

Design and Analysis of a Flat Tool for Grooving a Circular Job

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Abstract

The current research article presents the fabrication and machining challenges due to the intricate complexity/geometry of form tool designs. In this paper the form tools available for utility in the machine shop floor are classified as per the cross-section. The form tools are manufactured using High Speed Steel (HSS) tool and more lately, the carbide-forming tool are also in demand, owing to better mechanical properties and extended tool life/enhanced productivity. The discussion on the design of a form tool with their geometric features and the analysis will be the major contribution of the research paper. The various profile of the formed surface will be discussed using geometric analysis methods. This paper will be useful for the practicing engineers, machinist, tool room engineer, production engineer during manufacturing of automotive components.

Keyword:-

Form tool, circular, flat, design, analysis, machining, production etc.

Introduction

Cutting tool design in engineering is a specialized domain and requires exhaustive knowledge to create/design a tool using various software's and computer based system. But traditionally the tool design where done using graphical and analytical methods so that design engineers can understands in a better way.

Manipulative a forming tool is one of the vigorous factor of a tool engineering in know a days, every design engineer must know about it. Developing a tool means we are providing a particular and useful shape with required dimensions to the part. The parts which we are developing generally it is formed by forming operation generally its takes the shape of the die or punch.

During the forming process, the flow of metal is not uniform and localized to some amount, depending upon the shape of the work piece. Bending along a large radius in a straight line may also be referred to as a forming operation. It is difficult to distinguish between a bending and forming tools. Forming operation may be simple and extremely complicated.

While we are feeding into the work a form tool can be turned into one or more than one diameters. Before at the time of using the form tools, diameters were turned by multiple slide and turret operations, and thus tool. More work to make the part. For example, a form tool can turn many diameters and in addition can also cut off the part in a single operation and eliminate the need to index the turret.

Here different types of form tools available Enclosure form tools are the furthestmost common for diminutive-toward medium range jobs (50 to 20,000pcs), Circular form tools are usually for longer jobs, since the tool wear can be ground off the tool tip many times as the tool is rotated in its holder. There is also a skiving tool that can be used for light finishing cuts.

At the time of turning a longer size lengths a support is provided from the turret so that we can increase the turning lengths from 2.5 times to 5 times the smallest diameter of the part being turned, and this also can help reduces chatter? Despite the drawbacks, the elimination of extra operations often makes using form tools the most efficient option.

The major drawback is while we are using the form tools the speed of feed is very slow generally its 0.0005 to 0.0012 per revolutions depending on the width of the tool. Wide form tools create more heat and usually are problematic for chatter reduces tool life. Also, form tools wider than 2.5 times the smaller diameter of the part being turned have a greater risk of the part breaking off.

Keywords:-

Forming tool, feed, tool design, and operation.

Objective

- To understands different types of forming tools,
- To understand design of forming tools.

What do you understand by form tool?

Form tool is defined as a tool or machine attachment so shaped that is imparts a predetermined shape or profile to the work piece.

