2.008 Quiz 1 Review

Quiz Scope & Logistics

- Quiz 1 will cover HW 1 - 4 and through Lecture 12 (3/13) . Even if content was not explicitly asked about in a HW, if it was discussed in class, it is fair game for the quiz
- You are allowed one double sided, handwritten 8.5” x 11” notes sheet. This is for equations and any other pertinent information
- We will supply you with calculators for the exam
- Show your work, box your answers

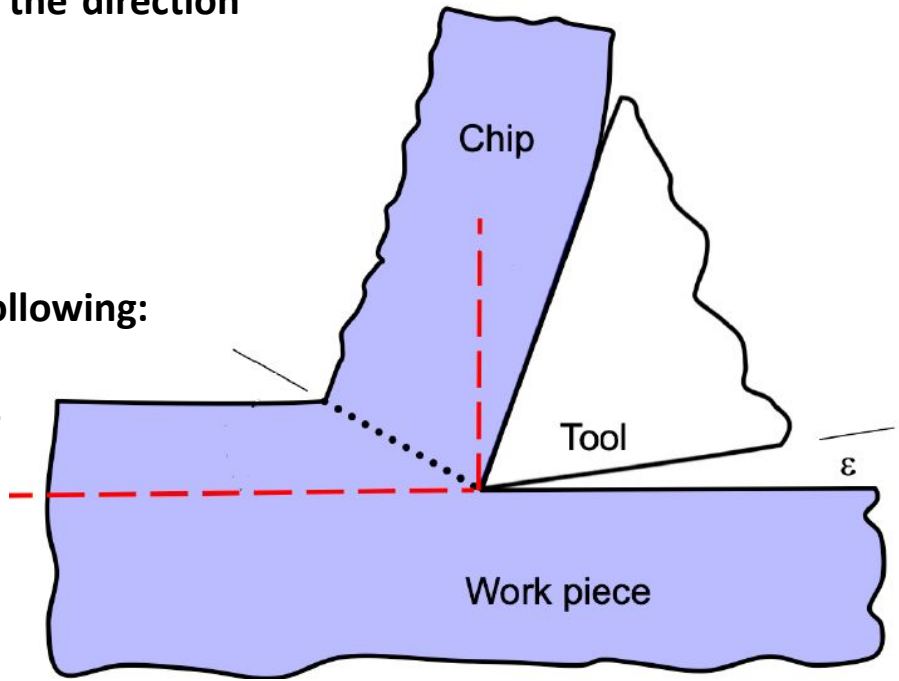
Merchant's Diagram - HW2 Question

Draw and complete Merchant's Diagram with respect to this operation. Your drawing should label, and indicate the direction of

- **Each of the forces from part a**
- **The 3 angles described in Merchant's equation**
- **The resultant force vector**

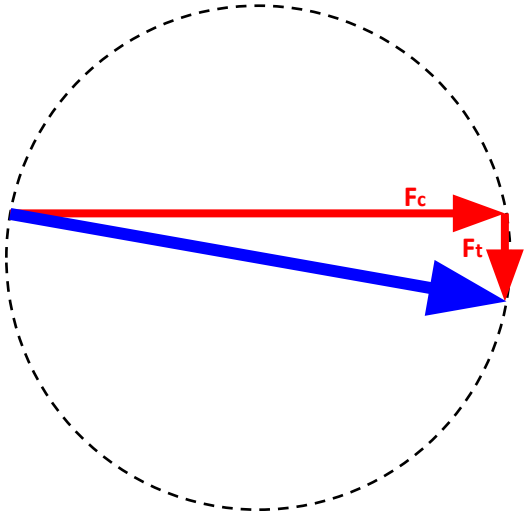
Directions of forces and angles should assume the following:

