Telecommunications Industry Foundation

The Telecommunications Industry Foundation is pleased to announce publication of the following TIF White Paper:

RELIABILITY OF TELECOMMUNICATIONS STRUCTURES

Publication No.: November 19, 2020

tifonline.org
TIF LinkedIn

NOTICE OF DISCLAIMER AND LIMITATIONS OF LIABILITY

THE TELECOMMUNICATIONS INDUSTRY FOUNDATION (**"TIF"**) DOES NOT ENFORCE OR MONITOR COMPLIANCE WITH THE CONTENTS OF THIS DOCUMENT. ADDITIONALLY, TIF DOES NOT CERTIFY, INSPECT, TEST OR OTHERWISE INVESTIGATE PRODUCTS, DESIGNS OR SERVICES OR ANY CLAIMS OF COMPLIANCE WITH THE CONTENTS OF THIS DOCUMENT.

ALL WARRANTIES, EXPRESS OR IMPLIED, ARE DISCLAIMED, INCLUDING WITHOUT LIMITATION, ANY AND ALL WARRANTIES CONCERNING THE ACCURACY OF THIS DOCUMENT OR ITS CONTENTS, ITS FITNESS OR APPROPRIATENESS FOR A PARTICULAR PURPOSE OR USE, ITS MERCHANTABILITY AND ITS NONINFRINGEMENT OF ANY THIRD PARTY'S INTELLECTUAL PROPERTY RIGHTS. TIF EXPRESSLY DISCLAIMS ANY AND ALL RESPONSIBILITIES FOR THE ACCURACY OF THE CONTENTS HEREIN AND MAKES NO REPRESENTATIONS OR WARRANTIES REGARDING THE CONTENT'S COMPLIANCE WITH ANY APPLICABLE STATUTE, RULE, REGULATION, INDUSTRY STANDARD OR THE SAFETY OR HEALTH EFFECTS OF THE CONTENTS HEREOF OR ANY PRODUCT OR SERVICE REFERRED TO IN THIS DOCUMENT OR PRODUCED OR RENDERED TO COMPLY HEREWITH .

TIF SHALL NOT BE LIABLE FOR ANY DAMAGES, DIRECT OR INDIRECT, ARISING FROM OR RELATING TO ANY USE OF THIS DOCUMENT OR THE CONTENTS CONTAINED HEREIN, INCLUDING WITHOUT LIMITATION ANY AND ALL INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE OR CONSEQUENTIAL DAMAGES (INCLUDING DAMAGES FOR LOSS OF BUSINESS, LOSS OF PROFITS, LITIGATION, OR THE LIKE), WHETHER BASED UPON BREACH OF CONTRACT, BREACH OF WARRANTY, TORT (INCLUDING NEGLIGENCE), PRODUCT LIABILITY OR OTHERWISE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THE FOREGOING NEGATION OF DAMAGES IS A FUNDAMENTAL ELEMENT OF THE USE OF THE CONTENTS HEREOF, AND THESE CONTENTS WOULD NOT BE PUBLISHED BY THE TELECOMMUNICATIONS INDUSTRY ASSOCIATION (**"TIA"**) OR TIF WITHOUT SUCH LIMITATIONS. THE DOCUMENT IS TO BE USED FOR INFORMATION PURPOSES ONLY AND IS INTENDED TO PROVIDE AN OVERVIEW FOR EDUCATIONAL PURPOSES AND TO SOLICIT INPUT FROM THE INDUSTRY.

THIS DOCUMENT IS NOT A STANDARD. THIS DOCUMENT ONLY REPRESENTS THE COMMENTS AND OPINIONS OF THE AUTHORS AND IS NOT INTENDED TO SUPERSEDE, MODIFY OR INTERPRET ANY STATUTE, RULE, REGULATION OR OTHER INDUSTRY OR TIA STANDARD. THE PUBLICATION OF THIS DOCUMENT DOES NOT REPRESENT THE POSITION OR ENDORSEMENT OF TIA OR TIF.

