

Force Distribution Along Height Analysis

Rules Sheet

Rules

;note: all values per unit length becuae this is analysis along height

;Pressure at height h due to weight of gravel

$$P = \gamma \cdot h$$

;Value of total equivalent force acting on box

$$F_{\text{totperlength}} = \frac{P \cdot h}{2}$$

;Sectioning height along three parts and determining height for optimal support location

;Section 1

;equivalent force for section

$$F1 = \frac{\gamma \cdot h1^2}{2}$$

;Moment for equivalent force

$$M = F1 \cdot (1/3 \cdot h1)$$

;Section 2

;length

$$x2 = h - h1$$

;Equivalent force

;uniform portion

$$F2_u = x2 \cdot h1 \cdot \gamma$$

;Variable portion

$$F2_v = \frac{x2^2 \cdot \gamma}{2}$$

$$F2 = F2_v + F2_u$$

;Moment

$$M2_u = \frac{F2_u \cdot x2}{2}$$

$$M2_v = \frac{F2_v \cdot x2 \cdot 2}{3}$$

;Find horizontal component of reaction force

$$F_{\text{support1}} = \frac{F2_u \cdot \left[\frac{x2}{2} \right] + F2_v \cdot \left[\frac{x2}{3} \right] + F1 \cdot \left[x2 + \frac{h1}{3} \right]}{x2}$$

$$F_{\text{support2}} = F1 + F2 - F_{\text{support1}}$$

Rules

;Constraints

$$F1 = \frac{F2}{2}$$

Variables Sheet

Input	Name	Output	Unit	Comment
	P	4.0488		Maximum pressure along height (lbf/in^2)
.0723	γ			Specific weight of gravel (lbf/in^3)
56	h			Height (in)
	F_totperlength	113.3664		Total equivalent Force along length (lbf/in)
	F1	37.7888		Equivalent force in section 1 (lbf/in)
	h1	32.331615		Height from bottom to section 1 (in)
	F2	75.5776		Equivalent Force in section 2 (lbf/in)
	x2	23.668385		Length of section 2 (in)
	F2_u	55.326643		Equivalent force due to uniform distributed load in section 2 (lbf/in)
	F2_v	20.250957		Equivalent force due to variable distributed load in section 2 (lbf/in)
	M2_u	654.746143		Moment due to uniform distributed load (lbf-in/in)
	M2_v	319.538295		Moment due to variable distributed load (lbf-in/in)
	F_support1	89.409261		Horizontal force at Support 1 (lbf/in)
	F_support2	23.957139		Horizontal force at Support 2 (lbf/in)