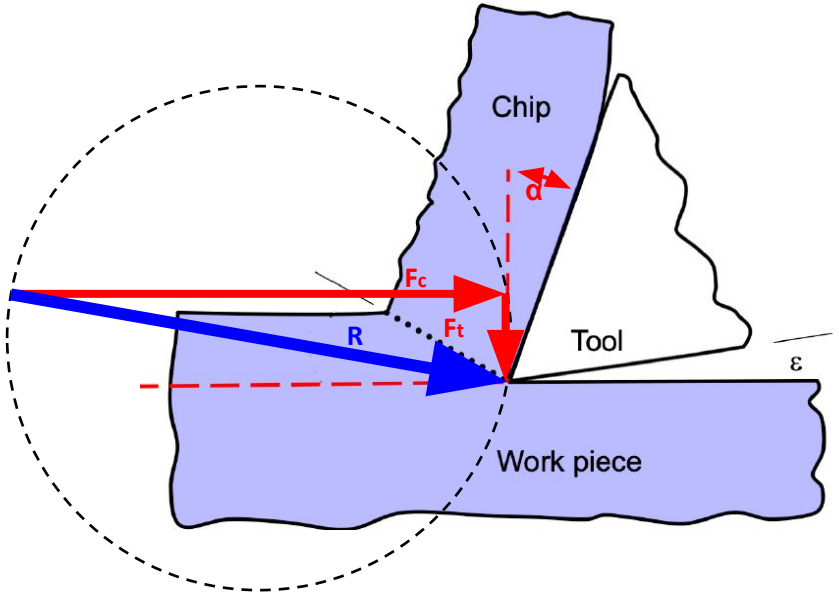
- **Cutting force is acting on the tool**
- **The rake angle is positive, as the image implies**
- **Friction angle is less than the rake angle**



