M33x2		2,463	5,391	1.457	0.686	3.189		
	70	M48x2	M33x2		3,848	4,006	**1.961**	0.510	2.041		
125	56	M42x2	-	12,272	2,463	9,809	1.251	0.799	4.982	2	M33x2
	70	M48x2	M42x2		3,848	8,423	1.457	0.686	3.189		
	90	M64x3	M42x2		6,362	5,910	**2.076**	0.482	1.929		
160	70	M48x2	-	20,106	3,848	16,258	1.237	0.809	5.224	2	M33x2
	90	M64x3	M48x2		6,362	13,744	1.463	0.684	3.160		
	110	M80x3	M48x2		9,503	10,603	**1.896**	0.527	2.116		
200	90	M64x3	-	31,416	6,362	25,054	1.254	0.798	4.938		M42x2
	110	M80x3	M64x3		9,503	21,913	1.434	0.698	3.306		
	140	M100x3	M64x3		15,394	16,022	**1.961**	0.510	2.041		

Table 2.2 Standard values of cylinder diameter, rod diameter, force and flow rate,

Piston	Piston rod	Area ratio	Areas			Force at 160 bar [1]			Flow at 0.1 m/s [2]		
			Piston	Rod	Annulus	Pushing	Diff.	Pulling	Out	Diff.	In
AL Ø mm	MM Ø mm	φ A_1/A_3	A_1 cm²	A_2 cm²	A_3 cm²	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
125	56 70 [12] 90	1.25 1.46 2.08	122.72	24.63 38.48 63.62	98.09 84.23 59.10	196.35	39.41 61.58 101.79	156.94 134.77 94.56	73.6	14.8 23.1 38.2	58.9 50.5 35.5
160	70 110	1.25 1.90	201.06	38.48 95.03	162.58 106.03	321.70	61.58 152.05	260.12 169.64	120.6	23.1 57.0	97.5 63.6
200	90 140	1.25 1.96	314.16	63.62 153.94	250.54 160.22	502.65	101.79 246.30	400.86 256.35	188.5	38.2 92.4	150.3 96.1

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Design Calculations:

4.1.1 The force:

F = m * g

F = 500 * 9.8 = 4900 N

4.1.2 Cylinder diameter:

D = √4F/πPη

D = √4*4900/3.14*50*0.9 = 37.8 mm

Take it = 40 mm

4.1.3 Velocity of the piston:

V = Q/A

From table 3-2: Q = 7.5 L/min

V = 0.02 m/s

4.1.4 Rod diameter:

From table 3-1: d = 22 mm

At D = 40 mm

4.2 Mechanical Analysis:

4.2.1 Mesh (Moderate Mesh):

Meshing is the process used to fill the solid model with nodes and elements to create finite element analysis model (FEA) model.

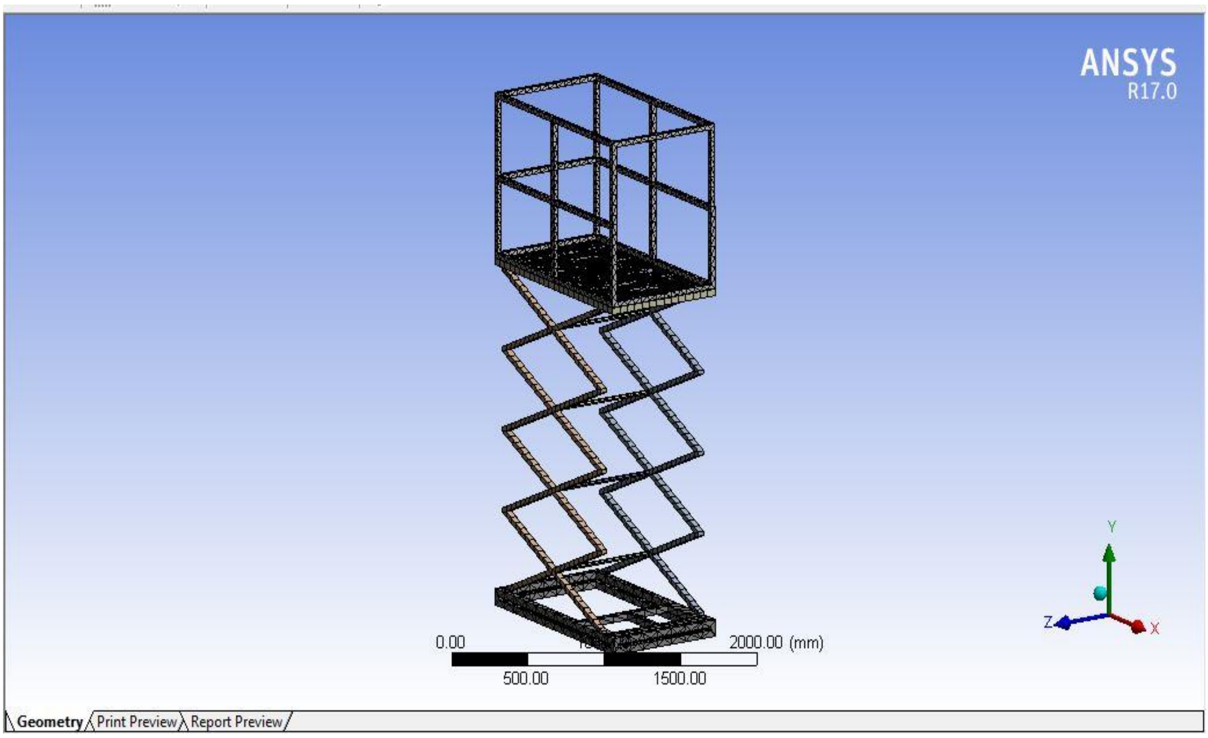

Figure 4.1 (Mesh)

4.2.2 Simulation Results

The analysis was made to get the maximum and the minimum of:

- The total deformation.
- The stress.
- The strain.

