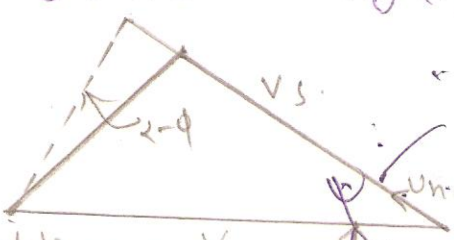
MANOJ KUMAR Assignment-2
07MEH026

3.5/5

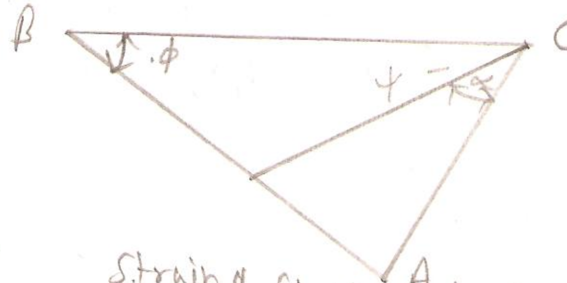
(1)

Q#1

Ans:- The chip velocity, V_c is the velocity of the chip relative to the tool & directed along the tool face. the shear velocity, V_{s} is the velocity of the chip relative to the chip relative to the work piece & directed Along the shear plane. these two velocities Along with the cutting velocity, V would from a closed tringle AS :- fig (i)



vel. relationship in orthogonal cutting.



Strain & Strain rate in orthogonal cutting

from this we can get

$$\frac{V}{\sin(90^\circ-(\phi-\alpha))} = \frac{V_s}{\sin(90^\circ-\alpha)} = \frac{V_c}{\sin\phi} \quad \text{—(1)}$$

$$V_c = \frac{V\sin\phi}{\cos(\phi-\alpha)} \quad \text{—(2)}$$

$$V_s = \frac{V\cos\alpha}{\cos(\phi-\alpha)} \quad \text{—(3)}$$

To evalnate the shear strain, we take help of Piispanen's model, as shown in fig (2)

$$\gamma = \frac{\Delta S}{\Delta y} = \frac{AB}{CD} = \frac{AD}{CD} + \frac{DB}{CD} = \tan\phi + \cot(\phi-\alpha) \quad \text{—(4)}$$

$$\text{or } \gamma = \frac{\cos\alpha}{\sin\phi\cos(\phi-\alpha)} = \frac{V_s}{V\sin\phi} \quad \text{—(5)}$$

the Strain rate is given by.

$$\dot{\gamma} = \frac{\Delta S}{\Delta Y\,\Delta t} = \frac{V_s}{\Delta Y} = \frac{\cos\alpha}{\cos(\phi-\alpha)}\frac{V}{\Delta Y} \quad \text{—(6)}$$

Where ΔY is the thickness of the deformation zone and 't' is the time to Achive the final value of Strain. ΔY can be considered as the mean value of the spacing of successive slip planes, which is of the order of 2.5 microns.

most of the energy consumed in metal cutting is utilised in plastic Deformation. the Total work Done W_1 is given by.

$$W = F_H = V \qquad (6)$$

~~who~~ the work done in shear W_s is

$$W_s = F_s V_s. \qquad (7)$$

similarly the work done in friction W_f is.

