DESIGN AND FABRICATION OF FRICTIONLESS BRAKING SYSTEM

Submitted in partial fulfilment of the requirements

of the degree of

Bachelor of Engineering

(In The Subject Mechanical Engineering)

By

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CERTIFICATE

This is to certify that the project entitled "**Design and Fabrication of Frictionless Braking System**"is a bonafide work of "**Nikhila Vijay Patil, Nitin Parshuram Khule, Preeti Ramkrushna Jadhav, Sushant Dattu Choraghe**" submitted to the University of Mumbai in partial fulfilment of the requirement for the award of the degree of "Undergraduate" in "**Bachelor of Engineering in the Subject Mechanical Engineering**".

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Project Report Approval

This project report entitled “**DESIGN AND FABRICATION OF FRICTIONLESS BRAKING SYSTEM**”by **Nikhila Vijay Patil, Nitin Parshuram Khule, Preeti Ramkrushna Jadhav, Sushant Dattu Choraghe,** is approved for the degree of Bachelor of Engineering.

Examiner 1

Examiner 2

Date:

Place:

Declaration

We hereby declare that written submission represents our ideas in our own words and where others ideas or words have been included, we have been adequately cited and referenced the original sources. We also declared that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

(Nikhila Vijay Patil)

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Date: /06/2020

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Abstract

Majority of braking systems work on the principle of dissipation of kinetic energy to heat energy. This method has its own drawbacks and must be replaced with a more reliable braking system that is quick in response, doesn’t heat up and is maintenance free.

This project is about development and analysis of Frictionless braking system. In which it is planned to demonstrate the “Design and Fabrication of Frictionless Braking System”, where, it shows the Copper’s or Aluminium is sudden reaction to Strong Neodymium Magnets. Braking System should ensure the safety and comfort of the passenger or pillion, driver and other road user. The brake must be strong enough to stop the vehicle during emergency within shortest distance. A frictionless braking system tends to increase life span and reliability of the components of brakes since absence of friction leads to less wearing of brakes also it requires less maintenance and lubrication as compared to other braking mechanisms.

The conventional braking systems are bulky and power to weight ratio is low. Proper lubrication and maintenance must be used to operate braking system safely, effective and progressive with minimum fatigue to driver. Frictionless braking system is high-tech braking system which we found in locomotives, trains, and roller coasters. This project is about introducing frictionless braking system in motorcycle in order to increase efficiency and safety to avoid accidents. It also reduces the maintenance of braking system. The effectiveness of brake increases. This system provides better response time for emergency situations.

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Nomenclature

B_{max}	Maximum magnetic flux density
B_r	Flux Density
H_{ci}	Permanence
hp	Horse power
hr/day	Hour per day
kA/m	Kilo Ampere per meter
kg	Kilogram
kgf	Kilogram-force
kgf/cm	Kilogram-force per centimeter
kmph	Kilo meter per hour
kw	Kilo watt
m	Meter
m/s	Meter per second
mm	Millimeter
mm^2	Meter square
N	Newton
N/mm^2	Newton per meter square
N-m	Newton meter
N-mm	Newton millimeter
rpm	Radian per minute
T	Tesla
T_c	Case temperature

W	Watt
^{O}C	Centigrade Celsius
^{O}F	Fahrenheit

Chapter 01: Introduction

This chapter professes about the background of the project along with its objective, scope and its expected outcomes. The background gives the detail idea of why this project was chosen and what are its basic requirements. A sketch of approved concept and also its reasoning is given. The objective and scope stream towards the methodology to be adopted for the project.

1.1-Various Convectional Types of Brakes

Various types of braking exist when dealing with roller coasters, some of which have been recently developed due to technological advancements in design.

A)Skid Brakes

Figure(1.1):T bolt-skid brakes[1]

Skid brakes essentially involve a long piece of material, often ceramic-covered, situated in the middle of the track parallel to the rails. When the brake is engaged, the skid raises and friction against the underside of the train causes the train to slow and eventually stop. Skid brakes were one of the first advancements in roller coaster braking and are typically not utilized in modern creations with the exception of Twister at Knoebels Amusement Park in Elysburg, PA and the Matterhorn at Disneyland in California[2]

B) Fin Brakes

Figure(1.2): Steel roller coaster -Fin brakes[3]

Fin brakes involve a metal fin being attached to the underside of a train. The track is fitted with two computer-controlled squeezing mechanisms which upon closing, squeeze the fin and either slow or stop the train. Fin brakes are the most common form of brakes on roller coasters today. Sometimes they are thick metal box beams (mostly on Bolliger & Mabillard roller coasters), others are thin metal plates. They slide between pairs of friction pads similar to automotive brake pads. Fin brakes are designed to be fail-safe, so that a loss of power will cause them to engage. Brakes are constructed according to a certain measure of redundancy, meaning the ride is usually fitted with one extra set of brakes to bring the train to a hold even if one brake fails. Closing is done by a bellow type of air operated actuator. Each set of brakes is fitted with its own air supply system and normally opened supply valves which actuate the brake in a closed position in case a power down occurs. A heavy springs, usually made of steel, is used to open the brake.

1.2-Background of Frictionless brakes

Frictionless brakes are a relatively new technology that is beginning to gain popularity due to their high degree of safety. Rather than slowing a train via friction (such as air or pneumatic brakes), which can often be affected by various elements such as rain, Frictionless brakes rely completely on certain magnetic properties and resistance.

Figure(1.3): linear Frictionless brake in a German ICE 3high-speed train in action[4]

In locomotive frictionless brakes are made up of one or two rows of neodymium magnets. When a metal fin (typically copper or a copper/aluminium alloy) passes between the rows of magnets, eddy currents are generated in the fin, which creates a magnetic field opposing the fin's motion. The resultant braking force is directly proportional to the speed at which the fin is moving through the brake element.

Frictionless brakes are silent and are much smoother than friction brakes, gradually increases braking power so that the people on the ride do not experience rapid changes in deceleration. Many modern roller coasters, especially those being manufactured by Intiman, have utilized frictionless braking for several years. Another major roller coaster designer implementing these brakes is Bollinger & Maxillary in 2004 on their Silver Bullet inverted coaster, making it the first suspended roller coaster to feature magnetic brakes, and again used them on their newer projects, such as Leviathan at Canada's Wonderland.[5] These later applications have proven effectively comfortable and relevant for these inverted coasters which often give the sense of flight. There also exist third party companies such as Magnatar tech.[6] which provide various configurations of the technology to be used to replace and retrofit braking systems on existing roller coasters to increase safety, improve rider comfort, and lower maintenance costs and labor.

1.3- Problem Statement

The conventional brakes used in current automobile vehicles have two major problems. One is, wear and tear and other is unnecessary excessive temperature attained during the motion which results in reduction in efficiency of braking system. Hence, we are trying to make Frictionless brakes which have better efficiency with no wear and tear.

1.4-Objective

01-To design and fabricate Frictionless Braking system with greater performance replacing conventional braking system.

02-To achieve better braking efficiency.

03-To increase the reliability and life span of brakes.

04-To obtain optimum heat dissipation.

05-To increase power to weight ratio.

06-To reduce the maintenance cost.

07-To analyses the stresses in braking system.

1.5-Scope

01-Frictionless brakes satisfy all the energy requirements of braking without use of friction. They have better heat dissipation capability to avoid problems that friction brake faces with the time.

02-With the help of frictionless braking system, the braking time is reduced.

03-They can also use as supplementary retardation equipment in addition to the regular friction brakes in heavy vehicles.

04-These brake components have less cost, so the installation cost is less.

05-With the use of this technology noise will be reduced.

This can be used as an alternative method for the future crisis of the oils.

1.6-Expected Outcomes

01-Braking efficiency and safety of vehicle increases.

02-Stopping time of vehicle decreases.

03-Stopping distance of vehicle decreases.

04-Power consumption of vehicle reduces.

05-Heat dissipation rate increases.

Chapter 02: Literature Review

This chapter briefs about the findings of the research paper. The research papers related to the topic are discussed and reviewed. The literature gap explains about the uniqueness of the project as referred from the review.

2.1-Review of finding

1) Ajay Yadav : 2013

Area of Interest: Electromagnetic brakes in two wheelers.

Electromagnetic brakes can be applicable in two wheeler at high speed with low maintenance cost. Electromagnetic brake slows or stops the motion using electromagnetic force. Hence the name is electromechanical brakes but over the years it is change to electromagnetic brakes. It was used in mid 20th century specially in trains and trolleys and for variety of application. Both the electromagnetic brakes and eddy current brakes use electromagnetic force but electromagnetic brakes ultimately depend on friction and eddy current brakes use magnetic force directly[7].

2) Sergey Kitanov and Anatoly Podol'skii : 2008

Area of Interest: Eddy current and magnetic rail brakes for high speed trains

A rail brake that combines both the magnetic rail brake and eddy current brake permits profitable braking action through the range of acceptable speed. These brakes are characterized by least feasible mass and dimension. The magnetic eddy current brakes containing permanent magnet pieces offer several advantages over convention braking system[8].

3) Akshaykumar S. Puttewar, Nagnath U. Kakade : 2014

Area of Interest: Electromagnetic brakes in automobile

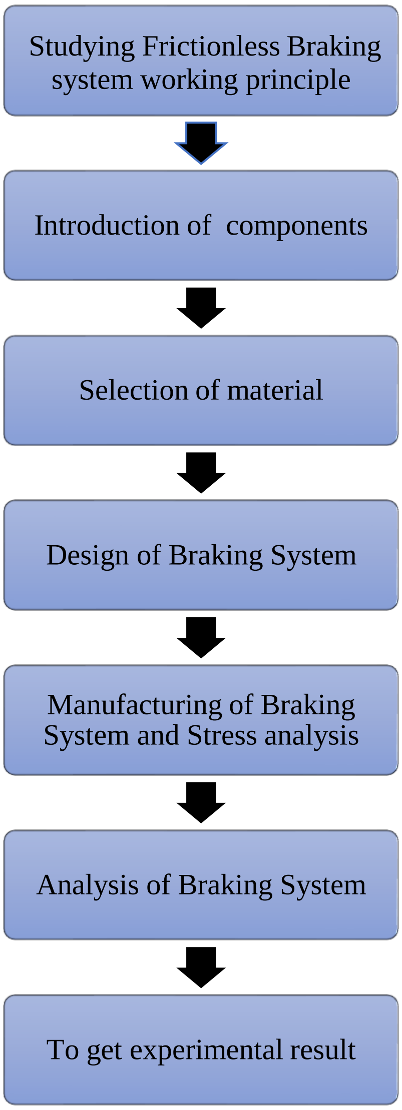
In oil braking system or air braking system even a small leakage may lead to complete failure of brakes. While in electromagnetic braking system as four disc plates, coils and firing circuits are attached individually on each wheel, even any coil fails the brake does not completely fails and remaining three coils work properly. This system needs very low maintenance. In addition, it is found that electromagnetic brakes make up approximately 80% of all of the power applied brake applications[9].

Chapter 03: Research Methodology

This chapter used pictorial tools to justify the process and methodology followed for the execution of the project. It shows a flow chart and action plan of the process.

3.1-Flow Chart

The chart describes about the process flow of the project along with the detail fragmentation of the steps to be followed.



Figure(3.1): Flow chart of Methodology/ experimental setup

3.2-Action plan

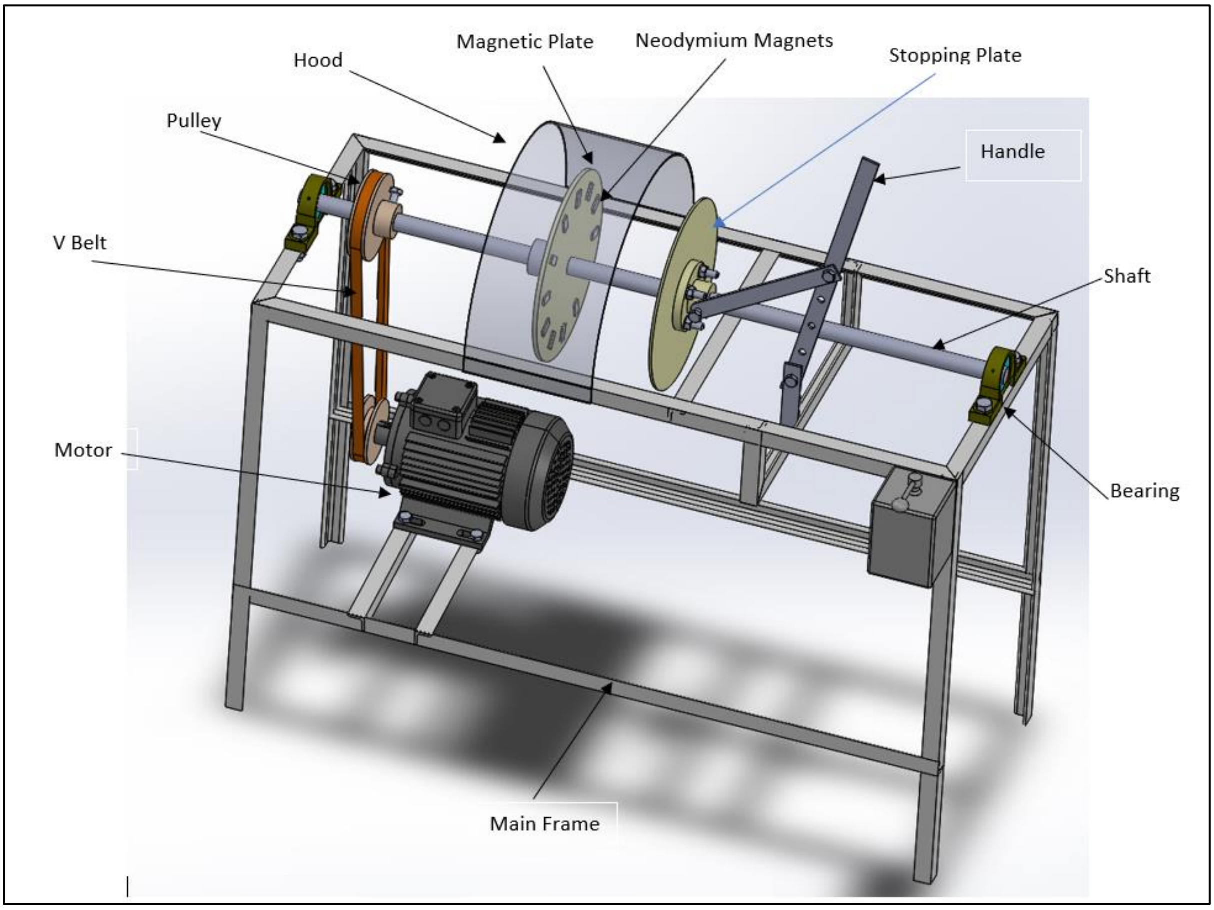
Table(3.1): Action Plan

SR NO	PROJECT ACTIVITIES	RESOURCE	STAT DATE	COMP DATE
1	PLANNING THE TASK	Humble Guide	19/8/19	14/9/19
2	MARKET SURVEY	T.T.C.M.I.D.C.	4/10/19	18/10/19
3	DESIGN & PLANNING THE FABRICATION PROCESS	WITH HOMBLE GUIDE	14/12/19	28/12/19
4	PREPAIRING DRAWING AND ESTIMATION OF MATERIAL	GROUP DISCUSSION	3/01/2020	17/01/2020
5	MARKET SURVEY FOR PURCHASE AND PROCURING THE MATERIAL	SURROUNDING MARKET	30/1/2020	8/02/2020
6	PLANNING AND PROCESS	TOOL ROOM	21/2/2020	23/02/2020
7	MANUFACTURING THE SUBCOMONENTS	TOOL ROOM/WORKSHOP	28/2/2020	04/06/2020
8	ASSEMBLY	WORKSHOP	05/06/2020	08/06/2020
9	COMPARATIVE STUDY	GROUP DISCUSSION	-	-

Chapter 04: Working of Fictional Braking

4.1-Fictionless Braking

When an electrical conductor, such as copper or aluminium, moves through the field of a permanent magnet or an electromagnet, electromagnetic induction creates eddy currents, which dissipate some of the kinetic energy into Joule heat and results in slowing the motion of the conductor.[10]

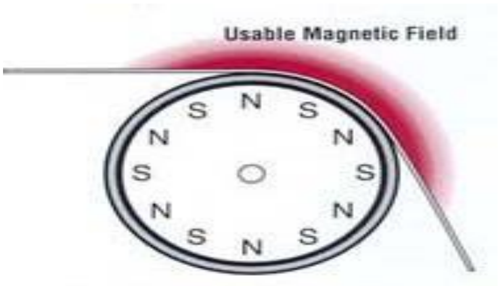


Figure(4.1): Frictionless Braking System

This principle is utilized in the construction of frictionless brakes. This Demonstration shows frictionless braking applied to a rotating metallic plate. Frictionless braking can also find applications in roller coasters and railroad trains, in which the metallic conductor has the shape of a linear rail. In contrast to conventional friction brakes, there is no direct contact between interacting surfaces, which makes frictionless braking more reliable and reduces wear and tear. A frictionless brake is a device that leverages strong magnetic forces to stop vehicle. There are various different types of frictionless brake systems, including ones that use electromagnets to actuate traditional friction pads, and those that leverage magnetic repulsion itself to provide resistance. These can be found on a variety of vehicles, from trains to roller coasters.