4.2.2.1 Total Deformation:

Max = 11179mm

Min = 0

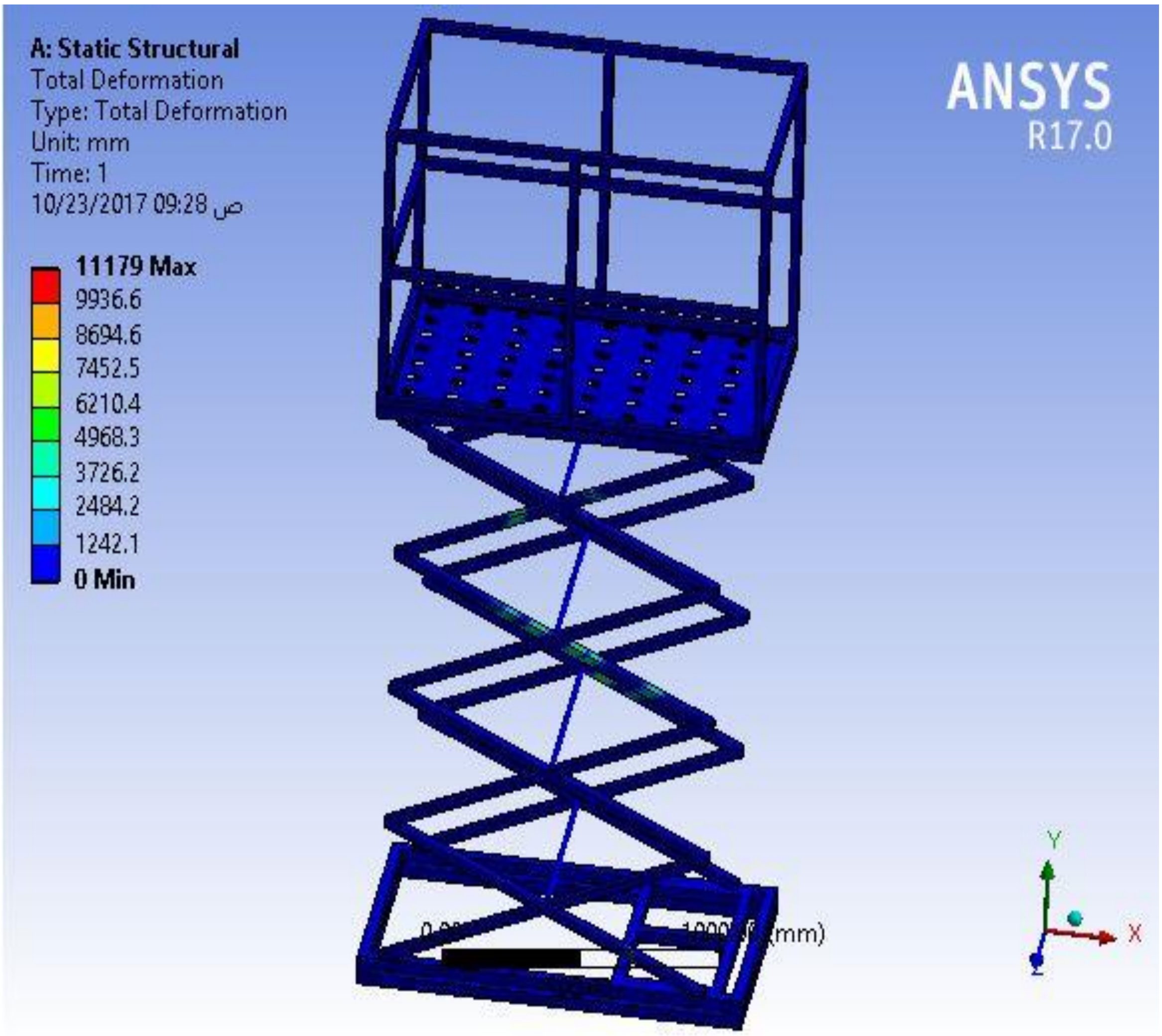

Figure4.2 (Total Deformation)

The deformation is very low among the scissors

4.2.2.2 Maximum Principle Stress:

Max = 48.921 MPa

Min = -9.9173

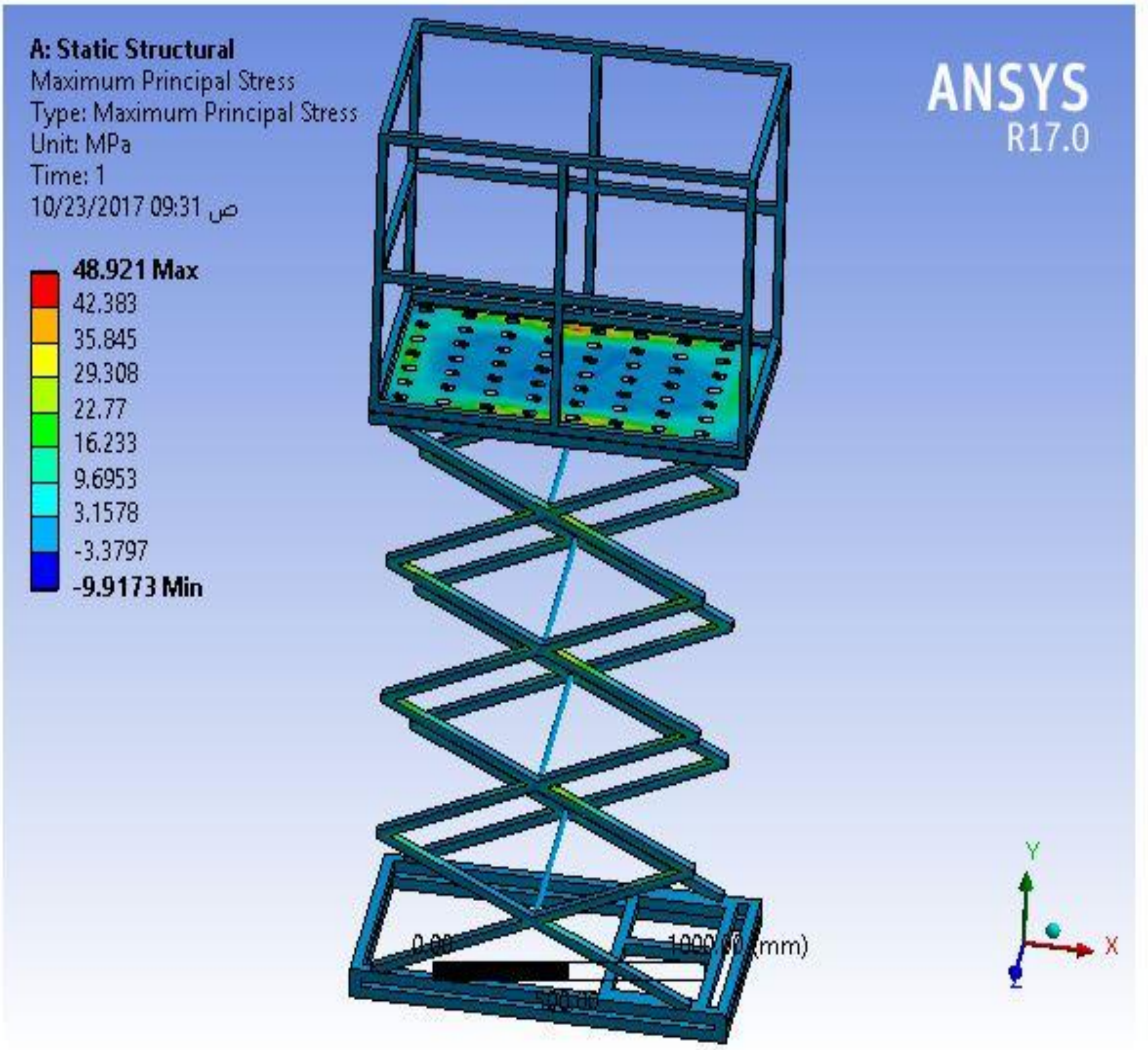

Figure 4.3 (Maximum Principe Stress)

The maximum stress pointed on the platform and it increases towards the ends.

