FLANK WEAR AND ITS IMPLICATIONS ON THE TOOL DIMENSIONAL STABILITY ASPECTS OF SINGLE POINT CUTTING TOOL GEOMETRY

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ABSTRACT:

The state of a cutting tool is a critical factor in any metal cutting process because dull or damaged machine tool. Different wear theories are in use to assess the wear phenomenon in metal cutting. Amongst them, diffusion and adhesion wear theories are predominantly considered in determining the crater wear and flank wear phenomena. The work herein proposes a mathematical approach for determining worn tool cutting forces of a single point cutting tool in an orthogonal cutting. To say explicitly, in the present work, simple mathematical formulae in terms of rake angle, relief angle and wear land are utilized in the analysis of a single point cutting tool forces. Estimating wear land and its impact on the geometry of a single point cutting tool assumes significance in view of the fact that the surface irregularity changes caused by tool wear and results to the change of the cutting forces and energy consumption are used as a criterion for estimating the cutting tool life and quality of the work piece.

Keywords:*Flank wear, Cutting Forces, Cutting Velocity, Specific Energy, Worn Tool, Wear Land Curve*

1. INTRODUCTION

Father of Machine Tool –Henry Maudslay.

Single point cutting tools are those having one sharp cutting edge attached to the shank. The cutting edge is intended to perform cutting, produce chips by the consumption of energy and create a machined surface on the work piece. Cutting process with the single point cutting tool can be done in two main ways; Orthogonal Cutting (Rake angle =0), Oblique cutting. This article is relevant to know the exact implications of flank wear on cutting tool and also the ways of numerical theories and calculations to know its effect on the tool. The objective of this article is to declare mainly the primary and secondary objectives.

Primary objective is to determine the dimensional changes takes place when the invariable values of the wear land of the desired material are considered and calculated. Secondary objective is to determine the cutting forces at different conditions and theories and compare the results of the worn tool by waldrof theory. By considering the sharp tool and the worn tool, specific energy consumed during the machiningof the work piece by the cutting tool is also determined clearly.

2. METHODOLOGY

To undergo the process of the cutting forces calculations and its energy consumption determinations, some of the theories and methods are considered which are listed below,

- Merchant Theory
- Lee-Shaffer Theory
- Taylor's Equation
- Waldrof Model for worn tool
- Energy consumptions of cutting planes

2.1. Merchant Theory:

The relationship between shear angle , rake angle, friction angle , cutting force, thrust force, frictional force are considered .

Formula For Merchant Theory:

$$2\o + \beta - \alpha = \frac{\pi}{2}$$

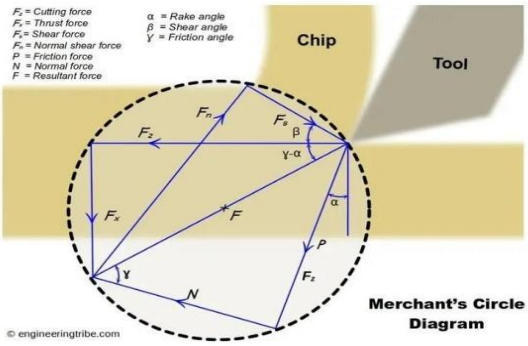

Fig.2.1 Merchant Circle Diagram

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2.2. Lee Shaffer Theory:

Lee Shaffer theory Lee and Shaffer's relationship between and is derived on the assumption that:

A. The material being cut behaves like an ideal plastic which does not strain harden.

B. The shear plane represents a direction of maximum shear stresses in the material cut.

Assuming the possible slip line field to represent the present condition

Formula For Lee Shaffer Theory:

$$\text{Ø}+\beta-\alpha=\frac{\pi}{4}$$

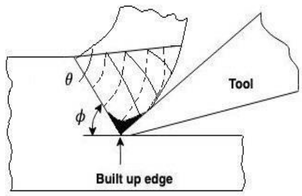


Fig.2.2 Lee-Shaffer Theory Diagram

2.3. Taylor's Equation:

To find the cutting speed and time consumed by the tool for the machining of workpiece in one go.

Formula Of Taylor's Equation:

$$\mathbf{V}T^{n}=C$$

❖ Cutting Velocity effects the tool life at larger extent.

