Beam & Post Check — What Each Number Means

This page explains the symbols, units, and pass/check logic used in your deck screening calculator.

Quick Glossary

Units

Area Load psf

Pounds per square foot on deck surface (DL, SL, LL).

Line Load plf

Pounds per linear foot along the beam (w).

Force lb

Shear/reactions (V, R) and axial loads (P).

Stress psi

Pounds per square inch (f_b, f_v, bearing).

Moment lb·in

Bending moment (M).

Deflection in

Mid-span displacement (Δ), compared to L/ratio.

1) Surface Load → Line Load

Convert deck surface loads (psf) into a uniform load on the beam (plf).

```
q = DL + SL + LL [psf]
w = q × tributary_width [plf]
```

Symbol	Meaning	Example values
DL	Dead load (materials), psf	`3.75 psf`
SL	Snow load, psf	`40 psf`

Symbol	Meaning	Example values
LL	Live load (people/furniture), psf	0–40 psf (project dependent)
q	Total area load	43.75 psf
tributary_width	Deck width feeding this beam	4.75 ft
w	Uniform line load on beam	207.8 plf

2) Shear & Reactions

Support reactions and maximum shear from uniform load.

$$V_{max} = (w \times L) / 2 \ [lb]$$

L	Beam span (ft)
V_{max}	Max shear = reaction per support (lb)
R	Reaction per post (lb) = V_{max}

This is the vertical force that the beam delivers into each post/connector.

3) Bending Check

PASS if $f_b \le Fb'$

$$M_{max} = (w_{lb/in} \times L_{in}^2) / 8 \ [lb \cdot in]$$
$$S = (b \times d^2) / 6 \ [in^3]$$
$$f_b = M_{max} / S \ [psi]$$

Symbol	Meaning	Example values
b, d	Beam width & depth (in)	b = 3.5 in, d = 9.25 in
S	Section modulus	≈ 49.8 in³
M_{max}	Maximum bending moment	computed from w & L
f_b	Bending stress	252 psi
Fb′	Allowable bending stress	725 psi

Status = PASS if 252 ≤ 725 ; Utilization = 252/725 ≈ 0.35 (35%).

4) Shear Check

PASS if $f_v \le F_v'$

$$f_v = (1.5 \times V_{max}) / (b \times d) \text{ [psi]}$$

Symbol	Meaning	Example values
V_{max}	Max shear / reaction	from Step 2 (lb)
$b \times d$	Beam cross-section area	in^2
f_v	Shear stress	e.g., 70 psi
F_v'	Allowable shear stress	e.g., 135 psi

Status = PASS if 70 ≤ 135. Shear concentrates near supports and is max at the neutral axis.

5) Bearing at Beam–Post Seat

PASS if $f_{bearing} \le F_{c\perp}'$

$$f_{bearing} = R / A_{bearing} \text{ [psi]}$$

Symbol	Meaning	Example values
R	Reaction per post	= V_{max} (lb)
$A_{bearing}$	Contact area at seat	in^2
$F_{c\perp}'$	Allowable compression ⊥ grain	psi

This makes sure the beam end doesn't crush where it sits on the post or hanger.

6) Deflection

PASS if Δ ≤ L / ratio

$$\Delta = [5 \times w_{lb/in} \times L_{in}^4] / (384 \times E \times I) \text{ [in]}$$
$$I = (b \times d^3) / 12 \text{ [in}^4\text{]}$$

Symbol	Meaning	Example values
E	Modulus of elasticity	psi (species/grade-dependent)
I	Moment of inertia	in^4 (from b, d)

Symbol	Meaning	Example values
Δ	Mid-span deflection	e.g., 0.21 in
L/ratio	Limit (comfort/finish)	e.g., L/240 = 0.38 in

Serviceability check to control bounce/sag. Uses stiffness (E·I), not strength.

7) Post (Column) Axial Capacity

PASS if R ≤ P allow

Checks the post's ability to carry vertical load with slenderness effects.

$$A = b \times d \ [in^2], \quad r = \sqrt{(I/A)}, \quad (I = b \times d^3 / 12)$$
$$\text{slenderness} = Le / r \ [-]$$
$$P_{crit} \approx (\pi^2 \times E \times A) / (\text{slenderness}^2) \ [lb]$$
$$P_{allow} = \min(Fc' \times A, 0.3 \times P_{crit}) \ [lb]$$

Symbol	Meaning	Example values
Fc′	Allowable compression ∥ grain	psi
Le	Unsupported height	in
R	Reaction per post (demand)	lb (from Step 2)
P_{allow}	Allowable axial per post	reported in Results

Result appears as "Allowable axial per post (lb)" in your Results summary.

8) Connectors (Top & Base)

Demands come from reactions, wind, and geometry. Compared to published connector capacities.

Top: download = R; uplift = roof_uplift_psf × area; lateral ≈ w_{lat} × span / 2;
moment = lateral × arm
Base: shear ≈ lateral; uplift per base as applicable

Check	Demand	Capacity	Status
Download	lb	allowable lb	PASS
Uplift	lb	allowable lb	PASS
Lateral	lb	allowable lb	PASS

Check	Demand	Capacity	Status
Moment (top)	lb·in	allowable lb·in	PASS

Your spreadsheet auto-selects/validates models and prints PASS/CHECK with utilization.

9) Footing (Per Post)

Ensures the soil/footing can support vertical, sliding, and uplift demands.

$$\text{Bearing: } q_{actual} = V_{struct} / A_{ftg} \le q_{allow}/SF$$

$$\text{Sliding: } H \le (\mu \times V_{eff})/SF$$

$$\text{Uplift: } U \le (W_{footing} + W_{overburden} + \text{credit})/SF$$

Item	Demand	Capacity	Status
Bearing (psf)	q_{actual}	$q_{allow,eff}$	PASS
Sliding (lb)	H	R_{slide}	PASS
Uplift (lb)	U	R_{uplift}	PASS

How to Read Your Results Summary

- `Line load w (plf)`: The uniform load along the beam. Drives moment & shear.
- `Reaction per post (lb)`: The vertical demand delivered into each post.
- `Bending/Shear/Bearing (psi)`: Computed stresses. **PASS** if ≤ their allowables (Fb′, Fv′, Fc⊥′).
- `Deflection Δ (in)`: Serviceability. **PASS** if ≤ L/ratio.
- `Allowable axial per post (lb)`: Column capacity with slenderness. **PASS** if R ≤ this value.
- `Connectors/Footing`: Each shows Demand vs Capacity with PASS/CHECK.

If any item shows CHECK, adjust size/species/spacing, add bracing, or revise loading as appropriate.