
# DISCLAIMER

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# INTRODUCTION

This is a Windows (tm) based analysis program for determining signal strain pole sizes in conjunction with the Ohio Department of Transportation's (ODOT) Standard Construction Drawing (SCD) TC-81.10. By using the resultant base moment from the program, an appropriate strain pole can be chosen from the Standard Construction Drawing. Output includes, among other results, stringing tension, attachment heights and base moments for each pole.

Multiple span configurations for several intersections may be entered into a single project file or separate files may be created for each intersection.

Six basic span wire configurations are included in the program and are identified by their general shape and the number of span segments.

| Span Configuration | Number of Segments | Number of Poles | Number of Bullrings |
|---|---|---|---|
| Simple | 1 | 2 | 0 |
| Wye | 3 | 3 | 1 |
| H | 5 | 4 | 2 |
| Delta | 6 | 3 | 3 |
| Hybrid | 7 | 5 | 3 |
| Box (4 tails) | 8 | 4 | 4 |

By using the additional input for combinations, the basic configurations can be combined to form other shapes; for example: 4 simple spans can form a box without tails, 2 wyes can form a box with 2 tails, etc.

The analysis program assumes a tension in the wire and calculates sags and attachment heights for each span segment. The elevation difference between the highest and lowest points in the system is calculated and compared to the required sag, which is part of the input data. The tension is adjusted until the required sag is

achieved and the pole results are calculated from the final tension.

# PREPARING INPUT

Typically, a scaled plan view of the signal installation must be available in order to obtain accurate distances and angles. The plan view should show the location of all signs and signals.

1. Select **File, Print Input Sheet**.
2. Select the types of span configurations being used and print out blank input forms.

The input form should be filled out except for some fields (i.e., sum of loads, sum of areas) that will be calculated by the program as the screen entries are made. Detailed instructions on the various types of required data follow under their respective heading.

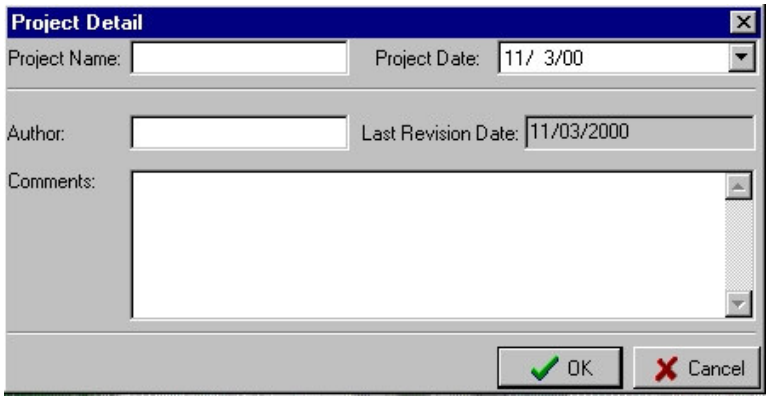
To start a new project, select **File, New**. If the program has an open file with unsaved data, you will be prompted by a dialog box to cancel or continue.

# APPLICATION, PROJECT DETAIL

Entry of project information is optional, but provides an area to enter dates, comments and the analyst's name. Multiple span configurations for several intersections may be entered into a single project file so a description of the overall project may be helpful to the analyst. The project detail information appears as the first page in any printout of the project solution.

1. Select **Application, Project Detail**.
2. Enter the information in the Project Detail window and select **OK** when finished.

Information in Project Detail may be edited at any time by repeating steps 1 and 2.

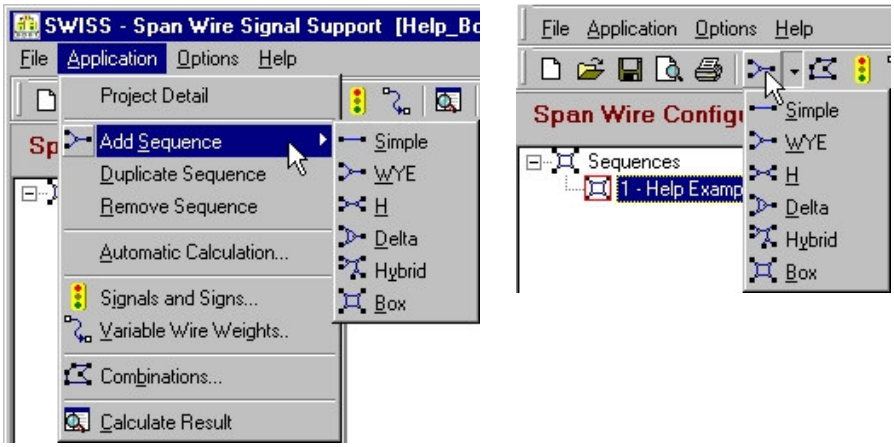



To have the project detail window automatically appear on selection of **File-New**, have this feature enabled under **Options, Parameters, Application Parameters**.

# APPLICATION, ADD SEQUENCE

To add a span configuration to the file:

1. Select **Application, Add Sequence**.
   (The icon in the tool bar for **Add Span Wire Configuration** can also be used.)
2. Select the type of span configuration to be added to the file.




A graphic representation of the span configuration will appear in the window on the right side of the screen. Also, the sequence number and span type will appear in the left window under "Span Wire Configuration". Data may now be input for this span.

# COMMON MISTAKES

## Data Validation

The user should always use the Application-Automatic Calculation feature when inputting a box or delta span.

With the Delta and Box span configurations, the interior closed geometry can be input inaccurately. For the box span, angles A2 + A4 + A6 + A7 should equal 360 degrees; and for the delta span, angles A2 + A4 + A6 should equal 180 degrees.

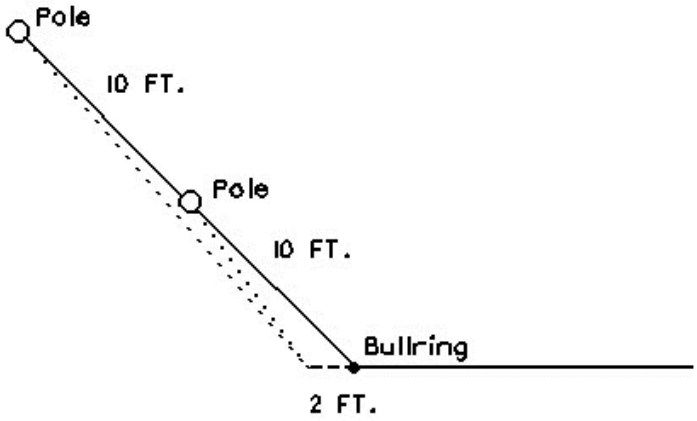
If a message is displayed in the bottom-right corner of the screen that **"data are not valid"** the Application-Automatic Calculation feature must be run. If the data is invalid, the pole to pole lengths in the Angles and Lengths tab will display "N/A". The program will still provide a span solution even if the data is not valid.

Typically when using the Application-Automatic Calculation feature, the user should use 4 lengths and one angle for the box span, and 3 lengths for the delta span. This most closely resembles how the contractor will construct the span on the ground by assembling the interior span lengths.

## Short Tails on a Box Span

The "tail" is the section in the box span configuration from the pole to the nearest bullring. Tails on a box span configuration that are less than 10 feet should be avoided, if possible. The program can analyze the short tails and a suitable span configuration can be designed with them; however, the problem occurs if the actual construction of the span is not built exactly according to the intended design.

In the illustration below, if the contractor installs one of the interior sections of the box span 2 feet longer or shorter than designed, the change in the angles will be greater as the tail gets shorter. For very short tails, the spans should be connected directly to the pole without using a tail. Various combinations of wyes, and simple spans can be used to form box shaped span configurations




## Rotation of Pole No. 2

For the delta span and box span configurations, the program solution may require that pole #2 be rotated. This rotation requires revising the input angle (A5 for delta, A8 for box) so that the span segment attached to pole #2 rotates around the bullring in the direction stated in the program output (clockwise/counter clockwise). The **user should note** that the program will "calculate results" for the span analysis solution using the rotated pole #2 position.

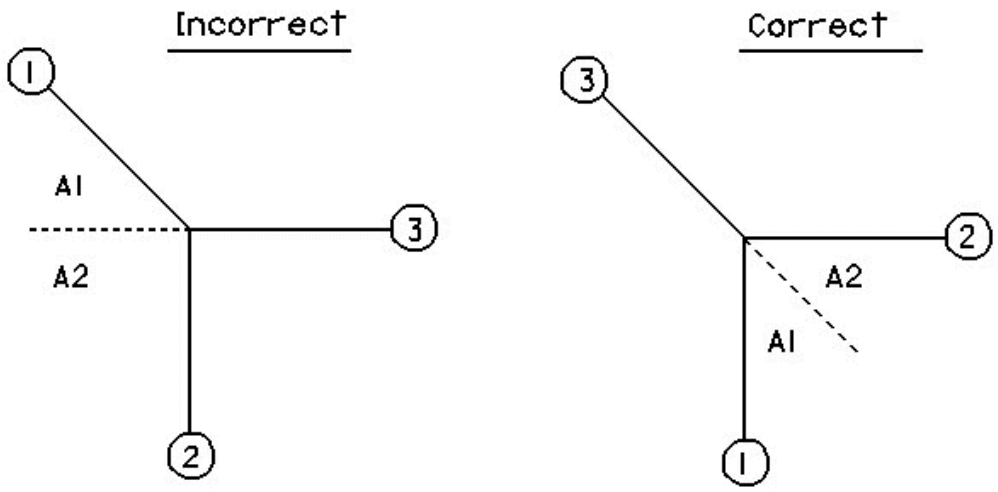
If the input geometry is such that pole #2 is within one degree of the balanced position, the program solution will issue the message "system is in balance"; otherwise, the message will be "For system balance rotate pole 2 __ degrees clockwise/counterclockwise".

