DESCRIPTION OF E GUYED TOWER

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1. GENERAL

1.01 This section describes the E Guyed Tower which is primarily intended for use with light route microwave systems. This tower physically resembles the B Guyed Tower described in Section AG25.200. The E Guyed Tower is of somewhat heavier construction and is specifically designed to accommodate 10 ft. by 15 ft. passive reflectors.

2. FOUNDATIONS AND ANCHORS

2.01 The E Guyed Tower is designed to mount on concrete foundations described in Section AG25.320. Guys are attached to concrete anchors which are also described in Section AG25.320. Design of the foundation and anchors assumes soil which has a bearing capability of 4,000 lbs. per square foot. Anchor bolts, guy rods and anchor rods used with the guying system and foundations are parts of the E Guyed Tower Anchor which is to be ordered separately.

2.02 Foundations and anchors must be equipped with B Guyed Tower Ground to protect them against lightning damage. It is not shipped with the tower and must be ordered separately. Installation of the B Guyed Tower Ground is covered in Section AG25.320.

3. LOT REQUIREMENTS

3.01 The amount of land or size of lot required is determined primarily by the height of the tower. Land requirements are also affected by the slope (if any) of the ground.

3.02 Where the terrain is flat, the size of the lot must be large enough to accommodate three radii of length equal to the height of the tower plus 5 feet, spaced 120 degrees apart and oriented in the direction of the guys. On level ground, the distance from the center of the tower to the point where the guy rods enter the ground is approximately equal to the height of the tower less 10 feet. Allowance must also be made, however, for the anchors to which the guy loads are transmitted, and further for the angle of shear of the soil.

3.03 Where the terrain is not level, the length of the three radii mentioned above must be increased or decreased by one foot for each foot of difference in elevation between the center and the outer extremity so as to maintain a 45-degree angle of elevation for the top guys.

3.04 The ***minimum*** sizes of rectangular lot which will meet the previously stated requirements on ***flat*** land are shown below. These dimensions should be increased or decreased for sloping terrain as explained in 3.03. The maximum slope should preferably not exceed 3 degrees.

TOWER HEIGHT (Feet)	LOT SIZE (Feet)
80	125 x 145
100	155 x 179
120	186 x 215
140	216 x 249
160	246 x 284
180	276 x 319
200	306 x 354
220	336 x 388
240	366 x 423
260	396 x 458
280	426 x 492
300	456 x 527

**Reprinted to comply with modified final judgment.

3.05 It is not absolutely necessary, of course, to employ a solid rectangular lot. If the lot involves land in agricultural use, for example, substantial savings in land costs may be possible by obtaining a relatively small lot for the tower foundation and building (eg, 30 ft. by 30 ft.) and small individual lots for the anchors. In such cases, it will often be desirable to fence in the anchor locations in order to avoid possible damage to the guys by farm machinery. It will generally be advisable to obtain a good idea of the kind of agricultural machinery which may be used in the vicinity. Fencing should be placed so as to protect all parts of the guys which will be low enough to be subject to damage by the tallest farm machinery plus an allowance for personnel riding on top of such machinery, if this is possible.

4. STRUCTURAL FEATURES

4 01 The E Guyed Tower is a single guyed mast which is fabricated of galvanized steel. It is of triangular cross section, 4 feet on a side, and comes in height sizes from 80 feet to 300 feet in 20-foot increments. It is shipped knocked down to be field assembled using bolts only. The general appearance of the tower is shown in Fig. 1.

4.02 Occasionally, antenna heights are specified which will require a nonstandard height tower. Usually the result of raising the antenna a few feet will not be too serious. Antenna heights should not be changed without the concurrence of the responsible radio people, however, since transmission can be impaired in some cases. It should be noted that nonstandard height towers cost more than the next larger size of standard tower because of the need for special engineering and handling by the manufacturer.

4.03 The tower rests upon a single support and depends entirely upon the guys for its ability to withstand overturning or twisting forces. Guys extend out from the tower in three directions, spaced 120 degrees apart. The top section of the tower is equipped with torque arms to provide increased leverage for the top set of six guys. The outer end of each torque arm is 15 feet from the outer end of the other torque arms.