By increasing or decreasing the amount of electric current, the stopping power of an Eddy current electromagnetic brake can be correspondingly attenuated up or down. Rather than pads pressing harder on a rotor, the resistive magnetic force is applied on rotor. Though there is no physical contact, the process still generate heat, as a result of the resistance. It is also known as eddy current brake systems. [11]

A sub-type of the Eddy current brake is known as the linear Eddy current brake. Instead of the normal circular design, magnetic coils are wound around a straight rail. The coils alternate between a positive and negative magnetic charge, so, when activated, generate resistance and slowing action.



Figure(4.2): Usable Magnetic Field

Unpowered versions of the linear design, which instead use permanent, rare Earth magnets are the brake of choice on most roller coasters. As anyone who has ridden a roller coasterwill be aware, these non-electromagnetic types work on an on-off basis, and cannot be easily modulated.

Chapter 05: Concept of Neodymium Magnet

Reason behind introducing concept of Neodymium Magnet

Frictionless brakes are a relatively new technology that is beginning to gain popularity due to their high degree of safety but for designing and fabricating Frictionless Braking system with greater performance and to obtain objectives like following-

- To achieve better braking efficiency.
- To increase the reliability and life span of brakes.
- To obtain optimum heat dissipation.
- To increase power to weight ratio.
- To reduce the maintenance cost.

We have to be very much specific in terms of magnets which we are using in this project.

When an electrical conductor, such as copper or aluminium , moves through the field of a specifically Neodymium Magnet, electromagnetic induction creates eddy current very effectively, due to which it dissipate some of the kinetic energy into Joule heat and results in slowing the motion of the conductor.

A neodymium magnet (also known as NdFeB, NIB or Neo magnet), the most widely used type of rare-earth magnet, is permanent magnet made from an alloy of neodymium, iron and boron to form the $Nd_2Fe_{14}B$ tetragonal crystalline structure. Developed in 1982 by General Motors and Sumitomo Special Metals, neodymium magnets are the strongest type of permanent magnet commercially available. They have replaced other types of magnets in the many applications in modern products that require strong permanent magnets, such as motors in cordless tools, hard disk drives and magnetic fasteners.[12]

5.1-Discription

The tetragonal $Nd_2Fe_{14}B$ crystal structure has exceptionally high uniaxial magneto-crystalline anisotropy (HA~7 tesla - magnetic field strength H in A/m versus magnetic moment in $A.m^2$).[4] This gives the compound the potential to have high-coercivity (i.e., resistance to being demagnetized). The compound also has a high saturation magnetization (J_s ~1.6 T or 16 kg) and typically 1.3 tesla. Therefore, as the maximum energy density is proportional to J_s^2, this magnetic phase has the potential for storing large amounts of magnetic energy (BH_{max} ~ 512 kJ/m^3 or 64 MG·Oe). This property is considerably higher in NdFeB alloys than in samarium cobalt (SmCo) magnets, which

were the first type of rare-earth magnet to be commercialized. In practice, the magnetic properties of neodymium magnets depend on the alloy composition, microstructure, and manufacturing technique employed.[13]

5.2-History

In 1982, General Motors (GM) and Sumitomo Special Metals discovered the $Nd_2Fe_{14}B$ compound. The research was initially driven by the high raw materials cost ofSmCo permanent magnets, which had been developed earlier. GM focused on the development of melt-spun nanocrystalline $Nd_2Fe_{14}B$ magnets, while Sumitomo developed full-density sintered $Nd_2Fe_{14}B$ magnets.

GM commercialized its inventions of isotropic Neo powder, bonded Neo magnets, and the related production processes by founding Magnequench in 1986 (Magnequench has since become part of Neo Materials Technology, Inc., which later merged into Molycorp). The company supplied melt-spun $Nd_2Fe_{14}B$ powder to bonded magnet manufacturers.

The Sumitomo facility became part of the Hitachi Corporation, and currently manufactures and licenses other companies to produce sintered $Nd_2Fe_{14}B$ magnets. Hitachi holds more than 600 patents covering neodymium magnets.[14]

Chinese manufacturers have become a dominant force in neodymium magnet production, based on their control of much of the world's sources of rare earth ores.

The United States Department of Energy has identified a need to find substitutes for rare earth metals in permanent magnet technology, and has begun funding such research. The Advanced Research Projects Agency-Energy has sponsored a Rare Earth Alternatives in Critical Technologies (REACT) program, to develop alternative materials. In 2011, ARPA-E awarded 31.6 million dollars to fund Rare-Earth Substitute projects.

5.3-Production

As of 2012, 50,000 tons of neodymium magnets are produced officially each year in China, and 80,000 tons in a "company-by-company" build-up done in 2013.China produces more than 95% of rare earth elements, and produces about 76% of the world's total rare-earth magnets.

Bonded Nd-magnets are prepared by melt spinning a thin ribbon of the NdFeB alloy. The ribbon contains randomly oriented Nd2Fe14B nano-scale grains. This ribbon is then pulverized into particles, mixed with a polymer, and either compression- or injection molded into bonded magnets. Bonded magnets offer less flux intensity than sintered magnets, but can be net-shape formed into intricately shaped parts, as is typical with Halbach arrays or arcs, trapezoids and other shapes and assemblies (e.g. Pot Magnets, Separator Grids, etc.). There are approximately 5,500 tons of Neo bonded magnets produced each year. In addition, it is possible to hot-press the melt spun nanocrystalline particles into fully dense isotropic magnets, and then upset-forge or back-extrude these into high-energy anisotropic magnets.[15]

5.4-Corrosion problems

Sintered $Nd_2Fe_{14}B$ tends to be vulnerable to corrosion, especially along grain boundaries of a sintered magnet. This type of corrosion can cause serious deterioration, including crumbling of a magnet into a powder of small magnetic particles, or spalling of a surface layer.

This vulnerability is addressed in many commercial products by adding a protective coating to prevent exposure to the atmosphere. Nickel plating or two-layered copper-nickel plating are the standard methods, although plating with other metals, or polymer and lacquer protective coatings are also in use[16]

5.5-Magnetic Properties

Neodymium magnets are graded according to their maximum energy product, which relates to the magnetic flux output per unit volume. Higher values indicate stronger magnets and range from N35 up to N52. Letters following the grade indicate maximum operating temperatures (often the Curie temperature), which range from M (up to 100 degrees Celsius) to EH (200 degrees Celsius).

Some important properties used to compare permanent magnets are:

- remanence (B_r) - Which measures the strength of the magnetic field
- coercivity (H_{ci}) - The material's resistance to becoming demagnetized
- energy product (BH_{max}) - The density of magnetic energy
- Curie temperature (T_C) - The temperature at which the material loses its magnetism

Neodymium magnets have higher remanence, much higher coercivity and energy product, but often lower Curie temperature than other types. Neodymium is alloyed with terbium and dysprosium in order to preserve its magnetic properties at high temperatures

Following table shows the Comparison of magnetic performance of neodymium magnets with other types of permanent magnets.

Table(5.1): Comparison of magnetic performance of neodymium magnets with other types of permanent magnets.[17]

Magnet	**B_r (T)**	**H_{ci} (kA/m)**	**BH_{max} (kJ/m^3)**	**T_C (°C)**	**T_C (°F)**
$Nd_2Fe_{14}B$ (sintered)	1.0–1.4	750–2000	200–440	310–400	590–752
$Nd_2Fe_{14}B$ (bonded)	0.6–0.7	600–1200	60–100	310–400	590–752
$SmCo_5$ (sintered)	0.8–1.1	600–2000	120–200	720	1328
$Sm(Co, Fe, Cu, Zr)_7$ (sintered)	0.9–1.15	450–1300	150–240	800	1472
Alnico (sintered)	0.6–1.4	275	10–88	700–860	1292–1580
Sr-ferrite (sintered)	0.2–0.4	100–300	10–40	450	842

5.6- Hazards

The greater force exerted by rare-earth magnets creates hazards that are not seen with other types of magnet. Neodymium magnets larger than a few cubic centi-meters are strong enough to cause injuries to body parts pinched between two magnets, or a magnet and a metal surface, even causing broken bones.

Magnets allowed to get too near each other can strike each other with enough force to chip and shatter the brittle material, and the flying chips can cause injuries. There have even been cases where young children who have swallowed several magnets have had sections of the digestive tract pinched between two magnets, causing injury or death.[19] The stronger magnetic fields can be hazardous to mechanical and electronic devices, as they can erase magnetic media such as floppy disks and credit cards, and magnetize watches and the shadow masks of CRT type monitors at a greater distance than other types of magnet.[18]

5.7-Applications

(A)Existing magnet applications

Neodymium magnets have replaced alnico and ferrite magnets in many of the myriad applications in modern technology where strong permanent magnets are required, because their greater strength allows the use of smaller, lighter magnets for a given application. Some examples are:

01-Head actuators for computer hard disks

02-Erase heads for cheap cassette recorders

03-Magnetic resonance imaging (MRI)

04-Mechanical e-cigarette firing switches

05-Locks for doors

06-Loudspeakers and headphones

07-Magnetic bearings and couplings

08-Benchtop NMR spectrometers

09-Electric motors:

10-Servomotors

11-Lifting and compressor motors

12-Synchronous motors

13-Spindle and stepper motors

14-Electrical power steering

15-Drive motors for hybrid and electric vehicles. The electric motors of each Toyota Prius require 1 kilogram (2.2 pounds) of neodymium.

16-Electric generators for wind turbines (only those with permanent magnet excitation)

17-direct-drive wind turbines require c. 600 kg of PM material per megawatt[20]

18-turbines using gears require less PM material per megawatt

Neodymium content is estimated to be 31% of magnet weight

(B) New applications

01-Neodymium magnet spheres constructed in the shape of a cube

02-In addition, the greater strength of neodymium magnets has inspired new applications in areas where magnets were not used before, such as magnetic jewellery clasps, children's magnetic building sets (and other neodymium magnet toys) and as part of the closing mechanism of modern sport parachute equipment.[21] They also are the main metal in the formerly popular desk-toy magnets, "Bucky balls", though some retailers have chosen not to sell them due to child-safety concerns.

03-The strength and magnetic field homogeneity on neodymium magnets has also opened new applications in the medical field with the introduction of open magnetic resonance imaging (MRI) scanners used to image the body in radiology departments as an alternative to superconducting magnets that use a coil of superconducting wire to produce the magnetic field

04-Neodymium magnets are used as a surgically placed anti-reflux system which is a band of magnets[23] surgically implanted around the lower esophagael sphincter to treat gastroesophageal reflux disease (GERD).

Chapter 06: Material Selection

The proper selection of material for the different part of a machine is the main objective in the fabrication of machine. For a design engineer it is must that he be familiar with the effect, which the manufacturing process and heat treatment have on the properties of materials.
The Choice of material for engineering purposes depends upon the following factors:

1. Availability of the materials.

2. Suitability of materials for the working condition in service.

3. The cost of materials.

4. Physical and chemical properties of material.

5. Mechanical properties of material

6.1- The mechanical properties of the metals

The mechanical properties of the metals are those, which are associated with the ability of the material to resist mechanical forces and load.

We shall now discuss these properties as follows:

1. Strength: It is the ability of a material to resist the externally applied
forces

2. Stress: Without breaking or yielding. The internal resistance offered by a part to an externally applied force is called stress.

3. Stiffness: It is the ability of material to resist deformation under stresses. The modules of elasticity of the measure of stiffness.

4. Elasticity: It is the property of a material to regain its original shape after deformation when the external forces are removed. This property is desirable for material used in tools and machines. It may be noted that steel is more elastic than rubber.

5. Brittleness: It is the property of material opposite to ductile. It is the property of breaking of a material with little permanent distortion. Brittle materials when subjected to tensile loads snap off without giving any sensible elongation. Cast iron is a brittle material

6. Malleability: It is a special case of ductility, which permits material to be rolled or hammered into thin sheets, a malleable material should be plastic but it is not essential to be so strong. The malleable materials commonly used in engineering practice are lead, soft steel, wrought iron, copper and aluminium.

7. Toughness: It is the property of a material to resist the fracture due to high impact loads like hammer blows. The toughness of the material decreases when it is heated. It is measured by the amount of absorbed after being stressed up to the point of fracture. This property is desirable in parts subjected to shock an impact load.

8. Resilience: It is the property of a material to absorb energy and to resist rock and impact loads. It is measured by amount of energy absorbed per unit volume within elastic limit. This property is essential for spring material.

9. Creep: When a part is subjected to a constant stress at high temperature for long period of time, it will undergo a slow and permanent deformation called creep. This property is considered in designing internal combustion engines, boilers and turbines.

10. Hardness: It is a very important property of the metals and has a wide verity of meanings. It embraces many different properties such as resistance to wear scratching, deformation and much inability etc. It also means the ability of the metal to cut another metal. The hardness is usually expressed in numbers, which are dependent on the method of making the test.

The hardness of a metal may be determined by the following test

a) Brinell hardness test

b) Rockwell hardness test

c) Vickers hardness (also called diamond pyramid) test and

d) Share scaleroscope.

6.2-Concepts of General Selection of Material

The science of the metal is a specialized and although it overflows in to realms of knowledge it tends to shut away from the general reader. The knowledge of materials and their properties is of great significance for a design engineer. The machine elements should be made of such a material which has properties suitable for the conditions of operations.

In addition to this a design engineer must be familiar with the manufacturing processes and the heat treatments have on the properties of the materials. In designing the various part of the machine it is necessary to know how the material will function in service. For this certain characteristics or mechanical properties mostly used in mechanical engineering practice are commonly determined from standard tensile tests. In engineering practice, the machine parts are subjected to various forces, which may be due to either one or more of the following.

1. Energy transmitted

2. Weight of machine

3. Frictional resistance

4. Inertia of reciprocating parts

5. Change of temperature

6. Lack of balance of moving parts

The selection of the materials depends upon the various types of stresses that are set up during operation. The material selected should with stand it. Another criteria for selection of metal depend upon the type of load because a machine part resist load more easily than a live load and live load more easily than a shock load.

Selection of the material depends upon factor of safety, which in turn depends upon the following factors.

1. Reliabilities of properties

2. Reliability of applied load

3. The certainty as to exact mode of failure

4. The extent of simplifying assumptions

5. The extent of localized

6. The extent of initial stresses set up during manufacturing

7. The extent loss of life if failure occurs

8. The extent of loss of property if failure occurs Materials selected in m/c Base plate, motor support, sleeve and shaft

6.3-Material Used

Mild steel:

Reasons:

1. Mild steel is readily available in market

2. It is economical to use

3. It is available in standard sizes

4. It has good mechanical properties i.e. it is easily machinable

5. It has moderate factor of safety, because factor of safety results in unnecessary wastage of material and heavy selection. Low factor of safety results in unnecessary risk of failure

6. It has high tensile strength

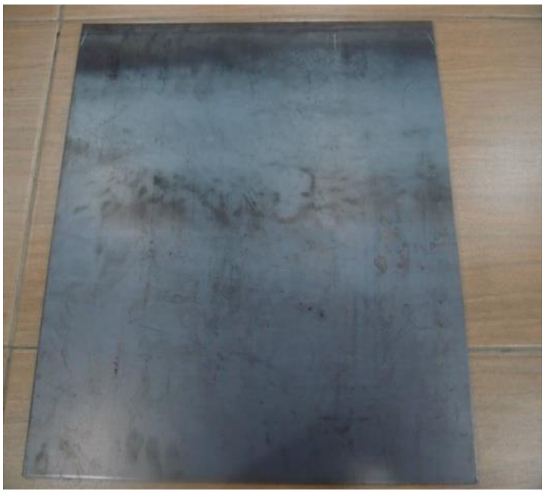
7. Low co-efficient of thermal expansion

Properties of Mild Steel:

M.S. has a carbon content from 0.15% to 0.30%. They are easily wieldable thus can be hardened only. They are similar to wrought iron in properties. Both ultimate tensile and compressive strength of these steel increases with increasing carbon content. They can be easily gas welded or electric or arc welded. With increase in the carbon percentage weld ability decreases.

