EM-Nextel-062-990324

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SITING COUNCIL

April 5, 1998

Mr. Robert K. Erling
Senior Analyst
Connecticut Siting Council
10 Franklin Square
New Britain, Connecticut 06051

Dear Mr. Erling

Attached please find as requested, a copy of a structural analysis performed by Tectonic Engineering Associates on an existing 250-foot tower owned by Message Management and located on Wintergreen Ave in Hamden, Connecticut. This is the facility for which Nextel filed a Request for Tower Sharing with the Council on March 24, 1999.

The modifications recommended by the Tectonic Engineers are to be included in drawings and plans submitted to the Town of Hamden in Nextel's application for a Building Permit.

If you have any questions or need more information, please let me know.

Sincerely,

Ronald C. Clark
Manager Real Estate Operations

attachment

NEXTEL COMMUNICATIONS: NEW HAVEN NORTH
W.O. 1170.C907
EXISTING 250' SELF-SUPPORTING TOWER
HAMDEN, CT
STRUCTURAL ANALYSIS REPORT - REVISION 1
OCTOBER 8, 1998

1.0 INTRODUCTION

The existing 250-foot self-supporting tower located at West Rock State Park in Hamden, CT is owned by Message Center Management. It serves as a personal communications services (PCS) facility, as well as the communication needs of the owner and several other paging companies. Nextel Communications anticipates installing their antennas on this tower in the near future, designated as site no. CT-0907.

Tectonic Engineering Consultants, PC has performed an inspection and detailed structural analysis to determine if the tower has adequate capacity to support the proposed additional antennas in accordance with current code requirements. This revision reflects a re-analysis of the tower to consider three (3) additional Nextel antennas and associated coaxial cables.

2.0 ORIGINAL TOWER DESIGN

2.1 Tower Structure

The tower was designed by Advance Industries (AI), and is a standard three-legged self-supporting tower. It consists of ten (10) 25' sections. All sections are constructed of pipe leg and bracing members and angle horizontal members. The tower is K-braced up to the 100' level and V-braced for the remaining 150'. It is approximately 25'-10" wide at its base, tapering uniformly to a 5'-0" face width at the 200' level. The remaining two sections are of constant width. The tower steel is galvanized and has been painted in seven alternating bands of orange and white. All member connections are bolted.

A diagram of the structure is presented in Figure 1, attached.

No drawings of the tower or documentation of its original design loading were furnished to Tectonic.

A 12' x 16' masonry equipment shelter is located within the base section of the tower. The main bracing members at the base of the northeast face of the tower penetrate through the shelter roof overhang.

2.2 Tower Foundation

The exposed portion of the foundation consists of (3) 2'-8" square concrete piers, one per tower leg. Based on the topography and geology of the site, it is believed that these piers bear on rock, and are anchored by rock bolts. Around the piers is a roughly triangular concrete mat, extending 0" to 12" above grade, which serves as the foundation for the equipment shelter. The top of this mat is 3" to 4" below the top of the piers. Anchorage of the tower is provided by four (4) 1-3/4" diameter anchor bolts per leg, secured with standard hex nuts. No drawings or other information about the tower foundation or specific geotechnical information for the site was available.

3.0 EXISTING CONDITION

3.1 Field Inspection

The tower was inspected on August 14, 1998 by representatives of Tectonic. A full-height climbing inspection was performed to identify the member sizes, structural condition, existing antennas, and dimensions of the antenna mounts. Numerous photographs were taken to document the existing configuration and conditions.

This inspection was limited in the following respects:

1. A detailed inspection of welds, bolts, and appurtenances was not performed.
2. The adequacy of the existing grounding system was not assessed.
3. No investigation of the existing soil conditions or foundation system was performed.
4. The tower was not measured for plumbness.

Based on our inspection, the tower legs and bracing appear to be in fair condition. The paint is weathered and some rust staining and minor spots of corrosion were observed. In addition, the connection bolts were observed to be rusty. Several cadwelds for grounding connections were observed in a small area of the north leg at the 15' level. No significant damage or deformation of the tower was observed. We therefore expect that the tower is capable of supporting its original design loads.

Some inconsistency was also observed in the diameters of the bolts for the bracing. Specifically, the bolts for the bracing at the 25' to 50' level are 3/4" in diameter, while the sections above and below have 1" diameter and 1-1/4" diameter bolts, respectively. In addition, the bolts for the bracing at the 75' to 100' level are 3/4" in diameter, while the sections above and below have 7/8" diameter and 1" diameter bolts, respectively.

