ABSTRACT

The pitman arm is part of the steering component in your vehicle. It is connected to the sector shaft and moves in a circular motion with the help of the ball joint. This motion causes the wheels to move left or right, depending on which way the steering wheel is moved. It is important you have your pitman arm in good working condition because poor steering can be hazardous to you and those around you. Keep an eye out for the following symptoms of a bad or failing pitman arm.

1. Poor steering

If you notice your steering has lots of play while you are driving, such as the wheel turns more than it should before the wheels engage, then chances are your pitman arm needs to be looked at. Since this is part of your steering and is critical for proper operation of the steering system, the diagnostics and repair should be done by the professionals at. Contact them as soon as you notice your vehicle is not steering like it used to and have your pitman arm replaced.

2. Wandering to the left or right while on the road

Is your vehicle pulling to one side or the steering seems difficult? It is time to have your pitman arm looked at. A bad or failing pitman arm can cause your vehicle to not respond appropriately when you turn the wheel. Not only can it have lots of play, it can be highly inaccurate or seem to have a mind of its own while you are driving down the road. This can be especially dangerous during hazardous weather conditions or on a busy highway.

3. Inability to steer

When the pitman arm completely fails, you will lose all steering in your vehicle. The pitman arm should be replaced before the problem gets to this point. This is a dangerous situation, so if you notice any of the symptoms above, they should be looked at before the pitman arm completely fails. If you do lose the ability to steer, do not keep driving. Slow down to a stop and call for assistance.

If you have poor steering, your vehicle seems to wander, or you have lost all ability to steer, chances are your pitman arm needs to be replaced. At Your Mechanic to have this

completed in a timely manner and before your steering completely fails. In addition, if you drive off-road often, inspect your pitman arm for wear and replace it as needed to keep yourself and others safe.

SUMMARY

The **Pitman arm** is a steering component in an automobile or truck. As a linkage attached to the steering box, it converts the angular motion of the sector shaft into the linear motion needed to steer the wheels. The arm is supported by the sector shaft and supports the drag link or center link with a ball joint. It transmits the motion it receives from the steering box into the drag (or center) link, causing it to move left or right to turn the wheels in the appropriate direction. The idler arm is attached between the opposite side of the center link from the Pitman arm and the vehicle's frame to hold the center or drag link at the proper height. A worn ball joint can cause play in the steering, and may get worse over time.

Pitman Arm is very important part of Steering system. It should be accurately machined with the acceptable tolerance. At present scenario productivity and economics of machining work pieces in a large quantity is greatly affected with the use of work holding devices like fixtures. This device reduce the production cost and ensure interchangeability of machined work pieces This project is about the design of Pitman arm which is used in the manufacturing of Pitman Arm of steering system. The design of Pitman arm is done by using software CATIAV5R21.The purpose of the fixture is to provide strength, holding, accuracy and interchangeability in the manufacturing of product. The fixture is designed and fabricated mainly to get the dimension of work piece within tolerance limit.

INTRODUCTION

1.1 Pitman Arm

The pitman arm is also called steering arm, it is a linkage which is attached at one side to the steering box (through sector shaft) at the bottom of the steering wheel shaft and on the other side to the track rod which is attached at the other end to the idler arm. When the steering wheel is turned left or right, a worm gear at the bottom of the steering shaft turns a set of teeth. That action moves a gear that activates the pitman arm, causing the steering linkage to move the wheels. The steering arm is part of an older recirculating ball steering system which is still used primarily in some full-size SUVs and trucks as compared with the smoother-handling rack and pinion steering mechanism more commonly used in automobiles. A properly functioning pitman arm, precisely directs the movement of all the other steering links, limits wheel wobble on bumpy surfaces, assures full wheel turning radius and helps to reduce steering wheel vibration.

The Pitman arm is the steering box transfer linkage in a Pitman type vehicle steering mechanism. It is the component in the system which translates the radial motion of the steering column or shaft into the linear motion to turn the wheels. The Pitman arm is the first of three angular rotation linkages that transfer the steering box inputs to the track rod which in turn moves the left and right tie rods and their respective wheels. The other two linkages are the idler arms which are attached to the ends of the track rod as stabilizers. The Pitman arm is a crucial part of a vehicle's steering system and, when worn or damaged, can cause potentially catastrophic loss of steering control.

Pitman steering systems are most commonly found on older vehicles and heavy trucks. Most newer models feature variations of rack and pinion type steering mechanisms. The Pitman system is, however, robust and reliable when maintained correctly. These systems typically consist of a rod that runs from the steering wheel, through the forward firewall, and into the engine compartment. Here it enters a steering box where the axis of its movement is turned at 90 degrees to drive a short transfer shaft by means of a worm gear and nut or roller arrangement.

The Pitman arm is a flat, off-set lever which is attached to the transfer shaft at one end and a ball joint on its other. A linkage arm attaches to this ball joint and a similar joint on the track rod. The track rod is, in turn, attached with ball joints to a set of tie rods on either end. The tie rods then connect to the wheels via articulated steering arms. When the steering wheel is turned, the shaft moves the Pitman arm through a short arc which then pulls the track rod to the left or right.

When the track rod moves, so do the tie rod/steering arm assemblies which cause both wheels to turn in the same direction and steer the vehicle. The track rod is also supported at either end by a pair of idler arms which keep the track/tie rod assembly stable and at the correct height. The Pitman arm thus represents the main actuator for the linear steering movement in Pitman steering systems. It then goes without saying that a worn or damaged Pitman arm will cause a loss of steering sensitivity or worse, i.e., a total loss of directional control over the vehicle. This makes the regular inspection and maintenance of this critical linkage a must for any vehicle maintenance regimen.

