

1 Introduction

The Tower Visibility Toolkit supports assessing proposed airport traffic control tower sites against a variety of visibility performance metrics. This toolkit allows assessment of both conventional brick-and-mortar and remote towers. The Federal Aviation Administration (FAA) has a method to assess conventional tower visibility performance that is documented in FAA Order 6480.4, “Airport Traffic Control Tower Siting Process” [1][2]. In 2005, the FAA developed a tool for assessing conventional tower visibility performance called the Visibility Analysis Tool. The Tower Visibility Toolkit replaces the FAA’s Visibility Analysis Tool, using updated methods for calculating probability metrics and adding assessment of remote tower visibility performance through the addition of video camera system modeling.

2 Getting Started

2.1 Tower Type

You can choose the type of tower you would like to assess by clicking on either tower type. Choosing “Conventional Tower” assumes that the observer is directly viewing the scene; choosing “Remote Tower” assumes that there is a video camera system between the observer and the scene.

United States Department of Transportation

About DOTOur ActivitiesAreas of Focus

FAA

Tower Visibility Toolkit

Help

Tower Type: What type of tower would you like to assess?

Conventional Tower

Remote Tower

Next: Enter Inputs

2.2 Metric Selection

You can choose which siting metrics that you would like to calculate for your tower site by clicking on all the metrics you wish to calculate:

Metrics: What siting aspects are you interested in?

Line of Sight Angle of Incidence

Calculate the line of sight angle of incidence based on siting geometry

Two-Point Lateral Discrimination

Calculate how close two points on the airport surface appear to each other from the proposed siting

Surface Object Detection Probability (Siting Check)

Calculate the likelihood of visual task success at various distances to surface object against FAA Guidance

Surface Object Discriminability - Exploratory

Calculate and explore the likelihood of visual task success at various distances to surface object

Airborne Object Discriminability

Calculate the likelihood of visual task success at various distances to target airborne object

Next: Enter Inputs

The toolkit offers five metrics to assess tower visibility, which are based on FAA Order 6480.4:

- “Line of Sight Angle of Incidence” is the angle at which the observer's view of a distant object intersects with the airport's surface. A higher value indicates a steeper look-down angle and a more “bird’s eye” view of the airport surface. Higher values are preferred because they support making spatial judgments about objects on the airport surface. For conventional towers, the toolkit evaluates whether the tower meets the FAA’s guidance of a 0.08 degree minimum.
- “Surface Object Detection Probability (Siting Check)” and “Surface Object Discriminability – Exploratory” are two related metrics for assessing surface target acquisition probability. Surface target acquisition probability is the estimated probability that an observer would be able to detect, recognize, or identify an object on the surface of an airport based on an Army visibility performance model ([2]). The three target acquisition tasks are defined as follows [1][2][3] :
 - Detection*: The ability to notice the presence of an object on the airport surface without regard to the class, type, or model. The observer knows something is present but cannot recognize or identify the object.
 - Recognition*: The ability to discriminate between object classes (e.g., can specify class of aircraft such as single engine general aviation).
 - Identification*: The ability to specify individual models (e.g., Cessna 172).

Although an observer is making a single correct or incorrect judgment on any one occasion (e.g., present or absent for detection), using probability allows description of how often a correct judgment would occur across many observation opportunities. Higher values indicate that an observer will more often detect, recognize, or identify the object. Using detection as an example, a probability of 100% indicates the observer will detect an object on every observation. A probability of 0% indicates that the observer will never detect the object. A probability of 50% indicates that the observer will detect an object on half the observations.

The Tower Visibility Toolkit computes probability metrics using the Target Task Performance (TTP) method, rather than the Johnson method that the legacy Visibility Analysis Tool uses. The TTP method is

