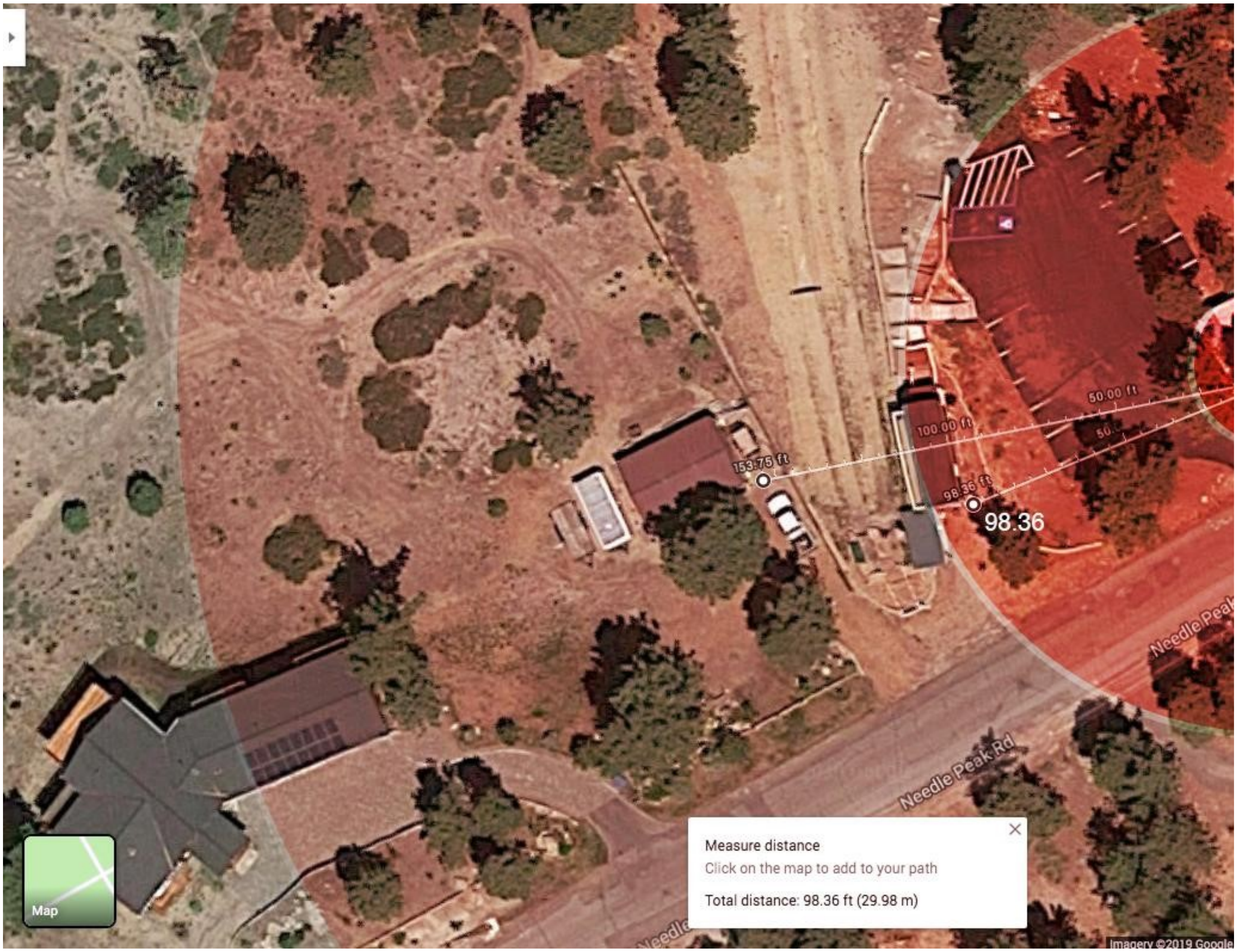
Scott Carey

From: Renuka Ray <renuka.ray@freedommail.ch>
Sent: Tuesday, November 1, 2022 8:12 PM
To: Scott Carey
Subject: NTRPA Governing Board Meeting [11/03/2022] {{Item 2 Public Comment}}
Attachments: Fall Zone.pdf; Classification of Tower Structures per ANSI-TIA-222-G, IBC, and ASCE 7.pdf

Dear NTRPA Governing Board;

I was never mailed any notice that there would be a hearing on the Ski Run Tower. I just learned about it the afternoon of the hearing when I was at work. I hear this is a common experience all around the entire Tahoe Rim. I really want you to consider this comment so that more towers—such as those proposed for Incline Village and Zephyr Cove—do not suffer the same lack of proper planning.

The tower is proposed to be 112 feet tall with a statutorily and regulatory pre-authorized allowance for extension to ~135 feet (47 U.S.C. § 1455(a); 47 C.F.R. § 1.6100(b)(7)(i)). If this tower were to fall over, it could fall upon and kill residents inside their own dwellings:



The affected properties are some of the Needle Peak Condominiums and a lodging structure currently being used for human habitation on the Hansen's Resort property.

Moreover, recently uploaded project plans reveal that the 12-story tower will be loaded with 10,000 pounds of faux plastic needles in a futile attempt to disguise the gargantuan tower as a "tree." However, none of the structural loading calculations for the tower accounted for snow, ice, and hoar frost loading which will be substantial considering the extreme surface area to weigh ratio of the faux plastic needles. Pine trees regularly uproot and fall over each winter due to such extreme ice and wind loads. This was missed by the perpetually sunny San Diego cell tower design firm(s) who rarely if ever encounter "extreme alpine winter constraints" within their southwestern regional business jurisdiction.

The tower's "[Class II design]" by definition proves it will not be built to [the "class" specification required for towers] within the "[fall zone]" of human habituated structures. This was completely overlooked by the City and the TRPA. A failure need not directly crush an inhabitant in order to result in fatality. The tower may crush a critical beam or other failure point of their dwelling structure which would then trigger its full or partial collapse upon inhabitants. The tower may also knock down any one of a number of intermediary trees which could in-turn directly crush the building's residents.

There has been yet another severe failure here by the regional and local regulatory agencies to consider a significant aspect of the problem. This is an industrial facility and design class being inappropriately erected in a dense residential area.

Thanks,

Renuka Ray

From: Monica Eisenstecken
To: Sue Blankenship
Subject: Fw: Tomas prints
Date: Thursday, January 9, 2020 5:02:01 PM

please put in the record for 1360 Ski Run Blvd, thank you, Monica Eisenstecken

The measurements in the application are incorrect. The application was approved by the planning department with inaccurate measurements. Here are more accurate measurements.

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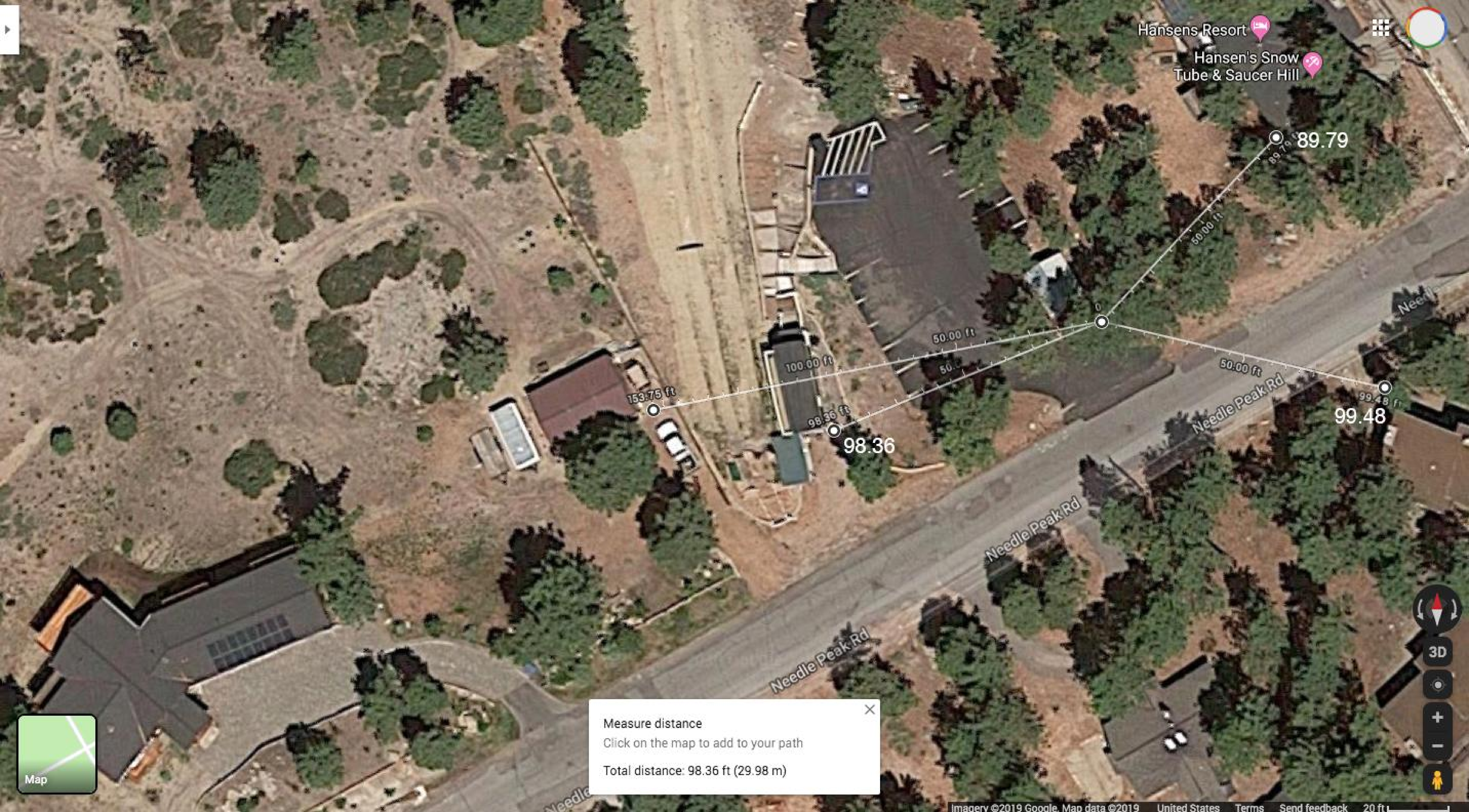