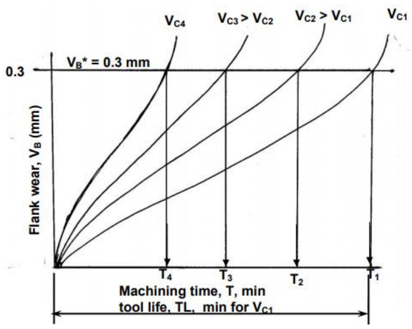


Fig.2.3 Velocity Vs Tool life Diagram

2.4.Waldrof's Equation:

Waldrof model is used in predicting the worn tool cutting forces($\mathbf{F_{tw}}$,$\mathbf{F_{cw}}$)and utilized the theory of slip-line field to predict the stresses at the tool tip. By using those stresses for determining the stress distribution on tool flank wear.

$$\mathbf{F_{tw}}=w\int_{0}^{VB}\sigma_{w}(x)dx$$

$$F_{cw} = w\int_0^{VB} \tau_w(x)dx$$

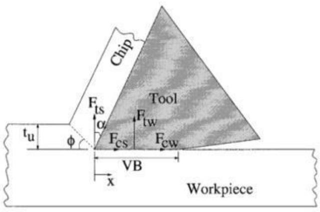


Fig.2.4. Mechanism of tool and workpiece

Where,

F_{cw}=Cutting force in cutting direction due to tool flank wear

F_{tw}=Cutting force in thrust direction due to tool flank wear

F_{cs}=Sharp tool cutting force in cutting direction

F_{ts}=Sharp tool cutting force in thrust direction

α = Tool rake angle

t_u=Uncut Chip Thickness.

It is to noted that summation of the cutting forces of the sharp tool and cutting forces of the worn tool together results the actual cutting force of the machine tool.

Energy Consumption on cutting planes:

Specific cutting energy-

$$SPCE = \frac{F_C V}{V \times b \times t}$$

Specific Shear Energy-

$$SPSE = \frac{F_S V_S}{V \times b \times t}$$

Specific Friction Energy-

$$SPFE = \frac{F V_C}{V \times b \times t}$$

Where;

F_c=Force exerted in cutting direction

V=Cutting Speed

b- Width of cut

t= Chip thickness

V_s=cutting speed due to shear

$V_s = \frac{V coscos\, \alpha}{coscos\, (\emptyset - \alpha)}$

F_s= Force exerted on the shear plane direction

r $= \frac{V_C}{V}$;

F=Friction Force

V_c= Chip velocity

$V_c = r \times V$

3.PROBLEM STATEMENT:

In my present work, to find the forces of the cutting tool at different machining parameter conditions of rake angle, cutting speed, width of cut, uncut chip thickness etc;

Some of the conditions/cases are followed in this attempt:

3.1.CASE(1):

For the cutting tool-cemented carbide

To find the change in dimensional size and the volume of the tool worn following formulae are applied,

$$h = \frac{wtantan\, \theta}{1 - tantan\, \alpha tantan\, \theta}$$

$$W = \frac{bw^2 tantan\, \theta}{2(1 - tantan\, \alpha tantan\, \theta)}$$

$$\text{Orthogonal Cutting: } W = \frac{bw^2 tantan\, \theta}{2} (\alpha = 0)$$

$$cot\, cot\, \theta \ = \frac{VB}{NB}$$

Where,

h =change in dimensional size

w =wear land size

for cemented carbide(roughing) w =0.762mm

for cemented carbide(finishing) w=0.3175mm.

θ= Clearance angle at the worn edge

α = rake angle

b =width of cut

VB= Width of the wear land

NB= wear normal to width of wear land

3.1.1.Cemented carbide(Roughing):