Mild steel serve the purpose and was hence was selected because of the above purpose

6.4-Tools Used



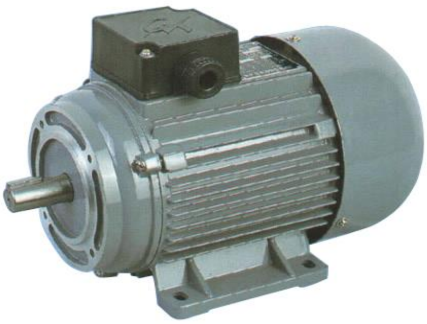
Figure(6.1): Mild Steel plate

Figure(6.2): Steel plate cutter

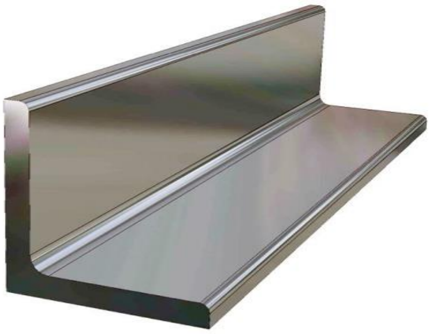
Figure(6.3): Welding machine

Figure(6.4): Lathe Machine

Figure(6.5): Drill machine

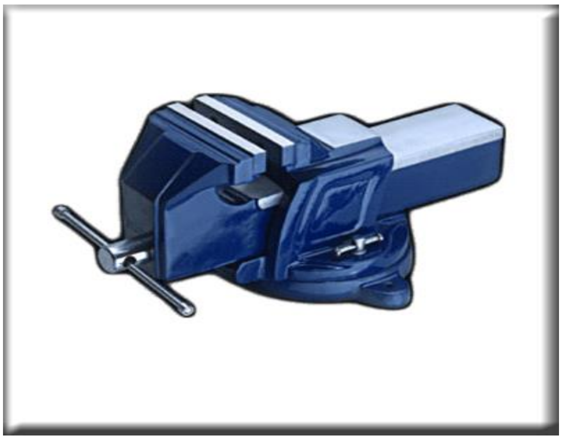


Figure(6.6): Electric motor



Figure(6.7): Iron angles

Figure(6.8): Steel file tool



Figure(6.9): Vices

Figure(6.10): Measuring tape

6.5-Raw Material & Standard Material

Table(6.1): Raw Material & Standard Material

SR NO	PART NAME	MAT	QTY
1	FRAME	MS	1NOS
2	MAGNET	NEO DYNEUM	12 NOS
3	SHAFT DIA 20 MM	EN 8	2 NOS
4	0.5 HP 3 PHASE AC MOTOR 1400	STD	1 NOS
5	PULLEY	MS	2 NOS
6	FLYWHEEL	STD	1NOS
7	ALUMINUM WHEEL	AL	1 NOS
8	PEDESTAL BEARING	CI	2NOS
9	FREE WHEEL	STD	1 NOS
10	NUT BOLT WASHER M 10	MS	8 NOS
11	WELDING ROD	-	1 50 NOS
12	COLOUR	-	2 LIT

Chapter 07: Cost Estimation

Cost estimation may be defined as the process of forecasting the expenses that must be incurred to manufacture a product. These expenses take into a consideration all expenditure involved in a design and manufacturing with all related services facilities such as pattern making, tool, making as well as a portion of the general administrative and selling costs.

7.1- Purpose of Cost Estimation

1. To determine the selling price of a product for a quotation or contract so as to ensure a reasonable profit to the company.

2. Check the quotation supplied by vendors.

3. Determine the most economical process or material to manufacture the product.

4. To determine standards of production performance that may be used to control the cost.

7.2-Tyres of Cost Estimation

1. Material cost

2. Machining cost

MATERIAL COST ESTIMATION:

Material cost estimation gives the total amount required to collect the raw material which has to be processed or fabricated to desired size and functioning of the components.

These materials are divided into two categories.

1. Material for fabrication:

In this the material in obtained in raw condition and is manufactured or processed to finished size for proper functioning of the component.

1. Standard purchased parts:

This includes the parts which was readily available in the market like allen screws etc. A list is forecast by the estimation stating the quality, size and standard parts, the weigh of raw material and cost per kg. For the fabricated parts.

MACHINING COST ESTIMATION:

This cost estimation is an attempt to forecast the total expenses that may include manufacturing apart from material cost. Cost estimation of manufactured parts can beconsidered as judgment on and after careful consideration which includes labour, material and factory services required to produce the required part.

7.3- Procedure for calculation of Material Cost

The general procedure for calculation of material cost estimation is

1. After designing a project a bill of material is prepared which is divided into two categories.

a. Fabricated components

b. Standard purchased components

2. The rates of all standard items are taken and added up.

3. Cost of raw material purchased taken and added up

7.4-Labour Cost

It is the cost of remuneration (wages, salaries, commission, bonus etc.) of the employees of a concern or enterprise

Labour cost is classifies as:

1-Direct labour cost

2-Indirect labour cost

Direct labour cost:-The direct labour cost is the cost of labour that can be identified directly with the manufacture of the product and allocated to cost centres or cost units. The direct labour is one who counters the direct material into saleable product; the wages etc. of such employees constitute direct labour cost. Direct labour cost may be apportioned to the unit cost of job or either on the basis of time spend by a worker on the job or as a price for some physical measurement of product.

Indirect labour cost:-It is that labour cost which cannot be allocated but which can be apportioned to or absorbed by cost centres or cost units. This is the cost of labour that doesn't alters the construction, confirmation, composition or condition of direct material but is necessary for the progressive movement and handling of product to the point of dispatch e.g. maintenance, men, helpers, machine setters, supervisors and foremen etc.

The total labour cost is calculated on the basis of wages paid to the labour for 8 hours per day.

7.5-Calculation of total Cost

TOTAL COST = Raw Material Cost + STD Parts Cost + Direct Labour Cost +Indirect Cost

A) Raw Material Cost & Standard Part Cost

Table(7.1): Raw Material Cost& Standard Part Cost

SR NO	PART NAME	MAT	QTY	COST
1	FRAME	MS	10 kg	600
2	MAGNET	NEODYMUM	10 NOS	2000
3	SHAFT DIA 20 MM	EN 8	1 NOS	350
4	0.75 hp ac 3 PH MOTOR	STD	1 NOS	3500
5	PULLEY	MS	2 NOS	650
6	FLYWHEEL	MS	1NOS	800
7	ALUMINUM WHEEL	AL	1 NOS	650
8	PEDESTAL BEARING P204	CI	2NOS	500
9	FREE WHEEL	STD	1 NOS	120
10	NUT BOLT WASHER M 10	MS	8 NOS	75
11	WELDING ROD	-	150 NOS	150
12	COLOUR	-	2 LIT	100
			TOTAL	9495/-

Total Raw Material Cost& Standard Part Cost = 9495 Rs.

B) Direct Labour Cost

Table(7.2): Direct Labour Cost

SR. NO.	OPERATION	HOURS	RATE / LABOUR	AMOUNT
1.	Turning	10	150	1500
2.	Milling	2	150	300
3.	Drilling	7	100	700
4.	Welding	16	175	2800
5.	Grinding	3	60	180
6.	Tapping	3	40	120
7.	Cutting	8	40	320
8.	Gas cutting	8	50	400
9.	Assembly	2	100	200
10.	Painting	2	100	200
			TOTAL	6720/-

Total Direct Labour Cost = 6720 Rs.

C) Indirect Cost

1. Transportation cost = 500/-
2. Coolent& lubricant = 100/-
3. Drawing cost = 500/-
4. Project report cost = 2000

Total Indirect Cost = 3100 Rs.

Total Cost = Raw Material Cost + STD Parts Cost + Direct Labour Cost +Indirect Cost

Total cost of project = (9495 + 6720 +3100) Rs.

Total cost of project = 19315 Rs.

Chapter 08: Machine Design

The subject of MACHINE DESIGN deals with the art of designing machine of structure. A machine is a combination of resistance bodies with successfully constrained relative motions which is used for transforming other forms of energy into mechanical energy or transmitting and modifying available design is to create new and better machines or structures and improving the existing ones such that it will convert and control motions either with or without transmitting power. It is the practical application of machinery to the design and construction of machine and structure. In order to design simple component satisfactorily, a sound knowledge of applied
science is essential. In addition, strength and properties of materials including some metrological are of prime importance. Knowledge of theory of machine and other branch of applied mechanics is also required in order to know the velocity. Acceleration and inertia force of the various links in motion, mechanics of machinery involve the design.

8.1-Consideration in Machine Design

When a machine is to be designed the following points to be considered: -

i)Types of load and stresses caused by the load.

ii) Motion of the parts and kinematics of machine. This deals with the type of motion i.e. reciprocating .Rotary and oscillator .

iii) Selection of material & factors like strength, durability, weight,
corrosion resistant, weld ability, machine ability are considered.

iv) Form and size of the components.

v) Frictional resistances and ease of lubrication.

vi) Convince and economical in operation.

vii) Use of standard parts.

viii) Facilities available for manufacturing.

ix) Cost of making the machine.

x) Number of machine or product are manufactured.

8.2-General Procedure in Machine Design

The general steps to be followed in designing the machine are as followed.

i) Preparation of a statement of the problem indicating the purpose of the machine.

ii) Selection of groups of mechanism for the desire motion.

iii) Calculation of the force and energy on each machine member.

iv) Selection of material.

v) Determining the size of component drawing and sending for manufacture.

vi) Preparation of component drawing and sending for manufacture.

vii) Manufacturing and assembling the machine.

viii) Testing of the machine and for functioning.

Chapter 9: Calculation

9.1-Motor Design

We want speed upto 43 kmph as average speed of bike on road is 40 to 45 kmph from research.

$\therefore$ 43kmph= 11.944 m/s & D=0.22 M

$$V = \pi \frac{DN}{60}$$

$\therefore$N=1036.88 RPN≈1036 RPM

The flywheel speed = 1036 RPM

Now for motor torque,

Weight of flywheel =1.5Kg

Taking G=10 m/s^2

Now breaking force F= 1.5 x 10= 15 N

Torque= F x R

= 15 X 0.11

= 1.65 Nm

P=$\frac{2\pi NT}{60}$

= $\frac{2\pi x\ 1036\ x\ 1.65}{60}$

= 179 watt

= $\frac{179}{746}$

= 0.2399 HP

≈ 0.24 HP

This is minimum power required for motor.

From psg 5.124 we select standard motor of 0.5 HP AND 1380 RPM

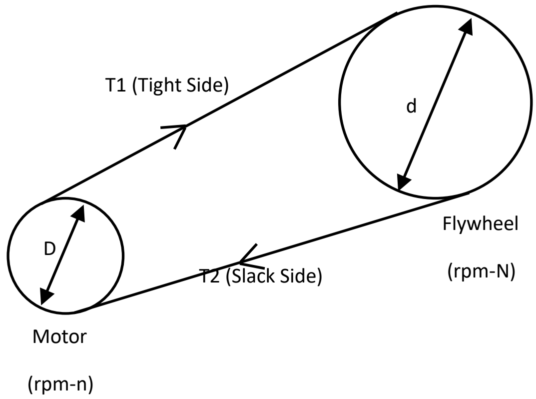
9.2-To Find Reduction Ratio

Now from motor speed and flywheel speed we will find the reduction ratio.

Reduction ratio $=\frac{n}{N}$

$=\frac{1036}{1380}$

$= 0.75$



And speed ratio (i) $= \frac{N}{n} = \frac{1380}{1036} = 1.332$

$i = \frac{N}{n} = \frac{d}{D} = 1.332$

$\therefore$ d=1.332D

for belt design (v belt design)

P= 0.5HP=0.373 =KW & 10 Hr/day duty shift

$\therefore$[P] = 0.373*1= 0.373 KW (PSG 7.69)

Now selection of belt type from PSG 7.58

C/S symbol	Load of drive (KW)	Width (mm)	Thickness (mm)
A	0.75 ~ 5	13	8

Since power required for us is not available in data book so we are taking value near to our requirement and design according to it.

Now,

Using saverian criteria,

$$1100\sqrt[3]{\frac{[P]}{N}} \leq D \leq 1300\sqrt[3]{\frac{[P]}{n}}$$

$$1100\sqrt[3]{\frac{0.373}{1036}} \leq D \leq 1300\sqrt[3]{\frac{0.373}{1380}}$$

73.25 mm ≤ D ≤ 84.05 mm

$\therefore$D =71 mm (PSG 7.54)

Now selecting D= 75 mm (for std pulley design)

Belt velocity (V) $=\frac{\Pi D n}{60}$

$= \frac{\Pi * 75 * 1036 * 10^{-3}}{60}$

=4.068 m/s $<$ 25 m/s

Now diameter of flywheel pulley

d= D * i * n

n=0.98

d= 75*1.33*0.98

d= 97.902 mm

selecting standard pulley = 100 mm (PSG 7.54)

Now for calculation of length of belt ,

C_{max}= 2*(D+d) = 350 mm

&C_{min}=0.55*(D+d)+thickness =104.25mm

Now for our convenience we are taking centre distance as 335 mm

L=2C+$\frac{\Pi}{2}(D+d)+\frac{(D-d)^2}{4C}$

L= 945.356 mm

L=37.22 inch

L≈ 37 Inch

Arc of contact (θ) $=2 * cos^{-1}\left(\frac{D-d}{2C}\right)$

$=2 * cos^{-1}(\frac{100-75}{2*335})$

=175.723°= 3.067 radian

Correction factor (f_d) for 175.723° is 0.99

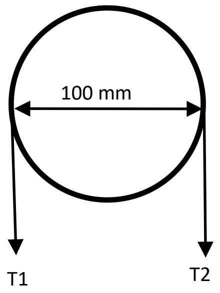
Let assume,

Semi groove angle (∝) = 20°

Friction(μ)= 0.25

For T_1&T_2,

$\frac{T_1}{T_2}=e^{\mu\theta cosec\alpha}$



$\frac{T_1}{T_2}=e^{0.25*3.067*cosec\ 20}$

$\frac{T_1}{T_2}$=9.412

T_1=9.412T_2

T_{max}=($T_1 - T_2$)*r .....(d=100mm)

For T_{max},

P =$\frac{2\Pi NT}{60}$

T=$\frac{0.5*746*60}{2\Pi*1380}$

T_{max}= 2581 N-mm

$\therefore$2581= ($T_1 - T_2$)*50

$T_1 - T_2$ =51.62

9.412T_2 - T_2 =51.62

T_2=6.136N

T_1=6.136*9.412

T_1=57.752 N

Now, Power that is deliver by belt

P= ($T_1 - T_2$)*v

= (57.752-6.136)*$\frac{\Pi*0.075*1380}{60}$

P = 279.72 Watt

Now no of belt required to deliver power,

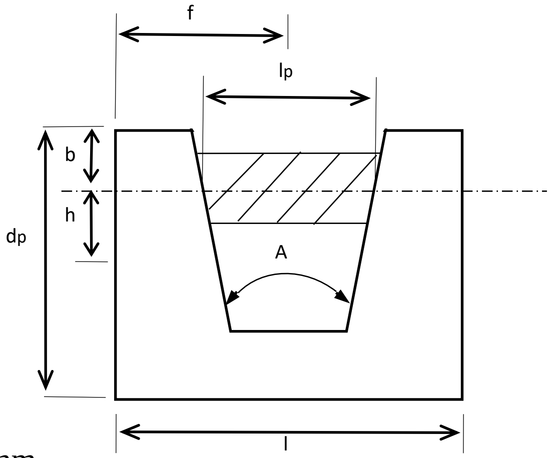
No of belt=$\frac{Powerdeliverbybelt}{Totalpowerdeliverperbelt}$

= $\frac{279.72}{373}$

= 0.7499 ≈ 0.75= 1

Hence only one belt is sufficient to deliver power.

