

**MODELING AND 3D PRINTING OF MULTI CLUTCH PLATE****G.Venkatesh<sup>\*1</sup>****Ch.Sai kumar<sup>\*2</sup>,G.Shyam<sup>\*3</sup>,B.Sanjay<sup>\*4</sup>.**<sup>\*1</sup>Assistant Professor, Department of Mechanical Engineering, GNITC, Hyderabad, Telangana.<sup>\*2,\*3,\*4</sup>UG Scholars, Department of Mechanical Engineering, GNITC, Hyderabad, Telangana.**ABSTRACT**

A multi clutch plate, also known as a multi-plate clutch, is a type of clutch system used in vehicles, particularly in high-performance or heavy-duty applications. It consists of multiple clutch plates sandwiched together, alternating between friction discs and steel plates. Multi-plate clutches are preferred in high-performance vehicles because they can handle greater torque loads and provide smoother engagement compared to single-plate clutches. They are commonly found in sports cars, racing cars, motorcycles, and some heavy-duty trucks.

By designing a three-dimensional model of multi clutch plate in solid works software and converting slicing and slicing is done by idea maker software. Then the three-dimensional object is created layering successive layers of material based on digital model in FDM 3D printing.

**Keywords:**

Clutch Plates, Engaged, Disengaged, SOLIDWORKS, idea maker software, 3D printing.

**INTRODUCTION**

In this project we explore the potential of 3D printing technology for manufacturing multi-clutch plates. Multi-clutch plates are critical components in various transmissions, enabling smooth gear changes and efficient power transfer. Traditionally, these parts are fabricated using metal machining processes. However, 3D printing offers unique advantages, including design flexibility, weight reduction, and potential for on-demand manufacturing.

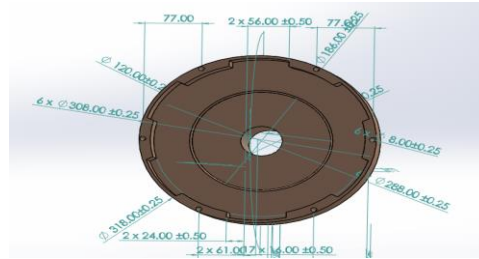
With 3D printing, complex geometries can be designed and manufactured for multi-clutch plates, potentially improving their performance and efficiency. Additive manufacturing also allows for the creation of lightweight structures, which can be beneficial for applications in weight-sensitive areas like aerospace and motorsports. Furthermore, 3D printing enables on-demand manufacturing, reducing the need for large inventories and enabling rapid prototyping.

Overall, 3D printing presents a promising approach for modeling and manufacturing multi-clutch plates, offering potential benefits in design, weight reduction, and production flexibility.

A clutch plate, also known as a friction disc, is a critical component of a manual transmission system in vehicles. It is situated between the engine and the gearbox and is responsible for engaging and disengaging the transmission from the engine's power. The clutch plate consists of a metal plate with friction material lining on both sides. When the driver presses the clutch pedal, the pressure plate releases pressure on the clutch plate, allowing it to disengage from the flywheel attached to the engine. This disengagement interrupts the power flow from the engine to the transmission, enabling the driver to shift gears smoothly. Conversely, when the driver releases the clutch pedal, the pressure plate applies pressure to the clutch plate, forcing it to engage with the flywheel. This engagement restores the power flow between the engine and the transmission, enabling the vehicle to move forward.

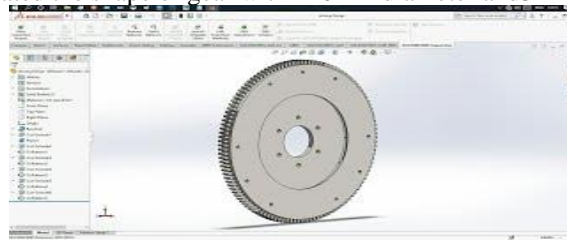
**MODELING AND ASSEMBLING OF MULTI CLATCH PLATE USING SOLIDWORKS**

Part 1: Shell To create go to SolidWorks software and click on start –Part design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. By using pad, pocket, shaft and revolve and etc. we created the shape of shell with 120mm diameter and 44 mm height boundary.



