



CES TOWERS

FORMERLY KNOWN AS GRASIS AND ANDREW TOWERS

A wholly owned subsidiary of CES, Inc.



Custom Design
Engineering &
Fabrication of:

Guyed Towers

●M46

●M54

●M64

Self-Supporters

●3ST

●KST

Monopoles

Optional Equipment

Tower Services

Rework Steel for
All Major Tower Brands





History...

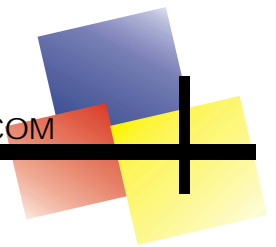


In August of 1987, Jeff Hawkins and Ed Keuck realized their dream and established Communication Equipment Specialists, Inc. (CES) in Lee's Summit, Missouri. The partners had worked together in the past at both Grasis Towers and Andrew Corporation, and recognized the need for a high quality installation and maintenance company. Their commitment to solve customer problems and address industry needs, while maintaining the highest quality level.

Why has the Grasis Tower Design been so popular over the past 40+ years? August Grasis began in the tower industry by establishing the very successful G.E. Mathis Tower Division in Chicago, Illinois in the mid 50's. In 1963, surrounded by several key employees, he opened the Grasis Fabricating Company. The Grasis Tower featured a formed leg that had been sheared to the proper width from a piece of plate steel of the desired thickness and was then formed to a 60 degree angle tower leg. This gave the Grasis engineers greater freedom to specify leg dimensions since they could control the thickness and the width of their leg steel. No longer did they have to "make do" with commercially available steel dimensions. Further more his forming process gave them less camber (curvature) on each leg section resulting in a straighter, stronger leg component. As Grasis expanded, his employee base was heavy with engineers. This assured that every detail of the Grasis Tower design had been scrutinized a countless numbers of times.

The Andrew Corporation developed their own tower division with the purchase of Grasis in 1983. These two companies combined have sold over 80,000 Towers worldwide. CES, Inc. eagerly purchased Andrew Corporation's tower division in December of 1999. We are proud to state that our towers are from the Grasis and Andrew heritage. CES Towers was also able to keep several key employees who offer over 100 combined years of experience with Grasis tower design, manufacturing and installation. CES Towers has established an archive with the drawings to most of these existing towers and they are available for your engineering needs.

Today, CES Towers, a wholly owned subsidiary of CES, Inc. offers a complete line of guyed and self support towers and components that still feature the Grasis formed leg design. We also offer in-house engineering services and rework analysis for all major tower brands. From just two people in 1987 to over 160 personnel today and regional offices throughout the United States the CES total commitment to quality and safety is not just a policy but a successful way of doing business.



Why Select CES Towers...



- For the Grasis Tower design and the most cost effective selection of guyed towers, self supporters, monopoles, components, antenna mounts, and tower hardware for **all makes of towers.**
- The inherent advantages of the formed leg over angular and tube legs.
- For the fastest, most direct path to system installation using CES “Single Source” supplier capabilities. We offer In-House Engineering & a full compliment of tower services, cafeteria style-you select the services you want. Additionally we are distributors for Andrew Corporation, Alcatel, Harris, MTS and many other major brands.
- For our complete Site Construction services. Site Engineering, Site and Civil Construction, Tower Assembly, Complete System Testing, Experienced Microwave System Installation, Path Alignment and Testing, PCS and Cellular Installation and thorough, In-House Project Management.
- For a financially responsible, high quality, overall low cost buying decision.
- For additional “After the Sale” customer support such as our Disaster Recovery Program a proactive response to a natural disaster. Tower inspections, engineering analysis and our maintenance of drawing archives. We even offer an informative Tower 101 and Tower 201 programs for an unbiased education on tower knowledge basics. These programs are aimed at educating the industry in tower management and safety.

There are no substitutes for the high degree of product quality, experience and the confidence obtained with the purchase of a CES tower.

Here are some of the reasons why...

Expeditious... “Time is money” **Speed of installation lowers costs and puts you on line sooner.**

CES uses Tower Application Design (TAD) and Computer Aided Design (CAD) computer programs to eliminate the delays that normally go along with “field engineering”. You’ll know exactly what to expect ahead of time.

Because CES can supply a full system of components from antenna and cable to towers and shelters, we have a unique ability to coordinate the manufacture and shipping of the various system components and to facilitate an efficient, timely installation.

When it comes to site civil construction requirements, CES site civil crews supervisors are available to perform all aspects of site civil construction. Services include initial layout, roadwork, concrete and foundation installation, fencing, etc. We are licensed in every state that requires one. You have your own work to do. You will be at ease with the confidence that CES professionals will do their job right - allowing you to complete yours - on time and without stress.



Experience and Technical Support...



Don Johnson, Production Manager-38 years of service with Grasis Towers.

The worst delays can occur long before the installation begins. Put CES on your team and streamline the process.

Working with the community where you want to install an antenna system can be a long and tedious process, unless you put CES on your side. Our in house engineering staff will provide the information you need to streamline the zoning approval process including:

- Tower permit drawing packages.
- A professional engineering staff available to answer local zoning board questions.
- Professional Registered Engineer stamped prints for tower and foundation
- Specialty Foundation design when required.
- Copies of the tower design analysis.
- Licensed Professional Engineers available in all 50 states.



Shane Polly, Inside Tower Sales-23 years of hands on experience.

CES brings a history of more than 20 years of successful and safe installations to your project and our tower designs go all the way back to the mid 60's with Grasis Towers.

Cost...

Choosing CES lowers the costs associated with your tower over the life of the installation.

- CES towers provide the highest value and are competitively priced for today's market demands.
- Lower maintenance costs are built into our towers by design.
- Tower Legs are constructed of formed "plate steel" members which promote accessibility to all surface areas facilitating inspection and preventative maintenance against corrosion damage. Our legs won't unexpectedly rust from the inside out.
- CES towers can be designed to facilitate future loading expansion. Our tower line provides significant advantages and reduced costs associated with the strengthening and rework required to safely support additional loads.



Kevin VanMaele, Head Engineer- 23 years of engineering and design.

Confidence...

Choosing CES reduces the risks involved in selecting a Tower Systems company.

CES will verify the tower type and model best suited for your application and help determine the options and accessories that will most efficiently keep your system operational and trouble free. The Tower Design Data Sheet found on page 13, allows you to specify the tower and equipment required for your application. Upon request, we will conduct a free budget analysis of the tower you've indicated. If you desire, our Project Management Team can assure the efficient, cost effective coordination of all installation steps, freeing you to attend to other aspects of your business. We are fast, responsive to changing demands, economical and safety is our companies # 1 priority.

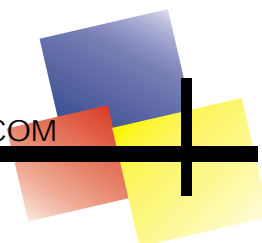
After a tower is installed and signed over to you, the customer, CES doesn't simply walk away. We continue to support our products through the Site Inspection program. A CES site inspection is inexpensive, and provides an extremely cost-effective way to protect your revenue flow by reducing the possibility of down time and expensive repairs. CES also provides tower analysis and drawing archive services that are not always available from other tower suppliers.



David Lohe, Project Engineer -23 years engineering and 12 years of direct tower experience.



Jeff Edwards, General Manager-15 years of service, started as a tower climber and worked his way up.



Guyed Towers

Guyed towers will usually provide lower steel, foundation, and construction costs. They also have a greater range of heights than self supporting towers. The guyed tower is composed of a central small-faced tower mast which is tethered and supported by guywires. These cables are the main means of support for a guyed tower. The cables extend from the tower at designated pulloffs or torque stabilizers and are anchored into the ground at various distances away from the tower. The guywires serve to stabilize the tower from twist and sway. To accomplish this, the guywires are maintained at calculated tensions in relation to the length and diameter of the cable.

Guyed towers can accommodate a variety of applications by simply changing the face width and member sizes. Towers of this sort can carry a wide combination of cellular and microwave communications. CES will computer-design a guyed tower to meet your specific requirements utilizing our three standard tower designs, having face widths of 46 and 54 inches (1170 and 1370 mm) or our colossal 64 inch (1625 mm).