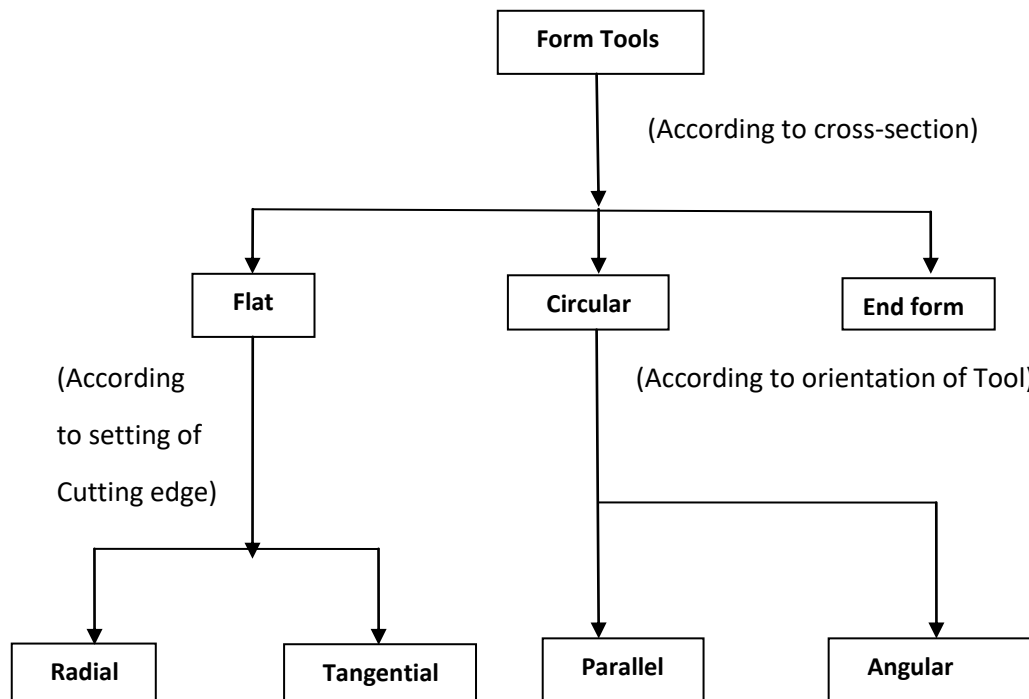
Form tools is generally used for mass production work on automatic lathe machine and capstan lathe machine in order to confirm:-

- (1) Parts of all machine cut in uniform shape.
- (2) It should have high production rate.
- (3) Better accuracy in dimensions and shapes of work piece.

Theory of Form Tool

A form tool having one or more than one cutting edges with well definite profile or curve that is to be replicated as the desired shapes on the work pieces surface desired form on the work piece surface. Different types of form tools that is used in turning operations according to cross section.

The various classification of form tool is explain with the help of line diagram in the given figure.



Classification of Tool

A form tool is described as having one or more than one cutting edge with well-defined profile or contour which is reproduced as the desired form on the work-piece surface. Form tools used for turning applications are classified as per to the type of cross section. The classification is displayed in the tree diagram.

Flat tools are classified according to the setting of tool with respect to the work pieces. VT' tangential feed tools and radial feed tools.



Flat Form



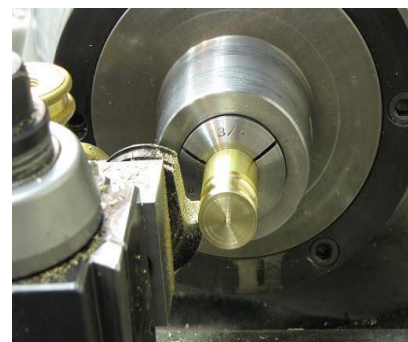
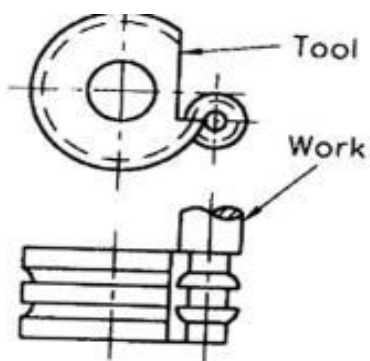
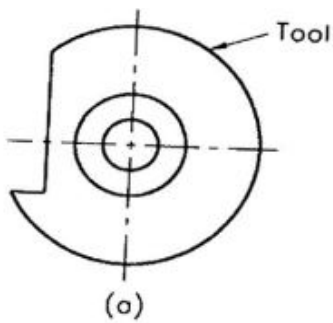
End Form



