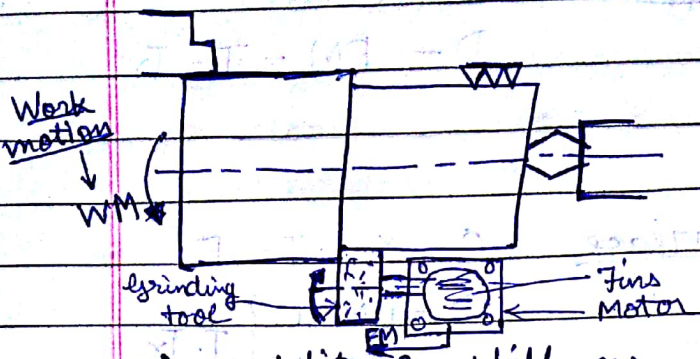
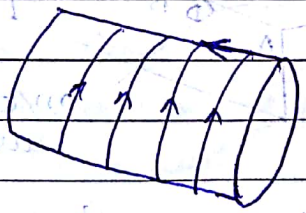


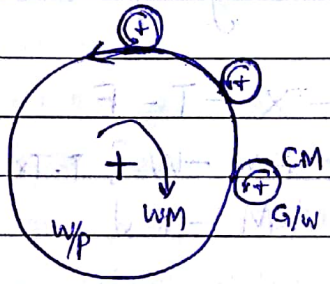
There are 3 motions
1. FM
2. CM of grinding wheel
3. CM of W/p

→ Rigidity & stiffness is high in grinding because Material Removal is very less ∴ if the stiffness is not good, it will deflect.



$G - \left\{ \begin{matrix} WM - W \\ CM - T \end{matrix} \right\} T \cdot T_r$

$D - FM - T - T_r$



Methods of generating 'G' & 'D' :-

- form of the tool
- tracing
- tangent tracing
- "generation"

} 'CM' or 'FM' or combinations of two. At times, there is also the concept of 'WM'. Combination of CM/FM/WM need not have any kinematic relation. example- end milling CM & FM provide D, but no particular speed ratio is to be maintained b/w CM & FM.

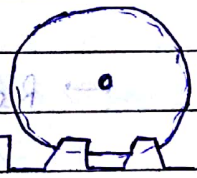
Date 24/1/18
Page

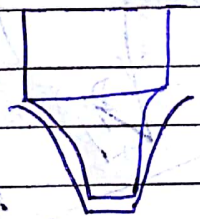
→ However, for thread cutting, 'D' is generated by combination of CM & FM and to maintain / cut a thread of certain pitch you need "coupled" FM & CM. "Generation" method typically requires coupling.

→ Gear profile → involute, but on a "rack" the gear profile look "trapezoidal".

→ Involute is typically generated by unwinding a thread from a circle, Normal at any point would be tangent to base circle (for involute)

→ Rack having trapezoidal profile.
Rack interfere with disc where it is being machined. velocity at point of contact is same.
Gear's profile is not trapezoidal (involute)

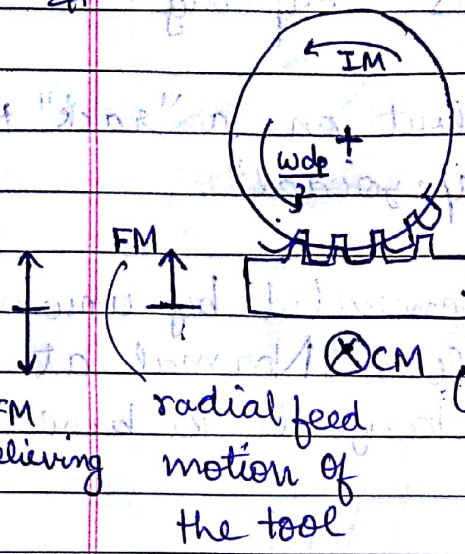


→ 
← This cutter generates same profile on gear (involute profile)

→ The motions of gear (disc) & rack are coupled. Also, the disc is wider than rack, so cutter is also allowed to oscillate also to give the cut to full width. This reciprocating motion is called "Cutting motion". Another motion required is to provide "depth of cut" (feed motion given to cutter in radial direction).