Standard Features

CES offers guyed tower designs utilizing bolted design to accommodate the preferences of you the end user.

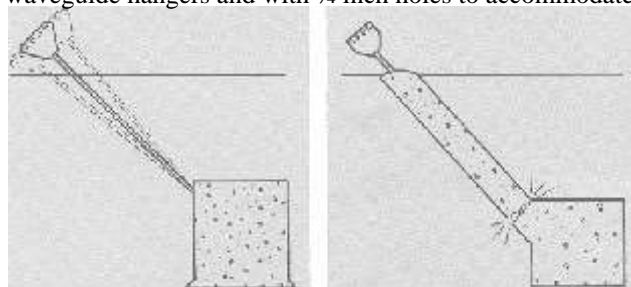
Optimum Design. The CES computer analysis program ensures maximum tower stiffness, minimum twist and sway and minimum bending moment. The computer program contains a variety of leg, diagonal and guywire sizes as well as bracing patterns and spans between supports. CES guyed towers are more cost effective for a wider range of heights and corresponding antenna, wind and ice loading combinations than generic tower designs. All CES towers are designed to your specifications in accordance with the latest EIA-222 standard.

High Strength Legs. Legs used on all guyed towers are made of 50,000 lb/in (345 MPa) yield strength steel for increased strength and lower weight design and are formed from plate steel for increased straightness and strength.

Stress-Free Foundation. An articulated base eliminates stress from uneven foundation settlement or wind-induced tower translation ensuring perfect, stress-free tower alignment. Problematic anchor bolts are not necessary. (A fixed base is available for special applications.)

Integrated Transmission Line Support. Pre-punched transmission line support channels are a built-in feature of our guyed tower bracing systems. No additional clamp or angle adapters are required for cable or waveguide attachment. Support channels are mounted at 4 foot (1.2 m) intervals inside, outside or on both sides of one or more tower faces. The supports are provided with 7/16 inch holes for mounting standard HELIAX cable and elliptical waveguide hangers and with 3/4 inch holes to accommodate standard snap-in hangers.

Reduced Guy Vibration. Flexible anchor shafts have a dampening effect on wind-induced guy vibrations. The shafts are galvanized and coated below grade with bitumastic paint to resist corrosion.



A typical CES flexible anchor shaft.

A typical rigid anchor shaft.



Heavy-Duty Cable and Hardware. All guy cable on CES Towers are either extra-high strength (EHS) or Bridge Strand (BS). Forged steel turnbuckles provide for future tensioning. Preformed dead-end type grips are standard. Fist grips are available on request.

Construction. The all-bolted construction of the M46, M54, and M64 tower models minimizes freight costs and readily accommodates future modifications and fast, easy replacement of tower members.

Climbing Ladder. All towers can be fitted with a 12 inch (305 mm) wide ladder with 5/8 inch (16 mm) rungs at 16 inch (406 mm) intervals. Ladders for the larger towers are standard and are internally mounted such that two tower faces form a safety cage.

U.S. FAA Requirements. Field applied latex paint and/or lighting can be provided for towers that require marking under FAA regulations. (Refer to page 12 for more information on tower lighting requirements.)

Lightning Protection. CES offers grounding components and systems to meet the minimum standards prescribed by EIA/TIA-222-F. Technical expertise is also available to assist you in specifying and obtaining more substantial protection when the minimum standards are not adequate ..

Rigidity. Tower column stiffness is controlled through the design and selection of various leg and diagonal sizes. Guy wires are attached at levels located to minimize bending. Torque stabilizers are utilized to resist twisting induced by large twisting forces.

Hot-Dip, Galvanized, Certified Structural Steel is used for all components. CES obtains certification on the physical and chemical characteristics of all steel used for its towers and we use only domestic suppliers when purchasing our raw materials.

Guy Tower vs. Self-Supporting

Cost Comparison...

Guyed towers typically cost less than self-supporting towers due to reduced steel usage. Generally foundations for self-supporting towers are more costly than guyed tower foundations. Construction time for guyed towers is generally less than for self-supporting towers. However Guy Towers do require more land for their construction.

Maintenance...

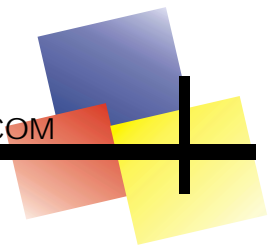
In general, self-supporting towers require slightly less maintenance. It is recommended that guyed towers undergo an annual inspection including the measurement and adjustment of guy wire tensions. Proper tensioning of guy wires ensures minimum deflection of antennas under high wind conditions and maximizes overall tower performance.



CES Towers feature an articulated base for stress free tower alignment Problematic anchor bolts are not necessary.

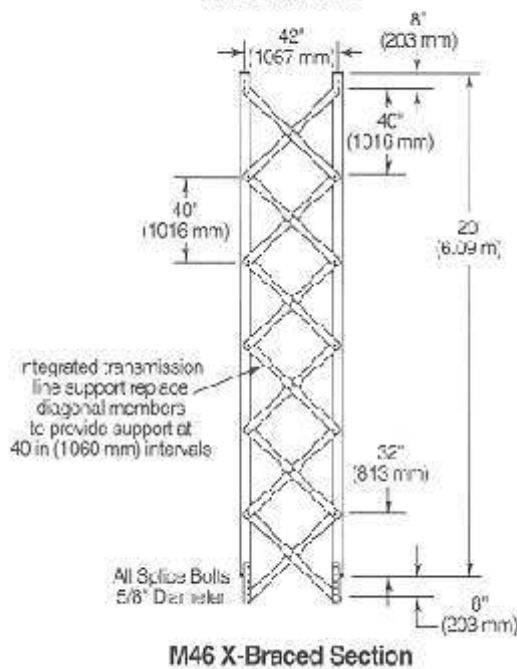
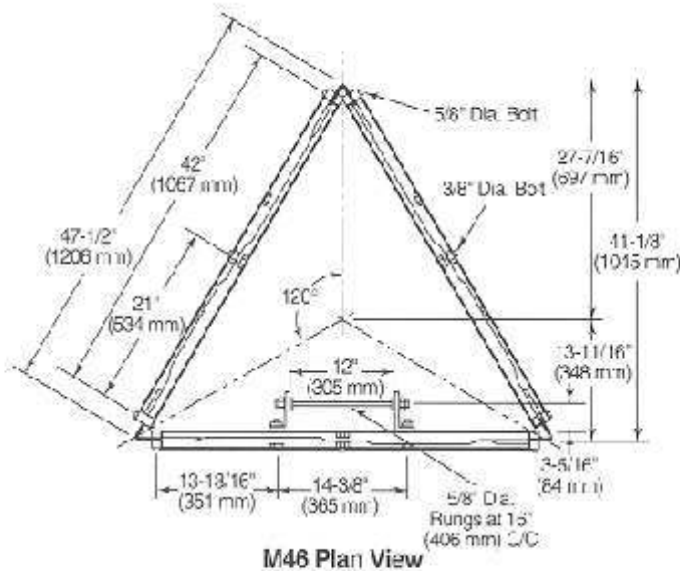


Integrated transmission line supports are a built in feature every 4 feet (1.2m) on a CES Tower.



Guyed Tower Models

M46



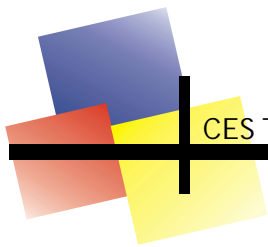
The M46 is a 46-inch (1170 mm) face width, all bolted construction guyed tower and can accommodate most microwave systems and cellular applications.

By varying leg, diagonal, and guy cables dimensions, as well as bracing patterns and spans between supports, the M46 tower is made versatile for a wide range of heights and corresponding antenna, wind, and ice loading combinations. This versatility in design creates overall design economy and makes the M46 one of our most popular guyed towers.

- **Maximum Height:** 480 ft (146m).
- **Tower Face Width:** 46-inch (1170 mm).
- **Bracing System:** The M46 is X-braced in 40-inch (1 m) bays throughout to provide an extremely strong and rigid mast.
- **Tower Legs:** Angular and made from formed high strength steel plate.
- **Transmission Line Supports:** Integrated transmission line supports carry up to 12 runs of cable and waveguide per face. When inside and out side are used, up to 24 runs per face can be carried.

