Standards Design Group, Inc.

Presents:

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Wind Loads on Signs 2002

1.1 Introduction

Standards Design Group, Inc., (SDG) developed this software in conjunction with Sign Industry professionals to provide sign shops with the ability to design and estimate an adequate sign structure, consistent with the International Building Code (IBC) which has recently been adopted in many jurisdictions throughout the United States. The IBC requires calculation of wind loads and the resulting forces in a way that significantly differs from the calculations that the sign industry traditionally used. In many cases, sign shops must submit bids or quotations for projects prior to incurring the costs of a registered professional engineer. This program is designed to assist these sign shops in selecting structural materials that meet or exceed the engineering requirements for the defined site parameters. Once the job has been contracted, a registered professional engineer, familiar with sign design, should be able to provide an adequate structure, consistent with the design parameters, within the material costs estimated for the job.

1.2 Features

WLSGN02 operates in a Windows™ environment and performs design calculations for sign structures with multiple panels and tapered supports. Toggling between US standard and SI units is easy by the press of a single button, updating all entered values. The program's ability to "read" the basic wind speed directly from a built-in version of the Basic Wind Speed maps given in Figure 6-1 of both ASCE 7-98 and ASCE 7-02 provides ease in determining the basic wind speed for the design structure. WLSGN02 takes into account user defined topography factors and includes sample figures of standard topographic shapes.

The user can easily define panel parameters by entering the panel height, panel width, panel center offset, and solidity ratio. WLSGN02 allows the user to "taper" each support by allowing multiple sections of different widths and cross-sections. WLSGN02 calculates wind forces, shear forces, bending moments, and torques acting at program-selected height intervals or at user-defined height intervals.

WLSGN02 produces detailed reports showing the wind pressure, shear force, bending moment, and torque acting on the sign structures. The user can "click" on various intermediate values of the Main Wind Force Resisting System (MWFRS) results to obtain the details of the calculations for a specific value, including: velocity pressure, gust effect factor, pressure coefficients, and sign structure forces. The printed detailed report provides user-defined and computed data suitable for presentation to a building official. The program also allows the

user to select adequate supporting members for the supporting structure based on the wind loads for cost estimation purposes.

Calculators within WLSGN02 allow the user to "play" with parameters without changing the current design. The user can print results from the calculators individually. These printouts provide the entered data, intermediate calculations with equations, and final computed values.

Getting Started

2.1 Opening Wind Loads on Signs 2002

WLSGN02 opens in three ways. (1) The user can follow the path "start/All Programs/Standards Design Group, Inc/Wind Loads on Sign 2002", or (2) the user can double click on a program file with the extension .wss. (3) If the user creates a program shortcut, the user can open the program by double clicking on this shortcut.

2.2 Starting a New Design

When the program starts, a startup screen, shown in Figure 2.1, appears. Click on "Create a New Sign Design" and click Ok to begin a new design.

Figure 2.1: Wind Loads on Signs 2002 Startup Window

The file path "File/New Sign Design" (Figure 2.2) or Ctrl+N begins a new sign structure design. This resets all the values in the current sign design to the default values and begins a new sign structure design. The "New Sign Design" button on the toolbar, shown in Figure 2.3, also begins a new design.

Figure 2.2: New Sign Design Menu

Figure 2.3: New Sign Design Button

2.3 Opening an Existing Design

WLSGN02 provides three convent ways to open an existing sign structure design. The first method consists of selecting "Open an Existing Sign Design" in the WLSGN02 startup window (Figure 2.1), clicking Ok, selecting the desired file path (Figure 2.4), and clicking on the open button. The second method consists of clicking "File/Open Design," as shown in Figure 2.5, or by simply pressing Ctrl+O. The third method consists of clicking the "Open Design" icon on the toolbar as shown in Figure 2.6, and selecting the desired file path as Figure 2.4 shows.

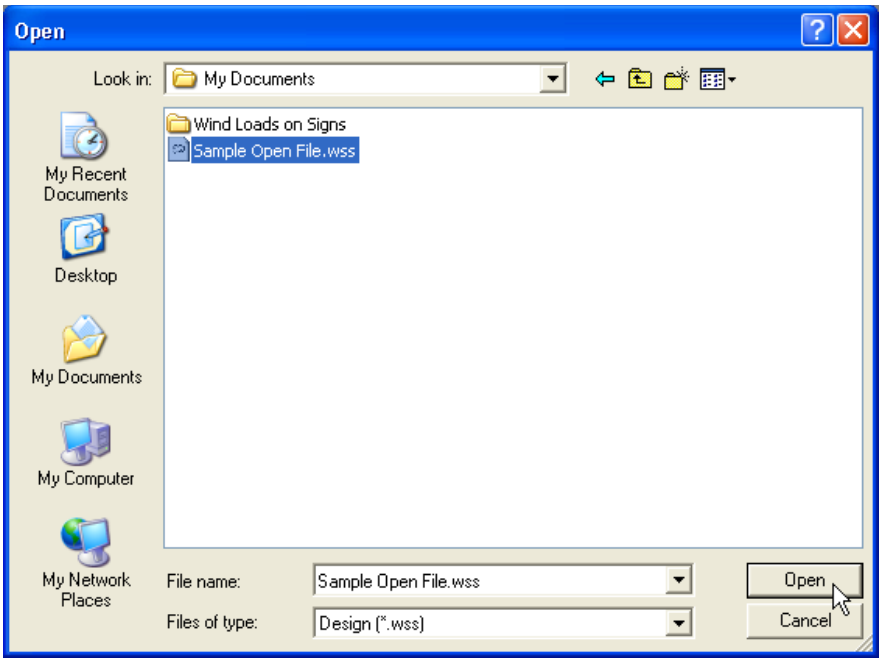


Figure 2.4: Open an Existing WLSGN02 Program

Figure 2.5: Open Design Menu

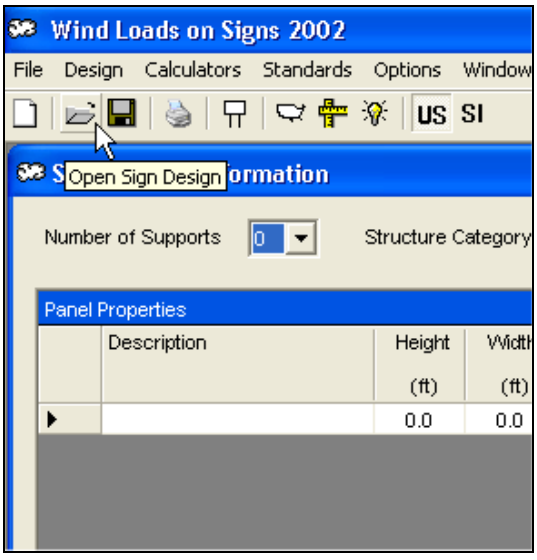


Figure 2.6: Open Design Button

2.4 Saving a Document

To save the current design, click “File/Save Design” or “File/Save Design As” (Figure 2.7) or click the “Save Design” button . If the current design has not been previously saved, the program opens the “Save As” window (Figure 2.8). Type in a file name and press the save button on the bottom right hand corner of the window (Figure 2.8) to save the file to the desired directory on the computer’s hard drive.

Figure 2.7: Save Design

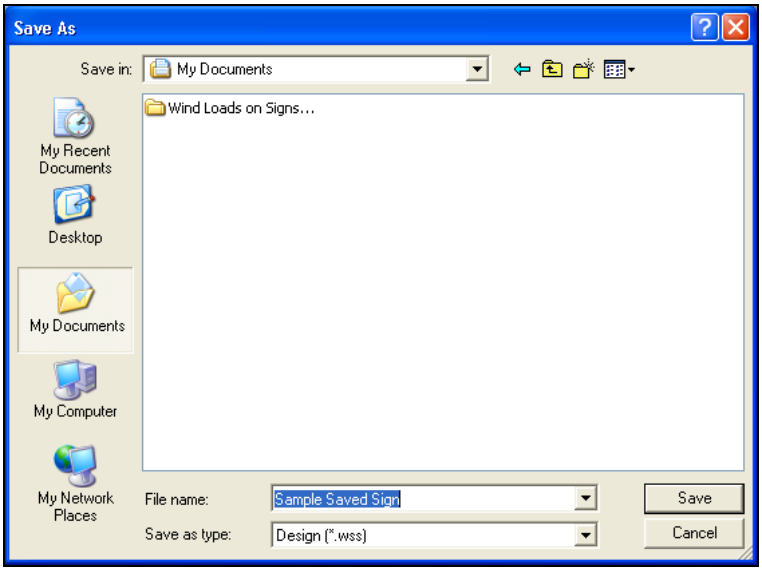


Figure 2.8: “Save As” Window

2.5 Selecting a Design Standard

WLSGN02 uses ASCE 7-98 or ASCE 7-02, at the user's option, to compute the wind loads acting on a sign structure. To change the current design standard, click on the path "Standard/*"Design Standard"*" as Figure 2.9 shows.

Figure 2.9: Design Standard

2.6 System of Units

WLSGN02 works in both US and SI units. It allows the user to toggle between US and SI systems of units, automatically updating all the entered data. To change the system of units click on the path "Options/System of Units/ "*System of Units"* as Figure 2.10 shows. WLSGN02 defaults to US units.

Figure 2.10: System of Units

2.7 Project Information

The "Project Information" window (Figure 2.11) contains reference information about the design project that includes the project name, location, and designer. The window provides a field for comments and other information relevant to the project. The data entered are for the user's information only. WLSGN02 does not require these data for design calculations.

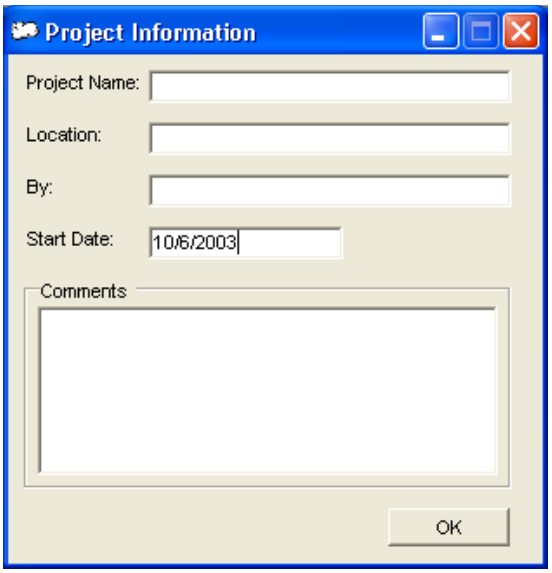


Figure 2.11: Project Information

2.8 Printing a Document

WLSGN02 prints a detailed report suitable for presentation to a building official. It allows the user to select which pages to print and also provides a print preview of the information provided in the current design.

2.8.1 Print Design Window

Figure 2.12 shows the “Print Design” window. The “Print Design” window allows the user to select the reports to print. The choices include the “Title Page”, the “Location Information” page, and the “Sign Structure Data” page. Upon completion of the MWFRS calculation the program allows the user to print the “MWFRS Results” page.

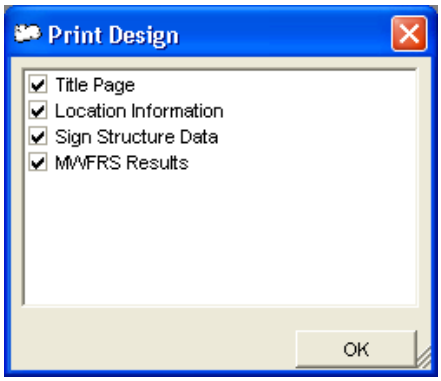


Figure 2.12: “Print Design” Window

To select the desired pages to print, simply place a check in the box next to the desired pages. This tells the program to print the selected page. Once all selections are made, press the Ok button on the bottom right hand corner of the “Print Design” window. This will display the “Print” window.

2.8.2 Print Window

To print a document, follow the path “File/Print” or press the “Print” button  . This displays the “Print Design” (Figure 2.12) window, allowing the user to select the pages to print. After selecting the desired pages, press the Ok button on the “Print Design” window and the “Print” window appears (Figure 2.13). Select the current printer in the printer section of this window. Press the Ok button on the bottom right hand corner of “Print” window and the program prints the design report.

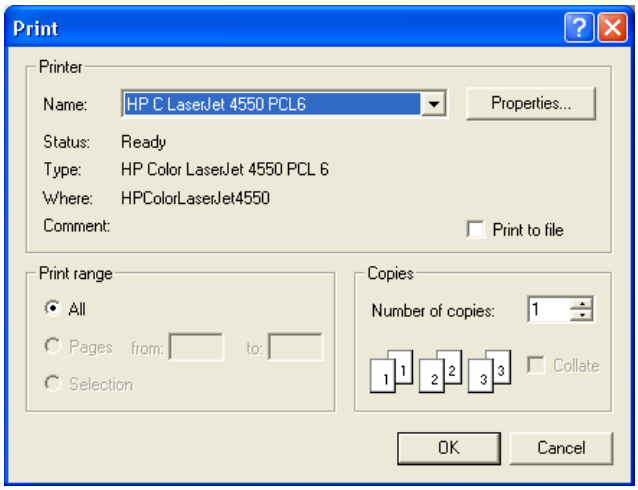


Figure 2.13: “Print” Window

2.8.3 Print Preview

WLSGN02 provides print preview functionality. Simply click on the path "File/Print Preview" as Figure 2.14 shows. The "Print Design" window (Figure 2.12) appears. Select the pages to print for the current project. Press the Ok button on the "Print Design" window and WLSGN02 shows a preview of the current report.

Figure 2.14: Print Preview

Sign Design Information

3.1 Access

To access the “Sign Design Information” window, click the path “Design\Input\Sign Design Information” (Figure 3.1) or the “Sign Design Information” button as Figure 3.2 shows.

Figure 3.1: Sign Design Information Menu

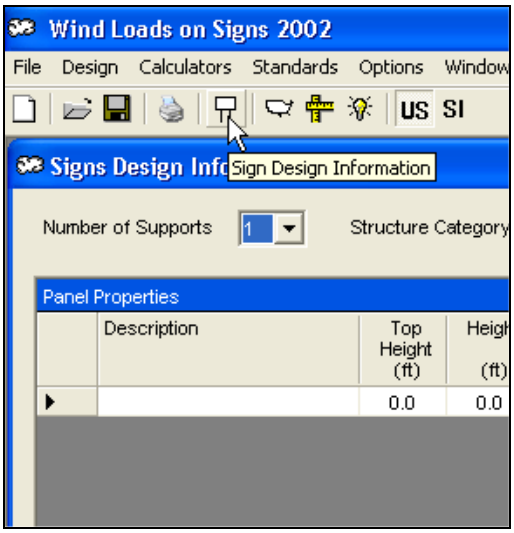


Figure 3.2: Sign Design Information Button

3.2 User Defined Input

The “Sign Design Information Window”, shown in Figure 3.3, allows the user to define all the panel and support properties necessary to analyze the wind forces, shear forces, bending moment, and torque acting on the sign structure.

3.3 Number of Supports

WLSGN02 facilitates a sign structure with zero to two supports. For sign structure designs with zero supports the programs considers a single panel at ground level. The program disables the panel “Top Height” input, the panel “Center Offset” input, and all support properties as Figure 3.3 shows.

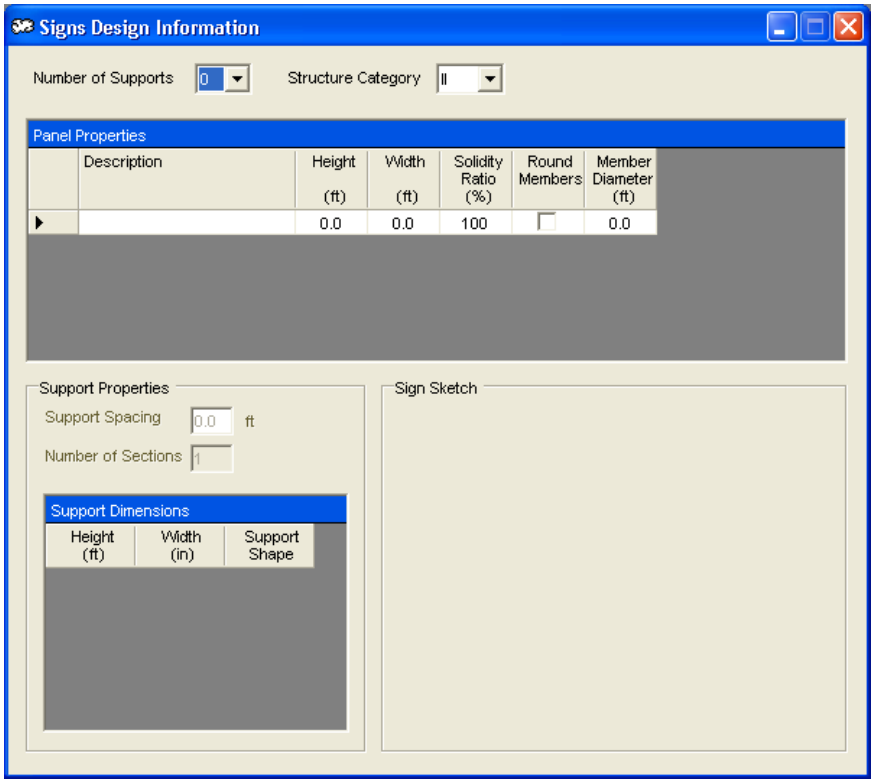


Figure 3.3: Sign Design Information Window, Zero Supports

For sign structures with one or more supports, the program allows a multiple panel sign structure design. For a single support sign structure, the program allows a "Center Offset" input for each panel and a support with multiple segments and shapes as Figure 3.4 shows.

