Palestine Polytechnic University

College of Engineering

Design and Building of a

Reliability Test Set-up for Plastic Chairs

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Abstract

Our project is conducted in cooperation with $ROYAL^{®}$ Industrial Trading Company which is one of the largest producers of plastic wares, in the Middle East. Our main work is to design and build the reliability and fatigue test set-up for plastic chairs.

Furthermore, investigations of the samples during the test; failure criteria will be specified. The machine has been controlled by PLC (Programmable Logic Controller), and monitored by a touch screen HMI (Human Machine Interface).

الإهداء

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

الحمدلله ... الحمدلله حمداً طيباً مباركاً ... والصلاة و السلام على معلمنا الأول, والرسول الأعظم محمد صلى الله عليه وسلم .

ها نحن نجني ثمرة جهدنا ...وحصاد سنيين قضيناها في طلب العلم... عَسانا ننهيها بنجاح وتفوق.. يطيب لنا ولكم أساتذتنا... ولكم أهالينا .

إلى أساتذتنا الأفاضل ... الذين بذلوا كل ما لديهم لإعطائنا ثمرة خبرتهم وعلمهم... فلهم ننحني, و لهم نرفع القبعات ونخص بالذكر مشرفنا العزيز الدكتور رائد عمرو.

إلى أهالينا ...أعزُ ما في قلوبنا... عسانا نحظى برضاكم ونكون على مستوى ما تتمنون وتأملون... فلولا دعمكم المتواصل واحتضانكم لنا ما كنا وصلنا إلى هذه المرحلة الحاسمة و المؤثرة في حياتنا .

إلى من يحملون في عيونهم ذكريات طفولتنا وشبابنا... إليكم إخوتنا و أخواتنا..

إلى من تَّحلو بالإخاء وتميزوا بالوفاء , إلي ينابيع الصدق الصافي , إلى من معهم سعدت , وبرفقتهم في دروب الحياة سررت, إلى من كانوا معي في طريق النجاح, إلى من عرفت كيف أجدهم وعلموني أن لا أُضيعهم إليكم أصدقائي.

إلى شركةٍ عريقة ومؤسسةٍ كبيرة , وقفت بجانبنا ولم تتخلى عنا حتى النهاية ,ودعمتنا كل الدعم, وتبنت مشروعنا بشكل كامل ,إليكي شركة رويال الصناعية التجارية .

ومن أحقُ منهم شهداءنا أن نهديهم باكورة عملنا وعلمنا فهم الأرقى منا جميعا , والأكرم منا مكانة فهم السباقون في الحصول على أعلى وأرفع الشهادات... تفوق مراتٍ ومرات شهاداتنا الدنيوية .

الى أسرانا الأبطال في سجون الاحتلال إخوتنا وأخواتنا الذين ضحوا بأجمل سنين حياتهم, من أجل وطنٍ ضمنا وضم مؤسسات كبيرة ومنها مؤسستنا العريقة العظيمة جامعتنا المتميزة جامعة بوليتكنك فلسطين والتي بها نفتخر نحن خريجيها و طلابها .

شكر و تقدير

"كن عالماً...فإن لم تستطع فكن متعلما...فإن لم تستطع فأحب العلماء... فإن لم تستطع فلا تبغضهم"

بعد رحلة عمل وجهد واجتهاد تكللت بإنجاز هذا المشروع , نحمد الله عز وجل على نعمه التي منّ بها علينا فهو العلي القدير, كما لا يسعنا إلا أن نتقدم بأسمى عبارات الشكر والتقدير إلى مشرفنا العزيز الدكتور "رائد عمرو" لما قدمه لنا طيلة انجاز هذا المشروع

كما نتقدم بالشكر الجزيل لكل من ساهم بتقديم يد العون لانجاز هذا المشروع ونخص بالذكر شركه رويال الصناعية التجارية التي احتضنتنا وتبنت مشروعنا , وقسم المخرطة في هذه الشركة الذي ساعدنا منذ البداية , كما ونتقدم بشكر كل من المهندس "عماد رجوب" , والمهندس "زياد مطاوع" أحد أركان هذه الشركة , كما ولن ننسى أن نتقدم بأرقى وأثمن عبارات الشكر والعرفان إلى الجندي المجهول ,والمشرف الميداني الذي رافقنا طوال الفترة التي عملنا بها داخل أروقه الشركة المهندس "معتز إسعيد"

وكما ونوجه الشكر الى دائرة الهندسة الميكانيكية بكافة طاقمها التدريسي الذي لم يبخل علينا بأي معلومة شكرا جزيلا لكم

ولا ننسى أصدقائنا الذين وقفوا بجانبنا في السراء و الضراء و خصوصا الذين كانوا أصدقاءً أوفياء ولم يترددوا في مد يد العون سائلين المولى عز و جل أن يوفقنا و يوفقهم في الحياة العلمية والعملية

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Chapter One

Introduction

1.1 Introduction

1.2 Objectives of the project

1.3 Project benefits

1.4 Types of Testing

1.5 Methodology and project plan work

1.6 Time schedule for the project

1.1 Introduction:

The project aims to design and build a reliability test set-up for plastic chairs. The reliability test is important in every factory to improve and develop the product and has enough information about the life cycle of the product. The test seeks to reveal the weaknesses of the product and hence leads to its improvement and development, thus increasing its lifespan.

The chair will be exposed to the back static load test and the drop test as mentioned in chapter 2. These tests will count the number of times the chair is exposed to the impact of constant force. The chair will be continuously monitored by a USB microscope which will monitor the formation of slits caused by the stresses undergone by the chair during the tests.

Reliability is the degree to which an assessment tool produces stable and consistent results. The reliability of a product is determined by its ability to perform its desired function throughout its lifespan. The machine reliability test can determine the quality of the chair. The first possible case (Infant Mortality) appears due to the failure in manufacturing, while the second case (Constant Failure Rate) appears due to the success in manufacturing. The final case (Wear Out) appears due the worn out of the plastic chair, as shown in **Figure1.1**.

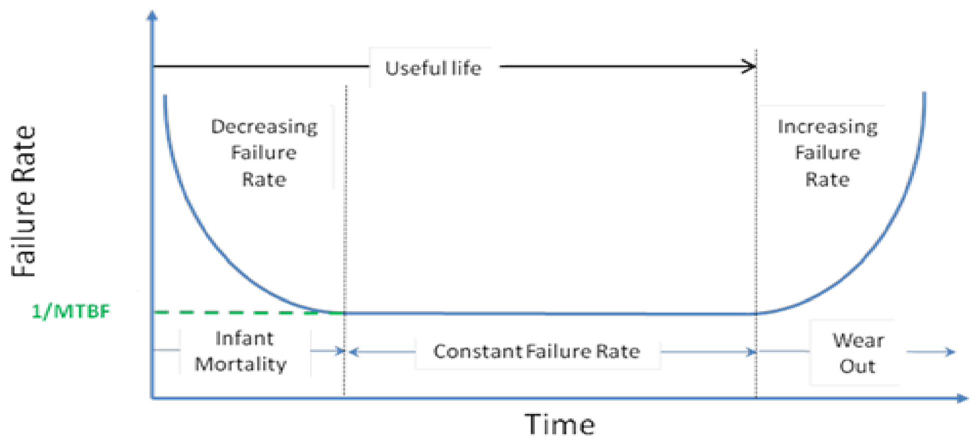

Figure1.1: Relationship between the failure rate and the time used [1]

The *ROYAL*® Industrial Trading Company, in Hebron is a conventional Palestinian manufacturer for plastic products such as tables and chairs as well as plastic tubing for pipe fitting.

At $ROYAL^{®}$ Industrial Trading Company, a machine reliability test is not found; therefore identifying weaknesses in the products is problematic. However, the factory thrives to correct this and increases its ability in identifying faulty and damaged plastic chairs. This will enable changes to be made to the design and production of the product and ultimately lead to the improvement of the functionality and reliability of the product.

Part of the aim is to improve product performance, compliance with applicable standards, and increase customer satisfaction of the company's products and services. It is therefore important for companies to take into account the importance of investing in quality assurance of any product.

At $ROYAL^{®}$'s laboratories they have experts adept in testing a wide range of materials, components and products. They test products on a daily basis to assure that all manufactured products are tested with high accuracy and compliance with quality assurance standards. Moreover, $ROYAL^{®}$ also test products by functional testing to determine whether the products meet customer expectations. Test scores yield information about problems and highlight areas which need improved.

$ROYAL^{®}$ has been awarded the International Quality Management System ISO 9001:2000 in 2000 and Environmental Management ISO14001 in 2014. In addition to this, the company has also been awarded the Palestinian Standard Institution Certificates for many of its products.[2]

This will hopefully be achieved by successfully implementing the machine reliability test to determine the quality of the plastic chair production at the $ROYAL^{®}$ Industrial Trading Company. Additionally, the test will be implemented in different ways such as changing the type of chair and the ground on which the chair is placed amongst others.

The machine will check the quality of the chair to determine its lifespan and will also perform additional tests including stress test, strain test, and forces test.

1.2 Objectives of the project:

1- Design and build a reliability test set-up for plastic chairs.

2- Specifying the parameters that must be monitored during the test.

3- Improving the quality of plastic products at ROYAL® factory.

4- Enhancing the cooperation and integration between the university and local industry.

1.3 Project Benefits:

The importance of this project after completion will be expected to:

1- Improving the quality of the plastic chairs and specifying their weak points.

2- Enhancing the synergy between industrial sector and academia.

1.4 Types of Testing:

Cooperation with $ROYAL^{®}$ Industrial Trading Company selected two type of testing by using European standard [3].

1- Seat and Back test:

In this test, two forces focus on the seat and the back of plastic chair as shown in **Figure1.2.**

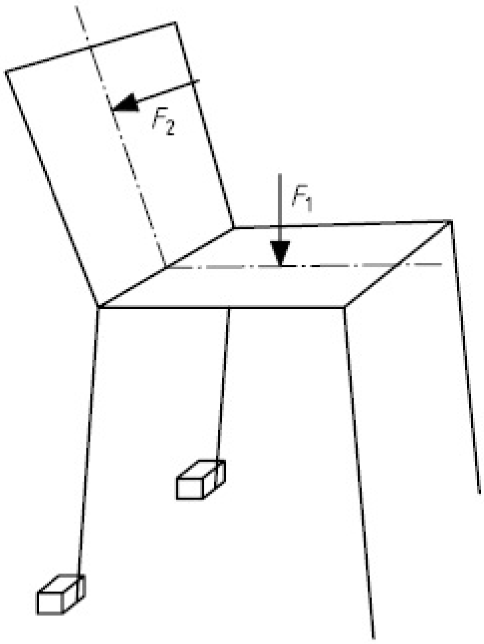

Figure1.2: Two forces focus on seat and back of plastic chair

2- Arm test:

Two forces focus on arm of plastic chair as shown in **Figure1.3.**

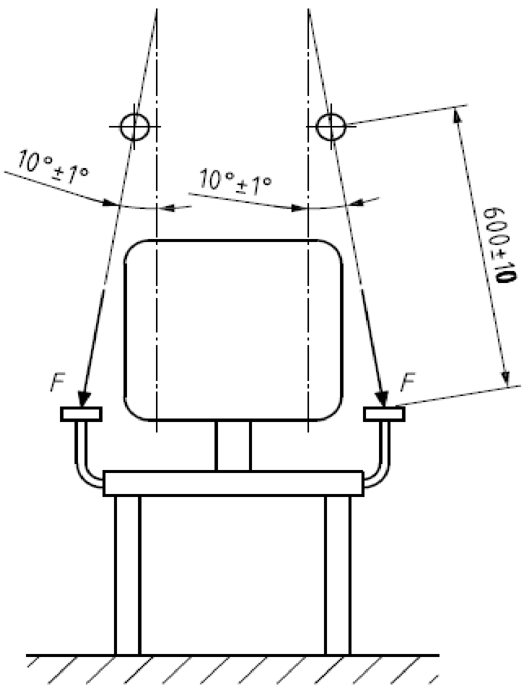

Figure1.3: Two forces focus on arm of plastic chair

1.5 Methodology and Project Plan work:

CATIA program will be used to design and build machine. PLC program will be used to control the machine and then getting the required results.

1.6 Time schedule for the project:

Table (1.1): The first semester time table:

Objective	Week #															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Project Selection																
Information Gathering																
Writing Introduction																
Design machine (CATIA)																
Writing Ch2 & Ch3																
Presentation																

Table (1.2): The second semester time table:

Objective	Week #															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Select component																
Connection component & Building machine																
PLC programing																
Making Tests																
Get result																
Presentation																

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Chapter Two

Plastic material

2.1 Plastic material definition.

2.2 Type of plastic material.

2.3 Properties of plastic materials.

2.4 Chair plastic.

2.1 Plastic material definition:

Plastic is the general common term for a wide range of synthetic or semi-synthetic materials used in a huge, and growing, range of application from packaging to building; from cars to medical devise, toys, clothes etc. [4].

The term "plastic" is derived from the Greek word "plastics" meaning fit for molding, and "plasters" meaning molded. It refers to the material's malleability or Plastic during manufacture that allows it to be cast, pressed, or extruded into a variety of shapes – such as films, fibers, plates, tubes, bottles, boxes, and much more [5].

There are two broad categories of plastic materials: thermoplastics and thermosetting plastic. Thermoplastics can be heated up to form products and then if these end products are re-heated, the plastic will soften and melt again. In contrast, thermoset plastics can be melted and formed, but once they take shape after they have solidified, they stay solid and, unlike thermoplastics cannot be remelted [4].

2.2 Type of plastic material:

Everywhere you look you will find plastics. We use plastics products to help make our lives cleaner, easier, safer and more enjoyable. You will plastics in the clothes we wear, the houses we live in, and the cares we travel in. The toys we play with, the television we watch, the computers we use and the CDs we listen to contain plastics. Even the toothbrush you use every day contains plastics!

Plastics are organic, the same as wood, paper or wool. The raw materials for plastics production are natural products such as cellulose, coal, natural gas, salt and, of course, crude oil. Plastics are today's and tomorrow's materials of choice because they make it possible to balance modern day need with environmental concerns.
The family is quite diverse, and includes: ABS/SAN, Epoxy resins, Expandable Polystyrene, Fluor polymers, PET, Polystyrene, PVC, PVDC, Styrenic polymers, and Unsaturated Polyester Resins (UPR) [6].

All these types of plastics can be grouped into two main polymer families: Thermoplastics, which soften on heating and then harden again on cooling, and Thermosets which never soften when they have been molded [7].

Examples of Thermoplastics:

1) Acrylonitrile butadiene styrene – ABS
2) Polycarbonate – PC
3) Polyethylene - PE
4) Polyethylene terephthalate – PET
5) Poly(vinyl chloride) – PVC
6) Poly(methyl methacrylate) – PMMA
7) Polypropylene – PP
8) Polystyrene – PS
9) Expanded Polystyrene – EPS

Examples of Thermosets:

1) Epoxide (EP)
2) Phenol-formaldehyde (PF)
3) Polyurethane (PUR)
4) Polytetrafluoroethylene (PTFE)
5) Unsaturated polyester resins (UP)

A range of additives are used to enhance the natural properties of the different types of plastics to soften them, color them, make them more process able or longer lasting, today not only are there many different types of plastic, but products can be made rigid or flexible, opaque, transparent, or coloured; insulating and conducting, fire-resistant etc., through the use of additives [9].

2.3 Properties of plastic materials

Plastics have numerous properties that make them superior to other materials in many applications. Plastics generally have [8, 9]:

1) Strength:

The plastics are sufficiently strong and can be used for load bearing structural members. The strength of plastics can further be increased by reinforcing them with various fibrous materials.

2) Weather resistant:

The plastics, prepared from phenolic resins, are only good in resisting weather effects. Certain plastics are seriously affected by ultraviolet light.

3) Fire resistance:

Plastics, being organic in nature, are combustible. But the resistance to fire temperature depends upon the plastic structure.

4) Durability:

Plastics generally possess sufficient durability, provided they offer sufficient surface hardness. Thermoplastic varieties are found to be attacked by termites and rodents.

5) Chemical resistance:

Plastics offer great resistance to moisture, chemicals and solvents. Many plastics are found to possess excellent corrosion resistance. Plastics are used to convey chemicals.

6) Thermal resistance:

The plastics have low thermal conductivity and therefore foamed or expanded varieties of plastics are used as thermal insulators.

7) Ductility:

Plastics, generally, have low ductility and hence plastic structural members may fail without prior warning.

2.4 Chair plastic:

In general, plastic chairs are made of Polypropylene (PP), Calcium carbonate and to color pigments.

1- **Polypropylene (PP):** is a linear hydrocarbon polymer, expressed as CnH2n. PP, like polyethylene (see HDPE, L/LLDPE) and polybutene (PB), is a polyolefin or saturated polymer. Polypropylene is one of those most versatile polymers available with applications, both as a plastic and as a fiber, in virtually all of the plastics end-use markets
The properties of Polypropylene include...

- Semi-rigid
- Translucent
- Good chemical resistance
- Tough
- Good fatigue resistance
- Integral hinge property
- Good heat resistance

PP does not present stress-cracking problems and offers excellent electrical and chemical resistance at higher temperatures. While the properties of PP are similar to those of Polyethylene, there are specific differences. These include a lower density, higher softening point (PP doesn't melt below 160oC, Polyethylene, a more common plastic, will anneal at around 100oC) and higher rigidity and hardness. Additives are applied to all commercially produce polypropylene resins to protect the polymer during processing and to enhance end-use performance.

Industrial applications:

PP is used to manufacture a range of Sheet, Pipe, Compounding and Returnable Transport Packaging (RTP). With the exception of RTP where Injection Molding is used, extrusion dominates the conversion process used for these products. Some PP is utilized by the construction sector, most notable domestic drainage pipes and plastic chairs. [10]

2- Calcium carbonate: In plastics processing, in addition to synthetic resin raw material as a basis, the scientifically correct, the rational use of various additives and auxiliaries are justifiable and that of inorganic mineral powder is one of the most important additives. As you know, the plastic material in inorganic mineral powder may help reduce raw material costs, improve performance and given the important role of the new features in recent years has further found that the use of inorganic mineral powder material to reduce the white pollution, protection environment environmental effect, the implementation of circular economy in today's stress, building resources and energy saving and environment-friendly trend of our society, the more prominent inorganic mineral powders in the significance of the application of plastic.

Not all plastic materials and products in the inorganic mineral powders to be added, nor are added the same amount of plastic used in the statistics of inorganic mineral powder quantity of material, usually plastic materials and products according to the total output of 10 % of that at present world's plastics processing industry, the inorganic powder material used in each of at least 400 million tons. Calcium carbonate (including GCC and light calcium) is the most widely used, the largest amount of inorganic mineral powders, used in the total amount of inorganic mineral powder materials, accounting for more than 70% calcium carbonate, not only because of carbonate Calcium-rich, low cost, good stability of calcium carbonate, pure color, low wear, easy to dry, easy processing, non-toxic and many other advantages are also widely used in a large number of important reasons.

Throughout the history of the plastics industry uses calcium carbonate can be considered since the sixties of last century since the start of plastic industry, the application of calcium carbonate has always accompanied the development of plastic processing industry development.

Application of Calcium Carbonate in Plastics initially thought due to calcium carbonate in the rubber materials and products in the application of experience, which is why the use of light calcium earlier than GCC, and has been extended to today's sake. To the mid-nineties of the last century, there leap TSP processing, fine particle size of 10μm below the market for GCC, GCC and light calcium and have a range of different thickness of the third stage TSP simultaneously. To the beginning of this century, industrialization of nanometer calcium carbonate, calcium carbonate in plastics for the application of a new world opened up. [11]

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Chapter Three

Mechanical design

3.1 Overview

3.2 Component and their functions

3.3 Mechanical Components

3.4 Design of connection

3.5 Analysis of machine

3.6 Machine safety

3.7 Pneumatic system

3.8 Specify forces and Calculations

3.1 Overview:

Building the machine started a year ago, but stopped due to $ROYAL^{®}$ Industrial Trading Company, time constraints and the vagueness of the implementation

Two designs for the machine have been built; the first was to test the seat and the back, and the second to test the two arms:
Two pistons were used to create a reliable seat and back test, as shown in **Figure 2.1**.

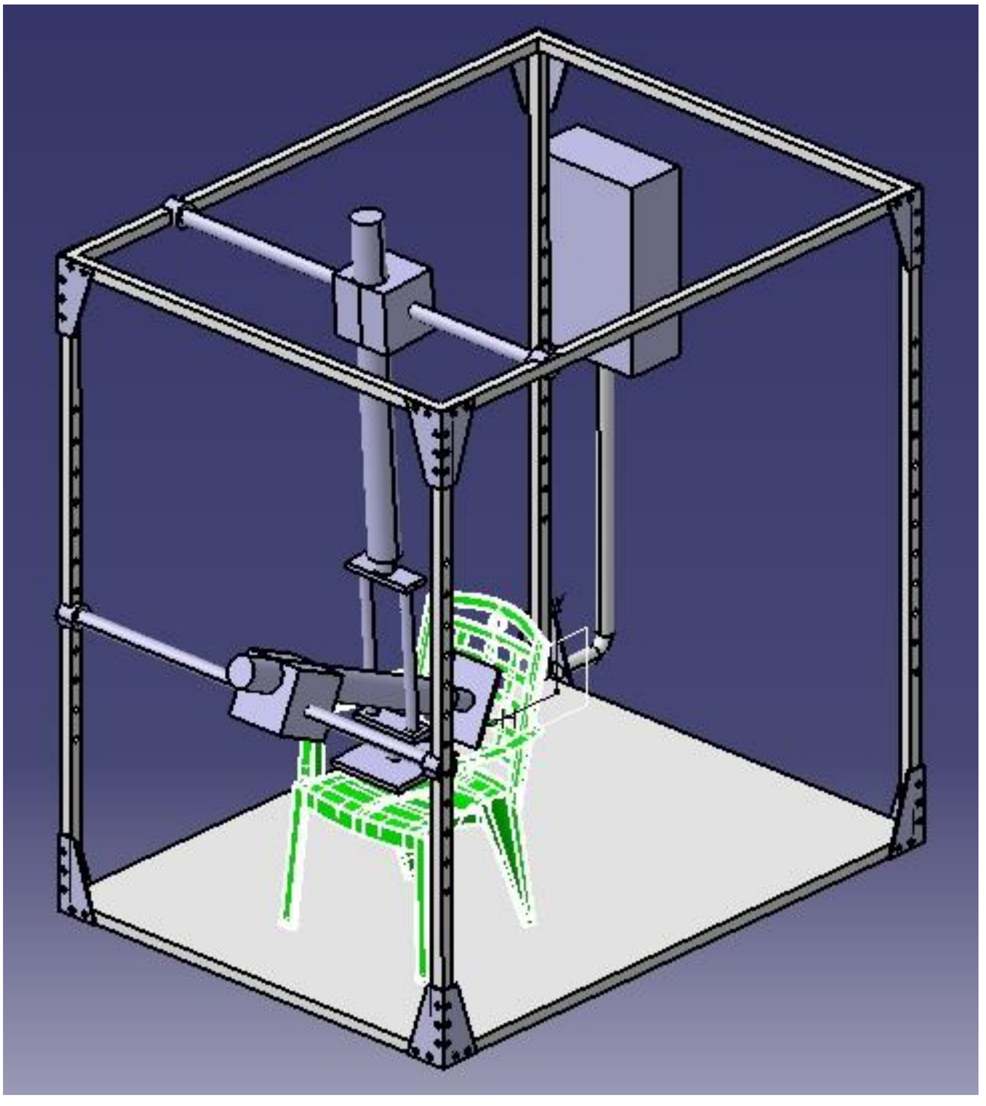


Figure 3.1: Overview design 1

One piston was used to test set-up machine to create a kind of reliability with user as shown in **Figure 3.2**

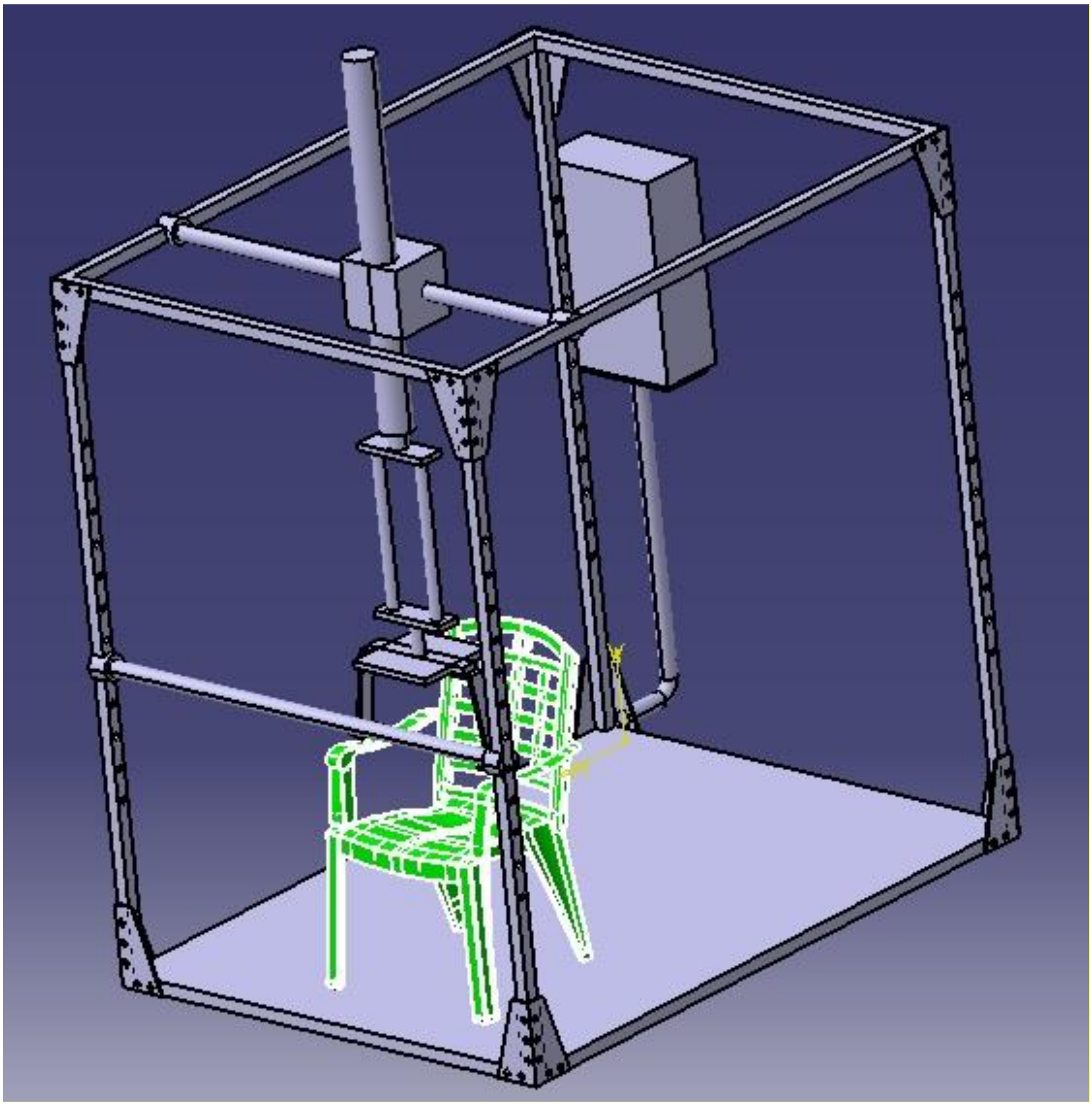


Figure 3.2: Overview design 2

Specification of Machine:

1) This Set-up is used to all plastic chairs; the design suits all types plastic chairs.
2) Easy to use.
3) Easy to develop machine in future.
4) Easy to switch between arm test and seat back test.