b =2.5mm

θ =2^0, 4^0, 6^0, 10^0

α = -5^0 , 0^0 , 5^0 , 20^0

1. At $\alpha = -5$

θ **= 2**

$$h = \frac{w tantan\ \theta}{1 - tantan\ \alpha tantan\ \theta}$$

$$h = \frac{0.762 \times tantan\ 2}{1 - tantan\ -52}$$

<u>h =0.0265mm</u>

$$W = \frac{b w^2 tantan\ \theta}{2(1 - tantan\ \alpha tantan\ \theta)}$$

$$W = \frac{2.5 \times 0.762^2 tantan\ 2}{2(1 - tantan\ 2 \times tantan\ -5}$$

<u>W=0.025mm</u>

For orthogonal Cutting :$W = \frac{b w^2 tantan\ \theta}{2}$

At θ **= 2** ===$W = \frac{b w^2 tantan\ \theta}{2}$

$W = \frac{2.5 \times 0.762^2 tantan\ 2}{2}$

W=0.0253mm

Cemented Carbide (Finishing):

b =2.5mm

w =0.3175mm

θ =2^0, 4^0, 6^0, 10^0

α = -5^0 , 0^0 , 5^0 , 20^0

1. At $\alpha = -5$

θ **= 2**

$$h = \frac{w tantan\ \theta}{1 - tantan\ \alpha tantan\ \theta}$$

$$h = \frac{0.3175 \times tantan\ 2}{1 - tantan\ -52}$$

h =0.0110mm

$$W = \frac{bw^2 tantan\ \theta}{2(1 - tantan\ \alpha tantan\ \theta)}$$

$$W = \frac{2.5 \times 0.3175^2 tantan\ 2}{2(1 - tantan\ 2 \times tantan\ -5}$$

W=0.0043mm

For orthogonal Cutting: $W = \frac{bw^2 tantan\ \theta}{2}$

At θ = **2** $W = \frac{bw^2 tantan\ \theta}{2}$

$W = \frac{2.5 \times 0.3175^2 tantan\ 2}{2}$

W=0.0044mm

➢ Ratio of the width of the wear land to its normal is defined by the following formulae by considerin g the clearance angle between them.

$$cot\ cot\ \theta\ = \frac{VB}{NB}$$

At θ = **2**

$$cot\ cot\ \theta\ = \frac{VB}{NB}$$

$$\frac{VB}{NB} = cot\ cot\ 2$$

$$\frac{VB}{NB} = 28.63mm$$

Case-2:

Cutting Time(t)	**V=30 mpm (VB)**	**V= 60 mpm (VB)**	**V= 80 mpm (VB)**	**V=100 mpm (VB)**
Start	0	0	0	0
5	0.075	0.375	0.575	0.825
10	0.150	0.525	0.775	1.025

15	0.250	0.650	1.05	1.25
20	0.40	0.80	1.30	1.53

Table.2.1. Relation between the cutting velocity and time

Note:Log V and Log T values are obtained by considering the above mean value at its extreme point on each wear land curve.

Values of the Log v and t are:

Log v	Log t
log 30 =1.477	**log 20=1.301**
log 60=1.778	**log 6=0.7781**
log 80=1.903	**log 3= 0.4771**
log 100=2	**log2=0.3010**

Table.2.2. Log V Vs Log T

❖ By finding the slope of the above tabulated values, **n** value is obtained which is used to find the tool life of the cutting tool at different cutting speed and time.

3.3.Case-(3):

As per stated in the condition of the paper [2], the coefficient of friction(μ) is nearly equal to unity. Three cases are considered as follows;

μ=1;

μ<1;

μ>1;

3.3.1.At μ=1,F_C=900; F_t=900,b =2.5mm, t=0.25mm, t_c=1.0mm, α=-5,0,5,20

To find the friction angle and compare the results at different conditions of rake angle by following the formula below;

$$\beta = \left(\frac{F_t}{F_c}\right) + \alpha$$

At μ=1,F_C=900; F_t=900,b =2.5mm, t=0.25mm, t_c=1.0mm, α= -5^0

$$\beta = \left(\frac{F_t}{F_c}\right) + \alpha$$

$$\beta = \left(\frac{900}{900}\right) + (-5)$$
$$\beta = 40^0$$

Substuiting the Friction angle value in merchant theory to find the shear angle and comparer the relation among the values at different α, β values

Merchant Theory:

$$2\emptyset + \beta - \alpha = \pi/2$$

At $\beta = 40^0$

α= **-5⁰**

$$2\emptyset + \beta - \alpha = \frac{\pi}{2}$$
$$2\emptyset + 40^0 - (-5) = \pi/2$$

Substuiting the Friction angle value in lee and Shaffer theory to find the shear angle and compare the relation among the values at different α, β values

Lee and Shaffer Theory:

$$\emptyset + \beta - \alpha = \pi/4$$

At $\beta = 40^0$

α= **-5⁰**

$$\emptyset + \beta - \alpha = \pi/4$$

$$\emptyset + 40 - (-5) = \pi/4$$

$$\emptyset = 0^0$$

Like wise for the below conditions also we can find the friction angle and can be determined the shear angle by merchant and Lee-Shaffer Theroy.

