Challenge 2: Sharpen the Pencil

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Under Prof. Madhu Vadali for the course ME 209 Principles of Manufacturing Processes

1. Objectives and Constraints

Objective: The objective of the challenge is to sharpen a brand new Apsara Black HB pencil using Milling center.
Constraints:

1. The milling demonstration should start with a brand new pencil; not a pre-sharpened pencil.

2. A high-quality image should show the conical nature of the sharpened pencil.

2. Choice of tool

We chose the ϕ - 5mm (Flat end mill) as the tool. The reasons for selecting the tool and parameters are listed as follows:

1. flat end mills are more efficient in removing material.

2. Flat end mills generate precise, clean cuts.

3. Designing the Pencil and tool path

We used the Autodesk Fusion 360 software to create a 3D model of the pencil that we have to sharpen. Since the tool removes material, we need to ensure that the sharpened edge of the pencil lies on the top instead of the bottom. Otherwise the pencil won't remain stable and the process could fail. The tool path looks something like the figure below:

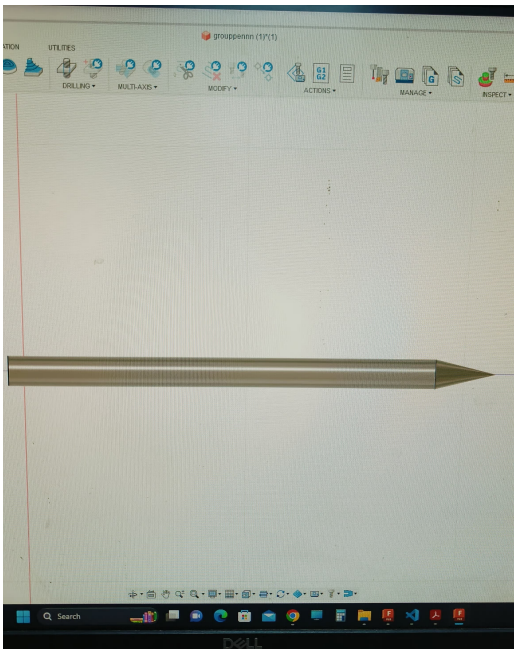

Figure 1. *Fusion 360 model of pencil*

4. Choice of Parameters

The parameters we selected for sharpening our pencil are:
• Spindle Speed - 3000rpm
• Cutting feed rate - 100rpm
• Depth of cut - 0mm

These parameters were standardized. Since 3000 rpm is the maximum spindle speed of our machine, we use it to ensure clean cuts.
The maximum cutting feed rate for our machine is 100rpm, therefore it is used.

5. Outcomes and Learnings.

We generate the Gcode of the tool path and place the unsharpened pencil in the milling machine. The final result we got looks something like this: By successfully sharpening the pen-

Figure 2. *High quality image of sharpened pencil*

cil, we complete the challenge and learn how to use a milling machine for such a purpose. This challenge beautifully demonstrates the nature of subtractive manufacturing and how precise it can be.
We learnt how to set the process parameters according to the tool path.

6. Peer Review

Abhijit Venkat P (22110008) - 10/10
Dharavath Mahesh (22110073) - 10/10
Diya Mehta (22110078) - 10/10
Hansin Shah (22110090) - 8/10
Mihika Desai (22110152) - 7/10
Tamanna Meena (22110268) - 3/10
Total - 48/60