3.2 Components and their functions:

Many components have been used:

1) Frist piston: Make pressure on seat in plastic chair or make pressure on arms.
2) Second piston: Make pressure on back in plastic chair.
3) In control panel :
    a) PLC: to make control of machine.
    b) Screen : to show No. of loop , force in each pistons (the user can select it) , select type of test , start and stop test
    c) Emergency switch: stop machine
4) Laser sensors: machine safety.
5) Two load cells: to make sure the weight reaches the input weight (make feedback on machine).

These are explained in chapter 3.

3.3 Mechanical Components:

The machine is divided into four parts connected to each other to cover all process needed; these parts are:

1) Frame.
2) Cylinders.
3) Pistons.
4) Pillars.

In $ROYAL^{®}$ Industrial Trading Company, a frame in dimension [200 , 150 , 200] cm has been made with a specific type of material of Galvanized Iron; the two pistons have been selected with pneumatic 4/3 way directional control valve. Cylinders have been made to fit the variable position with all types of plastic chairs and pillars to support the frame as shown in **Figure 2.3 .**

Figure 3.3: over view machine in $ROYAL^{®}$ Factory

Figure 3.3: shown: 1) piston one, 2) piston two, 3) pillar, 4) first cylinder and 5) second cylinder.

But the seat and back design is not complete yet. It needs to add bases to the pistons and the control panel and then design and complete it as shown in **Figure 3.4**, **Figure 3.5**, **Figure 3.6** and **Figure 3.7**

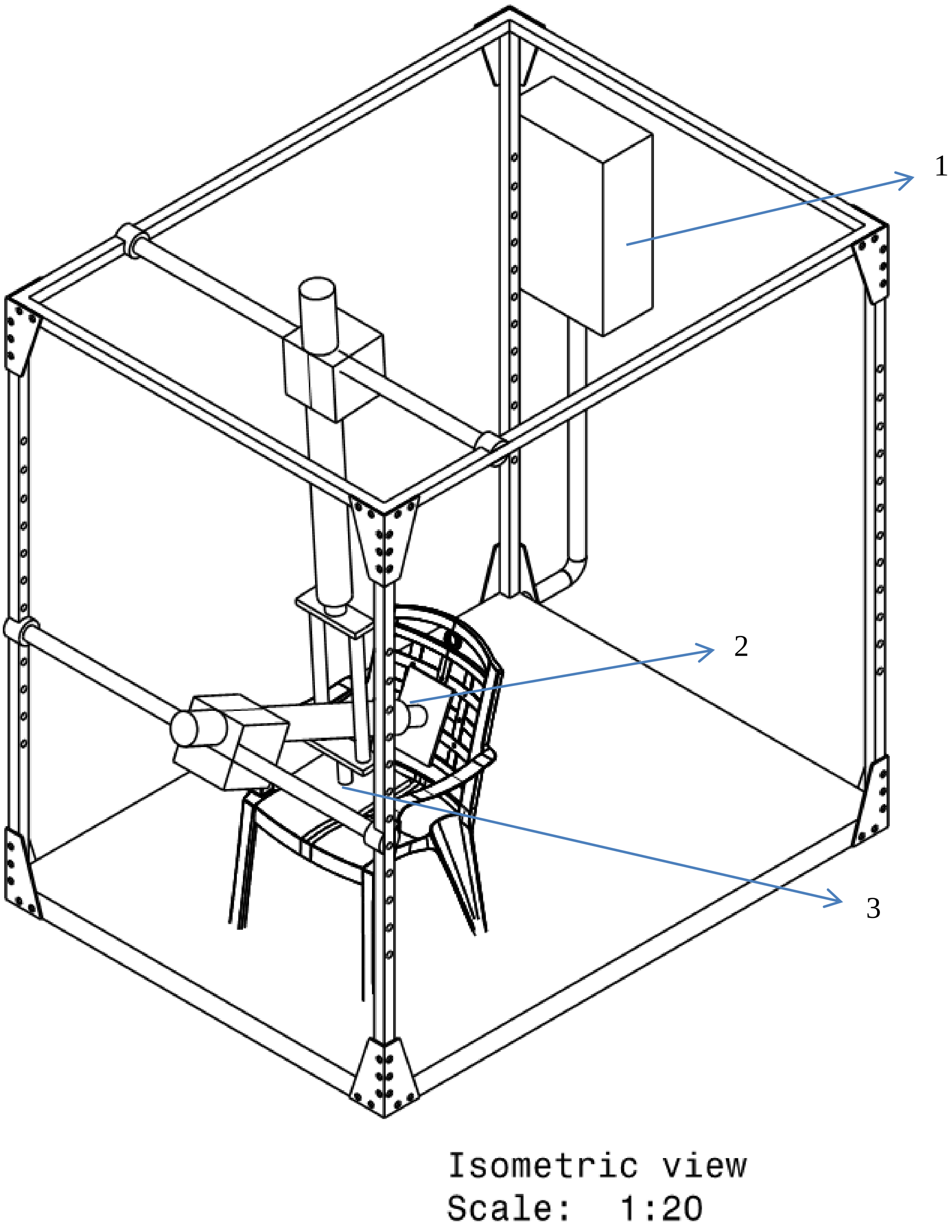


Figure 3.4: overview design1

Figure 2.4 shows: 1) control panel, 2) first base connect with first piston and 3) second base connect with second piston

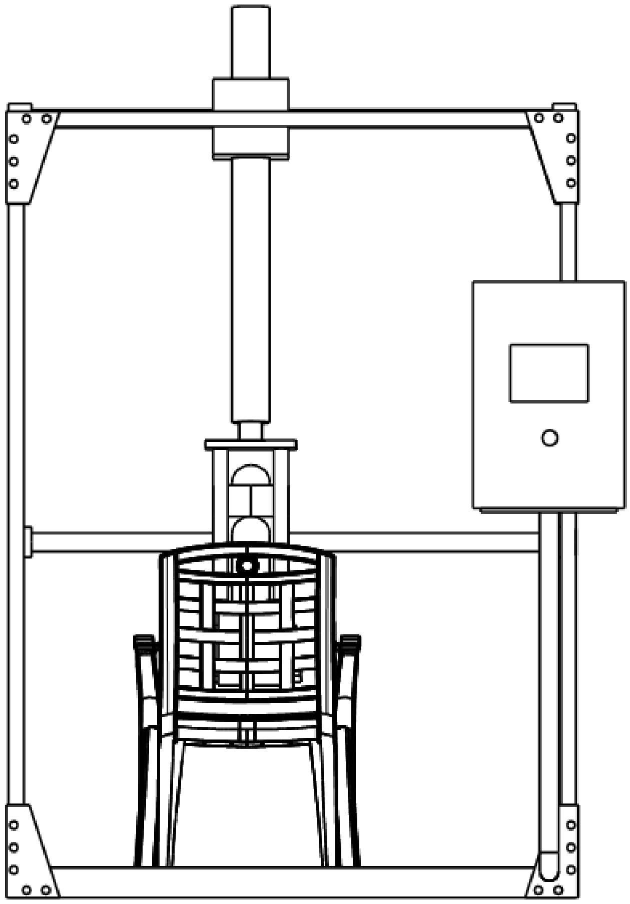


Figure 3.5: front view design1

Figure 3.5: shows front view of machine control panel, back view of plastic chair and first piston.

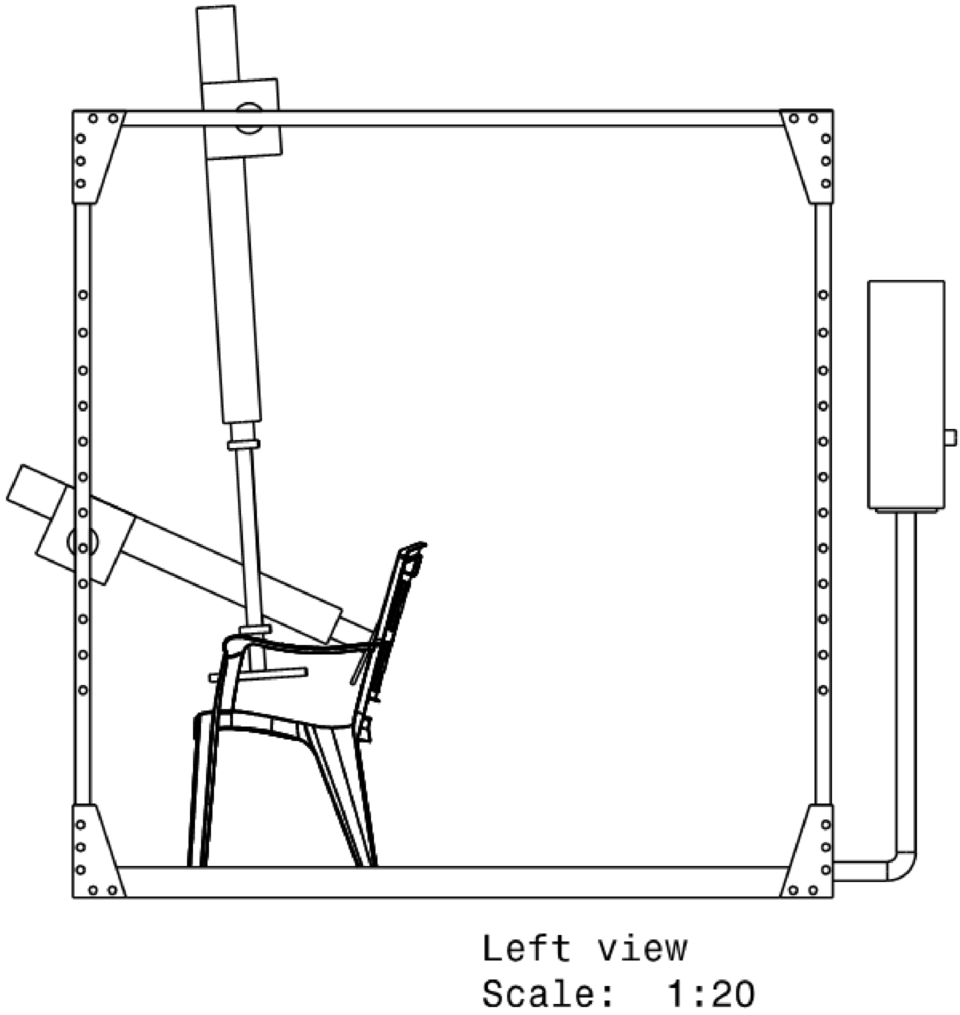


Figure 3.6: left view design1

Figure 3.6: shows left view of machine first piston, second piston and side view of plastic chair.

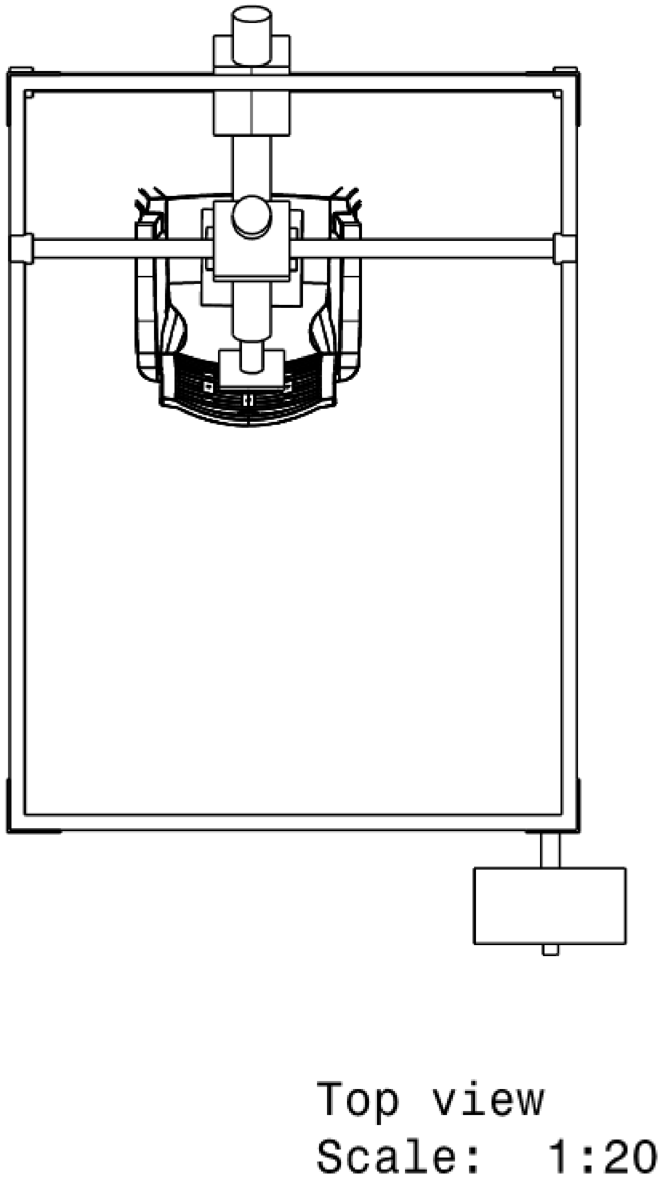


Figure 3.7: top view design1

Figure 3.7: shows top view of machine, first piston, second piston, control panel and plastic chair.

Addition on first design :

1) First piston:

The base is added to the design made by ecolon in dimension [25.5, 26.5, 2] cm to protect plastic chair from friction with steel and avoid reaction force with reliability physical contact between human and plastic chair as shown in **Figure 3.8**.

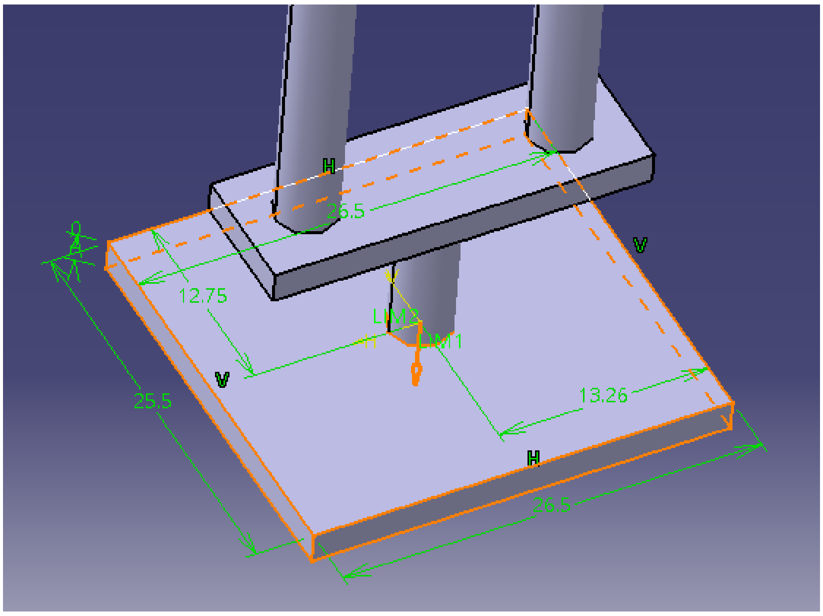


Figure 3.8: piston one with first base

The reason behind selecting the seat in dimension [25.5, 26.5, 2] cm is the location of reliability of physical contact between human (base of human) and plastic chair as shown **in Figure 3.9.**

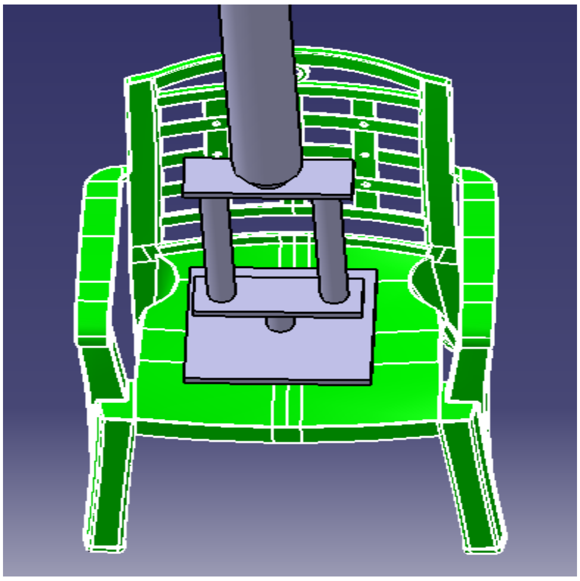


Figure 3.9: location of base

2) Second piston:

The base added to the design is made by ecolon in dimension [23.7, 17.3, 2] cm to protect plastic chair from friction with steel to avoid reaction force with reliability physical contact between human and plastic chair as shown **Figure 3.10**.

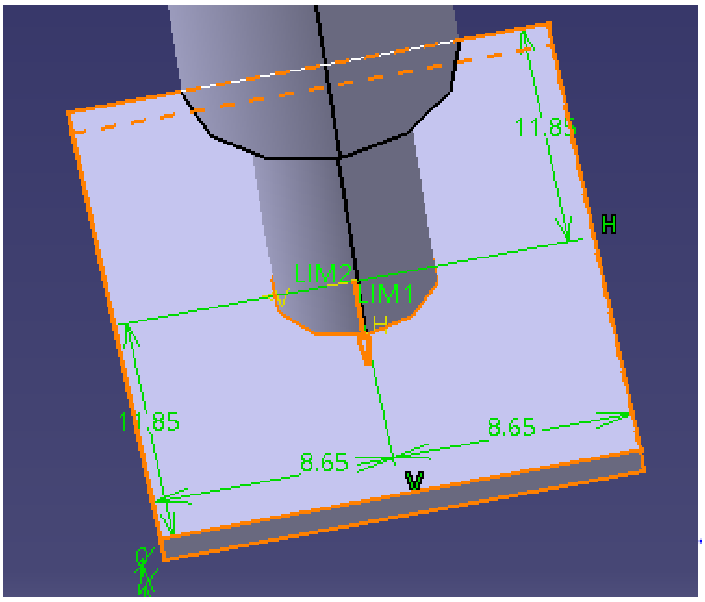


Figure 3.10: second piston

The reason behind selecting base in dimension [23.7, 17.3, 2] cm is the location of physical contact between human (Form the backbone) and plastic chair as shown in **Figure 3.11.**

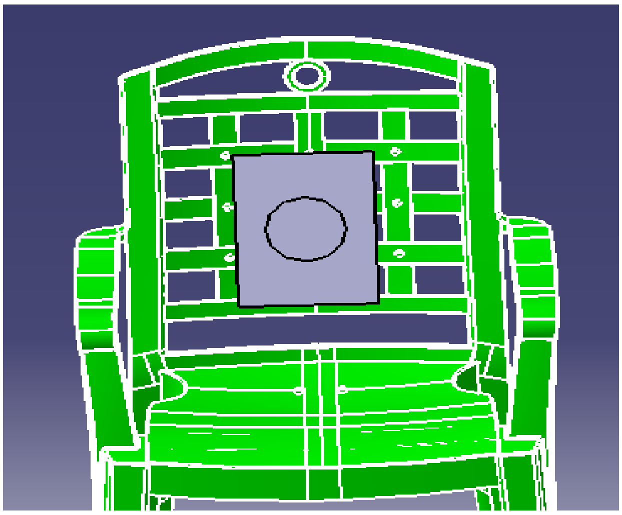


Figure 3.11: location of base

Second design was built by replacing the base of first piston with two arms as shown in **Figure 3.12**, **Figure 3.12**, **Figure 3.13** and **Figure 3.14**

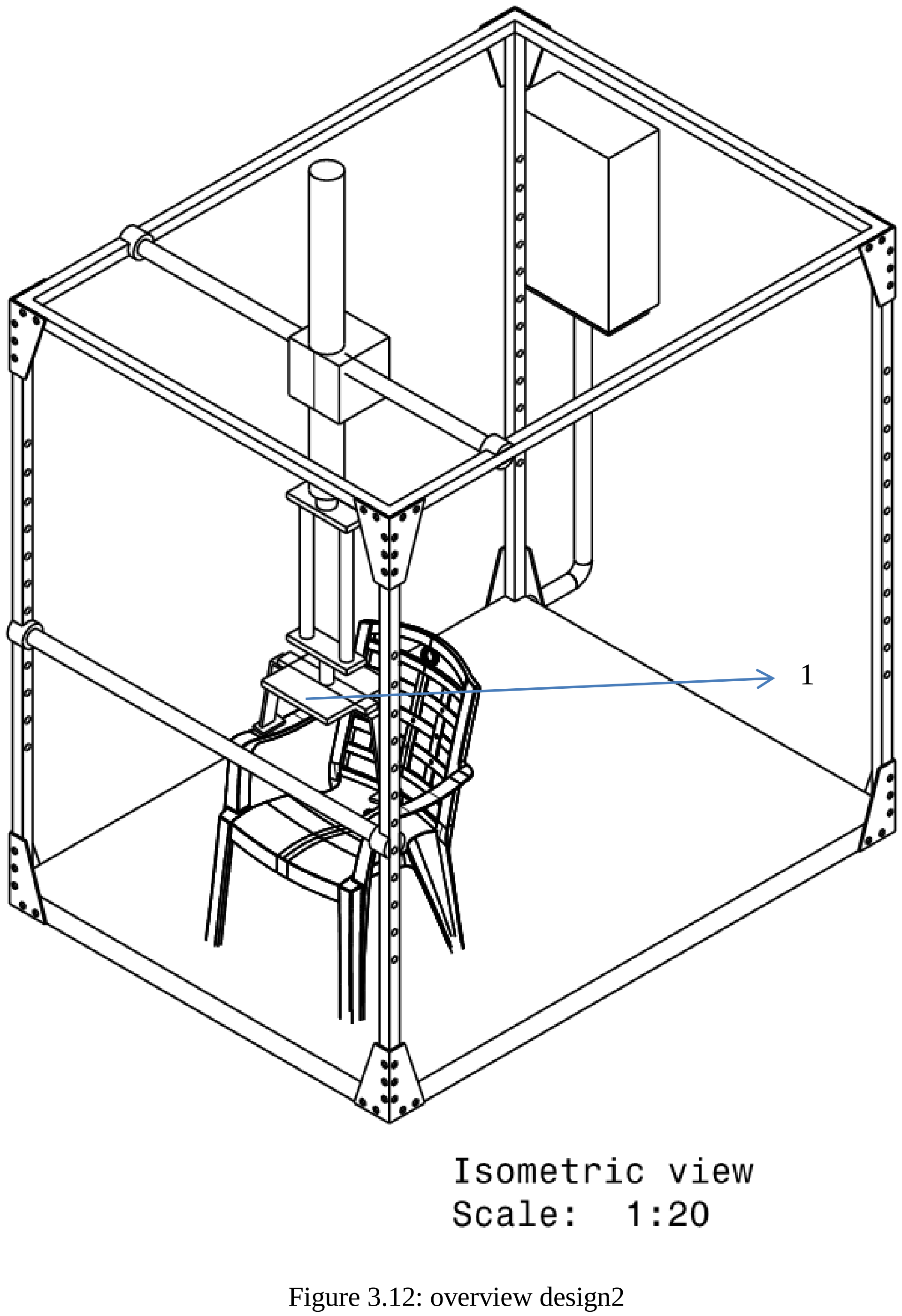


Figure 3.12: overview design2

Figure 3.12 shows: 1) two arms.

