CATIA V5 Automotive Extensions Vehicle Architecture — Wiper (CW9)

User Guide

BPA Delivery 7 for V5R19 (V 5.7)

TRANSCAT

Instruction symbols used in this guide

The following symbols are used in this guide; they should allow you to navigate throughout the text with greater ease:

Warning triangle

The warning triangle refers to *critical circumstances*, which should be considered imperatively in order to avoid serious problems in your work.

Hint symbol

The light bulb relates to *hints*, which provide you with practical examples to simplify your work.

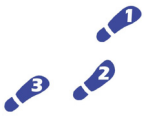
Note symbol

The hand symbol relates to *notes*, which you should pay attention to in order to assure that you can *work without problems*.

Information symbol

The information symbol relates to background *information*.

Work steps symbol



The work steps' symbol refers to a *step-by-step instruction* sheet.

Contents

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0. CAVA in General

In order to understand the basics of CATIA, please, read first the General CAVA User Manual. General information on CAVA is given only in that manual. You will find there also information required for work with CAVA WIPER, e. g.:

- How CAVA is started?
- How a CAVA feature is created and edited?
- How CAVA is configured?
- What is Standard Mode, what is Free Mode?
  Which parameters can be changed in which mode?
- How to export geometries?

1. Functionality of the WIPER Tool

The primary objective of the WIPER Feature is to calculate the wiped area on the windshield (and/or rear window). According to international standards the wiped area has to cover a certain percentage of the fields of view on the windshield (ECE, FMVSS – cp. Fields of View). A comparison with calculated Cava fields of view is also possible. Along with checking the standards the WIPER Feature also calculates parameters, which give information about wiper quality e.g. the normal angle or the rise and fall angle.

Already at an early stage and without knowledge of the exact data, the user should have the possibility to check the wiper or the wiped area respectively. The check can be carried out for the front as well as for the rear window. Thereby 1, 2 or 3 wipers per window can be defined. If 2 wipers are chosen they can be arranged to wipe in opposite directions (Butterfly). Two wiper types are considered: standard wipers and trapezoid wipers with normal or curved wiper blades.

There is no restriction in the number of WIPER Features within the model, which means that two features can be created at the same time for one window, e. g. in order to compare the influence of different parameters directly.

The WIPER Feature contains the following functionality:

- Definition of the wiper geometry
- Calculation of the wiped area of the window
- Percentage calculation of the wiped area of the fields of view (optional)
- Calculation of the rise and fall angle
- Calculation of the normal angle (blade ⇔ pane) in order to determine wiper quality
- Generation of a report (representation of the values in tables and diagrams).

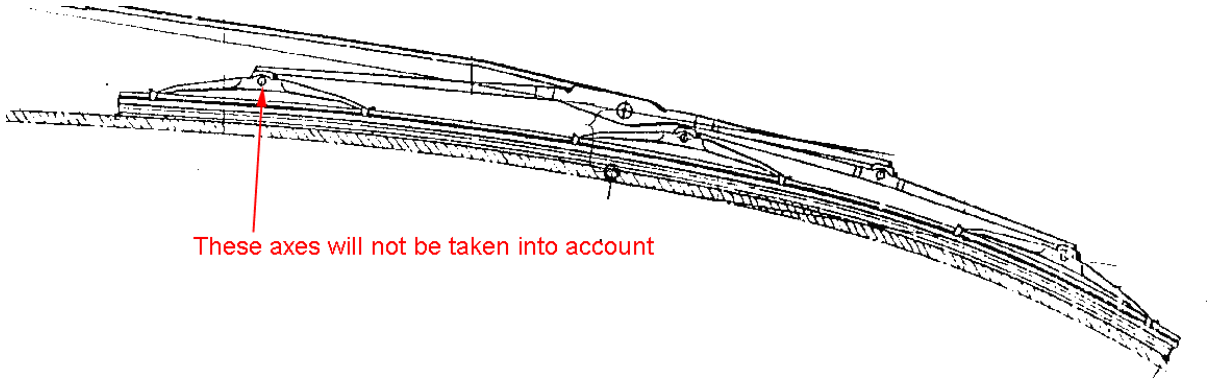
2. Basic Assembly of the Wipers (Both Types)

Generally the wiper for this program consists of different parts connected to each other with joint axes:

- The "*Driven" Part*, which depending on the type is driven by either one or two axes (trapezoid wiper) (see 3.2

Driving Device on page 10);

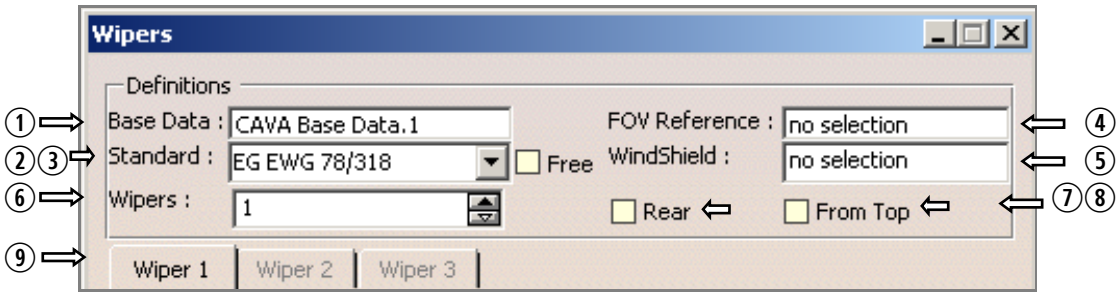
- *The wiper arm*, which is connected to the driven part via the folding axis (arm axis). The angle of the folding axis is the folding angle.
  Length and possible rotation are important parameters of the wiper arm.
- The *wiper blade,* which is connected to the wiper arm via the blade axis. Expansion in directions, blade height and possible curvature are important parameters of the wiper blade. Possible additional axes within the blade, which often exist with standard blades are not considered separately but contained in the parameter blade height. Thus the newer aero blades can be calculated as well. The blade itself is normal to the blade axis.



(The red text in Picture means that the axis, the arrow is pointed to, is not taken into account by the CAVA program)

3. The CAVA WIPER Feature

3.1 Definitions



① Reference field „Base Data"

For the underlying base data of this feature refer to the chapter "Base Data" in the CAVA OVA User Guide. After selecting the base data, the target data respective to the vehicle category is activated.

② List box „Standard"

Select a default. Predefined values for each feature are defined in the corresponding default. The individual standards and their values, available in this field, are stored in the respective configuration file (for the WIPER Feature in `Wipers.xml`).

Some fields are provided with values but will stay inactive for the user. This is the normal case - they contain the values defined by default.

③ Check box „Free"

By selecting the check box „Free" you can avoid the defaults and define your own settings for specific values

④ Reference field „FOV Reference"

Reference geometry for the calculation of the required and current coverage.

Activate this field and then select reference geometry for the fields of view in the model or from the specification tree. It is not imperative that the fields of view were created as faces in the *Fields of View* Feature, like it is sometimes assumed in other features (e. g. optical properties).

If you are using a FOV reference, there is no need to select fields of view in *Outputs*. The corresponding fields are adopted from the referenced *Field of View* Feature. Thus the corresponding fields are deactivated.

The whole Field of View Feature has to be selected in the tree. Some fields can not be selected.

In order to cancel the selection, click on the selected geometry (Field of View Feature in the tree of geometry in the model) once again.