1.2 Advantages of Pitman arm

1. Higher turning Ratio 2. Less Sensitive to errors in assembly 3. Simple in Design 4. Provides mechanical advantage to the driver 5. Pitman arm combined with power steering mechanism could be better than a rack and pinion mechanism

1.3 Intended Application

1. Passenger Car Steering 2. Truck Steering 3. Heavy Duty Equipment 4. Recreational Vehicles.

2.MATERIAL

2.1 Micro alloy Steel for Pitman Arm Forgings

The effect of a different type of micro alloy material on the durability and processing of an existing pitman arm design was evaluated. The durability properties of a particular type micro alloy material i.e. impact toughness, impact ductility, programmed fatigue life and high load fatigue life properties, were evaluated and compared to the current production conventional heat treated material. Metallurgical evaluation was performed and showed that the hardness and microstructure of the acicular ferrite - bainitic micro alloy was nearly independent of the cooling rate from hot forging and could provide equivalent or better properties as compared to conventional quench and tempered forgings.

Alloy steel iron, carbon steels, mild steels are also used for manufacturing pitman arm

2.2 Material Properties

Density of Material	**7.85e-6 kg/mm3**
Modulus of Elasticity	**210 Gpa**
Poisons Ratio	**0.3**
Yield Strength	**520MPa**

3. DESIGN CONSIDERATIONS

3.1 Part Description

A Pitman Arm (or Steering Arm) is part of the steering system of automobiles. It links the steering box at the bottom of the steering wheel shaft to the track rod. This link converts the angular motion of the wheel shaft into the linear motion needed to steer the wheels. To the right is a picture of a Pitman Arm.

3.2 Problem Definition

The design of a Pitman Arm is a multi-disciplinary effort requiring the balancing of multiple requirements. These include: geometry/space, structural durability, weight characteristics, and manufacturing processes to name a few. Many Pitman Arm manufacturers use a set of common design platform (or design series) as templates establishing design rules to fit them on new product requirements.

To implement these common design platforms and engineering practices, many Pitman Arm manufacturers have created their own internal design software tools. However, the effort to create, maintain and publish these internal tools is expensive both in terms of money and time. Moreover, these internal applications tools tend to be clunky, hard to maintain.

3.3 Solution

A customized (“Fit for Purpose”) web-enabled software application was rapidly created using EASA. This application embedded Pitman Arm design rules into the application itself creating an automated and streamlined the design process. The application linked and managed applications associated with CAD component, Excel, Databases, FEA structural analysis. Key features of this application included.

- Managed multiple software associated with CAD, FEA, ERP and Databases.
- Managed multiple users at the same time at various locations.
- Searched for prior designs to leverage in current product development.
- Leveraged the company’s existing common design platforms (design series).
- Enforced company’s design practices.

3.4 Design Considerations In Welding

- Use the minimum possible number of welds.
- Select the same thickness for the parts to be welded together.
- Locate the welds at the areas in the design where stresses and/or deflections are not critical.
- Effect of shrinkage and distortion should be minimized by post welding annealing and stress relief operations.
- Decide proper welding sequence.
- Design welding in the flat or horizontal position and not in the overhead position Use only the amount of weld metal that is absolutely required.

3.5 Design Considerations For Forgings

- Keep fibre lines parallel to tensile and compressive forces and perpendicular to shear forces Avoid deep machining cuts Keep vertical surfaces of forged parts tapered.
- Keep the parting line in one plane.
- Provide adequate fillet and corner radii.
- Avoid thin sections.

3.6 Design Considerations For Castings

- Design parts to be in compression then in tension.
- Strengthen parts under tension by use of external devices Shape the casting for orderly solidification.
- Avoid abrupt change in cross-section.
- Provide more thickness at the boss.
- Round off the corners.
- Avoid concentration of metal at junctions.
- Avoid thin sections.
- Make provision for easy removal of pattern from the mould.

4. MANUFACTURING PROCEDURE

4.1 Casting

Casting is a manufacturing process in which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a *casting*, which is ejected or broken out of the mold to complete the process. Casting materials are usually metals or various *time setting* materials that cure after mixing two or more components together; examples are epoxy, concrete, plaster and clay. Casting is most often used for making complex shapes that would be otherwise difficult or uneconomical to make by other methods. Heavy equipment like machine tool beds, ships' propellers, etc. can be cast easily in the required size, rather than fabricating by joining several small pieces.

4.2 Labeling and painting

Paints can be defined as: "A liquid solution of pigment (*coloring material*) and **solvent**, which is applied on different surfaces for decorative or protective reasons."

4.2.1 Qualities of Good Paints

(a) Good Hiding Power:

It should be capable of covering the existing surface of material uniformly and thoroughly.

(b) Color

After its use on outer surfaces, they are exposed to the atmosphere. Due to the exposure to the atmosphere, it may be effected by rain or various types of radiation from sunlight, which will cause bad effects on its 'Color.' Good paints must maintain its color under all these conditions or in any other circumstance.

(c) Resistance

Paints should be chemically inert to the atmosphere. This is essential if it has to protect the underlying surface of a metal.

(d) Easy Application

They might have to be used over wide surface areas.It is, therefore, necessary that it should be of such a nature that can be spread easily, smoothly, and uniformly.

4.3 Moulding

Molding or moulding (see spelling differences) is the process of manufacturing by shaping liquid or pliable raw material using a rigid frame called a mold or matrix.[1] This itself may have been made using a pattern or model of the final object.

A mold or mould is a hollowed-out block that is filled with a liquid or pliable material such as plastic, glass, metal, or ceramic raw material. The liquid hardens or sets inside the mold, adopting its shape. A mold is the counterpart to a cast. The very common bi-valve molding process uses two molds, one for each half of the object. Articulated molds have multiple pieces that come together to form the complete mold, and then disassemble to release the finished casting; they are expensive, but necessary when the casting shape has complex overhangs. Piece-molding uses a number of different molds, each creating a section of a complicated object. This is generally only used for larger and more valuable objects.

A manufacturer who makes molds is called a moldmaker. A release agent is typically used to make removal of the hardened set substance from the mold more easily effected. Typical uses for molded plastics include molded furniture, molded household goods, molded cases, and structural materials.