All CES Towers feature the patented formed leg design utilizing 50,000 psi flat plate steel that is sheared to the proper dimension and then mechanically formed to a superior leg. Round pipe is very effective but can rust from the inside out-without being noticed. Pipe is difficult and expensive to rework in the future and often requires welding for modifications, which is hard to certify. The certification of re-formed angular steel becomes questionable once it is bent for a second time and this type of steel is limited to standard production dimensions. Our formed legs overcome these limitations and excels as a tower leg component.



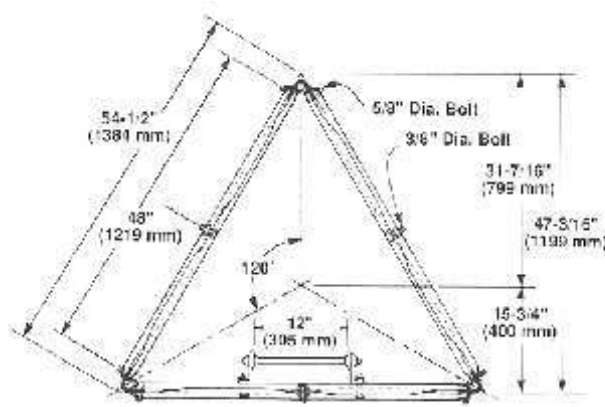


M54

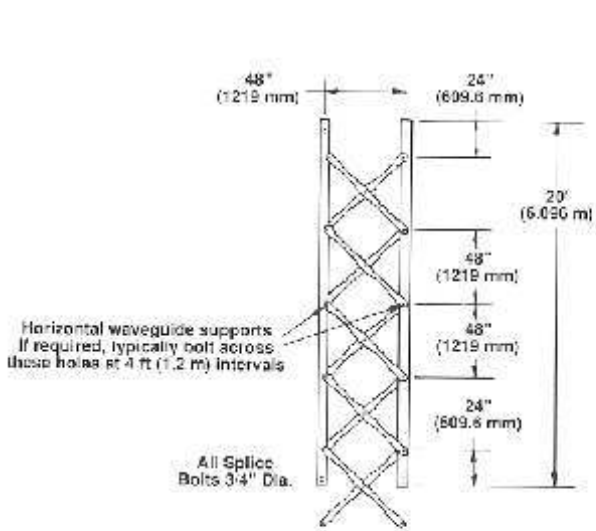
The 54 in (1370 mm) face width tower is intended for microwave applications using more or larger antennas or where your specification and location require more extreme wind and ice loading conditions than those commonly encountered.

The M54 is X-braced in 4 ft. (1.2 m) bays throughout to provide an extremely strong and rigid mast. Back-to-back X-bracing in high shear areas are used in the bracing system.

Integrated transmission line supports carry up to thirteen runs of HELIAX® elliptical waveguide or coaxial cable. When inside and outside supports are used, up to 26 runs of transmission line per face can be carried.



M54 Plan View



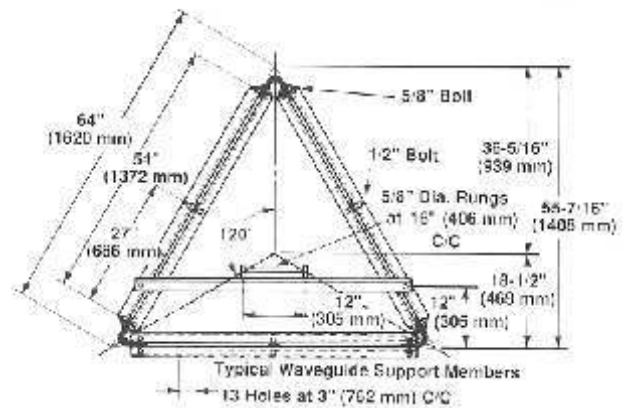
M54 X-Braced Section with Formed Diagonals

M64

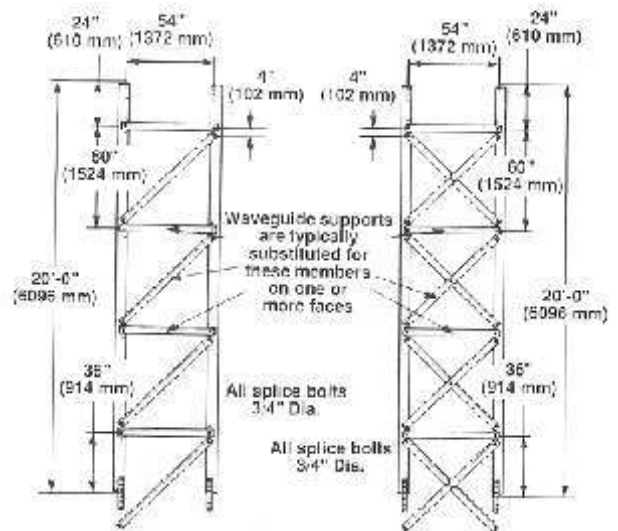
The 64 in (1625 mm) face width tower meets extremely heavy loading requirements associated with many horn or parabolic antennas, or if your specification and location requires extreme wind, unusually heavy icing conditions or a combination of all three.

The face width along with a wide range of leg member sizes allows for long spans between guy levels without sacrificing tower rigidity. The Z-bracing pattern of back-to-back angles more efficiently resists heavy ice coatings and wind.

Integrated transmission line supports carry up to fourteen runs of HELIAX® elliptical waveguide or coaxial cable. When inside and outside supports are used, up to 28 runs of transmission line per face can be carried.

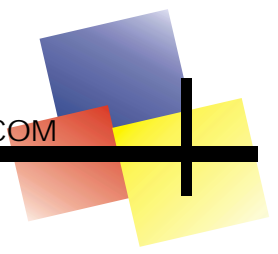


M64 Plan View



M64 Z-Braced Section

M64 X-Braced Section

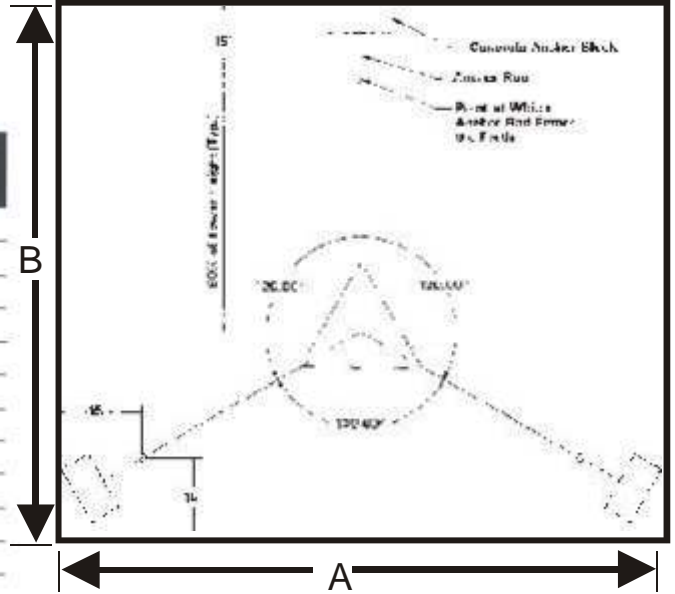


Land Requirements and Tower Orientation...