4.04 All guys are 19-wire extra-high-strength galvanized steel strand. They are secured to both the tower and anchor with preformed guy grip deadends. All guys are equipped with turnbuckles in order to make adjustments in guy tensions. Four different sizes of strand are used, ranging from 1/2 inch (26,700 lb. ultimate) to 3/4 inch (58,300 lb. ultimate), diameter.

4.05 Guys are attached at the following heights above ground (including an allowance of 6 inches above ground for the foundation pier).

NOMINAL HEIGHT OF TOWER	GUY ATTACHMENT HEIGHT BOTTOM	MIDDLE	TOP
(all heights are given to the nearest foot)			
80	—	—	66
100	—	—	86
120	41	—	106
140	61	—	126
160	61	—	146
180	81	—	166
200	81	—	186
220	61	121	206
240	61	141	226
260	81	161	246
280	81	161	266
300	81	181	286

Note: The middle guys and top guys are always installed with a lead/height ratio of 1.00 (ie, an angle of 45°). The angle of the lower guys varies.

4.06 Safety climbing equipment (designed to protect personnel from falling while climbing the tower) may be installed if desired. This equipment is not furnished with the tower however; it is a separate item and must be ordered as such. (See Section 081-725-105.)

5. WEIGHT

5.01 The approximate weight of the various sizes of towers exclusive of lighting fixtures, antennas, anchor bolts and other appurtenances or auxiliary equipment is as follows:

HEIGHT (Feet)	WEIGHT (Lbs.)
80	6,600
100	7,600
120	8,800
140	9,600

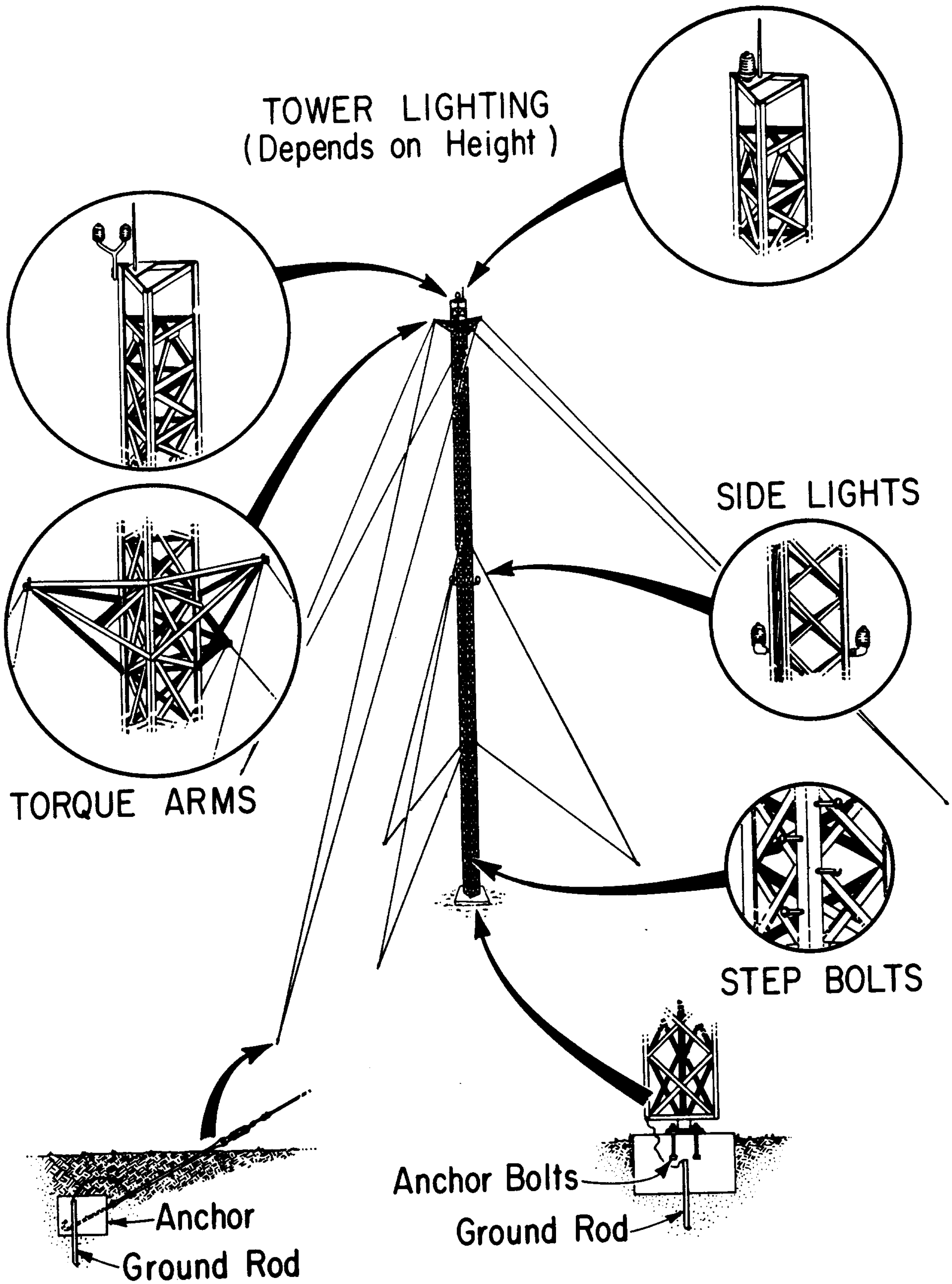
TOWER LIGHTING
(Depends on Height)
SIDE LIGHTS
TORQUE ARMS
STEP BOLTS
Anchor Bolts
Ground Rod
Anchor
Ground Rod