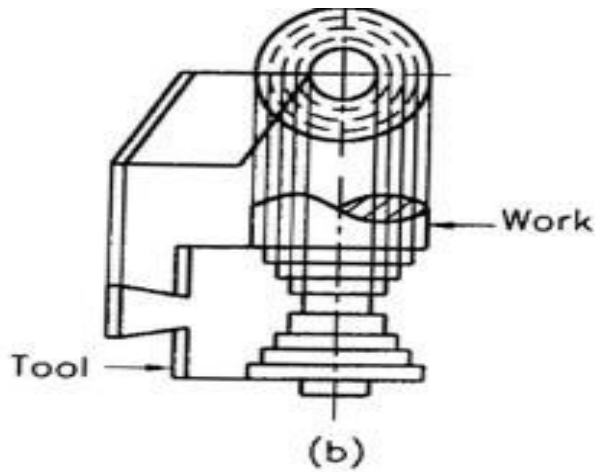
Circular Form

Types of Form Tools

(a) Circular form tool



(b) Flat form tool



Form Tool Materials

Generally form tools are made up of: -

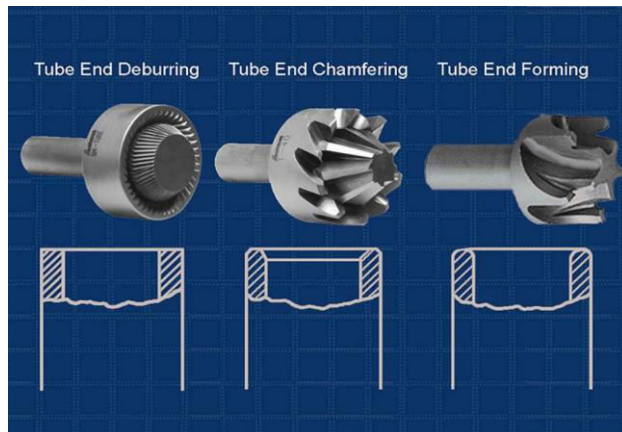
High speed steel but now a day's carbide forming tools are also gaining popularity owing to productivity being raised by 31-40%.

Rake angles are provided in the following table for different types of materials.

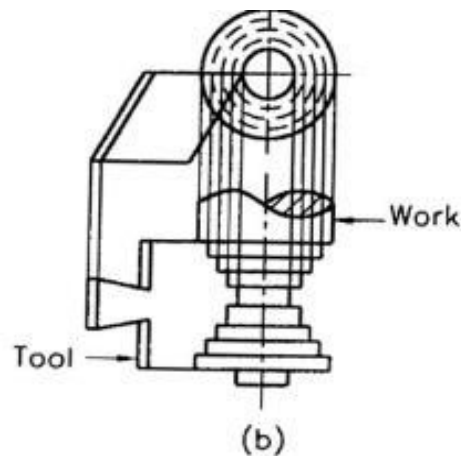
Material	Rake Angle (Degree) (γ)	Hardness (BHN)
Hard cast iron	13	151-202
Aluminium, Copper	12-26	19-26
Mild Steel	25.5	Up to 152
Soft Cast iron	15.5	Up to 151
Hard Steel	12.5	233-292
Leaded brass, Bronze	0-6	20-30

END FORM TOOL

End forming tools are used for expanding, reducing and calibrating the tube diameters. They change the circumference of a tube, which can allow the tube to connect to other components (e.g. other tubes, hoses or flanges). The primary uses for end forming include flaring, debarring, or beading a tube.