If the FOV Feature is used as reference, it is not necessary to select a pane geometry. The geometry underlying the FOV Feature is used. The *Windshield* field is deactivated in this case.

⑤ Reference field „Windshield“

Geometry of the windshield on which the wiped area is to be created.

If you want to check the whole windshield area, activate this field and then select geometry in the model or from the specification tree.

In order to cancel the selection, click on the selected geometry (*Field of View* Feature in the tree or geometry in the model) once again.

⑥ Spinner „Wipers“

In this field you can define the number of the wipers to be created. A maximum of 3 wipers can be created.

If you change the number, the corresponding tabbed pages are activated or deactivated respectively (see ⑨).

⑦ Check box „Rear“

Select this option if the wiper is a rear wiper. This is important to implement the direction (from right to left or from left to right respectively) correctly for calculation.

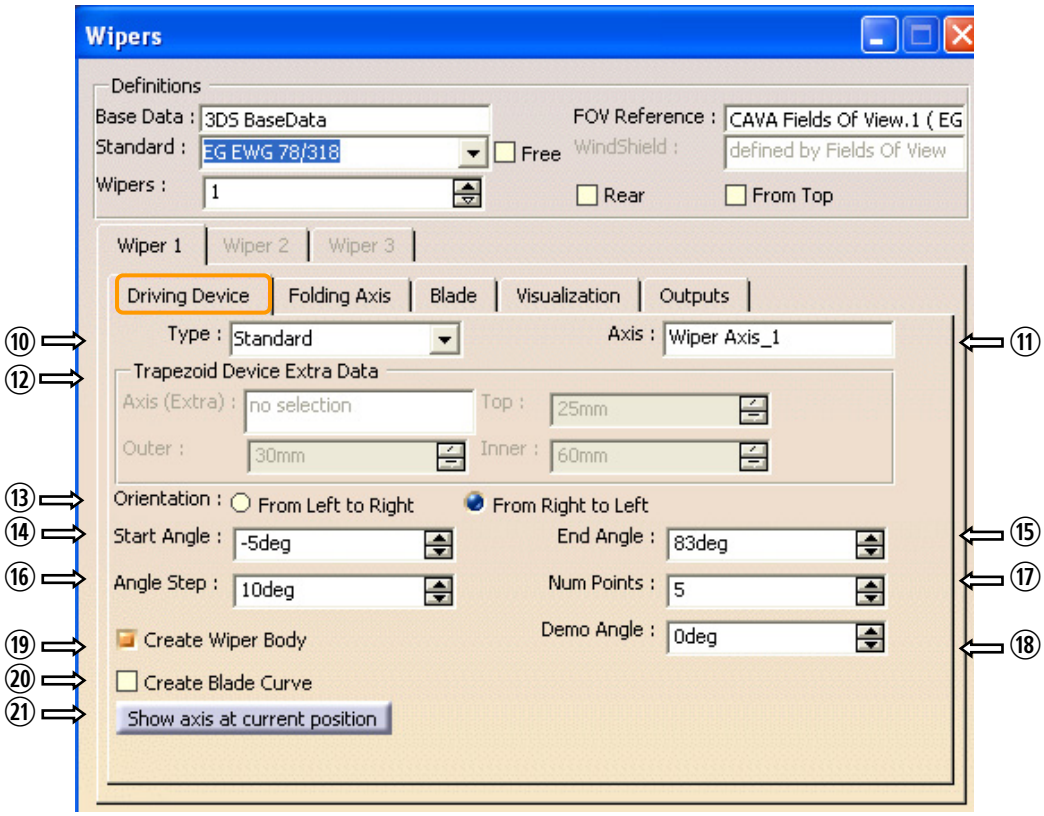
⑧ Check box „From top“

Choose this option, if the driving device is located above the pane geometry. This is important to implement the direction (from right to left or from left to right respectively) correctly for calculation.

⑨ Wiper—Wiper tab cards

The user has to do the required settings for each wiper in a separate tab page. The number of active tab pages is related to the value that is set on the Spinner „Wipers“ (see above ⑥).

3.2 Driving Device



⑩ List box „Type“

The wiper type is defined here. There is a choice of two types

- standard wiper and
- trapezoid wiper

The standard wiper is driven by a shaft moving the driven part and therefore the folding axis circularly.

If you select the trapezoid wiper type, you have to specify additional values (see below ⑫).

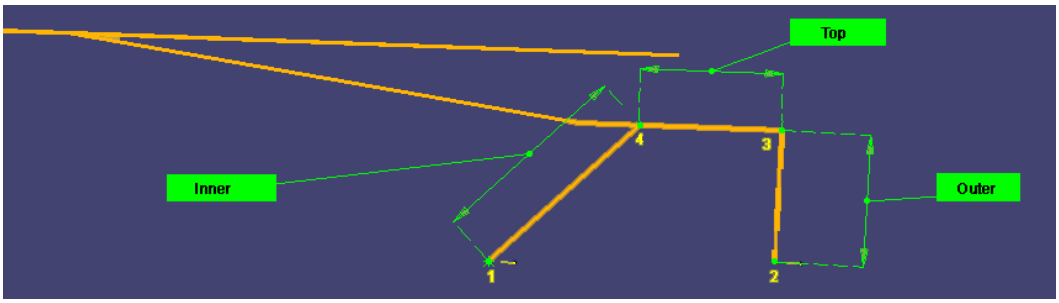
⑪ Reference field „Axis“

To select the driving device, activate the field by clicking on it and subsequently select a line element to be used as driving device.

⑫ Trapezoid Device Extra Data

The trapezoid wiper has two axes, one of which usually is driven. The two axes are connected trapezoidal to the driven part via two "guiding arms". Thus the folding axis moves depending on the parameters on a non-circular track, which allows for a better adaptation of the wiped area to the form of the windshield.

- Reference field „Axis (Extra)“ — Select a line element for the second wiper axis from the model or from the specification tree.
- Spinner „Outer“ — Length of the outer lever arm
- Spinner „Inner“ — Length of the inner lever arm
- Spinner „Top“ — Length of the connection between the inner and outer arm.



The points 1, 2, 3 and 4 must be located on a plane that is normal to the selected axes. (Generally this should already be given by kinematics.)

Orientation (from right to left or left to right respectively) is determined by the sequence of selection of the axes.

⑬ Option button „Orientation“

Orientation data refer to the view from inside the vehicle to the outside (in driving direction).

- From right to left
  The start angle is located to the right of the axis.
  The wiper arm describes a movement from the right to the left hand side.
- From left to right
  The start angle is located to the left of the axis.
  The wiper arm describes a movement from the left to the right hand side.

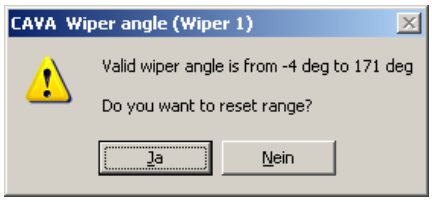
With trapezoid wipers orientation is given by the sequence of selection of the axes.

⑭ Start Angle

Defines the position of the wiper arm at the start of the calculation.

⑮ End Angle

Defines the final position of the wiper arm for the calculation.



- Confirm with *Yes*, in order to create the wiped area with valid values.
- If you click on *No*, only the wiper geometry is generated (if you have activated the *Create Wiper Body* Option) and the wiped area will not be calculated.