ANTITRUST STATEMENT

THE TELECOMMUNICATIONS INDUSTRY FOUNDATION (**"TIF"**) SUPPORTS FULL COMPLIANCE WITH ANTITRUST AND COMPETITION LAWS. ALL INDIVIDUALS WHO ASSISTED IN THE DEVELOPMENT OF THIS TIF WHITE PAPER AND ANY PARTICIPANTS IN MEETING CONVENED, ORGANIZED OR SUPPORTED BY TIF, INCLUDING BUT NOT LIMITED TO, THE PARTICIPANTS, TIF BOARD OF DIRECTORS, OFFICERS AND EMPLOYEES, TIF COMMITTEE MEMBERS, AND OTHER INVITED GUESTS (TOGETHER, THE "ATTENDEES") ARE EXPECTED TO TAKE ALL REASONABLE MEASURES NECESSARY TO COMPLY WITH APPLICABLE STATE AND FEDERAL ANTITRUST AND COMPETITION LAWS.

ATTENDEES SHOULD NOT DISCUSS OR EXCHANGE INFORMATION OR DATA CONCERNING PRICING, TERMS AND CONDITIONS OF SALE AFFECTING PRICE, INDUSTRY PRICING POLICIES, MARKETING PROCEDURES, ALLOCATIONS OF FUNDS, CUSTOMER LISTS, RESTRICTIONS ON TYPES AND QUANTITY OF PRODUCTS AND SERVICES, REFUSALS TO DO BUSINESS WITH CERTAIN SUPPLIERS OR CUSTOMERS, OR OTHER SIMILAR TOPICS. FURTHER INFORMATION CONCERNING TIF'S ANTITRUST POLICY IS AVAILABLE UPON REQUEST

TABLE OF CONTENTS

PREAMBLE

This TIF White Paper was created to address the telecommunications industry's approach to reliability of towers, monopoles, antenna supporting structures and other communication facilities (each, a **"Telecommunications Structure"**). In alignment with TIF'S educational goals, the authors' intent is for this TIF White Paper to be utilized as a resource document for education of jurisdictions, code enforcement officers, and landowners.

CHAPTER I
DESIGN STANDARDS FOR TELECOMMUNICATIONS STRUCTURES

The following codes and standards are believed to be applicable to the design, analysis, manufacture, installation and construction, modification, and maintenance of Telecommunications Structures. It should be noted that within these code and standards are reference to other codes and standards that the licensed engineer must apply. This list is not exhaustive and individual implementers are encouraged to conduct their own due diligence. The following information should be considered as an aid in researching requirements.

- International Building Code (**"IBC"**):
    - The IBC is a model code that provides minimum requirements to safeguard the public health, safety, and general welfare for occupants of new and existing buildings and structures.
    - The IBC addresses structural strength, means of egress, sanitation, adequate lighting and ventilation, accessibility, energy conservation, and life safety for new and existing buildings, facilities and systems.
- ANSI/TIA-222: Structural Standard for Antenna Supporting Structures, Antennas and Small Wind Turbines Support Structures:
    - This standard provides guidance concerning: (a) minimum load requirements as derived from ASCE 7, 'Minimum Design Loads for Buildings and Other Structures'; and (b) design criteria as derived from AISC-360, 'AISC Specification for Structural Steel Buildings' and ACI 318, 'Building Code Requirements for Structural Concrete'.
- ANSI/TIA-322: Loading, Analysis, and Design Criteria Related to the Installation, Alteration and Maintenance of Communication Structures:
    - The objective of the standard is to provide minimum loading, analysis, and design criteria related to the installation, alteration, and maintenance of Telecommunications Structures.
- ANSI/ASSP A10.48: Criteria for Safety Practices with the Construction, Demolition, Modification, and Maintenance of Communications Structures:
    - This standard establishes minimum criteria for safe work practices and training for personnel performing work on communication structures including antenna and antenna supporting structures, broadcast and other similar structures supporting communication related equipment.