4.4 Forming

Forming, metal forming, is the metalworking process of fashioning metal parts and objects through mechanical deformation; the workpiece is reshaped without adding or removing material, and its mass remains unchanged. Forming operates on the materials science principle of plastic deformation, where the physical shape of a material is permanently deformed.

4.5 Machining

Machining is any of various processes in which a piece of raw material is cut into a desired final shape and size by a controlled material-removal process. The processes that have this common theme, controlled material removal, are today collectively known as subtractive manufacturing in distinction from processes of controlled material addition, which are known as additive manufacturing. Exactly what the "controlled" part of the definition implies can vary, but it almost always implies the use of machine tools (in addition to just power tools and hand tools).

Machining is a part of the manufacture of many metal products, but it can also be used on materials such as wood, plastic, ceramic, and composites. A person who specializes in machining is called a machinist. A room, building, or company where machining is done is called a machine shop. Much of modern-day machining is carried out by computer numerical control (CNC), in which computers are used to control the movement and operation of the mills, lathes, and other cutting machines. This increases efficiency, as the CNC machine runs unmanned therefore reducing labour costs for machine shops.

4.6 Joining

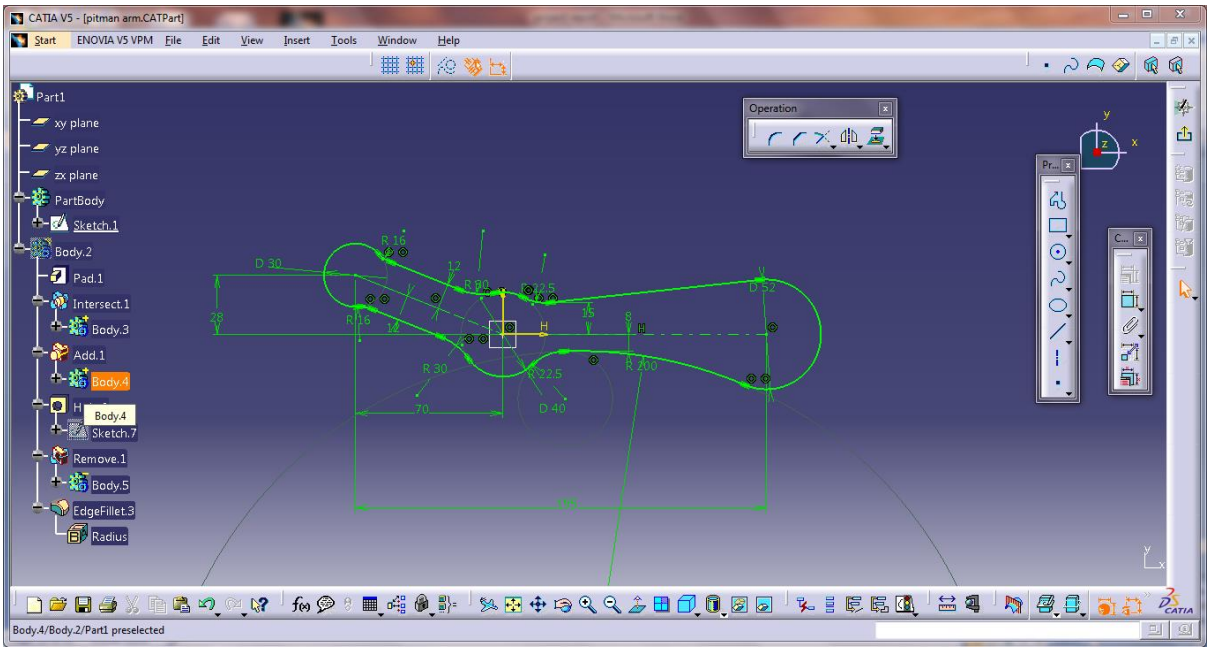
Joining includes welding, brazing, soldering, adhesive bonding of materials. They produce permanent joint between the parts to be assembled. They cannot be separated easily by application of forces. They are mainly used to assemble many parts to make a system.

4.7 Manufacturing

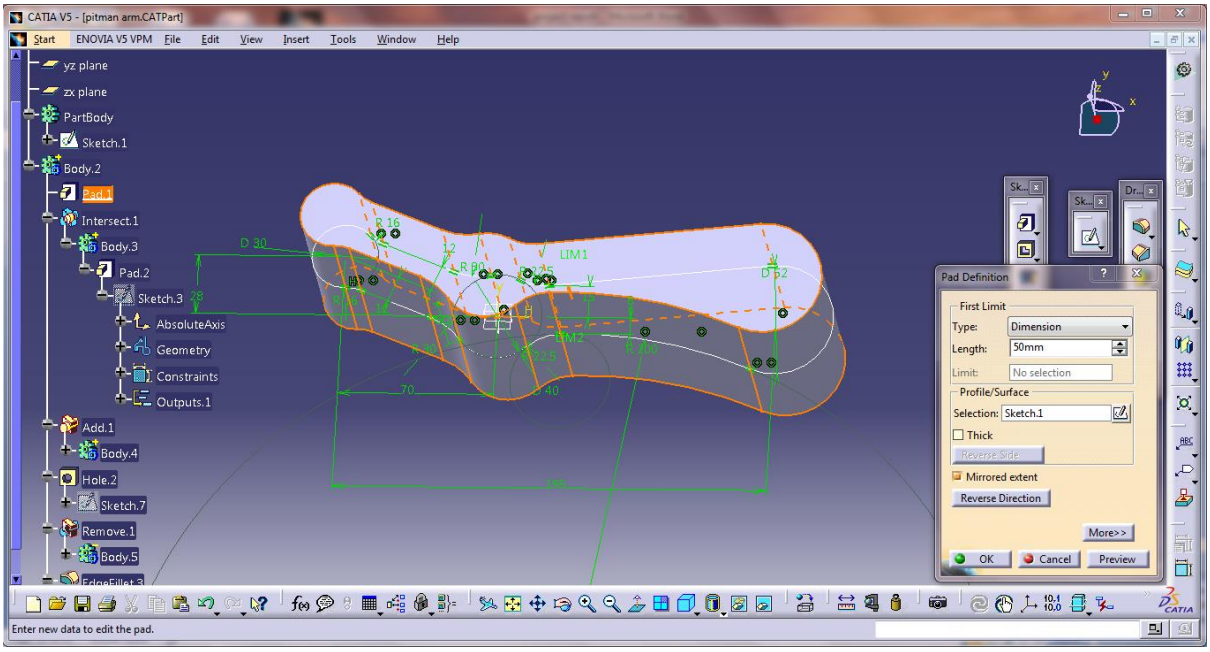
Additive manufacturing (sometimes referred to as rapid prototyping or 3D printing) is a method of manufacture where layers of a material are built up to create a solid object. While there are many different 3D printing technologies this article will focus on the general process from design to the final part. Whether the final part is a quick prototype or a final functional part, the general process does not change.