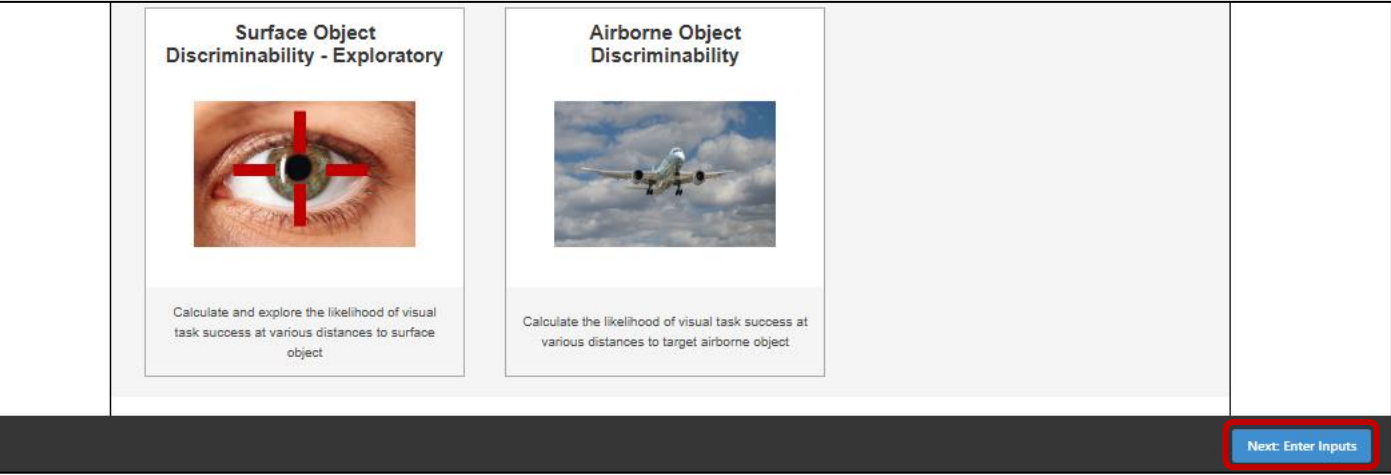
preferred because of its increased validation and closer match to human performance [3] [4]. The TTP method achieves improved estimates through more accurately modeling how the human visual system processes contrast changes, as well as better quantifying how spatial details in the scene are coupled to the human observer through a camera (when applicable).

The toolkit offers the following two separate target acquisition probability metrics:

- The “Surface Object Detection Probability (Siting Check)” metric assumes object and background characteristics consistent with FAA Order 6480.4 and the legacy Visibility Analysis Tool default values, and does not allow those parameters to be edited. The toolkit results include indication of whether the metric value meets FAA Order 6480.4 guidance for surface detection probability. For conventional towers, the toolkit evaluates whether the tower meets the guidance of 97.0% (calculated using the TTP method).
- The “Surface Object Discriminability – Exploratory” metric provides pre-filled but editable values for object and background characteristics. This metric does not include comparison to FAA guidance because the guidance assumes the object and background characteristics have not been changed.
- The “Airborne Object Discriminability” metric operates similar to the Surface Object Discriminability - Exploratory metric except that the toolkit computes the probability that an observer will be able to detect an airborne object. The airborne detection model differs from the surface model in its use of a Cessna 172 object rather than a Dodge Caravan, the view direction (looking up), and its computation of effective turbulence. This metric is for informational purposes only and the FAA does not provide guidance for it.
- “Two-Point Lateral Discrimination” refers to the angle between two laterally separated points on a distant portion of the airport surface. The purpose of the Two-Point Lateral Discrimination metric is to ensure the tower position provides controllers with a view to distinguish between operations at critical points of the airport surface. A higher Two-Point Lateral Discrimination angle is preferred. For conventional towers, the toolkit evaluates whether the tower meets the FAA Order 6480.4 guidance of a 0.13 degrees minimum. Two-Point Lateral Discrimination is calculated using the following formula:

$$\cos^{-1}\left(\frac{A^2 + B^2 - C^2}{2 * A * B}\right)$$

Upon selection of a tower and at least one metric, the “Next: Enter Inputs” button along the page’s footer section becomes enabled and clickable. You can proceed to the next step of the tool kit by clicking this button.



If at any point you want to return to this home page, clicking the “Tower Visibility Toolkit” title in the header will redirect you back to this page.

United States Department of Transportation

FAA

Tower Visibility Toolkit

Help

Home Page Selections

Tower Type

Conventional

Remote

Metrics

Line of Sight Angle of Incidence

Two Point Lateral Discrimination

Surface Object Detection Probability (Siting Check)

Surface Discriminability - Exploratory

Airborne Discriminability

Table of Contents

Operational Viewing Height

Operational Viewing Distance

Siting Check Surface Object and Background Characteristics

Siting Check Environmental and Perceptual Conditions

Siting Check Surface (Target Task Performance Metric)

Tower Visibility Inputs

Tower Site Name

New Tower

Please enter the following characteristics describing your tower siting. Model parameters can be seen [here](#).

Operational Viewing Height

Eye Height

Ground Elevation at Tower

Ground Elevation at Farthest Runway End

Corrected Eye Height (Surface)

Operational Viewing Distance

Distance from Tower to Farthest Runway End

Unit Selection

Distance from Tower to the Farthest Runway's Holdline

Unit Selection

Distance from Farthest Runway to the Nearest Holdline

3 Entering Inputs

3.1 Tower Visibility Inputs

The toolkit’s displayed inputs depend on the metrics selected. Input formats include both fields for numerical values and drop-down menus for categorical values. The inputs default to whole numbers, but decimal places can be added if desired. If you choose the Surface Object Detection Probability (Siting Check) metrics, values constrained by FAA guidance are disabled.

