Prestressed Concrete Utility Poles

Engineering Standards: Concrete vs. Wood

*Because wood deteriorates over time, The American National Standards Institute, **(ANSI)** and the National Electric Safety Code, **(NESC)**, require wood poles to have an initial load factor 60% greater than equivalent concrete poles.*

WOOD POLE EQUIVALENCY

Traditionally, designers have specified wood poles for use as utility structures according to the pole class system set forth in the American National Standards Institute's specification ANSI 05.1, *Specifications and Dimensions for Wood Poles.* In order to remain consistent with the pole class system for utility structures, we have developed a wood pole equivalency (WPE) system for our prestressed concrete poles. Our WPE system is based on criteria contained in ANSI 05.1 and the National Electric Safety Code (NESC), ANSI C2.

When establishing WPE criteria, the difference between the two structural systems (materials) must be considered:

Wood: *NESC requires an overload capacity factor (OCF) of 4.0*

Wood poles are composed of a naturally grown, biological material, which exhibits inconsistent material properties throughout the length of the pole. These inconsistencies, which have a direct impact on strength, are knots, checks, shakes and splits.

Wood poles are susceptible to rot and decay over the design life of the structure. The wood pole has less strength at the end of its service life than when it was originally placed in service.

Wood poles are susceptible to insect and animal attack. The effects of termite and woodpecker attack can significantly decrease the load carrying capacity of the wood pole well before the end of the anticipated service life.

Prestressed Concrete: *NESC overload capacity factor (OCF) of 2.5*

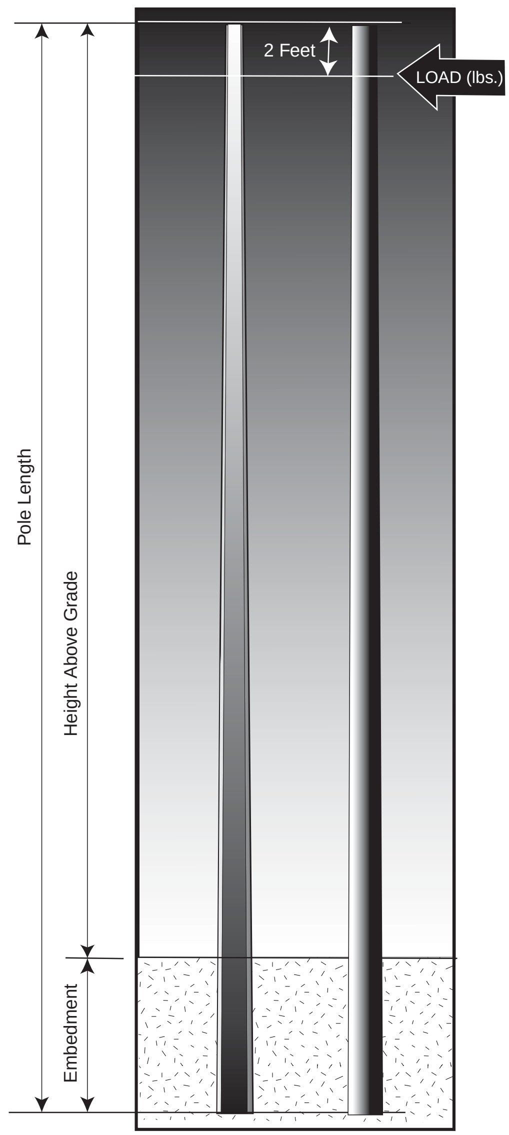
Prestressed concrete poles are fabricated from engineered materials. The prestressed concrete poles have consistent material properties throughout their length.

Prestressed concrete poles are not susceptible to rot and decay. The prestressed concrete pole has the same strength throughout its service life.

Prestressed concrete poles are not susceptible to insect and animal attack.

Wood pole classes are determined by the strength required at the groundline to resist a transverse ultimate load placed 2 ft. below the tip of the pole. Each length of pole within a pole class can resist the same load placed 2 ft. from the top.

When designing pole structures for transverse wind loading, the NESC requires an overload capacity factor (OCF) of 4.0 for wood poles and 2.5 for concrete poles when determining ultimate loads (Grade B construction). Due to the above mentioned differences in the structural systems, the NESC requires the wood pole to have a strength that is 60% higher than the prestressed concrete pole. Therefore, the prestressed concrete pole can be designed for a load that is 62.5% (2.5/4.0) of the wood pole load and attain the same strength for the specific pole class throughout the life of the structure.



