GUYMAST-G Communication Tower Analysis Software Instruction Manual

A Computer Program for the Specialized Analysis of

- Guyed Lattice Towers,
- Self-Supporting Lattice Towers, and
- Tubular Pole Towers,

with Graphical Display of

- Calculated Deformations, Forces, and Foundation Loads and
- 2D Tower Profiles and Plans,

with reference to Standard TIA-222-G.

Under Construction

GUYMAST-G

Limit of Liability

This manual and the program it describes have been prepared with due care. The program has been tested and we are satisfied that it performs in accordance with the description contained in this manual.

The user should know, however, that because of possible variances, neither Guymast Inc. nor its staff can assume responsibility for accuracy of results or for damages resulting from the use of this manual or the program described herein.

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Microsoft Corp.

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Under Construction

1 Welcome to GUYMAST-G

Thank you for purchasing GUYMAST-G. This powerful tower analysis tool allows you to define and analyze guyed latticed towers (also called Masts), self-supporting latticed towers, and tubular pole towers (also called monopoles) with due reference to ANSI/TIA Standard TIA-222-G. Our powerful but flexible and fast tower analysis engines are coupled with our latest and most accommodating user interface and these together should make your time spent analyzing towers more profitable and more pleasant.

In addition, our GUYMAST-G software suite includes features that go beyond rudimentary data input, analysis, and reporting:

- GUYMAST-G displays the forces and displacements, in easy-to-understand graphical forms on screen with the option of printing any and all screens viewed; and
- GUYMAST-G produces various drawings of the tower and any sections selected, giving you the opportunity to export these to AutoCAD for further manipulation by you, if you should choose to do so.

1.1 What's New?

Guymast Inc. and Weisman Consultants Inc. have been working on and with the GUYMAST set of tower analysis programs for over two decades. In GUYMAST-G we have integrated enhanced versions of these programs into one graphical interface, and have expanded and added features that have proved useful during years of industry service.

1.1.1 User Environment / Graphical User Interface (GUI)

In GUYMAST-G we have changed the way you enter tower definition data. Prior versions of our software used comma delineated data in text files. The new User Environment or Graphical User Interface (GUI) we have developed allows the user to enter data directly into on-screen tables, with clearly delineated columns and rows that include efficient and convenient individual data editing and error checking features.

Our new GUYMAST-G GUI allows you to check on the accuracy of the model with graphical tools, as you create it, more quickly throughout the data entry process. We have kept the power of our earlier versions and increased it.

1.1.2 Standard TIA-222-G

GUYMAST-G was developed specifically for the application of TIA-222-G in the analysis of towers. Future versions of the interface may support other standards, like TIA/EIA-222-F, CAN/CSA-S37-01, AS 3995:1994, and the Eurocode.

1.1.3 Flexibility in Reporting

With GUYMAST-G, users have the option of reporting either effects on the tower mast as a whole (spans, segments of spans, and sections), or effects on individual components of the mast (legs, diagonals, horizontals, pole shells, and splicing components). The first helps the engineer visualize overall tower behavior, thus helping in the design of the overall tower geometry and support system, and the second helps in the design and evaluation of individual tower elements and their connections. Our emphasis is always on giving the engineer all the tools and controls he needs to properly understand what is happening in the structure so that he can better evaluate and design towers.

1.1.4 Outrigger / Torsion Resister Analysis

GUYMAST-G has brought into the guyed tower analysis proper the analysis of the torsion resister that the user of previous versions had to perform separately in OUTRIG.

1.1.5 Tubular Pole Tower Analysis

In GUYMAST-G, the first Guymast module for the analysis of tubular poles has been introduced. The pole structure can be modeled with or without guys, and reports both pole forces and shell stresses, including stresses in bolts, anchor bolts, flanges, as well as contact stresses and hoop stresses in slip joints, which are ignored by other pole analysis programs.

1.2 Overview of Calculation Capabilities

1.2.1 Lattice Tower Loadings

In calculating loadings for lattice towers, both guyed and self-supporting, GUYMAST-G has a great deal of power, particularly in the following key features:

- Geometric description of towers using standard engineering terms and standard structural bracing types.
- Panel-oriented outline of mast geometry, allowing the description of large regions of the tower using a minimum amount of data input.
- Sub-diagonals and sub-horizontals (redundants) may be automatically generated by the program. T he user only needs to specify how many subdivisions are required.
- Member properties are defined through reference to a list of materials prepared by the user and easily re-usable from one tower to another.

- Material properties such as cross-sectional area and unit weight are calculated by the program on the basis of shapes and sizes specified by the user. The shapes and sizes available are those in common use by structural engineers and usually available on drawings of the structures to be analyzed. Round members may have an oval cross-section.

  The shapes include:

  - Solid Round, Round (SR, S.R.)
  - Tube (Pipe, RHS, and A.S.A. Pipe Schedules)
  - Plate (PL)
  - Bar
  - Angle (L, A)
  - Channel (C)
  - HSS
  - Wide Flange & Tee Sections (WF, T)
  - STD, XS, or E.H., XXS or DBLE. E.H. Pipes

- Any number of ladders of any size and composed of any of the materials listed in the materials list may be specified for any region of the tower. Ladder position and orientation may also be specified.

- Any number of transmission lines may be specified over any region of the tower, including position and orientation with respect to tower center. Standard transmission line types may be referenced and special types may be entered through the materials list.

- Special mountings such as platforms, torsion resistors and antenna mountings may be specified at any location of the tower. The position and orientation of each member of these attachments may be separately specified.

- Parabolic antennas and microwave horns may be specified at any elevation of the tower. The position and orientation of each antenna may be specified separately.

- Guy geometry information may be specified at any elevation of the tower. A guy database is available which allows the user to incorporate material properties by reference to guy diameter and guy type (BS, GS).

- Any number of loading conditions may be calculated in each processing session.

- Wind loading may be specified in terms of direction and speed or reference velocity pressure.

- Wind variation with height may be according to a number of Standards, or as specified by the user with the input of exposure factors.

- Ice loading may be specified in terms of radius of ice buildup and ice density.
- Extra loading (calculated elsewhere or supplied by someone else) that the user may wish to include can be input using the Extra Loading table.
- Partial safety factors (load factors) applicable to each loading condition may be specified.
- Input and output units may be specified by the user as Imperial or Metric (SI). These may be different for input and output if the user wishes.
- Output may be any combination of the following:
  - Loading usable in MAST
  - Loading usable in GUYMAST
  - Concentrated loads applicable at panel boundaries
  - Concentrated total load per panel applied at panel center
  - Loads due to ladders
  - Loads due to transmission lines
  - Loads due to other mountings
  - Individual element loads (material loads)
  - Loads due to antennas
  - Guy geometry and material properties

! GUYMAST-G will save considerable time and relieve engineers of the greatest tedium in the process of analyzing and designing towers. Especially high savings will be realized in the calculation of loads on a self-supporting tower where the tower changes with height, both in profile and member sizes.

! This manual describes the program and how to use it effectively to calculate wind, gravity and ice loads on any latticed structure of square or triangular cross-section. Although some requirements of governing Design Standards have been incorporated, users should still familiarize themselves with the relevant Standards to be used.

1.2.2 Self-Supporting Lattice Tower Forces and Deflections

As one of its main functions, GUYMAST-G facilitates the correct but speedy analysis of self-supporting (no guy stays) lattice broadcast, communication, and transmission towers having either square or triangular cross-sections (Figure 1 below).

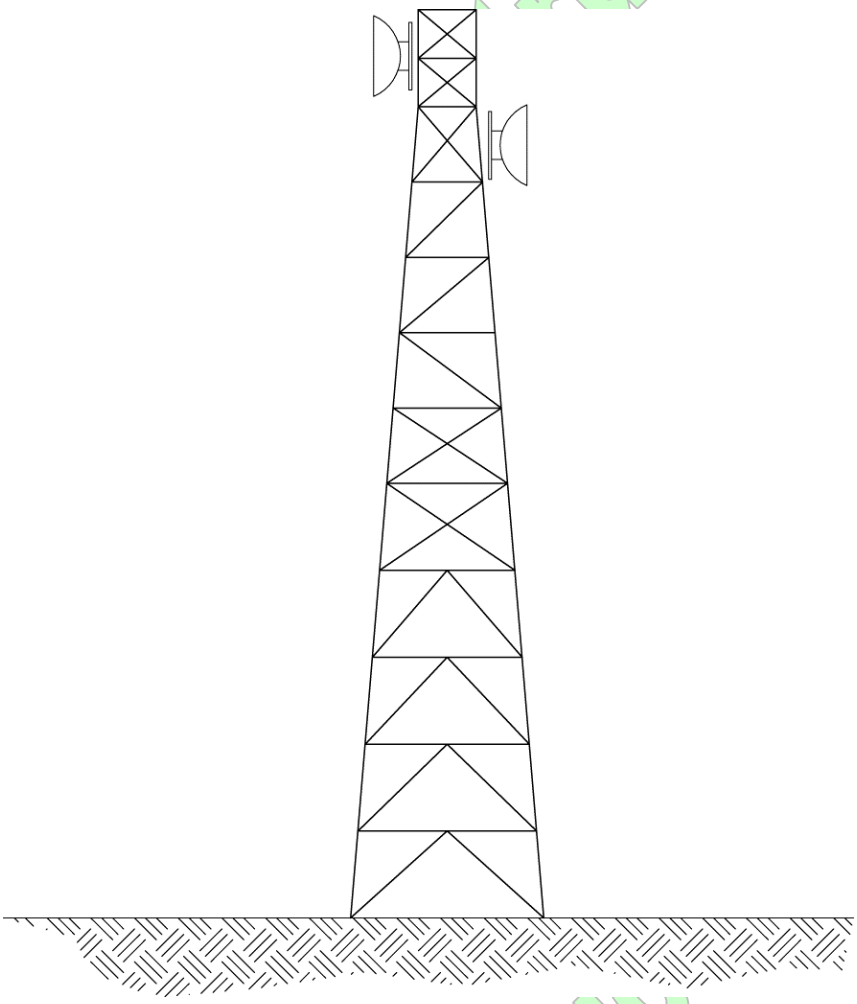


Figure 1 — Typical Self-Supporting Lattice Tower Profile

GUYMAST-G greatly simplifies the process of analysis by calculating forces and deflections for the user, reducing the time required and at the same time allowing the engineer considerable latitude in modeling the actual structure. Many features in GUYMAST-G are not readily available in any other program or process, and would be tedious and cumbersome to incorporate elsewhere, so that they are often ignored.

The following are key features of GUYMAST-G's self-supporting lattice tower analysis capabilities:

- Geometric description of towers using standard engineering terms and standard structural bracing types.

- Panel-oriented outline of mast geometry, allowing the description of large regions of the tower by entering only five individual values (5 numbers).
- Loadings may be entered either as concentrated forces at discrete elevations or as linearly varying forces distributed over any part of the tower height.
- Forces may be applied anywhere in space and related to the tower center using only two additional values.
- Horizontal forces may be acting in any arbitrary direction with respect to the tower.
- Antenna loads may be entered separately from other loads and uniquely identified.
- Cross-section bracing members (in the horizontal plane) required to maintain stability are automatically assigned by the program where needed and the resulting forces are automatically reported.
- Several loading conditions may be submitted simultaneously, and the maximums of the resulting values separately tabulated.
- The report is concise yet explicit. Results are presented in tabular fashion with clear labels identifying each element of output, using standard structural engineering terminology.
- Displacements of the tower centerline (not joints) are reported as three translations and three rotations (including tower twist) along and about the three major axes.
- Antenna rotations are presented in a separate table and take account of the angle between the principal system's axes and the direction of the antenna beam.
- Member forces are presented by panel, by member type and by nature of the force (i.e. compression or tension).
- Member forces may be reported for each member, for the member experiencing the maximum value only, or for both, using separate tables.
- Foundation loads are reported for individual piers as well as for a common footing, and each separate component is printed and labeled so that the foundations and coupling may be properly sized.
- The user may prepare data files in any set of units (Imperial or Metric) and request the output in units of his choice (Imperial or Metric).

! GUYMAST-G will prove useful to experienced as well as inexperienced engineers for both design and analysis of latticed self-supporting towers. The amount of detail provided and the rigorous methods used in the calculations will serve equally the practical needs of the design engineer and the academic requirements of a student or an investigator of structural behavior.

! This manual describes the means by which the program can be used to perform an analysis of a latticed self supporting tower. It is not meant to be a textbook on analysis of towers. The reader is referred to the many fine textbooks on structural analysis and design for such background.

1.2.3 Guyed Lattice Tower Forces and Deflections

GUYMAST-G is a convenient and powerful tool for the analysis of guyed communication towers. The program has been kept as general as possible with respect to geometric and loading description in order to accommodate all likely models. It is capable of handling the following aspects of tower analysis:

- Three orthogonal displacements and three orthogonal rotations at each guy attachment level and at the top and base of the tower.
- Axial force and bending moment interaction in the mast.
- Bending in the mast about two horizontal orthogonal axes.
- Guy displacements based on the three orthogonal displacements and three orthogonal rotations of the mast attachment points.
- Any guy orientation.
- Up to fifteen (15) guy levels, each having up to twenty-four (24) guys.
- Any tower shape, provided that the axes pass through the centroid of the cross-section.
- The user may choose to have the analysis disregard some of the displacements in the guy model or mast model independently, thus making it possible to test the effects of some simplifying assumptions used in other methods.
- Mast properties and loads may be entered by region without regard to individual spans, thus reducing input data requirements.
- Linearly varying distributed loads and discontinuity of loads can be accommodated.
- Initial guy level displacements may be supplied by the user to reduce the time of analysis.

- Up to 256 separate loading conditions may be studied in one submission, and maximum effects summarized.
- Antenna rotations are reported in terms of principal antenna axes.
- Something about outriggers/torsion resisters.

! We expect that this program will be used by experienced Professional Engineers who are familiar with the behavior of guyed masts, and that it will be used primarily in connection with the design of new towers and the modification of existing ones.

! From time to time the need will arise to compare the behavior of several types of towers using various assumptions, or to study the influence of certain assumptions on behavior and stress levels. Stress redistribution caused by the failure of some guy cables may have to be checked on, or the most critical wind direction for maximum rotations or stresses may need to be determined.

It is in these experimental areas that the engineer will realize even more the convenience and analytical power offered by GUYMAST-G. The reduced number of simplifying assumptions in this program should provide any student of guyed towers with an excellent and inexpensive learning tool.

1.2.4 Tubular Pole Tower Loadings

1.2.5 Tubular Pole Tower Forces and Deflections

1.2.6 References

Particularly for guyed towers, GUYMAST-G draws on the following publications:

- "Analysis of High Guyed Towers" by Ezra G. Odley, Proceedings of the American Society of Civil Engineers, Structural Division, Feb. 1966.
- "The Analysis of the Structural Behaviour of Guyed Antenna Masts under Wind & Ice Loading" by G.H. Schott and F.R. Thurston, the National Research Council of Canada, 1956.
- "An Introduction to Mechanics, Revised Edition", by J.W. Campbell, Pitman Publishers Ltd., N.Y., 1947.

- "Analysis of Framed Structures" by J. Gere and W. Weaver, D. Van Nostrand, 1965.
- "Structural Analysis" by R.C. Coates, M.G. Coutie and F.K. Kong, Second Edition, Thomas Nielson & Sons Ltd.

The first three publications are the basis for the guy model used, although many adjustments were made to handle the six degrees of freedom and special wind loading considerations. The mast analysis was primarily based on the fourth publication, and the fifth was used to introduce the beam-column action.

These references should give sufficient insight into the organization of the program and limitations of this analysis.

1.3 How to use this manual

1.3.1 Interactive Portion

If viewing this manual in PDF form in a reader program on a computer, there are many hyperlinks that will take you directly to the subject matter they identify. References to other sections are written as hyperlinks for interactivity with the full heading number reference in the text and underlining for maximum readability to know where the referred-to section is. Simply click the underlined text and it will jump to the appropriate item. Example: 1.3.1 Interactive Portion.

This same manual is used in the software itself as an interactive HTML-based form of context help and follows similar rules for hyperlinks.

Links to email and web addresses are written in typical blue underlined text and are fully functional links to the respective subject matter, depending on the software used to access them.

For printed reading, the number reference context is provided so the reader can find the correct section easily.

1.3.2 Section Break-Down

The main sections of this manual are listed with page numbers and a short description in the mini-table below.

A detailed description of every user function in the software interface. 1.3.4 Tips and Suggestions are provided to help you maximize your productivity with this software.

1.3.3 Color

This manual has icons, graphics, and some color text. It is ***best*** printed or viewed in color.

1.3.4 Tips and Suggestions

A form of *callout* is used throughout the manual to highlight important reminders, special tips, tricks, and suggestions for the user on how to use the features of the software best, or as warnings of certain special cases of operation of one form or another.

! Look for the large green ! exclamation mark icon for these important side-messages, tips, suggestions, and reminders.

Be sure to look for ***emphasized text*** indicating subject matter that should not be skipped if the function or option described is to be used properly.

1.3.5 Reference Text

Underlined text represents another section of the manual that can be navigated to. This text is used also to identify graphical figures that may be pertinent to a particular subject.

Italicized text represents important function and concept names that do not necessarily have their own section numbers.

Emphatic (bold and italic) text represents important information that should not be skipped if the function or option described is to be used properly. It is also used for simple emphasis of particular words.

1.4 Licenses and Support

1.4.1 Standalone License

A standalone license permits use of a single copy of GUYMAST-G on a single computer with a single hardware key. Multiple copies may be installed anywhere desired, but only one copy can be in use at a given time, as the software will only run if the key is installed on that computer. Multiple standalone licenses may be used, each with their own key.

1.4.2 Network License

A network license permits use of one or more copies of GUYMAST-G anywhere on a network. Network licenses are a convenience and multiple copies are purchased at a discount over the same number of standalone copies. For example, with a network license for 3 copies, many computers on the network could have the GUYMAST-G software installed, with up to 3 in use at any given moment and with a single hardware key's permitting access to those 3 from the network server.

It should be kept in mind that network software effectively makes the software more conveniently available to more of the company's users over the working day. One license could serve up to 3 users without any of them knowing that another is using the same software.

1.4.3 Support and Update Contracts

With your initial purchase of GUYMAST-G, you are entitled to one year of technical support and all software updates produced during that time. Payment of the annual maintenance fee extends this support beyond the initial support period.

For help with installation and use of GUYMAST-G and related products, Guymast Inc. can be contacted at the email address and phone number below.

Tel.: 416-736-7453
Technical Support email: support@guymast.com

1.5 Feedback and Suggestions

Guymast Inc. welcomes feedback and suggestions. Tell us how we can serve you better, and ***feel free*** to tell us what we are doing right so we can continue to anticipate your needs in your preferred way. If you have a particular need we can arrange to fulfill it either with customized programming contracts or extensions of existing products. We will always do our best to earn your business.

Contact Guymast Inc. at:

Guymast Inc.
814-1110 Finch Ave. West
Toronto, ON M3J 2T2
Canada

Tel.: 416-736-7453
email: info@guymast.com

1.6 Training

Guymast Inc. provides customized, up-to-date training sessions on our software and many tower engineering subjects, working with your company's current projects for better learning and to offset some of the cost of the session by completing part of the projects objectives during the training session. You can come to us or we will come to you!

1.7 Engineering Consultation

Our sister company, Weisman Consultants Inc., is happy to provide engineering consultation for specific issues and tower engineering in general. They will have to be consulted on questions that go significantly beyond the scope of technical support for the software itself.

Contact Weisman Consultants Inc. at:

Weisman Consultants Inc.
814-1110 Finch Ave. West
Toronto, ON M3J 2T2
Canada

Tel.: 416-736-7453
email: towers@weisman-consultants.com

2 Installation

The installation process for GUYMAST-G has been constructed to be the simplest possible. From the 2.4 Installation Source Directory, simply run the *SETUP* program, follow a couple of simple instructions to install the 2.1 GUYMAST-G Software and 2.2 License Protection Hardware Key and Driver and you will be moments away from defining and analyzing your first tower.

2.1 GUYMAST-G Software

The GUYMAST-G Software requires only a few pieces of information to get started: your name and company name and then the installation directory target. The GUYMAST-G Software will not operate without the 2.2 License Protection Hardware Key and Driver both installed and working.

2.2 License Protection Hardware Key and Driver

SafeNet Inc.'s Sentinel UltraPro USB key (Figure 2 below) and driver must be installed properly for the 2.1 GUYMAST-G Software to work.

Figure 2 — SafeNet Inc.'s Sentinel UltraPro Key

(Source: www.safenet-inc.com)

! Do not insert the key into your computer's USB port before installing the driver software.

The Sentinel UltraPro hardware keys and the device drivers are provided under license from SafeNet Inc. Guymast Inc. is not responsible for damages or losses resulting from their use. Read the terms of the license agreement in the displayed screen in the 2.5.6 Hardware Key Driver Installation process.

2.3 Hardware Requirements

2.3.1 Full Installation

To install the GUYMAST-G software and the hardware key driver requires the following hardware components:

- Microsoft Windows 98/NT4.0/2000/XP
- Pentium III 500MHz
- 256MB RAM (Windows XP/2000), 64MB RAM (Windows 98), 128MB RAM (Windows NT4.0)
- 1 USB port
- 60MB HDD Space

2.3.2 Hardware Key Driver Only

To install only the hardware key driver requires the same hardware as a 2.3.1 Full Installation but has reduced HDD Space requirements:

- 30MB HDD Space

2.4 Installation Source Directory

The GUYMAST-G installation SETUP program does not require a specific starting location, as long as all the files are present. You can install GUYMAST-G from the CD or from a common network drive. This goes also for all updates released.

2.4.1 CD Installations

The GUYMAST-G CD has files in its root directory. Simply run SETUP from the CD and follow the instructions of the 2.5 Installation Process.

2.4.2 Local Copy Installations

If you wish, you can copy the installation files to a directory of your choice and run SETUP from there, following the instructions of the 2.5 Installation Process. There is almost no speed advantage to operating SETUP this way, but if you download GUYMAST-G or an update from a link we provide, you will run it in this manner.

2.4.3 Over-Network Installations

Installing GUYMAST-G over a network is the same as installing from a local CD or hard drive directory. Simply run SETUP from the network drive and follow the instructions of the 2.5 Installation Process. GUYMAST-G must be installed to your local system, not onto a network directory location. Only SETUP will operate properly from a remote/network location.

! You should not install GUYMAST-G onto a network drive but installing ***from*** one is fine.

2.4.4 Hardware Key Driver Only Installations

We provide a separate SETUP program if you wish to install the hardware key driver on a network server which will never run the actual program. On the installation CD, navigate to the *Sentinel UltraPro* directory and execute the SETUP program there as discussed below in 2.5.8 Special: Installing Only the Hardware Key Driver.

- You may copy the files in the *Sentinel UltraPro* directory to wherever you wish and execute the SETUP program from there, similarly to the GUYMAST-G installation source directory.
- The hardware key driver SETUP program is a different program from the GUYMAST-G installation SETUP program. If you run the incorrect one, simply Exit it and find the correct program within your installation source directory.

2.5 Installation Process

2.5.1 Run SETUP

From the Installation directory, simply run the SETUP program (or SETUP.EXE as it may be displayed). After a short pause, you will be presented with the installation wizard (Figure 3 below). Press *Next*.

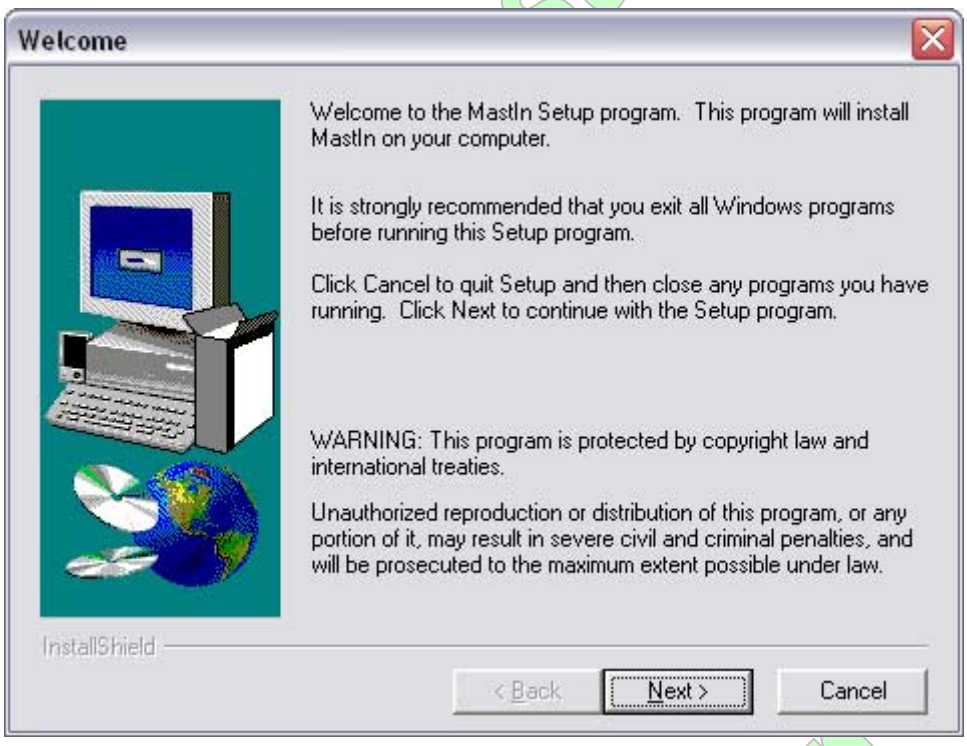


Figure 3 — Installation Welcome Screen

2.5.2 Enter Name/Company Name

Choose the name and the company name for registration (Figure 4 below) and press *Next*. Press *Back* to go back to the welcome screen.

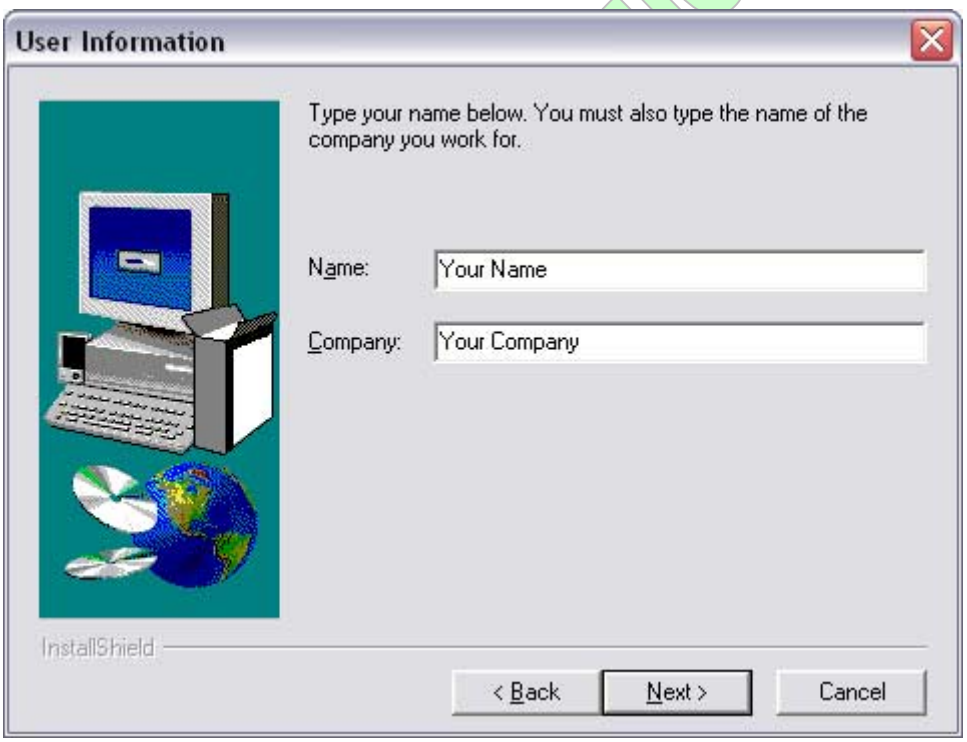


Figure 4 — Installation Name and Company

2.5.3 Enter Installation Path

Choose the installation directory (Figure 5 below), using the *Browse...* function if you need, and press *Next*. Press *Back* instead to go back to the name/company name entry screen.

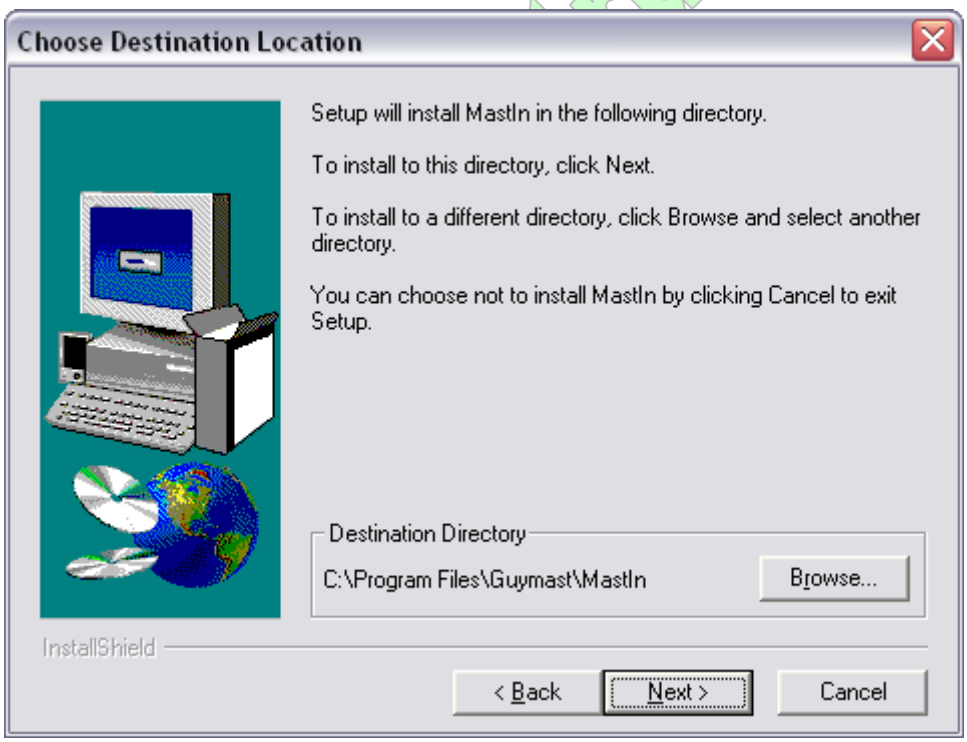


Figure 5 — Installation Directory

2.5.4 Confirmation Page

Confirm your settings (Figure 6 below) and press *Next*. Press *Back* instead to go back to the installation directory selection screen.

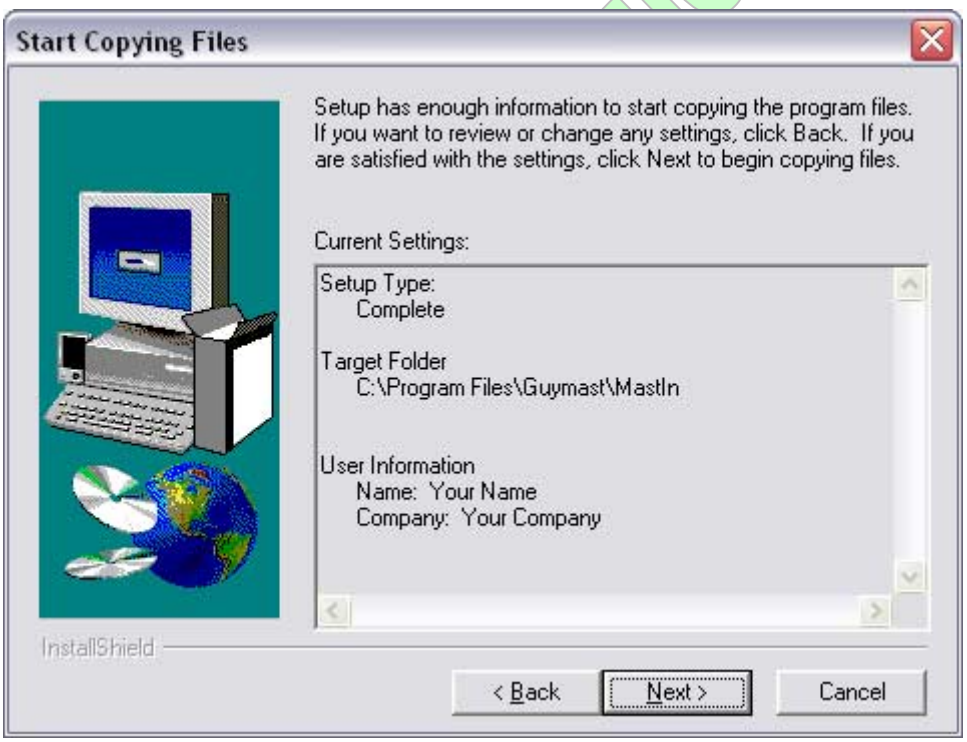


Figure 6 — Installation Confirmation

2.5.5 Automatic Copying of Files

After confirming your settings, ***SETUP will install the program***. When it is finished copying files it will start the 2.5.6 Hardware Key Driver Installation.