Such principles are used in gear hobbe & gear shaping machine (No such machin to cut the gear exists as such)

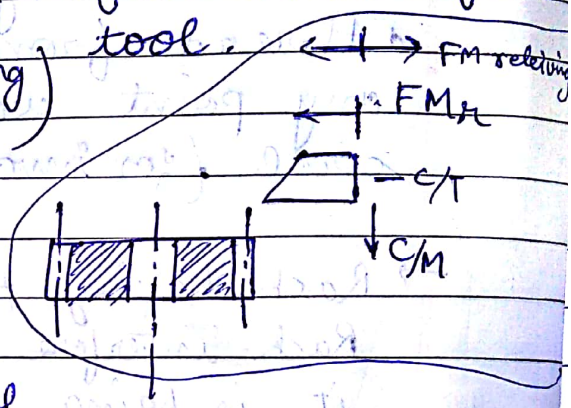
#



$v = \frac{\omega d_e}{2}$ { coupling }

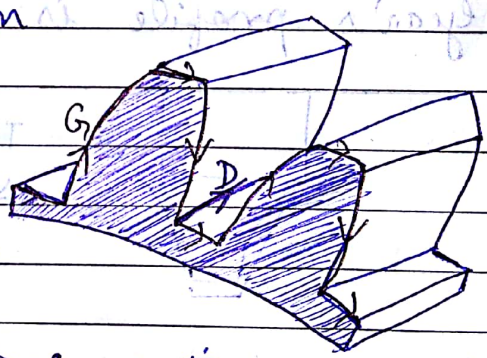
IM – Indexing motion of the w/p (circular)

FM – feed motion of the tool.



→ Relieving motion is required so that tool doesn't cut in the back stroke.

C/T only cuts from bottom edge.



G – IM – W
FM – T
} – Gen

D – CM – T – Tr
FM_R – T
$FM_{relieving}$ – T

Generation

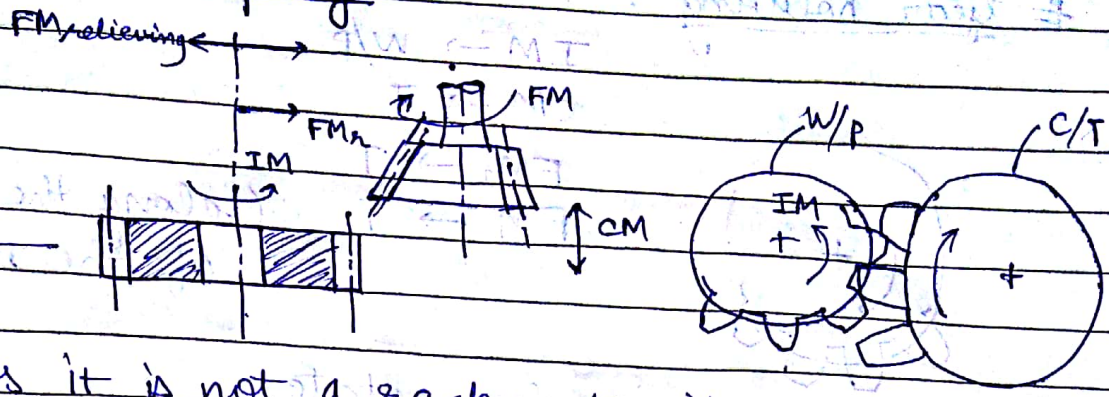
↓

creation of G & D because of coupled motion either to C/T or W/p or both.

→ When cutting a gear, to cut 1 particular tooth profile one after another — ∴ Indexing motion.

→ Feed motion is essential to provide required depth of tooth profile.

