Understanding SOHCAHTOA - Trigonometry Notes

SOHCAHTOA is a helpful mnemonic for remembering how to use sine, cosine, and tangent in right triangle trigonometry. Each letter stands for a part of a formula that relates the angles and sides of a right triangle.

S – Sine = Opposite / Hypotenuse

Use sine when you know (or want to find) the side opposite the angle and the hypotenuse.

Formula: $\sin(\theta)$ = opposite / hypotenuse

C – Cosine = Adjacent / Hypotenuse

Use cosine when you know (or want to find) the side adjacent to the angle and the hypotenuse.

Formula: $\cos(\theta)$ = adjacent / hypotenuse

T – Tangent = Opposite / Adjacent

Use tangent when you know (or want to find) the side opposite the angle and the side adjacent to the angle.

Formula: $\tan(\theta)$ = opposite / adjacent

When to Use Each Function:

- Use **sine** when the angle and the opposite/hypotenuse are involved.
- Use **cosine** when the angle and the adjacent/hypotenuse are involved.
- Use **tangent** when the angle and the opposite/adjacent are involved

Example – Sine:

A CNC machine arm raises at a 40° angle. The distance from the pivot to the end of the arm (hypotenuse) is 12 inches. How high (opposite side) is the arm lifted?

Solution:

$\sin(40°)$ = opposite / 12

opposite = $12 \times \sin(40°) \approx 7.71$ inches

Example – Cosine:

A part is mounted at a 30° angle in a fixture. The fixture arm is 10 inches long (hypotenuse). How far horizontally (adjacent side) does it extend?

Solution:

$\cos(30°)$ = adjacent / 10

adjacent = $10 \times \cos(30°) \approx 8.66$ inches

Example – Tangent:

A CNC tool path moves up 3 inches vertically while going forward 6 inches. What is the angle of the toolpath relative to the base (X-axis)?

Solution:

$\tan(\theta)$ = 3 / 6

$\theta = \tan^{-1}(3 / 6) \approx 26.57°$