Tower Visibility Inputs

Tower Site Name

New Tower

Please enter the following characteristics describing your tower siting. Model parameters can be seen [here](#).

Operational Viewing Height

Eye Height

Ground Elevation at Tower

Ground Elevation at Farthest Runway End

Corrected Eye Height (Surface)

Operational Viewing Distance

Distance from Tower to Farthest Runway End

Unit Selection

Siting Check Surface Object and and Background Characteristics

FAA regulation constrains the following values.

Description

Orientation

Width

Height

Length

Dodge Caravan

FRONT

6.56 Feet

5.91 Feet

15.75 Feet

Object Reflectivity

Background Reflectivity

39 %

21 %

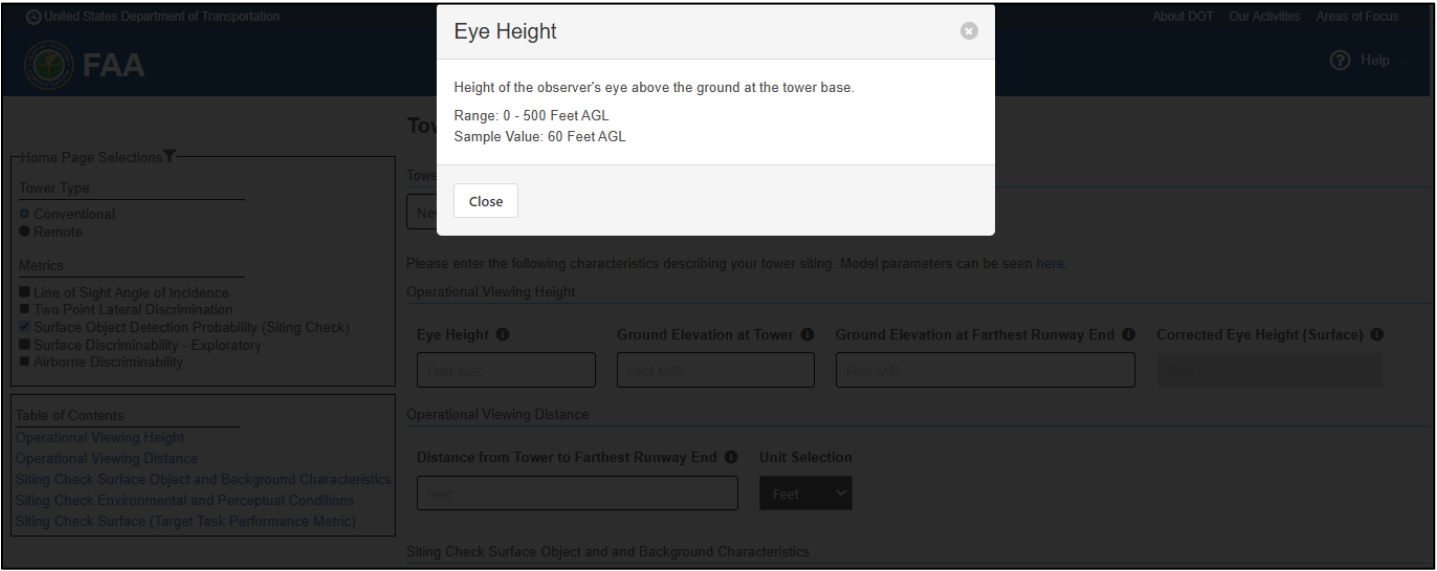
Siting Check Environmental and Perceptual Conditions

FAA regulation constrains the following values.

