A Project Report
Submitted for

Computer Aided Design & Analysis
(UME412)

Online Test 1
Modeling and drawings of a Feed Pump
using PTC 'ONSHAPE' SW

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Acknowledgement

This project would not have been possible without due support of my course instructor Dr. Bikramjit Sharma. His guidance, direction and methodology with which he taught us the subject was unparallel and unprecedented in every way. His guidance throughout the semester in classroom was the reason, I am in a position to bring this project to function. I would also like to thank my other course instructors who were always proactive in helping us and clarify our doubts whenever needed.

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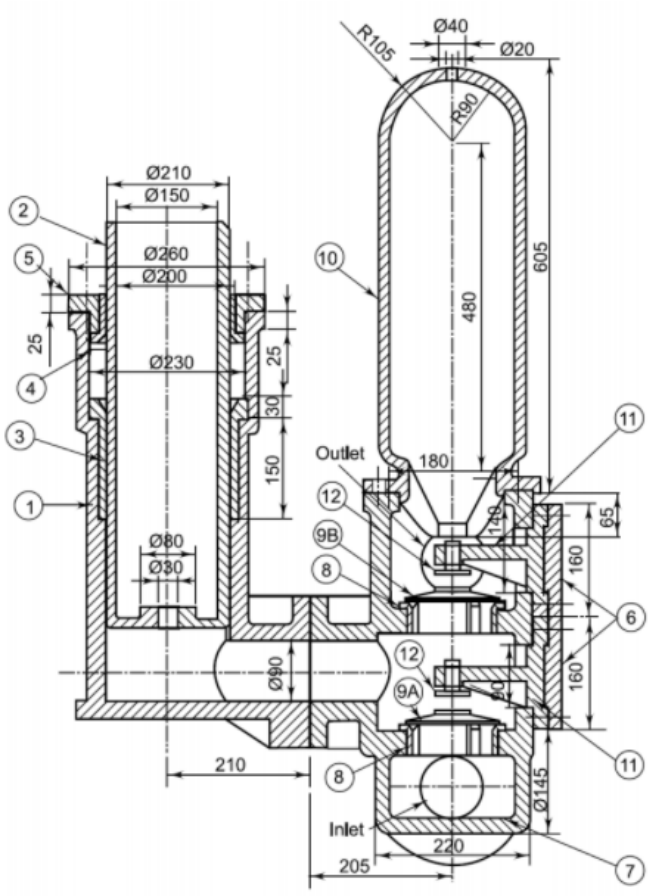
Introduction

The aim of this project is to do modeling and assembly of the provided feed pump drawings along with the production drawings of each part. The modeling, assembly and drawing has to be done on a cloud based CAD software PTC 'ONSHAPE' SW. The feed pump is a positive displacement type of a reciprocating pump. The main part is a body made of cast iron in which a plunger reciprocates. A barrel liner made of brass is put inside the barrel. The barrel is connected to a valve chest using a flange joint. The brackets and the chest covers are bolted together to the valve chest.

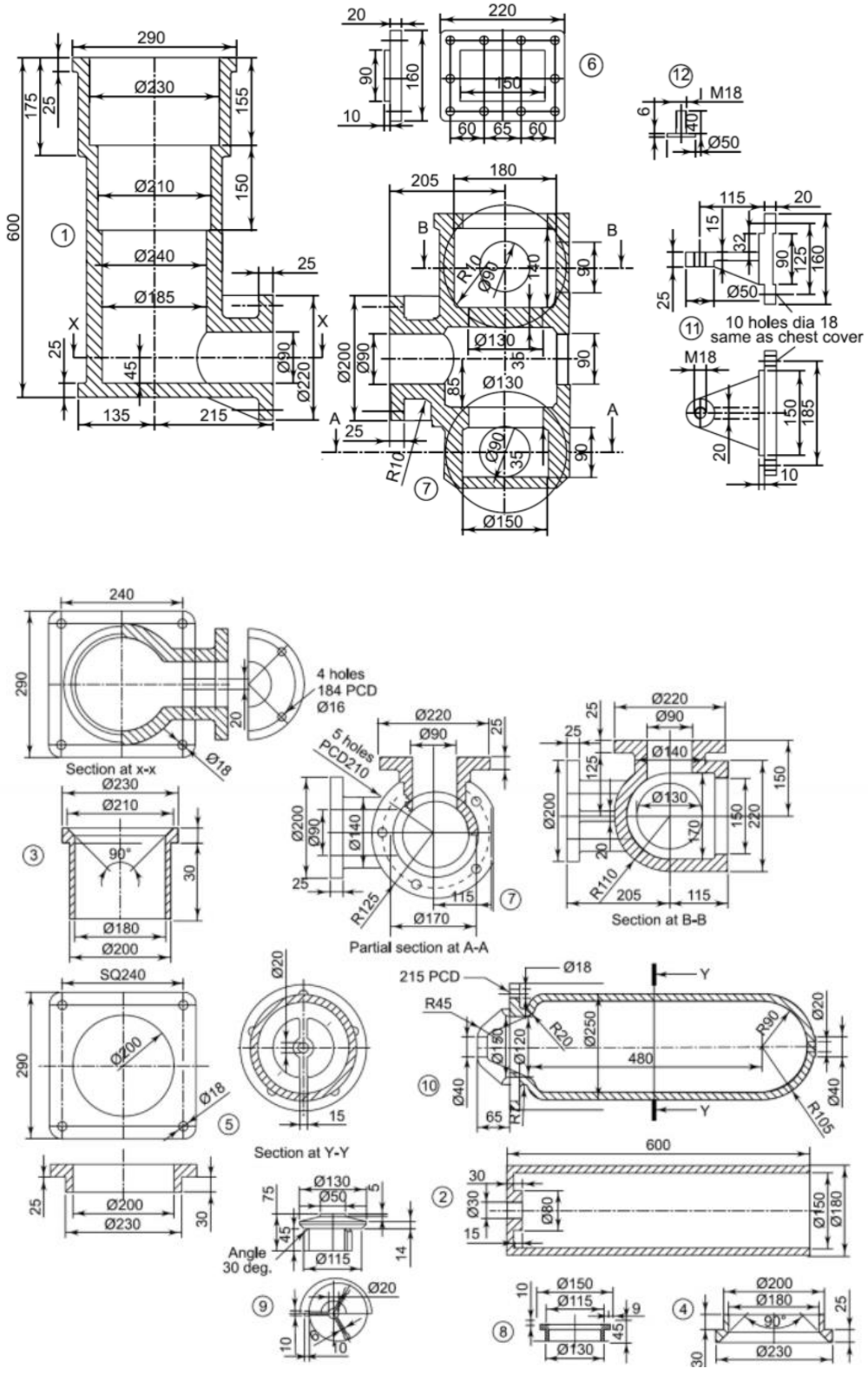
When the plunger moves up in the barrel, suction is created in the valve chest, which opens inlet valve and closes delivery valve. When the plunger moves downwards, inlet valve closes and the delivery valve opens due to pressure developed in the chest. Water is forced through delivery valve, till the plunger moves downwards. It is driven by electric motor or by steam engine.



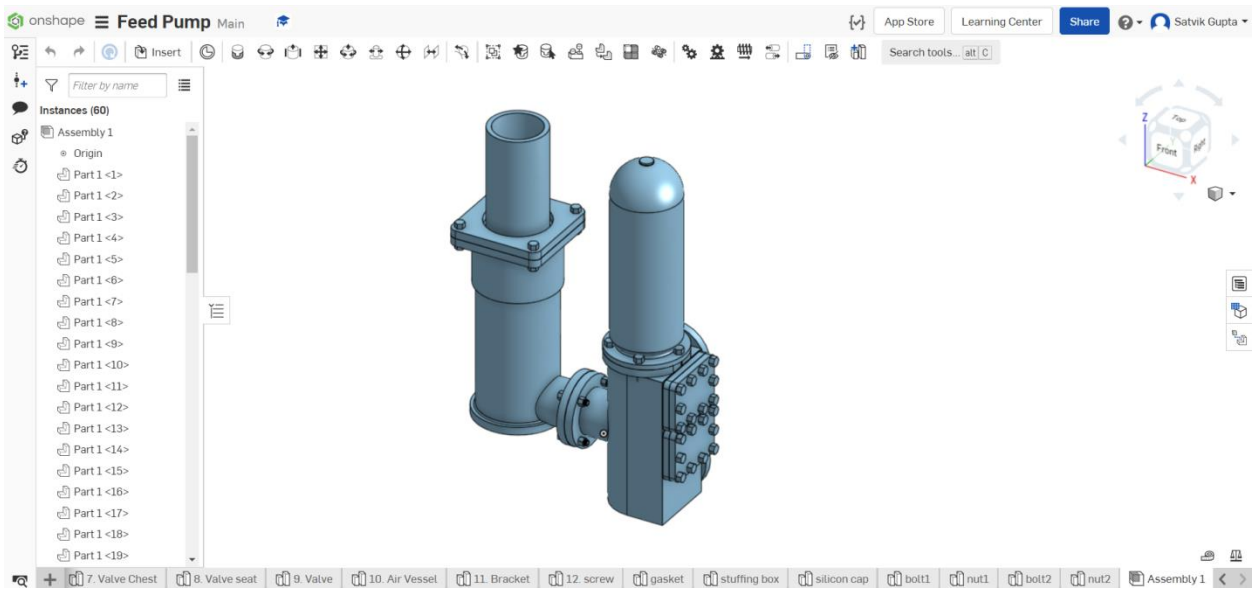
Part list

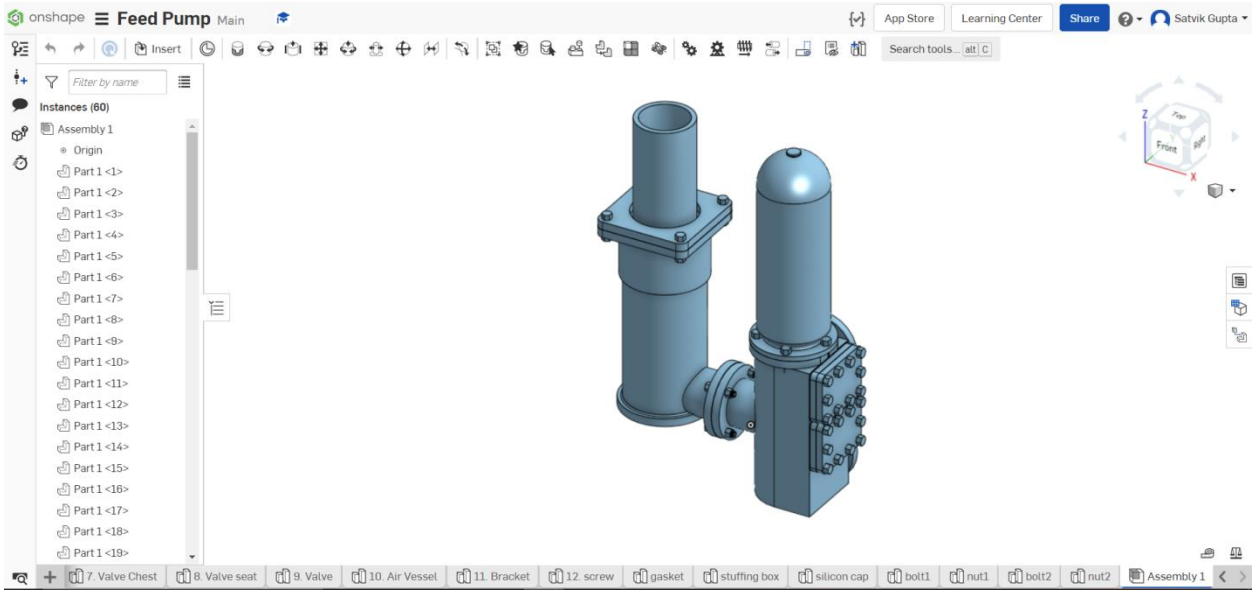
S.N.	Part name	Material	Qty
1	Barrel body	C.I.	1
2	Plunger	C.I.	1
3	Barrel liner	Brass	1
4	Cover liner	Gun metal	1
5	Barrel cover	C.I.	1
6	Chest cover	C.I.	2
7	Valve chest	C.I.	1
8	Valve seat	Gun metal	2
9	Valve	Gun metal	2
10	Air vessel	C.I.	1
11	Bracket	C.I.	2
12	Screw	M.S.	2

(Fig.1 Assembly of feed pump and part list)



(Fig.2 Part details of feed pump)