The exposed portions of the anchor bolts are in good condition. Several cracks were noted in the concrete pier for the north leg. The cause of these cracks could not be determined. The grout under the base plate is also cracked. All of these cracks should be repaired. No other deterioration of the concrete has occurred. If proper repairs are performed, we expect that the foundation is fully capable of supporting its original design loads.

3.2 Existing Antennas and Equipment

At the time of our inspection, the tower was found to be supporting the items listed below. The north leg of the tower is designated as leg A, while the east leg and the south legs are designated as B and C, respectively.

No	Antenna Model/Appurtenance	Mount	Location	Height	Cable
1	5' Lightning Rod	-	Leg A	250'	-
2	Celwave BMR10 Penetrator Antenna	-	Leg C	250'	1-5/8"
3	Beacon	-	Center	250'	-
4	Decibel DB809 Omni Antenna	3' Sidearm	Leg A	246'-11"	1-1/4"
5	(2) Decibel DB809 Omni Antennas (1 up, 1 inverted)	5' Sidearm	Leg C	242'	1-1/4"
6	Celwave PD1151 Omni Antenna and 5 element Yagi Antenna	2' Sidearm	Leg B	229'-8"	7/8"
7	Scala 5' Omni Antenna	3' Sidearm	Leg A	225'-6"	1-1/4"
8	Empty 4' Long Omni Antenna Top Support	-	Leg C	221'	-
9	Celwave PD1150 Omni Antenna	Leg Mounted	Leg B	205'	7/8"
10	Celwave PD1142 Omni Antenna	2' Sidearm	Leg A	203'-3"	7/8"
11	Celwave PD10017 Omni Antenna	2' Sidearm	Leg B	203'-3"	7/8"
12	Decibel DB806 Omni Antenna	2' Sidearm	Leg C	203'-3"	7/8"
13	Empty Set of U-Bolts and Mount Plates	-	Leg C	190'	-
14	Decibel DB224 Dipole Antenna	Top & Bottom Mtg. Pipes	Leg B	188'-5"	7/8"

No	Antenna Model/Appurtenance	Mount	Location	Height	Cable
15	Celwave PD1142 Omni Antenna	2' Sidearm	Leg A	178'-4"	7/8"
16	(2) Sinclair SRL-490 Omni Antenna	6' Sidearms	Legs B & C	178'	7/8"
17	(6) Stacked Sinclair SRL-410C-4 Enclosed Dipole Array Antennas (Sprint)	8' x 10' Tall Sidearms	Legs A, B, & C	166'	7/8"
18	Decibel DB212 Dipole Antenna	Leg Mounted	Leg C	152'	7/8"
19	Decibel DB212 Dipole Antenna	Mounting Pipe	Face A/B	148'-6"	7/8"
20	Scala 4' Omni Antenna	2' Sidearm	Leg A	148'	7/8"
21	Celwave PD10108 Yagi Antenna	Leg Mounted	Leg A	145'	1/2"
22	Decibel DB806 Omni Antenna	4' Sidearm	Leg C	142'	7/8"
23	Decibel DB806 Omni Antenna and Inverted Sinclair 8' Omni Antenna	4' Sidearm	Leg B	140'	7/8"
24	11' Omni Antenna	Mounting Pipe	Face A/B	138'	7/8"
25	(2) Side Lights	Mounting Pipe	Face A/B	130'-9"	-
26	6 element Yagi Antenna	Leg Mounted	Leg A	128'-6"	7/8"
27	Celwave Dipole Side Mount Antenna	Leg Mounted	Leg A	128'-6"	1/2"
28	Scala Kathrein Omni Antenna	2' Sidearm	Leg C	128'	1-1/4"
29	Celwave PD1151 Omni Antenna	1-1/2" Sidearm	Leg B	126'-6"	7/8"
30	Celwave PD400 Omni Antenna and Celwave 7 element Yagi Antenna	1' Sidearm	Leg B	116'	7/8" & 1/2"
31	Decibel DB809 Omni Antenna	6' Sidearm	Leg C	115'	1-1/4"
32	Decibel DB224 Dipole Antenna	Direct to Leg with intermediate support	Leg C	88'	1/2"
33	Decibel DB438 Yagi Antenna	Direct to Leg	Leg A	78'-4"	1/2"
34	(2) Celwave PD320 Side Mount Antennas	Direct to Legs	Legs B & C	69'	7/8"
35	GPS Antenna	4' Sidearm	Leg C	61'	1/2"
36	Decibel ASP-760 Yagi Antenna	Mounting Pipe	Face A/B	12'-6"	1/2"

An interior climbing ladder is mounted adjacent to leg A for the full height of the tower. A large ice shield is mounted above the shelter roof at the 12'-6" level.