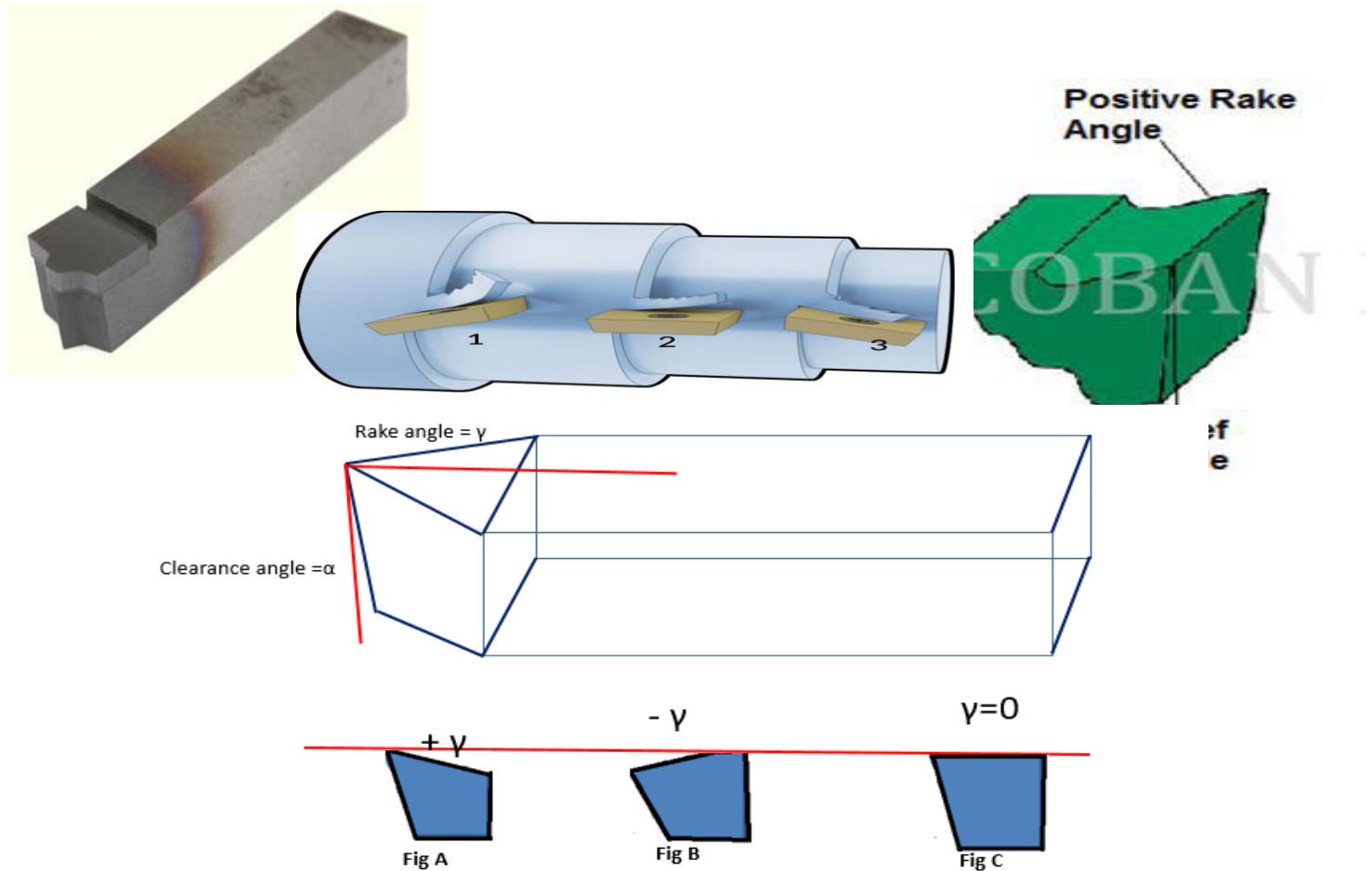
FLAT FORM TOOL



DETERMINING THE DEPTH OF FORM TOOL

FLAT FORM TOOL DESIGN