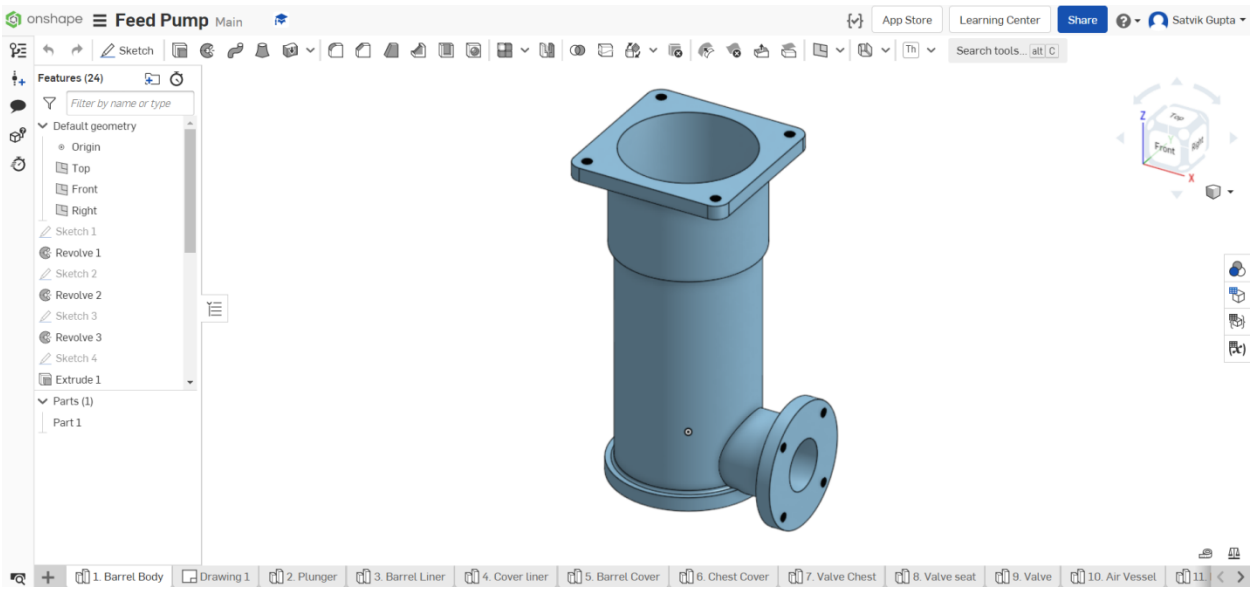


(Fig.3 Final Assembly made in Onshape)

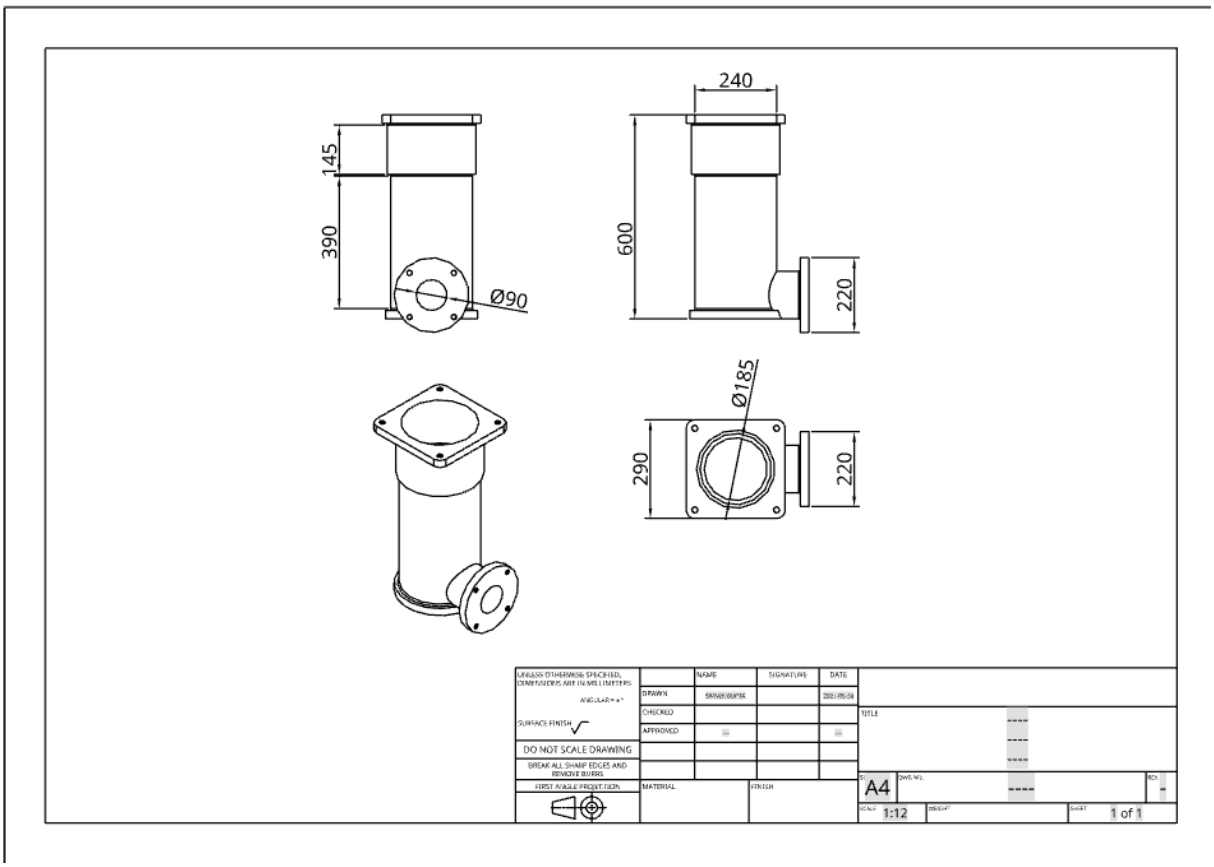
Parts and part drawings made on Onshape

All the parts were first separately made in the part studio and assembly was done when all the parts were ready. Part drawings were also created on ISO standard A4 size sheet for manufacturing purposes. Below we can find all the parts and part drawings in an ordered manner.

1. Barrel Body

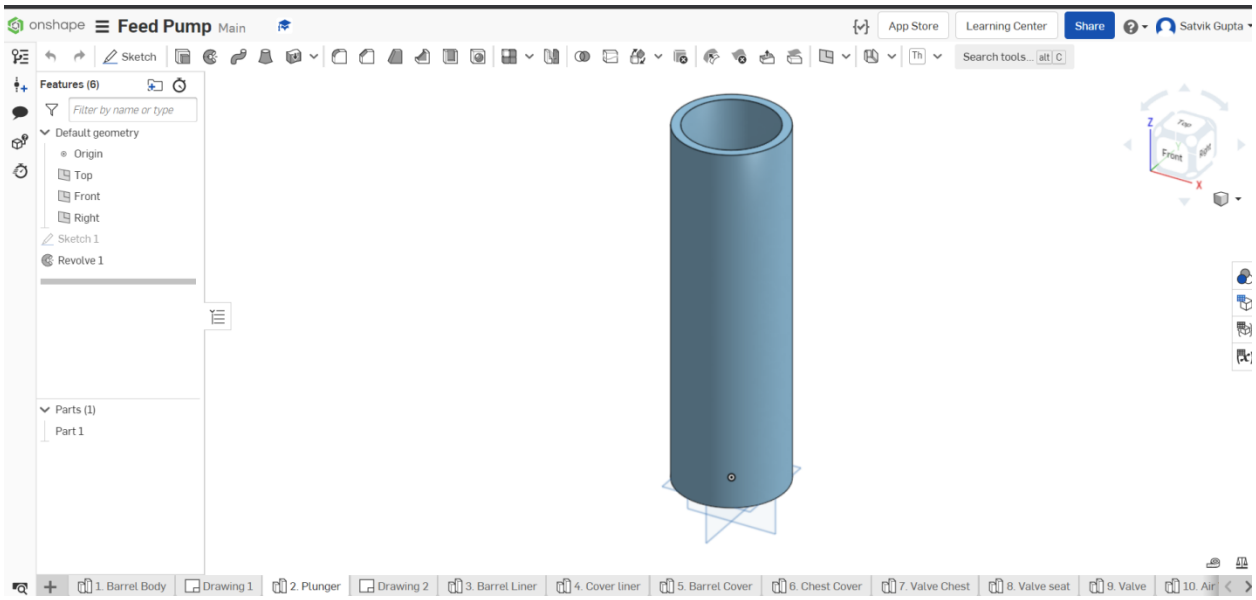


(Fig.4 Part modeling of barrel body)

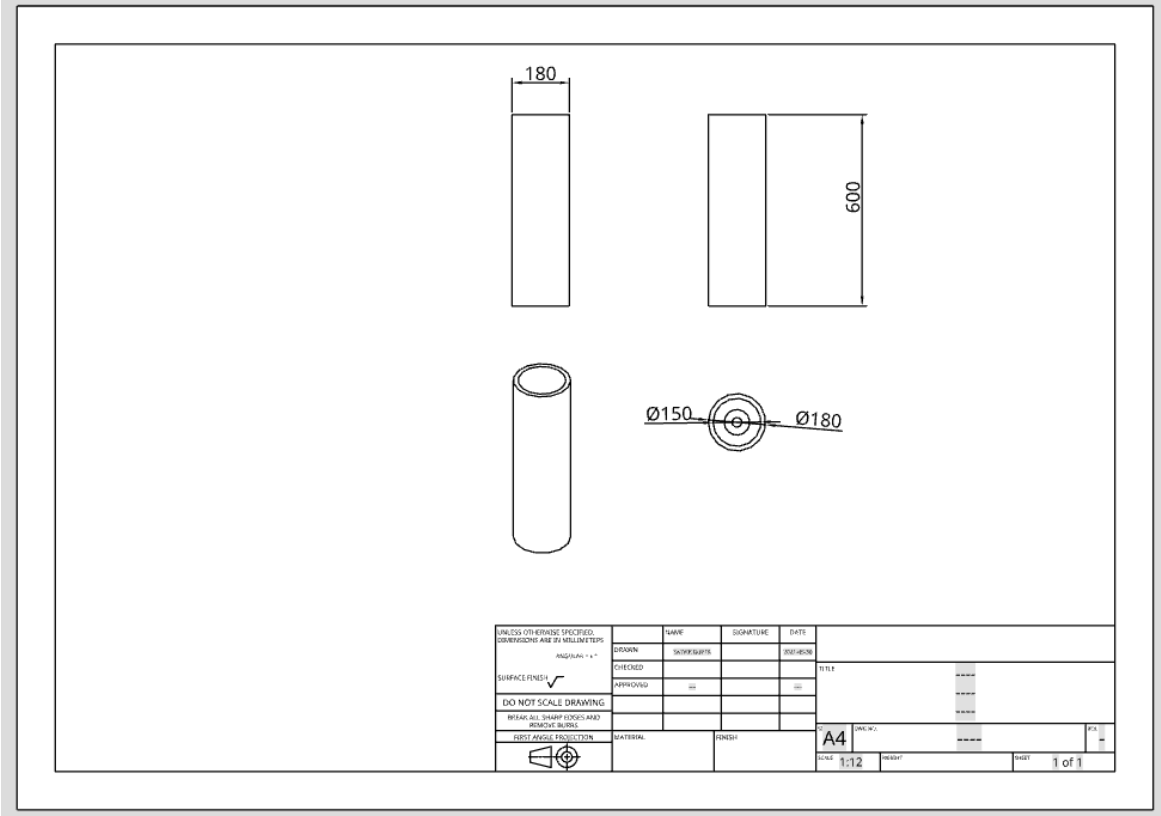


(Fig.5 Part drawing of barrel body)

2. Plunger

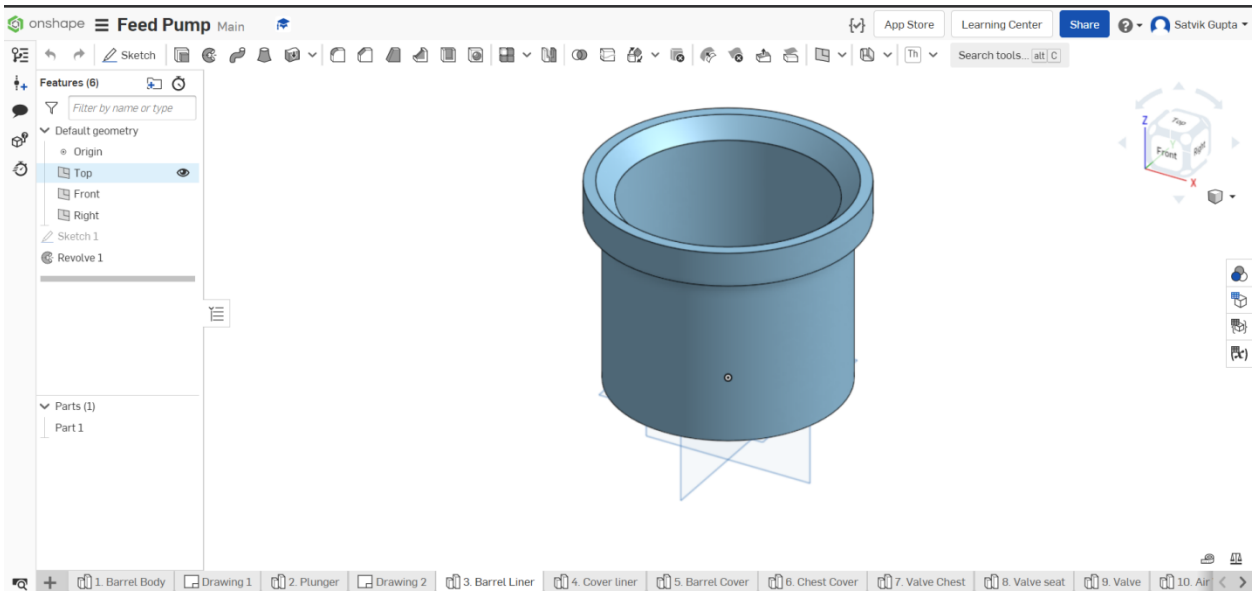


(Fig.6 Part modeling of Plunger)