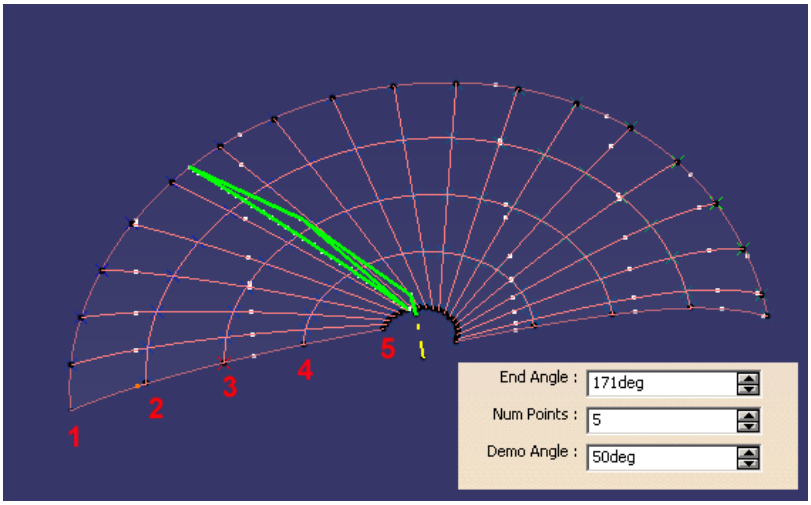
⑯ Spinner „Angle Step“

The start angle is increased by the angle step value specified here. At these positions trace points are generated and the deviation angle is calculated.

⑰ Spinner „Num Points“

Defines the number of trace points for the wiper blade. The points are distributed equidistantly on the wiper blade.

- Example for 5 points:



⑱ Spinner „Demo Angle“

You can place the wiper at the angle position defined in this field. The normal deviation for this position is then calculated along with the angles defined in Angle Step. Spinner „Angle Step“ (above ⑯) The results are shown in the Outputs tab (see below).

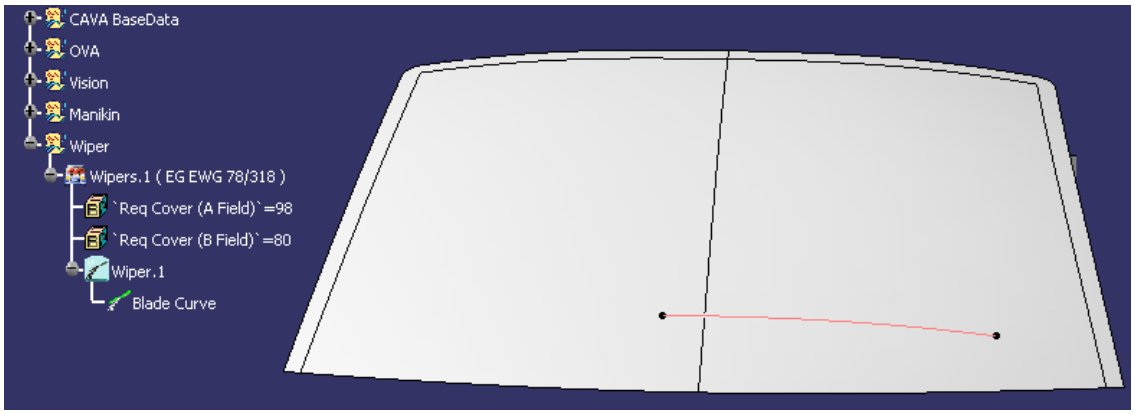
If you have activated the *Create Wiper Body Option* ⑲, the wiper is visualized in the specified angle position in the model (see figure in "NumPoints").

⑲ Create Wiper Body

If this option is activated, the wiper is created as geometry in the model with the values defined in the Driving Device, Folding Axis and Blade tab cards (see Fig. above point ⑰).

⑳ Create Blade Curve

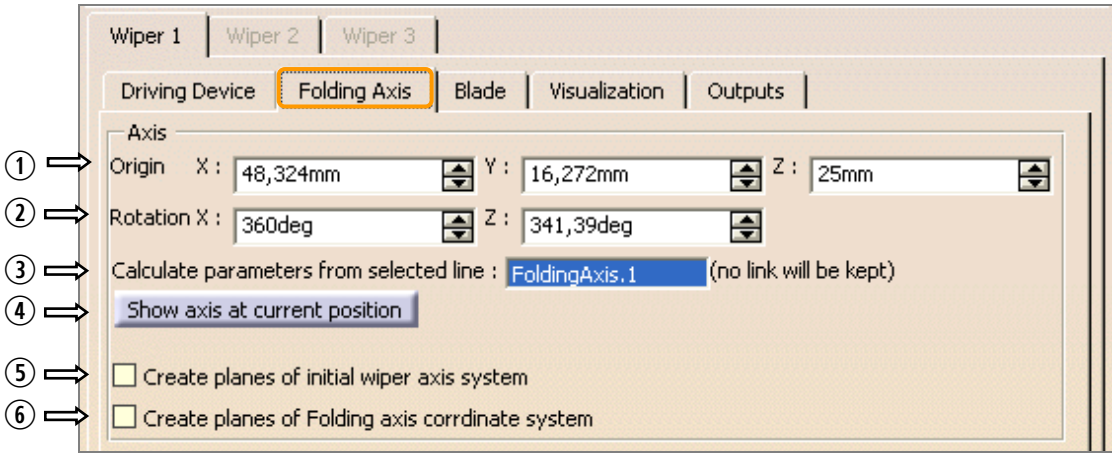
If this option is active, the wiper blade geometry on the windscreen is generated as a V5 curve using the current *Demo Angle*.



㉑ Show axis at current position

By pushing this button the axis systems will be visualized at the current defined position - without calculating the whole wiper kinematics / wiped area / ....

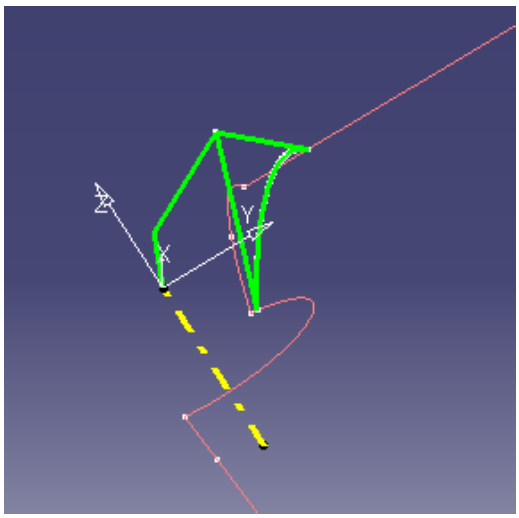
3.3 Folding Axis



① Origin

x, *y* and *z* values for the origin of the folding axis

The wiper system origin for standard wipers is located in the upper point of the wiper axis (driving device). The center point of the folding axis is defined by the coordinates in the wiper coordinate system (*x*, *y* and *z* values).



② Rotation

Optionally a rotation of the folding axis with regard to the axis system can be defined. This is done via two angles to the wiper axis by *x* and *z* (*y* is rotating).

If both angles have a value of 0 deg, the folding axis stands normal on the driving device and on the *x* axis.

③ Calculate parameters from selected line

If you already have a folding axis in your model, you can select it and calculate its coordinates with CAVA.

Select a line representing the folding axis, then click on the “Show axis at current position“ button to refresh the fields.

④ Show axis at current position

Click this button to visualize the axis systems in the currently defined position—without calculating the whole wiper kinematics / wiped area / ... .