The IBC is widely accepted as the model code in the United States. Each state adopts the IBC version on different cycles. At this point most states accept either the 2012, 2015, or 2018 IBC. The 2012 and 2015 IBC reference the ANSI/TIA-222-G as the design standard for Telecommunications Structures and the 2018 IBC references ANSI/TIA-222-H as the design standard. Meanwhile, ANSI/TIA-222-H references both ANSI/TIA-322 and ANSI/ASSP A10.48. The ANSI/TIA-322 and ANSI/ASSP A10.48 cross reference each other.

CHAPTER II
RISK AND RELIABILITY OF TELECOMMUNICATIONS STRUCTURES

ANSI/TIA-222 requires that each Telecommunications Structure be assigned a Risk Category based on reliability requirements. These four (4) Risk Categories are consistent with the methodology used in ASCE 7 and are used when determining the final design loads from wind, ice and earthquakes. The reliability requirements used to determine the appropriate risk category for a Telecommunications Structure are determined by examining the consequence of a structural failure to human life (welfare), surrounding structures, and the impact to the network while considering the type and quantity of primary services. As risk categories increase from I to IV, the loading requirements increase as well.

- The building codes and standards discussed in Chapter I endeavor to mitigate risk to a reasonable level to ensure all structures are functional and economically viable.
- Loads are adjusted based on code and standard defined Risk Category / Structure Class.
    - An example would be when a wind speed for a specific Telecommunications Structure increases from 105 mph Risk Category I to a 115 mph Risk Category II. There is a 20% increase in wind forces on the Telecommunications Structure, which, is a proportional increase in the required load (NOTE: for further information regarding Risk Category definitions, please reference the TIF White Paper entitled '*Risk Categorization in Accordance with ANSI/TIA-222-H and the 2018 IBC*').
- Code and standard requirements include built-in safety factors that result in Telecommunications Structures designed to withstand more loading than the maximum expected loads.
- Failure in an analysis based on the loading from building codes is not the same as actual damage to a structure.
- Risk is inherent in all types of structures and reliability must be evaluated through a different lens with respect to Telecommunication Structures. Like skyscrapers, elevated water tanks, bridges, school buildings, and other non-telecommunications facilities (together, **"Commercial Structures"**), Telecommunication Structures are designed to meet reliability requirements set forth in building codes and standards enacted at the time of construction. However, unlike Commercial Structures, when significant changes occur to a Telecommunications Structure, a reanalysis is required based on contemporary building codes and standards. This adherence to updated building code standards occurs anytime an alteration to a Telecommunications Structure (e.g. antenna replacement or addition) occurs which meets the definition of a changed condition (TIA-222-H, Sections 15.3 – 5)
- The IBC outlines situations deemed a significant change that require an analysis be completed in the latest code. The ANSI/TIA-222 standard adopted by the IBC tends to be more stringent for Telecommunications Structures; e.g. almost all loading changes are deemed a "changed condition" and require an analysis be completed under the latest building code and standards.
- Frequent reanalysis of Telecommunications Structures with most recent codes and standards create certainty regarding the current structural conditions and reliability targets.

Both Telecommunications Structures and other Commercial Structures are designed to meet code requirements, withstand the applicable environmental loads and support the weight of people and equipment. The tall, slender configurations of towers and lack of public access results in controlling load considerations that are much different from typical Commercial Structures. Unlike typical Commercial Structures where the weight from large groups of people ('live load') or drifting snow loads on roof

structures are a critical design consideration, on Telecommunication Structures the weight of individuals and equipment has a relatively minimal effect while the increased wind area from ice accumulation can be a controlling design factor.

Additionally, due to the frequent reanalysis that Telecommunications Structures must go through based upon changed conditions, there are distinct differences in the design process. For example, typical Commercial Structures are designed by an engineer and the design is intended to include any future loading that it may encounter during its design life. Rarely will a Commercial Structure be checked for a change in use that wasn't anticipated in the original design such as a tenant finish (or refinish) in an office building, i.e. the entire Commercial Structure would not typically be reanalyzed for these changed conditions. Conversely, Telecommunication Structures are generally designed for a specific quantity and size of equipment. However due to technology changes and increased coverage requirements, equipment on Telecommunications Structures are commonly added or replaced. These changes to equipment cause a change in loading on the Telecommunications Structure, which, as discussed above, requires a reanalysis under the most recent building codes and standards.

