



Tower Reworks

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With the upgrade of analog microwave to digital, and the intense focus on co-locating wireless services on existing towers, modifying communication towers to increase its load handling capability is becoming commonplace. It is our intent to identify and discuss some of the various issues that must be addressed to modify a communications tower in the safest and most cost effective manner possible.

According to TIA/EIA-222-F, Section 15.1.1, “Steel antenna towers and other supporting structures *should* be analyzed when changes occur to the original design or operational loading conditions” (our emphasis). Though analysis is not required by this statement, it should be considered a requirement before any additional attachments be made to the tower. Annex F states that an analysis should be performed if a) there is a change in antennas, transmission lines, and/or appurtenances (quantity, size, location, or type), b) there is a change in operational requirements (twist and sway), or c) there is a need to increase wind or ice loading. If you are the tower owner, you will want to insist that an analysis be performed to ensure that any additional loading will not affect the performance of the tower, or any other tenants you may have on the tower. If you want to co-locate on someone’s tower, you will want to insist that an analysis be performed to protect your own installation.

There are many good engineering firms across the country with qualified professional engineers (PE’s) capable of analyzing the load handling capabilities of a communications tower. The two most common pricing methods for tower analysis are pass/fail, and fixed fee with recommendations.

Pass/fail is the least expensive method when you have a tower that is likely capable of supporting the additional desired loading without modification. If the tower is capable of supporting the additional loads, your report will state that the tower “passed”. However if the tower “fails” the analysis, you will need to either reconfigure the loading parameters and re-analyze the tower, or request that the engineer design the necessary modifications to allow the tower to support the additional loading. You will be charged an additional analysis fee each time the tower is analyzed until the parameters are changed enough so that the tower will “pass”, or the engineer designs tower modifications that can support the new attachments.

The second approach to analysis is fixed fee with recommendations. For a fixed price, an engineer will analyze the existing tower and loads to determine if the tower will support the additional loads without modification. If not, the engineer will determine what modifications are necessary, and provide the required fabrication drawings for the modification hardware. The analysis process is the same for both methods; it is the pricing structure that is different. Most engineering analysis firms offer only one of the two pricing structures, though some may offer an al-a-cart menu.

Virtually every professional engineer is capable of analyzing towers structural capabilities, and every PE is capable of designing a modification that will strengthen that structure. If you had several PE's design a tower modification for the same tower, there would be several different methods of achieving the same results. Each solution would be technically correct. However, the PE's do not have to manufacture or install the hardware they design. Depending on the approach, their solutions though technically correct, could be very costly or even unsafe to implement. You need a solution that is safe and cost effective to manufacture and install. If you have several towers that need to be analyzed, you will want to choose an engineering firm that offers the pricing structure that is most advantageous to you. You will also need to determine if you only need stamped PE drawings, or if you need the drawings stamped for the state in which the tower is located.

One method of choosing a firm would be to develop a well-defined scope of work to analyze one tower. Send the scope of work to several engineering firms. Once the results are back from all of the firms, give them to an experienced tower service company. Ask them to quote the material and labor for each of the engineering firm's responses. You will also want to make sure that the engineering firm you select can meet your timetables, and can provide drawings for not only the fabrication of the modification hardware, but the installation drawings as well. Some modifications are simple and easy to understand however, many can be very complex with the installation of the hardware somewhat confusing – significantly affecting the installation costs. From a practical standpoint, few companies would really choose a firm this way. We just wanted to point out that the cost of implementation of a reworks design could range considerably for the same tower depending on the engineers solution.

All structural steel used on a communications tower must conform to American Institute of Steel Construction (AISC), Specification for Structural Steel Buildings, or American Iron and Steel Institute (AISI), Specification for the Design of Cold-Formed Steel Structural Members per EIA-222-F, Section 1.1.1. As information, the AISC document has been replaced by the Code of Standard Practice for Steel Buildings and Bridges (the Code) dated March 7, 2000. Per Section 5 of the Code, the verification of compliance is certified data from the supplier showing the test results of the mechanical and chemical properties of the material in the form of a Mill Certification Report. Section 1.1.2 of EIA-222-F also states that if materials other than those specified are to be used, that the supplier must still provide the same data. All structural steel must meet these requirements, therefore the materials used in the structural modification of a tower must also comply with these requirements.