4.2.2.3 Minimum Principle Stress:

Max = 9.4326 MPa

Min = -49.721

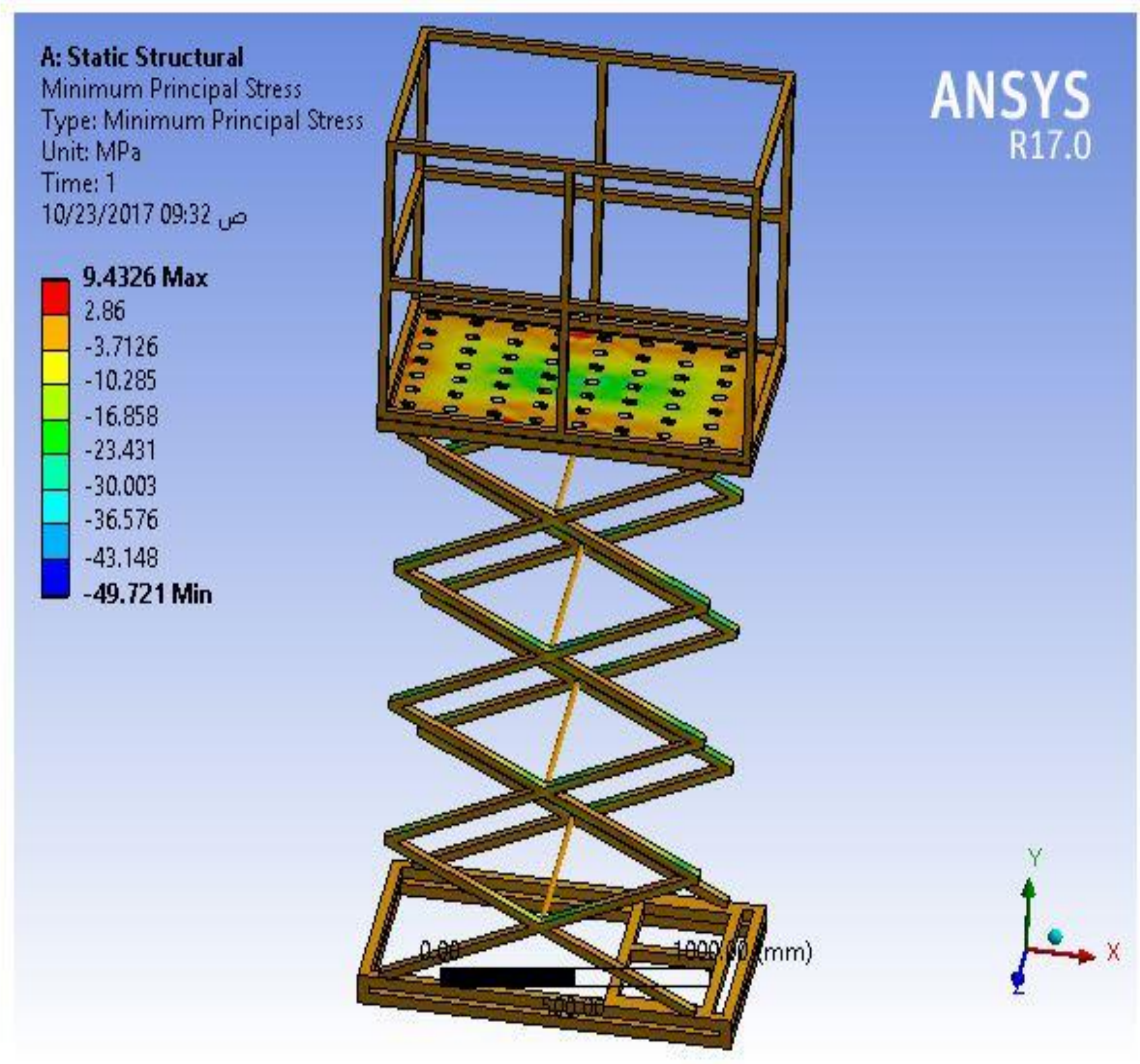

Figure 4.4 (Minimum Principle Stress)

The minimum stress decreases towards the middle of platform.

4.2.2.4 Maximum Principle Elastic Strain:

Max = 0.00028643 mm/mm

Min = -2.9953e-6

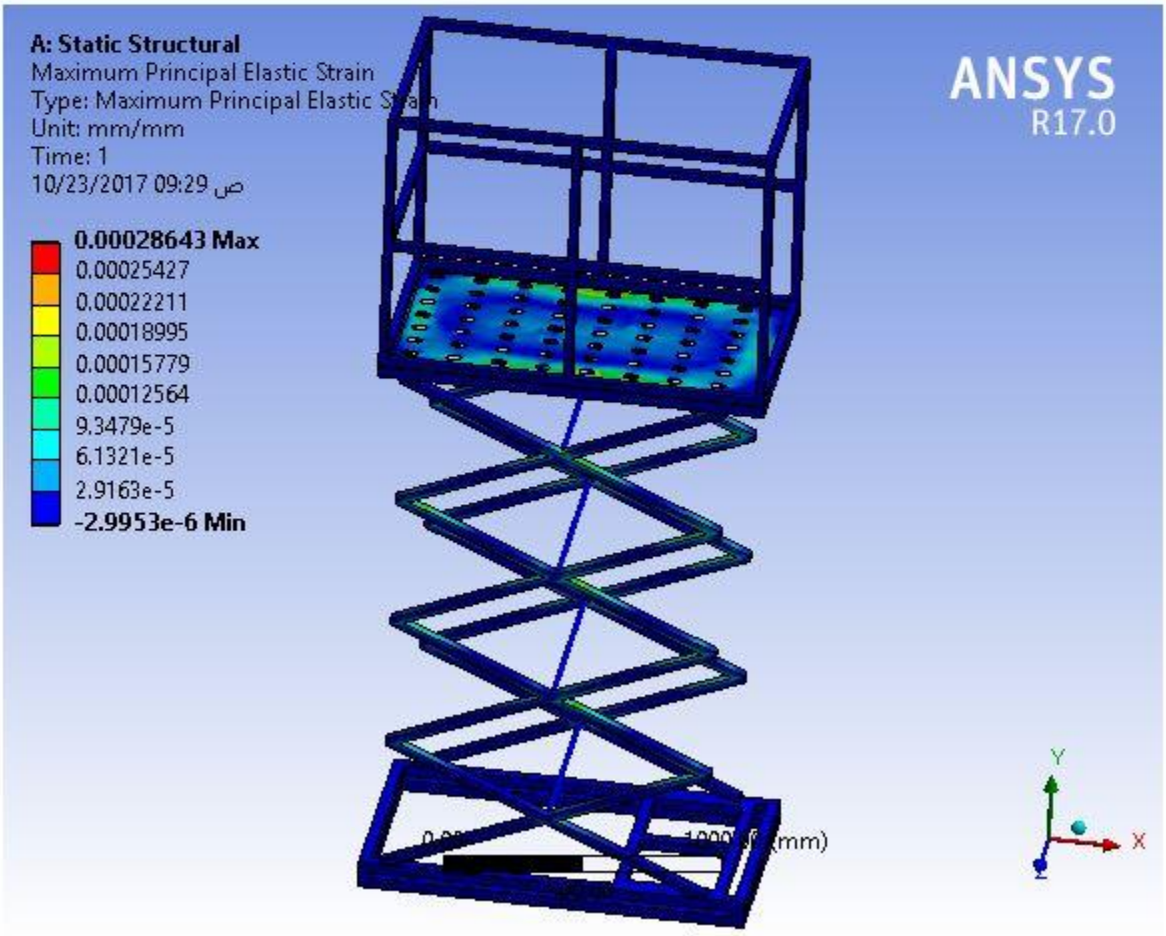

Figure 4.5 (Maximum Principle Elastic Strain)

The maximum elastic strain pointed on the ends of platform and scissors and it decreases towards the joints.