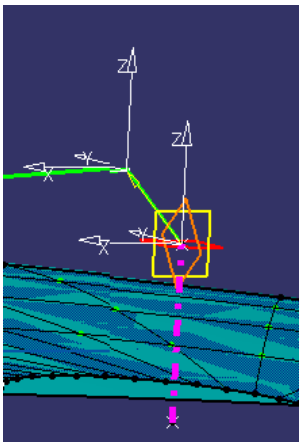
For example, if you have changed the selected line for the axis, you can click on this button to recalculate the coordinate fields and to move the visualized axis system to the new position without recreating the complete wiper outputs

⑤ Create planes of initial wiper axis system

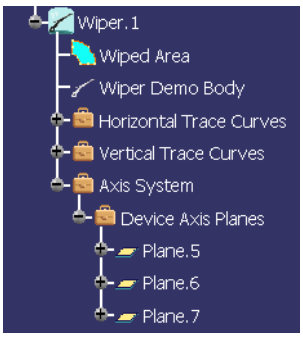
If this option is activated, the planes of the coordinate direction of the initial wiper axis system will be displayed in the model.

The generated planes will remain in the model even if the user dialog is closed. Therefore it can be used for further operations like measurements, etc.

In the picture you can see the color-marked *xy* plane (red), the *yz* plane (orange) and the *zx* plane (yellow) of the internal coordinate systems of the driving device axis.



The generated planes are also visualized in the structure tree.

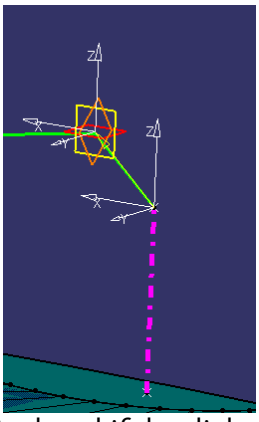


⑥ Create planes of Folding axis coordinate system

If this option is activated, the planes of the coordinate direction of the initial wiper axis system will be displayed in the model.

The generated planes will remain in the model even if the user dialog is closed. Therefore they can be used for further operations like measurements, etc.

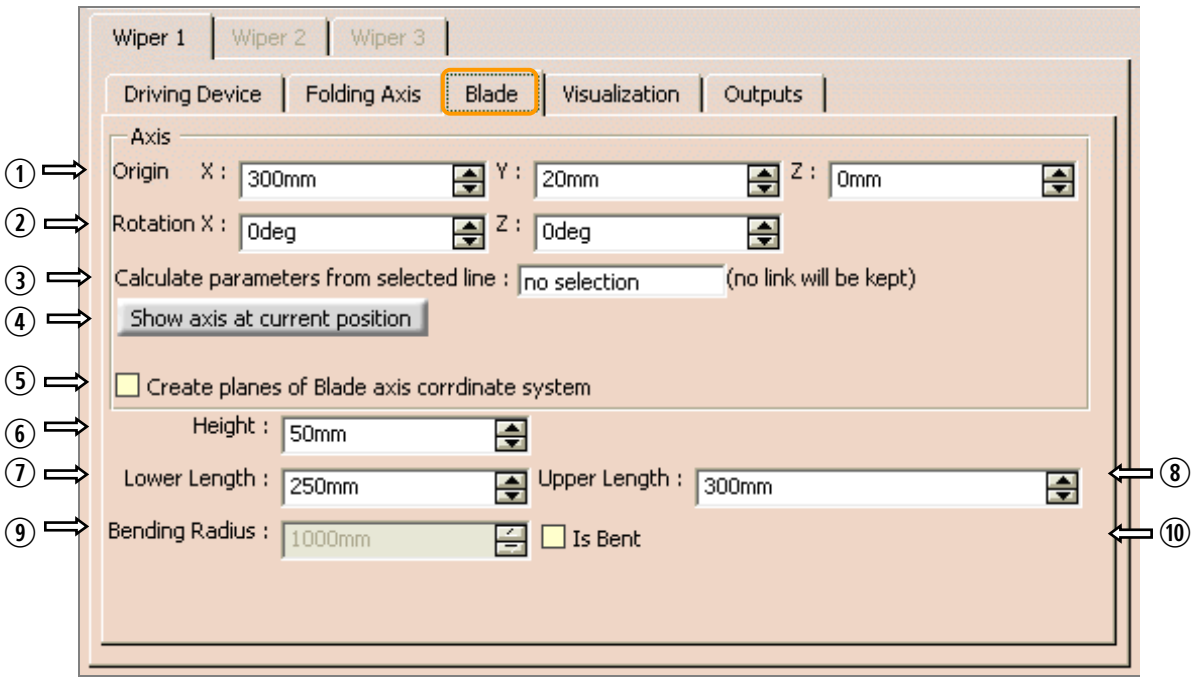
(See “Create planes of initial wiper axis system” on page 15 for a description.)



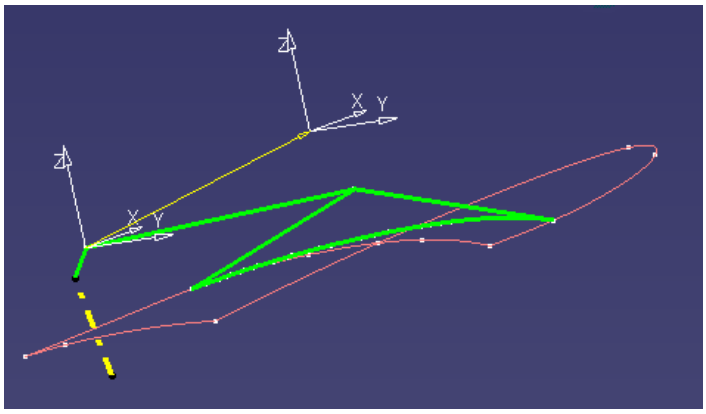
The internal coordinate system is only displayed if the dialogue is open and the corresponding tabs (*Driving Device*, *Folding Axis* or *Blade*) are selected.

3.4 Blade

The wiper blade is connected to the wiper arm via the blade axis. The blade itself is normal to the blade axis.



① Origin



The *x*, *y* and *z* values of the folding axis.

The values refer to the internal coordinate system of the folding axis. That means, the *x*, *y* and *z* values are measured from the origin of the folding axis coordinate system.

② Rotation

Optionally a rotation of the blade axis with regard to the axis system can be defined. This is done via two angles to the folding axis by *x* and *z* (*y* is rotating).

The wiper blade is attached via the folding axis to the pane outline. The internal coordinate systems of the axes are not moved. They remain at the position with the smallest angle.

③ Calculate parameters from selected line

If you already have a folding axis in your model, you can select it and calculate its coordinates with CAVA. Select a line representing the folding axis, then click the "Show axis at current position" button to refresh the fields.

④ Show axis at current position

By pushing this button the axis systems will be visualized at the currently defined position—without calculating the whole wiper kinematics / wiped area / ... .

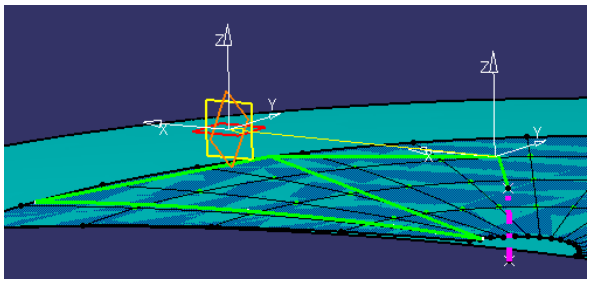
For example, if you have changed the selected line for the axis, click this button to recalculate the coordinate fields and to move the visualized axis system to the new position without recreating the complete wiper outputs.