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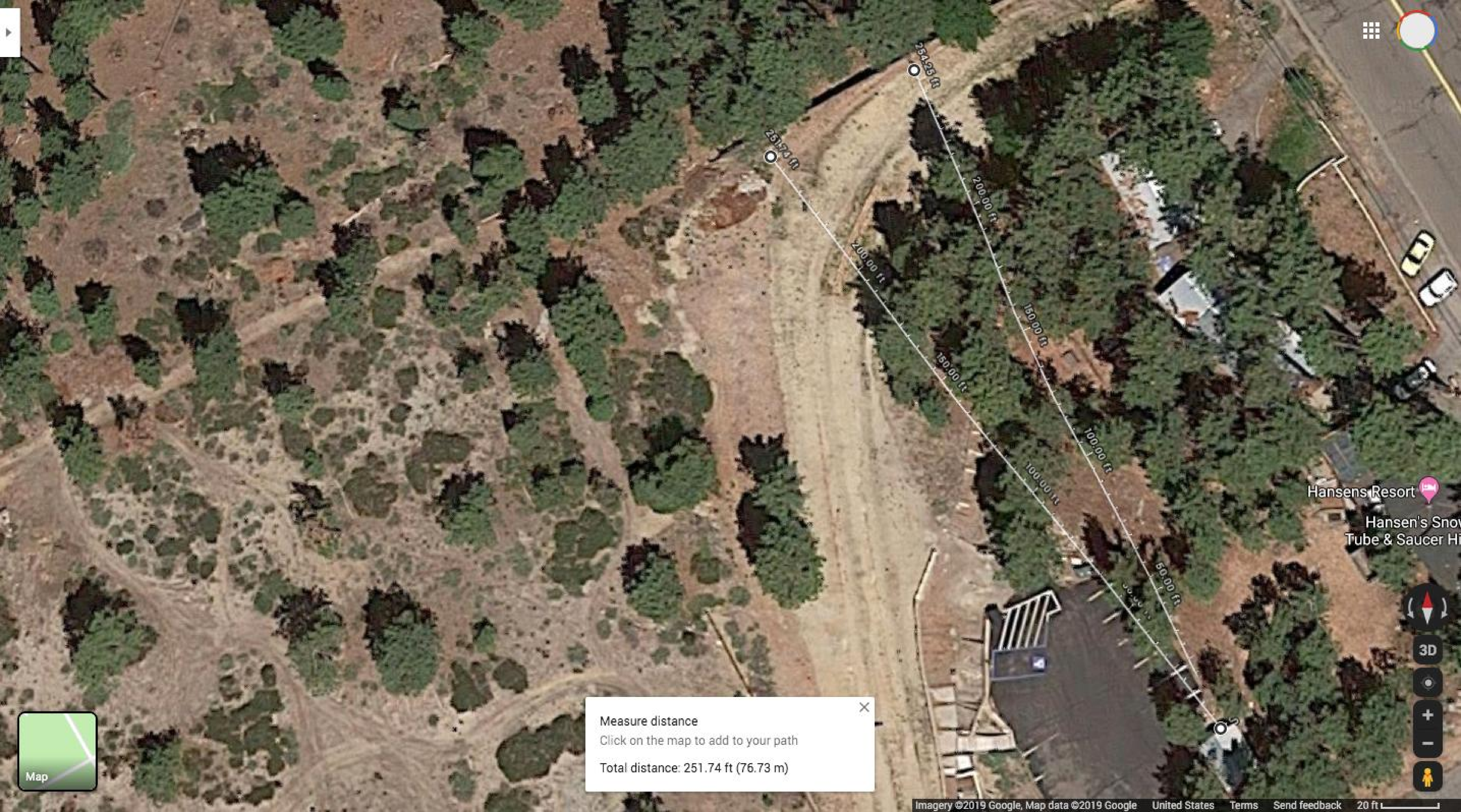

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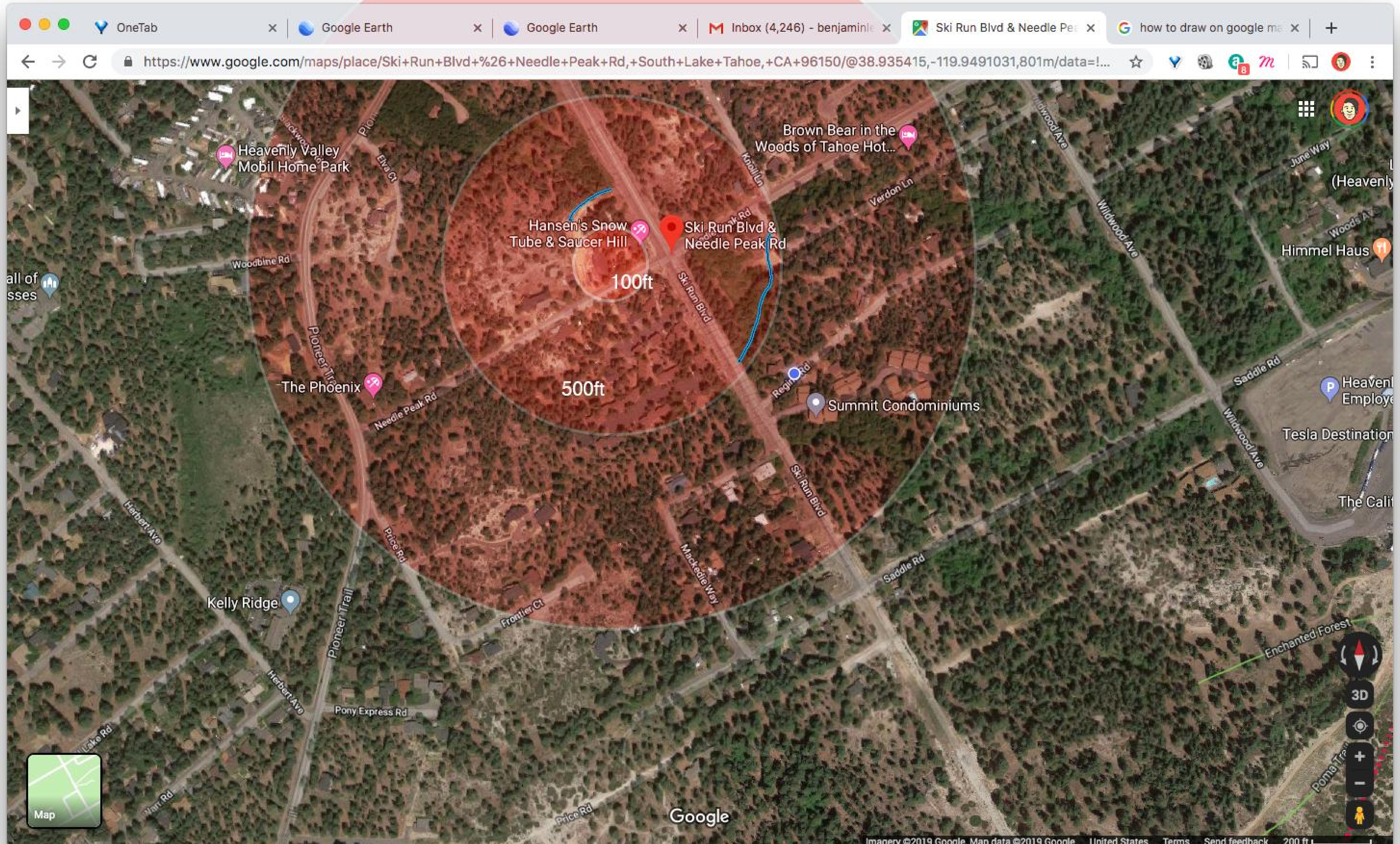
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Brown Bear in the Woods of Tahoe Hot...
Hansen's Snow Tube & Saucer Hill
Ski Run Blvd & Needle Peak Rd
100ft
500ft
Himmel Haus
The Phoenix
Summit Condominiums
Tesla Destination
Kelly Ridge
Woodbine Rd
Pioneer Trl
Needle Peak Rd
Ski Run Blvd
Verdon Ln
Knoll Ln
Wildwood Ave
Saddle Rd
Price Rd
Frontier Ct
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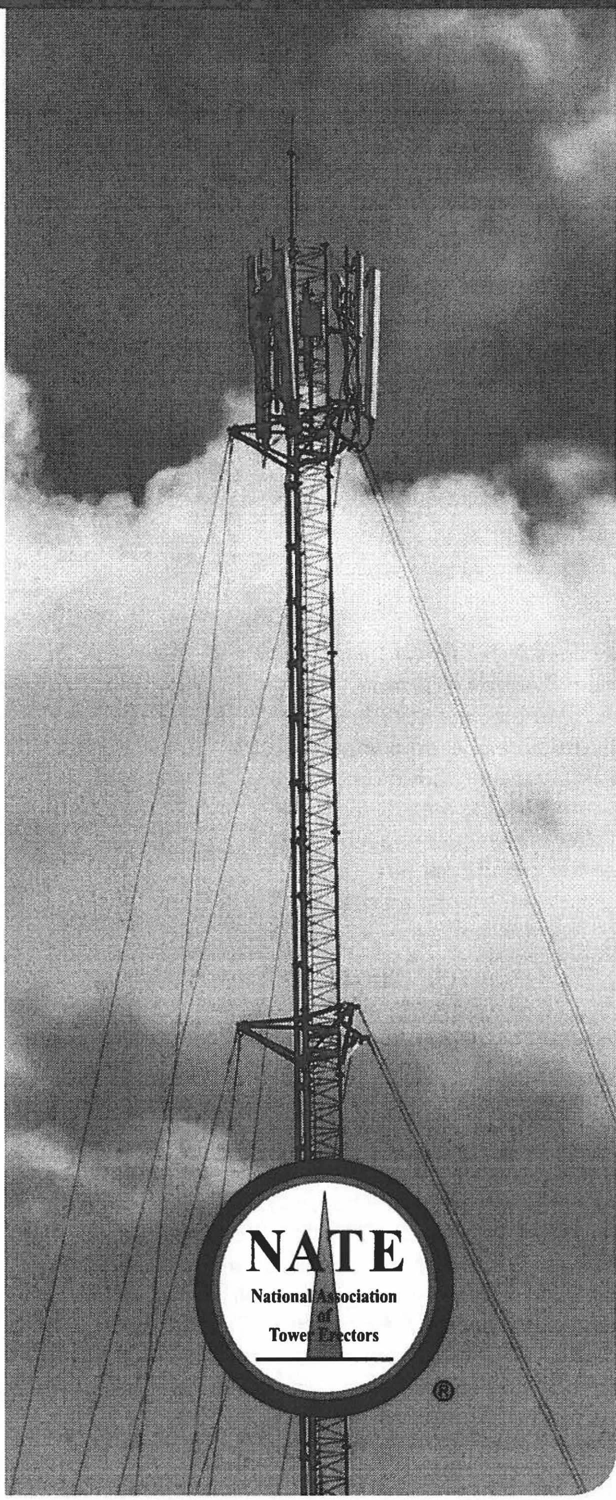