For sign structures with two supports the program disables the panel "Center Offset", but allows supports with multiple segments and shapes.

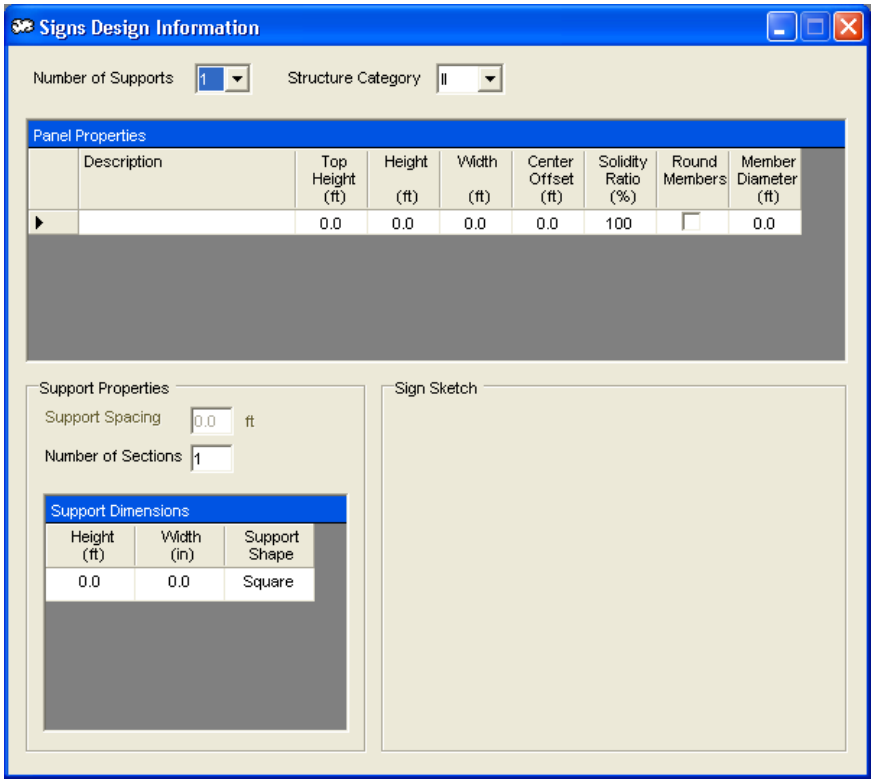


Figure 3.4: Sign Design Information Window, One Support

3.4 Structure Category

WLSGN02 allows structure categories of I, II, III, or IV. ASCE 7-98 and ASCE7-02 define each structural category in Table 1.1. This program assigns a default value of structure category II for design calculations.

3.4.1 Structure Category I

ASCE 7-98 and ASCE 7-02 classify Category I as, "*buildings and other structures that represent a low hazard to human life in the event of failure including, but not limited to agricultural facilities, certain temporary facilities, and minor storage facilities*."

3.4.2 Structure Category II

ASCE 7-98 and ASCE7-02 classify Category II as, "*All building and other structures except those listed in Categories I, III and IV*."

3.4.3 Structure Category III

ASCE 7-98 and ASCE7-02 classify Category III as, "*buildings and other structures that represent a substantial hazard to human life in the event of failure including, but not limited to buildings and other structures where more than 300 people congregate in one area, buildings and other structures with day-care facilities with capacity greater than 150, buildings and other structures with elementary or secondary school facilities with capacity greater than 150, building and other structures with a capacity greater than 500 for colleges or adult education facilities, health care facilities with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities, jails and detention facilities, power generating stations and other public utility facilities not included in Category IV*"

3.4.4 Structure Category IV

ASCE 7-98 and ASCE7-02 classify Category IV as follows:

Buildings and other structures containing sufficient quantities of toxic, explosive or other hazardous substances to be dangerous to the public if released including, but not limited to , petrochemical facilities, fuel storage facilities, manufacturing or storage facilities for hazardous chemicals, manufacturing or storage facilities for explosives.

Buildings and other structures that are equipped with secondary containment of toxic, explosive or other hazardous substances (including, but not limited to double wall tank, dike of sufficient size to contain a spill, or other means to contain a spill or a blast within the property boundary of the facility and prevent release of harmful quantities of contaminants to air, soil, ground water, or surface water) or atmosphere (where appropriate) shall be eligible for classification as a Category II structure.

In hurricane prone regions, building and other structures that contain toxic, explosive, or other hazardous substances and do not qualify as Category IV structures shall be eligible for classification as Category II structures for wind loads if these structures are operated in accordance with mandatory procedures that are acceptable to the authority having jurisdiction and which effectively diminish the effects of wind on critical structural element which alternatively protect against harmful releases during and after hurricanes.

Buildings and other structures designated as essential facilities including, but not limited to, hospitals and other health care facilities having surgery or emergency treatment facilities, fire, rescue and police stations and emergency vehicle garages, designated earthquake, hurricane, or other emergency shelters, communications center and other facilities required for emergency response,

power generating stations and other public utility facilities required in an emergency, ancillary structures (including, but not limited to communication towers, fuel storage tanks, cooling towers, electrical substation structures, fire water storage tanks or other structures housing or supporting water or other fire-suppression material or equipment) required for operation Category IV structures during an emergency, aviation control towers, air traffic control centers and emergency aircraft hangars, water storage facilities and pump structures required to maintain water pressure for fire suppression, buildings and other structures having critical national defense functions.

3.5 Panel Properties

The Panel Properties grid facilitates the input of panel properties necessary to define a sign structure with single or multiple panels. Eight properties describe the panels for analysis. The "Description" assigns each panel a name. "Top Height", "Height", "Width", and "Center Offset" describe the dimensions and locations of individual panels, and "Solidity Ratio", "Round Members", and "Member Diameter" describes the construction of each panel. Figure 3.5 shows the Panel Properties grid with one support.

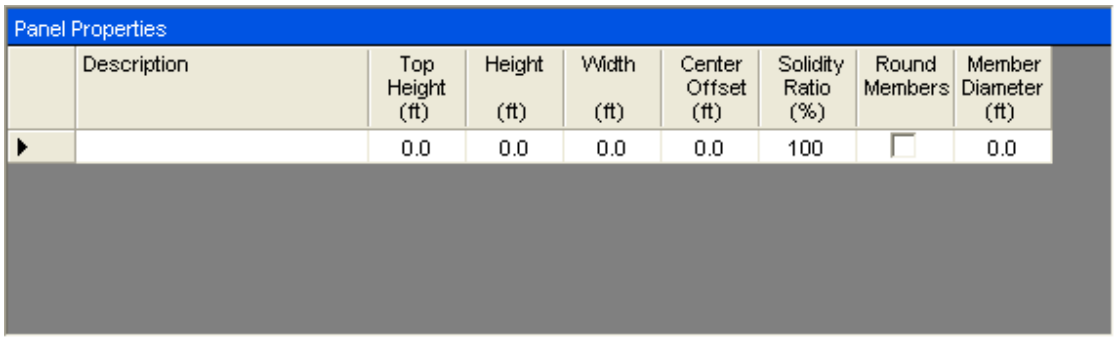


Figure 3.5: Panel Properties

3.5.1 Description

The description column allows the user to assign each individual panel a unique name. WLSGN02 uses this name to distinguish between each panel for the sign structure calculations. Without a description, the program disables all panel properties for the current panel, such as height or width. Once the user enters a panel description two events occur. (1) WLSGN02 adds an additional row to facilitate another panel for the sign structure. (2) WLSGN02 enables all panel properties for the current panel.

3.5.2 Top Height

The "Top Height" column defines the vertical distance, in feet (meters), from ground level to top of the current panel. WLSGN02 defines ground level as zero elevation.

3.5.3 Height

The "Height" column defines the vertical dimension of the current panel in feet (meters). The height of the panel cannot be greater that top height of the panel, since this creates a panel below ground level. If the user inputs a panel height greater than the top height WLSGN02 immediately updates the top height and assumes the panel springs from the ground.

3.5.4 Width

The "Width" column defines the horizontal dimension of each panel in feet (meters).

3.5.5 Center Offset

WLSGN02 allows the user to enter a center offset, in feet (meters), for single supported sign structures. For sign structures with multiple supports, the program disables the center offset. The user can enter a panel "Center Offset" value, negative or positive, no greater than one-half the sign width. This keeps the panel attached to the support. For sign structures with zero or two supports, the program disables the "Center Offset."

3.5.6 Solidity Ratio

WLSGN02 considers the solidity ratio as the ratio of solid area to gross area multiplied by 100 for each individual panel as ASCE 7-98 and ASCE7-02 define in Table 6-12. ASCE 7-98 or ASCE7-02 classifies a panel as open if the solidity ratio less is than 70%. WLSGN02 enables the typical "Round Member" column for the current panel for open signs.

3.5.7 Round Members

Place a check the checkbox in the “Round Member” column if current panel contains round members. This enables the “Member Diameter” column for the current panel, and allows the user to define the round member’s diameter. If the “Solidity Ratio” is greater than 70%, WLSGN02 disables this column for the current panel.

3.5.8 Member Diameter

Placing a checkmark in the “Round Member” column for the current sign enables the “Member Diameter” column for the current panel. Enter the typical round member diameter of the panel, in feet (meters), for the panel openings as defined in ASCE 7-98 and ASCE7-02, Table 6-12. If the Solidity Ratio is less than 70% WLSGN02 disables the “Member Diameter” for the current panel.

3.5.9 Delete Row

WLSGN02 facilitates the mechanism required to delete a panel row and all of its contents. First select the current panel row (indicated by a dark triangle in the first column) by clicking on the gray cell to the left of the panel description row. Then right click on that same cell and select delete row as shown in Figure 3.6. A pop-up window will appear to verify the program is deleting the correct panel. Select Ok to delete the selected current panel row.

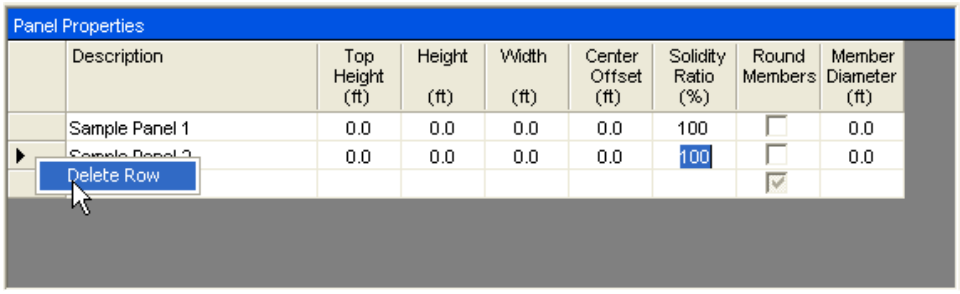


Figure 3.6: Deleting a Row in the Panel Properties

3.6 Support Properties

The Support Properties object facilitates the supports properties necessary to determine the wind load forces acting on the supporting structure. The support properties include the support spacing, number of sections (for tapered supports), and the width, height, and support shape of each section as shown in Figure 3.7.

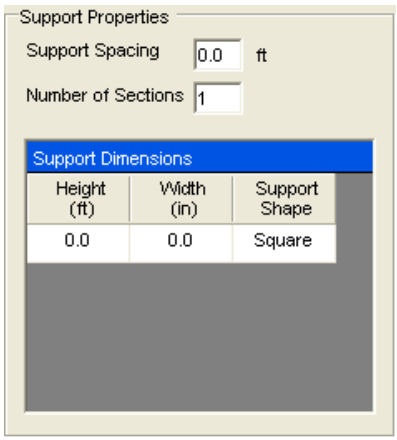


Figure 3.7: Support Properties

3.6.1 Support Spacing

Support Spacing defines the horizontal centerline distance in feet (meters) between each support. WLSGN02 disables the support spacing for designs with zero or one support.

3.6.2 Number Of Sections

This allows the user to define the number of sections in the supporting structure. Using multiple sections allows the design of a support structure that has multiple widths, shapes, and heights.

3.6.3 Height

The "Height" column of the "Support Dimensions" table defines the vertical distance to the top of the support segment in feet (meters) with respect to the ground level. WLSGN02 automatically fills the height column with evenly spaced sections based on the total sign structure height. The program then allows the user to adjust these values to facilitate the actual supporting structure dimensions.

3.6.4 Width

The "Width" column defines the diameter of a circular cross-section or the least horizontal dimension of a square, hexagonal, or octagonal cross-section for each support segment in inches (cm) as defined in Table 6-10 of ASCE 7-98 and ASCE7-02.

3.6.5 Support Shape

WLSGN02 allows two different supports shapes for each support segment defined in Table 6-10 of ASCE 7-98 or ASCE7-02. The allowed shapes include square and round.

3.7 Sign Sketch

WLSGN02 draws a scaled sketch of the sign structure (Figure 3.8) for the current project. The sketch dynamically updates as the user enters information.

The user can also copy the sign sketch to paste into other applications. Right click on the sign sketch and a pop-up window appears as shown in Figure 3.8. Click on "Copy Sketch" to send the sign sketch to the clipboard as a bitmap image.

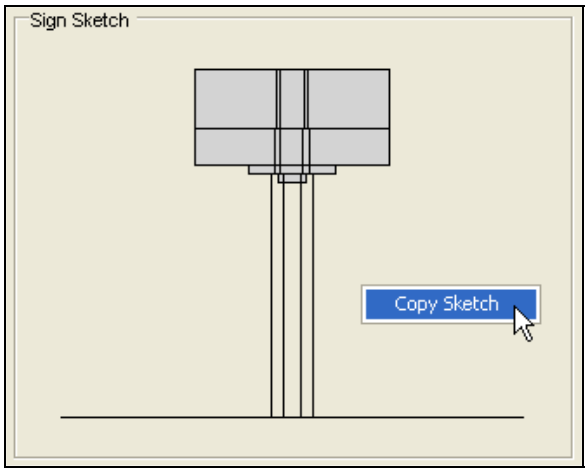


Figure 3.8: Sign Sketch

3.8 Foundation Input

Foundation design is complicated, therefore Wind Loads on Signs 2002-Plus could only provide a simplified design to maintain affordable costs. The design is from UBC 1806.8.2 and IBC 1805.7.2. Referring to Figure 3.9, the user may choose from five soil options whose descriptions are displayed in the box at the bottom of the window. The estimated foundation diameter is then entered in the right-hand box. From this information Wind Loads on Signs 2002-Plus calculates a recommended depth for the foundation. An example output is shown in figure 3.10.