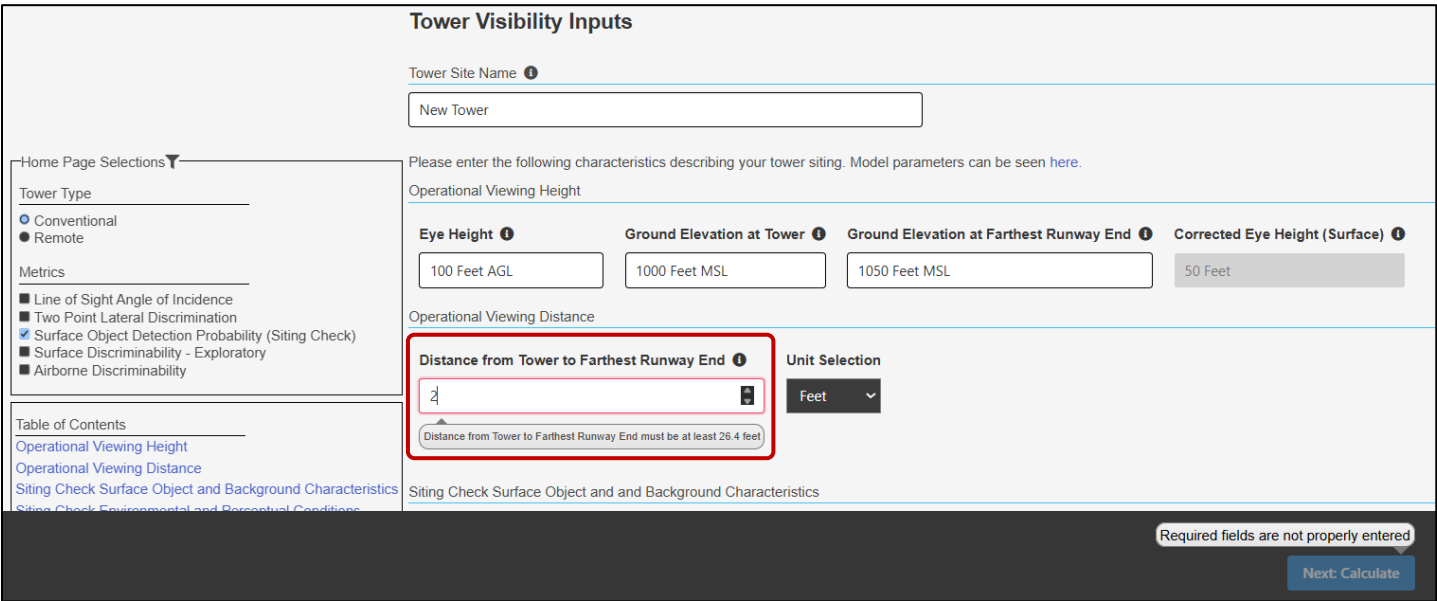
Required fields are not properly entered

Next: Calculate

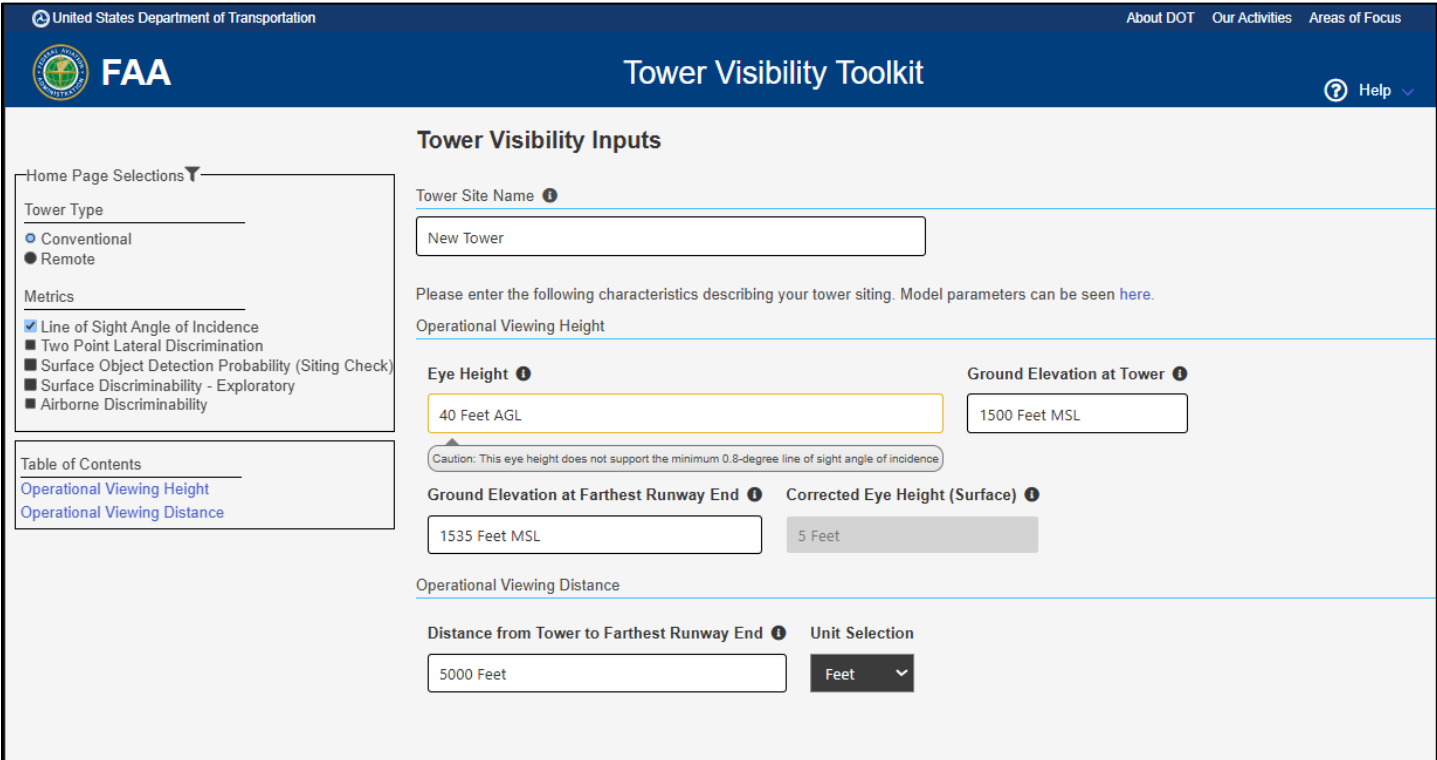
Each input field has an information icon near the field. Upon clicking the icon, a pop-up will appear that contains a description of the input field, a range of acceptable values, and a sample input value.