2.5.6 Hardware Key Driver Installation

! Do not insert the key into your computer's USB port before installing the driver software. If you do insert the key first, cancel and exit any "New Hardware Wizard" dialog boxes that appear.

First a welcome screen is shown (Figure 7 below). Press *Next*.

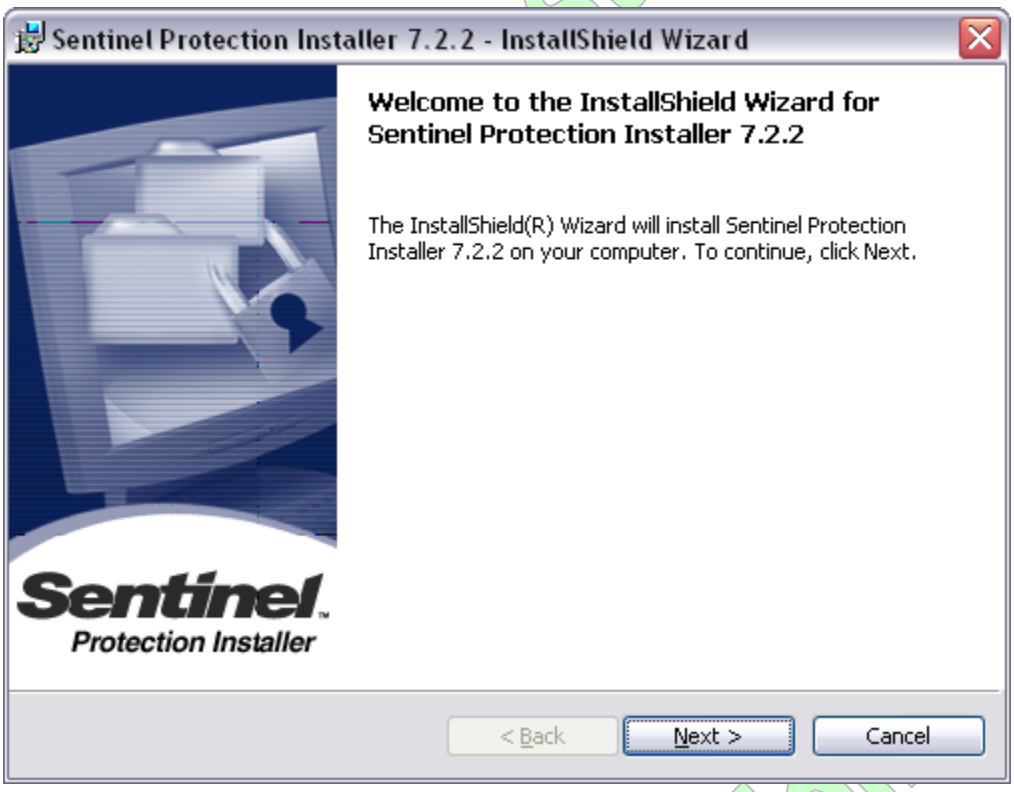


Figure 7 — Sentinel Installation Welcome

Next a license screen is shown (Figure 8 below). Read and *accept the terms* and press *Next*. Press *Back* to go back to the welcome screen.

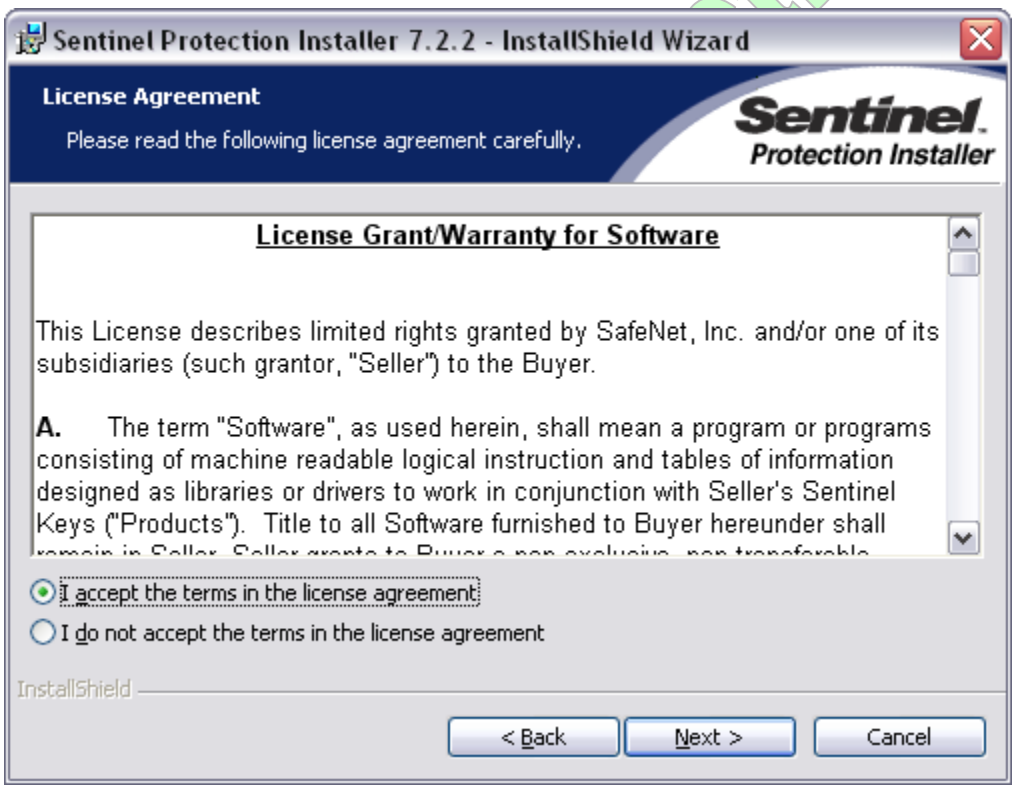


Figure 8 — Sentinel Installation License Agreement

Select the *Complete* setup type (Figure 9 below) and press *Next*. Press *Back* to go back to the license agreement screen.

! Do not select the Custom setup type.

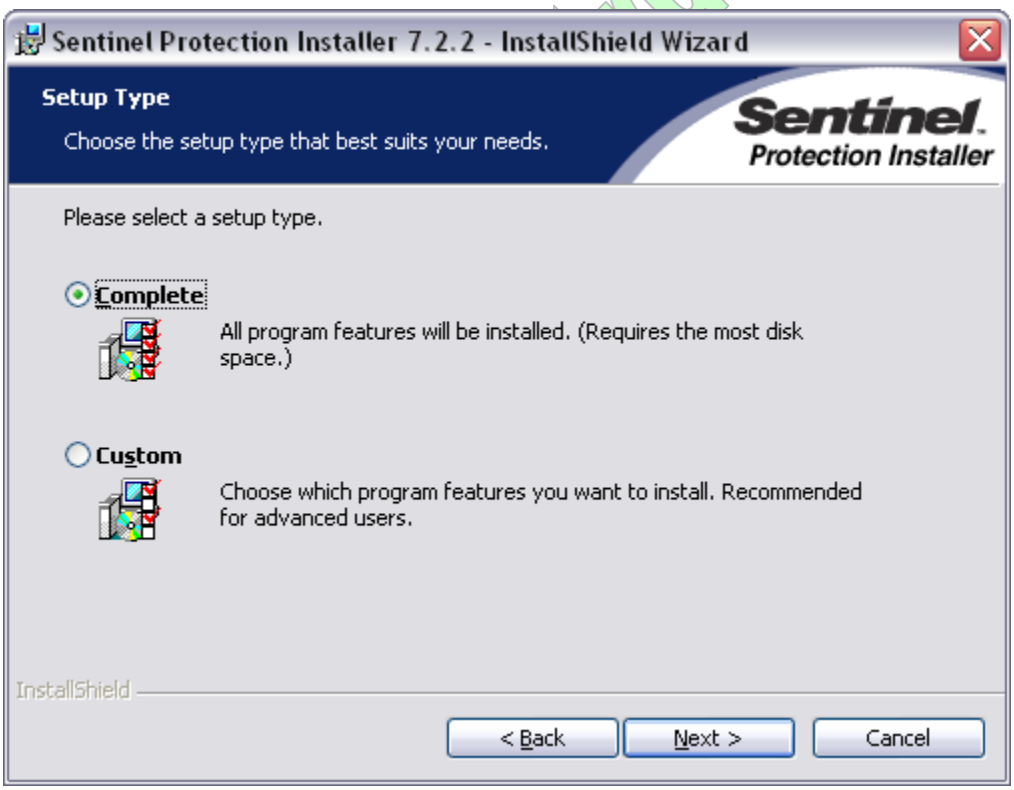


Figure 9 — Sentinel Installation Type

Confirm the installation by pressing *Install* (Figure 10 below). Press *Back* to go back to the installation type selection screen.

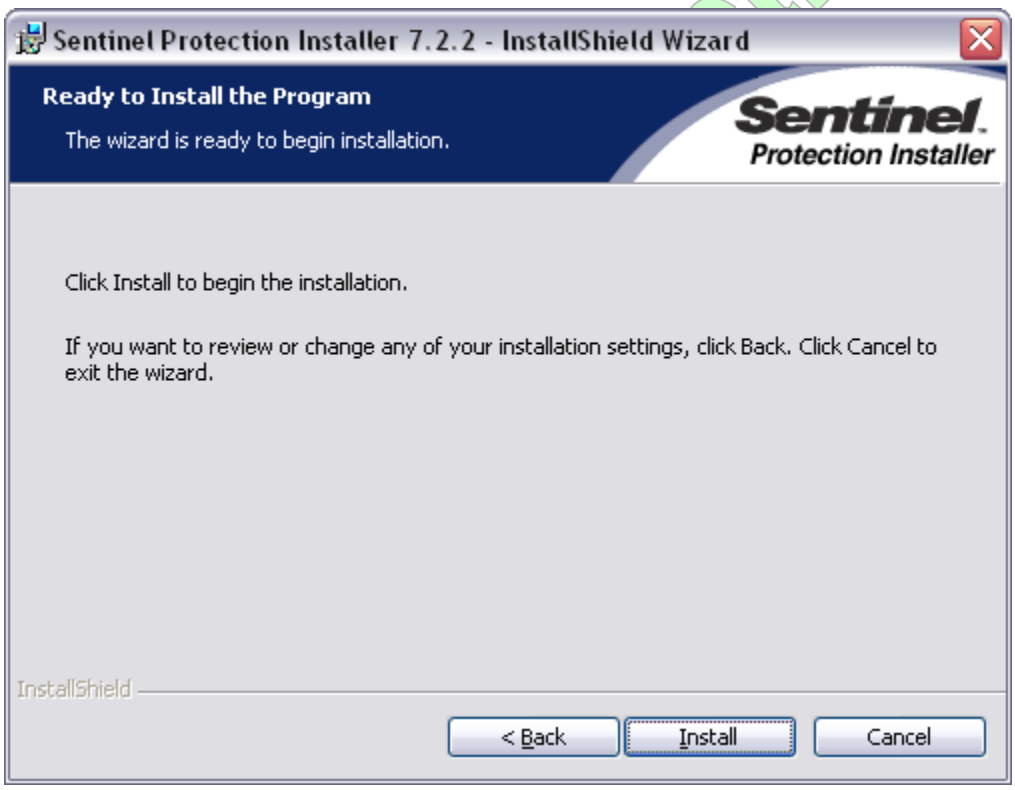


Figure 10 — Sentinel Installation Confirmation

On some systems (especially running Windows XP SP2) a warning will show up (Figure 11 below). If you will ***ever*** use the key as a network key, enable the firewall modification settings by pressing *Yes*. If this is a standalone copy and will never be enabled over a network, press *No* — the hardware key itself regulates what is possible. This option is displayed to allow you to use the computer as a network server for network keys if you have such a key.

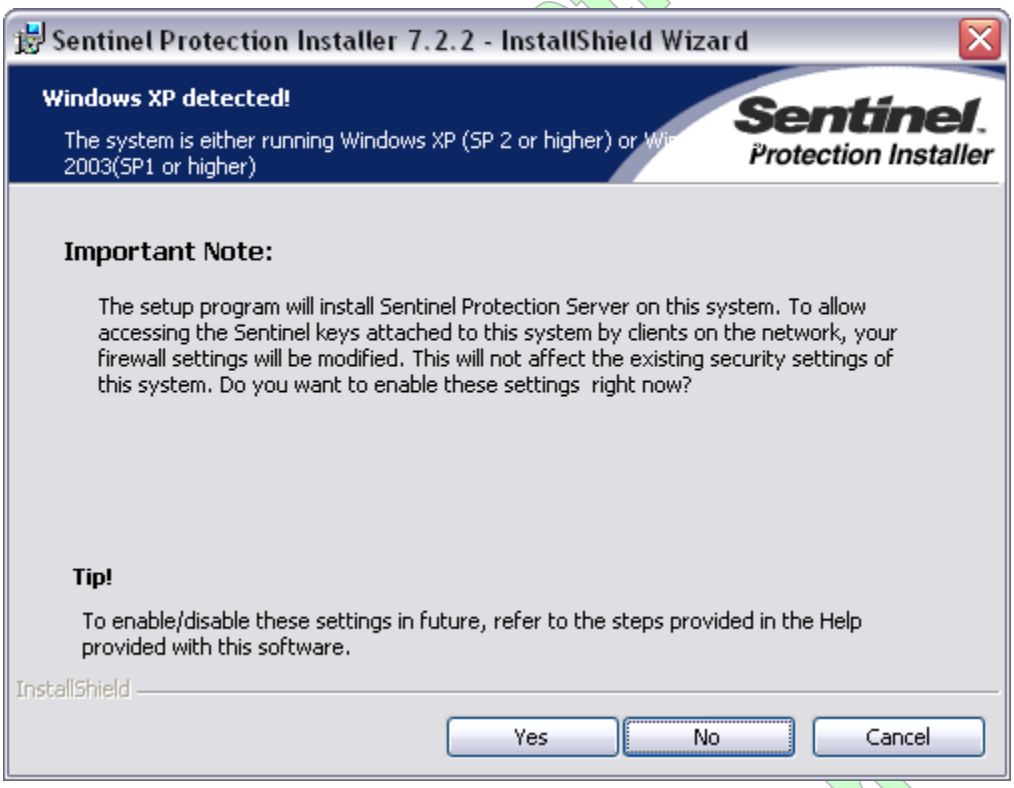


Figure 11 — Sentinel Installation Firewall/Network Settings

2.5.7 Complete

After both the driver and the software are installed, choose *Finish* to end the installation. This is the second *Finish* button you will have pressed, since the driver installation has its own that appears first.

2.5.8 Special: Installing Only the Hardware Key Driver

To install only the hardware key driver on a machine, especially for network server installations, navigate to the *Sentinel UltraPro* directory in your 2.4 Installation Source Directory and run SETUP. Then follow the instructions in 2.5.6 Hardware Key Driver Installation. Note that this SETUP program is different from the one to install a full version of GUYMAST-G.

2.6 Maintenance, Updates, and Upgrades

GUYMAST-G should run maintenance-free. When there are updates or upgrades available, Guymast Inc. will provide up-to-date information on how to install/overwrite/modify/update as we deem appropriate.

2.7 Uninstalling

2.7.1 Uninstalling GUYMAST-G Software

! Shut down/close the GUYMAST-G software and any other open programs before proceeding. Failure to close the GUYMAST-G software in particular will cause undefined errors only a proper full uninstall and reinstall will correct.

To uninstall the GUYMAST-G software:

- In the *Start* menu, navigate to your *Control Panel*.
- In the Control Panel, find the *Add/Remove Programs* item.
- On the *Change or Remove Programs* tab/section, find *GUYMAST-G* in the main listing, click on it, and press the *Change/Remove* button (Figure 12 below).
- The uninstall screen will appear and will remove the GUYMAST-G software from your system.

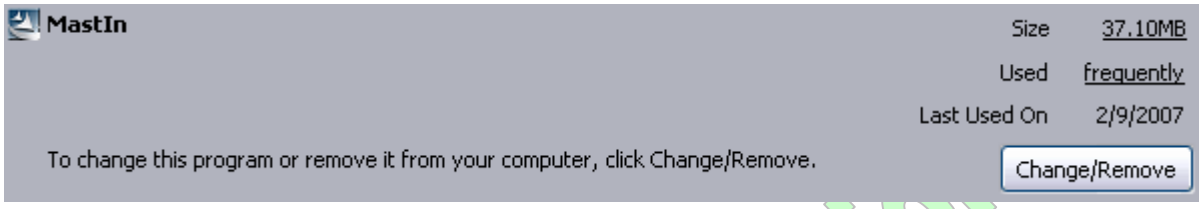


Figure 12 — MastIn item in Add/Remove Programs control panel

2.7.2 Uninstalling Sentinel UltraPro Drivers

! Shut down/close the GUYMAST-G software and any other open programs before proceeding. Failure to close the GUYMAST-G software in particular will cause undefined errors only a proper full uninstall and reinstall will correct.

To uninstall the Sentinel Protection driver software:

- In the *Start* menu, go to your *Control Panel*.
- In the Control Panel, find the Add/Remove Programs item.
- On the *Change or Remove Programs* (the default) sub-section, find *Sentinel Protection Installer* in the main listing, select it, and press the *Remove* button (Figure 13 below). (version number may not exactly match graphic below)
- Press *Yes* in the box that appears and the driver will be uninstalled.

Figure 13 — Sentinel Driver item in Add/Remove Programs control panel

3 The GUYMAST-G User Environment

GUYMAST-G has a User Environment or Graphical User Interface (GUI) different from previous Guymast Inc. software products. The environment is characterized by a near-complete lack of text files and simplicity of use and project management.

100% Legacy GUYMAST Compatibility

Over 20 years of development of Guymast Inc. software products has left many users quite familiar with and comfortable with our original methods of interacting with Guymast Inc.'s various analysis engines, particularly the .DAT text file input format used with MASTLOD and the TOWER interface that has been in use for the last few years. With our new user environment for GUYMAST-G, you are able to import and export those same text files through a simple conversion process that will take it from an older engineering standard to the new G revision.

We are confident that the new environment will quickly become familiar without disrupting your ability to be productive while you learn.

New Organization and Simplification

GUYMAST-G organizes your files and the data within them to simplify your working process in 2 new ways:

- GUYMAST-G 3.1 Workspaces contain 3.2 .MIN Project Files that store all necessary tower data, so to analyze towers you will not need to work with many same-named files and understand what they all are — ***though you can!*** This new system arranges your files and eliminates frequent file system navigation, letting you get to your engineering work more quickly.
- Once you are editing your tower data, our new 3.10 Table Editor and the 3.11 Table List combine to allow you to switch between the different elements of your tower and to navigate freely, reviewing data and jumping back to where you were in short order. The *Table Editor* and *Table List* are a new representation of the tower data in a graphical and annotated format and should help prevent confusion and errors.

3.1 Workspaces

In GUYMAST-G we have provided simplifications of common operations. GUYMAST-G will remember your working directories for easy repeated access without your having to dig through your file system and hunt down the correct file extensions.

Working with Workspaces

Selecting a Workspace in which to work with Project Files is done from within the 3.4 Select Workspace dialog box.

3.2 .MIN Project Files

In GUYMAST-G we have simplified the large number of text files that existed in previous versions of Guymast Inc. tower analysis software. Those text files still exist and ***can be accessed*** if such is desired (we do ***not*** recommend this action). As a simpler form, GUYMAST-G uses one project file with the extension *.MIN*. This single file is the only file the user needs in order to analyze a tower with GUYMAST-G.

Working with .MIN Project Files

Within the 3.5 Select Project dialog box, a list is displayed of all the project files in the current Workspace directory. Select one and open it.

3.3 Common Tasks

There are several common tasks you will do regularly while using GUYMAST-G.

- 3.3.1 Starting Up GUYMAST-G
- 3.3.2 Creating a New Project
- 3.3.3 Opening an Existing Project
- 3.3.4 Converting a Project from an Older Version or Other Standard
- 3.3.5 Editing Tower Data Tables
- 3.3.6 Checking Data Validity
- 3.3.7 Calculating and Reporting Loadings
- 3.3.8 Calculating and Reporting Deflections and Forces

3.3.1 Starting Up GUYMAST-G

Each time GUYMAST-G starts, after a splash screen showing version information is briefly displayed, the main interface appears and the 3.5 Select Project dialog box appears, allowing you to select a tower project to open and work on.

Unless a default workspace is selected, each time GUYMAST-G starts, including the first time, the 3.4 Select Workspace dialog box is displayed to allow you to specify the active workspace before working with projects.

3.3.2 Creating a New Project

You can create a new project from several different locations:

- from the *New...* menu item in the 3.9.1 Project menu;
- from the *New*  toolbar button; and
- from the 3.5 Select Project dialog box using the 3.5.5 New Project... button.

These methods open the 3.6 New Project dialog box where initial parameters for the tower project are specified. After selecting the *OK* button in the *New Project* dialog

box, the project is created and opened in the main GUYMAST-G editing area. Almost all the fields can be changed later from the 3.7 Project Properties dialog box.

3.3.3 Opening an Existing Project

Open a project first by selecting the *Open*  toolbar button or from the *Open* menu item in the 3.9.1 Project menu. From within the 3.5 Select Project dialog box that appears, select the project to open from the list and click the 3.5.6 Open Project... button. Your project will open in the main GUYMAST-G editing area.

3.3.4 Converting a Project from an Older Version or Other Standard

To convert data from an older version of Guymast Inc.'s software, or from another engineering standard, you must have the *.DAT file* for your tower. Create a new project file using the 3.6 New Project dialog box. At the bottom of the dialog box, select the *Load From .DAT File* checkbox and enter the name of the *.DAT file* or browse to it.

With the *.DAT file* specified, continue to enter the project setup information in the tabs of the New Project dialog box, and select the *OK* button to complete the New Project setup as usual. The tables for the tower definition data will be filled with the information from the *.DAT file*.

! You may need to add some information in some tables.

3.3.5 Editing Tower Data Tables

With a tower project open in the main GUYMAST-G editing area, you can navigate between different tables using the3.11 Table List.

Editing tower data itself is done in the 3.10 Table Editor. Within the Table Editor, simply navigate to the cell you wish to change and start typing. Rows can be added and deleted easily (see 3.10) and even copied and pasted in from other programs, such as Microsoft Excel. Some cells have extra help, guidance, and tip information, as well as selection tools to make data entry easier, that will pop up to assist you.

3.3.6 Checking Data Validity

3.11.6 Data Error Flags and 3.10.4 Error Indicators combine to provide an automatic assessment of your data based on known and common error types. For a complete listing of all known errors in a project, a *Check Data* tool exists that opens an error panel with the listing requested. This tool is activated with the *Check Data*  toolbar button or with *Check Data* in the 3.9.4 Tools menu.

! An automated checker highlights the cells with errors and suggests what problems might exist. The *Check Data* functions provide an extended itemized list of these problems on a pop-up panel.

! No automatic checker is a substitute for care and accuracy of preparation and entry of data. The automatic checkers are looking for values that are outside reasonable ranges, but will not find all errors of every kind. Use care in entry and reason as to your expectations of what these checkers can accomplish for you and they will become powerful tools to catch the exceptions.

3.3.7 Calculating and Reporting Loadings

Tower loadings are calculated when you click the *Calculate Loads*  toolbar button or select *Calculate Loads* in the 3.9.4 Tools menu. This function calculates the loads from the loading conditions. A report can be accessed from the *Report Loads*  toolbar button or *Loads Calculated* in the 3.9.5 Report menu.

! You can access a graphical chart display format with the *Draw Results*  toolbar button or *Draw Results* in the 3.9.5 Report menu.

3.3.8 Calculating and Reporting Deflections and Forces

Forces acting on the tower are calculated when you click on the *Analyze Tower*  toolbar button or select *Analyze Tower* in the 3.9.4 Tools menu. The calculated forces can be accessed from the *Report Results*  toolbar button or *Results of Analysis* in the 3.9.5 Report menu.

! You can access a graphical chart display format with the *Draw Results*  toolbar button or *Draw Results* in the 3.9.5 Report menu.

3.4 Select Workspace dialog box

Access the *Select Workspace* dialog box (Figure 14 below) from the *Change Workspace...* menu item in the 3.9.1 Project menu. This dialog box is also displayed on the first start of GUYMAST-G and if no workspace is selected as default in subsequent starts.

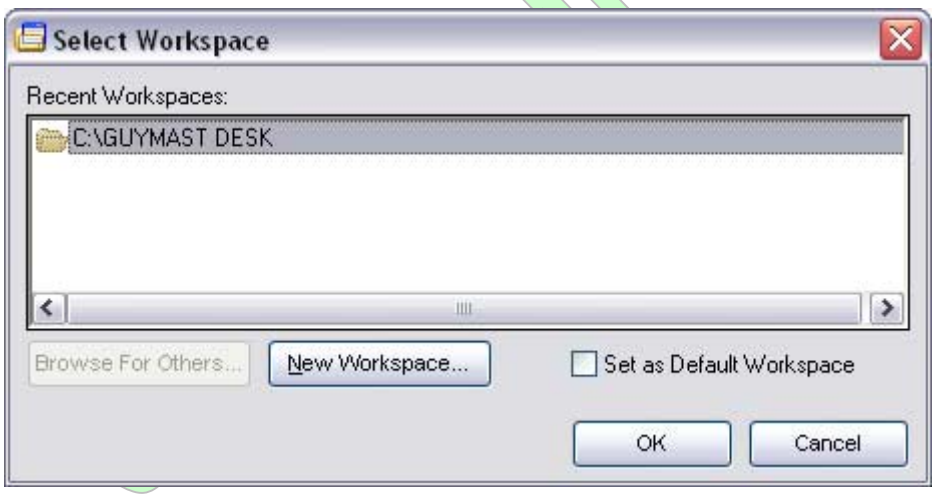


Figure 14 — Select Workspace dialog box

3.4.1 Recent Workspaces

The list of individual workspaces that have been opened on this computer is shown in the order of their most recent access and use, with a special red checkbox icon for the default workspace and the normal icon for the other workspaces. The currently selected workspace is shown with an open file folder or icon, depending on whether it is the default or not.

3.4.2 Browse For Others...

This button is disabled in the current version.

3.4.3 New Workspace...

Create a starting workspace by selecting the *New Workspace...* button. The default workspace directory for a fresh installation of GUYMAST is *C:\GUYMAST DESK*. Workspaces are discussed in more detail in 3.1 Workspaces.

3.4.4 Set as Default Workspace

Select the *Set as Default Workspace* checkbox to make the currently highlighted workspace the default for all future projects. The *Select Workspace* dialog box will not be shown on start-up after a workspace has been made the default. The dialog box is still available from the *Project* menu as the *Change Workspace...* menu item.

3.4.5 OK

Within the *Select Workspace* dialog the user can select/highlight a workspace listed and press *OK*. Pressing *OK* selects the highlighted workspace as the active workspace and all opening and creating of new projects will occur from within that workspace until it is changed again or the GUYMAST-G program exits.

3.4.6 Cancel

Selecting *Cancel* will exit the *Select Workspace* dialog, but ignore any change to the current workspace settings. Workspaces added and created ***will remain in the list***, though they will not be selected as the current operating workspace.

3.5 Select Project dialog box

The Select Project dialog box uses 3.1 Workspaces to display lists of tower projects. Earlier Guymast Inc. software products required manipulation of multiple text files and reports. While these files still exist and are accessible within the workspace directory, they are treated as single items within the GUYMAST-G user environment, and all the features and functions are available from within the interface.

With a workspace selected, the GUYMAST-G environment finds all tower projects in that file directory and displays the *Select Project* dialog box (Figure 15 below).

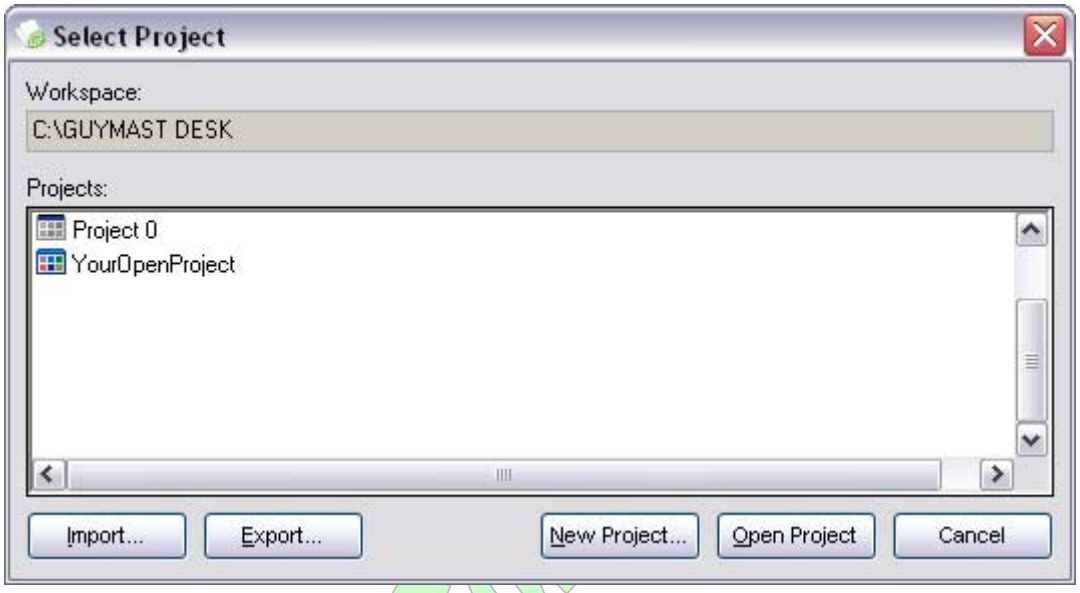


Figure 15 — Select Project dialog box

3.5.1 Workspace

The directory path to the currently selected workspace is displayed in this field.

3.5.2 Projects

All the 3.2 .MIN Project Files in a workspace represent individual projects, and their names are listed in this area. Each project in the list is given a small project icon. Currently open projects have a more brightly colored small project icon.

3.5.3 Import...

To import/copy a *.MIN* project file from another directory or workspace into the current workspace, select the *Import...* button. The *Import Project* dialog box (Figure 16 below) opens and allows you to select a .MIN file for importing.

