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1. PURPOSE:

This User Guide is intended to help users understand how to functionally use the ZipDesignTool. It is not intended to be a replacement for engineering judgment or as design suggestions.

2. TERMS AND CONDITIONS FOR USE OF THE ZIPDESIGNTOOL:

The ZipDesignTool is to be used as an aid in designing zip lines and challenge courses. ZipDesignTools.com LLC has worked to ensure the reliability and accuracy of the values and results provided by the ZipDesignTool, but we do not guarantee the performance of the ZipDesignTool. Because of the nature of zip lines and challenge courses and because errors in the ZipDesignTool results can occur, you should understand the capabilities and limitations of the ZipDesignTool and always examine the results before use. You are ultimately responsible for the use of the values and results of the ZipDesignTool. Unmanned testing should occur prior to the initial use of your zip line or challenge course. The entire liability of ZipDesignTools.com, LLC shall be limited to the price for use of the ZipDesignTool. You agree to defend, indemnify, and hold harmless ZipDesignTools.com LLC, its agents, representatives, officials, and employees, from and against any and all claims, damages, losses, expenses and liability for death or personal injury caused by its negligence (including but not limited to attorney fees, court costs, and the cost of appellate proceedings), relating to, arising out of, or alleged to have resulted from the acts, errors, mistakes, or omissions of you, your agents, employees, contractors, subcontractors, customers, invitees, guests or other persons doing business with you, in connection with the usage of the website or ZipDesignTool, even if ZipDesignTools.com, LLC or its officers have been advised of or should be aware of the possibility of such damages.

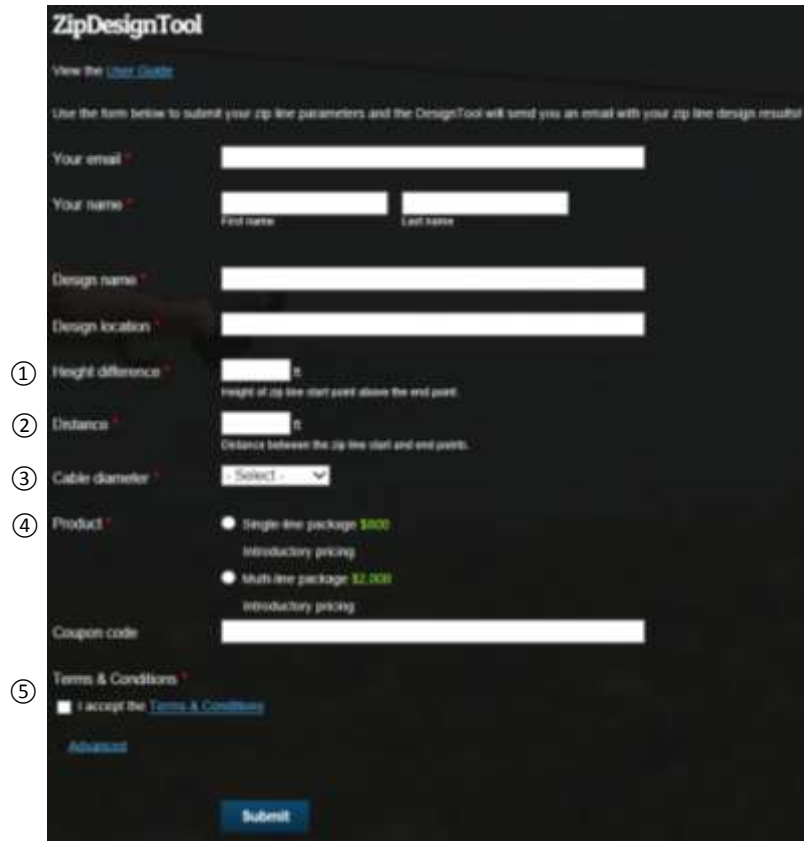
You shall not reverse engineer the ZipDesignTool in any way. Without the expressed written consent of ZipDesignTools.com, LLC the ZipDesignTool shall not be studied or assessed in any manner in any publication.

Please refer to the full TERMS AND CONDITIONS found at www.ZipDesignTools.com

3. USING THE ZipDesignTool

3.1. REQUIRED PARAMETERS

When you go to the ZipDesignTool page to start your data entry this is the form that you will see in Figure 1.