⑤ Create planes of Blade axis coordinate system

If this option is activated, the planes of the coordinate direction of the Blade axis system will be displayed in the model.

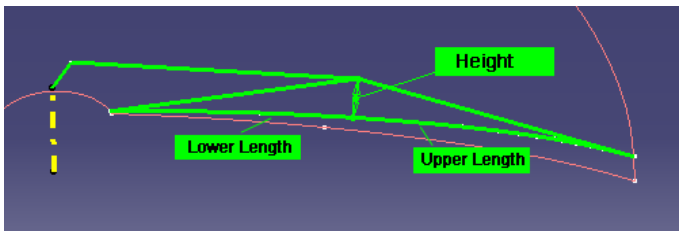
The generated planes will remain in the model even if the user dialog is closed. Therefore they can be used for further operations like measurements, etc.

(See "Create planes of initial wiper axis system" on page 15 for a description)



⑥ Height

Possible additional axes within the blade, which often exist with standard blades are not considered separately but contained in the blade height parameter. Thus the newer aero blades can be calculated as well.



⑦ Lower Length

Lower length of the wiper blade measured from the end of the blade, which points at the axis to the joint point projected on the blade.

⑧ Upper Length

Upper length of the wiper blade measured from the end of the blade, which points away from the axis to the joint point projected on the blade.

⑨ Bending Radius

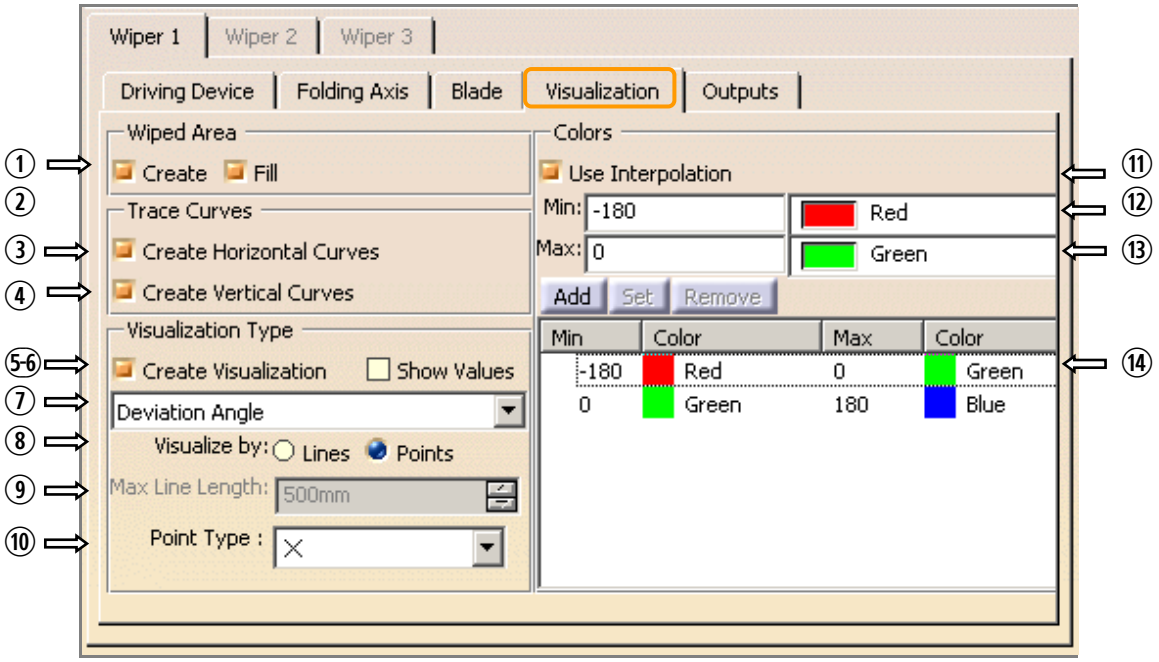
Here the radius for the bend is defined. This field is only activated if the *Is Bent* Option is selected.

⑩ Is Bent

This option specifies if the wiper blade is bent. This does not refer to the bending of the blade towards the pane but to the bending of the blade on pane level.

The internal coordinate system is only displayed if the dialogue is open and the corresponding tabs (*Driving Device, Folding Axis* or *Blade*) are selected.

3.5 Visualization



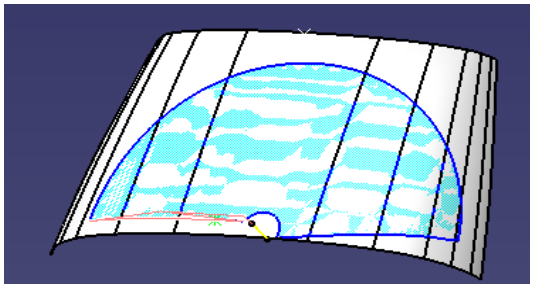
Wiped Area

① Create

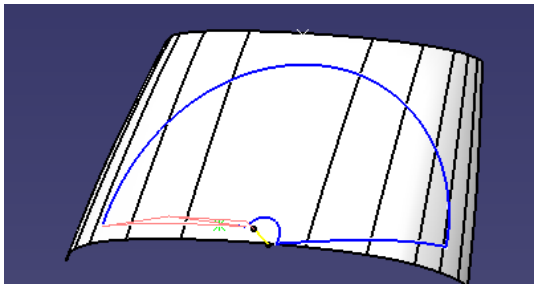
Hereby you can switch on/off the display of the wiped area for this wiper.

② Fill

If this option is activated, the wiped area is generated as a fill.



If this option is deactivated, the wiped area is displayed only as a line.

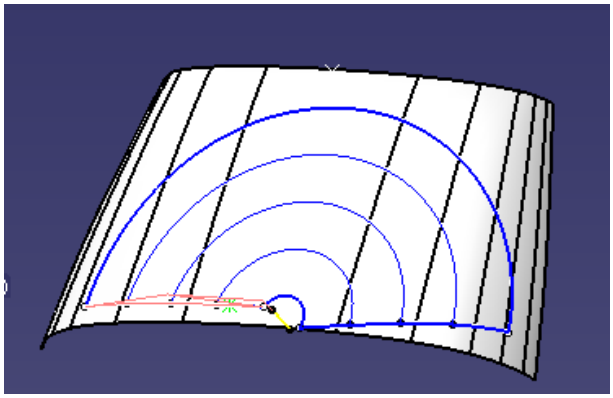


The settings for the wiped area (*create* and *fill*) can be defined separately for each wiper. They only refer to the wiper in the tab that is active at the moment. However, the settings further down in *Outputs* refer to all defined wipers as a whole. Therefore the fields of the two representations can overlay each other.

Trace Curves

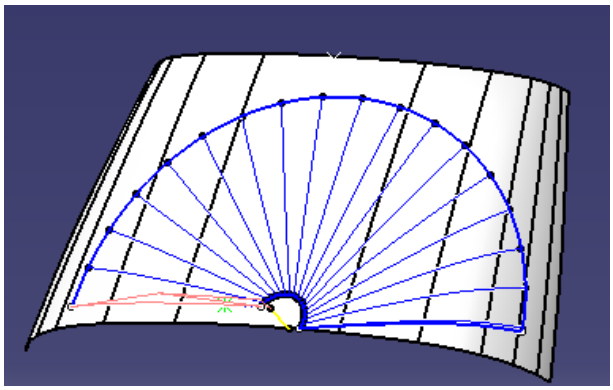
③ Create Horizontal Curves

The NumPoints entered in the Driving Device tab are distributed equidistantly over the length of the wiper blade. The horizontal trace curves describe the position of these points at discrete angles along the path between the start angle and the end angle.



