Feed Bin Slide Gate Force Calculation

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$$P_v = \frac{P_g A}{K \mu C}\left[1 - \exp\left(-\frac{\mu K C}{A}\cdot h\right)\right] \quad (1)$$

(Jassen Equation)

→ Using 15 ft diameter bins, filled to top w/ slide gate closed

$P_{feed} = 40\ lb/ft^3$

$g = 32.2\ ft/s^2$

$D = 15\ ft$

$\mu = \tan(\alpha)$

$\mu = \tan(60°) = 1.73$

$C = \pi(15\ ft) = 47.1\ ft$

$A = \frac{\pi}{4}(15\ ft)^2$

~~$= 147$~~ $= 176.71\ ft^2$

$K = 0.4$ (assumption)

$$P_v = \frac{(40\ lb/ft^3)(176.71\ ft^2)/32.2\ ft/s^2)}{(0.4)(1.73)(47.1\ ft)}\left[1 - \exp\frac{-(1.73)(0.4)(47.1\ ft)}{(176.71\ ft^2}(18.5 ft)\right]$$

$$= (6983.1\ lbs)[0.967]/32.2\ ft/s^2$$

$$P_v = 210\ lbs$$

$$P_{vf} = P_v\left(\frac{x}{h_h}\right)^n + \frac{\gamma h_h}{n-1}\left[\left(\frac{x}{h_h}\right) - \left(\frac{x}{h_h}\right)^n\right] \quad (2)$$

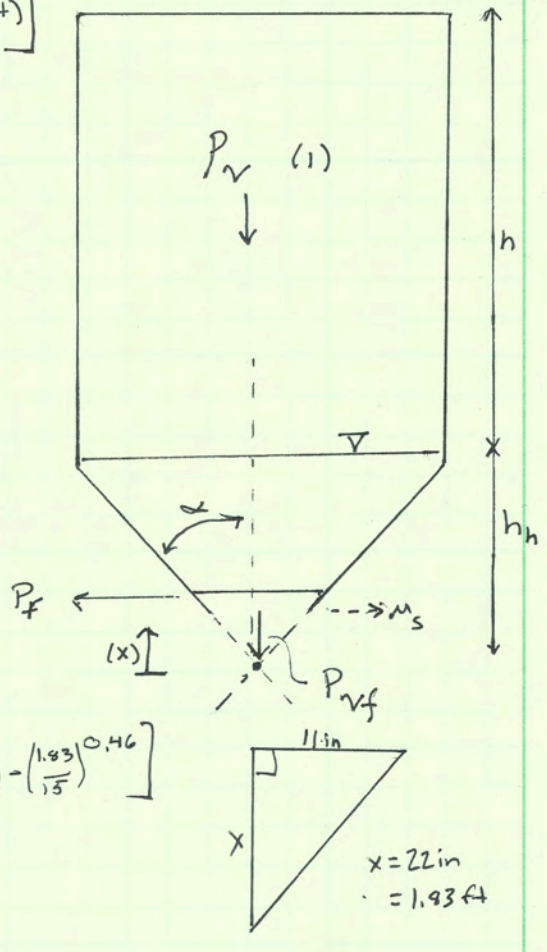
$n = 2a\mu_h \cot(\alpha)$

$= 2(0.8)(\mu = 0.5)(\cot(60°))$

$= 0.46$

$h_h = 15\ ft$

$x = 1.83\ ft$



$$P_{vf} = (210\ lbs)\left(\frac{1.83\ ft}{15\ ft}\right)^{0.46} + \frac{(40\ lb/ft^3)/32.2\ ft/s^2)(15\ ft)}{(0.46-1)}\left[\left(\frac{1.83}{15}\right) - \left(\frac{1.83}{15}\right)^{0.46}\right]$$

$$P_{vf} = \frac{9{,}308\ lbs}{32.2\ ft/s^2}$$

$P_{vf} = 289\ lbs$

$P_f = \mu_s(P_{vf})$ (3) $\quad \mu_s = 0.5$ (per Bahnasawy, 2011)

$= 0.5(289\ lbs)$

$P_f = 145\ lbs$ on slide