Classification of Tower Structures per ANSI/TIA-222-G, IBC and ASCE 7

Preface

Application of ANSI/TIA-222-G structure classes to communication tower design and analysis is frequently misapprehended. Risk categorization established within ASCE 7 and IBC are historically related to building occupancy among other factors has inconsistent correlation to communication tower use and function. Furthermore, the comprehensive application of Class III categorization to communication towers with the intention of increasing the reliability of wireless networks during emergency situations frequently fails to achieve the desired result and does not match the intent of the ANSI/TIA-222 Standard, as accepted by the IBC.

This white paper explains structure classification relationships between ANSI/TIA-222-G, *Structural Standard for Antenna Supporting Structures and Antennas, the International Building Code*, and ASCE 7, *Minimum Design Loads for Buildings and Other Structures*. It identifies the variables involved in structure classification and further defines how those requirements are to be applied per requirements with ANSI/TIA-222-G.

Definition of Structure Class – ANSI/TIA-222-G

The definition of Structure Class, per ANSI/TIA-222-G, with additional commentary by the authors, is provided below:

ANSI/TIA-222-G Definitions:

Structure Class I:
Structures that due to height, use or location represent a low hazard to human life and damage to property in the event of a failure and/or used for services that are

CONTINUED ON PAGE 46

Authors: **Bryan Lanier, P.E., S.E., C.W.I.** (Senior Manager, Operations Engineering – American Tower Corporation), **William Garrett, PE, SECB,** (Chief Engineer – American Tower Corporation). The members of the PAN Advisory Group who are involved in the writing and researching each PAN topic include: **John Erichsen Principal EET PE,** Chairman TIA committee TR 14), **Scott Kisting** (Senior Vice President – MUTI-Sabre Industries Telecom Services), **Richard Cullum** (Program Manager – Crown Castle), **Jeremy Buckles** (Safety and Compliance Officer – International, SBA Communications Corporation), **Craig Snyder** (President, Sioux Falls Tower & Communications), and **Stephanie Brewer** (Compliance Coordinator – MUTI-Sabre Industries Telecom Services).

LEGAL COMMITTEE ITEM NO. 3 &
AGENDA ITEM NO. VIII. A.

welfare associated with damage or failure by nature of occupancy or use. Once Risk Category is established, importance factors are to be applied based on ASCE 7-10, Table 1.5-2. These importance factors are included in the derivation of design loads for flood, wind, snow, earthquake, and ice applied to the structure during design and analysis. The different Risk Categories can be paraphrased/commented as follows:

Risk Category I: Failure results in low hazard to the public.

Risk Category II: Structures that do not fall within Risk Categories I, III and IV.

Risk Category III: Failure results in a substantial risk to the public. These structures can be thought of as being needed during times of emergency (e.g. hospitals, police stations, water treatment facilities) or supporting large population centers (e.g. malls, schools). Failure, while creating significant problems to the public, can be remediated. These structures can be considered as an essential facility.

Risk Category IV: Failure results in substantial hazard to the public. Failure of these structures typically means harm to the public extends well beyond the site of the failure. Often remediation cannot be completed due to the nature of the failure (e.g. nuclear facility). Failure of these structures also typically ensures failure of additional multiple systems critical to the public (e.g. loss of power results in loss of water and transportation). These structures can be considered as an essential facility.

Previous versions of the ACSE-7 used a parameter called Occupancy Category to define the appropriate risk category of a building or other structure. Occupancy Category, as used within the building codes, relates primarily to issues associated with life, safety, and fire protection across a number of building systems, like electrical, mechanical, etc. This use has caused some confusion as Risk Category's purpose is to appropriately derive the expected reoccurrence of environmental loads (wind, earthquake, ice, etc.) and the risks associated with structural failure.

Chapter 16 of the International Building Code addresses Risk Category within section 1604.5. The section is brief and relies on interpretation of the nature of occupancy in order to assign the appropriate risk cate-

CONTINUED ON NEXT PAGE

defined difference between essential communications or Class III structures with limited or zero redundancy and Class II structures that deliver inherent redundancy.

Conclusion

Structure Class definitions have been incorporated into the ANSI/TIA-222 Standard to provide accurate and reasonable classification of tower structures. The IBC specifically recognizes the ANSI/TIA-222 Standard as the guideline for communication tower design and analysis and fundamentally accepts the ANSI/TIA-222 structure classification as the basis required for telecommunication and broadcast towers. Use of the ANSI/TIA-222-G definitions allows for more appropriate application of assessing risk, when considering factors like public safety, service and network redundancy.

Inherent redundancy exists in the vast majority of wireless tower supported networks, including networks that support emergency services such as E911. Because of this redundancy, application of higher structure classes to individual towers typically has little effect on the resiliency of overall network performance. Although a significant total of the population may be potentially (or "be" here) impacted by the loss of service of a wireless provider, the loss of an individual wireless site does not consistently compromise the entire wireless network, nor eliminate the service provided in a specific location. Therefore, the potential impact to the public typically is actually very small, as opposed to what might initially be estimated.

Higher structure classes may be warranted when the failure of the tower implies significant physical consequences to the surrounding area, affects essential services, such as water, power, transportation, etc. or when loss of specific wireless service at a location significantly comprises the overall network or eliminates designated emergency service in a specific geographic location.

In effort to truly enhance the reliability of a wireless site in these scenarios, strengthening of all aspects of the wireless network, including individual antennas, mounts and connections, coax or fiber lines (backhaul for data), back-up power, water intrusion resiliency, and radio cabinet design is likely appropriate. Instituting a Structure Class III requirement only on the tower structure would likely result in a non to minimal improvement in reliability in comparison to the expectation of overall improved network performance and reliability. ■

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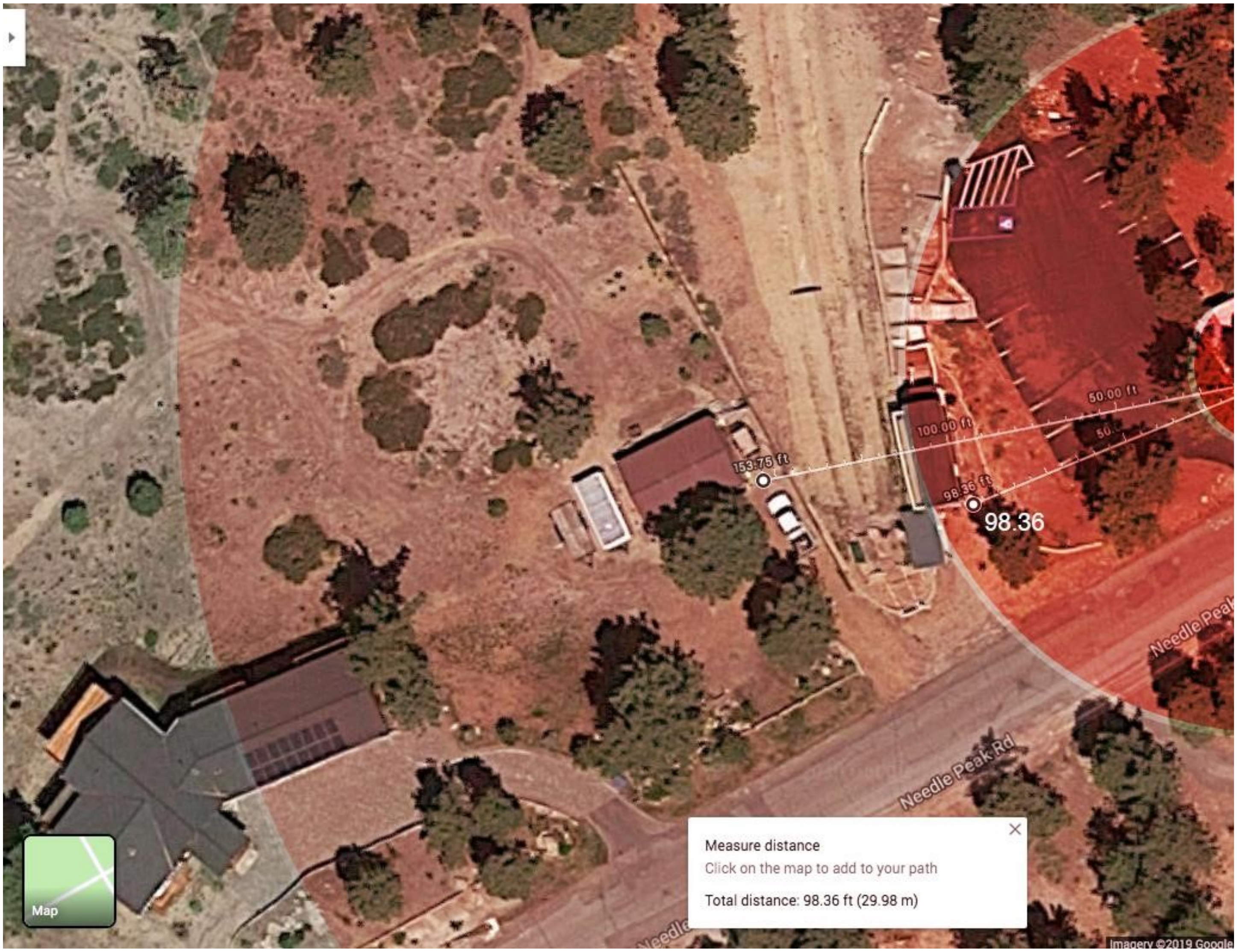