Regardless of the design considerations, Commercial Structures and Telecommunications Structures must comply with the prescribed codes and standards. Because Telecommunications Structures are generally much taller than surrounding buildings, this causes them to visually stand out from adjacent structures and surrounding landscapes and, in doing so, these tower structures tend to receive undue scrutiny even though they are designed to the same codes and standards as the buildings.

CHAPTER III
MAINTENANCE AND CONDITION ASSESSMENT PROGRAMS

In addition to the Risk Category and reliability factors considered during the design and analysis of Telecommunications Structures, it is standard practice to perform periodic assessment and maintenance utilizing the maintenance and condition assessment requirements of ANSI/TIA-222-H. This standard also sets requirements for post-modification inspections of upgrades to Telecommunications Structures. The maintenance program outlined in Rev. H consists of regular intervals of assessments to determine the existing condition of a Telecommunications Structure and provide guidelines to maintain compliance with the standard. ANSI/TIA-222-H outlines the necessary inspection and assessment items as noted below:

- ANSI/TIA-222-H Section 14: Maintenance and Condition Assessment:
    - Guidelines for completion of a maintenance and condition assessment are provided in ANSI/TIA-222-H Annex J: Maintenance and Condition Assessment (Normative).
    - Recommends three (3) year intervals for guyed masts and five (5) year intervals for self-supporting structures.
    - Recommends a condition assessment be performed after severe wind and/or ice storms, severe seismic events, or other extreme conditions.
    - Shorter intervals may be required for Risk Category III or IV structures, and structures in coastal regions, corrosive environments, and in areas subject to frequent vandalism.
    - Specifically notes guy anchor shafts with steel in direct contact with soil shall be assessed in accordance with a corrosion management plan based on site-specific corrosion conditions.

- ANSI/TIA-222-H Annex N: Initial Construction Inspection (Normative):
    - Recommends foundation and grounding be inspected to ensure compliance with the design drawings and specifications.
    - Annex J Recommends a maintenance and condition assessment be performed within one hundred eighty (180) days of installation.

When a Telecommunications Structure requires structural upgrades to maintain compliance with ANSI/TIA-222-H, the upgrades are inspected to confirm conformance with the design documents. The requirements for modification inspections are outlined in ANSI/TIA-222-H Section 15 and also in Annex O - Existing Structures Modification Inspection (Normative).

Structure condition is also assessed during touch points outside of regularly scheduled maintenance and condition assessment programs. Telecommunications Structures are climbed for carrier equipment maintenance and installation as well as lighting maintenance. Climbing crews regularly assess and report any issues that could lead to future maintenance or reliability issues. These touch points typically occur in addition to and more frequently than the ANSI/TIA-222-H maintenance and condition assessments intervals indicated above.

CHAPTER IV
RELIABILITY DURING CONSTRUCTION, MODIFICATION, & MAINTENANCE

The reliability of a Telecommunications Structure during construction, modification, and maintenance is addressed by three standards working in conjunction with one another. These standards are: (i) ANSI/TIA-222-H (ii) ANSI/TIA-322; and (iii) ANSI/ASSP A10.48. The structural analysis and design of the Telecommunications Structure to resist extreme climatic loads is contemplated by ANSI/TIA-222-H and considers both existing and to be installed wireless equipment. Results of the structural analysis may indicate strengthening upgrades are needed to meet the design requirements, in which case a modification design with construction drawings will be developed to remediate any potential deficiencies. Other construction drawings are typically completed to communicate the wireless equipment to be installed to support the wireless or broadcast network.

Once construction drawings are completed, a contractor then utilizes the ANSI/ASSP A10.48 to develop a work plan, commonly referred to as a **“Rigging Plan”**, which is focused on the planning and execution of the scope of work described in the construction drawings. ANSI/ASSP A10.48 specifically governs the contractor’s Rigging Plan, which includes their means and methods. This Rigging Plan ensures a safe working environment on and around the Telecommunications Structure. ANSI/ASSP A10.48 works in harmony with ANSI/TIA-322 which allows a qualified engineer to support the contractor with a review of the contractor’s Rigging Plan.