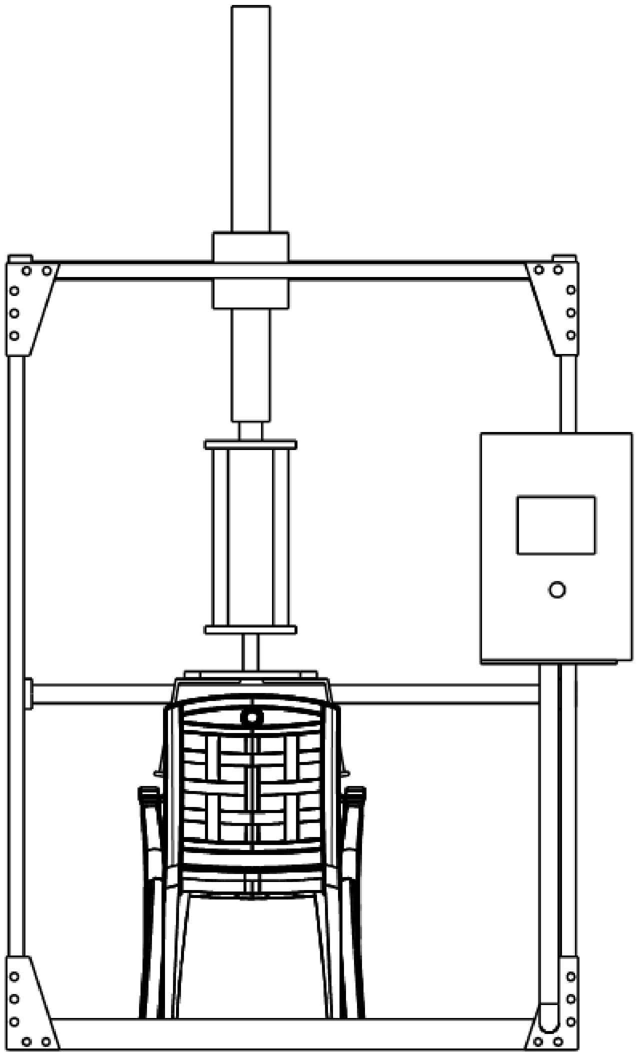


Figure 3.13: front view design2

Figure 3.13 shows the front view of machine control panel, back view of plastic chair and first piston.

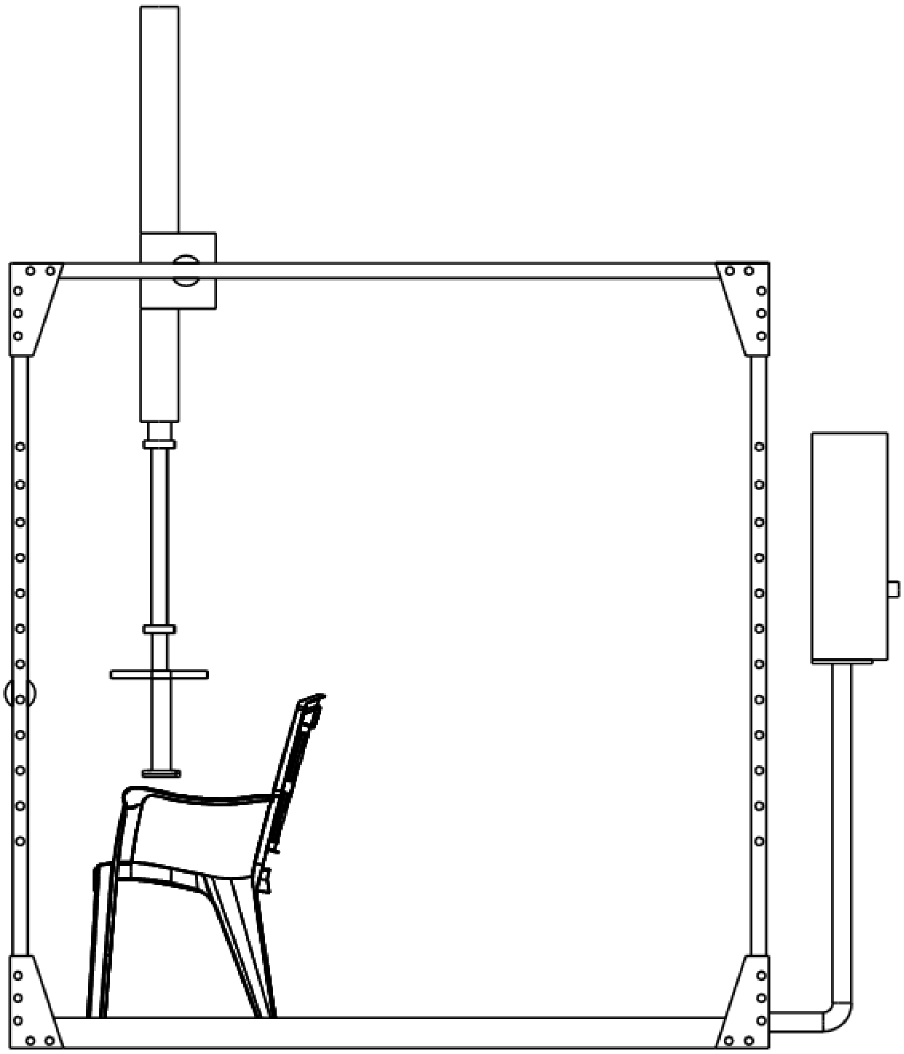


Figure 3.14: left view design2

Figure 3.14: shows left view of machine first piston, and side view of plastic chair.

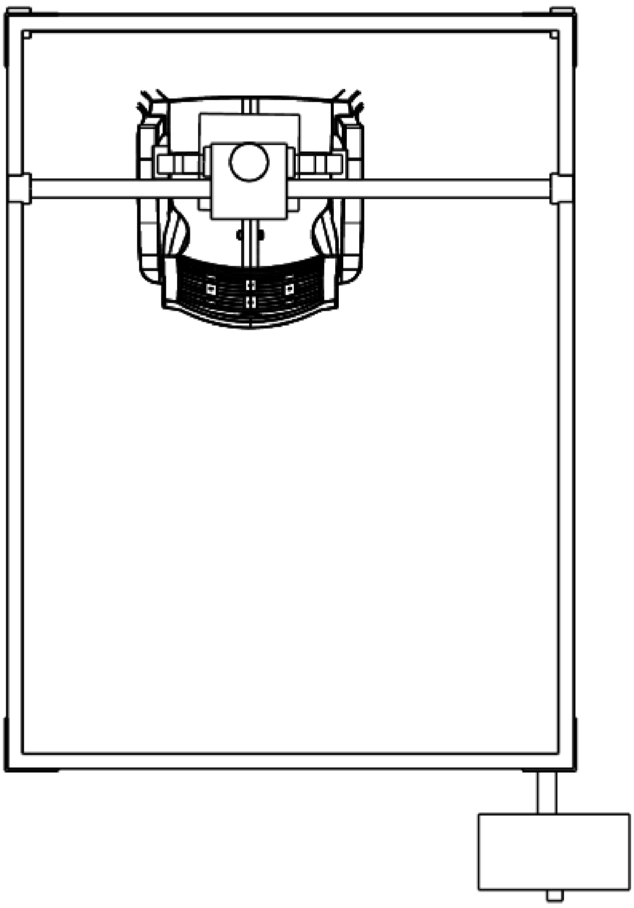


Figure 3.15: top view design2

Figure 3.15: shows top view of machine, first piston, second piston, control panel and plastic chair.

Additions to second design:

An arm was added to the first piston made by cast iron in dimension [25,17.14,5] with small Parallel Rectangle made by iclon to create a reliable physical contact between human and arm of plastic chair as shown in **Figure 3.16;** the 100 degree angle refers to European standard [4] as shown in **Figure 3.17.**

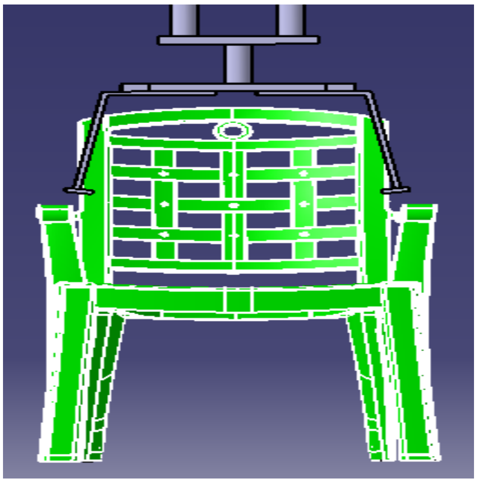


Figure 3.16: location of two arms

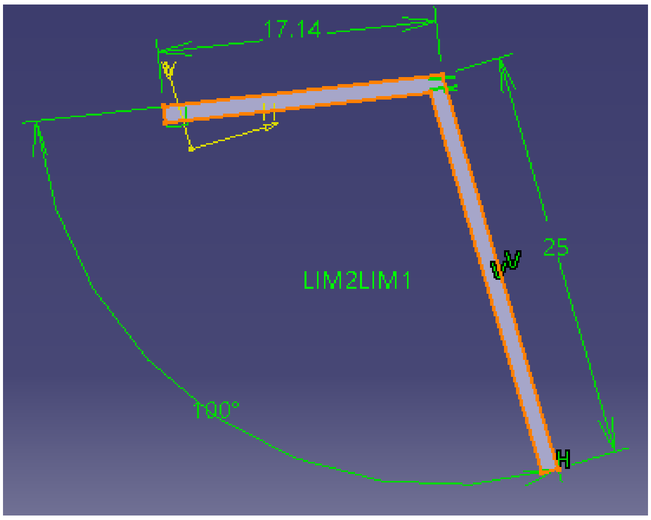


Figure 3.17: Angle & dimension of arm test

3) Control panel:

The control panel in dimensions [40 , 60 ,20] contains Two of Modules, Relays, Clemens, contactor and Magnetic Breakers inside it. The outside consists of a touch screen and emergency switch as shown in **Figure 3.18** and **Figure 3.19**

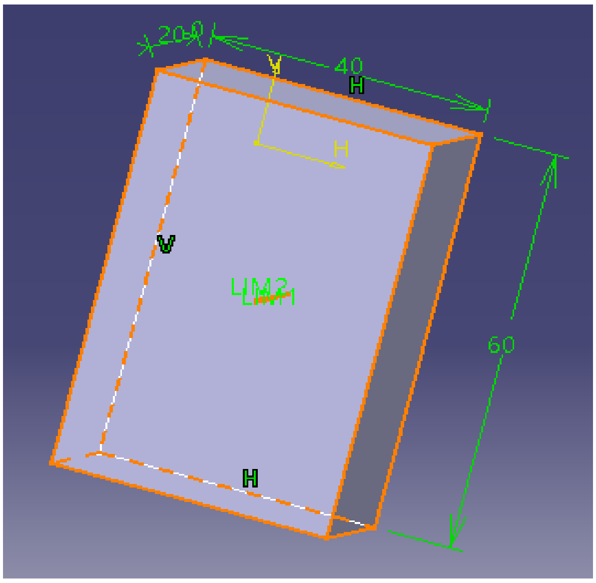


Figure 3.18: dimensions of control panel

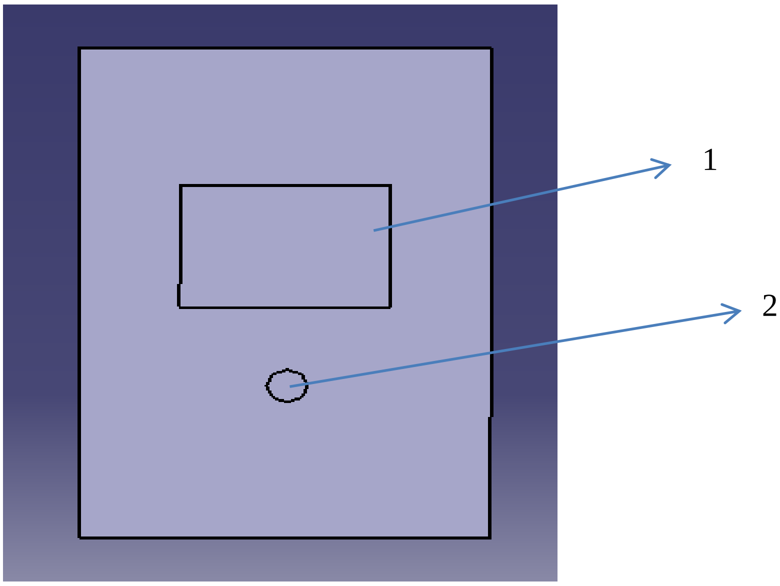


Figure 3.19: component of control panel

Figure 3.19 shows: 1) touch screen, 2) emergency

3.4 Design of connection:

In this section each part will be explained in details, the used material for most parts in this Machine is Galvanized Iron.

3.4.1 Frame:

Frame is important to carry another component; it made by Galvanized Iron as shown in **Figure 3.20.**

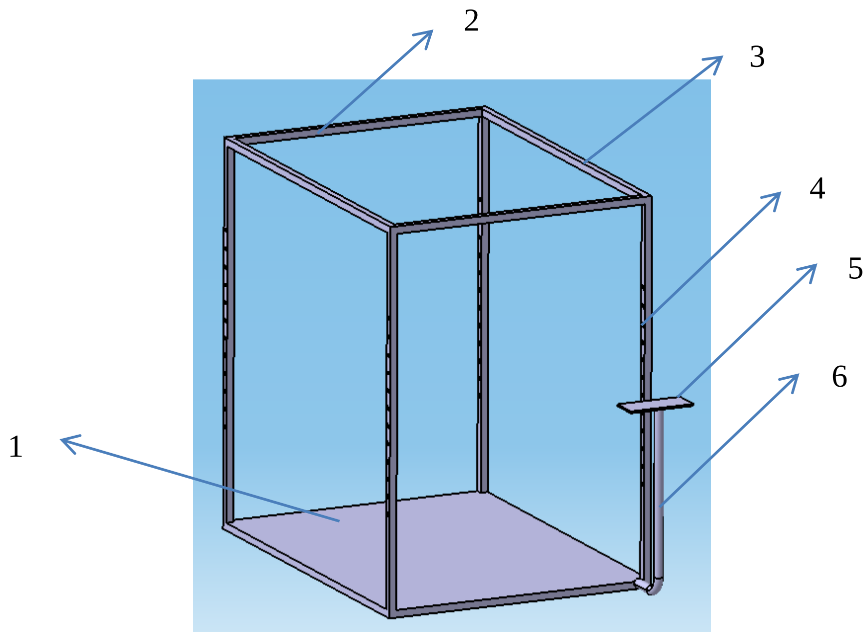


Figure 3.20: frame

Need find the volume of galvanized iron that used for make the frame, disassemble the frame into multi section or parts needed, the parts shown at **Figure 3.20**

V1=l*w*h Equation (3.1)
l: length
w: width
h: height
V1= 2 *1.5*0.04=0.12 m^3

V2=l*w*h Equation (3.1)
V2=2*0.04*0.04=0.0032 m^3

V3=l*w*h Equation (3.1)
V3=0.04*1.5*0.04=0.0024 m^3

V4=l*w*h Equation (3.1)
V4=0.04*0.04*2=0.0032 m^3

V5=l*w*h Equation (3.1)
V5= 0.16*0.01*0.36=0.000576 m^3

V6=π*r^2*h Equation (3.2)
r: radius
V6= π*0.025^2*1.1= 0.00216 m^3

To find the volume of galvanized iron that need to make the frame, should found the total volume of the upper parts:

V =V1+(2*V2)+(2*V3)+(4*V4)+V5+V6 ≈ 0.146 m^3 Equation (3.3)

The weight of frame:

M = V*ρ Equation (3.4)

V: total volume of frame

ρ: Density of Galvanized Iron

M= 0.146 *7850= 1146.1 Kg

3.4.2 Cylinders:

Cylinders are important to carry pistons; it made by Galvanized Iron as shown in **Figure 3.21.**

Figure 3.21: cylinders

The weight of each cylinder:

M = V*ρ Equation (3.4)

V= $\pi * r^2 *$h Equation (3.3)

V=π*0.025^2*1.5=0.003 m^3

M=0.003*7850=23.55Kg

3.4.3 Joints:

Joints are important to make connection between pistons and the machine; it made by Galvanized Iron as shown in **Figure 3.22.**

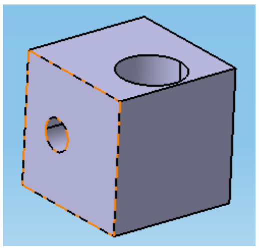


Figure 3.22: joint

Need find the volume of galvanized iron that used for make the joint, disassemble the pillars into multi section or parts needed, the parts shown at **Figure 3.23.**

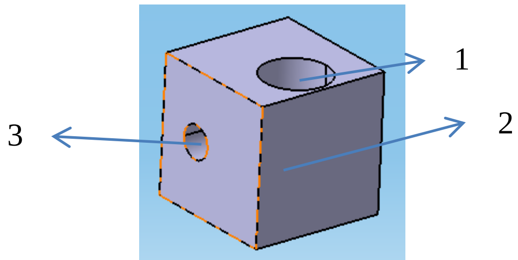


Figure 3.23: Parts of volumes in joint

V1= π*r^2*h Equation (3.3)
V1= π*0.05^2*0.2=0.00157 m^3

V2= π*r^2*h Equation (3.3)
V2= π*$.025^2$*0.2=0.000393 m^3

V3=l*w*h Equation (3.1)
V3=0.2*0.2*0.2=0.008 m^3

To find the volume of galvanized iron that need to make the joint, should found the total volume of the upper parts:

V=V3-V2-V1=0.006 m^3 Equation (3.5)

The weight of joint:

M = V*ρ Equation (3.4)
M=0.006*7850=47.1 Kg

3.5 Analysis of machine:

The analysis is dividing for two types, stress analysis and displacement analysis, this analysis was making by simulation in CATIA program.

Result of analysis for seat & back test machine in **Figure 3.24** and **Figure 3.25.**

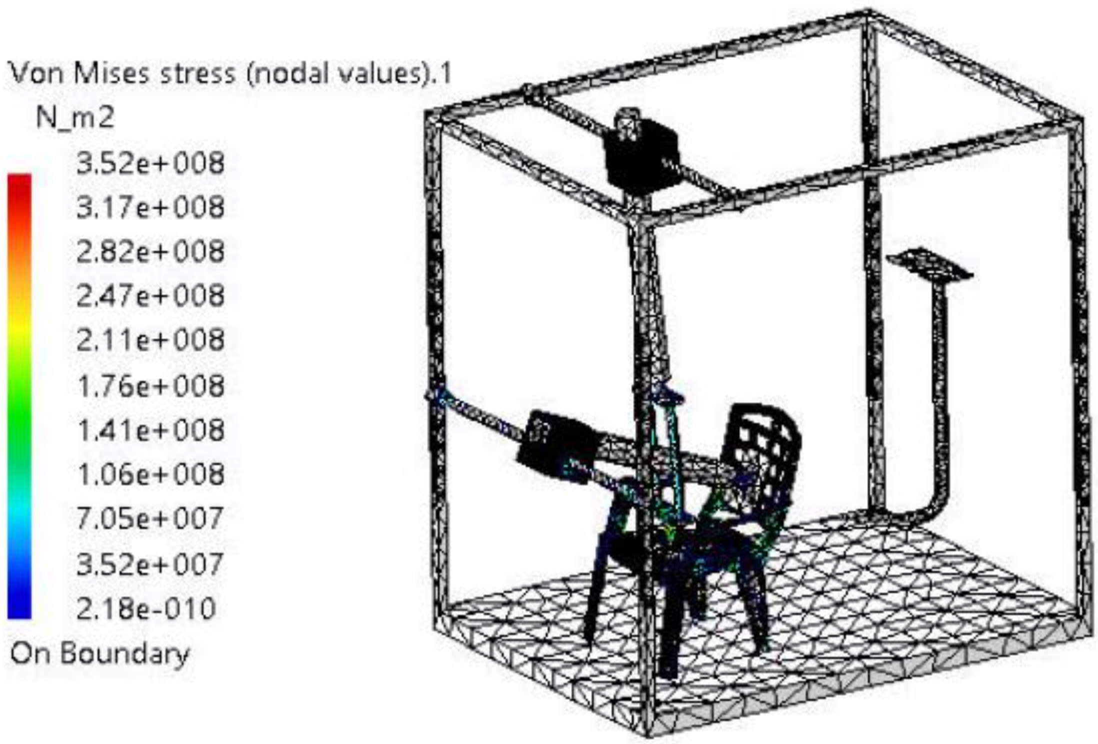


Figure 3.24: Stress analysis

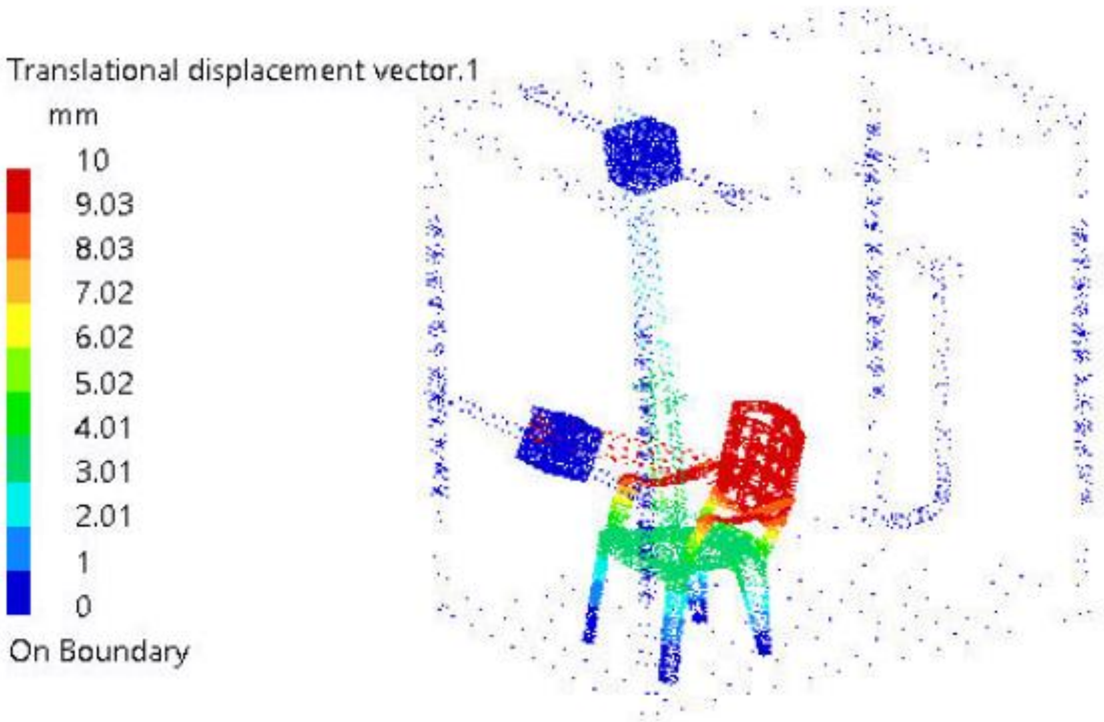


Figure 3.25: Displacement analysis

3.6 Machine Safety

Safety system is important to reduce accident in work , it's comes some of benefits Extensive : Extensive diagnostic information to help pinpoint problems, multiple operating modes with each mode optimized for adjustments, repairs or maintenance, run part of a machine or line while other areas are available for repairs or maintenance, fewer wiring problems by reducing the number and lengths of wires, condition information for predictive maintenance, fewer moving parts and less maintenance than electromechanical safety systems, easily reprogrammed to accommodate production changes and needs and often less expensive,

In this machine Safety system appear of using Three Laser sensors to avoid working machine when person went inside machine and emergency switch to stop machine in danger.

3.7 Pneumatic System:

Pneumatics has long since played an important role as a technology in the performance of mechanical work. It is also used in the development of automation solutions. In the majority of applications compressed air is used for one or more of the following functions:

1) To determine the status of processors (sensors).
2) Information processing (processors).
3) Switching of actuators by means of final control elements.

The pneumatic cylinder has a significant role as a linear drive unit, due to its :
relatively low cost, ease of installation, simple and robust construction and ready availability in various sizes and stroke lengths.

The pneumatic cylinder has the following general characteristics:

1) Diameters 2.5 to 320 mm.
2) Stroke lengths 1 to 2000 mm.
3) Available forces 2 to 45000 N at 6 bar .
4) Piston speed 0.1 to 1.5 m/s .

Selection criteria for the working section:

Force, Stroke, Type of motion (linear, rotating), Speed, Service life ,Safety and reliability, Energy costs, Controllability and Storage.

The following factors must be taken into account in the development of pneumatic control systems:

Reliability, Ease of maintenance, Cost of spare parts, Assembly and connection, Maintenance and repair cost, Interchangeability and adaptability, Compact design, Economic efficiency and Documentation.

The pipe diameter of the air distribution system should be selected in such a way that the pressure loss from the pressurized reservoir to the consuming device ideally does not exceed approx. 10 kPa (0.1 bar).

The selection of the pipe diameter is governed by:

1) Flow rate.
2) Line length.
3) Permissible pressure loss.
4) Operating pressure.
5) Number of flow control points in the line.

The double-acting cylinder is a cylinder in which the working fluid acts alternately on both sides of the piston. In order to connect the piston in a double-acting cylinder to an external mechanism, such as a crank shaft, a hole must be provided in one end of the cylinder for the piston rod and this is fitted with a gland or 'stuffing box' to prevent escape of the working fluid. Double-acting cylinders are common in steam engines but unusual in other engine types. Many hydraulic and pneumatic cylinders use them where it is needed to produce a force in both directions.