Fig. 1

HEIGHT (Feet)	WEIGHT (Lbs.)
160	10,400
180	11,300
200	12,700
220	14,200
240	15,600
260	17,400
280	18,700
300	20,000

6. WIND LOADING

6.01 The E Guyed Tower is designed to withstand a wind pressure of 40 lbs. per square foot while carrying a full complement of appurtenances as listed in Paragraph 7.01. This pressure roughly corresponds to a wind velocity of about 100 miles/hour. Design stresses under this wind loading are such as to provide a safety factor of at least 1.65 based upon the yield point of the material.

7. ANTENNA LOADING AND STABILITY

7.01 The E Guyed Tower is designed to withstand the above wind loading while carrying up to three of any System Standard passive reflector of the 10- by 15-foot size or smaller, or parabolic antenna not greater than 10 feet in diameter. Because of the extra wind loading imposed by waveguides, parabolic antennas should not be used on E Guyed Towers over 120 feet high.

7.02 E Guyed Towers carrying any of the above-mentioned antenna or reflector loads are designed to provide a mechanical stability of $\pm 1/4$ degree in tilt and $\pm 1/2$ degree in twist under a wind loading of 20 lbs./square foot (about 70 miles/hour).

7.03 The above degree of stability requires a terrain where the slope from the base of the tower will not exceed 3 degrees. For terrain sloping greater than 3 degrees, the above deflections will increase (eg, for a 6° slope, deflections will increase about 10%).

7.04 It should be noted that the E Guyed Tower provides maximum antenna stability at the level of the top set of guys. Resistance against twisting forces rapidly decreases from the level of the torque arms. Since the base of the tower rests on what is essentially a ball and socket joint, there is no restraint against twisting from this source. For towers with more than one level of guying, the lower guys must be considered relatively ineffectual in controlling the twist of the tower because they are attached directly to the tower, rather than to torque arms as are the top guys.