3.3.2. At μ<1,F_C=900; F_t=450,b =2.5mm, t=0.25mm, t_c=1.0mm, α=-5,0,5,20

3.3.3.At μ>1,F_C=700; F_t=900,b =2.5mm, t=0.25mm, t_c=1.0mm, α=-5,0,5,20

3.4.Case (4):

✓ By considering the tool material as Cemented car bide and reference work piece material for the cutting like (mild steel, cast iron)

✓ Analysis is to be done on those materials at different condition and method when the tool condition is sharp and worn out after some revolutions.

✓ To find the cutting forces of the worn tool, Waldorf's model equation (refer chapter-3) is used.

✓ Energy consumed by the sharp tool and worn tool is also found at 3 planes (cutting, shear, friction).

3.4.1.Combination -1:Tool: Cemented carbide

Workpiece : Cast Iron

Combination:

Cemented carbide-Tool	**Cast Iron-Workpiece**
VB=0.25mm-0.3mm	$\tau_s = 190\ mpa$
Feed=0.4mm/rev	$\alpha = -5^0, 0^0, 5^0, 20^0$
t_c= 1.0mm	b =2.5mm
t =0.25mm	

Formulae used:

- $r = \frac{V_C}{V} = \frac{t}{t_c}$;
- $\emptyset = \frac{r cos cos\ \alpha}{1 - r sin sin\ \alpha}$;
- $A_S = \frac{bt}{sin sin\ \emptyset}$
- $F_s = \tau_s \times A_S$
- $cos\ cos\ (\beta - \alpha + \emptyset) = \frac{F_S}{R}$
- $Sin(\beta - \alpha) = \frac{F_t}{R}$
- $Cos(\beta - \alpha) = \frac{F_C}{R}$

At α= -5⁰;b=2.5mm,t=0.25mm

$r = \frac{t}{t_c} = \frac{0.25}{1.0} = 0.25mm;$

$$\emptyset = \frac{rcos\alpha}{1 - rsin\alpha}$$

$$\emptyset = \frac{0.25 \times cos(-5)}{1 - 0.25 \times sin(-5)}$$

$$\emptyset = 13.69^0$$

$A_s = \frac{bt}{sin sin\ \emptyset}$

$A_s = \frac{0.25 \times 2.5}{sin sin\ 13.69}$

A_s=2.64mm

$$\tau_s = 190mpa$$

$F_s = \tau_s \times A_S$

F_s=190$\times$ 2.64

F_s=501.6N

R=$F_S / cos\ cos\ (\beta - \alpha + \emptyset)$

R=1131.69N

$F_t = sin\ sin\ (\beta - \alpha) \times R$

F_{ts}= 866.92N

$F_C = cos\ cos\ (\beta - \alpha) \times R$

F_{cs}=727.43N

3.4.2.Worn Tool:

Combination-1:

Cemented carbide-Tool material

Cast Iron -Workpiece material

VB,width of cut, flow stress in shear direction.

Formulae used in estimating the cutting forces of a worn tool are as follows;

$$\mathbf{F_{cw}=w}\int_0^{VB} \tau_w(x)dx$$

$$\mathbf{F_{tw}=w}\int_0^{VB} \sigma_w(x)dx$$

VB=0.25mm-0.3mm,b=w=2.5mm

As we all know from the chapter-3 that,$\tau_w = K$, where K is equal to the shear strength of the sharp tool (τ_s)

$$\mathbf{F_{cw}=w}\int_0^{VB} \tau_w(x)dx$$

- At VB=0.25mm,K=190.97mpa====$F_{cw}=2.5\int_0^{0.25} 190.97(x)dx$

$$=2.5\times 190.47(0.25-0)$$

F_{cw}=121.8125N

- At VB=0.28mm,K=190.97mpa====F_{cw}=136.43N
- At VB=0.3mm,K=190.97mpa==== F_{cw}=146.17N