The double-acting hydraulic cylinder has a port at each end, supplied with hydraulic fluid for both the retraction and extension of the piston.

The double-acting cylinder is used where an external force is not available to retract the piston or where high force is required in both directions of travel.

Control circuit for the double-acting cylinder The piston rod of a double-acting cylinder is to advance when a push button is operated and to return to the initial position when the push button is released.
The double-acting cylinder can carry out work in both directions of motion, due to the full air supply pressure being available for extension and retraction, the signal is generated or reset on the valve, if a push-button actuator is pressed or released as shown in **Figure 3.26.**

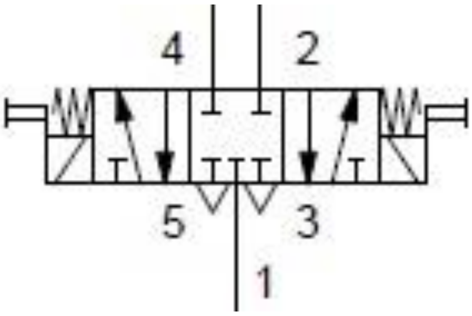


Figure 3.26: 5/3-way directional control valve controls the double-acting cylinder

5/3-way directional control valve: push button for operation, spring for return force, Supply air source connected to the 5/3-way valve, Air connections between valve and cylinder. [12]

3.8 Specify Forces and Calculations:

Seat and back test forces have been specified from European standard [3] as shown in **table 3.1;** in our case, the angle is less than 55 degree to horizontal.

Table 3.1 European standard forces for seat & back

Angle of back rest inclination Ø	Seat force F_1 (N)	Back force F_2 (N)
Back rest set to an angle 70° or more to the horizontal	Specified force	Specified force
Back rest set to an angle of less than 70°, but not less than 55° to the horizontal	Specified force x Sin (Ø)	((Ø/60°) – 0,1666) Specified force x Cos Ø
Back rest set to an angle of less than 55° to the horizontal	0,75 x Specified force	0,75 x Specified force x Cos Ø

Calculations force and pressure for (seat & back) and (arm):

These calculations refer to the average weight of people in word (M=80 kg)

1- Force of seat test:

F1 = 0.75*F Equation (3.1)
F1: The seat force (N)
F: specified force (N)

But our system dealing with weight
F= M*g Equation (3.2)
M: weight effect (Kg)
g: Gravity acceleration (m/s^2) specify by using European standard [3]; g=10 m/s^2

Then; F1 = 0.75*F=0.75*M*g=0.75*80*10=600 N

2- Force of back test:

F2 =0.75* F*cos Ø Equation (3.3)
F2: the back force (N)
Ø: the angle between direction of effect force and horizontal plane

Then; F2 =0.75* f*cos Ø = 0.75*M*A*cos Ø =0.75*80*10*cos 55̊ = 344N

3- Pressure seat & back test:

$P1 = \frac{F1}{A}$ Equations (3.4)

P1: pressure of seat's piston (N/m^2)

F1: force (A user can change it) (N)

A: area of seat's piston cylinder (m^2)

$P2 = \frac{F2}{A}$ Equations (3.5)

P2: pressure of back's piston (N/m^2)

F2: force (A user can change it) (N)

A: area of back's piston cylinder (m^2)

$A = (2\pi\ r * h) + 2\pi r^2$ Equations (3.6)

r: Radius of the cylinder base (m).

h: High cylinder (m).

Then;

$A = (2* \pi * 0.035*0.85) + (2* \pi * 0.035*0.035) = 0.186 + 0.007693= 0.1936\ m^2$

$P1 = \frac{F1}{A} = \frac{600}{0.1936} = 3099.17$ Pa

$P2 = \frac{F2}{A} = \frac{344}{0.1936} = 1776.85$ Pa

4- Force of arm:

Static load of arm as shown in **figure 3.27.**

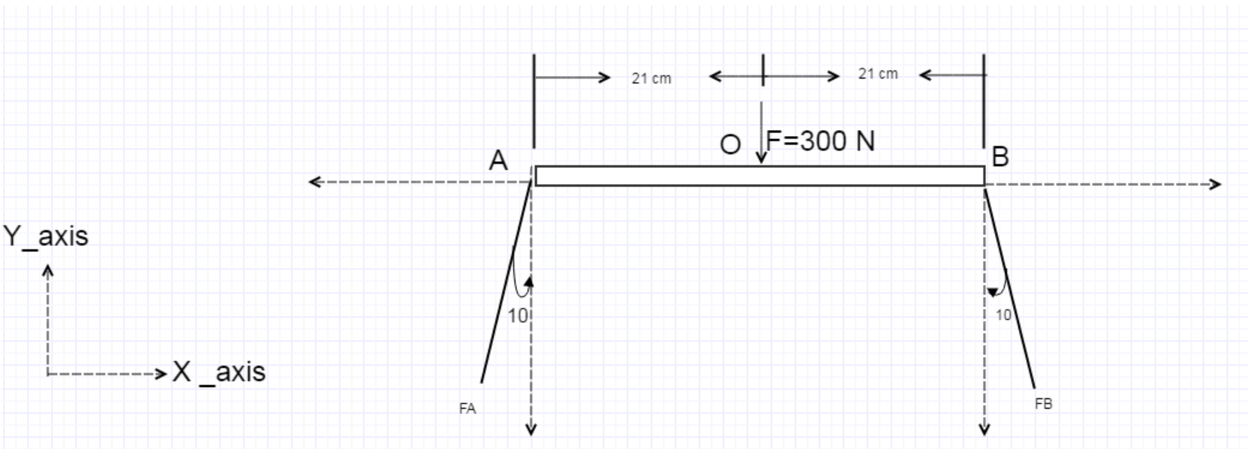


Figure 3.27:static load of arm

Static analysis force of arm is shown in **figure 2.28.**

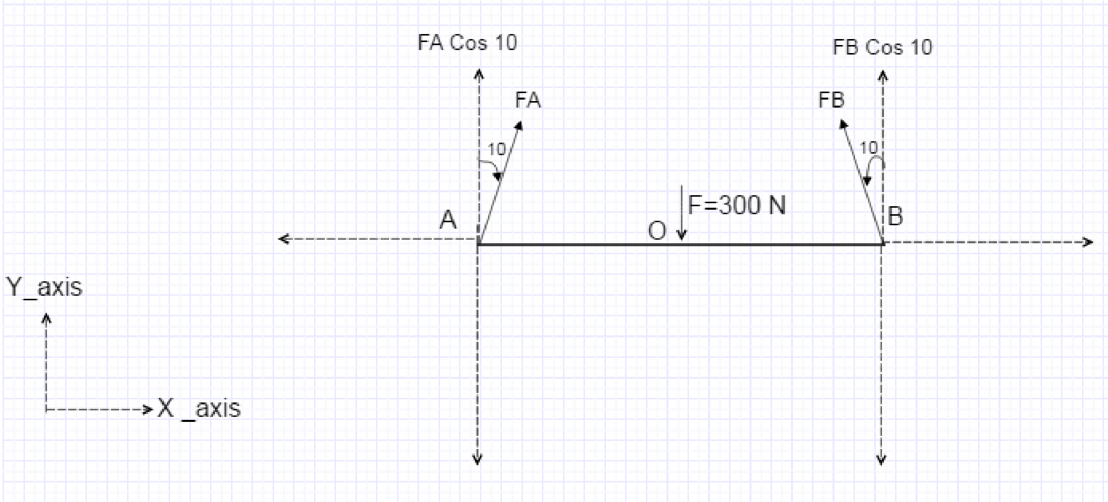


Figure 2.28: static analysis force of arm

FO: arm force (N).
FO = 300N.

Σ MA =0 Equations (3.7)
FB* $cos10 * (42 * 10^{-2}) -$ FO*(21*10^{-2}) =0
FB* $0.98 * (42 * 10^{-2}) -$ 300*(21*10^{-2}) =0
FB = 153.06 N

Σ MB =0 Equations (3.8)
-FA* $cos10 * (42 * 10^{-2}) +$ FO*(21*10^{-2}) =0
-FA* $0.98 * (42 * 10^{-2}) +$ 300*(21*10^{-2}) =0
FA= 153.06 N

Σ FY=0 Equations (3.9)

(FA *cos10) + (FB*cos10) –FO = 0 ; FO = 300 N
FA =FB = 153.06 N
Return to Equations (5.7) and Compensation its:
2*FA*cos10 = 300 N
FA *cos10=150 N
FB *cos10=150 N

5- Pressure arm test:

P3 = $\frac{FO}{A}$ Equations (3.10)

P3: pressure of arm’s piston (N/m^2)

FO: force (A user can change it) (N)

A: area of seat’s piston cylinder (m^2)

A = (2π r * h) + $2\pi r^2$ Equations (3.11)

r : Radius of the cylinder base (m).
h : High cylinder (m).

Then; A = (2* π * 0.035*0.85) + (2* π * 0.035*0.035) = 0.186 + 0.007693= 0.1936 m^2

P3= $\frac{300}{0.1936}$=1549.58 Pa

4

Chapter Four

Electrical Design and Protection

4.1 Introduction:

This chapter contain the electrical component specifications (Load Cell, Sensors), Pneumatic Control System, Control Panel and Protection.

4.2 Load Cell:

A load cell is a transducer used to produce an electrical signal whose magnitude is proportional to the measured force. Types of load cells include hydraulic load cells, pneumatic load cells and strain gauge load cells.

Two strain gauge load cells type S have been used as shown in the **figure 4.1**, to make control with two pistons; the piston creates force on plastic chair, and the load cell works as a feedback to make sure the weight has been reached.

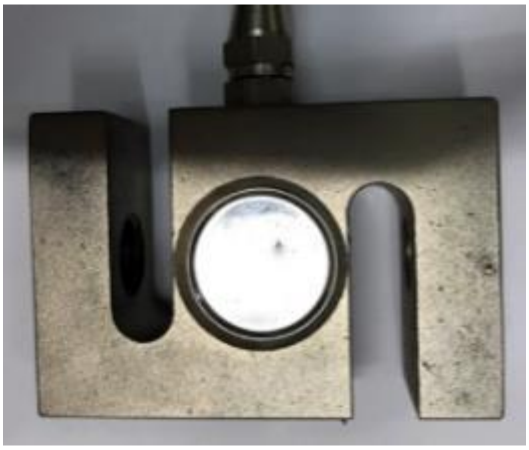


Figure 4.1: Strain gauge load cell

4.3 Laser Sensors:

Laser sensor is an electrical system used to get signal from laser sender-receiver as shown in **figure 4.2**. In case the laser is cut, a reflector gets signal (x=1) else (x=0). Three laser sensor-sender receivers have been used to create machine safety; if anything cuts laser, the machine stops.

Figure 4.2: Laser sensor

4.4 Emergency:

The emergence switch is used to stop the machine immediately when something wrong happened with the machine as shown in the **figure 4.3**.

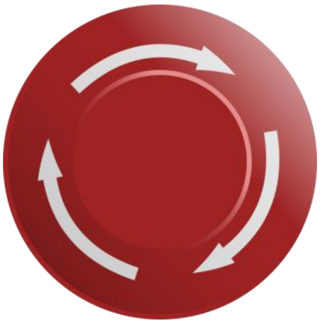


Figure 4.3: Emergence switch

4.5 Control panel:

Control panel is a cabinet which contains electrical components to control two pistons as shown in the **figure 4.4**.

Figure 4.4: Control panel

Control panel contains PLC, Two of Modules, Relays, Clemens, contactor and Magnetic Breakers as shown in **figure 4.5**.

Figure 4.5: Contains of control panel

A Caddy Basic program used control panel planning building as shown in **Figure 4.6**, **Figure 4.7**, **Figure 4.8** and **Figure 4.9.**

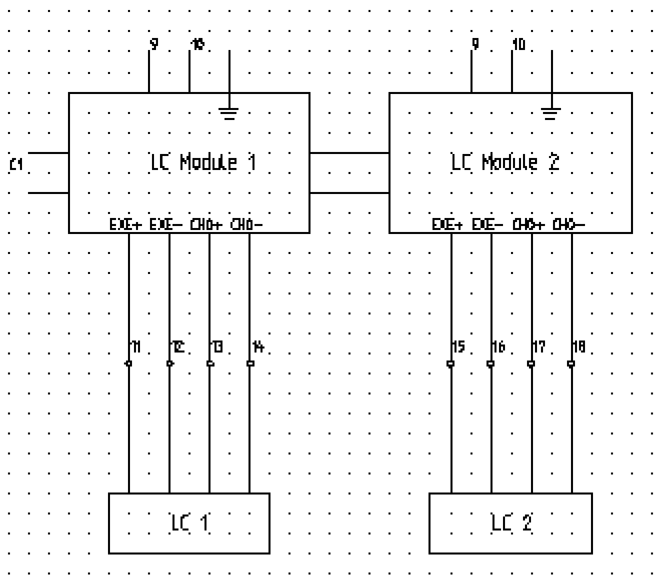


Figure 4.6: Load cell connection

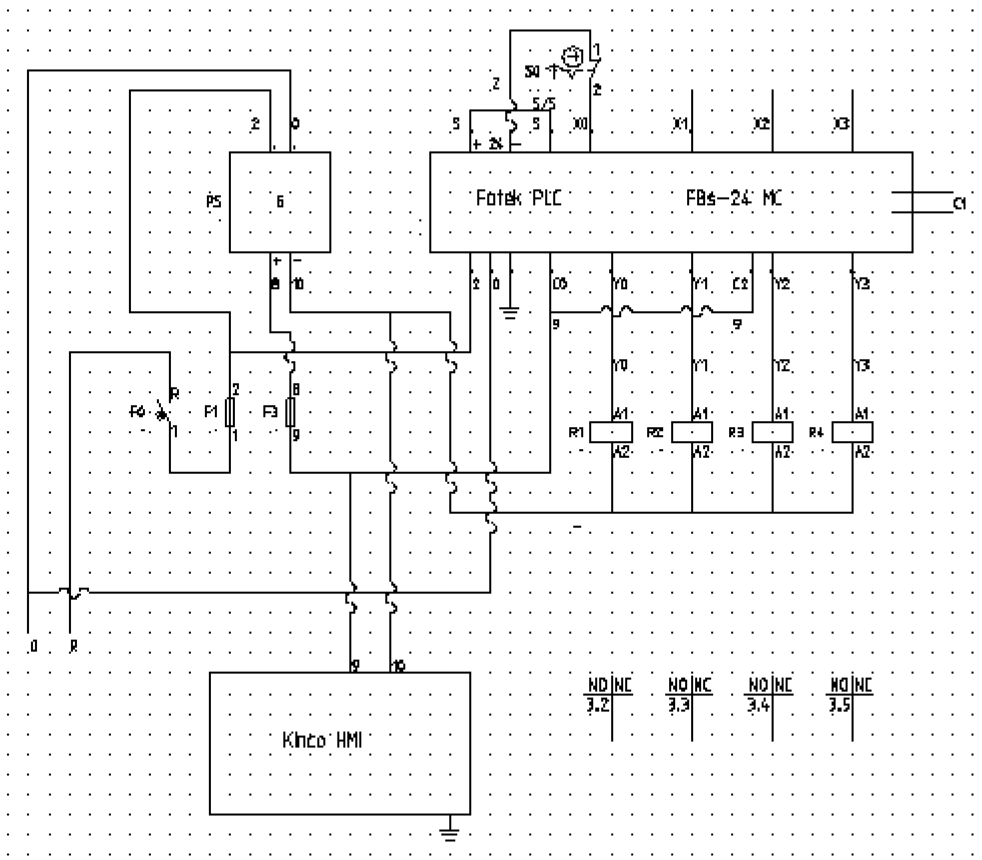


Figure 4.7: PLC, Relays, Power supply and HMI connection

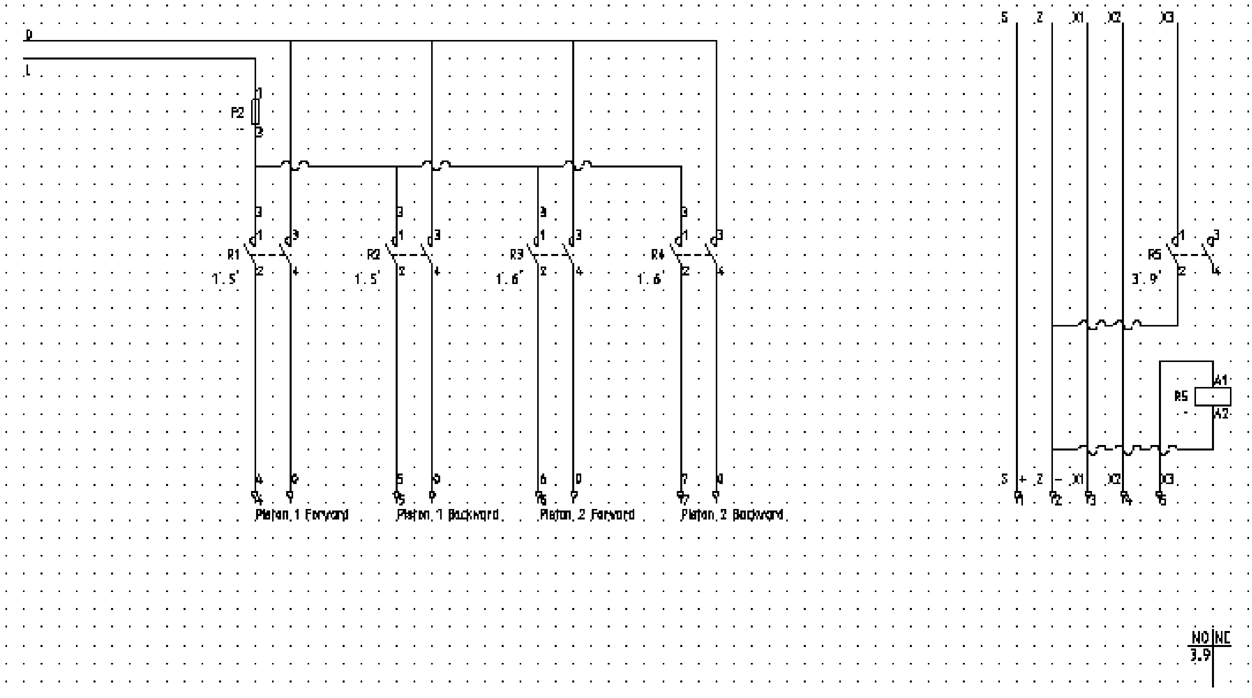


Figure 4.8: Clemens and contactor connection

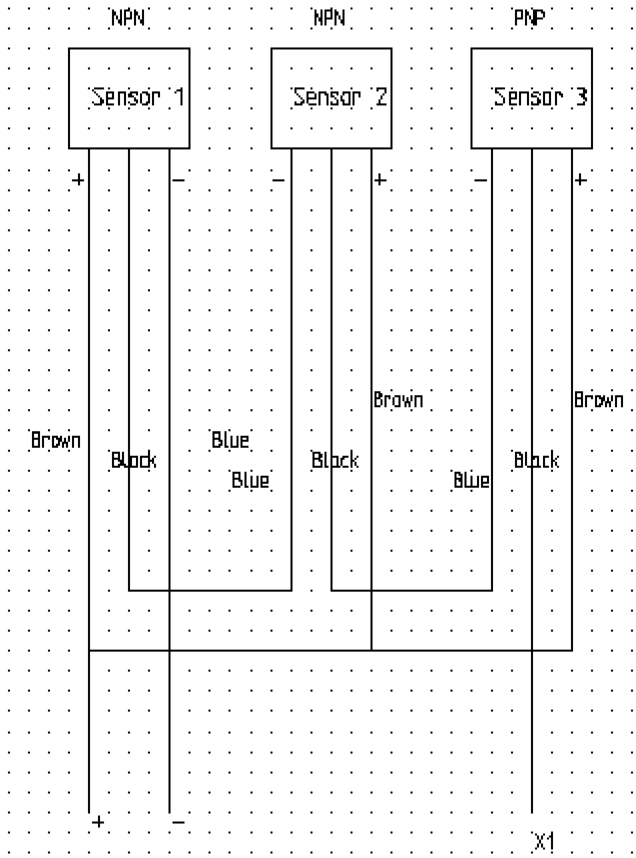


Figure 4.9: Sensors connection

4.6 Pneumatic system:

Pneumatic system contains air service unit, two valves 5/3 and throttle valve to control two pistons as shown in **figure 4.10**.

Figure 4.10: Pneumatic system

A Festo Fluidsim program used pneumatic system planning building as shown in **Figure 4.11**

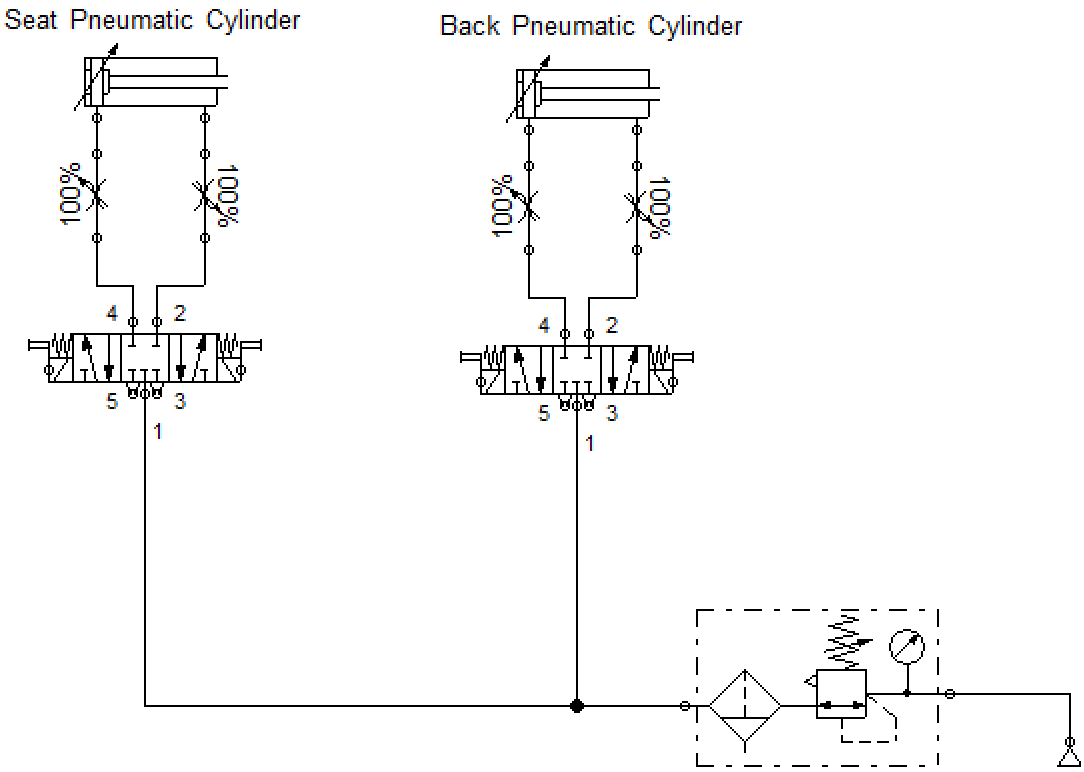


Figure 4.11: Pneumatic system connection

5

Chapter Five

PLC program & Touch screen

5.1 Introduction:

This machine is fully automated and the process is performed sequentially. This can be performed by using PLC to make control motion piston 1, 2 and screen. This automation capability and safety precautions are possible, which are explained in this section.

The PLC is chosen to be used rather than the microcontroller in view of its ability to operate with the voltage used at workshop (220v) without the need of other components where the microcontroller can operate only with 5v and needs other components with a high cost. A comparison between PLC and microcontroller has been made as shown in the **table (5.1)**.

Table 5.1: PLC VS Microcontroller

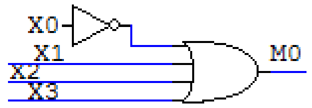
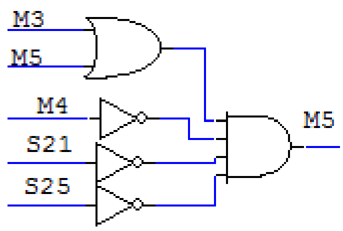
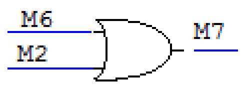
	PLC	Microcontroller
Less Initial Cost		✓
Ease In Programming	✓	
Work At 220V	✓	
Build In Modules	✓	
Faster Response		✓
Less Total Cost	✓	

5.2 PLC Characteristic:

PLC is a digital computer used for automation of electromechanical process, such as control of machinery on factory assembly lines, PLCs are used in many industries and machine. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery backed up or non-volatile memory.

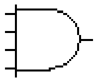
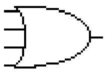
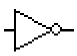
A PLC is an example of a hard real time system since output results must be produced in response to input conditions within a limited time otherwise unintended operation will result. In our controlling design it is desirable to use a PLC with 9 inputs and 4 outputs mention in the **table 5.2**, it must be compatible to use with 220 volt, **table 5.3** shown the meaning of gate.