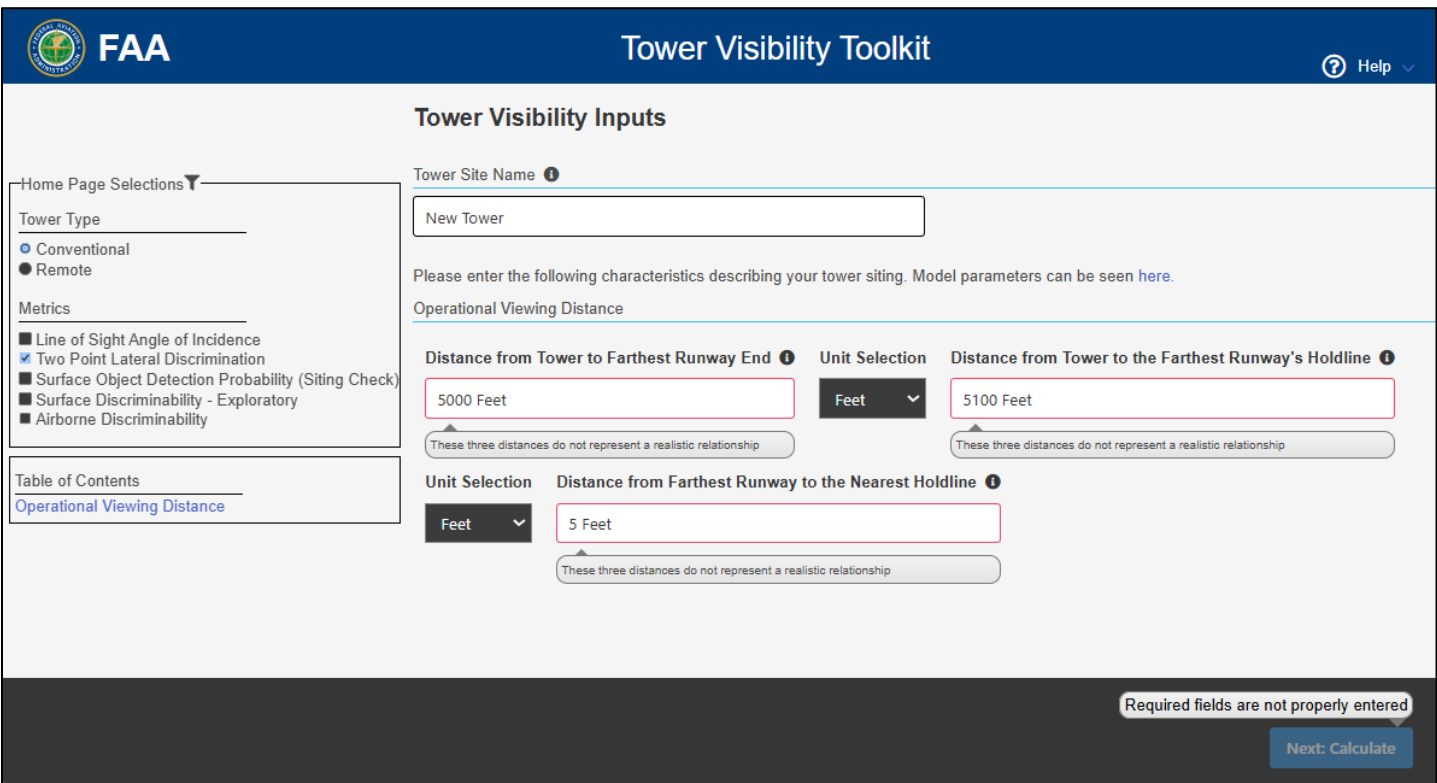
Entering a value outside the range of acceptable values causes the toolkit to highlight the input with an error message and prevents you from advancing.