4.2.2.5 Minimum Principle Elastic Strain:

Max = 6.2228e-8 mm/mm

Min = -0.00028745

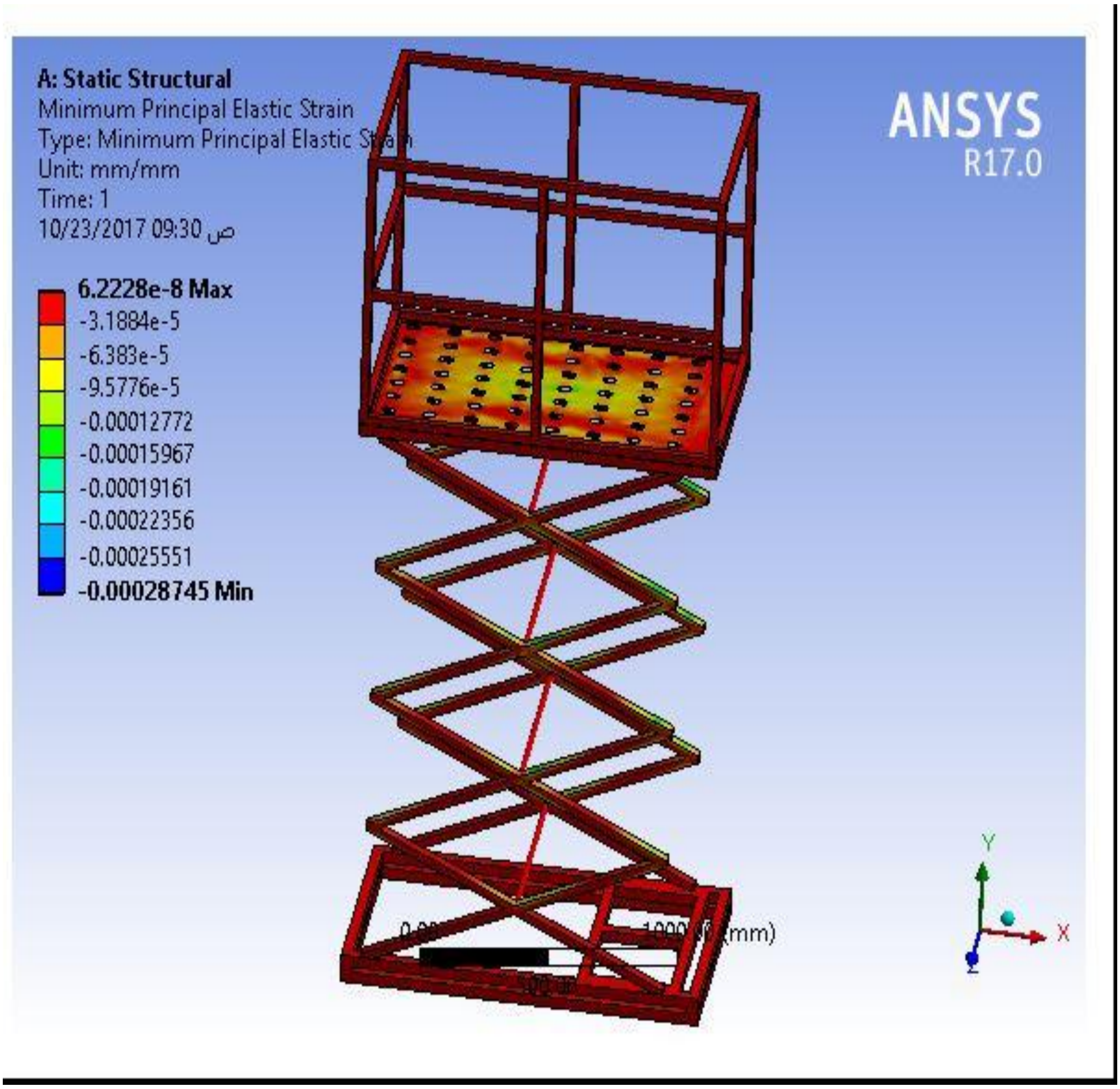

Figure 4.6 (Minimum Principle Elastic Strain)

The minimum elastic strain is pointed on the base platform and it decreases towards the joints and the top platform.

4.3 Hydraulic circuit:

4.3.1 Cylinder Configuration:

4.3.1.1 Configuration:

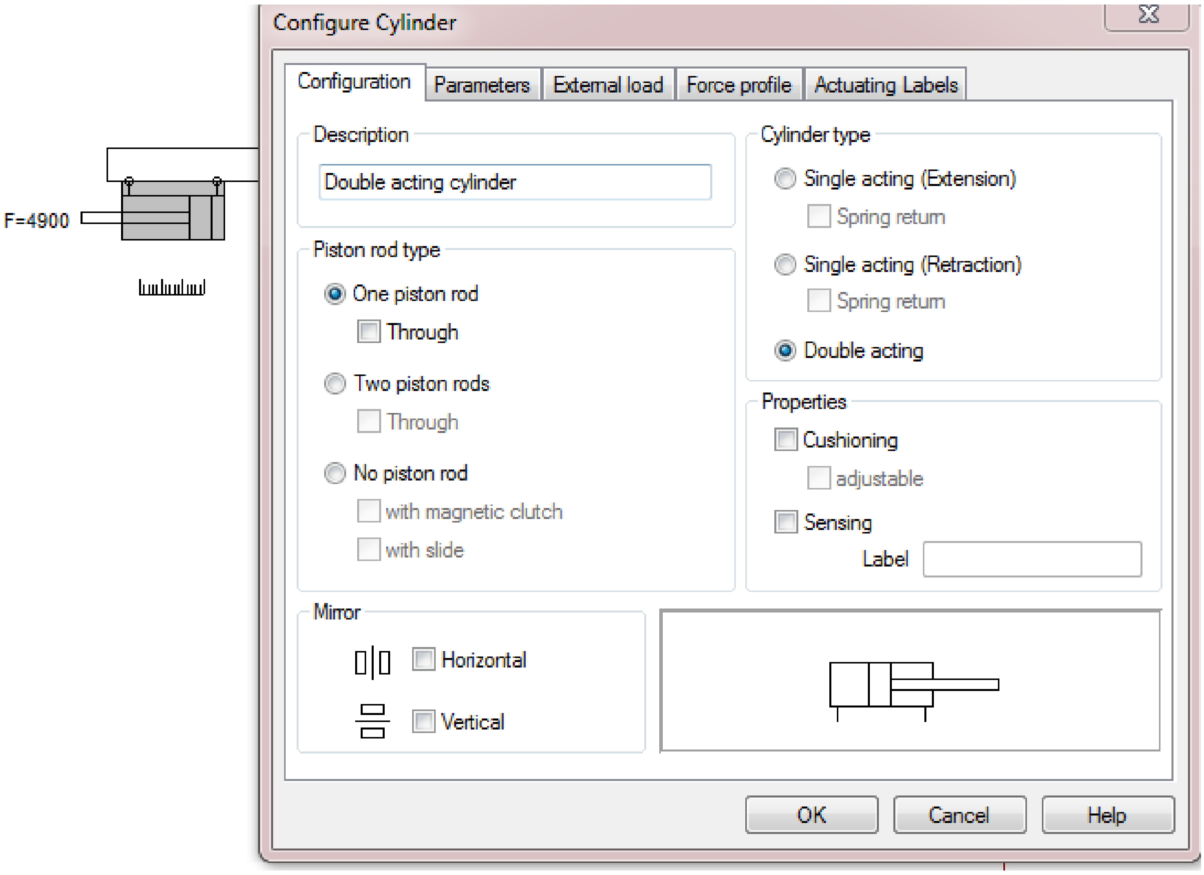

Figure 4.7 (Configuration)