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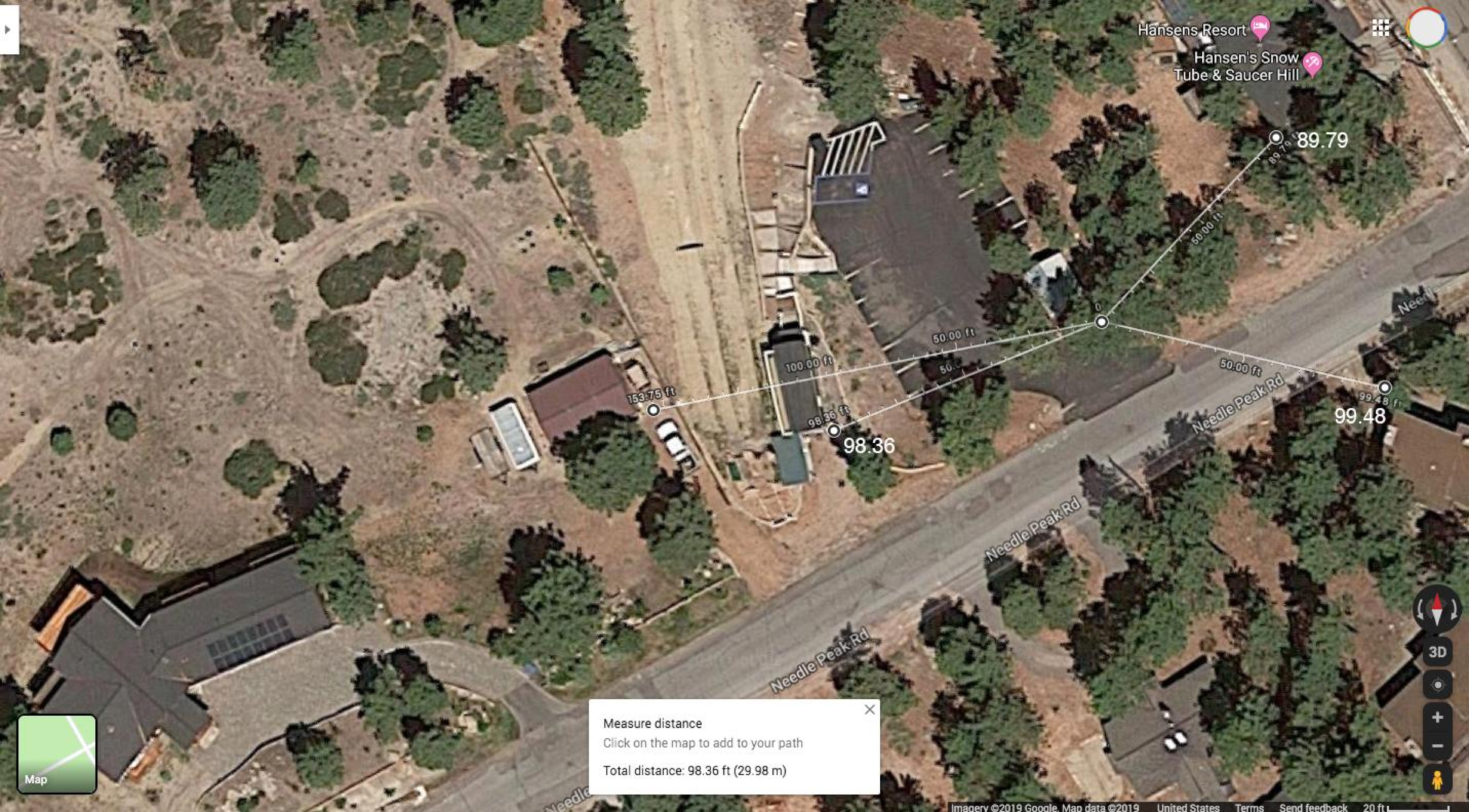

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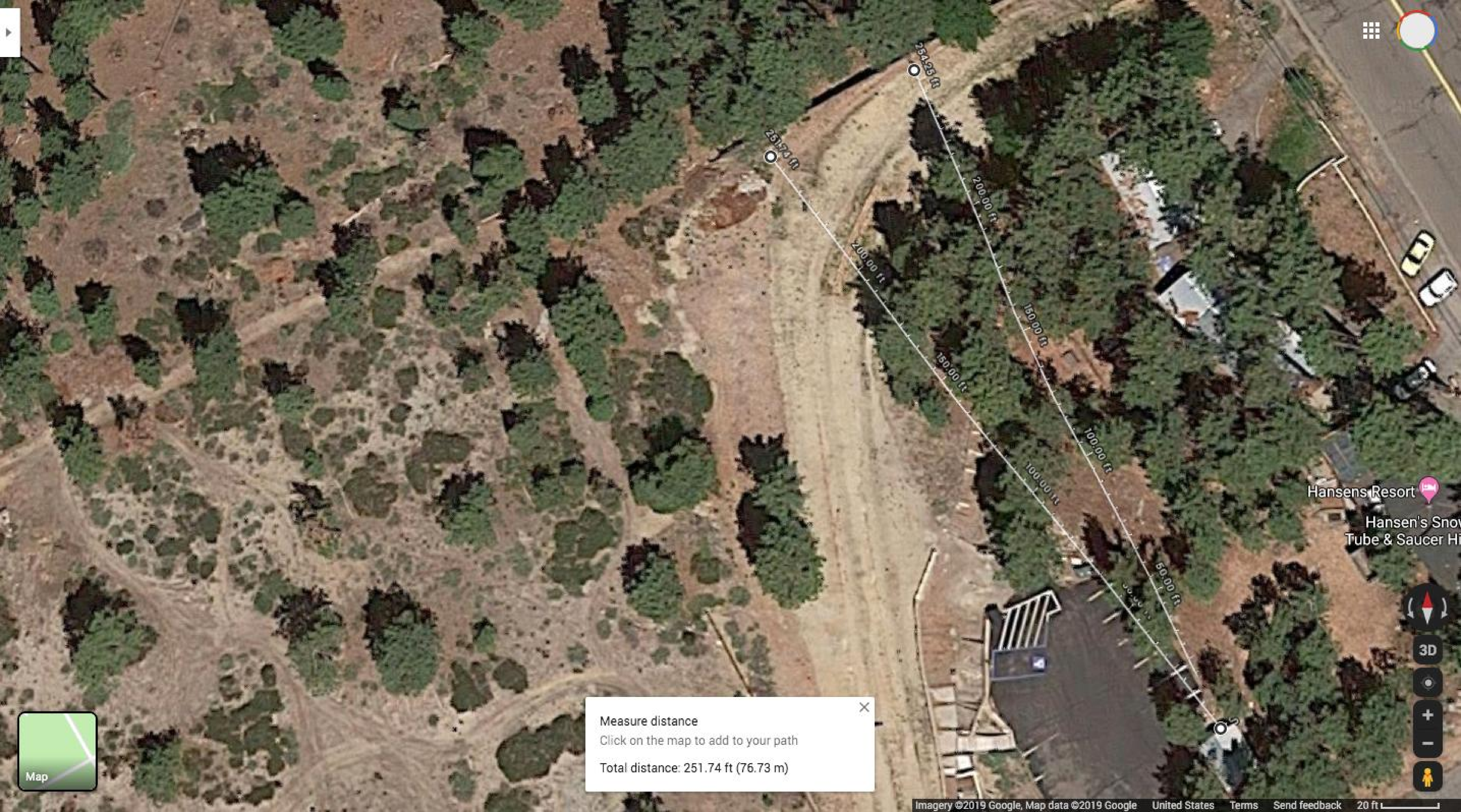