When calculating the Line of Sight Angle of Incidence metric, a cautionary note will appear if the entered values do not support the minimum value of 0.8 degrees. The toolkit will allow you to proceed with calculating this metric even if the value is below 0.8 degrees.

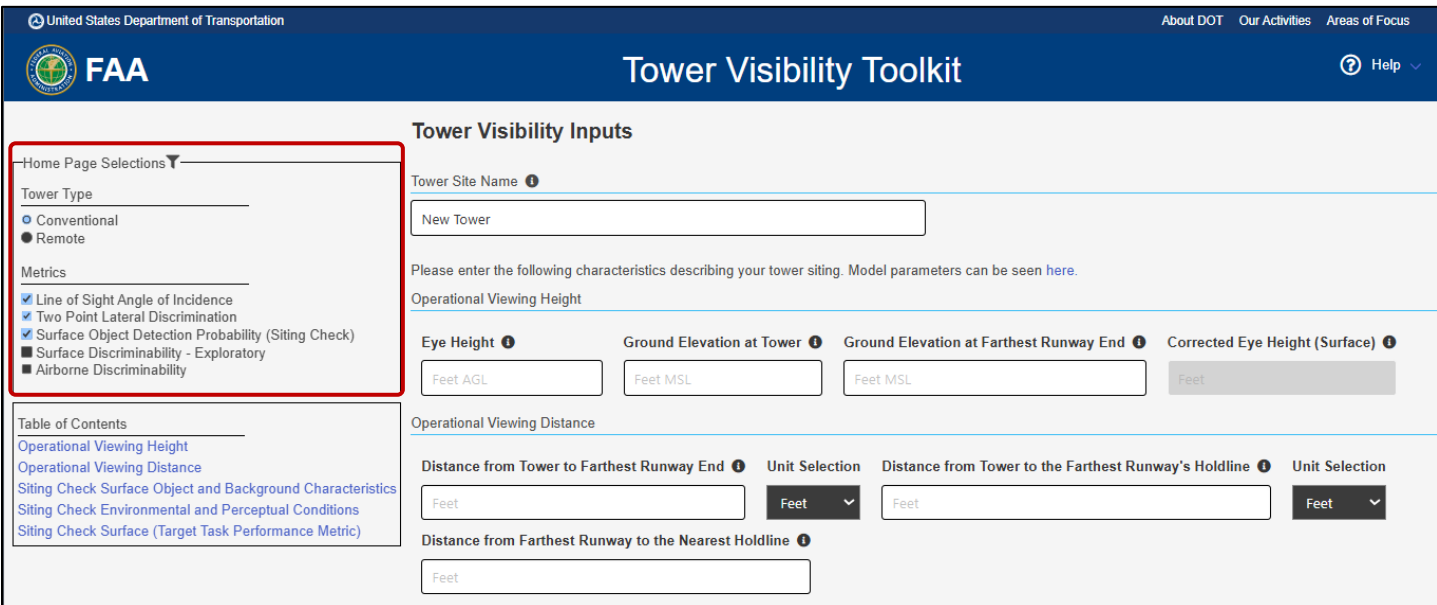


When calculating the Two-Point Lateral Discrimination metric, entering values inconsistent with airport layouts will highlight the input with an error message and prevent you from advancing.



3.2 Home Page Selections

On the left-hand side of the inputs page, you can view your home page selections (Tower Type and Metrics). You can change the home page selections from this menu, and the input fields will change accordingly.



A table of contents also exists for input section navigation. Clicking on links in the table of contents will take you to the relevant section of the inputs page. The table of contents updates if home page selections change.

United States Department of Transportation

About DOTOur ActivitiesAreas of Focus

FAA

Tower Visibility Toolkit

Help

Home Page Selections

Tower Type

Conventional

Remote

Metrics

Line of Sight Angle of Incidence

Two Point Lateral Discrimination

Surface Object Detection Probability (Siting Check)

Surface Discriminability - Exploratory

Airborne Discriminability

Table of Contents

Operational Viewing Height

Operational Viewing Distance

Siting Check Surface Object and Background Characteristics

Siting Check Environmental and Perceptual Conditions

Siting Check Surface (Target Task Performance Metric)

Tower Visibility Inputs

Tower Site Name

New Tower

Please enter the following characteristics describing your tower siting. Model parameters can be seen [here](#).

