__Important Notice__

The design specifications for Pole Base[TM] units suggest earth embedment depths with certain assumed conditions. The earth embedments were calculated using the assumed material properties and loading conditions described in the Design Resource Manual. These will vary from location to location depending upon the soil properties and terrain. Since soil conditions and topography vary greatly from site to site, a detailed engineering analysis must be performed for each Pole Base[TM] installation.

Because Pole Base[TM] does not manufacture nor install these units, it does not assume any responsibility regarding structural suitability of its products for any particular project. In addition, Pole Base[TM] assumes no responsibility in connection with any injury, death, or property damage claim whatsoever whether asserted against a Leasee, Leasor, Purchaser or others, arising out of or attributable to the operation of or produced with Pole Base[TM] equipment.

Pole Base^{TM} – Foundation Design Guide

Analysis Methods:

- This Guide was prepared for preliminary estimating and conceptual purposes only. All information is believed to be true and accurate; however, Pole Base^{TM} assumes no responsibility for the use of this design guide for actual construction. Determination of the suitability of each chart is the sole responsibility of the user. Final designs for construction purposes must be performed by a licensed Professional Engineer, using the actual conditions of the site.
- The foundation design guide for embedment of the round concrete poles is based upon the provisions described in the American Association of State Highway and Transportation Officials (AASHTO) publication: Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals, 6th Edition, 2013 (LTS-6), Washington, DC.

Wind Loading Assumptions:

- The wind loading on the fixtures, poles, and bases is based upon Section 3.8 – Wind Load
- The Basic Wind Speed Section 3.8.2. Assumed wind speed 90 mph (40 m/s).
- The following factors and assumptions were used in the creation of the guide. These factors will need to be analyzed and verified by the Licensed Professional Engineer of the project:
  - Wind Importance Factor, I_r = 1.00 (Section 3.8.3)
  - Velocity Conversion Factor, C_v = 1.00 (Table 3.8.3-3)
  - Height and Exposure Factor, Pole & Fixture K_z = 1.00; Base K_z = 0.86 (Section 3.8.4)
  - Gust Effect Factor, G=1.14 (Section 3.8.5)
  - Drad Coefficients, C_d: (Table 3.8.6-1)
    - Light Fixture, C_d=1.2
    - Light Pole, 6" square, C_d=1.875; 6" round, C_d= 0.915
    - Pole Base (40" tall), 24" square, C_d=1.75; 24" round, C_d= 0.45

Foundation Design Assumptions:

- The formulas for the earth embedment depth are based upon Section 13: Foundation Design.
- The following factors and assumptions were used in the creation of the guide. These factors will need to be analyzed and verified by the Licensed Professional Engineer of the project:
  - Dense backfill around the base: 2000 psi concrete, Well compacted clean sand, or (CLSM).
  - Minimum earth embedment of Pole Base^{TM} units is at least: the calculated value, 3'-0" (0.9 m), or the depth of local frost penetration.
  - Overload Factor = 2.5; Undercapacity Factor = 0.7 (Section C13.6.1.1)
  - Embedment Length in Granular Soil, Equation (C13.6.1.1-3)
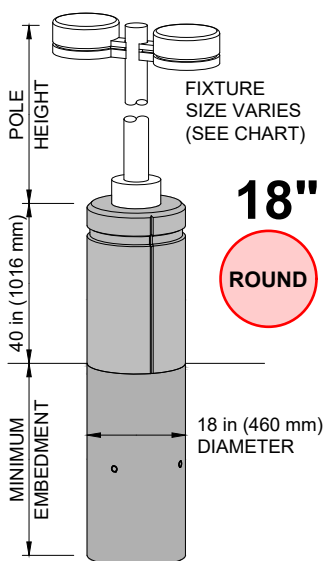 - Embedment Length in Cohesive Soil, Equation (C13.6.1.1-7)

MINIMUM EMBEDMENT GUIDE

18 in (460 mm) DIAMETER ROUND POLE BASE UNITS [1]   **6 in (150 mm) DIAMETER ROUND LIGHT POLE**

	POLE HEIGHT	SIGN OR FIXTURE AREA			
		2 ft² (0.186 m²)	**4 ft² (0.372 m²)**	**6 ft² (0.557 m²)**	**8 ft² (0.743 m²)**
MINIMUM EMBEDMENT	**BASES IN GRAVEL SOILS (GW, GP)** [2] [7]				
	15' (4.6 m)	3'-6" (1.1 m)	4'-0" (1.2 m)	4'-0" (1.2 m)	4'-6" (1.4 m)
	20' (6.1 m)	4'-0" (1.2 m)	4'-6" (1.4 m)	4'-6" (1.4 m)	5'-0" (1.5 m)
	25' (7.6 m)	4'-6" (1.4 m)	5'-0" (1.5 m)	5'-0" (1.5 m)	5'-6" (1.7 m)
	30' (9.1 m)	5'-0" (1.5 m)	5'-0" (1.5 m)	5'-6" (1.7 m)	6'-0" (1.8 m)
	35' (10.7 m)	5'-6" (1.7 m)	5'-6" (1.7 m)	6'-0" (1.8 m)	6'-0" (1.8 m)
	BASES IN SANDY SOILS (SW, SP, SM, SC, GM, GC) [3] [7]				
	15' (4.6 m)	4'-0" (1.2 m)	4'-0" (1.2 m)	4'-6" (1.4 m)	4'-6" (1.4 m)
	20' (6.1 m)	4'-6" (1.4 m)	4'-6" (1.4 m)	5'-0" (1.5 m)	5'-6" (1.7 m)
	25' (7.6 m)	5'-0" (1.5 m)	5'-0" (1.5 m)	5'-6" (1.7 m)	6'-0" (1.8 m)
	30' (9.1 m)	5'-6" (1.7 m)	5'-6" (1.7 m)	6'-0" (1.8 m)	6'-6" (2.0 m)
	35' (10.7 m)	6'-0" (1.8 m)	6'-0" (1.8 m)	6'-6" (2.0 m)	7'-0" (2.1 m)
	BASES IN CLAYEY SOILS (CL, ML, CH, MH) [4] [7]				
	15' (4.6 m)	6'-6" (2.0 m)	7'-0" (2.1 m)	7'-6" (2.3 m)	8'-0" (2.4 m)
	20' (6.1 m)	7'-0" (2.1 m)	8'-0" (2.4 m)	8'-6" (2.6 m)	9'-0" (2.7 m)
	25' (7.6 m)	8'-0" (2.4 m)	9'-0" (2.7 m)	9'-6" (2.9 m)	10'-0" (3.0 m)
	30' (9.1 m)	9'-0" (2.7 m)	10'-0" (3.0 m)	10'-6" (3.2 m)	11'-0" (3.4 m)
	35' (10.7 m)	10'-0" (3.0 m)	11'-0" (3.4 m)	11'-6" (3.5 m)	12'-0" (3.6 m)