A feature is available with the box span configuration that enables the program solution to show the adjusted angles that will result if angle A8 is not modified and then solve the problem based on these adjusted angles. This feature is sometimes referred to as "warp configuration".

The user should first "calculate results" with the adjust box angles disabled (not checked). If pole no. 2 does not need to be rotated very far (10 degrees or less) for system balance, pole no. 2 can be moved or the warp configuration can be enabled to compare base moments. If a large rotation for pole no. 2 is reported in the results, the user should redesign the entire span adjusting all the pole angles, rather than making a large rotation at pole no. 2 or "warping" the span severely.

## Orientation of the Wye Span

In the Wye span configuration, the angles A1 and A2 should not be allowed to approach 0 degrees or 90 degrees. Two identical Wye spans are illustrated below. Note that angle A2 is very close to 90 degrees in the "Incorrect" span and will produce an error message. By choosing different input pole numbers as shown in the "Correct" span, the angles can be shifted to a different portion of the span producing angles in the middle range between 0 and 90 degrees.



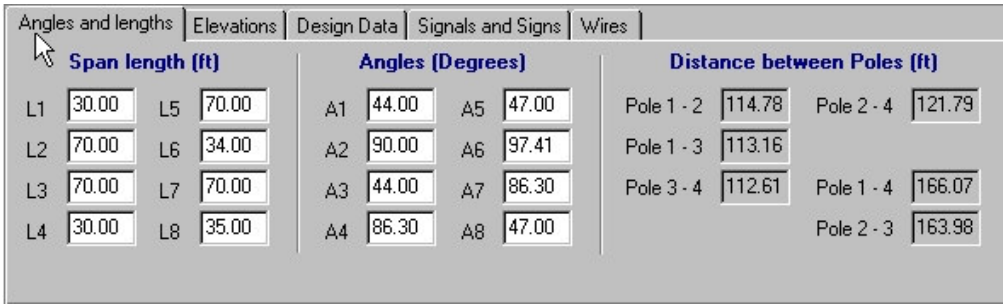

# IDENTIFICATION

Above the graphic representation of the span is an box to enter **Identification** data. This should consist of the intersection name or pole numbers from the project plans to identify the span location.

Note that the sequence number is automatically assigned by the program in the order that span configurations are added. The sequence number is used for internal calculations by the program when two span configurations are attached to the same pole by entering combination data.

# ANGLES AND LENGTHS

By selecting the **Angles and Lengths** tab located below the graphic representation of the span, the length of each span and the angles between certain spans are entered to define the geometry of the span configuration.



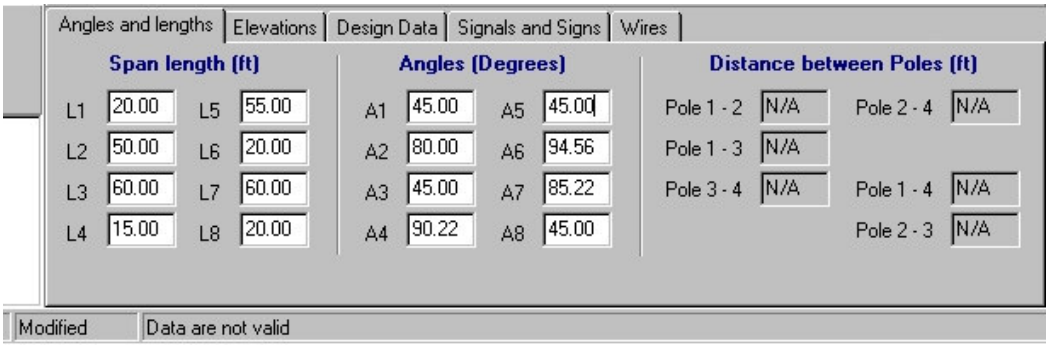

The length of each span segment is entered in feet. The span length is the horizontal distance from pole to pole, pole to bullring, or bullring to bullring depending on the span configuration. A number greater than zero must be entered for each length required in the configuration. A small value (0.1 foot) may be used for a span length attached to a pole to simulate the absence of the span segment.

Angle measurements are entered in degrees. Usually accuracy greater than the nearest whole (1.0) degree is not practical and should not affect results. Entries with a value greater than zero must be made for each angle required for the configuration.

For box and delta spans, a minimum number of lengths and angles can be entered and the program will calculate some of the remaining parameters. See Application, Automatic Calculation .

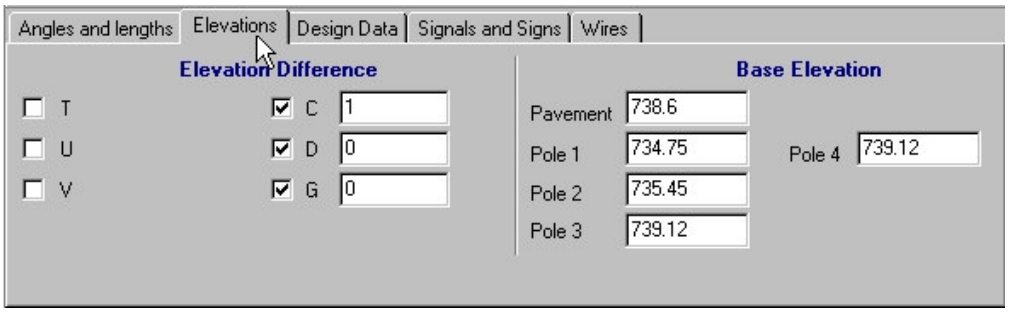
The distance between poles is calculated automatically by the program. The longest distance can be used to calculate the minimum and maximum sags. If using a box or delta span and the distance between poles appears as "N/A", and a message at the bottom of the screen states "data are not valid", the user must use the

**Application, Automatic Calculation** feature referenced in the paragraph above.




# ELEVATIONS

By selecting the **Elevations** tab located below the graphic representation of the span, pole base and pavement elevations, and elevation differences between the two points indicated on the graphic representation of the span may be entered. All elevation entries are optional.




If no entries are made for pole base and pavement elevation, it will be assumed that all elevations are equal. If relative elevations are used, negative entries may be made. The pavement elevation will be used with the clearance, ground to wire and the sag to calculate a pole attachment height. The pavement point used for the pavement elevation should be checked with the low point in the span or other span load locations to determine if the locations are proximate.

An entry for elevation differences will fix the relative elevation of the two points indicated on the graphic representation of the span configuration. If no entries are made for elevation differences, it will be assumed that all bullring elevations are equal and most pole attachment heights will be calculated independently.

A positive or negative value for T, U, V, or Y establishes which attachment point is higher according to the following convention:

| Elevation Constant | Poles Affected | Highest Attach. Point if Positve |
|---|---|---|
| T | 1 and 2 | 2 |
| U | 1 and 3 | 3 |
| V | 3 and 4<br>(3 and 2, Delta Span) | 4<br>(2) |
| Y | 4 and 5 | 5 |

If a value is entered for the parameters C, D or G, the elevation difference of the affected bullrings will be fixed. A positive value means that the beginning of the span segment is above the end (the arrow points "downward");

a negative value means the beginning of the span segment is below the end (the arrow points "upward").

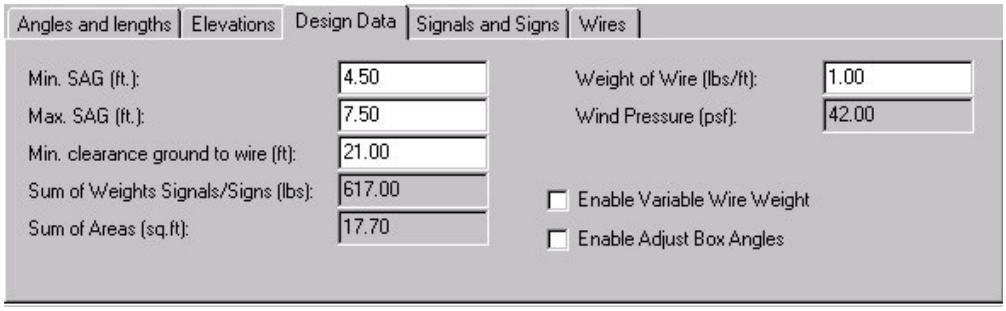
It is possible to specify too many values for the elevation difference parameters. If this occurs, the program will bring up a dialog box explaining the conflict. One of the parameters must be unchecked before the other parameter can be entered. The following elevation differences cannot be input together:

| Span Configuration | Elevation Differences |
|---|---|
| H | U and C |
| Delta | More than 2 of the 4 (U, V, C, D) |
| Box | More than 3 of the 6 (T, U, V, G, C, D) |
| Hybrid | More than 2 of the 4 (U, V, C, D) |

The elevation difference parameter allows the span installation to be designed for some specific constraints. Some examples of constraints are reuse of existing poles, overhead utility conflicts, and roadway superelevations.