Table 5.2: logic allocation input/output

Symbol In PLC	Name Input/output	Note
M1924	Initial Start	Start the program "Reserved address in PLC"
X0	Emergency Switch (NC)	X0=0; Stop Machine
X1	Laser Sensor (NO)	X1=1 ; Stop Machine
X2	Laser Sensor (NO)	X2=1 ; Stop Machine
X3	Laser Sensor (NO)	X3=1 ; Stop Machine
M0	Stop Machine Address in PLC""	
M1	Start Seat and Back Test	Push button in the Screen
M2	Stop Seat and Back Test	Push button in the Screen
M3	Start Manual	Push button in the Screen
M4	Stop Manual	Push button in the Screen
M5	Address in PLC""Start manual	
M6	Stop Arm Test	Push button in the Screen
M7	Rest machine Address in PLC""	
M8	Start Arm Test	Push button in the Screen
M9	Output Counter C254	M9=R100 ; RST C254
M10	Rest Counter C254	Push button in the screen
M11	Rest Counter C255	Push button in the screen
M12	Output Counter C255	M12=R102 ;RST C255
M100	Address in PLC	M100=1 ; SET T0
M101	Output Timer T0	M101=1 ; RST M100
M102	Address in PLC	M101=1 ; SET T1
M103	Output Timer T1	M103=1 RST M102
M106	Address in PLC	M106=1 ; SET S_22

M109	Address in PLC	M109=1 ; SET T100
M110	Output Timer T100	SET S_23
M112	Address in PLC	M112=1 ; SET T101
M113	Output Timer T101	SET S_24
M115	Address in PLC	M115=1 ; SET T102
M116	Output Timer T102	SET S_21
M202	Address in PLC	M202=1 ; SET T103
M203	Output Timer T103	SET S_26
M205	Address in PLC	M205=1 ; SET T104
M206	Output Timer T104	SET S_25
M300	Address in PLC	SET Y1
M301	Address in PLC	SETY0
M302	Address in PLC	SET Y3
M303	Address in PLC	SET Y2
R0	The real value read by Load cell "seat test"	
R2	The real value read by Load cell "back test"	
R17	The value of the seat force that is inserted from the screen	
R18	The value of the back force that is inserted from the screen	
R19	The value of the arm force that is inserted from the screen	
R100	The value of the number that is inserted from the screen "in C254"	
R102	The value of the number that is inserted from the screen "in C255"	
Y0	Piston Seat Out	Piston Seat Out = 1 ; piston touch base of chair
Y1	Piston Seat In	Piston Seat In = 1 ; piston return from base of chair
Y2	Piston Back Out	Piston Back Out = 1 ; piston touch back of chair
Y3	Piston Back In	Piston Back In = 1 ; piston return from back of chair
CMD	Comparator	

Table 5.3: meaning of gates

Symobl	Means
+	OR
.	AND
/	NOT
	AND
	OR
	NOT

The used PLC is Fatek FBS-24 MC Series as shown in **figure 5.1**, with 14 inputs and 10 outputs, with two modules.

Figure 4.1: Fatek PLC Series with two Modules

The software for the Fatek FBS Series is the program Win Pro ladder as shown in **figure 5.2**.

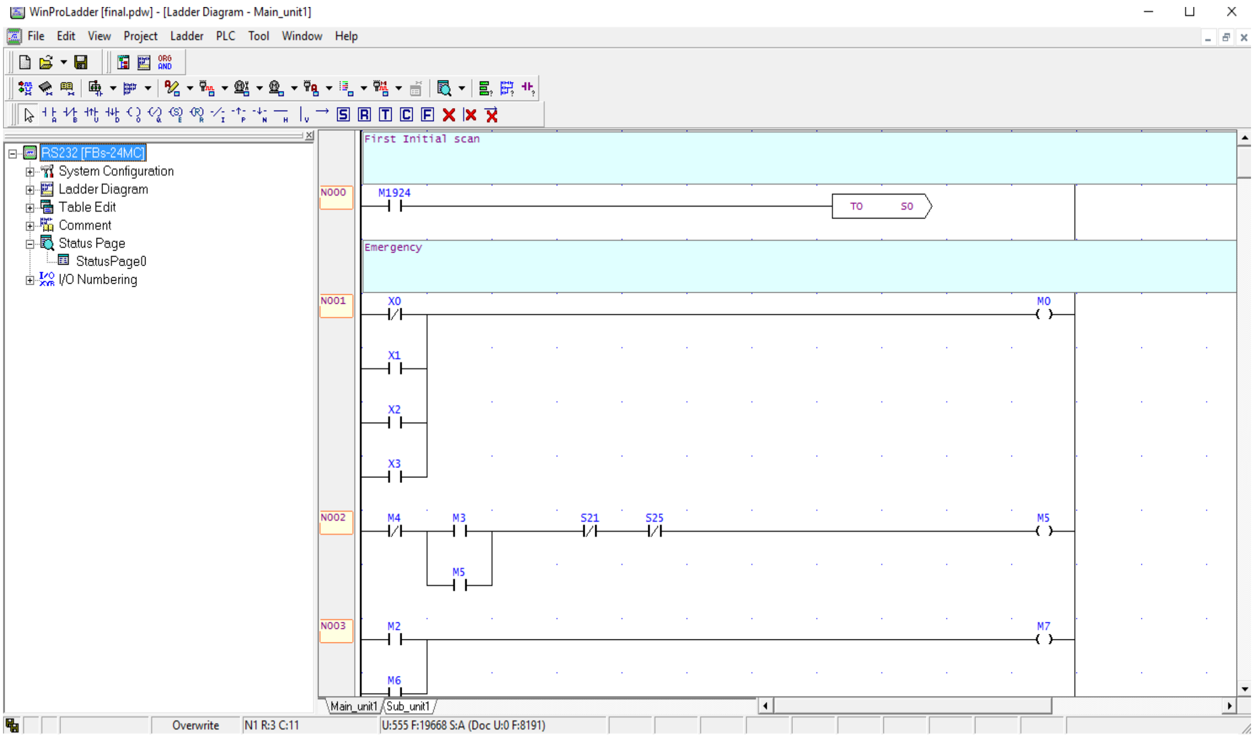


Figure 5.2: WinProladder Program

5.3 PLC Chart:

At first, it should be clear to us that the plastic chair is in the right position before starting the machine, selecting the type of test, and detecting the force. When selecting the seat & back test, press on start. The first piston goes down vertically to the base of plastic chair. A few seconds later, the second piston goes on horizontally by angle 45 to make proportionality with chap surface of backbones (user can change the angle). When the first piston touches the base, the counter increases one. A few seconds later, the second piston goes back and then the first piston goes back again; this cycle repeated to reach No. of the input cycles. After the arm test is selected, press on start. The first piston goes down vertically to the arms of plastic chair. A few seconds later, the first piston goes up and the counter increases one; this cycle repeated to reach No. of input cycles. The plastic chair can be monitored by a micro scope on incision on the weak point. When pressing on switch off, the machine stops as shown in **figure 5.3, figure 5.4, figure 5.5, figure 5.6, figure 5.7, figure 5.8, figure 5.9 and figure 5.10**.

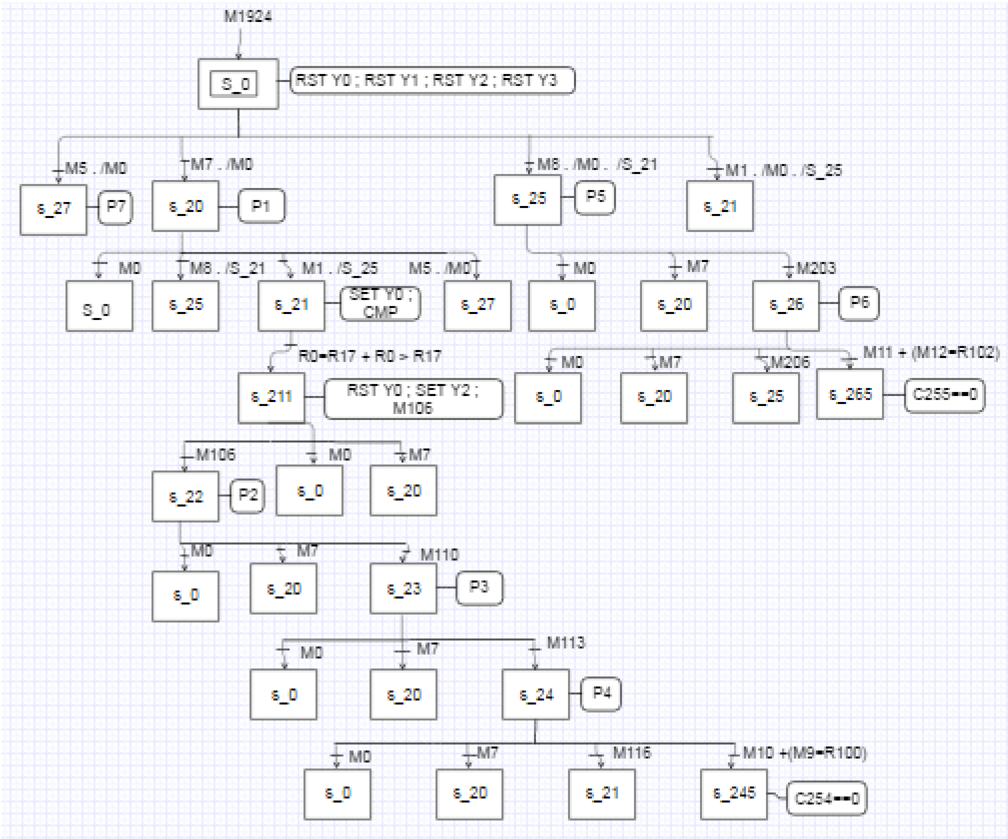


Figure 5.3: PLC Chart A

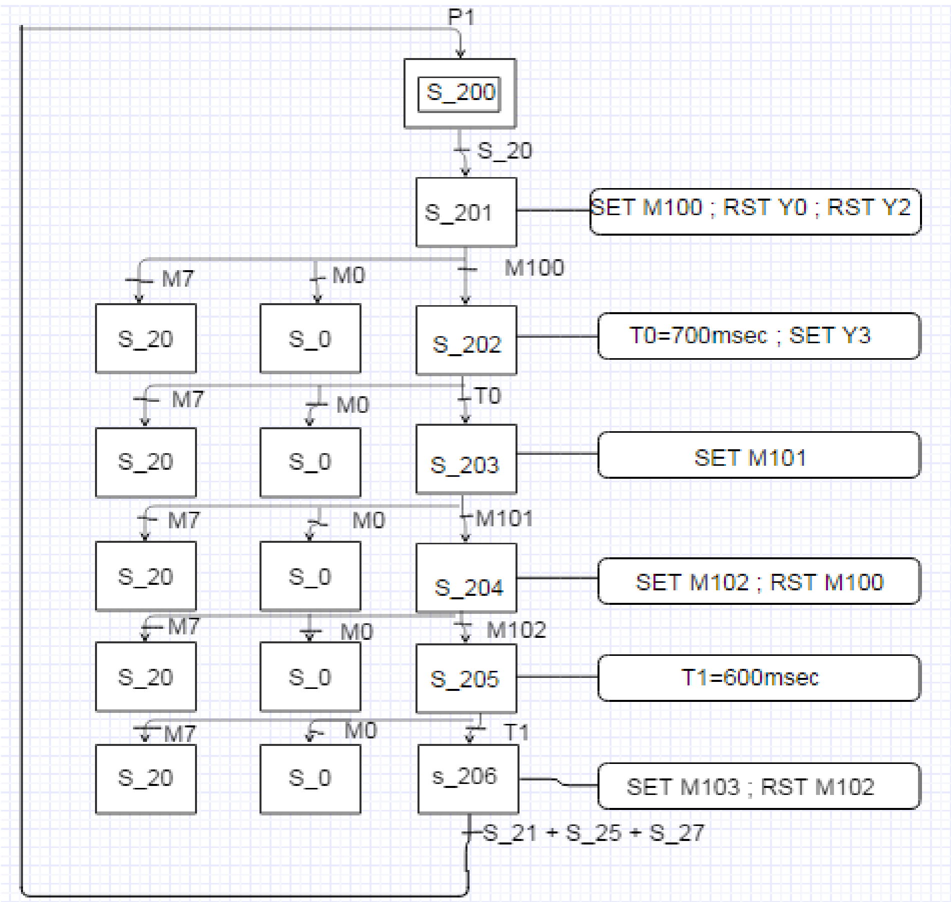


Figure 5.4: PLC Chart B

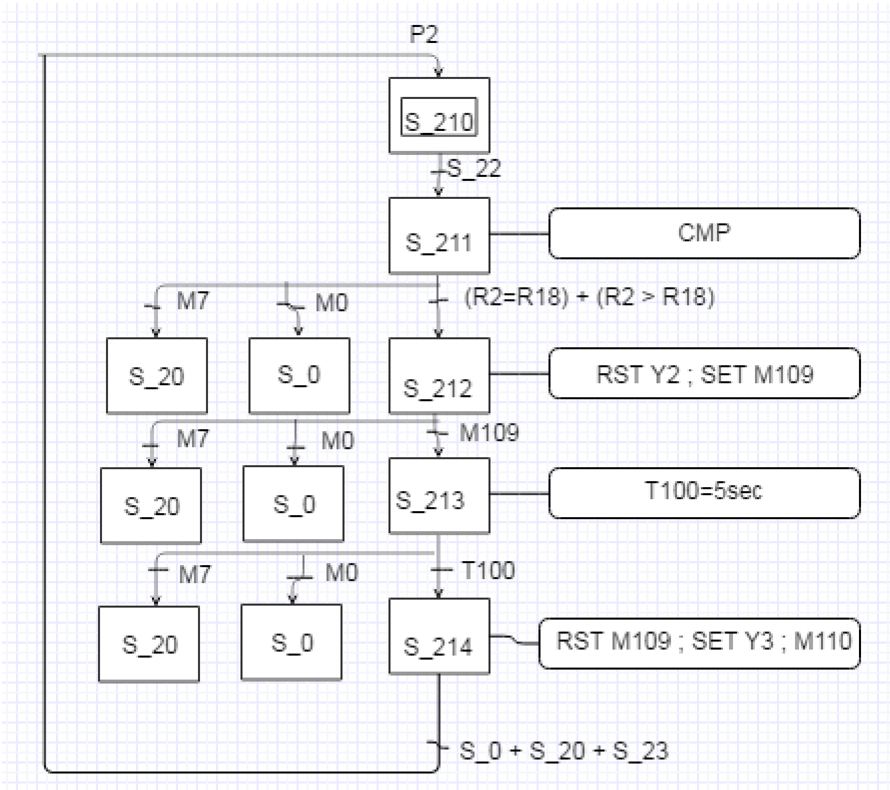


Figure 5.5: PLC Chart C

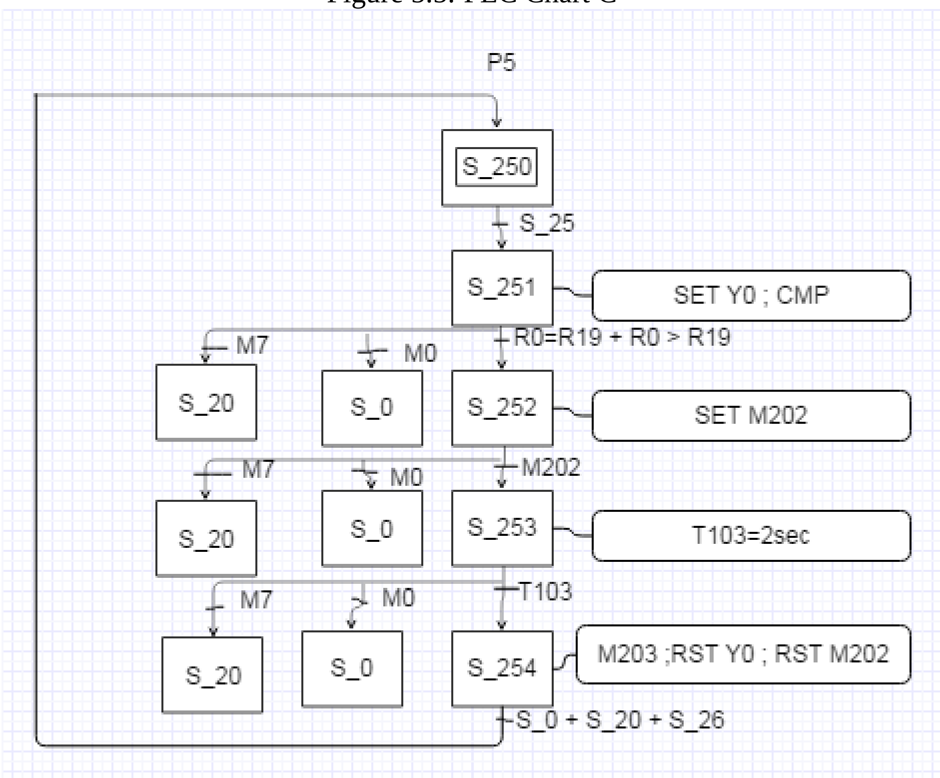


Figure 5.6: PLC Chart D

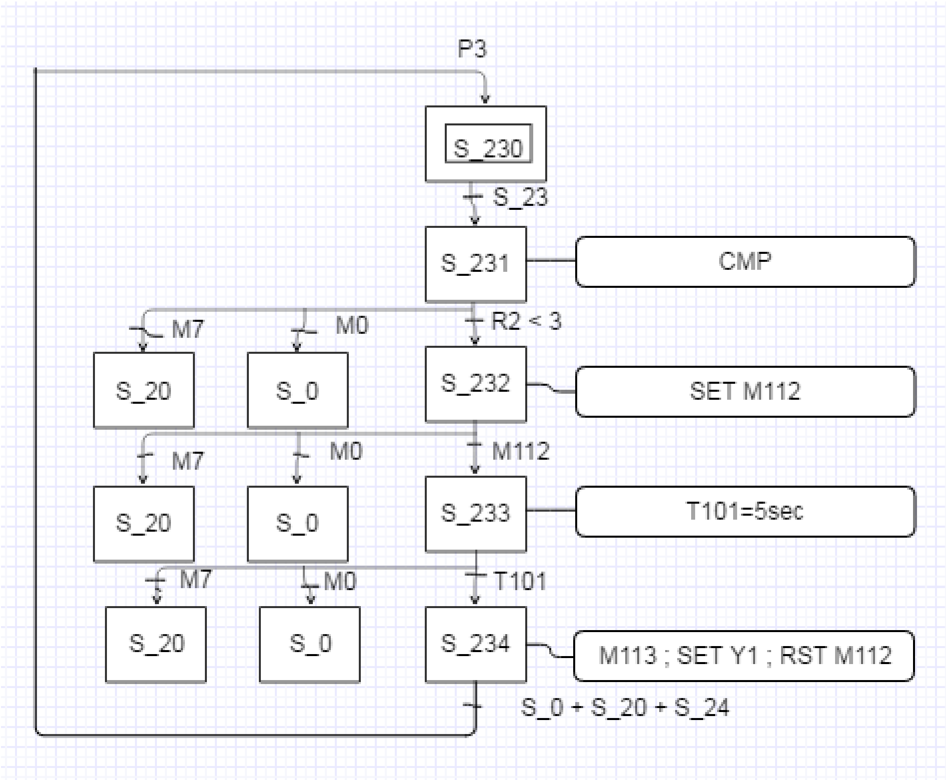


Figure 5.7: PLC Chart E

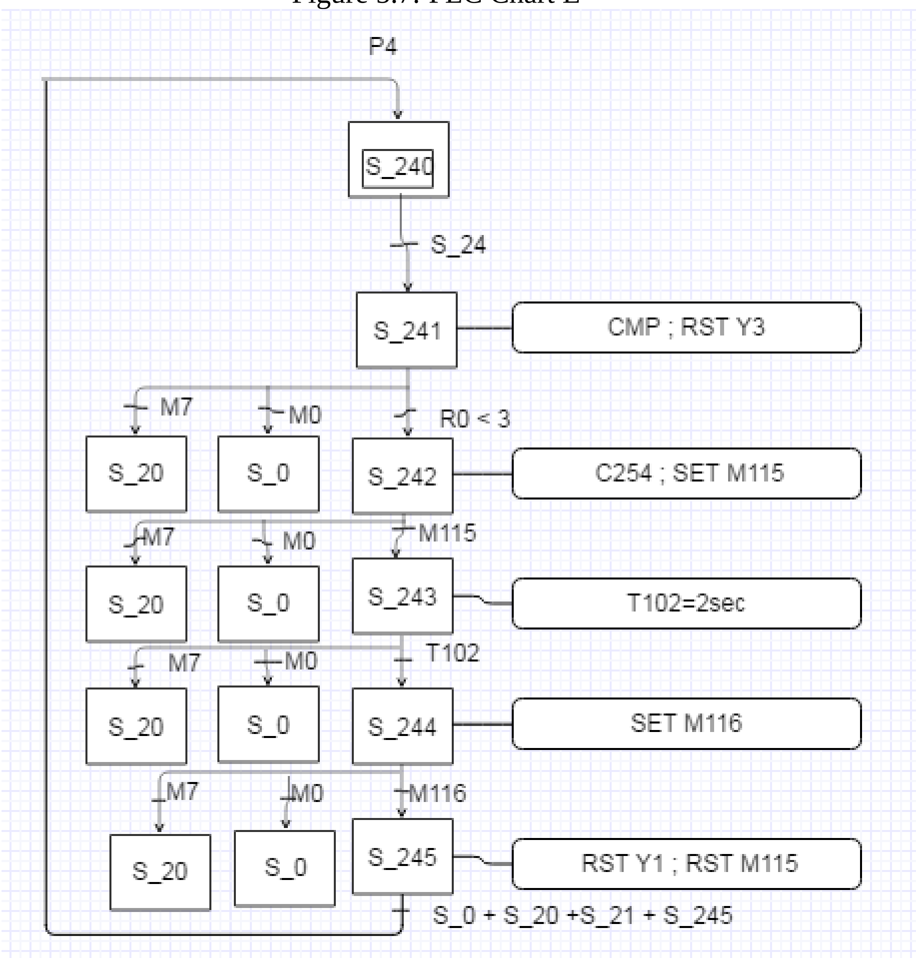


Figure 5.8: PLC Chart F

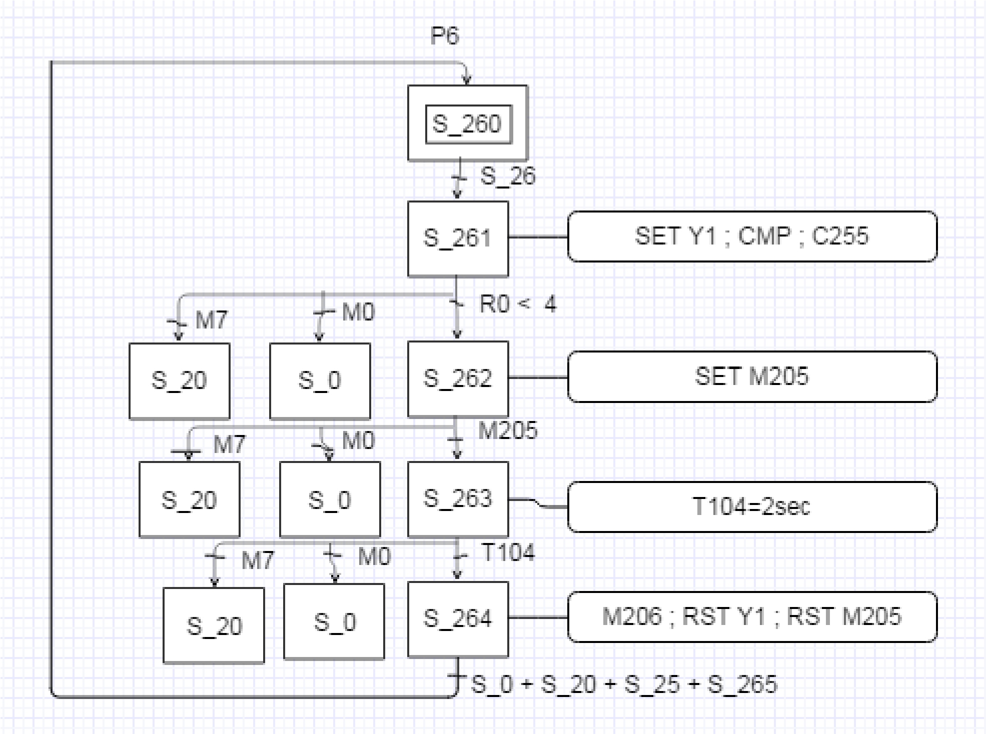


Figure 5.9: PLC Chart G

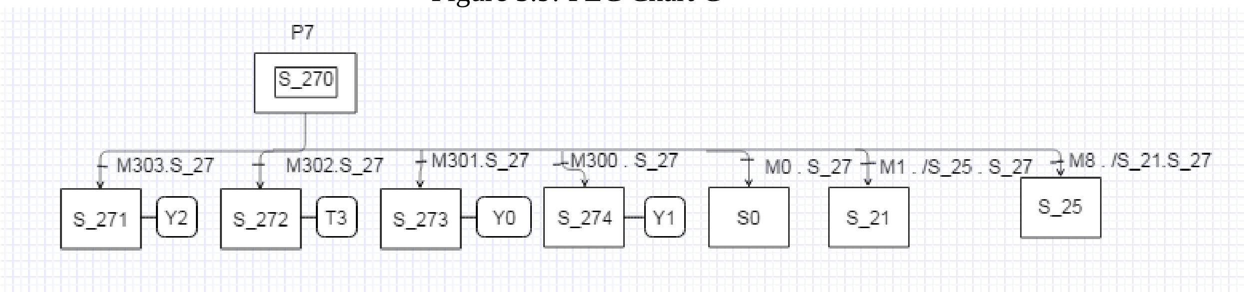


Figure 5.10: PLC Chart H

The Step code is obtained from the SFC is shown in appendix A.