9.3-Pully Design



For selection ,

l_p=11mm

b=3.3mm

h= 8.7mm

d_p=67 to 75 mm

Edge to centre pulley distance (f)= 10 mm

l= 2*f = 20 mm (width of pulley)

9.4-Shaft Design

Taking moment at A ,

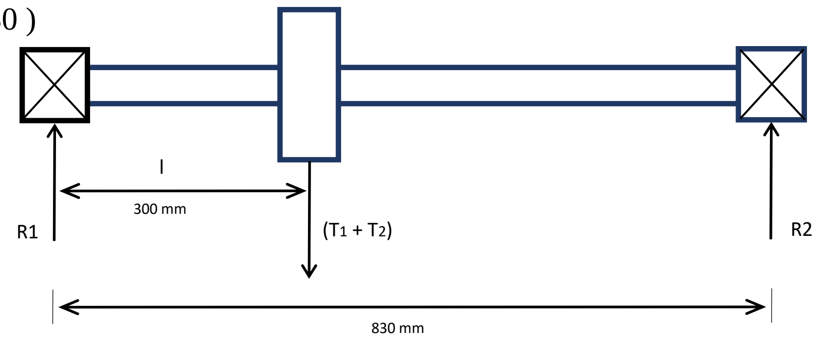
(R_2* 830) = 63.888* 300

R_2 =23.092 N

&R_1+R_2= $T_1 + T_2$

R_1=40.796 N

Moment = $(T_1 + T_2)$* l – (R_2*830)



Moment = $(T_1 + T_2)$* l

= 63.888*300

= 19.166Nm

& Torque = T_{max}= 2.581 Nm

T_{eq}=$\sqrt{T^2 + M^2}$…..($K_b = K_t$ =1)

=$\sqrt{19.166^2 + 2.581^2}$

T_{eq} = 19.34 Nm

= 19.34 * 10^3Nmm

Now selecting EN8 material for shaft.

From specification,

Maximum stress (ultimate) = 700 -850 N/mm^2

Yield stress = 465 N/mm^2

Now from ASME code,

$\tau_{permissible}$= 30 % of yield stress

= 18 % of maximum stress

$\tau_{permissible}$= 0.3 * 465 = 139.5 N/mm^2

= 0.18 * 700 = 126 N/mm^2

$\tau_{permissible}$= 126 N/mm^2

We are using grinder for mounting for mounting of flywheel and extra shaft .

So the strength is reduced by 25%.

τ_{final}= $0.75 * \tau_{permissible}$

τ_{final}= 0.75 * 126

τ_{final} = 94.5 N/mm^2

τ_{final} = 95 N/mm^2

Now for shaft diameter,

$T_{eq}=\frac{\Pi}{16} * d^3 * \tau_{final}$

$19.34*10^3=\frac{\Pi}{16} * d^3 * 95$

d^3=1036.82

d=10.12 mm

for safety purpose we are taking diameter of shaft 20 mm.

9.5-Bearing Selection

We have shaft diameter is 20 mm.

Hence we are using P204 bearing.

Where,

P= Pedestal bearing

2=Spherical ball / DGBB

04=5*04 =20 mm …..(bore diameter)

9.6-Design of Transverse Fillet Welded Part

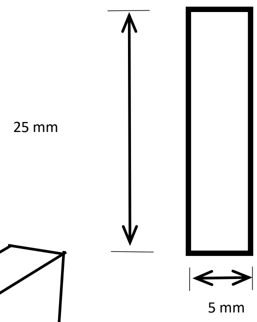
From PSG 11.4,

For 5 mm thick plate,

Weld size = 3 mm (diameter)

In practical model weld size = 3.2 mm(diameter)

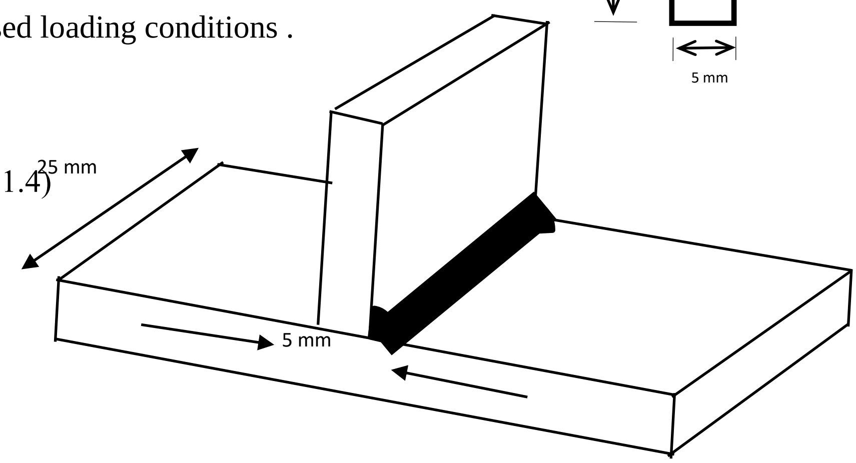
Area of weld (for single fillet weld)=0.707* weld size *L



A= 0.707*3.2*25

= 56.56 mm^2

Here we use bare electrodes and reversed loading conditions .



$\sigma_{forweldjoint}$=20.60 N/mm^2…(PSG 11.4)

$\sigma=\frac{F}{A}$

F=20.60*56.56

F=1185.136 N=118.77 Kgf

F/L =118.75/2.5 =47.508 Kgf/cm $<$ 170 Kgf/cm …(PSG 11.4)

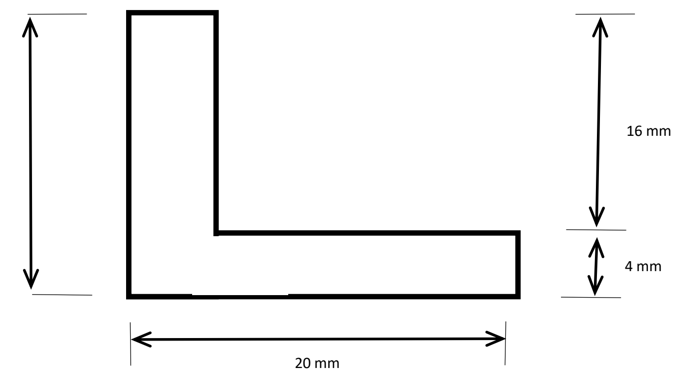
Hence welding is safe and applicable.

9.7-Design of Angle Stand

Now weight of our project/machine is 40 kg

$\therefore$W= 40 kg/leg

M= W *L



= 10*560*9.81

= 54938 Nmm

$Z=\frac{B^3}{6} - \frac{b^4}{6*B}$

$Z= \frac{20^3}{6} - \frac{16^4}{6*20}$

Z=787.2 mm

$\sigma_b = \frac{M}{Z}$

$= \frac{54938}{787.2}$

= 69.789 N/$mm^2 <$ 90 N/mm^2

Hence design is safe.

9.8-Design of Bolt

Selecting hexagonal bolt,

Material = C45

Shear stress (σ_s) = 45 N/mm^2

Tensile stress (σ_t) = 90 N/mm^2

We are taking bolt of size 9.31 mm. …(from market)

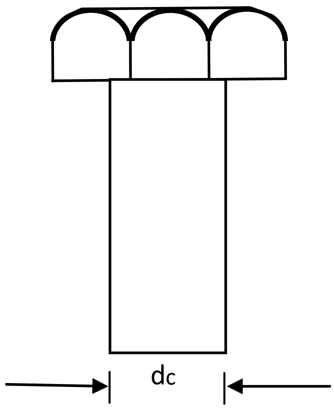
To check the safety of bolt,

From PSG data book we have select the series M8

d_e= 8 mm

& for maximum condition we assume

P = tightening force = 100 kg = 981 N



$P = \frac{\Pi}{4} * {d_e}^3 * \sigma_t$

$\sigma_t = \frac{981*4}{\Pi*8}$

σ_t= 19.52 N/mm^2 <90 N/mm^2

Since $\sigma_{tensile}$ is always ≥ σ_{shear}

Hence bolt will sustain both $\sigma_{tensile}$&σ_{shear}.

Therefore design is safe.

9.9-Braking Time Calculation For Disc Brake

1. Name of Bike = Honda Shine
2. Kerb Weight = 125 Kg
3. Weight with driver and pinion with luggage = 200 Kg
4. Total Weight = 325 Kg
5. Diameter of Calliper Piston = 0.032 m
6. Diameter of master cylinder = 0.01905 m
7. Diameter of Wheel = 0.508 m
8. Diameter of Brake Disk = 0.22 m
9. Rolling Friction Coefficient (μ_r) = 0.04
10. Coefficient of friction between wheel and road with dry condition (μ_{rw}) = 0.8
11. Coefficient of friction between wheel and road with wet condition = 0.45
12. Coefficient of friction between brake pad and brake disk(μ) = 0.3

Now,

A) The braking process starts with the application of force on the brake pedal with leverage and fluid in the master cylinder gets pressurized.
Hence,

$$P_e = \frac{\text{Pedal force} * \text{leverage}}{\text{Master cylinder area}}$$

$$= \frac{392 * 3}{\frac{\pi}{4} * (0.1905)^2}$$

$$= 4.126 * 10^6 \ \mathrm{N/m^2}$$

B) Friction force on each disc,

$$F_e = \mu * P_e * 2 * \text{area of calliper cylinder}$$

$$= 0.3 * 4.126 * 10^6 * \frac{\pi}{4} * (0.032)^2$$

$= 1990.995$ N

≈ 1991 N

C) The friction force provides braking torque to wheel and then this braking torque is converted into the braking force which can be calculated by the following equation. Brake force by each disc,

$$F_d = \frac{F_e * R_e}{R_w}$$

$$= \frac{1991 * 0.11}{\frac{0.508}{2}}$$

$= 862.244$ N

D) In addition to the braking force exerted by braking system addition rolling friction also acts against the motion of the vehicle.
Rolling friction force,

$$F_{f_r} = \mu_r * m * g$$

$$= 0.04 * 325 * 9.81$$

$= 127.53$ N

E) Now total braking force is the summation of forces exerted on disc brakes and rolling friction. Hence,
Total makeforce,

$$F_t = F_{f_r} + F_d$$

$$= 127.53 + 862.244$$

$= 989.774$ N

≈ 990 N

F) Now, for the Braking Time calculation we take,
speed of bike = 11.944 m/s

$$F = m * a$$

$$990 = 325 * a$$

$a = 3.0461\ m/s^2$

$a = \frac{v}{t}$

$t = \frac{v}{a}$

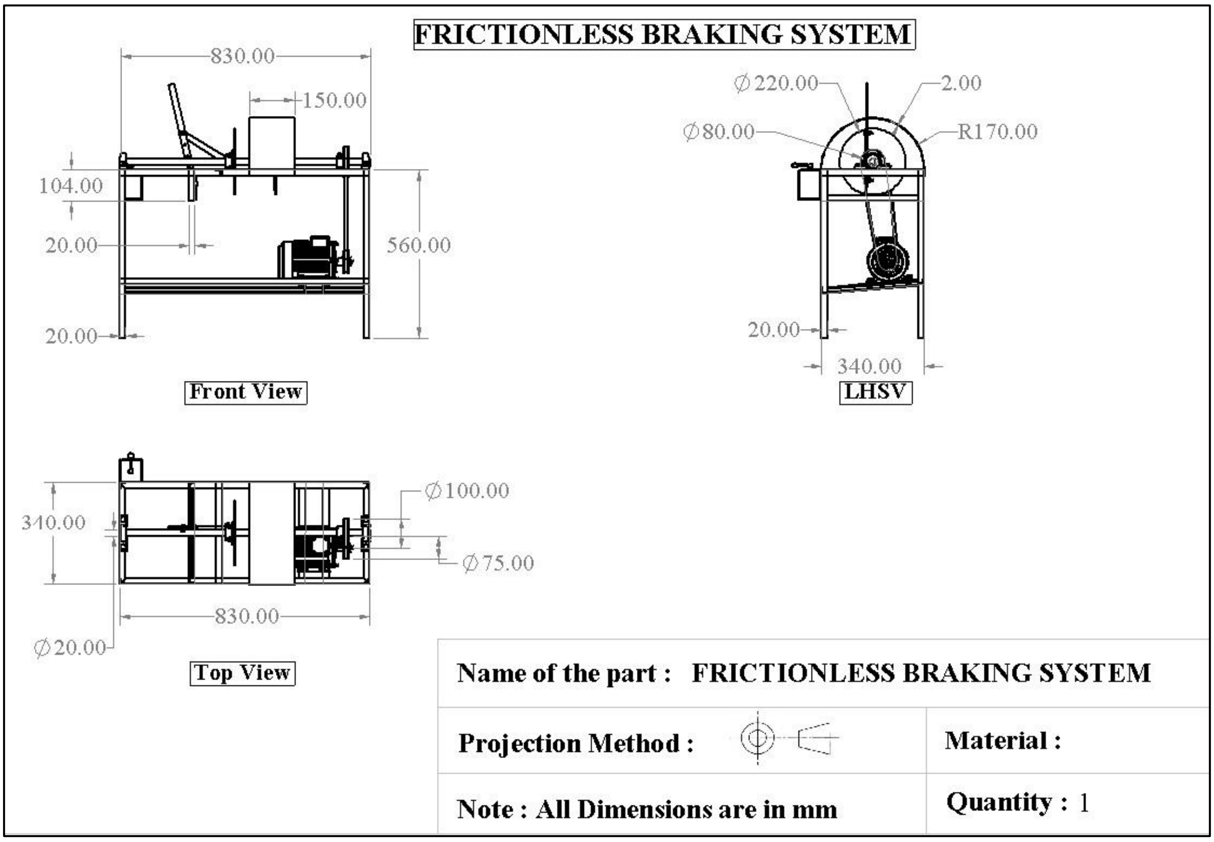
$t = \frac{11.944}{3.046}$

$t = 3.921\ sec$

Chapter 10: 2D Drafting

The 2D drafting of components used in the frictionless braking system are drafted for front, top, side and section view.

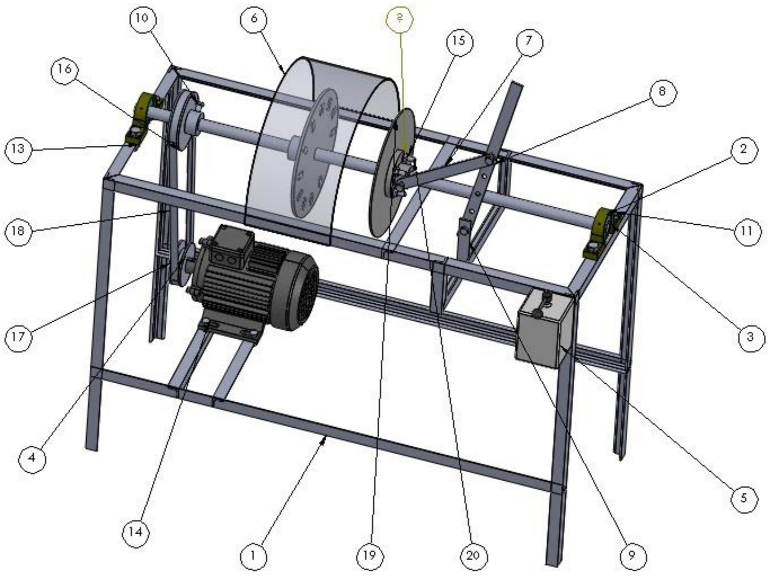
10.1-2D Drafting of Frictionless Braking System



Figure(10.1): 2D Drafting of Frictionless Braking system

10.2-Bill of Material

LIST OF PARTS



ITEM NO.	PART NUMBER	QTY.
1	Main Frame	1
2	Bearing	2
3	Shaft	1
4	3 PHASE MOTOR 0.5HP	1
5	startor	1
6	Hood	1
7	Joining link	1
8	Handle	1
9	Bottom link	1
10	Hex Screw M8	2
11	M10 Bolt	4
12	10 mm Washer	4
13	M10 Nut	4
14	M8 Bolt	6
15	M8 Nut	10
16	100 MM PULLEY	1
17	75 MM PULLEY	1
18	Belt1-1	1
19	Stopping Plate	1
20	Countersunk Hex Head Bolt M8	4
21	Free Wheel	1
22	Magnetic Disc	1
23	Neodymium Magnet	12
24	8 mm Washer	4