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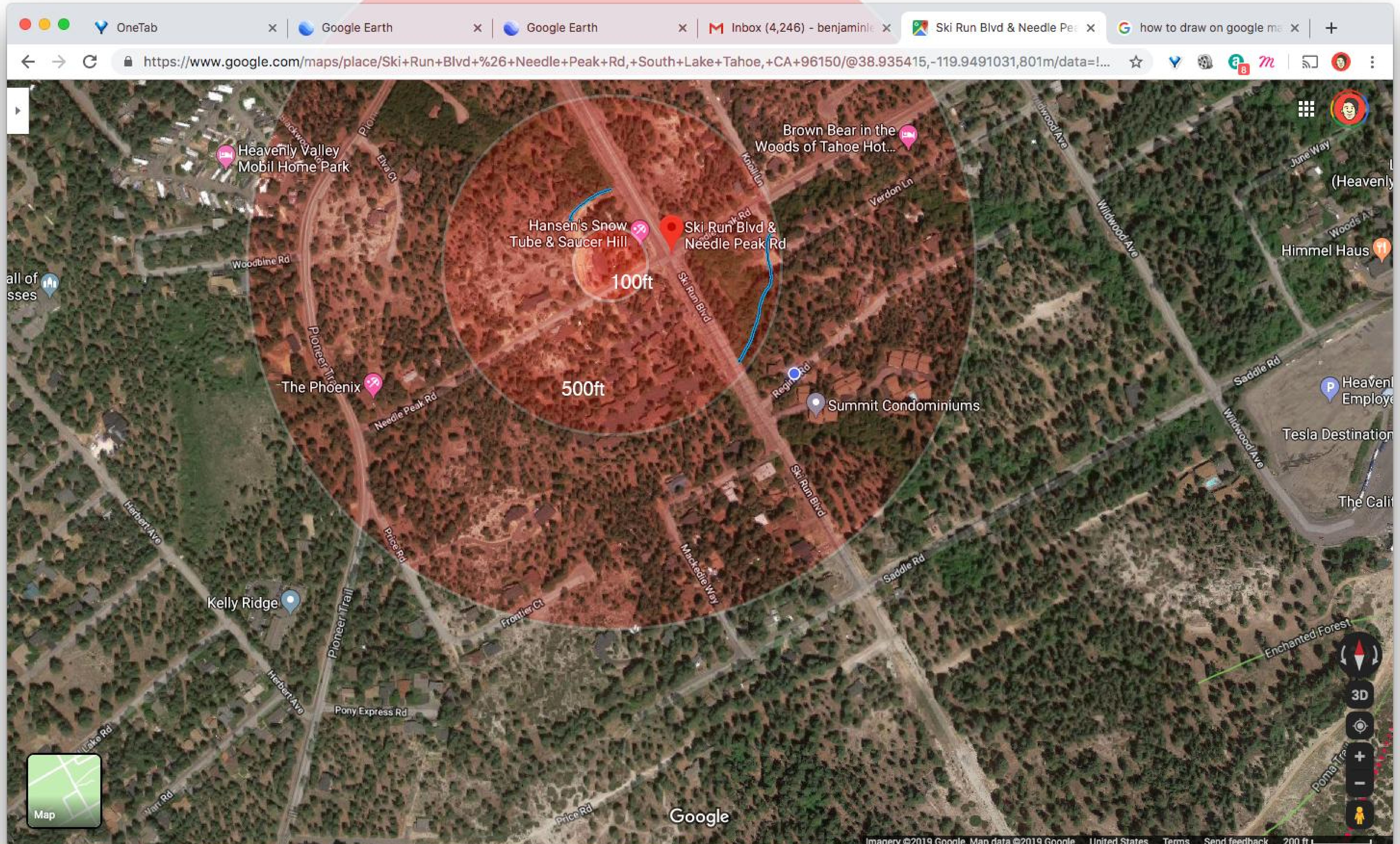

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Classification of Tower Structures per ANSI/TIA-222-G, IBC and ASCE-7

White Paper

Authored by:
William Garrett, PE, SECB
Bryan Lanier, PE, SE

May 2017

Preface

Application of ANSI/TIA-222-G structure classes to communication tower design and analysis is frequently misapprehended. Risk categorization by building officials and jurisdictional authorities with respect to communication towers often flows directly from baselines established within ASCE-7 and IBC that are historically related to building occupancy or other factors that have little correlation to communication tower use and function. Further, the comprehensive application of Class III categorization to communication towers with the intention of increasing the reliability of wireless networks during emergency situations frequently fails to achieve the desired result and does not match the intent of the TIA-222 Standard.

This paper is intended to identify the variables involved in structure classification and further define how those requirements are to be applied. The paper lists a simplified and consolidated approach to tower structure classification and is presented as a reference for interested bodies or authorities. The paper encompasses structure classification relationships between ANSI/TIA-222-G, Structural Standard for Antenna Supporting Structures and Antennas, the International Building Code, and ASCE 7, Minimum Design Loads for Buildings and Other Structures.

The authors of this publication have a combined 40 plus years of experience designing new and analyzing existing wireless infrastructure; specifically telecommunication towers. Their careers encompass work considering the perspective of the infrastructure owner, manufacturer, jurisdictional representative and wireless provider. The authors are licensed in 48 states, including PE and SE registrations and are active participants within various NCSEA (http://www.ncsea.com/) and TIA (http://www.tiaonline.org/all-standards/committees/tr-14) committees.

Definition of Structure Class –ANSI/TIA-222-G

The definition of Structure Class, per ANSI/TIA-222-G, with additional commentary by the authors, is provided below:

ANSI/TIA-222-G Definitions:

Structure Class I: Structures that due to height, use or location represent a *low* hazard to human life and damage to property in the event of a failure and/or used for services that are optional and/or where a delay in returning the services would be acceptable.

Section A.2.2 further defines Class I structures: Structures used for services that are optional or where a delay in returning the services would be acceptable such as: residential wireless and conventional 2-way radio communications; television, radio and scanner reception; wireless cable; amateur and CB radio communications.

Commentary: Failure of the structure defined as Structure Class I typical only affects the owner, although service provided may affect other users. Human life is essentially not at risk and the public well-being is largely unaffected by tower failure.

Structure Class II: Structures that due to height, use or location represent a *significant* hazard to human life and/or damage to property in the event of failure and/or used for services that may be provided by other means.

ANSI/TIA-222-G, Addendum 2 Annex A Section A.2.2 further defines Class II structures based on reliability criteria: Structures used for services that may be provided by other means such as: commercial wireless communications; television and radio broadcasting; cellular, PCS, CATV, and microwave communications.

Commentary: Failure of a structure defined as Structure Class II presents significant hazard to human life and/or property if a tower fails. Significant with respect to human life means failure of the structure could result in injury or casualties, but it's very limited in practicality (e.g. someone was on the tower at the time or tower happened to collapse onto persons, during an extreme climatic event (wind, ice or seismic event)). Significant with respect to property means property surrounding the tower could be damaged or destroyed. With respect to reliability, the phrase "Used for services that may be provided by other means" signifies redundancy of service. This redundancy is present in almost all public wireless service, including E911 networks.

Structure Class III: Structures that due to height, use or location represent a *substantial* hazard to human life and/or damage to property in the event of failure and/or used primarily for *essential* communications.

ANSI/TIA-222-G, Addendum 2 Annex A Section A.2.2 further defines Class III structures based on reliability criteria: Structures used primarily for essential communications such as civil or national defense, emergency, rescue, or disaster operations, military and navigation facilities.

Quantification of "primarily" can be surmised as follows:

Number of Attaching Entities Rule is Met: If the majority of the attaching entities on a tower structure offer essential communications, the tower structure should be classified Class III. However, if redundancy exists and the communication service can be supported/filled by a neighboring tower, the structure shall be designated CLASS II.

Commentary: With respect to reliability, Class III structures represent towers for which the owner / provider cannot tolerate any loss of the network / signal, due to either types of services provided or zero redundancy existing in the network. Beyond zero redundancy, failure could also potentially impact other services, such as power, water, transportation, etc. that are considered essential to human life. Finally, Structure Class III can be defined as when a high risk to life/safety exists in the event of a failure of the structure. The risk is exemplified when the public venue is not mobile (e.g. hospital, school, large public emergency gathering facility).

Return Periods of Structure Class I, II, and III

The probability that events such as floods, wind storms or tornadoes will occur is often expressed as a return period. To better understand the effect of Structure Class return period, derivation including load factors and importance factors are required. ANSI/TIA-222-G utilizes ASCE7-02 basic wind speeds for non-iced conditions considering a 50 year return period. Fifty (50) year return period means that the maximum actual observed wind speed is statistically likely be to equivalent to or exceed the design wind speed recommended in ANSI/TIA-222-G once every 50 years. However, the application of importance factor based on Structure Class and a 1.6 load factor (required for wind design) significantly increases the actual return period of the wind design loads. Demonstration of the actual return periods for wind are noted below:

Class I

- Return Period: 300 years
- Importance factor = 0.87
- 13% reduction in wind pressure in comparison to Structure Class II
- Chance of exceedance of design wind force within 50 years = 15%

Class II

- Return Period: 700 years
- Importance factor = 1.0
- Chance of exceedance of design wind force within 50 years =7%

Class III

- Return Period: 1700 years
- Importance factor = 1.15
- 15% increase in wind pressures in comparison to Structure Class II
- Chance of exceedance of design wind force within 50 years = 3%

It is important to clarify that even under extremely high wind loads, tower structures experience minimal damage. Experiences have shown that most catastrophic tower failures occur as a result of complete devastation of the surrounding area due to Acts of God, such as tornado or impact from flying debris. Many instances have occurred where Class II towers have withstood wind well above design and only received damage to the antennas, mounts, and coax cabling attached to the structure.

Definition of Risk Category – ASCE 7-10

The ASCE 7 Standard, Minimum Design Loads for Buildings and Other Structures provides the basis for structural load calculation for both TIA-222 and the International Building Code. The latest version of the ASCE 7-10 dictates classification of buildings and other structures by way of assignment of a Risk Category. Per ASCE 7-10, Risk Categories are to be determined from ASCE 7-10 Table 1.5-1 and are based on the risk to human life, health, and welfare associated with damage or failure by nature of occupancy or use. Once Risk Category is established, importance factors are to be determined based on ASCE 7-10, Table 1.5-2. These importance factors are to be included in the derivation of design loads for flood, wind, snow, earthquake, and ice applied to the structure during design and analysis.

Table 1.5-1 Risk Category of Buildings and Other Structures for Flood, Wind, Snow, Earthquake, and Ice Loads

Use or Occupancy of Buildings and Structures	Risk Category
Buildings and other structures that represent a low risk to human life in the event of failure	I
All buildings and other structures except those listed in Risk Categories I, III, and IV	II
Buildings and other structures, the failure of which could pose a substantial risk to human life. Buildings and other structures, not included in Risk Category IV, with potential to cause a substantial economic impact and/or mass disruption of day-to-day civilian life in the event of failure. Buildings and other structures not included in Risk Category IV (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing toxic or explosive substances where their quantity exceeds a threshold quantity established by the authority having jurisdiction and is sufficient to pose a threat to the public if released.	III
Buildings and other structures designated as essential facilities. Buildings and other structures, the failure of which could pose a substantial hazard to the community. Buildings and other structures (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, or hazardous waste) containing sufficient quantities of highly toxic substances where the quantity exceeds a threshold quantity established by the authority having jurisdiction to be dangerous to the public if released and is sufficient to pose a threat to the public if released.[a] Buildings and other structures required to maintain the functionality of other Risk Category IV structures.	IV

[a]Buildings and other structures containing toxic, highly toxic, or explosive substances shall be eligible for classification to a lower Risk Category if it can be demonstrated to the satisfaction of the authority having jurisdiction by a hazard assessment as described in Section 1.5.2 that a release of the substances is commensurate with the risk associated with that Risk Category.