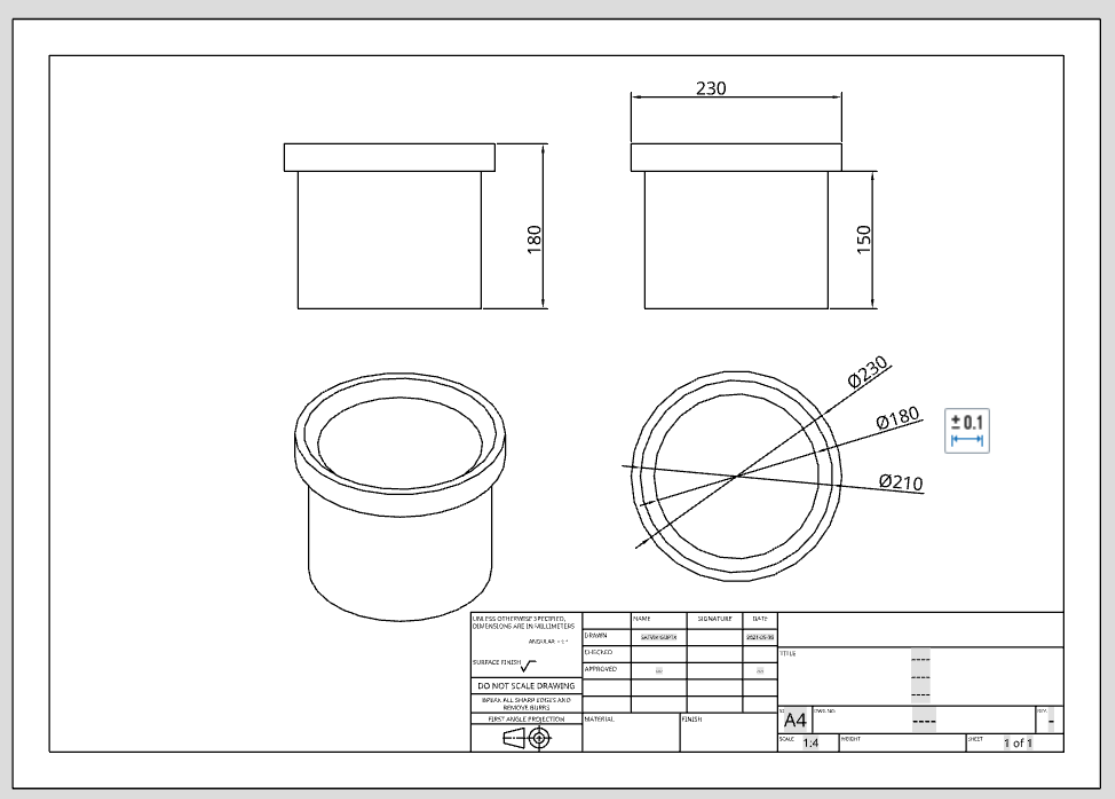


(Fig.7 Part drawing of Plunger)

3. Barrel Liner

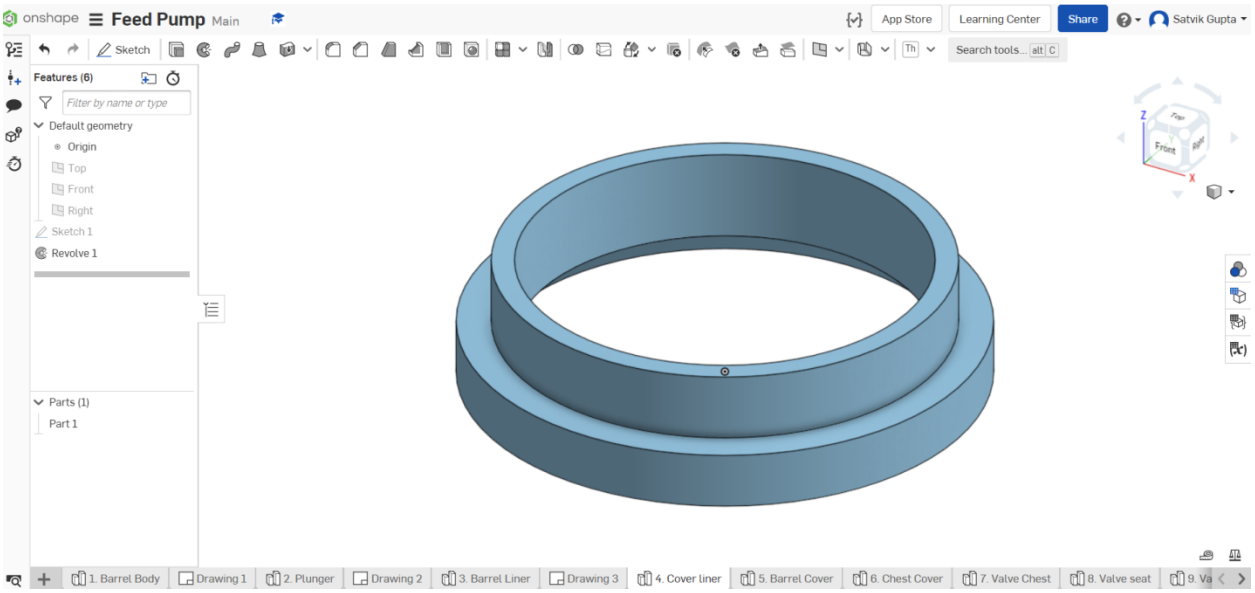


(Fig.8 Part modeling of barrel liner)

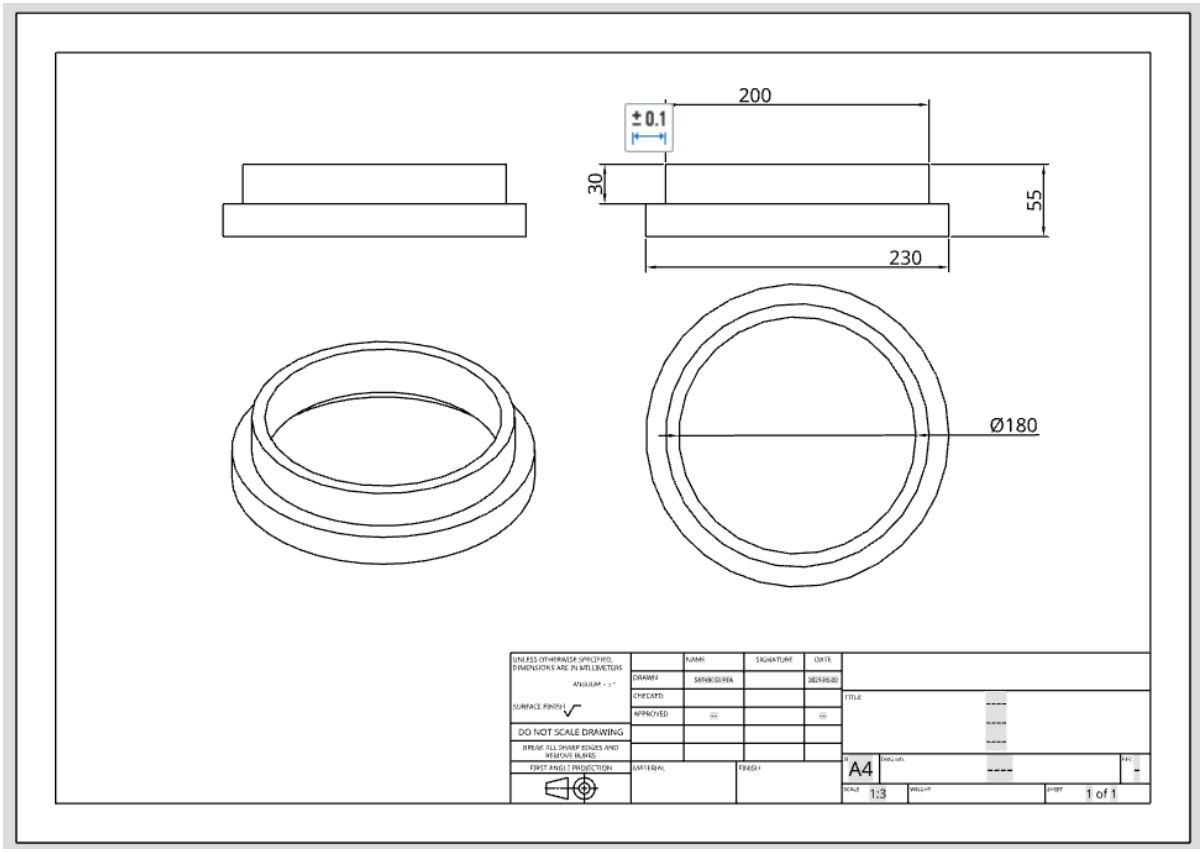


(Fig.9 Part drawing of barrel liner)

4. Cover Liner

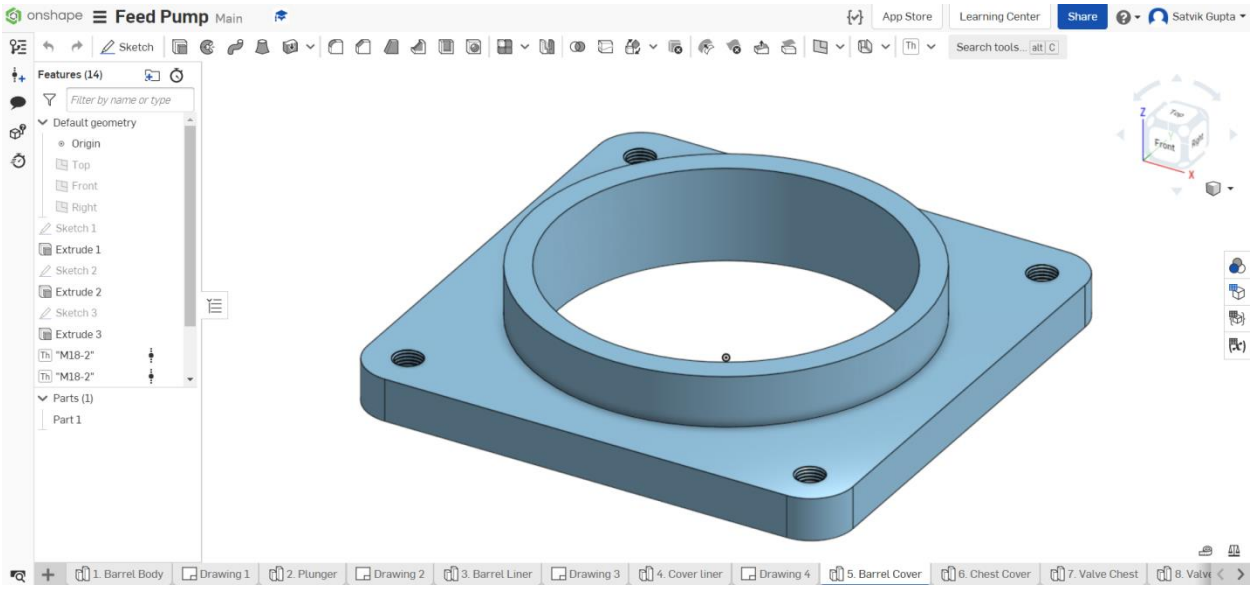


(Fig.10 Part modeling of cover liner)

