

MODELLING AND 3D PRINTING OF 2-WHEELER FRAME**Mr. N. Yadagiri ^{*1},****B. Rakesh ^{*2}, A. Roshan Reddy ^{*3}, G. Shilpika ^{*4}, Shiga Sravanthi ^{*5}**^{*1} Assistant Professor of Guru Nanak Institute of Technology, Khanapur, India.^{2,3,4,5}UG Scholars, Dept. Of Mechanical Engineering, Guru Nanak Institute of Technology, Khanapur, India**ABSTRACT**

The chassis frame forms the backbone of the vehicle. The vehicle chassis is the main support system of the vehicle. A two-wheeler chassis consists of a frame, suspension, wheels and brakes. The most common material used for two-wheeler chassis is steel. The steel material makes the chassis frame heavier and therefore increases the weight of the entire vehicle. Weight reduction is an important issue in the modern automotive industry as it has a significant impact on vehicle fuel consumption. Composite materials provide an excellent solution to this problem.

3D printing, or additive manufacturing, is a new way to produce parts from digital models using a layer-by-layer approach. This toolless manufacturing method can produce fully solid metal parts in a short time and with high precision. Additional manufacturing features such as part design freedom, part complexity and light weight. The frame is an important part of the two-wheeler and carries the load that moves in the vehicle. Therefore, it must be strong enough to withstand shocks, twists, vibrations and other stresses. stainless steel material used to print the chassis. Modeling of the two-wheeled chassis for the bicycle is done using Solid Works software and metal 3D printing of the chassis using EBAM (Electron Beam Additive Manufacturing.)

Keywords:

Chassis Frame, Two-Wheeler, Composite Materials, Weight Reduction.

INTRODUCTION**1.1 GENERAL**

A vehicle without a body is called a chassis. A chassis is nothing more than an inner frame that supports man-made objects. It looks like an animal bone. chassis that serves as a working frame to support the body and various parts of the car, such as the engine, transmission, driveshaft, differential and suspension. The body is not normally required for structural integrity built into the chassis to complete the vehicle. The vehicle chassis is tasked with holding all the components in the chassis through the suspension and wheels when driving vertical and lateral loads due to friction and acceleration. Therefore, the chassis is considered the most important element of the vehicle as it holds all the parts and components together. It is usually made of a steel frame that holds the body and engine of the car. The frame, the suspension system, is a collection of springs and shock absorbers that help the wheels stay in contact with the road and cushion the rider from bumps and shocks. Here we have mainly discussed only the two-wheeled chassis frame.

1.2 TYPES OF TWO-WHEELER FRAME

The different types of two-wheeler chassis frame include:

- Backbone Frame
- Diamond Frame
- Single Cradle Frame
- Double Cradle Frame
- Perimeter Frame

1.2.1 Backbone Frame

The backbone frame includes a single, wide main beam on which the engine is suspended. The backbone frame allows great flexibility in design because it is hidden in the finished motor. The engine seems to hang in the middle. It is simple and cheap to build and is mostly used on barebones and off-road motorcycles like the old Honda CD 100.

1.2.2 Diamond Frame

This is one of the most common types of frames found on Indian bikes. The diamond frame gets its name from the frame on the bike, which is shaped like a diamond. Examples of frame bikes like Bajaj Pulsar 135 LS, Hero CBZ Xtreme, Yamaha Fazer, TVS Flame etc.

1.2.3 Single Cradle Frame

A single cradle is the simplest type of motorcycle frame and similar to the early motorcycle frame. The engine is made of steel tubes surrounding a main tube at the top and a smaller diameter tube at the bottom. If the crib is double, as is often the case, then it is called a split frame single crib. Five frame frame is usually found in Bajaj Platina, Bajaj Discover 100, Honda bikes etc. it happened on the motorcycle.

1.2.4 Double Cradle Frame

A double-crimson frame comes from a single-crimson frame. It consists of two cradles that support the motor on both sides. Double-Crimson frame is used in standard motorcycles and simple road bikes. They offer a good compromise between stiffness, strength and lightness, but now technically superior frame perimeter. Ex-TVS Apache RTR 180, Bajaj Pulsar 180 DTS-i, Passion and all wheeler body Hero moto etc.

1.2.5 Perimeter Frame

Research in motorcycle racing has shown that a big advantage in stiffness can be achieved by joining the handlebars as short as possible. This is the concept behind the perimeter framework. Two solid beams pass through the engine and take the most direct route from the steering head to the swing arm.

1.3 Introduction To 3d Printer

3D printing, or additive manufacturing, is the process of creating three-dimensional solid objects of almost any shape from digital models. Adjacent layers of material are placed to build custom objects. Each layer can be seen as a thin cross-section of the final object. The materials available are also diverse. Plastic is the most common, but metals such as optical clarity and rubber can also be 3D printed.

