DISCLAIMER

No Warranty is expressed or implied by the Office of Design of the New York State Department of Transportation as to the accuracy and functioning of this program nor shall the fact of distribution of this program constitute any such warranty; and no responsibility is assumed by the Office of Design of the New York State Department of Transportation in any connection therewith.
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Introduction

This Program shall be used to determine the pole load on Tethered and Non-Tethered Span Wire Traffic Signal Poles. It utilizes the same methods found in Engineering Instructions EI 83-38 (Method for calculating the loads applied to span wire traffic signal poles) and EI 89-003 (Method for calculating the loads applied to span wire traffic signal poles: Non-Tethered). These two methods shall apply to traffic signals and/or signs suspended on a cable between poles with the ends of the cable attached to the poles at the same elevation. The length of the poles need not be equal. However, in such cases, the stiffness of the stiffer pole shall be used.

The 2003 Version 1.0.1 of this program was designed to replace the outdated “Traffic Signal Pole Design Program (Version 1.5)”, which had been in use by NYSDOT since 1987.

The 2003 improved Span Wire Analysis Program was prepared as a cooperative effort by the Office of Design and the Information Services Bureau (ISB). It was developed using Visual Basic. Many new features and capabilities were added and/or improved since the previous DOS-based version. Although the Engineering Instructions were in US Customary units, the Span Wire Analysis Program allows the user to run the analysis in either US Customary or Metric Units. Files can now be saved and retrieved at any time.

The 2013 Version 2.0.0 is a modification of the 2003 Visual Basic version. Key changes are the ability to include either 5 inch or 8 inch back plate widths, modeling of the 5-lens “doghouse” configuration, allowance for LED signs (as a heavier sign type), permitting back plates on aluminum heads, and permitting back plates on more than two- and three-lens heads.

The 2015 Version 2.1.0 is an update of the 2013 Version 2.0.0. This update was necessary due to incorrect results displaying when the data was reused to perform multiple iterations. To solve this issue expeditiously, it was necessary to remove the “Make Changes” function from program. Users can still make changes to their data by saving it to a file and opening the file.

As always, user comments and suggestions are appreciated. Many thanks to those of you who have helped develop this 2.1.0 version. Please send comments or suggestions to:

NYS DOT – Office of Design
Design Quality Assurance Bureau
(518) 457-4092
Getting Started

Before you start the program it is strongly recommended that a diagram of the proposed signal installation be developed and labeled. A sample diagram has been included in Appendix C. Remember that pole height and location depends on many factors. Analysis of a Span Wire Traffic Signal should be an interactive process. Placement of poles depends on Right Of Way (ROW), buried utilities, and Vertical Clearance. As a good design engineer, you should always consider constructability. It is good practice to gather all necessary information before getting started using the program. It will make your life a lot easier!

Another diagram (worksheet) has been included in Appendix B to help you determine the span wire mounting height based on vertical clearance. It is strongly recommended that you print this page to help you determine the height of the poles.

Besides gathering information on the physical layout of the span wire signal, the user must identify the types of materials that will be used (Aluminum, Polycarbonate, Glass, LED, etc).

The methodology used in this program is based on the methods found on EI 83-38 and EI 89-003. We have tried to make the program as flexible as possible. Sign and signal specifications can be found in Appendix A (page 13). Specifications have been revised to reflect both old and new materials used in span wire signal assemblies. Please make sure you take a look at the spec table before you run the program.

NOTE: The non-tethered analyses are based on data obtained from a limited number of wind tunnel tests which the researchers extrapolated to a slightly wider range of similar configurations. The team responsible for developing this version of SpanWire deemed it inappropriate to extrapolate those results still farther to cover head configuration that have come into more common use, such as the doghouse (1 section over 2 over 2) configuration. This decision is partially justified by a solid trend to discontinue installation of untethered span wire systems.
A brief Tour of the Span Wire Analysis Program

The first input screen is shown in Figure 1. This is the screen you will see every time you run the Span Wire Analysis Program. Most entries will be blank with the exception of a few defaults.

- **SpanWire** cannot handle a head where the number of sections differs from one way to another. If a single head has three sections pointing in one direction and a doghouse 5 pointing in the other, it should be modeled as two separate heads with a distance between the point loads of 0.1 feet or 0.1 meters.

