CAD/CAM Project

Flange Design and Manufacturing

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Second Semester 2024

6/4/2024

Introduction

This report details the design and manufacturing process of a flange for assembling a rod or screw, utilizing computer-aided design (CAD) software and computer numerical control (CNC) machining. The design will be created in Creo and machined on a 3-axis milling CNC machine.

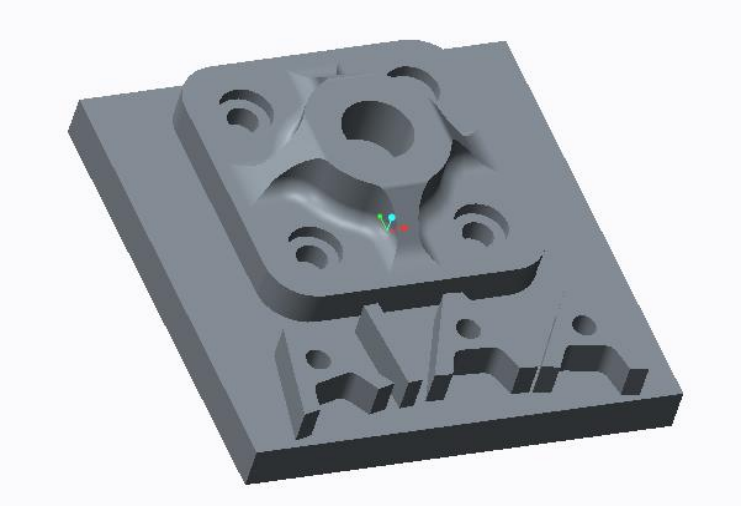
Objective

The objective of this project is to manufacture a functional flange that can be used to securely assemble a rod or a screw. The flange design should optimize strength, ease of use, and manufacturability on a 3-axis CNC machine.

Design Specifications

Flange Geometry:

- **Base:** Square-Circular plate with diameter (D) of 65 mm and thickness (T) of 8 mm.
- **Center Protrusion:** Cylinder with diameter (d) of 35 mm and height (H) of 12 mm and with base hole of 25mm.
- **Slots** (Triangles that support the piece)**:**
    - Number of slots (N): 4 (equally spaced around the circumference).
    - Slot length (L): 12 mm
    - Slot width (W): 8 mm.
    - Slot depth (S): 5 mm.
- **Holes** (To install the widget) **:**
    - Number of holes (Nh): 4 (equally spaced around the circumference).
    - Holes diameter (Dh): 7mm.
    - Holes depth (S): 8 mm



Material Selection:

The choice of material for the flange will depend on the application and the rod/screw it will be used with. Here are some common options:

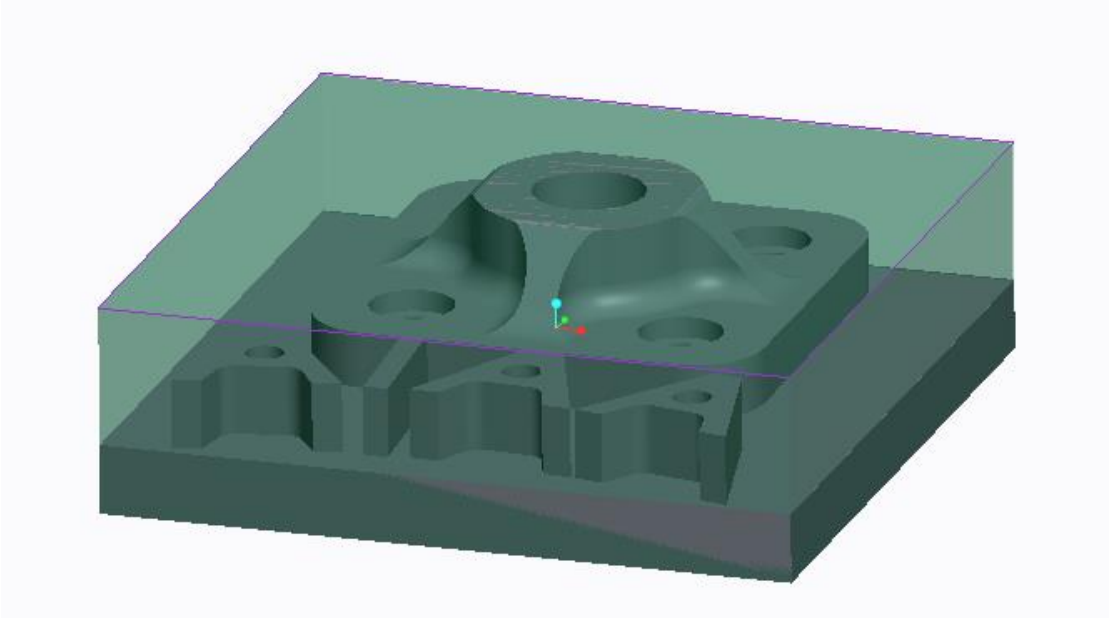
- **Aluminum:** Lightweight, good machinability, suitable for moderate loads. (Specify Aluminum grade if known).
- **Steel:** High strength, suitable for heavy loads. Requires proper tooling for machining (details in Tooling section).
- **Nylon:** Good wear resistance, electrically insulating, suitable for light loads. Requires slower machining speeds (details in Machining Parameters).

