Exp 3A: Tool Geometry Measurement Via Focus Variation Microscopy

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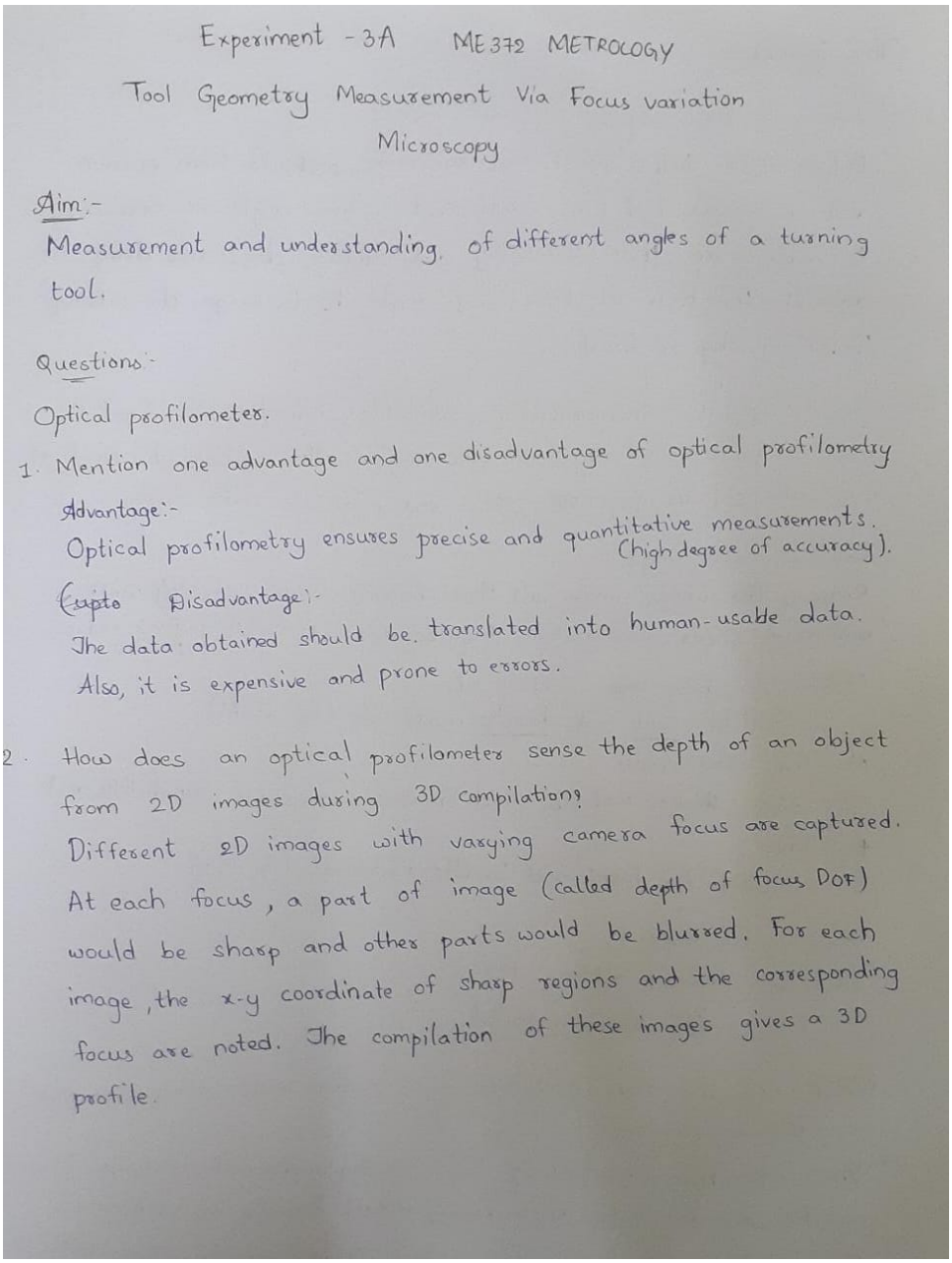


Experiment - 3A ME 372 METROLOGY

Tool Geometry Measurement Via Focus variation Microscopy

Aim:-

Measurement and understanding of different angles of a turning tool.