		UNFACTORED SHEAR FORCE / OVERTURNING MOMENT [5] [6]			
DESIGN FORCES	15' (4.6 m)	240 lb (1.07 kN)	290 lb (1.29 kN)	340 lb (1.51 kN)	390 lb (1.74 kN)
		2,553 lb * ft (3.46 kN * m)	3,474 lb * ft (4.71 kN * m)	4,395 lb * ft (5.96 kN * m)	5,316 lb * ft (7.21 kN * m)
	20' (6.1 m)	300 lb (1.33 kN)	353 lb (1.57 kN)	406 lb (1.81 kN)	459 lb (2.04 kN)
		3,996 lb * ft (5.42 kN * m)	5,229 lb * ft (7.09 kN * m)	6,462 lb * ft (8.76 kN * m)	7,695 lb * ft (10.43 kN * m)
	25' (7.6 m)	363 lb (1.62 kN)	418 lb (1.86 kN)	473 lb (2.11 kN)	528 lb (2.35 kN)
		5,790 * ft (7.85 kN * m)	7,350 lb * ft (9.97 kN * m)	8,910 lb * ft (12.08 kN * m)	10,470 lb * ft (14.20 kN * m)
	30' (9.1 m)	429 lb (1.91 kN)	485 lb (2.16 kN)	542 lb (2.41 kN)	600 lb (2.67 kN)
		7,948 lb * ft (10.78 kN * m)	9,847 lb * ft (13.35 kN * m)	11,747 lb * ft (15.93 kN * m)	13,646 lb * ft (18.50 kN * m)
	35' (10.7 m)	496 lb (2.21 kN)	555 lb (2.47 kN)	613 lb (2.73 kN)	672 lb (2.99 kN)
		10,481 lb * ft (14.21 kN * m)	12,730 lb * ft (17.26 kN * m)	14,979 lb * ft (20.31 kN * m)	17,229 lb * ft (23.36 kN * m)

FIXTURE SIZE VARIES (SEE CHART)

18"

ROUND

POLE HEIGHT

40 in (1016 mm)

MINIMUM EMBEDMENT

18 in (460 mm) DIAMETER

Design Reference: *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, 6th Edition, 2013 (LTS-6).

[1] Calculations have been run for a 18" (460 mm) diameter round base 3'-4" (1016 mm) above grade with a 18" (460 mm) diameter bury portion in the soil.

[2] Assumed ϕ = 34°, γ = 130 lb/ft³ (2080 kg/m³), c = 0 lb/ft² (0 kPa).

[3] Assumed ϕ = 30°, γ = 120 lb/ft³ (1920 kg/m³), c = 0 lb/ft² (0 kPa).

[4] Assumed ϕ = 10°, γ = 130 lb/ft³ (2080 kg/m³), c = 250 lb/ft² (12.0 kPa).

[5] Calculations run with the following factors and assumptions:

Exposure Condition C	Drag Coefficient (Fixture), $C_{d\ fixture}$ = 1.2
Basic Wind Speed, V = 90 mph (40m/s)	Drag Coefficient (Pole), $C_{d\ pole}$ = 0.915
Importance Factor, I_r = 1.0	Drag Coefficient (Base), $C_{d\ base}$ = 0.45
Velocity Conversion Factor, C_v = 1.00	Height and Exposure Factor (Pole and Fixture), $K_{z\ pole}$ = 1.00
Gust Factor, G = 1.14	Height and Exposure Factor (Base), $K_{z\ base}$ = 0.86
Overload Factor = 2.5	Undercapacity Factor = 0.7

[6] Calculations assume a double light fixture with the total surface area of both fixtures equal to the value shown in the chart. Unbalanced loading from a single offset fixture is not included in this preliminary guide, and must be addressed in final design calculations if planned for use.

[7] Minimum recommended embedment shall be the calculated value, depth of local frost penetration, or 3'-0" (0.9 m), whichever is greater.