5. CATIA FILE SCREENSHOTS WITH STEP BY STEP PROCEDURE

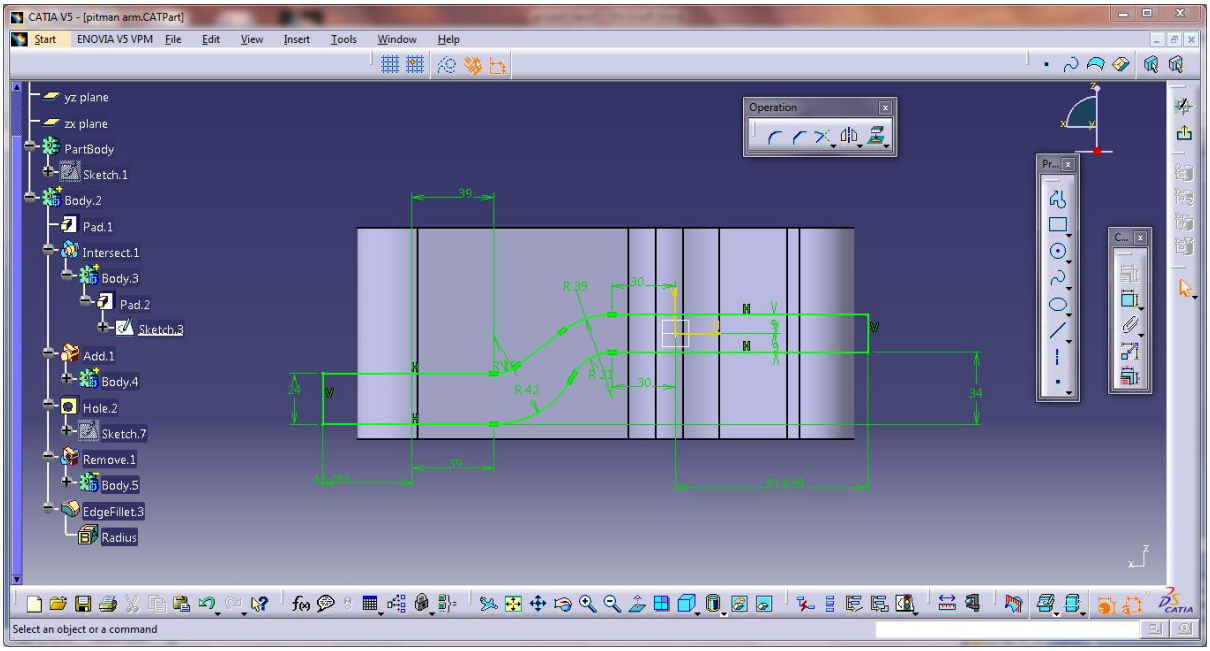
STEP 1: Draw the top view sketch on the xy-plane and ,



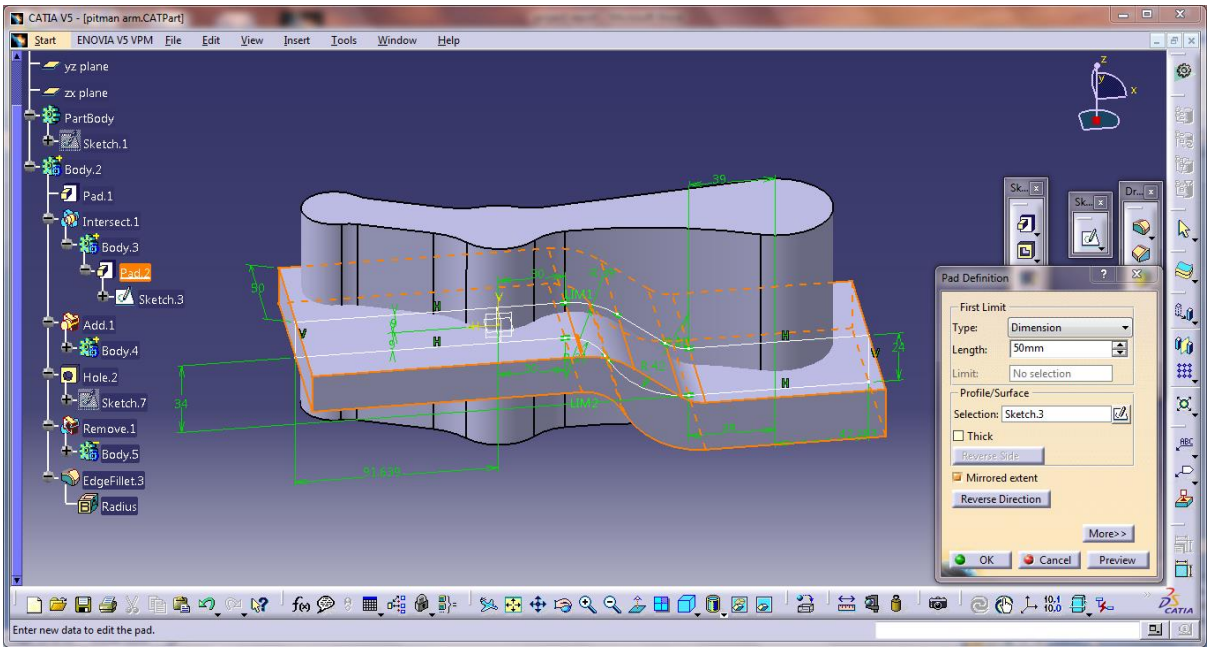
STEP 2: Then give pad to the sketch.