Questions:-

Optical profilometer.

1. Mention one advantage and one disadvantage of optical profilometry

Advantage:-

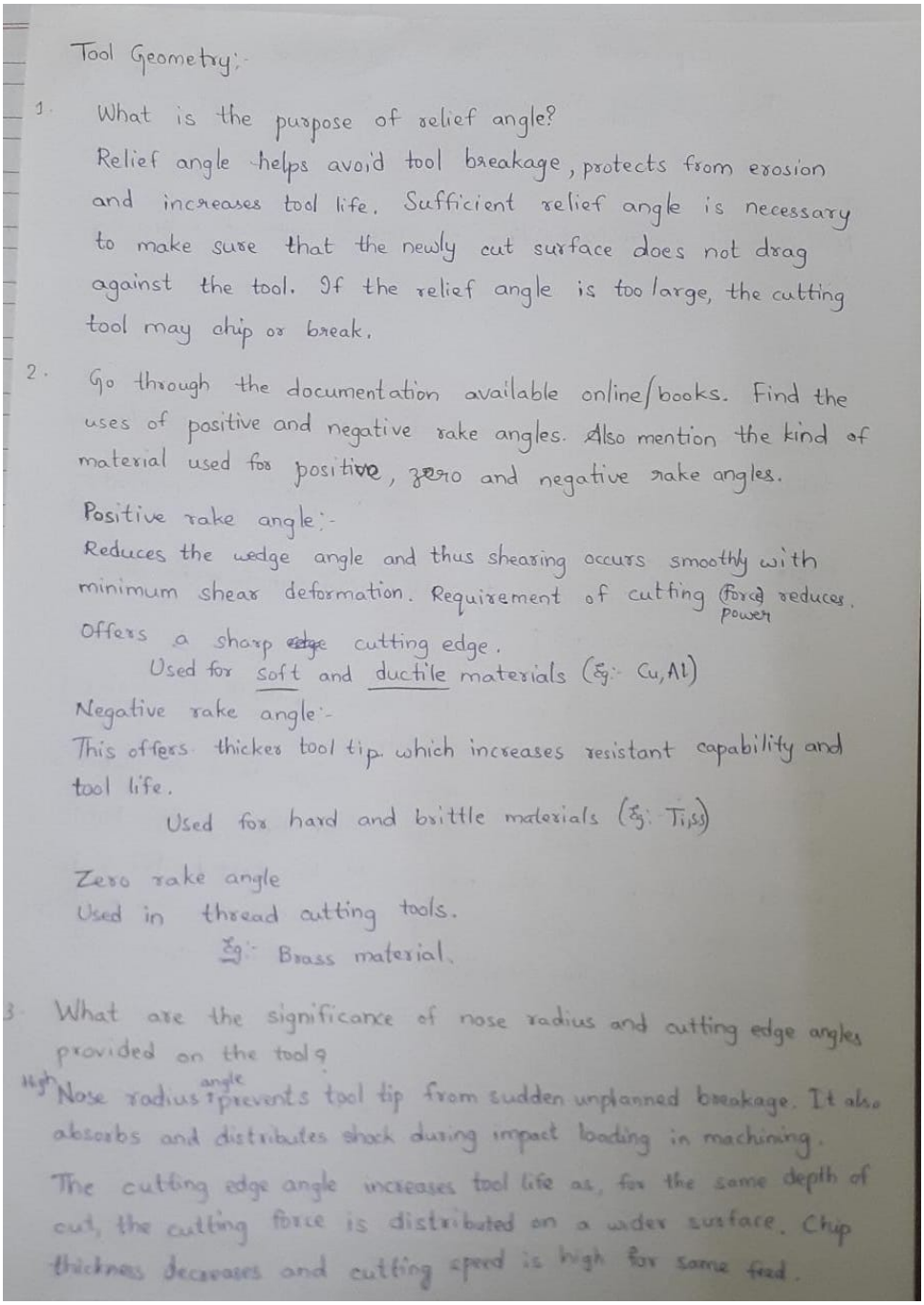
Optical profilometry ensures precise and quantitative measurements. (High degree of accuracy).

Disadvantage:-

The data obtained should be translated into human-usable data. Also, it is expensive and prone to errors.