④ Create Vertical Curves

The vertical trace curves represent the length of the wiper blade at discrete angles, which are defined in the Driving Device tab by the Angle Step value.



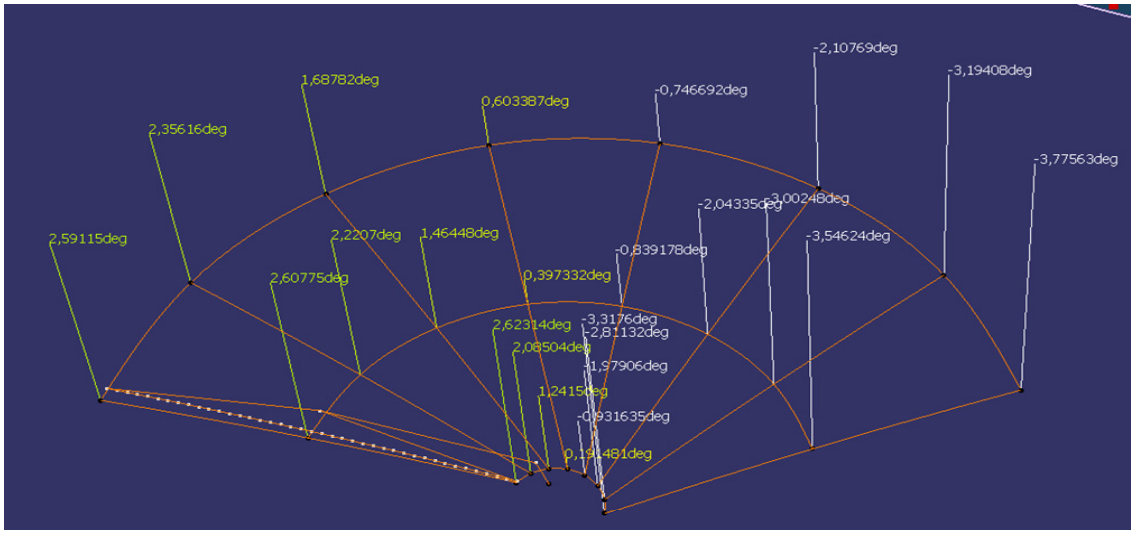
Visualization Type

⑤ Check box „Create Visualization“

With this option you can switch on/off the display of the deviation angle at the trace points in the wiped area for the respective wiper.

⑥ Check box „Show Values“

With this option you can label the measured values of the respective points in the workspace.



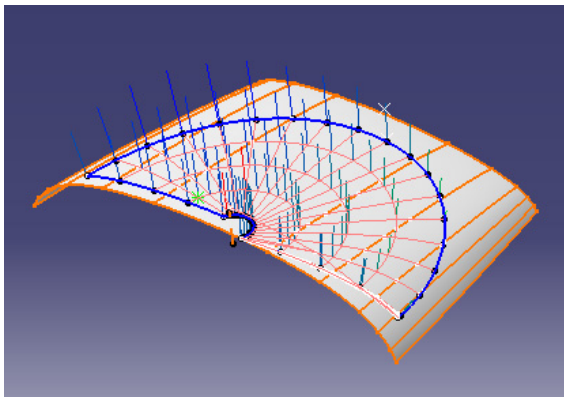
⑦ List box

From this list you can select which type of calculation and visualization should be done for the trace points. (See table „Overview of available calculation methods“ on page 26.)

⑧ Visualize by

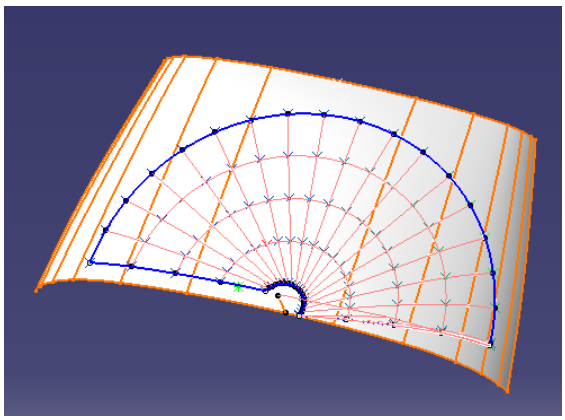
- Lines

Deviation angles are displayed in the form of lines to the pane geometry. The length of the lines corresponds to the calculated values in relation to the length of the maximum value defined in ⑨ *Max Line Length*.



- Points

Deviation angles are displayed as colored points.



⑨ Max. Line Length

This value defines the length of the normal representing the maximum deviation angle. All other values of deviation angles are represented in relative length to this maximum value

⑩ Point Type

Here you can select a graphical sign to display the point in the workspace.

⑪ Use Interpolation

- If this check box is activated you will be able to define an upper and lower boundary of a range and the related color for each. The interim values between the upper and lower boundary are displayed by interpolated colors.
- If this check box is deactivated, each range of values is displayed in one single color (The used color is the one that is selected in the color selection list right beside the text field „Min“).

⑫⑬ Text fields „Min“ and „Max“ and list boxes for color selection

In the text fields „Min“ and „Max“ you can define the upper and lower boundary of the value’s range for the type that is selected in field ⑦.

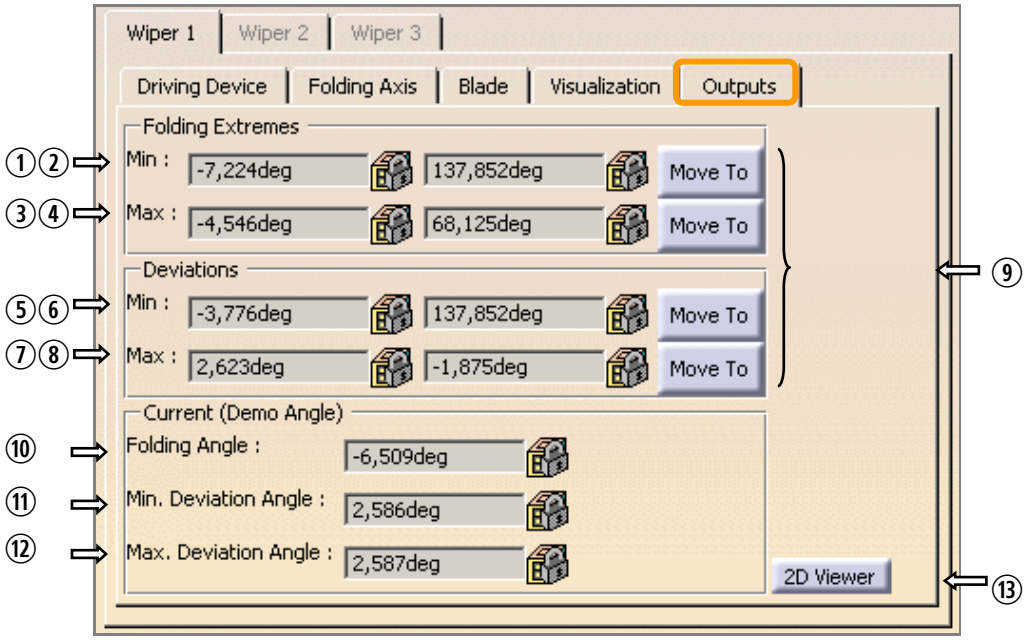
In the color selection fields you can define a color to the range boundaries. The color selection field right beside the text field „Max“ will only be activated, if the check box „Use Interpolation“ is enabled.