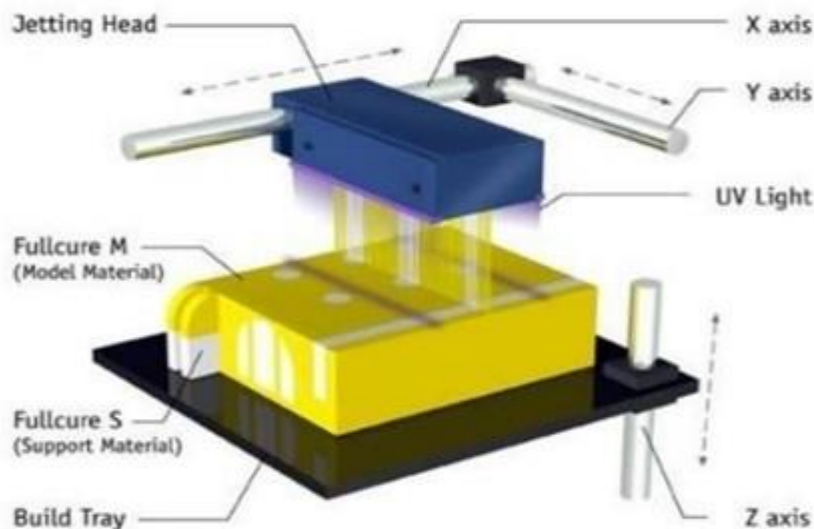


Fig 1.1 3D Printer

3D Printing allows the production of complex shapes using less material than traditional die-cast manufacturing methods that involve cutting / working an object from a larger block. 3D printers create three-

dimensional solid objects from digital models. It consists of a 3D printing device attached to a multi-axis robotic arm. the arm consists of a nozzle placed on iron powder or wire; and the energy source (laser, electron beam, or plasma arc) that forms solid Printer resolution describes layer thickness and X-Y resolution in dots per inch (dpi) or micrometres (μm). Layer thickness is usually around $100\mu\text{m}$ (250 dpi). Some machines can print a thin layer of $16\mu\text{m}$ (1600 dpi). The diameter of the particles is about $50\text{-}100\mu\text{m}$ (510-250 dpi). XY resolution is comparable to a laser printer. Displaying higher resolutions results in larger files. These technologies are Fuse Deposition Modelling (FDM), Stereo Sintering (SLA) and Selective Laser Sintering (SLS) and Electron Beam Addition Manufacturing (EBAM).

1.3 MODELING OF TWO-WHEELER CHASSIS

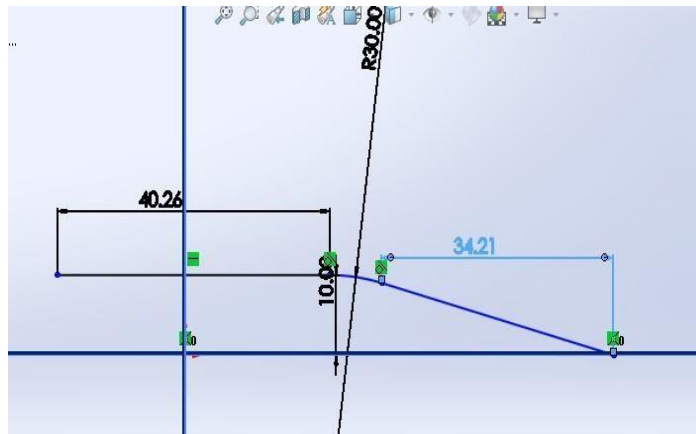


Fig 1.2 Two-Wheeler Chassis Dimension

1.3.1 Left Plate for the Chassis

- Log in and open Catia Software to create a form.
- Then start File and select it.
- In Startup File - Select Mechanical Design.
- In Mechanical Design - select Surface and Wireframe module.
- Now, open the Sketcher Tool Bar and select YZ Plane and create an isolated triangular profile. Then go to the existing Taskbar to switch to Wireframe and Surface Profile.

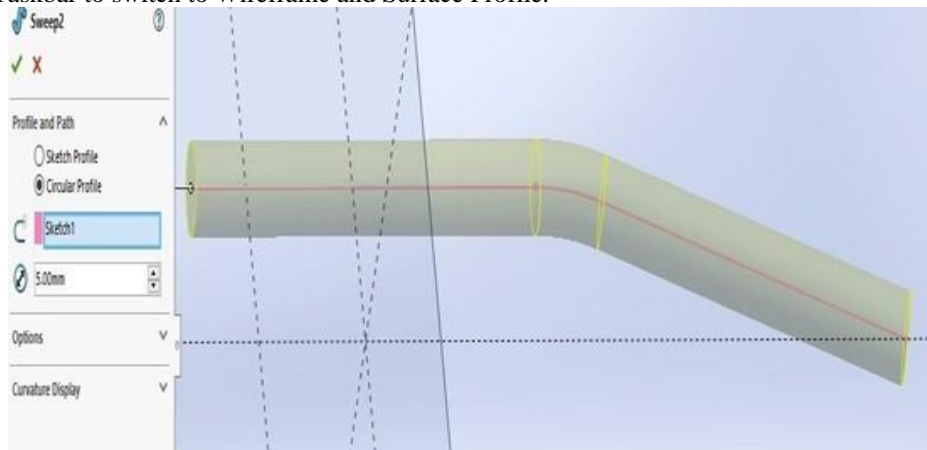


Fig 1.3 Left Plate for the Chassis

1.3.2 Front Plate for the Chassis

- Log in and open Catia Software to create a diagram.
- Then start File and select it.