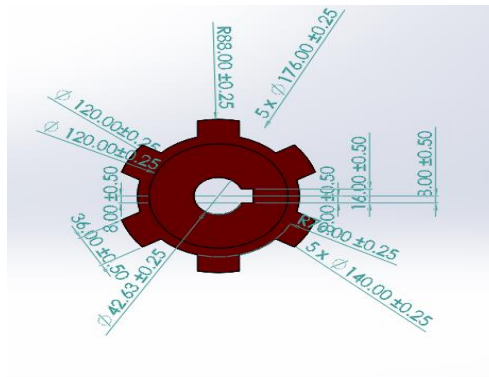
**Fig.1.Shell**

Part 2: Gear To create go to Solidworks software and click on start –mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. By using pad, pocket, shaft and revolve and etc. we created the shape of gear with 120mm diameter and 5 mm height boundary conditions.



**Fig.2.Gear**

Part 3: Gear Holder To create go to Solidworks software and click on start –mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. By using pad, pocket, shaft and revolve and etc. we created the shape of holder with 120mm diameter and 5mm height boundary conditions



**Fig.3.Gear Holder**

Part 4: Gear Pin To create go to Solidworks software and click on start –mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. By using pad, pocket, shaft and revolve and etc. we created the shape of holder with 120mm diameter and 10 mm height boundary conditions.



**Fig.4.Gear Pin**

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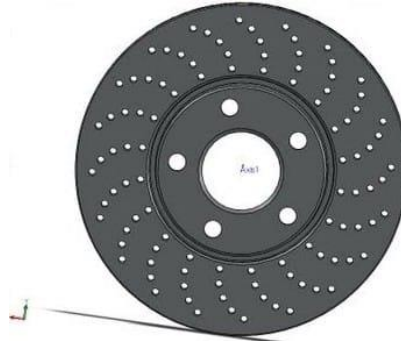
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Part 5: Gear Bearing To create go to Solidworks software and click on start –mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. By using pad, pocket, shaft and revolve and etc. we created the shape of gear with 30 mm diameter and 20 mm height boundary conditions.



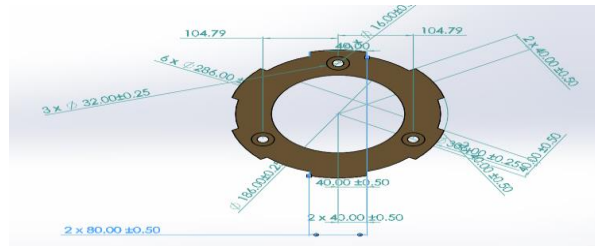
**Fig.5.Gear Bearing**

Part 6: Disc Plate Holder To create go to Solidworks software and click on start –mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. By using pad, pocket, shaft and revolve and etc. we created the shape of pressure holder with 120mm diameter and 44 mm height boundary conditions.



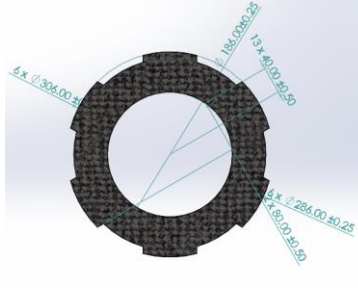
**Fig.6.Disc Plate Holder**

Part 7: Friction Disc To create go to Solidworks software and click on start –mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. By using pad, pocket, shaft and revolve and etc. we created the shape of frictional clutch with 120mm diameter and 5 mm height boundary conditions.



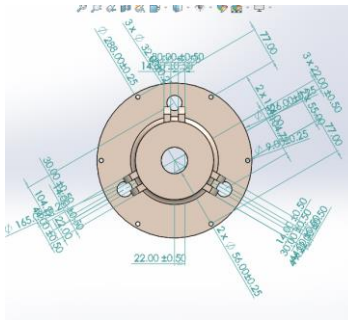
**Fig.7.Friction Disc**

Part 8: Disc To create go to Solidworks software and click on start –mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. By using pad, pocket, shaft and revolve and etc. we created the shape of clutch plate with 120mm diameter and 2 mm height boundary conditions.