4.3.1.2 Parameters:

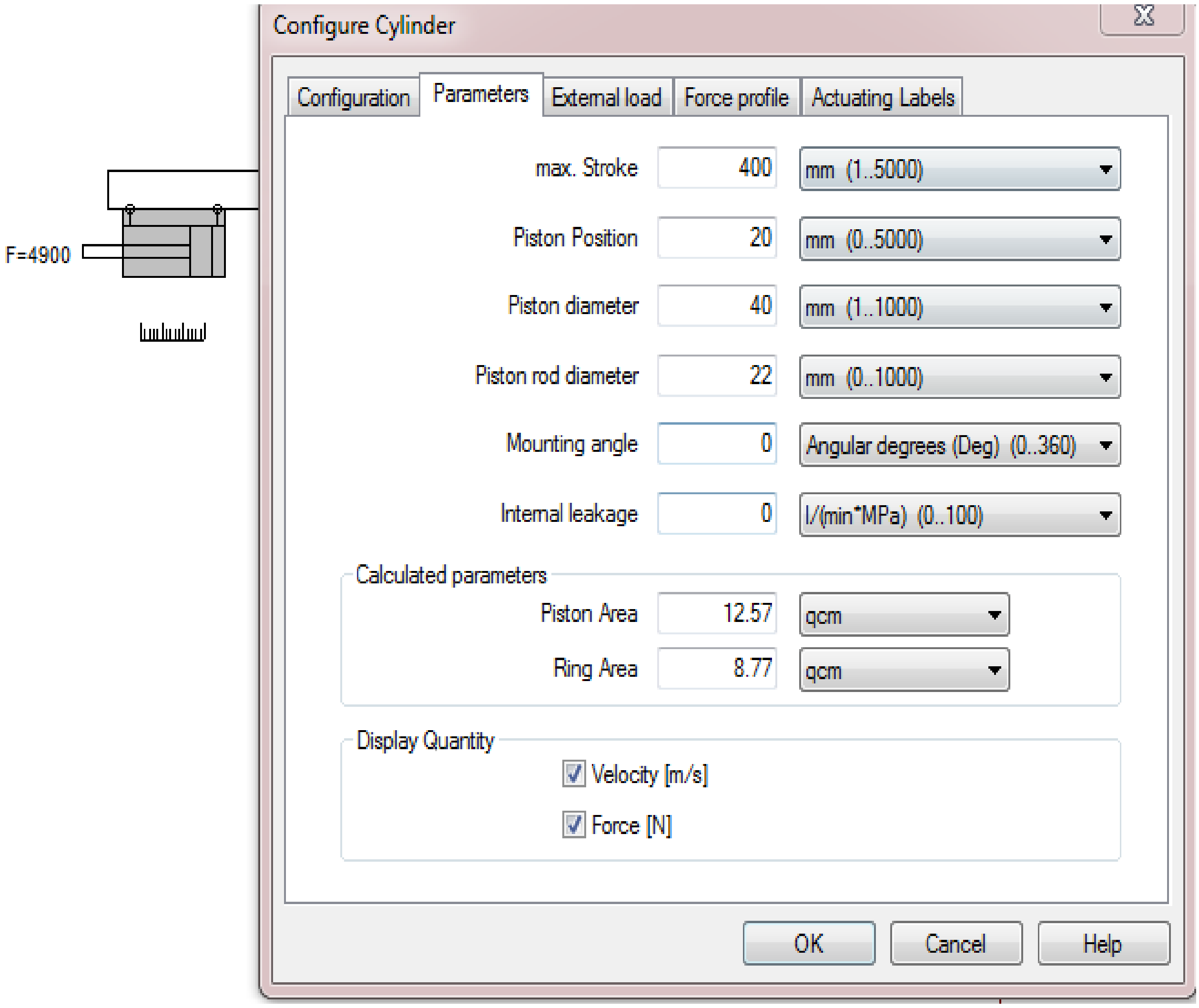

Figure 4.8(Parameters)

