Important Roof Live Loads Formulas PDF

Formulas
Examples
with Units

List of 48
Important Roof Live Loads Formulas

1) Roof Live Load Formula

Evaluate Formula

Formula

$$L_f = 20 \cdot R_1 \cdot R_2$$

Example with Units

$$18.18\,\text{N} = 20 \cdot 1.01 \cdot 0.90$$

2) Roof Live Load when Tributary Area Les in Range 200 to 600 square feet Formula

Evaluate Formula

Formula

$$L_f = 20 \cdot \left(1.2 - 0.001 \cdot A_t\right) \cdot R_2$$

Example with Units

$$17.9498\,\text{N} = 20 \cdot \left(1.2 - 0.001 \cdot 2182.782\,\text{ft}^2\right) \cdot 0.90$$

3) Tributary Area given Roof Live Load Formula

Evaluate Formula

Formula

$$A_t = 1000 \cdot \left(1.2 - \left(\frac{L_f}{20 \cdot R_2}\right)\right)$$

Example with Units

$$2092.9826\,\text{ft}^2 = 1000 \cdot \left(1.2 - \left(\frac{18.1\,\text{N}}{20 \cdot 0.90}\right)\right)$$

4) Seismic Loads Formulas

4.1) Building Height for other Buildings given Fundamental Period Formula

Evaluate Formula

Formula

$$h_n = \left(\frac{T}{0.02}\right)^{\frac{4}{3}}$$

Example with Units

$$56.9128\,\text{ft} = \left(\frac{0.170\,\text{s}}{0.02}\right)^{\frac{4}{3}}$$

4.2) Building Height for Reinforced Concrete Frames given Fundamental Period Formula

Evaluate Formula

Formula

$$h_n = \left(\frac{T}{0.03}\right)^{\frac{4}{3}}$$

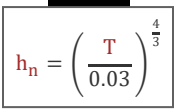
Example with Units

$$33.1453\,\text{ft} = \left(\frac{0.170\,\text{s}}{0.03}\right)^{\frac{4}{3}}$$

4.3) Building Height for Steel Eccentrically Braced Frames given Fundamental Period Formula

Evaluate Formula

Formula



$$h_n = \left(\frac{T}{0.03}\right)^{\frac{4}{3}}$$

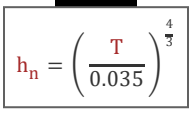
Example with Units

$$33.1453\,\text{ft} = \left(\frac{0.170\,\text{s}}{0.03}\right)^{\frac{4}{3}}$$

4.4) Building Height for Steel Frame given Fundamental Period Formula

Evaluate Formula

Formula



$$h_n = \left(\frac{T}{0.035}\right)^{\frac{4}{3}}$$

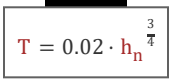
Example with Units

$$26.9873\,\text{ft} = \left(\frac{0.170\,\text{s}}{0.035}\right)^{\frac{4}{3}}$$