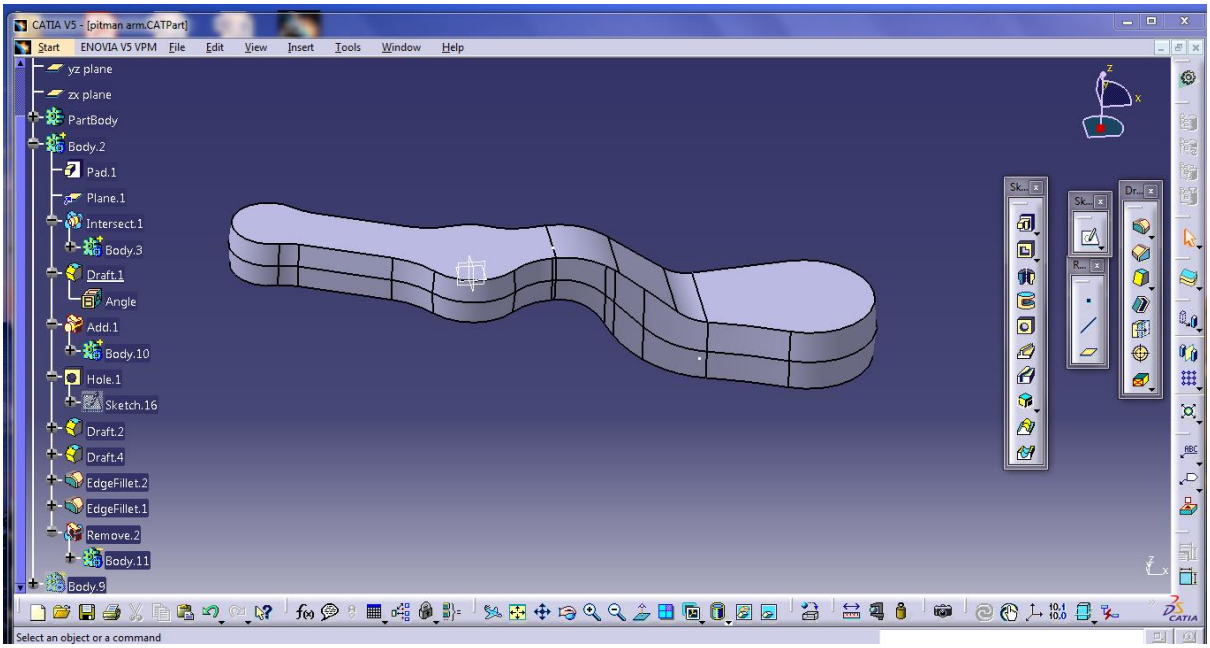
STEP 3: Draw the front view sketch on zx-plane ,



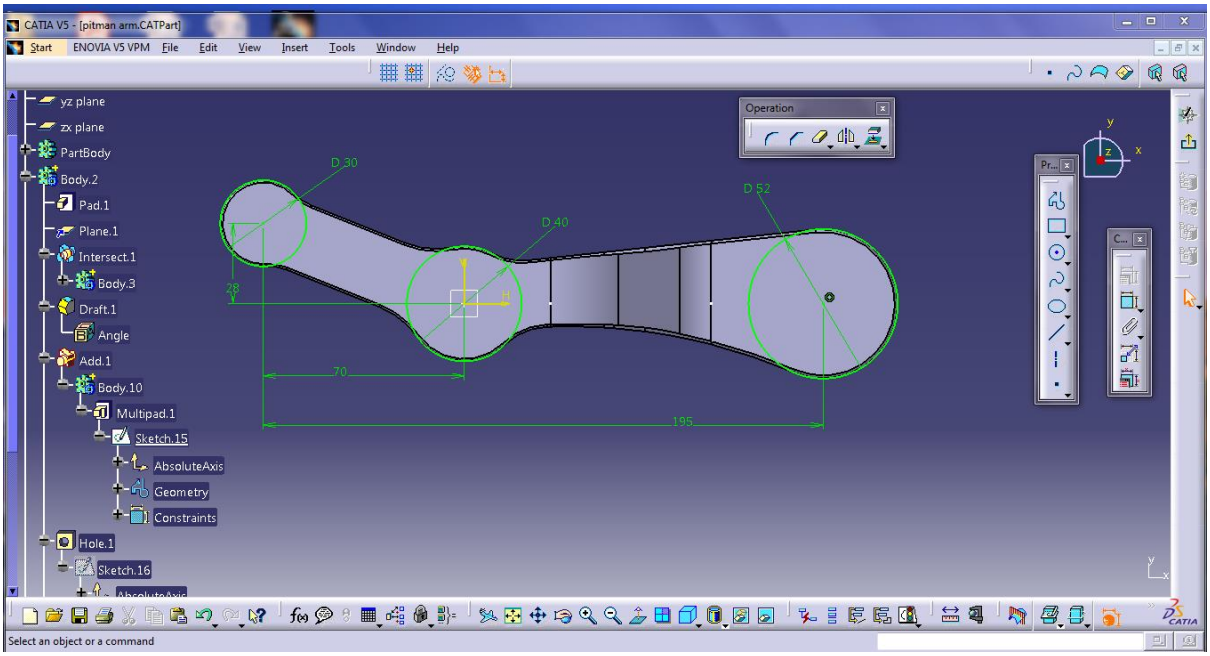
STEP 4: Then give pad to the sketch drawn on zx-plane and give intersection to those two bodies by using Boolean operations.