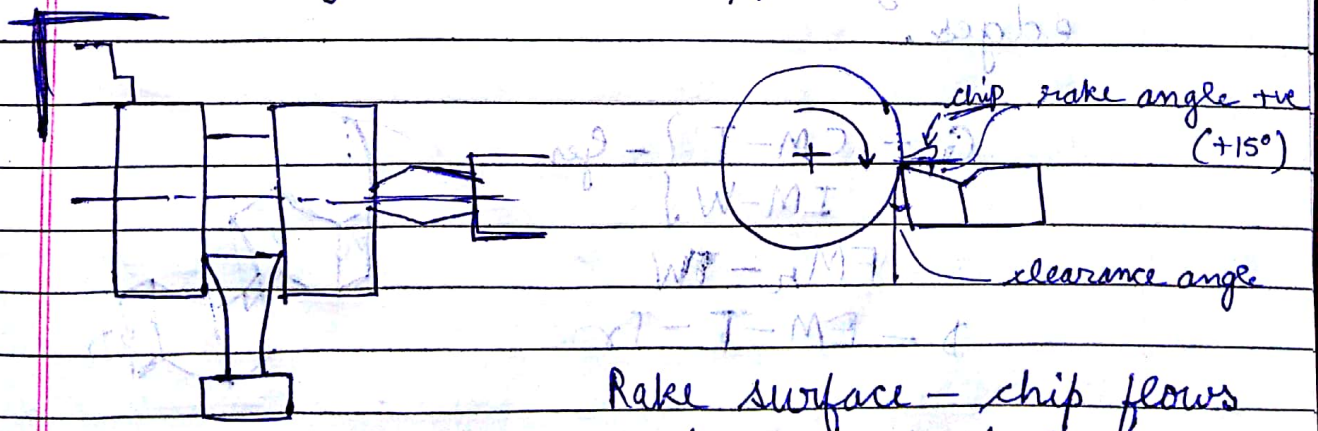
Gear shaping



As it is not a rack, so it could not be trapezoidal. ∴ it is involute. Only required criterion :- module of ~~w/p~~ required gear = module of C/T.
(Rack is the cutter with dia → ∞)
Involute profile is dictated by the choice of module. Pressure angles also same

→ G – IM – W } gen
FM – T }
D – CM – T – Tr
FMr – W
FMrelieving – W

* Tool mounted on spindle and experiences many forces, so if it's no. of DOF are ↑↑, it's stresses will increase ∴ FMr & FMrelieving is ~~not~~ given to ~~tool~~ w/p & not to the tool.



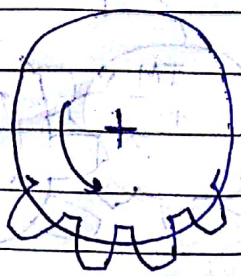
Rake surface – chip flows in that surface

Chip formation does not take place in backward motion

Date 25/1/18
Page

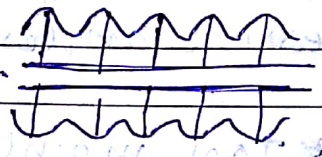
Gear hobbing :

IM → W/P
CM → T
FM_R → T
FM → T (along the width of the W/P)

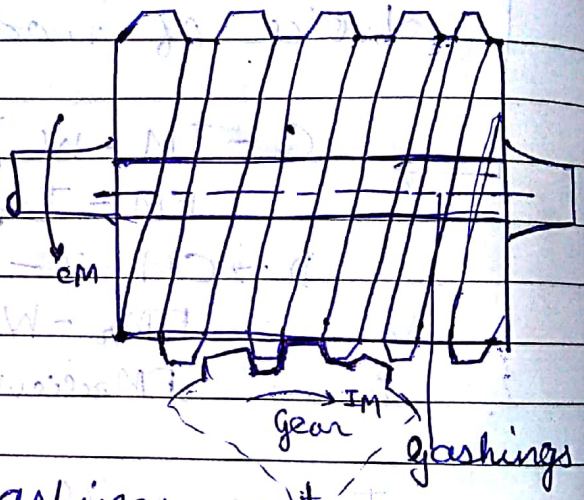


→ Hob continously rotates
→ Rack move linearly, point on the thread correspond to linear motion of rack.