Merchant's Diagram

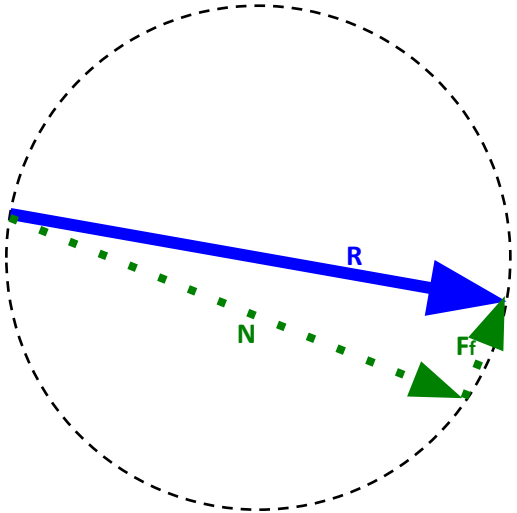
- Workpiece/Tool Interaction

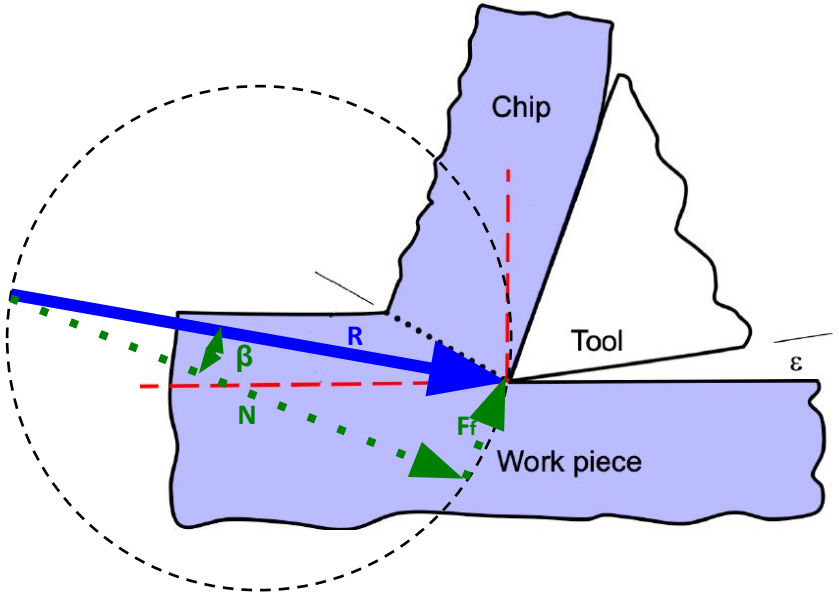




Merchant's Diagram

- Chip/Tool Interaction





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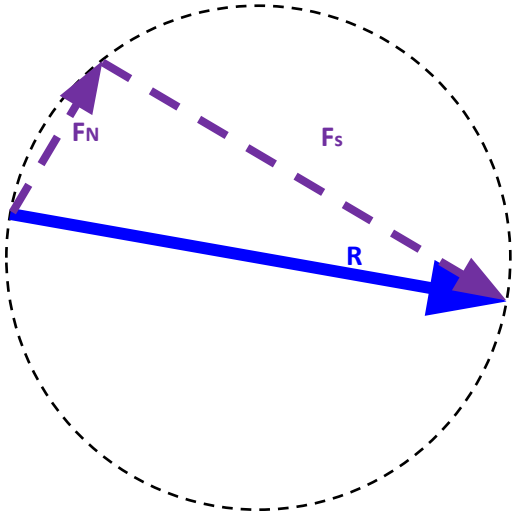
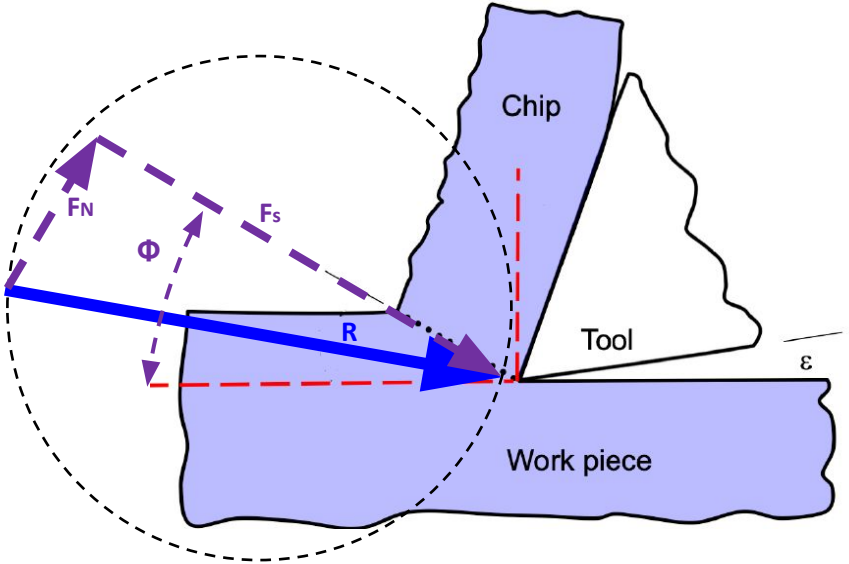
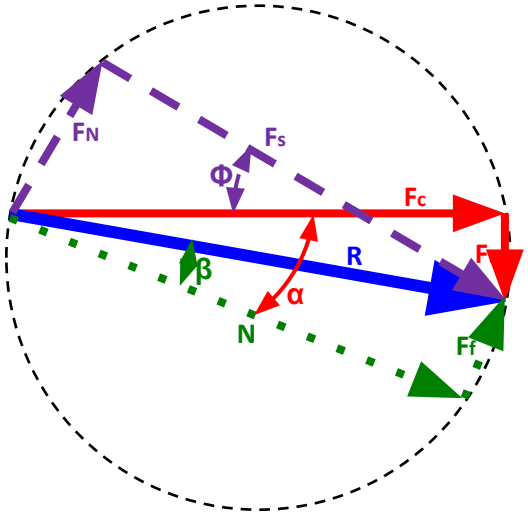
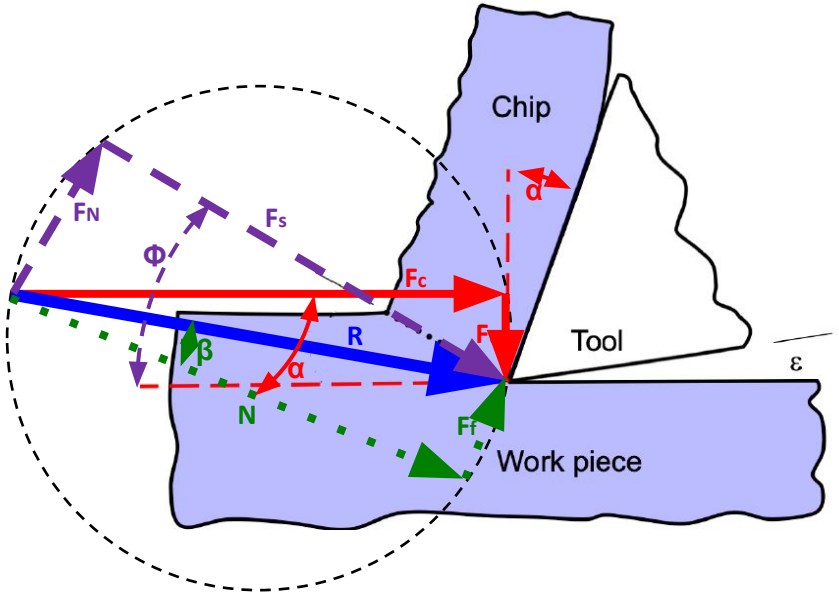




