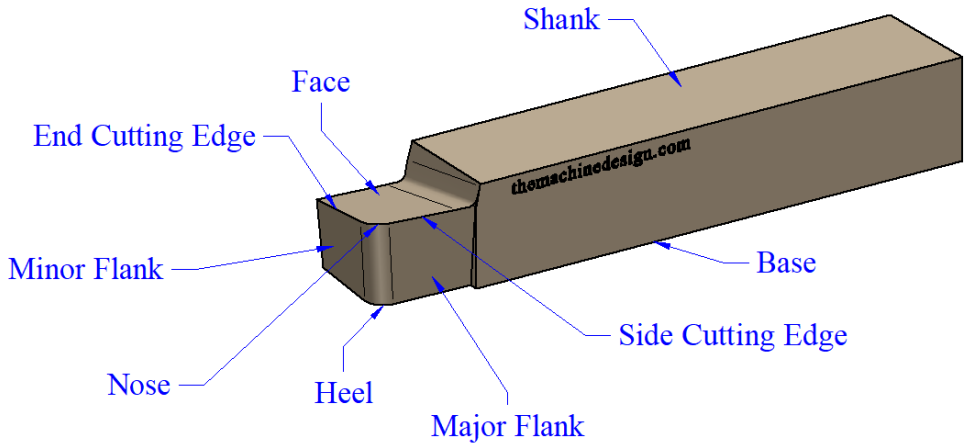
ME-372 : Heat transfer and Metrology lab

Tool Geometry Measurement Via Focus variation Microscopy

Introduction

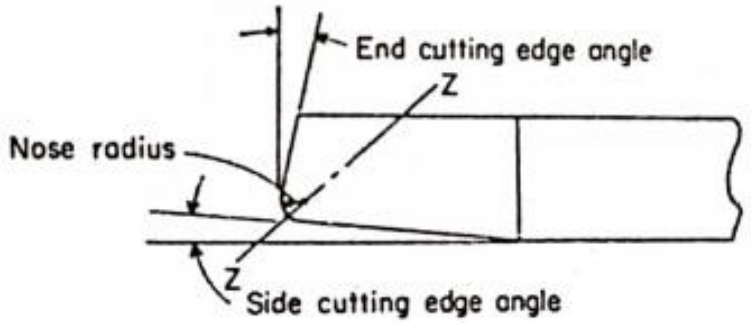
- A cutting tool is any tool that is used to remove metal from the work piece by means of shear deformation
- The tool must have a specific geometry (known as tool geometry) for effective cutting and smooth surface finish

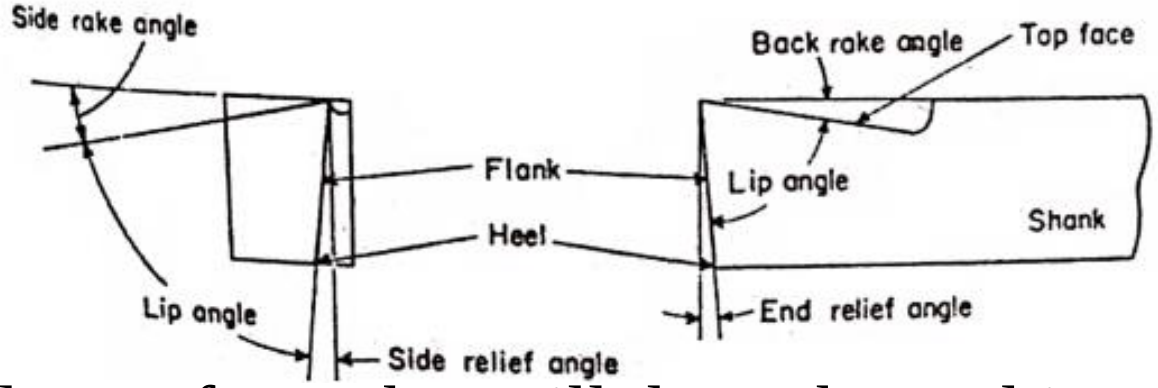


- There are two surfaces adjacent to the cutting edge of the tool:
  - Rake surface - directs the flow of newly formed chip. It is oriented at a certain angle called the rake angle ‘a’. It is measured relative to the plane perpendicular to the work surface. The rake angle can be positive or negative.
  - Flank surface - provides a clearance between the tool and the newly formed work surface, thus protecting the surface from abrasion which would degrade the finish. This angle between work surface and the flank surface is called the relief or clearance angle.

Introduction

- A turning tool is specified by
  1. Side cutting edge angle
  2. End cutting edge angle
  3. Side relief/clearance angle
  4. End relief/clearance angle
  5. Back rake angle
  6. Side rake angle
  7. Nose radius





- Increasing the rake angle will produce a force that will draw the tool into the workpiece
- The clearance angle will stop the tool rubbing on the workpiece
- Height of tooltip is on or just above the centre of workpiece.