- In Startup File - Select Mechanical Design.
- In Mechanical Design - select Surface and Wireframe module
- Now open the Sketcher Tool Bar and select the YZ plane and create an isolated triangular profile. Then return to the Exist Workbench to return to the Wireframe and Surface profiles.

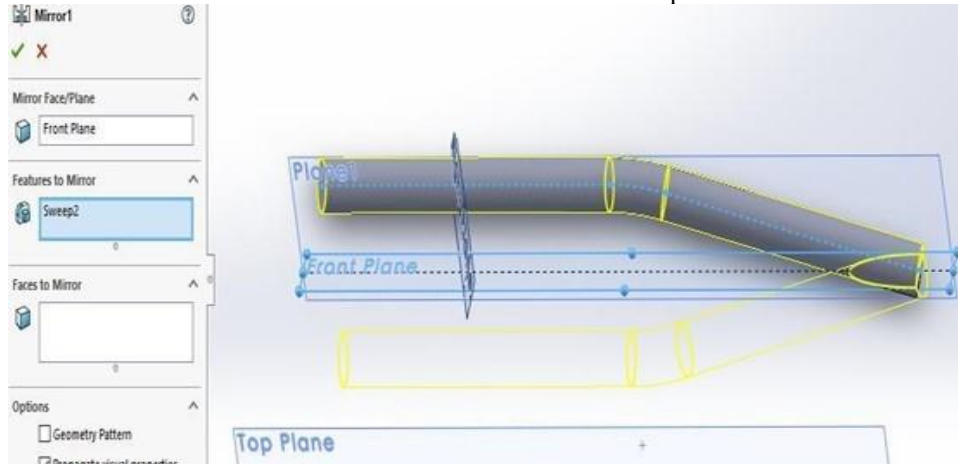


Fig 1.4 Front Plate for the Chassis

1.3.3 Top Plate for the Chassis

- To Create the Shape, go to Catia Software and Open It.
- Then go to Start File and Select It.
- On Start File- Select Mechanical Design.
- In Mechanical Design - Select Surface and Wireframe Module.
- Now, go to Sketcher Tool Bar and Select YZ Plane and Create an Isolate Triangle Profile. Later go to Exist Workbench to Jump Back to Wireframe Surface Profile.

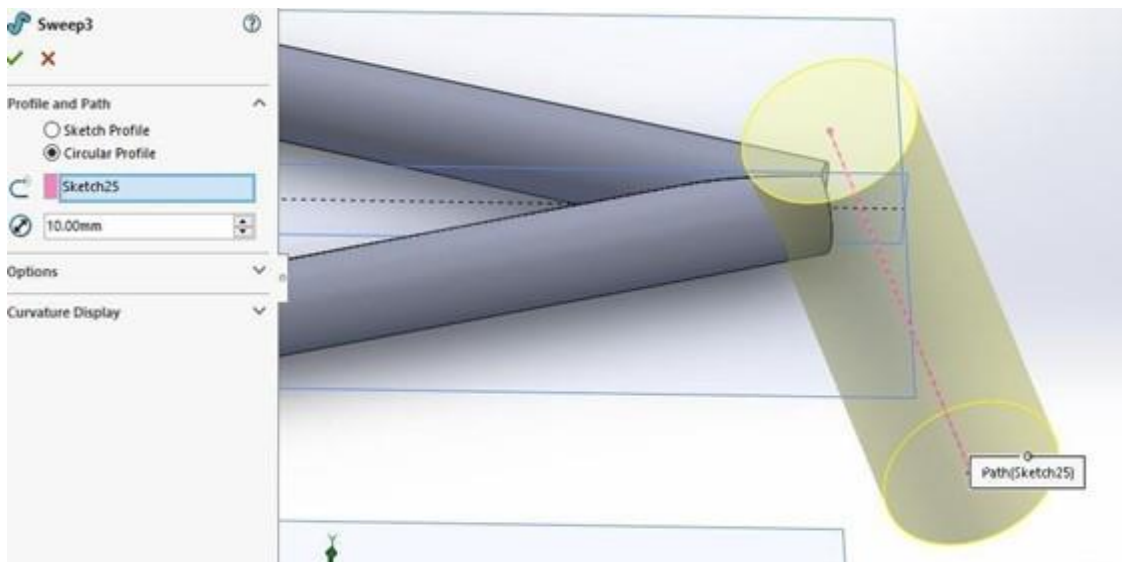
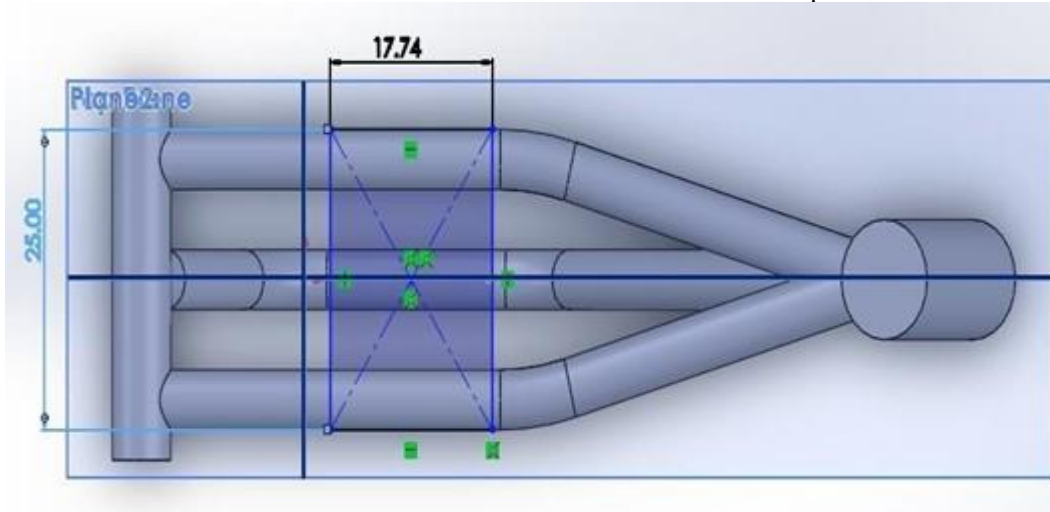