Guyed Tower Land Requirements at 80% Guying*

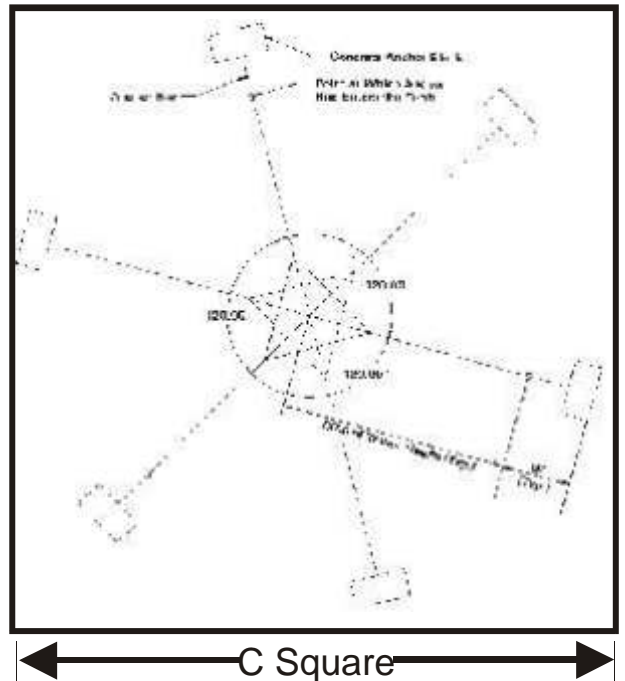
Tower Height	Acres	Layout 1		Layout 2	
		A	B	Acres	C
120'	0.80	200'	175'	1.16	225'
130'	0.94	215'	190'	1.32	240'
140'	1.04	225'	200'	1.49	255'
150'	1.16	240'	210'	1.67	270'
160'	1.32	255'	225'	1.93	290'
170'	1.46	270'	235'	2.14	305'
180'	1.64	285'	250'	2.35	320'
190'	1.76	295'	260'	2.58	335'
200'	1.92	310'	270'	2.81	350'
210'	2.13	325'	285'	3.14	370'
220'	2.31	340'	295'	3.40	385'
230'	2.50	350'	310'	3.67	400'
240'	2.68	365'	320'	3.95	415'
250'	2.88	380'	330'	4.24	430'
260'	3.13	395'	345'	4.65	450'
270'	3.34	410'	355'	4.96	465'
280'	3.57	420'	370'	5.29	480'
290'	3.80	435'	380'	5.63	495'
300'	4.03	450'	390'	5.97	510'
310'	4.33	465'	405'	6.45	530'
320'	4.53	475'	415'	6.82	545'
330'	4.84	490'	430'	7.20	560'
340'	5.10	505'	440'	7.59	575'
350'	5.37	520'	450'	8.00	590'
360'	5.71	535'	465'	8.54	610'
370'	5.94	545'	475'	8.97	625'
380'	6.30	560'	490'	9.40	640'
390'	6.60	575'	500'	9.85	655'
400'	6.91	590'	510'	10.31	670'
410'	7.23	600'	525'	10.93	690'
420'	7.55	615'	535'	11.41	705'
430'	7.96	630'	550'	11.90	720'
440'	8.29	645'	560'	12.40	735'
450'	8.64	660'	570'	12.91	750'
460'	9.00	670'	585'	13.61	770'
470'	9.36	685'	595'	14.15	785'
480'	9.80	700'	610'	14.69	800'
490'	10.18	715'	620'	15.25	815'
500'	10.49	725'	630'	15.81	830'

* The distance between the tower and outer guy anchor equals 80% of the tower height. Other ratios to 60% can usually be accommodated.



Layout 1

Minimum Area of land required. This area will not always permit orienting tower in the best position for antenna path direction.



Layout 2

The minimum area of land requires to permit orienting the tower in any position for optimizing antenna path direction.



Self-Supporting Towers

A self-supporting tower is a free-standing space frame. It requires less land than a guyed tower and can accommodate more and larger antennas. Because of its bolted construction, it can easily be modified to increase antenna capacity. Because of these reasons a self-supporting tower is usually the best choice when microwave communication is needed in addition to cellular.

Self-supporting towers can be provided as three-sided or four-sided structures. A triangular tower is usually preferred over the square tower because it has fewer parts and the fourth side of a square tower does not add as much capacity to the tower as it does cost. A three-sided tower is lighter and more economical to build and requires a less expensive foundation. Because of this, CES offers three-sided towers as our standard product but four sided towers are available when required.

CES provides two standard Self-Supporting Towers, the 3ST and the SCAT (formally called KST), both feature our formed plate leg design. Many leg and diagonal sizes are available for each tower section making the CES Self-Supporting Tower very versatile and economical. They are economical because we are able to use the exact dimension steel required for each tower design. Our leg construction is not limited to steel mill production sizes.

Standard Features

Optimum Design. CES uses TAD 9 (Tower Analysis Design) to consider antenna loads and effects on member stresses and displacements. The displacement of the actual tower is determined for every joint, and then used to calculate tower twist and sway. All CES towers are designed to your specifications in accordance with EIA/TIA-222-F.

High Strength Legs. All tower legs are made of 50,000 lb/in (345 MPa) yield strength steel for increased strength and lower weight design. The 3ST and SCAT feature flat steel plate formed into a 60 degree leg member.

High Strength Angle Bracing. All tower legs are braced along both planes to ensure rigidity. Further internal bracing provides required torsional stability and rigidity. Secondary horizontal and diagonal members are provided where required to adequately support the main members.

High Strength Leg Splices. High strength structural $\frac{3}{4}$ inch (19 mm) or larger bolts are used in all leg splices. Bolts are secured with lock washers and nuts torqued to exceed minimum requirements.

All-Bolted Construction. The all-bolted construction of the 3ST and SCAT towers permit compact and economical shipment. The tower is shipped completely knocked-down to minimize freight costs. Bolted construction readily accommodates fast, easy replacement of tower bracing members, if required for future modifications.

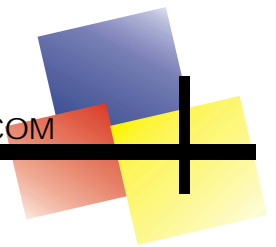
Climbing Ladder. The 3ST towers can be provided with a 12 inch (305 mm) wide ladder with $\frac{5}{8}$ inch (16 mm) diameter rungs at 16 inch (406 mm) intervals. The ladder is internally mounted so that two tower sides form a safety cage.

U.S. FAA Requirements. Field applied latex paint and/or lighting can be provided for towers that require marking under FAA regulations. See page 12 for more details on tower lighting.

Lightning Protection. CES offers grounding components and systems to meet minimum standards prescribed by EIA/TIA-222-F. Technical expertise is also available to assist you in specifying and obtaining more reliable protection than that afforded by the minimum standards.

Foundation Designs. The cost of the foundation design is included with the tower purchase. CES will custom design the foundation using a customer-supplied soil analysis at no additional charge. Standard foundations consist of three or four isolated spread footings or drilled piers. CES is also fully prepared to design non-conventional foundations such as piling, rock anchorage, etc., where unusual soil conditions exist.

Hot-Dip Galvanized, Certified Structural Steel. All tower components are protected by hot-dipped galvanizing. CES obtains certification on the physical and chemical characteristics of all steel used for its towers.



Self-Supporting Towers

Monopoles

Monopole towers offer the advantages of simplified construction, internal cabling, minimal land requirements, and greater community acceptance. Field assembly requires no field welding and an absolute minimum number of connections. Our monopoles are designed to your specifications and to EIA/TIA 222 standard with a graceful taper.

CES can incorporate product design with the required equipment into a coordinated project. Limiting on sight logistics, shipping costs and installation to an absolute minimum. All projects include detailed assembly instructions and detailed drawings. CES can also handle all phases of the site acquisitions and preparation, foundation work and structure installation.

Climbing systems, safety harnesses, waveguide bridges, tower lighting, antenna mounts as well as grounding kits and many other accessories are also available as part of our complete equipment and services capability.

Structural and decorative products for rooftop, water tank, and architectural requirements are also available from CES.