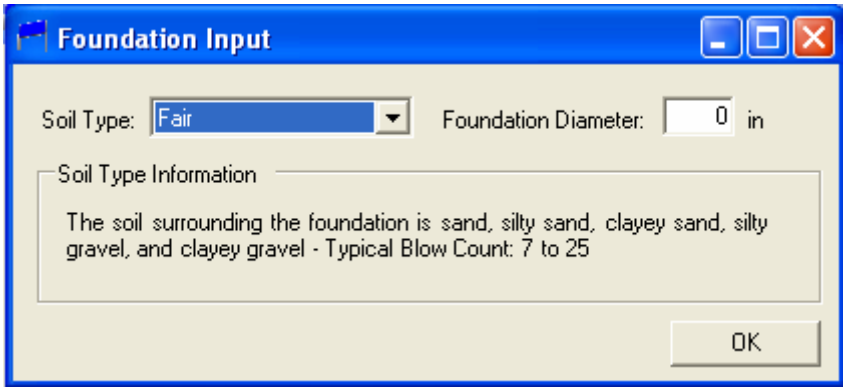


Figure 3.9: Foundation Input Window

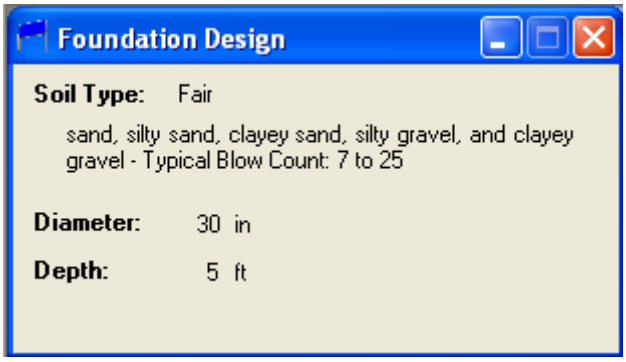


Figure 3.10: Foundation Results Window

Location Information

4.1 Access

To access the Location Information window (Figure 4.1), click the "Location Information button", or click the path "Design\ Input\Location."

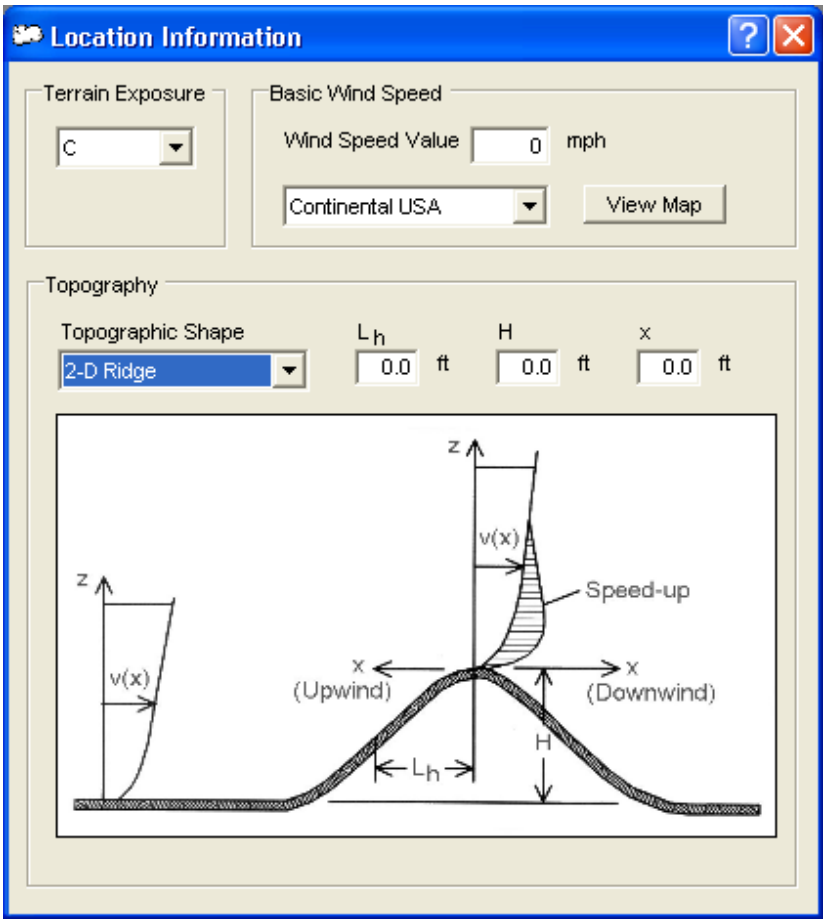


Figure 4.1: Location Information Window

4.2 User Defined Input

WLSGN02 utilizes the terrain exposure, basic wind speed, topographic shape, and the topographic shape factors to obtain the forces necessary to design a sign structure.

4.2.1 Terrain Exposure

WLSGN02 uses the terrain exposure categories from Section 6.5.6 of ASCE 7-98 or ASCE7-02, and terrain exposure C as the default value.

4.2.1.1 Exposure A

Exposure A encompasses large city centers in which at least 50% of the buildings have a height in excess of 70 ft (21.3 m). Use of this exposure category shall be limited to those areas for which terrain representative of Exposure A prevails in the upwind direction for a distance of at least ½ mile (0.8 km) or 10 times the height of the building or other structure, whichever is greater. Possible channeling effects or increased velocity pressure resulting from the building or structure being located in the wake of adjacent building shall be taken into account. Exposure Category A has been deleted from ASCE7-02.

4.2.1.2 Exposure B

Exposure B encompasses urban and suburban areas, wooded areas, or other terrain with numerous closely spaces obstructions having the size of a single family dwelling or larger. Use of this exposure category shall be limited to those areas for which terrain representative of Exposure B prevails in the upwind direction for a distance of at least 1,500 ft (460 m) or 10 times the height of the building or structure, whichever is greater.

4.2.1.3 Exposure C

Exposure C encompasses open terrain with scattered obstructions having heights generally less that 30 ft (9.1 m). This category includes flat open country, grasslands and shorelines in hurricane prone regions.

4.2.1.4 Exposure D

Exposure D encompasses flat, unobstructed areas exposed to wind flowing over open water (excluding shorelines in hurricane prone regions) for a distance of at least 1 mile (1.61 km). Shorelines in Exposure D include inland waterways, the Great Lakes and coastal area of California, Oregon, Washington, and Alaska. This exposure shall apply only to those buildings and other structures exposed to the wind coming from over the water. Exposure D extends inland from the shoreline a distance of 1,500 ft (460 m) or 10 times the height of the building or structure, whichever is greater.

4.3 Basic Wind Speed

The basic wind speed corresponds to a 3-second gust at 33 ft (10 m). WLSGN02 facilitates a "user defined" wind speed value or the program can "read" the ASCE basic wind speed maps. WLSGN02 supplies the user with a depiction of the basic wind speed maps given in Figure 6-1 of ASCE 7-98 and ASCE7-02. Standards Design Group, Inc. divided these maps into counties and allows the user to point and double click on the location where the sign structure is located. The program then reads and interpolates the basic wind speed as Figure 4.2 shows. To access these maps click on the view map button shown in Figure 4.1. To select Alaska, Hawaii, Puerto Rico, Guam, American Samoa, and the Virgin Islands, click on the drop down list shown in Figure 4.1 and select the region in question. Since Hawaii, Puerto Rico, Guam, American Samoa, and the Virgin Islands have a wind speed allocated for their whole regions, WLSGN02 does not provide maps of these regions. Instead WLSGN02 uses the single basic wind speed value for these regions defined in Figure 6-1 of ASCE7-98 and ASCE7-02.

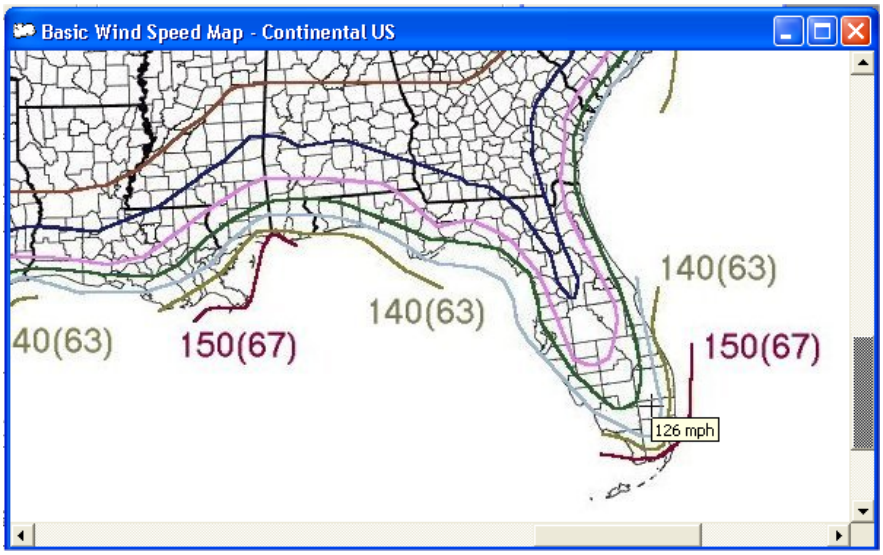


Figure 4.2: Basic Wind Speed Map

4.4 Topography

WLSGN02 takes into account topographic factors for the sign structure design. According to ASCE 7-98, "wind speed-up effects at isolated hills, ridges and escarpments constituting abrupt changes in the general topography, located in any exposure category, shall be included in the design when buildings and other site conditions and locations of structures meet all of the following conditions:

1. The hill, ridge or escarpment is isolated and unobstructed upwind by other similar topographic features of comparable height for 100 times the height of the topographic feature (100 *H*) or 2 mi (3.22 km), whichever is less. This distance shall be measured horizontally from the point at which the height *H* of the hill, ridge, or escarpment is determined;

2. The hill, ridge or escarpment protrudes above the height of upwind terrain features within a 2 mi (3.22 km) radius in any quadrant by a factor of two or more;

3. The structures is located as shown in Fig. 6.2 in the upper one-half of a hill or ridge or near the crest of and escarpment;

4. $H/L_h \leq 0.2$; and

5. *H* is greater than or equal to 15 ft (4.5 m) for Exposures C and D and 60 ft (18 m) for Exposures A and B"

4.4.1 Topographic Shape

WLSGN02 takes into account topography factors for the location of a sign structure. The program allows the user to select four different topographic shapes, none, 2-D Ridge, 2-D Escarpment, and 3-D Axisymmetric Hill as shown in Figure 4.3.

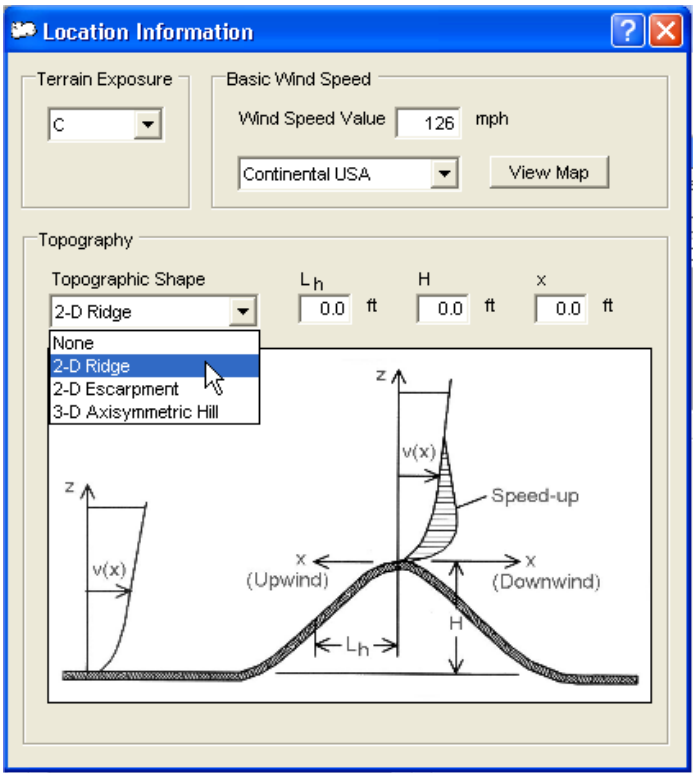


Figure 4.3: Topography Shapes

4.4.2 L_h

ASCE 7-98 and ASCE 7-02, Figure 6-2 defines L_h as the distance upwind of the crest to where the difference in ground elevation is half the height of the hill or the escarpment, in feet (meters).

4.4.3 H

ASCE 7-98 and ASCE 7-02, Figure 6-2 defines H as the height of hill or escarpment relative to the upwind terrain, in feet (meters).

4.4.4 x

ASCE 7-98 and ASCE 7-02, Figure 6-2 defines x as the distance (upwind or downwind) from the crest to the sign structure, in feet (meters).

Optional Factors

5.1 Access

To access to the "Optional Factors" window (Figure 5.1) click on the "Optional Factors" button , or click on the path "Design\Input\Optional Factors."

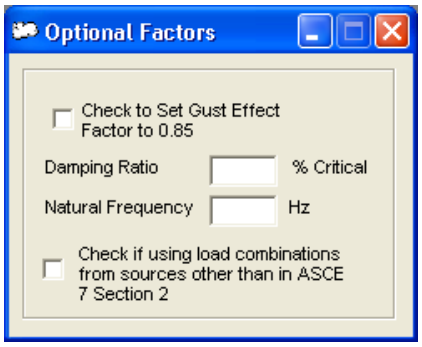


Figure 5.1: Optional Factors Window

5.2 User Defined Input

The "Optional Factors" window allows the user to set the gust effect factor to 0.85 or enter a damping ratio and natural frequency causing the program to treat the sign structure as a flexible structure.

5.3 Check to Set Gust Effect Factor to 0.85

ASCE 7-98, Section 6.5.8.1 allows the user the set the gust effect factor to 0.85 for rigid structures. If the user does not check this box, WLSGN02 calculates a rigid gust effect factor using Equation 6-2 from ASCE7-98 or ASCE 7-02.

5.4 Damping Ratio

The damping ratio is a percent of the critical total sign structure height, horizontal dimension of the sign structure normal to the wind direction, and the horizontal dimension of a building measured parallel to the wind direction.

5.5 Natural Frequency

This field allows the user to define a natural frequency for the sign structure. The programs calculates a gust effect factor using ASCE 7-98 or ASCE 7-02, Equation 6.6 if the user inputs a damping ratio and a natural frequency for the sign structure.

5.6 Check for Other Load Combinations

ASCE calibrated the wind directionality factor, K_d, using load combinations specified in ASCE 7-98 or ASCE7-02 Sections 2.3 and 2.4. If other load combinations are used in the sign structure design, the program sets the wind directionality factor to 1.0.

Height Increment

6.1 Access

To access the “Height Increment” window (Figure 6.1) click the “Height Increment” button  , or by clicking on the path “Design\Input\Height Increment.”

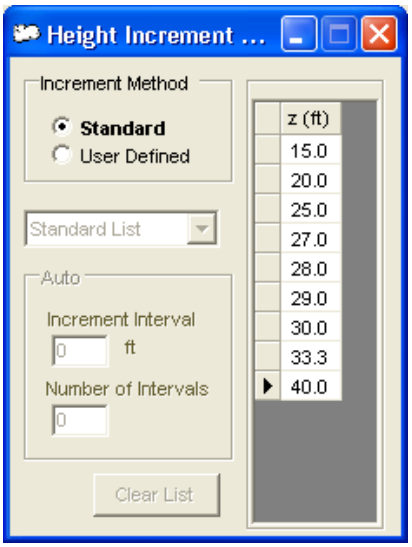


Figure 6.1: Height Increment, Standard Increments

6.2 User Defined Input

The height increment window customizes the height increments for the wind loads calculations.

6.3 Standard Increment Method

WLSGN02 automatically uses the standard height increments given in ASCE 7-98, Table 6-5, or ASCE7-02, Table 6-3, for design calculations. When the standard increment method is selected, the program uses these increments for wind load computations.

6.4 User Defined Height Increment Method

The user defined height increment method allows the user to specify the height increment in which the program calculates the wind loads for the sign structure. WLSGN02 maintains the values of the total sign structure height, support heights, top panel heights, and bottom panel heights in the height increment list even when the user defined increment method is selected. WLSGN02 DOES NOT allow the deletion of these values.

6.4.1 Standard List

The standard list allows the user to enter random height values for design computations. The user can add new height increment values by right clicking on the first column (gray) of the height increment list. The program then displays a popup menu that allows the user to add a new row as shown in Figure 6.2. This adds a new cell to the z column with a value of 0.0 Figure 6.2. The user can then enter the desired height in this cell. The program automatically sorts the height list as shown in Figure 6.2. (Note: The user cannot enter a height increment greater than the total sign structure height.)

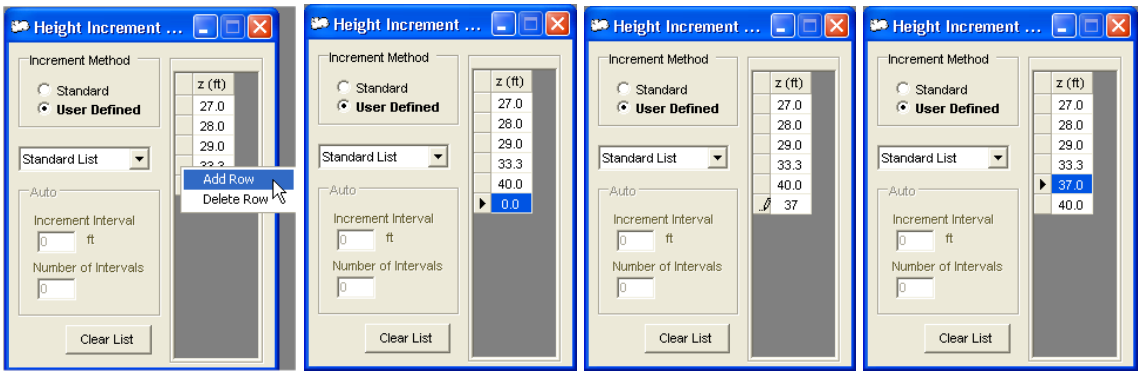


Figure 6.2: Adding a New Height to the Height List

6.4.2 Auto Increment

The auto increment function increments the height list for a specified number of intervals as Figure 6.3 shows.