4.5) Fundamental Period for other Buildings Formula

Evaluate Formula

Formula



$$T = 0.02 \cdot h_n^{\frac{3}{4}}$$

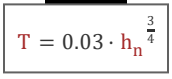
Example with Units

$$0.1104\,\text{s} = 0.02 \cdot 32\,\text{ft}^{\frac{3}{4}}$$

4.6) Fundamental Period for Reinforced Concrete Frames Formula

Evaluate Formula

Formula



$$T = 0.03 \cdot h_n^{\frac{3}{4}}$$

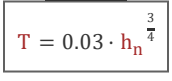
Example with Units

$$0.1656\,\text{s} = 0.03 \cdot 32\,\text{ft}^{\frac{3}{4}}$$

4.7) Fundamental Period for Steel Eccentrically Braced Frames Formula

Evaluate Formula

Formula



$$T = 0.03 \cdot h_n^{\frac{3}{4}}$$

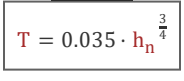
Example with Units

$$0.1656\,\text{s} = 0.03 \cdot 32\,\text{ft}^{\frac{3}{4}}$$

4.8) Fundamental Period for Steel Frames Formula

Evaluate Formula

Formula



$$T = 0.035 \cdot h_n^{\frac{3}{4}}$$

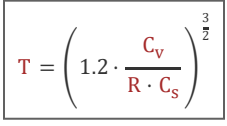
Example with Units

$$0.1932\,\text{s} = 0.035 \cdot 32\,\text{ft}^{\frac{3}{4}}$$

4.9) Fundamental Period given Seismic Response Coefficient Formula

Evaluate Formula

Formula



$$T = \left(1.2 \cdot \frac{C_v}{R \cdot C_s}\right)^{\frac{3}{2}}$$

Example with Units

$$0.1714\,\text{s} = \left(1.2 \cdot \frac{0.54}{6 \cdot 0.35}\right)^{\frac{3}{2}}$$

4.10) Lateral Force Formula

Evaluate Formula

Formula

$$V = \frac{F_x}{C_{ux}}$$

Example with Units

$$8.3827\,\text{kipf} = \frac{44000\,\text{N}}{1.18}$$

4.11) Lateral Seismic Force Formula

Evaluate Formula

Formula

$$F_x = C_{ux} \cdot V$$

Example with Units

$$44090.7727\,\text{N} = 1.18 \cdot 8.40\,\text{kipf}$$

4.12) Response Modification Factor Formula

Evaluate Formula

Formula

$$R = 1.2 \cdot \frac{C_v}{C_s \cdot T^{\frac{2}{3}}}$$

Example with Units

$$6.0331 = 1.2 \cdot \frac{0.54}{0.35 \cdot 0.170\,\text{s}^{\frac{2}{3}}}$$

4.13) Response Modification Factor by Velocity Dependent Structures Formula

Evaluate Formula

Formula

$$R = 2.5 \cdot \frac{C_a}{C_s}$$

Example

$$10.7143 = 2.5 \cdot \frac{1.5}{0.35}$$

4.14) Seismic Coefficient for Short Period Structures Formula

Evaluate Formula

Formula

$$C_v = \frac{C_s \cdot \left(R \cdot T^{\frac{2}{3}}\right)}{1.2}$$

Example with Units

$$0.537 = \frac{0.35 \cdot \left(6 \cdot 0.170\,\text{s}^{\frac{2}{3}}\right)}{1.2}$$

4.15) Seismic Coefficient for Velocity Dependent Structures Formula

Evaluate Formula

Formula

$$C_a = C_s \cdot \frac{R}{2.5}$$

Example

$$0.84 = 0.35 \cdot \frac{6}{2.5}$$

4.16) Seismic Response Coefficient given Base Shear Formula

Evaluate Formula

Formula

$$C_s = \frac{V}{W}$$

Example with Units

$$0.35 = \frac{8.40\,\text{kipf}}{106.75\,\text{kN}}$$

4.17) Seismic Response Coefficient given Fundamental Period Formula

Evaluate Formula

Formula

$$C_s = 1.2 \cdot \frac{C_v}{R \cdot T^{\frac{2}{3}}}$$

Example with Units

$$0.3519 = 1.2 \cdot \frac{0.54}{6 \cdot 0.170\,\text{s}^{\frac{2}{3}}}$$

4.18) Seismic Response Coefficient given Seismic Coefficient for Velocity Dependent Structures Formula