This preliminary guide was prepared by Pole Base for estimating and conceptual purposes only. All information is believed to be true and accurage; however, Pole Base assumes no responsibility for the use of these preliminary guides for actual construction. Determination of the suitability of each recommendation is the sole responsibility of the User. Final designs for construction must be performed by a licensed Professional Engineer using the actual conditions of the site. *(Rev. May 12, 2021)*

MINIMUM EMBEDMENT GUIDE

24 in (610 mm) DIAMETER ROUND POLE BASE™ UNITS [1]　　　　　　　　**6 in (150 mm) DIAMETER ROUND LIGHT POLE**

<div style="font-weight:bold">MINIMUM EMBEDMENT</div>

POLE HEIGHT	SIGN OR FIXTURE AREA			
	2 ft² (0.186 m²)	4 ft² (0.372 m²)	6 ft² (0.557 m²)	8 ft² (0.743 m²)
BASES IN GRAVEL SOILS (GW, GP) [2] [7]				
15' (4.6 m)	3'-0" (0.9 m)	3'-6" (1.1 m)	3'-6" (1.1 m)	4'-0" (1.2 m)
20' (6.1 m)	3'-6" (1.1 m)	4'-0" (1.2 m)	4'-0" (1.2 m)	4'-6" (1.4 m)
25' (7.6 m)	4'-0" (1.2 m)	4'-6" (1.4 m)	4'-6" (1.4 m)	5'-0" (1.5 m)
30' (9.1 m)	4'-6" (1.4 m)	4'-6" (1.4 m)	5'-0" (1.5 m)	5'-6" (1.7 m)
35' (10.7 m)	5'-0" (1.5 m)	5'-6" (1.7 m)	5'-6" (1.7 m)	5'-6" (1.7 m)
BASES IN SANDY SOILS (SW, SP, SM, SC, GM, GC) [3] [7]				
15' (4.6 m)	3'-6" (1.1 m)	4'-0" (1.2 m)	4'-0" (1.2 m)	4'-6" (1.4 m)
20' (6.1 m)	4'-0" (1.2 m)	4'-6" (1.4 m)	4'-6" (1.4 m)	5'-0" (1.5 m)
25' (7.6 m)	4'-6" (1.4 m)	4'-6" (1.4 m)	5'-0" (1.5 m)	5'-6" (1.7 m)
30' (9.1 m)	5'-0" (1.5 m)	5'-0" (1.5 m)	5'-6" (1.7 m)	5'-6" (1.7 m)
35' (10.7 m)	5'-6" (1.7 m)	5'-6" (1.7 m)	6'-0" (1.8 m)	6'-0" (1.8 m)
BASES IN CLAYEY SOILS (CL, ML, CH, MH) [4] [7]				
15' (4.6 m)	6'-6" (2.0 m)	7'-0" (2.1 m)	7'-6" (2.3 m)	8'-0" (2.4 m)
20' (6.1 m)	7'-6" (2.3 m)	8'-0" (2.4 m)	8'-6" (2.6 m)	9'-0" (2.7 m)
25' (7.6 m)	8'-0" (2.4 m)	9'-0" (2.7 m)	9'-6" (2.9 m)	10'-0" (3.0 m)
30' (9.1 m)	9'-0" (2.7 m)	9'-6" (2.9 m)	10'-0" (3.0 m)	10'-6" (3.2 m)
35' (10.7 m)	10'-0" (3.0 m)	10'-6" (3.2 m)	11'-0" (3.4 m)	11'-6" (3.5 m)

<div style="font-weight:bold">DESIGN FORCES</div>

UNFACTORED SHEAR FORCE / OVERTURNING MOMENT [5] [6]				
15' (4.6 m)	255 lb (1.14 kN)	305 lb (1.37 kN)	355 lb (1.59 kN)	406 lb (1.82 kN)
	2,579 lb * ft (3.50 kN * m)	3,500 lb * ft (4.75 kN * m)	4,421 lb * ft (5.99 kN * m)	5,342 lb * ft (7.24 kN * m)
20' (6.1 m)	315 lb (1.41 kN)	368 lb (1.65 kN)	421 lb (1.89 kN)	474 lb (2.12 kN)
	4,022 lb * ft (5.45 kN * m)	5,255 lb * ft (7.12 kN * m)	6,488 lb * ft (8.80 kN * m)	7,722 lb * ft (10.47 kN * m)
25' (7.6 m)	379 lb (1.70 kN)	434 lb (1.94 kN)	489 lb (2.19 kN)	544 lb (2.44 kN)
	5,816 * ft (7.89 kN * m)	7,376 lb * ft (10.00 kN * m)	8,936 lb * ft (12.12 kN * m)	10,497 lb * ft (14.23 kN * m)
30' (9.1 m)	444 lb (1.99 kN)	501 lb (2.24 kN)	558 lb (2.50 kN)	615 lb (2.76 kN)
	7,975 lb * ft (10.81 kN * m)	9,874 lb * ft (13.39 kN * m)	11,773 lb * ft (15.96 kN * m)	13,672 lb * ft (18.54 kN * m)
35' (10.7 m)	511 lb (2.29 kN)	570 lb (2.55 kN)	629 lb (2.82 kN)	687 lb (3.08 kN)
	10,507 lb * ft (14.25 kN * m)	12,757 lb * ft (17.30 kN * m)	15,006 lb * ft (20.34 kN * m)	17,255 lb * ft (23.40 kN * m)
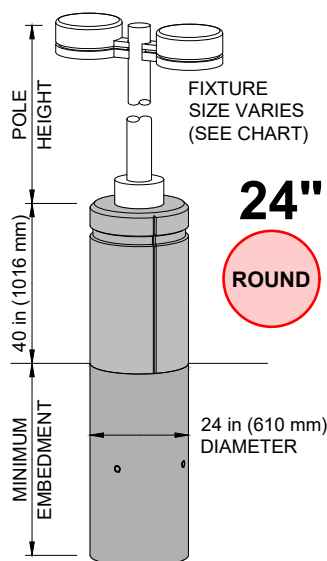
Design Reference: *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, 6th Edition, 2013 (LTS-6).