6.4.2.1 Increment Interval

The program calculates the wind loads acting on sign structure based on the increment interval when defined. For instance the program will calculate the wind loads every five feet if the increment interval is set to five feet as shown in Figure 6.4.

6.4.2.2 Number of Intervals

Number of intervals gives the user the freedom to the stop the increment intervals at a predetermined height. Figure 6.4 shows an incremented interval at five feet with eight intervals. As Figure 6.4 shows, the incremented intervals stop at forty feet.

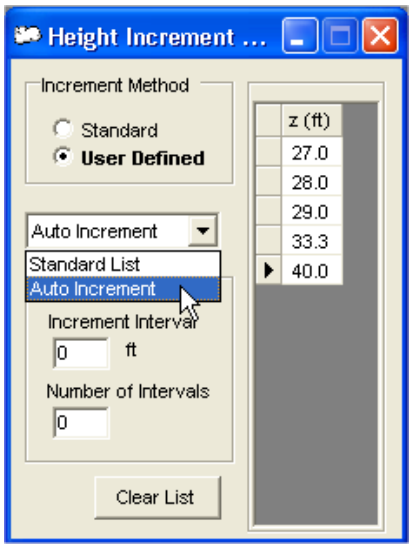


Figure 6.3: Height Increment Window, Auto Increment

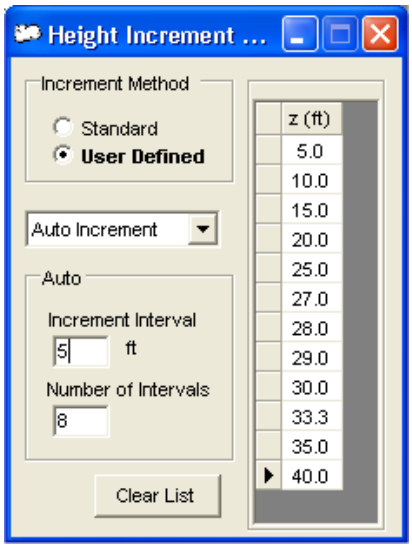


Figure 6.4: Height Increment Window, Increment Interval and Number of Intervals

6.5 Clear List

The clear list button clears all values in the height increment list except those vital to wind load computation, such as support heights, top panel height, and bottom panel heights.

Support Manager

7.1 Access

To access the “Support Manager” window (Figure 7.2) click the path “Design\Input\Support Manager” as shown in Figure 7.1.

Figure 7.1: Support Manager Window

Figure 7.2: Support Cross-Section Manager

7.2 Support Cross-Section Manager

The Support Manager allows the user to add custom support cross-sections (round pipes or square tubing). The user can enter the bending moment capacity, the diameter or width, thickness, and weight of the cross-section for designs. WLSGN02 does not allow the user to edit supports provided by the program.

7.3 Adding a Custom Cross-Section

To add a custom cross-section, click on the add button shown in Figure 7.2. This will add a new line to the database with all the section properties as shown in Figure 7.3. Click each cell to edit the values in the manager.

Figure 7.3: Adding a New Section Property

7.4 Deleting a Cross-Section from the Database

To delete a cross-section from the database right click on the row header and select “Delete Current Row” as shown in Figure 7.4. A dialog box will confirm the delete. Select “Yes” to delete the current row or select “No” to cancel the deletion of the current row. **Warning**: Selecting “Yes” permanently removes the custom cross-section from the database.

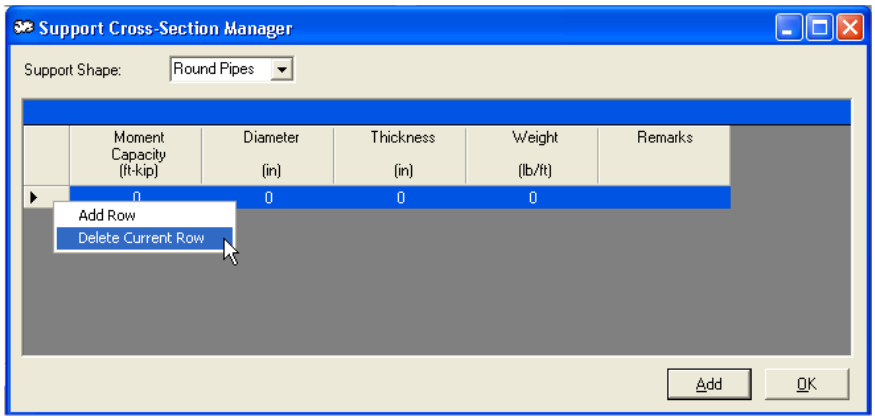


Figure 7.4: Deleting a Row from the Support Manager

Main Wind Force Resisting System Results

8.1 Access

WLSGN02 calculates the wind loads, shear forces, bending moment, and torque when the user clicks the path "Design\ Results\ All MWFRS Calculations." WLSGN02 also allows the user to compute the wind load calculations separate from the support internal forces calculation. To compute only the wind loads, click "Design \ Results \ MWFRS Wind Loads." To compute only the support internal forces, click "Design\ Results\ MWFRS Support Forces."

If critical values are missing or the user inputs invalid values, WLSGN02 prompts the user to correct these values; else, the program asks whether the structure is rigid or flexible as shown in Figure 8.1. If the structure is considered rigid, press "No." If the user presses "Yes" the optional factor window appears. The appropriate values then must be entered in the "Optional Factor" window as described in Section 5.

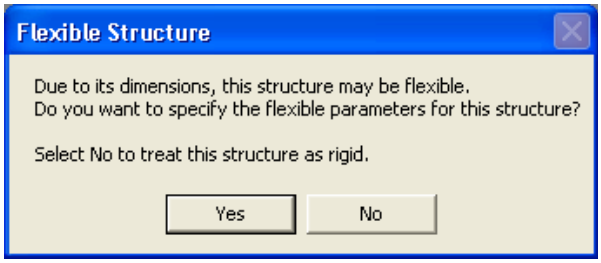


Figure 8.1: Flexible Structure Pop-Up Window

8.2 Internal Support Forces

After WLSGN02 completes the design calculations, the program displays the "Shear, Bending Moment, and Torque on Critical Sections" window if one support is chosen or the "Shear and Bending Moment on Critical Sections" window if zero or two supports is selected. WLSGN02 reports the critical shear force, the critical bending moment, and the critical torque acting on the support(s). The program uses the largest resultant support reaction from the wind load computation to determine the resulting shear force, bending moment, and torque on the critical support. Standards Design Group, Inc. defines the critical support as the support which develops the largest internal forces (shear force, bending moment, and torque) from the resulting main wind force resisting structure wind load computations.

8.2.1 First Column, Support

The first column displays the support segments in the same order as entered, number from one to the total number of support segments.

8.2.2 Second Column Length, ft (m)

The second column displays the length of each support segment.

8.2.3 Third Column Width, in (ft)

The third column displays the width of the support segment in the same as order as entered by the user.

8.2.4 Fourth Column, Shear, kip (kN)

The fourth column displays the select shape of the support.

8.2.5 Fifth Column, Shear, kip (kN)

The fifth column displays the shear force in kips (kN) acting on the critical support at the critical support height.

8.2.6 Sixth Column, Moment, kip-ft (kN-m)

The sixth column displays the moment in kip-ft (kN-m) acting on the critical support at the critical support height.

8.2.7 Seventh Column, Torque

The seventh column displays the torque in kip-ft (kN-m) acting on the critical support at the critical support height.

8.2.8 Eight Column, Cross-Sections

The eighth column allows the user to click on the button labeled “Display Cross-Sections.” Clicking this button displays the support results screen and allows the user to select a support from the support database.

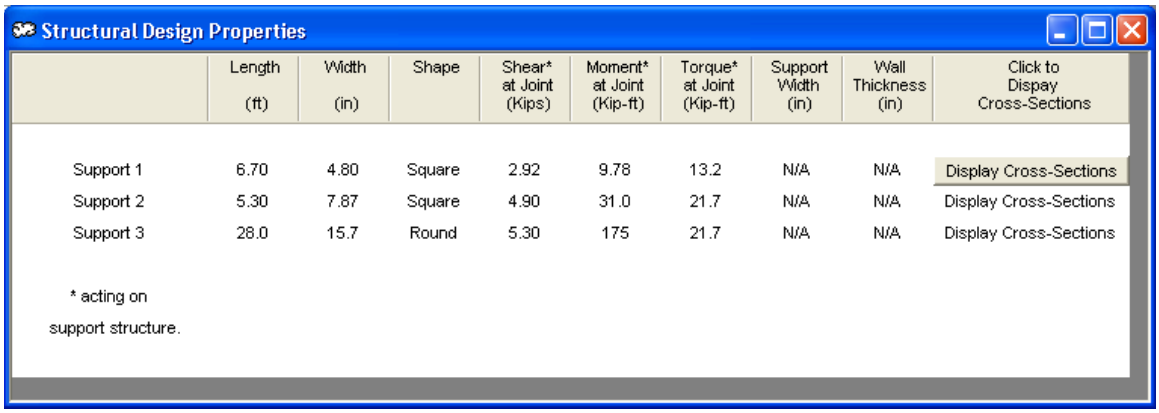


Figure 8.2: Internal Forces Results Window

8.3 Support Results

Clicking on "Display Cross-Sections" (Figure 8.2) displays the Support Results window shown in Figure 8.3. This allows, for cost estimation purposes, the user to select a support cross-section that resists the defined wind loads. This window displays pre-defined supports adequate to resist specified wind load criteria.

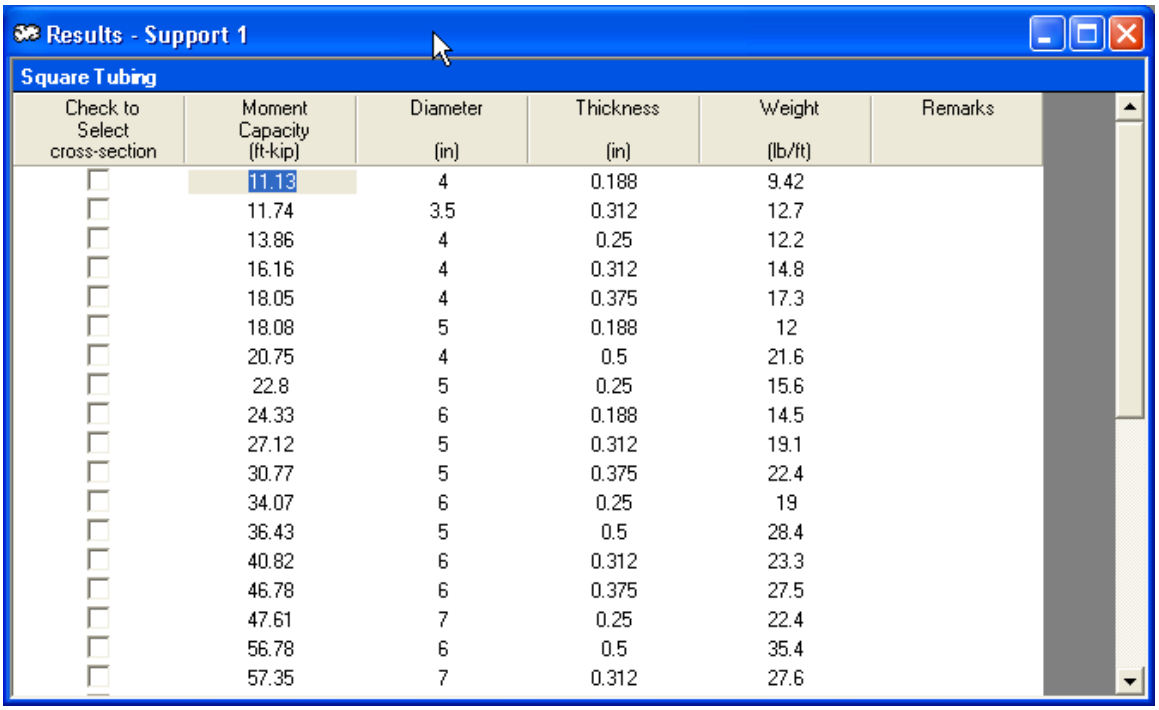


Figure 8.3: Support Results Window

8.3.1 Selecting a Member

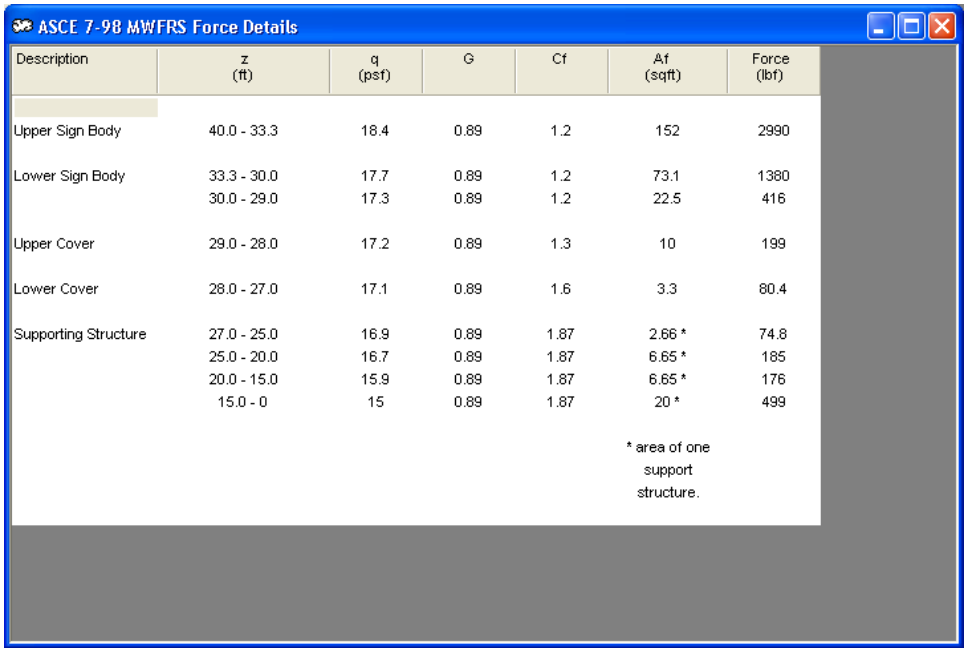
WLSGN02 only allows the user to select one support from the database for each support segment. To select a support cross-section simply click in the check box next to the desired support in the "Click to Select Cross-Section" column. The selected members display in the project report.

8.3.2 Sorting

WLSGN02 allows the user to sort each column in both ascending and descending order. To sort each column, simply click on the column header. Clicking the column header once sorts the column in ascending order and clicking a second time sorts the column in descending order.

8.4 MWFRS Force Details

The "ASCE 7- MWFRS Force Details" (Figure 8.4) page displays ASCE 7-98 or ASCE7-02 wind load computations. This window categorizes the wind loads computations by the each panel and support.



Description	z (ft)	q (psf)	G	Cf	Af (sqft)	Force (lbf)
Upper Sign Body	40.0 - 33.3	18.4	0.89	1.2	152	2990
Lower Sign Body	33.3 - 30.0	17.7	0.89	1.2	73.1	1380
	30.0 - 29.0	17.3	0.89	1.2	22.5	416
Upper Cover	29.0 - 28.0	17.2	0.89	1.3	10	199
Lower Cover	28.0 - 27.0	17.1	0.89	1.6	3.3	80.4
Supporting Structure	27.0 - 25.0	16.9	0.89	1.87	2.66 *	74.8
	25.0 - 20.0	16.7	0.89	1.87	6.65 *	185
	20.0 - 15.0	15.9	0.89	1.87	6.65 *	176
	15.0 - 0	15	0.89	1.87	20 *	499

* area of one support structure.

Figure 8.4: MWFRS Force Details

8.4.1 First Column "Description"

The description column displays the name of each panel and supporting structure for design purposes. The "Description" places the user defined panel name for each panel in the sign structure, and "supporting structure" for support calculations.