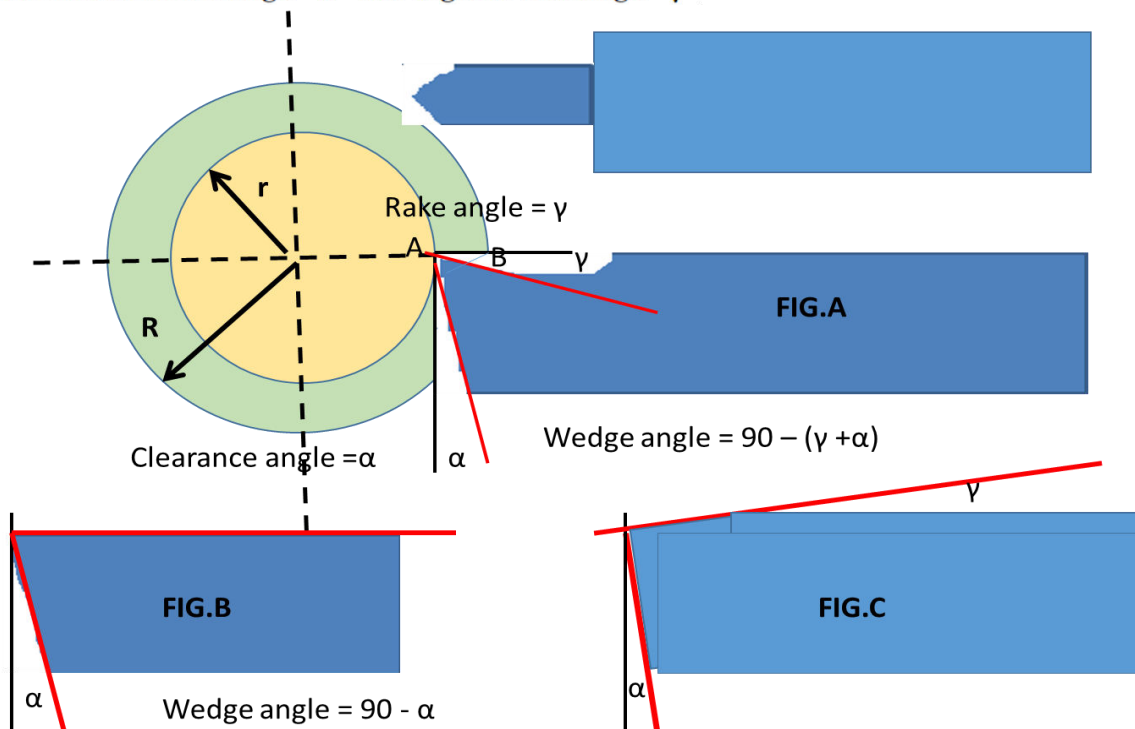
When clearance (relief) angle " α " and **POSITIVE** rake (" γ ") angle " γ "}