As we all know from the chapter-3 that,$\sigma_w = K(1+\frac{\pi}{2})$ where K is equal to the shear strength of the sharp tool (τ_s)

$\sigma_w = K\left(1+\frac{\pi}{2}\right)$= 2.57K

$$\sigma_w = 190.97\left(1+\frac{22}{14}\right)$$

$$\sigma_w = 501.35 N/mm^2$$

$$\mathbf{F_{tw}=w}\int_0^{VB} \sigma_w(x)dx$$

- At VB=0.25mm, σ_w=501.35 N/mm^2====F_{tw}=2.5$\int_0^{0.25} 501.35(x)dx$

  =2.5× 501.35(0.25 − 0)

  F_{tw}=313.34N
- At VB=0.28mm, σ_w=501.35 N/mm^2====F_{tw}=350.945N
- At VB=0.3mm, σ_w=501.35 N/mm^2==== F_{tw}=376.0125N

It should be noted that actual cutting forces in the cutting and thrust directions, F_c and F_t respectively, are the summation of the forces due to wear and the sharp tool cutting forces when tool flank wear is not present,

$$\mathbf{F_c= F_{cw}+ F_{cs};}$$

$$\mathbf{F_t=F_{tw}+ F_{ts};}$$

From the above calculations,

3.4.3.Combination :

Cemented carbide and Cast iron

Sharp tool:

At α= -5^0, $\emptyset = 13.69^0$

F_{cs}=727.43N

F_{ts}= 866.92N

Worn Tool:

F_{cw}=134.804N

F_{tw}=346.765N

$$\mathbf{F_c= F_{cw}+ F_{cs};}$$

$$F_c=134.804+727.43$$

$$\mathbf{F_c=862.234N}$$

$$\mathbf{F_t = F_{tw}+ F_{ts};}$$

$$F_t=346.765+866.92$$

$$\mathbf{F_t=1213.685N}$$

3.4.5. Specific Energy Consumption in Primary and Secondary Shear Zones

To find the specific energy consumption at different planes, foremost we have to find the following nomenclature which are used to find in the following energy consumption formulae of the planes (Cutting, shear, friction).

By the force equations,

$$F_s = F_c \cos \cos \emptyset - F_t \sin \sin \emptyset$$

$$F = F_c \sin \sin \alpha + F_t \cos \cos \alpha$$

Energy consumption equation:

$$SPCE = \frac{F_C\,V}{V \times b \times t}$$

$$SPSE = \frac{F_S V_S}{V \times b \times t}$$

$$SPFE = \frac{F\,V_C}{V \times b \times t}$$

Combination:

Cemented carbide-tool material

Cast Iron- Workpiece material

At α= -5⁰;b=2.5mm,t=0.25mm,$\emptyset = 13.69$

F_c=862.234N

F_t=1213.685N

$F_s = F_c \cos \cos \emptyset - F_t \sin \sin \emptyset$

$F_s = 862.234 \times \cos(13.69) - 1213.685 \times \sin(13.69)$

F_s=550.497N

$F = F_c \sin \sin \alpha + F_t \cos \cos \alpha$

$F = 862.234 \sin \sin (-5) + 1213.685 \cos \cos (-5)$

F=1133.917N

Specific Cutting Energy(SPCE)=

$$SPCE = \frac{F_C\,V}{V \times b \times t}$$

$$\textbf{SPCE} = \frac{862.234}{2.5 \times 0.25}$$

$$\textbf{SPCE=1379.5741N}/mm^2$$

Specific Shearing Energy(SPSE):

$$SPSE = \frac{F_S V_S}{V \times b \times t}$$

- At V=30mpm, $V_s = \frac{V coscos\,\alpha}{coscos\,(\emptyset-\alpha)}$=31.54m/min===SPSE=$\frac{550.497\times31.54}{30\times2.5\times0.25}$

SPSE=926.15N/mm^2

Specific Friction Energy(SPFE):

$$SPFE = \frac{F\,V_C}{V \times b \times t}$$

SPFE=$\frac{1231.685\times0.25}{2.5\times0.25}$

SPFE=485.474 N/mm^2

By Following the above process of calculation, another combination -Cemented Carbide, Cast Iron can be determined.