Software Selection

- **Creo CAD Software:** This powerful CAD software allows for the creation of a detailed 3D model of the flange. Creo offers various functionalities for modeling geometric shapes, adding features, and defining design intent.
- **Creo CAM Software:** Specialized CAM software will be used to generate toolpaths for the CNC machine. The CAM software will import the Creo CAD model and translate it into a series of instructions for the CNC machine's cutting tool.

Design Process for Creo CAD software

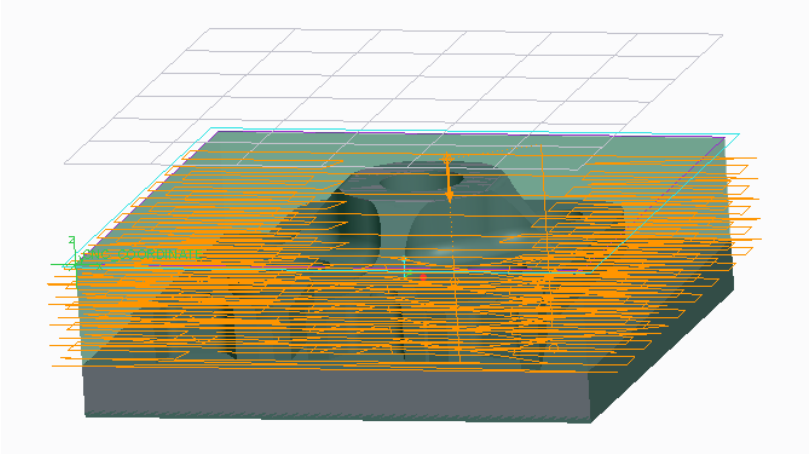
1. **Start a new Creo project.**
2. **Create a sketch** on a new plane.
3. **Draw a Square-circle** with diameter D (65 mm). This will define the base of the flange.
4. **Extrude the circle** with a thickness of T (8 mm).
5. **Create another sketch** on the top face of the base.
6. **Draw a circle** with diameter d (35 mm). This will define the center protrusion.
7. **Extrude the circle** with a height of H (12 mm).
8. **Create a new sketch** on the top face of the base, offset from the center.
9. **Draw a rectangle** with dimensions W (8 mm) and L (12 mm). This will define the slot geometry.
10. **Extrude it** by 5mm.
11. **Use the Pattern tool** to create the remaining slots (4) equally spaced around the circumference using the first slot as a reference.
12. **Fillet the slots** with a diameter equal 4mm.
13. **Create another sketch** on the top face of the base, centered on the previously created sketch for hole placement.
14. **Draw circles** with diameter Dh (based on chosen rod/screw size) to define the holes.
15. **Extrude the circles** through the entire thickness of the flange to create the holes.
16. **Then I Add my name** onto the flange using text features within a designated area (maximum length 80 mm, extrusion 10 mm).
17. **Then Save the Creo model** as a native Creo file (.prt) for CAM software.



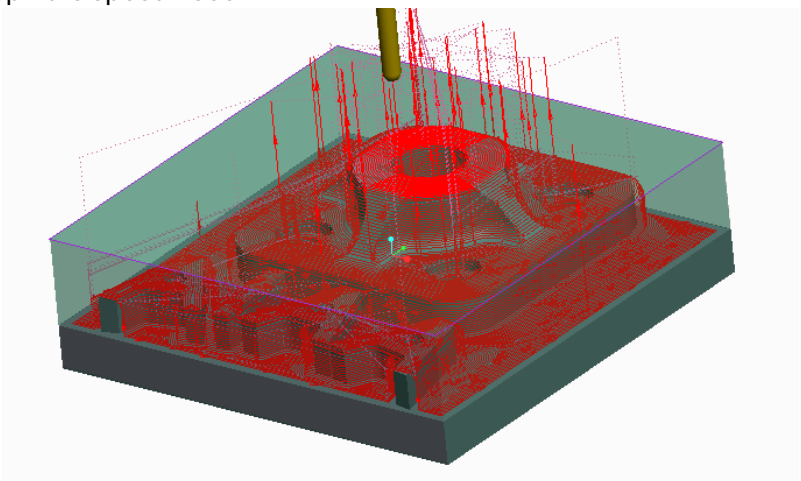
Toolpath Generation (Machining Parameters in CAM Software)

The CAM software will be used to generate specific toolpaths for different machining operations:

- **Facing Toolpath:** A large diameter flat end mill will be used for the facing operation. The toolpath will define a spiral or raster pattern to ensure a smooth and even top surface for the flange base. Specific parameters like feed rate, spindle speed, clear distance, and step depth are below:
  - feed rate 150 mm/min.
  - clear distance 0.5 mm.
  - step depth 4 mm.
  - spindle speed 1000.