2. How does an optical profilometer sense the depth of an object from 2D images during 3D compilation?

Different 2D images with varying camera focus are captured. At each focus, a part of image (called depth of focus DOF) would be sharp and other parts would be blurred. For each image, the x-y coordinate of sharp regions and the corresponding focus are noted. The compilation of these images gives a 3D profile.



Tool Geometry:-

1. What is the purpose of relief angle?

Relief angle helps avoid tool breakage, protects from erosion and increases tool life. Sufficient relief angle is necessary to make sure that the newly cut surface does not drag against the tool. If the relief angle is too large, the cutting tool may chip or break.

2. Go through the documentation available online/books. Find the uses of positive and negative rake angles. Also mention the kind of material used for positive, zero and negative rake angles.

Positive rake angle:-

Reduces the wedge angle and thus shearing occurs smoothly with minimum shear deformation. Requirement of cutting (Force) power reduces.

Offers a sharp ~~edge~~ cutting edge.

Used for soft and ductile materials (Eg: Cu, Al)

Negative rake angle:-

This offers thicker tool tip which increases resistant capability and tool life.

Used for hard and brittle materials (Eg: Tiss)

Zero rake angle

Used in thread cutting tools.

Eg: Brass material.

3. What are the significance of nose radius and cutting edge angles provided on the tool?

High Nose radius angle prevents tool tip from sudden unplanned breakage. It also absorbs and distributes shock during impact loading in machining.

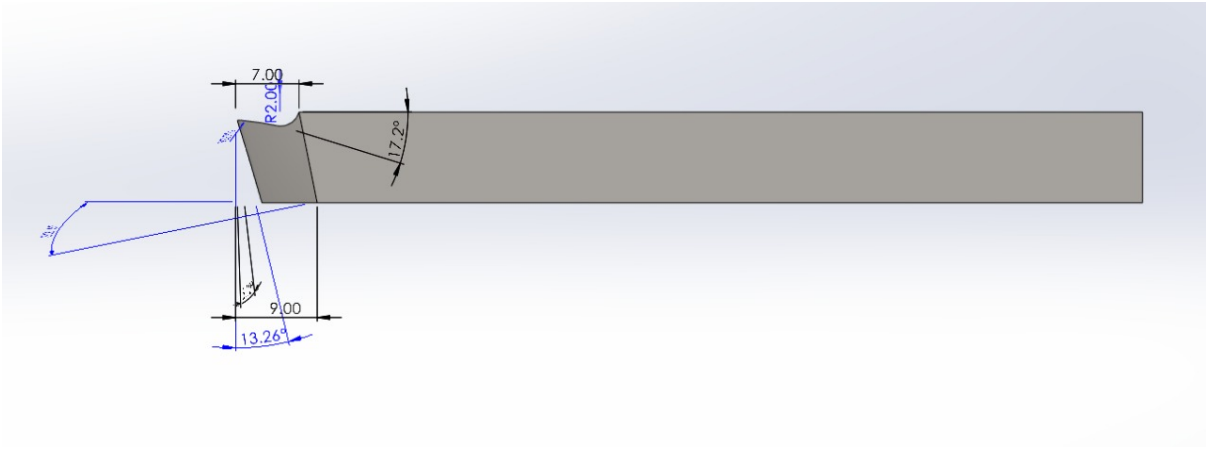
The cutting edge angle increases tool life as, for the same depth of cut, the cutting force is distributed on a wider surface. Chip thickness decreases and cutting speed is high for same feed.

