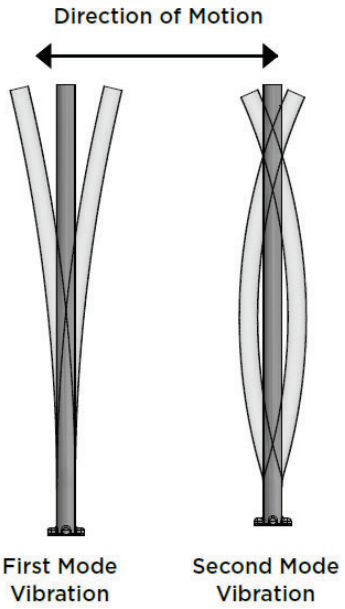
Definitions

First Mode Vibration (Harmonic)

First mode vibration, also known as harmonic vibration, is characterized by the side to side motion of a pole and typically referred tp as "sway". High velocity gusts of wind cause the greatest displacement at the top of the pole moving at a frequency of about 1 cycle per second. First mode vibration is generally not harmful to the pole or luminare.

Second Mode Vibration (Resonance)

Second mode vibration, also known resonance vibration, is characterized by the symmetric oscillation that occurs when the wind synchronizes with the pole's natural frequency. Second mode vibration occurs near the midpoint of the pole and can cause the material to fatigue related to pole failure. They typical frequency of movement is 3 to 6 cycles per second.



Vortex Shedddding

VOrtex shedding occurs when the second mode vibration matches the natural frequency of the pole. This is caused by a steady low speed wind moving perpendicular across the pole creating alternating low-ressure vortices on the downwind side of the pole.

EPA

EPA is a coefficient used by the lighting industry to determine how much force a luminaire will apply to the mounting brackets or pole at a given wind velocity. This value is used in combination with a luminaire's weight to determine the mounting requirements for a particular application. To determine the EPA of a luminaire, the frontal projected area is mulitplied by the drag coefficient of the luminaire.

Pole Design Considerations

Height

Pole deflection increases as the height of a pole increases causing greater risk of wind induced vibration.

Wall Thickness

The gage (thickness) of material affects the rigidity and flexability of the pole. The higher the gage the less risk for wind induced vibration because of the reduced flexability and increased rigidity.

Material

Poles are available in many different types of material. The most common include steel, aluminum, fibreglass, concrete and wood. Stell and aluminum are the most common materials used for light poles, with steel having more strength than aluminum.

EPA Values/Loading

Overloading and light loading a pole can greatly affect its performance. The risk of pole failure greatly increases if the EPA value of the luminaire and bracket exceeds the EPA rating of the pole. Poles with a height greater or equal to 25 feet loaded with less than 2 EPA increase the risk of destructive vibration. Poles are designed to carry a load and should not be installed before the luminaire is mounted.

Shape

Aerodynamics also affect pole performance. Straight square poles are more often affected by first mode vibration. Straight round poles are more often affected by second mode fibration. A taered pole can positively change the aerodynamic characteristics, reducing the risk of destructive vibration.

Vibration Mitigation

Pole Damper

A pole damper can reduce the risk of destructive vibration by adding mass and interruppting the natural frequency on the pole. It is recommended that poles over 25 feet especially square poles include a vibration damper. Consult a local engineer to assess if a damper is appropriate for your particular application.

First Mode Damper

First mode vibration dampers can be installed to reduce the sway motion of the pole.

Second Mode Damper

Second mode vibration dampers are used to interrupt the natural frequency of the pole, minimizing the material fatigue caused by the wind.

Chain Damper

A factory installed second mode vibration damper that consist of a coated chain hanging from the top f the pole. This disrupts vibration by moving in the opposite direction of the shaft. The chains may create some noise.

Snake Damper

A field installed second mode vibration damper that is installed through the hand hole to disrupt vibration of the shaft.

Increased Risk Areas

Areas with certain environmental variables, such as constant low steady wind, flat open terrain, large open landscape, and buildings affect the sustainability of the pole. The following applications show where wind may affect pole vibration.