Merchant's Diagram

- All Forces shown together





Problem 1 - Injection Molding

Your injection molding machine has a fixed maximum injection pressure. If you are producing two parts of equivalent volume, a _____ (small, thick part / large, thin part) has the greatest risk of a short-shot defect.

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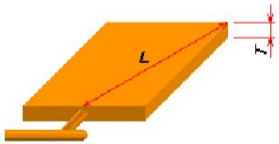
Flow Path Ratio = L/T



Rule of thumb

Polyethylene (PE)	L/T = 280-100
Polypropylene (PP)	L/T = 280-150
Polyvinyl chloride (PVC)	L/T = 280-70
Polystyrene (PS)	L/T = 300-220
Polycarbonate (PC)	L/T = 160-90
Acrylonitrile butadienstylene (ABS)	L/T = 280-120
Polyamide (PA)	L/T = 320-200

Problem 1 - Injection Molding

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Clamp force is the amount of force, (tonnage in english units) required to keep the mold closed

F_clamp = A_proj * P_injection

What is viscosity? Does a high or low viscosity translate to a high or low injection pressure?

Problem 1 - Injection Molding

The packing pressure is usually _____ (higher/lower) than the injection pressure.

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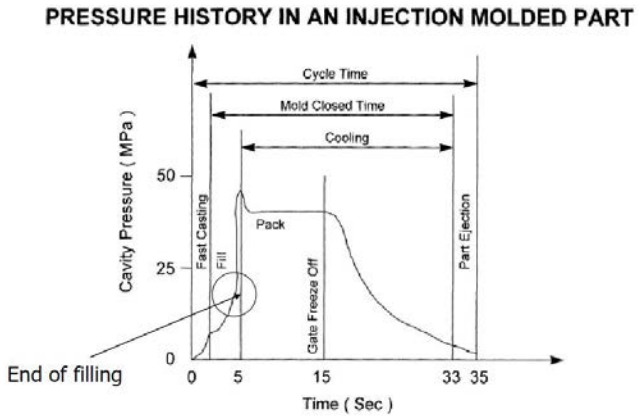
The packing pressure is usually _____ (higher/lower) than the injection pressure.

What happens as a molten plastic part cools in a mold? How might we compensate for that with our process parameter?



Problem 1 - Thermoforming

Draft angles are needed on both thermoformed and injection molded parts. True / False

What does a draft angle assist with? Is this a common need for both processes?