WOOD POLE EQUIVALENCY EXPLAINED

In order to simplify our WPE system we choose to use the ultimate pole top load that is two load classes lower than the wood pole. For example, ANSI O5.1 lists an ultimate pole top load of 4,500 lbs. for a Class 1 wood pole. Our concrete Class 1-C pole is designed for a 3000 lbs. (Class 3 wood pole load) ultimate pole top load. The ratio of the loads is 3000/4500=0.666, which is in excess of 2.5/4.0=0.625 using NESC overload capacity factors for transverse wind.

CONCRETE POLE CLASS LOADS		
CONCRETE POLE CLASS	LOAD 2 FT FROM TIP (LBS)	CONCRETE LOAD WOOD LOAD
H2-C	4,500	0.703
H1-C	3,700	0.685
1-C	3,000	0.666
2-C	2,400	0.649
3-C	1,900	0.633
4-C	1,500	0.625
5-C	1,200	0.632

The above wood pole equivalency system is based on the following assumption:

1. Transverse wind is the controlling design load.
2. The load acts perpendicular to the face of the pole.

When design configurations involve the use of angle poles and dead end poles where other than transverse winds control the design, our technical staff should be consulted.

WOOD POLE EQUIVALENCY EXAMPLE

Example:

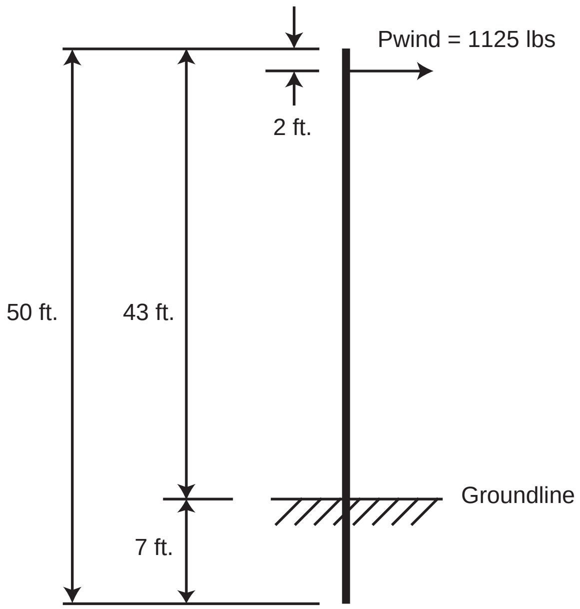
Example:

The following example is for the purpose of demonstrating our WPE system only. In actual design cases, loads other than transverse wind may control and must be investigated.

Assumptions:

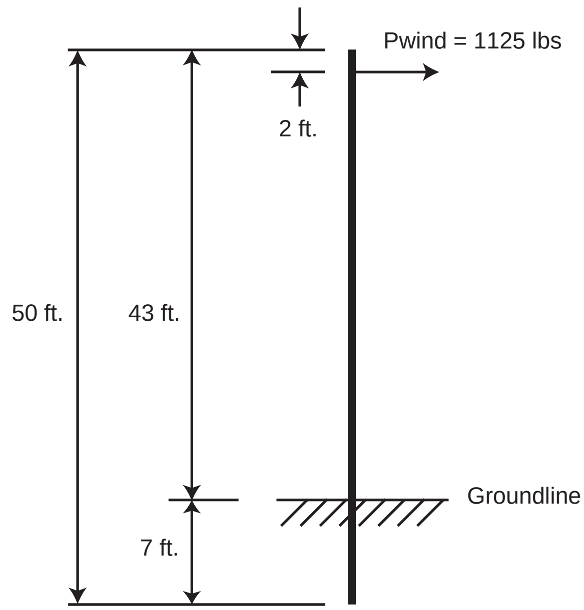
- Tangent pole.
- Equal conductor spans on both sides of poles.
- Transverse wind creates controlling load case for selection of pole.
- For simplicity, the wind pressure on the pole is neglected in this example but should be added to the ground line moment for actual design.
- NESC overload capacity factors: 4.0 for wood poles
  2.5 for prestressed concrete poles
- Wind load on conductors produce a resultant load of 1125 lbs., 2 ft. down from the top of the pole.

WOOD



Pu = 4.0(1125 lbs.) = 4500 lbs.
For ANSI Class 1 wood pole:
Pmax = 4500 lbs.

PRESTRESSED CONCRETE



Pu = 2.5(1125 lbs.) = 2813 lbs.
For ANSI Class 1-C prestressed concrete pole:
Pmax = 3000 lbs. (Class 3 wood pole load)

The concrete Class 1-C pole is more than adequate for the transverse wind load. Note the max load of 3000 lbs. for the prestressed concrete pole is the same as for a Class 3 ANSI wood pole.