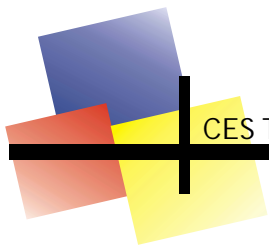


3ST Dimensions

Section	Base Width ft (m)	Tower Height ft (m)
1	3.75 (1.20)	20 (6.10)
2	5.25 (1.60)	40 (12.19)
3	7.00 (2.13)	60 (18.29)
4	8.75 (2.59)	80 (24.38)
5	10.50 (3.20)	100 (30.48)
6	12.25 (3.73)	120 (36.58)
7	14.00 (4.26)	140 (42.67)
8	15.75 (4.80)	160 (48.77)
9	17.50 (5.33)	180 (54.86)
10	19.25 (5.86)	200 (60.96)
11	21.00 (6.40)	220 (67.06)
12	22.75 (6.93)	240 (73.15)
13	24.50 (7.47)	260 (79.27)
14	26.25 (8.00)	280 (85.34)
15	28.00 (8.53)	300 (91.44)
16	29.75 (9.07)	320 (97.54)
17	31.50 (9.60)	340 (103.63)
18	33.25 (10.1)	360 (109.73)
19	35.00 (10.6)	380 (115.82)
20	36.75 (11.2)	400 (121.92)
21	38.50 (11.7)	420 (128.02)
22	42.00 (12.8)	440 (134.11)
23	45.50 (13.9)	460 (140.21)

SCAT Dimensions

Section	Base Width ft (m)	Tower Height ft (m)
1	6.50 (1.98)	20 (6.10)
2	9.25 (2.82)	40 (12.19)
3	12.00 (3.65)	60 (18.29)
4	15.00 (4.57)	80 (24.38)
5	18.00 (5.48)	100 (30.48)
6	20.75 (6.32)	120 (36.58)
7	23.75 (7.24)	140 (42.67)
8	26.75 (8.15)	160 (48.77)
9	29.75 (9.06)	180 (54.86)
10	32.75 (9.98)	200 (60.96)
11	35.75 (10.8)	220 (67.06)
12	38.75 (11.8)	240 (73.15)
13	41.75 (12.7)	260 (79.25)
14	47.75 (14.5)	280 (85.34)
15	46.33 (14.1)	300 (91.44)

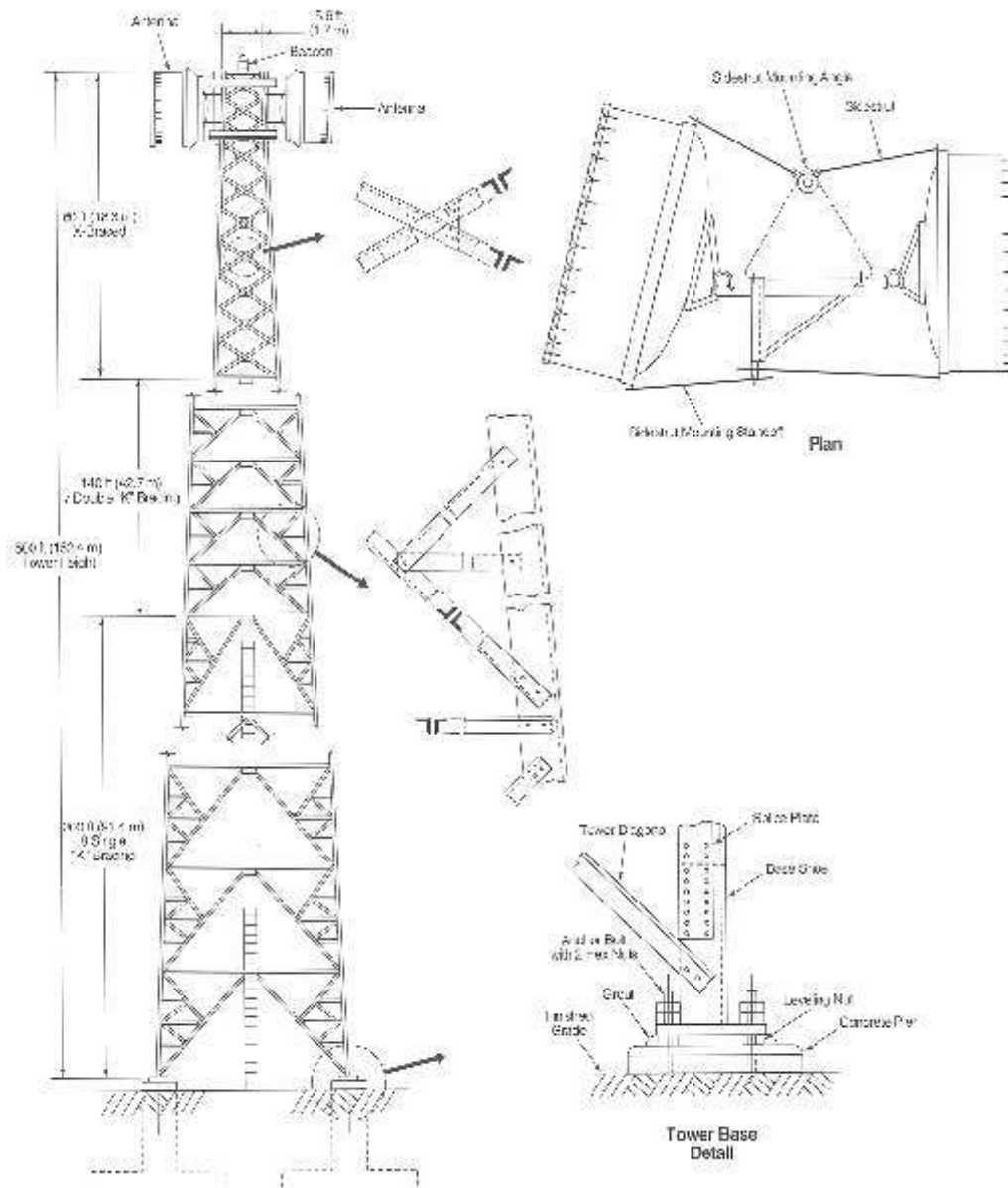


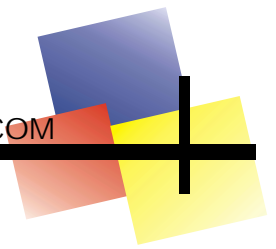
3ST

The 3ST series tower is a triangular, medium/heavy self-supporting tower designed to meet a wide range of applications. Its steep taper makes it very attractive in limited site space applications.

The three main legs are constructed from steel plate formed to a 60 degree angle creating an equilateral triangular cross-section. Combined with the internal bracing system the 3ST tower becomes an exceptionally stable and rigid structure. Many leg and diagonal sizes are available for each tower section making the 3ST versatile and economical. The formed "steel plate" construction facilitates reinforcement and strengthening to accommodate future loading requirements that were unforeseen at the time of the initial design.

- **Maximum Height:** 540 ft. (165 m).
- **Section Length:** Sections 1 thru 21 are 20 ft (6.08 m) long. Sections 22 and 23 are 40 ft (12 m) long.
- **Taper:** 21-inches (533 mm) per 20 ft (6 m).
- **Bracing System:** The 3ST is X-braced in the top five sections, double K-braced for the following seven sections and single K-braced for the remaining lower sections. All braces are angular and in a back-to-back configuration that eliminates eccentricity in compression.
- **Tower Legs:** Sheared to the proper dimension from high strength steel plate and formed into a superior performing tower leg.