ANSI/TIA-322 would then be used to ensure the Telecommunications Structure remains stable during all sequences of the construction process. Specific references from ANSI/TIA-222-H are used in ANSI/TIA-322 to evaluate the impact of the construction loading under different climatic conditions during construction work. The process of utilizing ANSI/ASSP A10.48 and ANSI/TIA-322 in conjunction with one another ensures that structure reliability is maintained for the contractor completing the work and that the Telecommunications Structure will remain stable and not sustain damage during upgrade.

CHAPTER V
SUMMARY

This TIF White Paper has provided an overview of the current building codes, industry standards, and design documents that are applicable to the construction, modification, and maintenance of a Telecommunications Structure. These include the IBC, commonly referred to as the model code, which purports to safeguard the health, safety, and general welfare of occupants while identifying subsequent codes and standards. Industry and structure specific standards discussed include: (i) ANSI/TIA-222-H: Structural Standard for Antenna Supporting Structures; (ii) ANSI/TIA-322: Criteria Related to the Installation, Alteration and Maintenance of Communication Structures; and (iii) ANSI/ASSP A10.48: Safety Practices with the Construction, Demolition, Modification and Maintenance of Communications Structures. Together, these standards represent the engineering standard of care for the telecommunications industry.

Along with the aforementioned standards, the reliability and risk criteria for Telecommunications Structures are developed through the ASCE 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures. ASCE 7 is referenced in the IBC and is integrated into most structural codes in the United States. The engineering guidelines for all buildings and structures endeavor to mitigate risk by assigning a Risk Category proportional to the impact caused by potential damage. However, engineering guidelines for Telecommunications Structures must also evaluate the type of loads, structure slenderness, and network redundancy. Both Commercial Structures and Telecommunications Structures are designed by licensed engineers; however, Telecommunications Structures receive the benefit of frequent re-analysis which results in a review of a Telecommunications Structures pursuant to the latest building codes and standards rather than staying “grandfathered” like many Commercial Structures.

Additionally, this TIF White Paper has discussed both the prescriptive and normative maintenance and inspection requirements set forth in ANSI/TIA-222-H and outlines the common practice of maintenance condition assessment and implementation of modifications to a Telecommunications Structure, which includes proper documentation of structural parameters, upgrades, and maintenance. The maintenance and inspection programs also plan for and proactively address remediation concerns to keep Telecommunications Structure safe and stable through multiple touch points of both the tenants and owner.

It is worth noting that the idea of a Telecommunications Structure having a “fall zone” has surfaced in some jurisdictions, zoning boards, lenders, and other similar groups based on the premise that a Telecommunications Structure could become overstressed and collapse. However, as clarified in the foregoing discussions, this concept does not have any more merit than the same concern being applied to other properly engineered Commercial Structures such as buildings or utility structures having a “fall zone”. To assume that Telecommunications Structures would fail at any theoretical weak point or connection is no more logical than assuming the exact failure mechanism of any other Commercial Structure subjected to a code level load event. In actuality, because Telecommunications Structures go through frequent re-analysis under current building codes and standards, and assuming routine inspection and maintenance upgrades per TIA-222-H Section 14, their reliability is at a minimum equivalent to other Commercial Structures. Additionally, the basis of fall-zone letters or analyses does not increase the reliability of the subject structure or any other surrounding structures.

RELIABILITY OF TELECOMMUNICATIONS STRUCTURES

Communities with Telecommunications Structures can and should have the same level of comfort with these structures that they do with other tall Commercial Structures. Living or working adjacent to a Telecommunications Structure should not elicit more concern than walking past one of the many high-rise buildings commonly encountered in cities across the country. The knowledge that licensed engineers have designed, frequently reanalyze, and physically evaluated Telecommunications Structures should alleviate any concerns about the reliability of them, as should the long history of reliability from the more than 300,000 Telecommunications Structures designed to and maintained to the above-mentioned standards and codes.