⇒Hobbing (G/D statements):

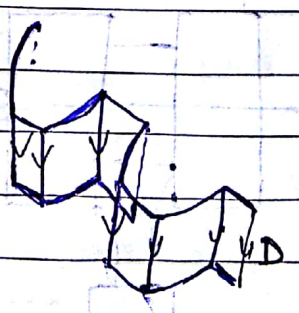


Groove creates more cutting edges (In cont. thread no cutting edges).



Typically → 6 to 8 gashings.
→ horizontal slots which creates cutting edges.

G – CM–T } – Gen
IM–W }
FM_R – W
D – FM – T – T_R



Coupled motions → CM & IM
→ Peripheral vel. of cutter at pitch line = pitch

gear.
velocity of w/p at pitch line.

→ axial feed (speed) of the cutter
= peripheral speed of the gear being cut

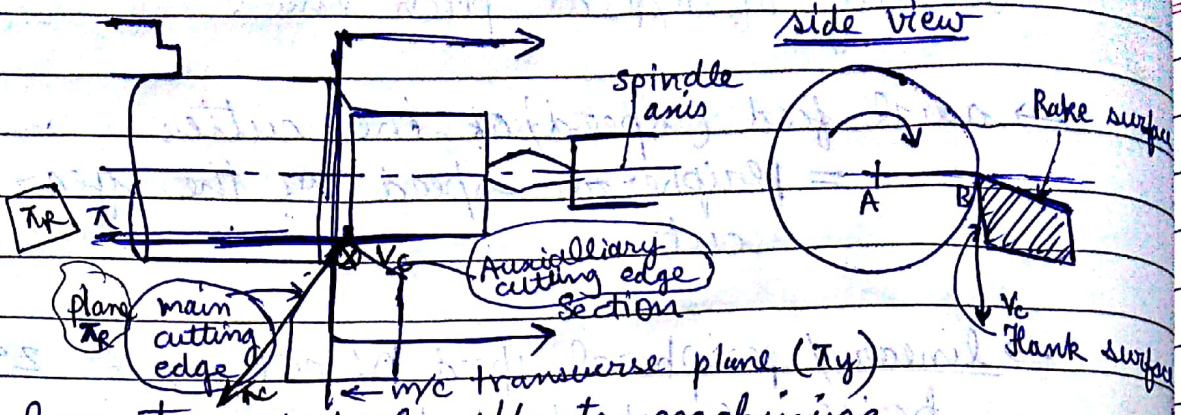
→ linear / peripheral speed of cutter = $\frac{z}{s}$ (z ← no. of teeth on gear; s ← start of the hob)
peripheral speed of the gear at its pitch line / circle

Imp Qn end sem → Machining a helical gear using form tool.
↳ 3 motions → one of which is coupled work motion → Write gen. & dir. statement for this.
In Tangent Tracing, an additional motion is required to obtain helix for this.

→ Relieving motion is required in shaping but not in hobbing, geometry is always favourable here, cutter cuts in 1 direcn so no back stroke chances are there.
∴ No relieving motion is required here.

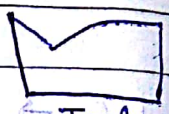
Date 25/1/18
Page

Module 3 : Tool Geometry



→ Geometry of tool affects machining to a greater extent.

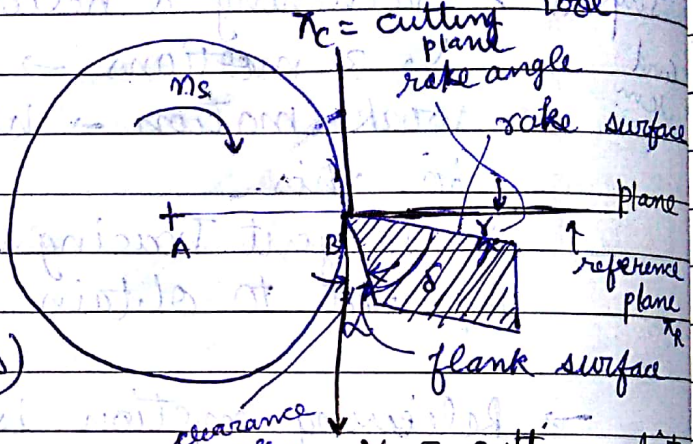
★ → Many questions in exam 😐.