# DESIGN DATA

By selecting the **Design Data** tab located below the graphic representation of the span, miscellaneous data can be entered for the span.




**Min. Sag (ft.)** - The value for this input entry is figured by multiplying the greatest horizontal distance between any two poles times a percentage, usually 3%. The distance between any two poles can be found by selecting the Angles and Lengths tab. The strength of the pole will usually be determined from this entry. If the minimum sag value is too small, an error message will be generated when the results are calculated.

**Max. Sag (ft.)** - The value for this input entry is figured by multiplying the greatest horizontal distance between any two poles times a percentage, usually 5%. The distance between any two poles can be found by selecting the Angles and Lengths tab. The height of the pole will usually be determined from this entry.

**Min. Clearance Ground to Wire (ft.)** - This input represents the minimum clearance from the pavement to the wire attachment point of the lowest sign or signal. This value should equal the required clearance from pavement to the bottom of signal head or sign, plus the total signal head or sign height, including attachment hardware.

To change the program's default setting, select **Options, Parameters, Design Data**.

**Sum of Weights Signals/Signs (lbs.)** - The program automatically updates this field as signals and signs are added.

**Sum of Areas (sq. ft.)** - The program automatically updates this field as signals and signs are added.

**Weight of Wire (lbs./ft.)** - The average combined weight of the electrical cables and the messenger wire can

be specified. This weight will be used on all span segments. ODOT typically uses a value of 1 lb/ft over all span lengths unless there is a large number of cables due to loop detector lead-in cables or pedestrian cables. In this case, the weight can be increased to 1.5 lbs/ft. See Wire Weights to estimate the average weight of the cables on a span.

To change the program's default setting, select **Options, Parameters, Design Data**.

**Wind Pressure (psi)** - The value shown in this field, in pounds per square foot, represents the wind pressure created on signal heads by the design wind velocity. ODOT typically uses a value of 42 psf.

To change the program's default setting, select **Options, Parameters, Design Data**.

**Enable Variable Wire Weight** - Wire weights can be specified for each segment between signals and signs on any span. Select the box so that a checkmark appears in it. See Variable Wire Weights for information on using this feature.

If this feature is not selected, the value specified in the **Weight of Wire** field on this screen will be used uniformly on all span segments.

To change the program's default setting, select **Options, Parameters, Design Data**.

**Enable Adjust Box Angles** - This feature only appears with a box span design. With this feature's box not checked, the calculation results may state that pole no. 2 should be rotated a certain number of degrees to obtain system balance. With the box checked, the program will twist or "warp" the span configuration to bring the system calculations into balance.

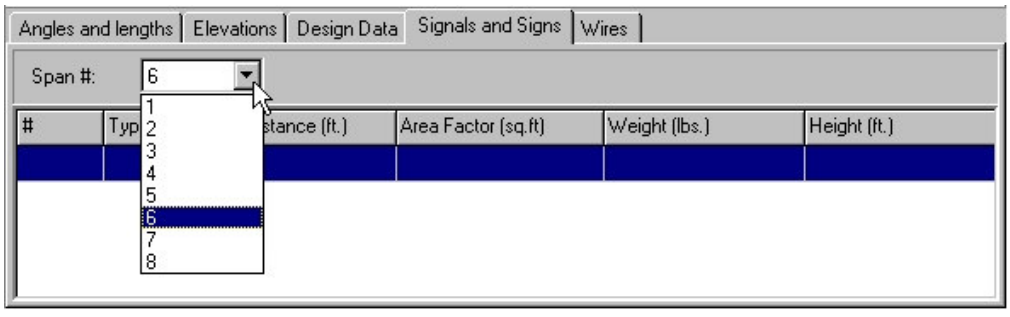
The user should first run the calculations result with the adjust box angles disabled (not checked). If pole no. 2 does not need to be rotated very far (10 degrees or less) for system balance, the warp configuration can be enabled to compare base moments. If a large rotation for pole no. 2 is reported in the results, the user should redesign the entire span adjusting all the pole angles, rather than making a large rotation at pole no. 2.

# APPLICATION, SIGNALS AND SIGNS

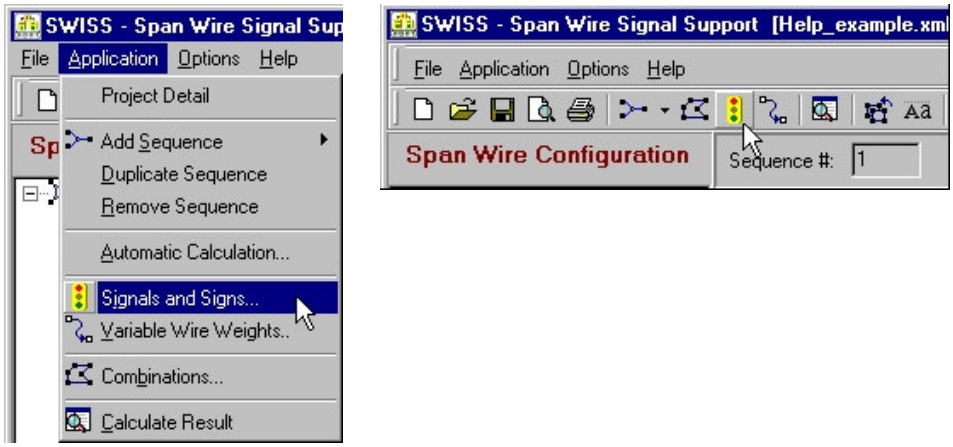
After the span lengths have been entered into the program, the signals and signs can be placed on each span length in various configurations.

To select a span and initialize the "Signals and Signs Distribution" window for adding, updating or removing signal heads and signs:

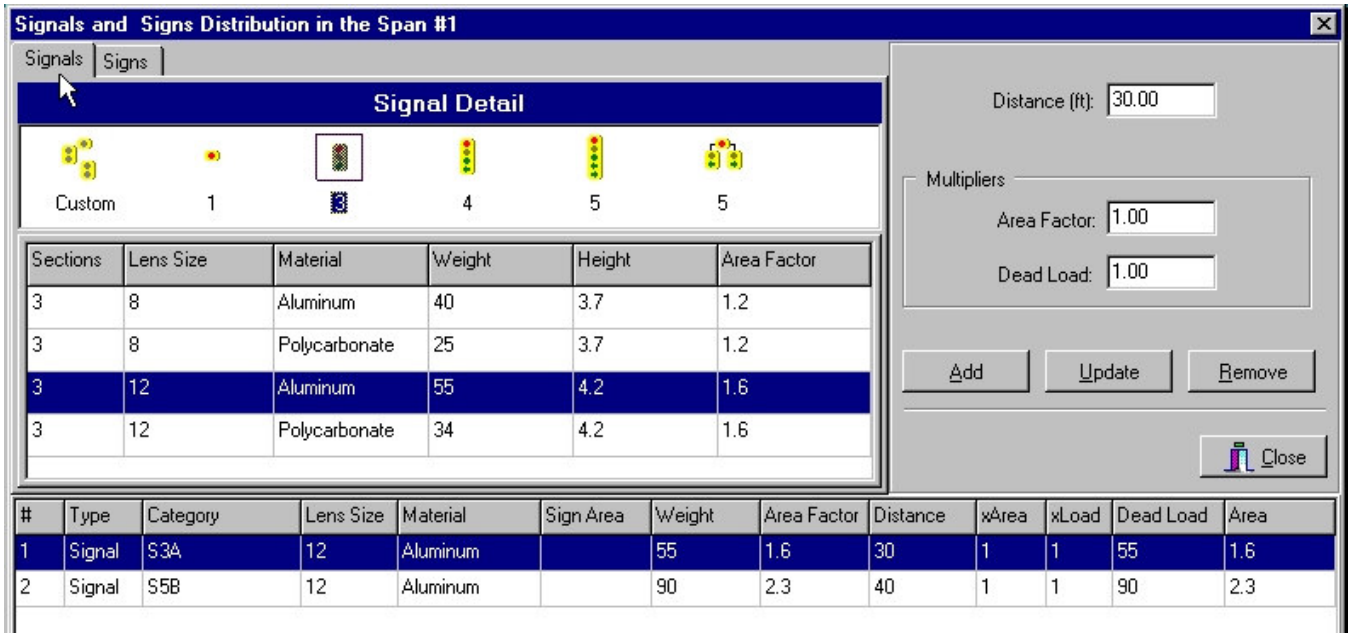
1. Select the **Signals and Signs** tab located below the graphic representation of the span.
2. Use the pull down menu to select the span number to be used.