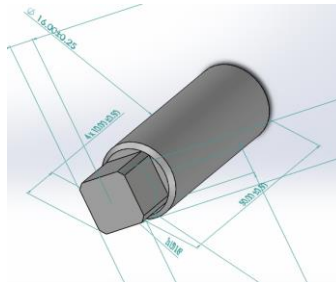
**Fig.8. Disc**

Part 9: cover To create go to Solidworks software and click on start –mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. By using pad, pocket, shaft and revolve and etc. we created the shape of cover with 120mm diameter and 20 mm height boundary conditions.



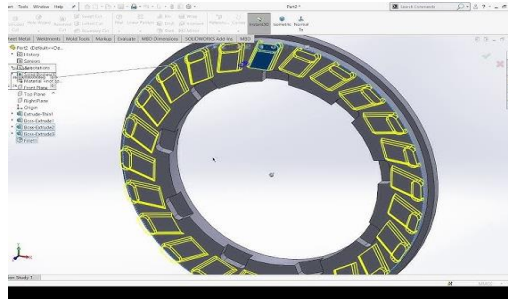
**Fig.9. Cover**

Part 10: Bolt To create go to Solidworks software and click on start –mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. By using pad, pocket, shaft and revolve and etc. we created the shape of shell with 30mm diameter and 30 mm height boundary conditions.



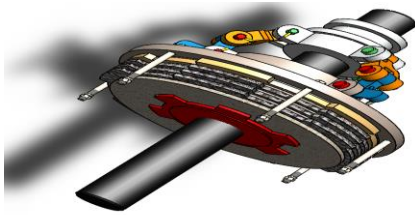
**Fig.10. Bolt**

Part 11: Springs To create go to Solidworks software and click on start –mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. By using pad, pocket, shaft and revolve and etc. we created the shape of shell with 30mm diameter and 30 mm height boundary conditions.

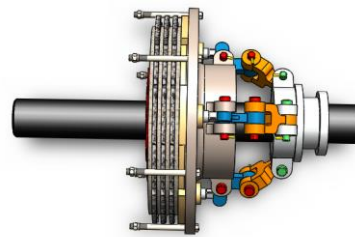


*Fig.11. Spring Assembly*

To create go to Solidworks software and click on start –mechanical design and select assembly design module. In assembly design module then go to insert menu and select existing component and select product.1.then browser to part.1 from above and click ok then you can see the component. Go to constraints in insert and select fixed constraints and select body to fix in position as shown in fig,



*Fig.12.Clutch Plate Assembly in Solidworks*

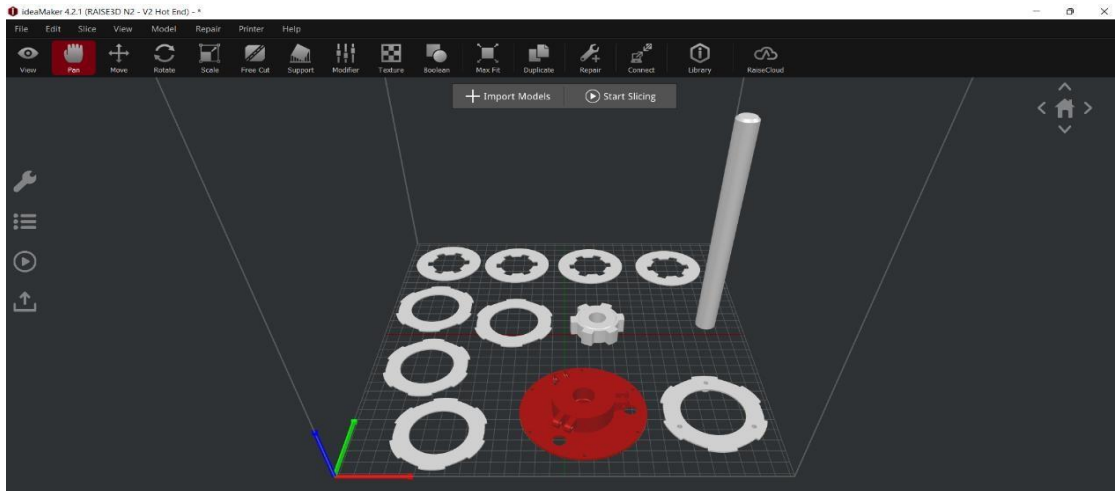


*Fig.13.Half Section*

#### **SLICING OF MULTI CLUTCH PLATE SOLIDWORK MODEL USING IDEA MAKER SOFTWARE**

After setting up the print settings, it's time to finally slice it into g-code.