⑭ List of the defined ranges with related colors

This list contains all defined ranges with the related colors as they were assigned under ⑫–⑬.

3.6 Output (Single Wiper)

The values in this tab are the results of the calculation of the activated wiper.



"Rise and Fall"-Folding Extremes

① Min

Minimum Rise and Fall angle calculated by the program.

② Angle of the wiper arm at which the minimum Rise and Fall angle was calculated.

③ Max

Maximum Rise and Fall angle calculated by the program.

④ Angle of the wiper arm at which the maximum Rise and Fall angle was calculated.

Deviations

⑤ Min

Minimum deviation calculated by the program.

⑥ Angle of the wiper arm at which the minimum Rise and Fall angle was calculated.

⑦ Max

Maximum deviation calculated by the program.

⑧ Angle of the wiper arm at which the maximum deviation angle was calculated.

⑨ Button „Move To"

Click on this button, in order to move the wiper in the model to the aforementioned angle position.

Current (Demo Angle)

⑩ "Rise and Fall" *(Folding Angle)*

"Rise and Fall" for the current wiper arm position defined in the *Demo Angle* field in the *Driving Device* tab.

⑪ Min Deviation Angle

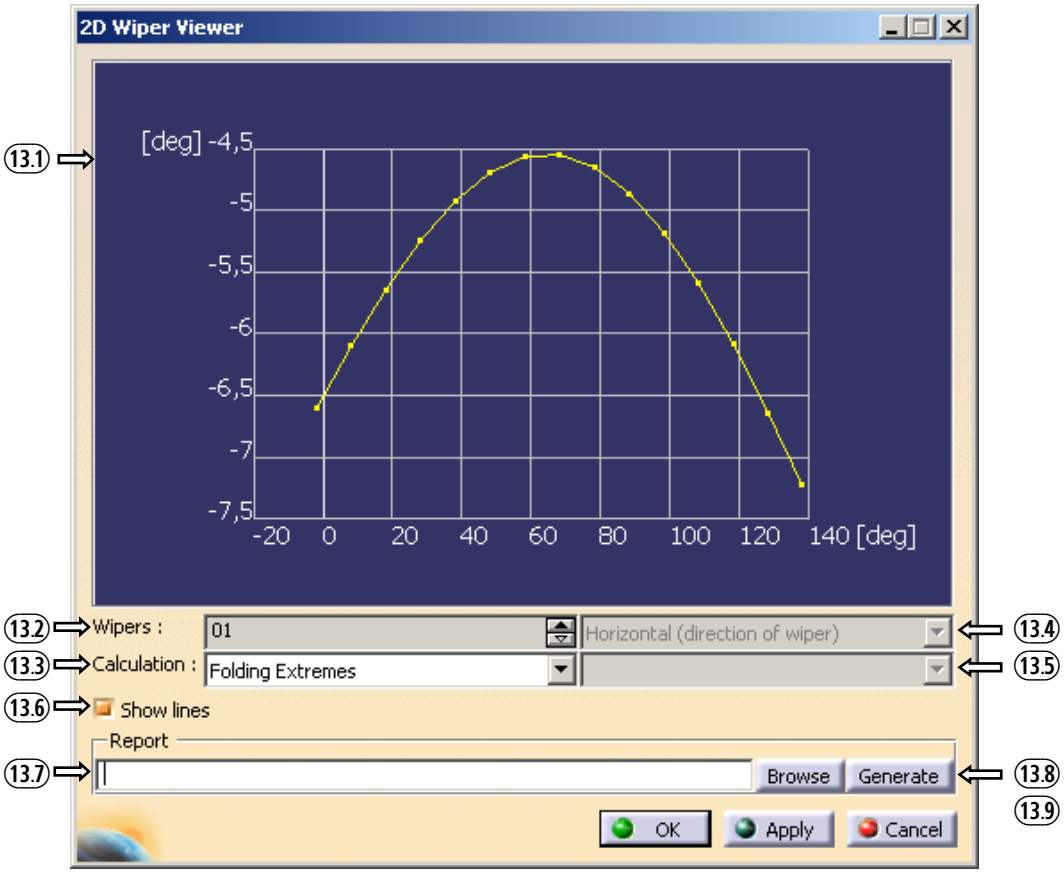
Minimum deviation angle for the current wiper arm position defined in the *Demo Angle* field in the *Driving Device* tab.

⑫ Max Deviation Angle

Maximum deviation angle for the current wiper arm position defined in the *Demo Angle* field in the *Driving Device* tab.

⑬ Button „2D-Viewer"

If you click on this button a dialog box will open that visualizes the calculated values as 2D-curves.



⑬.① 2D-diagram

Visualization of the calculated values as 2D-curves.

⑬.② Spinner „Wipers“

Select the wiper of which the calculated results should be visualized in the diagram.

⑬.③ List box „Calculation“

Select a calculation from the list. (See table “Overview of available calculation methods“ on page 26.)

⑬.④ List box „Horizontal/Vertical“

In this List box you have to define the direction of the trace points for the visualization in the diagram.

- Horizontal — In wiping direction
- Vertical — Along the wiper blade

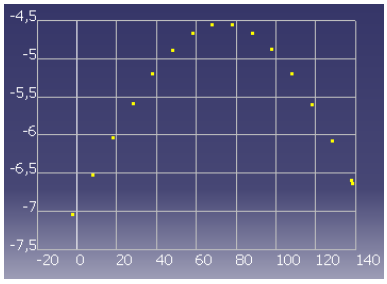
Remark:
The possibility to select one option here is depending on the selected calculation.

⑬.⑤ List box „Trace points“

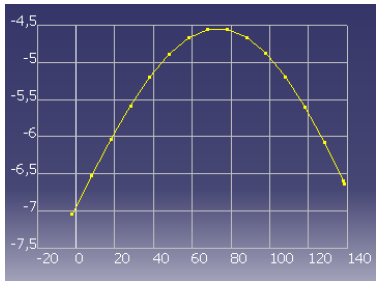
In this list box you have to define which trace-points should be visualized in the diagram. The content of the list depends on the selection in the list box List box „Horizontal/Vertical (see above ⑬.④).

⑬.⑥ Check box „Show lines“

- If deactivated:
The calculated values are visualized as points in the 2D-diagram.



- If active:
The calculated values are visualized as poly line in the 2D-diagram.



⑬.⑦ Text field „Report“

Here you can specify a path and file name for a report text file in which the results for the selected calculation at the trace points are saved to.

⑬.⑧ Button „Browse“

With this button you can open a file selection box. You can browse for a directory where you want to save the report file or select an existing report file to override. The path and file name will be put to the text field ⑬.⑦.