Evaluate Formula

Formula

$$C_s = 2.5 \cdot \frac{C_a}{R}$$

Example

$$0.625 = 2.5 \cdot \frac{1.5}{6}$$

4.19) Total Dead Load given Base Shear Formula

Evaluate Formula

Formula

$$W = \frac{V}{C_s}$$

Example with Units

$$106.7573\,\text{kN} = \frac{8.40\,\text{kipf}}{0.35}$$

4.20) Total Lateral Force Acting in Direction of each of Principal Axis Formula

Evaluate Formula

Formula

$$V = C_s \cdot W$$

Example with Units

$$8.3994\,\text{kipf} = 0.35 \cdot 106.75\,\text{kN}$$

4.21) Vertical Distribution Factor given Lateral Force Formula

Evaluate Formula

Formula

$$C_{ux} = \frac{F_x}{V}$$

Example with Units

$$1.1776 = \frac{44000\,\text{N}}{8.40\,\text{kipf}}$$

5) Snow Loads Formulas

5.1) Ground Snow Load given Roof Snow Load Formula

Evaluate Formula

Formula

$$P_g = \frac{P_f}{0.7 \cdot C_e \cdot C_t \cdot I}$$

Example with Units

$$22.137\,\text{psf} = \frac{12\,\text{psf}}{0.7 \cdot 0.80 \cdot 1.21 \cdot 0.8}$$

5.2) Ground Snow Load using Roof Type Formula

Evaluate Formula

Formula

$$P_g = \frac{P_f}{C \cdot I}$$

Example with Units

$$5\,\text{psf} = \frac{12\,\text{psf}}{3 \cdot 0.8}$$

5.3) Importance Factor for End Use using Roof Snow Load Formula

Evaluate Formula

Formula

$$I = \frac{P_f}{0.7 \cdot C_e \cdot C_t \cdot P_g}$$

Example with Units

$$0.9839 = \frac{12\,\text{psf}}{0.7 \cdot 0.80 \cdot 1.21 \cdot 18\,\text{psf}}$$

5.4) Importance Factor using Roof Type Formula

Evaluate Formula

Formula

$$I = \frac{P_f}{C \cdot P_g}$$

Example with Units

$$0.2222 = \frac{12\,\text{psf}}{3 \cdot 18\,\text{psf}}$$

5.5) Roof Snow Load Formula

Evaluate Formula

Formula

$$P_f = 0.7 \cdot C_e \cdot C_t \cdot I \cdot P_g$$

Example with Units

$$9.7574\,\text{psf} = 0.7 \cdot 0.80 \cdot 1.21 \cdot 0.8 \cdot 18\,\text{psf}$$

5.6) Roof Snow Load given Roof Type Formula

Evaluate Formula

Formula

$$P_f = I \cdot C \cdot P_g$$

Example with Units

$$43.2\,\text{psf} = 0.8 \cdot 3 \cdot 18\,\text{psf}$$

5.7) Thermal Effects factor given Roof Snow Load Formula

Evaluate Formula

Formula

$$C_t = \frac{P_f}{0.7 \cdot C_e \cdot I \cdot P_g}$$

Example with Units

$$1.4881 = \frac{12\,\text{psf}}{0.7 \cdot 0.80 \cdot 0.8 \cdot 18\,\text{psf}}$$

5.8) Wind Exposure Factor given Roof Snow Load Formula

Evaluate Formula

Formula

$$C_e = \frac{P_f}{0.7 \cdot C_t \cdot I \cdot P_g}$$

Example with Units

$$0.9839 = \frac{12\,\text{psf}}{0.7 \cdot 1.21 \cdot 0.8 \cdot 18\,\text{psf}}$$

6) Wind Loads Formulas

6.1) Basic Wind given Velocity Pressure Formula

Evaluate Formula

Formula

$$V_B = \sqrt{\frac{q}{0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot I}}$$

Example with Units

$$29.6107\,\text{m/s} = \sqrt{\frac{20\,\text{pdl/ft}^2}{0.00256 \cdot 0.85 \cdot 25 \cdot 0.78 \cdot 0.8}}$$