4.3.1.3 External Load:

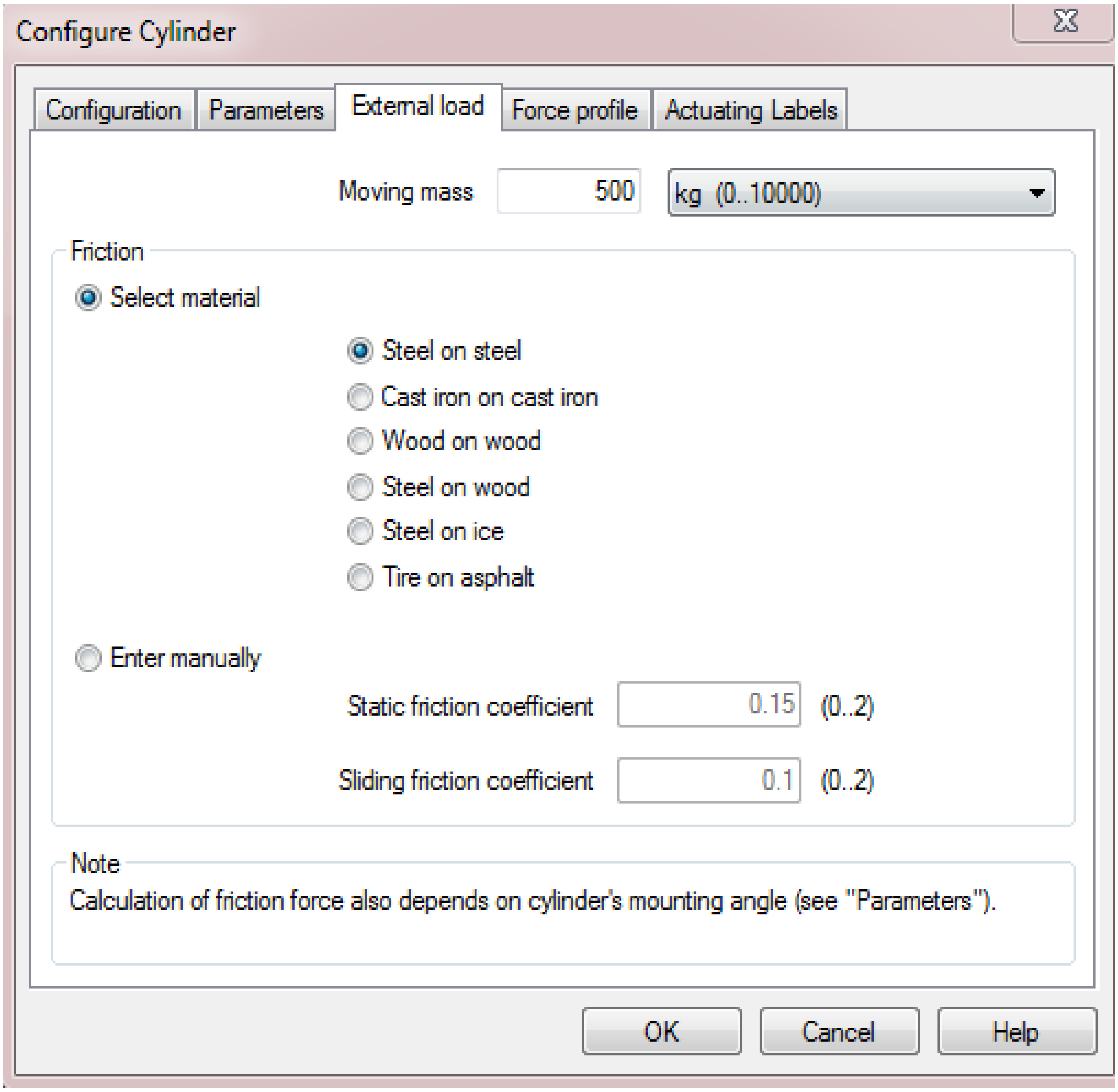

Figure 4.9 (External Load)

4.3.1.4 Force Profile:

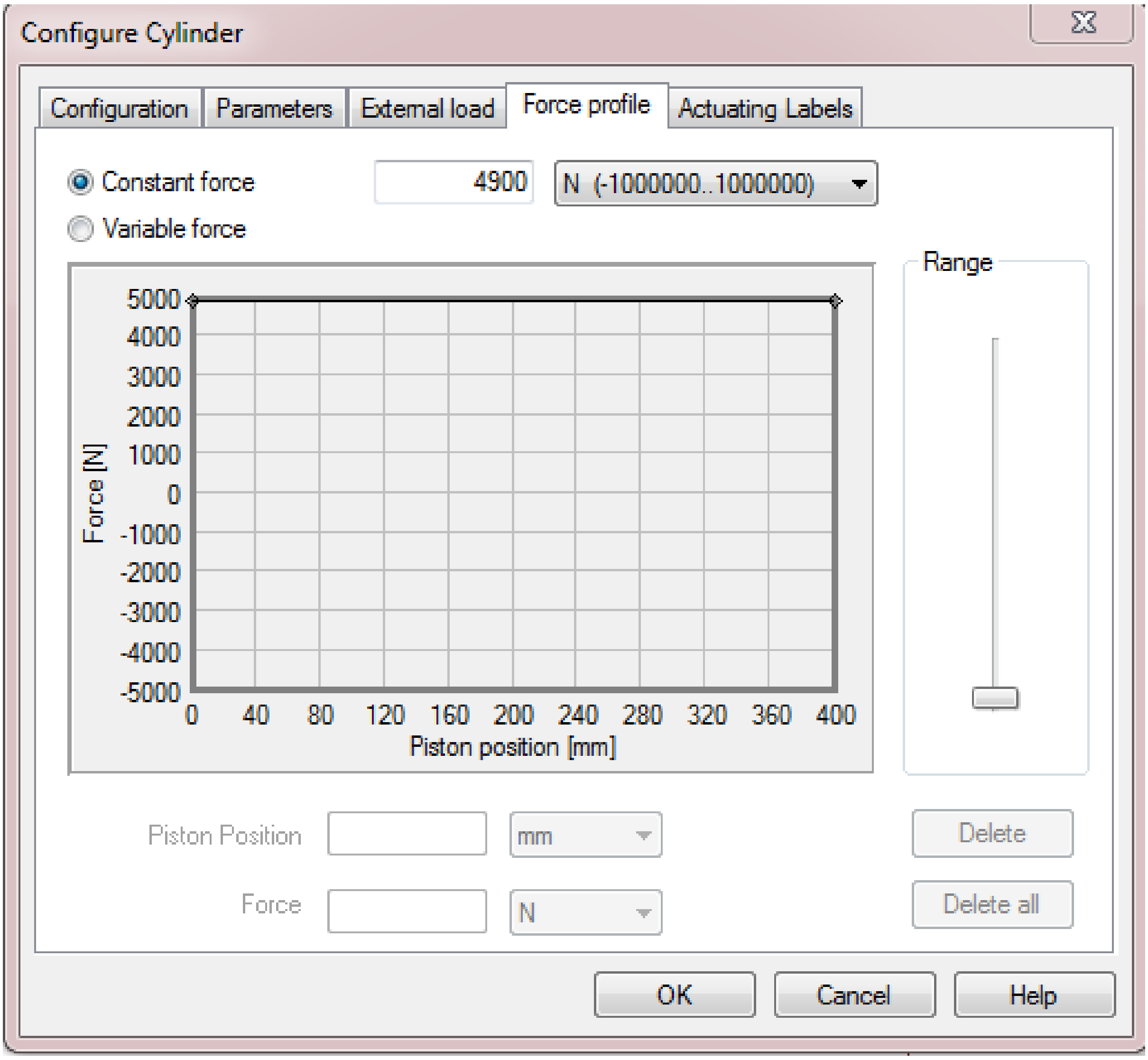

Figure 4.10 (Force Profile)

4.3.2 Configure Way Valve:

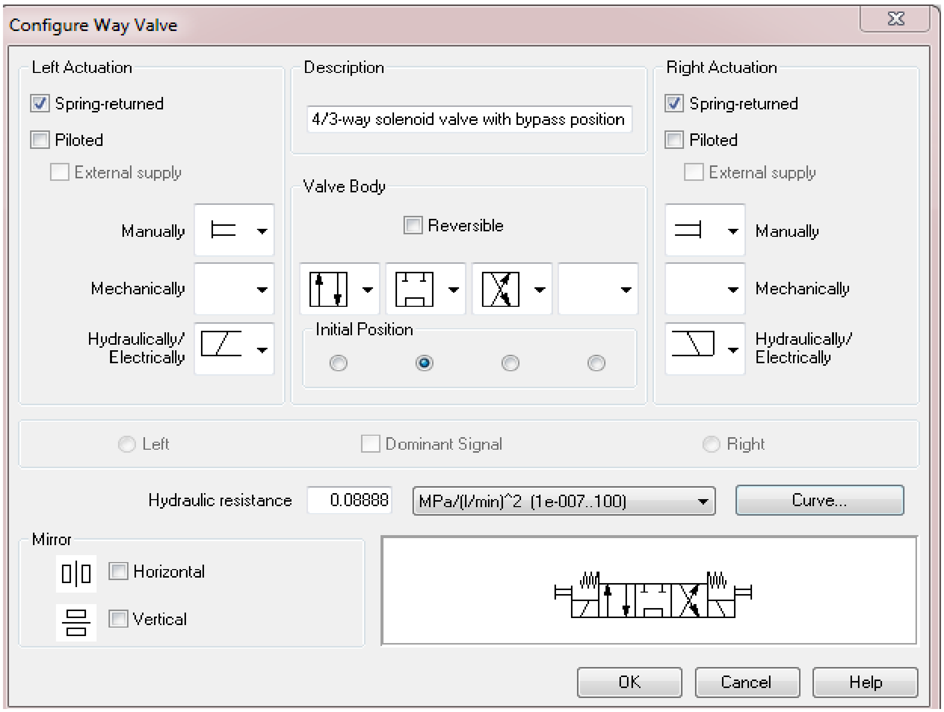

Figure 4.11 (Configure Way Valve)