[1] Calculations have been run for a 24" (610 mm) diameter round base 3'-4" (1016 mm) above grade with a 24" (610 mm) diameter bury portion in the soil.

[2] Assumed $\phi = 34°$, $\gamma = 130$ lb/ft³ (2080 kg/m³), c = 0 lb/ft² (0 kPa).

[3] Assumed $\phi = 30°$, $\gamma = 120$ lb/ft³ (1920 kg/m³), c = 0 lb/ft² (0 kPa).

[4] Assumed $\phi = 10°$, $\gamma = 130$ lb/ft³ (2080 kg/m³), c = 250 lb/ft² (12.0 kPa).

[5] Calculations run with the following factors and assumptions:

Exposure Condition C	Drag Coefficient (Fixture), $C_{d\ fixture} = 1.2$
Basic Wind Speed, V = 90 mph (40m/s)	Drag Coefficient (Pole), $C_{d\ pole} = 0.915$
Importance Factor, $I_r = 1.0$	Drag Coefficient (Base), $C_{d\ base} = 0.45$
Velocity Conversion Factor, $C_v = 1.00$	Height and Exposure Factor (Pole and Fixture), $K_{z\ pole} = 1.00$
Gust Factor, G = 1.14	Height and Exposure Factor (Base), $K_{z\ base} = 0.86$
Overload Factor = 2.5	Undercapacity Factor = 0.7

[6] Calculations assume a double light fixture with the total surface area of both fixtures equal to the value shown in the chart. Unbalanced loading from a single offset fixture is not included in this preliminary guide, and must be addressed in final design calculations if planned for use.

[7] Minimum recommended embedment shall be the calculated value, depth of local frost penetration, or 3'-0" (0.9 m), whichever is greater.

This preliminary guide was prepared by Pole Base™ for estimating and conceptual purposes only. All information is believed to be true and accurage; however, Pole Base™ assumes no responsibility for the use of these preliminary guides for actual construction. Determination of the suitability of each recommendation is the sole responsibility of the User. Final designs for construction must be performed by a licensed Professional Engineer using the actual conditions of the site. *(Rev. 5SEP2014)*
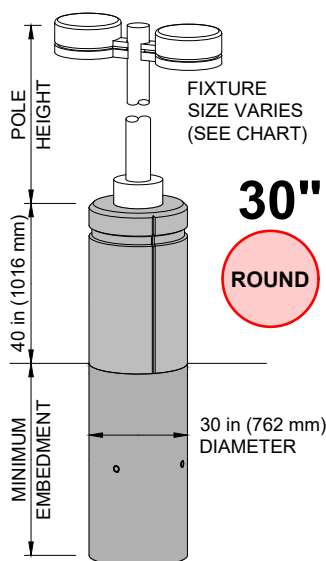
POLE HEIGHT

FIXTURE SIZE VARIES (SEE CHART)

40 in (1016 mm)

24"

ROUND

MINIMUM EMBEDMENT

24 in (610 mm) DIAMETER

MINIMUM EMBEDMENT GUIDE

30 in (762 mm) DIAMETER ROUND POLE BASE UNITS [1]   **6 in (150 mm) DIAMETER ROUND LIGHT POLE**

<table>
<tr><th rowspan="2">POLE HEIGHT ft'</th><th colspan="4">SIGN OR FIXTURE AREA</th></tr>
<tr><th>2 ft² (0.186 m²)</th><th>4 ft² (0.372 m²)</th><th>6 ft² (0.557 m²)</th><th>8 ft² (0.743 m²)</th></tr>
<tr><td colspan="5">BASES IN GRAVEL SOILS (GW, GP) [2] [7]</td></tr>
<tr><td>15' (4.6 m)</td><td>3'-0" (.91 m)</td><td>3'-6" (1.1 m)</td><td>3'-6" (1.1 m)</td><td>3'-6" (1.1 m)</td></tr>
<tr><td>20' (6.1 m)</td><td>3'-6 (1.1 m)</td><td>3'-6" (1.1 m)</td><td>4'-0" (1.2 m)</td><td>4'-0" (1.2 m)</td></tr>
<tr><td>25' (7.6 m)</td><td>4'-0" (1.2 m)</td><td>4'-0" (1.2 m)</td><td>4'-6" (1.4 m)</td><td>4'-6" (1.4 m)</td></tr>
<tr><td>30' (9.1 m)</td><td>4'-0" (1.2 m)</td><td>4'-6" (1.4 m)</td><td>4'-6" (1.4 m)</td><td>5'-0" (1.5 m)</td></tr>
<tr><td>35' (10.7 m)</td><td>4'-6" (1.4 m)</td><td>5'-0" (1.5 m)</td><td>5'-0" (1.5 m)</td><td>5'-6" (1.7 m)</td></tr>
<tr><td colspan="5">BASES IN SANDY SOILS (SW, SP, SM, SC, GM, GC) [3] [7]</td></tr>
<tr><td>15' (4.6 m)</td><td>3'-0" (.91 m)</td><td>3'-6" (1.1 m)</td><td>4'-0" (1.2 m)</td><td>4'-0" (1.2 m)</td></tr>
<tr><td>20' (6.1 m)</td><td>3'-6" (1.1 m)</td><td>4'-0" (1.2 m)</td><td>4'-6" (1.4 m)</td><td>4'-6" (1.4 m)</td></tr>
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<tr><td>35' (10.7 m)</td><td>5'-0" (1.5 m)</td><td>5'-0" (1.5 m)</td><td>5'-6" (1.7 m)</td><td>6'-0" (1.9 m)</td></tr>
<tr><td colspan="5">BASES IN CLAYEY SOILS (CL, ML, CH, MH) [4] [7]</td></tr>
<tr><td>15' (4.6 m)</td><td>7'-0" (2.1 m)</td><td>7'-6" (2.3 m)</td><td>8'-0" (2.4 m)</td><td>8'-6" (2.6 m)</td></tr>
<tr><td>20' (6.1 m)</td><td>8'-0" (2.4 m)</td><td>8'-6" (2.6 m)</td><td>8'-6" (2.6 m)</td><td>9'-0" (2.7 m)</td></tr>
<tr><td>25' (7.6 m)</td><td>8'-6" (2.6 m)</td><td>9'-0" (2.7 m)</td><td>9'-6" (2.9 m)</td><td>10'-0" (3.0 m)</td></tr>
<tr><td>30' (9.1 m)</td><td>9'-0" (2.7 m)</td><td>9'-6" (2.9 m)</td><td>10'-0" (3.0 m)</td><td>10'-6" (3.2 m)</td></tr>
<tr><td>35' (10.7 m)</td><td>10'-0" (3.0 m)</td><td>10'-6" (3.2 m)</td><td>11'-0" (3.4 m)</td><td>11-6" (3.5 m)</td></tr>
</table>