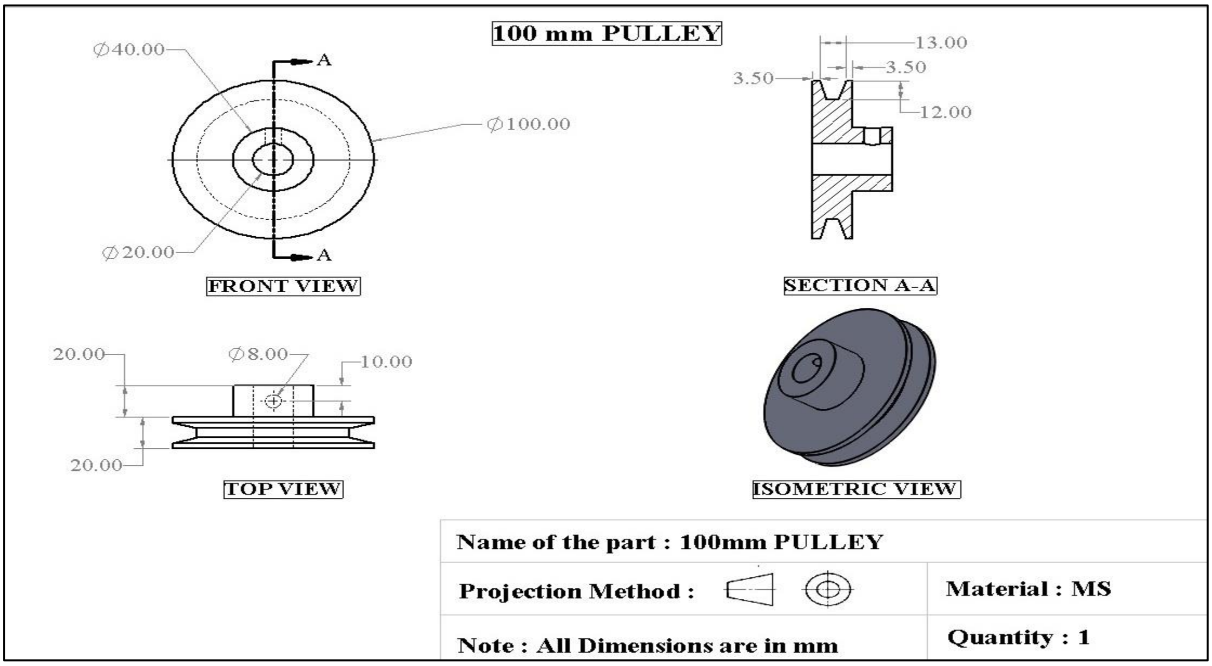
Name of the part : LIST OF PARTS	
Projection Method :	**Material :**
Note : All Dimensions are in mm	**Quantity :**

Figure(10.2): Bill of Material

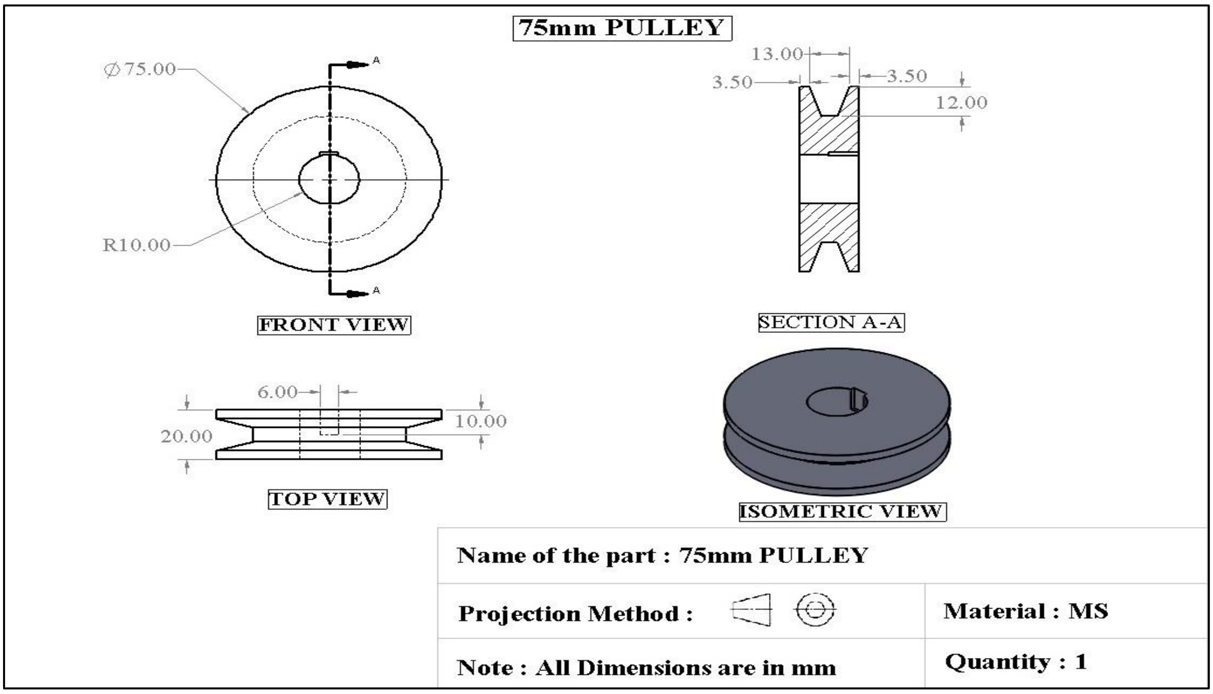
Table(10.1): Bill of Material

Sr No.	Part Name	Material	Quantity
1	Main Frame	M.S.	1
2	Bearing	C.I.	1
3	Shaft	EN 8	1
4	Three Phase Motor 0.5HP	STD	1
5	Stator	STD	1
6	Hood	M.S.	1
7	Joining Link	M.S.	1
8	Handle	M.S.	1
9	Bottom Link	M.S.	1
10	Hex Screw M8	C45	2
11	M10 Bolt	C45	4
12	10mm Washer	C45	4
13	M10 Nut	C45	4
14	M8 Bolt	C45	6
15	M8 Nut	C45	10
16	100 mm Pulley	M.S.	1
17	75 mm Pulley	M.S.	1
18	Belt 1-1	STD	1
19	Stopping Plate	Al	1
20	Countersunk Hex Head Bolt M8	C45	4
21	Free Wheel	STD	1
22	Magnetic Plate	M.S.	1
23	Neodymium Magnet	Neodymium	12
24	8 mm Washer	C45	4