8.4.2 Second Column "z", ft (m)

The "z" column shows the elevations which the velocity pressures act over in feet (m).

8.4.3 Third Column, Velocity Pressure

The third column displays the velocity pressure for the sign structure calculated using Equation 6-13 in ASCE 7-98. The velocity pressure displayed in this column remains constant over the elevations given in the "z" column. To display the velocity pressure details double click on the velocity pressure column as Figure 8.5 shows.

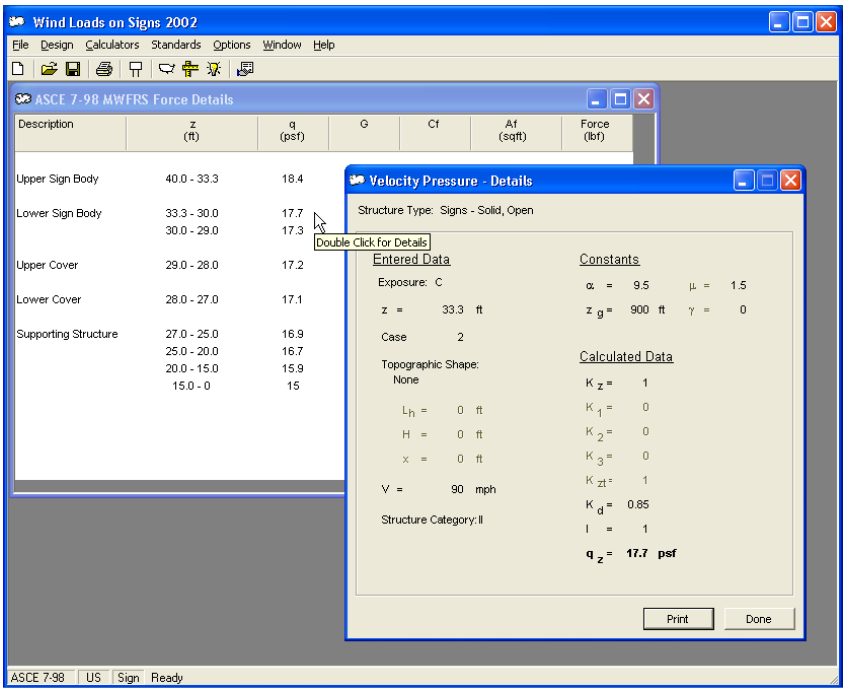


Figure 8.5: Velocity Pressure Details

8.4.4 Fourth Column, Gust Effect Factor

The fourth column displays the gust effect factor for the user defined sign structure. WLSGN02 uses the rigid structures gust effect factor or the flexible gust effect factor depending on the user input. To display the calculation details, double click on the gust effect factor column as Figure 8.6 shows.

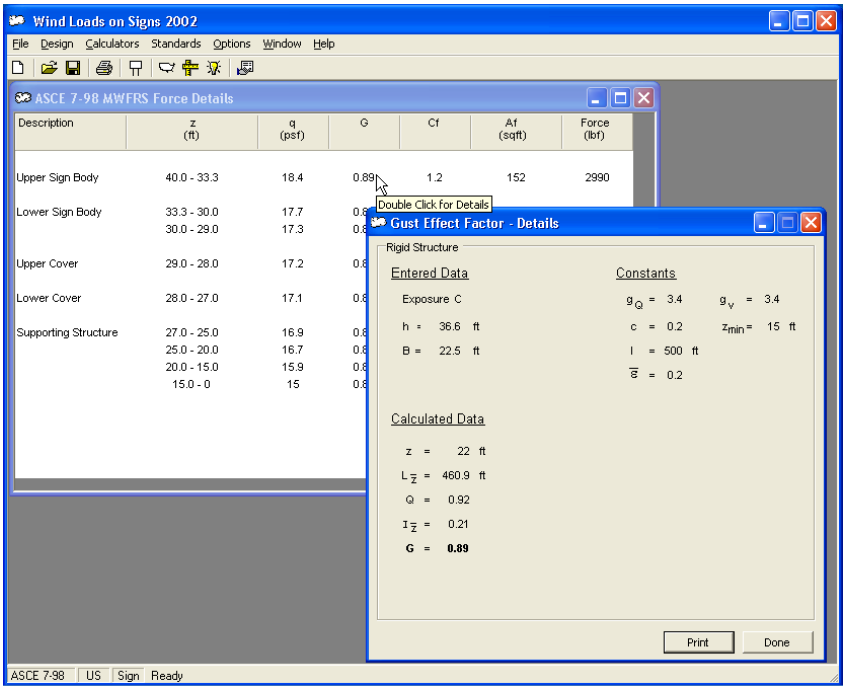


Figure 8.6: Gust Effect Factor Column Details

8.4.5 Fifth Column, Force Coefficient, C_f

The fifth column displays the force coefficients for each section of the sign structure. WLSGN02 calculates the force coefficients for the supports using ASCE 7-98 orASCE7-02, Table 6-10 and ASCE 7-98 or ASCE7-02, Table 6-11 to Table 6-12 for the panel force coefficients. To display the external force coefficient details double click on the force coefficient column as Figure 8.7 shows.

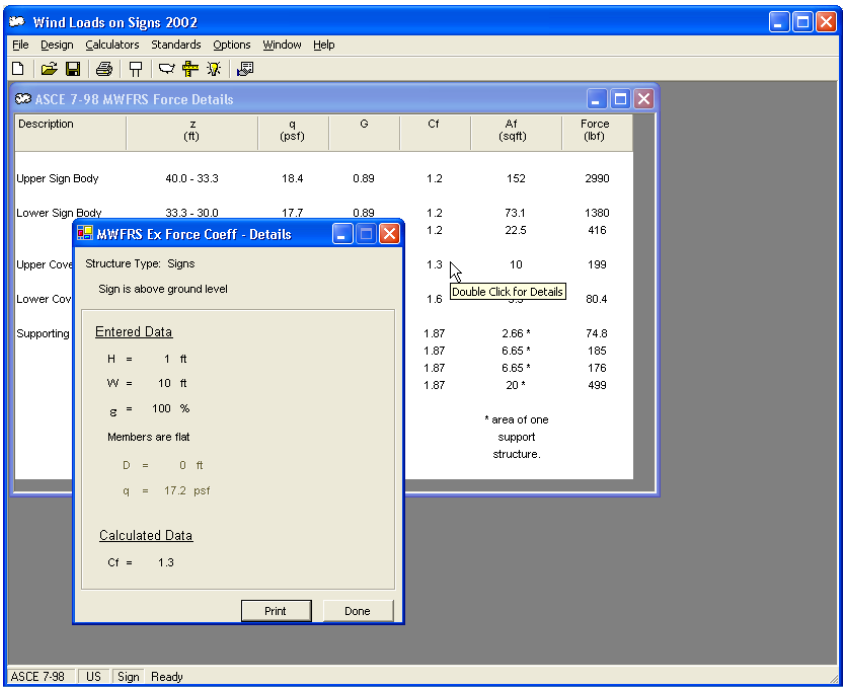


Figure 8.7: Force Coefficient Column Details

8.4.6 Sixth Column, Area

The sixth column displays the area of the sign structure the velocity pressure acts over ft^2 (m^2).

8.4.7 Seventh Column, Force

The seventh column displays the force acting at the centroid of the velocity pressure. This is the design wind force for open buildings and other structures. WLSGN02 calculates this force using Equation 6-20 in ASCE 7-98 or ASCE7-02. To display the force calculation details double click on a cell in the force column as Figure 8.8 shows.

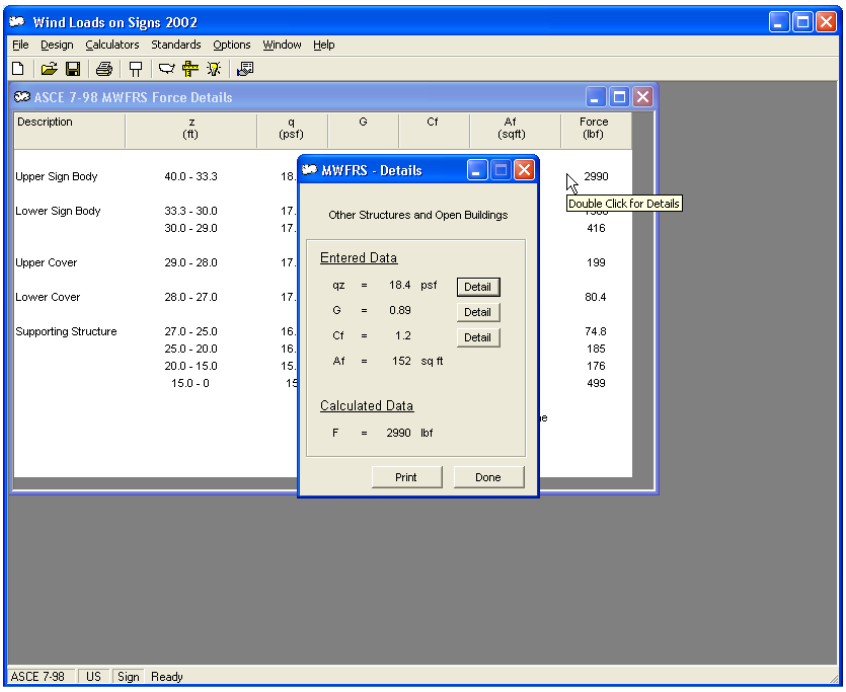


Figure 8.8: Force Column Details

8.5 Coping MWFRS Data

WLSGN02 provides functionality to copy the data in the “Shear, Bending Moment, and Torque at Critical Sections” window and the “MWFRS Force Details” window. Simply right click on any cell in the data grid and click on the “copy data” menu as shown in Figure 8.9. This copies all the information in the data grid to the clipboard. This allows the user to paste the results in a spread sheet program such as Microsoft Excel.

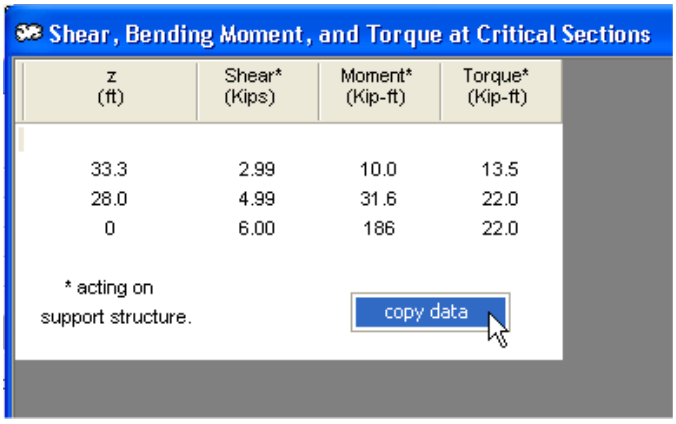


Figure 8.9: Copy Data (MWFRS Results)

Calculators

9.1 Introduction

WLSGN02 provides five calculators to perform calculation separate from the current design program. These calculators allow the user to "play" with parameters without changing the current design. The user can print results from the calculators individually. The printouts include the data entered, intermediate calculations with equations, and the final answers.

9.2 Access

To access each calculator, click on the “Calculators” menu located on the menu bar on the top of the “Wind Loads on Signs 2002” window. Then select the desired calculator as Figure 9.1 shows.

Figure 9.1: Calculator Access

9.3 Velocity Pressure Calculators

The velocity pressure calculator, Figure 9.2, calculates the velocity pressure at a user-defined height above the ground. This calculator uses Equation 6-13 from ASCE7-98 or ASCE 7-02 and shows all intermediate calculations for this equation. The velocity pressure calculator performs calculations for square supports, hexagonal supports, round supports, solid sign panels and open signs panels. To select the structure type click on the structure type drop down list (Figure 9.2) and select the structure type for calculations.

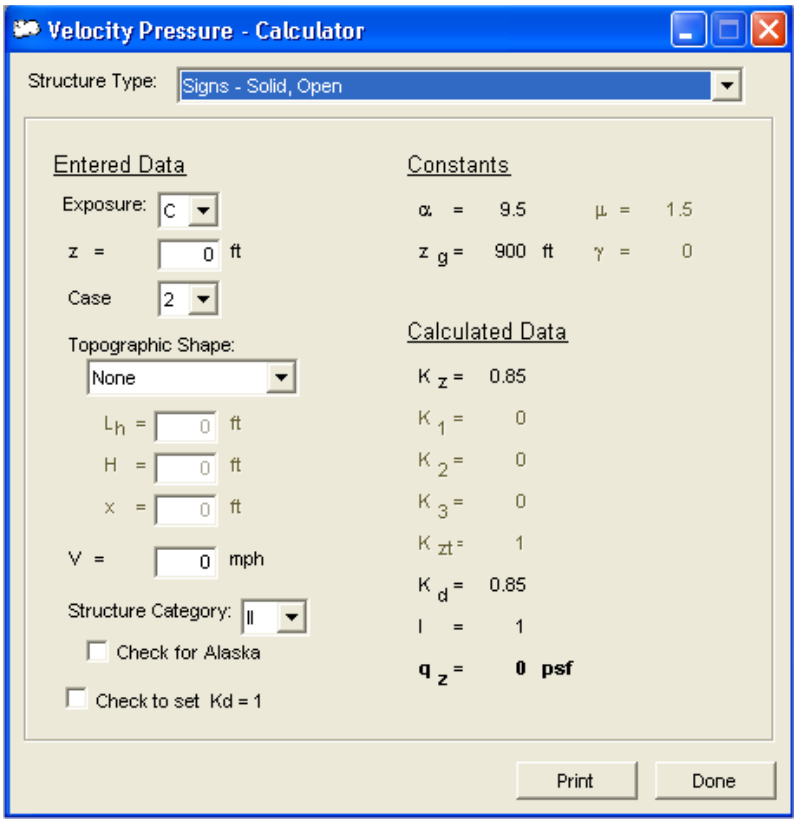


Figure 9.2: Velocity Pressure Calculator

9.4 Gust Effect Factor

WLSGN02 provides calculators to determine both rigid and flexible gust effect factor.

9.4.1 Rigid Structure

The rigid gust effect factor calculator (Figure 9.3) uses Equation 6-2 from ASCE7-98 orASCE7-02 to compute the gust effect factor. The calculator shows all intermediate values for calculations. Press the Print button to printout a detailed report including all intermediate value, equations, and the final answer.

9.4.1.1 Variable h

ASCE 7-98 and ASCE 7-02 define h as the total height of the sign structure.

9.4.1.2 Variable B

ASCE 7-98 and ASCE 7-02 define B as the horizontal dimension of a building measured normal to the wind direction.

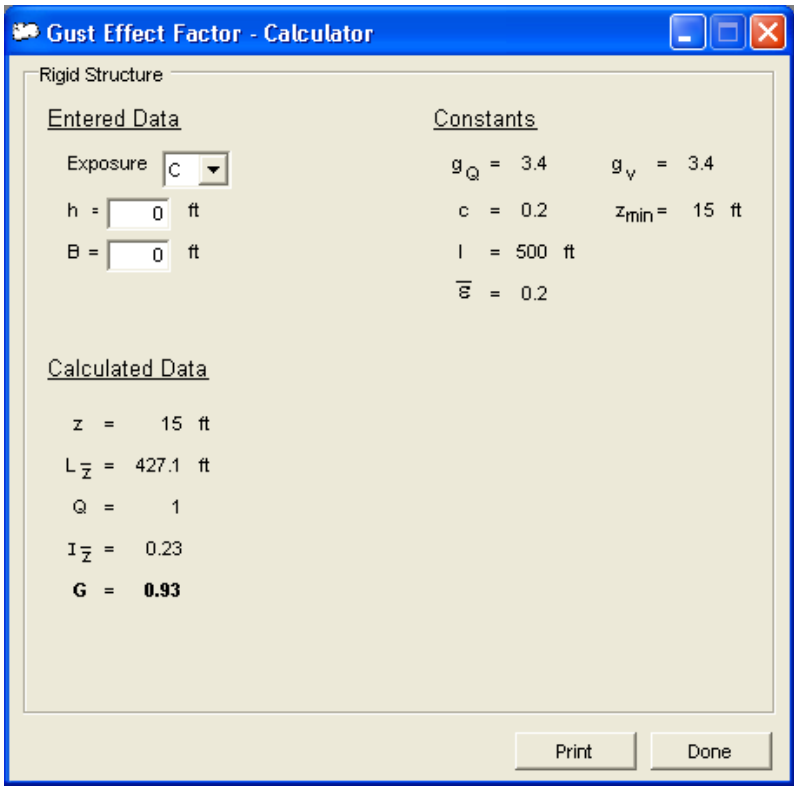


Figure 9.3: Gust Effect Factor Calculator (Rigid Structure)

9.4.2 Flexible Structure

The rigid gust effect factor calculator (Figure 9.4) uses Equation 6-6 from ASCE7-98 or ASCE7-02 to compute a flexible gust effect factor. The calculator window shows all intermediate values used to compute the gust effect factor. The calculator printout shows all intermediate values, equations, and the final answer.