7.05 When considering deflection of the E Guyed Tower, it should be noted there are two separate and distinct effects. One is the movement of the tower as a unit as the guys stretch under load. The other is the bending of the tower between guy points. Both of these effects are brought into play by wind pressure acting on the tower and its appurtenances. The wind pressure on the antennas or reflectors represents a fairly concentrated load and they are therefore placed as close as possible to the level of attachment of the top guys. This minimizes the bending moment between guy points and the deflection which is caused by it. In considering the deflection of antennas or reflectors at locations other than standard, it should also be noted that the tower should be considered as a continuous beam on flexible supports.

8. ANTENNA MOUNTING

8.01 Facilities are available for mounting the appurtenances described in Paragraph 7.01 but they are not furnished as a part of the tower. The mounting areas are located on each of the three legs in the top section of the tower above the torque arms.

8.02 Using the standard mounting arrangement, the center of the 10- by 15-ft. reflector will be approximately 6 feet below the top of the tower; the center of the 8- by 12-ft. reflector will be approximately 7 feet below the top of the tower; the center of parabolic antennas will be approximately 9 feet from the top of the tower.

8.03 It will be necessary to exercise some care in orienting the tower because of the "blind" sectors which occur due to the mechanical limitations of the mountings and antenna or reflector adjustment mechanisms. As shown in Fig. 2, three blind sectors, 40 degrees wide and spaced at 120 degrees, occur when mounting passive reflectors. Similar sectors of 30- and 52-degrees, occur for 8- and 10-foot antennas,