MINIMUM EMBEDMENT (row label, left side)

<table>
<tr><th colspan="5">UNFACTORED SHEAR FORCE / OVERTURNING MOMENT [5] [6]</th></tr>
<tr><td>15' (4.6 m)</td><td>270 lb (1.20 kN)
2,604 lb*ft (3.53 kN*m)</td><td>320 lb (1.42 kN)
3,525 lb*ft (4.78 kN*m)</td><td>371 lb (1.65 kN)
4,447 lb*ft (6.03 kN*m)</td><td>420 lb (1.87 kN)
5,368 lb*ft (7.28 kN*m)</td></tr>
<tr><td>20' (6.1 m)</td><td>331 lb (1.47 kN)
4,047 lb*ft (5.49 kN*m)</td><td>384 lb (1.71 kN)
5,281 lb*ft (7.16 kN*m)</td><td>436 lb (1.94 kN)
6,514 lb*ft (8.83 kN*m)</td><td>489 lb (2.18 kN)
7,747 lb*ft (10.50 kN*m)</td></tr>
<tr><td>25' (7.6 m)</td><td>394 lb (1.75 kN)
5,842 *ft (7.92 kN*m)</td><td>449 lb (2.00 kN)
7,402 lb*ft (10.04 kN*m)</td><td>504 lb (2.24 kN)
8,962 lb*ft (12.15 kN*m)</td><td>559 lb (2.49 kN)
10,522 lb*ft (14.27 kN*m)</td></tr>
<tr><td>30' (9.1 m)</td><td>459 lb 2.04 kN)
8,000 lb*ft (10.85 kN*m)</td><td>516 lb (2.30 kN)
9,899 lb*ft (13.42 kN*m)</td><td>573 lb (2.55 kN)
11,799 lb*ft (16.00 kN*m)</td><td>630 lb (2.80 kN)
13,698 lb*ft (18.57 kN*m)</td></tr>
<tr><td>35' (10.7 m)</td><td>527 lb (2.34 kN)
10,533 lb*ft (14.28 kN*m)</td><td>585 lb (2.60 kN)
12,782 lb*ft (17.33 kN*m)</td><td>644 lb (2.86 kN)
15,031 lb*ft (20.38 kN*m)</td><td>703 lb (3.13 kN)
17,281 lb*ft (23.43 kN*m)</td></tr>
</table>

DESIGN FORCES (row label, left side)

POLE HEIGHT

FIXTURE SIZE VARIES (SEE CHART)

40 in (1016 mm)

MINIMUM EMBEDMENT

30" ROUND

30 in (762 mm) DIAMETER

Design Reference: *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, 6th Edition, 2013 (LTS-6).

[1] Calculations have been run for a 30 in (762 mm) diameter round base 40 in (1016 mm) above grade with a 30 in (762 mm) diameter bury portion in the soil.

[2] Assumed $\phi = 34°$, $\gamma = 130$ lb/ft³ (2080 kg/m³), c = 0 lb/ft² (0 kPa).

[3] Assumed $\phi = 30°$, $\gamma = 120$ lb/ft³ (1920 kg/m³), c = 0 lb/ft² (0 kPa).

[4] Assumed $\phi = 10°$, $\gamma = 130$ lb/ft³ (2080 kg/m³), c = 250 lb/ft² (12.0 kPa).

[5] Calculations run with the following factors and assumptions:

Exposure Condition C	Drag Coefficient (Fixture), $C_{d\ fixture} = 1.2$
Basic Wind Speed, V = 90 mph (40m/s)	Drag Coefficient (Pole), $C_{d\ pole} = 0.915$
Importance Factor, $I_r = 1.0$	Drag Coefficient (Base), $C_{d\ base} = 0.45$
Velocity Conversion Factor, $C_v = 1.00$	Height and Exposure Factor (Pole and Fixture), $K_{z\ pole} = 1.00$
Gust Factor, G = 1.14	Height and Exposure Factor (Base), $K_{z\ base} = 0.86$
Overload Factor = 2.5	Undercapacity Factor = 0.7

[6] Calculations assume a double light fixture with the total surface area of both fixtures equal to the value shown in the chart. Unbalanced loading from a single offset fixture is not included in this preliminary guide, and must be addressed in final design calculations if planned for use.