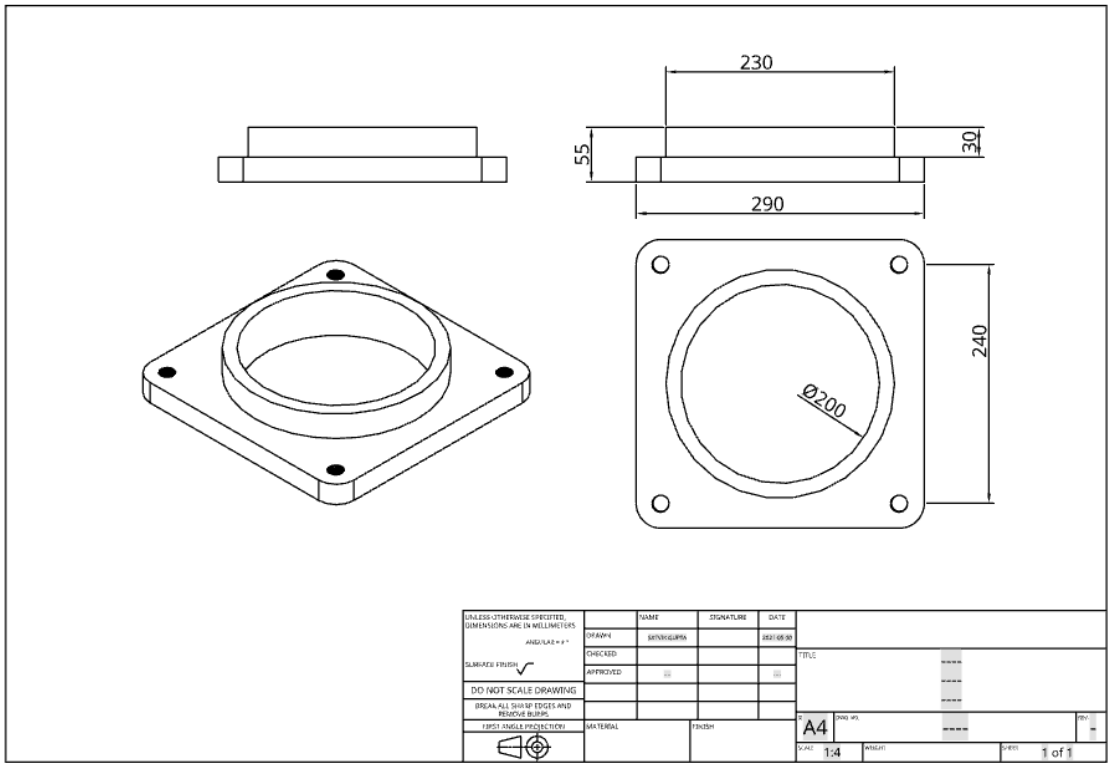


(Fig.11 Part drawing of cover liner)

5. Barrel cover

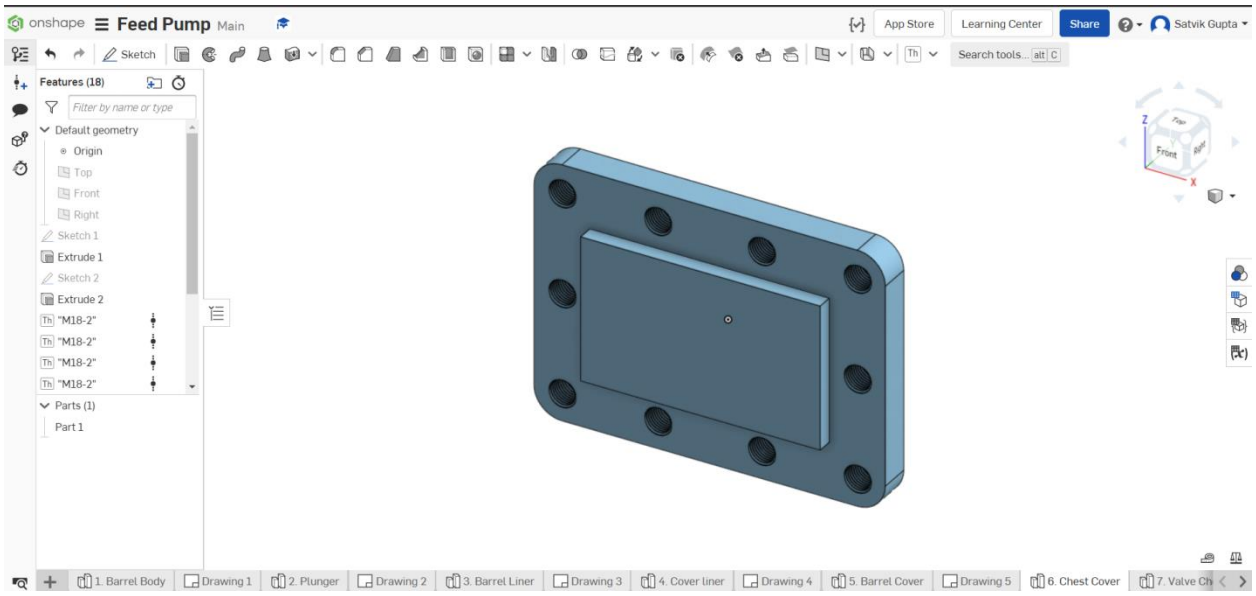


(Fig.12 Part modeling of barrel cover)

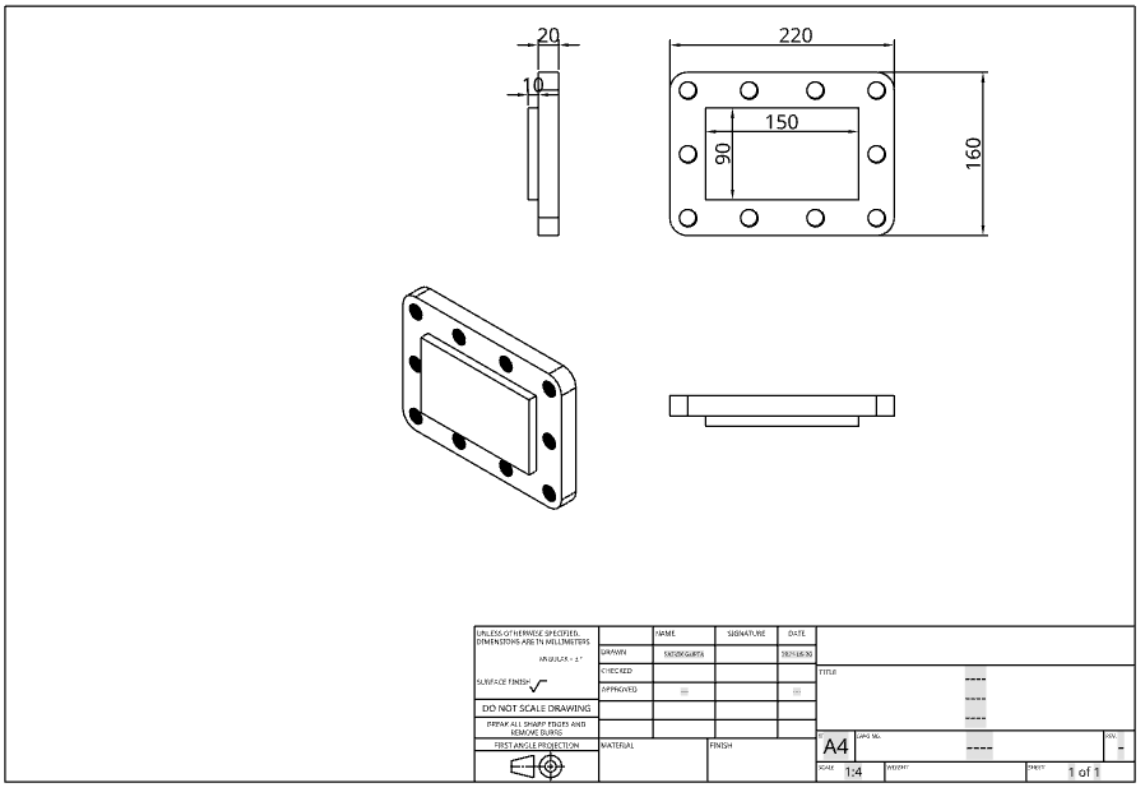


(Fig.13 Part drawing of barrel cover)

6. Chest cover

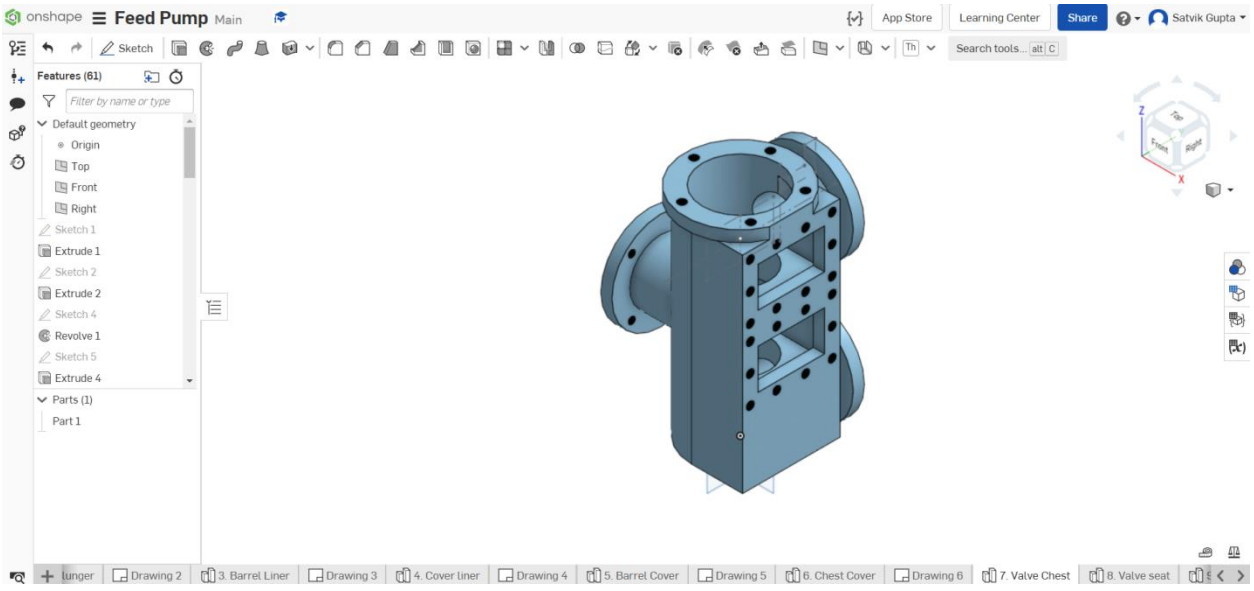


(Fig.14 Part modeling of chest cover)

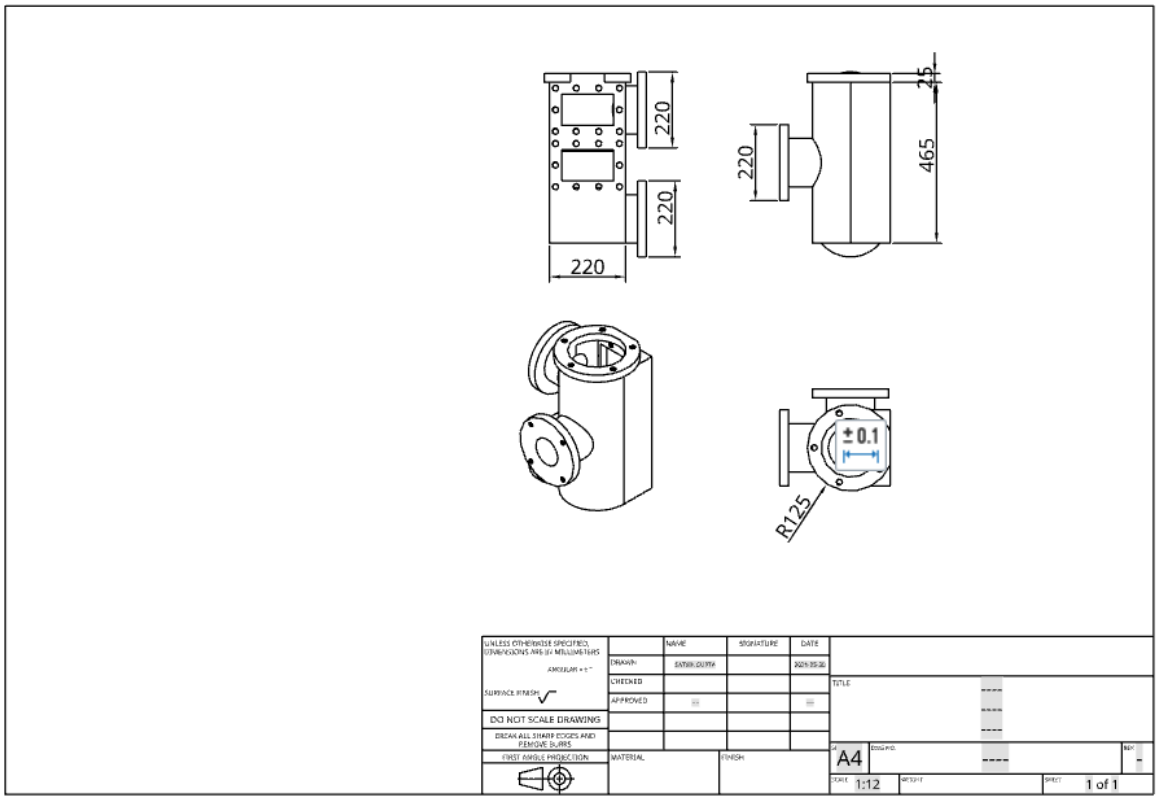


(Fig.15 Part drawing of chest cover)