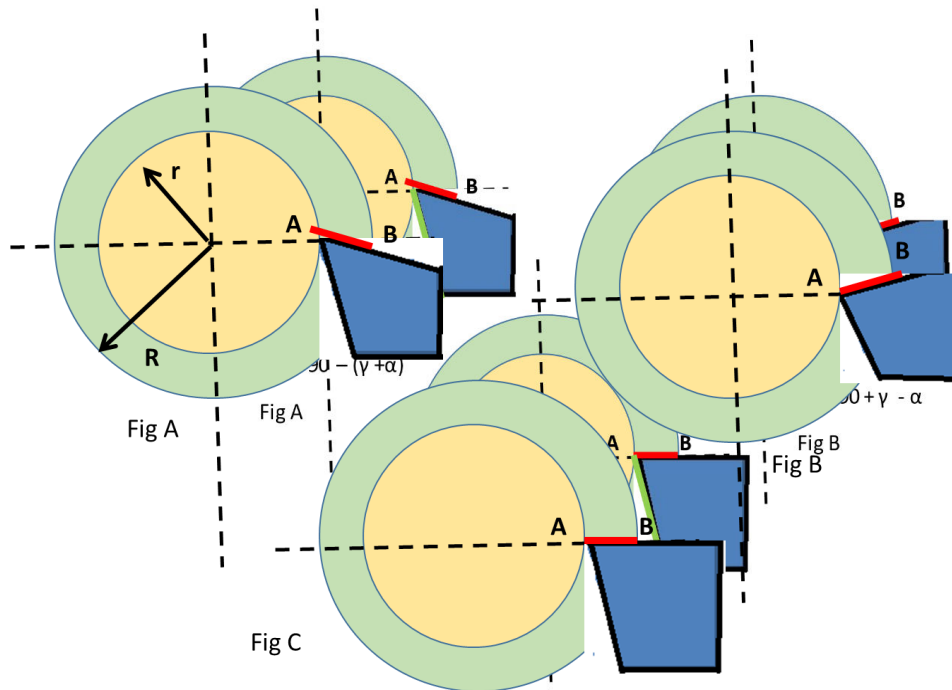


Flat tool with clearance angle " α " and positive rake angle " γ " FIG.A

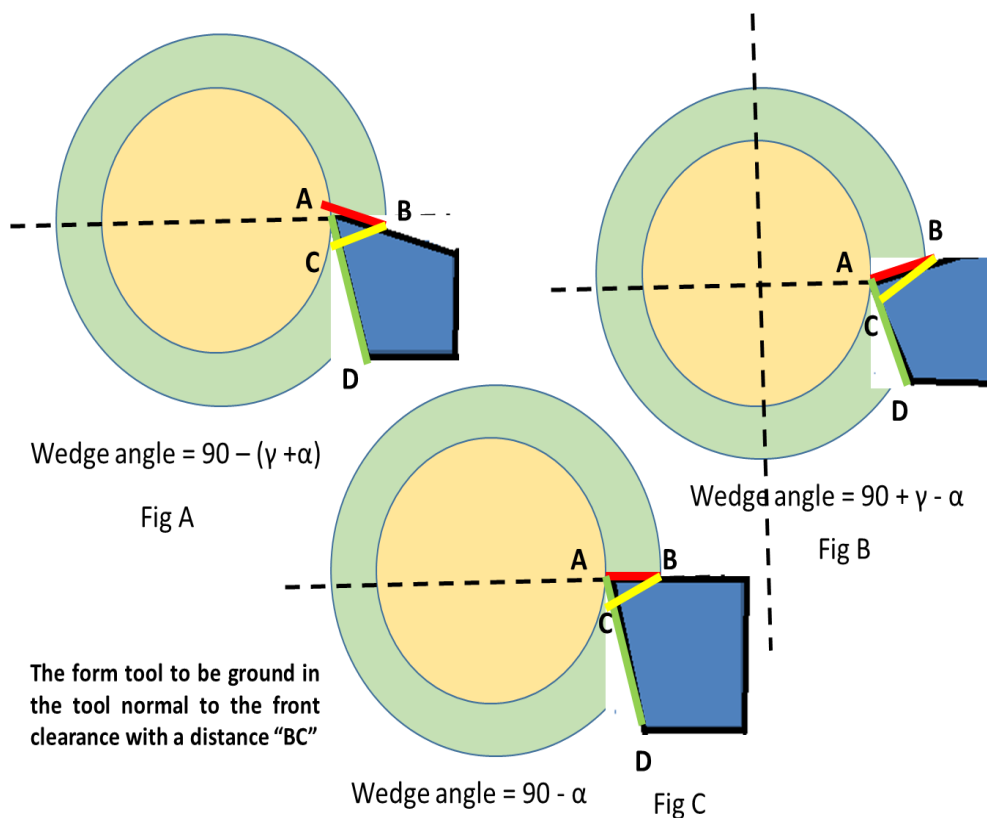
Flat tool with clearance angle " α " and zero rake angle " γ " FIG.B