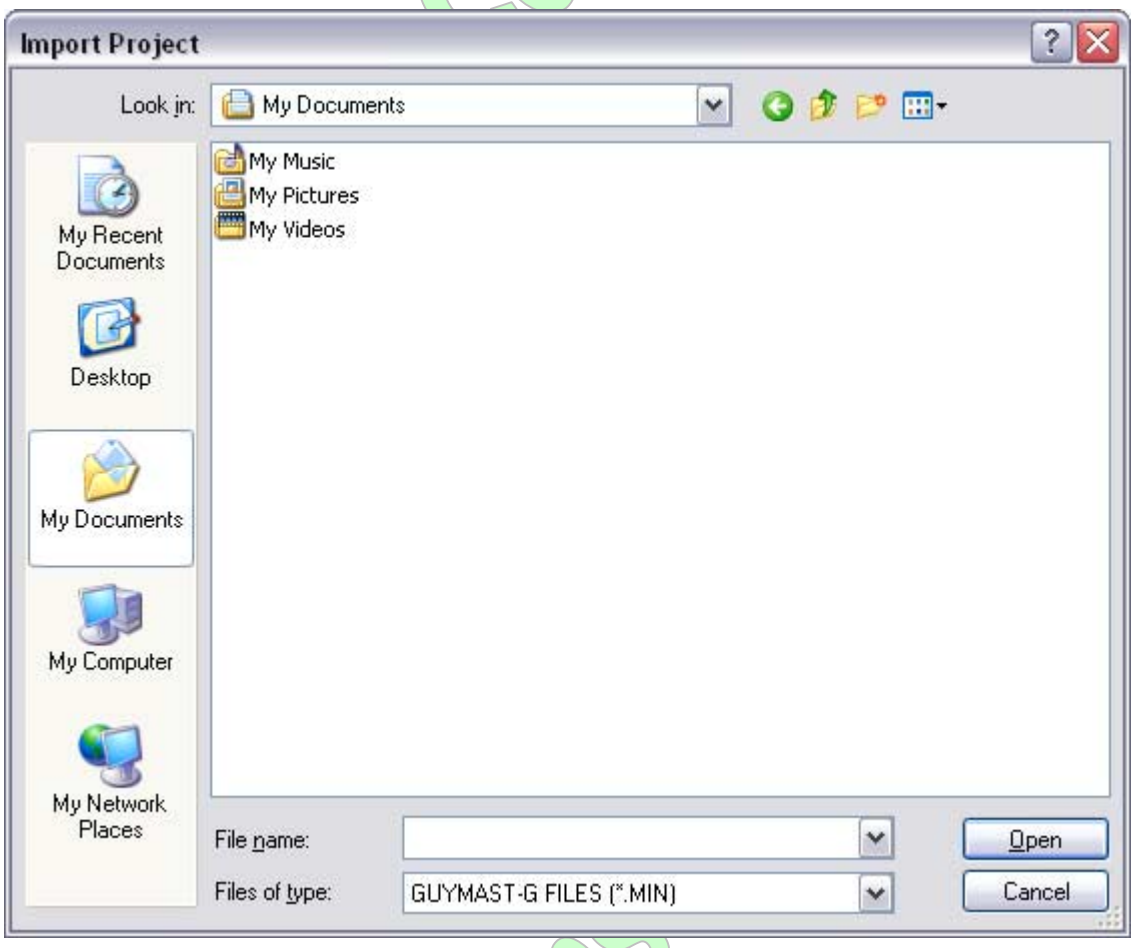


Figure 16 — Import Project dialog box

The *Import Project* dialog box is a standard Open File type of dialog box: select a file and select the *Open* button or select *Cancel* to exit with no action.

3.5.4 Export...

To copy/export a *.MIN* project file from the current workspace to another directory or workspace, select a project in the *Projects* list and then select the *Export...* button. The *Export To* dialog box (Figure 17 below) then opens and allows selection of the directory to which the project will be copied. Select the *Make New Folder* button to make a new directory in the currently selected location.

Figure 17 — Export To dialog box

3.5.5 New Project...

The *New Project...* button opens the 3.6 New Project dialog box to create a new project in the current workspace.

3.5.6 Open Project...

Select a project in the 3.5.2 Projects list and select the *Open Project...* button to open an existing project file.

3.5.7 Cancel

Select the *Cancel* button to exit from the 3.5 Select Project dialog box without Opening or Creating a project.

3.6 New Project dialog box

The *New Project* dialog box has three tabs at the top defining project data.

3.6.1 Main tab

In the ***Main*** tab (Figure 18 below), the tower project file base formatting are specified.

! Two fields ***must*** be specified to create a new project: *Project Name* and *Type of Tower* on the *Main* tab (Figure 18 below). The *OK* button to exit the dialog box and create the new project is enabled with this data.

! *Cancel* to quit making a new project *without* creating a new project file.

! You can access project properties and settings at any time from the 3.7 Project Properties dialog box.

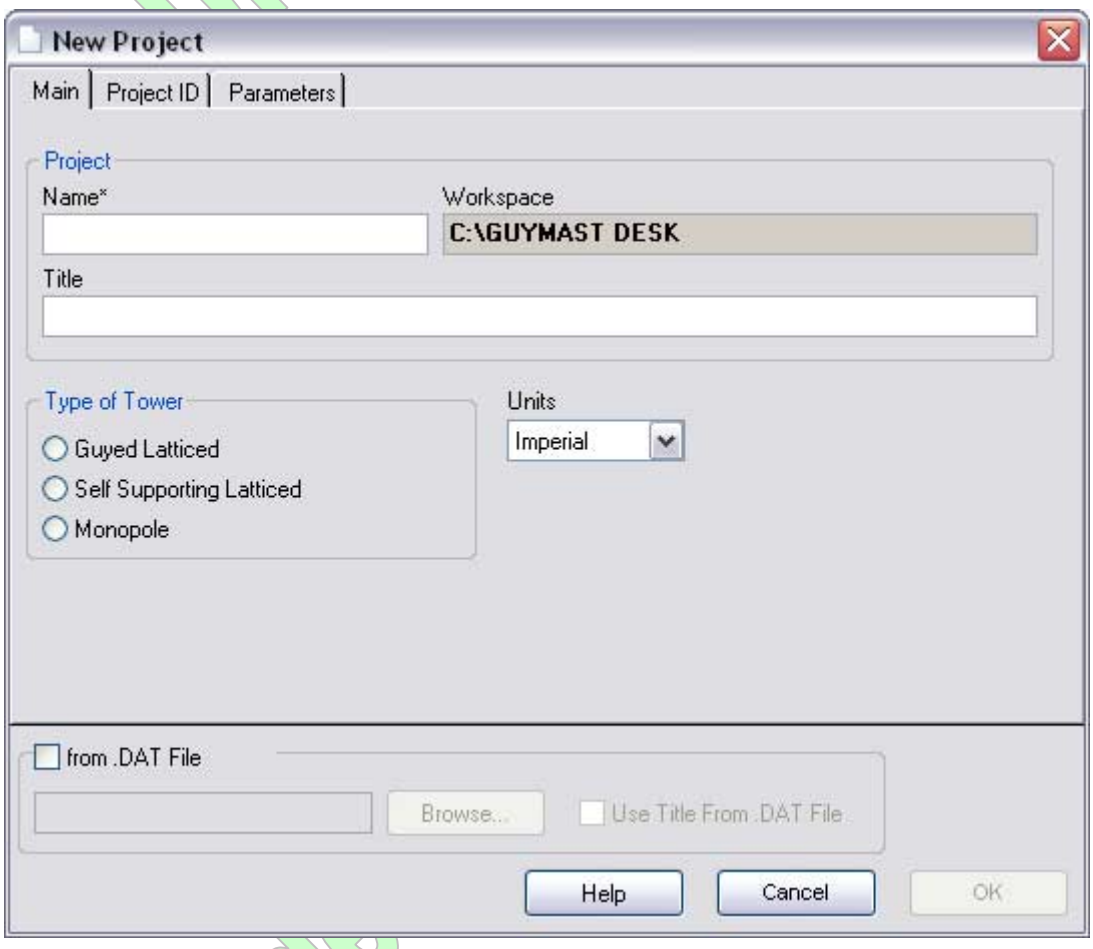


Figure 18 — New Project dialog box Main tab

Project Name
This is the file name of the project.

Project Workspace
This is the workspace your file is in. It cannot be changed from this dialog box.

Project Title
This is an extended title for your project. Be as descriptive as you like. You can change this setting whenever you wish later from the 3.7 Project Properties dialog box.

Type of Tower
Choose your tower's structure here.

Units
Choose metric/imperial units. You can change this setting whenever you wish later from the 3.7 Project Properties dialog box.

from .DAT file
Select this checkbox and use the *Browse...* button to find the *.DAT file* of your choice. This function will import the table data for your tower definition (loads, loading conditions, and structure) from another version of Guymast Inc.'s software. Optionally select the *Use Title from .DAT file* checkbox to import the project title as well.

3.6.2 Project ID tab

In the *Project ID* tab (Figure 19 below), details about the tower's owner, location, and construction are specified. These details are optional and you can change all of these settings whenever you wish later from the 3.7 Project Properties dialog box.

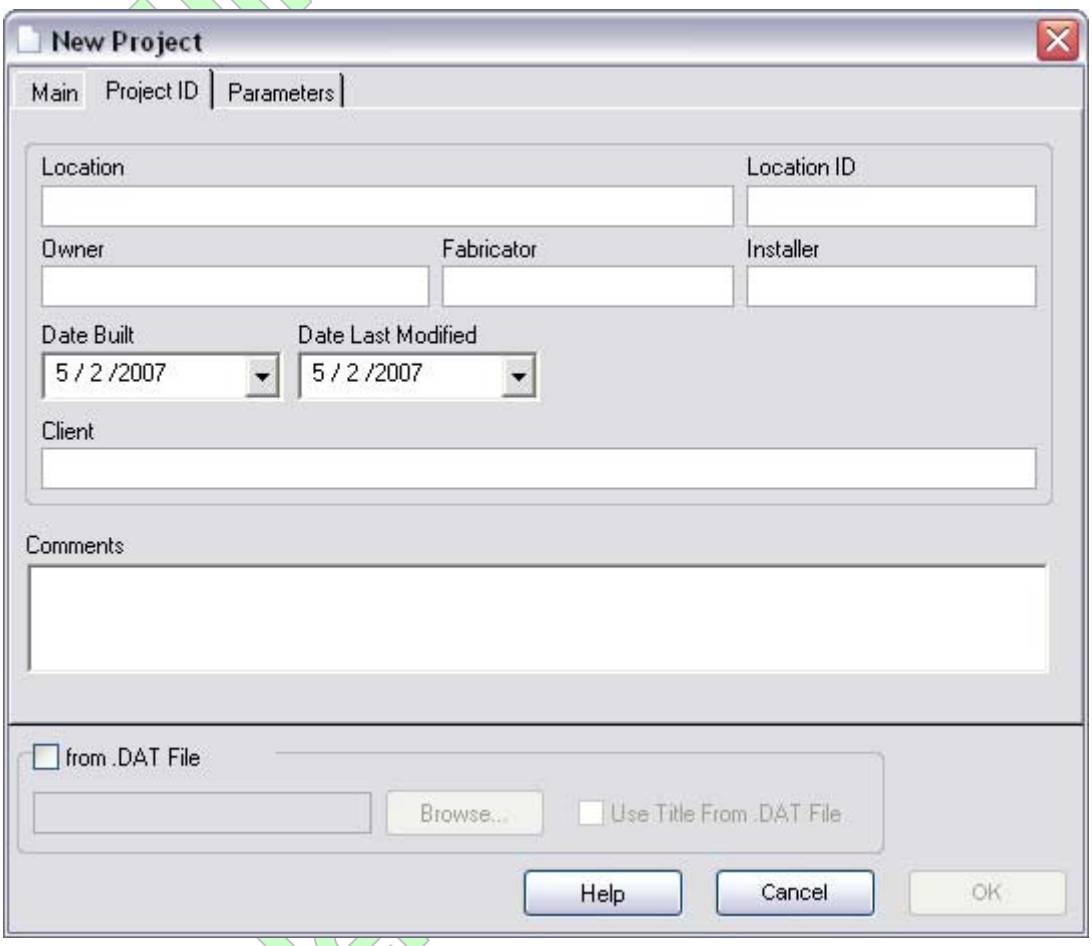


Figure 19 — New Project dialog box Project ID tab

Location
Describe the location of the tower.

Location ID
Enter the Site or Location of the location of the tower.

Owner
Enter the owner of the tower.

Fabricator
Enter the fabricator of the tower.

Installer
Enter the installer of the tower.

Date Built
Enter the date the tower was built.

Date Last Modified
Enter the date the tower was last modified.

Client
Enter the client of the tower analysis.

Comments
Enter any comments you wish.

from .DAT file
This checkbox and its related functions are the same as in the 3.6.1 Main tab.

Under Construction

3.6.3 Parameters tab

In the ***Parameters*** tab (Figure 20 below), information about the tower's location and climate, as well as about a few more structural items, is specified. These details are optional and you can change all of these settings whenever you wish later from the 3.7 Project Properties dialog box.

! The TIA-222-G engineering standard requires at least the climate-related details for its loading calculations.

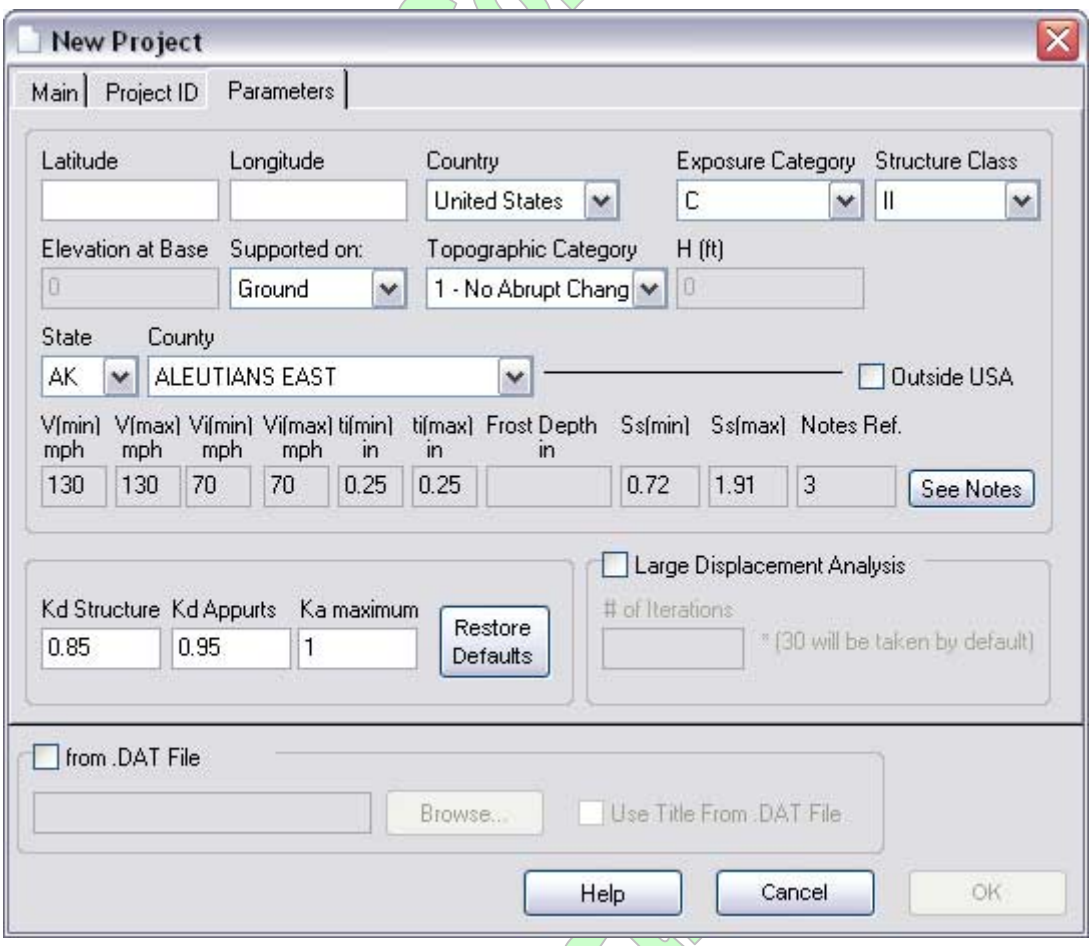


Figure 20 — New Project dialog box Parameters tab

Latitude
Enter the latitude of the tower.

Longitude
Enter the longitude of the tower.

Country drop-down menu
Select the Country the tower is in. If the country selected is *United States*, then several other options become available.

Exposure Category drop-down menu
Select *B*, *C*, or *D*.

Structure Class drop-down menu
Select *I*, *II*, or *III*.

Elevation at Base
Select the base elevation of the tower. If *Ground* is selected in the *Supported on* item, this field will be greyed-out.

Supported on drop-down menu
Select whether the tower is supported on the ground, the roof of another structure, or some other structure. Selecting *Ground* will disable the *Elevation at Base* item.

Topographic Category drop-down menu
Select from

- 1 – No Abrupt Changes
- 2 – Escarpment
- 3 – Hill
- 4 – Ridge
- 5 – Site-Spefific Investigation

H (ft)
Enter the Height of the Escarpment, Hill, or Ridge on which the tower is located. If No Abrupt Changes or Site-Specific Investigation are selected, this field will be greyed out.

State drop-down menu
If the tower is in the USA, select the state it is located in.

County drop-down menu
If the tower is in the USA, select the county it is located in. The specific climate data (V(max), V(min), etc.) for that county will appear automatically.

Outside USA checkbox
If the tower is outside the USA, ensure this checkbox is selected. This checkbox is directly linked with the Country selector drop-down menu (above) so selecting "United States" there unchecks it and any other country automatically checks it.

V (min) mph

V (max) mph

V_i (min) mph

V_i (max) mph

t_i (min) in

t_i (max) in

Frost Depth in

S_s (min)

S_s (max)

Notes Reference No.
For more information on the area selected, click the ***See Notes*** button and look for the note number shown in this field.

See Notes button
This button displays notes from the TIA-222-G engineering standard related to the settings on this ***Parameters*** tab of the ***New Project*** dialog box.

K_d Structure

K_d Appurtenances

K_a maximum

Restore Defaults button
This button sets the ***K_x*** values above back to the defaults of 0.85, 0.95, and 1, respectively.

Large Displacements Analysis checkbox
Select this checkbox to enable Large Displacements Analysis.

# of Iterations
This field is multiplied by 30 to give the number of iterations for Large Displacement Analysis.

from .DAT file
This checkbox and its related functions are the same as in the 3.6.1 Main tab.

3.7 Project Properties dialog box

The *Project Properties dialog box* is identical to the 3.6 New Project dialog box with four exceptions:

1. It is accessed from the *Properties* toolbar button or the *Properties* item in the 3.9.1 Project menu.
2. The engineering standard for the tower's analysis is displayed.
3. The type of tower is displayed but cannot be changed from this dialog box. To change it, use the *Save as Self-Supporting Tower Project* and *Save as Guyed Tower Project* items in the 3.9.1 Project menu. Note that Tubular Pole towers cannot be converted to other tower types.
4. Changing the Project Name field and pressing OK ***renames*** the project file.

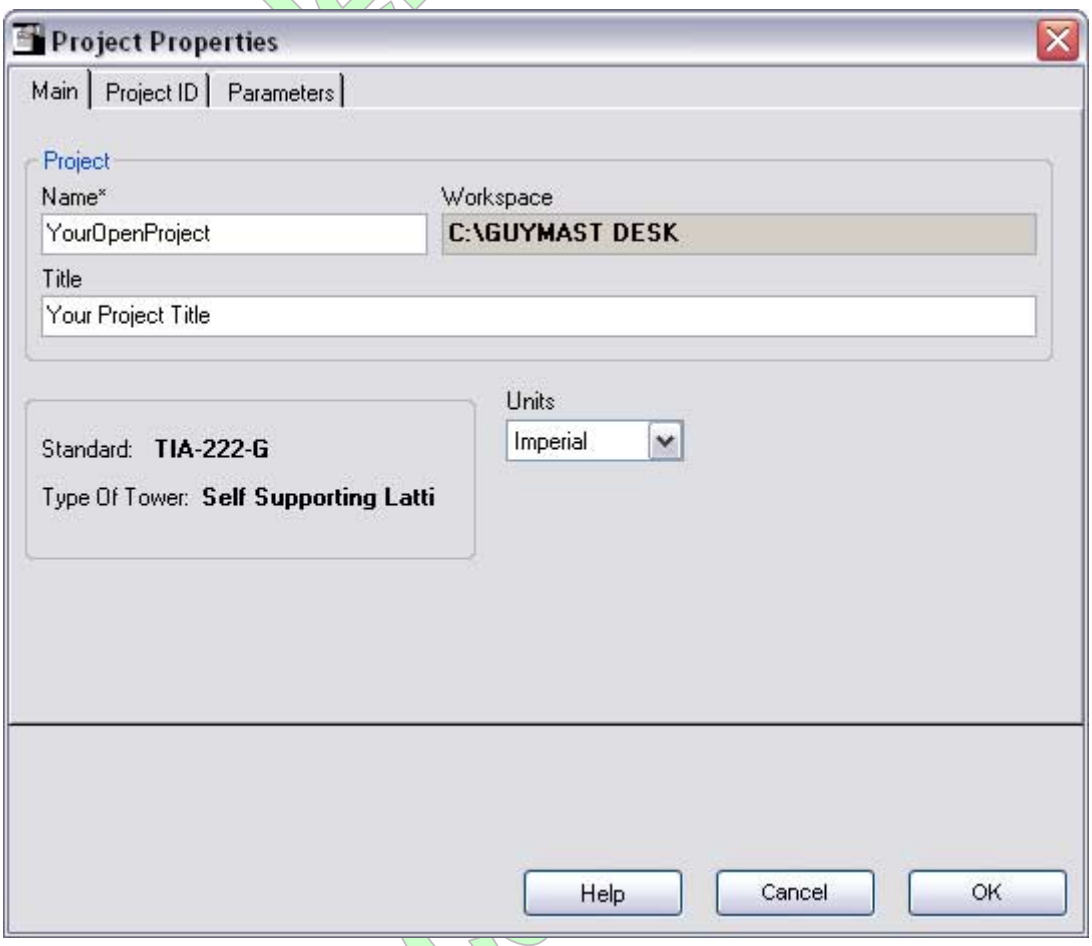


Figure 21 — Project Properties dialog box Main tab

3.8 Toolbar Functions

Each of the buttons and functions in the toolbar (Figure 22 below) is directly related to a function in the various 3.9 Menus.

Figure 22 — Toolbar

New

The *New*  toolbar button opens the 3.6 New Project dialog box to create a new project. The same function is available in the 3.9.1 Project menu.

Open

The *Open*  toolbar button opens the 3.5 Select Project dialog box to open and create new projects. The same function is available in the 3.9.1 Project menu.

Save

The *Save*  toolbar button saves the current (top) project open in the GUYMAST-G user environment. The same function is available in the 3.9.1 Project menu.

Print...

The *Print...*  toolbar button opens the *Print* dialog box (Figure 23 below), offering the option to print *All Tables*, the *Current Table* visible, or all the currently *Selected Tables*. Tables are selected individually or in groups from within the 3.11 Table List. The same function is available in the 3.9.1 Project menu.

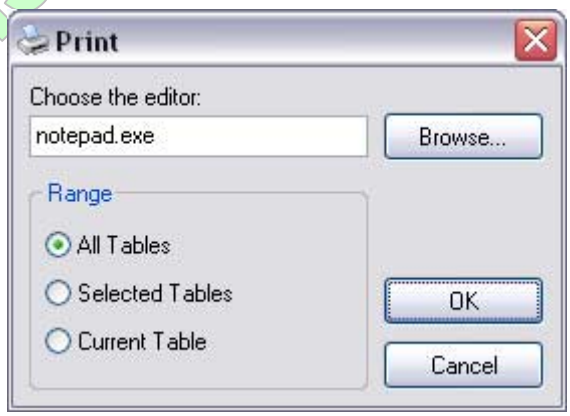


Figure 23 —Print... dialog box

! A text editor provides the actual printing function according to your needs. Select the editor to use in the *Choose the editor:* field. The editor can be changed at any time with the *Text Editor* item in the 3.9.4 Tools menu.

Properties

The *Properties*  toolbar button opens the 3.7 Project Properties dialog box to edit the parameters associated with the tower project. The same function is available in the 3.9.1 Project menu.

Check Data

The *Check Data*  toolbar button runs a data check on the entries in the data tables and identifies many errors and mistakes, data that is out of valid ranges, particularly. The same function is available in the 3.9.4 Tools menu.

Calculate Loads

The *Calculate Loads*  toolbar button calculates the loads for each loading condition. The same function is available in the 3.9.4 Tools menu.

Analyze Tower

The *Analyze Tower*  toolbar button calculates the forces acting on the tower for each loading condition, and the deflections that result. The same function is available in the 3.9.4 Tools menu.

Report Loads

The *Report Loads*  toolbar button displays, in the designated text editor, the loads calculated for each loading condition and the maximum loads calculated.

Report Results

The *Report Forces*  toolbar button displays, in the designated text editor, the calculated forces for each loading condition and the maximum forces calculated.

Draw Tower

The *Plans*  toolbar button displays profile and plan views of the tower through our drawing and display tool, DRAWMAST, the use of which is specified in section 7 Tower Drawing Tool.

Draw Results

The *Draw Results*  toolbar button displays graphical representations of the calculated loads and forces through our drawing and display tool, DRAWFORCE, the use of which is specified in section 8 Results Drawing Tool.

3.9 Menus

3.9.1 Project

The *Project* menu contains function items related to projects and project files as a whole. Use this menu to create, open, and save projects, to change project properties and workspaces, and to print table data.

New...
Opens the 3.6 New Project dialog box.

Open
Opens the 3.5 Select Project dialog box.

Close
Closes the current project and asks if you wish to save your work.

Close All
Closes all open projects and for each one asks if you wish to save your work.

Workspaces...
Opens the 3.4 Select Workspace dialog box.

Save
Saves the current project.

Save As...
Opens a dialog box to save a new copy of the project file under another name or the same name.

Save as Self-Supporting Tower Project...
Saves a guyed tower as a self-supporting tower. This function is unavailable when editing a self-supporting or monopole tower.

Save as Guyed Tower Project...
Saves a self-supporting tower as a guyed tower. This function is unavailable when editing a guyed or monopole tower.

Print...

Provides the same function as the *Print...*  toolbar button, opens the *Print* dialog box (Figure 23 above in the section on 3.8 Toolbar Functions) and gives printing options, such as *All Tables*, the *Current Table* visible, or all the currently *Selected Tables*.

Properties
Opens the 3.7 Project Properties dialog box.

Exit
Exits the GUYMAST-G program.

3.9.2 Edit

The *Edit* menu contains functions that are duplicated for your convenience in the 3.10.3 Right-Click context menu in the 3.10 Table Editor. These functions are concerned with editing the data in the table editor.

Cut
Copies the data selected in the table editor into the clipboard and then deletes it from the table.

Copy
Copies the data selected in the table editor into the clipboard.

Paste
Pastes the data in the clipboard into the table editor.

Clear Table
Removes all data from the current table.

Select Row
Selects the whole current row.

Delete Row
Deletes the current row. Asks for confirmation.

Insert Blank Row
Inserts a blank row above the current row.

Append Blank Row
Adds a blank row to the bottom of the table.

Attempting to create a new row after an already blank bottom row is not be permitted. This limitation is present to prevent cluttered, large, empty tables, since more than one blank row is not needed.

Copy and Insert Row
Copies the current row to a new row at the current location.

Copy and Append Row
Copies the current row to a new row at the bottom of the table.

Ignore Row
Sets the current row to be disabled for calculation purposes. Colors the text blue and greys out the background.

! This function works only on a single row at a time. Blank rows at the end of a table cannot be Ignored.

Restore Row
Restores an *Ignored* row to active status for calculation purposes. Removes coloring.

! This function works only on a single row at a time.

3.9.3 View

The ***View*** menu contains functions and options that change the layout and structure of the visible elements of the GUYMAST-G interface.

Toolbar
Shows and hides the 3.8 Toolbar Functions.

Status Bar
Shows and hides the 3.13 Status Bar.

Help Panel
Shows and hides the 3.12 Help Panel.

Table List
Shows and hides the 3.11 Table List.

Split Table View
Splits the current 3.10 Table Editor view in either the *Horizontal* or *Vertical* orientation, for viewing and comparison, copying, editing, or any other purpose you like. Select *None* to set the view to normal single table view.

3.9.4 Tools

The ***Tools*** menu contains functions and options for major pieces of the program.

Check Data...
This function quickly analyzes the data in the tower editing tables and provides helpful tips for where there are errors in the data and/or missing information.

Calculate Loads
Runs the data through the load calculation engine, checking the data first and noting any errors that would cause analysis to fail.

Analyze Tower
Runs the data through the force analysis calculation engine, checking the data first and noting any errors that would cause analysis to fail.

Loading Case
In this extended menu, there are options to:

- *Add* new loading cases,
- *Delete* a selected loading case,
- *Copy and Append* a selected loading case to the bottom of the list as a new loading case,
- *Repeat*-copy the current loading case with wind-azimuth changes for each repetition,
- and *Edit...* the wind loadings in a convenient dialog box by the *Change WL* item instead of in the table editor.

Some of these sub-menu tems may be greyed-out and disabled when not currently editing a loading case table in the list panel.

! You can also right-click in the to bring up the context menu that has these same functions. Do so on an actual loading case and the Copy and Append and Repeat functions will be applied using that case.

Tx-Line Database...
Opens the Transmission- or 3.14 Tx-Line Database for editing or viewing.

Guy Database
Opens the 3.15 Guy Database for editing or viewing.

Export to .DAT file
Takes the table data from GUYMAST-G format and exports it to a MASTLOD-compatible .DAT text file for use in other Guymast Inc. software.

Text Editor...
This function opens a dialog box to allow specification of the executable file of a text editor. By default, the editor is Microsoft Windows' Notepad, also known as NOTEPAD.EXE.

3.9.5 Report

The *Report* menu allows the user to view the data entered and the results of the calculations in various formats for confirmation that the model is correct and to see where errors have been made. These can be viewed in text (Applied Loads and Results of Analysis) and graphical (Drawings and Graphs) formats.

Loads Calculated
Generates a report of all analyzed loads.

Results of Analysis
Generates a report of all analyzed forces and deflections.

Draw Tower
Starts the 7 Tower Drawing Tool.

Draw Results
Starts the 8 Results Drawing Tool to draw graphs of the tabular results of loading, force, and deflection analysis.

View in 3D
This item is disabled in the current version.

3.9.6 Window

The *Window* menu controls the viewing area, especially when there are multiple tower projects open.

Tile Horizontally
Arranges the open tower projects one by one, side by side.

Tile Vertically
Arranges the open tower projects one by one, over each other.

Cascade
Arranges the open tower projects one over the other, staggered diagonally.

1, 2, 3…
Each numbered item has a name/label and represents a single open tower project file.

3.9.7 Help

The *Help* menu lists functions to assist the user with information about GUYMAST-G and guidance in its use.

GUYMAST-G Help
Opens the full GUYMAST-G help system.

Check for Updates
Contacts Guymast Inc.'s servers and informs as to whether there is a new version available.

! Requires internet connection.

Guymast Inc. on the Web
Opens Guymast Inc.'s web site.

! Requires internet connection.

Send to Guymast Inc.
Opens a Microsoft Outlook email with the appropriate files attached and email address applied for Guymast Inc. technical support to be able to help you better with any problems.

! Requires internet connection and Microsoft Outlook 97 or newer.

About GUYMAST-G
Opens a dialog box containing information about the GUYMAST-G program version.

3.10 Table Editor

The *Table Editor* displays the currently selected tables for editing. Each table has a header area and the main 3.10.1 Navigating and Editing area, as well as a 3.10.2 Comments cell at the end of each row.

- From the 3.9.3 View menu, a *Split Table View* can be selected to show two tables at a time.
- To select a cell, click on it with the mouse or move to it using the arrow keys on the keyboard. The currently selected cell is shown with a  cell cursor selection box.
- To select multiple cells, click and drag the mouse or hold the shift key and move the selection with the arrow keys. The selection box will expand to cover all the selected cells.
- More editor features are available from the 3.9.2 Edit menu and from the 3.10.3 Right-Click context menu.

The *Table Editor* also has a *Title Area* (Figure 24 below) where you can view the project title, tower type, and engineering standard quickly.