In Figure 2, all entries have been filled and we are ready to continue with the analysis. Figure 3A shows the next input screen. Information about each point load is entered there.
Figure 3A prior to data input

Figure 3B after data input
NOTE: Make sure that the number of sections entered for a head is the sum for all directions, (A 2-way head with 3 sections per way should be entered as 6 sections,) and that your values entered are correct. Omitted values may produce an error message.

The output screen is shown in the figure below (Figure 4). The user has the option to either preview what the output would look like as a printed report or to close the program.

**Definitions**

**INPUT:**

1. **Point Load:** Any object whose load (weight) is concentrated at a single point (i.e. signal heads, signs, etc).

2. **Span Length:** The distance between the signal poles in feet or meters.

3. **Type of Load:** Either a signal head assembly or sign assembly.
4. Signal Material Type: Either aluminum or polycarbonate.

5. Signal Lens Material: Either glass or LED.

6. Number of Directions (Ways): The number of directions a point load faces.

7. Number of 8” Sections: Total number of 8” sections per signal head assembly.

8. Number of 12” Sections: Total number of 12” sections per signal head assembly.

9. Backplate: User must indicate back plate selection for a signal head assembly (None, 5-in, or 8-in).

10. Backplate Material: Either Aluminum or plastic.

11. Disconnect Hanger: User must indicate if a signal head assembly uses a disconnect hanger.

12. Sign Hanger: User must indicate if a sign is to be mounted as a single panel, perpendicular, back to back, or box kite assembly.

13. Area of Sign: Any value in square feet (sf) or square meters (sm). Sign dimensions can be found in the Manual on Uniform Traffic Control Devices (MUTCD). If more than one panel is used, the average panel area should be entered.

14. Distance between Point Loads: The distance measured from one point load to the next. These distances are measured from the left pole to the first point load and continue from point load to point load until the last point load is reached. The program calculates the remaining distance between the last point load and the right pole.

OUTPUT:

1. Dead Load: The load due to the weight of the point loads.

2. Ice Dead Load: The load due to the weight of the ice acting on the point loads.

3. Left Reaction: The portion of the dead load transmitted to the left support.

4. Right Reaction: The portion of the dead load transmitted to the right support.

5. Sag: The vertical difference in feet or meters between the low point and the mounting height of the span wire (usually 5% of the span length).

6. Zero Shear: The distance from the left support to the point of zero shear due to the dead load.

7. Resultant HD: Horizontal force resulting from the dead load at the attachment point on the pole. This reaction is obtained by resolving the moments of the dead loads about the point of zero shear.
8. **Left Reaction Ice:** The portion of the ice load transmitted to the left support.

9. **Right Reaction Ice:** The portion of the ice load transmitted to the right support.

10. **Zero Ice Shear:** The distance from the left support to the point of zero shear due to the ice load.

11. **Resultant Hi:** Horizontal force resulting from the ice load at the attachment point on the pole. This reaction is obtained by resolving the moments of the ice loads about the point of zero ice shear.

12. **Pole Height No. 1:** The height of the left pole in feet or meters.

13. **Pole Height No. 2:** The height of the right pole in feet or meters.

14. **Group Loading 1 (tethered):** The loading due to the dead load acting on the support (DL).

15. **Group Loading 2 (tethered):** The loading due to the sum of the dead load and wind load acting on the support (DL + WIND).

16. **Group Loading 3 (tethered):** The loading due to the sum of the dead load, ice load and one half of the wind load acting on the support (DL + ICE + ½ WIND).

17. **Design Loading (tethered):** The load that the signal poles must support. This value is the greater of either the Group Loading 2 or Group Loading 3 rounded up to the next higher thousand pound increment. Since the design load maybe different for each signal pole, the value is listed for both poles.

18. **Wind Load:** The loading created by the wind (see standard spec 724-03 for wind speeds in different Counties).

19. **Ftg. Moment:** The moment at the base of the support. This value is listed for each pole in ft-kip or N-m.

20. **Group Loading 1 (Non-tethered):** The loading due to the dead load acting on the support (DL).

21. **Group Loading 2 (Non-tethered):** The loading due to the dead load plus the wind load acting on the support: \((DL)^2 + WIND^2\)^{1/2}.

22. **Group Loading 3 (Non-tethered):** The loading due to the dead load, ice load and one half of the wind load acting on the support: \([ (DL + ICE)^2 + (\frac{1}{2} WIND)^2 ]^{1/2}]\.