4.3.3 Hydraulic Resistance:

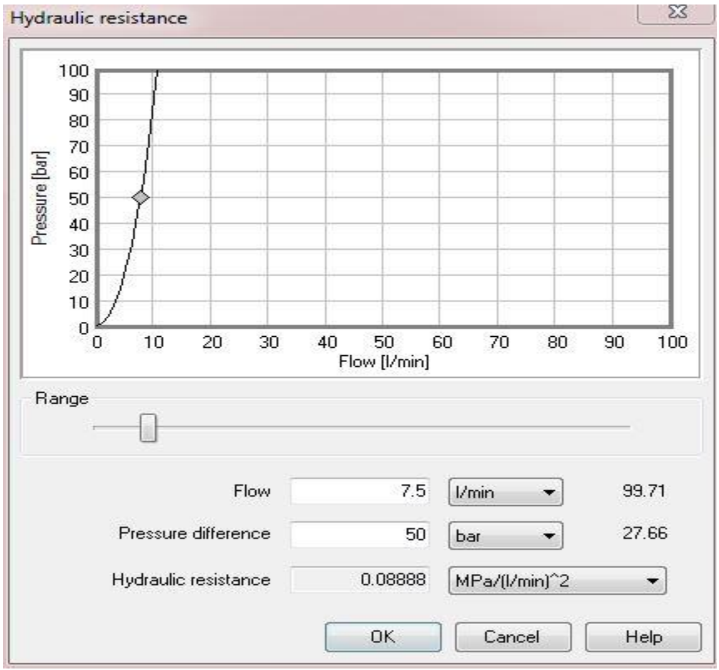

Figure 4.12 (Hydraulic Resistance)

4.3.4 Pump Unit:

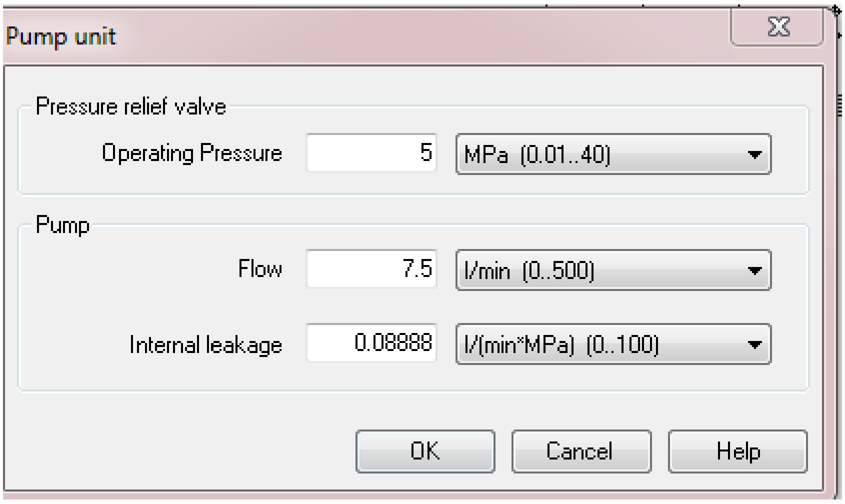

Figure 4.13 (Pump Unit)

4.3.5 Reservoir:

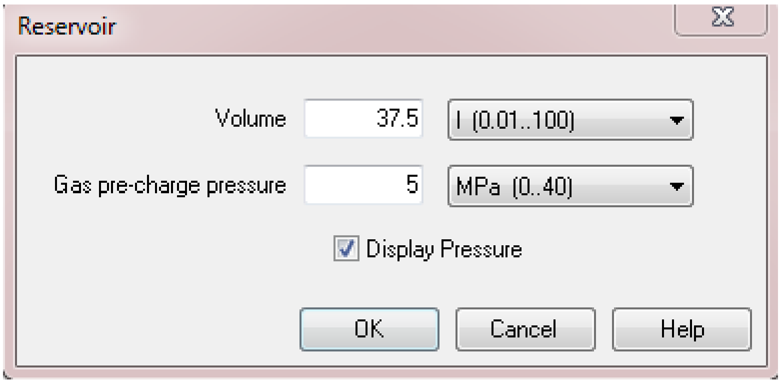

Figure 4.14 (Reservoir)

4.3.6 Fixed Displacement Pump:

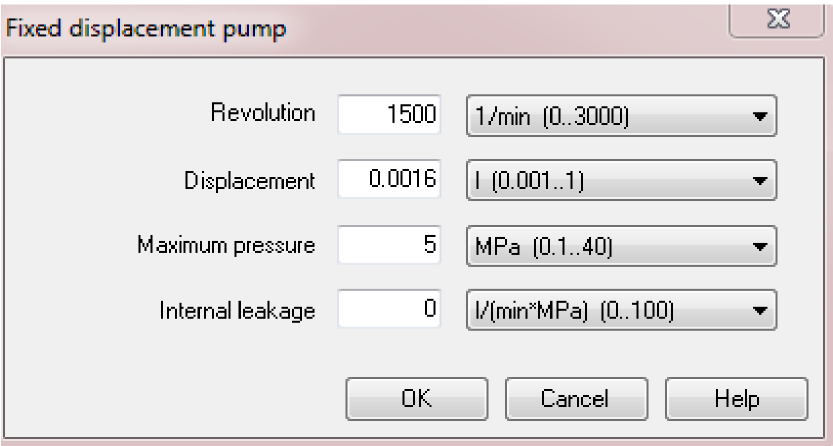

Figure 4.15 (Fixed Displacement Pump)