Figure 24 — Table Editor Project Title Area

3.10.1 Navigating and Editing area

! Only one table is shown here, for the purposes of describing how to edit tables. Specific data tables and their actual data types, purposes, and uses are described in section 5 User-Supplied Data.

MAST GEOMETRY (ft)

PANEL TYPE	NO.OF LEGS	SUB DIVIDE	..ELEVATION OF.. BOTTOM	TOP	..FACE WIDTH AT.. BOTTOM	TOP	TYPICAL PANEL HEIGHT
X	3	0	0.000	120.000	24.000	12.000	10.00
X	3	0	120.000	190.000	12.000	5.000	5.00
X	3	0	190.000	230.000	5.000	5.000	5.00

Figure 25 — Table Editor Tower Definition Data table

Each table has a header portion and a body portion (Figure 25 above). The header indicates what data type to enter in the column below. In the body portion, data is entered that defines the tower. Simply navigate, enter or change data, and continue.

- Use the Tab key as a quick way to move one cell to the right and to go to the beginning of the next row if at the end of the current row. Tabbing from the right-most cell of the bottom row of the table will create a new row in which to enter data and will move the cell cursor selection box to the beginning of that new row.
- Use the Enter key as a quick way to move one cell down. Using Enter from any cell in the bottom row of the table will create a new row in which to enter data and will move the cell cursor selection box to the ***beginning*** of that new row.
- Attempting to create a new row after an already blank bottom row will not be permitted. This limitation is present to prevent cluttered, large, empty tables, since more than one blank row is not needed.
- More *Table Editor* features are available from the 3.9.2 Edit menu and from the 3.10.3 Right-Click context menu.

3.10.2 Comments

Each table contains a right-most column for *Comments* (Figure 26 below). *Comments* can be of any text you like.

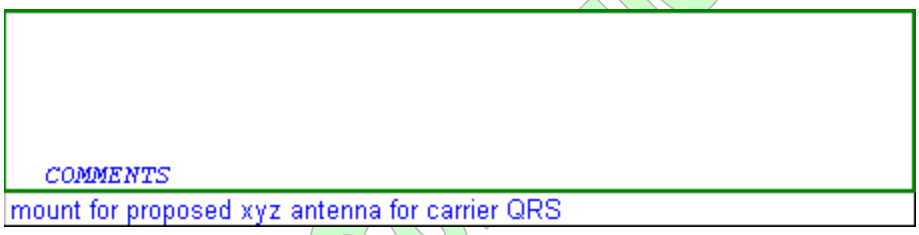


Figure 26 — Table Editor Comments table

! Use the cells in this column to indicate anything important and descriptive. Suggestions include: descriptions of complex pieces, identifications of special circumstances, indications of further review and analysis required, and combinations of these.

3.10.3 Right-Click context menu

The *Right-Click context menu* contains exactly the same options for editing table data as the 3.9.2 Edit menu.

3.10.4 Error Indicators

A table that has data errors that the GUYMAST-G software has detected will have indicators on its 3.11 Table List entry as a red flag icon. Another red flag is shown for the table group heading. In the *Table Editor*, cells containing erroneous data show in red text, and an error message is shown in the 3.13 Status Bar.

! Use the flag system to identify which tables have errors and to track them down and correct them.

! Use the *Check Data* toolbar button or the *Check Data* menu item in the 3.9.4 Tools menu to display an itemized list of all the errors in the project and click each to go directly to it in the list panel that appears.

! The GUYMAST-G software should not be expected to find all errors of all kinds. It will attempt to identify missing data and data that is out of the valid range. It will also attempt to identify where relationships between different lines of the table have been invalidated, such as with overlapping panels of the tower. There is no substitute for care on first entry, and Guymast Inc. will not be held responsible for erroneous data entry.

3.11 Table List

The *Table List* (Figure 27 below) provides a list of named tables to select for editing in the 3.10 Table Editor. The panel can be resized or hidden, and tables listed in the panel can be selected for purposes such as printing and reporting.

! The tables have been reorganized and grouped differently in version 3.0.0 of GUYMAST-G in order to group and describe their functions.

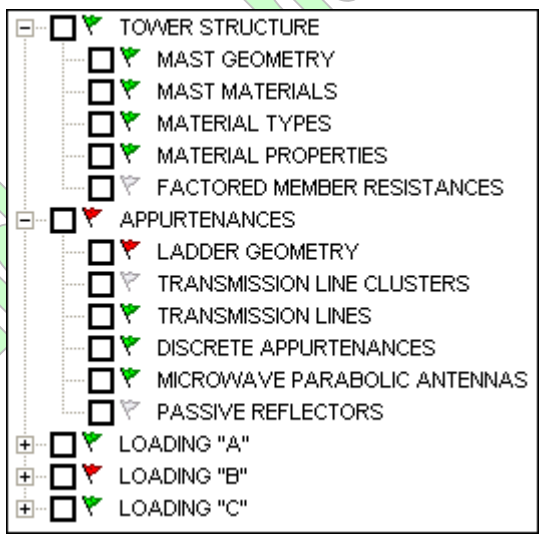


Figure 27 — Table List Panel

3.11.1 Resizing

To resize the *Table List*, move your mouse over the dark border-bar on the right side of the panel, until your mouse cursor changes to a double-arrow ⇹ icon. Click on that dark border bar and drag horizontally to change the width of the panel.

3.11.2 Selecting Tables for Editing

Edit a table in the 3.10 Table Editor by clicking on its name. Clicking on a group name will open the group and the first table in the group.

3.11.3 Selecting Tables for Printing and Otherwise

Select specific tables for printing by selecting the ☐ empty checkbox icon to the left of the table title. It will become ☑ checked/selected.

! You can also use the table selection system to “flag” particular tables you have edited or finished working with or for any other reason, if you wish to keep track of them for any reason. They will all be reset to de-selected ☐ empty checkbox icons when you re-open the project file, however.

3.11.4 Expanding and Collapsing Table Lists

The table list is shown hierarchically, to separate table items into logical groups. The hierarchical list expands and contracts by either clicking on the ⊞ plus/⊟ minus icons and expands and selects the first table by clicking on the group name.

- Clicking a ⊞ plus icon will expand the table list to show hidden sub-tables. By default, Loading Cases are listed with hidden sub-tables until expanded.
- Clicking a ⊟ minus icon will collapse that branch of the tree.

3.11.5 Hiding the Table List

Select the *Table List* item in the 3.9.3 View menu to hide the entire *Table List*.

! Use the hide function to save desktop space. With the *Table List* hidden, there is more horizontal area on which a table itself can be displayed.

3.11.6 Data Error Flags

One of colored flag icon is displayed beside each table and each table group.

- A green flag indicates that there is data present (incomplete or not) and that the GUYMAST-G software does not find any technical errors with it.
- A red flag indicates that there is data present and that the GUYMAST-G software has found errors. Open that table for viewing to see what is wrong.
- A grey flag indicates that there is no data present in that table.

3.11.7 Right-Click Loading Case context menu

Right-click on a table in the *Table List to* open the *Loading Case context menu*. It has the ***same menu items*** as in the *Loading Case* expanded menu in the 3.9.4 Tools menu.

! Some items in the *Loading Case context menu* may be greyed-out and disabled when not right-clicking directly on a loading case or loading case table in the list panel.

3.12 Help Panel

The all-new *Help Panel* (Figure 28 below) in GUYMAST-G displays context-relevant sections of this manual in an HTML form. The panel can be hidden or shown at any time by double-clicking the Help *Help* tab at the bottom of the 3.10 Table Editor. The panel can be "pinned" and "unpinned" (set static or into an auto-hide mode) with the pin button in the top left.

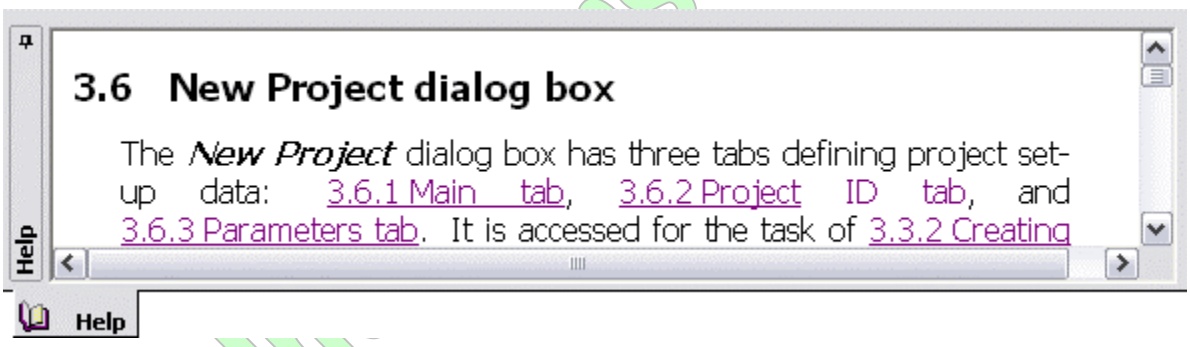


Figure 28 — Help Panel

Sections of the manual are displayed as the software detects a relevant context. Clicking links will jump to the appropriate section, and clicking links that refer to sections that are not in the current display will open the full help system (this entire manual) in your default web browser.

3.13 Status Bar

The *Status Bar* (Figure 29 below) shows the table editor cell selection's row and column number information. It also displays current selection error messages — for errors in the data that the program can detect.

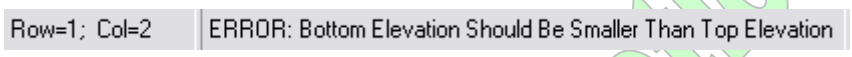


Figure 29 — Status Bar

3.14 Tx-Line Database

The *Tx-Line Database* (Figure 30 below) stores information about transmission line types for use with easy reference in the description of a tower.

Figure 30 — Tx-Line Database Editor

3.14.1 Editor Functions

The editor allows you to add, delete, and change values and entries as you see fit. Guymast Inc. provides an extensive database of many known types for your use.

Add

Add a transmission line by entering all the appropriate data in the top row of the table and pressing the *Add* button.

Delete/Delete All

Asks for confirmation before deleting the currently selected row(s) or the entire table.

Find

Search the table for a particular text string/numerical value. Values can also be *Replaced*.

Load Defaults

Restore the default database provided by Guymast Inc. with the GUYMAST-G software.

Print...

Prints the table.

Metric/Imperial Database Auto Completion

3.14.2 Data Types

Transmission Line — Name

A label of your choosing. We recommend using common product names from vendors.

Transmission Line — Type

Two characters defining the type of line:

AH — Air Heliax

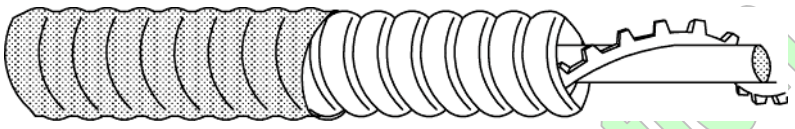


Figure 31 — Air Heliax Transmission Line

FH — Foam Heliax

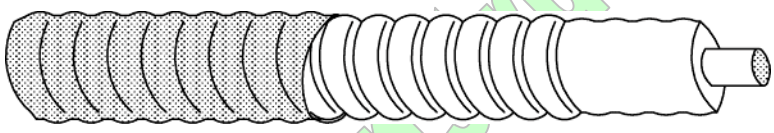


Figure 32 — Foam Heliax Transmission Line

EW — Elliptical Waveguide (heliax)

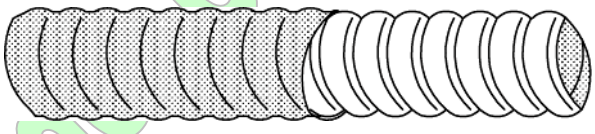


Figure 33 — Elliptical Waveguide (heliax) Transmission Line

CW or WC — Circular Waveguide (rigid)

Figure 34 — Circular Waveguide (rigid) Transmission Line

WR or RW — Rectangular Waveguide (rigid)

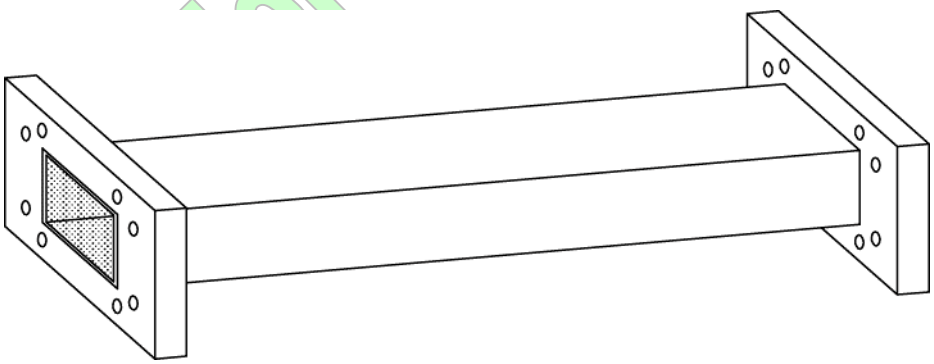


Figure 35 — Rectangular Waveguide (rigid) Transmission Line

RC — Coaxial Line (rigid)

Figure 36 — Coaxial Line (rigid) Transmission Line

Transmission Line — Nominal Size

The common name for the size of transmission line.

Diameter — Vertical (in or mm)

The vertical diameter of the line.

Diameter — Horizontal (in or mm)

The horizontal diameter of the line.

Weight/Unit Length (plf or kg/m)

The weight per standard unit length of the line.

Shape

0 for Round or 1 for Rectangular.

3.15 Guy Database

The *Guy Database* (Figure 30 above) stores information about guy wire types for use with easy reference in the description of a tower.

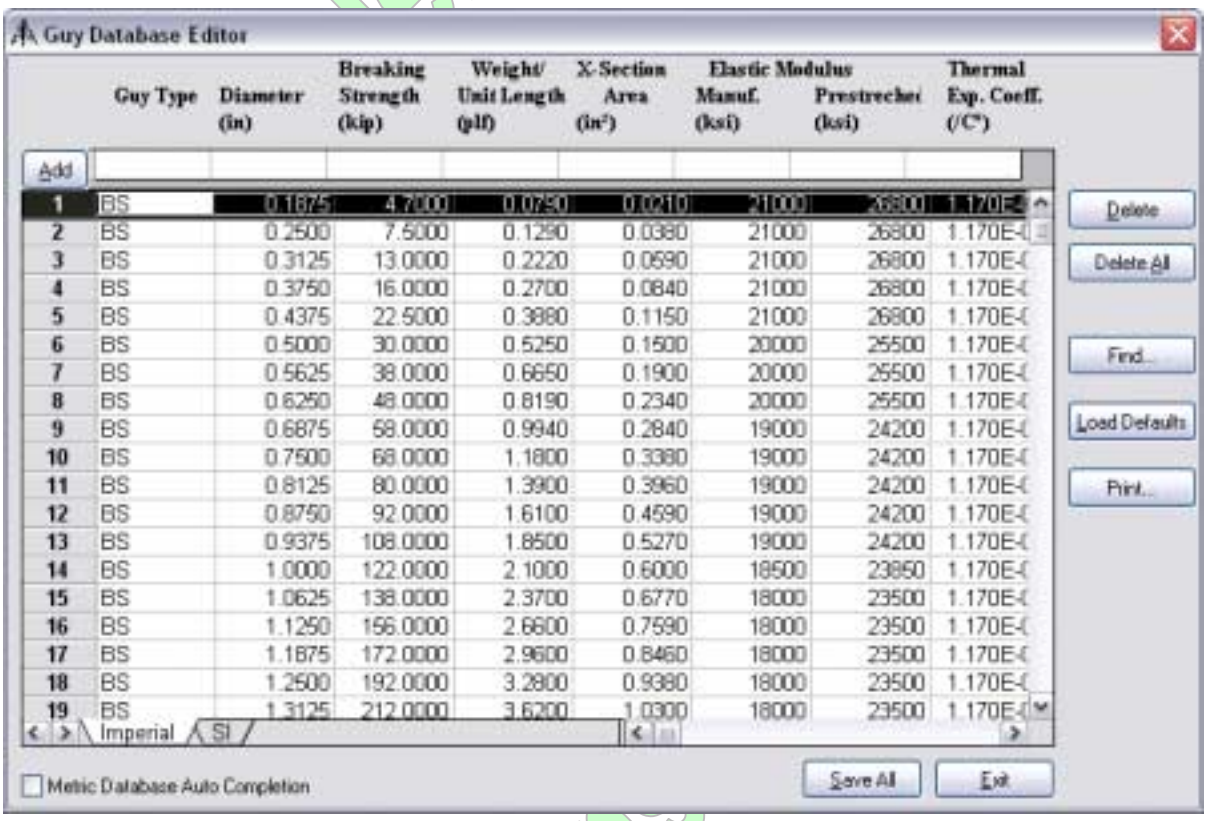


Figure 37 — Guy Database Editor

3.15.1 Editor Functions

Has the same functions as are in the 3.14 Tx-Line Database editor.

3.15.2 Data Types

Guy Type

GS — Guy Strand or BS — Bridge Strand

Diameter (in or mm)

The diameter of the guy.

Breaking Strength (kip or kN)

The breaking strength of the guy.

Weight / Unit Length (plf or kg / m)

The weight per standard unit length of the guy.

X-Section Area (in^2 or mm^2)

The cross-sectional area of the guy.

Elastic Modulus — Manufacturer (ksi or MPa)

The manufacturer's stated elastic modulus for the guy.

Elastic Modulus — Pre-stretched (ksi or MPa)

The elastic modulus of the guy as pre-stretched.

Thermal Expansion Coefficient (/ °C)

The thermal expansion coefficient of the guy.

! GUYMAST-G references temperature only in °C, not in °F.

4 Modeling Capabilities and Conventions

5 User-Supplied Data

The user supplies GUYMAST-G with data to describe the tower project for analysis. Location and some control data is entered in the 3.6 New Project dialog box, 3.7 Project Properties dialog box, and tower structure, appurtenance, and loading condition data is entered in various tables displayed in the 3.10 Table Editor accessed through the 3.11 Table List.

5.1 Project Information

The main project information is entered either in the 3.6 New Project dialog box when a project is started or in the 3.7 Project Properties dialog box at any time after. Data such as the location of the tower, its climate area, the owner, and other such details are stored in those dialog boxes.

! This structure for storing this data is under review and is likely to change in future versions of GUYMAST-G to increase general usability.

5.2 Tower Structure

Consult the table below to identify which tables are used to define structure for which types of towers. The table descriptions themselves also include the same reference information.

In defining your tower, keep in mind its orientation to North (Figure 38 and Figure 39 below).

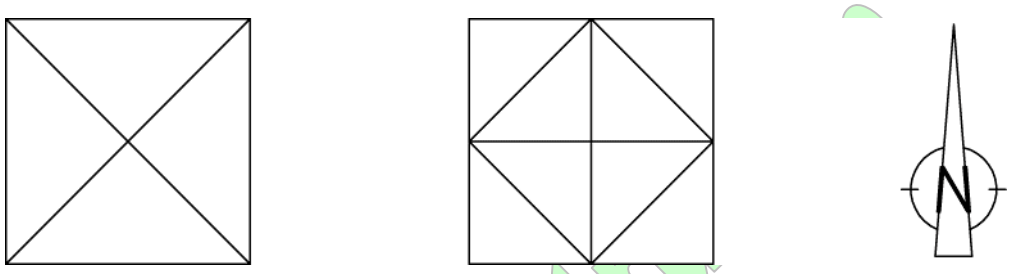


Figure 38 — Square Tower Plan — Orientation to North

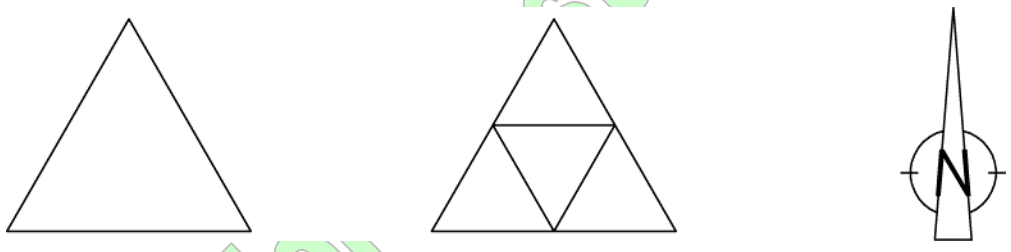


Figure 39 — Triangular Tower Plan — Orientation to North

Section		Guyed Lattice	Self-Supporting Lattice	Tubular Pole
5.2.1	Lattice Mast Geometry	✓	✓	
5.2.2	Lattice Mast Materials	✓	✓	
5.2.3	Material Types	✓	✓	✓
5.2.4	Material Properties	✓	✓	✓
5.2.5	Factored Leg and Face Shear Resistance	✓		
5.2.6	Factored Member Resistances		✓	
5.2.7	Pole Assembly			✓
5.2.8	Pole Sections			✓
5.2.9	Pole Flanges			✓
5.2.10	Flange Gussets			✓
5.2.11	Access Hole in Shell			✓
5.2.12	Access Hole Reinforcing			✓
5.2.13	Weld Lines			✓
5.2.14	Weld Groups			✓

5.2.1 Lattice Mast Geometry

Used in: Guyed Lattice and Self-Supporting Lattice Towers

Lattice Mast Geometry defines each region of the tower in which the panel height, panel type, and slope of the legs remain constant.

Panel Type

- Type: 1 Letter

A, V, X — Fundamental Double-Diagonal Systems

S, Z — Fundamental Single-Diagonal Systems

C, D — Combinational Systems

Defines the bracing system used on each face of the tower within each panel included in the region. Panel types are structured as shown in the figures below.

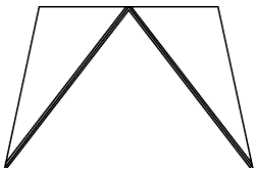


Figure 40 — Fundamental Double-Diagonal Panel Type A

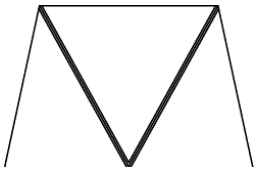


Figure 41 — Fundamental Double-Diagonal Panel Type V

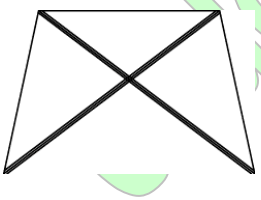


Figure 42 — Fundamental Double-Diagonal Panel Type X

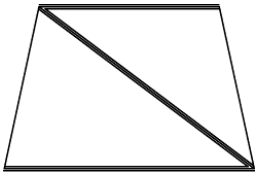


Figure 43 — Fundamental Single-Diagonal Panel Type S

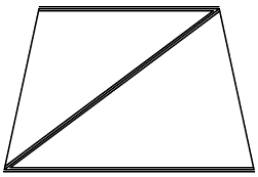


Figure 44 — Fundamental Single-Diagonal Panel Type Z

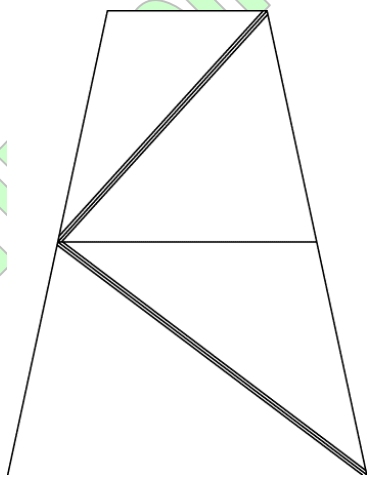


Figure 45 — Combinational Panel Type C

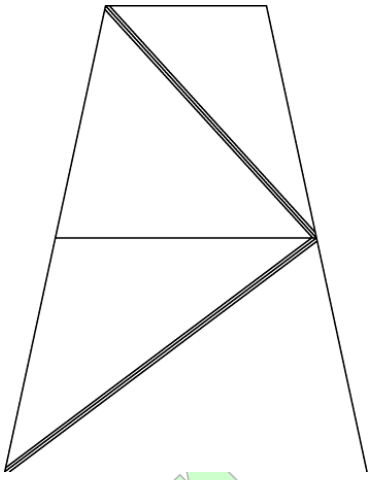


Figure 46 — Combinational Panel Type D

Number of Legs

- Type: Integer

3 or 4 — legs in panel

The number of legs in the typical panel.

Sub-Divide

- Type: Integer

0 to 12 — sub-divisions

The number of sub-divisions of each leg by sub-horizontals and sub-diagonals. If there are two parts to the leg in the typical panel for the region, the sub-division value will be 1; if three parts, sub-division will be 3, etc. Examples are shown in the figures below.

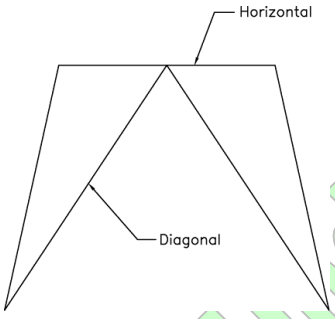


Figure 47 — Panel Type A
Sub-Divide = 0

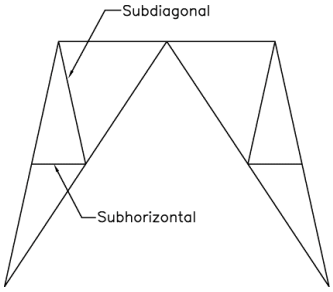


Figure 48 — Panel Type A
Sub-Divide = 1

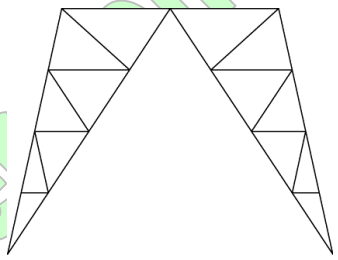


Figure 49 — Panel Type A
Sub-Divide = 3

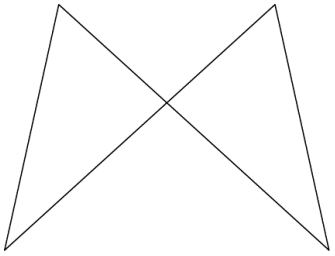


Figure 50 — Panel Type X
Sub-Divide = 0

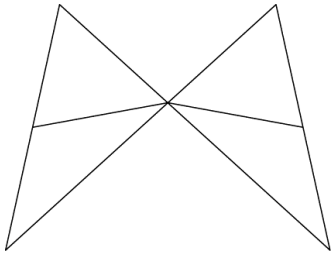


Figure 51 — Panel Type X
Sub-Divide = 1

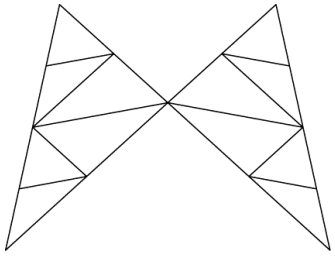


Figure 52 — Panel Type X
Sub-Divide = 3

Elevation of Bottom

- Type: Floating Point Decimal ft or m

The lowest elevation in this region.

Elevation of Top

- Type: Floating Point Decimal ft or m

The highest elevation in this region.

Face Width at Bottom

- Type: Floating Point Decimal ft or m

The face width of the bottom of the lowest panel in the region.

Face Width at Top

- Type: Floating Point Decimal ft or m

The face width of the top of the highest panel in the region.

Typical Panel Height

- Type: Floating Point Decimal ft or m

The typical panel height in this region.

5.2.2 Lattice Mast Materials

Used in: Guyed Lattice and Self-Supporting Lattice Towers

Lattice Mast Materials defines the region of the tower over which the properties of all members in one panel remain constant. This is without regard to any geometric changes in the mast.

Bottom Elevation

- Type: Floating Point Decimal ft or m

The lowest elevation in this region.

Top Elevation

- Type: Floating Point Decimal ft or m

The highest elevation in this region.

Type of Materials Used in Legs

- Type: Integer

The material type ID number used for the legs in these panels.

Type of Materials Used in Diagonals

- Type: Integer

The material type ID number used for the diagonals in these panels.

Type of Materials Used in Horizontals

- Type: Integer

The material type ID number used for the horizontals, if any, in these panels. Use 0 if absent from the panel being described.

Type of Materials Used in Internal Bracing

- Type: Integer

The material type ID number used for the internal bracing members, if any. Use value of 0 if absent from the panel being described.

Type of Materials Used in Sub-Diagonals

- Type: Integer

The material type ID number used for the sub-diagonals, if any. Use value of 0 if absent from the panel being described.

Type of Materials Used in Sub-Horizontals

- Type: Integer

The material type ID number used for the sub-horizontals, if any. Use value of 0 if absent from the panel being described.

Type of Materials Used in Gusset

- Type: Integer

The material type ID number to be used for the gussets, if any. Use value of 0 if absent from the panel being described.

5.2.3 Material Types

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

Material Types defines the properties of materials that may be used anywhere in the tower. Each material is referenced from several other tables by use of its Type Number, defined below.

The material is defined by Type of Shape (an alphabetic string up to 12 characters long), the Number of Elements or components (2 in a back-to-back angle; 1 in a single angle, pipe or solid round), the Orientation, and some dimensional properties.

The bare and iced weights are calculated by the program from the data entered based on the shape of the material.

Type of Shape

- Type: Text Label

Most standard structural shapes are recognized, abbreviations can be used:

Solid Round (SR) — diameter given

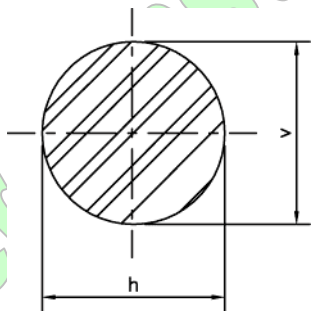


Figure 53 — Solid Round (SR)

Pipes — STD; XS or E.H.;
XXS or DBLE E.H.; or
A.S.A. pipe schedules (e.g. SCH40)
nominal diameter given

Tubes and *RHSS (RHS)* — outside diameter and wall thickness given

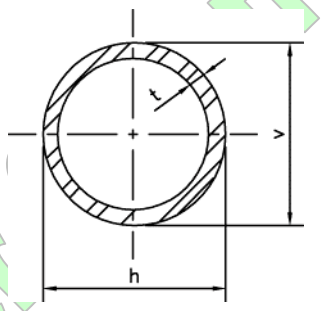


Figure 54 — Tube (RHS)

Angles (L) — dimensions and thickness given

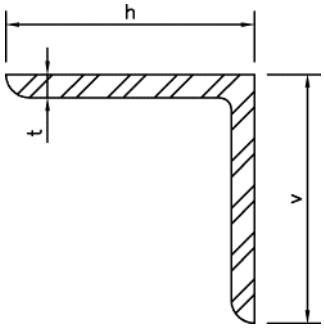


Figure 55 — Angle (L)

Tees (T), *Channels (C)*, and given *Wide Flange* (WF) shapes — dimensions and web and flange thickness

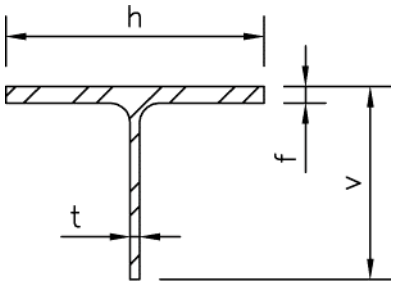


Figure 56 — Tee (T)

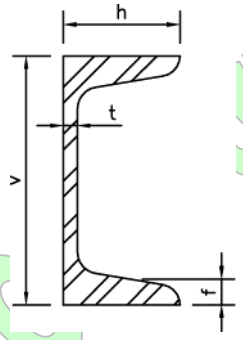


Figure 57 — Channel (C)

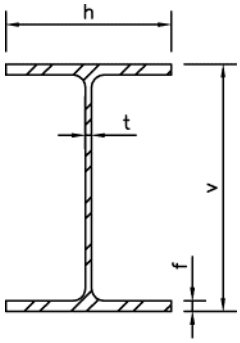


Figure 58 — Wide Flange (WF)

HSS Sections (HSS) — outside dimensions and thickness given

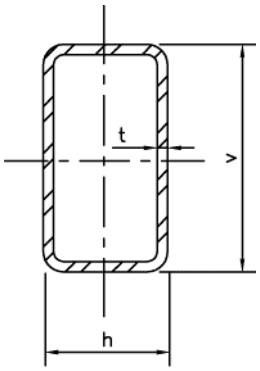


Figure 59 — Hollow Section (HSS)

Elliptical shapes (Elliptical) — specified in a fashion similar to rounds and tubes with major and minor diameters and wall thickness given

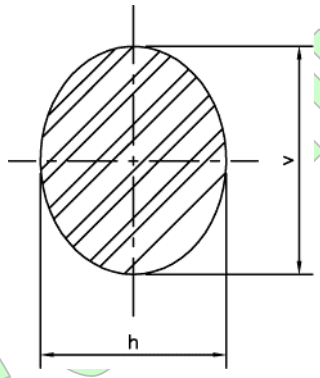


Figure 60 — Round (Elliptical)

Plates and *Bars (PL)* — dimensions and thickness given

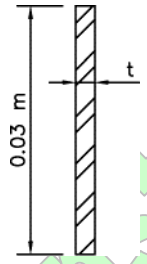


Figure 61 — Plate (PL)

! Except for Wide Flange, Channel, and Tee shapes, which are assumed to be made of steel, the user must specify a density of material to be used to determine the weight of the section.