⑬.⑨ Button „Generate“

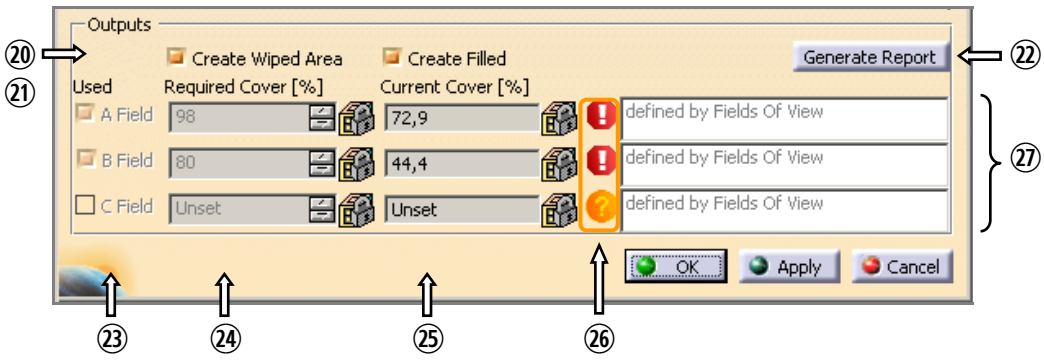
Click on this button to start the generation of the report file.

Overview of the available calculation methods

Type	3D visualization	2D Viewer	Calculation
Folding Extremes	–	x	Extreme value of the folding axis
Normal Deviation	x	x	Angle between the normal of the windscreen and the wiper blade
Curvature Radius of Blade	x	x	Curvature radius of the blade
Curvature of Blade	x	x	Curvature of the blade
Sag of Blade	x	x	Distance between the trace points along the blade and a connection line of the blades end points (=> Value at the end points = 0)
Horizontal Curvature Radius	–	x	Curvature radius of the horizontal trace curves (theoretical value)
Horizontal Curvature	–	x	Curvature of the horizontal trace curves (theoretical value)
Derivation of Blade Curvature	–	x	Derivation of the blade curvature
Derivation of Normal Deviation	–	x	Derivation of the normal deviation

3.7 Outputs (All Wipers)

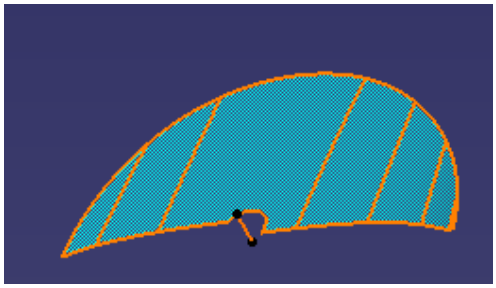
These values are the results of the calculation for all activated wipers.



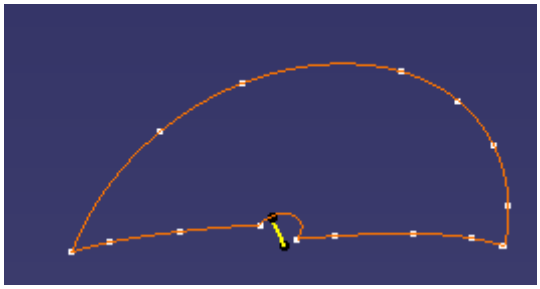
⑳ Check box „Create Wiped Area“

㉑ Check box „Create Filled“

The wiped area is visualized as curve.



The wiped area is visualized as face.



㉒ Generate Report

If you click on this button a file selection dialog box will open where you can specify a path and a name for the report file. The mandatory type of the file is „Report-File“. A text file (`*.txt`) will be created that contains the *trace* points with the corresponding normal vector and the normal deviation for each wiper angle position. Below you can find an extract of a report file that shows an example for a wiper arm angle of –4 deg.

```
Example:

>>>>>>>>>> Report begin
Wiper: 1
Arm angle:                    -4,000000 deg
Folding angle:                -7,668019 deg
Trace points:

            Point(490,951007, 0,909937, 572,179036)
              Deviation angle: 0,163518
            Normal vector(-0,601337, 0,000308, 0,798996)
            Point(483,818746, 273,754312, 549,862747)
              Deviation angle: 0,037287
            Normal vector(-0,602132, 0,100117, 0,792095)
            Point(499,573423, 543,627189, 497,300332)
              Deviation angle: -1,436242
            Normal vector(-0,562253, 0,340055, 0,753813)

<<<<<<<<<< Report end
```

㉓ Used

By activating or deactivating the options you can define which of the fields of view are being taken into account for the calculation of the wiped area. These options are only enabled in the „Free“ mode.

In the standard mode these values are defined by the chosen standard in the configuration file.

㉔ Required Cover

Percentage value of the required coverage of the wiped area for the respective field of view. These values are given by the standard and are defined in the configuration file.

㉕ Current Cover

Percentage value of the actual coverage of the wiped area for the respective field of view using the defined wiper parameter.

If the wiped area of the field of view is smaller than the required value or the calculation could not be done a warning symbol will be added to the feature icon in the structure tree.

The required/actual comparison will only be acting if the option „*Create Wiped Area*“ is activated.

㉖ Check symbols

Beside the numeric values, the results of the required/actual comparison are also visualized as symbols.

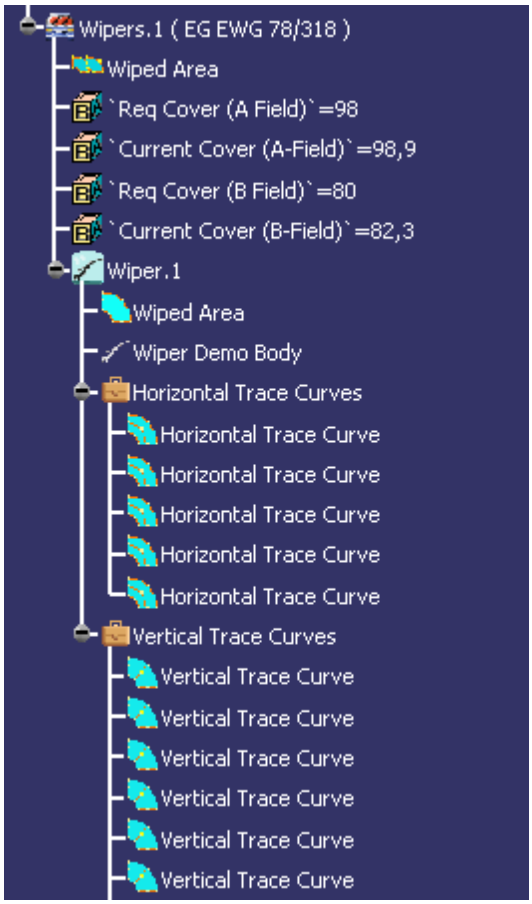
	Calculation not possible	The user has not selected any element – the list of elements is empty.
	Not defined	The field of view is not defined in the respective standard.
	OK	The wiped area of the field of view is equal or greater than the required value.
	Error	The wiped area of the field of view is smaller than the required value.

㉗ Reference fields for the Geometry Selection for the Fields of View

Activate the selection by placing the mouse pointer in the field. Then you can select a face for the respective field of view in the model or structure tree.

- Faces that were created by the CAVA feature *„Fields of view“* (see CAVA product „Vision“) cannot be used in this field. You also cannot select a „*Fields of View*“ feature itself in this field. Here for you have to use the field „FOV Reference“ (see chapter 3.1 *Definitions* on page 8 – point ④ – Reference field „FOV Reference“).

- In the structure tree you can find the percentage of the required and actual coverage of the fields of view as numeric values right beside the sub feature entry (see figure to the right).



The internally used coordinate systems for the wiper axis are not identical to the vehicle grid coordinate system. The *x* direction of the wiper coordinate system is equal to the *y* direction (+ or –) of the vehicle grid coordinate system and therefore defines the origin of the wiping angle (position of the wiper on the windshield).

* * *