23. **Pole Deflection Rate:** Deflection rate due to the Horizontal Force in in/100 lb or mm/500N.
Using the Program

If you are running the program for the first time, click on the short cut for the Span Wire Analysis Program. The shortcut can be found under:

![Shortcut to Span Wire Analysis Program]

The project input screen will open (Figure 1, page 4). At this point you are ready to enter the project information:

1. Type the Project name, Designer Name, Intersection Name, PIN and Signal Number
2. Select the respective County from the drop down menu
3. Select Working Units (English or Metric)
4. Select Cable Type (tethered or non-tethered)
5. Enter the span length *(3 decimals for Metric)*
6. Enter the sag percentage. The default value has been set to 5%
7. Enter the height of poles *(3 decimals for Metric)*
8. Enter the number of point loads (signals and signs)
9. Press the OK button

**NOTE:** If you leave any field entry blank, the program will give you a warning message. Make sure that all fields are completed.

**NOTE:** At this point, you can choose to exit the program. If you press the exit button, you’ll be prompted to save your file (Figure 5). If you press “Yes”, the program will close. If you press “No”, you will be directed back to the first input screen (Figure 1, page 4).

![If you have entered any data, and did not complete the analysis, the data will be lost. Are you sure you want to exit?]

**Figure 5**

Any project information entered here can be changed and edited later on. More on editing saved files will be covered later in this section.

After you have entered all necessary information and press **OK**, the next input screen will be displayed (figure 3A, page 5). Point load numbers will automatically appear in this window. Remember that point loads are **numbered in ascending order from left to right pole**. For each load number:
1. Select type of load (Signal, Sign, or LED Sign).
2. If type of load = Signal, select the material type (Aluminum or polycarbonate)
3. If type of load = Signal, select the lens material (Glass or LED)
4. If type of load = Signal, select the number of directions or ways that the signal faces
5. If type of load = Signal, enter the total number of 8” sections (enter “0” if none)
6. If type of load = Signal, enter the total number of 12” sections (enter “0” if none)
7. If type of load = Signal, determine if disconnect hanger is used
8. If type of load = Signal, determine back plate selection (None, 5-in, 8-in)
9. If type of load = Sign or LED Sign, select Sign Hanger (single panel, perpendicular, back to back or box kite)
10. If type of load = Sign or LED Sign, enter the area of sign
11. Enter the distance between point loads
12. Press “Update Analysis”

After pressing “Update Analysis”, the following message will be displayed (Figure 6):

![Figure 6](image)

If the distance from the last point load to the right pole is NOT correct, press “No” and revise your data. If the remaining distance is correct, then press “Yes”. The output screen will be displayed (Figure 4, page 6). If you wish to print the analysis report, press “PREVIEW” and then press “PRINT”. Printouts will go to the default printer regardless of what printer is selected.

When finished printing, close the window and close the output screen by pressing the “CLOSE” button. A dialog box (Figure 7) will appear telling you that the program will close. If you plan on running the analysis again with the data you provided you need to save it.

![Figure 7](image)
If you select “Yes” when asked if you want to save your data (Figure 7), you will be directed to the Save As screen, where you can navigate to save your current data before the program closes.

If, instead, you select “No”, the program closes.

NOTE: If you have multiple signal assemblies in a project, you will need to reopen the program for each intersection you want to analyze.

To save a file, select “Save” from the “Save As” screen. The dialog box shown in Figure 8 will be displayed. In order to avoid replacing existing files every time you save a file, you will have the chance to rename the file. The file name will be displayed and highlighted. The files will be stored in this directory: C:\DOTPrograms\SpanWire\data

![Figure 8](image)

Saved files can be opened for editing and/or analysis. Select the file you want to open at the first input screen (Figure 9) and click “Open”. Now you are ready to make changes to the existing file. Remember to save your file after running the analysis.
Figure 9
APPENDIX A

SIGN AND SIGNAL SPECIFICATIONS (US Customary units)

Dead Loads:

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>12” Signal Section *</td>
<td></td>
</tr>
<tr>
<td>- Aluminum (glass lens)</td>
<td>11.0 lbs ¹</td>
</tr>
<tr>
<td>- Aluminum (LED lens)</td>
<td>11.0 lbs ¹</td>
</tr>
<tr>
<td>- Polycarbonate (glass lens)</td>
<td>8.0 lbs ¹</td>
</tr>
<tr>
<td>- Polycarbonate (LED lens)</td>
<td>8.0 lbs ¹</td>
</tr>
<tr>
<td>8” Signal Section *</td>
<td></td>
</tr>
<tr>
<td>- Aluminum (glass lens)</td>
<td>7.0 lbs ¹</td>
</tr>
<tr>
<td>- Aluminum (LED lens)</td>
<td>7.0 lbs ¹</td>
</tr>
<tr>
<td>- Polycarbonate (glass lens)</td>
<td>6.0 lbs ¹</td>
</tr>
<tr>
<td>- Polycarbonate (LED lens)</td>
<td>6.0 lbs ¹</td>
</tr>
<tr>
<td>Backplates:</td>
<td></td>
</tr>
<tr>
<td>- Polycarbonate (12-12-12 configuration)</td>
<td>3.3 lbs ²</td>
</tr>
<tr>
<td>- Polycarbonate (12-12-12-12 configuration)</td>
<td>4.2 lbs ²</td>
</tr>
<tr>
<td>- Polycarbonate (8-8-8 configuration)</td>
<td>2.4 lbs ²</td>
</tr>
<tr>
<td>- Polycarbonate (12-8-8 configuration)</td>
<td>3.2 lbs ²</td>
</tr>
<tr>
<td>- Polycarbonate (12-8-8-8 configuration)</td>
<td>4.0 lbs ²</td>
</tr>
<tr>
<td>Signal hanger b</td>
<td></td>
</tr>
<tr>
<td>- 1-way hanger (vertical array)</td>
<td>9.5 lbs ³</td>
</tr>
<tr>
<td>- 1-way hanger (doghouse array)</td>
<td>22.5 lbs</td>
</tr>
<tr>
<td>- 2-way hanger</td>
<td>20 lbs ³</td>
</tr>
<tr>
<td>- 3-way hanger</td>
<td>25 lbs ³</td>
</tr>
<tr>
<td>- 4-way hanger</td>
<td>30 lbs ³</td>
</tr>
<tr>
<td>Disconnect Hanger (see M680-3)</td>
<td>10.5 lbs</td>
</tr>
<tr>
<td>Span wire cable c</td>
<td></td>
</tr>
<tr>
<td>- 7/16”</td>
<td>1.0 lbs/ft</td>
</tr>
<tr>
<td>Sign hanger d</td>
<td></td>
</tr>
<tr>
<td>- One-way (single panel)</td>
<td>Conduit length x 2.4 lb/ft + 7.2 lbs ¹</td>
</tr>
<tr>
<td>- Two-way (perpendicular)</td>
<td>“ + 11.5 lbs ¹</td>
</tr>
<tr>
<td>- Two-way (back to back)</td>
<td>“ + 9.5 lbs ¹</td>
</tr>
<tr>
<td>- Box kite (Type B)</td>
<td>“ + 17.5 lbs ³</td>
</tr>
<tr>
<td>Signs e</td>
<td>2.0 lbs/sf</td>
</tr>
<tr>
<td>LED Signs</td>
<td>9.0 lbs/sf</td>
</tr>
</tbody>
</table>
APPENDIX A (continued)

Ice Loads:

<table>
<thead>
<tr>
<th>Description</th>
<th>Spec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Cable</td>
<td>0.6 lb/lf</td>
</tr>
<tr>
<td>- Signal Head (calculated for 4 sides)</td>
<td>3.0 lbs/sf</td>
</tr>
<tr>
<td>- Signs (one side only)</td>
<td>3.0 lbs/sf</td>
</tr>
</tbody>
</table>

Minimum Projected Areas:

<table>
<thead>
<tr>
<th>Description</th>
<th>Spec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal section f</td>
<td></td>
</tr>
<tr>
<td>- 8” (for wind load calc.)</td>
<td>0.68 sf</td>
</tr>
<tr>
<td>- 8” (for ice load calc.)</td>
<td>0.68 sf</td>
</tr>
<tr>
<td>- 12” (for wind load calc.)</td>
<td>1.24 sf</td>
</tr>
<tr>
<td>- 12” (for ice load calc.)</td>
<td>1.00 sf</td>
</tr>
</tbody>
</table>

Backplates (Net area):