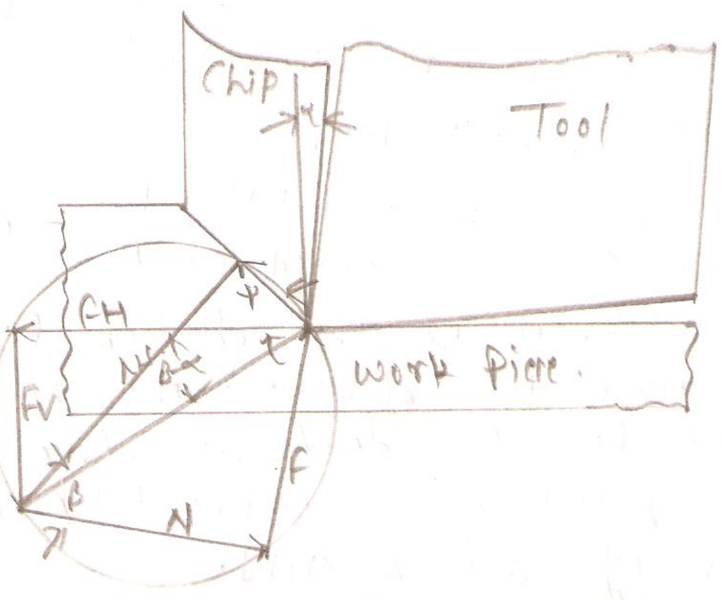
$$W_f = F V_c \qquad (8)$$

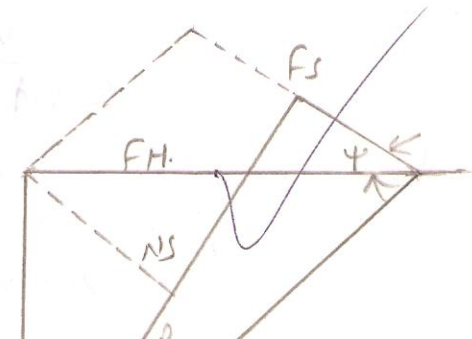
$$\boxed{W = F_H V = F_s V_s + F V_s.}$$

Q. 2

Ans. It is possible to represent all these forces be acting at the tool point in place of their Actual point of Action. By doing so, It is possible to construct a cutting force circle as shown in fig. which is often called Merchant's circle. It is a simple exercise to derive the various relationship among the forces.

we will make some construction into fig. to get the relation ship b/w the various forces as in fig.:-





from fig:→

$$F_s = F_H \cos\phi - F_V \sin\phi \quad \text{—— (1)}$$

$$N_s = F_V \cos\alpha + F_H \sin\phi \quad \text{—— (2)}$$

$$= F_s \tan(\phi + \beta - \alpha) \quad \text{—— (3)}$$

from fig. we can write..

$$F = F_H \sin\alpha + F_V \cos\alpha.$$

$$N = F_H \cos\alpha - F_V \sin\alpha.$$

If μ is the coefficient of friction along the rake face, then.

$$\mu = \tan\beta = \frac{F}{N} = \frac{F_V + F_H \tan\alpha}{F_H - F_V \tan\alpha}.$$

Where β is the friction angle and ϕ is the shear Angle.

This friction is Not similar to the usual sliding case, since F and N are Not uniformly distributed over the sliding Area, this Aspect is dicussed later.

Now, the area of shear plane A, is given by.

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

the shear force is given by

$$F_s = \tau A_s = \frac{\tau bt}{\sin\phi}$$

Where τ is the mean shear stress in the shear plane. b is the width of cut and t is the uncut chip thickness.

$$\sigma = \frac{N_s}{A_s} \text{ or,}$$

$$N_s = \frac{\sigma bt}{\sin\phi}$$

Where σ is the mean Normal stress in the shear plane.

Now

we can show that by resolving.

$$F_H = F_s \cos\phi + N_s \sin\phi \quad \text{——— (4)}$$

$$F_V = N_s \cos\phi + F_s \sin\phi. \quad \text{——— (5)}$$

Substituting eqn. (3) in (5), we get

$$F_H = F_s \left[\cos\phi + \sin\phi \tan(\phi+\beta-\alpha) \right]$$

Similarly.

$$F_V = F_s \left[\cos\phi \tan(\phi+\beta-\alpha) - \sin\phi \right]$$

Rearranging we get.

$$\boxed{F_H = F_s \left[\frac{\cos(\alpha-\beta)}{\cos(\phi+\beta-\alpha)} \right]}$$