There is also a requirement per Section 6.1.3 of EIA-222-F, to place part numbers on all structural steel used on a communications tower. The EIA-222-F standard does not differentiate between structural materials used for the original tower, and materials used later to structurally modify the tower. Therefore, all requirements that apply to the original structural steel also apply to structural steel used for tower reworks. Though it is the fabricators responsibility to ensure that the materials used to structurally modify the tower comply with the standards, the purchaser must verify that the fabricator has

properly met the requirements. Therefore, in addition to asking questions such as “When can I get the parts, and how much will they cost?” liability protection requires the purchaser to confirm the fabricators compliance to the standard.

Once the parts have been fabricated, they will have to be installed by a competent tower service company. It is important to note that there were several fatal accidents in 2002 while tower service companies were modifying towers to increase load-handling capabilities. Make sure the tower service companies you use have strong safety policies – and enforce them. The fastest method available to determine a tower service company’s safety record is to ask what their Experience Modification Rate (EMR) has been for the last three years.

EMR is a modifier calculated by the insurance industry and applied to a basic insurance coverage rate. The base rate is established at “1.0”. The modifier is then applied to the base rate. For those companies with good safety records, their modifier will be less than one. For those companies with poor safety records, the modifier will be higher than one. If the tower service company does not have the information readily available, it can be obtained from their insurance provider. The modifier is calculated based on the number of accidents per man-hours worked, the severity of the accidents, the number of lost workdays, and the estimated costs to resolve any future problems for the injured employees. A three-year history of EMR’s below 1.0 tells you that the insurance industry has considered them a lower risk.

Once you have selected a tower service company, you have to decide whether you want to supply the materials for the rework, or for the contractor to obtain the materials. If the contractor is conversant with the requirements we have already covered, and you are confident that they will comply with the requirements, all that remains is a business decision. However, if they are not familiar with the standards requirements that the materials must meet, you may want to provide the materials to protect against any future liability. If the tower fails, and it is determined that materials have been used that did not comply with the standards, liability will fall to the group coordinating the work. It is your responsibility, through due-diligence, to ensure that the materials used are proper and that the work was performed correctly.

As discussed earlier there are several methods that can be used, that are technically correct, to strengthen a communications tower. Common solutions would be to add steel alongside tower legs, add or increase the thickness of diagonal bracing, add or change sizes of guy wires on guyed towers. As mentioned earlier, the combination of methods the engineer chooses will directly affect the cost of the work – both in materials and labor. Additionally the method the engineer recommends to attach the materials to the tower will have a considerable impact on the job – and the tower.

Welding on communications towers has been considered only as a very last resort. Welding historically would only be considered if there was no other method that would allow attaching additional steel to legs or diagonals etc., and then only the absolute minimum welding required, and then only under the most controlled of conditions. There

were several concerns: the structural impact to the tower by welding on the steel with the tower under load, corrosion impact due to the welding process, how to test or certify the welding at heights, and how to find certified welders that are qualified to climb towers.

The safety concerns regarding structural impact relate directly to the skill of the welder. If the structural element being welded is heated too much, it could fail under load. If the leg is heated below the failure point, has the steel strength been changed as a result – possibly causing a failure in the future under high-wind loads? Most importantly – how do you know?

The galvanizing layer must be completely removed from all parts that are to be welded. Failure to do so will result in a poor weld that will not meet minimum standards for strength or durability. Welding on steel pipe will destroy the galvanization protection on the inside of the tower member, rapidly accelerating the corrosion process. Additionally, the welder must know the steel composition of the two parts to be joined to select the correct welding rods. Using the incorrect rod materials can create an inadequate weld and corrosion.

Engineering recommendations do not specify that the welder must be certified, but instead leaves that responsibility with you. It is assumed that you are aware that EAI-222-F requires welding to be done in accordance with AISC or AISI specifications. Both of those standards refer to AWS D1.1, “Structural Welding Code”. They assume you are aware of all the steel standards requirements, and that you must use a certified welder. If you choose to weld on communications towers, you choose to accept the responsibility if the structure fails.

There are several “opportunities” associated with tower modifications or reworks to take on unnecessary liabilities. Those liabilities come from all directions, and it is very important that you take all the steps necessary to protect yourself and your company. The courts take a somewhat lenient approach when someone is found guilty of ignorance. We however are all considered professionals in our industry. As such, failure to perform due diligence and enforce industry rules will likely be treated as negligence. The penalties associated with negligence can be severe for both you as an individual and your company. The information presented within this document is intended to help you identify and develop a plan to protect you from some of those liabilities.