(Courtesy of ASCE, ASCE 7-10)

Table 1.5-2 Importance Factors by Risk Category of Buildings and Other Structures for Snow, Ice, and Earthquake Loads[a]

Risk Category from Table 1.5-1	Snow Importance Factor, I_s	Ice Importance Factor—Thickness, I_i	Ice Importance Factor—Wind, I_w	Seismic Importance Factor, I_e
I	0.80	0.80	1.00	1.00
II	1.00	1.00	1.00	1.00
III	1.10	1.25	1.00	1.25
IV	1.20	1.25	1.00	1.50

[a]The component importance factor, I_p, applicable to earthquake loads, is not included in this table because it is dependent on the importance of the individual component rather than that of the building as a whole, or its occupancy. Refer to Section 13.1.3.

(Courtesy of ASCE, ASCE 7-10)

Note: Wind importance factors are incorporated into wind-speed maps within ASCE 7-10 based on the same criteria outlined above.

Previous versions of the ACSE-7 used a parameter called Occupancy Category to define the appropriate risk category of a building or other structure. Occupancy Category as used within the building codes relates primarily to issues associated with life, safety, and fire protection, which caused some confusion as Risk Category's purpose is primarily based on environmental loads (wind, earthquake, ice, etc.) and the risks associated with structural failure.

Commentary C1.5 within ASCE 7-10 contains useful descriptions of structure types with respect to Risk Category. Wireless telecommunication towers are not specifically mentioned within these descriptions. Commentary C1.5 also mentions the possibility of misapplication of risk category and emphasizes use a rational basis based on the number of persons whose lives would be endangered or whose welfare would be decidedly affected in the event of structural failure. The commentary includes Figure C1-1 to illustrate the concept:

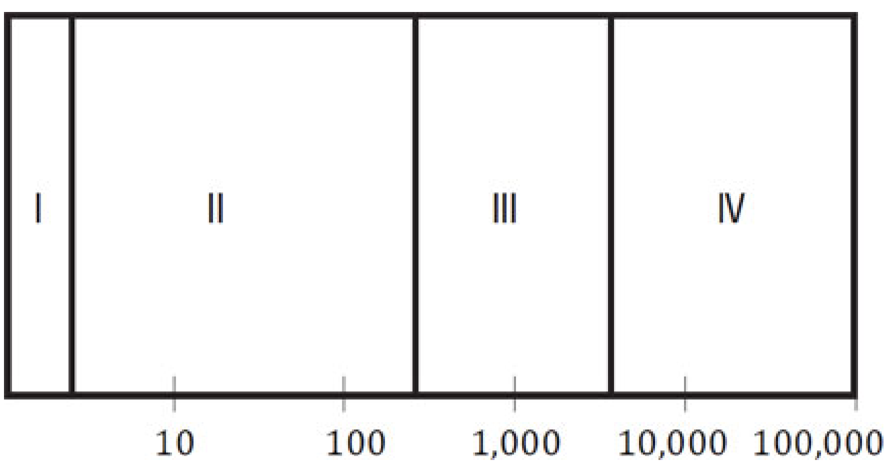


Figure C1-1. Approximate Relationship between Number of Lives Placed at Risk by a Failure and Risk Category (Courtesy of ASCE, ASCE 7-10 Commentary Figure C1-1).

What this chart essentially means is the higher the number of lives affected; the more stringent the Risk Category should be used. As noted above, number of lives affected indicates lives placed in peril due to catastrophic failure of the structure or termination of the provided service which may be essential to sustaining of life.

Definition of Risk Category – IBC

Chapter 16 of the International Building Code addresses Risk Category within section 1604.5. The section is brief and relies on interpretation of the nature of occupancy in order to assign the appropriate risk category for design and analysis. IBC risk categories closely parallel ASCE 7-10. IBC further includes certain specific building types, contents, and occupancies within its risk category definitions for the sake of direct examples. Wireless telecommunication towers are not listed within Class III or Class IV Risk Categories.

IBC fully recognizes that unique structures require specific design and performance criteria. This criterion includes unique application of risk categorization. Telecommunication and Broadcast towers are specifically addressed as unique structures within IBC Chapter 35 Referenced Standards and within Section 3108. Section 3108 states specifically that telecommunication and broadcast towers shall be designed and constructed in accordance with the provisions of TIA-222.

TABLE 1604.5 RISK CATEGORY OF BUILDINGS AND OTHER STRUCTURES

RISK CATEGORY	NATURE OF OCCUPANCY
I	Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to: • Agricultural facilities. • Certain temporary facilities. • Minor storage facilities.
II	Buildings and other structures except those listed in Risk Categories I, III and IV
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to: • Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300. • Buildings and other structures containing elementary school, secondary school or day care facilities with an occupant load greater than 250. • Buildings and other structures containing adult education facilities, such as colleges and universities, with an occupant load greater than 500. • Group I-2 occupancies with an occupant load of 50 or more resident care recipients but not having surgery or emergency treatment facilities. • Group I-3 occupancies. • Any other occupancy with an occupant load greater than 5,000[a]. • Power-generating stations, water treatment facilities for potable water, waste water treatment facilities and other public utility facilities not included in Risk Category IV. • Buildings and other structures not included in Risk Category IV containing quantities of toxic or explosive materials that: Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area in accordance with the *International Fire Code*; and Are sufficient to pose a threat to the public if released[b].

IV	Buildings and other structures designated as essential facilities, including but not limited to: • Group I-2 occupancies having surgery or emergency treatment facilities. • Fire, rescue, ambulance and police stations and emergency vehicle garages. • Designated earthquake, hurricane or other emergency shelters. • Designated emergency preparedness, communications and operations centers and other facilities required for emergency response. • Power-generating stations and other public utility facilities required as emergency backup facilities for Risk Category IV structures. • Buildings and other structures containing quantities of highly toxic materials that: Exceed maximum allowable quantities per control area as given in Table 307.1(2) or per outdoor control area in accordance with the *International Fire Code*; and Are sufficient to pose a threat to the public if released[b]. • Aviation control towers, air traffic control centers and emergency aircraft hangars. • Buildings and other structures having critical national defense functions. • Water storage facilities and pump structures required to maintain water pressure for fire suppression.

a. For purposes of occupant load calculation, occupancies required by Table 1004.1.2 to use gross floor area calculations shall be permitted to use net floor areas to determine the total occupant load.

b. Where approved by the building official, the classification of buildings and other structures as Risk Category III or IV based on their quantities of toxic, highly toxic or explosive materials is permitted to be reduced to Risk Category II, provided it can be demonstrated by a hazard assessment in accordance with Section 1.5.3 of ASCE 7 that a release of the toxic, highly toxic or explosive materials is not sufficient to pose a threat to the public.

(Courtesy of ICC 2012 International Building Code, Table 1604.5).

Application of Structure Class to Towers

The ANSI/TIA-222-G Standard does not incorporate the same risk category definitions as ASCE7 and IBC purposely due to the fact that communication towers are unique, uninhabited, and unoccupied structures that in most cases pose a minimal threat to human life and welfare in the event of a structural failure. ANSI/TIA-222-G structure classification and associated importance factors are intended to compliment the established risk and importance baselines within ASCE7 and IBC but also conserve the unique nature of telecommunication and broadcast tower structures.

ANSI/TIA-222-G references the term “essential communications” within Table 2-1 and A.2.2. This reference is to further establish a link between ASCE-7 and IBC Class III and IV “essential facility” criteria and structure classification definitions within the ANSI/TIA-222-G Standard. “Essential communications” are defined within ANSI/TIA-222-G Annex A, A.2.2 as structures used *primarily* in support of civil or national defense, emergency, rescue or disaster operations, military and navigation facilities. On occasion building officials or other authorities have interpreted “emergency” and “rescue” in the above definition as validation of Class III requirements for all wireless telecommunication towers, as the expectation is typical personal communication use of a mobile wireless device may be use during an emergency or rescue event. This is not the intent of the Standard. To properly apply the correct Structure Class per ANSI/TIA-222-G the term “primarily” must be defined and weighed against the number of lives at risk, as well as purpose of the structure or wireless equipment installed. “Primarily” within the definition above is used to define structures that support wireless telecommunication systems with limited or zero redundancy and hence very place large numbers of lives at risk in the event of a failure. It also defines structures whose purpose for installation is to support wireless services used primarily by emergency service providers, military, navigational or mass transit. ANSI/TIA-222-G addresses redundancy of under Table 2-1. The terminology “used for services that may be provided by other means” is the defined difference between essential communications or Class III structures with limited or zero redundancy and Class II structures that deliver inherent redundancy.