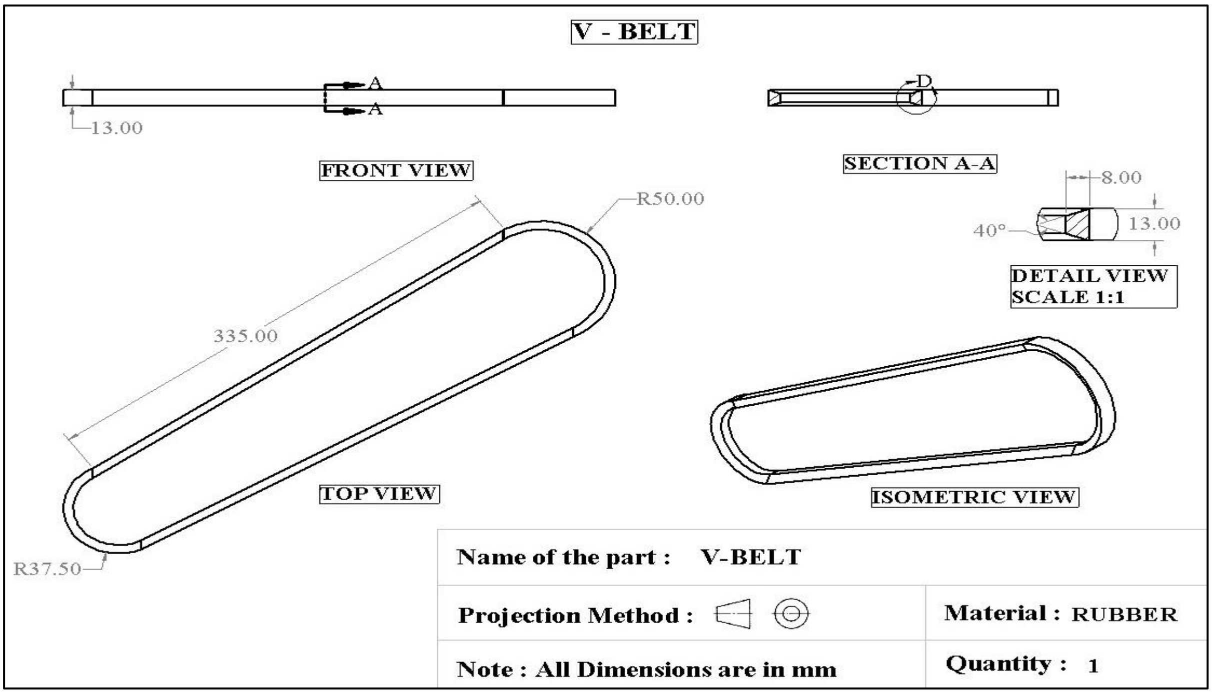
10.3-2D Drafting of Parts



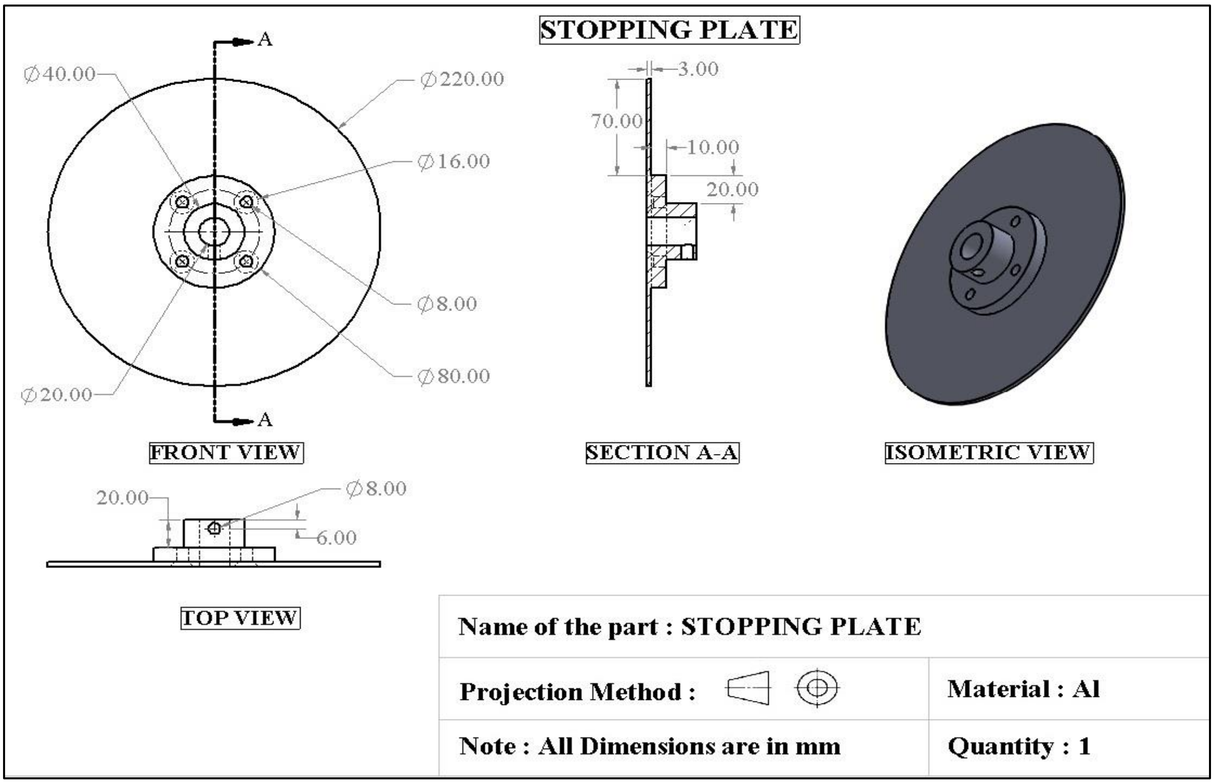
Figure(10.3): 100 mm Pulley



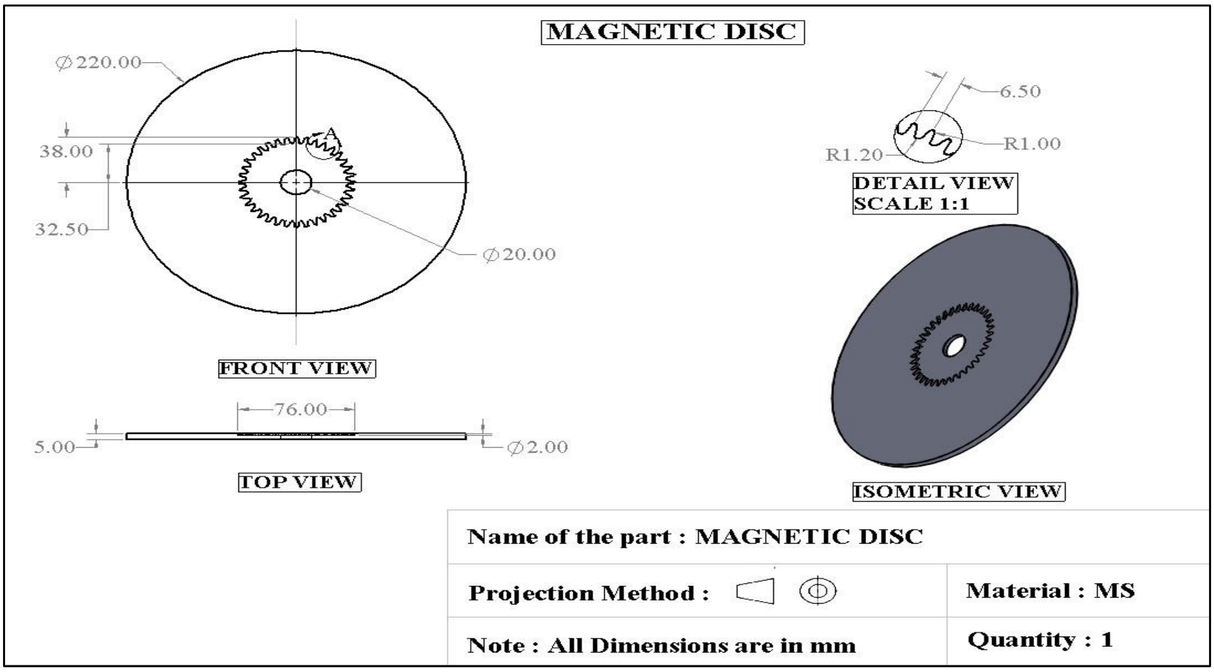
Figure(10.4): 75 mm Pulley



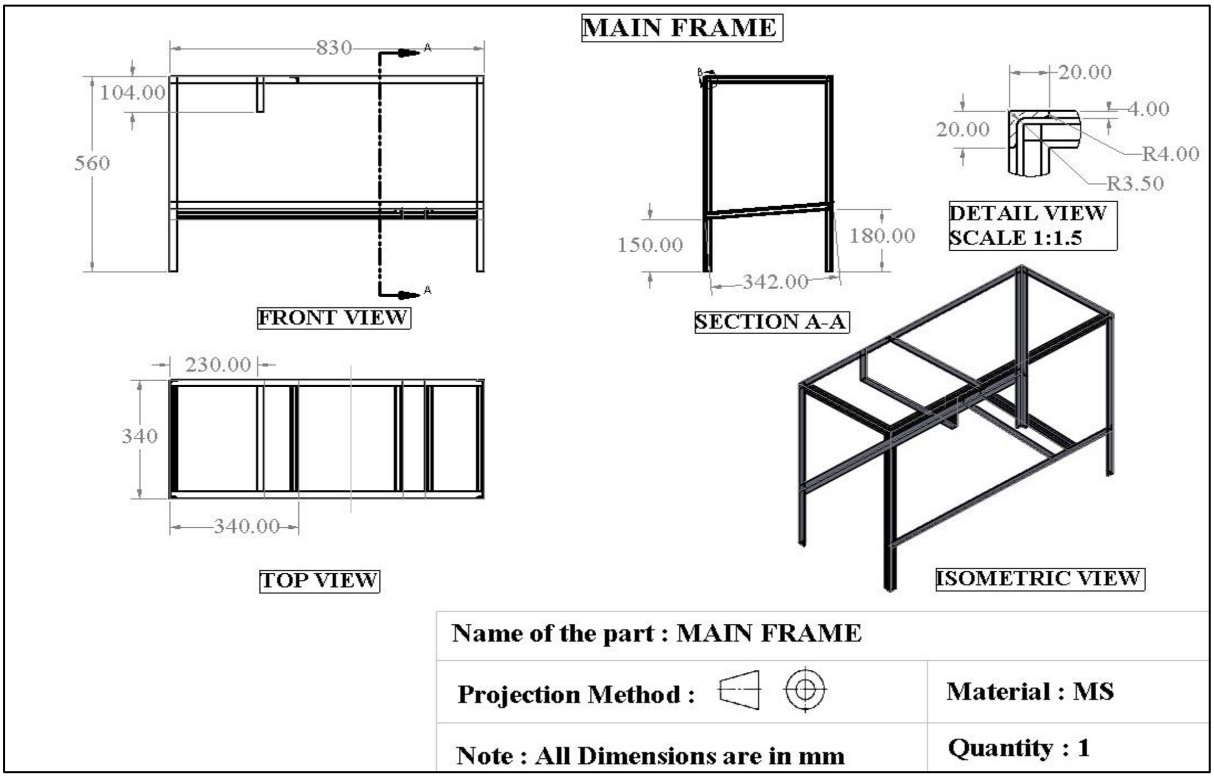
Figure(10.5): V-Belt



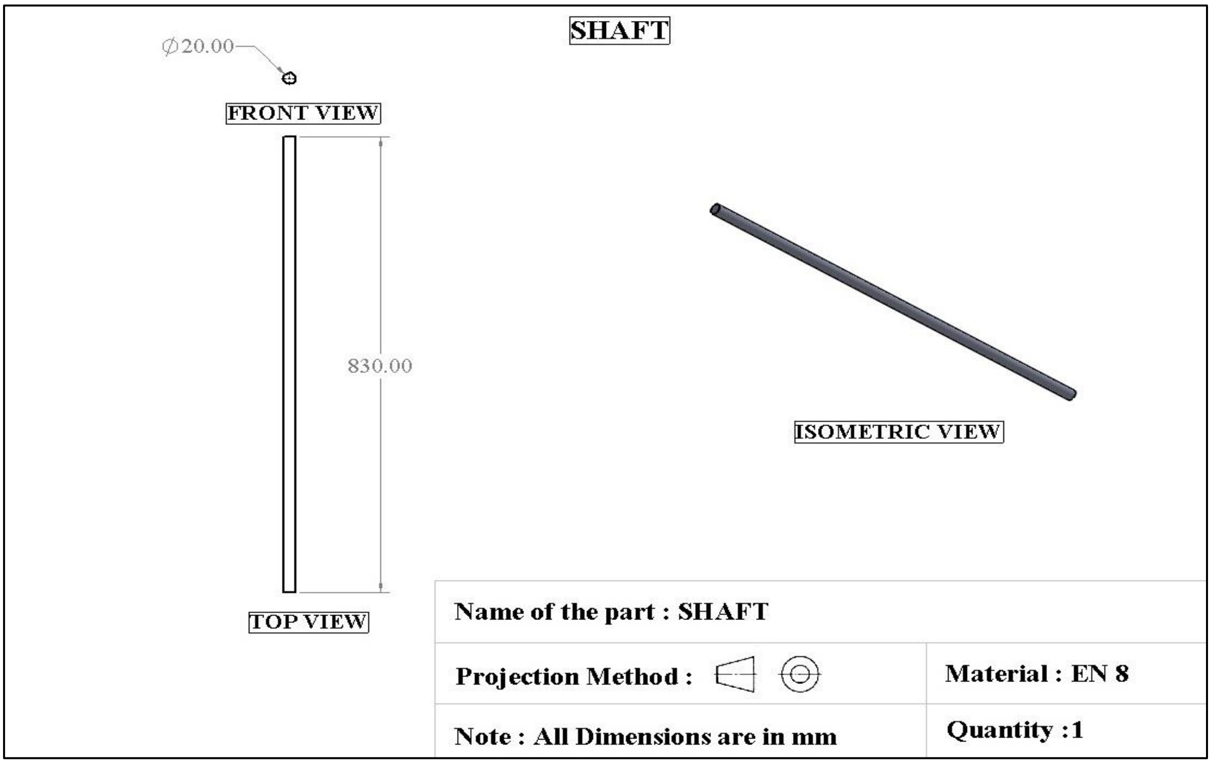
Figure(10.6): Stopping Plate



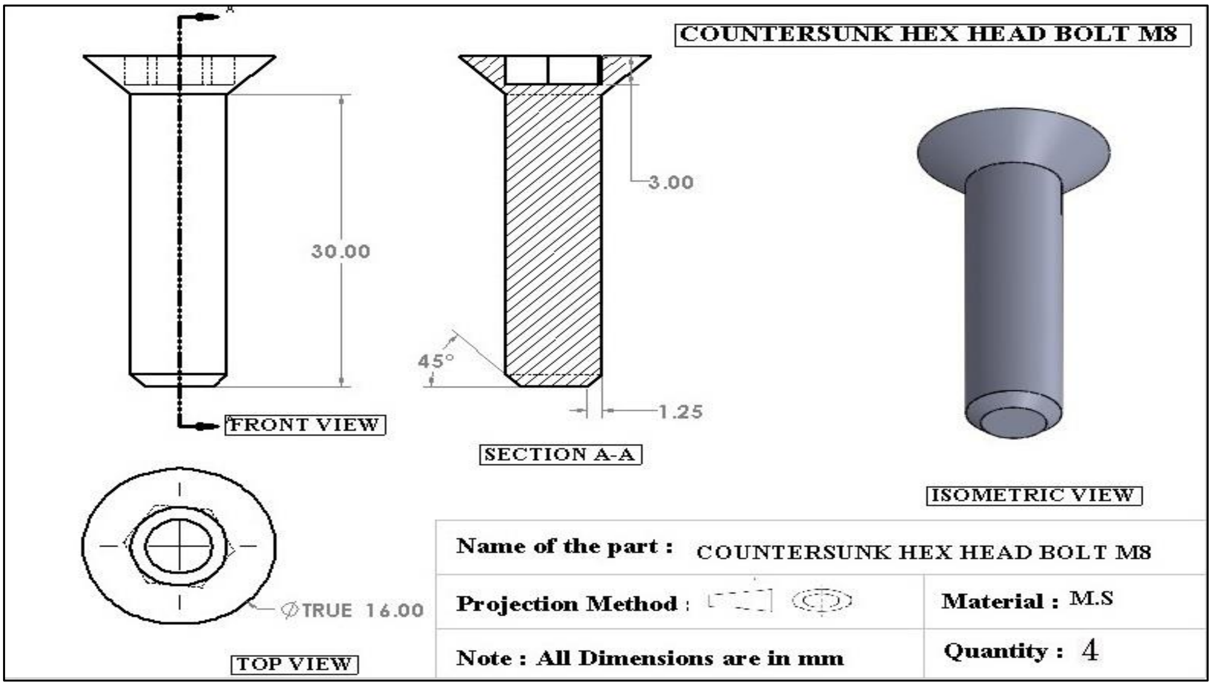
Figure(10.7): Magnetic Disc



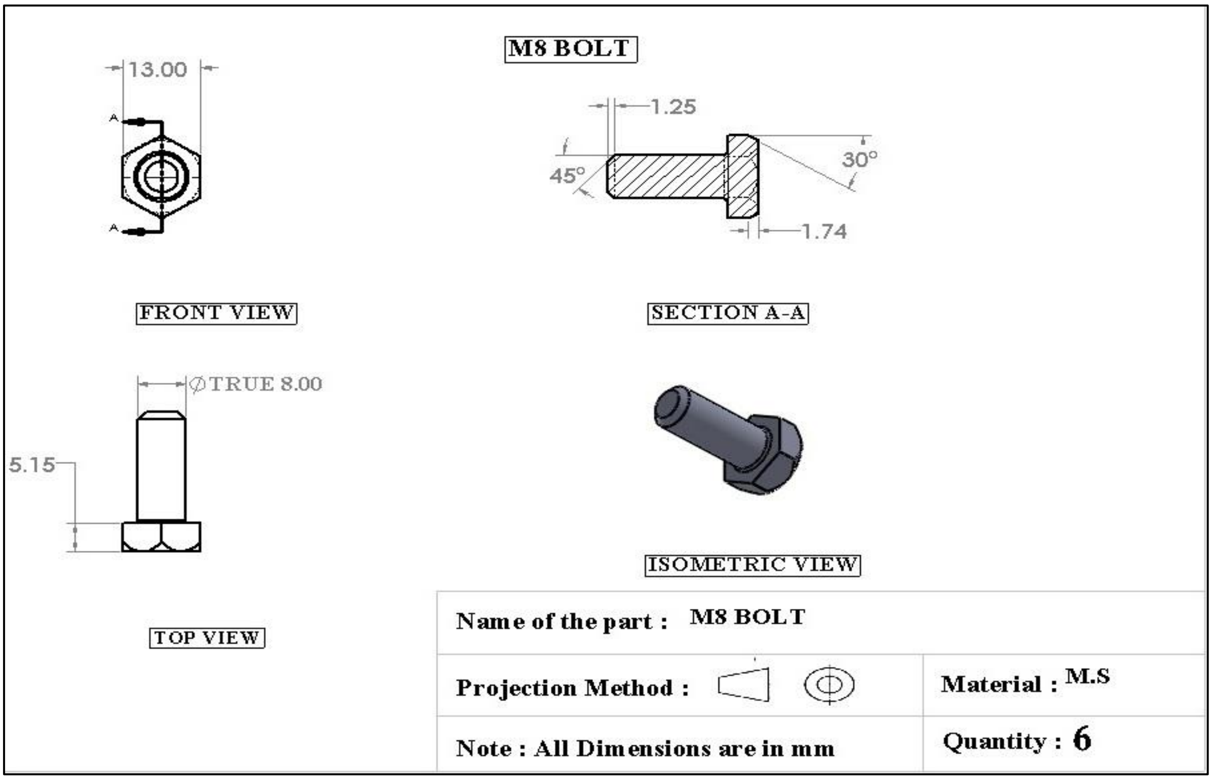
Figure(10.8): Main Frame



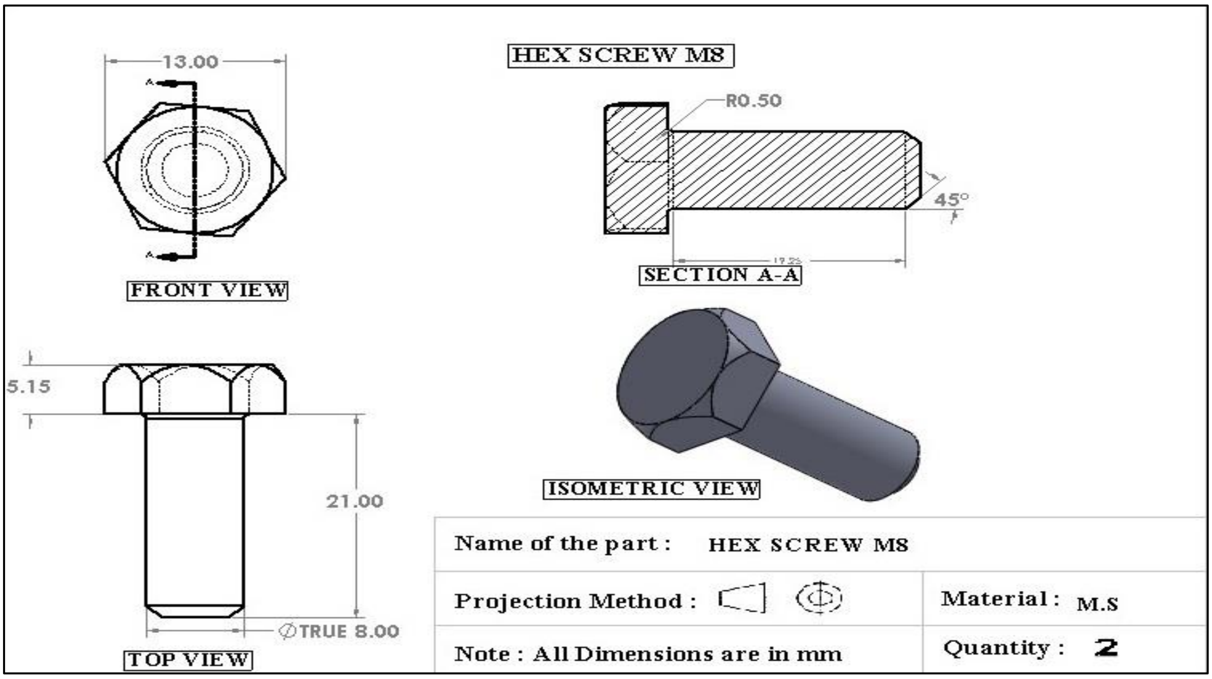
Figure(10.9): Shaft



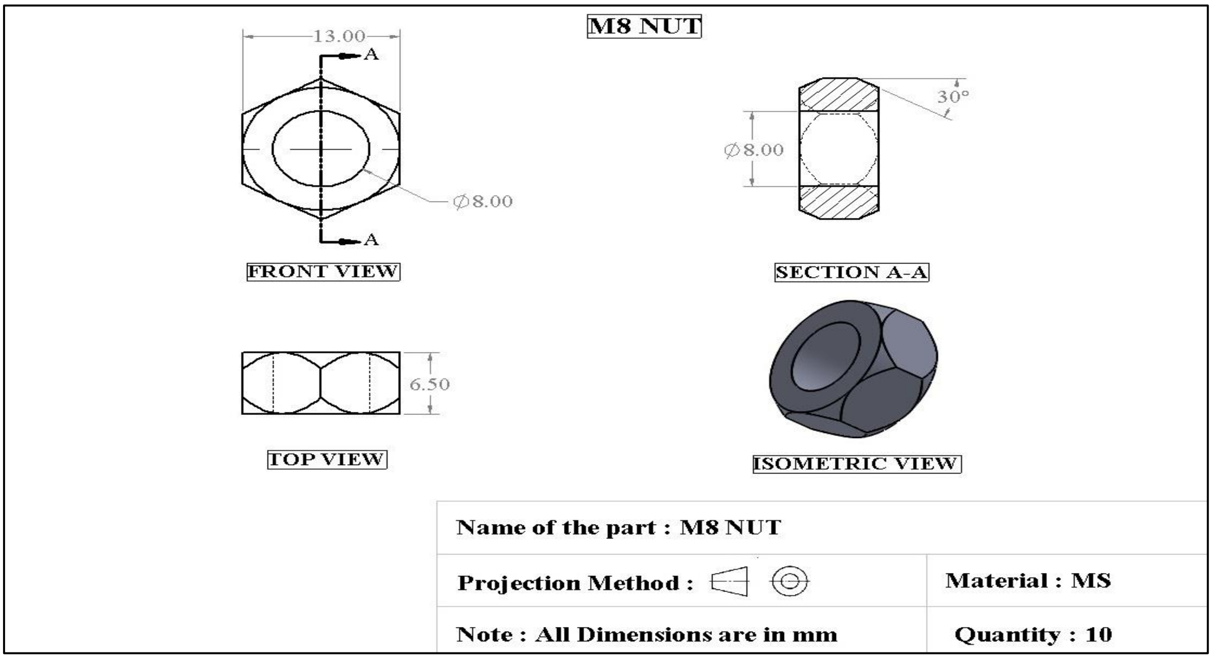
Figure(10.10): Countersunk Hex Head Bolt M8