! For a plate, the horizontal dimension is the same as thickness unless it is to be used for gussets.

Type Number

- Type: Integer

The material type number used to refer back to this particular material from many other tables.

Number of Elements

- Type: Integer

The number of similar elements or components making up one member. This value is 2 in the case of back-to-back elements, and 0 (zero) if the member is to be excluded from load calculations.

Orientation

- Type: Floating Point Decimal degrees (°)

Orientation of the section's vertical axis with respect to the Up direction of the structure (Figure 62 below). If this value is 0 (zero), the member is in its normal vertical position. Otherwise, it is rotated through a number of degrees clockwise from Up.

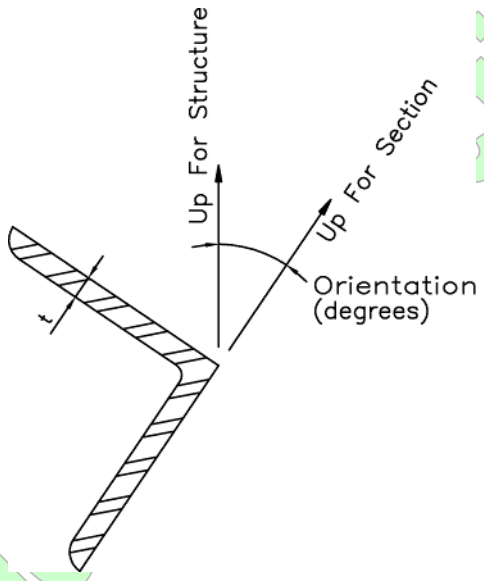


Figure 62 — Section Orientation (30 degrees shown)

Height

- Type: Floating Point Decimal in or mm

Projection along vertical (based on orientation of zero) establishes one aspect of the member size and the projected wind area.

! Height is represented as *v* (for projection along vertical axis) in the figures above.

Width

- Type: Floating Point Decimal in or mm

Projection along horizontal establishes the other aspect of member size when applicable (in elliptical members, angles, WF, C, and T sections).

! Width is represented as *h* (for projection along horizontal axis) in the figures above.

Thickness — Web

- Type: Floating Point Decimal in or mm

Thickness used to determine weight and ice build-up. Generally applies to tubes, HSS, RHSS, and angles, and to web thickness for Channel, Tee, and WF sections.

! Thickness is represented as *t* in the figures above.

Thickness — Flange

- Type: Floating Point Decimal in or mm

! Thickness is represented as *t* in the figures above.

Irregularity Projection — % of Area

- Type: Floating Point Decimal percentage (%)

Irregularity Projection — Orientation

- Type: Floating Point Decimal degrees (°)

5.2.4 Material Properties

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

Material Type Number

- Type: Integer

The material ID number for the material being described.

Elastic Modulus

- Type: Floating Point Decimal ksi or GPa

The elastic modulus of the material comprising the member being described.

Unit Weight

- Type: Floating Point Decimal pcf or kg/ m^3

The mass/weight per unit volume of the material being described.

Strength — F_u

- Type: Floating Point Decimal ksi or MPa

The *ultimate* strength of the material.

Strength — F_y

- Type: Floating Point Decimal ksi or MPa

The *yield* strength of the material.

Thermal Coefficient

- Type: Floating Point Decimal /degrees Celsius (/°C)

The thermal expansion coefficient of the material of which the member being described is made. This is only required if a change in temperature is to be applied in any of the loading conditions.

! The units are inverse degrees, consistent with the temperature changes specified in the loading conditions.

! GUYMAST-G references temperature only in °C, not in °F.

5.2.5 Factored Leg and Face Shear Resistance

Used in: Guyed Lattice Towers

Bottom Elevation
- Type: Floating Point Decimal ft or m

Top Elevation
- Type: Floating Point Decimal ft or m

Leg Compression
- Type: Floating Point Decimal kip or kN

Face Shear
- Type: Floating Point Decimal kip or kN

Leg Tension
- Type: Floating Point Decimal kip or kN

5.2.6 Factored Member Resistances

Used in: Self-Supporting Lattice Towers

Bottom Elevation
- Type: Floating Point Decimal ft or m

Top Elevation
- Type: Floating Point Decimal ft or m

Legs — Compression
- Type: Floating Point Decimal ft or m

Legs — Tension
- Type: Floating Point Decimal kip or kN

Diagonals — Compression
- Type: Floating Point Decimal kip or kN

Diagonals — Tension
- Type: Floating Point Decimal kip or kN

Horizontals — Compression
- Type: Floating Point Decimal kip or kN

Horizontals — Tension
- Type: Floating Point Decimal kip or kN

Internal Bracing — Compression
- Type: Floating Point Decimal kip or kN

Internal Bracing — Tension
- Type: Floating Point Decimal kip or kN

5.2.7 Pole Assembly

Used in: Tubular Pole Towers

Section Name
- Type: Text Label

Base Elevation
- Type: Floating Point Decimal ft or m

Bolts at Base of Section — Number
- Type: Integer

Bolts at Base of Section — Type
- Type: Text Label

Bolts at Base of Section — Diameter
- Type: Floating Point Decimal in or mm

Bolts at Base of Section — Strength
- Type: Floating Point Decimal ksi or MPa

Bolts at Base of Section — Threads in Shear Plane
- Type: Integer

0 — Threads are not in shear plane.

1 — Threads are in shear plane.

5.2.8 Pole Sections

Used in: Tubular Pole Towers

Section Name
- Type: Text Label

Number of Sides
- Type: Integer

0 to 50 — sides

Length
- Type: Floating Point Decimal ft or m

Outside Diameter — Bottom
- Type: Floating Point Decimal in or mm

Outside Diameter — Top
- Type: Floating Point Decimal in or mm

Thickness
- Type: Floating Point Decimal in or mm

Material
- Type: Integer

Flange ID — Bottom
- Type: Integer

Flange ID — Top
- Type: Integer

Flange Weld Group ID — Bottom
- Type: Integer

Flange Weld Group ID — Top
- Type: Integer

5.2.9 Pole Flanges

Used in: Tubular Pole Towers

Flange — ID
- Type: Integer

Flange — Diameter — Inside
- Type: Floating Point Decimal in or mm

Flange — Diameter — Outside
- Type: Floating Point Decimal in or mm

Flange — Thickness
- Type: Floating Point Decimal in or mm

Flange — Recess
- Type: Floating Point Decimal in or mm

Flange — Material Type
- Type: Integer

Bolt Holes — Number
- Type: Integer

Bolt Holes — Hole Diameter
- Type: Floating Point Decimal in or mm

Bolt Holes — Radius
- Type: Floating Point Decimal in or mm

Bolt Holes — Start Azimuth
- Type: Floating Point Decimal degrees (°)

Gusset — ID
- Type: Integer

Gusset — Number
- Type: Integer

Gusset — Start Azimuth
- Type: Floating Point Decimal degrees (°)

5.2.10 Flange Gussets

Used in: Tubular Pole Towers

ID
- Type: Integer

Copes — Top — Horizontal
- Type: Floating Point Decimal in or mm

Copes — Top — Vertical
- Type: Floating Point Decimal in or mm

Copes — Bottom — Horizontal
- Type: Floating Point Decimal in or mm

Copes — Bottom — Vertical
- Type: Floating Point Decimal in or mm

Weld Group ID — Pole
- Type: Integer

Weld Group ID — Flange
- Type: Integer

Material Type
- Type: Integer

5.2.11 Access Hole in Shell

Used in: Tubular Pole Towers

Section Name
- Type: Text Label

Position — Distance from Base
- Type: Floating Point Decimal ft or m

Position — Azimuth
- Type: Floating Point Decimal degrees (°)

Size — Width
- Type: Floating Point Decimal in or mm

Size — Height
- Type: Floating Point Decimal in or mm

Shape
- Type: Integer

0 — Elliptical

1 — Rectangular

Dimensions defined with Size — Width and Size — Height.

Corner Radius
- Type: Floating Point Decimal in or mm

Reinforcement ID
- Type: Integer

5.2.12 Access Hole Reinforcing

Used in: Tubular Pole Towers

ID
- Type: Integer

Vertical — Material Type
- Type: Integer

Vertical — Weld Line
- Type: Integer

Vertical — Edge Distance — Normal
- Type: Floating Point Decimal in or mm

Vertical — Edge Distance — Tangent
- Type: Floating Point Decimal in or mm

Horizontal — Material Type
- Type: Integer

Horizontal — Weld Line
- Type: Integer

Horizontal — Edge Distance — Normal
- Type: Floating Point Decimal in or mm

Horizontal — Edge Distance — Tangent
- Type: Floating Point Decimal in or mm

5.2.13 Weld Lines

Used in: Tubular Pole Towers

Weld Line ID

- Type: Integer

Type

- Type: 2-3 Letters

FIL — Fillet

VEE — Vee

PLU — Plug

BEV — Bevel

SQU — Square

CP — Complete Penetration

Size

- Type: Floating Point Decimal in or mm

Intermittent — Length

- Type: Floating Point Decimal in or mm

Intermittent — Pitch

- Type: Floating Point Decimal in or mm

Unit Strength

- Type: Floating Point Decimal ksi or MPa

5.2.14 Weld Groups

Used in: Tubular Pole Towers

Weld Group ID
- Type: Integer

Weld Line ID
- Type: Integer

Gage Distance
- Type: Floating Point Decimal in or mm

End Distance
- Type: Floating Point Decimal in or mm

Rotation
- Type: Floating Point Decimal degrees (°)

Length
- Type: Floating Point Decimal in or mm

Side — Near
- Type: Integer

0 — Weld is not on near side

1 — Weld is on near side

Side — Far
- Type: Integer

0 — Weld is not on far side

1 — Weld is on far side

Around
- Type: Integer

0 — Weld is not around the connection

1 — Weld is around the connection

5.3 Guy Information

Section		Guyed Lattice	Self-Supporting Lattice	Tubular Pole
5.3.1	Guy Geometry	✓		✓

5.3.1 Guy Geometry

Used in: Guyed Lattice and Tubular Pole Towers

Elevation

- Type: Floating Point Decimal ft or m

The elevation at the mast at which the guy is attached.

Guy Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the line joining the tower base to the guy anchor.

Guy Type

- Type: 2 Letters
- BS — Bridge Strand
- GS — Guy Strand

The type of guy used.

Diameter

- Type: Floating Point Decimal in or mm

The diameter of the guy wire.

Height

- Type: Floating Point Decimal ft or m

The vertical projection (height) from the anchor to the guy's attachment on the mast.

Radius

- Type: Floating Point Decimal ft or m

The radius from the mast centerline to the anchor.

Mast Attachment Radius

- Type: Floating Point Decimal ft or m

The radius measured from the centerline of the tower to the guy attachment point.

Attachment Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the attachment of the guy with respect to the centerline of the tower.

Initial Tension

- Type: Floating Point Decimal kip or kN

The initial tension (tension upon completion of construction) of the guy wire. If the guy's initial tension is entered as 0 (zero), it will be calculated using the unstressed length specified in the 3.15 Guy Database.

5.4 Appurtenances

Section		Guyed Lattice	Self-Supporting Lattice	Tubular Pole
5.4.1	Ladder Geometry	✓	✓	✓
5.4.2	Transmission Line Clusters	✓	✓	✓
5.4.3	Transmission Lines	✓	✓	✓
5.4.4	Microwave Parabolic Antennas	✓	✓	✓
5.4.5	Passive Reflectors	✓	✓	✓
5.4.6	Discrete Appurtenances	✓	✓	✓
5.4.7	Description of Outrigger	✓		

5.4.1 Ladder Geometry

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

Ladder Geometry describes any number of ladder types anywhere in the tower, giving the ladder geometry, material types, position, and orientation (Figure 63 below).

! This table can be used to define any set of horizontal elements that have a standard vertical separation and are of equal size and identical material.

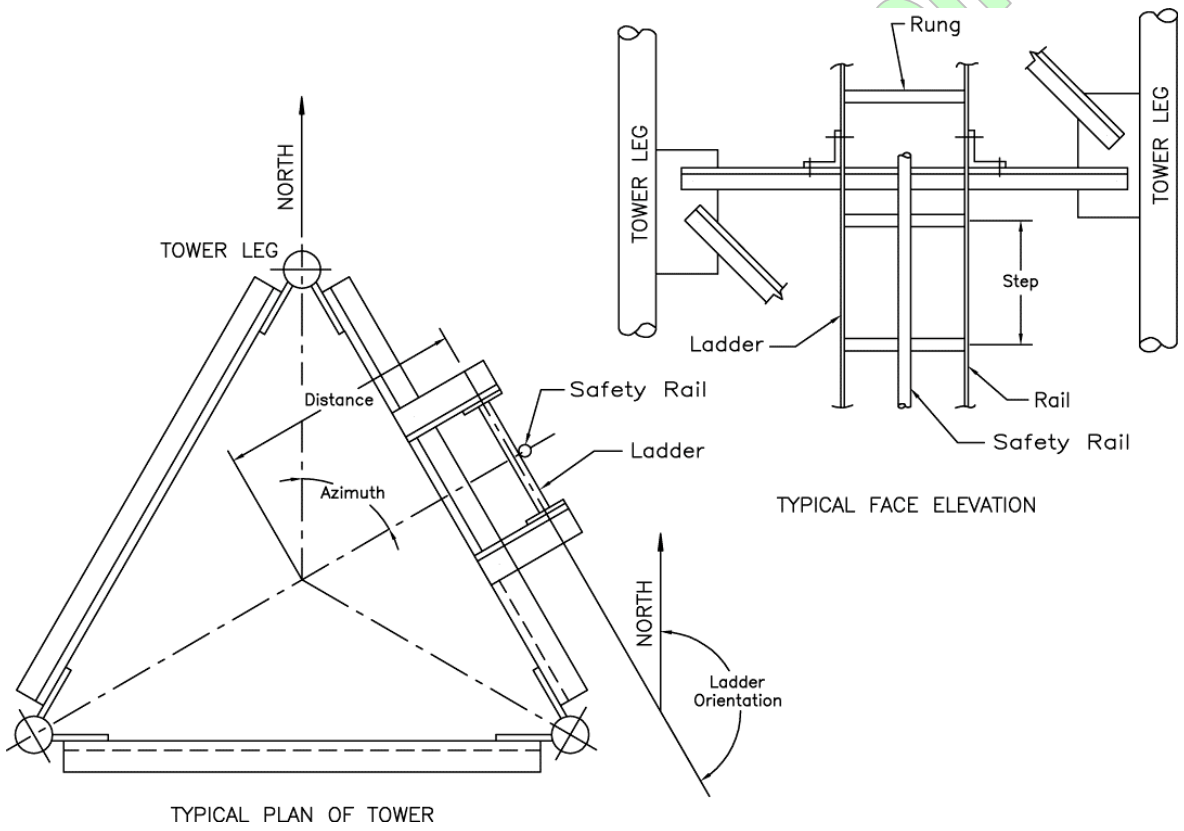


Figure 63 — Position and Orientation of Ladder

Elevation of Bottom

- Type: Floating Point Decimal ft or m

The bottom elevation of the region in which these ladder properties apply.

Elevation of Top

- Type: Floating Point Decimal ft or m

The top elevation of the region in which these ladder properties apply.

Size — Wide

- Type: Floating Point Decimal in or mm

The width of the ladder — the horizontal center-to-center distance between ladder rails (Figure 63 above).

Size — Step

- Type: Floating Point Decimal ft or m

The vertical distance between successive ladder rungs — the step distance (Figure 63 above).

Position — Bottom — Distance

- Type: Floating Point Decimal ft or m

The distance from the center of the tower to the center of the ladder (Figure 63 above and Figure 64 below) at the bottom of the ladder section. When negative, this value establishes the constant distance from the tower face, based on the face width of the tower at the bottom of the region as defined in Elevation of Bottom.

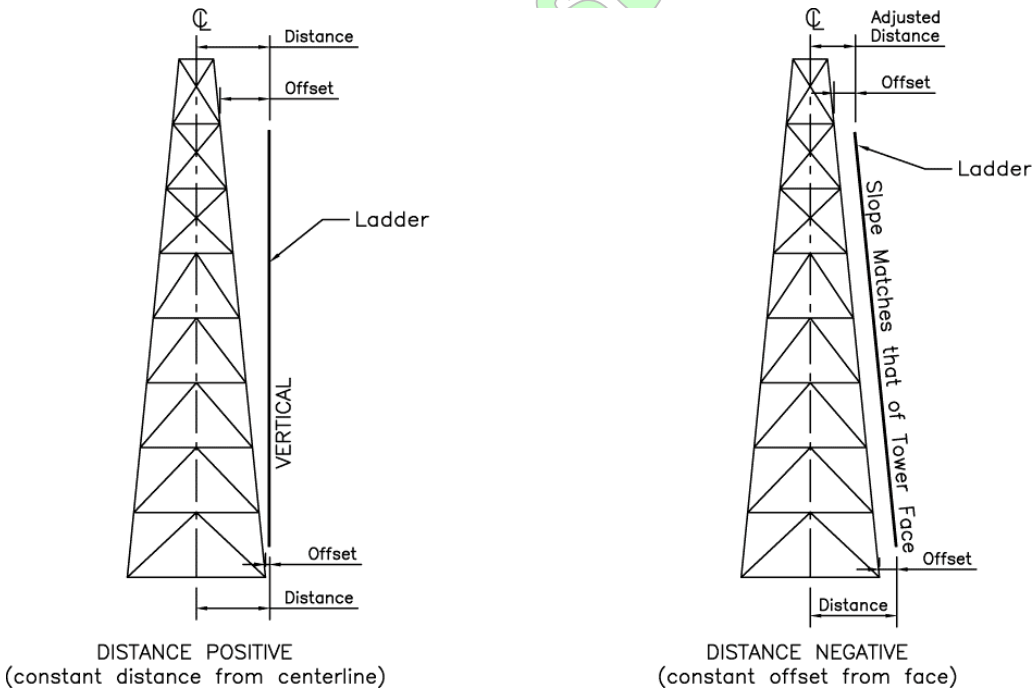


Figure 64 — Distance of Ladder in Elevation

Position — Bottom — Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the line joining the center of the tower to the center of the ladder at the bottom of the ladder section (Figure 63 above).

Position — Top — Distance

- Type: Floating Point Decimal ft or m

The distance from the center of the tower to the center of the ladder (Figure 63 above and Figure 64 above) at the top of the ladder section. When negative, this value establishes the constant distance from the tower face, based on the face width of the tower at the bottom of the region as defined in Elevation of Top.

Position — Top — Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the line joining the center of the tower to the center of the ladder at the top of the ladder section (Figure 63 above).

Orientation

- Type: Floating Point Decimal degrees (°)

The orientation of the ladder (Figure 63 above). The azimuth of the typical ladder rung. When negative, this value indicates that the orientation should not be a factor in calculating the loadings. The maximum possible exposure of the ladder will then be used regardless of wind direction.

Materials — Rail

- Type: Integer

Material type number of which the rails are made.

Materials — Rung

- Type: Integer

Material type number of which the rungs are made.

Materials — Safety Rail

- Type: Integer

Material type number of which the safety rail is made.

5.4.2 Transmission Line Clusters

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

! This table is optional.

Cluster ID
- Type: Integer

Type of Line
- Type: Text Label

Configuration — Circular — # of Lines
- Type: Integer

0 to 36 — lines

Configuration — Circular — Radius
- Type: Floating Point Decimal in or mm

Configuration — Rectangular — Normal — # of Lines
- Type: Integer

0 to 36 — lines

Configuration — Rectangular — Normal — Center to Center (C/C) Spacing
- Type: Floating Point Decimal in or mm

Configuration — Rectangular — Tangential — # of Lines
- Type: Integer

0 to 36 — lines

Configuration — Rectangular — Tangential — Center to Center (C/C) Spacing
- Type: Floating Point Decimal in or mm

5.4.3 Transmission Lines

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

Transmission Lines allows for a quick description of the typical transmission lines used in communication towers and permits the specification of the line's location with respect to the tower centerline. Similar transmission lines may be grouped in one entry. The description is characterized with a type code, elevation regions, numbers of lines, distance from the center of the tower, azimuths, and orientations (Figure 65 below).

! This table is optional.

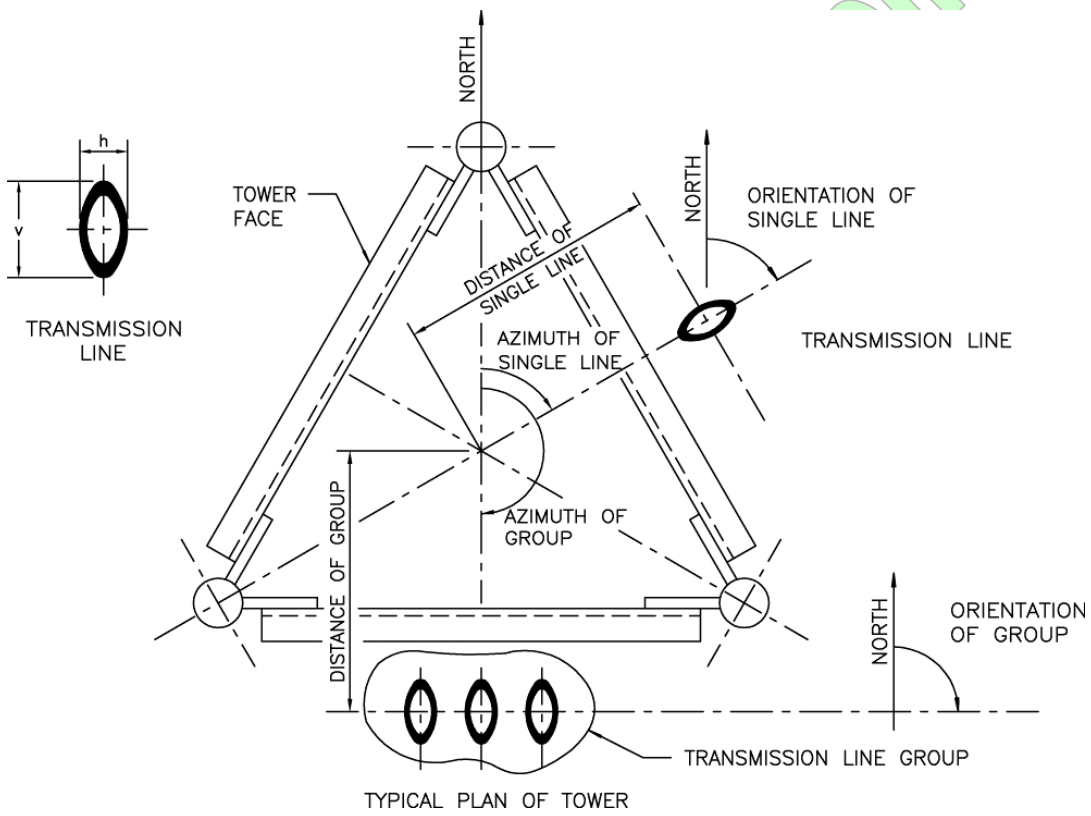


Figure 65 — Position and Orientation of Transmission Lines

Type of Line

- Type: Text Label

Describes the type and size of line used. Designates a particular line from the 3.14 Tx-Line Database to be used in this instance. Types supported include:

! If a type other than the above is used, the type of line must be specified as one of the materials defined in the 5.2.3 Material Types table. The material type number preceded by the symbol # then forms the type of line for use in this table.

! A #C and then a number refers to a Cluster ID for 5.4.2 Transmission Line Clusters.

Examples of correct strings describing types of lines are: CW3.125, EW71, EWP64, WR2300, FH0.785, #5, #C10, and AH3.

Elevation of Bottom

- Type: Floating Point Decimal ft or m

The bottom elevation of the region in which these properties apply.

Elevation of Top

- Type: Floating Point Decimal ft or m

The top elevation of the region in which these properties apply.

Number of Lines

- Type: Integer

0 to 36 — lines

The number of lines of similar type in this group. The center-to-center separation of these lines is assumed to be twice the smaller dimension of the line.

Position — Bottom — Distance

- Type: Floating Point Decimal ft or m

The distance from the centerline of the tower to the center of the transmission line or group of lines (Figure 65 above and Figure 66 below).

! When negative, this value establishes the constant distance from the tower face, based on the face width of the tower at the bottom of the region, as defined in Elevation of Bottom. When this value is negative, the transmission lines are assumed to be located on each face of the tower and integral with the mast. They are then excluded from transmission line loading and included with the solidity ratio of the tower.

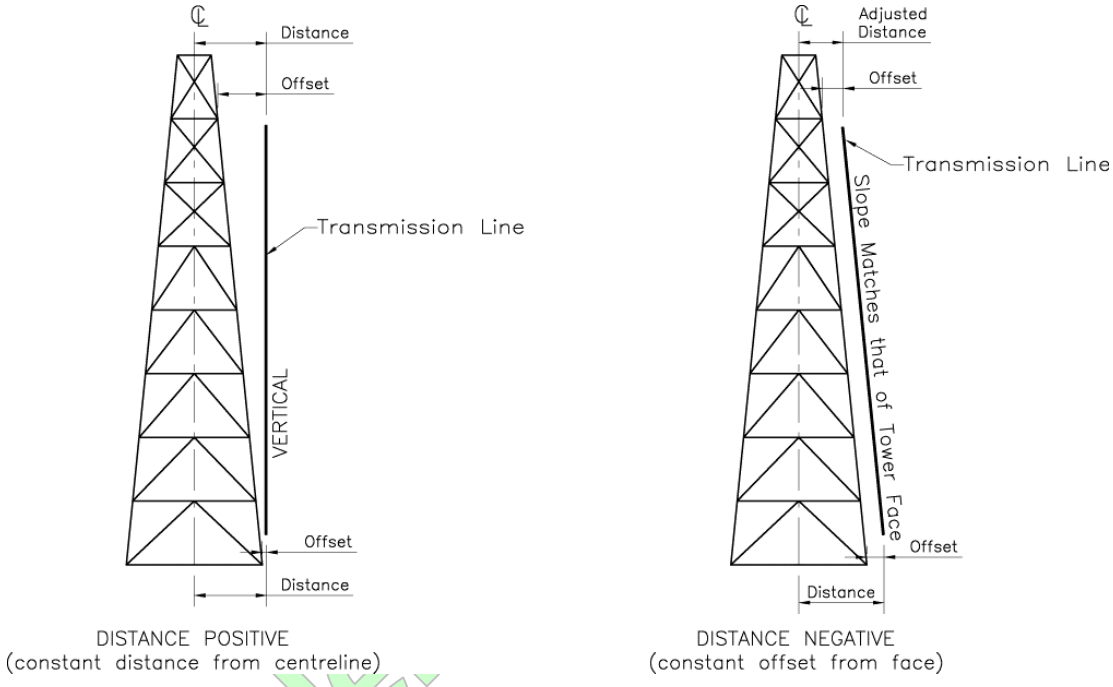


Figure 66 — Distance of Transmission Lines in Elevation

Position — Bottom — Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the line joining the center of the tower and the center of the transmission line or group of lines.

! When this value is negative, the transmission lines are assumed to be located on each face of the tower and integral with the mast. They are then excluded from transmission line loading and included with the solidity ratio of the tower.

! The weight of these lines will be multiplied by the number of faces to account for those on the other faces.

Position — Top — Distance

- Type: Floating Point Decimal ft or m

The distance from the centerline of the tower to the center of the transmission line or group of lines (Figure 65 above and Figure 66 above).

! Will not be considered if the constant distance from face option is specified.

! When negative, this value establishes the constant distance from the tower face, based on the face width of the tower at the bottom of the region, as defined in Elevation of Top.

Position — Top — Azimuth

- Type: Floating Point Decimal degrees (°)

Will not be considered if the constant distance from face option is specified.

Orientation

- Type: Floating Point Decimal degrees (°)

Orientation of the transmission line or group of lines (Figure 65 above). This is the azimuth of the major axis of the cross-section of the transmission line or the azimuth of the line joining the individual elements of a group of lines.

! When negative, this value indicates that the orientation should not be a factor in calculating the loadings. The maximum possible exposure of the transmission line will then be used regardless of wind direction.

Center to Center (C/C) Spacing

- Type: Floating Point Decimal in or mm

5.4.4 Microwave Parabolic Antennas

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

Microwave Parabolic Antennas describes parabolic dish antennas and microwave horns used in communication towers and permits specification of the location of the antenna with respect to the tower centerline.

! This table is optional.

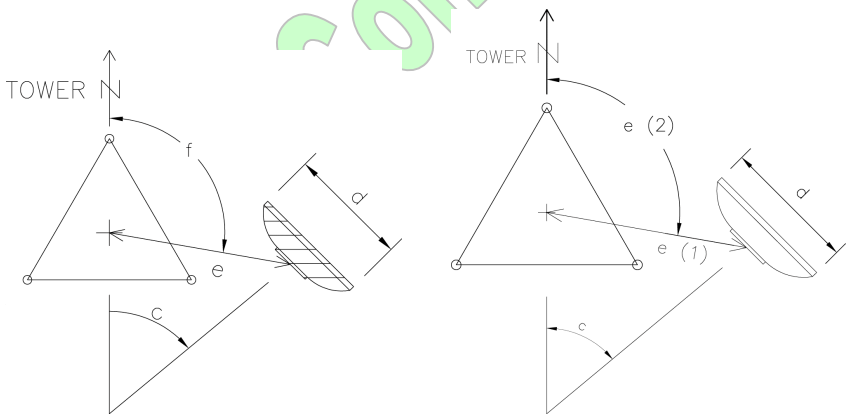


Figure 67 — Antenna Description and Location

Type

- Type: Text Label

STD — standard antenna

Figure 68 — Standard Parabolic Antenna

STD+R — standard antenna with radome

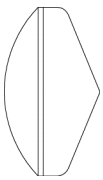


Figure 69 — Standard Parabolic Antenna with Radome

HP — high performance antenna

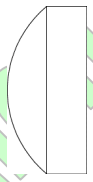


Figure 70 — High Performance Parabolic Antenna

GRID — grid antenna

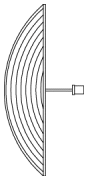


Figure 71 — Grid Parabolic Antenna

CH — conical horn antenna

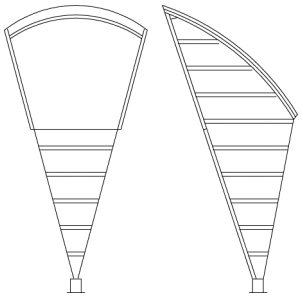


Figure 72 — Conical Horn Parabolic Antenna

KS — pyramidal horn antenna

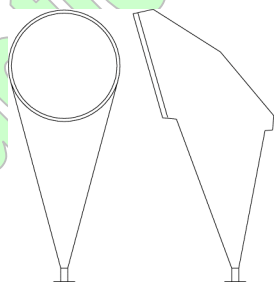


Figure 73 — Pyramidal Horn Parabolic Antenna

Elevation

- Type: Floating Point Decimal ft or m

The elevation of the centerline at which this antenna is attached.