→ plane is ⊥ to velocity vector. It is called reference plane, π_R.

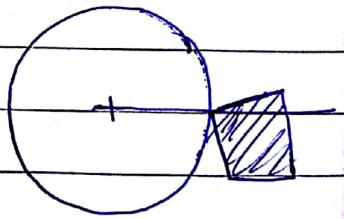
→ $\pi_R \perp \vec{V_c}$ (always)

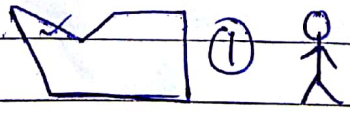
→ Drawing plane is π_R.

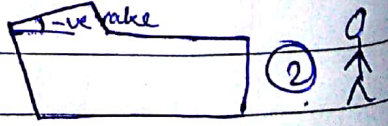


→ Rake Angle → Angle b/w rake surface & reference plane.

→ HSS do not require this type of geometry. They require above type.







★ back

① → Rake surface is drooping ~~towards away from observer~~ towards observer → +ve rake

② → Rake surface is drooping towards tool

→ $\gamma + \alpha + \delta = 90^\circ$ (clearance angle)

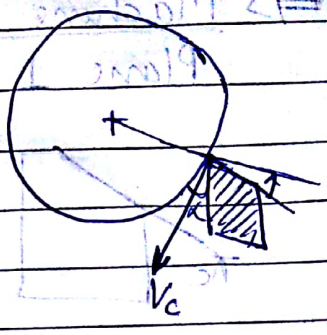
Rake angle, wedge angle

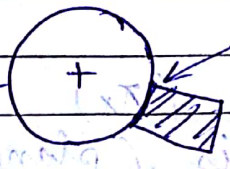
tip → -ve rake.

→ Tool tip to be alligned with the dead centre

If tool tip is misoriented :-

Defⁿ of reference plane is ⊥ to $\vec{V_c}$. ∴ Rake angle may be different than what was thought by observer.



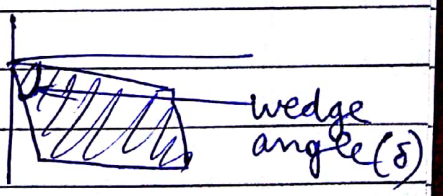
→ If this :-  lot of rubbing, frict^n will be there, temp will ↑↑ and lot of vibra^n will be there

To avoid all of these, flank surface is kept away; certain clearance angle (α) is provided

π_c → Plane ⊥ to π_R and containing main cutting edge. Angle b/w this plane & flank surface → clearance angle → α ($\alpha \geq 0$)

clearance angle should be as large as possible but typically it is only 5-6° (not 20°)

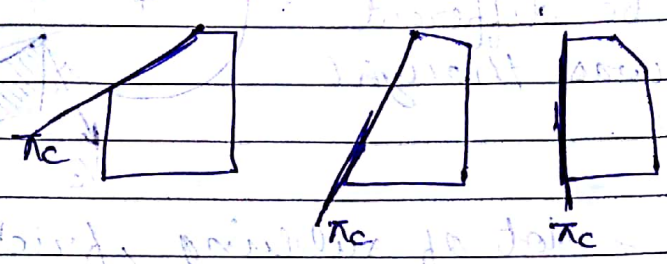
→ If wedge angle ↓↓, tool tip's strength also ↓↓. which is undesirable so clearance angle is kept but not that much that it may affect wedge angle.



→ α may become 0 or -ve. If flank surface is away from W/p then it

is the clearance angle. If α_{pp} then -ve. We always want α to be +ve to avoid interference of tool with the w/p.

⇒ Machine Transverse plane (π_y)
Plane ⊥ to spindle axis (machine axis)
(⊥ to both π_R & π_x) taken in direction of cross feed.



⇒ M/c longitudinal plane (π_x)
Plane || to m/c axis. (plane ⊥ to π_R and taken in direction of assumed longitudinal feed)
→ π_c → Plane ⊥ to π_R containing main cutting edge