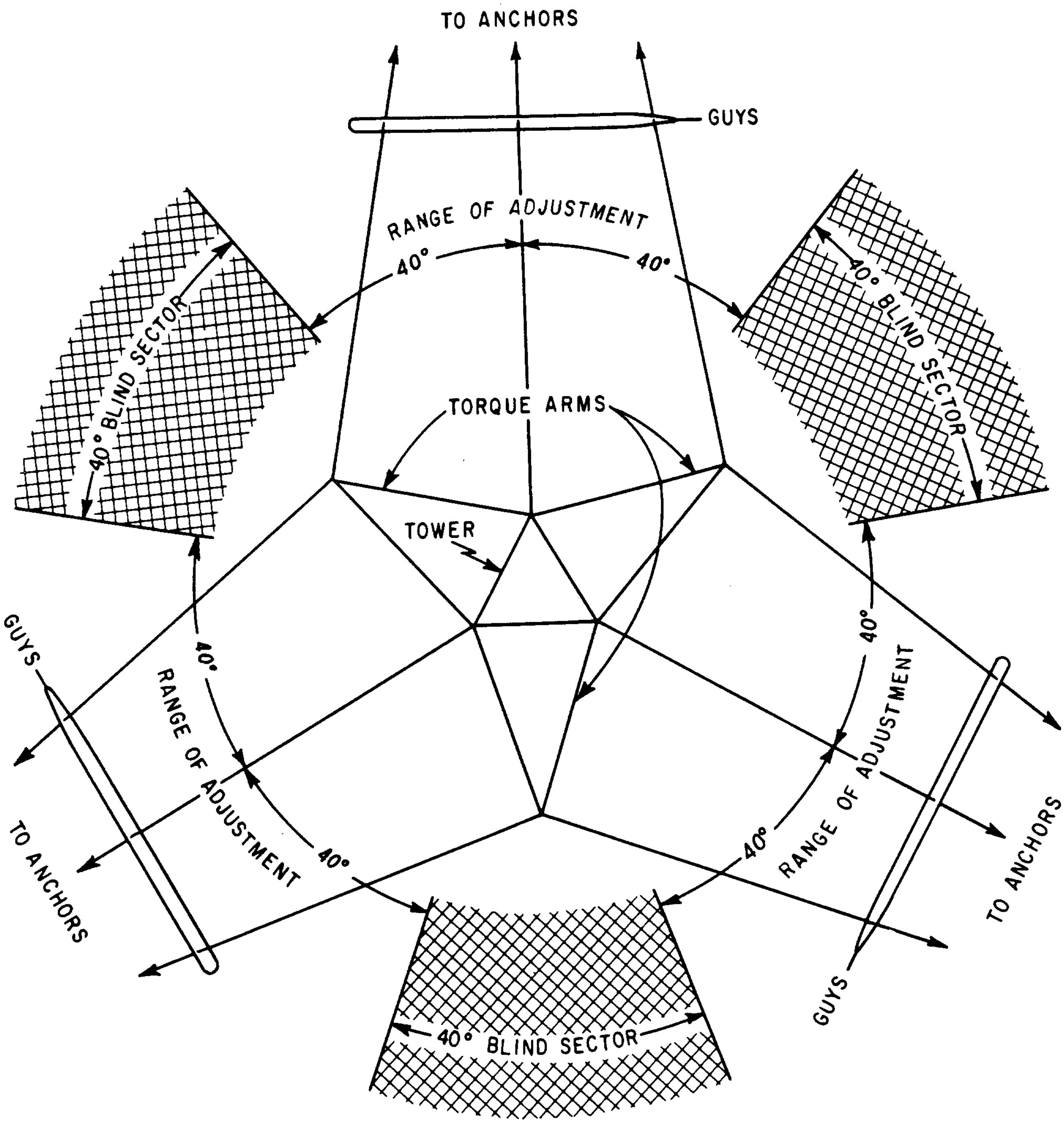

Fig. 2 – Typical Azimuth Limitations of Passive Reflectors Used With E Guyed Towers

respectively. The above-mentioned limitations need not affect the orientation of minimum size rectangular lots described in Part 3 of this section, however, since the tower can usually be oriented on the lot in either of two positions which are 180 degrees apart.

8.04 Transmission requirements will occasionally require that antennas or reflectors be mounted at other than the standard locations. As explained in Part 7 of this section, this will entail increased deflection and twist unless the tower is modified. The Western Electric Company has established a Tower Group (part of their System Standard Engineering — Department 155 at North Andover, Mass.) to handle tower modification work. Since this group has access to the design criteria and calculations for this tower, they are in a somewhat better position to do this work than outside consultants. Information necessary to enable modifications to be worked out should include the size of each antenna or reflector, its height of attachment, azimuth bearing and the nominal tower height.

9. LIGHTING

9.01 Air obstruction lighting for the E Guyed Tower is usually required for towers 160 feet high or taller but may be required for any height depending upon its location with respect to airports. Detailed requirements for air obstruction lighting and marking of radio towers is contained in Part 17 of the Rules and Regulations of the Federal Communications Commission.

9.02 Lighting for the E Guyed Tower must be ordered separately, and is available in three types as follows:

(a) F.C.C. 17.24 — Top light only.

(b) F.C.C. 17.25 — Top flashing beacon light and one set of side lights halfway up the tower.

(c) F.C.C. 17.26 — Top flashing beacon light and two sets of side lights at one-third and two-thirds tower height.

9.03 All lighting wiring on the tower is in conduit which is fastened to the tower by metal tapes. Sufficient wire and conduit is supplied to bring the wiring from the lighting fixtures to a junction box near the base of the tower. Conduit and wiring from the base of the tower to the lighting control box inside the building must be supplied locally. Other electrical needs at or near the base of the tower should also be considered in connection with these conduit and wire requirements (eg, antenna deicers, flood lighting, etc.).

9.04 The top lighting fixture on the E Guyed Tower is susceptible to lightning damage unless suitably protected. This is provided by installing a lightning rod which consists of a 5-foot piece of steel conduit equipped with an end cap. This material is included with the material normally supplied as part of the lighting kit. The lightning rod is not required unless the tower is equipped with lights.

10. PAINTING

10.01 Painting to increase visibility for air traffic is required by Part 17 of F.C.C. Regulations under the same conditions that require air obstruction lighting. Under the present rules, this takes the form of alternate equal bands of aviation surface orange (Federal Specification TT-P-59) and outside white (Federal Specification TT-P-102). The width of the bands shall be approximately one-seventh the height of the structure, provided the widths do not exceed 40 feet. The top and bottom bands must be aviation surface orange. Painting is usually done by the tower erector and the erection contract should so specify.