5.4 Touch Screen:

A touchscreen can be defined as an input and output device normally layered atop an electronic visual display of an information processing system. Input or control the information processing system can be given by a user through simple or multi-touch gestures. This can be done by touching the screen with a special stylus and/or one or more fingers.

Touch screen is important to make easy dealings with machine, in this project used Kinco HMI MT4434T as shown in **Figure 5.11**.

Figure 5.11: Kinco HMI MT4434T

Kinco HMI has been used to deal with machine; the user can select the type test, input the forces, the input No. of cycles and manual use.

The program used in the software for the Kinco HMI MT4434T is the Kinco HMIware as shown in the **figure 5.12**.

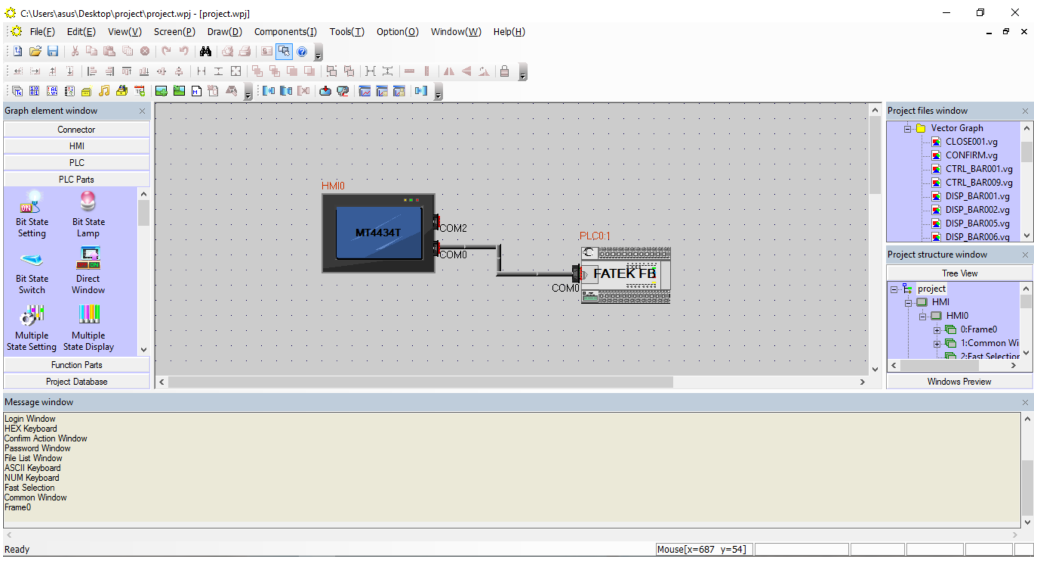


Figure 5.12: Program Kinco HMI ware

Touch screen windows as shown in appendix B.

6

Chapter Six

Results and Conclusions

6.1 Introduction

6.2 Methodology used in the experiment and results

6.3 Experimental Results

6.4 Conclusions

6.5 Recommendations

6.1 Introduction:

This chapter provides experimental results and some recommendations from the works of this project. Some goals were listed to be accomplished or at least to draw attention.

6.2 Methodology used in the experiment and results:

To get the expected results, the following two tools should be used after each test:
1- USB microscope:

A USB microscope is a low-powered digital microscope which connects to a computer, normally via a USB port as shown in **figure 6.1**. It is widely available at low cost for use at home or in commerce. The USB microscopes are a webcam with a high-powered micro lens and generally do not use transmitted light but rely on incident light from in-built LEDs lights situated next to the lens. The light reflected from the sample enters the camera lens. However, the camera is usually sensitive enough not to need additional lighting. As the camera attaches directly to the USB port of a computer, eyepieces are not required and the images are shown directly on the monitor.

This tool is important to check the plastic chair that shows whether the slits start or not.

Figure 6.1: USB microscope

2- Caliper:

A caliper is a device used to measure the distance between two opposite sides of an object as shown in **figure 6.2**. The tips of the caliper are adjusted to fit across the measured points. Then, the caliper is removed and the distance between the tips can be measured with a measuring tool, such as a ruler.

This tool is important to measure distance and spacing between the legs and parts to see if the distance changes after tests.

Figure 6.2: Caliper

6.3 Experimental Results:

In this factory, the King Chair product has been selected to make two tests as shown in **Figure 6.3.**

Figure6.3: king chair

Plastic chair is divided to 8 areas to make easy dealing with results as shown in **figure 6.4**

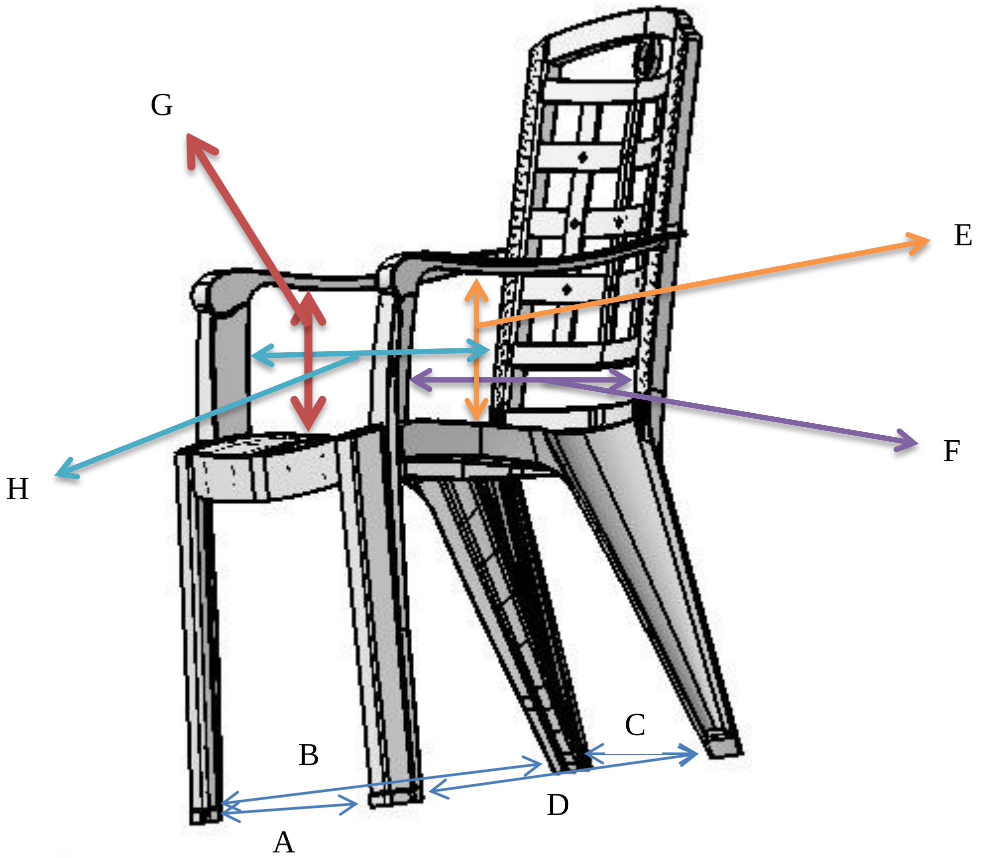


Figure 6.4: Chair plastic areas

Before starting any test, the plastic chair should be checked by USB microscope and caliper to make sure it has no industrial failure. Then seat and back test are started; after 5000 cycles the plastic chair should be checked as shown in **table 6.1** repeating that as user wants**;** the arm test should be made after that; after 5000 cycles, the plastic chair should be checked as shown in **table 6.2** repeating that as user wants. This result refers to chapter 3 section 6, and the curves of each area as shown in **figures 6.5, 6.6, 6.7, 6.8,6.9 and 6.10.**

Table 6.1: Seat & back test results

Number of hits	A [mm]	B [mm]	C [mm]	D [mm]	Slits
0	443.0	390.2	374.5	394.3	There is No
5000	443.0	390.2	374.5	394.3	There is No
10000	443.5	390.3	374.5	394.5	There is No
15000	444.0	390.5	374.5	394.7	There is No
20000	444.2	390.7	374.5	394.7	There is No
25000	444.5	391.0	374.5	394.7	There is No
30000	444.9	391.0	374.9	394.7	There is No
35000	445.2	391.0	375.4	394.7	There is No
40000	445.6	391.1	375.9	394.7	There is No
45000	446.0	391.1	376.3	394.8	There is No

Table 6.2: Arm test results

Number of hits	E [mm]	F [mm]	G [mm]	H [mm]	Slits
Zero	176.78	295.0	176.78	295.0	There is No
5000	176.40	295.0	176.40	2950.	There is No
10000	175.95	295.0	175.95	295.0	There is No
15000	175.55	294.9	175.55	294.9	There is No
20000	175.1	294.8	175.1	294.8	There is No
25000	174.8	294.7	174.8	294.7	There is No
30000	174.5	294.6	174.5	294.6	There is No
35000	174.35	294.6	174.35	294.6	There is No
40000	174.2	294.5	174.2	294.5	There is No
45000	173.9	294.5	173.9	294.5	There is No

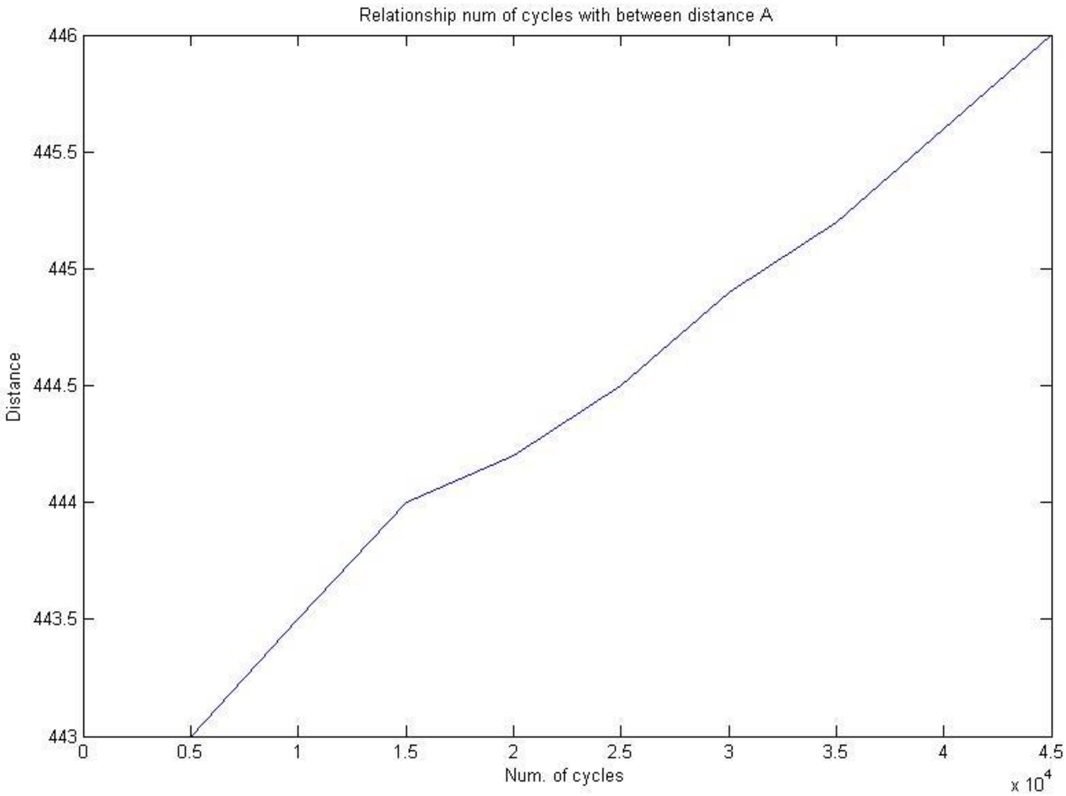


figure6.5 : relationship No. of cycles with between distances A

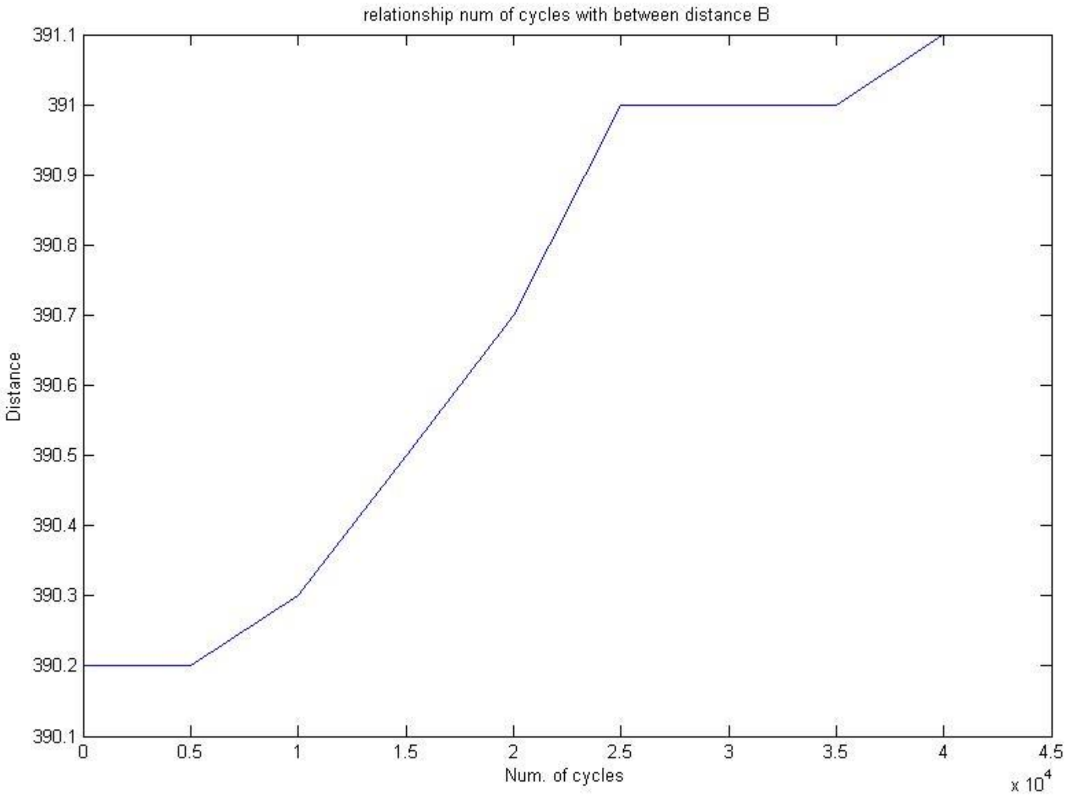


Figure6.6: relationship No. of cycles with between distances B

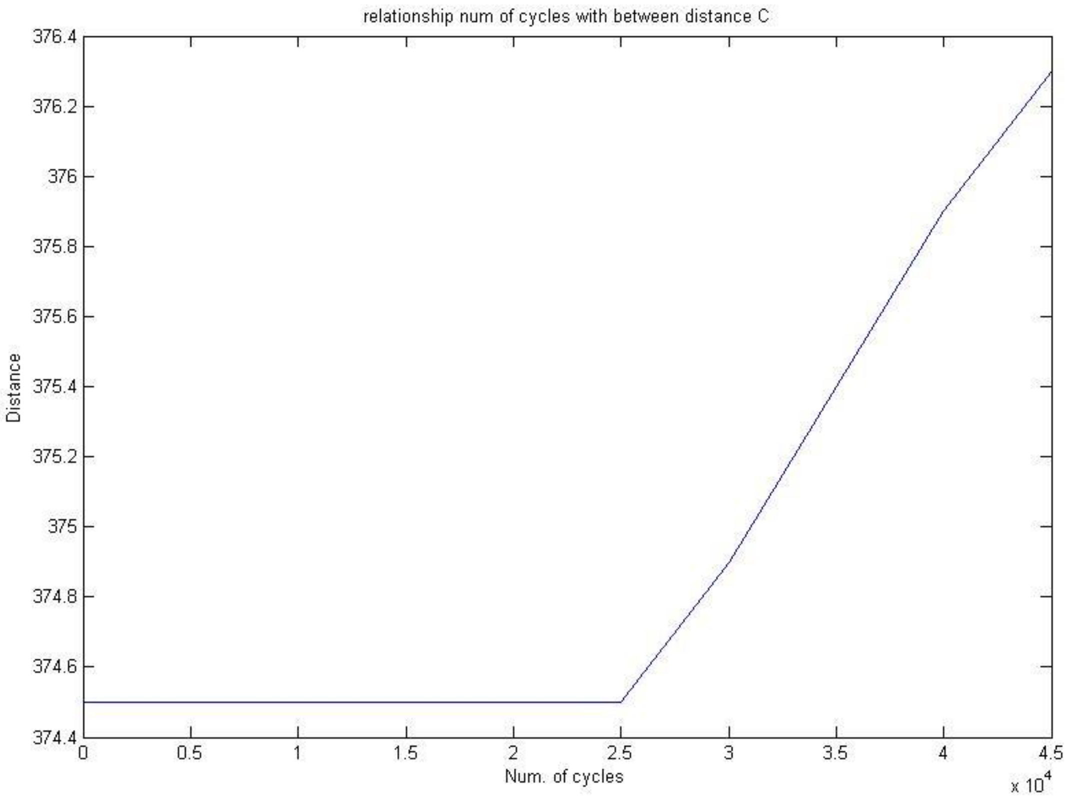


Figure6.7: relationship No. of cycles with between distances C

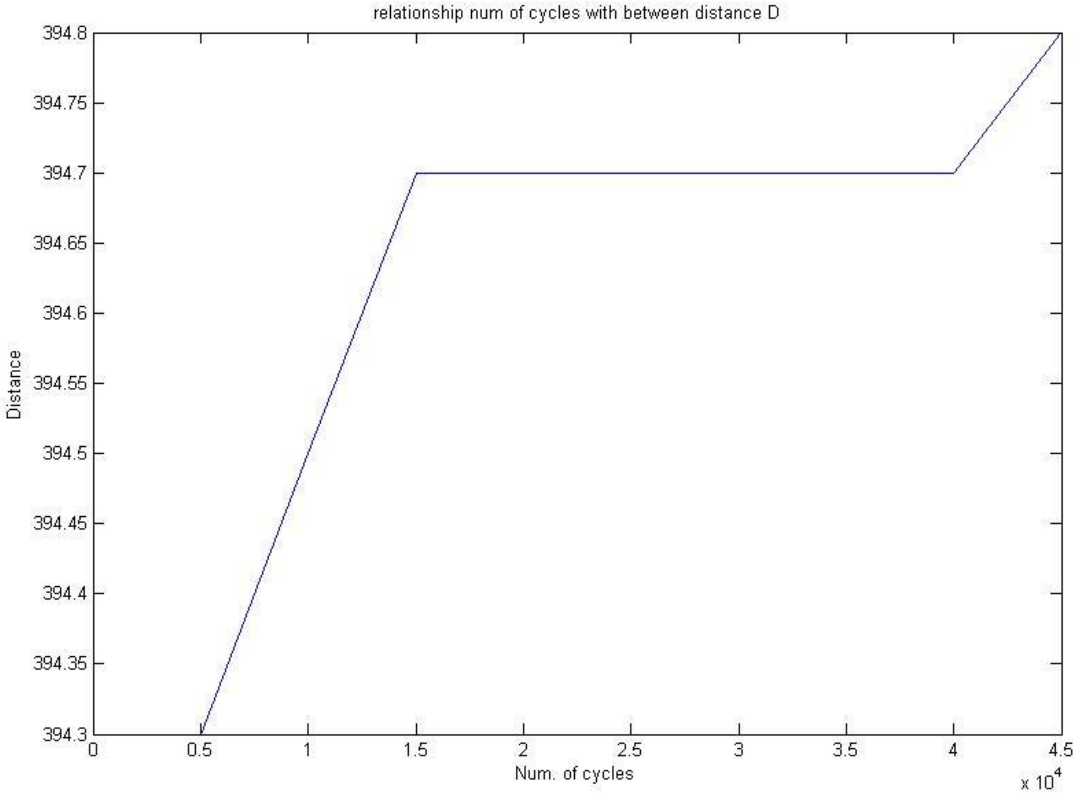


Figure6.8: relationship No. of cycles with between distances D

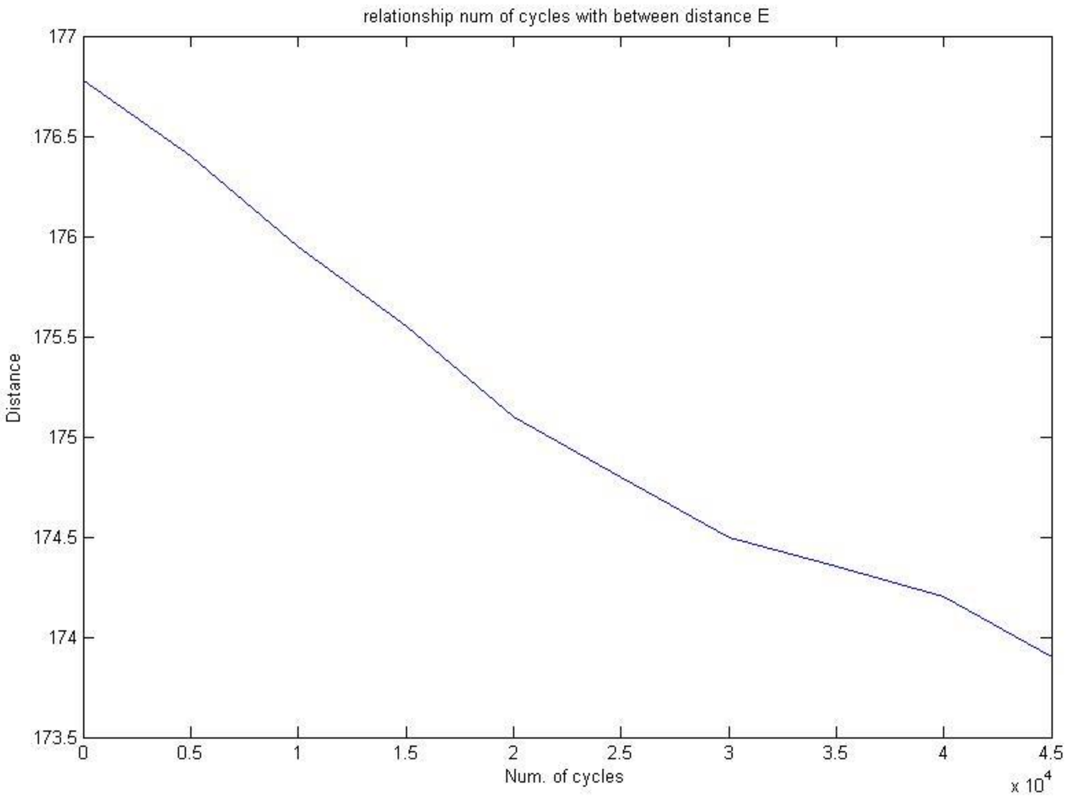


Figure6.9: relationship No. of cycles with between distances E

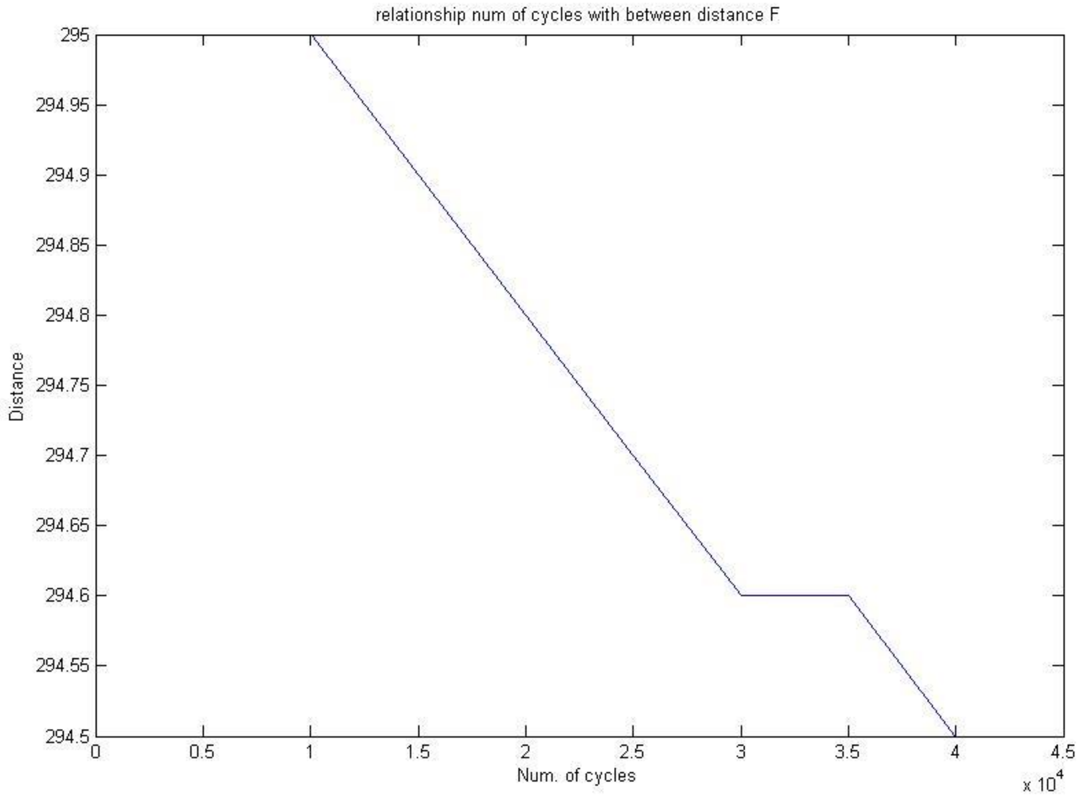


Figure6.10: relationship No. of cycles with between distances F

All curves are drawn in MATLAB program; curve G is similar to curve E and curve H is similar to curve F.