Antenna — Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the antenna.

Antenna — Size

- Type: Floating Point Decimal ft or m

The size of the antenna. For the KS type, the size is 12ft.

Position — Radius

- Type: Floating Point Decimal ft or m

The distance from the centerline of the tower to the back of the dish or the centroid of the horn.

Position — Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the line joining the center of the tower to the back of the dish or the centroid of the horn.

Shielding Permitted

- Type: Floating Point Decimal percentage (%)

The maximum permissible shielding of this antenna by other antennas up-wind of this antenna, and having some vertical overlap (Figure 74 below).

! This shielding checks the antennas entered and produces an error message if it discovers the permitted value to have been exceeded.

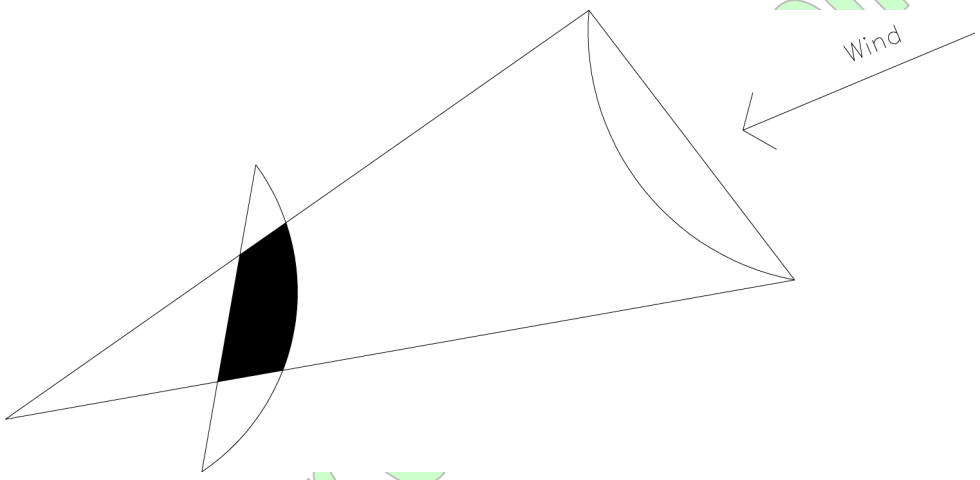


Figure 74 — Shielding of Leeward Antenna

5.4.5 Passive Reflectors

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

! This table is optional.

Description — Elevation
- Type: Floating Point Decimal ft or m

Description — Type
- Type: 1 Letter

E — Elliptical

R — Rectangular

Description — Height
- Type: Floating Point Decimal ft or m

Description — Width
- Type: Floating Point Decimal ft or m

Location — Distance
- Type: Floating Point Decimal ft or m

Location — Azimuth
- Type: Floating Point Decimal degrees (°)

Orientation — Azimuth
- Type: Floating Point Decimal degrees (°)

Orientation — Tilt
- Type: Floating Point Decimal degrees (°)

Weight
- Type: Floating Point Decimal kip or kN

5.4.6 Discrete Appurtenances

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

Discrete Appurtenances describes any arbitrary arrangement of components at a specific elevation (Figure 75 below). Each different component or group of components is entered on a separate line of the table. The elevation specified for any element should be the one at which the total load of all components that belong together should be applied. GUYMAST-G will group the loads by elevation.

! This table is optional.

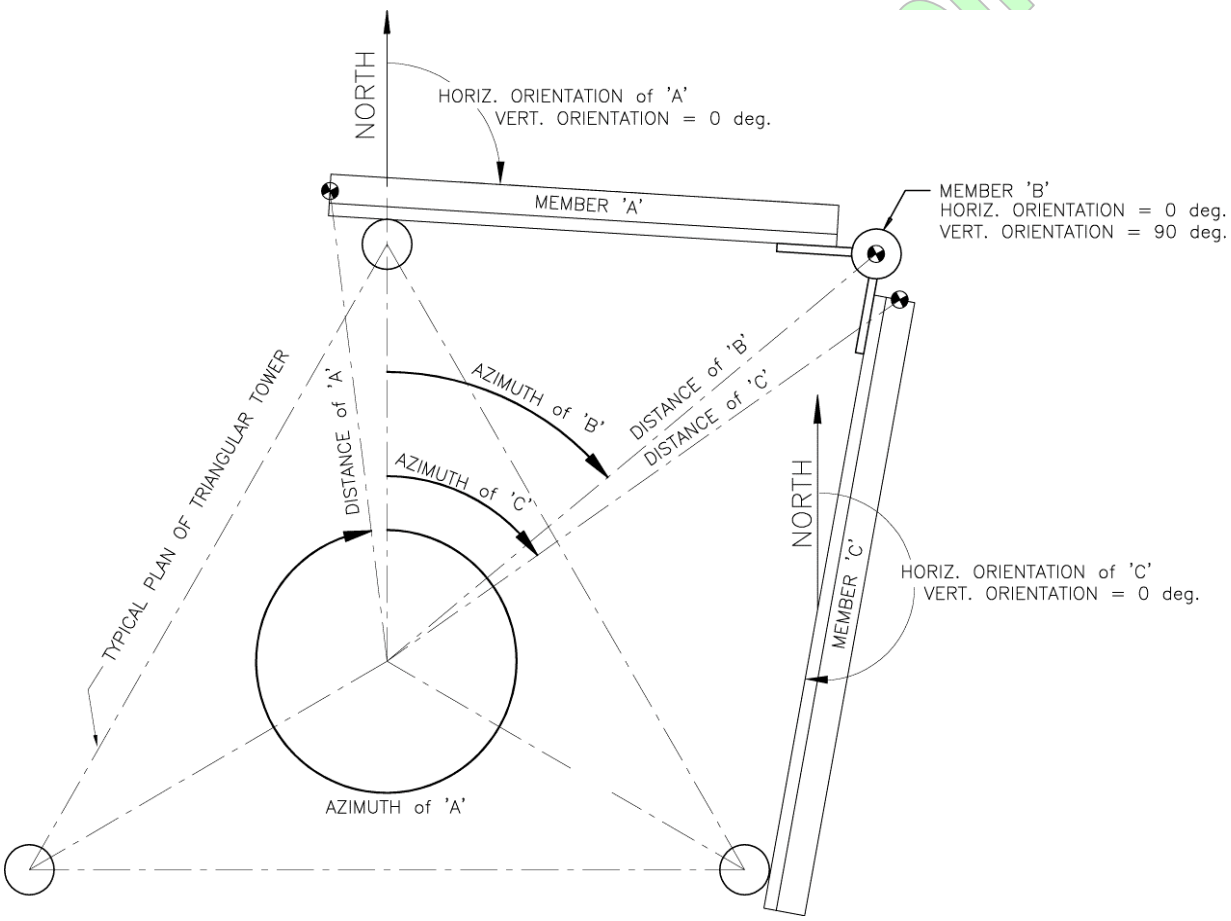


Figure 75 — Discrete Appurtenances Consisting of Members A, B, and C

Elevation

- Type: Floating Point Decimal ft or m

The elevation at which the resulting concentrated load will be applied.

Type of Material

- Type: Integer

The type of material (ID number) comprising this element or group of elements.

Number of Elements

- Type: Integer

The number of elements in this group.

Length

- Type: Floating Point Decimal ft or m

The length of each element in this group.

Location — Distance

- Type: Floating Point Decimal ft or m

The distance from the center of the tower to the end point of the group.

! This use of the end point of the group instead of the center of the group is different from versions of GUYMAST, MAST, MASTLOD, etc. software.

Location — Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the line joining the tower center to the end point of the group.

! If negative, then orientation is disregarded in calculation of loads.

! This use of the end point of the group instead of the center of the group is different from versions of GUYMAST, MAST, MASTLOD, etc. software.

Orientation — Horizontal

- Type: Floating Point Decimal degrees (°)

The horizontal orientation (the azimuth) of the member or group of members with respect to North as defined in — Figure 38, Figure 39, and Figure 75 above.

! When negative, this value indicates that the orientation should not be a factor in calculating the loadings. The maximum possible exposure will then be used regardless of wind direction.

Orientation — Vertical

- Type: Floating Point Decimal degrees (°)

The vertical orientation of the group. This is an angular measure from the horizontal.

! A value of ninety degrees (90°) means that the long axis of each member in the group is vertical.

Group ID

- Type: Integer

5.4.7 Description of Outrigger

Used in: Guyed Lattice Towers

! This table is optional.

Guy Elevation

- Type: Floating Point Decimal ft or m

The guy level at which the outrigger is attached.

! Identifies the torsion resistor when there are more than one on a particular tower.

Connection to the Mast — Upper Elevation

- Type: Floating Point Decimal ft or m

Establishes the upper position of the torsion resistor's attachment to the mast.

Connection to the Mast — Lower Elevation

- Type: Floating Point Decimal ft or m

Establishes the lower position of the torsion resistor's attachment to the mast.

Outrigger Material — Upper

- Type: Integer

The material used for the upper portions of the torsion resistor.

Outrigger Material — Lower

- Type: Integer

The material used for the lower portions of the torsion resistor.

5.5 Loading Conditions

Section		Guyed Lattice	Self-Supporting Lattice	Tubular Pole
5.5.1	Wind Loading	✓	✓	✓
5.5.2	Extra Loading	✓	✓	✓
5.5.3	Exposure Factors (Kz, Kiz)	✓	✓	✓
5.5.4	Exposure Factors (Qh Formula)	✓	✓	✓
5.5.5	Initial Displacements	✓		
5.5.6	Mast Restraints at Support	✓		
5.5.7	Guy Displacement Restraints	✓		

Section		Guyed Lattice	Self-Supporting Lattice	Tubular Pole
5.5.8	Special Factors	✓		
5.5.9	Support Conditions		✓	
5.5.10	Spring Characteristics		✓	
5.5.11	Member Temperature Change		✓	
5.5.12	Support Movement		✓	
5.5.13	Member Fit		✓	
5.5.14	Suppress Printing — Loading Calculations	✓	✓	✓
5.5.15	Suppress Printing — Guyed/Self-Supporting/	✓	✓	✓

5.5.1 Wind Loading

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

Wind Loading is used to specify the climatic conditions associated with any particular loading of the tower.

Wind Loading — Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the direction ***from*** which the wind is blowing.

Wind Loading — Speed

- Type: Floating Point Decimal mph or m/s

The wind speed.

! This value will be used if the Wind Loading — Reference Velocity Pressure is entered as 0 (zero).

Wind Loading — Reference Velocity Pressure

- Type: Floating Point Decimal psf or Pa

The reference velocity pressure (q in EIA standards).

! If this value is 0 (zero), Wind Loading — Speed is used to establish pressures.

Ice Loading — Radius

- Type: Floating Point Decimal in or mm

The radius of ice build-up on all members.

Ice Loading — Density

- Type: Floating Point Decimal pcf or kg/m^3

The density of ice.

Type of — Exposure

- Type: Integer

1 — EIA 222 G default

2 — Constant Kz = 1, Kiz = 1

3 — Step function for Kz, Kiz (requires definition of Exposure Factor Kz, Kiz table)

4 — Site specific wind formula, Kiz as EIA 222 G default (requires definition of Exposure Factor Qh formula table)

The type of exposure the tower has to wind, determining the variation of wind pressure with height.

Type of — Standard

- Type: Integer

0 —

1 — EIA Standard 222 E

2 — EIA Standard 222 C

3 — UBC-88

The standard to be used for calculation of wind loadings.

Type of — Antenna Load

- Type: Integer

1 — Antenna forces for this wind direction (forces relative to wind)

2 — Maximum possible forces regardless of wind direction

The type of antenna load to be reported.

Factors — Wind Load

- Type: Floating Point Decimal no units

A partial load factor applied to wind loads for this loading condition.

Factors — Dead Load

- Type: Floating Point Decimal no units

A partial load factor applied to dead loads for this loading condition.

Factors — Ice Load

- Type: Floating Point Decimal no units

A partial load factor applied to ice loads for this loading condition.

5.5.2 Extra Loading

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

The *Extra Loading* table is used to enter loadings that the user does not wish to have calculated, and are instead simply added to those which are calculated by the GUYMAST-G program. The loads should include load factors for this loading condition.

! This table is used to add antenna loads and the effects of other known loads and systems.

Load Type

- Type: 1 Letter

C — Concentrated

D — Distributed

The type of loading to be applied.

! For distributed loads, ***two full sets*** of data are required, each having the same data requirements in this table as for a concentrated load, but differing in that a D value is entered for the *Load Type*. The first set describes the loading at the bottom of the region of the distributed load and the second set describes the loading at the top of the region.

! Values between the two specified end points of the region will be ***linear*** interpolations of the two sets of extreme values given.

Elevation

- Type: Floating Point Decimal ft or m

The absolute elevation at which this load is to be applied.

Apply Load at Radius

- Type: Floating Point Decimal ft or m

The distance from the center of the tower to the point at which the load is to be applied.

Apply Load at Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the line joining the center of the tower to the point at which the load is to be applied.

Load Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth from which the horizontal force and vertical moment components are to act.

Forces — Horizontal

- Type: Floating Point Decimal kip or kN

The magnitude of the horizontal force component of loading (positive if the resulting deflection would be 108° with respect to the Load Azimuth specified).

Forces — Down

- Type: Floating Point Decimal kip or kN

The magnitude of the vertical force component of loading (positive when acting downward).

Moments — Vertical

- Type: Floating Point Decimal ft-kip or kN-m

The magnitude of the vertical moment component of loading (positive if the resulting deflection would be 108° with respect to the Load Azimuth specified).

Moments — Torsional

- Type: Floating Point Decimal ft-kip or kN-m

The magnitude of the torsional moment component of loading (positive when tending to twist the tower from East to North).

5.5.3 Exposure Factors (Kz, Kiz)

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

Exposure Factors of the Kz/Kiz varieties are used if the Type of — Exposure in the 5.5.1 Wind Loading table is set to a value of 3.

Elevation — Bottom

- Type: Floating Point Decimal ft or m

The bottom elevation of the region in which these factors are to be used.

Elevation — Top

- Type: Floating Point Decimal ft or m

The top elevation of the region in which these factors are to be used.

Wind Pressure Multiplier (Kz) — Bottom

- Type: Floating Point Decimal no units

The wind pressure factor Kz to be used at the bottom of the region defined.

Wind Pressure Multiplier (Kz) — Top

- Type: Floating Point Decimal no units

The wind pressure factor Kz to be used at the top of the region defined.

Ice Thickness Multiplier (Kiz) — Bottom

- Type: Floating Point Decimal no units

The ice thickness factor Kiz to be used at the bottom of the region defined.

Ice Thickness Multiplier (Kiz) — Top

- Type: Floating Point Decimal no units

The ice thickness factor Kiz to be used at the top of the region defined.

5.5.4 Exposure Factors (Qh Formula)

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

$$Q_h = A\left[v_{01}\left(a_1 e^{(-a_2 z)} + \frac{a_3 \ln(z/z_h)}{\ln(z/z_{01})}\right)\right]^B \left(\frac{z}{10}\right)^C$$

Bottom Elevation
- Type: Floating Point Decimal ft or m

Top Elevation
- Type: Floating Point Decimal ft or m

Site-Specific Wind Pressure Formula Constants — a1
- Type: Floating Point Decimal no units

Site-Specific Wind Pressure Formula Constants — a2
- Type: Floating Point Decimal no units

Site-Specific Wind Pressure Formula Constants — a3
- Type: Floating Point Decimal no units

Site-Specific Wind Pressure Formula Constants — zh
- Type: Floating Point Decimal no units

Site-Specific Wind Pressure Formula Constants — z01
- Type: Floating Point Decimal no units

Site-Specific Wind Pressure Formula Constants — v01
- Type: Floating Point Decimal no units

Site-Specific Wind Pressure Formula Constants — A
- Type: Floating Point Decimal no units

Default value: 0.12919 if no value provided

Site-Specific Wind Pressure Formula Constants — B
- Type: Floating Point Decimal no units

Default value: 2.0 if no value provided

Site-Specific Wind Pressure Formula Constants — C
- Type: Floating Point Decimal no units

Default value: 0.2 if no value provided

5.5.5 Initial Displacements

Used in: Guyed Lattice Towers

Initial Displacements become the first approximation of the guy level deflections and rotations. Each is entered with a list of three deflections and three rotations for each guy level.

! This table and calculation feature was very useful in the days of slow computers. It may be irrelevant now, but has been kept for possible future use.

Guy Elevation

- Type: Floating Point Decimal ft or m

The guy level.

Deflection — North

- Type: Floating Point Decimal ft or m

The initial deflection in the North direction.

Deflection — East

- Type: Floating Point Decimal ft or m

The initial deflection in the East direction.

Deflection — Down

- Type: Floating Point Decimal ft or m

The initial deflection in the Down direction.

Rotation — North

- Type: Floating Point Decimal degrees (°)

The initial rotation around the North direction.

Rotation — East

- Type: Floating Point Decimal degrees (°)

The initial rotation around the East direction.

Rotation — Twist

- Type: Floating Point Decimal degrees (°)

The initial rotation for Twisting.

5.5.6 Mast Restraints at Support

Used in: Guyed Lattice Towers

Mast Restraints are used to prevent the transfer to the guy model of deflections and rotations calculated in the mast model, and consist of six restraints for the base and at each guy level.

Support Elevation

- Type: Floating Point Decimal ft or m

The elevation of the support level.

! Use 0 for the base.

Deflection — North

- Type: Integer

0 — Do not restrain mast for deflections in the North direction at this support/guy level.

1 — Restrain mast for deflections in the North direction at this support/guy level.

Deflection — East

- Type: Integer

0 — Do not restrain mast for deflections in the East direction at this support/guy level.

1 — Restrain mast for deflections in the East direction at this support/guy level.

Deflection — Down

- Type: Integer

0 — Do not restrain mast for deflections in the Down direction at this support/guy level.

1 — Restrain mast for deflections in the Down direction at this support/guy level.

Rotation — North

- Type: Integer

0 — Do not restrain mast for rotations in the North direction at this support/guy level.

1 — Restrain mast for rotations in the North direction at this support/guy level.

Rotation — East

- Type: Integer

0 — Do not restrain mast for rotations in the East direction at this support/guy level.

1 — Restrain mast for rotations in the East direction at this support/guy level.

Rotation — Twist

- Type: Integer

0 — Do not restrain mast for Twisting at this support/guy level.

1 — Restrain mast for Twisting at this support/guy level.

5.5.7 Guy Displacement Restraints

Used in: Guyed Lattice Towers

Guy Restraints are used to prevent the use of certain guy point deflections and/or rotations in the evaluation of guy tensions.

! Guy stiffness in restrained directions will not be evaluated.

! Include one list of restraints for each guy level.

Guy Elevation

- Type: Floating Point Decimal ft or m

The guy level being described.

Deflection — North

- Type: Integer

0 — Do not restrain guys at this level for deflections in the North direction at this support/guy level.

1 — Restrain guys at this level for deflections in the North direction at this support/guy level.

Deflection — East

- Type: Integer

0 — Do not restrain guys at this level for deflections in the East direction at this support/guy level.

1 — Restrain guys at this level for deflections in the East direction at this support/guy level.

Deflection — Down

- Type: Integer

0 — Do not restrain guys at this level for deflections in the Down direction at this support/guy level.

1 — Restrain guys at this level for deflections in the Down direction at this support/guy level.

Rotation — North

- Type: Integer

0 — Do not restrain guys at this level for rotations in the North direction at this support/guy level.

1 — Restrain guys at this level for rotations in the North direction at this support/guy level.

Rotation — East

- Type: Integer

0 — Do not restrain guys at this level for rotations in the East direction at this support/guy level.

1 — Restrain guys at this level for rotations in the East direction at this support/guy level.

Rotation — Twist

- Type: Integer

0 — Do not restrain guys at this level for Twisting at this support/guy level.

1 — Restrain guys at this level for Twisting at this support/guy level.

5.5.8 Special Factors

Used in: Guyed Lattice Towers

These *Special Factors* determine the wind loading applied to each guy individually and must be specified for any particular guy with special considerations.

! This table is optional.

Elevation

- Type: Floating Point Decimal ft or m

The guy level of the guy in question.

Guy Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the guy in question.

Attachment at Mast Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the guy's attachment at the mast.

Radial Ice

- Type: Floating Point Decimal in or mm

The radial ice thickness.

Wind Gust Factor

- Type: Floating Point Decimal no units

The wind gust factor (G_h)

Guy Shape Factor

- Type: Floating Point Decimal no units

The guy drag factor.

Wind Height Factor

- Type: Floating Point Decimal no units

The wind height factor (K_z)

Temperature Change

- Type: Floating Point Decimal degrees Celsius (°C)

The temperature change.

! GUYMAST-G references temperature only in °C, not in °F.

5.5.9 Support Conditions

Used in: Self-Supporting Lattice Towers

Support Conditions are only specified when unusual conditions prevail at the ***base*** of the tower.

! This table is optional.

Under normal circumstances, the three or four legs of a lattice tower are assumed fixed against translation. The support conditions table may be used to indicate that some of the legs may translate in one or several directions, or that a number of legs may incorporate elastic springs, which may be actual springs or a representation of soil behaviour. It is also possible to indicate certain support movement or settlement to see the influence of such events. Some of these effects may be superimposed.

Support Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the support (leg) in question.

Conditions — North

- Type: 1 Letter

F — Free

R — Restrained

S — Spring

Free allows displacement in the North direction.

Restrained prevents displacement in the North direction.

Spring creates a spring restraint on the support in the North direction.

Conditions — East

- Type: 1 Letter

F — Free

R — Restrained

S — Spring

Free allows displacement in the East direction.

Restrained prevents displacement in the East direction.

Spring creates a spring restraint on the support in the East direction.

Conditions — Down

- Type: 1 Letter

F — Free

R — Restrained

S — Spring

Free allows displacement in the Down direction.

Restrained prevents displacement in the Down direction.

Spring creates a spring restraint on the support in the Down direction.

5.5.10 Spring Characteristics

Used in: Self-Supporting Lattice Towers

Spring Characteristics are for specification of spring constants and spring pre-load for individual supports.

! This table is optional. It is used when a support is given *Spring* type constraint conditions in the 5.5.9 Support Conditions table.

Support Azimuth

- Type: Floating Point Decimal degrees (°)

The azimuth of the support (leg) in question.

! Support azimuths must match appropriate *Spring* type constraints in the *Support Conditions* table.

Stiffness — North

- Type: Floating Point Decimal kip/ft or kN/m

The spring constant for the support in the North direction.

Stiffness — East

- Type: Floating Point Decimal kip/ft or kN/m

The spring constant for the support in the East direction.

Stiffness — Down

- Type: Floating Point Decimal kip/ft or kN/m

The spring constant for the support in the Down direction.

Pre-Load — North

- Type: Floating Point Decimal kip or kN

The pre-load to be applied at the support in the North direction.

! Negative values will apply as positive in the South direction.

Pre-Load — East

- Type: Floating Point Decimal kip or kN

The pre-load to be applied at the support in the East direction.

! Negative values will apply as positive in the West direction.

Pre-Load — Down

- Type: Floating Point Decimal kip or kN

The pre-load to be applied at the support in the Down direction.

! Negative values will apply as positive in the Up direction.

5.5.11 Member Temperature Change

Used in: Self-Supporting Lattice Towers

Member Temperature Change allows entry of a different temperature change specification for each member of the tower. Members are defined by type, elevation range, and azimuth of leg or face.

! It is not often that one wishes to check the temperature effect of only one member or part of a tower; however, this feature has been included for modeling freedom. Similarly to the 5.5.13 Member Fit table, this table exists to be able to model the tower more accurately to its actual construction. These two

tables are the same except the Temperature Increase value replaces the Length Increase value here.

! One entry is required for each temperature change for each member that is to be specified.

! This table is optional.

Member Type

- Type: 2 Letters

LE — Leg

DI — Diagonal

HO — Horizontal

BR — Bracing

The type of member in the region to which this temperature change will be applied.

Bottom Elevation

- Type: Floating Point Decimal ft or m

The lower elevation of the affected region.

Top Elevation

- Type: Floating Point Decimal ft or m

The upper elevation of the affected region.

Member Azimuth

- Type: Floating Point Decimal degrees (°)

The face or leg azimuth, depending on the member type being specified.

Temperature Increase

- Type: Floating Point Decimal degrees Celsius (°C)

The temperature change to be applied to the members and region described. This is a change in temperature from the assumed design or construction time temperature. A drop in temperature is represented by a negative value of temperature change. The degrees (°) are Celsius or Fahrenheit, consistent with the Thermal Coefficient specified in the 5.2.4 Material Properties table.

! GUYMAST-G references temperature only in °C, not in °F.

5.5.12 Support Movement

Used in: Self-Supporting Lattice Towers

Support Azimuth

- Type: Floating Point Decimal degrees (°)

Movement — North

- Type: Floating Point Decimal in or mm

Movement — East

- Type: Floating Point Decimal in or mm

Movement — Down

- Type: Floating Point Decimal in or mm

5.5.13 Member Fit

Used in: Self-Supporting Lattice Towers

With fabrication or installation error, the *Member Fit* table allows fitting of members that represent the conditions under which the tower was built.

! Similarly to the 5.5.11 Member Temperature Change table, this table exists to be able to model the tower more accurately to its actual construction. These two tables are the same except the Length Increase value replaces the Temperature Increase value here.

! One entry is required for each member with an adjusted length.

! This table is optional.

Member Type

- Type: 2 Letters

The type of member in the region to which this member length change will be applied.

Bottom Elevation

- Type: Floating Point Decimal ft or m

The lower elevation of the affected region.

Top Elevation

- Type: Floating Point Decimal ft or m

The upper elevation of the affected region.

Member Azimuth

- Type: Floating Point Decimal degrees (°)

The face or leg azimuth, depending on the member type being specified.

Length Increase

- Type: Floating Point Decimal in or mm

The difference in member length between what it was when built and what it should have been. If the member was too long, the value entered is positive; if too short, negative.

5.5.14 Suppress Printing — Loading Calculations

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

Suppress Printing for *Loading Calculations* is a set of flags that determines the tables to be reported by the loads calculator portion of GUYMAST-G.

! This table is optional.

! By default, all values except Load Summary Format — Panel Points and Load Components — Panels are reported.

! This table must be filled out for each loading condition in which the output required is to be other than the default.

Load Summary Format — Self-Supporting

- Type: Integer

0 — Do not report/print

1 — Report/print

Report loadings by panel.

Load Summary Format — Guyed

- Type: Integer

0 — Do not report/print

1 — Report/print

Report loadings by region.

Load Summary Format — Panel Points

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report concentrated panel loads.

Load Components — Panels

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report concentrated loads at panel boundaries.

Load Components — Ladders

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report distributed loads due to ladders.

Load Components — Transmission Lines

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report distributed loads due to transmission lines.

Load Components — Discrete Appurtenances

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report concentrated loads due to antennas and other extra loadings.

Load Components — Individual Elements

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report unit loads on individual elements.

5.5.15 Suppress Printing — Guyed / Self-Supporting / Monopole

Used in: Guyed Lattice, Self-Supporting Lattice, and Tubular Pole Towers

The *Suppress Printing* table for *Guyed*, *Self-Supporting*, and *Monopole* analysis determines which tables to be reported during the calculation of forces and deflections during the analysis portion of GUYMAST-G.

! This table is optional.

! By default, only the input (tower definition) data and the summary of maximum values will be reported. If other data is to be reported from the forces and deflections calculations, this *Suppress Printing* table must be included for each loading condition in which the output is to be other than the default.

For This Loading — Input Loads

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report loading input.

For This Loading — Displacement

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report mast displacements.

For This Loading — Member Forces

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report individual member forces.

For This Loading — Foundation Loads

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report foundation loads.

Maximums — All

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report maximums for all tables.

Maximums — Displacement

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report maximums for mast displacements.

Maximums — Member Forces

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report maximums for individual member forces.

Maximums — Foundation Loads

- Type: Integer

0 — Do not report/print

1 — Report/print

Report or do not report maximums for foundation loads.

6 Report Formats

7 Tower Drawing Tool

GUYMAST-G includes a powerful tower drawing tool, DRAWMAST.

DRAWMAST draws, under the control of the user, the tower profile with and without the various appurtenances, such as ladders, transmission lines, antennas, etc. It will also draw plan views at selected elevations.

These drawings can be used in bid packages, with sufficient engineering information to convey the basic design to a purchaser and his consultant without the need to go to a draftsman or CAD station. With this version, we have also introduced an export to AutoCAD function.

This feature is also very useful in checking whether the data used in the analysis of the tower is correct and complete. It will save the designer, analyst and employer a lot of time, trouble, and cost.

- The user can specify the display of a Plan View at any elevation. DRAWMAST provides a list of elevations that might be of interest (e.g., the elevation at which there is a special detail on the tower), but the user can specify any elevation for the Plan View.
- The user may select to have displayed, in the elevation and plan views, any combination of the following in addition to the mast: dishes, transmission lines, ladders and other mountings.
- Using the mouse, the user can select any part of the tower profile and appurtenances to be shown on the Plan View.
- A snapshot of the tower profile can stay on the screen for reference.
- The user can create a file containing special notes, additional data, etc., from within DRAWMAST.
- Properties of the components of discrete appurtenances can be viewed.
- The color of the mast, guy cables and various appurtenances can be separately customized.
- The file can be exported to AutoCAD.

7.1 Toolbar

Figure 76 — Tower Drawing Tool Toolbar

You can add or remove buttons on the toolbar using the *Utilities>Customize Toolbar* menu option.

Button	Function
	open a file
	print a file
	enlarge the image on the screen
	reduce the image on the screen
	enlarge or reduce the image according to the scale
100%	reset the image to the default size
	keep profile in top left corner
	list properties of the component
ft	change to imperial units
m	change to metric units
Dmt	create a .dmt file
Back	go to the previous display page
Next	go to the next display page
	allow selection of an area of the image to zoom
	show information about DRAWMAST

7.2 Menus

DRAWMAST offers the following menus:

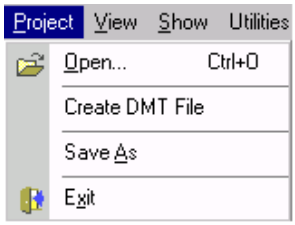


Figure 77 — Tower Drawing Tool — Project menu

Figure 78 — Tower Drawing Tool — View menu

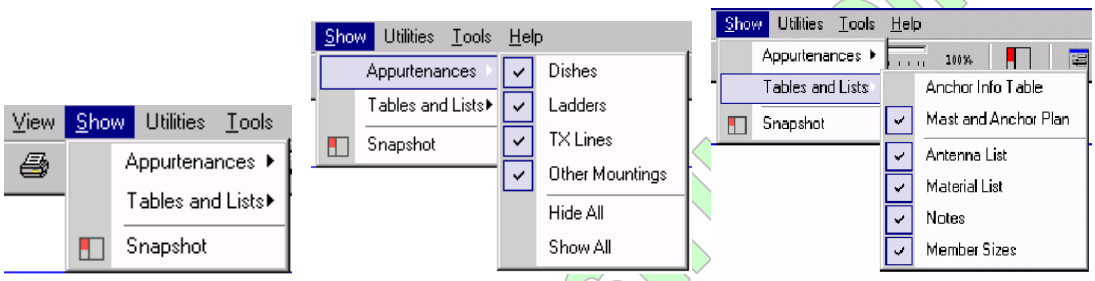


Figure 79 — Tower Drawing Tool — Show menu

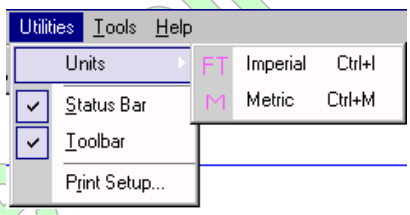


Figure 80 — Tower Drawing Tool — Utilities menu

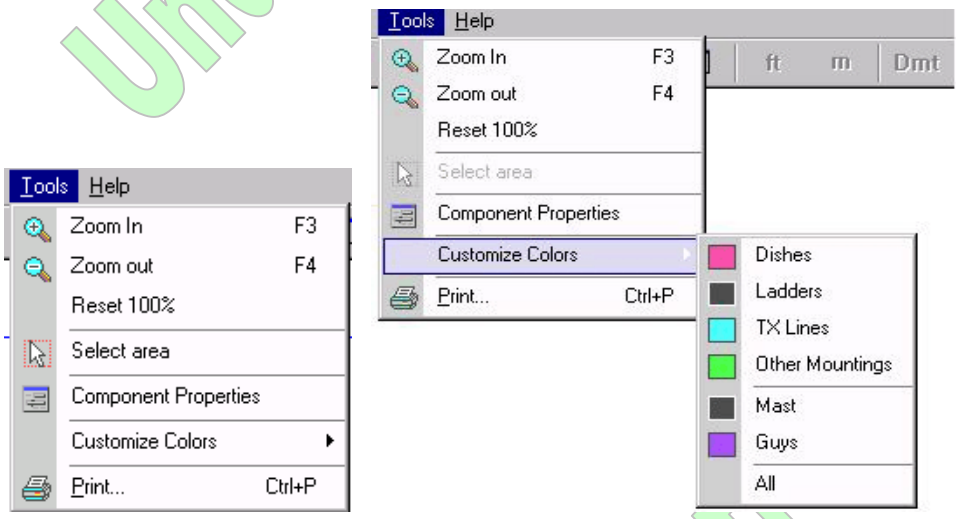


Figure 81 — Tower Drawing Tool — Tools menu

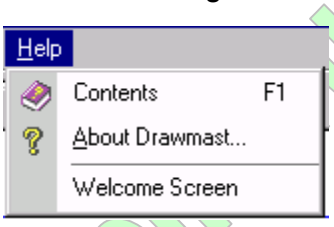


Figure 82 — Tower Drawing Tool — Help menu

DRAWMAST uses tower data created when the loading and analysis calculations are done. Information not available to GUYMAST-G, such as the client name, tower location, wind speed used, antenna, bolt and strength data, can be entered by the user and stored in a text file with the extension .dmt.