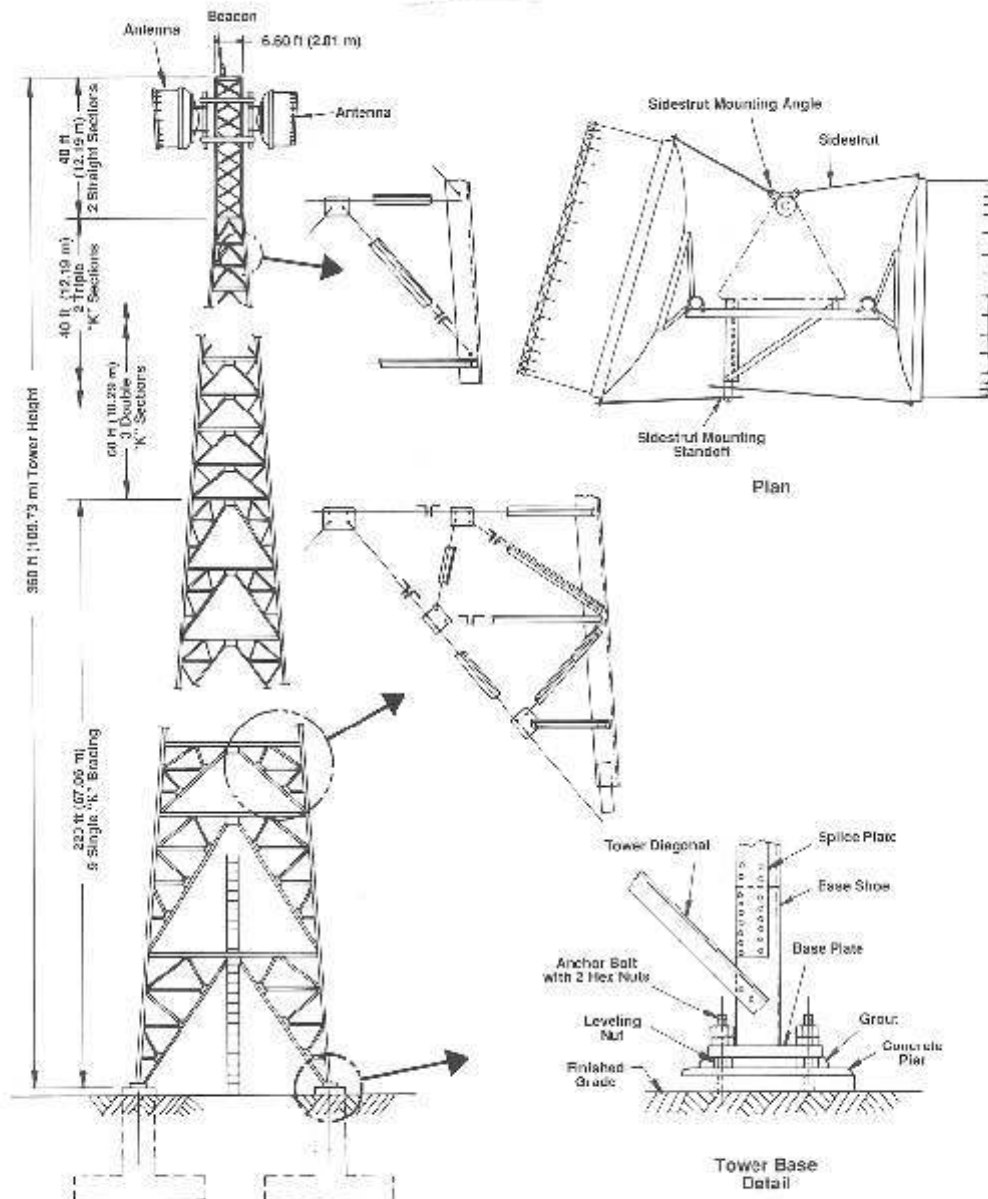


SCAT (formally know as KST)

The SCAT is suitable for most heavy microwave applications, especially those using multiple high performance antennas or combination of high performance antennas.

The 36-in taper every 20 ft (915 mm per 6 m) provides maximum rigidity and strength. It efficiently meets loading requirements for heavy common carrier loads. It is most efficient in applications requiring from four UHX 10-ft (3 m) diameter antennas up to nine 10-ft (3 m) diameter UHX.. The SCAT can easily carry its maximum design load, according to EIA/TIA 222 standards, up to a height of 300 ft (91 m). Maximum tower height is 360 ft (110 m).

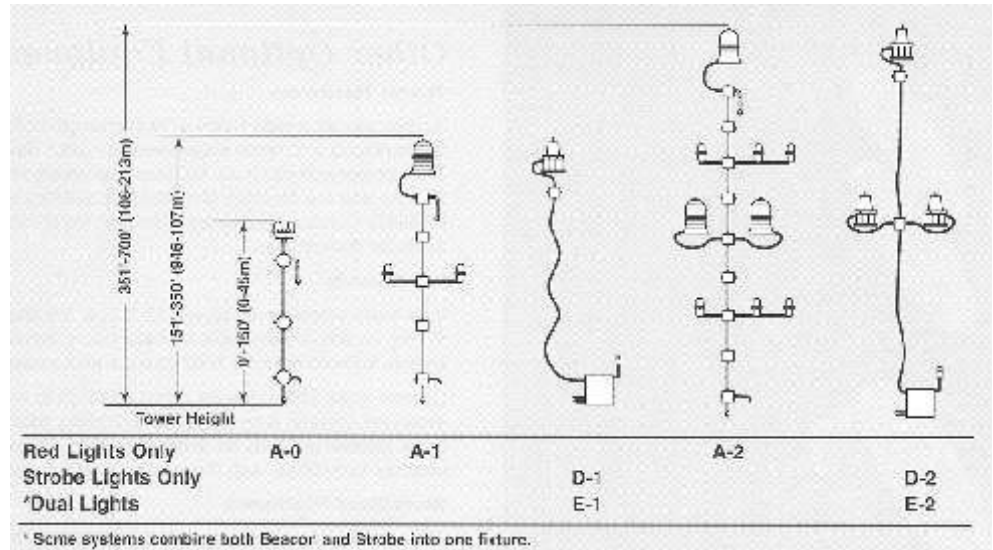
Angle Bracing. The bracing design of the SCAT consists of an “X” pattern in the upper portion of the tower and a “K” pattern in the lower sections. All main diagonals and horizontals in the K-braced sections are double angles bolted back-to-back. The added advantage of “formed - steel plate” shape members is the elimination of hidden corrosion and increased design freedom. Tower legs are braced along both planes to ensure rigidity. Redundant horizontal and diagonal members are provided where additional bracing is required in the lower sections to adequately support the main members. Internal diaphragm bracing members are installed in K-braced sections to provide complete stabilization of the main members and overall tower rigidity. Thus increasing tower performance.



Tower Lighting Systems

According to the FAA and FCC all towers over 200 ft. must have markings which are visible to air traffic. Towers under 200 ft do not require marking unless special circumstances such as proximity to an airport warrant special consideration. Marking a tower with lights is the most common means of meeting such requirements. Towers over 350 ft require two flashing lights at the tower's midlevel height instead of one.

CES tower lighting is designed to cover a wide range of applications using red lighting, dual lighting and/or strobe lighting. All lighting systems meet the requirements of all major government specifications.



Red Lighting Systems

Red lights (flashing beacons and steady burn lights) are used to identify a tower strictly at night. Towers with red lights must be painted for daytime and twilight. CES red lights are approved for L-864 and L-810 systems. All kits come with wiring and conduit.

Strobe Lighting Systems

Medium Intensity White Strobe

Omni-directional medium intensity strobe lighting systems provide tower visibility both day and night. During daytime operation the strobe puts out 20,000 candles of intensity. At night the intensity drops down to 2,000 candles. Use of the strobe system eliminates FAA required costly tower painting and the related expenses for towers under 500 ft.

The medium intensity strobe includes a flashing white beacon, a power supply, a photocell and controller. The photocell switches the system to a higher intensity during the day and lowers the light intensity at night. The strobe lighting system is FAA L-865 and L-866 approved.

The medium intensity strobe is available in two styles. Option 1: the power supply is located directly beneath the flat heads on the tower. This eliminates the need to run high voltage power lines up the tower. Option 2: the power supply is located at the base of the tower. This eliminates the need to climb up the tower to service the power supply.

Due to the bright intensity of the light, medium intensity strobes are usually not recommended on towers under 200 ft.

Dual Lighting System

In areas where strobes may be a distraction to the surrounding neighborhood, a dual lighting system may be used as an alternative. CES offers a dual lighting system which combines the subtler, more neighbor friendly red lighting at night and the increased safety of medium intensity strobes during the day. This system eliminates the expense and increased maintenance of FAA required painting for towers under 500 ft.

Tower Design Data Sheet

All information on this form is necessary to prepare an accurate tower quotation.

Design Load (We use EIA/TIA-222 Most Current Spec. for tower design)

Customer _____	Site Name _____
Telephone Number _____	County _____ State _____
Contact Name _____	Tower Type: (circle one) Guyed Self Support Monopole
email _____	Tower Height _____
Quote Due Date _____ Today's Date _____	Preferred Model _____

Standard Design Code

EIA County Specs (Most Current)
 _____ mph + _____ Ice

Special Design Codes _____
 (BOCA, SSBC, UBC, SFBC, etc.)