Problem 1 - Cutting

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If you double the spindle speed (while holding all other parameters the same), the cutting force _____ (stays the same / doubles)

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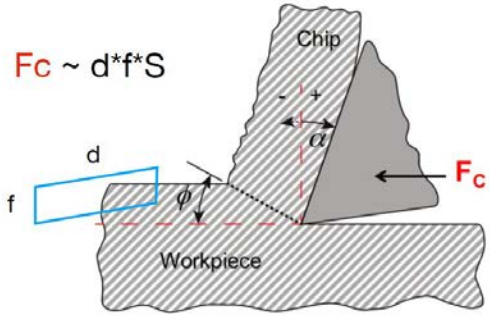
simplified estimate of cutting force on a lathe

d: depth of cut (in)
f: feed (in/rev)
S: shear strength (Pa or psi)

Material	UTS* (MPa)
Wax	0.86
Aluminum	110
Aluminum 6061-T6	310
Steel (high strength alloy) ASTM A-514	760
Titanium alloys	900

*UTS = Ultimate Tensile Strength
Shear strength ~0.5*UTS



Question to ask yourself: How does this change the amount of material removed?

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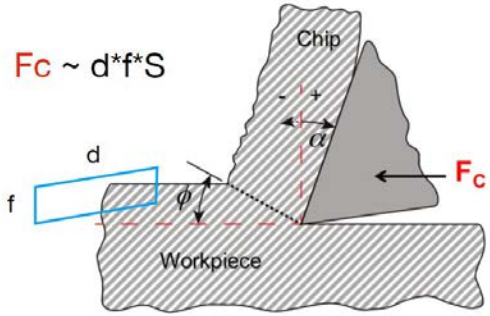

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A major assumption to simplify the geometry for analysis is _____ (orthogonal/oblique) cutting.

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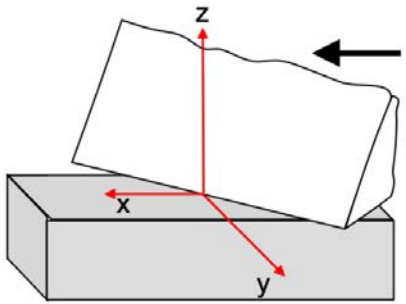
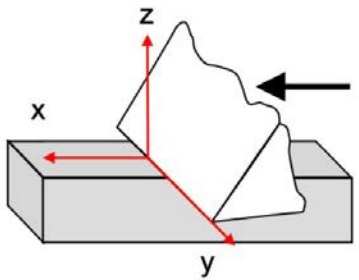


Oblique (3D)



Orthogonal (2D)

Problem 1 - Cutting

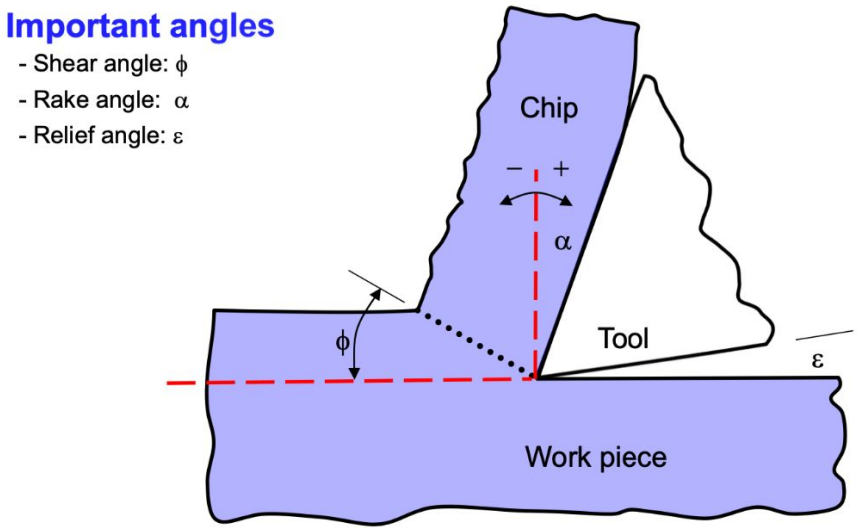
You can have a negative rake angle.
True / False

Problem 1 - Cutting

You can have a negative rake angle.