Operational Viewing Height

Eye Height

Ground Elevation at Tower

Ground Elevation at Farthest Runway End

Corrected Eye Height (Surface)

Feet AGL

Feet MSL

Feet MSL

Feet

Operational Viewing Distance

Distance from Tower to Farthest Runway End

Unit Selection

Distance from Tower to the Farthest Runway's Holdline

Unit Selection

Feet

Feet

Feet

Feet

Distance from Farthest Runway to the Nearest Holdline

Feet

Once you have provided valid values for all the required input fields, the “Next: Calculate” button along the page’s footer section becomes enabled and clickable. You can proceed to the next page of the toolkit by clicking this button.

United States Department of Transportation

About DOTOur ActivitiesAreas of Focus

FAA

Tower Visibility Toolkit

Help

Home Page Selections

Tower Type

Conventional

Remote

Metrics

Line of Sight Angle of Incidence

Two Point Lateral Discrimination

Surface Object Detection Probability (Siting Check)

Surface Discriminability - Exploratory

Airborne Discriminability

Table of Contents

Operational Viewing Height

Operational Viewing Distance

Siting Check Surface Object and Background Characteristics

Siting Check Environmental and Perceptual Conditions

Siting Check Surface (Target Task Performance Metric)

Tower Visibility Inputs

Tower Site Name

New Tower

Please enter the following characteristics describing your tower siting. Model parameters can be seen [here](#).

Operational Viewing Height

Eye Height

Ground Elevation at Tower

Ground Elevation at Farthest Runway End

Corrected Eye Height (Surface)