- **Finishing Toolpath:** A smaller diameter end mill with a sharp cutting edge will be used for the finishing operation. The toolpath will define a series of passes along the perimeter of the flange base, the sides of the center protrusion, and the walls of the drilled holes. Specific parameters like feed rate, spindle speed, clear distance, and step depth are below:
  - feed rate 200 mm/min.
  - step depth 1 mm,
  - clear distance 0.5mm.
  - spindle speed 1500.



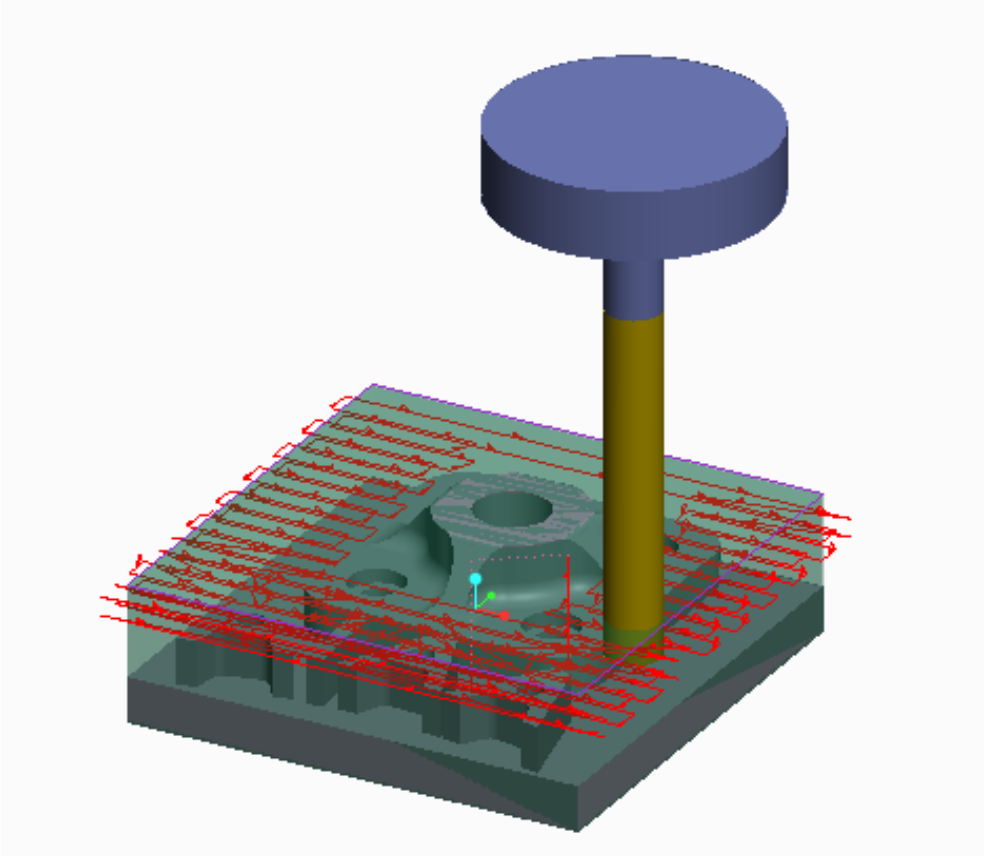
Tooling Selection

The specific tooling will depend on the chosen flange material. Here's a general guideline:

- **Ball Mill:** A ball nose end mill with a diameter 4 mm will be used for finishing Operation.
- **Face Mill:** A face mill with a diameter 12mm will be used for the facing operation.

Machining Setup and Process

- **Machine Selection:** A 3-axis milling CNC machine with sufficient travel and work envelope to accommodate the flange size will be used. The machine should also have a spindle with enough horsepower and RPM range to handle the chosen cutting tools and materials.
- **Workholding:** The flange material will be secured in the CNC machine vise using appropriate soft jaws to prevent damage and ensure stability during machining.



Tool Setup: The chosen cutting tools will be installed in the CNC machine's spindle using a toolholder with the appropriate shank diameter. Tool offsets and lengths will be carefully measured and programmed into the CNC controller to ensure accurate machining.

Conclusion

By following these steps, you can create a flange using Creo and CNC machining. The flange can be used to assemble a rod or a screw.

Additional Notes

- It is important to consult the safety manuals for Creo software and CNC machine before using them.
- When machining the flange, it is important to wear safety glasses and other appropriate personal protective equipment (PPE).