[7] Minimum recommended embedment shall be the calculated value, depth of local frost penetration, or 3'-0" (0.9 m), whichever is greater.

[8] Embedment provided in '-" = ft-in

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MINIMUM EMBEDMENT GUIDE

36 in (914 mm) DIAMETER ROUND POLE BASE UNITS [1]   **6 in (150 mm) DIAMETER ROUND LIGHT POLE**

MINIMUM EMBEDMENT		SIGN OR FIXTURE AREA			
	POLE HEIGHT ft'	**4 ft² (0.372 m²)**	**6 ft² (0.557 m²)**	**8 ft² (0.743 m²)**	**12 ft² (1.115 m²)**
	BASES IN GRAVEL SOILS (GW, GP) [2] [7]				
	20' (6.1 m)	**3'-6" (1.1 m)**	**3'-6" (1.1 m)**	**4'-0" (1.2 m)**	**4'-6" (1.4 m)**
	25' (7.6 m)	**4'-0" (1.2 m)**	**4'-0" (1.2 m)**	**4'-6" (1.4 m)**	**4'-6" (1.4 m)**
	30' (9.1 m)	**4'-0" (1.2 m)**	**4'-6" (1.4 m)**	**4'-6" (1.4 m)**	**5'-0" (1.5 m)**
	35' (10.7 m)	**4'-6" (1.4 m)**	**5'-0" (1.5 m)**	**5'-0" (1.5 m)**	**5'-6" (1.7 m)**
	40' (12.2 m)	**5'-0" (1.5 m)**	**5'-0" (1.5 m)**	**5'-6" (1.7 m)**	**5'-6" (1.7 m)**
	BASES IN SANDY SOILS (SW, SP, SM, SC, GM, GC) [3] [7]				
	20' (6.1 m)	**4'-0" (1.2 m)**	**4'-0" (1.2 m)**	**4'-6" (1.4 m)**	**4'-6" (1.4 m)**
	25' (7.6 m)	**4'-0" (1.2 m)**	**4'-6" (1.4 m)**	**5'-0" (1.5 m)**	**5'-0" (1.5 m)**
	30' (9.1 m)	**4'-6" (1.4 m)**	**5'-0" (1.5 m)**	**5'-0" (1.5 m)**	**5'-6" (1.5 m)**
	35' (10.7 m)	**5'-0" (1.5 m)**	**5'-0" (1.5m)**	**5'-6" (1.7 m)**	**6'-0" (1.8 m)**
	40' (12.2 m)	**5'-6" (1.7 m)**	**5'-6" (1.7m)**	**6'-0" (1.8 m)**	**6'-0" (1.8 m)**
	BASES IN CLAYEY SOILS (CL, ML, CH, MH) [4] [7]				
	20' (6.1 m)	**8'-6" (2.6 m)**	**9'-0" (2.7 m)**	**9'-6" (2.9 m)**	**10'-0" (3.0 m)**
	25' (7.6 m)	**9'-6" (2.9 m)**	**10'-0" (3.0 m)**	**10'-0" (3.0 m)**	**11'-0" (3.4 m)**
	30' (9.1 m)	**10'-0" (3.0 m)**	**10'-6" (3.2 m)**	**11'-0" (3.4 m)**	**11'-6" (3.5 m)**
	35' (10.7 m)	**10'-6" (3.2 m)**	**11'-0" (3.4 m)**	**11-6" (3.5 m)**	**12'-6" (3.8 m)**
	40' (12.2 m)	**11'-6" (3.5 m)**	**12'-0" (3.7 m)**	**12-6" (3.8 m)**	**13'-0" (4.0 m)**

DESIGN FORCES		UNFACTORED SHEAR FORCE / OVERTURNING MOMENT [5] [6]			
	20' (6.1 m)	**399 lb (1.77 kN)**	**452 lb (2.01 kN)**	**505 lb (2.25 kN)**	**610 lb (2.71 kN)**
		5,306 lb * ft (7.19 kN * m)	**6,539 lb * ft (8.87 kN * m)**	**7,773 lb * ft (10.54 kN * m)**	**10,239 lb * ft (13.88 kN * m)**
	25' (7.6 m)	**464 lb (2.06 kN)**	**519 lb (2.31 kN)**	**574 lb (2.55 kN)**	**684 lb (3.04 kN)**
		7,427 lb * ft (10.07 kN * m)	**8,987 lb * ft (12.18 kN * m)**	**10,547 lb * ft (14.30 kN * m)**	**13,667 lb * ft (18.53 kN * m)**
	30' (9.1 m)	**531 lb (2.36 kN)**	**588 lb (2.62 kN)**	**645 lb (2.87 kN)**	**759 lb (3.38 kN)**
		9,925 lb * ft (13.46 kN * m)	**11,824 lb * ft (16.03 kN * m)**	**13,723 lb * ft (18.61 kN * m)**	**17,522 lb * ft (23.76 kN * m)**
	35' (10.7 m)	**600 lb (2.67 kN)**	**659 lb (2.93 kN)**	**718 lb (3.19 kN)**	**835 lb (3.71 kN)**
		12,807 lb * ft (17.36 kN * m)	**15,057 lb * ft (20.41 kN * m)**	**17,306 lb * ft (23.46 kN * m)**	**21,805 lb * ft (29.56 kN * m)**
	40' (12.2 m)	**671 lb (2.98 kN)**	**731 lb (3.25 kN)**	**792 lb (3.52 kN)**	**912 lb (4.06 kN)**
		16,084 lb * ft (21.81 kN * m)	**18,693 lb * ft (25.34 kN * m)**	**21,302 lb * ft (28.88 kN * m)**	**26,521 lb * ft (35.96 kN * m)**
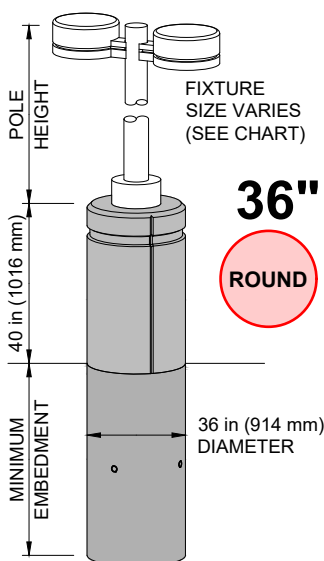
POLE HEIGHT