The .lod, .mst, .gym and .dmt files for a project must all be stored in the same directory. If these files cannot be found, the following warning messages will be displayed:

Figure 83 — Tower Drawing Tool — Missing File Warnings

If the above messages appear, copy the required files into the directory containing your .lod file.

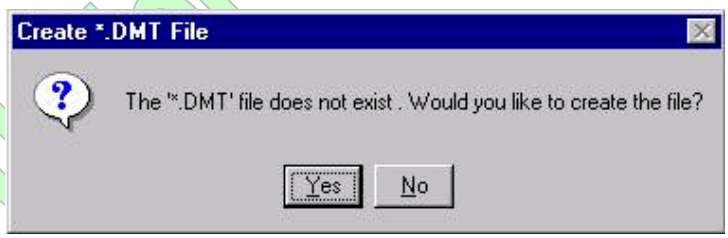


Figure 84 — Tower Drawing Tool — Create *.DMT File prompt

You can add this file now by clicking Yes, or at any other time by clicking Dmt on the Toolbar, selecting *Project>Create DMT file*, or using any text editor. Please see Page 10 for more information on creating a .dmt file.

If you decide not to create the file, the title block information, antenna, bolt and strength data will not appear on the profile view.

7.3 Tower Profile View

When you open a project, the tower profile will be displayed.

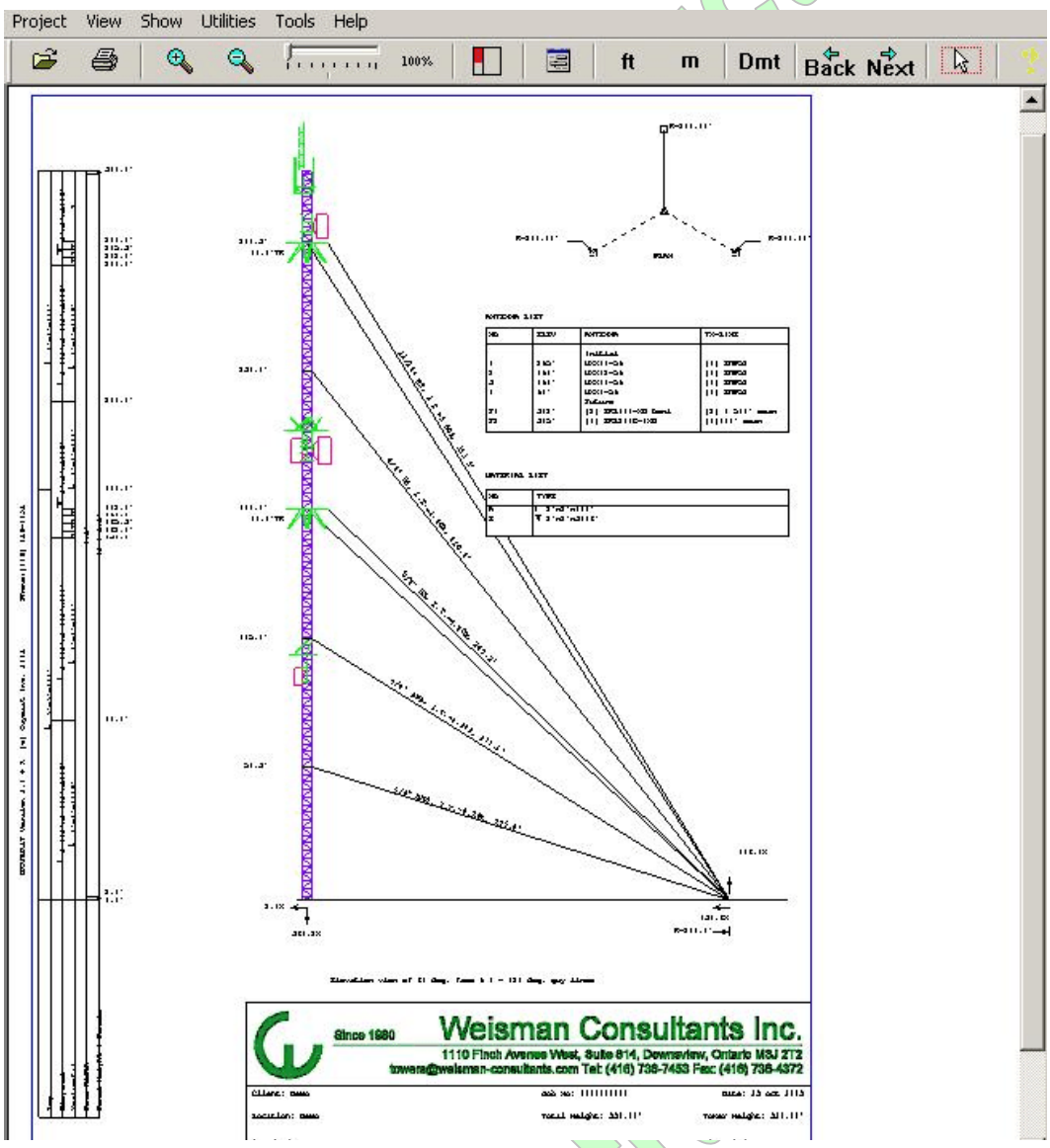


Figure 85 — Tower Drawing Tool — Tower Profile View

By default, DRAWMAST will show every appurtenance specified in the input data on the tower profile (antennas, ladders, transmission lines, etc.).

The plan of the mast will be shown at the upper right corner of the screen. If the tower is guyed, the guy plan will be shown. You can switch between the tabular and the graphical views of the guy anchor plans by selecting *Show>Tables and Lists>Anchor Info Table* and *Show>Tables and Lists> Mast and Anchor Plan*.

Along the left side of the tower profile is a table which contains information about the properties of the legs, diagonals, horizontals, etc. If there is not enough room in

that table, an additional "Material List" table will be displayed. This table can be turned on or off using *Show>Tables and Lists> Material List*.

If you added any notes or antenna information in a .dmt file, tables containing this information will be displayed by default. Please check or uncheck the corresponding item under *Show>Tables and Lists* to display or hide this information.

You can deselect and select again the appurtenances you wish to see. This can be done through the options available under the *Show>Appurtenances* menu. For further convenience, the same menu is available by right clicking your mouse.

Figure 86 — Tower Drawing Tool — Tower Profile View Right-Click context menu

You can also select different colors for each type of appurtenance using *Tools>Customize Colors*.

A snapshot of the tower can be displayed at the top left corner of the screen by selecting *Show>Snapshot* or clicking on the snapshot icon on the Toolbar.

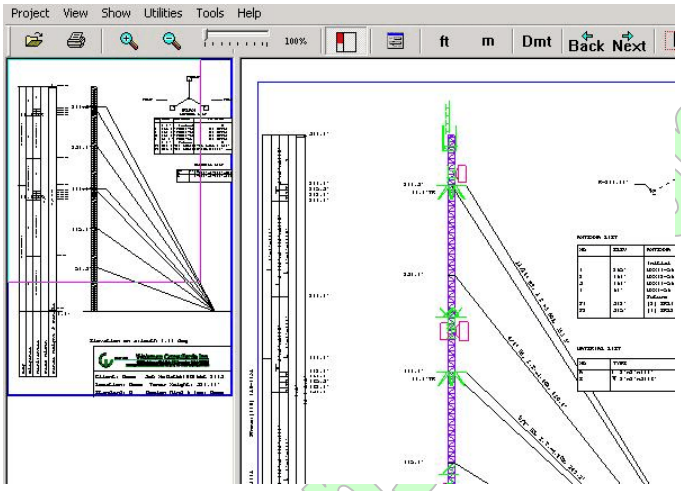


Figure 87 — Tower Drawing Tool — Tower Profile View Snapshot Preview

Please note that the scale of the profile view depends on several factors. The vertical scale depends on the height of the tower, the height of any appurtenances which extend beyond the top of the tower, and the available space for the drawing. The horizontal elements may not be drawn to the same scale as the vertical because the face width may then appear too narrow to show any details in the panels (bracings, ladder, etc.).

7.4 Tower Plan View

In order to see the Plan Views of appurtenances, select *View>Plan View*. The Plan views of the tower are drawn to scale.

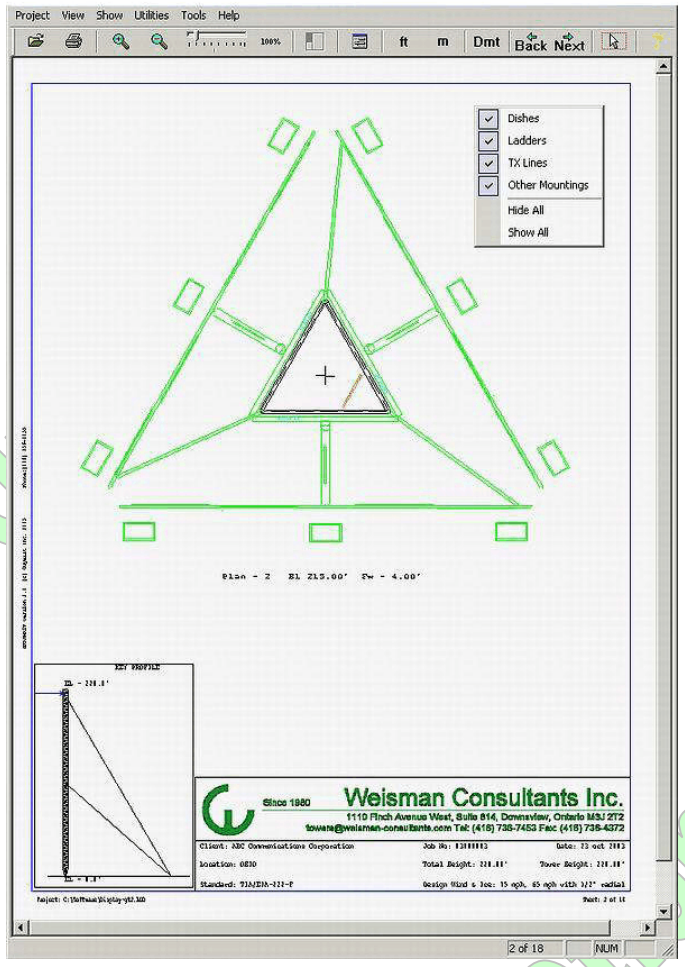


Figure 88 — Tower Drawing Tool — Tower Plan View

DRAWMAST selects the elevations to show on the Plan View according to the following rules:

Starting and ending elevations of transmission lines and ladders. Where there is a change in slope, this elevation will be shown too.

Elevations where dishes and other appurtenances are attached. Please note that if there is not enough space to draw the entire dish antenna, it will be represented by an X marking its centre and an arrow showing its azimuth. If there is not enough room for the X, the antenna will be represented by the arrow showing its azimuth.

To view the plans for the elevations DRAWMAST has selected, click on *View>Plan View>All* and cycle through the plans using Next and Back.

You can also specify the plan view you wish to see using *View>PlanView>Customize*.

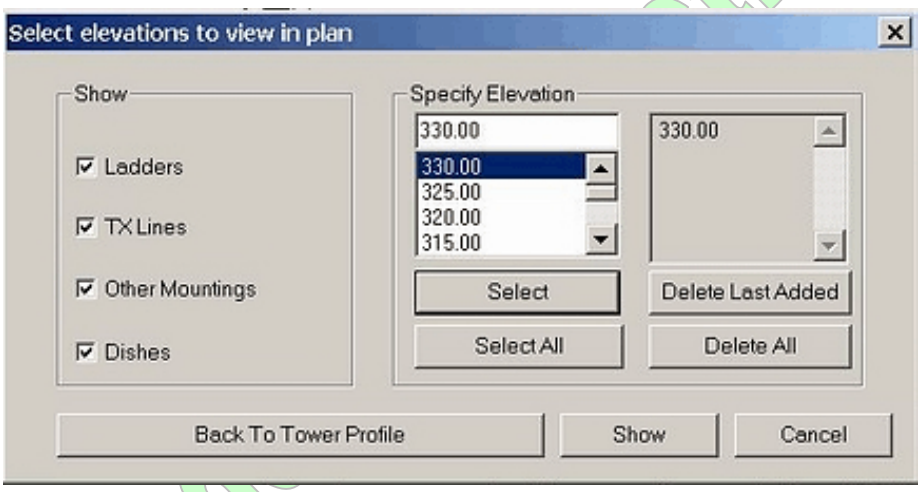


Figure 89 — Tower Drawing Tool — Tower Plan View Elevation and Component View Customizer

Select or unselect the elements you wish to see on the plan view by clicking on the appropriate box at the left. Then select a particular elevation by highlighting that elevation in the window and pressing Select, or typing the required elevation into the window on the right. You can delete any elevation you have selected before pressing Show.

Alternatively, while in the Profile View, you can select any part of the tower profile and/or appurtenances you wish to see in Plan View by doing the following:

Click on the "select area" icon on the Toolbar;

Highlight the area you wish to view by dragging your mouse;

Right click to get the Customize dialog box, make any desired adjustments, and press Show.

Cycle through the plan views selected using Next and Back.

To get back to the Profile View, select *View>Profile View*.

7.5 Component Properties

In order to see details of the properties of any of the appurtenances, follow these steps:

If the "area select" is not already on, click on the icon

Drag your mouse to highlight the element (a red rectangle will mark the area you selected)

Select *Tools>Component Property*, or click on the properties icon

The program will display the relevant portion of the original data file, showing the elevation of the element, the material type, etc. Clicking on an entry in the Material Type column will cause more information about the material type to be displayed, as shown below:

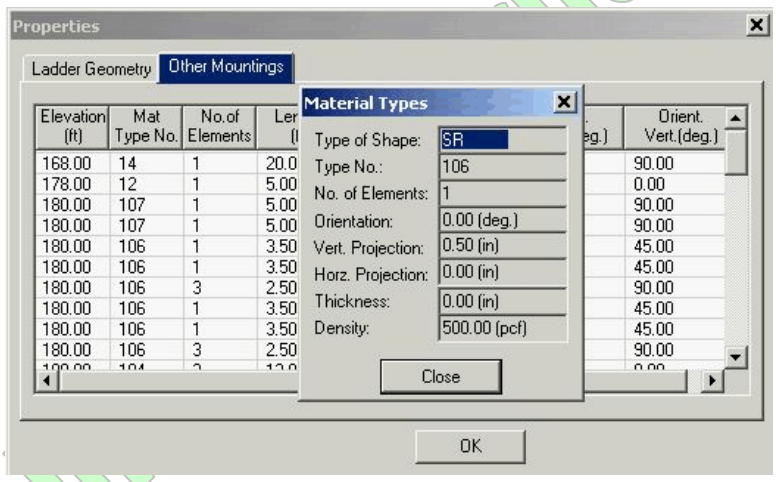


Figure 90 — Tower Drawing Tool — Other Mountings reviewer

If you select a mast element (leg, horizontal, diagonal) or a guy cable, the program will tell you it has NO COMPONENTS TO SHOW.

7.6 The .dmt File Graphical User Interface

We strongly recommend creating a file which contains the information necessary to identify the tower, display the Standard, wind and ice loading used, and give important information about antennas, material strengths, etc. Although this file can be created by any text editor, DRAWMAST provides an interface for creating and modifying this file, which is available by clicking on the Dmt button on the Toolbar. Since DRAWMAST does not use this information in calculations, the values displayed will not change if you change from imperial to metric units.

The .dmt file consists of five tables: Project Information, Material Strengths, Bolts, Notes, and Antennas.

7.6.1 Project Information

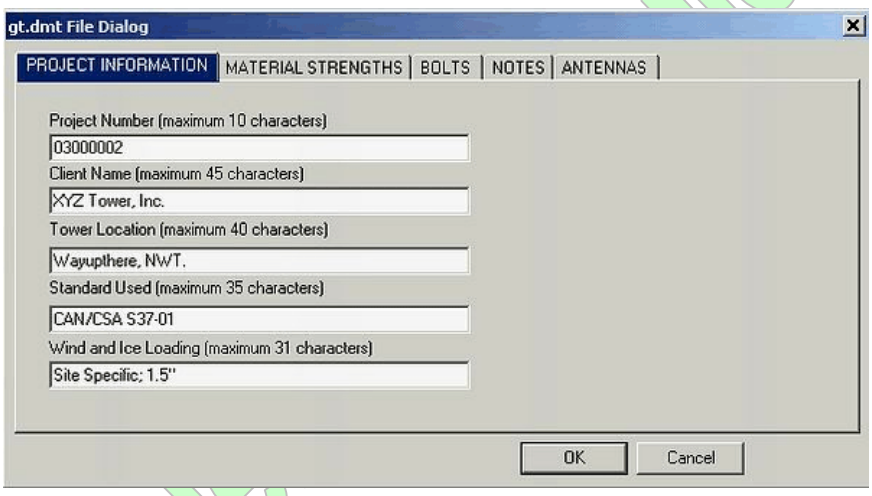


Figure 91 — Tower Drawing Tool — *.dmt file Reviewer Project Information tab

The length of each field in the Project Information table is limited to ensure that the data will fit in the area available on the profile drawing. If any of the fields are left blank, the following warning will appear:

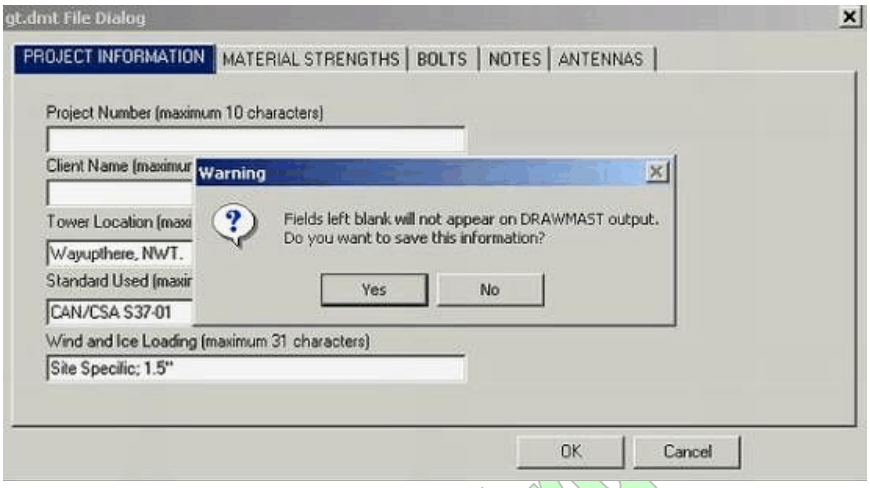


Figure 92 — Tower Drawing Tool — *.dmt file Reviewer warning

If you click Yes, the data file will be saved and you will return to the tower profile. If you click No, the warning box will disappear and you can fill in the missing data if you choose.

If you wish to return to the Profile View without saving the information, click on Cancel.

To enter information on Material Strengths, Bolts, Notes or Antennas, click on the corresponding tab at the top of the box.

7.6.2 Material Strengths

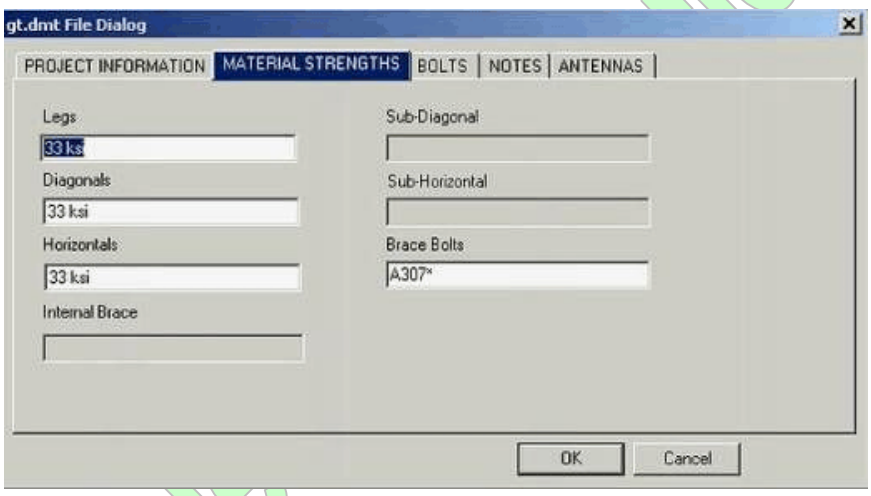


Figure 93 — Tower Drawing Tool — *.dmt file Reviewer Material Strengths tab

This table allows the user to specify the strengths of legs, diagonals, horizontals, internal bracing, sub-diagonals, sub-horizontals and brace bolts. If any of these elements do not appear in the original MASTLOD file, the corresponding field in the table will be greyed out. The information provided in this table will be displayed in a Materials Table on the tower profile.

7.6.3 Bolts

Information entered in the Bolts table will appear in the Materials Table on the tower profile. Please note that if the size of the bolt is shown with the unit (eg. d", or 12 mm), the bolt size will be shown in whatever units the user selects.

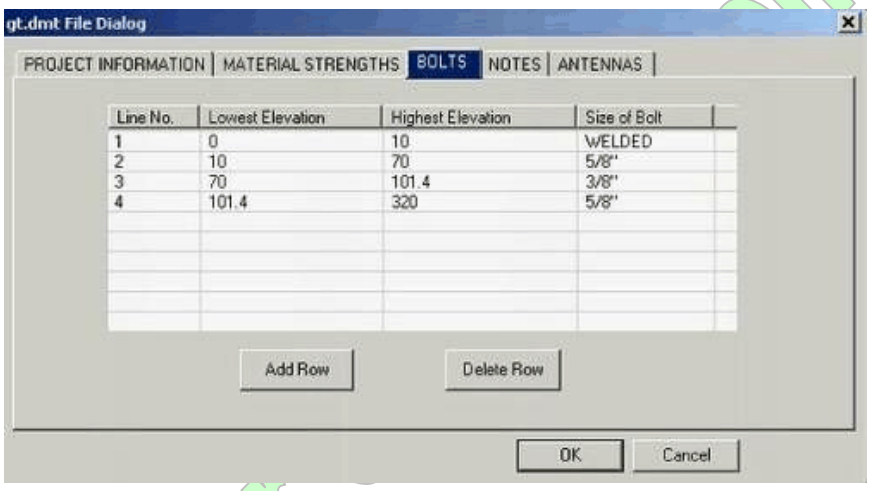


Figure 94 — Tower Drawing Tool — *.dmt file Reviewer Bolts tab

7.6.4 Notes

Any comments the user wishes to have appear on the tower profile can be entered through the Notes table. You can add up to 10 lines, each up to 45 characters long. The Notes table can be hidden using the *Show>Tables and Lists>Notes* menu.

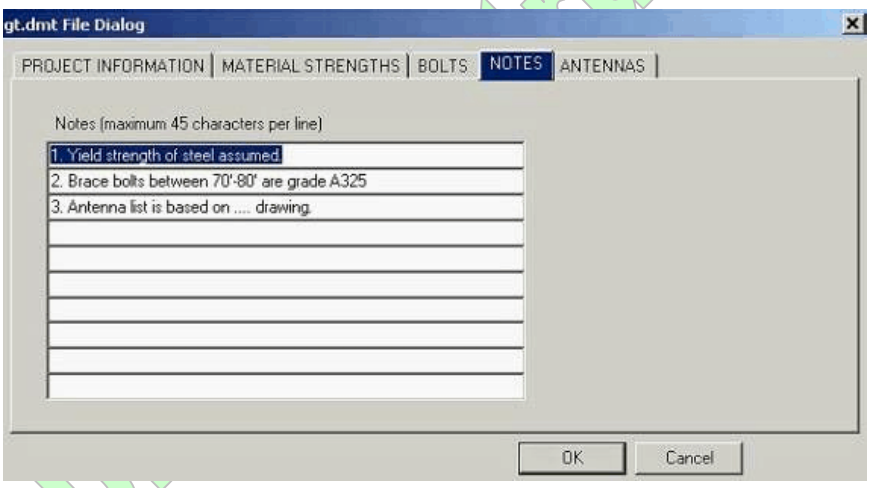


Figure 95 — Tower Drawing Tool — *.dmt file Reviewer Notes tab

7.6.5 Antennas

If the user enters data into the table of antennas and transmission lines, this information will appear in a separate table on the tower profile. This table can be hidden using the *Show>Tables and Lists> Antenna List* menu.

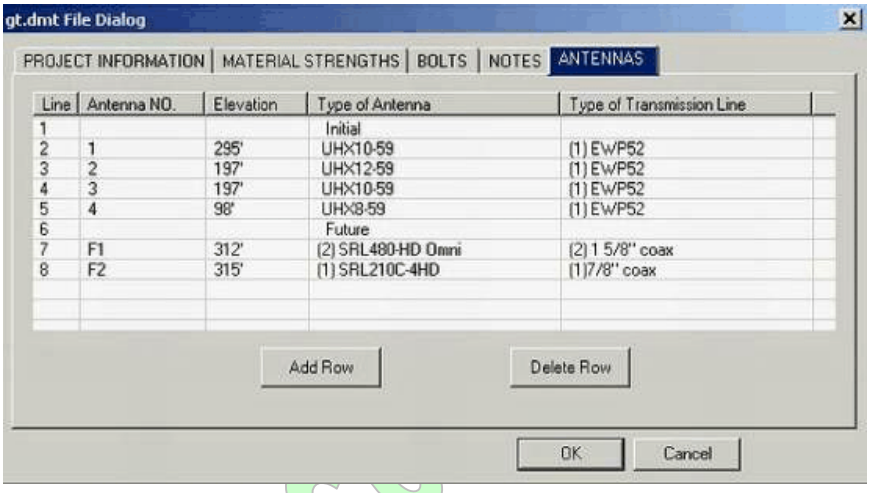


Figure 96 — Tower Drawing Tool — *.dmt file Reviewer Antennas tab

7.6.6 To Save the .dmt File

To save the file, click on OK at the bottom of the table, and on Yes in the *Save File* dialog box that pops up.

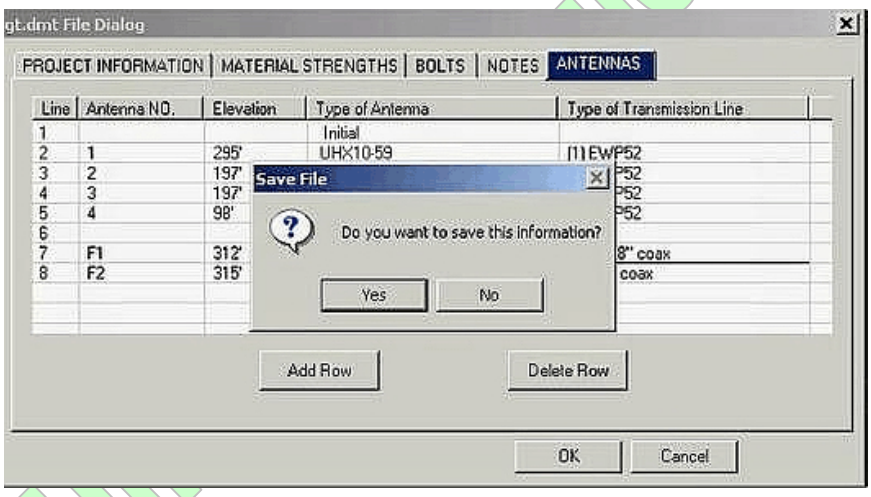


Figure 97 — Tower Drawing Tool — *.dmt file Reviewer Save Confirmation

If you select Yes, the program will save the file and take you back to the tower profile. If you select No, the dialog box will disappear, but you will still be in the Dmt interface. To exit the interface without saving the information, click Cancel.

7.7 How to Select Colors

You can select a different color for the tower mast, the guy cables, and each category of appurtenance using *Tools>Customize Colors*. The colors you select will become the preferred setting and will be used each time you run DRAWMAST until you change them. If you have a color printer, these elements will be printed in your selected colors.

7.8 How to Switch Units

By default, DRAWMAST shows all values in the imperial system of units. However, you can easily switch between units by selecting *Utilities>Units>Metric* or *Imperial*, pressing Ctrl+M or Ctrl+I, or clicking on ft or m on the Toolbar.

7.9 How to Zoom

Zoom functions are available under the *Tools* menu and on the Toolbar. For additional convenience, the Toolbar has a slider bar which allows the user to set the amount to zoom. You can also press F3 to zoom in and F4 to zoom out.

To select a specific area to zoom, press on the Toolbar, left click, hold and drag the mouse to highlight the area, and then zoom in or out.

Press 

to display the image in its original size.

Set the zoom to minimum to see the whole image on the screen.

7.10 How to Print

You can print any displayed profile at any time by selecting the *Tools>Print* menu option or by clicking on the printer icon on the Toolbar.

In order to set up the printer, you can either press the Setup button in the Print dialog box or select the *Utilities>Print Setup* menu option.

7.11 How to Return to the Main Program

When you have finished viewing or printing the tower, select *Project>Exit* to return to the main program.

8 Results Drawing Tool

DRAWFORCE produces graphical representations of the calculation results, including loads applied to the mast, deflected shape of the mast, forces in the mast and the mast components, and loads onto foundations.

The following information can be displayed for each loading condition selected. Maximum values can also be displayed.

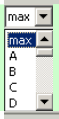
- Maximum compression and tension forces in legs, diagonals, horizontals and internal bracing in each panel (with shaded areas showing overstress if the user supplies capacities)
- Maximum shear forces in faces
- Axial forces and torsional moments in the mast
- Moments and shears in the mast
- Deflections, tilt and twist of the mast
- Concentrated loads and moments
- Distributed loads and moments
- Antenna rotations
- Pattern loads
- Tensions in guy cables, safety factors in guys, and loads on anchors
- Total loads onto foundations and loads on individual footings

8.1 Toolbar

Figure 98 — Results Drawing Tool — Toolbar

You can add or remove buttons on the toolbar using the *Utilities>Customize Toolbar* menu option.