6.2) Equivalent Static Design Wind Pressure Formula

Evaluate Formula

Formula

$$p = q \cdot G \cdot C_p$$

Example with Units

$$14.88\,\text{pdl/ft}^2 = 20\,\text{pdl/ft}^2 \cdot 1.20 \cdot 0.62$$

6.3) External Pressure Coefficient as given by ASCE 7 Formula

Evaluate Formula

Formula

$$C_{ep} = \frac{p + q_i \cdot GC_{pt}}{G \cdot q}$$

Example with Units

$$1.1887 = \frac{14.88\,\text{pdl/ft}^2 + 15\,\text{pdl/ft}^2 \cdot 0.91}{1.20 \cdot 20\,\text{pdl/ft}^2}$$

6.4) Gust Effect Factor as given by ASCE 7 Formula

Evaluate Formula

Formula

$$G = \frac{p + q_i \cdot GC_{pt}}{q \cdot C_{ep}}$$

Example with Units

$$1.5016 = \frac{14.88\,\text{pdl/ft}^2 + 15\,\text{pdl/ft}^2 \cdot 0.91}{20\,\text{pdl/ft}^2 \cdot 0.95}$$

6.5) Gust Response Factor using Wind Pressure Formula

Evaluate Formula

Formula

$$G = \frac{p}{q \cdot C_p}$$

Example with Units

$$1.2 = \frac{14.88\,\text{pdl/ft}^2}{20\,\text{pdl/ft}^2 \cdot 0.62}$$

6.6) Importance Factor given Velocity Pressure Formula

Evaluate Formula

Formula

$$I = \frac{q}{0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V_B^{\,2}}$$

Example with Units

$$0.8 = \frac{20\,\text{pdl/ft}^2}{0.00256 \cdot 0.85 \cdot 25 \cdot 0.78 \cdot 29.6107\,\text{m/s}^{\,2}}$$

6.7) Importance Factor using Velocity Pressure Formula

Evaluate Formula

Formula

$$I = \frac{q}{0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V_B^{\,2}}$$

Example with Units

$$0.8 = \frac{20\,\text{pdl/ft}^2}{0.00256 \cdot 0.85 \cdot 25 \cdot 0.78 \cdot 29.6107\,\text{m/s}^{\,2}}$$

6.8) Internal Pressure Coefficient as given by ASCE 7 Formula

Evaluate Formula

Formula

$$GC_{pt} = \frac{\left(q \cdot G \cdot C_{ep}\right) - p}{q_i}$$

Example with Units

$$0.528 = \frac{\left(20\,\text{pdl/ft}^2 \cdot 1.20 \cdot 0.95\right) - 14.88\,\text{pdl/ft}^2}{15\,\text{pdl/ft}^2}$$

6.9) Pressure Coefficient using Wind Pressure Formula

Evaluate Formula

Formula

$$C_p = \frac{p}{q \cdot G}$$

Example with Units

$$0.62 = \frac{14.88\,\text{pdl/ft}^2}{20\,\text{pdl/ft}^2 \cdot 1.20}$$

6.10) Topographic Factor given Velocity Pressure Formula

Evaluate Formula

Formula

$$K_{zt} = \frac{q}{0.00256 \cdot K_z \cdot I \cdot K_d \cdot V_B^{\,2}}$$

Example with Units

$$25 = \frac{20\,\text{pdl/ft}^2}{0.00256 \cdot 0.85 \cdot 0.8 \cdot 0.78 \cdot 29.6107\,\text{m/s}^{2}}$$

6.11) Velocity Pressure Formula

Evaluate Formula

Formula

$$q = 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot \left(V_B^{\,2}\right) \cdot I$$

Example with Units

$$20\,\text{pdl/ft}^2 = 0.00256 \cdot 0.85 \cdot 25 \cdot 0.78 \cdot \left(29.6107\,\text{m/s}^{2}\right) \cdot 0.8$$

6.12) Velocity Pressure as given by ASCE 7 Formula

Evaluate Formula

Formula

$$q = \frac{p + q_i \cdot GC_{pt}}{G \cdot C_{ep}}$$

Example with Units

$$25.0263\,\text{pdl/ft}^2 = \frac{14.88\,\text{pdl/ft}^2 + 15\,\text{pdl/ft}^2 \cdot 0.91}{1.20 \cdot 0.95}$$