The existing cables for the Sprint antennas are routed up the tower on leg A. All other cables are routed up the tower in two bundles on the climbing ladder.

It was observed that the top element on the Decibel DB224 dipole antenna at the 188'-5" level (antenna no. 14) is broken.

4.0 PROPOSED INSTALLATION

It is our understanding that the existing antennas and equipment will remain on the structure, and the following items are proposed to be added to the tower by Nextel Communications:

- 9 Swedcom ALP-E 9011 DIN antennas, mounted three (3) per face on an antenna frame at the 155' level (centerline)
- 9 1-1/4" diameter coaxial cables to the 155' level

We anticipate that the nine (9) 1-1/4" coaxial cables will be routed up the tower on a new 15 hole waveguide ladder.

The existing Sprint antennas limit the maximum possible mounting height to the 155' level. Relocation of the existing 8' long dipole antenna on Leg C at the 152' level may be necessary to avoid interference.

5.0 STRUCTURAL ANALYSIS

5.1 Current Loading Criteria

In accordance with the provisions of ANSI/TIA/EIA-222-F-1996 "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures", a basic wind speed of 85 mph applies to New Haven County, CT. The 1994 Connecticut supplement to BOCA National Building Code – 1990 requires a wind speed of 80 mph within the Town of Hamden, which is less than the TIA requirement. Thus, a wind speed of 85 mph was used in our analysis.

Ice loads have been established based on a 0.5" radial ice thickness in accordance with industry standard practice. A reduced wind speed of 74 mph is used in conjunction with ice.

5.2 Procedure

The tower has been analyzed with a general purpose, three-dimensional structural analysis program. The analysis included the following:

The tower with the existing antennas and cables, along with the proposed Nextel antennas and cables using:

a) 85 mph wind speed and no ice
b) 74 mph wind speed and 0.5" ice

5.3 Assumptions

Several assumptions were made in order to perform the analysis. Each of these is considered by Tectonic to be both reasonable and consistent with current standards of practice.

1. Tower legs have a yield strength of 50 ksi in accordance with AI standard fabrication practice. It is expected and consistent with general practice for tower leg members to be of this grade. Likewise, pipe bracing members have a yield strength of at least 42 ksi, and angle bracing members are ASTM A36 steel.
2. The tower foundation was designed and constructed based on design parameters reflecting actual subsurface conditions and the original tower reactions.
3. All bracing members are considered as pin-ended for simplicity, and connections were not modeled.
4. Only axial stresses are considered in the secondary members.

5.4 Results

With the existing and proposed Nextel antennas and cables, the forces in the tower legs do not exceed their allowable capacities in the K-braced tower sections. Some of the leg members in the V-braced tower sections, however, are overstressed. Specifically, the most critical leg member in these sections is overstressed by 19%. This can be remedied by installing additional horizontal struts midway between the existing horizontals from the 100' to the 200' level.

The analysis was re-run to include the additional bracing members. It was determined that the critical leg member is stressed to 95% of its capacity.

The forces in the bracing members are all below their allowable member capacities. The critical member is stressed to 93% of its capacity. Although some of the diagonal brace connection bolts at the locations mentioned in section 3.1 appear to be of a smaller diameter, they were found to have capacities greater than the members they connect and are thus not critical.

Although the original foundation reactions are unknown, we were able to estimate them based on the capacities of the existing structural members. We believe the original design compression reaction was between approximately 220 kips and 250 kips, and the uplift reaction was between approximately 180 kips and 210 kips. From this we find that the calculated foundation reactions are approximately equal to those used in the original design and well within-than the capacity of the anchor bolts.

6.0 CONCLUSIONS AND RECOMMENDATIONS

As a result of our inspection and analysis, we find that the existing tower is sufficient to support the existing antennas along with the proposed Nextel antennas if the additional horizontal struts described in section 5.4 above are installed. The cracks in the concrete pier and grout at leg A must be repaired.

In conjunction with this installation, the following measures should also be taken:

The existing grounding system should be tested and upgraded as needed.

Additional cadwelding to the north leg should be avoided.

Any further changes to the antenna configuration or other appurtenances should be reviewed with respect to their effect on structural loads prior to implementation.

Prepared by: Brian Curran
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Date: 10/8/98

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