The screenshot shows the ZipDesignTool data entry form. It includes fields for 'Your email', 'Your name' (split into 'First name' and 'Last name'), 'Design name', and 'Design location'. Below these are five numbered callouts: 1 points to the 'Height difference' field, 2 points to the 'Distance' field, 3 points to the 'Cable diameter' dropdown menu, 4 points to the 'Product' radio button options (Single-line package \$900 and Multi-line package \$2,000), and 5 points to the 'Terms & Conditions' checkbox. At the bottom is a 'Submit' button.

Figure 1: ZipDesignTools.com Data Form

① Height Difference: This is the height of the zip line start point above the end point of your zip line start point measured in feet.

② Distance: This is the distance between the start and end points of your zip line measured in feet.

③ Cable diameter: This is the diameter of the zip line cable measured in inches. The smaller the cable diameter will have lower maximum allowable tension values.

④ Product: The Single-line Design Package includes 5 runs of the design tool while the Multi-line Design Package includes 15 runs of the design tool.

⑤ Terms and Conditions: Please read and then check that you accept the Terms and Conditions.

3.2. ADVANCED PARAMETERS

When you go to the ZipDesignTool page to start your data entry these are the additional parameters that you will see in Figures 2, 3 and 4. None of the advanced parameters are required, but if you do not fill in the Desired cable tension parameter, ⑭, the ZipDesignTool will use default values for all the advanced parameters.



Advanced

⑥ Max rider weight lb
Weight of the heaviest rider that will be allowed to ride the zip line

⑦ Min rider weight lb
Weight of the lightest rider that will be allowed to ride the zip line

⑧ Max wind speed mph
Greatest sustained wind speed at which riders will not be allowed to ride the zip line

⑨ Max temperature °F
Highest temp reached at the location or the temp above which riders will not be allowed to ride the zip line

⑩ Min temperature °F
Lowest temp reached at the location or the temp below which riders will not be allowed to ride the zip line

⑪ Site elevation ft
Estimated elevation of the zip line site

Figure 2: ZipDesignTools.com Data Form Advanced Parameters

⑥ Maximum rider weight: This is the weight of the heaviest rider which you will allow to ride the zip line. This value is measured in pounds force. You may want to use a higher rider weight to ensure a sufficient factor of safety. If no value is entered the ZipDesignTool will default to your previously saved submission.

⑦ Minimum rider weight: This is the weight of the smallest rider which you will allow to ride the zip line. This value is measured in pounds force. You may want to use a lower rider weight to ensure a sufficient factor of safety. If no value is entered the ZipDesignTool will default to your previously saved submission.

⑧ Maximum wind speed: This is the highest sustained wind speeds measured in miles per hour. Depending on wind direction, wind speed will increase or decrease rider speed. If no value is entered the ZipDesignTool will default to your previously saved submission.

⑨ Maximum operating temperature: This is the highest temperature at which you will allow the zip line to continue to operate. This value is measured in degrees Fahrenheit. If no value is entered the ZipDesignTool will default to your previously saved submission.

⑩ Minimum operating temperature: This is the lowest temperature at which you will allow the zip line to continue to operate. This value is measured in degrees Fahrenheit. If no value is entered the ZipDesignTool will default to your previously saved submission.

⑪ Site elevation: This is the elevation of your zip line site measured in feet. It is the estimated elevation measured above sea level. If no value is entered the ZipDesignTool will default to your previously saved submission.

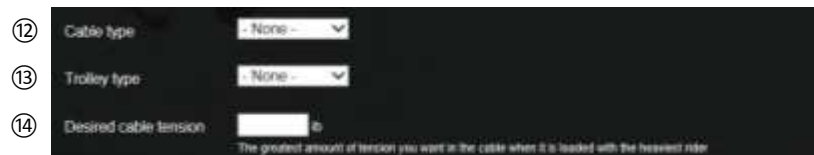


Figure 3: ZipDesignTools.com Data Form Advanced Parameters Continued

⑫ Cable type: This is the type of cable that you will be using for the zip line. Different types of cables can impact the speed at which the trolley travels down the zip line. If the cable construction type that you intend to use is not listed, you can select the generic cable type or please contact support@zipdesigntools.com to discuss having it added. If no value is entered the ZipDesignTool will default to the generic cable type.

⑬ Trolley type: This is the trolley that you will be using for the zip line. The different trolleys have different friction characteristics, which can impact the speed of the trolley. Each trolley manufacturer also has a maximum speed specification associated with their trollies. You can try the different types to see how they impact the speed of your rider. If the trolley that you intend to use is not listed, you can select either the standard or fast trolley type or please contact support@zipdesigntools.com to discuss having it added. If no value is entered the ZipDesignTool will default to your previously saved submission.