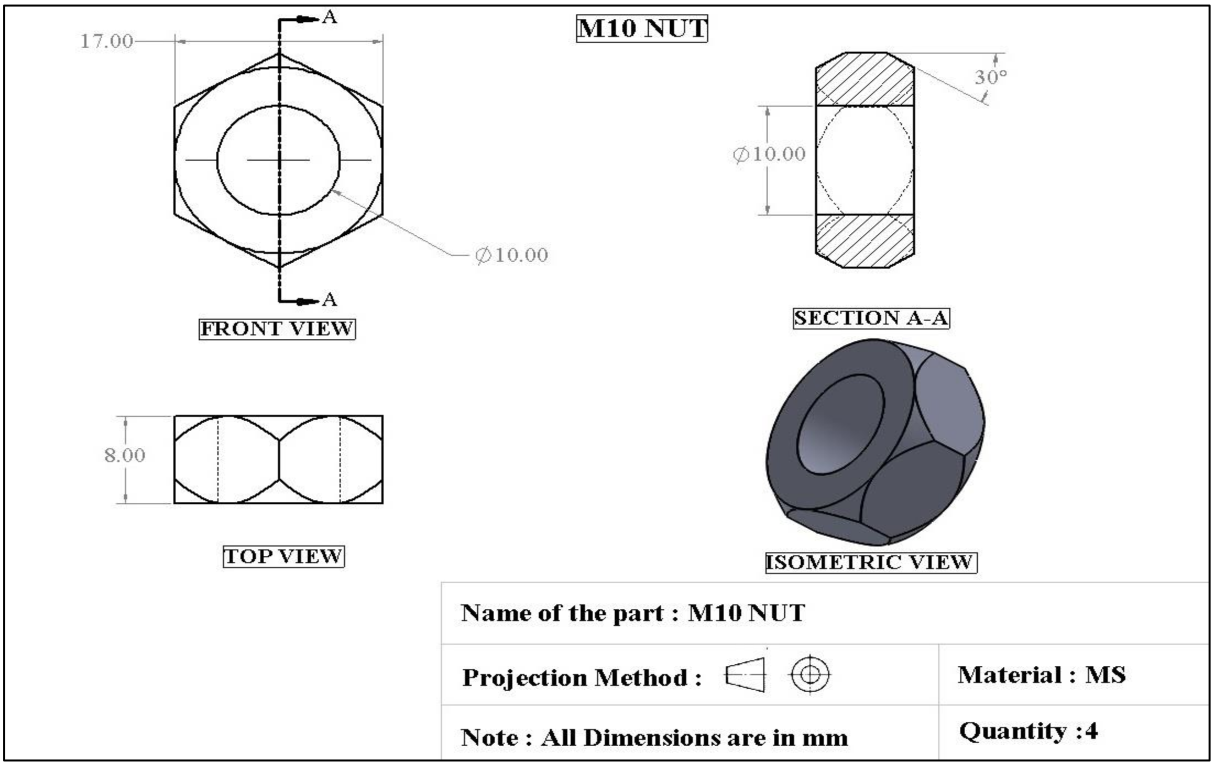
Figure(10.11) : M8 Bolt



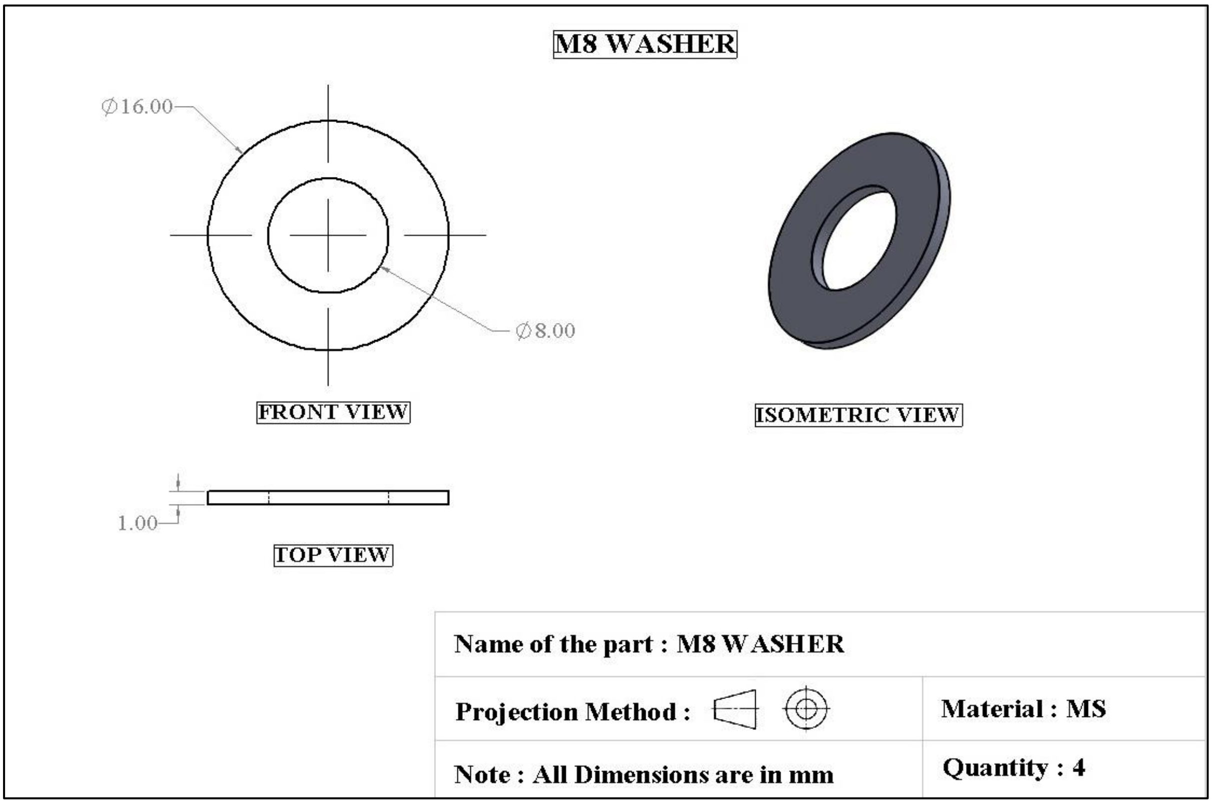
Figure(10.12): Hex Screw M8



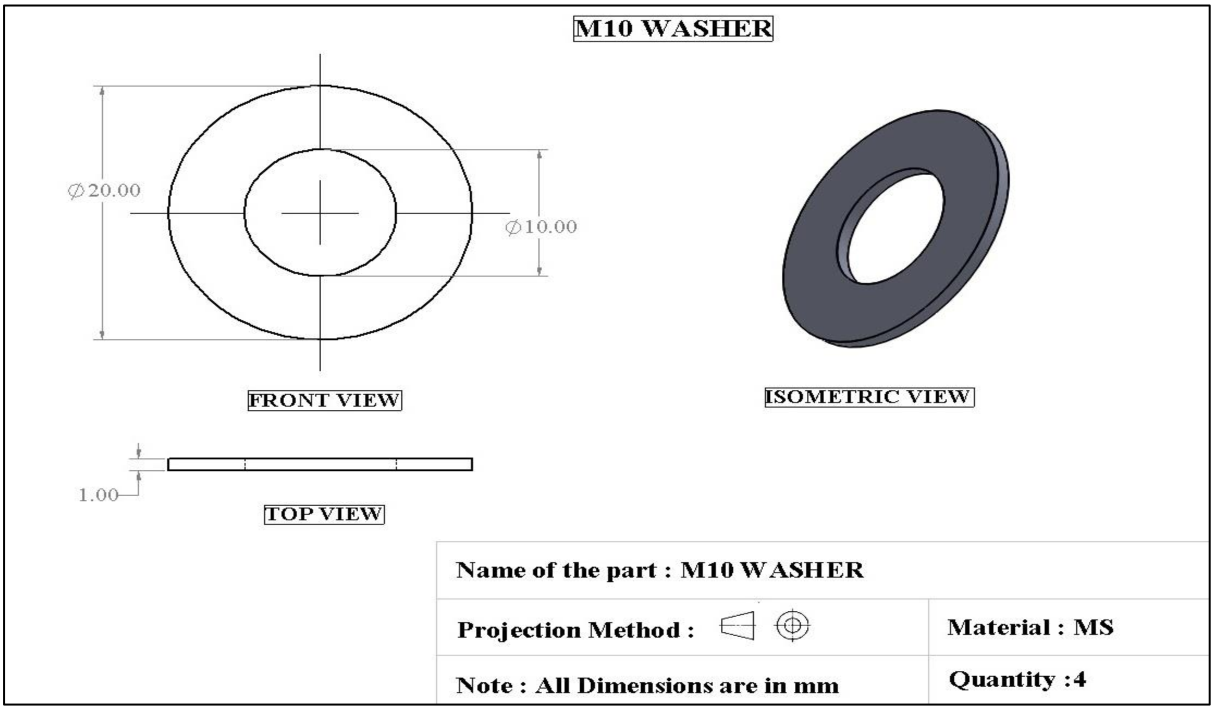
Figure(10.13): M8 Nut



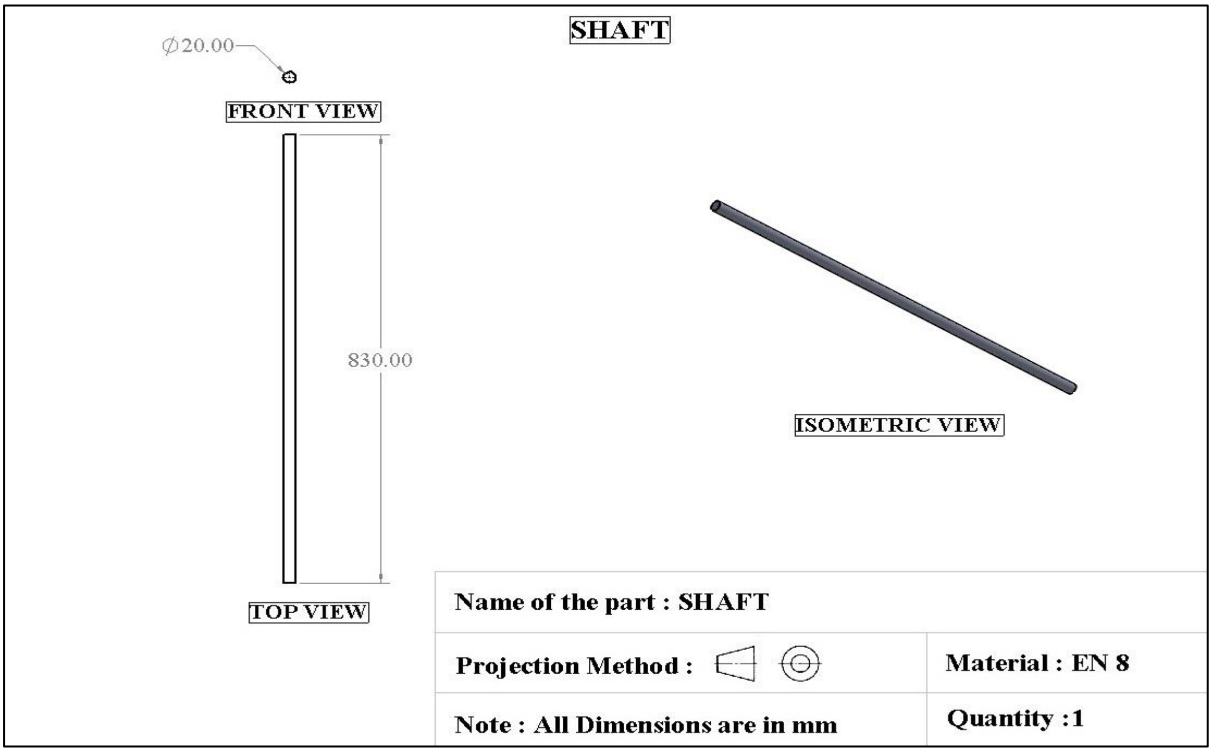
Figure(10.14): M10 Nut



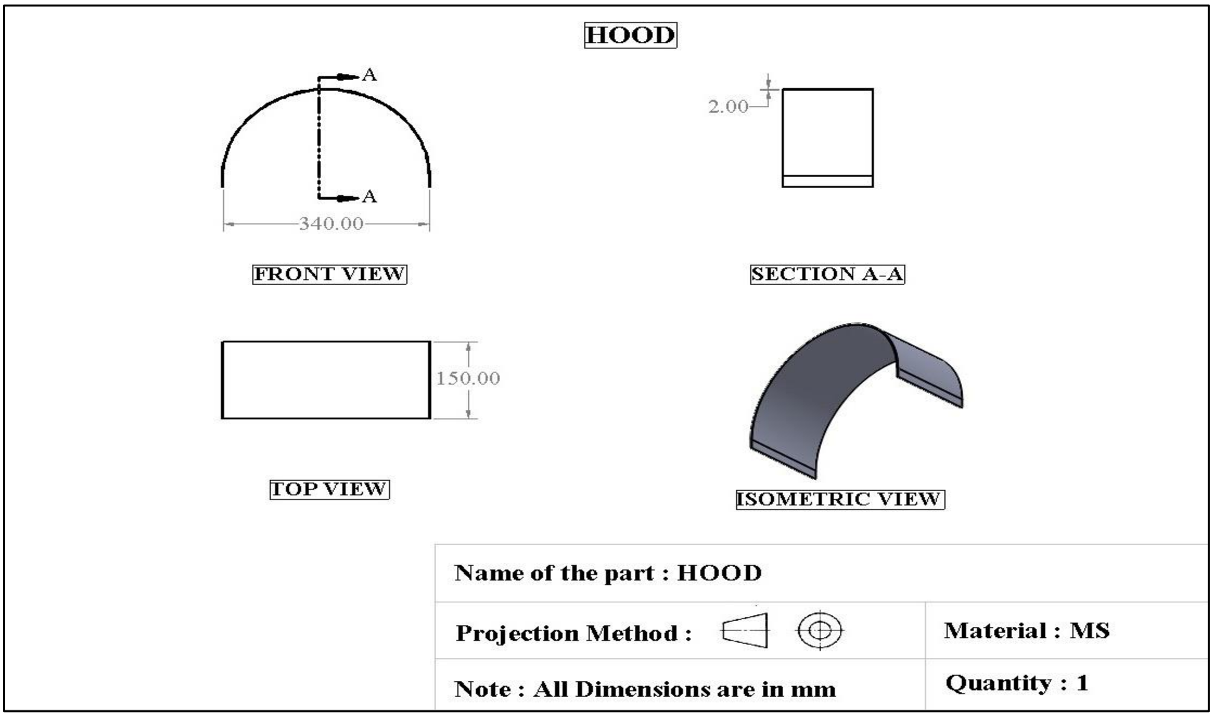
Figure(10.15): M8 Washer



Figure(10.16): M10 Washer



Figure(10.17): Shaft



Figure(10.18): Hood

Chapter 11: Manufacturing& Result

The process of conversion of raw material in to finished products using the three resources as Man, machine and finished sub-components.