4. RESULTS AND GRAPHS:

From the above attempt it is clear by the calculations that the cutting forces of the tool at different conditions is done by considering the 4 cases and determined the forces, VB, volume of the tool worn ,merchant theory analysis etc;

4.1.Case-1: Cemented Carbide(Roughing):

α and $\emptyset$	h(change in dimensional size)	W(Volume of the tool worn)	W(At α=0,Volume of the tool worn)
$\alpha = -5$ $\theta = 2$	0.0265mm	0.025mm	0.0253mm
$\alpha = 0$ $\theta = 4$	0.0532mm	0.0507mm	0.0507mm
$\alpha = 5$ $\theta = 6$	0.0808mm	0.0769mm	0.0762mm
$\alpha = 5$ $\theta = 6$	0.143mm	0.1367mm	0.1279mm

Table 4.1.1. Cemented carbide (Roughing)

Cemented Carbide (Finishing):

α and $\emptyset$	h(change in dimensional size)	W(Volume of the tool worn)	W(At α=0,Volume of the tool worn)
$\alpha = -5$ $\theta = 2$	0.0110mm	0.0043mm	0.0044mm
$\alpha = 0$ $\theta = 4$	0.022mm	0.00811mm	0.0088mm
$\alpha = 5$ $\theta = 6$	0.0336mm	0.0133mm	0.01324mm
$\alpha = 20$ $\theta = 10$	0.0598mm	0.0237mm	0.0222mm

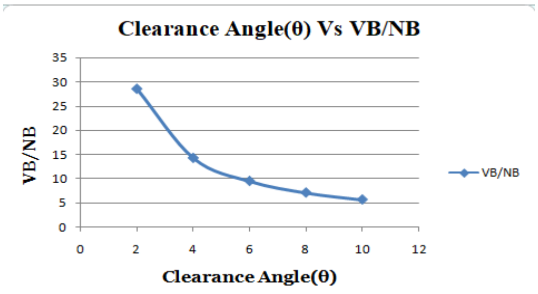
Table 4.1.2. Cemented carbide (Finishing)

Values of clearance angle in terms of VB/NB are tabulated below:

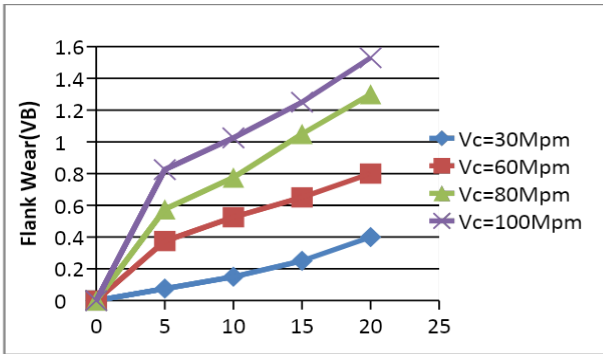
cotθ	$\frac{VB}{NB}$
$\theta = 2$	28.63mm
$\theta = 4$	14.30mm
$\theta = 6$	9.51mm
$\theta = 10$	5.67mm

Table 4.1.3. cotθ Vs VB/NB

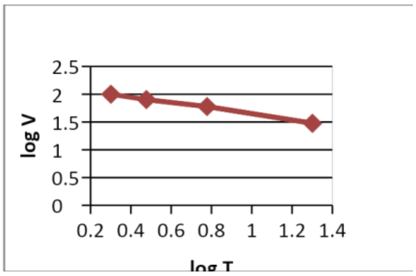
From the above tabulated values, as the clearance angle varies which increases results to the relation of VB/NB, decreases.