⑭ Desired cable tension: This is a value, measured in pounds force, which you determine based on the cable diameter, desired cable sag and rider speed. Increasing the tension can increase maximum rider speed, while decreasing the tension can decrease maximum rider speed. Generally a starting point would be to use the max allowable cable tension and then reduce it to optimize cable sag and rider speed as needed. The smaller cable diameters will have lower maximum allowable tension values. If you are uncertain of what tension to enter, it is not necessary to enter a value as the ZipDesignTool will enter the maximum allowable tension for the selected cable diameter and all other advance parameters will be default values.

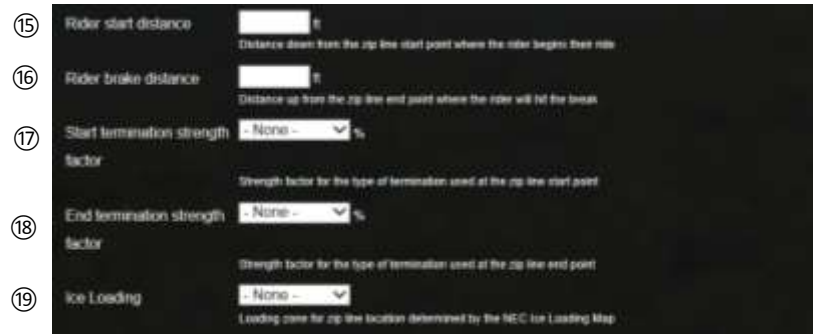
The maximum allowable tension value for a cable diameter is based on the formula:

$$\text{Max Allowable Tension} = 2 \times \text{Termination Strength Factor} \times \text{Cable Ultimate Strength} / \text{Safety Factor}$$

See Table 1 for the maximum allowable tension values for each of the cable diameters based on a Termination Strength Factor of 80%

Cable Diameter	Max Allowable Tension
3/8"	2,416 lbs
1/2"	4,256 lbs
5/8"	10,987 lbs
3/4"	15,680 lbs
7/8"	21,227 lbs
1"	27,573 lbs

Table 1: Maximum Allowable Cable Tension



⑮ Rider start distance ft
Distance down from the zip line start point where the rider begins their ride

⑯ Rider brake distance ft
Distance up from the zip line end point where the rider will hit the brake

⑰ Start termination strength factor %
Strength factor for the type of termination used at the zip line start point

⑱ End termination strength factor %
Strength factor for the type of termination used at the zip line end point

⑲ Ice Loading %
Loading zone for zip line location determined by the NEC Ice Loading Map

Figure 4: ZipDesignTools.com Data Form Advanced Parameters Continued

⑮ Rider start distance: This is the distance down from the zip line start point, measured in feet, that the rider begins their ride between the start and end points of your zip line. If you are uncertain where the rider will start, it is not necessary to enter a value as the ZipDesignTool will start the rider from the zip line start point.

⑯ Rider brake distance: This is the distance up from the zip line end point, measured in feet, that the rider will hit the zip line brake. If you are uncertain where the brake will be positioned, it is not necessary to enter a value as the ZipDesignTool will use the zip line end point as the brake point.

⑰ Start termination strength factor: This value is used to determine the maximum allowable tension value for the cable diameter. If you are uncertain which Termination Strength Factor to assign based on the termination type at the start of the zip line, it is not necessary to enter a value as the ZipDesignTool will default to a Termination Strength Factor of 80%.

⑱ End termination strength factor: This value is used to determine the maximum allowable tension value for the cable diameter. If you are uncertain which Termination Strength Factor to assign based on the termination type at the end of the zip line, it is not necessary to enter a value as the ZipDesignTool will default to a Termination Strength Factor of 80%.


⑲ Ice loading: This value is entered if you would like to run an Ice Loading Analysis. The Ice Loading Analysis will determine how much of an increase in tension and cable sag will be encountered if there is ice loading on the cable. User should search the internet for images of “National Electrical Safety Code district map for ice loads” to determine their loading zone. If you are uncertain which ice load to assign based on the map, it is not necessary to enter a value as the ZipDesignTool will default to none.