9.4.2.1 Variable h

Section 9.4.1.1, above, defines the variable h.

9.4.2.2 Variable B

Section 9.4.1.2, above, defines the variable B.

9.4.2.3 Variable L

ASCE 7-98 and ASCE 7-02 define L as the horizontal dimension of a building measured parallel to the wind direction.

9.4.2.4 η_1, Natural Frequency

Section 5.5, above, defines the natural frequency.

9.4.2.5 β, Damping Ratio

Section 5.4, above, defines the damping ratio.

9.4.2.6 V, Basic Wind Speed

Section 4.3, above, defines the basic wind speed.

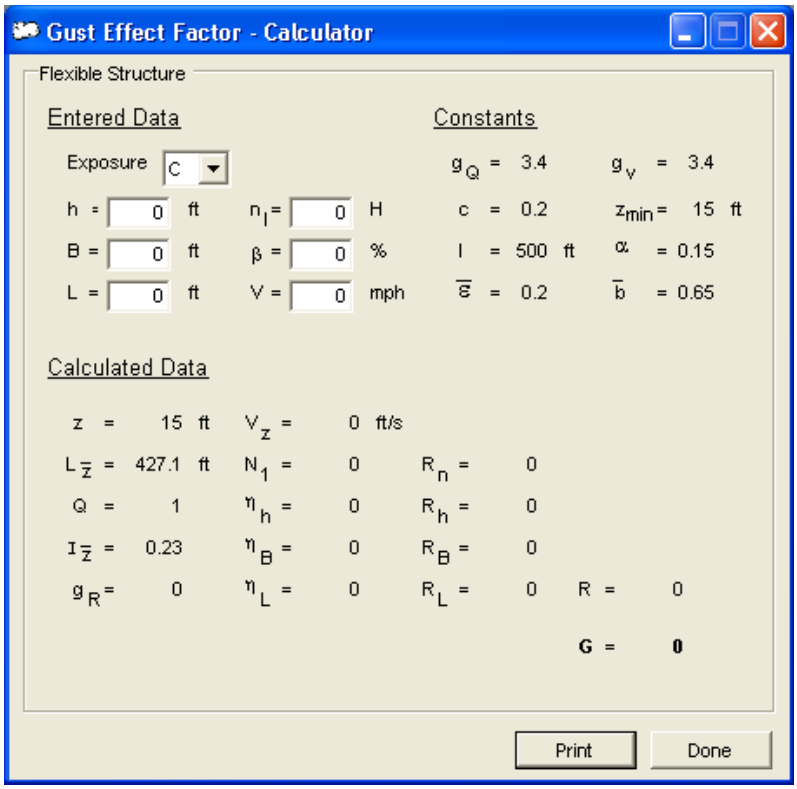


Figure 9.4: Gust Effect Factor Calculator (Flexible Structure)

9.5 MWFRS External Pressure Coefficient Calculator

The MWFRS External Pressure Coefficient calculator (Figure 9.5) computes the force coefficient for both the sign panels and the supports. To compute these values WLSGN02 uses Table 6-10 through Table 6-12 in ASCE 7-98 and ASCE7-02.

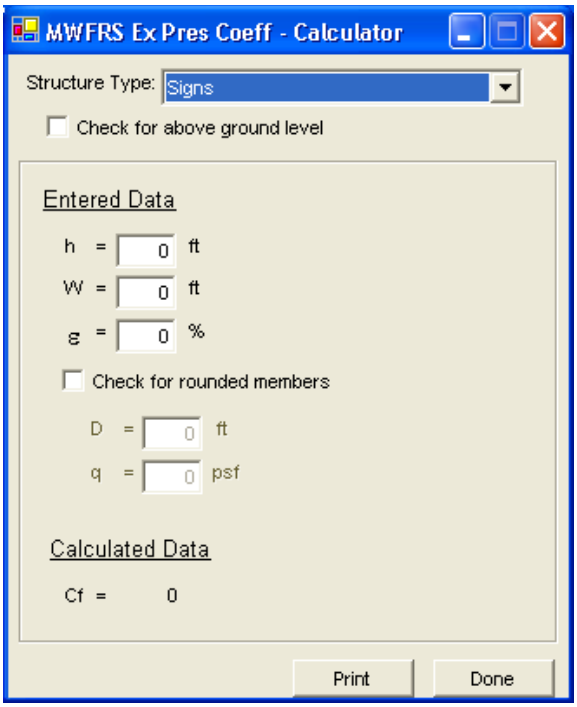


Figure 9.5: MWFRS External Pressure Coefficient Calculator

9.5.1 Structure Type

The External Pressure Coefficient calculator computes external force coefficient for signs (solid and open) and chimney, tanks, and similar structures (sign supports). To choose the structure type click on the selection arrow to the right of the structure type box.

9.5.2 Variable h

Section 9.4.1.1, above, defines the variable h.

9.5.3 Variable W

The variable W denotes the width of the panel or support.

9.5.4 Variable ε, Solidity Ratio

Section 3.5.6, above, defines the variable ε.

9.5.5 Check for Rounded Members

If the solidity ratio is less than 70%, check this box if round members are present on the panel.

9.5.6 D, Typical Round Member Diameter

Section 3.5.8, above, defines the variable D.

9.5.7 q, Velocity Pressure

q denotes the velocity pressure evaluated at height z above the ground in lb/ft^2 (N/m^2).

9.5.8 Cross-Section

If the user selects chimney, tanks, similar structures WLSGN02 gives the option to choose the cross-section of the members. These choices includes square, octagonal, hexagonal, and round.

9.5.9 C_f, External Pressure Force Coefficient

C_f denotes the final value given by the calculator. It represents the force coefficient used in the wind loads computations for other structures.

9.6 MWFRS Force Calculator

The MWFRS Force calculator (Figure 9.6) computes the equivalent force acting on the structure. To compute these values WLSGN02 uses Equation 6-20 from ASCE7-98 and ASCE7-02.

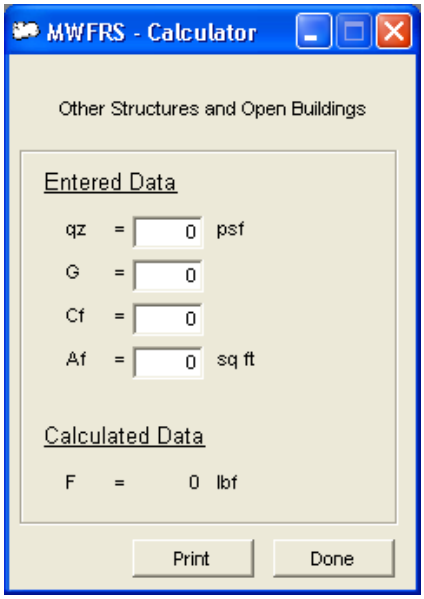


Figure 9.6: MWFRS External Force Coefficient Calculator

9.6.1 q_z, Velocity Pressure

Section 9.5.7, above, defines velocity pressure.

9.6.2 G, Gust Effect Factor

G denotes the gust effect factor for either a rigid or flexible structure.

9.6.3 Cf, Force Coefficient

Section 9.5.9 defines the force coefficient.

9.6.4 A_f, Area

A_f denotes the area of open buildings and other structures either normal to the wind direction or projected on a plane normal to the wind direction, in ft^2 (m^2.)

9.6.5 F, Force

F denotes the design wind force for open buildings and other structures.

Appendix A
Sign Structure Design Example 1

1. Open WLSGN02 by clicking “start/All Programs/Standards Design Group, Inc/Wind Loads on Sign 2002” or click on the WLSGN02 shortcut.

2. Once WLSGN02, the “Wind Loads on Signs 2002” startup window appears. Click “Create a New Sign Design” and click Ok as shown in Figure A.1.

Figure A.1: Wind Loads on Signs 2002 Startup Window

3. This brings up a blank “Sign Design Information” window. Select the standard for the current sign design by clicking “Standard/ASCE 7-02” as shown in Figure A.2. (This is the default standard.)

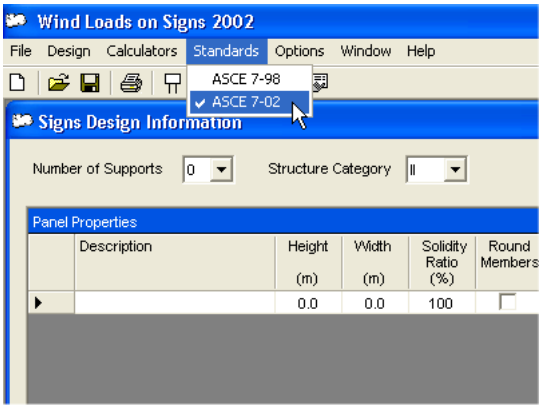


Figure A.2: Selecting the Design Standard

4. Next select the system of units for the current project by clicking “Options/System of Units/SI” as shown if Figure A.3.

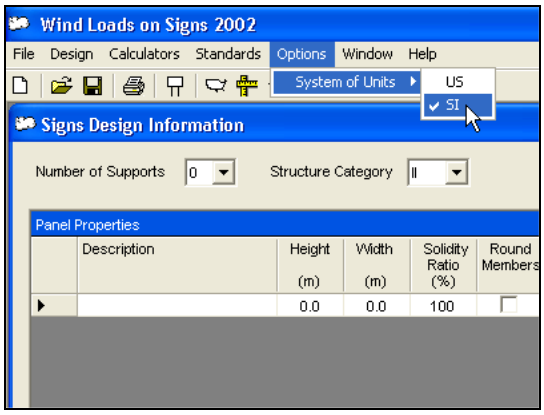


Figure A.3: Selecting the System of Units

5. Select the number of supports for the sign structure. For this example select one support as shown in Figure A.4.

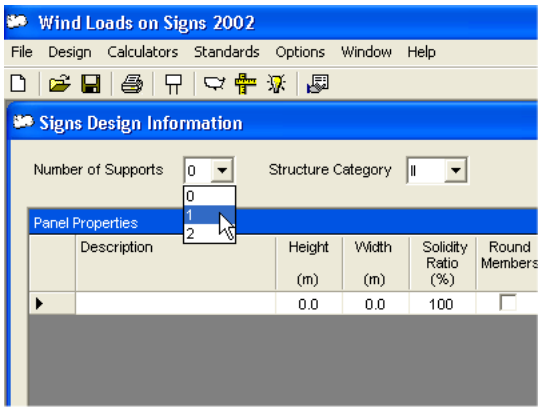


Figure A.4: Selecting the Number of Supports

6. Click in the first cell of the description column in the Panel Properties grid and type the panel description “Top Panel,” as shown in Figure A.5. Press the tab button. NOTE: A new row will appear in the Panel Properties grid. This allows for multiple panel sign structures.

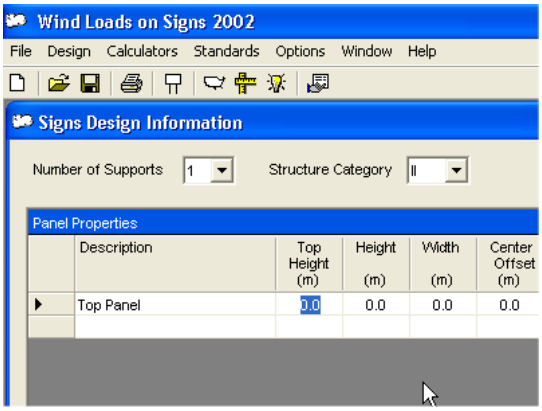


Figure A.5: Entering a Panel Description

7. Enter a "Top Height." This denotes the vertical distance, in feet (meters), from ground level to the top of the current panel. Enter 12 meters in the "Top Height" column for the "Top Panel" panel and hit tab button as shown in Figure A.6. This will highlight the "Height" cell for the current panel.

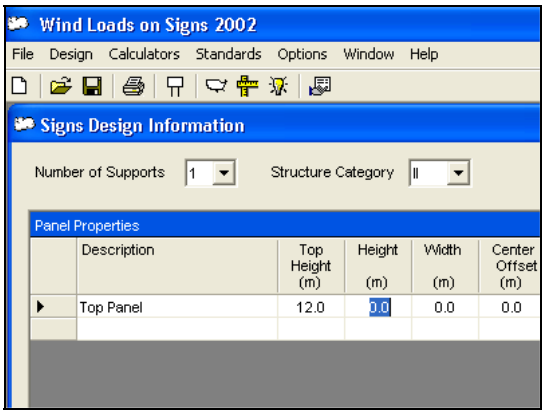


Figure A.6: Entering a Panel Top Height

8. Enter a panel "Height." This is the vertical dimension of the current panel. Enter 4.2 meters for the height of the "Top Panel" as shown in Figure A.7 and press the tab button. This highlights the "Width" cell for the current panel.

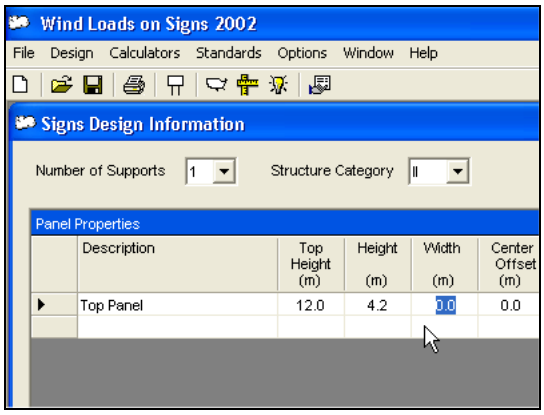


Figure A.7: Entering a Height

9. Enter the "Width" of the current panel. This is the horizontal dimension of the current panel for the sign structure. Enter 9 meters for the sign width as Figure A.8 shows and press the tab key. Since there is now enough information to draw the sign sketch, a sketch of the "Top Panel" appears on the "Sign Sketch" panel.

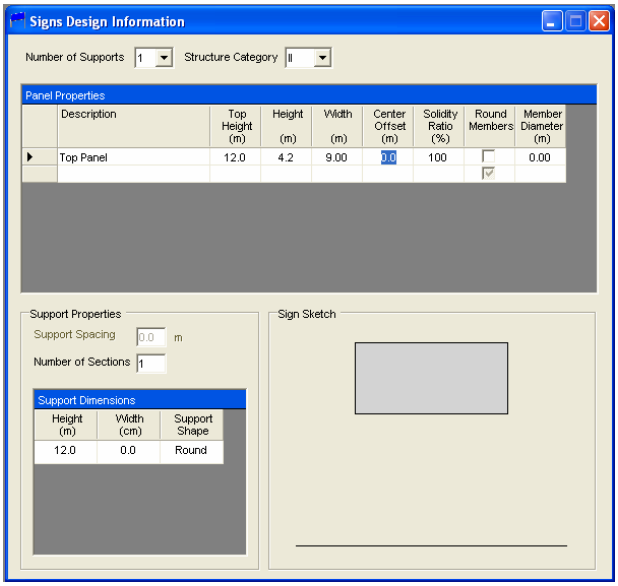


Figure A.8: Entering a Panel Width

10. Enter the "Center Offset" for the current panel. For this example enter 2.1 m for the panel "Center Offset" and press the tab key as Figure A.9 shows. The sign sketch is updated immediately.

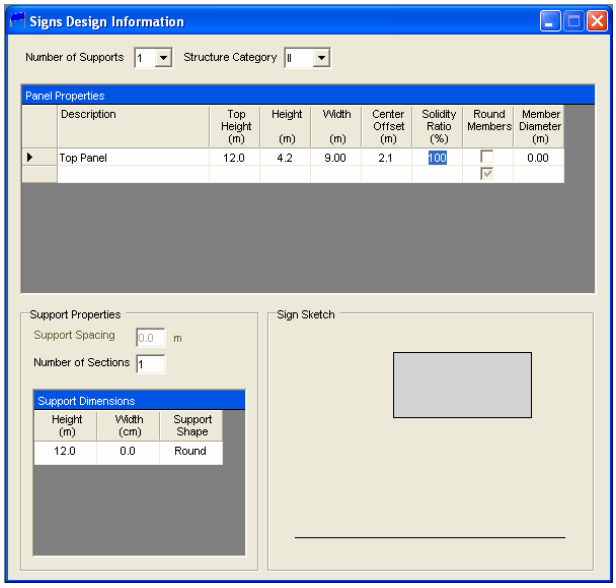


Figure A.9: Entering a Center Offset

11. Enter the "Solidity Ratio" of the current panel. This is the ratio of solid area to gross area multiplied by 100. For the design example enter a "Solidity Ratio" of 65% as shown in Figure A.10. This panel now defined as open.