Button	Function
	open a file
	print a file
	enlarge the image on the screen
	reduce the image on the screen
	enlarge or reduce the image according to the scale
100%	reset the image to the default size

Button	Function
	allow selection of an area of the image for zooming
ft	change to imperial units
m	change to metric units
Prev. Load	go to previous loading condition
Next Load	go to next loading condition
	select the loading condition
Prev. Page	go to the previous page
Next Page	go to the next page
	select a page within the loading condition
CAP	create or edit file of capacities or resistances
	show the *About* message

8.2 Menus

Although you can select most items to display using the toolbar at the top of the screen, from time to time you may need to select your preferences using the menus instead. The items available from the Utilities and Tools menus are shown below

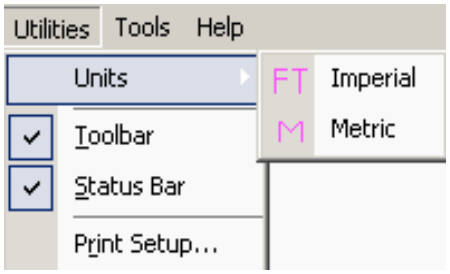


Figure 99 — Results Drawing Tool — Utilities Menu

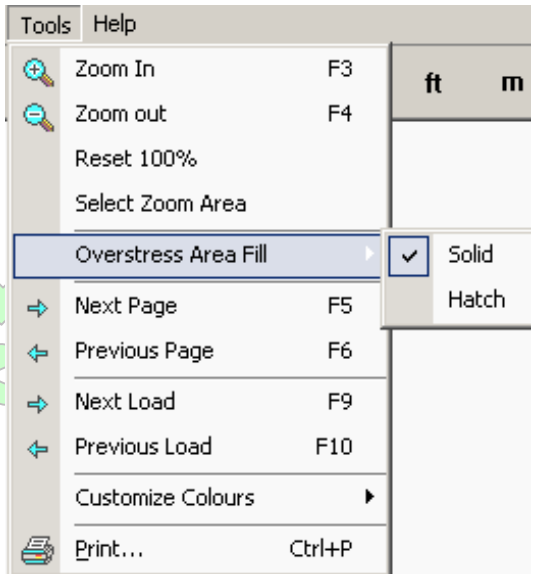


Figure 100 — Results Drawing Tool — Tools Menu

The items available on the View menu will be slightly different for guyed towers and self supporting towers:

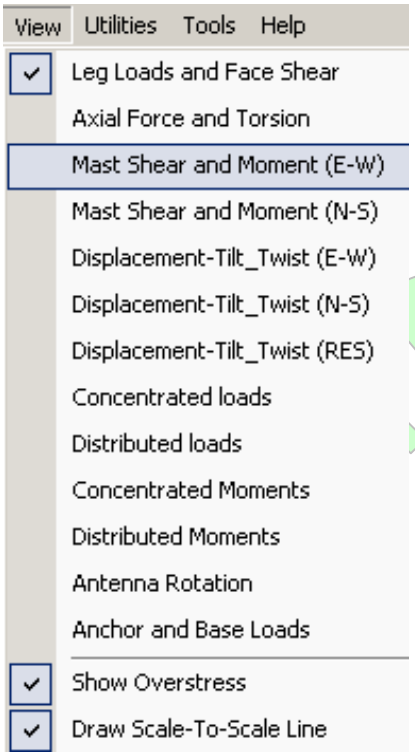


Figure 101 — Results Drawing Tool — View Menu for Guyed Lattice Towers

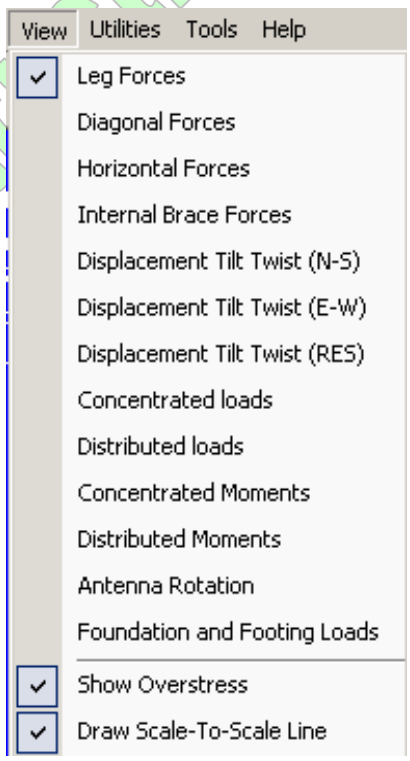


Figure 102 — Results Drawing Tool — View Menu for Self-Supporting Lattice Towers

Since DRAWFORCE allows the capacities or resistances of the legs and bracing members to be drawn on the graphs in addition to the forces, the program will look for a file containing the member capacities or resistances.

There are several ways to provide this information:

- through the table called "Factored Member Resistances";
- through the table called "Factored Leg and Face Shear Resistance"; and/or
- through a file created using the CAP interface provided in DRAWFORCE.

If no capacities file is found, and no factored resistance table was provided, the following dialog box will appear:

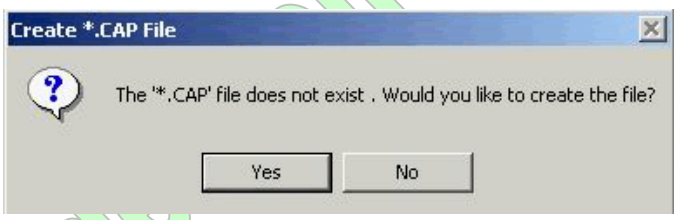


Figure 103 — Results Drawing Tool — missing .cap file query

If you click "No", no capacity information will appear on the graphs.

If DRAWFORCE finds a .cap file which was not created through the interface, the following screen will be displayed:

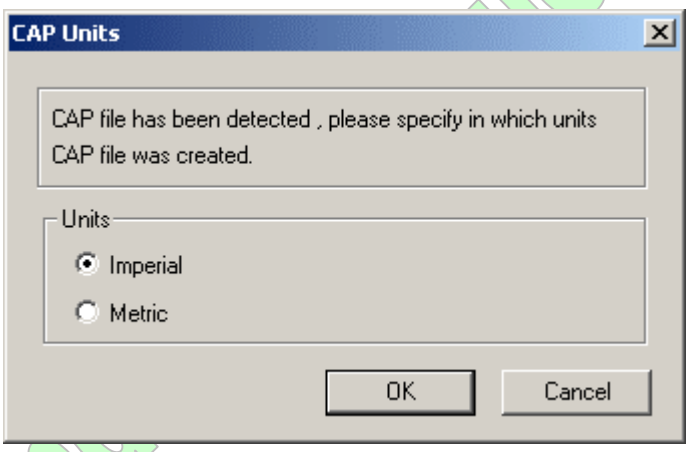


Figure 104 — Results Drawing Tool — .cap file detected

Once you press OK, the first screen of plotted calculated values will be displayed.

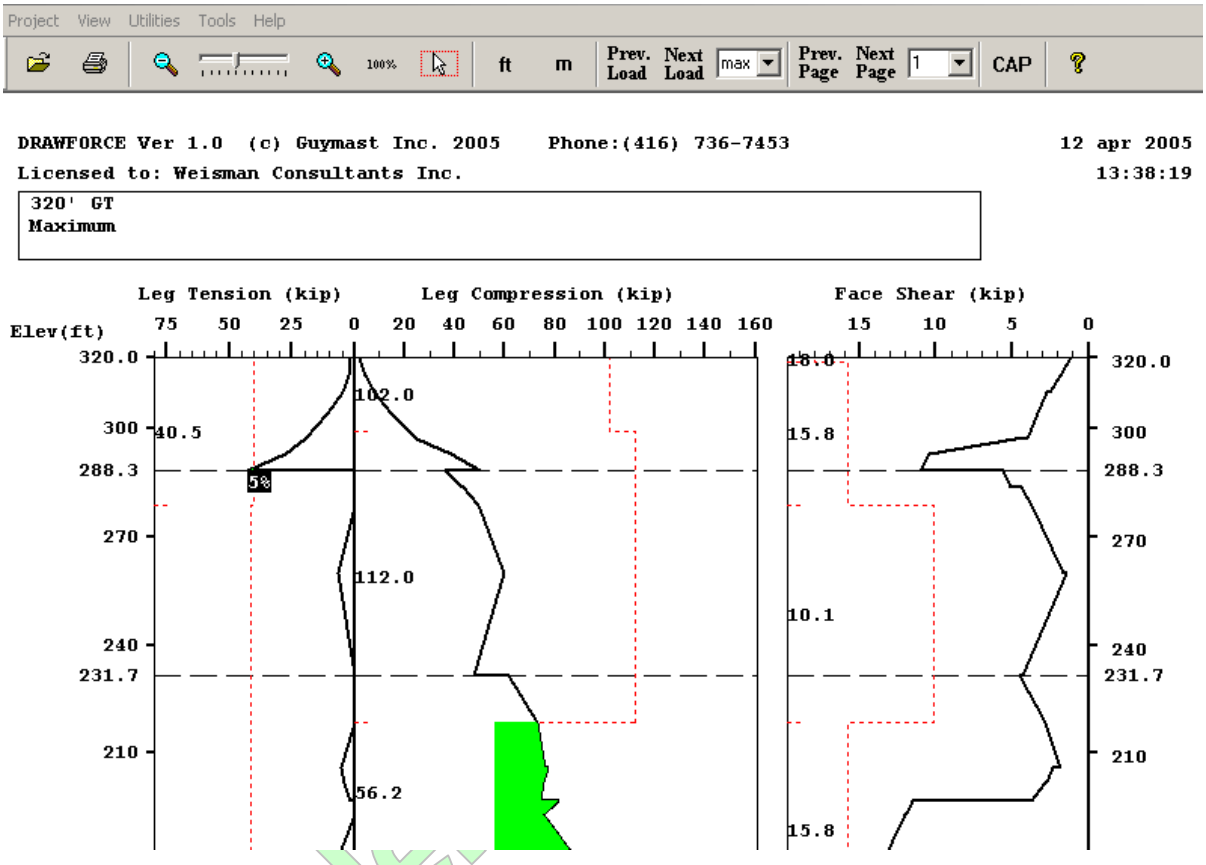


Figure 105 — Results Drawing Tool — DRAWFORCE with capacities plotted

The red dotted line represents the capacity or resistance of the element, the irregular black line represents the calculated force at various elevations, and the solid green area represents the region in which the calculated force exceeds the resistance (overstress).

8.3 How to Add/Modify the Capacity Information

DRAWFORCE provides a convenient interface to create or modify a capacity file. To access the interface, click on CAP or select *Project>Create .CAP file*. Information for the file may be entered and displayed in imperial or metric units. To change units, simply click on ft or m before opening the file.

8.3.1 For Guyed Towers

Once you have selected *Project>Create .CAP file* or clicked on the CAP button on the Toolbar, the following box will appear:

Figure 106 — Results Drawing Tool — Guyed tower capacities

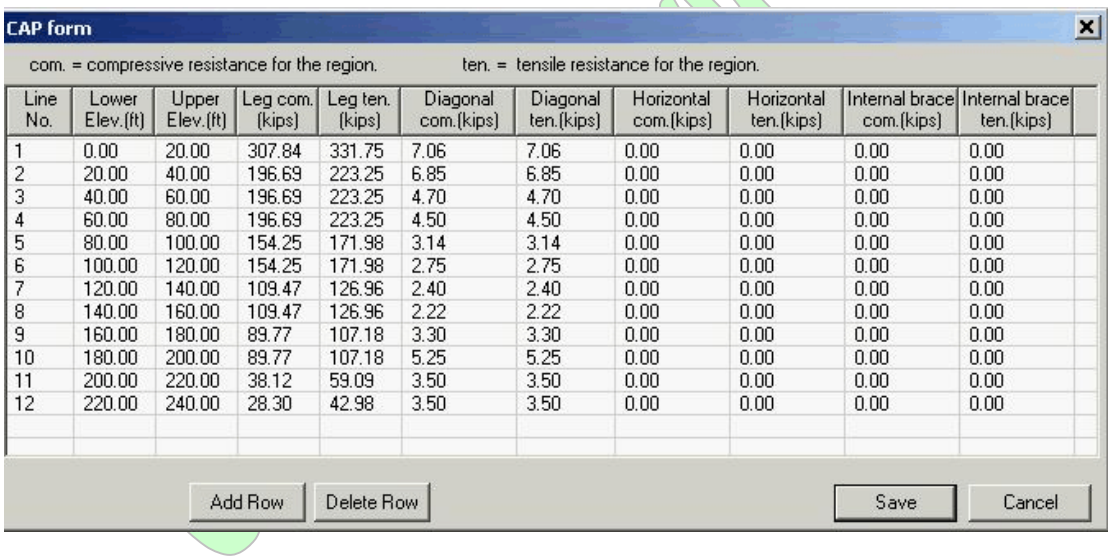
Type in new information, change existing information, add or delete rows. Please note that rows get added at the end of the existing information.

The values specified in the capacity file will override those provided in the Factored Leg and Face Shear Resistance table in the input file.

For backward compatibility, previously created .cap files can be modified through the CAP interface.

8.3.2 For Self-Supporting Towers

Once you have selected *Project>Create .CAP file* or clicked on the CAP button on the Toolbar, the following box will appear:



Line No.	Lower Elev.(ft)	Upper Elev.(ft)	Leg com. (kips)	Leg ten. (kips)	Diagonal com.(kips)	Diagonal ten.(kips)	Horizontal com.(kips)	Horizontal ten.(kips)	Internal brace com.(kips)	Internal brace ten.(kips)
1	0.00	20.00	307.84	331.75	7.06	7.06	0.00	0.00	0.00	0.00
2	20.00	40.00	196.69	223.25	6.85	6.85	0.00	0.00	0.00	0.00
3	40.00	60.00	196.69	223.25	4.70	4.70	0.00	0.00	0.00	0.00
4	60.00	80.00	196.69	223.25	4.50	4.50	0.00	0.00	0.00	0.00
5	80.00	100.00	154.25	171.98	3.14	3.14	0.00	0.00	0.00	0.00
6	100.00	120.00	154.25	171.98	2.75	2.75	0.00	0.00	0.00	0.00
7	120.00	140.00	109.47	126.96	2.40	2.40	0.00	0.00	0.00	0.00
8	140.00	160.00	109.47	126.96	2.22	2.22	0.00	0.00	0.00	0.00
9	160.00	180.00	89.77	107.18	3.30	3.30	0.00	0.00	0.00	0.00
10	180.00	200.00	89.77	107.18	5.25	5.25	0.00	0.00	0.00	0.00
11	200.00	220.00	38.12	59.09	3.50	3.50	0.00	0.00	0.00	0.00
12	220.00	240.00	28.30	42.98	3.50	3.50	0.00	0.00	0.00	0.00

Figure 107 — Results Drawing Tool — Self-Supporting tower capacities

Type in new information, change existing information, add or delete rows. Please note that rows get added at the end of the existing information.

The values specified in the capacity file will override those provided in the Factored Member Resistance table in the input file.

For backward compatibility, previously created .cap files can be modified through the CAP interface.

8.4 How to Select a Specific Load Case

By default, DRAWFORCE will show the maximum forces calculated.

To see the results for other loading conditions, click on Next Load and Prev. Load on the Toolbar, or select the specific loading case from the text box.

To cycle through the various pages of output for each loading condition, click on Next Page and Prev.Page on the Toolbar, or select the page number from the text box.

8.5 How to View Values at a Specific Elevation

If you click on any point on the graph, the elevation and the calculated force at that elevation will be displayed.

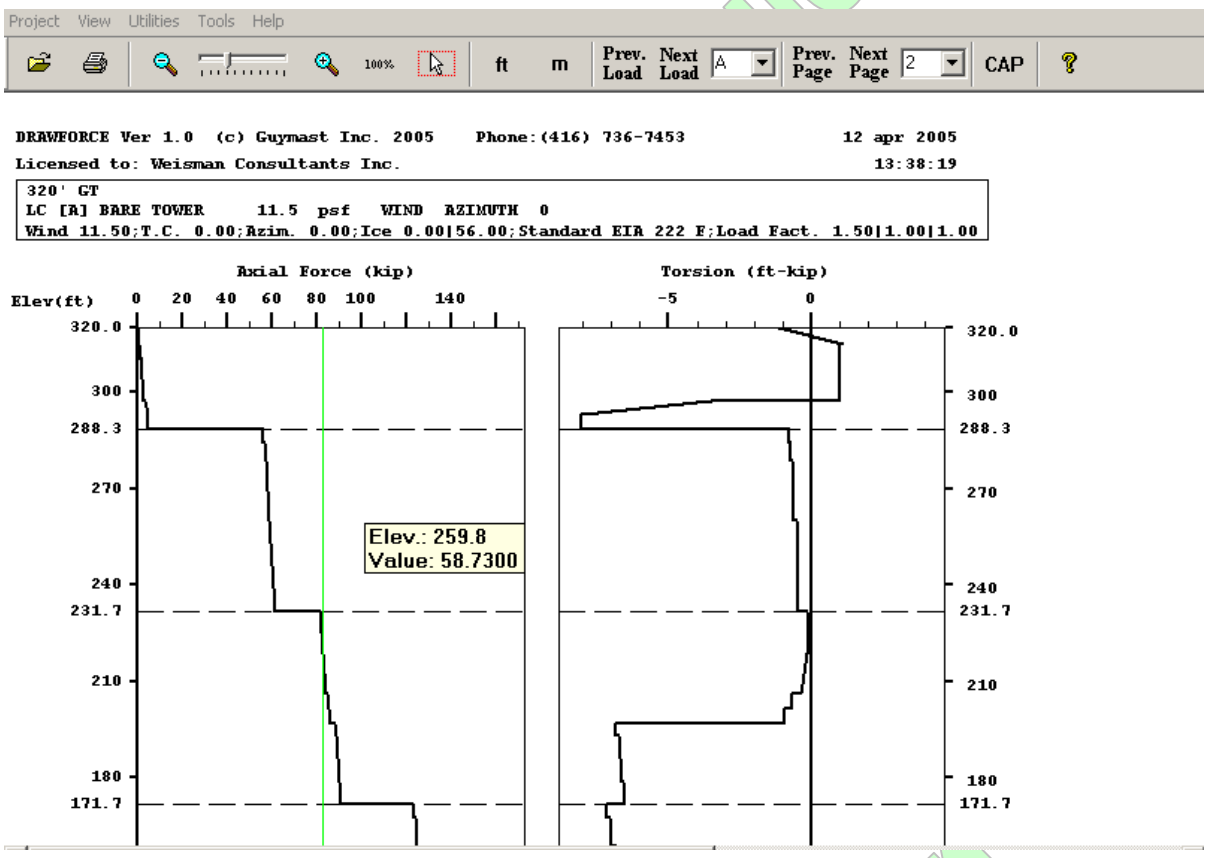


Figure 108 — Results Drawing Tool — point values displayed

This feature will not work if the area selection button is turned on. Please click on the button to turn it off before trying to obtain values at specific elevations.

When you click on a particular elevation, the program will draw a vertical line joining the upper and lower scales of the graph at the value on the plot at that elevation. This line can be hidden by un-checking the *Draw Scale-to-Scale Line* menu option.

8.6 Overstress Area

By default, DRAWFORCE will emphasize the areas where the calculated forces exceed the capacities (overstress) by shading these areas.

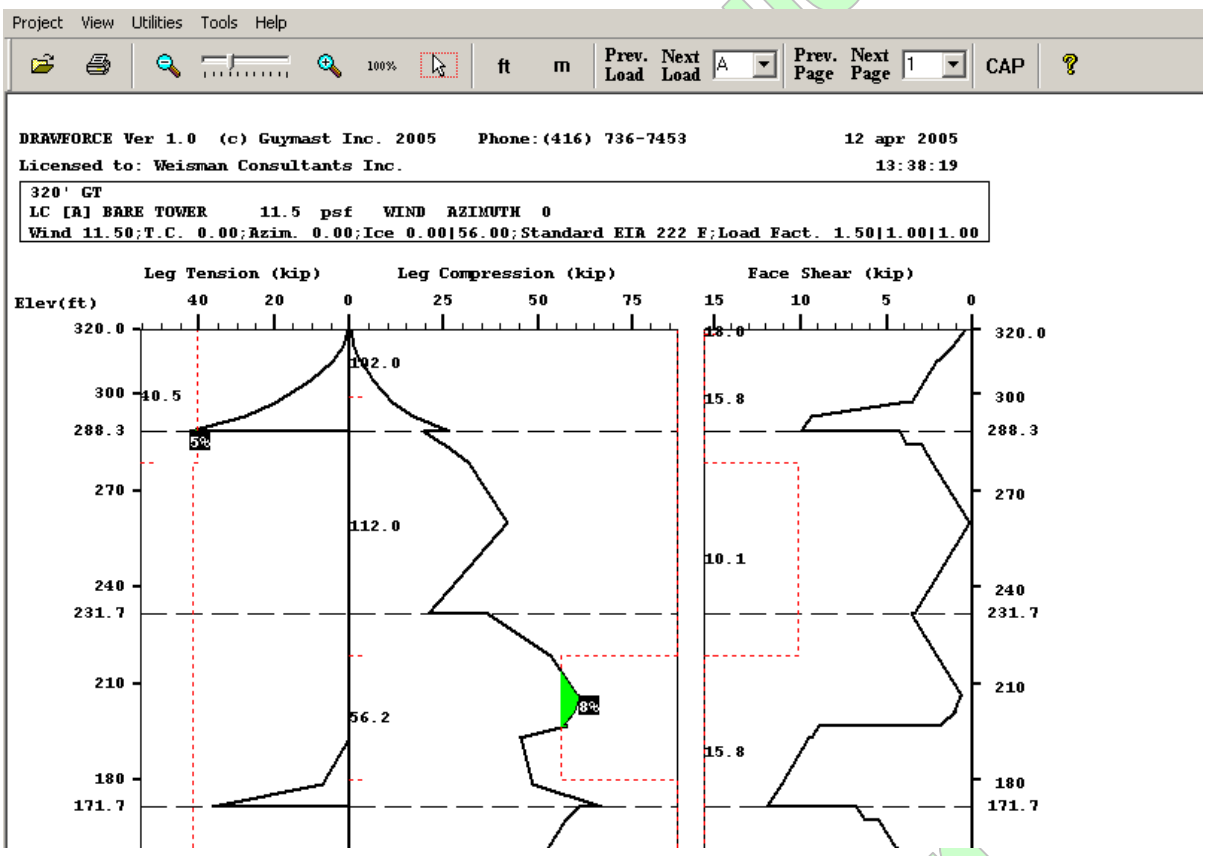


Figure 109 — Results Drawing Tool — capacities exceeded shading

The user can choose to highlight the overstressed area using a solid color (*Tools>Overstress Area Fill>Solid*) or hatch marks (*Tools>Overstress Area Fill>Hatch*), or turn off this feature in *View>Show Overstress*.

The calculated overstress in that region is shown as a percentage.

! The highlighting of the overstressed areas will only show when the fill color is different from the background color.

8.7 Concentrated Loads and Moments

DRAWFORCE represents the concentrated horizontal loads and the vertical, downward and torsional moments due to antennas and other mountings.

8.8 Distributed Loads and Moments

DRAWFORCE represents the distributed loads and moments due to the mast, ladders, transmission lines, antennas and other mountings. The loads and moments can be shown either in a square pie chart, or in an overlapping chart.

8.9 Antenna Rotations

Antenna rotations for each antenna, relative to its own principal axes, are shown under the headings "pitch", "yaw" and "roll".

8.10 How to Switch Units

By default, DRAWFORCE shows all values in the Imperial system of units. However, you can easily switch between units by selecting *Utilities>Units>Metric* or *Imperial*, pressing Ctrl+M or Ctrl+I, or clicking on ft or m on the Toolbar.

8.11 Setting Colors

The user can set preferred colors for the elements listed below using *Tools>Customize Colors*, or right clicking the mouse. It will be easier to distinguish one element from another at a glance if obviously different colors are chosen.

- Background
- Graph (graph, scales, license information, page number, etc.)
- Capacity line
- Overloaded Area and Scale to Scale line

Your last selected colors are stored as default values and will be used every time you run DRAWFORCE until you select other colors.

8.12 How to Zoom

Zoom functions are available under the *Tools* menu and on the Toolbar. For additional convenience, we have introduced a slider bar  which allows the user to set the degree to zoom. If you prefer to zoom using the keyboard, press F3 to zoom in and F4 to zoom out.

To select a specific area to zoom, press  on the Toolbar, left click, hold and drag the mouse to highlight the area, and then zoom in or out.

Press  to display the image in its default size.

To see the entire image on the screen, set the zoom to minimum.

8.13 How to Print a Plot

You can print any displayed image at any time by selecting the *Tools>Print* menu option or by clicking on the printer icon on the Toolbar. The following page will be displayed:

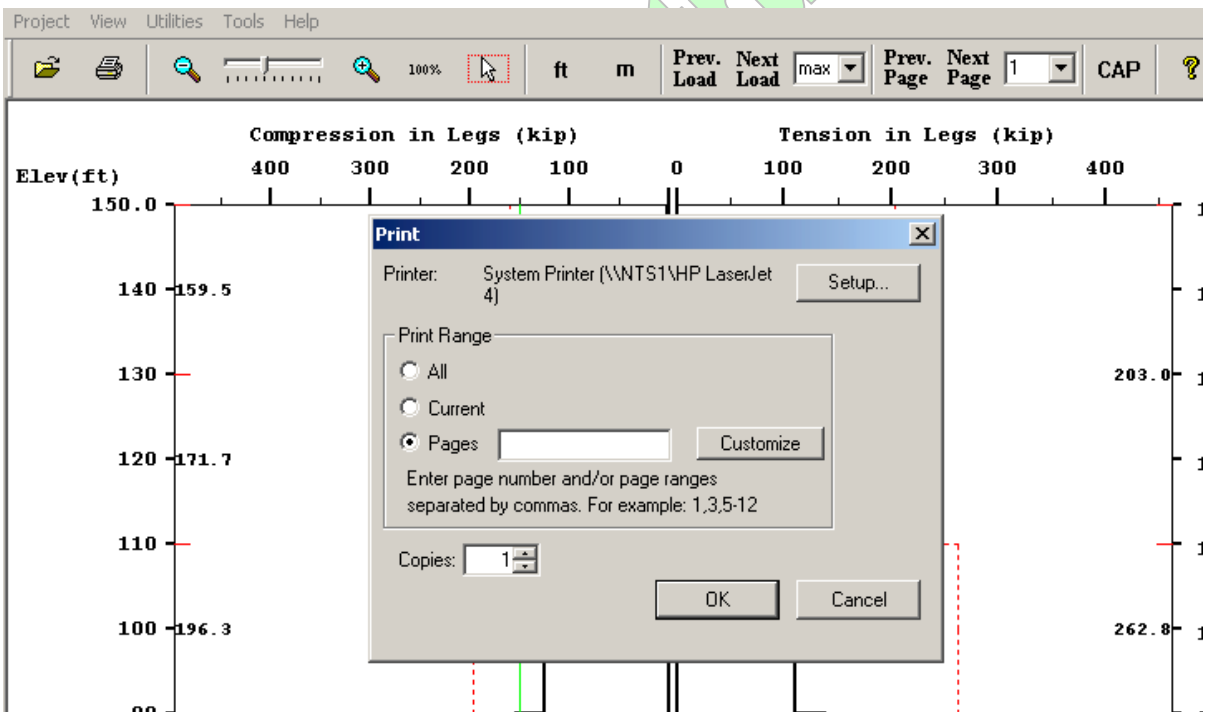


Figure 110 — Results Drawing Tool — Printing

In order to set up the printer, click on Setup in the Print dialog box or select the *Utilities>Print Setup* menu option. Please note that although the image you view can be enlarged or minimized, the size and orientation for printing is fixed. If you select 'Landscape' rather than 'Profile', the bottom section of the page will be cut off.

You can print all pages, the current page, or a selected range of pages for the current loading condition, and select the number of copies to print, by clicking on the appropriate button on the menu and then OK.

If you want to print selected pages only, click on Customize.

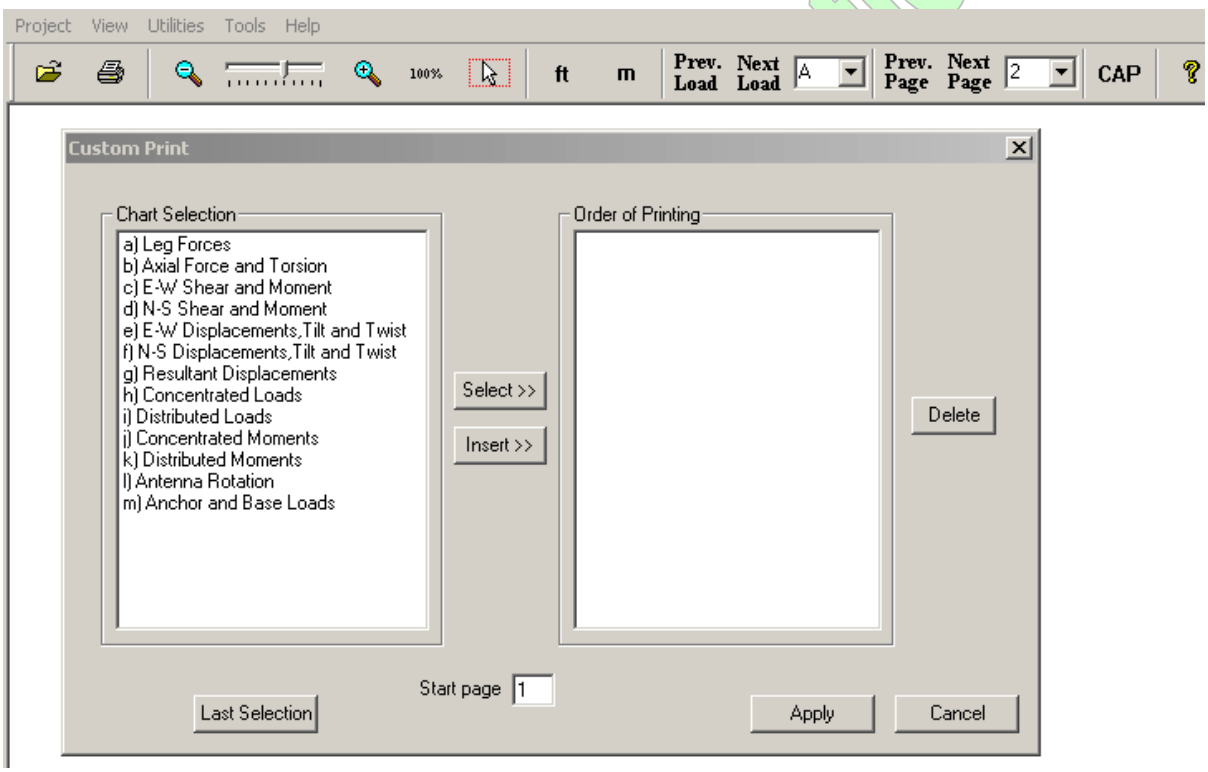


Figure 111 — Results Drawing Tool — Custom Printing

The left side of the screen shows the charts available to be printed, the right side shows the charts you have selected. You can add charts to be printed, or remove any chart shown on the right side. When you press Select>>, the chart disappears from the left side and reappears on the right. When you press Delete, the selection is removed from the right side of the screen and reappears on the left.

By default, the chart selected will be added at the bottom of the list displayed on the right of the screen, and charts will be printed in the order listed. If you wish to print in a particular order, highlight a chart on the right side of the screen, select the new chart, and press Insert>>. The new selection will appear in front of the highlighted chart. If you have not highlighted a chart, the new selection will be inserted at the top of the list.

If you press Apply, your customized selections will be saved, and you can retrieve them later by pressing Previous Selection. This is convenient if you want to print the same list of charts for different loading conditions or different files.

8.14 How to Return to the Main Program

When you have finished viewing or printing the graphs, select *Project>Exit* to return to the main program.