FIXTURE SIZE VARIES (SEE CHART)

36"

ROUND

40 in (1016 mm)

MINIMUM EMBEDMENT

36 in (914 mm) DIAMETER

Design Reference: *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, 6th Edition, 2013 (LTS-6)

[1] Calculations have been run for a 36 in (914 mm) diameter round base 40 in (1016 mm) above grade with a 36 in (762 mm) diameter bury portion in the soil.

[2] Assumed ϕ = 34°, γ = 130 lb/ft³ (2080 kg/m³), c = 0 lb/ft² (0 kPa).

[3] Assumed ϕ = 30°, γ = 120 lb/ft³ (1920 kg/m³), c = 0 lb/ft² (0 kPa).

[4] Assumed ϕ = 10°, γ = 130 lb/ft³ (2080 kg/m³), c = 250 lb/ft² (12.0 kPa).

[5] Calculations run with the following factors and assumptions:

Exposure Condition C	Drag Coefficient (Fixture), $C_{d\ fixture}$ = 1.2
Basic Wind Speed, V = 90 mph (40m/s)	Drag Coefficient (Pole), $C_{d\ pole}$ = 0.915
Importance Factor, I_r = 1.0	Drag Coefficient (Base), $C_{d\ base}$ = 0.45
Velocity Conversion Factor, C_v = 1.00	Height and Exposure Factor (Pole and Fixture), $K_{z\ pole}$ = 1.00
Gust Factor, G = 1.14	Height and Exposure Factor (Base), $K_{z\ base}$ = 0.86
Overload Factor = 2.5	Undercapacity Factor = 0.7

[6] Calculations assume a double light fixture with the total surface area of both fixtures equal to the value shown in the chart. Unbalanced loading from a single offset fixture is not included in this preliminary guide, and must be addressed in final design calculations if planned for use.

[7] Minimum recommended embedment shall be the calculated value, depth of local frost penetration, or 3'-0" (0.9 m), whichever is greater.

[8] Embedment provided in '-" = ft-inches

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(Rev. Oct. 8, 2021)

EXAMPLE CALCULATION
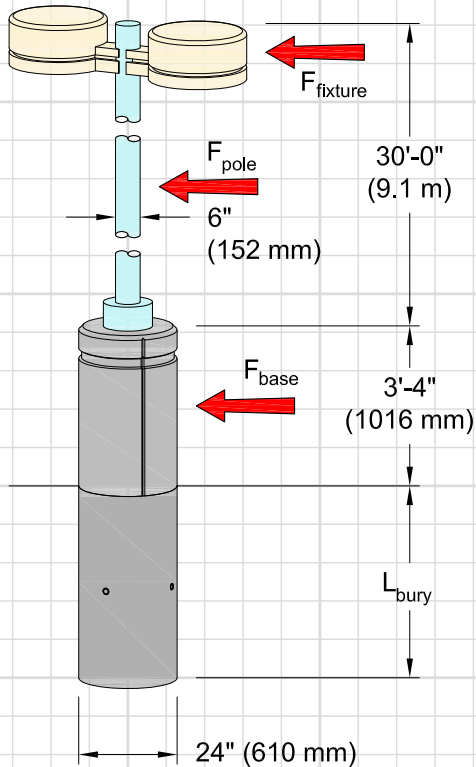
Determine minimum required embedment for a Pole Base™ Unit in the following conditions:

Pole Base™ Unit = 24" (610 mm) diameter round base with 3'-4" (1016 mm) textured portion above grade and a 24" (610 mm) diameter round bury portion.

Site Soils = Poorly graded sand (SP) with:
internal friction angle, ϕ = 30°
unit weight, γ = 120 lb/ft³ (1920 kg/m³)
cohesion, c = 0 lb/ft² (0 kPa).

Light Pole = 30' (9.1 m) tall, 6" (152 mm) diameter round pole.

Light Fixture Size = 4 ft² (0.372 m²)

Site Exposure Condition = C

Basic Wind Speed = 90 mph (40 m/s)

Figure labels (left diagram):
$F_{fixture}$
F_{pole}
30'-0" (9.1 m)
6" (152 mm)
F_{base}
3'-4" (1016 mm)
L_{bury}
24" (610 mm)

Design Reference: *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, 6th Edition, 2013 (LTS-6).