7. Valve chest

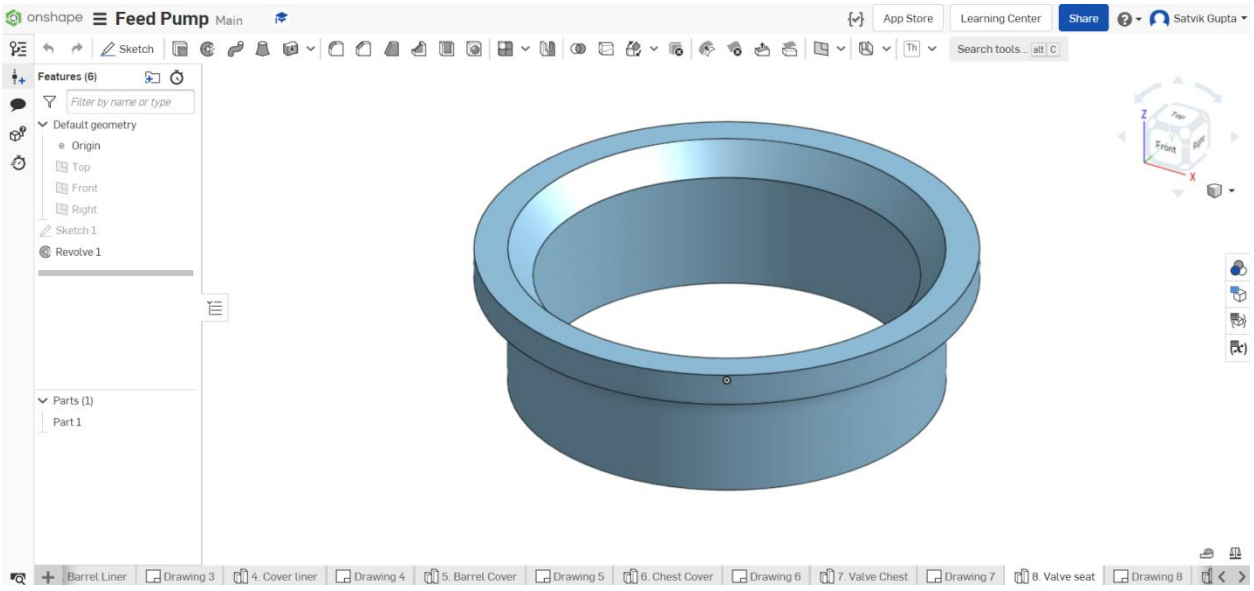


(Fig.16 Part modeling of valve chest)

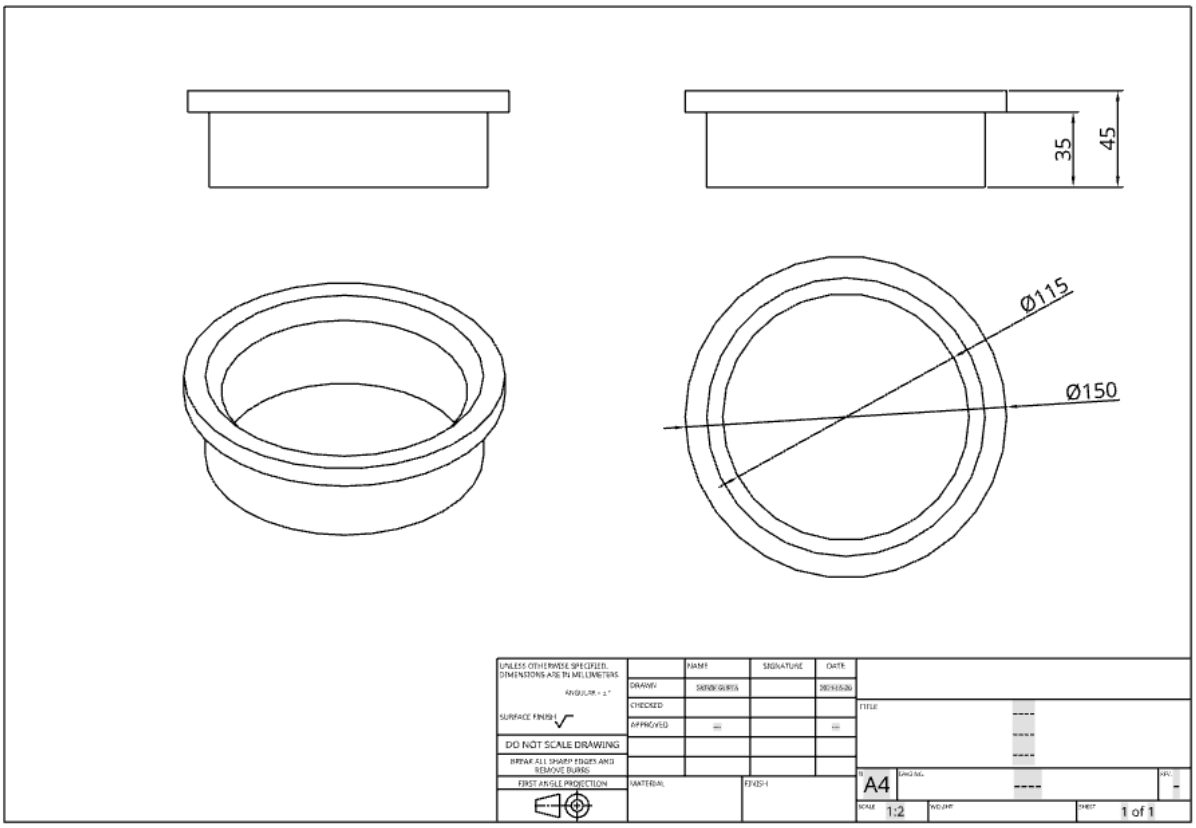


(Fig.17 Part drawing of valve chest)

8. Valve seat

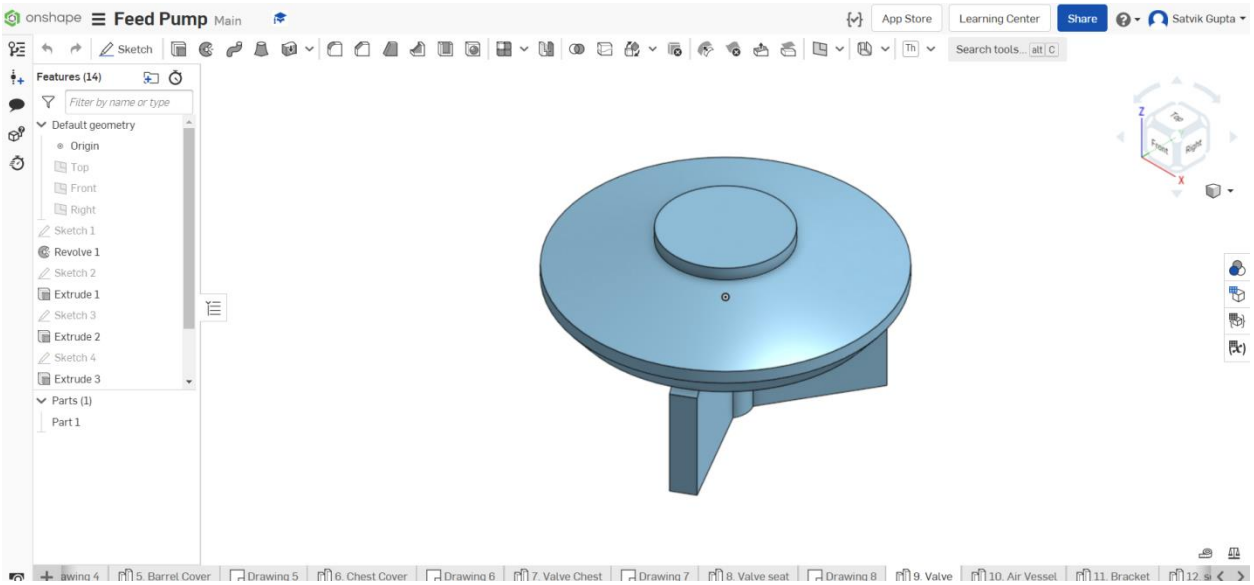


(Fig.18 Part modeling of valve seat)

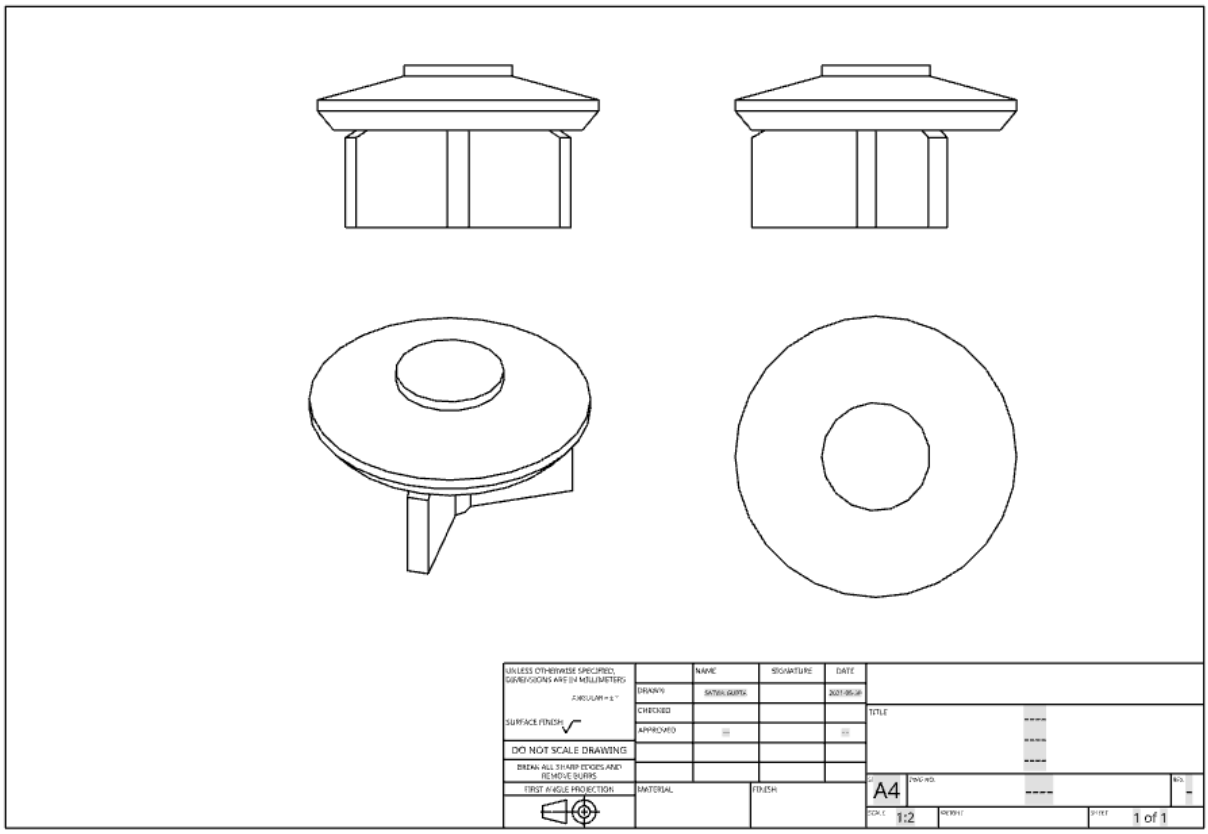


(Fig.19 Part drawing of valve seat)