Observation Table

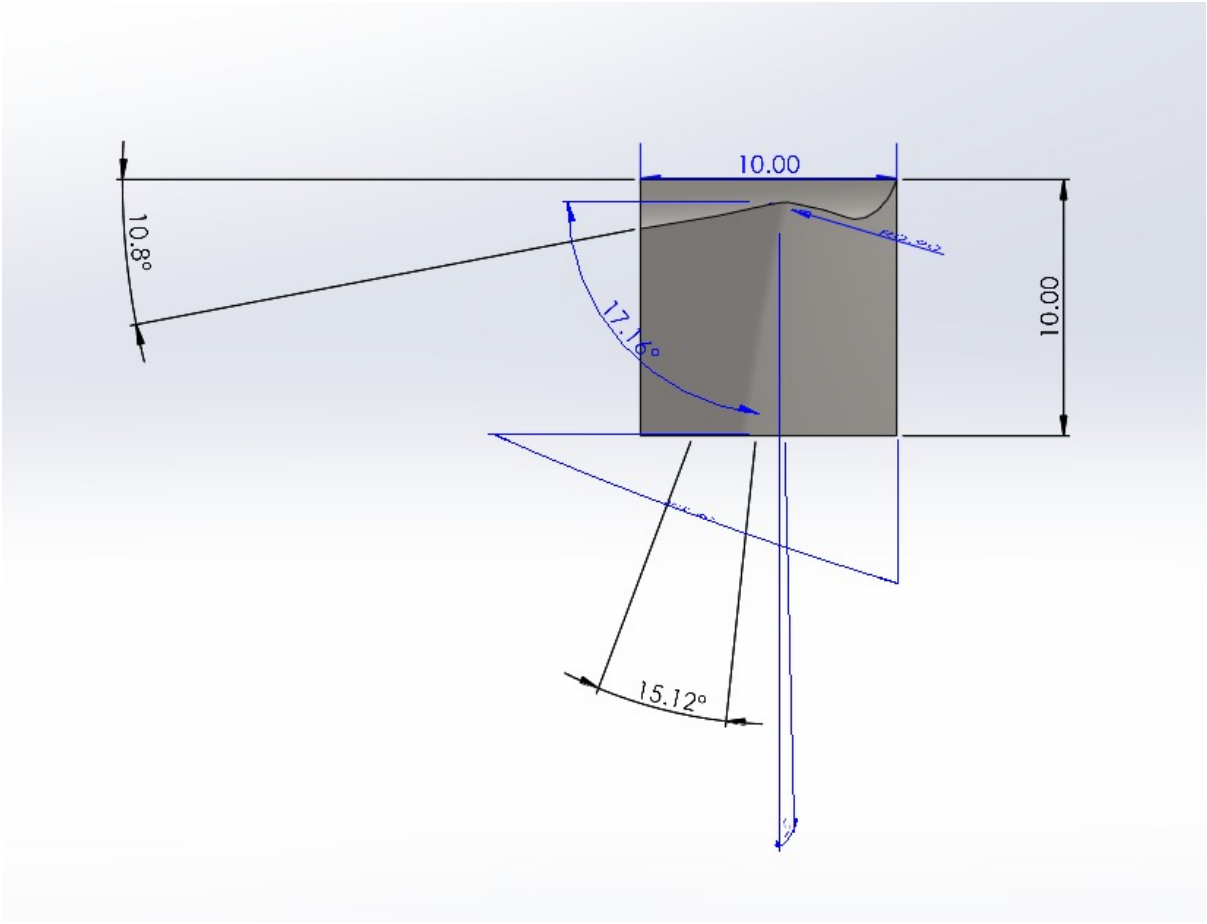
Side cutting edge angle	End cutting edge angle	Side Rake Angle	Back Rake Angle	Side Relief Angle	End Relief Angle	Nose radius (microns)
32.6°	17.16°	10.8°	17.2°	15.12°	13.26°	900