Fig 1.5 Top Plate for the Chass

1.3.4 Support Plate for the Chassis

- Log in and open Catia Software to create a diagram.
- Then start and select File.

- In Startup File - Select Mechanical Design.
- In Mechanical Design - select Surface and Wireframe module.
- Now, go to the Sketcher Tool Bar and select the YZ Plane and create an isolated triangular profile. Then return to the Exist Workbench to return to the Wireframe and Surface profiles.



1.3.5 Right Plate for the Chassis

Fig 1.6 Support Plate for the Chassis

- Log in and open Catia Software to create a diagram.
- Then start and select File.
- In Startup File - Select Mechanical Design.
- In Mechanical Design - select Surface and Wireframe module.
- Now open the Sketcher Tool Bar and select the YZ plane and create an isolated triangular profile. Then return to the Exist Workbench to return to the Wireframe and Surface profiles.

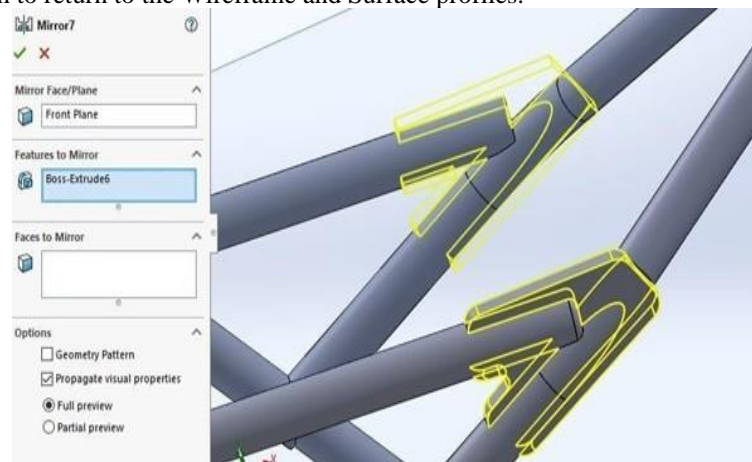


Fig 1.7 Right Plate for the Chassis

1.3.6 Bore for Handle for the Chassis

- Log in and open Catia Software to create a diagram.
- Then start and select File.
- In Startup File - Select Mechanical Design.

- In Mechanical Design - select Surface and Wireframe module.
- Now open the Sketcher Tool Bar and select the YZ plane and create an isolated triangular profile. Then return to the Exist Workbench to return to the Wireframe and Surface profiles.