Rigidity Specifications

Microwave Operating Frequency _____

_____ Standard 50 mph + Ice (EIA RS-222 Most Current)

_____ Other _____ mph + _____ Ice

Antenna Loading

Qty	Size	Make/Model	Radome	Level	Azimuth	WG/Coax	Initial/Future
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
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_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____

Tower Mounts	Qty	Climbing Devices	Qty	Waveguide Bridges	Qty
Antenna	_____	Step Bolts	_____	4½" x 10' (4 Run)	_____
6' Side Arms	_____	Climbing Ladder	_____	13½ x 10' (12 Run)	_____
3' Side Arms	_____	Cable Safety Climb	_____	20" x 10' (24 Run)	_____
Platform/Star Mounts	Qty	Rigid Safety Climb	_____	Cable Support Kit	_____
Cellular Platform	_____	Waveguide Supports/Ladders	Qty	FAA Lighting/Paint	Qty
Cellular Platform w/ retractable arms	_____	Waveguide Ladder (13 Run)	_____	Strobe Lighting Kit	_____
Star Mount 20' Separation (Torque Arm)	_____	Waveguide Ladder (10 Run)	_____	FAA Lighting	_____
Universal Mount	_____	Waveguide Ladder (8 Run)	_____	Dual Lighting System	_____
		Waveguide Ladder (6 Run)	_____	Latex Field Applied Paint	_____
				Other Accessories	Qty
				EIA Grounding	_____
				Ice Shields	_____

Additional Notes

Fax completed form to: CES Towers at 816-525-9898



APPLICATION FOR CREDIT

CES Towers

_____ Legal Name of Applicant	_____ Taxpayer ID #	\$ _____ Credit Limit Requested
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1) Applicant is a _____ Corporation _____ Partnership _____ Sole Proprietorship _____ 2) Date firm began Business: _____

a. Corporation: State of incorporation _____ Name of firm's president: _____

b. Partnership or Sole Proprietorship: List name, home address, and social security number of all owners.

Legal Name	Home Address	Social Security #

3) Location of main office:

Address	Phone Number
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4) Additional operating locations:

Address	Phone Number

5) Trade names operating under: _____

6) Banking Information		
Name of Bank	Address	Point of Contact and Phone Number

7) Names of individuals authorized to sign checks:

8) Name, address, telephone and fax numbers of five creditors who currently grant the highest line of credit:

Name	Address	Phone	Fax

9) DUNS number: _____ Dun and Bradstreet rating: _____ Estimated net worth of the firm: \$ _____

I warrant that the firm is solvent.

I warrant that no owner (if partnership or proprietorship) and no officer (if corporation) has been the subject of a personal bankruptcy in the last ten years and that the firm is not currently involved in any bankruptcy or similar proceeding.

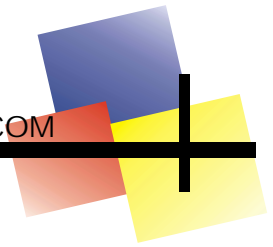
Terms are thirty (30) days net from invoice date without reduction for retainage unless other terms are accepted by CES Towers in writing. All sums not paid when due shall bear interest at the rate of 1.5% per month from the due date thereof until paid. To the extent permitted by law, applicant shall be liable for all costs, including reasonable attorneys' fees, incurred by CES Towers in the collection of any sums not paid when due. Any such accrued interest or costs of collection shall be payable to CES Towers upon demand. If CES Towers shall have a reasonable doubt as to applicant's ability to make payment when due, CES Towers may in its sole judgment require such other payment terms as it deems appropriate, including full or partial payment in advance of delivery or by letter of credit.

Permission is hereby granted to discuss our account with the bank and creditors identified in this application. An update of this application may be requested at least annually.

I warrant that the foregoing information is true and correct and understand that it will be relied on in the granting of future credit. I agree to the terms set forth above.

Signature of Authorized Agent	Title	Date
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Signature of Sole Proprietor



CES TOWERS CONDITIONS OF SALE

1. **PRICES.** Prices are subject to change without notice. Firm quotations are available for specific time periods, upon request. Prices as listed are F.O.B. Manufacturer's Factory where noted (*), freight collect, and do not include export packing, insurance, taxes, tariffs or duties. For international shipments, quotations may be obtained F.O.B. plant, F.A.S. port of departure, or C.I.F. port of entry.

2. **TAXES.** The prices do not include amounts for retailer's occupation, sales, use, gross income, privilege or excise tax or any other tax, duty or assessment which may arise from the sale of the equipment, and such amount may be added to the price in the event Seller becomes liable to pay or bear the burden thereof. A request for exemption from any such tax, duty or assessment must be accompanied by a properly executed exemption certificate.

3. **SHIPMENT.** Unless otherwise specified in an order, shipments are made F.O.B. shipping point, freight collect, and Buyer shall pay or bear all transportation charges and bear the risk of loss or damage to equipment from the time it is delivered to a carrier. When shipments are F.O.B. destination, Seller will deliver the equipment to carrier for transportation to Buyer, arrange for transportation thereof to destination, and pay transportation therefor, but Buyer assumes the risk of loss or damage to equipment from the time the equipment is deposited with a carrier and shall pay all charges at destination for cartage, storage, other accessorial services and demurrage. Seller may make partial shipments and submit for such partial shipments invoices payable in accordance with Seller's terms below.

4. **TERMS.** All shipments are made C.O.D. unless otherwise specified herein. When the terms are specified as "open account", shipments are payable within thirty (30) days of invoice date. Buyer is responsible for all reasonable attorney fees, court costs, and/or collection agency fees should such action become necessary by reason of Buyer's fault.

5. **RETURNABLE SHIPPING REELS.** Where a reel deposit has been charged Buyer, a credit for return of the reel will be issued to Buyer if the reel is returned F.O.B. Seller's factory within one year from the date of original shipment in good condition, reasonable wear and tear excepted.

6. **DELAYS.** In the event of any delay in delivery due directly or indirectly to priorities requested by the Government or granted for the Government's benefit, or Acts of God, acts of the public enemy, acts of the United States, any State, Territory of the United States or any political subdivision of the foregoing, or the District of Columbia, acts of Buyer, its employees, agents, or subcontractors, fires, floods, strikes, freight embargoes, unusually severe weather conditions, inadequate transportation facilities, or any cause whatsoever beyond the control and without the fault or negligence of Seller or its subcontractors, whether similar to or dissimilar from the causes herein enumerated, then Seller shall have an extension of time within which to perform hereunder as may be necessary.

7. **ACCEPTANCE.** Buyer's retention or possession of the equipment for a period in excess of 30 days, or Buyer's express acceptance prior to the expiration of such time period, shall constitute an irrevocable acceptance and, except as provided in Seller's WARRANTY below, a waiver by Buyer of all claims that the equipment does not conform to this order.

8. **WARRANTY.** All the equipment of Seller carries a warranty that is transferred rightfully and with good title; that is free from any lawful security interest or other line or encumbrance unknown to Buyer, and that for a period of one year from the date of installation of fifteen months from the date of original shipment, whichever period expires first, such equipment will be free from defects in material and workmanship which arise under proper and normal use and service, provided however, Buyer's exclusive remedy is limited to Seller's correction (either at its plant or at such other place as may be agreed upon between Seller and Buyer) of any such defects by repair or replacement at no increase in the price, provided further, however, the cost of any transportation in connection with the return of the equipment by reason of defects for the purpose of repair or replacement shall be borne by Buyer. The provisions of the warranty shall be applicable with respect to any equipment which Seller repairs or replaces pursuant to it. SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, OTHER THAN AS IS EXPRESSLY PROVIDED ABOVE. THERE BEING NO OTHER WARRANTIES WHICH EXTEND BEYOND THE WRITTEN DESCRIPTION OF THE EQUIPMENT, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS. THE FOREGOING SHALL CONSTITUTE ALL OF SELLER'S LIABILITY (EXCEPT AS TO PATENT INFRINGEMENT) WITH RESPECT TO THE EQUIPMENT, IN NO EVENT SHALL SELLER BE LIABLE FOR CONSEQUENTIAL DAMAGES, INSTALLATION COST, OR OTHER COST OF ANY NATURE AS A RESULT OF THE USE OF THE PRODUCTS MANUFACTURED BY THE SELLER, WHETHER USED IN ACCORDANCE WITH INSTRUCTIONS OR NOT. NO REPRESENTATIVE IS AUTHORIZED TO ASSUME FOR THE SELLER ANY OTHER LIABILITY IN CONNECTIONS WITH THE SELLER'S PRODUCTS.