After building machine, mechanical switch was made between two types of test. **Figure 6.11** shown over view, **figure 6.12** shown seat and back test, **figure 6.13** shown arm test.

Figure 6.11: machine over view

Figure 6.12: seat and back test

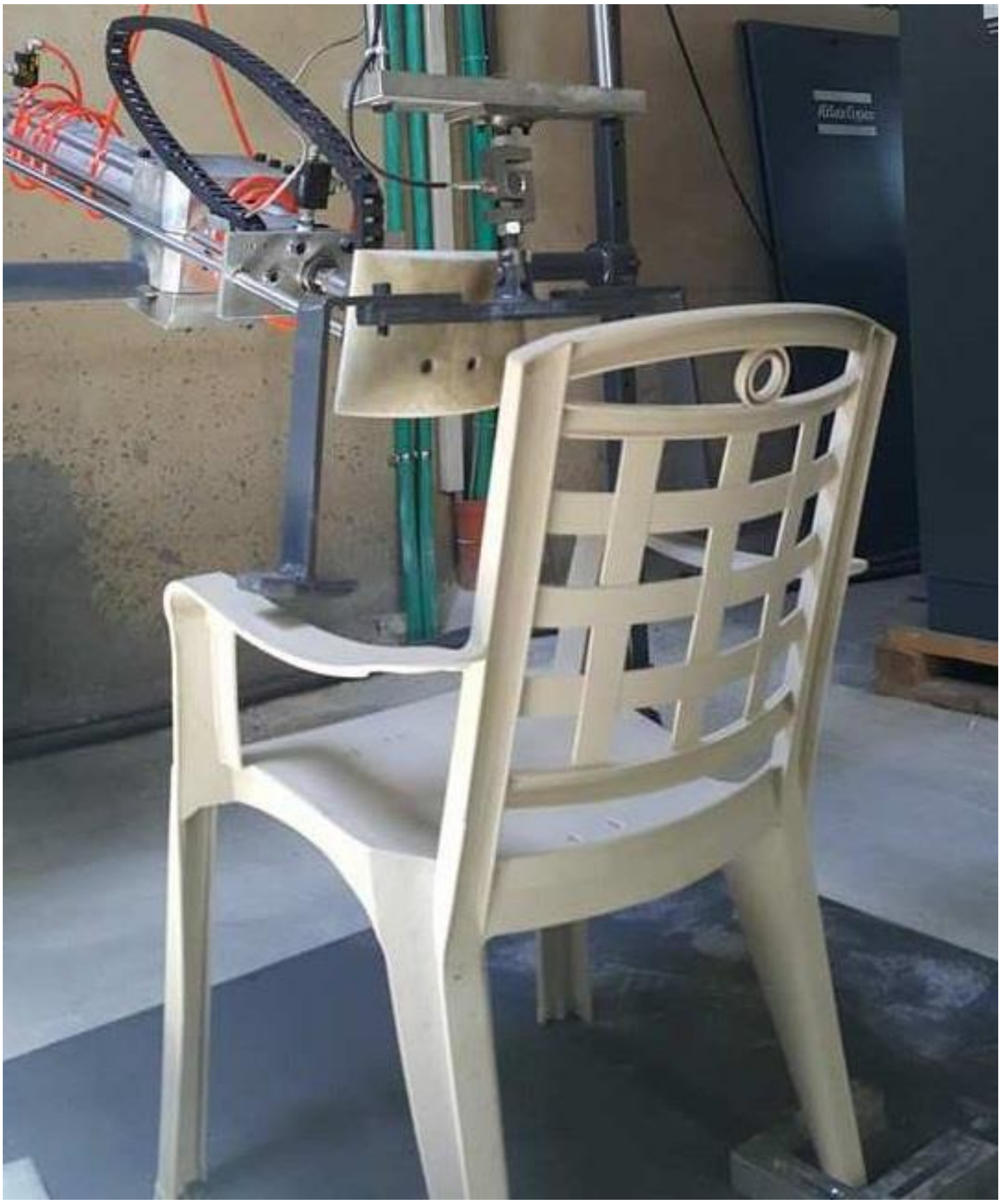


Figure 6.13: arm test

6.4 Conclusions:

After the design, the machine has been built and the testing has been made. The conclusions come as follows:

1- The Measurement tools used are inaccurate.
2- Every 24 hours the machine runs about 7,000 hits on the chair in first test.

3- There is an error rate in determining the required force as the air system takes time and delays in response to the commands of the PLC.

4- The slits may be created in nanometer, and cannot be shown in USB microscope.

5- Weak points do not appear during the test; it may appear after long time. Hence there are no-end-of life specified to the king chair

6- No failure has been detected due to the limited time for testing

6.5 Recommendations:

This machine should be rebuilt to cover more than two tests like drop load test and leg test to exploit all of the empty areas and spaces in the machine. These recommendations are:

1- Changing ground of machine as asphalt and Tiles to take more possible tests and compare the results.

2- More accurate equipment should be used to get better results like BOSCH GLM 250 professional as shown in figure 6.14. BOSCH GLM 250 professional has special specifications like accuracy ±1mm, range [0.05 -250] m and should be looked for electrical scan.

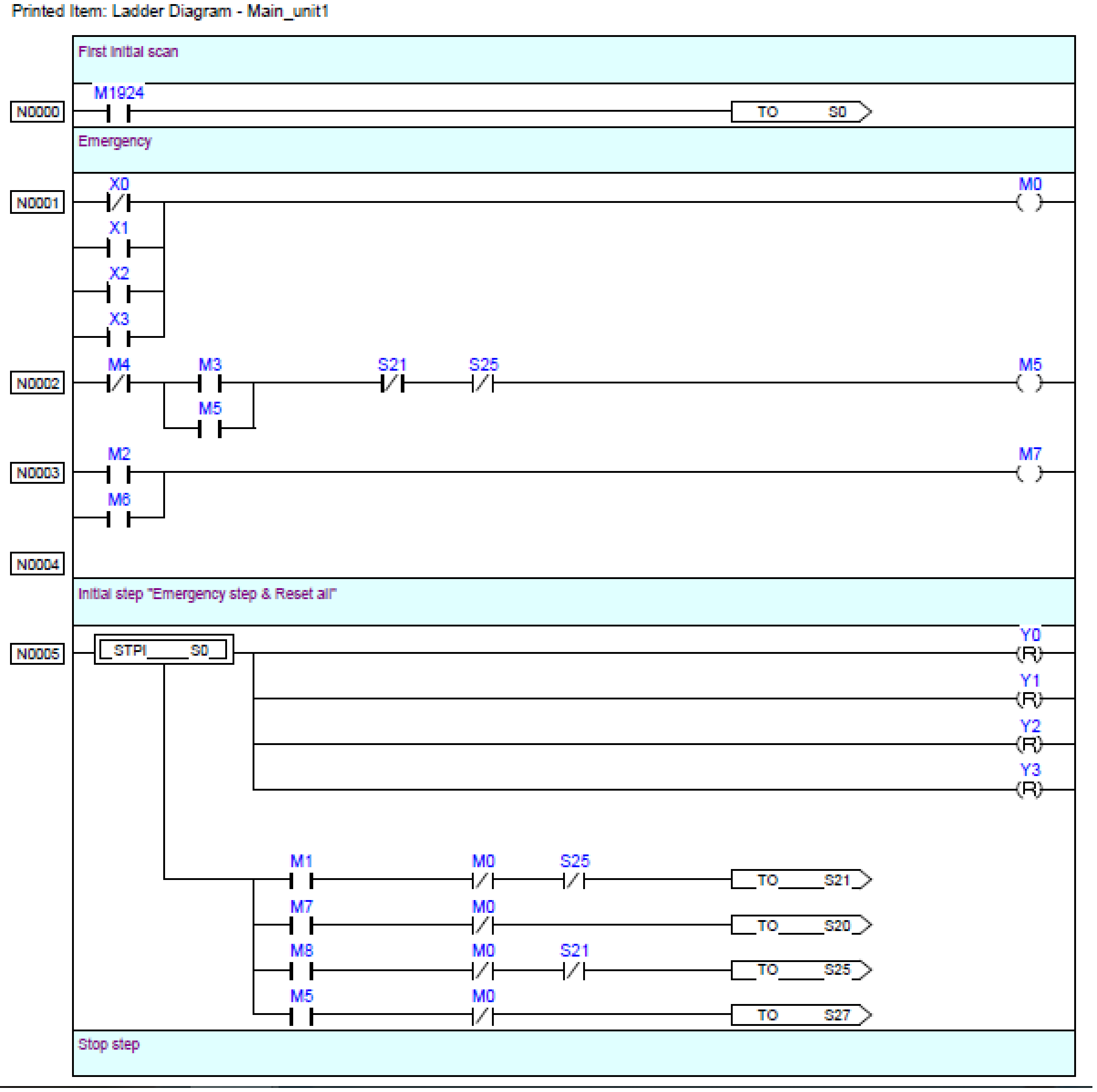
Figure 6.14: BOSCH GLM 250 professional

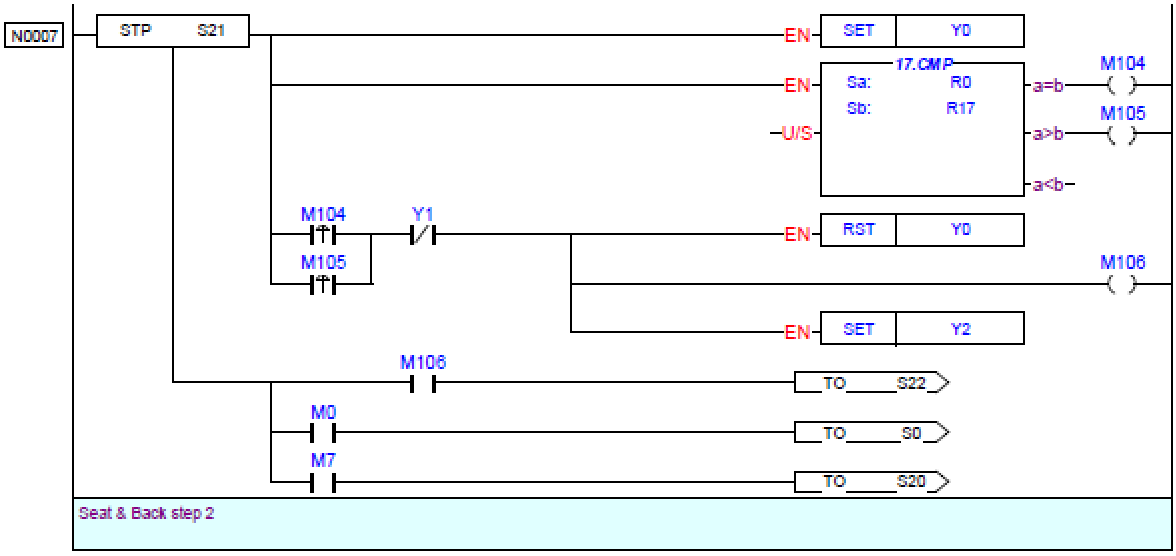
Appendix A

Programming Code

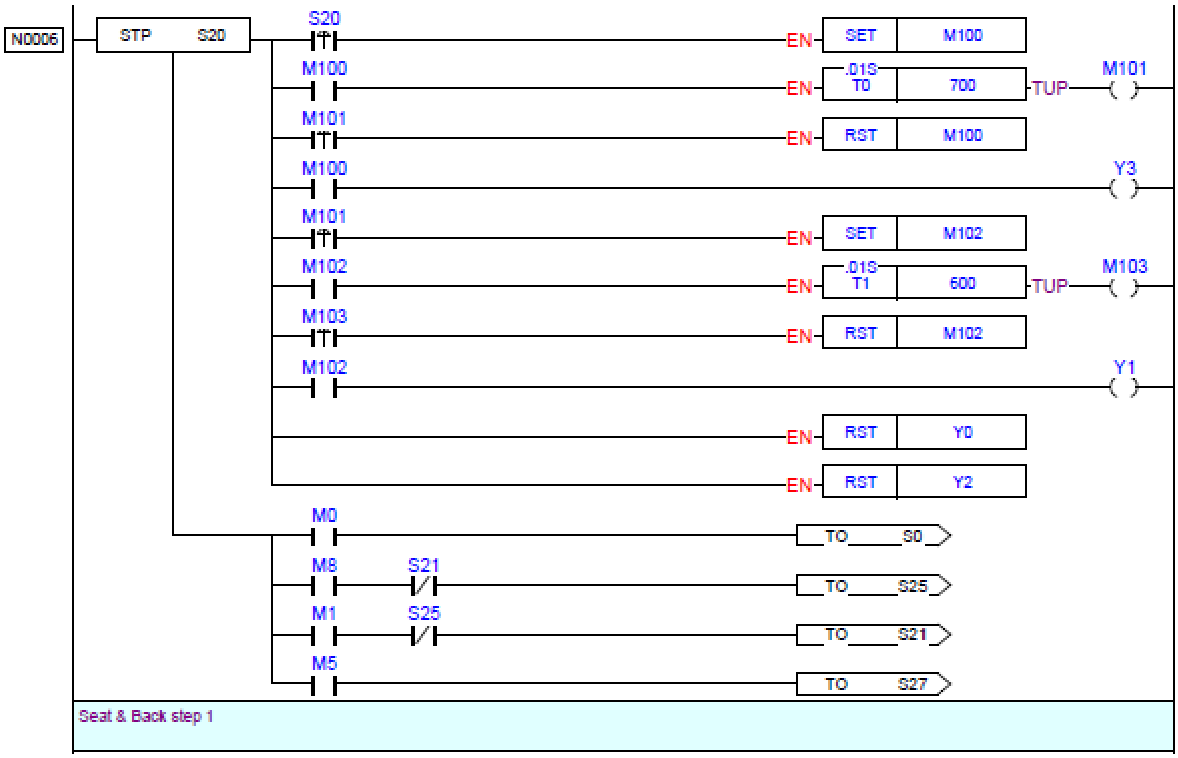
A.1 Ladder Code.

A.1 Ladder Code.

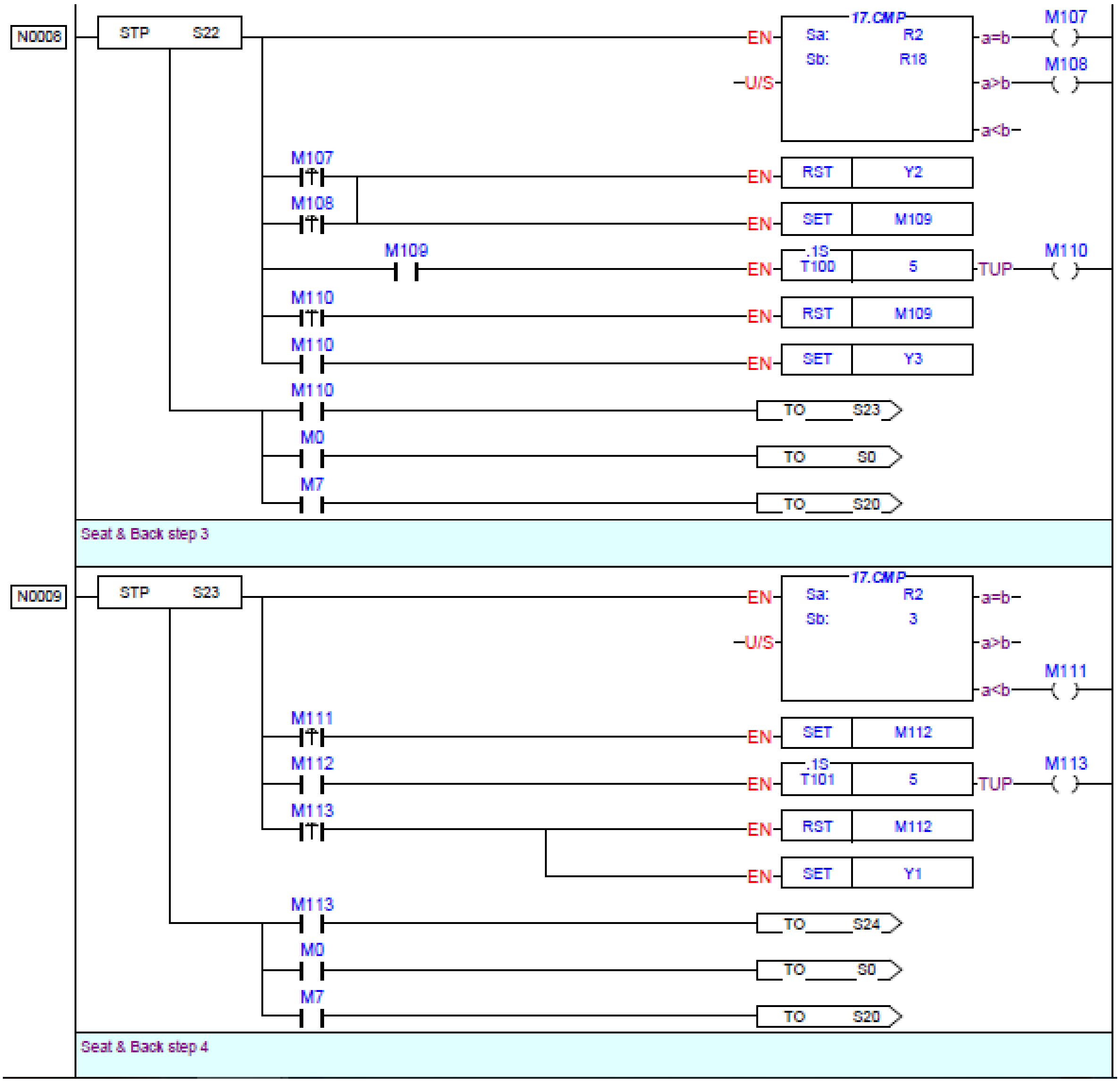




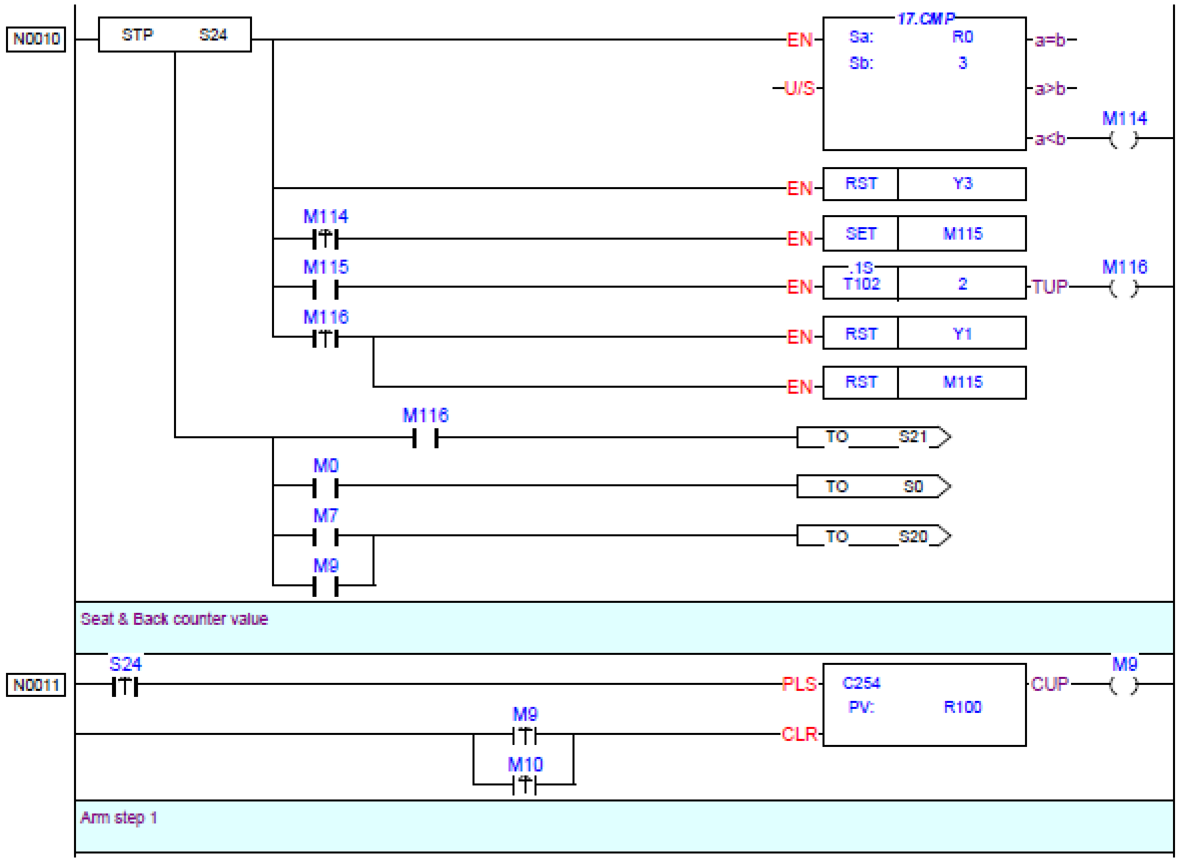
Printed Item: Ladder Diagram - Main_unit1

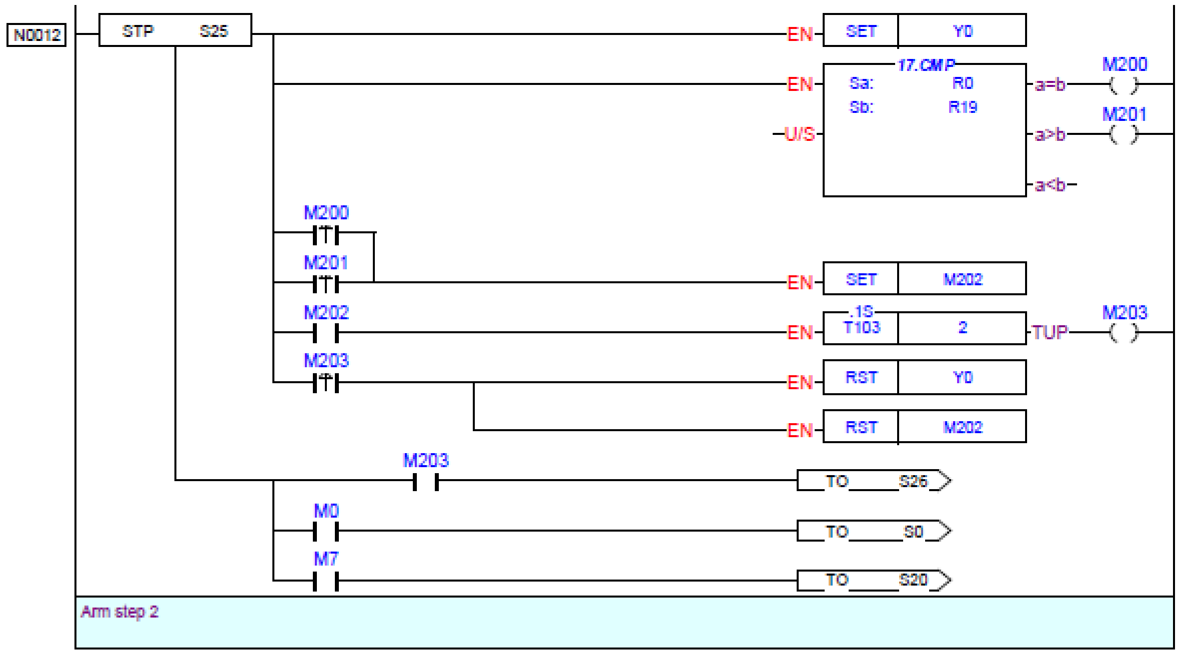


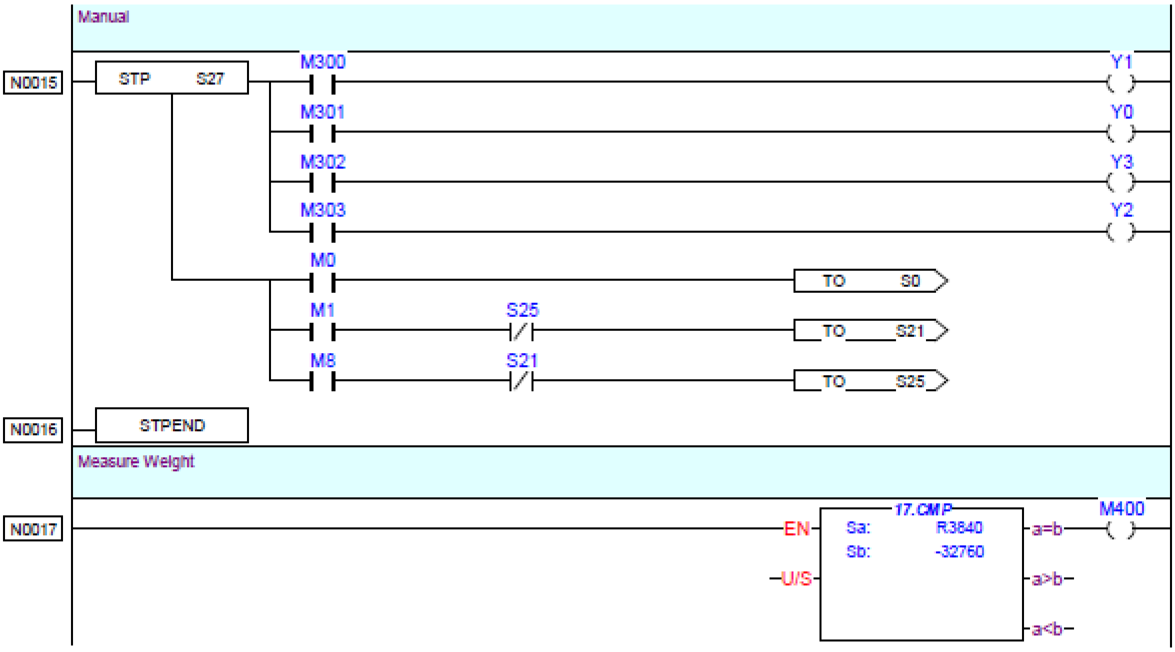
Printed Item: Ladder Diagram - Main_unit1