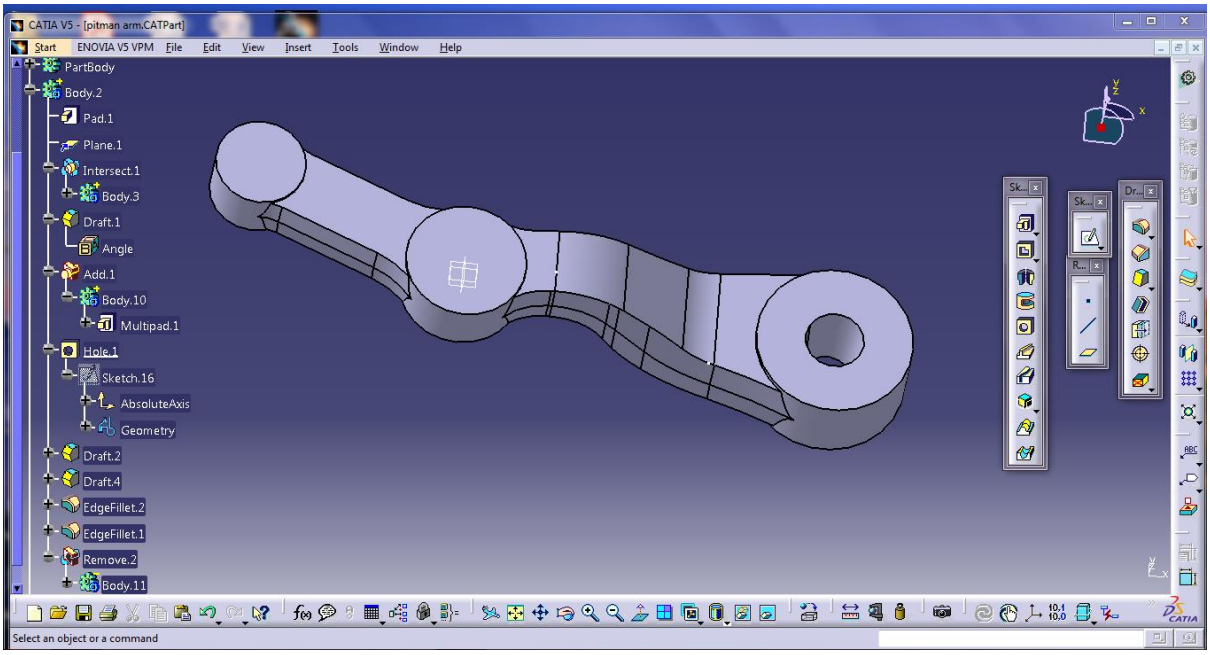
STEP 5 Give the draft angle 5 to the body as shown in below.



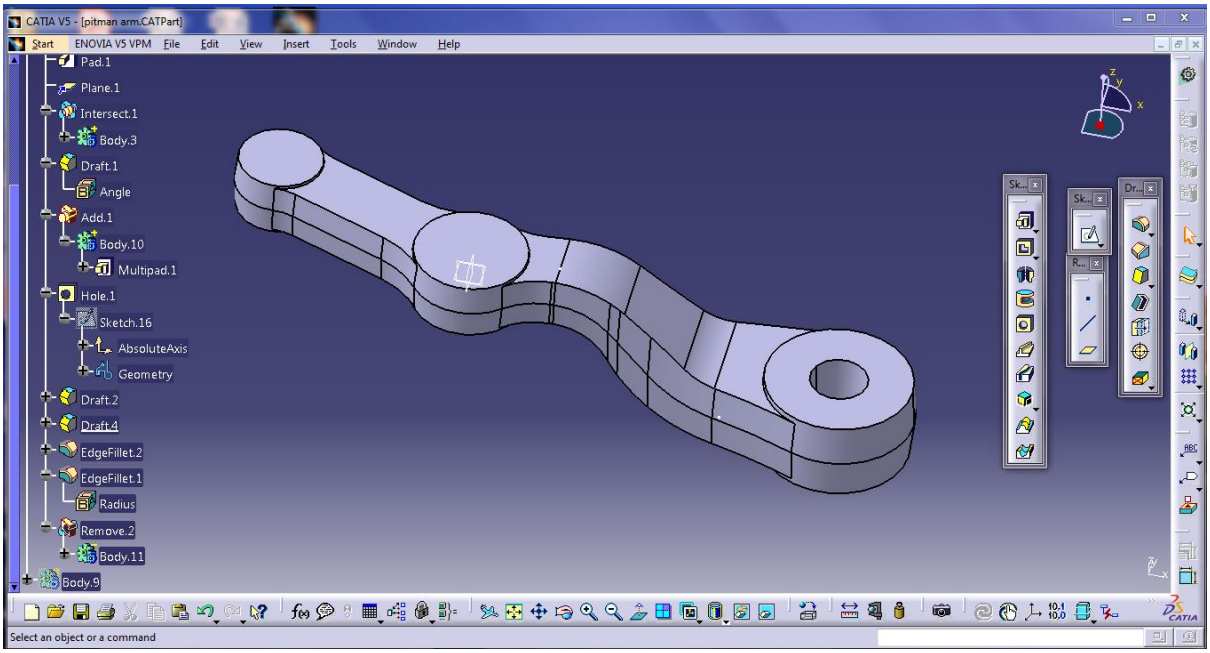
STEP 6: Draw the sketch on xy-plane as shown in figure below.



