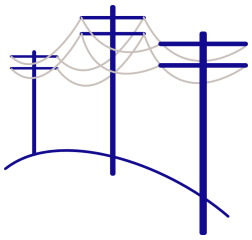
Raked Poles



A common practice when installing a bollard pole (a pole that has no power lines on it but solely supports another pole through a stay wire) is to lean the pole away from the direction of the load. A common guide is to rake the pole by one head width. But there is not usually any explanation of why this is desirable.

The strength benefits of leaning the pole away from the applied load (either through a slightly larger surface area for soil resistance in the footing or because the load then has a small vertical component reducing the horizontal component) are negligible.

The only apparent benefit seems to be that when the pole bends because of the applied load at the tip of the pole then it looks approximately vertical rather than leaning over and alarming the public.

The equation for the deflection of a round tapering pole fixed at ground level (the usual assumption for distribution timber poles) is

$$y = \frac{P.L^3}{3E.I_A} . \frac{1}{r^3}$$

where

y	deflection at tip
P	applied load
L	pole length
E	modulus of elasticity of timber
I_A	moment of inertia at tip[1]
r	ratio of base diameter to tip diameter

Two example calculations are shown on below.

1 Moment of inertia for a circular cross-section $\frac{\pi}{64} d_A^4$

Variable	Example 1	Example 2
P, applied load (kN)	10	20
L, pole length (ground to tip) (m)	10	8
E, mod elasticity (MPa)	Class S2, 18500	Class S3, 16000
I_A, moment of inertia (m^4)	1.92×10^{-4}	3.98×10^{-4}
d_G, Ground diameter (mm)	350	400
d_A Tip diameter (mm)	250	300
r, ratio ground/tip	1.4	1.33
Deflection at tip (mm)	342	226

Revision history

Rev No.	Date	Details
A	6 March 2019	Initial issue
B	25 April 2019	Correction to calculation (units)