Views of the 3D Model

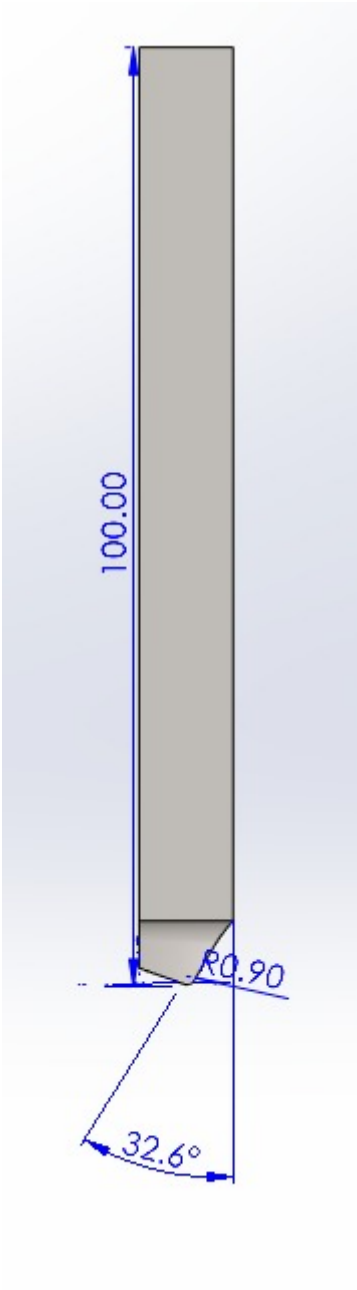
Right view



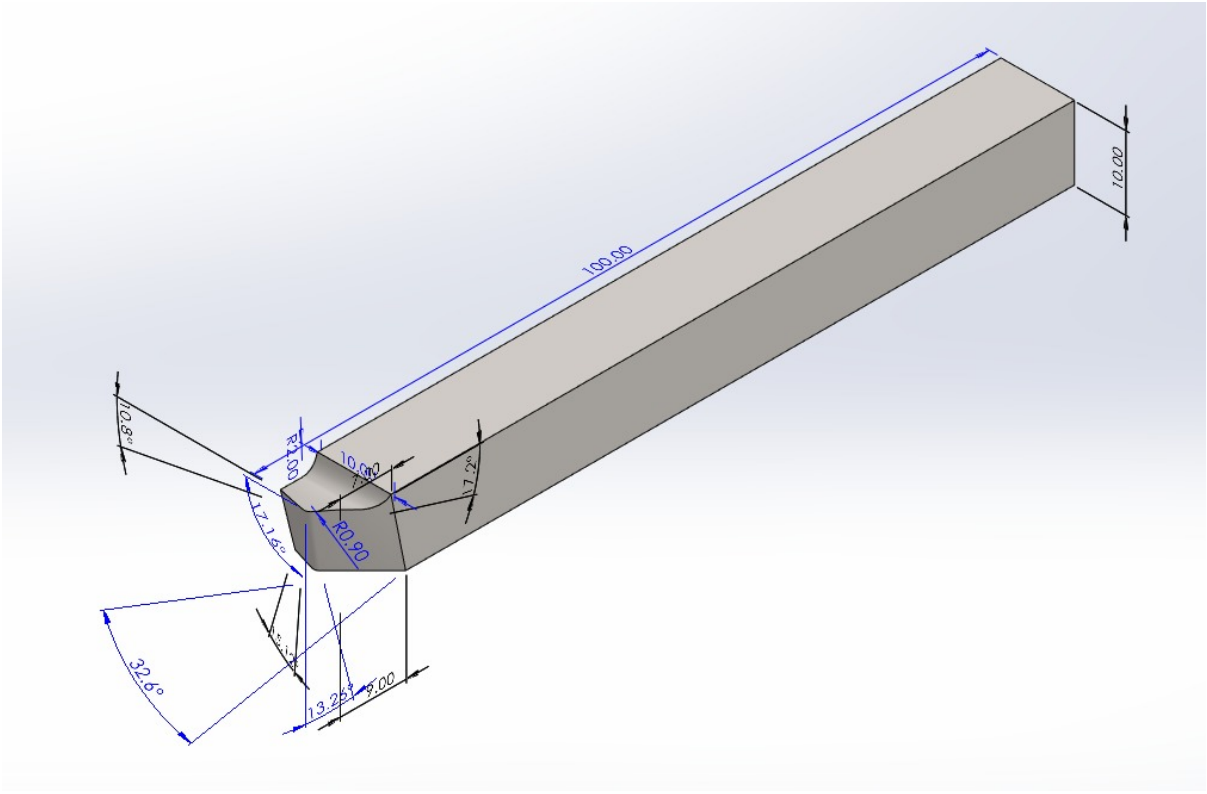
Front view



Top view



Isometric view



Results:

Using the principle of optical photometry, we can measure the 6 angles and nose radius and use those values to model the tool geometry in 3D accurately.

Sources of errors:

- Human error while measuring the angles from the image and nose radius.
- Any kind of vibrational disturbance or external force on the setup can lead to errors.
- Any kind of aberrations can vary the focussing of the lens.
- The bottom surface of the tool has been assumed to be flat, which is not realistic as there may be surface variations.