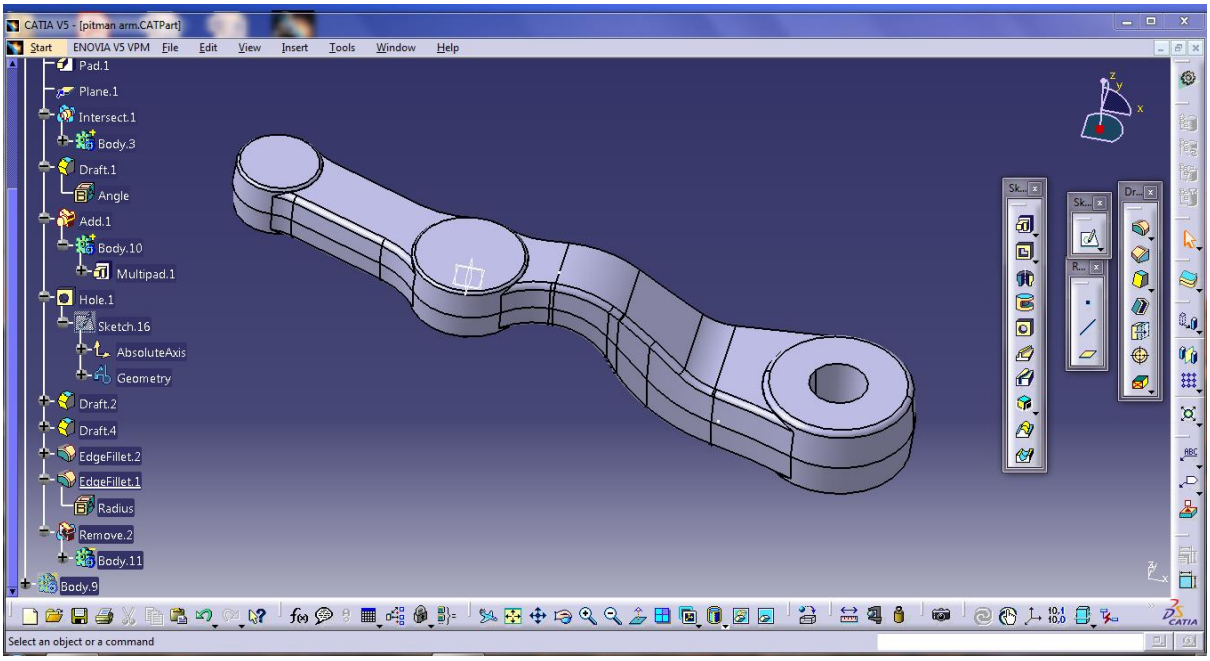
STEP 7: Add material to the by using Multipad option.



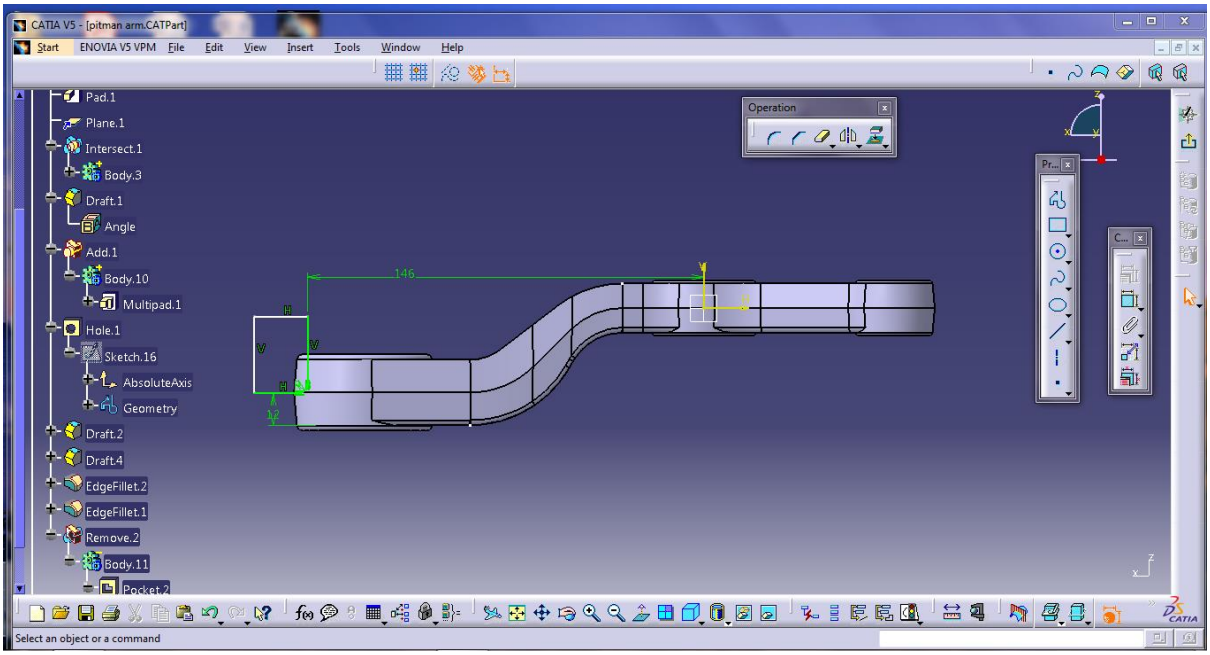
STEP 8: Give draft angle 5 to the step 6 sketch as shown in below.