Aim

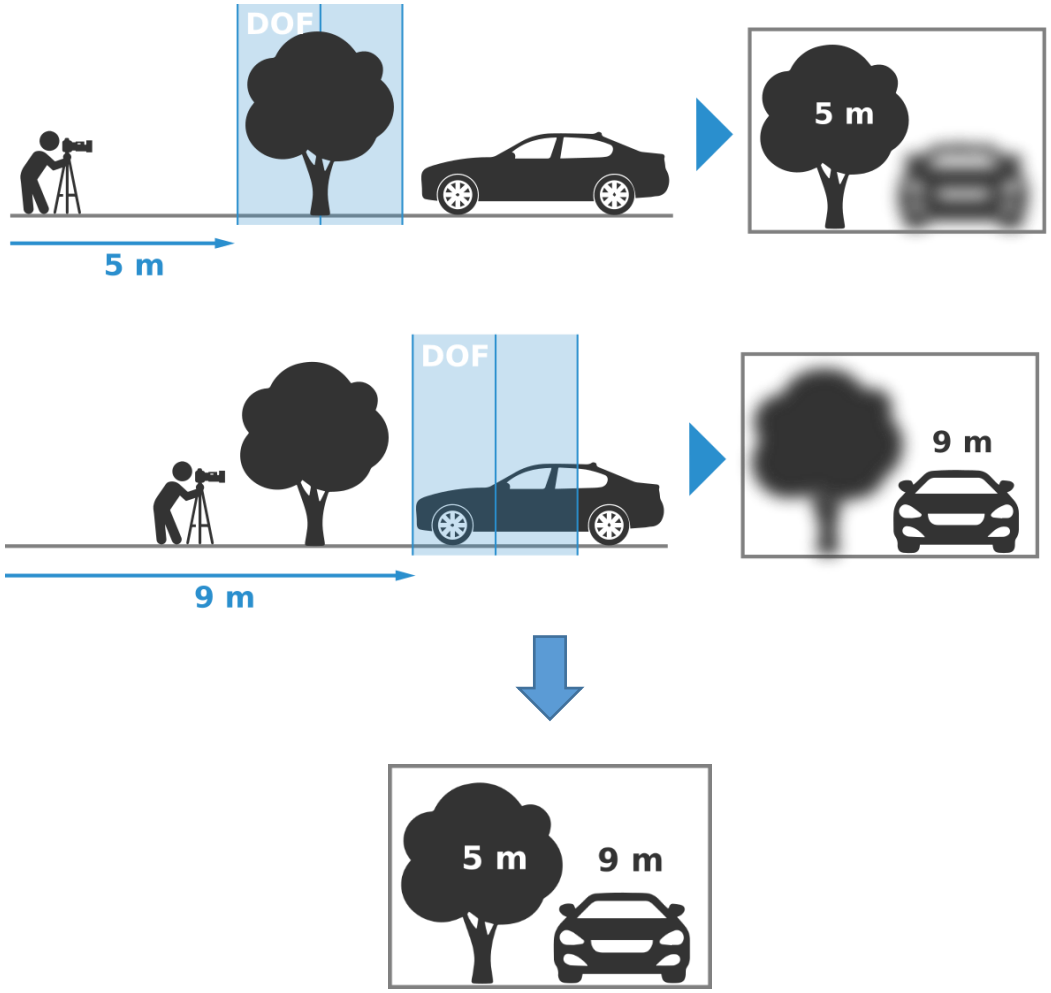
- Measurement and understanding of different angles of a turning tool

Equipment used

- Alicona Infintefocus
  - It is an optical profilometer
  - 3D measurement system
  - works on the principle of “Focus variation”
  - The 3D profile obtained can be used for accurate and precise measurement of dimensions, surface roughness, flatness, etc.
  - Optical properties of the material such as transparency and reflectivity are crucial

Principle of focus variation

- A 2-D image can give information in x-y coordinate system
- Focus variation uses multiple 2-D images to get a 3-D profile
- The images are capture at different camera focus
- The part of image within the depth of focus (DOF) would be sharp and other parts would be blurred.
- For each image, x-y coordinate of sharp regions and the corresponding focus (or depth) are noted
- The information from all the images are compiled to obtain a 3-D profile.



Procedure

1. Position the tool under the objective. The tip of tool should be under the light.
2. Close the window and switch of the fan of apparatus to avoid disturbances.
3. Open the Software module and position the camera properly.
4. Move the camera in z direction along the tool tip.
5. Select Z_{max} and Z_{min} for the measurement.
6. Retrieve the 3D profile, and select the “2D measurement” option.
7. Use the angle tool to draw over the image and measure the tool angles.
8. Change the tool orientation and repeat steps 1-7 until all the six angles are measured. (Nose radius can be measured by drawing a circle over the image)

Results

The results (all angles and nose radius) will be provided to you. Assume that the tool is made from a cuboidal block of dimension 1 cm × 1 cm × 10 cm.

1. Create a 3-D model of the tool. Attach the top view, front view, side view and isometric view of the 3-D model with dimensions (all the angles should be clearly visible)
2. The 3 D file should be submitted.
3. Write the conclusion and mention some potential sources of error

Report

1. Aim
2. Instruments used
3. Application
4. Working principle
5. Table of data
6. Figures
   - Front view
   - Top view
   - Side view
   - Isometric view
7. Results and conclusion
8. Sources of error

Questions

1. Mention one advantage and one disadvantage of optical profilometry.
2. What is the purpose of relief angle?
3. Which surface directs the flow of chip?