3. Select **Application, Signals and Signs**.
   (The icon in the tool bar for **Edit Signals and Signs** can also be used.)




Choose the **Signals** tab in the upper left corner of the screen to add, update or remove signals.




To **add** signals from within the "Signals and Signs Distribution" window:

1. Select the number of lenses, or Custom in the signal head at the top of the window.
2. Select the line containing the desired signal head.
3. Enter the distance from the pole or bullring.
4. Enter the area factor multiplier and dead load multiplier. By using the multipliers, 1, 2, 3 or 4 way signal heads can be created. The multipliers will be applied to the values listed for the selected signal head or sign.
5. Select the **Add** button. If the Update button is displayed instead of the Add Button, select the **Reset** button then the **Add** button.

To **create** Custom signals from within the "Signals and Signs Distribution" window:

1. Select the **Custom** signal head at the top of the window.
2. Select the **Add Signal** button below the Custom signal head.
3. Enter information in the Custom Signal window and select **OK**.
4. To add a custom signal head to a span, see steps 1-5 under "To add signals".

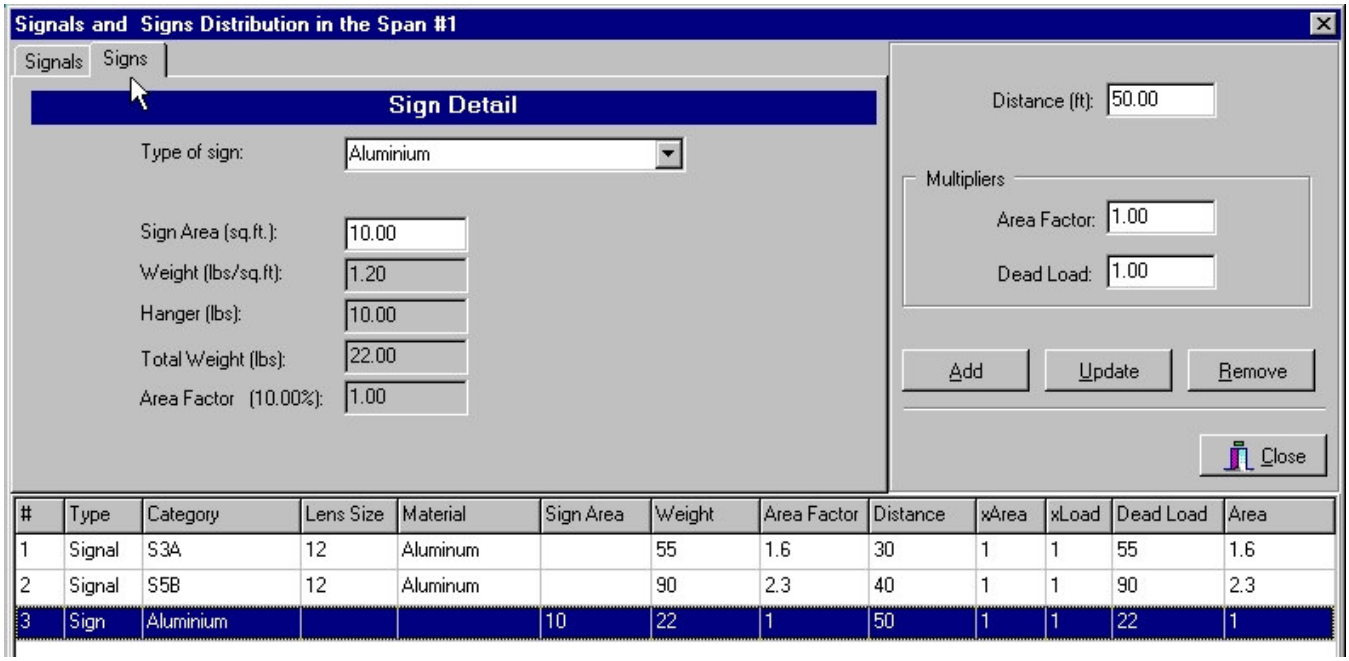
To **remove** signals from within the "Signals and Signs Distribution" window:

1. Select the line of information in the bottom portion of the window that is to be removed.
2. Select the Remove button.

To **update** signals from within the "Signals and Signs Distribution" window:

1. Select the line of information in the bottom portion of the window that is to be updated.
2. Select the signal head for the new update, even if it is to remain unchanged.
3. Revise the distance and multipliers, if necessary.
4. Select the **Update** button.

Choose the **Signs** tab in the upper left corner of the screen to add, update or remove signs.




| # | Type | Category | Lens Size | Material | Sign Area | Weight | Area Factor | Distance | xArea | xLoad | Dead Load | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Signal | S3A | 12 | Aluminum | | 55 | 1.6 | 30 | 1 | 1 | 55 | 1.6 |
| 2 | Signal | S5B | 12 | Aluminum | | 90 | 2.3 | 40 | 1 | 1 | 90 | 2.3 |
| 3 | Sign | Aluminium | | | 10 | 22 | 1 | 50 | 1 | 1 | 22 | 1 |

To **add** signs from within the "Signals and Signs Distribution" window:

1. Select the type of sign from the pull down menu at the top of the window.
2. For aluminum, illuminated or blankout signs, enter the sign area. For a custom sign, enter the sign area, weight (lbs/sq. ft.) and the hanger weight.
3. Enter the distance from the pole or bullring.
4. Enter the area factor multiplier and dead load multiplier. Back to back signs can be created by using an area factor multiplier of 1 and a dead load multiplier of 2. The multipliers will be applied to the values listed for the selected sign.
5. Select the **Add** button. If the Update button is displayed instead of the Add Button, select the **Reset** button then the **Add** button.

To **remove** signs from within the "Signals and Signs Distribution" window:

1. Select the line of information in the bottom portion of the window that is to be removed.
2. Select the Remove button.

To **update** signs from within the "Signals and Signs Distribution" window:

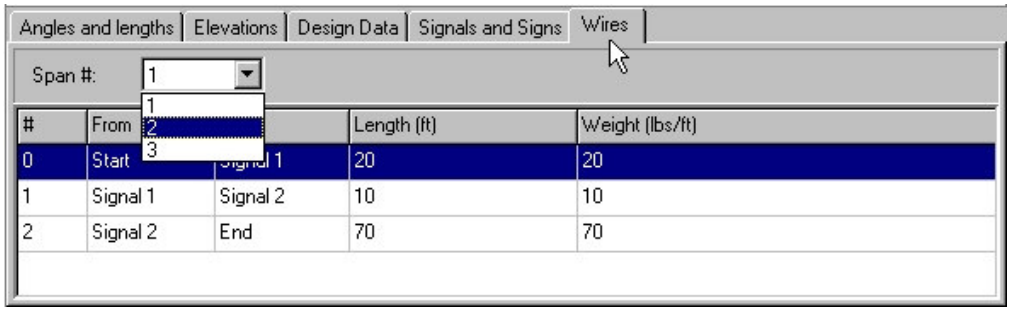
1. Select the line of information in the bottom portion of the window that is to be updated.
2. Select the sign for the new update, even if it is to remain unchanged.
3. Revise the distance and multipliers, if necessary.
4. Select the **Update** button.

To work on a different span number, **Close** the "Signals and Signs Distribution" window and use the pull down menu to select a new span number.

# WIRES

By selecting the **Wires** tab located below the graphic representation of the span, the weight of the wires for each span segment between signals and signs can be viewed. The various spans in the configuration are selected from the pull down menu. The value for the wire weight is set under the **Design Data** tab for Weight of Wire and is uniformly applied to all span segments.

The wire weights can be revised for any segment by using the variable wire weight feature. See Application, Variable Wire Weights.




# APPLICATION, COMBINATIONS

Any two span configurations may be combined to provide results for more complex arrangements.

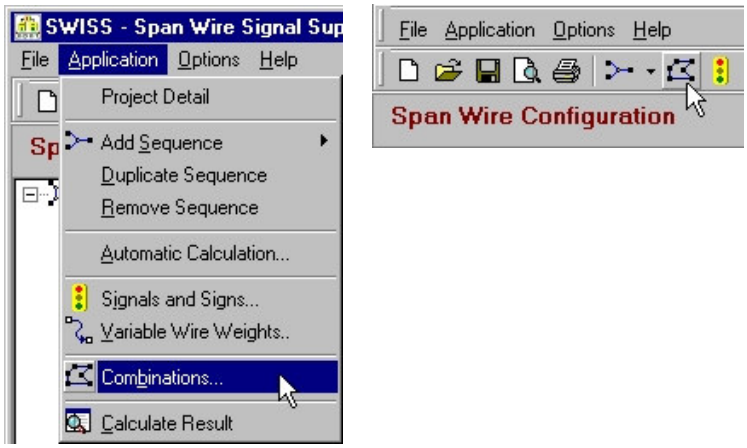
Each span configuration (sequence) is input separately and the combination data is entered to identify common poles. A pole can only be common to two span configurations.