9. Valve

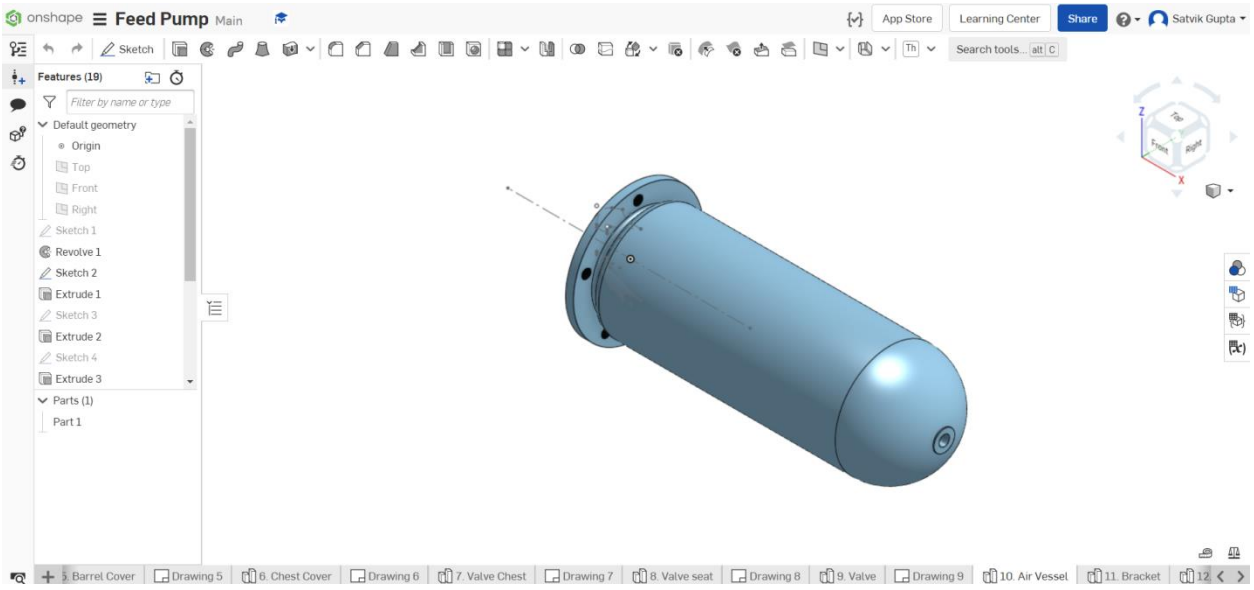


(Fig.20 Part modeling of valve)

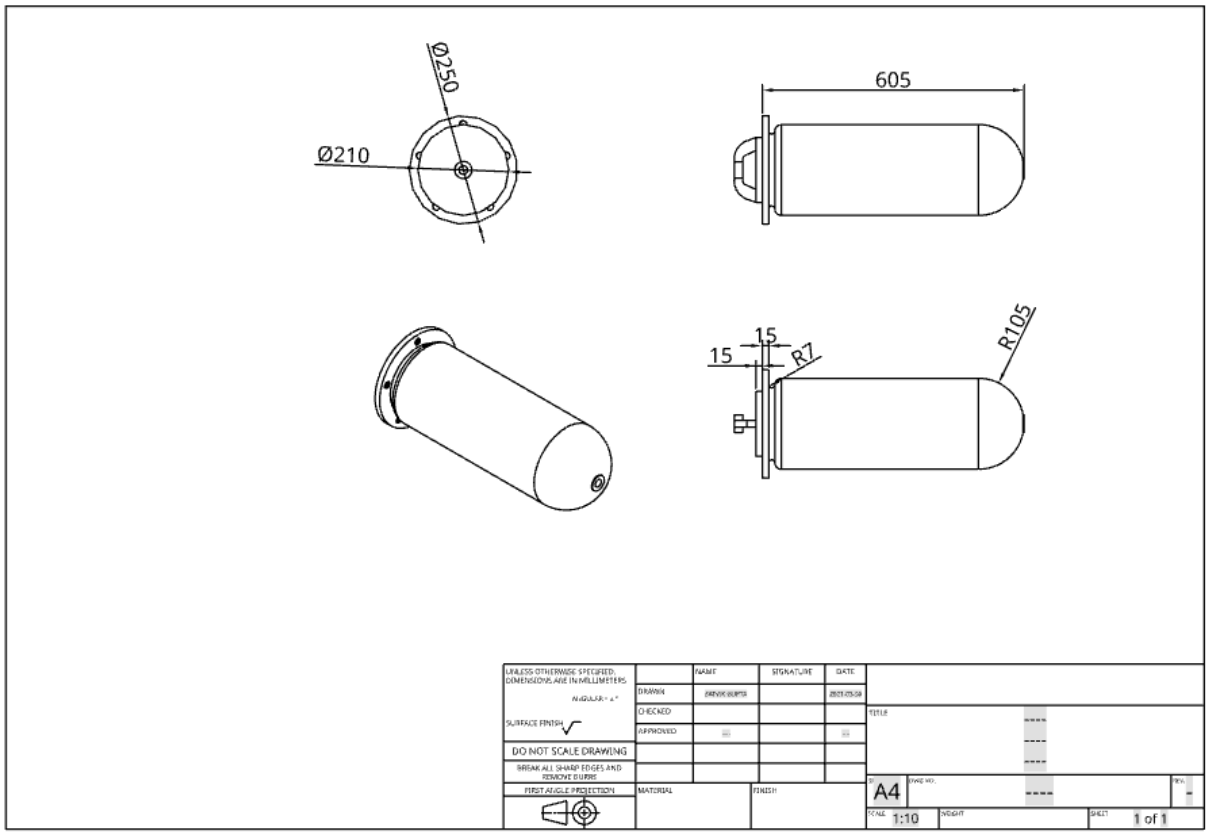


(Fig.21 Part drawing of valve)

10. Air Vessel

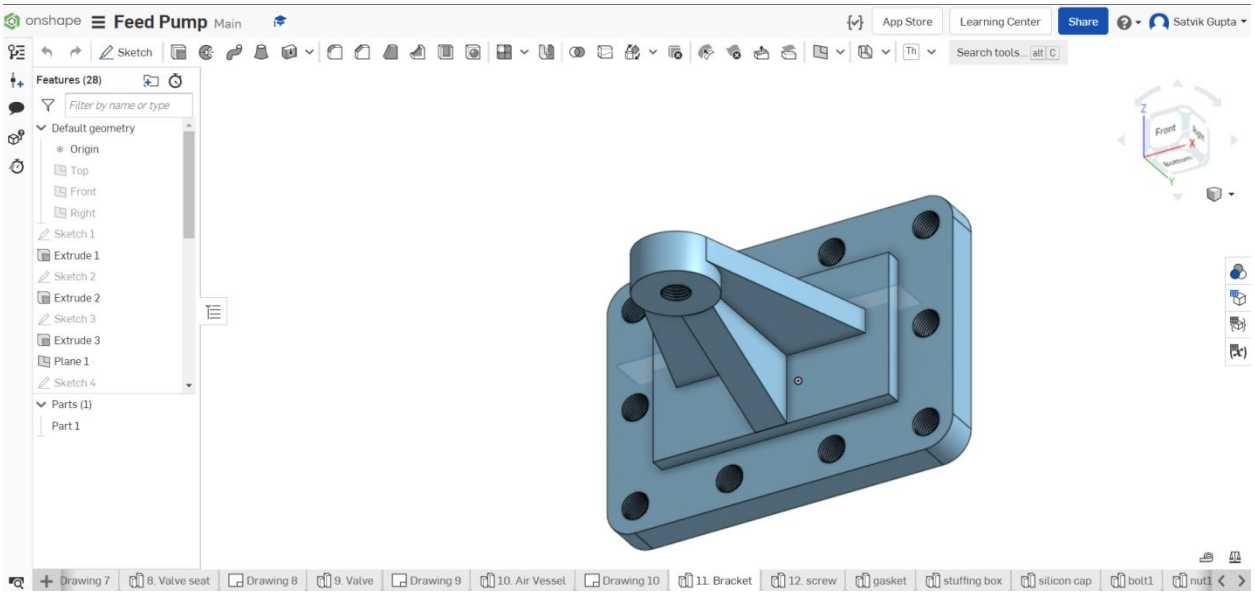


(Fig.22 Part modeling of air vessel)

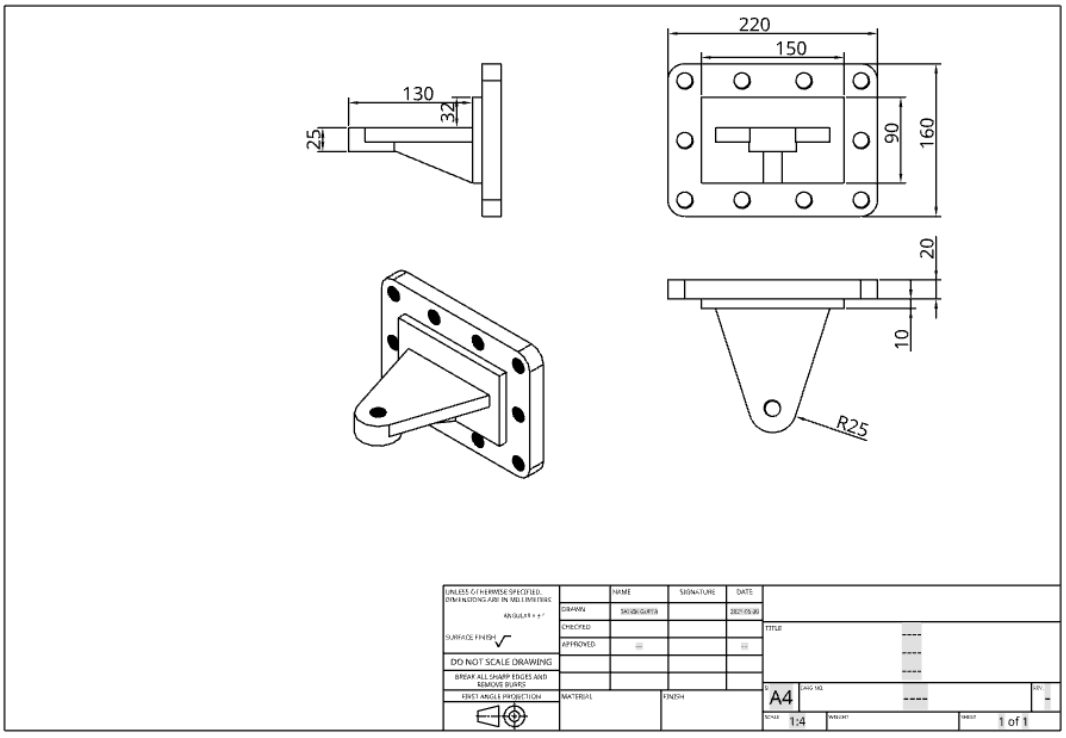


(Fig.23 Part drawing of air vessel)

11. Bracket

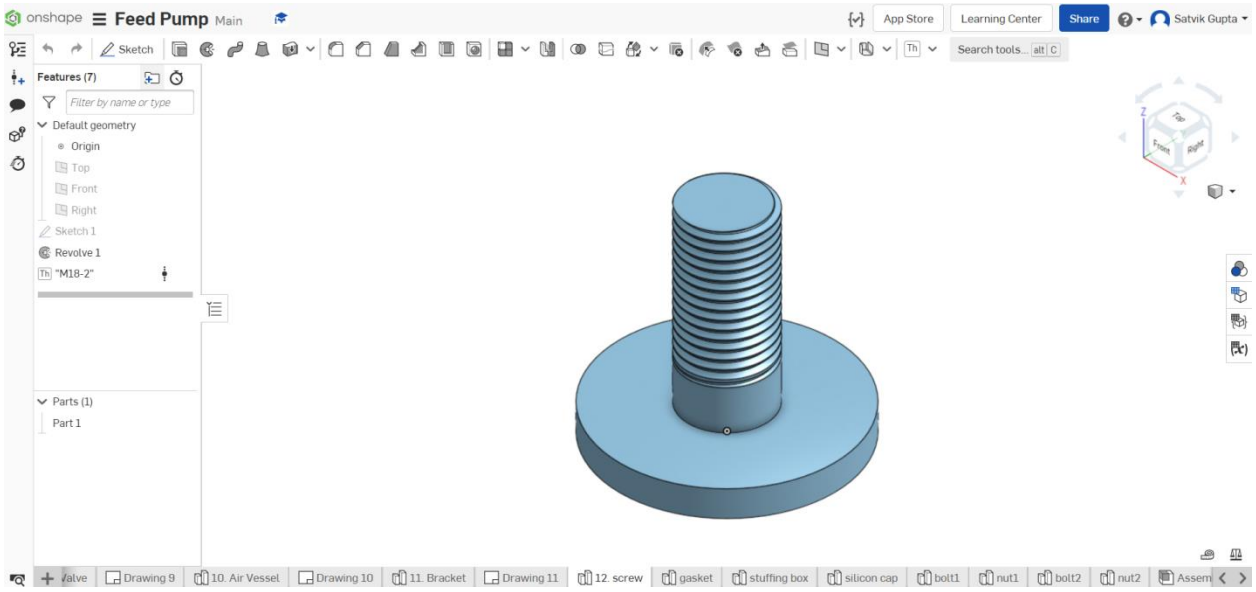


(Fig.24 Part modeling of bracket)