- DETERMINE WIND LOADS ON POLE BASE™ UNIT, LIGHT POLE, AND LIGHT FIXTURE:

Site Exposure Condition C (Given)

Basic Wind Speed, V = 90 mps (40 m/s) (Given)   *Reference AASHTO Figures 3.8.3-1 to 3.8.3-5*

Wind Importance Factor, I_r = 1.0   *AASHTO Table 3.8.3-1 (50 year recurrence, non-hurricane region)*

Design Life = 50 years   *AASHTO Table 3.8.3-2*

Velocity Conversion Factor, C_v = 1.00   *AASHTO Table 3.8.3-3 (50 year recurrence, basic wind speed in non-hurricane region)*

4.5

Height and Exposure Factor, K_z *AASHTO Section 3.8.4*

$K_z = 2.01 * (z / z_g)^{2/alpha}$ *AASHTO C3.8.4-1*

alpha = 9.5 and z_g = 900 ft (274.3 m)   *AASHTO Commentary C3.8.4*

z = height above ground ≥ 16 ft (5 m)

For Pole Base™:
$K_{z\ base} = 2.01 * (16 / 900)^{2/9.5} = 0.86$

For Light Pole and Fixture:
$K_{z\ pole} = 2.01 * (30 / 900)^{2/9.5} = 1.0$

Gust Factor, G = 1.14   *AASHTO Commentary C3.8.5*

Drag Coefficients, C_d *AASHTO Section 3.8.6*

For Light Fixture:
$C_{d\ fixture} = 1.2$ *AASHTO Table 3.8.6-1 (luminaires with rectangular flat shide shapes)*

For Light Pole:
$C_v*V*d = 1.0 * 90\ mph * 0.5\ ft = 45\ mph * ft$
$C_{d\ pole} = 129 / (C_v*V*d)^{1.3} = 0.915$ *AASHTO Table 3.8.6-1 (cylindrical)*

For Pole Base Unit:
$C_v*V*d = 1.0 * 90\ mph * 2.0\ ft = 180\ mph * ft$
$C_{d\ base} = 0.45$ *AASHTO Table 3.8.6-1 (cylindrical)*

Wind Pressure, $P_z = 0.00256 * K_z * G * V^2 * I_r * C_d$ *AASHTO 3.8.3-1*

For Light Fixture
$P_{z\ fixture} = 0.00256 * 1.0 * 1.14 * 90^2 * 1.0 * 1.2 = 28.5\ psf$

For Light Pole
$P_{z\ pole} = 0.00256 * 1.0 * 1.14 * 90^2 * 1.0 * 0.915 = 21.7\ psf$

For Pole Base™
$P_{z\ base} = 0.00256 * 0.86 * 1.14 * 90^2 * 1.0 * 0.45 = 9.2\ psf$

4.6

DETERMINE SHEAR FORCES AND OVERTURNING MOMENTS

Shear Forces

For Light Fixture:

$F_{fixture} = P_{z\ fixture} * A_{fixture} = 28.5 * 4.0 = 114.0$ lbf (0.51 kN)

For Light Pole:

$F_{pole} = P_{z\ pole} * A_{pole} = 21.7 * (30 * 0.5) = 325.8$ lbf (1.46 kN)

For Pole Base™:

$F_{base} = P_{z\ base} * A_{base} = 9.2 * (3.33 * 2.0) = 61.0$ lbf (0.27 kN)

Total Applied Shear Force = $F_{fixture} + F_{pole} + F_{base} = 500.8$ lbf (2.24 kN)

Overturning Moment

For Light Fixture:

$M_{fixture} = F_{fixture} * (h_{base} + h_{pole}) = 114.0 * (3.33 + 30) = 3,798$ lbf * ft (5.15 kN * m)

For Light Pole:

$M_{pole} = F_{pole} * (h_{base} + h_{pole}/2) = 325.8 * (3.33 + 30/2) = 5,973$ lbf * ft (8.10 kN * m)

For Pole Base™:

$M_{base} = F_{base} * (h_{base}/2) = 61.0 * (3.33 / 2) = 102$ lbf * ft (0.14 kN * m)

Total Applied Overturning Moment = $M_{fixture} + M_{pole} + M_{base} = 9,874$ lbf * ft (13.39 kN * m)

DETERMINE MINIMUM REQUIRED EMBEDMENT

Factor Shear and Overturning Moment for Use with Broms Design Method

Overload Factor = 2.5 and   *AASHTO Commentary C13.6.1.1*
Undercapacity Factor = 0.7

Safety Factor = Overload Factor / Undercapacity Factor = 3.57

V_F = Total Shear * (Safety Factor) = 1.79 kip (8.0 kN)   *AASHTO C13.6.1.1-1*

M_F = Total Moment * (Safety Factor) = 35.26 ft * kip (47.8 kN * m)   *AASHTO C13.6.1.1-2*

4.7

DETERMINE MINIMUM BURY

For a Foundation in Cohesionless Soil:

$$L^3 - \frac{2 * V_F * L}{K_p * \gamma * D} - \frac{2 * M_F}{K_p * \gamma * D} = 0 \qquad \qquad AASHTO\ C13.6.1.1\text{-}7$$

$$\phi = 30° \text{ (Given)}$$

$$\gamma = 120 \text{ lb/ft}^3 \ (1920 \text{ kg/m}^3) \text{ (Given)}$$

$$K_p = \tan^2(45 + \phi/2) = \tan^2(45 + 30/2) = 3 \qquad AASHTO\ C13.6.1.1\text{-}8$$

$$D = \text{Diameter of Base} = 2 \text{ ft } (0.61 \text{ m}) \text{ (Given)}$$

Solve by Iteration to find L = 4.97 ft (1.51 m)

$$L^3 - \frac{2 * V_F * L}{K_p * \gamma * D} - \frac{2 * M_F}{K_p * \gamma * D} = 4.97^3 - \frac{2 * 1.789 * 4.97}{3 * 0.120 * 2} - \frac{2 * 35.26}{3 * 0.120 * 2} \approx 0$$

MINIMUM BURY FOR POLE BASE™ UNIT = 4.97 USE **5'-0" (1.52 m)**.

4.8