Entries are made for the pole number and problem sequence number for the common pole from each span configuration to be combined, and the angle between the attached span lengths.

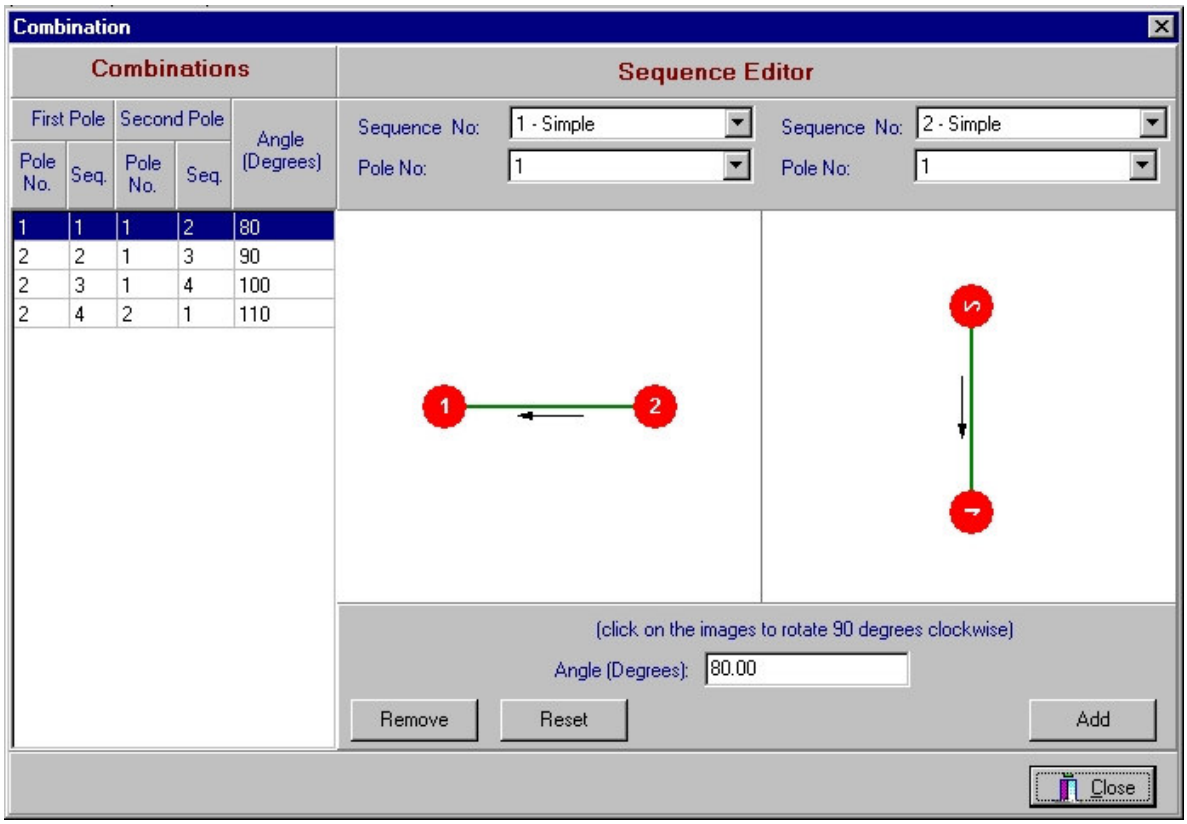
The output will list the input poles and angles, the resultant base moment, and line of action of the resultant moment. Other results for the pole such as attachment elevations, sag in the attached spans, etc., are obtained from the basic configuration problems. Since the attachment elevations of the two wires will not necessarily be equal, the pole height must be based on the highest attachment elevation.

To add, revise or remove a line of combination data:

1. Select **Application, Combinations**.
   (The icon in the tool bar for **Edit Combinations** can also be used.)




2. The following Combinations window will appear:




To **add** a line of combination data:

1. In the **Sequence Editor** window, if the **Update** button (lower right) is visible, select **Reset** so that the **Add** button is visible.
2. In the **Sequence Editor** window, use the pull down menu to select each span and pole number.
3. Enter the angle data and select **Add**.
4. To continue adding pole combinations, select **Reset** and repeat steps 3 and 4.

To **edit** a line of combination data:

1. In the **Combinations** window, select the line of data representing the combination to be revised. The

**Sequence Editor** window should reflect this selection.
2. In the **Sequence Editor** window, use the pull down menus to revise the sequence or pole number, or revise the angle.
3. Select **Update**.

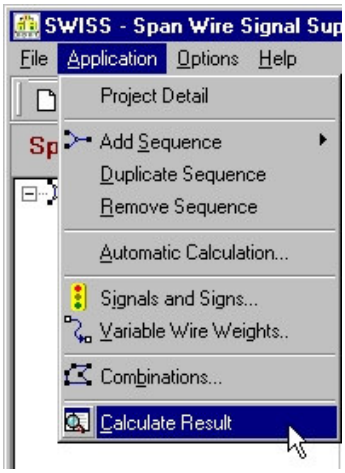
To **remove** a line of combination data:

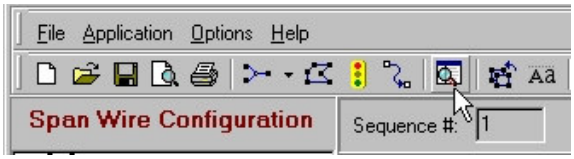
1. In the **Combinations** window, select the line of data representing the combination to be removed. The **Sequence Editor** window should reflect this selection.
2. In the **Sequence Editor** window, select **Remove**.

The graphic representation of the spans in the Sequence Editor window can be rotated to make it easier to illustrate the combinations. To rotate a span, left click the mouse in the window to be rotated.

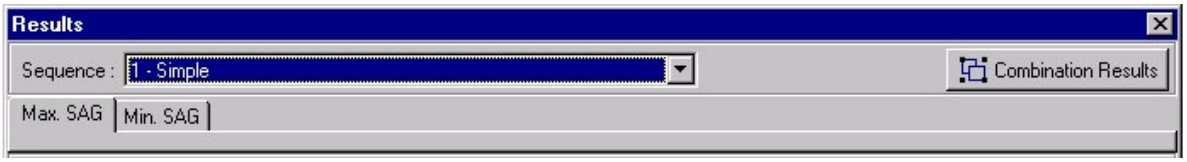
# APPLICATION, CALCULATE RESULT

After entering span data for all configurations in a problem, the results can be shown by selecting **Application, Calculate Results** or selecting the icon in the tool bar for **Display Results**.

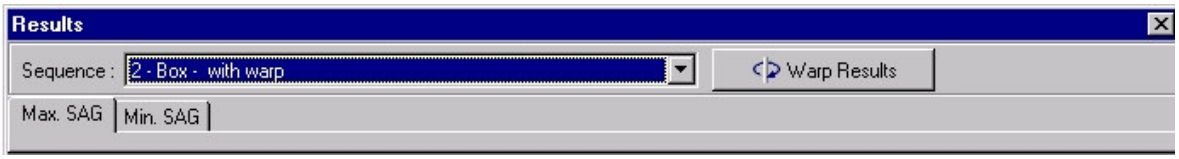



If the top right corner of the **Results** window shows a **Combination Results** button, also see the section on Combination Results.




If the top right corner of the **Results** window shows a **Warp Results** button, also see the section on Warp Results.



At the top of the **Results** window, use the pull down menu to select the problem **Sequence** results to view and select the tab for **Max. Sag** or **Min. Sag**.

Results

Sequence : 1 - WYE

Max. SAG | Min. SAG

**Span Values** Calculated Design Factor: 1.71 Warning: using default 1.8

| | Span 1 | Span 2 | Span 3 |
|---|---|---|---|
| Tension Relations | 0.67076 | 0.69635 | 1.00000 |
| Elevation Difference (ft) | 6.91 | 6.91 | 6.91 |
| Reaction at End of Span (lbs) | -24.22 | -13.64 | 37.86 |
| Distance from End to Low Point (ft) | 24.22 | 13.64 | 0.00 |
| SAG below End of Span (ft) | 0.34 | 0.10 | 0.00 |

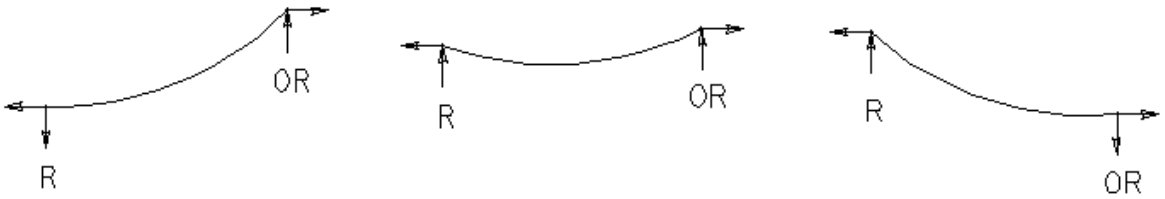
**Calculated Design Factor:** The calculated design factor is the ratio of the dead load to the resultant of the dead load and wind load (based on wind pressure and area as input) increased by 10 percent.