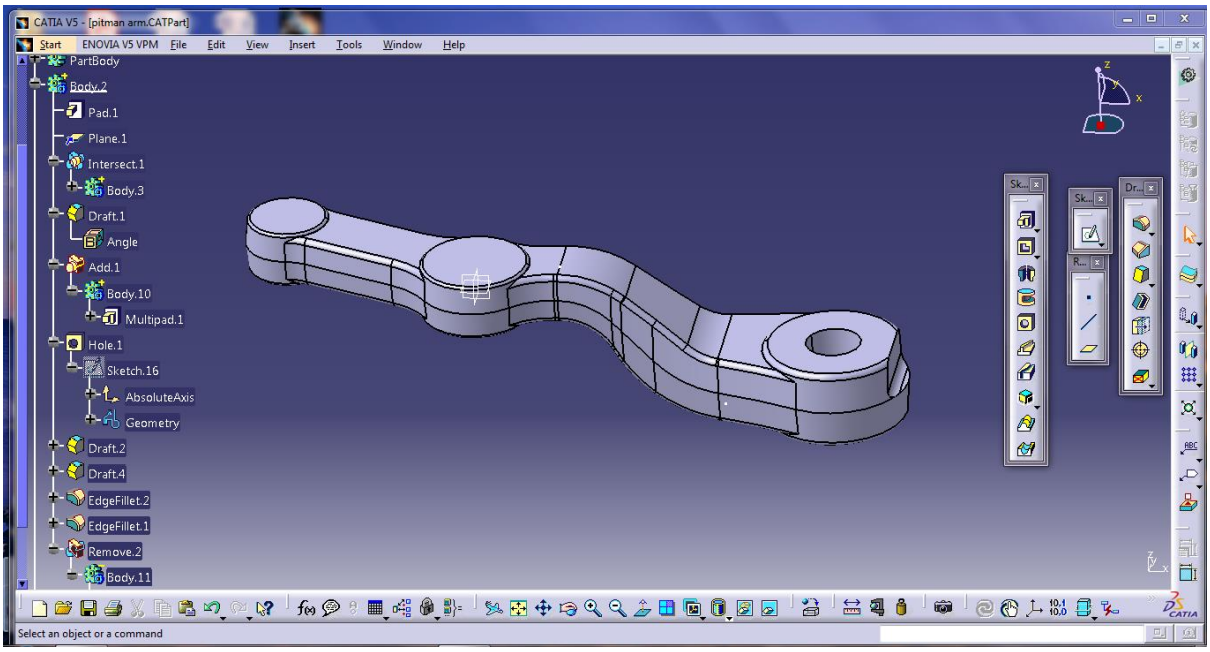
STEP 9: Give Edge fillet radius 2 as shown in below picture.



STEP 10: Draw the sketch as shown in below.



STEP 11: Remove material by using remove option on Boolean operation and finally we get required shape of PITMAN ARM.



6 PROBLEMS FACED WHILE DESIGNING THE COMPONENT AND SOLUTION.+6

6.1 The edge fillet radius 2 not obtained on these marked cylinders as shown in picture below because of these cylinders height. So we can give edge fillet radius. as 1.

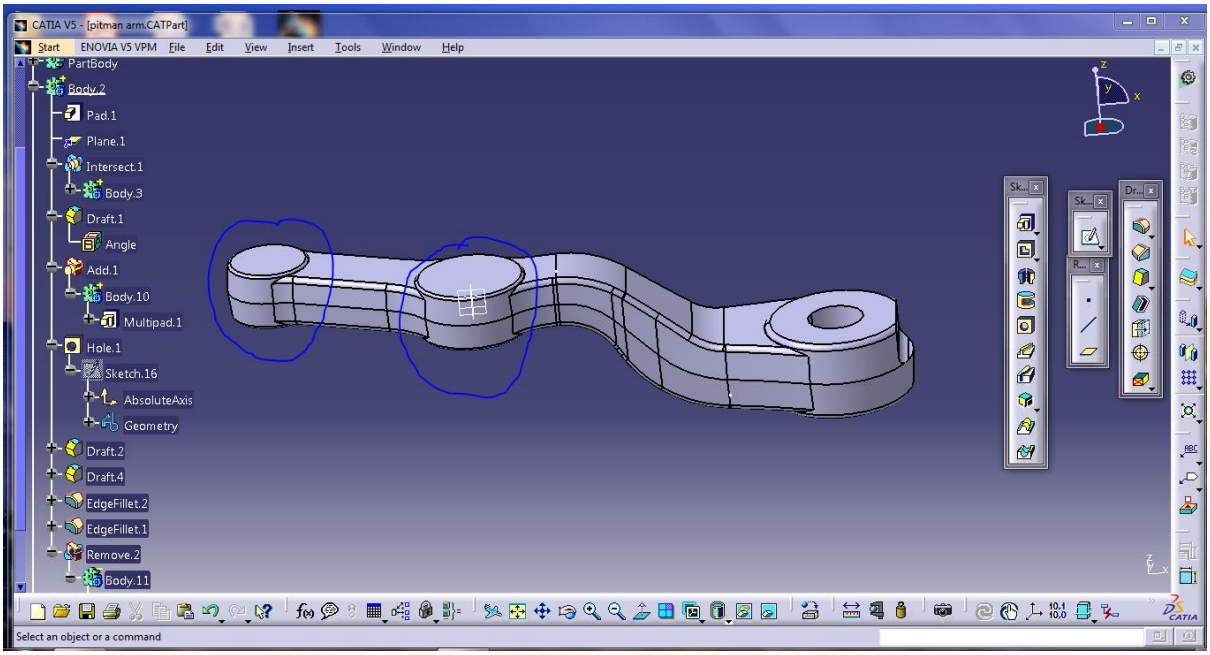


Fig: problem faced figure

7. REAL TIME IMAGES

7.1 Image 1

7.2 Image 2

7.3 Image 3

8. REFERENCES

8.1 www.homeandgardenideas.com/Results/Project reporting

8.2 en.wikipedia.org/wiki/Pitman arm

8.3 www.wisegeek.com/what-is-the-pitman-arm.htm

8.4 www.yourmechanic.com/article/symptoms-of-a-bad...

8.5 www.irjet.net/archives/V4/i5/IRJET-V4I5477.pdf

8.6 www.wisegeek.com/what-is-the-pitman-arm.htm

8.7 www.yourmechanic.com/question/what-are-the...

8.8 www.acdelco.com/parts/chassis/silver-pitman-arms