4. INTERPRETING THE ZipDesignTool RESULTS:

When you open the ZDTTOOLRESULTS.pdf to read your results this is the form that you will see in Figures 5 and 6:

Project: Zip 1

Design Inputs and Key Report Outputs:



Inputs:

Horizontal Length: 85 ft
 Start Elevation: 12 ft
 End Elevation: 0 ft
 Maximum Rider Weight: 155 lbs
 Minimum Rider Weight: 40lbs
 Cable Size : 3/8 inch diameter
 Maximum Sustained Wind Speed: 3 mph
 Maximum Temperature: 95 degrees
 Minimum Temperature: 45 degrees
 Cable Type: 7 X 19 Galvanized Aircraft Cable
 Trolley Type: Standard Two Wheel Pulley
 Desired Maximum Cable Tension: 1850 pounds
 Termination Factor: 0.8
 Ice Loading: Light Zone
 Start Distance (from beginning): 5 feet
 Brake Distance (from end): 8 feet

Estimated Design Outputs:

Maximum Loaded Tension in cable: 1850 lbs
 Maximum Brake Speed: 15 mph
 Minimum Brake Speed: 14 mph
 Maximum Speed Range: 14 mph to 15 mph
 Calculated Sag: (Vert. distance Below End Termination)
 - Unloaded: 0.00 feet
 - Minimum Weight Rider: 0.00 feet
 - Maximum Weight Rider: 0.05 feet
 Maximum Tension with Factor of Safety = 5 (for rider)
 2,416 pounds
 Maximum Calculated Rider Tension:
 1,850 pounds
 Maximum Tension with Factor of Safety = 2 (for ice)
 6,040 pounds
 Maximum Calculated Ice Tension:
 1,095 pounds

Installation Tension:

To utilize the estimates provided in this report, the cable should be installed (and maintained) at the following tensions relating directly to the temperature at the time of measurement.

Temperature	Tension (High End)	Tension (Low End)
45°	1010 pounds	1006 pounds
50°	981 pounds	879 pounds
55°	953 pounds	951 pounds
60°	925 pounds	924 pounds
65°	897 pounds	924 pounds
70°	869 pounds	896 pounds
75°	842 pounds	869 pounds
80°	814 pounds	842 pounds
85°	787 pounds	815 pounds
90°	760 pounds	788 pounds
95°	733 pounds	735 pounds

Maximum Pole Reactions

	High End	Low End
DL*	152 pounds vert.	-130 pounds vert.
	998 pounds hor.	998 pounds hor.
LL*	215 pounds vert.	155 pounds vert. (-60 for uplift)
	819 pounds hor.	819 pounds hor.
Ice (net)	12 pounds vert.	0 pounds vert.
	84 pounds hor.	84 pounds hor.

All values shown are based on principles of engineering and are based on the values and information provided by the user of the zip design tool. The values in this report should be considered estimates to be used for design purposes. Unwarmed testing should occur prior to use to verify validity of estimates. Notify ZipDesignTools.com of any discrepancy. Owner shall follow all maintenance procedures to avoid injury or death.

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Figure 5: Design Inputs and Key Report Outputs from the ZDTTOOLRESULTS.pdf

- ① Design Inputs: These values are that were submitted to the ZipDesignTool.
- ② Maximum Loaded Tension in cable: This is the highest tension found in the cable due to the static load of the heaviest rider.
- ③ Maximum Brake Speed: This is the highest speed at which a rider may be traveling when they reach the break point.
- ④ Minimum Brake Speed: This is the lowest speed at which a rider may be traveling when they reach the break point.
- ⑤ Maximum Speed Range: This is the range of highest speed which a rider may travel along the zip line.

⑥ Calculated Sag: This is the distance of the lowest point in the cable below the end termination for the following conditions: the unloaded cable, the cable loaded with the weight of the lightest rider, the cable loaded with the weight of the heaviest rider

⑦ Maximum Tension with Factor of Safety = 5 (for rider): This is the highest tension allowed for the cable with a safety factor of 5. This value is used to determine if the loads generated from the rider are acceptable. The maximum allowable tension value for a cable diameter is based on the formula (see ⑭ in Section 3.2):

$$\text{Max Allowable Tension} = 2 \times \text{Termination Strength Factor} \times \text{Cable Ultimate Strength} / \text{Safety Factor}$$

⑧ Maximum Calculated Rider Tension: This is the highest tension found in the cable due to the static load of the heaviest rider.

⑨ Maximum Tension with Factor of Safety = 2 (for ice): This is the highest tension allowed for the cable with a safety factor of 2. This value is used to determine if the loads generated from the selected ice loading condition are acceptable. The maximum allowable tension value for a cable diameter is based on the formula (see ⑭ in Section 3.2):

$$\text{Max Allowable Tension} = 2 \times \text{Termination Strength Factor} \times \text{Cable Ultimate Strength} / \text{Safety Factor}$$

⑩ Maximum Calculated Ice Tension: This is the highest tension found in the cable due to the static load of the selected ice loading condition.