- Click on the play icon labelled "Start Slicing" or use Ctrl+P. It might take some time to slice the model.
- Once the slicing is finished, you'll see a window indicating the estimated price, print duration, etc.
- If you've connected your printer, you can print directly from Idea Maker by clicking "Export". However, if you don't have your printer connected, it will export the g-code file.
- Selecting "Upload" will upload the g-code to the printer wirelessly. This is the case for Raise 3D printers.
- If you want to preview your g-code, click on "Preview". The preview screen itself will take some time to load.
- Copy the g code file to pen drive and input to 3d printer.
- On screen we can see the 4 tabs. 1. Watch 2. Prepare 3. Control 4. Card
- Go to the main menu and Check the temperature of the nozzle 1 and nozzle 2 and bed temperature.
- Make sure that temperature of the nozzle should be 220 C and bed temperature must be at 100 C.
- After the temperatures maintain, go back to main menu and select prepare.
- Then choose the bed prepare to apply suitable mixture to fixed the component at fixed location on construction time.
- After the bed preparation is done to go the prepare, select home to start programming then we can see the filament is loading in the any one of the nozzles or both the nozzles.



*Fig.14.Components in Slicing Software*

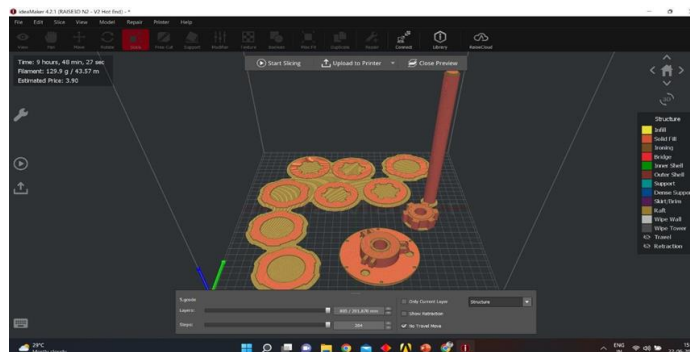
### FDM MACHINE SETUP AND 3D PRINTING OF MULTI CLUTCH PLATE

#### FDM Machine Setup

Prepare the FDM 3D printer for the printing process. This involves calibrating the printer, levelling the build plate, and ensuring proper filament loading. - Calibration includes levelling the build plate, adjusting the printer's extruder height, and verifying the printer's overall alignment. Proper calibration is essential to achieve accurate layer deposition and ensure adhesion between layers.

#### 3D Printing of Multi Clutch Plate

Load the ABS filament into the FDM printer's extruder, which heats and melts the filament. - The printer's nozzle moves along the X, Y, and Z axes, depositing the molten ABS filament layer by layer, according to the instructions from the slicing software. - As each layer is deposited, it solidifies and bonds with the previous layers, gradually building the robotic arm, Load the ABS filament into the FDM printer's extruder, which heats and melts the filament. - The printer's nozzle moves along the X, Y, and Z axes, depositing the molten ABS filament layer by layer, according to the instructions from the slicing software. - As each layer is deposited, it solidifies and bonds with the previous layers, gradually building the robotic arm.