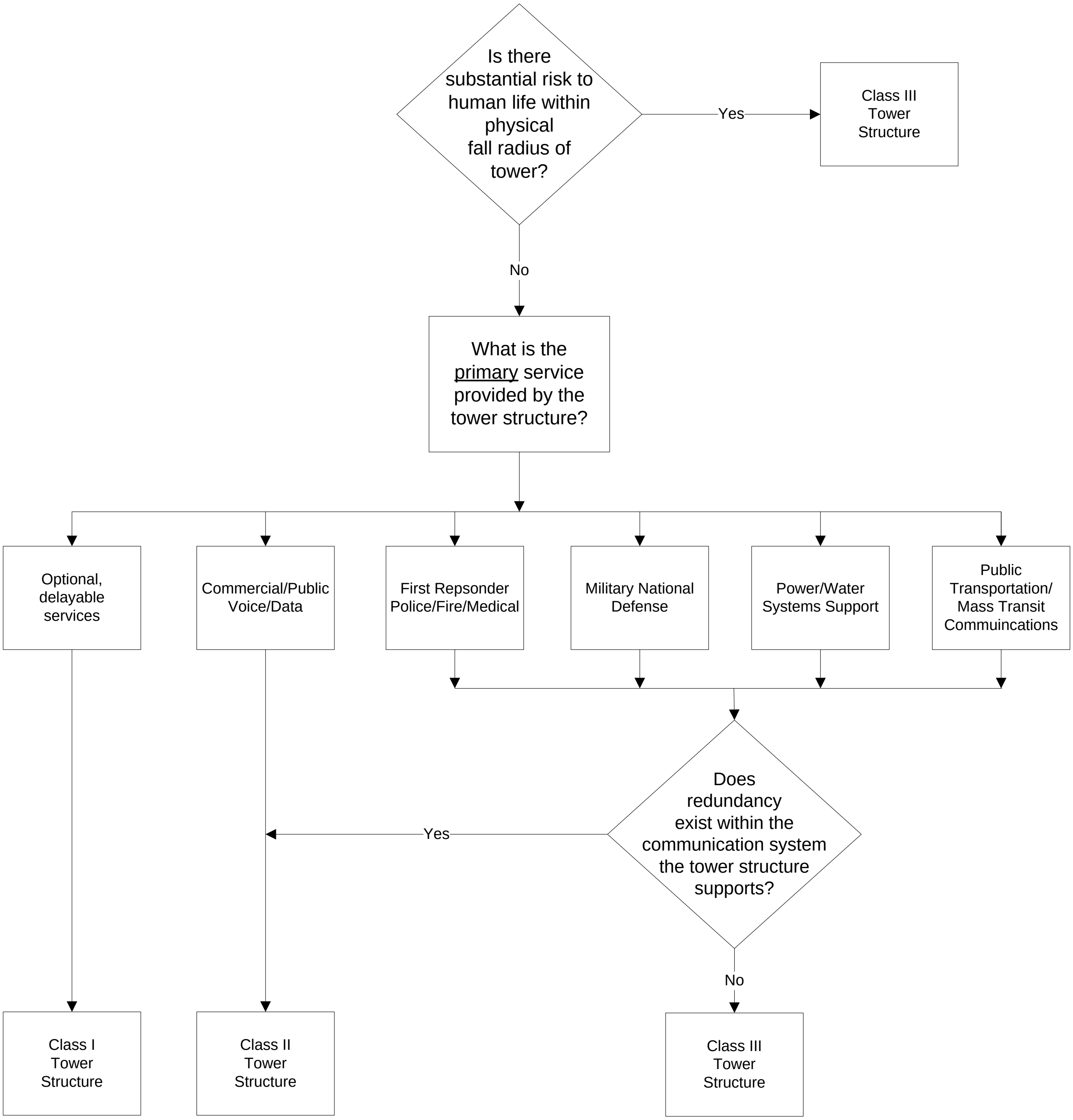
Tower Classification Simplification via Flow-Chart

Correct classification and application of importance factors for telecommunication and broadcast tower structures can be simplified based on the previous commentary. The basis for tower structure classification should be based on the following unique overarching criteria:

1. What is the risk to life safety directly related to the failure of the structure? Risk to life includes everything from physical danger to life to risk of damage to electrical substations which services large numbers of the population.
2. Who are the users of service who are impacted by the failure? Are the users primarily military, first responders, etc., or more for personal communication use?
3. What is the significance of the loss of services provided by the tower with respect to risk to human life? Also, is there adequate redundancy in the wireless network at large to maintain provided services with this loss of the structure?

The following flow chart is provided to consolidate the decision making process required when tasked with structure classification. The flow chart considers all variables discussed previously within this white paper and draws a definitive conclusion around classification of tower structures following provisions provided within ASCE 7-10, IBC, and ANSI/TIA-222-G.

Structure Classification per TIA-222-G in support of IBC 2012 and ASCE 7-10



Conclusion

The preceding discusses generalized structure risk categorization as defined within ASCE7 and the International Building Code and further compares those criteria to structure classification criteria defined within ANSI/TIA-222-G. Structure risk categorization is intended to apply required load factors based on environmental loads placed on structures during design and analysis. The factors are placed in order to appropriately fortify the structural integrity of a building or other structure and ultimately reasonably assess the risks to human life, health, and welfare associated with a structural failure. These load factors increase depending on the critical use of the building or structure. Buildings or other structures that shelter large occupancies or play a direct role in support of emergency response or national defense require the highest load factors, which implies the highest risk categories or structure class.

Building and jurisdictional officials responsible for public safety via governing building codes throughout the United States often rely on IBC and the underlying ASCE7 structure classification criteria when addressing communication towers. Structure classification with respect to communication towers is however very unique as it compares to non-tower structures. Correct application of structure classification to communication tower design and analysis must be undertaken with the understanding of the unique nature of wireless telecommunication networks and the role towers play in wireless network based communication. Confusion often exists regarding correct application of structure classification for telecommunication towers due to telecommunication services potentially being used during emergency situations.

The unique nature of telecommunication tower structural design is addressed within the United States by way of a specialized design standard. ANSI /TIA-222, Structural Standard for Antenna Supporting Structures and Antennas is specifically intended to provide the baseline for communication tower structural design and analysis. Structure Class definitions have been incorporated into the TIA-222 Standard to provide accurate classification of tower structures and avoid misapplication of building and other supporting structures based classification contained with the IBC and ASCE-7 to telecommunication towers. The IBC specifically recognizes the TIA-222 Standard as the guideline for communication tower design and analysis and fundamentally accepts the TIA-222 structure classification as the basis required for telecommunication and broadcast towers.

In the vast majority of wireless tower supported networks, inherent redundancy exists, including networks that support emergency services such as E911. Because of this redundancy, application of higher risk categorization and the associated increased structural load factors applied to individual towers has little effect on the resiliency of overall network performance. As noted in Figure C1.1 of ASCE7, although a significant number of lives may potentially impacted by the loss of service of a wireless provider, the loss of one wireless site does not compromise the entire wireless network, or eliminate the service provided in a specific location. Therefore, the number of lives impacted is actually very small, as opposed to what might initially be estimated.

When the failure of the tower implies significant physical consequences to the surrounding area, affects essential services, such as water, power, transportation, etc. or loss of specific wireless service at a location does significantly comprise the overall network or eliminates designated emergency service in a specific geographic location, higher risk categorization may be warranted. In these situations, additional reliability enhancement of all aspects of the wireless network, including individual antennas, mounts and connections, coax or fiber lines, back-up power, water intrusion resiliency, and/or seismic resilient shelters and radio cabinet design is likely appropriate. Instituting a Class III requirement only on the tower structure would likely result in a minimal improvement in reliability in comparison to the expectation of overall improved network performance and reliability.

A simplified and definitive approach to structure classification based on all variables discussed in this white paper is presented by way of flow chart within this document. This flow chart approach considers both risk to life within the physical fall zone of the structure and the type of service supported by the tower structure. The flow chart approach presented in this paper is arranged in a manner that supports all Code and Standard based criteria related to wireless tower structure classification.

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Classification of Tower Structures per ANSI/TIA-222-G, IBC and ASCE 7

Preface

Application of ANSI/TIA-222-G structure classes to communication tower design and analysis is frequently misapprehended. Risk categorization established within ASCE 7 and IBC are historically related to building occupancy among other factors has inconsistent correlation to communication tower use and function. Furthermore, the comprehensive application of Class III categorization to communication towers with the intention of increasing the reliability of wireless networks during emergency situations frequently fails to achieve the desired result and does not match the intent of the ANSI/TIA-222 Standard, as accepted by the IBC.

This white paper explains structure classification relationships between ANSI/TIA-222-G, *Structural Standard for Antenna Supporting Structures and Antennas, the International Building Code*, and ASCE 7, *Minimum Design Loads for Buildings and Other Structures*. It identifies the variables involved in structure classification and further defines how those requirements are to be applied per requirements with ANSI/TIA-222-G.

Definition of Structure Class – ANSI/TIA-222-G

The definition of Structure Class, per ANSI/TIA-222-G, with additional commentary by the authors, is provided below:

ANSI/TIA-222-G Definitions:

Structure Class I:
Structures that due to height, use or location represent a low hazard to human life and damage to property in the event of a failure and/or used for services that are

CONTINUED ON PAGE 46

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optional and/or where a delay in returning the services would be acceptable.

Section A.2.2 further defines Class I structures: Structures used for services that are optional or where a delay in returning the services would be acceptable such as: residential wireless and conventional two-way radio communications; television, radio and scanner reception; wireless cable; amateur and CB radio communications.

Nextel Cellsite in Cuiritiba, South of Brazil
230 Ft (70M) triangular self-support tower

Photographer: Paulo Abreu, Seccional Brasil S/A

Commentary: Failure of the structure defined as Structure Class I typically only affects the owner, although services provided may affect other users. Human life is essentially not at risk and the public well-being is largely unaffected by the tower failure.

Structure Class II: Structures that due to height, use or location, represent a significant hazard to human life and/or damage to property in the event of failure and/or used for services that may be provided by other means.

ANSI/TIA-222-G, Addendum 2 Annex A Section A.2.2 further defines Class II structures based on reliability criteria: Structures used for services that may be provided by other means such as: commercial wireless communications; television and radio broadcasting; cellular, PCS, CATV, and microwave communications.

Guy tower constructed by Mercury Communications, Inc.

Photographer: Trisha Fribis, Mercury Communications Inc.