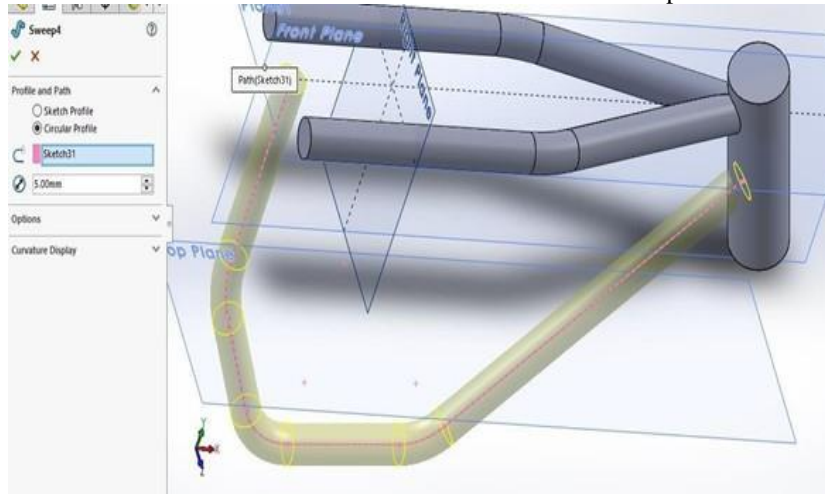


Fig 1.8 Bore for Handle for the Chassis

1.3.7 Holder of Rear Tire for the Chassis

- Log in and open Catia Software to create a diagram.
- Then start and select File.
- In Startup File - Select Mechanical Design.
- In Mechanical Design - select Surface and Wireframe module.
- Now open the Sketcher Tool Bar and select the YZ plane and create an isolated triangular profile. Then return to the Exist Workbench to return to the Wireframe and Surface profiles.

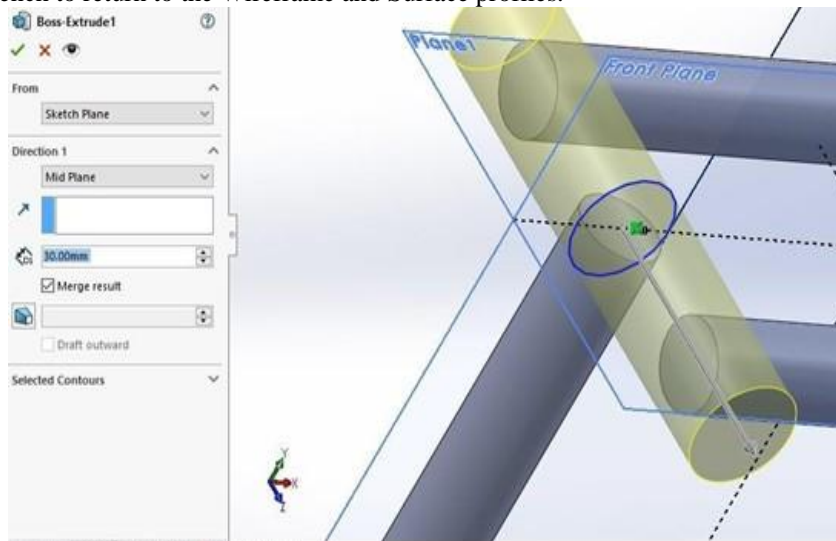


Fig 1.9 Holder of Rear Tire for the Chassis

1.3.8 Final Chassis

The final object as shown in the fig.3.13

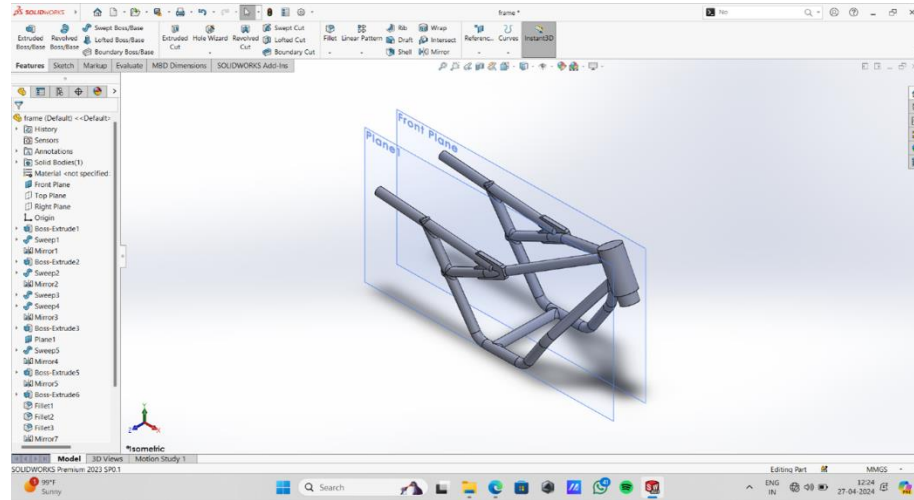


Fig 1.10 Final Chassis Frame

1.4 PRINTING OF 2- WHEELER FRAME

Step 1: Develop the CAD Model

Start by designing a 3D model using 3D modeling software such as SOLIDWORKS or CATIA. Use the modeling tools in the software to create the desired design.