9. **PATENT INFRINGEMENT ASSURANCE.** Seller shall at its own expense, settle or defend any claim, suit or action which may be brought against Buyer for infringement of United States patents arising out of Buyer's use of Seller's equipment furnished under this order, and Seller shall pay any final judgment for damages and costs which may be awarded against buyer, upon the condition that Buyer shall have given Seller prompt notice of any such claim, suit or action, together with affording Seller complete control of the conduct of such settlement or defense and all available information and reasonable cooperation shall have been furnished to Seller by Buyer at Seller's written request, but at its expense Seller may, at its own expense, elect to either procure for Buyer the right to continue using the equipment claimed to infringe, or replace it with non-infringing equipment, or modify it so that it becomes non-infringing, or remove it and repay the purchase price applicable hereto, as well as transportation costs. This paragraph shall not apply to infringement arising out of features of construction incorporated in the equipment at the request of the buyer or out of use of the equipment for purposes and uses other than as advertised or sold by Seller. The foregoing states Seller's entire liability for patent infringement by the equipment or any part of it.

10. **CONFIDENTIAL INFORMATION.** Unless otherwise specified in the schedule of this order, title to all drawings, specifications, reprints, technical designs, business plans or any other data furnished to Buyer by Seller in connection with the placing or performance of this order shall remain in Seller, including the right to have such data and all copies thereof returned to Seller upon request. All information contained in such data or embodied in any other property of Seller to which Seller retains title, and any use of, or manner of use of such data or other property by Seller, shown or communicated to Buyer in connection with the placing or performance of this order which is not known generally in the field of Seller or of Buyer shall be kept confidential by Buyer (except to any extent to which is established to have been know previously to Buyer from other sources other than Seller). Nothing in the schedule shall be interpreted or construed to require Seller to disclose any data containing information concerning the details of Sellers secrets of manufacture or other proprietary business interests.

11. **AFFILIATED SUBCONTRACTS.** An order, or any part of it, may be performed for and the rights thereunder may be enforced against Buyer by Seller's affiliated or associated corporations if subcontracted by Seller to any such affiliate or associate.

12. **FAIR LABOR STANDARD ACTS.** Seller hereby warrants that the equipment to be furnished or the services to be performed by it will be furnished or performed in accordance with the provisions of the Fair Labor Standards Act of 1938, as amended, including Sec. 6, 7 and 12 of the Act, and all valid and applicable regulations and orders of the Administrator of the Wage and Hour Division issued under Sec. 14 thereof.

13. **GOVERNMENT CONTRACTS.** If Seller's performance under an order is done with knowledge that it is pursuant to a U.S. Government prime or subcontract, then any clause required to be included in this order by any applicable law, or administrative order, rule or regulation having the effect of law, shall be deemed to be incorporated herein by this reference.

14. **PLACE OF ACCEPTANCE.** An order is valid only when accepted in writing at Seller's office, Three N.E. Victoria Drive, Lee's Summit, Missouri. The contract arising therefrom shall be deemed to have been entered into the State of Missouri, U.S.A., and its interpretation, construction, and the remedies for its enforcement or breach are to be applied in accordance with the laws of that state.

15. **SPECIFICATION CHANGES.** All designs and specifications of Seller's products are subject to change without notice provided the changes do not materially affect performance.

16. **TOOLS.** Unless otherwise expressly provided. Seller shall retain title to and possession of all models, patterns, dies, and tools.

17. **LIENS.** Seller hereby reserves all lien rights available under applicable law to secure payment for labor, materials, equipment and services. Buyer shall provide to Seller all information, give or file all notices and take all actions reasonably required to establish or preserve such lien rights in accordance with applicable law.

18. **MATERIAL SHORTAGE.** Any material shortage must be reported to Seller within 72 hours of material delivery/inventory.

19. **RESTOCKING FEE.** Seller imposes a 25% restocking fee for all material returned to Seller.

so/conditions 09/11/00

CES Offers...

1. The most comprehensive selection of tower products and accessories available on the market today, engineered to meet your requirements utilizing the classic Grasis Tower designs.
2. The fastest, most direct path to system installation using our turnkey capabilities. Our own tower fabrication company, in house antenna and Line Department, registered professional engineers, extremely experienced project managers and well trained crews with our own high quality testing equipment and an unsurpassed safety program.
3. A thorough pre-purchase quotation. We give an honest appraisal of the equipment and services that your project requires. When you open your bids you need to have confidence that all bids include everything needed to complete the job. We don't low ball bids to appear to be the cheapest.
4. An accurate delivery schedule that balances manufacturing capacity with a sincere desire to get you on line as quickly as possible.
5. To minimize the costly pre-installation delays associated with obtaining community and zoning approval thru our in house engineering department and our real-estate procurement department. Foundation design, tower permit drawing packages, copies of the tower design analysis, professional registered engineer stamped prints for tower and foundation, a professional engineering staff to answer local zoning board questions.
6. For additional follow up services such as tower analysis and maintenance of drawing archives
7. When it comes to site civil construction requirements, our site civil crews are available to perform all aspects of site construction. Services include initial layout, road work, concrete and foundation installation, fencing, etc.
8. Reduced installation costs resulting from time efficient installation
9. Site inspection and Tower analysis available.

Optional Tower Hardware

CES stocks a wide range of high-strength bolt and nut hardware and tower accessories for quick delivery. The components are manufactured specifically for CES and are carefully controlled for quality and reliability. Contact CES for a detailed list of the available components.

Tower Analysis

Our professional engineers can analyze any existing Grasis, Andrew or CES tower using TAD proprietary computer-design software to recommend the modifications necessary to adapt the tower to expanded applications. Our towers can be reinforced to meet additional loading requirements without sacrificing the structural integrity of the tower. CES maintains a drawing file of towers which goes back nearly 30 years. This file proves to be invaluable when an analysis is required and the customer's copy of the drawings cannot be easily located.



GUYED TOWER SUGGESTION CHART

GUYED TOWER MODEL	TYPICAL APPLICATION	FACE WIDTH INCHES (MM)	MAXIMUM TOWER HEIGHT	MAXIMUM TYPICAL ANTENNA CONFIGURATION	MAXIMUM ANTENNA SIZE
M46	CELLULAR, LIGHT/MEDIUM MICROWAVE, CAPTV, LPTV	46 (1170)	480 (146)	6, 10 ft. DIAMETER PARABOLIC ANTENNAS OR 3-4 CELLULAR	10 ft DIAMETER
M54	LIGHT/MEDIUM BROADCAST, LIGHT BROADCAST	54 (1370)	560 (171)	9, 12 ft. PARABOLIC ANTENNAS OR 4-5 CELLULAR CARRIERS	12 ft. DIAMETER
M64	HEAVY MICROWAVE MEDIUM BROADCAST	64 (1625)	700 (213)	12, 12 ft. DIAMETER PARABOLIC ANTENNAS OR 5-6 CELLULAR	15 ft. DIAMETER

SELF SUPPORTING TOWER SUGGESTION CHART

Tower	Typical Applications	Leg Construction Type	Tower Sections	Section Heights ft(m)	Maximum Tower Height ft(m)
Monopole	Cellular, Light Microwave, Radio, By-pass, CATV, LPTV Paging, Two - Way	Easily Assembled - Gracefully Tapered Pole	1-5	Varies by Design-up to 53'(16.4)	200'(62)
3ST	Light/Medium Microwave, Heavy Cellular, Light Broadcast	Easily Assembled - Formed 60 degree Steel Plates	1-21 22 and 23	20'(6.1) 40'(12.2)	540'(165)
SCAT	Heavy Microwave, Combination with Cellular, Broadcast	Easily Assembled - Formed 60 degree Steel Plates	1-15	20'(6.1)	360'(110)

CES offers a full line of services and accessories to compliment your needs. Please call (816)524-8242 for a complete accessory catalog by mail or visit our web site at www.ces-kcmo.com.