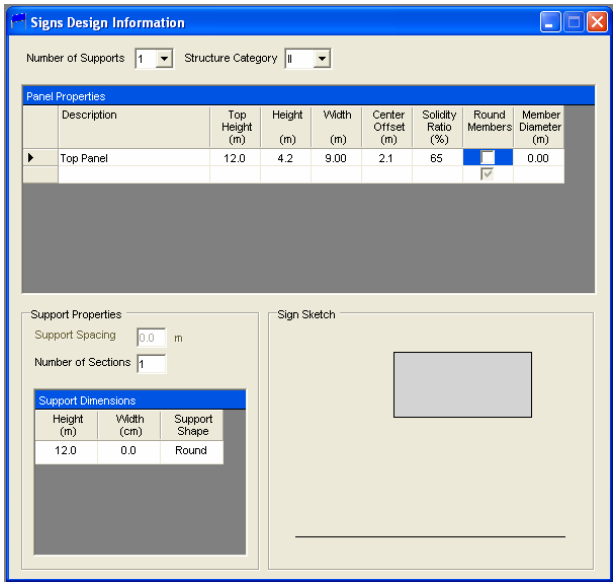


Figure A.10: Entering a Solidity Ratio

12. Next if the panel has typical round member openings then check this and press tab. Then enter the diameter of these opening. For this example there are no typical round member openings.

13. Next click in the “Number of Section” textbox and highlight the default value of one (1) as shown in Figure A.11. Next type 3 in the “Number of Sections” textbox as shown in Figure A.11 and press the tab key. (Note: Since there is only one support, the program disables the support spacing. Therefore this input is not applicable for this example.) The first cell in the “Support Dimensions” is now highlighted as shown in Figure A.11.

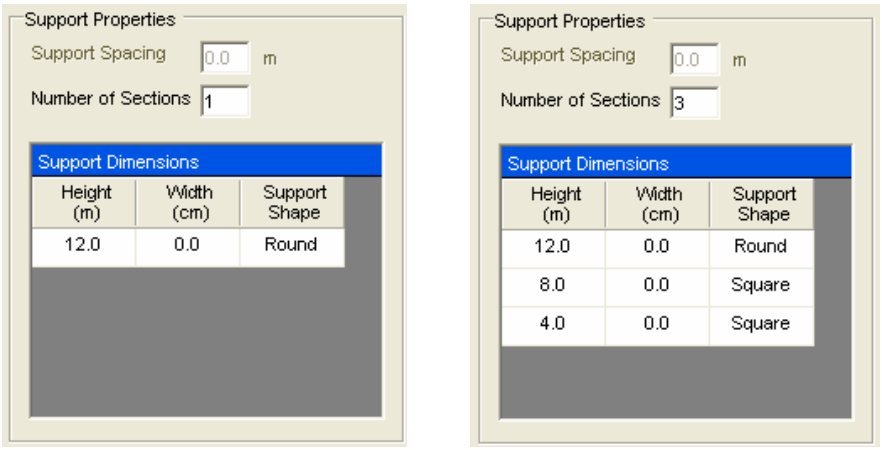


Figure A.11: Number of Sections

14. Notice the support segment heights are evenly spaced according to the top height of the highest panel. The program allows the user to change these dimensions to customize to the users sign structure. For this example, the supports are not taller than the “Top Panel”. Therefore the first section height remains 12 meters. Press the tab button. This highlights the width cell for the first segment as shown in Figure A.12. Enter a segment “Width” of 30 centimeters as shown in Figure A.12 and press the tab key. Click on the ▼ arrow in the current cell and choose a support shape of “Round” as shown in Figure A.12.

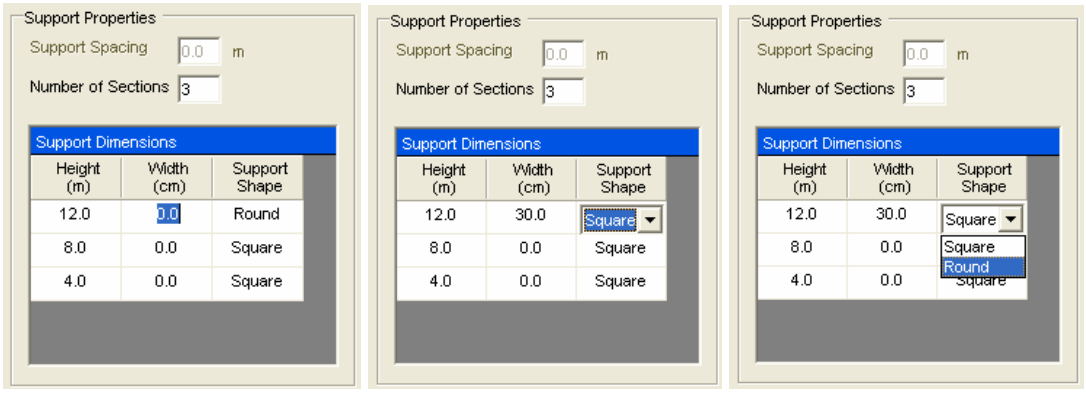


Figure A.12: Defining Support Properties

15. Now the second segment “Height” is highlighted. Enter a value of 6.0 meters for the second segment height, and press tab. Enter a segment “Width” of 50 centimeters and press tab. Choose a support shape of round and press enter. The input should look like Figure A.13.

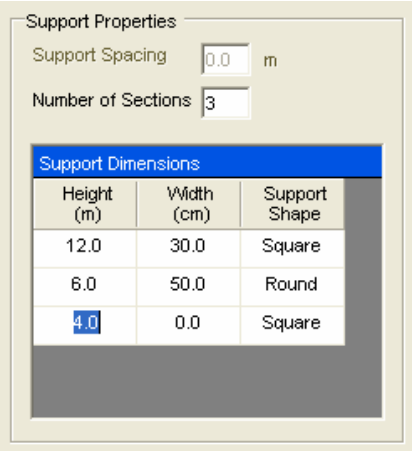


Figure A.13: Second Segment Support Dimensions

16. Enter a height of 3 meters for the third support segment and press tab. Enter a width of 70 centimeters and press tab. Leave the default support shape of square for the third support segment. The project should look like Figure A.14.

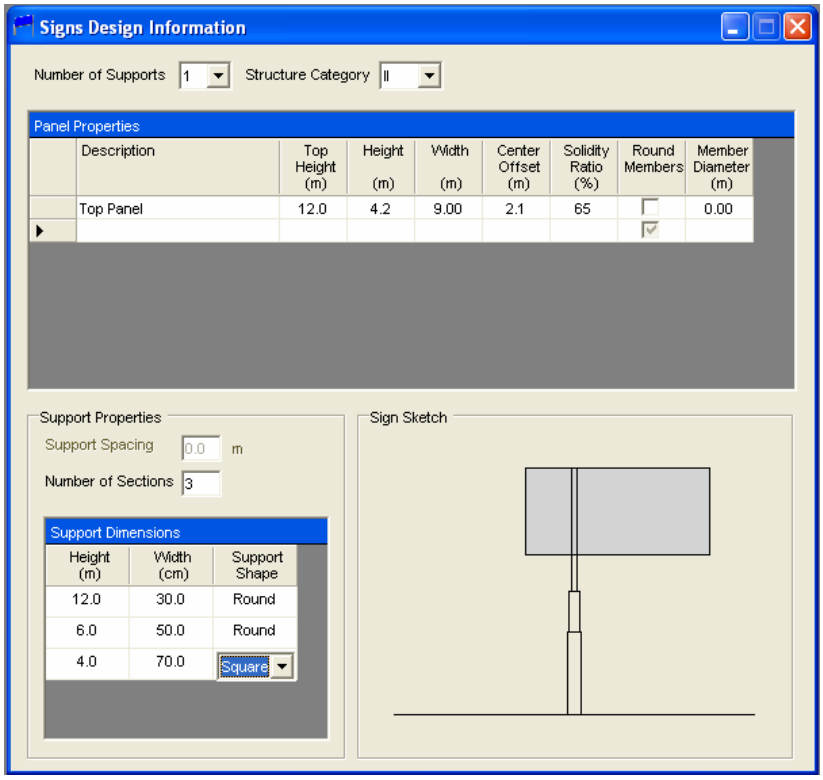


Figure A.14: Completed Sign Design Information

17. Next Click on Design > Input > Foundation Design Information shown in Figure A.15.

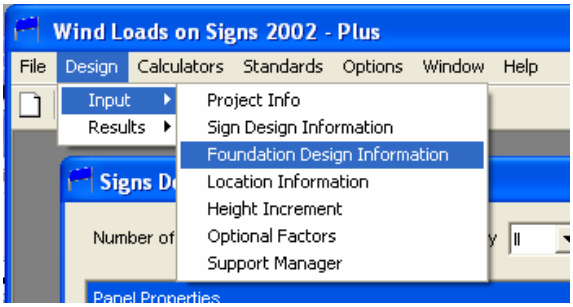


Figure A.15 Foundation Input Option

If you have zero supports selected in the Sign Input Window, this option will be disabled. Only pole supported signs can have a foundation design in this program.

18. The default soil type is “Fair”. This is an average and conservative soil type for most areas. For a foundation diameter, enter 140 centimeters as in Figure A.16.

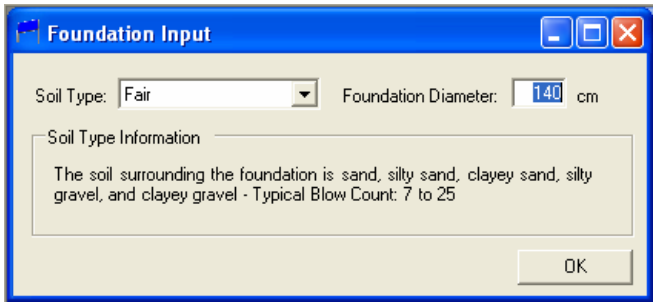


Figure A.16: Foundation Design Input

19. Next press the “Location Information” button as Figure A.17 shows.

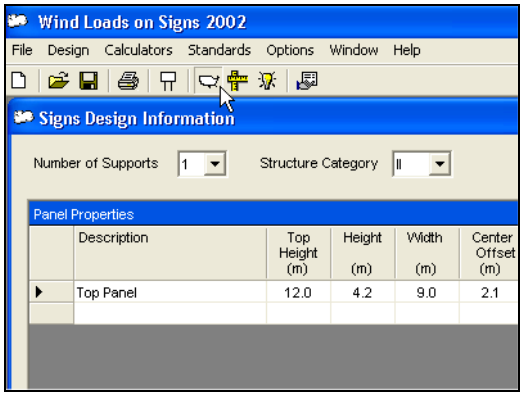


Figure A.17: Location Information Button

20. The location information window appears with the terrain exposure box highlighted. Press on the ▼ arrow and select “Terrain Exposure” B as Figure A.18 shows. Press the tab key. This will highlight the topographic shape. Since this example does not take into consideration topographic shape, press the tab key again.

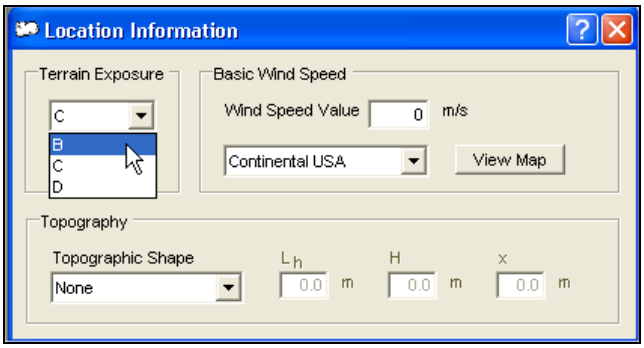


Figure A.18: Selecting the Terrain Exposure

21. The Wind Speed Value should now be highlighted. Click on the View Map button and a map of the US appears. Scroll over and down until the map shows Florida. Double click on the Florida Keys as Figure A.19 shows. This will hide the velocity map and automatically places the selected Basic Wind Speed in the Wind Speed Value textbox.

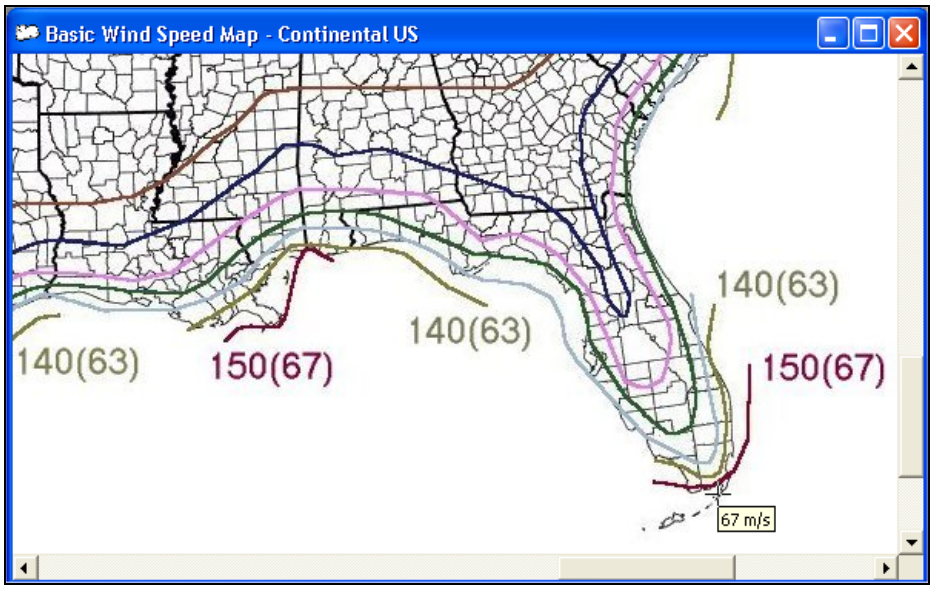


Figure A.19: Wind Speed Maps

22. Close the "Location Information" window by pressing the button in the top right hand corner. This closes the "Location Information" window. To change the values in this window simply follow step 17 to open the "Location Information" window again. (Note: Although the window is closed, WLSGN02 stores all the user-defined information.)

23. Now click the “Optional Factors” button as Figure A.20 shows.

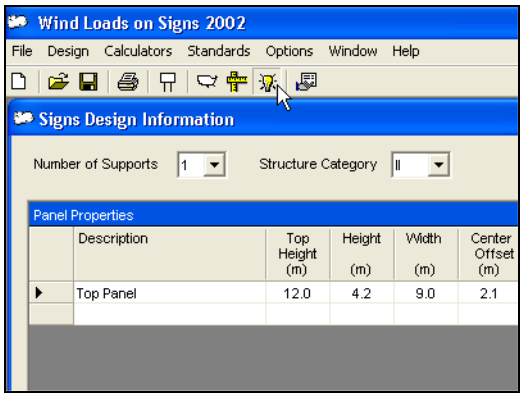


Figure A.20: Opening the “Optional Factors” Window

24. The “Optional Factors” window appears. The curser is in the damping ratio textbox. Enter a damping ratio of 5% and press tab. Enter a natural frequency of 0.7 Hz as Figure A.21 shows.

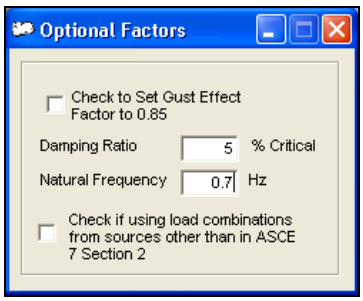


Figure A.21: Optional Factors

25. Close the optional Factors window by pressing on the button on the top right hand corner of the window.

26. All the required information is now complete for the sign structure design. The next step consists of running the MWFRS calculations. Simply press “Design/Results/All MWFRS Calculations” shown in Figure A.22. This brings up the result windows.