Flat tool with clearance angle " α " and negative rake angle " γ " FIG.C





ACTUAL DEPTH "AB" ON THE JOB DUE TO THE FED BY THE FORM TOOL



“AB” is the depth of the tool rake face penetration

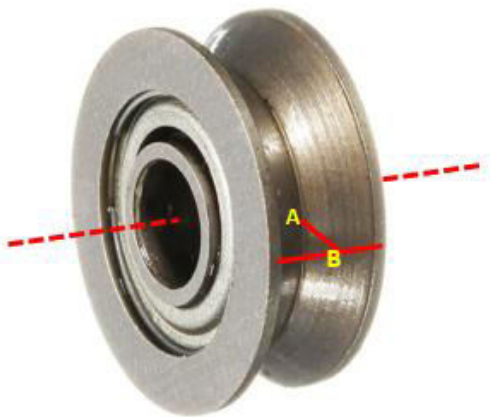


FIG A



FIG B

Triangle ODB

$$(\text{Distance DB})^2 = (\text{Distance OB})^2 - (\text{Distance OD})^2$$

$$C = \sqrt{R^2 - (r \sin \gamma)^2}$$

$$\text{Distance C2} = C - \text{Distance AD}$$

$$C2 = [C - (r \cos \gamma)]$$

$$\text{But } P2 = C2 \cos (\alpha + \gamma)$$

Substitute the value of C2 we get

$$\text{But } P2 = [C - (r \cos \gamma)] \cos (\alpha + \gamma)$$

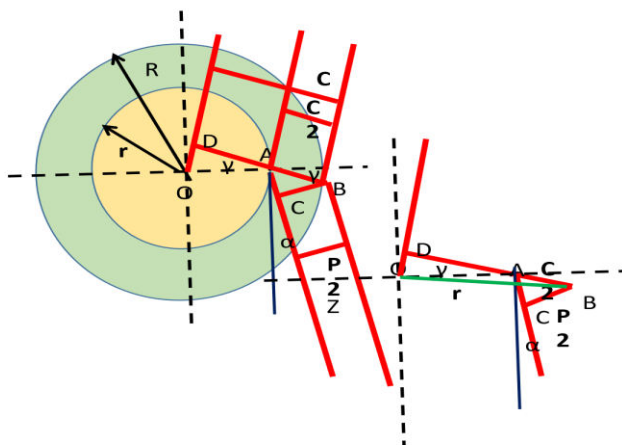
$$P_2 = [\sqrt{R^2 - (r \sin \gamma)^2} - r \cos \gamma] \cos (\gamma + \alpha)$$

OA is “r”

OB is ‘R’

(1) In triangle OAB

Flat form tool with clearance angle α and positive rake angle γ



$$\text{Wedge angle BAC} = 90 - (\gamma + \alpha)$$

$$\text{Angle BAC} = \alpha + \gamma$$

$$\text{Angle ACB} = 90$$

$$\text{Angle ABC} = [180 - 90 - (90 - (\gamma + \alpha))]$$

$$\text{Angle ABC} = \alpha + \gamma$$

$$\text{Angle DAO} = \gamma$$

$$\text{TRIANGLE ODA}$$

$$\text{Distance OD} = OA \sin \gamma$$

$$\text{Distance OD} = r \sin \gamma$$

$$\text{Distance C-C2} = AD$$

$$\text{Distance AD} = r \cos \gamma$$

$$\text{Distance DB} = C$$

$$\text{Distance AB} = C2$$

BC is P2

OAB is $180 - \gamma$

To solve the triangle OAB, we have

$$R/\sin (180-\gamma) = r/\sin OBA = AB/\sin BOA$$

$$\sin OBA = r/R \times \sin \gamma$$

$$BOA = 180 = (180 - \gamma + \sin^{-1} r/R (\sin \gamma) = [\gamma - \sin^{-1} r/R (\sin \gamma)]$$

$$AB = R/\sin \gamma \times \sin [\gamma - \sin^{-1} r/R (\sin \gamma)]$$

To solve the triangle ABC

$$AB/\sin 90 = BC/\sin (90 + \gamma - \alpha)$$

Therefore

$$P2 = BC = R \times \sin [\gamma - \sin^{-1} r/R (\sin \gamma)]/\sin \gamma \times \sin (90 + \gamma - \alpha) \quad (2)$$

Conclusion

A form tool having one or more than one cutting edges with definite profile or curve that is to be replicated as the desired shape on the work piece surface. There are different types of form tools circular form tools, End form tools, flat form tools, flat and straight form tools out of straight and flat form tools are rectangular or square cross section with the form alongside or end.

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