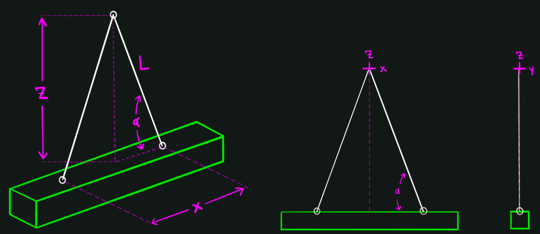
STL

RIGGING · QUICK REFERENCE 01

Static Pick Analysis - Sling Tension & Angle

Leg tension for symmetric 2- and 4-sling picks from static equilibrium. Load Weight (W) · Pick Spacing X (x) · Pick Spacing Y (y) · Sling Length (L) · Hook Height (z) · Horizontal Reach (r) · Sling Tension (T) · Sling Angle X-Z (φ) · Sling Angle Y-Z (θ) · Sling Angle X-Y (α) · X Axis Force (F_x) · Y Axis Force (F_y)

2-SLING PICK



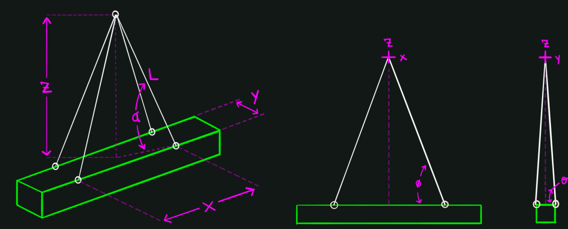
$$T = (W / 2) / \sin \alpha$$

$z = \sqrt{L^2 - (x/2)^2}$ $\tan \alpha = z / (x/2)$

$F_x = T \cdot \cos \alpha$ $F_y = 0$

Both slings lie in the x-z plane, so α sits between the x-axis and the sling (L). In the y-z view the sling is vertical, no angle to the y-axis.

4-SLING PICK



$$T = (W / 4) / \sin \alpha$$

$r = \sqrt{(x/2)^2 + (y/2)^2}$ $z = \sqrt{L^2 - r^2}$

$\tan \varphi = z / (x/2)$ $\tan \theta = z / (y/2)$

$\tan \alpha = z / r$ $\cot \alpha = \sqrt{\cot^2 \varphi + \cot^2 \theta}$

$F_x = T \cdot (x/2) / L$ $F_y = T \cdot (y/2) / L$

For a symmetric, rigid load with equal geometry and assumed equal load sharing, each of four legs is analyzed as W/4.

2-SLING VS 4-SLING

A 2-sling pick is flat geometry: both slings sit in one vertical plane through the member, so the single angle α between the x-axis and the sling describes the whole rig, and each leg carries half the load. A 4-sling pick is skewed in both directions: each sling leans away from the x-axis (φ) and the y-axis (θ) at the same time, and the working angle α between the x-y plane and the sling combines the two, so it is always flatter than either view suggests. Do not assume four-leg load sharing is perfectly equal unless the load and rigging system are sufficiently rigid and the load-sharing assumption is justified.

WORKED EXAMPLE 1: 2-SLING PICK

Given: W = 10,000 lb, x = 10 ft, L = 10 ft

1. $z = \sqrt{10^2 - 5^2} = 8.66$ ft
2. $\tan \alpha = 8.66 / 5 \rightarrow \alpha = 60.0°$
3. $T = (10{,}000 / 2) / \sin 60.0° = 5{,}774$ lb
4. $F_x = 5{,}774 \times \cos 60.0° = 2{,}887$ lb, $F_y = 0$

WORKED EXAMPLE 2: 4-SLING PICK, Y = 3 FT

Given: W = 10,000 lb, x = 10 ft, y = 3 ft, L = 10 ft

1. $r = \sqrt{5^2 + 1.5^2} = 5.22$ ft, $z = \sqrt{10^2 - 5.22^2} = 8.53$ ft
2. $\tan \alpha = 8.53 / 5.22 \rightarrow \alpha = 58.5°$ (φ = 59.6°, θ = 80.0°)
3. $T = (10{,}000 / 4) / \sin 58.5° = 2{,}931$ lb
4. $F_x = 2{,}931 \times (5 / 10) = 1{,}466$ lb, $F_y = 2{,}931 \times (1.5 / 10) = 440$ lb

Compare: two of the four equal-share sling legs have a combined tension of 5,862 lb, compared with 5,774 lb in one leg of the 2-sling pick. The 3 ft y-spacing flattens α from 60.0° to 58.5°, increasing the tension in each leg despite having twice as many legs sharing the load.

TENSION FACTOR 1 / SIN A

ANGLE A	SIN A	FACTOR
90° (max - vertical)	1.000	1.00
60° (rule of thumb)	0.866	1.15
45° (increased tension)	0.707	1.41
30° (high tension)	0.500	2.00

For 2-sling pick at 30-deg, each leg carries the full load W

FIELD NOTES

- **Keep sling angles ≥ 60°.** Tension grows as 1/sin α, so shallow angles spike both leg tension and the crushing force on the member.
- **Hook over the CG.** An offset hook skews the leg angles and the load sharing.
- **Static values only.** No dynamic amplification, shock, or safety factor is included; fast picks and swinging push real tension higher.
- **Then size the hardware.** Wire rope / sling SWL ≥ T and shackle WLL ≥ T, at a 5:1 design factor (confirm with rigging manufacturer or similar).
- **Longer slings.** A longer sling raises the sling angle and lowers leg tension.