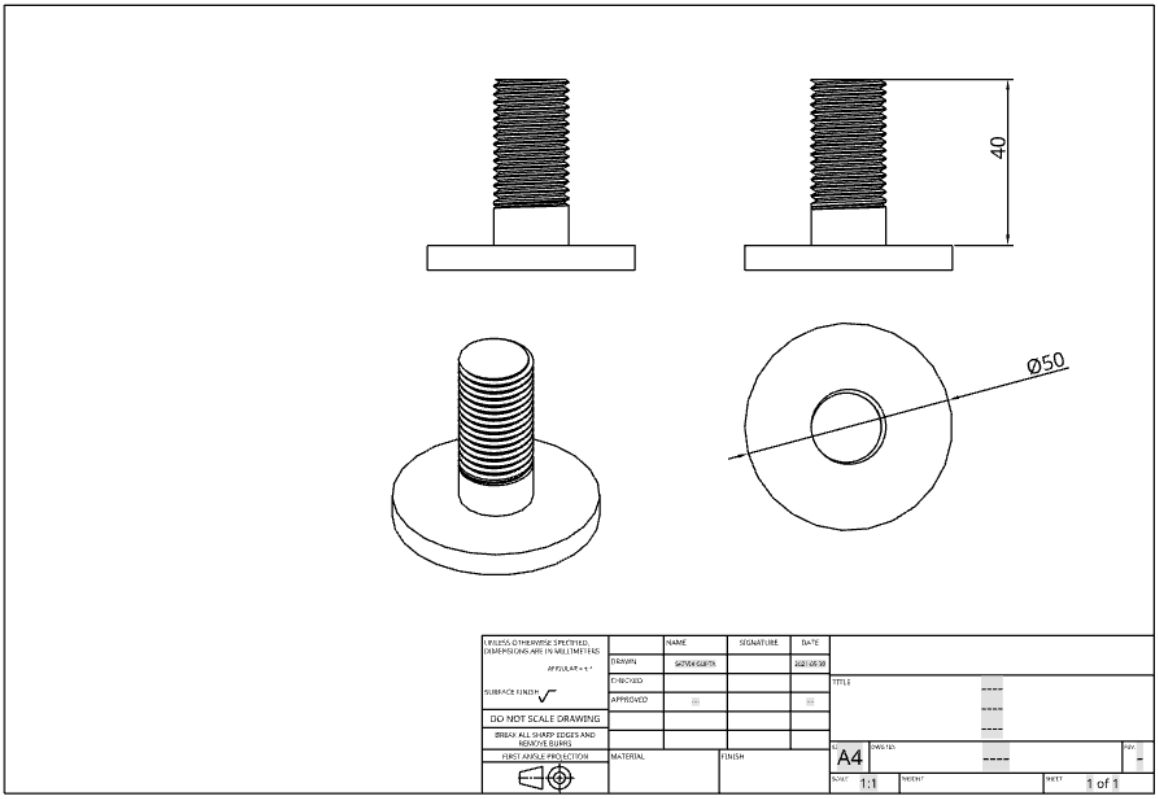


(Fig.25 Part drawing of bracket)

12. Screw



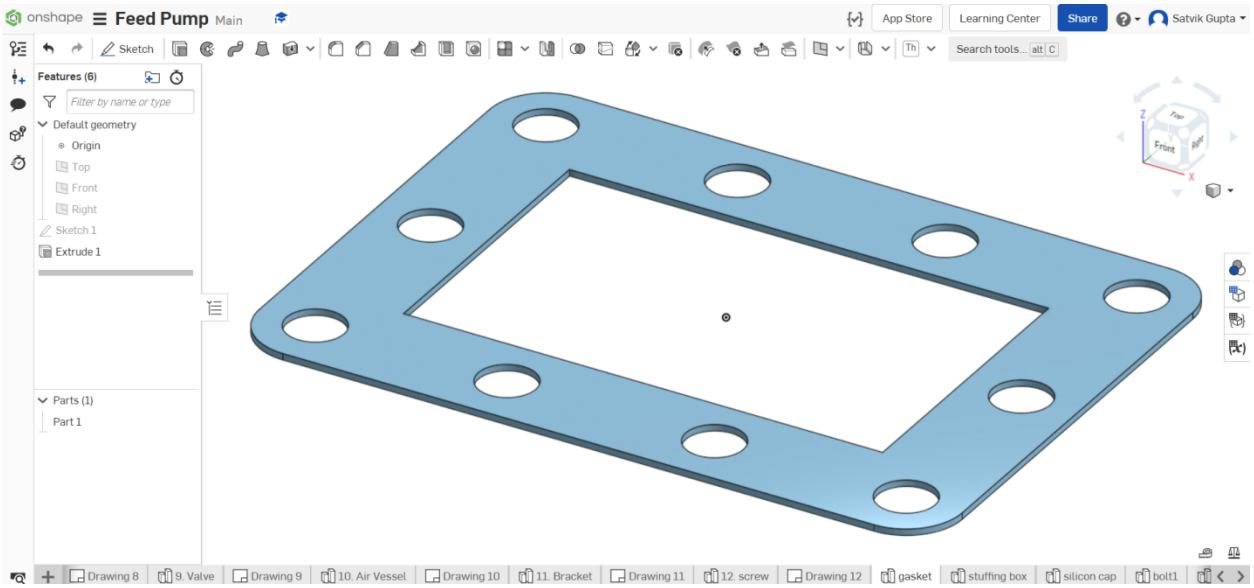
(Fig.26 Part modeling of screw)



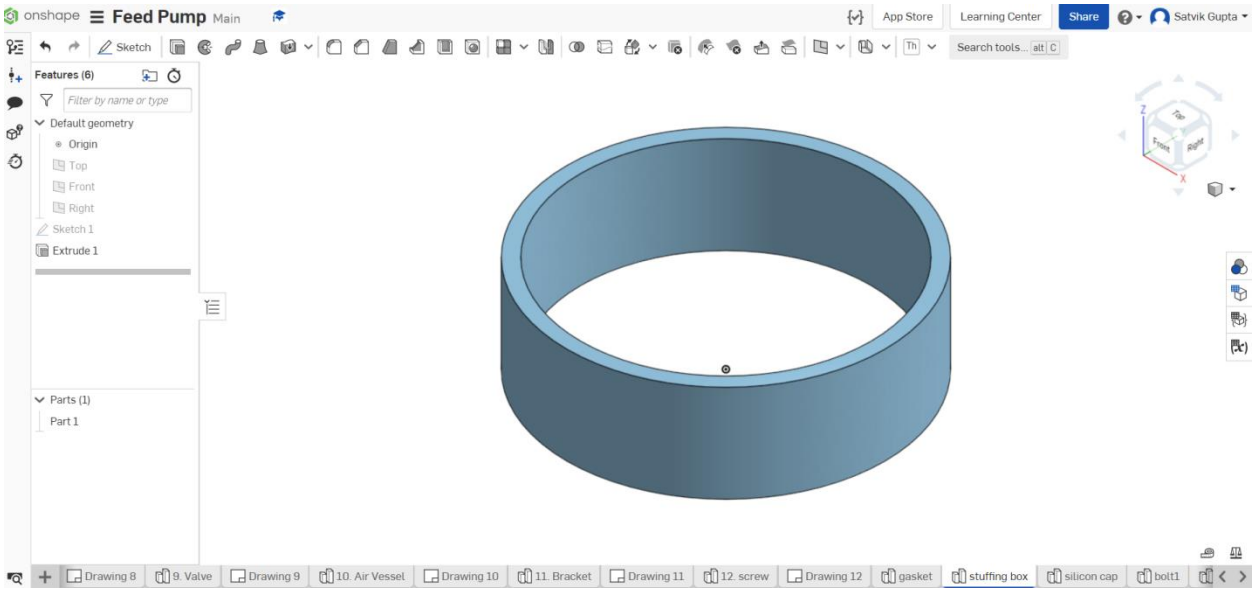
(Fig.27 Part drawing of screw)

Missing Parts

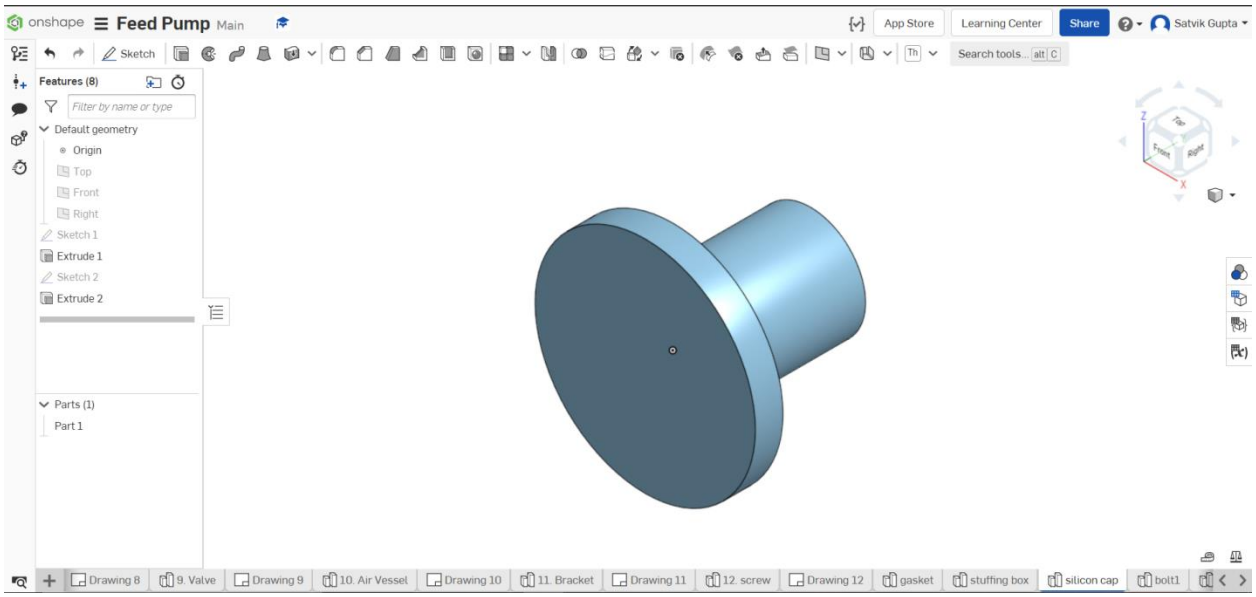
All the missing parts were designed taking appropriate dimensions according to given assembly. Missing parts that were designed for this assembly include gaskets, studs, nuts and bolts.Gaskets and stuffing boxes ensure leak proofing. Silicon cap is also designed to seal the top of the air vessel. Gaskets, silicon caps, stuffing box are made up of silicone rubber which ensures no leakage takes place.



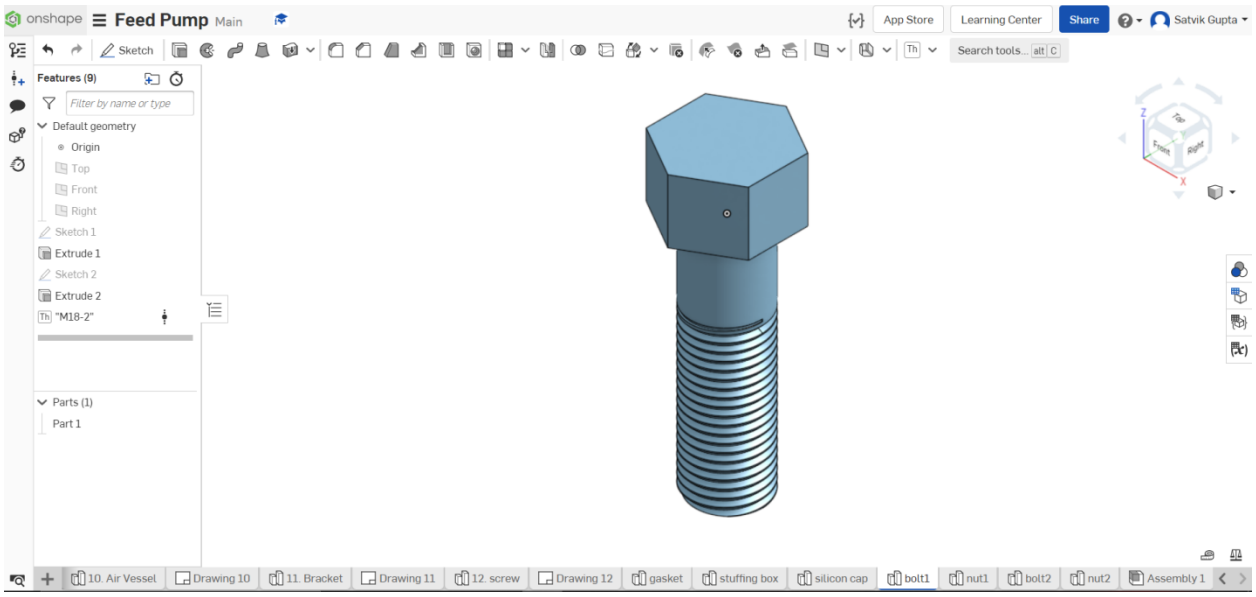
(Fig.28 gasket used for leak proofing made up of silicon rubber)