Commentary: Failure of a structure defined as Structure Class II presents significant hazard to human life and/or property if a tower fails. Significant with respect to human life means failure of the structure could result in injury or casualties, but it's very limited in practicality or exposure to more than a few individuals (e.g. Significant with respect to property means property surrounding the tower could be damaged or destroyed. With respect to reliability, the phrase "Used for services that may be provided by other means" signifies redundancy exists within the network to support temporary loss of service due to a specific site. This redundancy is present in almost all public wireless service, including E911 networks.

Structure Class III: Structures that due to height, use or location represent a substantial hazard to human life and/or damage to property in the event of failure and/or used primarily for essential communications.

ANSI/TIA-222-G, Addendum 2 Annex A Section A.2.2 further defines Class III structures based on reliability criteria: Structures used primarily for essential communications such as civil or national defense, emergency, rescue, or disaster operations, military and navigation facilities.

Monopole with cloud
East St. Louis, Illonois

Photographer: Steve Jones, US Tower Services, Inc.

Commentary: With respect to reliability, Class III structures represent towers for which the owner/provider cannot tolerate any loss of the network/signal, due to either types of services provided or zero redundancy existing in the network. Beyond zero redundancy, failure could also potentially impact other services, such as power, water, transportation, etc. that are considered essential to human life. Finally, Structure Class III can be quantified when a high risk to life/safety exists in the event of a failure of the structure. The risk is exemplified when the public venue is not mobile (e.g. hospital, school, large public emergency gathering facility).

Definition of Risk Category – ASCE 7-10 & IBC

The ASCE 7 Standard, *Minimum Design Loads for Buildings and Other Structures* provides the basis for structural load calculation for both TIA-222 and the International Building Code. The most recent published edition is ASCE 7-10, which dictates classification of buildings and other structures by assignment of a Risk Category. ASCE7-10 provides four Risk Categories (I, II, III, IV), with each higher number placing greater significance of risk to the public. The Risk Categories are generally based on the risk to human life, health, and welfare associated with damage or failure by nature of occupancy or use. Once Risk Category is established, importance factors are to be applied based on ASCE 7-10, Table 1.5-2. These importance factors are included in the derivation of design loads for flood, wind, snow, earthquake, and ice applied to the structure during design and analysis. The different Risk Categories can be paraphrased/commented as follows:

Risk Category I: Failure results in low hazard to the public.

Risk Category II: Structures that do not fall within Risk Categories I, III and IV.

Risk Category III: Failure results in a substantial risk to the public. These structures can be thought of as being needed during times of emergency (e.g. hospitals, police stations, water treatment facilities) or supporting large population centers (e.g. malls, schools). Failure, while creating significant problems to the public, can be remediated. These structures can be considered as an essential facility.

Risk Category IV: Failure results in substantial hazard to the public. Failure of these structures typically means harm to the public extends well beyond the site of the failure. Often remediation cannot be completed due to the nature of the failure (e.g. nuclear facility). Failure of these structures also typically ensures failure of additional multiple systems critical to the public (e.g. loss of power results in loss of water and transportation). These structures can be considered as an essential facility.

Previous versions of the ACSE-7 used a parameter called Occupancy Category to define the appropriate risk category of a building or other structure. Occupancy Category, as used within the building codes, relates primarily to issues associated with life, safety, and fire protection across a number of building systems, like electrical, mechanical, etc. This use has caused some confusion as Risk Category's purpose is to appropriately derive the expected reoccurrence of environmental loads (wind, earthquake, ice, etc.) and the risks associated with structural failure.

Chapter 16 of the International Building Code addresses Risk Category within section 1604.5. The section is brief and relies on interpretation of the nature of occupancy in order to assign the appropriate risk cate-

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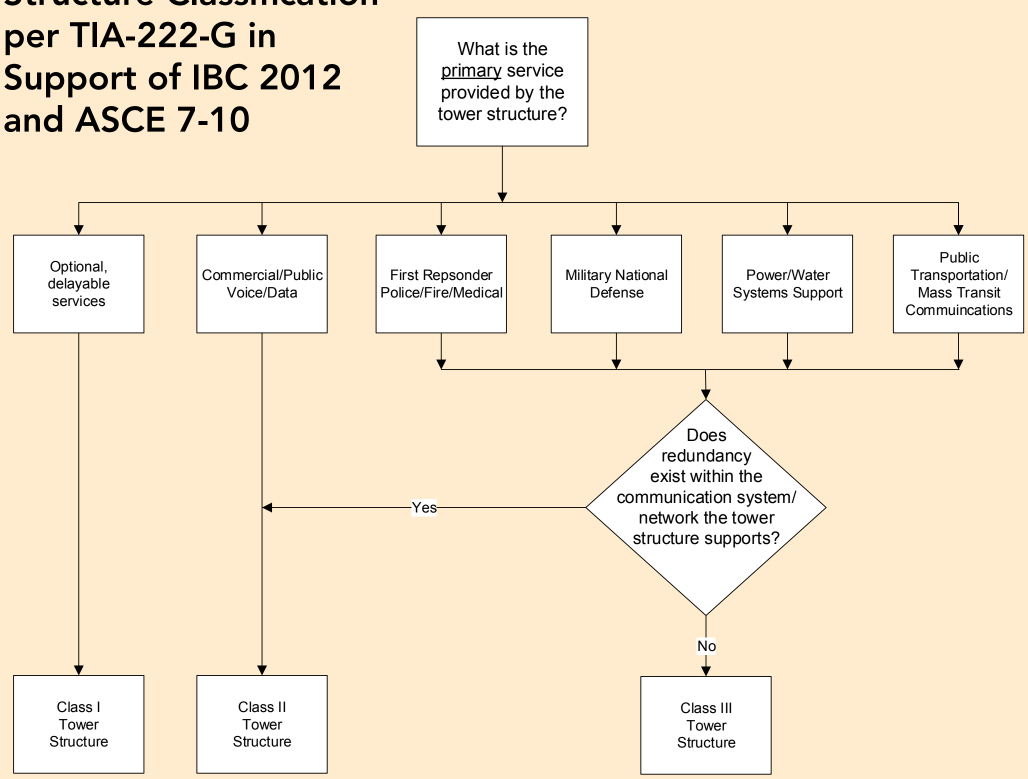
gory for design and analysis. IBC risk categories closely parallel ASCE 7-10. IBC further includes certain specific building types, contents, and occupancies within its risk category definitions for the sake of direct examples. Wireless telecommunication towers are not listed within Class III or Class IV Risk Categories.

IBC recognizes that unique structures require specific design and performance criteria. This criterion includes unique application of risk categorization. Telecommunication and broadcast towers are specifically addressed as unique structures within IBC Chapter 35 Referenced Standards and within Section 3108. Section 3108 states specifically that telecommunication and broadcast towers shall be designed and constructed in accordance with the provisions of ANSI/TIA-222.

Application of Structure Class to Towers

Appropriate application of Structure Class I is typically simple to evaluate and is rarely controversial. The misinterpretation primarily occurs with the misapplication of Structure Class III in place of Structure Class II. ANSI/TIA-222-G references the term "essential communications" within Table 2-1 and A.2.2. This reference is to establish a link between ASCE-7 and IBC Risk Category III and IV "essential facility" criteria and structure classification definitions within the ANSI/TIA-222-G Standard. "Essential communications" are defined within ANSI/TIA-222-G Annex A, A.2.2 as structures used primarily in support of civil or national defense, emergency, rescue or disaster operations, military and navigation facilities. On occasion, interpretations have been made based on the terms "emergency" and "rescue" in the above definition as validation of Class III requirements for wireless telecommunication towers, as the expectation is typical personal communication use of a mobile wireless device may be used during an emergency or rescue event, thus mandating the need for the higher classification. This is not the intent of the Standard. To properly apply the correct Structure Class per ANSI/TIA-222-G the term "primarily" must be defined and weighed against the number of lives at risk, as well as purpose and redundancy of the structure, wireless equipment installed, or the network design supported. "Primarily" within the definition above is used to define structures that support wireless telecommunication systems with limited or zero redundancy and hence place large numbers of lives at risk in the event of a failure. It also defines structures whose purpose for installation is to support wireless services used primarily by emergency service providers, military, navigational or mass transit. ANSI/TIA-222-G addresses redundancy of in Table 2-1. The terminology "used for services that may be provided by other means" is the

Structure Classification per TIA-222-G in Support of IBC 2012 and ASCE 7-10



defined difference between essential communications or Class III structures with limited or zero redundancy and Class II structures that deliver inherent redundancy.

Conclusion

Structure Class definitions have been incorporated into the ANSI/TIA-222 Standard to provide accurate and reasonable classification of tower structures. The IBC specifically recognizes the ANSI/TIA-222 Standard as the guideline for communication tower design and analysis and fundamentally accepts the ANSI/TIA-222 structure classification as the basis required for telecommunication and broadcast towers. Use of the ANSI/TIA-222-G definitions allows for more appropriate application of assessing risk, when considering factors like public safety, service and network redundancy.

Inherent redundancy exists in the vast majority of wireless tower supported networks, including networks that support emergency services such as E911. Because of this redundancy, application of higher structure classes to individual towers typically has little effect on the resiliency of overall network performance. Although a significant total of the population may be potentially (or "be" here) impacted by the loss of service of a wireless provider, the loss of an individual wireless site does not consistently compromise the entire wireless network, nor eliminate the service provided in a specific location. Therefore, the potential impact to the public typically is actually very small, as opposed to what might initially be estimated.

Higher structure classes may be warranted when the failure of the tower implies significant physical consequences to the surrounding area, affects essential services, such as water, power, transportation, etc. or when loss of specific wireless service at a location significantly comprises the overall network or eliminates designated emergency service in a specific geographic location.

In effort to truly enhance the reliability of a wireless site in these scenarios, strengthening of all aspects of the wireless network, including individual antennas, mounts and connections, coax or fiber lines (backhaul for data), back-up power, water intrusion resiliency, and radio cabinet design is likely appropriate. Instituting a Structure Class III requirement only on the tower structure would likely result in a non to minimal improvement in reliability in comparison to the expectation of overall improved network performance and reliability. ■