⑪ Installation Tension Report: This report provides the estimated tensions to which the cable should be installed based on the temperature at the time of measurement.

⑫ Maximum Pole Reactions: These are the maximum loads the cable transfers to the pole. These values should be used by a structural engineer to determine pole design.

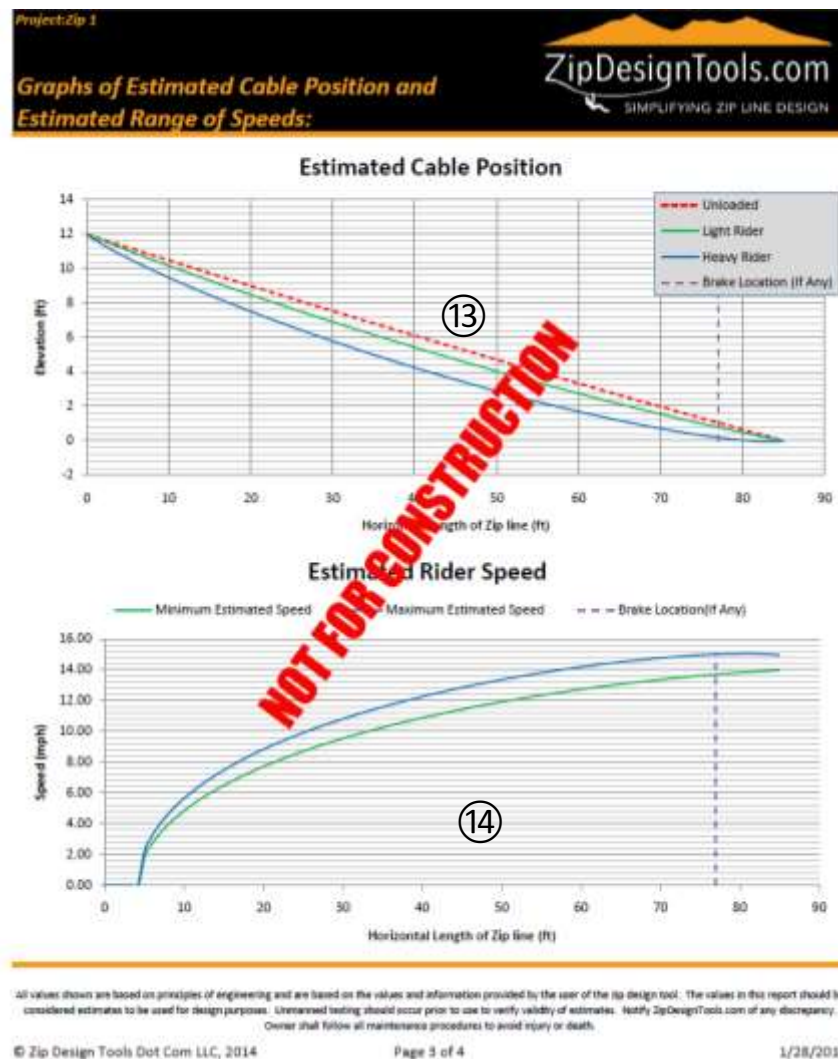


Figure 6: Graphs of Estimated Cable Position and Estimated Range of Speeds from the ZDTTOOLRESULTS.pdf

⑬ Estimated Cable Position Graph: This graph plots the estimated cable sag for the Unloaded, Light Rider and Heavy Rider conditions. The Unloaded Cable Sag Profile (dashed red line) represents the estimated position of the tensioned cable with no loads applied. The Light Rider Cable Sag Profile (solid green line) represents the estimated path of the light rider's trolley along the tensioned cable. The Heavy Rider Cable Sag Profile (solid blue line) represents the estimated path of the heavy rider's trolley along the tensioned cable. The Brake Location (dashed purple line) indicates the position where the rider's trolley would engage the brake.

⑭ Estimated Rider Speed Graph: This graph plots the estimated rider speed for the maximum and minimum conditions. The Minimum Estimated Rider Speed Curve (solid green line) represents the lowest speed that a rider might reach at that position along the cable. The Maximum Estimated Rider Speed Curve (solid blue line) represents the highest speed that a rider might reach at that position along the cable. The Brake Location (dashed purple line) indicates the position where the rider's trolley would engage the brake.

5. SUPPORT AND CONTACT INFORMATION:

If you need additional explanation or have any questions please do not hesitate to contact us. Suggestions for improvement or clarification are also welcome:

support@zipdesigntools.com

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