

TILTING HEAD HYDRAULIC ACTUATION

ANGLE VERSUS STROKE

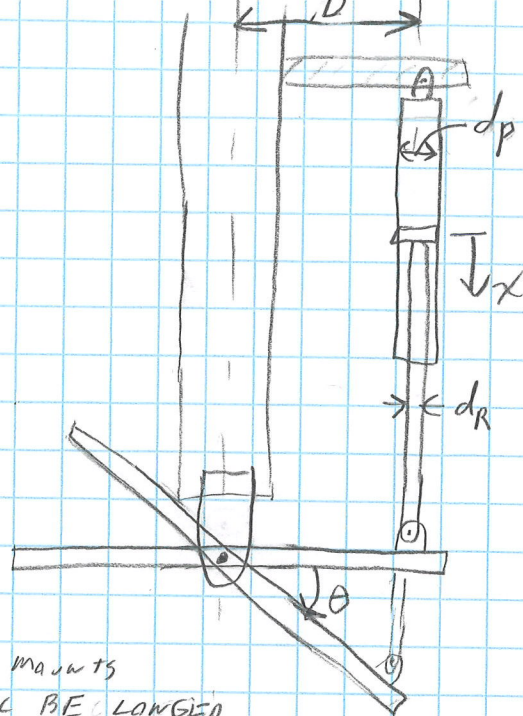
$$\theta \approx \text{ATAN}\left[\frac{x}{D}\right] \Leftrightarrow x = D \tan(\theta)$$

EXAMPLE: FOR RAM 6" OFF CENTERLINE, AND $\pm 30^\circ$ OF TILT.

$$\text{TOTAL STROKE} = 2x = 2(6") \tan(30^\circ)$$

$$\text{TOTAL STROKE} \approx 7"$$

RAM WITH MOUNTS
AND ALL WILL BE LONGER,
SAY 12-14"



ANGLE RATE VERSUS RAM RATE

$$\dot{\theta} = \frac{1}{D} \dot{x} \quad \left. \vphantom{\dot{\theta} = \frac{1}{D} \dot{x}} \right\} \text{AT } x=0, \text{ CLOSE FOR HIGHER ANGLES.}$$

$$\dot{x} = D \dot{\theta}$$

EXAMPLE: FOR 30°/s w/ RAM 6" OFF CENTERLINE,
 $\dot{x} \approx 3.1 \text{ in/s} = \text{RAM-RATE}$

OIL FLOW RATE REQUIREMENTS

- THIS DEPENDS ON RAM SIZE,

$$\text{PISTON SIDE AREA} = A_p = \pi d_p^2 / 4$$

$$\text{ROD SIDE AREA} = A_r = \frac{\pi}{4} (d_p^2 - d_r^2)$$

$$Q = A_p \dot{x} \quad \text{EXAMPLE, } 7/8" \text{ PISTON AND } 3/8" \text{ ROD, AT } 30^\circ/\text{SEC}$$

$$Q = \frac{\pi (1")^2}{4} \cdot 3.1 \frac{\text{in}}{\text{s}} = 2.5 \frac{\text{in}^3}{\text{s}} = 0.5 \text{ GPM} \quad \left. \vphantom{Q = \frac{\pi (1")^2}{4} \cdot 3.1 \frac{\text{in}}{\text{s}}} \right\} \text{PER DAF}$$

FORCE / TORQUE @ 2000 psi ACROSS PISTON [3000 psi SYSTEM AT MAX RATE]
7/8" PISTON, 3/8" ROD

$$\text{EXTEND} \rightarrow F_F = 2500 \text{ psi} \cdot A_p - 500 \text{ psi} \cdot A_r = 1260 \text{ lbs} \rightarrow \text{TORQUE} = 630 \text{ ft-lbs}$$

$$\text{RETRACT} \rightarrow F_R = 500 \text{ psi} \cdot A_p - 2500 \text{ psi} \cdot A_r = -930 \text{ lbs} \rightarrow \text{TORQUE} = -465 \text{ ft-lbs}$$