Open Landscape

CIties/Mountains

Airports

Top of Parking Decks

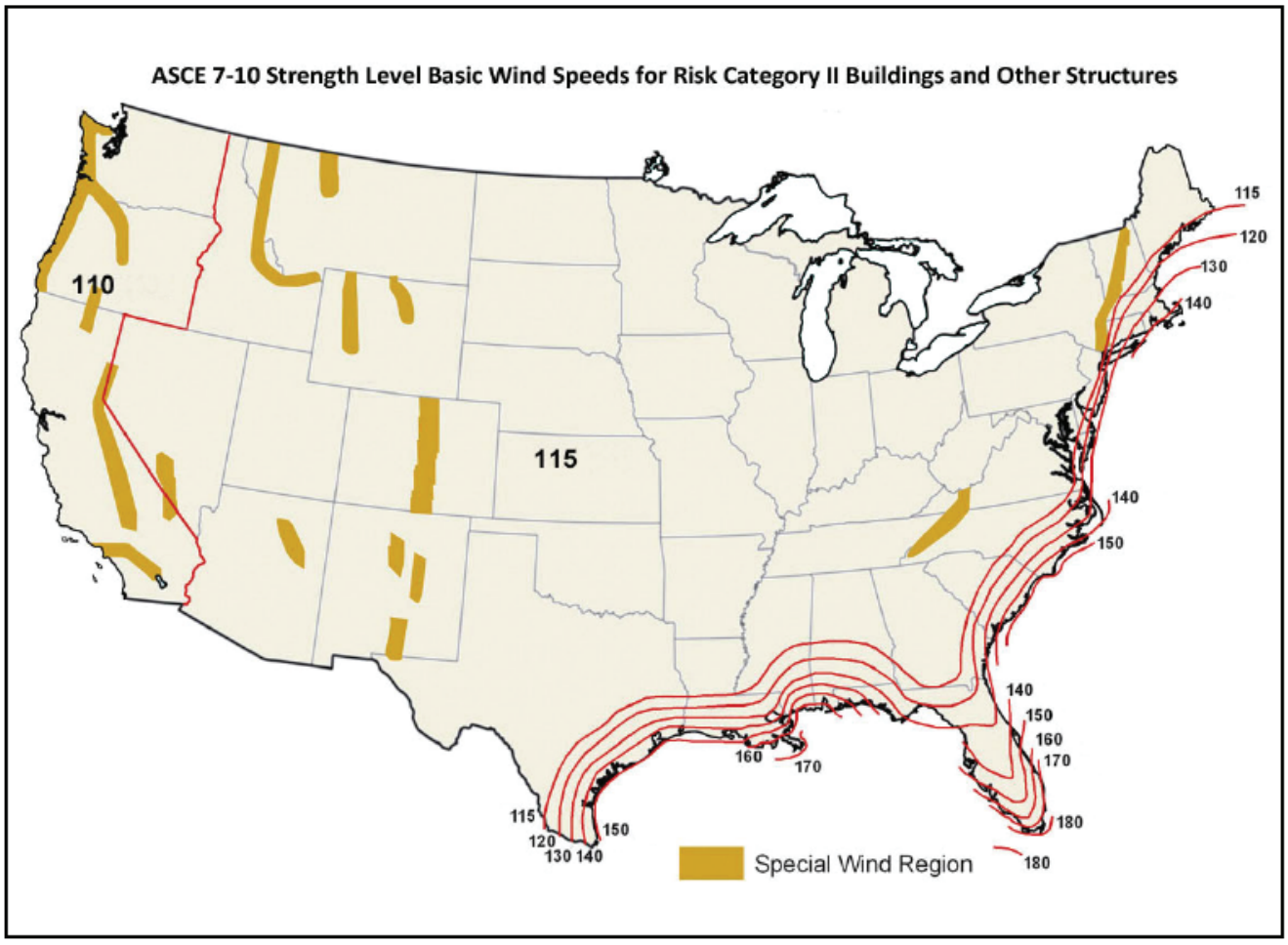
Local Conditions

Wind Speed Map

EPA values for light poles, brackets, and luminaires are calculated using wind speed map for ASCE 7-10.

Special Wind Regions - consult local engineer to determine correct spec.

Wind Speed Map for ASCE 7-10



Notes:
1. Values are the fastest-miles speeds at 33ft above the ground for exposure Category 2
2. Linear interpolation between wind speed contours is acceptable.
3. When using the map always use high end range.
4. Fixture and pole EPA values are based on wind pressures and forces specified above.
5. Local code may require speeds other than on map.

All Unite Ltg poles are guanteed to meet EPA requirements listed. Pole manufacturer is not responsibel if a pole order has a lower EPA rating than the indicated wind loading zone where located. Also the guarantee does not apply if the combination is used to support other items (flags, pennants etc) which would add stress. Unite LTG cannot accept responsibility for harm or damage in these cases.

Pole Inspection and Maintenance

Pole inspection and maintenceare very important to the longevity of the pose. It is impperative that destructive vibration be minimized in a timely manner before structural damage can occur. Inspections should be performed on a regular bases, beginning when installed and then after one wee, one month, siz months and annually. Pole inspections should also be performed after major wind events and well as when environmental changes occur.. If changes exist poles can be compromized in a short period of time which can result in failure. Indication can be observed with the below:

- Signs of corrosion directly above the baseplate weld and around the hand hole can suggest material fatigue. Hirline cracks also indicate a compromised pole.

- During windy conditions, observe the top of the pole for excessive deflection and look for rapid oscillation in the middle of the pole. In addition , listen to hear if wires inside are banging against the sides.

- Check torque values of the anchor bolts. Low values can indicate vibration.

- Loosening of threaded attachments, fasteners of the luminaire and pole caps

A structural engineer should be consulted if signs of ple fatigue exist. The affected pole should be dismantled and a site inspection should be performed. If the pole is deemed sould, mitigation steps including adding a damper should be performed. If vibration is still an issue the pole should be replaced with a suitable shape.

Limited Warranty

Pole fatigue, damage or failure as well as additional damage at the site caused by vibration, harmonic vibration or resonance associate with air movements and/or currents around the product or by any other condition are specifically excluded from the warranty.