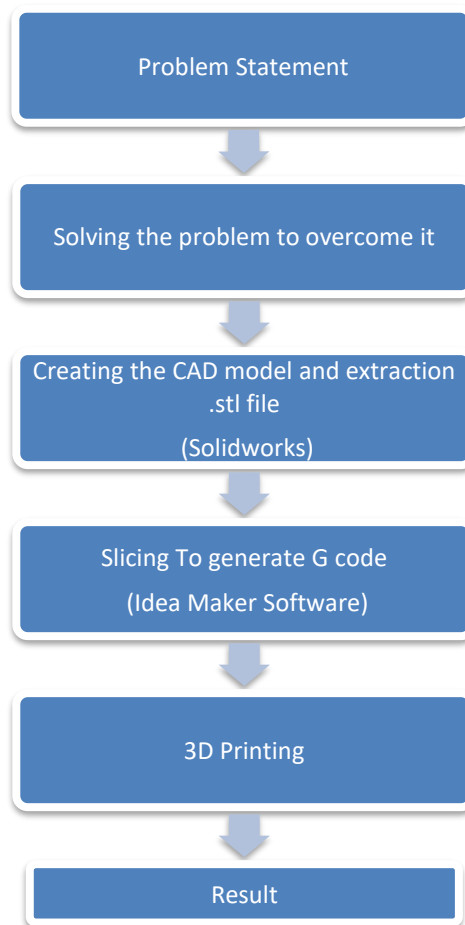


*Fig.15.Preview of Component before 3D Printing*



*Fig.16. Prototype of Multi Clutch Plate*

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### CONCLUSION

A Multi clutch plate is designed by using Solid Works 2023 software. We used polycarbonate material to develop the Multi clutch plate by which we obtained a lower weight Multi clutch plate. We used Fused Deposition Modeling (FDM) in 3D printing technology to develop Multi clutch plate. FDM is a low manufacturing cost process so we obtain a cost-efficient Multi clutch plate. Hence by using 3D printing technology we developed the prototype of Multi Clutch Plate with the help of Multi Clutch Plate we can enhance the power transmission, improve durability and reduce wear and tear.

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### REFERENCES

- [1] S Natsumeda, T Miyoshi. Numerical simulation of engagement of paper based wet clutch facing [J]. Journal of Tribology, 1994, vol.2, pp.232-237.
- [2] E J Berger, F Sadeghi, C M Krousgrill. Analytical and numerical modeling of engagement of rough, permeable, grooved wet clutches [J]. Journal of Tribology, 1997, vol. 119, pp.143- 148
- [3] Y. Yuan, E. A. Liu, J. Hill, and Q. Zou, "An improved hydrodynamic model for open wet transmission clutches," Journal of Fluids Engineering, Transactions of the ASME, vol. 129, no. 3, pp. 333–337, 2007.
- [4] S.Jaya Kishore, M.Lava kumar, "Structural Analysis of Multi Plate Clutch", International Journal of Computer Trends and Technology(IJCTT), Volume 4 Issue 7-July 2014
- [5] T.K. Garrett, K. Newton, W. Steeds, The Motor Vehicle, Third edition. Ganesh Rant, Anil Manjare, P. Bhaskar, "Analysis of Multi-Disc Clutch using FEA", International Journal of Engineering Trends and Technology (IJETT), Volume 6 Number-1- December 2013. [9] A. Nelson; 2009; Engineering Mechanics; New Edition; Tata M.C. Graw Hill Education.
- [6] S .Jaya Kishore, M. Lava Kumar, "Structural Analysis of Multi-Plate Clutch", International Journal of Computer Trends and Technology (IJCTT) – volume 4 Issue 7–July 2013.
- [7] Design and Analysis of clutch using Sintered Iron as a Friction Material by Mamta G Pawar, Monarch K Warambhe, Gautam R Jodh.
- [8] Jaya Kishore S, Lava Kumar M. "Structural Analysis of Multi-Plate Clutch." International Journal of Computer Trends and Technology (IJCTT) – volume 4 Issue 7–July 2013.
- [9] Dynamic Analysis of Single Plate Friction Clutch by Shrikant V Bhoyar. Dr. GD Mehta, Dr. JP Modak. International Journal of Engineering Research and Technology, ISSN: 2278-0181.
- [10] Modelling and assembly of single plate friction clutch of an automobile by Prafull S Thakare, Vishal J Deshbhratar and Abhinav P Ninawe. Indian Streams Research Journal, Volume: II, Issue: II, March – 2012.