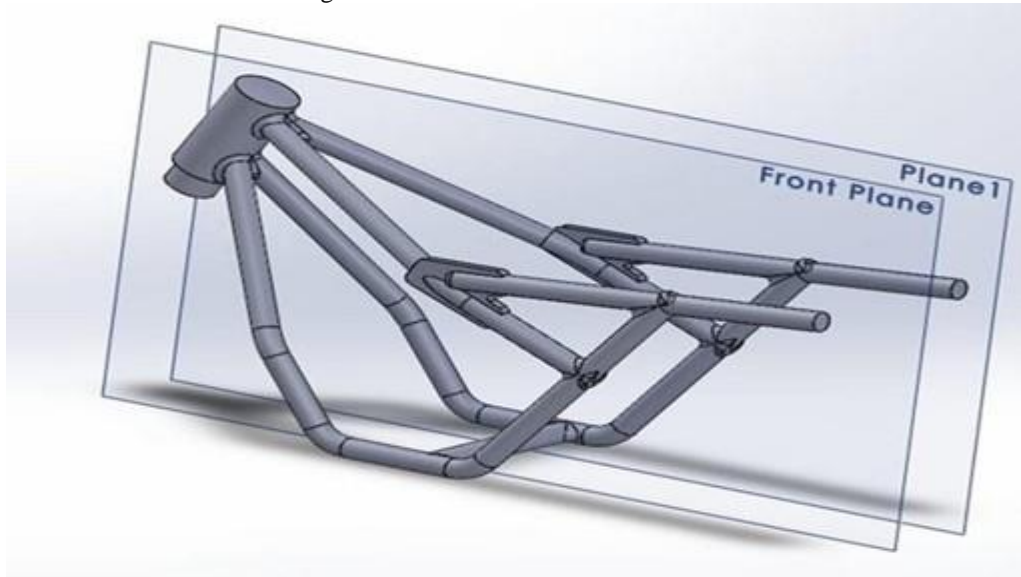


Fig 1.11 3D Model of 2- Wheeler frame

Step 2: Convert the CAD Model into. STL File Format

- Convert a 2-wheeler frame to a 3D model. STL format (stereolithography), follow these steps:
- Open the CAD software and enter the 3D model of the frame.
- Go to the file folder and select the "Save" option.
- A window will appear. Enter a file name for the frame.
- Select "Save as type" from the drop-down menu. STL format (*.stl).
- Click "Save" to save the file as STL.
- The 3D model of the frame is now converted and saved as a .STL file.

Step 3: Open the Flash Forge 3D Printing Software

- To start 3D printing a 2-wheel frame, follow these steps:

- Run Flash Forge 3D printing software on your computer.
- Make sure your 3D printer is connected and set up correctly.
- In the Flash Forge software, find and select the option to open or import the previously saved .STL file of the 2-wheeler frame.
- A pop-up window will appear allowing you to browse files on your computer. Navigate to the location where the .STL file is saved, select it, and click Open.
- Flash Forge software will now load and display a 3D model of a 2-wheeler frame in the workspace.

Step 4: Load and Adjust the STL File in the Flash Forge Software

- To load and adjust the .STL file of the 2- Wheeler frame in the Flash Forge software, follow these steps:
- In the Flash Forge software interface, locate and click on the "Load" option.
- A pop-up window will appear, allowing you to browse and select the .STL file of the 2- Wheeler frame that you saved earlier.
- Select the desired .STL file and click on the "Open" button to load it into the Flash Forge software.

Step 5: Selecting and Generating Supports in the Flash Forge Software

- After uploading the 2 wheeler frame to the platform in the Flash Forge software, follow these steps to select and create the support:
- Find the "Support" option in the software interface and click on it.
- A menu will appear with various support options. You can select the "Auto Support" option to make the process easier. Click and wait a few seconds while the software automatically creates support for the 3D model.