**Tension Relations:** These values are the relationship of the tension in each span segment to the tension in span segment 3. In a simple span, the value will always be 1.

**Elevation Difference:** These values are the difference in elevation of the START and END of each span segment. START and END are defined by the direction of the arrow on the input form. Positive numbers mean the END is below the START, negative numbers the opposite.

**Reaction at End of Span:** These values are the vertical reactions (R) at the END of each span segment. A negative number indicates that the force is acting upward on the wire and that there may be a low point in that segment. For the purpose of this program, a low point is defined as occurring if a point along the span segment drops below both the START and the END.

If R is negative, the opposite reaction (OR) is calculated, and if that force also acts upward, the low point is calculated. The three free body diagrams below illustrate that both reactions must act upward on the wire for a low point to occur.>




**Distance from End to Low Point:** A number other than zero is the horizontal distance from the END of the span to the low point in the span segment. START and END are defined by the direction of the arrow on the input form.

**Sag below End of Span:** A number other than zero is the elevation difference between the END of the span and the low point in the segment. START and END are defined by the direction of the arrow on the input form.

**Pole Values** Maximum Wire Load (lbs): 2393.46 Distance between Highest and Lowest Points (ft) : 9.00

| | Pole 1 | Pole 2 | Pole 3 | Pole 4 |
|---|---|---|---|---|
| Stringing Tension (lbs) | 1267.114 | 1290.456 | 1295.728 | 1303.294 |
| Attachment Height above Pole Base (ft) | 32.73 | 29.48 | 33.31 | 31.02 |
| Attachment Elevation (ft) | 767.48 | 768.60 | 767.76 | 768.49 |
| Base Moment (ft/lbs) | 74660.24 | 68476.76 | 77686.77 | 72781.55 |

**Maximum Wire Load:** This value is the stringing tension multiplied by the design factor. This value can be looked at with regard to the minimum breaking strength of the messenger wire.

**Distance between Highest and Lowest Points:** This value will be within 0.01 foot of the sag input value.

**Stringing Tension:** This is the horizontal load applied to the pole because of the dead load only.

**Attachment Height above Pole Base:** This value is the height above the pole base where the span attaches to the pole.

**Attachment Elevation:** This is the attachment height plus the base elevation.

**Base Moment:** This is the moment created by the stringing tension at the given attachment height multiplied by the design factor. When using calculations for the "Min. Sag.", this value can be compared to ODOT Standard Construction Drawing TC-81.10 to select a pole size.

**Height of Each Signal or Sign Attachment Point above the Lowest**

| | Span 1 | Span 2 | Span 3 |
|---|---|---|---|
| Weight 1 | 1.16 | 1.86 | 3.17 |
| Weight 2 | 0.00 | 0.47 | 2.11 |

OK

**Height of Each Signal or Sign Attachment Point above the Lowest:** These values represent the differences in the elevations of the attachment points on the span wire for all signals and signs. The lowest attachment point is set to zero and the elevation differences are calculated for the others.

The zero value location is not necessarily the low point in the span configuration. To determine if the low point occurs at the zero value signal/sign, compare the value for "Distance from End to Low Point" with the input locations for signals and signs.

# LUMINAIRES AND BRACKET ARMS

Even a long luminaire bracket arm (30 feet) will only have a small effect on the pole's base moment when compared to the effect of the span wire. The user can quickly figure the effect by adding 8,000 ft/lbs to the pole's base moment for the use of a 30 ft. bracket arm and luminaire.

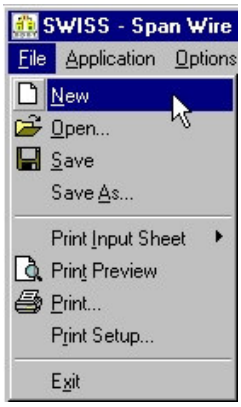
If a smaller bracket arm length is used, the following guidelines can be followed to calculate the moment caused by the luminaire and bracket arm:

1. The weight of the luminaire is approximately 75 pounds.
2. The 2.5 inch galvanized pipe in the bracket arm weighs aproximately 5.8 lbs/ft. Two pipes form a bracket arm (approx. 12 lbs/ft).
3. Use 1/2 the arm length for the point load of the bracket arm.

4. The luminaire and bracket arm moment is [75L + (12L x L/2)] where L equals the bracket arm length.

If long bracket arms are used, it is recommended that a minimum pole size of Design 5 be used. The deflection rate of smaller poles may produce poor aesthetics with the bracket arm appearing to bend towards the ground. The pole strength of a pole smaller than Design 5 may be adequate, but the aesthetics will look bad.

# FILE MENU




**File, New**
Start a project with a blank file. If the program has an open file with unsaved data, you will be prompted by a dialog box to cancel or continue.

**File, Open**
Open an existing project file. If the program has an open file with unsaved data, you will be prompted by a dialog box to cancel or continue.

**File, Save**
Save a span analysis problem. If this is the first time you are saving this file, the **Save As** dialog box will appear. Enter a name for the file, select the location where you want to save the file and select the **Save** button.

**File, Save As**
Save the file with a different name. The **Save As** dialog box will appear. Enter a name for the file, select the location where you want to save the file and select the **Save** button.

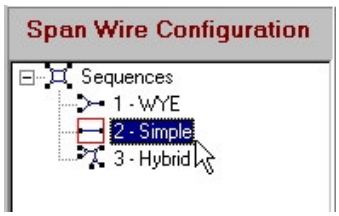
**File, Print Input Sheet**
Prints out a blank input sheet for any of the span configurations. Use the pull down menu to select a span type.

**File, Print Preview**
Displays the problem results on the screen in the same format as a printout.

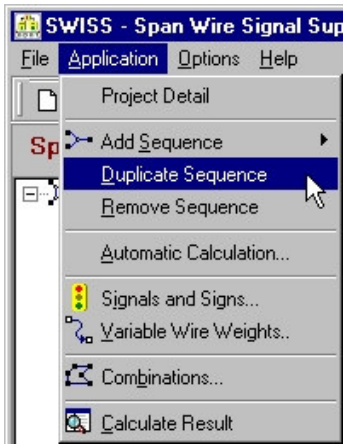
# APPLICATION, DUPLICATE SEQUENCE

To duplicate an existing span configuration:

1. Select the sequence to be copied in the left window under "Span Wire Configuration".



2. Select **Application, Duplicate Sequence**.

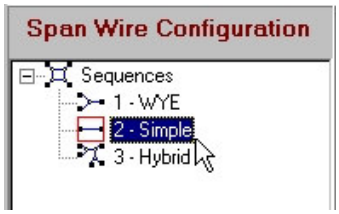



The span configuration and all data, excluding combination data, will be duplicated as the next available sequence number. This feature provides an easy way to compare multiple copies of the same span configuration with minor revisions in each one; such as changing the elevation differences or sag.

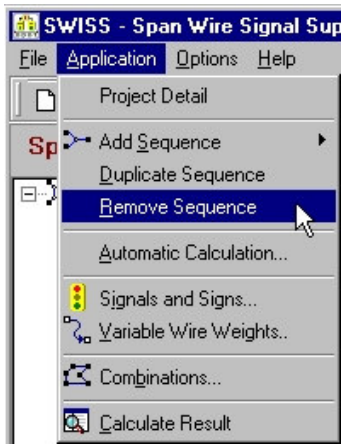
# APPLICATION, REMOVE SEQUENCE

To remove a span configuration from the file:

1. Select the sequence to be removed in the left window under "Span Wire Configuration".




2. Select **Application, Remove Sequence**.




3. Select **YES** in the dialog window and the span configuration and all associated data will be removed from the file.

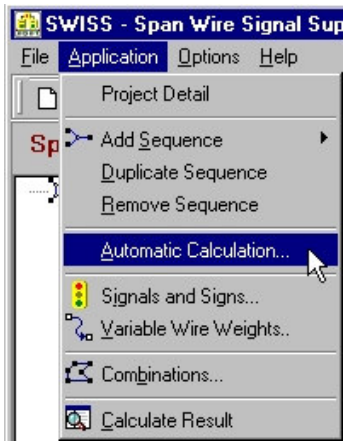
Note that any existing combination data using the removed sequence will also be deleted. When a span configuration is removed, the sequence numbers of the span configurations listed after it in the "Span Wire Configuration" window will update and any combination data will also be updated for spans whose sequence

number is revised.