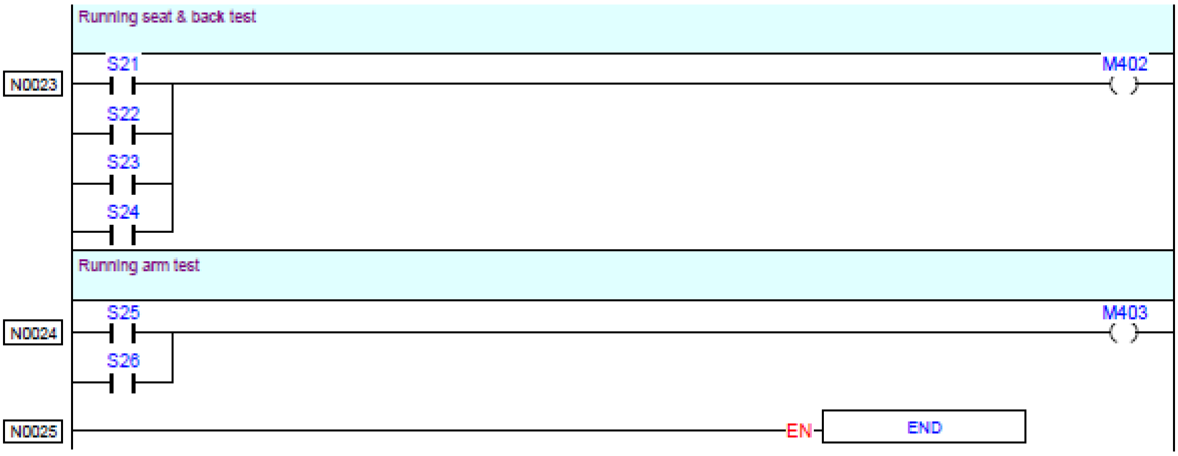


Printed Item: Ladder Diagram - Main_unit1

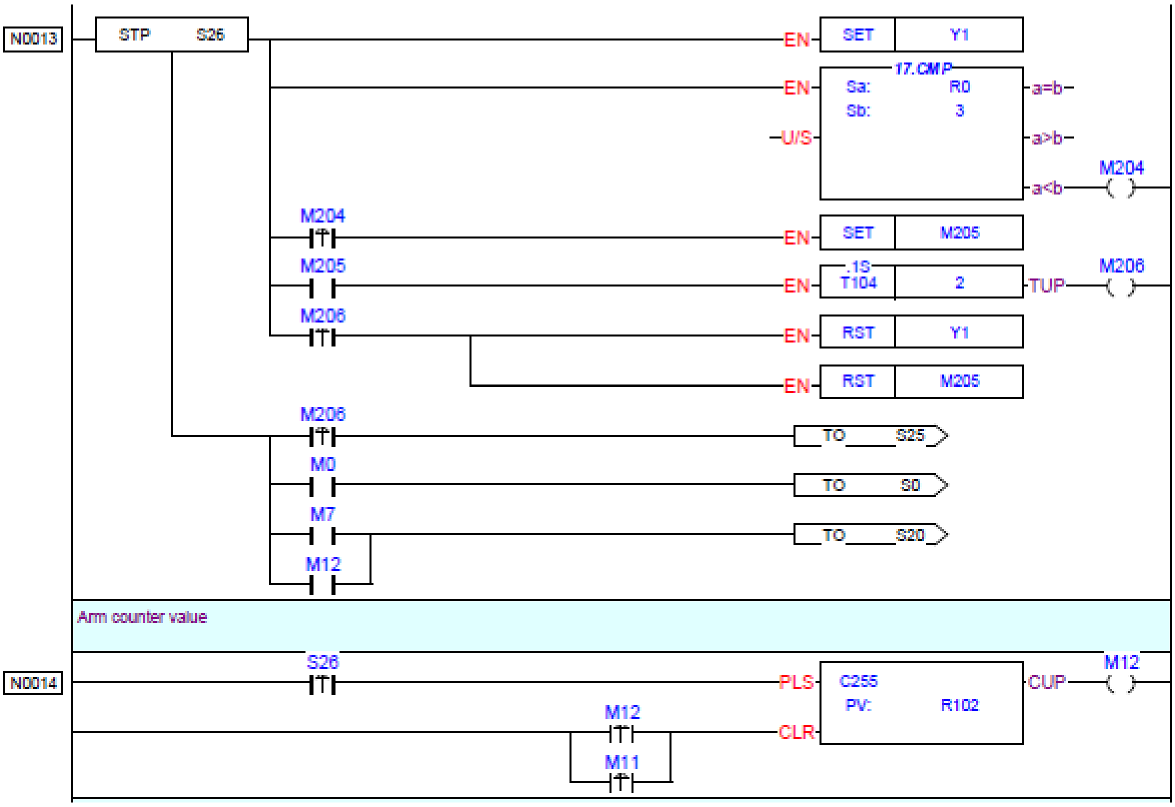




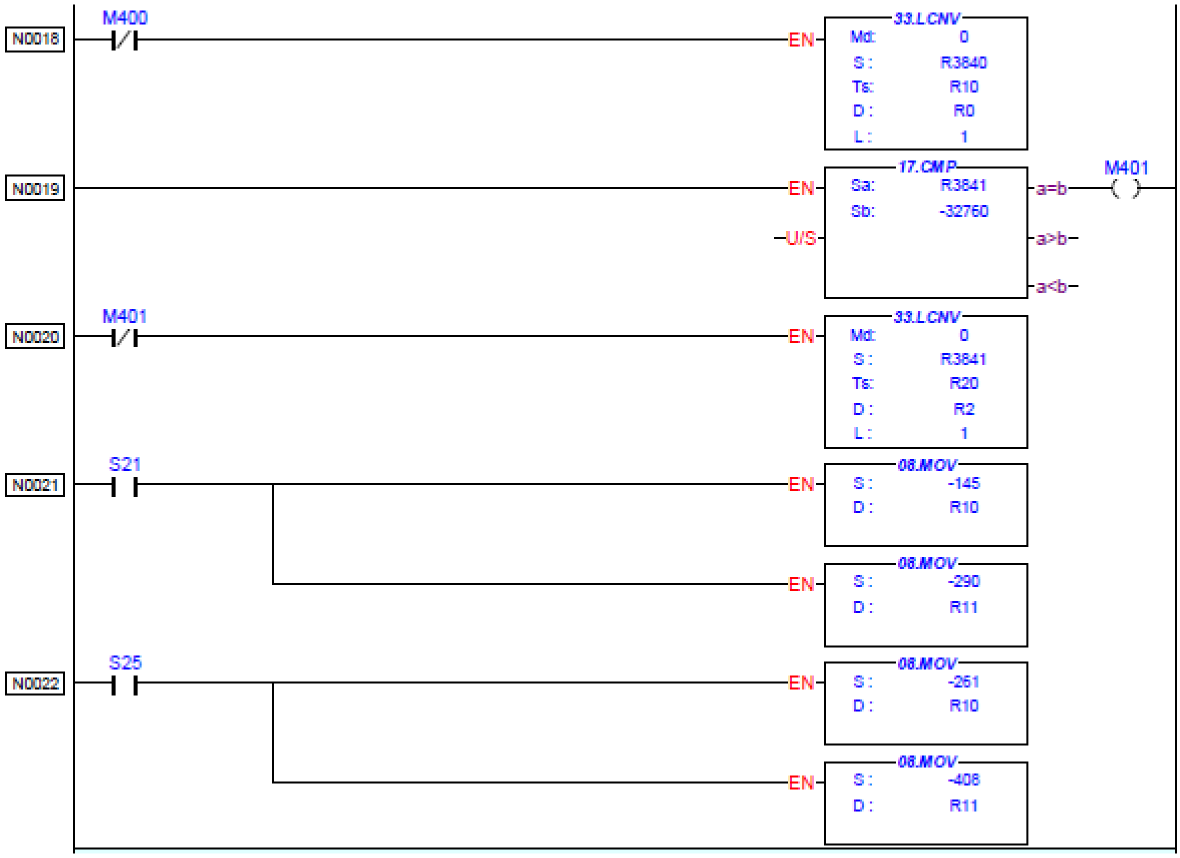

Manual
N0015
STP S27
M300
Y1
M301
Y0
M302
Y3
M303
Y2
M0
TO S0
M1
S25
TO S21
M8
S21
TO S25
N0016
STPEND
Measure Weight
N0017
EN
17.CMP
Sa: R3840
Sb: -32760
a=b
M400
U/S
a>b
a<b


Running seat & back test
N0023
S21
M402
S22
S23
S24
Running arm test
N0024
S25
M403
S26
N0025
EN
END

Printed Item: Ladder Diagram - Main_unit1



Printed Item: Ladder Diagram - Main_unit1

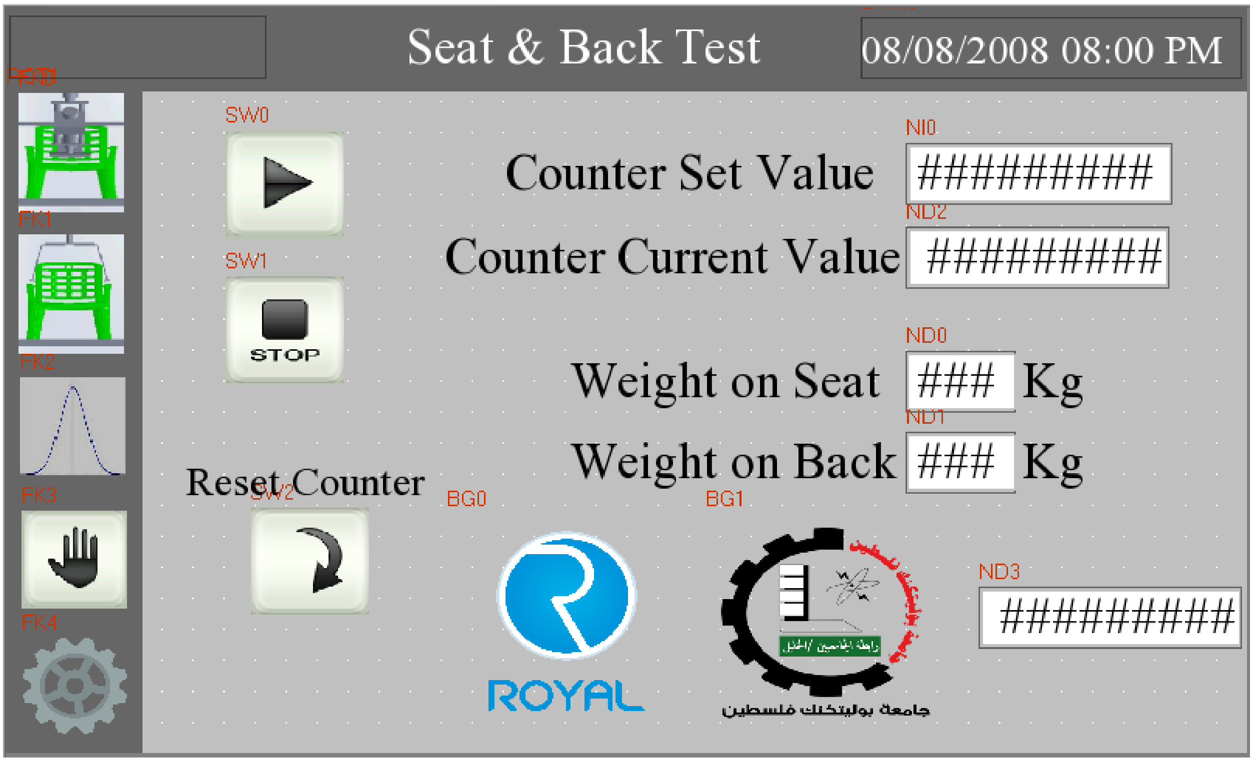


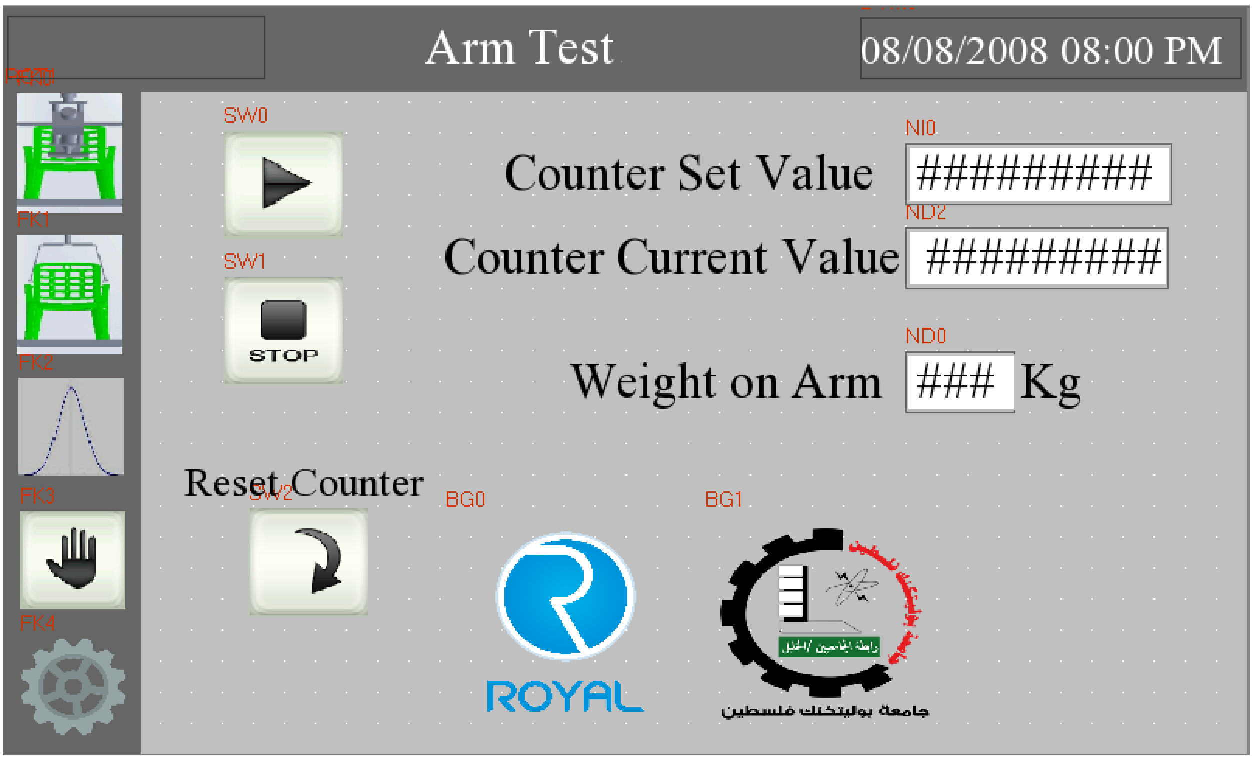
Appendix B

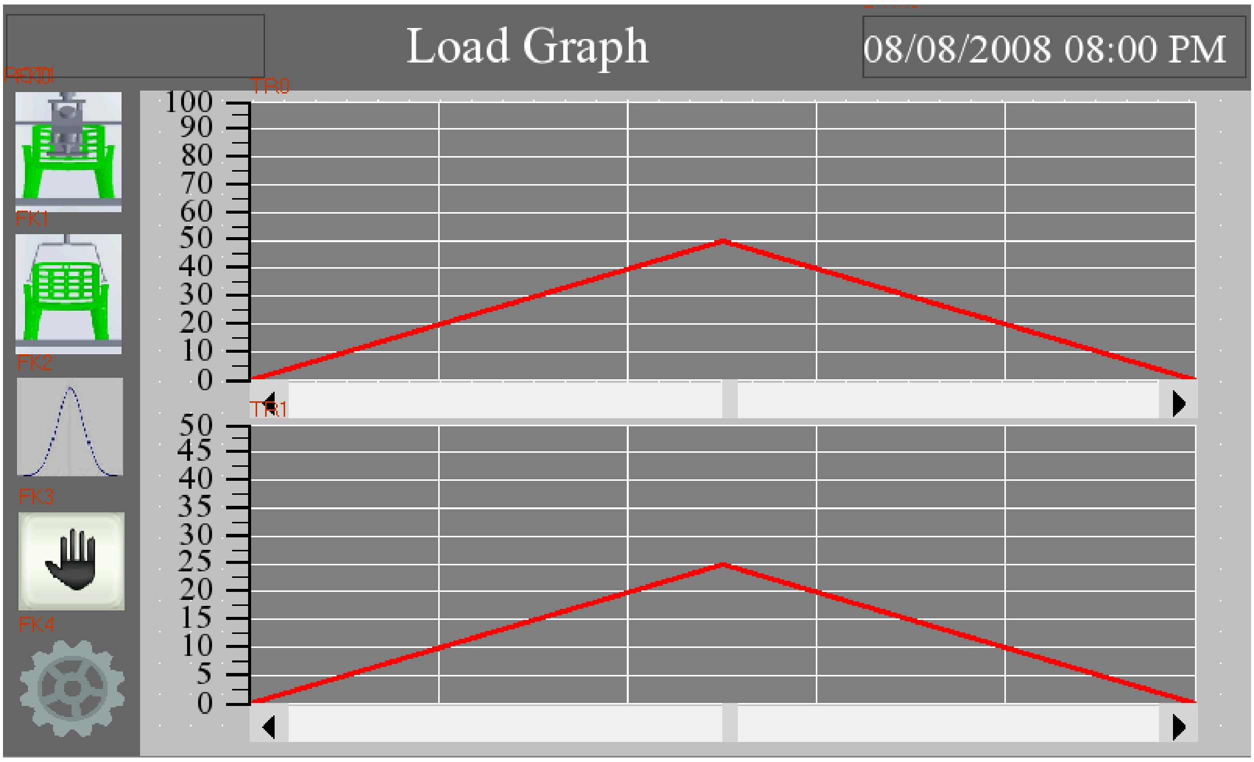
Touch screen windows

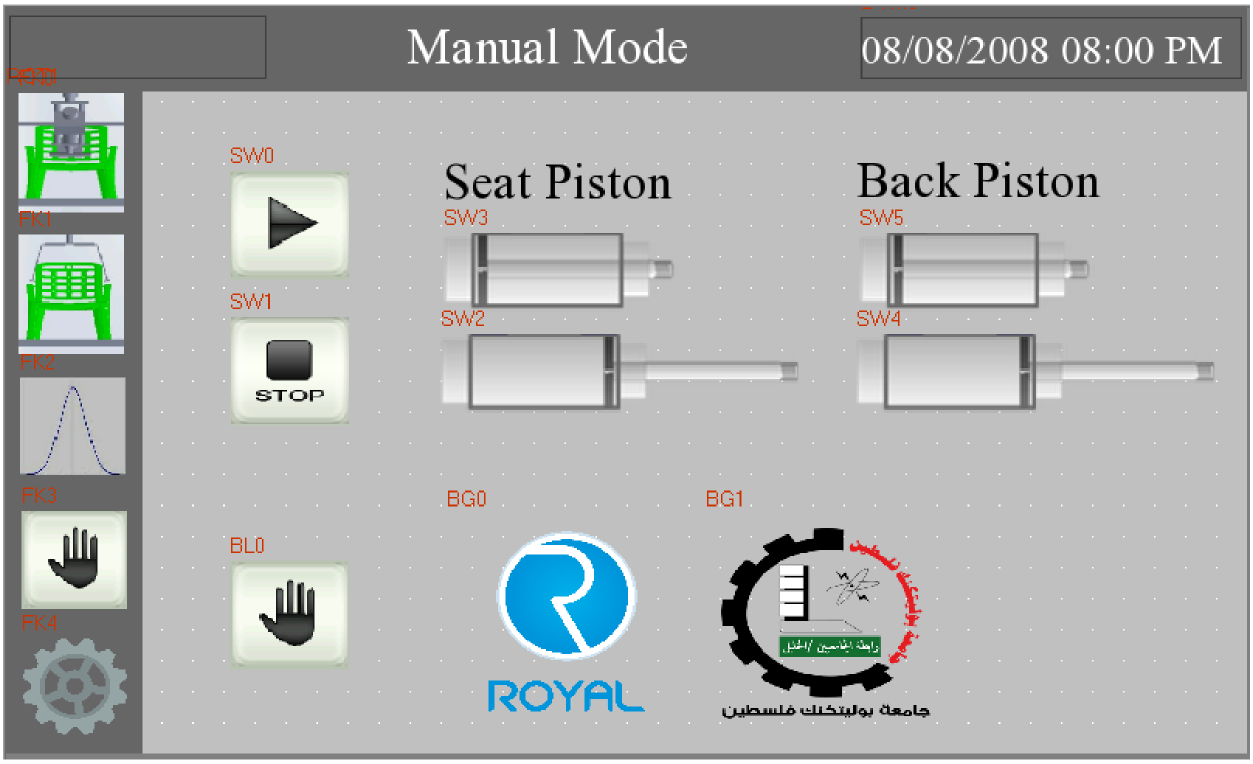
B.1 kinco HMIware windows.

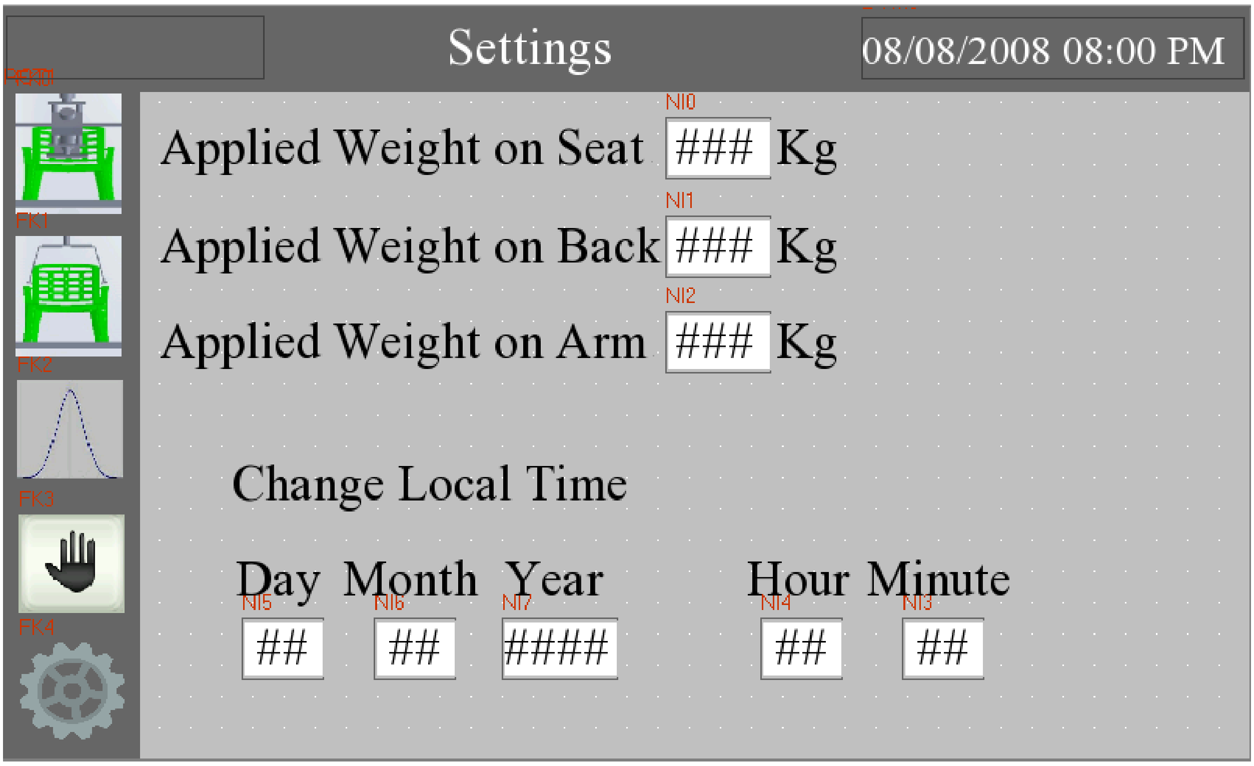
B.1 kinco HMIware windows.






Load Graph
08/08/2008 08:00 PM
FK1
FK2
FK3
FK4
TR0
TR1
100
90
80
70
60
50
40
30
20
10
0
50
45
40
35
30
25
20
15
10
5
0


Manual Mode
08/08/2008 08:00 PM
FK1
FK2
FK3
FK4
SW0
SW1
STOP
Seat Piston
SW3
SW2
Back Piston
SW5
SW4
BG0
BG1
BL0
ROYAL
جامعة بوليتكنك فلسطين


Settings
08/08/2008 08:00 PM
Applied Weight on Seat ### Kg
Applied Weight on Back ### Kg
Applied Weight on Arm ### Kg
Change Local Time
Day Month Year Hour Minute
##

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