<table>
<thead>
<tr>
<th>Description</th>
<th>(5” border)</th>
<th>(8” border)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- (12-12-12)</td>
<td>5.66 sf</td>
<td>9.08 sf</td>
</tr>
<tr>
<td>- (12-12-12-12)</td>
<td>7.00 sf</td>
<td>11.0 sf</td>
</tr>
<tr>
<td>- (8-8-8)</td>
<td>3.45 sf</td>
<td>6.22 sf</td>
</tr>
<tr>
<td>- (12-8-8)</td>
<td>4.94 sf</td>
<td>8.03 sf</td>
</tr>
<tr>
<td>- (12-8-8-8)</td>
<td>5.90 sf</td>
<td>9.42 sf</td>
</tr>
<tr>
<td>- (12-12-12-12-12)</td>
<td>8.99 sf</td>
<td>13.93 sf</td>
</tr>
</tbody>
</table>

Cable:

<table>
<thead>
<tr>
<th>Description</th>
<th>Spec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 7/16”</td>
<td>0.04 sf/ft</td>
</tr>
</tbody>
</table>

Wind Load:

<table>
<thead>
<tr>
<th>Description</th>
<th>Spec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Zone A (see standard spec 724-03)</td>
<td>70 mph, 25 lbs/sf</td>
</tr>
<tr>
<td>- Zone B (see standard spec 724-03)</td>
<td>80 mph, 33 lbs/sf</td>
</tr>
<tr>
<td>- Height Coefficient (C_h)</td>
<td>1.00</td>
</tr>
<tr>
<td>- Shape Coefficient (C_d)</td>
<td>1.20</td>
</tr>
</tbody>
</table>

---

a Includes housing, door, lens (Glass Lens, Bulb & Reflector or LED assembly) & visor
b Includes all assembly parts in standard sheet M680-3 (2 lb span wire clamp also included)
c Includes weight of signal control cable (span wire = 0.43 lbs/ft)
d Includes 2 lb span wire clamp
e Galvanized steel signs = 2.2 psf, Aluminum signs = 1.8 psf (use average of 2.0 psf)
f Dimensions obtained from Peek Traffic (Tallahassee, FL)

1 NYS DOT Traffic Engineering & Highway Safety Division lab & signal shop (Region 1)
2 Fortran Traffic Systems Limited (Ontario, Canada)
3 Eagle Signal Corporation & the Crouse Hinds Corporation (taken from NYS DOT Traffic Signal Pole Design Program V. 1.5 - Specs table)
SPAN WIRE ANALYSIS PROGRAM

APPENDIX B

PIN:
PROJECT NAME:
SIGNAL NUMBER:

SPAN LENGTH

\[ Y = 1.5 + \text{SAG} + H + C \pm X \]

<table>
<thead>
<tr>
<th>+ 1.5</th>
<th>MINIMUM TOP DISTANCE AS PER STD. SHEET 600-14</th>
<th>+ 1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>SAG = 5% OF SPAN (0.05 \times \text{SPAN LENGTH})</td>
<td>+</td>
</tr>
<tr>
<td>+</td>
<td>(H) HEAD &amp; HANGER (4.6' FOR 12&quot; LENSES &amp; 3.6' FOR 8&quot; LENSES) (H)</td>
<td>+</td>
</tr>
<tr>
<td>+</td>
<td>(C) CLEARANCE AT LOWEST HEAD (C)</td>
<td>+</td>
</tr>
<tr>
<td>±</td>
<td>(X_1) DIFFERENCE IN ELEVATION (X_2)</td>
<td>±</td>
</tr>
<tr>
<td>=</td>
<td>(Y_1) CALCULATED POLE LENGTH (Y_2)</td>
<td>=</td>
</tr>
</tbody>
</table>
APPENDIX C

SPAN WIRE ANALYSIS
SAMPLE DIAGRAM

PIN: ________________________________
PROJECT NAME: ________________________
COUNTY: ____________________________
SIGNAL NUMBER: ______________________
INTERSECTION NAME: __________________

DISTANCE BETWEEN POINT LOADS

PT. LOAD #1
SIGNAL

PT. LOAD #2
SIGN

PT. LOAD #3
SIGNAL

#WAYS
#SECTIONS *

#WAYS
#SECTIONS *

TOTAL NUMBER OF SIGNALS (PT. LOADS)
TOTAL NUMBER OF SIGNS (PT. LOADS)

* TOTAL NUMBER OF LENS SECTIONS PER POINT LOAD
** REMAINING DISTANCE IS CALCULATED BY THE PROGRAM

LEFT POLE (POLE #1)

POLE #1 HEIGHT

RIGHT POLE (POLE #2)

POLE #2 HEIGHT

SPAN LENGTH

DIST *1  DIST *2  DIST *3  DIST *4 **