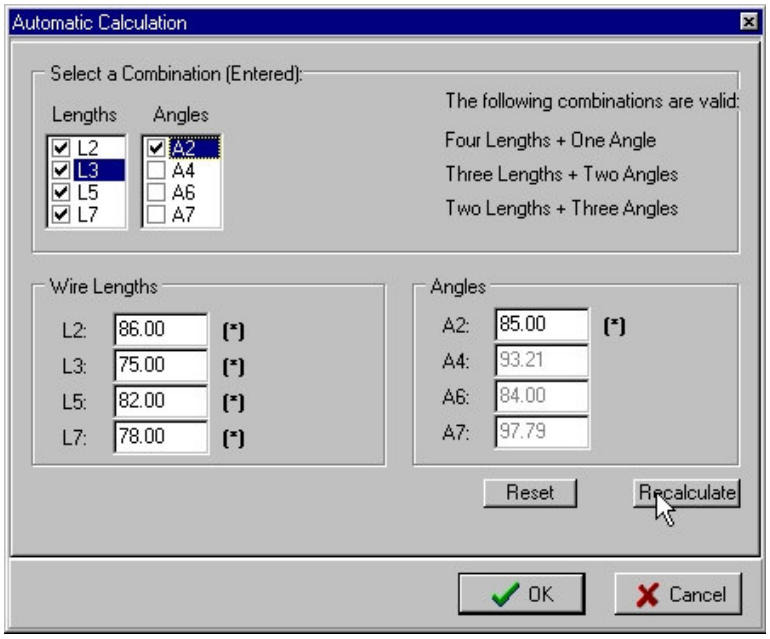
# APPLICATION, AUTOMATIC CALCULATION

With the Delta and Box span configurations, the interior closed geometry can be input inaccurately. For the box span, angles A2 + A4 + A6 + A7 should equal 360 degrees; and for the delta span, angles A2 + A4 + A6 should equal 180 degrees. Using the **Application, Automatic Calculation** feature ensures that the interior geometry of these spans is entered properly and the input data is valid. If the data is not valid as entered, a message at the bottom of the screen states "data are not valid" and the pole to pole distances in the **Angles and Lengths** tab appears as "N/A". The program will generate a result even if the data is not valid.

1. Select **Application, Automatic Calculation**.




2. Select the data that you want to enter.
3. Enter selected data.
4. Select the **Recalculate** button, and click **OK**.

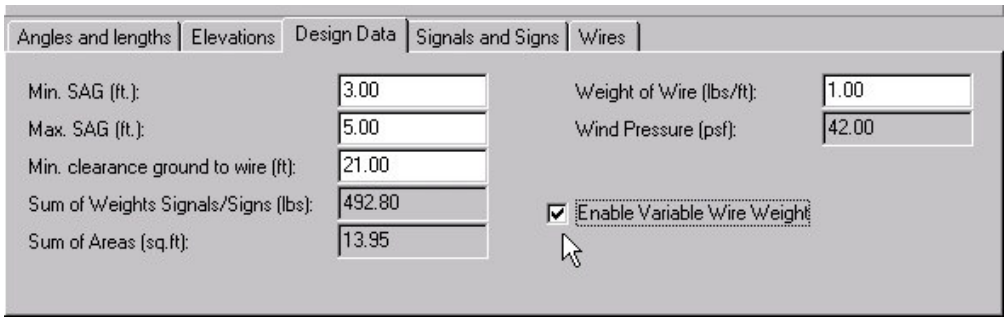



Enter the remaining angles and lengths for the tail segments. If the **Angles and Lengths** data is revised at some later time, the automatic calculation can be rerun by repeating steps 1 through 4.

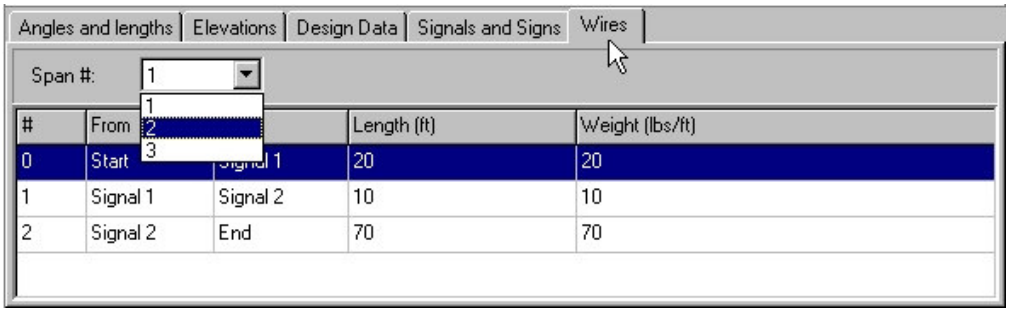
# APPLICATION, VARIABLE WIRE WEIGHTS

The program will use the wire weight specified under the **Design Data** tab for Weight of Wire uniformly on all span segments. To change or customize the wire weight on a span segment:

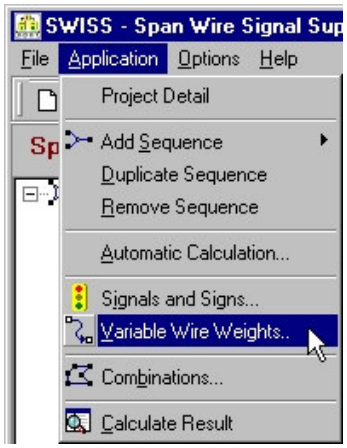
1. Select the **Design Data** tab located below the graphic representation of the span.
2. Select the **Enable Variable Wire Weight** so that a checkmark appears in the box.

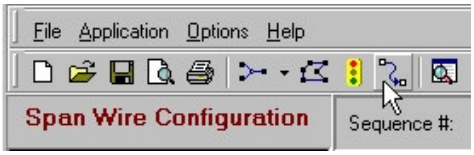



3. Select the **Wires** tab located below the graphic representation of the span.
4. Use the pull down menu to select the span number.

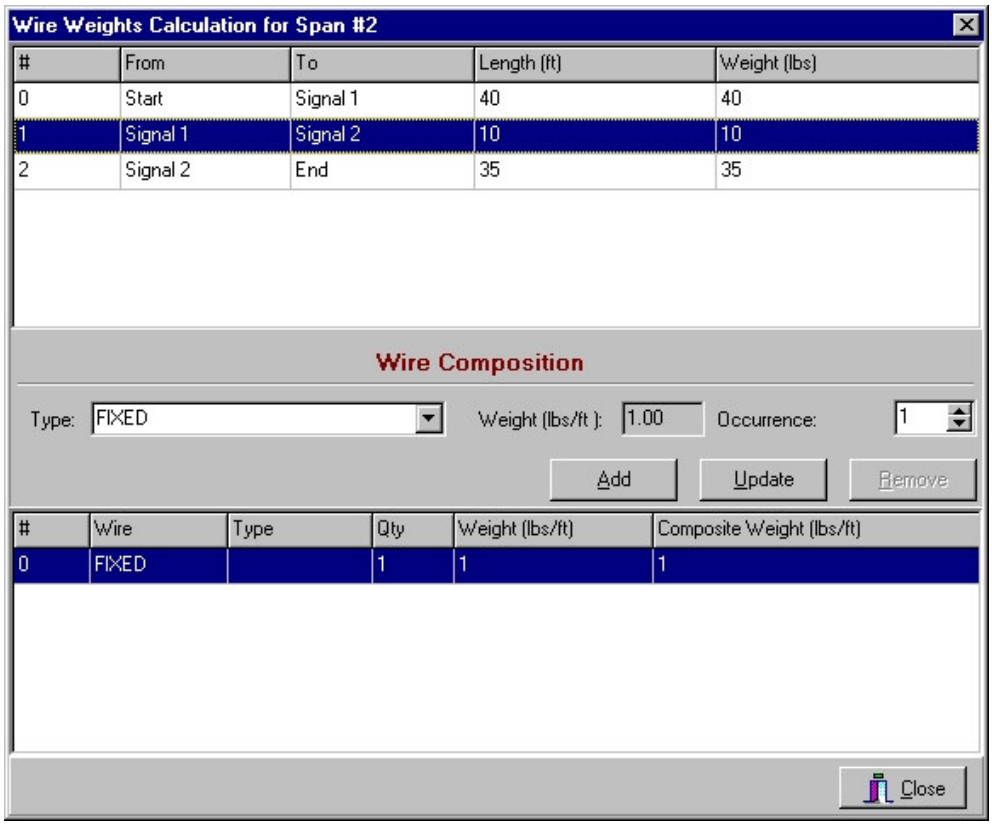



5. Select **Application, Variable Wire Weights**.
   (The icon in the tool bar for **Edit Variable Wire Weights** can also be used.)




6. Select the span segment to be revised at the top portion of the screen.




7. In the **Wire Composition** window,
   a. Select a wire **Type** from the pull down menu,
   b. Choose the occurrence (number) of wires of that type,
   c. Select the **Update** button. (Note that the first new entry of a wire should use **Update** instead of **Add**. This revises the entry for **FIXED** into the new wire entry. If the **Add** button is used for the first new entry, the user will have to select the **FIXED** entry and **Remove** it. All additional wire entries should use the **Add** button.)
8. Repeat step 7 using the **Add** button until all wires have been entered for a span segment.
9. Repeat steps 6, 7 and 8 until the all span segments on the span are correctly represented.
10. Select the **Close** button to return to the **Wires** tab. Other spans can be entered by repeating steps 4 through 10.

