

# WINDLETTER

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## **SMALL TURBINE COLUMN:**

### **Tower Engineering for Building Permits**

--Mick Sagrillo, Sagrillo Power & Light

It is typical for a zoning body issuing building permits to require an engineering analysis of the structure and foundation that the applicant is seeking permission to construct. This is true for wind turbines and towers, just as it is true for new houses, room additions, garages, barns, silos, or any other structure.

"Generic" engineering analyses for the structure are often provided by the manufacturer or contractor. Conducted by either an in-house engineer or an engineering firm retained by the manufacturer, the analysis is used by customers who submit them as part of their application for a building or zoning permit. This is the "normal" situation for most building projects requiring such documentation across the U.S.

I recently became aware of several situations across the country where applicants for wind turbines were required to have an independent in-state structural engineer do an analysis of the tower and foundation they wished to install for their wind turbine. In fact, neighbors opposing the wind turbines had urged the zoning committees to impose such requirements.

The requirement for a structural analysis of the tower and foundation by an independent, in-state registered structural or mechanical engineer could easily run into the thousands of dollars. One reason for the exorbitant expense is that, while the calculations are relatively straightforward for structural engineers, the implied liability assumed by the reviewing engineer is huge. Additionally, few engineers have the expertise required to actually do such an analysis of a wind generator tower and foundation, given the loads placed on these structures by the wind turbine. As such, they have to do some homework, at the applicant's expense, to educate and enlighten themselves about the loads specific to wind turbine towers and foundations.

Most engineers doing engineering analysis for home owners, zoning committees, construction companies, and municipal building departments do them for buildings, not towers. The loads on a building are essentially downward due to gravity, and slightly sideways when the wind blows. Not so with a wind turbine tower. When the wind is not blowing, the standard downward gravitational forces apply to wind turbine towers, just as

any other building or structure. When the wind is blowing, there is a sideways force on the tower, just as there is on any other structure as well. However, the wind turbine rotor turns the tower into a lever, as the wind tries to use the tower to pry the concrete foundation out of the ground. Interestingly, the upwind tower leg actually has an up-lifting force on it when the wind is blowing. This is something most engineers have never come across.

Such a structural analysis of the tower and foundation is already readily available from the manufacturing company supplying the wind turbine and tower. If for nothing else, the manufacturer has to do such analyses for its own protection, to assure its respective insurance companies that it is not selling equipment that is going to fall over or be yanked out of the ground the first time a storm passes through. Such manufacturer-conducted analyses are not only responsible behavior but are also driven by pure economics and self preservation.

In the above-mentioned cases where opposing neighbors have argued successfully for independent structural analyses, the opponents have asserted that the wind turbine and tower manufacturers, as well as their engineers, cannot be trusted, as they have a financial interest in selling the equipment. The implication is that the manufacturer is cutting corners in order to sell a less expensive product. An additional implication is that the engineer retained to analyze the tower and foundation is complicit in the manufacturer's corner-cutting, letting things slide for its client. After all, who does not want to be looked upon favorably by their "boss"? Who wants to tell their "boss" that they are not doing a good job?

Let's look at these assumptions and their downsides closely. First of all, why would any registered engineer do this? If the manufacturer of a failed product were taken to court, the first person the manufacturer would go after would be the retained engineer who approved the design of the tower and foundation in the first place. In addition to being culpable in court, the engineer would jeopardize his or her liability insurance and engineering license. One job is simply not logically worth that kind of risk.

Second, why would any manufacturer do this? It too would be culpable in court. Any such court case would have significant impact on a manufacturer's liability insurance. In addition, when word got out about failed products and lawsuits, the manufacturer would be tainted in the marketplace. The small wind turbine industry (up to 100 kW in capacity) is indeed a small industry. There are not that many manufacturers and not that many customers compared to other consumer goods and products. Word gets around fast in this industry. Any company selling shoddy equipment or distributing installation information that results in tower and foundation failures is not going to be in business very long. This is especially true in today's litigious society.

In light of the reality of the legal and financial ramifications of such alleged corner-cutting, a blanket assumption that manufacturers and their retained engineers are engaging in such behavior is faulty. Consequently, requiring an expensive independent engineering analysis is rather extreme, especially given the fact that there is no evidence

that manufacturer analyses are not reliable. As an independent contractor who installed wind systems from 1982 to 1997, and as a workshop presenter installing wind systems from 1987 through the present, I have not found this alleged corner cutting to be the case anywhere in the small turbine industry. Nor have there been any such reports from bona fide wind contractors or installers who know what they are doing.

As such, the generic engineering supplied by the tower or wind turbine manufacturer should easily meet the requirements for documentation required by building or zoning permits, just as they do for other building projects. Foundations are usually engineered for the most extreme conditions, with the exception of soils that are pure sand, gravel, muck, or under water. In these cases, a foundation engineering analysis for that specific installation may be in order.

More importantly, while data to determine the tower static and wild loads are readily available, the dynamic data for loads imposed by an operating wind turbine cannot be looked up in standard reference tables. These data are the exclusive domain of the manufacturer who is understandably likely not willing to share this information with third parties. This reason, more than any other, is the most compelling one to accept wind turbine manufacturer engineering for the zoning process.

The requirement of independent engineering analyses is merely used to stymie an applicant from installing a wind system by slapping additional—and sometimes considerable—expenses on applicants in hopes that they will abandon their wish to install wind turbines.

What is reasonable for engineering analysis requirements? Tower blueprints or drawings and foundation blueprints or drawings, supplied by the wind turbine or tower manufacturer, should suffice for even the most cautious building departments or zoning committees. After all, these requirements have worked for years.

[Editors Note: The opinions expressed in this column are those of the author and may not reflect those of AWEA staff or board.]