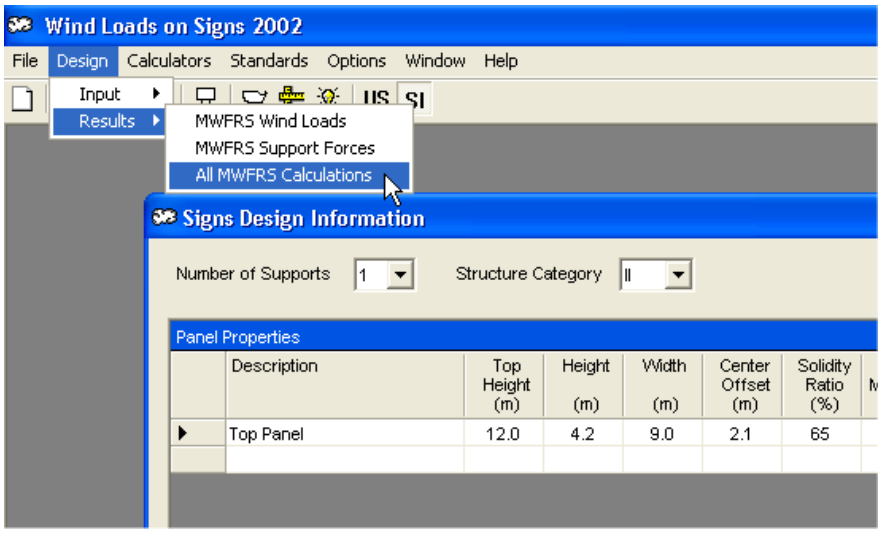


Figure A.22: Main Wind Force Resisting System Results Menu

27. The "Shear, Bending Moment, and Torque on Critical Section" (Figure A.23) window appears first. These values represent the internal forces acting on the critical support at the critical sections.

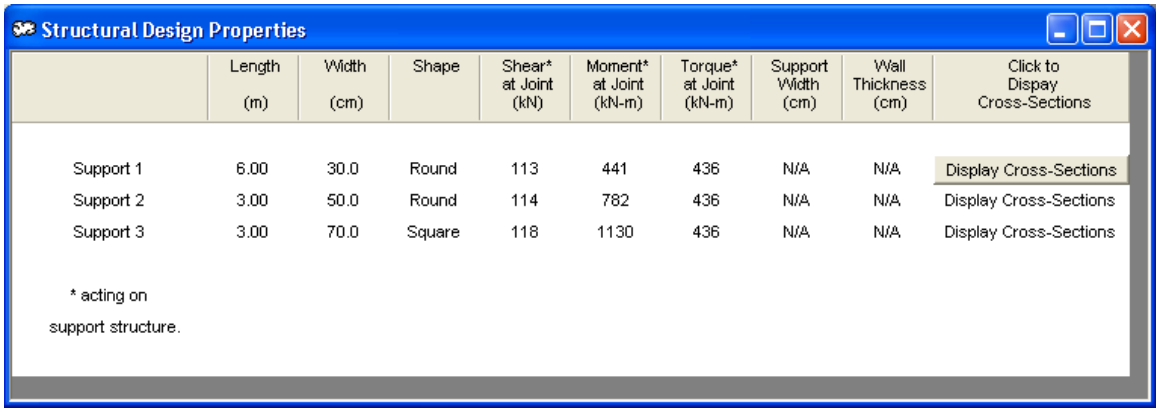
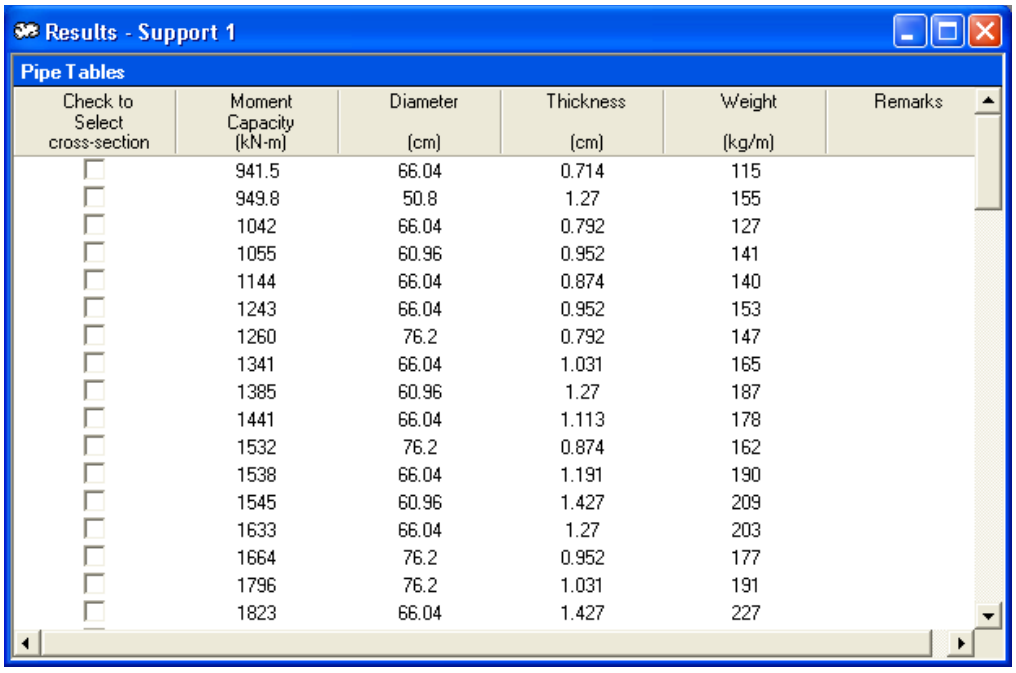


Figure A.23: "Shear, Bending Moment, and Torque at Critical Sections" Results Screen

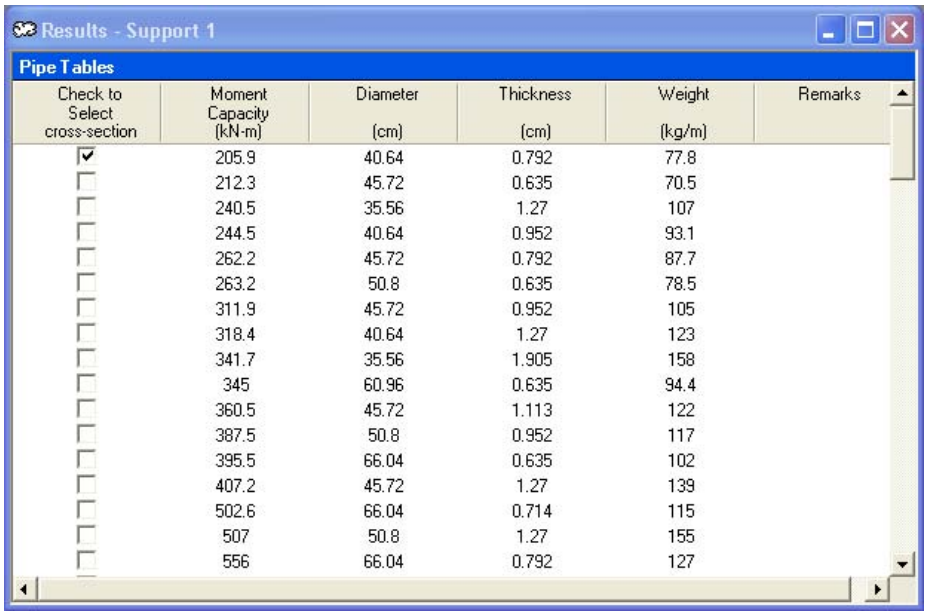
28. Click on the "Display Cross-Sections" button (Figure A.23). This displays all defined supporting structures that are adequate to resist the bending in the support due to the wind loads in the "Results" window (Figure A.24)



Check to Select cross-section	Moment Capacity (kN-m)	Diameter (cm)	Thickness (cm)	Weight (kg/m)	Remarks
☐	941.5	66.04	0.714	115	
☐	949.8	50.8	1.27	155	
☐	1042	66.04	0.792	127	
☐	1055	60.96	0.952	141	
☐	1144	66.04	0.874	140	
☐	1243	66.04	0.952	153	
☐	1260	76.2	0.792	147	
☐	1341	66.04	1.031	165	
☐	1385	60.96	1.27	187	
☐	1441	66.04	1.113	178	
☐	1532	76.2	0.874	162	
☐	1538	66.04	1.191	190	
☐	1545	60.96	1.427	209	
☐	1633	66.04	1.27	203	
☐	1664	76.2	0.952	177	
☐	1796	76.2	1.031	191	
☐	1823	66.04	1.427	227	

Figure A.24: Support Cross-Section Results Window

29. Select the first allowable size for this example as shown in Figure A.25 and close the window. This selection displays in the design report. Continue steps 28 and 29 until all supports segments cross-sections have been selected.



Check to Select cross-section	Moment Capacity (kN-m)	Diameter (cm)	Thickness (cm)	Weight (kg/m)	Remarks
☑	205.9	40.64	0.792	77.8	
☐	212.3	45.72	0.635	70.5	
☐	240.5	35.56	1.27	107	
☐	244.5	40.64	0.952	93.1	
☐	262.2	45.72	0.792	87.7	
☐	263.2	50.8	0.635	78.5	
☐	311.9	45.72	0.952	105	
☐	318.4	40.64	1.27	123	
☐	341.7	35.56	1.905	158	
☐	345	60.96	0.635	94.4	
☐	360.5	45.72	1.113	122	
☐	387.5	50.8	0.952	117	
☐	395.5	66.04	0.635	102	
☐	407.2	45.72	1.27	139	
☐	502.6	66.04	0.714	115	
☐	507	50.8	1.27	155	
☐	556	66.04	0.792	127	

Figure A.25: Selecting a Cross-Section

30. The second window is the MWFRS Force Details. To access this window click on "Window/ASCE 7-02 MWFRS Force Details" as Figure A.26 shows, or simply click on any portion of the window. This makes the MWFRS Force Details window the current window.

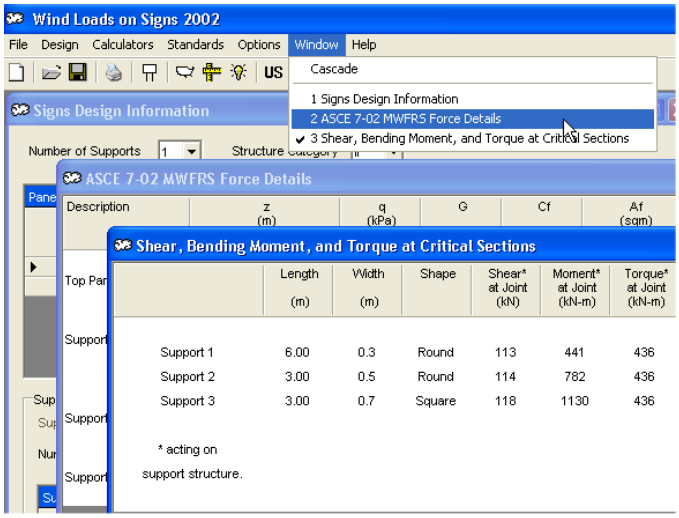


Figure A.26: MWFRS Force Details Window Access

31. This window shows MWFRS wind forces acting on the sign structure and the intermediate values used to calculate these forces. Double clicking on a value in this window brings up the calculation details for the value. Double click the top C_f value for the top panel as shown in Figure A.27.

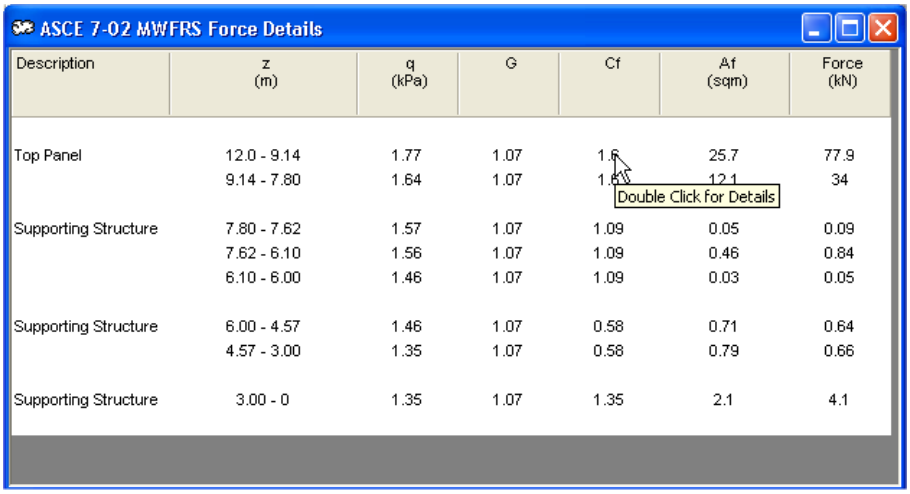


Figure A.27: ASCE 7-02 MWRFS Force Details Window

32. This brings up the detail screen for the external pressure coefficient as shown in Figure A.28. To print these details click the “Print” button on the bottom of the screen. Click the “Done” button to close the window.

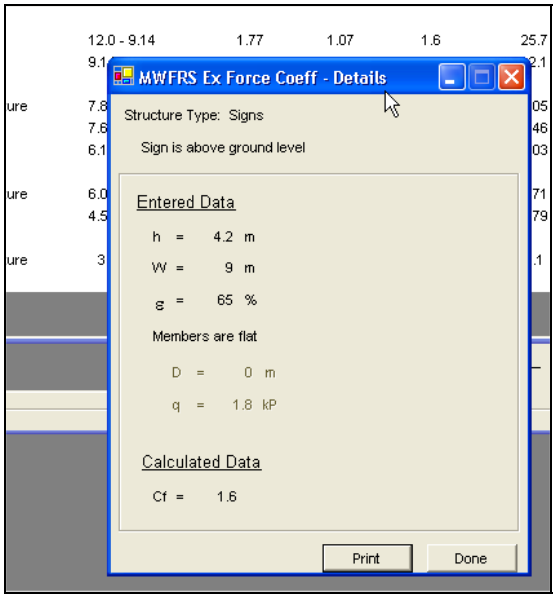


Figure A.28: MWFRS External Force Coefficient Details Window

33. The final window is the foundation design results. Displayed is the input information as well as the calculated depth, Figure A.29.

A.29: Foundation Results Display

34. Finally, to print a detailed report of the project, click “File/Print” as shown in Figure A.30.

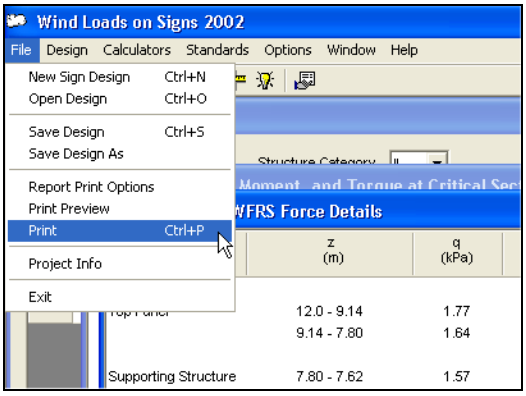


Figure A.30: Printing

35. This brings up the “Print Design” window shown in Figure A.31. This allows the user to select the pages to print. Leave all pages checked and press Ok.

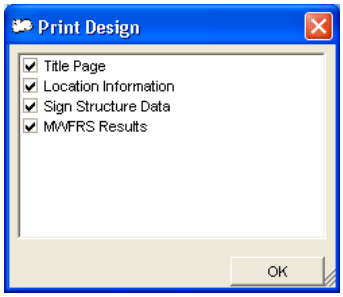


Figure A.31: Print Design Window

36. This brings up the “Print” window shown in Figure A.32. Select the current printer name and click Ok. This sends the detailed report to the printer. This completes the design example for WLSGN02.

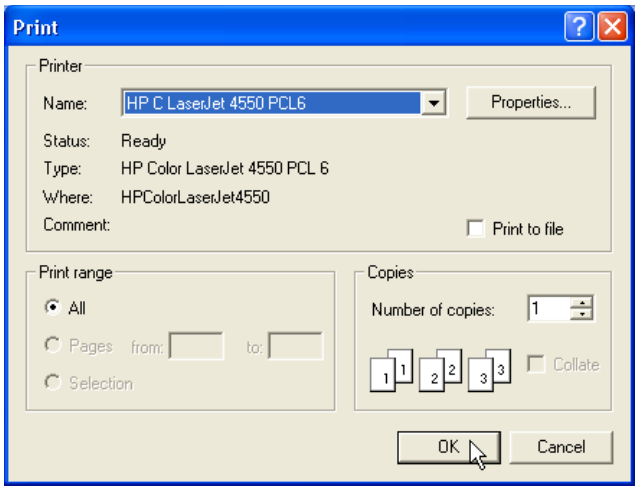


Figure A.32: “Print” Window