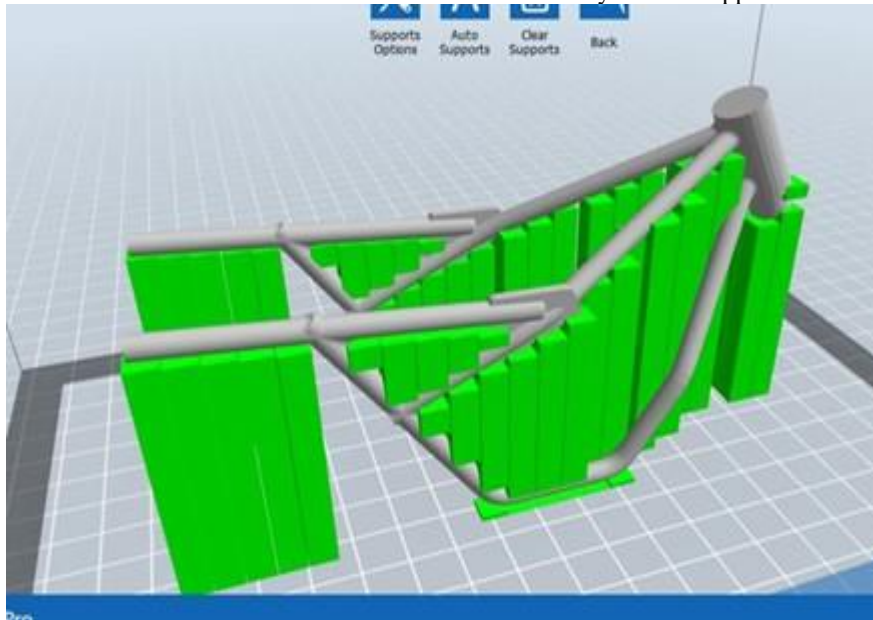


Fig 1.12 Providing Auto supports to the body

Step 7: Saving the Sliced Model and Estimating Print Time

- After configuring the 2-wheel frame print settings in the Flash Forge software, follow these steps to save the sliced model and the estimated print time: 0.
- After configuring all the necessary settings, find the "Save" or "Export" option in the software interface.
- In the Save window, select the desired file format for the sliced model. In this case, select the format as *. svgx (Scalable Vector Graphics).
- Give the sliced model a suitable file name and select the folder you want to save it to. Click "Save" to continue.

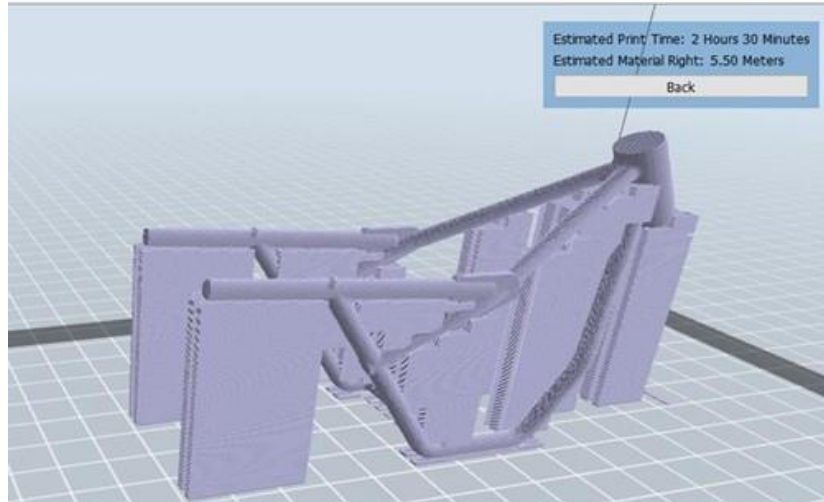


Fig 1.13 Final estimated print time

RESULT & DISCUSSION

Motorcycle chassis consists of frame, suspension, wheels and brakes. Motorcycle frame has a frame made of steel, aluminum or alloy. The frame is made mainly of hollow tubes and serves as a skeleton in which components such as the gearbox and the engine are installed. Today, some design and optimization work has been done to reduce the weight of the chassis frame by changing the design and varying with different metal materials. 2-wheeler chassis modeling done in part design using Solid work software, 2-wheeler chassis parts designed. These components are then assembled into an assembly design. The model was converted to STL file format and imported into the software, and orientation and cutting of the 3-D model was done using 3DXpert software. The G-code for printing the 2-wheeled chassis is loaded on the EB-300 machine. Finally, the 3D model of the 2-wheeled chassis was obtained using the EBAM (Electron Beam Additive Manufacturing) method.



Fig 1.14 3D Printing of Two Wheller Frame

CONCLUSION

The future of motorcycle chassis frame manufacturing holds significant promise with the advancement of metal 3D printing technology. Its advantages over conventional manufacturing processes, such as reduced waste and increased design flexibility, make it an attractive option for manufacturers. This environmentally friendly approach not only reduces material consumption but also offers commercial results. Through 3D printing, companies can optimize their manufacturing process, experiment with different materials, and adjust chassis dimensions to suit different requirements. Ultimately, metal 3D printing is poised to revolutionize two-wheeler chassis manufacturing, offering

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sustainability and benefits in the future automotive industry landscape.

FUTURE SCOPE

2-wheeled chassis has good potential for metal 3D printing due to its advantages over conventional processing. Many companies may use this technology to produce two-wheeled chassis in the future because it is cheaper. Since this manufacturing process is environmentally friendly and commercially very profitable, companies will adopt this 3D printing technology. This project can be further developed by changing the materials used in printing the chassis 2 wheels and giving different dimensions to the chassis 2 wheels when modeling the chassis.