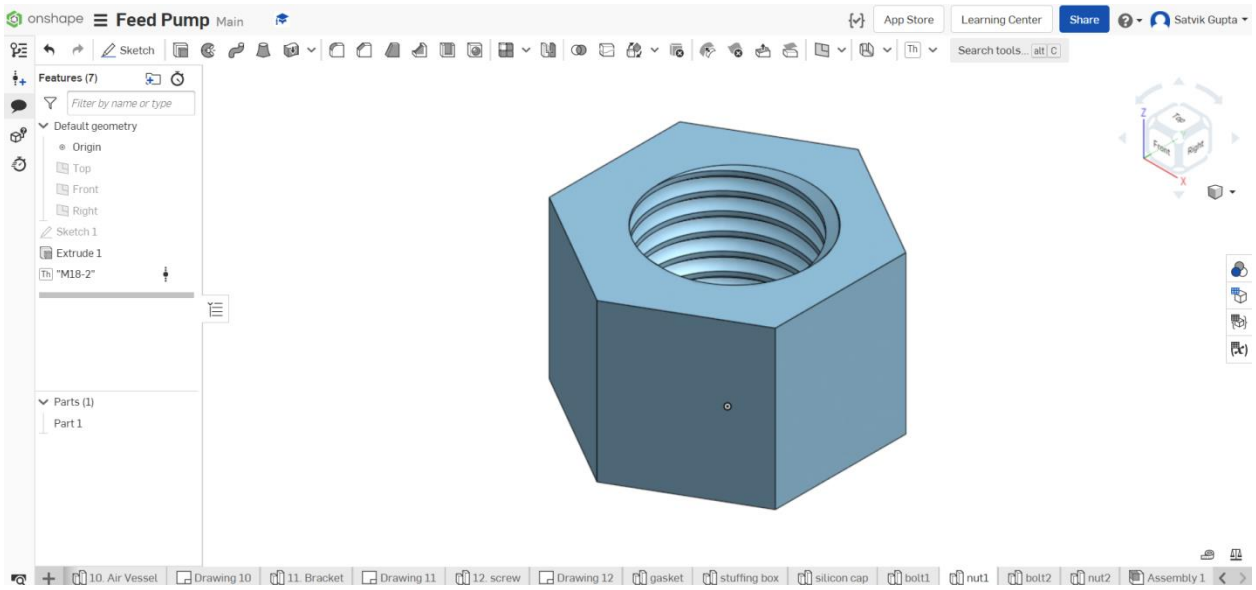


(Fig.29 stuffing box made up of silicon rubber)



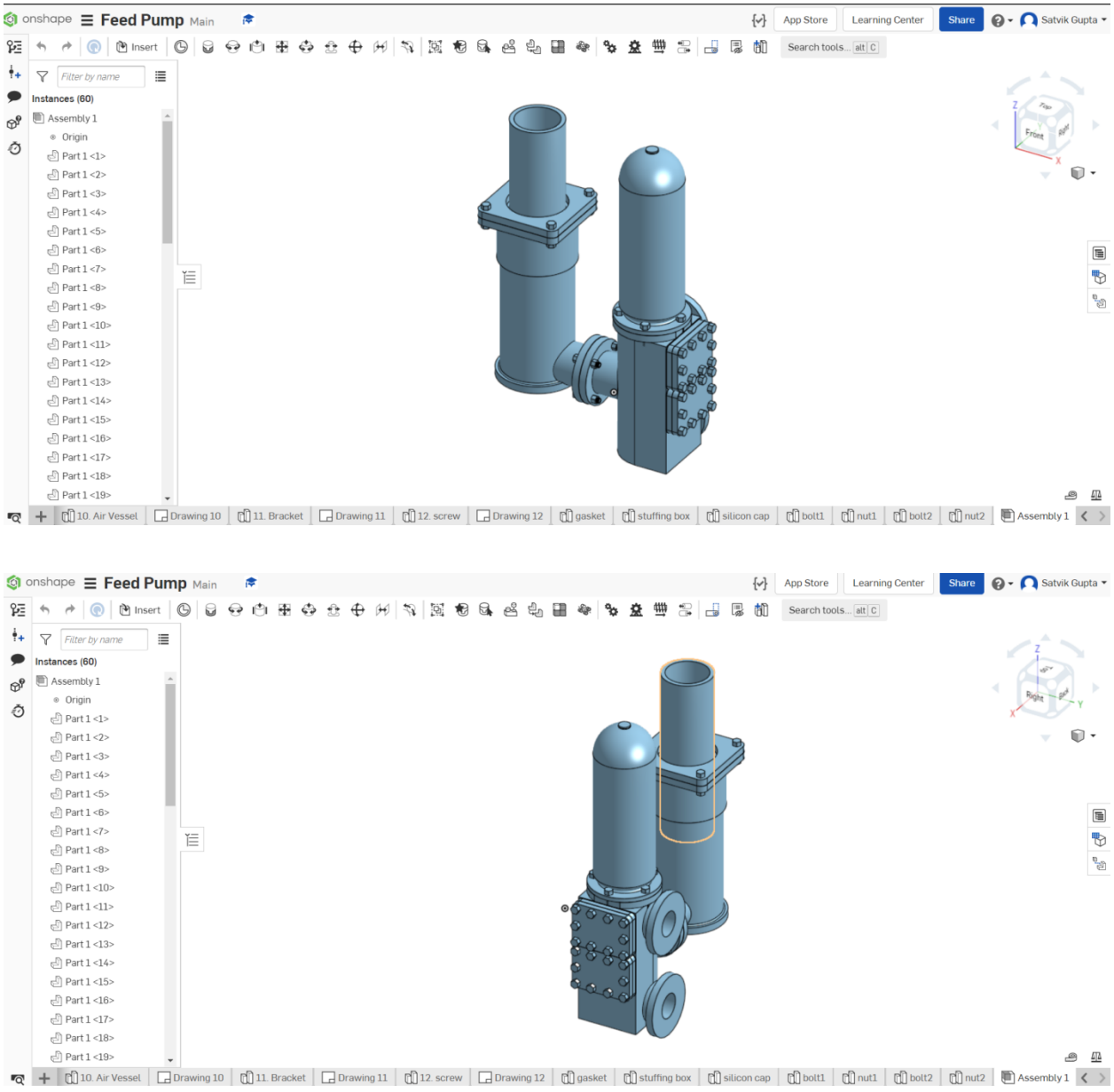
(Fig.30 Silicon cap used on top of the air vessel to seal it)



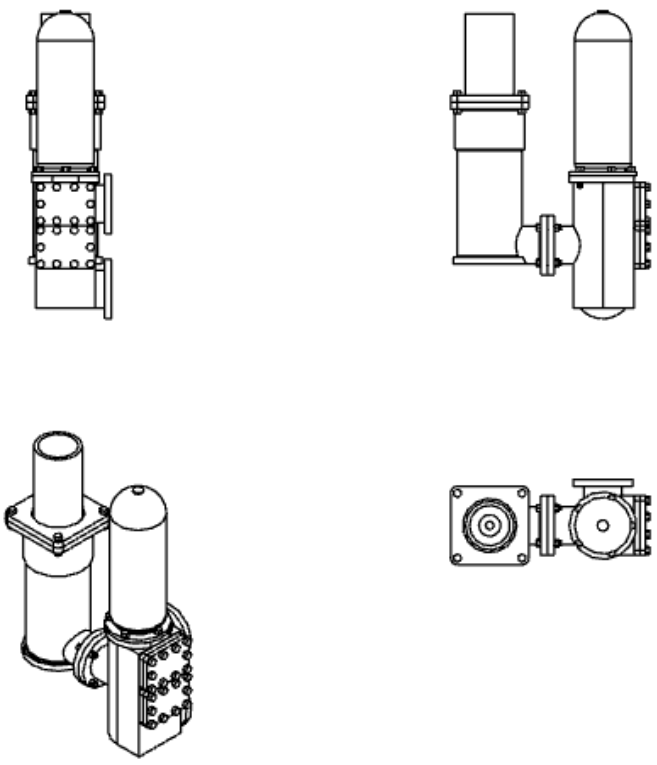


(Fig.31 standard size nut and bolts)

Assembly and Assembly drawings



(Fig.32 Final assembly of Feed pump)



(Fig.33 Final assembly drawing of Feed pump)

Reflections

1. Write on your learnings from this project and its use in making you a better mechanical design engineer?

A. There are a lot of learings from this project. Not only we learn to model and assemble the CAD model but also learn how to make difficult CAD models from 2D manufacturing drawings provided. The project overall helps us to grow and enhance our skills in terms of CAD designing, hence making us better mechanical design engineers.

2. What is the role of the stuffing box (made from parts number 3, 4, 5, 'stuffing material' and screwed fasteners)

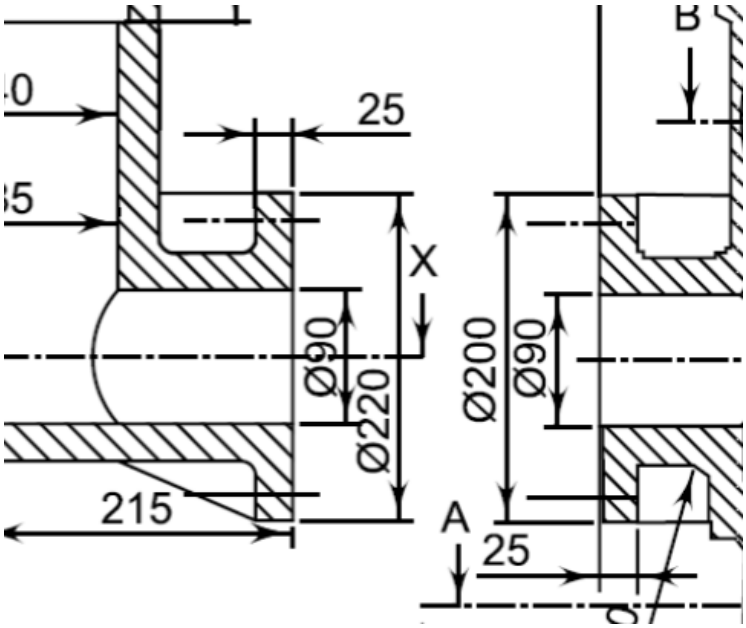
A. Pump packing, contained in stuffing boxes, may be used in some applications to prevent extreme loss of fluid from the low-pressure side of the pump, the stuffing box function is to prevent air leakage into the pump. If the pressure is above atmospheric, the function is to prevent liquid leakage out of the pump. So, they are made of stretchy and elastic material like rubber.

3. Describe the stepwise working of the pump describing the state of the plunger to get water into the pump, from the inlet, changes in the position of the two valves, the effect of the air vessel (as in a ram pump) to the state of the plunger when pumping water out of the outlet.

A. The feed pump is a positive displacement type of a reciprocating pump. The main part is a body made of cast iron in which a plunger reciprocates. A barrel liner made of brass is put inside the barrel. The barrel is connected to a valve chest using a flange joint. The brackets and the chest covers are bolted together to the valve chest. When the plunger moves up in the barrel, suction is created in the valve chest, which opens inlet valve and closes delivery valve. When the plunger moves downwards, inlet valve closes and the delivery valve opens due to pressure developed in the chest. Water is forced through delivery valve, till the plunger moves downwards. It is driven by electric motor or by steam engine.

4. There is a dimensional error in the fitting of the air vessel as given in the given drawings. Describe the error and how you have corrected the error based on sound engineering reasoning.

A. First dimensional error that we find is in the dimensions of outer diameters of the barrel body and valve chest are different, on the left side i.e in the barrel body we can see it is 220 and on right side i.e the valve chest it is 200. This error was resolved by taking same diameters at both sides of 220mm. (refer the fig given below).



Another error which we find is in plunger and face of barrel outlet. By looking at all the sketches provided, we find that the dimensions of plunger were different at 3 different locations. This was overcome by selecting a mutual dimension between the barrel body's inner diameters and selecting the plungers outer diameter on the basis of the same

Another error was found out while modelling the air vessel, we find a dimensional error where the disc which will be used to screw the air vessel and the valve chest together. The error was that all the holes in the disc in which the screws would be placed were made on a circle of 215 PCD while the holes on the valve chest were made on a circle of 210 PCD. This was resolved by making all the holes present of PCD 210mm.