# OPTIONS, DISPLAY DYNAMIC GRAPHIC

A graphical representation of the span will appear in the window on the right side of the screen when a new span configuration is added to the problem. With the dynamic graphics feature "off", the span representation will remain unchanged after all span lengths and angles are entered. With the dynamic graphics feature "on", the span representation will proportionally change after all span lengths and angles are entered, or will change as entries are revised.

With the dynamic graphics feature "on", sometimes the angle, span length or elevation difference labels will not be legible due to overlapping characters. Also, the dynamic graphics may not display correctly if large fonts are selected in the Windows desktop properties setting.

Select **Options, Display Dynamic Graphic** to toggle "on/off" the dynamic graphics feature.

To change the program's default setting, select **Options, Parameters, Application Parameters**.

# OPTIONS, DISPLAY LABELS

Angles, span lengths, or elevation differences are displayed on the graphic representation of the span depending on which tab is selected. The value for each item can also be displayed by toggling "on" the label display.

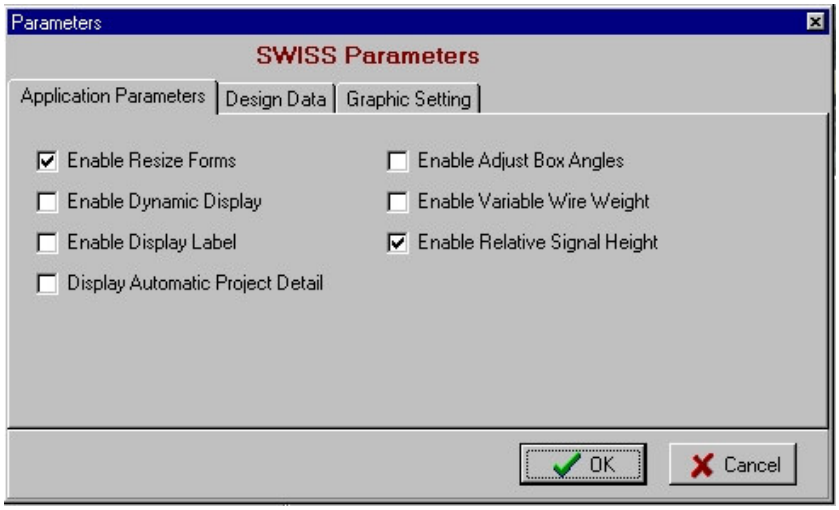
With the display labels feature "on", sometimes the angle, span length or elevation difference labels will not be legible due to overlapping characters.

Select **Options, Display Labels** to toggle "on/off" the display the value of the angles, span lengths, and elevation differences on the graphic representation of the span.

To change the default setting that the program uses, select **Options, Parameters, Application Parameters**.

# OPTIONS, PARAMETERS, APPLICATION PARAMETERS

From **Options, Parameters, Application Parameters** several features can be set to default either on or off each time the program is started.




**Enable Resize Forms** - Resize forms is an option that the user can enable when the screen is displayed incorrectly with some resolutions and fonts. It allows the program to calculate the position and the dimension of the forms. When everything is standard, switching between enabled and disabled doesn't produce any visual effect.

**Enable Dynamic Display** - A graphical representation of the span will appear in the window on the right side of the screen when a new span configuration is added to the problem. With the dynamic graphics feature "off", this span representation will remain unchanged after all span lengths and angles are entered. With the dynamic graphics feature "on", the span representation will proportionally change after all span lengths and angles are entered, or will change as entries are revised.

With the dynamic graphics feature "on", sometimes the angle, span length or elevation difference labels will not be legible due to overlapping characters.

**Enable Display Label** - Depending on which data entry window is displayed, the value for each angle, span length, or elevation difference will be displayed on the graphic representation of the span when this feature is enabled.

With the display labels feature "on", sometimes the angle, span length or elevation difference labels will not be legible due to overlapping characters.

**Display Automatic Project Detail** - With this feature "on", the **Project Detail** window will automatically appear every time **File, New** is selected.. With this feature "off", the **Project Detail** window can still be accessed by selecting **Application, Project Detail**.

**Enable Adjust Box Angles** - This feature only affects the box span configuration. In the mainframe computer version of this program, this feature was referred to as "warp configuration".

If the program determines that the system balance for the span configuration needs to be adjusted by rotating pole #2, the program will perform the span analysis using the rotated pole #2 location. If you select the box so that a checkmark appears in it, the program will calculate how the span configuration angles will change if pole #2 is not rotated to bring the span configuration into balance, and than solve the problem based on the new angles.

This feature can also be enabled for any box span configuration by selecting the **Design Data** tab located below the graphical representation of the span.

**Enable Variable Wire Weights** - Wire weights can be specified for each segment between signals and signs on any span. If you select the box so that a checkmark appears in it, variable wire weights will always be enabled. See Variable Wire Weights for information on using this feature.

If this feature is not selected, the value specified in the **Weight of Wire** field on the **Design Data** tab will be used uniformly on all span segments.

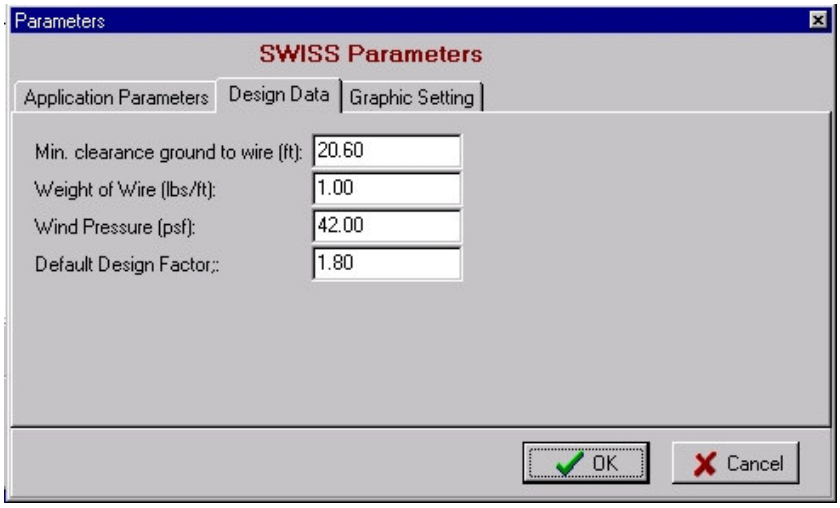
**Enable Relative Signal Heights** - With this feature "on", both the on-screen display and the printout of the problem results will include the difference in the attachment points at signal and sign loadings on the messenger wire when compared with the low point in the span configuration. This is the only place in the program that this feature can be enabled.

This feature will allow a designer to determine if signal drop pipes may be needed for signal heads located at the ends of a long span.

# OPTIONS, PARAMETERS, DESIGN DATA

When a new span configuration is added, certain parameters are initialized with default values. These are parameters that typically remain unchanged for any span. Some of these values can be revised within the program on a span by span basis.

From **Options, Parameters, Design Data** several features can be set to default either on or off each time the program is started.




**Min. Clearance Ground to Wire (ft)** - This input represents the minimum clearance from the pavement to the wire attachment point of the lowest sign or signal. This value should equal the required clearance from pavement to the bottom of signal head or sign, plus the total signal head or sign height, including attachment hardware.

ODOT requires a 16 ft. minimum clearance to the bottom of signs or signals. When used with vertical signal heads consisting of three 12 in. lenses, the value for "Min. Clearance Ground to Wire" will typically be 20.5 feet.

**Weight of Wire (lbs/ft)** - The average combined weight of the electrical cables and the messenger wire can be specified. This weight will be used on all span segments. ODOT typically uses a value of 1 lb/ft over all span lengths unless there is a large number of cables due to loop detector lead-in cables or pedestrian cables. In this case, the weight can be increased to 1.5 lbs/ft. See Wire Weights to estimate the average weight of the cables on a span.

The wire weight can be varied by span segment by using the Variable Wire Weight feature.

**Wind Pressure (psf)** - A value may be entered, in pounds per square foot, that represents the wind pressure created on signal heads by the design wind velocity. ODOT typically uses a value of 42 psf. This conforms to AASHTO criteria for wind pressure on traffic signals with 90 mph winds.

**Default Design Factor** - The design factor is the ratio of the dead load to the resultant of the dead load and wind load (based on wind pressure and area as input) increased by 10 percent. The default value for ODOT projects should be 1.80.

$$\frac{\sqrt{(\text{Total Dead Load Weight})^2 + (\text{Sum of Areas} \times \text{Wind Pressure})^2}}{\text{Total Dead Load Weight}} \times 1.1$$

# OPTIONS, PARAMETERS, GRAPHIC SETTING

From **Options, Parameters, Graphic Setting**,the fonts and colors for the graphical representation of the span can be revised. These settings will be saved by the application program in the file "swiss.def" as default settings.