March 15, 2022

Subject: Design Criteria and Failure Modes for Valmont Communication Towers

Design Criteria

Communication towers designed by Valmont Microflect, such as the structure proposed, are typically sized in accordance with the latest revision of the TIA-222 Standard entitled "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures." This standard has been approved by ANSI/ASCE, who has generated the standard for "Minimum Design Loads for Buildings and Other Structures". The standard, which is the basis for design loading for practically every building code and standard in the country, has dealt with the design of lattice type structures for over 40 years.

The TIA standard, based on provisions of this nationally known specification, has a long history of reliability. At its core philosophy is it's first and foremost priority to safeguard and maintain the health and welfare of the public.

The TIA standard dictates minimum wind loading (the predominant loading on a tower structure) for each location in the United States. It is our policy to use the wind loading provided as a **minimum** loading unless the customer specifies a larger value. Statistically, the wind speed listed in the TIA standard has been determined to be that wind which has an average reoccurrence of 50 years (i.e. the magnitude has a 2% chance of occurring in any one year). This wind is also a"3-second gust" wind speed, per the current TIA standard. This 3-second gust wind is by definition the 3-second gust wind speed at 33 ft. [10 m] above the ground in exposure category C for a 50-year mean recurrence interval. This "3-second gust" wind is customized with importance factors, height factors, exposure factors, topographic factors, and gust factors that apply to a particular installation which, in effect, increases the wind velocity.

The loads generated by this wind speed, along with weight of the tower members and any ice loading being considered, are used to design the structural tower members

Besides the magnitude of the wind, the orientation to the tower is also critical. Some directions are worse than others, depending on placement of antennas, appurtenances, etc. To fail tower members, the wind must exceed all of our estimates for magnitude, duration, be at worst orientation **and** overcome the member design strengths.

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valmont STRUCTURES

Failure Modes

Let us assume that a tower member force has exceeded all rational design criteria and has become overloaded. The typical consequence of the overloading is "local buckling" where a relatively small portion of the member distorts and "kinks" the steel. If this occurs, much of the loading is redistributed to members with unused reserve capacity. The end result is a localized distortion, but rarely a complete tower collapse. Of course, any overstressed member should be replaced as soon as possible.

Towers are made of many members. As stated, load redistribution enables the tower to sustain loads even in excess of extreme magnitudes used in tower design. Also, towers are flexible structures, which react well to wind gust or earthquake shocks and are typicality not damaged by impact loads. It takes some time for the entire structure to "see" the effects of loading.

We have no direct experience with tower failures. However, from what evidence we have seen from other vendor's experiences, we can state that it is rare for a tower to fall in a radius larger than, say, half its height, and that in most cases it will collapse in a small confined area as it comes down upon itself. .

It may be of interest to note that if there ever was such an extreme of event to fail a Valmont Microflect tower, a large number of nearby trees, telephone and poles, and other structures will also have structural failures and collapses.

Valmont Microflect's communication towers have proven to be very reliable products. In our over 60 years of engineering and fabricating thousands of towers we have not had one tower fail due to overloading (even in the extreme cases that wind speeds have exceeded design values). We use the latest standards, wind speed information, and sophisticated analytical tools to ensure that we maintain our unblemished record for quality. In good faith, we can confidently state that our towers are the best engineered Communication Structures available and the probability of any type of failure is remote at best.

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EXPIRES: 6/30/23

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