4.2. Case :2 Wear Land Curve:



Log V Vs Log T



4.3.Case-3:

Below tabulated results are following the condition of μ=1 (All the values are in Degrees)

Rake angle(α)	Friction angle(β)	Merchant Theory($\emptyset$)	Lee and Shaffer theory($\emptyset$)
-5	40	22.5	0
0	45	22.5	0
5	50	22.5	0
20	65	22.5	0

Table 4.3.1 μ=1

 μ<1

Rake angle(α)	Friction angle(β)	Merchant Theory($\emptyset$)	Lee and Shaffer theory($\emptyset$)
-5	21.5	31.75	18.5
0	26.5	31.75	18.5
5	31.5	31.75	18.5

20	46.5	31.75	18.5

Table 4.3.2. μ<1

- μ>1

Rake angle(α)	Friction angle(β)	Merchant Theory($\emptyset$)	Lee and Shaffer theory($\emptyset$)
-5	47.12	37.8	-7.15
0	52.12	37.8	-7.15
5	57.12	37.8	-7.15
20	72.12	37.8	-7.15

Table 4.3.3. μ>1

4.4.Case-4:

Below tabulated values are determined by calculated the cutting forces at varied rake angles and stipulated shear angles.

Combination: Cemented carbide and Cast Iron (Sharp Tool)

Rake angle(α)	Shear angle($\emptyset$)	A_s (mm^2)	F_s (N)	R (N)	F_{ts} (N)	F_{cs} (N)
$\alpha = -5$	13.69	2.64	501.6	1131.69	866.92	727.43
α =0	14.036	2.576	489.44	951.29	672.66	672.66
$\alpha = 5$	14.28	2.533	481.27	824.33	529.96	631.48
α =20	14.40	2.513	477.47	617.89	261.131	560.05

Table 4.4.1. Cemented carbide and Cast Iron (Sharp Tool)

Cemented carbide and Cast Iron (Worn Tool)

VB	F_{cw}	F_{tw}
0.25mm	121.8125N	313.34N
0.28mm	136.43N	350.945N
0.3mm	146.17N	376.0125N

Table 4.4.2. Cemented carbide and Cast Iron (Worn Tool)

Below tabulated values are actual forces of cutting tool at cutting, shear, friction plane and their energy consumption during machining.

Rake angle(α)	Shear angle($\emptyset$)	F_c(N)	F_t(N)	F_s(N)	F(N)	**SPCE (N/mm^2)**	**SPSE (N/mm^2)**	**SPFE (N/mm^2)**
-5	13.69	862.234	1213.685	550.497	1133.917	1379.574	926.18	485.474
0	14.036	807.464	1019.425	536.1132	1019.425	1292.2336	884.166	407.77
5	14.28	766.284	876.725	526.353	940.174	1226.0544	850.044	376.06
20	14.40	694.854	607.896	521.846	808.889	1111.76	788.276	323.556

Table 4.4.3. Cemented carbide and Cast Iron (Actual cutting Tool)

Below Tabulated values are forces exerted by the worn tool and energy consumed by the worn tool while machining

Rake angle(α)	Shear angle($\emptyset$)	F_{cw}(N)	F_{tw}(N)	F_s(N)	F(N)	**SPCE (N/mm^2)**	**SPSE (N/mm^2)**	**SPFE (N/mm^2)**
-5	13.69	134.80	346.765	48.902	333.69	215.68	82.2	133.476
0	14.036	134.80	346.765	46.65	346.765	215.68	78.47	138.706
5	14.28	134.80	346.765	45.10	357.19	215.68	75.87	142.876
20	14.40	134.80	346.765	44.32	371.856	215.68	74.56	148.78

Table 4.4.4. Cemented carbide and Cast Iron (Worn Tool) and its energy consumption

5. CONCLUSION:

In this work and attempt has been made to determine the dimensional stability of the cutting tool by selecting the respective tool material and combination of the workpiece. An attempt has been done by considering the invariable standard condition of many literatures and references of the articles.

In the present article, have cleared determined the cutting forces at different rake angle, shear angles. In this it has been clearly stipulated the conditions and its suitable scenarios of calculations by the help of the merchant and Lee – Shaffer Theory. By considering the cutting tool condition before machining (Sharp tool) and after machining (worn tool) calculated the cutting forces and determined the energy consumed by them.

By this attempt it is helpful to get the cutting tool of the required dimensions and methods to predict the cutting tool depending upon the energy it consumes and cutting forces it exerts. Through the prior note of the condition of Cutting tool selection, lead time decreases and the production rate increases.

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