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REFERENCES

- [1] Manoj Jaya Prakash Swain Prof. Amit Kumar “Exploration of Composite Material Chassis Frame Design and analysis” Protagonist International Journal of Management and Technology (PIJMT) Vol 2 No 3 (May-2015) ISSN-2394-3742.
- [2] M. Kunieda, B. Lauwers, K.P. Rajurkar, B.M Schumacher, 2005, Advancing EDM through Fundamental Insight into the Process, CIRP Annals - Manufacturing Technology, vol. 54 (2), pg. 64-87.
- [3] Derek Covilla*, Steven Begga, Eddy Eltona, Mark Milnea, Richard Morrisa, Tim Katza “Parametric finite element analysis of bicycle frame geometries” The 2014 conference of the International Sports Engineering Association.
- [4] Tony Foale, “Motorcycle Handling and Chassis Design – the art and science”, I edition, Cycle World Magazine, Spain, 2002.
- [5] Gourav Gupta, Ankur Kumar, Rahul Tyagi, Sachin Kumar” Application and Future of Composite Materials” International Journal of Innovative Research in Science, Engineering and Technology. Vol. 5, Issue 5, May 2016. ISSN (Online): 2319-8753.
- [6] “Design of Hybrid Electric Vehicle” -TOSHALLY MOHANADI, Department of Electrical Engineering National Institute of Technology Rourkela-769008 (Odisha) May-2013.
- [7] The Finite Element Method for Solids and Structural Mechanics, Zienkiewicz, Taylor, Fox, Elsevier, Seventh Edition 2014.
- [8] S S Rattan (2009), Theory of Machines, Professor of Mechanical Engineering, National Institute of Technology, Kurukshetra.
- [9] Prof. D K Chavan, Sachin V Margaje, Priyanka A Chinchorkar, "Suspension in Bikes Considering Preload, Damping Parameters and Employment of Mono Suspension in Recent Bikes “International Journal of Engineering Trends and Technology- Volume4Issue2- 2013.
- [10] Manishaben Jaiswal, "VIRUS ORIGIN AND EVALUATION WITH DATA ANALYTICS", International Journal of Creative Research Thoughts (IJCRT), ISSN:2320-2882, Volume.9, Issue 3, pp.6270-6280, March 2021, Available at: <http://www.ijcrt.org/papers/IJCRT210>.
- [11] Raut, Abhijeet R., and A. D. Shirbhate. "Design and Analysis of Two-Wheeler Composite Chassis Frame a Review." (2017).
- [12] Prof. Mahesh S. Khande, Mr. Akshay S. Patil, Mr. Gaurav C. Andhale, Mr. Rohan S. Shirsat, “Design and Development of Electric scooter”, International Research Journal of Engineering and Technology (IRJET), 2020.

- [13] CH. Neeraja, C.R. Sireesha and D. Jawaharlal, "Structural Analysis of Two-Wheeler Suspension Frame", International Journal of Engineering Research & Technology, Vol.1 Issue 6, August -2012.
- [14] Prakash katdare, S.C. Shilwant "design optimization of two-wheeler (bike) chassis" international engineering research journal (IERJ) special issue2 page 4273-4277, 2015, ISSN 2395-1621.
- [15] Material and Design Optimization for Aluminium Two-wheeler Frame by Forrest Dwyer, Adrian Shaw, Richard Tombarelli.
- [16] Rashid, H., Abdullah, A.H., Noh, M.H.M., Hamid, A.H.A., Abidin, N.M.Z., 2012, "Design of a superbike paddock stand using CAD and CAE tools", International Journal of Automotive and Mechanical Engineering, Vol. 5 (Jan-June), pp. 670-679.
- [17] Anurag, Amrendra Kumar Singh, Akash Tripathi, Aditya Pratap Tiwari, Nitish upadhyay, Design and Analysis of Chassis Frame, IJRE | Vol. 03 No. 04 | April 2016.
- [18] K. Venkatarao and J. Chandra Sekhar ,,,Design and Analisis of Heavy Vehicle Chassis by Using Composite Materials"" International journal and magazine of engineering, technology management and research. Volume no.2(2015). ISSN No.2348-4845.
- [19] Vignesh, Dr. Arumugam K, Vinoth.S, Hariharan.S "Design and Analysis of Frame of an Electric Bike" International Journal of Engineering Science Invention (IJESI) Vol-8 (2019) PP 08-16.
- [20] T. Kondaiah, D. Pavan Kumar," Shape and Material Optimization of a Two-Wheeler Front Suspension Frame for Pipe Type and Rectangular Cross Section", Internation Journal of Emerging Friends in Engineering Research, Volume 4, N0.6, June 2016.
- [21] K. Santa Rao, G. Musalaiah and K. Mohana Krishna Chowdary," Finite Element Analysis of a Four-Wheeler Automobile Car Chassis" Indian Journal of Science and Technology, Vol 9(2), January 2016.
- [22] Mr. Inzamam Mulla, Prof. A. M. Qureshi, "Design Analysis and Optimization of Two-Wheeler Chassis for Weight Reduction", International Research Journal of Engineering and Technology (IRJET), ISSN: 2395 0056, Volume: 06 Issue: 06 | June 2019.
- [23] CH.Neeraja, C.R. Sireesha and D. Jawaharlal, "Structural Analysis of Two-Wheeler Suspension Frame", International Journal of Engineering Reasearch & Technology, Vol.1 Issue 6, August -2012.
- [24] W.T. Foster, Basic Taguchi design of experiments, National Association of Industrial Technology Conference, Pittsburgh, PA, 2000.