4.3.7 Operation of the circuit:

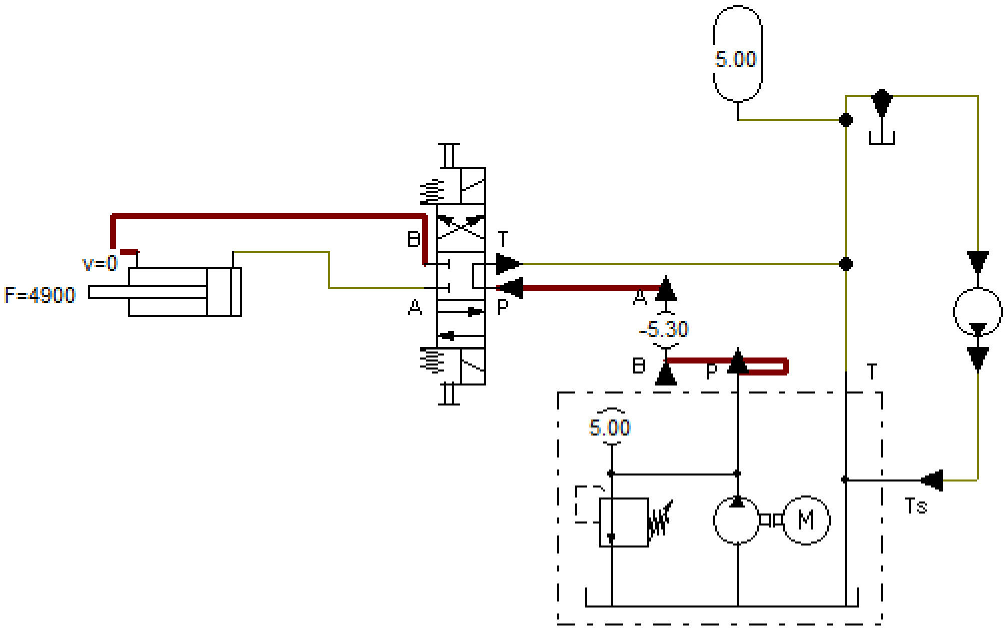

Figure 4.16 (The actuator is in the initial state)

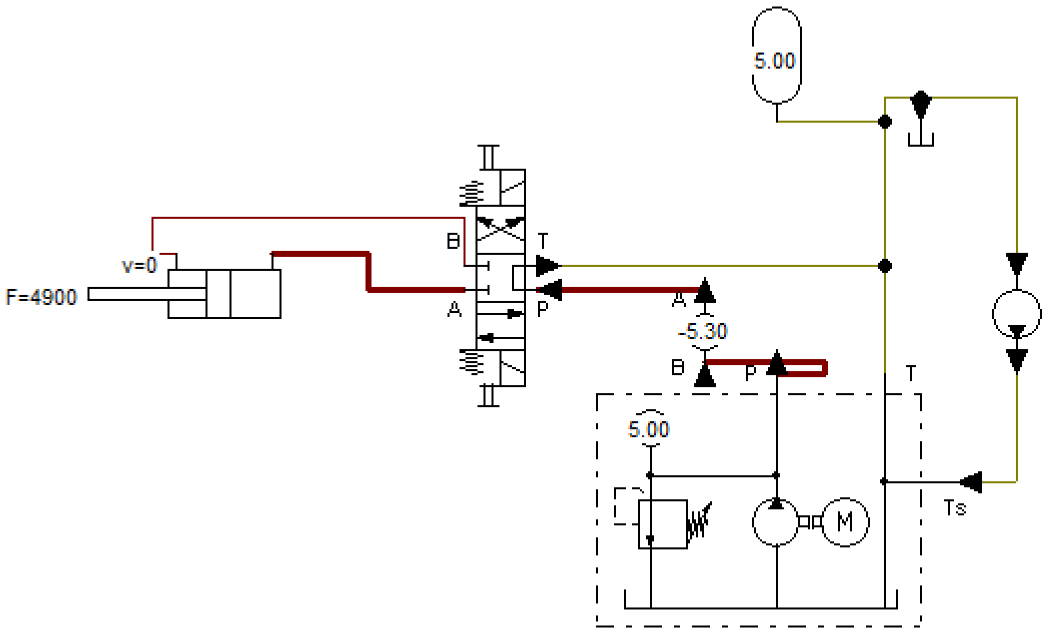

Figure 4.17 (The actuator is undergoing)

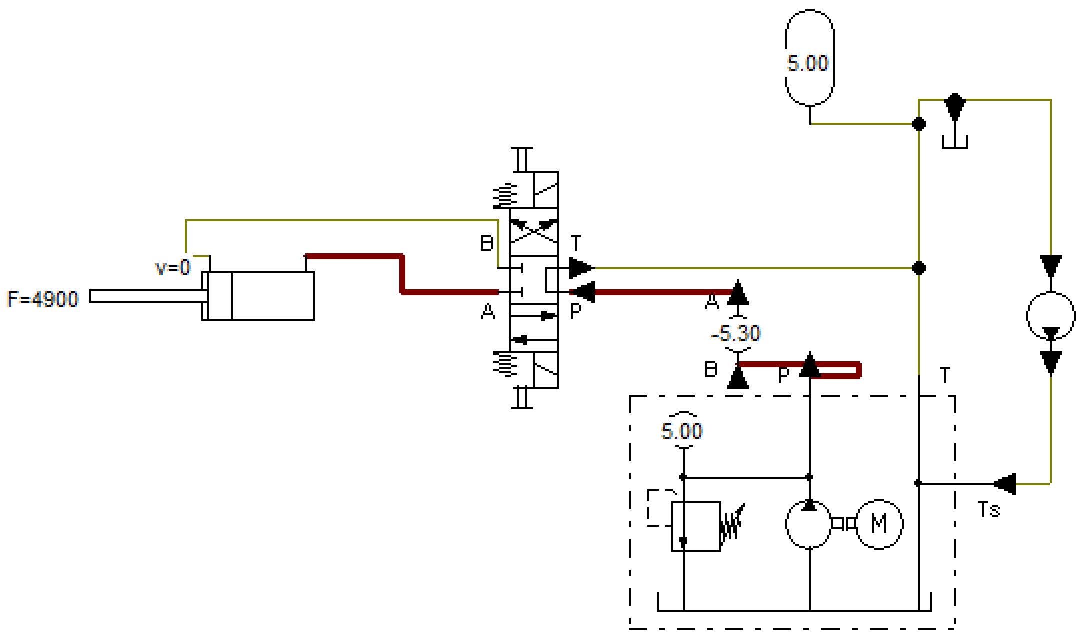

Figure 4.18 (The actuator in maximum extension)

4.4 Discussion:

In the above circuit, when the unit power switch on, the hydraulic fluid is pushed under pressure through a hydraulic pump, tubes, hoses, and hydraulic motor. If the valve is closed, the fluid will get back to the tank. And if the valve is opened, the hydraulic fluid is pushed through the cylinder to move heavy loads.

Chapter Five

CONCLUSION

AND

RECOMMENDATION

5.1 Conclusion:

Hydraulic scissor lift is designed to lift heavy loads to different heights using a hydraulic system.

The design of a portable work platform elevated by a hydraulic cylinder was carried out meeting the required design standards. The portable work platform is operated by hydraulic cylinder which is operated by a motor. The hydraulic scissor lift is simple in use and does not required routine maintenance. It can also lift heavier loads. The main constraint of this device is its high initial cost, but has a low operating cost. Savings resulting from the use of this device will make it pay for itself within short period of time and it can be a great companion in any engineering industry dealing with rusted and unused metals.

5.2 Recommendation:

The scissor lift can be design for high load also, if a suitable high capacity hydraulic cylinder is used.

This device affords plenty of scope for modifications for further improvements and operational efficiency, which should make it commercially available and attractive. Hence, its wide application in industries, hydraulic pressure system, for lifting of vehicle in garages, maintenance of huge machines, and for staking purpose. Thus, it is recommended for the engineering industry and for commercial production.

5.3 References:

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