6.13) Velocity Pressure at given Point as given by ASCE 7 Formula

Evaluate Formula

Formula

$$q_i = \frac{\left(q \cdot G \cdot C_{ep}\right) - p}{GC_{pt}}$$

Example with Units

$$8.7033\,\text{pdl/ft}^2 = \frac{\left(20\,\text{pdl/ft}^2 \cdot 1.20 \cdot 0.95\right) - 14.88\,\text{pdl/ft}^2}{0.91}$$

6.14) Velocity Pressure using Wind Pressure Formula

Evaluate Formula

Formula

$$q = \frac{p}{G \cdot C_p}$$

Example with Units

$$20\,\text{pdl/ft}^2 = \frac{14.88\,\text{pdl/ft}^2}{1.20 \cdot 0.62}$$

6.15) Wind Directionality Factor given Velocity Pressure Formula

Evaluate Formula

Formula

$$K_d = \frac{q}{0.00256 \cdot K_z \cdot K_{zt} \cdot I \cdot V_B^{\,2}}$$

Example with Units

$$0.78 = \frac{20\,\text{pdl/ft}^2}{0.00256 \cdot 0.85 \cdot 25 \cdot 0.8 \cdot 29.6107\,\text{m/s}^{2}}$$

6.16) Wind Pressure as given by ASCE 7 Formula

Evaluate Formula

Formula

$$p = q \cdot G \cdot C_{ep} - q_i \cdot GC_{pt}$$

Example with Units

$$9.15\,\text{pdl/ft}^2 = 20\,\text{pdl/ft}^2 \cdot 1.20 \cdot 0.95 - 15\,\text{pdl/ft}^2 \cdot 0.91$$

Variables used in list of Roof Live Loads Formulas above

- A_t Tributary Area *(Square Foot)*
- **C** Roof Type
- C_a Seismic Coefficient for Velocity Dependent
- C_e Wind Exposure Factor
- C_{ep} External Pressure Coefficient
- C_p Pressure Coefficient
- C_s Seismic Response Coefficient
- C_t Thermal Effects Factor
- C_{ux} Vertical Distribution Factor
- C_v Seismic Coefficient for Short Period Structures
- F_x Lateral Seismic Force *(Newton)*
- **G** Gust Response Factor
- GC_{pt} Internal Pressure Coefficient
- h_n Height of Building *(Foot)*
- **I** Importance Factor for End Use
- K_d Wind Directionality Factor
- K_z Velocity Exposure Coefficient
- K_{zt} Topographic Factor
- L_f Roof Live Load *(Newton)*
- **p** Wind Pressure *(Poundal per Square Foot)*
- P_f Roof Snow Load *(Pounds per Square Foot)*
- P_g Ground Snow Load *(Pounds per Square Foot)*
- **q** Velocity Pressure *(Poundal per Square Foot)*
- q_i Velocity Pressure at Point *(Poundal per Square Foot)*
- **R** Response Modification Factor
- R_1 Reduction Factor for Size of Tributary Area
- R_2 Reduction Factor for Slope of Roof
- **T** Fundamental Period *(Second)*
- **V** Lateral Force *(Kilopound-Force)*
- V_B Basic Wind Speed *(Meter per Second)*

Constants, Functions, Measurements used in list of Roof Live Loads Formulas above

- Functions: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Foot (ft)
  Length Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Area** in Square Foot (ft²)
  Area Unit Conversion
- Measurement: **Pressure** in Pounds per Square Foot (psf), Poundal per Square Foot (pdl/ft²)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Force** in Newton (N), Kilopound-Force (kipf), Kilonewton (kN)
  Force Unit Conversion

- **W** Total Dead Load *(Kilonewton)*

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