100 Feet AGL

1000 Feet MSL

1050 Feet MSL

50 Feet

Operational Viewing Distance

Distance from Tower to Farthest Runway End

Unit Selection

Distance from Tower to the Farthest Runway's Holdline

Unit Selection

3500 Feet

Feet

3600 Feet

Feet

Distance from Farthest Runway to the Nearest Holdline

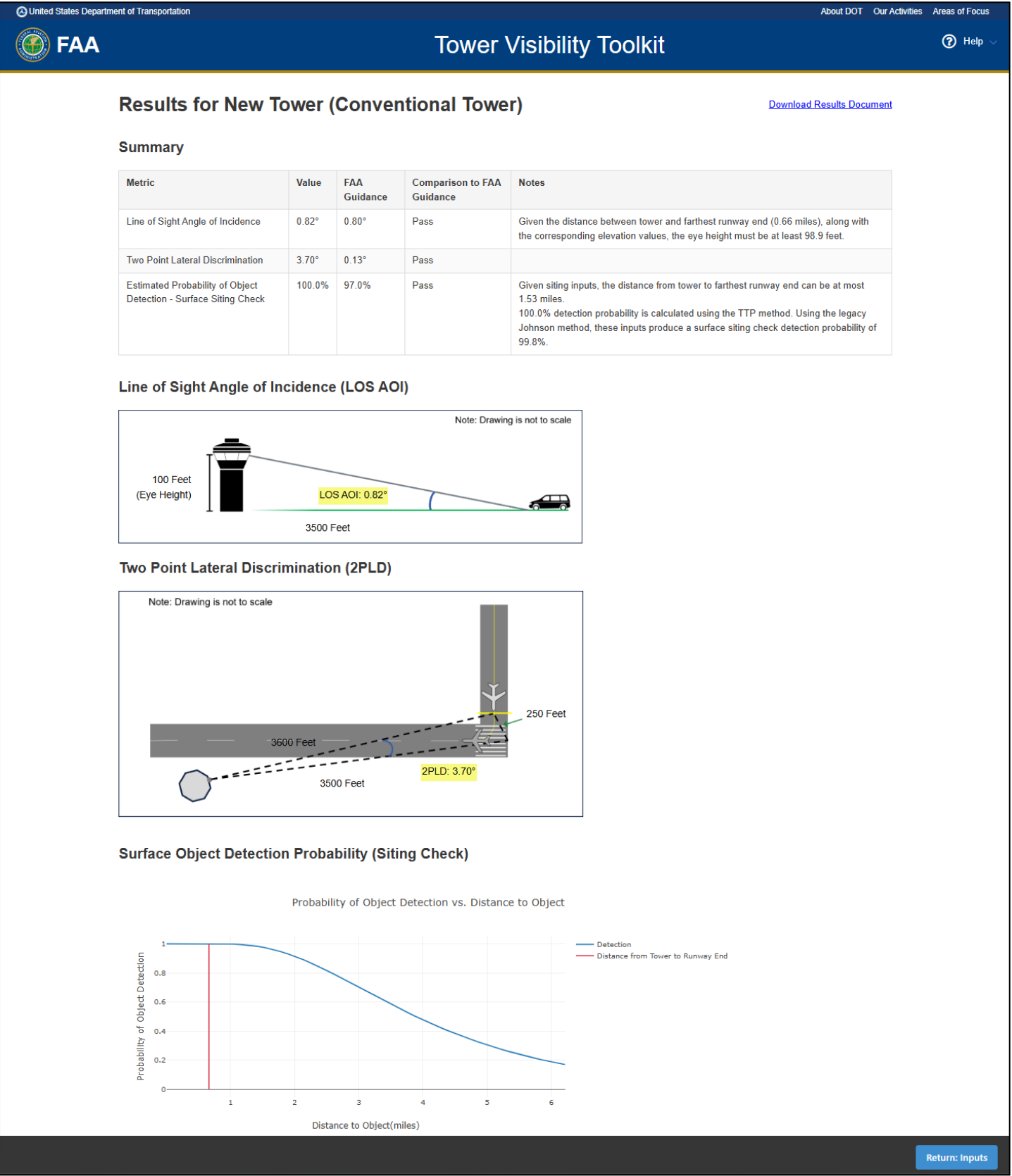
250 Feet

Next: Calculate

4 Viewing Results

The results page begins with a table of visibility metric values and related information. When applicable, the toolkit compares the metric values to FAA guidance. The toolkit also provides additional notes to help you interpret the results. You can download all the results to a Portable Document Format (PDF) file by clicking the “Download Results Document” link next to the “Results for…” header.

If Line of Sight Angle of Incidence or Two-Point Lateral Discrimination metrics are chosen, the toolkit also shows a diagram of the spatial relationships with the key input values and the resulting metric value. If surface or airborne discriminability metrics are chosen, the toolkit also shows interactive plots of probability values by distance. The interactive plots provide exact values when you hover over the lines with your mouse.



Below the summary table and plots are all the inputs that you entered to produce the results. If you wish to change what values are used, you can press the “Return: Inputs” button along the page’s footer to return to the inputs page and change their values or the tower type and metric selections.

Inputs Recap

Operational Viewing Height

Eye Height

100 Feet AGL

Ground Elevation at Tower

1000 Feet MSL

Ground Elevation at Farthest Runway End

1050 Feet MSL

Corrected Eye Height (Surface)

50 Feet

Operational Viewing Distance

Distance from Tower to Farthest Runway End

3500 Feet

Distance from Tower to the Farthest Runway's Holdline

3600 Feet

Distance from Farthest Runway to the Nearest Holdline

250 Feet

Siting Check Surface Object and and Background Characteristics

FAA regulation constrains the following values.

Description

Dodge Caravan

Orientation

FRONT

Width

6.56 Feet

Height

5.91 Feet

Length

15.75 Feet

Object Reflectivity

39 %

Background Reflectivity

21 %

Siting Check Environmental and Perceptual Conditions

FAA regulation constrains the following values.

Light Level

Direct Sunlight

Ground Turbulence Strength

Medium

Visible Range

10 Miles

Sky to Ground Ratio

1 Unitless

Siting Check Surface (Target Task Performance Metric)

FAA regulation constrains the following values.

V50 Detection

2 Cycles on Target

V50 Recognition

14.5 Cycles on Target

V50 Identification

19.5 Cycles on Target

Return: Inputs

5 Help Menu

The top right of the page in the header provides access to a “Help” menu. The “Report Issue” option generates a feedback email you can use to report issues with the toolkit. The “User Guide” option opens this user guide. The “Data Rights” option describes copyright and contract information for the toolkit.

United States Department of Transportation

About DOTOur ActivitiesAreas of Focus

FAA

Tower Visibility Toolkit

Results for New Tower (Conventional Tower)

[Download Results Document](#)

Summary

Metric	Value	FAA Guidance	Comparison to FAA Guidance	Notes
--------	-------	--------------	----------------------------	-------

Help

Report Issue

User Guide

Data Rights

6 User Guide References

[1] The Federal Aviation Administration, "FAA Order 6480.4B: Airport Traffic Control Tower Siting Process," 2021.

[2] The Federal Aviation Administration, "FAA Order 6480.4C: Siting of Airport Traffic Control Towers," 2024.

[3] R. Vollmerhausen and E. Jacobs, "The Targeting Task Performance (TTP) Metric: A New Model for Predicting Target Acquisition Performance," U.S. Army CERDEC, Fort Belvoir, VA 22060, 2004.

[4] E. Boettcher, T. Maurer, S. Murrill and B. Miller, "Experimental Determination of Visibility Modeling Parameters for Aircraft," in Society of Photo-Optical Instrumentation Engineers: Defense, Security, and Sensing, Orlando, FL, 2010.