Manufacturing is the term by which we transform resource inputs to create Useful goods and services as outputs. Manufacturing can also be said as an intentional act of producing something useful . The transformation process is Shown below-

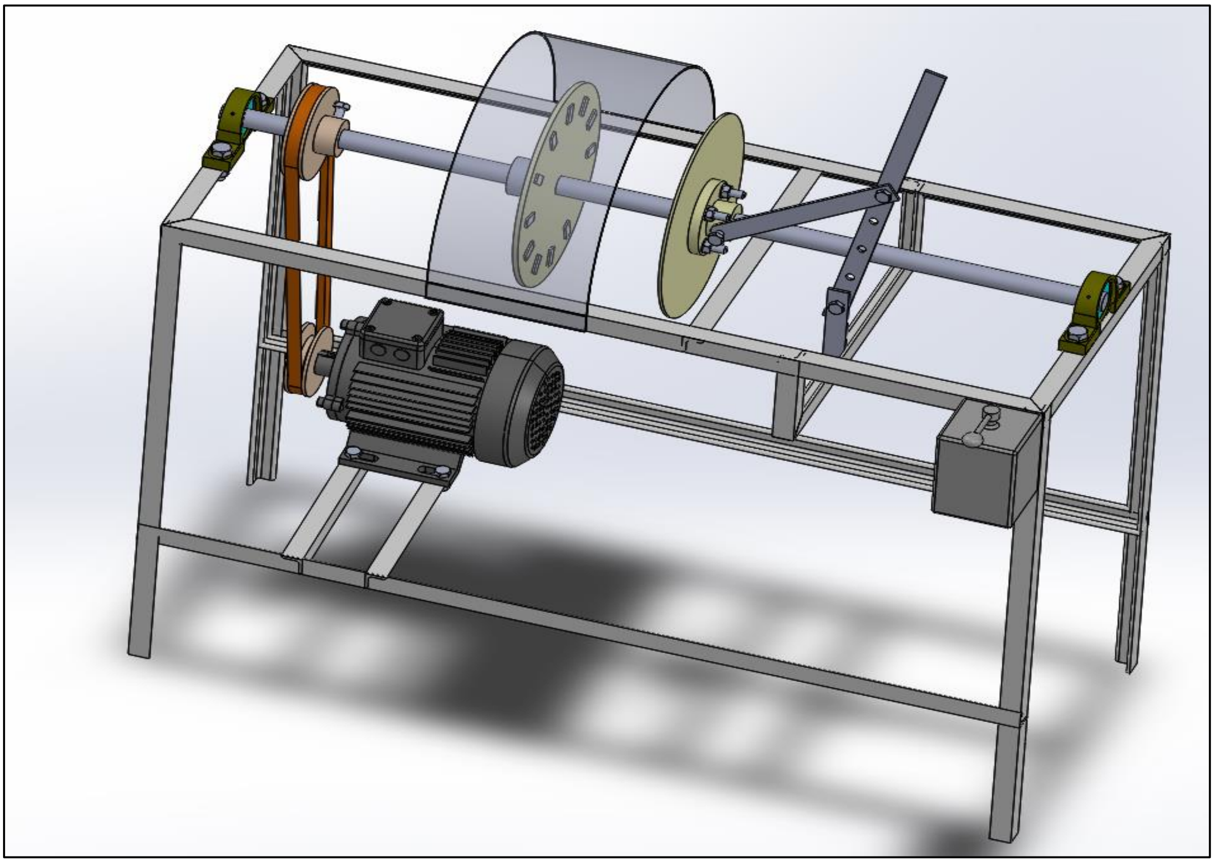
Table(11.1): Transformation Process

Input → conventional process → out put

Element	Transformation	Useful product
Material	Machines	Products
Data	Interpretation	Knowledge
Energy	Skill	Services
Variable cost	Fixed cost	Revenue

It is the phase after the design. Hence referring to the those values we will plan The various processes using the following machines:-

i) Universal lathe
ii) Milling machine
iii) Grinding machine
iv) Power saw
v) Drill machine
vi) Electric arc welding machine



Figure(11.1): CAD model of frictionless braking system

Figure(11.2): Basic fabrication of frictionless brakes

11.1-Frame Manufacturing

Component--Fame

Material--M.S.Angle

Quantity—01

Table(11.2): Frame Manufacturing

SR. NO	DESCRIPTION OF OPERATION	MACHINE USED	CUTTING	MEASUREMENT
1	Cutting the angle in to length as per dwg	Gas cutting machine	Gas cutter	Steel rule
2	Cutting the angle in to number of piece as per dwg	Gas cutting machine	Gas cutter	Steel rule
3	Filing operation can be performed on cutting side and bring it in perpendicular C.S.	Bench vice	File	Try square
4	Weld the angles to the required size as per the drawing	Electric arc welding machine	-------	Try square
5	Drilling the frame at required points as per the drawing.	Radial drill machine	Twist drill	Vernier calliper

11.2-Shaft Manufacturing

Component--Shaft

Material--Bright Steel

Quantity—02

Table(11.3): Shaft Manufacturing

SR.NO.	DETAIL OPER.	M/C. USED	TOOL USED	ACCES	MEA.INST.
1.	Marking on shaft	-	-	-	Scale
2.	Cutting as per dwg	Power hack saw	Hock saw blade	Jig & fixtures	Scale
3.	Facing both side of shaft	Lathe machine	Single point cutting tool	Chuck	Verniercaliper
4.	Turning as per dwg size	-	-	-	-
5.	Key way on end of shaft	Milling m/c.	Milling cutter	-	Verniercaliper
6.	Filling on both end	Flat file		Vice	-

11.3-Pulley Manufacturing

Component--Pulley

Material--C.I.

Quantity—02

Table(11.4): Pulley Manufacturing

SR. NO	DESCRIPTION OF OPERATION	MACHINE USED	CUTTING	MEASUREMENT	TIME
1	Take standard pulley as per design	------	----------	-------------	---------
2	Face both side of hub portion	Lathe machine	Single point cutting tool	Verniercaliper	15 min.
3	Hold it in three jaw chuck & bore inner dia as per shaft size	Lathe machine	Single point cutting tool	Verniercaliper	20 min.
4	Drilling the hub at required points as per the drawing	Radial drill machine	Twist drill	Vernier calliper	10 min.
5	Tap the hub at drill area.	Hand tap set	Tap	Vernier calliper	10 min.

11.4-Slide Bush Manufacturing

Component--Slide Bush

Material--M.S.

Quantity—02

Table(11.5): Slide Bush Manufacturing

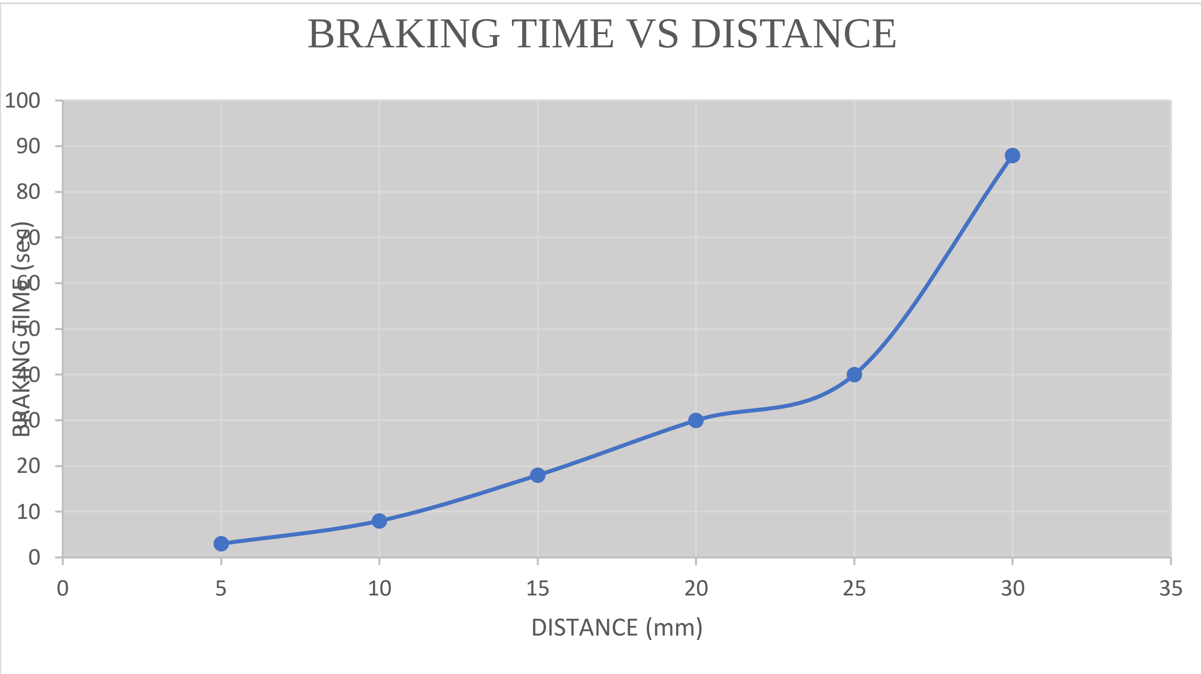
SR.NO.	DETAIL OPER.	M/C. USED	TOOL USED	ACCES	MEA.INST.
1.	Marking on pipe	-	-	-	Scale
2.	Cutting as per dwg	Power hack saw	Hock saw blade	Jig & fixtures	Scale
3.	Facing both side of pipe	Lathe machine	S.P.C.T	Chuck	Verniercaliper
4.	Turning as per dwg size	-	-	-	-
5	Filling on both end	Flat file		Vice	
6	Drill number of holes on pipe	Drilling m/c	Drill bit	Clamp	Verniercaliper

11.5-Results

BRAKING EFFECT

Table(11.6): Result of Braking effect

Sr no.	DISTANCE (mm)	BRAKING TIME (sec)
1	30	88
2	25	40
3	20	30
4	15	18
5	10	8
6	5	3



Fig(11.3): Graph of Braking time VS Distance

Chapter 12: Maintenance

No machine in the universe is 100% maintenance free machine. Due to its continuous use it is undergoing wear and tear of the mating and sliding components. Also due to the chemical reaction takes place when the material comes in the contact with water, makes its corrosion and corrosion. Hence it is required to replace or repair. This process of repairing and replacing is called as maintenance work.[19]

12.1-Autonomous Maintenance Activity

1) Conduct initial cleaning & inspection.
2) Eliminate sources of dirt debris excess lubricants.
3) Improve cleaning maintainability.
4) Understand equipment functioning.
5) Develop inspection skills.
6) Develop standard checklists
7) Institute autonomous inspection
8) Organize and manage the work environment
9) Manage equipment reliability.

12.2-Cleaning

Why cleaning?

Prevent or eliminate contamination.

Find ways to simplify the cleaning process.

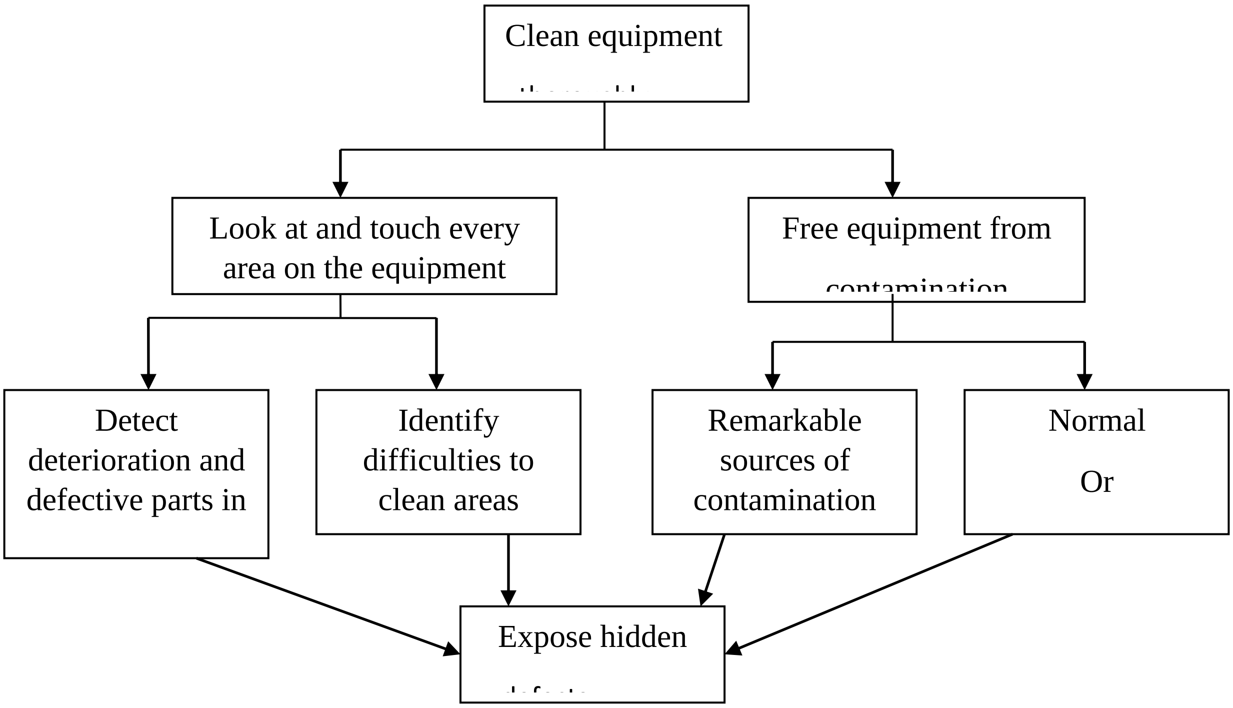
Facilitates through inspection when done by knowledgeable operators and \ or maintainers

- What to look for when cleaning.
    - Missing part
    - Wear
    - Rust and corrosion
    - Noise

- Cracks
- Proper alignment
- Leaks
- Play or sloppiness

CLEANING IS INSPECTION

Table(12.1): Cleaning Inspection



12.3-Visual Aids to Maintain Correct Equipment Condition

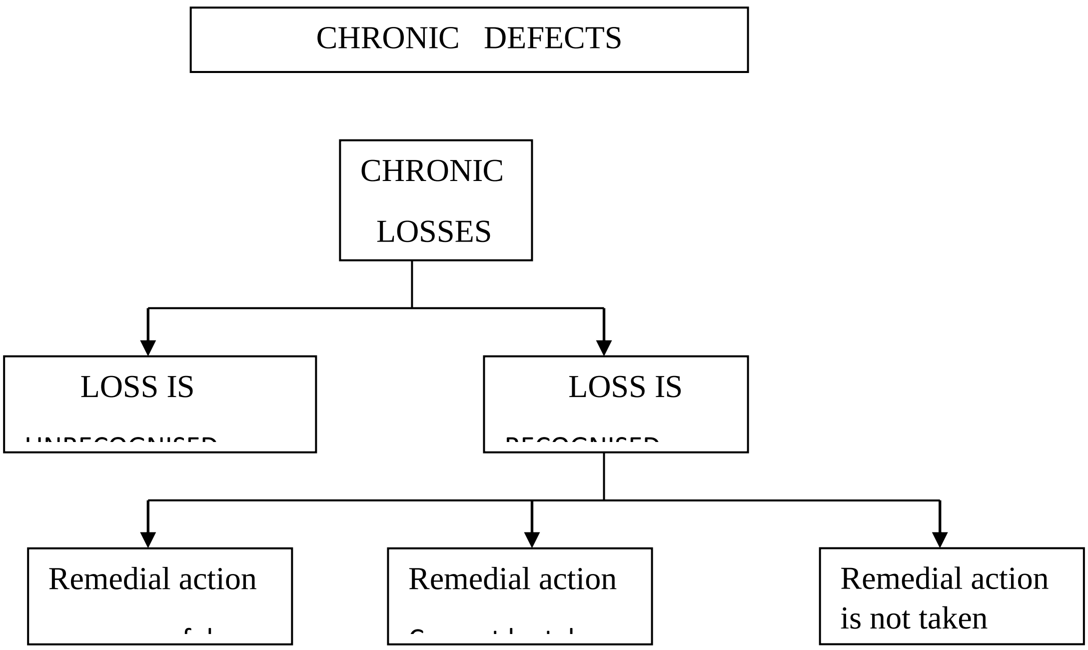
- Match marks on nut and bolts
- Colour marking of permissible operating ranges on dials and gauges
- Marking of fluid type and flow direction of pipes
- Marking at open / closed position on valves
- Labelling at lubrication inlets and tube type
- Marking minimum / maximum fluid levels
- Label inspection sequences

Adjust and Minor Repair

Minor repairs if

- Trained
- Experienced
- Performs safety
- Simple tool required
- Not longer than 20/30 minutes

Table(12.2): Chronic Defects



Equipment Requirement

1. Restore obvious deterioration throughout.
2. Establish plan select pilot area , determine bottleneck.
3. Study and understand the production process.
4. Establish goals for improvement.
5. Clarify the problem, collect the reference manuals contact resources.
6. Conduct evaluation through such techniques as RCM analysis, FMECA, FTA (Root cause failure analysis).
7. Determine improvement priorities, costs and benefits.
8. Execute improvement in pilot area standardize technique and document what you have done.

9. Monitor results and optimize based on those results.
10. Implement plant wide

12.4-Equipment Responsibility of operator

I. Operation with the proper standard procedure.
II. Failure prevention.
III. Failure resolution.
IV. Inspection.
V. Equipment up keep.
VI. Cleaning.
VII. Lubricating.
VIII. Lightning fasteners.
IX. Minor repairs.
X. Trouble shooting.

Chapter 13: Bibliography

A bibliography is a list of all of the sources you have used (whether referenced or not) in the process of researching your work. In general, a bibliography should include: the authors' names. the titles of the works. the names and locations of the companies that published your copies of the sources.

13.1-Address of Supplier

ESBEE ENGINEERING.

Authorized Dealer & Distributor; pumps & motors

2, Amrapli, 90 Feet Road, Mulund (E) Mumbai – 400081.

VENUS NUT BOLT MFG . CO

Manufacturer of All Types of Nut & Bolts

30, TrimbakParshuram Street, Kasam Building, 6thKumbharwada

Mumbai – 400004.

PRABATH METAL CORPORATION

Suppliers Of: - S.S.Steel Rod, Aluminum, Brass, Copper, M.S Angle, M.S

PatrawallaChawl, 169, TrimbakParshuram Street, Kasam Building, 6th

Kumbharwada Mumbai – 400004.

RELIANCE TOOLS & BEARING.

Dealers in All Kind Of: - Ball Roller & Tapered Bearing

163 Mutton Street,. Mumbai 400003

MAGNETO ENGINEERING

AUTHORIZED DEALERS IN ALL KIND OF: - FERRITE AND

NEDEODIEM MAGNETS

SHOP NO B/53

110 NAGDEVI STREET

MASJID BUNDER MUMBAI 400003

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