True / False

Rake angle is the angle between the tool and a reference plane that is normal to the applied cutting force



Problem 1 - Cutting

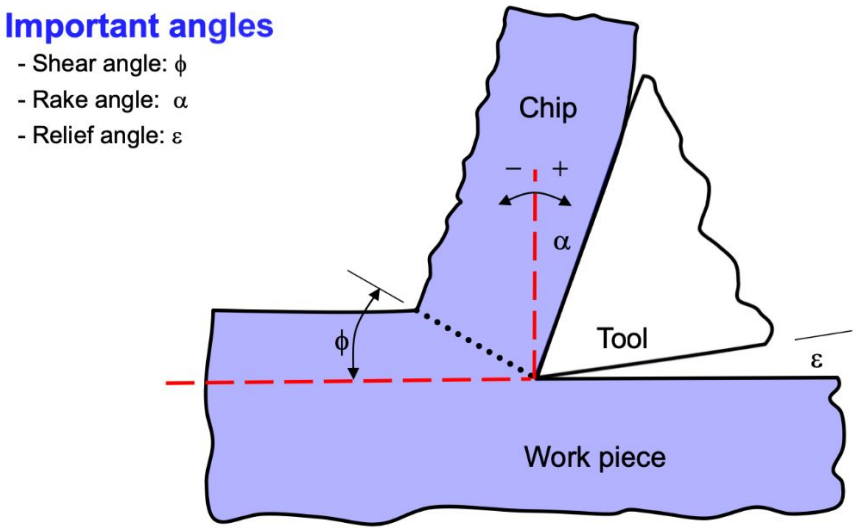
When the shear angle increases, the shear strain _____ (increases / decreases).

Problem 1 - Cutting

Shear angle is the angle between the workpiece and a shear plane

$$\gamma = \cot\varphi + \tan(\varphi - \alpha)$$

When the shear angle increases, the shear strain _____ (increases / decreases).



Problem 1 - Variation/Quality Control

If you set the tolerance of a shaft/stem diameter as 0.50” +/- 0.01”, it is the ____ (UCL / USL).

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Control limit = what the process is capable of achieving

Specification limit = desires of the designer

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According to the central limit theorem, _____ (more/less) samples increase the precision of the estimate of the average.

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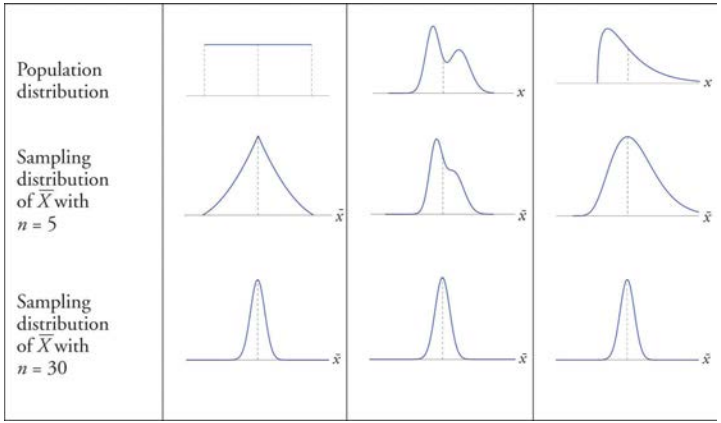
Central Limit Theorem: If random samples of size n are selected from a distribution,the distribution of sample means approach a normal distribution as sample size increases.



*Even if you don't remember what CLT is, you know that more samples, i.e., more data is good

Problem 1 - Variation/Quality Control

As the subgroup size decreases, the UCL and LCL move _____ (closer/further) to the center line, making the control chart ____ (more/less) sensitive to shifts in the mean.

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2.008 Design and Manufacturing II

Spring 2025